NCER

3rd National Conference on Ecosystem Restoration

The Spirit of Cooperation

July 20-24, 2009
Westin Bonaventure
Los Angeles, California

USGS science for a changing world
US Army Corps of Engineers
NRCS United States Department of Agriculture Natural Resources Conservation Service
UF UNIVERSITY of FLORIDA IFAS

NCER

3rd National Conference on Ecosystem Restoration

The Spirit of Cooperation

Welcome to the 3rd National Conference on Ecosystem Restoration, NCER'09:

Welcome to all attending NCER '09 and welcome back to those of you who attended NCER '04 in Orlando or NCER '07 in Kansas City. Many conferences focus on science and engineering or specific regional ecosystems. NCER does this too, but we also examine the planning and policy required to achieve success in these endeavors. As our meeting site has moved from east to west we have given importance to restoring our great wetlands and great river systems. With this year's venue we look at restoration efforts in urban surroundings as well as restoration activities that face water as a limiting resource. And, as we tackle today's problems in restoring these systems, we must design our efforts to allow these ecosystems to sustain themselves in the face of changing climatic conditions.

NCER can also be thought of as the biannual meeting of the national ecosystem restoration community of practice. As we execute our restoration workloads, each of us has a group of individuals we rely on to provide information and critical evaluation of our plans and decisions – our local ecosystem restoration community if you will. NCER is a valuable networking opportunity that allows us to link our local communities, interact within this larger community, share knowledge, seek methodologies to solve our restoration problems, and benefit from the synergy this opportunity affords.

As with past NCER's, we have a full program of presentations and two poster sessions giving you the opportunity to discuss restoration activities with authors in greater detail. Along with our opening plenary session we also address the application of ecosystem goods and service to large scale projects. In addition to a workshop addressing the theme of adaptive management – which also pervades throughout the conference itself – we have added a second workshop to address implications of climate change on environmental planning. Our Thursday schedule includes a plenary session to provoke thought on climate change, an all day breakout session that covers different approaches to impacts of climate change and the afternoon closes with a Restoration Coffeehouse (RCH) to discuss and elicit comment from those of you in attendance. Another RCH on Tuesday features national leaders who will examine how we define success in ecosystem restoration – a crucial element which cannot be overlooked.

This year's agenda also includes mid-week field trips to several ecosystem restoration projects in the region. In an urban area as large as the Los Angeles basin, one forgets that nature still exists and can thrive if given proper care and attention. Hopefully this won't be your only opportunity to see more of what nature has to offer in the vicinity of Los Angeles.

The success of this conference can be traced directly to the dedicated efforts of numerous committee members involved in planning the general program, special sessions, the plenary program, restoration coffee houses, field trips, exhibition and sponsorship efforts. And a special thank you goes out to the many moderators who are in charge of guiding our sessions throughout the week. We also appreciate the contributions of our valued sponsors, and the major financial support provided by the U.S. Geological Survey, the Natural Resources Conservation Service, the University of Florida and the U.S. Army Corps of Engineers. This conference would not be possible without the contributions of our many sponsors listed in the program and we appreciate your ongoing support.

Special kudos goes to Beth Miller-Tipton and the staff of the University of Florida, IFAS Office of Conferences and Institutes (OCI), for a superb job organizing logistics. Please let Beth and our conference staff or any member of the planning committee know if we may be of assistance throughout the week, and again, thanks for attending.

Sincerely,

Dave Koran
NCER '09 Conference Chair

Table of Contents

Welcome Letter i

Executive Committee iv

Planning Committee iv

Program Committee vi

Plenary Session Committee vii

Coffee House Committee viii

Field Trip Committee viii

Sponsorship Committee viii

Sponsor Recognition ix

Exhibitor Listing x

Plenary Speaker Biographies xv

Agenda xxix

Directory of Poster Presentations
- Session I xxxvii
- Session II xlix

List of Participants lxi

Conference Abstracts 1

Author Index 419

Notes 429

Executive Steering Committee

G. Ronnie Best
US Geological Survey
Fort Lauderdale, FL

Beverley Getzen
US Army Corps of Engineers
Wadesboro, NC

Dave Koran
US Army Corps of Engineers
Washington, DC

Casey Kruse
US Army Corps of Engineers
Yankton, SD

Dan Miller
Stanley Consultants Inc
Muscatine, IA

Beth Miller-Tipton
UF/IFAS Office of Conferences and Institutes
Gainesville, FL

Ramesh Reddy
UF/IFAS Soil and Water Science Department
Gainesville, FL

Tom St Clair
PBS&J (EPJV)
Jacksonville, FL

Mike Sullivan
USDA
North Little Rock, AR

David Vigh
US Army Corps of Engineers
Vicksburg, MS

Planning Committee

G. Ronnie Best
US Geological Survey
Fort Lauderdale, FL

Don Boesch
Univ of Maryland, Ctr for Environmental Science
Cambridge, MD

Kathryn Boyer
NRCS West National Technology Support Center
Portland, OR

Becky Brown
US Army Corps of Engineers
Boise, ID

Robert Daoust
Malcolm Pirnie, Inc.
Plantation, FL

Blaine Ebberts
US Army Corps of Engineers
Portland, OR

Gregory Eckert
National Park Service
Ecosystem Management & Restoration
Fort Collins, CO

Raed El-Farhan
The Louis Berger Group Inc
Washington, DC

Beth Fleming
US Army Corps of Engineers
Vicksburg, MS

Angela Freyermuth
US Army Corps of Engineers
Rock Island, IL

Miki Fujitsubo
US Army Corps of Engineers
Sacramento, CA

Beverley Getzen
US Army Corps of Engineers
Wadesboro, NC

Wendell Gilgert
NRCS West National Technology Support Center
Portland, OR

Bently Green
CH2M Hill
St Louis, MO

Ed Hackett
USDA NRCS
Madison, MS

Karen Hagerty
US Army Corp of Engineers
Rock Island, IL

Lauren Hastings
CALFED Science Program
Sacramento, CA

Dan Hayes
US Army Corps of Engineers
Rock Island, IL

Planning Committee (continued)

Pete Heard
USDA NRCS
Agricultural Wildlife Conservation Center
Madison, MS

Dave Koran
US Army Corps of Engineers
Washington, DC

Casey Kruse
US Army Corps of Engineers
Yankton, SD

Deborah Lamb
US Army Corps of Engineers
Los Angeles, CA

Allyson Lang
The Louis Berger Group Inc.
Washington, DC

Dan Miller
Stanley Consultants Inc.
Muscatine, IA

Beth Miller-Tipton
UF/IFAS Office of Conferences and Institutes
Gainesville, FL

Harry Oakes
ICF Jones & Stokes
Sacramento, CA

Alan Potok
AECOM
Houston, TX

Ramesh Reddy
UF/IFAS Soil and Water Science Department
Gainesville, FL

Denise Reed
University of New Orleans
New Orleans, LA

Chris Ross
Bureau of Land Management
Reno, NV

Steve Schwarzbach
US Geological Survey
Sacramento, CA

Dan Shively
USDA Forest Service, Region 6
Sandy, OR

Si Simenstad
University of Washington
Seattle, WA

Chad Smith
Headwaters Corporation
Lincoln, NE

Tom St Clair
PBS&J (EPJV)
Jacksonville, FL

Jodi Staebell
US Army Corps of Engineers
Rock Island, IL

Patricia Strayer
Brown & Caldwell
West Palm Beach, FL

Mike Sullivan
USDA
North Little Rock, AR

Dave Tazik
US Army Corps of Engineers
Vicksburg, MS

Ron Thom
Battelle Marine Sciences Laboratory
Sequim, WA

Mona Thomason
US Army Corps of Engineers
Seattle, WA

Bradley Thompson
US Army Corps of Engineers
Rock Island, IL

David Tipple
US Army Corps of Engineers
Jacksonville, FL

Mark Tompkins
CH2MHill
Oakland, CA

Dilip Trivedi
Moffatt & Nichol
Walnut Creek, CA

Cheryl Ulrich
Weston
Atlantic Beach, FL

David Vigh
US Army Corps of Engineers
Vicksburg, MS

Chris White
US Army Corps of Engineers
Champaign, IL

Wayne Wright
GeoEngineers Inc
Port Orchard, WA

Program Committee

Kat Anderson
NRCS National Plant Data Center
Davis, CA

G. Ronnie Best
US Geological Survey
Fort Lauderdale, FL

Kathryn Boyer
NRCS West National Technology Support Center
Portland, OR

Steve Brady
NRCS Central National Technology Support Center
Fort Worth, TX

Sandra Brewer
US Army Corps of Engineers
Rock Island, IL

Robert Daoust
Malcolm Pirnie, Inc.
Plantation, FL

Blaine Ebberts
US Army Corps of Engineers
Portland, OR

Gregory Eckert
National Park Service
Ecosystem Management & Restoration
Fort Collins, CO

Raed El-Farhan
The Louis Berger Group Inc.
Washington, DC

Karen Foster
Battelle
Arlington, VA

Beverley Getzen
US Army Corps of Engineers
Wadesboro, NC

Wendell Gilgert
NRCS West National Technology Support Center
Portland, OR

Karen Hagerty
US Army Corps of Engineers
Rock Island, IL

Valarie Hansen
US Army Corps of Engineers
Elmendorf AFB, AK

Pete Heard
USDA NRCS
Agricultural Wildlife Conservation Center
Madison, MS

Dave Koran
US Army Corps of Engineers
Washington, DC

Casey Kruse
US Army Corps of Engineers
Yankton, SD

Glenn Landers
US Army Corps of Engineers
Jacksonville, FL

Carl Lucero
USDA, NRCS
Animal Husbandry and Clean Water Division
Beltsville, MD

Dan Miller
Stanley Consultants Inc.
Muscatine, IA

Alan Potok
AECOM
Houiston, TX

Ramesh Reddy
UF/IFAS Soil and Water Science Department
Gainesville, FL

Denise Reed
University of New Orleans
New Orleans, LA

Chris Ross
Bureau of Land Management
Reno, NV

Steve Schwarzbach
US Geological Survey
Sacramento, CA

Si Simenstad
University of Washington
Seattle, WA

Chad Smith
Headwaters Corporation
Lincoln, NE

Tom St Clair
PBS&J (EPJV)
Jacksonville, FL

Laura Stroup
Texas State University - San Marcos
San Marcos, TX

Mike Sullivan
USDA
North Little Rock, AR

Program Committee (continued)

Tim Sweeney
NRCS National Water Management Center
Little Rock, AR

Dave Tazik
US Army Corps of Engineers
Vicksburg, MS

Ron Thom
Battelle Marine Sciences Laboratory
Sequim, WA

Bradley Thompson
US Army Corps of Engineers
Rock Island, IL

Rosendo Trevino
USDA NRCS C/O USGS
San Antonio, TX

David Vigh
US Army Corps of Engineers
Vicksburg, MS

Chris White
US Army Corps of Engineers
Land and Heritage Conservation Branch
Champaign, IL

Debra Willard
US Geological Survey
Reston, VA

Lynn Wingard
US Geological Survey
Reston, VA

Plenary Session Committee

G. Ronnie Best
US Geological Survey
Fort Lauderdale, FL

Raed El-Farhan
The Louis Berger Group Inc
Washington, DC

Wendell Gilgert
NRCS
West National Technology Support Center
Portland, OR

Dave Koran
US Army Corps of Engineers
Washington, DC

Denise Reed
Univ of New Orleans
New Orleans, LA

Si Simenstad
University of Washington
Seattle, WA

David Tipple
US Army Corps of Engineers
Jacksonville
FL

David Vigh
US Army Corps of Engineers
Vicksburg, MS

Chris White
US Army Corps of Engineers
Land and Heritage Conservation Branch
Champaign, IL

Coffee House Committee

G. Ronnie Best
US Geological Survey
Fort Lauderdale, FL

Don Boesch
Univ of Maryland, Ctr for Environmental Science
Cambridge, MD

John Ogden
Audubon of Florida
Miami, FL

Lynn Scarlett
Environmental Consultant
Arlington, VA

Si Simenstad
University of Washington
Seattle, WA

Tom St Clair
PBS&J (EPJV)
Jacksonville, FL

Barbara Stinson
Meridian Institute
Dillon, CO

David Tipple
US Army Corps of Engineers
Jacksonville, FL

Field Trip Committee

Miki Fujitsubo
US Army Corps of Engineers
Sacramento, CA

Wendell Gilgert
NRCS West National Technology Support Center
Portland, OR

James Hutchinson
US Army Corps of Engineers
Los Angeles, CA

Dave Koran
US Army Corps of Engineers
Washington, DC

Deborah Lamb
US Army Corps of Engineers
Los Angeles, CA

Margie Namba
Brown and Caldwell
Rancho Cordova, CA

Mark Tompkins
CH2MHill
Oakland, CA

Dilip Trivedi
Moffatt & Nichol
Walnut Creek, CA

Sponsorship Committee

Robert Daoust
Malcolm Pirnie, Inc.
Plantation, FL

Gregory Eckert
National Park Service
Ecosystem Management & Restoration
Fort Collins, CO

Raed El-Farhan
The Louis Berger Group Inc.
Washington, DC

Bently Green
CH2M Hill
St Louis, MO

Allyson Lang
The Louis Berger Group Inc.
Washington, DC

Dan Miller
Stanley Consultants Inc.
Muscatine, IA

Alan Potok
AECOM
Houston, TX

Dilip Trivedi
Moffatt & Nichol
Walnut Creek, CA

David Vigh
US Army Corps of Engineers
Vicksburg, MS

Chris White
US Army Corps of Engineers
Champaign, IL

Wayne Wright
GeoEngineers Inc
Port Orchard, WA

A Special Thank You to Our Conference Sponsors

AECOM

CDM

Coastal Conservancy

EkoSystem

Environ

HDR

ICF Jones & Stokes

Irvine Ranch Conservancy

Malcolm Pirnie

Midwest Natural Resources Group - MNRG

Moffatt & Nichol

Natural Resources Conservation Service

Northern Arizona University
Ecological Restoration Institute

PBS&J

Platte River Recovery Implementation Program

RBF Consulting

Stanley Consultants

University of Florida / IFAS

US Army Corps of Engineers

US Geological Survey

Weston Solutions

WireFly

Wisconsin Press: Ecological Restoration Magazine

Exhibitor Listing

AECOM Technologies Inc. [BOOTH #36]
WEB SITE: www.aecom.com
REPRESENTATIVE: Patty Matthews
(patty.matthews@aecom.com)

Gold Sponsor

AECOM is a leading global provider of design, engineering, program management, construction management, and operations and maintenance support as well as technical assistance. Since it was launched as an independent company in 1990, AECOM has become one of the largest providers of professional technical and management support services in the world.

CDM [BOOTH #28]
WEB SITE: www.cdm.com
REPRESENTATIVE: Wendy Katagi
(katagiwr@cdm.com)

Silver Sponsor

CDM is a consulting, engineering, construction, and operations firm that services public and private sector clients worldwide. We provide turnkey water resources services including ecosystem restoration at all scales.

Chesapeake Bay Program [BOOTH #23]
WEB SITE: www.chesapeakebay.net
REPRESENTATIVE: Travis Loop
(tloop@chesapeakebay.net)

The Chesapeake Bay Program is a regional partnership that has coordinated and conducted the restoration of the Chesapeake Bay since 1983. Partners include the U.S. Environmental Protection Agency, representing the federal government; the U.S. Department of Agriculture; the states of Delaware, Maryland, New York, Pennsylvania, Virginia and West Virginia; the District of Columbia; the Chesapeake Bay Commission, a tri-state legislative body; and advisory groups of citizens, scientists and local government officials.

EA Engineering, Science, and Technology, Inc. [BOOTH #13]
WEB SITE: www.eaest.com
REPRESENTATIVE: Jennifer Zoukis (jzoukis@eaest.com)

For more than 30 years, EA has integrated science, engineering, and technology to provide valuable solutions to our clients' water resource, environmental and regulatory issues. EA provides technical expertise that begins with project conceptualization through final construction and continues with long-term operations and maintenance for ecosystem restoration (wetlands, stream, salt marsh, fresh water; fish passage); watershed and storm water management; TMDLs; sediment characterization and dredge material management.

Ecological Restoration Institute [BOOTH #10]
WEB SITE: www.eri.nau.edu
REPRESENTATIVE: Wally Covington (kathleen.mitchell@nau.edu)

Silver Sponsor

The Ecological Restoration Institute (ERI) at Northern Arizona University (NAU) in Flagstaff, Arizona is nationally recognized for mobilizing the unique assets of a university to help solve the problem of unnaturally severe wildfire and degraded forest health in the region. The ERI works to help land management agencies and communities by providing comprehensive focused studies, monitoring and evaluation research, and technical support.

Ekosystem Environmental Knowledge Organizer
By Paladin Data Systems [BOOTH #27]
WEB SITE: www.paladindata.com
REPRESENTATIVE: Sara Simrell (ssimrell@paladindata.com)

Silver Sponsor

Paladin Data Systems is an award-winning software development company, established in 1994. Combining old-world values and modern technologies allows us to service and support such industries as military and government organizations, the natural resource community and city and county agencies. Paladin's development experts help you analyze the processes your business uses and helps you document and integrate these processes with your existing and future information architecture.

ENVIRON International Corporation [BOOTH #1]
WEB SITE: www.environcorp.com
REPRESENTATIVE: Rick Wenning (rjwenning@environcorp.com)

Silver Sponsor

An international consultancy, ENVIRON works with clients to help resolve their most demanding environmental and human health issues. We combine resources across geographic boundaries and technical and scientific disciplines to provide clients with the best, most responsive team—whether responding to existing challenges, evaluating opportunities to improve performance, or seeking to reduce future liabilities.

ETEBA [Table Top #2]
WEB SITE: www.eteba.org
REPRESENTATIVE: Angela Shilling (angela@eteba.org)

ETEBA is a non-profit trade association representing large and small companies that provide environmental, technology, energy, engineering, and construction services to both government and commercial clients. ETEBA advocates for sustained or increased funding for existing programs and for new programs that benefit member companies; monitors market opportunities and advocates for member companies; represents the views, issues, capabilities, and concerns of member companies to other entities; seeks opportunities to market the diversity of technical talent available among its member companies; provides facts, information, education, and such assistance as may be requested, in helping member companies become more competitive and marketable; and provides networking opportunities through regular membership meetings, conferences, and other events.

Hach Hydromet [BOOTH #11]
WEB SITE: www.hachenvironmental.com
REPRESENTATIVE: Eric Strahan (estrahan@hach.com)

Through the years, Hach, Hydrolab, and OTT independently built their reputations as the market leaders in various areas of water measurement equipment. The common link among these three independent companies was that they were all known as innovators in their field, and all three manufactured only the highest quality water measurement instruments. Hydrolab designed and manufactured multiparameter water quality monitoring equipment for more than 35 years; Hach provided advanced analytical systems and technical support for water quality testing in the lab, processes, and field for more than 55 years; and OTT supplied hydrological instruments and systems for more than 130 years. Today, Hydrolab water quality instruments and OTT water level and precipitation monitoring systems have been combined with the resources of Hach Company to create Hach Hydromet – the source for reliable and dependable environmental water monitoring data that is the gold standard in our industry. Hach Hydromet can provide completely integrated, turn-key solutions for water quality, water level, and precipitation monitoring. Hach Hydromet sales and support network spans the globe so that we can provide local support – no matter where water monitoring needs reside.

HDR, Inc. [BOOTH #7]
WEB SITE: www.hdrinc.com
REPRESENTATIVE: Dana Stob (dana.stob@hdrinc.com)

Silver Sponsor

HDR is an architectural, engineering and consulting firm that excels at managing complex projects and solving challenges for clients. We offer our clients the best possible economic, social and environmental value by delivering integrated sustainable solutions.

ICF Jones & Stokes [BOOTH #6]
WEB SITE: www.jonesandstokes.com
REPRESENTATIVE: Lorett Kinnicutt (lkinnicutt@jsanet.com)

Silver Sponsor

ICF Jones & Stokes is a multidisciplinary environmental consulting firm that provides a full range of environmental planning and resource-management services. In February 2008, we joined with ICF International to bring increased depth and provide expanded capabilities in environmental planning and natural resource management, especially in the transportation, energy, and water resources sectors.

Malcolm Pirnie, Inc. [BOOTH #3]
WEB SITE: www.pirnie.com
REPRESENTATIVE: Ed Theriot (etheriot@pirnie.com)

Solutions for Life™

Malcolm Pirnie is one of the largest firms in the U.S. focused exclusively on environmental issues. For more than 100 years, we've provided environmental engineering, science and consulting services to over 5,000 public and private clients. With a tradition of technical excellence, we solve complex problems and deliver results that help government and industry worldwide. We offer a full roster of services and our nationwide staff of nearly 1,700 professionals represent virtually all environmental service disciplines — from geologists and toxicologists, to structural engineers and construction managers and a variety of field support technicians.

Moffatt & Nichol [BOOTH #21]
WEB SITE: www.moffattnichol.com
REPRESENTATIVE: Dilip Trivedi (dtrivedi@moffattnichol.com)

Silver Sponsor

Moffatt & Nichol is an internationally recognized engineering, planning and scientific firm that serves public and private clients worldwide from offices in the United States, Canada, the United Kingdom and Latin America. The firm specializes in coastal and water resources engineering and ecosystem restoration, as well as those involving civil works, ports and harbors, and transportation.

Parsons [BOOTH #9]
WEB SITE: www.parsons.com
REPRESENTATIVE: Victoria Lehr
EMAIL: victoria.lehr@parsons.com

Founded in 1944, Parsons is an engineering and construction firm with revenues exceeding $3.4 billion in 2008. We conquer the toughest logistical challenges and deliver landmark design-build projects across the globe. Our ability to plan, design, construct, and operate diverse facilities and infrastructure systems has satisfied our clients' needs for more than 60 years. With more than 11,500 employees located worldwide, we team with an increasingly diverse group of global customers and stakeholders while providing dependable services. We measure our success one project at a time by exceeding expectations and satisfying our customers. Parsons continues to be actively involved in ecosystem restoration programs, including providing Program Management services for the past eight years to USACE in support of the Comprehensive Everglades Restoration Plan (CERP), which has been described as the world's largest ecosystem restoration effort.

PBS&J [BOOTH #2]
WEB SITE: www.pbsj.com
REPRESENTATIVE: Bill Hinsley III
(wehinsley@pbsj.com)

Silver Sponsor

PBS&J is an employee-owned firm that provides comprehensive consulting services in the areas of engineering, planning, construction management, program management, environmental sciences, facilities, landscape architecture, and applied technologies.

RBF Consulting [BOOTH #24]
WEB SITE: www.rbf.com
REPRESENTATIVE: Richard Beck
(rbeck@rbf.com)

Silver Sponsor

RBF Consulting is a full service firm providing consulting services for planning, design and construction of the built environment. These services are provided to both public and private sector clients, nationally and internationally, in a timely, cost effective and innovative manner while providing quality and responsive service by a qualified and experienced staff of over 900 professionals in 15 locations. RBF provides a broad spectrum of professional consulting services. RBF's diversity also allows us to serve our clients during each phase of a project, including advance/preliminary planning services, design, and finally, construction oversight.

Stanley Consultants [BOOTH #4]
WEB SITE: www.stanleyconsultants.com
REPRESENTATIVE: Ed Slattery
(slatteryed@stanleygroup.com)

Silver Sponsor

Stanley Consultants is a global engineering company headquartered on the Mississippi in Muscatine, IA. With 1,200+ members, our proud eco-restoration experience reflects projects in the Everglades, Biscayne Bay, Lake Okeechobee and several major rivers.

University of Maryland Center for Environmental Science [BOOTH #8]
WEB SITE: www.umces.edu and www.ian.umces.edu
REPRESENTATIVE: Dave Nemazie
(nemazie@umces.edu)

The University of Maryland Center for Environmental Science (UMCES) is the most prominent single institution involved in scientific discoveries about the Chesapeake Bay and its watershed. Although focusing more than 2/3 of its research on this region, the Center's activities are global, involving research from the Arabian Sea to the Yellowstone and from the poles to the tropics. UMCES' scientists include biologists, ecologists, physicists, chemists, geologists, engineers, and economists who work together in a truly transdisciplinary community. The Integration and Application Network (IAN) is an initiative of UMCES, but links with other academic institutions, resource management agencies and non-governmental organizations. IAN is a collection of scientists working to solve, not just study environmental problems. The intent of IAN is to inspire, manage and produce timely syntheses and assessments on key environmental issues, with a special emphasis on Chesapeake Bay and its watershed. The Center's programs are carried out at three laboratories located across the state: the Appalachian Laboratory in western Maryland, the Chesapeake Biological Laboratory, in southern Maryland and the Horn Point Laboratory on the Delmarva Peninsula. UMCES is also responsible for the administration of the Maryland Sea Grant College program.

University of Wisconsin Press [Table Top #1]
WEB SITE: www.wisc.edu/wisconsinpress
REPRESENTATIVE: Toni Gunnison (gunnison@wisc.edu)

Located in Madison, Wisconsin, the University of Wisconsin Press was founded in 1936. The Press publishes books and journals. We select the books using a careful process of review by Press staff, outside experts, and a board of University of Wisconsin faculty.

US Army Corps of Engineers ®

USACE Ecosystem Restoration Program [BOOTH #37, 38 & 39]
WEB SITE: www.wes.army.mil/el
REPRESENTATIVE: Dave Tazik
(Dave.J.Tazik@usace.army.mil)

Platinum Sponsor

The Environmental Laboratory is the problem solver for the Corps and the Nation in environmental science and engineering research and development in support of environmental systems. The staff supports the environmental missions of the U.S. Army, the Department of Defense, and the Nation through research, development, special studies, and technology transfer. Environmental Laboratory research includes a network of expertise and facilities from other Engineer Research and Development Center (ERDC) and Corps Laboratories, other government agencies, academia, and private sector.

USGS science for a changing world

US Geological Survey [BOOTH #25]
WEB SITE: www.usgs.gov
REPRESENTATIVE: Ronnie Best
(Ronnie_Best@usgs.gov)

Platinum Sponsor

The U.S. Geological Survey serves the Nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.

NRCS United States Department of Agriculture Natural Resources Conservation Service

USDA Natural Resources Conservation Service [BOOTH #32]
WEB SITE: www.nrcs.usda.gov
REPRESENTATIVE: Mike Sullivan
(Michael.Sullivan@wdc.usda.gov)

Platinum Sponsor

Since 1935, the Natural Resources Conservation Service (originally called the Soil Conservation Service) has provided leadership in a partnership effort to help America's private land owners and managers conserve their soil, water, and other natural resources.

WESTON SOLUTIONS *The Trusted Integrator for Sustainable Solutions*

Weston Solutions [BOOTH #12]
WEB SITE: www.westonsolutions.com
REPRESENTATIVE: Cheryl Ulrich
(Cheryl.Ulrich@westonsolutions.com)

Silver Sponsor

Weston Solutions delivers integrated, sustainable solutions for environmental restoration, property redevelopment, design/build construction, green buildings and clean energy. Weston can help develop solutions to maximize the value of your resources and turn environmental responsibility into economic growth. We help clients restore productive assets to build a stronger economy and a healthier ecology.

YSI

YSI, Inc. [BOOTH #14]
WEB SITE: www.ysi.com
REPRESENTATIVE: Mike Cook
(shaught@ysi.com)

YSI Incorporated is a global, employee-owned company that designs sensor instrumentation and real-time monitoring systems for professionals who protect natural resources and aquatic life. YSI's sensors and multiparameter systems provide a continuous and comprehensive data record of water quality and velocity for informed decision-making. Our long-term, in situ monitoring systems allow for early warning and rapid response to events such as algal blooms, floods, and source water protection. Parameters include; conductivity, chlorophyll, dissolved oxygen, blue-green algae, pH, ORP, salinity, chloride, nitrate, turbidity, TDB, flow, velocity, temperature and level. New this year; ProODO Optical Dissolved Oxygen Handheld, Pro20 Dissolved Oxygen Handheld and EcoMapper AUV.

Plenary Speaker Biogaphies

G. Ronnie Best

Dr. G. Ronnie Best conceived of and chaired the first National Conference on Ecosystem Restoration held in December 2004 in Orlando, FL. In addition, Dr. Best conceived of, organized and chaired the Greater Everglades Ecosystem Restoration (GEER) conferences (2000, 2003, 2005 and 2007). For many years, he has been an active proponent of conferences such as NCER and GEER, and other methods for exchanging and sharing information related to integrating planning, policy and science into decision-related processes critical for conserving, preserving and restoring our natural systems.

As a science coordinator with U.S. Geological Survey, Dr. Best coordinates USGS's Greater Everglades Priority Ecosystems Science -- where the Greater Everglades serves as a "living laboratory for understanding and predicting ecosystem change". Dr. Best retired from University of Florida's College of Engineering faculty where he taught graduate courses and conducted research on ecological engineering, ecosystem restoration and creation, and wetlands ecology.

Greg Biddinger

Dr. Greg Biddinger is currently the Natural Land Management Program Coordinator at ExxonMobil Biomedical Sciences, Inc. (EMBSI) where he is responsible for strategic development of methods and application of sustainable approaches to managing ExxonMobil’s current and former operating properties. To this effort he is exploring technical (e.g. native landscaping and natural approaches to remedial design), legal (e.g. wildlife property tax assessments, and conservation easements) and policy (e.g. conservation and wetlands banking and ecological re-use) mechanisms to bring fresh perspective to the management of ExxonMobil’s properties. Dr. Biddinger has practiced professionally as an environmental scientist for over 25 years. He has been an active leader in the Society of Environmental Toxicology and Chemistry (SETAC) where he was the founding chair of the SETAC’s Ecological Risk Assessment Advisory Group (1992-2002) and is a founding editor of the SETAC journal *Integrated Environmental Assessment and Management*. As well, he is currently a member of the U.S. Environmental Protection Agency’s (USEPA) *Chartered* Science Advisory Board (SAB). Pertinent to the topic of Ecosystem Services he is an active member of the Business for Social Responsibilities *Ecosystem Service Markets and Tools Workgroup* which is collaborating with government, academic and conservation organizations to advance the capacity and quality of ecosystem service assessment and valuation approaches for use in business planning processes.

Don Boesch

Dr. Don Boesch is Professor and President at the University of Maryland Center for Environmental Science. A biological oceanographer, he has conducted research along the U.S. East and Gulf Coasts and in Australia and the East China Sea. He has been particularly engaged in scientific assessments related to the coastal ocean environment and large-scale ecosystem restoration, notably for the Chesapeake Bay, the Mississippi River Delta, the Greater Everglades, and the Baltic Sea. Don is also actively engaged in scientific assessments of the impacts of climate change and was a contributing author to the recent report Global Climate Change Impacts on the United States.

Jean Brennan

Dr. Jean Brennan is the Senior Climate Change Scientist at Defenders of Wildlife. Her work focuses on the challenges facing species in adapting to climate changes. She is an experienced field biologist and has conducted research on primates and small carnivores in Kenya and Madagascar, Asian elephants and other endangered large mammals on Peninsula Malaysia, and orangutans and proboscis monkeys on Borneo, Indonesia. She received her doctorate from the University of Tennessee in population biology and ecology. She also holds a Masters of Forest Science from Yale University and a Masters of Science in Anthropology from the University of Pennsylvania. She has taught classes in Conservation Biology at the University of Michigan and on Air Resources at the University of California at Davis.

Prior to joining Defenders science staff, Jean worked as a Senior Conservation Science Advisor for the U.S. Agency for International Development, helping to design environmental programs to conserve biodiversity and natural resources in many developing countries. She has also worked as a Science Officer for the U.S. Department of State where she served as a member of the U.S. Delegation to the Intergovernmental Panel on Climate Change (IPCC). Dr. Brennan was recognized for her work with the IPCC and shares the 2007 Nobel Peace Prize.

David S. Brookshire

Dr. David S. Brookshire is a Professor of Economics at the University of New Mexico and Director of the "Science Impact Laboratory for Policy and Economics" at UNM. He serves on the Executive Board of the Sustainability of semi-Arid Hydrologic and Riparian Areas Science and Technology Center at the University of Arizona. He is a former Policy Sciences Editor of *Water Resources Research*.

He has been a contributor to the development of the contingent valuation method for valuing non-market commodities. He specializes in studies pertaining to public policy issues in the natural resource, environmental and natural hazards areas. In particular, he has completed studies pertaining to seismic building codes, earthquake prediction impacts, environmental regulations, endangered species, air pollution, the effect of seismic zoning and the value of geologic information and water.

Current research interests include ecosystems valuation, seismic risk and natural hazards issues, endangered species, urban hazards, field and laboratory experiments for the estimation of disaggregated demand of industrial and consumer water users, the value of water in non-market settings, western water market structures, modeling for exploring alternative institution and behavioral characteristics of water leasing markets and urban boundary issues relating to the preservation of open space.

COL Janice Lembke Dombi

Colonel Janice L. Dombi became the 53rd commander of the South Pacific Division of the U.S. Army Corps of Engineers on January 15, 2009. Established in 1888, the division comprises one-fifth of the United States and is one of the Corps' eight regional commands. Four operating district commands comprise the region, headquartered in Albuquerque, Los Angeles, Sacramento, and San Francisco.

As Division Commander, Colonel Dombi is responsible for leading a professional workforce of over 2,200 people, and managing military and civil works programs in Arizona, California, Nevada, New Mexico, Utah, and parts of Colorado, Oregon, Wyoming, Idaho, and Texas. The division's current program exceeds $2 billion. Key missions encompass strengthening national security, supporting the war on terror, and managing the nation's water resources infrastructure for economic growth and environmental sustainability. She synchronizes Corps of Engineers efforts with those of other federal, state and local agencies, the Army and Air Force, the Administration and the Congress to ensure that the Corps provides exceptional support to military installations and civilian communities throughout the region.

Prior to taking command, Colonel Dombi served as the Division's Deputy Commander from August 3, 2007 to January 2009. She also commanded the Corps of Engineers' Far East District, in Korea, from July 2004 to July 2007. While in college, Colonel Dombi enlisted in the Army Reserve and began her military career as a Private at Fort Jackson, SC. In 1981, she earned a Bachelor of Science Degree from Longwood College in Virginia and was commissioned in the Corps of Engineers. A Distinguished Military Graduate from the University of Richmond's ROTC program, she began her active duty service as a training officer at Ft Leonard Wood, MO.

Col Dombi's assignments include: Student, Air War College, Engineer Colonels Assignment Officer PERSCOM, Alexandria, VA; Commander, 864 Engineer Combat Battalion (Heavy), Ft Lewis WA; Engineer Plans Officer and Secretary of the Joint Staff, United States Southern Command, Republic of Panama and Miami, FL; Deputy Commander, Joint Task Force 411, Panama; Battalion Commander and Battalion Executive Officer, 536th Engineer Combat Battalion (Heavy), Panama; Engineer Plans Officer, United States Army South, Panama; Associate Professor of History, U.S. Military Academy, West Point, NY; Battalion Logistics Officer, 79th Engineer Battalion (Heavy), Karlsruhe, Germany; Assistant Plans Officer 18th Engineer Brigade, Germany; Engineer Officer Basic Course Platoon Trainer, Ft Belvoir, VA; Company Commander of Charlie Company, 3rd Battalion, 4th Brigade, and Officer in Charge of the Vertical Skills MOS training at, Ft Leonard Wood, MO.

Her military education includes the Engineer Officer Basic and Advanced Courses, Facility Management Course, Command and General Staff College, and the Armed Forces Staff College, and Air War College. Colonel Dombi holds an M.A. in History from North Carolina State University and an M.A. in both Management and Human Resource Development from Webster University, and an MA in Strategic Studies from Air University, Montgomery, Alabama. Colonel Dombi is currently a Regional Vice President in the Society of American Military Engineers.

Colonel Dombi has the additional skill identifiers of Strategist, Historian, Parachutist and Joint Service Officer. Her military awards include the Legion of Merit, Defense Meritorious Service Medal, Meritorious Service with four oak leaf clusters, Joint Service Commendation Medal, Humanitarian Service Medal, Army Superior Unit Award and Joint Meritorious Unit Award.

Martin Goebel

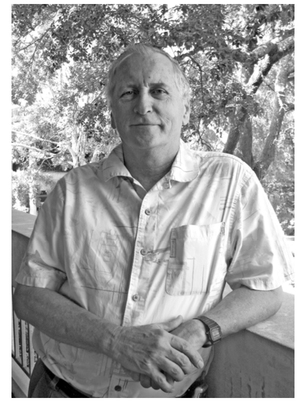
Martin Goebel is the founding President of Sustainable Northwest. He has been responsible for initiating most of its community sustainability partnerships in Oregon, Idaho, Washington and California. He spearheaded the early-stage design of Sustainable Northwest's Healthy Forests, Healthy Communities Partnership and its sustainability finance initiatives and serves as the principal liaison with Sustainable Northwest's board and donors.

Born and raised in Mexico in a tri-cultural environment, Martin received a Bachelor's Degree in Forestry at Oregon State University, and a Master's Degree at Texas A&M University in Natural Resources Conservation and Development.

In his early career Martin worked for the National Park Service as a seasonal ranger at Crater Lake National Park. He has also practiced community forestry with the forest service of Mexico. His international conservation career began with The Nature Conservancy's International Program as assistant director for science. He later helped found and worked at Conservation International as its Mexico Program director, a position he also held subsequently at World Wildlife Fund. As WWF's Mexico Program director he founded the Mexico Nature Conservation Fund.

From 1996 through 2006 Martin served as a trustee of the Summit Foundation. He has served on the Oregon Sustainability Board since its inception. Currently Martin is a Trustee of the Compton Foundation, where he chairs its environment & sustainability and its nominating committees, and of the recently established American School Foundation - USA. He also serves on the advisory councils of Oregon Solutions, San Diego Museum of Natural History Museum, and the Mexico Nature Conservation Fund (Mexico City). Since 2006 Martin has served as an advisor to the Walton Family Foundation. In all these organizations he endeavors to promote environmental and sustainable development values and practice, ecosystem-level conservation initiatives that build local capacity, foster responsible market and business practices, and foster healthy, long-term partnership between government agencies, non-profit organizations, research institutions, grassroots community groups, private enterprise, bi- and multi-lateral development agencies, and philanthropies. Martin enjoys speaking publicly and frequently writes and publishes on the subjects of conservation and sustainable development in the Pacific Northwest and Latin America. He is also an avid fly fisherman and enjoys sailing and travel.

Courtney T. Hackney



Dr. Courtney Hackney is a Professor of Biology and Director of Coastal Biology at the University of North Florida in Jacksonville. He earned a Ph.D. (1977) in Zoology with a minor in Wildlife & Fisheries from Mississippi State University, an M.S. in Biology from Emory University, and a B.S. in Biology from the University of South Alabama. He has conducted research on coastal ecosystems along all three U.S. coasts as well as on wetlands in upstate New York, Illinois, and Wisconsin.

He is the past President of the Society of Wetland Scientists and past Chair of the Southeastern Section of the Ecological Society of America. Many of Dr. Hackney's 60 + publications have dealt with Aquatic and Wetland Communities or interactions of humans with the natural world. His current research emphasis is the response of coastal wetlands and estuaries to alterations of freshwater flow and increased flooding levels; conditions expected from a rise in sea level, but also caused by human alterations of natural systems.

During his professional career, he has mentored many graduate and undergraduate students that now work in both private and public sector positions around the country. He has consulted with state and federal agencies as well as with the private sector. He is familiar with landscape level issues and their long-term implications to local communities. He has been actively involved in solving environmental problems through his research and through appointments to various local and state boards and commissions. He was appointed by three consecutive North Carolina governors to North Carolina's Coastal Resource Commission starting in 1989 and was Chairman from 2006-2007. He also served two terms as a member of the congressionally mandated Environmental Advisory Board, which advises the General in Charge of the U.S. Army Corps of Engineers.

Lauren Hastings

Dr. Lauren Hastings serves as Deputy Director for Science, CALFED Bay-Delta Program, California Natural Resources Agency, Sacramento, CA (http://www.science.calwater.ca.gov/) As Deputy Director, Lauren oversees implementation of the CALFED Science Program, including overall program management and working collaboratively with state and federal agencies, academic institutions, scientific experts and stakeholders to promote sound use of science within the CALFED Program. Prior to managing the Science Program, Lauren worked for the CALFED Ecosystem Restoration Program (ERP) where she focused on incorporation of science into ERP activities. Lauren's primary interests are communicating scientific information to California Bay-Delta policy- and decision-makers, promoting science-based adaptive management, and supporting research that will fill critical gaps in our understanding of the Bay-Delta system. Prior to working for CALFED, Lauren worked for the USGS in Sacramento, managing two field research projects evaluating effects of various water- and land-management strategies on mitigating subsidence of Delta peat soils. Lauren has a PhD and MS in Soil Chemistry from UC Davis, and a BA in biology from Luther College.

Michael D. Hubbs

Mr. Michael D. Hubbs is the Director of Ecological Sciences Division for the Natural Resources Conservation Service (NRCS) in Washington, D.C. He entered this position June of 2008.

Mr. Hubbs has held numerous positions with NRCS. Before coming on as Director of Ecological Sciences Division, he served as State Conservationist in Kentucky. He has served as National Agronomist and National Nutrient Management Specialist in Washington DC.

He began his career in 1977 as a soil conservationist in Tennessee. He served as a soil conservationist both in Cleveland and Memphis, Tennessee from 1977-1979. He served as District Conservationist in four locations in Tennessee: Maynardville, Dandridge, Morristown, and Memphis from 1979-1991. From 1991-1994, he served as Area Resource Conservationist in Columbia, Tennessee. He served as State Agronomist from 1994-1996, and served as Agronomist on the Soil Quality Institute 1996-2004.

He holds a Bachelor of Sciences degree in Plant and Soil Sciences from University of Tennessee and a Master of Agriculture degree focusing on Agronomy and Soil Quality from Auburn University.

Mr. Hubbs has received numerous awards in his career. He has been a national and international speaker soil quality and conservation cropping systems. He is a Certified Crop Advisor from Agronomy Society of America, a member of Soil Science Society of America, and Soil and Water Conservation Society.

Suzette Kimball

Dr. Suzette Kimball is Acting Director, Office of the Director, USGS. She is responsible for leading the Nation's largest water, earth, biological science, and civilian mapping agency in its mission to provide the scientific data that enable decisionmakers to create sound policies for a changing world.

Dr. Kimball was the Director of the Eastern Region in 2004 and became the Acting Associate Director for Geology in 2008.

Kimball joined the USGS as Eastern Regional Executive for Biology. In that position, she built many partnerships, helped shape programs, and led the establishment of the USGS Florida Integrated Science Center. She came to the USGS from the National Park Service in Atlanta, where she was Associate Regional Director.

She entered the National Park Service as a research coordinator in the Global Climate Change Program, became Southeast Regional Chief Scientist, then Associate Regional Director. She was assistant professor of environmental sciences at the University of Virginia, co-director of the Center for Coastal Management and Policy and marine scientist at the Virginia Institute of Marine Science, and managed coastal morphology and barrier island studies in the U.S. Army Corps of Engineers.

She serves on executive boards and many state and national committees, including the Consortium for Coastal Restoration through Science & Technology, the Council of Examiners of the National Association of State Boards of Geology, and the DOI Senior Executive Service Advisory Council. She was on the board of directors of the Coastal Society and has served as secretary of the American Geophysical Union's Ocean Sciences Section.

She has authored numerous publications on barrier island dynamics, coastal ecosystem science, coastal zone management and policy, and natural resource exploration, evaluation and management. She has received the Presidential Rank Award and the Secretary of the Interior's Meritorious Service Award.

Dr. Kimball has a doctorate in environmental sciences with a specialty in coastal processes from the University of Virginia, a master's in geology and geophysics from Ball State University, and a bachelor's in English and geology from the College of William & Mary.

Michael Krouse

Michael Krouse, CHME, CMP is the Senior Vice President of Sales for LA INC., The Los Angeles Convention and Visitors Bureau. In this role, Mr. Krouse is responsible for the management of the organization's meetings and convention sales and client services departments. Michael serves as the leader of more than 30 staff. He also has direct oversight of Los Angeles Convention Center Citywide Convention Sales.

For more than 15 years, Mr. Krouse has held senior hotel sales management positions. Mr. Krouse was Interstate Hotels and Resorts Vice President of Sales and Marketing, and to many in the meetings and convention industry, he is best known for his more than 13 years with Hilton Hotels Corporation, many of them as Regional Director of Sales and Marketing – West. His industry affiliations include an active presence in virtually all of the leading U.S. meetings and convention associations. He has a Certified Meeting Professional certification from MPI and has earned the title of Certified Hospitality Marketing Executive from the Hospitality Sales and Marketing Association International. He is also a member of the Professional Convention Management Association, American Society of Association Executives, MPI, and the Convention Liaison Council.

Bill Leary

Bill Leary served as Associate Director of Natural Resources for the White House Council on Environmental Quality from 1998 to 2005. In that capacity he served as Senior Advisor to Presidents Bill Clinton and George W. Bush on environmental issues related to land and water resources and was responsible for conflict resolution and the development of Administration policy and coordination of its implementation. He was lead Administration policy advisor for water issues, including wetlands and river systems and chaired the White House Wetlands Policy Group. He was also lead Administration policy advisor for ecosystem restoration issues, including Everglades, coastal Louisiana, Great Lakes, Chesapeake Bay, Missouri River, Mississippi

River, and San Francisco Bay. He supervised the American Heritage River Initiative and advised on policy matters relating to the Army Corps of Engineers, including environmental restoration, flood control, beach renourishment, and navigation. Previously he served as Senior Policy Advisory to Secretary of the Interior Bruce Babbitt on Everglades restoration issues and to Assistant Secretary for Fish and Wildlife and Parks George Frampton on matters relating to ecosystem restoration, wetlands, water resources and fish and wildlife, including national parks and national wildlife refuges. He also served as Staff director of the Subcommittee on Clean Water and Endangered Species of the United States Senate Committee on Environment and Public Works where he was responsible for matters relating to the Clean Water Act, Safe Drinking Water Act, Endangered Species Act, and Water Resources Development Act, and for other water related issues, including Everglades restoration. Upon retiring in 2005, Mr. Leary and his wife moved to St. Augustine, Florida. He can be reached at bill.leary4@yahoo.com.

Carl F. Lucero

Carl Lucero is the acting Deputy Director for USDA's new Office of Ecosystem Services and Markets where he leads development of a national infrastructure to establish environmental markets. Carl is also the National Leader for Clean Water at USDA's Natural Resources Conservation Service where he guides the agency on water quality policy issues. For the past 4 years Carl has led the USDA effort on Market based Conservation where he developed the USDA Policy on Market Based Approaches and drafted a new element on Environmental Services and Markets for the 2008 Farm Bill. As a result of this new element, USDA created the new USDA Office of Ecosystem Services and Markets where he currently resides. Over the past two years Carl has also completed all elements necessary for Senior Executive Service (SES) consideration including graduating from American University's Key Executive Leadership Program and is currently going through the SES certification process. Carl grew up in Santa Fe, New Mexico and graduated from the University of New Mexico with a bachelor's degree in Civil Engineering.

Carl has a 29 year professional career with the Natural Resources Conservation Service. He served his first 13 years in New Mexico working as a Project Engineer, Design Engineer and as the State Water Quality Specialist. During that time Carl also served a year on detail with the Army Corps of Engineers providing irrigation design assistance. In the late 90's Carl moved to Colorado where he accepted a 5 year assignment with the U.S. Environmental Protection Agency as the NRCS Liaison developing partnerships, promoting the watershed approach and working on various activities related to the Clean Water Action Plan.

In 2001, Carl returned to NRCS in the Animal Husbandry and Clean Water Division of National Headquarters in Washington, DC where he continued his partnership work with EPA and other Federal partners on water quality policy issues such as source water protection, hypoxia in the Gulf of Mexico, total maximum daily loads, concentrated animal feeding operations, and water quality credit trading. He has also developed and is implementing environmental credit trading partnership agreements with the EPA and the Fish and Wildlife Service.

Colonel Thomas H. Magness, IV

58th Commander, Los Angeles District
U.S. Army Corps of Engineers

Colonel Thomas H. Magness assumed command of the Los Angeles District, U.S. Army Corps of Engineers on July 10, 2007. Prior to coming to Los Angeles, Colonel Magness was a Senior Service College Fellow at the University of Texas at Austin.

Colonel Magness was born in Ft. Campbell, Kentucky. He graduated from the United States Military Academy in 1985 with a Bachelor of Science degree and was commissioned into the Corps of Engineers. He later earned a Master's Degree in Civil Engineering from the University of Texas at Austin. His professional military education includes the Engineer Officer Basic and Advanced Courses and the Command and General Staff College.

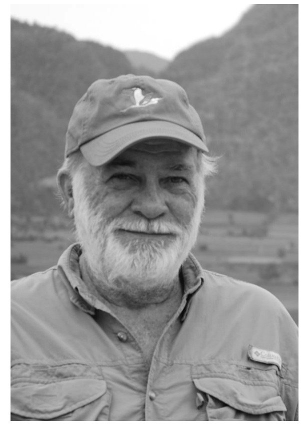
Colonel Magness has served in the 2nd Armored Division at Fort Hood, TX; the 1st Armored Division in Germany; and the 4th Infantry Division at Fort Hood, TX. He has been a platoon leader, battalion supply officer, company commander, and battalion operations officer. He deployed with the 1st Armored Division as part of Operation Desert Shield / Desert Storm. Colonel Magness served as the District Commander for the Detroit District, U.S. Army Corps of Engineers.

Colonel Magness has served as an instructor and assistant professor in the Department of Geography and Environmental Engineering at West Point. He has served two tours as an observer / controller (trainer) at the National Training Center at Fort Irwin, CA where he led the Sidewinder team, preparing engineer and maneuver support units and their leaders for combat operations.

Colonel Magness' military awards and decorations include the Legion of Merit, Bronze Star Medal, Meritorious Service Medal (four awards), and the Army Commendation Medal (four awards). He has been awarded the Parachutist Badge, Air Assault Badge, and the Ranger Tab. He is a licensed Professional Engineer in the Commonwealth of Virginia.

Colonel Magness is married to the former Michelle Carnes of Killeen, Texas. They have two daughters, Jenna and Shelby.

John C. Ogden



John C. Ogden currently (2009) is Director of Bird Conservation for Audubon of Florida. Previously, he was a research scientist at Everglades National Park for 16 years, Director of the Ornithological Research Unit and co-Director of the California Condor recovery program during his 14 years with the National Audubon Society's Research Department, and served 10 years as Chief Scientist for the South Florida Water Management District on the Everglades restoration program. John is a native Tennessean, who came to Florida to do graduate study at Florida State University. His introduction to the birds of Florida included field surveys of birds in all counties of the State.

John was the first President of the Colonial Waterbird Society, and was a member of the recovery teams for the American Crocodile, Wood Stork and California Condor. He is a Fellow of the American Ornithologists' Union, and received the Charles M. Brookfield award from Tropical Audubon in 2004 for his work in the conservation of our natural resources in Florida. His professional experiences and knowledge have primarily been in Everglades wetland ecology and restoration, the biology and conservation of raptors and colonial waterbirds, and the status and population trends of the birds of Florida. John co-edited the 1994 book, "Everglades. The Ecosystem and Its Restoration". In addition to his extensive field and conservation work in Florida, John has participated in surveys and studies in Mexico, Cuba, Venezuela, Brazil, Peru, Argentina, Zimbabwe and South Africa. At present John is continuing to work on Everglades restoration issues, and is developing new conservation programs for the birds in Florida (i.e., "common birds in decline" and neo-tropical birds "stop-over" habitats).

Denise Reed

Dr. Denise Reed is a Professor in the Department of Earth and Environmental Sciences at the University of New Orleans and is currently Interim Director of the Pontchartrain Institute for Environmental Sciences. Her research interests include coastal marsh response to sea-level rise, the contributions of fine sediments and organic material to marsh soil development, and how these are affected by human alterations to marsh hydrology. She has worked on coastal issues on the Atlantic, Pacific and Gulf coasts of the US, as well as other parts of the world, and has published the results in numerous papers and reports. She is involved in restoration planning both in Louisiana and in California, and in scientifically evaluating the results of restoration projects. Dr. Reed has served on numerous boards and panels concerning the effects of human alterations on coastal environments and the role of science in guiding ecosystem restoration, including the Chief of Engineers Environmental Advisory Board, a number of National Research Council Committees, and the Ecosystems Sciences and Management Working Group of the NOAA Science Advisory Board. She received her BA and PhD from the University of Cambridge in England and has worked in coastal Louisiana for over 20 years.

Terrence C. “Rock” Salt

Mr. Terrence “Rock” Salt assumed duties as the Principal Deputy Assistant Secretary of the Army (Civil Works) on March 12th, 2009. He is the principal policy and legislative advisor to the Assistant Secretary of the Army (Civil Works) and assists the Assistant Secretary in providing policy and performance oversight for the Army Corps of Engineers Civil Works directorate. He also serves as the Deputy Assistant Secretary for Policy and Legislation. In both these capacities Mr. Salt provides direction for the Army Civil Works legislative program, the development and articulation of the Department of the Army’s policies affecting Civil Works activities and is responsible for the coordination of the Army’s policies and practices in support of the Clean Water Act, the Rivers and Harbors Act and the related regulatory programs.

Prior to this assignment, Mr. Salt served as the Director of Everglades Restoration Initiatives for the Department of the Interior, reporting to the Deputy Secretary of the Interior. As Director of Everglades Restoration Initiatives, Mr. Salt was responsible for assisting in the development and implementation of administration policies supporting various Everglades restoration programs, including the Department of the Interior’s participation in the Comprehensive Everglades Restoration Plan, which was authorized by Congress in the Water Resource Development Act of 2000. Mr. Salt was responsible for coordinating the work of all Interior agencies involved in the Everglades restoration effort.

Mr. Salt graduated from the United States Military Academy at West Point and was commissioned as a second lieutenant in the U.S. Army in June 1966. He is a graduate of the Army’s Airborne and Ranger Schools, the Army Command and General Staff College, and the National War College. He received a Master of Science degree in physics from the University of Colorado in 1972. He retired from the Army on July 1, 1996 and continued as Executive Director of the South Florida Ecosystem Restoration Task Force as a senior executive with the Department of the Interior. Subsequently, he became the Director of the Everglades Restoration Initiatives.

In his last assignment in the Army, Mr. Salt served as the Commander and District Engineer of the Corps of Engineers’ Jacksonville District. His Army career included a variety of command and staff assignments in the United States, Germany and Vietnam. He served as deputy commander of the Corps of Engineers’ Walla Walla District and as commander of the 87th Engineer Battalion at Fort Leonard Wood, Missouri. In Washington, D.C., he was assigned to the Pentagon in the Office of the Deputy Chief of Staff for Operations and Plans on the Army Staff, and led the strategic planning initiative on Nation Assistance for the Chief of Engineers.

He is married to the former Heather Ann Miller. They have four children; Patrick, John, Charles, and James.

Lynn Scarlett

Lynn Scarlett is an independent environmental consultant working with an environmental organization on issues pertaining to climate change, ecosystem services, and landscape-scale conservation. From 2005 to January 2009, she served as Deputy Secretary and Chief Operating Officer of the U.S. Department of the Interior, a post she took on after 4 years as the Department's Assistant Secretary for Policy, Management and Budget. She served as Acting Secretary of the Department for two months in 2006. Ms. Scarlett chaired the Department's Climate Change Task Force and now serves on the Commission on Climate and Tropical Forests. From June 2003-2004, she chaired the federal Wildland Fire Leadership Council, an interagency and intergovernmental forum for implementing the National Fire Plan. Ms. Scarlett serves on the board of the American Hiking Society and is a trustee emeritus of the Udall Foundation. She is author of numerous publications on incentive-based environmental policies. She received her B.A. and M.A. in political science from the University of California, Santa Barbara, where she also completed her Ph.D. coursework and exams in political science. She is an avid hiker, canoe enthusiast, and birder.

Charles A. ("Si") Simenstad

Prof. Charles ("Si") Simenstad is the Coordinator of the *Wetland Ecosystem Team* (WET), School of Aquatic and Fishery Sciences (SAFS), University of Washington, Seattle, Washington. Heis an estuarine and coastal marine ecologist who has studied estuarine and coastal marine ecosystems throughout Puget Sound, the Washington coast, and Alaska for over thirty years.

Much of this research has focused on the functional role of estuarine and coastal habitats to support juvenile Pacific salmon and other fish and wildlife, and the associated ecological processes that are responsible for enhancing their production and life history diversity. Estuaries of particular research focus are estuaries of: the Columbia, Salmon and other coastal Oregon-Washington rivers; Puget Sound, Washington; San Francisco Bay and the Sacramento/San Joaquin Delta, California; and, Kachemak Bay, Alaska. His research interests focus on: natural (e.g., basic) ecosystem-, community- and habitat-level interactions, with emphasis on predator-prey relationships; sources, organization and flow of organic matter through food webs; estuarine ecology of juvenile Pacific salmon; and, landscape-scale interaction between estuarine circulation and ecological processes. Recent research has integrated such ecosystem interactions with applied issues such as restoration, creation and enhancement of estuarine and coastal wetland ecosystems, and ecological approaches to evaluating the success of coastal wetland restoration at ecosystem and landscape scales. For example, in this capacity, he was one of the lead authors of the tidal marsh conceptual model for the Delta Regional Ecosystem Restoration Implementation Plan (Kneib *et al.* 2008).

Si's present research includes: NOAA-NWFSC studies of juvenile salmon rearing in wetlands and restoring shallow-water ecosystems of the Columbia River estuary; developing and testing an ecosystem classification system for the Columbia River estuary; initiating a new, interdisciplinary study of restoration process at Liberty Island in the Sacramento River delta; and serving as Chair of the Nearshore Science Team (NST) of the Puget Sound Nearshore Ecosystem

Research Program (PSNERP) that is providing scientific guidance in developing a feasibility plan for large-scale restoration of estuarine and nearshore ecosystems of Puget Sound. He holds a B.S. (1969) and M.S. (1971) from the School of Fisheries at the University of Washington.

Barbara L. Stinson

Ms. Stinson is a founder and Senior Partner of the Meridian Institute. She offers over twenty years of experience in designing, facilitating and analyzing collaborative processes. Her expertise and insights have helped the public and private sectors pursue innovative approaches to identifying problems and solving conflicts, particularly on global climate change, air quality, transportation, land use, natural resource management and low-level radiation issues. Ms. Stinson has mediated national regulatory negotiations, conducted national policy dialogues, convened series of regional workshops on controversial public policy issues, and assisted parties settling long-standing disputes through the use of collaborative processes.

Before working for Meridian, Ms. Stinson was a Senior Associate in the Science and Public Policy Program for the Keystone Center. As Senior Associate, she provided neutral third-party mediation, facilitation and general conflict management services to resolve natural resource, environmental quality, and science and technology policy conflicts at the local, regional and national level. In addition, she conducted convening assessments, convened parties for discussion, developed and finalized consensus documents that contributed to federal agency regulatory and national legislative efforts.

Among other accomplishments, Ms. Stinson conducted an analysis of and co-authored a chapter on the use of Joint Fact-Finding in Consensus-Building Processes that was published in the Consensus-Building Handbook, A Comprehensive Guide to Reaching Agreement, 1999.

In addition to Ms. Stinson's extensive experience in dispute resolution, she has a Master's in City Planning, Environmental Policy and Mediation from the Massachusetts Institute of Technology at Cambridge, MA and a Bachelor of Arts in Environmental Conservation from the University of Colorado, Boulder.

Laura J. Stroup

Dr. Laura Stroup is an Assistant Professor of Geography at Texas State University—San Marcos, beginning her appointment in August 2008. Her specialties include water resources, physical geography, and U.S. environmental policy. She received her B.A. in Environmental Management with a minor in Geosciences at Franklin & Marshall College in Lancaster, PA. She received a M.S. in Geography from the University of South Carolina. Working under the direction of Dr. William L. Graf, at the University of South Carolina, her recently completed dissertation, "Climate Change Effects on U.S. Water Resources Management," examined the perspectives of over 40 water managers and stakeholders in four large U.S. river basins-- the Colorado, Platte, Delaware Rivers as well as the Everglades. This dissertation study examined how water managers in these basins intend to adapt water management practices to their understanding of climate change and variability. The project was supported by a National Science Foundation (NSF) Geography and Regional Science Doctoral Dissertation Research Improvement (DDRI) Grant. Laura has served as the Student Representative to the Association of American Geographers Water Resources Specialty Group where she has also won two competitive Research Proposal Awards. Graduate research endeavors also entailed assisting the National Park Service in compiling data regarding the federal relicensing of a dam upstream of Congaree National Park. Ecologically Sustainable Water Management (ESWM), principles were used in this project to incorporate instream flow considerations in the Federal Energy Regulatory Commission (FERC) relicensing of the upstream Saluda Dam.

LTG Robert L. Van Antwerp, Commanding General

On May 18, 2007, **Lieutenant General Robert L. "Van" Van Antwerp** became the U.S. Army Chief of Engineers and Commanding General of the U.S Army Corps of Engineers (USACE). General Van serves as the senior military officer overseeing most of the Nation's civil works infrastructure and military construction.

As the USACE Commanding General, he is responsible for approximately 33,000 Civilian and 600 military employees, who provide project management and construction support to 250 Army and Air Force installations in nearly 100 countries around the world. USACE has a key role in support to Overseas Contingency Operations, with thousands of Civilians and Soldiers deployed to support reconstruction in Iraq and Afghanistan. General Van is also responsible for hundreds of environmental protection projects and for overseeing the regulatory permit program to protect, restore and enhance thousands of acres of wetlands. In addition, USACE has an emergency response mission to support the Federal Emergency Management Agency in restoration and repair after a disaster, whether natural or manmade.

General Van took command of USACE after serving, most recently, as Commanding General, U.S. Army Accessions Command, responsible for recruiting and training thousands of young patriots who represent the epitome of "Army Strong."

Other command assignments include the U.S. Army Maneuver Support Center and Fort Leonard Wood; Commandant, U.S. Army Engineer School, Fort Leonard Wood, Missouri; U.S. Army Corps of Engineers, Los Angeles District during the Northridge Earthquake of 1994; the U.S. Army Corps of Engineers, South Atlantic Division, Atlanta, Georgia; and the 326th Engineer Battalion, 101st Airborne Division (Air Assault) during OPERATION DESERT SHIELD and OPERATION DESERT STORM in Saudi Arabia and Iraq.

A graduate of the U.S. Military Academy at West Point in 1972, General Van completed Ranger, Airborne and Air Assault training, and both the Engineer Officer Basic and Advanced Courses. He holds a Master of Science degree in Mechanical Engineering from the University of Michigan and a Master of Business Administration degree from Long Island University in New York. He is a Registered Professional Engineer.

Agenda

MONDAY 7/20/09	WELCOME to the 3rd National Conference on Ecosystem Restoration (NCER '09)
7:30-12:30	EXHIBITOR MOVE-IN (Conference Exhibition Hall - Pasadena Room)
7:30-12:30	SESSION I POSTER PRESENTERS SET-UP DISPLAYS (Conference Exhibition Hall - Pasadena Room)
7:30-5:30	Registration Opens for Conference Attendees (San Diego Ballroom - Level 2)
8:30-12:00	CLIMATE CHANGE WORKSHOP (Emerald Bay Room of Catalina Ballroom - Level 3) Developing Restoration and Management Strategies in the Context of Climate Change: G. Ronnie Best, U.S. Geological Survey, Gregory Eckert, National Park Service, Glenn Landers, U.S. Army Corps of Engineers and Laura Stroup, Texas State University
8:30-12:00	CAMNet ADAPTIVE MANAGEMENT WORKSHOP (Avalon Room - Level 3) Kent Loftin, Hydroplan LLC., Jennifer Pratt-Miles and Barbara Stinson, Meridian Institute, Chad Smith, Headwaters Corporation and Tom St. Clair, PBS&J
12:10-1:00	LUNCH ON YOUR OWN
1:00 - 5:30	WELCOMING PLENARY SESSION (Sacramento/San Francisco)
1:00 - 1:10	Moderator Introduction - David Koran, NCER Chair, U.S. Army Corps of Engineers
1:10 - 1:15	Welcome to the City of Los Angeles - Michael Krouse, CHME, CMP, Senior Vice President of Sales for LA INC., Los Angeles Convention and Visitors Bureau
1:15 - 1:20	Col. Thomas Magness III, Los Angeles District Commander, U.S. Army Corps of Engineers
1:20 - 1:30	Col. Janice L. Dombi, Commander, South Pacific Division, U.S. Army Corps of Engineers
1:30 - 2:00	LTG Robert L. Van Antwerp, Chief of Engineers and Commander of the U.S. Army Corps of Engineers
2:00 - 2:30	Suzette Kimball, Director, U.S. Geological Survey
2:30 - 3:00	Mike Hubbs, Director, Ecological Sciences Division Natural Resources Conservation Service
3:00 - 3:30	REFRESHMENT BREAK IN POSTER AND EXHIBIT DISPLAY AREA
3:30 - 5:30	WELCOMING PLENARY SESSION (Sacramento/San Francisco Ballroom)
3:30 - 3:40	Moderator Introduction - G. Ronnie Best, U.S. Geological Survey
3:40 - 4:10	Terrence "Rock" Salt, Principal Deputy Assistant Secretary, Office of the Assistant Secretary of the Army (Civil Works)
4:15 - 4:45	Bill Leary, Former Director for Natural Resources, Council for Environmental Quality (CEQ)
4:45 - 5:00	Question & Answer / Discussion Period
5:00- 5:30	Sponsor Recognition and Closing Comments
6:00 - 8:00	WELCOME RECEPTION (Plaza Outdoor Deck - Level 4)
TUESDAY 7/21/09	TUESDAY - JULY 21, 2009
7:30-8:30	MORNING REFRESHMENTS IN POSTER & EXHIBIT DISPLAY AREA (Conference Exhibition Hall - Pasadena Room)
8:30 - 9:35	Plenary Session - Integrating Ecosystem Services into Large-scale Ecosystem Restoration (Sacramento/San Francisco) This session will address the emerging challenge of incorporating ecosystem services into large-scale ecosystem restoration.
8:30 - 8:35	Moderator Introduction - Carl Shapiro, U.S. Geological Survey
8:35-8:55	David Brookshire, Professor of Economics, University of New Mexico
8:55 - 9:15	Greg Biddinger, Natural Land Management Program Coordinator, ExxonMobil Biomedical Sciences, Inc.
9:15 - 9:35	Carl Lucero, Acting Deputy Director, USDA's Office of Ecosystem Services and Markets
9:35 - 10:00	REFRESHMENT BREAK IN POSTER AND EXHIBIT DISPLAY AREA (Conference Exhibition Hall - Pasadena Room)

TUESDAY 7/21/09	TUESDAY - JULY 21, 2009 (continued)					
	CONCURRENT SESSIONS					
10:00 - 12:10	**SESSION 1: Large-Scale Ecosystem Restoration Program Comparison and Contrast**	**SESSION 2: The Appropriate Role for Ecosystem Services in Ecosystem Restoration and Environmental Decision Making**	**SESSION 3: Stream Corridor Conservation Actions to Restore Riverine Processes on Private Lands**	**SESSION 4: Restoration of an Urbanized Estuary: San Francisco Bay Shoreline**	**SESSION 5: Ecological History Relevance for Ecosystem Management**	**SESSION 6: Biogeochemistry, Water Quality and Contaminants**
	San Jose (Level 2)	Emerald Bay (Level 3)	Avalon Room (Level 3)	Hollywood Ballroom (Level 3)	Santa Monica B (Level 3)	Santa Monica A (Level 3)
	Moderator: Brad Thompson	**Moderator: Kevin Summers**	**Moderator: Kathryn Boyer**	**Moderator: Steven Ritchie**	**Moderator: Deb Willard**	**Moderator: G. Ronnie Best**
10:00 - 10:10	**Introduction and Overview**	**Introduction and Overview**	**Introduction and Overview**	**Introduction and Overview**	**Introduction and Overview**	**Introduction and Overview**
10:10 - 10:30	**Panel Session:** Large Ecosystem Restoration Program Comparison and Contrast **Troy Constance** Louisiana Coastal Area **Stu Appelbaum** Everglades **Mike Olson** Missouri River Recovery **Ken Barr** Upper Mississippi River **Carl Wilcox** California Delta **Marci Cook** Columbia River __Discussion Period:__ FACILITATOR: **David Galat,** USGS	**Kevin Summers -** The Relationships among Ecosystem Services, Restoration and Human Well Being and the Construction of an Index of Well-Being	**Thomas Moore -** A Planner's Perspective on Stream Corridor Restoration	**Dilip Trivedi -** San Francisco Bay: Its Past, Present, and Prospective Future	**G. Lynn Wingard -** Paleoecological Tools for Restoration - Setting Performance Measures In South Florida's Estuaries	**Billy Johnson -** Demonstration of a Physically Based Distributed Watershed Water Quality Model (Galle Watershed, WI)
10:30 - 10:50		**Curtis Tanner -** Why Care About Impacts to Natural Systems? Using Ecosystem Functions, Goods, and Services to Scale Changes to Nearshore Ecosystems in Puget Sound	**Howard Hankin –** Utilizing Farm Bill Conservation Programs to Implement Stream Corridor Restoration Projects on Private Lands	**Michelle Orr -** The Key Challenges Confronting Habitat Restoration in San Francisco Bay: Are They Manageable?	**Akira Tsujimoto -** The Effect of Anthropogenic Eutrophication on a Shallow Marine Benthic Ecosystem: Microfossil Records over the Last 200 Years in Osaka Bay, Japan	**Kevin O'Donnell -** A Hydrologic Event-Based Evaluation of Water Quality Trends in Goodwater Creek Experimental Watershed, Missouri
10:50 - 11:10		**Stephanie Pincetl -** Implementing a Nature's Services Infrastructure: The Case of a Million Trees Los Angeles	**Stan Gregory -** Floodplain Dynamics and Thermal Refuges for Native Fish Communities in the Willamette River	**Betsy Wilson -** Successes and Lessons Learned in San Pablo Bay Wetland Restoration	**Anna Wachnicka -** Diatom-Based Assessment of Past Water Quality in Biscayne Bay, Florida	**Kenneth Wagner** - Phosphorus Inactivation as a Lake Restoration Technique
11:10 - 11:30		**Carl Lucero -** USDA's Approach to Ecosystem Services and Environmental Markets	**Natasha Bankhead -** Stream Corridor Modeling Tools for Adaptive Management of the Upper Truckee River, Lake Tahoe, CA	**Steve Ritchie -** Successes and Lessons Learned in South San Francisco Bay Wetland Restoration	**Scott Starratt -** Too Cunning to be Understood: The Record of Late Holocene Central California Climate Change from San Francisco Bay Marsh Sediments	**William James -** Understanding Phosphorus Dynamics and Controls to Better Manage the Turbid Minnesota River System
11:30 - 11:50		**Kelly Burks-Copes -** Capturing the Human Dimension of Ecosystem Restoration: Using GIS and Multi-Criteria Decision Analysis to Measure Ecosystem Services - the Middle Rio Grande	**Richard Zembal -** Recovery of an Endangered Bird and Riparian Habitat by Restoration and Management on the Santa Ana River, CA	**John Callaway -** Biological Diversity in San Francisco Bay and the Effects of Climate Change	**Debra Willard -** Hydrologic Variability in the Florida Everglades: A Paleoecological Perspective	**Mark Krupka -** Use of Bioremediation in the Treatment of Natural and Man-made Bodies of Water to Improve Water Quality and Reduction of Organic Sediments
11:50 - 12:10		**Mark Judson -** Integration of Ecosystem Services into a Decision Support Platform	**Casey Burns -** Streambank Bioengineering and Riparian Habitat Restoration and Enhancement at Adobe Ranch, Mono County, CA	**Peter Downs -** Making Urban Ecosystem Restoration Real: Addressing Factors Limiting Threatened Steelhead in the San Francisco Bay Area	**Stephen Davis -** Restoring Raised Bog in Ireland: Prospects and Paleoenvironmental Perspectives	**Shelly Anghera -** Contaminated Sediments: The Balance Between a Functioning Ecosystem and the Desire for Contaminant Removal
12:10 - 1:30	LUNCH ON YOUR OWN					

TUESDAY 7/21/09	TUESDAY - JULY 21, 2009 (continued)					
	CONCURRENT SESSIONS					
1:30 - 3:40	**SESSION 1: Lessons Learned from Restoration Programs at the Watershed Scale**	**SESSION 2: Measuring Restoration Success: Tools & Partnerships**	**SESSION 3: River Restoration: Integrating Science and Engineering**	**SESSION 4: Urban Ecosystem Restoration**	**SESSION 5: Linking Monitoring Results with Management Decision Making**	**SESSION 6: Ecological Restoration on Public and Working Lands in the U.S.**
	San Jose (Level 2)	Emerald Bay (Level 3)	Avalon Room (Level 3)	Hollywood Ballroom (Level 3)	Santa Monica B (Level 3)	Santa Monica A (Level 3)
	Moderator: Eric Bush	**Moderator: Ruth Villalobos**	**Moderator: Kameran Onley**	**Moderator: Deborah Lamb**	**Moderator: Casey Kruse**	**Moderator: Steve Brady**
1:30 - 1:40	Introduction and Overview	Introduction and Overview	Introduction and Overview	Introduction and Overview	Introduction and Overview	Introduction and Overview
1:40 - 2:00	**Donald Boesch** - Independent Scientific Evaluations of Major Ecosystem Restoration Programs	**Shaun McKinney -** Water Quality Trading - Providing the Tools to Trade Nutrients	**David Galat -** Establishing System-Wide Goals and Objectives for Restoring the Upper Mississippi River within an Adaptive Management Framework	**Derek Booth -** Management, Monitoring, and Restoring Urban Streams	**Gregory Steyer** - Louisiana's Coastwide Reference Monitoring System: Using Web Services to Integrate and Visualize Data to Assess Restoration Effectiveness	**Pete Heard -** The Role of the Agricultural Wildlife Conservation Center in Ecological Restoration Efforts
2:00 - 2:20	**Russell Reed -** Contemporary Planning Issues for Large Scale Ecosystem Restoration Programs	**S. Kyle McKay -** Establishing Metrics for Environmental Benefits Analysis	**Brent Knights -** Fish Assemblages in Off-Channel Areas of the Upper Mississippi and Illinois Rivers: Implications for Restoration	**Timothy Brick -** Case Study-Central Arroyo Seco Stream Restoration Near Downtown Los Angeles	**Pamela Neubert -** West Falmouth Harbor-Baseline Monitoring for Management Decisions and Future Restoration (Cape Cod, Massachusetts)	**Wendell Gilgert -** The Development and Use of Ecological Site Descriptions for Ecosystem Restoration on Agricultural Working Lands in the US
2:20 - 2:40	**Lawrence Skaggs -** Applying Lessons Learned in Planning for USACE Ecosystem Restoration Projects: Reasons for Effective Stakeholder Participation	**Daniel McGrath -** An Estimation of the Social Value of Municipal Government Investment in Natural Capital	**Oliver Soong -** Coupling of Riparian Tree Recruitment and River Hydrology along a Recently Restored Reach of the Merced River, CA	**Brendan Belby -** Restoring Floodplain Connectivity and Re-Meandering a River Constrained by Urban Infrastructure: Upper Truckee River in South Lake Tahoe	**Craig Fischenich -** How Do We Measure Ecological Restoration Success?	**William Hohman -** Restoration of Biological Functions to Conservation Buffers in Intensive Agriculture Regions of the Upper Midwest
2:40 - 3:00	**Chemine Jackels -** The Green River Basin Wide Ecosystem Restoration Project : US Army Corps of Engineers - Seattle District	**Michele Mahoney** - Ecological Revitalization: Turning Contaminated Properties Into Community Assets	**Chris Budai -** Willamette River Floodplain Restoration Study – Coast Fork and Middle Fork Willamette River Subbasins	**Nicholas Garrity -** Ballona Wetlands Restoration: Recreating Estuarine Habitats in Los Angeles	**Sean Anderson -** The Value of Phased, Experimental Approaches to Wetland and Grassland Restoration: Lessons from Southern California to Central Asia	**Ellen Starr -** Hydrologic Restoration Provides Immediate Benefits for Wetland Dependent Species
3:00 - 3:20	**Andreas Krause -** A 25-Year Retrospective on Evolving Restoration Construction Philosophies for the Trinity River, CA	**Mitch West -** National Environmental Information Exchange Network: Sharing Data for Better Watershed Management	**Scott McBain** - River Corridor Design Considerations to Facilitate Salmon Reintroduction to the San Joaquin River	**Kimberly Garvey -** Restoring the Colorado Lagoon – The Little Lagoon That Could!	**Ondrea Hummel -** Evaluating Restoration Success and Applying Adaptive Management in the Middle Rio Grande Bosque	**John Pitre -** Utilization of USDA Farm Bill Conservation Programs to Restore Bottomland Hardwood Forest Habitat for a Federally Threatened Species in Louisiana
3:20 - 3:40	**Nate Nichols -** Establishing the Legacy Nature Preserve – Restoration in Urban/Lake Fringe of the Great Salt Lake Ecosystem through Collaborative Planning and Adaptive Management	**Lindsay Teunis -** Use of Hydrogeomorphic Assessment Method (HGM) and the California Rapid Assessment Method (CRAM) in Guiding Adaptive Management Decisions	**Chad Smith** - Land, Water, and Adaptive Management - Science and Engineering for Species Recovery on the Platte River	**Teresa Doss & Carl Alderson** Analysis and Assessment of Thirty Years of Wetland Restoration within the New York/New Jersey Harbor Estuary	**Robert Doren -** Ecological Indicators for Assessing Everglades Restoration	**Karen Fullen -** Restoring Utah Prairie Dogs to Working Lands
3:40 - 4:10	**REFRESHMENT BREAK IN POSTER AND EXHIBIT DISPLAY AREA (Conference Exhibition Hall - Pasadena Room)**					
4:10 - 6:00	**RESTORATION COFFEE HOUSE (Sacramento/San Francisco)** **Ecosystem Restoration Success: Challenges of Coordination and Governance** **MODERATOR: Martin Goebel, Director of Sustainable Northwest** **PANELISTS: Lynn Scarlett, John Ogden, Barbara Stinson and Don Boesch** **FORMAT: This panel will promote a highly interactive discussion with the audience on ecosystem restoration, partnerships, collaboration and governance issues. Outcome: Identification of (1) governance "models" most likely to support successful, ecosystem-scaled restoration programs (including the range of "tools" that should belong in a governance toolbox), and (2) opportunities for new and/or changing roles by federal, state, tribal, and local governments (including ideas for a national ecosystem program).**					
6:00 - 8:00	**POSTER SESSION I & RECEPTION (Conference Exhibition Hall - Pasadena Room)**					

WEDNESDAY 7/22/09	WEDNESDAY - JULY 22, 2009					
7:00 - 8:00	MORNING REFRESHMENTS IN POSTER & EXHIBIT DISPLAY AREA Poster Session II Poster Presenters to Put Up Displays (Conference Exhibition Hall - Pasadena Room)					
	CONCURRENT SESSIONS					
8:00 - 9:30	**SESSION 1: Issues in Dam Decommissioning**	**SESSION 2: Fish Passage**	**SESSION 3: Analysis of Historic and Future Change to Inform Ecosystem Restoration**	**SESSION 4: Urban Ecosystem Restoration**	**SESSION 5: Federal Conflict Resolution Centers: Managing Everyday Challenges**	**SESSION 6: International Ecosystem Restoration**
	San Jose (Level 2)	Emerald Bay (Level 3)	Avalon Room (Level 3)	Hollywood Ballroom (Level 3)	Santa Monica B (Level 3)	Santa Monica A (Level 3)
	Moderator: Bud Abbott	**Moderator: Wendi Goldsmith**	**Moderator: Charles "Si" Simenstad**	**Moderator: Patricia Matthews**	**Moderator: Brian Manwaring**	**Moderator: Rob Daoust**
8:00 - 8:10	**Introduction and Overview**	**Introduction and Overview**	**Introduction and Overview**	**Introduction and Overview**	**Introduction and Overview**	**Introduction and Overview**
8:10 - 8:30	**Keith Admire -** Issues Respective to the Natural Resources Conservation Service in Decommissioning Dams Pursuant to Public Law 83-566	**Brian Zettle -** Restoring Migratory Pathways in the Apalachicola-Chattahoochee-Flint River Basin Through Fish Passage Operations	**Gregory Hood -** Be Like Janus: The Need for a Two-faced Perspective on Ecosystem Restoration	**Leslie Carrere -** Urban Forestry Restoration Case Studies – Human Dimensions and Technical Approaches	**PANEL SESSION:** **Panelists:** **David Emmerson** (DOI) **Patricia Orr** (USIECR) **Hal Cardwell** (USACE) **Kerry Redican** (USACE)	**Francisco Zamora-Arroyo -** Local and Bi-National Restoration Efforts in the Colorado River Delta in Mexico
8:30 - 8:50	**Timothy Randle -** Progress on Guidelines for Assessing Physical Dam Removal Impacts	**Lee Becker -** Acushnet River Fish Passage Restoration Project	**Charles Simenstad -** Assessing Nearshore Change in Pudget Sound	**Mark Tompkins -** Restoring Urban Ecosystems: The Trinity River Corridor Program, Dallas, Texas		**Greg Eckert-** Best Practices for Ecological Restoration in Protected Areas: Foundation for the IUCN Restoration Guidelines
8:50 - 9:10	**Jason Weiss -** Economic and NED Account Considerations During Dam Decommissioning Plan Formulation	**Heather Schwar -** Evaluating Fish Passage Effectiveness for Alternatives at the Belvidere Dam (Belvidere, IL)	**Aundrea McBride -** Fragmentation and Loss of Pocket Estuary Habitat in the Whidbey Basin of Puget Sound	**Chris Webb -** Fairview Park Wetland Restoration Project		**Florentina Zurita -** Causes and Impacts of Zula River Pollution: Is it Possible it's Restoration?
9:10-9:30	**Jock Conyngham -** Frequently Asked Questions in Dam Decommissioning - Guidance for Data Collection, Analytic Needs and Project Implementation	**Jason Farmer -** Balancing Restoration Goals with Design and Function - The Melvin Price Locks and Dam Fish Passage Project	**William Brandau -** Restoration Efforts on the Upper Gila: 1918-2009	**Rob Sloop -** Restoration of Relic Wetlands - In Construction – A Grassroots Vision Finally Realized		**DISCUSSION**
9:30 - 9:50	REFRESHMENT BREAK IN POSTER AND EXHIBIT DISPLAY AREA (Conference Exhibition Hall - Pasadena Room)					

WEDNESDAY 7/22/09	WEDNESDAY - JULY 22, 2009 (continued)					
	CONCURRENT SESSIONS RESUME					
9:50 - 11:00	**SESSION 1: Ecosystem Restoration Program Management**	**SESSION 2: Wildlife Habitat Restoration**	**SESSION 3: Missouri River Recovery**	**SESSION 4: Urban Ecosystem Restoration (continued)**	**SESSION 5: Predictive Performance Measures**	**SESSION 6: Linking Monitoring Results with Decision-making**
	San Jose (Level 2)	Emerald Bay (Level 3)	Avalon Room (Level 3)	Hollywood Ballroom (Level 3)	Santa Monica B (Level 3)	Santa Monica A (Level 3)
	Moderator: Tony Buitrago	**Moderator: Sara Simrell**	**Moderator: Wayne Nelson-Stastny**	**Moderator: Scott Bell**	**Moderator: Tomma Barnes**	**Moderator: Eric Hughes**
9:50 - 10:00	**Introduction and Overview**	**Introduction and Overview**	**Introduction and Overview**	**Introduction and Overview**	**Introduction and Overview**	**Introduction and Overview**
10:00 - 10:20	**Mike Rogalski -** The Herbert Hoover Dike Major Rehabilitation Project - Program Management Strategies and Challenges	**Jutta Burger -** Scaling up Restoration of Nesting Habitat for Cactus Wrens in Orange County, California	**Mike George -** Challenges in Building Basin-Wide Consensus on Missouri River Recovery Activities	**Timothy Dekker -** Integrating Hydrology, Ecology and River Geomorphology into Urban Landscape Design: The Lower Don Lands Naturalization Project	**Jed Redwine -** Performance Measures are Essential for Planning, Operation and Validation of Landscape Restoration	**Eliza Hines -** CERP Monitoring and Assessment Plan System Status Reports: The Evolution from 2006-2009
10:20 - 10:40	**Karen Tippett -** The South Florida Ecosystem Restoration Program Integrated Delivery Schedule	**Allison Bremner -** Caspian Tern Relocation from the Columbia River Estuary: A Mitigation Strategy for the Recovery of the Endangered Columbia River Salmonids	**Suzanne Boltz -** Using Adaptive Management to Address Uncertainty in the Management of Missouri River Cottonwoods	**Steven Apfelbaum -** An Ecologist's Perspective on the Don River Naturalization: Toronto, Canada	**Chad Praul -** A Restoration Program Planning and Evaluation System: Selecting Performance Measures and Relating Them to Environmental Status	**Tisa Shostik -** NOAA's Open Rivers Initiative: Effectiveness Monitoring That Supports Decision Making
10:40 - 11:00	**Mike George -** Missouri River Recovery Program Governance Structure	**Peter Frederick -** Use of an Unmanned Aircraft System for Monitoring Nesting Responses of Wading Birds to Restoration of the Florida Everglades	**Carol Hale -** Development of an Adaptive Management (AM) Program to Support Recovery of the Missouri River: Creating Functional Shallow Water and Emergent Sandbar Habitat	**Michael Van Valkenburgh -** Towards an Ecological Agenda for Landscape Urbanism	**Lauren Hastings -** Conceptual Models, Monitoring, Assessment and Performance Measures in Support of Adaptive Management in the California Bay-Delta System	**Daniel Liebau -** Passive Treatment and Adaptive Management: Approaching an Endpoint for Ecosystem Restoration and Watershed Protection at the Buck Mine Discharge Site
11:15 - 8:00	**BOARD BUSSES FOR OPTIONAL TECHNICAL TRAINING FIELD TRIPS** Each Field Trip has an independent Itinerary. Consult your registration packet for bus loading instructions and detailed tour itineraries. Buses for each field trip will depart promptly at the scheduled time. Once buses depart, there are no alternative options for transportation.					
	EVENING & DINNER ON YOUR OWN					
THURSDAY 7/23/09	THURSDAY - JULY 23, 2009					
7:30 - 8:30	MORNING REFRESHMENTS IN POSTER & EXHIBIT DISPLAY AREA (Conference Exhibition Hall - Pasadena Room)					
8:30 - 9:30	Plenary Session - Global Climate Change (Sacramento/San Francisco)					
8:30 - 8:35	MODERATOR INTRODUCTION: G. Ronnie Best, US Geological Survey					
8:35 - 9:30	KEYNOTE PRESENTATION: Impacts of Climate Change on Large-scale Ecosystem Restoration Jean Brennan, Senior Climate Change Scientist, Defenders of Wildlife					
9:30 - 10:00	REFRESHMENT BREAK IN POSTER AND EXHIBIT DISPLAY AREA (Conference Exhibition Hall - Pasadena Room)					

THURSDAY 7/23/09	THURSDAY - JULY 23, 2009 (continued)					
	CONCURRENT SESSIONS					
10:00 - 12:10	**SESSION 1:** **Impacts of Climate Change on Ecosystem Restoration**	**SESSION 2:** **Comparison of Adaptive Management Programs**	**SESSION 3:** **Restoration and Rehabilitation in the Mississippi River System**	**SESSION 4:** **New Planning Approaches and Methodologies**	**SESSION 5:** **Aquatic Habitat Restoration: Integrating Science & Engineering**	**SESSION 6:** **Ecosystem Modeling**
	San Jose (Level 2)	**Emerald Bay (Level 3)**	**Avalon Room (Level 3)**	**Hollywood Ballroom (Level 3)**	**Santa Monica B (Level 3)**	**Santa Monica A (Level 3)**
	Moderator: Don Boesch	**Moderator: Tom St. Clair**	**Moderator: Roger Perk**	**Moderator: Dave Tipple**	**Moderator: Cheryl Ulrich**	**Moderator: Kevin MacKay**
10:00 - 10:10	**Introduction and Overview**	**Introduction and Overview**	**Introduction and Overview**	**Introduction and Overview**	**Introduction and Overview**	**Introduction and Overview**
10:10 - 10:30	**Denise Reed -** Restoring Coastal Ecosystems in the Face of Climate Change: Using What We Know	**Panel Session** **Part 1 -** Governance and Lessons Learned **Panelists:** **Andy Loschiavo** - Everglades **Dennis Kubly -** Glen Canyon **Chad Smith -** Platte River	**Paul DuBowy -** Navigation, Flood Management and the Mississippi River Ecosystem	**Doug Lamont -** Revisions to the Principles and Guidelines – Water Resources Planning for the 21st Century	**Andrew Albaugh -** NMFS and Ecoinformatics: Using Technology and Databases to Help Restore Endangered and Threatened Salmon Populations	**David Gorman -** Application of Computer Models for Ecosystem Restoration
10:30 - 10:50	**John Henz -** Climate Change: Dealing with Potential Impacts on Ecosystem Restoration		**Marvin Hubbell -** Environmental Restoration on the Upper Mississippi River - A Look Back and to the Future at Pioneering Programs	**Ana Toline -** A Practical Approach for Assessing the Benefits of Innovative Ecosystem Restoration Projects	**Noah Hume -** Salmonid and Predator Use of Nearshore Habitat Enhancement Features Throughout the Lower Sacramento River Levee System	**Tim Hanrahan -** Quantifying Large River Habitat Restoration Potential Through Hydrodynamic Modeling and Geomorphic Analysis
10:50 - 11:10	**Jon Porthouse -** Achieving Sustainable Ecosystems in the Future: A Framework for Today's Restoration Planning Programs		**Marshall Plumley -** Illinois River Basin Restoration Program - Comprehensive Plan Lessons Learned	**Chuck Padera** - The Values Triangle: Balancing the Science, Accountability and Fair Processes	**Meagan Montgomery** Restoring River-floodplain Connectivity for Fish Spawning and Nursery in the Lower Missouri River: Use of a Constructed Fish Passage Facility	**Joel Darnell** - Numerical Modeling: A Tool for Urban Conservation and Restoration at Ormond Lagoon
11:10 - 11:30	**Glenn Landers -** Climate Change Concerns for Everglades Restoration Planning	**Panel Session** **Part 2:** Linking Science to Decision Making **Panelists:** **Matt Harwell -** Everglades **Ted Melis -** Glen Canyon **Jim Jenniges -** Platte River	**Brian Johnson -** The Middle Mississippi River Regional Corridor Study - An Example of Collaborative Watershed Planning	**Joseph DePinto -** Modeling the Relationship between Water Flows/Levels and Ecological Endpoints	**Christopher Collins** Removal or Enhancement of Pilings and Pile Dikes as Potential Habitat Restoration Techniques for Pacific Salmon Recovery	**Andrew Casper -** Envirofish: A HEC-Compatible Floodplain Habitat Model for Evaluating Mitigation or Restoration Scenarios
11:30 - 11:50	**Michael Flaxman and Steve Traxler -** Exploring the Consequences of Global Warming on the Greater Everglades: A Stakeholder-based Approach		**Jack Killgore -** Restoration of Secondary Channels in the Free-flowing Mississippi River	**Herry Utomo -** Accomplishments and Challenges in Genetic Enhancement and Aerial Planting Applications for Restoration in Highly Eroded Intertidal Marshes	**Mike Dietl -** Collaboration and Designing for Endangered Fish Species in a Floodway	**Lisa Rabbe -** Modeling Cottonwood Habitat and Forecasting Landscape Changes along the Missouri River
11:50 - 12:10	**Brian Bergamaschi -** A Large-Scale Carbon Biosequestration Demonstration Project in the Sacramento-San Joaquin Delta		**Barry Johnson -** Monitoring on the Upper Mississippi River System: Working Toward Adaptive Management	**Jessica Clement -** The Role of Place-based Values to Ecosystem Governance in Western U.S.	**Sarah Miller -** Stability Thresholds and Performance Standards for Stream Restoration Materials and Methods	**John Hickey** - New Software Tools (HEC-EFM and GeoEFM) for Ecosystem Restoration and Management
12:10 - 1:30	LUNCH ON YOUR OWN					

THURSDAY 7/23/09	THURSDAY - JULY 23, 2009 (continued)					
	CONCURRENT SESSIONS					
1:30 - 3:40	**SESSION 1: Impacts of Climate Change on Ecosystem Restoration**	**SESSION 2: Assessing Cumulative Effects of Multiple Restoration Projects on an Ecosystem**	**SESSION 3: Restoration and Rehabilitation in the Mississippi River System**	**SESSION 4: Effective Partnering for Setting and Achieving Habitat Conservation Goals**	**SESSION 5: Coastal Restoration**	**SESSION 6: SCS/NRCS Watershed Planning and Effects of Upland Conservation on Coastal Ecosystems**
	San Jose (Level 2)	Emerald Bay (Level 3)	Avalon Room (Level 3)	Hollywood Ballroom (Level 3)	Santa Monica B (Level 3)	Santa Monica A (Level 3)
	Moderator: Laura Stroup	Moderator: Ron Thom	Moderator: Paul DuBowy	Moderator: Sandra Scoggin	Moderator: Dave Tazik	Moderator: Howard Hankin
1:30 - 1:40	Introduction and Overview	Introduction and Overview	Introduction and Overview	Introduction and Overview	Introduction and Overview	Introduction and Overview
1:40 - 2:00	**Richard Fischer -** Future Habitat and Population Viability of Shore-line dependent Birds in Florida: Assessing Risk and Uncertainty under Climate Change	**Gary Johnson -** Cumulative Effects Evaluation of Ecosystem Restoration in the Columbia River Estuary	**Leighann Gipson -** Conservation - The Other Economy	**Fred Reid -** Effective Partnering for Setting and Achieving Habitat Conservation Goals	**Jana Davis -** Living Shoreline Restoration: Evaluation of Ecological Benefits and Connections to Policy and Management	**Andrew Lipsky -** Ridgetop to Reef- Tapping the Potential of the US Farmbill
2:00 - 2:20	**Burton Suedel -** A Risk-Informed Decision Framework for Hurricane Protection and Coastal Planning	**Curtis Roegner -** Linking Juvenile Salmon Use to Habitat Restoration	**Leighann Gipson -** Overview of the Lower Mississippi River Resource Assessment	**Beth Huning -** The San Francisco Bay Joint Venture	**Deborah Shafer -** Large-Scale Submerged Aquatic Vegetation Restoration in Chesapeake Bay: 2003-2008	**Jan Surface -** The Future of the Watershed Approach - Rapid Watershed Assessments
2:20 - 2:40	**Tom Kendall -** Planning for Future Sea Level Rise in the USACE	**Heida Diefenderfer -** Evaluation of Synergistic and Linear Processes in the Cumulative Effects of Ecosystem Restoration	**Barbara Kleiss -** The Utilization of the Mississippi River in the Restoration of Coastal Louisiana	**John Brosnan -** Partnerships at Work Delivering Cutting-edge Wetland Restoration in North San Francisco Bay Estuary	**Anitra Thorhaug -** Comparison of Resilience of Restoration of the Seagrass Genus *Halodule* in Subtropical to Tropical Atlantic, Pacific, Gulf of Mexico and Caribbean	**Douglas Helms -** Heritage of the SCS Demonstration and Watershed Projects: Lessons for Conservation, Rehabilitation and Restoration Projects
2:40 - 3:00	**Jeremy Lowe -** Rip-rap or Realignment? Wetland Restoration and Sea Level Rise Adaptation Strategies	**Ron Thom -** Linking Site Restoration to Ecosystem Recovery: Scaling and Applications of Results from the Columbia River Estuary	**Glenn Constant -** Atchafalaya River Restoration and Its Role in Coastal Processes	**Lorraine Parsons -** Using Partnerships to Restore Our National Legacies	**Charles Rowney -** Regaining Overland Flow: Spreader Canals as an Adaptable and Secure Alternative for Flow Control and Habitat Recovery	**Lisa Duriancik -** Opportunities to Enhance Conservation Implementation and Watershed Planning: Conservation Effects Assessment Project
3:00 - 3:20	**Rudolph Rosen -** Building Practical On-the-Ground Responses to the Effect of Climate Change on West Coast Wetlands Restoration and Protection	**Catherine Corbett -** Preliminary Meta-Analysis of Data from Multiple Monitoring Programs - Effectiveness Monitoring, Reference Sites and Ecosystem Condition	**Dave Vigh -** Collaboration and Interdependence - Two Keys to Mississippi Valley Regionalization and Partnerships	**Renee Spenst -** The Role of Ducks Unlimited in Developing Strategic Partnerships for Restoration Planning and Implementation in the San Francisco Bay	**Jeffrey Corbino -** Coastal Restoration Efforts in Louisiana Using Dredged Material from Federal Navigation Channels	**Rosendo Trevino, III -** Borderlands Watershed Management: A Collaborative Approach to Resource Management
3:20 - 3:40	**Susan Colley -** Adaptations of Corals and Coral Reefs to Climate Change	**Blaine Ebberts -** Adaptive Management of Restoration in the Columbia River Estuary: From the Ecosystem to the Organization	DISCUSSION	**Nadav Nur -** Guiding Wetland Restoration in the San Francisco Estuary through Monitoring, Evaluation and Research: A Multi-partner Approach	**Brannon Ketcham -** Returning Natural Hydrologic Process through the Giacomini Wetland Restoration, Tomales Bay, CA	**Bob Snieckus -** Visualization Techniques for Watershed Planning and Restoration Design
3:40 - 4:10	REFRESHMENT BREAK IN POSTER & EXHIBIT DISPLAY AREA (Conference Exhibition Hall - Pasadena Room)					

THURSDAY 7/23/09	THURSDAY - JULY 23, 2009 (continued)					
4:10 - 5:30	RESTORATION COFFEE HOUSE (Sacramento/San Francisco) **"Climate Change: The 800-Pound Gorilla" — This session will focus on emerging challenges relevant to integrating climate change and sea-level rise into large-scale ecosystem restoration.** **MODERATOR: G. Ronnie Best, U.S. Geological Survey** **Jean Brennan,** Senior Climate Change Scientist, Defenders of Wildlife; **Courtney Hackney,** University of North Florida, Jacksonville, FL; **Lauren Hastings,** CALFED Bay-Delta Program; **Denise Reed,** Department of Geology and Geophysics, University of New Orleans, **Laura Stroup, A**ssistant Professor, Department of Geography, Texas State University-San Marcos and **Si Simenstad,** Research Professor at the School of Aquatic and Fishery Sciences, University of Washington					
5:30 - 7:30	POSTER SESSION II & RECEPTION IN POSTER & EXHIBIT DISPLAY AREA (Conference Exhibition Hall - Pasadena Room)					
FRIDAY 7/24/09	FRIDAY - JULY 24, 2009					
7:00-8:00	MORNING REFRESHMENTS IN POSTER & EXHIBIT DISPLAY AREA (Conference Exhibition Hall - Pasadena Room)					
	CONCURRENT SESSIONS					
8:00 - 10:30	SESSION 1: New Planning Approaches for Large-scale Ecosystem Restoration	SESSION 2: Multi-party Stakeholder Involvement	SESSION 3: Habitat Restoration and Enhancement on Working Landscapes	SESSION 4: Chesapeake Bay Ecosystem Restoration	SESSION 5: Desert Aquatic Habitat Restoration	SESSION 6: Ponds and Marsh Restoration
	San Jose (Level 2)	Emerald Bay (Level 3)	Avalon Room (Level 3)	Hollywood Ballroom (Level 3)	Santa Monica B (Level 3)	Santa Monica A (Level 3)
	Moderator: Sara Pauley	Moderator: Beverley Getzen	Moderator: Alyson Aquino	Moderator: Liana Vitali	Moderator: David Koran	Moderator: Greg Shellenbarger
8:00 - 8:10	Introduction and Overview	Introduction and Overview	Introduction and Overview	Introduction and Overview	Introduction and Overview	Introduction and Overview
8:10 - 8:30	**Zooey Diggory -** Balancing the Uncertainties: Approaches to Large-Scale River Corridor Restoration Planning in a Semi-Arid California Landscape	**Dennis Canty -** Building a Successful Funding Strategy for Ecosystem Restoration: The Puget Sound Experience	**Carlos de la Rosa -** Restoring Habitat in an Agricultural System on Catalina Island, CA	**Brenton McCloskey -** Restoration of the Chesapeake Bay from a Watershed-wide and State-specific Perspective	**Robert Andress -** Rehabilitation of School Spring, Ash Meadows Nevada to Improve Habitat Quality for Warm Springs Pupfish and Thermal Endemic Invertebrates	**Douglas Barnum -** Design, Construction and Management of Saline Ponds at the Salton Sea, CA
8:30 - 8:50	**Steve Ashby -** Planning and Assessment Tools for Watershed Studies	**Doris Washington & Jeannette Baker -** Partnering for Ecosystem Restoration: NRCS and the U.S. Army Corps of Engineers	**Leslie Koenig -** Livestock Pond Restoration and Habitat Management for California's Red-legged Frog and Tiger Salamander	**Kristen Fleming -** Maryland's Ecosystem Enhancement Program - A Better Model for Mitigation	**Valer Austin -** Stream Restoration	**Michael Anderson -** The Water Quality, Geochemistry and Physics of Shallow Pond Habitat at the Salton Sea, CA
8:50 - 9:10	**John White -** Restoration of Coastal Louisiana Wetlands Using Large Surface Water Diversions	**Patrick Kelly -** Challenges and Opportunities in Restoration of Retired Agricultural Lands in Fresno County, California	**Jessica Groves -** Wetland Restoration on Private Lands Through NRCS Programs	**Jennifer Raulin -** Putting Resources to the Level Where the Work Gets Done: Chesapeake Bay Restoration	**Boris Poff -** Spring Restoration in the Mojave National Preserve	**Nicole Athearn -** Monitoring to Better Understand Dissolved Oxygen Dynamics in Managed Salt Ponds
9:10-9:30	**Kim Gavigan -** Virgin River and Tributaries: Watershed and Floodplain Management Strategies	**Ann George -** Partnerships with Industry to Achieve Ecosystem Restoration	**David Hubbard -** Restoration of Vernal Pools on Urban Fragments in Coastal Southern California	**Lewis Linker -** Integrated Chesapeake Bay Computer Models of the Watershed, Airshed, Estuary, Living Resources, and Climate Change	**Jack Williams -** Potential Impacts of Nevada Groundwater Diversions to Regional Spring Restoration	**Cheryl Strong -** Biological Considerations in Managed Pond Design for Waterbirds
9:30-9:50	**Victoria Lehr -** Picayune Strand Restoration Project – Partnering to Achieve Success	**Michael Garello -** Consensus Based Approaches to Unite Landowners, Irrigators, Special Districts, Resource Agencies and NGO's	**Mace Vaughan -** Restoring Pollinator Habitat on Agricultural Lands	**Lewis Linker -** Development and Application of the Chesapeake Bay Program Watershed Model	**Carla Scheidlinger -** Restoration of Desert Riparian, Wash, and Marsh Wetland Communities Affected by the Lining of the Coachella Canal	**Peg McBrien -** Restoring Urban Salt Marshes - Ten Years of Lessons Learned
9:50-10:10	**Vechere Lampley -** Challenges and Opportunities of implementing Estuary Restoration Act Projects	**Ann Bleed -** Necessary Measures for Insuring Sustainable Long-term Success of Large-scale Ecosystem Restoration Management Projects	**Shea O'Keefe -** Restoring the San Dieguito Watershed for Sensitive Species Habitat and the Prevention of Catastrophic Wildlire Using a Multi-entity Approach	**Carl Cerco -** Restoring Chesapeake Bay from the Top Down	**Kathryn Boyer -** The Desert Fish Habitat Partnership: Striving for No More Extinctions	**Barry Dubinski -** Optimizing Long-Term Ecosystem Success in Freshwater and Saltwater Habitats at the Altas Tack Corporation Superfund Site
10:10 - 10:30	**Gregory Biddinger -** Natural Land Management: A Property Management Strategy to Enhance Ecological Value	**Richard Sparks -** Connecting Science, Policy and Projects for Renewal of Rivers: The Great Rivers Partnership - Second Generation	**Kevin MacKay -** Restoring Physical and Ecological Processes in an Agricultural Setting	**P. Soupy Dalyander -** Integration of an Individual-Based Fish Bioenergetics Model into a Spatially Explicit Water Quality Model: Chesapeake Bay	DISCUSSION	**Wendi Goldsmith -** Urban Pond and Marsh Restoration, a Cost-Saving Paradigm
10:30 - 11:00	REFRESHMENT BREAK (San Jose Foyer)					
11:00 - 12 noon	**CLOSING PLENARY: Taking NCER to the Next Level - A "National Coalition" for Ecosystem Restoration? (San Jose Room)** **Tom St. Clair,** PBS&J and **Cheryl Ulrich,** Weston Solutions					
10:00-1:30	Conference Concludes - POSTER DISPLAY REMOVAL & EXHIBITOR MOVE-OUT (Conference Exhibition Hall - Pasadena Room)					

Directory of Poster Presentations

Session 1 –Tuesday, July 21, 2009

(Alphabetical order by presenter’s last name)

Poster #	First Name	Last Name	Organization	City	ST	Theme of Presentation	Format	Poster Session	Day of Presentation	Time of Formal Presentation	Abstract Title
58	Pauline	Acosta	U.S. Army Corps of Engineers - Jacksonville District	Jacksonville	FL	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Overcoming Obstacles to Project Execution
64	Shauna	Allen	U.S. Army Corps of Engineers	Jacksonville	FL	Ecosystem Goods and Services	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Public Involvement Challenges in the CERP Master Recreation Plan
50	Eugene	Allevato	Woodbury University	Burbank	CA	Watershed Planning	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Feasibility of Bioretention to Treat Greywater
6	Ryan	Asman	HDR Engineering	Bellevue	WA	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	ADCPXP: A Novel Tool for Analysis of River Behavior
35	Erin	Avina	National Park Service	Thousand Oaks	CA	Linking Monitoring Results with Management Decision-making	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Post-fire Recovery Plan for Solstice Canyon in Malibu, CA, USA
66	Scott	Bell	LimnoTech	Ann Arbor	MI	Urban Ecosystem Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Development of a System-Specific Habitat Index to Support Restoration Assessment in an Urban Waterway System in Chicago, IL
71	Joe	Berg	Biohabitats, Inc.	Baltimore	MD	Urban Ecosystem Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Storing Water on the Landscape to Optimize Riparian and Aquatic System Restoration
72	Joe	Berg	Biohabitats, Inc.	Baltimore	MD	Ecosystem Goods and Services	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Regenerative Stormwater Conveyance as a technique for ero Discharge Stormwater
67	Robert	Bevilacqua	Michael Baker Jr., Inc.	Hamilton	NJ	Urban Ecosystem Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Strategic Public Partnering For Ecological Benefit: Leveraging Regulatory Requirements And Funding Opportunities For Environmental Benefit.
5	David	Blersch	University at Buffalo	Buffalo	N	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	A New Interdisciplinary Doctoral Program in Ecosystem Restoration at the University at Buffalo

Poster #	First Name	Last Name	Organization	City	ST	Theme of Presentation	Format	Poster Session	Day of Presentation	Time of Formal Presentation	Abstract Title
7	Derek	Booth	Stillwater Sciences	Berkeley	CA	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Linking Biological Responses to River Processes: A Focal Species Approach to Restoration and Management of the Sacramento River
68	Doug	Bradley	LimnoTech	Ann Arbor	MI	Urban Ecosystem Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Limitations of Standardized Habitat Indices in Urban Waterways
56	Michael	Breedlove	Grand Canyon Monitoring and Research Center	Flagstaff	AZ	Linking Monitoring Results with Management Decision-making	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Shoreline Habitat Mapping of the Colorado River Ecosystem in Grand Canyon, Arizona
90	Daniel	Bunting	University of Arizona	Tucson	AZ	Ecosystem Restoration at the Watershed Scale	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Irrigation Regime and Vegetation Density Effects on Success of Riparian Revegetation
4	Matthew	Burgess	FL Cooperative Fish and Wildlife Research Unit	Gainesville	FL	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	A Small Unmanned Aircraft System for Ecological Research
33	Kelly	Burks-Copes	US Army Engineer Research and Development Center	Vicksburg	MS	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Incorporating GIS into the Development of Community-Based Index Models to Better Capture the Watershed Response to Proposed Planning Designs
34	Kelly	Burks-Copes	US Army Engineer Research and Development Center	Vicksburg	MS	Linking Monitoring Results with Management Decision-making	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Using GIS and Multi Criteria Decision Analysis to Select Restoration and Preservation Sites for the Missouri River Cottonwood Management Plan
2	Andrew F.	Casper	ERDC - Environmental Lab	Vicksburg	MS	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Integrating Spatially Explicit Watershed with Hydraulic Habitat Models: Constraints and Tradeoffs Due to the Resolution of the Topographic (DEM) Data
1	Hwai-Ping	Cheng	US Army Engineer Research & Development Center	Vicksburg	MS	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Reactive Transport Capabilities in ADH

Poster #	First Name	Last Name	Organization	City	ST	Theme of Presentation	Format	Poster Session	Day of Presentation	Time of Formal Presentation	Abstract Title
69	William	Christner	ECORP Consulting, Inc	Rocklin	CA	Urban Ecosystem Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Application of Natural Channel Design Criteria to Restore and Enhance an Urban Stream Following Gravel Mining Activities
70	Romorno	Coney	Jackson State University	Jackson	MS	Urban Ecosystem Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	The Application of Spatial Information Systems in Ecosystem Restoration: The Case of the Colorado Rocky Mountain Arsenal
59	Barbara	Conlin	U.S. Army Corps of Engineers	Philadelphia	PA	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Delaware Bay Oyster Restoration 2005-2008
36	Michael	Cook	SonTek	San Diego	CA	Linking Monitoring Results with Management Decision-making	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	The Use of a Real-time telemetry System (EcoNet) for Ecological Monitoring: A Case Study in Resource Management
8	Zooey	Diggory	Stillwater Sciences	Berkeley	CA	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Restoration of a Severely Degraded Landscape: Revegetation of Native Riparian Trees on Floodplain Dredge Spoils in California's Central Valley
73	Teresa	Doss	Biohabitats	Glen Ridge	NJ	Urban Ecosystem Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Progress update of the New York/New Jersey Harbor Estuary History of Restoration Mapping and Database Project
9	Peter	Downs	Stillwater Sciences	Berkeley	CA	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Restoring Ecological Integrity in Fragmented Rivers: Using Analytical Reference Conditions to Restore a Dredged and Regulated River-Floodplain
10	Peter	Downs	Stillwater Sciences	Berkeley	CA	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Simulating Sediment Transport to Evaluate Dam Removal Restoration Strategies

Poster #	First Name	Last Name	Organization	City	ST	Theme of Presentation	Format	Poster Session	Day of Presentation	Time of Formal Presentation	Abstract Title
74	Anthony	Dvarskas	NOAA	Philadelphia	PA	Urban Ecosystem Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Regional Restoration Planning Case Study in the Delaware Estuary: Ecosystem Valuation Along an Urban Waterfront
3	Jennifer	Faler	Trinity River Restoration Program	Weaverville	CA	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	From Concept to Construction: A River Restoration Program's Lessons Learned
30	Gene	Foster	Burns & McDonnell Engineering, Co.	Kansas City	MO	Urban Ecosystem Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Successfully Restoring an Urban Stormwater Management System
31	Gene	Foster	Burns & McDonnell Engineering, Co.	Kansas City	MO	Urban Ecosystem Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Storm Sewer Rehabilitation Leads to Opportunity to Create Bat Habitat
32	Gene	Foster	Burns & McDonnell Engineering, Co.	Kansas City	MO	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	The S-4 Basin Diversion Project: Helping to Restore the Lake Okeechobee Ecosystem
63	David	Freiwald	U.S. Geological Survey - Arkansas Water Science Center	Little Rock	AR	Aquifer restoration through partnerships at all levels	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Aquifer Restoration in Arkansas and Louisiana through Science, Monitoring and Partnerships
15	Miki	Fujitsubo	U.S. Army Corps of Engineers	Sacramento	CA	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Yolo Basin Wetlands, CA: A 10-Years After Construction Story of the West's Largest Freshwater Wetland Ecosystem Restoration Project
40	Karen	Fullen	USDA	Salt Lake City	UT	Linking Monitoring Results with Management Decision-making	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Effects of Tamarisk on Stream Channel Morphology of the San Rafael River, Utah
23	Carianne	Funicelli	RECON Environmental, Inc.	Tucson	AZ	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Rillito River Ecological Restoration
62	Enid	Gerena	U.S. Army Corps of Engineers	Jacksonville	FL	Water Quality	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Periphyton Constructed Stormwater Treatment Area (PSTA) Constructed Wetlands to Achieve Water Quality for Everglades Restoration

Poster #	First Name	Last Name	Organization	City	ST	Theme of Presentation	Format	Poster Session	Day of Presentation	Time of Formal Presentation	Abstract Title
24	Stanford	Gibson	Hydrologic Engineering Center	Davis	CA	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Getting the Sediment Right: Using HEC-RAS for Restoration Analysis
37	Patricia	Goodman	South Florida Water Management District	West Palm Beach	FL	Linking Monitoring Results with Management Decision-making	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Seasonal and Spatial Variation in the Reproduction and Larval Recruitment of Oysters in Caloosahatchee Estuary as Indicators of the Influence of Managed Freshwater Inflows
91	Matthew	Grabau	GeoSystems Analysis, Inc.	Tucson	AZ	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Riparian Revegetation Using Native Seed: Feasibility Studies on the Lower Colorado River
75	Italia	Gray	RECON Environmental, Inc.	San Diego	CA	Urban Ecosystem Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Examples of Adaptive Management Strategies in Urban Ecosystems
29	Carol	Hale	U.S. Fish and Wildlife Service	Columbia	MO	Adaptive Management	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Structured Decision-making Rapid Prototyping Application to Biological Opinion Activities on the Missouri River
18	Meagan	Hall	HDR Engineering, Inc.	Omaha	NE	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Bioengineered Bank Stabilization: Restoring Eroded Vertical Bank to Usable Habitat in the Missouri National Recreational River
38	Matthew	Harwell	U.S. Fish and Wildlife Service	Vero Beach	FL	Linking Monitoring Results with Management Decision-making	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	The CERP Monitoring and Assessment Plan–Challenges to Sustainability of Long-term System-wide Monitoring in the Everglades and South Florida
83	Jim	Henderson	U.S. Army Corps of Engineers	Vicksburg	MS	Linking Monitoring Results with Management Decision-making	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Linking the Present to the Future--Using Environmental Expenditures to Improve Restoration Decisions
84	Jim	Henderson	U.S. Army Corps of Engineers	Vicksburg	MS	Ecosystem Goods and Services	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	The Corps of Engineers and Ecosystem Services - We've Identified them, now what do we do?

Poster #	First Name	Last Name	Organization	City	ST	Theme of Presentation	Format	Poster Session	Day of Presentation	Time of Formal Presentation	Abstract Title
76	Brook	Herman	U.S. Army Corps of Engineers	Chicago	IL	Urban Ecosystem Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Urban Habitat Restoration: Restoring Grassland Breeding Bird Habitat at Orland Grassland
77	Peter	Hill	District Department of the Environment	Washington	DC	Urban Ecosystem Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Meeting Water Quality and Habitat Goals through Multiple Targeted Efforts in an Urban Watershed
41	Eliza	Hines	U.S. Army Corps of Engineers	Jacksonville	FL	Linking Monitoring Results with Management Decision-making	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	The Evolution of the CERP Monitoring and Assessment Plan – 2004 to 2009
42	Michael	Hooper	U.S. Geological Survey - Columbia Environmental Research Center	Columbia	MO	Linking Monitoring Results with Management Decision-making	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Monitoring of Natural Resource Damage Assessment (NRDA)–Associated Restorations
43	Noah	Hume	Stillwater Sciences	Berkeley	CA	Linking Monitoring Results with Management Decision-making	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Monitoring for Adaptive Management: Meta-analysis of 32 Riparian Restoration Sites in Sacramento and San Joaquin Valleys and the Delta
78	Kathleen	Hurley	Windward Environmental	Seattle	WA	Urban Ecosystem Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Practical Considerations of Implementing a Natural Resources Damages Assessment Restoration Project
79	Hamid	Karimi	District Department of the Environment	Washington	DC	Urban Ecosystem Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Accumulated Impacts of Multi-faceted Urban Greening Projects: Is the whole more than the sum of the parts?
81	Wendy	Katagi	CDM, Inc.	Los Angeles	CA	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Steelhead Recovery in the San Juan Creek Watershed
82	Wendy	Katagi	CDM, Inc.	Los Angeles	CA	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Machado Lake and Wilmington Drain Ecosystem Rehabilitation

Poster #	First Name	Last Name	Organization	City	ST	Theme of Presentation	Format	Poster Session	Day of Presentation	Time of Formal Presentation	Abstract Title
27	Margaret	Lamont	University of Florida	Gainesville	FL	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Beach Nourishment as an Example of Successful Cooperation between Coastal Engineers and Wildlife Biologists
80	Everett	Laney	US Army Corps of Engineers	Tulsa	OK	Urban Ecosystem Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Arkansas River Corridor Restoration Plan, Tulsa OK
44	Michael	Mayer	The Louis Berger Group, Inc	Kansas City	MO	Linking Monitoring Results with Management Decision-making	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	The Necessity for Legal Certainty in the Face of Adaptive Management's Scientific Uncertainty
85	Kerrie	McArthur	AMEC-Geomatrix	Lynnwood	WA	Urban Ecosystem Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Urban Floodplain Restoration for Fish Habitat Enhancement, Kent, Washington
12	S. Kyle	McKay	US Army Engineer Research and Development Center	Athens	GA	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Accounting for Uncertainty in Predicted Benefits of Freshwater Flow Diversion to Coastal Marshes
92	Shaun	McKinney	USDA NRCS	Portland	OR	Riverine Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	The Use of Geomorphic and Ecological Templates for Stream Restoration
61	Sean	Meehan	NOAA	St. Petersburg	FL	Ecosystem Goods and Services	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Utilizing Autonomous Underwater Vehicles (AUV) and Side Scan Sonar to Locate Illegal Spiny Lobster Fishing Gear: Unconventional Restoration in Response to an Unconventional Problem
45	Cecilia	Meyer Lovell	EDAW, Inc.	San Diego	CA	Linking Monitoring Results with Management Decision-making	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Simple Statistics as Tools for Adaptive Management and Monitoring Success of Restoration Projects

Poster #	First Name	Last Name	Organization	City	ST	Theme of Presentation	Format	Poster Session	Day of Presentation	Time of Formal Presentation	Abstract Title
86	Ken	Mierzwa	Winzler & Kelly	Eureka	CA	Urban Ecosystem Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Restoring Rare and Endangered Species Habitat at the Urban/Wildland Interface
46	James B.	Murray	U.S. Geological Survey	Reston	VA	Linking Monitoring Results with Management Decision-making	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	The Non-Native Red Rimmed Melania *(Melanoides tuberculatus) i* n Biscayne Bay National Park, Florida, the Geographic Distribution and Potential Health Threats.
60	Sara	O'Connell	U.S. Army Corps of Engineers	Davis	CA	Ecosystem Goods and Services	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Determining Restorative Operating Patterns using Multi-objective Reservoir Optimization with HEC-ResPRM
48	Gregory	Peacock	U.S. Army Corps of Engineers	Los Angeles	CA	Linking Monitoring Results with Management Decision-making	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	The Bill Williams River Partnership and Ecological Management of Water Resources
14	Rich	Pfingsten	EA Engineering, Science, and Technology, Inc.	Sparks	MD	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Gooseneck Cove and Salt Marsh Restoration
26	Dennis	Pinigis	U.S. Fish and Wildlife Service	Carterville	IL	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Habitat Restoration at a Superfund Site – Overcoming Obstacles
47	Ronald	Prann	Shaw Environmental, Inc.	Trenton	NJ	Linking Monitoring Results with Management Decision-making	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	The use of Long Term Monitoring and Adaptive Management Techniques to Reach Project Goals at a New Jersey Wetland Mitigation Bank
49	Marcy	Protteau	Environmental Incentives, LLC	South Lake Tahoe	CA	Linking Monitoring Results with Management Decision-making	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Conceptual Models: Communication and Decision-Making Tools for Multi-Agency Resource Management
39	Randy	Root	Burns & McDonnell	Kansas City	MO	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Wetland Creation Using an Artificial Water Source

Poster #	First Name	Last Name	Organization	City	ST	Theme of Presentation	Format	Poster Session	Day of Presentation	Time of Formal Presentation	Abstract Title
57	Bruce	Sabol	U.S. Army ERDC	Vicksburg	MS	Linking Monitoring Results with Management Decision-making	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Use of Fused Hyperspectral and LIDAR Airborne Data to Map Offshore Stamp Sand Migration along Keweenaw Peninsula, Michigan
25	Brian	Schalk	JE Fuller Hydrology & Geomorphology	Phoenix	AZ	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Va Shly'ay Akimel Salt River Ecosystem Restoration Project
51	Anthony	Seeman	Iowa Soybean Association	Urbandale	IA	Linking Monitoring Results with Management Decision-making	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	The Iowa Soybean Association Watershed Programming: The Boone River Watershed Project
52	Anthony	Seeman	Iowa Soybean Association	Urbandale	IA	Linking Monitoring Results with Management Decision-making	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Use of a Public-Private Partnership to Establish a Regionally Coordinated Water Monitoring Network to Aid in Watershed Decision Making
16	MARK	SHAFER	U.S. Army Corps of Engineers	JACKSONVILLE	FL	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Using USEPA's Watershed Risk Assessment Guidelines to Quantify the Water Quality and Ecological Impacts Associated With Surface Water Discharges From a Regional-Scale Aquifer Storage and Recovery System
17	MARK	SHAFER	U.S. Army Corps of Engineers	JACKSONVILLE	FL	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	CERP Active Adaptive Management Practices—Addressing Aquifer Storage and Recovery Uncertainties While Making Progress
54	Tisa	Shostik	NOAA	Silver Spring	MD	Linking Monitoring Results with Management Decision-making	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Increasing Effectiveness of Coastal Habitat Restoration through Partnerships

Poster #	First Name	Last Name	Organization	City	ST	Theme of Presentation	Format	Poster Session	Day of Presentation	Time of Formal Presentation	Abstract Title
13	Thomas	Slowinski	V3 Companies	Woodridge	IL	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Adaptive Design, Construction and Management: Using a Design-Build-Manage Approach for the Successful Restoration of 500 Acres of Wetland, Prairie and Stream Corridor
21	Chadwin	Smith	Headwaters Corporation	Lincoln	NE	Linking Monitoring Results with Management Decision-making	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Structured Decision Making and Rapid Prototyping for Adaptive Management Implementation on the Platte River
22	Chadwin	Smith	Headwaters Corporation	Lincoln	NE	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Adaptive Management, Ecosystem Rehabilitation, and Collaboration on the Platte River
87	Donald	Stevens	The Louis Berger Group, Inc.	Morristown	NJ	Urban Ecosystem Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Wetland Restoration in an Ultra-Urban Environment
65	Frederick	Streb	SEEK Enterprises	Jacksonville	FL	Ecosystem Goods and Services	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Microbial Pre-Treatment of Ecosystem Restoration Projects
55	Lindsay	Teunis	EDAW San Diego	San Diego	CA	Linking Monitoring Results with Management Decision-making	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Use of Hydrogeomorphic Assessment Method (HGM) and the California Rapid Assessment Method (CRAM) in Guiding Adaptive Management Decisions: The Story of the City of Laguna Niguel and the Journey to Revitalizing a Southern California Urban Creek (Sulphur Creek)
88	Mark	Thompkins	CH2M Hill	Oakland	CA	Urban Ecosystem Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	The Lower Silver Creek Project, San José, California - From an Urban Flood Control Channel to a Naturally Functioning Urban Creek
20	Jenneke	Visser	University of Louisiana at Lafayette	Lafayette	LA	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Floating Marsh Creation Demonstration Project

Poster #	First Name	Last Name	Organization	City	ST	Theme of Presentation	Format	Poster Session	Day of Presentation	Time of Formal Presentation	Abstract Title
11	Leslie	Waguespack	Shaw Group	Baton Rouge	LA	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Modification of the Hydrologic Regime to Restore a Mississippi River Swamp Ecosystem
19	Ida	Wenefrida	Louisiana State University Agricultural Center	Rayne	LA	Science and Engineering Integration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Improving California Bulrush *(Schoenoplectus californicus)* for Waste Contaminant Remover in Urban Ecosystem Restoration and Wave Energy Buffering in Tidal Marsh Restoration
53	Ron	Wiederholt	North Dakota State University	Carrington	ND	Linking Monitoring Results with Management Decision-making	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Enabling Grass-Roots, Intensive, Runoff Water Monitoring Projects: The North Dakota Discovery Farms
89	Todd	Williams	HDR Engineering, Inc.	St. Louis	MO	Urban Ecosystem Restoration	Poster	Session One	Monday & Tuesday (July 20 & 21)	Tuesday July 21 6pm-8pm	Unique Tools to Deliver a Watershed Restoration Plan

Directory of Poster Presentations

Session II – Thursday, July 23, 2009

(Alphabetical order by presenter's last name)

Poster #	First Name	Last Name	Organization	City	ST	Theme of Presentation	Format	Poster Session	Day of Presentation	Time of Formal Presentation	Abstract Title
43	Robert	Abbott	ENVIRON International Corp	Emeryville	CA	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Sub-Tidal Structures in an Estuary as part of a Watershed Wide Restoration Effort
44	Marriah	Abellera	U.S. Army Corps of Engineers	Los Angeles	CA	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Ecosystem Restoration in the Malibu Creek Watershed
1	Kathleen	Anderson	U.S. Army Corps of Engineers	Pittsburgh	PA	Urban Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Nine Mile Run Ecosystem Restoration Project, Pittsburgh Pennsylvania
7	Steven	Apfelbaum	Applied Ecological Services, Inc.	Brodhead	WI	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Stormwater Management: Ernie Miller Nature Park
8	Steven	Apfelbaum	Applied Ecological Services, Inc.	Brodhead	WI	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Glen Wetland Park, Highlandview Park and Zona Rosa Mized Use Development
63	Christine	Arenal	CH2M HILL	Sacramento	CA	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Net Environmental Benefit Analysis (NEBA): Uses in Remediation/Restoration Decision-making for a Former Skeet Range
45	Peter	Besrutschko	U.S. Army Corps of Engineers	Jacksonville	FL	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Calcareous Periphyton dominated treatment wetlands effectively removes metals (barium, zinc, aluminum, iron, etc) from the water column.
46	Laura	Bittner	U.S. Army Corps of Engineers	Philadelphia	PA	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Evaluating Environmental Impacts Using System Wide Water Resources Program (SWWRP) Tools

Poster #	First Name	Last Name	Organization	City	ST	Theme of Presentation	Format	Poster Session	Day of Presentation	Time of Formal Presentation	Abstract Title
83	Stacey	Blersch	University at Buffalo	Buffalo	NY	Watershed Planning	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Urban watershed restoration planning using Arc GIS to determine benefits of watershed restoration projects in the Cameron Run Watershed near Washington DC
84	Stacey	Blersch	University at Buffalo	Buffalo	NY	Watershed Planning	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Comparison of stream assessment techniques to determine the degree of instability in the system in a western New York stream
47	Derek	Booth	Stillwater Sciences	Santa Barbara	CA	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Guiding Salmon Restoration at Regional and Watershed Scales
2	Brianna	Borders	Endangered Species Recovery Program	Fresno	CA	Science and Engineering Integration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Nursery Production of Local Ecotype Seed in Support of Regional Restoration Efforts
9	Catherine	Bozek	NOAA Restoration Center	Silver Spring	MD	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Climate Change Impacts on Salt Marsh Restoration Techniques in the Northeast United States
64	Edwin	Brown	U.S. Army Corps of Engineers	Jacksonville	FL	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Periphyton Stormwater Treatment Area (PSTA): Constructed Wetlands for Achieving Water Quality for Everglades Restoration
65	Edwin	Brown	U.S. Army Corps of Engineers	Jacksonville	FL	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Decoupling ASR from the Greater Everglades, A Modest Proposal for Everglades Restoration
66	Edwin	Brown	U.S. Army Corps of Engineers	Jacksonville	FL	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Forecasting Effects of Nutrient Loading and Availability of an Ecosystem Restoration Project in the Caloosahatchee and St. Lucie Estuaries of Florida

Poster #	First Name	Last Name	Organization	City	ST	Theme of Presentation	Format	Poster Session	Day of Presentation	Time of Formal Presentation	Abstract Title
10	Allegra	Bukojemsky	Biohabitats, Inc.	San Francisco	CA	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Smart Growth as a Catalyst for Tidal Wetlands Restoration in San Francisco Bay
48	Barbara	Burch	U.S. Army Corps of Engineers	Jacksonville	FL	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Tools for Increased Collaboration: The CERPZone
12	Kelly	Burks-Copes	US Army Engineer Research and Development Center	Vicksburg	MS	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Coupling Conceptual Models with GIS to Develop a Community-based Index Model for the Missouri River Cottonwood Management Plan
49	Dennis	Canty	Evergreen Funding Consultants	Seattle	WA	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Building a Successful Funding Strategy for Ecosystem Restoration: the Puget Sound Experience
3	Andrew F.	Casper	ERDC - Environmental Lab	Vicksburg	MS	Climate Change	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Impacts of regional climate change on seasonal patterns of river discharge: Current examples from select Florida, Great Lakes and New England river basins
11	Andrew F.	Casper	ERDC - Environmental Lab	Vicksburg	MS	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Planning and Assessment of Multiple River Restoration Projects in a Basin: A Reach to Valley-Level GIS-based Hydrogeomorphic Framework
50	Jae	Chung	U.S. Army Corps of Engineers	Los Angeles	CA	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Watershed-Based Approach to Restoration Site Selection in Southern California

Poster #	First Name	Last Name	Organization	City	ST	Theme of Presentation	Format	Poster Session	Day of Presentation	Time of Formal Presentation	Abstract Title
13	Richard	Cole	U.S. Army Corps of Engineers	Alexandria	VA	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	An alternative to habitat units for indicating benefits from ecosystem restoration projects planned by the U. S. Army Corps of Engineers
51	Josh	Collins	SFEI	Oakland	CA	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Using Goals to Guide Restoration Design and Report Effectiveness
52	Paul	Conrads	U.S. Geological Survey	Columbia	SC	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Dealing with Data Realities –Automation of Evaluation of Data Quality and Estimation of Missing Data for the Everglades Depth Estimation Network (EDEN)
53	Thomas	DeBusk	DB Environmental, Inc.	Rockledge	FL	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Optimization and Management of the Everglades Stormwater Treatment Areas
67	Mat	Denton	University of Florida	Davie	FL	Linking Monitoring Results with Management Decision-making	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Alligators and Crocodiles as Indicators for Restoration of Everglades Ecosystems
35	Bryan	Dick	AECOM	Raleigh	NC	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Dendrogeomorphic Methods of Using Exposed Roots for Relating BEHI and Near Bank Stress to Evaluate Stream Bank Erodibility
68	Zooey	Diggory	Stillwater Sciences	Berkeley	CA	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Linking Vegetation Dynamics with Physical Processes: A Key Step in Developing Restoration Strategies for a Semi-arid River and its Floodplain

Poster #	First Name	Last Name	Organization	City	ST	Theme of Presentation	Format	Poster Session	Day of Presentation	Time of Formal Presentation	Abstract Title
69	Paul	Drago	Battelle Memorial Institute	Duxbury	MA	Linking Monitoring Results with Management Decision-making	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Monitoring Suspended Sediment Plumes Formed during Dredging in Boston Harbor, Massachusetts, Using Acoustic Backscatter from ADCP
86	BLAINE	DWYER	AECOM USA, INC.	LAKEWOOD	CO	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Application of Adaptive Management in Current Federal Permitting, Eco-system Restoration and Endangered Species Recovery Programs
70	Gregory	Eckert	National Park Service	Ft. Collins	CO	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Fighting Cheatgrass instead of Fire in Zion National Park
71	Gregory	Eckert	National Park Service	Ft. Collins	CO	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	A Framework for Assessing the Ecological Integrity of Biological and Ecological Resources of the National Park System
72	Gregory	Eckert	National Park Service	Ft. Collins	CO	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Defining Desired Future Conditions in Uncertain Circumstances: Adventures in Paradoxical Planning
79	Lisa	Eckert	National Park Service	Jacksonville	FL	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Landscape Connectivity Modeling for Ecosystem Restoration in the Southwest Florida Feasibility Study
4	Randy	Epperson	USDA, NRCS Easement Programs	Lincoln	NE	Effective Partnering For Setting and Achieving Habitat Conservation Goals	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Partnership Approach Leads to Effective Missouri River Corridor Protection with WREP in Nebraska
54	Craig	Fischenich	US Army Engineer Research and Development Center	Vicksburg	MS	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Environmental Benefits of Fish Passage on the Truckee River

Poster #	First Name	Last Name	Organization	City	ST	Theme of Presentation	Format	Poster Session	Day of Presentation	Time of Formal Presentation	Abstract Title
85	Laura	Hagenauer	NAU	Flagstaff	AZ	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Incorporating Genetic Diversity into Riparian Restoration: the importance of merging restoration with landscape level experiments
75	Charles	Hanneken	U.S. Army Corp of Engineers	St. Louis	MO	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Application of a Hydrogeomorphic Study in Conservation Planning for the Middle Mississippi River Corridor
76	Matt	Harwell	U.S. Fish and Wildlife Service	Vero Beach	FL	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Rethinking Characterization of Uncertainty in Ecological Restoration
55	Nathan	Henderson	AECOM Water	Wakefield	MA	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Eelgrass Restoration: Using SCUBA to Restore Eelgrass Beds and Preserve Critical Coastal Habitat
80	Heather	Henkel	U.S. Geological Survey	St. Petersburg	FL	Ecosystem Goods and Services	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	The South Florida Information Access (SOFIA) System
81	Heather	Henkel	U.S. Geological Survey	Jacksonville	FL	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Assessing Everglades Restoration Using Everglades Depth Estimation Network (EDEN)
82	Heather	Henkel	U.S. Geological Survey	Jacksonville	FL	Linking Monitoring Results with Management Decision-making	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Rainfall and Potential Evapotranspiration Data for Everglades Depth Estimation Network (EDEN) Gages
14	Bill	Hinsley	PBS&J	Seattle	WA	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Lessons Learned from Four Major Ecosystem Restoration Programs
57	Meg	Jonas	U.S. Army Corps of Engineers	Vicksburg	MS	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Streambank Protection Measures: Extension of Corps Design Criteria

Poster #	First Name	Last Name	Organization	City	ST	Theme of Presentation	Format	Poster Session	Day of Presentation	Time of Formal Presentation	Abstract Title
23	Karla	Kennedy	Northern Arizona University	Flagstaff	AZ	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	The Importance of Considering the Effects of Genetics and Climate Change in Riparian Restoration
58	Brannon	Ketcham	National Park Service	Point Reyes Station	CA	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Restoring Connections – Fish Passage and Coastal Estuary Enhancement in the Estero de Limantour, Point Reyes National Seashore, CA
56	Shawn	Komlos	U.S. Army Corps of Engineers	Alexandria	VA	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	A Decision Aid for United States Army Corps of Engineers Watershed Investments
15	Paul	Krause	ARCADIS	Los Angeles	CA	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Habitat Equivalency Analysis (HEA) as a Tool to Rank Environmental Project Alternatives
16	Everett	Laney	U.S. Army Corps of Engineers	Tulsa	OK	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	USACE Invasive Species Policy
59	Chunyan	Li	Louisiana State University	Baton Rouge	LA	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Application of Finite Volume Coastal Ocean Model to the Coast of Southeast Louisiana
77	Andy	LoSchiavo	U.S. Army Corps of Engineers	Jacksonville	FL	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Potential Solutions to Address Challenges in Implementing Adaptive Management for Ecosystem Restoration Programs and Projects
78	Andrew	LoSchiavo	Everglades Partnership Joint Venture	Jacksonville	FL	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	CERP AM Program Implementation
41	Megan	Lulow	Irvine Ranch Conservancy	Irvine	CA	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Using a Return on Investment Approach to Prioritize Habitat Restoration in a Southern California Landscape

Poster #	First Name	Last Name	Organization	City	ST	Theme of Presentation	Format	Poster Session	Day of Presentation	Time of Formal Presentation	Abstract Title
40	Christopher	Matthews	HDR Engineering	Charlotte	NC	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Wilson Bay Aquatic Ecosystem Restoration Section 206 Project
30	Katie	McCallion	Everglades Partners Joint Venture	Jacksonville	FL	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	RECOVER and the Role of Science in Everglades Restoration
31	Katie	McCallion	Everglades Partners Joint Venture/Parsons	Jacksonville	FL	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	The Southwest Florida Feasibility Study; A Framework for Ecosystem Restoration on a Regional Scale
60	Ehab	Meselhe	University of Louisiana	Lafayette	LA	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Coastal Restoration and Protection of the Chenier Plain: Southwest Coastal Louisiana Feasibility Study
32	James B.	Murray	U.S. Geological Survey	Reston	VA	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Monitoring Sea Level Rise Using Floral and Faunal Assemblages and Observed Associations in Southwest Florida
24	Wayne	Nelson-Stastny	U.S. Army Corps of Engineers	Kansas City	MO	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Innovative Methods of Integrating Conservation Planning Methods, Conceptual Ecological Models, USACE Planning
37	Lorraine	Parsons	Point Reyes National Seashore	Point Reyes Station	CA	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Improving the Health of the Tomales Bay Ecosystem Through Restoration
6	Emily	Pifer	University of Florida	Davie	FL	Linking inventory results with management decision-making	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Small and Medium Sized Mammal Inventory of Everglades National Park and Big Cypress National Preserve

Poster #	First Name	Last Name	Organization	City	ST	Theme of Presentation	Format	Poster Session	Day of Presentation	Time of Formal Presentation	Abstract Title
38	David	Price	Engineer Research and Development Center	Vicksburg	MS	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Ecological Dynamics Simulation Model a Restoration Tool
19	Jed	Redwine	EPJV	Jacksonville	FL	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Comprehensive Everglades Restoration Program Adaptive Management Opportunities: What regional simulations suggest about the risks and rewards of the first ten restoration projects
20	Jed	Redwine	EPJV	Jacksonville	FL	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Interpreting the ecological effects of the first ten Everglades Restoration Projects using simulation modeling and Performance Measures
21	Jed	Redwine	EPJV	Jacksonville	FL	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	System-wide Planning and Evaluation: Simulating the Hydrologic Effects of the first ten Restoration Projects on the Everglades Ecosystem and Regional Infrastructure
39	Kristen	Risch	Malcolm Pirnie, Inc.	Columbus	OH	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Addressing the Sources of Gulf Hypoxia in the Midwest: The Economics and Water Quality Benefits of Agricultural Ditch Restoration Using Two-Stage Channels
22	Patricia	Robinson	U.S. Army Corps of Engineers	Seattle	WA	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Puget Sound Nearshore Restoration Planning
73	Randy	Root	Burns & McDonnell Engineering, Co.	Kansas City	MO	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Frazier Lake and Wetland Restoration

Poster #	First Name	Last Name	Organization	City	ST	Theme of Presentation	Format	Poster Session	Day of Presentation	Time of Formal Presentation	Abstract Title
74	Randy	Root	Burns & McDonnell Engineering, Co.	Kansas City	MO	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	New Lake Restoration Methods
33	Heather	Schwar	HNTB Corporation	Milwaukee	WI	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Watershed Initiatives for Water Quality Improvements, Nubbin Slough Wetland Restoration Project
34	Michael	Schwar	HNTB Corporation	Milwaukee	WI	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Use of River- and Watershed-scale Hydrologic and Hydraulic Models to Support Development of Function-based River Restoration Plans
17	Ajay	Sharma	University of Florida	Gainesville	FL	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Conversion and Restoration of Even-aged Slash Pine Plantation to Uneven-aged Slash Pine/Longleaf Pine Ecosystem in Florida Coastal Flatwoods
18	Jose	Silva-Lugo	University of Florida	Gainesville	FL	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Responses of Long-Unburned Coastal Scrubby Flatwoods to Prescribed Burning
25	Alison	Sleath Grzegorzewski	USACE	New Orleans	LA	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Storm Protection Benefits from Barrier Island Restoration in Southeast Louisiana and Mississippi
61	David	Soballe	U.S. Army Corps of Engineers	Vicksburg	MS	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	The Influence of Habitat Restoration Projects on Nutrient Regimes in the Missouri River
42	Jeremy	Sokulsky	Environmental Incentives, LLC	South Lake Tahoe	CA	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	The Lake Tahoe Management System: Integrating Adaptive Management and Continual Improvement to Increase Restoration Effectiveness and Multi-Agency Coordination

Poster #	First Name	Last Name	Organization	City	ST	Theme of Presentation	Format	Poster Session	Day of Presentation	Time of Formal Presentation	Abstract Title
26	Harry	Stone	Battelle	Cincinnati	OH	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Environmental Evaluation System for Water Resource Planning (Version 2)
27	Burton	Suedel	U.S. Army Corps of Engineers	Vicksburg	MS	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Stakeholder Value Elicitation Process for LACPR and MsCIP
5	Charles	Theiling	USACE & Univ of Iowa	Rock Island	IL	Upper Mississippi River	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Large Scale Geomorphology and Land Cover Associations in the Upper Mississippi River System
36	Liana	Vitali	U.S. Geological Survey	Annapolis	MD	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Geospatial Technology for Executive Decision Support – the Chesapeake Bay Experience
28	Paul	Wagner	U.S. Army Corps of Engineers	Alexandria	VA	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	A Framework for Adaptively Managed Stream Restoration Efforts
29	Chris	Webb	Moffatt & Nichol	Long Beach	CA	New Planning Approaches to Achieve Ecosystem Restoration	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	Parsons Slough Restoration Project Feasibility Study
62	Zhixiao	Xie	Florida Atlantic University	Boca Raton	FL	Ecosystem Restoration at the Watershed Scale	Poster	Session Two	Thursday & Friday July 23 & 24	Thursday July 23 5:30pm-7:30pm	The Development of Digital Elevation Model for the Area South of the Big Cypress National Park in the Greater Everglades Restoration

List of Participants

Bud Abbott
ENVIRON International Corp
6001 Shellmound St #700
Emeryville, CA 94608
PH: 510-420-2593 | FX: 510-655-9517
Email: RAbbott@environcorp.com

Marriah Abellera
US Army Corps of Engineers
915 Wilshire Blvd
Los Angeles, CA 90017
PH: 213-452-3835
Email: marriah.s.abellera@usace.army.mil

Pauline Acosta
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, FL 32207
PH: 904-232-3878 | FX: 904-232-1434
Email: pauline.m.acosta@usace.army.mil

Keith Admire
USDA NRCS
101 E Capitol Ave Ste B100
Little Rock, AR 72201
PH: 501-210-8940 | FX: 501-210-8935
Email: Keith.Admire@ar.usda.gov

Andrew Albaugh
NOAA
2725 Montlake Blvd E
Seattle, WA 98112
PH: 206-860-3497
Email: andrew.albaugh@noaa.gov

Carl Alderson
NOAA
74 Magruder Road
Highlands, NJ 07732
PH: 732-872-3087
Email: Carl.alderson@noaa.gov

Shauna Allen
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, FL 32207
PH: 904-232-1071
Email: shauna.r.allen@usace.army.mil

Daniella Allevato
Univ of California - Berkeley
10269 McBroom st
Sunland, CA 91040
PH: 818-515-6413
Email: dmallevato@gmail.com

Eugene Allevato
Woodbury University
7500 Glenoaks Blvd
Burbank, CA 91510
PH: 818-252-5148
Email: eugene.allevato@woodbury.edu

Rich Ambrose
UCLA
Box 951772, Room 46-081 CHS
Los Angeles, CA 90095
PH: 310-825-6144 | FX: 310-206-3358
Email: rambrose@ucla.edu

Kristine Amendt
Univ of Colorado - Denver
8225 Fairmount Dr #6-208
Denver, CO 80247
PH: 303-355-7506
Email: shpunk@excite.com

Kathy Anderson
US Army Corps of Engineers
William Moorhead Federal Bldg, 100
Liberty Ave
Pittsburgh, PA 15222
PH: 412-395-7178 | FX: 412-644-6810
Email:
kathleen.j.anderson@usace.army.mil

Michael Anderson
Univ of California - Riverside
Dept of Environmental Sciences
Riverside, CA 92521
PH: 951-827-3757
Email: michael.anderson@ucr.edu

Sean Anderson
California State University Channel
Islands
One University Drive
Camarillo, CA 93012
PH: 805-732-2732
Email: sean.anderson@csuci.edu

Robert Andress
Otis Bay Ecological Consultants
PO Box 711134
Salt Lake City, UT 84171
PH: 801-390-7174
Email: rjandress@gmail.com

Shelly Anghera
Weston Solutions Inc
2433 Impala Drive
Carlsbad, CA 92010
PH: 760-497-3527
Email:
shelly.anghera@westonsolutions.com

Susie Anon
Irvine Ranch Conservancy
4727 Portola Parkway
Irvine, CA 92620
PH: 714-508-4773 | FX: 714-508-4793
Email: sanon@irconservancy.org

Kwaku Boakye Apau
Brandenburg university of Technology
Konrade-Wachsman Allee
Cottbus, 3046 Germany
PH: 49-3558694527
Email: kbapau@yahoo.co.uk

Steve Apfelbaum
Applied Ecological Services Inc
17921 Smith Road. PO Box 256
Brodhead, WI 53520
PH: 608-897-8641 | FX: 608-897-8486
Email: steve@appliedeco.com

Stu Appelbaum
US Army Corps of Engineers
PO Box 4970
Jacksonville, FL 32232
PH: 904-232-2584 | FX: 904-232-1251
Email:
stuart.j.appelbaum@usace.army.mil

Alyson Aquino
USDA NRCS
5552 Clayton Rd
Concord, CA 94521
PH: 925-672-4577
Email: alyson.aquino@ca.usda.gov

Christine Arenal
CH2M HILL
2485 Natomas Park Drive Suite 600
Sacramento, CA 95833
PH: 916-286-0403 | FX: 916-614-3592
Email: carenal@ch2m.com

Steve Ashby
US Army Corps of Engineers ERDC
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 601-634-2387 | FX: 601-634-2430
Email: steven.l.ashby@usace.army.mil

Nicole Athearn
US Geological Survey
505 Azuar Dr
Vallejo, CA 94592
PH: 707-562-2002 | FX: 707-562-3001
Email: nathearn@usgs.gov

Valer Austin
Cuenca Los Ojos Foundation
12626 E Turkey Creek
Pearce, AZ 85625
PH: 520-824-3566
Email: vaustin@elcoronadoranch.net

Erin Avina
National Park Service
401 West Hillcrest Dr
Thousand Oaks, CA 91360
PH: 805-370-2386 | FX: 805-370-1850
Email: Erin_Avina@nps.gov

Josephine Axt
US Army Corps of Engineers
915 Wilshire Blvd
Los Angeles, CA 90017
PH: 213-452-3783 | FX: 213-452-3906
Email: Josephine.R.Axt@usace.army.mil

Jeannette Baker
US Army Corps of Engineers
7701 Telegraph Road
Alexandria, VA 22315
PH: 703-428-6116
Email: jeannette.m.baker@usace.army.mil

Natasha Bankhead
USDA ARS
PO Box 1157
Oxford, MS 38655
PH: 662-281-5712 | FX: 662-281-5706
Email: natasha.bankhead@ars.usda.gov

Tomma Barnes
US Army Corps of Engineers
7400 Leake Ave
New Orleans, LA 70118
PH: 504-862-1481
Email: tomma.k.barnes@usace.army.mil

Doug Barnum
US Geological Survey
78401 Hwy 111 Suite R
La Quinta, CA 92253
PH: 760-777-1564
Email: doug_barnum@usgs.gov

Ken Barr
US Army Corps of Engineers
Clock Tower Building; PO Box 2004
Rock Island, IL 61204
PH: 309-794-5221 | FX: 309-794-5497
Email: Kenneth.A.Barr@usace.army.mil

Bridget Barron
Platte River Recovery Implementation Program
3710 Central Avenue Suite E
Kearney, NE 68847
PH: 308-237-5728 | FX: 308-237-4651
Email: barronb@headwaterscorp.com

Rebecca Bartley
CSIRO
120 Meiers Rd
Brisbane, 4104 Australia
PH: 61-732142741
Email: rebecca.bartley@csiro.au

Archie Beaton
Chlorine Free Products Association
1304 N Main St
Algonquin, IL 60102
PH: 847-658-6104 | FX: 847-658-3152
Email: archie@chlorinefreeproducts.org

Richard Beck
RBF Consulting
14725 Alton Parkway
Irvine, CA 92618
PH: 949-855-3687 | FX: 949-837-4122
Email: rbeck@rbf.com

Lee Becker
EA Engineering Science & Technology Inc
221 Sun Valley Blvd Suite D
Lincoln, NE 68528
PH: 402-476-3766 | FX: 402-476-7825
Email: lbecker@eaest.com

Nancy Beckvar
NOAA
7600 Sand Point Way NE
Seattle, WA 98115
PH: 206-526-6557
Email: nancy.beckvar@noaa.gov

Chris Behrens
US Army Corps of Engineers
PO Box 3755
Seattle, WA 98124
PH: 206-764-6917
Email: christopher.behrens@usace.army.mil

Brendan Belby
ENTRIX
701 University Ave Suite 200
Sacramento, CA 95825
PH: 916-923-1097
Email: bbelby@entrix.com

Scott Bell
LimnoTech
501 Avis Drive
Ann Arbor, MI 48108
PH: 734-332-1200 | FX: 734-332-1212
Email: sbell@limno.com

Kristen Bender
Huntington Beach Wetlands Conservancy
21900 Pacific Coast Highway
Huntington Beach, CA 92646
PH: 714-536-0141
Email: kristenbender0@gmail.com

Joe Berg
Biohabitats Inc
The Stables 2081 Clipper Park Road
Baltimore, MD 21211
PH: 410-554-0156
Email: jberg@biohabitats.com

Peter Besrutschko
US Army Corps of Engineers
706 San Marco Blvd
Jacksonville, FL 32207
PH: 904-232-2298
Email: peter.h.besrutschko@usace.army.mil

Ronnie Best
US Geological Survey
3205 College Avenue
Davie, FL 33314
PH: 954-577-6354 | FX: 954-577-6347
Email: ronnie_best@usgs.gov

Robert Bevilacqua
Michael Baker Jr Inc
300 American Metro Boulevard
Hamilton, NJ 08619
PH: 609-807-9583 | FX: 609-807-9550
Email: rbevilacqua@mbakercorp.com

Greg Biddinger
ExxonMobil Biomedical Sciences
CORP-EMB-4155F 800 Bell Street
Houston, TX 77002
PH: 713-656-4978 | FX: 713-656-1512
Email: gregory.r.biddinger@exxonmobil.com

Terry Birkenstock
US Army Corps of Engineers
190 Fifth St E Ste 401
St Paul, MN 55101
PH: 651-357-8510
Email: terry.birkenstock@usace.army.mil

Meg Bishop
USDA NRCS
1201 NE Lloyd Blvd Ste 1000
Portland, OR 97232
PH: 503-273-2404 | FX: 503-273-2401
Email: meg.bishop@por.usda.gov

Laura Bittner
US Army Corps of Engineers
100 Penn Square East
Philadelphia, PA 19107
PH: 215-656-6668
Email: laura.d.bittner@usace.army.mil

Ann Bleed
CDR Associates
100 Arapahoe Ave Suite 12
Boulder, CO 80302
PH: 303-442-7367 x251 | FX: 303-442-7442
Email: ableed@mediate.org

David Blersch
University at Buffalo
202 Jarvis Hall
Buffalo, NY 14260
PH: 716-645-2114 x2352 | FX: 716-645-3667
Email: dblersch@buffalo.edu

Stacey Blersch
University at Buffalo
202 Jarvis Hall
Buffalo, NY 14260
PH: 716-645-2114 x2327
Email: sblersch@buffalo.edu

Steve Block
NOAA
55 Great Republic Drive
Gloucester, MA 01930
PH: 978-281-9127
Email: steve.block@noaa.gov

Don Boesch
Univ of Maryland
PO Box 775
Cambridge, MD 21613
PH: 410-221-2000 | FX: 410-228-3843
Email: boesch@umces.edu

Suzanne Boltz
EA Engineering Science & Technology Inc
15 Loveton Circle
Sparks, MD 21152
PH: 410-329-5143 | FX: 410-771-4204
Email: sboltz@eaest.com

Derek Booth
Stillwater Sciences
2855 Telegraph Avenue Suite 400
Berkeley, CA 94705
PH: 510-848-8098
Email: dbooth@stillwatersci.com

Tim Boozer
US Geological Survey
7920 NW 71st Street
Gainesville, FL 32653
PH: 352-264-3516 | FX: 352-378-4956
Email: tboozer@usgs.gov

Brianna Borders
California State University Stanislaus
4186 W Swift Avenue Suite 101
Fresno, CA 93722
PH: 559-271-2646
Email: bborders@esrp.csustan.edu

Michelle Boudreaux
PBS&J
3501 North Causeway Blvd Suite 725
Metairie, LA 70002
PH: 504-841-2226
Email: mlboudreaux@pbsj.com

Kathryn Boyer
USDA NRCS
1201 NE Lloyd Blvd Ste 1000
Portland, OR 97232
PH: 503-273-2412 | FX: 503-273-2401
Email: kathryn.boyer@por.usda.gov

Cathy Bozek
NOAA
1315 East West Highway
Silver Spring, MD 20910
PH: 301-713-0174
Email: cathy.bozek@noaa.gov

Doug Bradley
LimnoTech
501 Avis Drive
Ann Arbor, MI 48108
PH: 734-332-1200 | FX: 734-332-1212
Email: dbradley@limno.com

Steve Brady
USDA NRCS
501 W Felix St Bldg 23
Fort Worth, TX 76115
PH: 817-509-3285 | FX: 817-509-3337
Email: steve.brady@ftw.usda.gov

Bill Brandau
Univ of Arizona
PO Box 12
Solomon, AZ 85551
PH: 928-428-2611 | FX: 928-428-7032
Email: wbrandau@cals.arizona.edu

Michael Breedlove
US Geological Survey
2255 N Gemini Dr
Flagstaff, AZ 86001
PH: 928-556-7344 | FX: 928-556-7092
Email: mbreedlove@usgs.gov

Allison Bremner
US Army Corps of Engineers
1455 Market Street
San Francisco, CA 94103
PH: 415-503-6861
Email: allison.m.bremner@usace.army.mil

Jean Brennan
Defenders of Wildlife
1130 17th St NW
Washington, DC 20036
PH: 202-682-9400
Email: jbrennan@defenders.org

Brian Brgamaschi
US Geological Survey
California State University
Sacramnto, CA 95819
PH: 916-278-3053
Email: bbergama@usgs.gov

Tim Brick
Arroyo Seco Foundation
539 E Villa St #2
Pasadena, CA 91101
PH: 626-792-2442
Email: TBrick@mwdh2o.com

David Brookshire
Univ of New Mexico
MSC05- 3060; 1 Univ of New Mexico
Albuquerque, NM 87131
PH: 505-277-1964 | FX: 505-277-9445
Email: brookshi@unm.edu

John Brosnan
Sonoma Land Trust
966 Sonoma Avenue
Santa Rosa, CA 95404
PH: 707-526-6930 x109 | FX: 707-526-3001
Email: john@sonomalandtrust.org

Bill Brostoff
US Army Corps of Engineers
1455 Market St
San Francisco, CA 94103
PH: 415-503-6867 | FX: 415-503-6692
Email: William.N.Brostoff@usace.army.mil

Ed Brown
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, FL 32207
PH: 904-232-3647
Email: edwin.brown@usace.army.mil

Chris Budai
US Army Corps of Engineers
333 SW 1st Ave
Portland, OR 97204
PH: 503-808-4723 | FX: 503-808-4756
Email: ChristineBudai@yahoo.com

Tony Buitrago
Parsons
701 San Marco Blvd Suite 1201
Jacksonville, FL 32207
PH: 904-232-1453 | FX: 904-232-1056
Email: Tony.buitrago@parsons.com

Allegra Bukojemsky
Biohabitats Inc
520 Sutter St
San Francisco, CA 94102
PH: 415-274-2822
Email: allegrab@biohabitats.com

Daniel Bunting
Univ of Arizona
250 E Valencia Rd
Tucson, AZ 85706
PH: 520-240-7832
Email: bunting@email.arizona.edu

Barbara Burch
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, FL 32207
PH: 904-232-2741
Email: barbara.j.burch@usace.army.mil

Jutta Burger
Irvine Ranch Conservancy
4727 Portola Pkwy Building C
Irvine, CA 92602
PH: 714-508-4765 | FX: 714-508-4785
Email: jburger@irconservancy.org

Matthew Burgess
FL Cooperative Fish & Wildlife Research Unit
PO Box 110485 University of Florida
Gainesville, FL 32611
PH: 352-318-1615 | FX: 352-846-0841
Email: mburgess@ufl.edu

Kelly Burks-Copes
US Army Corps of Engineers ERDC
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 601-634-2290 | FX: 601-634-3519
Email: Kelly.A.Burks-Copes@usace.army.mil

Casey Burns
USDA NRCS
PO Box 260
Somis, CA 93066
PH: 805-386-4489
Email: casey.burns@ca.usda.gov

Eric Bush
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, FL 32207
PH: 904-232-1517
Email: Eric.L.Bush@usace.army.mil

John Callaway
Univ of San Francisco
Dept of Envir Science 2130 Fulton St
San Francisco, CA 94117
PH: 415-422-5702
Email: callaway@usfca.edu

Dennis Canty
Evergreen Funding Consultants
1109 First Avenue Suite 400
Seattle, WA 98101
PH: 206-691-0700
Email: dcanty@evergreenfc.com

Hal Cardwell
US Army Corps of Engineers
7701 Telegraph Rd - CEIWR-GR
Alexandria, VA 22315
PH: 703-428-9071
Email: Hal.E.Cardwell@usace.army.mil

Bruce Carlson
US Army Corps of Engineers
441 G Street NW
Washington, DC 20314
PH: 202-761-4703
Email: bruce.d.carlson@usace.army.mil

Leslie Carrere
RPM Ecosystems LLC
2150 Dryden Rd
Dryden, NY 13053
PH: 607-844-9590 | FX: 607-844-9591
Email: lc@rpmecosystems.com

Lee Case
US Geological Survey
78401 Hwy 111 Suite R
La Quinta, CA 92253
PH: 760-777-1574 | FX: 760-777-0164
Email: hlcase@usgs.gov

Andy Casper
US Army Corps of Engineers ERDC
3909 Halls Ferry Rd
Vicksburg, MS 39180
PH: 601-634-4681
Email: andrew.f.casper@usace.army.mil

Carl Cerco
US Army Corps of Engineers
US Army ERDC EP-W
Vicksburg, MS 39180
PH: 601-634-4207 | FX: 601-634-3129
Email: carl.f.cerco@usace.army.mil

Courtney Chambers
US Army Corps of Engineers ERDC
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 601-634-4333
Email: Courtney.E.Chambers@usace.army.mil

Allen Chau
Univ of California - Irvine
824 Engineering Tower
Irvine, CA 92697
PH: 949-824-7711
Email: allen.c@uci.edu

Denesia Cheek
National Park Service
100 Alabama StreetSW
Atlanta, GA 30303
PH: 404-507-5809
Email: denesia_cheek@nps.gov

Pearce Cheng
US Army Corps of Engineers ERDC
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 601-634-3699
Email: hwai-ping.cheng@usace.army.mil

Jae Chung
US Army Corps of Engineers
PO Box 532711
Los Angeles, CA 90053
PH: 951-898-6171
Email: yong.j.chung@usace.army.mil

Buddy Clairain
Moffatt & Nichol
1905 A Mission 66 Suite 6
Vicksburg, MS 39180
PH: 601-629-6415 | FX: 601-629-6416
Email: eclairain@moffattnichol.com

Jessica Clement
Colorado State University
Campus Delivery 1472
Fort Collins, CO 80523
PH: 970-491-2104 x7196416680
Email: jessica.clement@colostate.edu

Jodi Clifford
US Army Corps of Engineers
915 Wilshire Blvd
Los Angeles, CA 90017
PH: 213-452-3840 | FX: 213-452-3906
Email: Jodi.L.Clifford@usace.army.mil

Neil Clipperton
California Dept of Fish & Game
830 S Street
Sacramento, CA 95811
PH: 916-445-1724 | FX: 916-445-1768
Email: nclipperton@dfg.ca.gov

Al Cofrancesco
US Army Corps of Engineers
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 601-634-3182
Email:
Alfred.F.Cofrancesco@usace.army.mil

Dick Cole
US Army Corps of Engineers
7701 Telegraph Road Casey Building
Alexandria, VA 22315
PH: 703-428-7291
Email: Richard.A.Cole@usace.army.mil

Chris Collins
Lower Columbia River Estuary Partnership
811 SW Naito Parkway Suite 410
Portland, OR 97204
PH: 503-226-1565 x235
Email: collins@lcrep.org

Josh Collins
San Francisco Estuary Institute
7770 Pardee Lane
Oakland, CA 94621
PH: 510-746-7365 | FX: 510-746-7300
Email: josh@sfei.org

Romorno CONEY
Jackson State University
13153 Maxwell Place
Denver, CO 80239
PH: 303-330-5360 | FX: 303-969-2930
Email: ROMORNO@yahoo.com

Barbara Conlin
US Army Corps of Engineers
100 Penn Square East
Philadelphia, PA 19107
PH: 215-656-6557 | FX: 215-656-6543
Email: barbara.e.conlin@usace.army.mil

Paul Conrads
US Geological Survey
720 Gracern Road
Columbia, SC 29210
PH: 803-750-6140
Email: pconrads@usgs.gov

Troy Constance
US Army Corps of Engineers
PO Bx 60267
New Orleans, LA 70160
PH: 504-862-2742
Email: troy.g.constance@usace.army.mil

Glenn Constant
US Fish & Wildlife Service
239 Parker Coliseum LSU
Baton Rouge, LA 70803
PH: 225-578-8067
Email: glenn_constant@fws.gov

Jock Conyngham
US Army Corps of Engineers ERDC
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 406-426-5002
Email: jock.n.conyngham@usace.army.mil

Craig Conzelmann
US Geological Survey
700 Cajundome Blvd
Lafayette, LA 70506
PH: 337-266-8842 | FX: 337-266-8616
Email: conzelmannc@usgs.gov

Marci Cook
US Army Corps of Engineers
333 SW First Ave
Portland, OR 97204
PH: 503-808-4765 | FX: 503-808-4756
Email: marci.e.cook@usace.army.mil

Mike Cook
SonTek/YSI
9940 Summers Ridge Road
San Diego, CA 92121
PH: 858-546-8327 | FX: 858-546-8150
Email: mcook@sontek.com

Catherine Corbett
Lower Columbia River Estuary Partnership
811 SW Naito Parkway Ste 410
Portland, OR 97204
PH: 503-226-1565
Email: corbett@lcrep.org

Jeff Corbino
US Army Corps of Engineers
PO Box 60267
New Orleans, LA 70160
PH: 504-862-1958 | FX: 504-862-2317
Email: jeffrey.m.corbino@usace.army.mil

Rachel Couch
CA Coastal Conservancy
880 Tornoe Road
Santa Barbara, CA 93105
PH: 805-845-8853
Email: rcouch@scc.ca.gov

Wally Covington
Ecological Restoration Institute
Box 15017
Flagstaff, AZ 86011
PH: 928-523-6635 | FX: 928-523-0296
Email: wally.covington@nau.edu

Dave Crane
US Army Corps of Engineers
1616 Capitol Ave
Omaha, NE 68102
PH: 402-995-2676
Email: David.J.Crane@usace.army.mil

Jeremy Crossland
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, FL 32207
PH: 904-232-2215
Email:
jeremy.m.crossland@usace.army.mil

Ellen Cummings
US Army Corps of Engineers
441 G Street NW 3D72
Washington, DC 20314
PH: 202-761-4750
Email:
Ellen.M.Cummings@usace.army.mil

Soupy Dalyander
US Army Corps of Engineers
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 601-634-4612
Email:
Patricia.A.Dalyander@usace.army.mil

Rob Daoust
Malcolm Pirnie Inc
8201 Peters Road Suite 3400
Plantation, FL 33324
PH: 954-414-9016 | FX: 954-761-7939
Email: rdaoust@pirnie.com

Joel Darnell
HDR Engineering Inc
500 108th Ave NE Suite 1200
Bellevue, WA 98004
PH: 425-450-6396 | FX: 425-453-7107
Email: Joel.Darnell@hdrinc.com

Adam Daugherty
Univ of Florida
3205 College Ave
Davie, FL 33314
PH: 954-577-6362
Email: adaugher@ufl.edu

Michael Davidson
Claremont Graduate University
PO Box 6337
Altadena, CA 91003
PH: 626-278-1842 | FX: 626-398-4646
Email: michaeldavidson24@gmail.com

Jana Davis
Chesapeake Bay Trust
60 West St Suite 405
Annapolis, MD 21401
PH: 410-974-2941
Email: jdavis@cbtrust.org

Steve Davis
University College Dublin
School of Archaeology Newman Building
D4 Ireland
PH: 353-12101683
Email: stephen.davis@ucd.ie

Carlos de la Rosa
Catalina Island Conservancy
PO Box 2739
Avalon, CA 90704
PH: 310-510-1299 x225 | FX: 310-510-1729
Email: cdelarosa@catalinaconservancy.org

Tom DeBusk
DB Environmental Inc
365 Gus Hipp Blvd
Rockledge, FL 32955
PH: 321-639-4896 | FX: 321-631-3169
Email: tom@dbenv.com

Tim Dekker
LimnoTech
501 Avis Drive
Ann Arbor, MI 48108
PH: 734-332-1200 | FX: 734-332-1212
Email: tdekker@limno.com

Pat Deliman
US Army Corps of Engineers
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 601-634-3623 | FX: 601-634-2430
Email: Patrick.N.Deliman@usace.army.mil

Mat Denton
Univ of Florida
3205 College Ave
Davie, FL 33314
PH: 954-577-6362
Email: mdenton@ufl.edu

Joe DePinto
LimnoTech
501 Avis Drive
Ann Arbor, MI 48108
PH: 734-332-1200 | FX: 734-332-1212
Email: jdepinto@limno.com

Dino DeSimone
USDA NRCS
230 N First Ave STE 509
Phoenix, AZ 85003
PH: 602-280-8786 | FX: 602-280-8795
Email: dino.desimone@az.usda.gov

Bryan Dick
AECOM
701 Corporate Center Dr Suite 475
Raleigh, NC 27607
PH: 919-854-6252 | FX: 919-854-6259
Email: bryan.dick@aecom.com

Heida Diefenderfer
Pacific Northwest National Lab
1529 West Sequim Bay Road
Sequim, WA 98382
PH: 360-681-3619 | FX: 360-681-3681
Email: heida.diefenderfer@pnl.gov

Michael Dietl
US Army Corps of Engineers
1325 J Street
Sacramento, CA 95814
PH: 916-557-6742
Email: Michael.L.Dietl@usace.army.mil

Zooey Diggory
Stillwater Sciences
2855 Telegraph Avenue Suite 400
Berkeley, CA 94705
PH: 510-848-8098
Email: zooey@stillwatersci.com

Doug Donalson
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, FL 32207
PH: 904-210-4599
Email: douglas.d.donalson@usace.army.mil

Bob Doren
South Florida Ecosystem Restoration Task Force
11200 SW 8 Street
Miami, FL 33199
PH: 305-348-6721 | FX: 305-348-1667
Email: darmel@sfrestore.org

Ann Dorsey
National Park Service
401 West Hillcrest Dr
Thousand Oaks, CA 91360
PH: 805-370-2386 | FX: 805-370-1850
Email: Ann_Dorsey@nps.gov

Terry Doss
Biohabitats
855 Bloomfield Avenue
Glen Ridge, NJ 07028
PH: 973-748-9800 | FX: 973-748-9801
Email: tdoss@biohabitats.com

Pete Downs
Stillwater Sciences
2855 Telegraph Avenue Suite 400
Berkeley, CA 94705
PH: 510-848-8098
Email: downs@stillwatersci.com

Paul Dragos
Battelle
397 Washington Steet
Duxbury, MA 02332
PH: 781-952-5357
Email: dragosp@battelle.org

Barry Dubinski
Weston Solutions Inc
1400 Weston Way
West Chester, PA 19380
PH: 610-701-3137 | FX: 610-701-3739
Email: barry.dubinski@westonsolutions.com

Paul DuBowy
US Army Corps of Engineers
CEMVD-PD-WM
Vicksburg, MS 39181
PH: 601-634-5930
Email: paul.j.dubowy@usace.army.mil

Truman Duncan
Miccosukee Tribe of Indians of Florida
PO Box 440021
Miami, FL 33144
PH: 305-223-8380 | FX: 305-894-5225
Email: duncan2u@aol.com

Lisa Duriancik
USDA NRCS
5601 Sunnyside Ave MS-5410
Beltsville, MD 20705
PH: 301-504-2304 | FX: 301-504-3788
Email: lisa.duriancik@wdc.usda.gov

Anthony Dvarskas
NOAA
1305 East-West Highway
Silver Spring, MD 20910
PH: 917-378-4201
Email: Anthony.Dvarskas@noaa.gov

Addisu Adugna Eba
Student
Tu-Darmstadt
Darmstadt Hessen, 64283 Germany
PH: 49-015224725533
Email: addisuadugna@yahoo.com

Blaine Ebberts
US Army Corps of Engineers
333 SW First Ave
Portland, OR 97204
PH: 503-808-4763 | FX: 503-808-4756
Email: blaine.d.ebberts@usace.army.mil

Greg Eckert
National Park Service
1201 Oakridge Dr Suite #200
Fort Collins, CO 80525
PH: 970-225-3594 | FX: 970-225-3585
Email: greg_eckert@nps.gov

Lisa Eckert
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, FL 32207
PH: 904-232-1156
Email: lisa.e.eckert@usace.army.mil

Dave Egan
Ecological Restoration Institute
PO Box 15017
Flagstaff, AZ 86011
PH: 928-523-8129
Email: David.Egan@nau.edu

Forester Einarsen
US Army Corps of Engineers
27 Greenleaf Terrace
Stafford, VA 22556
PH: 540-846-1855
Email: skogmon@comcast.net

Fred Ellerbusch
Rhodia
8 Cedarbrook Drive
Cranbury, NJ 08512
PH: 609-860-3671 | FX: 609-860-2235
Email: fred.ellerbusch@us.rhodia.com

David Emmerson
US DOI
1801 Pennsylvania Ave #544
Washington, DC 20240
PH: 202-327-5318 | FX: 202-327-5390
Email: davemm22201@yahoo.com

Joel Engleson
HDR San Diego/ Univ of South Florida
8690 Balboa Ave Suite 200
San Diego, CA 92123
PH: 858-712-8397 | FX: 858-712-8333
Email: joel.engleson@hdrinc.com

Randy Epperson
USDA NRCS
100 Centennial Mall N
Lincoln, NE 68508
PH: 402-437-4048 | FX: 402-437-5327
Email: randy.epperson@ne.usda.gov

Scott Estergard
US Army Corps of Engineers
3636 N Central Ave Ste 900
Phoenix, AZ 85012
PH: 602-640-2003 x242 | FX: 602-640-5382
Email: Scott.K.Estergard@usace.army.mil

Jennifer Faler
Bureau of Reclamation
PO Box 1300
Weaverville, CA 96093
PH: 530-623-1800
Email: jfaler@mp.usbr.gov

Jason Farmer
US Army Corps of Engineers
1222 Spruce Street
St Louis, MO 63103
PH: 314-331-8033
Email: jason.w.farmer@usace.army.mil

Tim Feather
CDM
1050 North Reed Station Road Suite D
Carbondale, IL 62902
PH: 618-351-4646
Email: feathertd@cdm.com

Sue Ferguson
CELRN-PM-P
PO Box 1070
Nashville, TN 37202
PH: 615-736-7192
Email: sue.l.ferguson@usace.army.mil

Brian Files
EPJV/Parsons
701 San Marco Blvd Ste 1201
Jacksonville, FL 32207
PH: 904-232-2170 | FX: 904-232-1056
Email: brian.files@parsons.com

Craig Fischenich
Fischenich
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 601-634-3449 | FX: 601-634-3519
Email: craig.j.fischenich@usace.army.mil

Rich Fischer
US Army Corps of Engineers ERDC
3910 Halls Ferry Road
Vicksburg, MS 39180
PH: 502-315-6707 | FX: 502-315-6713
Email: Richard.A.Fischer@usace.army.mil

Mike Flaxman
MIT
77 Massachusetts Avenue Room 9-522
Cambridge, MA 02139
PH: 617-710-9087
Email: mflaxman@mit.edu

Beth Fleming
US Army Corps of Engineers ERDC
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 601-634-3943 | FX: 601-634-3842
Email: Beth.Fleming@usace.army.mil

Kristen Fleming
Maryland Dept of Natural Resources
580 Taylor Ave E2
Annapolis, MD 21401
PH: 410-260-8813 | FX: 410-260-8779
Email: kfleming@dnr.state.md.us

Gene Foster
Burns & McDonnell Engineering Company
9400 Ward Parkway
Kansas City, MO 64114
PH: 816-822-3167 | FX: 816-822-3514
Email: gfoster@burnsmcd.com

Peter Frederick
Univ of Florida
PO Box 110430
Gainesville, FL 32611
PH: 352-846-0565
Email: pfred@ufl.edu

Herb Fredrickson
US EPA NRMRL
42 West Martin Luther King
Cincinnati, OH 45268
PH: 513-569-7402
Email: fredrickson.herbert@epa.gov

Dave Freiwald
US Geological Survey
401 Hardin Rd
Little Rock, AR 72211
PH: 501-228-3618
Email: freiwald@usgs.gov

Roger Fujii
US Geological Survey
6000 J St Placer Hall CSUS Campus
Sacramento, CA 95819
PH: 916-278-3055
Email: rfujii@usgs.gov

Miki Fujitsubo
US Army Corps of Engineers
1325 J Street
Sacramento, CA 95814
PH: 916-557-7440
Email: Miki.Fujitsubo@usace.army.mil

Karen Fullen
USDA NRCS
125 South State Room 4402
Salt Lake City, UT 84138
PH: 801-524-4566 | FX: 801-524-4593
Email: Karen.Fullen@ut.usda.gov

Raina Fulton
US Army Corps of Engineers
915 Wilshire Blvd
Los Angeles, CA 90017
PH: 213-452-3872 | FX: 213-452-3906
Email: Raina.Fulton@usace.army.mil

Carianne Funicelli
RECON Environmental Inc
1927 Fifth Avenue
San Diego, CA 92101
PH: 520-325-9977 x201 | FX: 520-293-3051
Email: cfunicelli@recon-us.com

Paula Gagnon
Gagnon Consulting
3014 NE 36th Avenue
Portland, OR 97212
PH: 402-403-0337
Email: gagnon.paula@gmail.com

David Galat
US Geological Survey
302 ABNR Building, Univ of Missouri
Columbia, MO 65211
PH: 573-882-9426 | FX: 573-884-5070
Email: galatd@missouri.edu

William Gallagher
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, FL 32207
PH: 904-232-1102 | FX: 904-232-3442
Email: william.j.gallagher@usace.army.mil

Jeanette Gallihugh
US Army Corps of Engineers
441 G Street NW
Washington, DC 20314
PH: 202-761-0668
Email:
jeanette.l.gallihugh@usace.army.mil

Mike Garello
HDR Engineering Inc
9717 97th Street NW
Gig Harbor, WA 98322
PH: 253-858-5635 | FX: 253-858-5263
Email: mike.garello@hdrinc.com

Nick Garrity
PWA
3911 Green Ave
Los Alamitos, CA 90720
PH: 562-296-5679 | FX: 562-296-5679
Email: n.garrity@pwa-ltd.com

Kim Garvey
Moffatt & Nichol
3780 Kilroy Airport Way Suite 600
Long Beach, CA 90806
PH: 562-426-9551
Email: kgarvey@moffattnichol.com

Kim Gavigan
US Army Corps of Engineers
3636 N Central Ave Ste 900
Phoenix, AZ 85012
PH: 602-640-2003 x262 | FX: 602-640-5382
Email: Kim.M.Gavigan@usace.army.mil

Dana Gentry
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, FL 32207
PH: 904-232-2405
Email: Dana.K.Gentry@usace.army.mil

Ann George
Wildlife Habitat Council
8737 Colesville Rd Suite 800
Silver Spring, MD 20910
PH: 301-588-8994
Email: ann_george@fmi.com

Mike George
US Army Corps of Engineers
1616 Capitol Avenue
Omaha, NE 68102
PH: 402-995-2712 | FX: 402-995-2454
Email: michael.d.george@usace.army.mil

Enid Gerena
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, FL 32207
PH: 904-232-1815
Email: enid.a.gerena@usace.army.mil

Beverly Getzen
NCER 2009
PO Box 202
Wadesboro, NC 28170
PH: 704-694-7022
Email: bbgetzen@gmail.com

Stanford Gibson
Hydrologic Engineering Center
609 Second Street
Davis, CA 95616
PH: 530-756-1104 | FX: 530-756-8250
Email: stanford.a.gibson@usace.army.mil

Noel Gilbrough
US Army Corps of Engineers
PO Box 3755
Seattle, WA 98124
PH: 206-764-3652
Email: noel.l.gilbrough@usace.army.mil

Wendell Gilgert
USDA NRCS
1201 NE Lloyd Blvd Ste 1000
Portland, OR 97232
PH: 503-273-2426 | FX: 503-273-2401
Email: wendell.gilgert@por.usda.gov

Leighann Gipson
US Army Corps of Engineers
167 N Main St Rm B-202
Memphis, TN 38103
PH: 901-544-4015 | FX: 901-544-3955
Email: leighann.c.gipson@usace.army.mil

Nancy Gleason
US Army Corps of Engineers
PO Box 3755
Seattle, WA 98124
PH: 206-764-6577
Email: nancy.c.gleason@usace.army.mil

Wendi Goldsmith
Bioengineering Group
18 Commercial Street
Salem, MA 01970
PH: 978-740-0096 | FX: 978-740-0097
Email: wgoldsmith@bioengineering.com

Patricia Goodman
South Florida Water Management District
3301 Gun Club Road
West Palm Beach, FL 33406
PH: 561-682-2427
Email: pgoodman@sfwmd.gov

David Gorman
AECOM
333 SW Fifth Avenue Suite 225
Portland, OR 97204
PH: 503-227-1042 | FX: 503-227-1048
Email: david.gorman@aecom.com

Matt Grabau
GeoSystems Analysis Inc
2015 N Forbes Blvd #105
Tucson, AZ 85745
PH: 520-628-9330 | FX: 520-628-1122
Email: matt@gsanalysis.com

Italia Gray
RECON Environmental Inc
1927 Fifth Avenue
San Diego, CA 92101
PH: 619-308-9333 | FX: 619-308-9334
Email: igray@recon-us.com

Windy Greer
Ecological Restoration Institute
Box 15017
Flagstaff, AZ 86004
PH: 928-523-8129
Email: windy.greer@nau.edu

Stan Gregory
Oregon State University
104 Nash Hall
Corvallis, OR 97331
PH: 541-737-1951 | FX: 541-737-3590
Email: Stanley.Gregory@oregonstate.edu

Jessica Groves
USDA NRCS
430 G St #4164
Davis, CA 95616
PH: 530-792-5604 | FX: 530-792-5793
Email: jessica.groves@ca.usda.gov

Alison Sleath Grzegorzewski
US Army Corps of Engineers ERDC
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 504-280-3867
Email:
alison.s.grzegorzewski@usace.army.mil

Lisa Gued
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, FL 32207
PH: 904-232-1793 | FX: 904-232-3665
Email: lisa.r.gued@usace.army.mil

Darlene Guinto
HydroPlan LLC
3720 SE Tolman Street
Portland, OR 97202
PH: 503-297-4397 | FX: 503-297-4397
Email: DGuinto@HydroPlanLLC.com

Vanessa Gutierrez
POWER Engineers Inc
731 E Ball Rd Suite 100
Anaheim, CA 92805
PH: 714-507-2729
Email: vanessa.gutierrez@powereng.com

Courtney Hackney
Univ of North Florida
Dept Biology 1 UNF Dr
Jacksonville, FL 32224
PH: 904-620-1850 | FX: 904-620-3885
Email: c.hackney@unf.edu

Laura Hagenauer
NAU
Department of Biology PO Box 5640
Flagstaff, AZ 86001
PH: 928-523-7500
Email: Laura.Hagenauer@nau.edu

Karen Hagerty
US Army Corps of Engineers
Clock Tower Building; PO Box 2004
Rock Island, IL 61204
PH: 309-794-5221 | FX: 309-794-5497
Email: Karen.H.Hagerty@usace.army.mil

Carol Hale
US Fish & Wildlife Service
PO Box 710
Yankton, SD 57078
PH: 402-667-2887 | FX: 402-667-2588
Email: carol_hale@fws.gov

Meagan Hall
HDR Engineering Inc
8404 Indian Hills Drive
Omaha, NE 68114
PH: 402-399-4983 | FX: 402-399-1111
Email: meagan.hall@hdrinc.com

Howard Hankin
USDA NRCS
1400 Independence Ave
Washington, DC 20250
PH: 202-698-0082 | FX: 202-720-1814
Email: howard.hankin@wdc.usda.gov

Charlie Hanneken
US Army Corps of Engineers
1222 Spruce Street
St Louis, MO 63103
PH: 314-331-8496
Email:
charles.d.hanneken@usace.army.mil

Tim Hanrahan
Pacific Northwest National Lab
PO Box 999 MS K6-85
Richland, WA 99352
PH: 509-371-7182
Email: tim.hanrahan@pnl.gov

Bernie Hargrave
US Army Corps of Engineers
4735 E Marginal Way S
Seattle, WA 98124
PH: 206-764-6839
Email:
bernard.l.hargrave.jr@usace.army.mil

Chris Haring
US Army Corps of Engineers
PO Box 2004
Rock Island, IL 61204
PH: 309-794-5885
Email:
christopher.p.haring@usace.army.mil

Matt Harwell
ARM Loxahatchee National Wildlife Refuge
1339 20th Street
Vero Beach, FL 32960
PH: 772-562-3909 x255 | FX: 772-562-4288
Email: matthew_harwell@fws.gov

Ilima Hawkins
USDA NRCS
82-901 Bliss Ave
Indio, CA 92201
PH: 760-342-4624
Email: ilima.hawkins@ca.usda.gov

Pete Heard
USDA NRCS
100 Webster Circle Suite 2
Madison, MS 39110
PH: 601-607-3131 | FX: 601-607-3139
Email: pete.heard@ms.usda.gov

David Heffington
USDA NRCS
101 E Capitol Ave Ste B100
Little Rock, AR 72201
PH: 501-210-8923 | FX: 501-210-8935
Email: David.Heffington@ar.usda.gov

Douglas Helms
USDA NRCS
1400 Independence Ave SW
Washington, DC 20250
PH: 202-720-3766 | FX: 202-720-6473
Email: douglas.helms@wdc.usda.gov

Jim Henderson
US Army Corps of Engineers ERDC
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 601-634-3305 | FX: 601-634-3519
Email: jim.e.henderson@usace.army.mil

Nathan Henderson
AECOM
701 Edgewater Drive
Wakefield, MA 01880
PH: 781-224-6504 | FX: 781-224-5986
Email: nathan.henderson@aecom.com

Heather Henkel
US Geological Survey
600 4th St South
St Petersburg, FL 33701
PH: 727-803-8747 x3028
Email: hhenkel@usgs.gov

John Henz
HDR Engineering Inc
303 East 17th Avenue Suite 700
Denver, CO 80203
PH: 303-764-1582
Email: john.henz@hdrinc.com

Brook Herman
US Army Corps of Engineers
111 N Canal St suite 600
Chicago, IL 60606
PH: 312-846-5559
Email: brook.d.herman@usace.army.mil

Edgar Hernandez
US Geological Survey
3110 SW 9th Ave
Fort Lauderdale, FL 33315
PH: 954-377-5958
Email: ehernandez@usgs.gov

John Hickey
Hydrologic Engineering Center
609 Second Street
Davis, CA 95616
PH: 530-756-1104 | FX: 530-756-8250
Email: john.t.hickey@usace.army.mil

Tim Higgs
CELRNPM-P
PO Box 1070
Nashville, TN 37202
PH: 615-736-7863
Email: timothy.a.higgs@usace.army.mil

Melissa Hightower
US Army Corps of Engineers
PO Box 60267
New Orleans, LA 70160
PH: 504-862-1738
Email:
melissa.a.hightower@usace.army.mil

Pete Hill
District Dept of the Environment
51 N St NE 5th Fl
Washington, DC 20002
PH: 202-535-2241
Email: peter.hill@dc.gov

Eliza Hines
EPJV/PBS&J
701 San Marco Blvd Suite #1201
Jacksonville, FL 32207
PH: 904-232-2011 | FX: 904-232-1056
Email: ebhines@pbsj.com

Bill Hinsley, III
PBS&J
3620 47th Ave SW
Seattle, WA 98116
PH: 504-237-2770 | FX: 916-442-3013
Email: WEHinsley@pbsj.com

Bill Hohman
USDA NRCS
501 W Felix St Bldg 23
Fort Worth, TX 76115
PH: 817-509-3332 | FX: 817-509-3337
Email: william.hohman@ftw.usda.gov

Gregory Hood
Skagit River System Cooperative
PO Box 368
LaConner, WA 98257
PH: 360-466-7282 | FX: 360-466-4047
Email: ghood@skagitcoop.org

Mike Hooper
US Geological Survey
4200 E New Haven Rd
Columbia, MO 65201
PH: 573-441-2985
Email: mhooper@usgs.gov

Kristina Hopkins
Chesapeake Research Consortium
410 Severn Avenue Suite 109
Annapolis, MD 21403
PH: 410-267-9848
Email: krhopkin@chesapeakebay.net

David Hubbard
Coastal Restoration Consultants
808 California Street
Santa Barbara, CA 93103
PH: 808-698-1119
Email: dave@crcsb.com

Marv Hubbell
US Army Corps of Engineers
Clock Tower Building; PO Box 2004
Rock Island, IL 61204
PH: 309-794-5221 | FX: 309-794-5497
Email: Marvin.E.Hubbell@usace.army.mil

Michael Hubbs
USDA NRCS
PO Box 2890
Washington, DC 20013
PH: 202-720-2587 | FX: 202-720-1814
Email: mike.hubbs@wdc.usda.gov

Coral Huber
US Army Corps of Engineers
PO Box 710
Yankton, SD 57078
PH: 402-667-2883
Email: coral.j.huber@usace.army.mil

Noah Hume
Stillwater Sciences
2855 Telegraph Avenue Suite 400
Berkeley, CA 94705
PH: 510-848-8098
Email: noah@stillwatersci.com

Ondrea Hummel
US Army Corps of Engineers
4101 Jefferson Plaza NE
Albuquerque, NM 87109
PH: 505-342-3375 | FX: 505-342-3668
Email: ondrea.c.hummel@usace.army.mil

Beth Huning
San Francisco Bay Joint Venture
735 B Center Blvd
Fairfax, CA 94930
PH: 415-259-0334 | FX: 415-259-0340
Email: bhuning@sfbayjv.org

Kathleen Hurley
Windward Environmental LLC
200 W Mercer St Suite 401
Seattle, WA 98119
PH: 206-812-5416
Email: kathleenh@windwardenv.com

Jim Hutchison
US Army Corps of Engineers
915 Wilshire Blvd
Los Angeles, CA 90017
PH: 213-452-3826 | FX: 213-452-3906
Email:
James.D.Hutchison@usace.army.mil

Chemine Jackels
US Army Corps of Engineers
4735 East Marginal Way S
Seattle, WA 98134
PH: 206-764-3646
Email: chemine.r.jackels@usace.army.mil

William James
US Army Corps of Engineers ERDC
W500 Eau Galle Dam Rd
Spring Valley, WI 54767
PH: 715-778-5896 | FX: 715-778-5897
Email: william.f.james@usace.army.mil

Hank Jarboe
US Army Corps of Engineers
550 Main Street
Cincinnati, OH 45202
PH: 513-684-6050 | FX: 513-684-2907
Email: hank.jarboe@lrdor.usace.army.mil

David Jenkins
US Army Corps of Engineers
1400 Walnut Street
Vicksburg, MS 39180
PH: 601-634-5902 | FX: 601-634-5371
Email: david.g.jenkins@usace.army.mil

Jim Jenniges
Nebraska Public Power District
Box 2170
Kearney, NE 68848
PH: 308-236-2293
Email: jjjenni@nppd.com

Ian Jewell
AECOM
701 Corporate Center Dr St 475
Raleigh, NC 27607
PH: 919-854-6254
Email: ian.jewell@aecom.com

Barry Johnson
US Geological Survey
2630 Fanta Reed Road
La Crosse, WI 54603
PH: 608-781-6230 | FX: 608-783-6066
Email: bljohnson@usgs.gov

Billy Johnson
US Army Corps of Engineers
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 601-634-3714 | FX: 601-634-3129
Email: Billy.E.Johnson@usace.army.mil

Brian Johnson
US Army Corps of Engineers
1222 Spruce St
St Louis, MO 63304
PH: 314-331-8146 | FX: 314-331-8806
Email: brian.l.johnson@usace.army.mil

Carol Johnson
USDA NRCS
101 East Capitol Ave B100
Little Rock, AR 72201
PH: 501-210-8901 | FX: 501-210-8935
Email: Carol.Johnson@ar.usda.gov

Gary Johnson
Pacific Northwest National Lab
620 SW 5th Avenue Suite 810
Portland, OR 97204
PH: 503-417-7567 | FX: 503-417-2175
Email: gary.johnson@pnl.gov

Karen Johnson-Young
Battelle
1400 Centrepark Blvd Suite 1005
West Palm Beach, FL 33401
PH: 561-656-6304 | FX: 561-683-0125
Email: johnson-youngk@battelle.org

Eric Jolliffe
US Army Corps of Engineers
1455 Market St
San Francisco, CA 94103
PH: 415-503-6869 | FX: 415-503-6692
Email: Eric.F.Jolliffe@usace.army.mil

Meg Jonas
US Army Corps of Engineers
3909 Halls Ferry Rd
Vicksburg, MS 39180
PH: 574-299-0214
Email: margaret.m.jonas@usace.army.mil

Mark Judson
EIM Sensor
12801 Worldgate Drive Suite 500
Herndon, VA 20170
PH: 703-232-7111
Email: mark.judson@eimsensor.com

Hamid Karimi
District Dept of the Environment
51 N Street NE
Washington, DC 20895
PH: 202-535-2277
Email: hamid.karimi@dc.gov

Wendy Katagi
CDM
523 W 6th Street #400
Los Angeles, CA 90014
PH: 213-457-2132 | FX: 213-457-2132
Email: katagiwr@cdm.com

Jeff Keay
US Geological Survey
3020 State University Dr E Suite 3005
Sacramento, CA 95819
PH: 916-278-9561
Email: jkeay@usgs.gov

Kelly Keefe
US Army Corps of Engineers
702 San Marco Blvd
Jacksonville, FL 32207
PH: 904-232-1654
Email: kelly.j.keefe@usace.army.mil

Patrick Kelly
California State University Stanislaus
4186 W Swift Avenue Suite 101
Fresno, CA 93722
PH: 559-271-2646
Email: pkelly@esrp.csustan.edu

Kara Kemmler
California Coastal Conservancy
PO Box 91227
Santa Barbara, CA 93190
PH: 805-252-5272
Email: kkemmler@scc.ca.gov

Thomas Kendall
US Army Corps of Engineers
1455 Market St #1590
San Francisco, CA 94103
PH: 415-503-6822 | FX: 415-503-6692
Email:
Thomas.R.Kendall@usace.army.mil

Alison Kennedy
Environment Canada
4905 Dufferin Street
Toronto Ontario, M3H 5T4 Canada
PH: 416-739-5913
Email: alison.kennedy@ec.gc.ca

Deanie Kennedy
US Army Corps of Engineers
1455 Market St Ste 2045A
San Francisco, CA 94103
PH: 415-503-6585 | FX: 415-503-6644
Email:
Nedenia.C.Kennedy@usace.army.mil

Karla Kennedy
Northern Arizona University
Box 5640
Flagstaff, AZ 86011
PH: 928-523-2381
Email: karla.kennedy@nau.edu

Susan Kennedy
US DOI
PO Box 25007 (D-110)
Denver, CO 80225
PH: 303-445-3882 | FX: 303-445-3887
Email: susan_kennedy@ios.doi.gov

Jerry Kenny
Platte River Recovery Implementation Program
3710 Central Avenue Suite E
Kearney, NE 68847
PH: 308-237-5728 | FX: 308-237-4651
Email: kennyj@headwaterscorp.com

Brannon Ketcham
National Park Service
Point Reyes National Seashore
Point Reyes Station, CA 94956
PH: 415-464-5192 | FX: 415-663-8132
Email: brannon_ketcham@nps.gov

Jack Killgore
US Army Corps of Engineers ERDC
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 601-634-3397 | FX: 601-634-2398
Email: jack.killgore@usace.army.mil

Suzette Kimball
US Geological Survey
12201 Sunrise Valley Dr
Reston, VA 20192
PH: 703-648-7411 | FX: 703-648-4454
Email: suzette_kimball@usgs.gov

Barbara Kleiss
Louisiana Coastal Area Science & Technology Office
3909 Fisher Ferry Rd
Vicksburg, MS 39180
PH: 601-634-4674
Email: Barbara.A.Kleiss@usace.army.mil

Brent Knights
US Geological Survey
2630 Fanta Reed Road
La Crosse, WI 54603
PH: 608-781-6332
Email: bknights@usgs.gov

Camie Knollenberg
US Army Corps of Engineers
PO Box 2004
Rock Island, IL 61204
PH: 309-794-5487
Email:
camie.a.knollenberg@usace.army.mil

Leslie Koenig
Alameda County Resource Conservation District
3585 Greenville Rd Ste 2
Livermore, CA 94550
PH: 925-371-0154 x115
Email: leslie.koenig@ca.nacdnet.net

Shawn Komlos
US Army Corps of Engineers
7701 Telegraph Road - Casey Building
Alexandria, VA 22315
PH: 703-428-6605 | FX: 703-428-7979
Email: shawn.b.komlos@usace.army.mil

Dave Koran
US Army Corps of Engineers
441 G Street NW
Washington, DC 20314
PH: 202-761-0076
Email: david.koran@usace.army.mil

Andreas Krause
Bureau of Reclamation
PO Box 1300
Weaverville, CA 96093
PH: 530-623-1800
Email: akrause@mp.usbr.gov

Paul Krause
ARCADIS
6080 Center Drive Suite 636
Los Angeles, CA 90045
PH: 310-242-6712 | FX: 310-242-6601
Email: paul.krause@arcadis-us.com

Mark Krupka
Ecological Laboratories Inc
2525 NE 9th Avenue
Cape Coral, FL 33909
PH: 609-693-6910 | FX: 609-693-6910
Email: mark@microbelift.com

Casey Kruse
US Army Corps of Engineers
PO Box 710
Yankton, SD 57078
PH: 402-667-2580
Email: casey.d.kruse@usace.army.mil

Dennis Kubly
Bureau of Reclamation
125 S State Street
Salt Lake City, UT 84138
PH: 801-524-3715 | FX: 801-524-3858
Email: DKubly@usbr.gov

Harbans Lal
USDA NRCS
1201 NE Lloyd Blvd Ste 1000
Portland, OR 97232
PH: 503-273-2441 | FX: 503-273-2401
Email: harbans.lal@por.usda.gov

Deborah Lamb
US Army Corps of Engineers
915 Wilshire Blvd
Los Angeles, CA 90017
PH: 213-452-3898 | FX: 213-452-3906
Email: Deborah.L.Lamb@usace.army.mil

Doug Lamont
Assistant Secretary of the Army (Civil Works)
108 Army Pentagon
Washington, DC 20310
PH: 202-761-0016 | FX: 202-761-0050
Email: doug.lamont@us.army.mil

Meg Lamont
Univ of Florida
PO Box 110485
Gainesville, FL 32611
PH: 352-392-1861
Email: mmlamont@mindspring.com

Vechere' Lampley
US Army Corps of Engineers
60th Forsyth St
Atlanta, GA 30303
PH: 404-562-5227 | FX: 404-562-5218
Email: vechere.v.lampley@usace.army.mil

Glenn Landers
US Army Corps of Engineers
701 San Marco Blvd
Jacksonvillle, FL 32207
PH: 904-232-2125
Email: glenn.b.landers@usace.army.mil

Mark Lane
Parsons
901 NE Loop 410 Suite 610
San Antonio, TX 78209
PH: 210-383-2766
Email: Mark.Lane@parsons.com

Everett Laney
US Army Corps of Engineers
1645 S 101 E AVE
Tulsa, OK 74128
PH: 918-669-7411 | FX: 918-669-7546
Email: everett.laney@usace.army.mil

Eric Laux
US Army Corps of Engineers
1616 Capitol Ave
Omaha, NE 68102
PH: 402-995-2682 | FX: 402-995-2758
Email: eric.a.laux@usace.army.mil

Bob Lazor
US Army Corps of Engineers
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 601-634-2935
Email: Robert.L.Lazor@usace.army.mil

Bill Leary

28 E Park Ave
St Augustine, FL 32084
PH: 904-315-0790
Email: bill.leary4@yahoo.com

David Lee
YSI Inc
1725 Brannum Lane
Yellow Springs, OH 45387
PH: 937-767-7241
Email: dlee@ysi.com

Richard Legere
US Army Corps of Engineers
3636 N Central Ave Ste 900
Phoenix, AZ 85012
PH: 602-640-2003 x247 | FX: 602-640-5382
Email: Richard.H.Legere@usace.army.mil

Victoria Lehr
Parsons
1555 Palm Beach Lakes Blvd Ste 1105
West Palm Beach, FL 33401
PH: 561-656-6373
Email: victoria.lehr@parsons.com

Leo Lentsch
ENTRIX
829 Front Street Suite J
Georgetown, SC 29440
PH: 843-545-1015
Email: llentsch@entrix.com

C Y Li
Louisiana State University
331 Howe-Russell
Baton Rouge, LA 70803
PH: 225-578-3619
Email: cli@lsu.edu

Dani Liebau
Weston Solutions Inc
600 East Lakeshore Drive Suite 200
Houghton, MI 49931
PH: 906-482-7207 | FX: 906-482-7745
Email: daniel.liebau@westonsolutions.com

Brad Lindaman
Barr Engineering Co
4700 W 77th St
Minneapolis, MN 55435
PH: 952-832-2808
Email: blindaman@barr.com

Andy Lipsky
USDA NRCS
60 Quaker Lane
Warwick, RI 02886
PH: 401-822-8842 | FX: 401-828-0433
Email: andrew.lipsky@ri.usda.gov

Kent Loftin
HydroPlan LLC
8949 SE Bridge Road #301
Hobe Sound, FL 33455
PH: 561-307-2618 | FX: 772-546-1126
Email: KLoftin@HydroPlanLLC.com

Eric Lopez
City of Long Beach/Prop Srvs Bur
333 W Ocean Blvd 3rd Floor
Long Beach, CA 90802
PH: 562-570-5690 | FX: 562-570-6380
Email: eric.lopez@longbeach.gov

Stephanie Lopez
Coastal Restoration Consultants
808 California St
Santa Barbara, CA 93103
PH: 805-451-4573
Email: matt@crcsb.com

Marie Lopez-Balaez
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville,, FL 32207
PH: 904-232-3484 | FX: 904-232-3665
Email: Marie.C.Lopez@usace.army.mil

Andy LoSchiavo
US Army Corps of Engineers
CESAJ DR-R; 701 San Marco Blvd
Jacksonville, FL 32207
PH: 904-232-2077
Email: andrew.j.loschiavo@usace.army.mil

Jeremy Lowe
Philip Williams & Associates
550 Kearny St Suite 900
San Francisco, CA 94591
PH: 415-262-2304
Email: lowe@pwa-ltd.com

Carl Lucero
USDA Ecosystem Services & Markets
1400 Independence Ave SW
Washington, DC 20250
PH: 202-205-9871
Email: carl.lucero@osec.usda.gov

Megan Lulow
Irvine Ranch Conservancy
4727 Portola Pkwy Building C
Irvine, CA 92602
PH: 714-508-4766 | FX: 714-508-4786
Email: mlulow@irconservancy.org

Kevin MacKay
ICF Jones & Stokes
2841 Junction Ave Suite 114
San Jose, CA 95124
PH: 408-434-2244 | FX: 408-434-2240
Email: kmackay@jsanet.com

Carrie Madden
HDR Engineering Inc
3230 El Camino Real Ste 200
Irvine, CA 92602
PH: 714-368-5637 | FX: 714-730-2301
Email: camadden@hdrinc.com

Michele Mahoney
US EPA
1200 PA Ave NW MC 5203P
Washington, DC 22202
PH: 703-603-9057
Email: mahoney.michele@epa.gov

Brian Manwaring
US Institute for Environmental Conflict Resolution
130 S Scott Ave
Tucson, AZ 85701
PH: 520-901-8529
Email: manwaring@ecr.gov

Robert Marinai
Bluefield Holdings Inc
2505 Second Ave Suite 602
Seattle, WA 98121
PH: 510-326-7131
Email: robm@bluefieldholdings.com

Juan Martinez
USDA NRCS
PO BOX 364868
San Juan, PR 00936
PH: 787-766-5206 | FX: 787-766-6563
Email: juan.martinez@pr.usda.gov

Chris Matthews
HDR Engineering Inc
128 S Tryon St Suite 1400
Charlotte, NC 28202
PH: 704-338-6778 | FX: 704-338-6760
Email: chris.matthews@hdrinc.com

Patty Matthews
AECOM
5757 Woodway Suite 101W
Houston, TX 77057
PH: 713-267-2781 | FX: 713-278-3110
Email: patty.matthews@aecom.com

Mike Mayer
The Louis Berger Group Inc
4050 Pennsylvania Ave
Kansas City, MO 64111
PH: 816-785-2345
Email: mmayer@louisberger.com

Sheri Mayta
Coastal Restoration Consultants
808 California St
Santa Barbara, CA 93103
PH: 805-844-5131
Email: smayta@sbcglobal.net

Daria Mazey
US Army Corps of Engineers
1455 Market Street
San Francisco, CA 94103
PH: 415-503-6856
Email: daria.s.mazey@usace.army.mil

Rob McAdory
US Army Corps of Engineers ERDC
3909 Halls Ferry Road
Vicksburg, MS 39183
PH: 601-634-3057 | FX: 601-634-2823
Email: Robert.T.McAdory@usace.army.mil

Roy McAllister
US Army Corps of Engineers
1616 Capitol Avenue Suite 9000
Omaha, NE 68102
PH: 402-995-2507 | FX: 402-995-2454
Email: roy.f.mcallister@usace.army.mil

Kerrie McArthur
AMEC Geomatrix
3500 188th Street SW Suite 600
Lynnwood, WA 98037
PH: 425-921-4026 | FX: 425-921-4040
Email: kerrie.mcarthur@amec.com

Scott McBain
McBain & Trush Inc
980 7th Street
Arcata, CA 95521
PH: 707-826-7794
Email: scott@mcbaintrush.com

Aundrea McBride
Skagit River System Cooperative
PO Box 369
LaConner, WA 98257
PH: 360-466-4691 | FX: 360-466-4047
Email: amcbride@skagitcoop.org

Peg McBrien
The Louis Berger Group Inc
412 Mount Kemble Ave
Morristown, NJ 07962
PH: 973-407-1465
Email: mmcbrien@louisberger.com

Katie McCallion
Everglades Partners Joint Venture/Parsons
701 San Marco Blvd Suite 1201
Jacksonville, FL 32207
PH: 904-232-1560
Email: katie.mccallion@parsons.com

Catherine McCalvin
The Nature Conservancy
3639 Harbor Blvd Suite 201
Ventura, CA 93001
PH: 805-558-6500
Email: cmccalvin@tnc.org

John McCarthy
RBF Consulting
14725 Alton Parkway
Irvine, CA 92618
PH: 949-472-3505 | FX: 949-472-8373
Email: jmccarthy@rbf.com

Brent McCloskey
Maryland Dept of Natural Resources
580 Taylor Ave E2
Annapolis, MD 21401
PH: 410-260-8722 | FX: 410-260-8779
Email: bmccloskey@dnr.state.md.us

Dan McDonell
Environment Canada
867 Lakeshore Rd
Burlington Ontario, N1G 3J9 Canada
PH: 905-336-6457
Email: dan.mcdonell@ec.gc.ca

Dan McGrath
Berkeley Institute of the Environment
341 Mulford Hall MC 2100
Berkeley, CA 94720
PH: 510-642-1385
Email: dmcgrath@berkeley.edu

Lisa McGuire
US EPA
1200 Sixth Ave Ste #900
Seattle, WA 98101
PH: 206-553-0226
Email: mcguire.lisa@epa.gov

Kyle McKay
US Army Corps of Engineers ERDC
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 706-850-1974
Email: kyle.mckay@usace.army.mil

Mark McKevitt
Assistant Secretary of the Army (CW)
108 Army Pentagon
Washington, DC 20310
PH: 202-761-0028 | FX: 202-761-0050
Email: mark.mckevitt@us.army.mil

Shaun McKinney
USDA NRCS
1201 NE Lloyd Blvd Ste 1000
Portland, OR 97232
PH: 503-273-2413 | FX: 503-273-2401
Email: shaun.mckinney@por.usda.gov

Sean Meehan
NOAA
263 13t Ave S
St Petersburg, FL 33701
PH: 727-824-5330 | FX: 727-824-5390
Email: sean.meehan@noaa.gov

Ehab Meselhe
Univ of Louisiana at Lafayette
PO Box 42347
Lafayette, LA 70504
PH: 337-739-9716
Email: meselhe@louisiana.edu

Cecilia Meyer Lovell
EDAW/AECOM
1420 Kettner Blvd Suite 500
San Diego, CA 92117
PH: 619-233-1454 | FX: 619-233-0952
Email: Cecilia.MeyerLovell@edaw.com

Ken Mierzwa
Winzler & Kelly
633 Third Street
Eureka, CA 95501
PH: 707-443-8326 | FX: 707-444-8330
Email: kenmierzwa@w-and-k.com

Sarah Miller
US Army Corps of Engineers ERDC
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 601-634-5247 | FX: 601-634-3519
Email: sarah.j.miller@usace.army.mil

Ellen Milliron
US Army Corps of Engineers
Clock Tower Building; PO Box 2004
Rock Island, IL 61204
PH: 309-794-5221 | FX: 309-794-5497
Email: Ellen.S.Milliron@usace.army.mil

Cindy Montepagano
USDA NRCS
14393 Park Avenue Ste 200
Victorville, CA 92392
PH: 760-843-6882 | FX: 760-843-9521
Email: cindy.montepagano@ca.usda.gov

Meagan Montgomery
Univ of Missouri
Fisheries & Wildlife Sciences; 302 ABNR Bldg
Columbia, MO 65211
PH: 573-882-0752
Email: mdm01a@mizzou.edu

David Moore
Weston Solutions Inc
2433 Impala Drive
Carlsbad, CA 92011
PH: 760-795-6956
Email: david.moore@westonsolutions.com

Tom Moore
USDA NRCS
430 G Street #4164
Davis, CA 95616
PH: 530-792-5652
Email: thomas.moore@ca.usda.gov

Mayor John W Morgan
Cape Breton Regional Municipality
320 Esplanade
Sydney Nova Scotia, B1P 7B9 Canada
PH: 902-563-5000 | FX: 902-563-5585
Email: jwmorgan@cbrm.ns.ca

Bill Mullen
US Army Corps of Engineers ERDC
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 601-634-2061
Email: Bill.K.Mullen@usace.army.mil

James Murray
US Geological Survey
12201 Sunrise Valley Dr
Reston, VA 20192
PH: 703-648-6918
Email: jbmurray@usgs.gov

Linda Nelson
US Army Corps of Engineers ERDC
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 601-634-2656 | FX: 601-634-3664
Email: Linda.S.Nelson@usace.army.mil

Wayne Nelson-Stastny
US Fish & Wildlife Service
55245 NE Hwy 121
Crofton, NE 68730
PH: 402-667-2884 | FX: 402-667-2588
Email: wayne_nelsonstastny@fws.gov

Pamela Neubert
AECOM
89 Water St
Woods Hole, MA 02543
PH: 508-457-7900 | FX: 508-457-7595
Email: pamela.neubert@aecom.com

Derek Nguyen
Univ of California - Irvine
824 Engineering Tower
Irvine, CA 92697
PH: 714-468-3821
Email: Derek.Nguyen@uci.edu

Nate Nichols
HDR Inc
3098 W Exec Prky Suite 125
Lehi, UT 84043
PH: 801-341-6338
Email: nathan.nichols@hdrinc.com

Matt Nobriga
California Dept of Fish & Game
830 S Street
Sacramento, CA 95811
PH: 916-445-0076
Email: mnobriga@dfg.ca.gov

Pat Nunnally
Univ of Minnesota
1954 Buford Ave
St Paul, MN 55118
PH: 612-626-0714 | FX: 612-626-5555
Email: pdn@umn.edu

Nadav Nur
PRBO Conservation Science
3820 Cypress Drive #11
Petaluma, CA 94954
PH: 707-781-2555 x301
Email: nnur@prbo.org

Harry Oakes
ICF Jones & Stokes
630 K Street Suite 400
Sacramento, CA 95814
PH: 916-737-3000 | FX: 916-737-3030
Email: hoakes@jsanet.com

Sara O'Connell
Hydrologic Engineering Center
609 Second Street
Davis, CA 95616
PH: 530-756-1104 | FX: 530-756-8250
Email: sara.m.oconnell@usace.army.mil

Kevin O'Donnell
Univ of Missouri
302 ABNR
Columbia, MO 65211
PH: 573-884-8533 | FX: 573-884-5070
Email: tkot24@mizzou.edu

John Ogden
Audubon of Florida
444 Brickell Ave Suite 850
Miami, FL 33131
PH: 305-491-9722
Email: jogden@audubon.org

Shea O'Keefe
USDA NRCS
332 S Juniper St Ste #110
Escondido, CA 92025
PH: 760-745-2061 x104 | FX: 760-745-3210
Email: shea.okeefe@ca.usda.gov

Michael Olson
US Fish & Wildlife Service
3425 Miriam Avenue
Bismarck, ND 58501
PH: 701-250-4481 | FX: 701-355-8513
Email: michael_olson@fws.gov

Kameran Onley
PBS&J
200 Daingerfield Rd Ste 200
Alexandria, VA 22314
PH: 703-535-3008
Email: klonley@pbsj.com

Michelle Orr
Philip Williams & Associates
550 Kearny Street Suite 900
San Francisco, CA 94108
PH: 415-262-2300
Email: m.orr@pwa-ltd.com

Patricia Orr
US Institute for Environmental Conflict Resolution
130 South Scott Avenue
Tucson, AZ 85701
PH: 520-901-8548 | FX: 520-901-8549
Email: orr@ecr.gov

Chuck Padera
PBS&J
7406 Fullerton Street
Jacksonville, FL 32256
PH: 904-519-5106
Email: capadera@pbsj.com

Lorraine Parsons
Point Reyes National Seashore
1 Bear Valley Road
Point Reyes Station, CA 94956
PH: 415-464-5193
Email: Lorraine_Parsons@nps.gov

Mike Passmore
US Army Corps of Engineers ERDC
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 601-634-4862 | FX: 601-634-3842
Email: michael.f.passmore@usace.army.mil

Sara Pauley
DJ Case & Associates
PO Box 86
Hartsburg, MO 65039
PH: 573-635-0532
Email: spauley@djcase.com

Cindy Paulson
Brown & Caldwell
201 North Civic Drive Suite 115
Walnut Creek, CA 94596
PH: 925-210-2348 | FX: 925-937-9026
Email: cpaulson@brwncald.com

Don Paulus
USDA NRCS
230 N First Ave STE 509
Phoenix, AZ 85003
PH: 602-280-8780 | FX: 602-280-8795
Email: don.paulus@az.usda.gov

Greg Peacock
US Army Corps of Engineers
915 Wilshire Blvd
Los Angeles, CA 90017
PH: 213-452-3536
Email: gregory.peacock@usace.army.mil

Rob Pearce
USDA NRCS
270 See Vee Lane
Bishop, CA 93514
PH: 760-872-6111
Email: robert.pearce@ca.usda.gov

Roger Perk
US Army Corps of Engineers
Clock Tower Building; PO Box 2004
Rock Island, IL 61204
PH: 309-794-5221 | FX: 309-794-5497
Email: Roger.A.Perk@usace.army.mil

Mike Perkins
HDR Inc
3995 South 700 East Suite 100
SLC, UT 84107
PH: 801-341-6333
Email: Michael.Perkins@hdrinc.com

Rich Pfingsten
EA Engineering Science & Technology Inc
15 Loveton Circle
Sparks, MD 21152
PH: 410-329-5134 | FX: 410-771-4204
Email: rpfingsten@eaest.com

Emily Pifer
Univ of Florida
3205 College Ave
Davie, FL 33314
PH: 954-577-6362
Email: epifer@ufl.edu

Stephanie Pincetl
Pacific South West Research Station
USFS/UCLA
LaKretz Hall 300, 619 Charles E Young Dr
Los Angeles, CA 90095
PH: 310-825-2434
Email: spincetl@ioe.ucla.edu

Dennis Pinigis
US Fish & Wildlife Service
8588 Route 148
Marion, IL 62959
PH: 618-998-5961 | FX: 618-998-0674
Email: dennis_pinigis@fws.gov

John Pitre
USDA NRCS
3737 Government Street
Alexandria, LA 71302
PH: 318-473-7809 | FX: 318-473-7616
Email: john.pitre@la.usda.gov

Marshall Plumley
US Army Corps of Engineers
Clock Tower Building; PO Box 2004
Rock Island, IL 61204
PH: 309-794-5221 | FX: 309-794-5497
Email:
Marshall.B.Plumley@usace.army.mil

Boris Poff
Mojave National Preserve
2701 Barstow Road
Barstow, CA 92311
PH: 760-252-6140
Email: boris_poff@nps.gov

Jon Porthouse
Halcrow Inc
5615 Corporate Blvd Suite 500B
Baton Rouge, LA 70808
PH: 225-925-5693 | FX: 225-924-6762
Email: porthousej@halcrow.com

Ron Prann
Shaw Environmental Inc
200 Horizon Center Blvd
Trenton, NJ 08691
PH: 609-588-6345 | FX: 609-689-7771
Email: ron.prann@shawgrp.com

Jennifer Pratt Miles
Meridian Institute
105 Village Place POB 1829
Dillon, CO 80435
PH: 970-513-8340 x213
Email: jprattmiles@merid.org

Chad Praul
Environmental Incentives
1027 Emerald Bay Road
South Lake Tahoe, CA 96150
PH: 530-541-2980
Email: cpraul@enviroincentives.com

David Price
US Army Corps of Engineers ERDC
3911 Halls Ferry Road
Vicksburg, MS 39180
PH: 601-634-4874 | FX: 601-634-3725
Email: David.L.Price@usace.army.mil

Caroline Prose
US Fish & Wildlife Service
2800 Cottage Way Room W-2606
Sacramento, CA 95825
PH: 916-414-6575 | FX: 916-414-6712
Email: caroline_prose@fws.gov

Marcy Protteau
Environmental Incentives
1027 Emerald Bay Road
South Lake Tahoe, 96150
PH: 530-541-2980
Email: mprotteau@enviroincentives.com

Pat Quinn
JE Fuller/ Hydrology & Geomorphology
8400 S Kyrene Rd Ste 201
Tempe, AZ 85284
PH: 480-222-5708
Email: pat@jefuller.com

Lisa Rabbe
US Army Corps of Engineers
2204 3rd Street
Elmendorf AFB, AK 99506
PH: 907-753-2634 | FX: 907-753-2625
Email: lisa.a.rabbe@usace.army.mil

Tim Randle
US Bureau of Reclamation
PO Box 25007 (Mail Code: 86-68240)
Denver, CO 80225
PH: 303-445-2557 | FX: 303-445-6351
Email: trandle@usbr.gov

Steph Raulerson
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, FL 32207
PH: 904-232-1612 | FX: 904-232-1875
Email:
Stephanie.J.Raulerson@usace.army.mil

Jennifer Raulin
Maryland Dept of Natural Resources
580 Taylor Ave E2
Annapolis, MD 21401
PH: 410-260-8745 | FX: 410-260-8779
Email: jraulin@dnr.state.md.us

Matt Rayl
Aquatic Eco-Systems Inc
2395 Apopka Blvd Suite 100
Apopka, FL 32703
PH: 407-886-3939 | FX: 407-886-0800
Email: AES@aquaticeco.com

Joe Redican
US Army Corps of Engineers
441 G Street NW
Washington, DC 20314
PH: 202-761-4523
Email: joseph.h.redican@usace.army.mil

Kerry Redican
US Army Corps of Engineers
7701 Telegraph Road
Alexandria, VA 22315
PH: 703-428-9088
Email: kerry.m.redican@usace.army.mil

Jed Redwine
EPJV/US Army Corp of Engineers
Suite 1201 701 San Marco BLVD
Jacksonville, FL 32204
PH: 904-232-1181 | FX: 904-232-1056
Email: jed.redwine@usace.army.mil

Denise Reed
Univ of New Orleans
Pontchartrain Institute for Environmental Sciences
New Orleans, LA 70148
PH: 504-280-7395
Email: djreed@uno.edu

Russ Reed
HydroPlan LLC
3720 SE Tolman Street
Portland, OR 97202
PH: 503-297-4397 | FX: 503-297-4397
Email: RReed@HydroPlanLLC.com

Jeanne Reeves
Cotton Incorporated
6399 Weston Parkway
Cary, NC 27513
PH: 919-678-2370 | FX: 919-678-2233
Email: jreeves@cottoninc.com

Frederic Reid
Ducks Unlimited
3074 Gold Canal Drive
Rancho Cordova, CA 95670
PH: 916-852-2000 | FX: 916-852-2200
Email: freid@ducks.org

Glenn Rhett
US Army Corps of Engineers
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 601-634-3717
Email: Richard.G.Rhett@usace.army.mil

Valerie Ringold
US Army Corps of Engineers
1125 NW Couch St
Portland, OR 97209
PH: 907-947-4297
Email: valerie.a.ringold@usace.army.mil

Kristen Risch
Malcolm Pirnie Inc
1900 Polaris Parkway Suite 200
Columbus, OH 43240
PH: 614-888-4953
Email: krisch@pirnie.com

Steve Ritchie
California State Coastal Conservancy
1330 Broadway 13th Floor
Oakland, CA 94612
PH: 510-384-4105
Email: sritchie@scc.ca.gov

Jenn Rivo
US Army Corps of Engineers
915 Wilshire Blvd
Los Angeles, CA 90017
PH: 213-452-3836
Email: jennifer.c.rivo@usace.army.mil

Colleen Rochelle
NOAA
101 Pivers Island Road
Beaufort, NC 28516
PH: 252-728-8701
Email: colleen.rochelle@noaa.gov

Curtis Roegner
NOAA
520 Heceta Pl
Hammond, OR 97121
PH: 503-791-5954
Email: curtis.roegner@noaa.gov

Mike Rogalski
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, FL 32207
PH: 904-232-1460
Email: mikerogs@yahoo.com

Stephanie Romanach
US Geological Survey
3205 College Ave
Davie, FL 33314
PH: 754-260-6464 | FX: 954-475-4125
Email: sromanach@usgs.gov

Randall Root
Burns & McDonnell Engineering Company
9400 Ward Parkway
Kansas City, MO 64114
PH: 816-822-3961 | FX: 816-822-4299
Email: rroot@burnsmcd.com

Rudy Rosen
Ducks Unlimited
3074 Gold Canal Drive
Rancho Cordova, CA 95670
PH: 916-852-2000
Email: rrosen@ducks.org

Charles Rowney
ACR LLC
184 Tollgate Branch
Longwood, FL 32750
PH: 407-970-8744
Email: acr@rowney.com

Kip Runyon
US Army Corps of Engineers
1222 Spruce St
St Louis, MO 63103
PH: 314-331-8396
Email: kip.r.runyon@usace.army.mil

Bruce Sabol
US Army Corps of Engineers ERDC
3909 Halls Ferry Rd
Vicksburg, MS 39180
PH: 601-634-2297
Email: bruce.m.sabol@usace.army.mil

Joana Savinon
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, FL 32277
PH: 904-232-3642
Email: Joana.Savinon@us.army.mil

Lynn Scarlett
Environmental Consultant
830 S Lincoln St
Arlington, VA 22204
PH: 805-895-7057
Email: lynnscarlett@comcast.net

Debby Scerno
EPJV/Parsons
701 San Marco Blvd Ste 1201
Jacksonville, FL 32207
PH: 904-232-2805 | FX: 904-232-1054
Email: deborah.scerno@parsons.com

Brian Schalk
JE Fuller Hydrology & Geomorphology
1 W Deer Valley Rd Ste 101
Phoenix, AZ 85027
PH: 623-889-0166 x308
Email: brianschalk@jefuller.com

Carla Scheidlinger
AMEC
9210 Sky Park Ct # 200
San Diego, CA 92123
PH: 858-300-4311 | FX: 858-300-4301
Email: carla.scheidlinger@amec.com

Heather Schwar
HNTB
11414 West Park Place Suite 300
Milwaukee, WI 53224
PH: 414-410-6827 | FX: 414-359-2310
Email: Hschwar@HNTB.com

Steven Schwarzbach
Western Ecological Research Center
3020 State University Drive East
Sacramento, CA 95819
PH: 916-278-9490
Email: Schwarzbach@usgs.gov

Bruce Schwenneker
Malcolm Pirnie Inc
701 Town Center Drive
Newport News, VA 23662
PH: 757-873-4420
Email: bschwenneker@Pirnie.com

Sandra Scoggin
San Francisco Bay Joint Venture
735 B Center Blvd
Fairfax, CA 94602
PH: 415-259-0334
Email: sscoggin@sfbayjv.org

Anthony Seeman
Iowa Soybean Association
4554 114th St
Urbandale, IA 50322
PH: 515-251-8640
Email: aseeman@iasoybeans.com

Aliza Segal
Coastal Restoration Consultants
808 California St
Santa Barbara, CA 93103
PH: 608-658-9191
Email: segaliza@gmail.com

Deborah Shafer
US Army ERDC
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 601-634-3650
Email: Deborah.J.Shafer@us.army.mil

Mark Shafer
US Army Corps of Engineers
702 San Marco Blvd
Jacksonville, FL 32207
PH: 904-232-3594 | FX: 904-232-3442
Email: mark.d.shafer@usace.army.mil

Carl Shapiro
US Geological Survey
516 National Center
Reston, VA 20192
PH: 703-648-4446
Email: cshapiro@usgs.gov

Ajay Sharma
Univ of Florida
369 Newins-Ziegler Hall
Gainesville, FL 32611
PH: 352-846-0120
Email: ajay.sharma@ufl.edu

Pervaze Sheikh
Congressional Research Service
423 Madison Building, 101 Independence SE
Washington, DC 20540
PH: 202-707-6070
Email: psheikh@crs.loc.gov

Greg Shellenbarger
US Geological Survey
Placer Hall 6000 J Street
Sacramento, CA 95819
PH: 916-278-3191
Email: gshellen@usgs.gov

Rennie Sherman
US Army Corps of Engineers
441 G Street NW
Washington, DC 20314
PH: 202-761-7771
Email: rennie.h.sherman@usace.army.mil

Angela Shilling
ETEBA
PO Box 5483
Oak Ridge, TN 37831
PH: 865-228-3544 | FX: 888-769-0130
Email: angela@eteba.org

Tisa Shostik
NOAA
1315 East-West Highway
Silver Spring, MD 20910
PH: 301-713-0174
Email: tisa.shostik@noaa.gov

Jose Silva-Lugo
Univ of Florida
132 Hub Stadium Road
Gainesville, FL 32611
PH: 352-273-1579 | FX: 352-392-3760
Email: joselugo@ufl.edu

Charles Simenstad
Univ of Washington
Box 355020
Seattle, WA 98195
PH: 206-543-7185 | FX: 206-685-7471
Email: simenstd@u.washington.edu

Sara Simrell
Paladin Data Systems Corporation
19362 Powder Hill Pl NE
Poulsbo, WA 98370
PH: 360-265-5978
Email: ssimrell@paladindata.com

Leigh Skaggs
US Army Corps of Engineers
441 G St NW #3H24
Washington, DC 20314
PH: 202-761-5541 | FX: 202-761-8957
Email: lawrence.l.skaggs@usace.army.mil

Ed Slattery
Stanley Consultants Inc
100 Court Avenue Suite 300
Des Moines, IA 50309
PH: 515-246-8585
Email: slatteryed@stanleygroup.com

Robbie Sliwinski
US Army Corps of Engineers
111 N Canal St
Chicago, IL 60606
PH: 312-846-5486
Email: robbie.sliwinski@usace.army.mil

Rob Sloop
Moffatt & Nichol
3780 Kilroy Airport Way #600
Long Beach, CA 90803
PH: 562-426-9551 | FX: 562-424-7489
Email: rsloop@moffattnichol.com

Tom Slowinski
V3 Companies Ltd
7325 Janes Ave
Woodridge, IL 60517
PH: 630-729-6285 | FX: 630-724-9202
Email: tslowinski@v3co.com

Chad Smith
Platte River Recovery Implementation Program
3710 Central Avenue Suite E
Kearney, NE 68847
PH: 308-237-5728 | FX: 308-237-4651
Email: smithc@headwaterscorp.com

Mark Smith
US Army Corps of Engineers
167 N Main St Rm B202
Memphis, TN 38103
PH: 901-544-0670 | FX: 901-544-3955
Email: mark.royal.smith@us.army.mil

Susan Smith
US Army Corps of Engineers
1400 Walnut Street
Vicksburg, MS 39180
PH: 601-634-5827 | FX: 601-634-5371
Email: susan.k.smith@usace.army.mil

Tim Smith
Paladin Data Systems Corporation
19362 Powder Hill Pl NE
Poulsbo, WA 98370
PH: 360-790-3887
Email: tsmith@paladindata.com

Bob Snieckus
USDA NRCS
PO Box 2890
Washington, DC 20013
PH: 202-720-9155 | FX: 202-720-0428
Email: robert.snieckus@wdc.usda.gov

Dave Soballe
US Army Corps of Engineers ERDC
3909 Halls Ferry Rd
Vicksburg, MS 39180
PH: 601-634-4631 | FX: 601-634-3713
Email: david.m.soballe@usace.army.mil

Sue Sofia
US Army Corps of Engineers
PO Box 4970
Jacksonville, FL 32232
PH: 904-232-2785 | FX: 904-232-1772
Email: suzanne.c.sofia@usace.army.mil

Jeremy Sokulsky
Environmental Incentives
1027 Emerald Bay Road
South Lake Tahoe, CA 96150
PH: 530-541-2980
Email: jsokulsky@enviroincentives.com

Oliver Soong
Univ of California - Santa Barbara
2400 Bren Hall
Santa Barbara, CA 93106
PH: 805-893-7044
Email: osoong@bren.ucsb.edu

Karla Sparks
US Army Corps of Engineers
700 Federal Building, 601 E 12th Street
Kansas City, MO 64106
PH: 816-389-3081 | FX: 816-389-2025
Email: karla.k.sparks@usace.army.mil

Rip Sparks
The Nature Conservancy
PO Box 176
Elsah, IL 62028
PH: 618-786-2811
Email: rsparks@illinois.edu

Linnea Spears-Lebrun
EDAW
1420 Kettner Blvd Suite 500
San Diego, CA 92117
PH: 619-233-1454
Email: linnea.spears-lebrun@edaw.com

Renee Spenst
Ducks Unlimited
3074 Gold Canal Drive
Rancho Cordova, CA 95670
PH: 916-852-2000 | FX: 916-852-2200
Email: rspenst@ducks.org

Tom St.Clair
PBS&J
7406 Fullerton Street
Jacksonville, FL 32256
PH: 904-232-1774
Email: gstclair@pbsj.com

Jodi Staebell
US Army Corps of Engineers
PO Box 2004
Rock Island, IL 61204
PH: 309-794-5448 | FX: 309-794-5710
Email: jodi.k.staebell@usace.army.mil

Bob Stark
ICF Jones & Stokes
9775 Businesspark Ave Suite 200
San Diego, CA 92131
PH: 858-578-8964
Email: bstark@jsanet.com

Ellen Starr
USDA NRCS
1511 University Ct
Henry, IL 61537
PH: 309-364-3913 | FX: 309-364-3802
Email: ellen.starr@il.usda.gov

Scott Starratt
US Geological Survey
345 Middlefield Road
Menlo Park, CA 94025
PH: 650-329-4990
Email: sstarrat@usgs.gov

Greg Steele
US Army Corps of Engineers
803 Front Street
Norfolk, VA 23510
PH: 757-201-7779 | FX: 757-201-7646
Email:
GREGORY.C.STEELE@USACE.ARMY.MIL

Rose Stefani
Bureau of Reclamation
2800 Cottage Way MP-152
Sacramento, CA 95825
PH: 916-978-5045 | FX: 916-978-5055
Email: rstefani@mp.usbr.gov

Elliott Stefanik
US Army Corps of Engineers
190 5th Street East
St Paul, MN 55101
PH: 651-290-5260 | FX: 651-290-5258
Email: Elliott.L.Stefanik@usace.army.mil

Bonnie Stevens
Ecological Restoration Institute
Box 15017
Flagstaff, AZ 86004
PH: 928-523-8129
Email: Bonnie.Stevens@nau.edu

Donald Stevens
The Louis Berger Group Inc
412 Mount Kemble Ave
Morristown, NJ 07962
PH: 973-407-1407
Email: dstevens@louisberger.com

Greg Steyer
US Geological Survey
PO Box 25098
Baton Rouge, LA 70894
PH: 225-578-7201 | FX: 225-578-7927
Email: gsteyer@usgs.gov

Jennifer Stiner
EPJV/PBS&J
701 San Marco Blvd Suite 1201
Jacksonville, FL 32256
PH: 904-232-1807 | FX: 904-232-1056
Email: Jennifer.L.Stiner@usace.army.mil

Barbara Stinson
Meridian Institute
PO Box 1829
Dillon, CO 80435
PH: 970-513-8340 x203
Email: bstinson@merid.org

Harry Stone
Battelle
10300 Alliance Road Suite 155
Cincinnati, OH 45242
PH: 513-362-2600 | FX: 614-458-0150
Email: stoneh@battelle.org

Jeff Strahan
US Army Corps of Engineers
804 Front Street
Norfolk, VA 23510
PH: 757-201-7195 | FX: 757-201-7646
Email:
JEFFERY.P.STRAHAN@USACE.ARMY.MIL

Fred Streb
SEEK Enterprises Inc
104 Barkfield St
Brandon, FL 33511
PH: 703-209-2830 | FX: 703-441-1003
Email: Dozer@Quixnet.net

Cheryl Strong
US Fish & Wildlife Service
9500 Thornton Ave
Newark, CA 94560
PH: 510-557-1271
Email: cheryl_strong@fws.gov

Laura Stroup
Texas State University
601 University Dr
San Marcos, TX 78666
PH: 512-245-2536
Email: LJStroup@txstate.edu

Mark Sudol
US Army Corps of Engineers
7701 Telegraph Rd
Alexandria, VA 22315
PH: 703-428-7570
Email: mark.f.sudol@usace.army.mil

Burton Suedel
US Army Corps of Engineers ERDC
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 601-634-4578
Email: burton.suedel@usace.army.mil

Mike Sullivan
USDA NRCS
4004 McCain Blvd Room 208
North Little Rock, AR 72116
PH: 501-758-2544 | FX: 501-771-0896
Email: Michael.Sullivan@wdc.usda.gov

Eric Summa
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, FL 32207
PH: 904-232-1665 | FX: 904-232-3442
Email: eric.p.summa@usace.army.mil

Kevin Summers
US EPA
1 Sabine Island Drive
Gulf Breeze, FL 32561
PH: 850-934-9244 | FX: 850-934-2406
Email: summers.kevin@epa.gov

Jan Surface
USDA NRCS
1400 Independence Ave SW
Washington, DC 20250
PH: 202-690-3501
Email: jan.surface@wdc.usda.gov

Karen Suyama
Snoqualmie Tribe
PO Box 969
Snoqualmie, WA 98065
PH: 206-427-7256 | FX: 425-292-9350
Email: karen1@snoqualmienation.com

Robert Swanson
US Geological Survey
5231 S 19th Street
Lincoln, NE 68512
PH: 402-328-4110 | FX: 402-328-4101
Email: rswanson@usgs.gov

Amy Swiecichowski
EPJV/US Army Corp of Engineers
Suite 1201 701 San Marco Blvd
Jacksonville, FL 32207
PH: 904-200-9473 | FX: 904-232-1056
Email:
amy.l.swiecichowski@usace.army.mil

Fari Tabatabai
US Army Corps of Engineers
1455 Market St
San Francisco, CA 94103
PH: 415-503-6860 | FX: 415-503-6692
Email: Fari.Tabatabai@usace.army.mil

Curtis Tanner
Puget Sound Nearshore Partnership
WDFW; PO Box 43145
Olympia, WA 98504
PH: 360-902-2815
Email: curtis_tanner@fws.gov

Dave Tazik
US Army ERDC
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 601-634-2610 | FX: 601-634-3842
Email: dave.tazik@us.army.mil

Cindy Tejeda
US Army Corps of Engineers
1455 Market St
San Francisco, CA 94103
PH: 415-503-6591
Email: Cindy.L.Tejeda@usace.army.mil

Steve Temmel
Dawson & Associates
20462 Coulson St
Woodland Hills, CA 91367
PH: 818-887-9410 | FX: 818-883-7896
Email: temmel@earthlink.net

Lindsay Teunis
EDAW
1420 Kettner Blvd Suite 500
San Diego, CA 92101
PH: 619-233-1454
Email: lindsay.teunis@edaw.com

Chuck Theiling
US Army Corps of Engineers
PO Box 2004 Clock Tower bldg
Rock Island, IL 61204
PH: 563-210-4350
Email: charles.h.theiling@usace.army.mil

Kassy Theobald
National Park Service
PO Box 129
Grand Canyon, AZ 86023
PH: 928-638-7857
Email: kassandra_theobald@nps.gov

Susan Theodosiou
PBS&J
3501 N Causeway Blvd Suite 725
Metairie, LA 70002
PH: 504-841-2226 | FX: 954-540-2690
Email: sctheodosiou@pbsj.com

Ed Theriot
Malcolm Pirnie Inc
201 St Charles Ave
New Orleans, LA 70170
PH: 504-599-5925
Email: etheriot@pirnie.com

Bob Thiel
State Coastal Conservancy
Box 23440
Santa Barbara, CA 93121
PH: 805-957-9299
Email: bthiel@scc.ca.gov

Ronald Thom
PNNL Marine Sciences Lab
1529 West Sequim Bay Road
Sequim, WA 98382
PH: 360-681-3668 | FX: 360-681-3681
Email: ron.thom@pnl.gov

Brad Thompson
US Army Corps of Engineers
1616 Capitol Ave
Omaha, NE 68102
PH: 402-995-2678
Email:
bradley.e.thompson@usace.army.mil

Anitra Thorhaug
Yale School of Forestry & Environmental Studies
1359 SW 22 Terrace
Miami, FL 33145
PH: 305-858-0014 | FX: 305-858-6697
Email: thorhaug@msn.com

Karen Tippett
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, FL 32207
PH: 904-232-1016 | FX: 904-232-1251
Email: karen.s.tippett@usace.army.mil

Dave Tipple
US Army Corps of Engineers
701 San Marco Boulevard
Jacksonville, FL 32207
PH: 904-232-1375 | FX: 904-232-1888
Email: david.a.tipple@usace.army.mil

Anna Toline
ENTRIX
829 Front Street Suite J
Georgetown, SC 29440
PH: 843-545-1013
Email: atoline@entrix.com

Mark Tompkins
CH2M HILL
155 Grand Avenue Suite 1000
Oakland, CA 94612
PH: 510-587-7793
Email: Mark.Tompkins@ch2m.com

Rosendo Trevino
USDA NRCS
5563 De Zavala Suite 290
San Antonio, TX 78249
PH: 210-691-9248
Email: Rosendo.Trevino@tx.usda.gov

Dilip Trivedi
Moffatt & Nichol
2001 North Main Street Suite 360
Walnut Creek, CA 94596
PH: 925-944-5411 | FX: 925-944-4732
Email: dtrivedi@moffattnichol.com

Jeff Trulick
US Army Corps of Engineers
441 G Street NW
Washington, DC 20314
PH: 202-761-1380
Email: jeff.trulick@usace.army.mil

Akira Tsujimoto
Osaka City University
Sugimoto 3-3-138 Sumiyoshi-ku
Osaka, 558-8585 Japan
PH: 81-666053176 | FX: 81-666053176
Email: akiratsujimoto@gmail.com

Solialofi Tuaumu
Am Samoa DOC/Am Samoa Government
AP Lutali EOB - 2nd Floor
Pago Pago, AS 96799 American Samoa
PH: 684-633-5155 | FX: 684-633-4195
Email: solialofi.tuaumu@doc.as

Cheryl Ulrich
Weston Solutions Inc
329 8th Street
Atlantic Beach, FL 32233
PH: 904-248-8275
Email: cheryl.ulrich@westonsolutions.com

Herry Utomo
Louisiana State University
1373 Caffey Rd
Rayne, LA 70508
PH: 337-788-7578 | FX: 337-788-7553
Email: hutomo@agcenter.lsu.edu

Craig Uyeda
AR Game & Fish Commission
2 Natural Resources Drive
Little Rock, AR 72205
PH: 501-978-7302 | FX: 501-978-7395
Email: ckuyeda@agfc.state.ar.us

Laura Valoppi
US Geological Survey
6000 J Street Placer Hall Suite 4001
Sacramento, CA 95819
PH: 916-278-3124
Email: Laura_Valoppi@fws.gov

Bea Van Horne
US Geological Survey
12201 Sunrise Valley Dr
Reston, VA 20192
PH: 703-648-4053
Email: bvanhorne@usgs.gov

Michael Van Valkenburgh
Michael Van Valkenburgh Associates Inc
16 Court Street 11th Floor
Brooklyn, NY 11241
PH: 718-243-2044
Email: michael@mvvainc.com

Mace Vaughan
Xerces Society
4828 SE Hawthorne Blvd
Portland, OR 97215
PH: 503-232-6639
Email: mace@xerces.org

Jim Vearil
US Army Corps of Engineers
701 San Marco Boulevard
Jacksonville, FL 32207
PH: 904-232-1591
Email: james.w.vearil@usace.army.mil

David Vigh
US Army Corps of Engineers
1400 Walnut Street
Vicksburg, MS 39181
PH: 601-634-5854 | FX: 601-634-5849
Email: david.a.vigh@usace.army.mil

Ruth Villalobos
RBF Consulting
3300 East Guasti Road First Floor
Ontario, CA 91761
PH: 909-974-4920 | FX: 909-974-4004
Email: rvillalobos@rbf.com

Joy Vinci
Univ of Florida
3205 College Ave
Davie, FL 33314
PH: 954-577-6304 | FX: 954-475-4125
Email: alphawav@ufl.edu

Jenneke Visser
Univ of Louisiana at Lafayette
PO Box 44650
Lafayette, LA 70504
PH: 337-482-6966 | FX: 337-482-5395
Email: jvisser@louisiana.edu

Liana Vitali
Chesapeake Research Consortium
410 Severn Avenue Suite 109
Annapolis, MD 21043
PH: 410-267-5718
Email: vitali.liana@epa.gov

Diane Vosick
The Nature Conservancy
115 NW Oregon Suite 30
Bend, OR 97701
PH: 541-388-3020 x308 | FX: 541-388-3021
Email: dvosick@tnc.org

Anna Wachnicka
Florida International University
11200 SW 8 Street
Miami, FL 33199
PH: 305-348-1876 | FX: 305-348-4096
Email: wachnick@fiu.edu

Ken Wagner
AECOM
11 Phelps Way
Willington, CT 06279
PH: 508-612-5799
Email: ken.wagner@aecom.com

Paul Wagner
US Army Corps of Engineers
7701 Telegraph Road - Casey Building
Alexandria, VA 22315
PH: 703-428-7071
Email: paul.f.wagner@usace.army.mil

Les Waguespack
Shaw
4171 Essen Lane
Baton Rouge, LA 70809
PH: 225-987-7475
Email: les.waguespack@shawgrp.com

Al Walker
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, FL 32207
PH: 904-232-1818
Email: alfred.e.walker@usace.army.mil

Jun Wang
CDM
111 Academy Suite 150
Irvine, CA 92617
PH: 949-752-5452
Email: wangj@cdm.com

Robert Warren
Bonneville Environmental Foundation
240 SW 1st Avenue
Portland, OR 97204
PH: 360-391-8491
Email: rwarren@b-e-f.org

Matt Wartian
Weston Solutions Inc
2433 Impala Dr
Carlsbad, CA 92010
PH: 760-795-6983 | FX: 760-497-3527
Email: matt.wartian@westonsolutions.com

Doris Washington
USDA NRCS
101 E Capitol Avenue Ste B100
Little Rock, AR 72201
PH: 501-210-8910 | FX: 501-210-8935
Email: Doris.Washington@ar.usda.gov

Chris Webb
Moffatt & Nichol
3780 Kilroy Airport Way Suite 600
Long Beach, CA 90806
PH: 562-426-9551 | FX: 562-424-7489
Email: cwebb@moffattnichol.com

Tisa Webb
US Army Corps of Engineers ERDC
3909 Halls Ferry Road
Vicksburg, MS 39180
PH: 601-634-4259 | FX: 601-634-3519
Email: antisa.c.webb@usace.army.mil

Steve Weber
RBF Consulting
8335 W Flamingo Road First Floor
Las Vegas, NV 89147
PH: 702-364-0180 | FX: 702-364-0189
Email: sweber@rbf.com

Anne Wein
US Geological Survey
345 Middlefield Rd
Menlo Park, CA 94025
PH: 650-329-4263
Email: awein@usgs.gov

Doron Weinstein
Cal State Northridge
19031 Gault St D-112
Reseda, CA 91335
PH: 818-708-7047
Email: doronwen@gmail.com

Jason Weiss
URS
200 Orchard Ridge Drive Suite 101
Gaithersburg, MD 20878
PH: 301-258-5859
Email: jason_weiss@urscorp.com

Tim Welker
US Army Corps of Engineers
PO Box 710
Yankton, SD 57078
PH: 402-667-2582
Email: tim.l.welker@usace.army.mil

Ida Wenefrida
Louisiana State University
1373 Caffey Rd
Rayne, LA 70578
PH: 337-788-7590 | FX: 337-788-7553
Email: iwenefrida@agcenter.lsu.edu

Richard Wenning
ENVIRON International Corp
7001 Shellmound St #700
Emeryville, CA 94608
PH: 510-420-2556 | FX: 510-655-9517
Email: rjwenning@environcorp.com

Bill Werner
Arizona Floodplain Management Association
17239 N 19th Ave No 2124
Phoenix, AZ 85023
PH: 602-771-8412
Email: wewerner@earthlink.net

Mitch West
Environmental Information Exchange Network
10531 SW 30th Ave
Portland, OR 97219
PH: 503-452-3891
Email: mitch.west@exchangenetwork.net

Olivia Westbrook
USAF
560 Interceptor Road
Pope AFB, NC 28308
PH: 910-394-1635 | FX: 910-394-1911
Email: olivia.westbrook@pope.af.mil

Chris White
US Army Corps of Engineers ERDC CERL
2902 Newmark Drive
Champaign, IL 61826
PH: 217-373-7239
Email:
christopher.m.white@usace.army.mil

John White
Louisiana State University
3239 Energy Coast & Env Bld
Baton Rouge, LA 70803
PH: 225-578-8792 | FX: 225-578-6423
Email: jrwhite@lsu.edu

Ron Wiederholt
North Dakota State University
663 Hwy 281 N
Carrington, ND 58421
PH: 701-652-2951
Email: ron.wiederholt@ndsu.edu

Robert Wiley
David Miller & Assoc Inc
3050 Glennfinnan Drive
Albany, OH 45710
PH: 740-698-9100 | FX: 740-687-2700
Email: rwiley@dma-us.com

Deb Willard
US Geological Survey
926A National Center
Reston, VA 20192
PH: 703-648-5320
Email: dwillard@usgs.gov

Carrie Williams
HDR Engineering Inc
326 S 21St Street
St Louis, MO 63103
PH: 636-825-2458
Email: tcwill001@sbcglobal.net

George Williams
US Army Corps of Engineers
PO Box 710
Yankton, SD 57078
PH: 402-667-2897 | FX: 402-667-2537
Email: george.a.williams@usace.army.mil

Gregg Williams
US Army Corps of Engineers
167 North Main Room B202
Memphis, TN 38103
PH: 901-544-3852 | FX: 901-544-3955
Email: Gregg.W.Williams@usace.army.mil

Jack Williams
Trout Unlimited
329 Crater Lake Avenue
Medford, OR 97504
PH: 541-772-7724
Email: jwilliams@tu.org

Todd Williams
HDR Engineering Inc
326 S 21st Street
St Louis, MO 63103
PH: 314-425-8329 | FX: 314-425-8301
Email: todd.williams@hdrinc.com

Robert Willis
US Army Corps of Engineers
333 SW First Ave
Portland, OR 97204
PH: 503-528-4771 | FX: 503-808-4756
Email: robert.e.willis@usace.army.mil

Sandra Willis
US Army Corps of Engineers
915 Wilshire Blvd
Los Angeles, CA 90017
PH: 213-452-3638 | FX: 213-452-4248
Email: Sandra.L.Willis@usace.army.mil

Betsy Wilson
State Coastal Conservancy
1330 Broadway
Oakland, CA 94612
PH: 510-286-4167 | FX: 510-286-0470
Email: bwilson@scc.ca.gov

Kiara Winans
Univ of Florida
PO Box 14854
Gainesville, FL 32604
PH: 352-231-1962
Email: kiara@ufl.edu

Lynn Wingard
US Geological Survey
12201 Sunrise Valley Dr MS926A
Reston, VA 20192
PH: 703-648-5352 | FX: 703-648-6952
Email: lwingard@usgs.gov

Nancy Withrow
USDA NRCS
332 S Juniper #110
Escondido, CA 92061
PH: 760-745-2061
Email: nancy.withrow@ca.usda.gov

Megan Wong
US Army Corps of Engineers
915 Wilshire Blvd
Los Angeles, CA 90017
PH: 213-452-3859 | FX: 213-452-3906
Email: Megan.T.Wong@usace.army.mil

Wayne Wright
GeoEngineers Inc
1101 Fawcett Avenue Suite 200
Tacoma, WA 98402
PH: 253-383-4940
Email: wwright@geoengineers.com

Frank Xie
Florida Atlantic University
777 Glades Rd
Boca Raton, FL 33431
PH: 561-297-2852
Email: xie@fau.edu

Gary Young
US Army Corps of Engineers
4155 Clay St
Vicksburg, MS 39183
PH: 601-631-7156
Email: gary.l.young@usace.army.mil

Francisco Zamora-Arroyo
Univ of Arizona
7650 E Broadway Blvd Suite 203
Tucson, AZ 85710
PH: 520-290-0828
Email: Fzamora@sonoraninstitute.org

Paul Zellmer
USDA NRCS
14393 Park Ave STE 200
Victorville, CA 92392
PH: 760-843-6882 x118
Email: paul.zellmer@ca.usda.gov

Richard Zembal
Orange County Water District
18700 Ward Street
Fountain Valley, CA 92802
PH: 714-378-3213 | FX: 714-378-3370
Email: rzembal@ocwd.com

Brian Zettle
US Army Corps of Engineers
109 Saint Joseph St
Mobile, AL 36602
PH: 251-690-2115 | FX: 251-694-3815
Email: brian.a.zettle@usace.army.mil

Dave Zezulak
California Dept of Fish & Game
830 S Street
Sacramento, CA 95811
PH: 916-445-3960 | FX: 916-445-1768
Email: dzezulak@dfg.ca.gov

Robert Zicafoose
Stanley Consultants Inc
1661 E Camelback Rd Suite 400
Phoenix, AZ 85016
PH: 602-333-2235 | FX: 602-333-2333
Email: zicafooserobert@stanleygroup.com

Florentina Zurita
Universidad de Guadalajara
UGU-250907-MH5 Av Juárez # 975
Colonia Americana
Ocotlán Jalisco, Mexico
PH: 55-39292594008602
Email: fzurita2001@yahoo.com

Conference Abstracts

Listed alphabetically by presenting author.
Presenting author names appear in **bold**.

Sub-Tidal Structures in an Estuary as Part of a Watershed Wide Restoration Effort

Robert R. Abbott and *Rena Obernolte*
ENVIRON International Corporation, Emeryville, CA, USA

Our estuaries are highly degraded due to shore line modifications to accommodate industrial and residential development. Vertical structures in the water column such as rocky outcroppings have been removed as hazards to navigation. The vertical edge of natural wetland drainage channels that surrounded our bays and estuaries has been filled. These lost structural elements are essential habitat for numerous fish and invertebrates that are not adapted to living on a soft mud that constitutes the benthic habitat of many bays and estuaries. Replacing vertical structural elements to increase habitat complexity, and edge habitat needs to be seen in the context of total watershed restoration. A habitat restoration project in San Francisco Bay has used bags of oyster cultch to create mounds that are functionally equivalent to a tropical reef coral head with numerous interstices that greatly increase the habitat for numerous sessile invertebrates that require a hard surface. They have been observed to be spawning habitat for gobies and Pacific herring. There are some indications that the mounds facilitate the restoration of eelgrass. They have proved to exceptionally successful for restoring native Olympia oyster habitat. An alternative to the mounds of shell which are not sourced from San Francisco Bay is the construction and deployment "reef balls" made primarily from material dredged from San Francisco Bay. These small projects that are from 1/10 of an acre, up to one acre in extent are the focus of broad community participation involving over 100-volunteers, and extensive media coverage because they are hands-on and the community sees them as "interesting and different". The mounds and reef balls are presently being used as part of a study on how to increase elements of the estuary food web that are essential forage for salmonid smolts. The mounds are also being used to model an increment of vertical habitat contribution to the aquatic food web so that policy decisions can be made as to the quantity and distribution of sub-tidal aquatic reef like structures to improve foraging opportunities for salmon, steelhead, sharks and sturgeon.

Contact Information: Robert R. Abbott, ENVIRON International Corporation, 6001 Shellmound St., Suite 700, Emeryville, CA 94608, Phone: 510-420-2593, Fax: 510 655-9517, Email:rabbott@environcorp.com

Ecosystem Restoration in the Malibu Creek Watershed

Marriah Abellera[1], *Suzanne Goode*[2], *Nat Cox*[2] and *Wendy Katagi*[3]
[1]U.S. Army Corps of Engineers, Los Angeles, California, USA
[2]California State Parks, Calabasas, California, USA
[3]CDM, Los Angeles, California, USA

The U.S. Army Corps of Engineers, Los Angeles District in conjunction with the State of California, Department of Parks and Recreation (Sponsor) and other stakeholders is conducting an environmental restoration feasibility study of the Malibu Creek watershed from Malibou Dam to the influences of Malibu Lagoon, specifically, the area immediately upstream and downstream of an obsolete water supply dam on Malibu Creek known as Rindge Dam. Malibu Creek is an important regional corridor linking Santa Monica Bay, a National Estuary, Malibu Lagoon, one of the last two remaining estuaries in Los Angeles County, and riparian systems from the immediate coastal plain with interior plains and valleys of both California State Parks and the Santa Monica Mountains National Recreation Area, administered by the National Park Service. As such, the watershed represents a unique opportunity for systemic and sustainable environmental restoration. Located within a one-hour commute of one of the most densely populated areas of the United States, the Santa Monica Mountains occur within a "Mediterranean" ecosystem with plant and animal species adapted to wet winters and warm, dry summers. This ecosystem is among the rarest on earth, with only 18 percent of such potential habitats remaining undisturbed. Freshwater habitat, salt marsh, oak woodland, and chaparral and coastal sage scrub provide refuge to more than 450 animal species, including more than 20 federal- and state-listed threatened or endangered plants and animals and more than 50 other plants and animals of concern, making the area a biodiversity "hot spot".

The Sponsor and stakeholder interests have been interested in pursuing the modification to, and possible removal of Rindge Dam for years primarily to reconnect the former Malibu Creek watershed habitat for the endangered southern steelhead. Both the National Marine Fisheries Service and California Department of Fish and Game have cited barriers to upstream habitat as a major factor in steelhead decline. The evaluation of alternatives for addressing the ecological damage caused by Rindge Dam provides an important opportunity to achieve potential long-term enhancements, recovery of steelhead in Malibu Creek, and ultimately contribute to achieving the goal of the Endangered Species Act – to delist the species. Like most dams, Rindge Dam and its impoundment significantly affect stream habitat for steelhead and other aquatic species by fragmenting habitat and disrupting ecosystem function. With the potential of increased surface water temperature due to global warming, and the unique tolerance of southern steelhead to warmer water, restoring this population has taken on more critical importance in order to ensure preservation and recovery of the species throughout its Pacific Coast range. With economically important Santa Monica Bay beaches eroding, the use of Rindge Dam sediments to nourish these beaches creates a unique "win-win" ecological and economic nexus that may achieve multiple public benefits.

Contact Information: Marriah Abellera, U.S. Army Corps of Engineers, Planning Division USACE, CESPL-PD-WW, 915 Wilshire Blvd., Los Angeles, CA 90017, Phone: 213- 452-3835,
Email: Marriah.S.Abellera@usace.army.mil

Issues Respective to the Natural Resources Conservation Service in the Decommissioning of Dams Pursuant to Public Law 83-566

Dale J. Pekar and ***Keith Admire***
National Water Management Center, USDA-NRCS, Little Rock, AR, USA

The decommissioning of dams in NRCS is typically conducted within an analytical framework defined by the National Environmental Policy Act (NEPA); the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G); the Watershed Protection and Flood Prevention Act, as amended (PL 83-566); a host of related laws and policy interpretations; and established contractual arrangements with the local sponsors.

As such, when considering whether to decommission a dam NRCS necessarily plays a dual role in the planning process—identifying the various options available to local sponsors and protecting the federal interest. Any substantive changes which are to occur within the timeframe of the established agreements require mutual agreement by the local sponsors and NRCS, after public participation. Once the term of the agreement lapses however, the local sponsors are free to act on the project independently of NRCS.

This paper examines this interplay in the analysis process for those dams which may be decommissioned pursuant to PL 83-566, including such particulars as the identification of design life, cost-share implications, hazard classification, potential changes in land use, operation and maintenance, and formulation of the NEPA alternative of "No Action."

Contact Information: Keith Admire, National Water Management Center, USDA-Natural Resources Conservation Service, 101 East Capitol Avenue, Suite B100, Little Rock, AR 72201, USA, Phone: 501-210-8924,
Fax: 501-210-8935, Email: Keith.Admire@ar.usda.gov

NMFS and Ecoinformatics: Using Technology and Databases to Help Restore Endangered and Threatened Salmon Populations

Andrew M. Albaugh
NOAA Fisheries, National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, WA, USA

The evolution of computer science and database technology has impacted fisheries science and ecosystem restoration in countless ways. The discipline of ecoinformatics, or the management of biological and environmental information with a focus on both human and computer elements, is quickly becoming an essential tool within the NMFS organization, and it too continues to evolve. At the Northwest Fisheries Science Center we have developed several such tools to aid Technical Recovery Teams (TRT) in the management and production of data critical to salmon ESA listing decisions. The Salmon Population Summary (SPS) database and the Salmon Population Analyzer (SPAZ) statistical program were created to aid in the production of regular Status Review Reports. SPS is a database system that stores salmon abundance, wild fraction, harvest numbers, and age structure data summarized at the ESU and Population level across the Northwest Region. SPAZ is a statistical package that utilizes the data generated in SPS to produce population trend data that then feeds directly into the listing and de-listing decisions under the ESA. In the recent past each TRT chair had different methods and practices when dealing with their own salmon data. This resulted in a very tedious and laboring endeavor when it came to generating the needed salmon population summaries and trends for a Status Review. Moving forward, it is our intent, with both SPS and SPAZ, to allow those tasked with the job of restoring endangered and threatened salmon species the ease and flexibility to manage their own data on a central system. SPS and SPAZ will demonstrate how a large agency in charge of managing data over a very large spatial scale can benefit from the tools created within ecoinformatics.

Contact Information: Andrew M. Albaugh, Northwest Fisheries Science Center, Seattle, WA 98112,
Phone: 206-860-3497, Email: andrew.albaugh@noaa.gov

Progress Update of the New York/New Jersey Harbor Estuary History of Restoration Mapping and Database Project

Carl Alderson[1] and *Teresa Doss*[2]
[1]National Oceanic and Atmospheric Administration Restoration Center, Sandy Hook, NJ, USA
[2]Biohabitats, Glen Ridge, NJ, USA

The NOAA Restoration Center initiated a study in 2006 that catalogs historic natural resource restoration projects in the area equivalent to the boundaries of the New York/New Jersey Harbor Estuary Program (HEP). One hundred and twenty five projects have been identified to date. The draft product consists of a highly sortable database in spreadsheet format and mapping product available in Google Earth .kmz file format. Information is divided into major attribute fields and sub attribute fields; e.g. habitat, species, location, funding, cost, restored acres, contact information, and project update and comment. The database captures a wide range of restoration projects completed since the early 1980's including wetlands, forest, riparian edge treatments, shellfish, and fish passage. Initial analysis of the data includes project distribution; project purpose (i.e. mitigation, natural resource damage compensation, state and federal grant program); project goals (habitat restoration, species reintroduction, environmental control); and category of restoration (restoration vs. enhancement vs. creation). Contributors to the database include long term restoration practitioners whose knowledge of individual sites is critical to the assembly of the data. A current edition of the database is being prepared for inclusion in the Comprehensive Restoration Plan (CRP) - Hudson Raritan Estuary (HRE) ecosystem restoration study, sponsored by the U.S. Army Corps of Engineers and the Port Authority of New York and New Jersey. Other applications of the database include sharing web-based information; tracking long term monitoring and maintenance; practitioner planning tool; research analysis and assessment by the scientific community; and archiving the historical record.

Contact Information: Carl Alderson CLA, NOAA Restoration Center - Sandy Hook Office, JJ Howard National Marine Fisheries Science Center, 74 Magruder Road, Highlands, NJ 07732 USA, Phone:732-872-3087, Email: Carl.Alderson@noaa.gov

Public Involvement Challenges in the CERP Master Recreation Plan

Shauna R. Allen, *Paul C. Stevenson* and *Grady H. Caulk*
US Army Corps of Engineers, Jacksonville District, Jacksonville, FL USA

The Master Recreation Plan being developed under the Comprehensive Everglades Restoration Project (CERP) takes a system-wide approach to tackling the impacts of project implementation on existing recreation use within the South Florida Ecosystem and identifying new recreation, public use and public educational opportunities as the project is implemented. As CERP plan components are developed recreational opportunities will be developed with partnerships through the non-federal sponsor and other state and local agencies. Key to the success of this plan is public involvement and input as the plan is being developed. The team has conducted several rounds of public meetings across the South Florida Region using multiple partners to reach interested and affected customers. Public concerns for access, resource based recreation, and education were clearly expressed across the region. In response to public concerns for the loss of traditional recreational activities the team commissioned an Ethnographic Study to evaluate the Gladesmen/Swamp Folk Culture. Through this study we can understand the ultimate goal of restoring the Everglades for the enjoyment of future generations.

Contact Information: Shauna Allen, US Army Corps of Engineers, 701 San Marco Blvd, Jacksonville, FL 32207, Phone: 904-232-1071, Email: shauna.r.allen@usace.army.mil

Feasibility of Bioretention to Treat Greywater

Eugene Allevato, *Hayley Lewis, Christine Jambazian, Diana Jimenez, Scott Vanderheyden* and *Elise Constans*
Woodbury University, Burbank, CA, USA

Water scarcity has been an increasing environmental issue due to natural causes such as climate change and the result of human activity such as population growth and urbanization based on unsustainable systems. The present work investigates the possibility to reuse grey water by studying the effects of grey water on plants. The main goal is to find promising plant species that can be implemented in a constructed wetland, to be utilized as a buffer station for grey water before discharging to common vegetation in the garden. Grey water that results from sinks and showers typically contains soap, salt, phosphate, nitrates, bacteria and organic matter. As plants grow; toxins are removed from the water, and becomes available for reuse. Cattail was the best specie studied, showing a 90% reduction in turbidity after one week. Values of pH ranging around 7.2 and conductivity 1.7µS/cm were monitored and did not show any significant difference. However, it was observed that grey water facilitated growth when compared with plants exposed to regular tap water. In addition, a cost analysis was conducted, and a decision tree was formulated to evaluate the feasibility of retrofitting a household of four after 10 years. This research demonstrated significant potential benefit of using plants for improving grey water quality.

Contact Information: Eugene Allevato, Woodbury University, 7500 Glenoaks Blvd., Burbank, California, 91510 USA, Phone: 818-252-5148, E-Mail: Eugene.allevato@woodbury.edu

Nine Mile Run Aquatic Ecosystem Restoration Project, Pittsburgh Pennsylvania

Kathleen J. Anderson
U.S. Army Corps of Engineers, Pittsburgh District, Pittsburgh, PA, USA

Nine Mile Run is one of the last remaining free flowing streams in the City of Pittsburgh, Pennsylvania. Over the years, most of the stream has been culverted except for the lower 1.9 miles which runs through a city park named Frick. It was not uncommon for the stream to go from disconnected pools to raging rapids, within minutes, due to storm water runoff coming from the city streets and into the watershed. The stream suffered from combined sewage overflows during wet weather, sewage laced pools during dry weather, damage by mountain bike riders and ATVs, stream bank erosion and a general lack of form and sinuosity.

Through the U.S. Army Corps of Engineers Aquatic Ecosystem Restoration Program (known as Section 206), the Corps Pittsburgh District partnered with the City of Pittsburgh to reconstruct the stream. The project cost $7.69 Million and initial construction was completed in the summer of 2006. Goals of the project were: 1. Restore the stream to a more functional aquatic habitat which would include not only an increase in macroinvertibrates and small vertebrates, but also an increase of the number of both fish and fish species; 2.Rework the stream in such a way that it would flow continuously and at a more consistent flow rate during both wet and dry conditions; 3. Stabilize its banks to reduce and prevent future erosion and sedimentation.

Since the stream is within a city park, a challenge was how best to increase the stream's ecosystem values without diminishing the recreation opportunities in the park. In the end, the stream was re-routed through the natural floodplain and the soccer field was re-built in an adjacent area of the park more suitable for such use and less susceptible to flooding. Rerouting the creek along with installing riffles and pools helped to regain sinuosity and more natural form. Natural stream features such as root wads, j-vanes, and plantings within these structures and on the stream banks helped to create roughness to slow the stream and keep high flows from eroding the banks.

In addition to designing for high fluctuation in flows, a key challenge in the design was to accommodate the approximately 4 feet square box culvert and 36" sewer lines which crossed the stream in numerous places. Prior to the project these sewers acted as dams during dry weather, preventing any fish from traveling upstream or downstream. Fish would sometimes work their way upstream during higher flows and become stranded in disconnected pools as the flows receded.

To mitigate for the sewer lines, a series of riffle/pools were constructed on top of the lines to enable fish and other aquatic species to be able to navigate over each sewer crossing. A fish survey conducted immediately after completion of construction indicated that positive results from the project were already being realized. A fish sampling found 3 sport fish which have been previously unreported in Nine Mile Run. In addition, total fish species, number of fish, and the overall biomass of fish sampled increased 140, 130, and 650 percent respectively between pre and post project sampling.

There are many lessons learned, and some elements did not turn out quite as expected. After one year of monitoring, we were able to return to Nine Mile in September 2007 and re-work the structures over some of the sewer line crossings that were being flanked in order to increase the restoration’s long term prognosis. We also added more bank plantings to increase roughness and shade in the stream.

With project completion, the local partners are responsible to maintain the project. One of the key offshoots to the project has been the formation of the Nine Mile Watershed Association, which has plans to continue the necessary maintenance on the project.

Contact Information: Kathleen Anderson, Project Manager, U.S. Army Corps of Engineers, Pittsburgh District, William Moorhead Federal Building,1000 Liberty Avenue, Pittsburgh, PA 15222, Phone: 412- 395-7178, Fax: 412-644-6810, Email: Kathleen.j.anderson@usace.army.mil

The Water Quality, Geochemistry and Physics of Shallow Pond Habitat at the Salton Sea, California

Michael A. Anderson and *Barbara M. Barry*
Department of Environmental Sciences, University of California, Riverside, CA USA

Shallow experimental ponds were constructed by the USGS in 2006 to evaluate their suitability as replacement habitat at the Salton Sea. Four ponds with water depths about 1-2 foot were constructed in series that grade in salinities from 10-20 ppt to >100 ppt. Sampling has been conducted every two to three weeks since January 2008 to quantify water quality, geochemistry and physics of the ponds. These shallow ponds were subject to pronounced seasonal changes in temperature, with summer daytime water temperatures often approaching 40°C, while minimum wintertime temperatures were often <4°C. Water temperatures varied strongly over the course of a day as well, with >10°C swings in temperature over a 24 h period commonplace. The ponds were also subject to sediment resuspension during strong wind events. The geochemistry of the ponds also varied, with evidence of precipitation of calcium carbonate in all of the ponds, and precipitation of gypsum at salinities >30 ppt. Nutrient concentrations in the ponds were typically much lower than influent concentrations, indicating net removal of NH_4-N, NO_3-N and SRP. Very high NH_4-N concentrations (15-25 mg/L) and high SRP concentrations (1-2 mg/L) were found in the sediment porewater however, suggesting rapid remineralization and potential diffusive (and resuspension) flux to the water column. At the same time, calculations suggest that volatilization may be an important loss process for NH_4-N in the system.. The sediment-water and air-water interfaces thus play critical roles in defining the water quality and geochemistry, physics and ultimately the ecology of these shallow pond systems.

Contact Information: Michael A. Anderson, Department of Environmental Sciences, University of California, Riverside, CA 92521 USA, Phone: 951-827-3757, Email: michael.anderson@ucr.edu.

The Value of Phased, Experimental Approaches to Wetland and Grassland Restoration: Lessons from Southern California to Central Asia

Sean S. Anderson
Environmental Science and Resource Management Program, California State University Channel Islands, Camarillo, CA, USA

So-called "adaptive management" is an increasingly popular component of restoration project design and monitoring in the United States. Unfortunately "adaptive management" has typically been an afterthought, usually added to a proposal to meet the requirement of the regulator or funder, often not central to project design, and frequently the first casualty of logistic or budgetary constraints. To demonstrate the value of active adaptive management, my colleagues and I have developed a phased, experimental approach to restoring degraded communities wherein the results from previous phases inform the design and implementation of subsequent phases. I will discuss examples from restoration experiments in salt marshes, seasonal and perennial wetlands, oak woodlands, and grasslands. By beginning at small spatial and temporal scales, these projects have been able to rapidly incorporate site-specific results into the design of subsequent restoration phases and dramatically increase the likelihood of a successful restoration. One of the most important benefits of such an approach is the ability to build community support for the project. This is most clearly demonstrated in a current project I lead in the borderlands of eastern Turkey where such a phased approach is producing a wide variety of benefits to the ecosystem as well as the local residents.

Contact Information: Sean S. Anderson, ESRM Program, CSU Channel Islands, One University Drive, Camarillo, CA 93012, Phone: 805-732-2732, Email: sean.anderson@csuci.edu, Web: faculty.csuci.edu/sean.anderson/

Rehabilitation of School Spring, Ash Meadows, Nevada to Improve Habitat Quality for Warm Springs Pupfish, *Cyprinodon nevadensis pectoralis*, and Thermal Endemic Invertebrates

Robert J. Andress[1], *Sharon McKelvey*[2], *Cristi R. Baldino*[2] and *Darrick Weissenfluh*[2]
[1]Otis Bay Ecological Consultants, Reno, NV, USA
[2]United States Fish and Wildlife Service, Ash Meadows National Wildlife Refuge, Amargosa Valley, NV, USA

School Spring is one of six low discharge thermal springs within the Warm Springs complex, on the Ash Meadows National Wildlife Refuge. Springs within the complex occur within a 500 m radius, and are sufficiently isolated from other Ash Meadows springs, to harbor their own endemic biota, premiere of which is the Warm Springs pupfish *Cyprinodon nevadensis pectoralis*. This unique biota is imperiled due to habitat alteration and invasion of non-native species prior to the area becoming a National Wildlife Refuge. Ash Meadows National Wildlife Refuge personnel have given the Warm Springs complex high priority for restoring habitat and extirpating non-native species. Rehabilitation of School Spring is an important first step in restoring the Warm Springs complex to a semblance of its historic condition. The rehabilitation goal was to create habitat that would be a strong-hold for *C. nevadensis pectoralis* and its cohabiting endemic invertebrates while other Warm Spring complex spring systems are being restored. School Spring was selected for rehabilitation because its thermal endemic invertebrates had been previously extirpated and it had been serving as a *C. nevadensis pectoralis* refuge for the past 25 years. Our rehabilitation efforts included the removal of the deteriorating concrete ponds serving as the pupfish refuge; construction of a semi-natural stream channel in the vicinity of the historical spring outflow channel; improving the hydraulic and thermal conditions to accommodate thermal endemic invertebrates as well as *C. nevadensis pectoralis*; and eradicating non-native species. Monitoring to date indicates that the red swamp crayfish *Procambarus clarkii* and mosquitofish *Gambusia affinis* have successfully been eradicated from the system, and *C. nevadensis pectoralis* flourish. We are presently working on re-introduction of thermal endemic invertebrates.

Contact Information: Robert J. Andress, Otis Bay Ecological Consultants, Reno, NV 89439, USA,
Phone: 801-390-7174, Email: rjandress@gmail.com

An Ecologist's Perspective on the Don River Naturalization: Toronto, Canada

Steven I. Apfelbaum[1], *Timothy J. Dekker*[2] and *Michael Van Valkenburgh*[3]
[1]Applied Ecological Services, Brodhead, WI, USA
[2]LimnoTech, Ann Arbor, MI USA
[3]Michael Van Valkenburgh and Associates, New York, NY USA

As urban rivers in the Great Lakes have been altered by the effects of shoreline development and watershed urbanization, many problems, including upstream and downstream damages from flooding, impaired water quality, and impacts to biological communities have resulted. Like most urban rivers in the Great Lakes, the Don River in Toronto is impacted by a complex combination of impacts that have not been successfully addressed historically. Solutions to date have typically focused only on a single aspect of the problem, rather than the complex whole.

The Don River naturalization project design attempts to understand the complex challenges of restoring river function in a constrained urban setting, where urban infrastructure and intense land use contribute to extreme flooding, high sediment loads, compromised water quality, and very limited biodiversity. Instead of the single problem, single solution, we have optimized a suite of solutions that first are driven by the site constraints and limitations, secondly by solving mandatory problems such as flooding, and then by conceptualizing a river restoration. The result is what may be the first-ever reconstruction and restoration of a new Great Lakes river mouth, with an associated park system that would accommodate floodwaters, create a restored river mouth ecology, and provide habitat for species diversification.

In addition to the ecological benefit of the restored river mouth, the restoration also provides structure for re-investment in a neglected part of the Toronto industrial waterfront, through the creation of dense urban neighborhoods serviced by rails and trails, allowing short walking distances and supporting low vehicle use. The interdisciplinary approach employed from the beginning will be highlighted, along with technical strategies used to undergird the design process.

Contact Information: Steven I. Apfelbaum, Applied Ecologinal Services, 17921 Smith Road, PO Box 256, Brodhead, WI 53520, Phone: 608-897-8641, Email: steve@appliedeco.com

Net Environmental Benefit Analysis (NEBA): Uses in Remediation/ Restoration Decision-making for a Former Skeet Range

Christine Arenal[1], *Linda Sands*[2], *Pei-Fen Tamashiro*[3], *Jennifer Sullivan*[4], *Si Le*[4] and *Bryant Wong*[2]

[1]CH2M HILL, Sacramento, CA, USA
[2]CH2M HILL, Santa Ana, CA, USA
[3]Naval Weapons Station Seal Beach, Seal Beach, CA, USA
[4]Naval Facilities Engineering Command Southwest, San Diego, CA, USA

Net Environmental Benefit Analysis (NEBA) provides an analytical framework to quantify and compare the ecosystem service benefits and/or losses associated with proposed remedial actions and restoration activities at contaminated sites. NEBA is particularly useful at sites where one or more of the proposed remedial actions (e.g., excavation and disposal) may cause additional natural resource injury. It can also be applied to evaluate benefits of proposed restoration and/or compensation activities following remediation. Ultimately, NEBAs provide quantifiable metrics for robust decision-making, are consistent with the policy and direction from natural resource agencies, display benefits for the public, demonstrate environmental sustainability, and contribute to better environmental management and greater environmental stewardship at lower costs. This presentation outlines the key steps in the NEBA process using Site 74 at Naval Weapons Station Seal Beach as a Case Study.

Site 74, a former skeet range, was constructed in the late 1960s and operated for about 25 years. Skeet range activities resulted in widespread distribution of solid lead shot and broken clay targets in upland and salt marsh habitats. Subsequent to findings of potential risk to ecological receptors in the initial screening-level ecological risk assessment (ERA), a Tier II ERA was conducted to provide a more detailed site-specific evaluation of ecological risk on which to base risk management decisions and develop preliminary remediation goals. Results of the Tier II ERA indicated that lead and antimony in soil and sediment pose risks to birds and mammals, lead shot pose risks to birds, and lead and antimony in sediment pose risks to sediment invertebrates. No risks to soil invertebrates or plants were identified. Because portions of Site 74 lie within the Seal Beach National Wildlife Refuge and provide habitat for the federally endangered light-footed clapper rail and the state-endangered Belding's savannah sparrow (also a federal candidate species), habitat loss due to remedial activities was a concern. A NEBA was therefore conducted to consider various remedial scenarios, including excavation and offsite disposal of contaminated sediments and soils, capping, and hot-spot removal in marsh areas. Additionally, restoration/creation of a nearby wetland was considered as mitigation for habitat loss within the marsh areas of the site. The NEBA aids risk managers in minimizing natural resource injury while managing risks (through remedial strategy), implementation time, and costs.

<u>Contact Information</u>: Christine Arenal, CH2M HILL, 2485 Natomas Park Drive, Suite 600, Sacramento, CA USA 95833, Phone: 916-286-0403, Fax: 916-614-3592, Email: carenal@ch2m.com

Planning and Assessment Tools for Watershed Studies

Steven L. Ashby[1], *David R. Richards*[2], *Mark R.Graves*[1] and *Robert M.Wallace*[2]
[1]Environmental Laboratory, Engineer Research and Development Center, Vicksburg, MS, USA
[2]Information and Technology Laboratory, Engineer Research and Development Center, Vicksburg, MS, USA

The U.S Army Corps of Engineers has developed a system of tools to improve environmental forecasting and decision-making in comprehensive water resources management. Currently available tools include geospatial assessment techniques, habitat and index-based models, single- and multi-dimensional numerical models, and ecological models based on concepts of bioenergetics, individual-based response, and trophic structure. Applications of these models for sustainable water resource management provide opportunities to assess and predict landscape changes, owing to activities such as urbanization, ecosystem restoration, water resource project operations, etc. at various temporal and spatial scales. Since resources (e.g., data, time, expertise, funding, etc.) are often limited, a tiered or hierarchical approach to water resources management is recommended. For example, geospatial technologies can be used to develop land cover and land use data layers for applications in habitat based models or numerical models for watershed runoff predictions. Index-based models can be used in conjunction with stakeholder-developed performance criteria to forecast potential adaptive management trajectories for sustained and multi-purpose use of water resources. Another level of water resource assessment combines predictions of land use changes and subsequent changes in material loadings with potential biological response in aquatic systems using multi-dimensional models. This suite of tools has been developed within a framework to "customize" comprehensive tool selection in the decision-making process, thus ultimately allowing user communities to maintain databases, conduct alternative analyses, and transfer information in a user-friendly format. Selected case study applications will be presented.

Contact Information: Steven L. Ashby, Environmental Laboratory, Engineer Research and Development Center, Vicksburg, MS 39180, USA, Phone: 601-634-2387, Fax: 601-634-2430, Email: Steven.L.Ashby@usace.army.mil

ADCPXP: A Novel Tool for Analysis of River Behavior

Ryan R. Asman
HDR Engineering, Inc., Bellevue, WA, USA

Recent research at the University of Iowa has led to the development of an ADCP post-processing software used for visualizing hydrodynamic characteristics in rivers. Post-processing of ADCP data to date has been largely user specific with labor intensive computer codes, or limited to the manufacturer's software capabilities. Most of the features in the new software describe velocity-derived quantities, such as bed shear stress or mean flow field. 3-D visualization of physical processes can be graphically represented in the user-friendly interface, and was developed for use by engineers and scientists from various disciplines. Post-processing of data in ADCPXP allows for export into Excel-compatible formats for further customization, and also has compatibility to import ESRI shapefiles (ArcGIS) for use in certain features. Specifically, the tool provides an ability to quantify and visualize the hydrodynamics before and after a restored system is in place. Contemporary literature contains many applications of hydrodynamic characteristics being utilized to identify riverine habitat for various biota, and these studies will be discussed as potentially applied to the software's processed results to address user-specific concerns, i.e. identifying habitat for various biota (bed shear stress as an indicator of freshwater mussel habitat, velocity field in which fish migrate/navigate, etc). The tool provides unique opportunity to aid in adaptively managing restored systems.

Contact Information: Ryan R. Asman, HDR Engineering, Inc., Bellevue, WA 98004 USA, Phone: 425-450-6238, Email: ryan.asman@hdrinc.com

Monitoring to Better Understand Dissolved Oxygen Dynamics in Managed Salt Ponds of the South Bay Salt Pond Restoration Project

Nicole Athearn[1], *Greg Shellenbarger*[2], *Kathleen Henderson*[1] and *John Takekawa*[1]
[1]U.S. Geological Survey, Western Ecological Research Center, Vallejo, California, USA
[2]U.S. Geological Survey, California Water Science Center, Sacramento, California, USA

In a 2003 purchase agreement, 53 former salt evaporation ponds in the Alviso, Eden Landing, and Ravenswood complexes of the South San Francisco Bay were transferred from Cargill to the management of the U. S. Fish and Wildlife Service (FWS) and California Department of Fish and Game. The purchase initiated one of the largest wetland restoration programs in the United States. The Initial Stewardship Plan (ISP) specified transfer of the ponds at a salinity level that met standards set by the Regional Water Quality Control Board (RWQCB), San Francisco Bay Region. The initial intent of the ISP was to promote pond circulation with bay waters to prevent the buildup of salts and resulting ecological problems during an interim management period. Salinity reduction has been successful, but monitored discharge ponds have experienced substantial periods of low dissolved oxygen since first being opened to circulation in 2004 and 2005. Early management response to low DO was driven by attempts to reduce the discharge of low DO water into receiving waters using such techniques as baffles and solar aerators, with varying degrees of success. Because some salt ponds will likely be managed as waterbird habitat well into the future, project focus has shifted to address long-term concerns about the potential impacts of low DO pond water on the bay and tidal sloughs. Our 2008 study focused on understanding DO dynamics within salt ponds. This study examined both spatial and temporal variability of water quality parameters, nutrients, and chlorophyll within ponds and across seasons from early summer through fall, and additionally examined water flow and meteorological conditions at the salt ponds. This intensive periodic monitoring will provide the data necessary to characterize factors that affect DO within specific ponds over time.

Contact Information: Nicole Athearn, U.S. Geological Survey, 505 Azuar Dr., Vallejo, CA 94592 USA, Phone: 707-562-2002, Fax: 708-562-3001, Email: nathearn@usgs.gov

Stream Restoration

Valer Austin
Cuenca Los Ojos Foundation, Pearce, AZ, USA

This presentation will demonstrate stream restoration of two working models, one an entire watershed in a small stream system and the second a large watershed model beginning restoration in the middle of the system. Both models have significantly benefitted the ecology of the region and the presentation will show dramatic results.

CLO is working cross borders in Arizona, US and Sonora, Mexico. The area is semi arid and receives monsoon rains in July and August. It is possible to receive 45% of the annual rainfall in one event. Harvesting water therefore becomes an important objective. Many streams are seasonal and, depending upon the watershed, can go from dry to flooding in an hour's time. A large cienega or wetlands used to be located in the region to be discussed. The wetlands was a major stopping place for migrating birds and animals coming up from South America to the States. In the early 1900's the wetlands dried up. The reasons why the cienega disappeared and the ways it is now being restored and the aquifer is being recharged will be explained and, time permitting, questions will be answered.

The work CLO is doing on a regional level fits into a larger landscape scale picture. It is a regional model that needs to be done on a global scale for climate adaptation and mitigation. There is no question that bringing back the water is an investment with social benefits, but just as important is bringing back the biodiversity of this ecosystem. Interest in the project has the attention of the Mexican government. They have planned workshops on the ranch and are planning to put a plant lab and native seed center there. Over 27 NGO's and other organizations in the US and Mexico have joined CLO in forming a group of interested parties to exchange scientific information and protect species and create a wildlife corridor in the 4 corners area of Chihuahua, Sonora, New Mexico, and Arizona.

Contact Information: Valer Austin, Cuenca Los Ojos Foundation, 12626 East Turkey Creek Road, Pearce, AZ 85625, Phone: 520-824-3566, Email: vaustin@elcoronadoranch.net

Post-fire Recovery Plan for Solstice Canyon in Malibu, CA, USA

Christy Brigham, ***Erin Aviña*** and ***Ann Dorsey***
Santa Monica Mountains National Recreation Area, Thousand Oaks, CA, USA

Solstice Canyon is a 550 acre national park in Malibu, CA, USA. This park is part of a watershed with a perennial stream making the region floristically diverse, sustaining five major vegetation types and several uncommon vegetation associations (2004 vegetation mapping project). Since 1956 the fire interval for this region has been 8-9 years (the most recent in November of 2007). This contrasts sharply from the historic fire regime in chaparral communities in the Santa Monica Mountains of 25 – 100 years. The high frequency of fires makes this area extremely susceptible to invasion by non-native plant species. One such species, *Euphorbia terracina*, is of particular concern. The dramatic invasive potential of *E. terracina* stems from explosive seed dispersal, production of hundreds of seeds per plant, and seed viability for up to 3 years. These combined characteristics contribute to the formation of dense monotypic stands, necessitating recovery efforts in the park so that plant diversity is maintained.

Post-fire recovery (Burned Area Emergency Response) started in spring 2008 and included 200 acres of park land. The restoration plan for this area consisted of 1) GPS mapping of *E. terracina* and other invasive plants targeted for removal, 2) assessing (18 acres) of infested areas for native and targeted plant percent cover, 3) treating (35 acres) of these mapped infested areas, 4) surveying the areas post-treatment to determine the need for further treatment, 5) post assessing all infested areas at the end of the treatment season to ascertain treatment effectiveness, and 6) native plant revegetation projects. Overall, there was a 23% reduction in exotic species including *Euphorbia terracina* (15%) and other ecologically damaging non-native invasive species (1.3%). Native plant species increased by 4%. Experimental plots were also set up to ascertain the effectiveness of different weed eradication methods

In 2009 the recovery plan (Burned Area Rehabilitation) has been modified to include 1) GPS mapping of new infested areas, 2) prioritization of assessed areas based on 2008 composition, 3) establishment of monitoring transects to track areas with scattered infestations, 4) canvassing the park for future revegetation projects, and 5) further experiments to test effectiveness of treatment methods. The overall goals of this restoration plan is to find ways to rapidly, inexpensively, and reliably attain a state of recovery that is then self-sustaining with minor upkeep.

Contact Information: Erin Aviña, Ann Dorsey, Santa Monica Mountains National Recreation Area, 401 West Hillcrest Drive, Thousand Oaks, CA, 91360 USA, Phone: 805-270-2386, Email: Erin_Avina@nps.gov; Ann_Dorsey@nps.gov

Stream Corridor Modeling Tools for Adaptive Management of the Upper Truckee River, Lake Tahoe, California

Andrew Simon and ***Natasha Bankhead***
USDA-Agricultural Research Service, National Sedimentation Laboratory, Oxford, MS, USA

A declining trend of lake clarity has been documented for the past 35 years in Lake Tahoe. This has been attributed largely to the delivery of fine sediment and nutrients from the surrounding watershed that drain directly to the lake. Previous research has found that erosion from streambanks is an important contributor of suspended solids to Lake Tahoe. A recent study calculated that about 25% of the median annual, fine-grained loading of sediment to the lake was derived from streambank erosion. In fact, about 20% of all fine sediment delivered to Lake Tahoe was found to come from the banks of the Upper Truckee River and Blackwood Creek. Little if any quantitative information is available on the effectiveness of bank treatments on reducing erosion. To evaluate potential reduction in fine-sediment (silts and clays) loadings emanating from streambanks, it was necessary to analyze the discrete processes that control streambank erosion under existing and mitigated conditions. These can be described in terms of the controlling driving and resisting forces that affect steepening by hydraulic erosion and bank stability, that is controlled by gravity. These processes include hydraulic erosion of bank-toe sediments, mass failure of upper-bank materials and the reinforcing effects of vegetation, if present. All of these processes can be modeled using the Bank-Stability and Toe-Erosion Model (BSTEM) developed by Simon *et al*., (1999; 2000). Two critical erosion sites were selected from each of the three watersheds known to contribute the greatest amounts of fine sediment by streambank processes in the Lake Tahoe Basin. A typical high-flow annual hydrograph was selected for analysis. Bank-material strength data was collected for each layer as was species-specific root-reinforcement values. The effects of the first flow event on bank-toe erosion were simulated using an excess shear-stress approach. The resulting geometry was then exported into the bank-stability sub-model to test for the relative stability of the bank under peak flow and drawdown conditions. In this way, BSTEM was used iteratively for all flow events for both existing and mitigated conditions. On average, 13.6% of the material was eroded by hydraulic shear, the remainder by mass failures, which occurred about 5 times over the simulation period. Simulations with 1.0 m-high rock-toe protection showed a dramatic reduction in streambank erosion (69%-100%). Failure frequency for the simulation period was reduced in most cases to a single episode. Thus, an almost 90% reduction in streambank loadings was achieved by virtually eliminating the erosion of only 14% of the material that was entrained by hydraulic forces. Consequently, simulations show average load reductions of about an order of magnitude. Results stress the critical importance of protecting the bank toe-region from steepening by hydraulic forces that would otherwise entrain previously failed and *in situ* bank materials, thereby allowing the upper bank to flatten (by failure) to a stable slope.

Contact Information: Andrew Simon, USDA-ARS, National Sedimentation Laboratory, P.O. Box 1157, Oxford, MS 38655, Phone: 662-232-2918, Email: andrew.simon@ars.usda.gov

Design, Construction and Management of Saline Ponds at the Salton Sea, California

Douglas A. Barnum and *Thomas Anderson*
U.S. Geological Survey, Salton Sea Science Office, La Quinta, CA, USA

Terminal lakes and wetlands provide essential resting, feeding, and nesting habitat for millions of migratory birds along the Pacific Flyway. Salinity of these saline wetlands limits the diversity of the aquatic community to salt-tolerant organisms. However, these wetlands often are very productive and provide an ample food supply for many waterbirds. Bird numbers, species, and utility of these wetlands are dependent upon physical and biological factors including water depth and temperature, presence/absence or type of vegetation, patchiness, availability of food and shelter; the presence or absence of predators, water chemistry, and type of soils. The Salton Sea is a critical terminal lake for many species of resident and migratory birds, including several species of special concern, due in part to widespread loss of wetland habitat in the United States and Mexico. Inflows deposit more than 4 million tons of salts to the lake annually. Water diversions, evaporative losses of approximately 6 feet per year, and upstream conservation measures are causing the lake to recede and become increasingly saline resulting in the degradation and loss of fish and wildlife habitat. Recently the State of California recommended constructing 62,000 acres of habitat at the Salton Sea as part of its restoration plan to replace habitat that will be lost. The US Geological Survey and US Bureau of Reclamation constructed a pond system to evaluate and model ecological risks associated with development of these constructed wetlands. Additionally, the experimental ponds provide an opportunity to evaluate the technical feasibility for the construction, maintenance and operations of infrastructure such as pumps, pipelines, levees and islands. The 100-acre project is divided into four 25-acre ponds, each containing 4 earthen islands, operated in series with average water depths of less than two feet deep. Water pumped from the Salton Sea is mixed with Alamo River water to maintain salinities in the ponds between 20 and 150 mg/l. Design criteria focused on facilitating production of aquatic invertebrates as food for the birds, shallow water to make food items available to foraging birds, provision of levees and islands for nest and roosting sites, a salinity gradient to promote biological diversity, salinity management as a means of manipulating selenium risk, and minimizing emergent plant growth. The dual strategy of maintaining both salinity and water elevation for these shallow ponds in an extremely hot desert environment is challenging. Islands and levees constructed with native materials are exhibiting little evidence of erosion. Pumps and intake structures are subject to stresses of handling highly saline water and require regular maintenance. Evaluations are being conducted on nesting success and fate, bird-use patterns, numerical abundance of birds, species diversity, habitat partitioning, water and sediment chemistry, aquatic invertebrate productivity, contaminants of bird food items, contaminants in bird eggs, and post-hatch survival. Bird species diversity and nest success at the site after 3 years compare favorably with reference sites at the Salton Sea and are better than at sites such as commercial salt production facilities.

Contact Information: Douglas A. Barnum, U.S. Geological Survey, Salton Sea Science Office, 78401 Hwy 111, Suite R, La Quinta, CA, 92253 USA, Phone: 760-777-1564, Email: doug_barnum@usgs.gov

Acushnet River Fish Passage Restoration Project

Lee Becker[1] and *Steve Block*[2]
[1]EA Engineering, Science, and Technology, Inc., Lincoln, NE, USA
[2]National Oceanic and Atmospheric Administration (NOAA), Gloucester, MA, USA

The Acushnet River is a perennial stream located in southeastern Massachusetts. The Acushnet River has its headwaters in the Town of Freetown, and flows generally southward through the Towns of Acushnet, New Bedford, and Fairhaven, Massachusetts to discharge into New Bedford Harbor. The river drains a watershed of approximately 15 mi^2. Land use within the watershed is predominantly urban and suburban land. Historically, the Acushnet River was used as an industrial waterway during the 18th and early 19th centuries. Dams were constructed along the river to provide hydropower for numerous mills. These dams impaired the function of the Acushnet River to serve as habitat for resident aquatic life and as a conduit for a variety of seasonally-transient aquatic life, including anadromous fish such as river herring. At present, the lowest 4.4 mi of the 8.2-mi Acushnet River system is tidally influenced estuarine and riverine habitat with no significant impediments to anadromous fish passage. The first obstruction along the river is the Sawmill Dam, an earth-fill dam with a 118-ft wide concrete and stone spillway approximately 4.6 ft high. The Hamlin Street Dam, located 0.9 mi north of the Sawmill Dam, is a public roadway over a former mill dam which passes the Acushnet River through three granite block culverts. At the head of the Acushnet River system, the New Bedford Reservoir provides 220 acres of underutilized spawning habitat. An 11-ft high dam at the reservoir outlet formerly posed a third obstruction to fish passage along the river; however, in 2002, a state-of-the-art Denil fishway was installed at the outlet from the New Bedford Reservoir. The Acushnet River Fish Passage Restoration Project will reestablish river continuity with the goal of improving fish passage from Sawmill Dam up to the New Bedford Reservoir. Fish passage will be restored by a combination of channel alterations, bank reconstruction/stabilization, and modification of the Sawmill and Hamlin Street dams. Engineering design was completed and engineering plans were prepared along with required state and federal permit applications and filings. Upon receipt of applicable state and federal permits, final engineering plans and construction specifications were prepared. NOAA solicited construction bids in March 2007 and the contract for construction was in place by June 2007. Construction of the planned improvements was initiated in July 2007 with acceptance of final project completion in September 2008.

Contact Information: Lee Becker, EA Engineering, Science, and Technology, Inc., 221 Sun Valley Blvd, Suite D, Lincoln, NE 68528, Phone: 402-476-3766, Fax: 402-476-7825, Email: lbecker@eaest.com

Gooseneck Cove and Salt Marsh Restoration

***Lee Becker*[1], *Richard Pfingsten*[2]** and *Sam Whitin*[3]

[1]EA Engineering, Science, and Technology, Inc., Lincoln, NE, USA
[2]EA Engineering, Science, and Technology, Inc., Sparks, MD NE, USA
[3]EA Engineering, Science, and Technology, Inc., Warwick, RI, USA

Gooseneck Cove is a 64-acre estuary located in Newport, Rhode Island that is physically separated from Rhode Island Sound by Ocean Drive. The marsh system consists of three primary tidal basins connected by a poorly defined natural channel that is orientated north-south. The basins are surrounded by bedrock controlled landforms with several bedrock outcrops visible, particularly on the eastern side. Tidal exchange between the cove and Narragansett Bay has been adversely affected by three restrictions: two undersized culverts at Ocean Drive, a defunct concrete dam crossing the central portion of the cove, and a collapsing culvert at Hazard Road; these three restrictions have artificially created three open water cells. Gooseneck Cove has been tidally restricted for over a century and, as a result, exhibits signs of degraded marsh and subtidal habitat resulting from the reduced tidal range, loss of *Spartina*-dominated wetland vegetation, erosion of peat substrate, elevated water column temperatures, excessive algal growth, depressed dissolved oxygen levels, and release of sulfides. These conditions have adversely affected marsh basin habitat and decreased habitat quality for fish, macroinvertebrates, and wildlife. In addition, the tidal restriction has promoted the spread of the invasive common reed (*Phragmites australis*) and has supported the seasonal growth of expansive and pervasive filamentous algal mats in shallow open water areas. Various options for removing the tidal restrictions at each of the three locations were considered and compared as part of a Feasibility Study, and the option that best met the goals of the project for the particular restoration alternative being evaluated was then selected for further refinement. The primary goal of the project was to restore the ecological integrity of this important coastal ecosystem. Four alternatives, including a "No Action" alternative were evaluated to predict the anticipated hydraulic and ecological improvements and impacts within Gooseneck Cove resulting from their implementation, then compared using an alternatives screening matrix to select a preferred alternative. Engineering plans were prepared for the selected alternative and required state and federal permit applications were prepared and submitted for approval. Upon receipt of applicable state and federal permits, final engineering plans and construction specifications were prepared. The City of Newport solicited construction bids in September 2008 and the contract for construction was in place by November 2008. Construction of the planned improvements is scheduled for completion by the end of May 2009.

Contact Information: Lee Becker, EA Engineering, Science, and Technology, Inc., 221 Sun Valley Blvd, Suite D, Lincoln, NE 68528, Phone: 402-476-3766, Fax: 402-476-7825, Email: lbecker@eaest.com

Rich Pfingsten, EA Engineering, Science, and Technology, Inc., 15 Loveton Circle, Sparks, MD 21152, Phone: 410-329-5134, Fax: 410-771-4202, Email: rpfingsten@eaest.com

Restoring Floodplain Connectivity and Re-Meandering a River Constrained by Urban Infrastructure: A Case Study of the Constructed Restoration Design of the Upper Truckee River in South Lake Tahoe, California

Brendan R. Belby[1], *Michael J. Rudd, P.E.*[2], *Charles Miller*[3] and *Chad Krofta*[3]
[1]ENTRIX Environmental Consultants, Sacramento, CA, USA
[2]ENTRIX Environmental Consultants, Concord, CA, USA
[3]ENTRIX Environmental Consultants, South Lake Tahoe, CA, USA

Lake Tahoe in California and Nevada of the United States is world renowned for its spectacular alpine setting and deep water clarity. Unfortunately, Lake Tahoe's water clarity has declined since measurements began in the 1960s due to increased atmospheric and watershed pollutant inputs of fine-grained minerals and phosphorous and nitrogen nutrients. The Upper Truckee River watershed drains 145 square kilometers and is the largest tributary in the Lake Tahoe Basin. Before the river empties into the lake, it flows through one of the largest meadows in the Sierra Nevada. Construction of an airport on the river's floodplain in the 1960s resulted in channelization of the river and loss of two-thirds of available floodplain. Historically, the meadow stored fine-grained minerals and nutrients deposited by the river's near-annual floods, thus filtering pollutants and contributing to the maintenance of Lake Tahoe's water clarity. The impact of channelization and other watershed-scale disturbances have degraded the river's geomorphic condition. Field studies and modeling show the river currently has twice the in-channel flow capacity it did prior to degradation. As a result, the meadow floodplain is becoming increasingly hydrologically disconnected from the channel and now only receives overbank flows approximately once every five years. The severity of the channel degradation and loss of floodplain connectivity has led to the river's identification as a major contributor of pollutants detrimental to Lake Tahoe's water clarity.

ENTRIX is working with federal, state, and local agencies to implement Upper Truckee River channel and floodplain restoration designs for projects that extend eleven kilometers through delta and meadow environments. The primary goals of the projects are to reduce suspended sediment and nutrient delivery to Lake Tahoe and to improve aquatic and riparian habitat. Construction on the first project to restore a floodplain and re-meander the reach channelized to accommodate the airport began in summer 2008. This presentation begins with a short description of the historic geomorphic adjustments of the river to human impacts, followed by a longer description of how we developed a restoration design that is: 1) based on applying recent advances in geomorphic science that link sediment transport and hydrologic regimes with a sustainable channel form, and 2) compatible with existing urban constraints that include an airport and utility lines. Despite the concerns of some stakeholders, it became clear early in the planning process that the urban constraints would remain. Therefore, restoration goals were established that acknowledged the constraints and an urban restoration project was implemented that provides enhanced ecological value, yet also accommodates the infrastructure.

Contact Information: Brendan R. Belby, Sr. Project Scientist, ENTRIX Environmental Consultants, 701 University Avenue, Suite 200, Sacramento, CA, 95825 USA, Phone: 916-923-1097, Fax : 916-923-6251, Email: bbelby@entrix.com

Restoring the Upper Truckee River, Lake Tahoe, CA

Michael J. Rudd[1], ***Brendan Belby***[2] and *Charles Miller*[3]
[1]Vice President, Technical Director of Restoration and Engineering, ENTRIX, Inc., Concord, CA
[2]Senior Project Scientist, ENTRIX, Inc., Concord, CA
[3]Senior Project Scientist, ENTRIX, Inc., Concord, CA

Over the past 150 years, the Upper Truckee River watershed situated in the southern end of the Lake Tahoe Basin has been subjected to environmental degradation due to anthropogenic activities including land development, grazing, farming, and airport construction. Some of most significant landscape changes have occurred in the lower reaches in and around the City of South Lake Tahoe, California. Hundreds of acres of the river floodplain have been filled, developed, or disconnected; segments of the river have been channelized; and almost a century of grazing has caused bank destabilization. In addition to disconnecting large areas of habitat and degrading the quality in-stream habitat, these disturbances have triggered channel adjustments that have further destabilized banks, reduced water quality and increased sediment delivery to Lake Tahoe. Restoration of the Upper Truckee has been approached by partitioning the river into separate reaches based on the geomorphology, constraints, and ecology of the system. The Marsh Reach extends from the mouth of Lake Tahoe 3.2 Km upstream to the U.S. Highway 50 Bridge at Lake Tahoe Boulevard, and includes the 600 acre Upper Truckee Marsh. The Middle Reach extends upstream from the Lake Tahoe Boulevard Bridge about 6.9 Km. This reach includes a severely constrained segment along the South Lake Tahoe Airport. ENTRIX is currently providing professional engineering and environmental consulting services for four separate restoration projects on these reaches of the Upper Truckee River. The general objective of these ongoing projects are to restore natural geomorphic process and function, improve aquatic and wildlife habitat, and improve water quality of Lake Tahoe. Working within the complex regulatory framework of the Lake Tahoe Basin, ENTRIX is developing innovative solutions integrating science and engineering aimed at solving the challenging problem of implementing restoration projects critical to Upper Truckee River. This presentation will focus on challenges being faced and present some of the solutions that are being developed and implemented.

Contact Information: Michael J. Rudd, P.E., Vice President, ENTRIX Environmental Consultants, 2300 Clayton Road, Suite 200, Concord, CA, 94520 USA, Phone: 925-935-9920 Ext 227, Fax 925-935-5368, Email: mrudd@entrix.com

Development of a System-Specific Habitat Index to Support Restoration Assessment in an Urban Waterway System in Chicago, IL

Scott B. Bell, *Douglas J. Bradley* and *R. Scott Wade*
LimnoTech, Ann Arbor, MI

The Chicago Area Waterways System (CAWS) is comprised of approximately 80 miles of urban waterways in the greater Chicago metropolitan area. The CAWS is a network of rivers and man-made channels, including systems constructed at the turn of the last century to divert flows from Lake Michigan into the Mississippi River basin. Approximately 75 percent of the length of the CAWS is man-made, while most of the rest is significantly modified. The main uses of the CAWS are wastewater effluent disposal, storm water management, flood control, and both commercial and recreational navigation. Flows in the CAWS are mainly regulated by the operation of locks and by pumping stations; a recognizable hydrologic regime does not exist. Much of the CAWS is dredged to maintain adequate depth for navigation. Most of the CAWS is straightened with armored banks. For more than a century, the CAWS have received discharge from municipal wastewater treatment, urban storm water runoff, combined sewer overflows, and industrial effluents.

To some, urban waterways such as those in the CAWS might be seen as having little potential to support aquatic life. In fact, however, the CAWS does support active and relatively diverse aquatic life. For decades, the CAWS fisheries and other aspects of the aquatic system have been monitored by scientists with the Metropolitan Water Reclamation District of Greater Chicago (the District), who are the stewards of the CAWS. In addition, the District has implemented innovative technologies to improve the aquatic conditions in the CAWS, such as the sidestream elevated pool aeration (SEPA) systems, designed to improve dissolved oxygen.

In an effort to better understand current habitat conditions quantify habitat variability, understand the most influential factors affecting the fisheries, and understand what else, if anything, might be done to improve habitat quality in the CAWS, the District commissioned the CAWS Habitat Evaluation and Improvement Study. A key component of this study was the development of a customized habitat index for the CAWS. The need for a system-specific habitat index was driven by the highly urban nature of the CAWS and the many factors present in the system that affect aquatic life that are not commonly addressed by standardized habitat indices.

This paper presents the development and application of the system-specific CAWS habitat index, which was based on years of data on fisheries, macroinvertebrates, water quality, physical habitat, and other aspects of the system. The process of index development will be discussed, as will be the ways in which system-unique factors were dealt with. The outcome of the CAWS habitat evaluation and the identification of restoration potential will be presented. Lesson learned and recommendations for similar urban waterways will be included.

Contact Information: Scott Bell, LimnoTech, 501 Avis Drive, Ann Arbor, MI 48108, Phone: 734-332-1200, Email: sbell@limno.com

Regenerative Stormwater Conveyance as a technique for Zero Discharge Stormwater

Joe Berg
Biohabitats the Stables, Baltimore, MD

Regenerative Stormwater Conveyance (RSC) is an open-channel water approach using stream restoration and sand seepage wetland restoration elements. The RSC technique is used for the collection and conveyance of stormwater that can replace the more common pipe and pond infrastructure in new projects, can be used to repair failing infrastructure and degraded headwater streams associated with older projects, and can be used to retrofit watersheds developed prior to widespread use of stormwater management practices. With proper design and emphasis, these RSC techniques can result in minimizing runoff increases between the pre- and post-development condition, eliminating the need for stormwater detention facilities. The RSC technique is green infrastructure which integrates aquatic, terrestrial, and groundwater resources, maximizing the social value associated with providing stormwater quantity and quality functions, while providing significant aesthetic value. Furthermore, the ecosystem restoration/conservation benefits of the RSC approach are difficult to overestimate. They include rehydration of riparian and wetland areas, suppression of invasive exotics, groundwater recharge and maintenance of stream baseflow, stimulation of biodiversity (e.g., vernal pool, peat production, etc.), water quality improvement, reduced velocity and shear stress of runoff, increased storm flow concentration time, and safe, non-erosive conveyance of runoff. A recent residential development project will be used to compare and contrast conventional stormwater practices with RSC.

Contact Information: Joe Berg, Biohabitats the Stables, 2081 Clipper Park Road, Baltimore, MD 21211,
Phone: 410-554-0156, Email: jberg@biohabitats.com

A Large-Scale Carbon Biosequestration Demonstration Project in the Sacramento-San Joaquin Delta – Carbon Capture Wetland Farming as a Means to Elevate Land Surface and Sequester Atmospheric Carbon Dioxide on Subsided Delta Islands

***Brian Bergamaschi**, Roger Fujii* and *Robin Miller*
U.S. Geological Survey, California Water Science Center, Sacramento, CA

Agricultural production in the Sacramento-San Joaquin Delta oxidizes the peat soils, emitting 7 mt carbon dioxide (CO_2) per acre per year and causing 1 cm per year of land subsidence. A century of agriculture has resulted in subsidence of over 500,000 acres of agricultural lands in the Delta. Based on information from two 7 acre pilot wetlands established in 1997, it appears possible to reverse these carbon emissions and restore the land surface elevation by removing carbon from the atmosphere through photosynthetic production, and then transferring it into organic soil material as buried biomass, humus, and, eventually, peat. This long-term study has demonstrated that it is feasible to accelerate accretion rates and increase land-surface elevation through carbon sequestration by controlling the depth of water in the wetland and the composition of wetland vegetation. Biomass accumulation rates combined with emissions reduction result in a net potential atmospheric benefit of over 30 mt CO_2 per acre per year, much larger than other proposed or established means of terrestrial biological carbon capture and sequestration.

It seems possible, therefore, that wetlands of this type could be used to "farm" carbon: California's recent landmark Greenhouse Gases laws are expected to establish a market for carbon sequestration trading, so "carbon capture wetland farming" at a large scale could provide a viable economic return to the Delta farming communities while at the same time reducing the public risk management costs associated with subsidence. California DWR has recently funded our research group to further evaluate the potential of carbon farming at the scale of hundreds of acres. We will examine the fundamental wetland biogeochemical processes for the purpose of developing wetland management approaches that maximize carbon sequestration and subsidence reversal, and minimize the potential for adverse outcomes and environmental consequences. Quantifying the processes and factors affecting accretion and sequestration, determining management scenarios that maximize these effects, and establishing protocols that will allow the resulting benefits to be marketed are all critical to forging the link between greenhouse gas initiatives and Delta risk reduction.

Contact Information: Brian Bergamaschi, U.S. Geological Survey, California Water Science Center, California State University, 6000 J Street, Sacramento, CA 95819-6129, Phone: 916-278-3053, Fax: 916-278-3071, Email: bbergama@usgs.gov

Calcareous Periphyton Dominated Treatment Wetlands Effectively Removes Metals (Barium, Zinc, Aluminum, Iron, etc) from the Water Column

Ed Brown, Lisa Gued, Tim Brown, Enid Gerena and ***Peter Besrutschko***
US Army Corps of Engineers, Jacksonville, FL

Emergent growth treatment wetlands have been used to remove metals and other contaminants from the water column. Recent periphyton stormwater treatment area (PSTA) indicate that calcareous periphyton efficiently removes metal pollutants. The physical and biological processes within periphyton mats remove metals (Ba, Zn, Al, Fe) as well as phosphorus. Fully activated periphyton precipitates calcium carbonate within the mat interior, as the biological derived pH increase reaches and exceeds 10.3 . The increased pH may also reduces the half-life of pesticides. Corps of Engineers plans to further evaluate metals removal efficientcies at the mesocosm and field-scale PSTA demonstration.

Contact Information: Peter Besrutschko, Corps of Engineers, 701 San Marco Blvd, Jacksonville, FL 32207, Phone: 904-232-2298, Email: peter.h.besrutschko@usace.army.mil

Strategic Public Partnering For Ecological Benefit: Leveraging Regulatory Requirements and Funding Opportunities for Environmental Benefit

Robert A. Bevilacqua
Michael Baker Jr., Inc., Hamilton, New Jersey, USA

The New Jersey Department of Transportation (NJDOT) Route 52 Causeway Replacement Project is the largest transportation infrastructure improvement project undertaken in the State. The project involves reconstruction of approximately 2.8 miles of NJ Route 52 including replacement of four existing bridges and causeway crossing over two miles of the Great Egg Harbor Bay Estuary. Construction will result in unavoidable impacts to sensitive environmental resources including wetlands and aquatic estuarine habitat requiring compensatory mitigation to satisfy regulatory requirements and permit conditions. In addition to maximizing on-site wetland restoration and creation opportunities by proposing construction of nearly three acres of tidal salt marsh and shallow water habitat restoration, additional off-site mitigation was required to satisfy minimum permit requirements. During the preliminary design phase in 2003, the NJDOT approached the New Jersey Department of Environmental Protection (NJDEP) to enter into a partnership. The NJDOT proposal offered compensation for the acquisition of a high value waterfront property known as Malibu Beach that was under threat of development for off-site and out-of-kind compensatory mitigation credit. The NJDEP accepted the NJDOT proposal and entered into a Memorandum of Understanding (MOU) that provided mitigation credit for the Route 52 Causeway Replacement Project in return for financial assistance with the acquisition and preservation of the Malibu Beach property as well as restoration of wetlands and habitat enhancement activities.

The Malibu Beach property in Egg Harbor Township is currently owned by the NJDEP Division of Fish and Wildlife and is now an important habitat component of the Malibu Beach Wildlife Management Area (WMA). The property is 28.5 acres and is recognized as an extraordinary ecological and recreational resource for being one of the last remaining natural beachfront areas along the southern New Jersey shoreline and the only such area between Ocean City and Atlantic City. Its bayward edge, sandy beach, dune complex, and brackish water pond offer suitable habitat for protected species including piping plover (*Charadrius melodus*), black skimmer (*Rynchops niger*), and least tern (*Sterna antillarum*). The native vegetation and brackish shallow water pond with fringing emergent wetlands are recognized as an EPA Priority wetland for its value to wildlife, especially migratory bird populations. The Malibu Beach WMA complex is recognized as one of the most valuable resting and foraging sites for migratory birds using the Atlantic Flyway. Moreover, Malibu Beach has been long recognized as a significant recreational resource.

In 2008, the NJDOT initiated ecological restoration and enhancement activities at Malibu Beach consisting of concrete rubble and invasive species removal and planting of native vegetation and creation of fringing wetland habitat. The overall result of the strategic partnership between the NJDOT and NJDEP has been the preservation of valuable wildlife habitat and reducing the imminent threat to this important ecological and recreational resource.

Contact Information: Robert A. Bevilacqua, Michael Baker Jr., Inc., Hamilton, NJ 08619 USA, Phone: 609-807-9583, Fax: 609-807-9550, Email: rbevilacqua@mbakercorp.com

Natural Land Management: A Property Management Strategy to Enhance Ecological Value

Gregory R. Biddinger*, Richard W. Woods* and *Laura J. Napoli*
Natural Land Management Program, Toxicology and Environmental Sciences Division, ExxonMobil Biomedical Sciences, Inc., Clinton, N.J. USA

ExxonMobil has developed a technical management practice which is designed to deliver triple bottom-line results in the management of operating properties through out their lifecycle, including their remediation and redevelopment. The practice, known as *Natural Land Management* (NLM), incorporates technical, legal and regulatory approaches to deliver value to the corporation's shareholders and the communities and environments in which we operate. The presentation will provide an overview of the NLM framework with case examples and discuss how the supporting approaches can be blended together to achieve outcomes with superior environmental performance relative to typical property management approaches. The integration of conservation and recreational re-use into the redevelopment of former operating properties will be highlighted. The challenges, opportunities for implementation and developmental needs will be reviewed.

Contact Information: Gregory R. Biddinger, Ph.D., Natural Land Management Program Coordinator ExxonMobil Biomedical Sciences, Inc., 800 Bell St., Room 4155F, Houston, TX 77002, Phone: 713-656-4978, Cell: 713-201-7231, Fax: 713-656-1512, Email: gregory.r.biddinger@exxonmobil.com

Evaluating Environmental Impacts Using System Wide Water Resources Program (SWWRP) Tools

Stephen M. England[1], ***Laura D. Bittner***[1], *Clarissa M. Hansen*[1], *Stacy E. Howington*[2] and *Hwai-Ping (Pearce) Cheng*[2]
[1]US Army Corps of Engineers, Philadelphia District, Philadelphia, PA, USA
[2]US Army Engineer Research and Development Center, Vicksburg, MS, USA

The System-Wide Water Resources Program (SWWRP)[a] is a USACE research and development initiative designed to integrate the diverse components of water resources management. Products from this program are intended to help engineers and planners develop superior regional watershed analyses, and apply enhanced technologies for multidisciplinary, system-wide assessments. Tools developed or extended by SWWRP include the Conceptual Model Builder (CMB), ADaptive Hydrology/Hydraulics (ADH) numerical code, and various Google Earth technologies. The CMB promises to allow large numerical models to be developed with relative ease by simplifying and parallelizing the model construction process. ADH is a finite element modeling code that uses parallel processing and adaptive refinement to simulate a variety of complex surface and ground water flow systems. Advancements in Google Earth technology, such as the KMZ animator and CorpsGlobe, will be an excellent way to display complex model output in a format that is readily understandable to various audiences as well as useful for planning and decision making.

SWWRP tools are currently being used to develop regional and sub-regional scale, density-dependent groundwater models to assess the impacts of the proposed Aquifer Storage and Recovery (ASR) component of the Comprehensive Everglades Restoration Program (CERP)[b]. The goal of CERP ASR is to help with water supply, storage, and distribution of water in South Florida through the use of up to 333 ASR wells with a combined capacity of approximately 1.65 billion gallons per day. This paper will demonstrate how various SWWRP tools are being used to evaluate the regional groundwater flow system in South Florida in order to address the potential impact of the proposed CERP ASR system.

---

[a] https://swwrp.usace.army.mil
[b] http://www.evergladesplan.org/index.aspx

Contact Information: Stephen M. England, US Army Corps of Engineers, Philadelphia District, Wanamaker Building, 100 Penn Square East, Philadelphia, PA 19107-3390, USA, Phone: 215-656-6605, Fax: 215-656-6797, Email: Stephen.M.England@uasce.army.mil

Necessary Measures for Insuring Sustainable Long-Term Success of Large-Scale Ecosystem Restoration Management Projects

Ann Bleed, *Chris Moore, Jonathan Bartsch* and *Susan Wildau*
CDR Associates, Boulder, CO, USA

The long-term success of large-scale ecosystem restoration project is heavily dependent on the development of sustainable institutional frameworks that are needed for any necessary long-term oversight of the restoration effort. These frameworks are needed not only to insure the implementation of regulations necessary to limit exploitation of the system, but also to provide for continued management and research activities, particularly when adaptive management is a critical component of the management plan. A critical component for establishing a sustainable oversight framework is support for the effort among those people who can affect the project outcome, both in the initial development of the restoration plan and in the long-term implementation of the plan. If people believe in the goals of the project, are personally invested in the successful outcome of the project, and believe their continued involvement can make a difference, there will be sustained support for the project. If not, the likelihood that the project will eventually fail is high.

The need for widespread support is particularly critical when the restoration involves complex large scale ecosystems covering multiple institutional jurisdictions. Large scale ecosystem management often involves complex scientific problems considerable uncertainty on whether management actions will have the intended results. Difficulty in understanding the need for costly studies and management actions, when combined with the uncertainty creates problems for both the development of the plan and for maintaining the willingness of stakeholders to provide sustained support the effort.

Thus, it is important to focus significant attention on the human decision-making components of plan development. Education to help stakeholders understand and have confidence in the data and research used to develop the plan; development of effective processes to appropriately involve stakeholders in plan development and long-term monitoring and maintenance of the plan; establishing funding mechanisms for management activities; and establishing processes to deal with the inevitable disputes over plan management are all critical components. When large scale ecosystems are involved, often such processes must transcend institutional, cultural, cross-jurisdictional and international boundaries.

The authors of this paper have been involved in a number of large-scale basin-wide natural resources management efforts involving stakeholders with conflicting interests. This paper will present lessons-learned from the authors experience in how to implement processes to involve stakeholders in the design of management plans, help the stakeholders understand and develop confidence in complex technical data, include stakeholders in the long-term monitoring and management of the effort, and establish processes to effectively and efficiently resolve any future disputes among participating institutions and stakeholders.

Contact Information: Ann Bleed, CDR Associates, 100 Arapahoe Ave., Boulder, CO 80302 USA,
Phone: 303-442-7367 or 402-466-6805, Fax: 303-442-7442, Email:ableed@mediate.org

A New Interdisciplinary Doctoral Program in Ecosystem Restoration at the University at Buffalo

David Blersch *and Alan Rabideau*
Department of Civil, Structural and Environmental Engineering, State University of New York at Buffalo, Buffalo, NY

The restoration of biodiversity in impaired aquatic and terrestrial environments is a growing national priority and is of critical importance to New York State. Spanning hydrologic and political boundaries between the US, Canada, and Native Tribes, the western New York region contains a unique variety of habitats that includes two Great Lakes, numerous smaller lakes, tributary rivers, and diverse associated ecotones with a spectrum of land uses and associated aquatic and terrestrial ecological disturbances. The Ecosystem Restoration through Interdisciplinary Exchange (ERIE) program at the University at Buffalo (UB) is a collaborative doctoral program that advances ecosystem restoration science and engineering and contributes to the ecological recovery of the Great Lakes and upstate NY. Collaborative partnerships in ERIE span across eight UB departments, research groups at nearby Buffalo State College and Niagara University, and over 20 external partner organizations, including Native American tribes, local, state, and federal agencies, and corporate entities. Through the integration of natural and social science, engineering, and policy, ERIE addresses critical knowledge gaps in ecosystem restoration and trains students in restoration science and engineering expertise and in policy and cultural issues that influence restoration practice. Program interdisciplinarity is reinforced by activities that include field-oriented short courses in ecosystem restoration taught by nationally-recognized experts, leadership workshops in interdisciplinary team dynamics, professional internships with external partners, instruction and mentoring in case study methods, and development training for the dissemination of new K-16 educational materials. Generous and competitive funding is available for ERIE doctoral trainees through a National Science Foundation Integrative Graduate Education and Research Traineeship (IGERT) grant. Through this comprehensive interdisciplinary environment, ERIE strives to train new leaders in the rapidly advancing field of ecosystem restoration.

Contact Information: David Blersch, Department of Civil, Structural and Environmental Engineering, 202 Jarvis Hall, State University of New York at Buffalo, Buffalo, NY 14260 USA, Phone: 716-645-2114, Fax: 716-645-3667, Email: dblersch@buffalo.edu

Independent Scientific Evaluations of Major Ecosystem Restoration Programs

Donald F. Boesch
University of Maryland Center for Environmental Science, Cambridge, MD, USA

There comes a time in most large-scale ecosystem restoration programs when, because of controversy, slow progress, or mistrust, a call is made for an independent, non-conflicted panel of scientists to come in and tell the truth. Such a panel may be called upon to evaluate plans, assess progress, adjudicate debates, or provide constructive advice. Although the agency or program responsible for the restoration program may itself assemble a panel of experts to conduct the scientific review, evaluations have often been elevated to a committee empanelled by the National Research Council (NRC), the operating arm of the National Academies of Sciences and Engineering and considered the "gold standard" of review for its ability to engage top experts, independence, rigorous review process and credibility. The recently published Second Biennial Review of Progress Toward Restoring the Everglades is an example of the outcome of such an evaluation. Similar NRC reviews have been completed for of restoration programs focusing on the Louisiana Coastal Area (LCA), Upper Mississippi, and the Missouri River. The NRC has also just been engaged to form a committee to serve as an "independent evaluator" of the effectiveness of Chesapeake Bay Program restoration efforts.

I will offer perspectives gained from serving on both sides of the independent scientific evaluation process through membership on the NRC Everglades Committee and on internal advisory committees for the Chesapeake Bay and LCA restoration programs. Suggestions will be offered both to scientists serving on the independent evaluation committees and to the managers and scientific contributors of the restoration programs under review. First and foremost, if the evaluation is to be useful, its objectives, key questions that should be resolved, and potential uses and consequences of the evaluation must be clearly and mutually understood and articulated. At the same time the panel should be allowed some scope beyond the charge to offer important insights that are not sought but perhaps should be. It is important that the information presented to the panel is germane to the charge and efficiently communicated, thus avoiding the "death by Powerpoint" syndrome. Safe avenues for candid and critical exchange of ideas and concerns should be established between panel members and technical analysts and scientific advisors of the restoration program. Colorful war stories will be used to illustrate these and other perspectives.

Contact Information: Donald F. Boesch, University of Maryland Center for Environmental Science, P.S. Box 775, Cambridge, MD 21613, Phone: 410-221-2000, Fax: 410-228-3843, Email: boesch@umces.edu

Using Adaptive Management to Address Uncertainty in the Management of Missouri River Cottonwoods

Suzanne Boltz, *Lisa A. Rabbe, Kelly A. Burks-Copes, Kristine Nemec, Richard Pfingsten* and *Sarah Koser*
EA Engineering, Sparks, MD, USA

In compliance with the U.S. Fish and Wildlife Service (USFWS) Biological Opinion (Bi-Op) regarding the Missouri River Operation activities, the Omaha and Kansas City Districts are pursuing initiatives to offset past losses of cottonwood forests due in part to the damming and channelizing of the Missouri River in the early 1950s. This effort will result in the Missouri River Cottonwood Management Plan, which the Corps will use to guide cottonwood habitat restoration and management on the river. Concurrently, the Corps has numerous other habitat restoration programs ongoing or under study. It is not possible to know with certainty the microhabitat conditions on the river 20 years from now, let alone 100 years from now, along the defined length of this project. A plan to manage the cottonwood community over this temporal and geographic scope can have significant uncertainty in the later years of the management plan. Adaptive management is based on the premise that managed ecosystems are complex and inherently unpredictable, and is an effective tool for managing this uncertainty. It allows decision makers to adjust and refine their analysis as new data become available to add to the evaluation, reflecting habitat responses to implemented actions. The complexity of the Missouri River ecosystem and the ongoing restoration efforts underscore the need for such an approach. We will describe our plans to monitor cottonwood habitat, and river conditions affecting habitat, over this large geographic area. We will discuss the critical elements of our adaptive management plan that will allow us to assess the effectiveness of implemented strategies and, if appropriate, identify corrective actions.

Contact Information: Suzanne Boltz, EA Engineering, Science, and Technology, Inc. 15 Loveton Circle, Sparks, MD 21152, Phone: 410-329-5143, Fax: 410-771-4204, Email: sboltz@eaest.com

Management, Monitoring, and Restoring Urban Streams

Derek B. Booth[1,2] and *Stephen C. Ralph*[1]
[1]Stillwater Sciences, Berkeley, CA, USA
[2]Department of Earth and Space Sciences, University of Washington, Seattle, WA, USA

Urban streams present unique challenges for society, because these systems offer some of our most accessible experiences of the natural environment but they strenuously resist our efforts to manage them. Enhancement efforts in urban streams typically focus on rehabilitating channel morphology and riparian habitat, but such physical improvements alone do not address all factors affecting biotic health. Some habitat-forming processes, such as the delivery of woody debris or sediment, may be amenable to partial restoration, even in highly disturbed streams, and they constitute obvious high-priority actions. There is no evidence to suggest, however, that improving these factors can fully mitigate the profound hydrologic and water-quality consequences of urban development. Rather than address these problems at their source, namely the watershed area, most remedial efforts are expended only at the final point of symptomatic expression, namely the stream channel. Clearly, this is not rational.

Even degraded urban streams support complex ecosystems, however, although the stressors are diverse and change is ubiquitous. The science of understanding their interactions and consequences is still young, and we will probably never have enough information to fully inform management decisions designed to protect or enhance them. Common responses to this conundrum are (1) faith-based restoration ("build it and they will come"), (2) initial actions with intentional mid-course corrections, or (3) paralysis. This middle path, commonly given the term "adaptive management," holds the best hope for dynamic, complex systems where scientific and engineering certainty is elusive but inaction is tantamount to failure. Under adaptive management, actions are viewed as experimental treatments, results are systematically evaluated, uncertainty and risk are explicitly acknowledged, and contingency plan(s) are integral to the management process. This approach should be distinguished from simple "monitoring," wherein we hope that measuring the effects of past management actions will somehow catalyze improvements in future management actions. The difference is subtle, but critical: in true (i.e., functional) adaptive management, monitoring is integral to the initial management design, and the "management action" is only the first step of an ongoing experiment.

Scientific uncertainty is not the language of public works, and it can be an unwelcome message for managers, elected officials, and the public. Failure to reassess and adapt, however, almost surely precludes the success of any ecological restoration program. Long-term improvement of stream conditions may not be feasible under typical urban constraints, so large sums of money should not be spent on unrealistic or unreachable targets for urban stream rehabilitation. However, such a strategy should not be an excuse to preclude potential future gains by taking irreversible present-day development or rehabilitative actions.

Contact Information: Derek Booth, Stillwater Sciences, Box 904, Santa Barbara, CA 93102, Phone: 206-914-5031, Email dbooth@stillwatersci.com

Nursery Production of Local Ecotype Seed in Support of Regional Restoration Efforts

Brianna D. Borders[1], *Patrick A. Kelly*[1], *Nur P. Ritter*[2] and *Kenneth D. Lair*[3]
[1]California State University Stanislaus' Endangered Species Recovery Program, Fresno, CA, USA
[2]The New Hampshire Chapter of The Nature Conservancy, Concord, NH, USA
[3]H.T. Harvey and Associates, Fresno, CA, USA

In the San Joaquin Valley of California, land conversion for agricultural and urban uses has resulted in profound habitat loss and diminished biological diversity. Due to drainage-related problems, several thousand acres of farmland in the region have been retired (i.e., removed from irrigated agricultural production). With appropriate habitat restoration, including revegetation with native species, select areas of retired farmland could potentially provide wildlife habitat and contribute to the recovery of endangered and threatened plant and animal species. Seed stock of San Joaquin Valley native flora is largely unavailable from commercial suppliers, and the amount of seed that could be responsibly collected from areas of native habitat would be insufficient for reseeding large tracts of retired farmland. In response to this lack of native seed availability, the Valley Flora Propagation Center (VFPC) was established by the CSU Stanislaus' Endangered Species Recovery Program, with support from the U.S. Department of Interior's Land Retirement Program. The VFPC consists of a 3-ha field nursery located near Tranquillity, California and a seed-processing facility located in Fresno, CA. Seeds of over 100 species have been collected from local native populations and planted in the nursery, in order to increase available seed supplies through field propagation. The nursery site was formerly used for irrigated agriculture and thereby provides a setting where native species can be screened for their potential applicability in the restoration of retired agricultural lands. Challenges to nursery seed production in the western San Joaquin Valley include competition from weeds, herbivory, insect damage, and a semi-arid climate with highly variable precipitation patterns. When local sources of native plant seed are scarce, the establishment of a seed production nursery can be a viable option for providing seed stock. However, the inadvertent selection and reduced genetic variation that could potentially result from the practice of seed increase should be considered.

Contact Information: Brianna Borders, California State University Stanislaus' Endangered Species Recovery Program, Fresno, CA 93722 USA, Phone: 559-271-2646, Email: bborders@esrp.csustan.edu

The Desert Fish Habitat Partnership: Striving for No More Extinctions

Heidi B. Blasius[1], ***K. Boyer***[2]**,** *C. Cantrell*[3] and *J. Sjoberg*[4]
[1]Bureau of Land Management, Safford, AZ, USA
[2]USDA Natural Resources Conservation Service, Portland, OR, USA
[3]Arizona Game and Fish Department, Phoenix, AZ, USA
[4]Nevada Department of Wildlife, Las Vegas, NV, USA

Approximately half of U.S. threatened and endangered fishes occur in the arid western United States. State Wildlife Action Plans identify habitat loss as a primary factor threatening aquatic species in desert ecosystems. Conservation of aquatic resources is a fundamental and pervasive challenge facing people and fish sharing increasingly limited waters of the arid west. The Desert Fish Habitat Partnership is mobilizing to address this issue. In light of global climate change and enormous population growth in western states, our challenge is daunting. Yet our goals are clear: no species will go extinct and no species will be added to the threatened and endangered species list. Our objectives are simple: protect intact habitats by addressing threats and prioritize our efforts based on likelihood of success. We intend to meet these goals by integrating and implementing strategies and actions for desert fish identified in the State Wildlife Action Plans of Arizona, California, Colorado, Idaho, Nevada, New Mexico, Oregon, Texas, Utah, Washington, and Wyoming, multi-species conservation plans, or other species/habitat plans. Partners are poised to work across jurisdictions to focus dollars, expertise, and efforts on protecting intact desert fish habitats and restoring degraded ones. Yet with all the partners and conservation efforts in place, we still need your help. We need partners that are currently working on desert fish species to share data we can use to evaluate species and habitat trends, provide additional opportunities for leveraging money to accomplish our ambitious goals, and offer innovative ideas to expedite progress. Time is of the essence. This presentation will provide details of the emerging Desert Fish Habitat Partnership and offer participants the opportunity to join our efforts to protect and conserve desert fishes and their habitats.

Contact Information: H. Blasius, Bureau of Land Management, Safford Field Office, 711 South 14th Avenue, Safford, AZ 85546, USA, Phone: 928-348-4427, Fax: 928-348-4450, Email: Heidi_Blasius@BLM.Gov

Climate Change Impacts on Salt Marsh Restoration Techniques in the Northeast United States

Catherine M. Bozek
National Oceanic and Atmospheric Administration, Restoration Center, Silver Spring, MD USA

Recent assessments of climate change impacts project that the northeast United States will be subject to higher temperatures, increased sea level rise, heavier precipitation, and stronger storms within this century. Coastal systems in the northeast, such as salt marshes, will be affected by these changes; therefore, traditional ecological restoration paradigms and techniques need to be re-evaluated. Considerations should include how marshes will react to higher sea levels and increased precipitation, how climate change will impact vegetation productivity and interactions, and what changes may need to be made to restoration techniques such as surface elevation regrading, reconnection of tidal hydrology, and reestablishment of native vegetation, in order for restoration to continue being effective. This re-evaluation of restoration techniques is essential to ensure that marsh systems continue to function over time and that the funding available for restoration is used efficiently. There may also be a need for change in how scientists and practitioners think of northeast salt marsh restoration in the future, including shifts in the guiding principles and ultimate goals of restoration.

Contact Information: Catherine Bozek, NOAA Restoration Center, 1315 East West Highway, 14th Floor, Silver Spring MD 20910, Phone: 301-713-0174, Fax: 301-713-0184, Email: cathy.bozek@noaa.gov

Limitations of Standardized Habitat Indices in Urban Waterways

Douglas J. Bradley*, Scott B. Bell* and *R. Scott Wade*
LimnoTech, Ann Arbor, MI

Habitat indices are frequently used in river restoration efforts to help identify problems and define restoration goals. Habitat indices developed to quantify habitat quality in rivers and streams commonly rely on high quality or least-impacted reference reaches to determine upper endpoint of system potential. The indices are typically developed using data from systems exhibiting a range of anthropogenic influences, from heavily impacted to near pristine, if possible. This range of conditions allows development of a condition scale, which is the basis of the index scoring system. Identification of the metrics that are used in the indices often emphasizes inclusion of metrics that represent habitat conditions or factors that are desirable to target species or communities, and the index is built by assigning numeric values to these metrics to represent their presence, absence, or relative condition. These indices are useful for assessing habitat quality in waters that are comparable in nature, scale, hydrologic regime, and geographic setting to those used in the development of the original index.

Two major factors limit the utility of standardized habitat indices in urban waterways. First, the indices may rely on frequently used metrics that reflect conditions that are present in natural systems and valuable to aquatic life, but that are non-existent or severely limited, in urban waterways. An example would be the use of certain stream morphology features in urban indices. While most ecologists would agree that factors such as sinuousity and riffle-run-pool sequences are valuable metrics of habitat quality for fish in natural systems, these factors may be non-existent, or unattainable in an urban waterway that has been dredged and straightened to support the conveyance of stormwater or treated effluent. Furthermore, the continuation of these uses combined with impacts such as riparian urban development, may prevent restoration of these qualities. Applying a metric that relies, in part, on unattainable parameters to assess habitat quality and/or identify restoration opportunities, may be misguided.

The second major factor that may limit the application of standardized habitat indices in urban waterways is the presence of conditions that have a significant impact on aquatic life, but were simply not considered or included in the development of the index for non-urban systems. An example of this might be navigation impacts. In the rivers and streams used for index development, boat traffic may be limited or nonexistent and may have relatively minor impacts on aquatic life. In urban, commercial navigation waterways, shipping may have significant adverse impacts on habitat and water quality and omitting a measure of these impacts may miss a key attribute of the waterway potential. Furthermore, ignoring the impacts of such uses might erroneously attribute impacts to other causes, leading to poor and misguided restoration decisions.

This paper uses data acquired during a habitat evaluation and improvement study for the Chicago Area Waterways System to illustrate the range of factors in urban waterways that can significantly influence habitat quality in these systems, particularly with respect to fisheries. The objective is to demonstrate why the application of standardized indices may be off-base and to endorse the development of system-specific indices, where appropriate. Development of a customized habitat index for the Chicago Area Waterways System is discussed in a companion paper.

Contact Information: Doug Bradley, LimnoTech, 501 Avis Drive, Ann Arbor, MI 48108, Phone: 734-332-1200, Email: dbradley@limno.com

Restoration Efforts on the Upper Gila, 1918-2009

William K. Brandau
University of Arizona, Graham County Cooperative Extension, Safford, AZ

This paper reviews restoration efforts spanning almost 100 years in the Upper Gila Watershed in South Eastern Arizona. The Gila has a history of conflicts and partnership between the people and resources. A review of this history provides insights into how best to implement a sustainable restoration effort. There are two restoration efforts working in the Upper Gila Watershed, the Gila Watershed Partnership and the San Simon Restoration. These efforts have used historic reviews to set the course for restoration. Without this insight it is doubtful that either will be a sustained restoration effort, because they may repeat the mistakes of the past. The mistakes are not having a common viable vision among partners for the restoration, not having a binding trust among partner and not completing timely significant actions to maintain a momentum.

The Upper Gila Watershed is approximately 15,000 square miles, with elevations ranging from 2,300 feet to above 10,000 feet at its highest elevation. The vegetation type is diverse ranging from desert shrub/grassland types at lower elevation to Douglas fir at the higher elevations. The streams support classic southwestern cottonwood riparian types along most channels. The river is a typical southwest river characterized by low flows the majority of the time with intermittent high flows from the summer monsoon or snow melts.

The Gila Watershed Partnership (GWP) started in 1993 to address non point source pollution. GWP started as a grass root group that identified problems, proposed solutions and implement them. It has implemented $4,900, 000.00 in projects. In 2009 GWP will begin the Gila River Restoration at Apache Grove project, a $796,000 project funded by Arizona Water Protection Fund (AWPF). This project is the first major action implemented of those identified in the Upper Gila River Fluvial Geomorphology Study, Bureau of Reclamation, 2004. This study reviewed the historical context of Gila River management along with the physical nature of the river and proposed kinds of projects that would help in the management of the river.

The San Simon River Assessment and Restoration is a process to restore the San Simon a 2,000 square mile sub watershed of the Gila. The San Simon was incised early in the 20th century and is known for its erosion. Grade control structures were installed on the river and tributaries, beginning in the 1930's. The purposes of these structures were to halt channel incision and degradation of the watershed. Many of these structures have out lived their useful life and are in need of repair. The assessment uses historical review to help decide what has worked and may work in the future and is a prerequisite to the restoration plan that would set direction and management of the watershed.

Contact Information: W.K. Brandau, University of Arizona Graham County Cooperative Extension, P.O. Box 127, Solomon, AZ 85551, Phone: 928-428- 2611, Fax: 928-428-7023

Shoreline Habitat Mapping of the Colorado River Ecosystem in Grand Canyon, Arizona

Thomas M. Gushue[1] and ***Michael J. Breedlove***[2]
[1]U.S. Geological Survey, Flagstaff, AZ, USA
[2]Utah State University, Flagstaff, AZ, USA

Closure of Glen Canyon Dam in 1963 has resulted in significant changes to the physical processes and environments of the Colorado River in Grand Canyon. Flow regulation by the dam raised annual minimum flows, reduced annual peak flows, and increased daily flow fluctuations in response to hydropower demand. Approximately 90 percent of the sand load of the Colorado River is now deposited upstream of Glen Canyon Dam in Lake Powell. As a result, the river is much less turbid and sandbars have declined in size and number, thus limiting recreational camp sites. The dam has also transformed the seasonally warm Colorado River into a consistently cold river. The altered thermal regime, combined with modified flows, reduced organic inputs, and decreased turbidity has also altered the aquatic food web and the native and non-native fish communities, particularly the humpback chub (*Gila cypha*). In 1973, the humpback chub was given full protection under the Endangered Species Act.

The U.S. Geological Survey's Grand Canyon Monitoring and Research Center (GCMRC) is the designated science provider to the Glen Canyon Dam Adaptive Management Program and has evaluated dam operations intended to achieve sandbar conservation and improve habitat conditions for humpback chub since 1995. Previous research has suggested that suitable fish habitat may be related to specific elements of the river's geomorphic framework; such as debris fan controlled eddies and related sandbars, as well as other shoreline features. Mapping the distribution and abundance of these features throughout Grand Canyon is important to understanding more complex physical and biological interactions that make up the Colorado River Ecosystem (CRE). In order to facilitate better understanding of this ecosystem, we have assembled a series of data sets that can be used by fisheries scientists to support more in-depth physical and biological research below the dam.

This study presents the utilization of remotely-sensed data within the GIS environment to identify specific physical and biological characteristics derived from digital imagery of over 400 kilometers of the CRE between the forebay of Glen Canyon Dam and upper Lake Mead. The objective of the study is to develop a suite of GIS databases representing landscape characteristics of the river corridor with particular attention to broad geomorphic features, vegetation and sandbars. These databases may then be utilized to evaluate changes resulting from flow experiments and will provide a spatial framework through which more extensive physical and biological research and model simulations can be conducted to address scientific hypotheses and management goals related to the CRE. The methods used in the study offer a cost effective approach to system wide change detection that allows for repeatability in the future, while also providing a vehicle for communicating these results to a variety of resource managers in an adaptive ecosystem assessment and management program setting.

Contact Information: Michael J. Breedlove, Utah State University, 2255 N. Gemini Drive, Flagstaff, AZ 86001 USA, Phone: 928-556-7344, Fax: 928-556-7092, Email: mbreedlove@usgs.gov

Caspian Tern Relocation from the Columbia River Estuary: A Mitigation Strategy for the Recovery of the Endangered Columbia River Salmonids

Allison M. Bremner[1], *Geoff L. Dorsey*[2], *Kitia D. Chambers*[2], *Paul A. Schmidt*[2] and *Fari Tabatabai*[1]

[1]United States Army Corps of Engineers, San Francisco District, San Francisco, CA, USA
[2]United States Army Corps of Engineers, Portland District, Portland, OR, USA

In 1984, Caspian terns established a nesting colony on a portion of East Sand Island in the Columbia River Estuary that was used as a dredged material placement site by the United States Army Corps of Engineers (USACE). The Caspian tern colony, consisting of 1000 pairs of birds, relocated to Rice Island in 1986. By 1998, the colony had attained approximately 8700 pairs, and continues to be the largest colony of Caspian terns in the world. Monitoring results show the tern colony consumes millions of endangered salmon every year, representing a substantial portion of the out-migrant population of juvenile salmonids from some ESA-listed species reaching the Columbia River Estuary.

The Portland and San Francisco Districts of USACE have teamed up to relocate the Caspian tern colony to several alternative nesting sites in Oregon and California. Though ESA-listed fish prey species are difficult to avoid in Oregon and California, the proposed alternative nesting sites are located in watersheds that are rich in fish biodiversity. Per resource agency-issued Biological Opinions, a half-acre of tern habitat at Rice Island may be removed for every acre of habitat created elsewhere. The creation of islands designed for nesting habitat, in conjunction with social facilitation measures, thus far has proven successful. USACE is in the midst of monitoring relocated tern colonies at new nesting sites in Central Oregon, and building and planning new nesting sites in the San Francisco Bay Area and Northern California. Ultimately, this effort has the potential to significantly contribute to the recovery of the endangered Columbia River salmonids.

Contact Information: Allison M. Bremner, United States Army Corps of Engineers, San Francisco District, San Francisco, CA 94103, Phone: 415-503-6861, Fax: 415-503-6692, Email: allison.m.bremner@usace.army.mil

Case Study-Central Arroyo Seco Stream Restoration near Downtown Los Angeles

Timothy Brick[1], *Theodore Johnson*[2] and *Wendy Katagi*[3]
[1]Arroyo Seco Foundation, Pasadena, California, USA
[2]CDM, Denver, Colorado, USA
[3]CDM, Los Angeles, California, USA

The Arroyo Seco Watershed is a sub-watershed of the Los Angeles River watershed. The Arroyo Seco stream runs in a deeply incised canyon that begins in the San Gabriel Mountains and drains into the Los Angeles River near downtown Los Angeles. Below Devil's Gate Dam, most of the stream has been channelized. Prior to channelization, stands of alder, willow, and sycamore lined a perennial, trout-filled stream. Most stream and riparian habitats are located above the dam. The removal of riparian vegetation has significantly impacted wildlife and plant diversity. Urban development and exotic plant species have replaced the native vegetation below the dam. Chaparral, which covers much of the land mass in the adjacent Angeles National Forest, has encroached significantly within the Arroyo Seco watershed. The remaining riparian habitat now comprises only 15 percent of the total land mass within the watershed.

The natural channel reaches are also subject to flash flood events due to the highly impervious upstream-urbanized watershed, operational releases from the Devils Gate Dam and the hydraulic efficiency of the concrete-lined channel reach. Without backwater pools, fish and other aquatic species are at risk for being washed through to the downstream concrete-lined channelized portions of the Lower Arroyo Seco that are completely devoid of habitat.

The Central Arroyo Seco stream restoration is a pilot project to re-establish habitat for native fish populations with the arroyo chub as the target indicator species. Resting areas, juvenile rearing, and spawning grounds were created for the arroyo chub and other native fish through the construction of backwater pools, riffle/weirs, and a series of wing deflectors and snags. Local materials including boulders, fallen trees and logs, and root wads were utilized in the construction of stream channel enhancements. Construction of these stream improvements along with water quality related improvements to trails, banks, upland areas, adjacent parking lot, and citywide storm drains serve as a model for stream restoration in the community of Pasadena, the Los Angeles River watershed and the state of California.

Contact Informationa: Timothy Brick, Arroyo Seco Foundation, 539 E. Villa St. #2, Pasadena, California 91101, Phone: 626-792-2442, Email: tim@arroyoseco.org

Building Farmer Partnerships in a New Watershed-Scale Water Quality Project in Wisconsin

Joseph Britt
Sand County Foundation, Madison, WI

Several years of experience by Sand County Foundation and its partners in several Midwestern states with an incentive program for nutrient management practices at the farm scale led them to conclude that improvements in water quality – specifically reduced nutrient loads – resulting from altered land management practices could best be verified by applying practices on a subwatershed scale and monitoring the impact on nutrient loads in the subwatershed.

The site chosen, Kummel Creek in the Upper Rock River watershed in southeastern Wisconsin, is in an area primarily agricultural as to land use, with a mix of cash crop and dairy operations. Sand County Foundation, working in partnership with Wisconsin Discovery Farms, initiated a project by attempting to engage landowners within the watershed as active partners in the design and operation of the project, reasoning that technical obstacles to more effective nutrient management are less significant than underdeveloped relationships among neighbors and other parties interested in taking ownership of local water quality.

Cooperative projects, the logical alternative to command-and-control regulation of agriculture and other nonpoint sources of water pollution, have a mixed record of success to date. This is largely due, we believe, to inadequate attention given to why landowners choose to enter partnerships and how those partnerships can be made effective and sustained. The paper will explore lessons learned from the early, organizational stages of the Kummel Creek project.

Contact Information: Joseph Britt, Agricultural Incentives Director, Sand County Foundation, 5999 Monona Drive, Monona, WI 53716, Phone: 608-663-4605, ext. 30, Fax: 608-443-4617, Email: jbritt@sandcounty.net

Partnerships at Work Delivering Cutting-Edge Wetland Restoration in the North San Francisco Bay Estuary

John Brosnan
Sonoma Land Trust, Santa Rosa, CA, USA

This presentation will delve into how various types of project partnerships and efficiencies are coming together to complete the Sears Point Wetlands and Watershed Restoration Project in southern Sonoma County, California. In 2003, Sonoma Land Trust (SLT) spearheaded a coalition of public agencies, conservation organizations, private foundations, and local community members to raise $20 million to purchase and permanently protect 2,327 acres of ranchland and farm fields that had been proposed for development as a casino gaming complex along San Pablo Bay. Since then, SLT has maintained that same stakeholder group and, with them, set out to restore 970 acres of historic tidal marsh, associated seasonal wetlands, and an upland watershed of over 1,000 acres. The broad stakeholder group, along with a project team of wetlands experts, has developed innovative strategies by integrating two or more uses in one action, which ultimately seeks to streamline the restoration timetable and reduce overall costs.

While the restoration of 970 acres of historic tidal marsh is the most costly and engineering intensive element of the property's restoration, there are numerous other elements that comprise the project. The land trust's commitment to agriculture in the Sonoma Baylands region led to establishing a project goal to maintain agriculture in a way that enhanced the natural environment. SLT developed watershed and grazing management plans that propose a rotational grazing program to improve and restore habitats, allowing SLT to achieve its restoration goals while the cattle ranchers' operation is enhanced. Similarly, SLT is proposing to collaborate with farmers to continue oat-hay production on diked Baylands while enhancing native seasonal wetlands. SLT's project team worked with state and federal agencies to develop a lead contaminated soil clean up plan that allows for on-site reuse of the material and avoids an estimated $1 million in removal and disposal costs. Public access is being expanded along the bayfront in southern Sonoma County in conjunction with the development of stronger flood control levees.

Contact Information: John Brosnan, Sonoma Land Trust, 966 Sonoma Avenue, Santa Rosa, CA 95404, Phone: 707-526-6930 x 109, Email: john@sonomalandtrust.org

Periphyton Stormwater Treatment Areas (PSTA); Constructed Wetlands for Achieving Water Quality for Everglades Restoration

Peter Besrutschko[1] *Lisa Gued*[1], *Enid Gerena*[1], *Tim Brown*[1], *Ronald Jones*[2] and ***Ed Brown***[1]
[1]U.S. Army Corps of Engineers, Jacksonville, FL, USA
[2]Portland State University, Portland, OR, USA

The model for restoration Everglades ecosystem is based upon four (4) paradigms. To achieve restoration to produce historical patterns of; (1) water quantity, (2) water quality , (3) timing , and (4) distribution. The preponderance of the Comprehensive Everglades Restoration Plan (CERP) addresses components that achieve of quantity, timing and distribution of water. Yet it has been the water quality paradigm and its subsequent challenges that have forestalled CERP implementation. Restoration flows to the Everglades require a Total Phosphorus (TP) concentration of 10 μg/l. This standard has challenged CERP. To meet this imperative, the Jacksonsonville District studied promising technologies over the last decade. One biological technology "Periphyton Stormwater Treatment Areas (PSTA) has come the fore for meeting this standard and fulfilling the challenge.

Jacksonville District Corps of Engineers has conducted a "three phase" approach for scaling up STA 1 East to meet the imperative of achieving Everglades Quality Water. These phases comprise; 1) 1000 square foot mesocosm cells, 2) a 150 acre field scale PSTA demonstration, and 3) full scale implementation (multi-thousand acre) periphyton marshes. Currently, the program is in the 2nd phase (field scale application).

This presentation will discuss, compare and contrast the data from the first two phases of the program, the Flying Cow Rd Mesocosm data and the Field scale PSTA demonstration. Results for the 3 candidate substrates will be discussed as well as the processing rates. This will be used to forecast the effects of this promising technology for full scale implementation

Contact Information: Edwin Brown, US Army Corps of Engineers, 701 San Marco Blvd, Jacksonville, FL 32207, Phone: 904-232-2298, Email: edwin.brown@usace.army.mil

Decoupling ASR from the Greater Everglades, A Modest Proposal for Everglades Restoration

***Ed Brown**, June Mirecki, Orlando Ramos, Jessica McCaffrey* and *Jeff Hendel*
U.S. Army Corps of Engineers, Jacksonville, Florida, USA

Aquifer Storage & Recovery (ASR) was conceived as one of the pillars of Everglades Restoration. It creates approximately 236,000 ac-ft/yr of water to supply to the restoration of the natural system. Since its initial planning in the 90's, several pilot studies have been inaugurated. During these pilot studies several realities have emerged that affect full scale implementation. These include: (1) high cost of pre-storage treatment; (2) further evolution of Everglades Water Quality criteria; (3) realities of suitable storage zones and lower recovery efficiencies at point of recharge; (4) commencement of the Lake Okeechobee Fast Track Projects (LOFT) North of the Lake storage requirements; (5) Northern Everglades and Estuaries Protection Program; (6) increased requirements of dry season water in Northern Estuaries (Caloosahatchee and Saint Lucie); (7) impact of Hurricanes Jean, Frances, and Wilma upon Lake Okeechobee; (8) selection of a CERP Lake Okeechobee Watershed Project(LOWS).

This presentation proposes a decoupling of ASR from flows to Greater Everglades and dedicates it to supplying dry season flows to Saint Lucie River Estuary and Caloosahatchee River Estuary. Demands for dry season flows are 300 and 450 cubic feet per second (CFS), respectively, during five(5) months of dry season, totaling volumes of thousand acre-feet per year. This equates to almost 140 ASR wells at 70% recovery. This accounts for a 100% redundancy in the LOWS project reservoirs. Dry season water supply deliveries are employed to maintain mesohaline conditions for oyster reef and sea-grass bed recovery. These restoration communities are not impacted by chlorides and other ions as soft-water periphyton communities of Greater Everglades ecosystem, although ASR water is not proven yet to adversely affect the softwater periphyton communities. Meanwhile, the 236,000 acre feet of ASR storage provide significant respite from regulatory releases that impact the oyster and sea-grass communities.

The CERP LOWS tentatively selected plan, IRL South Plan, LOFT, Northern Everglades and Estuary Protection plan identify substantial needs for storage and identify several feasible reservoirs and Storm water Treatment Areas (STA's). These plans state the need for increased water storage approaching one million acre-feet. The projects are strategically suited and optimally located for the application of apply ASR. Coupling of these components with ASR provides redundancy and contingency in the plans. STA's consistently meet ASR quality storage standards and are strategically located for treatment of recovered water. Coupling STAs with ASR leverages water treatment capabilities. It further increases program feasibility as it is believed that treatment accounts for 50-75 % of ASR facility capital cost. ***This presentation will describe how this planning approach could be used to address uncertainties in ASR and implementing these large scale Restoration Plan Components.***

Contact Information: Edwin Brown, U.S. Army Corps of Engineers, 701 San Marco Blvd., Jacksonville, FL 32207 USA, Phone: 904-232-3647, Fax: 904-232-3665, Email: edwin.brown@usace.army.mil

Forecasting Effects of Nutrient Loading and Availability of an Ecosystem Restoration Project in the Caloosahatchee and St. Lucie Estuaries of Florida

Edwin Brown[1], *Gretchen Ehlinger*[1], *Kelly Keefe*[1], *Marie Carmen Lopez*[1] and *Katie McCallion*[2]
[1]U.S. Army Corps of Engineers, Jacksonville, FL USA
[2]Everglades Joint Partners Venture, Jacksonville, FL USA

The magnitude, timing and distribution of freshwater inflow to the St. Lucie River Estuary (SLE) and the Caloosahatchee River Estuary (CRE) have been disrupted by anthropogenic alterations over the course of Southern Florida history. These include over drainage of coastal watersheds and artificial connections to Lake Okeechobee (LO). This has affected nutrient loads as well as the relative availability of nutrients. Comprehensive Everglades Restoration Program (CERP) projects are proposed to achieve a more ecologically suitable pattern of freshwater inflow to these systems. This will similarly affect nutrient loads and availability.

Nitrogen: phosphorus stoichiometry in primary producers has served as integrators of ecological processes. Restoration of seagrass communities (in estuarine components) of the Everglades is one of the goals of CERP. The “Redfield ratio” facilitates understanding of nutrient dynamics and further serves as an evaluation method of the relative availability of nutrients in estuarine plant communities. This has been used as a surrogate for relative nutrient availability for seagrasses, macroalgae and phytoplankton. An idealized succession of phytoplankton to *Thalassia* spp. occurs from Redfield gradients of 16 to 30, respectively. Similarly, high Redfields (above 30) create similar create phosphorus limitation of seagrasses.

Regulatory releases provide significant loads to the SLE and CRE. According to the South Florida Water Management District, 83 MT of TP and 881 MT of TN are contributed annually to the SLE from Lake Okeechobee. Similarly, 65 MT of TP and 1584 MT of TN are contributed annually to the CRE from Lake Okeechobee. These have Redfield ratios of 23.4 for SLE and 53.7 for CRE. These vary significantly from theoretical seagrass ratios of 30 and favor blue green macroalgae. Since Lake Okeechobee contributes significant nutrient loads to the both the CRE and SLE estuaries, these loads and ratios will be effected by the construction and operation of CERP Reservoirs and Stormwater Treatment Areas (STA’s). Moreover, they can be isolated from the effect of other non-CERP programs such as BMP’s, land use changes, TMDLs, and basin run off controls.

Conceptual ecological models require further development in order use the South Florida Water Management Model (SFWMM) output to evaluate restoration effects. For this reason, CERP regional evaluations, CERP updates and other forecasting techniques have not employed these models. This poses a dilemma as the ecological effects of CERP can not be examined in regional evaluations. To address this dilemma, an interim methodology is proposed that employs SFWMM output and uses structure nutrient data to forecast the effects of CERP on seagrass nutrient availability. This presentation will present this methodology.

Contact Information: Edwin Brown, U.S. Army Corps of Engineers, 701 San Marco Blvd., Jacksonville, FL 32207 USA, Phone: 904-232-3647, Fax: 904-232-3665, Email: Edwin.Brown@uasce.army.mil

Willamette River Floodplain Restoration Study – Coast Fork and Middle Fork Willamette River Subbasins

Chris Budai[1], *Merri Martz*[2] and *Leslie Bach*[3]
[1]Planning and Project Management Branch, Portland District, U.S. Army Corps of Engineers, Portland, OR, USA
[2]Surface Water Group, Tetra Tech, Inc., Portland, OR, USA
[3]Freshwater Programs, The Nature Conservancy, Portland, OR, USA

The purpose of this study is to restore natural floodplain function along the Willamette River and its tributaries. The study emphasizes the identification of opportunities for the restoration of aquatic and riparian ecosystems, recovery of proposed and listed threatened and endangered species, and improvement of water quality. The study area is the Willamette River Basin of western Oregon. The Willamette is a major tributary of the Columbia River and is the tenth largest river in the United States, based on average annual flow.

This study is being conducted in phases due to the large size and complexity of the Willamette River Basin. The current study phase involves the feasibility study of floodplain restoration opportunities in the lower Coast and Middle Forks of the Willamette River. The Coast and Middle Forks study is a pilot project to develop the tools needed to more clearly understand the complex and dynamic interaction between the river and its floodplain and develop restoration alternatives to function in this dynamic environment. The tools and other information developed in this phase will then be used in the analysis of other subbasins within the larger Willamette River Basin.

The Coast Fork and Middle Fork subbasins are located in the southern portion of the Willamette River Basin. These particular subbasins were chosen for several reasons. First, many opportunities exist below the dams to restore natural floodplain functions. Second, Corps' dams and bank protection projects, among other activities, have significantly altered hydrologic and hydraulic conditions in these subbasins. Third, the high percentage of public land ownership in these subbasins, as compared to other major tributaries and the mainstem Willamette, increases the likelihood that a cost-effective, integrated restoration plan can be implemented. Finally, there is a high degree of interest in floodplain restoration among stakeholders and potential sponsors in these subbasins.

In addition to the restoration alternatives the study evaluates, the Corps has collaborated with The Nature Conservancy on the Sustainable Rivers Project (SRP) to develop and implement environmental flows on the Middle Fork. Environmental flows that consist of a full range of pulses or high flows accomplish various fish habitat maintenance and creation through mechanisms such as sediment distribution, channel forming processes, overbank flows, and maintaining access to side or off-channel habitat.

Contact Information: Chris Budai, U.S. Army Corps of Engineers, Portland, OR 97204, USA, Phone: 503-808-4725, Email: christine.m.budai@usace.army.mil

Smart Growth as a Catalyst for Tidal Wetlands Restoration in San Francisco Bay

Keith Bowers and ***Allegra Bukojemsky***
Biohabitats, Inc.

Redwood City is a community centrally located on the San Francisco peninsula fronting the San Francisco Bay. With both an active port and as a hub of Silicon Valley, Redwood City is an area rich in jobs that promises continued population and economic growth. However, the availability of housing is not keeping up with the jobs growth, and is becoming less affordable to the working class. Many households resort to living in outlying communities and commuting long distances to work, which places a burden on air quality, public roadways, quality-of-life and contributes to climate change. The projected regional impacts to traffic congestion and resource demand necessitate a transition for smarter, denser communities.

To address these regional issues, the Redwood City Saltworks site, a 1,433 acre salt production facility owned and operated by Cargill Salt's West Bay operations, is contemplating, based on citizen input, a mixed-use urban community that will also serve as a catalyst for the restoration of hundreds of acres of tidal salt marsh restoration on the site at no expense to the public. The project is committed to preserving at least 50 percent of the site for open space and restored wetlands habitat — while utilizing up to 50 percent of the land for a mixture of developed uses.

The Redwood City Saltworks project proposes a privately funded, innovative restoration approach that incorporates a unique combination of active and passive restoration techniques. This approach places emphasis on protecting adjacent tidal wetlands while creating a diversity of tidal wetland and upland transition habitat

Contact Information: Allegra Bukojemsky, Biohabitats, Inc. 520 Sutter St, San Francisco, CA 94110 USA, Phone: 415-274-2822, Email: allegrab@biohabitats.com

Irrigation Regime and Vegetation Density Effects on Success of Riparian Revegetation

***Daniel P. Bunting*[1]**, *Matthew R. Grabau*[2], *Michael A. Milczarek*[3], *Gregg Garnett*[4], *Martin Karpiscak*[5] and *David Quanrud*[6]
[1]Office of Arid Lands Studies, The University of Arizona, Tucson, AZ, USA
[2]GeoSystems Analysis, Inc.,Tucson, AZ, USA
[3]GeoSystems Analysis, Inc., Tucson, AZ, USA
[4]US Bureau of Reclamation, Boulder City, NV, USA
[5]Office of Arid Lands Studies, The University of Arizona (Emeritus), Tucson, AZ, USA
[6]Office of Arid Lands Studies, The University of Arizona, Tucson, AZ, USA

A major objective of land management agencies in the west is the development of riparian plant communities for the benefit of native fauna. As a portion of the Lower Colorado River Multi-Species Conservation Program, the Bureau of Reclamation is converting agricultural fields to restoration areas using existing irrigation infrastructure to support native mesic species. For long-term management considerations, high water use and low drought tolerance of cottonwood, willows, and other desired species must be considered. A balance is desired to minimize water use and maintenance costs, while limiting tree stress and mortality. Additionally, irrigation practices might be used which favor native species over saltcedar (*Tamarix* spp.) in restoration areas. Numerous studies have shown that cottonwood (*Populus* spp.) outcompete saltcedar under irrigation that mimics natural flooding. Optimum drawdown rates encourage root elongation and above-ground growth. Riparian trees also access shallow water tables, complicating irrigation management and salinity control, but potentially reducing reliance on irrigation.

In May 2007, small-scale study plots at Cibola National Wildlife Refuge were planted with Fremont cottonwood (*Populus fremontii*), Goodding's willow (*Salix gooddingii*), and coyote willow (*Salix exigua*). Saltcedar established in abundance as a volunteer species. Soil salinity, temperature, and water content at various depths as well as depth to groundwater are being monitored continuously with an automated data acquisition system. Cottonwood establishment ranged from 0 to 60 trees per sq meter, with abundant saltcedar establishment as well.

During the 2008 growing season, two irrigation regimes were implemented—7 cm of water once per week versus 21 cm of water once per three weeks—to provide two treaments, i.e. small versus large estimated depletion of plant-available water. Vegetation characteristics were monitored at the beginning and end of the growing season, and individual trees were tagged to allow repeat measurements of height and mortality. During the 2008 growing season, cottonwood crown (overstory) cover increased from 41% to 57% whereas saltcedar crown cover increased from 10% to 12%. Cottonwood density decreased from 13.6 stems/m^2 to 12.8 stems/m^2 with a mortality rate of 5.85%. Saltcedar density decreased from 16.3 stems/m^2 to 14.4 stems/m^2 with a mortality rate of 11.59%. Total average cottonwood growth rates were 0.44 cm/day while saltcedar were 0.06 cm/day. Trees in larger height classes had higher growing rates across all treatments. Current results indicate that cottonwood seedlings might exhibit a competitive advantage over saltcedar. Proposed 2009 variables include higher moisture depletion between irrigation events to determine if irrigation frequency can be further reduced while maintaining high survival and competitive advantage of native trees.

Contact Information: P. Daniel Bunting, Office of Arid Lands Studies, University of Arizona, Tucson, AZ 85721 USA, Phone: 520-240-7832, Fax: 520-741-1468, Email: bunting@Email.arizona.edu

Tools for Increased Collaboration: The CERPZone

***Barbara Burch*[1], *Bill Hall*[2]** and *Deborah Hesse Scerno*[3]
[1]Jacksonville District, Army Corps of Engineers – Information Technology, Jacksonville, FL, USA
[2]South Florida Water Management District, West Palm Beach, FL, USA
[3]Everglades Partners Joint Venture/Parsons, Jacksonville, FL, USA

From the inception of the Comprehensive Everglades Restoration Plan, it was realized that a multi-agency interactive collaborative environment was going to be required. An environment that enabled not only collaboration, but also the storage, retrieval and preservation of information related to the Everglades Restoration effort. In 2001, the CERPZone website was created and over the past 8 years the information professionals involved have provided a number of tools to enable collaboration between the various CERP stakeholders through the Internet.

One of the first tools to gain widespread use among the stakeholders was Documentum, which is a records management and control system. This system allows access to documents through the Internet for interagency collaboration. Documentum access control provides for different privilege levels to be assigned to users on a folder or document level and enables documents to be “locked” while being edited. Edits can be saved as a new version and includes information to identify the author of the changes. Lastly, this solution allows for the storage of many types of documents as well as information about the properties of documents.

Although Documentum allows for the storage of many types of documents, there are some files that are better stored in an electronic file system. Some examples are model result files, model runs, raw sample data, databases, geographic information and maps. To store this information, a “common drive” that is accessible from the Internet was established utilizing a Citrix environment. Access is secured by requiring a user account and password. This collaboration tool is easy to use and has proven invaluable for transferring large files from one location (or agency) to another.

Another collaborative tool that quickly gained popularity is the interactive web conferencing. Web conferencing is used to conduct live meetings or presentations over the Internet. This allows each participant to sit at his or her own computer and view the same content as it is being presented or changed. This tool, which is based on Adobe Connect, has reduced the amount of travel required for meetings.

Besides the collaboration tools, there are many other resources on the CERPZone website. Examples of resources include information such as a directory of users, key contacts for projects, meeting announcements and a map library. Other resources include access to tools to do such things as post meeting announcements, display benefits of the projects, schedule web conferences, and request the creation of maps. The CERPZone is a diverse Internet resource for stakeholders involved in Everglades Restoration that promotes collaboration and information sharing.

Contact Information: Barbara Burch, Army Corps of Engineers-Information Technology, 701 San Marco Boulevard, Jacksonville, FL 32207 USA, Phone: 904-232-2741, Email: Barbara.J.Burch@usace.army.mil

Bill Hall, South Florida Water Management District, 3301 Gun Club Road, West Palm Beach, FL 33406 USA, Phone 561-682-6035, Email: bhall@sfwmd.gov

Scaling Up Restoration of Nesting Habitat for Cactus Wrens in Orange County, California

Jutta C. Burger[1], *Megan Lulow*[1], *Robert A. Hamilton*[2], *Susan Anon*[1], *Isaac Ostmann*[1], *Yi-Chin Fang*[1], *David Olson*[1] and *Michael O'Connell*[1]
[1]Irvine Ranch Conservancy, Irvine, CA, USA
[2]Consulting Biologist, Long Beach, CA, USA

Populations of the Cactus Wren (*Campylorhynchus brunneicapillus sandiegensis*, *C. b. anthonyi* in part) have been declining rapidly in coastal southern California over the last 15 years. Cactus Wrens require older-growth cactus patches to nest and shelter. Numerous large wildfires have substantially decreased, damaged, and fragmented the cover of mature cactus scrub in the region. Long-term monitoring has demonstrated that restoration efforts are urgently needed to keep this species from being extirpated locally. We are using three coordinated interventions to rapidly increase habitat for the Cactus Wren. First, we designed and installed two distinct models of "artificial cactus" in seven locations currently occupied by Cactus Wrens to determine whether the birds will build nests in them. If successful, such structures could be used as a stop-gap measure to provide wrens with nesting substrate while suitable cactus scrub habitat recovers. Results from the first year of this experiment will be presented. Second, to determine best practices for cactus restoration, propagules have been planted across two weed-cover regimes and in burned and unburned microsites of four cactus scrub patches. Patterns of first-year survival and growth will be presented. Lastly, we are scaling up restoration across 40 sites in strategic locations within the Nature Reserve of Orange County, taking into account connectivity between Cactus Wren territories, the size of extant cactus patches, minimum patch size required by wrens, and severity of damage to burned cactus patches. Results from these efforts should identify practical techniques for restoration of cactus scrub at temporal and spatial scales significant to the Cactus Wren.

Contact Information: Jutta C. Burger, Irvine Ranch Conservancy, 4727 Portola Parkway, Irvine, CA 92602, Phone: 714-508-4765, Fax: 714-508-4785, Email: jburger@irconservancy.org

A Small Unmanned Aircraft System for Ecological Research

Matthew A. Burgess[1]*, H. Franklin Percival*[1]*, Adam C. Watts*[1]*, Peter G. Ifju*[2]*, Kyuho Lee*[2]*,*
Joshua A. Childs[2]*, Brandon Evers*[2]*, Thomas J. Rambo*[2]*, Scot E. Smith*[3]*, Ahmed Mohamed*[3]*,*
Bon A. Dewitt[3]*, John H. Perry*[3]*, Zoltan Szantoi*[3]*, Peter C. Frederick*[4]*, John C. Simon*[4]*,*
Larry E. Taylor[5] and *Jon S. Lane*[5]

[1]Florida Cooperative Fish and Wildlife Research Unit, University of Florida, Gainesville, FL, USA
[2]Department of Mechanical and Aerospace Engineering, University of Florida, Gainesville, FL, USA
[3]School of Forest Resources and Conservation, University of Florida, Gainesville, FL, USA
[4]Department of Wildlife Ecology and Conservation, University of Florida, Gainesville, FL, USA
[5]US Army Corps of Engineers, Jacksonville District, Jacksonville, FL, USA

An interdisciplinary team of researchers at the University of Florida (UF) have developed the Nova 2 small Unmanned Aircraft System (sUAS) designed specifically as a low-cost, autonomous, survey-grade tool for ecological research. The system is comprised of a 2.5 meter wingspan aerial platform capable of amphibious landing, a ground station for autonomous control, and a wireless datalink connecting the components. The hand-launchable airframe has electric motor propulsion, and operates on lithium-ion batteries which provide power for missions of up to one hour in duration. The autopilot is a commercial-off-the-shelf unit produced by Procerus Technologies. Imagery data is achieved with a variety of onboard sensor payloads including a high-resolution single lens reflex digital camera, a video camera, or thermal infrared camera depending on the application. Still images are automatically georeferenced using a high-resolution inertial measurement unit attached to the imaging payload. Georeferenced images can be overlaid into popular mapping tools such as Google Earth or ArcGIS using technology developed at UF. Image resolution, as high as 2 cm at an altitude of 60 meters, with georeferencing accuracy of 10 meters, has been routinely attained. Applications of the Nova 2 sUAS include surveys of wildlife populations, habitat assessments, and invasive species monitoring. The feasibility and limitations of additional ecological applications are also discussed.

Contact Information: Matthew A. Burgess, Florida Cooperative Fish and Wildlife Research Unit, PO Box 110485, University of Florida, Gainesville, FL. 32611-0485, USA, Phone: 352-318-1615, Fax: 352-846-0841, Email: mburgess@ufl.edu

Capturing the Human Dimension of Ecosystem Restoration: Using GIS and Multi-Criteria Decision Analysis to Measure Ecosystem Services Affected by Proposed Restoration Plans Along the Middle Rio Grande

Kelly A. Burks-Copes[1], *Jim E. Henderson*[1], *Ondrea C. Hummel*[2], *Barry S. Payne*[1] and *Antisa C. Webb*[1]

[1]Environmental Laboratory, US Army Engineer Research and Development Center, Vicksburg, MS
[2]Albuquerque District, US Army Corps of Engineers

Historically, the Rio Grande was a heavily braided, aggrading stream meandering freely across a wide floodplain in the arid southwest (Colorado, New Mexico and Texas). As it meandered through time and space, the river and floodplain sustained a mosaic of riparian communities from cottonwood riparian gallery forest and coyote willow shrublands, to wet meadows, oxbow ponds, and open water areas referred to collectively as the “Bosque.” This unique ecosystem provided goods and services to local communities including fresh water, fuels, climate regulation, groundwater recharge, recreation opportunities, and an overall sense of societal connectivity to the environment. Urban development and water management measures have resulted in the disruption of the Bosque’s original hydrologic regime, reducing the system’s overall functionality and threatening the continuation of these critical ecosystem services. The goal of the Middle Rio Grande Bosque Ecosystem Restoration Project has therefore been to develop and evaluate plans to restore the Bosque’s structure, function, and provisions of services back to a healthy, biologically diverse, stable, and sustainable system that embodies the historic wildness and beauty of this unique ecosystem. Over the course of three years, the study team developed and evaluated more than 50 restoration plans using state-of-the-art technology developed by the U.S. Army Engineer Research and Development Center’s Environmental Laboratory (ERDC-EL). Although the traditional (well accepted) tools of habitat evaluation (i.e., HEP) were used to assess some ecosystem benefits, the stakeholders made a novel choice to include the valuation of critical ecosystem services in the process. Using GIS, expert elicitation and Multi-Criteria Decision Analysis (MCDA), ERDC-EL developed a process to bundle both the services and the more traditional outputs in a fashion that infused the ecosystem’s human dimension seamlessly into evaluation process. Here we present the USACE’s first ever attempt to incorporate ecosystem services into a restoration project and discuss our experiences in selecting, mapping, and quantifying ecosystem services under the current USACE planning paradigm.

Contact Information: Kelly A. Burks, Environmental Laboratory, US Army Engineer Research and Development Center, Vicksburg, MS 39180, USA, Phone: 601- 634-2290, Fax: 601- 634-2417,
Email: Kelly.A.Burks-Copes@usace.army.mil

Coupling Conceptual Models with GIS to Develop a Community-based Index Model for the Missouri River Cottonwood Management Plan

Kelly A. Burks-Copes[1], *Lisa A. Rabbe*[2], *Suzanne Boltz*[3], *Kristine Nemec*[4], *Antisa C. Webb*[1] and *Greg Kiker*[5]
[1]Environmental Laboratory, US Army Engineer Research and Development Center, Vicksburg, MS
[2]US Army Corps of Engineers, Alaska District
[3]EA Engineering, Science and Technology
[4]US Army Corps of Engineers, Omaha District
[5]Agricultural and Biological Engineering Department, University of Florida

In compliance with the U.S. Fish and Wildlife Service (USFWS) Biological Opinion (Bi-Op) regarding the Missouri River Operation activities, the Omaha and Kansas City Districts are actively pursuing restoration and preservation initiatives to offset past losses of cottonwood forests due in part to damming and channelizing the Missouri River in the early 1950s. Because the study area encompasses an enormous geographic range (1,500+ river miles flowing through 7 states), a decision was made to divide the system into 13 (6 of which were designated as priorities by USFWS) segments and address the restoration/preservation of each segment in an incremental (segment-by-segment) fashion. However, the functioning of the system's cottonwood riparian ecosystem can be affected by the current and future conditions at the local, regional and basin-wide scales. As such, the emphasis placed on a "systems" approach to the Missouri River Bi-Op's planning process has given rise to the need for methods to characterize habitat conditions now and in the future in a portable, adaptive manner with landscape-level sensitivity. As part of the cottonwood management planning effort, an extensive multidisciplinary ecosystem evaluation team has developed (and is currently applying) a community-based cottonwood index model to characterize the current state of the ecosystem today, and evaluate/compare the outputs of proposed preservation and restoration plans in the first of the 6 segments in the study (Segment 10 – a 59-mile stretch of "Wild and Scenic" Missouri River flowing from Gavins Point Dam to Ponca State Park in South Dakota and Nebraska). Here we provide a detailed look at the cottonwood model – its variables, formulas, and overall composition. A discussion of the modeling and application process will include our reference-based approach to calibration (including historical pre-damming characterizations); the expert elicitation strategies used to forecast landuse conversion, forest succession, and potential global climate change factors; the risk and uncertainty analysis incorporated into the plan formulation and evaluation efforts; and ultimately the development of a standardized, integrated planning procedure that will now be used to systematically evaluate the segments (both upstream and downstream) highlighted in the Missouri River Bi-Op's cottonwood management plan.

Contact Information: Kelly A. Burks, Environmental Laboratory, US Army Engineer Research and Development Center, Vicksburg, MS 39180, USA, Phone: 601-634-2290, Fax: 601-634-2417,
Email: Kelly.A.Burks-Copes@usace.army.mil

Incorporating GIS into the Development of Community-Based Index Models to Better Capture the Watershed Response to Proposed Planning Designs

Kelly A. Burks-Copes[1], *Lisa A. Rabbe*[2], *Ondrea C. Hummel*[3], *Andrea K. Catanzaro*[4] and *Antisa C. Webb*[1]
[1]Environmental Laboratory, US Army Engineer Research and Development Center, Vicksburg, MS
[2]US Army Corps of Engineers, Alaska District
[3]US Army Corps of Engineers, Albuquerque District
[4]US Army Corps of Engineers, Galveston District

Abstract: Despite the fact that landscape level processes dictate ecosystem function and sustainability, past USACE ecosystem restoration planning and management decisions have typically been made on a project-by-project basis. Watershed planning, centered on the strategic restoration of land and water resources, has the potential to provide dramatic benefits by restoring ecosystem-level functions and services. Attaining ecosystem integrity (i.e., health, biodiversity, stability, sustainability, naturalness, wildness, and beauty) is the goal of ecosystem restoration and management and of particular concern to the USACE. Here the authors propose the development of community-based index models that capture ecosystem integrity using four primary components: Diversity, Vegetative structure, Hydrography (including water quality, hydrology, and biogeochemical/soil characteristics), and Spatial Context (ranging from connectivity to disturbance). Modelers and planners alike can use this information to develop community index models for any setting, and by loosely coupling GIS with these tools, can improve the efficiency and effectiveness of the alternative design and evaluation process. We will present examples of various GIS-derived variables we have successfully used within the community modeling context in three studies, and offer some lessons learned to modelers, planners, GIS experts regarding their development and application. To conclude, we will demonstrate the visualization of these modeling outcomes inside the System-Wide Water Resources CorpsGlobe (Google Earth) environment. This visually engaging medium allows scientists and stakeholders alike to compare and contrast the proposed alternatives from a unique "flyover" perspective.

Contact Information: Kelly A. Burks, Environmental Laboratory, US Army Engineer Research and Development Center, Vicksburg, MS 39180, USA, Phone: 601-634-2290, Fax: 601-634-2417,
Email: Kelly.A.Burks-Copes@usace.army.mil

Using GIS and Multi Criteria Decision Analysis to Select Restoration and Preservation Sites for the Missouri River Cottonwood Management Plan

Kelly A. Burks-Copes[1], *Lisa A. Rabbe*[2], *Suzanne Boltz*[3], *Kristine Nemec*[4], *Antisa C. Webb*[1] and *Greg Kiker*[5]

[1]Environmental Laboratory, US Army Engineer Research and Development Center, Vicksburg, MS
[2]US Army Corps of Engineers, Alaska District
[3]EA Engineering, Science and Technology
[4]US Army Corps of Engineers, Omaha District
[5]Agricultural and Biological Engineering Department, University of Florida

In response to the USFWS Biological Opinion (Bi-Op) on the impacts to cottonwood riparian zones supporting bald eagles along the Missouri River, the Omaha and Kansas City Districts have initiated planning effort to study and select potential conservation and restoration sites to offset these loses. However, the sheer magnitude of this effort has led the Districts to streamline their typical site screening procedures and adopt more standardized and automated approaches to selecting recommended targets for restoration/preservation to save time and money. Here we introduce a sieve-mapping GIS-based decision support system that employs expert elicitation to identify spatially-explicit “siting” criteria and prioritizes these inputs within a Multi-Criteria Decision Analysis (MCDA) framework. We will provide a detailed look at the site selection process – the expert elicitation, the criteria themselves, and the decision support tools used to locate and screen potential sites. We will conclude with a discussion of how these tools and processes have been automated to facilitate the site selection process in support of future segment evaluations under the Missouri River Bi-Op’s Cottonwood Management Plan.

Contact Information: Kelly A. Burks, Environmental Laboratory, US Army Engineer Research and Development Center, Vicksburg, MS 39180, USA, Phone: 601-634-2290, Fax: 601-634-2417,
Email: Kelly.A.Burks-Copes@usace.army.mil

Streambank BioEngineering and Riparian and Aquatic Habitat Restoration and Enhancement at Adobe Ranch, Mono Co., California

Robert Pearce[1] and ***Casey Burns***[2]
[1]USDA-Natural Resources Conservation Service Field Office, Bishop, CA, USA
[2]USDA-Natural, Resources Conservation Service Field Office, Somis, CA, USA

In this presentation we describe work done on a Natural Resources Conservation Service (NRCS) Wetland Reserve Program (WRP) easement located on Adobe Creek, Mono County, California. Private land agricultural operators in this region are faced with development pressure as a result of limited private lands (Mono County is 91% federal, state, or agency owned).

Conservation easements are an option for land owners, allowing them to maintain their agriculture lands while promoting environmental stewardship and wildlife habitat, and providing financial incentives to keep their land undeveloped. The Adobe project began in 2003 and has undergone primary planning and engineering phases. Restoration work began during the fall of 2007. The Adobe easement covers approximately 1,600 acres. The goals of the project are to enhance wildlife habitat, reduce streambank erosion, and to restore irrigated meadows and grazing lands to native wetland, riparian, and upland habitats. The project increases the diversity and total acreage of wetlands for shorebird and waterfowl habitat, and restores riparian habitat to benefit migrant and resident birds and other wildlife. Through structure placement and water management, we will restore irrigated meadows to a combination of seasonal wetlands and upland shrub habitant. In order to measure the success of the project we have implemented a multifaceted monitoring component. Monitoring will allow us to track changes in stream geomorphology, discharge, and wetland function and condition. We have been monitoring changes in vegetation as irrigated lands return to upland, pastures convert to seasonal wetlands, and riparian systems recover from past diversions. Finally, are measuring the response of bird populations and other wildlife. Data has been gathered since 2004. The Adobe WRP project is a perpetual easement and will require adaptive management in response to habitat changes as the project moves forward.

Contact Information: Casey Burns, Natural Resources Conservation Service, PO Box 260, Somis, CA 93066 USA, Phone: 805-386-4489 x105, Email: casey.burns@ca.usda.gov

Streambank BioEngineering and Riparian Habitat Restoration and Enhancement at Adobe Meadows, Mono Co., California

Robert Pearce[1], ***Casey Burns***[2]**,** *Jessica Groves*[3]*, Jon Fripp*[4]*, Chris Hoag*[5] and *Peter Frick*[6]
[1]USDA-Natural Resources Conservation Service (NRCS) Field Office, Bishop, CA
[2]NRCS Field Office, Somis, CA
[3]NRCS State Office, Davis, CA
[4]NRCS National Design, Construction & Soil Mechanics Center, Fort Worth, TX
[5]NRCS Plant Materials Center, Aberdeen, ID
[6]Greenbridges, LLC., Bakersfield, CA

In this presentation we describe work done on a Natural Resources Conservation Service (NRCS) Wetland Reserve Program (WRP) easement located on Adobe Creek, Mono County, California. Private land agricultural operators in this region are faced with development pressure as a result of limited private lands (Mono County is 91% federal, state, or agency owned).

Conservation easements are an option for land owners, allowing them to maintain their agriculture lands while promoting environmental stewardship, wildlife habitat, and providing financial incentives to keep their land undeveloped. The Adobe project began in 2003 and has undergone primary planning and engineering phases. Restoration work began during the fall of 2007. The Adobe easement covers approximately 1,600 acres. The goals of the project are to enhance wildlife habitat, reduce streambank erosion, and to restore irrigated meadows and grazing lands to native wetland, riparian, and upland habitats. The project increases the diversity and total acreage of wetlands for shorebird and waterfowl habitat, and restores riparian habitat to benefit migrant and resident birds and other wildlife. Through structure placement and water management, we will restore irrigated meadows to a combination of seasonal wetlands and upland shrub habitant. In order to measure the success of the project we have implemented a multifaceted monitoring component. Monitoring will allow us to track changes in stream geomorphology, discharge, and wetland function and condition. We have been monitoring changes in vegetation as irrigated lands return to upland, pastures convert to seasonal wetlands, and riparian systems recover from past diversions. Finally, PRBO Conservation Science has been measuring the response of bird populations since 2004. The Adobe WRP project is a perpetual easement and will require adaptive management in response to habitat changes as the project moves forward.

Contact Information: Casey Burns, Natural Resources Conservation Service, PO Box 260, Somis, CA 93066 USA, Phone: 805-386-4489 x105, Email: casey.burns@ca.usda.gov

Biological Diversity in San Francisco Bay and the Effects of Climate Change

John C. Callaway[1], *V. Tom Parker*[2], *Michael C. Vasey*[3], *Lisa M. Schile*[4] and *Ellen R. Herbert*[2]
[1]Department of Environmental Science, University of San Francisco, San Francisco, CA, USA
[2]Department of Biology, San Francisco State University, San Francisco, CA, USA
[3]Department of Environmental Studies, University of California, Santa Cruz, CA, USA
[4]Department of Environmental Science, Policy & Management, University of California, Berkeley, CA, USA

Climate change is likely to cause significant shifts in salinity regimes and inundation rates of San Francisco Bay tidal wetlands, resulting in substantial impacts on the plant community. Climate models predict changes in freshwater runoff to coastal areas due to reductions in snowmelt and increases in rain, leading to seasonal shifts in estuarine salinities.

Increases in salinity during the growing season are likely to reduce wetland plant diversity as freshwater and brackish wetlands are converted to salt marsh ecosystems. Our recent research at sites across the North San Francisco Bay and Delta indicates that plant species richness decreases from over 200 species in freshwater tidal systems to 10-20 species in Bay salt marshes. Rare plants in tidal freshwater and brackish wetlands are likely to be affected, and shifts in physical conditions could cause changes in distributions of non-native plants within the Bay. In addition, as tidal wetlands become subjected to increased salinity stress, overall rates of primary productivity will decrease.

Projected increases in sea-level rise will increase tidal inundation rates. Tidal wetlands can counteract increases in sea-level rise through increased rates of sediment accumulation, although there are limits to the amount of sediment that can accumulate. If tidal wetlands can not keep pace with sea-level rise, they may migrate inland in places where they are not surrounded by steep topography or developed landscapes. Under high rates of sea-level rise, tidal wetlands are likely to be inundated and converted to unvegetated mudflats, resulting in major losses in overall plant diversity.

Restoration sites will be particularly vulnerable to climate change given unpredictable sediment inputs and newly established vegetation that will be particularly sensitive to changes in salinity and inundation. Without vegetation in place to stabilize sediments, large areas could be subject to erosion. Another important feedback mechanism associated with climate change is the reduction in primary productivity causing reduced organic matter accumulation belowground, a critical component to sediment accumulation rates in many tidal wetlands.

Contact Information: John Callaway, Department of Environmental Science, University of San Francisco, 2130 Fulton St., San Francisco, CA 94117, USA, Phone: 1.415.422.5702, Fax: 1.415.422.6387,
Email: callaway@usfca.edu

Partnering for Ecosystem Restoration: the Natural Resources Conservation Service and the U.S. Army Corps of Engineers

Anne Cann[1] and ***Doris Washington***[2]
[1]Institute for Water Resources, U.S. Army Corps of Engineers, Alexandria, VA, USA
[2]National Water Management Center, Natural Resources Conservation Service, Little Rock, AR, USA

The NRCS/USACE Partnership Agreement, signed July 7, 2005, promotes a long-term working relationship to improve the management of water and related natural resources under the missions and authorities of NRCS and USACE. The agencies have pledged to work together in the following areas: 1) watershed planning; 2) wetlands creation, restoration and enhancement; 3) natural disaster recovery; and 4) activities related to Wetlands Conservation and Regulatory Compliance.

An interagency team has been working on the development of mechanisms for strengthening working relationships between NRCS and USACE. Senior leaders meet on a regular basis to discuss issues of mutual concern. Liaisons have been established by each agency and serve as communication and coordination nodes. A partnership website has been created. A brochure describing the partnership has been produced. An Action Plan has been developed to guide implementation. A field level review of the action plan stimulated increased collaboration among staff. It also yielded a great deal of thoughtful input, information on how the agencies are currently working together and suggestions for new joint activities and projects. This paper will highlight examples of how NRCS and the USACE are working together and combining their authorities and programs in the area of ecosystem restoration.

Contact Information: Anne Cann, Institute for Water Resources, U.S. Army Corps of Engineers, 7701 Telegraph Road, Alexandria, VA 22315, Phone: 703-428-7166, Email: R.Anne.Cann@usace.army.mil

Doris Washington, National Water Management Center, Natural Resources Conservation Service, 101 East Capitol Avenue, Suite B100, Little Rock, AR, USA, Phone: 501-210-8910, Email: doris.washington@ar.usda.gov

Building a Successful Funding Strategy for Ecosystem Restoration: The Puget Sound Experience

Dennis Canty
Evergreen Funding Consultants, Seattle, Washington USA

Funding is a crucial element of any successful ecosystem restoration strategy. In this era of ever tightening budgets, progress on restoration initiatives will be determined to a large extent by the effectiveness of the funding strategy. This session will focus on the development of successful funding strategies for large-scale ecosystem restoration programs.

Ecosystem-scale restoration has unique funding challenges. First, restoration must be pursued at a scale – often multi-watershed or even multi-state – that results in very substantial funding needs, often measured in the billions of dollars. Second, the identification of ecosystem restoration as a critical infrastructure need has been slow in coming, as has the widespread political constituency ready to look at funding of restoration as an essential public service. Third, there are few dedicated revenue sources for ecosystem restoration, resulting in use of a patchwork quilt of sources to fund most larger restoration efforts.

The author has been involved in funding of restoration efforts in the Puget Sound basin of Washington state since 1997, working first on the funding strategy for the regional salmon recovery plan and more recently on the cleanup and restoration strategy for the Sound being undertaken by a new state agency, the Puget Sound Partnership. Through a collaborative partnership of public agencies, Indian tribes, private organizations, and the business community, a diverse funding strategy has been crafted that combines federal and state appropriations, mitigation and settlement funds, private donations, and the creation of ecosystem service markets. The strategy has served as the blueprint for raising more than $150 million for ecosystem restoration in the region.

The presentation will focus on how to develop a successful funding strategy, including defining the costs of restoration actions, matching them to existing and potential funding sources, developing a consensus on funding in a diverse political community, and implementing the fundraising strategy through agency budget processes, legislative initiatives, and nuts-and-bolts fundraising.

Contact Information: Dennis Canty, Evergreen Funding Consultants, 1109 First Avenue, Suite 400, Seattle, Washington 98101 USA, Phone: 206-691-0700, Fax: 206-343-9819, Email: dcanty@evergreenfc.com

Federal Conflict Resolution Centers – Collaboration and Technology

Hal Cardwell[1], *Larry Fisher*[2], *Stacy Langsdale*[1] and *Brian Manwaring*[2]
[1]US Army Corps of Engineers, Institute for Water Resources, Alexandria, VA, USA
[2]US Institute for Environmental Conflict Resolution, Tucson, AZ, USA

Computer technologies can and already are influencing the way that federal agencies collaborate with stakeholders in environmental management issues. From web-based collaborative workspaces to e-newsletter, to online webinars, to decision support systems to public comment elicitation and analysis software, federal agencies can and are doing a better job of soliciting public input and involving stakeholders in public decision making processes. In fall of 07, the White House National Science and Technology Council's Subcommittee on Water Availability and Quality (SWAQ) called for federal research into Collaborative Processes for US water solutions. An interagency working group opted to focus a SWAQ-endorsed initiative to develop and advance the integration of computer based modeling tools within multi-stakeholder public decision processes for US water solutions. A first workshop on Computer Aided Dispute Resolution (CADRe) in the water field in 07 focused on this intersection – USACE, USIECR, and DOE's Sandia National Laboratory took the lead, with a follow-on workshop planned for fall 09. In May 09, the U.S. Institute for Environmental Conflict Resolution is sponsoring a national workshop to highlight the use of new technologies in ECR processes, with the goal of identifying further opportunities to support innovation, effective partnerships, and capacity building in this area of ECR practice.

This presentation will report on these many initiatives underway that explore this link between collaborative processes and technology, and highlight some of these intersections between collaboration and technology.

Contact Information: Hal Cardwell, US Army Corps of Engineers, Institute for Water Resources, 7701 Telegraph Rd, Alexandria, VA, 22315 USA, Phone: 703-428-9071, Email: Hal.E.Cardwell@usace.army.mil

Envirofish: a HEC-Compatible Floodplain Habitat Model for Evaluating Mitigation or Restoration Scenarios

K. Jack Killgore[1], *Jan J. Hoover*[1], *David R. Johnson*[2] and ***Andrew F. Casper***[1]

[1]Aquatic Ecology Branch and Invasive Species Branch, Environmental Lab, Engineering Research and Development Center, Vicksburg, MS

[2]U. S. Army Corps of Engineers, Vicksburg District, Vicksburg, MS

Environmental impacts of flood control projects, subsequent mitigation requirements and prioritization of mitigation restoration opportunities are all important, controversial and challenging issues for the Corps' civil works program. Research has clearly shown that flood control changes in inundation regime strongly influences the habitat and biota of rivers and floodplains. Mitigation and restoration techniques to address adverse floodplain inundation changes can include reforestation, managing water levels, improving backwaters connectivity, etc., though evaluating benefits of potential methods during the planning phase can be complex. EnviroFish can quantify predicted losses or benefits resulting from floodplain alterations for fish, invertebrates, amphibians and waterfowl. Mitigation and restoration credits are calculated by the same procedure used to estimate impacts so compensation can be directly assessed. EnviroFish does this through an integration of HEC data (stage-discharge rating curve, land use) and organism-specific floodplain habitat requirements (habitat suitability indices) for a range of restoration or planning alternatives. EnviroFish can be used anywhere that HEC, hydrogeomorphic (HGM) models, or other watershed-level techniques can provide site specific data. Because hydraulic engineers are familiar with the HEC modeling process rapid technology transfer is possible. Most importantly, EnviroFish provides a unique capability to document benefits of mitigation or restoration based on sound scientific principles of fish and fluvial ecology, and is fully compatible with increment cost analysis to justify expenditures. We will present the description of the workflow and variables and data required and show a case study including some suggested output formats.

Contact Information: Andrew F. Casper, ERDC - Environmental Lab , 3909 Halls Ferry Rd , Vicksburg, MS 39180, Phone: 601-634-4681, Email: andrew.f.casper@usace.army.mil

Impacts of Regional Climate Change on Seasonal Patterns of River Discharge: Current examples from Select Florida, Great Lakes and New England River Basins

Andrew F. Casper[1], *James A. Gore*[2], *Christy M. Messing*[2] and *Martin H. Kelly*[3]
[1]Aquatic Ecology and Invasive Species Branch, USACE, Waterways Experiment Station, Vicksburg, MS
[2]Environmental Science & Policy Program, University of South Florida, St. Petersburg, FL
[3]Ecological Evaluation Section, Southwest Florida Water Management District, Brooksville, FL

The Atlantic Multidecadal Oscillation (AMO) is a natural sea surface temperature oscillation in the Mid-Atlantic. The AMO has had a strong and well-documented historical influence on river discharge in the US, especially the amount and timing of discharge. Basic assumptions in project planning, comparison of alternatives, modeling or basic operations and management processes could therefore be undermined if future shifts in regional climate and subsequent changes in river hydrology cannot be effectively assessed. Using USGS stage/discharge records corresponding to past AMO oscillations as a surrogate shows little affect on total annual discharge in New England; however there was a marked effect on the Spring/Fall seasonal discharge. Similarly there was little difference in annual discharge in Great Lake tributaries, but there was again a notable seasonal response (though this time in summer). In contrast, Florida rivers have been affected to a greater extent, but their seasonal and annual patterns depend on geographic location (panhandle vs. peninsular basins). Examples using modeling of minimum flows and levels for sport and forage fish habitat with IFIM-PHABSIM in Florida will be given. This work demonstrates how existing gauge data can be used to predict some future effects of climate shifts in other Districts or regions.

Contact Information: Andrew F. Casper, ERDC - Environmental Lab , 3909 Halls Ferry Rd , Vicksburg, MS 39180, Phone: 601-634-4681, Email: andrew.f.casper@usace.army.mil

Integrating Spatially Explicit Watershed with Hydraulic Habitat Models: Constraints and Tradeoffs Due to the Resolution of the Topographic (DEM) Data

***Andrew F. Casper*[1]**, *B. Dixon*[2,3], *J. A. Gore*[2] and *J. Earls*[3]

[1]Aquatic Ecology Branch, Environmental Lab, US Army Corps of Engineers-Water Ways Experiment Station, Vicksburg, MS

[2]Environmental Science, Policy and Geography Program, University of South Florida, St. Petersburg, FL

[3]Geo-Spatial Analytics Laboratory, University of South Florida, St. Petersburg, FL

A wide variety of hydraulic models use discharge to estimate changes in or availability of critical in-stream habitat units. However, a large proportion of the country's rivers and their watersheds are ungauged. One widely promoted solution for these situations is to use GIS-based models of watershed topography and runoff to estimate the in-stream hydrograph. However, the elevation/topographic grid resolution supplied by the most commonly available software has been in flux since the advent of the technology. Thus a largely untested assumption is that grid resolution used to model watershed runoff does not significantly affect the accuracy of a simulated hydrograph. We have tested this assumption by linking the Soil Water Assessment Tool (SWAT) model to Physical Habitat Simulation Model (PHABSIM) for in-stream habitat. Both models were calibrated for a low-gradient SE coastal system, the Hillsborough River Watershed (FL). There is a large discrepancy between modeled and measured hydrograph. We show that in a coastal river basin the coarser the topographic grid which artificially smoothes the watershed is, leads to unrealistically elevated wet season discharge. As a result, the seasonal simulation of habitat was overestimated. Thus while GIS-based modeling of ungauged in-stream habitats on the desktop is possible, the efficacy of this approach may depend more on the raw topographic GIS data sets than on the mathematical and computer model used.

Contact Information: Andrew F. Casper, ERDC - Environmental Lab , 3909 Halls Ferry Rd , Vicksburg, MS 39180, Phone: 601-634-4681, Email: andrew.f.casper@usace.army.mil

Planning and Assessment of Multiple River Restoration Projects in a Basin: A Reach to Valley-Level GIS-based Hydrogeomorphic Framework

James H. Thorp[1] and ***Andrew F. Casper***[2]
[1]Senior Scientist, Kansas Biological Survey, Professor Dept. Ecology and Evolutionary Biology, Univ. of Kansas, Higuchi Hall, Lawrence, KS
[2]Aquatic Ecology Branch and Invasive Species Branch, Environmental Lab, Engineering Research and Development Center, Vicksburg, MS

Historically many river ecosystem management and restoration strategies have been predominantly based on two theories that emphasize biotic interactions and/or food resources as the main drivers of river structure and function (i.e. the river continuum and the flood pulse concepts). Those theories are both ill-suited and largely irrelevant to CoE mission and applications because they have little connection to basic tools of hydrologic and hydraulic engineering tools that are the Corps strength. In contrast, a recent synthesis demonstrates that ecosystem structure and function are more realistically viewed as a spatial mosaic of alternating geomorphic functional process zones. *We suggest that these valley-to-reach scale zones are a much more relevant framework for the comparison of alternative plans, mitigation and restoration.* 15 hydrogeomorphic variables lead to emergence of objective, river-specific zones in any river. Variables and spatial framework are extracted from DEM's, GIS and LIDAR hydrogeomorphic data using a combination of standard ArcMap tools and automated scripts. Numerous functional and ecological patterns are better explained in this manner than with standard frameworks. This approach has applications wherever whole basin coordination of mitigation (NED), Environmental Benefits, or restoration (NER) projects is needed.

Contact Information: Andrew F. Casper , ERDC - Environmental Lab, 3909 Halls Ferry Rd, Vicksburg, MS 39180, Phone: 601-634-4681, Email: andrew.f.casper@usace.army.mil

Restoring Chesapeake Bay from the Top Down

***Carl F. Cerco**, Mark R. Noel, Dorothy Tillman and Patricia Dalyander*
Environmental Laboratory, US Army Engineer Research and Development Center, Vicksburg, MS, USA

Management of eutrophication is usually based on a "bottom up" approach. Nutrient loads are reduced with the intention of limiting excess production of phytoplankton and abating associated effects. Recent management developments focus on a "top down" approach. The "top down" approach is based on the premise that restoration of algal predators will limit excess phytoplankton production and, perhaps, substitute for costly nutrient control programs.

Chesapeake Bay, an extensive estuarine system located on the east coast of the United States of America, is subject to cultural eutrophication characterized by bottom-water hypoxia, diminished aquatic vegetation, and undesirable algal blooms. For more than twenty years, restoration efforts have focused on reducing nutrient and solids loads to the bay. The "Chesapeake 2000 Agreement" calls for investigation of a different approach: an assessment of the effects of different population levels of filter feeders such as oysters, menhaden, and clams on Bay water quality and habitat. Our approach to this assessment considers oysters and menhaden and employs several predictive models which are incorporated into the larger Chesapeake Bay Environmental Model Package.

Present oyster population in the bay is only a small fraction of historical levels. The Chesapeake 2000 Agreement specifically calls for a ten-fold increase in native oysters in the bay. We investigated the effects of this ten-fold restoration by inserting a unit oyster model into the CE-QUAL-ICM eutrophication model. The unit model included essential processes such as filtration, ingestion, assimilation, and mortality and was extensively validated against laboratory and in-situ observations. A ten-fold increase in existing oysters is projected to reduce system-wide summer surface chlorophyll by 1 mg m^{-3}, increase summer-average deep-water dissolved oxygen by 0.25 g m^{-3}, add 2100 kg C (20%) to summer SAV biomass, and remove 30,000 kg day^{-1} nitrogen through deposition and subsequent denitrification.

Atlantic menhaden are a migratory species which enter the bay, from the ocean, in late spring and leave in autumn. They feed primarily on phytoplankton although zooplankton and detritus make up a portion of their diet. A modeling approach to menhaden is much more complex than oysters and a "weight of evidence" approach based on multiple model solutions is recommended. One approach combines CE-QUAL-ICM with the ECOPATH fisheries model. This approach results in projections of phytoplankton reduction averaged over seasons and large spatial areas. A second approach employs an individual-based menhaden model and species-specific bioenergetics calculations. Preliminary results indicate a twenty-percent increase in menhaden predation on phytoplankton would have limited impact. However, these preliminary results are subject to review and further investigation.

Contact Information: Carl F. Cerco, Environmental Laboratory, US Army ERDC, 3909 Halls Ferry Road, Vicksburg, MS 39180 USA, Phone: 601-634-4207, Fax: 601-634-3129, Email: carl.f.cerco@usace.army.mil

Reactive Transport Capabilities in ADH

Hwai-Ping Cheng[1], *Christian J. McGrath*[2], *Stacy E. Howington*[1] and *Jing-Ru C. Cheng*[3]
[1]Coastal & Hydraulics Laboratory, US Army Engineer Research & Development Center (ERDC), Vicksburg, MS, USA
[2]Envoronmental Laboratory, US Army Engineer Research & Development Center (ERDC), Vicksburg, MS, USA
[3]Major Shared Resources Center, US Army Engineer Research & Development Center (ERDC), Vicksburg, MS, USA

Simulation of flow and transport in coupled surface and subsurface systems is an essential component in the rigorous analysis of water supply and quality issues in ecosystem restoration. Reactive transport simulation is the only quantitative approach for integrating multiple, complex, environmental processes into an internally consistent conceptual model with which to assess water quality and design remedial alternatives. We demonstrate the reactive transport capability in the ADaptive Hydrology/Hydraulics (ADH) model for large-scale subsurface simulations. ADH is a modular, parallel, adaptive finite-element model for multi-dimensional flow and transport. ADH simulates groundwater flow in porous media, internal flow through hydraulic structures, overland flow, and estuarine and riverine flows. It was developed at the Engineer Research and Development Center and is supported by the System-Wide Water Resources Program (SWWRP)[1]. In ADH, the primitive reactive transport equations are solved with an operator-splitting approach, with sub-stepping to allow multiple reaction time steps within one transport time step. Flexible reaction kinetics is accommodated, including special treatment of fast irreversible reactions that can be used to simulate virtually instantaneous transformation of contaminants during remediation. A hypothetical example is presented that considers the remediation of perchloroethylene (PCE) and trichloroethylene (TCE) [both are parent compounds] and their biodegradation products, dichloroethylene (DCE), vinyl chloride (VC), and ethane.

---

[1]https://swwrp.usace.army.mil

Contact Information: Hwai-Ping Cheng, Coastal & Hydraulics Laboratory, US Army Engineer Research & Development Center, Vicksburg, MS 39180-6199, USA, Phone: 601-634-3699, Fax: 601-634-4208, Email: hwai-ping.cheng@usace.army.mil

Application of Natural Channel Design Criteria to Restore and Enhance an Urban Stream Following Gravel Mining Activities

***Bill Christner**, David Krolick,* and *Sally Bartindale*
ECORP Consulting, Inc, Sacramento, CA

At the request of the client, ECORP Consulting Inc developed a restoration plan for 6,700 linear feet (1.5 mi) of perennial stream channel and its associated riparian corridor following the completion of gravel mining activities. A compound channel design within a 300-ft wide riparian corridor was utilized to contain the low-flow, bankfull, and 100-yr flows. Channel restoration incorporated natural channel design criteria based on the current geomorphic conditions. The channel design incorporated a dimension, pattern, and profile similar to the original channel morphology, while accommodating for increased discharge from post-mining activities and urban development. Channel features included pools, riffles, and off-channel wetlands. Habitats created included seasonal wetlands, perennial marsh, oak woodland, and native species grasslands. Results from completed phases indicate good establishment of native trees shrubs, and grassland species.

The purpose of the Project is to mine the on-site aggregate resources to a depth of 50 - 60 feet below existing grade. At the completion of each phase, overburden soil materials were used to construct the 300-ft wide riparian corridor. Creation of riparian and oak woodland habitat will help compensate for losses to the limited riparian habitat found at the site before project development.

Contact Information: William Christner, ECORP Consulting, Inc, 2525 Warren Drive, Rocklin, CA 95677, Phone: 916-782-9100, Email: bchristner@ecorpconsulting.com

Watershed-Based Approach to Restoration Site Selection in Southern California

Jae Chung
United States Army Corps of Engineers, Los Angeles District, Regulatory Division

In select watersheds in Southern California, the Corps of Engineers in the Los Angeles District is adopting a watershed-based approach to identify restoration sites in the context of making better decisions on compensatory mitigation for impacts authorized under Section 404 of the Clean Water Act. With the watershed approach, landscape considerations and watershed needs drive restoration site selection, replacing restoration policies that advocate on-site replacement of aquatic resources. In implementing the watershed-based approach, the Corps' research laboratory, the Engineer Research Development Center (ERDC), first undertook a multi-scale assessment of watershed integrity based on a suite of field and remote sensing indicators, evaluating existing hydrology, water quality, and habitat integrity of all riparian reaches within a watershed. Using this baseline information, ERDC determined restoration potential of each riparian reach based on restoration templates appropriate for the reach's geomorphic zone and calculated the effect of the restoration on improving hydrology, water quality, and habit integrity scores. These actions identified numerous riparian reaches where restoration would result in a large functional lift. Then in conjunction with other state and federal resource agencies to further prioritize restoration, the Corps developed additional thematic restoration objectives, including restoration of local connectivity, restoration of habitat in existing open space, restoration to benefit local sensitive species, and/or restoration to address water quality functions. In considering functional lift and other thematic restoration objectives, the Corps was able to develop a hierarchical list of restoration priorities as part of a watershed plan that would inform future restoration activities within specific watersheds.

Contact Information: Jae Chung, United States Army Corps of Engineers, Los Angeles District, Regulatory Division, P.O. Box 532711, Los Angeles, CA 90053-2325 USA, Phone: 213-452-3292, Fax: 213-452-4196, Email: yong.j.chung@usace.army.mil

Shoreline Restoration: Big Island, Lake Minnetonka, Minnesota

Jeff D. Weiss[1], *Jeff T. Lee*[1] and ***Renae Clark***[2]
[1]Barr Engineering Company, Minneapolis, MN
[2]Minnehaha Creek Watershed District, Deephaven, MN

Background

Big Island, located within Lake Minnetonka in Orono MN, contains a 56 acres park that is managed to be rustic in nature and function. Very little infrastructure is allowed within the park in an effort to restore and preserve a large natural area in an area where shoreline property is in high demand. Lake Minnetonka is surrounded by several affluent western suburbs of the Twin Cities, and the lake is a popular boating and recreation destination. Big Island Park includes 7,500 feet of undeveloped shoreline, over seven acres of high quality wetlands, significant maple-basswood forest areas, and bald eagle nesting sites.

Problem

Approximately one third of the shoreline within Big Island Park consists of tall, steep banks up to 60 feet high. Wave action from long fetches around the island causes significant erosion of the shoreline toe. The toe erosion causes bank failure, which causes impairment of the water quality of Lake Minnetonka due to the slumping soil; loss of shoreline habitat as the shoreline recovers; and long-term threats to the viability of this large natural area.

Coordination

Addressing the problems within Big Island Park required coordination between the City of Orono (who owns and manages the park), the State of Minnesota, Minnehaha Creek Watershed District (who hold the shoreline easement), and local residents.

Solutions

Due to the tall banks and difficult site access, it was determined that the shoreline restoration should incorporate stabilization that will halt or minimize existing erosion and still allow natural vegetation stabilization process to be put in place to allow the banks to stabilize themselves. The shoreline restoration is being completed in two stages: riprap toe protection and bioengineering of the banks. The field stone riprap was deemed to be the only natural looking material that can withstand the stresses associated with the long fetch waves and ice heave that have eroded the shore. Riprap was installed in areas with extremely steep or near vertical banks, it was placed some distance away from the shore and backfill was placed between the riprap and the bank. The second stage is to install bioengineering slope stabilization techniques within these areas of backfill and along other banks. The bioengineering approaches in backfill areas will help to stabilize the bank and reintroduce native vegetation while preventing the need to grade out the banks to a stable slope. Because of the distance between the existing bank and the new edge of the riprap, additional natural bank failure will be allowed to continue at a smaller scale without posing a significant threat to water quality.

Contact Information: Jeff D. Weiss, Barr Engineering Company, 4700 W 77th Street, Minneapolis, MN 55435 USA, Phone: 952-832-2706, Fax: 952-832-2601, Email: jweiss@barr.com

The Role of Place-based Values in Governance of Public Lands in Western United States

Jessica M. Clement and *Tony S. Cheng*
Colorado Forest Restoration Institute, Colorado State University, Fort Collins, CO

In 2007 values, attitudes and preferences were explored among local residents in relation to three National Forests, one in Colorado, two in Wyoming, using a random sample survey methodology. The study included a map, allowing the values and other information to be spatially documented and analyzed. The study was followed up with interviews among forest planners to explore the effectiveness of this data to planning efforts. The results indicate that while there are some strong commonalities among residents' values in relation to local forested landscapes, there are also significant differences. Both commonalities and differences, combined with forest planners' feedback, have implications for finding zones of agreement among diverse public groups, management of these large landscapes, for governance of natural resources in the context of sustainability and for the effectiveness of collaboration.

Contact Information: Jessica Clement, PhD, Colorado Forest Restoration Institute, Colorado State University, Campus Delivery 1472, Fort Collins, CO 80523, Phone: 970-491 2104, Email: Jessica.Clement@colostate.edu

An Alternative to Habitat Units for Indicating Benefits from Ecosystem Restoration Projects Planned by the U. S. Army Corps of Engineers

Richard A. Cole
Institute for Water Resources, U. S. Army Corps of Engineers, Alexandria, VA, USA

The usual approach to measuring ecosystem restoration benefits from projects planned by the U. S. Army Corps of Engineers is to calculate habitat units from the product of a habitat suitability index and the number of acres planned for restoration. The habitat suitability index is determined for one or more indicator species selected to represent the ecosystem support needs of “desired outputs” or “desired ecosystem resources”. Corps planning policy indicates that the desired outputs are species that are scarce with respect to their desired abundance for reasons other than their economic value. Reliance on an indicator species necessarily incorporates the uncertainty of the habitat relationship that exists between the indicator species and the desired species. Habitat units do not take into account the risks of project failure. In addition, because the desired outputs of projects are indirectly indicated by a variety of species, habitat units cannot be compared across projects to rank them for relative contribution to public welfare improvement as required by the Government Performance and Results Act.

A recently developed alternative to habitat units contends with these problems. The new indicator of benefit restoration benefit, the Biodiversity Security Index (BSI), is based on viable population units of desired species instead of habitat units. Several laws and treaties, led by the Endangered Species Act, indicate public desire to restore species to a secure status in the context of their supporting ecosystems. The BSI includes terms for species scarcity, distinctiveness, and risk of restoration failure. The scarcity of species is determined by the security status of species identified in the widely accepted NatureServe Explorer database, which ranks each species with respect to their security from extinction. The distinctiveness term is indicated by the number of other species classified in the same taxonomic genus and family. The risk term indicates the risk that the project will fail to result in restoration of viable populations for each of the species targeted for recovery in the project area. Each term is weighted for the relative emphasis determined by agency policy. Unlike habitat units, the new metric indicates the desired outputs directly, is more clearly indicative of ecosystem restoration objective achievement, and can be compared directly across projects over the entire ecosystem restoration program for project ranking purposes.

Contact Information: Richard. A. Cole, Institute for Water Resources, U. S. Army Corps of Engineers, 7701 Telegraph Road, Casey Building, Alexandria, VA 22315-3868 USA, Phone: 703-428-7291, Fax: 703-428-6686, Email: Richard.A.Cole@usace.army.mil

Removal or Enhancement of Pilings and Pile Dikes as Potential Habitat Restoration Techniques for Pacific Salmon Recovery

Catherine A. Corbett[1], ***Christopher M. Collins***[1], *Blaine D. Ebberts*[2], *Tracey Yerxa*[3] and *Phil Trask*[4]

[1]Lower Columbia River Estuary Partnership, Portland, OR, USA
[2]U.S. Army Corps of Engineers, Portland District, Portland, OR, USA
[3]Bonneville Power Administration, Portland, OR, USA
[4]PC Trask and Associates, Portland, OR, USA

The lower Columbia River and estuary are critical areas for ESA listed anadromous stocks of Pacific salmon and steelhead as this area is used in migration, juvenile rearing, refuge and feeding. Since the mid 1800's the lower Columbia River below Bonneville Dam has been altered by a variety of anthropogenic impacts, including shoreline diking and wetland conversion for industry, urbanization and agriculture. These impacts have reduced the quantity, quality and access to important rearing habitat for juvenile salmonids and have contributed to a modified river system drastically different than historical conditions. In the current intensively managed lower river, pilings and pile dikes (pile structures) likely play a role in creating and maintaining ecological features. In some cases, pile structures may help retain large wood to form complex habitat in the system. In other cases, pile structures may trap sediments in a manner that establishes conditions favorable for tidal wetland development. Hence, some pile structures may perform an important ecological role in the modern lower Columbia River. However, pile structures may also increase predation on juvenile salmonids by piscivorous birds and fish; reduce access to important salmonid habitat and/or be a source of toxic contaminants.

In the past, habitat restoration efforts have generally focused on the lower Columbia River tributaries and tidal reaches within those systems. Removal or enhancement of pile structures in the mainstem may represent an important mechanism for mainstem restoration benefiting both adult and juvenile salmonids from all migratory Columbia River populations. However, structure removal or enhancement for the benefit of salmonids and the ecosystem is untested and the potential benefits or problems are uncertain.

A Project Team consisting of the Lower Columbia River Estuary Partnership, U.S. Army Corps of Engineers and Bonneville Power Administration have designed and initiated a phased scientific approach to guide a lower Columbia River Pile Structure Program. During Phase 1 the Project Team first created an inventory and classification system of all pile structures in the study area and investigated of a subset of these. A list of hypotheses describing potential benefits and impacts associated with pile structures was created to guide the determination of potential benefits to juvenile salmonids and the ecosystem. Results from testing these hypotheses with experiments at pilot projects will guide future implementation efforts. Pilot project sites were selected through a collaborative, systematic evaluation process for the possibility of testing multiple hypotheses. The structures were also chosen because they may allow good field comparison study conditions. The next phase will use the results from these steps to guide future program implementation.

Contact Information: Catherine A. Corbett, 811 SW Naito Parkway, Suite 410, Portland, Oregon, 97204, USA, Phone: 503-226-1565 ext 240, Fax: 503-226-1580, Email: corbett@lcrep.org

Using Goals to Guide Restoration Design and Report Effectiveness

Josh Collins[1] and *Richard Sumner*[2]
[1]San Francisco Estuary Institute, Oakland, CA
[2]U.S. Environmental Protection Agency, Corvallis, OR

Public investments in ecosystem restoration and the number of projects continue to grow across the Western US. The stress on ecosystems likewise continues to increase, due to land use and climate change. As a result, restoration practitioners may not be able to keep pace with the rate of landscape degradation.

Looking at the problem from the ground up reveals a basic fact: Project-by-project environmental review leaves too little time and money for regulatory, conservation and development communities to adequately plan and assess land and water use. Monitoring is generally inadequate to reveal problems or trigger corrective actions. Looking down from the landscape level reveals a path toward problem reconciliation: a scaling-up of project design. The design of multi-scale projects is achieved through adoption of explicit watershed goals.

Landscape ecology and information technology have matured together as a powerful toolkit for watershed analysis and goal setting. Conceptually, the conservation of natural processes is the ecological foundation of restoration planning, implementation and the evaluation of project success. Those processes, such as flowing water, produce physical structure within the environment. The structure helps to support life. Life is sustained because the flow of water and materials through the structure is not impeded beyond levels to which life has become accustomed. A geographical information system (GIS) is used to depict alternative landscape designs that conserve the natural structure of a watershed. A preferred design can then be translated into a set of community-based watershed goals. The adopted goals guide restoration projects and allow for the reporting of restoration effectiveness with a known level of certainty.

Wetland restoration is a good example of how project scale can be increased using watershed goals. A wetland goals project is initiated using the relatively simple approach of generating wetland landscape profiles. The theory behind wetland landscape profiles is that the abundance, distribution and condition of wetlands in the landscape control the delivery of ecosystem services. Those services include the provisioning of habitat, flood control and water quality. GIS is used to characterize profiles and display restoration opportunity. The resulting information informs the articulation of goal options. Once goals are established, restoration and mitigation decisions are made in way that helps sustain or improve an area’s wetland landscape profile. Relationships between the landscape profiles and the provisioning of ecosystem services are built over time with a monitoring and assessment program.

Contact Information: Josh Collins, San Francisco Estuary Institute, 7770 Pardee Lane, Oakland, CA 94621-1424, Phone: 510-746-7334, Fax: 510-746-7300, Email: josh@sfei.org

Delaware Bay Oyster Restoration 2005-2008

Barbara E. Conlin
U.S. Army Corps of Engineers, Philadelphia District, PA, USA

Oysters are important to estuaries for many reasons. In Delaware Bay the Eastern oyster (*Crassostrea virginica*) is prized as a food source and has been a part of the cultural history of the Mid-Atlantic region for centuries. An oyster disease (MSX) hit the bay's oysters in the 1950s. The oysters recovered in the 1970s and mid-1980s, only to be hit again by a second disease (Dermo) in1990, and the oyster industry nearly disappeared.

Oyster beds provide critical habitat for many estuarine species and as a fishery, contribute to the local economies. Oysters are vital to the health of the bay overall because they provide increased habitat complexity and improve water quality through filtration. Oyster production today in Delaware Bay is a fraction of historical levels. Resistance to MSX disease is improving in wild stocks within the bay, but Dermo still poses a significant problem.

In 2003, the New Jersey Department of Environmental Protection (NJDEP) carried out a small pilot program that planted clamshell in the bay to provide clean surface for oyster set. About 40,000 bushels were planted on ~ 6 acres. This area provided more than half of the marketable oysters harvested from this entire (~ 660 acres) seed bed for the 2006 oyster season.

Following this, the USACE, Philadelphia District became involved in a partnership effort through Section 1135 of the Water Resources Development Act of 1986, "Ecosystem Restoration". Nearly 2 million bushels of shell were planted in the bay between 2005 and 2008. The program was designed to remedy low levels of oyster recruitment and to improve habitat sustainability. Since 1999, the NJ oyster beds have been losing shell at a rate of hundreds of thousands of bushels annually. This trend, if unchecked, would result in the deterioration of reef habitat with declines in oyster numbers, associated reef animal abundance, and the reduction of ecosystem services provided by the habitat and the oyster itself. Both enhanced recruitment and the shell resource objectives are being achieved through shell planting. Planted shell has caught set at higher levels than the native shell and the shell budget of New Jersey oyster beds was approximately balanced in 2007 for the first time in nearly a decade.

Monitoring studies were conducted by Rutgers University Haskin Shellfish Research Laboratory, Delaware State University, and the two non-Federal sponsors, NJDEP and Delaware's Department of Natural Resources and Environmental Control (DNREC). The project has the support of nine federal, state, and local government agencies as well as Senators Tom Carper (DE) and Robert Menendez (NJ), Congressmen Mike Castle (DE) and Frank LoBiondo (NJ), former Governor Ruth Ann Minner (DE) and current Governor Jon Corzine (NJ). In 2008, the project earned both the "Coastal America Award" and a "Government Award" (Water Resources Association of the Delaware River Basin).

Contact Information: Barbara E. Conlin, USACE Philadelphia District, 100 Penn Square East, Philadelphia, PA 19107 USA, Phone: 215-656-6557. Email: Barbara.E.Conlin@USACE.army.mil

Dealing with Data Realities –Automation of Evaluation of Data Quality and Estimation of Missing Data for the Everglades Depth Estimation Network (EDEN)

Paul A. Conrads[1], *Mathew D. Petkewich*[1], *Ruby C. Daamen*[2] and *Edwin A. Roelh*[2]
[1]U.S. Geological Survey, South Carolina Water Science Center, Columbia, SC, USA
[2]Advanced Data Mining, LLC, Greenville, SC, USA

The Everglades Depth Estimation Network (EDEN) is an integrated network of 253 real-time water-level gaging stations, ground-elevation models, and water-surface models designed to provide scientists, engineers, and water-resource managers with current (2000-present) water-depth information for the entire freshwater portion of the greater Everglades. A spatially-continuous interpolated water surface across the greater Everglades is generated from daily median water-level values. Missing or erroneous data compromise the quality of the modeled water-surfaces. To increase the accuracy of the daily water-surface model, two applications were developed to (1) evaluate the data quality at each station and (2) estimate water levels to fill data gaps.

The data-quality evaluation application uses results from cluster analysis to group gages of similar hydrologic behavior. A series of tunable filters were developed from the historical database and are used to evaluate the data for each site based on historical behaviors and comparison to other sites of similar behavior. Filters include time derivatives to evaluate various rates of changes and differences with time series from other sites. Missing data were estimated by developing linear regression equations for each site. To minimize the inability to estimate data due to a missing data from an input site, three or four regression equations were developed for each site using different input sites. For each site, a priority was established for the order of regression equation to be used to fill a data gap. The equations (over 700) were incorporated into a database application that automatically estimates missing record. The challenges of developing the applications will be presented along with future plans for the application to EDEN and to other hydrologic networks.

Contact Information: Paul Conrads, U.S. Geological Survey, South Carolina Water Science Center, Columbia, SC, 29210 USA, Phone: 803-750-6140, Fax: 803-750-6181, Email:pconrads@usgs.gov

Atchafalaya River Restoration and its Role in Coastal Processes

Glenn C. Constant
U. S. Fish and Wildlife Service, Baton Rouge, LA

The Atchafalaya River basin is the largest floodplain ecosystem in North America. It encompasses over 830,000 acres of forest and waterways that serve to buffer Louisiana residents from the annual floodwaters that travel to the Gulf of Mexico from over one third of the nation. In the process, it continues to be a conduit for the valuable natural resources that will be required to halt the rapid disappearance of Louisiana's coastal estuaries. Many demands have been placed on the wetlands of the Atchafalaya River Basin during almost a century of being designated as a floodway, and the ecosystem that once provided services to flora and fauna of a naturally building delta is now host to a very different cast of inhabitants.

Efficient channels now carry most of the floodwaters past the floodplains into the Gulf. However, the water they funnel moves faster and carries more sediment that is deposited in aberrant patterns that alter natural ecosystem processes. Exploration for fossil fuels and dredging for navigation exacerbate the ecosystem burden by segmenting the floodplain, isolating wetlands from the resources of the river, ponding stagnant water, and contributing to degradation of much of wetland forests. Beyond the floodway, water and sediment resources that were once evenly distributed along the coast are now delivered in bulk via two channels. Nutrient concentrations are also elevated and delivered in the same manner. The results have been a staggering loss of coastal estuaries and persistent hypoxia in the Gulf of Mexico.

Corrective measures are being sought within the floodplain at the state and federal level to restore ecosystem function, mainly through water and sediment management. However, conservation and management measures within the floodplain must include solutions that account for the needs of those efforts and problems beyond the flood control levees. The demand on the resources of the Atchafalaya River will be great and opportunities exists that can be beneficial to both systems, but there is a potential for conflicting strategies in the absence of coordination. Proposed concepts include very significant ecosystem alteration that include diverting a large percentage of the water that flows through the floodway into decaying coastal marshes or altering the pre-set distribution of water that is now diverted into the Atchafalaya River from the Mississippi. Whichever of the many options is ultimately chosen, the Atchafalaya River Basin will need to be part of the solution.

Contact Information: Glenn C. Constant, Baton Rouge Fish and Wildlife Conservation Office, U.S. Fish and Wildlife Service, Baton Rouge, LA, 70803 USA, Phone: 225-578-8067, Fax 225-578-4210,
Email: glenn_constant@fws.gov

Frequently Asked Questions in Dam Decommissionings—Guidance for Data Collection, Analytic Needs, and Project Implementation

Jock Conyngham[1], *Craig Fischenich*[1] and *Kathleen White*[2]

[1]Environmental Laboratory, Engineer Research and Development Center, U.S. Army Corps of Engineers, Vicksburg, MS, USA

[2]Cold Regions Research and Engineering Laboratory, Engineer Research and Development Center, U.S. Army Corps of Engineers, Hanover, NH, USA

Dam decommissioning practitioners, planning and regulatory personnel, and stakeholder groups may face a potentially broad array of relevant or required information needs, but only a subset are universal to all but the smallest projects. This subset represents the core issues with implications for public interest and decision guidance. It includes responses in water quality and flow characteristics, physical channel morphology, infrastructure risk, and ecosystem processes to dam removal or major modification. This presentation discusses central data and analysis needs, complex processes in sediment transport and ecosystem dynamics that currently exceed the capabilities of predictive tools, and their implications for project implementation.

Contact Information: Jock Conyngham, Environmental Laboratory, Engineer Research and Development Center, U.S. Army Corps of Engineers, Missoula, MT 59801 USA, Phone: 406-541-4845 ext. 324, Fax 406-541-4849, Email: Jock.N.Conyngham@usace.army.mil

The Use of a Real-time Telemetry System (EcoNet) for Ecological Monitoring: A Case Study in Resource Management

M. J. Cook[1], *S. C. Walters*[2] and *M. S. Woodrey*[3]
[1]SonTek/YSI, San Diego, CA
[2]Grand Bay National Estuarine Research Reserve, Moss Point, MS and Mississippi Department of Marine Resources, Biloxi, MS
[3]Grand Bay National Estuarine Research Reserve, Moss Point, MS and Mississippi State University Coastal Research and Extension Center, Biloxi, MS

The National Estuarine Research Reserve (NERR) program, using a system of protected areas, is designed to practice and promote coastal and estuarine stewardship through innovative research and education. The Grand Bay NERR is one of 27 protected areas across the United States. The reserves serve as platforms for long-term research and monitoring, as well as reference sites for comparative studies. One example of the reserve system's long-term monitoring efforts is the System-wide Monitoring Program (SWMP) (pronounced "swamp"). The SWMP documents quantitative measurements of short-term variability and long-term changes in the water quality, biotic diversity, and land-use/land-cover characteristics of estuaries and estuarine ecosystems for the purposes of contributing to effective coastal zone management. At the Grand Bay NERR, this in-situ monitoring system coupled with a near real-time telemetry system (EcoNet), allows managers and technicians to monitor environmental changes in water quality and weather at various temporal scales, providing a greater understanding of the ecosystem dynamics. A detailed evaluation of the telemetry system will be presented with the main focus on EcoNet's advantages for ecological monitoring, as well as, economic resource management.

Contact Information: Mike Cook, PhD, SonTek/YSI, 9940 Summers Ridge Road, San Diego, CA 92121, Phone: 858-546-8327 x136, Email:mcook@sontek.com

Preliminary Meta-Analysis of Data from Multiple Monitoring Programs—Effectiveness Monitoring, Reference Sites and Ecosystem Condition

Catherine Corbett[1], *Heida Diefenderfer*[2], *Blaine Ebberts*[3], *Gary Johnson*[2], *Krista Jones*[1], *Amy Borde*[2] and *Ron Thom*[2]
[1]Lower Columbia River Estuary Partnership, Portland, OR, USA
[2]Coastal Assessment and Restoration Group, Pacific Northwest National Laboratory, Sequim, WA, USA
[3]Environmental Resources Branch, Portland District, U.S. Army Corps of Engineers, Portland, OR, USA

The Lower Columbia River Estuary Partnership, Pacific Northwest National Laboratory, U.S. Geological Survey and NOAA National Marine Fisheries Service with funding from Bonneville Power Administration annually collect vegetation, water quality and fish data at different reaches of the lower Columbia River for its Ecosystem Monitoring Project. These and additional partners collect action effectiveness monitoring data at five pilot restoration sites which were chosen to represent different restoration activities (culvert enhancement to improve fish passage, large wood installation, re-vegetation, cattle exclusion, and culvert removal for tidal reconnection). The sites also represent different habitats (bottomland forest, riparian forest, emergent wetland, and brackish wetland) and geographic reaches of the river ranging from tidal freshwater to saltwater intrusion. These monitoring partners have also created a system of 41 reference sites. Data collected at these reference sites will provide a baseline characterization of different, relatively unaltered habitats, and the environmental conditions at these sites can then be used as targets for restoration sites. In particular, information characterizing the elevation, soil, and inundation range required by native tidal wetland vegetation is critical for designing successful restoration projects. This network of reference sites will provide resource managers a means of statistically analyzing and comparing projects with habitat restoration project sites coming on line and to assess effectiveness not only at the site scale but of the cumulative, multi-agency estuary-wide habitat protection/restoration program.

Compiling, merging, and analyzing monitoring data from multiple programs is fundamental to this evaluation of cumulative effects. The challenge is to integrate multiple site-scale monitoring results to make inferences at an estuary-wide scale. This presentation describes a meta-analysis of effectiveness monitoring data from habitat restoration (tidal reconnection) sites and their associated reference sites throughout the 235-km lower Columbia River and estuary. As an example, the response variables of interest are vegetation composition and vegetation percent cover are assessed at paired restoration and reference sites using a similarity index. Additionally, sediment accretion and erosion rates are assessed relative to baseline elevations to determine whether the tidal wetland restoration sites are on a trajectory toward land elevations suitable for target plant communities. Each step and lessons learned in the meta-analysis process are described. The results from this type of analysis will inform decision-makers in the Columbia River Estuary Habitat Restoration Program and the National Estuary Program.

Contact Information: Catherine A. Corbett, 811 SW Naito Parkway, Suite 410, Portland, Oregon, 97204, USA, Phone: 503-226-1565 ext 240, Fax: 503-226-1580, Email: corbett@lcrep.org

Coastal Restoration Efforts in Louisiana Using Dredged Material from Federal Navigation Channels

Edward D. Creef, ***Jeffrey M. Corbino*** and *Melissa A. Hightower*
US Army Corps of Engineers, New Orleans District, New Orleans, LA, USA

Following the passage of two major hurricanes in 2005, Louisiana's coastal scientists proclaimed that wetland loss must be curtailed within 10 years or the trend would become irreversible. The beneficial use of dredged material from maintenance of Federal navigation channels was targeted as a major source of sediment to restore coastal marshes. During the 20 years preceding the 2005 hurricane season, the Operations and Maintenance program (O&M) of the US Army Corps of Engineers New Orleans District created over 26 square miles of coastal wetlands through the beneficial use of dredged material. Approximately 16.5 million cubic yards of dredged material is used annually for marsh restoration projects, representing about 48% of sediment dredged from navigation channels within District boundaries that is suitable for beneficial use. These projects were funded largely through the O&M budget, with some supplemental funding provided through Section 204 of the Water Resources and Development Act of 1992 and Coastal Wetlands Planning Protection and Restoration Act (CWPPRA) authorities. Availability of supplemental funds from these programs for future projects is questionable, due to a reduction in appropriated funds for Section 204 projects and philosophical undertones within the CWPPRA program that the funding should not be put forth to "…help the O&M program".

Three years after dire warnings of coastal wetland loss in Louisiana, few projects optimizing the beneficial use of dredged material have successfully been constructed with funds contributed to the O&M dredging program. The incremental cost to construct marsh beyond the Federal Standard was funded at two separate sites in 2007 by the CWPPRA program, but with planning for these projects beginning in the mid to late 1990's. A third project constructed in 2007 provided state surplus funds shortly before a 'notice to proceed' was issued for a dredging contract. The short lead time required modification to project permits and contract specifications, and did not result in any appreciable marsh creation. Two additional programs have been identified as a source of incremental cost funds for future channel maintenance. Beginning in 2008, oil revenues have been provided annually to coastal parishes through the Coastal Impact Assistance Program (CIAP) for restoration projects. However, administrative and legal problems associated with the transfer of funds between state agencies and the Corps have delayed cost sharing of beneficial use projects with CIAP, and it is unlikely that this program will be able to provide incremental cost funding before 2010. Additional funds have been authorized, but not appropriated, for beneficial use projects beginning in 2010 through the Louisiana Coastal Authority Beneficial Use of Dredged Material program. While the O&M program will continue to create marsh as a secondary benefit to maintenance dredging, it remains to be seen when other programs will contribute to the reversal of coastal wetland loss in Louisiana.

Contact Information: Jeffrey M. Corbino, Operations Division – Technical Support Branch, US Army Corps of Engineers, New Orleans District, New Orleans, LA 70160 USA, Phone: 504-862-1958, Fax: 504-862-2317, Email: jeffrey.m.corbino@usace.army.mil

Machado Lake and Wilmington Drain Ecosystem Rehabilitation

Alfred Mata[1], ***Dick Corneille***[2], *Wendy Katagi*[2] and *Mel Vargas*[3]
[1]City of Los Angeles, Los Angeles, CA, USA
[2]CDM, Los Angeles, CA, USA
[3]Parsons, Austin, TX, USA

The Machado Lake Ecosystem is one of the largest remaining wetlands in southern California. As part of the Pacific Flyway, the 40-acre Machado Lake, 20-acre wetland and riparian corridor, and 130-acre park provide resting, nesting, rearing, and foraging habitat for multiple species. Conservation areas have already been established throughout the park to allow for sensitive bird species to coexist within park boundaries. Two of the plant communities, Coastal Valley Freshwater Marsh and Southern Willow Scrub, are designated as sensitive by the California Department of Fish and Game. This habitat provides a unique structure and complexity ideal for many bird species including, Least Bell's Vireo, Least Bittern, Tricolored Blackbird, and Swainson's Thrush, Black-crowned Night Heron, Gadwall, Cinnamon Teal, Ruddy Duck, and Killdeer, among others. Audubon Society volunteers provide consistent leadership and stewardship of park resources and advocacy for recovering bird populations. Regular monthly bird watching programs and interpretive field tours together with City of Los Angeles funded bird surveys, monitoring, and restoration projects will continue to support long-term conservation goals in the future. City of Los Angeles Recreation and Parks management and maintenance staff are dedicated to these conservation efforts and provide resources needed to maintain restored habitat for target species.

The broad goal of the Machado Lake and Wilmington Drain Ecosystem Rehabilitation project is to improve the water quality conditions and related park facilities, enhance wetland function and values, enhance habitat for target species such as the endangered least Bell's vireo, re-introduce recreational fishing opportunities, and to meet Total Maximum Daily Load (TMDL) requirements and other water quality targets. Both Machado Lake and Wilmington Drain have been identified as impaired water bodies as a result of pollution in stormwater and urban runoff flowing from its 15,553-acre watershed. In order to meet this broad goal, the project team utilizes integrated ecological and engineering strategies and solutions, watershed-based management approaches, in-lake rehabilitation techniques, riparian system enhancements, guidance from resource agencies to enhance target species habitat, and application of best management practices (BMPs) in targeted areas throughout the project area. The project is funded through the City of Los Angeles Proposition O Program, which is a voter passed initiative to provide general obligation bonds for projects to protect public health by cleaning up pollution, including bacteria and trash, in the City's watercourses, beaches and the ocean, in order to meet Federal Clean Water Act requirements.

Contact Information: Dick Corneille CDM, 523 W. 6th Street, #400, Los Angeles, CA 90014, Phone: 213- 457-2200, Email: corneillerw@cdm.com

Integration of an Individual-Based Fish Bioenergetics Model into a Spatially Explicit Water Quality Model: Application to Menhaden in Chesapeake Bay

***P. Soupy Dalyander**, Carl F. Cerco* and *David L. Smith*
Environmental Laboratory, US Army Engineer Research and Development Center, Vicksburg, MS, USA

Although environmental restoration in estuaries is traditionally based on reducing the influx of nutrients from anthropogenic sources to prevent the formation of widespread algal blooms, the expense and complexity of implementing such an approach has made it difficult achieve the targeted improvements in water quality. One alternate strategy consists of attacking the problem from the "top down", by increasing the population of primary consumers to limit phytoplankton growth. This approach is currently under consideration for Chesapeake Bay, the United States' largest estuarine system and an area historically plagued by eutrophication processes that have persisted despite efforts to reduce nutrient influx.

Atlantic menhaden (*Brevoortia tyrannus*) are a species of commercially exploited planktivorous fish that move in schools, often of half a million members or more, along the eastern seaboard of the United States. During the winter and spring, large numbers of larval menhaden (along with adults) enter Chesapeake Bay to use the estuary as a nursery ground, where they consume considerable amounts of phytoplankton (as well as detritus and zooplankton) before returning to the open ocean in the fall. In addition to the possible limiting effect menhaden may have on algal growth, the nitrogen and phosphorus they sequester during growth and subsequently transport out of the system when returning to sea may be significant. To make a reasonable assessment of the impact of menhaden on the Bay and the potential effects of a population increase, their interaction with the water column must be realistically modeled.

In the present study, a fish bioenergetics model is incorporated into CE-QUAL-ICM, a spatially explicit eutrophication model. Using empirically derived parameters for menhaden, the bioenergetics model allows for fish growth to be quantified based on food intake and species-specific energy losses to life processes such as respiration. In addition to consumption, fish biomass and nutrient accumulation/recycling are explicitly accounted for, allowing for a more realistic estimate of the impact of fish on the water column. Schools of fish are tracked individually, allowing for spatial resolution of their effects on phytoplankton and nutrient loading. These developments advance prior modeling efforts of the impact of fish on water quality, many of which are based on integrated estimates over an entire watershed or omit the feedback the fish have through nitrogen excretion, nutrient recycling, and (in the case of large schools of menhaden) respiration. Initial runs on a test grid have qualitatively replicated local effects on water quality observed in the field, including significant algal consumption, oxygen depletion, and ammonia excretion; however, application of the model to a full scale and more detailed mesh grid for Chesapeake Bay is required before a more definitive assessment is made of the potential impact a population increase might have on managing eutrophication.

Contact Information: P. Soupy Dalyander, Environmental Laboratory, US Army ERDC, 3909 Halls Ferry Road, Vicksburg, MS 39180, USA, Phone: 601-634-4612, Fax: 601-634-3129,
Email: Patricia.A.Dalyander@usace.army.mil

Numerical Modeling: A Tool for Urban Conservation and Restoration at Ormond Lagoon

Joel Darnell[1] and *Robert Thomas*[2]
[1]HDR Engineering, Seattle, WA, USA
[2]HDR Engineering, Corpus Christi, TX, USA

Numerical models are increasing useful tools for evaluating the complex physical processes that occur when freshwater runoff encounters the sea. In coastal California, these encounters typically occur in lagoons that open and close throughout the seasons. The majority of coastal lagoons have been impacted by urban development and the few remaining lagoons provide critical habitat for protected species. In this case considered here, the Ventura County Watershed Protection District is conducting preliminary design to reconstruct approximately 2.2 miles of the J-Street stormwater drain in the City of Oxnard, California. The drain discharges into Ormond Lagoon, habitat for the endangered Tidewater Goby, before discharging to the Pacific Ocean through an ephemeral tidal inlet. Upstream flooding, which is to be reduced as part of the project, is a function of the backwater effect of the lagoon. Therefore, a detailed study and numerical analysis of lagoon morphology and hydraulics was undertaken to quantify physical and environmental impacts associated with potential lagoon outlet modifications. The analysis indicated that flooding could be reduced while allowing natural breaching and inlet formation to continue, thus preserving the existing function of the coupled channel-lagoon-ocean system.

Tidal exchange at Ormond Lagoon, a highly modified urban lagoon, is typically initiated by a gradual buildup of water originating from J-Street, Hueneme and Industrial Drains behind the barrier beach. Water levels exceed the beach crest, creating an inlet through which tidal exchange between the lagoon and ocean acts to temporarily maintain the inlet. Waves transport sediment onshore and the varying tide and wave run-up distribute the sediment along the shoreface. Swash transport effectively carries sediment into the breach, facilitating closure. When tidal flow in the inlet is insufficient to remove all of the sand being transported in by the waves, the inlet closes and the processes restart.

The project considered alternative approaches to managing and modifying the lagoon to minimize impacts to sensitive habitat. Alternatives range from installing jetties to allowing natural intermittent breaching to continue. The project team developed a suite of numerical hydrodynamic, waves and sediment transport models to characterize lagoon morphology during storm events, assess alternative scenarios, and demonstrate the concepts in concert with field data collection and an extensive historical review of beach morphology. An intensive data collection effort enabled model calibration. Planned future restoration and expansion of Ormond Lagoon can utilize the field data and numerical analysis applied to evaluate potential restoration options as they relate to the key physical processes of freshwater supply, tidal exchange, sea level rise, and beach morphology.

Contact Information: Joel Darnell, HDR Engineering, 500 108th AVE NE, STE 1200, Bellevue, WA 98004-5549 USA, Phone: 425-450-6396, Email: joel.darnell@hdrinc.com

Restoring Raised Bog in Ireland: Prospects and Palaeoenvironmental Perspectives

Stephen Davis[1], *Michael Delaney*[2], *Angela Wallace*[2] and *John Derwin*[2]
[1]School of Archaeology, University College Dublin, Belfield, Dublin 4, Republic of Ireland
[2]Coillte Teoranta, Central Park, Harbour Street, Mullingar, Co. Westmeath, Republic of Ireland

Ombrotrophic raised bog has been a habitat increasingly under threat worldwide for much of the last millennium. Specific threats to raised mire integrity have been cutting for fuel and horticultural purposes and afforestation. While 17% of the land area of Ireland was originally occupied by peatlands, less than one fifth of this cover remains. In the Atlantic region of Northern Europe Ireland possesses 51% of all remaining raised mire with significant conservation value. In recent years a sea change in attitudes towards raised mire has occurred, with increasing emphasis being placed on efforts to restore damaged or non-functional raised mires to active, growing systems.

The current EU/LIFE funded study highlights efforts by Coillte Teoranta, the state-sponsored forestry board of Ireland at the restoration of a number of raised mires previously under plantation forestry. In addition to vegetation and water-table monitoring, the analysis of testate amoebae (Protozoa: Rhizopoda) was employed as a means of monitoring raised mire restoration progress. Initial results from four study sites suggest that at two of these sites restoration efforts are meeting with considerable success and a return to semi-natural raised mire conditions is underway. In the other two sites thus far studied, while some progress towards restoration is evident this is so far of limited success.

Contact Information: Stephen Davis, University College Dublin, Newman Building, Belfield, Dublin D4, Phone: 3-531-210-1683, Email: stephen.davis@ucd.ie

Living Shoreline Restoration: Evaluation of Ecological Benefits and Connections to Policy and Management

Jana L. D. Davis
Chesapeake Bay Trust, Annapolis, MD USA

In many estuarines, most of the shoreline has been artificially hardened to prevent erosion, resulting in loss of soft (vegetated) nearshore habitat. To counter this trend, restoration groups and managers in certain regions of the United States have been moving towards use of “living shorelines,” techniques that use natural habitat elements for stabilization rather than bulkhead or riprap revetment. This restoration practice has roots in the Chesapeake Bay region, and has since spread south to North Carolina, Florida, and Texas. Certain policies, however, have prevented use of the approach in other areas.

Despite the fact that some regions are moving ahead with policy change, gaps in knowledge about ecological performance exist. The data presented in this talk are among the first steps in quantifying how quickly living shorelines assume "natural" ecological function. Macrofauna at control marsh sites and at bulkhead sites slated for living shoreline installation were sampled before and after construction in a before-after control-impact design. Results suggest that certain species can respond almost immediately to installation of living shorelines. However, ultimate species assemblage may not exactly mirror natural marshes, as living shorelines often incorporate elements such as riprap or oyster shell not found in natural marsh. Rather than a negative, these differences may be viewed as a positive, and incorporation of multiple structural habitat elements may expand the functional value of living shorelines.

The goal of this talk is to bring together groups interested in learning about and discussing (a) the science and engineering of this technique, and (b) when we know “enough” to push for policy change and encourage/incent/require use of living shorelines. Data on ecological function will be put in the context of questions about how these shorelines work, what their ecological benefits are, where to use them, how their use differs among regions, and next steps in science and policy.

Contact Information: Jana L. D. Davis, Chesapeake Bay Trust, Annapolis, MD 21401 USA, Phone: 410-974-2941, Email: jdavis@cbtrust.org

Restoring Habitat in an Agricultural System on Catalina Island, California

Carlos de la Rosa and *Shane Barrow*
Conservation and Education Department, Catalina Island Conservancy, Avalon, CA, USA

For almost 200 years, Santa Catalina Island, part of the California Channel Islands, has endured a heavy agricultural use. The island was intensely grazed by up to 22,000 sheep in the 1800s and up to the 1920s, when they were replaced by cattle. Goats, pigs and bison were introduced to the landscape for various reasons and at various times, as well as mule deer and black buck antelope. Large tracks of the island were converted to hayfields to sustain the cattle herds, all of which (about 5,000 head) were finally removed by the late 1950s. The Catalina Island Conservancy was created in 1972 and now owns and oversees 88% of the 46,000-acre island. Since its creation, the Conservancy has: (1) reduced the bison herd from a peak of 600 to a herd of 150 to 200 individuals; (2) completely removed about 30,000 feral goats and 12,000 pigs; (3) manages a 1,500 to 2,500 herd of mule deer through agreements with the California Department of Fish and Game; and (4) continues to study and monitor the bison and mule deer populations with the aim of further reducing their ecological impact and maximize the benefits to the local economy. The accumulated footprint of these large mammal introductions has also been the focus of large-scale restoration projects that include habitat and species-specific restoration, invasive plant management, and strict protection of certain species and habitats, including several endemic species of plants and animals. The tourism-based economy of the island (close to 1 million visitors per year and over 4,000 permanent residents) influences some of the conservation and management decisions and requires a continued educational effort with the resident and visiting communities. Long-term trends include: (1) the natural and assisted recuperation of the vegetation over vast areas; (2) mitigating the potential effects of non-natural fires that, together with non-native browsers, can change the make up of the natural communities; and (3) the long-term goal of achieving a sustainable island economy consistent with modern conservation and environmental management practice.

Contact Information: Carlos de la Rosa, Catalina Island Conservancy, P.O. Box 2739, Avalon, CA 90704, USA, Phone: 310-510-1299 ext. 225, Fax: 310-510-1729, Email: cdelarosa@catalinaconservancy.org

Optimization and Management of the Everglades Stormwater Treatment Areas

Thomas A. DeBusk[1] and *Deborah L. Drum*[2]
[1] DB Environmental, Inc., Rockledge, FL, USA
[2] South Florida Water Management District (SFWMD), West Palm Beach, FL, USA

Six large treatment wetlands, designated Stormwater Treatment Areas (STAs), have been constructed on south Florida farmlands to treat agricultural runoff and eutrophic lake waters prior to entering the Everglades. The Everglades STAs, ranging in size from 910 – 6,700 hectares, comprise the largest complex of treatment wetlands in the world. In addition to its enormous size, this ecological engineering project is ambitious in several other respects. First, the STAs have extremely low outflow total phosphorus (TP) target concentrations (as low as 10 ug/L). Second, hydrologic management of the STAs is complex, with the wetlands subjected to long periods of stagnant conditions followed by moderate to large wet season flow pulses from the watershed. Finally, because the wetland sediments represent the ultimate reservoir for P removed from the water column, the sustainability of long-term P removal by these systems is not well understood. Operational experience with the Everglades STAs over the past decade has shown the following:

- optimum treatment performance is attained under low P loading conditions, with lowest outflow TP levels achieved by wetland flow paths receiving average loading rates of 1.3 g P/m^2-yr or lower;
- phosphorus removal performance by the STAs is influenced by vegetation community type, with submerged aquatic vegetation (SAV) typically providing lower outflow TP concentrations, and higher mass P removal rates, than emergent aquatic vegetation (EAV);
- vegetation health and cover within the wetland can influence water column P concentrations;
- SAV in large STA wetlands can be adversely impacted by wind and waves during storm events. Bands of EAV recently have been interspersed with SAV communities in an attempt to minimize future impacts;
- STAs built on previously farmed land can achieve long-term TP outflows in the range of 20 - 25 ug/L. However, to date none have yet achieved a long term outflow TP concentration approaching 10 ug/L;
- STA inflow waters contain P in relatively biodegradable forms, whereas outflow P from well performing STAs is dominated by relatively recalcitrant particulate P and dissolved organic P. These recalcitrant P species appear to place constraints on the minimum achievable outflow TP concentrations for the Everglades STAs.

Due to their immense size and long flow paths (up to 7.5 km), internal monitoring of the water column and sediments along transects at varying distance from the inflow has proven to be an effective tool for monitoring the STAs. Such monitoring efforts are a key component of a SFWMD-sponsored research program designed to identify opportunities for improving performance and sustainability of the Everglades STAs.

Contact Information: Thomas A. DeBusk, DB Environmental, Inc., 365 Gus Hipp Blvd. Rockledge, FL 32955 USA, Phone: 321-631-0610, Fax: 321-631-3169, Email: tom@dbenv.com

Integrating Hydrology, Ecology and River Geomorphology into Urban Landscape Design: The Lower Don Lands Naturalization Project

Timothy J. Dekker[1], *Dan Lautenbach*[1], *Steve Apfelbaum*[2], *Elizabeth Silver*[3] and *Gullivar Shepard*[3]
[1]LimnoTech, Ann Arbor, MI, USA
[2]Applied Ecological Services, Brodhead, WI, USA
[3]Michael Van Valkenburgh and Associates, New York, NY, USA

The Lower Don Lands Area of Toronto is located at the intersection of three emerging Toronto neighborhoods: the West Don Lands, East Bayfront, and the Port Lands area. This intersection of neighborhoods contains the mouth of the lower Don River, a channelized and constrained river mouth surrounded by transportation corridors and other aging urban infrastructure. In recent years, the public demand for restoration of the river mouth area have greatly increased, while the emerging neighborhoods have created a need to find a dynamic balance between the surrounding urban environment and the hydrologic and ecologic requirements of the river mouth. An international design competition to develop a plan for resolving these competing needs was held in 2007.

This talk describes how the winning design was developed as a highly multidisciplinary creative effort supported by a strong technical understanding of local hydrology, local freshwater estuarine ecology, and hydrologic and ecological interactions with Lake Ontario. The result is a proposal to create over 1.5 km of new winding river and mouth with natural meanders, wetland margins, wildlife habitat, and recreational opportunities. The plan also retains and enhances the function of the lower Don as a floodway, greatly increasing floodwater conveyance capacity to allow passage of the most extreme regulatory flood event. These functional aspects of the river system were developed in tandem with a major restructuring of the urban fabric of the Toronto lower Donlands area. The plan provides for a mix of residential and commercial land uses that are highly connected to the river corridor, floodplain, and associated wetlands via bridges, bikeways, and walking paths. The result is anticipated to be substantial increase in property values, enhanced commercial development in a neglected part of the Toronto waterfront, and the creation of a significant recreational and ecological development opportunity for the citizens of Toronto.

Contact Information: Timothy J. Dekker, LimnoTech, 501 Avis Drive, Ann Arbor, MI, 48105, USA, Phone: 734-332-1200, Email: tdekker@limno.com

Alligators and Crocodiles as Indicators for Restoration of Everglades Ecosystems

Frank J. Mazzotti[1], *G. Ronnie Best*[2], *Laura A. Brandt*[3], *Michael S. Cherkiss*[1], *Brian M. Jeffery*[1], *Kenneth G. Rice*[4] and ***Mat Denton***[1]

[1]University of Florida, Ft. Lauderdale Research and Education Center, Davie, Florida
[2]Greater Everglades Priority Ecosystems Science, United States Geological Survey, c/o University of Florida/IFAS, Fort Lauderdale Research & Education Center, Ft. Lauderdale, FL
[3]U.S. Fish and Wildlife, Joint Ecosystem Modeling, Fort Lauderdale Research and Education Center, Davie, FL
[4]U.S. Geological Survey, Florida Integrated Science Center FISC-Gainesville, Gainesville, FL

Ecological monitoring is a key part of adaptive management and successful restoration. Not everything within an ecosystem can be monitored so it is important to select indicators that are representative of the system, show clear responses to system change, can be effectively and efficiently monitored, and are easily communicated. Crocodilians (alligators and crocodiles) are one of the indicators that meet these criteria within the Everglades ecosystem. The alligator indicator uses relative density, body condition, nesting effort and success, and occupancy rates of alligator holes, while crocodile indicators use growth and survival, and trends in their populations related to hydrology. Correlations between biological responses and environmental conditions contribute to an understanding of species' status and trends over time. Positive or negative trends of crocodilian populations relative to hydrologic changes permit assessment of positive or negative trends in restoration. The crocodilian indicator is currently stable; with alligator trends negative in seven management areas and stable in two, and crocodile trends in Everglades National Park and Biscayne Bay Complex showing a stable trend. Restoration success or failure can be evaluated by comparing recent and future trends and status of crocodilian populations with historical or reference population data and model predictions.

- We have developed a monitoring program for alligator populations that can be used to evaluate the effects of restoration throughout the Greater Everglades Ecosystem. This program includes a comprehensive set of performance measures that can evaluate short (body condition), medium (population density, alligator hole occupancy), and long-term (nesting) effects of restoration on alligator populations.

- We have developed a monitoring program for crocodile populations that is effective at detecting impacts of short term disturbances that may impact population responses to ecosystem restoration. This combination of condition, growth, survival, and nesting of crocodiles allows for monitoring response of crocodile populations at different temporal scales.

- Restoration progress can be evaluated by comparing recent and future trends and status of crocodilian populations with historical or reference population data and model predictions.

Contact Information: Dr. Frank Mazzotti, University of Florida, Fort Lauderdale Research and Education Center, 3205 College Ave, Davie, FL 33314 USA, Phone: 954-577-6304, Fax: 954-475-4125, Email: fjma@ufl.edu

Modeling the Relationship between Water Flows/Levels and Ecological Endpoints

Joseph V. DePinto, *Todd Redder, Scott Bell* and *Laura Weintraub*
LimnoTech, Ann Arbor, MI

Many studies, including several conducted by The Nature Conservancy in supporting their *Ecologically Sustainable Water Management* Framework, have noted a strong relationship between the existence of natural environmental flow regimes and the success of aquatic biota in a given system. This raises the management question of how to balance the competing demands for a system's water to provide human uses (i.e., drinking water supply, irrigation, recreation, navigation, shoreline development) against a desire to minimize hydrologic/hydraulic alterations relative to a natural flow regime. We have developed models that have supported decisions relative to water levels and flows management by quantifying the relationship between ecological response and alternative management options.

A major example of such a hydrologic-ecological modeling framework was the Integrated Ecological Response Model (IERM) developed in support of the Lake Ontario – St. Lawrence River water level/flow regulation study (LOSL) conducted by the International Joint Commission to evaluate existing and alternative water regulation plans while including ecological response among the various other use interests. The IERM was developed to simulate the response of a variety of ecological performance indicators (wetland and nearshore habitat and associated flora and fauna) to variations in water levels and flows. This allowed a ranking of alternative regulation plans based on the key ecological indicator responses. The best regulation plan for the environment permitted periodic high and low water levels that are closer to historic conditions prior to regulation. However, adoption of this plan would require trade-offs in terms of recreational boating and coastal flooding damages.

LimnoTech has also developed a linked flow-ecological response modeling framework (GLECO) for river-based watershed systems in support of the analysis of ecological impacts of water withdrawals or diversions in the Great Lakes. This modeling framework links the HSPF watershed model to habitat-based ecosystem sub-models. The model has been field-tested on the Muskegon River watershed in Michigan. Water withdrawals in this watershed have been shown to impact flow regime and water temperature in mainstem and tributary reaches, thus affecting the habitat of brown trout.

Recently, LimnoTech has begun developing a hydraulic model for the San Joaquin River-Delta system that will simulate real-time flows and salinity profiles as a function of various competing water uses and basin hydrometeorology. We will use this basic framework and our experience in the Great Lakes to present a conceptualization of a linked flow-salinity-ecological model that could be used as an integrated decision support framework to evaluate the response of key ecological endpoints such as Chinook salmon and Delta smelt to alterations of freshwater flow into the estuary. Since freshwater flow is a key driver and arguably one of the most important resource management manipulations available for the system, such a model could be an invaluable tool for adaptive ecosystem management and restoration.

Contact Information: Joseph V. DePinto, LimnoTech, 501 Avis Drive, Ann Arbor, MI 48130 USA, Phone: 734-332-1200, Fax: 734-332-1212, Email: jdepinto@Limno.com

Evaluation of Synergistic and Linear Processes in the Cumulative Effects of Ecosystem Restoration

Heida L. Diefenderfer*, Gary E. Johnson, John R. Skalski, Ronald M. Thom, Andre M. Coleman, and Stephen A. Breithaupt*
Pacific Northwest National Laboratory, Sequim, WA

The preponderance of nonlinear effects in degradation of coastal and riverine ecosystems remains undetermined, and the significance of such effects for ecological restoration is perhaps understood even less. Rarely are both additive and synergistic effects evaluated to quantify net ecosystem improvement from restoration programs. In this study, we examined linear and synergistic relationships in dike-breach restoration scenarios on the tidal portion of the Grays River, a tributary of the Columbia River estuary. The purpose was to improve the efficacy of suites of projects designed to provide habitat for endangered anadromous fishes. Hydrological processes are a determinate factor in floodplain and wetland restoration, influencing plant community types and habitat functions. On the Columbia River estuary in particular, juvenile salmonids rear during out-migration so managed hydrological cycles affect fish opportunity to enter tidal wetlands as well as the capacity of these habitats to contribute to fitness. We used a hydrodynamic model and robust statistical design to test the hypothesis that the cluster size of hydrological reconnection projects has a nonlinear effect on the area of floodplain inundation and available habitat, under both even and uneven spatial configuration scenarios. Additionally, toward the additive evaluation of effects, we calculated potential materials export from these tidal floodplain wetlands to the main stem river based on field-collected data. Finally, we developed a time-area inundation index integrating LIDAR data with water level data in order to represent the net effects of watershed and oceanic processes on the hydrographs of such coastal wetlands. The results of this modeling and analysis will be summarized and integrated in this presentation using a lines-of-evidence approach to evaluate cumulative effects.

Contact Information: Heida Diefenderfer, Pacific Northwest National Laboratory, 1529 West Sequim Bay Road, Sequim, WA 98382, Phone: 360-681-3619, Email: heida.diefenderfer@pnl.gov

Collaboration and Designing for Endangered Fish Species in a Floodway

Mike Dietl
U.S. Army Corps of Engineers, Sacramento District, Sacramento, CA, USA

During 2006-2008 the Sacramento District of the Corps of Engineers repaired 36 eroding sites totaling approximately 28,000 linear feet, at a cost of approximately $150,000,000. These sites were located along the Sacramento River Flood Protection Project in the Sacramento and American Rivers, and the San Francisco Bay/Delta. Since 2001 progress on repairing erosion sites has been slow due to lack of funding and environmental concerns primarily concerning endangered and threatened fish species and the receipt of a draft jeopardy opinion from the U.S. Fish and Wildlife Service and National Marine Fisheries The 36 sites were designed by interagency/interdisciplinary team using Corps engineering guidance and a Standard Assessment Methodology developed by the Corps and resource agencies to assess the benefits to the environment. As a result, these constructed sites require little off-site mitigation and were permitted and constructed in a timely manner. This application of mitigation features including floodplain benches, large woody debris, soil in rock, riparian and wetland plantings, and preservation of onsite habitat features has been recognized by the National Marine Fisheries Service and U.S. Fish and Wildlife Service as an acceptable approach to bank protection in the SRFCP. The Corps has received additional authorization of 80,000 linear feet to construct addition protections to SRFCP at an estimated cost of over $300,000,000. This additional effort will require the close coordination between public and private stakeholders.

Contact Information: Mike Dietl, U.S. Army Corps of Engineers, Sacramento District, 1325 J St. Sacramento, CA 95814, Phone: 916-557-6742, Fax: 916-557-7866, Email: Michael.L.Dietl@usace.army.mil

Balancing the Uncertainties: Approaches to Large-Scale River Corridor Restoration Planning in a Semi-Arid California Landscape

Bruce K. Orr[1], ***Zooey E. Diggory***[1], *Peter W. Downs*[1], *William A. Sears*[1,2] and *Peter Brand*[3]
[1]Stillwater Sciences, Berkeley, CA, USA
[2]San Francisco Public Utilities Commission, San Francisco CA, USA
[3]California Coastal Conservancy, Oakland, CA, USA

Conservation and restoration of California's semi-arid river corridors is a daunting challenge, particularly in light of increasing demands for water and land coupled with global climate change. The lower Santa Clara River (SCR) (Ventura County, CA, USA) has been significantly altered by levees, water diversions, agriculture, and urbanization that have modified geomorphic and hydrologic processes, often causing aquatic and riparian habitat loss or degradation. Despite these changes the lower SCR is still one of the least altered rivers in southern California, supporting a wide variety of natural aquatic and terrestrial communities and native species, relatively intact patches of riparian and floodplain habitats, headwaters-to-ocean aquatic habitat linkages, and a regionally important north-south connection between protected terrestrial wildlife areas. Because of its regional importance, the California State Coastal Conservancy and numerous partners are seeking to develop a 30 mile-long floodplain corridor that ameliorates habitat degradation and conserves existing aquatic and riparian habitats. The overall vision is to integrate ecosystem research, natural resource planning and management, and agricultural and commercial development to illustrate how science and regional planning may lead to cost-effective conservation of biodiversity and ecosystem functions, and sustainable communities.

Planning for this ambitious project has required a phased integrative framework involving: 1) assessment of current and historical watershed hydrogeomorphic conditions and processes; 2) mapping historical changes in channel form and floodplain vegetation in response to large "ecosystem resetting" floods (typically during wet El Niño winters); 3) high resolution mapping and classification of existing native and non-native riparian-floodplain vegetation; 4) investigations of life history and habitat requirements of key focal species; 5) studies of the physical process-habitat-biotic response linkages for valued flora and fauna; and 6) information synthesis to inform restoration strategies and management decisions that are practicable within the context of contemporary land uses. Restoration strategies are centered on acquisition from willing sellers of threatened and/or high-value habitat that is currently prone to regular flooding; levee setback and removal, floodplain recontouring, and floodplain infrastructure modification; active and passive revegetation; non-native invasive species removal; creating a network of water-quality treatment wetlands; and aquatic habitat enhancements focused on fish passage improvements. These strategies should also provide benefit to heightened concerns for flood risk management resulting from intensified ENSO events over the last 40 years. Such approaches are necessary in large-scale ecosystem restoration as the basis for developing successful, cost-effective strategies that provide ecosystem and societal benefits while remaining resilient to altered conditions that will inevitably occur as a result of local, regional and global change.

Contact Information: Bruce K. Orr, Stillwater Sciences, 2855 Telegraph Avenue #400, Berkeley, CA 94705, USA, Phone: 510-848-8098 x111, Fax: 510-848-8398, Email: bruce@stillwatersci.com

Ecological Indicators for Assessing Everglades Restoration

Robert F. Doren[1], *Joel C. Trexler*[2], *Andrew D. Gottlieb*[3] and *Matthew C. Harwell*[4]
[1]Florida International University, University Park Campus, Southeast Environmental Research Center, Miami, FL, USA
[2]Florida International University, University Park Campus, Department of Biology, Miami, FL, USA
[3]South Florida Water Management District, West Palm Beach, FL, USA
[4]US Fish and Wildlife Service, A.R.M. Loxahatchee National Wildlife Refuge, Boynton Beach, FL, USA

Developing scientifically credible tools for measuring the success of ecological restoration projects is a difficult and a non-trivial task. Yet, reliable measures of the general health and ecological integrity of ecosystems are critical for assessing the success of restoration programs. The South Florida Ecosystem Restoration Task Force (Task Force), which helps coordinate a multi-billion dollar multi-organizational effort between federal, state, local and tribal governments to restore the Florida Everglades, is using a small set of system-wide ecological indicators to assess the restoration efforts. A team of scientists and managers identified eleven ecological indicators from a field of several hundred through a selection process using 12 criteria to determine their applicability as part of a system-wide suite. The 12 criteria are: (1) is the indicator relevant to the ecosystem? (2) Does it respond to variability at a scale that makes it applicable to the entire system? (3) Is the indicator feasible to implement and is it measureable? (4) Is the indicator sensitive to system drivers and is it predictable? (5) Is the indicator interpretable in a common language? (6) Are there situations where an optimistic trend with regard to an indicator might suggest a pessimistic restoration trend? (7) Are there situations where a pessimistic trend with regard to an indicator may be unrelated to restoration activities? (8) Is the indicator scientifically defensible? (9) Can clear, measureable targets be established for the indicator to allow for assessments of success? (10) Does the indicator have specificity to be able to result in corrective action? (11) What level of ecosystem process or structure does the indicator address? (12) Does the indicator provide early warning signs of ecological change? In addition, a two page stoplight report card was developed to assist in communicating the complex science inherent in ecological indicators in a common language for resource managers, policy makers and the public. The report card employs a universally understood stoplight symbol that uses green to indicate that targets are being met, yellow to indicate that targets have not been met and corrective action may be needed and red to represent that targets are far from being met and corrective action is required. This paper presents the scientific process and the results of the development and selection of the criteria, the indicators and the stoplight report card format and content. The detailed process and results for the individual indicators are presented in companion papers in this special issue of Ecological Indicators.

Contact Information: Robert Doren, US Dept. of Interior, Florida International University, OE 148, SERC, Miami, FL 33199, Phone: 305-348-6721, Email: dorenr@fiu.edu

Analysis and Assessment of Thirty Years of Wetland Restoration within the New York/New Jersey Harbor Estuary

***Teresa Doss*[1] *and* *Carl Alderson*[2]**
[1]Biohabitats, Glen Ridge, NJ, USA
[2]National Oceanic and Atmospheric Administration Restoration Center, Sandy Hook, NJ, USA

Restoration of urban wetland systems such as those within the New York/New Jersey Harbor Estuary typically involves the manipulation of hydrology and the management of invasive plant species, with an expected net overall improvement in habitat quality for fishery and wildlife species. However, the evolving science of restoration is documenting how other parameters such as landscape setting, habitat type, soil properties, topography, nutrient supplies, disturbance regimes, seed banks and declining biodiversity can constrain the restoration process. Using the NOAA Restoration Center's NY/NJ Harbor Estuary Mapping Database, 125 projects located within the NY/NJ Harbor Estuary are analyzed to determine if restoration goals were met and what factors contributed in moving a project towards a more sustainable trajectory. Based on these case studies, we attempt to highlight those factors that can help us predict the path restored sites will follow with more assurance that specific goals will be met. Until 2006 no clearinghouse of completed habitat improvement projects existed for the NY/NJ Harbor Estuary. Records were scattered among personal and retired project files of still-active restoration professionals. NOAA Restoration Center's regional staff decided to capture this history before it became irretrievable. Thus began a three year effort to design a data capture system, populate its fields and test its usefulness. Its present form is a simple system of spreadsheets and Google Earth map files. This was determined to be the most portable technology to reach out to those who possessed knowledge and written information. Its ultimate format for presentation and storage is still undetermined. The database provides an easy means for ultimate retrieval, analysis and storage of the historic record via a system of attribute and sub-attribute categories. Seven long time and still active practitioners were called upon to help recount the history. The database captures all known restoration projects completed since 1984, the date of the first identified project. Recorded is every type of restoration performed from that date forward, including wetlands, forests, grasslands, riparian corridors, shellfish, and fish passage. The database is intended for use by planners and planning bodies to inform future decision making and assist in setting targets for future restoration. The current edition of the NOAA RC NY/NJ Harbor Estuary Mapping Database has been placed in the hands of the leadership of the Comprehensive Restoration Plan (CRP) - Hudson Raritan Estuary (HRE) ecosystem restoration study, in hopes that the 2nd edition CRP will integrate and inform planning decisions with this planning tool. The CRP is sponsored by the U.S. Army Corps of Engineers and the Port Authority of New York and New Jersey. Draft Volume 1 & 2 of the CRP was published in March of 2009.

With gratitude to Bill Young, John McLaughlin, James Rossi, Brett Bragin, and Tim Wenskus who along with the authors provided the project histories.

Contact Information: Teresa Doss, Biohabitats, 855 Bloomfield Avenue, Glen Ridge, NJ 07028, USA, Phone: 973-868-2238, Email: tdoss@biohabitats.com

Carl Alderson CLA, NOAA Restoration Center - JJ Howard National Marine Fisheries Science Center, 74 Magruder Road, Highlands, NJ 07732 USA, Phone: 732-872-3087, Email: Carl.Alderson@noaa.gov

Making Urban Ecosystem Restoration Real: Addressing the Factors Limiting Threatened Steelhead in the San Francisco Bay Area

Peter W. Downs[1], *A.J. Keith*[1], *Frank K. Ligon*[1], *Matt R. Sloat*[1,2] and *Neil S. Lassettre*[1]
[1]Stillwater Sciences, Berkeley, CA, USA
[2]Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR, USA

Urban stream restoration has generally been morphologically-inspired, returning the channel to a configuration that functions better in terms of hydraulics and geomorphology, and/or aesthetically-inspired, pursuing societal goals through human quality-of-life improvements to the urban stream corridor. Although both are highly worthy aims, neither intrinsically tackles the particular challenges faced by threatened and endangered species in urban landscapes. We argue that the third component of urban ecosystem restoration is the explicit recognition of biophysical improvements required to achieve self-sustaining populations of focal species. This requires a process-based understanding of the linkages between human activities and the resultant changes in watershed inputs (e.g., water, sediment), geomorphic processes, habitat characteristics, species abundance, and population dynamics.

This approach was employed to address factors limiting the production of steelhead (*Oncorhynchus mykiss*), a federally threatened anadromous salmonid, in two highly urbanized creeks draining into San Francisco Bay, California. Local physical and biological data for each watershed were interpreted within the context of the general conceptual model to develop hypotheses of the mechanisms that control abundance under current conditions. The hypotheses were tested through targeted field studies and analyses of existing data, and synthesized in a multi-stage stock recruitment steelhead population model. The population model estimated carrying capacities and density-independent mortality at different life stages to simulate how mortality at one or more life stages may limit population size. The iterative process of hypothesis development, testing, and refinement provides an adaptive and efficient process for identifying priority restoration strategies.

In Stevens Creek, downstream of a reservoir that moderates base flows and reduces winter/spring peak flows, the most likely limiting factors were identified as physical- and flow-related barriers to steelhead migration and restrictions on available juvenile overwintering habitat due to a lack of coarse bed sediment. In Upper Penitencia Creek, analyses identified steelhead migration barriers caused by seasonal channel drying, and low quality of juvenile overwintering habitat due to fine sediment intrusion into coarse bed sediment, as the dominant limiting factors. Proposed restoration and management actions included barrier remediation and studies to determine the feasibility of adding coarse substrate, and the development of a biologically-based flow release schedule and implementation of fine sediment reduction measures, respectively. Such analyses are required in addition to other approaches as the basis for genuine and sustained improvements to the urban ecosystem.

Contact Information: Peter W. Downs, Stillwater Sciences, 2855 Telegraph Avenue #400, Berkeley, CA 94705, USA, Phone: 510-848-8098 x138, Fax: 510-848-8398, Email: downs@stillwatersci.com

Restoring Ecological Integrity in Fragmented Rivers: Using Analytical Reference Conditions to Restore a Dredged and Regulated River-Floodplain

Peter W. Downs*, Maia S. Singer, Bruce K. Orr, Zooey E. Diggory* and *Tami S. N. Cosio*
Stillwater Sciences, Berkeley, CA, USA

In many rivers regulated by large dams, changes to the river's morphology, hydrology and sediment regimes are so profound, and longitudinal and lateral disconnection so complete, that no credible reference reach, past or present, exists as the basis for restoring ecological integrity. We posit that in these fragmented rivers restoration should be developed using a 'naturalization' design approach based on analytical reference conditions that allow the restored river to function within the context of contemporary flow and sediment regimes. The approach is practical because it works within the existing disturbance regime of the watershed to develop discrete reach-based restoration actions targeted directly at factors limiting the success of valued native species and ecosystem services.

The Dredger Tailings Reach of the lower Merced River in California's Central Valley is fragmented from flow regulation by upstream dams and historic gold mining which has overturned and elevated the former floodplain. However, it is a primary spawning area, especially for anadromous fall-run Chinook salmon (*Oncorhynchus tshawytscha)*. Pre-design monitoring and predictive modeling are used to identify inherent restoration challenges and restoration first principles are applied to support ecosystem naturalization. Primary restoration activities include channel-downscaling, coarse sediment augmentation, floodplain re-grading, active revegetation, and preservation of existing native riparian vegetation. Ultimately, the project will provide opportunities to test whether morphological channel reconstruction without additional river flow is a viable approach to achieving broader water resources management goals in the California Central Valley or in other fragmented river systems.

Contact Information: Peter W. Downs, Stillwater Sciences, 2855 Telegraph Avenue #400, Berkeley, CA 94705, USA, Phone 510-848-8098 x138, Fax: 510-848-8398, Email downs@stillwatersci.com

Simulating Sediment Transport to Evaluate Dam Removal Restoration Strategies

Yantao Cui, John K. Wooster, ***Peter W. Downs*** and *Scott R. Dusterhoff*
Stillwater Sciences, Berkeley, CA, USA

Many large-scale restoration actions are characterized by significant uncertainty in their eventual outcome, leading to considerable concern on the part of agencies and stakeholders about whether and how to pursue the proposed restoration strategy. Dam removal is an excellent case in point: removing large dams typically releases large volumes of sediment to downstream reaches that can potentially cause significant environmental and economic consequences, or be quite benign, depending on the circumstance. Accurate scientific information regarding the dynamics of released sediment is therefore critical to guide the engineering approach to dam removal. We present five case studies to demonstrate the utility of numerical models in predicting the potential impact of releasing large volumes of sediment ahead of management action. They involve (a) the removal of Marmot Dam on Sandy River, Oregon; (b) the removal of Saeltzer Dam on Clear Creek, California; (c) the proposed removal of Soda Springs Dam on North Umpqua River, Oregon; (d) the proposed removal of Irongate, J.C. Boyle, and Copco (I & II) dams on the Klamath River, California; and (e) disposal of mine-related sediment to Ok Tedi/Fly River system in Papua New Guinea.

In most cases, several simulations were conducted to assist in selecting an appropriate dam removal and/or sediment management strategy. For instance, ahead of the removal of Marmot Dam, model simulations were used to inform a diverse stakeholder group in the selection of the most cost effective and environmentally-appropriate removal alternative. This led directly to the approach used in Marmot Dam's removal in September 2008. Post-removal data indicates a good comparison between model simulations and initial field survey results. Experiences with numerical modeling for the Soda Springs Dam and Marmot Dam removal studies resulted in the development of numerical models specifically designed to accommodate the challenges of dam removal. The Dam Removal Express Assessment Models (DREAM-1 and -2) were used to simulate the proposed Klamath River dam removals. Sensitivity tests with DREAM-1 and -2 indicated that grain size distribution of the reservoir sediment deposit is the key parameter that controls the dynamics of sediment transport following dam removal. Later tests also indicated that the models could adequately simulate the reach-averaged bed elevation changes due to sediment pulses moving through a flume channel with a pool-riffle morphology, suggesting other prospective uses for the models. Overall, there is increasing capacity for predictive models to advise large-scale restoration activity, both to guide engineering practices and reduce the environmental uncertainty surrounding activities such as dam removal.

Contact Information: Peter W. Downs, Stillwater Sciences, 2855 Telegraph Avenue #400, Berkeley, CA 94705, USA, Phone: 510-848-8098 x138, Fax: 510-848-8398, Email: downs@stillwatersci.com

Monitoring Suspended Sediment Plumes Formed during Dredging in Boston Harbor, Massachusetts, Using Acoustic Backscatter from ADCP

Paul Dragos and *Matt Fitzpatrick*
Battelle, Duxbury, MA, USA

Turbidity and suspended sediment concentrations in plumes resulting from clamshell dredging and dredged material disposal operations in Boston Harbor were observed using Acoustic Doppler Current Profiler (ADCP) calibrated against water samples collected on site. Beginning in the spring of 2008, the US Army Corps of Engineers conducted maintenance dredging of the inner portion of the Federal navigation channels in Boston Harbor removing approximately 1.7 million cubic yards of dredged material. The primary objective of this monitoring effort was to gauge the extent of potential water quality impacts. In particular, dredged material plume transport and subsequent deposition on potential winter flounder spawning grounds have been identified by the resource agencies as an environmental concern. This information was available in real-time to make operational adjustments as may have been necessary to minimize impacts.

Suspended sediment plumes produced by dredging activity were monitored during four slack, two ebb and two flood tides in each of two study areas during dredging activities and during five dredged material disposal events. The measurements consist of velocity, turbidity and suspended sediment concentration derived from continuous, underway ADCP measurements of acoustic backscatter; turbidity and suspended sediment concentration derived from Optical Back-Scatter (OBS) along with other hydrographic parameters during vertical profiles at discrete locations; and whole water samples for shipboard and laboratory analysis also collected during vertical profiles. ADCP data were calibrated for turbidity against water samples analyzed with a bench top turbidimeter and against water samples analyzed in the laboratory for TSS using a simplified version of the sonar equation. The resulting turbidity and TSS calibrations had 95% confidence intervals of ± 4.14 NTU and ± 4.50 mg/L, respectively. Turbidity values never exceeded the established threshold criteria and the dredge plumes were typically confined to the navigation channel. Detailed observations of dredged material plume movement and dissipation are presented.

Contact Information: Paul Dragos, Battelle, 397 Washington Street, Duxbury, MA, USA, Phone: 781-952-5357, Fax: 614-458-6880, Email: dragosp@battelle.org

Collaboration and Interdependence - Two Keys to Mississippi Valley Regionalization and Partnerships

Brig. Gen. Michael J. Walsh and ***Paul J. DuBowy***
Mississippi Valley Division, US Army Corps of Engineers, Vicksburg, MS, USA

The Mississippi Valley Division is attempting to set new standards for the Corps regarding collaboration. Within MVD, the Mississippi River Commission has taken the lead with an emphasis on building relationships through a formal process of *Listening, Inspecting, and Partnering*. We have already made great strides on the Upper Mississippi and Illinois Rivers, but we cannot stop there. We must find ways to work collaboratively with all of our stakeholders to develop comprehensive, integrated solutions to our region's water resources problems.

Over the past year and a half, the Mississippi Valley Division has formed or strengthened a number of partnerships with non-federal, local, State and Federal customers and stakeholders. These partnerships are focused on sharing knowledge, material resources and expertise to create a compelling and unified future *Vision for the Mississippi River* – a vision dependent on collaboration and interdependence.

Key examples of improved collaborative efforts during the past 18 months include a renewed focus on gathering stakeholder ideas and suggestions during MRC Inspection Trips, the Mid-West Natural Resource Group (comprised of 14 Federal Agencies), the Mississippi River Diversion Summit in Louisiana, a new Regional Ducks Unlimited Partnership Agreement, the formation of a Forecasting Fusion Cell with the National Weather Service and the US Geological Survey following the Rainfall-River Forecast Summit, the close working relationship with levee districts regarding new levee safety standards, our continued partnership with the Mississippi Valley Flood Control Association, and the chartering and institution of the Interagency Levee Task Force.

All of these collaborative efforts are unified under the umbrella of the world's third largest watershed (America's Watershed – the Mississippi River).

Contact Information: BG Michael J. Walsh, Mississippi Valley Division, US Army Corps of Engineers, PO Box 80, Vicksburg, MS 39181 USA, Phone: 601-634-5753, Email: michael.j.walsh@usace.army.mil

Optimizing Long-Term Ecosystem Success in Freshwater and Saltwater Habitats at the Atlas Tack Corporation Superfund Site

Barry J. Dubinski[1] and *Ed Benton*[2]
[1]Weston Solutions, Inc., West Chester, PA, USA
[2]Weston Solutions, Inc., Bedford, NH, USA

The Record of Decision for the Atlas Tack Superfund site included regrading and revegetating remediated areas to original pre-contamination (pre-1901) conditions to the extent possible. However, post-1901 activities (e.g., construction of a hurricane barrier in the 1960s) precluded restoring some areas to pre-1901 conditions.

The primary performance goals were redefined to include:

- Erosion protection
- Invasive species management (primarily Phragmites australis), and
- To the extent practicable, restoration of the salt marsh and other areas consistent with anticipated future use of the site, and providing an equal ecologically valued land use, when compared to pre-1901 site characteristics.

Through an iterative approach involving the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the National Oceanic and Atmospheric Administration, the Massachusetts Department of Environmental Protection, and other stakeholders, a restoration plan was developed which:

1) Maximized the restoration of impacted salt marsh
2) To the extent practicable, constructed a non-tidal emergent wetland system designed to exclude the invasive species P. australis, and
3) Provided for invasive species management.

The development of this design and implementation in 2007 will be presented, as it included a supplemental emergent berm that helped to maintain both freshwater and saltwater habitats while minimizing opportunities for invasive species and still meeting site remediation goals.

Preliminary results from monitoring the restored areas in 2008 will be presented.

Contact Information: Barry J. Dubinski, Weston Solutions, Inc., 1400 Weston Way, West Chester, PA 19380 USA, Phone: 610-701-3137, Fax: 610-701-7401, Email: Barry.Dubinski@westonsolutions.com

Navigation, Flood Management and the Mississippi River Ecosystem

Paul J. DuBowy
Mississippi River and Tributaries Regional Technical Center, US Army Corps of Engineers, Vicksburg, MS

The Mississippi River is one of the world's great rivers and is the only river in the United States to be formally recognized by Congress as both a nationally significant ecosystem and commercial navigation system. The river has a long and colorful history and has played a significant role in shaping our social and economic development. However, the Mississippi River is not a single homogeneous unit. From its source in northern Minnesota to the Gulf of Mexico one can discern at least five distinct Mississippi Rivers based on geomorphology and hydraulics. Concomitant with these differences in the river are differences in navigation and flood risk management that result in different river management strategies. Levees, reservoirs, floodways, pools and locks are some of the different structures that are in place on various reaches of the river to address the concerns of flood management and navigation. Consequently, river rehabilitation, as well as recreation, must be developed within the context of the potentially different directions that navigation and flood management have taken the river.

The effects of river regulation, floodplain development and watershed modifications present constant challenges to the integrity of the Mississippi River. Since the late 1980s Mississippi River rehabilitation has proceeded at a quick pace. Because the Mississippi system varies widely in hydraulics and hydrology from source to the Gulf, river rehabilitation likewise takes different forms in different regions along the river. Additionally, the goals, targets and metrics of river rehabilitation are not constant across the entire river. However, the engineering expertise of the US Army Corps of Engineers coupled with the environmental proficiency of the US Fish and Wildlife Service and other federal and state agencies make for a powerful dynamic to meet these restoration needs.

Contact Information: Paul DuBowy, CEMVD-PD-WM, PO Box 80, Vicksburg MS 39181, Phone: 601-634-5930, Fax: 601-634-7073, Email: paul.j.dubowy@usace.army.mil

Opportunities to Enhance Conservation Implementation and Watershed Planning: The Conservation Effects Assessment Project (CEAP)

Lisa F. Duriancik and *William R. Effland*
U.S. Department of Agriculture, Natural Resources Conservation Service, Resources Inventory and Assessment Division, Beltsville, MD, USA

New perspectives and scientific advances in watershed planning are needed to address increasingly complex environmental challenges, for example, biofuels production, drought, climate change, and urbanization. Effective conservation is needed to protect and restore natural resources. The Conservation Effects Assessment Project (CEAP), a multi-agency project led by the U.S. Department of Agriculture, was initiated in 2003. Many activities undertaken at watershed, regional, and national scales address the original goal of CEAP, quantifying the effects of conservation practices on the landscape. In the CEAP watershed scale studies, significant advancements are being made in the science base to improve our knowledge of conservation effectiveness and address environmental goals. Analyses of long-term databases are occurring in watersheds across the nation to assess the effectiveness of conservation practices and to examine related water resource outcomes. In addition, new technologies and modeling approaches are being developed to analyze conservation options and optimize impact. Socio-economic conditions affecting conservation are also studied and are revealing new perspectives to be considered in watershed planning. One unique CEAP watershed study in Puerto Rico examines the effects that conservation practices implemented by farmers in the uplands may have on coastal waters and associated estuarine ecosystems. Examples of watershed scale work and new insights for enhancing effective conservation and watershed-based resource protection will be reviewed.

Contact Information: Lisa F. Duriancik, USDA/NRCS/RIAD, 5601 Sunnyside Avenue, Mail Stop 5410, Beltsville, MD, 20705 USA, Phone: 301-504-2304, Fax: 301-504-3788, Email: lisa.duriancik@wdc.usda.gov

Application of Adaptive Management in Current Federal Permitting, Eco-system Restoration and Endangered Species Recovery Programs

Blaine N. Dwyer
AECOM Water, Lakewood, CO, USA

Steadily increasing competition for water supplies and intense concern over future hydrologic variability due to climate change is bringing the need for flexible management of limited water resources to critical levels. State water laws, federal project authorizations, and historic water uses can severely restrict future water allocation decisions. Many on-going river basin planning programs involving ecosystem restoration, endangered species recovery and federal permitting for new water supply infrastructure must be made as part of public processes where early disclosure of vulnerabilities can have far-reaching consequences. Complex data collection and computer simulation of hydrologic and ecosystem response must be performed to measure program performance and support decisions that are often required before scientifically defensible cause-and-effect relationships between water management options and environmental effects can be determined. Therefore, large-scale water management decision-making is frequently based on Adaptive Management processes that provide intriguing approaches to the identification and implementation of long-term solutions to multi-disciplinary water resource issues. The number of such programs is growing and includes federally supported processes on the Everglades in Florida, the CALFED program in California, the Colorado River Storage Project, and the multi-state cooperative programs on the Rio Grande and Platte River Basins. These programs offer opportunities for diverse interests to work toward acceptable compromise solutions. However, highly competitive water interests, whose futures depend so directly on protecting their water supplies, continually struggle with the inherent uncertainty of Adaptive Management. This presentation concisely summarizes the guiding principles of Adaptive Management and its use in on-going federally sponsored programs. It then presents examples from the author's current involvement in five major federal permitting processes and endangered species programs to compare and contrast application of Adaptive Management principles and treatment of climate change concerns. The presentation concludes with an *"Ode to Adaptive Management"*.

Contact Information: Blaine N. Dwyer, AECOM Water, 215 Union Blvd., Suite 500, Lakewood, CO 80228 USA, Phone: 303-987-3443, Fax: 303-987-3908, Email: blaine.dwyer@aecom.com

Adaptive Management of Restoration in the Columbia River Estuary: From the Ecosystem to the Organization

***Blaine Ebberts*[1], *Ron Thom*[2], *Heida Diefenderfer*[2], and *Doug Putman*[1]
[1]Environmental Resources Branch, Portland District, U.S. Army Corps of Engineers, Portland, OR, USA
[2]Coastal Assessment and Restoration Group, Pacific Northwest National Laboratory, Sequim, WA, USA

As part of a project to evaluate the cumulative ecosystem response to restoration projects we developed an adaptive management framework to capture learning from projects. This study was conducted under the present Corps of Engineers Portland District ecosystem restoration programs in the Columbia River estuary (CRE). This framework will be used to help the Portland District fulfill its mission of providing cost-effective, ecologically successful ecosystem restoration projects on the tidal portions of the Columbia River. We designed the program to be effective and long lasting within the District based on adherence to the following principles: 1) Science Based – Congruent with scientific principles of data acquisition, analysis and interpretation; 2) Implementable – Is cost-effective, feasible and reasonable; 3) Corps-Centric in Scope – Adheres to Corps planning process and procedures for Corps of Engineers' restoration programs; 4) Regional Collaboration – Captures and complements learning from others' projects, works collaboratively to raise the success of all restoration projects in the CRE, and in cooperation with others funding and implementing projects in the CRE as well as other Pacific Northwest estuaries. The framework is focused on reducing uncertainties in the design and implementation of restoration projects in order to maximize the probability of meeting project goals, while minimizing project costs. The ultimate aim of an adaptive management program is to understand what initial actions efficiently produce optimal, predictable, and repeatable results that meet goals and objectives. Our framework takes maximum advantage of existing practices within the District so as to minimize issues with acceptance and incorporation into the daily work of the staff and associated costs.

Contact Information: Blaine D. Ebberts, U.S. Army Corps of Engineers, Portland, OR 97204 USA,
Phone: 503-808-4763, Fax: 503-808-4756, Email: blaine.d.ebberts@usace.army.mil

Best Practices for Ecological Restoration in Protected Areas

Karen Keenleyside[1], *Wayne Tucker*[1], *Catherine Dumouchel*[1], *David Gummer*[2], *Joyce Gould*[3], and ***Greg Eckert***[4]
[1]Parks Canada, Gatineau, Quebec, Canada
[2]Parks Canada, Calgary, Alberta, Canada
[3]Alberta Tourism, Parks, and Recreation, Edmonton, Alberta, Canada
[4]US National Park Service, Fort Collins, CO, USA

This presentation provides an overview of work being done in Canada to develop and implement best practice guidance for ecological restoration in protected areas. Ecological restoration is an important protected area management tool that not only serves as a means of halting and reversing ecosystem degradation but also provides opportunities to facilitate meaningful engagement and experiences that connect the public, communities, and visitors to their protected areas and helps ensure the relevance of these places into the future. Protected area agencies are increasingly recognizing that long-lasting positive outcomes for people and protected areas are more likely to be achieved if ecological restoration is conducted such that it not only ensures ecological success (i.e., is effective) but is also practical and affordable (i.e., is efficient), enables meaningful participation of indigenous and local communities, and recognizes and embraces interrelationships between culture and nature (i.e., is engaging).

Canadian protected area agencies have recently agreed to a national approach to ecological restoration that articulates the above vision for effective, efficient, and engaging ecological restoration. In collaboration with Canadian, US and international universities, the US National Park Service, the Society for Ecological Restoration International (SER), and SER's Indigenous Peoples Restoration Network Working Group, they have developed *Principles and Guidelines for Ecological Restoration in Canada's Protected Natural Areas*. The document, which was published in 2008, sets out national principles for restoration that is effective in restoring and maintaining ecological integrity, efficient in using practical and economic methods to achieve functional success, and also engaging for people. It includes practical guidelines for a range of restoration actions as well as a planning and implementation framework. These tools serve as the basis for making consistent, credible and informed decisions regarding ecological restoration in protected areas.

This approach is being implemented in Canada and is also supported internationally. It was the basis for a successful motion at IUCN World Conservation Congress in Barcelona in October 2008 to develop an *IUCN Best Practice Protected Area Guideline* for ecological restoration prior to the next World Conservation Congress in 2012. Highlights of the Canadian approach and examples of its implementation will be presented.

Contact Information: Karen Keenleyside, Parks Canada, 25 Eddy St., 4th Floor (25-4-S), Gatineau, QC, K1A 0M5, Canada, Phone: 819-934-4797, Fax: 819-997-3380, Email: Karen.Keenleyside@pc.gc.ca

Defining Desired Future Conditions in Uncertain Circumstances: Adventures in Paradoxical Planning

Gregory E. Eckert and *Kirsten M. Leong*
National Park Service, Ft. Collins, CO, USA

Increasingly, federal restoration managers are working under a rubric of performance management requiring that project objectives be tied to quantitative desired future conditions. At the same time, an emerging concept to address for the factors of global change –climate, biological invasions, landscape fragmentation and pervasive contaminants – is to "manage for change." This leads to management paradox: How does a manager define a reasonable condition for which she manages resources when she has little confidence in how controlling factors of the resources will change, much less how the resources will respond to those changes? The objective of this poster is to suggest a structured approach to available concepts and frameworks to 1) improve communications between managers and stakeholders; and 2) to define measurable, yet reasonable, standards for success in highly variable circumstances. We do this as much to solicit feedback and discussion as to present existing planning structures in federal agencies.

Managing for change acknowledges paradigm shifts in natural resource management related to 1) Stakeholder engagement, transparency and accountability; 2) Scale and Complexity; 3) Uncertainty; and 4) Acknowledgement of human influence across landscapes.

Establishing desired conditions for restoration requires knowledge of three dimensions, and associated concepts of the management context: (1) resource dimensions (the biotic and abiotic components of the system and their interactions), (2) institutional dimensions (agency mission, laws, and policies that place value on certain aspects of resources over others), and (3) human dimensions (socioeconomic, political, economic, and other factors that contribute to the meanings and values that various publics assign to the resources). Concepts and frameworks applied are ecological integrity, strategic thinking, scenario planning, resiliency, conceptual models, ecosystem management, decision support tools, adaptive management, and sustainability.

Concepts and frameworks are ways we translate science to management. Characteristics of concepts that make them "operational" are presented for discussion, including translation to metrics, relationship to technical capacity of field actions, and relationship of scale between science and action.

Contact Information: Gregory E. Eckert, National Park Service, Suite 200, 1201 Oakridge Drive, Ft. Collins, CO 80525 USA, Phone: 970-225-3594, Fax: 970-225-3585, Email: greg_eckert@nps.gov

Fighting Cheatgrass Instead of Fire in Zion National Park

Cheryl Decker[1], Kelly Fuhrmann[2], Andi Thode[3], Karen Weber[3] – presented by ***Gregory Eckert***[4]
[1]Zion National Park, Springdale, UT, USA
[2]Bryce Canyon National Park, Bryce, UT, USA
[3]Northern Arizona University, Flagstaff, AZ, USA
[4]National Park Service, Fort Collins, CO, USA

The Kolob Fire was the largest wildland fire in the history of Zion National Park. It had the potential to type convert 10,000 acres of predominantly pinon-juniper woodland to a predominantly cheatgrass system. In an effort to break the cheatgrass fire cycle and to aid in the restoration of native species, a precedent setting aerial application of Imazipic was applied over 8,839 acres of the burn.

This presentation will give an overview of the research in place prior to the fire, lessons learned from the project, and results (to date) from a three year study conducted by Northern Arizona University and funded through the Burned Area Rehabilitation program.

Contact Information: Cheryl Decker, Zion National Park, State Route 9, Springdale, UT 84767,
Phone: 435-772-0216, Email: Cheryl_Decker@nps.gov

A Framework for Assessing the Ecological Integrity of Biological and Ecological Resources of the National Park System

Robert S. Unnasch[1], *David P. Braun*[2], *Patrick J. Comer*[3] and ***Gregory E. Eckert***[4]
[1]Sound Science, Boise, ID, USA
[2]The Nature Conservancy, NY, USA
[3]NatureServe, Boulder, CO, USA
[4]National Park Service, Ft. Collins, CO, USA

This poster provides an overview of the ***Ecological Integrity Assessment Framework****,* a methodology to guide planning for the conservation of biological and ecological resources in U.S. National Parks. The framework is proposed as a tool to maintain a broad ecosystem-based framework for park management. The Ecological Integrity Assessment Framework combines aspects of the conservation planning processes developed by NatureServe and The Nature Conservancy; and rests on established ecological theory as well as on the experiences of these two and many other conservation organizations worldwide. Core concepts of the methodology and key elements are presented. These include 1) the identification of focal ecological resources through appropriate scoping; 2) the development of conceptual models through the identification of key ecological attributes – those aspects of a species or system that are most relevant to the persistence of the resource; 3) the identification of indicators; 4) the assessment of an acceptable range of variation of measures for indicators; and 5) the development of key threshold measures to identify status and trends of resource condition. Use of various degrees of condition assessment and application of the framework to developing condition scorecards are presented.

Contact Information: Gregory E. Eckert, National Park Service, Suite 200, 1201 Oakridge Drive, Ft. Collins, CO 80525 USA, Phone: 970-225-3594, Fax: 970-225-3585, Email: greg_eckert@nps.gov

Use of Bioremediation in the Treatment of Natural and Man-made Bodies of Water to Improve Water Quality and Reduction of Organic Sediments

Ralph E. Elliott III[1], ***Mark Krupka***[2] and *Douglas Dent*[2]
[1]MacDonald Bedford, LLC and SEEK Enterprises, Inc., Jacksonville, FL, USA
[2]Ecological laboratories Inc. Cape Coral, FL, USA

The most common technologies currently utilized in the treatment of natural bodies of water that become polluted or begin to undergo *eutrophication* involve primarily some form of physical/chemical treatment such as chemical oxidizers, flocculants, activated carbon and zeolites and/or mechanical treatments such as dredging. The primary drawback to physical/chemical treatments is that the treatments are based on *stoichiometry*, or molecule to molecule interactions. As a result, they get very expensive when treating large volumes of water. Likewise, dredging is also expensive because it is labor and capital equipment intensive. There are also other issues such as final disposition of the dredge spoils, disturbing of the site and surrounding areas, and risks associated with operating equipment in and around bodies of water.

In recent years bioremediation has been proven to be not only effective, but, in most cases, very economical, in treating natural bodies of water. Bioremediation takes advantage of nature's own processes for recycling of the basic elements of most pollutants and organic sediments back into the biosphere through what are known as the biogeochemical cycles. To accelerate these natural processes bio-augmentation may be utilized. Bio-augmentation is the purposeful inoculation of a system with microorganisms that have been selected for their particular metabolic characteristics.

The technology has been successfully applied in a number of natural and man-made bodies of water to improve water quality and break down organic bottom solids. A review of several applications including a river in China, a retention pond in Malaysia and multiple lakes in the United States will be presented. In these applications, substantial reductions in aqueous phase pollutants were observed including Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), Total Nitrogen (TN) and Total Phosphorous (TP). In addition, reductions of 80% and more of bottom solids were observed without the need for dredging with the associated disposal of dredge spoils. Currently, projects are being investigated that will address the presence of priority pollutants such as pesticides and pesticides breakdown products, for example DDD and DDT, in both the aqueous phase and sediments.

Many 3rd Party Studies are available indicating a reduction of organic bottom sediment of as much as 3 feet during an 18 month period. In all cases where bioremediation has been successfully employed savings of up to 70% over conventional technologies have been realized.

Contact Information: Ralph Elliott, MacDonald Bedford LLC, 710 San Marco Blvd, Jacksonville, FL 32207, USA, Phone: 904-545-0377, Fax: 904-861-3709, Email: elliottriii@msn.com

Federal Conflict Resolution Centers – Annual Environmental Conflict Resolution Report for the Council on Environmental Quality

Deborah Dalton[1], ***David Emmerson***[2], *Brian Manwaring*[3] and *Kerry Redican*[4]
[1]US Environmental Protection Agency, Conflict Prevention and Resolution Center, Washington, DC, USA
[2]US Department of the Interior, Office of Collaborative Action and Dispute Resolution, Washington, DC, USA
[3]US Institute for Environmental Conflict Resolution, Tucson, AZ, USA
[4]US Army Corps of Engineers, Institute for Water Resources, Alexandria, VA, USA

The Office of Management and Budget (OMB) and the Council on Environmental Quality (CEQ), issued a Joint Memorandum on Environmental Conflict Resolution (ECR) that directs federal agencies involved in implementing the National Environmental Policy Act (NEPA) and other environmental laws to "increase the effective use of environmental conflict resolution and build institutional capacity for collaborative problem-solving". The Memorandum also requires these agencies to submit annual reports on their use of ECR.

For the past three years federal agencies have submitted annual reports on their use of ECR and then the collected information has been analyzed. Prior year's analysis has shown an increasing use of ECR and the continued use of ECR in the early phases of decision making. ECR also played a valuable role in resolving conflicts at the later stages when administrative or judicial recourse was sought. The third set of ECR Annual Reports was submitted to OMB and CEQ in January 2009. The analysis of these reports and previous reports will be presented as well as future directions of ECR based on the new administration.

Contact Information: David Emmerson, Office of Collaborative Action and Dispute Resolution, US Department of the Interior, 1849 C. St NW, Room 544, Washington, DC 20009, USA, Phone: 202-327-5318,
Email: David_Emmerson@ios.doi.gov

Partnership Approach Leads to Effective Missouri River Corridor Protection with WREP in Nebraska

Steve Chick and ***Randy Epperson***
USDA, Natural Resources Conservation Service, Lincoln, NE

The Natural Resources Conservation Service (NRCS) funded the first ever Wetlands Reserve Enhancement Program (WREP) in the Lower Missouri River basin of Nebraska in 2004. The success of this original project has led to the expansion of the program to the upper reach of the Missouri River in 2009. The upper reach involves an area of the River designated as a Recreational River under the National Park Service's Wild and Scenic River program which has led to additional partnerships.

The WREP has been successful in providing restoration and protection of important habitats found adjacent to the Missouri River and connection with the historic wetland habitats found across the floodplain. WREP is being used effectively to connect lands that are already protected providing a contiguous corridor benefit. This corridor concept builds on the philosophy that the whole is greater than the sum of the parts.

Through a comprehensive partnership approach, WREP is providing many public benefits including wildlife habitat, flood prevention and water quality. WREP enrollment through easements and restorations provides habitat for sensitive species like the Interior Least Tern, Piping Plover and Pallid Sturgeon.

Early partnership commitment is the key to the success of WREP in Nebraska. The strategies used to implement this easement program on a watershed scale to landowners and Tribes will be presented. Examples of this collaboration with key partners will be illustrated. This poster presentation will outline the success NRCS and partners have achieved in establishing a protected corridor along the Missouri River in Nebraska.

Contact Information: Randy Epperson, Natural Resources Conservation Service, Federal Building, Room 152, 100 Centennial Mall, North, Lincoln, NE 68508-3866 USA, Phone: 402-437-4048, Fax: 402-437-5327, Email: randy.epperson@ne.usda.gov

From Concept to Construction: A River Restoration Program's Lessons Learned

Jennifer Faler
Implementation Branch Chief, US Bureau of Reclamation, Weaverville, CA, USA

The Trinity River Restoration Program (TRRP) is legally mandated to restore and maintain the natural production of salmon and steelhead on the Trinity River, located in far northern California. Through nearly two decades of scientific study it was recognized that the fishery restoration is dependant on restoring the attributes of a natural alluvial river. The restoration strategy does not strive to recreate pre-dam conditions; rather, to create a smaller, dynamic alluvial channel exhibiting all the characteristics of the pre-dam river but at a smaller scale. The TRRP has completed construction on 16 rehabilitation sites in the upper 40 miles of the mainstem of the Trinity River.

Construction activities on this year's project, Lewiston-Dark Gulch, were completed in December 2008. A post-construction job walk with an interdisciplinary team including a geomorphologist, physical scientist, fish biologist, civil engineer, and environmental, realty and contracting specialists revealed a host of lessons learned. These lessons were not common lessons for typical construction projects and include understanding feature purpose, having an established design process, coping with staff turnover, and maintaining an intricate schedule.

Feature Purpose: There were several locations in the Lewiston-Dark Gulch project where the original design concepts did not appear to be carried through to construction. Lesson: Ensure design engineer and construction contractor understand and document the intended purpose of the restoration features. A formal review schedule by technical specialists (geomorphologists, biologists, botanists) who helped create the design concepts is also needed.

Design Process: It is common in river or stream restoration projects for a variety of stakeholders to be involved in the planning and design as is the case for the TRRP. Diversity amongst stakeholders can lead to differing opinions during the planning and design process. Lesson: A design process with stakeholder buy in can create the environment for difficult design decisions to be made in a timely manner.

Staff Turnover: Midway through the Lewiston-Dark Gulch project the Project Engineer and Construction Manager were replaced by new staff. Due to a loss of institutional knowledge design features that were intended to be field directed activities were not constructed. Lesson: All design features should be contained in construction plans and specifications or more flexible contract mechanisms should be utilized.

Schedule: Performing construction activities in a river channel on an annual basis requires a rigid schedule. Because of a backlog in our contracting office, the contract was awarded 8 weeks late allowing only 3 weeks to complete in-channel activities causing a frenzied pace of construction, improper phasing of the work, and insufficient internal communication amongst field support personnel. Lessons: All aspects of the project schedule are equally important and consider IDIQ contracts which require less lead time for contract award.

Contact Information: Jennifer Faler, P.E., Implementation Branch Chief, US Bureau of Reclamation, Weaverville, CA, Phone: 530-623-1802, Fax: 530-623-5944, Email: jfaler@usbr.gov

Balancing Restoration Goals with Design and Function - The Melvin Price Locks and Dam Fish Passage Project

Jason Farmer
U.S. Army Corps of Engineers St. Louis District, St. Louis, MO, USA

The U.S. Army Corps of Engineers St. Louis District is currently designing a fish passage for the Melvin Price Locks and Dam Site (Mel Price). Mel Price is located in Alton, Illinois and is the first barrier fish encounter when traveling up the Mississippi River. When completed, the Mel Price Fish Passage would be one of the largest structures of its kind in the world and would reconnect a substantial portion of a large river ecosystem.

A variety of complex engineering problems are being addressed by the designers. The goal established by a team of interagency biologists dictates that the passage must be available 95% of the year and must be usable by 37 species of migratory fish. Numerous factors complicate the ability to achieve this goal. Mel Price utilizes hinge-point control to manage the upper pool, which results in regular fluctuations of 7 feet at the fish passage location. Concurrently, the Missouri River radically effects water elevations in the tailwaters below Mel Price. In addition, the mouth of the fish passage must be located as close to the dam as possible in order to provide sufficient attraction to migrating fish. The project will be subject to major flood events, substantial ice flows, and regular debris. Taking precedent over all other factors is that Mel Price is a functioning lock and dam which must continue to operate effectively without compromise to safety or adverse impacts to navigation activities.

The goal of this project is to reestablish connectivity for migratory species attempting to travel upstream from the unimpounded Lower Mississippi River into the Upper Mississippi River and Illinois River Basin. This presentation outlines the innovation and engineering expertise being utilized to accomplish this goal as well as the potential large-scale ecosystem benefits.

Contact Information: Jason Farmer, Plan Formulation Branch, St Louis District U.S. Army Corps of Engineers, St Louis Missouri 63103 USA, Phone: 314-331-8033, Email: jason.w.farmer@usace.army.mil

How Do We Measure Ecological Restoration Success?

J. Craig Fischenich
US Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS, USA

The U.S. Army Corps of Engineers (USACE) spends more than $500M annually on ecosystem restoration. The return on that investment has not been meaningfully quantified, due in part to difficulties in characterizing environmental outcomes. The USACE requires an approach for measuring restoration success that is applicable at both project and programmatic levels, and across ecosystem types. Past techniques for measuring success have been criticized as highly subjective, overly reliant upon "professional judgment", unrepeatable, and expressive of agendas. The myriad existing metrics are also very difficult to transfer into programmatic summaries and make comparisons of projects for budget prioritizations difficult. More recently, scientists and practitioners have advanced alternative methods to quantify environmental benefits, including: peer review committees, reference system analyses, monetization of ecosystem services, emergy analysis, and net environmental benefits analysis. Each of these techniques serves a unique role in quantifying environmental benefits and contributes to the blossoming field of Environmental Benefits Analysis (EBA), although each is also limited and none appear to fully address the Corps' needs. As a major land holder, environmental manager, and funding source of many restoration projects, the USACE has a significant interest in advancing the field of EBA. As such, a multi-year, multi-million dollar program has been initiated to develop an EBA framework that assures scientifically valid assessments of the benefits derived from the Corps' ecosystem restoration projects and program. This new effort emphasizes eight research focus areas for furthering EBA: conceptual modeling, metrics for EBA, ecosystem evaluation and forecasting, decision analysis, environmental benefits quantification, ecosystem services, programmatic assessment, and technology transfer. This presentation will highlight the intent, status, and futures of Environmental Benefits Analysis, will explain the USACE's role in developing these methods through the EBA research program and associated focus areas, and will outline opportunities for engagement and collaboration by those in the restoration community of practice.

Contact Information: J. Craig Fischenich, 3909 Halls Ferry Rd., Vicksburg, MS 39180, USA, Phone: 601-634-3449, Email: Craig.J.Fischenich@usace.army.mil

Environmental Benefits of Fish Passage on the Truckee River

***J. Craig Fischenich*[1]**, *Jock N. Conyngham*[1], *S. Kyle McKay*[1] and *Daniel F. Artho*[2]
[1]US Army Engineer Research and Development Center, Environmental Laboratory
[2]US Army Corps of Engineers, Sacramento District

As part of a large ecosystem restoration and flood management project on the Truckee River, the U.S. Army Corps of Engineers (USACE) developed and assessed a range of alternatives for a basin-wide fish passage program extending from Lake Tahoe in California to the system's terminus at Pyramid Lake in Nevada. In accordance with Corps policy, an assessment of the environmental benefits and costs of alternative restoration strategies was required. In coordination with a diverse array of local, state, tribal, and federal partners, USACE scientists identified viable alternatives for bidirectional passage at 18 structures and developed a methodology for quantifying the relative benefits of fish passage improvement alternatives targeting eight native species (two threatened or endangered). These benefits calculations were developed to include effects of eight critical system processes influencing upstream and downstream passage of the target species, as well as larger restoration goals. Due to gaps in knowledge and data, some of these parameters were subjective, index-based parameters. In order to overcome individual bias and assess uncertainty associated with the proposed benefits analyses, individual parameters were scored by a panel of subject matter experts. In addition to quantifying passage benefits at individual structures, the cumulative effects of passage were examined in order to develop system-wide plans of alternative implementation. The analysis required the inclusion of means to account for dependencies among alternatives; i.e. the benefits of removing one obstruction were dependant upon actions taken at other obstructions. This presentation will provide an overview of the project and will focus on the development of techniques to account for system-wide benefits when dependencies exist and using approaches that explicitly incorporate uncertainty.

Contact Information: J. Craig Fischenich, 3909 Halls Ferry Rd., Vicksburg, MS 39180, Phone: 601-634-3449, Email: Craig.J.Fischenich@usace.army.mil

Future Habitat and Population Viability of Shoreline-dependent Birds in Florida: Assessing Risk and Uncertainty under Climate Change

Richard A. Fischer[1], *Igor Linkov*[1], *Gregory Kiker*[2], *Resit Akçakaya*[3] and *Lev Ginzburg* [4]
[1]U.S. Army Engineer Research & Development Center, Vicksburg, MS, USA
[2]University of Florida, Department of Agricultural and Biological Engineering, Gainesville, FL, USA
[3]Department of Ecology and Evolution, State University of New York – Stony Brook, NY, USA
[4]Applied Biomathematics, Setauket, NY, USA

Coastal military installations in Florida provide key seasonal habitats for shoreline-dependent birds. Climate change (via sea-level rise and altered weather patterns) is expected to significantly alter low-lying coastal and intertidal areas important to these and other coastal organisms. Potential land use changes and human population increases, coupled with uncertain predictions for sea-level rise, and storm frequency and intensity have created a significant planning challenge for natural resource managers in the face of climate change. This project will integrate multi-scale climate, land use and ecosystem information into a systematic tool set to explore how climate variability and change effects may influence habitat and population dynamics for Snowy Plovers, and simplified habitat effects on Piping Plover and Red Knot on Eglin Air Force Base (AFB) and Tyndall AFB, FL. We will present methodology to: (1) assess current vulnerability scenarios and information on selected Florida bases by documenting and reviewing Florida-specific climate, land use databases and information; (2) develop a set of habitat- and species-based models for selected coastal Threatened, Endangered, and Sensitive At-Risk Species (TER-S); (3) assess the current prediction level and assumptions of selected categories of TER-S models for use in benchmarking model performance and uncertainty levels; and (4) integrate the scientific data, modeling and uncertainty results into a risk-informed, multi-criteria decision analysis system to allow systematic analysis of potential management options for shoreline-dependent birds and associated habitats.

Contact Information: Richard A. Fischer, U.S. Army Engineer Research & Development Center, Environmental Laboratory (CEERD-EE-E), 3909 Halls Ferry Rd., Vicksburg, MS 39180-6199 USA, Phone: 502-315-6707, Email: Richard.A.Fischer@usace.army.mil

Exploring the Consequences of Global Warming on the Greater Florida Everglades Ecosystem: A Stakeholder-based Approach

Michael Flaxman[1] – co-presented by ***Steve Traxler***[2]
[1]MIT, Cambridge, MA, USA
[2]U.S. Fish and Wildlife Service, Vero Beach, FL, USA

The greater Florida Everglades ecosystem is among the most important natural resources in North America. It is in the midst of perhaps the most complex and ambitious ecosystem restoration planning efforts in U.S. history, an effort involving billions of dollars, hundreds of organizations and jurisdictions and thousands of people. In order to be successful, such a project must adopt a variety of planning, management and communication strategies: some "top-down", others "bottom-up" and still others "side-to-side." Because it is already a multi-decadal project, it must also consider adaptive management: how can processes be organized learn over time from both purposeful and accidental experiments, incorporate new scientific knowledge, and respond to challenges unforeseen in their original formulation.

In this regard, global warming is arguably the most significant and difficult issue to rise to prominence since the original formulation of the Comprehensive Everglades Restoration Plan (CERP) in 2000. It is significant because even the lowest current scientific consensus estimates of moderate term climate change are likely to have important impacts on Southern Florida. It is difficult because it is an issue which will likely affect a wide variety of human and natural systems, and must be addressed within a context of considerable uncertainty in policy, human adaptive responses, and indirect effects.

In order to help the responsible parties to plan and manage effectively in the face of such uncertainties, we at the MIT-USGS Science Impact Collaborative (MUSIC) are developing a stakeholder-based alternative futures process. This will have two major objectives. The first, in collaboration with USGS, is to develop a set of regional-scale "alternative futures" which spatially simulate likely climatic, hydrologic and land use conditions over the next 100 years (based in part on IPCC scenarios and population projections). The second, in collaboration with the U.S. Fish and Wildlife Service, is to examine the impacts of such changes on several types of wildlife habitat in the Florida Everglades, and to plan for potential changes to the region's conservation reserve network. In both parts of the project, we are conducting our work using a spatially-enabled stakeholder process, designed to combine the best available scientific information with local knowledge.

The scale of the effort is considerable, and it has pushed us to develop novel methods for managing complex scenario formulation. We will discuss three aspects here. The first is a scoping and scenario generation process which we term "spatial Delphi." The second is a participatory modeling technique known as "cognitive mapping" which we use to diagram current rules and institutional relationships, and also to generate scenarios under which either of these elements are changed. Finally, we present a prototype scenario management system which takes the form of a rich internet application. This zero-configuration web application allows the sharing of complex scenarios between stakeholders, as well as managing specific comments about scenario parameters or element.

The prospect of global climate change and the reality of large economic disruptions mean that traditional planning methods based on a single fixed projection are now clearly obsolete. Scenario planning can avoid some of these pitfalls, but independently generated uncoordinated scenarios vary in too many dimensions to be comparable. In large and complex regions, the transparent formulation, sharing and management of scenarios is now a major pressing issue. We feel that the methods presented here can help to scale scenario planning to address complex and long term planning problems without loosing the vital element of stakeholder participation.

Contact Information: Michael Flaxman, MIT, 77 Massachusetts Avenue, Room 9-522, Cambridge, MA 02139, Phone: 617-258-0461, Email:mflaxman@mit.edu

Maryland's Ecosystem Enhancement Program – A Better Model for Mitigation

Kristen B. Fleming
Ecosystem Restoration Center, Maryland Department of Natural Resources, Annapolis, MD, USA

After 25 years of dedicated effort to restore the Chesapeake Bay, it is clear that Maryland and our partners are not achieving our goal. While improvements have been realized in some areas, there is now growing evidence that conditions may be worsening in other areas. A new approach is needed now if we are to be successful. To that end, State leaders in Maryland have taken bold steps in their efforts to restore the Chesapeake Bay and Atlantic Coastal Bays.

In 2007 the State of Maryland identified new ways to enhance their land conservation programs, using targeting, to maximize available funding by setting priorities for which new lands were to be acquired. They followed suit in 2008 with the passage of the Chesapeake and Atlantic Coastal Bays 2010 Trust Fund and Non-point Source Fund (CBTF), laying the foundation for an ambitious strategy for restoring and protecting the bays and their tributaries. Again, in 2009 the State is moving forward with the Chesapeake Bay restoration effort by applying a targeted approach towards State mitigation projects with Maryland's Ecological Enhancement Program (ME2).

The fundamental purpose of **Maryland's Ecological Enhancement Program** (ME2), is to provide a better model for mitigation in the State by targeting our limited resources (funding) towards mitigation that enhances Bay Restoration. This is done through a simple, ecosystem based targeting approach that emphasizes both programmatic and geographic components.

Currently, state mitigation dollars are spent on costly projects; are not targeted in advance yet planted at "where available" locations; and provide little true ecological benefit for what was lost. With ME2 - mitigation sites will be planned, targeted and constructed in advance of the impacts. All mitigation done through ME2 is on State land and therefore does not have the added expense incurred through costly private land deals and time delays. ME2 will target sites by looking at gaps in the State's Green Infrastructure (GI) – continuous lands with high ecological value - and provide highly beneficial projects in these areas that will yield nutrient reductions far greater than those found in a typical mitigation project. Using peer approved nutrient reduction efficiencies an average 5 fold higher nutrient reduction rate can be obtained from agricultural Best Management Practices - BMP's (forest buffers, wetlands, and grass buffers) than urban BMP's. ME2 will construct agricultural BMP's in areas already targeted by the GI as having a high ecological value, thereby providing the best practice (BMP) in the best location (GI) and helping to accelerate Bay restoration in the most fiscally responsible manner.

Contact Information: Kristen B. Fleming, Watershed Services, Maryland Department of Natural Resources, 580 Taylor Ave., E2, Annapolis, Maryland 21401 USA, Phone: 410-260-8813, Email: kfleming@dnr.state.md.us

The S-4 Basin Diversion Project: Helping to Restore the Lake Okeechobee Ecosystem

Gene L. Foster and *Stephanie C. Otis*
Burns & McDonnell Engineering Co., Kansas City, MO, USA

The Florida Department of Environmental Protection (FDEP) and the South Florida Water Management District (SFWMD) have established policies that seek to limit the discharge of phosphorus contained in stormwater runoff to Lake Okeechobee. In Florida's 1994 Everglades Forever Act (EFA), several drainage districts located on the south shore of Lake Okeechobee are specifically required to install conveyance systems that would divert drainage historically discharged to the lake into one of the SFWMD's primary conveyance canals. Through these canals, this drainage is delivered to one of the stormwater treatment areas for treatment prior to its discharge into the sensitive Everglades ecosystem.

The S-4 Basin is another of the water management basins located along the south shore of Lake Okeechobee, but none of its component drainage districts are required in the EFA to install diversion systems. However, in light of pending regulations that may further limit phosphorus discharges to Lake Okeechobee, it is anticipated that this basin's discharges to the lake may be restricted in the future as well. For this reason, the Everglades Agricultural Area Environmental Protection District (EAAEPD) commissioned a feasibility study (in cooperation with the SFWMD) to investigate alternatives to reduce discharges to Lake Okeechobee from the S-4 Basin.

During this study, several alternatives for diversion of S-4 Basin drainage into the adjacent C-139 and S-3/S-8 basins were identified. To assess the potential performance of the various diversion alternatives, it was necessary to model the hydraulics and water quality treatment within all three drainage basins. While the results of each alternative achieved or nearly achieved the diversion goals, they each have different implications on the system performance.

This paper will focus on the overall system results with respect to reductions in stormwater volumes and the phosphorus loadings to Lake Okeechobee and downstream facilities. While an overview of the project alternatives will be presented, including the design options and associated costs, the emphasis will be on intricacies of the modeling results. Also presented will be a brief overview of how the results affect the costs of each alternative.

Contact Information: G. Foster, Burns & McDonnell Engineering Co., 9400 Ward Parkway, Kansas City, MO 64114-3319 USA, Phone: 816-822-3167, Fax: 816-822-3514, Email: gfoster@burnsmcd.com,

S. Otis, Burns & McDonnell Engineering Co., 9400 Ward Parkway, Kansas City, MO 64114-3319 USA, Phone: 816-822-4399, Email: sotis@burnsmcd.com

Storm Sewer Rehabilitation Leads to Opportunity to Create Bat Habitat

Richard E. Besancon, Melissa Goerlitz and *Brian Roh* – presented by ***Gene Foster***
Burns & McDonnell Engineering Company, Kansas City, Missouri, USA

The City of Pittsburg, Kansas had experienced severe street flooding in the area of 7th and Joplin Streets. Burns & McDonnell Engineering began study and design of the area in August 2006. The solution to the flooding problems was to upgrade the existing 30-inch storm system to an 8' by 4' reinforced concrete box culvert (RCB) tapering to a 48-inch reinforced concrete pipe (RCP) at the upstream end of the project. In total, 3,500 linear feet of RCB and RCP were installed on the project. In the process of designing the system and writing the Storm Water Pollution Prevention Plan (SWPPP), Burns & McDonnell permitting specialists discovered that all sewers in Pittsburg, Kansas are designated as critical habitat for the gray bat. Pittsburg has several storm sewers which act as habitat for the gray bat. The gray bat is endangered at both the state and federal levels. The endangered designation requires strict adherence to federal regulations including limitations on construction times and disturbance of the bats.

Burns & McDonnell personnel met with state personnel at the site to determine the potential for bats in the storm sewer that was slated for removal. It was determined that although there are areas in Pittsburg that have gray bats using the storm sewers as roosting habitat, the storm sewer in question did not tie into the part of the storm sewer system that the gray bats have been found in previously (storm sewers on the west side of Broadway) and the project would not likely result in any impacts to gray bats or their critical habitats. Burns & McDonnell also contacted local bat experts to determine what habitat and roosting conditions were best for the bats. Burns & McDonnell determined that the best approach for creating potential habitat was to roughen the crown of the RCB to provide a place for the bats to grab hold. The precaster roughened the boxes by scraping the crown of the box with a bow rake. According to bat experts, bats tend toward areas without uniform roughness, so that they have the ability to pick and choose where to roost. By using this method to scrape the crown, it is virtually impossible to create uniform roughness; therefore, it was ideal for constructing bat habitat.

Although there were no bats in the storm sewer, Burns & McDonnell and the City decided to add amenities to the project to encourage bat roosting. This approach will potentially add habitat for an endangered species and also determine if habitat can be created to offset that which may be lost in other areas in the future. By creating this habitat, other storm sewers may be replaced throughout town with the knowledge that the gray bat habitat will not be destroyed.

Contact Information: Richard E. Besancon, Burns & McDonnell Engineering, 9400 Ward Parkway, Kansas City, Missouri 64114 USA, Phone: 816-822-3950, Fax: 816-822-3514, Email: rbesanc@burnsmcd.com

Successfully Restoring an Urban Stormwater Management System

Laura Baldwin and *Dennis Haag* – presented by ***Gene Foster***
Burns & McDonnell Engineering Company, Kansas City, Missouri, USA

In the summer of 2007, Burns & McDonnell designed a new stormwater management system at its world headquarters in Kansas City, Missouri. The existing system consisted of concrete pipes that resulted in high peak flows and conveyed pollutants to local streams. Sitting on a major thoroughfare through a highly urbanized area, the project required a number of creative solutions. Its success ultimately hinged on open communication between engineer, landscape architect, wildlife biologist, and property owner.

The new stormwater management system was designed to divert runoff from the first flush through bioretention cells and bioswales. The location and grading of these new systems had to be carefully coordinated with existing features while not posing additional flooding hazards. "Agridrains" with adjustable stop logs were installed to help control water levels. A StormTreat® unit was installed and acts as a large, submerged wetland that traps and removes pollutants. Since the site is leased, all changes had to be coordinated with the owner to discuss effects to the property, including security and maintenance issues.

Approximately 6% of the property's 20 acres was converted into overland treatment areas. By strategically locating the bioretention cells, nearly 37% of the stormwater that falls on the property will be routed through these areas. It is estimated that this will result in an 18% reduction in the volume of runoff and peak flows will be reduced by 30%. Literature suggests that an 80% reduction in TSS may be achieved through native plantings of the bioretention cells.

Due to the need of integrating new plantings within an existing manicured landscape environment, a combination of native and horticultural varieties of plant materials, as well as other landscape features such as native stone rock walls and stream beds, were used to enhance the landscape appearance and improve the stormwater retention function. Native plantings were selected for both aesthetic value and their ability to neutralize pollutants introduced from parking lots. Plants were also selected based on their ability to absorb water and improve the hydraulic function of the proposed systems.

This paper will discuss how various innovative solutions were incorporated into the project. It will also address how the success of the project was due in part to the engineer, landscape architect, biologist, and property manager collaborating to create an aesthetic and hydraulically feasible solution to an urban sewer system in dire need of a sustainable make-over.

Contact Information: Laura Baldwin, Burns & McDonnell Engineering Company, 9400 Ward Parkway, Kansas City, Missouri 64114 USA, Phone: 816-333-9400, Fax: 816-822-3514, Email: lbaldwin@burnsmcd.com

Use of an Unmanned Aircraft System for Monitoring Nesting Responses of Wading Birds (Ciconiiformes) to Restoration of the Florida Everglades, USA

Peter C. Frederick[1], *John Simon*[1], *John Perry*[2], *Adam Watts*[2], *Scot Smith*[2], *Franklin Percival*[3], *Peter Ifju*[4] and *Matthew Burgess*[3]

[1]Department of Wildlife Ecology and Conservation, University of Florida, Gainesville, FL, USA
[2]School of Natural Resources and the Environment, University of Florida, Gainesville, FL, USA
[3]USGS Cooperative Research Unit, University of Florida, Gainesville, FL, USA
[4]Department of Mechanical and Aerospace Engineering, University of Florida, Gainesville, FL, USA

Large nesting populations of herons, egrets, ibises, storks and spoonbills (wading birds) were characteristic of the predrainage Everglades, and there is good evidence to functionally link aspects of these populations (size, timing, community composition) with hydrological and ecological characteristics of a restored wetland. While wading birds therefore are a high priority for tracking the progress of ecosystem restoration, there remain large logistical challenges to monitoring such large and variable populations (20 – 120k nesting birds annually) accurately over a very large landscape (cf 3,600 km^2). The largest error in estimating nesting aggregations is accounting for turnover and asynchrony during the season, which requires following large numbers of individually identifiable nests in space and time. Ground surveys of marked nests are limited to surveying <100 nests at a time; aerial surveys using manned fixed-wing aircraft have proven to have severe limitations in accuracy and repeatability.

We developed an unmanned aircraft system (UAS) specifically to document wildlife and natural resources. The UAS consists of a 2.5m wingspan aircraft with an electric motor guided by onboard GPS and autopilot carrying an integrated SLR digital camera and controlled by a computer driven ground station. Under field conditions the UAS was capable of producing high resolution pictures in which golf balls could be counted and identified from 200m altitude (2 cm accuracy at 60m altitude). Repeat transects even under high crosswinds were within 25m of each other, suggesting good geographic repeatability. Images are automatically geo-referenced using a high resolution IMU attached to the imaging system as well as GPS and altitude information from the autopilot. We were able to overlay images from weekly visits to the same transects within the same breeding aggregations, and thus follow the fates of large numbers of individually identifiable nests. We estimated avian population size using a modified mark-resight model (superpopulation approach). Preliminary results indicate that populations of Great Egrets estimated using the superpopulation approach were 147 – 482% of the traditional direct counting method, and populations of White Ibises were 213 – 300%. This suggests that traditional counting methods have resulted in a dramatic underestimation of nesting population size in these birds. The UAS we used has resulted in a considerably more accurate and much safer way of monitoring populations of wading birds in the Everglades, and seems to have potential for many other wildlife and natural resource applications.

Contact Information: Peter Frederick, Department of Wildlife Ecology and Conservation, P.O. Box 110430 University of Florida, Gainesville Fl 32611-0430 USA, Phone: 352-846-0565, Email: pfred@ufl.edu

The Restoration of Fluvial Systems - The Need for an Integrated Approach to Streams, Floodplains, and Wetlands

Richard Weber[1] and ***Jon Fripp***[1]
USDA-NRCS, Fort Worth, TX, USA

Natural systems formed and maintained by the presence of flowing water are the focus of increasingly large expenditures of time and money in the United States and around the world with various goals. In recent years, the focus has begun to shift to the restoration of ecosystem functions. Depending on the discipline of the practitioner, the perceived need of project proponents, and the funding mechanisms, the project is based on restoration of natural stream channel, wetland, floodplain, stream corridor, or riparian area functions. Each of the previous definitions has associated classification systems, assessment methods, and analytical tools.

Natural systems are uniquely complex, as they have no hard lateral or longitudinal boundaries, processes occurring in one defined landscape position have direct and profound effects on adjacent positions, and the processes are spatially and temporally dynamic. In addition, projects focused on current system boundary definitions can potentially have adverse effects on adjacent systems which are intimately connected to the project boundary. This potential is particularly acute across a landscape transitioning across active stream channels, floodplains, and wetlands.

The term "Fluvial System" is introduced, and a method of defining the spatial boundary of this system based on hydrology and soil hydrodynamics is proposed. The potential for use of NRCS Soil Survey data, including soil taxonomy and physical characteristics is presented for interpretations of fluvial system functions. The broad outline of a functional assessment methodology based on lateral and longitudinal connectivity, and surface topography is proposed. These broad functions are examined in the context of hydrology, sediment cycling and transport, and surface topography.

The most common classification and assessment systems applied to stream and riverine wetland systems are examined for their mutual compatibility and exclusivity in a broad system context. Finally, specific examples of fluvial systems around the United States are presented, and the examined with current classifications and assessment models. These examples are chosen are ones which do not fit neatly into common classification systems and assessments.

<u>Contact Information</u>: Richard A. Weber, USDA-NRCS, Fort Worth, TX 76113 USA, Phone: 817-509-3576, Fax: 817-509-3337, Email: richard.weber@ftw.usda.gov

Yolo Basin Wetlands, CA: A 10-Years after Construction Story of the West's Largest Freshwater Wetland Ecosystem Restoration Project

Dave Feliz[1], *Robin Kulakow*[2] and ***Miki Fujitsubo***[3]
[1]State of California, Department of Fish and Game, Yolo County, CA, USA
[2]Yolo Basin Foundation, Davis, CA, USA
[3]U.S. Army Corps of Engineers, Sacramento District, CA, USA

It has been over 12 years since the construction of the Yolo Basin Wetlands, an ecosystem restoration project located in the Yolo Bypass in Yolo County, California within the shadow of the State capitol. The Yolo Basin Wetlands, now known as the Yolo Bypass Wildlife Area was the culmination of a cooperative effort of many agencies, groups, and people, and has expanded from the original 3,500 acres to over 16,000 acres of multi-use management by the California Department of Fish & Game and in cooperation of the Yolo Basin Foundation.

Over the years, the Wetlands evolved through active adaptive management with many lessons learned and gained that changed the original wetland design, but not the intent. The original constructed project was not an end, but the beginning of an overall vision of the Yolo Bypass that has nurtured the working relationships and agreements of the original partners of the Yolo Basin Wetlands. The resulting group of stakeholders memorialized their vision in the "Yolo Bypass Wildlife Area Land Management Plan," a document that captures the concerns and aspirations of the people of this region. They formed the Yolo Bypass Working Group which serves as the voice of the area.

A clear, yet adaptive strategy for the management of the Wildlife Area is now reflected in the Yolo Bypass Wildlife Area Land Management Plan, authored by the Department of Fish and Game and the Yolo Basin Foundation.

This poster will present the Yolo Basin Wetlands as they exist today and the many lessons learned through adaptive management, and present the Yolo Bypass Wildlife Area Land Management Plan of which the Wetlands were the critical beginning.

Contact Information: Miki Fujitsubo, U.S. Army Corps of Engineers, 1325 J Street, Sacramento, CA 95814 USA, Phone: 916-557-7440, Email: Miki.Fujitsubo@usace.army.mil

Effects of Tamarisk on Stream Channel Morphology of the San Rafael River, Utah

Karen L. Fullen*[1]*, *Jack Schmidt*[2] and *Kenny Breidinger*[3]
[1]USDA-NRCS, Salt Lake City, UT, USA
[2]Department of Watershed Sciences, Utah State University, Logan, UT, USA
[3]Utah Division of Wildlife Resources, Price, UT, USA

The San Rafael River has been severely impacted by the invasive species tamarisk (*Tamarix ramosissima*). Tamarisk has replaced much of the native vegetation along the riparian zone and has established on former sediment bars within the river channel. The presence of tamarisk in these locations traps additional sediments, eventually narrowing and deepening the channel and disconnecting the stream from the riparian zone. In addition, the loss of a diverse, native riparian community dominated by cottonwood and willow has likely diminished habitat for wildlife.

Major landowners along the river corridor are the Bureau of Land Management (BLM) and the Utah Division of Wildlife Resources (UDWR). In 2008, NRCS provided funding to UDWR through the Wildlife Habitat Incentives Program (WHIP) to remove tamarisk and restore native vegetation. The project goals are to improve fish and wildlife habitat by increasing the amount of native vegetation in the riparian zone, increasing streamflows in the river, and improving the ability of the stream channel to respond to large flow events and access its floodplain.

However, some tamarisk researchers argue that tamarisk provides acceptable wildlife habitat, native riparian vegetation uses just as much water, and streamflow management (i.e., reductions in flow due to dams and irrigation diversions), not the tamarisk, creates and maintains conditions that favor tamarisk invasion.

To evaluate the geomorphic response of the San Rafael River to tamarisk removal and native plant restoration, and help predict the effects of future similar projects, NRCS provided funding through the Conservation Effects Assessment Project (CEAP) to Utah State University (USU). USU researchers will (1) describe the geomorphic history of the lower San Rafael River, including the rate and magnitude of channel narrowing that has degraded native fish habitat and disconnected the river from much of its floodplain; (2) describe the history of changing water flows, sediment delivery, and non-native riparian vegetation invasion and describe the mechanisms by which these factors have caused channel narrowing; and, (3) identify appropriate metrics to evaluate stream corridor response to tamarisk removal and restoration of native riparian vegetation. This investigation incorporates analyses of aerial photographs, USGS stream gage records, stratigraphy of sediments, and analysis of tree-ring characteristics of buried tamarisk to determine the timing and elevations of initial establishment and the rate of subsequent floodplain accretion.

Contact Information: Karen L. Fullen, USDA-NRCS, Wallace F. Bennett Federal Building, 125 S. State St., Room 4418, Salt Lake City, UT 84138 USA, Phone:801-524-4566, Fax: 801-524-4593, Email: Karen.Fullen@ut.usda.gov

Restoring Utah Prairie Dogs to Working Lands

Karen L. Fullen[1], *Clair Baldwin*[2], *Nathan Brown*[3] and *Theodore P. Toombs* [4]
[1]USDA-NRCS, Salt Lake City, UT, USA
[2]Panoramaland Resource Conservation and Development, Richfield, UT, USA
[3]Utah Division of Wildlife Resources, Cedar City, UT, USA
[4]Environmental Defense Fund, Boulder, CO, USA

The Utah prairie dog (*Cynomys parvidens*) is endemic to southwestern and central Utah. Historically, the species was widely distributed across this area, with a total population estimated at 95,000 animals. Control programs were initiated in the 1920s, and by the 1960s distribution of the Utah prairie dog was greatly reduced as a result of poisoning, sylvatic plague, drought, and habitat alteration. The species was listed as endangered in 1973, with an estimated 3,300 individuals remaining.

By 1984, populations had increased and the species was reclassified as threatened. The 1991 recovery plan focused on conserving the species on federal lands; federal land ownership averages 82% in the seven counties where Utah prairie dogs persist. However, an estimated 70% of the population occurs on private lands, where habitat conditions are generally more favorable. The Iron County Habitat Conservation Plan provides for trapping of Utah prairie dogs on private lands slated for development, and translocation to federal lands, a process that only 5 - 10% of individuals survive. Consequently, these efforts have not contributed towards recovery of the species.

In 2005, Environmental Defense and other partners began an effort to involve private landowners in conservation of Utah prairie dogs, in concert with a revision of the recovery plan. Utah rancher Allen Henrie was the first to sign a Safe Harbor Agreement (SHA) with the U.S. Fish & Wildlife Service, agreeing to restore Utah prairie dog habitat on his ranch in exchange for protection from liability for incidental take of the species related to his operation. Habitat restoration under the SHA included brush management, seeding native grasses, and rest from grazing to allow time for the grasses to become established. In 2008, Utah prairie dogs were reintroduced to the Henrie property.

The Henrie project served as a pilot for what is now a programmatic SHA managed by the Panoramaland Resource Conservation and Development Council. Since 2006, several partners have contributed staff time and funding to the SHA. A Project Coordinator employed by the Council contacts private landowners and helps them develop Safe Harbor Agreements. To date, 6 landowners have entered into SHAs; agreeing to improve habitat, manage grazing, and share their lands with Utah prairie dogs. An additional 5 landowners have expressed interest in enrolling in SHAs this year. The partners anticipate private landowner conservation efforts will contribute towards recovery and eventual delisting of the species.

Contact Information: Karen L. Fullen, USDA-NRCS, Wallace F. Bennett Federal Building, 125 S. State St., Room 4418, Salt Lake City, UT 84138 USA, Phone:801-524-4566, Fax: 801-524-4593, Email: Karen.Fullen@ut.usda.gov

Rillito River Ecosystem Restoration

Carianne Funicelli*[1]*, *Lori Woods*[1]*, Mike Fink*[2]*, John Taylor*[3] and *Andy Wigg*[4]
[1]RECON Environmental, Inc., Tucson, AZ, USA
[2]U.S. Army Corps of Engineers, Los Angeles District, Phoenix, AZ, USA
[3]U.S. Army Corps of Engineers, Los Angeles District, Tucson, AZ, USA
[4]Pima County Regional Flood Control District, Tucson, AZ, USA

The Rillito River Ecosystem Restoration Project totals over 55 acres. This ecosystem restoration project was initiated under the U.S. Army Corps of Engineer (USACE) Continuing Authorities Program under Section 1135 of the Water Resources Development Act of 1986 (Public Law 99-662), as amended. Section 1135 authorizes the Secretary of the Army to modify the structures and operations of water resources projects constructed by USACE to improve the quality of the environment consistent with authorized purposes; and to undertake measures for restoration of environmental quality where the construction or operation of a water resources project built by USACE has contributed to the degradation of the of the quality of the environment. In this case, Section 1135 is used to modify an existing flood control project on the south bank of the Rillito River in metropolitan Tucson. This work was coordinated with Pima County Regional Flood Control District (PCRFCD), the nonfederal sponsor, in cooperation with the USACE.

This project is committed to conserving groundwater resources through the use of reclaimed water to support new plantings through their establishment period. The design further conserves water through the creation of earthen water catchment basins to direct and capture surface water, concentrating it in areas where new plantings will be installed, and the design of a temporary irrigation system with battery-operated valves. The water catchment basins function as passive stormwater harvesting elements, by collecting rainwater that would otherwise run off, and concentrating moisture in basins with native plant materials. The resulting increase in soil moisture has been instrumental in the successful establishment of plant species native to this site.

In areas of desirable native vegetation and known locations of native amphibian breeding, the restoration design emphasized limiting surface disturbance to the greatest extent possible. This low-impact approach protects existing vegetation and soil structure, minimizes the potential for ecologically harmful invasive species to establish, and avoids impacts to native amphibians which are burrowed in the soil. The preservation of existing mature trees in place contributed significantly to the structural diversity of the new plant communities. Intensive invasive species management was performed before and during construction, and continues through the 5-year maintenance and monitoring period. In a separate effort, PCRFCD conducted an amphibian salvage and translocation project prior to project construction to further limit impacts to these animals. The restoration site is monitored by the habitat restoration specialist both qualitatively and quantitatively before, during, and for five years following the construction year.

Contact Information: Carianne Funicelli, RECON Environmental, Inc., Tucson, AZ 85705 USA,
Phone: 520-325-9977, Email: cfunicelli@recon-us.com

The Missouri River Ecosystem Restoration Plan Roadmap and Planning Framework

Paula Gagnon
Independent Consultant

The Missouri River Ecosystem Restoration Plan and associated Environmental Impact Statement (MRERP/EIS) is a multi-year, multi-agency effort encompassing the second largest river basin in the United States. A roadmap outlining major milestones over the next 7 years has been developed in order to help guide and communicate in a broad sense the MRERP process. The roadmap is broken into 4 phases: 1) plan initiation; 2) study of the affected environment; 3) alternative consideration; and 4) plan selection. During phase 1), the MRERP project delivery team (PDT) prepared for study initiation and developed cooperating agency partnerships throughout the basin. Phase 1 is also the time during which study rational and focus is established. During Phase 2, current resources conditions will be assessed and possible future issues and situations will be evaluated. During phase 3, restoration alternatives with an adaptive management framework will be developed. In addition, alternative impacts will be compared and the Corps will consider a preferred alternative. In phase 4, the draft MRERP/EIS will be published for public review. After this review period the MRERP/EIS will be revised, finalized, and published in final form and a Record of Decision will be signed. Intense and frequent public scoping and communication is expected to occur throughout the MRERP process and is a major reason this study is expected to take several years to complete.

Contact Information: Paula Gagnon, Independent Consultant, 402 W. 20th Street, Vancouver, WA 98660 USA, Phone: 402-403-0337, Email: gagnon.paula@gmail.com

Establishing System-Wide Goals and Objectives for Restoring the Upper Mississippi River System within an Adaptive Management Framework

***David L. Galat*[1]**, *J. Barko*[2], *S. Bartell*[3], *M. Davis*[4], *B. Johnson*[5], *K. Lubinski*[5], *J. Nestler*[6] and *D. Wilcox*[7]

[1]US Geological Survey, Cooperative Research Units, University of Missouri, Columbia, MO, USA
[2]Barko Environmental, Gulf Shores, AL, USA
[3]E2 Consulting, Maryville, TN, USA
[4]Minnesota Department of Natural Resources, Lake City, MN, USA
[5]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI, USA
[6]U.S. Army Corps of Engineers, Engineer Research and Development Center, Vicksburg, MS, USA
[7]U.S. Army Corps of Engineers, U.S. Army Engineer District-St. Paul, St. Paul, MN, USA

The Navigation and Ecosystem Sustainability Program (NESP) will direct $3.28 billion over 15 years for the dual proposes of improving navigation efficiency and environmental sustainability within the highly engineered Upper Mississippi River System (UMRS). Decisions to address restoration needs within the UMRS will be conducted through a long-term commitment to adaptive management (AM). Components of AM developed during the planning phase include a general conceptual model, an overarching vision, goals and objectives, performance criteria, indicators, monitoring programs, and environmental report cards.

NESP will focus on restoring ecosystem processes and functions rather than on rehabilitation of individual sites. Restoring ecosystem structure and function will be more effective than restoring locations to achieve a sustainable UMRS. Process-based restoration will more likely provide life requirements of aquatic biota, and therefore be more resilient to human and natural disturbances. Success of restoration planning depends on identifying key ecological functions and processes within the UMRS and incorporating them into goals and objectives at all levels. Five system-wide goals are identified: to manage for (1) a more natural hydrologic regime; (2) processes that shape a diverse and dynamic river-floodplain system; (3) processes that input, transport, assimilate, and output materials within UMR basin river-floodplains; (4) a diverse and dynamic pattern of habitats to support native biota, and; (5) viable populations of native species and diverse plant and animal communities. Challenges to realizing restoration of engineered great rivers include implementing a system-wide perspective in a project dominated culture and incorporating a function-process approach along with traditional composition-structure outcomes.

Contact Information: David L. Galat, US Geological Survey , Missouri Cooperative Fish & Wildlife Research Unit, 302 ABNR Building, University of Missouri, Columbia, MO 65211-7240 USA, Phone: 573-882-9426, Fax: 573-884-5070, Email: galatd@missouri.edu

Using Consensus Based Approaches to Bring Landowners, Irrigators, Special Districts, Resource Agencies, and Non-Government Organizations Together– A Case Study of the Manastash Creek Restoration Program

Michael C. Garello
HDR Engineering, Gig Harbor, WA, USA

The greatest tool for implementing environmentally sensitive projects is fostering an environment where consensus among project stakeholders can occur. The process of obtaining consensus can often take years, a great deal of patience, and a genuine commitment from all involved. The results however are gratifying as landowners, irrigators, special districts, resource agencies, and non-government organizations walk away at the end of the day as partners, all with a tally in the win column. The Manastash Creek Restoration Program in Ellensburg, Washington is a strong example of how project adversaries can learn to work together and implement important projects that benefit the recovery of sensitive endangered fish species such as bull trout and steelhead trout.

The objective of the Manastash Creek Restoration Program is to restore upstream and downstream fish passage along Manastash Creek by: upgrading six 80-year old stream diversions to meet current NOAA and WDFW standards; removing five partial and total fish passage barriers; implementing several irrigation and water conveyance efficiency projects; improving instream flows during the irrigation season, and developing instream habitat lost over years of degradation. After project implementation, endangered bull trout and steelhead trout will have access to 30 miles of high quality spawning and rearing habitat that has been inaccessible for over 100 years. The area however is a hotbed of political agendas, water shortages, degraded fishery resources, tribal law, and traditional agricultural values. The project would not have moved forward without the formation of a system that allowed stakeholders to work out their differences while bringing the right balance of technical problem solving and money to the table.

The Manastash Restoration Steering Committee was formed in 2001 to facilitate the implementation of the Manastash Creek Restoration Program using the term “consensus” as their primary ground rule. This Steering Committee consisted of representatives of seven irrigation distributaries; the Washington Department of Ecology, Washington Department of Fish & Wildlife, Washington Environmental Council, West Side Irrigating Company, Kittitas Reclamation District, US Bureau of Reclamation and the Yakama Nation. Not a single step forward was taken until each member of the Steering Committee Board agreed on the proposed plan of action. Throughout the course of plan development and project implementation, members honored their commitment to exhibit patience, learn to trust one another, and respect each others points of view. After years of facilitation by the Kittitas County Conservation District and collaboration among the Steering Committee, five major project components are slated to begin construction during the summer of 2009 - eight years in the making. A project that began as a class action law-suit between three members of the Steering Committee, ended as a success.

Contact Information: Michael C. Garello, PE, HDR Engineering, Inc., 4717 97th Street, NW, Gig Harbor, Washington, 98332-5710, USA, Phone: 253-858-5635, Fax: 253-858-5263, Email: mike.garello@hdrinc.com

Ballona Wetlands Restoration: Recreating Estuarine Habitats in Los Angeles

Mary Small[1], *Sean Bergquist*[2], *Jeremy Lowe*[3], **Nicholas Garrity**[4] and *Jeff Haltiner*[3]
[1]California State Coastal Conservancy, Oakland, CA, USA
[2]Santa Monica Bay Restoration Commission, Los Angeles, CA, USA
[3]Philip Williams & Associates (PWA), San Francisco, CA, USA
[4]Philip Williams & Associates (PWA), Los Alamitos, CA, USA

In 2004, the State of California took title to 600-acres of the remaining Ballona Wetlands in Los Angeles. The property is owned by two state agencies, the Department of Fish and Game and the State Lands Commission. The Coastal Conservancy has funding for planning the restoration of the property. Together, the three agencies are working with stakeholders and other agencies to develop a plan for restoration of this extraordinary resource in the middle of Los Angeles..

The agencies and stakeholders have established restoration goals, which include: 1) Restore and enhance salt-water influenced wetland habitats to benefit Endangered and Threatened species, migratory shorebirds, waterfowl, seabirds, and coastal fish and aquatic species. Restoration of seasonal ponds, riparian and freshwater wetlands, and upland habitats will be considered where beneficial to other project goals or biological and habitat diversity; 2) Provide for wildlife-dependent public access and recreation opportunities compatible with the habitats, fish and wildlife conservation; 3) Identify and implement a cost-effective, ecologically beneficial, and sustainable (low maintenance) habitat restoration alternative.
Five preliminary alternatives which meet these objectives were developed and refined by the Project Management Team and a consultant team led by Philip Williams & Associates (PWA) in a Feasibility Report, with the advice of stakeholders and agencies.

Two preferred restoration alternatives were selected based on the results of the Feasibility Report. Both alternatives include full tidal wetland restoration to support a range of functional estuarine habitats. One will create a large area of open water and extensive mudflats and salt marsh within the existing levee system; the other will remove the levees that constrain Ballona Creek and create a meandering channel connected to a large tidal floodplain.

Currently, the two preferred alternatives are undergoing further refinement to include the desired mix of estuarine and upland habitats, consider adaptation strategies to accommodate sea level rise in the next 50 to 100 years, and improve cost effectiveness.

The Ballona Wetlands Restoration planning process and supporting technical studies will be presented as a case study of tidal wetland restoration in a highly-urbanized environment with accelerated sea-level rise.

Contact Information: Nicholas Garrity, Philip Williams & Associates (PWA), Los Alamitos, CA 90720 USA, Phone: 562-296-5679. Email: n.garrity@pwa-ltd.com

Restoring the Colorado Lagoon – The Little Lagoon That Could!

Kimberly Garvey[1] and *Eric Lopez*[2]
[1]Moffatt & Nichol, Long Beach, CA, USA
[2]Project Development Bureau, City of Long Beach, Long Beach, CA, USA

The Colorado Lagoon is a small tidal lagoon in the middle of a suburban neighborhood in Long Beach, California. It serves three main functions: hosting estuarine habitat, providing public recreation (including swimming), and retaining and conveying storm water. The site is degraded in many respects due to being overburdened by these competing uses. A restoration project is in process. The goal (and challenge) of the project is to maintain and improve all three functions.

Some of the existing problems of the site are: a) poor water quality (beach advisory postings due to elevated bacteria levels are frequent); b) contaminated sediments (the lagoon is listed on the State's 303(d) list); and c) limited intertidal habitat area (due to a muted tide range and steep side slopes). While the lagoon hosts sensitive habitat and is a popular swimming area, it is also a major storm drain basin for a large watershed and there are eleven storm drains which discharge into this small lagoon. It is isolated from the adjacent tidal water body by a partially-blocked underground culvert and is constrained on all sides by a golf course, streets, and residences.

The restoration process began with a feasibility study in 2004 which involved field surveys to determine the lagoon's existing conditions for water and sediment quality, tidal hydraulics, and biological habitat. Restoration solutions were then developed based on these surveys as well as feedback from several public and technical advisory committee meetings. An EIR for the project was certified in 2008. Ongoing efforts include final engineering, pre-construction monitoring, and construction funding acquisition.

The proposed restoration plan is a set of improvements which can be implemented in a time-phased approach and which can maintain all of the lagoon's existing uses ("the little lagoon that could"). The improvements include: a) cleaning the underground tidal culvert and/or building an open channel between the lagoon and adjacent water body in order to improve circulation, b) installing storm drain diversions and trash capture devices, c) dredging the lagoon to remove contaminated sediments, d) construction of bio-swales to treat dry weather runoff into the lagoon from the golf course, e) recontouring the lagoon's slopes to increase intertidal habitat area, f) removing non-native vegetation and planting native vegetation, and g) installing recreational elements such as a perimeter trail and educational signs.

The local stakeholder group has played and continues to play an active role in the restoration process. The group works closely with the City to procure the funds necessary to implement the project. They are also active in educational / outreach efforts, habitat and water quality monitoring, and native vegetation propagation.

Contact Information: Kim Garvey, Moffatt & Nichol, Long Beach, CA 90806 USA, Phone: 562-426-9551, Fax: 562-424-7489, Email: kgarvey@moffattnichol.com

Virgin River and Tributaries: Comprehensive Watershed and Floodplain Management Strategies

Kim M. Gavigan[1]*, Scott Estergard*[1] and *Patricia K. Quinn*[2]
[1]U.S. Army Corps of Engineers, Los Angeles District, Phoenix, AZ, USA
[2]JE Fuller/ Hydrology & Geomorphology, Inc., Tempe, AZ, USA

The *Virgin River and Tributaries Floodplain Management Strategy* is one component of the *Virgin River Watershed Study*, a multi-jurisdictional analysis of the Virgin River watershed in Utah, Arizona, and Nevada. The *Virgin River Watershed Study* is one of five comprehensive studies conducted by the U.S. Army Corps of Engineers (USACE) that were funded through General Expenses in response to the Fiscal Year 2006 Energy and Water Development Appropriations Act (PL 109-103). That legislation directs the Secretary to conduct "at full federal expense, comprehensive analyses that examine multi-jurisdictional use and management of water resources on a watershed or regional scale."

The Virgin River basin is one of the largest essentially unregulated and free flowing rivers in the western United States. The basin is being impacted by rapid land development and expanding infrastructure in Washington County, Utah and northeast Clark County, Nevada. Much of the development is occurring in lowland areas adjacent to, and within, floodplains and erosion hazard areas. Major floods and wildfires in the basin have recently occurred with negative consequences to vegetation, soil, runoff characteristics, and sediment movement. This rapid land development, in combination with flood and wildfire events, has critically impacted important habitat for protected and sensitive wildlife species. These issues are being evaluated individually and/or in combination by various entities; however, the USACE *Virgin River Watershed Study* addresses these issues comprehensively as a whole at regional scale.

The *Virgin River Watershed Study* emphasizes the development of integrated strategies to mitigate impacts to watershed and floodplain ecosystems resulting from wildfire, floods, erosion, sedimentation, debris blockage, invasive plants, and urbanization. The recommended mitigation actions include integrated solutions through land use planning, watershed and riparian restoration, and regulatory programs organized in a cohesive framework to streamline efficiency and leverage resources. The implementation plan includes a resource toolbox, establishes priorities for planning and investment, and identifies partners and funding programs to inform sound management decision-making.

The USACE worked in partnership with local and county governments, state and federal agencies, landowners, and citizen groups in carrying out this watershed study. This collaborative effort produced a watershed strategy that assists stakeholders within the Virgin River basin in successful ecosystem management of the watershed, river, tributaries, and related resources. The success of the *Virgin River Watershed Study* is demonstrated in the establishment of a watershed steering committee, post-wildfire watershed hydrology studies, and initial assessment of a regional flood warning system.

Contact Information: Kim M. Gavigan, U.S. Army Corps of Engineers, Los Angeles District, Phoenix, AZ 85012 USA, Phone: 602-640-2015 x274, Fax: 602-640-5383, Email: kim.m.gavigan@usace.army.mil

Partnerships with Industry to Achieve Ecosystem Restoration

Josiane Bonneau and ***Ann George***
Wildlife Habitat Council, Silver Spring, MD, USA

It has recently been estimated that less than 5% of the world's species will be protected in traditional reserves such as parks, wildlife refuges and other natural areas (Rosenzweig 2003). Therefore the conservation of species and habitats by only relying on protected public land is unlikely to be successful. With approximately 61-75% or land being owned outside of federal government, there is an increasing need to work with private landowners to create sustainable programs in order to conserve biodiversity.

As a conservation organization, the Wildlife Habitat Council works with corporations and private landholders on a voluntary basis for the purpose of preserving and restoring functional ecosystems. WHC recognizes the importance of stakeholder involvement in habitat enhancement projects, and strives to promote cooperative ventures between businesses, government agencies, communities and other non-profit groups.

During this session, I will explore the value of diverse partnerships in conservation projects. These include improving visibility and increasing public engagement with industry through initiatives that demonstrate a commitment to conservation. It is important to nurture partnerships early in the collaborative process, as this promotes trust between stakeholders and allows for a more productive relationship while increasing the transparency of a company's environmental stewardship efforts.

I will highlight several examples of successful ecosystem restoration projects carried out by WHC member corporations in tandem with a diverse stakeholder group. These include Bridgestone's Woodlawn Wildlife Area: formerly a 90- acre municipal and industrial waste landfill, which was restored to wildlife habitat and also used as an outdoor lab for environmental educators and learners of all ages.

Finally, I will highlight the importance of using ecosystem restoration as an opportunity to increase outdoor learning experiences. Environmental education has a strong role to play in combating the "nature deficit disorder" and increasing public awareness of conservation issues. Using restored areas as greenspaces for education and outreach not only provides an added value to the community, but promotes a vested interest in the program, thereby increasing the probability of long-term restoration success.

Contact Information: Ann George, Wildlife Habitat Council, Silver Spring MD, 20910 USA, Phone: 301-588-8994, Fax: 301-588-4629, Email: ageorge@wildlifehc.org

Missouri River Recovery Program Governance Structure

Mike George[1] and *Tom St. Clair*[2]
[1]US Army Corps of Engineers, Omaha, NE, USA
[2]PBS&J, Jacksonville, FL, USA

The Missouri River Recovery Program (MRRP) was developed as a regional program jointly managed by the Omaha and Kansas City Districts of the US Army Corps of Engineers in partnership with the US Fish & Wildlife Service (FWS). The purpose of the MRRP is to guide the recovery of the Missouri River ecosystem and restore habitat for fish and wildlife, while maintaining other Congressionally authorized uses of the river including flood control, navigation, irrigation, hydropower, water supply, fish and wildlife preservation, and recreation. The goal of the MRRP is to mitigate for habitat losses due to construction of a series of reservoirs on the mainstem of the river and construction of navigation channels. Previous program to mitigate for these impact to the natural environment included the Congressionally authorized Bank Stabilization and Navigation Project and the Fish and Wildlife Mitigation Program (Mitigation Program) contained in the Water Resources Act of 1986. These two Acts authorized the construction of habitat loss mitigation projects on lands covering 166,750 acres. In 2003, the FWS issued a final Biological Opinion (BiOP) that addressed the habitat needs of the listed threatened and endangered species (i.e., interior least tern, piping plover, and pallid sturgeon). In response to the BiOp, the Corps implemented two major actions: establishment of the MRRP and also creation of the Missouri River Recovery Implementation Committee (MRRIC) to engage river user groups, organizations, Indian Tribes, and interested individuals in recovery of the Missouri River Basin, including actions affecting listed species.

How to organize the MRRP program with a governance structure that allows participation by all involved parties, yet at the same time facilitates decision making for successful recovery of the river system has been a challenge. This presentation will describe the evolution of the MRRP governance structure and convey lessons learned to benefit other large-scale ecosystem restoration programs facing similar challenges. Perhaps the greatest challenge confronted by the program has been the integration of the historical “mitigation programs” (established 1986) with efforts by the Omaha and Kansas City Districts to meet the requirements of the BiOp. Additionally, determining how best to incorporate input from MRRIC and the program’s Integrated Science Program are still issues confronting the Governance Structure.

Contact Information: Tom St. Clair, PBS&J, 701 San Marco Blvd. Suite 1201, Jacksonville, FL 32207, Email: gstclair@pbsj.com

Periphyton Constructed Stormwater Treatment Areas (PSTA); Constructed Wetlands for Achieving Water Quality for Everglades Restoration

Peter Besrutschko, Ed Brown, Lisa Gued, Tim Brown and ***Enid Gerena***
US Army Corps of Engineers, Jacksonville, FL, USA

Restoration of the Everglades ecosystem is dependant upon restoring water quantity quality , timing and distribution of to historical patterns . The preponderance of the Comprehensive Everglades Restoration Plan (CERP) focuses on the components that collect store and deliver water to the Everglades. Yet it has been the water quality challenges that have forestalled CERP implementation. Everglades water requires a total phosphorus concentration of 10 ppb or the concentration of rain. This project is offered as a solution to that challenge.

The constructed wetland will use a biological technology will use a Periphyton-based stormwater treatment areas (PSTA) technology was proposed in 1996 (Doren and Jones, 1996). This technology was based upon research in the “hole-in-the-doughnut” restoration area of Everglades National Park. As part of an exotic plant control study, portions of former agricultural land were scraped to the limestone substrate. A natural succession of periphyton and sparse macrophytes quickly occurred. These organisms are pioneer species that occur in oligotrophic environments where the water column TP is less than 10 ppb. This technology is attractive as it is a green technology and has been demonstrated to produce effluent (by the U.S. Army Corps of Engineers [Corps] and SFWMD) to meet EFA requirements of less than 10 ppb TP.

This poster presentation summarizes This has been a three (3) phase approach; beginning with 1000 square foot mesocosm cells, a 140 acre field scale demonstration , and the application of full-scale periphyton marshs for STA-1E. The program currently in start-up of the 2nd phase (field scale application).

Contact Information: Enid Gerena, US Army Corps of Engineers, 701 San Marco Blvd, Jacksonville, FL 32207
Phone: 904-232-1815, Email: enid.a.gerena@usace.army.mil

Getting the Sediment Right: Using HEC-RAS for Restoration Analysis

Stanford Gibson and *Gary Brunner*
Hydrologic Engineering Center, Davis CA, USA

Predicting geomorphic and sediment transport responses to river restoration alternatives is essential to their success. HEC-RAS 4.0, the most recent release of the US Army Corps of Engineers' one dimensional, open channel hydraulics model, simulates sediment transport processes. This model is already in use for a wide variety of ecosystem functionality applications.

In particular, HEC-RAS has new capabilities to analyze flushing flows and dam removals. Flushing flows are reservoir releases with the intent of replicating a peak flow regime closer to the river's natural behavior. By restoring hydraulic variability to the regulated reach flushing flows reclaim a natural geomorphic processes designed to increase spawning opportunities and habitat for benthic invertebrates. When flushing flows are not sufficient, and economic and political factors align, dams are removed. The rate of dam removal has increased dramatically over the last two decades and the size range of dams considered for removal is expanding. Both of these restoration alternatives require a detailed and quantitative understanding of system sediment behavior and uncertainties.

The paper will introduce sediment transport modeling, describe the data required for a sediment transport model and present examples of flushing flow and dam removal analyses with HEC-RAS.

Contact Information: Stanford Gibson, Hydrologic Engineering Center, 609 Second Street, Davis CA, 95616 USA, Phone: 530-756-1104 #333, Email: stanford.gibson@usace.army.mil

The Development and Use of Ecological Site Descriptions for Ecosystem Restoration on Agricultural Working Lands in the United States

Wendell Gilgert[1] and *Stephen Brady*[2]
[1]Natural Resources Conservation Service, Portland, OR, USA
[2]Natural Resources Conservation Service, Ft. Worth, TX, USA

There are 1.3 billion acres of agricultural working lands in the contiguous 48 states (NRCS 2007). They can be classified into land uses consisting of 405.6 million acres of forest land, 405.1 million acres of rangeland, 399.4 million acres of cropland, and 117 million acres of pasture (NRCS 2007). They are inequitably distributed across the nation with 75% of the nonfederal forest land occurring east of the Mississippi River, while 99% of the nonfederal rangeland occurs west of the Mississippi. Half of the cropland occurs in 2 Major River Basins in the north central part of the United States. Further those lands have declined by 41.8 million acres during the interval 1982-2003 while developed land uses have increased by 35.2 million acres.

It is incumbent upon the nation to manage those working lands in a sustainable manner because they yield many benefits to society, are declining in abundance, and are inequitably distributed across the nation. While the most obvious societal benefit is the production of food, fiber and oilseed crops with a huge economic impact there are many other benefits including water quality and quantity, open space, fish and wildlife habitat, carbon sequestration, and others. The ecological potential of the land is principally determined by soils, climate, hydrology, topography and related factors. Soil maps with site descriptions and limitations are available for most of the nonfederal lands as are vegetation maps for much of the land in natural or semi-natural cover. However in recent years the concept of describing their ecological condition and potential has evolved. An ecological site is defined as a distinctive kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation.

Ecological site descriptions (ESD's) contain information about soils, physical features, climatic features, associated hydrologic features, plant communities possible on the site, plant community dynamics, annual production estimates and distribution of production throughout the year, associated animal communities, associated and similar sites, and interpretations for management. State and Transition models embedded in ESD's can be used as decision support for ecological restoration.

Contact Information: Wendell Gilgert, USDA-NRCS-WNTSC, 1201 NE Lloyd Blvd, Ste.1000, Portland, OR 97232 USA, Phone: 505-273-2426, Fax: 503-273-2401, Email: wendell.gilgert@por.usda.gov

Overview of the Lower Mississippi River Resource Assessment

Leighann C. Gipson[1] and *Ron Nassar*[2]
[1]U.S. Army Corps of Engineers, Memphis, TN, USA
[2]U.S. Fish and Wildlife Service, Vicksburg, MS, USA

The Lower Mississippi River Resource Assessment was authorized by the United States Congress in Section 402 of the Water Resources Development Act of 2000. This legislation authorized a study to assess information needed for river-related management, natural resource habitat needs, and river-related recreation and access in the Lower Mississippi River system. Geographical boundaries of the project include portions of 7 states, 953 river-miles of the Lower Mississippi River mainstem within the leveed floodplain, and tributaries that have current commercial navigation. An initial appropriation of $254,000 included in the Water Resources Development Act of 2007 is being utilized to prepare a reconnaissance report for Congress. The report will inventory existing data and identify data gaps relative to the three project objectives. The report will also address problems and opportunities within the project area and present potential solutions. Project management responsibilities were assigned to the Memphis District of the U. S. Army Corps of Engineers by the Mississippi Valley Division and representatives from the Lower Mississippi River Conservation Committee and Department of Interior are considered an integral part of the project team.

Contact Information: Leighann C. Gipson, U.S. Army Corps of Engineers, Memphis District, Memphis, TN 38103 USA, Phone: 901-544-4015, Fax: 901-544-3955, Email: leighann.c.gipson@usace.army.mil

Urban Pond and Marsh Restoration, a Cost-Saving Paradigm

Wendi Goldsmith
Bioengineering Group, Salem, MA, USA

How can restoration and management of ponds, marshes, and the watersheds that contribute to them be more sustainably managed within urban settings? Several recent projects highlight the potential to restore ponds and marshes, and to manage stormwater runoff with a very high degree of water quality treatment, beneficial reuse, energy savings, and even flood protection as a result. The best solutions go beyond mere regulatory compliance for mitigation, restoration, or water quality treatment, and enter the realm of embracing environmental sustainability on the site scale. Low impact development techniques often include raingardens and biofiltration swales, as well as more mechanized systems for water harvesting, all falling into the category of green infrastructure for water management are essential precursors to establish appropriate hydrology for ponds and marshes. Often the true benefits result from synergies between elements. Several examples from Metropolitan Boston, New York City, Washington DC, and elsewhere will be explored to share detailed analysis of how restorative projects have been a smart choice to save money while delivering improved water quality, habitats, energy savings, and public enjoyment. Ms. Goldsmith will explore the topic of urban pond and marsh restoration case studies outlining features, benefits, and anecdotes affecting decision-making; computational models for water quality functions, and life-cycle cost/benefit analysis of green infrastructure; and issues affecting regulatory acceptance including tailored ordinances and incentives.

Contact Information: Wendi Goldsmith, CPG, CPSSc, Bioengineering Group, 18 Commercial Street, Salem, MA 01970, USA, Phone: 978-740-0096, Fax: 978-740-0097, Email: wgoldsmith@bioengineering.com

Seasonal and Spatial Variation in the Reproduction and Larval Recruitment of Oysters in Caloosahatchee Estuary as Indicators of the Influence of Managed Freshwater Inflows

Aswani Volety[1], ***Patricia Goodman***[2], *Patricia Sime*[2], *Lesli Hayes*[1] and *Lacey Smith*[1]
[1]Florida Gulf Coast University, Fort Myers, FL, USA
[2]South Florida Water Management District, West Palm Beach, FL, USA

Alterations in freshwater inflow, resulting from watershed development and water management practices, have impacted salinity and water quality within southwest Florida estuaries thereby affecting responses of valued ecosystem components such as oysters. Oyster responses including reproduction and recruitment are used to set water quality targets in southwest Florida estuaries, and as indicators of restoration success of the Comprehensive Everglades Restoration Plan, which attempts to restore more desirable flows into the south Florida estuaries. This study investigated the effects of seasonal changes, watershed management, freshwater inflows, and salinities on oyster responses in the Caloosahatchee River Estuary, Florida.

Oysters, *Crassostrea virginica* are prolific in the estuaries along the east coast of the United States as well as the Gulf of Mexico, including the southwest Florida coast. Oyster abundances have declined precipitously in the Caloosahatchee estuary, and altered hydrology has been identified as a key stressor. Since oysters are benthic, sessile, filter feeding organisms, it is easy to recognize cause-and-effect relationships between water quality and organism responses. Southwest Florida estuaries encounter heavy rains during the summer months resulting in flushing of larvae to downstream locations, and little or no rain during the winter months resulting in very high salinities that are unfavorable for the survival of oyster larvae. Oysters in the Caloosahatchee appear to spawn actively between May – October, a period that coincides with freshwater releases and or watershed runoff. These results are corroborated by larval recruitment, with recruitment occurring between April – November. High flows during summer months result in larva being flushed to downstream locations where substrate availability is low, and growth and survival of juveniles is poor due to high salinities. A combination of freshwater releases resulting in lower salinities and the antagonistic effect of higher temperatures and salinities in summer and winter has resulted in a relatively low overall prevalence of *P. marinus*. However, disease prevalence increases with distance downstream, suggesting that higher salinities result in increased disease incidence.

Low disease incidence, high condition index, sufficient spat recruitment and high growth rate at the upstream locations (e.g. Iona Cove) suggest that with the provision of suitable substrate and limited freshwater flows during the spawning season, oyster reefs will survive and grow at the upstream locations. Small, periodic freshwater releases for durations of less than 2 weeks will result in lower disease prevalence and intensity, and higher juvenile oyster survival. Limiting freshwater releases to < 4000 CFS during late summer months will limit flushing of oyster larvae to downstream locations and create favorable salinity regime for spat recruitment and survival.

Contact Information: Aswani Volety, Coastal Watershed Institute, Florida Gulf Coast University, 10501 FGCU Blvd, Fort Myers, FL 33965, USA, Phone: 239-590-7216, Fax: 239-590-7200, Email: avolety@fgcu.edu

Application of Computer Models for Ecosystem Restoration

Marcia Greenblatt[1], *Matthew Kennedy*[1], *Donald Galya*[1], *Mizan Rashid*[2], *Liza Roy*[3]
– presented by ***David Gorman***
[1]AECOM, Westford, MA, USA
[2]AECOM, Redmond, WA, USA
[3]AECOM, Portland, OR, USA

Numerous aquatic and watershed ecosystems have experienced physical habitat loss and disruption due to hydrologic modification, construction of dams and roadway stream crossings, river channel modification, development in riparian zones, and construction of impervious surfaces in watersheds. Water quality problems associated with nutrient-induced eutrophication and toxic pollutant contamination also affect many aquatic ecosystems. Restoration of impaired aquatic habitat requires the ability to evaluate engineering design alternatives for roadway culvert replacement, construction of in-stream and riparian habitat features, restoring natural flow release patterns at dams, and pollutant control. Computer models that provide hydrodynamic (water height, velocities, and flow rates) and water quality predictions throughout a study area are essential tools for this assessment.

Numerical models typically used for these application range from relatively simple one-dimensional models that provide spatially-averaged predictions to very complex three-dimensional models that provide predictions throughout the length, width, and depth of a study area. Though the more complex models provide much more detailed predictions, they are not appropriate for all applications because the input data and the cost required to build, calibrate and run the model both increase substantially with increasing model complexity. Model selection depends on the study objectives, complexity of the study area, and available data and funding. In general, the most appropriate model is the simplest model that can simulate all the critical features and behavioral characteristics of the study area. This paper will discuss the selection parameters and process for models used in aquatic ecosystem restoration design and present case study projects with important lessons learned.

Contact Information: Marcia Greenblatt, AECOM, 2 Technology Park Drive, Westford, MA 01886 USA,
Phone: 978-589-3000, Fax: 978-589-3100, Email: marcia.greenblatt@aecom.com

Riparian Revegetation Using Native Seed: Feasibility Studies on the Lower Colorado River

Matthew R. Grabau[1], *Michael A. Milczarek*[1], *Gregg Garnett*[2], *Daniel Bunting*[3] and *Martin Karpiscak*[3]
[1]GeoSystems Analysis, Inc., Tucson, AZ, USA
[2]US Bureau of Reclamation, Boulder City, NV, USA
[3]Office of Arid Lands Studies, The University of Arizona, Tucson, AZ, USA

Restoring native riparian plant communities is a major objective of management agencies in the West, with significant plans to revegetate areas currently farmed or dominated by invasive species with cottonwood and willow. Vegetative propagation and subsequent planting of potted plants or rooted cuttings is currently the standard method of revegetation. If direct seeding can be achieved, restoration costs could be dramatically reduced while increasing the density of trees and maximizing genetic diversity. Passive revegetation from seed occurs in natural and managed riparian ecosystems where moist, bare soil is available during seed dispersal as a result of favorable hydrologic conditions. Direct seeding of cottonwood and willow has not yet been implemented in large-scale restoration due to perceived limits of seed viability and an unproven record of success. The Bureau of Reclamation is conducting feasibility studies to assess revegetation of riparian trees along the lower Colorado River using native seed. Feasibility studies conducted to date consist of a three year, phased germination, greenhouse, and field study program.

Germination and greenhouse study results indicated that: 1) viability of Fremont cottonwood (*Populus fremontii*), Goodding's willow (*Salix gooddingii*), and coyote willow (*Salix exigua*) seed can be extended to greater than two years using simple preservation methods; and 2) direct seeding results in dense cottonwood and willow establishment. Soil conditions (bulk density, texture and fertility) and seeding rates were also shown to significantly affected plant establishment, growth, and species diversity.

Field studies implemented at Cibola National Wildlife Refuge are assessing optimum seeding and irrigation methods. Fremont cottonwood establishment was favorable during 2007 field studies with greatest success shown with hydroseeded, un-cleaned seed under furrow irrigation; Goodding's and coyote willow establishment was poor in all plots. Saltcedar (*Tamarix ramosissima*), an introduced invasive species, also established in abundance, but was primarily in the understory of cottonwood. Furthermore, during the second year of growth, cottonwood exhibited superior growth rates compared to saltcedar. Results also indicate the need for intensive grass and broadleaf weed management in retired agricultural fields. 2008 field studies also showed low Goodding's willow establishment. However, the desired tree density for restoration appear to be achievable with high seeding rates and at reduced revegetation costs compared to vegetative propagation techniques.

Contact Information: Matthew R. Grabau, GeoSystems Analysis, Inc., 2015 N. Forbes Blvd. #105, Tucson, AZ 85745 USA, Phone: 520-628-9330, Fax: 520-628-1122, Email: matt@gsanalysis.com

Examples of Adaptive Management Strategies in Urban Ecosystems

***Italia Gray**, Paul Fromer* and *Carianne Funicelli*
RECON Environmental, Inc., San Diego, CA, USA

Restoring an ecosystem to its original community structure, natural complement of species, and natural functions is complicated at best. Natural variability, management objectives, and economic constraints can all influence restoration success. RECON's adaptive management strategy embraces uncertainty and provides opportunities for learning and adapting to change. The Rillito River Ecosystem Restoration Project, Area 1, Pima County, Arizona, will provide restored xeroriparian habitat on an 8.6-acre parcel of land on the southern bank of the Rillito River west of Craycroft Road in Tucson, Arizona. This project is the first phase of the larger Rillito River Ecosystem Restoration and Environmental Project, which covers over 60 acres along the southern bank of the river between Alvernon Way and Craycroft Road. For this project, RECON employed an approach that involved performance standards, monitoring, lessons learned and recommendations that were implemented in later phases of the Rillito River Ecosystem Restoration and Environmental Project.

The San Luis Rey River Flood Risk Management Project is a levied river that provides flood risk reduction to the City of Oceanside, San Diego County, California. The San Luis Rey River is home to the federally listed endangered least Bell's Vireo as well as other state listed species. RECON has been tasked with creating an Adaptive Habitat Management Plan (AHMP) that involves a systematic approach for improving resource management outcomes and provides processes for future decision-making related to vegetation and habitat management activities in the project area. The AHMP must accomplish this while also meeting the intent of terms, conditions and agreements in the approval documents issued by all agencies involved.

In both cases, the success of the projects will be judged by the flexibility of the management plan to adjust to uncertainty from either natural variability or social and economic change. Reviewing how RECON has dealt with integrating new information and feedback on these and other projects will add to the current discussion of how best to implement adaptive management strategies.

Contact Information: Italia B. Gray, RECON Environmental, Inc., San Diego, CA 92101 USA,
Phone: 619-308-9333, Fax: 619-308-9334, Email: igray@recon-us.com

Floodplain Dynamics and Thermal Refuges for Native Fish Communities in the Willamette River

Stan Gregory
Oregon State University, Corvallis, Oregon, USA

Land use change and industrial/municipal development have directly and indirectly warmed streams and rivers throughout the Pacific Northwest, contributing to the decline of anadromous salmon and trout, resident salmonids, and other cold water species. Distributions of native fish species will undoubtedly shrink and become disconnected as thermal regimes in river networks warm more rapidly due to human influences and climate warming. Cold water habitats provide critical refuges for native salmonids, but few studies have directly linked the use of cold water habitats with the geomorphic patterns and processes that create and maintain these critical features. Floodplain simplification and channel hardening with levees and riprap decrease floodplain dynamics and diminish the processes that form cold water refuges in large rivers. Regional agencies have established cold water refuge standards under the Clean Water Act. Though designated beneficial uses clearly require cold water refuges, seasonal use of cold water habitats and migration between these habitats in regional rivers are poorly understood.

Our research in the upper Willamette River showed that floodplain alcoves provide the colder and larger refuges than smaller alcoves on gravel bars in the active river channel. We observed that more than 90% of the fish species observed in floodplain alcoves that are colder than the mainstem were native species, but the majority of species observed in floodplain alcoves that are warmer than the mainstem were non-native species. Similar relationships were observed between side channels versus isolated floodplain ponds, which contained greater abundances of non-native species. Using radiotracking, we found that more than half of the cutthroat trout released back into cold water refuges remained in these habitats during late summer. We implanted iButton temperature dataloggers in cutthroat trout to determine the thermal properties of habitats used by cold water native species. These trout used habitats that were 2 to 3 degrees C colder than the temperatures in the mainstem river. River conservation must protect cold water refuges if we are to maintain our native fish assemblages in the face of human population growth and climate change. Past practices that hardened rivers and reduced natural flood events must be reversed if we are going to restore dynamic channels that create the cold water refuges associated with changing river channels and their floodplains. Innovative approaches for collaboration with private land owners and public land managers in large river floodplains (e.g., land trust, conservation easements, thermal credit trading) offer new opportunities to provide floodplain restoration, restore cold water refuges, and provide income sources for land owners along large rivers.

Contact Information: Stan Gregory, Department of Fisheries & Wildlife, Oregon State University, Corvallis, OR 97331 USA, Phone: 541-737-1951, Fax: 541-737-3590, Email: Stanley.Gregory@oregonstate.edu

Wetland Restoration on Private Lands through NRCS Programs

Jessica Groves
Natural Resources Conservation Service, Davis, CA, USA

In California, the Natural Resources Conservation Service (NRCS) has implemented wetland, riparian, and floodplain restoration on private agricultural lands for the last 15 years through the Wetlands Reserve Program (WRP). The program restores properties that were formerly wetland, were converted for agricultural use, and have the capacity to be restored to a wetland condition. Statewide nearly 100,000 acres of wetland habitat has been restored and protected through the voluntary participation of landowners in the WRP. Over the years, the enrollment of smaller individual parcels has resulted in large complexes of habitat, integrated on the landscape with on-going adjacent agricultural uses. Because the WRP properties remain privately owned, NRCS and its partners work closely with the landowners to assist them in making the transition from agricultural operators to habitat managers on the restored properties. I will present two case studies as examples of the landscape-scale changes that have resulted from the aggregation of projects that have been restored over time, and discuss the challenges and opportunities encountered in the course of undergoing these changes in land use.

Contact Information: Jessica Groves, State Wetlands Biologist, Natural Resources Conservation Service, 430 G St., #4164, Davis, CA 95616, USA, Phone: 530-792-5604, Fax: 530-792-5793, Email: jessica.groves@ca.usda.gov

Frazier Lake and Wetland Restoration

Dennis A. Haag[1], *Jeff Kreie*[2] and *Peter W. Earles*[3]
[1]Burns & McDonnell Engineering, Co., Kansas City, MO, USA
[2]Ulysses City Parks and Recreation Department, Ulysses, KS, USA
[3]Earles Engineering & Inspection, Inc., Salina, KS, USA

Frazier Park Lake is a 43-acre sediment filled lake located on the North Fork of the Cimarron River, Grant County, Kansas. The area is owned and managed by the City of Ulysses, Kansas. Since filling with sediment, the lake and surrounding habitat in the floodplain of the Cimarron River has deteriorated. Therefore, the City has implemented a plan to restore a portion of the lake including 15 acres of open water, 3 acres of adjacent marsh lands, and enhance 10 acres of adjoining floodplain riparian and wetland vegetation along the Cimarron River. In addition to Frazier Park Lake, the restoration plan included installation of wetland and stream systems that feed treated wastewater to the restored lake and Cimarron floodplain: 6 cells - 8 acres of constructed wetlands; approximately 5000 linear feet - 4 acres of new stream channels; waterfall and equalization wetland; 2 acre wetland plant nursery; and new golf course irrigation pump station. Design plans and construction permits were prepared in 2005-2006; construction was initiated in 2007; and completion of the project in 2008.

Contact Information: Dennis A. Haag, Burns & McDonnell Engineering Co., 9400 Ward Parkway, Kansas City, MO 64114-3319 USA, Phone: 816-822-3484, Fax: 816-822-4299, Email: dhaag@burnsmcd.com

New Lake Restoration Methods

Dennis A. Haag
Burns & McDonnell Engineering, Co., Kansas City, MO, USA

Sedimentation is a natural process that occurs in bodies of water when the flow velocity is not strong enough to keep insoluble materials moving. The increasing amount of sedimentation is threatening water supply and water quality nationwide. Burns & McDonnell has used several new methods to restore lakes and managing lake sediment that are alternatives to building new dams or conventional dredging. These methods include air dredging and hydraulic dredging that speeds up the lakes' natural cleansing process. Air dredging involves sending condensed air through weighted hoses on the lake bottom. The bubbles agitate the water in a way similar to mechanical rotors in treatment lagoons – but far more efficiently. The increased oxygen speeds up decomposition of organic material, and the mixing action re-suspends fine particulate, such as clay, which tends to hold more nutrients. When sedimentation is too advanced for air dredging to be effective, a hydraulic dredge called the "mini-dredge" can be used to pull sediment from the bottom of a lake and collect it in large filter bags. The bags concentrate and de-water the sediment in a short period of time. The de-watered sediment is cheaper to haul and dispose of than normally dredged material. It can often be reshaped and used as topsoil or for other landscaping purposes. The presentation will highlight six lake restoration projects located in the Kansas City and Chicago metropolitan areas.

Contact Information: Dennis A. Haag, Burns & McDonnell Engineering Co., 9400 Ward Parkway, Kansas City, MO 64114-3319 USA, Phone: 816-822-3484, Fax: 816-822-4299, Email: dhaag@burnsmcd.com

Incorporating Genetic Diversity into Riparian Restoration: the Importance of Merging Restoration with Landscape Level Experiments

Sharon M. Ferrier[1], *R. K. Bangert*[2], *G. J. Allan*[1], **L. E. Hagenauer**[1], *K. J. Kennedy*[1], *C. Leroy*[3], *D. Fischer*[3], *E. Lonsdorf*[4] and *T. G. Whitham*[1]
[1]Department of Biological Sciences, Northern Arizona University, Flagstaff, AZ, USA
[2]Department of Biological Sciences, Idaho State University, Pocatello, ID, USA
[3]Evergreen State College, Olympia, WA, USA
[4]Lincoln Park Zoo, Chicago, IL, USA

In the spring of 2007 the Cottonwood Ecology Group planted 27,000 cottonwoods and willows on the Lower Colorado River as part of a restoration/science collaboration with the Bureau of Reclamation, the Cibola National Wildlife Refuge, California Fish and Game, the National Science Foundation, and Americorps. Such collaborations with both basic and applied goals among diverse agencies and institutions represent a major leveraging of funds and a rare opportunity to merge the latest scientific developments with current management practices.

Contact Information: Laura E. Hagenauer, Northern Arizona University, Department of Biology, Box 5640, Flagstaff, AZ 86011 USA, Email: Laura.Hagenauer@nau.edu

Regional Restoration Planning Case Study in the Delaware Estuary: Ecosystem Valuation along an Urban Waterfront

Simeon Hahn[1], *Anthony Dvarskas*[2], *Jill Bodnar*[2], *Daniel Kreeger*[3], *Laura Whalen*[3], *Paul Racette*[4] and *Lance Butler*[5]

[1]National Oceanic and Atmospheric Administration Office of Response and Restoration Assessment and Restoration Division, Philadelphia, PA

[2]NOAA NOS ARD

[3]Partnership for the Delaware Estuary

[4]Pennsylvania Environmental Council

[5]Philadelphia Water Department

A Regional Restoration Initiative (RRI) is being initiated by the Partnership for the Delaware Estuary, a National Estuary Program, working with several government and non-government organizations including NOAA ORR. The primary goals of this initiative are to (1) facilitate coordination among various conservation, enhancement, and restoration efforts underway, (2) apply scientific principles in evaluating ecosystem services resulting from different types of restoration efforts, (3) provide decision tools and a registry of high value projects for future restoration, and (4) encourage ecosystem-based approaches that maximize natural resource benefits over long time scales within the Delaware Estuary and its watershed. To launch the RRI, up to four case studies will be completed, including urban waterfronts, tidal wetlands, shellfish, and headwater streams.

The Pennsylvania Environmental Council is leading an effort for ecological restoration along the tidal Delaware River in North Philadelphia through a Coastal Zone Management grant. Restoration activities within the urban corridor of the Delaware Estuary face many challenges, and this effort will provide important information for the urban waterfront case study of the RRI. Urban habitat restoration is challenging because of concerns including high costs, potential contamination, and potential impacts on infrastructure. When a broader suite of ecosystem services in addition to local habitat are considered in the evaluation, restoration of urban areas provide substantially more benefits than are traditionally realized. An evaluation of this urban pilot area using the BRM and VARM approach in the Delaware Estuary RRI will be presented with a focus on shoreline protection and stabilization practices.

NOAA served as a natural resource trustee for the November 26, 2004, M/T *Athos I* Oil Spill on the Delaware River near the Citgo Refinery in Paulsboro, New Jersey. Habitat Equivalency Analysis (HEA) was used to quantify natural resource injuries resulting from the spill and to scale restoration benefits of potential restoration projects. Lardner's Point is a proposed restoration site located along the North Philadelphia Delaware Riverfront and is within the area oiled by the *Athos* spill. The shoreline restoration component, proposed to compensate for a portion of the *Athos* losses, involves demolishing existing structures, removing debris, importing fill material, grading the site to restore tidal inundation, and creating and planting intertidal marsh and wet meadow habitat. A "living shorelines" approach will be used, with excavated rock forming a toe sill at the marsh edge to stabilize the area and protect it from erosion. For the RRI pilot an extrapolation of the HEA was conducted to evaluate potential increases in an ecosystem service (productivity) under a potential restoration scenario.

<u>Contact Information</u>: Simeon Hahn, National Oceanic and Atmospheric Administration Office of Response and Restoration Assessment and Restoration Division, 1650 Arch Street, Philadelphia, PA 19103, USA,
Phone: 215-814-5419, Fax: 215-814-3015, Email: simeon.hahn@noaa.gov

Development of an Adaptive Management (AM) Program to Support Recovery of the Missouri River: Creating Functional Shallow Water and Emergent Sandbar Habitat

Craig A. Fleming, ***Carol Hale***, *Drew J. Tyre*, *Ronald M. Thom* and *Heida L. Diefenderfer*
US Fish and Wildlife Service, Yankton, SD, USA

The purpose of the Missouri River Recovery Program (MRRP) is to restore sustainable ecosystem functions, mitigate historical habitat losses, and recover and prevent further declines of terrestrial and aquatic habitat and species while seeking to balance social, economic, and cultural values. The program is a long-term, comprehensive effort to develop and implement ecological restoration of the system. That said, the constraints to actual ecosystem restoration are great, and much of the near-term recovery is focused on implementing Biological Opinion actions by building specific habitat types believed to support endangered and threatened species including the Pallid sturgeon, least tern and piping plover. There are critical uncertainties associated with decisions about potential actions. These uncertainties generally concern the ability of constructed habitat to significantly improve the populations of the target species, and the location density and type of engineering designs to implement to maximize the habitat size, quality and long-term sustainability. Because these uncertainties hamper decisions about actions, the MRRP has chosen to approach the program using an adaptive management framework. The MRRP has developed a stakeholder group and a management team, as well as a set of technical teams. The stakeholders and management team are responsible for key decisions in the process. The technical teams are responsible for researching the technical uncertainties through development and evaluating of models employing a structured decision-making process. We will report on the status of the AM program and provide specific examples showing how learning is being incorporated into the process at this point and in the future.

Contact Information: Carol Hale, US Fish and Wildlife Service, PO Box 710, Yankton, SD 57078, USA
Phone: 402-667-2887, Email: Carol_Hale@fws.gov

Bioengineered Bank Stabilization: Restoring Eroded Vertical Bank to Usable Habitat in the Missouri National Recreational River

Meagan Hall and *John Engel*
HDR Engineering, Inc., Omaha, Nebraska

Lewis & Clark Regional Water System (Lewis & Clark) is in the process of developing a high-quality three-state water supply system to serve the growing needs of southeastern South Dakota, southwestern Minnesota, and northwestern Iowa. In order to protect a well field along the Missouri River (approximate river mile 777.8 to 776.7), Lewis & Clark would require a 5,120-foot long bank stabilization.

This specific stretch of the Missouri River, near Vermillion, South Dakota, is designated as the Missouri National Recreational River (MNRR) under the Wild and Scenic Rivers Act. The National Park Service (NPS) had concerns with conventional riprap bank stabilization applications and the ability to preserve the outstandingly remarkable values of the MNRR. To address these concerns, the bioengineered bank stabilization incorporated a soil-choked stone toe, 115 cottonwood and cedar tree locked logs, 48,000 unrooted willow plantings, and 59,300 rooted red osier dogwood plantings. This type of locked log and willow planting bank armor stabilizes the eroding bank while camouflaging the riprap and providing aquatic and terrestrial habitat diversity.

The U.S. Army Corps of Engineers (USACE), South Dakota Regulatory, expedited the Section 404 permitting process so that the project construction could fit within the threatened and endangered species time restrictions. This project required extensive coordination with the Bureau of Reclamation; Lewis & Clark; NPS; USACE; U.S. Fish and Wildlife Service; South Dakota Game, Fish and Parks; South Dakota Department of Environment and Natural Resources; and South Dakota State University. Constructed in the winter of 2007-2008 and followed by a wet spring 2008, the bank stabilization now blends seamlessly into its surroundings. This project serves as an example of using bioengineering techniques for bank stabilization on a major river system to protect infrastructure from lateral migration, yet preserving the natural state and restoring usable habitat for fish and migratory birds.

Contact Information: Meagan Hall, HDR Engineering, Inc., Omaha, Nebraska 68114 USA, Phone: 402-399-4983, Fax: 402-399-1111, Email: meagan.hall@hdrinc.com

Utilizing Farm Bill Conservation Programs to Implement Stream Corridor Restoration Projects on Private Lands

Kathryn Boyer[1] and ***Howard Hankin***[2]
[1]NRCS West National Technology Support Center, Portland, OR, USA
[2]NRCS, National Headquarters, Washington, DC, USA

The USDA Natural Resources Conservation Service provides technical assistance and funding to mainly private land owners to sustain and improve natural resources, including soil, water, air, plants, and animals. Because over 70% of the US is private land, NRCS can potentially influence many types of aquatic habitats that sustain coastal, estuarine, wetland, stream, river, lake, pond, and vernal pool species. NRCS partners with scientists, natural resource practitioners, National Fish Habitat Partnerships, and non-government organizations to leverage dollars and expertise to evaluate and assess new techniques in stream corridor restoration, implement small and large-scale restoration efforts with single or multiple landowners, and evaluate results of these efforts. This presentation will provide an overview of how NRCS provides technical and financial assistance to landowners, and collaborates with scientists and partners to improve planning, design, and implementation of practices that contribute to the conservation and management of stream corridors. These efforts include using Farm Bill programs to plan and implement practices to benefit aquatic species, assessment and monitoring thru CEAP, collaboration with Plant Materials Centers and the Agricultural Research Service, Conservation Innovation Grants, and cooperative agreements with Land Grant Institutions across the US.

Contact Information: Kathryn Boyer, West National Technology Support Center, 1201 NE Lloyd Blvd, Suite 1000, Portland, OR, 97232, USA, Phone: 503-273-2412, Fax: 503-273-2401, Email: Kathryn.Boyer@por.usda.gov

Application of a Hydrogeomorphic Study in Conservation Planning for the Middle Mississippi River Corridor

Charlie Hanneken[1] and *Mickey Heitmeyer*[2]
[1]U.S. Army Corp of Engineers, St. Louis, MO, USA
[2]Greenbrier Wetland Services, Advance, MO, USA

The Corps of Engineers and the Middle Mississippi River Partnership (MMRP) are working in cooperation to utilize a hydrogeomorphic (HGM) study to improve science-based natural resource planning for the Middle Mississippi River (MMR) and its floodplain. The MMR is the 200 mile long stretch of river between St. Louis, Missouri and Cairo, Illinois. The HGM methodology uses information on geomorphology, soils, topography, and hydrology to estimate pre-European settlement habitats and document existing ecosystem conditions including remnant habitats. The results are presented in a report, series of maps, and ArcGIS shapefiles. The report documents the changes that have occurred within the corridor since European settlement and allows users to visualize these changes using ArcGIS shapefiles. These useful tools have broad applicability that serve to improve collaborative planning within the region. These tools were developed to allow state, federal, and local agencies and groups to better execute their own planning programs and dollars, jointly develop smarter mitigation and restoration projects with better chances of success, help avoid sensitive ecological areas, and help agencies and regional entities jointly leverage and focus their collective resources. Specifically, the HGM tools are helping the MMRP develop appropriate, realistic and science-based conservation goals and objectives for the 500,000 acres of the MMR and its floodplain. The tools also allow the MMRP to focus the planning process toward specific sites and/or habitat types for restoration, conservation, or preservation. These more focused efforts combined with improved knowledge of the region's habitats and their historical locations will result in ecosystem restoration projects that will have higher potential for success.

Contact Information: Charlie Hanneken, Environmental Branch, U. S. Army Corps of Engineers, St. Louis District, 1222 Spruce St., St. Louis, MO 63103-2833 USA, Phone: 314-331-8496, Fax: 314-331-8806, Email: charles.d.hanneken@usace.army.mil

Quantifying Large River Habitat Restoration Potential through Hydrodynamic Modeling and Geomorphic Analysis

Tim Hanrahan and *Marshall Richmond*
Pacific Northwest National Laboratory, Richland, WA, USA

Many large river and estuary habitat restoration efforts present unique challenges because their environments have been dramatically altered by physical modifications, through both engineered alterations and anthropogenic perturbations to natural processes. Estimating future habitat availability resulting from restoration of these environments involves significant uncertainty, particularly when these estimates are based on only simple hydraulic variables such as flow depth and velocity. Uncertainty can be reduced by incorporating controlling factors of habitat availability, such as channel morphology, into an analysis of habitat restoration potential. We present a case study of this approach from the Columbia River Basin.

In the Columbia River Basin there is considerable debate and uncertainty regarding hydroelectric dam management activities directed at enhancement of mainstem habitat and anadromous salmonid populations. This research evaluated the restoration potential of mainstem habitats for Snake River fall Chinook salmon. We used empirical and modeled physical habitat data to compare potential fall Chinook salmon spawning habitat in the Snake River, under current and modified dam operations, with the analogous physical characteristics of an existing fall Chinook salmon spawning area in the Columbia River. Results from two-dimensional depth-averaged hydraulic modeling indicated that under current and modified dam operations, 79% and 88%, respectively, of the potential spawning habitat had a suitability index value of less than half the optimal value. The estimates of potential spawning habitat under modified hydrosystem operations represented a 28% decrease from the potential spawning habitat available for the same discharges under current hydrosystem operations. Quantification of cross-sectional and longitudinal channel morphology indicated that the Snake River study areas were geomorphically compromised as fall Chinook salmon spawning areas. One of the study areas lacked significant bedforms along the longitudinal profile while the other lacked cross-sectional topographic diversity, both largely as a result of navigation channel construction and maintenance. The findings suggest that modifications to hydrosystem operations alone will not provide the physical habitat characteristics required for restoring and expanding Snake River fall Chinook salmon spawning habitat. Large river and estuary restoration efforts can be improved by incorporating geomorphology and other controlling factors of habitat availability into evaluations of restoration potential.

<u>Contact Information</u>: Tim Hanrahan, Pacific Northwest National Laboratory, P.O. Box 999 MS K6-85, Richland, WA 99354, USA, Phone: 509-371-7182, Email: tim.hanrahan@pnl.gov

Restoration in the Sky Islands: Bringing Volunteers, Landowners, Practioneers and Agencies together to Benefit Wildlife and Habitats in a Global Biodiversity Hotspot

Trevor Hare and *Sarah Williams*
Sky Island Alliance, Tucson, Arizona USA

The Sky Island region of the Southwestern US and Northwestern Mexico is recognized internationally as a biodiversity hotspot and is garnering increased conservation attention. Due to its dramatic topographical relief and its location between the Sonoran and Chihuahuan Deserts and subtropical and temperate North America many unique and rare species and habitats occur in the region. Sky Island Alliance is a grassroots organization dedicated to the protection and restoration of this rich natural heritage. We bring volunteers, landowners and agency personnel together to plan and implement riparian and upland restoration projects to protect vital desert, grassland and riparian wildlife and habitats.

Four case studies on restoration projects are presented that can inform similar projects and plans. First is a study of a funded but flawed restoration planning project in the headwaters of the Santa Cruz River where a lack of communication between the project manager, adjacent landowners, and land and wildlife managers doomed its completion. Second is a study on an un-funded but ongoing restoration project in the Huachuca Mountains where man-made spring and creek impoundments allowed bullfrogs to extirpate native aquatic species. Third is a study of a fully funded large-scale ciénega restoration project in the Peloncillo Mountains where in 2009 we hope to restore flood flows across a 200-acre wetland that is drying due to man-made diversions. Fourth is a study on upland restoration focusing on wildland road density reductions to protect the oak savannas and riparian areas of the Sonoita Valley and Ciénega Creek watershed.

Contact Information: Trevor Hare, Sky Island Alliance 738 N Fifth Avenue, Suite 201, Tucson, Arizona 85705 USA, Phone: 520 624-7080 x14, Email: trevor@skyislandalliance.org

Challenges in Building Basin-Wide Consensus on Missouri River Recovery Activities

Mary S. Roth[1] and ***Rosemary C. Hargrave***[2]
[1]Omaha District, US Army Corps of Engineers, Omaha, NE, USA
[2]Northwestern Division, US Army Corps of Engineers, Omaha, NE, USA

Subsection (b) of Section 5018 of the Water Resources Development Act of 2007 directed the establishment of the Missouri River Recovery Implementation Committee (MRRIC) to provide recommendations and guidance to the US Army Corps of Engineers with respect to the Missouri River recovery and mitigation activities and on a study to be conducted under Subsection (a). The charter for the MRRIC was approved by the Assistant Secretary of the Army for Civil Works on July 1, 2008, marking the culmination of over a year of work by the MRRIC Planning Group. Following a membership selection process, the MRRIC held its first meeting at the end of September, 2008. Members include representatives from eight basin states, sixteen basin tribes, fifteen federal agencies, and twenty-eight stakeholder categories.

The MRRIC will make consensus recommendations on the existing Missouri River Recovery Program (MRRP) and the study that will result in the Missouri River Ecosystem Restoration Plan (MRERP), a long-term vision for Missouri River recovery. Numerous challenges are involved in working with such a large, diverse, and geographically dispersed group.

The meetings are facilitated by the US Institute for Environmental Conflict Resolution.

<u>Contact Information</u>: Mary S. Roth, PE, PMP, Omaha District, US Army Corps of Engineers, Omaha, NE 68102, USA, Phone: 402-995-2719, Fax: 402-995-2454, Email: mary.s.roth@usace.army.mil

The CERP Monitoring and Assessment Plan–Challenges to Sustainability of Long-term System-wide Monitoring in the Everglades and South Florida

Matthew Harwell[1], *Gretchen Ehlinger*[2], *Jack Gentile*[3], *Greg Graves*[4], *Eliza Hines*[5], *Patti Sime*[4], and *Steve Traxler*[1]

[1]U.S Fish and Wildlife Service, Vero Beach, FL, USA
[2]U.S. Army Corps of Engineers-Jacksonville District, Jacksonville, FL, USA
[3]Harwell Gentile & Associates, Brewster, MA, USA
[4]South Florida Water Management District, West Palm Beach, FL, USA
[5]Everglades Partners Joint Venture/PBS&J, Jacksonville, FL, USA

The Comprehensive Everglades Restoration Plan (CERP) *Monitoring and Assessment Plan (MAP), Part 1*: *Monitoring and Supporting Research* (MAP 2004) is a system-wide/regional monitoring and assessment program capable of evaluating CERP performance and system responses. The 2006 companion document, *MAP, Part 2: Assessment Strategy for the MAP* outlines assessment protocols and was used as guidance for the development of the first System Status Reports (SSRs [2006 and 2007]) produced by Restoration Coordination and Verification (RECOVER). The SSR assesses data garnered from both system-wide and CERP project-level monitoring and is produced biennially. Over the first five years of implementation, the MAP--envisioned as a long-term system-wide monitoring program for the Everglades and South Florida --has faced many challenges. Sustained implementation of the MAP relies upon successfully addressing the five principles of sustainable ecosystem management (Machlis et al. 1997). These principles include: (1) socially defined management goals and objectives; (2) an integrated holistic science program; (3) broad spatial and temporal scales; (4) adaptable institutions; and (5) collaborative decision-making. The application of these principles highlights challenges to MAP implementation including those associated with insufficiency of funding needed to establish pre-CERP conditions throughout the system, constantly changing guidance about CERP project implementation schedules, and difficulty with coordination of the multiple entities conducting monitoring and research in the Everglades and South Florida. These challenges have also provided opportunities to improve system-wide monitoring. The MAP 2004 is currently undergoing revision in order to optimize monitoring so that it not only better meets the needs of CERP project implementation schedules, but also integrates the principles of adaptive management by incorporating flexibility and stakeholder involvement. Additionally, these challenges emphasize the need for adequate funding for monitoring and research via authorization of a potential Water Resources Development Act (WRDA) bill in 2009 or 2010.

<u>Contact Information</u>: Matthew Harwell, U.S. Fish and Wildlife Service, A.R.M Loxahatchee National Wildlife Refuge, c/o FWS Vero Beach, FL 32960, USA. Phone: 772-562-3909 x255, Fax: 772-562-4288, Email: matthew_harwell@fws.gov

Rethinking Characterization of Uncertainty in Ecological Restoration

Matthew C. Harwell[1], *John H. Gentile*[2] and *Mark A. Harwell*[2]
[1]U.S. Fish and Wildlife Service, Vero Beach, FL, USA
[2]Harwell Gentile & Associates, LC, Brewster MA and Palm Coast, FL, USA

The intent of this presentation is to illustrate that a comprehensive understanding of uncertainty is a powerful tool and ally to the manager in making informed decisions. Managers and decision makers often find themselves in a position in which they frequently must make decisions that have a wide range of inherent uncertainties and risk. It is to their advantage to understand the nature, magnitude, and importance of uncertainty to inform their decision. This is particularly important in large, complex restoration programs that often focus on characterization of three types of uncertainties, policy, institutional, and scientific, the latter having many diverse components, such as insufficient data, natural variability, interactions of stressors, extrapolations across species, time or space, and modeling and analytical uncertainties. This compartmentalization of uncertainty, while useful operationally, has not necessarily resulted in an improved ability to move forward in restoration efforts, as this approach ignores the interaction of various categories of uncertainty in the decision process. Consequently, addressing uncertainty has become an integral element in planning, designing, and assessing activities in government, industry, and academia. Within the context of environmental assessments and restoration, a systematic risk-based strategy provides a comprehensive and integrated framework for addressing uncertainty. A risk assessment approach has been successfully used for almost two decades in a wide range of environmental and health assessments.

The ecological risk assessment approach utilizes a multi-component framework involving *problem formulation*, characterization of *stressors*, characterization of potential *ecological effects*, *analysis of best technical information*, and ultimately a characterization of *risk and associated uncertainty*. This approach focuses on identifying the uncertainties relevant to all three aspects of the risk process and addresses such topics as: 1) characterizing natural and anthropogenic sources of uncertainty; 2) identifying relative importance of the spectrum of uncertainties to decision-making process; 3) assessing whether the sources of uncertainty can be reduced, controlled, or mitigated, or have to be accepted; 4) assessing whether the reduction of some uncertainties significantly improve the assessment/restoration process; and 5) accommodating those uncertainties that contribute to Type II errors in decision making (e.g., being overcautious in making a decision when direct action is needed to move restoration forward) through the use of a "safety factor" if the uncertainty can not be managed at the time the decisions are being made.

While ecological risk assessment concepts are directly relevant and applicable to restoration activities, they have not been comprehensively applied in advancing restoration projects. We argue that addressing uncertainties in such a risk-based systematic manner improves confidence in the decision-making process and helps decision makers more effectively target future research to reduce those uncertainties that have the greatest impact. This strategy will enhance the ultimate success of the decisions that are made to restore and sustain the ecosystem of interest.

Contact Information: M.C. Harwell, U.S. Fish and Wildlife Service, Vero Beach, FL 32962 USA, Phone: 772-562-3909 x255, Fax: 772-562-4288, Email: matthew_harwell@fws.gov

Conceptual Models, Monitoring, Assessment and Performance Measures in Support of Adaptive Management in the California Bay-Delta System

Lauren L. Hastings[1], *Matt Nobriga*[2] and *Carl Wilcox*[2]
[1]CALFED Science Program, California Natural Resources Agency, Sacramento, CA, USA
[2]California Department of Fish and Game, Sacramento, CA USA

Implementing adaptive management, especially active adaptive management, is hard. There are few examples of it being used successfully in large-scale ecosystem restoration programs. Adaptive management was identified in 2000 as a foundation for implementing the CALFED Ecosystem Restoration Program (ERP) in the Strategic Plan for Ecosystem Restoration, one of several ERP programmatic EIR/EIS documents. The ERP Strategic Plan outlines an ecosystem-based management approach couched in the adaptive management process including use of conceptual models and simulation models, clearly identifying goals, objectives, and the corresponding performance measures up front, treating management interventions as experiments designed to reduce uncertainty, adequate monitoring, assessment and reporting, and adjusting management interventions as necessary to reflect new understanding.

The CALFED ERP, with help from the CALFED Science Program, has achieved successes in some aspects of its adaptive management approach. The ERP has developed a suite of peer-reviewed ecosystem and species conceptual models through the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) effort. The DRERIP process also includes a decision tree approach for using the conceptual models to scientifically evaluate proposed restoration actions. The DRERIP models were recently used to evaluate proposed conservation measures in the Bay Delta Conservation Plan (BDCP), an ongoing effort designed for obtaining state and federal endangered species act permits for proposed Delta water management actions.

Although several attempts have been made, the ERP, Science Program and other groups engaged in Delta ecosystem restoration continue to struggle with identifying and reporting on meaningful performance measures and indicators, in part because it has proven scientifically difficult to link small numbers of manageable system “drivers” to abundance trends of focal species. Improved science funding during the CALFED “era” contributed to greatly increased quantities of Bay-Delta scientific information, which increases the already difficult task of communicating the information to policymakers who are willing and able to use the information in decision making, thereby closing the all-important feedback loop. To better translate the very large quantities of new scientific information being reported, the BDCP Science Advisors’ adaptive management report suggests a governance approach that explicitly includes a group of highly skilled individuals who understand both the technical and policy aspects of the science and make sound recommendations to decision makers. In addition the Science Program is working with a group of academics and agency staff to develop a new monitoring framework in the Bay-Delta that will provide a way to better combine data from widely distributed monitoring programs, identify important gaps in existing programs and assure ongoing interpretive assessments of the data.

Contact Information: Lauren L. Hastings, CALFED Science Program, 650 Capitol Mall, 5th floor, Sacramento, CA 95814 USA, Phone: 916-445-5026, Fax: 916-445-7297, Email: lauren.hastings@calwater.ca.gov

Urban Forestry Restoration Case Studies – Human Dimensions and Technical Approaches

Janet Hawkes
RPM Ecosystems LLC, Dryden, NY, USA

Urban forests provide a multitude of environmental, economic, social, and cultural benefits. In order to maximize these benefits, urban forests need to be maintained and often restored, particularly after natural disasters, development, or neglect. Urban forestry restoration initiatives often involve complex partnerships, and increasingly are looking to new technical approaches and methodologies for successful results.

A series of mini-case studies will demonstrate an array of organizational approaches and urban reforestation techniques. From ice storms in the Northeast to hurricanes in the Gulf Coast examples of urban reforestation efforts will be highlighted. For example, a creative initiative in Baltimore demonstrates creative mechanism for reforestation funding, implementation, and community involvement. Hurricanes Katrina and Rita produced the largest single forestry disaster on record in America. In some towns along the Mississippi coast not a tree remained standing. While coping with their personal loses, residents in the communities of the six counties along the Mississippi Gulf Coast came together immediately to first address saving heritage trees that survived and develop partnerships called Replant South Mississippi to launch a critical effort to replace the over 1.5 million trees that were lost or damaged.

Federally funded demonstrations of restoration using fast growing native hardwoods are being conducted to determine the efficacy of new method for urban and rural forests. In a project with USDA- FSA, Mississippi State University, USDA Bottomland Hardwood Research Center and others, new techniques for reforestation are being researched and monitored on private, not-for-profit, and municipal lands. Another mini-case study will feature this effort.

Contact Information: Janet Hawkes, RPM Ecosystems LLC, 2150 Dryden Rd, Dryden, NY 13053, USA,
Phone: 607-844-9590, Email: jeh@rpmecosystems.com

The Role of the Agricultural Wildlife Conservation Center in Ecological Restoration Efforts

L. Pete Heard and *Edward J. Hackett*
USDA NRCS Agricultural Wildlife Conservation Center, Madison, MS, USA

The mission of the Agricultural Wildlife Conservation Center is: "In cooperation with partners, develop and disseminate scientifically based technical materials that will assist Natural Resources Conservation Service (NRCS) field staffs and others to promote conservation stewardship of fish and wildlife and deliver sound habitat management principles and practices to America's land users." Through a grants and agreements program, the AWCC has conducted over 115 projects for technology development and transfer to field offices and NGO's for use. AWCC is part of the technology arm of the NRCS, an agency that administers the Wetland Reserve Program, the largest wetland restoration program on private lands in the country.

Results from a number of AWCC projects will demonstrate their value to ecological restoration concepts.

Contact Information: Pete Heard, USDA/NRCS Agricultural Wildlife Conservation Center, 100 Webster Circle, Suite 2, Madison, MS 39110 USA, Phone 601-607-3131, Fax 601-607-3139, Email: pete.heard@ms.usda.gov

Heritage of the SCS Demonstration and Watershed Projects: Lessons for Conservation, Rehabilitation and Restoration Projects. (Watershed Planning Panel)

Douglas Helms
Natural Resources Conservation Service, Washington, DC USA

Hugh Hammond Bennett, who was largely responsible for creating the Soil Conservation Service (SCS) in the U. S. Department of Agriculture (UDA) in 1935, had campaigned for farming practices that would allow for efficient agriculture, while simultaneously conserving soil. Much of the agency's work has been with individual landowners, advocating and assisting with preventative measures to conserve soil and water on farmlands. The agency also has a heritage of working on watershed-wide projects that encompass multiple farms. The causes of problems and the benefits of rehabilitation crossed property boundaries. The financial needs and technical knowledge for rehabilitation were often beyond the capability of individual farm owners.

The predecessor to the SCS, the Soil Erosion Service started work in 1933 on watershed-sized demonstration projects. Civilian Conservation Corps enrollees and Work Projects Administration workers made it possible for the agency to assist farmers with cropland conservation measures as well as to work on problems such as flood control, stream bank erosion and coastal erosion. Two examples would be the sand dune restoration near Warrenton, Oregon, and stream bank erosion control on the Winooski River in Vermont. In working on watershed-wide projects requiring significant agency contributions in labor and heavy equipment, SCS established an important precedent. They worked on sources of the problems in the watershed, not just the in-stream manifestation of problems. In addition to rehabilitation work on the land, the SCS staff often recommended less intensive land use. For example, the land may have been more suited to pasture or forest uses rather than cropland use. Rehabilitation more accurately describes the work than restoration, if by restoration one means achieving some presumed natural state. SCS staff assumed continued human use, but perhaps less intensive use.

The Flood Control Act of 1936 and the Watershed Protection and Flood Prevention Act of 1954, as amended, (WPFP) provided authorities to USDA for projects beyond the capability of individual landowners that could be sponsored by legal entities under state law. Administrative guidelines, at first, strongly linked project type work to requirements to implement conservation measures on the farms in the watershed. Adherence to the requirements slipped over time, and that fact, coupled with objections to channel modifications, cost the program some support. The WPFP authorities continue to be the best vehicle in USDA for accomplishing watershed-wide conservation, rehabilitation, or restoration projects. The 1980s-1990s emphasis on "land treatment watershed" illustrates the point. Much of the current financial assistance for conservation is to individuals and individual land parcels. WPFP should be revitalized to address conservation problems involving multiple owners where local, legal sponsorship is needed.

Contact Information: Douglas Helms, National Historian, Natural Resources Conservation Service, P.O. Box 2890, Washington, DC 20013-2890 USA, Phone 202-720-3766, Fax: 202-7206473, Email: douglas.helms@wdc.usda.gov

The Corps of Engineers and Ecosystem Services – "We've Identified Them, Now What Do We Do?"

Jim E. Henderson
Environmental Lab, US Army Engineer Research and Development Center, Vicksburg, MS, USA

As part of research to improve characterization of ecosystem restoration results, the Army Corps of Engineers (Corps) has identified the ecosystem services affected by Corps activities and is identifying mechanisms to improve incorporation of ecosystem services into planning, evaluation, and operation of Corps projects. In June 2007 ecosystem services affected by the Corps were identified by a workshop composed of Corps personnel, other agency ecosystem researchers, and National Science Foundation representatives. The ecosystem services identified are:

- Water Supply and Regulation
- Erosion Regulation / Sediment Management
- Water Purification and Waste Treatment
- Natural Hazard Regulation
- Biodiversity Maintenance
- Recreational Opportunities
- Food
- Fiber, Fuel, and Other Raw Materials
- Climate Regulation
- Clean Air
- Science and Education
- Maintenance of Cultural Diversity
- Spiritual and Inspirational
- Aesthetics

The services identified by the panel are representative of the range of the definitions of ecosystem services found in current scientific literature and practice. That is, ecosystem services are variously characterized as (1) strictly components of nature and natural processes (Biodiversity, Clean Air), (2) natural components that fulfill human demands (Erosion Regulation, Natural Hazard Regulation); and (3) anthropogenic functions performed by ecological outputs (Science and Education, Aesthetics).

Evaluation policy for Corps restoration projects focuses on a single output, e.g. habitat units. The current research efforts include investigations of evaluation approaches that would incorporate ecosystem services.

Contact Information: Jim. E. Henderson, Environmental Laboratory, US Army Engineer Research and Development Center, Vicksburg, MS 38180, USA, Phone: 601-634-3305, Email: jim.e.henderson@usace.army.mil

Linking the Present to the Future—Using Environmental Expenditures to Improve Restoration Decisions

Jim E. Henderson
Environmental Laboratory, US Army Engineer Research and Development Center, Vicksburg, MS

Monitoring data (information on performance of operating projects) are available in forms other than the frequently used physical, chemical, and engineering parameters. Expenditure information provides insights useful to formulation and operation decisions for restoration projects. Pulling together expenditure data can be a torturous effort with no apparent connection to any program output or purpose. However, expenditures can actually yield information that identify the following:

- potential restoration opportunities
- context, constraints and technical measurements for restoration objectives
- species and communities for inclusion in projects
- existing commitments of agency resources.

In 2006 the Corps of Engineers (Corps) established a system to track the expenditures for operations, planning, and regulatory activities associated with threatened and endangered species (TES). With four years of spending data, information from the system can be used to identify potential:

- restoration sites with existing commitment of agency resources
- areas or projects potentially affected by increasing TES efforts
- conflicts between restoration objectives and TES commitments

The TES Costs Template was established to automate a statutory reporting requirement of the Endangered Species Act. In 2009 a cost tracking system was deployed for a different purpose. The Invasive Species Costs Template tracks expenditures for invasive species and aquatic plant management efforts. This action was taken in response to a need to understand current spending and to adequately plan for future requirements. Though expenditure information is being developed for different reasons, the invasive species effort will provide the same types of information for restoration projects.

Contact Information: Jim. E. Henderson, Environmental Laboratory, US Army Engineer Research and Development Center, Vicksburg, MS 38180, Phone: 601-634-3305, Email: jim.e.henderson@usace.army.mil

Eelgrass Restoration: Using SCUBA to Restore Eelgrass Beds and Preserve Critical Coastal Habitat

Nathan Henderson[1], *Jenifer Doyle-Breen*[1], *Tom Touchet*[1] and *Richard Clarke*[2]
[1]AECOM Water, Wakefield, MA, USA
[2]City of Gloucester, Gloucester, MA, USA

In 2007, the City of Gloucester implemented a large scale sewer separation project designed to significantly reduce annual combined sewer overflow activations to Gloucester Harbor, MA. Due to the City's coastal setting, alternatives for selecting the location of a 550 foot stormwater outfall pipe were limited as many options involved impacts to coastal habitat including shellfish areas, salt marsh, and eelgrass (*Zostera marina*) beds. The final location was selected in consultation with USEPA and the Massachusetts Division of Marine Fisheries based on environmental, economic, and engineering considerations. The chosen route, however, traversed a 5-acre eelgrass bed and involved dredging approximately 0.5 acre of eelgrass.

The City was required to develop an eelgrass restoration program to return the function and value of the impacted eelgrass. Prior to construction, extensive SCUBA surveys were conducted to verify and map eelgrass boundaries, propose mitigation, and recommend future compliance monitoring. The 2008 restoration program involved techniques that required harvesting over 34,000 eelgrass shoots from donor beds and planting them within the construction corridor. The restored eelgrass area will be monitored annually for three years to assess shoot count, bio-mass, and canopy height. The results will be compared to nearby reference beds to measure the success of transplanted eelgrass. To test the planting methodology, a 16m^2 test plot was planted in 2007 using SCUBA and assessed for shoot survivability and anchoring following a two week and 14 month period. Survivability of transplanted eelgrass shoots was 68% following two weeks and ranged from 0% to 100% after 14 months. These results indicate good short term success and helped to refine the planting techniques that were performed along the entire restoration corridor in 2008.

<u>Contact Information</u>: Nathan Henderson, AECOM Water, Wakefield, MA 01880, Phone: 781-224-6504, Fax: 781-224-5986, Email: nathan.henderson@aecom.com

The South Florida Information Access (SOFIA) System

Heather S. Henkel
U.S. Geological Survey, Florida Integrated Science Center, St. Petersburg, FL

The South Florida Information Access (SOFIA) system was created by the U.S. Geological Survey (USGS) in 1995. Its mission is to provide easy access to information about research projects and products generated as part of USGS Greater Everglades Priority Ecosystems Science (PES) and other Federal, State, and local science providers. SOFIA provides this service by integrating information systems and tools enabling efficient storage, organization, and search and retrieval of scientific information about the south Florida ecosystem. SOFIA was designed to benefit three major user groups: USGS program managers and scientists working with the Greater Everglades PES Program, managers and scientists working for other organizations involved with Everglades restoration, and members of the public interested in USGS research and the science behind the Everglades restoration effort.

SOFIA is an evolving and dynamic system that builds on the ever-increasing sophistication of new information technology. The current architecture consists of four integrated components: website, data, FGDC-compliant metadata, and database. The SOFIA website (**http://sofia.usgs.gov/**) provides links to all of these components including project descriptions, proposals, publications, data (via our Data Exchange website), metadata, presentations, and contact information, as well as items of general interest, such as photographs and posters.

The SOFIA site also hosts the website for the Everglades Depth Estimation Network (EDEN) (http://sofia.usgs.gov/eden). EDEN is an integrated network of real-time water-level monitoring, ground-elevation modeling, and water-surface modeling that provides scientists and managers with current (1999-present), on-line water-depth information for the entire freshwater portion of the Greater Everglades. Presented on a 400-m^2 grid spacing, EDEN offers a consistent and documented dataset that can be used by scientists and managers to: (1) guide large-scale field operations, (2) integrate hydrological and ecological responses, and (3) support biological and ecological assessments that measure ecosystem responses to the implementation of the Comprehensive Everglades Restoration Plan (CERP). The target users are biologists and ecologists examining trophic level responses to hydrodynamic changes in the Everglades.

On the EDEN website, users can download data, documentation, publications, as well as tools that provide access and manipulation of the data produced by EDEN. Please see the EDEN abstract for further information about this project.

Contact Information: Heather S. Henkel, U.S. Geological Survey, Florida Integrated Science Center, 600 4th St. South, St. Petersburg, FL 33701 USA, Phone: 727-803-8747 ext. 3028, Fax: 727-803-2032, Email: hhenkel@usgs.gov

Climate Change: Dealing with Potential Impacts on Ecosystem Restoration

John Henz
HDR Engineering, Inc., Denver, CO, USA

Over the past five years growing concern has surfaced on the potential impacts of climate change on both the planning/design of eco-systems and the adaptation of existing wetlands to climate change. Confusion exists because the basic engineering assumption of “static climatology” used in many early designs and planning has come under attack from the scientific community. Many climatologists have declared that static climatology is “dead”.

The “static climatology” premise was based on the assumption that the range of common climate parameters could be defined successfully by selecting a representative 30-year period of record. The range of natural variability of such common climatological parameters as temperature, precipitation, wind speed/direction and events such as severe weather, drought and floods were included in this assumption. However our knowledge of natural variability of climate parameters has expended significantly since the discussion about man-made or influenced climate changes began in the past decade.

This paper will present a discussion and perspective on the alternatives being considered for “best practice” within the engineering community to deal with potential climate change impacts on the planning, design and adaptation for different types of eco-system developments.

Contact Information: John Henz, C.C.M., Senior Professional Associate, Atmospheric Science Group Leader, HDR Engineering, Inc., 303 East 17th Avenue, Suite 700, Denver, CO 80203, USA, Phone: 303-764-1582, Email: john.henz@hdrinc.com

Urban Habitat Restoration: Restoring Grassland Breeding Bird Habitat at Orland Grassland

Brook Herman and *Frank Veraldi*
Planning Branch, U.S. Army Corps of Engineers, Chicago District, Chicago, IL, USA

The Orland Grassland Preserve in Illinois is over 900-acres and contains a mixture of habitat types including, marsh, grassland, shrubland and forest. Located within the heavily urbanized Cook County, IL, the grassland is affected by the increasing residential and commercial development adjacent to the site as the population of Orland Park, IL, continues to expand. The past use of the site was mainly agricultural and is the origin of three watersheds. Grassland bird species have experienced marked population declines and there is an increased need for viable habitat through restoration and better grassland management. Species that are known to nest on the site include Henslow's sparrow (IL State endangered), Bobolink and Savanna sparrow (both area sensitive species).

For approximately the last forty years management actions on the site have not fully supported grassland species; as a result there has been extensive woody species establishment, invasion of non-native species and low coverage of native conservative plant species. However, a small remnant of prairie vegetation was discovered (e.g., Scurfy pea (*Psoralea tenuiflora*) and Yellowish gentian (*Gentiana flavida*)) and has been diligently managed by a team of dedicated volunteers. Dominant plant species include non-native cool season grasses, Tall goldenrod (*Solidago altissima*) and a variety of aggressive invasive species: Reed canary grass (*Phalaris arundinacea*), Common reed (*Phragmites australis*), Cut-leaved teasel (*Dipsacus laciniatus*), Bird's foot trefoil (*Lotus corniculatus*) and Sweet clover (*Melilotus spp*.). Restoration actions will include hydrologic resurgence (drain tile disablement), woody species removal, invasive species control and reestablishment of native prairie species. Restoration progress will be assessed using the Floristic Quality Assessment (FQA).

Contact Information: Brook Herman, Planning Branch, Chicago District, U.S. Army Corps of Engineers, 111 N Canal, Suite 600, Chicago, IL 60606 USA, Phone: 312-846-5559, Fax: 312-886-2891, Email: brook.d.herman@usace.army.mil

New Software Tools (HEC-EFM and GeoEFM) for Ecosystem Restoration and Management

John T. Hickey[1]*, Andrew B. Hautzinger*[2]*, Patrick B. Shafroth*[3]*, Gregory Peacock*[4] and *Rene A. Vermeeren*[4]

[1]Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, CA, USA
[2]Division of Natural Resources, U.S. Fish and Wildlife Service, Albuquerque, NM, USA
[3]Fort Collins Science Center, U.S. Geological Survey, Fort Collins, CO, USA
[4]Los Angeles District, U.S. Army Corps of Engineers, Los Angeles, CA, USA

The Hydrologic Engineering Center (HEC) of the U.S. Army Corps of Engineers (USACE) has been actively developing new software tools in the ecosystem restoration and management arena. This presentation provides an overview of HEC-EFM (Ecosystem Functions Model), GeoEFM, and an ongoing application of the software to study connections between water management and ecosystems on the Bill Williams River.

EFM is a software tool designed to help planners, biologists, and engineers determine ecosystem responses to changes in the flow regime. EFM analyses involve: 1) statistical analyses of relationships between hydrology, hydraulics, and ecology, 2) hydraulic modeling, and 3) GIS programs to display results and other relevant spatial data.

GeoEFM is the spatial component of EFM. It is programmed as an ArcGIS extension and is being developed through a partnership between HEC and the Environmental Systems Research Institute (ESRI). When complete, GeoEFM will compute and compare habitat areas for different water management policies, provide GIS calculators for querying spatial data sets, and offer a patch tool for looking at habitat connectivity.

The Bill Williams River is an arid lands river in western Arizona, USA. Flows in the Bill Williams are regulated by Alamo Dam, which is operated by USACE. The Bill Williams EFM application focuses on vegetation establishment and removal as influenced by the regulated flow regime, including several experimental releases from the dam. EFM is now available (free of cost) via the web at **http://www.hec.usace.army.mil/**. In its first 4 months online, EFM had around 6,000 visitors and 1,000 downloads.

Contact Information: John T. Hickey, Water Resources Division, Hydrologic Engineering Center, Institute for Water Resources, U. S. Army Corps of Engineers, Davis, CA 95616 USA, Phone: 530-756-1104, Fax: 530-756-8250, Email: john.t.hickey@usace.army.mil

Aquifer Restoration in Arkansas and Louisiana through Science, Monitoring and Partnerships

Patrick J. Higgins[1] and *David A. Freiwald*[2]
[1]Burns & McDonnell Engineering Co., Kansas City, MO
[2]U.S. Geological Survey, Little Rock, AR

Until October 2004, the Sparta aquifer supplied all water for industrial, municipal, and agricultural uses in Union County, Arkansas and surrounding counties and Louisiana parishes. As a result of withdrawals, ground-water levels in the Sparta aquifer declined more than 360 feet in some areas, forming deep cones of depression under the major pumping centers in El Dorado, Arkansas, and Monroe, Louisiana. Previous studies had concluded that the rate of withdrawal in the five southern Arkansas counties exceeded the aquifer recharge rate, resulting in large water-level declines beginning in the 1920's. The counties were declared Arkansas's first Critical Ground Water Area by the Arkansas Natural Resources Commission in 1996. Ground-water flow models developed by the U.S. Geological Survey (USGS) indicated that water levels could be maintained at or above the top of the aquifer by reducing Sparta aquifer withdrawals in Union County by 72 percent compared to 1997 rates. Water quality had degraded in some areas as usage increased.

In January 1999, following two years of intensive county-wide education, consensus- building, data gathering, and defining the exact nature of the problem, Union County stakeholders – private citizens, elected officials, business and industry – united to support legislation authorizing formation of critical ground-water county conservation boards. In June 1999, the state's first such board, the Union County Water Conservation Board (UCWCB) was formed. Building on the education and consensus-building achieved the previous two years, the UCWCB immediately hired an engineering firm to explore solutions.

The resulting $65-million Ouachita River Alternative Water Supply Project provides water from the Ouachita River to Union County's three largest industrial users as an alternative to ground water, reducing withdrawals from the Sparta aquifer by about 7.5 million gallons per day. Combined with previous conservation measures, this project reduces Union County's ground water consumption by about 36 percent.

Additionally, in 2002, the UCWCB in partnership with the USGS, the Union County Conservation District, the Arkansas Natural Resources Commission, Burns & McDonnell Engineering Co., and the citizens of Union County embarked on a 5-year study funded by the Environmental Protection Agency (EPA) to monitor and document changes within the Sparta aquifer in southern Arkansas and northern Louisiana resulting from the project. Historical water levels and benchmark data gathered from the EPA study's monitoring well network has allowed meaningful "before and after" water-level comparisons.

Timely monitoring of water levels and water quality in the aquifer is critical to evaluating the success of this conservation project and determining the need for future actions. USGS provides real-time water-level data (available on its website and through a link on the UCWCB website[*]) and collects two water-quality samples per year (specific conductance and chloride) from selected wells; additional wells are equipped with automated data loggers. The combined monitoring network consists of 28 wells strategically placed in five southern Arkansas counties and three northern Louisiana parishes. Real-time water-level monitoring is conducted using a pressure transducer connected to a digital data logger. Data from USGS real-time wells are retrieved automatically every 6 hours via telephone modem, processed, and placed on the USGS website. Data from automated data logger wells are maintained and posted regularly on the UCWCB web site. The internet based real-time water-level data allow citizens and officials to quickly assess the changing water levels.

Water conservation efforts prior to water supply project completion allowed ground-water levels to rise 2 to 3 feet in less than 2 years in the areas with the greatest water-level declines. During the first 3.5 years (October 2004 – April 2008) since surface water was supplied to industry, water levels have risen in observation wells between 4 and 56.1 feet. Water quality results show no major changes through time with average specific conductance ranging from 216 to 1,157 microsiemens per centimeter at 25 degrees Celsius, and average chloride ranging from 3.2 to 214 milligrams per liter in wells sampled.

*USGS, ar.water.usgs.gov: Union County Water Conservation Board, www.ucwcb.org

Contact Information: Patrick Higgins, Burns & McDonnell, Kansas City, MO 64114, USA, Phone: 816-822-3887, Fax: 816-822-3414, Email: phigg@burnsmcd.com

Meeting Water Quality and Habitat Goals through Multiple Targeted Efforts in an Urban Watershed

Peter Hill
District Department of the Environment (DDOE), Watershed Protection Division, Washington, DC, USA

Located in southeast Washington, DC, Pope Branch is a 1.6-mile first-order tributary of the Anacostia River. The entire stream lies within DC city boundaries. The primary land uses of the 250-acre watershed are parkland and residential lands. Pope Branch is listed on the 303-D List for bacteria, organics, and metals. In order to meet the water quality standards for this impaired waterbody, DDOE has initiated numerous efforts that, when complete, are anticipated to bring the waterbody into attainment. Given that only 100 NPS impaired waterbodies have been taken off of the 303-D list nationwide, this will be a significant achievement.

The largest project is a 1.2 mile stream restoration project in conjunction with a sewer line replacement. Close coordination and cost-sharing among numerous government agencies has been required to negotiate a technically challenging project. Completion of this project is expected to drastically reduce the bacteria fecal counts and substantially reduce sediment loads in the stream.

A second complimentary project is a residential homeowner outreach program that is being piloted in the watershed. This program, called RiverSmart Homes, will provide free or highly subsidized stormwater detention and treatment practices on private lots. DDOE will plant trees and install rain barrels, rain gardens and permeable surfaces in over 75 houses in the watershed to address uncontrolled stormwater entering the stream.

Finally, DDOE has constructed several bioretention basins in the watershed to retain and treat stormwater runoff from city streets. Each project has involved different stakeholders and a different approach in order to gain support for these efforts. The approach of applying multiple projects aimed at different landowners will hopefully result in water quality benefits and habitat improvements.

Contact Information: Peter Hill, District Department of the Environment, 51 N St. NE, 5th Fl., Washington, DC, 20002, USA, Phone: 202-535-2245, Fax: 202-535-1364, Email: Peter.hill@dc.gov

CERP Monitoring and Assessment Plan System Status Reports: The Evolution from 2006 to 2009

Eliza Hines[1], *Gretchen Ehlinger*[2], *Jack Gentile*[3], *Greg Graves*[4], *Matthew Harwell*[5], *Patti Sime*[4] and *Steve Traxler*[5]

[1]Everglades Partners Joint Venture/PBS&J, Jacksonville, FL, USA
[2]U.S. Army Corps of Engineers-Jacksonville District, Jacksonville, FL, USA
[3]Harwell Gentile & Associates, Brewster, MA, USA
[4]South Florida Water Management District, West Palm Beach, FL, USA
[5]U.S Fish and Wildlife Service, Vero Beach, FL, USA

The REstoration, COordination and VERification (RECOVER) Assessment Team (AT) is in the process of compiling the 2009 System Status Report (SSR) using the lessons learned from the 2006 SSR–Pilot Assessment and the 2007 SSR, the first complete assessment report on the status of the Everglades and South Florida related to the implementation of the Comprehensive Everglades Restoration Plan (CERP). Monitoring data generated by the principal investigators in each of the Monitoring and Assessment Plan (MAP) modules is compiled by RECOVER and used to generate the biennial SSR. The SSR plays an important role within the CERP; it is designed to assess and document the overall status of the ecosystem relative to system level hypotheses, performance measures (PMs), and restoration goals. The SSR functions as the interface between the science and communication of the restoration by providing information not only for adaptive management (AM), but for reports to the National Research Council, Interim Goals and Targets (IG/IT) Report, and the CERP Report Card, and constitutes a major component of the RECOVER Technical Report mandated by the Programmatic Regulations. As a result, the role of the MAP and the SSR in the CERP AM program is essential. Results of this and future SSRs, as well as monitoring, are necessary for assessing positive responses to CERP actions and essential for identifying management actions that may be necessary to adjust the CERP to achieve its goal of restoring the Everglades and the South Florida ecosystem.

The focus of the 2006 SSR-Pilot Assessment was to use the assessment strategy detailed in the *MAP, Part 2: 2006 Assessment Strategy for the MAP* to determine whether current sampling designs, data quality objectives, variability, power analyses, and relevant spatial-temporal patterns were sufficient to establish a pre-CERP reference condition and to be able to detect change. The 2006 SSR represented a proof-of-concept for applying the assessment strategy (MAP, Part 2). The 2007 SSR was the first comprehensive technical assessment of monitoring data. Because few CERP projects had been implemented at the time, the 2007 SSR provided estimates of pre-CERP conditions for ecosystem indicators monitored by the MAP, in conjunction with data from other sources. Lessons learned to apply in developing the 2009 SSR include organization of monitoring and assessment data via hypothesis clusters; assessment across geographic module boundaries; the ability to detect and track change; demonstrate links to management actions; and the importance of reaching several different audiences including the public, stakeholders, Congressional staff, upper and middle management and scientists. The 2009 SSR will also aim to better integrate with other ecosystem status reporting efforts in South Florida, including the stoplight communication tools developed for the South Florida Ecosystem Restoration Task Force. While the 2007 SSR was highly technical in nature, the aim of the 2009 SSR is to also “tell the story” in a drill-down-into-the-details format from high-level overview to technical analysis.

Contact Information: Eliza Hines, Everglades Partners Joint Venture/PBS&J, Jacksonville, FL 32207, USA, Phone: 904-232-2011, Fax: 904-232-1056, Email: eliza.b.hines@usace.army.mil

The Evolution of the CERP Monitoring and Assessment Plan –2004 to 2009

Gretchen Ehlinger[1], *Jack Gentile*[2], *Greg Graves*[3], *Matthew Harwell*[4], ***Eliza Hines***[5], *Patti Sime*[3] and *Steve Traxler*[4]

[1]U.S. Army Corps of Engineers-Jacksonville District, Jacksonville, FL, USA
[2]Harwell Gentile & Associates, Brewster, MA, USA
[3]South Florida Water Management District, West Palm Beach, FL, USA
[4]U.S Fish and Wildlife Service, Vero Beach, FL, USA
[5]Everglades Partners Joint Venture/PBS&J, Jacksonville, FL, USA

The Comprehensive Everglades Restoration Plan (CERP) *Monitoring and Assessment Plan (MAP), Part 1*: *Monitoring and Supporting Research* (MAP 2004) was released in January 2004. It fulfilled the responsibility of Restoration Coordination and Verification (RECOVER) to design and implement a monitoring and assessment program capable of evaluating CERP performance and system responses and producing assessment reports describing and interpreting these responses. The release of the MAP was followed by a 2006 assessment protocols and processes document (MAP, Part 2: Assessment Strategy for the MAP) as well as the first assessments of the Everglades and South Florida ecosystem in the 2006 and 2007 RECOVER System Status Reports (SSRs). In 2008, it became evident that the MAP 2004 was in need of revision – the revised MAP (MAP 2008). It utilizes the conceptual ecological model approach and retains its focus on long-term system-wide monitoring and assessment; it also incorporates adaptive management principles as well as flexibility to address CERP project-level monitoring. During the course of this refinement, the composition of the monitoring and research components implemented by the MAP has changed based upon both newly acquired scientific information, as well as changes in project implementation schedules. The goal of MAP 2008 was not only to implement a full complement of monitoring as intended by MAP 2004, but to ensure that sufficient data was collected in order to establish a pre-CERP reference condition, detect change, and drive the AM process given the finite resources of a state-federal cost-shared project. Ultimately, to ensure success of the MAP, it was critical that RECOVER link the results of system-wide/regional monitoring and assessment with decision-making as it relates to Everglades restoration. This poster will highlight the specific changes made from the MAP 2004 to MAP 2008.

Contact Information: Gretchen Ehlinger, U.S. Army Corps of Engineers-Jacksonville District Jacksonville, FL 32207, USA, Phone: 904-232-1682, Fax: 904-232-1888, Email: gretchen.s.ehlinger@usace.army.mil

Lessons Learned from Four Major Ecosystem Restoration Programs

Bill Hinsley
PBS&J, Seattle, WA

This presentation focuses on sharing lessons learned from four major ecosystem restoration initiatives: the C&SF Project Comprehensive Review Study (Everglades), Louisiana Coastal Area Ecosystem Restoration Study (Louisiana), Puget Sound Nearshore Ecosystem Restoration Project (Puget Sound), and Delta Islands & Levees Feasibility Study (Sacramento-San Joaquin Delta). All four studies included leadership from federal (USACE) and non-Federal (State) governments. Furthermore, each study has had to follow the Economic and Environmental Principles for Water and Related Land Resources Implementation Studies and The Economic and Environmental Guidelines for Water and Related Land Resources Implementation Studies. That said, each study has a unique approach to planning. After summarizing some of the more relevant similarities and differences, the presenter will discuss desired results and achieve outcomes of each study.

Contact Information: Bill Hinsley, PBS&J, Seattle, WA 98116 USA, Phone: 504-237-2770, Fax: 305-514-2064. Email: wehinsley@pbsj.com

Restoration of Biological Functions to Conservation Buffers in Intensive Agricultural Regions of the Upper Midwest

William L. Hohman[1]*, Diane M. Debinski*[2]*, Nicole M. Davros*[3] and *Katy Reeder*[4]

[1]Natural Resources Conservation Service, Central National Technology Support Center, Fort Worth, TX, USA
[2]Department of Ecology, Evolution, and Organismal Biology, Iowa State University, Ames, IA, USA
[3]Program in Ecology, Evolution, and Conservation Biology, University of Illinois at Urbana-Champaign, IL, USA
[4]Iowa Department of Natural Resources, Des Moines, IA, USA

Loss and degradation of grasslands and other native habitats have been extensive on the intensively farmed landscapes of the agricultural Midwest. In Iowa and southern Minnesota, for example, losses of native prairies exceed 99%, and remaining habitats are fragmented and often linear in configuration with large amounts of edge. Consequently, many wildlife species, especially those associated with grasslands, have experienced long-term and widespread population declines. Herbaceous or combined herbaceous and woody plantings adjacent to waterways are increasingly evident on the Midwestern landscape. Indeed, active promotion of conservation buffers in the region by the U.S. Department of Agriculture (USDA) under the continuous Conservation Reserve Program resulted in the establishment of over 1.7 million acres or about 470,000 miles of buffers in Midwestern states between 1997 and 2002. Common buffer practices include herbaceous filter strips, riparian forest buffers, grassed waterways, contour buffer strips, field windbreaks, shelterbelts, and living snow fences. Designed primarily to improve water quality and conserve soil resources, individual buffer practices have widely different potential effects on wildlife. To maximize soil and water quality benefits and optimize biological conservation on land enrolled in USDA conservation programs, program managers and planners sought better information on how to design and manage buffers for keystone wildlife species. Here we report on grassland bird and butterfly use of conservation buffers and their responses to buffer width, vegetative characteristics, and landscape features.

Contact Information: William L. Hohman, USDA/NRCS, CNTSC, 501 W. Felix St. Bldg. 23, Fort Worth, TX 76115 USA, Phone: 817-509-3332, Fax: 817-509-3336, Email: william.hohman@ftw.usda.gov

Be Like Janus: the Need for a Two-Faced Perspective on Ecosystem Restoration

W. Gregory Hood[1] and *C. A. "Si" Simenstad*[2]
[1]Skagit River System Cooperative, LaConner, WA, USA
[2]School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA, USA

Janus was the two-faced Roman god who could simultaneously see the past and future. He was the patron of beginnings and endings, transitions, and change in general (and more prosaically the god of doorways, gates, and halls). The myth of Janus can serve to remind restoration ecologists/engineers of the need to be aware of the dynamic past and future of the systems we are working to restore. Too often, ecosystems and landscapes are viewed from a static perspective, when in fact they are dynamic—ever changing. Furthermore, there is a tension between the dynamism of natural systems and the human desire for stasis (complete predictability and safety) in built systems. An ecological and geomorphological perspective on system health recognizes that dyanamism is necessary for sustainability of ecological function and services. In contrast, the traditional planning, engineering, and economic perspective on system health has typically seen such dynamism as a problem to be controlled. Restoration is an attempt to find a balance between the unfettered dynamism typical of natural systems and the stasis of built systems, so that human society can derive necessary benefits from both sustainable natural ecological functions and from high productivity possible in agricultural, industrial, and urban systems. Effective restoration needs to restore ecosystem and landscape dynamics, not merely ecosystem and landscape structure. To do so, one needs to understand the nature and history of a system's dynamics. Looking toward the past is necessary to recover from ecological amnesia or moving baseline effects, to accurately determine reference conditions, to assist in setting restoration goals, to recognize and remedy persistent legacies of historical anthropogenic impacts, and to recognize how landscape- and habitat-forming processes have been altered. Sustainable and long-lasting restoration requires looking forward to the future to anticipate and plan for climate change effects, demographic change and associated landuse change, likely natural or anthropogenic disturbances, and normal landscape- and habitat-forming processes that routinely operate on the system.

Contact Information: W. Gregory Hood, Skagit River System Cooperative, PO Box 368, LaConner, WA 98257, USA, Phone: 360-466-7282, Fax: 360-466-4047, Email: ghood@skagitcoop.org

Monitoring of Natural Resource Damage Assessment (NRDA)–Associated Restorations

Michael J. Hooper[1], *Susan E. Finger*[1], *Aida M. Farag*[2], *Stephen J. Glomb*[3], *Susan C. Kennedy*[4] and *Ralph G. Stahl, Jr.*[5]

[1]USGS Columbia Environmental Research Center, Columbia, MO, USA
[2]USGS Columbia Environmental Research Center, Jackson Hole, WY, USA
[3]US Department of the Interior, Natural Resource Damage Assessment and Restoration Program, Washington, DC, USA
[4]US Department of the Interior, Natural Resource Damage Assessment and Restoration Program, Restoration Support Unit, Denver, CO, USA
[5]DuPont Company, Corporate Remediation Group, Wilmington, DE, USA

Restoration of aquatic and terrestrial ecosystems injured by chemical contamination results in the return of affected areas to their baseline condition, a relevant reference condition, or a successional trajectory toward desired target conditions. The Natural Resource Damage Assessment and Restoration Program within the Department of the Interior seeks to restore natural resources injured as a result of oil spills or hazardous substance releases into the environment. In partnership with other affected State, Tribal, and Federal trustee agencies, damage assessments provide the basis for determining the restoration needs that address the public's loss and use of these resources. Settlements with responsible parties fund projects that restore or replace damaged resources and acquire habitat that supplements or replaces that lost to contamination. Success in meeting the goals and objectives of restoration activities is generally measured by monitoring programs that use performance standards incorporated into restoration plans, focusing on both ecological recovery and elimination of toxicological effects. In addition to simply measuring success, monitoring determines the progress of the restoration and identifies needs for adjustments and modifications necessary to obtain desired habitat characteristics. Recent reviews of restoration projects within and outside of the NRDAR process indicate that in some instances post-restoration monitoring may not be rigorous enough to demonstrate success or to identify needs for adaptive actions. We reviewed a variety of NRDAR-associated restorations to determine the characteristics of post-restoration monitoring programs. Monitoring efforts varied considerably between programs, ranging from simple qualitative evaluation of the site once initial activities had been completed to thorough multi-year programs with substantial data collection and analysis demonstrating multi-level responses to restoration efforts. Some sites prioritized funding nearly entirely to restoration activities leaving scant resources for monitoring. Many programs documented growth and establishment of plant and wildlife species on sites. Fewer evaluated community-level development or resiliency of species to stochastic stressors. In some cases, restoration evaluations were scheduled to occur in tandem with assessments mandated by other regulatory programs or linked with other ongoing monitoring efforts. Strengthening of restoration monitoring efforts will better document project successes, provide data necessary to ensure desired outcomes through implementation of adaptive measures and aid in the design of future restorations.

Contact Information: Michael J. Hooper, USGS Columbia Environmental Research Center, 4200 New Haven Rd., Columbia, MO 65201, USA, Phone:573-441-2985, Fax: 573-876-1896, Email: mhooper@usgs.gov

Watershed Initiatives for Water Quality Improvements, Nubbin Slough Wetland Restoration Project

Michael T. Schwar[2], ***Michael A. Hrzic***[1] and *John Duncan*[1]
[1]HNTB Corp, Milwaukee, WI, USA
[2]South Florida Water Management District, FL, USA

The Lake Okeechobee watershed covers 8,700 square miles collecting runoff from 4 major tributary basins. The watershed has been significantly changed in the past 50 years due to ranching, farming practices and more recently urbanization, and the changed hydrology and nutrient loading have stressed the Lake Okeechobee ecosystem. In 2003 the Lake Okeechobee Watershed Project Plan identified several actions to address the water quality and hydrologic issues in the watershed, including storage, treatment and sediment. Since that time the South Florida Water Management District (SFWMD) has implemented actions presented in that plan in order to improve Lake Okeechobee's water quality characteristics, lake level management and wetland hydrology throughout the watershed. This paper presents one of the projects currently under construction by the SFWMD, Nubbin Slough Wetland Restoration Project (Nubbin Slough).

The SFWMD acquired 300 acres of farm and ranch land in the vicinity of Nubbin Slough and modified the altered drainage network to re-hydrate and enhance existing wetlands, which will lead to a reduction in the amount of phosphorus running into Lake Okeechobee. Work included developing a wetland restoration plan based on local ecology, hydrologic and hydraulic conditions, and geotechnical information. Analysis of these conditions utilized the Watershed Assessment Model (WAM) to establish the local hydrology and phosphorous loading of the project area, and an alternative hydraulic analysis was carried out using XP SWMM to establish structures that would provide wetland areas with hydroperiods that would promote wetland enhancement and sustainability. Recreational opportunities were also incorporated into the design.

The Lake Okeechobee Watershed continues to present challenges as local and federal agencies attempt to improve the ecological integrity of the lake. Five years after the watershed project plan was issued, SFWMD has moved forward with acquiring and rehabilitating historic wetlands to improve storage characteristics and treatment capacity. Nubbin Slough demonstrates the opportunities in land acquisition, the issues present and the benefits that could be achieved as efforts continue on the larger watershed based scale.

Contact Information: Michael A. Hrzic, HNTB Corp, 111 N. Canal St Suite 1250, Chicago, IL 60606 USA, Phone: 312-930-9119, Fax: 312-930-9063, Email: mhrzic@hntb.com

Restoration of Vernal Pools on Urban Fragments in Coastal Southern California

David M. Hubbard[1], *Matthew James*[1] and *K. Kelly Hildner*[2]
[1]Coastal Restoration Consultants, Inc., Santa Barbara, CA, USA
[2]Storke Ranch Homeowner's Association, Goleta, CA, USA

Vernal pools are wetlands that fill with winter rains and dry completely during summer drought. In California and other regions with Mediterranean climates, they support rare plants and animals which are adapted to dramatic seasonal changes in the habitat. Most vernal pool landscapes in coastal California have low-relief topography which has been subject to strong agricultural and development pressures. Most of the vernal pool landscapes in coastal southern California have been destroyed or reduced to fragments surrounded by development. Many of the remaining vernal pool habitats have been degraded by agricultural practices, development, and the introduction of invasive non-native species.

On coastal post-agricultural landscapes in Isla Vista, Goleta and Ojai, California vernal pool restoration efforts have decreased weed cover and increased hydroperiods, native plant cover and diversity, and bird use. Measures for restored pools fall within the ranges found for nearby reference pools.

The approach has focused on restoring natural processes. Restoration of deeper basin topography and more natural hydroperiods achieved by grading basins in areas with clay subsoil and seasonally-perched water tables has produced pools that are similar to reference pools. Extended hydroperiods favor native plants and animals, and tend to reduce weeds in vernal pool settings. Older restoration projects have been nearly self-sustaining in this region.

In addition to the goal of mimicking the performance of individual reference pools, managers of remnant vernal pool landscapes should consider the importance of the functioning of vernal pool complexes (groups of pools) and the predicted consequences of climate change. Large pools may support higher densities and greater diversity of birds, which can connect distant wetlands by transporting seeds and other propagules. To address predicted changes in rainfall patterns, restoration efforts should include a range of basin depths and sizes. To address larger conservation concerns relative to shifting climate zones and the widely-spaced distribution of natural vernal pools, a regional approach to conserving diversity of these wetlands should be considered.

Contact Information: David Hubbard, CRC Inc., 808 California St., Santa Barbara, CA, USA,
Email: david@coastalrestorationconsultants.com

Environmental Restoration on the Upper Mississippi River System – A Look Back and to the Future at Pioneering Programs

Marvin E. Hubbell and *Kenneth Barr*
U.S. Army Corps of Engineers, Rock Island District, Rock Island, IL, USA

The Upper Mississippi River Restoration - Environmental Management Program (EMP) was authorized in 1986 and is recognized as the first major effort to restore the vitality of the Upper Mississippi River System's (UMRS) diverse and significant ecosystem. In filling this role, it became the first major effort in both the nation and the world to address large river restoration and scientific monitoring issues.

To date, the program has completed 50 projects that have improved 83,000 acres of aquatic and floodplain habitat. There are currently 26 additional projects under design or construction, which will result in an additional 45,000 acres of restored habitat. In addition to restoration projects, the EMP has a rigorous research and Long Term Resource Monitoring Program, where data on water quality, fish, vegetation and invertebrates are collected and analyzed, and system-wide data acquisition for land use land cover, bathymetry, and floodplain elevation are analyzed and provided. However, possibly the most important contribution of the EMP has been to pioneer the development of an effective regional partnership comprised of five states, five federal agencies, numerous NGO's, and the public.

In spite of these successes, the amount of restoration accomplished to date represents only approximately 3 percent of the 2.7 million acres of the UMRS bottomland forest, islands, backwaters, side channels and aquatic areas, and wetlands.. In addition, there are still opportunities to expand upon these efforts and the integration of ecosystem restoration with the economic needs of the region – primarily inland navigation.

In order to expand the UMRS capacity for ecosystem restoration and related scientific efforts and to facilitate more direct integration between ecosystem restoration with navigation issues, In 2007, Congress authorized the Upper Mississippi River and Illinois Water Way Improvements: this program's current working title is the Navigation and Ecosystem Sustainability Program (NESP). NESP was designed to build upon the 21 year history of EMP and to expand the restoration capabilities on the UMRS. New opportunities presented by NESP are that the authorized spending limit is 3.5 to 4 times that of EMP, it has a greater emphasis on the use of adaptive management in the evaluation of habitat restoration projects, there is a formal expansion of the regional partnership, and there is direct linkage between ecosystem restoration efforts and expansion of inland navigation opportunities.

These two programs are being managed so that each compliments the other in order to maximize the overall ecosystem restoration potential, the inland water capabilities, and the partnership opportunities of the UMRS.

Contact Information: Marvin E. Hubbell, United States Army Corps of Engineers, Rock Island District, Clock Tower Building, Rock Island, IL 61201 USA, Phone: 309-794-5428, Fax: 309-794-5710, Email: Marvin.E.Hubbell@usace.army.mil

Salmonid and Predator Use of Nearshore Habitat Enhancement Features Throughout the Lower Sacramento River Levee System

Noah P. Hume[1], *Michael L. Dietl*[2], *Glen T. Leverich*[1] and *David Zajanc*[3]
[1]Stillwater Sciences, Berkeley, CA, USA
[2]Environmental Planning Section, U. S. Army Corps of Engineers, Sacramento, CA, USA
[3]Stillwater Sciences, Arcata, CA, USA

In response to regulatory concerns under the Endangered Species Act that revetted streambanks lacking natural habitat features may support lower juvenile salmon densities in comparison to natural bank areas, the U.S. Army Corps of Engineers has included a number of enhancement features into their bank stabilization designs for the Sacramento River Bank Protection Project. The features, which include a seasonally-inundated bench with anchored woody material and a diverse mix of overstory and ground cover plantings, are thought to help moderate water temperatures, support food organisms, and provide low-velocity resting places and/or refuge from predators. In an effort to validate the effectiveness of these habitat enhancements, the Corps contracted a two-year fisheries monitoring study throughout a 60-mile reach of the lower Sacramento River between the Feather River confluence and downstream towards the delta. Using a statistically-focused monitoring design, boat electrofishing was conducted at 16 recently constructed sites and for comparative purposes, at several older sites, as well as natural bank areas with a range of cover attributes. The results generally support a hypothesis of increased salmonid densities at sites with lower depths and velocities, and sites with greater instream wood. Results for predator species (e.g., black bass and Sacramento pikeminnow) support greater densities in low velocity but deeper water areas, revetted versus natural bank areas, and at revetted sites containing relatively low instream wood loading. Overall, the study findings support the continued use of soil-capped shallow water benches but with a higher density of anchored instream woody materials. The results are presently being used to improve designs of future bank stabilization projects, to better inform offsite habitat compensation needs, and to update the Corps' Standard Assessment Methodology (USACE 2004), a river bank and near-shore habitat assessment tool used to evaluate `potential project impacts to federally listed delta smelt (*Hypomesus transpacificus*), Chinook salmon (*Oncorhynchus tshawytscha*), Central Valley steelhead (*O. mykiss*), and green sturgeon (*Acipenser medirostris*).

Contact Information: Noah P. Hume, Stillwater Sciences, 2855 Telegraph Avenue, Berkeley, CA 94705 USA, Phone: 510-848-8098, Fax: 510-848-8398, Email: noah@stillwatersci.com

Evaluating Restoration Success and Applying Adaptive Management in the Middle Rio Grande Bosque

Ondrea Hummel[1] and *Todd Caplan*[2]
[1]U.S. Army Corps of Engineers, Albuquerque District, Albuquerque, New Mexico, USA
[2]Parametrix, Albuquerque, New Mexico, USA

The U.S. Army Corps of Engineers Albuquerque District, in collaboration with various local partners, has been implementing restoration projects in the Albuquerque Reach of the Middle Rio Grande. These projects have included the removal of the metal jetty jacks, debris, and dense thickets of non-native vegetation (salt cedar, Russian olive, and Siberian elm) that occur in the bosque (riparian forest), creation of wet habitats (such as willow swales and high-flow channels), and revegetation schemes focused on increasing the diversity and quality of wildlife habitat. The goal of many of these projects is to develop a framework to restore the bosque into a more functional and sustainable ecosystem. Projects implemented on the ground are being monitored for various restoration success components – such as vegetation response, wildlife use and response, and surface water-ground water interaction. This monitoring has provided important information in regards to planning future restoration efforts that meet all project objectives. Monitoring has also pointed out where improvement is needed and adaptive management can be implemented. This presentation will give an overview of the various projects and monitoring that has taken place and how information gained has been beneficial.

Contact Information: Ondrea Hummel, US Army Corps of Engineers, 4101 Jefferson Plaza NE, Albuquerque, NM 87109, USA, Phone: 505-342-3375, Fax: 505-342-3668, Email: Ondrea.C.Hummel@usace.army.mil

The San Francisco Bay Joint Venture Partnership

Beth Huning and *Sandra Scoggin*
San Francisco Bay Joint Venture, Fairfax, CA, USA

The San Francisco Bay Joint Venture (SFBJV) is one of eighteen Joint Ventures funded under the annual Interior Appropriations Act and established to implement the federal bird conservation plans. The goal of the San Francisco Bay Joint Venture is to protect, restore, increase and enhance 200,000 acres of all types of wetlands, riparian habitat and associated uplands throughout the San Francisco Bay region to benefit birds, fish and other wildlife. The SFBJV brings together public and private agencies, conservation groups, development interests, and others to restore wetlands and wildlife habitat in San Francisco Bay watersheds and along the Pacific coasts of San Mateo, Marin and Sonoma counties.

The SFBJV partnership has been highly successful at setting and achieving its goals through its broad partnership. With a 26 member Manager Board and many additional partners involved in JV technical, outreach and legislative working committees, the partnership has been successful at meeting acreage objectives, leveraging funding, influencing policy, and moving on the ground restoration, enhancement and acquisition projects forward. This session will provide an overview of the San Francisco Bay Joint Venture composition, structure, programs and tools and will highlight some of the large scale projects happening in the region and how participation in the Joint Venture partnership has played a role in these projects.

Topics presented will include: The significance and unique values of the San Francisco Bay; SFBJV goals, projects, challenges and accomplishments; The continental decline in waterfowl and other bird populations that precipitated the creation of joint ventures to review those declines; The federal bird conservation plans and how joint ventures have implemented programs to deliver conservation goals of the plans, with a focus on the *North American Waterfowl Management Plan;* Regional plans that are being implemented through the San Francisco Bay Joint Venture including the *Wetland Habitat Goals Report and* the SFBJV Implementation Strategy*, Restoring the Estuary;* Technology and tools: The SFBJV Project Tracking System- an online tool for tracking and mapping project information; and Wetland Restoration and Projected Impacts from Climate Change – Recommendations for Partners of the SFBJV.

Contact Information: Beth Huning, San Francisco Bay Joint Venture, 735 B Center Blvd., Fairfax, CA 94960 USA, Phone: 415-259-0334, Fax: 415-259-0340, Email: bhuning@sfbayjv.org

Practical Considerations of Implementing a Natural Resources Damages Assessment Restoration Project

Kathleen Hurley, *Lisa Saban* and *Maryann Welsch*
Windward Environmental LLC, Seattle, WA, USA

Natural resources damage assessment (NRDA) is used to measure injury to air, water, lands, plants, or animals by the release of hazardous substances. The purpose of the NRDA assessment is to restore the injured or lost natural resources and to compensate the public for the interim loss of use. An NRDA was conducted in Commencement Bay, Tacoma, Washington, USA to measure losses of natural resources from widespread sediment contamination. Through a restoration-based settlement, a Responsible Party will implement an off-site stream and wetland restoration project to compensate for natural resource damages associated with their industrial property in the bay. We present the project design for this stream and wetland restoration, and the practical considerations of implementing an NRDA restoration project in an urban setting.

Contact Information: Kathleen Hurley, Windward Environmental LLC, 200 W Mercer St, Suite 401, Seattle, WA 98119, USA, Phone: 206-812-5416, Email: kathleenh@windwardenv.com

The Green River Basin Wide Ecosystem Restoration Project; US Army Corps of Engineers- Seattle District

*Noel Gilbrough, **Chemine Jackels**, Scott Pozcarycki, Pat Cagney* and *Nancy Gleason*
United States Army Corps of Engineers, Seattle District, Seattle, WA USA

In 1995 the U.S. Army Corps of Engineers-Seattle District was tasked with developing a basin wide ecosystem restoration plan for the 450 square mile Duwamish-Green River. Involvement includes state, federal and local resource agencies, NGOs, Tribes, 17 Cities, and King County (the study sponsor). This large scale restoration is to be done in a river basin that ranges from high density development and industry in its lower reaches, where it ultimately empties into Elliot Bay in Puget Sound, to being fairly pristine in the upstream reaches that originate in the Cascade Mountains. However, upstream of river mile 65 is currently inaccessible to migrating salmon due to Howard Hanson Dam.

The process leading up to getting the project authorized in WRDA 2000 was challenging, rewarding and well worth the effort. Restoration projects primarily target declining populations of salmonids, but as a whole benefit entire ecosystems processes by creating pockets of “refuge habitat” in the lower watershed and habitat connectivity in the upper watershed for a variety of fish, birds, invertebrates, and mammals. Projects include the restoration of salt marsh habitat in the lower Duwamish (the tidally influenced portion of the Green River), creation of side channel habitat, re-meandering tributaries that are essentially channelized ditches through forested areas, and the creation of a fish passage facility on Howard Hansen dam to open approximately 106 miles of stream habitat to federally threatened salmonids Obtaining funding of individual projects has been a hurdle for the project delivery team, nevertheless a few projects have already been built and others are slated for construction in the next couple of years. Presentation will be given from the perspective of both a project manager and a biologist.

Contact Information: Chemine Jackels, U.S. Army Corps of Engineering, Environmental Resource Section, Seattle WA 98134 USA, Phone 206-764-3646, Email: chemine.r.jackels@usace.army.mil

Understanding Phosphorus Dynamics and Controls to Better Manage the Turbid Minnesota River System

William F. James[1], *Catherine E. Larson*[2] and *David L. Smith*[3]
[1]ERDC Eau Galle Aquatic Ecology Laboratory, Spring Valley, WI USA
[2]Metropolitan Council Environmental Services, St. Paul, MN USA
[3]ERDC Environmental Laboratory, Vicksburg, MS USA

The Minnesota River drains a large watershed that is intensively-managed for agricultural production and conveys turbid, nutrient-rich loads that adversely impact water quality in navigation pools of the Upper Mississippi River (UMR). Nutrient loads are also influenced by point source inputs from wastewater treatment plants servicing several metropolitan areas, including Minneapolis-St. Paul, MN. In an effort to better understand and address current and future conditions, a six-year project was coordinated with federal, state, and local agencies to examine and model nutrient sources, transport, and fate in the lower 40 mile reach of the river. Phosphorus (P) dynamics were regulated by abiotic equilibrium processes during periods of elevated discharge and allochthonous loading, resulting in high soluble P concentrations (0.10 mg/L) and loading to the UMR. Redox-sensitive P forms comprised ~ 43% of particulate P loading during high discharge periods. Recycling of this material via diffusive sediment P flux after deposition represented an important soluble P source to UMR navigation pools. During periods of lower discharge, P loadings were influenced more by wastewater treatment plant contributions versus allochthonous sources. Soluble P declined in the river during these periods in conjunction with increases in chlorophyll, suggesting biotic transformation to particulate P via phytoplankton uptake. The reactive nature and high P recycling potential of suspended sediment loads in the Minnesota River has important consequences for eutrophication of the UMR.

Contact Information: William F. James, ERDC Eau Galle Aquatic Ecology Laboratory, W. 500 Eau Galle Dam Rd., Spring Valley, WI 54767 USA, Phone: 715-778-5896, Fax: 715-778-5897, Email: William.f.james@usace.army.mil

Monitoring on the Upper Mississippi River System: Working Toward Adaptive Management

Barry Johnson
U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI, USA

The U.S. Army Corps of Engineers Environmental Management Program (EMP) on the Upper Mississippi River System began in 1988 as a partnership of federal and state agencies to assess and rehabilitate the System. One third of EMP funding goes to the Long Term Resource Monitoring Program (LTRMP) conducted by the U. S. Geological Survey. The LTRMP collects data annually on water quality, fish, invertebrates (through 2004), and vegetation at six focal areas through state operated field stations. Information on land cover is collected systemically about every 10 years. The data are used primarily for determining trends in ecological indicators and relations among physical, chemical, and biological components of the system. The EMP has suffered from a lack of well defined resource management goals and a poorly defined connection between the LTRMP and habitat rehabilitation projects. However, based on construction experiences from a variety of restoration efforts, the EMP produced a manual for designing and engineering local habitat projects. A new Corps of Engineers program, the Navigation and Ecosystem Sustainability Program (NESP), was authorized in 2007 to expand the EMP based on an adaptive management approach. A panel of river scientists was convened to develop a framework for adaptive management under NESP. The panel suggested that developing management objectives and indicators of success for the system was a critical early step, and such efforts are now underway. The LTRMP will become part of NESP and may be modified based on the indicators that are defined for the program. The application of adaptive management will likely focus on uncertainties associated with major management techniques (which techniques are most effective under different conditions?), the incremental effect of multiple projects of similar design (how much is enough?), and the combined effect of multiple projects (can synergies result from combining different project types?). In addition, an effort is underway to develop institutional arrangements that will support adaptive management within the institutional cultures of partner agencies.

Contact Information: Barry L. Johnson, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI, 54603, Phone: 608-781-6230, Fax: 608-783-6066, Email: bljohnson@usgs.gov

Demonstration of a Physically Based Distributed Watershed Water Quality Model (Gridded Surface Sub-Surface Hydrologic Analysis Model) - Eau Galle Watershed, Wisconsin

Billy E. Johnson[1], *Terry K. Gerald*[1], *William F. James*[1], *Charles W. Downer*[2] and *Aaron R. Byrd*[2]
[1]Environmental Laboratory, Engineer Research and Development Center, Vicksburg, MS, USA
[2]Coastal and Hydraulics Laboratory, Engineer Research and Development Center, Vicksburg, MS, USA

The control of nutrients arising form Non-Point Source Pollution (NPSP) is difficult because the source areas can be hard to identify and typical treatment methods are infeasible due to the distributed nature of the pollutants. While restoration attempts may provide significant returns, they can be costly to implement and often are met with resistance. In order to quantify potential benefits, detailed hydrologic/water quality modeling of watersheds and the effects of BMPs is required. Extending model results beyond the range of calibration to model future conditions requires the use of physically based models that include the important processes that generate stream flow, material transport, uptake, loss, transformation, and recycling. In addition, given the complex nature of surface water and groundwater interaction, as well as the spatial nature of constituent distribution, a distributed source transport model is needed to accurately account for the movement of water and material through the various landscape media where more simplistic models are not applicable, or are homogeneous which is not appropriate for the heterogeneous nature of distributed sources. This paper will briefly discuss the current research effort taking place at the Engineer Research and Development Center (ERDC) as it relates to the development of a physically based distributed watershed water quality model in addition to presenting the demonstration study currently being conducted at the Eau Galle Watershed located in Wisconsin. The goal of the demonstration study is to validate the flow, sediment, and water quality formulations against measured field data. Results from this modeling effort will be presented in addition to future directions for the development of water quality kinetics.

Contact Information: Billy E. Johnson, Environmental Laboratory, Engineer Research and Development Center, 3909 Halls Ferry Road, Vicksburg, MS 39180, USA, Phone: 601-634-3714, Fax: 601-634-3129, Email: Billy.E.Johnson@erdc.usace.army.mil

The Middle Mississippi River Regional Corridor Study – An Example of Collaborative Watershed Planning

Brian L. Johnson
U.S. Army Corps of Engineers, St. Louis District, MO, USA

In 2008, the Corps of Engineers completed a two-year collaborative planning study in the Middle Mississippi River. The objectives of the Middle Mississippi River Regional Corridor (MMRRC) study were to improve regional collaboration and provide the tools and products necessary to improve interagency planning. The framework of the MMRRC study focused on ecosystem restoration, natural resources management, and the interaction between the natural resources community and other communities of practice which impact, or are impacted by, natural resources planning and decision-making.

Based on stakeholder input, the MMRRC study had three major focus areas: 1) development of a science-based tool that would aid agencies in conducting natural resource and ecosystem restoration planning; 2) development and refinement of regional interagency natural resources based goals, objectives, strategies, and targets; and 3) completion of collectively developed "on-the-ground" natural resource needs and opportunities within the region.

Major accomplishments of the study included completion of a science-based ecosystem restoration planning report, development of new Geographic Information Systems (GIS) data layers, completion of a collaboratively developed plan focused on addressing regional issues, and ongoing development of five reach level assessments, designed to identify local natural resource needs and opportunities. All of the reports and tools are intended to guide future regional planning efforts.

The study had a very high level of collaboration, with over 40 agencies and organizations actively participating. The products of the study are already being put to use within the region. The Middle Mississippi River Partnership, which includes 20 regional agencies and organizations, has already used the planning outputs to help focus and prioritize their collective direction over the next 3 to 5 years. The results of this study have shown what can be accomplished when federal dollars are used to lead holistic regional planning efforts. The reports and data layers are posted on the Middle Mississippi River Partnership Website (www.midmiss.org).

Contact Information: Brian L. Johnson, U.S. Army Corps of Engineers, St. Louis District, 1222 Spruce Street, St. Louis, MO, 63103-2833, USA, Phone: 314-331-8146, Fax: 314-331-8806, Email: Brian.L.Johnson@usace.army.mil

Cumulative Effects Evaluation of Ecosystem Restoration in the Columbia River Estuary

Gary Johnson[1], *Heida Diefenderfer*[1], *Ron Thom*[1], *Curtis Roegner*[2], *John Skalski*[3] and *Blaine Ebberts*[4]
[1]Coastal Assessment and Restoration Group, Pacific Northwest National Laboratory, Sequim, WA, USA
[2]Estuarine and Ocean Ecology Program, National Marine Fisheries Service, Hammond, OR, USA
[3]Columbia Basin Research, University of Washington, Seattle, WA, USA
[4]Environmental Resources Branch, Portland District, U.S. Army Corps of Engineers, Portland, OR, USA

The restoration of wetland salmon habitat in the 235-km tidal portion of the Columbia River is anticipated to improve habitat quality through hydrological reconnection of existing and restored habitats. The goal of our research in 2004-2010 is to develop and begin to implement an evaluation of the cumulative effects of multiple habitat restoration actions in the Columbia River estuary (CRE). Because we could find no studies that explicitly attempted to assess cumulative effects of restoration projects on an ecosystem benefitting fish, we developed a “lines of evidence” approach. In this approach, field-collected and modeled data are analyzed additively for net ecosystem improvement; hydrodynamic model outputs and meta-analyses are examined for synergistic effects; and predictive ecological relationships between structure and function are developed relative to hydrology, vegetation, and fish. Synthesis of these three lines of evidence forms the basis for the cumulative effects evaluation. The program requires input from multiple projects and practitioners in the system. Thus, to facilitate comparison of monitoring data across restoration projects, we established a protocols manual for standardized monitoring of physical and biological metrics. Monitored indicators include water depth and temperature, channel geometry, vegetation and elevation surveys, above-ground biomass, fish species composition and abundance. During 2005 through 2009 field studies, baseline and post-restoration data were collected on restoration sites and associated reference sites, including brackish marsh and tidal freshwater swamp habitats that have sustained substantial areal losses due to flood control, hydropower and water withdrawals. Information on the cumulative effects of ecosystem restoration actions will provide the Corps of Engineers Portland District with predictive capabilities to help design the best projects to meet program goals, as well as highlight uncertainties and methods to modify approaches within an adaptive management framework.

Contact Information: Gary E. Johnson, Pacific Northwest National Laboratory, Portland, OR 97204 USA, Phone: 503-417-7567, Fax: 503-417-2175, Email: gary.johnson@pnl.gov

The Role of the U. S. Army Corps of Engineers in Estuarine Restoration: A San Francisco Bay Perspective

Eric Jolliffe, *William Brostoff* and *Fari Tabatabai*
U.S. Army Corps of Engineers, San Francisco District, San Francisco, CA, USA

The San Francisco District of the U.S. Army Corps of Engineers (USACE) is one of several agencies working together to reverse the trend of wetland loss in the Bay Estuary by restoring large areas of former tidal salt marsh. The USACE is the federal lead agency on four large scale estuarine wetlands restoration projects which are at varying stages of completion. Four sample projects in the San Francisco Bay are illustrated as follows.

One of the first large scale restoration projects in the San Francisco Bay, the Sonoma Baylands Project, is a 320-acre estuarine wetlands completed in 1996. Early monitoring results raised concern due to restricted tidal connectivity. Neither the geomorphic development nor the trajectory of vegetation succession was consistent with predictions. However, after ten years, full tidal exchange had established and site evolution for these features developed as expected. Monitoring will continue until quantitative metrics are achieved as they relate to pre-selected success criteria.

The Hamilton Wetlands Restoration Project is approximately 1000 acres of estuarine and seasonal wetlands currently under construction. More than 3.2 million of the authorized 10.6 million cubic yards of dredged material has been placed to date. Lessons learned from the Sonoma Baylands Project have informed the design and implementation of the restoration effort at Hamilton. On-going construction is being fine tuned by a scrupulous adaptive management process. Up to 1,600 acres has been authorized and acquired to be added to the greater

Planning and congressional authorization are complete for the 6,700 acre Napa Salt Ponds Project. This formerly managed salt extraction complex is being restored to tidal wetlands and managed ponds for birds. Portions of the restoration have been completed by our local sponsor, the California Department of Fish and Game. Approximately 3,000 acres to date have been opened to full tidal action. Design for the upper ponds is complete and construction will proceed when funding is obtained.

The South San Francisco Bay Shoreline Study is a multi-purpose ecosystem restoration and flood risk management project in the planning stage. The USACE is working with state and local agencies to restore 8,000-acres of the 31,500 acre salt extraction complex.

Together, these projects could restore nearly 18,000 acres of vital wetlands that fringe the San Francisco Bay.

Contact Information: Eric Jolliffe, Army Corps of Engineers, Environmental Section A, 1455 Market St., San Francisco, CA 94103, USA, Phone: 415 503-6869, Fax: 415-503-6692, Email: eric.f.jolliffe@usace.army.mil

Analysis of Existing Streambank Protection Measures & Development of Design Criteria

Meg Jonas and *Lisa Hubbard*
U.S. Army Corps of Engineers, Vicksburg, MS

The focus of this work area is the development of design criteria for streambank protection measures, including longitudinal peaked stone toe, bendway weirs, and bioengineering techniques. Data is being collected on the performance of constructed projects. Corps work efforts have been leveraged against work performed by the Bureau of Reclamation and the NRCS. The presentation will cover the status of the ongoing work.

Contact Information: Meg Jonas, U.S. Army Corps of Engineers,3909 Halls Ferry Rd., Vicksburg, MS, 39180, Phone: 574-299-0214, Email: margaret.m.jonas@usace.army.mil

Integration of Ecosystem Services into a Decision Support Platform

Mark A. Judson
EIM Sensor Inc, Herndon, VA, USA

Ecological Forecasting tools provide an indication of the future health of ecosystem services deemed most valuable to human wellbeing. The session will demonstrate mapping, modeling, and monitoring techniques that can provide value in defining actions required to maintain services that many urban coastal regions. Remote Sensing are being integrated into decision support platforms for the purpose of landscape characterization and assigning a meaningful valuation of benefits provided by ecosystem services over a short, medium, and long period of time. Decision support platforms of the future will deliver maps and models to render a spatial visualization of the valuation of ecosystem services presented within a given area.

We are currently working with the EPA to develop Urban Planning Land Management decision support tools which combine spatial information, ecological models, and historical and near real-time sensor data with a common framework to qualitatively and quantitatively describe the effects of change and impacts of urbanization, and environmental policies.

Interactive simulation models are in development to hypothesize on alternative futures based on today's land management decision making activities. The goal is to better enable policy-makers to anticipate the ecological and economic outcome and make better decisions. Improvements in the quantity of environmental data will facilitate optimization of the benefits of ecosystem services against manmade development projects.

The insights discovered by utilizing these tools will allow federal, state, and local government policy-makers to determine budget allocation among local and state agencies to best maintain the quality of ecosystem services within a specified region of interest.

Contact Information: Mark Judson, CEO, EIM Sensor, 12801 Worldgate Drive, Suite 500, Herndon, VA 20170, USA, Phone: 703-232-7111, Email: mark.judson@eimsensor.com

Controlling Pathogen and Nutrient Transport in Surface Water Sources with Vegetative Filter Strips

Prasanta K. Kalita[1] and *Mark S. Kuhlenschimidt*[2]
[1]Agricultural & Biological Engineering Department, University of Illinois, Urbana, IL, USA
[2]Mark S. Kuhlenschmidt, Pathobiology Department, University of Illinois, Urbana, IL, USA

Surface water quality near animal production facilities has been a concern for decades. Surface runoff may contain high levels of nutrients, solids, and microorganisms that have the potential to degrade water quality. This issue becomes of great concern when there is a substantial risk for disease transmission by water-borne microorganisms, especially pathogens. Cryptosporidium parvum (C. parvum) is one pathogen that is of particular concern due to its resistant nature in the environment. Laboratory experiments have clearly indicated that vegetative surfaces are very effective in reducing the overall transport of C. parvum in overland, near-surface, and vertical flow. Laboratory experiments showed that for various slope and rainfall conditions, surface runoff from the vegetated surfaces had much lower recovery of the pathogen than that from the bare-ground conditions. Vegetation acts as an effective barrier by enhancing pathogen entrapment within the vegetation, adsorption to soil and plant materials, and infiltration through the soil profile. Soil adsorption experiments indicated that the microorganism strongly adheres to clay particles, and the bond is much stronger than that with sand and silt loam soil particles. Leachates from soil column studies showed very little or no recovery of C. parvum oocysts, indicating that the risk of oocyst transport to shallow groundwater from a vegetative surface is minimum. Watershed scale experiments in four watersheds indicated that concentrations of E. coli, fecal coliforms, fecal streptococci, total nitrogen, total phosphorus, and sediment can be considerably reduced in runoff when it passes through a vegetative filter strip. Increased infiltration of surface runoff within vegetative filter strips was the primary mechanism responsible for reducing solids, flow, and the flow-associated pollutants to the surface water sources.

Contact Information: Prasanta K. Kalita, Department of Agricultural & Biological Engineering, University of Illinois, Urbana, IL 61801, USA, Phone: 217-333-0945, Fax: 217-244-0323, Email: pkalita@illinois.edu

Accumulated Impacts of Multi-Faceted Urban Greening Projects: Is the Whole Greater than the Sum of the Parts?

Hamid Karimi and *Peter Hill*
District Department of the Environment

Urban greening efforts in urban areas take the form of green roof installation, schoolyard habitat sites, low impact development (LID) retrofits, and backyard habitat projects. In the District of Columbia, the goals of these projects vary from stormwater control to educational value to habitat creation. Frequently two or three functions are served even though the funding authority usually originates from the goal of stormwater control and treatment. What is unknown is whether or not wide application of these practices will result in measurable and significant habitat improvements in the urban environment. This presentation showcases what the District has done to date, what is planned for the next two years, and what could potentially be accomplished with sufficient resources.

The District Department of the Environment (DDOE) has several programs that implement these urban greening projects. The Greener Schools, Cleaner water program (to be renamed the RiverSmart Schools program has implemented 31 schoolyard conservation sites since 2002. The RiverSmart homes program is a new program that will offer highly subsidized lot-level stormwater BMPs such as rain gardens, porous pavers, large trees, and rain barrels, all with the purpose of detaining and treating rainwater on home lots. DDOE is also aggressively installing greenroofs through a subsidy program and has installed over 20 LID retrofits since 2003. The backyard habitat program is a new

Given that these projects have numerous benefits, we have mapped the project completed to date, the projects that will be completed in the next two years, and an aggressive full implementation scenario that will show the matrix of these practices in the urban landscape. It is expected that these practices will eventually collectively provide habitat that expands upon the city parks and mature forest stands generally found in stream valleys in the city. Further targeted monitoring of wildlife usage of these habitat patches is planned for the future.

Contact Information: Hamid Karimi, District Department of the Environment, 51 N St. NE, 5th Fl., Washington, DC, 20002, USA, Phone: 202-535-2277, Fax: 202-535-1364, Email: hamid.karim@dc.gov

Two Levels Involvement of Boundary Objects in Complex Ecosystems Management: The Case of the Florida Everglades

Olivier Barreteau[1,2], *Juan-Carlos Vargas Moreno*[1], **Herman Karl**[3] and *Mike Flaxman*[1]
[1]MIT-USGS Science Impact Collaborative, DUSP, MIT, Cambridge, MA, USA
[2]Cemagref, UMR G-EAU, Montpellier, France
[3]MIT-USGS Science Impact Collaborative, USGS, Cambridge, MA, USA

The practitioner committed to the management or the restoration of complex ecosystems faces situations characterized by high uncertainties about influences of contextual as well as internal dynamics, multiple and interdependent stakes, multiple paths of interdependences, and controversies about values in driving management choices. In such situations it is now strongly recommended to involve stakeholders in the decision processes, from problem elicitation to alternative arrangements design, in order to match their needs as good as possible, to reduce uncertainties thanks to the knowledge they can bring in, and to increase their commitment to endorse the collective decisions. Participatory approaches are still much of black boxes, with some good guidance books to ease their implementation, but few opening of their engine.

In this communication, we focus on one specific feature of participatory approaches: the use of specific boundary objects(Star and Griesemer 1989) to facilitate the participatory process. We illustrate with the use of Cognitive Mapping in a project dealing with the restoration of Greater Everglades in the context of climate change.

We consider boundary objects as any abstract or concrete entity which has a meaning in various worlds, such as those centred around each stakeholder, encompassing his/her categories, values and stakes. They find their place in socio-technical networks together with stakeholders. They may serve as an interface between various communities of practice.

We organized collective 2 hours group works with managers and biologists active in the restoration of the Greater Everglades, asking them to diagram the socio-technical networks suitable to design scenarios of evolution for wildlife refuges of the region. The cognitive maps produced are boundary objects, at a strategic level, which support the collective work and provide a joint representation of the refuge system. These cognitive maps make then visible the presence of other boundary objects at the operational level: these are for example endangered species, lands surrounding refuges, water level in a given location. The state of these objects is modified and/or understood by several stakeholders, but not necessary in the same way.

The experience with the Greater Everglades case study has raised the awareness of stakeholders of the existence of possible objects to support a joint management of the ecosystem, in order to cope with the diversity of stakes and values and face jointly the necessary adaptation to climate change.

References:

Star, S. L., and J. R. Griesemer. 1989. Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berleley's Museum of Vertebrate Zoology, 1907-39. *Social Studies of Science* **19**(3):387-420.

Contact Information: H. Karl, MUSIC, USGS / MIT, Cambridge, MA 02139 USA, Phone: 617-324-0262, Fax: 617-253-7402, Email: hkarl@mit.edu

Steelhead Recovery in the San Juan Creek Watershed

George Sutherland[1], *Mary Larson*[2], *Stan Glowacki*[3], *Ted Johnson*[4] and ***Wendy Katagi***[5]
[1]Trout Unlimited, San Clemente, California, USA
[2]California Department of Fish and Game, Los Alamitos, California, USA
[3]National Oceanic Atmospheric Administration, Long Beach, California, USA
[4]CDM, Denver, Colorado, USA
[5]CDM, Los Angeles, California, USA

The San Juan Creek Watershed, located in Orange County, California encompasses approximately 176 square miles, extending from the Pacific Ocean to the Cleveland National Forest in the Santa Ana Mountains and provides critical habitat for the federally-endangered Southern Steelhead Trout (Oncoryhnchus mykiss irideus). The upper portion of the watershed is largely undeveloped and includes Casper's Wilderness Park and a large portion of Cleveland National Forest. In contrast, the lower portion of the watershed is highly developed with a mix of commercial, industrial, and residential land uses. Developed areas within the watershed include portions of the cities of Rancho Santa Margarita, Mission Viejo, Laguna Hills, Aliso Viejo, Laguna Niguel, San Juan Capistrano, and Dana Point, as well as unincorporated portions of Orange County.

San Juan, Trabuco, nearby San Mateo, and San Onofre Creeks all had consistent steelhead runs up until at least the late 1940’s. The decline in steelhead is a result of: Agriculture, mining, urban development, migration barriers such as the Trabuco Creek at Interstate 5 culvert, degraded stream habitat, decreased stream flow, and degraded water quality. Currently, the San Juan Creek estuary is highly impacted by sediment loading without natural flushing to the ocean and cannot sustain plant and macroinvertebrate communities necessary for a functioning and productive ecosystem. Inconsistent water levels, increased water temperatures, invasive exotic plants and animals, and decreased access to spawning habitat led to the placement of Steelhead on the endangered species list in 1997. The discovery of a single wild Steelhead in a small stream in San Diego County in 1999 led to increased efforts to preserve this species. In 2003, a Steelhead was observed in Trabuco Creek between Interstate 5 (I-5) and the Pacific Ocean. Then again in March 2007, a 24-inch salmonid was sighted upstream of the estuary along the north trail side of San Juan Creek. NOAA, CDFG, and Trout Unlimited are dedicated to Steelhead recovery in this and other critical watersheds that provide habitat vital to the survival of this amazing species.

Enhancement of the estuary and upstream reaches of Trabuco Creek may include sediment management, alteration of existing instream structures and installation of new structures to address sedimentation and bank stabilization issues, creation of refugia in the form of pools and backwater areas to address flow velocity and depth problems from channel alteration, and native plantings instream and in riparian areas to restore wetland habitat for native fish and wildlife. Design of upstream restoration projects, including the Metrolink and Interstate-5 fishways will restore fish passage for adult Steelhead migration to spawning grounds.

Contact Information: Wendy Katagi, CDM, 523 W. 6th Street, #400, Los Angeles, CA 90014,
Phone: 213-457-2132, Email: katagiwr@cdm.com

Challenges and Opportunities in Restoration of Retired Agricultural Lands in Fresno County, California

***Patrick Kelly*[1]**, *Brianna Borders*[1], *Nur Ritter*[2], *Ken Lair*[3] and *Stephen Lee*[4]
[1]Endangered Species Recovery Program, Department of Biological Sciences, California State University, Stanislaus, Turlock, CA, USA
[2]The New Hampshire Chapter of The Nature Conservancy, Concord, NH, USA
[3]H.T. Harvey & Associates, Fresno, CA, USA
[4]US Bureau of Reclamation, Fresno CA, USA

Historically, the floor of the San Joaquin Valley in central California supported vast tracts of wetlands and uplands (approx. 3.5 million ha). Following the California Gold Rush (1848 to 1855), conversion of the valley floor to agricultural cultivation got under way, initially along major river courses. Completion of large federal and state water projects through about 1970 quickened the pace of land conversion to result today in more than 90% of the region's upland habitats being converted to agriculture and other uses. However, large expanses of land, especially in the western San Joaquin Valley, are characterized by high salinity, poor drainage, and high concentrations of selenium and boron, making them generally ill-suited for agriculture. In the 1990s, a significant portion of those lands was targeted for retirement from irrigated cultivation (potentially 81,000 ha). Restoration of these retired agricultural lands provides an opportunity to reintroduce numerous plant species that have become locally rare or extirpated, and to concomitantly provide habitat for rare, threatened or endangered animals, and for wildlife in general. Since 1998, we have been conducting a pilot project (on approx. 800 ha) in western Fresno County to better understand the challenges of restoring arid lands that have a long history of intensive irrigated cultivation. Those challenges include low and highly variable annual rainfall (approx. 25 cm) and depauperate native seed banks, but competition from non-native grasses and broadleaf weeds is the most significant challenge to restoration. Implementing large-scale restoration on degraded arid lands in the San Joaquin Valley will likely require a high degree of adaptability to site-specific needs and conditions (e.g., use of integrated weed control strategies, embracing an array of techniques, in re-seeding protocols). Perhaps a long-term restoration strategy with phased implementation—modest first steps—will be the best approach to restoring retired agricultural lands in the San Joaquin Valley. After all, the San Joaquin kit fox (*Vulpes macrotis mutica*), a magnificent little carnivore—listed as threatened by the State of California and endangered by the federal government—that is endemic to but largely extirpated from much of the San Joaquin Valley, is known to persist in degraded and disturbed areas, just as long as they provide a prey base, denning opportunities, and protection from predators.

Contact Information: Patrick Kelly, Department of Biological Sciences, California State University Stanislaus, One University Circle, Turlock, CA 95382, USA, Phone: 559-271-2646, Fax: 209-667-3694,
Email: pkelly@esrp.csustan.edu

Planning for Future Sea Level Rise in the Corps of Engineers

Thomas R. Kendall, *Judy P. Seen* and *Eric F. Jolliffe*
US Army Corps of Engineers, San Francisco District, San Francisco, CA, USA

According to a 2007 Corps of Engineers Climate Change Strategies white paper, “the water resources public works being planned today must be robust and resilient to future extreme events and designed with an added degree of uncertainty in their re-occurrence frequency and/or magnitude due to global warming. The inventory of infrastructure that we manage today must likewise be maintained and, perhaps, upgraded to provide an extra degree of safety, resiliency and reliability to address these uncertainties.”

One of the variables that must be addressed in planning for a resilient restoration project in tidal areas is sea level rise. Sea level rise can impact both the function of a tidal ecosystem restoration project as well as pose an increased risk of tidal flooding to adjacent properties. This presentation will focus on evolving Corps policy and guidance on how to plan for this key climatic variable with examples from two large-scale wetland restoration projects in San Francisco Bay.

Contact Information: Thomas R. Kendall, USACE, 1455 Market St. #1590, San Francisco, CA 94103, USA
Phone: 415-503-6822, Fax: 415-503-6692, Email: Thomas.R.Kendall@usace.army.mil

The Importance of Considering the Effects of Genetics and Climate Change in Riparian Restoration

Karla J. Kennedy[1], *R. Bangert*[2], *S. Ferrier*[1]*L. Hagenauer*[1], *G. Allen*[1] and *T. Whitham*[1]
[1]Department of Biological Sciences, Northern Arizona University, Flagstaff, AZ, USA
[2]Department of Biological Sciences, Idaho State University, USA

Cottonwoods and willows form a dominant plant community on many river corridors in the American Southwest. We have investigated areas of high genetic diversity and found a link between host plant genetic diversity in cottonwood trees and arthropod community diversity and structure (Wimp et al. 2004). This evidence supports the conservation of host plant genetic diversity in restoration. Restoration projects that do not consider the maintenance of genetic diversity may not maximize effectiveness because different plant genotypes support different associated communities and ecosystem processes (Schweitzer et al. 2005, Schuster et al. 2006). Given the predictions for climate change, we must also consider that the common practice of using local plant stock may produce plants that will not be adapted to the climate as temperatures and droughts increase. We have partnered with government agencies (the USDA Bureau of Reclamation, Utah's Department of Natural Resources, the National Wildlife Refuge system) and integrated scientific designs into restoration plantings in Arizona, California, and Utah. The goal of these large-scale common gardens is to help us better understand the relationship between genetic diversity and climate change and community and ecosystem processes while creating functional restoration habitats.

Contact Information: Karla J. Kennedy, Department of Biological Sciences, Northern Arizona University, Box 5640 Flagstaff, AZ 86011, USA, Email: karla.kennedy@nau.edu

Restoring Connections – Fish Passage and Coastal Estuary Enhancement in the Estero de Limantour, Point Reyes National Seashore, CA

Brannon J. Ketcham
National Park Service, Point Reyes National Seashore, Point Reyes Station, CA, USA

Point Reyes National Seashore was established in 1962 to preserve and protect the diminishing coastal resources along the Pacific Coast. The Point Reyes Peninsula was under extreme development pressure after more than a century of agriculture and dairy operations. The lands around Estero de Limantour were subdivided, and infrastructure to support a 1,500 unit development was established. Since establishment of the Seashore, this area has been protected from further development, but the impacts of past development remain.

The centerpiece of coastal Point Reyes is the Drakes Estero Complex, including the Estero de Limantour. A number of small coastal watersheds drain to the 2,000 acre Drakes Estero and its many estuarine arms. The Coastal Watershed Restoration Project targeted multiple culverts and dams within watersheds draining to the Drakes Estero complex that were identified as impediments to natural channel processes. Through the project, the Seashore replaced three culverts with bridges, restored natural channel process to a wilderness watershed, and removed two dams to reconnect the estuarine floodplain complex at the mouth of Muddy Hollow and Laguna Creeks. Design considerations included the development of off-site California red-legged frog habitat as well as enhancement of public access. Restoration planning and design was conducted over a period of five years, with project implementation during 2007 and 2008.

The project approach was to restore natural channel and shoreline processes to these coastal watersheds through the removal or replacement of culverts and dams. Culverts were replaced with bridge structures to accommodate fish passage for federally threatened steelhead using state and federal fish passage design guidelines. Roughened rock ramps and cross-vane structures were installed in the bed of the stream to provide fish passage for all ages of salmonids in the watersheds. These fish passage designs also reduce long-term maintenance requirements and costs and will enhance ecological connectivity for many other species using the stream and riparian corridor.

Two dams were removed from estuarine habitat to restore a more natural estuarine transition zone to these areas expanding the Drakes Estero Complex by more than ten acres. The complexity of removing earthen dam structures within an active estuarine ecosystem necessitated careful planning and dedicated implementation. The combination of restoration efforts in the estuary and at road crossings upstream has restored ecological connections at the watershed scale. The Drakes Estero watershed has the potential to support federally endangered coho salmon, and the efforts of this project have addressed the physical impediments to their return or reintroduction.

Contact Information: Brannon Ketcham, National Park Service, 1 Bear Valley Road, Point Reyes Station, CA 94956, Phone: 415-464-5192, Email:brannon_ketcham@nps.gov

Returning Natural Hydrologic Process through the Giacomini Wetland Restoration, Tomales Bay, CA

Brannon J. Ketcham and *Lorraine Parsons*
National Park Service, Point Reyes National Seashore, Point Reyes Station, CA, USA

The Giacomini Wetland Restoration, completed in October 2008, represents a significant ecological restoration at the southern end of Tomales Bay, a Ramsar Wetland of International Importance. Disconnected in the early 1940s with the expansion of the Giacomini Dairy, the project has removed the dairy infrastructure and levees in order to reintroduce natural hydrologic dynamics to this 550-acre tidal marsh/floodplain complex.

The resilience of the ecosystem is driven by the hydrologic dynamics in the area. The project is located at the confluence of Tomales Bay with Lagunitas Creek and Olema Creek, in a dynamic estuarine transition zone with a tidal range greater than six feet daily.

The Lagunitas/Olema Creek watersheds are documented to support more than 10% of the federal and state endangered coho salmon within the central California coast Evolutionarily Significant Unit. Because of the significant ecological resources, the watersheds and Bay are also listed as water quality limited under Clean Water Act Section 303 (d) for pollutants including sediment, nutrients and pathogens.

Removal of more than three miles of levee and creation of more than one mile of tidal channels has reintroduced tidal and floodplain dynamics which will accommodate a diverse array of aquatic and avian species. The return of the project area from a leveed dairy pasture system to a connected estuarine transition zone has dramatically expanded the potential aquatic nursery habitat for estuarine and anadromous species, as well as reducing delivery of sediment, nutrients, and pathogens to the Bay.

The project approach was to restore natural hydrologic processes through the removal of anthropogenic impediments and creation of a limited tidal network. Daily tidal flooding combined with winter storm flows will continue to shape the landscape and ecosystem in a manner that will support increasingly diverse wildlife resources. As part of the project, the National Park Service has developed an extensive restoration monitoring program.

Through these efforts the NPS anticipates documentation of changes associated with the restoration project, both at the site, and Bay scales. This project complements broader protection and restoration efforts that are ongoing in the 220 square mile Tomales Bay watershed. More than 50% of the watershed is under public management, including two units of the National Park Service. Efforts to protect water quality and enhance aquatic and riparian habitat are under way by multiple agencies and organizations in the watershed. There is a strong community interest in the protection and enhancement of habitat and water quality throughout the watershed. This project sets a strong basis for continued restoration and protection efforts in the future.

Contact Information: Brannon Ketcham, National Park Service, 1 Bear Valley Road, Point Reyes Station, CA 94956, Phone: 415-464-5192, Email:brannon_ketcham@nps.gov

Mitigation of Land Loss in Coastal Louisiana: Restoration, Maintenance, and Monitoring of Degrading Deltafront Barrier Islands

Syed M. Khalil
Louisiana Office of Coastal Protection and Restoration, Baton Rouge, LA

Barrier Island System of the Coastal Louisiana (USA) is a sedimentary barrier that extends from Chandeleur in the east to Raccoon Island in the west over a distance of about 250 kilometers in the northern Gulf of Mexico. These barriers act as critical buffer in protecting bay areas from storm surges, waves, and erosion, and are also unique habitats and the foundation for complex coastal and marine ecosystems. These coastal landscapes provide safety to low lying population centers, infrastructures, domestic oil and gas industrial facilities. The severe and rapid degradation of the barrier islands also impacts the vitality of strategic economic and biological resources (including aquatic habitat). This land loss has also contributed to barrier island rollover (landward migration) and rapid disintegration of the barrier island sedimentary system.

The hurricanes of 2005 (Katrina and Rita) and of 2008 (Gustav and Ike) have clearly demonstrated advantages of robust barrier islands and a well managed coastline in terms of shore line resilience and hurricane damage reduction and has resulted into renewed thinking for immediate steps to restore barrier islands. In order to mitigate this critical situation of barrier island disintegration, a massive restoration effort of beach nourishment on the Gulfside and marsh creation on the bayside has been undertaken. The strategic plan is to stabilize the landward retreat and subsequent disintegration of the barrier islands by adding sand to the system and translating the barriers into various types of modified morpho-sedimentary environments. The science and engineering of rebuilding these barriers is still evolving. It was observed that this mitigative effort will be incomplete without a regional monitoring program associated with a robust maintenance strategy. In this presentation the restoration techniques, maintenance, and monitoring strategies of these unique geomorphic features along with the lesson learned will be presented and discussed.

Contact Information: Syed M. Khalil, Louisiana Coastal Engineering and Science (LACES) Division, Louisiana Office of Coastal Protection and Restoration, P.O. Box 44027, Capital Station, Baton Rouge, LA 70804-4027, Phone: 225-342-1641, Email: Syed.Khalil@la.gov

Large-Scale Ecosystem Restoration Challenges - Greater Everglades Ecosystem Case Study

Anwar Khan, *Lewis Hornung, Eli Brossell* and *Daryl Schneider*
HDR Engineering, Inc., West Palm Beach, FL, USA

The Greater Everglades Ecosystem Restoration initiative is one of the world's largest and most expensive restoration efforts to date. It is being undertaken under two separate but complementary regulatory initiatives, the Comprehensive Everglades Restoration Plan (CERP) and the Northern Everglades and Estuaries Protection Program (NEEPP). CERP is joint initiative between the federal and state government; NEEPP is being implemented by Florida State.

Planning for Everglades restoration has had to deal with many of the challenges faced by other similar large-scale ecosystems across the United States, such as how to combine federal and state interests, tackle problems over a vast and ecologically diverse geographical area, address multiple water bodies with numerous tributaries, deal with multiple problems and simultaneous opportunities, rapid population growth and development issues, and entrenched economic interests.

Scope, magnitude, and cost of the myriad of solutions currently recommended by CERP and NEEPP are enormous. This paper will elaborate upon some of the larger and more complex issues associated with the solutions currently being proposed. These include total project costs that run into billions of dollars, enormous real estate requirements for siting project features, potential for significant adverse impacts to local economies, competing water management needs, prolonged implementation periods, extended timing of benefits accrual, and long-term monitoring. Recommendations for adaptive management and incremental implementation will be presented.

Contact Information: Anwar Khan, Sr. Project Manager, HDR Engineering, Inc., 1400 Centrepark Blvd, Suite 1000, West Palm Beach, FL 33401-7412, USA, Phone: 561-209-6608, Fax: 561-209-6606,
Email: anwar.khan@hdrinc.com

Restoration of Secondary Channels in the Free-flowing Mississippi River

Jack Killgore[1] and *Tom Keevin*[2]
[1]Engineer Research and Development Center, U. S. Army Corps of Engineers, Vicksburg, MS, USA
[2]U. S. Army Corps of Engineers, St. Louis District, St. Louis, MO, USA

Dike fields are constructed in our navigable rivers to increase water depth in the main channel and minimize dredging. A common engineering approach was to construct closure dikes in the secondary channels, thus deflecting more water into the main channel. In the free-flowing Mississippi River, which encompasses a 1,200 mile reach between the mouth of the Missouri River downstream to the Gulf of Mexico, approximately 125 secondary channels or chutes occur most of which have closure dikes in the upper reaches. More recent environmental engineering practices in Corps Districts have recognized that secondary channels can be re-connected without comprising navigation benefits.

The Corps has conducted multiple studies to determine the function and value of secondary channels to justify restoration projects. In the middle Mississippi River (MMR) between the mouths of the Missouri and Ohio, bathymetric surveys were made in all secondary channels to determine period of connectivity relative to river stages. Studies were also conducted to determine different arrangements of dikes to promote sinuosity in the channel and scour sediments. In the lower Mississippi River (LMR) downstream of the mouth of the Ohio River, the Corps has worked collaboratively with the Lower Mississippi River Conservation Committee and states to develop a decision-support model to rank the value of restoring individual secondary channels according to a benefit-cost ratio (B/C).

Using aerial, geo-referenced video (i.e., Red Hen video) and aerial photography from TerraServer, attributes of various side channels (e.g., number of sediment plugs, diversity of habitat types, size, etc.) were determined. These data were used to develop an index to rate the habitat quality of secondary channels during low water. Working with the design branches of Mississippi Valley Division and Districts, the longevity of expected benefits (e.g., years a restored secondary channel will convey flow) and estimated cost of modifying dikes to restore flow through the secondary channel are estimated. From these data, a B/C ratio can be calculated for each secondary channel, and those with the highest B/C ratio can be prioritized for restoration, funding partners can be established, and dike modifications can be implemented to restore flow through the channel. It is anticipated that thousands of acres of isolated, many times dewatered, secondary channels can be re-connected to the mainstem river providing habitat, recreation, and socio-economic benefits. Our findings have illustrated that secondary channels can be restored relatively inexpensively, large aquatic areas can be re-watered at a minimal cost, and most secondary channels are within the Corps' authorized boundaries of the MR&T projects, thus providing justification to assist in these restoration efforts.

Contact Information: Jack Killgore, Engineer Research and Development Center, Environmental Laboratory, 3909 Halls Ferry Road, Vicksburg, MS 39180 USA, Phone: 601-634-3397, Fax: 601-634-2398,
Email: jack.killgore@usace.army.mil

The Utilization of the Mississippi River in the Restoration of Coastal Louisiana

Barbara A. Kleiss[1] and *Sally L. Yost*[2]
[1]USACE, Mississippi Valley Division, Vicksburg, MS, USA
[2]USACE, Engineer Research and Development Center, Vicksburg, MS, USA

During the past 10,000 to 12,000 years, the Mississippi River has occupied several channels in coastal Louisiana, depositing large delta lobes which have developed into the current coastal system of wetlands, barrier islands, coastal ridges and shallow open water. In the recent past, the wetland and fast land portions of this system have been reverting to open water at a significant rate. There are several recognized causes for this land-loss, some man-made, some natural, and the responsibility of the contribution of each of these processes towards the total loss is not likely to be resolved in the near future.

On the average, the Mississippi River carries in excess of 350,000 tons of sediment per day and additional unmeasured bedload. The utilization of this sediment in a project which would imitate the natural geologic process of delta-building in order to offset land loss is a concept that has been discussed for decades. However, unlike during its geologic history, the Mississippi River is now a multi-use system and decisions to use the water and sediment for ecosystem restoration will involve a complex trade-off between the needs of fish and wildlife habitat preservation, navigation, flood control, water supply, water quality, and storm damage reduction.

Efforts are currently underway which seek to clearly articulate the issues associated with large river diversions, to develop a set of tools to compare and assess alternatives, and to establish a path forward that will meet the competing needs of those who are dependent on the lower Mississippi River.

Contact Information: Barbara A. Kleiss, USACE, Mississippi Valley Division, Building 3296, Room 101, 3909 Halls Ferry Road, Vicksburg, MS 39180 USA, Phone: 601-634-4674, Email: Barb.Kleiss@us.army.mil

Fish Assemblages in Off-Channel Areas of the Upper Mississippi and Illinois Rivers: Implications for Restoration

***Brent C. Knights**, Brian S. Ickes, Jeff N. Houser* and *Yao Yin*
U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI

Off-channel areas (OCAs) are central to the productivity and diversity of large floodplain river systems like the Upper Mississippi River System (UMRS). Restoration efforts focus on OCAs because of their ecological and recreational importance and degrading condition. System changes to accommodate navigation and agriculture have altered the physical, biological and biogeochemical regimes of OCAs. These altered regimes are the new ecological template that regulates fish assemblages.

To identify important relations between fish assemblages and environmental characteristics of OCAs, we modeled existing observational data from the Long Term Resource Monitoring Program of the UMRS. Six "major" fish assemblages were identified amongst 35 OCAs. The assemblages in the Upper Mississippi River ranged from those typically associated with highly degraded systems dominated by common carp *Cyprinus carpio* and freshwater drum *Aplodinotus grunniens* to those reflective of a good recreational fishery dominated by centrarchids. The assemblage in OCAs of the Illinois River was dominated by fishes characteristic of turbid systems including common carp, smallmouth buffalo *Ictiobus bubalus*, black and white crappie *Pomoxis nigromaculatus and P. annularis*, white bass *Morone chrysops*, freshwater drum, and gizzard shad *Dorosoma cepedianum*.

The environmental variables that best explained fish assemblages in OCAs included total suspended solids concentration (TSS), total nitrogen concentration, proportion of moderately deep water (≥1 m) and the variation of dissolved oxygen concentration. These four variables explained 58% of the variation in fish assemblage. Of these, TSS explained the most variation (41%) in single-factor models. The TSS is influenced by local- and large-scale factors and can influence fish assemblages through physiological tolerances, food web interactions, and cascading environmental effects.

This research suggests that restoration efforts for fish in degraded OCAs of large floodplain rivers like the UMRS should focus on reducing TSS through floodplain engineering or watershed programs. The potential influence of watershed factors on TSS and nutrients suggests that achieving desirable fish assemblages in degraded OCAs under some ecosystem restoration programs might be difficult because these programs are limited to in-floodplain measures. Further research along related lines are needed including 1) elucidating the composition of TSS in OCAs (e.g., organic versus inorganic), 2) determining the sources of TSS (e.g., in-floodplain versus watershed and autochthonous versus allochthonous), 3) better understanding the relations of variables correlated to TSS including aquatic macrophyte abundance, nutrient concentrations, and water depth, and 4) determining the most effective in-floodplain or watershed measures to reduce TSS.

Contact Information: Brent C. Knights, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603, USA, Phone: 608-781-6332, Email: bknights@usgs.gov

Livestock Pond Restoration and Habitat Management on Private Grazing Lands to Benefit the California Red-Legged Frog and California Tiger Salamander

Jackie Charbonneau[1] and *Pete Van Hoorn*[2] – presented by ***Leslie Koenig***
[1]USDA Natural Resources Conservation Service, Livermore, CA USA
[2]Alameda County Resource Conservation District, Livermore, CA USA

The Natural Resources Conservation Service, Alameda County Resource Conservation District, U.S. Fish and Wildlife Service, and Environmental Defense Fund have created a program to benefit the federally threatened California red-legged frog (*Rana draytonii*) and California tiger salamander (*Ambystoma californiense*). Livestock watering ponds provide the majority of remaining aquatic habitat in Alameda County, CA, but most have exceeded their planned lifespan and will be lost if not repaired. Upland habitat surrounding the ponds is being lost to urban and ranchette sprawl. To support ranchers who want to repair, restore, and manage stock ponds and uplands for habitat, we are offering several incentives: (1) 90% cost share that leverages funds from NRCS, USFWS, and other sources; (2) programmatic environmental permitting; (3) Safe Harbor Agreements; and (4) facilitation of conservation and mitigation easement opportunities. NRCS technical specifications for pond repair were customized to meet the habitat requirements of the two amphibians, with assistance from several species experts. We are developing scientifically rigorous, practical guidelines for grazing management to benefit these species; current guidance can be insufficient or contradictory. The program provides a much-needed model for using Farm Bill funds to assist species recovery and to help ranchers stay on the land.

Contact Information: Jackie Charbonneau, USDA Natural Resources Conservation Service, Livermore, CA 94550 USA, Phone 925-371-0154 ext. 114, Fax: 925-371-0155, Email: jackie.charbonneau@ca.usda.gov

A Decision Aid for United States Army Corps of Engineers Watershed Investments

Shawn B. Komlos[1], *P. Wagner*[1], *M. Sudol*[1], *K. White*[2], *J. Schlagel*[2] and *N. Myers*[3]
[1]US Army Corps of Engineers Institute for Water Resources, Alexandria, VA, USA
[2]US Army Corps of Engineers Cold Regions Research and Engineering Laboratory, Hanover, NH, USA
[3]US Army Corps of Engineers Construction Engineering Research Laboratory, Champaign, IL, USA

The ability of the United States to effectively secure, rehabilitate, and sustainably manage its natural and constructed resources is critical. To do this requires the ability to analyze large quantities of many different types of information, to effectively resolve and communicate findings to and among diverse groups of individuals, and a capacity to identify and take appropriate actions in the absence of complete and perfect data. As economic pressures grow, the quality of our nation's investment decisions becomes increasingly important. We, therefore, have a pressing need for tools to help us understand and communicate the magnitude and nature of challenges facing our natural and constructed strategic resources, their relationships to one another, and their relative significance to the Nation's overall well-being. An interdisciplinary team of personnel from the Corps' Cold Regions Research and Engineering Laboratory (CRREL), Construction and Engineering Research Laboratory (CERL), and Institute for Water Resources (IWR) is building on the Army's existing Sustainable Installations Regional Resource Assessment (SIRRA) tool to develop a GIS-based decision aid that aims to facilitate effective communication of important information; enhance transparency in decision-making; allow tracking of program performance; and enhance workforce and workload planning capabilities

Contact Information: Shawn B. Komlos, United States Army Corps of Engineers Institute For Water Resources, Alexandria, VA 22315-3868 USA, Phone: 703 428-6605, Fax: 703 428-8171,
Email: Shawn.B.Komlos@usace.army.mil

A 25-Year Retrospective on Evolving Restoration Construction Philosophies for the Trinity River, CA

Andreas F. Krause and *Dave Geauman*
Trinity River Restoration Program, Weaverville, CA, USA

Construction projects to facilitate salmon restoration on the Trinity River have changed greatly in form and function since the inception of the Trinity River Restoration Program more than 25 years ago. These changes have been driven by an evolving understanding of the physical and biological workings of the river, within a backdrop of changing legal mandates and organizational structure. Projects in the 1980's focused on building small, static spawning beds, constructed side channels, and mechanically creating "pools" where none existed previously. Over time, the spawning gravels moved out, side channels plugged, and the constructed pools filled in. These projects demonstrated that mechanical alteration alone cannot create sufficient habitat and is unsustainable. Pilot projects in the 1990's combined mechanical alteration (vegetation removal and sloping back banks) with modest flow releases in an effort to have the river build the needed salmon habitat. These pilot projects had some short term success but ultimately proved unsustainable as riparian vegetation re-encroached. In 2000, the Trinity River Restoration Program was restructured with a new focus on encouraging dynamic river processes to restore and maintain adequate salmon habitat. This new approach required revising the operation of Trinity Dam to establish a more natural flood regime, gravel augmentation to replenish the supply lost upstream of the reservoir, and mechanical bank rehabilitation construction to "set the river free."

2004 saw the first bank rehabilitation project to be constructed under the new restoration approach. The design included major earthwork to create low, wide, flat floodplains with riparian re-vegetation on floodplain surfaces, but not near the bank. There was little geomorphic response to subsequent flood events and monitoring showed low initial utilization by salmon. Construction projects in 2005 included large wood placements that were immediately utilized by the salmon. Projects since 2006 have attempted to create greater overall diversity by adding micro-topography and high flow scour channels to floodplain surfaces; including pools, riffles, and large wood placement in constructed side channels; and adding gravel in the form of point bars to encourage bank erosion, increase sinuosity, and transport gravel downstream to create new gravel bars. A new vision is emerging on how to design these various features, both individually and collectively, to integrate their function to best support geomorphic processes, riparian regeneration, and salmon recovery. A companion presentation entitled "Concept to Construction: A River Restoration Program's Lessons Learned" investigates ways to improve the engineering design and construction process.

Contact Information: Andreas F. Krause, Trinity River Restoration Program, U.S. Bureau of Reclamation, P.O. Box 1300, Weaverville, CA. 96093, USA, Phone: 530-623-1807, Email: akrause@usbr.gov

Habitat Equivalency Analysis (HEA) as a Tool to Rank Environmental Project Alternatives

***Paul R. Krause*[1]**, *Leigh A. Hostetter*[2] and *William R. Gala*[3]
[1]ARCADIS, Los Angeles, CA USA
[2]ARCADIS, New York, NY USA
[3]Chevron Energy Technology Company, Richmond, CA USA

Project alternatives for environmental projects are often difficult to compare and rank because each alternative may have different magnitude and types of impacts to multiple habitats over varying time scales (e.g., short-term, long-term). Habitat Equivalency Analysis (HEA) is a methodology developed by the National Oceanic and Atmospheric Administration (NOAA) that can quantify and compare the net environmental effects on affected habitats, including the short-term and long-term effects of project alternatives and compensation measures. It can be used to rank the alternatives according to their relative net environmental impact, which helps project teams and decision executives identify the alternatives with the most favorable (or most adverse) environmental effects.

The use of HEA proved critical to identifying the environmentally superior alternative proposed to regulatory agencies for the disposition of the Chevron 4H Shell Mounds. The 4H Shell Mounds are drill cuttings (and associated drilling fluids) piles, covered by several feet of shell hash, off the coast of California that were left following removal of the 4H platforms. As part of a California Environmental Quality Act process, Chevron was requested to propose a project for the final disposition of the 4H Shell Mounds. Chevron evaluated four project alternatives: leave in place with offsite compensation in the form of enhancement of a nearby salt marsh, enhancing with an artificial reef, capping, and removal by dredging. A HEA was performed that compared the net environmental impacts of the four project alternatives on an important marine biological resource (i.e., fish habitat value). The HEA demonstrated that leaving the mounds in place with enhancement of a nearby salt marsh (i.e., offsite compensation) provides the greatest gain in fish habitat value while averting significant and unavoidable impacts to the local marine environment associated with mounds removal. Besides this demonstrated use of HEA to identify the environmentally superior alternative within an environmental impact assessment (EIA) process, HEA should prove equally valuable for scaling the actions necessary to mitigate environmental impacts.

Contact Information: Paul R. Krause, ARCADIS, Ecosystems Science and Restoration, 6080 Center Drive, Suite 636, Los Angeles, CA 90045, Phone:320.242.6712, Fax:310.242.6601, Email: paul.krause@arcadis-us.com

Potential Solutions to Address Challenges in Implementing Adaptive Management for Ecosystem Restoration Programs and Projects

***Elmar Kurzbach*[1]**, *Jim Vearil*[1], *Matt Harwell*[2], *Agnes McLean*[3], *Steve Traxler*[4], *Patti Sime*[5], *Greg Graves*[5], *Tom St. Clair*[6], *Andrew LoSchiavo*[6] and *Eliza Hines*[6]

[1]U.S. Army Corps of Engineers, Jacksonville District, Jacksonville, FL
[2]Everglades Program Team, A.R.M. Loxahatchee National Wildlife Refuge, Boynton Beach, FL
[3]National Park Service, Everglades National Park, Homestead, FL
[4]U.S. Fish and Wildlife Service, Vero Beach, FL
[5]South Florida Water Management District, Everglades Restoration Resource Area, RECOVER Division
[6]PBS&J – Everglades Partners Joint Venture (EPJV), Jacksonville, FL

Adaptive management is one of the primary management tools used to address uncertainty inherent with large scale ecosystem restoration programs, such as, Comprehensive Everglades Restoration Plan, Glen Canyon, Missouri River Recovery Program, and Platte River Restoration. Each ecosystem restoration program has faced both similar and unique challenges in the set up and implementation of AM to address uncertainties associated with ecosystem restoration. This paper examines the following challenges in the implementation of AM:

1) Authority to implement adaptive management;

2) Science and research program to improve predictive tools and effectively synthesize monitoring and assessment data on key indicators;

3) Governance structure that is able to both incorporate new information, and able to adjust management actions;

4) Agency culture that acknowledges risk and uncertainty by valuing robust projects and learning to improve program implementation;

5) FACA compliant stakeholder engagement and collaboration process that allows interaction between agency and non-agency stakeholders, as well as conflict resolution; and

6) Institutional processes that work with goal achievement timeframes commensurate with ecosystem response (decadal to multi decadal).

Each program has implemented or is proposing solutions to help address these issues that will be compared in an effort to provide a learning opportunity for all ecosystem restoration programs.

Contact Information: Elmar G. Kurzbach, U.S. Army Corps of Engineers, Jacksonville District, 701 San Marco Blvd., Jacksonville Florida, 32207 USA, Phone: 904-232-1591, Email; Elmar.G.Kurzbach@usace.army.mil

Upgrading Animal Waste Management (AWM) System

Harbans Lal[1] and *Chris Gross*[2]
[1]Environmental Engineer, National Water Quality and Quantity Team, NRCS/USA, Portland, OR, USA
[2]Nutrient Management Specialist, National Water Quality and Quantity Team, NRCS/USA, Beltsville, MD, USA

AWM (Animal Waste Management) system is a software tool that estimates waste production of liquids and solids from animal feeding operations and designs storage and treatment facilities using the site-specific waste management flows, weather information and user-specified withdrawal months. The current version of AWM does not allow evaluation of existing structures for their adequacy in storing the waste during the critical period and to account for their capacities in designing new facilities. In addition, several other improvements have been identified by AWM developers and user community to make this tool more adept to its functions. This paper outlines these needs and discusses efforts that are underway in implementing these improvements. The near term goal of the project is to upgrade the AWM (version 2.3) for evaluating existing structures. In the long term, we intend to re-engineer AWM and develop an integrated nutrient management system by combining its capabilities with Manure Management Planner (MMP) – another tool used by the USDA/NRCS field staff and Technical Service Providers (TSPs) for developing Comprehensive Nutrient Management Plans (CNMPs).

Contact Information: Harbans Lal, West National Technology Support Center, USDA/NRCS, 1201 NE Lloyd Blvd # 1000, Portland, OR 97232, USA, Phone: 503-273-2441, Fax: 503-273-2401, Email: Harbans.lal@por.usda.gov

Challenges and Opportunities of Implementing Estuary Restoration Act Projects

Jamie Higgins – presented by ***Vechere Lampley***
South Atlantic Division, USAC, Atlanta, GA, USA

This presentation will examine the challenges and opportunities of implementing Estuary Restoration Act projects within the South Atlantic Division. The Estuary Restoration Act of 2000 was legislated with the purpose of restoring America's estuary habitats and establishing a national estuary restoration strategy. The Corps was given oversight of the program, but unlike other Corps construction projects, Estuary Restoration Act projects are approved by an Estuary Habitat Restoration Council consisting of Federal partners from the Environmental Protection Agency (EPA), National Oceanic and Atmospheric Administration (NOAA), U.S. Fish and Wildlife Service (FWS) and the Departments of Agriculture and Department of the Army. The Council is also responsible for developing and implementing the National Estuary Restoration Strategy. The Corps program has on average only been appropriated $1 million dollars per year and in FY 08 no funds were appropriated to the Corps for this program. These programs are very small and are often under $250,000 for planning, design and implementation. One of the unique aspects of the program is that non-governmental organizations (NGOs) are eligible to apply for these funds. Because of these unique features, the Jacksonville District and the South Atlantic Division has been innovative and creative in implementing and constructing these projects. Despite the small nature of these projects, the projects yield great benefits for the amount of funds expended. For example, Alligator Creek was built at a total project cost of $400,000 and 350 acres of estuary habitat was restored, which is $1142/acre cost. Considering the low cost/acre of implementation and construction, this program has the potential to quickly and relatively inexpensively restore many acres of estuary.

This presentation will examine some of the unique challenges facing the program within the South Atlantic Division as well as exploring possible opportunities for improvements. The presentation will also discuss project specific lessons learned. Additionally, the presentation will address some of the latest WRDA 07 amendments that will impact the program.

Contact Information: Jamie Higgins, Biologist, South Atlantic Division, USACE, Sam Nunn Atlanta Federal Center, 60 Forsyth Street, NW, Atlanta, GA, USA, Phone: 404-562-5223, Email: Jamie.m.higgins@usace.army.mil

Revisions to the Principles and Guidelines – Water Resources Planning for the 21st Century

Doug Lamont and *Mark McKevitt*
Office of the Assistant Secretary of the Army (Civil Works), Washington, DC, USA

Since 1983, the Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G) has provided the framework for the planning and justification for most all Federal water projects. Section 2031 of the Water Resources Development Act (WRDA) of 2007 requires the Secretary of the Army to issue revisions to the P&G for use in planning by the U.S. Army Corps of Engineers in the formulation, evaluation, and implementation of water resources investments. Considerable efforts have been expended since the passage of WRDA 2007 to initiate a review of the current P&G, to develop a revised framework which incorporates the legislative requirements of Section 2031, to collaborate with stakeholders, and to publish a draft version of the revised principles portion of the document as a framework for further discussions.

This presentation will update the current status of the revision process and outline the areas of consensus and controversy in this process. One area of particular difficulty continues to the methods that planners have (or do not have) for comparing the National collective value of ecosystem restoration benefits relative to the cost of restoring or protecting our diminishing supply of natural habits.

Contact Information: Doug Lamont, Office of the Assistant Secretary of the Army (Civil Works), Washington, D.C. 20310-0108, Phone: 202-761-0033 Fax: 202-761-0050, Email: Doug.Lamont@us.army.mil

Beach Nourishment as an Example of Successful Cooperation between Coastal Engineers and Wildlife Biologists

Margaret M. Lamont and *Raymond R. Carthy*
Florida Cooperative Fish and Wildlife Research Unit, University of Florida, Gainesville, FL USA

As erosion rates increase with global climate change so do threats to beachfront homes and businesses. To protect their investments, coastal residents employ many different methods in an attempt to reverse, slow or stop beach erosion, including beach nourishment. However, species that rely on beaches for survival must adjust not only to variations in the natural patterns of erosion and accretion, but also to man-made changes that may completely alter the dynamics of the beach system. Beach nourishment is typically conducted in the winter when turtles are not nesting; however a complex set of circumstances that occurred along the St. Joseph Peninsula, Florida in 2008 required nourishment of this beach during the nesting season. This exceptional circumstance presented a unique challenge to coastal engineers, construction workers, wildlife agency regulators and wildlife biologists to successfully balance human needs with sea turtle conservation.

The relationship between beach characteristics, such as slope, temperature and sand grain size, and successful sea turtle nesting is complex thereby making it impossible to develop a rigid set of rules for engineers to follow to avoid harming turtles. Definitions of success often differed between engineers and wildlife biologists making constant communication critical. Daily morning meetings with the construction crew allowed continuous nourishment activities while weekly meetings with engineers allowed adaptations to the schedule or to procedures to ensure project goals were being met. Engineers were able to change offshore borrow sites if sand temperatures were inappropriate, workplace lighting was altered if turtle disorientation was observed, and beach slope was changed if nest site selection was unnatural. This ability to adapt to daily sea turtle monitoring was extraordinary and enabled the success of this project.

Of the 102 sea turtle nests laid, 28 (28%) were laid in nourished sand including 67% of all endangered green turtle nests. Nests laid on the nourished portions experienced greater hatching success than those laid in non-nourished sand (75% versus 48%), particularly for green turtle nests (79% versus 28%). Beach temperatures throughout the summer were similar (t-test; $p<0.05$) between the non-nourished and nourished portions of the peninsula. This project represented a successful cooperative effort between scientists and engineers. Results of this project may be implemented in other locales when beach nourishment is required during sea turtle nesting season.

Contact Information: Margaret M. Lamont, Florida Cooperative Fish and Wildlife Research Unit, University of Florida, PO Box 110485, Gainesville, FL 32611 USA, Phone: 352-392-1861, Fax: 352-846-0841, Email: mmlamont@mindspring.com

Climate Change Concerns for Everglades Restoration Planning

Glenn B. Landers
Everglades Division, U.S. Army Corps of Engineers, Jacksonville, FL, USA

The Comprehensive Everglades Restoration Plan (CERP) was completed in April 1999 and approved by Congress in WRDA 2000 as the basis for additional detailed design studies and subsequent requests for construction authorizations. CERP goals include restoration of natural hydrologic conditions in the remaining 50% of the historic Everglades while maintaining existing levels of flood protection, water supply and other project services in developed areas. Studies during development of the CERP indicated that a potential 0.5 foot sea level rise by 2050 (the project planning horizon) would not significantly impact project performance.

The rate and magnitude of future climate changes and impacts is uncertain, but recent climate change data indicate global warming trends are accelerating significantly and will continue well beyond 2100. This paper will give an overview of forecast climate change concerns related to Everglades Restoration Planning and identify problems to be addressed by current or future studies. These concerns and potential impacts are relevant to water resources planners and others dealing with natural and developed areas in coastal and inland environments. They include sea level rise, salt water intrusion, increases in average annual air and water temperatures, changes in precipitation and evaporation patterns, increases in tropical storm activity, and other items. Significant climate changes may be coming more rapidly than many people anticipate. Proactive interagency cooperation and planning are required now to help reduce future risks and losses.

Key findings:

- In South Florida, relative sea level rose about 1 foot over the past 100 years.
- Estimates of future sea level rise are uncertain, but the rate of rise is accelerating.
- Natural areas need quick restoration of freshwater flows and proactive regional adaptation.
- Developed areas need to reduce risks of future flooding and water supply well damages.
- FY09 start of CERP sea level rise sensitivity study for various climate change scenarios.

Contact Information: Glenn B. Landers, U.S. Army Corps of Engineers, Everglades Division, 701 San Marco Boulevard, Jacksonville, FL 32207-8175 USA, Phone: 904-232-2125, Email: glenn.b.landers@usace.army.mil

Arkansas River Corridor Restoration Plan, Tulsa, Oklahoma

Everett E. Laney
U.S. Army Corps of Engineers, Tulsa District, Environmental Compliance & Analysis Branch, Tulsa, OK, USA

The construction of Keystone Dam was complete in 1964. The dam has successfully reduced the negative impacts of flooding along the Arkansas River in Tulsa County. However, changes have occurred to the natural flow regime of the river. These changes, in combination with land use changes in the watershed, have altered the river corridor ecosystem. For example, Keystone Lake significantly reduces the amount of sediment that maintains downstream island habitat for the endangered Interior Least Tern. Also, frequent and extreme river fluctuations from hydropower operations have a drying effect on the aquatic habitat.

The impacted geomorphology has resulted in streambank erosion problems at various locations and the destruction of riverine wetlands and oxbow habitats that were once important fish nurseries and feeding and resting areas to migrant waterfowl. The destruction of these habitats has decreased the species diversity and overall productivity of the remaining downstream habitat. Other watershed concerns include pathogens, pesticides, and organics from urban, municipal, commercial, and agriculture runoff that may have affected the water quality.

The cumulative effects of these impacts have adversely affected the native fish populations. Following the construction of Keystone Lake, game fish that are more tolerant of the altered aquatic ecosystem were introduced in an attempt to offset the reduction to the native riverine fishery. The river now has a viable population of striped bass, paddlefish, sand bass, largemouth bass, channel catfish, sauger, and sunfish.

The communities in Tulsa County approved a 0.6-penny, 13-year tax to support Vision 2025 for community enrichment of the Greater Tulsa Area. A portion of the sales tax is devoted to improvements associated with the Arkansas River Corridor. The Greater Tulsa Area communities recognize that the Arkansas River Corridor is an important natural resource that could be developed to stimulate immense private investment and greatly improve the quality of life for current and future generations. They implemented an Arkansas River Corridor Master Plan/Phase 1 Vision Plan that was completed in August 2004. The plan was general in nature and scale, but established a framework in which future planning and design work would be accomplished. The Phase-2 Master Plan and Pre-Reconnaissance Study was finalized in October 2005 under the Corps Planning Assistance to States program for the 42-mile Arkansas River Corridor within Tulsa County. The major objectives of the plan are to recommend potential environmental and economic planning initiatives. To address the potential environmental initiatives a Letter of Agreement was signed by Tulsa County, the Oklahoma Water Resources Board, and the Tulsa District Corps of Engineers for a Ecosystem Restoration Study, in Conjunction with Future Low Water Dam Requirements.

Contact Information: Everett Laney, Corps Of Engineers, 1645 S. 101 E. Ave, Tulsa, OK 74128, USA
Phone: 918-669-7411, Email: everett.laney@usace.army.mil

USACE Invasive Species Policy

Everett E. Laney
U.S. Army Corps of Engineers, Tulsa District, Environmental Compliance & Analysis Branch, Tulsa, OK, USA

It is the policy of the U.S. Army Corps of Engineers, Civil Works (Corps) to apply principles of good environmental stewardship to the natural resources occurring on the Corps administered and /or managed lands and waters, and those lands and waters being impacted or proposed for impact by Federal Civil Works and Regulatory Programs. The Corps has been active in restoring ecosystems by controlling invasive species for over 100 years beginning with legislation in the River and Harbor Act of 1899 which directed the Crops to remove water hyacinth and other obstructions to navigation certain Federal navigation projects. Subsequent amendments to the Act expanded Corps authority to include navigable waters, tributary streams, connecting channels, and other allied waters of the U.S. for the control of invasive aquatic vegetation that constitute a serious threat to navigation, agriculture, public health, the efficient operation of drainage and flood control works, or the use of the nation's waterways.

Many Federal laws, authorities, and programs, as well as international agreements and treaties, have been established as part of efforts to prevent, control, and manage the many different types of invasive species and their impacts. More that 20 Federal agencies now have responsibilities, authorities, and programs that address some aspect of the invasive species issue.

The National Environmental Policy Act (NEPA) requires the consideration of impacts such as the potential spread of invasive species throughout the decision making process. Environmental stewardship includes both passive and active management to sustain healthy ecosystems and biodiversity, and conserve natural resources. The natural resources they support shall be conserved to meet the needs of present and future generations. Invasive species considerations should be addressed in all Corps land and water programs; including but not limited to resource management plans, Regulatory permits, Planning Assistance to States, and O&M manuals for completed Civil Works projects.

Contact Information: Everett Laney, Corps Of Engineers, 1645 S. 101 E. Ave, Tulsa, OK 74128, USA,
Phone: 918-669-7411, Email: everett.laney@usace.army.mil

The Lower Silver Creek Project, San José, California - From an Urban Flood Control Channel to a Naturally Functioning Urban Creek

René Langis[1], *Mark R. Tompkins*[1], *Anthony Falzone*[1] and *Marc Klemencic*[2]
[1]CH2M HILL, Oakland, CA
[2]Santa Clara Valley Water District

Lower Silver Creek, a former agricultural drainage channel, has seen its hydrology progressively altered over the last 60 years by intense urbanization. In the summer of 2002, the Santa Clara Valley Water District started the construction of a 5-mile long flood control channel improvement project with the objective of providing 100-year flood protection while enhancing habitat value through the creation of a functional riparian and wetland system. To meet this objective, efforts were made to enhance in-stream and riparian ecosystem features while integrating principles of fluvial geomorphology into the project design. Design features include: 1) a vegetated multi-stage channel composed of an in-channel floodplain to dissipate high flow energy and facilitate the formation of a base flow channel by natural fluvial processes and, 2) a sediment transport channel sized to mobilize and transport sediment once every one or two years. The downstream reach of the project (approximately 2.5 miles) was completed in stages from November 2003 to November 2005. This presentation will present results of five years of monitoring riparian, wetlands and geomorphological features as well as address the major benefits, constraints, and limitations of integrating fluvial geomorphology concepts with urban stream flood control efforts.

Contact Information: René Langis, CH2M HILL, 155 Grand Avenue, Suite 1000, Oakland CA 94612, Phone: 510-587-7774, Fax: 510-622-9274, Email: Rene.Langis@ch2m.com

Picayune Strand Restoration Project – Partnering to Achieve Success

Janet Starnes[1], ***Victoria Lehr***[2] and *Norm Prima*[2]
[1]South Florida Water Management District, Fort Myers, FL, USA
[2]Parsons, Pasadena, CA, USA

The Picayune Strand Restoration Project (PSRP) was included as part of the Comprehensive Everglades Restoration Plan (CERP) which was authorized by the Water Resources Development Act (WRDA) of 2000. The project will restore 55,000 acres of environmentally sensitive lands located in southwestern Collier County, Florida to its pre-development condition, generating positive effects on the hydrology, vegetation and wildlife of the project area and the surrounding public lands. Formerly known as the Southern Golden Gate Estates, the project area was planned as a residential subdivision in the 1950s and roads and drainage canals were constructed in the 1960s and early 1970s. The planned residential development failed and the roads and four large canals have over-drained the area resulting in a reduction of aquifer recharge, increased freshwater shock load discharges to estuaries to the south, invasion by upland vegetation, loss of ecological connectivity and associated habitat, and increased frequency of forest fires.

The PSRP involves the construction of three high volume, low head pumping stations, spreader berms, a tie back levee and canal plugs. To help promote the return of sheet flow across the site, existing roadways and utilities will be dismantled, with culverts added to roads which need to remain in service. When complete, the central location of this project will reconnect and benefit the adjacent nature preserves and wildlife areas which include the Florida Panther National Wildlife Refuge, Fakahatchee Strand State Preserve, 10,000 Islands National Wildlife Refuge and Collier Seminole State Park.

A team led by the South Florida Water Management District and the United States Army Corp of Engineers guided a diverse group of hydrologists, ecologists, engineers, agency and tribal representatives and other stakeholders in an evaluation of over twenty different alternatives. Their task was to determine which alternative would best meet the restoration goals while maintaining the existing drainage and level of flood protection of the adjacent private lands in the most cost effective way. The alternative described above was recommended and the record of decision for the Integrated Final Impact Statement of the Picayune Strand Restoration recommended plan was signed on April 13, 2007, and the final implementation report was transmitted to Congress for authorization. The PSRP was authorized under WRDA 2007.

Implementation of the project has begun and is anticipated to be completed by 2013. The success of this project and the continued movement forward is due to a true partnership between the federal government, the local sponsor, impacted stakeholders and the scientific and engineering community.

Contact Information: Victoria H. Lehr, P.E., Parsons, 1555 Palm Beach Lakes Blvd., Ste 1105, West Palm Beach, FL 33401, USA, Phone: 561-656-6373, Fax: 561-688-6915, Email: victoria.lehr@parsons.com

Structured Decision Making Rapid Prototyping Application to Biological Opinion Activities on the Missouri River

Craig Fleming[1] and ***Jane Ledwin***[2]
[1]US Corps of Engineers, Integrated Science Program, Yankton, SD, USA
[2]US Fish & Wildlife Service, Ecological Services, Columbia, MO, USA

To improve our effectiveness in implementing the Missouri River Biological opinion (BO) the US Corps of Engineers and the US Fish & Wildlife Service explored the use of Rapid Prototyping in a Structured Decision-Making framework as we continue to build an adaptive management (AM) program for our Missouri River Recovery. We chose two components of the BO: the Shallow Water and Emergent Sandbar Habitat programs as case studies in real-world application of this emerging tool for resource management. The process included multi-agency teams of biologists and managers working over several weeks to draft initial SDM structures for each program that relate to the much broader river-level AM program. Results to-date have included focused objectives, system and species models helpful to the decision making process, and consequences of specific scenarios/alternatives. This process has also resulted in a broader understanding of the complexity of the decision support needed to evaluate our management actions, and apply that information to better management of the river We found rapid prototyping and the SDM process helped us articulate both the decisions and alternatives under consideration, as well as provide a consistent method of measuring results. These are valuable tools in the natural resource management arena to ensure focused progress towards goals and objectives.

Contact Information: Craig Fleming, US Corps of Engineers, PO Box 710 Yankton, SD 57078, USA, Phone: 402-667-2880 MF and 605-384-4152 TWTH, Email: Craig.A.Fleming@usace.army.mil

Jane Ledwin, US Fish & Wildlife Service, 101 Park Deville Drive, Columbia, MO 65203, USA, Phone 573-234-2132, x109, Email: jane_ledwin@fws.gov

Application of Finite Volume Coastal Ocean Model to the Coast of Southeast Louisiana

C. Li[1], *C. Chen*[2], *H. Lin*[2], *D. Braud*[1], *E. Weeks*[2] and *R. Twilley*[1]
[1]Department of Oceanography and Coastal Sciences, Louisiana State University, Baton Rouge, LA, USA
[2]School of Marine Science and Technology, University of Massachusetts - Dartmouth, USA

The Coast 2050 Plan of the Louisiana State government includes pulsed river diversions as a restoration action designed to nourish the wetland with freshwater, sediments, and nutrients. This would act to restore the habitat role of the wetlands, and contribute to land building or at least prevent further land loss. The optimal objective would be to “Rebuild the wetlands with river diversion that optimally allocate sediments, minimally impact native flora and fauna, and positively affect water quality” (Louisiana Sea Grant Priority Strategy 1.1.2). How can we assess the effect of river diversion both in short term and long term? An objective method is to use a validated numerical model. However, not all models are created equal. The southeastern Louisiana coast is a deteriorating deltaic system in which land is disappearing, coastlines are very complex, and weather plays a major role in affecting water quality and inundation of wetlands. Thus, a realistic hydrodynamic model needs to be able to resolve complex geometry, inundation, and salinity changes with high-resolution. The Finite Volume Coastal Ocean Model (FVCOM) is well-suited to such situations. We have applied the FVCOM model to the areas covering the southeast Louisiana including the Caernarvon Diversion and Breton Sound. This is a powerful tool that can be used for research, teaching, and eventually decision making. Our multiple simulations with various scenarios (calm weather, strong wind, dry season, wet season, higher sea level, lower sea level, etc., mimicking the effect of climate change induced sea level change) showed the great promise of this model as a management tool.

Contact Information: Chunyan, Li, Louisiana State University, 331 Howe-Russell, CSI, Baton Rouge, LA 70803, USA, Phone: 225-578-3619, Email: cli@lsu.edu

Passive Treatment and Adaptive Management: Approaching an Endpoint for Ecosystem Restoration and Watershed Protection at the Buck Mine Discharge Site

Jeffrey S. Binkley and ***Daniel Liebau***
Weston Solutions, Inc., Houghton, MI, USA

The integration of scientific and engineering principles into an adaptive management approach have resulted in the successful reestablishment of a damaged local ecosystem and the long term sustainable protection of the watershed. The Buck Mine Discharge Site was a complex of interconnected former iron mines that operated for nearly 60 years. The Site includes a wetland with adjacent ponds and is bordered on the east by approximately 20 acres of waste rock and on the west by the Iron River. The Iron River, a blue-ribbon brook trout stream, is part of the Iron River Watershed, and by way of the Brule and Menominee Rivers, discharges into Lake Michigan 38 miles downstream.

The percolation of water through the waste rock at the Site results in the creation of a weak sulfuric acid that leaches metals and other contaminants from the waste rock. The untreated concentrations of these contaminants in the ponds have been acutely toxic to aquatic organisms and have resulted in the deposition of yellowish-brown hydroxide precipitate on the river bottom. Hydroxide precipitate has an adverse impact on aquatic insects, fish respiration, reproduction and habitat, and negatively impacts aesthetics.

The in-place passive remedial system at the Site diverts the percolating water emanating from the waste rock pile through a series of interconnected ponds and a natural wetland. The passive remedial system that operated for nearly two decades, began experiencing failures, including plugging, flooding, and short-circuiting due to the reduction of freeboard from the accumulation of precipitate within the ponds. The frequency and extent of these failures were becoming increasingly difficult to manage and were resulting in undesirable conditions for both the local riverine ecosystem and the Iron River Watershed.

Based on regulatory standards for water quality, the desired goals for the failing system were established. Achieving this endpoint included scientific complexities and design considerations that were necessary to ensure that the river and wetland habitats were preserved and/or improved. Regular monitoring of the treatment system made the project well suited for a passive adaptive management approach. With the rehabilitation of the treatment system modeled; scientists collected data to support the anticipated management actions including the performance surveys, the collection analytical samples, and the performance of bench scale testing. The recorded data was interpreted and incorporated into a design and specifications that resulted in the rehabilitation of the passive treatment system as well as the preservation and restoration of the local ecosystem. Post-construction monitoring activities performed at the Site provide biological, chemical, and toxicological data that measure the ecological response within the local ecosystem and the success of the restoration activities. Further, interpretation of the analytical data continues the iterative process for predicting anticipated management actions.

Contact Information: Daniel Liebau, Weston Solutions, Inc., 600 East Lakeshore Drive, Suite 200, Houghton, MI 49931 USA, Phone: 906-482-7207, Fax: 906-482-7745, Email: daniel.liebau@westonsolutions.com

From Ridgetop to Reef: Tapping the Potential of the U.S Farm Bill

Andrew Lipsky
USDA Natural Resources Conservation Service, Warwick, RI, USA

The U.S Department of Agriculture, Natural Resources Conservation Service (NRCS) works in cooperation with private landowners, tribal governments, state agencies, and non-government organization, and land managers to address local and regional resource concerns by providing technical and financial assistance throughout the watersheds and coasts of the United States. NRCS assists landowners to implement on the ground conservation practices or best management practices throughout our nation's watersheds to address a multitude of watershed resource concerns, such as soil erosion, nutrient management, biodiversity, and air quality. These watershed conservation efforts have resulted in significant benefits both locally and downstream. Additionally, NRCS and our partnerships have dovetailed watershed efforts with directed conservation in a variety of coastal and estuarine habitats throughout the Atlantic, Pacific, and Gulf Coast regions. Both *On the ground* and *in water* conservation is made possible through the significant resources that Farm Bill programs make available to our nation's landowners.

With the recent passage of the Food, Conservation and Energy Act of 2008 (The Farm Bill), whose conservation title authorizes $54 billion over the next decade, historic opportunities and new tools are now available to continue these efforts in one of our nation's single greatest conservation investments. Opportunities provided by a combination of NRCS Programs, Special Initiatives, Joint Ventures, and Partnership collaboration to apply conservation from ridgetop to reef ecosystems will be highlighted. Farm Bill program funded projects and initiatives that have resulted in estuary and coastal restoration will be presented in this session with a focus on how to increase their application along our nation's coastal watersheds.

Contact Information: Andrew Lipsky, State Biologist, USDA Natural Resources Conservation Service, Suite 46 60 Quaker Lane, Warwick, RI 02886, USA, Phone: 401-822-8842, Fax: 401-828-0433,
Email: andrew.lipsky@ri.usda.gov

CERP AM Program Implementation

Elmar Kurzbach[1], Jim Vearil[1], Matt Harwell[2], Agnes McLean[3], Steve Traxler[4], Patti Sime[5], Greg Graves[5], Tom St. Clair[6], ***Andrew LoSchiavo[6]*** and *Eliza Hines[6]*
[1]U.S. Army Corps of Engineers, Jacksonville District, Jacksonville, FL
[2]Everglades Program Team, A.R.M. Loxahatchee National Wildlife Refuge, Boynton Beach, FL
[3]National Park Service, Everglades National Park, Homestead, FL
[4]U.S. Fish and Wildlife Service, Vero Beach, FL
[5]South Florida Water Management District, Everglades Restoration Resource Area, RECOVER Division
[6]PBS&J – Everglades Partners Joint Venture (EPJV), Jacksonville, FL

The Comprehensive Everglades Restoration Plan (CERP or Plan) provides a framework to restore, protect and preserve the water resources of central and southern Florida, including the Everglades. Congress authorized the use of an adaptive management (AM) approach for CERP (*Water Resource Development Act [WRDA], 2000*) to allow the Plan to proceed in the face of complexity and incomplete scientific data (uncertainties). AM has been applied to small-scale projects in numerous ecosystem restoration programs across the country and in large-scale forestry and fishery management programs. However, a comprehensive AM program in support of a system-wide ecosystem restoration program at the size and scale of CERP has never before been attempted. This presentation details the status of the CERP AM Program development and implementation.

Though many components of the CERP AM Program have been developed since CERP was authorized in 2000 (*e.g.*, creation of a monitoring and assessment plan as well as performance measures, conceptual ecological modeling, development of interim goals and targets etc.), the specific documents describing the AM Program have only recently been developed. These include the CERP AM Strategy and the CERP AM Implementation Guidance Manual. The CERP AM Strategy provides a framework for integrating AM into:

1. Implementation of AM at both project-level and system-wide scales;
2. Measuring and assessing natural and human system responses to Plan implementation;
3. Identification of potential solutions to performance issues with the Plan; and
4. Decision-making for Plan improvement.

The CERP AM Implementation Guidance Manual provides the details on how to implement AM within the six-step planning process utilized by the U.S. Army Corps of Engineers (Corps); this process governs the planning and implementation of CERP projects. The CERP AM Implementation Guidance Manual provides details about AM application for CERP, specifically step-by-step guidance on:

1. How to facilitate stakeholder engagement and collaboration;
2. Determination of when it is appropriate to apply AM (project-level);
3. How AM can be applied at both the project-level and system-wide scales via specific activities;
4. Identification of legal and policy issues to consider;

5. Development of criteria for determining successful implementation of AM; and
6. Presentation of case studies on Corps ecosystem restoration projects that apply AM.

Implementation of the CERP AM Implementation Guidance Manual will help ensure CERP restoration efforts meet the system-wide goals and objectives for the South Florida ecosystem and increase the chance for restoration success.

The AM Strategy was finalized in 2006. The CERP AM Implementation Guidance Manual is currently under development (both project-level and system-wide AM guidance) and a draft was released for comment in September 2008. Several key AM policy issues were identified that need to be addressed in the final revised version:

1. Should a more simplistic process for implementing CERP AM be used or should a more detailed process be used?;
2. What types of uncertainties should be addressed by the CERP AM program?;
3. What are the differences between program and project-level AM, and what triggers AM for each level?;
4. What are the roles and responsibilities for each CERP agency staff, team, manager, and agency in implementing AM?; and
5. What level of stakeholder involvement should there be in CERP AM implementation?

Key messages relevant to larger-scale ecosystem restoration include:

- There is currently limited guidance available on how to implement AM for large-scale ecosystem restoration programs. The CERP AM Implementation Guidance Manual represent one of the first attempts to provide this type of detail.
- Adaptive management is a management approach that must be integrated into all phases of implementation (project-level and program-wide) and should not just be simply viewed as a tool for restoration.

Contact Information: Andrew LoSchiavo, 701 San Marco Blvd., Suite #1201, Jacksonville, FL 32207, Phone: 904-232-1256, Email: andrew.j.loschiavo@usace.army.mil

Rip-rap or Realignment? Wetland Restoration and Sea-Level Rise Adaptation Strategies

Jeremy Lowe and *Philip Williams*
PWA Ltd, San Francisco, CA, USA

State and federal agencies and NGOs have invested substantial resources over the past two decades for acquisition and restoration of intertidal habitat around the margins of California's estuaries. Much of this investment is now threatened by enhanced erosion and inundation due to future sea-level rise. Local governments are also increasingly concerned about the potential increase in tidal flood damages due to accelerated erosion of fronting marshes and levees.

The traditional response has been to armor our shorelines and raise flood levees to resist shoreline change; but this may conflict with natural resource management goals and also decrease the ability of the natural and restored intertidal wetlands to migrate inland with sea-level rise. Alternatively, we can develop adaptation strategies, such as managed realignment, that work with the natural processes of shoreline transgression to gain both flood protection and ecological benefits.

Developing multi-objective adaptation strategies requires an understanding of how estuarine morphology is responding to changes in both sediment dynamics and sea-level rise. Long-term projections of morphologic change can be translated into predictions of mudflat and marsh response under different management scenarios. Through monitoring of natural and restored marshes over the last 30 years, we are in a position to address some of the management questions that local communities need to consider, such as:

- How will shorelines evolve with rising sea-levels?

- Are there benefits to maintaining or increasing the width of fronting marsh and mudflat?

- What are the benefits of restoring wetlands behind outboard levees?

- What are the benefits of realigning outboard levees to gain more marsh?

- How can we accommodate rising sea-levels in areas where space is limited by development?

We discuss adaptation strategies to rising sea-level in different estuarine environments that are sediment rich and sediment limited. We use examples along the Pacific coast, from Arcata to Southern California, to illustrate how sea-level rise has been incorporated into wetland restoration design to benefit both natural resources and flood protection.

Contact Information: Jeremy Lowe, PWA Ltd, 550 Kearny Street, Suite 900, San Francisco, CA 94108 USA, Phone: 415-262-2304, Fax: 415-262-2303, Email: j.lowe@pwa-ltd.com

USDA's Approach to Ecosystem Services and Environmental Markets

Carl F. Lucero
Natural Resources Conservation Service, Beltsville, MD, USA

Market based approaches are an innovative way to stretch resources and take conservation beyond the boundaries of the farm, ranch and forest, while preserving productivity, maintaining and enhancing landowner livelihoods, and producing environmental benefits. Market based solutions provide flexibility to undertake actions that have the lowest cost and result in more cost-effective achievement of natural resource conservation and environmental goals compared to traditional command and control approaches.

The efficient operation of a market is based on an understanding of credits, trading, and banking as well as the interaction of society and our natural resources. Effective markets require consistent, well-defined, and quantifiable environmental goods and services. Currently, there are many challenges facing the expansion of market based solutions but none more important than the need for consistency. Uniform standards and metrics, uniform definitions, and credible models and verification protocols are all necessary for environmental markets to succeed.

To address these challenges, USDA will use the new authority provided in the 2008 Farm Bill to establish technical guidelines and science-based methods to measure the environmental services benefits from conservation and land management activities in support of emerging environmental services markets.

USDA is embarking on a new initiative that involves looking at markets and the philosophy behind their success. It will use the principles of the marketplace to leverage Federal funds and services with private funds to address nonpoint source problems and achieve enhanced environmental outcomes.

This presentation will describe USDA's policy for an organized approach to enable markets to expand. It will describe USDA's procedure to leverage expertise and ensure consistency across the federal government. It will discuss the establishment of a government-wide Environmental Services Board charged with developing guidelines and methods for quantifying the air quality, water quality, greenhouse gases, wetlands and endangered species benefits of conservation and land management practices. The presentation will also detail the tools and reference materials USDA has developed to enhance an efficient operation of markets for environmental improvement.

Contact Information: Carl Lucero, USDA Natural Resources Conservation Service, 5601 Sunnyside Avenue, Beltsville, MD 20705, Phone: 301-504-2222, Email: carl.lucero@wdc.usda.gov

Using a Return on Investment Approach to Prioritize Habitat Restoration in a Southern California Landscape

Kerrie A. Wilson[2], *Marissa F. McBride*[3], *Jutta Burger*[1], ***Megan Lulow***[1], *Yi-Chin Fang*[1], *Caitlen Anderson*[1], *David Olson*[1], *Hugh Possingham*[2] and *Michael O'Connell*[1]

[1]Irvine Ranch Conservancy, Irvine, CA, USA

[2]The Ecology Centre, School of Integrative Biology, University of Queensland, St Lucia, Australia

[3]School of Botany, University of Melbourne, Victoria, Australia

Ecological restoration is expensive, involves both short and long term goals, and requires complex decision-making involving multiple variables, such as when and where to restore, which methodologies to apply, and how much money to invest. When prioritizing restoration sites on a landscape scale, a weighted scoring system can be used, yet it provides only a static evaluation of priorities and does not explicitly guide investment of resources over time. Using a decision-theoretic framework, we develop a spatially and temporally explicit prioritization model that accounts for: 1) cost of restoration, 2) likelihood of success, 3) probability of a catastrophic fire event, and 4) benefit in terms of area restored, spatial connectivity, and relative contribution of a site toward ecological resilience on a landscape scale. Using a dynamic simulation approach we determine a 50-year near-optimal schedule for restoration investment. We explore the sensitivity of our results to uncertainties in key parameters and compare restoration schedules under alternative benefit functions to demonstrate trade-offs associated with different objectives and assumptions. Our prioritization model demonstrates time and resource efficiency to managers, and provides a transparent and adaptable decision-making process. Managers must decide what ecosystem benefits they value and explicitly identify costs, uncertainties, and constraints. The resulting Return on Investment framework can be adapted temporally to changing conditions and be applied to any protected landscape.

Contact Information: Megan Lulow, Irvine Ranch Conservancy, 4727 Portola Parkway, Irvine, CA 92602 USA, Phone: 714-508-4766, Fax: 714-508-4786, Email: mlulow@irconservancy.org

Restoring Physical and Ecological Processes in an Agricultural Setting

Kevin MacKay
ICF Jones & Stokes, San Jose, CA, USA

Historic changes in land use and management in the Napa River Watershed have resulted in confinement of the river into a narrow channel, loss of riparian and wetland habitats, accelerated channel incision and bank erosion, and reduction in the quality and quantity of instream habitat for salmonids and other native fish. Because of this ongoing degradation, properties along the 4.5-mile Rutherford Reach of the Napa River have been subject to bank instability and failure leading to the loss of valuable vineyard land, and costly repairs. Additionally, streambank erosion has been identified in Total Maximum Daily Load (TMDL) Program developed by the San Francisco Bay Regional Water Quality Control Board for the Napa River watershed as a significant source of fine sediments. Over the past 5 years, the Rutherford Dust Society has been working collaboratively with neighbors, and local, state, and federal agencies to develop a landowner-initiated plan to address these issues. This presentation will provide an overview of the Rutherford collaborative planning and design process, and will describe major features of the project including: setting back and rebuilding existing earthen berms to create vegetated buffers between the river and adjacent land use; using biotechnical techniques to stabilize actively eroding streambanks and reduce inputs of fine sediments; and excavating inset floodplain benches and installing large woody debris structures to enhance riparian and aquatic habitats.

Contact Information: Kevin MacKay, ICF Jones & Stokes, 2841 Junction Ave., Suite 114, San Jose, CA 94134 USA, Phone: 408/434-2244 x2206, Fax: 408/434-2240, Email: kmackay@jsanet.com

Ecological Revitalization: Turning Contaminated Properties in Community Assets

Michele Mahoney
US Environmental Protection Agency, Office of Superfund Remediation & Technology Innovation, Washington, DC

Ecological revitalization refers to the process of returning land from a contaminated state to one that supports a functioning and sustainable habitat. Although the final decision on how a property is reused is inherently a local decision that often rests with the property owner, the U.S. Environmental Protection Agency (EPA) actively supports and encourages ecological revitalization, when appropriate, during and after the assessment and cleanup of contaminated properties under its cleanup programs. Ecological revitalization of contaminated properties is consistent with EPA's mission to protect human health and the environment, and it is an integral component of EPA's cleanup programs. Under its cleanup programs, EPA ensures that (1) ecological revitalization does not compromise the protectiveness of the cleanup and (2) the best interests of stakeholders are considered. EPA's cleanup programs have established initiatives that support ecological revitalization and provide a variety of tools, information resources, and technical assistance. Collaboration and coordination with stakeholders is important for promoting ecological revitalization across EPA's programs.

EPA recently released a cross-cleanup program paper on this subject. This document (1) provides an overview of EPA's cleanup programs and resources available to support ecological revitalization; (2) addresses technical considerations to help property managers and other stakeholders carry out ecological revitalization at contaminated properties; and (3) presents general planning and process considerations for ecological revitalization of wetlands, streams, and terrestrial ecosystems as well as successful long-term stewardship. Appendix A at the end of the document presents additional case studies on ecological revitalization at various sites. You can find this paper at **www.cluin.org/ecotools** under Resources.

Contact Information: Michele Mahoney, Environmental Scientist, US EPA, 1200 Pennsylvania Ave. NW MC 5203P, Washington, DC 20460, Phone: 703-603-9057, Email: Mahoney.michele@epa.gov

Wilson Bay Aquatic Ecosystem Restoration Section 206 Project

Glenn Hargett[1], *Stacy Samuelson*[2] and ***Christopher R. Matthews***[3]
[1]City of Jacksonville, Jacksonville, NC, USA
[2]U.S. Army Corps of Engineers, Wilmington District, Wilmington, NC, USA
[3]HDR Engineering, Inc., Charlotte, NC, USA

Wilson Bay is a 106-acre shallow estuarine embayment in the New River Watershed adjacent to the City of Jacksonville in Onslow County, North Carolina. Until recently, the Wilson Bay ecosystem has been degraded by many years of urban effects including wastewater plant discharges and urban runoff. In 1997, the City of Jacksonville held a series of Community Summits resulting in a program to restore Wilson Bay, known as the Wilson Bay Water Quality Initiative. As such, an ecosystem engineering approach was undertaken by the City that involved local staff and schools, Universities, the Wilmington District US Army Corps of Engineers and several environmental and engineering consultants.

The Project study was conducted under authority of Section 206 of the Water Resources Development Act of 1996, as amended. A comprehensive, holistic aquatic ecosystem restoration approach was emphasized. Combining restoration techniques provided a comprehensive plan to foster a healthy, self-sustaining ecosystem. Alleviating the problems, in combination with treating the effects was preferred, as improving the conditions throughout the Project area would reduce the stressors on the aquatic ecosystem. Measures which did not promote a self-sustaining, more natural aquatic ecosystem were eliminated.

The Project goals include 8,254 linear feet of stream and/or channel improvements, 11.8 acres of wetland and riparian habitat improvements in the Bay watershed, and 6.5 acres of SAV and bivalve establishment within the Bay. The recommended plan includes measures to address source water pollution, increase freshwater and brackish habitat, restore floodplains and reduce flooding in the urban environment, and improve aquatic and benthic habitat in Wilson Bay. The final array of alternatives comprises 28 components, including 6 floating aeration units, 10 storm water BMP areas, 10 stream, floodplain, and wetland restoration or enhancement areas, 5 submerged aquatic vegetation (SAV) restoration locations, 2 bivalve bed restoration locations. Evaluation of the environmental benefits, trade-offs, and costs involved with each component yielded a recommended plan. In addition, several components were determined to be higher risk, such as the SAV establishment, but were included in the recommended plan due to the significant environmental benefits associated with these risks.

Public involvement has been significant in the development of the Project. Individual property owner consensus was a significant constraint to implementation of the aquatic ecosystem restoration plan. An intensive public outreach was conducted to explain actual planned impacts to each property owner and to facilitate acquisition of agreements for continued plan implementation. The Project will compliment the ongoing downtown redevelopment of the City and the Sturgeon City educational and research center being constructed at the WWTP site.

Contact Information: Christopher R. Matthews, HDR Engineering, Inc., 128 S, Tryon St., Suite 1400, Charlotte, NC 28202 USA, Phone:704-338-6778, Fax: 704-338-6760, Email: chris.matthews@hdrinc.com

The Necessity for Legal Certainty in the Face of Adaptive Management's Scientific Uncertainty

Michael S. Mayer[1] and *David Jacob*[2]
[1]The Louis Berger Group, Inc., Kansas City, MO, USA
[2]The Natural Resource Program Center, National Park Service, Lakewood, CO, USA

The term "Adaptive Management" has often been invoked to allow resource managers flexibility in managing. Frequently, adaptive management has been used for either trial by error management or when managers have wanted to manage free from public review and scrutiny. These types of approaches however, have not had favorable results when challenged in court. While courts have recognized the challenges resource managers have when attempting to manage dynamic resources in the realm of scientific uncertainty, several federal laws require a level of legal certainty when assessing the impacts of specific actions. Currently, adaptive management is seeing a resurgence and is quickly becoming an integral part of the way federal agencies intend to manage resources in the future. In 2007, the Department of the Interior released its Adaptive Management Technical Guide, defining the term and providing a clear process for building adaptive management processes into natural resource management. A critical component of this process is navigating through the spectrum of laws, which if not complied with will result in even the best decision being overturned. The Endangered Species Act (ESA) is just such a law; one that requires legal certainty. This paper examines two case studies related to the same federal action where one adaptive management strategy was found to be legally deficient under the ESA and the other adequate. The paper then proposes ways to ensure that an adaptive management framework meets the legal certainty required by law while allowing for the scientific uncertainty that lies at the heart of adaptive management.

Contact Information: Michael Mayer, The Louis Berger Group, Inc., 3700 Broadway, Suite 300, Kansas City, MO 64111 USA, Phone: 816-785-2345, Fax: 816-561-9222, Email: mmayer@louisberger.com

Restoring Urban Intertidal Salmonid Habitat, West Alderbrook Lagoon, OR

Kerrie A. McArthur and *Katherine L. Wolff*
AMEC-Geomatrix Inc., Lynnwood, WA, USA

The U.S. Coast Guard (USCG) constructed a seawall at Tongue Point on the Lower Columbia River near Astoria, Oregon. In accordance with US Army Corps of Engineers regulations, the USCG mitigated the filling of 0.79 acre of shallow-water habitat required for the sea wall construction by reconnecting 3.95 acres of habitat to the Columbia River.

The restoration site was a functional palustrine emergent and scrub-shrub wetland surrounded by a fringe of deciduous forest. A dike with a footpath effectively created a physical and hydrological barrier, isolating the site and rendering its wetland habitat inaccessible to migrating juvenile salmonids.

The design proposal included the following actions: 1) Excavating approximately 35 feet of the existing footpath dike; 2) Bridging the breach in the dike with a suspended pedestrian footbridge to maintain connectivity of the footpath; and 3) Excavating the areas on both sides of the breach to provide access for anadromous salmonids to the wetlands beyond the footpath dike.

Following successful construction and implementation of the mitigation plan, the restored intertidal wetlands in West Alderbrook Lagoon now provide multiple benefits, including enhanced salmonid habitat and water quality improvement in the project vicinity.

Contact Information: Kerrie A. McArthur, AMEC-Geomatrix, Lynnwood, WA, 98037, USA, Phone: 425-921-4026, Fax: 425-921-4040, Email: kerrie.mcarthur@amec.com

Katherine L. Wolff, AMEC-Geomatrix, Lynnwood, WA, 98037, USA, Phone: 425-921-4026, Fax: 425-921-4040, Email: katie.wolff@amec.com

Urban Floodplain Restoration for Fish Habitat Enhancement, Kent, Washington

Kerrie A. McArthur and *Katherine L. Wolff*
AMEC-Geomatrix Inc., Lynnwood, WA, USA

AMEC Geomatrix, Inc. is supporting the City of Kent in the design of an 8-acre floodplain and habitat restoration site in the urban lowlands of Puget Sound along the Green River in Kent, Washington. The objective is to design a side channel to increase access to floodplain habitat for Chinook and other salmonids, and to restore natural floodplain functions. Additional phases of the restoration project will include invasive plant removal, native riparian re-vegetation, and installation of woody debris structures. This site – a former apple orchard in a rapidly developing area – presents numerous logistical challenges. AMEC must accordingly develop a site design that fits within the constraints of encroaching development and adjacent highway 167.

AMEC has completed a feasibility study to evaluate conceptual design alternatives, and will assist the City through the design process. The feasibility assessment included a habitat survey, stream bank and floodplain surveys, and preliminary conceptual design analysis. Because this site formerly contained an orchard, the feasibility assessment also included a soil condition survey, including analysis of insecticides and herbicides. Additionally AMEC conducted a hydrologic assessment to simulate conceptual design alternatives and to compare the increase in habitat functions and values from implementing the various restoration designs.

Following the evaluation, AMEC developed a new design alternative that would double the area of restored instream habitat and improve ecosystem functions while substantially reducing the construction costs of restoration. We are currently working with the City of Kent to secure funding for final design and project construction.

Contact Information: Kerrie A. McArthur, AMEC-Geomatrix, Lynnwood, WA, 98037, USA, Phone: 425-921-4026, Fax: 425-921-4040, Email: kerrie.mcarthur@amec.com,

Katherine L. Wolff, AMEC-Geomatrix, Lynnwood, WA, 98037, USA, Phone: 425-921-4026, Fax: 425-921-4040, Email: katie.wolff@amec.com

River Corridor Design Considerations to Facilitate Salmon Reintroduction to the San Joaquin River

Scott McBain
McBain & Trush, Inc., Arcata, CA, USA

The 2006 Settlement Agreement between the Friant Water Users Authority and the Natural Resources Defense Council seeks to restore naturally producing and self-sustaining populations of Chinook salmon and other fish, as well as reduce or avoid adverse water supply impacts to Friant Division water contractors. Historic land and water management has caused dramatic alterations to flood flows, floodway width, and channel morphology. The historic spring snowmelt runoff typically inundated vast tule marshes and riparian vegetation along the axis of the San Joaquin Valley; presently, the channel is severely degraded, and in some locations, cannot convey any flow.

One of the key engineering and scientific challenges will be to rehabilitate portions of the San Joaquin River channel to convey a range of flows, allow adult and juvenile fish migration, restore riparian vegetation and wildlife habitat, and rehabilitate fish habitat. Research has shown that fry and juvenile salmon rearing on inundated floodplains have higher growth rates, size, and fitness than those rearing on simple confined channels, which increases survival rates as the salmon smolt and transition from the river environment to the ocean environment. Channel rehabilitation designs should consider a variety of scientific and engineering aspects, including: inundation depth, timing, duration, and frequency of designed surfaces; flood management; earthworks, access, construction logistics (cost); maintenance risks and obligations; and other factors. Integration of these scientific and engineering factors will improve our chances of restoring salmon populations to the San Joaquin River.

Contact Information: Scott McBain, McBain & Trush, Inc., 980 7th Street, Arcata, CA 95521, USA, Phone: 707-826-7794 ext 11, Fax: 707-826-7795, Email: scott@mcbaintrush.com

Fragmentation and Loss of Pocket Estuary Habitat in the Whidbey Basin of Puget Sound: Implications for Restoration Planning and Prioritization

Aundrea McBride, *Eric Beamer* and *W. Gregory Hood*
Skagit River System Cooperative, LaConner, WA, USA

We describe historical changes in pocket estuary abundance and distribution within Whidbey Basin, a sub-basin of Puget Sound, and discuss the implications of this change for juvenile Chinook salmon coastal migration. Pocket estuaries are small-scale estuaries that form behind coastal accretion landforms with freshwater inflows from groundwater or small creeks. ESA-listed juvenile Chinook salmon use pocket estuaries as predation refuges and feeding sites during their migration from larger natal streams and deltas to the ocean. We identified 113 historical and current pocket estuaries within the Whidbey Basin using a synthesis of nearshore geomorphic indicators. Field reconnaissance, geologic and topographic map data, historical maps, and remote sensing by current and historic air photo interpretation were used to verify identified pocket estuaries. To date we have evaluated and verified 75% of the 113 predicted pocket estuaries. Where the model predicts a pocket estuary, it has been 100% accurate for sites verified thus far. Only one missed pocket estuary has been identified during field verification. Of our validated sample (85 of the 113 predicted pocket estuaries), 58 historical pocket estuaries (68%) no longer exist, while the remaining 27 sites have been partially modified by dredging, filling, shoreline hardening, and diking with concomitant habitat loss. Historically, the mapped pocket estuaries ranged from 0.6 hectares to 186 hectares of intertidal and subtidal habitat, with a median size of 9.7 hectares. Currently the remaining pocket estuaries range from 0 to 93.5 hectares, with a median size of 4.5 hectares. Historically the area of pocket estuaries near the Skagit River delta amounted to 340.7 hectares. Today they amount to only 47.5 hectares, an 86% loss. The complete loss of many individual pocket estuaries within the Whidbey Basin has also further fragmented these habitats, decreasing the opportunity for juvenile salmon and other fish to find pocket estuaries during their nearshore migrations. The number of pocket estuaries within 9.5 km of the Skagit and Stillaguamish River mouths (the two largest salmon-bearing rivers in the basin) has declined by 50% and 77%, respectively. Likewise the average distance between pocket estuaries has increased 70% from 2.2km historically to 3.7 km today. This habitat loss and fragmentation has likely had significant impacts on juvenile salmon migration success and on other nearshore fish using these habitats.

Contact Information: Aundrea McBride, Skagit River System Cooperative, PO Box 368, LaConner, WA 98257, USA, Phone: 360-466-4691, Fax: 360-466-4047, Email: amcbride@skagitcoop.org

Restoring Urban Salt Marshes–10 Years of Lessons Learned

Peg McBrien[1], *Donald Stevens*[1], *Ann Reed*[1] and *Richard Mogensen*[2]
[1]The Louis Berger Group, Inc., Morristown, NJ, USA
[2]EarthMark Mitigation Services, LLC, Concord, NC USA

On behalf of The Meadowlands Conservation Trust, EarthMark Mitigation Services, LLC has teamed with The Louis Berger Group Inc., Geo-Con, Inc. and The Dawson Corporation to restore the 250-acre Kane Natural Area from a degraded, tidally restricted *Phragmites australis* (common reed) monoculture to a functioning and diverse marsh. The Kane Tract is located in the New Jersey Meadowlands which are one of the most intensely urbanized tidal marsh areas in the country. The site was historically cut off from tidal influence of the Hackensack River by the creation of multiple berms adjacent to the river, the installation of multiple tide gates, and the construction of a human- made mosquito ditch network throughout the site. The design will restore tidal hydrology to the majority of the site to support a thriving tidal marsh habitat and will also restore freshwater forested wetland habitat and hydrology to a portion of the site.

This team is the exact team of wetland designers, construction contractors and landscape contractors that developed Phases 1 and 2 of the Marsh Resources, Inc. (MRI) Meadowlands Mitigation Bank, which is a contiguous 206-acre tidal marsh located immediately adjacent to the Kane Tract, separated only by the New Jersey Turnpike.

Design work began on Phase 1 of the MRI Mitigation Bank in 1998 and the team developed many innovative methods to implement a design/build program in 1999 for the first wetland bank approved by the U.S. Army Corps of Engineers – New York District. Over time, we learned that some of the methods were sound while others were not. These methods were further refined with the technical studies, design, construction, monitoring and maintenance of Phase 2 leading to the successful sale of all bank credits by 2006.

With adaptive management still occurring on each of these phases, including spot treatment of herbicides to control *Phragmities*, the team will apply these lessons-learned to the Kane Tract to create another successful wetland restoration project in the New Jersey Meadowlands. The Kane Tract offers a new set of challenges for the team, from marsh subsidence, to a heavy presence of invasive species, and a gas pipe line bisecting the site. This presentation will present the challenges and solutions of the MRI bank as well as document the design process of the Kane Tract, particularly under the new wetland mitigation banking rules.

Contact Information: Peg McBrien, PE, PWS, Manager, Ecological Engineering, The Louis Berger Group, Inc., 412 Mount Kemble Avenue, Morristown, NJ 07962-1946, Phone: 973-407-1465, Fax: 973-267-6468, Mobile: 973-951-3285, Email: mmcbrien@louisberger.com

RECOVER and the Role of Science in Everglades Restoration

Dave Tipple[1] and ***Katie McCallion***[2] *– on behalf of RECOVER*
[1]U.S. Army Corps of Engineers-Jacksonville District, Jacksonville, FL, USA
[2]Everglades Partners Joint Venture, Jacksonville, FL, USA

REstoration COordination and VERification (RECOVER) is the system-wide component of the Comprehensive Everglades Restoration Plan (CERP or Plan) responsible for linking science and the tools of science to a set of system-wide planning, evaluation and assessment tasks. Everglades restoration is science-based; the role of RECOVER is to ensure that the best available science continues to guide the Plan's implementation and that a system-wide perspective is maintained throughout the restoration process. This includes using applied science to optimize the design, sequencing and operations of CERP projects. RECOVER also supports the application of adaptive management (AM) to CERP, advocating the use of a scientific process that promotes and applies learning, reduces uncertainty and increases the chances of CERP success.

RECOVER executes its mission through the activities of three interdisciplinary technical teams: (1) Planning Team; (2) Evaluation Team; and (3) Assessment Team. The teams are guided by the RECOVER Leadership Group, which includes membership from 12 agencies including six federal agencies, four state agencies, and two Native American Tribes. RECOVER members are scientists, modelers, planners and resource specialists who organize and apply scientific and technical information in ways that are most effective in supporting the objectives of CERP. RECOVER uses multi-governmental and interdisciplinary collaboration to foster inclusiveness, cooperation, transparency, and universal access to tools and data. RECOVER works with the CERP projects to relate system-wide goals and objectives to project design and performance and to help integrate both system-wide science and AM into the project planning process.

RECOVER products include the publication of System Status Reports which use monitoring data to assess the status of the Everglades and South Florida ecosystem; regional evaluations that evaluate and account for system-wide changes attributed to implementation of project alternatives and project contributions to achieving the overall restoration envisioned; development of system performance measures that guide the evaluation of project designs and reporting of CERP performance; and development of the CERP AM Strategy and the AM Implementation Guidance Manual, which detail an AM program for both project-level implementation and system-wide application of AM principles.

Contact Information: Katie McCallion, Everglades Partners Joint Venture, 701 San Marco Blvd. Suite #1201 Jacksonville, FL 32207, USA, Phone: 904-232-1560, Fax: 904-232-1056, Email: katie.a.mccallion@usace.army.mil

The Southwest Florida Feasibility Study; A Framework for Ecosystem Restoration on a Regional Scale

Beth Marlowe[1], ***Kathleen McCallion***[2] and *Amy Thompson*[2]
[1]U. S. Army Corps of Engineers, Jacksonville, FL, USA
[2]Everglades Partners Joint Venture, Jacksonville, FL, USA

Authorized as part of the Comprehensive Everglades Restoration Plan (CERP), the Southwest Florida Feasibility Study (SWFFS) is a multi-agency effort to develop a conceptual framework for regional ecosystem restoration and water resource management. The 4,300 sq. mile study area encompasses all of Lee County and Collier County, as well as portions of Charlotte, Hendry, Glades, and Monroe Counties. The anticipated level of detail included in the regional plan will be similar to that of the Central and Southern Florida Project Comprehensive Review Study ("Yellow Book"). Incorporating and building upon ongoing regional and county level efforts, the SWFFS proposes over 170 projects for further study and implementation by local, state, and federal agencies in cooperation with public and private land owners.

Prior to development, the study area was characterized by a mosaic of wetland and upland habitat. The regional water table was shallow and species composition was primarily driven by the hydrologic regime. Herbaceous wetlands interspersed with pine flatwoods and cypress hammock communities created habitat unique to the region supporting populations of several threatened and endangered species including the Florida panther and the West Indian manatee. The wetland habitats created numerous flowways that allowed for gradual sheetflow to the coast, maintaining healthy estuarine salinity regimes. In more recent years, urban and agricultural development has lead to channelization of flow throughout the system; draining inland wetlands, lowering the water table, and flushing coastal estuaries with unnatural pulses of freshwater. Development has also lead to an increase in nutrients in the system leading to a decline in water quality.

The primary goal of the SWFFS is to develop a conceptual watershed plan for regional ecosystem restoration focused on hydrologic improvement. Proposed projects include but are not limited to: (1) wetlands restoration; (2) construction of reservoirs, stormwater treatment areas (STAs), and algal turf scrubbers (ATS); (3) weir installation; (4) exotic plant removal; (5) stormwater and sewer retrofits; (6) berm removal; and (7) canal backfill. The objective of these proposed projects is to restore habitat and landscape connectivity while improving distribution and quality of water throughout the system.

Contact Information: Kathleen McCallion, Everglades Partners Joint Venture, 701 San Marco Blvd., Jacksonville, FL 32207 USA, Phone: 904-232-1560, Fax: 904-232-1056, Email: Kathleen.A.McCallion@usace.army.mil

Restoration of the Chesapeake Bay from both a Watershed-Wide and State-Specific Perspective

Frank W. Dawson, III – presented by ***Brenton McCloskey***
Aquatic Resources Programs, Maryland Department of Natural Resources, Annapolis, MD USA

Historically, the Chesapeake Bay has been one of the most productive estuaries on earth, providing a tremendous habitat for fish and wildlife, as well as unparalleled economic and recreational opportunity. The past year has been one of leadership, innovation, enhanced coordination and accountability, marked by actions large and small that will advance progress in the effort to the Chesapeake Bay restoration effort. Despite important restoration steps by our federal, state, local and private partners and the benefit of our world-renowned science, sobering reports of Bay conditions remind us of the significant challenges ahead. This presentation will focus on the steps taken by the partnership to intensify the clean-up effort – including the adoption of a new strategy for establishing specific milestones for intensifying restoration efforts and tracking progress toward the overall restoration deadline. As well as highlight how in Maryland, we have used BayStat, a powerful statewide tool designed to access, coordinate and target Maryland's Bay restoration programs, and to inform our citizens on progress.

This discussion will provide an overview of the Chesapeake restoration effort from both a watershed-wide and state-specific perspective and will set the stage for subsequent sessions that will go into further detail regarding Maryland's restoration and mitigation programs.

(Part I – Discussion on Chesapeake Bay Restoration – spoke with Tom St. Clair and David Koran about oral presentation of all three abstracts submitted from MD Dept. of Natural Resources)

Contact Information: Kristen B. Fleming, Watershed Services, Maryland Department of Natural Resources, 580 Taylor Ave., E2, Annapolis, Maryland 21401 USA, Phone: 410-260-8813, Email: kfleming@dnr.state.md.us

An Estimation of the Social Value of Municipal Government Investment in Natural Capital

Daniel T. McGrath
Berkeley Institute of the Environment, University of California, Berkeley, CA, USA

Empirical estimations of the economic value of natural areas within urban settings are few, most likely due to the fact that municipal government investment in natural capital within the urban core is uncommon and because there is not often a pressing need to justify public spending on conservation or preservation at small scales. However, there is growing interest in the reclaiming of derelict and compromised natural areas existing within urban cores as accessible amenities, and there is a tacit recognition that this kind of public investment creates value that improves the quality of life of citizens and over time will be capitalized into neighborhood property values thereby justifying the government investment.

In this study, a dual estimation of the non-market economic benefits associated with an urban natural area, where a significant government investment was made to improve the quality and accessibility, is presented. A straightforward on-site travel cost analysis of an urban nature center is presented to provide a comparison of the estimated flow of recreational values to the stock measure of value of the same site obtainable via a hedonic pricing approach, using both the standard and repeat-sales methods. By providing a comparison of the results of the two valuation methodologies, this study facilitates and estimation of use and non-use values accruing from this urban natural amenity at a point in time. A key contribution of this paper is that it is the first study to compare the valuation estimation results of a travel cost study with that of a hedonic valuation approach for the same environmental amenity.

Contact Information: Daniel T. McGrath, Berkeley Institute of the Environment, University of California, Berkeley, Phone: 510-642-1385, Fax: 510-642-0225, Email: dmcgrath@berkeley.edu

Accounting for Uncertainty in Predicted Benefits of Freshwater Flow Diversion to Coastal Marshes

S. Kyle McKay[1], *Craig Fischenich*[1], *Ronald Paille*[2] and *Tamieka Armstrong*[3]
[1]US Army Engineer Research and Development Center, Environmental Laboratory, Athens, GA, USA
[2]U.S. Fish and Wildlife Service, Lafayette, Louisiana Field Office, USA
[3]IAP Worldwide Services

Louisiana's coastal marshes are receding at alarming rates of over 77 sq. km/yr on average with loss attributed to a number of factors such as: sea level rise, river/marsh disconnection, local compaction and subsidence, and coastal erosion. Freshwater flow diversion is the one restoration technique scientists agree is most capable of counteracting these processes; however, gaps in conceptual understanding, predictive capability, and appropriate consideration of uncertainty hinder planning and design associated with large diversions. Land gain benefits of flow diversions are derived through two major mechanisms: 1) addition of inorganic suspended sediment from the diversion source water and 2) addition of nutrients which stimulate marsh vegetation growth and increase organic accretion. This presentation will focus on development of a screening level model for assessment of inorganic and organic land gain benefits of freshwater flow diversion, and how the model explicitly accounts for uncertainty in outcomes. The model provided a tool for estimating the benefit of flow diversion alternatives (locations, magnitudes, structure type, operational scenarios, etc) in the Louisiana Coastal Protection and Restoration (LACPR) project. The utility of the model will be demonstrated by examining its application to this project for screening flow diversion alternatives throughout Coastal Louisiana. This presentation will outline how several key issues associated with projecting flow diversion benefits with uncertainty were addressed, including: use of conceptual models to drive model development, formulation of a predictive tool in short time by modifying existing tools, tracking and presenting uncertainty using Monte Carlo simulation, and addressing uncertainty through scenario analysis.

Contact Information: S. Kyle McKay, 1660 S. Lumpkin St. #9, Athens, GA 30606, USA, Phone: 706-850-1974, Email: Kyle.McKay@usace.army.mil

Establishing Metrics for Environmental Benefits Analysis

S. Kyle McKay
US Army Engineer Research and Development Center, Environmental Laboratory, Athens, GA, USA

Although aquatic ecosystem preservation, restoration, and management have become topics of great concern in recent decades, the ability to consistently and robustly quantify the benefits, goods, and services provided by aquatic ecosystems has remained elusive. A key component to assessing environmental benefit is the development of robust metrics to evaluate projects from both scientific and societal perspectives while working in the context of larger project and programmatic objectives and constraints. Results of a multidisciplinary, interagency meeting focusing on metric development and application for ecosystem restoration projects will be summarized, and proposed approaches for establishing metrics offered. An approach will be presented that considers the total value of ecosystem outputs for decision-making at scales ranging from alternative-project comparison to project performance tracking to regional/national/global environmental management. Choice of appropriate metrics will be integrated into a decision analytic framework, and the importance of setting clear and complete objectives highlighted. An iterative three-step metric development process will be presented based on: 1) selecting metrics based on a logical hierarchy of natural, constructed, and proxy metrics, 2) evaluating results based on desirable properties of metrics, and 3) documenting and archiving metric development and application. This work is significant in that metrics measure progress toward goals and objectives of ecosystem restoration projects, raise awareness and understanding, and support decision making.

Contact Information: S. Kyle McKay, 1660 S. Lumpkin St. #9, Athens, GA 30606, Phone: 706-850-1974, Email: Kyle.McKay@usace.army.mil

The Use of Geomorphic and Ecological Templates for Stream Restoration

Shaun P. McKinney and *W. Barry Southerland*
USDA, Natural Resource Conservation Service (NRCS), Water Quality and Quantity Team, OR, USA

There are many approaches to restoring streams that have experienced anthropogenic perturbations. The Natural Resource Conservation Service (NRCS) is employing the use of geomorphic and ecological analogs to guide restoration activities along with empirical and analytical methodologies. Streams with functional physical and ecological characteristics were analyzed to determine quantitative restoration objectives. Critical geomorphic parameters as well as key aquatic ecological factors were identified for successful stream restoration. Physical and biological monitoring and assessment provides necessary feedback regarding both measures of success and improved analogs for future planning and design. The functional stream analog process along with monitoring examples will be presented displaying stream dimension, pattern, and profiles along with species specific habitat recommendations.

Contact Information: Shaun P. McKinney, USDA, NRCS, Water Quality and Quantity Team, 1201 NE Lloyd Blvd., Portland, OR 97232 USA, Phone: 503 273 2413, Fax: 503 273 2401, Email: shaun.mckinney@por.usda.gov

Water Quality Trading – Providing the Tools to Trade Nutrients

Shaun P. McKinney
USDA, Natural Resource Conservation Service (NRCS), Water Quality and Quantity Team, OR, USA

Ecosystem markets are emerging across the country in an attempt to curb negative anthropogenic effects to the environment. Water quality trading holds great promise to reduce nutrient delivery and still provide an economic derivative to producers. One of the main obstacles in the exchange of water quality credits is a tool to measure conservation measures in terms of nutrient reductions. NRCS has a prototype tool the Nutrient Trading Tool (NTT) that addresses these needs. NTT provides a user friendly, web-based interface linked to two different rigorous nutrient models. The tool allows users to select fields or farms with an on-line Geographical Information System and run agronomic scenarios that display nutrients that will not be delivered to the environment (delta constituents). The NTT is being tested in the Chesapeake Bay area. This presentation will outline the tool and report preliminary results from the East Coast.

Contact Information: Shaun P. McKinney, USDA, NRCS, Water Quality and Quantity Team, 1201 NE Lloyd Blvd., Portland, OR 97232 USA, Phone: 503 273 2413, Fax: 503 273 2401, Email: shaun.mckinney@por.usda.gov

Utilizing Autonomous Underwater Vehicles (AUV) and Side Scan Sonar to Locate Illegal Spiny Lobster Fishing Gear: Unconventional Restoration in Response to an Unconventional Problem

S. Richard Meehan[1], *Micheal Annis*[2], *Steve Broudet* [2], *Rob Downs*[2] and *Rex C. Herron*[3]
[1]NOAA Restoration Center SE, St. Petersburg, FL USA
[2]NOAA Hydrographic Systems and Technology Program, Silver Spring, MD, USA
[3]NOAA S.E. Fisheries Science Center, Stennis, MS, USA

With the increased availability of side scan sonar, we have utilized this technology on two different vehicle platforms to locate the illegal fishing structures on the seafloor within the Florida Keys National Marine Sanctuary (FKNMS). Methods for collecting spiny lobster in the FKNMS include a commercial trap fishery and a diving fishery on natural habitat. There is small contingent of illegal divers that construct artificial habitats and dump it in the hard bottom and seagrass habitats within the FKNMS. The structures used are called casitas, lobster condos or reefs. They vary in size and materials but are often the size of a large coffee table sitting 4-6 inches off of the substrate. As a result, the entire footprint of the casita smothers the seafloor.

A towed system (2007) and an autonomous system (2008) were employed. In 2007, sonar and video instruments were towed simultaneously along transects roughly parallel to bottom contours in a study area encompassing approximately 602 km^2. Transects totaling 220.6 nautical miles and an area of 81 km^2 were completed and 95 sonar targets that appeared to be anthropogenic were located. Of these, 53 appeared to be lobster casitas and 26 were verified as true casitas. A cost per casita located of $3653.84 resulted from this effort. In 2008, the autonomous underwater vehicle system mapped over 24 km^2 in 6 days finding 109 likely targets. Of these 63 were picked as highly likely. A ground truth sub sample verified each target selected and produced 100% accuracy rate. Removal of these additional casitas will take place in early 2009. The cost of locating each casita in 2008 is around $500.00 per casita.

Restoration of these sites will be simply to remove the casitas from the seafloor. This will allow for the natural recruitment of benthic invertebrates and seagrasses to recolonize the affected areas. Biological monitoring of the recovery will be done for several years after removal. This project demonstrates the synergy between the availability and practicality of advances in side scan sonar applications with the need to restore valuable marine habitats negatively impacted by illegal fishing methods.

Contact Information: S. Richard Meehan NOAA NMFS Restoration Center, 263 13th Ave S. St. Petersburg, FL 33701, Phone: 727-824-5330, Fax: 727-824-5390, Email: sean.meehan@noaa.gov

The Applications of Spatial Information Systems in Ecosystem Restoration: The Case of the Colorado Rocky Mountain Arsenal

Edmund C. Merem*, R. Coney* and *B. Robinson*
Department of Urban & Regional Planning, Jackson State University, Jackson, MS, USA

The vast network of abandoned contaminated sites scattered across the United States during the Cold War era continues to be a national concern today for federal government agencies charged with the task of initiating the ecological restoration of these hazardous sites to their pre-land use form. One of the largest contaminated sites from the Cold War era, the Rocky Mountain Arsenal—a 17,000 acre U.S. Army facility in Adams County, Colorado—was established in 1942 to manufacture chemical weapons at the height of World War II. During that period also, private corporations leased facilities at the Arsenal to manufacture pesticides. Before the government acquired the land through eminent domain, the Arsenal was originally prairie and farmland, located only 10 miles northeast of downtown Denver. Decades of chemical weapons and pesticide manufacturing at the Arsenal has caused extensive contamination and ecosystem damage to areas on-site and beyond its boundary. No longer operational, the Arsenal was placed on the National Priorities List by the Environmental Protection Agency (EPA) in 1987 to clean up the contaminated soils, structures, and groundwater. Coincidentally, officials discovered that the arsenal also provided habitat for the bald eagle and more than 300 species of birds, mammals, reptiles, and fish and other wildlife in its surrounding buffer and encouraged conservation. Accordingly, Congress passed a bill in 1992 that will change the Rocky Mountain Arsenal to a national wildlife habitat upon completion of the cleanup and restoration. Notwithstanding these efforts, no serious attempt has been made to apply spatial information systems in the on-going ecosystem recovery efforts in the area.

In light of that, this paper presents a case study that applies mix scale methods of geospatial analysis involving historical aerial photographs connected to GIS, and statistical analysis of regression to analyze the ecosystem trends and restoration in the study area between the time period of 1942 and 2007. Emphasis is placed on those factors responsible for the problems, ecological change analysis of several environmental variables and mapping of the land use trends, mitigation efforts and the viability of the study area as a potential national wildlife refuge and future lines of action. This approach not only allows for a better understanding of how land-use change analysis helps track negative impacts, but it also offers a road map for proper management of the surrounding ecology of the Rocky Mountain Arsenal and Denver metropolitan areas. The expectation is that the study would provide managers of various agencies with support tools to make more informed and ecologically sound decisions with clearly defined restoration goals in the reuse of contaminated public lands.

Contact Information: Edmund C. Merem, Department of Urban & Regional Planning, Jackson State University, Jackson, MS 39211 USA, Phone: 601-432-6864, Fax: 601-432-6862, Email: edmund.c.merem@jsums.edu

Coastal Restoration and Protection of the Chenier Plain: Southwest Coastal Louisiana Feasibility Study

***Ehab A. Meselhe*[1]**, *Norwyn Johnson*[2], *Carol Parsons Richards*[2], *James Pahl*[2] and *Paul Varnado*[3]
[1]University of Louisiana, Inst. of Coastal Ecology and Engineering, Center for Louisiana Water Studies, Lafayette, LA, USA
[2]Louisiana Office of Coastal Protection and Restoration, Baton Rouge, LA, USA
[3]United States Army Corps of Engineers, New Orleans District, New Orleans, LA, USA

The Louisiana's Chenier Plain extends from Vermilion Bay southwest of Cypremort Point Louisiana to Sabine Lake in southeast Texas. It encompasses Region Four of the Louisiana Coastal Zone covering Cameron, Calcasieu, and Vermilion Parishes. The main goal of the first phase of this feasibility study is to examine proposed large-scale protection and restoration strategies. The study is a joint effort between the State of Louisiana, the US Army Corp of Engineers, and the University of Louisiana.

A regional scale hydrodynamic and salinity transport model was developed to better understand the circulation patterns and salinity regimes of the region. The model was developed using a coupled one-and-two dimensional approach through the Danish Hydraulic Institute's MIKE FLOOD software. The model domain includes the near-shore Gulf of Mexico, Sabine, Calcasieu, Grand, and White Lakes, marshes, as well as the interconnected network of channels, canals, and hydraulic structures. Overall, the model includes over 870 miles of channels and bayous including the Gulf Intracoastal Waterway, Sabine-Neches Ship Channel, Calcasieu Ship Channel and other natural and engineered canals. The model also includes various CWPPRA project structures and real-time operations on lock-structures operated by the US Corps of Engineers.

The model was calibrated and validated against daily and monthly averaged water levels and salinity throughout the region as well as hourly velocity field samples at the Calcasieu, Sabine, and Mermentau tidal passes. The statistical analysis and visual observation of the model performance indicate that the model provide reasonable information about daily variation of water level and monthly-averaged salinity within the system. The model will be key analysis tool to evaluate the various protection and restoration strategies.

Contact Information: Ehab Meselhe, Department of Civil Engineering, University of Louisiana, Lafayette, LA 70504 USA, Phone: 337-482-5802, Fax: 337-482-6688, Email: meselhe@louisiana.edu

Simple Statistics as Tools for Adaptive Management and Monitoring Success of Restoration Projects

Linnea Spears-Lebrun, ***Cecilia Meyer Lovell*** and *James Prine*
EDAW, Inc., San Diego, CA, USA

The goal of restoration is to create, enhance, or restore a site into a self-sustaining, functional ecosystem. Success standards are developed to determine if a site is trending towards this ultimate goal. Quantitative monitoring is used to collect data to determine if these success standards are being met. Simple statistics such as establishing a minimal detectable change and using power analyses and confidence intervals are important tools in determining the success of a restoration site, but are not always employed. A power analysis can determine if the monitoring design is capable of detecting true change (high power, low Type II error rate) in the variables of interest at a restoration site. Confidence intervals can be used to determine if the success standards have been achieved given the variability in the data collected. If success standards are not being met, adaptive management techniques can be employed to correct the trend of the site.

EDAW is currently using these methods at several wetland/riparian restoration site in San Diego County, California as part of the 5-year maintenance and monitoring post-installation program. On one of these projects the monitoring design was found to have over 90 percent power. Using 90 percent confidence intervals, success criteria for native cover are being met; however, nonnative cover success criteria are not being met. Determining this early in a 5-year program allows management decisions to be made to adaptively address deficiencies. Overall, including power analyses in restoration monitoring allows for collection of data that can detect true change and using confidence intervals allows for statistical comparisons to success standards. Using a project example, we show how these simple statistical tests can ultimately determine if success has been achieved at a site.

<u>Contact Information</u>: Cecilia Meyer Lovell, Senior Restoration Ecologist, EDAW, Inc., San Diego, CA 92101 USA, Phone: 619-233-1454, Fax: 619-233-0952, Email: Cecilia.MeyerLovell@edaw.com

Restoring Rare and Endangered Species Habitat at the Urban/Wildland Interface

Kenneth S. Mierzwa and *Lia Webb*
Winzler & Kelly, Eureka CA, USA

Restoration sites at the edge of urban areas offer unique challenges. Often natural ecosystem processes have been disrupted, allowing gradual habitat degradation over time. Sometimes sites have been so profoundly disturbed that an understanding of the presettlement condition must be inferred from historical data such as Government Land Office survey notes, early land use records, the earliest available aerial photographs, or historical resources reports. Nearby best-remaining-example reference sites are also useful both for conceptual design and for establishing success criteria.

For this paper, restoration sites in the San Francisco Bay Area, the Chicago Region, and southern Illinois were evaluated. Two of the sites were small (2.5 and 14.0 acres), and one exceeded 200 acres. All were in proximity to both developed land and open space areas, and all were within 1 km of known populations of rare or protected species. Major restoration activities were completed 12 or more years ago at two locations, but less than two years ago at another, allowing evaluation over a range of time.

All of the restorations were successful in the sense that they met their stated objectives. In all cases, goals were realistic, attainable, and considered the constraints imposed by nearby urban or developed areas. All of the projects succeeded in part because they looked beyond single-species goals to assess larger scale ecosystem functions, and were designed to restore those functions or at least reduce the degree to which functions were impaired. An adaptive management approach was implemented on two of the sites. Because of this bigger-picture approach the sites are largely self-sustaining and the need for long term management, while not eliminated, has been reduced considerably.

Contact Information: Kenneth S. Mierzwa, Winzler & Kelly, 633 Third Street, Eureka, CA, USA, Phone: 707-443-8326, Fax: 707-444-8330, Email: kenmierzwa@w-and-k.com

Stability Thresholds and Performance Standards for Stream Restoration Materials and Methods

Sarah J Miller[1], *Craig J Fischenich*[1], *John Oldenburger III*[2] and *Mark A Vian*[3]
[1]US Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS, USA
[2]Propex, Inc., Rocklin, CA, USA
[3]New York City Department of Environmental Protection, Stream Management Program, Kingston, NY, USA

The document “Stability Thresholds for Stream Restoration Materials” (ERDC TN-EMRRP-SR-29, 2001) has proved an indispensable reference for stream restoration engineers and practitioners nationwide. However, the stabilization and channel restoration fields have seen some important advances in methods and materials that improve success and expand applications since the publication of this guidance in 2001, and new performance data is available for existing methods. Practitioners within and outside the Corps have consequently called for an updated reference to reflect new performance data, materials and methods information. Stability thresholds based upon hydraulic criteria such as maximum shear stress, stream power and velocity demonstrate considerable variability in actual performance depending on various environmental conditions. Additional performance criteria could be included in design, evaluation and prioritization of restoration methods to reduce some of this uncertainty. Additional performance standards might include: Geotechnical stability; Resilience of method to uncertain climate conditions; Maintenance requirements and costs; Additional hydraulic forces, such as wave action or overtopping; Chemical environment tolerance to corrosives, salinity, acidity, etc.; UV exposure tolerance and impact to functions or life span; Environmental acceptability/performance; Other effective-life issues or ranges. This presentation will summarize research with the user community, academia and industry to update EMRRP-SR-29 to document new understanding and advances in stream restoration materials and methods, and to incorporate a broader suite of performance criteria.

Contact Information: Sarah J Miller, Research Ecologist, US Army Engineer Research and Development Center, Environmental Laboratory, 3909 Halls Ferry Rd., Vicksburg, MS 39180, Phone: 601-634-5247,
Email: Sarah.J.Miller@usace.army.mil

Partnering to Restore Watersheds in Urban Areas: Quebrada Mundaca, Caguas, PR

H. A. Minnigh and *G. I. Ramírez toro*
CECIA, Interamerican University of Puerto Rico, San Germán, PR

Watersheds in urban areas can be, and in Puerto Rico generally are, nigh-impossible to restore; simple improvement is extremely difficult. The problem discovering permanent or intermittent streams that have been covered or diverted through residential areas is common to all islands. This case began with a pharmaceutical firm becoming concerned about the quality of water flowing through the parking lot of their manufacturing facility in Caguas, PR. The stream entered their grounds from a box culvert on the margin and appeared to carry raw sewage at least intermittently. In addition to its noisome character, raw sewage presented a serious health risk to their employees and the neighboring high-density housing. In addition, the stream discharged into Rio Grande de Loíza, the source of about half of the potable water for Metropolitan San Juan. Caguas is the fifth-largest urban area in Puerto Rico, with about 89,000 people in 33,000 dwelling units. CECIA, the environmental studies institute of Interamerican University of Puerto Rico was contracted to study and eventually to help resolve the problem. The stream did not appear on maps of the area and Commonwealth and local agencies were unable to engage in corrective action, the assumption being that the flow was entirely stormwater. CECIA and the company documented the quality of the water and conducted tracer studies and GPS mapping activities. An interagency committee was formed and extensive research with archivists and local utility personnel verified that a permanent stream, Quebrada Mundaca, had been covered over in the period 1900-1970. A risk inventory was conducted and thematic maps of the quebrada's route through downtown Caguas were created. Most importantly, during the project municipal, Commonwealth, Federal and private individuals with community members, participated in the mapping and planning process. In addition, in collaboration with the PR Department of Education, teachers and students also participated in the risk inventory and mapping processes. All these stakeholders worked together to identify both feasible goals to improve water quality in the quebrada, scheduled activities to achieve those goals and implement corrective actions. The manners and means of engaging both public employees and community members in the process are discussed as are the benefits of interagency committees in fostering discussion.

Contact Information: H A Minnigh, PO Box 48, Lajas, PR 00667, Phone: 787-616-1588, Fax: 866-457-2282, Email: hminnigh@compuserve.com

Restoring River-Floodplain Connectivity for Fish Spawning and Nursery in the Lower Missouri River: Use of a Constructed Fish Passage Facility

Meagan D. Montgomery[1] and *David L. Galat*[2]
[1]Department of Fisheries & Wildlife Sciences, University of Missouri, Columbia, MO, USA
[2]U.S. Geological Survey, Cooperative Fish and Wildlife Research Unit, University of Missouri, Columbia, MO, USA

Restoration projects are being undertaken along many large floodplain rivers, including the lower Missouri River (LMOR) to mitigate past channelization and levee construction that severed river-floodplain connectivity and denied riverine fishes access to seasonally-flooded wetlands. Two wetland pools were constructed at Eagle Bluffs Conservation Area (EBCA) as part of the Missouri River Mitigation Project. These pools were built with water-control structures to allow controlled passage of riverine fishes into EBCA for spawning and nursery. Evaluating rehabilitation projects is an important component of river restoration and this study assessed potential benefits of fish passage structures at EBCA as well as future implementation of similar designs at other river-floodplain mitigation sites. Research objectives include: (1) modeling the discharge-stage relationship between the LMOR and wetland pools to determine frequency, timing and duration of connectivity; (2) predicting fish species that potentially use wetland pools based on reproductive guilds, water temperature, and timing of flood events, and; (3) quantifying ingress and egress of fishes at EBCA during periods of LMOR connection.

Predictions of probable fish use were based on integration of habitat use and reproductive guild information with 72 years of water temperature data and 17 years of discharge and stage-height data for LMOR. Fish sampling was conducted during spring/summer 2007 and 2008 to quantify composition of the assemblage entering and exiting the wetland complex from LMOR. Fishes collected during ingress and egress events through the water control structures and an overbank flood event were compared with predictions of fish immigration into EBCA. Highest probability of a flood event occurs in May (93%) and June (86%). Water temperatures during this period range from 15-25°C and the majority of LMOR fishes that spawn in floodplain wetlands require this temperature range. Thirty-six fish species were predicted to use EBCA as spawning or nursery habitat; however, over 60 species, a mixture of native and introduced fishes, accessed the pools. Dominate species accessing EBCA via the fishway included *Cyprinus carpio* (56%), *Hypopthalmichthys spp.* (21%), *Dorosoma cepedianum* (6%), and *Cyprinella lutrensis* (3%).

The stage-discharge model can help resource agencies manage for future flood events by determining optimal dates for enabling river-floodplain connectivity via the fishway. Designed connectivity can be used to improve integrating fish and waterbird use of riverine floodplain wetlands. Predictions of fish use of floodplains enable managers to promote or regulate ingress of targeted species. A greater number of fish species accessed the wetland pools than was predicted due to the 2007 overbank flood event, which allowed for not only active migration of adults but also passive transportation of adults, larvae, and eggs into the area. Research results strengthen knowledge of riverine fish use of LMOR floodplains by coupling species specific immigration and water temperature during actual immigration with generic literature reports.

Contact Information: Meagan D. Montgomery, Department of Fisheries & Wildlife Sciences, 302 ABNR Building, University of Missouri, Columbia, MO 65211 USA, Phone: 573-882-0752, Email: mdm01a@mizzou.edu

A Planner's Perspective on Stream Corridor Restoration

Thomas G. Moore
USDA-Natural Resources Conservation Service, Davis, CA USA

Improving streams and their functions on private lands in California are plagued with numerous obstacles that, when overcome can achieve goals addressing sediment control, stabilizing banks, improving fish habitat, and restoring the ecological functions and processes of a stream and its flood plain. Recommending stream corridor restoration practices requires progression through a NRCS 9-step planning process where alternative resource management systems (RMS) are developed for the conservation management unit, or in this case, the stream reach or stream corridor, and an RMS is selected by the client and then implemented. The complex physical, biological, and social nature of stream corridors creates a challenge to planners when requested to assist in improving stream functions and conditions.

Stream restoration begins when landowners or watershed groups seek assistance from NRCS to address stream-related concerns. NRCS planners assist clients with assessing stream conditions and identifying what management or natural processes may be affecting those conditions. A suite of management objectives is identified by describing the desired physical, chemical, and biological functions of the stream. We then formulate and evaluate alternatives to determine which processes and functions can be improved through specific conservation actions, and decide if these actions are sustainable and self-reinforcing. Throughout the planning process planners are performing an environmental assessment of the potential consequences of employing any recommended practices to achieve the desired outcome. The goal of the analysis of the ecological, economic, social, and regulatory consideration of employing any of these practices is to provide all necessary information so that the client can make an informed decision in the development of their conservation plan. Once the client has decided on the selected practices for their conservation plan implementation of these plans may then be facilitated by utilizing technical, educational, and financial assistance programs from NRCS or other sources.

Successful implementation of conservation plans addressing stream, floodplain and associated riparian zones is accomplished only through cooperative efforts of clients, neighbors, resource agencies, and regulatory agencies. One such project will be briefly described where the multiple partners working cooperatively completed an instream and riparian project to improve habitat for aquatic and terrestrial special status species by improving fish passage, the riparian corridor, and stream bank stability.

Contact Information: Thomas G. Moore USDA-Natural Resources Conservation Service, 430 G Street, #4164, Davis, CA 95616 USA, Phone 530-792-5652, Fax 530-792-5793, Email thomas.moore@ca.usda.gov

Effect of Soil Particle Size Distribution and Water Content on the Solute Transport in Unsaturated Soil

Ehsan Moradabadi[1] and *Aliakbar Golshani*[1,2]

[1]Soil and Foundation Engineering Division, Civil Engineering Department, Engineering Faculty, Tarbiat Modares University, Tehran, Iran

[2] Faculty of Engineering and Surveying, University of Southern Queensland, Toowoomba, Australia

Growing concern about soil and ground water pollution has resulted in many studies on solute transport. In most of available literature, the effect of water content or soil mechanical properties on solute transport in unsaturated porous media has been individually investigated without considering the interactive effect of water content and soil type on solute movement. The objective of our study was to investigate the interactive effect of soil particle size distribution and volumetric water content (10% to 100%) on salt transport in unsaturated porous media under steady state flow condition. Sandy soil samples with different particle size distribution and the same rock based material were used as media in a 25cm experimental column. A mobile-immobile model (MIM) was employed to describe the movement of solute under pre-Fichian regime. Experimental results indicate that in some cases a poor graded sandy soil with lower water content has lower dispersion and faster mass transfer between the mobile and immobile regions comparing to a well graded sandy soil with higher water content.

Contact Information: Ehsan Moradabadi, Soil and Foundation Engineering Division ,Civil Engineering Department ,Engineering Faculty, Tarbiat Modares University, Tehran, Iran, Phone:+989122763203, Fax:+982188971159 , Email: e.moradabadi@modares.ac.ir

Monitoring Sea Level Rise Using Floral and Faunal Assemblages and Observed Associations in Southwest Florida

James B. Murray and *G. Lynn Wingard*
U.S.Geological Survey, Reston, VA, USA

A possible habitat association between the clam, *Polymesoda caroliniana,* and several plant species including; *Cladium jamaicense, Acrostichum sp., Rhizophora mangle*, *Laguncularia racemosa*, and *Avicennia germinans* is being investigated in the Shark River and Harney River basins along the Southwest Coast of Florida, in Everglades National Park. Site surveys conducted in the spring of 2008 within the Shark River system found “nests” of the clam *P. caroliniana* closely associated with the prop root structures of the mangroves *R. mangle* and *L. racemosa.* Understory plants include *C. jamaicense* and *Acrostichum* sp., with the *Acrostichum* sp. showing degradation at some sites. The studied areas appear to be the transition zone between mesohaline/oligohaline environments and within the low tide zone. Some of the plants in these regions have low tolerance to saltwater and low survival rates with even brief exposures to elevated salinities. Plant assemblages respond quickly to environmental changes whereas *P. caroliniana* can aestivate during brief exposures to conditions outside their tolerance limits.

Cores taken at the mouth of the Harney River and the north leg of the Shark River in the summer of 2005 were found to have *P. caroliniana* debris in abundance at depths of 114-165 cm, and 10-64 cm respectively. Based on modern observations, *P.caroliniana* in abundance is an indicator of freshwater to upper estuarine environments. *P. caroliniana* debris also was found in core samples in the Lostman’s River Second Bay area at a depth of 72-76 cm. Depositional rates for these cores are currently being determined (Wingard, et.al., “Descriptions and Preliminary Report on Sediment Cores from the Southwest Coastal Area, Part II: Collected July 2005, Everglades National Park, Florida”, OFR 2006-1271). Evidence of a substantial change in flow regime was seen in the mid-system cores from the Harney and Shark Rivers. The lower portions of both cores were deposited in freshwater environments, with no indicators of estuarine influence. A shift toward more estuarine conditions in the upper portions of the cores is evident from the loss of the larger freshwater fauna.

The observed associations between *P. caroliniana* and certain plant species, such as *C. jamaicense*, *Acrostichum* sp., *R. mangle*, *L. racemosa*, and *A. germinans,* may provide a tool for monitoring short term fluctuations and for indentifying long term changes in salinity regimes at the critical fresh/salt water transition zone. By examining these faunal-floral associations in cores, we can determine past positions of this transition zone, which is a function of both freshwater outflow and sea level changes. Future migration of this particular assemblage could serve as an indicator of the progress of restoration of freshwater flow through the Shark River Slough. It also could signal the encroachment of rising sea level.

Contact Information: James B. Murray, EESPT USGS, 12201 Sunrise Valley Dr., Reston, VA, 20192, USA, Phone: 703-648-6918, Fax: 703-648-6953, Email: jbmurray@usgs.gov

The Non-Native Red Rimmed Melania (*Melanoides tuberculatus*) in Biscayne Bay National Park, Florida, the Geographic Distribution and Potential Health Threats

***James B. Murray*[1]*,** *G. Lynn Wingard*[1] and *William B. Schill*[2]
[1]U.S.Geological Survey, Reston, VA, USA
[2]U.S. Geological Survey, Leetown Science Center, WV, USA

USGS researchers working in Biscayne National Park (BNP), Florida, indentified the non-native gastropod *Melanoides tuberculatus* (Family Thiaridae: common name red-rimmed Melania) in the summer of 2003. First introduced in the United States in the late 1930's in the San Francisco area, it has spread throughout the southern U.S. via the aquarium trade and subsequent releases by people into the wild. In its native habitat of Southeast Asia and parts of Africa, *M. tuberculatus* is a freshwater snail; however we have made live collections in salinities up to 30 parts per thousand (ppt) salts (typical marine waters are 30-35ppt). This finding initiated a study to determine the distribution, genetics, salinity tolerance, and threat to the native species that compete for a similar niche as *M. tuberculatus*. The presence of *M. tuberculatus* is significant to the visitors in BNP because it is an intermediate host for several human parasitic trematode worms including *Clonorchis sinensis* and *Opisthorchis* sp. (liver flukes), and *Paragonimus westermani* (lung fluke). Additionally, it is an intermediate host for other digenic trematode parasites including, *Philophthalmus megalurus,* which affects the eyes of birds, and *Centrocestus formosanus*, which is a serious pathogen of fish, crustaceans, and some mammals. *Centrocestus formosanus* also is known to occasionally infect humans and is a documented parasite in Florida and Texas. All intermediate host stages of these trematode lifecycles are present in BNP and elsewhere in the southern U.S. and new cases of lung and liver fluke have been documented in the Miami area in recent years. The proximity of BNP to a landfill, a sewage treatment center, and multiple septic systems may increase the potential for infections.

M. tuberculatus can spread very quickly because it can reproduce asexually (parthenogenesis) and broods internally (viviparous) so the offspring are live born; this strategy increases the overall survivability of the young. Based on raw counts using three petit ponar samples from each transect(TR) site in the Black Point area on the west-central edge of BNP, *M. tuberculatus* shows increasing estimated population densities over the 2004--2006 time period. At site TR4 which is approximately 1400m from shore, densities increased from $696/m^2$ in 2004 to $60,000/m^2$ in 2006. At TR6, the most seaward site, approximately 2200m from shore, densities increased from $87/m^2$ in 2004 to $3826/m^2$ in 2006. *M. tuberculatus* is apparently adapting to higher salinity, eliminating the marine barrier to dispersal and increasing its habitat range. This combination of factors will increase the competition with the native species that utilize a similar food source. It also may increase the potential of infection of native species by the parasites associated with *M. tuberculatus* and thus increase the threat to human health in BNP and in other locations in the southern U.S. South Florida water temperatures are very similar to the water temperatures of Southeast Asia and with the changes predicted by the IPCC report on climate change, the range of *M. tuberculatus* is likely to expand northward.

Resource managers and the general public need to be aware of this non-native/invasive snail and take steps to monitor its parasite host status and prevent its spread and additional introductions.

Contact Information: James B. Murray, EESPT USGS, 12201 Sunrise Valley Dr., Reston, VA, 20192, USA, Phone: 703-648-6918, Fax: 703-648-6953, Email: jbmurray@usgs.gov

The History of the Management of the Missouri River

Wayne Nelson-Stastny
The U.S. Fish and Wildlife Service, Yankton, SD, USA

In the late 1800s, the U.S. Army Corps of Engineers began to modify the Missouri River mainstem channel with snag removal efforts. In the early 1900s "channel enhancement" projects strived to make the Missouri River a more suitable navigation route. Finally, in the 1930s, the Corps began damming the Missouri River mainstem and flows became heavily regulated. As floodplain and river-side development increased, more levees and other bank stabilization structured were constructed. These projects resulted in a drastic change in river dynamics throughout the entire Missouri River basin. This alteration in natural riverine processes allowed for navigation in the lower basin, floodplain farming, generation of hydroelectric power, and alternative recreational opportunities, among other economic impacts. Modifications to the river have led to the degradation of the basin's ecosystem goods and services available to humans and wildlife, instability of sediment transportation throughout most of the river, and decline among native aquatic and terrestrial species, among other negative impacts.

Contact Information: Wayne Nelson-Stastny, USFWS Gavins Point, P.O. Box 710, Yankton, SD 57078 USA, Phone: 402-667-2884, Email: Wayne_NelsonStastny@fws.gov

West Falmouth Harbor-Baseline Monitoring for Management Decisions and Future Restoration (Cape Cod, Massachusetts)

Pamela L. Neubert[1], *Paula S. Winchell*[1], *Stephen B. Aubrey*[2] and *Derek McDonald*[3]
[1]AECOM Environment Marine and Coastal Center, Woods Hole, MA
[2]Rogue Wave Field Services
[3]Marine BioControl

Increasing year round and summer population on Cape Cod, Massachusetts provides the Cape with its major source of economic stability but has consequently led to ubiquitous degradation of coastal marine habitats. Finding the fine line between preserving Cape Cod's prized coastlines and maintaining economics is no simple task. The Town of Falmouth (Town) recognizes that healthy marine habitats are just as critical for economic stability as is human utilization of these habitats. To best manage the Town's coastal pond habitats, the Falmouth Coastal Ponds Management Committee (CPMC) was initiated. The CPMC was charged with the task to monitor the current status of several coastal ponds including West Falmouth Harbor. Baseline habitat assessments provide scientific data that affords the Town opportunities to make educated management decisions on topics such as: development of harbor management plans, shellfisheries seeding, opportune placement of sewering projects, and eelgrass recovery. AECOM Environment's Marine and Coastal Center was hired to assist the CPMC and monitored West Falmouth Harbor for the Town through funding provided by the Community Preservation Committee. Monitoring determined the status of four shellfish species, eelgrass habitat, characterized benthic infauna, assessed physical sediment parameters in perspective of anthropogenic impacts. Results were incorporated and mapped using ArcMap 9.3 software. Data is currently cataloged as a public resource and hearings will present findings to local stakeholders for their input. This strategy provides the Town with the ability to understand the dynamics of West Falmouth Harbor and to directly assist with addressing future coastal habitat management needs and restoration goals for this unique marine environment.

Contact Information: Pamela Neubert, Ph.D. AECOM Environment Marine and Coastal Center, 89 Water St., Woods Hole, MA 02543, Phone: 508-457-7900, Fax: 508-457-7595, Email: pamela.neubert@aecom.com

Ecosystem Service Values in Remediation Sites

Joeseph Nicolette[1] and ***David Nicholas***[2]
[1]CH2M Hill, Inc.
[2]Office of Solid Waste and Emergency Response, US Environmental Protection Agency

In response to Agency-wide efforts to improve techniques for ecological benefit assessment, the EPA Office of Solid Waste and Emergency Response (OSWER), Policy Analysis and Regulatory Management Staff (PARMS), is exploring alternative approaches for valuing and quantifying the net environmental impacts from OSWER programs.

In this PARMS-sponsored study, the ability of alternative ecological and economic valuation metrics to demonstrate the net benefit associated with site cleanup is being explored at an active remediation site. The four metrics to be evaluated are as follows: ecological service value in service-acre-years, ecosystem service value in dollars, human recreational use value in dollars, and real estate and community impact value in dollars.

The purposes of the study are to (1) explore the ability of the four metrics to demonstrate the benefits of site cleanup; (2) identify and quantify new benefit streams; (3) identify data gaps that could be addressed in the documentation process at active sites so that net benefit metric calculations can be supported by the available site data; and (4) understand more fully how these metrics may be used at sites to identify, prior to remediation, the cleanup and reuse alternatives that provide the greatest net environmental benefit. A status report of the study will be presented.

Contact Information: David S. Nicholas, Policy Team Leader, Policy Analysis and Regulatory Management Staff, Office of Solid Waste and Emergency Response, US Environmental Protection Agency, 1200 Penn Ave., Washington, DC 20460, USA, Phone: 202-566-1927, Fax: 202-566-1934, Email: nicholas.david@epa.gov

Establishing the Legacy Nature Preserve – Restoration in Urban/Lake Fringe of the Great Salt Lake Ecosystem through Collaborative Planning and Adaptive Management

Nate Nichols and *Mike Perkins*
HDR Engineering, Salt Lake City, UT, USA

The Great Salt Lake Ecosystem is recognized as a site of hemispheric significance for millions of migratory birds. It provides a mosaic of diverse wetland and upland habitats, especially along the eastern shorelands of the lake, where freshwater from the Wasatch Mountains interfaces with the saline basin. This area between the lake and the mountains has been subjected to extensive modifications through various land-uses and hydrologic manipulations. Much of this area is now urbanized and new development

Developing large-scale mitigation that is appropriate and successful in this ecosystem is complex and challenging. The Legacy Parkway was constructed near the South-East shore of the Great Salt Lake. As mitigation for impacts to wetlands and wildlife, the Utah Department of Transportation was charged with developing a 2,225-acre nature preserve within the Great Salt Lake Ecosystem. The Preserve would include areas of habitat restoration, creation and preservation. Due to the size and diversity of habitats, a “Collaborative Design Team” (CDT) was assembled to develop and consult on an “Adaptive Management Plan” for the creation of the preserve. Adaptive management is based on the premises that natural systems are complex and inherently dynamic. Adaptive Management is a flexible, iterative approach that directs conservation management practices over time by the results of research monitoring activities. Strategies that were developed during this process are currently being implemented, with efforts focusing on weed control, hydrology development, and wetland creation.

- Ecosystem Restoration at the Watershed Scale
- New Planning Approaches to Achieve Ecosystem Restoration
- Science and Engineering Integration
- Linking Monitoring Results with Management Decision-making
- Urban Ecosystem Restoration
- Ecosystem Goods and Services

Contact Information: Nate Nichols, HDR Engineering, 3995 South 700 East, Suite 100, Salt Lake City, UT 84107, USA, Phone: 801-341-6338, Fax: 801-341-6341, Email: Nathan.Nichols@hdrinc.com

Guiding Wetland Restoration in the San Francisco Estuary through Monitoring, Evaluation, and Research: A Multi-Partner Approach

Nadav Nur, *Julian K. Wood, Leonard Liu, Diana Stralberg* and *Mark Herzog*
PRBO Conservation Science, Petaluma, CA, USA

Loss of historical tidal wetlands in the San Francisco Estuary, especially saline and brackish tidal marsh habitat, has led to a large-scale investment of public and private funds to restore and enhance tidal wetlands, especially because many species of birds and wildlife are critically dependent on this habitat for all or part of their annual cycle. In the past two decades, many government agencies, non-governmental organizations, and strategic partnerships of public and private entities have focused their activities on habitat restoration and enhancement in this Estuary, the largest on the West Coast of North America. In order to guide the design, implementation, and assessment of restoration activities so as to maximize the benefit to birds and wildlife, PRBO Conservation Science has worked with multiple partner organizations and consortia. Here we describe these fruitful partnerships which have been carried out at the local, regional, and national scales. PRBO's activities have coalesced around five interlocking themes: 1) research focused on the ecological relationships of birds and their physical and biological environments, carried out as part of multi-disciplinary studies, 2) development and implementation of monitoring programs to assess avian response to restoration at the local and regional scales, 3) evaluation of success of restoration and management activities to inform future efforts, 4) modeling current and future trajectories of wetland birds to assess current and future threats, such as that posed by sea level rise or invasive species, and 5) engaging with the public to promote outreach of our findings and enhance appreciation of these endangered tidal wetland ecosystems. Examples and achievements representing each theme will be presented.

Contact Information: Nadav Nur, PRBO Conservation Science, 3820 Cypress Drive, #11, Petaluma, CA 94954 USA, Phone: 707-781-2555 ext. 301, Fax: 707-765-1685, Email: nnur@prbo.org.

Determining Restorative Operating Patterns Using Multi-objective Reservoir Optimization with HEC-ResPRM

Sara M. O'Connell and *Beth A. Faber*
US Army Corps of Engineers, Hydrologic Engineering Center, Davis, CA, USA

Development of reservoir system operation plans has historically relied heavily on economic data, but today environmental concerns are of increasing importance. A system that is undergoing environmental restoration requires restructuring of its operation plans to balance the traditional economic objectives with new restoration goals. Finding that balance can be a challenge due to lack of precedent, experience, and tools, but taking a system optimization approach can inform the decision process by calculating the tradeoffs between different objectives. HEC-ResPRM is multi-reservoir system optimization software that can be used to develop and support optimal operational strategies that meet a variety of objectives over time.

HEC-ResPRM (Prescriptive Reservoir Model) is a generalized computer program that performs multi-period deterministic network-flow optimization of multi-reservoir systems. HEC-ResPRM "prescribes" optimal values of flow and storage over time by minimizing penalty functions at selected locations in the water resource network. Penalty functions associate a penalty or reward with designated levels of flow or storage. These functions can be reviewed and adapted to capture the system priorities. Tradeoff analysis can then be used to evaluate potential balances between all objectives within a system. This provides a way to optimize values such as ecosystem goods and functions alongside traditional values. HEC-ResPRM can also be used to maximize benefits to a variety of restoration goals or demonstrate to stakeholders the interplay among conflicting interests in the restoration project. This presentation will discuss the use of HEC-ResPRM to determine optimal operating patterns that achieve restoration goals in conjunction with other objectives.

Contact Information: Sara M. O'Connell, US Army Corps of Engineers, Hydrologic Engineering Center, 609 Second St., Davis, CA 95616, USA, Phone: 530-756-1104, Fax: 530-756-8250,
Email: Sara.M.OConnell@usace.army.mil

A Hydrologic Event-Based Evaluation of Water Quality Trends in Goodwater Creek Experimental Watershed, Missouri USA: Implications for Watershed Monitoring Strategies and Objective Setting

T. Kevin O'Donnell[1]*, Stephen H. Anderson*[1]*, Claire Baffaut*[2] and *Teri Oster*[2]
[1]Department of Soil, Environmental, and Atmospheric Sciences, University of Missouri, Columbia, MO, USA
[2]Cropping Systems and Water Quality Research Unit, USDA Agricultural Research Service, Columbia, MO, USA

Continued public support for U.S. tax-payer funded programs aimed at reducing agricultural non-point source pollutants depends on clear demonstrations of water quality improvements. However, little is currently known about past watershed-scale effects due to implementation of structural best management practices (BMPs). Effectiveness of structural BMPs, as well as watershed monitoring networks are important information needs to make future efforts more defensible. Watershed-scale assessments of BMP effects using existing monitoring data can simultaneously inform program managers on the type and spatial coverage of physical processes (i.e., monitored variables) critical to tracking future water quality improvements.

The objective of this research is to determine if significant linear trends exist between atrazine at three locations in the Goodwater Creek Experimental Watershed (GCEW) and flow, precipitation, and structural BMP implementation chronology between 1993 and 2006. Atrazine is a herbicide of great concern for surface water contamination in the U.S. Midwest. Structural BMPs implemented in the GCEW included grass waterways, terraces, and establishment of permanent vegetation. The GCEW is a 73 km^2 instrumented watershed located in the north-central Missouri and currently included in the USDA Conservation Effects Assessment Project (CEAP) watershed assessment studies. Three stream gauges with automated water samplers and ten rainfall gauges provided sub-daily data at varying seasons and years between 1993 and 2006 for three nested watersheds (12, 31, 73 km^2). Hydrologic events at each weir were determined by the Hewlett-Hibbert constant slope method. A total of 282 events were identified at the watershed outlet between 1993 and 2006. Atrazine flow-weighted concentrations and loads were determined for each hydrologic event by straight-line interpolation between consecutive chemical samples occurring during the same event. Closer examination of hydrologic events indicated 116 events were sampled during the months of April through June, a critical period for atrazine loss. Variables useful for predicting atrazine trends included event discharge, time to peak discharge during an event, and rainfall contributing to an identified event as well as prior to an event. Results indicated variation associated with atrazine trends was not reduced by including all rainfall gages in linear trends. Effects of BMPs were not consistently shown after 14% of the total watershed area was protected by structural BMPs. However, resulting trends are useful in quantifying minimum reductions in atrazine needed for detection with monitoring networks.

Contact Information: T. Kevin O'Donnell, Department of Soil, Environmental, and Atmospheric Sciences, 302 ABNR Building, University of Missouri-Columbia, Columbia, Missouri 65211-7240, Phone: 573-884-8533, Fax: 573-884-5070, Email: tkot24@mizzou.edu

Restoring the San Dieguito Watershed for Sensitive Species Habitat and the Prevention of Catastrophic Wildlife Using a Multi-Entity Approach

Shea V. O'Keefe
USDA – Natural Resources Conservation Service, Escondido, CA, USA

This presentation will describe a Natural Resources Conservation Service (NRCS) Wildlife Habitat Incentives Program (WHIP) project, and the coordinated effort necessary to restore riparian and the associated upland habitat along the Santa Ysabel Creek. The creek is located within the San Pasqual Valley and is part of the San Dieguito watershed in San Diego County. The riparian and upland area is designated as critical and important habitat for several threatened, endangered and sensitive species including arroyo toad, least bells vireo, California gnatcatcher and coastal cactus wren. This watershed burned during the October 2007 Witch Creek wildfire which is recorded as the second largest wildfire in recorded history (almost 200,000 acres effected). The Santa Ysabel Creek portion of the fire allowed a quick spread of fire due to its dense infestation of eucalyptus, tamarisk and arundo. Directly after the fires, the existing eucalyptus, tamarisk and arundo were greatly reduced which provided an opportune time to eradicate these invasive species completely and restore the native vegetation. But a challenge to restoring this watershed is that its owned by various entities including the city and county of San Diego, but maintained under operating agreements by several private landowners, a joint powers authority and a land conservancy. These multi-agency ownerships and multi-entity operating agreements provided a need for a coordinated effort in order to get habitat restoration at this important time facilitated. Due to the diligent efforts by all involved parties, approximately 550 acres of the watershed was funded in 2008 under the WHIP program. Under this program platform, funding and leadership were provided for restoring this ecologically important valley, as well as decrease the susceptibility for future wildfires. This coordination also led to other funding opportunities with US Fish and Wildlife Service and the San Diego Association of Governments (SANDAG). As of January of 2009, approximately 3 months after this portion of the watershed was funded, 150 acres has been treated for arundo and tamarisk and 20 acres has been revegetated. By March 2009, another 290 acres will be treated, and by December 2009 all acres will have been initially treated.

Contact Information: Shea O'Keefe, Natural Resources Conservation Service, 332 South Juniper St. Ste 110, Escondido, CA 92025, Phone: 760-745-2061 ext. 104, Email: shea.okeefe@ca.usda.gov

Linking Biological Responses to River Processes: a Focal Species Approach to Restoration and Management of the Sacramento River

***Bruce K. Orr*[1]**, *Clifford S. Riebe*[1,2] and *Ryan Peek*[1,3]
[1]Stillwater Sciences, Berkeley, CA, USA
[2]Department of Geology and Geophysics, University of Wyoming, Laramie, WY, USA
[3]Department of Biology, University of San Francisco, San Francisco, CA, USA

The loss and degradation of essential habitats in the Sacramento River (California, USA) corridor has generally reduced the river's capacity to support native species. The processes, habitats, and species of the Sacramento River have been the focus of much study, and the volume of available reports and datasets poses a challenge for synthesizing information and organizing a discussion of ecosystem components. Divergent conceptual models about process–habitat–biotic linkages complicate the process of summarizing what is known about the Sacramento River, and add to the challenge of evaluating alternative approaches for conserving and restoring the river ecosystem. To help overcome these challenges, our study discusses and analyzes the Sacramento River through the lens of six focal species. A focal species approach facilitates the exploration of linkages among ecosystem processes, resultant habitats, and biotic needs. For each focal species, we identify the different life history stages that occur in the Sacramento River, the habitats used by each of those life history stages, the ecological processes that create and maintain those habitats, and the management actions (e.g., changes in the flow regime, bank revetment, levees, gravel augmentation, horticultural restoration of riparian habitats) that influence those ecological processes and habitat conditions. The six focal species selected for this study are Chinook salmon (*Oncorhynchus tshawytscha*), steelhead (*Oncorhynchus mykiss*), green sturgeon (*Acipenser medirostros*), bank swallow (*Riparia riparia*), western pond turtle (*Clemmys marmorata*), and Fremont cottonwood (*Populus fremontii*). Because fish species have generally received more attention in past studies of the Sacramento River system, our poster focuses on the three non-fish focal species. We summarize the key findings and hypotheses generated by our focal species approach, including (i) the effects of land use and water supply development on the broader ecosystem, and (ii) the key resource management challenges in the Sacramento River system using the focal species as a framework. We conclude with recommendations for appropriate restoration, monitoring and adaptive management actions for each focal species and an assessment of which actions are most likely to provide benefits to multiple species.

Contact Information: Bruce K. Orr, Stillwater Sciences, 2855 Telegraph Avenue, Suite 400, Berkeley, CA 94705, USA, Phone: 510-848-8098 x111, Fax: 510-848-8398, Email: bruce@stillwatersci.com

Linking Vegetation Dynamics with Physical Processes: a Key Step in Developing Restoration Strategies for a Semi-arid River and its Floodplain

Zooey Diggory[1], ***Bruce Orr***[1], *Amy Merrill*[1], *Gretchen Coffman*[2], *William Sears*[1,3] and *Peter Brand*[4]

[1]Stillwater Sciences, Berkeley, CA, USA
[2]University of California, Los Angeles and Santa Barbara, CA, USA
[3]San Francisco Public Utility Commission, San Francisco, CA, USA
[4]California Coastal Conservancy, Oakland, CA, USA

The lower Santa Clara River (Ventura County, CA, USA) has been significantly altered by levees, water diversions, agriculture, and urbanization that have altered natural geomorphic and hydrologic processes, causing riparian habitat loss or degradation. The California Coastal Conservancy's Santa Clara River Parkway project seeks to ameliorate these impacts and conserve existing riparian habitats by acquiring and restoring a 25 mile-long floodplain corridor. Understanding the physical drivers for riparian vegetation distribution and composition is a crucial part of developing feasible restoration strategies for the Parkway project. We used a variety of analytical tools, including historical analysis, vegetation classification and mapping, and riparian dynamics analysis to elucidate the conditions and processes that shape vegetation distribution and composition. We found that the extent of riparian vegetation has been dramatically reduced by levees and floodplain development; that large areas of native riparian vegetation have been replaced by invasive, non-native species; and that longitudinal position, groundwater, time since last flood and relative elevation are the physical variables most strongly correlated with riparian plant species distribution. Our understanding of watershed conditions and vegetation response to physical variables allowed us to develop effective and feasible restoration strategies for the lower Santa Clara River Parkway, including: identification of priority areas for restoring floodplain connectivity, conserving native vegetation, as well as active (horticultural) and passive (process-based) revegetation; tools for developing site-appropriate planting palettes; and development of a strategy for non-native invasive plant species control.

Contact Information: Bruce K. Orr, Stillwater Sciences, 2855 Telegraph Avenue, Suite 400, Berkeley, CA 94705, USA, Phone: 510-848-8098 x111, Fax: 510-848-8398, Email: bruce@stillwatersci.com

Restoration of a Severely Degraded Landscape: Revegetation of Native Riparian Trees on Floodplain Dredge Spoils in California's Central Valley

John C. Stella[1], *Zooey E. Diggory*[2], *Marie D. Reil*[2], **Bruce K. Orr**[2] and *John J. Battles*[3]
[1]SUNY College of Environmental Science and Forestry, Syracuse, NY, USA
[2]Stillwater Sciences, Berkeley, CA, USA
[3]Department of Environmental Science, Policy, and Management, University of California, Berkeley, CA, USA

On river floodplains in semi-arid regions, establishment of riparian trees is often constrained by both abiotic and biotic factors. This is particularly true of floodplains restored to ameliorate the effects of dredge spoils: dredger mining has severely degraded floodplain soils and elevations, and there is considerable uncertainty in how post-restored floodplain conditions will influence riparian vegetation establishment and growth. From 2004 to 2006, we conducted a field experiment along the Merced River in California's Central Valley to test the influence of distance to groundwater and direct irrigation (two abiotic factors) versus initial plant size and weed competition (two biotic factors) on seedling survival of four native tree species planted in restored floodplain dredge spoils. Treatment effects on survival were analyzed using a Cox proportional hazard model. Plant mortality was influenced most strongly by initial planting size in the first year, by irrigation treatment in the second year, and by elevation above groundwater in the third year. Weed competition did not significantly affect survival of any species, although valley oak (*Quercus lobata*) survival was somewhat higher in weed control treatment groups. In the first year, box elder (*Acer negundo*) and Fremont cottonwood (*Populus fremontii*) seedling mortality decreased 78 and 19 percent respectively with every 1-mm increase in basal diameter at planting. Similarly, Oregon ash (*Fraxinus latifolia*) mortality decreased 12 percent per extra centimeter in height. In the second year, irrigated plants survived better than unirrigated ones by 16 to 31 percent across species, and there was no residual effect of initial plant size. In the third year, planting elevation emerged as the most important influence; mortality was 67 to 124 percent higher per meter above the water table. These results are critical for reducing uncertainty related to the successful revegetation of large areas of floodplain throughout the Central Valley that have been degraded by dredge spoils. Furthermore, the methods used are applicable to tailings restoration sites throughout much of the western United States and other ecosystem restoration efforts where there are multiple ecological constraints on plant survival and teasing apart environmental influences is necessary.

Contact Information: Bruce K. Orr, Stillwater Sciences, 2855 Telegraph Avenue #400, Berkeley, CA 94705, USA, Phone: 510-848-8098 x111, Fax: 510-848-8398, Email: bruce@stillwatersci.com

The Key Challenges Confronting Habitat Restoration in San Francisco Bay: Are They Manageable?

***Michelle Orr**, Stephen Crooks, Jeremy Lowe* and *Philip Williams*
Philip Williams & Associates, San Francisco, California, USA

Ambitious plans for large-scale tidal wetland restoration in San Francisco Bay face several key challenges – a dwindling sediment supply, accelerated sea level rise with global warming, and the need for improved flood protection along the wetland/urban edge. Changes in sediment management, a regional approach to restoration planning, integration of flood protection and wetland restoration, and adaptive management will be needed to manage these challenges.

Most potential restoration sites are subsided below natural marshplain elevations and require sedimentation to restore ecological functions. As the acreage of restored wetlands increases, so do the demands on the Bay's limited sediment supply. For San Francisco Bay, it is not known whether sediment supply can keep pace with the increasing demand. Dredged sediment that could be kept in the Bay is currently exported to landfills and the ocean. Long-term sustainability of Bay wetlands requires a regional approach to sediment management and financial incentives to beneficially re-use sediments in the Bay. A demonstration re-use project in the North Bay will be discussed.

Accelerated global sea level rise increases the demand for sediment, and also accelerates the landward movement of tidal marshes. Where the landward edge of tidal marshes meets urban and agricultural development, tidal marshes will be squeezed between the rising open water and developed edge. Managing for sea level rise requires providing wide corridors of tidal marsh and a regional approach to land acquisition that prioritizes preservation of the undeveloped upland edge. Ultimately, it may also require designing the future estuary to create sustainable marsh and mudflat habitats in a different configuration than existed historically.

Wetland restoration projects in San Francisco Bay typically require flood control elements to protect adjacent low lying developed areas. Flood protection with wetland restoration is a challenge, but also an opportunity. Integrating flood protection and restoration can ultimately improve levels of flood protection, with lower construction and maintenance costs.

Given the challenges and uncertainties in regional wetland restoration, adaptive management has become more developed as a key element in managing for resiliency.

Contact Information: Michelle Orr, Philip Williams & Associates, 550 Kearny Street, Suite 900, San Francisco, California, 94108, USA, Phone: 415.262.2310, Email: m.orr@pwa-ltd.com

Federal Conflict Resolution Centers – Evaluating Collaborative Processes

Patricia Orr[1], *David Emmerson*[2] and *Stacy Langsdale*[3]
[1]US Institute for Environmental Conflict Resolution, Tucson, AZ, USA
[2]US Department of the Interior, Office of Collaborative Action and Dispute Resolution, Washington, DC, USA
[3]US Army Corps of Engineers, Institute for Water Resources, Alexandria, VA, USA

Several agencies all have an interest in evaluating collaborative processes to learn more about process dynamics and to use this information to improve environmental conflict resolution (ECR) processes. The USIECR has been leading an initiative referred to as the Mult-Agency Evaluation Study (MAES). MAES was designed to shed light on how ECR performs, identify key factors that contribute to ECR success, and distill feedback from participants and practitioners so that future processes can be improved. EPA and DOI are currently co-leading another initiative referred to as the Systematic Evaluation of Environmental and Economic Results (SEEER). SEEER varies from MAES in that it focuses on environmental impacts, the impacts of the processes, and includes the development of plausible, counterfactual scenarios. IWR is building on both of these initiatives by developing questions specific to collaborative modeling and the use of technical tools. The insights gained by using these collaboration tools will help to develop the field and increase the quality and success of ECR processes in the future.

Contact Information: Patricia Orr, Program Manager for Evaluation, U.S. Institute for Environmental Conflict Resolution, 130 South Scott Avenue, Tucson, Arizona 85701, Phone: 520-901-8548, Fax: 520-901-8549, Email: orr@ecr.gov

Cost Effective Regional Phosphorus Concentration Mapping of Oligotrophic Open Water Systems

Peter Besrutschko[1], *Ed Brown*[1], *Lisa Gued*[1], *Tim Brown*[1] and ***Chris Osburn***[2]
[1]U.S. Army Corps of Engineers, Jacksonville, FL, USA
[2]North Carolina State University, NC, USA

A preliminary data set from a pilot program conducted in periphyton stormwater treatment area (PSTA) mesocosms shows that light absorbing properties of dissolved organic carbon (DOC) decrease while the concentration of total phosphorus (TP) also decreases. Evidence from DOC stable isotope values, supported by measurements of DOC light absorption, suggests that new DOC is being produced in the mesocosms. The emerging hypothesis is that the periphyton communities in these mesocosms produce new DOC that is uncolored. The effect of this new DOC production is an increase in DOC concentration and a shift in the stable isotope values reflecting this new carbon source. Further, the new DOC produced dilutes the light absorbing properties, demonstrated as a decrease in the colored dissolved organic matter (CDOM) absorption at 412 nm and a decrease in the spectral slope coefficient (S-value). Driving this production of new, uncolored DOC is the removal of TP by the periphyton communities.

Hyperspectral imagery (HSI) must be acquired simultaneously with CDOM measurements to completely develop the algorithm relating the change in the S-values with a similar change in slope coefficients from HSI spectra. No other combination of CDOM, DOC, and TP data exist that elucidate these possible mechanisms. The hypothesis that periphyton produce low-CDOM DOC must be rigorously tested in the mesocosms and in the treatment cells to document the efficacy of this relationship. We caution that, lacking HSI data, we do not know how robust algorithm development will be, thus the need for further study. The key finding relevant to restoration is the ability to scale up CDOM:TP relationships to remote sensing platforms (ideally, CASI-type HSI instruments on fixed wing aircraft) promises to increase cost-effectiveness for water treatment systems such as PSTA. This study provides some of the first evidence that such a strategy is scientifically valid.

Contact Information: Dr. Chris Osburn, Assistant Professor, Department of Marine, Earth,& Atmospheric Sciences North Carolina State University, 2800 Faucette Drive Campus Box 8208, 4150 Jordan Hall Raleigh, NC 27695-8208, USA, Email: chris_osburn@ncsu.edu

Improving the Health of the Tomales Bay Ecosystem through Restoration

Lorraine Parsons[1], *Brannon Ketcham*[1] and *Greg Kamman*[2]
[1]Point Reyes National Seashore, Point Reyes Station, CA USA
[2]Kamman Hydrology & Engineering, San Rafael, CA USA

Located in an undeveloped section of coastline near San Francisco, Tomales Bay is generally viewed as pristine and often used as a "reference" site in ecological studies. However, the watershed is not immune to negative anthropogenic influences, such as leaking septic systems, agriculture, and mercury mining. Waters of the Tomales Bay estuary have been designated by the State of California as impaired by sediment, nutrients, pathogens, and mercury. These problems have galvanized public and private efforts within Tomales Bay to improve water quality through both source reduction and restoration.

The largest restoration proposed to date in Tomales Bay is the Giacomini Wetland Restoration Project, which is being conducted by the National Park Service and its partners. In 2000, the Park Service purchased a 563-acre dairy ranch, the Waldo Giacomini Ranch, located at the southern end of Tomales Bay in central California. The Giacomini Ranch was once part of a large integrated tidal wetland complex at the southern end of Tomales Bay. It was leveed for dairy ranching in 1946, resulting in loss of more than 50% of the wetlands in this estuary.

Rather than trying to restore historic conditions, Point Reyes National Seashore, the Park Service unit managing the project, decided to focus the project on restoring natural hydrologic and ecological processes and functions and allowing wetland habitats and functions within this very dynamic estuarine transition zone to develop within the context of current watershed conditions. After more than six years of planning, the second and largest phase of implementation is almost complete. Principal restoration actions included levee and culvert/tidegate removal, drainage ditch filling, tidal channel creation, creek realignment, and creation of special status species habitat.

While Tomales Bay is only 40 miles northwest of San Francisco Bay, planning and implementation issues facing restoration projects here are very different from those of some of the much larger restoration efforts being currently planned or conducted in that watershed, with diked wetlands in Tomales suffering only minimal subsidence or elevation loss. This lack of subsidence translates into accelerated timelines for conversion of pasture to marsh and for development of natural processes and wetland functions, many of which will have value not only for the restoration area, but the entire Tomales Bay.

By restoring hydrologic connectivity through levee and culvert removal, this restoration project could have tremendous benefits to reducing flooding, improving water quality, and incwater quality by restoring hydrologic connectivity and wetland functions to a historic marsh that is currently diked. Two-thirds of the Bay's freshwater input -- the principal contaminant source -- comes from tributaries upstream of the Giacomini Ranch.

More than two-thirds of the freshwater inflow to the Bay flows through the Project Area. By removing levees and restoring hydrologic processes and functions, this project could have tremendous implications for improving downstream water quality to this internationally renowned Ramsar Wetland and critical coastal ecosystem and thereby benefit both humans and wildlife.

Contact Information: Lorraine, Parsons, Point Reyes National Seashore, 1 Bear Valley Road, Point Reyes Station,CA,94956, Phone: 415-464-5193, Email: Lorraine_Parsons@nps.gov

Using Partnerships to Restore Our National Legacies

Lorraine Parsons[1], *Brannon Ketcham*[1] and *Sally Bolger*[2]
[1]Point Reyes National Seashore, Point Reyes Station, CA USA
[2]Point Reyes National Seashore Association, Point Reyes Station, CA USA

Historically, the National Park Service has focused more on preservation and conservation rather than restoration. However, it has come to realize that preservation may not be enough to protect and conserve natural resources, so recent policies encourage parks to restore natural systems. Unfortunately, monies for restoration of natural systems from traditional Park Service funding sources such as Congressional appropriations are scarce.

In 2000, the Park Service acquired the Waldo Giacomini Ranch in southern Tomales Bay for the purpose of wetland restoration. Tomales Bay is located approximately 40 miles northwest of San Francisco. The Giacomini Ranch was once part of a large integrated tidal wetland complex at the southern end of Tomales Bay, before it was leveed for dairy ranching in 1946, thereby resulting in loss of more than 50% of the wetlands in this estuary. Because of the difficulty in securing Park Service or Congressional funding, Point Reyes National Seashore, which manages the area in which the ranch occurs, had to develop innovative approaches to purchasing and restoring the ranch, including use of mitigation funding and monies from several private and governmental grant sources. The Seashore partnered with several non-profit organizations, Point Reyes National Seashore Association (PRNSA), the San Francisco Bay Joint Venture, and the Tomales Bay Watershed Council, to raise funds and implement the restoration project.

In addition, successful restoration also required a strong partnership with the local community. While many national parks occur in undeveloped, isolated areas, the Giacomini Ranch is directly adjacent to two West Marin communities that are intensely interested and invested in the restoration process. Without community support and "buy-in," implementation would have been more difficult, and the overall project would not have been as successful.

Contact Information: Lorraine Parsons, Point Reyes National Seashore, 1 Bear Valley Road, Point Reyes Station, CA 94956 USA, Phone: 415-464-5193, Fax: 415-663-8132, Email: Lorraine_Parsons@nps.gov

The Bill Williams River Partnership and Ecological Management of Water Resources

***Gregory Peacock*[1]**, *Andrew B. Hautzinger*[2], *John T. Hickey*[3], *Patrick B. Shafroth*[4] and *Rene A. Vermeeren*[1]
[1]Los Angeles District, U.S. Army Corps of Engineers, Los Angeles, CA, USA
[2]Division of Natural Resources, U.S. Fish and Wildlife Service, Albuquerque, NM, USA
[3]Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, CA, USA
[4]Fort Collins Science Center, U.S. Geological Survey, Fort Collins, CO, USA

Alamo Dam is a Corps of Engineers project on the Bill Williams River, a tributary to the Colorado River, in western Arizona. The original purposes of the dam, which was completed in 1968, included flood control, water conservation, and recreation. Riparian woodland habitats, particularly cottonwood/willow forests, found on the Bill Williams are a relic of habitats once common along the mainstream Colorado River. In 1990, a multi-agency effort was initiated to develop a consensus recommendation among resource agencies on improvements to operation to benefit a suite of resources including fish, wildlife and their habitat both upstream and downstream of the dam. That process culminated with a Record of Decision in 1999 and a new Water Control Manual in 2003. In 2002, the Steering Committee that developed the original consensus recommendation was reconvened and additional entities added, including the Nature Conservancy and the City of Scottsdale.

The Steering Committee is now working to gather data and develop models to support adaptive management of the system. Recent products include: Digital Terrain Model, high flow measurements (sediment, turbidity and water surface elevations), physical models (HEC-RAS, RES-SIM, MODFLOW), an ecosystem functions model (HEC-EFM), and intensive biologic monitoring to link flows to ecologic responses. The keystone to these efforts has been the Corps' support of a series of experimental flows conducted annually between 2005 and 2008. These flows have provided critical information to elucidate relationships between flow and biota. Further, willingness on the part of the Corps, with the support of the Steering Committee, to conduct these flow events has generated a high degree of interest and involvement from other agencies and academia. Of special note is the engagement of the U.S. Geological Survey, University of Oregon, University of Washington, University of Nevada-Reno, as well as Arizona State University and University of Arizona.

A major strength of the work on the Bill Williams River has been the ability to develop feedback loops between research, monitoring, and operational decisions the Corps makes regarding dam releases. Focus has been placed on how flow impacts the system's riparian forests, beaver population (and their dams), and aquatic insects and fish. Use of HEC-EFM has been especially valuable, as this model provides the means to couple physical models with biological field data, providing a predictive capability for ecological response to flow events. These efforts will result in the development of flow-ecology response curves that contribute generally to river science as well as to science-based flow management recommendations.

Contact Information: Gregory Peacock, Los Angeles District, U.S. Army Corps of Engineers, 915 Wilshire Boulevard, Los Angeles, CA 90017, Phone: 213-452-3536, Fax: 213-452-3545, Email: Gregory.Peacock@usace.army.mil

Use of an Unmanned Aircraft System for Monitoring Selected Invasive Plants in Lake Okeechobee and the Florida Everglades, USA

H. Franklin Percival[1], *Matthew A. Burgess*[1], *Scot E. Smith*[2], *Ahmed Mohamed*[2], *John H. Perry*[2], *Zoltan Szantoi*[2], *Peter G. Ifju*[3], *Jon S. Lane*[4] and *Larry E. Taylor*[4]

[1]Florida Cooperative Fish and Wildlife Research Unit, University of Florida, Gainesville, FL, USA
[2]School of Forest Resources and Conservation, University of Florida, Gainesville FL, USA
[3]Department of Mechanical and Aerospace Engineering, University of Florida, Gainesville FL, USA
[4]US Army Corps of Engineers, Jacksonville District, Jacksonville, FL, USA

The US Army Corps of Engineers (USACE) supported the University of Florida's development of the Nova 2 unmanned aircraft system (UAS) designed specifically as a survey-grade tool for the documentation of wildlife and natural resources. One of the priority missions of the USACE is to manage invasive plants in large parts of south Florida including the Everglades. We used multi-spectral imagery ($\pm$ 10 m accuracy) collected from the Nova 2 UAS to delineate areas infested with water hyacinth (*Eichhornia crassipes*) and water lettuce (*Pistia stratiotes*). The infestations were from <8 ha to >1000 ha in size. Subsequent flights allowed much more precise assessment of the efficacy of herbicidal treatments on these invasive plants. The results of the preliminary missions indicate that the Nova 2 UAS can be used as a powerful and efficient tool for rapid and affordable monitoring of invasive plants as well as natural vegetation communities in wetlands.

Contact Information: H. Franklin Percival, Florida Cooperative Fish and Wildlife Research Unit, PO Box 110485, University of Florida, Gainesville, FL 32611-0485, USA, Phone: 352-846-0543, Fax: 352-846-0841, Email: percivaf@ufl.edu

Landscape Connectivity Modeling for Ecosystem Restoration in the Southwest Florida Feasibility Study

***Deborah Peterson**, A. Walker, L. Eckert, J. Saviñon* and *B. Schwichtenberg*
United States Army Corps of Engineers, Planning Division, Jacksonville, FL, USA

The Water Resources Development Act of 2000 authorized the United States Army Corps of Engineers (USACE) to conduct the Southwest Florida Feasibility Study (SWFFS). Congress authorized the USACE to address the health of aquatic ecosystems; the quantity, quality, timing, and distribution of water flows; agricultural, environmental, and urban water supply; flood protection; fish and wildlife; biological diversity; and natural habitat. The SWFFS has developed a Comprehensive Watershed Master Plan that provides regional restoration and addresses other water resources development needs in the study area. One of the planning objectives of the SWFFS is to decrease the loss of habitat connectivity for large mammals throughout the project area by 20 percent above the forecasted 2050 without project condition by the year 2050.

Existing natural areas are being degraded by habitat fragmentation (from roadways, levees, and other linear features), poor water quality, invasion of exotics, suppression of natural fire regime, shoreline hardening (loss of mangroves, intertidal zones), erosion, and recreational overuse. In Southwest Florida, three native species of large mammals are particularly affected by habitat loss and fragmentation: the critically endangered Florida panther (*Puma concolor coryi*), threatened Florida black bear (*Ursus americanus floridanus*), and the Florida bobcat (*Lynx rufus floridanus*)).

Conservation of large mammals requires the protection of large, well-connected habitat patches to help mitigate the effects of fragmentation. The SWFFS uses regional hydrological and water quality models and an ecological forecasting model to evaluate and compare alternative restoration plans. The ecological forecasting model is a landscape connectivity model that portrays the availability of suitable habitat for large mammals in Southwest Florida, and describes how the spatial extent and location of such habitat is expected to change as a result of restoration activities.

This presentation will describe the landscape connectivity modeling process and provide the modeling outputs. The modeling results demonstrate that implementation of the SWFFS comprehensive master plan will restore habitat connectivity for the critically endangered Florida panther, threatened Florida black bear and the Florida bobcat, to that existing in the early 1900's. This restored habitat connectivity will enable large mammals to travel from the Everglades, Big Cypress National Preserve and Florida Panther Wildlife Refuge in southwest Florida, north to Lake Okeechobee. In addition, this project will provide the largest range of movement these mammals have experienced in the last 75 or so years and ensuring their species sustainability.

Contact Information: D. Peterson, United States Army Corps of Engineers, 701 San Marco Blvd, Jacksonville, FL 32207, Phone: 904-614-5064, Fax: 904-232-3442, Email: Debbie.R.Peterson@usace.army.mil

Small and Medium Sized Mammal Inventory of Everglades National Park and Big Cypress National Preserve

Emily K. Pifer[1], *Jennifer L. Eells*[1], *Amanda Breon*[1], *Frank J. Mazzotti*[1] and *Kristen Hart*[2]
[1]University of Florida, Department of Wildlife Ecology and Conservation, Fort Lauderdale, FL, USA
[2]USGS, Florida Integrated Science Center, Fort Lauderdale, FL, USA

Small and medium sized mammals are ecologically critical as a food base, as predators, as vectors for disease and seed distribution, and provide numerous other connections in the natural system. Despite their importance, these taxa have not been systematically inventoried in South Florida since the mid 1950's. To fill this void, we inventoried upland, wetland, and coastal habitats in Everglades National Park (ENP) and Big Cypress National Preserve (BCNP). Methods utilized included standard live trapping techniques, tracking, remote sensing cameras, visual encounters, and analysis of python gut contents and owl pellets. Our goal was to identify presence and absence of mammals occurring in various communities in both the park and the preserve. In addition, we are evaluating the occurrence of mammals of specific interest (those listed as present in ENP and BCNP, but not reported for decades). Geographic information system data layers are also being developed for each species, to be used for modeling, prescribed fire planning, and long term monitoring. To accomplish these goals, a species/habitat matrix was constructed from existing literature/documentation regarding occurrence of mammals within ENP and BCNP. Using this matrix, we conducted a systematic sampling effort within major habitats in both ENP and BCNP using a Proportion Area Occupied (PAO) approach. This approach allows for estimation of detection probabilities of each species and provides the baseline for future monitoring. Twenty-one species of mammals were documented in Everglades National Park, while twenty-two species have been documented in Big Cypress. Specialized survey techniques are being developed for species that remained undetected during systematic sampling. By understanding the current status of these species, we can ensure that they will be considered as key components in future restoration efforts. Key findings relevant to restoration:

- A mammal inventory provides a comprehensive list of expected mammalian species as well as distribution data on species of special concern (i.e. Big Cypress Fox Squirrel, Everglades Mink, Round-tailed Muskrat)

- A mammal inventory will provide baseline data for evaluation and assessment of ecosystem restoration projects

- A mammal inventory coupled with an analysis of gut contents of Burmese pythons is providing insight into the impacts of this invasive species on native fauna.

Contact Information: Emily K. Pifer, University of Florida, Department of Wildlife Ecology and Conservation, Fort Lauderdale, FL, USA, Phone: 954-577-6362, Email: epifer@ufl.edu

Implementing a Nature's Services Infrastructure: the Case of a Million Trees Los Angeles

Stephanie Pincetl[1], *Diane Pataki*[2], *Jean-Daniel Saphores*[3] and *Sassan Saatchi*[4]
[1]Pacific Southwest Research Station, USFS and Institute of the Environment, UCLA, Los Angeles, CA, USA
[2]Department of Earth System Science and Department of Ecology and Evolutionary Biology, UC Irvine, Irvine, CA, USA
[3]Civil/Environmental Engineering, UC Irvine, Irvine, CA, USA
[4]JPL/NASA, Institute of the Environment, UCLA, Los Angeles, CA, USA

Urban forestry is being seen as a means to improve urban environments through the biophysical functions of trees. One might term this the implementation of a biogenic infrastructure. This presentation will present research on the implementation of the million tree planting initiative in Los Angeles that includes research on water and energy costs and benefits of one million new trees in the city. Our research methods include qualitative interviews, observations and analysis as well as the deployment of monitoring instruments in the urban forest and economic analysis. This presentation will be an overview of our interdisciplinary research, and a discussion of the institutional complexities in implementing a large scale forestry program which began as a campaign promise, but exhibits all the requirements of an infrastructure program. It will examine the promise of nature's services in the context of a conventional city management structure.

Contact Information: Stephanie Pincetl, Institute of the Environment, UCLA, La Kretz Hall, Suite 300, 619 Charles E. Young Dr. East, Los Angeles, CA 90095-1496, USA, Phone: 310-825-2434, Email: spincetl@ioe.ucla.edu

Habitat Restoration at a Superfund Site – Overcoming Obstacles

Dennis J. Pinigis and *Charles Beasley*
U.S. Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Marion, IL

After remediating a wastewater treatment facility containing PCBs, heavy metals, dioxin, and pesticides a restoration plan was implemented. The objective of the plan was to restore the ecosystem in a manner consistent with the conservation management goals of Crab Orchard National Wildlife Refuge. What once was a 50-acre site composed of treatment facilities, sludge drying beds, a concrete digester filled with 180,000 gallons of sludge, two small ponds, and two 10-acre lagoons would revert back to habitat. For this we needed the help of the Refuge Manager and two key members of his staff; the Refuge Biologist and Refuge Forester. They recommended that the land containing the wastewater treatment facility be planted with trees and managed as a diverse upland terrestrial system. They recommended that the downstream portion of the site be planted with hardwoods and managed as a bottomland hardwood and potential wetland community.

In the Spring of 2007, approximately 15,000 trees were planted on the site. Unfortunately, an unusually hot summer resulted in a high mortality rate for the trees. Additionally, erosion began impacting the site washing away valuable topsoil. Responding to the challenges of erosion and tree mortality after a large-scale environmental remediation in a manner that best serves the habitat is the focus of this poster.

Contact Information: Dennis J. Pinigis, U.S. Fish and Wildlife Service, 8588 route 148, Marion, IL 62959, USA, Phone: 618-998-5912, Fax: 618-998-0674, Email: dennis_pinigis@fws.gov

Utilization of USDA Farm Bill Conservation Programs to Restore Bottomland Hardwood Forest Habitat for a Federally Threatened Species in Louisiana

John M. Pitre[1] and *Andrew Dolan*[2]
[1]USDA Natural Resources Conservation Service, Alexandria, LA, USA
[2]US Fish and Wildlife Service, Lafayette, LA, USA

During the 1970s, soaring soybean prices and various federal subsides led to extensive conversions of bottomland hardwood forests within the Lower Mississippi Alluvial Valley (LMAV). An estimated 75% of the original forested wetlands that once occurred across this region were lost during that time period. More than two and a half million acres in Louisiana were converted from mixed hardwood forests to cropland by 1980. Although state and federal agencies acquired lands in Louisiana to benefit impacted wildlife species including the federally threatened Louisiana black bear (*Ursus americanus luteolus*), the vast majority (approximately 90%) of the lands within this region of Louisiana were, and still are, privately owned.

Voluntary United States Department of Agriculture Farm Bill conservation programs such as Wetland Reserve Program (WRP), Conservation Reserve Program (CRP), Emergency Watershed Protection (EWP) program, Environmental Quality Incentives Program (EQIP), and Wildlife Habitat Incentives Program (WHIP) provide technical and financial assistance to private landowners to implement habitat restoration and enhancement practices. As profitability from farming marginal lands decreased and associated environmental concerns were realized; government agencies, conservation organizations, private companies, and individuals (collectively known as the Black Bear Conservation Coalition or BBCC) encouraged conservation program enrollment. These groups collaborated with USDA to develop ranking methodologies which prioritized restoration efforts, and initiated a WRP Special Project to benefit the bear from a landscape-level planning perspective. As of this date, Louisiana leads the nation in WRP participation. The majority of WRP easements in Louisiana are located within the LMAV and these easements provide direct benefit to the Louisiana black bear and associated wildlife species. The bear population appears to be responding, with at least five confirmed litters produced in Louisiana on restored WRP tracts. In 1997, the statewide Louisiana black bear population was estimated to range from 200 to 400 individual bears. While studies to define reliable population estimates are currently underway, it is generally believed the population may have increased to as many as 700 individuals. Although WRP is credited for significantly contributing to the bear population increases, participation in CRP, EWP, EQIP, and WHIP cannot be discounted for the cumulative benefits to bears, associated fish and wildlife species, and overall conservation of natural resources.

Contact Information: John M. Pitre, USDA Natural Resources Conservation Service, Alexandria State Office, Alexandria, LA, USA 71302, Phone: 318-473-7809, Fax: 318- 473-7616, Email: john.pitre@la.usda.gov

Illinois River Basin Restoration Program - Comprehensive Plan Lessons Learned

Marshall B. Plumley
U. S. Army Corps of Engineers; Rock Island District, Rock Island, IL, USA

The Corps of Engineers and Illinois Department of Natural Resources (sponsor) working in coordination with numerous state and Federal agencies developed a comprehensive plan for the restoration of the Illinois River Basin as authorized in Section 519 of the Water Resources Development Act (WRDA) of 2000. The watershed based restoration study developed the goals, objectives, and recommended plan to restore the ecological integrity of the 30,000 square mile basin. The plan recommends a tiered approach with initial implementation of a $130 million adaptive restoration program. The study addressed all restoration needs regardless of implementation agency and developed a multi-agency implementation approach. This presentation will highlight the lessons learned in conducting this study effort. Topics covered will include: the approach taken to define problems and establish goals and objectives; establishment of a collaborative planning and implementation framework; formulation of total restoration needs and a near term implementation approach, and the approach to monitoring and adaptive management. Implementation is ongoing with the first restoration project under construction in 2009.

Contact Information: Marshall B. Plumley, U. S. Army Corps of Engineers; Rock Island District, USACE-Rock Island District, PO Box 2004, Rock Island, IL 61204-2004, Phone: 309-794-5447,
Email: marshall.b.plumley@usace.army.mil

Spring Restoration in the Mojave National Preserve

Boris Poff, *David R. Nichols* and *Debra L. Hughson*
Mojave National Preserve, National Park Service, Barstow, CA, USA

The Mojave National Preserve is located in one of the driest parts of the nation, with an annual precipitation ranging from two to six inches. However, within its 1.6 million acres, it has more than 200 natural water sources that sustain wildlife and often endemic biota. Long periods of drought combined with infrequent and sometimes severe storms characterize the Mojave Desert. Understanding, restoring and maintaining water resources in these extreme environmental conditions is one of the great challenges facing resource manager, even without changes in our current climatic conditions. While there is generally public support for the restoration of springs and other water resources within the park boundaries, there is great disagreement what to restore these resources to. Historically miners and ranchers have modified naturally occurring water to fit their needs. However, does that mean we should restore springs to pre-European settlement conditions? Did the native inhabitants alter the water resources to fit their needs? Has wildlife become accustomed to and dependent on the water modifications put in place by humans? Should management attempt to off-set changes in water availability due to a changing climate? These are just some of the questions addressed in current studies involving spring restoration in the Mojave National Preserve.

Contact Information: Boris Poff, Mojave National Preserve, Barstow, CA 92311, USA, Phone: 760-928-2069, Fax 760-252-6174, Email: boris_poff@nps.gov

Achieving Sustainable Ecosystems in the Future: A Framework for Today's Restoration Planning Programs

Adam Hosking[1], ***Jon Porthouse***[2] and *Peter von Lany*[3]
[1]Halcrow, Inc, Tampa, FL, USA
[2]Halcrow, Inc, Baton Rouge, LA, USA
[3]Halcrow Group Ltd, Exeter, England

Climate change, regardless of its causes and despite our mitigation efforts, will affect coastal, estuarine and fluvial ecosystems. Future sea level rise, changes in sea-surface and air temperatures, altered rainfall patterns, and changes in frequency and/or intensity of tropical storms and hurricanes are all potential drivers for change in ecosystem form and function. Sustainability, by definition, requires us to consider future conditions (needs, opportunities, and constraints) as a foundation of ecosystem restoration planning. In this context, restoration practitioners must: have an awareness of how ecosystems will evolve with no intervention; understand the range of uncertainty; and assess how any potential interventions may function in the future under conditions that may be very different than those evident today. Future climate changes may affect the probability of achieving some management and restoration objectives and increase the potential for conflicts as certain resources become scarcer. Early identification of these issues will enable ecosystem restoration programs to adopt proactive approaches to management and restoration based on a range of future scenarios.

In formulating ecosystem objectives and implementing restoration activities, we can draw on lessons from international best practice in long-term planning that takes climate change into account. The United Kingdom offers a strong role model in that long-term planning (up to 100 years) is a central feature of the watershed and coastal management process. The use of sustainability indicators for plan appraisal provide a means of evaluating the performance of restoration options across a range of future scenarios against sustainability criteria such as adaptability, resilience, robustness, social justice and good governance.

Concerns over sustainability have also led to the recognition that planned efforts to mitigate the causes of climate change need to be complemented by planned adaptation actions. Adaptation can take various forms: (a) *anticipatory* or *proactive* adaptation, which takes place before impacts of climate change are observed; (b) *autonomous* or *spontaneous* adaptation, which is triggered by ecological changes in natural systems; and (c) *planned adaptation,* which results from deliberate policy decisions based on an awareness that conditions have changed or are about to change. Adaptation can be delivered through state or national policies, watershed strategies, and restoration project or program implementation to ensure sustainable ecosystems.

This paper will draw on our experiences in the United Kingdom and in coastal Louisiana to highlight best practices that can improve our ability to adapt and deliver sustainable ecosystem restoration in the face of uncertain effects from climate change.

Contact Information: Jon Porthouse, Regional Manager, Halcrow, Inc., 5615 Corporate Blvd. Suite 500B, Baton Rouge, LA 70808, Phone: 225-247-1078, Email: PorthouseJ@halcrow.com

The Use of Long Term Monitoring and Adaptive Management Techniques to Reach Project Goals at a New Jersey Wetland Mitigation Bank

Ronald W. Prann and *Denise Page*
Shaw Environmental, Inc., Trenton, NJ, USA

Shaw Environmental, Inc. has completed the eighth year of a wetland monitoring at Wyckoff's Mills Wetland Mitigation Bank (Wetland Bank) in Monroe Township, NJ. The goal of the Wetland Bank is to replace freshwater wetland acreage, and ecological functions and values that are lost or altered due to authorized impacts to freshwater wetlands.

The site consists of 161 acres, comprised of 86 acres of created freshwater wetlands of different classes, 62 acres of preserved mature forested wetland, 13 acres of transition areas. After the first four years, approximately one third of the created wetland continued to fall short of meeting the hydrology requirements, inundation or saturation within 12 inches of the ground surface for two weeks within the growing season. During monitoring years 5 and 6, a few minor inexpensive adaptive management modifications were performed in hopes of capturing additional precipitation on site and slowing the overall flow of water off site with a goal to expand and extend the inundated and saturated areas on site.

After the completion of the sixth year of monitoring it was determined that larger modifications were necessary to ensure that the hydrologic requirements were met. A 20 acre portion of the site was re-graded and re-vegetated with a goal of capturing more water on the site for longer periods of time. Soils and vegetation continue to be monitored annually, with hydrology being monitored weekly to determine the success of the adaptive management activities.

With the additional adaptive management modifications in place, conditions are expected to continue to improve thus making the Wetland Bank a success.

Contact Information: Ronald W. Prann, Shaw Environmental Inc., 200 Horizon Center Blvd, Trenton, NJ 08691 USA, Phone 609 588 6345, Email ron.prann@shawgrp.com

A Restoration Program Planning and Evaluation System: Selecting Performance Measures and Relating Them to Environmental Status

Chad Praul, *Jeremy Sokulsky* and *Marcy Protteau*
Environmental Incentives, LLC, South Lake Tahoe, CA, USA

Ecosystem restoration programs have found it challenging to clearly describe and effectively report benefits, yet these functions are critical to maintaining support. An issue that programs often face is accountability for environmental or socioeconomic conditions that they may influence but cannot control. In some cases this has lead to either a focus on simple "bean counting" or reluctance to measure the status of the system being influenced. The planning and evaluation system described here provides an evaluation structure for linking program actions to environmental outcomes and a process for selecting meaningful performance measures.

The evaluation structure includes (1) performance measures that quantify actions taken by the program, (2) indicators describing environmental or socioeconomic conditions and (3) management-oriented conceptual models to describe linkages between metrics. Performance measures are outputs of program actions and should be directly related to the program's strategic goals and objectives. Performance measures should be relatively easy to collect and should be measurable shortly after actions are complete. Indicators should be closely related to the status of the environmental or socioeconomic system that the program is designed to influence. Indicators should also be understandable to the public and measurable within the resource limitations of the program. Conceptual models provide important context that depicts program goals, the drivers that are understood to affect the system and the actions that the program will take to work toward the goals.

The performance measure selection process includes several steps that enhance internal support and external understanding of the performance measures. The process starts with an initial brainstorming session among program managers, scientists and key stakeholders that generates a large number of potential performance measures. The group of performance measures is focused via two screening steps by performance specialists that result in ratings of the performance measures in three categories: level of measurement effort, relevance to environmental and socioeconomic systems, and frequency of use by similar restoration programs. Further input is gained from program staff, board members, all stakeholders and the public in several additional rating categories: information value, usability, ability to fund, and necessity for management decisions. Last, a focused group of decisionmakers reviews all input and selects a manageable set of performance measures for the program in a workshop format.

The evaluation structure and process for selecting performance measures helps program managers who are pressured to quantify benefits by structuring selection of appropriate metrics and building support among stakeholders. When used within a continual improvement or adaptive management cycle, these tools and processes enhance the potential for a successful long-term restoration effort by helping funders to understand how resources are employed and why they are expected to improve environmental or socioeconomic conditions.

Contact Information: Chad Praul, Partner, Environmental Incentives, LLC, 1027 Emerald Bay Road, South Lake Tahoe, CA 96150, Phone: 530.541.2980, Email: cpraul@enviroincentives.com

Ecological Dynamics Simulation Model a Restoration Tool

David Price[1]*, Terry McLendon*[2]*, Cade Coldren*[2]*, Michael Childress*[2]*, Rob Newman*[3] and
David W. Martin[4]
[1]Engineer Research and Development Center, Vicksburg, MS, USA
[2]Raven Enterprises, LLC, Fort Collins, CO, USA
[3]US Army Corps of Engineers, Fort Worth, TX, USA
[4]Los Angeles Department of Water and Power, Bishop, CA, USA

Problem: Ecosystem restoration at watershed scales is hindered by a lack of predictive tools that assess restoration alternatives under a wide variety of land/water use and disturbance scenarios. This is especially problematic on lands subjected to multiple land use practices, stakeholders, and regulatory constraints. Tools that adequately accommodate the process complexities of ecological dynamics at various spatial and temporal scales can be of great utility to decision makers. The Ecological DYnamics Simulation (EDYS) system was developed to assist managers in selecting defensible strategies to best meet difficult management and restoration objectives, given complex regulatory constraints, and variable climatic and disturbance scenarios.

Solution: EDYS is designed to mechanistically simulate complex ecological dynamics across spatial scales ranging from square meters to landscape and watershed levels. Modules include climatic simulators, hydrology, soil profile, nutrient and contaminant cycles, plant community dynamics, herbivory, management activities, and natural and anthropogenic disturbances. Designation of scenarios and management alternatives for each simulation run is conducted within a Microsoft Windows user interface.

Benefit: EDYS allows the user to quickly evaluate restoration alternatives that include a combination of several different management actions implemented at different spatial and temporal scales depending on the alternative. The alternatives can also be evaluated based on a range of weather patterns e.g., dry versus average versus wet periods. EDYS is science based and can be used within an MCDA framework so that risk can be adequately addressed. EDYS can and has been linked with surface and ground water models to provide a holistic approach to watershed analysis and simulation. EDYS has been through multiple peer reviews and has been verified and independently validated, including accuracy assessment and sensitivity analysis.

Collaboration: EDYS was conceived and originally developed by Terry McLendon as a teaching tool for his ecology courses. The team developed several applications for military installations and watersheds managed by the Bureau of Land Management and the Natural Resources Conservation Service. We have also collaborated with the US Army Corps of Engineers, several Universities, private firms, foreign government agencies, and municipalities to develop numerous applications in the U.S., Indonesia, and Australia. EDYS Light (EDYS-L) is a recent product that comes fully parameterized, with visualization tools and a GIS interface.

Contact Information: David Price, Environmental Laboratory, Engineer Research and Development Center, Vicksburg, MS 39180 USA, Phone: 601-634-4874, Fax: 601-634-3519, Email: david.l.price@erdc.usace.army.mil

Conceptual Models: Communication and Decision-Making Tools for Multi-Agency Resource Management

***Marcy Protteau*[1]**, *Jeremy Sokulsky*[1], *Chad Praul*[1] and *Shane Romsos*[2]
[1]Environmental Incentives, LLC, South Lake Tahoe, CA, USA
[2]Tahoe Regional Planning Agency, Stateline, NV, USA

When a region's natural and cultural resources are managed by several agencies with overlapping jurisdictions and goals, it can lead to duplication of monitoring efforts, competing understandings of what restoration actions can best lead to goals, and inefficient use of available funds and staff time. Because funding and staff time are limited, resource managers are faced with a challenge – how should multiple agencies coordinate their efforts and allocate resources to achieve common goals in a cost-effective manner?

Conceptual models (CMs) provide an opportunity for collaboration and alignment of goals and efforts, and can improve agency decision-making and increase understanding of environmental and socioeconomic conditions. CMs provide a "big picture" description of system condition without getting bogged down in the details. They are used to 1) define the current understanding of the most important drivers that affect the status of a system, 2) assist in the selection and interpretation of meaningful indicators to track system status, and 3) identify the most influential actions for improving system status.

While CMs are used in many efforts, they are frequently not used by resource managers and stakeholders. The Lake Tahoe Status and Trend Monitoring and Evaluation Program (M&E Program) has defined a CM development process and a set of standards that result in well documented CMs that are useful for agency management, executives and engaged stakeholders. Resource managers can use CMs to inform decisions about where to allocate funds and staff time for monitoring and restoration activities. The CMs are also a valuable communication tool to convey decision-making rationale and progress toward goals to stakeholders, the public, and agency executives. As part of a comprehensive adaptive management system, CMs can be modified over time to reflect new scientific knowledge, evolving system understanding, innovations in management actions, and changes in policy context.

Contact Information: Marcy Protteau, Environmental Incentives, LLC, 1027 Emerald Bay Road, South Lake Tahoe, CA 96150, Phone: 530.541.2980, Fax: 530.541.1387, Email: mprotteau@enviroincentives.com

Modeling Cottonwood Habitat and Forecasting Landscape Changes along the Missouri River

Lisa A Rabbe[1], *Kristine Nemec*[2], *Kelly Burks-Copes*[3] and *Suzie Boltz*[4]
[1]Corps of Engineers, Kansas City District, Kansas City, MO, USA
[2]Corps of Engineers, Omaha District, Omaha, NE, USA
[3]Engineer Research & Development Center, Vicksburg, MS, USA
[4]EA Engineering, Baltimore, MD, USA

In the Corps Planning process, a quantitative and qualitative description of resources is made, for both current and future conditions, and is used to define existing and future without-project conditions. The forecast of the future without-project condition reflects the conditions expected during the period of analysis and provides the basis from which alternative plans are formulated and impacts are assessed.

While this sounds easy in theory, not everything from the past mirrors what may happen in the future so the forecasting is a blend of projecting historical trends with polling the opinions of experts where data is lacking. This requires an interagency multi-disciplinary team of experts for realistic forecasting.

Our presentation will discuss how the Corps has blended data and expert opinion in the future forecasting for habitat modeling and how that contributes to the overall planning process for recommending better plans.

Contact Information: Lisa Rabbe, Corps of Engineers, Alaska District, PO Box 6898, Elmendorf AFB 99506 USA, Phone: 907-753-2634, Fax: 907-753-2625, Email: lisa.a.rabbe@usace.army.mil

Progress on Guidelines for Assessing Physical Dam Removal Impacts

Timothy Randle, *Blair Greimann,* and *Jennifer Bountry*
U.S. Bureau of Reclamation, Sedimentation and River Hydraulics Group Denver, CO

The interagency Subcommittee on Sedimentation is preparing guidelines to assess the sediment-related impacts associated with dam removal on the river channel and former reservoir area. These guidelines will assist engineers and scientists when they are determining the proper level of data collection, analysis, modeling, and monitoring needed for assessing dam removal impacts. The guidelines are intended to be applicable to a wide range of potential dam removal scenarios with a wide range of sediment issues. Sediment-related impacts of dam removal fundamentally depend on the initial reservoir sediment mass, size, and quality; and the extent and rate of reservoir sediment erosion.

The Subcommittee began this effort by sponsoring an interagency workshop in Portland, Oregon during October 14-16, 2008. The workshop focused on the three topics:

1. Reservoir sediment erosion and redistribution.
2. Downstream sediment transport and deposition.
3. Water quality changes and impacts on biologic resources.

The guidelines will consist of a two-tiered analysis decision tree. The first tier will be to assess the scope of the sediment problem through the use of scoping questions, data collection, and analysis. These activities will be used to determine the probability, consequence, and risk of sediment impacts.

The second analysis tier will predict the sediment impacts resulting from the dam removal. Additional questions will be used to guide impact predictions. Data collection and analysis tools will be proposed to predict sediment impacts and guide dam removal mitigation measures based on the potential level of risk.

Contact Information: Tim Randle, Manager, Sedimentation and River Hydraulics Group (86-68240), U.S. Bureau of Reclamation, P.O. Box 25007, Denver, CO 80225, Email: trandle@do.usbr.gov

Putting Resources to the Level Where the Work Gets Done: New Opportunities for Chesapeake Bay Restoration in Maryland

Matthew J. Fleming[1], *John McCoy*[2] and ***Jennifer Raulin***[1]
[1]Chesapeake & Coastal Program, Maryland Department of Natural Resources, Annapolis, MD, USA
[2]Ecosystem Restoration Center, Maryland Department of Natural Resources, Annapolis, MD, USA

After 25 years of dedicated effort to restore the Chesapeake Bay, it is clear that Maryland and our partners are not achieving our goal. While improvements have been realized in some areas, there is now growing evidence that conditions may be worsening in other areas. A new approach is needed now if we are to be successful. To that end, State leaders in Maryland have taken bold steps in their efforts to restore the Chesapeake Bay and Atlantic Coastal Bays.

In 2007 the State of Maryland identified new ways to enhance their land conservation programs, using targeting, to maximize available funding by setting priorities for which new lands were to be acquired. They followed suit in 2008 with the passage of the Chesapeake and Atlantic Coastal Bays 2010 Trust Fund and Non-point Source Fund (CBTF), laying the foundation for an ambitious strategy for restoring and protecting the bays and their tributaries.

CBTF is a unique, dedicated source of funding that is generated from rental car and motor fuel tax revenue. The CBTF allows Maryland to accelerate Bay restoration by focusing limited financial resources on the most effective non-point source pollution control projects. Watersheds are prioritized based on potential nutrient load into the mainstem of the Bay, strength of local government and partner support, ability to leverage maximum funding, and the potential to demonstrate a measurable difference in a relatively short amount of time. In addition to resources provided through the CBTF, the Watershed Assistance Collaborative (WAC) was formed to increase capacity in Maryland communities interested in undertaking these types of comprehensive watershed restoration projects, through training, financial and technical assistance.

As a case study, an update on the Corsica River Watershed Restoration Initiative will be discussed. The Corsica River watershed was selected as a pilot project to demonstrate the effectiveness of a targeted, multi-practice, restoration effort. Implementation efforts have included cover crops, stormwater retrofits, septic upgrades, and wetland, oyster, and SAV restoration. In addition, recent outreach and awareness campaigns have led to changes in behavior and policy.

(Part II – Continuation of Discussion on Chesapeake Bay Restoration – spoke with Tom St. Clair and David Koran about oral presentation of all three abstracts submitted from MD Dept. of Natural Resources)

<u>Contact Information</u>: Jennifer Raulin, Maryland Department of Natural Resources, Watershed Services, Tawes State Office Building, E-2, Annapolis, MD 21401 USA, Phone: 410.260.8745, Fax: 410.260.8739,
Email: jraulin@dnr.state.md.us

Federal Conflict Resolution Centers – Introduction to the Federal Centers

Deborah, Dalton[1], *Elena Gonzalez*[2], *Brian Manwaring*[3] *and* ***Kerry Redican***[4]
[1]US Environmental Protection Agency, Conflict Prevention and Resolution Center, Washington, DC, USA
[2]US Department of the Interior, Office of Collaborative Action and Dispute Resolution, Washington, DC, USA
[3]US Institute for Environmental Conflict Resolution, Tucson, AZ, USA
[4]US Army Corps of Engineers, Institute for Water Resources, Alexandria, VA, USA

Conflict resolution centers have been created in many Federal agencies to provide services and resources in the fields of collaboration, public participation and conflict resolution. These centers provide important services that can help staff work through challenging and complex ecosystem restoration initiatives. This presentation will include an introduction to the Federal conflict resolution centers in the Army Corps of Engineers, Environmental Protection Agency, Department of the Interior, and US Institute for Environmental Conflict Resolution. A summary will be provided of the resources and services that are available including professional rosters, tools, training, and case studies.

Contact Information: Kerry Redican, Institute for Water Resources, US Army Corps of Engineers, 7701 Telegraph Rd., Alexandria, VA 22315-3868 USA, Phone: 703-428-9088, Fax: 703-428-8171,
Email: kerry.m.redican@usace.army.mil

Comprehensive Everglades Restoration Program Adaptive Management Opportunities: What Regional Simulations Suggest about the Risks and Rewards of the First Ten Proposed Restoration Projects

Jim Vearil[1]*, Elmar Kurzbach*[1]*, Agnes McLean*[2]*, Steve Traxler*[3]*, Andy Gottlieb*[4]*, Rebecca Elliot*[5]*, Tom St. Clair*[6]*,* ***Jed Redwine***[6] and *Andy LoSchaivo*[6]
[1]US Army Corps of Engineers, Jacksonville, FL, USA
[2]Everglades National Park, Miami, FL, USA
[3]U.S. Fish and Wildlife Service South Florida Field OfficeVero Beach, FL, USA
[4]South Florida Water Management District, Everglades Restoration Planning Offices, West Palm Beach, FL, USA
[5]Florida Department of Agriculture and Consumer Services, West Palm Beach, FL, USA
[6]EPJV, Jacksonville, FL, USA

Regional watershed managers and stakeholders need to know how managed and natural systems are expected to function as restoration projects under CERP are built. Since the intent of the projects is to alter the qualities of the system to achieve restoration, it is necessary to determine both what benefits to the system are likely to occur and what risks may exist during the course of project construction and implementation. Simulation models are used for planning purposes, and the information that can be gleaned from these planning exercises is useful for anticipating areas of success as well as areas of concern. Project benefits or concerns may ultimately need to be addressed through alteration of plans for future projects, or outside of the planning context by either operators of the existing infrastructure or managers who consider the sequencing of future projects. In addition to the significant benefits indicated by the simulations, evaluation of model results that describe the first ten proposed CERP projects resulted in the identification of five potential areas of concern that should likely be addressed through adaptive management processes:

1. Demand increases in the Lower East Coast Service Areas (Palm Beach, Broward, and Miami-Dade Counties) indicate critical shortfalls in water availability every two to three years.
2. Balancing the health of Lake Okeechobee with estuarine health and the Lake's ability to increase hydroperiods throughout the Everglades wetlands.
3. The intensity of extreme droughts may increase across the system.
4. A 90 mile^2 wetland landscape contained in Water Conservation Area 3B appears likely to experience a very different hydropattern than exists currently, or than existed historically. A strategy to manage the transition of landscape type is advisable.
5. Operations along the northern (upstream) boundary of Water Conservation Area 3A (the current interface with the Everglades Agricultural Area) need to be optimized so that this area does not experience increased frequency and intensity of drought conditions. This issue is integrally related to the operations and compliance methods used to address existing water quality issues.

These AM opportunities are based on the simulated results from a system-wide modeling construct, and are offered to managers, stakeholders, and the general public to support future decisions in the implementation of CERP.

Contact Information: Jed Redwine, PBS&J/EPJV, 701 San Marco Suite 1201, Jacksonville, FL 32207, Phone: 904-232-1181, Fax: 904-232-1056, Email: jed.redwine@usace.army.mil

Interpreting the Ecological Effects of the First Ten Everglades Restoration Projects Using Simulation Modeling and Performance Measures

Dan Nehler[1], *Alicia LoGalbo*[2], *Gregg Reynolds*[2], *Doug Donalson*[3], *Agnes McLean*[2], *Andy Gottlieb*[4] and ***Jed Redwine***[5]
[1]U.S. Fish and Wildlife Service South Florida Field Office, Vero Beach, FL, USA
[2]Everglades National Park, Miami, FL, USA
[3]US Army Corps of Engineers, Jacksonville, FL, USA
[4]South Florida Water Management District, Everglades Restoration Planning OfficesWest Palm Beach, FL, USA
[5]EPJV, Jacksonville, FL, USA

The simulation models used to evaluate the ecological effects of the first set of restoration projects (Band 1) portrays a regional system where restoration delivers ecological benefits to over a thousand square miles of Everglades freshwater wetlands, saltwater marshes, and seagrass beds. The majority of the areas experience reduced drought or less saline conditions. Several hundred square miles of wetlands located along the eastern and southern (downstream) boundaries of the impounded Water Conservation Area (WCA) 3A are relieved of long periods of deep water, and while some deep water periods remain, nearly half of the time spent experiencing deep water has been eliminated.

A few issues of concern remain, and the simulations suggest that opportunities exist for optimizing two specific areas of the regional system. The most extreme dry conditions in the future may be slightly worse in most of northern WCA 3A if Band 1 projects are not followed up with an Adaptive Management process that begins to integrate future projects that add significant water storage and delivery capacity to the Regional System (like Reservoirs, Aquifer Storage and Recovery systems, and/or treatment wetland flow-ways that allow a significant hydraulic connection of Lake Okeechobee with the River of Grass). The increased duration of inundations projected to occur in WCA 3B will likely require a managed transition so that the landscape can be slowly shifted to plant and animal communities which tolerate longer hydroperiods in a manner that is consistent with maintaining a healthy landscape.

Contact Information: Jed Redwine, PBS&J/EPJV, 701 San Marco Suite 1201, Jacksonville, FL 32207,
Phone: 904-232-1181, Fax: 904-232-1056, Email: jed.redwine@usace.army.mil

Performance Measures are Essential for Planning, Operation and Validation of Landscape Restoration Projects

Jed Redwine
PBS&J, Jacksonville, FL, USA

Landscape restoration projects are likely to be a central organizing feature in determining how the United States re-engineers its infrastructure in the coming decades. Quantitative determinations of how a landscape can be expected to perform following engineered modifications are essential for planning, actual operation, and subsequent validation of the effects of an engineered solution. The term "Performance Measures" has been coined by scientists working with the Comprehensive Everglades Restoration Program (CERP) to describe topic-specific, information filters that quantitatively describe the simulated effects of engineered projects and altered operations on the landscape. Ideal performance measures are based on objective facts determined through scientific experiment. When performance measures have been developed in this way, they are also very useful for guiding operation of the system, since they provide specific information about the environmental conditions that lead to negative environmental impacts. Finally, the predictive relationships upon which performance measures are based can be essential for validating the effects of a restoration program and the validity of the simulation models that are used to compare alternative project designs. Put simply, performance measures are grounded in physical principals, use predictive relationships to provide quantitative estimates of change, and are useful for validating the changes that occur once projects are constructed and operated. While developing and utilizing performance measures is intellectually challenging, these tools are essential for crafting credible programs which will affect the lives of millions of people.

Contact Information: Jed Redwine, PBS&J/EPJV, 701 San Marco Suite 1201, Jacksonville, FL 32207,
Phone: 904-232-1181, Fax: 904-232-1056, Email: jed.redwine@usace.army.mil

System-wide Planning and Evaluation: Simulating the Hydrologic Effects of the First Ten Proposed Restoration Projects on the Everglades Ecosystem and Regional Infrastructure

Jim Vearil[1], *Agnes McLean*[2], *Lisa Cannon*[3], ***Jed Redwine***[4] and *Andy LoSchiavo*[4]
[1]US Army Corps of Engineers, Jacksonville, FL, USA
[2]Everglades National Park, Miami, FL, USA
[3]South Florida Water Management District, Everglades Restoration Planning Offices, West Palm Beach, FL, USA
[4]EPJV, Jacksonville, FL, USA

System-wide planning and evaluation is essential for managing the transition from an impounded and heavily managed regional watershed to a more passively managed and restored landscape that sustainably supports the defining features of the historic Everglades. System-wide simulation models are used for planning purposes to describe the condition of the regional system over a long time series. By conducting this type of simulation, planners are able to learn how future projects are likely to interact to produce ecological effects, supplement regional water supply, and manage flood risk. The system-wide modeling approach offers planners the opportunity to address some of the most difficult issues associated with watershed planning, such as:

1. What types of local changes and/or regional trade-offs may need to be identified and considered in order to maximize the desired regional effects?

2. How do projects interact to produce greater effects on the regional system than they appear to produce when simulated as isolated components (i.e. is the effect of a set of projects greater than the projected effects of individual projects)?

3. As projects are added to a regional system where water supply demands continue to escalate, what are the short-term risks that should be anticipated and/or adaptively managed with operations or changes to the schedule for future projects?

The multi-project simulations provided planners and managers a platform to address these types of questions for CERP in a way that has not been possible with previously conducted simulations of individual projects.

Contact Information: Jed Redwine, PBS&J/EPJV, 701 San Marco Suite 1201, Jacksonville, FL 32207,
Phone: 904 232-1181, Fax: 904 232-1056, Email: jed.redwine@usace.army.mil

Restoring Coastal Ecosystems in the Face of Climate Change: Using What We Know

Denise J. Reed
University of New Orleans, New Orleans, LA, USA

Advances in the scientific community's ability to predict and model the future climate have been steadily increasing, highlighted in the most recent Intergovernmental Panel on Climate Change report (i.e. IPCC AR4). However, precise values of future temperatures and precipitation are not known due to uncertainties in the complex nature of the affecting atmospheric, terrestrial, and oceanic processes and due to the uncertainties of the future levels of anthropogenic development that influence the production of greenhouse gases linked to climate change. Even if they don't provide definitive predictions the climate models, as used in the IPCC report, do offer insight into the range of possible future climates by exploring the effects of a wide range of environmental process interactions and development scenarios. Applying this knowledge of the range of possibilities is especially helpful as regional planners and managers prepare for the effects of a changing climate in coastal systems that are highly susceptible to sea-level rise, storm related damages, and droughts and flooding.

This paper explores two approaches, one analytical and one expert based, to using existing knowledge about climate change and coastal system dynamics to explore an array of plausible future states for coastal wetlands and describes how such information can be used to assess restoration options.

Contact Information: Denise J. Reed, Pontchartrain Institute for Environmental Sciences, University of New Orleans, New Orleans, LA 70148, USA, Phone: 504-280-7395, Fax: 504-280-7396, Email: djreed@uno.edu

Contemporary Planning Issues for Large Scale Ecosystem Restoration Programs

Russell Reed[1] and *Bill Hinsley*[2]
[1]HydroPlan LLC, Portland, OR, USA
[2]PBS&J

This presentation focuses on contemporary planning issues for large scale ecosystem restoration initiatives through an investigation (case studies) of three ongoing programs. These water resources planning and ecosystem restoration programs include the Louisiana Coastal Area, the Comprehensive Everglades Restoration Plan, and the Illinois River Basin Restoration Comprehensive Plan. All three studies included leadership from federal (USACE) and non-Federal (State) governments with significant contributions for multiple Federal and State Agencies. Furthermore, each study has had to follow the Economic and Environmental Principles for Water and Related Land Resources Implementation Studies and The Economic and Environmental Guidelines for Water and Related Land Resources Implementation Studies. A summary showing the major steps undertaken by each of these studies to formulate a system-wide comprehensive plan and the methods used to ultimately select specific projects for construction authority through a Water Resources Development Act (WRDA) will be presented. Although analytic approaches varied among these projects, the general tasks remain the same. After illustrating relevant similarities and differences, the presenters will discuss desired results and outcomes of each study.

Contact Information: Russell Reed, HydroPlan LLC, 3720 SE Tolman Street, Portland OR 97202, USA, Phone: 503-297-4397, Fax: 503-297-4397, Email: rreed@HydroPlanLLC.com

Effective Partnering for Setting and Achieving Habitat Conservation Goals

Fritz Reid[1], *Beth Huning*[2] and *Sandra Scoggin*[2]
[1]Ducks Unlimited, Rancho Cordova, CA, USA
[2]San Francisco Bay Joint Venture, Fairfax, CA, USA

In the effort to create a climate and constituency for wetlands protection and restoration in San Francisco Bay, one element is absolutely essential - the formation of strategic partnerships. With a complex political, regulatory and ecological landscape in the Bay Area, collaboration is the key to be able to navigate and achieve success. Whether the major challenges are political, funding related, public opinion, or technical, solutions can be found by working together with partners who share a vision for the project or for the larger landscape. This presentation will explore and describe the structure, process and successes of many partnerships that have been formed over the last decade that have resulted in the protection and restoration of tens of thousands of acres of wetland habitat in the San Francisco Bay Area. We will present ideas to help those looking to create new partnerships as well as strategies for enhancing existing collaborations. Bringing together unique strengths of individuals and groups with solid science and visionary funding has been the core of success in San Francisco Bay. This presentation will provide an introduction to many concepts that will be described in further detail by the partners that have joined us for the remainder of this session.

Contact Information: Frederic Reid, Ducks Unlimited, 3074 Gold Canal Drive, Rancho Cordova, CA 95670, USA, Phone: 916-852-2000, Email: freid@ducks.org

Addressing the Sources of Gulf Hypoxia in the Midwest: The Economics and Water Quality Benefits of Agricultural Ditch Restoration Using Two-Stage Channels

Heather L. Dardinger and ***Kristen D. Risch***
Malcolm Pirnie, Inc., Columbus, OH, USA

Hypoxia in the Gulf of Mexico is a significant environmental and economic issue. While there is no single solution to the problem, it is widely agreed that any scheme of potential solutions must focus on ecosystem restoration throughout the Mississippi River Basin, especially in highly agricultural areas. Implementation of two-stage channels within these watersheds offers a significant advantage over traditional agricultural ditches, providing both improved drainage function and ecological function at costs comparable to typical ditch maintenance.

Two case studies involving two-stage channel construction on highly modified, agricultural stream channels in the Ohio River Basin in Ohio will be discussed, including projects completed on North Fork Massies Creek, located in the Upper Little Miami River watershed in Greene County, and Sugar Creek, located in the Ottawa River watershed in Allen County. Each of these projects was partially financed through grant funding, including the Ohio Water Resource Restoration Sponsor Program, Section 319(h) Nonpoint Source Program, and the Great Lakes Basin Program for Soil Erosion and Sediment Control.

For these projects, Malcolm Pirnie evaluated non-point source, watershed-based nutrient reduction alternatives that would reduce the total phosphorus and nitrogen loads in the receiving watersheds by implementing a two-stage channel design to stabilize stream banks and restore riparian buffers. These activities were designed to reduce the nonpoint source sediment load associated with bank erosion and sediment-laden runoff from adjacent agricultural fields, as well as providing higher nutrient assimilative capacity.

In the case of Greene County, this nonpoint source load reduction project will additionally be utilized as a non-point source water quality trade in order to meet National Pollutant Discharge Elimination System permitting requirements for phosphorus for the Sugarcreek Water Resource Reclamation Facility. Reducing the phosphorus load to receiving streams via watershed restoration rather than conventional in-plant treatment represents an innovative and sustainable approach to permitting and water quality improvement on a watershed scale.

Based on the available project data related to erosion and nutrient concentrations from each of the case studies, as well as data from additional two-stage channel projects that have been implemented in Ohio, there is evidence that two-stage channel implementation may have significant implications in relation to the issue of hypoxia in the Gulf of Mexico. This data, as well as the watershed evaluation and decision making processes, project funding, restoration design techniques, construction costs, stakeholder involvement, and public outreach components implemented for each project will be discussed.

Contact Information: Kristen D. Risch, Malcolm Pirnie, Inc., Columbus, OH 43240 USA, Phone: 614-430-2669, Fax: 614-888-6295, Email: krisch@pirnie.com

Successes and Lessons Learned in South San Francisco Bay Wetland Restoration

Steven R. Ritchie[1], *Michelle Orr*[2], *Dilip Trivedi*[3] and *G. Mendel Stewart*[4]
[1]State Coastal Conservancy, Oakland, CA, USA
[2]Philip Williams & Associates, San Francisco, CA, USA
[3]Moffatt & Nichol, Walnut Creek, Ca, USA
[4]U.S. Fish & Wildlife Service, Fremont, CA, USA

South San Francisco Bay is the site of some of the earliest tidal wetland restoration projects in the Bay Area as well as some of the most ambitious. In both the planning and the implementation and monitoring of these projects, much has been learned regarding tidal wetland restoration and adaptive management.

From the early 1900s until the 1990s, the landscape of the South Bay was dominated by evaporative salt production ponds which were created by the piecemeal encirclement of tidal marshes with levees. Over time, many of these ponds have come back into public ownership and have created unprecedented habitat restoration opportunities. Four of the most prominent efforts have been Cooley Landing (115 acres restored to tidal action in 2000), Eden Landing (835 acres restored to tidal action in 2006 and 2008), Bair Island (2600 acres with restoration commencing in 2008), and the South Bay Salt Ponds (15,100 acres with 479 acres restored to tidal action in 2006 and large-scale restoration commencing in 2009).

Each of these projects has provided valuable lessons regarding tidal restoration. These include lessons regarding sediment management, control of invasive plants (particularly invasive *Spartina alterniflora* and it hybrids), and mercury contamination. Additionally, flood control has been a key consideration. This is due to anticipated sea level rise, and also due to the substantial land subsidence that occurred throughout the South Bay as a result of groundwater extraction during a major portion of the salt production era.

In this talk, the 4 restoration projects will be briefly described, and the important lessons learned regarding the issues identified above will be explored.

Contact Information: Steven R. Ritchie, State Coastal Conservancy, 1330 Broadway, 13th Floor, Oakland, CA 94612, USA, Phone: 510-384-4105, Fax: 510-286-0470, Email: sritchie@scc.ca.gov

Puget Sound Nearshore Strategic Needs Assessment and Restoration Planning

Patricia Robinson and *Scott Campbell*
Seattle District Corps of Engineers, Seattle, WA, USA

The Puget Sound Nearshore Ecosystem Restoration Project (PSNERP) is a large-scale, comprehensive initiative to protect and restore the natural processes and functions in the nearshore ecosystems of Puget Sound. PSNERP provides an opportunity to examine the fundamental causes of ecological decline within the Puget Sound basin and to recommend feasible solutions. The study is being conducted under the Corps of Engineers general investigation authority with the Washington State Department of Fish and Wildlife serving as the local (non-federal) sponsor.

One of the initial restoration planning tasks under the program is to conduct a Strategic Needs Assessment. The primary objective of the Strategic Needs Assessment task is to identify impaired processes and restoration and preservation needs based on interpretation of the change analysis data. This presentation will walk through the process of evaluating change analysis data to identify dominant stressors and the potential impact those stressors have on shoreline processes and Valued Ecosystem components. The evaluation of change analysis data will lead to the development of specific problem & opportunity (objective) statements for each of the sub-basins and sound-wide. Restoration strategies will be grounded in guidance on restoration and conservation strategies derived from the peer-reviewed literature. With the specific objective statements, guidance on restoration and conservation strategies, spatially explicit impaired areas in hand the Puget Sound Nearshore team will develop and evaluate comprehensive basin-wide restoration alternatives. This presentation will provide an overview of the planning process and lessons learned.

Contact Information: Patricia A. Robinson, Planning Branch, Seattle District Corps of Engineers, 4735 E. Marginal Way South, Seattle WA 98124, Email: patricia.a.robinson@usace.army.mil

Scott W. Campbell, Technical Services Branch, Seattle District Corps of Engineers, 4735 E. Marginal Way South, Seattle WA 98124, Email: scott.w.campbell@usace.army.mil

Linking Juvenile Salmon Use to Habitat Restoration

Curtis Roegner
NOAA, Hammond, OR, USA

A primary management goal for restoration projects in the tidally-influenced sections the lower Columbia River and estuary (CRE) is to improve rearing habitat for out-migrating juvenile salmonids. Data from individual restoration projects is the basic element needed for more complex regional and cumulative effects analyses. We field-tested standardized monitoring protocols to measure changes in wetland structure and function before and after removal of hydrological barriers. In this talk, we highlight two main metrics, hydrology and salmonid habitat use, to compare conditions before and after a dike breach of a pastureland site. Salmonid "use" includes measures of fish opportunity (presence) and capacity (feeding) in restored and reference sites. Dike breaching caused an immediate return of full semidiurnal tidal fluctuations to the pastureland. We found that juvenile salmonids quickly expanded into this newly available habitat and utilized prey items presumably produced within the marsh. There were differences in habitat utilization by salmon species, with chum and coho salmon exhibiting higher abundances in restoration sites compared with Chinook salmon. Differential migration patterns and life-history stages were also evident, with size-frequency data showing that chum were fry that migrated rapidly through the system; Chinook were a mixture of fry and fingerling-sized animals that were present from March to at least July; and coho were composed of fry, fingerling, and yearling fish also present from March to at least July. Moreover, diet analysis demonstrates that restoring wetland habitats benefits salmonids by providing a high production of varied food items compared to adjacent aquatic systems. Standardized monitoring of key metrics such as hydrography and fishes allows for 1) an evaluation of restoration trajectories for individual sites; 2) a means for comparison between sites; and 3) data inputs for modeling and analysis of the cumulative effects of many restoration sites.

Contact Information: Curtis Roegner, NOAA, 502 Heceta Pl, Hammond, OR 97103, Phone: 503-861-1818, Email: curtis.roegner@noaa.gov

The Herbert Hoover Dike Major Rehabilitation Project, Program Management, Strategies and Challenges of Managing a Major Program

Mike Rogalski
Jacksonville District, U.S. Army Corps of Engineers, Jacksonville, FL, USA

The goal of the Herbert Hoover Dike (HHD) Rehabilitation Project is to rehabilitate HHD to current Corps of Engineers dam safety standards while providing flood protection in accordance with previous authorizations. The project, actually a program includes five major focus areas (construction, design, development of a major rehabilitation report, NEPA and public Outreach) that are ongoing concurrently and have various interdependencies. The HHD rehabilitation project is one of national significance for the Corps of Engineers and is ranked near the top of dam rehabilitation projects.

The HHD rehabilitation effort requires a robust program management effort coordinating the efforts of the sub-teams that include staff from the Corps Jacksonville District, field personnel working at project site located nearly 300 miles from District office, other Corps of Engineers Districts, construction and Architect/Engineer contractors as well as nationwide agency technical review team that provides reviews of all aspects of the project.

The presentation will focus on the management of this effort, utilization of innovative construction contracting techniques to expedite construction and the challenges faced by the project delivery team and the development of the project and balancing of the ongoing concurrent project activities and the changes that occur on almost a daily basis. While the HHD project is not a component of the Comprehensive Everglades Restoration project (CERP), there is regular interaction with the HHD and teams that are working on CERP.

Contact Information: Mike Rogalski, PE, PMP, Chief Herbert Hoover Dike Branch, Jacksonville District, U.S. Army Corps of Engineers, 701 San Marco Boulevard, Jacksonville, FL 32207 USA, Phone: 904-232-1460
Email: Michael.B.Rogalski@usace.army.mil

Building Practical On-The-Ground Responses to the Effect of Climate Change on West Coast Wetlands Restoration and Protection

Rudolph A. Rosen[1], *Kevin L. Petrik*[1], *Xiangyue Wei*[1] and *Mark J. Petrie*[2]
[1]Ducks Unlimited, Inc., Rancho Cordova, CA, USA
[2]Ducks Unlimited, Inc., Vancouver, WA, USA

Ducks Unlimited has approximately 300 wetlands restoration projects now underway in partnership with state, federal, and local governments and private interests in the western states, and has completed over 2,700 projects. Many projects are in coastal areas and projected to be impacted by sea level rise or other climate change caused effects. Current predictions show 44% to 52% loss of northwest coastal tidal flats and brackish marsh due to sea-level rise over the next 90 years. In an effort to maintain past investment in restored wetlands and ensure future work integrates climate change in early planning, DU is taking steps to ensure the resiliency of West Coast wetlands in the face of climate change. Among efforts, DU is refining current predictive models to better predict coastal wetland loss, including introducing measures of uncertainty. This will allow an estimate of resiliency of various wetlands conservation strategies. Work is also underway to fill information gaps in the effects of sea-level rise for some key wetlands areas along the West Coast, such as Gray's Harbor in Washington, and along the Oregon coast south of Tillamook Bay. DU is also working with the agriculture community and county and local governments along the coast to gain support for keeping coastal areas free of development to preserve options for inland migration of wetlands as sea level rises. Maintaining today's coastal farmland may be the most important step in providing space for tomorrow's coastal wetlands.

Contact Information: Rudolph A. Rosen, Ducks Unlimited, 3074 Gold Canal Drive, Rancho Cordova, CA 95670, USA, Phone: 916-296-0769, Fax: 916-852-2200, Email: rrosen@ducks.org

Regaining Overland Flow - Spreader Canals as an Adaptable and Secure Alternative for Flow Control and Habitat Recovery

A. Charles Rowney[1], *Victoria Lehr*[2], *Dave Weston*[3] and *Ron Armstrong*[4]
[1]Manager, ACR, LLC, Orlando, FL, USA
[2]PWI, West Palm Beach, FL, USA
[3]USACE, Jacksonville, FL, USA
[4]PWI, Tampa, FL, USA

Land development in the 1950s caused massive changes in the ecosystems prevailing in the area of the Picayune Strand Restoration Project (PSRP) in south-west Florida. Artificial drainage systems implemented in this area have eliminated the original mix of natural overland flow and amorphous flow ways. Present remediation plans include a major effort to restore 85 square miles of artificially drained lands to a natural wetlands condition. This is complex because the network of canals that exists now is critical to flood drainage from extensive residential developments upstream, and removal of that network must be done in a way that does not threaten those developments. Collection of upstream flows can be accomplished by placing several large (several thousand cfs) pumps to collect and discharge drainage from upstream areas to the rehabilitation area below. Discharging these flows over the land surface below is not simple because the potential exists for erosion and preferential flow path development below the discharge points, particularly under extreme events but also over the long term as a result of frequent lower flows. If preferential flow paths re-occur, the system will not be rehabilitated as intended but will tend to an alternative un-natural flow pattern. Spreader canals can achieve the desired discharge pattern, but are challenging because of the need to ensure hydraulic efficiency while spreading flows without impeding the natural movement of wildlife in the area or causing major operational issues. An extensive literature review and interview process demonstrated that precisely similar solutions and situations are rare and extensive site specific analysis and field investigation was carried out. Detailed large scale modeling and habitat analysis suggested an approach that resolved the diverse flood flow management, recharge distribution, facility placement, engineering issues and habitat requirements. Key to this approach is that it enables adaptive management of flow distribution as recovery patterns and preferential flow paths begin to express themselves, which adds considerably to the resilience and promise of this approach. This paper discusses the precedents and differences for this type of system, and outlines the hydraulic, geomorphic, hydrologic and other analyses that were considered as the alternative configurations were evaluated. The selected discharge/spreader system, which constitutes a hydraulic interface between the developed and natural areas of the watershed, may prove to be a solution that will have relevance in a number of other areas where the interests of rehabilitation collide with the requirement to respect existing development. Lessons learned and potential applications elsewhere are discussed.

Contact Information: A.Charles Rowney, ACR, LLC, Florida, 32750, USA, Phone: 407-970-8744,
Email: acr@rowney.com

Use of Fused Hyperspectral and LIDAR Airborne Data to Map Offshore Stamp Sand Migration in Keweenaw Peninsula, Michigan

Mark R. Graves and ***Bruce M. Sabol***
Environmental Laboratory, US Army Engineer Research and Development Center, Vicksburg, MS, USA

Restoration decisions need to be based on the best and most current knowledge of environmental conditions at the restoration site. Towards this end, a major multi-faceted field data collection and sampling effort was conducted to examine the migration of copper mining waste sands (stamp sands) at two sites along the Lake Superior shoreline. The CHARTS (Compact Hydrographic Airborne Rapid Total Survey) airborne Light Detection and Ranging (LIDAR)/hyperspectral sensor system, jointly operated by the Corps, National Oceanic and Atmospheric Administration (NOAA) and the Navy, collected imagery and LIDAR data over two copper mining waste sites along the Keweenaw Peninsula in Lake Superior to support a study examining the transport of the black copper-bearing stamp sands by natural processes. Corps of Engineers researchers coordinated with local study participants at Michigan Technological University (MTU) to develop a week-long sampling effort to provide ground truth during the CHARTS overflight. Measurements were taken of spectral reflectance of terrain and lake bottom surface, light reflection and extinction characteristics within the lake water, acoustic bottom typing of the lake bottom near the stamp sands deposits, water quality parameters, and bottom samples. These data served to aid in processing the data collected by the CHARTS system to delineate the progressive spread of the stamp sands. Study conclusions will assist the Corps' Detroit District in developing plans for stamp sands remediation. This study represents one of the first major studies using CHARTS for environmental analysis purposes and is funded by the System-Wide Water Resources Program under a work unit targeted at the development of data fusion techniques.

Contact Information: Bruce Sabol, US Army ERDC, 3909 Halls Ferry Road, Vicksburg, MS 39180 USA, Phone: 601-634-2297, Fax: 601-634-3726, Email: Bruce.M.Sabol@usace.army.mil

Developing a Non-Profit Restoration Program

Lia K. Sansom and *Kendall W. Kroesen*
Tucson Audubon Society, Tucson, AZ, USA

Tucson Audubon Society has developed its habitat restoration program to promote the organization's mission of conserving habitat and providing educational and recreational resources; to accommodate the demands and interests of all stakeholders involved in the properties we work on; and to raise funds to support other Tucson Audubon education and conservation programs. What began as a program to try and increase bird habitat on parcels of abandoned agricultural land in the Santa Cruz River Valley now includes test sites for a variety of restoration techniques; an urban program teaching Tucson residents, neighborhood associations and landscapers how to incorporate wildlife habitat into their landscapes; and a crew to hire out for other restoration projects.

Navigating these various demands while effectively restoring and rehabilitating lands is proving to be a good lesson in adaptive management. Additionally, the success of this program depends on a strong, well-managed, supporting organization. Due to the beneficial and reciprocal relationship between Tucson Audubon Society and its restoration program, this organization has become one of the leading Audubon chapters in the nation.

Contact Information: Lia Sansom, Tucson Audubon Society, Tucson, AZ 85705, USA, Phone: 520-971-6238, Fax: 520-623-2476, Email: lsansom@tucsonaudubon.org

Va Shly'ay Akimel Salt River Ecosystem Restoration Project

Jeff Engelmann[1], *Dan Miller*[2], *Tom Moody*[3] and ***Brian Schalk***[4]
[1]J2 Engineering and Environmental Design, Phoenix, AZ, USA
[2]Stanley Consultants, Phoenix, AZ, USA
[3]Natural Channel Design, Flagstaff, AZ, USA
[4]JE Fuller/Hydrology & Geomorphology, Inc., Phoenix, AZ, USA

A joint venture design team was created between Stanley Consultants, Inc. and J2 Engineering and Environmental Design, LLC to complete the on-going U.S. Army Corps of Engineers' Salt River ecosystem restoration project. The project entails the development of a river ecosystem restoration master plan for over 18 miles and approximately 2,000 acres of the flood-regulated and heavily gravel-mined Salt River passing through the City of Mesa, Arizona and the Salt River Pima Maricopa Indian Community of Arizona. Restoration design has focused on reestablishing the natural form and function, habitat and native vegetation of the Salt River. In addition, the design incorporates a multi-use recreational trail system, reuse of river ruins and public staging area as well as scenic overlooks.

This multi-million dollar project is being completed in three separate phases, with the Phase I Design Documentation Report near completion. Design challenges within the Phase I Reach (approximately 3.2 miles) include identification and protection of naturally occurring cottonwood and willow habitat types, reintroduction of suitable habitats for the disturbed portions of the river ecosystem, design and development of an adequate water supply and irrigation system to establish any re-vegetation efforts, and developing a more natural river ground plan and form that will function within an active river system that has been modified as a result of mining activities. These design concepts are all being coordinated through active participation of all of the key stakeholders of the project.

The Salt River channel bottom, approximately 1,200 feet in width and bounded by significant hard bank levees on both sides of the channel, has been heavily impacted by historic and recent sand and gravel mining activities. To mitigate mining impacts, the channel bottom will be re-graded to reflect a more natural, semi-braided stream system typical of large rivers in the arid southwest. However, the system will incorporate wetland ponds in areas where extensive mining has occurred, creating an opportunity for water storage. In addition, flood terraces will be constructed for native tree species of cottonwood, willow and mesquite, which are accustomed to frequent or extended flood inundation. Finally, to help reestablish the natural ecosystem, removal of the non-native riparian tamarisk will be required. Tamarisk will be replaced with native plant and tree species such as willow, cottonwood and mesquite. Native species, depending on type, will be located adjacent to more active low flow channels or on flood terraces. Irrigation for newly planted native species will come from a combination of sources, which may include redistribution of storm drains and irrigation tailwater.

Contact Information: Brian Schalk, JE Fuller/Hydrology & Geomorphology, Inc., Phoenix, AZ, 85027, USA, Phone: 623-889-0166 x308, Fax: 480-839-2193, Email: brianschalk@jefuller.com

Restoration of Desert Riparian, Wash, and Marsh Wetland Communities Affected by the Lining of the Coachella Canal: Partnerships and Strategies that Work

Carla Scheidlinger and *Julie Janssen*
AMEC Earth & Environmental, Inc., San Diego, CA, USA

When the Coachella Valley Water District in Riverside County, California partnered with the San Diego County Water Authority to line the Coachella Canal in 2004, the impacts of that activity were identified, and mitigation requirements set forth by the United States Fish and Wildlife Service and the California Department of Fish and Game, as well as by other agencies. Significant impacts to vegetation and listed animal species resulted from the interruption of the seepage of over 30,000 AF/year of water from the 32 miles of unlined canal. This water supported over 7,000 acres of vegetation, including small, isolated, marsh wetlands as well as larger diffuse desert wash and desert riparian communities. AMEC worked with the CVWD and the SDCWA from the start of the project to help them identify the most logical mitigation strategies that would satisfy the requirements of the Environmental Commitment Program, and substantially benefit the environment. A multitude of agencies and stakeholders, including the United States Bureau of Reclamation, the Bureau of Land Management, and the Center for Natural Lands Management came together to support the implementation of most of the required mitigation at the Dos Palmas Area of Critical Environmental Concern (ACEC), located approximately 10 miles to the east of the Salton Sea. The Dos Palmas ACEC is now home to a 120-acre desert wash restoration project that includes over 2,500 planted palo verde (*Cercidium floridum*), ironwood (*Olneya tesota*), smoke tree (*Psorothamnus spinosus*), and mesquite (*Prosopis glandulosa*) trees, a 17-acre created freshwater marsh to benefit the California Black Rail (*Laterallus jamaicensis coturniculus*), and a 352.5-acre restoration project for the desert riparian community. Existing marsh and desert pupfish (*Cyprinodon macularius*) habitats on the ACEC are the subject of a long-term monitoring and adaptive management strategy to assure that they remain in a condition to support the listed species, including the Yuma Clapper Rail (*Rallus longirostris yumanensis*), that depend upon them. The implementation of these restoration projects, along with the development of a management strategy for a water supply to replace the water lost by the seepage of the unlined canal, is a challenging and exciting project for all stakeholders involved. Major accomplishments of the project were the strategies that allowed for all on-site mitigation, the establishment of a sustainable desert wash community that will not rely indefinitely on irrigation, a focus on long-term ecological solutions for mitigation instead of highly engineered efforts, and a collaborative multi-agency approach to mitigation and monitoring.

Contact Information: Carla Scheidlinger, AMEC Earth & Environmental, Inc., 9210 Sky Park Court, Suite 200, San Diego, CA 92123, Phone: 858-300-4311, Fax: 858-300-4301. Email: Carla.scheidlinger@amec.com

Unprecedented Restoration of a Native Oyster Metapopulation to the Chesapeake Bay

David M. Schulte[1,2]***,*** *Russell P. Burke*[1] and *Romuald N. Lipcius*[1]
[1]Department of Fisheries Science, Virginia Institute of Marine Science, The College of William and Mary, Gloucester Point, VA, USA
[2]US Army Corps of Engineers, Planning and Policy Branch, Norfolk, VA, USA

Native oyster species were once vital ecosystem engineers whose populations have collapsed worldwide due to overfishing and habitat destruction. In 2004 we initiated a vast (85 ha) field experiment with native oyster (*Crassostrea virginica*) reefs in sanctuaries protected from exploitation in the Great Wicomico River, Virginia, Chesapeake Bay using three reef types (high-relief, low-relief, unrestored) sampled in 2007. We report an unparalleled restoration of this metapopulation, comprising 185 million oysters of three year classes. This restored population is roughly equivalent to the approximately 200 million oysters currently found on all of Maryland's public oyster grounds, which encompass 111,600 ha. One of the key mechanisms underlying this recovery was vertical relief—oyster density was fivefold greater on high-relief than low-relief reef. Juvenile recruitment and reef accretion correlated with oyster density, processes that facilitate reef development and population persistence. Other key mechanisms included building the reef network at an appropriate scale, in this case approximately 50% of the estimated pre-exploitation reef acreage was restored, building in a hydrodynamically retentive sub-estuary known for high recruitment, and preserving the restored reefs as permanent sanctuaries. This reef network is to remain free from oyster harvesting, which not only removes broodstock, but severely damages the reef structure and integrity. The re-established metapopulation in the Great Wicomico is the largest of any restored native oyster population worldwide, and confirms that ecological restoration of native oyster species is achievable.

Contact Information: David M. Schulte, US Army Corps of Engineers, Planning Branch, 803 Front Street, Norfolk, VA 23510, USA, Phone: 757-201-7007, Fax: 757-201-7646, Email: david.m.schulte@usace.army.mil

Evaluating Fish Passage Effectiveness for Alternatives at the Belvidere Dam (Belvidere, IL)

Heather E. Schwar and *Michael Schwar*
HNTB Corporation, Milwaukee, WI, USA

The Belvidere Dam is the only major obstruction to fish passage along the North Branch of the Kishwaukee River. By providing fish passage at the dam, 620 upstream miles would be reconnected with nearly 400 downstream miles within the watershed. The dam, originally constructed in 1865 for a local mill, consists of a 350-foot wide, 9-foot high rock-filled timber crib structure encased in concrete with a concrete cap. The dam creates a 50 acre slack-water impoundment that extends for 2.5 miles upstream, and the elevated water level behind the dam allows water to flow into the Belvidere Park mill race without pumping.

The Belvidere Dam Fish Passage Committee was established to work toward implementing fish passage at the dam. The purpose of this study, funded by an Illinois DNR Conservation 2000 Ecosystems Program grant, was to develop enough information regarding design and performance of three defined fish passage alternatives (removal of the dam, constructing a rock ramp across the full width of the dam, and constructing a nature-like bypass fishway around one side of the dam), as well as the alternative to "do nothing", to allow the public to make an informed choice as to which alternative should be pursued.

Improving the upstream passage of fish at structures requires creating a pathway that is both attractive and hydraulically appropriate to allow passage of desired species and life stages. Each of the proposed alternatives have different hydraulic features that may limit their ability to pass fish upstream. Fish passage alternatives must be designed to provide flows configured to attract fish and encourage them to continue to move upstream. Beyond this, the hydraulic conditions must include velocities within each cross section that are low enough to allow passage and sufficient depth of flow.

Nine fish species that represent a range of sizes and swimming ability, and include both sport fishes and other regionally significant species to target for passage at the Belvidere Dam were identified. Although species-specific data regarding swimming characteristics are not available for each species, data was compiled from several sources that adequately represent characteristics relevant to fish passage such as representative length, representative height, burst speeds and prolonged speeds. Using these characteristics, the critical hydraulic conditions for each alternative were quantified and numerical criteria for establishing fish passage developed.

Gage records were analyzed to determine the probability that daily flows will exceed specific levels during fish spawning/migration months and for the entire year. Then, using a hydraulic model, the hydraulic features for each alternative were evaluated relative to the fish passage requirements over a range of flows. These results were used to determine the range of river flows under which fish would be able to pass the dam for each alternative. Each range of passable flows was then compared to the flow frequencies to determine the percent of the year and the percent of the fish migration season that would be passable under each alternative.

The preliminary design of three alternatives will be described. Then the background and assumptions used to evaluate the hydraulic model results to quantify the fish passage effectiveness of each Belvidere Dam fish passage alternatives will be discussed.

Contact Information: Heather E. Schwar, HNTB Corporation, 11414 West Park Place, Suite 300, Milwaukee, WI 53224-3526, USA, Phone: 414-410-6827, Email: hschwar@hntb.com

Use of River- and Watershed-scale Hydrologic and Hydraulic Models to Support Development of Function-based River Restoration Plans

Michael T. Schwar
HNTB Corporation, Milwaukee, WI, USA

Continuous hydrologic and hydraulic models can be useful tools to quantify anticipated benefits of river restoration strategies and therefore to compare the effectiveness of alternative approaches. There is general agreement within the restoration community that the use of traditional planning measures such as "acres restored" does not adequately quantify the benefits received from ecosystem projects because of the intrinsic differences between natural systems and because of the differing levels of success that restoration efforts may have at providing natural functions. Specifically, when altered abiotic processes or biotic interactions limit ecosystem function to a larger degree than habitat limitation it is necessary to incorporate both spatial and functional considerations to develop meaningful measures of restoration benefit. Models of physical processes that assess conditions at appropriate time scales can be used to estimate changes in desirable or undesirable conditions, thereby providing useful indicators of the relative effectiveness of different restoration strategies.

In the Illinois River system (IL), state, federal, and nongovernmental researchers have identified that ecosystem function is limited by a combination of abiotic processes (including sediment transport, water level and water quality), biotic interactions (including lost connectivity and exotic species), and habitat limitation (including deep waters, connected backwaters and floodplains), as well as other factors. For the Illinois River Basin Restoration study, developed by the USACE in partnership with the State of Illinois, six overall restoration objectives were developed, each addressing one of the identified limiting factor. Each objective was quantified using individually specific criteria, such as tons of sediment delivered to the river, degree of water level fluctuation, miles of connected tributary mainstem and acres of connected backwater multiplied by a depth distribution function.

The methods used to develop the Illinois River plan provide a good example of the development of evaluation criteria relevant to restoration objectives and using sophisticated hydrologic and hydraulic modeling to support decisions regarding required level of effort. Project hydrologists and ecologists related functionality for several of the Illinois River restoration objectives to flow, water level and/or sediment transport factors. HSPF hydrologic and UNET hydraulic modeling were then used to quantify the relevant factors for both existing conditions and with conditions incorporating a number of restoration features under consideration. Effects of alternative implementation was quantified at the tributary, basin and reach levels. The relationships between level of implementation and modeled effect were used to evaluate the effectiveness of the features and the intensity of implementation required to meet desired levels of function.

Contact Information: Michael T. Schwar, HNTB Corporation, 11414 West Park Place Suite 300, Milwaukee, WI 53224, Phone: 414-359-2300, Fax: 414-359-2310, Email: mschwar@hntb.com

The Iowa Soybean Association Watershed Programming: The Boone River Watershed Project.

*Todd Sutphin, **Anthony Seeman**, Roger Wolf* and *Gary Hammitt*
Iowa Soybean Association, Urbandale, IA, USA

Increased water quality concerns, TMDLs, livestock operations, development pressures, and growing public scrutiny surrounding local rivers is prompting the need for effective watershed planning. An integrated approach to watershed management for achieving multiple objectives for water quality issues, agronomic and economic performance, and coordination across multiple partners and agencies is needed. The Iowa Soybean Association (ISA) is providing leadership and coordination in watershed planning, and has developed watershed programs that help farmers act on a commitment to improving economic and environmental performance.

Partnering with Prairie Rivers RC&D, Prairie Winds RC&D, and The Nature Conservancy, ISA is taking a lead role in performance-based watershed management by combining watershed planning, water monitoring, field scale evaluations, and environmental management system evaluation into the Boone River watershed.

A Rapid Watershed Assessment, Conservation Action Plan, and Ecological Assessment have been completed for the entire watershed. In 2007, water monitoring was initiated at 30 HUC 12 sub-watersheds throughout the Boone River. Results have assisted in establishing baseline conditions, and allowed for the identification and prioritization of "hot spots" for further programming. A targeted watershed project in the Lyons Creek sub-watershed has been initiated that includes a RASCAL assessment, paired-watershed study, and investigative water monitoring as part of overall watershed planning efforts.

Nutrient management evaluation results from 2004 thru 2008 have also shown that managing for optimal efficiency is difficult and highly weather/seasonally dependent. However, over a period of years, farmers can use the data to improve their overall management of nitrogen and make changes that best suit their own operations. Results of watershed activities to be presented.

Contact Information: Todd Sutphin, Iowa Soybean Association, Urbandale, IA 50322 USA, Phone: 515-251-8640, Fax: 515-251-8657, Email: tsutphin@iasoybeans.com

Use of a Public-Private Partnership to Establish a Regionally Coordinated Water Monitoring Network to Aid in Watershed Decision Making

Roger Wolf[1], ***Anthony Seeman***[1], *Todd Sutphin*[1], *Gordon Brand*[2] and *Chris Jones*[2]
[1]Iowa Soybean Association, Urbandale, IA, USA
[2]Des Moines Water Works, Des Moines, IA, USA

The Raccoon River (RR) and Des Moines River (DMR) watersheds in central Iowa drain 6.3 million acres dominated by highly productive farmland and are also a source of drinking water to almost 500,000 people. Various segments of the RR and DMR are listed on Iowa's 303(d) list as impaired for nitrate and pathogens. Increasing nitrate concentrations since the 1970s forced the Des Moines Water Works (DMWW) to invest in expensive treatment technologies to comply with the USEPA 10 mg/L MCL. In 1999, a synoptic study funded by USEPA and led by DMWW was initiated using trained volunteers to assist in monitoring smaller tributaries in the RR watershed for contaminant contributions. Results showed that: 1. the majority of nitrate was contributed from the North Raccoon main stem, 2. the majority of fecal indicator bacteria were contributed from the South Raccoon, and 3. trained volunteers could be relied on to collect representative samples. DMWW also initiated a meeting with the fertilizer retailers that operate in the watershed to discuss the role of fertilizer management to river water quality. In 2000 those retailers formed Agriculture's Clean Water Alliance (ACWA); a 501c3 with the mission of reducing nutrient loss from farm fields in the RR watershed. Members pay dues based on the amount of nitrogen sold in the watershed to support an annual plan of work. ACWA coordinated and funded the continuation of the high resolution water monitoring during each crop growing season using technical and administrative support provided by the Iowa Soybean Association (ISA) Environmental Programs. ACWA also developed a mutually agreed upon code of practice, which provides members practicable guidelines for fall nitrogen sales and application. Since 2000 ACWA has invested over $600,000 in continuation and expansion of the water monitoring in the RR and beginning in 2008 the Upper DMR watershed. This expansion has resulted in a three-fold increase in water monitoring locations. Members annually reaffirm their commitment to the code of practice, even during uncertain weather and market conditions. Also in 2008 ACWA began funding the installation and evaluation of several tile line bioreactors, a practice intended to remove nitrate from tile drainage water. ACWA data has been used by ISA to target subwatersheds for planning and implementation of environmental programs and by Iowa DNR in developing a TMDL for the Raccoon River. ACWA resources have been leveraged with state, local, and private organizations to investigate *E. coli* dynamics and other acute contaminant episodes in the rivers and to assist in applying for and to support implementing watershed improvement projects.

Contact Information: Anthony Seeman, Iowa Soybean Association, Urbandale, IA 50322 USA, Phone: 515-251-8640, Fax: 515-251-8657, Email: aseeman@iasoybeans.com

A Description of the Missouri River Ecosystem Restoration Plan

Randy Sellers
U.S. Army Corps of Engineers, Omaha District, Omaha, NE, USA

The Missouri River Ecosystem Restoration Plan and associated Environmental Impact Statement (MRERP/EIS) is among the largest basin-wide restoration planning efforts in the U.S. and represents an unparalleled opportunity and challenge. Authorized by the Water Resources Development Act of 2007 (WRDA), the MRERP/EIS study will set out to define the actions required to mitigate losses of aquatic and terrestrial habitat, recover federally list species under the Endangered Species Act, and restore the ecosystem to prevent further declines among other native species. This study will look at current activities in the Missouri River basin and propose future management options consistent with e the congressionally-mandated WRDA language, while considering social, cultural, technical, economic, and environmental issues. The geographic scope of this effort includes the mainstem-floodplain system and basin tributaries (that support target resource functions and needs). In order to prepare a MRERP/EIS that most effectively analyzes, describes, and identifies the best alternatives for the basin, this effort requires the active participation of basin Tribes, states, federal agencies, and a congressionally authorized committee, the Missouri River Recovery Implementation Committee (MRRIC). WRDA 2007 created the MRRIC to, in part, act in an advisory capacity to provide consensus-based guidance and recommendations to the MRERP project delivery team.

Contact Information: Randy Sellers, U.S. Army Corps of Engineers, Omaha District, 1616 Capitol Ave., Omaha, NE, 68102 USA, Phone: 402-995-2689, Email: randy.p.seller@susace.army.mil

Large-Scale Submerged Aquatic Vegetation Restoration in Chesapeake Bay: 2003-2008

Deborah Shafer[1] and *Peter Bergstrom*[2]
[1]USACE Engineer Research and Development Center, Vicksburg, MS, USA
[2]NOAA Chesapeake Bay Office, Annapolis, MD, USA

A comprehensive research effort to restore submerged aquatic vegetation (SAV) was initiated in 2003, led by the US Army Corps of Engineers (USACE) Engineer Research and Development Center (ERDC) and the NOAA Chesapeake Bay Office (NCBO), involving numerous federal, state, local, and private partners and stakeholders within the Chesapeake Bay region. These two federally funded research programs represent the largest single coordinated research effort to date to develop, evaluate, and refine protocols suitable for large-scale SAV restoration.

An agricultural approach to the restoration of underwater grasses has been employed through the use of seeds for the production of new plants and the use of mechanical equipment for the harvest and planting of seeds. Seeds are typically the most cost effective method for the production of all major domesticated crop plants. Similarly, seeding has the potential to offer the most cost effective approach for restoring large, genetically diverse, self-maintaining populations of underwater grasses. Since the beginning of this research initiative, a total of 133 acres of SAV has been planted in the Chesapeake Bay, an average of 33 acres per year. By comparison, during the previous 21 years (1983-2003), approximately 189 acres of SAV were planted, an average rate of 9 acres per year.

These results demonstrate that we have been successful in developing tools and techniques necessary to plant SAV at scales that would have been unattainable with existing technologies only a few short years ago. Furthermore, the costs of conducting these plantings are on a downward trend as our understanding of the limiting factors is increased and new advances are made in technology development. Although seedling establishment rates were lower than expected, the problems seem to lie in site selection rather than in planting techniques. We hope to improve site selection models in the near future, using research funded in part through these programs.

Contact Information: Dr. Deborah Shafer, USACE Engineer Research and Development Center, 3909 Halls Ferry Road, Vicksburg, MS 39180, Phone: 601-634-3650, Email: Deborah.J.Shafer@us.army.mil

CERP Active Adaptive Management Practices—Addressing Aquifer Storage and Recovery Uncertainties while Making Progress

Orlando Ramos-Gines[1], *Bob Verrastro*[2] and *Rick Nevulis*[3] – presented by ***Mark Shafer***[1]
[1]U.S. Army Corps of Engineers, Jacksonville District, Jacksonville, FL, USA
[2,3]South Florida Water Management District, West Palm Beach, FL, USA

The combination of pilot, regional and contingency planning projects is a great example of an active adaptive management approach to the implementation of the Comprehensive Everglades Restoration Program (CERP). The CERP Aquifer Storage and Recovery (ASR) Program has received national and international attention perhaps because the technology has never being used for ecosystem restoration purposes, environmentally-friendly technologies are being tested and developed to answer uncertainties identified for large regional implementation of the technology, and maybe because of the state-of-the-art design for a program of this magnitude.

Numerous scientific and engineering investigations have been conducted over the past five years resulting in a wealth of knowledge and understanding of the dynamic physical, chemical and biological components of the Greater Everglades ecosystem in response to the application of ASR technology. Several more years of work involving additional investigations and studies are ongoing to provide restoration managers with strong, scientific and engineering information for making technically sound decisions. Results of future studies will be incorporated into the final ASR Program Technical Data Report, which is expected to be available by 2012.

When completed, the Aquifer Storage and Recovery (ASR) pilot and regional studies will offer adaptive management options for consideration in incorporating changes that may be needed to the ASR implementation strategy, including technology and operations. The studies will also offer best engineering and scientific information and strategies which can be used to complete contingency planning for surface-water storage should ASR cannot be implemented at the envisioned 333 wells levels each with a five millions of gallon per day capacity.

The active adaptive management strategy being followed and how we currently envision this active adaptive management strategy to evolve for potential CERP ASR Program implementation in the following years will be presented.

Contact Information: Orlando Ramos-Ginés, U.S. Army Corps of Engineers Jacksonville District, 701 San Marco Blvd, Jacksonville, FL 32207 USA, Phone: 904-232-1662, Fax: 904-232-1251
Email: orlando.ramos-gines@saj02.usace.army.mil

Using USEPA's Watershed Risk Assessment Guidelines to Quantify the Water Quality and Ecological Impacts Associated with Surface Water Discharges from a Regional-Scale Aquifer Storage and Recovery System

Mark Shafer[1], *June Mirecki*[1], *Orlando Ramos-Gines*[1], *Isabel Johnson*[2] and *Robert Verrastro*[3]
[1]US Army Corps of Engineers, Jacksonville, FL, USA
[2]Golder Associates, Gainesville, FL, USA
[3]South Florida Water Management District, West Palm Beach, FL, USA

The Jacksonville District of the US Army Corps of Engineers and the South Florida Water Management District have undertaken a multi-year study (Regional ASR Study) of the feasibility of implementing Aquifer Storage and Recovery (ASR) technology on a wide-scale as part of the Comprehensive Everglades Restoration Program (CERP). The CERP ASR components (330 wells capable of moving 1.5 billion gallons of water per day) are expected to take surplus surface water collected during wet periods and store it deep underground in the Floridan Aquifer System (FAS) for subsequent recovery during dry periods. The downstream ecosystems that may be affected by CERP ASR discharges include Lake Okeechobee, Caloosahatchee Estuary, St. Lucie Estuary, Lake Worth Lagoon, and the Everglades Protection Area. The extent to which discharge of recovered of water from the ASR affects downstream surface water body ecology and water quality is a function of: (1) timing and duration of ASR discharges; (2) chemical composition of the recovered water; and (3) proximity of valued ecosystem components to ASR discharges. Physical, chemical, and biological impacts can be anticipated from ASR recovered water. Physical impacts potentially include change in water temperature and light penetration. Chemical impacts potentially include change in pH, hardness, alkalinity, and the concentrations of dissolved organic carbon (DOC), dissolved oxygen (DO), sulfate ($SO_4^{=}$), sulfide ($S^{=}$), trace metals and radionuclides. Biological impacts potentially include changes in concentrations of bacteria, stimulatory or toxic effects to primary producers, and toxic effects to embryolarval and adult fish and macroinvertebrates.

The EPA's watershed ecological risk assessment guidelines are being used to organize and evaluate field data and modeling data to quantify the ecological risks and uncertainties associated with implementation of CERP ASR. Water quality and toxicological data are currently being collected at two pilot ASR sites. These data will be integrated with groundwater and surface water quality models in an effort to extrapolate watershed scale impacts from short-term local testing results. The overall goal is to complete a watershed risk assessment study that presents resource managers a summary of the ecological and human health risks, uncertainties, and benefits associated with several different ASR implementation scenarios.

The presentation will outline the list of stressors, assessment endpoints, conceptual model, and the assessment plan developed for the watershed risk assessment. Initial testing and modeling results will also be presented.

Contact Information: Mark Shafer, P.E. Planning Division, US Army Corps of Engineers, Jacksonville District, Jacksonville, FL 32207 USA, Phone: 904-232-3594, Fax: 904-232-3442, Email: mark.d.shafer@usace.army.mil

Conversion and Restoration of Even-aged Slash Pine Plantation to Uneven-aged Slash Pine/Longleaf Pine Ecosystem in Florida Coastal Flatwoods

***Ajay Sharma**, Shibu Jose* and *Kimberly Bohn*
School of Forest Resources and Conservation, University of Florida, Gainesville, FL, USA

Restoration of longleaf pine ecosystems is currently the focus of significant restoration efforts in the southeastern U.S. These ecosystems which once dominated the southeastern U.S. Coastal Plain are now reduced to a small fraction of the original extent. They were characterized by a generally open, park-like stand structure typically as an uneven-aged mosaic of even-aged patches varying in size, structure, composition and density. Many prior such longleaf pine sites now exist as slash pine and other pine plantations. Restoration of such sites will involve gradually replacing slash pine or other pine with longleaf pine and managing these complex ecosystems (longleaf/slash) with uneven-aged approach (selection systems) to meet diverse objectives of production, biodiversity enhancement, habitat conservation, recreation and carbon sequestration. However, our knowledge base to practice such a conversion and multifunctional management is inadequate. Additionally, selection system has been practiced little and studied less in shade-intolerant to moderately tolerant forest types, because of the perceived difficulties of regenerating these species beneath residual trees left from the cutting treatments.

The current study is aimed to model the conversion and restoration of even-aged slash pine plantation to an uneven-aged slashpine/longleaf pine ecosystem in order to achieve a sustainable multifunctional longleaf pine ecosystem in the coastal flatwoods. We will evaluate different uneven-aged forest reproduction methods (single-tree selection, group selection and irregular shelterwood) and a control (no tree cutting) with two fire frequencies (burning every 1 year and 2 years) through simulation modeling. The experimental set up has been established for these treatments with three replications at Tate's Hell State Forest, Carrabelle, FL. The preliminary preharvest stand structure data has been collected that will be used to develop tree marking guide using residual basal area, gap size and /or diameter classes to guide and regulate stand conversion. The reproduction cuttings are scheduled to be carried out in August 2009. Thereafter, longleaf pine seedlings will be planted in the gaps created and their survival and growth dynamics will be observed over time. We will also assess regeneration, growth, understory response and carbon sequestration. The initial structural conditions, regeneration and growth responses resulting from field trials will be used to initiate a spatially-explicit stand model that predicts timber production, forest and understory structure over multiple cutting cycles in an uneven-aged slash/longleaf pine ecosystem. The model will be used to evaluate the parameters (gap size, residual basal area, cutting cycle, fire frequency) of the reproduction methods that optimize and sustain values in a multifunctional management system. The sustainable multifunctional uneven aged method will be one providing sustained values over multiple cutting cycles during the simulation period. The study will help forest managers and practitioners to make informed decisions when manipulating stand structure through partial cutting treatments.

Contact Information: Ajay Sharma, School of Forest Resources and Conservation, University of Florida, Gainesville, FL 32608, USA, Phone: 352-846-0120, Fax: 352-846-1277, Email: ajay.sharma@ufl.edu

Development and Application of the Chesapeake Bay Program Watershed Model

Gary W. Shenk[1], *Lewis Linker*[1] and *Jing Wu*[2]
[1]U.S. Environmental Protection Agency, Annapolis, MD, USA
[2]University of Maryland Center for Environmental Science, Annapolis, MD, USA

The Phase 5 version of the Chesapeake Bay Program's Watershed Model, based on Hydrologic Simulation Program – Fortran (HSPF) simulates hydrology, nutrients, and sediment from 24 land use types in the Chesapeake Bay Watershed and the surrounding area for a total simulated area of 90,000 square miles. The intended purposes of the completed model are to inform Chesapeake Bay Program decision makers of specific relationships between nutrient and sediment control measures on the watershed and the change in load to the Chesapeake Bay, and to serve as the loading model for the Chesapeake Bay TMDL and regional TMDLs in Virginia and Maryland. This version of the Watershed Model is being developed by an affiliation of federal and state government agencies, universities, and non-profit organizations. These groups are cooperating so that the Watershed Model can be used for multiple purposes and on multiple scales.

The Phase 5 Watershed Model has advances in several areas over previous versions in order to satisfy the requirements of this large-scale and multi-purpose modeling. The segmentation is on a fine enough scale to calculate loading from an individual county and to take advantage of nearly 300 flow sampling stations and 150 water quality sampling stations for calibration. Additional functionality has been developed in the software system that allows the user to specify a wide range of management practice effects and include effects that vary over time and hydrologic state. An automated calibration method has been developed to ensure that the calibration is fair and repeatable across all jurisdictions and to compress calibration time to take advantage of the latest information. In addition, a model input database with a user-friendly web interface is under development to facilitate the use of the model by non-modelers.

Contact Information: Gary Shenk, EPA / Chesapeake Bay Program Office, 410 Severn Ave, Suite 109, Annapolis, MD 21403, Phone: 410-267-5745, Email: gshenk@chesapeakebay.net

Integrated Chesapeake Bay Computer Models of the Watershed, Airshed, Estuary, Living Resources, and Climate Change

Lewis Linker[1], ***Gary W. Shenk***[1] and *Carl Cerco*[2]
[1]U.S. Environmental Protection Agency, Annapolis, MD, USA
[2]U.S. CoE Engineering Research Development Center, MS, USA

The Chesapeake Bay Program (CBP) integrated models include a watershed model, an airshed model, models of the estuarine water quality and living resources, and linkages to global climate models allowing an assessment of climate change effects on water quality. The Phase 5 Chesapeake Community Watershed Model consists of open source, public domain programs of model code, preprocessors, postprocessors, and input data that are freely distributed over the Web: **http://ccmp.chesapeake.org/CCMP/models/CBPhase5/index.php**. The operating system, Linux, is also open source. Model input data, such as the precipitation fields, point source discharges, atmospheric deposition, and land use are made freely available in a web based data-sharing approach. The current Watershed Model, Phase 5, is specifically designed as a community model that can be used in a direct, *as-is* application, or can be used as a point of departure for more detailed, small-scale models. The data sharing and the modularity of Phase 5 are intended to encourage the efficient use of the model's data, or particular model elements, in other independent analyses or models of the watershed. All of the CBP integrated models share this same open source, public domain approach.

The Watershed Model is linked to two other models that, together, form a simulation system sufficient for attainment analysis of the Chesapeake Bay water quality standards of dissolved oxygen, clarity, and chlorophyll. The two models are are the Airshed Model and the Water Quality and Sediment Transport Model (WQSTM). The Airshed Model provides atmospheric deposition loads of nitrogen to the watershed lands and water bodies including the tidal Bay and adjacent coastal ocean. Taking the nutrient loads from the Airshed Model and the nutrient and sediment loads from the Watershed Model, the Chesapeake Bay WQSTM simulates water quality and living resource responses to the nutrient and sediment input loads. The model package is applied in one continuous simulation period (1985–2005) to model transport, eutrophication processes, and sediment-water interactions under various management scenarios designed to analyze the water quality and living resource responses to load reductions at all points in the Bay. To estimate climate change in the Chesapeake climate change scenarios were evaluated reflecting the range of potential changes in temperature and precipitation in the year 2030 based on projections from seven global climate models.

Contact Information: Lewis Linker, U.S. EPA Chesapeake Bay Program Office, 410 Severn Ave, Suite 109, Annapolis, MD 21403, Phone 410-267-5741, Email: llinker@chesapeakebay.net

Increasing Effectiveness of Coastal Habitat Restoration through Partnerships

Robin J. Bruckner and *Melanie L. Gange* – presented by ***Tisa Shostick***
Community-based Restoration Program, National Oceanic and Atmospheric Administration, Silver Spring, MD, USA

Partnerships are the foundation on which NOAA's Community-based Restoration Program (CRP) has been built. At first, when the CRP began in 1996, partnerships between NOAA and community organizations accomplished individual local level projects such as marsh and wetland restoration, riparian planting, small dam removals, shellfish restoration and hydrologic reconnection of tidal systems. As CRP evolved, national and regional partnerships were cultivated, and have since played an increasingly important role in delivering NOAA funding and technical expertise directly to communities in coastal watersheds. By working in concert with partners, NOAA staff can better work locally to help identify restoration alternatives, participate in the review of engineering and design plans, help secure required consultations and permits, develop monitoring plans and generally ensure sound technical practices for community-based restoration. Our partners provide invaluable support for these activities, and also carry out the operational aspects of soliciting proposals, awarding funds, and tracking and reporting on project status.

The Community-based Restoration Program is currently soliciting proposals to establish a new suite of three-year partnerships that will run from 2010 through 2012. Applications will be selected through a competitive process based on several criteria, including how well potential partnerships meet the NOAA Restoration Center's strategic priorities. Setting priorities helps focus the range of restoration actions CRP will pursue, and ensures that restoration actions deliver tangible outcome-based results. Habitat restoration, through both small-scale and watershed-scale projects, not only helps coastal communities address their restoration needs, but also strengthens local economies through the creation of jobs and prospects to establish or improve public parks, green space and recreation.

Another way CRP engages partner organizations is through restoration monitoring. In 2005, using Thayer el al.'s *Science-based Restoration Monitoring of Coastal Habitats* as a guide, CRP began implementing systematic restoration monitoring. Since then, recipients of NOAA restoration project funding are asked to monitor progress towards a structural and functional target for the habitat they restore. However, making sure that the appropriate monitoring data is collected can be challenging, as monitoring often occurs outside the project award period, and cannot often be supported by CRP dollars. In knowing that accountability is a high priority for NOAA, the CRP is working to develop a tiered system of monitoring and performance measures. This approach will allow NOAA to gather information at a variety of levels—both limited and more in-depth—on a wide array of project types and scales.

Public demand for restoration is growing, and CRP is a proven means to partner to affect positive change for the nation's coastal and marine resources and generate local stewardship.

Contact Information: Robin J. Bruckner, NOAA Community-based Restoration Program, Silver Spring, MD 20772 USA, Phone: 301-713-0174, Email: Robin.Bruckner@noaa.gov

NOAA's Open Rivers Initiative: Effectiveness Monitoring that Supports Decision Making

Tisa Shostik[1], *David Landsman*[1] and *Donald "Kit" Crump*[2]
[1]National Oceanic and Atmospheric Administration, Restoration Center, Silver Spring, MD, USA
[2]National Oceanic and Atmospheric Administration, Restoration Center, Santa Rosa, CA, USA

NOAA's Open Rivers Initiative (ORI) is restoring populations of diadromous fish by removing dams and other fish passage barriers in coastal streams and rivers. Beginning in 2005, the ORI has worked to help communities restore vital fish habitat, support sustainable fish populations, enhance watershed health, and foster community safety and vitality. In three years, total requests for project funding have exceeded $40M—demonstrating a high demand for barrier removal funding.

While the initiative has already implemented many priority barrier removal projects, success will be determined based on quantifiable ecosystem benefits from the projects. Institutionalizing cost-effective short, medium and long-term monitoring of these benefits will be critical to demonstrate near-term program effectiveness, inform future prioritization of project funding, and communicate the strength of the overall ORI model of funding and technical assistance.

To this end, ORI program managers have developed a framework of key monitoring parameters to be measured across projects. Individual project monitoring results are linked to performance measures that align with the outcome goals of the ORI program. This allows decision makers to gauge progress towards the goals of ORI, which aim to restore habitat critical to the sustainability of diadromous fish resources and to generate economic, educational, and social benefits for citizens and their communities.

This presentation will detail the application of project level monitoring on a set of fish passage barrier removal projects in the Carpinteria Creek watershed in Santa Barbara County, CA; and how those results relate to program level, outcome-based performance measures. Parameters measured for these projects include 1) amount of available habitat, 2) status of fish passage and 3) presence of the target species. Targets have been set for each parameter, and measurements will occur both before and after project implementation. Documentation will also consist of recording community participation, community enhancement, and public safety. Assessment of available habitat will include type (pool, riffle, run, etc.) and amount (stream miles) of habitat produced by removing the fish passage barriers. The measurement of fish passage status for both adults and juveniles will reflect the structural change at the site of the former barrier (e.g. jump height). Assessment of adult and juvenile fish presence, density and distribution will reflect changes associated with fish populations by making habitat more accessible. The results of this monitoring will feed into program level performance measures identified within the ORI framework at a regional scale. In turn, this data will contribute to the understanding of overall ORI effectiveness and will assist in focusing future resources to yield maximum restoration benefits.

Contact Information: Tisa Shostik, NOAA Restoration Center, 1315 East West Highway, F/HC3, Silver Spring, MD, 20910 USA, Phone: 301-713-0174, Fax: 301-713-0184, Email: tisa.shostik@noaa.gov

Responses of Long-Unburned Coastal Scrubby Flatwoods to Prescribed Burning

Jose L. Silva-Lugo and *George W. Tanner*
Department of Wildlife Ecology and Conservation, University of Florida, Gainesville, FL, USA

Although prescribed burning is an important management tool for ecosystem restoration in Cedar Key Scrub State Reserve (CKSSR), this is the first study that analyzes the effect of prescribed burning on plants. In addition, this is the first research carried out on plant community response to prescribed fire in coastal scrubby flatwoods on the west side of Florida. The objective was to document recovery modes and structural and compositional changes in the post-burn community. To achieve this objective, a site analysis was needed to determine if treatment and control sites were ecologically similar before burning. The experimental design consisted of two treatment and two control sites that were sampled before and after burning from December 2003 to August 2006. Preburn vegetation samples were conducted one time in all sites, and postburn vegetation samples were carried out every three months for a 12 month period. Fifty quadrats (4 m^2 each) per site were assessed in each sampling. A cluster analysis in combination with an ordination technique and a F-ratio test (with the respective multiple comparison test) was used to carry out a site analysis. Statistically, treatment and control sites in CKSSR were ecologically similar, and they were compared to determine prescribed burning effects. Resprouting was the main way of surviving and recovering from fire by the majority of the species, and almost all of the dominant species reached preburn levels during the 12 months period**.** This fast recovery of the vegetation after burning has been reported in the literature but not in one year. The Detrended Correspondence Analysis showed that woody species had structural and compositional changes during the first three months postburn, but there were more compositional than structural changes after that. According to the Multi-response Permutation Procedure, the structural changes were significant; therefore, there were significant changes in absolute densities in treatment sites between pre- and 12 months postburn and between control values and 12 months postburn as a consequence of prescribed burning. These results will provide guidance to managers in prescribed burning plans to establish a fire return interval according to the recuperation of the vegetation.

Contact Information: Jose L. Silva-Lugo, Department of Wildlife Ecology and Conservation, University of Florida, 110 Newins-Ziegler Hall, Gainesville, FL 32611-0430 USA, Phone: 352-273-1579, Email: joselugo@ufl.edu

Assessing Nearshore Ecosystem Change in Puget Sound

Charles A. Simenstad[1] and *Curtis D. Tanner*[2]
[1]School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA USA
[2]Washington Department of Fish and Wildlife, Olympia, WA USA

The Puget Sound Nearshore Ecosystem Restoration Project (PSNERP) General Investigation is evaluating significant degradation of nearshore environments of the Puget Sound Basin in order to formulate, evaluate, and screen potential solutions to these problems, and to recommend a series of comprehensive restoration and protection actions. As one means to assess the level of current impairment of Puget Sound's shorelines, estuaries and deltas at a general "screening" level, PSNERP's Nearshore Science Team (NST) has systematically analyzed historic change between the earliest comprehensive data on nearshore ecosystem structure (e.g., General Land Office surveys of 1850's and US Coast and Geodetic Surveys of 1870's-1890's) and the present (2004-2006). This Change Analysis was organized around a unique Geomorphic Classification of Puget Sound's nearshore landforms, which allowed the application of geospatial rules to delineate different shoreforms from both the historic and modern geospatial data. The shoreforms are the primary accounting units in a geospatial hierarchy of data that included: (1) shoreline drainage units; (2) shoreforms; (3) drift cell or delta hydrogeomorphic components; (4) adjacent upland catchment areas; and, (4) various larger units that encompassed nearshore variability, e.g., sub-basins of Puget Sound. Thus, data on changes could be assessed at various scales of tabulation, analysis and mapping ("units"), but the primary "process units" (PU) that we used for this basic screening effort were the drift cell or delta hydrogeomorphic components of this hierarchy. The Change Analysis assessment is organized around four "tiers" of spatial organization: (1) Tier 1: changes in shoreform composition in every process unit; (2) Tier 2: changes in process unit attributes (either historically mapped, such as wetlands, or obvious anthropogenic modifications) along the shoreline; (3) Tier 3: anthropogenic changes within 200-m buffer in the adjoining uplands to the process unit and to the -10-m depth (e.g., average photic zone limit) offshore; and, (4) Tier 4: anthropogenic changes in the total process unit drainage area. This data architecture enables PSNERP to identify nearshore change from the standpoint of restoration and preservation need as well as broader landscape constraints. In order to relate structural change to actual changes in nearshore ecosystem processes, the NST used conceptual models to attribute and rank the relationships of biotic and abiotic nearshore ecosystem processes to shoreform transitions (including complete loss) and anthropogenic modifications. Further evaluation of the risk of nearshore ecosystem change in the absence of comprehensive restoration and preservation actions, PSNERP is also conducting analyses to project the location and type of potential changes in land use, land cover and associated physical (anthropogenic) alterations to nearshore ecosystems of Puget Sound by the year 2060.

Contact Information: C. Simenstad, Wetland Ecosystem Team, School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA USA, Phone: 206-543-7185, Fax: 206-685-7471, Email: simenstd@u.washington.edu

Applying Lessons Learned in Planning for USACE Ecosystem Restoration Projects: Reasons for Effective Stakeholder Participation

L. Leigh Skaggs and *Jeanette L. Gallihugh*
Office of Water Project Review, Headquarters, U.S. Army Corps of Engineers, Washington, DC, USA

The planning, design, and implementation of US Army Corps of Engineers (Corps) ecosystem restoration projects are often difficult and complex undertakings. Stakeholders can participate more effectively if they better understand the Corps' planning and project delivery process, as well as the potential pitfalls and opportunities along the way. Stakeholders can help address such problematic issues as: 1) development of appropriate planning objectives, including determining which objectives are most important; 2) determination of geographic scope of project effects, relevant to the Corps' focus on aquatic ecosystem restoration; 3) collection of adequate and accurate data in assessing current conditions and forecasting future conditions, ensuring that project delivery teams have the "right" data; 4) formulation of a range of reasonable alternatives -- not just one "answer", but several options – to address problems and opportunities; 5) development of necessary predictive ecological models, so that the benefits of aquatic restoration projects can be meaningfully measured; 6) the consideration of multiple evaluation criteria and integration of those criteria, and determining which criteria are most important and how they can they be synthesized to provide "an answer"; 7) justification of the recommended plan in terms of non-monetary ecological benefits by describing the significance of the ecological resources and why they are "worth" the investment; 8) consideration of other entities that may have authorities, capabilities, obligations, or interest in conducting some or all proposed restoration activities; and 9) application of monitoring and adaptive management strategies that adequately address inherent uncertainties and dynamic environments.

While no one presentation could hope to cover the gamut of concerns that may arise, the authors endeavor to highlight a few of the most critical issues encountered through their experiences both participating in the planning of ecosystem restoration projects throughout the country as well as in conducting policy and legal compliance reviews on ecosystem restoration feasibility reports at Headquarters (for example, the Everglades, Chesapeake Bay, Upper Mississippi River, and Rio Salado in the desert Southwest). Organized around the six-step planning process, the presentation illustrates planning problems, potential resolution of those problems, and successful practices from a variety of projects. Sharing these lessons learned may help stakeholders, especially, benefit from a better appreciation of the technical and procedural challenges any Corps project must overcome, as well as the importance of their contributions and expertise, in helping to meet those challenges.

Contact Information: L. Leigh Skaggs, Office of Water Project Review, Planning and Policy Division, HQUSACE, Attn: CECW-PC, 441 G St., NW, #3H24, Washington, DC 20314 USA, Phone: 202-761-5541, Fax: 2020-761-8957, Email: Lawrence.l.skaggs@usace.army.mil

Storm Protection Benefits from Barrier Island Restoration in Southeast Louisiana and Mississippi

Alison Sleath-Grzegorzewski[1], *Ioannis Georgiou*[2], *Mary Cialone*[1] and *Tate McAlpin*[1]
[1]USACE Engineer Research and Development Center, Coastal and Hydraulics Laboratory, Vicksburg, MS, USA
[2]Department of Earth and Environmental Sciences, University of New Orleans, New Orleans, LA, USA

A numerical modeling study was performed to qualitatively assess the impact of barrier island restoration and degradation on storm surge and wave energy in Southeast Louisiana and Mississippi for high intensity hurricanes as well as lower intensity storms. Natural landscape features such as barrier islands have the potential to create frictional and bathymetric resistance and affect storm surge and wave energy even when submerged. Land elevations greater than the storm surge elevation act as a physical barrier and create bathymetric resistance for the surge and waves. Landscape features such as barrier islands also have the potential to create frictional resistance and affect storm surge and wave energy even when below the surge elevation. The study area includes the Chandeleur Islands as well as Cat Island, Ship Island, and Horn Island.

The modeling methodologies applied throughout this study are in accordance with the unified technical approach developed as part of the Joint Coastal Surge (JCS) Analysis Study with the US Army Corps of Engineers (USACE) and the Federal Emergency Management Agency (FEMA). The circulation model ADCIRC was used to simulate storm surge and was coupled with the nearshore wave generation and transformation model STWAVE. The restored barrier island scenario represents massive restoration on an extremely large scale. Likewise, the degradation scenario is catastrophic, with entire barrier islands degraded to open water. The coupled model results indicate that the barrier islands provide some level of protection as a natural buffer and line of defense for Southeast Louisiana and Mississippi and the efficacy is reduced with degradation. Typically, the wave heights are increased by up to 10 ft landward of the barrier islands for the degradation scenario. For the restoration scenario, waves are decreased by up to 3 ft immediately landward of the Chandeleur Islands. The study has been expanded from previous works to include a time series analysis of surge for the synthetic storm suite. The study results could be used to evaluate the benefits of barrier island restoration and to optimize sustainable coastal protection strategies along the Gulf coast.

Contact Information: Alison Sleath-Grzegorzewski, USACE Engineer Research and Development Center, Coastal and Hydraulics Laboratory, Vicksburg, MS 39180, USA, Phone: 504-280-3867, Fax: 601-634-4314, Email: Alison.S.Grzegorzewski@usace.army.mil

Restoration of Relic Wetlands - In Construction – A Grassroots Vision Finally Realized

***Robert V. Sloop*[1]**, *Gary C. Gorman*[2] and *Chris K. Webb*[1]
[1]Moffatt & Nichol, Long Beach, CA, USA
[2]Huntington Beach Wetlands Conservancy, Huntington Beach, CA, USA

California's Huntington Beach Wetlands represent one of few remaining opportunities to undo the damage of past industry and reconnect one of the state's rare relic marsh plains with the Pacific Ocean. The not-for-profit Huntington Beach Wetlands Conservancy (HBWC) embraced the undertaking in 1985 and, over 22 years, acquired land and $7.5 million of the projected $10 million needed for the project. Funding sources for the project have come from city, county, state, federal, and private sources, and the HBWC has teamed with the County of Orange in a partnership for the construction of the present phase of work.

Made up of salt marsh, seasonal ponds, and coastal dunes, the once-vibrant wetlands at the mouth of the Santa Ana River gave way over the years to residential, agricultural, and industrial development. The site's sole source of seawater filled with sand, trapped from tidal flow by a patchwork of flood control levees and channels, leaving a thirsty coastal habitat. Limited from further development by the California Coastal Act of 1972, the site today stands alone, flanked by upscale residential tracts.

The HBWC has begun construction on the restoration, targeting 130 acres of the 188 acres that remain of the 2,900-acre historic Santa Ana River Estuary. The project will restore fish and wildlife habitats, improve flood control and water quality, and provide controlled public access. Phased over three years to accommodate the breeding seasons of endangered native birds, construction will move about 290,000 cubic yards of material. The proposed project includes the maintenance dredging of the Talbert Ocean Channel, dredging sand shoals and constructing a sediment trap in Talbert Marsh, and introducing tidal flow to Brookhurst and Magnolia Marshes by creating channels and removing historic levees utilizing typical upland excavation equipment.

The critical goal in the restoration plan is the distribution of various types of habitat to establish a viable wetland ecosystem. The different habitat zones are separated by elevation and tidal inundation, so detailed hydraulic modeling was performed with varying grading plans to create the proper mix of subtidal, mudflat, salt marsh cord grass, pickleweed, salt grass, salt panne, and upland areas.

The modeling and design work was completed in the summer of 2008 and the first phase of construction began in the fall of 2008 and will be completed in the spring of 2009. There have been numerous challenges overcome during the construction, including high groundwater, rain, mud, extreme tidal swings, large waves, sinking excavators, and dredges left high and dry, but the construction is marching on.

Contact Information: Rob Sloop, Moffatt & Nichol, Long Beach, CA 90806 USA, Phone: 562-426-9551, Fax: 562-424-7489, Email: rsloop@moffattnichol.com

Adaptive Design, Construction and Management: Using a Design-Build-Manage Approach for the Successful Restoration of 500 Acres of Wetland, Prairie and Stream Corridor

Julianne E. Mason[1], ***Thomas E. Slowinski***[2], *George R. Milner*[2] and *Derrick C. Martin*[2]
[1]Forest Preserve District of Will County, Joliet, IL, USA
[2]V3 Companies, Woodridge, IL, USA

The Forest Preserve District of Will County (District), southwest of Chicago, has been involved in the preservation of Spring Creek and its resources since 1930. Through successful bond referendums, the Hadley Valley Preserve/Spring Creek Greenway now consists of 1,600 acres. Few existing wetlands are present along the corridor as they had been drained and used for agriculture for over a century. Both wetlands and uplands had been colonized by invasive or low quality vegetation.

In conjunction with the Illinois State Toll Highway Authority (ISTHA), which required wetland mitigation for the extension of I-355, and City of Chicago O'Hare Modernization Mitigation Account (OMMA) administered by CorLands, the District is in the process of restoring 500 acres to various types of native plant communities. Within Hadley Valley Preserve, nearly three miles of the incised Spring Creek was relocated to its former meandering course. The re-meandering increased the total stream length by about 2,000 feet. Hydrology was restored to 150 acres of former wetlands by disabling eight miles of drain tiles. Emergent wetland, sedge meadow, wet prairie, and floodplain forest community types are being restored. Approximately 350 acres were restored to prairie. The uplands will be planted with 32,000 contract-grown native trees and shrubs. Open and closed canopy oak savannas are the target community type.

Many adaptive design measures were necessary in the restoration design to account for more than a century of agricultural land use. In relocating Spring Creek to its former meandering course, the historic stream alignment and dimensions were adjusted to accommodate increased stream flows in a partially urbanized watershed. Restored wetland limits and community types were modified due to land use and associated hydrology changes. Due to the presence of invasive species, typical prairie seed mixes were modified to accommodate an intensive weed control regime for the first five years.

Adaptive construction measures included: sequencing of creek construction activities to facilitate access and movement of construction equipment, deal with storm events and flooding of the construction site, and maintain soil erosion and sediment control; riffle placement and transitions between restored stream sections were adjusted based on field conditions. Close coordination between construction and planting insured that both dormant and growing season seeding occurred in a timely fashion. Oversight and management of the native vegetation installation was conducted by experienced ecologists in order to make appropriate field changes based on actual site conditions.

Due to the presence of invasive species, an intensive regime of pre-seeding weed control was implemented including multiple seasons of herbicide application, mowing, and prescribed burn management. After the initial seeding, the adaptive management strategy of invasive species monitoring, phased seeding with species tolerant of particular herbicides, boom spray applications of selective herbicides, timed mowing, and prescribed burn management has been implemented.

V3 Companies designed, constructed and is conducting management and monitoring activities on the Hadley Valley Preserve wetland and stream restoration.

Contact Information: Thomas Slowinski, V3 Companies Ltd., Woodridge, IL 60517, USA, Phone: 630-729-6285, Fax: 630-724-9202, Email: tslowinski@v3co.com

Adaptive Management, Ecosystem Rehabilitation, and Collaboration on the Platte River

Chadwin B. Smith[1], *Jerry Kenny*[2] and *Bridget Barron*[2]
[1]Headwaters Corporation, Lincoln, NE, USA
[2]Headwaters Corporation, Kearney, NE, USA

The Platte River Recovery Implementation Program (Program) is the result of a Cooperative Agreement negotiating process that started in 1997 between the states of Colorado, Wyoming, and Nebraska; the Department of Interior; waters users; and conservation groups. The Program is intended to address issues related to the Endangered Species Act (ESA) and loss of habitat in the river in central Nebraska by managing certain land and water resources following the principles of adaptive management to provide benefits for four “target species”: the endangered whooping crane (*Grus americana*), interior least tern (*Sternula antillarum*), and pallid sturgeon (*Scaphirhynchus albus*); and the threatened piping plover (*Charadrius melodus*). The Program is led by a Governance Committee that is assisted by several standing Advisory Committee as well as an Executive Director and staff. The Program’s 13-year First Increment began in 2007. The Program is estimated, in 2005 dollars, to cost roughly $320 million, with the monetary portion of that being $187 million; the total cost of the Program in terms of cash, water, and land will be shared equally between the federal government and the states.

The Program has three main elements:

- Increasing streamflows in the central Platte River during relevant time periods through re-timing and water conservation/supply projects; First Increment objective is to re-time and improve flows in the central Platte River to reduce shortages to target flows by an average of 130,000 to 150,000 acre-feet per year at Grand Island.

- Enhancing, restoring, and protecting habitat lands for the target bird species; First Increment objective is to protect, restore, and maintain 10,000 acres of habitat.

- Accommodating certain new water-related activities

Central to the Program is its Adaptive Management Plan (AMP). The AMP is focused on priority hypotheses developed jointly by numerous Program partners that reflect different interpretations of how river processes work and the best approach to meeting Program goals. The cooperative nature of the hypotheses reveals a shared attempt on the part of Program cooperators and partners to use the best available science in an agreed-upon manner to test strategies, learn, and revise management actions accordingly. The AMP’s Integrated Monitoring and Research Plan (IMRP) will guide implementation of monitoring and research protocols during the course of implementation over the First Increment.

This poster will describe the unique aspects of the Platte River Program’s Adaptive Management Plan, its governance structure, and the interface between science and policy that defines the structure and direction of the Program.

Contact Information: Chadwin B. Smith, Headwaters Corporation, 6512 Crooked Creek Drive, Lincoln, NE 68516 USA, Phone: 402-261-3185, Email: smithc@headwaterscorp.com

Structured Decision Making and Rapid Prototyping for Adaptive Management Implementation on the Platte River

Chadwin B. Smith
Headwaters Corporation, Lincoln, NE USA

The Platte River Recovery Implementation Program (Program) is utilizing a Structured Decision Making (SDM) approach to implement the Program's Adaptive Management Plan (AMP) on the Platte River through management actions and experiments. A team of Program staff and cooperators, all members of the Program's Adaptive Management Working Group (AMWG), conducted a SDM workshop in July 2008 to develop specific, measurable objectives for implementing adaptive management and relating the response of target species to management actions. The workshop was facilitated by Dr. Andrew Tyre of the University of Nebraska-Lincoln. The workshop included the use of Rapid Prototyping as a means to develop simple ecological models that utilize Program monitoring data, species life history parameters, and other data to predict possible species response to management actions over the course of the Program's First Increment (2007-2019). The workshop resulted in specific objectives for implementing adaptive management and the development of models for the endangered whooping crane (*Grus americana*) and interior least tern (*Sternula antillarum*), and the threatened piping plover (*Charadrius melodus*). Those models are now being utilized to help guide Program management actions, establish habitat goals, refine the definitions of "available habitat", and ultimately assess progress toward meeting broader Program objectives.

The AMWG kicked off a series of additional SDM workshops in December 2008 to help define specific means objectives for several adaptive management experiments related to sediment augmentation, flow consolidation, mechanical actions, and pulse flows. The workshops are designed to provide design details for the experiments, identify data needs and gaps, and help guide overall implementation of the AMP over the next five years. The SDM process is helping the AMWG to better define objectives, assess alternatives, and ensure monitoring and research data are directly linked to evaluating the Program's priority hypotheses – keeping the Program focused on "need to know" information as opposed to "nice to know" information. Structured Decision Making and Rapid Prototyping are proving to be valuable tools for rigorous implementation of adaptive management on the Platte River.

Contact Information: Chadwin B. Smith, Headwaters Corporation, 6512 Crooked Creek Drive, Lincoln, NE 68516 USA, Phone: 402-261-3185, Email: smithc@headwaterscorp.com

Salt Marsh Restoration at High Pines, Duxbury Beach, Massachusetts: Beneficial Use of Dredged Material to Restore Eroding Salt Marsh

Lester B. Smith, Jr., *Mark Rits* and *Christine Vaccaro*
Epsilon Associates, Inc., Maynard, MA, USA

The High Pines salt marsh, located on the landward side of Duxbury Beach in Duxbury, MA, has experienced significant erosion over the last 50 years. A review of historical aerial photographs indicates that approximately 7 acres of salt marsh have been lost since 1952, with localized losses of over 100 feet. In addition to providing vital ecological functions such as habitat for estuarine organisms and providing a trophic link to the nearshore environment, this salt marsh also protects the narrowest portion of the Duxbury barrier beach from significant erosion.

The US Army Corps of Engineers (USACE) is proposing to dredge the Duxbury Bay anchorage and navigation channel, which will yield approximately 60,000 cubic yards (CY) of mostly fine sand, silt, and clay sized material. This project provides a beneficial use opportunity for the dredged material to restore the eroded High Pines salt marsh area. The sediments were deemed suitable for marine disposal, and thus are appropriate for restoration purposes.

The Duxbury Beach Reservation, Inc. (DBR) is a private non-profit group, which owns and manages Duxbury Beach, and aims to preserve its ecological values and to provide public access. DBR requested that USACE consider making the dredged material available for salt marsh restoration at High Pines. Originally, the USACE had considered using a mechanical dredge and split hull scow to dispose the dredged material offshore. However, a split hull scow would be infeasible to use for disposal at High Pines due to shallow water surrounding the salt marsh. DBR proposed that USACE consider using a cutterhead dredge in conjunction with booster pumps to place the dredged material at High Pines. The material would be dewatered behind a geotextile tube and allowed to compact prior to planting with appropriate salt marsh vegetation.

DBR submitted several funding applications to assist with this restoration effort, including an application to USACE for funding under Section 204 of the Water Resources Development Act of 1992, which provides support for wetland restoration projects in connection with dredging projects. An application was also submitted to the Massachusetts Coastal Zone Management Wetland Restoration Program which provides funding and technical assistance for salt marsh restoration projects. Additionally, DBR worked cooperatively with the Town of Duxbury and local environmental groups to solicit political and other funding support for this project.

While most salt marsh restoration projects in Massachusetts have sought to remove fill from or restore hydrologic conditions at degraded salt marshes, this project aims to restore salt marsh that has been lost by coastal erosion. With sea level rise and the accelerated erosion of salt marshes in the Northeast, the use of dredged material to restore eroded marshes may inform additional restoration efforts in the future.

Contact Information: Lester B. Smith, Jr., Epsilon Associates, Inc., 3 Clock Tower Place, Suite 250, Maynard, MA 01754 USA, Phone: 978-897-7100, Fax: 978-897-0099, Email: lsmith@epsilonassociates.com

Visualization Techniques for Watershed Planning and Restoration Design

Robert E. Snieckus
USDA Natural Resources Conservation Service, Washington, DC, USA

The USDA Natural Resources Conservation Service is using visual simulation tools and techniques to assist in the planning and design of coastal watershed projects. Prior to these tools, NRCS planners could only sketch an outline on a map or place flags in the ground to help stakeholders "visualize" what an implemented project might look like. Today, utilizing simple two and three-dimensional sketches, photo editing, and online mapping, NRCS is able to successfully negotiate the increasingly complex path to watershed solutions.

This talk will illustrate how simulation techniques have fostered trust between watershed planners and the public, how visualizing alternatives prior to final design may uncover a surprise, and how visualization can help convince budget officials to allow construction dollars to flow.

Contact Information: Robert E. Snieckus, USDA Natural Resources Conservation Service, PO Box 2890, Washington, DC 20013 USA, Phone: 202-720-9155, Fax: 202-720-0428, Email: robert.snieckus@wdc.usda.gov

Wetland Creation Using an Artificial Water Source

Kevin P. Tobin[1], ***Sarah J. Soard***[2] and *Fred C. Pinkney*[2]
[1]Metropolitan Utilities District, Omaha, NE, USA
[2]Burns & McDonnell Engineering Company, Inc., Kansas City, MO, USA

The Metropolitan Utilities District (District) provides municipal and industrial water to the city of Omaha, Nebraska. The District has constructed the Platte West Water Production Facilities Project to provide up to 100 million gallons of water per day. As part of the Platte West Project, the District obtained a Section 404 Individual Permit from the U.S. Army Corps of Engineers, Omaha District, which requires that wetlands impacted by the Project be mitigated. As part of the Phase II wetland mitigation effort, a 16-acre wetland complex was constructed in former crop land through the use of backwash water generated by Project operation. This wetland was created by using the backwash water from the treatment plant that would have otherwise been discharged to a nearby stream. The backwash water provides the hydrology necessary to sustain the wetland system. Berms and upland islands were constructed to direct the water through the wetland and to allow for the formation of the desired wetland soils, vegetation, and hydrology. Due to the amount of backwash water available, special considerations were given to dissipating water velocities, allowing any remaining solids time to settle in a sedimentation basin before entering the wetland, and maintaining the ability to divert excess backwash water around the wetland to prevent the formation of a pond rather than an emergent wetland.

Contact Information: Sarah J. Soard, Burns & McDonnell Engineering Company, Inc., 9400 Ward Parkway, Kansas City, MO 64114, Phone: 816.822.4330, Fax: 816.822.4299, Email: ssoard@burnsmcd.com

The Influence of Habitat Restoration Projects on Nutrient Regimes in the Missouri River

***David M. Soballe*[1], *William A. Boyd*[1] and *Steven A. Fischer*[2]
[1]Environmental Laboratory, Engineer Research and Development Center, Vicksburg, MS, USA
[2]Kansas City District, U.S. Army Corps of Engineers, Kansas City, MO, USA

Habitat rehabilitiation projects on the Missouri River often involve remobilzation of sediments that have deposited in off-channel areas of the system. These mobilized sediments can affect the system's ecology and the loading of contaminants and nutrients in downstream areas as far away as the Louisiana coast and the Gulf of Mexico. Of particular interest to the U. S. Army Corps of Engineers (USACE) are the linkages between sediment, habitat restoration, and water quality that can influence management strategies and rehabilitation activities.

In this study, we compiled fragmentary data collected at proposed and completed restoration projects on the Missouri River, literature values from the region and other large rivers (e.g. the Upper Mississippi) and simple sediment-nutrient models to examine the likely contribution of Missouri River restoration projects to the phosphorus and nitrogen regime in the Missouri River and beyond. We interpreted these contributions in the context of a dynamic river that has been subjected to substantial hydrologic, geomorphic, and material load alterations. Our assessment indicates that the influences of restoration projects on phosphorus levels can be significant, but are relatively minor in the context of this large river system, and should not impede rehabilitation efforts.

Contact Information: David M. Soballe, ERDC, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199 USA, Phone: 601-634-4631, Fax 601-634-3713, Email: david.m.soballe@erdc.usace.army.mil

The Lake Tahoe Management System: Integrating Adaptive Management and Continual Improvement to Increase Restoration Effectiveness and Multi-Agency Coordination

Jeremy Sokulsky[1], *Chad Praul*[1] and *Shane Romsos*[2]
[1]Environmental Incentives, LLC, South Lake Tahoe, CA, USA
[2]Tahoe Regional Planning Agency, Stateline, NV, USA

The extraordinary clarity of Lake Tahoe's waters and the value of the recreational and natural resources has inspired more than $1 billion in investment for restoration of the Tahoe Basin watershed over the past ten years. Federal and state funds for restoration are matched by local government commitment to maintain projects and private property owners' compliance with strong land use regulations. Despite these efforts, most of the Tahoe Regional Planning Agency's environmental thresholds remain out of attainment, and there is limited understanding of the benefits from the investment of public funds. The US Forest Service, Tahoe Regional Planning Agency, California Regional Water Quality Control Board, and Nevada Division of Environmental Protection joined together to align their policies and develop a coordinated approach to implementation.

The Lake Tahoe Management System integrates continual improvement and adaptive management to close the loop between research, implementation and management decisions. A generalized Management System Manual was developed and is being implemented for specific programs that have significant scientific uncertainty related to important management decisions. The Management System uses conceptual models to link restoration actions to goals; tracks and reports operational performance and employs performance measures to define outcomes related to plans; and defines research and effectiveness monitoring needs within the context of management decisions. A Synthesis of Findings report integrates practical operational matters with effectiveness monitoring and research results to inform policy and resource allocation decisions. The Synthesis of Findings is developed by a science-agency working group and is targeted to agency management. By defining the roles and products at each step in this "plan-do-check-act" cycle and employing online tracking and reporting tools, the Management System closes the loop between data generation and management decisions.

The Lake Tahoe Management System is a template that can be applied to any ongoing multi-organization restoration program. It drives performance through information and decision-making transparency without usurping autonomy from any one participating organization. It also produces the information necessary to report the benefits of restoration actions related to defined goals, which is necessary to engender long-term support and ongoing funding. Finally, as ecosystem services and credits are employed in policies, the need for effectiveness evaluations and scientific research will increase to ensure that the credit is indeed resulting in net environmental benefits. The Management System defines a means to govern programs that increase flexibility and incentivize public and private investment in environmental restoration.

<u>Contact Information</u>: Jeremy Sokulsky, Environmental Incentives, LLC, 1027 Emerald Bay Road, South Lake Tahoe, CA 96150 USA, Phone: 650-283-7997, Fax: 530-541-1387, Email: jsokulsky@enviroincentives.com

Coupling of Riparian Tree Recruitment and River Hydrology along a Recently Restored Reach of the Merced River, CA

Frank Davis, ***Oliver Soong*** and *Lee Harrison*
Donald Bren School of Environmental Science and Management, University of California, Santa Barbara, CA, USA

Riparian trees are strongly coupled to river hydrology and floodplain geomorphology. Beginning in 2001, the Robinson Reach of the Merced River was restored with an engineered channel scaled to suit the current modified flow regime. Revegetation attempts were limited to the floodplain and were not conducted in the active channel. We measured tree height and position in plots situated at point bars, cut banks, and the banks between. Plots extend from within the active channel out onto the floodplain. Most naturally occurring stems are located within the active channel and are of short stature. Somewhat counter-intuitively, we find fewer recent recruits on point bars, which we speculate to be a result of competition with dense herbaceous cover. Using a detailed survey of the active channel, a 2-D model is used to simulate recent historical flows and estimate basic flow parameters such as extent, depth, velocity, and shear stress. Patterns of tree community structure and composition are related to these hydrologic parameters. The river extent during periods of seed release and dispersal can create differences in seed supply in different areas of the channel and floodplain. Extended inundation increases seedling mortality through drowning, while velocity and shear stress influence patterns of scour, burial, and other forms of mechanical insult.

Contact Information: Oliver Soong, Donald Bren School of Environmental Science and Management, University of California, Santa Barbara, CA 93106-5131 USA, Phone: 805-893-7044, Email: osoong@bren.ucsb.edu

Connecting Science, Policy and Projects to Sustain Great Rivers: The Great Rivers Partnership, Second Generation

Michael A. Reuter and ***Richard E. Sparks***
The Great Rivers Partnership, The Nature Conservancy, Peoria, IL, USA

Since its inception by The Nature Conservancy (TNC) and Caterpillar Inc. in 2005, the Great Rivers Partnership (GRP) has contributed technical and financial support to the conservation and sustainable development of great rivers on five continents. Each of these project areas have been settings for transformative work by a variety of partners. The GRP has supported development of the Yangtze River Blueprint in China, the Grasslands Exchange Program in Brazil, and the U.S. Army Corps of Engineers' Navigation and Ecosystem Sustainability Program on the Mississippi River.

Following the positive outcomes of the GRP in its first generation, Caterpillar challenged TNC and other partners to create a permanent Center for Great Rivers and Sustainability (the Center). The second generation of work would begin with a focus on the Mississippi, leveraging the efforts of the many entities and organizations already working on the river to: 1) aggregate and synthesize what is known about the Mississippi River across disciplines and professions; 2) support development of a shared vision for integrated river management; 3) serve as an "expert voice" in support of a sustained, intergenerational implementation of the vision; and 4) implement the vision by forging action plans among diverse interests to spur proof-of-concept projects, improve public policies, and promote research to address knowledge gaps.

Lessons learned on the Mississippi River would be shared broadly, and the work of the Center would, in turn, be influenced by best practices taking place on other great rivers in the United States and worldwide. This follows the logic in a recent paper by Paul Keddy and other scientists interested in the conservation of large wetlands around the world (BioScience, Jan. 2009): "The Mississippi River is probably the most intensively studied system of its type, yet it is often treated in isolation. This misses two important opportunities: that of learning from work carried out elsewhere, and that of sharing knowledge."

The Center will be led by a small staff that is highly networked to partners, engaging representatives from transportation, agriculture, utilities, energy, government, education, environment, and other sectors in strategic roles. An upcoming symposium on the Mississippi River provides one forum, and is aptly titled: "A Vision of a Sustainable Mississippi River: Merging Economic, Ecological, and Cultural Perspectives" (www.conferences.uiuc.edu/mississippiriver/index.html).

Contact Information: Richard Sparks, P. O. Box 176, Elsah, IL, Phone: 618-786-2811, Email: rsparks@illinois.edu

The Role of Ducks Unlimited in Developing Strategic Partnerships for Restoration Planning and Implementation in the San Francisco Bay Area

Jeff McCreary – presented by ***Renee Spenst***[1]
Ducks Unlimited, Rancho Cordova, CA, USA

Wetland restoration projects in the San Francisco Bay Area are complex and expensive. The complicated interface between 7 million people, multiple endangered species, sensitive natural resources, and the few remaining marshlands surrounding the Bay create a complex social, political, and environmental setting for restoration. As such, single entities find it difficult to implement projects on their own. The solution is the formation of strategic partnerships between land owners/managers, funding entities, biologists, and engineers that combine resources for successful project implementation. There are currently dozens of wetland restoration projects throughout the San Francisco Bay Area in various stages of implementation, with nearly 20,000 acres of wetlands planned for restoration. We will utilize a selection of these as case studies on the benefits of strategic partnerships and how they worked to successfully implement ambitious wetland restoration and enhancement projects. Case study projects include the Bair Island Restoration Project and the Napa River Salt Marsh Restoration Project.

Contact Information: Jeff, McCreary, Manager of Conservation Programs in the San Francisco Bay and Delta, Ducks Unlimited, 3074 Gold Canal Drive, Rancho Cordova, CA, 95746, USA, Phone: 916-852-2000, Email: jmccreary@ducks.org

A GIS Modeling Toolset for NRCS Watershed Planning and Hydrologic Analysis

***Scott L. Splean**, G.R. Norris* and *J. K. Grim*
USDA - Natural Resources Conservation Service, Davis, CA, USA

A Geographic Information Systems (GIS) based Hydrologic Modeling Toolset has been developed that provides spatial and tabular hydrology and morphometric data inputs and summary information required for nationally-used standard hydrologic analysis models.

The ArcGIS 9 Model Builder technology toolset includes:

1. **Watershed Delineation Model**: Computes flow direction, flow accumulation, stream and link network, watershed area boundaries, and acreage calculations for any input Digital Elevation Model (DEM) geodata source.

2. **RunoffCN_Model:** Computes Runoff Curve Number (CN) for individual areas where soils and land cover geodata intersect within a watershed of interest, and calculates CN, soils, and land cover summary statistics for entire watershed

3. **Slope-FlowLength/Path Model:** Computes percent slope, longest flow length, and flow path from a DEM surface, and calculates percent slope, flow length, and relief ratio statistics within a watershed of interest.

4. **iRainDrop Model**: With Rain Drop location point source input from user, model computes stream flow path from input source to destination outlet within a DEM.

These tools were developed to facilitate hydrology and sediment yield studies by NRCS technical specialists, which are conducted as a part of watershed planning efforts and to evaluate and design soil and water conservation measures in the field. The toolset was developed with specific regard to standard NRCS hydrology model methods and requirements (i.e. TR-55, EFH2, TR-20), but may be applied as part of other spatially-based morphometric and/or hydrologic analyses in support of natural resource evaluations and applied watershed restoration efforts.

The toolset provides an automated, time-saving, and higher data resolution and accuracy approach to hydrologic analyses than older labor-intensive traditional methodology. In addition, the tools offer timely and flexible enhancements to existing NRCS GIS applications, rather than introducing new software applications, where agency technical approval and certification may take months or years.

Contact Information: Scott Splean, State GIS Coordinator, USDA - Natural Resources Conservation Service, 430 G St., #4164, Davis, CA 95616, USA, Phone: 530-792-5631, Fax: 530-792-5794, Email: scott.splean@ca.usda.gov

Comparison of Adaptive Management Programs Currently Being Utilized to Guide Ecosystem Restoration/Recovery: Part 1 – Governance and Lessons Learned (A Panel Discussion)

Tom St. Clair
PBS&J, Jacksonville, Florida

Adaptive management (AM) is a formal science-based approach used to guide ecosystem restoration/recovery in situations where predicted outcomes have a high level of uncertainty. AM advances achievement of desired goals by reducing uncertainty, encouraging robust project designs and incorporating new information about ecosystem interactions and processes as our understanding of these relationships is augmented and refined. A panel session will be convened to examine how successfully AM is being utilized to guide restoration/recovery of three programs across the Country: Everglades Restoration, Platte River Recovery and Glenn Canyon Dam. These programs were chosen because each has an active AM program, but the maturity of each program and scale of application is substantially different. In this initial AM session representatives from these three programs will be asked to answer questions related to governance, funding, stakeholder involvement and lessons learned to allow comparison across programs. Questions to be asked include:

- What is the governance structure of your AM program?
- What is the current status of your AM program?
- How are monitoring, data management and assessment activities funded and maintained over the life of the AM program.
- How are stakeholders engaged in AM program execution?
- How have the predictive planning aspects of your AM program been developed and utilized to establish desired end-points and a vision for measuring success?
- What is and is not working with your AM program; what challenges have been overcome and what were the approaches used to overcome these challenges?

Panel members will include:

- Everglades Restoration: Elmar Kurzbach, Jacksonville District, US Army Corps of Engineers, Jacksonville, FL
- Glenn Canyon Dam: Dennis Kubly, Bureau of Reclamation, Salt Lake City, UT
- Platte River Recovery Implementation Program: Chad Smith, Headwaters Corporation, Lincoln, Nebraska

Contact Information: Tom St. Clair, PBS&J, 701 San Marco Blvd. Suite 1201, Jacksonville, FL 32207, Email: gstclair@pbsj.com

Comparison of Adaptive Management Programs Currently Being Utilized to Guide Ecosystem Restoration/Recovery: Part 2 – Linking Science to Decision Making (A Panel Discussion)

Tom St. Clair
PBS&J, Jacksonville, Florida

As a continuation of the adaptive management tract, Part 2 will address an issue that is confronting each of the major ecosystem restoration/recovery programs across the United States. That issue is how best to utilize the learning gained from monitoring to guide future decision making. Once again a panel session will be convened to examine how each of three AM programs is addressing this issue: Everglades Restoration, Platte River Recovery and Glenn Canyon Dam. These programs were chosen because each has an active AM program including ongoing monitoring, but the maturity of each program and scale of application is substantially different. In this second AM session, representatives from each program will be asked to make a presentation describing the monitoring program, methodology used for data assessment, and process used to integrate new knowledge into the decision-making process. At the conclusion of the briefings each panel member will be asked to answer a series of questions. Questions to be asked include:

- How is scientific information (new learning) communicated and integrated into management action decision-making?
- Is independent science a part of your AM program? If so, how is it integrated into implementation of AM and overall decision making?
- How does your program address the issue of scale – moving from assessment of ecological response at a project-level to assessment of restoration success at a watershed level?

Panel members will include:

- Everglades Restoration: Matt Harwell, US Fish & Wildlife Service, Vero Beach, FL
- Glenn Canyon Dam: Ted Melis, US Geological Survey, Flag Staff, AZ
- Platte River Recovery Implementation Program: Chad Smith, Headwaters Corporation, Lincoln, Nebraska

Contact Information: Tom St. Clair, PBS&J, 701 San Marco Blvd. Suite 1201, Jacksonville, FL 32207, Email: gstclair@pbsj.com

Hydrologic Restoration Provides Immediate Benefits for Wetland Dependent Species

Ellen M. Starr[1] and *Mark Guetersloh*[2]
[1]USDA NRCS, Henry, IL, USA
[2]IDNR, Ullin, IL, USA

The USDA Natural Resources Conservation Service funded a wetland restoration project with the Illinois Department of Natural Resources (IDNR) through the Wildlife Habitat Incentive Program in 2003. The project targeted high quality forested wetlands in the Upper Cache River of southern Illinois. The Cache River is recognized a "Wetland of International Importance" as designated by the UNESCO Ramsar Convention on November 1, 1994. The Cache River area is one of only six places in the U.S. where four or more physiographic regions converge. Southern deepwater swamps dominated by bald cypress (*Taxodium distichum*) and water tupelo (*Nyssa aquatica*) reach the northernmost extent of their range in the upper reaches of the Cache River floodplain. Many of these off channel wetlands were being de-watered by gullies that had formed as the result of channel incision and lateral gullying/channel widening instigated by the Post Creek Cut Off, a man-made diversion of the Upper Cache River into the Ohio River that was completed in 1915.

The wetland restoration project included the installation of a series of nine gully-plugs that restored water to approximately 420 acres of wetland habitat, including more than 250 acres of Grade A/B cypress-tupelo swamp. These wetlands are part of the 11,768-acre Cache River State Natural Area. One hundred and three state endangered and threatened species occur within these palustrine forested wetlands (Wetland Impact Review Tool IDNR, 2008). Restoration of a more natural hydroperiod in wetlands affected by unnatural de-watering had an immediate beneficial effect on the nesting success of birds breeding in the forested wetlands. An increase in nests was observed in the restored project wetlands for the yellow-crowned night heron (*Nyctanassa violacea*), a state endangered species (Hoover, 2009). The population density of the prothonotary warbler (*Protonotaria citrea*) nearly doubled from pre to post hydrology restoration of the gully-plug wetlands (Hoover 2009).

Illinois' Wildlife Action Plan recognizes the prothonotary warbler as a priority species located in southern Illinois and a non-game indicator species inhabiting palustrine forested wetlands throughout the state. It is considered a species in greatest need of conservation because of its dependence on a rare and vulnerable habitat. The presence of relatively deep water, 60 cm deep, in the restored wetlands resulted in decreased rates of nest predation which, in turn, led to an approximate 75 percent increase in fecundity for the prothonotary warbler (Hoover 2006, 2009). Hydrologic restoration success can be measured by the fecundity of the warblers which provides a mechanism for measuring the success of wetland restoration activities in floodplain forests (Hoover, 2009).

Contact Information: Ellen M. Starr, USDA-NRCS 1511 University Ct., Henry, IL 61537 USA, Phone: 309-364-3913, Fax: 309-364-3802, Email: ellen.starr@il.usda.gov

Too Cunning to be Understood: The Record of Late Holocene Central California Climate from San Francisco Bay Marsh Sediments

Scott W. Starratt
U.S. Geological Survey, Menlo Park, CA, USA

Sediment cores collected from three marshes on the northern margin of San Francisco Bay provide differing records of late Holocene climate variation in central California. The timing of changes in the diatom floras illustrates the complex interaction between local and regional climatic processes.

Results from Rush Ranch and Petaluma marsh suggest that conditions along the central coast became drier prior to the Medieval Climatic Anomaly and that fresh water became increasingly abundant during the transition from the Medieval Climate Anomaly (A.D. 800-1300) to the Little Ice Age (A.D. 1300-1900). In contrast, the Benicia State Park site is dominated by a freshwater flora during the Medieval Climate Anomaly, and conditions become brackish at the beginning of the Little Ice Age.

The Rush Ranch site shows periods of increased salinity between 3,000 to 2,700 cal yr B.P., 1,750 to 750 cal yr B.P., and from about A.D. 1930 to the present. The 3,700 year-long Benicia State Park record shows a rapid decrease in salinity around 3,200 cal yr B.P. Fresher conditions continue until 500 cal yr B.P., after which salinity increases. During this later period, sediment deposition occurred in the summer and fall when river flow rates were lower, resulting in a more brackish diatom flora.

Differences in the timing and duration of the fresher and more saline intervals at Rush Ranch and Benicia State Park are largely controlled by proximity to the main channel of the Sacramento-San Joaquin River system. The short (about 15 km) distance from the mouth of the tidal channel to Rush Ranch appears to have a dampening effect on the signal of climate variation. For example, the transition from brackish to fresher conditions takes place between 3,200 and 3,100 cal yr B.P. at Benicia State Park, but does not occur until several hundred years later at Rush Ranch. The subsequent transition from fresher to more brackish conditions occurs 150 to 200 years earlier at Rush Ranch.

The record at Petaluma marsh is strongly controlled by precipitation in the Coast Ranges. Beginning about 1550 cal yr B.P., conditions become more saline, and, with the exception of a 200-year period from ~700 to 500 cal yr B.P., continued to increase in salinity to the present. This shift in the diatom flora may be influenced by marsh accretion, resulting in longer periods of exposure during the summer and fall.

Contact Information: Scott W. Starratt, M.S. 910, U. S. Geological Survey, 345 Middlefield Road, Menlo Park, CA 94025 USA, Phone: 650-329-4990, Fax: 650-329-5203, Email: sstarrat@usgs.gov

Wetland Restoration in an Ultra-Urban Environment

Donald Stevens and *Tara Stewart*
The Louis Berger Group, Inc., Morristown, NJ, USA

During the 20th century 99% of New York City's wetlands (and 100% of the Borough of Manhattan's tidal salt marshes) were destroyed by the construction and expansion of the city, robbing the region of a sustainable wetland complex that would improve water quality and provide wildlife habitat, as well as educational and passive recreation opportunities. With nearly complete urbanization in the New York City area, it has become almost impossible to find suitable and viable wetland restoration sites. Surrounded by a landscape of concrete and disturbed land, Randall's Island provided an innovative opportunity to restore a valuable fresh water wetland and create the only tidal salt marsh in Manhattan's ultra-urban environment.

To seek creative community input and maximize project value to this important project, Berger met with the Randall's Island Sport Foundation, the New York City Department of Parks and Recreation, the New York City Economic Development Corporation and public outreach groups leading to the ultimate design of a freshwater wetland system and a tidal salt marsh.

The salt marsh restoration design involved removing trash piles and excavating fill material to intertidal elevations that support native salt marsh species. Once the correct elevation was established, the area was planted with a diverse mosaic of marsh and scrub-shrub habitat. Berger incorporated public access into the design by integrating portions of an existing path with a new boardwalk and two observation areas into the design, allowing for continued public and school science class access. Shorter-growing vegetative species were planted along the boardwalk to ensure views of the marsh.

The freshwater wetland restoration focused on excavating the site (including debris) and constructing an earthen berm to redirect stormwater and extend retention time, establishing a natural flow pattern with the goal of discharging cleaner water back to the Little Hell Gate Inlet. An innovative planting plan replaced invasive species with a great variety of native vegetation in forested upland, scrub/shrub, and emergent habitats to further promote a more diverse, sustainable, and fully functioning ecosystem. Educational and public access was provided along a raised, landscaped path running through the center of the site.

In addition to improving urban wildlife habitat, aesthetics, diversity and water quality, the restoration project reduced heat island effect, flooding, erosion and gave the community a valuable, sustainable resource for education, recreation and land use. The design team developed an inventive urban parkland design that equally satisfied public use and environmental goals, serving as a model for future park development projects. Remarkably, in the midst of an intensely urbanized environment, the Manhattan ecosystem now benefits from both a new freshwater wetland and its only salt marsh.

Contact Information: Donald B. Stevens P.E., Restoration Design Group, 412 Mount Kemble Ave, P.O. Box 1946, Morristown, New Jersey, 07962-1946 USA, Phone: 976-407-1407, Fax: 973-267-6468,
Email: dstevens@louisberger.com

Louisiana's Coastwide Reference Monitoring System: Using Web Services to Integrate and Visualize Data for Assessing Restoration Effectiveness

***Gregory D. Steyer*[1] and *C. Conzelmann*[2]**
[1]U.S. Geological Survey, National Wetlands Research Center, Coastal Restoration Field Station, Baton Rouge, LA, USA
[2]U.S. Geological Survey, National Wetlands Research Center, Lafayette, LA, USA

The Coastwide Reference Monitoring System - *Wetlands* (CRMS- *Wetlands*) is collecting, analyzing and reporting on a consistent suite of water, vegetation, soil and spatial variables at 390 sites across coastal Louisiana. These data are used to evaluate coastal baseline conditions as well as restoration and rehabilitation efforts. These evaluations can occur over a multiple scales, ranging from site-specific scales of less than1 km^2 to tens of thousands of km^2 over a 20-yr period. CRMS-*Wetlands* uses coastal scientists to develop analytical tools in partnership with database managers and information technology specialists such that they can be visualized through web services (**http://www.lacoast.gov/crms2/**). This partnership allows for the development of data automations that optimize data processing and maximize analytical flexibility of large datasets. It also provides opportunities to present and synthesize scientific data in a manner that is visually informative. The development of a hydrologic index that describes the suitability of hydrologic characteristics to specific wetland habitat will be presented to illustrate how large datasets are integrated and visualized. The hydrologic index is used with other ecological indices as a report card to assess the effectiveness of restoration efforts and provide an overall indication of wetland condition at various spatial and temporal scales.

Contact Information: Gregory D. Steyer, U.S. Geological Survey, National Wetlands Research Center, Coastal Restoration Field Station, c/o Livestock Show Office, Parker Coliseum, Louisiana State University, Baton Rouge, LA 70803 USA, Phone: 225-578-7201, Fax: 225-578-7927, Email: gsteyer@usgs.gov

Environmental Evaluation System for Water Resource Planning (Version 2)

Harry J. Stone, *Stephanie A. Hines* and *Daniel J. Chappie*
Battelle, Cincinnati, OH, USA

The widely-used “Battelle Method” (1972), *Environmental Evaluation System for Water Resource Planning*, is being updated to reflect the state of ecological knowledge. The original conceptual framework includes ecology, environmental pollution, esthetics, and human interest defined by 78 environmental quality parameters. Each parameter is scaled from 0 (bad) to 1 (good) to establish a common base in Ecological Impact Units (EIUs); weights are assigned to each parameter to reflect relative importance.

Building on this approach, the updated Battelle Method establishes a conceptual framework that links human stressors to resilience of ecosystem functioning, preservation of intrinsic value, and changes in ecosystem goods and services – collectively, the environmental impact of the human activity. The conceptual framework is useful for estimating the impact of human stressors or restoration activities at various levels of data intensity (and cost) from a screening level, supported by heuristics derived from empirical data, to incorporation of case-specific ecological modeling. The output from the analysis can provide a baseline of environmental quality and predict likely changes in environmental quality resulting from proposed human activities. An example of the use of the updated methodology as a low-cost approach to screen the likelihood that restoration alternatives may restore ecological functioning will be presented.

Contact Information: Harry J. Stone, Battelle, 10300 Alliance Rd., Suite 155, Cincinnati, OH 45242 USA, Phone: 513-362-2600 Ext. 12, Fax: 614-458-0146, Email: stoneh@battelle.org.

Use of Microbial Pre-Treatment in Ecosystem Restoration Projects

Ralph E. Elliott III[1], *Mark Krupka*[2] and *Douglas Dent*[2] – presented by ***Frederick Streb***[1]
[1]MacDonald Bedford, LLC and SEEK Enterprises, Inc., Jacksonville, FL, USA
[2]Ecological laboratories Inc. Cape Coral, FL, USA

The most common technologies currently utilized in the treatment of natural bodies of water that become polluted or begin to undergo *eutrophication* involve primarily some form of physical/chemical treatment such as chemical oxidizers, flocculants, activated carbon and zeolites and/or mechanical treatments such as dredging. The primary drawback to physical/chemical treatments is that the treatments are based on *stoichiometry*, or molecule to molecule interactions. As a result, they get very expensive when treating large volumes of water. Likewise, dredging is also expensive because it is labor and capital equipment intensive. There are also other issues such as final disposition of the dredge spoils, disturbing of the site and surrounding areas, and risks associated with operating equipment in and around bodies of water.

In recent years bioremediation has been proven to be not only effective, but, in most cases, very economical, in treating natural bodies of water. Bioremediation takes advantage of nature's own processes for recycling of the basic elements of most pollutants and organic sediments back into the biosphere through what are known as the biogeochemical cycles. To accelerate these natural processes bio-augmentation may be utilized. Bio-augmentation is the purposeful inoculation of a system with microorganisms that have been selected for their particular metabolic characteristics.

The technology has been successfully applied in a number of natural and man-made bodies of water to improve water quality and break down organic bottom solids. A review of several applications including a river in China, a retention pond in Malaysia and multiple lakes in the United States will be presented. In these applications, substantial reductions in aqueous phase pollutants were observed including Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), Total Nitrogen (TN) and Total Phosphorous (TP). In addition, reductions of 80% and more of organic bottom solids were observed without the need for dredging with the associated disposal of dredge spoils. Currently, projects are being investigated that will address the presence of priority pollutants such as pesticides and pesticides breakdown products, for example DDD and DDT, in both the aqueous phase and sediments.

Many 3rd Party Studies are available indicating a reduction of organic bottom sediment of as much as 3 feet during an 18 month period. CD's of these studies will be available. In all cases where bioremediation has been successfully employed a large cost savings of up to 65% over conventional technologies have been realized. Pre-treatment of Ecosystem Restoration project areas can save as much as 65% of the cost of mechanical restoration.

Contact Information: Ralph Elliott, SEEK MacDonald Bedford LLC, 710 San Marco Blvd, Jacksonville, FL 32207, Phone: 904-545-0377, Fax: 904-861-3709, Email: elliottriii@msn.com

Biological Considerations in Managed Pond Design for Waterbirds

Cheryl M. Strong
San Francisco Bay National Wildlife Refuge Complex, USFWS, Newark, CA, USA

The restoration of ~16,500 acres of former commercial salt evaporator ponds in the San Francisco Bay area is currently underway. Some of this land will be returned to tidal action for the benefit of endangered marsh species. However, this area also contains the most important pond habitat for waterbirds on the Pacific Flyway, supporting more than a million shorebirds and waterfowl throughout the year. The restoration of some ponds to tidal marsh create a challenge for the South Bay Salt Pond Restoration Project to maintain the numbers and diversity of birds within a smaller footprint of ponds. This consideration is a key component of the Project's Adaptive Management Plan.

Our current understanding of waterbird use of managed ponds indicates different foraging guilds require different water salinities and depths. So the design of managed ponds must include considerations for varying water depths and salinities depending on target species. The location of the pond within the overall complex is important in maintaining target salinity levels. For example, "batch" ponds can be managed at higher salinities for brine shrimp production that are the forage preference for Eared Grebes. Lower salinity ponds near the complex's intake can be managed at deeper water levels conducive to fish-eating birds. In addition, distance from the pond to the Bay is also a consideration since many shorebirds roosting on the ponds travel twice daily to forage on mudflats at low tide; this distance influences energetics and therefore survival.

Other biological considerations for the design and management of ponds for wildlife include island habitat, water quality issues, and fish entrainment. Islands are used both as high-tide refugia and nesting sites for terns, shorebirds, and state listed Western Snowy Plovers, and their design varies depending on target species. For example, Caspian terns prefer flat surfaces covered with sand with no vegetation to obstruct views, but shorebirds may benefit from vegetation to conceal chicks and nests from avian predators. We are in the process of trying to understand water circulation patterns within ponds to minimize low dissolved oxygen "dead zones", and have designed ponds to minimize water residence times. And although the spatial use of the South Bay by salmonids is not well understood, along creek channels known to have salmon runs we are either installing fish screens or managing water intake seasonally to prevent salmonids from entering during migrations.

Managed ponds are resource intensive, requiring high up-front construction costs as well as perpetual maintenance. However, in the San Francisco Bay, ponds managed for waterbirds need to be retained in the landscape, and the design and management of these ponds will require monitoring and adaptive management on the part of the South Bay Salt Pond Restoration Project in order to meet the project goal of maintaining current numbers of waterbirds breeding, wintering and migrating at the ponds.

Contact Information: Cheryl Strong, San Francisco Bay National Wildlife Refuge Complex, USFWS, Newark, CA, 94560, USA, Phone: 510-557-1271, Fax: 510-792-5828, Email: cheryl_strong@fws.gov

Developing Restoration and Management Strategies in the Context of Climate Change

Laura J. Stroup[1], *Gregory E. Eckert*[2], *Glenn B. Landers*[3] and *G. Ronnie Best*[4]
[1]Department of Geography, Texas State University-San Marcos, San Marcos, TX USA
[2]US National Park Service, Fort Collins, CO, USA
3U.S. Army Corps of Engineers, Jacksonville, FL, USA
[4]United States Geological Survey, Ft. Lauderdale, FL, USA

This three hour pre-conference workshop will introduce the topic of climate change and identify forecast consequences on a regional basis. Potential strategies for contending with the effects of climate change within environmental management and restoration practice will be presented. The workshop is intended to provide resource managers with an understanding of the tools and approaches to address uncertainties associated with climate change. To do this, the workshop will be structured to:

- Review the relevant definitions, variability and conclusions from the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report;
- Describe conceptual frameworks and tools for addressing uncertainty under global change. These include vulnerability, scenario planning, resiliency, adaptive management, risk assessment, ecological integrity, adaptation and transformability;
- Framework and tool applications through case studies from upland, coastal and aquatic systems; and
- Break out sessions where participants will share ideas and interact with fellow attendees to conceptualize challenges and approaches to manage the consequences of climate change. The use of adaptive management as a framework for managing this change will be introduced.

Registered participants should familiarize themselves with pre-workshop materials.

Contact Information: Laura Stroup, Texas State University-San Marcos, 601 University Drive, San Marcos, TX 78666, USA, Phone: 512-245-2536, Email: LJStroup@txstate.edu

A Risk-Informed Decision Framework for Hurricane Protection and Coastal Planning

Todd S. Bridges[1], ***Burton Suedel***[1], *Martin Schultz*[1], *Brian Harper*[2] and *Tim Axtman*[3]
[1]US Army Corps of Engineers, Engineer Research and Development Center, Vicksburg, MS, USA
[2]US Army Corps of Engineers, Institute for Water Resources, Alexandria, VA, USA
[3]US Army Corps of Engineers, New Orleans District, New Orleans, LA, USA

The Louisiana Coastal Protection and Restoration (LACPR) and the Mississippi Coastal Improvement Program (MsCIP) have developed a risk-informed decision framework (RIDF) that draws from current practice in the fields of risk and uncertainty analysis and multi-criteria decision analysis (MCDA). The approaches incorporated within the RIDF have enhanced communication and collaboration among decision-makers and stakeholders by providing a clear process for defining objectives, metrics, and weightings that reflect respective priorities. Using these metrics, values and weightings, the techniques comprising MCDA are used to derive quantitative scores for several plans under consideration. The RIDF also facilitates critical communication about the role of uncertainty in decision-making and about residual risks. Taking into account uncertainty concerning future conditions, particularly in regards to sea level rise and land-use development, can affect scoring such that the optimal planning strategy may shift. Therefore, the RIDF includes approaches for characterizing uncertainty in risk estimates and metrics and incorporating estimates of uncertainty into the quantitative scores and ranks developed for alternative plans. In this way, the quantitative techniques within the RIDF can be used to identify the needs for follow-on studies and to facilitate communication and negotiation among the parties to a decision. Finally, emphasis is placed upon the role of adaptive planning and management in connection with the RIDF as a mechanism for optimizing the performance of protection measures.

Contact Information: Burton Suedel, US Army Corps of Engineers, Engineer Research and Development Center, Vicksburg, MS 39180 USA, Phone: 601-634-4578, Fax: 601-634-2263, Email: Burton.Suedel@usace.army.mil

Stakeholder Value Elicitation Process for LACPR and MsCIP

Larry Donovan[1], ***Burton Suedel***[2], *Todd S. Bridges*[2], *Barry Payne*[2], *Brett Boston*[3] and *Vern Herr*[3]
[1]US Army Corps of Engineers, New Orleans District, New Orleans, LA, USA
[2]US Army Corps of Engineers, Engineer Research and Development Center, Vicksburg, MS, USA
[3]Group Solutions, Inc., Alpharetta, GA, USA

The Louisiana Coastal Protection and Restoration (LACPR) program and the Mississippi Coastal Improvement Program (MsCIP) have developed planning efforts with several objectives and are charged with meeting those objectives in a manner suitable to the citizens and stakeholders of Louisiana, Mississippi and the Nation. Emphasis has been placed on open communication with the public, leading to an extensive public scoping process conducted in the spring of 2006. The goal of the public meetings was to solicit stakeholder views on problems and opportunities and measures that the public feels would reduce risks. A common resulting theme was that input based on local experience and knowledge was critical to a successful risk-reduction effort. There was also broad recognition of the need for an integrated, multidisciplinary solution. Topics frequently raised included environmental protection and restoration; freshwater diversion; accounting for coastal subsidence and by extension, sediment delivery; and promotion of regional economic vitality. In order to ensure that all such concerns are factored into the planning effort, LACPR and MsCIP used multi-criteria decision analysis (MCDA) as a means to combine the results of technical analysis with value information concerning risk metrics. Multi-Attribute Utility Theory was used to combine input values for metrics with information on stakeholder and decision maker priorities. The interactive meetings of stakeholders, experts, and decision analysts were used to assign weightings to the metrics used for evaluating planning alternatives. Meeting participants were introduced to the mechanics of the MCDA model and then given the opportunity to explore the sensitivity of ranking to slightly altered weightings. The decision framework will be used to discover the nature of disagreements and spur additional analysis, study, and negotiation.

Contact Information: Burton Suedel, US Army Corps of Engineers, Engineer Research and Development Center, Vicksburg, MS 39180 USA, Phone: 601-634-4578, Fax: 601-634-2263, Email: Burton.Suedel@usace.army.mil

The Relationships among Ecosystem Services, Restoration and Human Well Being and the Construction of an Index of Well-Being

Kevin Summers and *Lisa Smith*
US Environmental Protection Agency, Gulf Breeze, FL, USA

The Millennium Ecosystem Assessment produced a compelling synthesis of the global value of ecosystem services to human well-being. While the MEA was a critical, initial step to demonstrate the potential for assessing global trends in ecosystem services, it is important to note that the MEA did not attempt to down-scale such assessments to regional or even national scales of analysis, nor did it attempt to create methods and tools to support decision-makers at any level of governance, industry, or citizen action. A new research perspective focusing on ecosystem services is needed in which we define ecosystem services as the products of ecological functions or processes that directly or indirectly contribute to human well-being, or have the potential to do so in the future. This approach can easily be applied to ecosystem restoration as an Index of Restorative Potential. The vision of this approach would be to contribute to a comprehensive theory and practice for characterizing, quantifying, and valuing ecosystem services and to ensure that their relationship to human well-being is consistently incorporated into environmental decision making. Building upon indicators linking ecosystem services to human and community health, both ecosystem and placed based information could be used to develop a U.S. measure of human well-being. This measure would expand the interpretation of ecosystem service indicators into an overall quality of life measurement for environmental decision support.

Contact Information: Kevin Summers, US EPA, 1 Sabine Island Drive, Gulf Breeze, FL 32561, USA,
Phone: 850-934-9244, Email: summers.kevin@epa.gov

Panel Discussion: The Appropriate Role for Ecosystem Services in Ecosystem Restoration and Environmental Decision-Making

Panel: ***Kevin Summers***[1], *Rick Linthurst*[2], *Steve Weisberg*[3] and likely to include two others
[1]US Environmental Protection Agency, Gulf Breeze, FL, USA
[2]Ecosystem National Program Director, US Environmental Protection Agency, Research Triangle Park, NC, USA
[3]Executive Director, Southern California Coastal Water Research Project Authority, Costa Mesa, CA, USA

The Millennium Ecosystem Assessment produced a compelling synthesis of the global value of ecosystem services to human well-being. Ecosystem restoration has a goal of restoration of ecosystem structure and function but not without the restoration of ecosystem services. Restoration of these services has a positive effect on human well-being. The same argument could be made for the goals and objectives of general environmental decision-making. Environmental decisions, almost always, “impact” ecosystem services and human well-being yet these “impacts” are rarely considered in the decision-making process. The panel will discuss:

(1) Is there a role for ecosystem services in the restoration decision process? If so, what?

(2) Can/Should the reclamation of ecosystem services be used as a performance metric to determine to overall success of the restoration?

(3) Should loss of ecosystem services and the value of its reclamation be a factor (a primary factor) in the process to assess restoration potential? Formally?

(4) How do we inform and educate decision-makers and the public regarding the importance of eco-services in all environmental decision-making?

Contact Information: Kevin Summers, US EPA, 1 Sabine Island Drive, Gulf Breeze, FL 32561, USA,
Phone: 850-934-9244, Email: summers.kevin@epa.gov

The Future of the Watershed Approach—Rapid Watershed Assessments

Jan M. Surface
Conservation Planning and Technical Assistance Division, USDA Natural Resources Conservation Service, Washington, DC, USA

Historically, the Natural Resources Conservation Service (NRCS) has accomplished much of its watershed scale planning through the Watershed Surveys and Planning Program. Planning under this program included watershed protection, flood prevention, agricultural water management, non-agricultural water management, ground water recharge, water quality management, and municipal and industrial water supply. In recent years, the Watershed Surveys and Planning program has received limited or no funding. NRCS has developed a new approach to watershed planning to streamline delivery of NRCS programs at the watershed level, to better integrate a wide range of NRCS programs, and to better coordinate with non-NRCS conservation efforts.

NRCS Rapid Watershed Assessments (RWA) provide initial estimates of where conservation investments would best address the concerns of landowners, conservation districts, and other community organizations within a watershed. RWAs contain a descriptive watershed resource profile and a tabular assessment matrix that summarizes current resource conditions, desired resource conditions, conservation opportunities, related installation and maintenance costs, and potential sources of funding. RWA are being used to help prioritize the implementation of conservation practices, as a platform for more extensive planning, and to identify public-private partnerships in leveraging additional resources. RWA are also being used as background documentation for grant proposals, in setting base levels for future watershed planning, as background information for TMDL watershed implementation plans, to connect watershed groups, in decision making to analyze staffing levels, to evaluate existing conservation programs for an economic perspective, and as a tool for outreach on promoting NRCS conservation programs.

Contact Information: Jan M. Surface, USDA Natural Resources Conservation Service, Conservation Planning and Technical Assistance Division, 1400 Independence Avenue SW, Washington DC 20250, USA,
Phone: 202-690-2501, Fax: 202-720-2998, Email: jan.surface@wdc.usda.gov

Innovative Methods of Integrating Conservation Planning Methods, Conceptual Ecological Models, USACE Planning Requirements, and NEPA to Develop a Comprehensive Plan: Missouri River Ecosystem Restoration Plan Case Study

Jennifer Switzer
US Army Corps of Engineers, Kansas City, MO, USA

The Missouri River Ecosystem Restoration Plan/EIS (MRERP/EIS) is among the largest basin-wide restoration planning efforts in the US, and represents an unparalleled opportunity and challenge. The aim of the effort is to identify restoration, mitigation and recovery goals for the Missouri River and its tributaries, ecological systems and native species for the coming 30-50 years. The complexity of the project and its geographic scale present numerous challenges, among which is the need to provide real engagement opportunities for the interested public and stakeholders, including members of 29 basin tribes, 8 states and dozens of federal, state and local agencies. To address this challenge, a team of planners representing multiple backgrounds and approaches has developed the MRERP roadmap, which incorporates tested and innovative techniques to ensure procedural and legal requirements are met through a transparent, objective, and scientifically based planning approach. The roadmap integrates NEPA principles and practices, the USACE 6-Step Planning Process, the Open Standards for the Practice of Conservation, and the lessons and best practices of previous large-scale ecosystem restoration planning efforts.

During the poster session, participants will be introduced to the MRERP-style resource baseline conceptual model.

Contact Information: Jennifer Switzer, US Army Corps of Engineers, Rm. 843, Fed Bldg 601 E 12th St, Kansas City, MO 64106; Phone: 816-389-3062, Email: jennifer.l.switzer@usace.army.mil

The Integration of the National Environmental Policy Act and U.S. Army Corps of Engineers' Planning Requirements

Jennifer Switzer
U.S. Army Corps of Engineers, Kansas City District, Kansas City, MO, USA

As a federal agency, the U.S. Army Corps of Engineers (Corps) is required to ensure that all of their major federal actions are carried out in compliance with the National Environmental Policy Act (NEPA). The preparation of the Missouri River Ecosystem Restoration Plan and integrated environmental impact statement (MREPR/EIS) is a major federal action, requiring compliance with the NEPA and the Corps' agency-specific laws and guidelines regarding planning. Specifically, Corps studies must be conducted in a manner that satisfies the Corps' 6 Step Planning Process. The NEPA and the 6-Step Planning Process have common elements and requirements including the requirement to consider a full range of alternatives, engage the public, identify current issues and resources, describe the affected environment, and select a final plan. Given the commonalities, the MRERP planning process will integrate and implement Corps' and NEPA planning requirements into one unified process which satisfies both at once. Not only does integration of these two processes save time and resources, but it is a requirement as per the Economic and Environmental Principles and Guideline for Water and Related Land Resources Implementation Studies. Integration of the NEPA and Corps' planning steps serves to streamline the MRERP process, help avoid duplication of effort, and improve the efficiency at which the MRERP participants engage with each other throughout the study.

Contact Information: Jennifer Switzer, U.S. Army Corps of Engineers, Room 843 Fed. Bldg, 601 E. 12th Street, Kansas City, MO 64106 USA, Phone: 816-389-3062, Email: jennifer.l.switzer@usace.army.mil

Why Care About Impacts to Natural Systems? Using Ecosystem Functions, Goods, and Services to Scale Changes to Nearshore Ecosystems in Puget Sound

Curtis D. Tanner[1], *Miles G. Logsdon*[2] and *Charles A. Simenstad*[3]
[1]Puget Sound Nearshore Partnership, Washington Department of Fish and Wildlife, Olympia, WA, USA
[2]School of Oceanography, University of Washington, Seattle, WA, USA
[3]School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA, USA

Scientists and restoration planners reporting loss or anthropogenic impacts to ecosystems are often challenged to answer the question “so what?” In dramatically changed landscapes, it is often difficult to describe what has been lost in socially relevant terms. It is equally challenging to provide a compelling vision of what could be achieved through ecosystem restoration. In the Puget Sound Nearshore Ecosystem Restoration Project (PSNERP), we have attempted to address the need to translate observed changes in Puget Sound nearshore ecosystems to a human values framework using the Millennium Ecosystem Assessment (MEA) categorization of ecosystem functions, goods and services. The PSNERP analyses of anthropogenic impacts along Puget Sound’s beaches, estuaries and deltas has generated a comprehensive, spatially-explicit and ecosystem process based classification of historic change (Change Analysis) and we are using the same framework to project future changes to 2060. Using a Delphi approach, PSNERP’s interdisciplinary Nearshore Science Team (NST), ranked the relative ability of PSNERP change analysis attributes to impact MEA ecosystem functions, goods, and services. These results will allow PSNERP to scale geographic areas of analysis to “level of impairment”. In this case, impairment can be defined as disruption of the ability of Puget Sound nearshore ecosystems to support ecosystem functions, goods, and services. This approach allows us to identify areas of high impairment to focus restoration actions, and areas of relatively low impairment for potential preservation or conservation management. Benefits of restoration and protection actions can be translated to managers and the general public in socially relevant terms, helping to describe benefits and inform policy.

Contact Information: Curtis D. Tanner, Puget Sound Nearshore Partnership, Washington Department of Fish and Wildlife, P.O. Box 43145, Olympia, WA, USA 98504-3145, Phone: 360-902-2815,
Email: curtis.tanner@dfw.wa.gov.

Improving Ecosystem Restoration Science and Engineering Practice in the US Army Corps of Engineers

Susan Smith[1], *Jodi Staebell*[1], *Al Cofrancesco*[2], *Craig Fischenich*[2], ***David Tazik***[2] and *Rennie Sherman*[3]

[1]US Army Engineer Mississippi Valley Division, Vicksburg, MS, USA
[2]US Army Engineer Research and Development Center, Vicksburg, MS, USA
[3]Headquarters, US Army Corps of Engineers, Washington, DC, USA

The US Army Corps of Engineers has established an integrated team to support its aquatic ecosystem restoration mission. The Corps' Ecosystem Restoration Planning Center of Expertise and US Army Engineer Research and Development Center work jointly with guidance from HQUSACE to (1) enhance science and technology, training, and technical support available to Corps practitioners, (2) facilitate lessons learned, and (3) effectively engage the broader restoration community of practice.

Aquatic ecosystem restoration is a national priority and a primary Corps mission. The Corps' purpose is to restore significant aquatic ecosystem function, structure, and dynamic processes that have been degraded, based on a comprehensive examination of the problems contributing to ecosystem degradation, and the development of alternative means for their solution. Restoration investments are significant. The Corps has budgeted approximately $400M annually for restoration projects in recent years. Beyond the Corps, the number of river restoration projects alone has increased exponentially in the US; with an average of over $1 billion dollars spent per year since 1990. The need for restoration investments will continue to grow because human infrastructure and water extractions will expand, and many aquatic systems will experience significant changes in flow and sediment regimes due to external stressors such as climate and land use change. Concomitantly, the demand for sound science-based approaches and technologies will also increase.

In this presentation, we will review the most significant initiatives undertaken during the past year to upgrade the Corps' ecosystem restoration training and technology integration programs, and discuss planned improvements and initiatives—e.g., technical support, interagency and academic collaboration, research planning, information exchange and technology transfer. We will also discuss future directions and the challenges we face, and will solicit feedback from the audience on their needs as restoration practitioners.

Contact Information: David Tazik, Environmental Laboratory, US Army Engineer Research and Development Center, Vicksburg, MS 39056 USA, Phone: 601-634-2610, Fax: 601-634-3842, Email: dave.tazik@us.army.mil

Assessing Everglades Restoration Using Everglades Depth Estimation Network (EDEN)

Pamela A. Telis[1] and *Heather Henkel*[2]
[1]U.S. Geological Survey, Florida Integrated Science Center, Jacksonville, FL, USA
[2]U.S. Geological Survey, Florida Integrated Science Center, St. Petersburg, FL, USA

Successful restoration of the Everglades depends, in part, on restoring more natural volume, timing, and distribution of sheetflow in the wetlands and the corresponding response of the natural system to these changes. The Everglades Depth Estimation Network (EDEN), a primary product of the integrated hydrology of the REstoration COordination and VERification (RECOVER) Monitoring and Assessment Plan (MAP), provides much of the hydrologic data that underpins many of the MAP's restoration hypotheses. EDEN's computation of the water depth and hydroperiod, important ecological drivers, provide biologists and ecologists with the data necessary to examine trophic-level responses to hydrodynamic changes in the Everglades.

The EDEN project creates daily model simulations of water surface covering the greater Everglades based on daily surface water level at 253 wetlands and canal gages. The integrated network of gages records data throughout Big Cypress National Park (BCNP), Everglades National Park (ENP), and the Water Conservation Areas (WCA) 1, 2, and 3 and are operated by the BCNP, ENP, the South Florida Water Management District and the U.S. Geological Survey (USGS). Data from the multiple agencies are combined with the data from the USGS in the USGS National Water Information System (NWIS) database and then served real-time to scientists, managers, and the general public. The water level surfaces are posted on the EDEN website (**http://sofia.usgs.gov/eden**) daily with a one-day delay and are presented as follows:

- Daily water surfaces are generated from daily median water-level gages data from the period January 1, 2000 to current
- Surfaces are created on a 400 x 400 meter grid
- Water-level surfaces are in units of centimeters
- Vertical datum is North American Vertical Datum of 1988
- Surfaces are available as NetCDF and GeoTiff files

By combining the daily water-level surfaces with the ground elevation model and using the EDEN applications, a full suite of hydrologic data is made available to scientists and others including:

- Water depth
- Hydroperiod (computation of days since last dry)
- Water surface slope
- Surface animations of water elevation and water depth over time
- Transects of water depth animated over time

Contact Information: Pamela Telis, U.S. Geological Survey, Jacksonville, FL 32207 USA, Phone: 904-232-2602, Fax: 904-899-5097, Email: patelis@usgs.gov

Rainfall and Potential Evapotranspiration Data for Everglades Depth Estimation Network (EDEN) Gages

Pamela A. Telis[1] and *Michael Holmes*[2]
[1]U.S. Geological Survey, Florida Integrated Science Center, Jacksonville, FL, USA
[2]U.S. Geological Survey, Florida Integrated Science Center, Tampa, FL, USA

The Everglades Depth Estimation Network (EDEN) is a network of real-time water-level stations, ground-elevation models, and water-surface models that provides scientists and managers with current (2000 to present) on-line water-elevation and water-depth information for the entire freshwater portion of the greater Everglades. Recently, EDEN compiled rainfall and potential evapotranspiration data and assembled the data for each EDEN station, over 200 locations throughout the Everglades. These meteorological data sets offer users easy access to data for biological and ecological assessments, and watershed modeling and management. The meteorological data are available on the EDEN website, **http://sofia.usgs.gov/eden**

The rainfall data for the Everglades is based on the NEXRAD data from the U.S. National Weather Service coverage of rainfall statewide. The accuracy of the NEXRAD data is enhanced when adjusted using the local rain-gage data and a proprietary algorithm based on the Brandes method. EDEN receives rainfall data for the EDEN domain gridded to 2 kilometers for the period 2002 to 2007 and updated annually. Daily rainfall data are assigned for each of the EDEN water-level stations based on the 2-kilometer grid estimates of rainfall.

Potential evapotranspiration is the evapotranspiration rate of a surface without moisture stress, a condition that is generally met in the wetlands of the Everglades. The potential evapotranspiration (PET) data for the Everglades was computed by the Priestley-Taylor equation based on solar radiation estimates derived from data from Geostationary Operational Environmental Satellites (GOES) and meteorological data from the Florida Automated Weather Network, the State of Florida Water Management Districts and the National Oceanographic and Atmospheric Administration. Daily PET is available throughout the State of Florida for the period 1995 to 2007 at the identical 2-kilometer grid as is rainfall and updated annually. Daily PET values are assigned for each of the EDEN water-level stations based on the 2-kilometer grid estimates of PET.

Contact Information: Pamela Telis, U.S. Geological Survey, Jacksonville, FL 32207 USA, Phone: 904-232-2602, Fax: 904-899-509, Email: patelis@usgs.gov

Use of Hydrogeomorphic Assessment Method (HGM) and the California Rapid Assessment Method (CRAM) in Guiding Adaptive Management Decisions: The Story of the City of Laguna Niguel and the Journey to Revitalizing a Southern California Urban Creek (Sulphur Creek)

Michelle Mattson[1] and ***Lindsay Teunis***[2]
[1]United States Army Corps of Engineers, Los Angeles District Regulatory Branch, San Diego Section, CA, USA
[2]EDAW | AECOM, Ecological and Environmental Planning Practice, San Diego, CA, USA

In 2002 the City of Laguna Niguel embarked on a journey to address the ongoing degradation of the City's surface water quality through restoration of a degraded stream to native wetland, riparian, and upland habitats through the center of an urban area. Through a State Proposition 13 grant, a State Coastal Conservancy grant, a State Urban Streams Restoration grant, a Federal Section 206 cost-share with the United States Army corps of Engineers, and partnerships with the local Homeowners Associations and the County of Orange, the City has successfully planned and installed over 2.5 miles of restoration along a semi-contiguous portion of Sulphur Creek located in the Aliso Creek Watershed. The restoration effort was divided into two projects referred to as Upper Sulphur Creek and Middle Sulphur Creek. Specific restoration goals identified during the planning process for both projects included (1) restoring hydrologic processes including water storage, stream stability, and energy dissipation; (2) restoring biogeochemical functions including nutrient cycling, nutrient availability, and sediment deposition; and (3) restoring biologic functions including native wetland and riparian vegetation, plant and animal movement and dispersal, biomass production, and native plant and animal diversity. To meet these goals, the Aliso Creek Watershed Hydrogeomorphic Functional Assessment Method (HGM) Guidebook (MacNeil 2001) was used to assess baseline conditions, develop and compare restoration alternatives, conduct a cost-benefit analysis, and set success criteria for the alternative implemented. The two restoration projects are currently in Year 1 and Year 2 of 5-year maintenance and monitoring programs. Restoration ecologists annually conduct HGM analysis and the more recently developed California Rapid Assessment Method (CRAM) to aid in quantifying the improvement in wetland condition and guide adaptive management decisions. Currently the average CRAM score ranges from 52% to 76% across all assessment areas with an average score of 58%.A CRAM score of 88% is projected to be the highest obtainable value for the restoration projects due to the urban setting and absence of large native buffer areas. Through the use of functional assessment tools such as CRAM, restoration ecologists have identified and implemented new strategies in an effort to achieve restoration goals.

Contact Information: Lindsay Teunis, Ecological and Environmental Planning Practice, EDAW | AECOM, San Diego, CA 92101 USA, Phone: 619-684-6943, Fax: 619-233-0952, Email: lindasy.teunis@edaw.com

Large Scale Geomorphology and Land Cover Associations in the Upper Mississippi River System

Charles Theiling
USACE Rock Island District and University of Iowa, Rock Island, IL, USA

Geomorphology has been identified as one of five Essential Ecosystem Characteristics (EECs) for the Upper Mississippi River System (UMRS). There are many geomorphic features and processes relevant in large floodplain rivers like the UMRS, including: the underlying geology, glacial processes, alluvial processes since glaciations, sediment transport and deposition; fluvial processes affecting the geometry of channels and floodplains, and environmental response to human development. Upper Mississippi River ecosystem restoration programs consider geomorphology at several scales.

A large-scale longitudinal characterization of the river landscape developed a hierarchical system of "Geomorphic Reach" classifications that includes nested levels of twelve geomorphic reaches, and 37 navigation pools. Geomorphic reaches were defined by the channel profile, the occurrence of large geologic controls, alluvial characteristics, and response to development. This classification is supplemented at a finer scale by an aquatic area classification to map aquatic areas of the river based on geomorphic and navigation project features (Wilcox 1993). There is extensive historic and contemporary land cover information for the floodplain, but a classification of floodplain features is lacking.

Geomorphology is also important to identify the potential for the presence of cultural resources sites. A system-wide Landscape Sediment Assemblage (LSA) classification was developed to aid UMRS project planning by identifying the relative age and composition of large scale geomorphic features to estimate the potential for prehistoric settlement and significant archeological sites. The LSA classification is also hierarchical in nature and can be quite discrete when applied at fine scales. The LSA data provide an excellent resource for ecological investigations because they can be reclassified and related to important ecological attributes like frequency of inundation, soil type and drainage characteristics, and plant community development. Four investigations were completed for separate river reaches, and each used slightly different methods. A unified classification was completed to join the data for the entire river.

The objective of this work was to assess the utility of the geomorphic reach classification and the system-wide LSA classification to explain the spatial distribution of presettlement, contemporary, and future floodplain vegetation communities. Another objective was to compare system-wide, pre- and post-development aquatic area class distribution to evaluate aquatic habitat response and changes in aquatic vegetation communities.

Contact Information: Charles Theiling, USACE Rock Island District and University of Iowa, PO Box 2004, Clock Tower Bldg, Rock Island, IL 61204; Phone: 563-210-4350, Email: Charles.h.theiling@usace.army.mil

Linking Site Restoration to Ecosystem Recovery: Approach to Scaling and Applications of Results from the Columbia River Estuary

Ronald Thom, *Heida Diefenderfer, Curtis Roegner, John Skalski, John Vavrinec, Gary Johnson* and *Blaine Ebberts*
Pacific Northwest National Laboratory, Sequim, WA, USA

Our objective is to link the ecological effects from site-based restoration projects with broader ecosystem responses. We use Net Ecosystem Improvement (NEI) as an organizing model which considers three basic factors: (1) change in function at a site, (2) change in area of that function, and (3) the probability that the restoration project will work. Our site-scale studies have illustrated the level and rate of change in key functional metrics such as net aerial primary production, biodiversity adjustment, and fish prey. Because the vast majority of projects involve restoring tidal hydrology, we are quantifying hydrological changes and using derived metrics such as wetted area and channel edge length to characterize functional area changes. We use this information to develop relationships between structure and function, specifically to predict functional responses to changes in community structure. The probability factor is assessed based on the success of past projects, the natural variation among sites, and the degree of disturbance and stress on site and landscape scales. Because broader scale effects depend largely on the flow of energy, materials and individual organisms between landscape "elements" (i.e., habitats or sites), we are evaluating the exchange of nutrients, phytoplankton, insects and organic carbon between the sites and the estuary. In addition, we are using the concept of increased capacity and opportunity to characterize the potential functional benefit to migratory and resident fish populations through improved access, food supply, and refuge. Taken together, these results are now providing an estimate of ecosystem benefits from multiple restoration projects, as well as a basis for prioritizing restoration projects. In addition, they are helping refine predictions of future benefits, and reducing uncertainties around both site-scale projects and ecosystem-scale restoration programs. Overall results of the research and modeling of these wetlands are being applied to the adaptive management of the lower Columbia River and estuary protection and restoration program.

Contact Information: Ronald Thom, Pacific Northwest National Laboratory, 1529 W. Sequim Bay Road, Sequim, WA 98382, USA, Phone: 360-681-3657, Email: ron.thom@pnl.gov

Large Ecosystem Restoration Programs Comparison and Contrast: Louisiana Coastal Area; Upper Mississippi River; Comprehensive Everglades Restoration Program; Missouri River Recovery Program, Columbia River, and California-Federal (CAL-FED)

Kenneth Barr[1], *Troy Constance*[2], *Marci Cook*[3], *Larry Gerry*[4], *David Gallat*[5], *Lauren Hastings*[6], *Mike Olson*[7] and ***Brad Thompson***[8]
[1]US Army Corps of Engineers, Rock Island District
[2]US Army Corps of Engineers, New Orleans District
[3]US Army Corps of Engineers, Portland District
[4]South Florida Water Management District
[5]US Geological Survey, Columbia Missouri
[6]State of California
[7]US Fish and Wildlife Service,
[8]US Army Corps of Engineers, Omaha District

The purpose of this session is to provide a forum for comparison and contrast of a number of the nation's largest ecosystem restoration efforts. The programs highlighted range from coastal wetlands to large river ecosystems, while also representing a variety of partnership approaches, funding sources and levels, and stages of implementation. Increasingly the nation and many regions of the country have realized the need to restore large ecosystems. Due to time and funding limitations, joint presentations by several ongoing programs have rarely occurred. This session will provide a forum for the discussion of similarities, differences, and lessons learned from several of the nation's largest ongoing programs. As the number of large-scale ecosystem restoration efforts grows, so does the need to transfer knowledge gained from these ongoing efforts.

This session will include brief overview presentations of each effort and then a facilitated discussion and Q&A session for the participant to engage the panelists with specific questions regarding the respective programs. Topics to be addressed during the session will include: purpose and scope of study/program, major ecological issues, goals and objectives, stakeholder involvement, interagency coordination, approaches taken to formulate system plans, estimated total restoration needs, actual authorized and current funding levels, level of monitoring and adaptive management, major areas of risk and uncertainty, lessons learned, and a summary of items needed to provide more successful implementation. A handout summarizing some of the basic elements of all programs will be provided as a reference and to assist in understanding similarities and differences.

Contact Information: Brad Thompson, US Army Corps of Engineers, Omaha District, 1616 Capitol Street, Omaha, NE 68102 USA, Phone: 402-995-2678, Fax: 402-995-2697, Email: Bradley.E.Thompson@usace.army.mil

Comparison of Resilience of Restoration of the Seagrass Genus *Halodule* in Subtropical Atlantic, Tropical to Subtropical Pacific, Subtropical Gulf of Mexico and Tropical Caribbean

Anitra Thorhaug
School of Forestry and Environmental Studies, Yale University

The genus *Halodule* created several species when the Atlantic separated from the Pacific during geological period of the uplift of Panama. The morphology appears to be very similar of *H. wrightii* and *H.uninervis* from descriptions (den Hartog, 1973; Tomlinson, 1978). Our comparative restoration projects and experiments took place with *Halodule wrightii* in Texas (10 test locations in North Laguna Madre and 3 major sites), in Florida (20 locations in Biscayne Bay, 3 in Fort Lauderdale, and 2 in Jacksonville and 5 major sites), in Jamaica (at 17 areas around the island), and with *Halodule uninervis* in the Philippines (5 areas in from Manila Bay and Bataan southward to other islands). The methodologies included sprigs (turions) *vs.* plugs including their roots. The results of these planting were generally between 65 and 90% successful and have been monitored over time showing the restored beds have continually expanded into available space for up to three decades (dependent on planting dates which range between 1973 to 2001). The large plantings (from 1 to 75 acres per site) have all maintained resilience by continuing as a seagrass bed for years (individually reported). There have been major hurricanes, wind events and tornados which results will be reported. The individual subsites within the test plot areas (prior to the large plantings) differed depending on the light compensation depth *vs* planting depth, sediment type, sediment quality, salinity regime, energy level, turbidity and/or light level. These factor were important to the growth responses of the *Halodule* plantings. Little difference was seen between Atlantic *vs.* Pacific restoration: *Halodule* behaved similarly between the two. The major difference between subtropical and tropical plantings were the late-fall-winter low growth response in the subtropics vs. tropical high growth rates during late fall and winter.

Contact Information: Anitra Thorhaug, School of Forestry and Environmental Studies, 1359 SW 22 Terrace, Miami, Fl 33145, Phone: 305-858-0014, Email: thorhaug@msn.com

The South Florida Ecosystem Restoration Program Integrated Delivery Schedule

Karen S. Tippett[1] and *Brian K. Files*[2]
[1]Jacksonville District, U.S. Army Corps of Engineers, Jacksonville, FL, USA
[2]Everglades Partners Joint Venture/Parsons, Jacksonville, FL, USA

The goal of the South Florida ecosystem restoration program Integrated Delivery Schedule (IDS) is to identify the optimum sequencing of key hydrologic projects to deliver meaningful restoration benefits to the ecosystem as soon as possible, consistent with law and forecasted funding. The IDS incorporates both Federal and State initiatives. It includes the Comprehensive Everglades Restoration Plan (CERP) and non-CERP projects. The non-CERP projects include Kissimmee River Restoration, Modified Water Deliveries to Everglades National Park, Herbert Hoover Dike Rehabilitation, and ongoing components of the Central & Southern Florida project, as well as the South Florida Water Management District (SFWMD) Northern Everglades Plan and Long-Term Plan for Achieving Water Quality Goals in the Everglades Protection Area projects. Additional projects will be added as necessary. The IDS also includes system operating manual revisions at key points.

The IDS development team consisted of members from the U.S. Army Corps of Engineers, SFWMD, the U.S. Fish and Wildlife Service, Everglades National Park, and the Florida Department of Environmental Protection. The initial IDS is the result of nearly two years of comprehensive interagency and public collaboration. The effort included public workshops and close coordination with the NAS Committee on Independent Scientific Review of Everglades Restoration Progress, the South Florida Ecosystem Restoration Task Force and Working Group, the CERP Quality Review Board, the CERP Design Coordination Team, the SFWMD Governing Board, the SFWMD Water Resources Advisory Commission, and the CERP REstoration COordination & VERification team. Several approaches were used in developing the IDS, including incremental adaptive restoration, priorities based strictly on project authorization and funding, and finally a hybrid of the two. The team developed an interactive tool to depict project sequencing alternatives that considered the status of project planning and design, real estate availability, construction authority, and program funding.

The IDS was developed in response to recommendations provided in the 2007 General Accountability Office report and the 2006 National Academy of Science (NAS) Report to Congress. The IDS allows the Federal and State implementing agencies to provide guidance to decision-makers for scheduling, staffing, and budgeting South Florida ecosystem restoration program efforts. The initial IDS was endorsed by the South Florida Ecosystem Restoration Task Force in September 2008. The IDS is a living document and will be updated as necessary to reflect any major changes in program authorities, funding, or any other significant events.

Contact Information: Karen S. Tippett, Jacksonville District, U.S. Army Corps of Engineers, 701 San Marco Boulevard, Jacksonville, FL 32207 USA, Phone: 904-232-1016, Email: Karen.S.Tippett@usace.army.mil

A Practical Approach for Assessing the Benefits of Innovative Ecosystem Restoration Projects

Leo D. Lentsch[1], *T. Abbe*[2], ***A. Toline***[1] and *L. Musilanski*[2]
[1]ENTRIX Inc., Georgetown, SC, USA
[2]ENTRIX Inc., Seattle, WA, USA

Land and resource managers and planners are faced with overwhelming challenges in complying with the Endangered Species Act, the Clean Water Act, flood protection, and sustainable development. Establishing scientifically-based and practical metrics for evaluating ecosystem restoration and mitigation with respect to meeting these compliance demands is an ongoing challenge. We provide several examples of applying geomorphic and ecologic metrics to measure the benefits of aquatic ecosystem restoration actions. This presentation will provide a national perspective by outlining: 1) the challenges facing river and coastal resource managers implementing ecosystem restoration in river and coastal environments; 2) innovative approaches for addressing those challenges, and 3) case histories detailing on the ground practical approaches that demonstrate integration of river and coastal ecosystem restoration into resource management planning.

Three critical components of ecosystem restoration or conservation planning are: 1) what are the environmental factors limiting ecosystem processes, 2) where (geographically) are those limitations, and 3) quantitatively estimating the benefits of implementing restoration or conservation measures. This information forms the basis for determining the benefits and costs associated with ecosystem restoration investments. As conservation and restoration needs increase and funding is exposed to more review and scrutiny, cost-effective results are paramount. Some of the more common criticisms center around the facts that commonly used methods: 1) do not have a quantitative basis for the estimates, 2) are not transparent to allow thorough review and stakeholder input, and 3) are not reproducible to allow use for future improvements, estimates, and subsequent adjustment.

This paper presents case studies that demonstrate innovative approaches in restoration and resource/flood management and assess the benefits of ecosystem restoration projects. For example, an inventive approach for assessing potential impacts and benefits from mitigation measures associated with potential coastal resource threats was developed for approximately 2.3 million acres of marine and estuarine habitat (e.g. Pacific Coast and Puget Sound) in the state of Washington. An overview of a model is presented as a tool to assist resource managers in the development of quantitative-based metrics for assessing potential impacts and benefits associated with mitigation measures. Another example from Washington State shows how new approaches to flood protection may be transforming cumulative impacts into cumulative benefits.

Contact Information: Leo D. Lentsch, ENTRIX Inc., 829 Front Street, Suite J Georgetown, SC 29440, USA, Phone: 843-545-0125, Email: llentsch@entrix.com

Restoring Urban Ecosystems: The Trinity River Corridor Program, Dallas, Texas

Mark R. Tompkins[1], *Denny Mengel*[1], *Kyle Winslow*[1], *Anthony Falzone*[1], *Paul Frank*[1], *Beatriz Dongell*[1], *Greg Welch*[1] and *Greg Ajemian*[2]
[1]CH2M HILL, Oakland, CA, USA
[2]City of Dallas, Dallas, TX, USA

The Trinity River corridor in Dallas, Texas (drainage area 6,100 mi^2) has experienced dramatic ecological change over the past century, with the most rapid and extensive changes occurring during the construction of the original Dallas Floodway project in the late-1920s and the US Army Corps of Engineers (USACE) reconstruction of the floodway in the mid-1950s. The Balanced Vision Plan (BVP) for the Trinity River Corridor, completed by the City of Dallas in 2003, focuses on ecosystem restoration as a primary objective, as well as flood protection, recreation, transportation, and economic redevelopment. The ongoing design of the Trinity River Corridor Program includes significant ecosystem enhancements aimed at creating more natural channel and riparian conditions that are sustainable with respect to the other features of the program and the heavily urbanized condition of the eight mile long project area. Ecological enhancements to the channel and floodway include restoration of channel meanders and morphologically diverse channel geometry, creation of an oxbow lake, establishment of a diverse native riparian plant assemblage, and construction of three lakes in the floodway adjacent to the river channel. Given the dynamic nature typical of alluvial systems such as the Trinity River, designing these ecosystem improvements in concert with the aesthetic, recreational, and flood management features of the project in a sustainable way posed significant challenges during the design process. We present an integrated application of hydrology, fluvial geomorphology, and two dimensional hydraulic and sediment transport modeling tools developed to address critical channel and floodplain design issues for the Trinity River Corridor project, and summarize key ecosystem restoration design features of this large-scale urban river corridor restoration program.

Contact Information: Mark R. Tompkins, CH2M HILL, 155 Grand Avenue, Suite 1000, Oakland CA 94612, Phone: 510-587-7793, Fax: 510-622-9149, Email: Mark.Tompkins@ch2m.com

Addressing the Challenge of Climate Change in the Greater Everglades Ecosystem: A Stakeholder-Based Approach

Juan Carlos Vargas[1], *Michael Flaxman*[1], ***Steve Traxler***[2], *Todd Hopkins*[2], *Paul Souza*[2], *Ronnie Best*[3] and *Herman Karl*[4]
[1]Department of Urban Studies and Planning, Massachusetts Institute of Technology, Cambridge MA, USA
[2]US Fish and Wildlife Service, Vero Beach, FL, USA
[3]US Geological Survey, Ft Lauderdale, FL, USA
[4]US Geological Survey, Massachusetts Institute of Technology, Cambridge MA, USA

The Florida Everglades ecosystem is among the most important natural resources in North America and it is in the midst of perhaps the most complex and ambitious ecosystem restoration planning effort in U.S. history. This effort will involve hundreds of semi-autonomous organizations and jurisdictions of thousands of people. To be successful, such a project must adopt a variety of planning, management, and communication strategies. In this regard, climate change is arguably the most significant and difficult issue to rise to prominence since the original formulation of the Comprehensive Everglades Restoration Plan (CERP) in 2000. Climate change will affect a wide variety of human and natural systems, and must be addressed within a context of considerable uncertainty in policy, human responses, and indirect effects. In order to plan and manage effectively in the face of such uncertainties, we are developing a stakeholder-based alternative futures process with two major objectives. First, in collaboration with the MIT-U.S. Geological Survey Science Impact Collaborative (MUSIC) and the U.S. Fish and Wildlife Service (FWS), we will develop a set of regional-scale “alternative futures” that spatially simulate likely climatic, hydrologic, and land use conditions in 2030 (based on IPCC scenarios). Secondly, in collaboration with MUSIC and FWS, is to examine the impacts of such changes on fish, wildlife, plants, and their habitats, such as National Wildlife Refuges in the Greater Everglades and Florida Keys Ecosystems. The work will be conducted using a spatially enabled stakeholder process, designed to combine the best available scientific information with local knowledge. The major outputs of our study will include information that characterizations of the potential impacts on the Everglades from climate change (this could take many forms such as research reports, GIS maps, and publications), and structured public and expert group processes.

Experience has shown that collaborative decision making reduces conflict among participants, increases the credibility of science-based information underlying environmental decisions, and improves the overall legitimacy of the participation process. Therefore, inviting the stakeholders to be part of the decision-making process in environmental management is at the core of the exploring the consequences of climate change on the Greater Everglades Ecosystem. The process and deliverables outlined in this study will provide staff and mangers the needed foundations for current and future Strategic Habitat Conservation efforts in south Florida.

<u>Contact Information</u>: Steve Traxler, US Fish and Wildlife Service, 1339 20th Street, Vero Beach, FL 32960, USA, Phone: 772-562-3909 ext.265, Email: steve_traxler@fws.gov

Borderlands Watershed Management: A Collaborative Approach to Resource Management

Rosendo Treviño III[1] and *Jose Manuel Perez Cantu*[2]
[1]USDA Natural Resources Conservation Service, San Antonio, TX, USA
[2]PRONATURA NE, Monterrey Nuevo Leon, Mexico

Abstract: Introduction: The majority of the Mexico-United States border region is a semi-arid and fragile desert ecosystem. For more than 200 years the primary land use along the border has been ranching, and much of the land has suffered from overgrazing, loss of ecosystem biodiversity, soil erosion and desertification. As the economic viability of traditional ranching has declined due to grassland resource depletion, the land has become more and more fragmented, and in many instances abandoned worsening problems of poverty and unemployment, and contributing to border security concerns.

Background: Natural resource management in the United States has long been accomplished in a watershed approach. Decisions about the use and management of natural resources are best made by focusing on the functioning of natural systems within a landscape. Watersheds cross all political and social-economic boundaries. Protecting watershed health along the U.S. and Mexico borders is of immense concern and key to solving resource and economical development problems. Restoration of ecosystems provides multiple benefits to humans and the wild life that inhabits these regions.

Present Day Collaboration: Ecological Restoration of Northeastern Mexico by SEMARNAT, PRONATURA, CUENCA LOS OJOS (CLO) and CEMEX. To date approximately 40,000 ha have been treated with a Lawson Aerator and reseeding to native grass where needed.

Efforts/Proposal: Creation of a Bi-National Borderland Ecological Restoration Program to protect our Natural Resources and to combat the effects of desertification. The Bi-National approach to Cooperative Conservation on shared watersheds will yield Clean Water and a Healthy Environment and Habitat.

Contact Information: Rosendo Treviño III, USDA Natural Resources Conservation Service, C/O USGS, 5563 De Zavala Suite 290, San Antonio Texas, 78249 USA, Phone: 210-691-9248, Fax: 210-691-9270

San Francisco Bay: Its Past, Present, and Prospective Future

Dilip Trivedi
Moffatt & Nichol, Walnut Creek, CA, USA

The San Francisco Estuary is a large, complex coastal estuary system which communicates with the ocean through the Golden Gate. It is comprised of several large bays, with deep channels, shallow mudflats, and a sprawling tidal river delta. The present estuary originated when the Pacific Ocean entered the Golden Gate about 10,000 years ago, well past the start of the last glacial period. Between about 2,000 and 3,000 years ago, mudflats and tidal marshes began to form around the edges of the interior bays within the Estuary. The deep parts of the Estuary contained the submerged topography of ancient valleys, with old river courses draining the valleys. Shallow water dominated the broad tidal basins of the upstream, brackish bays. Each day, as the tide went out, thousands of acres of tidal flats emerged along the margins of the bays and larger tidal channels. Large tidal channels connected the marshes to the bays and spread into dendritic networks of thousands of smaller channels distributed throughout the marshes.

Since the arrival of the Europeans in ca. 1769, the Bay saw steady alterations to the landscape. These included large-scale changes in the region's natural habitats such as the conversion of large areas of native perennial grasslands to pastures of non-native invasive annual grasses, and the advent of excessive erosion from local hillsides and creek banks. Beginning in the mid-1800s, following the Gold Rush in the Sierra Nevada, large areas of the Estuary's tidal marshes and mudflats were filled, diked, or drained. Extensive portions of the baylands were filled to provide land for ports, rail lines, and roads, as the Bay Area became a major transportation center. Today, the Bay is about 300 square miles smaller at high tide compared to the pre-settlement era. Coincidentally, 300 square miles is the amount of tidal marsh that's been lost in the period. The Bay is presently home to about 7 million inhabitants.

In response to environmental concerns during the last 3 to 4 decades, several legislative actions resulted in the formation of laws and regulatory agencies with the goal of protecting the Bay's resources. One of the key elements that emerged through consensus was the value of the marshes and tidal flats. Over that time period, the state of scientific knowledge increased dramatically, and several land acquisitions targeted towards conservation occurred. At the present time, there is the impetus to restore over 30,000 acres of tidal marshes, mud flats, and seasonal wetlands in the Bay. Agencies specifically tasked with conserving public lands and restoring habitat have been created, and numerous projects are either being implemented or close to being implemented. There are, however, significant challenges associated with conserving and restoring habitat in an urbanized estuary such as San Francisco Bay.

Contact Information: Dilip R. Trivedi, Moffatt & Nichol, 2001 North Main Street, Ste 360, Walnut Creek, CA 94596, USA, Phone: 925-944-5411, Fax 925-944-4732, Email: dtrivedi@moffattnichol.com

The Effect of Anthropogenic Eutrophication on a Shallow Marine Benthic Ecosystem: Microfossil Records over the Last 200 Years in Osaka Bay, Japan

Akira Tsujimoto[1], *Moriaki Yasuhara*[2], *Hideo Yamazaki*[3] and *Kotaro Hirose*[1]
[1]Division of Biology and Geosciences, Graduate School of Science, Osaka City University, Osaka, Japan
[2]Department of Paleobiology, National Museum of Natural History, Smithsonian Institution, Washington, DC, USA
[3]Department of Life Science, School of Science and Engineering, Kinki University, Higashiosaka, Osaka, Japan

Anthropogenic eutrophication and the resulting hypoxia have been one of the most significant problems for benthic ecosystems in world's coastal oceans. Hypoxic zones have been increasing over the past decades in many countries, contributing to ecosystem degradation. To trace the process of ecosystem degradation is important to assess the changing ecosystem. In this context, we can learn ecosystem history using paleoecological proxies such as microfossils that are abundantly preserved in sediment cores. We reconstruct spatial and temporal changes of a benthic ecosystem and its response to anthropogenic eutrophication over the last 200 years in Osaka Bay, Japan, using multiple paleoecological proxies (foraminifera, ostracod, and diatom). This typical urban embayment of Japan provides one of the most serious Asian examples of the effect of anthropogenic eutrophication on a shallow marine benthic ecosystem.

The results suggest that a high-density/low-diversity assemblage, which is characterized by extremely high population densities of a few opportunistic species, appeared in the early 1900s, coinciding with the eutrophication of the bay resulting from the Japanese industrial revolution. Most species collapsed in the inner part of the bay, most likely due to severe hypoxia. This unusual benthic community developed in response to increasing food and decreasing competitors. In contrast, at a non-hypoxic site located in the outer part of the bay, eutrophication increased food for benthos and so population density of whole benthic community. A sewage treatment program was enacted in 1970s in order to reduce the nutrients load. Coincident with this program, the absolute abundances of a few opportunistic species decreased in the inner part of the bay.

The microfossil records clearly reflected various ecosystem degradations (e.g., simplification of benthic community, development of high-density/low-diversity assemblage, and collapse of many benthic species) after the Japanese industrialization at ~1900, which is ~100 years later than European/American industrialization and the resulting ecosystem degradation.

Contact Information: A. Tsujimoto, Division of Biology and Geosciences, Graduate School of Science, Osaka City University, Osaka, 558-8585 Japan, Phone: +81-6-6605-3176, Fax: +81-6-6605-3176,
Email: akiratsujimoto@gmail.com

After a Year Away: My Perspective on a Decade of Everglades Restoration

Cheryl P. Ulrich
Weston Solutions, Atlantic Beach, Florida, USA

Introduction

From 1998-2008, I had the honor of working for the Corps of Engineers, Jacksonville District on Everglades Restoration….also known as the South Florida vortex. My journey included various roles beginning with project manager for the Modified Water Deliveries to Everglades National Park to senior regional project manager for the South Dade, Florida Bay and Florida Keys region to South Florida Restoration Project Management Branch Chief and ultimately Strategic Execution Branch Chief for the Everglades Division. Towards the end of my Corps of Engineers' career, I had the opportunity to be the project manager at HQUSACE for creating a National Center for Ecosystem Restoration.

Purpose

This presentation will highlight the top ten insights I've gained during this past year of reflection regarding the Everglades Restoration efforts as well as make a case for the need of a vision/strategy for all of our nation's water resources.

The National Problem

Several of our global trading partners, such as New Zealand, Australia, South Africa, Brazil, and the European Union, have already developed overarching water policies and strategies designed to address the kinds of water resource challenges facing the US. *The US does not have a national vision for one of the most important natural and strategic resources on earth*! Currently the water policy of the US consists of a mix-match set of laws, guidance, regulations and executive orders overseen by many government organizations at all levels.

The Vision

The Nation needs to coalesce and reconstruct these directives into a common but succinct national water policy vision and strategy. Such a coherent national strategy would provide a roadmap for planning and resource deployment. America needs a national water resources vision that articulates a strategy that protects the quality of the nation's water resources, ensures a sustainable supply, and promotes the wise use of our floodplains, wetlands and watersheds. Collaborative leadership and accountability will be essential for success.

Contact Information: Cheryl P. Ulrich, Weston Solutions, Atlantic Beach, FL 32233 USA, Phone: 904 338-8100, Email: cpucpu@comcast.net

Accomplishments and Challenges in Genetic Enhancement and Aerial Planting Applications for a Large-Scale Ecosystem Restoration in Highly Eroded Intertidal Marshes

Herry S. Utomo[1], *Michael D. Materne*[2] and *Ida Wenefrida*[1]
[1]Rice Research Station, Louisiana State University Agricultural Center, Crowley, LA, USA
[2]School of Plant, Environmental and Soil sciences, Louisiana State University Agricultural Center, Baton Rouge, LA, USA

Ecological restoration on highly impacted tidal marshes represents substantial technical challenges. In highly impacted areas, such as Louisiana coastal marshes where 65-91 km^2 of saltmarsh loss occurs annually, the only amenable erosion control and habitat restoration is through large-scale efforts. Three major components need to be addressed to support this large-scale restoration, including (1) new breeds of native plants that have better growth characteristics and adaptation to offset rapid rates of erosion, (2) planting techniques and logistical problems associated with large-scale restoration, and (3) ecological considerations associated with developing long-term sustainability and obtaining optimum ecosystem functionality.

Native vegetation can provide seed for ecological restoration. However, the availability of seed could vary depending on environmental condition in a given year. To address this problem, a set of 13 genetically distinctive, superior, and high seed-producing lines of native coastal plant species, smooth cordgrass (*Spartina alterniflora)*, was developed and used to produce polycross populations that gives rise to genetically diverse progeny suitable for ecological restoration. Under cultivated environments, the average yield of *S. alterniflora* polycross population was 347.2 lb/A, which is equivalent to approximately 16.9 million viable seeds. Cultivation and incorporation of this seed production system into the existing restoration practices would be the next challenge to overcome.

An aerial seeding using seed produced from this population can be used to reach marsh interior marshes most affected by erosion, not only to restore coastal marshes but also maintain the entire saltmarsh systems. Though hundreds of acres can easily be planted aerially in a day at a fraction of the cost of current planting practices, the successful application is largely time dependent (early spring). Additional planting techniques will need to be developed, including the use of coated seed, pelleted plugs, and gallon-pot plants. Providing a variety of planting techniques associated with direct seeding and seed-based transplanting is crucial for the successful vegetative establishment in each restoration project.

Evaluation of genetic diversity among the existing native populations in major basins of Louisiana saltmarshes using molecular markers indicates a high level of diversity within basins (96.6%) and only a small amount of diversity found among basins (3.4%). Based on the information obtained, a particular population configuration necessary to achieve a low probability of extinction can be designed. Concurrently, the smallest number of sites needed to represent diversity may be determined and can be used as a genetic core to support revegetation capable of providing long-term sustainability and obtaining optimum ecosystem functionality.

Contact Information: Herry S. Utomo, Rice Research Station, Louisiana State University Agricultural Center, 1373 Caffey Road, Rayne, LA 70578 USA, Phone: 337-788-7531, Fax: 337-788-7553, Email: hutomo@agcenter.lsu.edu.

Towards an Ecological Agenda for Landscape Urbanism

Michael Van Valkenburgh[1], *Mack Scogin*[2], *Thomas Auer*[3], *Steve Apfelbaum*[4] and *Tim Dekker*[5]
[1]Michael Van Valkenburgh Associates, Inc., New York, NY, USA
[2]Mack Scogin Merrill Elam Architects, Atlanta, GA, USA
[3]Transsolar Energietechnik GmbH, Stuttgart, Germany
[4]Applied Ecological Services, Inc., Brodhead, WI, USA
[5]LimnoTech, Inc., Ann Arbor, MI, USA

Landscape architecture is emerging as a compelling professional voice in urban planning projects around the world and proposals for implementing new ecological functions within the city abound. Contemplating ecological restoration in a non-urban context has the benefit of tremendous resources in collected-data and built case studies. However, there are far few examples of urban ecology projects to draw upon as a resource to understand the effectiveness of sustaining ecological functions within the city. Relative to the massive urbanization occurring globally, this is a much needed area of exploration. This new rhetoric of landscape architecture influencing city-building seems to be far ahead of the evidence of its applicability with regard to sustainable ecological systems. So how do we know that we are, in fact, making progress?

Although landscape urbanism may sometimes be perceived as the milieu of the urban planner, it is the landscape architect who is trained to understand ecology from an experiential perspective and urbanism from an environmental perspective, positioning this profession to be uniquely suited to synthesize the efforts of multiple related disciplines into a landscape-based urban planning approach. Michael Van Valkenburgh Associates' (MVVA) development of a working ecological agenda—one that aspires to a reciprocity between human-made and natural environments—grows out of designing, building, and revisiting the firm's projects.

In May 2007, MVVA was awarded the Lower Don Lands project in Toronto, Ontario, which asked what new city-building potential could be unlocked by relocating of the channelized mouth of the Don River. The 300+ acre urban-environmental development born out of this extreme act of terra-forming presents an opportunity for self-evaluation and critical positioning. It is a project that, by necessity, has to integrate ecological forces within the context of large-scale city planning and, by its unique circumstance, possesses an underlying imperative for landscape urbanism: the river makes the city, the city sustains the river. A companion is a reciprocal piece of urban design work by Mack Scogin Merrill Elam Architects and Transsolar Climate Engineers to forge urban neighbors based on stringent assessment of climate factors within the larger frame established by the river scientists (Applied Ecological Services), the hydrologists (LimnoTech) and the landscape architects (MVVA). Finally, it is the capacity of landscape architects that comes from their fluency of these agencies of change that make us well situated to receive and transform the synthetic results.

Contact Information: Michael Van Valkenburgh, Michael Van Valkenburgh Associates, Inc., 18 East 17th Street, 6th Floor, New York, NY 10003 USA, Phone: 212.243.2506, Fax: 212.243.2016, Email: michael@mvvainc.com

Restoring Pollinator Habitat on Agricultural Lands

Mace Vaughan
Pollinator Conservation Program, Xerces Society for Invertebrate Conservation, Portland, OR, USA

Pollinators are an essential component of all environments, including agricultural systems. Without pollinators, at least 80 percent of our flowering plants could not reproduce. In California, production of several crop species is enhanced by or dependent upon insect pollination. These crops include almond, sunflower, squash, melon, blueberry, plum, apple, strawberry, tomatoes, avocado, and more.

Despite their importance pollinators are declining in many areas as their habitat is converted to other land uses. In addition, pesticide use and other practices in agricultural systems also have reduced populations of pollinator insects. In places, however, this is changing. Conservation practices such as hedgerow plantings, integrated pest management, and management of ground cover and field borders are being used to restore nesting and egg-laying sites for bees, butterflies and other insects and preserve the benefits (and services) these insects provide.

These efforts are further bolstered by new language in the 2008 Farm Bill that encourages the Natural Resource Conservation Service and the Farm Service Agency to facilitate pollinator conservation practices through the conservation programs they administer.

The Xerces Society's Pollinator Conservation Program has been working in California – and across the country – with a wide range of government, agricultural, and non-profit partners to implement pollinator habitat conservation projects on working agricultural lands. In this talk, Mr. Vaughan will discuss examples of this restoration work and the diverse partnerships formed to make these projects happen.

Contact Information: Mace Vaughan, Xerces Society Pollinator Conservation Program, 4828 SE Hawthorne Blvd., Portland, OR 97215, Phone: 503-232-6639, Fax: 503-233-6794, Email: mace@xerces.org (Mr. Vaughan also serves as the Joint Pollinator Conservation Specialist for NRCS West National Technology Support Center)

Floating Marsh Creation Demonstration Project

Charles E. Sasser[1] and ***Jenneke M. Visser***[2]
[1]AgCenter, Louisiana State University, Baton Rouge, LA, USA
[2]Institute for Coastal Ecology and Engineering, University of Louisiana at Lafayette, Lafayette, LA, USA

The objective of the project is to develop methods for restoration of open water areas within thin and deteriorated floating marsh habitats that once supported thick-mat maidencane (*Panicum hemitomon*) marsh, and other fresh water areas where establishment of maidencane marsh is desired. The first phase was the development of a floating system which provides the structure with substrate and vegetation in place and provides the buoyancy during the period in which *P. hemitomon* plants become established. For this component, structures using a variety of mat materials, support structures, and plant materials were evaluated. The second phase of the demonstration project consists of field testing of the selected designs in a marsh setting. Based on the structural integrity, buoyancy, and growth response results from the first phase investigations, the selected designs were deployed at the Mandalay National Wildlife Refuge (MNWR) in Terrebonne Parish, Louisiana in the spring of 2006. The deployed structures at the Mandalay field site are functioning as designed. Similarly, the *P. hemitomon* plants associated with the structures are growing very well and many other plant species are colonizing the structures. Both aboveground and belowground material are increasing, with the belowground plant material generating an increasingly extensive network of the fibrous roots and rhizomes necessary to establish the foundation of a sustainable organic marsh mat. The plants have also exhibited spreading outside of the individual structures through rhizome growth. By the third growing season in the field, plants spread significantly from their mother structures and are beginning to interweave in some cases with plants from adjacent structures. This spreading, joining, and interweaving of belowground plant material from adjacent floating structures is an important mechanism for growing increasingly larger marshes. Hurricanes Gustav and Ike impacted coastal Louisiana during the late summer 2008. Some of the deployed structures at Mandalay were damaged, but overall the project structures and associated vegetation weathered the storm well. The high water in the marsh associated with these storms allowed higher salinity water to encroach into some parts of the project area. *P. hemitomon* is not tolerant of saline conditions, and even small increases in salinity reduces plant growth and productivity. Nutria (*Myocastor coypu*) grazing activity occurs in and around the structures, and there was evidence that the nutria were using some of the structures for food or resting. Nutria grazing is a serious stressor on *P. hemitomon*, as well as other desirable wetland vegetation and must be controlled to maximize vegetation restoration success.

Contact Information: Jenneke M. Visser, PO Box 44650, University of Louisiana at Lafayette, Lafayette, LA 70504 USA, Phone:337-482-6966, Fax: 337-482-5395, Email: jvisser@louisiana.edu

Geospatial Technology for Executive Decision Support – the Chesapeake Bay Experience

John C. Wolf – presented by ***Liana Vitali***
U.S. Geological Survey, Chesapeake Bay Program, Annapolis, MD, USA

The Chesapeake Bay, the largest estuary in North America and one of the most productive in the world, is being threatened by excessive nutrients and sediment pollution. These pollutants originate from throughout the 64,000 square mile Chesapeake Bay watershed, which encompasses parts of six U.S. states and Washington, D.C.

The Chesapeake Bay Program (CBP) is a multi-jurisdictional partnership that is working to restore and protect the Bay and its many resources from these and other stressors. In 2008 CBP developed the ***Chesapeake Action Plan*** (CAP) to enhance coordination of restoration activities and increase the collective accountability for protecting the Chesapeake Bay. The four primary components of CAP include restoration and protection strategy development, activity and accountability tracking, management dashboards, and a framework for adaptive management. Geographic information, science, and technology play a key role in the CAP components.

This poster will focus on the role of geospatial technology in decision support for the CAP, and highlight how geospatial technology has been incorporated into the ***Chesapeake Online Adaptive Support Toolkit (COAST)***. COAST is an integrated framework of information and web-based tools that allows managers to employ an adaptive management approach for coordinating, implementing, and assessing management actions and ecosystem change.

Contact Information: John C. Wolf, U.S. Geological Survey, Chesapeake Bay Program, Annapolis, MD 21403, Phone 410-267-5739, Fax 410-267-5777, Email: jwolf@chesapeakebay.net

Diatom-Based Assessment of Past Water Quality in Biscayne Bay, Florida

Anna Wachnicka[1,3], *Evelyn Gaiser*[2,3] and *Lynn Brewster-Wingard* [4]
[1]Department of Earth and Environment, Florida International University, Miami, FL, USA
[2]Department of Biology, Florida International University, Miami, FL, USA
[3]Southeast Environmental Research Center, Florida International University, Miami, FL, USA
[4]U.S. Geological Survey, Reston, VA, USA

The ecology of Biscayne Bay has been greatly affected in the last few decades by changes in the quantity and quality of water flowing into the bay from the adjacent ecosystems, caused by the South Florida urban development. Due to the planned water management changes related to the Comprehensive Everglades Restoration Plan (CERP), which aims to decrease freshwater flow to the bay from canals and restore flow through natural creeks, it is important to determine the degree of variability in salinity and nutrient concentrations prior to anthropogenic modifications of South Florida ecosystems in order to aid selection of appropriate restoration targets. Because of the lack of long-term continuous water quality data in this region, fossil biological remains, such as diatoms, can provide an excellent tool to estimate past environmental conditions in the bay. In this study, we determined the modern distribution of diatoms across the bay and then used species preferences to infer water quality changes from diatoms preserved in ~ 400 years old sediment cores.

We conducted an extensive survey of modern diatoms in Biscayne Bay in order to determine ecological preferences. Cluster analysis distinguished near-shore from off-shore assemblages that were more distinct during the wet season than the dry season. The most influential water quality variables affecting diatom assemblages in the dry season were salinity, water depth, and sediment total phosphorus (STP), while salinity, pH, STP and water total phosphorus (WTP) were the most important driving variables in the wet season. Because water concentrations of salts, total phosphorus, total nitrogen (WTN) and total dissolved organic carbon (WTOC) are partly controlled by water management in this region, we produced diatom-based models to assess these variables in modern and retrospective assessments. Weighted averaging partial least squares regressions produced reliable estimates of salinity, WTP, WTN and WTOC from diatoms (r^2=0.91, 0.78, 0.76, 0.89 respectively). A discriminant function analysis was used to infer changes in the distribution of ecological zones and habitat quality in the bay.

Stratigraphically constrained cluster analysis distinguished three major groups of diatom assemblages in Card Bank, Featherbed Bank and No Name Bank cores. The major transition in diatom assemblages in all cores occurred in 1960s, which corresponds to the time of construction of water conservation areas, canals and levees in this region. Reconstructed salinity and nutrient values show increased magnitude since that time as well. These uppermost sediments (2003-early 1960s) were dominated by marine epiphytic and benthic species (eg. *Hyalosynedra laevigata, Mastogloia corsicana, Dimeregramma dubium*) that were less common or absent from the lower parts of the cores. The middle parts were dominated by planktonic marine species *Cyclotella litoralis,* and benthic *species Amphora ostrearia* var. *vitrea, Tryblionella granulata* that can tolerate lower salinity conditions. Basal sections of the Featherbed Bank core contained freshwater taxa (eg. *Brachysira neoexilis, Brachysira serians*) that were not found in more recent material. Discriminant Function analyses revealed that all three cores show fluctuation between nearshore and open-bay diatom communities and between macrophyte, benthos and plankton-dominated habits, implying that these sites experiences significant water quality alterations during the time of deposition.

Contact Information: Anna Wachnicka, Southeast Environmental Research Center, Florida International University, University Park, 11200 SW Street, Miami, FL 33199, USA, Phone: 305-348-1876, Fax: 305-348-4096, Email: wachnick@fiu.edu

Phosphorus Inactivation as a Lake Restoration Technique

Kenneth J. Wagner, *David F. Mitchell, Wendy B. Gendron* and *Donald Kretchmer*
AECOM, Willington, CT, USA

Algal blooms are best handled by limiting sources of nutrients, but this is not always feasible or practical, and in some cases the accumulated internal reserves can continue to support algal blooms indefinitely after successful watershed management. Dredging can remove those nutrient reserves at great cost, and oxygenation and mixing can minimize impacts of nutrient recycling with continued application. Inactivation of P reserves, however, can offer long-term benefits with a one time treatment at an affordable cost. Several phosphorus (P) binders have been used, with aluminum providing the greatest benefit over the widest range of encountered conditions. However, longevity of results depends on control of external loading and potential toxicity is a concern that must be addressed in treatment planning. Treatments that inactivate P in the water column will tend to provide benefits for 3-5 times the detention time of the system, and except in some larger lakes with small watersheds, will be a maintenance technique, not true restoration. Inactivation of available sediment P can provide lasting benefits, but requires specialized testing, careful dose determination and treatment planning, and toxicity avoidance measures. Development of techniques over the last decade has allowed successful restoration of aquatic habitats without substantial damage to non-target system components.

Key aspects of pre-treatment testing include:

- Verification that internal loading is the primary problem to be addressed.
- Assessment of available sediment P, which is often unrelated to total P.
- Assays to determine the level of inactivation over the range of feasible doses.
- Evaluation of potentially sensitive flora and fauna in the target lake.
- Analysis of treatment logistics, including access, sequence of activities and treatment areas, and contingencies.
- Development of an appropriate monitoring program.

Avoidance of toxicity is best achieved by some combination of the following:

- Aluminum dose at any one time should be <10 mg/L, preferably <5 mg/L.
- Treat defined areas of the lake in a patchwork pattern with adjacent blocks not treated sequentially.
- Apply aluminum at a depth that creates a surface refuge.
- When buffering alum with aluminate, use a 2:1 ratio of alum to aluminate, by volume, to avoid pH change.

Successful and problem cases of aluminum treatments for P inactivation will be used to illustrate principles of proper planning and application of this approach to lake restoration. It is feasible to reduce the internal load by up to 90% without measurable damage to non-target organisms, although each case must be evaluated on its own merits in the planning stage.

Contact Information: Ken Wagner, AECOM Global Environment, PO Box 506, Willington, CT 06279, Phone: 860- 429-5323. Email: ken.wagner@aecom.com

A Framework for Adaptively Managed Stream Restoration Efforts

Paul F. Wagner*, G. Mendoza, M. Sudol, S. Komlos* and *P. Scodari*
US Army Corps of Engineers Institute for Water Resources, Alexandria, VA, USA

Restoring natural stream channel course is often implemented using large investments spent on extensive physical changes, primarily in an initial construction effort with expensive heavy equipment. This approach is not only costly, but makes little use of a stream's natural hydraulic energy to affect substantial changes in geomorphology that the stream, itself, is capable of making over time. Monitoring of stream restoration projects is intended to allow for a process of adaptive management, but it is often constrained by project design and availability of funds. We present an alternative approach that would use a portion of the funds required to complete a more traditional stream restoration effort to fund an adaptive management approach to restoration focusing on incremental work in the stream, exploitation of natural hydrologic processes, longer monitoring durations, and an eventual transfer to a land conservation group with a non-wasting endowment. This approach would significantly reduce construction costs, utilize “softer” restoration techniques, and leverage project funds against those of land conservation groups to iteratively manage the restored area for a longer period with the inclusion of the endowment. We present the enabling characteristics of this adaptive management approach to stream de-channelization. Namely, when and to what extent can we use limited financial resources for stream restoration by taking advantage of the power of water? Our proposal underlines implementing limited geomorphological intervention changes at low cost, taking advantage of the natural power of streams, and having financial resources for sustainable monitoring and subsequently implementing small corrective action activities where necessary. While this approach is not applicable to all restoration efforts, it can be part of a new approach that emphasizes integrated analysis of economics, hydrology, geomorphology, and ecology to identify the best strategy for restoration.

Contact Information: Paul F. Wagner, United States Army Corps of Engineers Institute For Water Resources, Alexandria, VA 22315-3868 USA, Phone: 703-428-7071, Fax: 703-428-8171,
Email: Paul.F.Wagner@usace.army.mil

Modification of the Hydrologic Regime to Restore a Mississippi River Swamp Ecosystem

Leslie S. Waguespack[1] and *Glendon L. Coffee*[2]
[1]Shaw Coastal, Inc., Baton Rouge, LA, USA
[2]Discovery Services, LLC, Dauphin Island, AL, USA

Spanish Lake Swamp is a 20,000-acre backwater depression that was formed by the alluvial processes of the Mississippi River. The swamp system persists today as an island of natural habitat near Baton Rouge, Louisiana, in a region that has been heavily developed for industrial, agricultural, and urban purposes. The remnant swamp is typical of the overflow forest ecosystems that characterize much of the Mississippi River's floodplain in southern Louisiana.

Following the historic 1927 flood, construction of the Mainline Mississippi River Levee permanently severed the Spanish Lake Swamp from periodic overbank flooding by the Mississippi River. Beginning in the 1940s and early 1950s, a series of human activities farther modified the swamp. These included the construction of internal drainage projects; oil and gas exploration efforts; timber harvest activities; and the construction of water control structures. These activities modified the swamp's internal drainage patterns that resulted in the permanent inundation of a significant portion of the swamp. The cumulative effects of extended flooding adversely affected the habitat quality of the floodplain forests, converting large areas to shallow aquatic flats and emergent vegetation while allowing undesirable plants to invade the wet areas. Lastly, the permanent inundation of the lowest areas of the swamp also resulted in the loss of the natural flood storage potential of this system.

Hydrologic and hydraulic modeling studies were performed in conjunction with habitat improvement analyses to identify a water regulation scenario that would more closely mimic the natural hydrologic regime that originally shaped the Spanish Lake Swamp ecosystem while returning the natural flood storage potential of the swamp. Structures were designed that would allow the identified water regulation scenario to be implemented. Traditional flood protection monetary benefits and non-monetary ecosystem restoration outputs were calculated and compared against the anticipated costs to implement the combined flood protection/ecosystem restoration project. The combined flood protection and ecosystem restoration benefits were essential to justifying the feasibility of the recommended project.

Restoration of a hydrologic regime that more closely resembles natural conditions will allow the floodplain forest system to be restored. Due to the scope of habitat deterioration experienced by the swamp, even with reducing the duration of flooding, the timeframe for recovery under natural regeneration processes can be quite extensive, possibly requiring up to a 100 years for complete restoration. However, the rate of forest recovery can be accelerated by the elimination of invasive of plant species and the planting of desirable bottomland hardwood trees. Aggressive revegetation techniques in similar habitats indicate complete restoration of bottomland hardwood forest ecosystems can be accomplished within as little as 20 years.

Contract Information: Leslie S. Waguespack, Project Manager, Shaw Group, Environmental & Infrastructure Group, 4171 Essen Lane, Baton Rouge, LA 70809 USA, Phone: 225-987-7475, Fax: 225-932-2701,
Email: les.waguespack@shawgrp.com

Economic Performance Metrics for Restoration – Promoting Human Well-Being

Lisa Wainger
University of Maryland Center for Environmental Science, Solomons, MD, USA

How do restoration projects promote human well-being? By applying resources to produce ecosystem services that people need and value. The expected benefits of restoration depend on two project aspects: 1) successfully restoring the functions necessary to produce a service and 2) ensuring the functions are restored in a location where they can provide valued services. A variety of metrics can be applied to serve as performance metrics to examine the environmental effectiveness and economic efficiency of restoration choices.

We demonstrate a decision analysis framework in which the expected benefits of restoration are calculated from the probability of successfully meeting environmental goals and the potential benefits if successful. This framework provides a means to compare restoration projects with different levels of outcome risk as well of differences in beneficial outcomes. The value people place on ecosystem services is a function of the quality, scarcity and reliability of those services, just as they would consider if they were purchasing such goods and services. We employ a framework that considers site quality and landscape context to evaluate the potential benefits and characteristics that promote self-sustaining restoration. The result is the ability to assess potential benefits of projects for targeting or demonstrating results of restoration.

Contact Information: Lisa Wainger, University of Maryland Center for Environmental Science, P.O. Box 38, Solomons, MD 20688, USA, Phone: 410-326-7401, Email: wainger@cbl.umces.edu

Fairview Park Wetland Restoration Project

Chris Webb[1], *Bart Mejia*[2] and *Hayley Lovan*[3]
[1]Moffatt & Nichol, Long Beach, CA, USA
[2]City of Costa Mesa, Costa Mesa, CA, USA
[3]U.S. Army Corps of Engineers, Los Angeles, CA, USA

The Fairview Park Wetland Restoration Project is a partnership between the City of Costa Mesa and other regional stakeholders to create wetland habitat area, improve water quality, and reduce diversion of urban low flow runoff to the Orange County Sanitation District (OCSD). The U.S. Army Corps of Engineers is creating 17 acres of riparian habitat area on undeveloped City land adjacent to Fairview Park. The City partnered with the USACE and the County of Orange to establish the habitat, and to use existing low flow runoff presently diverted to the OCSD for the water supply.

Local flood control channels are presently diverted to the OCSD for water quality improvement downstream. This water will be re-routed upstream into the riparian habitat area, and into water quality treatment ponds to improve its quality, and to reduce dependence on treatment by the OCSD for downstream water quality improvement. The City will install perimeter trails and interpretive opportunities around the habitat area, and extend a portion of their passive park area close to the upstream end of the riparian area as an overlook.

Design is complete and construction is planned soon for the riparian habitat area. The park area is a subsequent future phase to occur at an undefined date.

Contact Information: Chris Webb, Moffatt & Nichol, 3870 Kilroy Airport Way, Suite 600, Long Beach, CA 90806 USA, Phone: 562-426-9551, Fax: 562-424-7489, Email: cwebb@moffattnichol.com

Parsons Slough Restoration Project Feasibility Study

Chris Webb[1], *Trish Chapman*[2] and *Bryan Largay*[3]
[1]Moffatt & Nichol, Long Beach, CA, USA
[2]California State Coastal Conservancy, Oakland, CA, USA
[3]Elkhorn Slough National Estuarine Research Reserve, Watsonville, CA, USA

The Parsons Slough Restoration Project is a partnership between the State of California and other regional stakeholders to investigate creation of salt marsh habitat area and improvement of existing habitat quality, and improvement of water quality in a degrading ecosystem of Elkhorn Slough. The site is a 460-acre subsided salt marsh that has converted to largely mudflat area, with limited subtidal and salt marsh habitat. It represents a significant portion of the tidal prism of the larger Elkhorn Slough. Elkhorn Slough is degrading at a rapid rate, and reduction of tidal prism is one approach to arresting or reducing the rate of salt marsh degradation.

The Feasibility Study investigates options for restoration including filling the site with sediment to raise its elevation, muting tides to modify hydrology, or a combination of both appropriate for salt marsh establishment. Analyses of hydrology/hydraulics, water quality, habitat, sea level rise, and other factors are presented to identify a preferred alternative. Restoration is being considered using fill to raise the site and hydraulic controls to reduce tidal prism. Numerous constraints and challenges exist to restoration scenarios. Study results are being finalized in early 2009.

Contact Information: Chris Webb, Moffatt & Nichol, 3870 Kilroy Airport Way, Suite 600, Long Beach, CA 90806 USA, Phone: 562-426-9551, Fax: 562-424-7489, Email: cwebb@moffattnichol.com

Economic and NED Account Considerations during Dam Decommissioning Plan Formulation

Jason Weiss
URS Corporation, Gaithersburg, MD, USA

During the planning process, how the No-Action (without project) and with-project alternatives are defined can significantly influence how a project is analyzed and the resulting outcome of an economic evaluation. Defining the No Action alternative is critical because it is the basis on which all impacts are compared. The No Action alterative does not necessarily mean doing nothing; in an unsafe situation, some action will always be warranted. Likewise, the with-project alternatives must be carefully defined.

When analyzing alternatives for dam mitigation, such as decommissioning or rehabilitation, a number of consequences should be considered during the economic evaluation, such as changes to downstream flooding, loss of municipal water supply, and changes in recreational opportunities. These impacts must be evaluated within the framework of the applicable regulations and guidelines (e.g., the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* [U.S. Water Resources Council, 1983]).

This paper discusses defining the alternatives during the dam mitigation planning process and the impacts that should be considered when conducting an economic evaluation. Additionally, this paper focuses on evaluating the economic impacts in relation to national economic development (NED) benefits, which are used to determine the cost-effectiveness of the alternatives.

Contact Information: Jason Weiss, URS Corporation, 200 Orchard Ridge Drive, Suite 101, Gaithersburg, MD 20878 USA, Phone: 301-258-5859, Email: jason_weiss@urscorp.com.

Improving California Bulrush (*Schoenoplectus californicus*) for Waste Contaminant Remover in Urban Ecosystem Restoration and Wave Energy Buffering in Tidal Marsh Restoration

Ida Wenefrida[1], *Herry S. Utomo*[1] and *Michael D. Materne*[2]
[1]Rice Research Station, Louisiana State University Agricultural Center, Rayne, LA, USA
[2]School of Plant, Environmental and Soil sciences, Louisiana State University Agricultural Center, Baton Rouge, LA, USA

Natural phyto-remediating plants, such as California bulrush, can be integrated in the urban architecture and design while providing ecological restoration function in highly polluted areas in which native vegetation unable or has difficulty to grow. Easily blend into the designed landscape, this plant give a natural way to remove some toxic metals from both municipal and industrial pollutants. Because of its ability to grow well under highly inundated regions, this plant can also be used to provide vegetative buffer in tidal marshes, dissipate wave energy, reduce shoreline scouring, and trap suspended sediments and other solids.

Promising lines have been identified for potential release. These lines were selected based on replicated preliminary field tests at the Rice Research Station in 2004 and 2005, followed by multi-location trials in 2006 to 2008 at the Great Lake site. In the preliminary field tests, a total of 48 bulrush ecotypes collected from marshes across Louisiana was evaluated in replicated field trials at the Rice Research Station. Nine promising lines that have good spread, stem density, biomass accumulation and seed production were selected for multi-location trials in 2006 at the Great Lake site, and in 2008 at Sweet Lake, Cameron, LA. In parallel to the field tests, greenhouse screenings to determine the salt-tolerance levels among these ecotypes were also carried out in the same years. After exposure in a salt concentration of 12 parts per thousand in continuous flooding for 6 months, eight survivors were recovered.

Experimental line LA268 spreads the fastest among the 48 tested accessions. Under freshwater environment, LA268 spreads vegetatively with an average rate of 7.5 m^2 annually (Table 1). As a comparison, cultivar *Restorer* that was released by USDA-NRCS Georgia Plant Materials Center, Americus, GA, has an average spread of 5.17 m^2 per year. With an average height of 182.8 cm (18 cm taller than *Restorer*), LA268 has dark green hard stems with an average diameter of 1.3 cm. An established LA268 colony of 2 years of age has an average stem density of 89 stems per m^2 around the center. Each productive stem produces a reddish brown stalk on the tip of the stems in the spring and fall. The stalk contains florets that bear hard-coated dark seeds. Mature seed has an average germination rate of 4%, shows dormancy, and if the seed is left in the ground, a portion of the seed remains viable for several years. The LA268 flower is composed of many spikelets that typically produce a total of 400 bracts. Twenty to 40 fully mature seeds are produced from one flower. Its ability to take up the hazardous level contaminants Hg, Se, Pb, Zn, Me, and As from the water and soil is being evaluated. Development of improved California bulrush lines will help in erosion control efforts, remediate metal toxicity and pollutant problems, and increase the effectiveness of wastewater treatments.

Contact Information: Ida Wenefrida, Rice Research Station, Louisiana State University Agricultural Center, 1373 Caffey Road, Rayne, LA 70578 USA, Phone: 337-788-7531, Fax: 337-788-7553,
Email: iwenefrida@agcenter.lsu.edu

National Environmental Information Exchange Network: Sharing Data for Better Watershed Management

Mitch West
National Environmental Information Exchange Network, Portland, OR, USA

Effective restoration efforts rest on accurate measurement of ambient conditions and results. Even assuming effective design and execution of measurement efforts, Access to necessary information in usable and consistent format has been a challenge. Traditional monitoring project design has led to a report and to a set of raw data, which is frequently inaccessible to other projects or analyses. When analytical tools are made available to future projects, they are often limited by a proprietary format and user interface. As restoration projects extend across geopolitical boundaries and scientific disciplines, the challenges of collecting, integrating and analyzing "what is known" are nearly insurmountable in many cases.

The National Environmental Information Exchange Network (the Network) is a partnership between USEPA, states, tribes, and territories designed to promote seamless access to like data from multiple sources, and to promote the use of standard definitions and formats to promote data access and comparability. When multiple network partners offer like data collections, they do so in a commonly adopted form which facilitates access without the need for traditional collection, warehousing, and interpretation. Three Exchange Network projects that provide potential value to ecosystem restoration are outlined:

In 2003, the four states of EPA's region 10 established the "Pacific Northwest Water Quality Exchange, defining access protocols and formats to access ambient water monitoring data. The USEPA used this project as a template for the current Water Quality Exchange (WQX). The offered services provide access to EPA's STORET warehouse along with means for fully automate data submission. In addition, through an agreement with USGS, the data store in the NWIS database is available in the same format, allowing seamless access and integration to both collections.

Stakeholder and project tam surveys of the Chesapeake Bay Project revealed that analysts were frustrated by lack of access to information about restoration projects (known as "Best Management Practices" or BMPs) often funded by the EPA 319 grants program. Scientists were unable to link observed changed in ambient conditions to the projects being undertaken in the name of restoration. Led by Pennsylvania, the state members of the Chesapeake Bay Project published information on their projects in a common format linkable to other data sources.

NatureServe applied for an EPA grant in 2005 to make endangered species population and (Natural Heritage Data) available using the Exchange Network. This approach is now being implemented. Custodians in four states are also implementing these services—the sensitive nature of the data means that it is limited to known users through network security. This data enhances decision making in issuing water permits and performing NEPA reviews.

These projects have three things in common: They rest on proven processes and infrastructure of the Exchange Network. They provide access to multiple data sets using a common interface and standards to ensure comparability. They are based on "web services", so that the published data can be integrated into products that access multiple data sets. Using the Exchange Network allows analytic tools to be easily portable between locations and projects, and to be kept in synch with the newest available data *without user intervention.* Analysts can use existing access tools, or build new ones, confident that the investment is worthwhile.

Contact Information: Mitchell West, Executive Coordinator, Environmental Information Exchange Network, 10531 SW 30th Ave, Portland, OR 97219, Phone: 503-452-3891, Email: mitch.west@exchangenetwork.net

Restoration of Coastal Louisiana Wetlands Using Large Surface Water Diversions

John R. White[1], *Ron. D. DeLaune*[1], *Nan N. Walker*[1] and *Charles Villarrubia*[2]
[1]Department of Oceanography and Coastal Sciences, LSU, Baton Rouge, LA USA
[2]Office of Coastal Protection and Restoration, Baton Rouge, LA USA

Historically, the Mississippi River delivered sediment and nutrients to riparian and coastal wetlands during periods of high discharge as floodwater overtopped the natural levees along the course of the river. Flood control levees have been constructed which prevent this natural seasonal pulsing. The hydrologic isolation of the marshes from the river is a significant driving force in the loss of coastal Louisiana wetlands. The loss of the coastal wetlands endangers communities as well as oil and gas infrastructure from storm surge, decreases nursery habitat and diminishes coastal food webs. As part of the coastal restoration efforts, several diversion have been constructed along the course of the Mississippi River in order to supply the adjacent marshes with water, nutrients and sediments. There are 3 major water diversions along the southern reach of the Mississippi River; the Davis Pond Diversion, The Bonnet Carré Spillway and the Caernarvon Diversion. Two diversions are operated annually, discharge into wetland areas and can only discharging water when the river stage is high. The spillway is opened high flood years and discharges into Lake Pontchartrain, a coastal estuarine lake.

The Caernarvon diversion is the longest continually operating water diversion, built in 1991. The maximum discharge of river water is ~ 8,000 cubic feet per second (cfs) into the Breton Sound Estuary. The Davis Pond diversion, constructed in 2004, has only begun continuous operation in 2007 and has a maximum discharge of 10,000 cfs. The Bonner Carré Spillway was opened in the spring of 2008 with a maximum discharge of 160,000 cfs. The opening of the diversions coincides with the peak nitrate concentrations of the Mississippi River. The discharge of such large amounts of water into coastal systems has an immediate effect of lowering the salinity. Decreasing salinity is generally beneficial to the vegetation communities. Sediment accretion is generally constrained within close proximity of the outfall, as the particles drop out of suspension.

Dependent on discharge rate, nitrate removal rates in the Davis Pond wetland range from 60-90% removal similar to the Caernarvon Diversion. The Bonnet Carré Spillway diverted up to 10,000 metric tons of N into Lake Pontchartrain during the 1 month opening and much of the nutrient load was pushed through the lake and discharged into the coastal ocean. The effect of diversions on the overall marsh accretion and stability is a hotly debated topic. Breton Sound estuary has been disrupted by several hurricanes recently, especially Hurricane Katrina in 2005. There are plans to construct several more diversions in order to provide restoration to an even greater coastal marsh area.

Contact Information: John R. White, Wetland & Aquatic Biogeochemistry Lab, Department of Oceanography and Coastal Sciences, Louisiana State University, Baton Rouge. LA 70803 USA, Phone: 225-578-8792, Fax: 225-578-6423, Email: jrwhite@lsu.edu

Enabling Grass-Roots, Intensive, Runoff Water Monitoring Projects: The North Dakota Discovery Farms

Ron Wiederholt[1], *Kathleen Rowland*[2], *William Damschen*[2] and *Steve Robinson*[2]
[1]North Dakota State University, Carrington Research Extension Center, Carrington, ND, USA
[2]North Dakota US Geological Survey, Bismarck, ND, USA

Like many States, North Dakota has focused considerable ecosystem-improvement efforts, such as regulations and cost-share funding, on decreasing the potential risks associated with surface-water runoff from livestock facilities. However, many producers, regulators, academicians, and conservation managers agree that many of these improvement efforts are commonly based on unproven methods. To investigate the utility of these efforts, State and Federal agency personnel within North Dakota have implemented runoff-water monitoring projects at three private livestock operations willing to allow the monitoring and collection of water at the edges of feedlots and fields. Information from the projects will enable the livestock producers to be innovative in addressing issues raised as a result of monitoring and data collection. The project is a combined effort of the livestock producers, North Dakota State University, U.S. Geological Survey, and North Dakota Department of Health.

Contact Information: Ron Wiederholt, Carrington Research Extension Center, North Dakota State University, Carrington, ND 58421 USA, Phone: 701-652-2951, Fax: 701-652-2055, Email: ron.wiederholt@ndsu.edu

Hydrologic Variability in the Florida Everglades: A Paleoecological Perspective

Debra A. Willard and *Christopher E. Bernhardt*
U.S. Geological Survey, Reston, VA, USA

Restoration of the Florida Everglades is based primarily on the re-establishment of natural water depths and hydroperiods. Increasingly, the spatial complexity of this extensive wetland ecosystem has been recognized, and research is underway to determine past hydrologic patterns at critical sites throughout the greater Everglades ecosystem. Paleoecological analyses from different wetland habitats throughout the system can establish the relative roles played by climate variability and anthropogenic manipulation of hydrology in structuring and maintaining the landscape. We present results from 60 sediment cores collected from tree islands, sawgrass ridges, sloughs, and marl prairies as a basis for a synoptic reconstruction of Everglades hydrology and vegetation at discrete time periods.

Age models for sediment cores constructed using radiocarbon dates, lead-210, cesium-137, and pollen biostratigraphy provide the chronologies needed to compare patterns in different regions. Fossil pollen assemblages were compared to those from a 250-site modern calibration dataset to identify analogs and reconstruct trends in past vegetation and hydrology. These data indicate that several critical habitats, i.e. tree islands and sawgrass ridges, initially formed during intervals of sustained droughts. These records also provide evidence for the resilience of other wetland habitats to a range of hydrologic and climatic conditions. Marl prairies, which host a distinctive flora and fauna, are particularly illustrative of the spatial heterogeneity inherent to the Everglades ecosystem. Cores collected in the marl-prairies indicate large differences in the timing of marl initiation from 1000 AD at some sites to as recently as ~1930 AD at others. These data highlight the importance of understanding the spatio-temporal variability of plant communities before setting homogeneous restoration goals based on a limited number of sites.

Twentieth-century water-management practices caused considerable changes to plant community composition and distribution at every site examined. Human impacts on hydrology exceed any documented due to climate fluctuations, and increased the spatial variability of plant communities within the Everglades. Paleoecological data also indicate rapid wetland vegetation response to hydrologic changes over just decades. In addition to informing restoration targets, such data improve predictions of the wetland response to future climate change.

Contact Information: Debra A. Willard, US Geological Survey, 926A National Center, Reston, VA 20192 USA, Phone: 703-648-5320, Fax: 703-648-6953, Email: dwillard@usgs.gov

Potential Impacts of Nevada Groundwater Diversions on Regional Spring Restoration

Jack E. Williams[1], *James E. Deacon*[2], *Austin E. Williams*[3] and *Cindy Deacon Williams*[4]
[1]Trout Unlimited, Medford, OR, USA
[2]Department of Environmental Studies, University of Nevada, Las Vegas, NV, USA
[3]Trout Unlimited, Lander, WY, USA
[4]National Center for Conservation Science and Policy, Ashland, OR, USA

Explosive human population growth in and around Las Vegas, Nevada, has stimulated demand for substantially more water than can be supplied through existing sources. As a result, southern Nevada officials hope to obtain rights to about 200,000 acre-feet of groundwater from a regional aquifer extending from near Salt Lake City, Utah, to Death Valley, California. Such large-scale withdrawals could impact water resources across 78 basins and potentially up to 157 spring-depedent species, including endangered and threatened forms.

Clearly there is a high potential for such large-scale groundwater withdrawal to severely impact regional biodiversity. Projected impacts will occur at greater spatial and temporal scales than fisheries biologists and restoration planners normally examine. Those concerned with the integrity of interconnected groundwater aquifers should understand the scale of such proposals and their potential impact to spring and wetland ecosystems in the region. The ecological consequences of explosive human population growth and urban sprawl in the region as well as alternatives that provide a more sustainable future also should be more commonly understood by the public and policy makers.

Contact Information: Jack E. Williams, Trout Unlimited, 329 Crater Lake Avenue, Medford, OR 97504 USA, Phone: 541-772-7724, Fax: 541-772-7725, Email: jwilliams@tu.org

Unique Tools to Deliver a Watershed Restoration Plan

Todd D. Williams[1], *Joe Krypciak*[2], *Michael S. Martin*[1] and *Andrew M. Andonoff*[1]
[1]HDR Engineering, Inc., St. Louis, MO, USA
[2]City of Maryland Heights, Maryland Heights, MO, USA

HDR has worked with City of Maryland Heights to develop a variety of unique tools that will decrease City costs, improve and streamline data collection and data management processes, and maximize the utility and value of the City's Watershed Restoration Plans. These tools include:

GPS - GPS Is a cost-effective way to collect field data using satellite signals. The data is geographic, as well as descriptive, and can be directly integrated into data storage and management systems. The approach developed by HDR and the City capitalizes on GPS's capabilities to both spatially locate and catalog field data. This GPS technique has been successfully used to implement electronic field collection for rapid stream assessments. Standard input forms utilized by field personnel prompt the field crew for required data and minimize data entry errors. HDR has also established structured data collection standards as a second level of quality control applied to collected data.

GIS - is a geospatial arrangement of data that can help visualize data, problems and solutions. GIS has become a widely accepted tool and is frequently used as a visualization or platform to display data. HDR's process utilizes GIS to its full potential. For Watershed Restoration Plans, HDR developed and built a comprehensive GIS database to centralize all available mapping and facilitate not only the Master Plan preparation, but also to assist in its implementation. Other powerful applications include:

- Overlay complaints with identified projects.
- Historical comparison of aerial photography to better understand stream dynamics.
- Analysis of LiDAR data
- Electronic Stream rapid assessment data.
- Identification of study reaches
- Landuse mapping
- Hydrology/hydraulics
- Post-construction monitoring

This poster presentation will review the techniques used during the project to maximize the value, and deliver a sustainable restoration plan that provided a watershed wide baseline study of the stream morphology, a recommended action plan for restoring the impacted reaches of stream in this urban watershed, and a tool set for use in its implementation.

Contact Information: Todd D. Williams, PE, Section Manager, HDR Engineering, Inc., St. Louis, MO 63146 USA, Phone: 3143740946, Fax: 3142751723, Email: todd.williams@hdrinc.com

Successes and Lessons Learned in San Pablo Bay Wetland Restoration

Amy Hutzel, ***Betsy Wilson*** and *Tom Gandesbery*
State Coastal Conservancy, Oakland, CA, USA

San Pablo Bay, a subregion of the San Francisco Bay estuarine system with large areas of baylands diked off from the Bay for agriculture and salt production, has provided and continues to provide significant opportunities for tidal wetland restoration, as well as enhancement of managed ponds and restoration of seasonal wetlands. The projects undertaken in San Pablo Bay represent a variety of techniques, from levee breaching with minimal cut and fill to the use of large amounts of dredge material. The *San Francisco Baylands Habitat Goals Report* calls for ~100,000 acres of tidal marsh in the San Francisco Bay, with ~40,000 acres existing today. The goal for San Pablo Bay is ~38,000 acres. This high goal represents the significant opportunities in San Pablo Bay for restoration compared to the other subregions, which have faced greater development (Central and South Bays) or conversion to managed marsh for duck clubs (Suisun). A large proportion of the diked baylands and former salt ponds in the San Pablo Bay have been acquired by public agencies and private conservation organizations, and planning has occurred or is underway on these acquired lands, with implementation started or completed on several projects. Projects to be discussed in detail are Napa River Salt Marsh and Hamilton/Bel Marin Keys. Other San Pablo Bay projects include Sonoma Baylands, Petaluma Marsh, Guadalcanal, Tolay Creek, Sears Point, Cullinan Ranch, Napa Plant Site, and Skaggs Island.

In 1994, Cargill Salt sold almost 10,000 acres of salt ponds and adjoining lands along the Napa River to the State of California. In 2004, the Napa River Salt Marsh Feasibility Study was completed. The project objectives are: to restore large patches of tidal habitats in a band along the Napa River to support a wide variety of fish, wildlife, and plants, including special status species, and to effectively manage water depths and salinity levels of remaining ponds to benefit migratory and resident shorebirds and waterfowl. Implementation began in 2006 with the tidal restoration of 3 ponds (3,000 acres, the largest tidal restoration to date in San Francisco Bay), using levee lowering, ditch blocks, channels and berms, and levee breaches, as well as enhancement of 3 additional ponds (1,700 acres), with levee improvements and new water control structures.

The first phase of the Hamilton Wetland Restoration Project will provide 668 acres of restored tidal and seasonal wetlands at a former Army airfield in Marin County. The adjoining properties will expand the wetland project size to over 2,500 acres. The Hamilton Project is advancing the beneficial reuse of dredged material from San Francisco Bay and using the material to raise the elevation of the deeply subsided lands prior to breaching the levees. Since dredge material delivery began in January of 2008, 2.2 million cubic yards have been placed. The capacity of the site is 24 million cubic yards.

Contact Information: Amy Hutzel, State Coastal Conservancy, 1330 Broadway, 13th Floor, Oakland, CA 94612 USA, Phone: 510-286-4180, Fax: 510-286-0470, Email: ahutzel@scc.ca.gov

Oronogo-Duenweg Mine Tailings Remediation Project - Habitat Rehabilitation, Webb City, Missouri

Roger Kuhns, Pam Liu, ***Devin Wilson****, Mike Naughter* and *Gia Huy-Nh-Ba*
Black & Veatch, Overland Park, KS, USA

The Oronogo-Duenweg Mine Tailings Project site in Webb City, Missouri is situated in the historic Tri-State zinc-lead mining district. This project is focused on remediation of minelands, rehabilitation of natural stream habitats and hydrology, and protective measures to reduce transport of upstream contaminants and to ensure water quality improvements.

The remediation plan was developed by Black & Veatch in coordination with EPA's Region 7 Superfund program. The site includes abandoned mine shafts and 525 acres contaminated by mine tailings and chat waste. Field tests verified presence of lead, zinc, cadmium and iron that leached from the tailings and sulfides (marcasite, sphalerite, galena, and pyrite).

Goals for remediation and rehabilitation include: (1) removal of metal-contaminated material, (2) grading to establish a stable landscape, (3) assessment and preservation of pre-mining soil horizons, (4) rehabilitation of the stream channel, its habitats and connectivity, (5) mapping of the 100-year floodplain, (6) water quality improvement measures, and (7) management of remediated/rehabilitated areas to reduce any subsequent introduction of upstream contaminants.

Stream rehabilitation affects approximately 65 acres and over 6,900 linear feet of channel. Rehabilitation includes construction of wetland environments based on soil moisture, topography, and proximity to the restored stream. A forested buffer strip, guided by the 2-year and 100-year storm boundaries, was designed to protect the wetland habitats and to stabilize up-slope environments. Trees that can adapt to wide fluctuations in moisture availability are selected. Shrubs, coir logs, straw blankets, and live staking will provide soil stability, habitat diversity as well as reinforcing the buffer strip. Indigenous plant ecotypes will be widely incorporated.

The area hydrology has been profoundly altered by the mining activities. Mine shafts and collapsed workings existed as small, deep ponds and are direct conduits to the first surficial aquifer. The remediation plan utilized many of these openings as locations for chat storage. Several of the pits have been incorporated into the stream rehabilitation plan to help capture sediment that washes into the remediated area from contaminated lands upstream.

This presentation documents both the significant impacts of historical mining practices as well as the impacts of rehabilitation efforts. For this project, rehabilitation necessitated the removal of partially recovered habitats in order to remediate the site and establish successful wetland and woodland habitats. The final remediation plan presents a self-maintaining and sustainable solution that is founded on native habitats, historic soil horizons, and restored waterways. This approach allows for safe land use by adjacent property owners and stakeholders, as well as water quality protection through habitat reconstruction.

Contact Information: Devin P. Wilson, Black & Veatch, Kansas City, MO 64114 USA, Phone: 913-458-3320, Fax: 913-458-3518, Email: wilsondp@bv.com

Paleoecologic Tools for Restoration: Setting Performance Measures in South Florida's Estuaries

G. Lynn Wingard[1], *Frank E. Marshall*[2], *Patrick A. Pitts*[3] and *Joel W. Hudley*[4]
[1]U.S. Geological Survey, Reston, VA, USA
[2]Cetacean Logic Foundation, New Smyrna Beach, FL, USA
[3]U.S. Fish & Wildlife Service, Vero Beach, FL, USA
[4]University of North Carolina, Chapel Hill, NC, USA

A primary goal of the Comprehensive Everglades Restoration Plan (CERP) is to restore more natural hydrologic conditions to the wetlands and estuaries of South Florida. For the estuaries, this means restoring the quantity, timing and distribution of freshwater that is delivered to Florida Bay, Biscayne Bay and the southwestern coastal area. The Southern-Estuaries Sub-Team, a component of the CERP Restoration, Coordination and Recovery effort, is responsible for setting performance measures and targets for the estuaries. The Sub-Team has utilized both paleoecologic analyses of faunal assemblages from sediment cores and the Natural Systems Model (NSM ver. 4.6.2), developed by the South Florida Water Management District, in an effort to set salinity performance measures that reflect natural hydrologic conditions. Both methods, however, have drawbacks. Faunal assemblage analysis provides empirical data but no statistical measures of confidence or information on daily and seasonal responses to meteorological events. Large-scale models are based, at least to some extent, on theoretical data; however, they can provide information on seasonal responses.

A method has been developed that couples paleoecologic data with multivariate linear regression models (MLRM) based on observed hydrologic relationships between the wetlands and Florida Bay (Marshall, Wingard, and Pitts, 2009); thus overcoming problems associated with individual modeling or paleoecological analysis. In phase one of the method, molluscan assemblage analyses are used to determine the paleo-salinity regime for the ~1900 AD pre-disturbance estuary. The NSM is adjusted to the ~1900 paleo-salinity and used to produce simulated daily and seasonal salinity values. In phase two, linear regression equations are developed from modern observations in freshwater wetlands (flow and stage) and estuaries (salinity). These equations predict the salinity within the estuary, given a stage height (or flow) within the wetlands. The final phase couples the simulated paleo-salinity regime with the equations to produce estimates of flow, stage, and hydroperiod in the historical Everglades wetlands.

To add to the confidence associated with the coupled model, a method has been developed to produce a cumulative weighted percent average salinity value for each sample within a core, similar to methods used in paleoceanography to derive sea surface temperature estimates (see for example, Dowsett, et al., 2005). The basis of this method is a modern database, which is used to establish salinity tolerances for the paleo-species. The end result provides statistical measures of confidence for each sample. These data can then be input into the MLRMs and the resulting output can be used to establish performance measures for flow and stage in the terrestrial Everglades, and salinity in the estuaries.

Contact Information: G. Lynn Wingard, Eastern Earth Surface Processes, U.S. Geological Survey, MS926A, National Center, Reston, VA 20192 USA, Phone: 703-648-5352, Fax: 703-648-6953, Email: lwingard@usgs.gov

The Development of Digital Elevation Model for the Area South of the Big Cypress National Park in the Greater Everglades Restoration

Zhixiao Xie[1], *Zhongwei Liu*[2] and *John W. Jones*[3]
[1]Geosciences Department, Florida Atlantic University, FL, USA
[2]Ft. Lauderdale Research and Education Center, University of Florida, Davie, FL, USA
[3]Eastern Geographic Science Center, U.S. Geological Survey, Reston, VA, USA

Hydrology regime is a critical limiting factor in the delicate ecosystem in the Greater Everglades area in Southeastern Florida, and "making the water right" is regarded as the key to the successful restoration of this unique wetland ecosystem. One essential component to represent and model the hydrological regime is a reliable and accurate ground Digital Elevation Model (DEM). The Everglades Depth Estimation Network (EDEN) products (including ground DEM) developed by the USGS have been a great success and well received by scientists and resource mangers involved in Everglades restoration. The EDEN ground DEM is interpolated from data collected by USGS scientists through the High Accuracy Elevation Data (HAED) project. The current version of the HAED database covers Water Conservation Area (WCA) 1, WCA 2, WCA 3A and 3B, the Everglades National Park (ENP), and a large portion of the Big Cypress Nature Preserve (BCNP). Earlier versions of the EDEN ground DEM were produced before all BCNP data were available. We extended the EDEN ground DEM to fill the gap in the area South of the BCNP. This and other efforts to expand and improve the EDEN products will lead to a fuller and better characterization of the hydrological regime, and supply sound support to restoration efforts.

Contact Information: Zhixiao Xie, Geosciences Department, Florida Atlantic University, FL 33431, USA, Phone: 561-297-2852, Fax: 561-297-2745, Email: xie@fau.edu

Local and Bi-National Restoration Efforts in the Colorado River Delta in Mexico

Francisco Zamora-Arroyo[1] and *Osvel Hinojosa Huerta*[2]
[1]Sonoran Institute, Tucson, AZ. USA
[2]Pronatura Noroeste, San Luis Rio Colorado, Sonora, Mexico

The Colorado River originates in the United States, and travels approximately 1,400 miles before reaching the Gulf of California in Mexico. The river is one of the most controlled rivers in the world, with several major dams and diversions that deliver water to meet human needs in cities and the agricultural sector both in Mexico and the United States. The result is a river that no longer reaches the sea. Its Delta, which is perhaps the most impacted region of the entire basin, is less than ten percent of its original nearly 2 million acres. However, remnant wetlands inadvertently created still provide habitat for over 370 species of birds as well as several endangered fish and other protected species.

Conservation efforts in the Delta started in the late 1990s with the collaboration of non-governmental organizations and research institutions from Mexico and US with local communities. Efforts focused on activities to protect existing areas in good condition and in the identification of areas needing restoration actions. With the interest and support from local natural resource users, NGOs began implementation of small on-the-ground restoration projects. Early success was key to strengthen the relationship between local community and NGOs, which led to the development of an overall restoration vision. This vision calls for restoring flows to the river and enhancing critical riparian, marsh, and estuarine habitat in the Delta. To achieve this vision, NGOs designed a strategy that includes implementation of on-the-ground projects along the riparian corridor as well as implementation of policy and market mechanisms to secure instream flows and the land that will be restored.

The first demonstration project started in 2001, with the conversion of fifteen acres of abandoned farmland into a mesquite bosque. Since then, a total of eleven projects including riparian, wetland, mesquite bosque, and estuarine restoration are taking place in conservation priority areas in the Delta. Approximately 50 acres of mesquite bosque and 30 acres of riparian habitat have been restored along the Hardy and Colorado Rivers, and El Doctor. Also, extensive areas in the Delta are in the process of becoming functional wetlands. Within the last year, restoration efforts have started in the estuarine portion by establishing a monitoring program and exploring opportunities to enhance connectivity between the river and the estuary. For securing instream flows, NGOs have created the Colorado River Delta Water Trust, which through voluntary water transactions has been able to secure over 1,000 acre-feet of water to be used in restoration efforts. Also in the last three years these restoration efforts have received strong support from government agencies in both countries. This support has been instrumental for implementation of small restoration projects, for the establishment of 1,200 acres of federal land as restoration areas, and the dedication of treated wastewater for the river, all of which provides a solid foundation for the scaling up of restoration efforts in the Delta.

Contact Information: Francisco Zamora-Arroyo, Sonoran Institute, Tucson, AZ 85710 USA, Phone: 520-290-0828, Fax: 520-290-0969, Email: Fzamora@sonoran.org

Recovery of an Endangered Bird and 3,000 ac of Riparian Habitat by Restoration and Management on the Santa Ana River, CA

Richard Zembal
Orange County Water District, Fountain Valley, CA, USA

Encompassing 3,200 square miles, the Santa Ana River Watershed is the largest drainage in coastal southern California. Since 1997, the Santa Ana River Watershed Program has been working to reverse past damage to the river, restore its natural functions, and invest people in the river's resources through control of invasive species, restoration of riparian habitat, and wildlife management emphasizing rare and endangered species. About half of the riparian habitat on the river had been replaced by giant reed, *Arundo donax*. We are gradually replacing the weeds with native cover and recovering migratory songbird populations as well. Approximately 3,200 acres of giant reed and associated weeds have been removed and native riparian habitat has expanded into at least 75% of the reclaimed floodplain. Migratory songbird populations including the endangered least Bell's vireo, *Vireo bellii pusillus*, have greatly benefited with the increased habitat and our management efforts. By 2004, the vireo population on the Santa Ana River at 837 territories had become the largest in existence and grew to over 1,000 territories in 2008. The US Fish and Wildlife Service recommended the vireo for down-listing to threatened status in 2006 based upon such success.

Contact Information: Richard Zembal, Orange County Water District, 18700 Ward Street, Fountain Valley, CA 92708, USA, Phone: 714-378-3213, Email: RZembal@ocwd.com

Restoring Migratory Pathways in the Apalachicola-Chattahoochee-Flint River Basin through Fish Passage Operations at Jim Woodruff Lock and Dam

Brian A. Zettle
Planning and Environmental Division, U.S. Army Corps of Engineers, Mobile, AL, USA

The construction of Federal and private dams in the Alabama-Coosa-Tallapoosa (ACT) and Apalachicola-Chattahoochee-Flint (ACF) River Basins have blocked historical migratory pathways for native fishes to access important spawning habitat. In an effort to restore access to previously available spawning habitat for Alabama shad and Gulf striped bass, the U.S. Army Corps of Engineers (Corps) has worked collaboratively with several other agencies to study fish passage opportunities at Jim Woodruff Lock and Dam in the ACF Basin. The Corps has participated in interagency study efforts over the past four years by incorporating operations that use the navigation lock to give the fish access to nearly 200 miles of previously inaccessible spawning habitat in the Flint and Chattahoochee rivers. Restoration of these and other migratory fish populations can improve the overall ecology of the ACF river system, Apalachicola Bay and the Gulf of Mexico. Preliminary data analysis suggests that the Corps could also use the locking technique to help migratory fishes repopulate from declines experienced after construction of Claiborne and other locks and dams throughout the ACT River Basin.

Contact Information: Brian A. Zettle, Planning and Environmental Division, U.S. Army Corps of Engineers, 109 Saint Joseph Street, Mobile, AL 36602 USA, Phone: 251-690-2115, Fax: 251-690-2721, Email: brian.a.zettle@ usace.army.mil

Causes and Impacts of the Zula River Pollution: Is It Possible its Restoration?

Florentina Zurita
Departamento de Ciencias Tecnológicas. Centro Universitario de la Ciénega. Universidad de Guadalajara, Mexico

In developing countries, such as México, the pollution of fresh water supplies is a very big problem. The rivers and lakes are the receptor of untreated domestic wastewater, semi-treated industry effluents, agricultural runoffs and agro industry runoffs. In these countries, the economic resource is scarce and the environmental education is poor, so the surface water pollution receives low attention. This is the case of Zula River, a tributary of Santiago River (which flows out of Lake Chapala), located within the Lerma-Chapala-Santiago watershed at the northwest part of México. Currently the pollution of Zula River is noticeable: the water is gray in colour and full of invasive aquatic plants (*Eichornia crassipes*), it is the source for mosquitoes proliferation and bad smells mainly for Ocotlán city. The Zula River flows through four municipalities (where several tequila factories are located); the biggest in population is Ocotlán, with around one hundred thousand inhabitants. Along the past eight years, two different municipal goverments of Ocotlán tried to focus on the solution of Zula River pollution but they got disappointed very soon when they realized which a complex problem it is. Nowdays there is a new municipal government which began two years ago and its term will finish this year. They focused on the problem after the first year and during the second year they organized several workshops with the actors involved in the problem as well as academics. The main achievement they got was the legal association of the four municipalities located on the Zula banks, with the specific purpose of taking actions to restore the river. The aim of this work is to analyze the causes which have conducted the Zula River to its current situation and the good and services lost due to its deterioration as well as the current plans for its restoration.

Contact Information: Florentina Zurita, Departamento de Ciencias Tecnológicas, Centro Universitario de la Ciénega, Universidad de Guadalajara, Av. Universidad # 1115, Col. Linda Vista, C.P. 47820, Mexico,
Phone: +52 392 92 594 00 ext. 8602, Email: fzurita2001@yahoo.com

Author Index

Bold numbers indicate presenting authors.

Abbe, T. 383
Abbott, Robert R. **3**
Abellera, Marriah **4**
Admire, Keith **5**
Ajemian, Greg 384
Akçakaya, Resit 125
Albaugh, Andrew M. **6**
Alderson, Carl **7**, **103**
Allan, G. J. 159
Allen, G. 212
Allen, Shauna R. **8**
Allevato, Eugene **9**
Anderson, Caitlen 242
Anderson, Kathleen J. **10**
Anderson, Michael A. **12**
Anderson, Sean S. **13**
Anderson, Stephen H. 278
Anderson, Thomas 23
Andonoff, Andrew M. 410
Andress, Robert J. **14**
Annis, Micheal 260
Anon, Susan 57
Apfelbaum, Steve **15**, 96, 391
Arenal, Christine **16**
Armstrong, Ron 319
Armstrong, Tamieka 256
Artho, Daniel F. 124
Ashby, Steven L. **17**
Asman, Ryan R. **18**
Athearn, Nicole **19**
Aubrey, Stephen B. 273
Auer, Thomas 391
Austin, Valer **20**
Aviña, Erin **21**
Axtman, Tim 366
Bach, Leslie 53
Baffaut, Claire 278
Baldino, Cristi R. 14
Baldwin, Clair 136
Baldwin, Laura 131
Bangert, R. K. 159, 212
Bankhead, Natasha **22**
Barko, J. 139
Barnum, Douglas A. **23**
Barr, Kenneth 192, 380
Barreteau, Olivier 208
Barron, Bridget 345
Barrow, Shane 94
Barry, Barbara M. 12
Bartell, S. 139
Bartindale, Sally 75
Bartsch, Jonathan 35
Battles, John J. 282
Beamer, Eric 250
Beasley, Charles 293
Becker, Lee **24**, **25**
Belby, Brendan R. **26**, **27**
Bell, Scott B. **28**, 43, 98
Benton, Ed 109
Berg, Joe **29**
Bergamaschi, Brian **30**
Bergquist, Sean 141
Bergstrom, Peter 330
Bernhardt, Christopher E. 408
Besancon, Richard E. 130
Besrutschko, Peter **31**, 50, 146, 285
Best, G. Ronnie 97, 365, 385
Bevilacqua, Robert A. **32**
Biddinger, Gregory R. **33**
Binkley, Jeffrey S. 236
Bittner, Laura D. **34**
Blasius, Heidi B. 41
Bleed, Ann **35**
Blersch, David **36**
Block, Steve 24
Bodnar, Jill 160
Boesch, Donald F. **37**
Bohn, Kimberly 333
Bolger, Sally 287
Boltz, Suzanne **38**, 60, 62, 302
Bonneau, Josiane 144
Booth, Derek B. **39**
Borde, Amy 87
Borders, Brianna D. **40**, 210
Boston, Brett 367
Bountry, Jennifer 303
Bowers, Keith 54
Boyd, William A. 350
Boyer, Kathryn **41**, 163
Bozek, Catherine M. **42**

Bradley, Douglas J. 28, **43**
Brady, Stephen 148
Brand, Gordon 328
Brand, Peter 101, 281
Brandau, William K. **44**
Brandt, Laura A. 97
Braud, D. 235
Braun, David P. 117
Breedlove, Michael J. **45**
Breidinger, Kenny 135
Breithaupt, Stephen A. 99
Bremner, Allison M. **46**
Breon, Amanda 291
Brewster-Wingard, Lynn 395
Brick, Timothy **47**
Bridges, Todd S. 366, 367
Brigham, Christy 21
Britt, Joseph **48**
Brosnan, John **49**
Brossell, Eli 216
Brostoff, William 203
Broudet, Steve 260
Brown, Edwin 31, **50**, **51**, **52**, 146, 285
Brown, Nathan 136
Brown, Tim 31, 50, 146, 285
Bruckner, Robin J. 336
Brunner, Gary 147
Budai, Chris **53**
Bukojemsky, Allegra **54**
Bunting, Daniel P. **55**, 153
Burch, Barbara **56**
Burger, Jutta C. **57**, 242
Burgess, Matthew A. **58**, 132, 289
Burke, Russell P. 324
Burks-Copes, Kelly A. 38, **59**, **60**, **61**, **62**, 302
Burns, Casey **63**, **64**
Butler, Lance 160
Byrd, Aaron R. 200
Cagney, Pat 197
Callaway, John C. **65**
Campbell, Scott 315
Cann, Anne **66**
Cannon, Lisa 309
Cantrell, C. 41
Cantu, Jose Manuel Perez 386
Canty, Dennis **67**
Caplan, Todd 194
Cardwell, Hal **68**
Carthy, Raymond R. 228
Casper, Andrew F. **69**, **70**, **71**, **72**
Catanzaro, Andrea K. 61
Caulk, Grady H. 8
Cerco, Carl F. **73**, 90, 335
Chambers, Kitia D. 46
Chapman, Trish 401
Chappie, Daniel J. 362
Charbonneau, Jackie 220
Chen, C. 235
Cheng, Hwai-Ping (Pearce) 34, **74**
Cheng, Jing-Ru C. 74
Cheng, Tony S. 78
Cherkiss, Michael S. 97
Chick, Steve 120
Childress, Michael 300
Childs, Joshua A. 58
Christner, Bill **75**
Chung, Jae **76**
Cialone, Mary 341
Clark, Renae **77**
Clarke, Richard 176
Clement, Jessica M. **78**
Coffee, Glendon L. 398
Coffman, Gretchen 281
Cofrancesco, Al 374
Coldren, Cade 300
Cole, Richard A. **79**
Coleman,, Andre M. 99
Collins, Christopher M. **80**
Collins, Josh **81**
Comer, Patrick J. 117
Coney, R. 261
Conlin, Barbara E. **82**
Conrads, Paul A. **83**
Constance, Troy 380
Constans, Elise 9
Constant, Glenn C. **84**
Conyngham, Jock **85**, 124
Conzelmann, C. 361
Cook, M. J. **86**
Cook, Marci 380
Corbett, Catherine 80, **87**
Corbino, Jeffrey M. **88**
Corneille, Dick **89**
Cosio, Tami S. N. 105
Cox, Nat 4
Creef, Edward D. 88
Crooks, Stephen 283
Crump, Donald "Kit" 337

Cui, Yantao 106
Daamen, Ruby C. 83
Dalton, Deborah 119, 305
Dalyander, Patricia Soupy 73, **90**
Damschen, William 407
Dardinger, Heather L. 313
Darnell, Joel **91**
Davis, Frank 352
Davis, Jana L. D. **93**
Davis, M. 139
Davis, Stephen **92**
Davros, Nicole M. 187
Dawson, Frank W., III 254
de la Rosa, Carlos **94**
Deacon, James E. 409
Debinski, Diane M. 187
DeBusk, Thomas A. **95**
Decker, Cheryl 116
Dekker, Timothy J. 15, **96**, 391
Delaney, Michael 92
DeLaune, Ron. D. 406
Dent, Douglas 118, 363
Denton, Mat **97**
DePinto, Joseph V. **98**
Derwin, John 92
Dewitt, Bon A. 58
Diefenderfer, Heida L. 87, **99**, 113, 161, 202, 379
Dietl, Michael L. **100**, 193
Diggory, Zooey E. **101**, 105, 281, 282
Dixon, B. 71
Dolan, Andrew 294
Donalson, Doug 307
Dongell, Beatriz 384
Donovan, Larry 367
Doren, Robert F. **102**
Dorsey, Ann **21**
Dorsey, Geoff L. 46
Doss, Teresa 7, **103**
Downer, Charles W. 200
Downs, Peter W. 101, **104**, **105**, **106**
Downs, Rob 260
Doyle-Breen, Jenifer 176
Dragos, Paul **107**
Drum, Deborah L. 95
Dubinski, Barry J. **109**
DuBowy, Paul J. **108**, **110**
Dumouchel, Catherine 114
Duncan, John 190
Duriancik, Lisa F. **111**
Dusterhoff, Scott R. 106
Dvarskas, Anthony 160
Dwyer, Blaine N. **112**
Earles, Peter W. 157
Earls, J. 71
Ebberts, Blaine D. 80, 87, **113**, 202, 379
Eckert, Gregory E. **114**, **115**, **116**, **117**, 365
Eckert, L. 290
Eells, Jennifer L. 291
Effland, William R. 111
Ehlinger, Gretchen 52, 168, 184, 185
Elliot, Rebecca 306
Elliott, Ralph E., III 118, 363
Emmerson, David **119**, 284
Engel, John 162
Engelmann, Jeff 322
England, Stephen M. 34
Epperson, Randy **120**
Estergard, Scott 143
Evers, Brandon 58
Faber, Beth A. 277
Faler, Jennifer **121**
Falzone, Anthony 232, 384
Fang, Yi-Chin 57, 242
Farag, Aida M. 189
Farmer, Jason **122**
Feliz, Dave 134
Ferrier, Sharon M. 159, 212
Files, Brian K. 382
Finger, Susan E. 189
Fink, Mike 137
Fischenich, J. Craig 85, **123**, **124**, 256, 265, 374
Fischer, D. 159
Fischer, Richard A. **125**
Fischer, Steven A. 350
Fisher, Larry 68
Fitzpatrick, Matt 107
Flaxman, Michael **126**, 208, 385
Fleming, Craig A. 161, 234
Fleming, Kristen B. **128**
Fleming, Matthew J. 304
Foster, Gene L. **129**, **130**, **131**
Frank, Paul 384
Frederick, Peter C. 58, **132**
Freiwald, David A. 181
Frick, Peter 64
Fripp, Jon 64, **133**
Fromer, Paul 154
Fuhrmann, Kelly 116

Fujii, Roger 30
Fujitsubo, Miki **134**
Fullen, Karen L. **135**, **136**
Funicelli, Carianne **137**, 154
Gagnon, Paula **138**
Gaiser, Evelyn 395
Gala, William R. 223
Galat, David L. **139**, 267, 380
Gallihugh, Jeanette L. 340
Galya, Donald 152
Gandesbery, Tom 411
Gange, Melanie L. 336
Garello, Michael C. **140**
Garnett, Gregg 55, 153
Garrity, Nicholas **141**
Garvey, Kimberly **142**
Gavigan, Kim M. **143**
Geauman, Dave 222
Gendron, Wendy B. 396
Gentile, John H. 168, 169, 184, 185
George, Ann **144**
George, Mike **145**
Georgiou, Ioannis 341
Gerald, Terry K. 200
Gerena, Enid 31, 50, **146**
Gerry, Larry 380
Gibson, Stanford **147**
Gilbrough, Noel 197
Gilgert, Wendell **148**
Ginzburg, Lev 125
Gipson, Leighann C. **149**
Gleason, Nancy 197
Glomb, Stephen J. 189
Glowacki, Stan 209
Goerlitz, Melissa 130
Goldsmith, Wendi **150**
Golshani, Aliakbar 269
Gonzalez, Elena 305
Goode, Suzanne 4
Goodman, Patricia **151**
Gore, James A. 70, 71
Gorman, David **152**
Gorman, Gary C. 342
Gottlieb, Andrew D. 102, 306, 307
Gould, Joyce 114
Grabau, Matthew R. 55, **153**
Graves, Greg 168, 184, 185, 224, 238
Graves, Mark R. 17, 320
Gray, Italia **154**
Greenblatt, Marcia 152
Gregory, Stan **155**
Greimann, Blair 303
Grim, J. K. 355
Gross, Chris 225
Groves, Jessica 64, **156**
Gued, Lisa 31, 50, 146, 285
Guetersloh, Mark 358
Gummer, David 114
Gushue, Thomas M. 45
Haag, Dennis A. 131, **157**, **158**
Hackett, Edward J. 172
Hagenauer, L. E. **159**, 212
Hahn, Simeon **160**
Hale, Carol **161**
Hall, Bill **56**
Hall, Meagan **162**
Haltiner, Jeff 141
Hamilton, Robert A. 57
Hammitt, Gary 327
Hankin, Howard **163**
Hanneken, Charlie **164**
Hanrahan, Tim **165**
Hansen, Clarissa M. 34
Hare, Trevor **166**
Hargett, Glenn 245
Hargrave, Rosemary C. **167**
Harper, Brian 366
Harrison, Lee 352
Hart, Kristen 291
Harwell, Mark A. 169
Harwell, Matthew C. 102, **168**, **169**, 184, 185, 224, 238
Hastings, Lauren L. **170**, 380
Hautzinger, Andrew B. 180, 288
Hawkes, Janet **171**
Hayes, Lesli 151
Heard, L. Pete **172**
Heitmeyer, Mickey 164
Helms, Douglas **173**
Hendel, Jeff 51
Henderson, Jim E. 59, **174**, **175**
Henderson, Kathleen 19
Henderson, Nathan **176**
Henkel, Heather S. **177**, 375
Henz, John **178**
Herbert, Ellen R. 65
Herman, Brook **179**
Herr, Vern 367

Herron, Rex C. 260
Herzog, Mark 276
Hickey, John T. **180**, 288
Higgins, Jamie 226
Higgins, Patrick J. **181**
Hightower, Melissa A. 88
Hildner, K. Kelly 191
Hill, Peter **183**, 207
Hines, Eliza 168, **184**, **185**, 224, 238
Hines, Stephanie A. 362
Hinsley, Bill **186**, 311
Hirose, Kotaro 388
Hoag, Chris 64
Hohman, William L. **187**
Holmes, Michael 376
Hood, W. Gregory **188**, 250
Hooper, Michael J. **189**
Hoover, Jan J. 69
Hopkins, Todd 385
Hornung, Lewis 216
Hosking, Adam 297
Hostetter, Leigh A. 223
Houser, Jeff N. 219
Howington, Stacy E. 34, 74
Hrzic, Michael A. **190**
Hubbard, David M. **191**
Hubbard, Lisa 204
Hubbell, Marvin E. **192**
Hudley, Joel W. 413
Huerta, Osvel Hinojosa 415
Hughson, Debra L. 296
Hume, Noah P. **193**
Hummel, Ondrea C. 59, 61, **194**
Huning, Beth **195**, 312
Hurley, Kathleen **196**
Hutzel, Amy 411
Huy-Nh-Ba, Gia 412
Ickes, Brian S. 219
Ifju, Peter G. 58, 132, 289
Jackels, Chemine **197**
Jacob, David 246
Jambazian, Christine 9
James, Matthew 191
James, William F. **198**, 200
Janssen, Julie 323
Jeffery, Brian M. 97
Jimenez, Diana 9
Johnson, Barry 139, **199**
Johnson, Billy E. **200**
Johnson, Brian L. **201**
Johnson, David R. 69
Johnson, Gary E. 87, 99, **202**, 379
Johnson, Isabel 332
Johnson, Norwyn 262
Johnson, Theodore 47, 209
Jolliffe, Eric **203**, 211
Jonas, Meg **204**
Jones, Chris 328
Jones, John W. 414
Jones, Krista 87
Jones, Ronald 50
Jose, Shibu 333
Judson, Mark A. **205**
Kalita, Prasanta K. **206**
Kamman, Greg 286
Karimi, Hamid **207**
Karl, Herman **208**, 385
Karpiscak, Martin 55, 153
Katagi, Wendy 4, 47, 89, **209**
Keefe, Kelly 52
Keenleyside, Karen 114
Keevin, Tom 217
Keith, A.J. 104
Kelly, Martin H. 70
Kelly, Patrick A. 40, **210**
Kendall, Thomas R. **211**
Kennedy, Karla J. 159, **212**
Kennedy, Matthew 152
Kennedy, Susan C. 189
Kenny, Jerry 345
Ketcham, Brannon J. **213**, **214**, 286, 287
Khalil, Syed M. **215**
Khan, Anwar **216**
Kiker, Gregory 60, 62, 125
Killgore, Jack 69, **217**
Kleiss, Barbara A. **218**
Klemencic, Marc 232
Knights, Brent C. **219**
Koenig, Leslie **220**
Komlos, Shawn B. **221**, 397
Koser, Sarah 38
Krause, Andreas F. **222**
Krause, Paul R. **223**
Kreeger, Daniel 160
Kreie, Jeff 157
Kretchmer, Donald 396
Kroesen, Kendall W. 321
Krofta, Chad 26

Krolick, David 75
Krupka, Mark...**118**, 363
Krypciak, Joe 410
Kuhlenschimidt, Mark S. 206
Kuhns, Roger 412
Kulakow, Robin 134
Kurzbach, Elmar **224**, 238, 306
Lair, Kenneth D. 40, 210
Lal, Harbans..**225**
Lamont, Doug **227**
Lamont, Margaret M...**228**
Lampley, Vechere **226**
Landers, Glenn B. **229**, 365
Landsman, David 337
Lane, Jon S. 58, 289
Laney, Everett E. **230**, **231**
Langis, René **232**
Langsdale, Stacy 68, 284
Largay, Bryan 401
Larson, Catherine E. 198
Larson, Mary 209
Lassettre, Neil S..104
Lautenbach, Dan 96
Le, Si...16
Ledwin, Jane **234**
Lee, Jeff T. 77
Lee, Kyuho 58
Lee, Stephen 210
Lehr, Victoria..**233**, 319
Lentsch, Leo D...383
Leong, Kirsten M. 115
Leroy, C. 159
Leverich, Glen T. 193
Lewis, Hayley 9
Li, C. **235**
Liebau, Daniel..**236**
Ligon, Frank K...104
Lin, H. 235
Linker, Lewis...334, 335
Linkov, Igor 125
Linthurst, Rick 369
Lipcius, Romuald N. 324
Lipsky, Andrew **237**
Liu, Leonard 276
Liu, Pam..412
Liu, Zhongwei 414
LoGalbo, Alicia 307
Logsdon, Miles G. 373
Lonsdorf, E. 159
Lopez, Eric...142
Lopez, Marie Carmen 52
LoSchiavo, Andrew 224, **238**, 306, 309
Lovan, Hayley...400
Lowe, Jeremy.................................141, **240**, 283
Lubinski, K. 139
Lucero, Carl F. **241**
Lulow, Megan...57, **242**
MacKay, Kevin..**243**
Mahoney, Michele **244**
Manwaring, Brian 68, 119, 305
Marlowe, Beth 253
Marshall, Frank E. 413
Martin, David W. 300
Martin, Derrick C..343
Martin, Michael S. 410
Martz, Merri...53
Mason, Julianne E...343
Mata, Alfred..89
Materne, Michael D. 390, 403
Matthews, Christopher R. **245**
Mattson, Michelle 377
Mayer, Michael S..**246**
Mazzotti, Frank J. 97, 291
McAlpin, Tate 341
McArthur, Kerrie A. **247**, **248**
McBain, Scott **249**
McBride, Aundrea **250**
McBride, Marissa F. 242
McBrien, Peg **251**
McCaffrey, Jessica..51
McCallion, Kathleen (Katie)...................52, **252**, **253**
McCloskey, Brenton **254**
McCoy, John...304
McCreary, Jeff 354
McDonald, Derek 273
McGrath, Christian J...74
McGrath, Daniel T. **255**
McKay, S. Kyle 124, **256**, **257**
McKelvey, Sharon 14
McKevitt, Mark 227
McKinney, Shaun P. **258**, **259**
McLean, Agnes.....................224, 238, 306, 307, 309
McLendon, Terry 300
Meehan, S. Richard...**260**
Mejia, Bart 400
Mendoza, G. 397
Mengel, Denny 384
Merem, Edmund C. **261**

Merrill, Amy........281
Meselhe, Ehab A. **262**
Messing, Christy M. 70
Meyer Lovell, Cecilia **263**
Mierzwa, Kenneth S. **264**
Milczarek, Michael A. 55, 153
Miller, Charles........26, 27
Miller, Dan 322
Miller, Robin 30
Miller, Sarah J **265**
Milner, George R........343
Minnigh, H A **266**
Mirecki, June........51, 332
Mitchell, David F. 396
Mogensen, Richard........251
Mohamed, Ahmed........58, 289
Montgomery, Meagan D. **267**
Moody, Tom........322
Moore, Chris........35
Moore, Thomas G........**268**
Moradabadi, Ehsan........**269**
Moreno, Juan-Carlos Vargas........208
Murray, James B........**270**, **271**
Musilanski, L........383
Myers, N........221
Napoli, Laura J. 33
Nassar, Ron 149
Naughter, Mike........412
Nehler, Dan 307
Nelson-Stastny, Wayne **272**
Nemec, Kristine........38, 60, 62, 302
Nestler, J........139
Neubert, Pamela L........**273**
Nevulis, Rick........331
Newman, Rob........300
Nicholas, David........**274**, 296
Nichols, Nate........**275**
Nicolette, Joeseph........274
Nobriga, Matt 170
Noel, Mark R........73
Norris, G.R. 355
Nur, Nadav **276**
O’Connell, Michael........57, 242
O’Connell, Sara M........**277**
O’Donnell, T. Kevin........**278**
O’Keefe, Shea V........**279**
Obernolte, Rena........3
Oldenburger, John, III 265
Olson, David........57, 242
Olson, Mike........380
Orr, Bruce K. 101, 105, **280**, **281**, **282**
Orr, Michelle **283**, 314
Orr, Patricia **284**
Osburn, Chris........**285**
Oster, Teri........278
Ostmann, Isaac 57
Otis, Stephanie C. 129
Page, Denise 298
Pahl, James 262
Paille, Ronald 256
Parker, V. Tom 65
Parsons, Lorraine 214, **286**, **287**
Pataki, Diane 292
Payne, Barry S. 59, 367
Peacock, Gregory 180, **288**
Pearce, Robert 63, 64
Peek, Ryan........280
Pekar, Dale J........5
Percival, H. Franklin........58, 132, **289**
Perkins, Mike........275
Perry, John H. 58, 132, 289
Peterson, Deborah **290**
Petkewich, Mathew D. 83
Petrie, Mark J. 318
Petrik, Kevin L. 318
Pfingsten, Richard **25**, 38
Pifer, Emily K........**291**
Pincetl, Stephanie **292**
Pinigis, Dennis J. **293**
Pinkney, Fred C. 349
Pitre, John M. **294**
Pitts, Patrick A........413
Plumley, Marshall B. **295**
Poff, Boris **296**
Porthouse, Jon **297**
Possingham, Hugh........242
Pozcarycki, Scott 197
Prann, Ronald W. **298**
Praul, Chad **299**, 301, 351
Price, David........**300**
Prima, Norm 233
Prine, James........263
Protteau, Marcy 299, **301**
Putman, Doug........113
Quanrud, David 55
Quinn, Patricia K. 143
Rabbe, Lisa A 38, 60, 61, 62, **302**
Rabideau, Alan 36

Racette, Paul 160
Ralph, Stephen C. 39
Rambo, Thomas J. 58
Ramírez toro, G. I. 266
Ramos-Gines, Orlando 51, 331, 332
Randle, Timothy **303**
Rashid, Mizan 152
Raulin, Jennifer........**304**
Redder, Todd 98
Redican, Kerry........119, **305**
Redwine, Jed........**306**, **307**, **308**, **309**
Reed, Ann 251
Reed, Denise J. **310**
Reed, Russell **311**
Reeder, Katy 187
Reid, Fritz **312**
Reil, Marie D. 282
Reuter, Michael A........353
Reynolds, Gregg 307
Rice, Kenneth G........97
Richards, Carol Parsons........262
Richards, David R........17
Richmond, Marshall 165
Riebe, Clifford S. 280
Risch, Kristen D........**313**
Ritchie, Steven R. **314**
Rits, Mark 347
Ritter, Nur P........40, 210
Robinson, B. 261
Robinson, Patricia........**315**
Robinson, Steve 407
Roegner, Curtis........202, **316**, 379
Roelh, Edwin A. 83
Rogalski, Mike........**317**
Roh, Brian........130
Romsos, Shane........301, 351
Rosen, Rudolph A........**318**
Roth, Mary S........167
Rowland, Kathleen 407
Rowney, A. Charles........**319**
Roy, Liza 152
Rudd, Michael J. 26, 27
Saatchi, Sassan........292
Saban, Lisa........196
Sabol, Bruce M. **320**
Samuelson, Stacy........245
Sands, Linda 16
Sansom, Lia K. **321**
Saphores, Jean-Daniel........292
Sasser, Charles E. 393
Saviñon, J........290
Scerno, Deborah Hesse........56
Schalk, Brian **322**
Scheidlinger, Carla **323**
Schile, Lisa M. 65
Schill, William B. 271
Schlagel, J. 221
Schmidt, Jack 135
Schmidt, Paul A. 46
Schneider, Daryl 216
Schulte, David M. **324**
Schultz, Martin 366
Schwar, Heather E. **325**
Schwar, Michael T. 190, 325, **326**
Schwichtenberg, B. 290
Scodari, P. 397
Scoggin, Sandra 195, 312
Scogin, Mack 391
Sears, William A........101, 281
Seeman, Anthony........**327**, **328**
Seen, Judy P........211
Sellers, Randy **329**
Shafer, Deborah **330**
Shafer, Mark **331**, **332**
Shafroth, Patrick B........180, 288
Sharma, Ajay **333**
Shellenbarger, Greg 19
Shenk, Gary W........**334**, **335**
Shepard, Gullivar........96
Sherman, Rennie........374
Shostick, Tisa........**336**, **337**
Silva-Lugo, Jose L. **338**
Silver, Elizabeth 96
Sime, Patricia........151, 168, 184, 185, 224, 238
Simenstad, Charles A........188, **339**, 373
Simon, Andrew 22
Simon, John C........58, 132
Singer, Maia S. 105
Sjoberg, J. 41
Skaggs, L. Leigh **340**
Skalski, John R. 99, 202, 379
Sleath-Grzegorzewski, Alison **341**
Sloat, Matt R. 104
Sloop, Robert V. **342**
Slowinski, Thomas E. **343**
Small, Mary 141
Smith, Chadwin B........**345**, **346**
Smith, David L........90, 198

Smith, Lacey....151
Smith, Lester B., Jr.....**347**
Smith, Lisa....368
Smith, Scot E.....58, 132, 289
Smith, Susan....374
Snieckus, Robert E.....**348**
Soard, Sarah J.....**349**
Soballe, David M.....**350**
Sokulsky, Jeremy....299, 301, **351**
Soong, Oliver....**352**
Southerland, W. Barry....258
Souza, Paul....385
Sparks, Richard E.....**353**
Spears-Lebrun, Linnea....263
Spenst, Renee....**354**
Splean, Scott L.....**355**
St. Clair, Tom....145, 224, 238, 306, **356**, **357**
Staebell, Jodi....374
Stahl, Ralph G., Jr.....189
Starnes, Janet....233
Starr, Ellen M.....**358**
Starratt, Scott W.....**359**
Stella, John C.....282
Stevens, Donald....251, **360**
Stevenson, Paul C.....8
Stewart, G. Mendel....314
Stewart, Tara....360
Steyer, Gregory D.....**361**
Stone, Harry J.....**362**
Stralberg, Diana....276
Streb, Frederick....**363**
Strong, Cheryl M.....**364**
Stroup, Laura J.....**365**
Sudol, M.....221, 397
Suedel, Burton....**366**, **367**
Sullivan, Jennifer....16
Summers, Kevin....**368**, **369**
Sumner, Richard....81
Surface, Jan M.....**370**
Sutherland, George....209
Sutphin, Todd....327, 328
Switzer, Jennifer....**371**, **372**
Szantoi, Zoltan....58, 289
Tabatabai, Fari....46, 203
Takekawa, John....19
Tamashiro, Pei-Fen....16
Tanner, Curtis D.....339, **373**
Tanner, George W.....338
Taylor, John....137
Taylor, Larry E.....58, 289
Tazik, David....**374**
Telis, Pamela A.....**375**, **376**
Teunis, Lindsay....**377**
Theiling, Charles....**378**
Thode, Andi....116
Thom, Ronald M.....87, 99, 113, 161, 202, **379**
Thomas, Robert....91
Thompson, Amy....253
Thompson, Brad....**380**
Thorhaug, Anitra....**381**
Thorp, James H.....72
Tillman, Dorothy....73
Tippett, Karen S.....**382**
Tipple, Dave....252
Tobin, Kevin P.....349
Toline, A.....**383**
Tompkins, Mark R.....232, **384**
Toombs, Theodore P.....136
Touchet, Tom....176
Trask, Phil....80
Traxler, Steve....**126**, 168, 184, 185
....224, 238, 306, **385**
Treviño, Rosendo, III....**386**
Trexler, Joel C.....102
Trivedi, Dilip....314, **387**
Tsujimoto, Akira....**388**
Tucker, Wayne....114
Twilley, R.....235
Tyre, Drew J.....161
Ulrich, Cheryl P.....**389**
Unnasch, Robert S.....117
Utomo, Herry S.....**390**, 403
Vaccaro, Christine....347
Van Hoorn, Pete....220
Van Valkenburgh, Michael....15, **391**
Vanderheyden, Scott....9
Vargas, Juan Carlos....385
Vargas, Mel....89
Varnado, Paul....262
Vasey, Michael C.....65
Vaughan, Mace....**392**
Vavrinec, John....379
Vearil, Jim....224, 238, 306, 309
Veraldi, Frank....179
Vermeeren, Rene A.....180, 288
Verrastro, Robert....331, 332
Vian, Mark A.....265
Villarrubia, Charles....406

Visser, Jenneke M. **393**
Vitali, Liana **394**
Volety, Aswani 151
von Lany, Peter 297
Wachnicka, Anna **395**
Wade, R. Scott 28, 43
Wagner, Kenneth J. **396**
Wagner, Paul F. 221, **397**
Waguespack, Leslie S. **398**
Wainger, Lisa **399**
Walker, A. 290
Walker, Nan N. 406
Wallace, Angela 92
Wallace, Robert M. 17
Walsh, Brig. Gen. Michael J. 108
Walters, S. C. 86
Washington, Doris **66**
Watts, Adam C. 58, 132
Webb, Antisa C. 59, 60, 61, 62
Webb, Chris K. 342, **400**, **401**
Webb, Lia 264
Weber, Karen 116
Weber, Richard 133
Weeks, E. 235
Wei, Xiangyue 318
Weintraub, Laura 98
Weisberg, Steve 369
Weiss, Jason **402**
Weiss, Jeff D. 77
Weissenfluh, Darrick 14
Welch, Greg 384
Welsch, Maryann 196
Wenefrida, Ida 390, **403**
West, Mitch **404**
Weston, Dave 319
Whalen, Laura 160
White, John R. **406**
White, Kathleen 85, 221
Whitham, T. G. 159, 212
Whitin, Sam 25
Wiederholt, Ron **407**
Wigg, Andy 137
Wilcox, Carl 170
Wilcox, D. 139
Wildau, Susan 35
Willard, Debra A. **408**
Williams, Austin E. 409
Williams, Cindy Deacon 409
Williams, Jack E. **409**
Williams, Philip 240, 283
Williams, Sarah 166
Williams, Todd D. **410**
Wilson, Betsy **411**
Wilson, Devin **412**
Wilson, Kerrie A. 242
Winchell, Paula S. 273
Wingard, G. Lynn 270, 271, 395, **413**
Winslow, Kyle 384
Woehlke, Carl 306
Wolf, John C. 394
Wolf, Roger 327, 328
Wolff, Katherine L. 247, 248
Wong, Bryant 16
Wood, Julian K. 276
Woodrey, M. S. 86
Woods, Lori 137
Woods, Richard W. 33
Wooster, John K. 106
Wu, Jing 334
Xie, Zhixiao **414**
Yamazaki, Hideo 388
Yasuhara, Moriaki 388
Yerxa, Tracey 80
Yin, Yao 219
Yost, Sally L. 218
Zajanc, David 193
Zamora-Arroyo, Francisco **415**
Zembal, Richard **416**
Zettle, Brian A. **417**
Zurita, Florentina **418**

Notes

Notes