Report to the Fish and Wildlife Health Committee of the Association of Fish and Wildlife Agencies from USGS Science Centers

March 22, 2010

Wildlife Highlights

New areas reporting white-nose syndrome of bats (CT, MA, NH, NJ, MD, NY, PA, TN, VA, VT, WV, Ontario, Canada): The USGS National Wildlife Health Center (NWHC) has confirmed that samples from bats collected at two new locations, Maryland and Ontario, Canada are infected with the fungus Geomyces destructans, the likely cause of white-nose syndrome (WNS). This is the first time the disease has been documented in Canada. Tennessee was also recently added to the list of states with confirmed cases of WNS in bats (WHB 2010-01), bringing the total number of states that have confirmed WNS to 11.

The Ontario Ministry of Natural Resources (MNR) announced on March 18 that white nose syndrome was confirmed at one site in the Bancroft-Minden area, and has been associated with the death of a small number of little brown and northern long-eared bats in Ontario. The MNR is continuing to monitor the area to determine the extent of the mortality. In addition, the MNR is investigating two additional sites. Ministry staff is working with the Canadian Cooperative Wildlife Health Centre (CCWHC) to monitor sites where bats hibernate, and this work will continue until the end of the hibernation season in May. The MNR is asking the public not to enter non-commercial caves and abandoned mines where bats may be present to help curb the spread of WNS; not to touch bats, whether living or dead, as a small percentage carry rabies; and to report unusual bat deaths to the Canadian Cooperative Wildlife Health Centre.

Maryland Department of Natural Resources (DNR) biologists confirmed that little brown and northern long-eared bat carcasses collected from a cave near Cumberland on March 5, 2010, were infected with WNS. “This is the first confirmed WNS case in Maryland. The DNR will implement a regimen of restricted access and decontamination procedures for all known bat locations,” said DNR Veterinarian Cindy Driscoll. “DNR has also encouraged the owners of the Cumberland cave to prohibit all access to the site.”

NWHC received samples from both sites for diagnostic testing. Molecular testing (PCR) detected the genetic signature of Geomyces destructans in both instances. The diagnosis of WNS was confirmed by histopathology at NWHC for the Maryland bats and was confirmed by CCWHC pathologists for the Canadian bats.**Contacts:** David Blehert, National Wildlife Health Center, 608-270-2466, dblehert@usgs.gov; Anne Ballmann, 608-270-2445, aballmann@usgs.gov

Conservation/ecological support for WNS (NY, TN): WNS research at the Fort Collins Science Center (FORT) focuses on studying the ecology and dynamics of WNS in bats in their natural habitats. Skin infection by *G. destructans* is believed to be the primary cause of mortality associated with WNS, but the exact process by which skin infection could lead to death is unknown. Pathologic findings thus far indicate that bats affected by *G. destructans* may die from homeostatic imbalance that compromises their usual strategies for surviving harsh winter conditions and the lack of food for 6-8 months each year. Current field research at FORT is aimed at observing the hibernation behaviors of bats *in situ* during winter to better understand how aberrant behaviors associated with infection by *G. destructans* might cause WNS mortality. Working in collaboration with the U.S. National Park Service, U.S. Fish &

Wildlife Service, and New York State Department of Environmental Conservation, FORT oversaw rapid development and deployment of infrared video surveillance systems capable of imaging bats deep in the caves and mines where they hibernate during winter. Two prototype systems are running at remote sites in New York and Tennessee. This new technology represents the first successful effort to develop a system capable of automatically recording the behaviors of bats in hibernation sites over entire winters. In addition to possibly establishing a causal link between skin infection by *G. destructans* and mortality, video imagery gathered by these surveillance systems has the potential to inprove our understanding of how WNS is spread. Additional WNS activities at FORT include using habitat-association modeling to predict the potential spread of WNS at a continental scale and developing a national specimen-tracking database for helping to coordinate the emergency response. **Contact:** Paul Cryan, Fort Collins Science Center, 970-226-9389, cryanp@usgs.gov

Population demographic models for the conservation of endangered Indiana bats at risk of WNS: The Upper Midwest Environmental Sciences Center is working with the U.S. Fish and Wildlife Service (FWS) to develop modeling software for allowing recovery coordinators and associated FWS biologists to predict the consequences of alternative management scenarios for the endangered Indiana bat (Myotis sodalist). The modeling process will occur in 4 stages. Stage 1 will accommodate dynamics of a single recovery unit with the population of bats ostensibly using a single hibernacula for overwintering. In stage 2 uncertainty in parameter estimates will be allowed. Users will be allowed to specify expected ranges of variation in survival, reproductive success, take, and the propensity to reproduce. In stage 3, a user-specified number of hibernacula to partition the population will allow users to specify the number of hibernacula. In stage 4, model development will primarily be associated with making the software more user-friendly. Contact: Wayne Thogmartin, Upper Midwest Environmental Sciences Center, 608-781-6309, wthogmartin@usgs.gov.

Ecology of rabies transmission in commensal bats (CO): A study investigating the relationships among the ecology of commensal bats (those that roost in human-occupied buildings), the dynamics of rabies virus infections, and public health surveillance measures against rabies exposure was completed in 2010. The research focused on big brown bats (*Eptesicus fuscus*) living in houses and commercial buildings in Fort Collins, Colo. This species occurs nationwide and is the most commonly submitted bat for rabies diagnostic examinations nationally; more people are potentially exposed to rabies from this bat species than from any other species. The results of this research have important implications for public health programs and for conservation of bat populations. The research clearly showed that rabies exposure is widespread in bats and that the disease is enzootic, not epizootic. There are unlikely to be large scale outbreaks and mass public exposure due to irruptions of rabies in bats, but instead public health authorities can expect a continual low level number of cases annually similar to past decades. Bats have a natural "herd immunity" from low level exposure to rabies from other bats of their own species, and vaccination control programs would not only be impractical, but probably unnecessary. Similarly, die-offs of entire populations due to rabies are unlikely to occur in endangered species of bats. The host population dynamics aspects of the study are important in planning management strategies for bats because they demonstrate that the most important demographic parameter for maintaining positive bat population growth is high adult survival. The recent outbreak of the fungal "white-nosed syndrome", for example, is affecting precisely this parameter. This study also has set the stage for better understanding the potential range of host-virus parameters that may be important to the emergence of other viruses in bats (bats have been the source for viruses leading to diseases with human health consequences, such as Ebola, SARS, and Nipah), a topic of increasing concern. **Contact:** Tom O'Shea, Fort Collins Science Center, 970-226-9397, osheat@usgs.gov

Oral baits and biomarkers for plague vaccine delivery to prairie dogs: Recent laboratory studies demonstrated that oral vaccination of prairie dogs against plague using raccoon pox-vectored vaccine is feasible, resulting in significant protection against challenge with *Yersinia pestis*. However, before field

application is considered, a delivery bait that is palatable to prairie dogs, resistant to environmental conditions, and capable of maintaining vaccine titer must be selected, along with an appropriate biomarker to evaluate uptake by animals. We evaluated three bait formulations to determine the most palatable to prairie dogs, tested vaccine stability in baits held at 3 different temperatures, and confirmed that ingestion of the preferred bait formulation with vaccine resulted in immunization. In addition, a field study with baits incorporated with a biomarker confirmed bait uptake in > 90% of prairie dogs after an application rate of 4 baits per active burrow. These results further validate the feasibility of oral vaccination of prairie dogs against plague and provide all the critical elements needed to move forward with registration of the vaccine and eventual field trails. **Contact**: Tonie Rocke, National Wildlife Health Center, 608-270-2451, trocke@usgs.gov

Proceedings from the symposium on the ecology of plague and its effect on wildlife: Although much is known about plague and the bacterium responsible for historic human plague endemics, less is known regarding its impact on wildlife. For the few wildlife species where the effects of plague have been studied, there is cause for alarm as important questions have been raised regarding how plague might be affecting conservation efforts in North America, in general. These questions were addressed in November 2008 at an international symposium held in Fort Collins, CO., on the ecology of plague and its effects on wildlife hosted by FORT, Colorado State University, the USFWS, and the Centers for Disease Control. Many topics were explored at the symposium. Most importantly, the symposium explored the impacts of plague on wildlife populations, the consequences for conservation of imperiled species, and raised awareness in the natural resource management community of this persistent and real threat to many wildlife species of conservation concern. A special issue of the journal *Vector-Borne and Zoonotic Diseases*, presenting articles and abstracts from the symposium, was released in February 2010 (http://www.liebertonline.com/toc/vbz/10/1). **Contact:** Patty Stevens, Fort Collins Science Center, 970-226-9499, stevens@usgs.gov

H5N1 highly pathogenic avian influenza surveillance (U.S.): The Federal, State and Tribal partnership formed to develop and implement the National Interagency Early Detection System for Highly Pathogenic H5N1 Avian Influenza in Wild Migratory Birds continues into its fifth year of surveillance. Birds have been tested from all 50 states and 6 freely-associated states and territories. Surveillance has focused on waterfowl, shorebirds, gulls and terns and a total of 284 species have been sampled. So far, during the 2009 sampling year (April 1, 2009 – March 31, 2010), cooperating agencies collected and analyzed over 18,496 wild bird samples and the highly pathogenic avian influenza H5N1 virus was **not** detected. Of these, 632 have tested positive for avian influenza based on molecular screening; 27 were H5 positive, but none were H5N1. No highly pathogenic avian influenza viruses have been detected so far. **Contact:** Scott Wright, National Wildlife Health Center, 608-270-2460, swright@usgs.gov

Migratory birds and highly pathogenic avian influenza (International) – studies from endemic regions of eurasia: USGS Patuxent Wildlife Research Center (PWRC) and Western Ecological Research Center (WERC) have joined forces with the United Nations Food and Agriculture Organization to study wild birds and highly pathogenic avian influenza (HPAI) in regions of persistent circulation including much of Eurasia. Since the program's inception in 2007, the team has worked with partners in 9 countries to study migratory movements of over 500 waterfowl (23 species) in relation to influenza outbreaks and disease risk factors. In 2009, disease sampling and marking occurred in India, Egypt, Kazakhstan, Hong Kong, Mongolia, and Nigeria. Preliminary results from some sites indicate that although wild migratory movements may overlap with disease events spatially, a temporal discord exists in many regions. The Qinghai-Tibetan Plateau (China) may be one area were this does not hold true. Our studies aim to improve our understanding of the potential for wild bird movement of HPAI. **Contacts:** Diann Prosser, Patuxent Wildlife Research Center; diann_prosser@usgs.gov; John Takekawa, Western Ecological Research Center john_takekawa@usgs.gov.

Climate change and disease in Hawaiian forest birds (HA): Many species of Hawaiian honeycreepers have persisted into the 20th century because high elevation montane rain forests on the islands of Kaua'i, Maui, and Hawai'i are cool enough to limit transmission of introduced avian malaria (*Plasmodium relictum*) and pox virus (*Avipoxvirus* spp.). Malaria transmission is tied closely to the effects of temperature on development of malarial parasites within their mosquito vectors and the effects of temperature and rainfall on seasonal and altitudinal changes in mosquito populations. As a result, this system may be very sensitive to recently documented increases in mean temperature in the Hawaiian Islands. The Alaka'i plateau, 1200 to 1500 m in elevation, is the highest area on Kaua'i and falls within a zone where malarial transmission is dependent on increases in vector populations during the warmest months of the year. Populations of two endemic honeycreepers, the `Akikiki (Kaua`i Creeper, *Oreomystis bairdi*) and `Akeke`e (Kaua`i `Akepa, *Loxops caeruleirostris*), have undergone recent dramatic range contractions on the Plateau, and the USFWS and Zoological Society of San Diego are currently working to restore the Puaiohi (Small Kauai Thrush, *Myadestes palmeri*) through captive propagation and release. Based on extensive surveys conducted by USGS in the mid-1990's, prevalence of malaria on the Alaka`i Plateau was approximately 10% in the native forest bird community. We sampled birds in the same areas in 2007 and 2008 to test whether prevalence of infection has increased over the past decade – a response that might be expected if mean temperatures have increased. Overall prevalence of malaria has doubled in the past decade to 20%, with the most dramatic changes at higher elevations on the plateau. These changes are consistent with predicted altitudinal changes in disease transmission that would be expected in a warming climate and could affect recovery of the `Akikiki, `Akeke`e, and Puaiohi. **Contact:** Carter T. Atkinson, Pacific Island Ecosystems Research Center, 808-967-8119, catkinson@usgs.gov.

Knemidokoptic manage in Hawaii amakihi: (HA) Scientists at the USGS Pacific Islands Ecosystems Research Center in collaboration with the University of Hawaii at Hilo and the Hawaii Department of Forestry and Wildlife have conducted field surveys and begun laboratory studies to investigate the spread and impact of the scaley leg mite, *Knemidokoptes jamaicensis*, on Hawaii amakihi. Previously unknown in wild passerines in the Hawaiian Islands, knemidokoptic mange has been confirmed in amakihi from two locations on the island of Hawaii. Infested amakihi were mist-netted throughout the Manuka Natural Area Reserve from 350 to 1585 m above sea level (asl). Infested birds have been brought into captivity to follow pathogenesis and investigate modes of transmission. In advance cases, severe hyperkeratosis of the foot resulted in loss of perching reflex. Ongoing studies will also examine the influence of concomitant infections with avian malaria and avian pox on knemidokoptic mange. **Contact:** Dennis A. LaPointe, Pacific Island Ecosystems Research Center, 808-967-8119 x273, dennis_lapointe@usgs.gov

Remediation of CWD-contaminated sites: Anecdotal, epidemiological and controlled field experiments have all indicated that prions are stable in the environment and in soil. A goal of our research program is to identify and characterize biotic and abiotic means of degrading prions in the environment. We have found that certain lichens, common fungi-algae symbiotic organisms, contain a potent anti-prion activity that could influence CWD persistence on the landscape. Additionally, we have found that the common oxidative soil mineral birnessite (MnO2) is capable of degrading prions in *in vitro* experiments. We are pursuing each of these lines of study to try to achieve practical means of remediating CWD-contaminated sites. **Contact:** Bryan Richards, National Wildlife Health Center, 608-270-2485, brichards@usgs.gov

Widespread wildlife deaths due to Florida's january cold wave (FL): USGS scientists have been working with state, federal, and university partners to document the extent of wildlife mortalities in Florida caused by an extended cold wave that included widespread freezes throughout the state in January. The cold event killed a wide variety of plants and animals including endangered natives such as manatees, crocodiles, and sea turtles, as well as invasive species such as Burmese pythons. Fishes, both native and introduced, were impacted by prolonged cold weather. This winter mortality event has been

the largest ever recorded for manatees throughout their range. Carcasses are still coming in and the ramifications to the populations may be felt for generations to come. Based on limited surveys in Everglades National Park and around Tampa Bay and Charlotte Harbor, it is quite possible that this cold event killed and damaged more mangroves than the hurricanes of 2004 and 2005 combined. Springs continue to be important thermal refugia for aquatic species during cold snaps. By performing necropsies on manatees, we assisted the State in gathering data on their cause of death, health conditions, and population structure that can later be applied to research questions that impact management decisions. **Contact:** Robert Bonde, Southeast Ecological Science Center, (352) 264-3555, rbonde@usgs.gov

Disease Investigations

Suspect lead toxicosis in geese in Louisiana (LA): In February 2010, NWHC was contacted about a large avian mortality event, involving several hundred snow geese, occurring in Vermillion Parish, Louisiana. The suspected cause of death was aflatoxicosis or avian cholera due to the species involved, the time of year, and recent diagnosis of these diseases in other nearby locations in LA. However, field necropsies identified the presence of lead shot in several gizzards. There had been no previously reported mortalities associated with lead in this area so NWHC, in partnership with local USGS, USFWS, and Louisiana Department of Wildlife and Fisheries, conducted a field investigation to determine the extent of the mortality event, species involved, and primary cause of death. When the die-off ended in late February 2010, total mortality was estimated to be approximately 600 geese, consisting primarily of snow geese and a few white-fronted geese. The primary cause of death for this mortality event was determined to be lead poisoning. NWHC is continuing to work with interested parties on potential management recommendations. **Contact:** LeAnn White, National Wildlife Health Center, 608-270-2491, clwhite@usgs.gov

Parasitism of song and water birds (MT): In August 2009, approximately 29 double-crested cormorants were found dead on a nesting island in Lake County, Montana. Only one carcass was suitable for submission to NWHC; this bird was emaciated and heavily parasitized by Syngamus trachea and several other gastrointestinal parasites. S. trachea is a nematode that infects the respiratory tract of wild and domestic birds and is often referred to as a gapeworm because adult worms can block the trachea of infected birds causing them to “gape” or gasp for air. Severe gapeworm infections that cause clinical illness are thought to be uncommon in wildlife; however, recently lowered water levels in the reservoir surrounding the nesting island may have increased the availability of invertebrates, crustaceans, mollusks, or fish (which serve as host for various parasites) to foraging cormorants.

Parasitism also was a cause of death for American robins found in the yard of a private residence in Montana. The parasites involved in this mortality event were acanthocephalans (Plagiorhynchus sp.) and several nematode species. The pathogenesis associated with acanthocephalan infections are poorly understood, but paralyzed and moribund American robins with acanthocephalans have previously been reported. **Contact:** Krysten Schuler, National Wildlife Health Center, 608-270-2447.

Viral and bacterial infections in pelicans (MN): During an annual banding project of American white pelicans by the Minnesota Department of Natural Resources, biologists reported a large number of dead and moribund animals at a large pelican breeding colony in Minnesota. West Nile virus (WNV) was determined to be the primary cause of this large die-off; however, several fledglings from one focal location of nestlings had severe infections with the bacteria Riemerella anatipestifer. WNV has been documented previously in juvenile American white pelicans at this Minnesota location and several other major breeding colony locations in the northern plains. R. anatipestifer infections are primarily observed in domestic waterfowl, but also have been observed in several other waterfowl species including wood

ducks, snow geese, and tundra swans. **Contact:** LeAnn White, National Wildlife Health Center, 608-270-2491, clwhite@usgs.gov

Large-scale botulism type C outbreaks in waterfowl (UT, ID) Botulism type C is a neurotoxin produced by bacteria, Clostridium botulinium, under appropriate environmental conditions. Overall, botulism events decreased this year with above normal precipitation values across many western states and below normal temperatures in the Midwest (National Climatic Data Center, http://www.noaa.gov). There were, however, several disease outbreaks that killed tens of thousands of waterfowl. The largest event this year occurred at the Great Salt Lake, Utah. Biologists with the U.S. Fish and Wildlife Service Bear River Migratory Bird Refuge and the Utah Division of Wildlife estimated that more than 50,000 ducks, gulls, shorebirds, and grebes died between July and October. Historic records indicate botulism events occurred as early as 1912 at the Bear River refuge. Over fifteen outbreaks that killed thousands of birds have occurred sporadically over the years, the largest being in 1980 and 1997 with 100,000 and 250,000 birds, respectively. Less than 150 miles to the north, American Falls reservoir, Idaho, and several surrounding water bodies experienced a die-off of 20,000 ducks, geese, shorebirds, and grebes between August and November of 2009. This was the first event of this magnitude at this location, although previous smaller outbreaks occurred between 1982 and 1984 and in 1997. On-site management activities included the removal of carcasses to reduce further transmission of the toxin. **Contact:** Krysten Schuler, National Wildlife Health Center, 608-270-2447.

Unusual morbidity and mortality in Lake Erie water snakes (OH): Around the beginning of July, several dead Lake Erie water snakes (Nerodia sipedon insularum) were found floating in the water without obvious signs of trauma. Sick snakes were weak and lacked a righting reflex when placed on their backs. Subsequent submissions in late August presented with small blister-like lesions rather than neurologic signs. Of the eleven snakes submitted to NWHC, no singular cause of death could be determined. Snakes experienced mortality from trauma, dystocia, malignant leukemia, and bacterial sepsis. Botulism type E was initially suspected as a cause in snakes with neurologic signs, due to the water snake's diet consisting mainly of round gobies (Neogobius melanostomus) and links to botulism type E in water birds feeding on round gobies, but conventional tests for botulism were negative. The Lake Erie water snake lives offshore on islands in western Lake Erie and is federally listed as a threatened species by the U.S. Fish and Wildlife Service. Contact: Anne Ballmann, National Wildlife Health Center, 608-270-2445, aballmann@usgs.gov

California brown pelican mortality along the Pacific Coast (CA, OR): For the second consecutive winter, California brown pelicans were stranded along the Pacific coast. Reports, ranging from southern California to northern Oregon, are of adult and juvenile pelicans being found in unusual places, emaciated, and weak. Rehabilitation centers, such as the International Bird Rescue and Rehabilitation Center in San Pedro, have several hundred pelicans under their care. A multi-agency effort to examine the causes of morbidity and mortality included California Department of Fish and Game, Sea World – San Diego, USGS National Wildlife Health Center, and U.S. Fish and Wildlife Service. Preliminary diagnosis was emaciation due to food shortages of fish, such as anchovies and sardines, coupled with harsh winter weather. No infectious pathogens have been identified. The feathers of some affected birds were reported to have loss of waterproofing, and research is ongoing to determine the cause of the soiled feathers.

Ocean conditions and marine fisheries can be significantly impacted by climate phenomenon such as El Niño events. The current El Niño, which is expected to persist through the 2009 - 2010 winter, may have contributed to the reduction in forage fish and increased severity and number of winter storms observed along the western coast of the U.S. In 2009, pelicans remained in their northern range in Oregon during freezing temperatures, resulting in emaciated and frostbitten birds arriving in southern California. The California brown pelican was recently removed from the federal endangered species list because

population levels had recovered. **Contact:** Krysten Schuler, National Wildlife Health Center, 608-270-2447

Mortality in Eurasian collared doves in Western states (AZ, MT): Eurasian collared doves have expanded their range across most of the southern and western U.S. since their introduction into the Caribbean Islands and Florida in the 1970s and 80s. During 2009, two mortality events involving Eurasian collared doves were reported to USGS National Wildlife Health Center (NWHC). The first occurred in Arizona in October, and the second occurred in Montana in December – both events occurred at backyard feeders. In each event, 20 to 30 doves were found dead over a period of several days. Carcasses were submitted to NWHC for examination. Laboratory testing revealed that the doves were infected with an avian paramyxovirus. Further testing at the USDA National Veterinary Services Laboratory in Ames, Iowa, identified the virus as pigeon paramyxovirus-1. Although this virus is in the same family of avian paramyxoviruses as Newcastle Disease, pigeon paramyxovirus-1 is not considered to be a threat to poultry. Information was not available to determine if other avian species were involved in these disease outbreaks. Pigeon paramyxovirus has been observed previously in dove mortality events in Florida in 2001 and 2006. The 2009 events suggest a marked westward expansion of the disease. Surveillance for mortality outbreaks in Arizona and Montana were effective in identifying this new disease in free-ranging birds. **Contact:** Krysten Schuler, National Wildlife Health Center, 608-270-2447

Avian cholera in geese and ducks (TX): During December 2009, avian cholera mortalities were documented in Hartley and Moore Counties, Texas. The mortality events occurred at three locations, all within 30 miles of each other. Several duck and geese species were affected: mallards, American wigeons, Canada geese, snow geese, and Ross's geese. The final combined mortality from these sites was estimated to be close to 3,000 birds. Avian cholera occurred previously in two of these sites in the mid-1990s. Cholera outbreaks have occur at any time of the year, but seasonal patterns can often been seen in areas where the disease has become established. In Texas, the majority of avian cholera outbreaks usually occur in the winter (approximately November through March). **Contact:** Krysten Schuler, National Wildlife Health Center, 608-270-2447

Fisheries Highlights

Emergence of infectious hematopoietic necrosis virus in steelhead (WA): During the past three years, there has been an emergence of a new strain of infectious hematopoietic necrosis virus (IHNV) that is threatening Federal, State and Tribal steelhead and rainbow trout populations in river basins on the Olympic Peninsula and Puget Sound in Washington State. The M-D strain of the virus differs from the strains of IHNV that are common among sockeye throughout the Washington coast and Puget Sound in that it is highly lethal to steelhead and rainbow trout. The current distribution and potential spread of this virus constitutes dangerous risks to both hatchery and wild stocks of steelhead that support economically important treaty and non-treaty fisheries and that are important elements in recovery planning for ESA listed stocks. With support from the Bureau of Indian Affairs, The US Fish and Wildlife Service, Washington Department of Fish and Wildlife, the Northwest Indian Fisheries Commission and the Quinault Tribe, scientists at the WFRC initiated a research project to provide managers with information about the emergence of the new strain of the virus. Genetic typing has been used to provide data about the epidemiology and evolution of the virus, and results have been communicated to co-manager partners to provide up-to-date knowledge of the M-D geographic range, how it moves within and between watersheds, and how it is changing over time. Ongoing work will continue to involve typing of field isolates and wet-lab experiments to explore components of viral transmission like animal density, viral shedding, and water temperature. **Contact:** Jim Winton, Western Fisheries Research Center, (206-526-6587; jim_winton@usgs.gov).

Continued spread of viral hemorrhagic septicemia virus: Beginning in 2005, reports from the Great Lakes region indicated that VHSV had been isolated from fish that had experienced very large die-offs in the wild. By the end of 2008, VHSV has been isolated from more than 25 species of fish in Lake Michigan, Lake Huron, Lake St. Clair, Lake Erie, Lake Ontario, the Saint Lawrence River and from inland lakes in New York, Michigan, Wisconsin and Ohio. The Great Lakes strain of VHSV appears to have an exceptionally broad host range and significant mortality has occurred in muskellunge, freshwater drum, yellow perch, round goby, emerald shiners and gizzard shad. Surveillance activities by federal, state, tribal and private sector entities have increased in the region and movement restrictions have been implemented; however, the virus was found in fish from an Ohio reservoir connected to the Mississippi River drainage. In 2009, the virus was confirmed in yellow perch collected from Lake Superior meaning the entire watershed should be considered a virus-positive zone. Currently, the WFRC has completed work on a VHSV sequence database that includes sequence analysis of more than 100 isolates. The database will provide important epidemiological insights about changes in the host or geographic range, virulence and translocation of the virus as it emerges in the Great Lakes system. **Contact:** Jim Winton, Western Fisheries Research Center, (206-526-6587; jim_winton@usgs.gov).

Algal toxins as possible reason for poor survival of juvenile endangered suckers in Upper Klamath Lake (OR): The largest remaining habitat for endangered Lost River and shortnose suckers is Upper Klamath Lake, a lake in southern Oregon where massive cyanobacteria blooms occur annually. In addition to producing extreme dissolved oxygen and pH levels, these blooms can produce toxins potentially harmful to fish. To better understand what toxins are present and how they may be affecting endangered suckers, a collaborative research project is being conducted by the Western Fisheries Research Center, Oregon Water Science Center, Leetown Science Center, Columbia Environmental Research Center, Office of the Regional Executive-SE Area, and National Research Program. Preliminary findings indicate microcystin – a liver toxin – is present in Upper Klamath Lake often at potentially harmful levels. Additionally, we have found tissue damage consistent with toxin exposure in juvenile suckers collected from the lake. These findings are of particular concern as poor juvenile survival may be a key factor in an ongoing lack of recruitment into adult populations. The route of exposure to toxins was likely oral via the food chain as shown by the presence of colonies of *Microcystis aeruginosa*, a known cyanotoxin producer, in the digestive tracts of insect larvae ingested by juvenile suckers. Furthermore, the histology of the fish showed numerous gastro-intestinal lesions. These lesions were observed when liver necrosis was either present or absent suggesting that the gastro-intestinal tract was the first point of toxin contact. **Contact:** Scott VanderKooi, Western Fisheries Research Center, Klamath Falls Field Station, Klamath Falls, OR, 541-273-8689, svanderkooi@usgs.gov

Research on viral hemorrhagic septicemia virus: The Upper Midwest Environmental Sciences Center in La Crosse, WI and the U.S. Fish and Wildlife Service's La Crosse Fish Health Center have tested a disinfection solution presently used for salmon eggs and found it prevents the transmission of the virus that causes Viral Hemorrhagic Septicemia (VHSv) in other hatchery-reared fish eggs. Since the 1970s, iodophor disinfection of salmonid eggs has been a standard hatchery practice used to reduce the risk of pathogen transfer through ovarian or seminal fluids during gamete collection ("spawning") operations. This long history made iodophor disinfection a leading candidate for reducing VHSV transmission, so studies were conducted to assess its efficacy for eliminating VHSV (strain IVb) from fertilized eggs of walleye and northern pike, intentionally challenged with VHSV following egg fertilization. Egg iodophor disinfection appears to effectively eliminate VHSV (strain IVb) from the surfaces of walleye and northern pike eggs, although certain iodophor disinfection regimens reduced egg hatch. Additional information is available at http://pubs.usgs.gov/fs/2009/3107/. Contact: Mark Gaikowski, Upper Midwest Environmental Sciences Center, 608-781-6284, mgaikowski@usgs.gov.

Etiology of atlantic salmon egg production mortality and implications for USFWS restoration programs in the Northeast (MA): The USFWS Craig Brook NFH and Green Lake NFH were short approximately 400,000 fry for 2009 stocking in the Penobscot River Atlantic salmon recovery program in 2009. This resulted from egg mortality among approximately 40+ sea run females. Although the losses have been most serious in the Penobscot River, other Downeast River stocks have also been affected. Externally and in all cases, *Pseudomonas fluorescens* was the predominant bacterium associated with the surface of all eggs. The results of assays conducted at the Leetown Science Center indicated that *P. fluorescens* was resistant to the germicidal activities of formalin. Consequently, the monoclonal nature of the bacterial flora on the surface of all eggs was not considered to be a function of disease but rather a result of the formalin treatments. The continued finding of *F. psychrophilum* within captive Atlantic salmon broodstock bears witness to its widespread and persistent prevalence, which presents additional concerns for Atlantic salmon restoration in New England. There is no reason to doubt that the bacterium does not persist within infected individuals after the egg has hatched. This was evident by the cases of sac fry and juvenile mortality continually diagnosed within restoration facilities. It appears that a significant portion of fry stocked into New England rivers may harbor the bacterium as a result of intraovum infection. The introduction of infected individuals may, therefore, have an adverse impact upon wild fish survival. Contact: Rocco Cipriano, 304-724-4432, rcipriano@usgs.gov at the National Fish Health Research Laboratory, Kearneysville, WV.

Putative bacterial etiology of lesions and fish kills in Virginia rivers (VA): The Virginia Department of Environmental Quality and the Department of Game and Inland Fisheries, along with their partners on the Shenandoah River Fish Kill Task Force (including the USGS), have researched putative causes of the fish kills in the Shenandoah River watershed among smallmouth bass and redbreast sunfish since 2004. In previous work, *Aeromonas salmonicida* was identified as the principal pathogen isolated from the lesions of smallmouth bass, redbreast sunfish, and rock bass from the Shenandoah, James, Cowpasture, and Jackson Rivers. In 2008, pre-kill microbial analyses were conducted from the South Branch of the Potomac River, the North and South Forks of the Shenandoah River, the James and Cowpasture Rivers when water temperatures approximated 10°C. As water temperatures climbed towards 15°C during late April, lesions and dead fish were reported from the North and South Fork of the Shenandoah River, the Cowpasture River, the James River, and the Jackson River. In each case, *Aeromonas salmonicida* was the principal pathogen isolated from lesions. Also, during this period a few fish were determined to be infected with Largemouth Bass Virus and neither of these latter two pathogens was considered prevalent enough to cause large-scale lesion development and mortality. Smallmouth bass from the Maury River (an unaffected river) were used in experimental challenges with smallmouth bass to fulfill Koch's postulates. In addition to these studies, additional field work was conducted to determine where reservoir of infections may exist in the natural environment. Those results are still pending analysis. Contact: Rocco Cipriano, 304-724-4432, rcipriano@usgs.gov at the National Fish Health Research Laboratory, Kearneysville, WV.

Contaminants Highlights

Endocrine Disruption in Wild Fish: The USGS is collaborating with other government agencies to conduct water quality and bioassay studies that have linked endocrine disrupting compounds in rivers, lakes, and waste water sources to adverse effects in faunal populations, organisms, and progeny. Evidence to date has suggested that exposure to potent steroidal estrogens are the primary cause of endocrine disruption in fish, particularly the feminization of males. NWRC has worked in watersheds around the country where ongoing interdisciplinary studies are being performed on assessing potential impacts of contaminants from anthropogenic activities on the health of fish of concern or their sentinels. Examples include the endangered razorback sucker, common carp, and largemouth bass in Lake Mead National Recreational Area, Nevada; the large-scale sucker in the Columbia River; and yellow perch in

the Chesapeake Bay. Contact: Jill Jenkins, National Wetlands Research Center, 337-277-8607; jenkinsj@usgs.gov.

Impact of mosquito control sprays to resident butterflies of the National Key Deer Wildlife Refuge, Florida Keys: The National Key Deer Wildlife Refuge (Refuge) has permitted aerial application of pesticides over Refuge lands for the past few decades for the control of adult mosquito populations. However, the 2006 addition of two of the Refuge's resident butterfly species (Florida leafwing and Bartram's hairstreak) to the list of species that are candidates for listing under the Endangered Species Act has led to Refuge management concerns that the mosquito control pesticides are impacting those butterflies. It also highlights the struggle to conserve imperiled species on conservation lands that are intimately associated with residential areas where mosquito-borne disease control is mandated. The USGS, U.S. Fish and Wildlife Service, and the Florida Keys Mosquito Control District (District) are collaborating in a study to evaluate the potential impact of typical aerial pesticide applications to butterflies on the Refuge. Results of the study to date indicate pesticide deposition in targeted as well as in non-targeted areas of the Refuge is sufficient to result in butterfly mortality. The impact to butterflies in the non-targeted areas has led the District to improve their aerial spraying technology to lessen pesticide deposition in areas that are not targeted by the sprays. **Contact:** Tim Bargar, Southeast Ecological Science Center, (352) 264-3520, tbargar@usgs.gov

Mercury Bioaccumulation in Everglades Pythons: The USGS and NPS are collaborating on an examination of mercury bioaccumulation in pythons captured in Everglades National Park. Interest in understanding the levels of mercury in pythons from the Everglades is two fold: (1) an examination of the literature revealed no published papers with any information regarding mercury body burdens in pythons; and, (2) one possible population-control strategy for the pythons is allowing hunting, so concerns exist for safe mercury exposure to hunters who may distribute or consume python tissue. In the summer of 2009, the USGS Mercury Research Laboratory analyzed 24 python tail-tissue samples for their total mercury and methylmercury content. The mean observed levels of mercury were a surprisingly high 5.5 ppm (micro grams per gram, dry weight), which is about three times greater than concentrations in tail tissues of the American alligator (Alligator mississippiensis), the long held apical predator in the Everglades. The results for methylmercury, which is the more toxic and bioaccumulative form of mercury, showed that on average 79% of the total mercury body burden in the pythons was in the methylated form. Whether pythons are more mercury-enriched because they occupy a higher trophic position, consume a more mercury-rich diet, or simply have lower depuration rates is unknown. In addition, an initial examination of this data set revealed no apparent spatial trends, or any associations with age, size, length or sex, so an explanation as to why Everglades python mercury levels are so high is as of yet unexplained. Currently the NPS and USGS are collaborating on a follow up effort to examine the mercury and methylmercury content of an additional 100 specimens. With this added information, we hope to better understand the anonymously high mercury bioaccumulation levels of pythons, so resource managers can better inform the public about potentially unsafe exposure levels from consuming python tissue. Contact: Kristen M. Hart, Research Ecologist, US Geological Survey, Southeast Ecological Science Center, Davie Field Office, 3205 College Avenue, Davie, FL 33314, Phone: 954.577.6335, Fax: 954.475.4125, Email: kristen_hart@usgs.gov