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

March 16, 2009

Wildlife Highlights

White-Nose Syndrome in Bats (NY, VT, MA, CT, NJ, PA, WV, VA, NH): Since the winter of 2006/2007, hundreds of thousands of hibernating, insect-eating bats from at least nine northeastern states have died as the result of a newly-emerged disease, white-nose syndrome (WNS). This disease represents an unprecedented threat to bats of the northeastern United States and potentially to cave-hibernating bat species of the world. In collaboration with other state and federal conservation agencies, the USGS-National Wildlife Health Center (NWHC) identified a previously undescribed cold-loving fungus, *Geomyces* sp., causative of the WNS-skin infection. In addition to the ongoing diagnostic investigation to document the occurrence and spread of WNS, the NWHC has initiated several studies, in collaboration with partners, to enhance WNS diagnostic capabilities and to increase our understanding of the pathogenesis, physiology, and ecology of the WNS-associated *Geomyces* sp. fungus. Diagnostic tools currently under development include polymerase chain reaction and fluorescent *in situ* hybridization assays for rapid and specific detection of the WNS-associated fungus. An infection trial is underway to identify mechanisms by which the *Geomyces* sp. fungus may be transmitted bat-to-bat and to determine whether the fungus is the sole causative agent of WNS. Also, an environmental survey is underway to characterize the distribution of the WNS-associated fungus in the eastern US and to determine the role that cave sediments may play in the WNS transmission cycle. Based on its current distribution, WNS threatens already endangered Indiana bats, Virginia big-eared bats, and associated ecosystems. Published report: "Bat White Nose Syndrome: An Emerging Fungal Pathogen?" about the newly described cold-loving fungus (*Geomyces* sp.) was published in the January 9, 2009 issue of *Science*. **Contacts:** David Blehert, National Wildlife Health Center, 608-270-2466, dblehert@usgs.gov; Anne Ballmann, 608-270-2445

Conservation/Ecological Support for WNS: The USGS Fort Collins Science Center (FORT) has been collaborating with disease specialists and land managers to understand the causes and conservation implications of white-nose syndrome to bats including co-hosting a Science Strategy Meeting to examine the latest facts and hypotheses concerning the cause of bat die-offs linked to white-nose syndrome and to identify the most promising approaches for vital scientific investigation; synthesizing and reporting information on WNS to the scientific community and public; providing technical support on bat ecology to disease experts and land managers, as well as serving as a liaison between researchers in North America and those investigating observations of fungi on bats in Europe. **Contacts:** Paul Cryan, Fort Collins Science Center, 970-226-9389, cryanp@usgs.gov or Tom O'Shea, 970-226-9397, osheat@usgs.gov

H5N1 Highly Pathogenic Avian Influenza: 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 has continued into its third year of surveillance. Birds have been tested from all 50 states and 6 freely-associated states and territories. While the surveillance focused on waterfowl, shorebirds, gulls and terns, a total of 284 species were sampled. So far, during the 2008 sampling year (April 1, 2008 – March 31, 2009), cooperating agencies collected and analyzed over 71,000 wild bird samples and the highly pathogenic avian influenza H5N1 virus was **not** detected. Since

April 1, 2008, over 25,000 birds have been sampled for avian influenza at the NWHC. Of these, 563 have tested positive for avian influenza based on molecular screening; 49 were H5 positive and 4 were H5N1 (none of these were highly pathogenic). **Contacts:** Scott Wright, National Wildlife Health Center, 608-270-2460, swright@usgs.gov

Experimental Infection of American Kestrels with H5N1 Highly Pathogenic Avian Influenza: Several raptor species in Europe and Asia have died from H5N1 HPAI during periods of die-offs in other wild birds, but their relative susceptibility and potential role in the epizootiology of this disease are essentially unknown. Using American kestrels as a model raptor species, NWHC determined the effect of HPAI H5N1 infection on raptor survival, including dose-response, antibody production, virus shedding, pathology and potential risks.

All inoculated birds succumbed to viral infection regardless of dose within seven days of inoculation. Within 24 hours of inoculation with HPAI, all birds were shedding large amounts of virus orally. There was no difference in the amounts of oral viral shedding between doses. Cloacal shedding had a different profile, typically lagging a day or more behind the oral shedding before becoming detectable. **Contact:** Jeff Hall, National Wildlife Health Center, 608-270-2458, jshall@usgs.gov

Experimental Infection of Dunlin with H5N1 Highly Pathogenic Avian Influenza: Dunlin are one of the target species for HPAI surveillance and knowledge regarding transmission, viral shedding, mortality, and infectious dose are critical components of meaningful risk assessments of the introduction of HPAI into North America. In this study, dunlins captured in Alaska were experimentally infected with various doses of H5N1 HPAI at NWHC to determine morbidity, dose-response, infectious dose, lethal dose, and antibody production. Results are pending. **Contact:** Jeff Hall, National Wildlife Health Center, 608-270-2458, jshall@usgs.gov

USGS Study on Avian Influenza Genetics Published in *Molecular Ecology*: In an article published in the November 2008 issue of *Molecular Ecology*, USGS scientists observed that nearly half of the low pathogenic avian influenza viruses found in wild northern pintail ducks in Alaska contained at least one of eight gene segments that were more closely related to Asian than to North American strains of avian influenza. **Contact:** John Pearce, Alaska Science Center, 907-786-7094, jpearce@usgs.gov

USGS and Japan Investigate Potential of Intercontinental Migration As Route for HPAI Spread: In 2007 the USGS began collaborating with Japanese scientists to assess the likelihood that migratory birds could transmit highly pathogenic H5N1 avian influenza virus from Asia to North America. The study focuses on northern pintails as a model species for intercontinental virus transmission because they migrate between Asia and North America, and because a relatively high proportion of pintails carry low pathogenic avian influenza strains of the virus. Japan is an important wintering area for northern pintails in east Asia, and has had repeated outbreaks of the highly pathogenic H5N1 virus. Northern pintails are being marked with satellite transmitters at wintering areas in Japan in order to estimate the likelihood that they use nesting and molting areas in Russia that are also used by pintails that migrate from North America. The project has been expanded to include whooper swans because in 2008 the H5N1 virus was detected in whooper swans at three sites in Japan. Whooper Swans and Northern Pintails often share winter and migration habitats and can occur together in high concentrations. **Contact:** Dirk Derksen, Alaska Science Center, 907-786-3531, dirk_derksen@usgs.gov

Wild bird migration in China and Highly Pathogenic Avian Influenza: USGS Patuxent Wildlife Research Center (PWRC) and Western Ecological Research Center (WERC) continued studies of wild bird migration in China, the epicenter of highly pathogenic avian influenza (H5N1). In September 2008, USGS worked with international partners (UNFAO, Chinese Academy of Sciences) to mark an additional 10 ruddy shelducks (65 waterfowl marked in total) from Qinghai Lake, China, location of the largest

H5N1 epizootic in wild birds. Disease surveillance and migration patterns of wild waterfowl from this region are being conducted to improve our understanding of the potential for wild bird movement of HPAI. During the period of September 2008 through March 2009, PWRC also led an international effort to spatially model poultry populations across China, to be used in future disease risk models of avian influenza spread. **Contacts:** Diann Prosser, Patuxent Wildlife Research Center; diann_prosser@usgs.gov; John Takekawa, Western Ecological Research Center john_takekawa@usgs.gov

Identifying At-Risk Areas for Spread of Avian Influenza into Egypt: USGS experts in satellite telemetry are working with the United Nations Food and Agriculture Organization, government agencies, and NGOs to help track movements of wild waterfowl in support of surveillance programs in countries with avian influenza outbreaks. In January 2009, USGS scientists began a collaborative effort at Lake Manzala near Port Said, Egypt, to better understand the movements of waterbirds within migratory flyways, interactions among wild and domestic birds, and findings from avian influenza surveillance. Egypt is located at the intersection of the Black Sea-Mediterranean Flyway and the East Africa-West Asia Flyway and due to spatial overlap in migration pathways is an important site for the potential transmission of avian influenza between waterfowl. Movements of satellite-tagged waterfowl can be viewed at the USGS Western Ecological Research Center web site: http://www.werc.usgs.gov/sattrack/egypt/index.html **Contact:** John Takekawa, Western Ecological Research Center, 707-562-2000, john_takekawa@usgs.gov

Chronic Wasting Disease Status Update: CWD was not detected in any new states in 2008. Currently, CWD has been detected in free-ranging populations in 11 states and 2 Canadian provinces (Colorado, Illinois, Kansas, Nebraska, New Mexico, New York, South Dakota, Utah, West Virginia, Wisconsin, Wyoming, Alberta and Saskatchewan) and in captive facilities in 9 states and 2 Canadian provinces (Colorado, Kansas, Minnesota, Montana, Nebraska, New York, Oklahoma, South Dakota, Wisconsin, Alberta and Saskatchewan). **Contact:** Bryan Richards, National Wildlife Health Center, 608-270-2485, brichards@usgs.gov

Flea Control and Vaccination: The Ecology of Plague and Controlling Plague Outbreaks (MT, UT, SD): Sylvatic plague is a serious threat to prairie dog colonies and the endangered black-footed ferrets (*Mustela nigripes*) that depend upon them. Plague outbreaks in prairie dogs occur frequently in western states such as Colorado, Montana and Utah, but have only recently spread into South Dakota. During the summer of 2008, sylvatic plague was confirmed in prairie dog colonies in the Conata Basin of South Dakota; some of the affected areas include colonies occupied by black-footed ferrets. USGS scientists at FORT and NWHC are using flea control and plague vaccination to investigate the dynamics of plague in the wild. Two studies were conducted to assess the possible effects of enzootic plague on populations of prairie dogs and black-footed ferrets. If enzootic plague is affecting populations of prairie dogs and ferrets, an ambitious effort to reduce the population of fleas and vaccinate animals with an experimental plague vaccine should increase their survival rates. Flea control resulted in an 82% improvement in survival for ferrets and 31-45% improvement in survival of 3 species of prairie dogs. Vaccine improved ferret survival 91% (vaccine was not used on prairie dogs). Results suggest that (1) enzootic plague is having chronic effects on prairie dogs and black-footed ferrets, (2) enzootic plague is very difficult to detect with standard sampling and diagnostic methods, (3) fleas are at least partially responsible for maintaining or transmitting plague at low disease levels, and (4) the experimental vaccine provided ferrets protection against plague. The recent invasion of plague in South Dakota poses potential disaster for prairie dogs (*Cynomys* spp.) and the endangered black-footed ferrets and for the ferret recovery program in general. USGS scientists are also using flea control and plague vaccination in the Conata Basin to determine whether (1) the invasion of plague in the Conata Basin was an anomaly, temporarily presenting conditions for only transitory occurrence of epizootics, or (2) plague advanced during an optimal year but will become established as an enzootic disease. The plague vaccine, being tested for animals at the

NWHC in Madison, Wisconsin, was also used by the U.S. Fish and Wildlife Service in the Conata Basin in 2008 to protect and increase survival of black-footed ferrets during the outbreak. **Contact:** Dean Biggins, Fort Collins Science Center, 970-226-9467, bigginsd@usgs.gov; Tonie Rocke, National Wildlife Health Center, 608-270-2451, tonie_rocke@usgs.gov

Food Choices and Location Influence California Sea Otter Exposure to Disease: Sea otters living along the central California coast risk higher exposure to disease-causing parasites as a consequence of the food they eat and where they feed, according to a new study co-led by scientists at the University of California-Davis and USGS, published in the Proceedings of the National Academy of Sciences (titled *Prey choice and habitat use drive sea otter pathogen exposure in a resource-limited coastal system. doi/10.1073/pnas.0806449106)*. Scientists have found that where food resources are limited, individual sea otters tend to become diet specialists, and the result is that individual otters inhabiting the same area can have very different diets from one another. It now appears that high levels of infection with *Toxoplasma gondii* or *Sarcocystis neurona,* parasites of cats and opossums, respectively, may be a consequence of this dietary diversification. Findings indicate that prey choice in sea otters has implications for their health, and depleted resources and high rates of infectious disease may be acting in concert to limit the recovery of this threatened species. **Contact:** Tim Tinker, Western Ecological Research Center, 831-459-2357, ttinker@usgs.gov

Bats in North America Harbor Coronaviruses (CO): FORT scientists are collaborating with researchers at the University of Colorado (CU) Health Sciences Center to study coronaviruses in bats. Recent evidence suggests that coronaviruses originated in bats, and likely spillover and mutation of a bat coronavirus caused the 2002-2003 Asian severe acute respiratory syndrome (SARS) epidemic in humans. The USGS-CU team have discovered the first coronaviruses in New World bats (found only in the Western Hemisphere) and recently discovered new coronaviruses from additional species of bats. Future work will focus on assessing the evolutionary relationships of bat coronaviruses as they relate to disease emergence, examine the role of virus receptors in viral pathogenesis, and attempt to isolate the first live bat coronavirus for use in biomedical studies. **Contacts:** Paul Cryan, 970-226-9389, cryanp@usgs.gov or Tom O'Shea, 970-226-9397, osheat@usgs.gov

Ecology of Virus Transmission in Commensal Bats (CO): FORT scientists, in collaboration with Colorado State University (CSU), the Centers for Disease Control and Prevention, and the National Science Foundation, are investigating the dynamics of rabies transmission in bat populations that roost and live within cities, using Fort Collins, Colo., and big brown bats (*Eptesicus fuscus*) as the case study. The research concentrates on understanding the population ecology of the host in relation to virus attributes. Field, laboratory, and modeling efforts have been completed for this study. Results are being prepared for publication and are expected to be of considerable interest to public health agencies and bat conservationists. **Contact:** Tom O'Shea, Fort Collins Science Center, 970-226-9397, osheat@usgs.gov

Social scientists at FORT are also collaborating with CSU to survey of Fort Collins residents' attitudes and knowledge regarding bats. This survey was conducted in conjunction with ecologists at FORT who were in the midst of an ecological study of big brown bats in Fort Collins The purpose of this study was to assess residents' attitudes about bats, knowledge of bat ecology and the relationship between bats and rabies, as well as the perceptions of risk associated with bats and disease. **Contact:** Natalie Sexton, 970-226-9313, sexton@usgs.gov

Effects of mixed infections in ticks on pathogen transmission dynamics: Scientists from the Patuxent Wildlife Research Center have published a paper reviewing literature and reanalyzed published data on mixed infections of pathogens in ticks from Europe and North America. Titled "Potential effects of mixed infections in ticks on transmission dynamics of pathogens: comparative analysis of published records" it was published in *Experimental and Applied Acarology* 46:29-41.2008. Some studies have found negative

interactions between pathogens within ticks, especially among rickettsia. However, most examples of nonrandom levels of coinfection of pathogens within ticks could be explained by associations of the pathogens with particular groups of wildlife hosts, which also serve as hosts for the ticks. **Contact:** Howard Ginsberg; 401-874-4537, hginsberg@usgs.gov

Model species for studying enhanced disease resistance: Patuxent Wildlife Research Center and collaborators in College Station, TX, carried out a set of innate immune assays to establish the relative disease resistance of brown-headed cowbirds versus a related, non-parasitic blackbird (Icteridae). Leukocytes isolated from the cowbirds were 25% more effective than those of the red-winged blackbirds, which supported their hypothesis that the cowbirds have significantly stronger immune responses. This is part of an ongoing research program to evaluate the potential of the parasitic cowbirds as model organisms useful for biomedical research on the design and function of exceptionally effective immune systems. **Contact:** Caldwell Hahn, Patuxent Wildlife Research Center, 301-497-5653, chahn@usgs.gov

Disease Investigations

Botulism E bird mortalities in the Great Lakes declined in 2008: Avian mortalities attributed to botulism type E in the Great Lakes between June - December 2008 were significantly less than last year's estimated total of 17,125 birds although final numbers are not yet available from all lakes. Current tallies are estimated to be 162 for Lake Ontario, 458 for Lake Erie, 234 for Lake Michigan despite similar beach survey efforts as the previous year. Although total mortalities were low in 2008, the distribution of affected birds expanded further south (Emmet County, MI) along the western shore of Lake Michigan than previously recorded. Common loons and various gull species remain the primary birds affected. Type E avian botulism has caused the deaths of thousands of fish eating birds per year since 2000. Carcasses have been received by NWHC for confirmation of botulism type E in 2008 from Lakes Michigan (MI, WI) and Erie (PA). **Contact:** Anne Ballmann, National Wildlife Health Center, 608-270-2445, aballmann@usgs.gov

Multiple Sandhill crane mortality events in north central Oklahoma (OK): Lesser sandhill cranes in north central Oklahoma were plagued by a variety of mortality events this winter. USFWS Biologists from Salt Plains National Wildlife Refuge responded to a die-off of over 100 cranes in early November. Carcasses examined at NWHC were found to have experienced extreme trauma and had multiple fractures and lacerations without any external evidence of injury. A storm event occurring the evening prior to the carcasses discovery was the likely cause of death due to severe storm winds. In late December and mid-January, two separate events occurred with cranes being found dead in peanut fields. The first event involved about 24 birds and the second was 160 birds. The cranes were consuming the peanuts and are suspected to have died from mycotoxin poisoning. Mycotoxins are produced from fungus that grows on the peanuts in appropriate environmental conditions. Waste peanuts are normally plowed under the soil, but wet conditions prevented farmers from tilling the fields. **Contact:** Krysten Schuler, National Wildlife Health Center, 608-270-2447

Unusual mortality event in California brown pelicans (CA): In mid-December, a higher than normal number of California brown pelicans were submitted to rehabilitation facilities. Sick and disorientated pelicans were found along the coast from San Francisco down to Los Angeles. The International Bird Rescue and Rehabilitation Center estimated that 300-400 pelicans, both adults and juveniles, were affected. Carcass testing by multiple state and federal labs revealed a variety of findings, including infarcts on the feet (suggestive of frostbite), anemia, and emaciation. Many sick pelicans responded to supportive care in rehabilitation. Field information from Oregon indicated that substantial numbers (~5,000) of brown pelicans were present on East Sand Island at the Columbia River in Oregon in December when typical migration is mid-November. Extremely cold weather during the week of

December 10 occurred around the same time that the pelicans started to move south. Corroborating pathology findings and field data indicate that severe winter weather and subsequent forced migration were responsible for some of the observed morbidity and mortality. California brown pelicans have recently been proposed for delisting so understanding impacts of mortality events is critical for continued overall population health. **Contact:** Krysten Schuler, National Wildlife Health Center, 608-270-2447

Infected faucet snails detected at Lake Winnibigoshish (MN)
For the second consecutive year, Lake Winnibigoshish experienced avian mortalities this fall due to intestinal trematodes infections with *Sphaeridiotrema globulus* and *Cyathocoytle bushinesis*. Mortalities were also detected at nearby Bowstring Lake (MN) for the first time. An estimated 857 birds, primarily lesser scaup and American coots, died. Snail surveys conducted this summer at Lake Winnibigoshish found the invasive host *Bithynia tentaculata* snail with parasite infection rates ranging from 0-93%. In some instances, a single snail was infected by more than 1 species of the metacercariae, the intermediate life stage of these trematode parasites. Trematode-related waterfowl mortalities in the Upper Mississippi River NWR (WI) also occurred this spring and fall as it has annually since 2002 and so far has resulted in the death of between 50,000-60,000 individuals since its discovery. Mortalities in 2008 were down by approximately 80% from 2007 mortality estimates, totaling between 2,800-3,500 birds for both spring and fall mortality this season. **Contact:** Anne Ballmann, National Wildlife Health Center, 608-270-2445, aballmann@usgs.gov

Leucistic Tiger salamanders in Yellowstone National Park (WY): Tiger salamanders (*Ambystoma tigrinum melanostictum*) were monitored and collected from Slough Creek area of Yellowstone National Park as part of a summer survey. Large numbers of apparently healthy tiger salamanders were found in pools, some of which had severely reduced amounts of black pigment (melanin) in the skin of their heads, bodies and limbs. This genetic condition is known as leucism or leucistic variation, where melanin in skin cells is severely reduced. During monitoring, a die-off of the aquatic larvae occurred. Healthy animals collected prior to the die-off, sick, and dead salamanders were submitted to NWHC for diagnostic examinations. A ranavirus was isolated from one of the sick salamanders and is the presumptive cause of the die-off in this unique population. Additional diagnostic tests are in progress. **Contact:** Krysten Schuler, National Wildlife Health Center, 608-270-2447

Amphibian Highlights

Amphibian Chytrid Fungus Research and Monitoring (MT, CO, WY): The amphibian chytrid fungus (*Batrachochytrium dendrobatidis*) is recognized worldwide as a significant threat to amphibian species and has been linked to amphibian population declines on nearly every continent from the United States to Australia and Europe to South America. While the exact etiology of chytridiomycosis is not known, this fungus causes a thickening of amphibian skin which compromises the exchange of oxygen and water in the animal and is generally fatal. In the Rocky Mountain Region, USGS scientists have looked at the distribution of this fungus along an 11 degree latitudinal transect from Montana through Colorado and found that the fungus was detected at 64% of sites, but there were more infected sites in the northern than in the southern portion of transect. We have also quantified the effect of chytridiomycosis on boreal toad populations in the Rocky Mountains over six years showing that survival is lower at sites where the disease is present, but that it is not lethal to all toads. Because this disease affects local amphibians, we routinely test for this disease during our research and monitoring efforts in Rocky Mountain National Park and other study areas. **Contact**: Erin Muths, Fort Collins Science Center, 970-226-9474, muthse@usgs.gov

Boreal Toad and Wood Frog Demographics (CO): Population dynamics and the impacts of disease are important when trying to elucidate the causes behind amphibian population declines. Declines of boreal

toads, documented in Rocky Mountain National Park, are coincident with the detection of the amphibian chytrid fungus (*Batrachochytrium dendrobatidis*). Long-term studies that track population parameters such as recruitment and survival assist in understanding the dynamics of particular populations. However, studies of habitat use by boreal toads (an endangered species in the State of Colorado) and wood frogs (a species recently delisted as threatened in the State of Colorado) in the southern Rocky Mountains are limited. Few quantitative data are available about these species' use of habitat, their habitat preferences, or limitations imposed by changes in the environment, both natural and anthropogenic. The ecological questions of movement and habitat use are of primary importance in developing management plans for amphibians and in implementing recovery plans for the boreal toad in Colorado. Rocky Mountain National Park provides an important outdoor laboratory where FORT ecologists are investigating such questions. The information these studies produce will support managers in developing recovery plans and detecting and managing disease. **Contact:** Erin Muths, Fort Collins Science Center, 970-226-9474, muthse@usgs.gov

Fisheries Highlights

Thiamine Deficiency Complex: Reproductive failure in certain populations of lake trout and salmon in the Great Lakes is linked to a deficiency in thiamine (vitamin B1). Excessive numbers of alewives, an exotic forage species, in the diets of trout and salmon are thought to be causally related to the thiamine deficiency. Alewife contain an enzyme, thiaminase, that destroys thiamine during digestion in the gut of the salmonines. The resulting vitamin deficiency leads to thiamine deficient eggs and fry that die before they begin to feed. Additionally, the adult salmonines have nutritional stress, which can lead to disease conditions. The Columbia Environmental Research Center is investigating sources of thiaminase in the aquatic environment, early life stage mortality of lake trout caused by this thiamine deficiency, and spatial and temporal differences in thiaminase in the Great Lakes food web. **Contact**: Donald Tillitt, Columbia Environmental Research Center, 573-876-1886, dtillitt@usgs.gov

Fish Parasites and Ecosystem Health: In three recent journal articles, USGS scientist Kevin Lafferty explored parasites in fishes in a review for the *Journal of Fish Biology,* (title: Ecosystem consequences of fish parasites, 73:2083–2093. doi:10.1111/j.1095-8649.2008.02059.). he studied how parasites in fishes may be useful indicators of fish health and aquatic health because they are sensitive to environmental degradation and overfishing. In *EcoHealth,* he found that parasite communities are more diverse in coral reef fishes at pristine atolls, suggesting that healthy reefs support diverse parasite communities (title: Reef fishes have higher parasite richness at unfished Palmyra Atoll compared to fished Kiritimati Island. EcoHealth, DOI: 10.1007/s10393-008-0196-7). In the *Proceedings of the Royal Society B,* he and colleagues described how a trematode parasite uses sophisticated neuromodulators like serotonin to alter the behavior of California killifish to increase the likelihood that infected fish will be eaten by birds, where the parasite completes its life cycle (title: Parasite manipulation of brain monoamines in California killifish (*Fundulus parvipinnis*) by the trematode *Euhaplorchis californiensis*, doi:10.1098/rspb.2008.1597). **Contact:** Kevin Lafferty, Western Ecological Research Center, 805-893-8778, klafferty@usgs.gov

Emergence of infectious hematopoietic necrosis virus in steelhead: A recent emergence of a deadly fish virus, the M-D strain of Infectious Hematopoietic Necrosis Virus (IHNV), is threatening steelhead and rainbow trout populations in river basins on the Olympic Peninsula and Puget Sound in Washington State. This virus differs from the strains of IHNV that are common to sockeye stocks 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 constitute dangerous risks to both hatchery and wild stocks of steelhead that support economically important fisheries and are important elements in recovery

planning for ESA listed stocks. **Contact:** Jim Winton, Western Fisheries Research Center, 206-526-6587; jim_winton@usgs.gov

Research on Viral Hemorrhagic Septicemia Virus: Viral hemorrhagic septicemia virus (VHSV) is considered by many nations and international organizations to be one of the most important viral pathogens of finfish. By 2008, VHSV had been isolated from more than 25 species of fish in Lakes Michigan, Huron, St. Clair, Erie, and 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.

The Western Fisheries Research Center (WFRC) in Seattle, WA has an established history of research on viral hemorrhagic septicemia among other pathogens of finfish. The WFRC's research work on VHSV includes: providing immediate technical assistance and information to federal, state and tribal agencies as well as to the private sector; providing reference laboratory services for VHSV (sending cell lines, PCR primers, control materials) to various laboratories involved in increased surveillance activities; attending workshops to give background information and to lead research planning efforts; conducting sequence analysis of VHSV isolates to gain rapid epidemiological insights, testing cell lines and PCR assays to ensure diagnostic procedures were optimal for the new strain of virus; providing regular advice and consultation to staff at USDA-APHIS, USFWS and various state agencies; and performing several laboratory experiments at the request of federal and state fisheries managers.
Contact: Jim Winton, Western Fisheries Research Center, Seattle, WA, 206-526-6587; jim_winton@usgs.gov

Warming Climate Can Affect Fish Health: *Ichthyophonus* is a fungal-like microorganism that has caused disease in several species of marine fish in the Pacific and Atlantic Oceans and in adult salmon returning to the Yukon River in Alaska where, in recent decades, summer temperatures have begun to reach 20°C (68°F). Rainbow trout (*Oncorhynchus mykiss*) were infected with *Ichthyophonus sp*. and held at 10°C, 15°C and 20°C for 28 days to monitor mortality and disease progression. Infected fish demonstrated more rapid onset of disease, higher parasite load, more severe host tissue reaction and reduced mean-day-to-death at 20°C. In a second experiment, *Ichthyophonus*-infected fish were reared at 15°C for 16 weeks then subjected to forced swimming at 10°C, 15°C and 20°C. Stamina improved significantly with increased temperature in uninfected fish; however, this was not observed for infected fish. The difference in performance between infected and uninfected fish became significant at 15°C (P = 0.02) and highly significant at 20°C (P = 0.005). These results demonstrate the effects of higher temperature on the progression and severity of ichthyophoniasis as well as on swimming stamina, a critical fitness trait of salmonids, and have implications for changes in the ecology of fish diseases in the face of global warming. **Contact:** Jim Winton, Western Fisheries Research Center, Seattle, WA, 206-526-6587; jim_winton@usgs.gov

Control of saprolegniosis on cool and coldwater fish: Laboratory studies are on-going to confirm the minimum effective dose of 35% PEROX-AID™ For Fish (hydrogen peroxide) required to control mortality caused by either *Saprolegnia parasitica* or *S. diclina* on walleye *Sander vitreum* or rainbow trout *Oncorhynchus mykiss*. Completion of effectiveness trials will likely allow the expansion of the 35% PEROX-AID™ For Fish drug label to control saprolegniosis in all freshwater-reared finfish. **Contact:** Randy Hines, Upper Midwest Science Center, 608-781-6398, rkhines@usgs.gov

Control of external parasites on freshwater-reared finfish: Recently completed the field component of a dose-titration study to evaluate the ability of 35% PEROX-AID™ For Fish to control *Gyrodactylus* spp. on coaster brook trout *Salvelinus fontinalis*. Initial parasite counts indicate that the hydrogen peroxide

treatments were effective in reducing parasite numbers on adult fish. **Contact:** Randy Hines, Upper Midwest Science Center, 608-781-6398, rkhines@usgs.gov

Control of motile aeromonad infections (MAI) in cool and warmwater fish: A new research effort has been initiated through funding provided by the North Central Regional Aquaculture Center (NCRAC) to identify the aeromonas species causing MAI in cool and warmwater fish. Following confirmation of the etiological agent, field effectiveness trials will be conducted to evaluate the efficacy of TM-200® For Fish (oxytetracycline dihydrate) or Aquaflor® (florfenicol) to control mortality associated with MAI. **Contact:** Randy Hines, Upper Midwest Science Center, 608-781-6398, rkhines@usgs.gov

Disinfection of cool and warmwater fish eggs to eliminate Viral Hemorrhagic Septicemia: A new research effort has been initiated through funding provided by NCRAC to evaluate the ability of iodophor-disinfection to eliminate the virus responsible for VHS from eggs of cool and warmwater fish. **Contact:** Randy Hines, Upper Midwest Science Center, 608-781-6398, rkhines@usgs.gov

Modification of the analytical method to quantify para-toluene sulfonamide (p-TSA; the marker residue of the therapeutic drug, Halamid®, chloramine-T) in fish fillet tissue: At the request of the U.S. Food and Drug Administration Center for Veterinary Medicine (CVM), UMESC is modifying the current method for p-TSA in an effort to reduce the method quantitation limit (MQL). The current method for p-TSA has a MQL of ~30 ppb. CVM is considering setting a p-TSA tolerance of 20 ppb in fish fillet meaning the p-TSA concentration in fish fillet tissue must be ≤20 ppb before the tissue is considered safe to consume. UMESC scientists are working to achieve a MQL of ≤20 ppb. **Contact:** Randy Hines, Upper Midwest Science Center, 608-781-6398, rkhines@usgs.gov

Evaluate time to first feeding of fish following sedation by benzocaine or eugenol: As part of efforts to evaluate potential sedatives that could be used in fish with immediate release after sedation, UMESC is collaborating with the University of Wisconsin-La Crosse and Viterbo University to evaluate the time required between fish capture and sedation to the resumption of normal feeding activities. The data generated will be used by CVM to determine whether fish could be immediately released post-sedation. **Contact:** Randy Hines, Upper Midwest Science Center, 608-781-6398, rkhines@usgs.gov

Infection levels of eastern oysters: Infection levels of eastern oysters by the unicellular pathogen *Perkinsus marinus* have been associated with anthropogenic influences in laboratory studies. However, these relationships have been difficult to investigate in the field because anthropogenic inputs are often associated with natural influences such as freshwater inflow, which can also affect infection levels. Scientists at the Upper Midwest Environmental Sciences Center addressed *P. marinus*-land use associations using field-collected data from Murrells Inlet, South Carolina, a developed, coastal estuary with relatively minor freshwater inputs. The study was able to detect effects inferred from the exploratory dataset, and these results suggest that effects of land-use gradients were largely insubstantial or were ephemeral with duration less than 3 months. Findings were published in the journal *Ecotoxicology* in 2009 by Brian Gray coauthors. **Contact:** Brian Gray, Upper Midwest Environmental Sciences Center, 608-781-6234, brgray@usgs.gov

Contaminants Highlights

Mercury Correlations Among Six Tissue Types in Waterbirds in San Francisco Bay: To understand how mercury distributes through waterbird tissues, USGS and U.S. Fish and Wildlife Service scientists investigated the relationships between mercury concentrations in six different tissues of four waterbird species, and provide equations to predict concentrations in one tissue from those in another. Overall, their work shows that for migratory species blood is an excellent, non-lethal predictor of mercury

concentrations in internal tissues but that feathers are relatively poor indicators of mercury concentrations in internal tissues. Published in *Environmental Toxicology and Chemistry (2008) 27:2136–2153* (Mercury correlations among six tissues for four waterbird species breeding in San Francisco Bay, California, USA.) http://www.werc.usgs.gov/pubbriefs/eagles-smithpbfeb2009.html. **Contact:** Collin Eagles-Smith, Western Ecological Research Center, 530-754-8130, ceagles-smith@usgs.gov

Mercury Threat to Waterbirds in San Francisco Bay: An article by USGS scientists on mercury bioaccumulation and effects on birds in San Francisco Bay appears in The Pulse of the Estuary, the annual report of the Regional Monitoring Program for Water Quality in San Francisco Bay. Recent research has shown that waterbirds in San Francisco Bay appear to be at elevated risk of reproductive impairment from mercury. Results will be essential for guiding site selection for waterbird habitat enhancement relative to mercury risk, as well as for evaluating the effects of restoration activities on methylmercury production and subsequent bioaccumulation in waterbirds. See pages 56-64: http://sfei.org/rmp/pulse/index.html **Contacts:** Collin Eagles-Smith, Western Ecological Research Center, 530-754-8130, ceagles-smith@usgs.gov; Josh Ackerman, 530-752-0485, jackerman@usgs.gov

Sources of Organochlorine Contaminants and Mercury in Seabirds from the Aleutian Archipelago of Alaska: USGS Western Ecological Research Center and the Oregon Cooperative Fish and Wildlife Research Unit collected and analyzed concentrations of organochlorine compounds and mercury in liver samples from representative seabirds inhabiting the western and central archipelago to help describe point and distant sources of contaminants. Their results indicate seabirds inhabiting the Aleutians are still exposed to environmentally persistent chlorinated compounds derived from local and distant sources. Contaminant concentrations in seabirds may pose risks to apex predators such as bald eagles that consume seabirds. Published online in *Science of the Total Environment,* titled "Sources of organochlorine contaminants and mercury in seabirds from the Aleutian archipelago of Alaska: inferences from spatial and trophic variation" *DOI 10.1016/j.scitotenv.2008.06.030.* http://www.werc.usgs.gov/pubbriefs/riccapbsep2008.html **Contact:** Mark Ricca, Western Ecological Science Center, 530-752-2505, mark_ricca@usgs.gov

Methylmercury Detoxification in Waterbird Livers: Methylmercury contamination of wetlands and waterbodies worldwide is a cause for concern because it is a highly potent neurotoxin that bioaccumulates to potentially toxic levels in wildlife such as waterbirds. USGS and U.S Fish and Wildlife Service investigated the detoxification of methylmercury in livers of waterbirds (American avocet, black-necked stilt, Caspian tern, and Forster's tern) that nest in the mercury contaminated San Francisco Bay. Their study showed that avian species may be able to convert methlymercury in their livers to less-toxic inorganic mercury if exposure exceeds a threshold value. Selenium may act as a binding site for demethylated mercury and may reduce the potential for secondary toxicity. Taxonomic differences in demethylation ability may be an important factor in evaluating species-specific risk to methylmercury exposure. Published in *Environmental Toxicology and Chemistry,* titled "Mercury demethylation in waterbird livers: dose-response thresholds and differences among species." *28:568–577.* http://www.werc.usgs.gov/pubbriefs/eagles-smithpbmar2009.html **Contact:** Collin Eagles-Smith, 530-754-8130, ceagles-smith@usgs.gov