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

September 14, 2011

Wildlife Highlights

White-nose syndrome Update for Winter 2010/2011

White-nose syndrome (WNS) in cave-hibernating bats was detected in five new U.S. states (Maine, North Carolina, Ohio, Indiana, Kentucky) and two new Canadian provinces (New Brunswick, Nova Scotia) during the Winter 2010/2011 season. This brings the total number of confirmed WNS-positive states and provinces to 16 and 4, respectively, since the disease was first detected in New York in February 2006. The genetic signature of *Geomyces destructans*, the causative agent of WNS, was also detected on bats in 3 additional states including Delaware, Missouri, and Oklahoma in the previous winter season, although the disease has yet to be detected in these states. No significant westward expansion of WNS was detected this winter beyond Trigg County, Kentucky. The disease continued to spread into new counties within WNS-confirmed states and provinces (Maryland, Virginia, West Virginia, Pennsylvania, Connecticut, Tennessee, Quebec, and Ontario). With the exception of one New Brunswick hibernaculum, where an estimated 4,980 bats died, all other new locations reported minimal to no bat mortality at the time of their surveys. Several surveys were conducted outside the entrances of the hibernacula only and may not reflect the true mortality counts. Also, because winter bat surveys are typically conducted once during the season to minimize disturbance to hibernating bats, total mortality estimates are not available until the following season when returning population counts are assessed. Thus far, WNS has not been confirmed in any new bat species this season. Six species, including Little Brown, Northern Long-eared, Tri-colored, Indiana, Eastern Small-footed, and Big Brown bats, are known to be susceptible to WNS. Genetic evidence of *Geomyces destructans* has been identified on three additional species (Southeastern myotis, Cave myotis, and Gray bats). For the latest WNS updates, consult the USGS-NWHC Wildlife Health Bulletins.
http://www.nwhc.usgs.gov/publications/wildlife_health_bulletins/index.jsp.

Current bat submission guidelines to NWHC are available at:
http://www.nwhc.usgs.gov/disease_information/white-nose_syndrome/USGS_NWHC_Bat_WNS_submission_protocol.pdf

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White-nose syndrome research updates

The USGS National Wildlife Health Center (NWHC), along with many partners, continues to play a primary role in WNS research, including WNS transmission/pathogenesis/recovery studies, development of improved tools for molecular detection of *G. destructans*, and investigation into the microbial ecology of *G. destructans* in bat hibernacula.

1) Studies to determine the role of *G. destructans* as the cause of WNS and modes of fungal transmission have been completed, and a manuscript describing study results is in review. As a continuation of this work, NWHC scientists are collaborating with others to complete laboratory experiments to determine how/why fungal skin infection kills bats. The leading hypothesis is that fungal damage to bat wing skin catastrophically disrupts physiological homeostasis during hibernation. Additionally, NWHC scientists recently published findings demonstrating that bats with WNS can readily recover from the disease with provision of supportive care (food, water, and warm temperature). These results confirm that hibernation

predisposes bats to infection by *G. destructans* and further indicate that management actions to reduce infection severity may allow bats to survive and naturally recover from WNS following spring emergence.

2) Scientists at the NWHC recently developed and published a rapid PCR test for detecting DNA from *G. destructans* on bat wing skin and have shared this new test with multiple laboratories as a much needed diagnostic tool. Additionally, work at the NWHC is ongoing to standardize non-invasive techniques (i.e. swabbing) to collect fungal samples from bat skin, and efforts are underway to develop/qualify a new quantitative PCR method for detecting *G. destructans* with enhanced specificity necessary to analyze environmental samples.

3) An environmental survey of caves was conducted by USGS scientists in collaboration with several states to characterize the distribution of *G. destructans* in cave soil. This study demonstrated that DNA from *G. destructans* was present in soil collected only from hibernation sites within the WNS-infested region of the United States. Follow-up analyses further confirmed that the viable fungus was also present in these samples indicating that the environment likely plays a role in the WNS disease/transmission cycle. Bat ecologists from the USGS Fort Collins Science Center have developed and deployed infrared video surveillance systems for use inside bat hibernation sites to investigate potential behavioral links between skin infection by *G. destructans* and WNS mortality. Through a collaborative study with Northern Arizona University, genomic analyses of multiple isolates of *G. destructans* from both Europe and North America suggest that *G. destructans* is an exotic species in North America of European origin. Additionally, a detailed analysis of the role of temperature on the proliferation and persistence of *G. destructans* is underway.

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Lake Michigan Volunteer AMBLE (Avian Monitoring for Botulism Lakeshore Events) program
Avian botulism type E outbreaks have occurred on the Great Lakes annually since the late 1990s. With support from the Great Lakes Restoration Initiative, scientists from the U.S. Geological Survey, the National Park Service, and the private sector are working together to explore the ecological pathways through which the toxin produced by a natural bacteria (*Clostridium botulinum)* is transported to birds.

The help of volunteer beach monitors to record timing, numbers, and species of bird carcasses deposited on beaches will provide valuable information needed to better understand this important wildlife disease. This spring, 52 volunteers in Door County, Wisconsin, were trained by NWHC staff to become beach monitors in the Lake Michigan Volunteer AMBLE (Avian Monitoring for Botulism Lakeshore Events) program. These volunteers walk segments of Lake Michigan shoreline to monitor for dead birds and record beach conditions every 7-10 days from June through November. AMBLE volunteers are currently covering 29 segments of beach totaling 14.8 miles. Local partners in the creation of the AMBLE program include The Ridges Sanctuary, Wisconsin Department of Natural Resources, Northeastern Wisconsin Audubon Society, Crossroads at Big Creek, and The Nature Conservancy.

During the month of June, over 3,300 healthy and 16 sick or dead birds were reported by AMBLE beach monitors. Eleven of the 16 sick or dead birds were gulls. An alewife die-off in Lake Michigan was obvious along the shores of Door County this summer. Fresh avian specimens found by volunteers are being temporarily stored in state park freezers and will be sent to NWHC for botulism type E testing. More information about AMBLE can be found at http://www.nwhc.usgs.gov/mortality_events/amble/ **Contact:** Jennifer Chipault, National Wildlife Health Center, 608-270-2473, AMBLE@usgs.gov

Oral baits and biomarkers for plague vaccine delivery to prairie dogs
Laboratory studies have 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*. Peanut butter-flavored baits were shown to be preferred by prairie dogs in laboratory studies, and preliminary field studies using baits containing a biomarker have shown rates of uptake by wild prairie dogs > 90% within 3-4 days of application. The vaccine remains viable within the baits for up to 7 days at 28°C. Efforts are underway to license the vaccine-laden bait for use in field trials to confirm the safety of the vaccine in non-target animals. Under the direction of the Executive Committee of the Black-footed Ferret Recovery Implementation Team, a work group was established in December 2010 to complete development and delivery of the oral plague vaccine (OPV) as a management tool to combat plague in prairie dogs and promote the recovery of the black-footed ferret. As part of the strong interagency foundation of the Work Group, the Western Association of Fish and Wildlife Agencies will play a vital role in overseeing the OPV project. **Contact**: Tonie Rocke, National Wildlife Health Center, 608-270-2451, trocke@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 has finished after five years 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. During the 2010 sampling year (April 1, 2010 – March 31, 2011), cooperating agencies collected and analyzed over 15,500 wild bird samples and the highly pathogenic avian influenza H5N1 virus was **not** detected. Of these, 488 tested positive for avian influenza based on molecular screening; 34 were H5 positive, and 2 were positive for low pathogenic H5N1. Over the 5 years of surveillance, a total of 111,175 birds were sampled as part of this program. **Contact:** Scott Wright, National Wildlife Health Center, 608-270-2460, swright@usgs.gov

Wild manatee health assessments conducted in Crystal River, FL
SESC scientists, joined by Deputy Assistant Secretary for Water and Science for the Department of the Interior, Deanna Archuleta, conducted Manatee captures and assessments on 13 wild manatees in Crystal River, Florida. The research team also included personnel from the USFWS Crystal River National Wildlife Refuge, the Florida Fish and Wildlife Conservation Commission, veterinarians, researchers and students from the University of Florida, and invited international researchers from Australia, Brazil, Canada, Colombia, and Venezuela. The manatees were captured during the two day event using nets deployed from boats and each manatee was monitored while out-of-water during their extensive biomedical health assessments. All manatees appeared healthy during this late winter season examination. Samples and biological data were collected for further detailed analyses. **Contact:** Dr. Robert Bonde, Southeast Ecological Science Center, rbonde@usgs.gov, 352-264-3555.

Disease Investigations

New and Ongoing Wildlife Mortality Events Nationwide
USGS and a network of partners across the country document wildlife mortality events in order to provide timely and accurate information on locations, species and causes of death. For current wildlife mortality events Nationwide please see the link below or visit the NWHC website at: http://www.nwhc.usgs.gov/ and go to the spotlight: View Recent Mortality Events. http://www.nwhc.usgs.gov/mortality_events/ongoing.jsp

The NWHC Mortality Events Map shows recent mortality events that have been reported to the NWHC. Each event is shown on the map and listed on the left with newest events on top. To view the list of events in a tabular format please visit the New and Ongoing Wildlife Mortality Events page.
http://www.nwhc.usgs.gov/map/mortality_events.jsp

Trematodiasis in Bowstring Lake (Minnesota)
For the third consecutive year, Bowstring Lake experienced avian mortalities in October and November due to intestinal trematode infections with *Sphaeridiotrema globulus* and *Cyathocoytle bushinesis*. Avian mortality due to intestinal trematodes was first detected at Bowstring Lake in 2008 and has been seen every year since. In this 2010 mortality event, an estimated 1,200 birds died; primarily lesser scaup and American coots. Avian mortality due to intestinal trematodes has been observed at nearby Lake Winnibigoshish since 2005. Snail surveys conducted in the summer of 2008 at Lake Winnibigoshish found the invasive host snail, *Bithynia tentaculata.* Parasite infection rate for snails was between 0-93% with the highest prevalence occurring near shore. All 3 trematodes, *S. globulus, C. bushinesis*, and *Legyonimus polyoon* were detected and in some instances, a single snail was infected by more than 1 species of metacercariae, the intermediate life stage of the parasites. **Contact:** LeAnn White, National Wildlife Health Center, 608-270-2491, clwhite@usgs.gov

Trauma and undetermined cause of death in various avian species (Alabama, Arkansas, California, Kentucky, Louisiana, North Carolina, Oklahoma, Texas)
New Year's Eve of 2010 Arkansas Game and Fish Commission received reports from residents in White County, Arkansas, of thousands of red-winged blackbirds, common grackles, and European starlings appearing to fall from the sky. Specimens were sent to US Geological Survey's National Wildlife Health Center (NWHC), Arkansas Livestock and Poultry Commission, and Southeastern Cooperative Wildlife Disease Study (SCWDS). The cause of death was determined by all laboratories to be impact trauma. A resident in the area reported seeing birds flying into houses and mailboxes after hearing several loud noises. This mortality event received considerable press coverage and was followed by several other blackbird mortality reports that were also determined to be caused by trauma but were considered to be unrelated. For example, several days after the mortality event in Arkansas, approximately 500 dead red-winged blackbirds, brown-headed cowbirds, common grackles, and European starlings were found near a power line in Pointe Coupee Parish, Louisiana by the Louisiana Department of Wildlife and Fisheries. Birds from this event were examined by NWHC and SCWDS and found to have hemorrhaging and fractures consistent with colliding with a stationary object such as a power line. In Alabama and California, 100 to 200 common grackles and European starlings died from impact trauma along interstates and highways in mid-January.

In early January 2011 approximately 1,000 dead birds were also found by US Fish and Wildlife Service (USFWS) biologists in a salt marsh complex in Aransas, Texas. The species involved in this event included American white pelicans, black-bellied plovers, northern pintails, roseate spoonbills, Forster's terns, and sandhill cranes. USFWS reported severe weather including hail the day before the birds were found. Specimens examined by NWHC were found to have injuries, including severe blunt trauma to the head, consistent with those that could be caused by hail.

Other mortality events involving red-winged blackbirds which occurred in January were investigated in Alabama, Oklahoma, and at Pocosin Lakes National Wildlife Refuge (North Carolina). The cause of death for these events could not be determined. No toxins or significant underlying infectious diseases were detected. In some cases, it was known that flocks consisting of several hundred thousand birds were in the area. Overall, the number of mortality events involving "blackbirds" reported to NWHC in the first quarter of 2011 was quadruple the average number of reports from the same period during the previous five years. Publicity of the Arkansas event was frequently cited as a reason for diagnostic evaluation requests. **Contact:** LeAnn White, National Wildlife Health Center, 608-270-2491, clwhite@usgs.gov

Avian cholera at Tule Lake NWR (California)
Avian cholera mortality occurred once again at Tule Lake at the beginning of 2011. Total mortality was estimated to involve 5538 birds of numerous waterfowl species including geese, swans, and ducks. Avian cholera mortality events at this location have occurred almost annually since 1969 with the largest event estimated to have killed 10,000 birds in 2008. Avian cholera is caused by the bacterium, *Pasteurella multocida*, which is shed at high levels in the feces and nasal discharge of infected individuals. Both inapparent carriers and an environment contaminated by animals shedding the bacteria can serve as reservoirs of infectious material to naïve susceptible animals in the area. Careful handling and prompt disposal of carcasses, preferably by incineration, reduces the bacterial load in the environment but will not completely eliminate disease recurrence due to inapparent carriers. **Contact:** LeAnn White, National Wildlife Health Center, 608-270-2491, clwhite@usgs.gov

Suspected mycotoxicosis in Canada geese (Delaware)
Sick and dying Canada geese at a private refuge that included both resident and migratory birds were first reported in early January 2011. The area consisted of a 5 acre partially-aerated pond and surrounding fields with standing corn where geese had been observed feeding. Supplemental whole corn was also provided mainly for mallards at the site and was discontinued shortly after the onset of the die-off. Only Canada geese appeared to be involved. Mortality began slowly and quickly escalated over the course of a week. Mortality continued for approximately four weeks and resulted in 1,247 dead geese. Clinical signs were vague consisting mostly of depression and lack of flight response; many were simply found dead. Other birds were seemingly unaffected. Examination of carcasses from early in the event did not reveal any significant lesions while those collected during peak mortality had evidence of kidney and liver damage. Birds collected late in the event also had evidence of mild aspergillosis. Grain samples collected from the geese as well as from standing corn tested strongly positive for fumonisin B1 toxin by two independent labs. High levels of this toxin are known to cause liver changes in domestic poultry but its effects on waterfowl have not been previously studied. **Contact:** Anne Ballmann, National Wildlife Health Center, 608-270-2445, aballmann@usgs.gov

Newcastle disease virus detected in double-crested cormorants (Florida)
Seven juvenile double-crested cormorants were admitted to quarantine at a rehabilitation facility in Pinellas County, Florida, beginning in late December 2010 with clinical signs of head weaving, weakness and torticollis. Several birds died within 24 hours of admission and were submitted for diagnostic evaluation to the USGS National Wildlife Health Center and Florida Fish and Wildlife Conservation Commission Wildlife Health Program. Newcastle disease virus (NDV) was isolated from samples from four individuals submitted to the USDA National Veterinary Diagnostic Services Laboratory (Ames, IA). Salmonellosis was detected in a fifth individual which had histologic evidence of encephalitis and conjunctivitis but from which NDV was not isolated. This is the first reported detection of Newcastle disease virus in wild birds from Florida and only the second report of the disease in the state. The detection of NDV during winter months is unusual in cormorant populations. Nestling and juvenile double-crested cormorants often experience high fatality rates while older birds do not. Those individuals that survive infection by Newcastle disease virus are thought to mount an immune response that neutralizes the virus and inhibits viral shedding and isolation but permanent neurologic damage remains. The source and extent of the infection in free-ranging Florida cormorant populations was not known. No other birds at the facility appeared affected and other rehabilitation facilities

were alerted by state officials to monitor for signs of the disease, although none was detected. **Contact:** Anne Ballmann, National Wildlife Health Center, 608-270-2445, aballmann@usgs.gov

Fungal pneumonia in mallards (South Dakota)
Beginning in late January 2011 a large-scale mortality event involving mallards was reported by USFWS biologists in Sully County, South Dakota. The final mortality estimate for this event was about 8,000 mallards. Most of the birds were found dead and were in fair to excellent body condition. Some sick birds appeared weak and lethargic and were in emaciated to poor body condition. Biologists were able to collect fresh dead carcasses and also euthanize several sick birds for submission to the USGS National Wildlife Health Center. The primary cause of death in the mortality event was determined to be fungal pneumonia, but interestingly the two groups of birds (fresh dead versus sick) seemed to be infected by two different types of fungi. *Aspergillosis fumigatus* (causative agent of aspergillosis in birds) was cultured from the lungs and airsacs of the sick birds that were euthanized whereas *Rhizopus* sp. was identified in the lungs and airsacs of the birds that were found dead. Both types of fungi have been associated with moist conditions on spoiled grain which was a likely source for exposure by the mallards in this event. **Contact:** LeAnn White, National Wildlife Health Center, 608-270-2491, clwhite@usgs.gov

Effects of chronic wasting disease on population dynamics of elk at Wind Cave National Park
Chronic wasting disease is typically less prevalent in elk than deer, a disparity that has resulted in a concomitant focus on population consequences for deer. Prior to our ongoing studies of elk at Wind Cave National Park, direct estimates of mortality attributable to CWD infection were not available for elk. Despite recent origins of CWD in South Dakota (first known case in 2000), cause-specific mortality of adult elk at Wind Cave National Park reached approx. 3.5% during 2005-2009. Collective effects of CWD, an expanding cougar population, and reduced recruitment reduced population growth from approx. 12% annually during the 1990s to approximately 0 during 2005-2009 . Such effects have profound implications for management of overabundant elk, one of the most contentious topics presently facing the National Park Service. For additional information, see Sargeant et al. (2011. *Implications of Chronic Wasting Disease, Cougar Predation, and Reduced Recruitment for Elk Management*. Journal of Wildlife Management 75:171-177). **Contact:** Glen Sargeant, Northern Prairie Wildlife Research Center, 701-253-5528, glen_sargeant@usgs.gov.

Canine parvovirus in wolves
USGS scientists from Northern Prairie Wildlife Research Center collaborating with the Veterinary Diagnostic Lab of the University of Minnesota have been studying canine parvovirus (CPV) in Minnesota wolves since the very inception of the disease in 1973. Recent findings based on seroprevalence showed that CPV reduced pup survival from 1987 to 1993. After that, the population apparently gained resistance, and seroprevalence approached 100%, but little effect on pup survival was found. Current research uses PCR to examine wolf feces for CPV and seeks to determine whether CPV is density dependent. **Contact:** L. David Mech, USGS, The Raptor Center, University of Minnesota, St. Paul, MN, david_mech@usgs.gov, 651-649-5231

Fisheries Highlights

Thiamine deficiency in Great Lakes lake trout
Lake trout *Salvelinus namaycush* in the Great Lakes suffer from thiamine deficiency as a result of adult lake trout consuming prey containing thiaminase, a thiamine-degrading enzyme. Sufficiently low egg thiamine concentrations result in direct mortality of or sublethal effects on newly hatched lake trout, and this may be a significant impediment to the restoration of lake trout populations in the Great Lakes. To determine the prevalence and severity of low egg thiamine in lake trout eggs, thiamine concentrations were monitored in lake trout eggs from 15 sites in lakes Huron and Michigan from 2001 to 2009. Lake trout egg thiamine concentrations at most sites in both lakes were initially low and have increased over time at 11 of 15 sites, and the proportion of females with egg thiamine concentrations lower than the recommended management objective of 4 nmol/g decreased over time at eight sites. Egg thiamine concentrations at five of six sites in Lake Huron and Lake Michigan were significantly inversely related to estimates of alewife *Alosa*

pseudoharengus abundance, and successful natural reproduction of lake trout has been observed in Lake Huron since the recent alewife population collapse. These results suggest that low egg thiamine in Great Lakes lake trout is associated with increased alewife abundance and that low alewife abundance may currently be a prerequisite for successful reproduction by lake trout in the Great Lakes. Results of this work are currently in press (Riley, S. C., J. Rinchard, D. C. Honeyfield, A. N. Evans, and L. Begnoche. *In press*. Increasing thiamine concentrations in lake trout eggs from lakes Huron and Michigan coincide with low alewife abundance. North American Journal of Fisheries Management). **Contacts:** Stephen Riley, USGS Great Lakes Science Center (sriley@usgs.gov) or Dale Honeyfield, Northern Appalachian Research Laboratory (honeyfie@usgs.gov).

Epidemiology and control of emergent diseases associated with interjurisdictional fish restoration programs in New England

Specific concerns regarding major communicable diseases of salmonid populations of Atlantic salmon, as well as trout, which are target species within restoration programs in New England and the Great Lakes Basin are being investigated by bacteriologists and fishery biologists at the Leetown Science Center. Epidemiological studies focus on the nature of protection afforded by furunculosis vaccination among fish that are already infected with *Aeromonas salmonicida.* The necessity to use selected antibiotics treatments administered in concert with vaccination are being investigated as well as the immunosuppressive contraindications resulting from these antibiotics. In 2011, Atlantic salmon for these studies were approved by the Atlantic Salmon Commission and received from the USFWS White River National Fish Hatchery in November 2010. Unfortunately, the salmon were <3 inches and not of an appropriate size for the challenge and blood chemistry work that required a larger fish. The fish were placed on a growth diet and fed at 3% body weight. These fish will be used in an experiment to test the hypothesis that fish can be treated with oxytetracycline after challenge with *Aeromonas salmonicida* but prior to the onset of any furunculosis mortality to determine the reproducibility of treating Atlantic salmon for the control of pathogen. **Contact**: Dr. Rocco Cipriano, rcipriano@usgs.gov.

Putative bacterial etiology of lesions and fish kills in Virginia Rivers

Studies were conducted to determine the overall prevalence of *Aeromonas salmonicida* affecting fishes in both the South Fork Shenandoah River and James River watersheds in the Commonwealth of Virginia. Smallmouth bass were sampled at each site as the primary or target species with the assistance of fishery crews from the Virginia Department of Game and Inland Fisheries. A second species was also sampled at each site which consisted of either rock bass or redbreast sunfish depending upon availability. Samples of smallmouth bass and rockbass were also elctroshocked in the Maury River at Buena Vista. Fish from the Maury River have not been affected by the chronic skin lesions occurring in the Shenandoah and the James Rivers and, therefore, Maury River fish were sampled as negative controls. By comparison, there was a 17.4% prevalence of lesions in 2011 while in 2010 approximately 58.0% of smallmouth bass were infected with *A. salmonicida* at these sites. Likewise, 2011 saw a reduction in the prevalence of lesions in rockbass to 20% from that of 55% in 2010. Reductions in lesion development and infection caused by *A. salmonicida* were supported by a greatly reduced number of 'sick fish' reports received by the Virginia Department of Game and Inland Fisheries from the general public during the spring of 2011. **Contact**: Dr. Rocco Cipriano, rcipriano@usgs.gov.

Effects of standard 3-pass depletion electrofishing on fish health

This study examined the effects of electrofishing on native, non-game fishes and in particular, those non-target species subjected to multiple electrical shocks routinely used in depletion sampling programs. Fish were exposed to either one, two or three shocks at 100V PDC 60 Hz spaced 1-hr apart or held as an untreated control. In total we included 675 fish of seven species in the experiment, examined radiographs of 355 fish for spinal injuries and performed necropsies on 303 fish for hemorrhagic trauma in soft tissue. Using linear regression we demonstrated statistically significant relationships ($p < 0.05$) between increasing electrical shock and the frequency and severity of hemorrhagic and spinal trauma in each of the non-target or by-catch

species. Most of injuries in non-target species (Potomac sculpin, channel catfish, fathead minnow, green sunfish and largemouth bass were classified as either minor or moderate. While rainbow trout and brook trout generally sustained the highest incidence and severity of injuries, those injuries were generally independent of the number of electrical shocks. The exception to this was the frequency of hemorrhagic trauma in rainbow trout which demonstrated a positive linear relationship ($p < 0.05$) with the number of shocks. Thirty-day post shock survival for the salmonids was better than 94% and for the non-salmonids, ranged from a low of 80% in fathead minnows to 100% survival in green sunfish and channel catfish. There were no statistically significant differences in 30-day post-shock condition factors (KTL) for any species despite observations of altered feeding behaviors in several species lasting several days to a week post-shock. **Contact**: Frank Panek, fpanek@usgs.gov.

Investigating an unknown virus from invasive Northern Snakehead in the Chesapeake Bay waters of Maryland and Virginia

A virus has been isolated from northern snakehead inhabiting the Chesapeake Bay watershed in samples collected by the Virginia Department of Game and Inland Fisheries. It was unknown if this virus is a possible pathogen of indigenous fish species in the Chesapeake Bay or was a novel expression of an undescribed, possibly introduced virus. Given the ongoing fish kills in the Shenandoah and Potomac Rivers, it is clear that environmental conditions predispose fish to disease outbreaks within the watershed. Prudence suggests that the virus be taxonomically identified, pathogenicity characterized, and molecular methods developed to facilitate future identification and determination of geographical range. Virus was propagated in Fathead Minnow Cells (FHM) and amplified with a primer set universal for iridovirus MCP. This amplification yielded a PCR product that was subsequently sequenced and determined to be Largemouth Bass Virus (LMBV). **Contact**: Luke Iwanowicz, liwanowicz@usgs.gov.

Reproductive health of yellow perch in urbanized tributaries to the Chesapeake Bay, Maryland

Scientists at Leetown Science Center have been investigating the reproductive health of yellow perch in five tributaries of the Chesapeake Bay for several years. Two highly urbanized tributaries, the Severn and South Rivers have had poor recruitment. With the assistance of the Maryland Department of Natural Resources LSC scientists sampled both rivers for three successive years during the spawning run. Fish were analyzed for plasma hormone and vitellogenin, sperm analyses, molecular analyses and gonad histology, as well as some contaminant analyses on liver and ovary tissue. Major findings to date suggest effects on Leydig cells in testes and on final maturation (yolk hydration and abnormal vitelline membranes). The results date suggest chemicals such as neurotransmitter modulators (e.g., dopamine) may be involved. This is a new type of emerging contaminant that warrants further study. **Contact**: Vicki Blazer, vblazer@usgs.gov).

Development of aquatic pathogen databases

Scientists from the Western Fisheries Research Center in cooperation with the USGS National Biological Information Infrastructure and colleagues at Oregon State University have designed a template database, AquaPathogen X, for recording information on aquatic pathogens. The database is freely available for download from the WFRC website (http://wfrc.usgs.gov) and can accommodate the nucleotide sequence data generated in molecular epidemiological studies along with the many abiotic and biotic traits associated with isolates of various pathogens (e.g. viruses, parasites and bacteria) from multiple aquatic animal host species (e.g. fish, shellfish and shrimp). The simultaneous cataloguing of isolates from different aquatic pathogens is a unique feature of the AquaPathogen X database, which can be used in surveillance of emerging aquatic animal diseases and elucidation of key risk factors associated with pathogen introductions into new aquatic systems. A version of the database that stores epidemiological profiles of fish virus isolates, called Fish ViroTrak, was also developed. Records for two aquatic rhabdoviruses, *Infectious hematopoietic necrosis virus* and *Viral hemorrhagic septicemia virus*, were used in creating two separate web-accessible databases (http://gis.nacse.org/ihnv/ and http://gis.nacse.org/vhsv/). A publication in *Journal of Fish Diseases* discussing the development and utility of the database has been released. See: doi:10.1111/j.1365-2761.2011.01270.x. **Contact:** Evi Emmenegger or Gael Kurath, Western Fisheries Research Center, 206-526-

6282; eemmenegger@usgs.gov or gkurath@usgs.gov.

Improved diagnostic tests for *Renibacterium salmoninarum*
Researchers at the Western Fisheries Research Center are leading an effort to improve and standardize diagnostic testing for the important fish pathogen *Renibacterium salmoninarum.* The WFRC was recently awarded a grant by the Great Lakes Fishery Trust to coordinate this effort. Multiple fish health laboratories in the United States and Canada will participate in an inter-laboratory testing scheme that will be coordinated by the WFRC. The key participants met recently at a WFRC hosted workshop at the Wisconsin Veterinary Diagnostic Laboratory (Madison, WI) on May 24-25, 2011. Standardized diagnostic protocols for important fish pathogens including *R. salmoninarum* are now publicly available via the USGS Microbiology website. This site will provide rapid dissemination of standard operating procedures for diagnostic tests (http://microbiology.usgs.gov/diagnostic_protocols.html). **Contact:** Maureen Purcell or Diane Elliott, Western Fisheries Research Center, 206-526-6282; mpurcell@usgs.gov, dgelliott@usgs.gov

***Nucleospora salmonis* in Snake River salmonids**
In the April 2011 issue of the *Journal of Aquatic Animal Health*, researchers from the Western Fisheries Research Center and the University of California Davis report the results from a 3-year pathogen survey of migrating juvenile Snake River salmonids. The study found significantly higher prevalence of the parasite *Nucleospora salmonis* in hatchery origin steelhead relative to wild steelhead or both wild and hatchery origin Chinook salmon. *N. salmonis* is a microsporidian parasite of trout and salmon that can cause a leukemia-like condition. The potential impact of this parasite on the fitness of hatchery origin steelhead is unknown. Results from this study were incorporated into the "*American Fisheries Society Blue Book: Suggested Procedures for the Detection of Certain Finfish and Shellfish Pathogens*". The *N. salmonis* chapter was co-authored by USGS and UC Davis researchers. For more information see:
http://www.tandfonline.com/doi/abs/10.1080/08997659.2011.559418 or
http://www.fisheries.org/units/fhs/BlueBook_access.php. **Contact:** Maureen Purcell, Western Fisheries Center, Seattle, 206-526-6282 x 252; mpurcell@usgs.gov.

Forecasting VHS epizootics in wild populations of marine fish
Viral hemorrhagic septicemia (VHS) is a serious disease that occurs in wild marine fishes throughout the NE Pacific Ocean and the North American Great Lakes. In the Pacific, periodic epizootics occur in Pacific herring, Pacific sardines, and other marine forage species; additionally, mortality from VHSV and other diseases represents a leading hypothesis accounting for the decline and failed recovery of Pacific herring populations in Prince William Sound and other areas. Unfortunately, by the time these VHS epizootics are initiated little can be done to mitigate their impacts to involved populations. USGS researchers are developing quantitative tools, to forecast the potential for the VHS epizootics in wild fish populations. Knowledge of this disease potential will enable fisheries managers to develop adaptive disease management strategies intended to anticipate, prevent or mitigate population-level effects of VHS. **Contact:** Paul Hershberger, Western Fisheries Research Center, Marrowstone Marine Field Station, 360-385-1007, Ext. 225; phershberger@usgs.gov.

Viral hemorrhagic septicemia virus in the Great Lakes
A large research project on *Viral hemorrhagic septicemia virus* funded by the Great Lakes Fishery Trust was recently completed. In 2005, VHSV emerged in the Great Lakes and was associated with wild fish kills in a wide range of species. The 3-year project was a collaborative research effort between five co-investigators at two academic universities and the Western Fisheries Research Center. The overall goal was to: 1) Provide information on the susceptibility of selected, highly visible finfish species in the Great Lakes to VHSV in order to assess the magnitude of the threat to these populations, especially those for which recovery or enhancement actions are in place (e.g. captive populations reared in hatcheries with open water supplies); 2) Provide new tools and improved assays used to determine the current and previous infection status of important Great Lakes finfish species and to make these tools available to fish health laboratories; 3) Provide

a comprehensive database for information on all isolates of VHSV in the Great Lakes for use by managers via internet that will facilitate epidemiological analysis and risk assessment; 4) Provide new insights on the epidemiology of VHSV in the Great Lakes to help managers better evaluate the potential risks to various species and populations as well as the benefits of possible management actions. **Contact**: James Winton, Western Fisheries Research Center, (206) 526-6587; jwinton@usgs.gov.

Genetic tools for research on the Great Lakes strain of *Viral hemorrhagic septicemia virus* (VHSV)
In related work, researchers from the Western Fisheries Research Center (USGS) and the University of Maryland Biotechnology Institute have developed reverse genetic capabilities for the Great Lakes strain of *Viral hemorrhagic septicemia virus* (VHSV IVb). This new tool was used to knock-out the VHSV IVb non-viron (NV) gene and demonstrate that the NV is essential for pathogenicity in yellow perch. The VHSV IVb reverse genetic system will be a valuable tool to investigate all aspects of the viral life cycle. The results are reported in the latest issue of *Marine Biotechnology* (http://www.ncbi.nlm.nih.gov/pubmed/20936318). **Contact:** Gael Kurath, Western Fisheries Research Center, 206-526-6282; gkurath@usgs.gov.

Pathogen fitness and virulence of a fish virus
In a latest issue of the *Journal of Virology*, researchers from the USGS Western Fisheries Research Center and the University of Washington examined the relationship between pathogen fitness and virulence using an important fish virus, Infectious hematopoietic necrosis virus (IHNV). Pathogen fitness and virulence are typically quantified by measuring only one or two pathogen fitness traits. In this study, the researchers independently quantified four viral infection cycle traits, namely: host entry, within-host replication, within-host co-infection ability, and shedding. The researchers report that viral fitness was independently regulated by each of the traits, with the largest impact on fitness being provided by within-host replication. The results are thus congruent with the assumption that virulence and within-host replication are correlated but suggest that infection cycle fitness is complex and that replication is not the only trait associated with virulence. For more information see: http://www.ncbi.nlm.nih.gov/pubmed/21307204. **Contact**: Gael Kurath, Western Fisheries Research Center, 206-526-6282; gkurath@usgs.gov.

Characterization of a novel hepatitis-like virus in fish
Researchers at the Western Fisheries Research Center have recently published a paper in the journal *Virus Research* (Batts, W., S. Yun, R. Hedrick & J. Winton. 2011. A novel member of the family *Hepeviridae* from cutthroat trout (*Oncorhynchus clarki*). Vir. Res. 158:116-123) that reports the full genome sequence and other molecular characteristics of a new fish virus, first isolated from adult cutthroat trout in California. The virus, termed cutthroat trout virus (CTV), has been isolated from seven species of trout at numerous locations in 10 western states, however, no significant disease or mortality has been associated with the infections. The research shows that CTV is most similar to *Hepatitis E virus*, a significant pathogen of humans and domestic animals. The ability of CTV to grow in fish cell lines and to form persistent infections opens the possible use of a fish model for research on antiviral drugs or novel vaccine strategies to control Hepatitis E-like diseases of humans for which optimal model systems are lacking. **Contact:** Jim Winton, Western Fisheries Research Center, 206-526-6282; jwinton@usgs.gov.

Contaminants Highlights

Effect of atrazine exposure on sexual development in smallmouth bass
Numerous contaminants found in ecosystems act as endocrine system disrupters (EDCs), which affect many animals' immune functions and sexual processes. One noted abnormality is the development of testicular oocytes ("intersex") in the males of some fish species. Testicular oocytes (TO) have been induced in a number of fish species through exposure to various EDCs and estradiol in laboratories, although the exact mechanism of hormonal interference varies. Smallmouth bass populations in several northeast river systems have shown various levels of male intersex, sometimes as high as 100% of the fish sampled. A large number

of water contaminants are EDCs, including many agricultural herbicides and their degradation products. A recent study in the Potomac River indicated high concentrations of organic contaminants, especially atrazine and metolachlor, which also showed seasonal flucuations, peaking in the early spring when smallmouth bass are spawning. In 2011 we took pond spawned smallmouth bass fry and exposed them to atrazine at several doses in 20-gallon aquaria. These were subsequently stocked into ¼ -acre ponds Fish will be maintained in the ponds and 50 fish sampled at six-month intervals until they are 2 years old and beginning sexual maturation at which time they will be examined for the prevalence of intersex. **Contact**: Vicki Blazer, vblazer@usgs.gov.

Miscellaneous Items

WNS Congressional Hearing
USGS NWHC microbiologist David Blehert served as one of the technical witnesses at a Congressional Hearing on white-nose syndrome in bats at the U.S. House Natural Resources Subcommittee on Fisheries, Wildlife, Oceans and Insular Affairs on June 24, for which the U.S. Fish and Wildlife Service prepared the testimony. NWHC Director Jonathan Sleeman also attended the Hearing.

OIE Collaborating Centre
The USGS National Wildlife Health Center has been granted provisional approval as a Collaborating Centre for Research and Diagnoses of Emerging and Existing Pathogens of Wildlife by the World Organisation for Animal Health (OIE). The OIE is an intergovernmental organization responsible for improving animal health worldwide. Its objectives include ensuring transparency in the global disease situation, collecting, analyzing and disseminating veterinary scientific information, and the promotion of veterinary services, among other activities. A critical component of the scientific expertise is the network of Collaborating Centres. These are centers of expertise in a specific designated sphere of competence relating to management of animal health issues, and Collaborating Centres assist the OIE by providing their expertise internationally. This designation will facilitate cooperative work with other Collaborating Centres within North America and beyond, and includes several centers within the USDA as well as the Canadian Cooperative Wildlife Health Centre. A full list of Collaborating Centres can be found at: http://www.oie.int/en/our-scientific-expertise/collaborating-centres/list-of-centres/ A media release announcing this designation can be viewed at http://www.usgs.gov/newsroom/article.asp?ID=2851

Recent NWHC publications of interest
USGS NWHC scientists Chris J. Johnson (lead author), James P. Bennett, and Tonie Rocke are among co-authors of a publication entitled "Degradation of the Disease-associated Prion Protein by a Serine Protease from Lichens" to be published in Public Library of Science (PLoS One) in May. Few agents degrade prions, which are misshapen proteins that can cause fatal neurological diseases called transmissible spongiform encephalopathies (TSEs) like bovine spongiform encephalopathy ("Mad cow" disease), sheep scrapie, deer chronic wasting disease (CWD) or human Creutzfeldt-Jakob disease. These scientists discovered that certain types of lichen (using extracts) were able to break down the prion protein with the use of an enzyme that cuts protein called a protease. A USGS news release about this publication can be viewed at http://www.usgs.gov/newsroom/article.asp?ID=2803

USGS NWHC wildlife disease specialist Thierry Work is the lead author of a paper on coral disease recently published in PLoS ONE titled "Inter-Specific Coral Chimerism: Genetically Distinct Multicellular Structures Associated with Tissue Loss in Montipora capitata." It can be viewed online at http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0022869

USGS NWHC wildlife pathologist Carol Meteyer is the lead author of a paper on recovery of little brown bats from infection with Geomyces destructans titled “Recovery of little brown bats (*Myotis lucifugus)* from

natural infections with *Geomyces destructans*, white-nose syndrome" published in the Journal of Wildlife Diseases http://www.jwildlifedis.org/cgi/content/abstract/47/3/618

USGS NWHC statistician Dennis Heisey is the lead author of the following 2010 paper: Linking process to pattern: estimating spatiotemporal dynamics of a wildlife epidemic from cross-sectional data. Ecological Monographs 80(2):221-240. http://www.esajournals.org/doi/abs/10.1890/09-0052.1