USGS science for a changing world

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Western Fisheries Research Center (WFRC)

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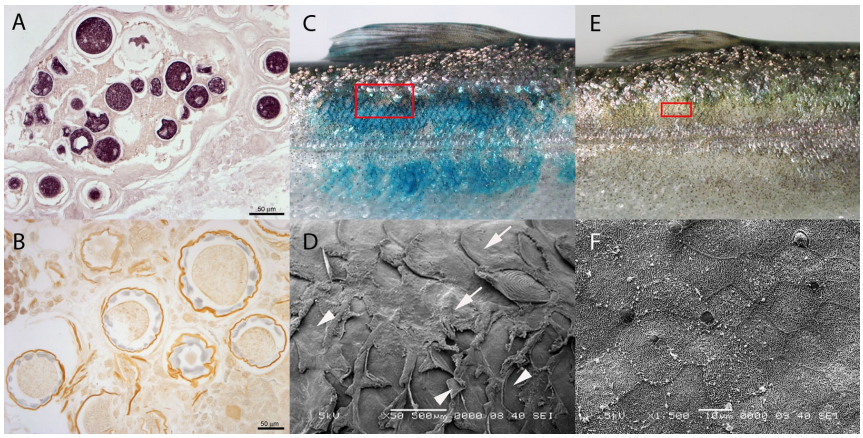

Figures 1A and B. Histological sections of Pacific herring heart (A) and red-spotted newt skeletal muscle (B) after CISH staining. (A) Dark purple specific DNA staining identifies the *Ichthyophonus* parasite. (B) No specific DNA staining in a parasite previously identified as *Ichthyophonus*.

Figures 1C to F. Juvenile Chinook salmon exposed to 0.1 % fast green FCF following descaling injury. (C) Descaling site 6 hours after injury, showing blue-green stained areas of scale loss and epidermal injury. Unstained areas have intact epidermis. (D) Scanning electron micrograph (SEM) of descaled area delimited by box in (C), showing empty scale pockets and epidermal disruption (white arrowheads) and areas of intact epidermis covering scales (white arrows). (E) Descaling site 24 hours after injury, showing scale loss but no fast green staining. (F) SEM of descaled area delimited by box in (E), showing individual epithelial cells that have migrated to cover the injury site. Photos by USGS.

Histopathology at WFRC: New Applications for an Old Discipline

Histopathology, the microscopic examination of tissues to investigate the manifestations of a disease, is a scientific discipline that originated in the 1800s. Today, however, histopathology has evolved to incorporate new technologies to address research questions that cannot be answered by other approaches. At the WFRC, a variety of tools, including light microscopy, scanning electron microscopy, and transmission electron microscopy are used in both disease diagnosis and research. Because histopathology can often reveal the presence of novel pathogens or tissue abnormalities that cannot be detected by other conventional or molecular methods, the WFRC histology laboratory has provided technical assistance to help characterize the nature of several new or baffling diseases in fish. Histopathology is also used at the WFRC as an important adjunct to molecular, microbiological or immunological approaches to research questions, as illustrated by the following examples.

Ichthyophonus is a protistan parasite that infects both freshwater and marine fish species, and ichthyophoniasis (Continued on page 2)

Research

Sturgeon Capture Training Provided to Yakama Nation: On June 24-25, 2014, USGS scientist Mike Parsley provided training in larval sturgeon capture techniques to Yakama Nation Fisheries Program biologists and technicians. The Yakama Tribe and others in the Columbia River Basin are implementing larvae repatriation as a sturgeon restoration strategy. Repatriation of wild-caught fish has benefits over traditional hatchery broodstock collection and onsite spawning techniques as it eliminates concerns about genetics because the wild-caught larvae originate from naturally-selected mates. For more information on the larvae capture techniques, see our USGS Open-File Report or contact Mike Parsley at mparsley@usgs.gov or 509-538-2299.

Events

USGS Scientist Contributes to Tribal Climate Webinar Series: The WFRC, Marrowstone Marine Field Station contributed to a webinar series co-hosted by the Tribal Environmental Professionals, Northern Arizona University, Pacific Northwest Tribal Climate Change Project, University of Oregon, and North Pacific Landscape Conservation Cooperative. In a webinar titled "Climate Change and Marine Issues", Paul Hershberger discussed the effects of shifting ocean currents on infectious and parasitic diseases of marine fishes. For more information contact Paul Hershberger at phershberger@usgs.gov or 360-385-1007.

Workshop on Aquatic Animal Pathogen Testing: On June 17, 2014, WFRC microbiologist Dr. Maureen Purcell presented an invited talk on laboratory testing methodology for infectious hematopoietic necrosis virus (IHNV). The invitation-only workshop was held in Campbell River, BC and focused on laboratory accreditation and standardization in support of the Canadian National Aquatic Animal Health Plan. (Continued on page 2)

(continued from page 1) is considered one of the most ecologically and economically important diseases of wild marine fishes worldwide. Research is underway at both the WFRC's Marrowstone Marine Field Station and the Seattle laboratory to develop a better understanding of interactions among the fish host, the pathogen, and environmental factors that may ultimately determine the prevalence and outcome of *Ichthyophonus* infections in species such as Pacific herring and Chinook salmon. Histopathology is an important component of this research because it can simultaneously characterize the host response and infection severity. However, previously there were no methods to confirm the identity of the several, morphologically diverse life stages observed in tissue sections, or to distinguish these putative *Ichthyophonus* stages from similar appearing or staining organisms or host components. Recently, WFRC scientists developed a variation of a new technique, called chromogenic in situ hybridization (CISH), to identify a specific *Ichthyophonus* gene in standard histological sections (Fig. 1A and B) (Conway, C.M., et. al., accepted J. Fish Dis., 2014). The CISH method complements standard histological diagnosis by providing highly specific molecular confirmation of the identity of organisms observed by standard light microscopy, and it can be readily applied to archival material. While many unanswered questions remain regarding the *Ichthyophonus* life cycle, transmission, and presence of non-piscine hosts, CISH provides a powerful new tool for these investigations.

Histopathology also played a key role in the development of a method to evaluate skin injury in juvenile salmon. Skin injury can occur from passage through or around hydroelectric dams, during capture and handling for tagging, as well as from various hatchery procedures. Visual inspections usually cannot detect damage to the transparent epidermal tissue that is external to the scales and is important for preventing the entry and establishment of pathogens. Histological analysis can detect injuries that are invisible to the naked eye, but it usually requires sacrificing the fish. As a non-lethal alternative, WFRC scientists developed a simple technique for visual detection of small epidermal injuries by a short immersion of fish in a diluted exclusion dye, the synthetic food coloring fast green FCF, which stains dead cells but is excluded by living ones (Fig. 1 C and E) (Elliott, D.G., et al., Dis. Aquat. Org. 84:139-150, 2009). In contrast to human epidermis, in which the outer cell layers are dead, the healthy epidermis of most fishes including salmonids is a living tissue throughout all its layers. To validate the staining procedure, WFRC scientists employed both light and scanning electron microscopy (Fig. 1 D and F) to confirm that the dye only stained sites of recent skin injury in juvenile Chinook salmon. For more information, contact Diane Elliott at dgelliott@usgs.gov or Carla Conway at cmconway@usgs.gov.

Events

(Continued from page 1) Dr. Purcell was the only U.S. scientist invited to participate in the workshop. The focus was to advance testing methods for aquatic pathogens of international importance, including IHNV. For more information contact Maureen Purcell at mpurcell@usgs.gov or 206-626-2052.

USGS Conducts Research at Fishing Derby: On June 21, 2014, WFRC Reno scientists worked with anglers during the first of three fish-tagging days this year at Independence Lake, CA. This is the third year USGS has partnered with the Nature Conservancy (TNC) in which volunteers and donors for TNC assist USGS biologists in capturing juvenile Lahontan cutthroat trout (LCT). Juvenile LCT are measured, weighed, PIT tagged and released back into the lake. This effort assists USGS biologist in modeling juvenile LCT survival in the lake. About 15 volunteers and donors came out on Saturday and were successful in capturing 20 LCT, of which 17 were juveniles that were tagged and released. For more information contact Mark Fabes at mfabes@usgs.gov, or 775-861-6389.

In The News

On May 27th, WFRC scientist Jill Hardiman was mentioned in an article by the *Hood River News* (Hood River, OR). The story titled "Concerns voiced for lower White Salmon River's future" discusses a recent public meeting where interested parties could voice their concerns for what the future may hold for the lower White Salmon River and surrounding near shore area since the dam breach in 2011 and complete removal in 2012. Hardiman presented her recent findings from a salmon habitat assessment for the lower six river miles. Full Article

On June 13, research by WFRC scientists was featured in an article by the *Columbia Basin Bulletin* (Bend, OR). The story titled "Study Looks At How Off-Channel Habitat Contributes To Columbia River Basin Salmon Production" discusses findings from a study recently published in *Transactions of the American Fisheries Society* that explores the important role of off-channel habitat in salmonid production. Full Article

Publications

Palmer, A.D., and E.J. Emmenegger. 2014. Susceptibility of Koi and Yellow Perch to Infectious Hematopoietic Necrosis Virus by experimental exposure. J. Aquat. Anim. Health 26: 78-83.

Kock, T.J., T.L. Liedtke, B.K. Ekstrom, C. Gleizes, and W. Dammers. 2014. Evaluation of the behavior and movement of adult summer steelhead in the lower Cowlitz River, Washington, following collection and release, 2013-2014. U.S. Geological Sruvey Open-File Report 2014-1122, 20 p.

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