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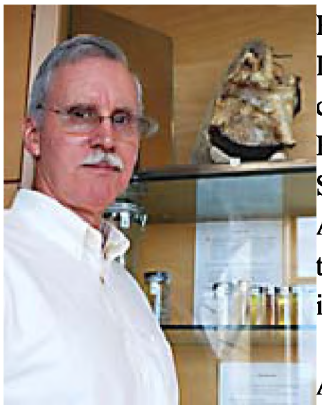
Aquatic specialists apply deadly fish virus research to real world problems



Fish health specialist Dr. Paul Bowser of Cornell's Department of Microbiology and Immunology recently received his third award in the last four years. Bowser and his collaborator, New York Sea Grant Fisheries Specialist Dave MacNeill, accepted an award for Extension and other Outreach Efforts after using recent research results on Viral Hemorrhagic Septicemia Virus to educate the public and promote environmental stewardship. The Sea Grant Association bestowed its first "Research to Application Award" on October 20th 2010, honoring the duo's successful and continued application of SGA-funded research to help solve problems in the real world.

An extension of the congressional National Oceanic and Atmospheric Administration program, the Sea Grant program promotes coastal stewardship by supporting relevant research, education, and extension programs at universities in every state touching a coast or a Great Lake. Since returning to Cornell as faculty in 1985, Dr. Paul Bowser '70, B.S., has received continual funding from New York's Sea Grant program for his work in the field of aquatic animal medicine. "These grants are hard to get," says department chair Dr. Avery August, "but Dr. Bowser has gotten eight of them and put them to good use. An award like this highlights how our interdisciplinary programs and faculty can partner with colleagues outside of Cornell and reach out to wider communities."

The researchers' fish disease expertise proved particularly relevant when Viral Hemorrhagic Septicemia Virus (VHSV) first appeared in the Northeast in 2005. The foreign animal disease has since been found in every Great Lake and several of its subsidiary water systems, devastating wild fish populations. Funded by the New York Sea Grant Program and other sources, Bowser and MacNeill were involved with some of the premiere research and outreach initiatives on the epidemic. While it does not affect humans, the virus causes deadly hemorrhaging and anemia in fish, and strains of the virus in Europe have wreaked havoc on rainbow trout populations across the pond. So far the disease has not infected aquaculture on this continent, but it has already been found in 28 different North American freshwater species of wild fish.

"The strain we're dealing with in North America is different from that found in Europe and does not appear to affect rainbow trout," says Bowser, "but it does infect other important species such as muskellunge, yellow perch, largemouth bass, and various other members of the sunfish family; all of which are prized in sport-fishing." While the virus infects only fish, it may prove equally dangerous to the sport-fishing industry, which feeds $1.4 billion a year to New York State's economy and generates nearly $4.2 billion a year across the Great Lakes Basin. "That's people going fishing, buying gear,

paying guides, spending money at restaurants and motels," says Bowser. "It's a huge economic entity. We hope to minimize the impact of VHSV on the economy and the environment."

After a series of major mortalities following the outbreak, the virus seems to have quieted down since 2008, and Bowser's team is trying to figure out why. "We may be seeing a classic example of what happens when a new pathogen enters a new area. When it first arrives, the fish have never seen it before, and many become severely affected. As time goes on, the population grows more accustomed to the virus." But the threat is far from over, and the sleeping virus remains in the population.

"You could almost compare it to what happens with the Flu virus," says Bowser. "Every 20 years or so we have a major shift in the genetic makeup of the influenza virus. In that particular year, a lot of people get severely sick from the new strain. As time goes on, the population becomes more accustomed to the new influenza virus, until the virus mutates and the cycle starts again." Both the VHSV and the influenza virus are RNA viruses. Lacking the enzymes that proof-read replication in DNA viruses, RNA viruses tend to make copying mistakes, causing high rates of mutation. "So far the various VHSV isolates we've found have been very similar to those first found in the Great Lakes in 2005. They have not yet initiated a major genetic change, but we predict that might eventually occur."

Environmental stressors probably also contributed to the virus's initial impact during its first three years. Warm springtime temperatures in 2005, 2006, and 2007 may have been a blessing to winter-bound humans, but coldblooded fish were not so lucky. Preferring a stable environment, fish find rapid change hard, especially changes in temperature. "Springtime is a bad time for fish," says Bowser. "It's when we see the highest mortalities from a wide variety of diseases in both aquaculture and in the wild. So we have many fish pouring their resources into springtime spawning while dealing with rapid temperature changes, and in comes a new pathogen they've never seen before. It's the perfect storm."

Cooler springtime temperatures in 2008, 2009, and 2010 combined with growing tolerance in fish populations may have helped lessen the disease's impact, but as Bowser says, "it's important to realize the virus is still there." Over the past five years the Aquatic Animal Health Program, which Bowser coordinates has conducted surveillance efforts, collecting and testing fish all over the Great Lakes. They have found that at least some of the fish collected from many locations are still carrying the virus. "If you go out without a coat on in the winter, you'll probably get a cold. There are always viruses present in the environment, but the stress to your immune system allows those you carry to act up. It's the same with fish. If we have a warm spring this year, if the virus mutates, if anything rocks the boat, we might see another outbreak."

Yet ecological factors are only part of the equation. Human activity plays a major part in aquatic health, and that is the element of Bowser's work that the "Research to Application Award" seeks to recognize. In addition to their pioneering research on the outbreak, Bowser and MacNeill have spearheaded efforts to inform coastal users and stakeholders about the disease and what they can do to help. Dr. James Casey, a virologist and one of Bowser's colleagues in the Aquatic Animal Health Program at Cornell developed quantitative RT-PCR method to detect the virus. This vastly improvement in detection capabilities has provided timely insight into the virus, its spread, and its impact on Great Lakes fisheries.

Dr. Casey joined Bowser and MacNeill in producing and disseminating informational materials about VHSV and how to limit its spread and minimize impact. The trio presented at New York State aquaculture workshops in 2009 and 2010 and demonstrated applicable bio-security measures developed by the Aquatic Animal Health Program for fish culturists, including methods of disinfection, containment, and prevention. In workshop evaluations, 100 percent of attendees indicated they would use the guidelines in their aquaculture facilities, and share them with others in the field.

Dr. Bowser has received several awards in the past few years, including the State University of New York Chancellor's Award for Faculty Service in 2007, and the S.F. Snieszko Distinguished Service Award from the American Fisheries Society in 2009, honoring his career achievement and contributions to aquatic medicine. He will continue his work at the Aquatic Animal Health Program at Cornell, providing service to fish enthusiasts, aquaculture practitioners, and partnering

with the New York State Department of Conservation fish pathology unit to investigate wild fish kills like those caused by VHSV.

"We're keeping an eye on things," says Dr. Bowser, who is already gearing up for next summer's surveillance activities, during which his crew will collect and test fish across all the Great Lakes Basin for VHSV and other pathogens. "We can't cure the virus, but we can learn as much as possible about it and keep people informed."