columnaris furunculosis infectious pancreatic n

Infectious Diseases of Freshwater Fish:

Understanding Disease in Wild Fish and Management of Fish Health

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Similar to other vertebrates, fish can be affected by diseases that are initiated by genetic, environmental or infectious causes. A broad range of infectious diseases are specific to fish and often specific to species. The presence of infectious pathogens, including parasites, bacteria, and viruses, are a natural component of a healthy ecosystem, though some of these may contribute to fish population declines.

In nature, pathogens may be present in low numbers within healthy fish, although environmental influences such as changes to the ecosystem, warming water temperatures and other environmental stressors may cause the pathogens to multiply and thus cause disease within the host. Determining the reasons for disease and mortality in fish populations is a combination of understanding the biology of both the host and pathogen, as well as identifying environmental stressors that may lead to disease outbreaks.

The Pequest Fish Pathology Laboratory is a component of the Office of Fish and Wildlife Health and Forensics and is responsible for research in fish diseases. The program mission has two components:

1. To understand the impacts of infectious pathogens present in wild fish populations and to suggest practices that will reduce the spread of disease and
2. To monitor the health of hatchery-reared fish and recommending management or treatment strategies.

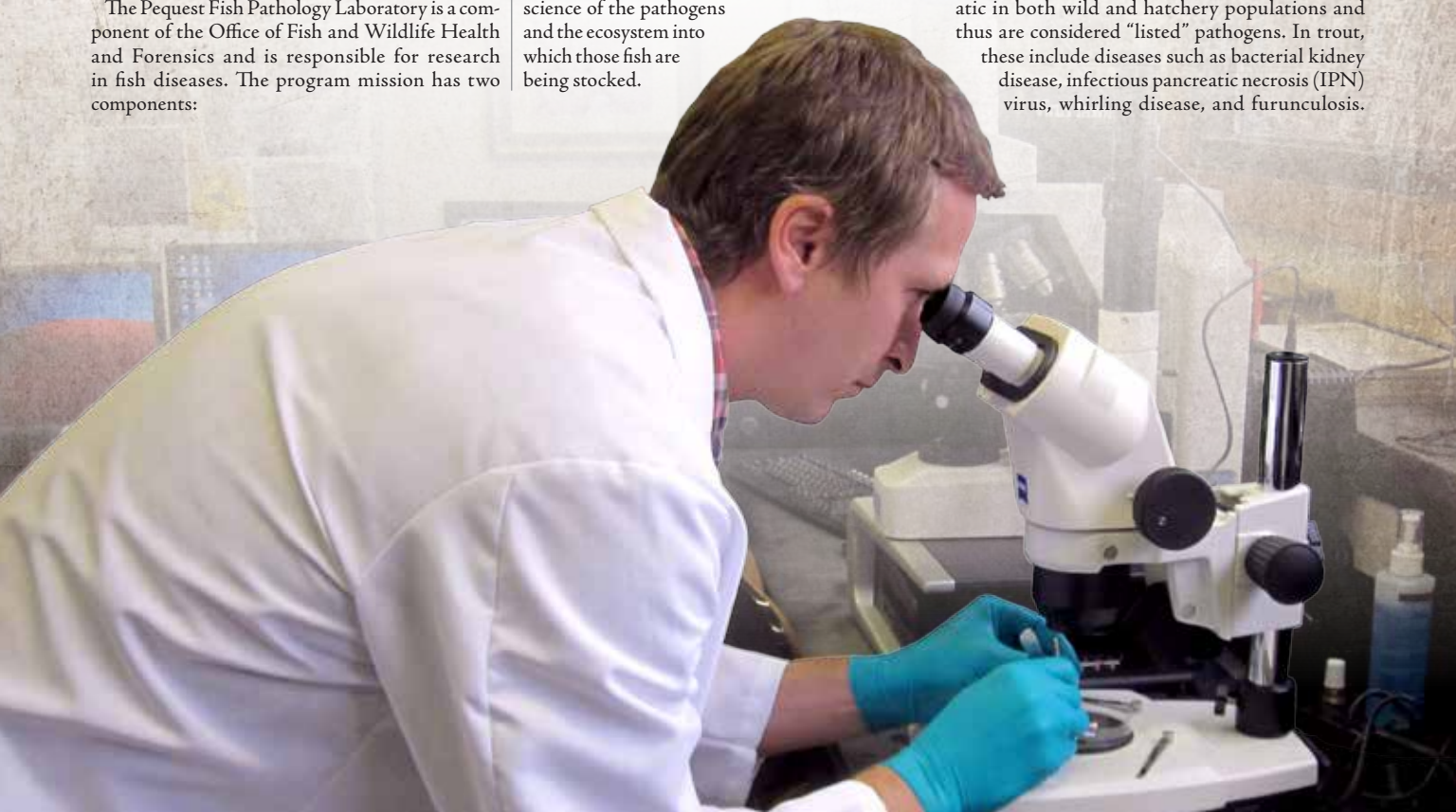
Our office collaborates regularly with the New Jersey Department of Agriculture Animal Health Diagnostic Laboratory for disease diagnostics and also with universities to research diseases in fish populations.

To ensure healthy fisheries throughout the state, we run a fish health management program in conjunction with our fish hatcheries and fisheries management programs to minimize risks of disease spread. The actions taken to manage infectious fish pathogens are based on the science of the pathogens and the ecosystem into which those fish are being stocked.

For example, there are many endemic pathogens that are part of the aquatic environment and are unavoidable. Generally these pathogens are kept in check by the fish's immune system, although they can cause disease when environmental stress is encountered.

One example is a bacterial disease known as columnaris which can cause fish kills in multiple species (often sunfish) in the spring or early summer. It is likely that warming water temperatures combined with other environmental stressors can initiate mortality in fish populations from this ubiquitously present bacterium. This bacterial disease can also be problematic in hatcheries, although it is avoided by maintaining appropriate fish densities and ideal water quality.

A second class of endemic fish pathogens are found predominantly within the fish, can be highly contagious, and are known to be more problematic in both wild and hatchery populations and thus are considered "listed" pathogens. In trout, these include diseases such as bacterial kidney disease, infectious pancreatic necrosis (IPN) virus, whirling disease, and furunculosis.



Although these pathogens are endemic within the state, we take precautions to avoid their introduction into the hatcheries and their further spread through the environment.

The last class of pathogens includes emergency or exotic pathogens which are not currently found in the state and have the potential to cause serious fish mortality. A good example of this is the fish viral disease known as viral hemorrhagic septicemia (VHS), which was first described in Europe in 1938 and first isolated in the Pacific Northwestern U.S. in the late 1980s. The virus is an RNA rhabdovirus—the same family as rabies virus—and causes a hemorrhagic disease in fish that can result in heavy mortalities. This virus had more recently (2003) been introduced into the Great Lakes, which led to large kills in many fish species. Currently the virus in the Great Lakes has been found to infect about 30 different species of fish and is pathogenic to species including muskellunge, yellow perch and gizzard shad.

All precautions are being taken by states to avoid human-related practices that may spread this viral disease from the Great Lakes region. This is done through restrictions on fish transport from areas where the virus is found, as well as avoiding the spread of the virus by cleaning fishing gear and boats if traveling from affected areas.

Infectious pathogens are a natural part of life and are often present in healthy wild fish populations. Nonetheless, pathogens and diseases are important considerations in the management of a fisheries program. Management actions are taken to protect the environment and ensure healthy fish populations for the future. Making a conscious effort to reduce the prevalence of listed pathogens will benefit the health of wild fish and help to avoid future disease problems in the hatcheries, since the main source of these pathogens is the outside environment.

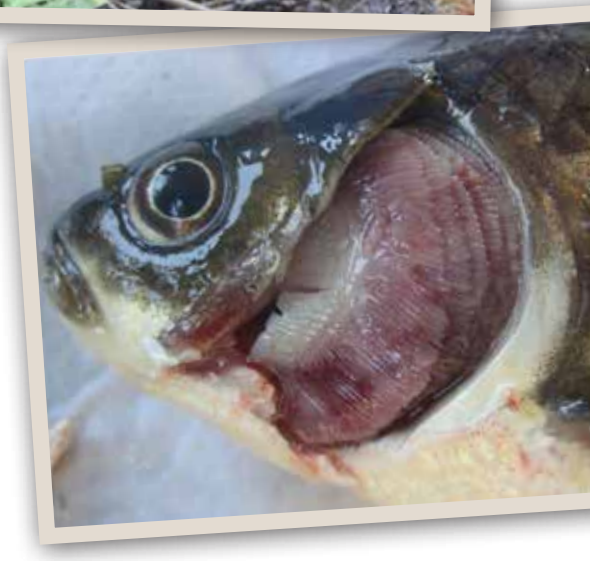
Field surveillance is important to understanding the diseases in our fish populations. Through our program we monitor the health of fish populations and investigate fish kills. The public can help by alerting us of fish kills or fish that appear diseased. Please contact Fish and Wildlife so that we can coordinate delivery of the fish to the lab to perform a necropsy and test for infectious pathogens. For more information about reporting diseased fish, current fish health projects, and information about common fish diseases visit our fish health website at http://www.NJFishandWildlife.com/fishhealth.htm.

In 2013, furunculosis was encountered in the Pequest Trout Hatchery for the first time in its 30 year history. Restrictions on trout stocking were implemented to avoid its further spread in the environment. (See page 8 for further discussion about furunculosis at Pequest.) >>

COLUMNARIS

A sunfish sampled from the wild with a columnaris bacterial infection. Notice the loss of scales and tissue necrosis in the area of infection.

VIRAL PATHOGENS



Viral pathogens can result in heavy losses of wild fish. Goldfish are an exotic species in New Jersey and were densely populated in Runnemede Lake. In the summer of 2013 a massive mortality of goldfish occurred over a several day period resulting in an estimated loss of 5,000-6,000 goldfish from this small lake. The mortality was caused by a herpes virus. The outbreak was likely triggered by warming water temperatures and other environmental factors in the early summer. The only external signs of disease included slight bleeding on skin around the fin bases and extremely pale gills. Internally the virus caused destruction of the cells within the spleen and kidney.

>> Furunculosis Outbreak at the Pequest Trout Hatchery

In the early fall of 2013, the Pequest Trout Hatchery became infected with the bacterial disease known as furunculosis.

Furunculosis is caused by the bacterium, *Aeromonas salmonicida*, which has nearly a world-wide distribution and is common in the northeastern United States. The bacterium in trout causes a systemic infection that leads to acute mortality (generally in young fish) or chronic disease (in older fish) that produces signs including boils within the muscle of the fish. The bacterium is considered mostly problematic in salmonid fish, including trout and salmon, although it has been isolated from numerous other fish species. *Aeromonas salmonicida* is also known to persist in the tissues of fish even when no symptoms of disease are observed.

It is expected that after a furunculosis outbreak over half of the surviving fish may be asymptomatic carriers of the bacterium and thus sources of further spread of the bacterium. Although the disease is treatable with the use of antibiotics, it can be difficult to completely eradicate the bacterium from large fish populations. This was particularly true for the brook trout reared at Pequest in which a portion of the fish population developed clinical furunculosis within weeks of the treatment regime.

Despite numerous attempts, the inability to fully treat hatchery brook trout for the disease led to the humane euthanasia of about 200,000 fish.

In contrast, brown trout in the facility were successfully treated; the fish did not exhibit any post-treatment symptoms of disease and follow-up bacterial testing of the population was negative, allowing for the stocking of these fish in select locations.

In the early days of trout rearing in New Jersey, trout were raised in the Hackettstown Hatchery and furunculosis was an annual problem. In fact, many of the serious endemic trout diseases became problematic in the Hackettstown facility, which led to the opening of the Pequest Trout Hatchery, designed to have a water source free of these infectious pathogens. Since that time the Hackettstown facility was renovated and is now the cool and warmwater fish hatchery responsible for raising and stocking about 15 different species of fish into state waters. Similar to Pequest, the fish at the Hackettstown facility are regularly inspected for diseases.

Following about 30 years of disease-free status in Pequest trout, furunculosis was introduced into the facility. The introduction most likely came from predatory birds such as ospreys, which may have

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FURUNCULOSIS

A large brown trout with clinical furunculosis. Notice the reddened boils on the side of the fish. The bacterium can be isolated from the kidney and grown on bacterial media (right); *Aeromonas salmonicida* produces a characteristic brown pigment on the media.

An electrofishing crew from the Bureau of Freshwater Fisheries sampling fish for health testing. Examining fish from the wild helps us to understand the health and prevalence of infectious pathogens in the wild.

Leave No Trace

Includes Cleaning Your Gear

Inspect
- Remove any rocks, mud, plants, moss or other materials from your gear.

Clean
- Thoroughly clean your equipment with water and a brush to remove any attached materials.

Dry
- Completely dry your equipment in the sun.

Protect Your Stream from Aquatic Invasive Species

Raritan Headwaters Association

ToyotaTogetherGreen by AmeriCorps

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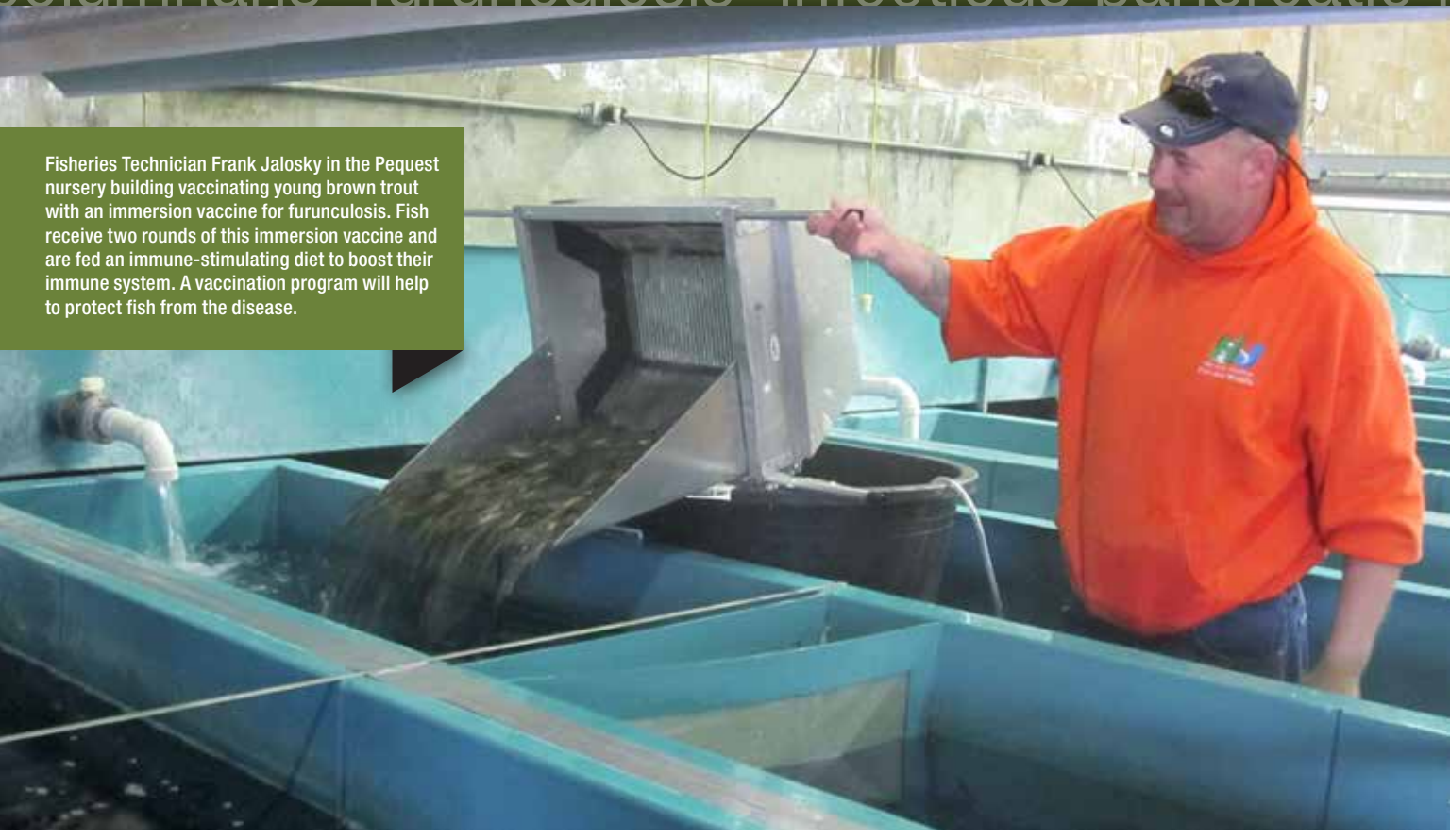

Fisheries Technician Frank Jalosky in the Pequest nursery building vaccinating young brown trout with an immersion vaccine for furunculosis. Fish receive two rounds of this immersion vaccine and are fed an immune-stimulating diet to boost their immune system. A vaccination program will help to protect fish from the disease.

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transferred the bacterium from the wild to one of the outdoor trout raceways. Birds and mammals pose a serious risk for introducing diseases by carrying pathogens on their bodies (feet or beak) and transferring them into the hatchery when attempting to eat fish from the raceways. Some pathogens, such as IPN virus, can even survive the digestive tract of birds and can become introduced into the hatchery through bird droppings.

The Pequest hatchery staff uses various deterrents to keep birds and other wildlife out of the facility, but this becomes challenging as birds can quickly learn how to overcome these obstacles. Currently options to better enclose the facility are being discussed to help prevent the introduction of pathogens from birds and other wildlife. Additionally, similar to wildlife, human traffic could be a means for disseminating pathogens into a facility, so careful disinfection protocols are utilized and human traffic is minimized in the fish culture areas.

Once the bacterium was introduced into the facility it quickly spread throughout the raceways because of the water-flow connecting all the raceways. In addition to a treatment regime with antibiotics to eradicate the bacterium from the fish, many management actions were taken to control the disease in the hatchery. Following the removal of fish from the raceways, they were steam-disinfected and kept free of fish for an extended period.

Scientific evidence suggests that the bacterium cannot survive effectively for over a month in the environment without a fish host, thus keeping the raceways fish-free is a management strategy to starve the bacterium out of the system. Additionally, rainbow trout have proved to be more resistant to this disease than the brook and brown trout.

Taking advantage of this natural disease resistance, rainbow trout are now the predominant species being reared in the hatchery, and this will continue for the next several years. A limited number of brown trout are maintained at the hatchery for future broodstock and these fish are on a vaccination program, which helps to protect them from the disease.

Furunculosis impacted the 2014 trout stocking season as actions were taken to avoid the further spread of this bacterial disease into the state's waters. A conservative policy—driven by understanding the science of the bacterium as well as the environment in which the trout were to be stocked—was developed. Based on science and a risk analysis that was conducted in collaboration with the Great Lakes Fish Health Committee, New Jersey developed a policy that is highly protective of the states freshwater resources and continues with a modified trout stocking program. This policy allowed only healthy fish that tested negative for the bacterium to be stocked into state waters. Fish that were successfully treated for the disease were stocked into waters not supporting trout populations year-round. This ensured that treated fish, which could be potential carriers of the bacterium, were not put in any waters that would risk further spread of the bacteria within trout populations.

Even though this bacterium is endemic within the state, the policy ensured the long-term protection of the trout resources by avoiding further spread. With furunculosis being a cold-water bacterium unable to survive temperatures above 74°F, the healthy, treated fish were stocked into waters considered "put and take" fisheries which do not support trout year round and are known to exceed 74°F in the summer.