Pequest Trout Hatchery Biosecurity Improvements

Jan Lovy, Ph.D.
Research Scientist, Fish Pathologist
NJ Division of Fish & Wildlife
Office of Fish & Wildlife Health & Forensics
605 Pequest Rd
Oxford, NJ 07863

The information in this document has been reviewed and updated with comments/suggestions from the Blue Ribbon Panel (Hatchery Biosecurity). The panel members include Wendy Anderson, Patricia Barbash, Rod Getchell, Agust Gudmundsson, Donald W. Stremme, Ed Washuta, and Gary Whelan. Further information about the panel members can be found at the end of the document.

General background information for the Pequest trout hatchery:

The Pequest trout hatchery annually produces approximately 600,000 trout for the trout stocking program. The facility is composed of an indoor nursery building with a separate water supply and a series of outdoor raceways used for the production fish. Pequest is the only state trout hatchery responsible for all trout stocking in N.J. The outdoor raceways are set up as a serial re-use system with first pass water distributed into the upper raceways (comprising of 100,000 ft^3 of water volume), second pass water flowing into the lower raceways (60,000 ft^3), and third pass water used for the broodstock pools (10,000 ft^3). See the figure at the end of the document to see the general raceway set up. The approximate trout biomass maintained within the raceways is from 0.61 lb/ft^3 to 3 lb/ft^3 depending on the stage in the production cycle. The water turnover rate ranges from 1.8 to 2 hours for the upper raceways.

Furunculosis outbreak in September 2013:

The Pequest trout hatchery experienced an outbreak of furunculosis, a bacterial disease caused by *Aeromonas salmonicida* subsp. *salmonicida*, for the first time in its 30 year history. The bacterium was first isolated in September 2013; previous to this the bacterium was never isolated from this facility from previous fish health inspections or mortality investigations The disease manifested in a chronic form, with a common gross observation of boils in the musculature (furuncles). This caused persistent chronic mortalities. Brown trout responded well to antibiotic treatment, whereas the brook trout had recurring episodes of furunculosis despite multiple oral treatments with florfenicol. Brook trout are considered one of the most susceptible trout species. The ineffective treatments were also believed to be partially attributed to an apparently unrelated neurological disorder of unknown etiology in this same

population of fish. This other stressor likely did not allow for effective treatment of the entire population with oral antibiotics.

Fish health policy for the trout stocking program:

A fish health policy was developed and followed to conserve the state's trout waters in order to avoid the spread of disease. The fish health policy allowed for stocking of treated fish into non-trout waters (waters that do not support trout holdover and/or reproduction). Treated fish were defined as fish previously testing positive for the bacterium and successfully treated to a point where the bacterium was no longer detectable in the population. No populations of fish that had detectable *A. salmonicida* were stocked into any state waters and no fish with a history of *A. salmonicida* were stocked into trout waters (waters that contain holdover and/or reproducing trout populations) to avoid the introduction of carrier fish into these areas. The treated/possible carrier fish were stocked into areas considered "put and take" fisheries, where there is little risk of spread to wild trout and where temperature ranges rise above the preferred temperature range for *A. salmonicida*. The policy led to the humane euthanasia of 230,000 predominantly brook trout, which did not respond well to treatments as mentioned earlier.

Biosecurity at the Pequest trout hatchery:

The purpose of the document is to summarize biosecurity actions taken at the hatchery and to propose actions/improvements to increase the biosecurity at the facility. The recommendations for improvements were also discussed during the Great Lakes Fish Health Committee Meeting held in State College, PA in February 2014. This document has been reviewed by the Hatchery Biosecurity Panel consisting of eight fish health experts detailed at the end of the document; revisions have been made following review from this panel.

Preventative actions to control/manage the disease at the hatchery:

A) Steam-disinfection of all raceway lines and allowing them to sit dry for as long as possible (between 3-4 weeks) was done when fish were removed from the system. The facility has been depopulated of all fish that were impacted by the furunculosis outbreak. Chlorine disinfection was not possible in 2013-2014 because all fish could not be removed from the system at one time. Additionally it is difficult to fully contain the water within the hatchery raceways, therefor it is a risk to introduce high concentrations of chlorine which may escape into the pond and river below the hatchery. To fully eliminate the bacterium from the facility it is recommended to complete a chlorine disinfection to ensure that underground piping and biofilms are properly disinfected. This may be split into disinfection of the upper hatchery and lower hatchery separately. If there is any danger of chlorine leaking out of any systems then sodium thiosulfate solution should be on hand to quickly de-chlorinate the solution. Full eradication of the

pathogen from the system is not likely to happen unless chlorine disinfection is completed.

B) The hatchery traditionally raises brook, brown, and rainbow trout. Rainbow trout at the hatchery demonstrated to be highly resistant to furunculosis. No rainbow trout showed disease signs during the outbreak and the bacterium was never detectable in the kidneys of these fish, despite being held downstream of affected fish. For the next several years the hatchery will produce predominantly rainbow trout to avoid outbreaks with the disease. This will also help to reduce bacterial numbers and to aid in elimination of the bacterium. The stocking of predominantly rainbow trout for several years was viewed as a positive for the fisheries program, because of angler success with this species. It is important to note that rainbow trout are susceptible to infection, but resistant to disease therefor they may still be carriers of the bacterium. Reintroduction of larger numbers of brown trout will occur after a set time and may first start with introducing brook or brown trout at the end of the system to serve as sentinels for the bacterium. Monitoring of fish in the hatchery will also include skin and mucus bacteriological cultures on TSA-CBB agar to determine if the bacterium is present on asymptomatic fish.

C) The small numbers of brown trout maintained at the facility have been vaccinated using an autogenous vaccine administered by an immersion bath. Two immersions were given to the fish (once when fish weighed 20g and a second one at about 50g). During the second vaccination, the fish were fed with an immune-stimulating diet composed of beta-glucans two weeks before and two weeks after the vaccination to boost their immune response to the bacterial antigens. Fish were stocked from the nursery building to the outdoor raceways one month after the second vaccination. This practice will continue as long as brown trout are maintained at the facility. As long as the bacterium is not fully eliminated from the facility, it is advisable to vaccinate all fish in the facility to reduce the numbers of potential carrier fish.

D) Brown trout that have been selectively bred for resistance against furunculosis may be introduced to the hatchery to start a broodstock source of these more resistant fish. Early discussions suggest that the selectively bred brown trout, though more resistant to furunculosis, do not tolerate warm water temperatures as other strains. This may pose a problem to N.J. waters, which tend to warm up above optimal trout temperatures in the summer months.

E) Fish densities/biomass were reduced in the susceptible species maintained at the hatchery (brown trout) in order to maintain healthy skin and fins and optimal water quality. The brown trout are maintained at a density between 0.27 lb/ft^3 to 1.8 lb/ft^3 at the end of the system. Rainbow trout in the facility are maintained at 0.6-3 lb/ft^3. It is highly advisable to continue the practice of maintaining low fish densities to ensure that stress is limited in the production system and that fish condition is optimally maintained.

F) Increased biosecurity has been implemented at the hatchery and should continue. Hatchery biosecurity is split into several groups (see 1-4 below) including the protection of environmental factors as well as biosecurity within the facility.

Practices at the hatchery to limit biosecurity threats:

1) The protection of the hatchery from pathogens which may be introduced from private hatcheries through private stockings within the watershed.
    a. Stocking permits will not be issued to private hatcheries to stock fish into the Pequest River (watershed in which the hatchery is located) in order to protect the hatchery. It is strongly advised that the entire Pequest watershed is stocked only by the state facility. In case this is not possible then fish entering these waters must meet similar fish health standards as the state facility. Field research that we conducted found other diseases, such as infectious pancreatic necrosis virus (IPNV) within the Pequest River. Additionally furunculosis was isolated from the Raritan River in what appeared to be hatchery stocked fish, which likely originated from a private fish culture facility. With the lower level of confidence for fish health testing in private culture facilities, it is strongly recommended to avoid stocking trout from private facilities in the Pequest watershed.
    b. A second possible source for trout introductions into the Pequest watershed is through the use of trout as fishing bait. Within the watershed are two lakes in which trout are commonly used as fishing bait. This has emerged since the increased popularity to use trout as bait for large predatory species, such as esocids. This practice could result in the unregulated transfer of trout into the Pequest watershed and thus restrictions to avoid this practice are strongly advised.

2) Environmental biosecurity threats to the hatchery:
    a. Other hatcheries have reported that it is possible for the groundwater supply for a hatchery to become contaminated by surface waters. Discussions with geologists that designed the Pequest hatchery believe that there may be little risk for pathogens from the surface river water to enter the ground water that feeds the hatchery. The ground water supply at the facility is from 7 wells varying in depth from 54' to 200'. The Bedrock is well below the Pequest River (30-60') making it less likely for river water to directly enter the ground water through caverns in the bedrock. Any surface water that will enter the groundwater supply is filtered through of silt and clay. The two wells closest to the Pequest River are wells #7 and #5, which are 200' and 151' respectively. Well #1 is the shallowest well, being 54' deep. Small pathogens, such as viruses would be more likely to enter the groundwater supply. To be sure no surface water from the river is directly entering the wells it is recommended to do a dye study to determine if river water enters any of the wells. Considering that some

wells are in close proximity to the river it is advisable to limit the fish introductions to the Pequest River watershed to avoid the introduction of pathogens (see section 1 above).

b. Predators, including birds and mammals, are a major risk for the introduction of pathogens. In recent years, the numbers of osprey have dramatically increased in the area. Currently numerous bird deterrents are being utilized, including noise makers (propane canons), wires over the raceways, glittery streamers hanging above the raceways, and other moving objects around the facility to deter birds. The birds have been so problematic this year that the facility has obtained a depredation permit to kill a small number of ospreys. Other ideas were discussed, such as netting over the top of the raceways, although this was not further pursued because the netting may encourage birds to perch over the raceways and defecate into the production systems. Viruses, such as IPNV, may survive the digestive tract of birds and become introduced into a facility through feces from birds predating feral fish. It is believed that birds and other wildlife pose the greatest biosecurity risk to the facility. Human traffic, whether it is staff or the public is also a concern for introducing or spreading pathogens. Limiting human traffic in addition to eliminating the problem of wildlife entering the raceways are important steps in eliminating disease risks in the facility.
c. There are little environmental risks to the nursery building because this is a fully enclosed building with little to no influence from the environment.

3) Internal biosecurity threats in hatcheries: Equipment and tanks
    a. Maintenance of separate brushes and nets for each isolated system.
    b. Maintenance of disinfectant for brushes and nets at each raceway line. This must be changed regularly depending on the disinfectant used.
    c. Year-class separation of fish and disinfection prior to introducing new class of fish
    d. Nursery building in Pequest: For all isolated systems, it is advisable to use separate equipment or disinfect equipment when using in more than one tank.

4) Internal biosecurity threats in hatcheries: Human traffic and work flow
    a. Have dedicated staff to work in outdoor raceways or the nursery building. If the same staff will work in both areas, do maintenance in nursery building prior to working in the outdoor raceways. If working between buildings or raceways then disinfection of shoes and hands should be done. Also it is recommended to keep separate rain gear or protective clothing to wear when working in either the outdoor raceways or the nursery building.
    b. Work from upstream to downstream with general maintenance, particularly mortality collection. Mortality collection must be done as often as possible to remove the dead fish, which are the major sources of infectious pathogens when a disease is present.
    c. Disinfection foot baths in high traffic areas and when entering culture facilities.

d. Vehicle traffic and disinfection. Ensure that hatchery vehicles are disinfected prior to entering the culture facility. This is done by spraying tires and undercarriage with disinfectant (Virkon Aquatic). This should be done any time a vehicle exits and enters the fish culture area.
e. Staff working between two facilities (Pequest and Hackettstown); consider keeping separate shoes and clothing at each facility.
f. Human traffic must be limited within the culture areas and disinfection of shoes must occur when reentering the culture area. Limitations must be made on public access adjacent to the culture facility.

Recommendations for improvements to the current biosecurity:

1) It is advisable to do a full chlorine disinfection of the raceways and the underground piping to fully eliminate the bacterium from the system. Underground pipes should first be pre-cleaned with a roto-rooter, followed by chlorine disinfection. Other precautions mentioned earlier will limit the presence of the bacterium and maintain it at low manageable levels, but the only way to eliminate it completely will be through disinfection of the facility. It may be possible to disinfect the upper hatchery and the lower hatchery at different times to have less impact to the trout culture in the facility.

   Currently the plumbing of the hatchery is not designed in a way that allows for isolating systems from each other and bypassing water flow from one raceway to the next. For purposes of disinfection and isolating raceways from each other when diseases are encountered, it is recommended to add valves and make adjustments to the plumbing in order to have better control of water flow in the facility.

2) The largest environmental biosecurity risk at the facility is the inability to eliminate predatory birds and mammals from entering the production raceways. It is believed that *A. salmonicida* was introduced through this pathway. The presence of other endemic pathogens, such as IPNV, in feral fish within the watershed make the presence of birds a continued risk for pathogen introductions. It is recommended that the outdoor raceways are enclosed within a building structure, including a cover with sturdy walls, to eliminate birds and wildlife from entering the facility. Netting over top of the raceways is not recommended due to the possibility of setting up a perch for birds over the raceways. In addition to increasing the biosecurity, covering the raceways benefit fish production by reducing stress to the fish, reduce the fouling of raceways by eliminating sun exposure, eliminating sun burn and cataracts in the trout (a common problem at Pequest), improving the growth conversion factors in fish, and reducing phosphorus discharges into the Pequest River. Several members of the Hatchery Biosecurity Panel had mentioned that the covering of the raceways has made the largest difference in improving the quality of fish raised at the facility. Discussion also suggested the installation of solar panels on the roof structure, which may open other sources for funding opportunities as well as benefit the facility by lowering operating costs and have a more sustainable source of energy.

3) A major problem at the facility is the maintenance of broodstock fish in the third-pass water in the serial re-use hatchery. Currently broodstock are maintained at the end of facility within third-pass water from the production fish held upstream. The broodstock are held downstream of the production fish to avoid the introduction of pathogens from the broodstock to the production fish. A disadvantage is having the broodstock fish held in suboptimal water quality, leading to potential disease problems. It is highly recommended to provide fresh (first pass) water to the broodstock and for the effluent to go directly to the treatment plant/settling ponds. This way water flow will be separated between production fish and broodstock.

4) A UV sterilization system should be installed in the plumbing between the upper hatchery (first use water) and lower hatchery (second use water). This will reduce or eliminate the spread of pathogens from the fish held in the upper series of raceways to the lower series of raceways. The pathogen load would be reduced from the system and there would be a lower risk for the production fish held in second-pass water to become affected by an infectious disease.

5) New personal work at the hatchery every season. It is important for all hatchery workers to be familiar with proper biosecurity practices. Jan will offer a biosecurity training workshop to all personnel on an annual basis.

Blue Ribbon panel (Hatchery Biosecurity) members:

Wendy Anderson
NJ State Director
Certified Wildlife Biologist
USDA-APHIS

Patricia Barbash
Senior Fish Health Biologist,
USFWS, Fish Health Center

Rod Getchell
Sr. Research Associate
Cornell University
College of Veterinary Medicine

Agust Gudmundsson
Councilman
N.J. Fish & Game Council

Jan Lovy
Fish Pathologist
N.J. Division of Fish & Wildlife

Donald W. Stremme
AQUAVET® Director
School of Veterinary Medicine
University of Pennsylvania

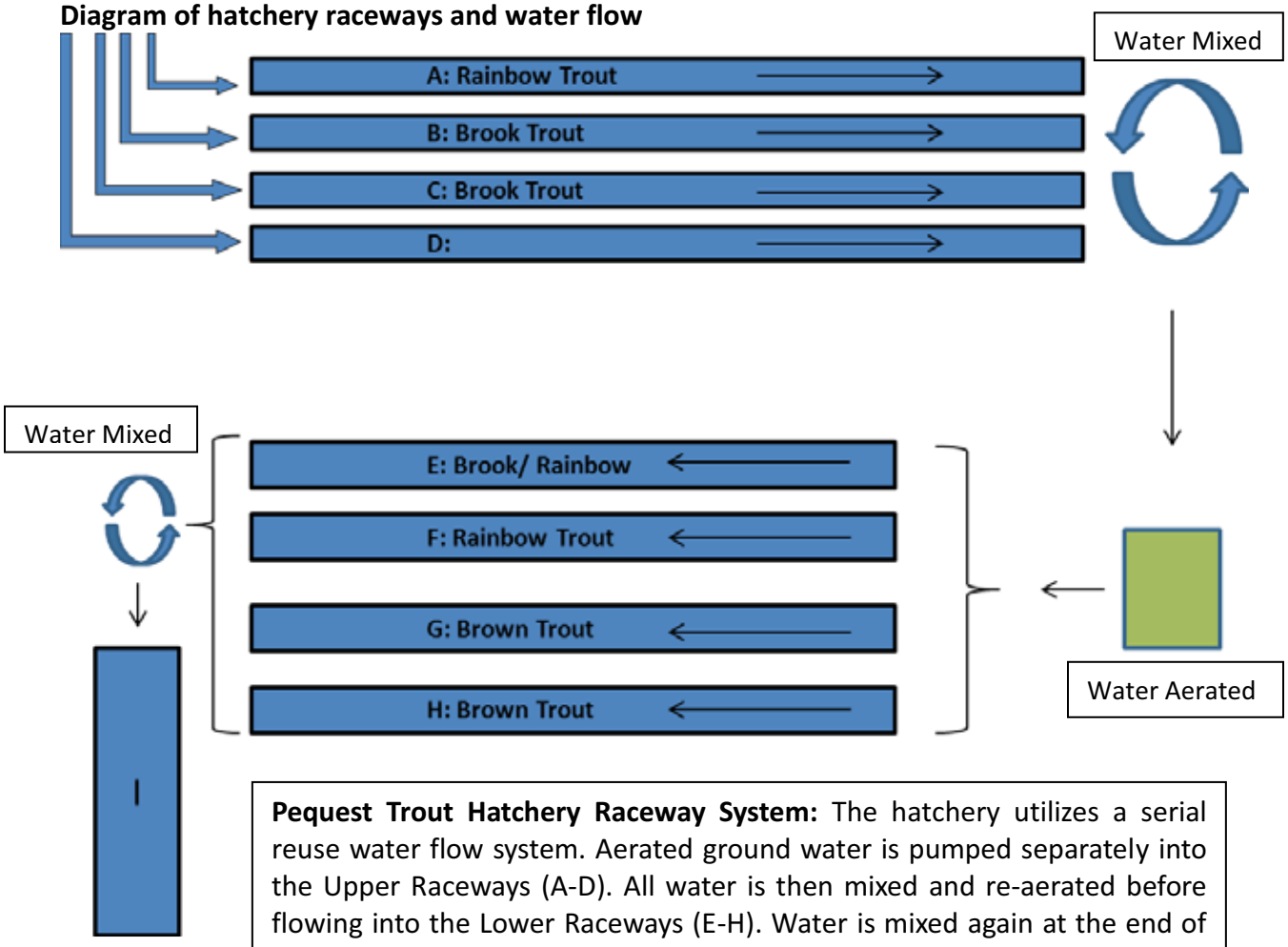
Ed Washuta
Fish Health Biologist
N.J. Division of Fish & Wildlife (retired)

Gary Whelan
Michigan DNR Fisheries Division

Pequest Trout Hatchery

(Disregard the species classifications in the raceway lines; currently all raceway lines have rainbow trout, with the exception of the I line which has limited brown trout)

Diagram of hatchery raceways and water flow



Pequest Trout Hatchery Raceway System: The hatchery utilizes a serial reuse water flow system. Aerated ground water is pumped separately into the Upper Raceways (A-D). All water is then mixed and re-aerated before flowing into the Lower Raceways (E-H). Water is mixed again at the end of the Lower Raceways before flowing into the Brood Stock Pools (I).