GREAT LAKES FISH HEALTH COMMITTEE

2018 Summer Meeting
Erie, Pennsylvania
August 1-2, 2018

Minutes
(with attachments)

Submitted By:

Erin Bertram

Great Lakes Fishery Commission

GREAT LAKES FISHERY COMMISSION
2100 Commonwealth Blvd, Suite 100
Ann Arbor, Michigan 48105
Great Lakes Fish Health Committee

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List of Attendees

John Coll	U.S. Fish and Wildlife Service- Pennsylvania
John Dettmers	Great Lakes Fishery Commission
Kevin Kayle	Ohio Department of Natural Resources
Kerry Hobden	Ontario Ministry of Natural Resources and Forestry
Dave Meuninck	Indiana Department of Natural Resources
Andy Noyes	New York State Department of Environmental Conservation
Paula Phelps	Minnesota Department of Natural Resources
Gary Whelan	Michigan Department of Natural Resources
Coja Yamashita	Pennsylvania Fish and Boat Commission
Ken Phillips	U.S. Fish and Wildlife Service- Wisconsin
Dave Giehtbrock	Wisconsin Department of Natural Resources
Danielle Godard	Wisconsin Department of Natural Resources

Other Attendees included:

Loredana Locatelli	Cornell University
Rod Getchell	Cornell University, College of Veterinary Medicine
Erika First	Cornell University, College of Veterinary Medicine
Jacques Rinchard	The College at Brockport – State University of New York
Matt Futia	The College at Brockport – State University of New York
Brian McHail	Pennsylvania Fish and Boat Commission
Mark Haffley	Pennsylvania Fish and Boat Commission
Craig Lucas	Pennsylvania Fish and Boat Commission

Great Lakes Fish Health Committee Meeting

The Sheraton Erie Bayfront Hotel
55 W Bay Rd Drive, Erie, PA 16507
August 1-2, 2018

Agenda

Wednesday, August 1st 2018

8:00-8:15	Welcome & Introductions (A. Noyes)
	Minutes explanation and GLFC webpage navigation (J. Dettmers)
	Perox-aid purchase dilemma (All)
8:15-8:30	GLFC Update (J. Dettmers)
8:30-9:00	Science Transfer (A. Noyes, All)
9:00-10:00	Revisit and Update Model Program, Risk Assessment, and Research Priorities (All)
10:00-10:15	**Break**
10:15-11:00	Baitfish Update (J. Dettmers)
11:00-11:15	Minnesota Ballast Permit (A. Noyes, All)
11:15-12:00	Agency Updates (All)
12:00-1:00	**Lunch**
1:00-1:30	Fish Health and the PFBC Cooperative Nursery Program (B. McHail)
1:30-2:00	Thiamine Deficiency Study (TDC) Update (J. Rinchard and M. Futia)
2:00-2:15	Outbreak of *Vagococcus salmoninarum* at the Iron River, WI National Fish Hatchery (K. Phillips)
2:15-2:30	Investigations of 2017 and 2018 VHSvV Outbreaks in New York (R. Getchell)
2:30-2:45	**Break**
2:45-3:30	VHSv Roundtable-"What's the status of VHSv in basin?" (All)
3:30-4:00	PFBC Lake Erie Research Unit (M. Haffley)
6:00	**Dinner**

<u>Thursday, August 2nd, 2018</u>

8:00-8:15	Reconvene and introductions (A. Noyes)
8:15-9:00	PA Fish and Boat Commission Presentation (C. Yamashita)
9:00-9:30	Overview of PFBC Lake Erie STT and BNT Program, Fairview SFH Overview (C. Lucas)
9:30-10:00	Agency Updates (All)
10:00-10:15	**Break**
10:15-11:30	Agency Updates (All)
11:30-12:00	2019 Summer Meeting Location/Meeting Recap/Generate Meeting Summary for GLFC (A. Noyes)
12:00	**Adjourn**
	Fairview SFH and Local Co-op Tour

Progress of Action Items from the Summer 2018 Meeting as of April 2019

ACTION ITEM: The commission will format and bind the past meeting minutes from 2016 and 2017 with the table of contents, title pages, and associated documents and update them on the commission's website for the Fish Health Committee (FHC) page.
STATUS: In progress

ACTION ITEM: The commission will update the FHC membership on the web page. With removal of Mohammed and the addition of Dave Giehtbrock with WI DNR. It was requested that his name be linked to the WI DNR home page.
STATUS: Completed

ACTION ITEM: The commission will also be sure to check that all other members have the correct link associated with their names.
STATUS: Completed

ACTION ITEM: The commission will address the issue related to the availability of the FHC hatchery classification reports and other works and come back to the FHC with options in improving the search engine on the GLFC website.
STATUS: Completed

ACTION ITEM: To have the FHC summarize this decision (regarding IPNv reclassification) back to the hatcheries that brought up this concern.
STATUS: Completed

ACTION ITEM: Additions to the research interests list:
What are the pathogens of concern from freshwater mussels? Are there any validated testing methods including testing for their fish hosts (including mudpuppies as hosts)?
STATUS: Completed

ACTION ITEM: The commission will draft a position statement for additional review by the FHC before providing it to the CLC for its review and possible adoption.
STATUS: Completed

ACTION ITEM: The commission associate will send the minutes to the FHC chair
STATUS: Completed

ACTION ITEM: A summary document of all decisions, action items, and products from this meeting and for future FHC meetings will be created and shared.
STATUS: Summer 2018 FHC Meeting Summary document completed

1. **Welcome & Introductions** (A. Noyes)

The chair of the Great Lakes Fish Health Committee (FHC), Andy Noyes with NYSDEC, welcomed all attendees and guests.

Navigating the Fish Health Committee webpage on the Great Lakes Fishery Commission (GLFC) website:
To find the FHC meeting minutes and annual reports:
Go to the GLFC website at www.glfc.org, select *For Our Partners-Joint Strategic Plan Committees-Fish Health Committee*, then scroll down under Publications and Products and select *More publications available through the Publication Search*

ACTION ITEM: The commission will format and bind the past meeting minutes (2016 and 2017) with the table of contents, title pages, and associated documents and update them on the commission's website for the Fish Health Committee (FHC) page.

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ACTION ITEM: The commission will also be sure to check that all other members have the correct link associated with their names.

ACTION ITEM: The WI DNR noted that there is a need to search for a new bacteriologist for their technical committee at this time.

Perox-Aid purchase dilemma: There is an issue with Western Chemical not selling the barrels in the preferred 40-gallon quantities. The tanks it is delivered in can only be used once and cause problems in recycling them and storing them. There was discussion about either writing a letter of concern or inviting a Western Chemical Representative to a FHC meeting would be useful to discuss the concerns with available quantities of peroxide for purchase.

DECISION: The committee will wait until next year to take the next step with this issue.

2. **GLFC Update** (J. Dettmers)

John Dettmers with the Great Lakes Fishery Commission (GLFC) added the topic of the Commission's Fish Pass project for discussion later in the meeting during other scheduled updates from the commission.

3. **Science Transfer** (A. Noyes, All)

Sharing established science to the FHC and other partners and interested parties could be improved. The commission is still figuring out the logistics of the program. Ideally, it will be used to provide information that is already available in literature, summarize it, and make available to the FHC and other committees to use to their benefit.
Question- what topics do the FHC feel they are not up to date on in the current literature that would be requested for the commission to make available or synthesized?

ACTION ITEM: The FHC will communicate to the commission any specific fish health related topics that they would like to see more of and available.

Options for information sharing
The FHC and the commission could write an issue statement for the Science Transfer Board (board) to consider. The best timing for developing topics during the summer meeting, would be to submit them for discussion by the board in the following spring. For example, one project involves an expert panel working with managers to answer their questions about the functional utility of using eDNA in the Great Lakes for making management decisions. Other projects include developing communications about changes and shifts in lower trophic levels. There is no specific final product; instead, final products are tailored by each proposal. For example, fact sheets and other documents and information can be developed that can be used by fishery managers. For instance, there are a lot of interpretations with the use and reliability of eDNA but managers are the ones that must make the decisions so providing summarized research will help them make those decisions.

Discussion
The FHC would like to make sure that its historical body of work such as fish hatchery classification reports is available and searchable.
The current FHC database has historic information from Great Lakes parasite information that was developed in 2011 and that is available.

ACTION ITEM: The commission will investigate this issue to come back to the FHC with options in improving the search engine on the GLFC website.

Discussion
The commission could add a third category on the FHC webpage next to the minutes and annual reports column as "summary of decisions & action items" with available summaries per meeting. These summaries would be sent to fish chiefs, the council of lake committees (CLC), individual lake committees, and technical committees on an annual basis.

4. Revisit and Update Model Program, Risk Assessment, and Research Priorities (All)

- *Model Program for Fish Health Management in the Great Lakes*

Restricted Pathogens- Hatchery staff are suggesting that infectious pancreatic necrosis virus (IPNv) should be reclassified from a restricted level II to a restricted level I pathogen and that there be a similar recommendation for it as used for largemouth bass disease (LMB) found on page 10 of the Model Program. The current recommendation as a restricted level II pathogen is as follows: "*Eradicate infected hatchery lots and do not stock positive lots*". Hatchery staff see this change as a benefit as it would allow them more options in what to do with infected fish and fish lots especially for infected brood stocks. *Options considered by the FHC-* were to create a secondary or sub category action or add provisions to the current recommended guidelines for IPNv. These provisions would be written to specifically allow hatchery managers more options in making decisions under certain circumstances that would be of the best interest for the fish lots and retaining their value versus going through the process of re-classifying IPNv as a restricted level I.

DECISION: No change made at this time

ACTION ITEM: To have the FHC summarize this decision back to the hatcheries that brought up this concern.

Provisional Pathogens- Should *Epizootic epitheliotropic disease virus* (EEDV) that is endemic in the Great Lakes basin, be moved to a restricted level I? Recent reliable molecular tests are available to detect the pathogen, however, there is not enough information about the testing for EEDV for the FHC to be confident that it can keep the virus out of hatcheries. There would need to be a protocol in place for if or when it is detected in a hatchery and the testing for EEDV is not economical.

DECISION: The FHC decided not to reclassify EEDV as a restricted level I pathogen at this time.

Table 2. Page 15. - The statistics of the table assumes standardized random distribution but this is not commonly seen in hatcheries. What is the real prevalence and at what level? At least 300 fish need to be sampled for accuracy. However, the problem is that there is a limit to how many fish can be tested due to cost and the value of the fish. The data analysis should be based on AFS "Blue Book" recommendations which also suggests sampling should target morbid fish for accuracy.

DECISION: No definitive changes are being made to the model program.

- *Risk Assessment for the Introduction or Transfer of Fish and Associated Pathogens into the Great Lakes Basin*

USFWS is reevaluating their scoring system of the Risk Assessment.

ACTION ITEM: To consider comparing FHC risk assessments with other risk assessments that deal with other species or from other agencies

ACTION ITEM: To talk with the Northeast Fish Health Committee about how they do risk assessments

ACTION ITEM: To add evaluation and validation of the GLFHC Risk Assessment as a research priority to the current risk factors and their relevant weighting in the current risk assessment appropriate?"

DECISION: No changes were made to the risk assessment at this time

- *Fishery Research Priorities*

The following research priorities from the document were discussed.

-What non-lethal field sampling methods and tissue/fluid samples are equivalent to conventional lethal field sampling methods to determine fish pathogen and/or disease status?
-Develop and validate new methods to detect emerging fish pathogens or pathogens of concern in the Great Lakes Basin.

ACTION ITEM: The FHC is still interested in identifying non-lethal field sampling methods and will add language to these specific research interests as follows: The identification and validation of non-lethal methods is a desired product.

- *Additional Research Interests*

Specific research questions under this heading of the document were also discussed.

1. *What is the effectiveness of the FHC disinfection protocols in eliminating key pathogens of interest from fish eggs?*

There is a need for a reliable disinfection methodology to prevent pathogen transmission via eggs and sperm.

ACTION ITEM: the FHC will still pursue this as there are still issues with reliability of the disinfection protocols.

3*. Nutritional Aspects of Fish Health in the Great Lakes.*
(a) What is the role of lipids or other nutrients in determining and predicting health status?
(b) What is the role of thiaminase-producing organisms in Great Lakes ecosystems?
(c) What affect do invasive species have on nutrient stores in the Great Lakes and what are the associated effects on fish health? Do these still need more weight and priority?

DECISION: No change made

ACTION ITEM: Additions to the research interests list:
What are the pathogens of concern from freshwater mussels?
Are there any validated testing methods including testing for their fish hosts (including mudpuppies as hosts)?

5. Baitfish Update (J. Dettmers)

Does the FHC think there is enough information based on the work that has been done about risks associated with bait fish in terms of spreading pathogens? Does the FHC want to communicate this concern to personnel that have power to create regulations on bait fish that can provide administrative rule changes perhaps to be able to help managers/agencies deal with this?
It is evident that bait fish can carry numerous pathogens and it is important to make people aware that this is a possibly hidden risk to the healthof fish populations throughout the region. Are there recommendations from the FHC about how to communicate this?
An option is to write up a position statement on the issue that would be based on the concern of transport of pathogens to be presented to the Council of the Lakes Committee (CLC).

Components to the Position Statement

a. What is currently known? What technically should be communicated to managers?
It is known that Pathogens are present in bait fish and that this is a pathogen-based concern, and not a bait species concern. The pathogens of most concern are viral hemorrhagic septicemia (VHSv), nidoviruses, and Asian tapeworm. Baitfish shipments and transport are key vectors of risk that are currently not well regulated. Fish health experts lack knowledge about the suite of pathogens traveling with bait as there is limited information about pathogen home ranges, which in turn increases decision

making uncertainty. Wholesalers and retailers often use questionable methods of mixing bait fish within or between jurisdictions. It is not clear how certain pathogens would be transmitted, what species they may infect, and how and what species may be vectors for them. Given there is a large and dispersed sale of bait fish, even a very rare occurrence of a pathogen substantially increases the risk of it appearing in the wild.

b. What does he FHC recommend? Precautions, regulations, ad rules, contract stipulations, and Best Management Practices (BMPs)

It would be beneficial to create outreach efforts to the bait industry and anglers that purchase bait from those sources. Any existing agency bait sampling protocols may need to be made more robust to reliably detect pathogens in bait supply. There will also be a need for explicit views of the testing data made available. It would be important to develop a common list of baitfish that should be tested among all Great Lakes jurisdictions and to educate samplers for proper sampling techniques and protocols that are common across third party samplers. Lastly, the FHC may consider developing a model program for handling baitfish within states and the province of Ontario.

ACTION ITEM: The commission will draft a position statement for additional review by the FHC before providing it to the CLC for its review and possible adoption.

6. **Minnesota Ballast Permit** (A. Noyes, All)

The Minnesota Pollution Control Agency had notified relevant agencies about Minnesota's Ballast Water Discharge General Permit expiring September 30th 2018 with intent to reissue the permit and had requested any comments during a 30-day public notice for the reissued permit starting July 23rd.

The draft permit was made available at https://www.pca.state.mn.us/public-notices.

The draft permit was reviewed by the committee and the following concerns or thoughts were discussed:

The requirement to switch the language into English for reporting is not seen as necessary and may hinder the willingness to provide the reports.

The treatability study is very vague and there is no oversight of the study.

The high-risk form requirement by the National Pollution Agency (NPA) is not seen as necessary and redundant with other required forms.

The permit duration increase from five to 10 years is too long as technology is being developed rapidly for ballast water management and would need to be incorporated immediately

Question- Does the FHC or partners want to contact Minnesota to make comments on any changes or additions to the permitting?

7. **Agency Updates** (All)

Indiana Department of Natural Resources (IN DNR) (D. Meuninck)

Usually 700 adult steelhead trout from Trail Creek in Michigan City are collected in June or early July and brought to the Bodine fish hatchery to hold them until February when they are mature and then strip the eggs and sperm for spawning. Thiamine has been injected into adults for eight years. Brood collection usually begins in July and there are minimal losses due to handling. However, this year the first week was going well but then lost 60 fish in a nine-day period. A sub sample of fish was sent to Purdue where they found mucous buildup on the gills as well as *Aeromonas hydrophila* which was resistant to antibiotics. The remaining fish in the hatchery had wounds with fungus growth, tails were frayed, and caudal fin erosion was seen only within a week's time (only sometimes this is seen but not until February). So far total loss is 12-15%. Currently conducting salt treatments. Recently, lost 30 fish, and continuing treatment for fungus. The first egg takes are planned for January and February.

Possible causes of loss of fish- Trail Creek collection site was running five degrees warmer than earlier years. Also, it can be stressful moving up the river before they get to their spawning site. Lake Michigan biologists were made aware and will watch for fish kills around Trail Creek. IN DNR is requesting recommendations on how to treat the fish for this issue and keep mortalities low.

Pennsylvania Fish and Boat Commission (PFBC) (C. Yamashita)

The PFBC has detected whirling disease at the Bellefonte State Fish Hatchery. The hatchery has historically been positive for the pathogen; its recurrence at the hatchery is likely due to using poor methodologies that make the hatchery more susceptible to pathogens and introduction of the disease. Lake trout at the Huntsdale State Fish Hatchery suffered severe mortality following a mud event where mortality was attributed to Epitheliocystis. Other species of salmonids at the facility also tested positive for the pathogen.

The PFBC is recently looking into mussel culture for some of their facilities. State facilities stocking fish into the Great Lakes Basin were negative for IPNv. Brook trout which were historically positive for IPNv were removed from the facility.

Walleye infected with leaches were reported in Lake Erie as well as for American Shad from Chesapeake Bay and Delaware River estuary this year.

The PFBC is concentrating on the R3 (3 R's) initiative. For example, there are plans to stock catfish in local ponds for fishing events. However, there is a need to consider fish health when doing this for public event purposes.

Wisconsin Department of Natural Resources (WI DNR): (D. Godard)

There have been 22 inspections done so far this year with no issues identified.
However, there were three unusual morbidity/mortality cases seen in Walleye

a) *Columnaris*- was detected and treated with Aquaflor but it did not work effectively as it should. Currently, waiting on test results (conducting a sensitivity study to the Aquaflor) to figure out why.

Possible causes: Should the medicated feed be tested for effectiveness and dose? Is the feeding protocol sufficient? Is the current vaccine ineffective?
In the meantime, hydrogen peroxide is being used to supplement Aquaflor

b*) Cold water disease*- Was detected in coho fingerlings, in spite of being treated with iodine as eggs. There was an associated high mortality but Aquaflor treatment was successful.
c) *Unknown disease-* An increased mortality was seen for lake sturgeon fry in the Milwaukee streamside rearing station. However, there was no sign of any disease during the gross exam by the veterinarian in June. By July a large spike in mortality was seen in a single tank with clinical signs of disease. Further testing for *Flavobacterium* sp. was completed and was detected, along with other tests for herpesvirus 1 that came back negative, and for herpesvirus 2 which are awaiting results.

Plans- To conduct detailed water quality testing from the river water entering the collection trailer and to send samples to UC Davis for fungal analysis. The food was also analyzed (brine shrimp and meal worms).

Research: In spring 2017, small circular plaques on lake sturgeon were noticed; these tested positive for AciHerpV1 which is normally found in white sturgeon not in lake sturgeon.
Question: Is this active infection in other areas of the state? Scrapings of lake sturgeon from Wolf River were collected and tested via PCR only (not cell culture). Nine out of 10 were positive for Herpes 1. Two other fish from the Menominee River also tested positive. At this point the plan is to continue to test samples as they are submitted. In addition, there will be ongoing surveillance in broodstock and forage fish, will test fish from vendors that are used to support musky and walleye stocking, and will also be looking for VHSv by collecting VHSv susceptible species annually, and continuing with Aciherpv1 monitoring.

<u>Investigational New Animal Drug (INAD)-</u> overall treatments have been successful but minimal reports of toxicity available or shared.

<u>Oxytetracycline (OTC)-</u> Emerging global concerns on antibiotic resistance along with its judicial use (mostly for cool water fish). WI DNR is trying to amend a commonplace use of OTC for skeletal marking of fish due to its resistance effects.

8. Fish Health and the PFBC Cooperative Nursery Program (B. McHail)

The PFBC cooperative nursery started in 1932 with 21 sportsman's organizations. Since then, only is one is still around. Sponsors such as the Sportsman's groups, Rod & Gun club/outdoor groups, and schools fund the nursery program**.** The nurseries receive fingerlings from the PFBC such as trout, musky, or largemouth bass in early spring and summer. Then they are stocked once they reach legal size. Cooperative nurseries are typically a very basic set up with usually one race way about 25 ft. long with some coverage or a roof, a few spring fed ponds, and a small recirculating system. The maximum security prison also aids in running a cooperative nursery. Inmates will take a course on fish rearing and two of them are chosen to go through a program and become certified to work in the nursery.

2017 Stocking data- A total of 998,390 trout were stocked for angling. As an agency, 3.2 million are stocked annually through the program plus the 1 million from PFBC. Co-ops are run solely by volunteers. About 135,000 volunteer hours have been documented. The co-ops also hold around 200 derbies for veterans, elderly, disabled, kids etc. The 2017 sponsor expenditures on feed, electricity, improvements are in the 100's of thousands of dollars, but the co-op's cost per fish is only about $1.02. The sponsors are responsible to raise the fish and take on those expenses once the fish are delivered to the nursey. The 2017 Grant Program for FY 17-18 had $30,000 available. All 41 applications were approved. The co-op nursery unit has biannual inspections, emergency inspections, prospective inspections, biennial co-op seminars, provides daily technical guidance to co-ops, and provides annual report/RFP data entry.

Fish Health: Stressors in co-op nurseries are usually seasonal water fluctuations, drought, storms, or other environmentally induced stressors.

Emergency nursery inspections- These are on-site diagnostics for parasites, bacteria, environmental causes etc. and provide samples to the fish health unit. Overall, the inspections, biosecurity, and fish health management are much more advanced than they used to be and now only use approved treatments. Emergency inspections were the highest they have ever been in 2017. The likely cause is due to hot weather and other uncommon environmental conditions, although, more awareness of fish health, may also lead to more health issues being reported.
<u>Veterinary Feed Directives (VFD):</u> Fifty-six were submitted. Gill lice monitoring was conducted and 12 co-ops were positive. There are nine nurseries in Erie County. IPNv was detected in the Erie nurseries forcing them to destroy all their steelhead trout. GLRI funding of $60,000 was available; Pennsylvania used $36,000 of it to purchase new equipment, disinfectant, PPE, aeration equipment, stocking tanks, lab equipment etc. for the Erie County co-ops.

Question: Do any other states representing the FHC have Co-op nurseries? Wisconsin does and uses similar logistics and methods i.e. based on volunteers except stocking the fish.

9. **Thiamine Deficiency Study (TDC) Update** (J. Rinchard and M. Futia)

<u>*Overview of Thiamine Deficiency Complex, Matt Futia-*</u> Thiamine is an essential vitamin (B1) for energy metabolism. Thiamine deficiency complex (TDC) was first documented in hatcheries in 1960s- when it was called early mortality syndrome as it was seen only in fingerlings. By the 1990s, mortality had peaked to 100% of all offspring and spurred research to understand the cause. Research revealed that the addition of thiamine (via thiamine baths) would increase the fishes' concentrations and would increase their health

and growth as well as for their offspring which could also be injected with Thiamine. TDC is occurring in other regions such as NY finger lakes and is considered an emerging global concern. Specific explanation for the cause of TDC remains unknown.

The impacts of TDC: Primarily affects offspring but can impair adults. The insufficient transfer of thiamine to offspring from the adults results in deficient offspring and thus may have decreased recruitment in wild populations. Deficient offspring were only observed in hatcheries, not in the wild.

Question: Can wild offspring acquire thiamine during development from other sources in the wild? Such as decaying organisms releasing thiamine?
The impacted adults may also show behavior abnormalities that result in reduced fitness and increased mortality due to a lack of coordination and limited migrating abilities. TDC intensity varies among species.

Potential causes being investigated- Thiaminase- the enzyme that is capable of degrading thiamine and occurs in some plants and bacteria as well as in fish species, shellfish, zooplankton, and insects. Fish such as prey fish, may be producing thiaminase on their own. As to why they would be, it is not clear. Thiaminase activity is very variable over time. The cause of the variability in activity is not known or understood.

Other factors- For example: In the Baltic Sea, there was a case of TDC and prey species were analyzed as the cause. Prey species are high in or have more lipids or fat which is used as energy more so to metabolize fat and not so much for thiamine production. Oxidative stress may limit thiamine concentrations because it is used as an antioxidant. TDC may be associated with low concentrations of antioxidants. However, all these correlations have only been supported in the wild.

Objectives- Lipid content was analyzed in prey species of alewife, rainbow smelt, and round goby over time focusing on the varied lipid or fat content in the winter vs in the spring, and compared lipid content to size (age) of the fish, and the relationship of Thiamine abundance in each species.

Lake Champlain example- the invasion of alewife was preceded by an increase in natural recruitment of lake trout. The reason for an increase in recruitment is still unknown. Coexistence of alewife and lake trout have occurred in other lakes as well.
The increased diversity of forage base can alleviate TDC. For example, Cayuga Lake following Round Goby had an increase in lake trout egg thiamine concentrations. It was understood that more forage base diversity can increase thiamine concentrations. Still seeing declines of thiamine for lake trout in Lake Michigan and Lake Huron. Thiamine deficiency in Lake Ontario lake trout shows a lot of variability within years. There is also intraspecific variation seen in Lake Ontario where individual smaller lake trout appear to incorporate more round goby in their diets and larger lake trout have lower thiamine concentrations. Thiamine concentrations in Lake Ontario eggs varies greatly by species

which also have a lot of variation in their adult parent diets. The percent contribution of vitamers also varies. Lake Superior lake trout thiamine concentrations are far greater than in any other lake. Ontario has the least amount.

Thiamine Thresholds- part of this study was to compare egg thiamine concentrations to TDC induced offspring to determine thiamine thresholds. Based on mortality it varies among species for thiamine thresholds. Species vary in the amount of thiamine they need in development and reproduction which might explain threshold variation.

<u>Health Assessment of Thiamine Deficiency in Lake Ontario, Jacques Rinchard-</u>
Objectives- The current study is based on thiamine concentrations among Lake Ontario Salmonids. One objective is to validate the ELISA (enzyme-linked immunosorbent assay) method to measure thiamine concentration in fish tissues.

Methods- Tissues were collected for lake trout, coho, chinook, and steelhead trout in 2016 to 2017 during a time when the fish are done doing major eating before spawning. Thiamine is tested for in the eggs, muscle, liver. A thiamine dependent enzyme and Vitamin E, etc. was also analyzed. Also, looked at thiamine concentration of the three thiamine forms among fish from both the east and west sides of lake, looked at percent females above and below thiamine threshold inducing 50% mortality, and thiaminase in alewife (east and west).

Conclusion: TDC occurrence is declining. The question remains whether TDC is thiaminase induced or a lipid effect? Plans are to continue to monitor to detect the occurrence of TDC in salmon species and conduct controlled experiments to determine the cause of TDC vs simple correlations. Additionally, plans are to evaluate *in situ* TDC in alevins and see if access to natural food could reduce the TDC in wild alevins. Lastly, the PI's will explore whether other factors could contribute to TDC.

10. Outbreak of *Vagococcus salmoninarum* at the Iron River, WI National Fish Hatchery (K. Phillips)

Coaster brook trout spawn in early fall. In fall of 2017, staff noticed eggs were green but there were no issues with egg quality as they eyed up. Mortality began post spawning in the 2013- and 2014-year classes reaching 39-40%**.** Later, the staff noticed some females had eggs still encased in the skein after spawning. The hatchery contacted LaCrosse Fish Health Center in January and scheduled an inspection in February**.** A necropsy was done on the fish, finding egg retention, cloudy fluid surrounding the heart, necrosis of cardiac tissue, and ascites in fluid. Samples for bacterial analysis from the brain, egg skein, heart, and kidney were taken. Subsequent tests identified the bacterial pathogen as *V. salmoninarum*.

<u>What is *V. salmoninarum*?</u>
It is a gram-positive chain forming coccobacillus, and a lactic acid bacterium that is common gut fauna of some animals including birds. Observations at Iron River were consistent with the literature, affecting spawning in adults, egg retention, cardiac tissue, and forming ascites

in the fluid. It is found in rainbow trout, Atlantic salmon, and brown trout. The first isolation was identified in late 1960s in Oregon and later first identified and described in the 1980s in Europe.

Treatment options- INAD options are available or extra-label drug use prescription methods (ELDU). Some of these may work but some of them have short half-lives and staff must do repeated injections to have an effect. There will need to be a lot of dosing experiments to see what works effectively using ELDU.

Next steps- USFWS will investigate vaccinations or additional treatments and will continue monitoring Iron River broodstock of brook trout, lake trout, and production of both. Brook trout progeny monitoring in Genoa NFH and Jordan River NFH will also occur.

Again, there was a loss of the older year classes of 2013 and 2014 of up to 50% with a higher percentage of them being females. At this point the USFWS cannot predict the quality and quantity of eggs from spawning fish this year and is not sure how many or what shape they'll be in. The two-year-old year class will be the backup plans for now or may use wild gametes from Isle Royale. *V. salmoninarum* is currently classified as an emergent pathogen in Europe**.** Most literature is available on the effect of this bacterium on hatchery fish but not for wild fish.

11. Investigations of 2017 and 2018 VHSv Outbreaks in New York (R. Getchell)

In May 2017 a fish kill of 1000s of round gobies occurred on Cayuga Lake with many dead gobies washing up on shore. The inspected gobies had hemorrhagic lesions in the gonads and liver.

Question:

What could be causing these hemorrhagic lesions?

- High on the list is Viral Hemorrhagic Septicemia virus (VHSv)
- Last VHSv induced mortality event was in 2013 and 2014 in Lake Erie and Lake Ontario
- Round gobies invaded NY waters five years ago

Questions:

Could it be possible that they carried VHSv with them during their invasion?
If so, why did it take until 2017 to see fish kills caused by VHSv?
Where did the virus originate from?

Microbial assays and several other tests were done on the ground for gobies to determine their origin. Round gobies were sighted in Erie Canal several years ago and spread over time. It is not understood if the present round goby distributions come from migration into Cayuga Lake from Lake Ontario and Lake Erie or vice versa? The VHSv results from Cayuga Lake in 2017 showed a very low copy number of VHSv but fish still died.

2017 Prevalence of VHSv in Round Goby in NY- The St. Lawrence River had not previously been sampled but they did sample there and round gobies were infected.
All samples from 2017 sites were sequenced. The likely source of the May 2017 VHSv outbreak on the eastern shore of Cayuga Lake was originally from Lake Erie.

Conclusion on migration: Round goby migration was from Lake Erie/Lake St. Clair through the Erie Canal to Lake Ontario and on to Lake Cayuga (not the other way around). Round gobies are now migrating into the middle of NY and are now head east past Lake Oneida.

2018 VHSv outbreaks in NY:

There was a large gizzard shad die off in Irondequoit Bay early this year. This is normally an annual event usually related to winter kill and cold-water stress. However, hundreds of freshly dead gizzard shad were found on the shores again with significant external hemorrhages. A gizzard shad tested positive for VHSv again at a low level but no information on where it originated from.

On May 2nd, dead and moribund sunfish were submitted from Sodus Bay for analysis. Pumpkinseeds and Bluegills had tested positive (also low concentrations) but were also found to be co-infected with *Pseudomonas mandelii*; a severe bacteremia found in almost every tissue but doesn't reflect external lesions. A few days later, it was discovered that these fish were infected with VHSv but was so acute and at low levels. It is likely the fish kill was due to *P. mandelii*. An RNA extraction and qPCR were conducted and came back as 1000s of copies of the VHSv revealing a co-infection occurred. Which pathogen is to blame, the bacterium or VHSv? Not much is known about *P. mandelii*. It was first found in mineral water in France.

Sea lamprey were also tested during this time and all came back as negative.

The take home message: When VHSv hit 15 years ago and then spread, there was a blast of it early on and then detections became very sparse. Now it is back again and reliably easy to find. If you look for gobies in Cayuga Lake you will almost always find VHSv positive fish. Gobies are now essentially reservoirs and vectors of VHSv.

12. VHSv Roundtable- "What's the status of viral hemorrhagic septicemia virus (VHSv) in basin?" (All)

Michigan- Gizzard shad is an important vector for VHSv. When there is even only one or two infected fish it spreads rapidly due to the highly concentrated populations of gizzard shad moving together. The public noticed gizzard shad mortalities in February, and by March 7th in Anchor Bay of Lake St. Clair gizzard shad were confirmed positive for VHSv. Of those fish, four out of 10 were CPE positive and the titrewas very high in those fish. Water temperatures were down in low 30s and VHS is most active at colder temperatures. Monsoons made it difficult to collect any samples until May when the water temperature had then warmed up to 53 F. More mortalities were seen in the same bay including bluegill and gizzard shad, both of which were positive for VHS. There were mortalities across Lake St.

Clair in previous years, but most mortalities this year were specifically in the Anchor Bay, all believed to be from gizzard shad origination. Also, some dead mudpuppies were seen a month or so later but all were deceased for some time and were not useable to test. A reasonable hypothesis for these mortalities is that the mudpuppies ate infected shad. The plan is to do yearly surveillance and collect samples to keep an eye on the spread. It is believed that gizzard shad are a key vector. This is predicted to be a reoccurring event where gizzard shad are reoccurring virus reservoirs. There hasn't been any event of young of year (YOY) dead gizzard shad. It is only seen in adults. There were no inland kills since 2012, except in Budd Lake, which had a small fish kill. Lastly, there were a lot more carp kills than typically seen this year.

Minnesota- Viral Hemorrhagic Septicemia has not been detected even in Lake Superior in MN (even though it is in Lake Superior). Minnesota DNR is going through budget cuts, resulting in loss of manpower and funding for testing. The MN DNR is looking into other options to make sure testing for VHSv frequency and intensity is still sufficient despite cuts to funding. This will be done by looking into VHSv testing priorities based on fish kills and needs and focus in high recreation areas etc.

Ohio- Some fish from the Maumee River system were positive for VHSv. Ohio also believes that gizzard shad are reservoirs of the virus. Last spring (2017), Maumee River walleye were also found to be VHSv positive, but they were not associated with a fish kill. There was one centrarchid dominated fish kill on the shores of Lake Erie and in the lower Huron River where it empties into the lake. For 2018, no fish tested were found positive for VHSv, and no other fish kills occurred that would have been associated with VHSv. Only in 2008 and 2009 were inland fish in one location positive for VHSv - in Clear Fork Reservoir, (part of the Ohio River drainage) south of the OH DNR VHS line of demarcation. There were seven successful annual follow-up tests that were negative through 2017, so no further testing was done on Clear Fork. To note, there is no active pathway, but the plan is to keep an eye on it as gizzard shad are present there.

Pennsylvania – VHSv has not been found. The PFBC hasn't had VHSv in a long time. There were two detections from bluegill in Presque Isle Erie, PA approximately five or six years ago and PFBC knows that VHSv is present but it has not been detected in years.

Wisconsin- Coregonid sampling was conducted and used to test for VHSv but all were negative. Gizzard shad from Port Washington and Menominee Rivers tested positive for VHSv. Lake Winnebago at Fond Du Lac, High Cliff, and Oshkosh had several species (freshwater drum, black crappie, bluegill, LMB, yellow perch, gizzard shad) test positive for VHSv. The plan is to continue to monitor and provide guidance to relevant people dealing with these species in the area to limit its spread.

ACTION ITEM: Danielle Godard has the chronology of VHSv in Wisconsin waters (provided in the PowerPoint presentation: the circled ones on this slide are from 2018) and can share it as requested.

Indiana- Potentially many years ago, yellow perch may have been positive for VHSv but it is not confirmed. It is most likely not in the Indiana waters of Lake Michigan.

13. PFBC Lake Erie Research Unit (Mark Haffley)

Research projects currently on Lake Erie-

Questions: Do discrete spawning stocks contribute deferentially to Lake Erie's walleye fisheries? Pennsylvania's fishery is believed to be based on western migration. Are local fisheries part of the big picture? Do local spawning congregations add to local fishery? Are these truly residents or migrators?

Objectives: To tag walleye to see if they are Pennsylvania (PA) fish by origin or if they just spawn where they are at, at the time.

Methods: To implant 20 acoustic tags into walleye on spawning shoals in PA waters. The tag insertion surgery uses instant electrosedation trays. Fish are immediately anesthetized and remain unconscious for surgery. Then when the fish is put back into water they recover normally. There have been no issues from using electrolysis. All fish are healthy and ready to be released. This process is faster and eliminates withdraw periods from other chemicals used to put fish under anesthesia. The electrolysis treys are made by Smith Root.
The tags used were from VEMCO which have super long battery life, and longer detection delays to reduce the probability of tag collisions on receivers. It is now possible to monitor western migration and movement of walleye and figure out where they are spawning. Pennsylvania expects to see about 10% harvest of tagged fish. There is also an incentive of $100 reward from anglers for picking up tagged fish. They can be identified with an exterior marker.

Time frame for tagging- On April 23rd, 2018 250-foot nets were set near shore where walleye spawn in four to six feet of water. The next day the nets were pulled and had over 200 adult walleye caught. The fish were kept in live wells before surgery and for after recovery.

Receiver array on Lake Erie for 2018- These were set up over the entire lake and basin and separated by eastern and western basins. These arrays can send notifications when the fish enter either basin and get directional information (east to west, west to east). One adult walleye did an entire tour of the lake and returned to Lake St. Claire to spawn.

Question: Where do lake trout spawn in Lake Erie?
East basin receivers were set in fall 2016- Lake trout (n= 107) were collected and tagged lake wide: off the Dunkirk Escarpment, Nanticoke shoal, offshore Dunkirk, and north west Brockton Shoal.

In October shortly after installation of receivers, fish began searching out shoals and spawning areas. When the lake turned over and became homothermal, that exact day, lake trout went to shore to spawn. After spawning most came back to PA waters while others still hung out near Buffalo, NY and in Ontario waters. Male lake stayed around the spawning reefs for a total of eight weeks while females were there for maybe only up to 45 minutes. Females are harder to detect and collect because of this. This causes a challenge for management implications for PA in terms of detecting females for spawning and gamete collection.

Acoustic Receiver- Is an internal transmitter inside the fish. The fish are also marked with an exterior tag for identification as well. After a month after stocking the tagged fish, one was caught in 2018 with its incision well healed with no infection from tag insertion.
Leeches were found on the tails of walleye a few weeks ago. Also saw hemorrhaging on some fish recently, as well as Heterosporis sp., which crews typically see on two to four fish a year. The public are starting to see these diseases more, but it doesn't mean it's more prevalent in the system or more fish infected, it's relative to scale. There are millions of fish in Lake Erie so more likely to see infected ones. Female lake trout were found with a large mass in the gonads with one fish having a yellowish discharge that was found in the swim bladder along with growths on the insides.

Gizzard shad have been found with exterior lesions but did not test positive for VHSv. Musky in an inland lake had white spots/plaque as well as sea lamprey wounds causing secondary infections. South of here, koi herpes virus in carp was seen with a huge die off.

In conclusion: The Lake Erie Research Unit will try to target more walleye females for tagging for the movement study but will be difficult as mentioned before. Additional techniques will also be used such as night time electrofishing. Also, will plan to use trap nets but with 95% males being caught, targeting females in June when the water is still cold and they are near shore versus later in the year when they are in deeper waters may still see same female to male ratio. Will know more about where lake trout go after they spawn and where they spend the rest of their summer after analyzing the movement data.

14. **Pennsylvania Fish and Boat Commission (PFBC) Presentation** (C. Yamashita)

Historical overview: A chronological document of events was provided.

Salmincola (gill lice) impact in PA: Gill lice is known to be in commercial hatcheries in commonwealth waters since 1980s.

2016-2018: Twelve co-op nurseries had infected trout. Nearly 50,000 were euthanized and replaced with less susceptible species. Now, most hatcheries have brown trout due to this cleaning out of susceptible species. The likely source of the gill lice is from commercial hatcheries as it always links back to commercial hatchery origin.

2016: the PFBC altered stocking methodologies to avoid stocking positive waters with a susceptible host species.

2017: The PFBC had encouraged commercial hatcheries to monitor for gill lice at their facilities and refrain from selling fish with gill lice

2018: PA law enforcement was left out of the loop on gill lice and received complaints from the public about gill lice. So, they did something about it on their own. The soon required trout to be certified as gill lice free if they were to be used in an event requiring a special activities permit. Law enforcement created a protocol and required gill lice certification to be done by a pathologist and created this a “gill lice free certificate”. A draft form of certificate is circulating and will be official down the road. The PFBC will also do a gill lice certification course with the Pennsylvania Department of Agriculture, University of Pennsylvania, and PA law enforcement. It was proposed to include language to the PFBC approved species for introduction and propagation list to prohibit the release of salmonids infested with gill lice.

The PFBC is assessing the extent and impact of gill lice in the wild. It is seen in small streams and starting to see YOY infected. Brown trout populations are taking off in these streams and YOY can’t handle gill lice and the adult brown trout pressure resulting in large die offs of YOY brown trout. Adult brown trout are mostly near culverts or popular fishing holes that have the heaviest amount of gill lice because fishermen get them from infested commercial fisheries and drop them in.

Pennsylvania Fish and Boat Commission was established in1866 and is the second oldest conservation agency in the US. However, there is no game component or DNR based component to the PFBC. Funds are based entirely on fishing license sales. There is an executive director that oversees day to day operations. The PFBC operates on a resource first policy where decisions are made based on the resource and what’s good for the resource.
More than $1.2 billion dollars in 2011 were spent as PA fishing expenditures. The PFBC is made up of divisions and bureaus, regions and hatcheries separated by Interstate 80 north and south. It used to be called the research unit and had published a lot of papers but now the PFBC is mostly taking care of the 14 state fish hatcheries that are spread across the state.
The PFBC operates on 14-million-dollar budget for fish production.

Trout culture- There are eight trout hatcheries stocking 3.2 million trout a year and stock grow-and-take fingerlings (around 700,000) and distribute 1 million fish annually.

Fish production process- Fish management requests fish and the PFBC sets production goals, hatcheries develop stocking schedules, law enforcement reviews, and then the stocking coordinator finalizes the schedule (more details on the slide).

Adult trout stocking- Had placed trout all over the state from various hatcheries. The streams are ranked A, B, C, D and E based on biomass of reproducing fish. It seems like the PFBC stocks a lot in Class A waters (over 2,000miles of it) but only actually stock 40 miles of it and will not stock over wild trout reproduction if it is there.

Trout in the classroom- Is a partnership with PFBC and PA Trout Unlimited as an interdisciplinary program for grades 3-12 where the collaboration raises brook trout from eggs to fingerlings and visit over 300 schools in PA.

Lake Erie Stocking: Steelhead and Brown Trout
Warm/cool water production: For walleye, there are more than 80 million eggs 50 million fry, and 1 million phase 1 fish produced or stocked. For Channel catfish there are 300,000 eggs spawned from domesticated wild brood stock that is replenished periodically, 150,000 3-4" fall stocked, and 3-5,000 8-10 inch yearling for family fishing events. For Musky, there are 120,000 fish stocked in the fall at 7-9 inches and 34,225 stocked in the spring at 12-14 inches. PFBC had switched the program over now to stock less at larger sizes. PA Musky stocking strategies have changed to spring yearlings at 12-14 inches (14 months old hatch in May and stock in first half of July) with an alternate year stocking goal to stock 34,000 purebred musky and 6,000 tiger muskies. All fish are to be stocked out by mid-June. There is a gradual trend upward in size (grams) of stocking musky and tiger musky (up to close to 80 grams per fish from 10-20 grams per fish) seen from 2007-2018. For 2014 musky stocked waters (map provided on the slide), musky, tiger musky, musky alternative year, tiger alternative year, and musky and tiger alternative year stocking results were provided. There were several streams and rivers in PA (7 sections to one stream) included.

Hatchery challenges: The effluent discharges are cleaned and maintained using (20-micron microscreen filters) as hatcheries are regulated based on annual hatchery effluent total suspended solids (TSS) in pounds. Pennsylvania hatcheries are all on high quality trout streams as well. This filtering system is very expensive to run and maintain but works very well. Hatcheries have seen more than 65% reduction in overall TSS from 2003-2014. The control of TSS is based mostly on flow which affects TSS output.

Bureau of hatchery expenses- Are responsible for fish brood going out, personnel, fish food, and utilities/fuels and maintenance expenses. The total cost has stayed the same with a lot less people even with increased feed cost and using less feed.

15. Overview of the PFBC Lake Erie Steelhead Trout and Brown Trout Program, Fairview State Fish Hatchery Overview (C. Lucas)

Craig oversees the Fairview and Tionesta State Fish hatcheries**.** Between the two hatcheries, they have raised approximately 1 million steelhead trout smolts and 30,000 Lake Erie brown trout annually. Twelve tributaries are stocked with steelhead smolts resulting in a popular fishery.

Tionesta Overview: Tionesta hatchery also raises walleye fry and fingerling and musky, tiger musky, and channel catfish. It also holds some cold water trout and a warm water unit for musky.

Fairview hatchery- This hatchery is based all on gravity flow through with seven raceways and growth ponds for steelhead and brown trout. It also uses surface water, but the source water is not close and flow through goes through a stream section with round gobies in it. The hatchery has a U.V. unit but the water is typically muddy, so it doesn't always work effectively; however, bacteria counts before and after U.V. treatments are significantly different.

Biosecurity- The hatcheries had used Great Lakes Research Initiative (GLRI) money to get clean equipment that translated into better overall biosecurity with an improved set up. The spawning set up is also improved and more effective in a new indoor facility.

Steelhead and brown trout stocking- The hatcheries try to stock brown trout smolts as far upstream as possible to give them enough time to grow before migrating downstream to Lake Erie. Most of the stocked streams have few predators; suckers and round gobies are typically common. Staff usually go back out and recollect and measure and weigh each species. Sometimes, there are extreme sizes of steelhead trout on the streams.

Steelhead collections: There are usually six to eight steelhead collections every year starting in winter and continuing through the spring. Spring collections are all in streams that are not spring fed, so ice is all the way through and tough to get to the fish at times.

Steelhead drives- Nets are at the top and nets are at the bottom of the section and fish are run into the middle where they are scooped up and collected (video provided). Frequently, as many as 1000 fish are collected in the first run, with subsequent runs collecting around 400 to 500 fish. Staff take ovarian fluid samples and eggs rid of fluid. Then eggs and sperm from three females to five males are mixed in hardened water (treated for coldwater disease), bagged up and taken on a 1.5 hour drive back to the Tionesta hatchery hatch house. Usually, there are 30 families per spawning event. Approximately 4.1 million eggs were taken last year.

16. Agency Updates (All)

Great Lakes Fishery Commission (GLFC)

Issue: To seek advice from the Fish Health Committee about the potential implications of enhanced connectivity and passage of fishes above barriers to fish health and disease transfer.

Background: Initiatives to remove barriers for river and fishery restoration contrast strongly with needs to maintain barriers for blockage and control of invasive species. This is a global issue. To confront this issue, the Great Lakes Fishery Commission is developing FishPass (http://www.glfc.org/fishpass.php), a selective, bi-directional fish passageway. FishPass is an innovative project to enhance fish passage and connectivity between the Boardman River and Lake Michigan, while removing invasive or non-desirable fishes through controlled sorting. The project is being implemented within an adaptive management framework, such that the species passed and the number of each species passed can be controlled. The approach to FishPass will be exportable to other systems within the Great Lakes basin and elsewhere.

The FishPass team is requesting input from the Fish Health Committee regarding the potential health and disease risks associated with reconnecting watersheds or selectively passing fishes. The commission realizes that the risks could vary spatially, temporally, and by species; however, can any general guidance for the FishPass team to consider potential risks and what, if any, monitoring or assessment could be implemented to mitigate such risks would be especially helpful.

Questions:

1. Does the FHC have any guidance about fish health and disease risks to previously isolated fish populations associated with barrier removal, restoring connectivity, or selective fish passage? In particular, the commission is concerned about movement of animals from lakes to rivers and vice versa.
2. What, if any monitoring or assessment is recommended by the FHC to detect potential disease transfers associated with reconnecting Great Lakes tributaries to their lakes or higher order streams.

Suggestion/feedback from FHC: Typically, this would be a case-by-case basis. For example, an infected stream in Maine has a dam barrier to a reservoir with disease free inland Atlantic salmon. This population is valued and would remain disease free while the dam is in place.

General recommendation: To test for pathogens above and below the barrier before removal (within a reasonable time before removal occurs). One cannot say there is zero probability that uninfected streams would be affected but, it would be very rare and would depend on the pathogen, its prevalence rate, and intensity.
General Recommendation: Create a risk factor based on the amount of water that will be opened to fish movement- i.e. culvert removal vs opening major river systems.

Explanation of the proposed fish passage project of discussion (G. Whelan, MI DNR): Boardman River is a midsized river with base flows around 300-400cfs and is 128 miles long. It is a typical low gradient dendritic system with high ground water inputs. Brown trout and brook trout reside in the upper most part of the system. There is overall low productivity in this river. The issue rises with the fact that there is angler pressure for trout such as steelhead in this river. The proposed project is to remove the bottom-most dam as an experimental process to sort out desirable vs. non-desirable fish above and below, and to create more movement of the desired steelhead. All preferred fish including natives would be able to be move upstream. Removing the dam will increase water for most of the basin, which would open the upper river to steelhead production. This is desired by anglers but also supported by MI DNR. This removal serves as an opportunity to create a very productive steelhead fishery. Overall, the FHC sees the risk of pathogen spread as relatively low and it is likely that there could be risk from the common suite of pathogens, but there is no downside to sampling for any possible disease transfers. Whirling disease has not been detected in the system.

Wisconsin DNR- Bait harvest in WI is contingent on barriers, so if certain areas are opened, they will end up having to close some of those bait harvesting areas and anticipate complaints from bait harvesters.

ACTION ITEM: The FHC will provide additional comments to the commission within the next few weeks.

U.S. Fish and Wildlife Service (USFWS)- Wisconsin

Updated information was provided to K. Phillips (with USFW-WI) by Kerry Hobden (with OMNRF) on *Vagococcus salmoninarum* detected in Chatsworth Fish Rearing Station in Ontario back in 2009. Fish were spawned in October 2009 and monitored for in November 2009 and were collected and tested. The lab reported their findings in January 2010. The number of fish sent in and information regarding testing is not known at this time. Treatments were not conducted until April 2010, and there has been no information about the efficacy of the treatments or any follow up to OMNRF yet. In conclusion from this updated information from OMNRF, V*. salmoninarum* is not a new thing in the Great Lakes as was thought when it was detected in Wisconsin this past year in 2017.

Northern WI had a lot of rain and flooding events and lost brook trout broodstock lots. In addition, USFWS also lost a future research broodstock lot due to a water quality issue and will have to go out to Isle Royale and get more.

Jordan River NFH- The hatchery had a small *Furunculosis* outbreak. Fish were vaccinated and only a few brook trout were infected. Water limitation was an issue and caused the fish to be stressed and potentially caused the outbreak to occur. Jordan River NFH is developing a future brood line of bloaters (*Coregonus hoyi)* on station that went through extensive pathology screening including an ELISA on all the pairs (300 fish). There was no detection of BKD. These fish will eventually be used to provide gametes for stocking on Lake Ontario (and lower lakes). The hatchery also has several thousand ciscoe to rear and stock in Saginaw Bay.

U.S. Fish and Wildlife Service (USFWS)- Pennsylvania

The USFWS in PA has started Coregonid (cisco and bloater) production with United States Geological Survey (USGS). The USFWS provides fish health services for USGS at Tunison. USGS collects the fish from eastern Lake Ontario to hold overnight and spawn them the next day. Then USFWS does pathogen screening and disease sampling. Allegheny National Fish Hatchery, located in Warren, Pennsylvania, uses ultraviolet light (UV) to limit IPNv. There is not an intensive culture done for coregonids, as it is not well known what other pathogens they might have. However, several inspections are done on them before turning off the UV. Bloater screening at the population level and egg jar testing from paired spawning are also being conducted. There is still an issue in not knowing what pathogens coregonids have. There is an effort in trying to start creating a cisco cell line with up to 60 passes. According to the literature, once it hits 50, it is an established cell line. They have only done 17 passes for bloater and this cell line is growing slow. However, the cisco line is taking off and easy to grow. IPNv, VHSv and LMB disease were put on the cisco cell line, but they did not show up. There was also no replication for EEDV seen. Eastern Massachusetts facility has brook trout brood stock from Genoa in isolation. This is the first year they will be mature and will spawn them. Also received eggs from Region 3 facilities and will continue to get them from them for the other three strains.

White River Hatchery- A flooding event happened but the facility is back up and running now, however it is not a lake trout facility right now. Allegheny facility will monitor for *epitheliocystis* by checking the fish every three weeks. They did not see it until nine months later along with anemia. The cause is most likely a water quality issue. With more flow and lower density of fish, it seemed to help limit the disease. This year, there was low mortality. There is no longer a backup lake trout stock at the Vermont facility. There has not been any detection of VHSv.

Wild fish survey- Did not get to look at many lake trout but there were still only a few hits of EEDv and not much LMBv. There seems to be decent geographic separation of EEDv and LMB, but one fish was found as co-infected with both pathogens in Lake Ontario, so there may be an overlap of the range of these pathogens.

<u>Ohio Department of Natural Resources (OH DNR)</u>

No VHSv related fish mortalities or fish kills were seen in Lake Erie, compared to 2017. Fish health tests from hatcheries were done for broodstock from either lakes or rivers. Maumee River was negative for VHSv and there were no spring VHSv kills from Lake Erie shores. A long winter had affected when and where eggs were taken for percids (specifically walleye). There was never a need to go into the Maumee River except for research with OSU and Bowling Green State University as they wanted gametes - so one trip was done to help provide them the gametes, but only after the testing was negative for VHSv. A total of 39 different tests were done out of the hatcheries. The only positive hit was for the golden shiner virus found in fathead minnows in one hatchery.

This year, there was no testing on the Ohio River because West Virginia had already tested weeks before with the same suite of species and was satisfied with the lots and species and the fact that they got all negative results. The regular fish kills were seen through the bulk of spring and summer this year with only one fish kill in Lake Erie around the fourth of July. There was a lot of upwelling and may be related to a cold-water patch close to shore. The fish were not sampled, but only freshwater drum were observed as dead fish on location at the time. Andy noted there was cold-water disease in steelhead trout, but they all responded to treatment. There was also a small outbreak in the London Hatchery seen in brown trout. Typically, OH DNR will contract with a veterinarian for completing a chain of custody for fish health test sampling, but they suddenly lost their veterinarian. They had to scramble to find a new DVM, but they were able to still get testing done.

Minnesota Department of Natural Resources (MN DNR)

The French River hatchery is now officially closed. Minnesota DNR is also in the process of discontinuing their SDS permit. The French River hatchery has flushed out their effluent system and equipment. The next step is to demolish the buildings.

An update from Ling- VHSv screening was done for walleye last fall and Frog adenovirus (FrAdV) was isolated from fish for the first time this spring by the MN DNR pathology lab. A decision was made to not stock fish from that pond in the spring. More testing was done and there was no success in isolating FrAdV again from tadpoles or fish and thus the plan is to re-test in the fall and then maybe stock those fish. Bacterial Kidney Disease incidents increased at the French River facility this spring from 12% up to 60% in wild fish, although the sample size was small. French River had broodstock for steelhead and took wild run gametes at the mouth of the French river outside the hatchery so it is a combined number reflecting an increase in BKD for both wild and hatchery fish.

The steelhead program is moving from French River to the Crystal Springs hatchery this coming spring. In the future, fish will be stocked out of Crystal Springs, but gametes will still come from Lake Superior once every 10 years.

Raising Splake- Peterson hatchery is seeing mortalities in their splake every time they handle them with a 10% loss over the course of the year. Every time they must move the lot or spawn them, they are seeing losses. There hasn't been any isolation of pathogens. No one else that raises them sees this.

Questions/inquires to the cause: What is the source of the Milt? It is from New Hampshire. Could this be an issue with the strain of fish used either from brook trout or lake trout? There are usually never issues raising brook and brown and splake trout. At the Marquette rearing station, it is usually very easy and these fish never get EEDv.
ACTION ITEM: Danielle Godard will search for any information to see what the cause is. Ling will also get in touch with Danielle to do some sections. MN DNR also notes they are not seeing any cardiomyopathy.

Ontario Ministry of Natural Resources and Forestry (OMNRF)

In the beginning of March this year, there was a report of dying gizzard shad around the power plant. A photo was submitted to see external hemorrhagic lesions but never detected VHSv out there. By the end of June, a report of VHSv was submitted for south of Guelph, ON associated with a carp die off. Just a couple hundred fish were seen and got a few samples but still waiting on those results.

In the stations right now- They are doing CFIA permitting. Hills Lake has results pending and sampling was done in the last two weeks. They plan to stock fish north of the Atlantic watershed into the Hudson and screen for VHSv. It isn't expected that anything will be there to prevent the proposed stocking.

There is the usual cold-water disease seen at Hardwood. It was re-treated with hydrogen peroxide for the rainbow trout brood. Treatments for cold water disease on Atlantic salmon have shown a huge difference in survival and condition of the fish in the last year. However, there is some resistance to continuing to do the treatment based on workload, but the results are worth it.

White Lake- This facility has gone through the Title 50. Everything came back fine on testing and eggs were sent out to the states and will do it again this year and several years into the future (will work with USFWS-PA and NYSDEC on it to meet federal requirements).

Blue Jay Creek-This is a hatchery linked to an island. There was elevated mortality in young splake that were tested and came back with *A. sal*. However, they treated them and it was successful. *Epitheliocystis* is seen annually in winter at the Blue Jay facility and usually is related to water quality. They are currently working on antibiotic sensitives but money for that is gone, so Ontario Animal Health Network (OAHN) wants to work on *Epitheliocystis* instead, as it is becoming more prevalent in Ontario and the funds are available for it. There is no information on what species the pathogen is infecting yet. There is a yearly occurrence of it seen in brook trout fry while in the facility when they are crowded. Bacterial gill disease usually also occurs from stress before stocking them out.
No bacterial gill disease was seen this year or any gross lesions. Ten out of 12 fish did get culture on them but will just monitor for it because mortality is going downwards. There is work coming up looking at the possibility of exporting bloater eggs and refreshing their Atlantic salmon stock. Atlantic salmon eggs were brought in from the Salmon River. They got the import permit to do so but the eggs were not viable.

Mudpuppies- In the spring, they might be doing freshwater mussel testing associated with mudpuppies as hosts. Mudpuppies are coming in and are being tested for pathogens (VHSv susceptible?). Not much is known on mudpuppies and pathogens and susceptibility. Nine out of 11 mudpuppies were obtained for testing but have passed away. Wisconsin is also checking mudpuppies lately but haven't found anything except *Bd* (Chytrid) on them and have never found any fish pathogens positive in mudpuppies.

<u>New York State Department of Environmental Conservation (NYDEC)</u>

A facility had supersaturation of nitrogen gas that caused a major loss of fish. They are trying to come up with an abatement program and trying to find a root for financial sources to come up with degassing systems. These use a radon gas abatement approach to de-gas so the system needs to vent to the outside. Another facility had a power outage where the emergency generator went on but the pump never went back on and so 70% of fish were lost due to not having an onsite hatchery manager.

Homeland Security abatement- They had their first annual inspection and it was successful. For the second inspection, they do look for the paperwork, so make it a point to have it done *i.e.,* have all the drills and training and inventory of all the drugs available and kept track of.

Rome strain of brown trout- This strain is *Furunculosis* resistant but is highly domesticated and starting to lose performance so now there are efforts to try to re-enhance them but also keep them *Furunculosis* resistant. The wild form of the Rome strain with *Furunculosis* resistance was found but it is not as good as the past strain. There is hope to use them with a domestic program and hope not to lose those that did not have the resistance.

In 2016 it was the first time crossing these fish and they are now three years old and are suffering a low-level dose of *Furunculosis*. Recently, an unknown organism was detected in musky. They were never stocked in the St. Lawrence River where VHSv wiped out the musky about 10 years ago. A SUNY-ESF person is trying to reintroduce musky into the St. Lawrence River, so it was tested and that is when the unknown organism was found. It was sent around to see what type of pathogen it is (virus or bacterium). Production continued for the musky until the type of pathogen was understood.

Statewide monitoring- Twenty-five locations of wild streams were monitored and results were sent John Coll for the wild fish survey. Cornell is investigating VHSv. In the St. Lawrence River and Lake Ontario VHSv is still present and it's not expected to go away. *P. mendalii* was detected in centrarchids which has never been seen before. Additionally, dead sturgeons were found with blunt trauma in the Sturgeon River, most likely from boat strikes.

<u>Michigan Department of Natural Resources (MI DNR)</u>

EEDv has been an issue this year at the Marquette State Fish Hatchery for brook and lake trout and splake. The Marquette facility is a surface water-based system but also has a combination of surface and groundwater. The Inline UV system is set up for water on the way in to treat all the water going into the broodstock. The water is not re-used and goes directly out. Water from Cherry Creek is used for the broodstock at Marquette fish hatchery. There were odd mortalities seen in late September. There was an investigation and found out it was EEDv. As a result, more intense analysis was done in February and found both brook trout and lake trout were positive. Marquette Harbor fish were tested and came back positive which is not a surprise. The herpes virus doesn't always show up right away. It was found in production fish and new broodstock lines.

Prevalences for the Lake Superior strain trout are up to 60%. Prevalences were higher than normal until March when it decreased and we saw less signs of EEDv. Mortalities in trout in Marquette were down to zero by February. There's almost always a big storm event on surface water that goes into the hatcheries and may be the trigger. It's common to see EEDv showing up shortly after large storm events. Currently, there are reductions in prevalence’s of EEDv. Prevalence also dropped in the Seneca strain fish, but not as quickly. By April, prevalence in both strains had dropped below 20%. It was thought that it was finally gone. Some committee members recommended not stocking, and some said Michigan could stock these fish, or do a risk assessment.

A risk assessment was done and didn’t show a high risk because EEDv is widespread. So, MI DNR decided to switch their sites of stocking with the sites USFWS uses. Later in May, prevalence’s of EEDv started to increase up to 45% in the Lake Superior strain. Every other month MI DNR will be doing EEDv sampling and looking for it across the Great Lakes.

In southern Lake Huron, one out of 90 fish were positive for EEDv. The positive fish was a hatchery raised fish. Another 10 fish from northern Lake Huron were tested and none were positive. An angler is going to help collect samples near the Rogers City area. He has collected fish from Lake Michigan. Information will be out soon. MI DNR is attempting to figure out how to manage EEDv. An option is to eliminate lean trout and their broodstock, but we decided against that right now because field crews could not go out and get a lean trout strain that was not already infected. There are no recommendations on it right now.

There was a large mortality of round goby on Presque Isle of northern Lake Huron. However, no botulism was seen, and no resulting dead birds were found. There was a lot of dead carp this year. The epicenter was in the Clinton River system, had lots of interactions with the public, but it was too late to take any action there.

Wild broodstock- Eggs from musky were collected in the Detroit River (which is VHSv positive), but we found no fish positive for VHSv or BKD.

MI DNR is working on reintroduction of arctic grayling into Michigan after the species was extirpated in 1938. The reintroduction sources will be from a river in Alaska which has done 10 years of fish health data. There are also artic grayling at Michigan State University at their quarantine facility. They are testing if they can interact well with brown trout populations and using them to get fish health information on them at same time. These fish will not be stocked until at least 2022. There is a plan to develop two captive brood stocks in isolation at Oden and to keep an eye on fish health. More screening on arctic grayling has been done than on any other broodstock. Results from these screenings will be available soon. The Upper Manistee River is the target reintroduction site for arctic grayling. They will not ever be stocked into the Great Lakes. Montana has shown that arctic grayling do not do well with brown trout but do well with brook trout.

Eyes in the Field- Is a MI DNR program that provides opportunities to assist in observations with a simple data base where the public can attach photos and report fish health issues. To date, 62 reports have been submitted. It takes reporting out of the email system which can be onerous.

17. 2019 Summer Meeting Location/Meeting Recap/Generate Meeting Summary for GLFC (A. Noyes and All)

Winter 2019 meeting: February 5-6 in East Peoria, IL.

Summer 2019 meeting: July 31-August 1 in Charlevoix, MI

ACTION ITEM: The commission associate will send the minutes to the FHC chair

ACTION ITEM: The FHC Chair will create a summary document within the next week to send out for review to the FHC and to submit on the FHC webpage and get the current 2016 and 2017 minutes to the GLFC associate to compile and format to be updated on the FHC webpage.

ACTION ITEM: A. Noyes, had requested any pictures of unique and creative ways to fix problems (health related) in fishery facilities to send out to get ideas rolling between hatcheries.

18. Adjourn

Fairview State Fish Hatchery and Local Co-op Tour

GREAT LAKES FISH HEALTH COMMITTEE TECHNICAL ADVISORS

August 2018

Bacteriology
Diane Elliot (U.S. Geological Survey)
Thomas Loch (Michigan State University)

Virology
James Winton (U.S. Geological Survey)
Tom Waltzek (University of Florida)

Molecular
Nick Phelps (University of Minnesota)
Sharon Clouthier (Fisheries and Oceans Canada)

Nutrition
Wendy Sealey (U.S. Fish and Wildlife Service)
Ann Gannam (U.S. Fish and Wildlife Service)

Quantitative Fish Health Data Analysis
Dominic Travis (University of Minnesota)
Travis Brenden (Michigan State University)

Epidemiology
Lori Gustafson (U.S. Department of Agriculture)

Parasitology
David J. Marcogliese (Environment Canada)

Great Lakes Fishery Commission

SPECIAL PUBLICATION 14-02

The Great Lakes Fishery Commission was established by the Convention on Great Lakes Fisheries between Canada and the United States, which was ratified on October 11, 1955. It was organized in April 1956 and assumed its duties as set forth in the Convention on July 1, 1956. The commission has two major responsibilities: first, develop coordinated programs of research in the Great Lakes, and, on the basis of the findings, recommend measures which will permit the maximum sustained productivity of stocks of fish of common concern; second, formulate and implement a program to eradicate or minimize sea lamprey populations in the Great Lakes.

The commission is also required to publish or authorize the publication of scientific or other information obtained in the performance of its duties. In fulfillment of this requirement the commission publishes two types of documents, those that are reviewed and edited for citation indexing and printing and those intended for hosting on the commission’s website without indexing or printing. Those intended for citation indexing include three series: *Technical Reports*—suitable for either interdisciplinary review and synthesis papers of general interest to Great Lakes fisheries researchers, managers, and administrators, or more narrowly focused material with special relevance to a single but important aspect of the commission's program (requires outside peer review); *Special Publications*—suitable for reports produced by working committees of the commission; and *Miscellaneous Publications*—suitable for specialized topics or lengthy reports not necessarily endorsed by a working committee of the commission. One series, *Agency Reports*, is not suited for citation indexing and printing. It is intended to provide a Web-based outlet for fishery management agencies to document plans or reviews of plans while foregoing review and editing by commission staff. Those series intended for citation indexing follow the style of the *Canadian Journal of Fisheries and Aquatic Sciences*. The style for *Agency Reports* is at the discretion of the authors. Sponsorship of publications does not necessarily imply that the findings or conclusions contained therein are endorsed by the commission.

Kenneth A. Phillips[1], Andrew Noyes[2], Ling Shen[3], and Gary Whelan[4]

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ABSTRACT

Fish diseases are known to have exerted unacceptably high natural mortality on some of the most-valuable fish populations in the Great Lakes, and, notwithstanding suppression efforts, their existence continues to present risks to fishery sustainability. To minimize these risks, the Great Lakes Fish Health Committee (formerly the Great Lakes Fish Disease Committee) formalized in 1985 a Great Lakes Fish Disease Control Policy and Model Program for which this document is the first update. This update is intended to further encourage the initiation of basinwide fish health initiatives and to improve their implementation among the agencies signatory to *A Joint Strategic Plan for Management of Great Lakes Fisheries* (GLFC 2007). The specific goals of this update are to prevent the introduction of new pathogens into the Great Lakes basin, to halt the spread within the Great Lakes of established pathogens deemed destructive, and to provide a system for classifying the disease status of fish hatcheries. To accomplish these goals, fish pathogens are classified into one of three groups: emergency pathogens—those that have not been detected previously from fish in the Great Lakes basin, are known to cause epizootic events in their enzootic range, and call for containment and eradication; restricted fish pathogens—those that have been detected in fish from the Great Lakes basin, are known to cause epizootic events in hatcheries or in the wild, and call for containment and minimization of effects; and provisional fish pathogens—those under scrutiny and of concern to at least one member agency of the fish health committee, owing primarily to unknown life-history strategies and possible unwanted effects. To achieve containment of fish pathogens, standards are provided for disease testing, hatchery classification and

certification, importation of fish, and transportation of fish and fish products. Implementation of these measures is expected to reduce the risks of disease outbreaks resulting from importation of new disease agents into the Great Lakes basin or from transfers of infected fish between individual Great Lakes drainages.

INTRODUCTION

The health of fish in the Great Lakes basin is the responsibility of those agencies that manage the fisheries. The Great Lakes Fish Health Committee (GLFHC), formerly the Great Lakes Fish Disease Control Committee, developed a Great Lakes Fish Disease Control Policy and Model Program, which was re-adopted by the Great Lakes Fishery Commission in 1985 (Hnath 1993). Its purpose was to unify and coordinate the fish-disease management efforts of those agencies signatory to *A Joint Strategic Plan for Management of Great Lakes Fisheries* (GLFC 2007). This updated model program supersedes Hnath (1993) and has been expanded to incorporate and update Horner and Eshenroder (1993), which dealt with the importation of emergency disease agents into the basin. The purpose of this model program is to provide fishery managers, fish health professionals, and fisheries policy makers with guidelines for fish-hatchery management, fish health testing, and transportation of fish into and within the Great Lakes basin. The specific goals are to prevent the introduction and spread of fish pathogens in the basin and in fish hatcheries and to provide for classification of the disease status of fish hatcheries. This model program will be revised as new information becomes available or new pathogens emerge in the basin, will be posted on the GLFHC website, and will be updated annually as needed.

AGENCY RESPONSIBILITIES

Each member agency is expected to work toward the control of fish pathogens in the Great Lakes basin by

- Developing legislative authority and regulations to enable the eradication of fish pathogens or minimization of their spread

- Minimizing the rearing and release of infected fish

- Preventing the release of clinically diseased fish
- Preventing the importation of fish infected with specified pathogens
- Limiting the transfer of fish infected with specified pathogens
- Developing response plans as needed and appropriate

At the time of this revision of the original model program, both the Canadian and U.S. governments began to implement their respective policies: the National Aquatic Animal Health Program (Canada) and the National Aquatic Animal Health Plan (U.S.). The objective of the Canadian NAAHP is to protect those Canadian fish/seafood industries and activities that rely on aquatic resources from the introduction and spread of potentially destructive fish pathogens. The U.S. NAAHP provides a framework for federal agencies to work together to protect aquatic resources. This model program does not replace or duplicate the components or obligations of member agencies to the NAAHPs, but rather it should be viewed as a complementary program directed specifically at the activities of member agencies, such as the collection, rearing, release, and transfer of hatchery and wild fish into and within the Great Lakes basin. Nothing in this model program should be interpreted as preventing member agencies from applying additional measures to control fish pathogens through inspection, testing, quarantine, and pathogen depopulation and eradication efforts.

All member agencies should anticipate the presence of undesirable fish pathogens, and appropriate response plans should be developed to ensure timely and effective actions to contain and minimize their impacts and, if possible, eliminate them. Response plans should include provisions on biosecurity (see Illinois Biosecurity Manual, http://fishdata.siu.edu/secure/bioman.pdf), staffing requirements, testing needs, necessary legislative authority for depopulation and disinfection, depopulation and disposal procedures, disinfection protocols, and communication needs for a coordinated response, which may involve state, provincial, and federal governments; universities; and private industry. The GLFHC may recommend additional steps to eradicate a pathogen from a hatchery and adjacent waters following the best science available in association with the guidelines provided here.

APPLICATION AND SCOPE

The recommendations in this model program apply to fish species that have the potential to harbor pathogens transmissible to other fish or aquatic animals in the Great Lakes basin (Appendix A). In particular, it discusses transportation into/within the Great Lakes basin of wild or hatchery-raised fish or their gametes that are or could be infected with designated pathogens.

This model program does not provide guidance to fishery managers regarding disease outbreaks in wild-fish populations. When disease outbreaks are detected in wild populations, member agencies should contact the GLFHC chairperson and/or vice chairperson. The chairperson (or vice chairperson in the absence of the chairperson) will provide appropriate recommendations to the member agency.

Provided that all necessary biological containment measures are taken to avoid any dissemination of fish pathogens, the recommendations in this model program shall not apply to

1. Fish and water in transit (in closed containers) through the Great Lakes basin that are not intended to be released from the original shipping containers while within the basin

2. Fish (alive, dead, or their excised organs and tissues) used for diagnostic services and related laboratory tests, assuming such fish are properly packaged, the chain of custody is documented, and release is not intended

This model program applies to GLFHC member agencies, i.e., those signatory to *A Joint Strategic Plan for Management of Great Lakes Fisheries* (GLFC 2007): Chippewa Ottawa Resource Authority, Fisheries and Oceans Canada, Great Lakes Indian Fish and Wildlife Commission, Illinois Department of Natural Resources (DNR), Indiana DNR, Michigan DNR, Minnesota DNR, New York State Department of Environmental Conservation, Ohio DNR, Ontario Ministry of Natural Resources, Pennsylvania Fish and Boat Commission, U.S. Fish and Wildlife Service (USFWS), and Wisconsin DNR. In practice, the GLFHC operates under the aegis of the Council of Lake Committees (CLC), a body formed to coordinate fishery management among the signatories to the strategic plan.

AMENDMENT

Model program amendments may be proposed by any member of the GLFHC or by the CLC operating as a whole. A proposed amendment should be submitted to the GLFHC chairperson in writing and contain the rationale for the request. The chairperson will seek to form from within the committee a consensus on the scientific merits of the proposed amendment; the results of this effort will be presented in writing to the CLC for its purview. If the proposed amendment is adopted by the CLC, it will become part of the model program.

PATHOGEN DETECTION MANUALS

The most-recent editions of the following three documents provide the basis for fish-hatchery inspections and standard testing methods:

1. *Suggested Procedures for the Detection and Identification of Certain Fish and Shellfish Pathogens* (Blue Book) developed by the American Fisheries Society-Fish Health Section (AFS-FHS)

2. *Fish Health Protection Regulations Manual of Compliance* (Miscellaneous Special Publication 31, Revised) of Fisheries and Oceans Canada

3. *Manual of Diagnostic Tests for Aquatic Animals* of the World Organisation for Animal Health (OIE)

More sensitive or definitive procedures may be used, but any departures from the basic procedures set forth in these manuals or updated versions of these manuals must be noted and explained on hatchery inspection reports. Agencies may employ the most currently accepted methods for detection of pathogens even if they are not included in the above manuals. Appendix B contains information on the pathogens covered in the model program and on the fish species they may infect.

When procedures set forth in the model program appear to be outdated owing to new information concerning testing for a particular pathogen and/or the disease(s) it causes, the member agency should contact the GLFHC chairperson. The chairperson will expediently provide recommendations to the member agency on how to proceed with testing. In the interim, the affected fish should not be released or transferred, and efforts should be made to contain the pathogen to the affected lot(s) or stock(s).

RISK ASSESSMENT

Procedures for risk assessment have been developed independently from this document and can be found on the GLFHC's website (http://www.glfc.org/boardcomm/fhealth/fhealth.php).

PATHOGENS COVERED BY THE MODEL PROGRAM

For pathogens covered by the model program, see Appendix B.

Emergency Fish Pathogens

Emergency fish pathogens are those that have not been detected from fish in the Great Lakes basin and are known to cause epizootic events in their enzootic range. The presence of any of these pathogens in a hatchery calls for the development of a containment and eradication plan that minimizes the risk of transmission to wild fish.

Emergency pathogens (asterisks indicate OIE-listed pathogens at the time of publication) are

- *Ceratomyxa shasta* (causes ceratomyxosis)
- infectious hematopoietic necrosis virus*
- infectious salmon anemia virus*
- *Tetracapsuloides bryosalmonae* (causes proliferative kidney disease)
- viral hemorrhagic septicemia virus (VHSv) (all strains except IVb)*

- white sturgeon herpesvirus
- white sturgeon iridovirus

Restricted Fish Pathogens

Restricted fish pathogens are those that have been detected from fish in the Great Lakes basin and are known to cause epizootic events in hatcheries or in the wild. Response plans to minimize the effects vary depending on the life history of the pathogen (Table 1). Agencies should strive to minimize the threat of pathogen transmission (e.g., fish exhibiting clinical signs of disease should not be transferred to other facilities or released in the Great Lakes basin). Level-1 restricted pathogens pose lesser threats to wild fish than Level-2 restricted pathogens. Fish infected with Level-1 pathogens may be stocked in areas where the pathogen is known to occur in susceptible fish and where its effect on such fish is predicted to be negligible. The GLFHC's risk management protocol should be used to determine if a proposed location is suitable for transfer or stocking. Level-2 restricted pathogens are untreatable, difficult to manage, and transmission continues throughout the life of infected fish; therefore, depopulation of infected stocks is recommended.

Table 1. Restricted pathogens and recommended actions for infected fish. The asterisks indicate OIE-listed pathogens.

Level	Pathogen	Recommended Actions
1	*Aeromonas salmonicida salmonicida* largemouth bass virus *Renibacterium salmoninarum* *Yersinia ruckeri*	Seek pathogen-free sources, if possible Fish exhibiting clinical signs of disease should not be transferred, stocked, or released Use biosecurity methods and approved treatments to reduce disease prevalence and transmission risks prior to stocking Stock fish in locations where potential effect is minimal Fish without clinical signs may be stocked where the pathogen is already established once all member agencies are notified Use of GLFHC's risk assessment is encouraged before stocking begins
2	*Heterosporis* sp. infectious pancreatic necrosis virus koi herpesvirus* *Myxobolus cerebralis* spring viremia of carp virus* VHSv IVb*	Avoid sources of infected fish Eradicate infected hatchery lots and do not stock positive lots

Provisional Fish Pathogens

Provisional fish pathogens are those that are not listed as emergency or restricted but are of concern to at least one member agency, primarily because their life-history strategies and potential effects are unknown. Additional information is needed to propose listing them as emergency or restricted pathogens. A pathogen may be classified as provisional if it has an unknown epidemiology and/or etiology, has the potential to negatively affect aquatic animal health, and meets the following criteria (adapted from the National Aquatic Health Plan (2008)):

1. The pathogen/disease has been demonstrated to cause significant hatchery losses due to morbidity or mortality

2. The pathogen/disease has been demonstrated to negatively affect wild populations

3. Evidence strongly suggests a negative effect

4. Infectious etiology has been proven

5. An infectious agent is strongly associated with a disease but its etiology is not known, and a potential exists for its spread via live animals or their products

A GLFHC member should complete the Pathogen Nomination Form (Appendix D) when proposing the addition of a provisional pathogen to the model program. This form requires background information on the pathogen, why it is a concern, and the rationale for classifying it as provisional. The completed form should be submitted to the chairperson (or in the chairperson's absence, the vice-chairperson) of the GLFHC, who will present it to the full committee for the purpose of compiling a technical analysis. This analysis will be submitted to the CLC, which will determine whether or not the pathogen qualifies for a provisional listing.

Because of the lack of knowledge concerning potential provisional pathogens, the appropriate management actions may be uncertain. Important considerations include

- Determine if diagnostic tools are available:

  - if yes, request member agencies begin surveillance

  - if no, recommend as a research priority the development of a reliable detection method, seek funding, and encourage researchers to submit proposals to funding sources

- Identify research needs and information gaps

- Identify vectors and hosts in the Great Lakes basin under the regulatory control of member agencies

- Minimize the spread of such pathogens until sufficient information is known to classify them

Provisional pathogens are

- *Bothriocephalus acheilognathi*

- *Nucleospora salmonis*

- epizootic epitheliotropic disease virus

- *Piscirickettsia*-like organism

- lymphosarcoma virus

Relisting Pathogens

To relist an emergency pathogen as a restricted pathogen, the pathogen must be confirmed enzootic somewhere in the Great Lakes basin. Actions to eradicate/control the pathogen must have been undertaken by a member agency(s) to restrict its spread or reduce its virulence.

To relist a provisional pathogen as a restricted pathogen, all of the following criteria should be met:

- It is enzootic somewhere in the Great Lakes basin
- It can cause epizootic events or reduction of fitness
- Active management against it, such as reducing its prevalence or spread, is needed
- Reliable testing is available
- Sufficient life history and biosecurity information are available to determine appropriate management actions

To relist a provisional pathogen as an emergency pathogen, all of the following criteria should be met

- It is not enzootic anywhere in the Great Lakes basin
- It causes significant epizootic events or reduction of fitness
- Legal or regulatory requirement for active management against it (generally, depopulation) is required

- Active management against it, such as reducing its prevalence or spread, is needed
- Reliable testing is available
- Sufficient life history and biosecurity information are available to determine appropriate management actions

To remove a pathogen from the provisional list without moving it to the emergency or restricted lists, all of the following criteria should be met

- It is not known to cause epizootic events or reduction of fitness
- Reliable testing is available
- Sufficient life history and biosecurity information are available to determine that management actions are not necessary

INSPECTION AND TESTING

Fish health inspections are vital tools that help limit and prevent the spread of deadly fish pathogens and the outbreaks of disease. Inspections allow fish health biologists to make informed decisions regarding transfer and release of fish and provide an opportunity for early detection using the Fish Health Inspection Report (Appendix D). Accordingly, fish health inspections should be conducted annually (at a minimum) at all fish hatcheries operated by member agencies and should include testing for all applicable restricted pathogens (Appendix B). Screening for emergency pathogens should be undertaken during diagnostic testing, while testing for provisional pathogens is encouraged but not required. Detections of provisional pathogen or an antibiotic-resistant bacterium in a hatchery should be noted on inspection reports, hatchery classifications, and annual member reports. Each member agency should designate individuals responsible for conducting fish health inspections at its facility.

Fish health inspections and all associated laboratory testing should be conducted according to methods described by the most-recent editions of the *Suggested Procedures for the Detection and Identification of Certain Fish and Shellfish Pathogens* (Blue Book) developed by the AFS-FHS; the *Fish Health Protection Regulations Manual of Compliance* (Miscellaneous Special Publication 31, Revised) of Fisheries and Oceans Canada; and the *Manual of Diagnostic Tests for Aquatic Animals* of the OIE. Methods published in peer-reviewed journals may be used only if the previously listed documents do not provide guidance. Recommended sample sizes for lot-based or facility-based inspections are provided in Table 2.

Table 2. Minimum suggested sample sizes for hatchery populations or lots of 50 to >100,000 fish. Sample sizes are based upon stratified random sampling that assumes a binomial distribution and provides 95% confidence of detection at a minimum incidence of 2% or 5%.

Population or Lot Size	Assumed Incidence	
	2%	5%
50	50	30
100	75	45
250	110	50
500	130	55
1,000	140	55
1,500	140	55
2,000	145	60
4,000	145	60
10,000	145	60
>100,000	150	60

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When sampling

- Collect moribund fish and fish with signs of disease, if possible, and consider the etiology of the pathogens and collect samples at the optimal conditions for detection (Appendix B)

- Employ non-lethal sampling whenever applicable and especially when working with threatened and endangered species, captive brood stock, or wild populations used as brood stock (a biostatistician or epidemiologist should be consulted prior to initiating sampling of wild populations).

CLASSIFICATION OF HATCHERIES AND WILD BROOD STOCK POPULATIONS

All member agencies should maintain classifications for each of their hatcheries and wild brood-stock populations and provide five years of classification history on a Fish Health Inspection Report (Appendix D). Classifications should be dated and include contact information for a person who can provide additional information. The following guidelines should be used when designating a classification:

- Class A hatcheries or wild brood stock populations where pathogens specified in the model program have not been detected during three consecutive annual inspection cycles shall be designated as SPF (specific-pathogen free) on a Fish Health Inspection Report (Appendix D)

- Class B hatcheries or wild brood stock populations which test positive for one or more emergency or restricted pathogens should identify the detection(s) on a Fish Health Inspection Report (Appendix D) by a pathogen code (Table 3) followed by the date of detection

Example: Hatchery XYZ tested positive for *Aeromonas salmonicida* during an annual fish health inspection that was conducted on October 10, 2009; the classification for this hatchery would now be AS (10/2009) (Table 3); the pathogen code and date will remain part of the hatchery's classification until the facility undergoes three *consecutive annual inspections* without the pathogen being detected

- Class C hatcheries or wild brood-stock populations without a positive detection and that have not completed a minimum of three annual inspections will be designated as Class C (incomplete)

Table 3. Pathogen codes for classifying hatcheries and wild brood stocks.

Pathogen (Disease)	Code
Aeromonas salmonicida salmonicida (causes furunculosis)	AS
Bothriocephalus acheilognathi (Asian tapeworm)	BA
Ceratomyxa shasta (causes ceratomyxosis)	CS
epizootic epitheliotropic disease virus	EEDV
Heterosporis sp.	HSP
infectious hematopoietic necrosis virus	IHNV
infectious pancreatic necrosis virus	IPNV
infectious salmon anemia virus	ISAV
koi herpesvirus	KHV
largemouth bass virus	LMBV
lymphosarcoma	LSV
Myxobolus cerebralis (causes whirling disease)	MC
Nucleospora salmonis	NS
Piscirickettsia-like organism (muskie pox)	PLO
Renibacterium salmoninarum (causes bacterial kidney disease)	RS
spring viremia of carp virus	SV
Tetracapsuloides bryosalmonae (causes proliferative kidney disease)	PKX
viral hemorrhagic septicemia virus (include strain)	VHSV
white sturgeon herpesvirus	WSHV
white sturgeon iridovirus	WSIV
Yersinia ruckeri (enteric redmouth)	YR

Reclassification

As test results become available, classification records should be updated (with date of reclassification) to include any emergency or restricted pathogens detected in the preceding 36-month period. Classifications may change owing to new test results or to a facility having received fish or gametes from a source classified lower at the time of the transfer or reclassified lower subsequent to the transfer. In any event, the receiving facility cannot have a higher classification than the donor facility, and fish from a source with a Level-1 restricted-pathogen classification should not be transferred to a facility with the same classification unless no other uninfected sources are available.

Exceptions for Gametes

If fertilized eggs originate from a hatchery or wild brood stock positive for the pathogens listed below and the fertilized eggs are properly disinfected (Appendix C), the hatchery classification will not change because the following pathogens are not vertically transmitted and can be eliminated with proper disinfection:

- *Aeromonas salmonicida salmonicida*
- *Ceratomyxa shasta*
- *Tetracapsuloides bryosalmonae*
- *Yersinia ruckeri*
- *Myxobolus cerebralis*

Exceptions for Isolation or Quarantine

Fish, fertilized eggs, or gametes in isolation or quarantine facilities that do not have the required three annual inspections will not affect the classification of an associated rearing station as long as the member agency can demonstrate such fish, fertilized eggs, or gametes had no direct or indirect contact with other fish on the associated station and strict biosecurity measures are in place. Isolation and quarantine facilities are considered independent of their host stations for classification purposes.

Hatchery Depopulation and Disinfection

A hatchery that was depopulated and disinfected to eliminate a pathogen(s) retains a Class B classification following the disinfection. The hatchery must go through the required three annual inspections during which time it will be considered suspect for the previously detected pathogen(s). The hatchery classification will include the code for the pathogen(s) and the date of detection(s). The disinfection date will be noted for five years on the facility's Fish Health Inspection Report.

IMPORTATION AND TRANSFER PROTOCOLS

Before gametes, fertilized eggs, or fish are imported or transferred into any member-agency facility in the Great Lakes basin other than quarantine facilities, testing for emergency and restricted pathogens as established below is required. Susceptibilities of fish to emergency and restricted pathogens are listed in Appendix B. If the testing specified here provides inadequate guidance, the GLFHC's risk assessment provided on its website should be conducted before an importation or transfer is initiated. Where stress tests are called for, the GLFHC recommends that fish health professionals be consulted to determine the stress test(s) that best induces the disease of concern.

If a member agency seeks to import gametes, fertilized eggs, or fish from a source not located in an area enzootic for an emergency pathogen, testing for emergency pathogens is not required. The determination of whether a source is in an area enzootic for an emergency pathogen should be based on expert knowledge, the opinions of fish health professionals working in the source jurisdiction(s), and a literature review. Importations and transfers should be conducted using pathogen-free sources of gametes, fertilized eggs, or fish to the greatest extent possible. The following measures should be implemented when making an importation or transfer from a source located in an area enzootic for an emergency pathogen.

Importing Gametes and Fertilized Eggs from Sources in Areas Enzootic for Emergency Pathogens

Fertilized eggs may be imported from an area enzootic for an emergency pathogen provided one of the following guidelines applies

- Fertilized eggs must be properly disinfected (Appendix C) and from a source that has been tested a minimum of five consecutive years without a positive detection of an emergency pathogen, sampling at the 5% prevalence level (Table 2)
- Fertilized eggs must be properly disinfected (Appendix C) and be from a source that has been tested a minimum of three times over two years with at least four months between tests without a positive detection for an emergency pathogen, sampling at the 2% prevalence level (Table 2)
- *Ceratomyxa shasta* and/or *Tetracapsuloides bryosalmonae* are the emergency pathogens of concern and the fertilized eggs have been properly disinfected

Gametes and fertilized eggs from a source with an incomplete history or that cannot be properly disinfected may be imported into a quarantine facility. Before release from quarantine, progeny should be tested for the emergency pathogen(s) of concern such that three negative inspections are recorded with consecutive inspections separated by at least four months. Sampling should occur at the 2% prevalence level (Table 2). Progeny should be subjected to an appropriate stress test for the pathogen(s) of concern prior to the final screening.

Importing or Transferring Gametes and Fertilized Eggs from Sources in Areas Enzootic for Restricted Pathogens

A member agency may import or transfer gametes or fertilized eggs from a source in an area where a restricted pathogen is enzootic if the pathogen is already present in the receiving hatchery. If the pathogen is not in the receiving hatchery, one of the following guidelines should apply

- The source must have been tested a minimum of three consecutive years without a positive detection for the restricted pathogen of concern, sampling at the 5% prevalence level (Table 2)

- The source must have been tested a minimum of three times within two consecutive years with at least four months between tests without a positive detection for the restricted pathogen of concern, sampling at the 2% prevalence level (Table 2)

- *Aeromonas salmonicida salmonicida*, *Yersinia ruckeri*, and/or *Myxobolus cerebralis* (pathogens not vertically transmissible) are the pathogens of concern and fertilized eggs are properly disinfected (Appendix C)

If one of the above criteria cannot be met, the gametes and subsequent progeny should be reared in isolation/quarantine from other fish at the receiving hatchery. Prior to release from isolation, progeny should be tested for the restricted pathogen(s) of concern such that three negative inspections are recorded, with consecutive inspections separated by at least four months before release from quarantine. Sampling should occur at the 2% prevalence level (Table 2). Progeny should be subjected to an appropriate stress test for the pathogen(s) of concern prior to the final screening.

Importing Fish from Sources in Areas Enzootic for Emergency Pathogens

If a member agency seeks to import fish from a source outside the Great Lakes basin where an emergency pathogen is enzootic or from a member-agency hatchery that has imported fish from such a source, the following guidelines apply

- If the receiving hatchery has a non-secure water supply, importation is NOT recommended

- If the receiving hatchery has a secure water supply, the fish should be held in isolation and one of the following stipulations should be met

    - testing should continue for a minimum of five consecutive years without a positive detection before release from isolation, sampling at the 5% prevalence level (Table 2)

    - testing should continue for a minimum of three times over two consecutive years with at least four months between tests without a positive detection before release from isolation, sampling at the 2% prevalence level (Table 2)

- If a quarter facility is available and neither of the above criteria regarding a secure water supply can be met

    - quarantine should be maintained for 12 months

    - during quarantine, three negative inspections separated by at least four months are required, with sampling at the 2% prevalence level (Table 2). Stress testing is recommended

Importing or Transferring Fish from Sources in Areas Enzootic for Restricted Pathogens

If a member agency seeks to import or transfer fish into a hatchery from a source located in an area enzootic for a restricted pathogen, one of the following guidelines applies

- The source must have been tested for a minimum of three consecutive years without a positive detection, sampling at the 5% prevalence level (Table 2)

- The source must have been tested a minimum of three times over two consecutive years with at least four months between tests without a positive detection, sampling at the 2% prevalence level (Table 2)

- The fish are quarantined for 12 months during which time three negative inspections spaced at a minimum of four months are recorded; sampling should be at the 2% prevalence level (Table 2); a sample of the fish should be subjected to an appropriate stress test prior to the final screening

If a member agency seeks to import or transfer fish into a non-quarantine facility from a source with a Level-1 restricted pathogen (Table 1), the receiving facility should have been classified as positive for the pathogen, and a health certificate should accompany the importation. Fish with Level-2 pathogens (Table 1) should not be imported or transferred between hatcheries.

PATHOGEN DETECTIONS

Emergency Pathogen Detections in a Hatchery

If an emergency pathogen is detected at a hatchery, the following steps should be initiated immediately to eradicate the pathogen from the facility, source, and receiving waters

- Destroy all infected lots
- Isolate as much as possible all susceptible species from infected fish
- Disinfect all potentially contaminated portions of the facility following procedures in Chapter 14 of Great Lakes Fishery Commission Special Publication 83-2 (http://www.glfc.org/pubs/SpecialPubs/sp83_2/index.html)
- Eradicate the pathogen from source and effluent water supplies if possible
- Disinfect all potentially contaminated gear
- Confirm the detection by another laboratory following standard procedures
- Notify the competent authority if it is OIE reportable

- Notify the GLFHC chairperson or, in the chair's absence, the vice-chairperson, who will advise the GLFHC and the CLC

- Notify all transfer sources or recipients of the fish, fertilized eggs, or gametes that an emergency pathogen has been detected

- Update the hatchery classification to reflect the new detection.

To demonstrate the pathogen has been eradicated, the facility should, in addition to the actions stated above, complete one of the following

- Test all lots of susceptible species three times with at least four months between tests, achieving negative results while sampling each lot at the 2% prevalence level (Table 2)

- If appropriate biosecurity measures have been taken to isolate rearing units, test susceptible species within the affected rearing unit three times at intervals at least four months apart, sampling at a 2% prevalence level (Table 2); if the results are negative and if the member agency can demonstrate the fish, fertilized eggs, or gametes in the affected rearing unit had no direct or indirect contact with other fish on station, fish in other rearing units do not need to be in compliance with the guideline immediately above

If the testing described above indicates the pathogen has been eradicated, the agency may stock those fish remaining on station after disinfection. The GLFHC's risk assessment (see the GLFHC website at http://www.glfc.org/boardcomm/fhealth/fhealth.php) should be consulted before stocking proceeds. If the testing described above indicates the pathogen has not been eradicated, the authority should proceed as though the pathogen had just been found, reinitiating the procedure from the beginning. The procedures described above should continue until testing indicates the pathogen has been eradicated.

Emergency Pathogen Detections in the Wild

If an emergency pathogen is detected in the wild

- Notify the GLFHC chairperson, who will advise the GLFHC and CLC and initiate procedures to amend the model program

- Employ all necessary/reasonable means to contain the spread of the pathogen, including limiting transportation of fish, fertilized eggs, and/or gametes from the affected location

- Notify the competent authority if it is OIE reportable

- If the pathogen is not OIE reportable, confirm the detection by another laboratory following standard procedures

- Initiate a surveillance program to determine the geographic distribution of the pathogen and the species susceptible to it, if possible

- Eradicate the pathogen, if possible, and undertake measures to prevent its spread

Restricted Pathogen Detections in a Hatchery

If a restricted pathogen is detected at a hatchery

- Enhance biosecurity measures as needed to limit the spread of the pathogen to other rearing units within the hatchery or to other hatcheries

- Optimize rearing conditions

- Confirm the detection by another laboratory following standard procedures

- Notify the competent authority if it is OIE reportable

- Treat infected rearing units to reduce the number of infected fish if appropriate and test afterwards as necessary

If the detection is new, determine the origin of the pathogen if possible, take action to prevent further spread, and notify the GLFHC chairperson, who in turn will inform the committee of the change in status of the hatchery.

Restricted Pathogen Detections in the Wild

If a restricted pathogen is detected in the wild

- Limit the collection of fish, fertilized eggs, and gametes from the location, if possible

- Employ reasonable means to prevent the spread of the pathogen to locations where it has not been detected previously

- Initiate a surveillance program to determine the geographic distribution of the pathogen, if possible

If the detection is new, inform the GLFHC chairperson, who in turn will inform the committee.

Provisional Pathogen Detections in a Hatchery

If a provisional pathogen is found within a hatchery, a risk assessment (see the GLFHC website at http://www.glfc.org/boardcomm/fhealth/fhealth.php) should be used to provide guidance regarding whether potentially infected fish can be transferred or stocked. In addition, the agency should assess risks, determine the pathogen's origin, determine if it was transferred to another region/hatchery, and minimize its spread.

Provisional Pathogen Detections in the Wild

If a provisional pathogen is detected in wild fish, member agencies should report the finding to the GLFHC chairperson for surveillance. A risk assessment (see the GLFHC website at http://www.glfc.org/boardcomm/fhealth/fhealth.php) can be used by the agency to address the situation and to provide guidance concerning use of potentially infected fish as brood stock.

RELEASE OF FISH INFECTED WITH PATHOGENS

Emergency Pathogens

Fish from a facility that has tested positive for an emergency pathogen may be released into the wild only if the guidance provided in the Pathogen Detection section is followed.

Restricted Pathogens

Infected fish without clinical signs of Level-1 restricted pathogens may be released in waters where the pathogen has been detected previously or where infected fish have been released within the last five years. Fish infected with Level-1 pathogens that have clinical signs of disease, or those infected with Level-2 pathogens, should not be stocked and all lots should be destroyed.

Fish should not be released into the Great Lakes basin if any of the following exist

- Fish exhibit clinical signs of any disease
- Mortality rates in a given rearing unit deviate from hatchery background levels (such rearing units should be tested for pathogens)
- Prevalence of infection is high
- Fish are infected with a pathogen that is resistant to common antibiotics used for treatment (such fish can be released into a lake without inlets or outlets)

Provisional Pathogens

If a provisional pathogen is found within a hatchery, a risk assessment should be used for guidance concerning release of infected fish. (see the GLFHC website at http://www.glfc.org/boardcomm/fhealth/fhealth.php).

REPORTING

Each member agency should provide to the GLFHC chairperson an annual (calendar year) report that describes the status of fish health within its Great Lakes waters and hatcheries. Annual reports will be distributed within the GLFHC and should include summaries of the following

- Classifications of agency hatcheries and wild brood stock populations
- Records of fish, fertilized eggs, and gametes imported into the Great Lakes basin
- Measures adopted for pathogen management

- Detections of emergency, restricted, or provisional pathogens within the member agency's jurisdiction and associated information pertinent to fish-sample collection, testing method(s), dates, locations (including latitude/longitude), and other information potentially useful for suppression/control

- High mortalities in fish hatcheries or in wild populations, including information on the causative pathogen(s)

- Issues where the member agency requested input from the GLFHC, including its final recommendation

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GLOSSARY

annual inspection	Tests conducted each calendar year on fish in hatcheries and on wild brood stocks under management by a member agency.
biosecurity	Preventive measures intended to reduce the spread of pathogens.
clinical sign	Visually apparent abnormalities in the body, organs, or behavior of a fish that potentially result from infection.
disease	An impairment of the normal functioning of fish that may be manifested by clinical signs.
emergency fish pathogen	A fish pathogen that has not been confirmed present in the Great Lakes basin and is known to cause epizootic events.
enzootic disease	A disease prevailing among or affecting animals in a particular locality.
epizootic	A disease event affecting a large number of animals at the same time within a particular geographic area often resulting in abnormally high mortality.
etiology	Study of the cause of disease.
fertilized eggs	Pertains here to fish eggs from the time of fertilization to hatch.
fish	Refers to species in Appendix A and encompassing their life stages from hatched egg to senescent adult.
gametes	Sperm and unfertilized eggs.
Great Lakes basin	Geographical area encompassing Lakes Ontario (including the St. Lawrence River from Lake Ontario to the 45th parallel of latitude), Erie, Huron, St. Clair, Michigan, and Superior, including their drainages.
hatchery	Facility holding and rearing fish.

importation	Transportation of fish or gametes from a source outside of the Great Lakes basin into the basin for purposes of propagation.
infection	Invasion by and multiplication of pathogenic microorganisms in a bodily organ or tissue.
intensity	The density of pathogens in a particular organism, also called load.
isolation facility	A structure that maintains a group of fish without any contact with other fish or water sources in order to allow observation for a specified length of time and, if appropriate, testing and treatment. The effluent waters are not treated.
lot	Fish of the same species and age that have always shared the same water supply and originated from a discrete spawning population.
member agency	Federal, provincial, tribal, or state government fishery management or conservation agency signatory to *A Joint Strategic Plan for Management of Great Lakes Fisheries*.
non-secure water supply	Untreated water source that may contain fish or fish pathogens.
pathogen	Any disease-producing agent, especially a virus, bacterium, or other microorganism.
prevalence	The proportion of infected individuals within a population at a given time.
provisional fish pathogen	A fish pathogen with uncertain geographic distribution whose life-history strategy is poorly understood, and whose ability to cause disease and epizootic events within the Great Lakes basin is unknown or uncertain.
quarantine facility	An isolation facility with treated effluent water.
rearing unit	Distinct raceway, pond, or tank used to culture fish at a hatchery.

restricted fish pathogen	A fish pathogen that exists in one or more locations in the Great Lakes basin; is known to cause epizootic events; and undergoes management to restrict its spread, prevalence, and impacts.
secure water supply	A water supply free of fish and fish pathogens (including those disinfected or treated to remove pathogens), such as a well or open or enclosed springs.
source	Any point or place of origin of fish or gametes, such as a fish hatchery or a free-ranging population.
transfer	The transportation of fish or gametes from one source to another source both within the Great Lakes Basin.
vertical transmission	Passage of pathogens from parents to progeny via their gametes.
wild brood stock population	Free-ranging fish population whose adults are captured for gamete collection, often in successive years, and then released unharmed.

APPENDIX A: COMMON FISH SPECIES OF THE MODEL PROGRAM

Commonly cultured fishes covered by the model program (the model program pertains to all fish species).

Common Name	Species Name
Atlantic salmon	*Salmo salar*
black crappie	*Pomoxis nigromaculatus*
bluegill	*Lepomis macrochirus*
brook trout	*Salvelinus fontinalis*
brown trout	*Salmo trutta*
burbot	*Lota lota*
channel catfish	*Ictalurus punctatus*
Chinook salmon	*Oncorhynchus tshawyscha*
coho salmon	*Oncorhynchus kisutch*
common carp	*Cyprinus carpio*
cutthroat trout	*Oncorhynchus clarki*
freshwater drum	*Aplodinotus grunniens*
lake herring	*Coregonus artedi*
lake sturgeon	*Acipenser fulvescens*
lake trout	*Salvelinus namaycush*
lake whitefish	*Coregonus clupeaformis*
largemouth bass	*Micropterus salmoides*
muskellunge	*Esox masquinongy*
northern pike	*Esox lucius*
pumpkinseed	*Lepomis gibbosus*

Common Name	Species Name
rainbow trout	*Oncorhynchus mykiss*
rock bass	*Ambloplites rupestris*
round goby	*Neogobius melanostomus*
smallmouth bass	*Micropterus dolomieu*
tubenose goby	*Proterorhinus marmoratus*
walleye	*Sander vitreus*
white bass	*Morone chrysops*
yellow perch	*Perca flavescens*

APPENDIX B: SAMPLING GUIDELINES FOR PATHOGENS

Sampling guidelines for pathogens listed in the model program, the disease they cause, their classification in the model program, and fish species recommended for screening should be consulted for current guidance: *Suggested Procedures for the Detection and Identification of Certain Fish and Shellfish Pathogens* (Blue Book) developed by the Fish Health Section of the American Fisheries Society; the *Manual of Diagnostic Tests for Aquatic Animals* of the OIE; and *Fish Health Protection Regulations Manual of Compliance* (Miscellaneous Special Publication 31, Revised) of Fisheries and Oceans Canada.

Organism	Common Name of Disease	Pathogen Classification	Species to be Screened	Temperature for Screening	Miscellaneous Considerations
Bacterial pathogens					
Aeromonas salmonicida	furunculosis	restricted	any freshwater fish		
Piscirickettsia-like organism	musky pox	provisional	esocids		
Renibacterium salmoninarum	bacterial kidney disease	restricted	salmonids		
Yersinia ruckeri	enteric red mouth (ERM)	restricted	any freshwater fish	>10°C	rainbow trout typically affected at ~7.5 cm (3”)

Organism	Common Name of Disease	Pathogen Classification	Species to be Screened	Temperature for Screening	Miscellaneous Considerations
Parasitic pathogens					
Bothriocephalus acheilognathi	Asian tapeworm	provisional	cyprinids		
Ceratomyxa shasta	ceratomyxosis	emergency	salmonids	4-10°C	spores are most likely found in the posterior intestine, but also occur in the kidney, liver, gall bladder, and pyloric caeca
Heterosporis sp.		restricted	percids, esocids, centrarchids	ambient	examine fish at least five weeks after the potential exposure
Myxobolus cerebralis	whirling disease	restricted	salmonids		rainbow trout are most sensitive
Nucleospora salmonis	salmonid intranuclear microsporidosis	provisional	salmonids	NA	
Tetracapsula bryosalmonae	proliferative kidney disease (PKD)	emergency	salmonids	any	disease develops after water reaches 12ºC and detectible in fish 30 days after exposure

Organism	Common Name of Disease	Pathogen Classification	Species to be Screened	Temperature for Screening	Miscellaneous Considerations
Viral pathogens					
Epizootic epithieliotropic disease virus	EED	provisional	salmonids	6-12°C	test fry to yearling life stages
Infectious hematopoitic necrosis virus	IHN	emergency	any freshwater fish	8-15°C	all age classes susceptible, fry most susceptible
Infectious pancreatic necrosis virus	IPN	restricted	any freshwater fish		
Infectious salmon anemia virus	ISA	emergency	salmonids/ Atlantic herring		
koi herpesvirus	KHV	restricted	Cyprinidae	16-28°C	horizontal transmission typical; vertical transmission possible; young life stages most susceptible
largemouth bass virus	LMBV	restricted	centrarchids /ecocids		
lymphosarcoma		provisional	esocids	unknown	no approved detection method

Organism	Common Name of Disease	Pathogen Classification	Species to be Screened	Temperature for Screening	Miscellaneous Considerations
spring viremia of carp virus	SVCV	restricted	any freshwater fish	10-18°C	horizontal transmission typical but vertical possible; juvenile fish (1 yr or less) most susceptible
viral hemorrhagic septicemia (IVb strain)	VHSv	restricted	any freshwater fish		
viral hemorrhagic septicemia (remaining strains)	VHSv	emergency	any freshwater fish		
white sturgeon herpesvirus	VHSv -1, VHSv -2	emergency	Acipenseridae		
white sturgeon iridovirus	VHSv	emergency	Acipenseridae		

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APPENDIX C: EGG DISINFECTION PROTOCOLS

Background

The recent emergence of VHSv as a fish health concern in the Great Lakes basin has served as a reminder of the need to reduce the risk of transferring pathogens into and between watersheds and hatcheries. The emergence of VHSv has also highlighted the need for a basinwide egg-disinfection methodology that could be supported by the GLFHC. Therefore, the GLFHC developed and is recommending a cool-water-egg disinfection protocol.

These recommendations were developed without complete information on the direct effectiveness of killing VHSv strain IVb associated with cool-water fish eggs and were based on

- The survivorship of cool-water eggs exposed to iodophor solution
- Expert opinion from national authorities on VHSv
- The USFWS Genoa National Fish Hatchery disinfection protocols for cool-water fish eggs
- The USFWS iodophor disinfection protocol for fish eggs
- Detailed literature reviews documenting that for VHSv strain IVa and infectious hematopoietic necrosis virus (a similar virus) the effective concentration of iodophor is 0.08 ppm (Amend et al. 1972; Elliott and Amend 1978; Batts et al. 1991; Yoshimizu et al. 2005

Thus, the recommendations for Great Lakes cool-water-egg disinfection were based on the best available information and should be considered a minimum disinfection methodology. As new information becomes available, these recommendations will be updated.

Recommended Methodology

The following cool-water-egg disinfection methodology is recommended by the GLFHC for use by all member agencies in the Great Lakes basin

1. The disinfection of fertilized cool-water fish eggs should be conducted during water hardening whenever possible, and, when not possible, surface disinfection should be used after water hardening

2. One of the following procedures should be used for cool-water egg disinfection

    a. During egg water hardening, a 50 ppm concentration of iodophor solution should be used for 30 minutes to kill pathogens and prevent them from entering the egg; water from a protected source should be used for water hardening, egg rinsing, and egg transport

    b. If disinfection during water hardening is not possible or if water from a protected source is not used during water hardening, egg rinsing and/or egg transport, a 100 ppm concentration of iodophor solution should be used for 10-15 minutes to kill pathogens adhering to the surface of eggs prior to their being moved into an agency hatchery building

    c. If eyed eggs are transferred between fish production facilities, a 100 ppm concentration of iodophor solution should be used for 10-15 minutes to kill pathogens adhering to the surface of eggs prior to their being moved into an agency hatchery building

3. When eggs are disinfected, the pH should be buffered to ensure it does not change by more than 0.3 units and remains between 7.0 and 7.5

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APPENDIX D: FORMS

Form MP-1. Pathogen Nomination Form

Downloadable pdf copies of this form can be found on the GLFHC's website http://www.glfc.org/boardcomm/fhealth/fhealth.php.

Date of Nomination:
Requesting Agency:
Pathogen name/disease name (include synonyms):
Suggested classification (Emergency, Restricted, Provisional):
Known geographic range:
Known host species:
Known intermediate/alternate host species (parasites only):
Concern to the Great Lakes or requesting agency, including estimated pathogenicity:
Clinical disease signs:
Methods for pathogen detection and disease diagnosis, including optimal sample testing guidance:
Relevant literature:
Other:

The following should be filled in by the chairperson of the Great Lakes Fish Health Committee.

Decision Date:
Decision Details:
Final Decision:

Form MP-2. Inspection Report

Downloadable pdf copies of this form can be found on the GLFHC's website http://www.glfc.org/boardcomm/fhealth/fhealth.php.

Form MP-2. Inspection Report.

ISH HEALTH INSPECTION REPORT
Agency Name
Fish Health Inspection Report

This report is not evidence of future disease status. To determine current status, contact Fish Health Official below.

Name and Location of Facility or Waterbody:	Owner/Manager/Contact:	Inspection Date(s):
		This:
		Prior:
		Classification:

Type of Water Supply: Well/Spring
Origin of Fish Examined: Hatchery
Type of Fish Examined: Salmonid

Species[2]	Designation	Lab Report #	Age	Number in Lot	Obtained as Eggs (E) or Fish (F) From:	Pathogens Inspected for and Results						
						As	*Yr*	*Rs*	VHSV	IHNV	IPNV	MC

Remarks/Recommendations:	Address/Phone of Contracted Fish Health Official	Signature of Contracted Fish Health Official

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FISH HEALTH INSPECTION REPORT CONTINUED. REPORT NUMBER:

Species	Designation	Lab Report #	Age	Number in Lot	Obtained as Eggs (E) or Fish (F) From:	Pathogens Inspected for and Results						
						As	*Yr*	*Rs*	VHSV	IHNV	IPNV	MC

SUPPLEMENTAL INSPECTION INFORMATION

Date	Species	Lot #	Findings

88-3 Age structured stock assessment of Lake Erie walleye (report of the July 22-24, 1986 Workshop). 1988. R. B. Deriso, S. J. Nepszy, and M. R. Rawson. 13 p.
88-4 The international Great Lakes sport fishery of 1980. 1988. D. R. Talhelm. 70 p.
89-1 A decision support system for the integrated management of sea lamprey. 1989. J. F. Koonce and A. B. Locci-Hernandez. 74 p.
90-1 Fish community objectives for Lake Superior. 1990. Edited by T. R. Busiahn. 24 p.
90-2 International position statement and evaluation guidelines for artificial reefs in the Great Lakes. 1990. Edited by J. E. Gannon. 24 p.
90-3 Lake Superior: the state of the lake in 1989. 1990. Edited by M. J. Hansen. 56 p.
90-4 An ecosystem approach to the integrity of the Great Lakes in turbulent times (proceedings of a 1988 workshop supported by the Great Lakes Fishery Commission and the Science Advisory Board of the International Joint Commission). 1990. Edited by C. J. Edwards and H. A. Regier. 302 p.
91-1 Status of walleye in the Great Lakes: case studies prepared for the 1989 workshop. 1991. Edited by P. J. Colby, C. A. Lewis, and R. L. Eshenroder. 222 p.
91-2 Lake Michigan: an ecosystem approach for remediation of critical pollutants and management of fish communities (report of a round table sponsored in 1990 by the Great Lakes Fishery Commission, the Science Advisory Board of the International Joint Commission, and the Lake Michigan Federation). 1991. Edited by R. L. Eshenroder, J. H. Hartig, and J. E. Gannon. 58 p.
91-3 The state of the Lake Ontario fish community in 1989. 1991. S. J. Kerr and G. C. LeTendre. 38 p.
93-1 Great Lakes fish disease control policy and model program. 1993. Edited by J. G. Hnath. 38 p. Protocol to minimize the risk of introducing emergency disease agents with importation of salmonid fishes from enzootic areas. 1993. Edited by R.W. Horner and R. L. Eshenroder. 15 p.
94-1 The state of Lake Superior in 1992. 1994. Edited by M. J. Hansen. 110 p.
94-2 An introduction to economic valuation principles for fisheries management. L.G. Anderson. 98 p.
95-1 Fish-community objectives for Lake Huron. 1995. R. L. DesJardine, T. K. Gorenflo, R. N. Payne, and J. D. Schrouder. 38 p.
95-2 The state of Lake Huron in 1992. Edited by M. P. Ebener. 140 p.
95-3 Fish-community objectives for Lake Michigan. R.L. Eshenroder, M.E. Holey, T.K. Gorenflo, and R.D. Clark, Jr. 56 p.
99-1 Fish-community objectives for Lake Ontario. T.J. Stewart, R.E. Lange, S.D. Orsatti, C.P. Schneider, A. Mathers, M.E. Daniels. 56 p.
03-01 Fish-community objectives for Lake Superior. W.H. Horns, C.R. Bronte, T.R. Busiahn, M.P. Ebener, R.L. Eshenroder, T. Gorenflo, N. Kmiecik, W. Mattes, J.W. Peck, M. Petzold, D.R. Schreiner. 86 p.
03-2 Fish-community goals and objectives for Lake Erie. P.A. Ryan, R. Knight, R. MacGregor, G. Towns, R. Hoopes, W. Culligan. 56 p.
05-01 The state of Lake Michigan in 2000. Edited by M.E. Holey and T.N. Trudeau. 114 p.
05-02 The state of Lake Huron in 1999. Edited by M.P. Ebener. 140 p.
07-01 The state of Lake Ontario in 2003. Edited by B.J. Morrison and S. R. LaPan. 108 p.
07-02 The state of Lake Superior in 2000. Edited by M.P. Ebener. 126 p.
08-01 The state of Lake Huron in 2004. Edited by J.R. Bence and L.C. Mohr. 88 p.
08-02 The state of Lake Michigan in 2005. Edited by D.F. Clapp and W. Horns. 124 p.
09-01 Standard operating procedures for fisheries acoustic surveys in the Great Lakes. S.L Parker-Stetter, L.G. Rudstam, P.J. Sullivan, and D. M. Warner. 168 p.
09-02 The state of Lake Erie in 2004. Edited by J.T. Tyson, R.A. Stein, and J.M. Dettmers. 124 p.
10-01 The state of Lake Superior in 2005. Edited by O.T. Gorman, M.P. Ebener, and M.R. Vinson. 130 p.
12-01 The state of Lake Michigan in 2011. Edited by David B. Bunnell. 80 p.
13-01 The state of Lake Huron in 2010. Edited by Stephen C. Riley. 106 p.
14-01 The state of Lake Ontario in 2008. Edited by Angela C. Adkinson and Bruce J. Morrison. 94 p.

Special Publications

79-1 Illustrated field guide for the classification of sea lamprey attack marks on Great Lakes lake trout. 1979. E. L. King and T. A. Edsall. 41 p.

82-1 Recommendations for freshwater fisheries research and management from the Stock Concept Symposium (STOCS). 1982. A. H. Berst and G. R. Spangler. 24 p.

82-2 A review of the adaptive management workshop addressing salmonid/lamprey management in the Great Lakes. 1982. Edited by J. F. Koonce, L. Greig, B. Henderson, D. Jester, K. Minns, and G. Spangler. 58 p.

82-3 Identification of larval fishes of the Great Lakes basin with emphasis on the Lake Michigan drainage. 1982. Edited by N. A. Auer. 744 p. (Cost: $10.50 U.S., $12.50 CAN)

83-1 Quota management of Lake Erie fisheries. 1983. Edited by J. F. Koonce, D. Jester, B. Henderson, R. Hatch, and M. Jones. 40 p.

83-2 A guide to integrated fish health management in the Great Lakes basin. 1983. Edited by F. P. Meyer, J. W. Warren, and T. G. Carey. 262 p.

84-1 Recommendations for standardizing the reporting of sea lamprey marking data. 1984. R. L. Eshenroder and J. F. Koonce. 22 p.

84-2 Working papers developed at the August 1983 conference on lake trout research. 1984. Edited by R. L. Eshenroder, T. P. Poe, and C. H. Olver.

84-3 Analysis of the response to the use of "Adaptive Environmental Assessment Methodology" by the Great Lakes Fishery Commission. 1984. C. K. Minns, J. M. Cooley, and J. E. Forney. 22 p.

85-1 Lake Erie fish community workshop (report of the April 4-5, 1979 meeting). 1985. Edited by J. R. Paine and R. B. Kenyon. 58 p.

85-2 A workshop concerning the application of integrated pest management (IPM) to sea lamprey control in the Great Lakes. 1985. Edited by G. R. Spangler and L. D. Jacobson. 98 p.

85-3 Presented papers from the Council of Lake Committees plenary session on Great Lakes predator-prey issues, March 20, 1985. 1985. Edited by R. L. Eshenroder. 134 p.

85-4 Great Lakes fish disease control policy and model program. 1985. Edited by J. G. Hnath. 24 p.

85-5 Great Lakes Law Enforcement/Fisheries Management Workshop (report of the 21, 22 September 1983 meeting). 1985. Edited by W. L. Hartman and M. A. Ross. 26 p.

85-6 TFM vs. the sea lamprey: a generation later. 1985. 18 p.

86-1 The lake trout rehabilitation model: program documentation. 1986. C. J. Walters, L. D. Jacobson, and G. R. Spangler. 34 p.

87-1 Guidelines for fish habitat management and planning in the Great Lakes (report of the Habitat Planning and Management Task Force and Habitat Advisory Board of the Great Lakes Fishery Commission). 1987. 16 p.

87-2 Workshop to evaluate sea lamprey populations "WESLP" (background papers and proceedings of the August 1985 workshop). 1987. Edited by B. G. H. Johnson.

87-3 Temperature relationships of Great Lakes fishes: a data compilation. 1987. D. A. Wismer and A. E. Christie. 196 p.

88-1 Committee of the Whole workshop on implementation of the Joint Strategic Plan for Management of Great Lakes Fisheries (reports and recommendations from the 18-20 February 1986 and 5-6 May 1986 meetings). 1988. Edited by M. R. Dochoda. 170 p.

88-2 A proposal for a bioassay procedure to assess impact of habitat conditions on lake trout reproduction in the Great Lakes (report of the ad hoc Committee to Assess the Feasibility of Conducting Lake Trout Habitat Degradation Research in the Great Lakes). 1988. Edited by R. L. Eshenroder. 13 p.

Risk Assessment for the Introduction or Transfer of Fish and Associated Pathogens into the Great Lakes Basin

October 2014
(supersedes Horner and Eshenroder 1993)

Movement of fish and their gametes has been, and continues to be, the cornerstone of many fishery conservation and restoration programs within the Laurentian Great Lakes. Often, pathogens have invaded new geographic ranges as a result of fish importation or stocking, resulting in negative consequences for fish populations in those systems. Numerous examples can be found in the literature such as the incidence of whirling disease in the intermountain west (Bartholomew and Reno 2002). Recognizing this, the Great Lakes Fish Health Committee (GLFHC) developed and adopted a protocol to assess and minimize the risk of introducing emerging disease agents with the importation of salmonid fishes from enzootic areas (Horner and Eshenroder 1993). Outbreaks of emerging diseases in wild and cultured fishes within the basin (such as *Heterosporis* sp., largemouth bass virus, *Piscirickettsia* sp., *Nucleospora salmonis*, and viral hemorrhagic septicemia virus) have indicated a more quantifiable protocol is needed when assessing the pathogen risk of potential introductions or transfers of fish and their gametes.

National and international agencies have developed a standard, science-based process to accurately assess pathogen introduction risks associated with fish movement, collectively called Import Risk Analysis (IRA) (Amos 2004; Bondad-Reantaso 2004; Hine 2004; Kanchanakhan and Chinabut 2004; Olivier 2004; Perera 2004). Guided by this widely accepted process of IRA for fish importation and movements, the GLFHC adopted a revised Risk Assessment (RA) process in compliance with the World Animal Health Organization Aquatic Code (OIE 2013), the International Council for the Exploration of the Sea Code (ICES 2004), the Food and Agriculture Organization of the United Nations (Bartley et al., 2006), and the U.S. Fish and Wildlife Service Handbook of Aquatic Animal Health Procedures and Protocols. Specifically, the GLFHC sought to

- Develop a general Risk Assessment framework the Committee will follow to reach recommendations regarding introductions or transfers for which no standard procedures are established, or which fall outside of or in conflict with the Model Program.
- Archive each Risk Assessment for review and evaluation when similar cases arise in the future.

The GLFHC's Risk Assessment is designed to determine the likelihood of pathogen introduction into or spread within the Great Lake Basin associated with fisheries management actions such as fish and aquatic organism transfers. The Risk Assessment will also document likely risks of such actions and provide Great Lakes fisheries managers GLFHC recommendations about how to minimize any identified risks using the best available information at the time the Risk Assessment is performed.

The GLFHC Risk Assessment will not address any issues outside of the aquatic animal health considerations of any proposed introduction. The determination of the benefits of fisheries management actions along with the potential ecological or genetic effects, if any, must be part of the decision record and are the responsibility of the proponent fisheries agency(ies), appropriate Great Lakes Committee(s), and the Council of Lake Committees (CLC).

The GLFHC strongly recommends that a Risk Assessment be conducted well prior to the planned importation or transfer of fish or other aquatic organisms, particularly when the Model Fish Health Program does not provide clear guidance to fisheries managers on minimizing potential aquatic animal health risks in receiving facilities and waters. This assessment is designed to support and assist in the decision record for the proposed fisheries management action. Based on all available information, the GLFHC will review, evaluate and provide recommendations on the proposed introduction exclusively focused on the potential aquatic animal health risks to the receiving facility or water body from the proposed management action. The term “introduction” is defined in this document to include any action in which fish and aquatic organisms and their associated gametes are being moved. These actions include fish or aquatic organism transfers, stocking, or importation.

Risk Assessment Objectives

a. Identify pathogen(s) of concern that may be introduced or transferred into the basin as a result of the proposed introduction of fish or aquatic organism, including their gametes.
b. Document potential aquatic organism disease issues to include epizootic risk associated with the proposed action.
c. Determine the most likely aquatic organism disease risks, to include the likelihood of such risks, associated with the proposed transfer or introduction of fish or aquatic organism and their gametes into the new Great Lakes waters or facilities.
d. Develop and provide Great Lakes basin fisheries managers with the GLFHC recommendation as to whether or not the proposed action to import or transfer fish or other aquatic organisms should proceed from a fish health standpoint.
e. Develop and provide Great Lakes basin fisheries managers with risk management options to eliminate or reduce the effects of the proposed action.
f. Facilitate responses to fish and aquatic organism disease questions from CLC members and other entities to the GLFHC on the proposed fish management action including the Risk Assessment process, supporting documentation, and recommendations.

Risk Assessment Procedure

The Risk Assessment is to be used in the following situations:

- A Level 1 Restricted Pathogen is detected at a member-operated facility,
- The Model Program does not provide clear guidance, or
- A proposed action is in direct conflict with the Model Program.

When one of these situations arises, the GLFHC Chairperson should be contacted by the affected agency’s representative on the GLFHC to begin the Risk Assessment process. Once contacted, the GLFHC Chairperson will work with the requesting member to select the appropriate RA form (RA-1 or RA-2) and to complete a preliminary Risk Assessment. The GLFHC Chairperson will share the preliminary Risk Assessment with the entire GLFHC and solicit input from members to develop a final RA report.

Final Assessment of the Pathogen Risk Potential

The process results in a numerical score, which is placed into one of three categories of risk: low, moderate, or high. The GLFHC will provide a summary report (Form RA-3) which will focus and summarize only the most critical information that was used in the process, including its recommendation, documentation of fish health risks to naturally occurring populations of native or naturalized species, important fisheries or aquaculture resources, biological communities and habitats which may be impacted by a proposed action, and potential options for mitigation (if applicable). The summary report will be provided to all member agencies, the appropriate lake committee(s), and the CLC.

Risk Communication

Risk communication represents the interactive exchange of information about risk among risk assessors, risk managers, and other interested parties. It begins when a risk assessment is requested and continues on after the implementation of a recommendation regarding the possible translocation of a pathogen of concern.

The communication of risk should be open, interactive, and involve transparent exchange of information that may continue after the decision on translocation is made. The uncertainty in the model, model inputs, and the risk estimates in the risk assessment should be communicated between the involved parties. The entire risk assessment process should include an evaluation of uncertainty and data sources.

Instructions for Risk Assessment Forms RA-1 and RA-2

Each of the RA forms should be scored as follows:
1. Choose the appropriate option for each situation and place its associated numerical value in the small box immediately to the right of that option.
2. Multiply the numerical value by the weighting factor (in parentheses) for the situational statement and place this value in the larger box on the far right.
3. Total all of the large box scores and place this value in the **Total Risk Score** box at the bottom of the worksheet.

Example for Form RA-1

In an instance where the prevalence of a pathogen in the source population is Medium and its pathogen transmission is vertical, the first part of Form RA-1 would be filled in as follows:

Current prevalence of pathogen in the source population (5)		
High (67-100) – 5		15
Medium (33-66) – 3	3	
Low (1-32) – 1		
None – 0		
Pathogen transmission through fish or their gametes (10)		
Vertical (and assumed horizontal) – 5	5	50
Horizontal – 1		
Unknown – 5		

Final Scoring

Form RA-1: For pathogen movements into a facility, the following risk potential and general recommendations apply.

Risk Score	Risk Potential	Recommendation
387 and below	Low	*Place fish or eggs into a standard facility; apply mitigation for pathogens as necessary. The movement must not result in a reduction of the health status of the*

		facility. If the movement would result in a reduction of health status, the fish or eggs should be placed into isolation or quarantine.
388 - 646	Moderate	*Place fish or eggs into isolation/quarantine. The fish should be tested a minimum of 3 times in 2 years with at least 4 months between tests without the detection of a pathogen listed in the Model Program before transfer or release. Sampling should be done at the 2% prevalence level (95% confidence).*
647 and above	High	*Place into quarantine. Fish may only be transferred or released based on recommendations made by the GLFHC in the Risk Assessment Summary document.*

Form RA-2: For pathogen movements out of a facility, the following risk potential and general recommendations apply.

Risk Score	Risk Potential	Recommendation
667 and below	Low**	*Allow unrestricted movement of the fish and their gametes.*
668-1070	Moderate**	*Allow fish and their gametes to only be transferred to facilities or released into waters that are positive for the pathogen(s) of concern.*
1071 and above	High	*Stocking and transfers are not recommended. Potential exceptions would allow fish and their gametes to only be stocked into the waters of origin or held in isolation/quarantine for further testing as suggested by the GLFHC.*

**Note: For situations when the pathogen(s) is not currently present in the Great Lakes Basin, or if more than one pathogen is present, the Risk Potential shall be raised by one level (low becomes moderate, moderate becomes high).

Recommendations to Decision-Makers

A risk assessment can result in one of three outcomes:

1. The request is recommended for approval without conditions.
2. The request is recommended for approval with conditions such that specific preventive or mitigating measures are to be followed before the proposed translocation of a potential pathogen takes place.
3. The request is not recommended for approval owing to a level of risk estimated to be unacceptable.

References Cited

Amos, K. 2004. National Aquatic Animal Health Plan for the United States of America. *In* Capacity and Awareness Building on Import Risk Analysis for Aquatic Animals. *Edited by* J.R. Arthur and M.G. Bondad-Reantaso. Proceedings of the Workshops held 1-6 April 2002 in Bangkok, Thailand and 12-17 August 2002 in Mazatlan, Mexico. APEC FWG 01/2002, NACA, Bangkok, pp. 147-150.

Bartholomew, J.L. and Reno, P.W. 2002. The history and dissemination of whirling disease. *In* Whirling disease: reviews and current topics. *Edited by* J.L Bartholomew and J.C. Wilson. American Fisheries Society, Symposium 29, Bethesda, Maryland, pp. 3-24.

Bartley, D.M., Bondad-Reantaso, M.G., and Subasinghe R.P. 2006. A risk analysis framework for aquatic animal health management in marine stock enhancement programmes. Fisheries Res **80**: 28-36.

Bondad-Reantaso, M.G. 2004. Development of national strategy on aquatic animal health management in Asia. *In* Capacity and Awareness Building on Import Risk Analysis for Aquatic Animals. *Edited by* J.R. Arthur and M.G. Bondad-Reantaso. Proceedings of the Workshops held 1-6 April 2002 in Bangkok, Thailand and 12-17 August 2002 in Mazatlan, Mexico. APEC FWG 01/2002, NACA, Bangkok. Pp. 103-108.

Hine, M. 2004. The development of import risk analysis (IRA) in relation to the history of New Zealand. *In* Capacity and Awareness Building on Import Risk Analysis for Aquatic Animals. *Edited by* J.R. Arthur and M.G. Bondad-Reantaso. Proceedings of the Workshops held 1-6 April 2002 in Bangkok, Thailand and 12-17 August 2002 in Mazatlan, Mexico. APEC FWG 01/ 2002, NACA, Bangkok, pp. 131-133.

Horner, R.W. and Eshenroder, R.L. 1993. Protocol to minimize the risk of introducing emergency disease agents with importation of salmonid fishes from enzootic areas. Great Lakes Fishery Commission Special Publication **93**: 39-53.

ICES. 2004. ICES code of practice on the introductions and transfers of marine organisms. International Council for the Exploration of the Sea, Copenhagen, Denmark.

Kanchanakhan, S. and Chinabut, S. 2004. Strategies for aquatic animal health management in Thailand. *In* Capacity and Awareness Building on Import Risk Analysis for Aquatic Animals. *Edited by* J.R. Arthur and M.G. Bondad-Reantaso. Proceedings of the Workshops held 1-6 April 2002 in Bangkok, Thailand and 12-17 August 2002 in Mazatlan, Mexico. APEC FWG 01/2002, NACA, Bangkok, pp. 139-142.

OIE. 2013. Aquatic Animal Health Code. 16th edn. World Animal Health Organization, Paris, France.

Olivier, G. 2004. Canada's National Aquatic Animal Health Program. *In* Capacity and Awareness Building on Import Risk Analysis for Aquatic Animals. *Edited by* J.R. Arthur and M.G. Bondad-Reantaso. Proceedings of the Workshops held 1-6 April 2002 in Bangkok, Thailand and 12-17 August 2002 in Mazatlan, Mexico. APEC FWG 01/2002, NACA, Bangkok, pp. 115-117.

Perera, R. 2004 The import risk analysis process in Australia. *In* Capacity and Awareness Building on Import Risk Analysis for Aquatic Animals. *Edited by* J.R. Arthur and M.G. Bondad-Reantaso. Proceedings of the Workshops held 1-6 April 2002 in Bangkok, Thailand and 12-17 August 2002 in Mazatlan, Mexico. APEC FWG 01/2002, NACA, Bangkok, pp. 109-113.

Form RA-1. Risk Assessment for pathogen movements into a facility. Complete this form when importing fish or fertilized eggs into a hatchery from either the wild or from another hatchery.

1. Current prevalence of pathogen in the source population (5)		
High (67-100) – 5		
Medium (33-66) – 3		
Low (1-32) – 1		
None – 0		
2. Pathogen transmission through fish or their gametes (10)		
Vertical (and assumed horizontal) – 5		
Horizontal – 1		
Unknown – 5		
3. Current prevalence of the pathogen in the receiving facility (20)		
High – 1		
Medium – 3		
Low – 5		
None – 10		
4. Current prevalence of the pathogen in the effluent receiving waters (20)		
High – 1		
Medium – 3		
Low – 5		
None/ Unknown - 10		
5. Confidence in the pathogen test methods in the hatchery (15)		
Standard methods (Blue Book and/or OIE protocols) – 1		
Non-standard (non-representative) methods – 3		
No testing methods available (clinical signs only) – 5		
6. Describe the known potential for disease to other aquatic animals (10)		
One fish species affected – 1		
One fish family affected – 3		
More than one fish family affected – 5		
Multiple classes affected – 7		
7. Are effective treatments available to control infection and transmission with the pathogen? (10)		
Yes (e.g., egg disinfection, vaccinations, etc.) – 0		
No – 10		
8. Describe the potential for an epidemic in cultured and wild stocks (15)		
Known to cause elsewhere – 5		
Does not cause epidemics – 1		
Unknown – 5		
9. Knowledge of the fish species and its culture requirements (5)		
Adequate – 1		
Inadequate/Unknown – 5		
10. Source fish health history (last 10 years) (10)		
Parental history with no other Model Program pathogens – 1		
Parental history with other Model Program pathogens – 5		
No parental history – 5		

11. Population source location (10)		
Within the same Great Lake watershed – 1		
Between Great Lakes – 3		
An adjacent basin to the Great Lakes (e.g., Mississippi River, Hudson River, etc.) – 5		
Outside of the adjacent Great Lakes basins – 10		
Total Risk Score		

Form RA-2. Risk assessment for pathogen movements out of a facility. Complete this form when transferring fish to the wild during stocking events.

1. Current prevalence of the pathogen in the hatchery (10)		
High (67-100) – 5		
Medium (33-66) – 3		
Low (1-32) – 1		
None – 0		
Unknown – 5		
2. Current prevalence of the pathogen in the lot (10)		
High (67-100) – 5		
Medium (33-66) – 3		
Low (1-32) – 1		
None – 0		
Unknown – 5		
3. Pathogen transmission through fish or their gametes (10)		
Vertical (and assumed horizontal) – 5		
Horizontal – 1		
Unknown – 5		
4. Will effective treatment/disinfection measures be implemented for the pathogen? (10)		
Yes (e.g., egg disinfection, etc) – 0		
No – 5		
5. Current geographic distribution of the pathogen in the Great Lakes basin (10)		
Presence – 0		
Absence – 30		
6. Will introductions of these fish likely increase a pathogen's geographic range within the Great Lakes basin? (10)		
Yes – 20		
Maybe (presumed presence of the pathogen within the geographic range) – 10		
No – 0		
7. Will introduction of these fish likely increase a pathogen's prevalence in Question #6 of the receiving water? (10)		
Yes – 10		
Maybe – 5		
No – 0		
8. Prevalence of the pathogen in the receiving water (5)		
High – 1		
Medium – 3		
Low – 5		
None – 10		
Unknown – 10		
9. Is the receiving waterbody a broodstock source? (10)		
Yes – 5		
No – 0		

10. Indicate which vectors enable transmission of the pathogen in the receiving water (5) **Choose all responses that apply and total the values.**		
Commercial activities (ballast, weed harvesting, fishing) – 5		
Fish stocking and bait – 5		
Predators (birds and mammals) – 1		
Human activity (recreational fishing) – 3		
11. Describe the potential for disease transfer to other aquatic animals (10)		
One fish species affected – 1		
One fish family affected – 2		
More than one fish family affected – 7		
Multiple classes affected – 10		
12. Describe the potential for an epidemic in wild stocks (20)		
Known to cause epidemics elsewhere – 10		
Does not cause epidemics – 0		
Unknown – 10		
13. Confidence in the pathogen test methods in the hatchery (5)		
Standard methods (Blue Book and/or OIE protocols) – 1		
Non-standard (non-representative) methods – 3		
No testing methods available (clinical signs only) – 7		
14. Fish health history of the lot (the last 2 years) (5)		
No history of other Model Program pathogens – 1		
History of other Model Program pathogens – 5		
No history – 5		
15. Fish health history of the current broodstock (the last 10 years) (5)		
No history of other Model Program pathogens – 1		
History of other Model Program pathogens – 5		
No history – 5		
16. Fish health history of the facility (the last 10 years) (5)		
No history of other Model Program pathogens – 1		
History of other Model Program pathogens – 5		
No history – 5		
17. Other pathogen presence (influence) in the receiving hatchery or waterbody (10)		
Comprehensive/Continual/Annual pathogen surveillance		
Other Model Program pathogen(s) detected – 7		
No other Model Program pathogen(s) detected – 1		
Limited/Sporadic pathogen surveillance		
Other Model Program pathogen(s) detected – 7		
No other Model Program pathogen(s) detected – 3		
No population/pathogen history – 7		
Total Risk Score		

Form RA-3. Risk Assessment Summary Information

Hazard Identification

Viruses:

Bacteria:

Fungi:

Parasites:

Other:

Comments:

Summary of the Request:

Summary of the Risk Assessment:

Statement on Overall Risk:

Signature of GLFHC Chairperson	Date

FISHERY RESEARCH PRIORITIES: GREAT LAKES FISH HEALTH COMMITTEE

Great Lakes Fishery Commission

Updated August 2018

This listing was compiled based on input from discussions within the Council of Lake Committees (for more information go to **http://www.glfc.org/lakecom.php**) and the Great Lakes Fish Health Committee **http://www.glfc.org/boardcomm/fhealth/fhealth.php)**. Order of listing does **not** imply relative ranking of priorities for the Fishery Research Program funding.

Research Priorities

- What is the ecology of fish pathogens and diseases of concern in the Great Lakes Basin? Examples include (but are not limited to) viral hemorrhagic septicemia virus (VHSv) genotype IVb, Heterosporis sp., Epizootic Epitheliotropic Disease virus (EEDv), Flavobacterium sp., and emerging diseases.
- What non-lethal field sampling methods and tissue/fluid samples are equivalent to conventional lethal field sampling methods to determine fish pathogen and/or disease status? Identification and validation of non-lethal methods to detect emerging fish pathogens or pathogens of concern in the Great Lakes basin is a special focus.
- Develop and validate new methods to detect emerging fish pathogens or pathogens of concern in the Great Lakes Basin.

Additional Research Interests

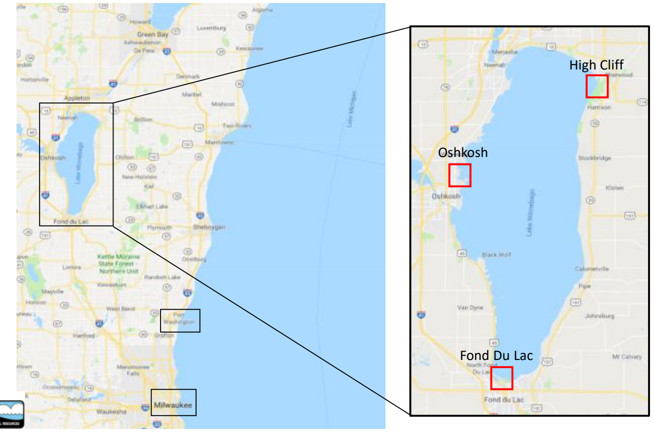
1. What is the effectiveness of the GLFHC disinfection protocols in eliminating key pathogens of interest from fish eggs? There is a need for a reliable disinfection methodology to prevent pathogen transmission via eggs and sperm.
2. Disease Ecology and Epidemiology
   - (a) What is the susceptibility of Great Lakes fish species to emerging fish pathogens in the Great Lakes?
   - (b) Identification of reservoirs and vectors (including ballast water) for fish pathogens in the Great Lakes Basin
   - (c) What mechanisms affect the virulence and persistence of fish pathogens?
   - (d) What is the effect of population size on disease expression?
   - (e) What are the effects of multiple pathogens or combination of pathogens and nutritional deficiency and/or contaminant exposure on disease expression?
   - (f) What are the projected changes on fish pathogen prevalence and intensity as a result of climate change?
3. Nutritional Aspects of Fish Health in the Great Lakes.
   - (a) What is the role of lipids or other nutrients in determining and predicting health status?
   - (b) What is the role of thiaminase-producing organisms in Great Lakes ecosystems?
   - (c) What affect do invasive species have on nutrient stores in the Great Lakes and what are the associated effects on fish health?
   - (d) What is the effect of nutrition on reproductive success?

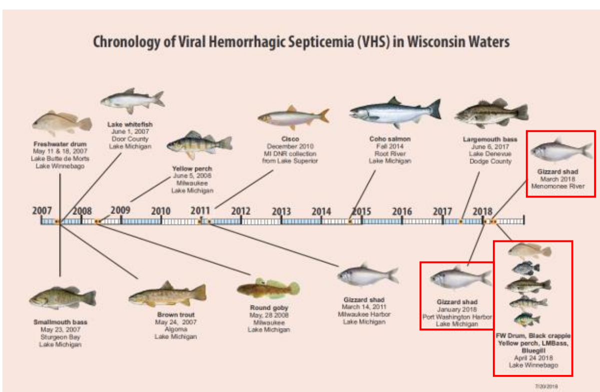
   (e) Does protein substitution in hatchery feeding formulations or extrusion manufacturing methods have a negative impact on survivorship, migratory behavior and reproductive success of hatchery-reared salmonids?

4. Fish Pathogen and Disease Management.
   (a) What are the effects of fish stocking and other management decisions on the manifestation of fish disease in the Great Lakes Basin?
   (b) What effects does culling brood stock for pathogen control have on the genetics of production fish?
   (c) When should fish not be moved past barriers (from a disease perspective)?
   (d) Development of an emergency response plan for disease outbreaks in the Great Lakes Basin, including (but not limited to) training of field personnel and preplanning.
   (e) What is the effectiveness of immunostimulants against key pathogens of interest in hatcheries?
   (f) What is the effect of vaccination of hatchery fish on pathogen virulence?
   (g) Are current risk factors and their relative weighting in the current risk assessment appropriate?
   (h) What are the pathogens of concern associated with freshwater mussels and their aquatic animal hosts, including mudpuppies, and are there validated testing methods available?

Wisconsin VHS UPDATE

- Three unusual mortality events
  - Two events specific to Gizzard Shad
  - One event multi-species (3 locations on Lake Winnebago)
- Press releases issued
  - Inform public of test results
  - Provide guidance on precautions to prevent spread
- Monitoring will continue



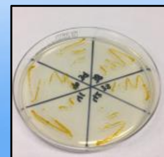


Wisconsin DNR Agency Updates

- **FHC Inspections**
  - 22, no issues identified
- **Unusual Morbidity/Mortality**
  - 1) Columnaris
    - Vx → Sampled/Tested → VFD for Aquaflor → 10 day Tx → low level mortality continued
    - C/S testing, testing of medicated feed, feeding protocol (?), ineffective vaccine (?)
    - H_2O_2 used to supplement Aquaflor Tx

Wisconsin DNR Agency Updates

- 2) Coldwater disease
  - Coho fingerlings with increase mortality, lethargy, eroded rostrums
  - Bacterial culture confirmed *Flavobacterium psychrophilum* → Tx: Aquaflor, successful
  - Broodstock was test positive for Coldwater disease
    - Eggs had iodine treatment on site and prior to hatchery, highlights disease transfer regardless
  - Kept isolate, vaccination next year



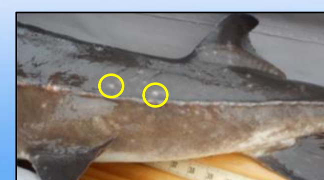
Wisconsin DNR Agency Updates

- 3) Unknown
  - June:
    - Increased mortality in sturgeon fry at Milwaukee rearing station (47 days old)
    - Water source: Milwaukee river, flow through system
    - FHI that week: nsf on gross exam
    - Bacteriology: *Acinetobacter Johnsonii, misc nonfermenter, probably Massilia sp, Kocunia camophila, Empedobater brewis, Chryseobacterium piscicola*
    - Virology: negative
    - Intermittent salt and H_2O_2 Tx anecdotally very effective
  - July
    - Large spike in mortality in a single tank
    - Clinical signs: lethargic, anorexic, anemic
    - Grossly: dark red/black gills on moribund fish with hyperemia/erythema on the abdomen

- Further testing
  - Another round of bacteriology → results: flavobacterium sp
  - Testing for Acipenserid herpesvirus 1 → to be discussed, results: negative
  - Testing for Acipenserid herpesvirus 2 and iridovirus → awaiting results
- Plans
  - Detailed water quality testing from the river water entering the trailer
  - Sending samples to Dr. Esteban Soto for fungal analysis and histology (UC Davis)
  - Getting food analyzed (brine shrimp, meal worms)

Wisconsin DNR Agency Updates

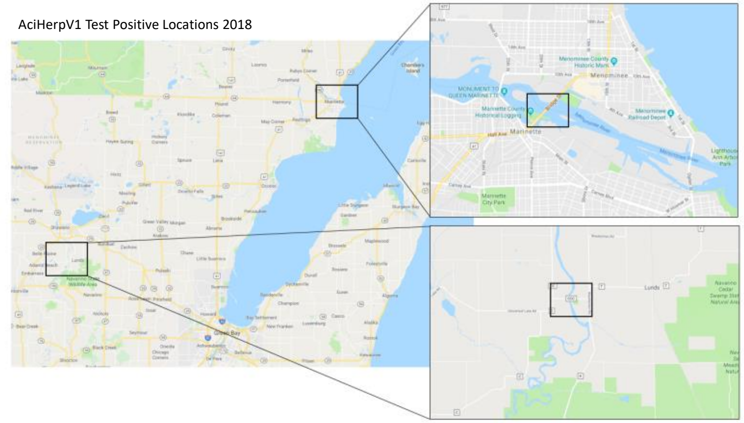
- **Research**
  - Acipenserid Herpesvirus 1 (AciHerpV1)
    - Spring 2017 (Wolf River):
      - small white circular lesions noted → skin scrape for PCR → + for AciHerpV1



Appendix 5.

- So what?
  - Previously only documented in White Sturgeon
  - Want to better characterize virus and determine if active infection is in other areas of the state
- What we did
  - 'Test kits' assembled and sent to biologists around the state (skin scrapes)
- Results (Spring 2018)
  - Wolf River: 9/10 suspect lesions sampled were + for AciHerpV1
  - Menominee River: 2/2 suspect lesions sampled (1 fish) were + for AciHerpV1
- From here
  - Continue to test samples as they are submitted
  - Send test positive tissues for histology and TEM (when available)

AciHerpV1 Test Positive Locations 2018



Wisconsin DNR Agency Updates

- **Ongoing Surveillance**
  - Broodstock:
    - Spring/Fall sampling of wild and farmed fish
    - Tissue and OVFL sampled
  - Forage
    - Test fish from vendors that are used to support our muskellunge and walleye stocking populations (VHS, FHMNv, IHNv, visual inspection for heterosporis)
  - VHS
    - Three of our Wisconsin hatcheries are surface water fed from 4 lake locations
    - VHS susceptible species (150 fish/lake) are collected annually
    - Results 2018: negative for all fish and sites
  - AciHerpV1
    - Previously discussed

Wisconsin DNR Agency Updates

- **INAD**
  - WiDNR continues to help give biologists legal access to Aqui-S®20E
  - Overall, treatments have been successful; minimal to no reports of toxicity
- **OTC**
  - Emerging global concerns on antibiotic resistance + judicial use
  - WiDNR fish health starting to examine/make efforts to amend commonplace use of OTC for skeletal marking of fish
  - Exploring genetic testing/markers
    - Hatchery vs wild fish
    - Reduce OTC use for non-therapeutic purposes

Cooperative Nursery Program

Brian McHail, Leader
Cooperative Nursery Unit

Mission: To protect, conserve, and enhance the Commonwealth's aquatic resources and provide fishing and boating opportunities

Overview

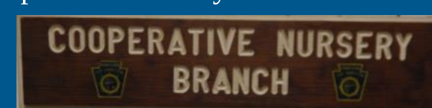
- History
- What is a cooperative nursery?
- 2016-2017 Production
- Fish Health

Cooperative Nursery Program

- U.S. Bureau of Fisheries (USBF)-1932
  - 21 Sportsmen's Organizations
  - Received 450,000 Brook Trout eggs/fry
  - 17 Sportsmen's Organizations-1951
  - Received 115,000 Brook Trout fingerlings
  - Only stocked 28,750 (25%)
  - Poor infrastructure and water quality

Cooperative Nursery Program

- U.S. Fish and Wildlife Service (USFWS)-1962
  - PFC takes over the program
- Cooperative Nursery Branch



- Cooperative Nursery Unit

What is a Cooperative Nursery???

- Cooperative Partnership with PFBC
- Sportsmen's Club/Rod & Gun Club/Outdoor Group/School
  - Aka…Sponsor
- Various Water Sources
- Flow-through Raceway/Pond/RAS
  - Aka…Nursery

What is a Cooperative Nursery???

- Receive fingerlings from PFBC
  - Trout/MUE/LMB/CC
  - Late Spring/Early Summer
- Stock legal size Trout in public waters

Cooperative Nurseries

- 144 Sponsors/157 Nurseries


OUTDOORS
CARING FOR CATFISH (AND MORE)
Inmates learn skills while raising healthy fish for anglers

2017 Stocking Data

- Trout Stocking
  - 847,274 Trout
  - 70,403 Steelhead
  - 80,713 Brown Trout
- **998,390** trout stocked for angling!!!

2017 Stocking Data

- Warm Water/Cool Water Stocking
  - 230 Muskellunge
  - 233 Tiger Muskellunge
  - 201 Channel Catfish
  - 250,000 Walleye fry

2017 Volunteer Data

- 135,904 volunteer hours
- 252 derbies

2017 Sponsor Expenditures

- Feed; $413,195
  - $0.68/pound
- Electricity; $121,327
- Improvements; $317,332
- Co-op cost; $1.02/fish

2017 Grant Program

- FY 2017-2018
  - $30,000 available
  - 23 applications; $41,457
  - All applications approved

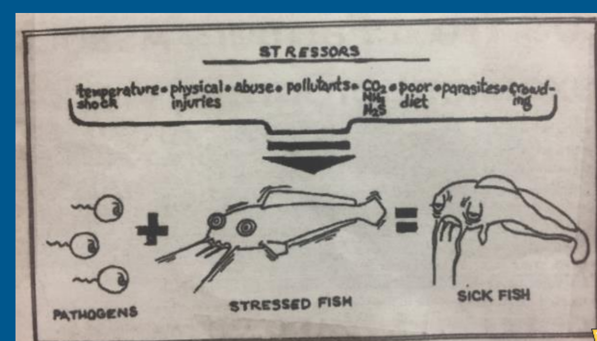
Cooperative Nursery Unit

- Brian McHail, Leader
- Josh Keslar, Fisheries Technician
- Vacant, Fisheries Technician
- Patty Kachik, Clerk Typist

Cooperative Nursery Unit

- Biannual nursery inspections
- Emergency nursery inspections
- Prospective nursery inspections
- Biennial co-op seminars
- Daily technical guidance to co-ops
- Annual report/RFP data entry

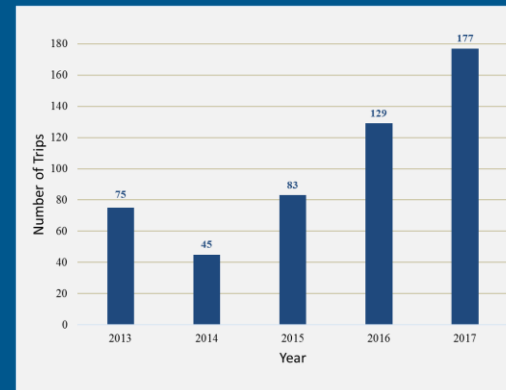
Fish Health



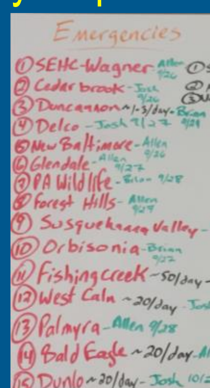
Emergency Nursery Inspections

- We've come a long way!!!
- On-site diagnostics
  - Parasites, bacteria, and environmental causes
- Provide samples to the Fish Health Unit
- Approved treatments

Emergency Nursery Inspections

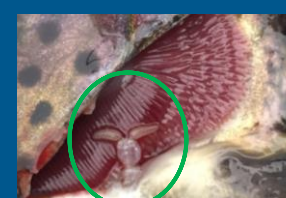


Emergency Nursery Inspections



Fish Health

- VFD
  - 2017: 56 VFD's submitted
- Gill lice monitoring
  - 12 cooperative nurseries are gill lice positive

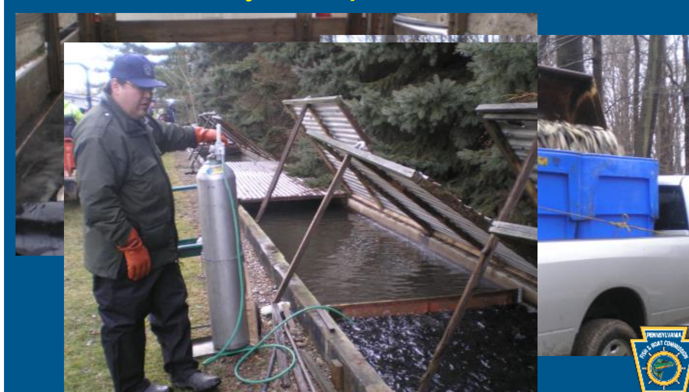


Erie County Cooperative Nurseries

Erie County Cooperative Nurseries

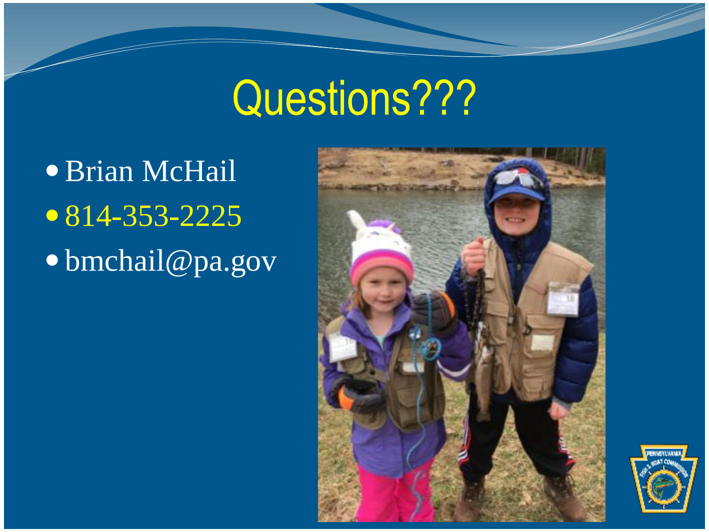
- Routine/Emergency Inspections
- Fish Health Inspections
  - CNU Staff/FHU Staff
  - Virology and Bacteriology

Erie County Cooperative Nurseries



Erie County Cooperative Nurseries

- Great Lakes Restoration Initiative (GLRI)
  - $36,000 used for Erie County Co-ops
  - Disinfectant, PPE, nets, buckets, brushes, gloves, boots, aeration equipment, stocking tanks, etc.
  - Lab equipment, rain gear, boots, etc. (CNU)


Questions???
• Brian McHail
• 814-353-2225
• bmchail@pa.gov

Overview of Thiamine Deficiency Complex

Jacques Rinchard[a]
Matt Futia[a]
Donald Tillitt[b]
Steve Smith[b]

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[b]U.S. Geological Survey, Columbia Environmental Research Center, Columbia, MO

Acknowledgments

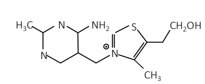
NYSDEC
USGS
Brockport Foundation
Great Lakes Research Consortium
Undergraduates and Graduate students from the Dr. Rinchard's lab

Outline

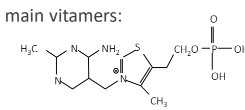
- Brief background and history of Thiamine Deficiency Complex (TDC)
- Potential causes of TDC
- TDC around the Great Lakes
- Extent of TDC in Lake Ontario
- Ongoing research projects

What is Thiamine?

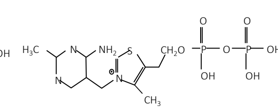
Thiamine: essential vitamin (B_1)
- Co-factor for energy metabolism
- Required for neurological development
- Potential use as an antioxidant
- Comprised of three main vitamers:



Free Thiamine (TH)
Mobile form



Thiamine Monophosphate (TMP)
Reserve



Thiamine Pyrophosphate (TPP)
Active form

Origin of TDC

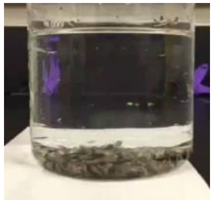
- First documented in Lake Michigan hatcheries in the late 1960s as elevated offspring mortality (< 30% mortality)
  - Similar mortality observed with Baltic Sea Atlantic salmon beginning in the 1970s (M74)
- Mortality peaked in the mid 1990s and was determined to be a thiamine deficiency
  - Affected individuals were treated with thiamine baths and injections, resulting in significantly decreased mortality
- Occurring in other locations as well (e.g. NY Finger Lakes) and recently considered an emerging issue for global conservation
- Specific explanations for the cause of TDC remain unknown


Trends in Ecology & Evolution
CellPress
REVIEWS
Review
A 2018 Horizon Scan of Emerging Issues for Global Conservation and Biological Diversity

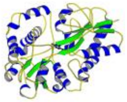
Sutherland et al. 2018

Impacts of TDC

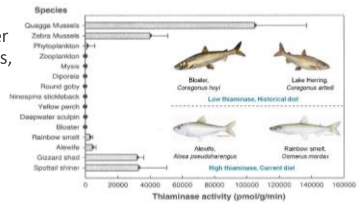
- Offspring impacted most significantly, but adults can be impaired as well
  - Offspring require relatively high amounts of thiamine during development
- Insufficient maternal transfer of thiamine to eggs results in deficient offspring
  - Abnormal swimming, hyperexcitability, lethargy, and often high mortality
  - Decreased recruitment in wild populations
- Deficient offspring have never been observed in the wild
  - Can wild offspring acquire thiamine during development?
- Impaired adults can also show behavioral abnormalities, reduced fitness, and mortality
  - Lack of coordination and limited migrating abilities
- Severity of TDC varies among species and over time



A Potential Cause - Thiaminase



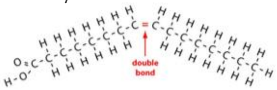
- Enzyme capable of degrading thiamine
- Produced by several species of bacteria, and can be found in certain marine and freshwater fish species and shellfish, zooplankton, insects, and plants
- *De novo* synthesis by in fish (e.g. goldfish, common carp)
  - Reasons for production by fish are unknown
- Thiaminase activity is highly variable, within and among species

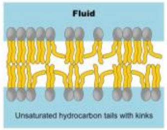


Tillitt et al. 2009

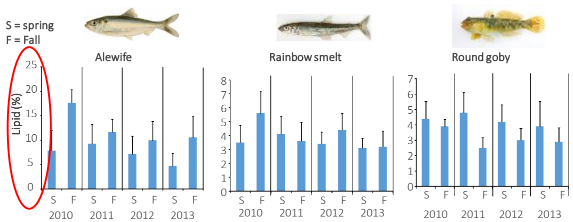
Additional Potential Factors

- High fat content in addition to low thiamine
  - Increased energy metabolism requires more thiamine
- Oxidative stress limiting thiamine concentrations
  - Thiamine may be used as an antioxidant
    - TDC has been associated with low concentrations of other antioxidants
  - Oxidation of unsaturated fatty acids may cause reactions that destroy thiamine and decrease the activity of thiamine-dependent enzymes
- Only supported by correlations in the wild



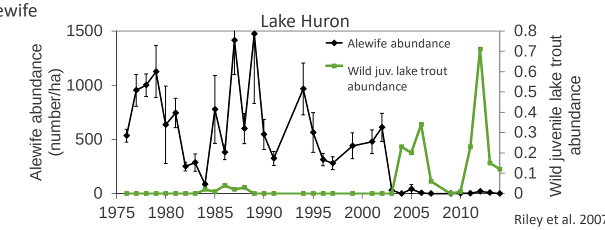


Lipid Content of Common Lake Ontario Prey



Relationships with Alewife

- Wild lake trout recruitment in Lake Huron increased following the collapse of alewife

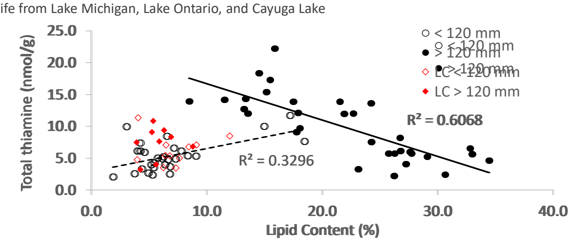


Riley et al. 2007

- Lakes Michigan and Ontario are seeing some increases in lake trout wild recruitment

Thiamine vs Lipid Content in Alewife

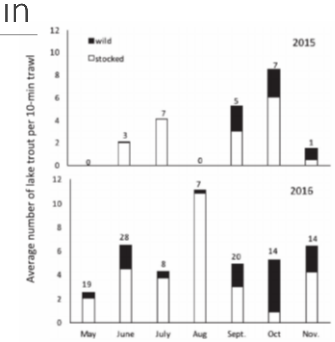
- Thiamine concentrations increase with lipid content for juvenile alewife, but decrease with lipid content for adults
  - Alewife from Lake Michigan, Lake Ontario, and Cayuga Lake



- Lake Champlain alewife have no correlations between lipid content and thiamine

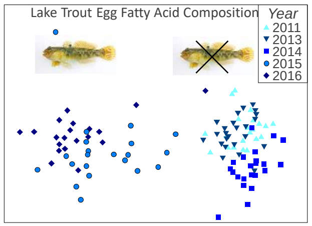
Lake Trout in Lake Champlain

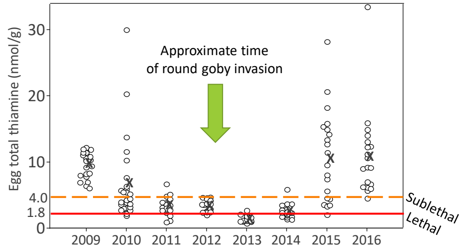
- Recent burst of wild recruitment despite the arrival of alewife in 2003 (Marsden et al. 2018)
  - Reason for increase in recruitment has yet to be determined
  - Lake trout fry from Lake Champlain have been shown to feed within two weeks of hatching (Ladago et al. 2016)
- Coexistence of alewife and wild lake trout has occurred in other lakes as well (Keuka Lake, NY)



Benefits of a Diverse Food Web

- Increased diversity of the forage base can alleviate TDC
  - Increase in lake trout egg thiamine concentrations in Cayuga Lake following round goby invasion

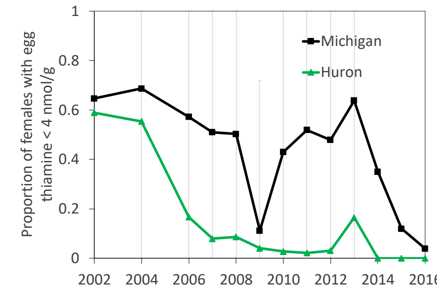




- Restoration of native prey (e.g. *Coregonines*) may increase salmonine thiamine concentrations

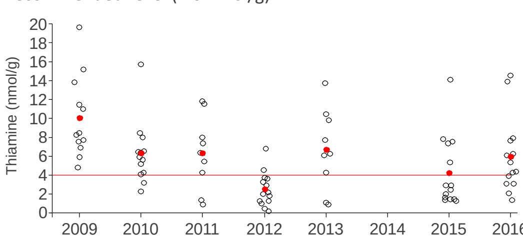
Current Declines in TDC for Lake Trout

- Drastic declines in proportion of females with thiamine concentrations below recommended levels
  - 4 nmol/g egg thiamine associated with sublethal impacts (Riley et al. 2008)
- Thiamine concentrations still reduced compared to reference populations



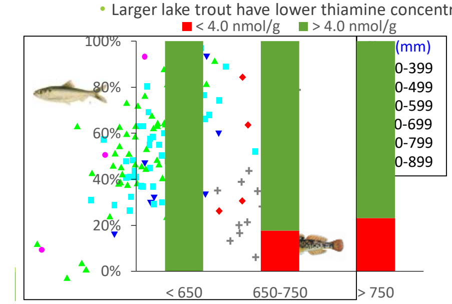
TDC in Lake Ontario Lake Trout

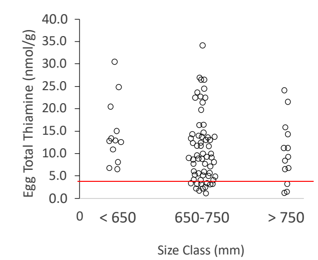
- Large variability within years with multiple individuals below the recommended level (4.0 nmol/g)



Intraspecific Variation

- In Lake Ontario, smaller lake trout appear to incorporate more round goby in their diets
  - Larger lake trout have lower thiamine concentrations

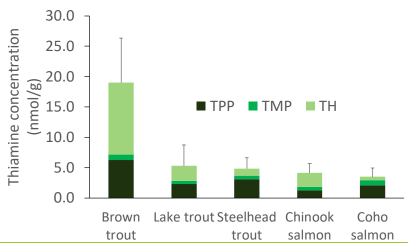


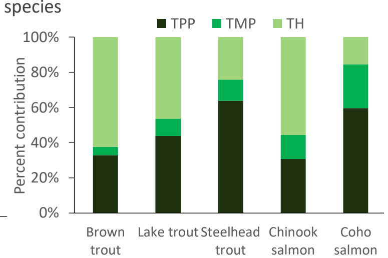


Appendix 7.

Egg Thiamine in Lake Ontario Salmonines

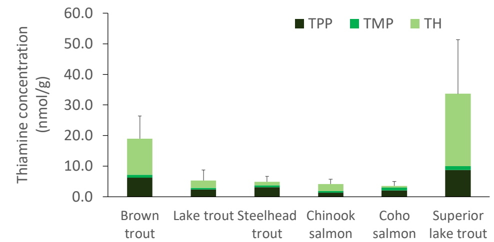
- Total thiamine varies by species
  - Resemble differences in diet
- Percent contribution of vitamers vary by species





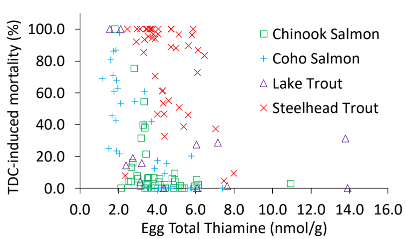
Comparisons with Lake Superior Lake Trout

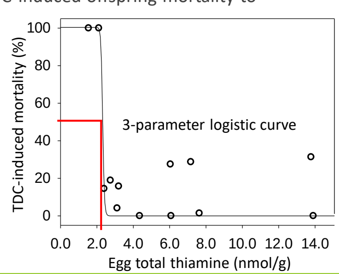
- Nearly all Lake Ontario salmonines have significantly lower egg thiamine concentrations than Lake Superior lake trout



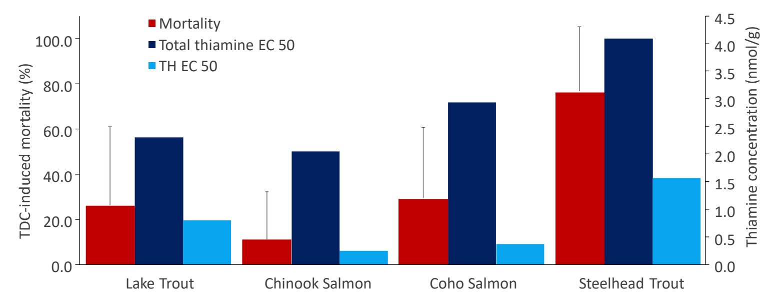
Thiamine Thresholds

- Compare egg thiamine concentrations to TDC-induced offspring mortality to determine thiamine thresholds (EC50)





Variation in Thiamine Thresholds



- Susceptibility to TDC varies by species

Health assessment of thiamine deficiency in Lake Ontario

J. Rinchard, M. Futia, D. Tillitt, S. Smith,
C. Kraft, K. Edwards

Objectives

1. Determine thiamine content in Lake Ontario salmonines (steelhead trout, Chinook salmon, coho salmon, and lake trout)
2. Compare variability in salmonine thiamine levels with diet analyses using stable isotope and fatty acid signatures
3. Describe spatial (east vs. west), temporal (spring vs. fall) and inter-annual variability in Lake Ontario Alewife thiamine content, thiaminase activity, lipid content, fatty acid signatures, and vitamin E

Objectives

4. Validate the "ELISA" method to measure thiamine concentration in fish tissues

Procedure:

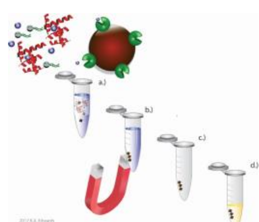
Carry out fish egg homogenization with modifications to standard protocol

A) The TBP-conjugated beads are mixed with fish egg extracts
Thiamine present binds to the beads

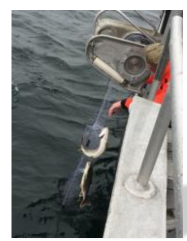
B) A magnet separates the beads from the solution

C) Unbound materials are washed away

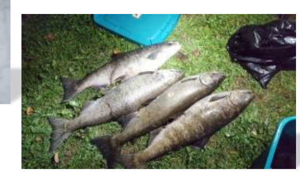
D) Bound thiamine is converted to thiochrome and simultaneously released from the beads using alkaline ferricyanide



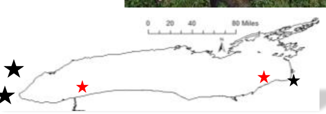
Read signal in a fluorescence plate reader (360/450 nm)



2016 - 2017



Lake trout ★
Coho salmon★
Chinook salmon ★
Steelhead trout★



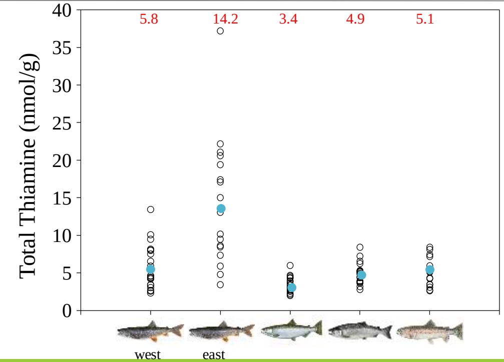
Thiamine
- Eggs
- Muscle
- Liver

Thiamine dependent enzyme
- Transketolase activity

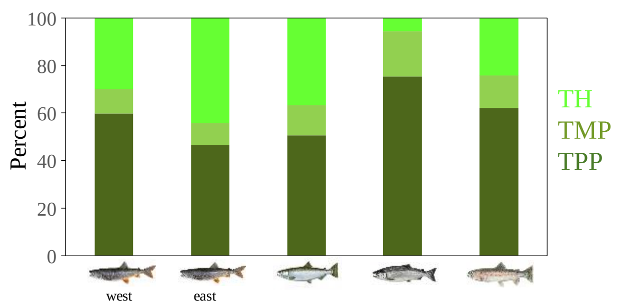
Vitamin E

Diets using FAS and SI

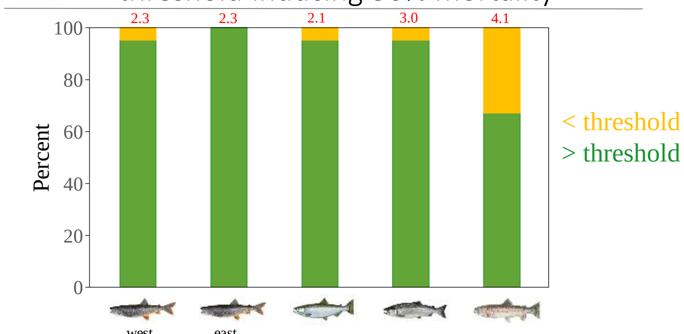
Egg thiamine concentration



Egg thiamine concentration

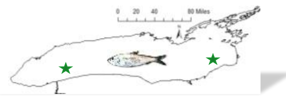


Percentage of females above and below thiamine threshold inducing 50% mortality

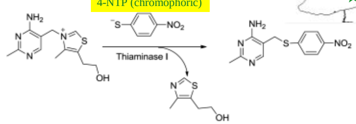


Appendix 7.

Thiaminase in alewife



4-NTP method



V_{max} (nmoles/sec) of consumption of 4-NTP in alewife extracts

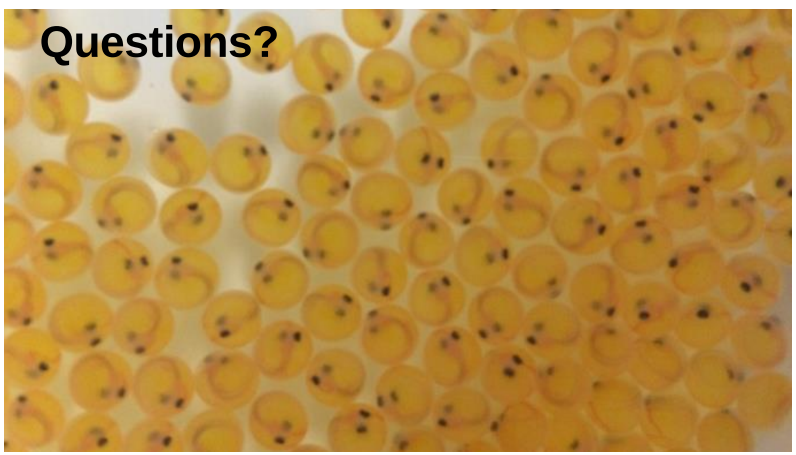
Each value represents the average V_{max} of extracts from ten fish

	West	East
Spring 2016	-14.5 +/- 6.78	-16.5 +/- 11.5
Fall 2016	-16.7 +/- 8.98	-17.9 +/- 3.33
Spring 2017	-25.1 +/- 7.31	-19.4 +/- 8.85
Fall 2017	-22.8 +/- 9.21	-23.3 +/- 10.0

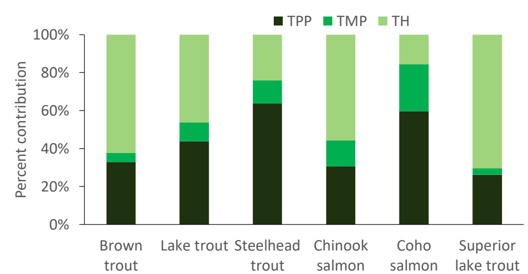
Conclusions

- Occurrence of TDC is declining; however, the direct cause remains unknown
- Continue monitoring to detect the occurrence of TDC in salmonine species (e.g. lake trout, steelhead trout, coho salmon)
- Conduct controlled experiments to determine the causes of TDC (e.g. role of lipids to induce occurrence of TDC) vs. simple correlation
- Evaluate in situ (or in the wild) TDC in alevins and determine if access to natural food could reduce the incidence of TDC in wild alevins
- Determine if other factors could contribute to TDC (e.g. vitamin E)

Questions?



Percent Contribution of Egg Vitamers



Vagococcus salmoninarum at the Iron River NFH

Ken Phillips
La Crosse Fish Health Center
Presentation to the
Great Lakes Fish Health Committee
August 1, 2018

Iron River National Fish Hatchery Staff Observations

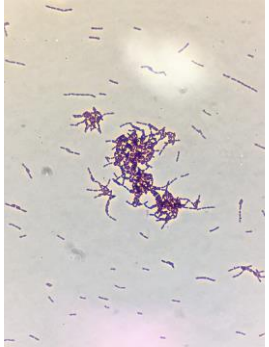
- Coaster BKT brood
- No apparent affects on LAT brood
- Began during Fall 2017 spawning
  - Staff noticed some females…
    - Eggs from one skein
    - green eggs
  - No issues with egg quality
- Mortality began post spawning
  - 2013 yr class →49% (to date)
  - 2014 yr class →39% (to date)
- Contacted La Crosse FHC late January
- Inspection moved to week of February 5

Diagnostic Observations & Results

- Necropsy
  - Egg retention
  - Cloudy fluid surrounding heart/necrosis of cardiac tissue
  - Ascites fluid
- Samples for bacterial analysis were collected from the brain, egg skein, heart, and kidney.
- *Vagococcus salmoninarum* isolated/identified
  - Biochemical & molecular assays

What is *Vagococcus salmoninarum*??

- Gram-positive, chain-forming coccobacillus
- Lactic acid bacteria
  - Common gut fauna of animals and birds
- Observations consistent with the literature
  - Spawning Adults
  - Egg retention, cardiac tissue targeted, ascites
- Species: RBT, ATS, BNT
- First Identified 1980s (Europe)
- First Isolation in late 1960s (Pacific NW)



Treatment Options

- INAD Options
  - Florfenicol
  - Oxytetracycline
- Extra-label Prescription
  - Romet
  - Erythromycin
  - Streptomycin
  - Penicillin
  - Amoxicillin
  - Ampicillin
  - Azythromycin
  - Enrofloxacin
  - Tulathromycin

Next Steps

- Additional treatment(s)?
- Vaccination
- Monitoring at Iron River
  - Brood stock (BKT, LAT)
  - Production (BKT, LAT)
- BKT Progeny Monitoring
  - Genoa NFH
  - Jordan River NFH

Investigations of 2017 & 2018 VHSV Outbreaks in New York

Rod Getchell, Loredana Locatelli, Erika First, Adam Schulman, Jordan Kramer, Steve Bogdanowicz, Jose Andrés, Andy Noyes, Geof Eckerlin, John Farrell, and Hélène Marquis

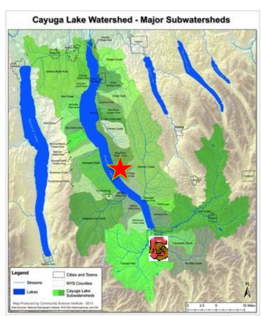
Aquatic Animal Health Program
Department of Microbiology and Immunology
Cornell University College of Veterinary Medicine

Outline

- 2017 Cayuga Lake fish kill
- Additional round goby collections
- 2017 VHSV prevalence
- Sequence analyses
- 2018 Lake Ontario fish kills
- Sodus Bay coinfection

Mayhem in May 2017

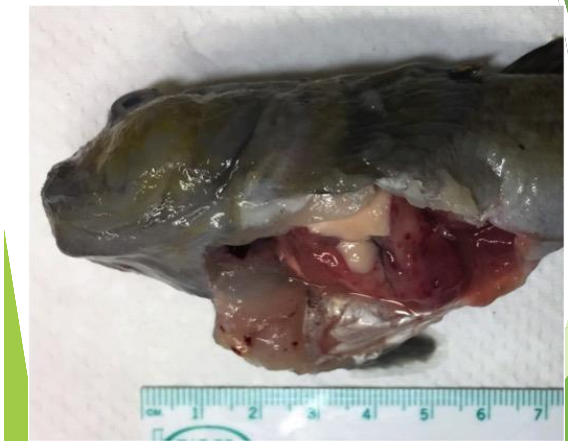
- In May 2017 we got a call from our Region 7 New York State Department of Environmental Conservation (DEC) fish biologist.
- A Cayuga Lake resident had reported there were 1000's of round gobies washed up on shore near his dock on the east side of the lake.
- The DEC biologist gathered a crew and boat and headed to the King Ferry area to collect specimens for our Aquatic Animal Health Laboratory.



The Round Gobies arrive.

Long Point, Cayuga Lake Round Goby

Long Point, Cayuga Lake Round Goby

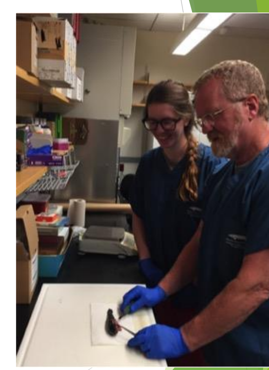


Cayuga Lake outbreak questions... that needed answers

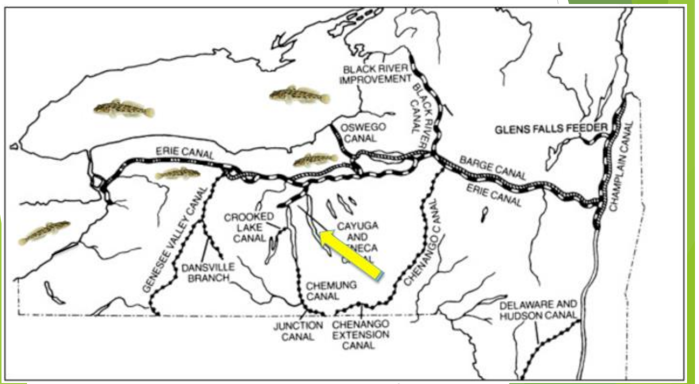
- What could be causing these hemorrhagic lesions?
  - There are many pathogens and parasites of fish that can cause petechial hemorrhages and erythema.
  - High on our list is the viral pathogen, VHSV, or viral hemorrhagic septicemia virus.
  - The last VHSV-induced mortality events were in 2013 and 2014 when gizzard shad, freshwater drum, white and yellow perch died in large numbers in Lake Erie and Lake Ontario.

Cayuga Lake outbreak questions... that needed answers

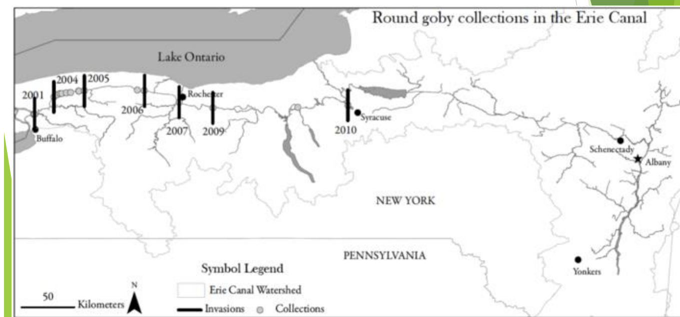
- Round gobies invaded Cayuga Lake at least 5 years ago.
- Are there any chances they carried the virus with them?
- If round gobies have been in the lake for several years why haven't we seen fish kills caused by VHSV until now?
- How can we determine where the virus has come from?
  - First, find an AQUAVET® Summer Research Fellow named Erika First!
  - Train her to become a molecular detective.
  - Ask your sequencing buddies down campus for some help.
  - And pay little neighborhood boys to fish for gobies.



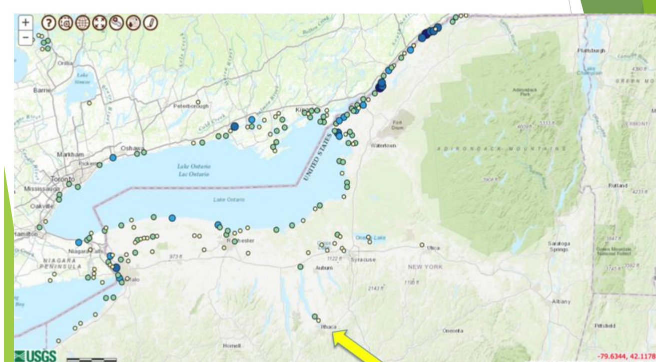
Canal Connections to Cayuga Lake



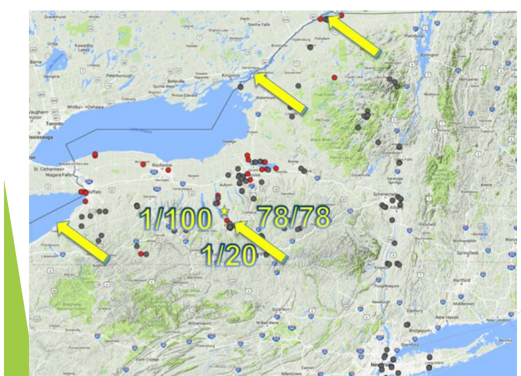
Round Roby Sightings in Erie Canal

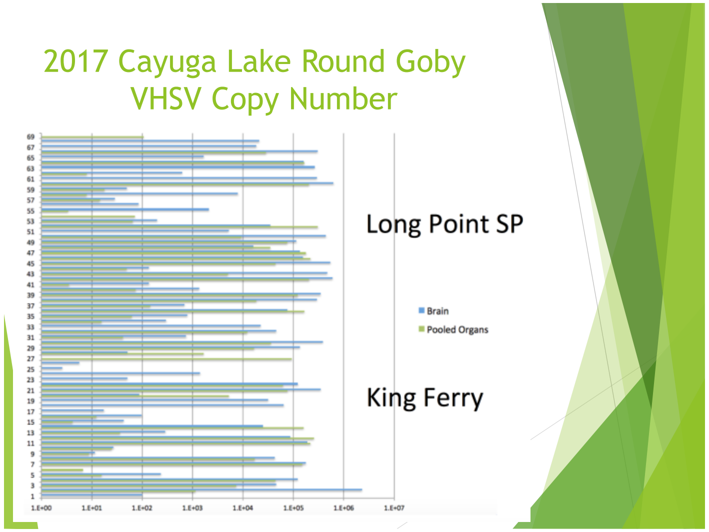


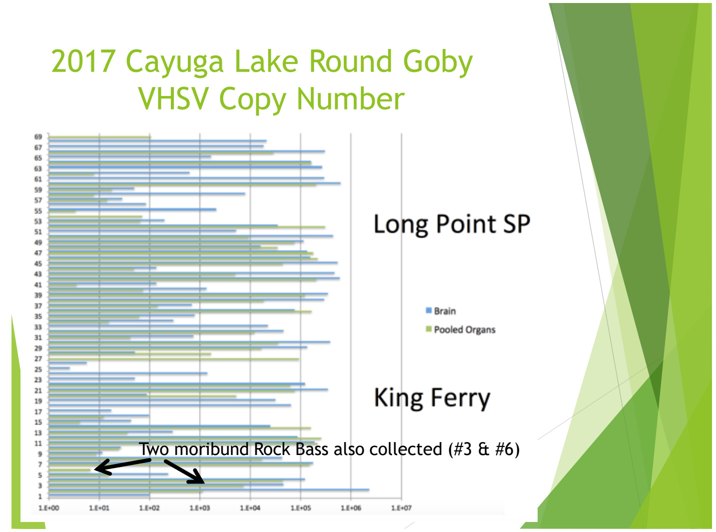
Present Round Goby Distribution

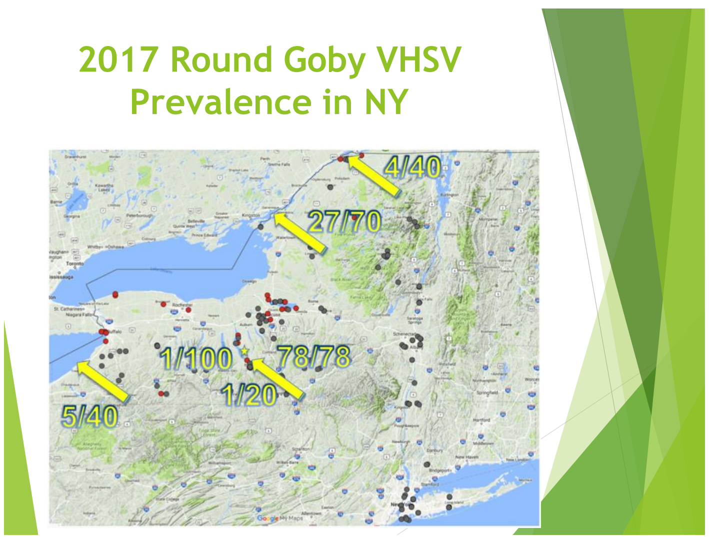


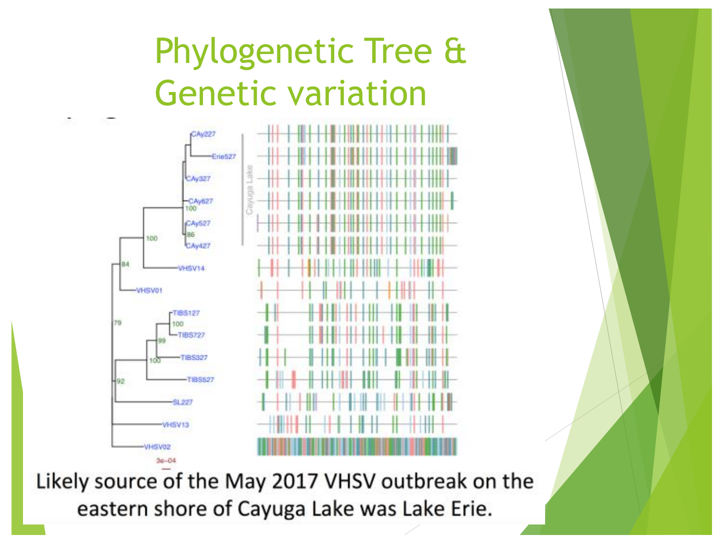
Spring 2017 Collection Sites with Cayuga Lake VHSV Results




2017 Cayuga Lake Round Goby
VHSV Copy Number
Long Point SP
King Ferry
Brain
Pooled Organs


2017 Cayuga Lake Round Goby
VHSV Copy Number
Long Point SP
King Ferry
Brain
Pooled Organs
Two moribund Rock Bass also collected (#3 & #6)


2017 Round Goby VHSV
Prevalence in NY
4/40
27/70
1/100
78/78
1/20
5/40

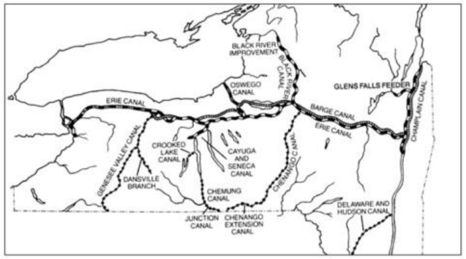

Phylogenetic Tree &
Genetic variation
Likely source of the May 2017 VHSV outbreak on the
eastern shore of Cayuga Lake was Lake Erie.

Non-synonymous SNPs

Position	01	02	14	13	Cay2	Cay3	Cay4	Cay5	Cay6	Erie5	SL2	TIBS1	TIBS3	TIBS5	TIBS7
N 291											G—D				
N 293															E—K
N 298												D—E	D—E	D—E	D—E
N 519					T—N	T—N	T—N	T—N	T—N	T—N					
M 2290					A—T	A—T	A—T	A—T	A—T	A—T					
M 2312		T—I		T—I							T—I	T—I	T—I	T—I	T—I
M 2798			K—R												
M 2818		V—I													
M 2887													R—W		
G 3160											A—V				
G 3229												I—T			I—T
G 3271												R—C	R—C	R—C	R—C
G 3289		K—R	K—R	K—R	K—R	K—R	K—R	K—R	K—R	K—R	K—R	K—R	K—R	K—R	K—R
G 3397		G—D		G—D							G—D	G—D	G—D	G—D	G—D
G 3789					K—Q	K—Q	K—Q	K—Q	K—Q	K—Q					
G 3829					R—K	R—K	R—K	R—K	R—K	R—K		R—K	R—K	R—K	R—K
G 3849			I—V		I—V	I—V	I—V	I—V	I—V	I—V	I—V	I—V	I—V		I—V
G 3969					S—P	S—P	S—P	S—P	S—P	S—P					
G 4273		P—L	P—L	P—L	P—L	P—L	P—L	P—L	P—L	P—L	P—L	P—L	P—L	P—L	P—L
NV 4746					L—S	L—S	L—S	L—S	L—S	L—S					
NV 4760											A—T				
NV 4831		I—M													
L 5598												N—D	N—D	N—D	N—D
L 5645			I—M		I—M	I—M	I—M	I—M	I—M	I—M					
L 5722												Q—R	Q—R	Q—R	Q—R
L 5853		T—A													
L 5983											T—I				
L 6600	A—T														
L 7615		T—I	T—I	T—I											
L 8272												T—I	T—I	T—I	T—I
L 9219			L—F												
L 9275				M—I											
L 9490			S—N												
L 9702			T—A												
L 9779		M—I													
L 10155					I—V	I—V	I—V	I—V	I—V	I—V					
L 10480			V—A												
L 10753														T—I	

Risks of Round Goby Movements

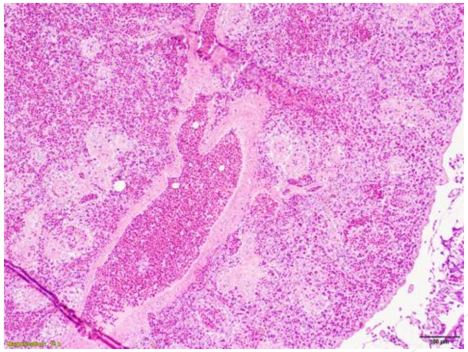
- Round goby are likely a transport vector and infectious source of VHSV.
- Fish in water bodies connected to the NYS canal system are at risk of infection.



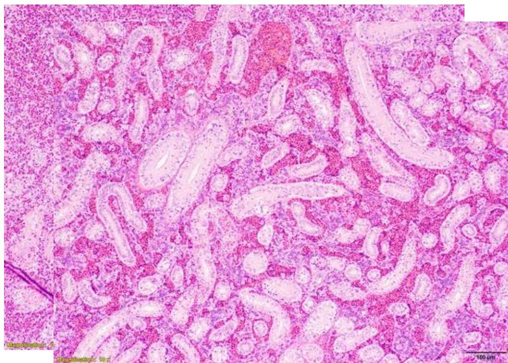
2018 VHSV outbreaks in New York

- Large gizzard shad die-off in Irondequoit Bay.
- This is an annual event, usually related to winter kill and cold water stress.
- Found hundreds of freshly dead gizzard shad on the shore of Little Massaug Cove and collected 10 specimens; One moribund, the remaining fresh dead.
- Significant external hemorrhages were noted as well as an erythematous liver.
- Low viral copies detected in the pooled organ and brain samples by RT-qPCR.

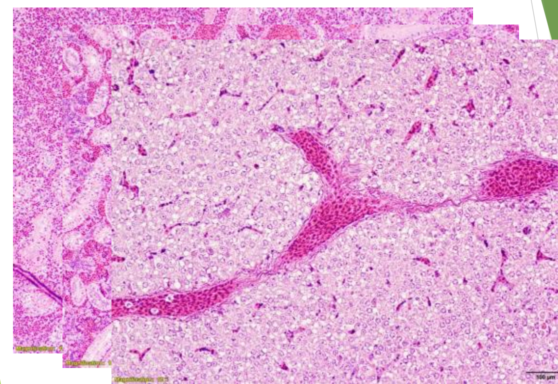
Congestion in VHSV-infected gizzard shad spleen, posterior kidney, and liver



Congestion in VHSV-infected gizzard shad spleen, posterior kidney, and liver



Congestion in VHSV-infected gizzard shad spleen, posterior kidney, and liver



2018 VHSV outbreaks in New York

- A single hemorrhagic gizzard shad was submitted from Long Pond on April 24th and tested positive for VHSV.
- No other fish losses were involved.

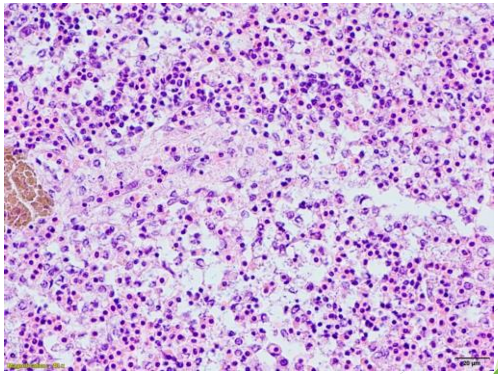
- sunfish
- showed
- ed with
- *lii* and iagnosis.

2018 VHSV outbreaks in New York

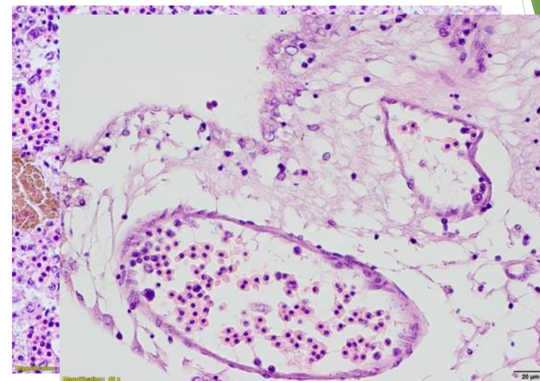
- A single hemorrhagic gizzard shad was submitted from Long Pond on April 24th and tested positive for VHSV.
- No other fish losses were involved.
- Finally, on May 2nd dead and moribund sunfish (*Lepomis gibbosus*) were submitted from Sodus Bay.
- Viral isolation in EPC cell culture results showed CPE with the five-fish pool.
- Confirmation of VHSV was again achieved with RT-qPCR.
- Co-infection with *Pseudomonas mandelii* and parasitic infestations complicated the diagnosis.

Appendix 9.

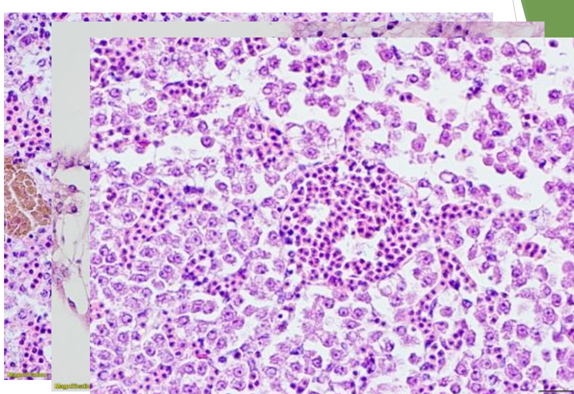
Bacteremia in pumpkinseed spleen, brain and liver



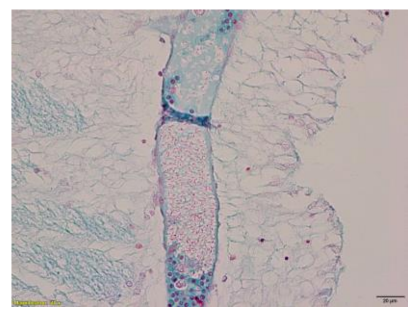
Bacteremia in pumpkinseed spleen, brain and liver



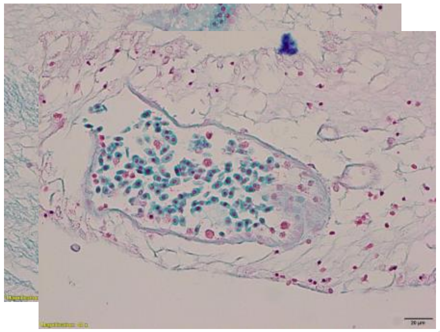
Bacteremia in pumpkinseed spleen, brain and liver



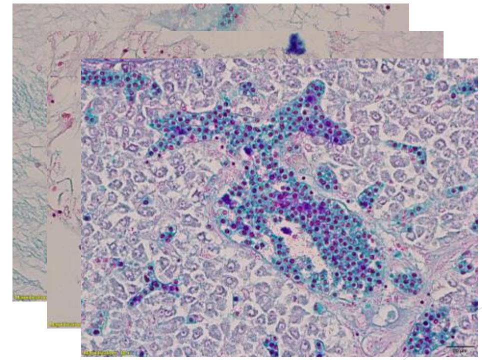
2018 Sodus Bay fish kill



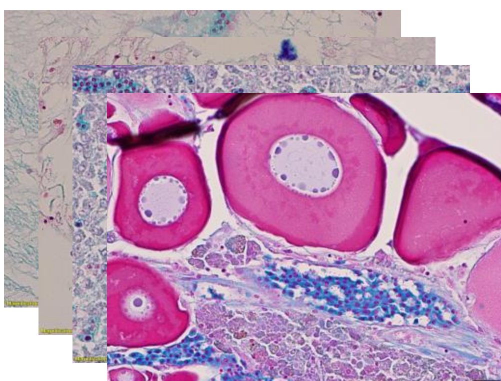
2018 Sodus Bay fish kill



2018 Sodus Bay fish kill



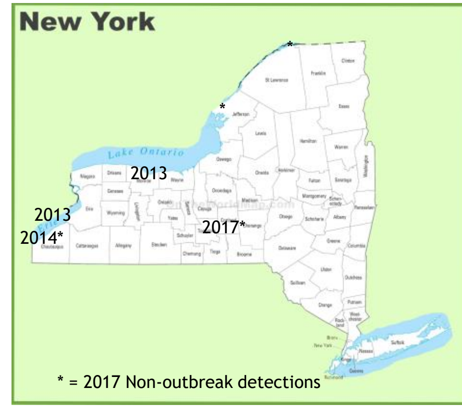
2018 Sodus Bay fish kill



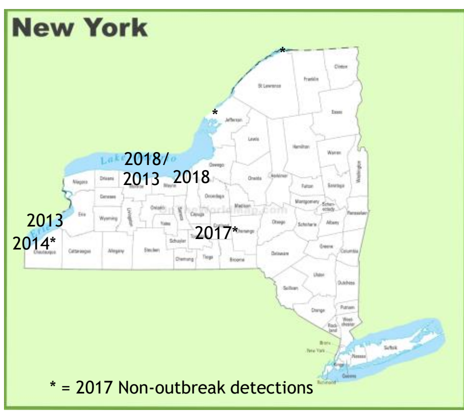
New York VHSV outbreak distribution 2013 to 2018

New York VHSV outbreak distribution 2013 to 2018

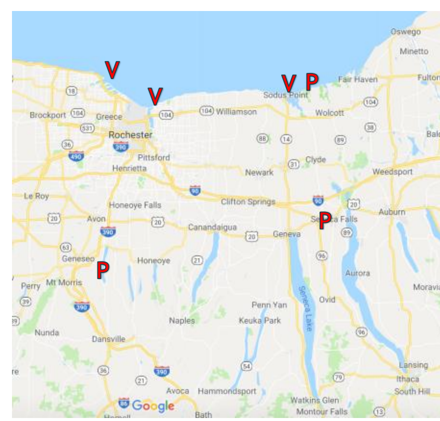
New York VHSV outbreak distribution 2013 to 2018



New York VHSV outbreak distribution 2013 to 2018



2018 New York VHSV & *Pseudomonas mandelii* locations



Acknowledgements

- The authors wish to thank:
  - Kelly Sams for her technical support;
  - Several young anglers including Kohan Anderson, Wylie Smalls, Boden Baier, and Rylan Boyer for their fishing prowess;
  - And members of the New York State Department of Environmental Conservation Fisheries and Thousand Islands Biological Station staff for fish collections.

Questions???

Great Lakes Fish Health Committee Meeting 2018

Lake Erie Research Unit

Mark Haffley

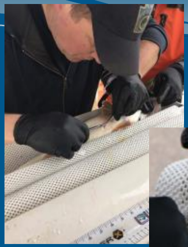
Mission: *To protect, conserve, and enhance the Commonwealth's aquatic resources and provide fishing and boating opportunities*

Project

- Do Discrete Spawning Stocks Contribute Differentially to Lake Erie's Walleye Fisheries?
  - Believed to be Western migration driven
  - "Local" fisheries not part of the big picture
  - Are there spawning sites around the lake

Objectives

- Implant 20 tags into Walleye on spawning shoals in PA waters
- Look at spawning site fidelity
- Does local spawning congregations add to a local fishery
- Are these tagged fish truly "residents" or migrators



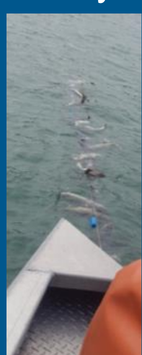
Tags Used

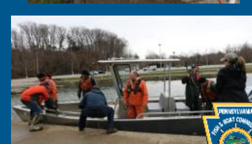
- Tags from VIMCO
- V16
  - Long battery life
  - Slower detection timing
  - Reads 750-1000 meters
  - $305.00 a tag
  - Tags are discounted through Great Lakes Fishery Commission
  - $100.00 reward
  - ~ 10% harvest

Time Frame for Tagging

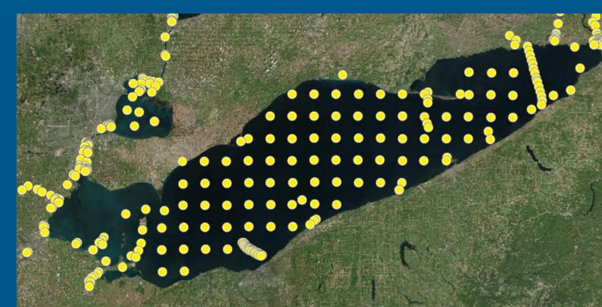
- Nets were set April 23, 2018
- Pulled April 24, 2018
- Over 200 adult walleye caught

A Day of Tagging

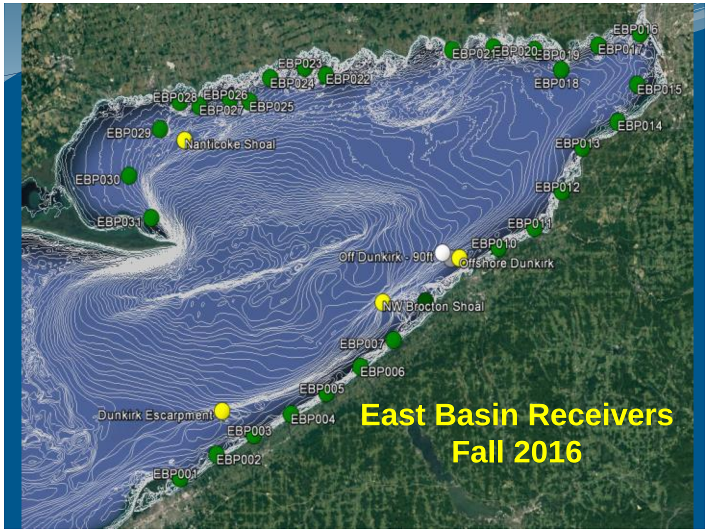




2018 Array



* http://glatos.glos.us/map


EBP001
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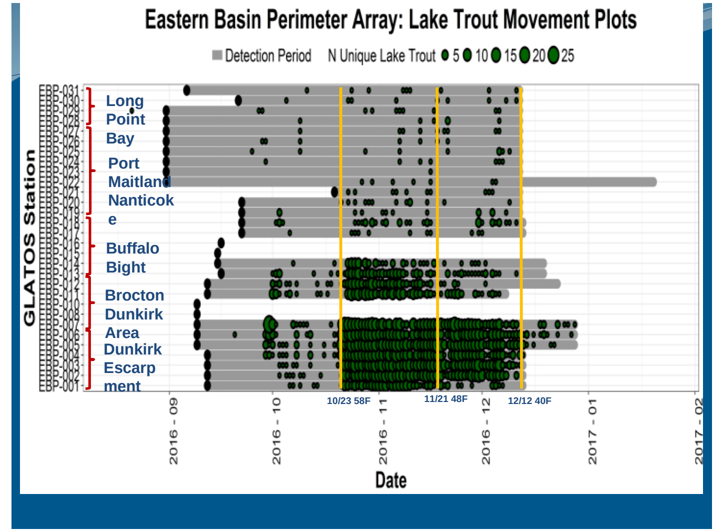
EBP021
EBP022
EBP023
EBP024
EBP025
EBP026
EBP027
EBP028
EBP029
EBP030
EBP031
Nanticoke Shoal
Off Dunkirk - 90ft
Offshore Dunkirk
NW Brocton Shoal
Dunkirk Escarpment
East Basin Receivers
Fall 2016


Eastern Basin Perimeter Array: Lake Trout Movement Plots
Detection Period
N Unique Lake Trout 5 10 15 20 25
GLATOS Station
Long Point Bay
Port Maitland
Nanticoke
Buffalo Bight
Brocton Dunkirk Area
Dunkirk Escarpment
10/23 58F
11/21 48F
12/12 40F
2016 - 09
2016 - 10
2016 - 11
2016 - 12
2017 - 01
2017 - 02
Date


Acoustic Equipment
The external tag
The internal transmitter
*Slide courtesy of Jason Robinson, NYDEC


"Caught One"
• Tagged April 24, 2018
• Caught May 22, 2018
• 12.14 miles away


Acknowledgements
GLATOS
Great Lakes Acoustic Telemetry Observation System
data.glos.us/glatos
NEW YORK STATE OF OPPORTUNITY
Department of Environmental Conservation
Ontario
Ministry of Natural Resources
USGS
science for a changing world
Great Lakes Fishery Commission
Founded 1855
Project funding:
Great Lakes Fish and Wildlife Restoration Act


Questions?

GLFHC Briefing

August 1, 2018

Coja Yamashita, Fish Health unit leader

Bureau of Hatcheries

Salmincola impact in PA

Known to be in PA commercial hatcheries and Commonwealth waters since 1980s

- *2016-2018*
  - *12 Cooperative Nurseries*
  - Infected trout were euthanized (~50,000) and replaced with less susceptible species
  - Likely source from commercial hatcheries
- **2016**
  - PFBC and co-op stockings were altered
  - Avoid stocking positive waters with susceptible host
- **2017**
  - Encourage commercial hatcheries to monitor for gill lice at their facilities and refrain from selling fish with gill lice

RESOURCE FIRST

PROTECT • CONSERVE • ENHANCE

Bureau of Hatcheries

Salmincola impact in PA

- 2018- Required trout to be certified Gill Lice (*Salmincola*) free if used in an event requiring a Special Activities Permit.
  - Required fish be certified Gill Lice free.
  - Resulted in developing a protocol and Certificate Gill Lice.
  - Gill Lice Certification Course (PADAG, University of PA, PFBC)
- 2018 -Proposed including language to the PFBC Approved Species for Introduction and Propagation List to prohibit the release of salmonids infested with Gill Lice.
- PFBC is assessing the extent and impact of the gill lice issue in the wild.

RESOURCE FIRST

PROTECT • CONSERVE • ENHANCE

Bureau of Hatcheries

PA Fish and Boat Commission

- Established in 1866 (Second oldest Conservation agency in the US)
- The Pennsylvania Fish and Boat Commission is an independent Commonwealth agency comprised of 10 Commissioners appointed by the Governor and approved by the Legislature. Day to day operations are overseen by our Executive Director.
- The mission of the Pennsylvania Fish and Boat Commission is: ***to protect, conserve, and enhance the Commonwealth's aquatic resources and provide fishing and boating opportunities***.

Bureau of Hatcheries

PA Fish and Boat Commission

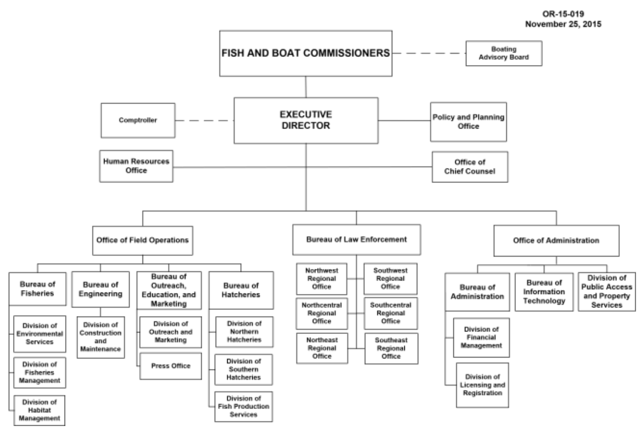
- Resource First" is a philosophy that describes the first priority of the Commission's mission and that of the Fish and Boat Code, as well as the Commission's fundamental role in fulfilling and supporting the provisions of Article 1, Section 27 (Natural Resources and Public Estate) of the Constitution of the Commonwealth of Pennsylvania.
  - The Commissioners' belief that the Commonwealth's aquatic resources are the valuable collateral that secures all fishing and boating activities.
  - The notion that protecting, conserving, and enhancing the Commonwealth's aquatic resources is the agency's first management priority.
  - The Commissioners' expectation that the agency's activities, regulations, and methods of work will be evaluated and practiced within the context of this priority.

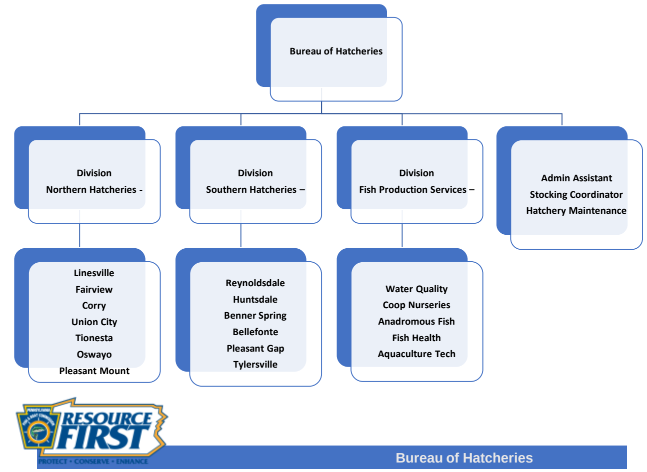
Bureau of Hatcheries

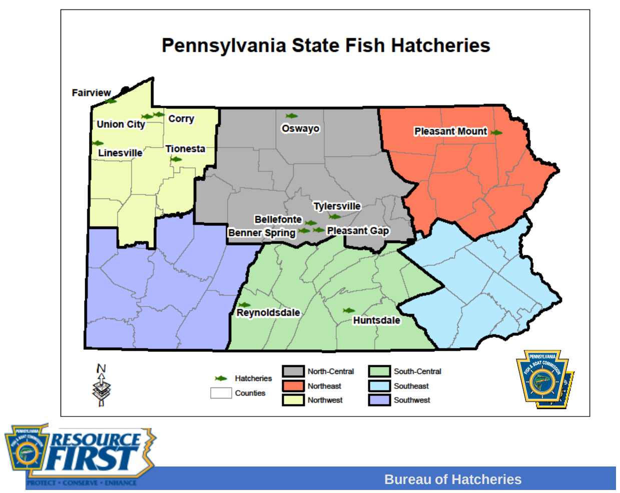
- PA Fishing Expenditures > $1.2 Billion (2011)
- Center for Rural PA: $4.7 Billion economic impact

Bureau of Hatcheries

Appendix 11.







<u>Fish Production</u>

Annual Budget ~ $14 Million

- Adult and Fingerling Trout
- Coop Nursery Trout and other species
- Lake Erie: Steelhead + Brown trout
- Muskellunge
- Tiger Musky
- Walleye
- Striped Bass
- Hybrid Stripers
- Channel Catfish
- Crappie
- Largemouth Bass
- Blue Gill
- Golden Shiner
- Lake Trout
- Northern Pike
- Yellow Perch

PFBC Trout Culture

- Eight trout hatcheries
- Stock ~3.2 million adults (11”)
- Stock ~ 700,000 Put-Grow-Take fingerlings
- Distribute ~ 1 million fingerlings to coop nurseries
- Provide eggs for Trout in the Classroom

Bureau of Hatcheries

Production and Stocking

Fisheries Management Requests Fish

Set Production Goals | Hatchery Assignments

↓

Hatcheries Develop Stocking Schedules

Law Enforcement Review | Fisheries Review

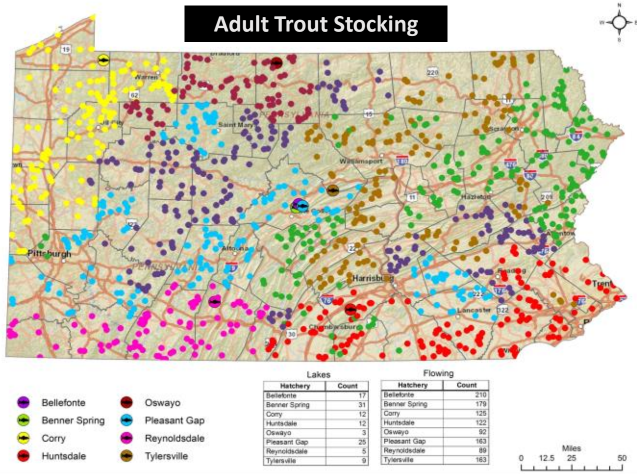
↓

Stocking Coordinator Finalizes Schedule

Placed on Website | Changes as Required

Bureau of Hatcheries

Adult Trout Stocking



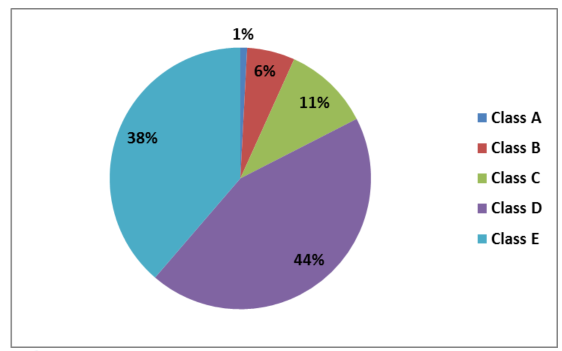
Lakes

Hatchery	Count
Bellefonte	17
Benner Spring	31
Corry	12
Huntsdale	12
Oswayo	3
Pleasant Gap	25
Reynoldsdale	5
Tylersville	9

Flowing

Hatchery	Count
Bellefonte	210
Benner Spring	179
Corry	125
Huntsdale	122
Oswayo	92
Pleasant Gap	163
Reynoldsdale	89
Tylersville	163

Stocked Trout Streams



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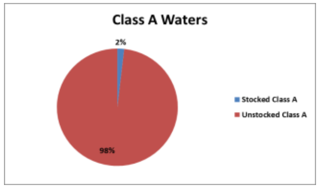
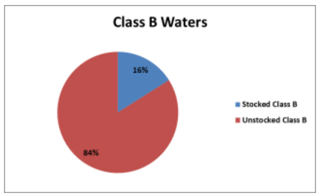
Appendix 11.

Miles of Class A & B Waters



- Stocked Class A - 40
- Unstocked Class A - 2154



- Stocked Class B- 282
- Unstocked Class - B 1475

Trout in the Classroom

- Partnership of PFBC and PA Trout Unlimited
- Interdisciplinary program grades 3-12
- Raise Brook Trout from eggs to fingerlings
- Over 300 schools in PA

Bureau of Hatcheries

Lake Erie Stocking

- Steelhead
  - Stock 1 million yearlings
  - 100,000 fingerlings to coops
- Brown Trout
  - Stock ~40,000 adults
  - ~40,000 fingerling to coops

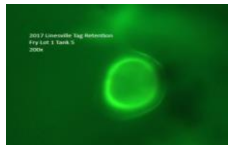
Bureau of Hatcheries

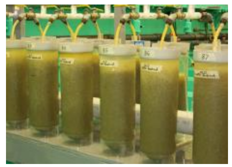
Warm/Cool Water Production

Bureau of Hatcheries

Walleye

- 80 million eggs
- 50 million fry
- 1 million Phase 1





RESOURCE FIRST

Bureau of Hatcheries

Channel Catfish

- 300,000 Eggs Spawned
- 150,000 3-4” Fall Stocked
- 3,000-5,000 8-10” yearling
- Family Fishing events

RESOURCE FIRST

Bureau of Hatcheries

Muskellunge

120,000 Fall Stocked → 34,225 Spring Stocked

7-9” average (10 fpp)

12-14” average (3 fpp)

RESOURCE FIRST

Bureau of Hatcheries

PA Musky Stocking Strategies

- <u>Changes to Size, Frequency and Rate:</u>

- Spring Yearlings at 12 -14 inches
- Alternate Year Stockings, 0.75/Acre
  - Goal: 34,000 Purebreds Musky
  - 6,000 Tiger Musky
- All fish to be stocked out by mid-June

RESOURCE FIRST

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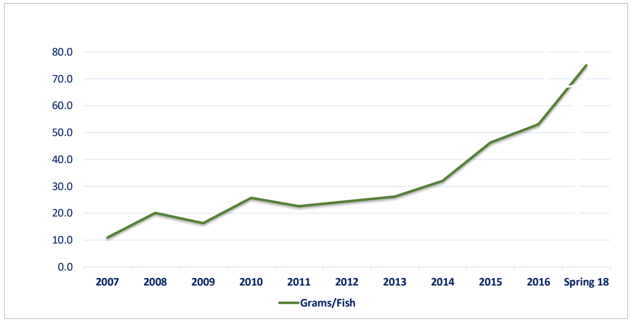
Musky & Tiger Musky



Bureau of Hatcheries

Hatchery Challenges

- Clean effluent discharge
- Maintain fleet
- Budget issues
- Training our future workforce

Bureau of Hatcheries

Microscreen Filters

Bureau of Hatcheries

Microscreen Filters

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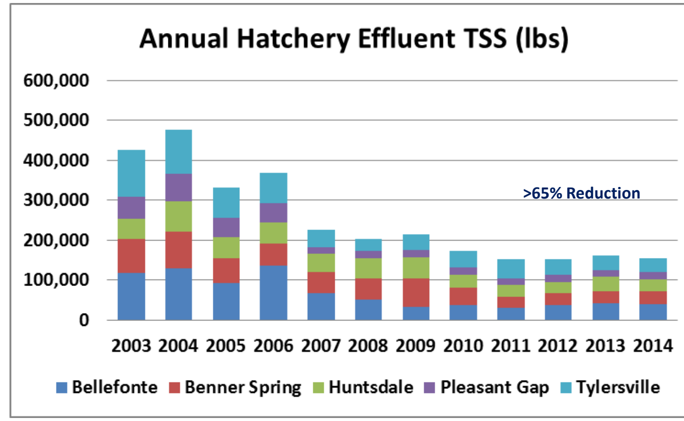
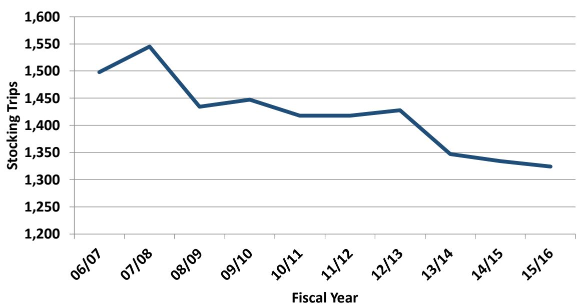


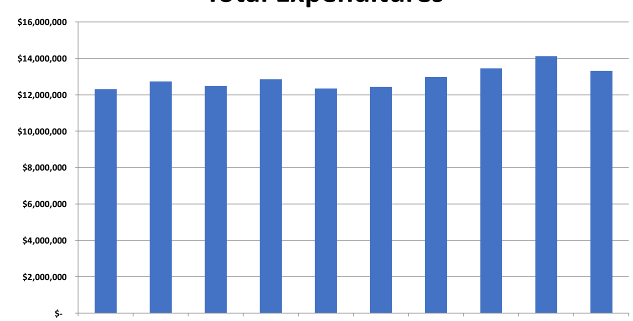
Bureau of Hatcheries

Adult Trout Stocking Trips Over the Last 10 Years



Bureau of Hatcheries

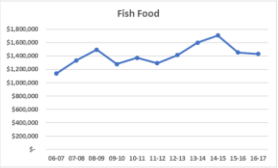
Bureau of Hatcheries Total Expenditures

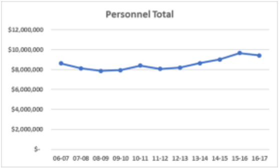


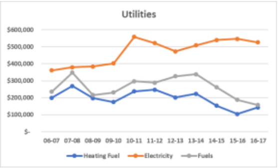
Bureau of Hatcheries

Major Hatchery Costs

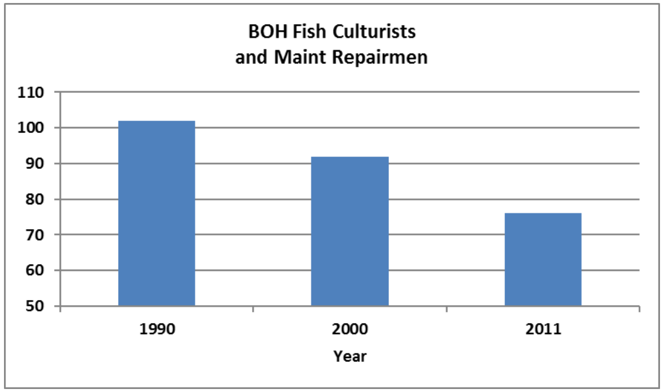
- Personnel ~70%
- Fish food
- Utilities/Fuels

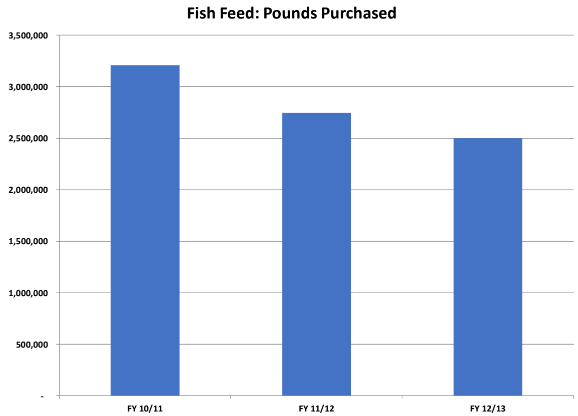






Staffing Levels





Questions???

PFBC CHRONOLOGY

1866-1900

- **1866** - A convention was held in Harrisburg to investigate pollution in mountain lakes and streams, and the stopping of spring shad runs by dams. Governor Andrew G. Curtin signed the law that named James Worrall ***Pennsylvania's first Commissioner of Fisheries***. This created what would become the Board of Fishery Commissioners (1925), then the Pennsylvania Fish Commission (1949) and now is the Pennsylvania Fish and Boat Commission (1991). (150th Anniversary)
- **1867** - The first fishway was constructed at the Columbia Dam on the Susquehanna River.
- **1868** - Legislature passed a law prohibiting the use of seines for taking fish within 200 yards of any device erected for the passage of fish.
- **1870** - Thad Norris, a private citizen, purchased 450 bass taken from the Potomac River at Harpers Ferry for $313 and released them in the Delaware River on October 26, just below the Lehigh River Dam at Easton. Residents along the Susquehanna and Schuylkill rivers later did the same thing.
- **1873** - Some 2.7 million young shad hatched and planted in the Susquehanna River. About 2,044 bass taken from the Delaware River and stocked in other Pennsylvania waters.
- **1873** - An act signed into law established a state-owned hatchery on Hoover's Spring, one of the famous Donegal Springs. John P. Creveling was the first superintendent.
- **1875** - The legislature appropriated $2,000 to purchase 9 acres in Corry and $3,000 for its immediate improvement to construct the "Western Hatchery." William Buller appointed as Superintendent.
- **1876** - Calico bass planted in the Susquehanna River near Harrisburg.
- **1878** - Act of June 3, 1878, forbade fishing on Sunday.
- **1879** - United States Fish Commission distributed 12,000 carp to individuals in 25 states, including Pennsylvania.
- **1879** - *Forest & Stream* magazine mentioned Pennsylvania as the best natural trout region in America.
- **1879** - Pennsylvania Fish Commission enlarged by three additional members.
- **1883** - The "Eastern Station" built on leased property (Troxell) on the Little Lehigh River.
- **1884** - The "Rogers" fish ladder was erected at the Columbia Dam on the Susquehanna River.
- **1885** - A $5,000 legislative appropriation established a hatchery in Erie that began operating on December 12.
- **1886** - The first Brown Trout eggs (10,000) were received from Germany and hatched at the Corry Hatchery.

- **1888** - The first recorded stocking of Rainbow Trout in the Susquehanna River.
- **1892** - The Commission had Jackson and Sharp of Wilmington, Delaware, build the rail car "Susquehanna" to transport fish. It was delivered to the Commission on June 5, 1892. The railcar was in operation through 1914 (more about the *Susquehanna*).
- **1893** - Legislative appropriation enabled the establishing of the shad propagation station at Bristol.
- **1893** - The Commission participated in Chicago World's Fair of 1893, *The Columbian Exposition*, with live fish displays (more about fairs).
- **1895** - The Fish Commission abandoned the cultivation of German carp and attempted to raise black bass.

1900-1925

- **1901** - Legislature passed a bill designating certain species of fish in either of two classes; game or food.
- **1903** - Bellefonte Hatchery opened on October 9, J. P. Creveling named superintendent. Citizens of Bellefonte raised $3,500 for hatchery land and railroad siding to the grounds. Property turned over to the department on August 9. October 16: Deeds turned over to the department for the Pleasant Mount Hatchery grounds.
- **1904** - About 90,900 frogs were distributed. More than 10.2 million Chain Pickerel propagated. Pickerel had never before been propagated in any fish cultural establishment in the United States. Yellow Perch propagation began.
- **1904** - The Commission participated in St. Louis World's Fair of 1904, *The Louisiana Purchase Exposition*, with live fish displays (more about fairs).
- **1905** - Citizens of Crawford County made a gift to the Commission of the Crawford Hatchery, located about a mile from Conneaut Lake, Union City Hatchery completed November 27.
- **1906** - Spruce Creek Hatchery, Huntingdon County, started in June. Smelt hatched at Torresdale Hatchery planted in Begelow Lake.
- **1907** - Experiments began on the artificial propagation of freshwater pearl mussels. Some 80,000 coho fingerlings planted in the Lackawaxen and Equinunk. Two were taken by hook and line in the Lackawaxen in July.
- **1907** - The *Commodore Perry*, a 70-foot stream tug, was built for the Commission's use on Lake Erie. The boat was christened April 21, 1908 (more about the Commodore Perry).
- **1909** - Law passed forbidding the emptying into any waters of the Commonwealth any waste deleterious to fish.
- **1910** - The Holtwood Dam was built on the Susquehanna River by Pennsylvania Water & Power Co., forming Lake Aldred.
- **1911** - September 1: Crawford Hatchery abandoned.
- **1912** - About 500,000 Muskellunge eggs hatched at Union City, the first to be planted in the waters of the state.
- **1913** - Spruce Creek Hatchery sold. Commodore Perry was a valuable aid in raising Perry's flagship, the Niagara, from Misery Bay. First effort to control motor

boating by law, Act 292 signed by Governor John K. Tenner, requiring motorboats (except steamboats) to have an efficient muffler.

- **1914** - Honus Wagner, Hall of Fame 2nd baseman for the Pittsburgh Pirates, named a Pennsylvania Fish Commissioner in the spring of 1914.
- **1914** - New hatchery erected on Erie filter plant grounds.
- **1915** - Fish wardens and deputy fish wardens were given power to make arrests by act of April 21, 1915.
- **1917** - Electric lights first installed on Commission hatcheries. New motor truce purchased by the Erie Hatchery.
- **1919** - Act of July 8 (effective that date) required that ***nonresidents buy a $5 fishing license***. Only 50 were sold that year.
- **1921** - Act of May 16, 1921, P.L. 559, known as the "Resident Fish License Law," was passed.
- **1921** - Bradford County Warden William E. Shoemaker shot on August 25, while apprehending two violators. Shoemaker died from the gunshot wound on September 22, 1921. He was inducted into the National Law Enforcement Officers Memorial in Washington, D.C. on May 13, 1999 (more about Shoemaker).
- **1922** - The ***first resident fishing licenses*** were established. Cost: $1. For the first time the Commission became self-supporting; a total of $207,425.53 was the first year's income for licenses sold to all citizens over 21 years of age.
- **1923** - Legislature reduced fishing license age limit to 18.
- **1923** - The ***first license button*** issued January 1, 1923.
- **1924** - Stream survey started to classify waters with regard to area, depth, fish species, aquatic life and general conditions.

1925-1950

- During 1924 to 1926 the fishing license age limit was reduced to 16 years of age.
- **1925** - Act 1925-263 established the ***Board of Fish Commissioners***.
- **1925** - Creel limits set at: trout - 25; bass - 10; walleye - 10; pickerel - 15; and muskellunge - 3.
- **1925** - A site was purchased in Bedford County to be known as the Reynoldsdale Hatchery.
- **1926** - Nonresident fishing license fees were made reciprocal but in no instance less than $2.50.
- **1927** - A new license button was made with a device on the back for carrying the license, together with an approved pin.
- **1928** - August 1: Lake Wallenpaupack opened to public fishing. Bureau of Research established. Commission stocked the lake created by the Conowingo Dam.
- **1928** - Resident fishing license fee increased to $1.50 (*see listing in the right column of this page for a historical summary*).
- **1929** - The Tionesta State Fish Hatchery was completed.
- **1930** - Most severe drought ever experienced during summer, many tributary streams dried entirely.

- **1931** - The Commission stopped sending out fish on application; all fish now stocked by Commission personnel.
- **1931** - The first issue of *Pennsylvania Angler* was published. The subscription price was 50 cents per year.
- **1931** - Act of May 28, effective July 1, required a ***license for motorboats*** operated on inland waters. Fees set at $1 per cylinder for internal combustion motors and $2 for electric motors. Enforcement of law placed with Fish Commission.
- **1932** - Safe Harbor Water Power Corporation created Lake Clarke with the Safe Harbor Dam. September: land purchased for Huntsdale Hatchery.
- **1932** - For the first time, the Commission distributed more than 1 million legal-sized trout.
- **1932** - The first regulations for motorboat operation were published by the Board of Fish Commissioners.
- **1933** - Creel limit of trout reduced to 20, previously was set at 25 in 1925 (*see listing in the right column of this page for a historical summary*). Act 275 amended Act 21 to specify procedures and language for license application, establishing outside issuing agents and special licenses for dealers.
- **1934** - Fisherman's Paradise, Centre County, was created. The number of visitors in the first year totaled 2, 952.
- **1934** - Regulation established the basic boating "100-foot rule."
- **1935** - The first tourist license (three days - fee $1.50) became available for nonresidents. Same bill also provided a 12-year age limit for nonresidents.
- **1936** - Flood waters washed away a great number of trout and destroyed many rearing pools. Fishermen still able to enjoy fairly successful trout and bass fishing.
- **1937** - House bill no. 6 made Sunday fishing lawful.
- **1937** - Creel limit for trout reduced to 15, previously set at 20 in 1933 (*see listing in the right column of this page for a historical summary*).
- **1938** - Creel limit for trout reduced to 10, previously set at 15 in 1937 (*see listing in the right column of this page for a historical summary*).
- **1938** - The Commission produced its own Brown Trout and Rainbow Trout eggs for the first time.
- **1939** - Senate bill 160, effective September 1, permitted the purchase of land and waters by the Fish Commission
- **1940** - Yellow Perch were raised to fingerling size for the first time.
- **1940** - A law prohibiting the sale of fish bait or bait fish taken from inland waters became effective October 1.
- **1941** - Pennsylvania regulation prohibited trolling from a motorboat.
- **1942** - Blue pike catch in Lake Erie up 400 percent over 1941.
- **1942** - Regulation added that prohibited the operation of a motorboat while intoxicated.
- **1943** - Free fishing licenses for military personnel were provided (Act No. 145).
- **1944** - Commission purchased Trexler Fish Hatchery in Allentown.
- **1944** - Trolling regulation amended to permit trolling from motorboats on all Commonwealth rivers.

- **1945** - Legal size of Muskellunge increased from 22 to 24 inches.
- **1946** - Fisheries management program began with mobile biological laboratory.
- **1947** - Act 81 provided free fishing licenses for certain disabled veterans.
- **1947** - The Commission's stream management program began.
- **1947** - Pennsylvania boating regulations rewritten to conform with the Federal Motorboat Act of 1940.
- **1949** - Act 1949-180 changed the name of the Commission to the ***Pennsylvania Fish Commission*** and described its powers and duties. The act repealed Act 263 from 1925, which had established the Board of Fish Commissioners.
- **1949** - The Commission appointed its ***first Executive Director***, Charles A. French, on April 25. Previously, Commission operations were headed by the Commissioner of Fisheries, which was established along with the Commission in 1866 (more about Executive Directors).
- **1949** - On Wednesday, April 13th, Governor James H. Duff signed into law Act 65, which prohibits fishing of any kind in all waters of the Commonwealth, between March 14 and 5:00 a.m., April 15 in any year, except in rivers, ponds and lakes not stocked with trout by the Commission. The new law prohibits fishing in trout streams which are stocked by the state for a month prior to the opening of the legal season on trout.

1950-1975

- **1950** - Fisherman's Paradise set new record attendance for one year: 34,796.
- **1951** - Fish were placed in the Schuylkill River for the first time in a decade after a cleanup campaign by the Department of Forest and Waters.
- **1951** - Act No. 68 directed the Fish Commission to make a study of the migratory habits of fish, particularly shad.
- **1951** - Legal size of pickerel increased from 12 inches to 15 inches.
- **1951** - The Commission acquired the Benner Spring Research Station property.
- **1952** - Creel limit for trout reduced to 8, previously set at 10 in 1938 (*see listing in the right column of this page for a historical summary*). Size limit removed on crappies.
- **1953** - Virgin Run Lake formally dedicated July 11.
- **1953** - First federal aid project of the Commission under the Dingell-Johnson Act and the first lake built from start to finish by the Commission.
- **1953** - Pymatuning Lake first stocked with muskellunge. Act 54 established a 10-horsepower limit on Lake Canadohta, Crawford County.
- **1954** - Fishing license fee increased from $2 to $2.50 (*see listing in the right column of this page for a historical summary*). Size and creel limits removed on panfish and food fishes.
- **1955** - Ground broken for construction of Lake Somerset on August 17. Act 205 established a 7 -horsepower limit on Quaker Lake, Susquehanna County.
- **1956** - Taking carp with long bow and arrow legalized. Commission established uniform fly-fishing-only regulations for all projects. Pellet feeding trout initiated at hatcheries.
- **1957** - Trout season extended to October 31 in selected lakes.

- **1957** - Act 330 increased fishing licenses to $3.25 with $1 now earmarked for acquisition and development (*see listing in the right column of this page for a historical summary*). Act 155 gave Commission right to accept donations. Act 121 gave wardens right to charge persons with littering.
- **1957** - Benner Springs Research Station began full operation.
- **1957** - Rules of the road regulation amended to prohibit water skiing within the provisions of the 100-foot rule.
- **1958** - First fish-for-fun area established on Left Branch of Young Women's Creek in Clinton County. Bell and Holmes hired to make Susquehanna Fishway Study. Kokanee salmon eggs procured from Montana, hatched at Pleasant Mount and stocked experimentally as fry and fingerling in eight lakes.
- **1958** - Lycoming County Warden Raymond Schroll loses his life attempting to rescue his partner after their boat capsizes in the rain-swollen Susquehanna River in Williamsport. He was inducted into the National Law Enforcement Officers Memorial in Washington, D.C. on May 15, 2000. (read more)
- **1959** - The research vessel *Perca* was launched at Lake Erie.
- **1959** - Act No. 673, the Fish Law of 1959, was signed by Governor David L. Lawrence on December 15, 1959. It eliminated the license button; permitted aliens to purchase a nonresident license; made nonresident fishing license fee a flat $7.50 (formerly it was reciprocal); and established the opening day of trout season as the 1st Saturday after April 11. The Act repealed the Fish Law of 1949 (Act 1949-180).
- **1959** - First "wired stocking area" installed on South Branch of Kinzua Creek, McKean County.
- **1960** - The opening day of trout set as the first Saturday after April 11, under provision of Act No. 673, Fish Law of 1959.
- **1960** - Aliens permitted to purchase fishing license for $7.50.
- **1961** - More than 116,280 fish were killed in the Susquehanna River during October. The Commission accepted a $45,000 voluntary contribution from the Glen Alden Mining Corporation - the largest settlement to date ever to be made in the United States for fish killed by pollution.
- **1961** - The largest shad migration of modern times was recorded in the Delaware River.
- **1961** - Belmont Lake, in Wayne County, opened June 17.
- **1961** - Act No. 474 eliminated the metal motorboat license tags.
- **1962** - Federal-state cooperative trout-stocking program became effective. Fisherman's Paradise opened April 14 on a "fish-for-fun" basis.
- **1963** - Last year that nonresident trout stamps were required. Pymatuning Compact amended, raising the horsepower limit to 10 and removing the prohibition on motorboat operation by persons under 16. Act 111 established a six-horsepower limit on Sugar Lake, Crawford County.
- **1963** - Act 400 approved the numbering system for boats - effective February 1, 1964. Boat registration fees set at $4 per year for motorboats less than 16 feet in length and $6 per year for larger motorboats (*see listing in the right column of this page for a historical summary*).

- **1964** - Resident fishing license fee increased to $5 (*see listing in the right column of this page for a historical summary*).
- **1966** - The ***100th Anniversary*** of the Pennsylvania Fish Commission was observed.
- **1966** - 25,000 coho salmon stocked in Harvey's Lake. Albino brook trout stocked for the first time. Palomino trout stocked for the first time.
- **1967** - Act 227 requires the display of a capacity plate on most boats, the act was signed into law August 10, 1967.
- **1968** - Oswayo Hatchery, Potter County, was constructed.
- **1968** - The first fall run of Coho "Jack" Salmon, from fingerlings planted in the spring, return to Erie's tributary streams.
- **1969** - April 12 opening day of trout season starts at 8:00 a.m., prior opening days had a 5:00 a.m. start time. Change is made after complaints from landowners about anglers overnight camping.
- **1969** - Senate bill 10-Liquid Fuels Tax bill signed by Governor Shafer. Commission received Amur pike eggs from Soviet Union.
- **1970** - The ***Brook Trout was named the official state fish***, March 9, 1970, Act 61.
- **1970** - Construction begins on Big Spring Hatchery, Cumberland County.
- **1971** - Chinook Salmon smolts released in Lake Erie.
- **1972** - The Commission named 75 streams in the "Wilderness Trout Program."
- **1972** - During Hurricane Agnes, Fish Commission personnel, using patrol boats, aided stricken residents throughout Pennsylvania and received special citations from Governor Milton J. Shapp.
- **1974** - Residents fishing license fee increased to $7.50 (*see listing in the right column of this page for a historical summary*).
- **1974** - Bog turtle protected by HB 1248.
- **1974** - New littering law was signed by Governor Shapp on March 22.
- **1974** - The use of electric motors authorized on all Commission lakes.
- **1974** - HB 2538 gave the Commission jurisdiction over reptiles, amphibians and aquatic organisms.

1975-2000

- **1975** – First strike by Commonwealth employees. Record number of miles of trout waters stocked: 5,042.8. Trout season extended to October 31 on all "approved trout waters" (stocked trout waters) for the first time.
- **1976** – The Commission began trout stream inventory.
- **1976** - World record Amur Pike (caught by hook and line) was taken from Glendale Lake, Cambria County (view state records).
- **1976** – The Commission adopted new regulations for organized snake hunts.
- **1979** – Fishing license fees increased (*see listing in the right column of this page for a historical summary*) — $9 resident; $14 nonresident; $9 seven-day tourist; $10 lifetime (residents 65 years and older). Dedication of fish ladder on Fairmont Dam, Schuylkill river, Philadelphia Dam, Schuylkill River, Philadelphia.

- **1980** – The ***Fish and Boat Code of 1980 (Act 175)*** codified fishing and boating laws. Limited police powers were given to Commission's waterways conservation officers.
- **1980** – The first striped bass tournament was held at Raystown Lake in Huntingdon County.
- **1980** – The first issue of the *PLAY* newsletter was published.
- **1981** – The Commission adopts Operation FUTURE. Landlocked salmon stocked in Harvey's Lake, Luzerne County.
- **1983** – Fishing license fees increased — $12 resident; $20 nonresident; $15 seven-day tourist (*see listing in the right column of this page for a historical summary*).
- **1984** – Act 1984-16 changed the name of "waterways patrolman" to "waterways conservation officer." Act also enacted one of first boating under the influence (BUI) implied consent laws in United States
- **1984** – American Shad were given gamefish status by the Fish Commission. Creel limit set at six per day.
- **1984** – First female waterways conservation officer hired.
- **1984** – First Fish-for-Free Day in Pennsylvania on September 22. The original scheduled date of June 2 had to be canceled because the necessary legislative action was not completed in time.
- **1984** – The first issue of *Boat Pennsylvania* was published.
- **1985** – Commission's Cooperative Nursery Program lists 188 fish culture facilities.
- **1986** – A 33-inch minimum size limit established for striped bass in the Delaware River.
- **1987** – "Resource First" was adopted as the Commission’s motto.
- **1987** – The Commission held the first "Day on a River" a Fort Hunter Park in Dauphin County.
- **1991** – The Commission introduces $5 ***Trout/Salmon Permit (Stamp)***, for the 1991 license year.
- **1991** – Under Act 1991-39, the Pennsylvania Fish Commission becomes the ***Pennsylvania Fish and Boat Commission***.
- **1991** – Boat registration fees increased for first time since 1963, Act 1991-39 (*see listing in the right column of this page for a historical summary*).
- **1995** – Lake Erie Permit (Act 79, signed into law October 5, 1994) required for Lake Erie, Presque Isle Bay, and their tributaries for the 1995 license year. The $3.00 permit (stamp) created to provide recompense for holders of commercial fishing licenses, who are now prohibited from using gill nets. Stamp discontinued after 1998 license year after adequate funds have been raised for the recompense program.
- **1996** – Fishing license fees increase for first time since 1983 — $16.25 resident; $34.25 nonresident; $14.25 three-day tourist; $29.25 seven-day tourist (*see listing in the right column of this page for a historical summary*). Issuing agent fee increased from $.50 to $.75 per license sold.
- **1996** – The Commission establishes a presence on the World Wide Web in May, website URL is www.fish.state.pa.us.

- **1998** – ***Boat Titling*** was first required in Pennsylvania for certain boats.
- **1999** – Warden William E. Shoemaker inducted into the National Law Enforcement Officers Memorial in Washington, D.C. on May 13 (more about Shoemaker).

2000-PRESENT

- **2000** – Effective January 1, operators of personal watercraft are required to complete a safe boating course or pass an equivalency examination.
- **2000** – Daily creel limit for trout reduced from 8 to 5. The limit was last changed in 1952 (*see listing in the right column of this page for a historical summary*).
- **2000** – Year-round open bass season begins. Catch and release and limited harvest in effect for much of the traditional closed season.
- **2000** – Warden Raymond Leroy Schroll Jr. inducted into the National Law Enforcement Officers Memorial in Washington, D.C. on May 15.
- **2000** – June 5, the Commission occupies its new headquarters at 1601 Elmerton Avenue, Harrisburg. Groundbreaking ceremonies - May 12, 1999. Building dedication - July 22, 2000.
- **2001** – Online (Internet) sales of fishing licenses begin in February, with instant licenses (printed on a home printer) becoming available in April. Other products (publication, patches, etc.) are sold online at The Outdoor Shop.
- **2001** – The sale of unpowered boat launch permits began in December.
- **2003** – Senate Bill 463, passed by the General Assembly in November 2002 and signed into law as Act 199 of 2002 by Governor Mark Schweiker on December 9, 2002, makes it mandatory for all persons born on or after January 1, 1982 to possess a certificate of boating safety education when operating a motorboat with a motor of more than 25 horsepower. Effective February 7, 2003.
- **2004** – Wild Brook Trout Enhancement regulations established, effective January 1. Initially only 1 area added - the Upper Kettle Creek Basin (main stem and all tributaries from Long Run upstream, including Long Run). Total length of 28.3 miles.
- **2004** – Online renewals for existing boat registrations begin February 28, sold through The Outdoor Shop. A temporary Internet registration, valid for 30 days, can be printed; the traditional registration materials are mailed to the registrant's home.
- **2005** – Act 159 of 2004 (House Bill 2155) establishes new fishing license fees, signed into law November 30, 2004, new fees go into effect January 1, 2005. Fees last increased in 1996, trout/salmon permit increased for the 1st time since its inception in 1991, Lake Erie permit and combination trout-salmon/Lake Erie permit created — resident - $21; nonresident - $51; senior resident annual - $10; senior resident lifetime - $50; three-day tourist - $25; seven-day tourist - $33; one-day resident (cannot be used in April) - $10; trout/salmon stamp - $8; Lake Erie permit - $8; combination trout-salmon/Lake Erie permit - $14. Issuing agent fee increased from $0.75 to $1 per license sold. Stamp/permit fee also increased to $1 for each sold, previously the issuing fee for a stamp was $0.50 (*see listing in the right column of this page for a historical summary*).

- **2005** – Act 159 of 2004 (House Bill 2155) establishes new boat registration fees, signed into law November 30, 2004, new fees go into effect January 1, 2005. Fees last increased in 1991. Prices for 2 year registrations: unpowered $18; motorboats less than 16 feet - $26; motorboats 16 feet and less than 20 feet - $39; motorboats 20 feet and longer - $52 (*see listing in the right column of this page for a historical summary*).
- **2005** – One-day tourist and National Guard & Armed Forces Reserve licenses established, made available in September. The 1-day license includes specialty fishing permits (trout/salmon stamps and Lake Erie permits), it is not valid during the month of April.
- **2006** – The first fishing license was sold in December (for 2007 license year) using the Commission's new point-of-sale system, Pennsylvania Automated Licensing System (PALS), at the Commission's headquarters in Harrisburg. Additional agents will be phased in over the course of the 2007 license year.
- **2007** – Regional opening day of trout season, two weeks before statewide trout season for southeastern Pennsylvania counties, was established.
- **2010** – Commission **Twitter** account established on February 24.
- **2012** – Commission **Facebook** page established on June 21.
- **2012** – A Pennsylvania historical marker was unveiled on July 17, honoring former Commission Executive Director Ralph W. Abele (1921-1990) in a dedication ceremony at PFBC headquarters, 1601 Elmerton Avenue, Harrisburg (*PA Angler & Boater* magazine article).
- **2012** – Act 66 (Senate Bill 1049) is signed on June 22, 2012. This legislative act provides the ability for the Commission to establish multi-year and group fishing licenses, along with promotional discounts for marketing purposes.
- **2013** – As a result of Act 66, 3-year and 5-year fishing licenses are sold for the first time in Pennsylvania (available December 1, 2012).
- **2013** – The first **Mentored Youth Trout Day** was held Saturday, March 23, 8 a.m. - 7:30 p.m., one week before the regional opening day of trout season. Established as a pilot program by temporary change of fishing regulations under the authority of 58 Pa. Code §65.25, individuals were permitted to fish at 12 waters in southeastern PA. Youth and required accompanying licensed mentor were permitted to keep 2 legal-size trout each.
- **2014** – In March, a Pennsylvania fishing license button was reintroduced. The optional button sold for $5. The color of the button was determined by a public online vote. Blue was selected. The button is similar to ones offered by PFBC in the 1930s, 1940s, 1950s, and 1974 and 1975. A paper license is still required to be carried by anglers, the button can be displayed in lieu of displaying the paper license.
- **2014** – Based on the success of the 2013 pilot, the Mentored Youth Fishing Program was expanded statewide. A mentored youth fishing day was held two weeks prior to both the statewide and regional trout opening days in 2014.
- **2014** – A Voluntary Youth Fishing License was established and sold in 2014, cost $1 (plus agent fee and surcharge). Revenues generated from sales will be dedicated to programs that increase youth fishing participation. For each license purchased, PFBC receives $5 back in funding as a federal reimbursement.

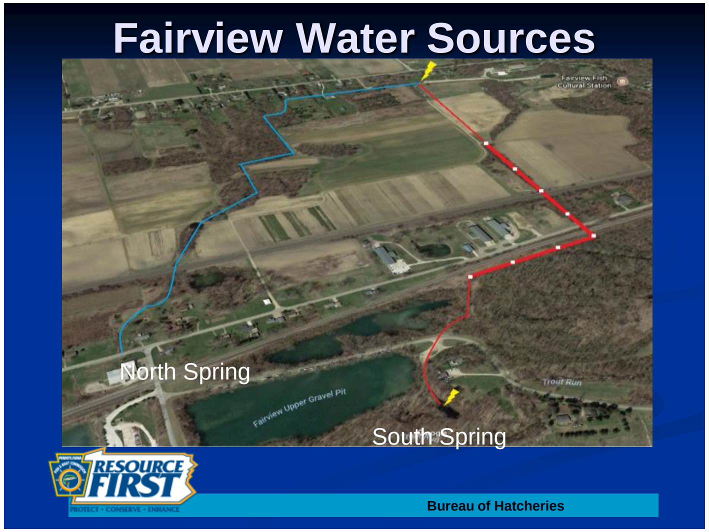
- **2015** – Fishing License prices are reduced $1 for Resident ($20), Senior Resident ($9) and Non-resident ($50) licenses. First price reduction in PFBC history. (*see listing in the right column of this page for a historical summary*).
- **2015** – The FishBoatPA app was released in March as the first mobile app from the Commission. Features include trout stocking schedules, locations of stocked trout waters and boat access areas, fish identification, issuing agent listing, rules and regulations, and a "my trophies" section for photos of angler catches. The app is available for free on both the Google Play Store and Apple App Store.
- **2016** – The Keystone Select Stocked Trout Waters program was introduced. Eight waters receive 14-20 inch trout (3,200 total). These stocked waters are regulated under Delayed Harvest Artificial Lures Only (DHALO) regulations. One water chosen in each Commissioner district. Six more waters were added in 2017, bringing the total to 14 waters.
- **2016** – Fishing License prices returned to pre-2015 prices (when three license tpyes were reduced by $1): Resident ($21), Senior Resident ($10) and Non-resident ($51). (*see listing in the right column of this page for a historical summary*).
- **2016** - The Commission celebrated its *150th Anniversary* of the creation of the agency in 1866.
- **2016** - Commission **Instagram** account established on May 3.
- **2017** - Personnel from the Commission's Pleasant Gap complex (450 Robinson Lane) relocated to the new Centre Region Office in Bellefonte (595 E Rolling Ridge Dr). Move in date for the majority of personnel - May 23. Building dedication and time capsule ceremony - August 12. The Pleasant Gap State Fish Hatchery remains at Pleasant Gap.

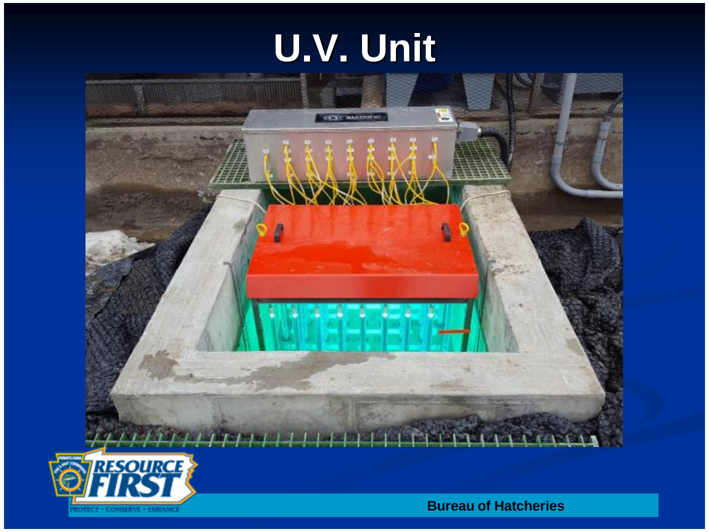

PENNSYLVANIA
FISH & BOAT COMMISSION
Fairview and Tionesta Hatcheries
August, 2018
Craig Lucas
To protect, conserve, and enhance the Commonwealth's aquatic resources and provide fishing and boating opportunities.
Bureau of Hatcheries

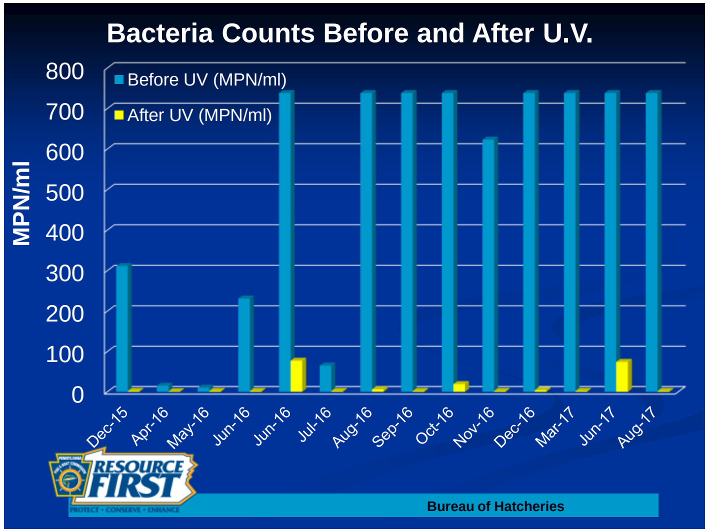

Fish Produced
Production is roughly 1 Million Steelhead smolts and 30,000 Lake Erie Brown Trout annually between Tionesta and Fairview.
RESOURCE FIRST
Bureau of Hatcheries


Tionesta Overview
Tionesta also raises Walleye Fry and Fingerling, Muskellunge, Tiger Muskellunge, and Channel Catfish
RESOURCE FIRST
Bureau of Hatcheries


Fairview Overview
RESOURCE FIRST
Bureau of Hatcheries


Fairview Water Sources
North Spring
South Spring
RESOURCE FIRST
Bureau of Hatcheries


U.V. Unit
RESOURCE FIRST
Bureau of Hatcheries


Bacteria Counts Before and After U.V.
MPN/ml
800
700
600
500
400
300
200
100
0
Before UV (MPN/ml)
After UV (MPN/ml)
Dec-15
Apr-16
May-16
Jun-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
Mar-17
Jun-17
Aug-17
RESOURCE FIRST
Bureau of Hatcheries


Biosecurity
Great Lakes Restoration
Initiative (G.L.R.I.) monies are
what made most of this possible
RESOURCE FIRST
Bureau of Hatcheries


Biosecurity and Steelhead Spawning…….Then
RESOURCE FIRST
Bureau of Hatcheries


Biosecurity and Steelhead Spawning……Now
RESOURCE FIRST
Bureau of Hatcheries


Fish Production
RESOURCE FIRST
Bureau of Hatcheries


Steelhead and Brown Trout Stocking
RESOURCE FIRST
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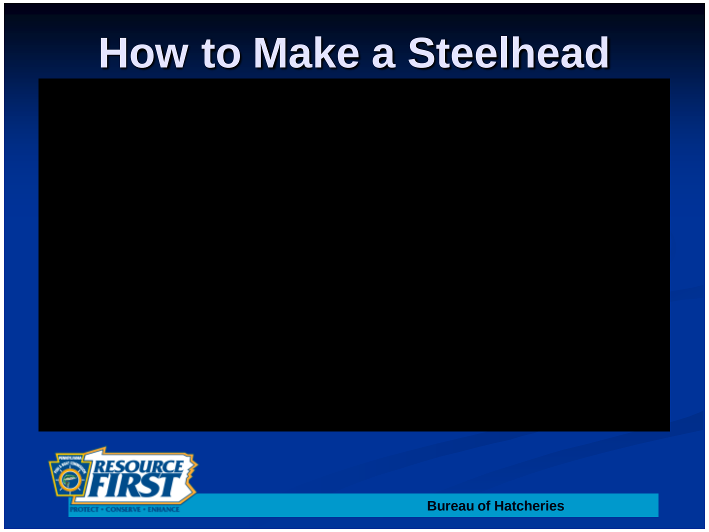
RESOURCE FIRST
Bureau of Hatcheries


Extreme Sizes
RESOURCE FIRST
Bureau of Hatcheries


Steelhead Collection
Adrian Prough Age 8
RESOURCE FIRST
Bureau of Hatcheries


Steelhead Drives
RESOURCE FIRST
Bureau of Hatcheries

Appendix 13.


How to Make a Steelhead
RESOURCE FIRST
Bureau of Hatcheries


Tionesta Hatch House
RESOURCE FIRST
Bureau of Hatcheries


Questions?
RESOURCE FIRST
Bureau of Hatcheries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