

GREAT LAKES FISH HEALTH COMMITTEE

**2010 Summer Meeting
Mishawaka, Indiana
August 11-12, 2010**

**Minutes
(with attachments)**

Submitted By:

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The data, results, and discussion herein are considered provisional; permission to cite the contents of this report must be requested from the authors or their agency.

**GREAT LAKES FISHERY COMMISSION
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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
Andy Dwilow	Department of Fisheries and Oceans Canada
Mohamed Faisal	Michigan State University
Christina Haska	Great Lakes Fishery Commission
Dave Insley	Ohio Department of Natural Resources
Roy Johannes	Minnesota Department of Natural Resources
Randy Lang	Indiana Department of Natural Resources
Dave Meuninck	Indiana Department of Natural Resources
Andy Noyes	New York State Department of Environmental Conservation
Ken Phillips	U.S. Fish and Wildlife Service- Wisconsin
Ling Shen	Minnesota Department of Natural Resources
Martha Wolgamood	Michigan Department of Natural Resources
Gary Whelan	Michigan Department of Natural Resources
Elizabeth Wright	Ontario Ministry of Natural Resources
Greg Wright	Chippewa- Ottawa Resource Authority
Coja Yamashita	Pennsylvania Fish and Boat Commission

Great Lakes Fish Health Committee Summer Meeting Agenda

Hyatt Place South Bend/Mishawaka

215 West Day Road

Mishawaka, IN 46545, USA

August 11-12, 2010

Wednesday August 11, 2010

- 9:00-9:15 am Welcome – Elizabeth Wright
- Introductions, logistics
- 9:15-9:30 am Approval of Meeting Minutes – Elizabeth Wright
- January 2010
- 9:30-9:45 am CLC/GLFC Update – John Dettmers
- 9:45-10:15 am Model program revisions - overview of revision process
- 10:15-10:30 am BREAK
- 10:30-11:45 am Model program revisions – discussion of pathogen descriptions
- 11:45 am – 1:00 pm LUNCH (on own)
- 1:00 -3:00 pm Model program revisions – emergency and restricted pathogens
- 3:00 -3:20 pm BREAK
- 3:20-5:15 pm Agency updates

Adjourn at 5:15 pm

Thursday August 12, 2010

- 8:30-10:15 am Model program discussions – other program elements and next steps
- 10:15-10:30 am BREAK
- 10:30-11:45 am Coolwater egg disinfection protocols
- 11:45–1:00 pm LUNCH (on own)
- 1:00-2:30 pm Other business – items appreciated from members
- 2:30-2:45 am BREAK
- 2:45-3:30 pm Other business continued
- 3:30-4:00 pm Agency updates, continued

Adjourn at 4:00 pm

Day 1: 11 August 2010

1. Introduction (B. Wright)

2. Committee Business (B. Wright)

Meeting Minutes: There were no comments on January's minutes. The committee has until September 1, 2010 to get comments to Beth. If she doesn't hear from you, it will be assumed that you agree.

Correspondence: There were multiple forms of communication, including the following:

- a. Freedom of Information and Protection Act- Ontario (it was requested the GLFHC approve it beforehand)
- b. Letter of support for Renibacterium
- c. Letter of support for Flavobacterium
- d. GLFT funded manuscript published: Dave Metzger

Cross-border enforcement issues: Kevin Ramsey gave a presentation in the spring, and Beth presented information on fish health diseases. The presentation received positive feedback. Beth will pdf the slides, send them to the committee, and post on the FHC website.

3. CLC/GLFC Update (J. Dettmers)

In January, there will be a change in leadership. Beth will leave as chair and Ken will come in. At the February meeting, the GLFHC will need to nominate a new vice-chair. Members can send nominations anytime before then to John.

The Lake Erie Committee is looking at potential ways to better integrate and have consistent regulations on transport of live bait fish (e.g., Whirling Disease, IPN). They will hold a meeting in September and may want feedback from GLFHC.

Are any GLFHC researchers looking into Restoration funds?

- a. John Coll put in 2 proposals and both were accepted.

4. Model Program Revisions (B. Wright and J. Dettmers)

Approximately one year ago, a subcommittee was formed to clean up the document (i.e., edit, reduce redundancy, etc). The committee was composed of Beth, Ken, Ling, Andy Noyes, and Sue.

This GLFHC meeting is meant to power through these revisions and gather input from the committee. It is meant to be an open working meeting.

The approach is to focus on gaining consensus on the content. The document will not final, but rather this meeting will determine the next steps needed to complete the Model Program. Any concerns can be addressed to the writing team.

The Ground Rules are as follows:

- Listen actively,
- Be tough on the issues and do not make it about the people,
- Provide your agency's perspective,
- Wait to be recognized,
- Contribute new information,
- Remain focused on what is being discussed.

Consensus will be reached with all parties participating. This process should help arrive at decisions, and discussion is encouraged. All points of view are important, and members are expected to cooperate. The ultimate result is an end product that everyone is satisfied with.

5. Model Program Edits: Introduction (All)

The following edits reached consensus:

- Lines 43-46: add a bullet that Response Plans will be done by individual agencies.
- Because it is not clearly defined who has the lead authority (e.g., in Ohio, it's the Department of Agriculture), say that fish health management is *a* responsibility, not "*the*" responsibility of the agencies.

6. Model Program Edits: Application (All)

The following edits reached consensus:

- Lines 8-9: will mention the water will not be flushed during transport.
- Line 11: put it before lines 8-9 so it clearly applies to both thoughts.
- State that member agencies are signatory to the Joint Strategic Plan.

The following edits will be addressed at a later time:

- Lines 8-9: Add that the fish are not released in the Great Lakes watershed.
- Consider adding a definition of "fish" to clear up any confusion about fish v. eggs.

7. Model Program Edits: Amendment (All)

The following edits will be addressed at a later time:

- The order of each of these sections within the document is not yet determined.
- The final document will be printed, but its main distribution will be through the GLFC website.

8. Model Program Edits: Definitions I (All)

The following edits reached consensus:

- Clinical sign: include behavior.
- Disease: include the word 'distinct' before 'clinical signs'.

- Gametes: use only the word 'sperm' instead of 'milt and sperm'.
- A definition for the word 'fish' will be included, stating that the animal may be alive or dead.
- Intensity: delete the word 'number' and replace with 'estimation of the pathogen load'.
- Pathogen: change the definition to 'a macro- or microorganism that is capable of causing disease'.
- Prevalence: use only the 'percent of infected individuals' and do not discuss incidence.
- Rearing unit: 'any hatchery unit that holds fish and includes...'
- Transfer: include the location may be a hatchery, lake, or other waterbody.
- Vertical transmission: delete the second sentence as it may not be correct.

The following edits will be addressed at a later time:

- It is unclear if a definition for Fish health Inspector is needed. The document should be checked to see where exactly this may be needed, and then the definition can be written accordingly.
- The GLFC must determine whether or not the GLFHC has permission to use the map of the Great Lakes in Figure 1.
- The definition of 'lot' may need to be revised after seeing its context in the document.
- 'Quarantine' could have multiple definitions depending on whether it's a noun or a verb. This needs to be revisited after seeing how it is used in the document.
- Make sure that the definition for 'source' is correct. Should the definition for 'fish' include gametes?

9. Model Program Edits: Definitions II (All)

The following edits reached consensus:

- Enzootic is 'present at a locality over an extended period of time'.
- Epizootic event is an 'occurrence of disease'

10. Model Program Edits: Emergency Fish Disease and Pathogen Management (All)

The committee was broken up into pairs to review this section and provide the pros and cons to the committee. In general, the pros included its easy-to-understand format and organization, its testing requirements for inspections, and its procedures for quarantine and detections. The cons included extending the length of time for fish health records to five years, increasing the level of testing for quarantined fish, providing the rationale/justification for values given, and not taking into account Canadian procedures.

Specific edits which reached consensus are as follows:

- The first paragraph needs to be rewritten to provide a better introduction to the section. It should be clear that the agencies are looking for multiple Emergency pathogens during testing and not just focusing on one.
- For importing fish, use testing of 5 years at the 5% prevalence level OR 2 years at the 2% level.
- Delete the paragraph from lines 21-24.

Day 2- 12 August 2010

1. Model Program Edits: Emergency Fish Disease and Pathogen Management, cont. (All)

The following edits reached consensus:

- Line 31: change 'fertilized eggs' to 'gametes'.
- Line 36: change 'non-tested' to 'incomplete life history'.
- Line 14: do same as line 36 above.
- Line 36: add 'and subsequent offspring' after 'gametes'.
- Lines 36-37: change wording so it is clear that the sample must be quarantined for 12 months once the offspring reach an appropriate size for testing (to mirror what is said in the fish section).
- Line 38-42: replace 'negative inspection' with 'without a positive detection'.
- Delete lines 43-46.
- Lines 50-51: delete the bullet and rewrite as 'test all lots and destroy infected rearing units'.
- Delete lines 61-62.
- Add new bullet to Detections in the Wild stating what to do if the pathogen is/is not OIE reportable. Copy to Emergency Pathogen Detections.
- Line 75: add 'if possible' to the end of the sentence.
- Delete Lines 79-84.

The following edits will be addressed at a later time:

- The bullet on lines 29-30 may need to be moved or incorporated into the second bullet. Once the committee sees the section on egg disinfection, the correct placement of this sentence should be clear.
- New bullets were added to the Emergency Pathogen Detections section, and this language needs to be cleaned up.

2. Agency Updates (All)

OMNR (B. Wright): Nothing to report.

Indiana DNR (D. Meuninck): There was nothing to report for the hatcheries, but there have been biosecurity workshops to develop HACCP plans with private hatcheries. There is a veterinarian training happening soon at Purdue about sampling techniques for fish health. The Bodine hatchery has several projects coming up, including designing new broodstock tanks away from the production tanks. Dillon is looking into getting a UV disinfection unit for the influent water. Money from APHIS was used for surveillance, and 6 lakes were analyzed this year. Approximately 1000 fish were found negative for pathogens. Steelhead broodstock, however, have been suffering from high mortality rates. Injections with thiamine seem to help.

CORA (G. Wright): This year had a terrible walleye spawning season. Warm temperatures drew them in but the photoperiod screwed them up. There has not been enough manpower for net lifting/settings, and

the ponds have been experiencing phytoplankton blooms at odd times. There have also been fungus problems occurring.

DFO (A. Dwilow): DFO is transitioning into Fish Health Protection Regulations (FHPR). This involved lab accreditation, but staffing is not adequate for everything. Regarding VHS, 105 samples were examined, and all were negative. A research scientist is now on staff to use PCR and virus isolation methods. There was a low level of BKD in two facilities in Ontario.

New York State DEC (A. Noyes): There is a potential change in rule-making for fish health regulations, including a no-overland transport clause. There are multiple options for how they could do this. Last fall, they added extra surveillance and did find Nucleospora.

USFWS- Pennsylvania (J. Coll): Archived lake trout are tested for RDTv. The water supply from Allegheny should be running in late winter/early spring. Current lake trout production is in Vermont until Allegheny is up and running.

Michigan DNR (G. Whelan): There was a reemergence of *Myxobolus* in hatchery YOY rainbow trout. This was previously detected in steelhead. Clinical signs appeared in late March. IPN has shown up in private hatcheries and the State of Michigan as well. This may be a problem of broodstock. A report was submitted to the commission for a wild fish pathogen database which would survey all pathogens in the basin. It would be a web-based application, and details can be discussed at a later meeting. An 800,000 gallon oil spill (heavy crude) happened in the Kalamazoo River and is affecting stream vegetation. It will be months before the clean-up is final. There has been little indication of direct mortality of fish, but surveys will begin this week using electrofishing. There is an expectation to have a delayed mortality from by-product effects.

Michigan State University (M. Faisal): GLFT has funded a project to work on immune response measurements in lake sturgeon to VHS in Lake St. Clair. Antibodies are protecting fish, and his lab is analyzing historical samples and so far sees similar results. A post-doc found walleyes are not extremely susceptible to VHS and are almost resistant to infection and heal quickly after exposure. Lake sturgeon are 100% resistant because of a lack of a receptor for the virus. Bluegills are extremely susceptible, as are lake herrings. Ronald Hedrick found PCR bands for EEDv in lake herrings, and this marks the first time this virus has been found in something other than lake trout. He will test more samples before publishing the results.

Minnesota DNR (R. Johannes): There was a news release regarding Cornell and research on Lake Superior. VHS was found, and there is a lot of interest in the Duluth area because that city is in the vicinity of the sample collection. In 2009, they reduced stocking to the area. Due to budget cuts, they're reducing production for 2011. The steelhead facility has approximately \$1 million in repairs. As of now, nothing has been found in hatcheries at the 2% level.

Minnesota DNR (L. Shen): A hatchery this spring had a mortality event, and the fish were treated with several options, but nothing worked. It was likely *Pseudomonas fluorescense* which is resistant to the treatments. They did detect BKD at other hatcheries from culture and are continuing surveillance work.

Pennsylvania FBC (C. Yamashita): They collected 30 lake trout from Lake Erie and an inland lake and submitted samples for testing. All were negative for EEDv. They also sent samples to Hedrick, who found BKD. They stocked the fish in an inland lake. They will be getting disease-free fish from Vermont and start again this year. Broodfish are being treated with erythromycin injections.

Ohio DNR (D. Insley): The London hatchery burned down in April. A neighbor had been burning cardboard boxes amidst high-power winds and the flames traveled over. An isolation facility at Ohio State University in Columbus is close to meeting standards to be a quarantine facility. Castalia is proceeding with construction for a new building to cover the raceway system. There was one small fish-kill this spring at Clear Fork. It was limited to crappies and researchers found *Columnaris*. As of October 2009, APHIS has acknowledged that Clear Fork is VHS positive.

USFWS- Wisconsin (K. Phillips): The hatcheries are doing well and some are in the process of erecting buildings over the raceways. VHS was isolated in lake trout in the Hammond Bay area of Lake Huron, and samples were collected for EEDv. The isolate IVb was confirmed from ovarian fluids. A bait fish study was started as a follow up to dealers in Wisconsin who were importing without proper permits. It's unknown what may be coming in with the bait.

3. Model Program Edits: Restricted Fish Disease and Pathogen Management (All)

The following edits reached consensus:

- Lines 2-7 are not a good introductory paragraph, and should instead be labeled 'Pathogen Screening'.
- Line 11: reword 'should *already* be present'.
- Line 12: 'Fish should not be *accepted*'.
- Line 18: change the timeframe to 8-12 months.
- Use Ontario's method for quarantine. Eggs are brought in, disinfected, tested per import permit, and stress tested. If all tests return with negative results, then the fish are released from quarantine. The room is cleaned and prepared for the next batch of fish.
- Delete lines 22-24.
- Line 29: change 'source' to 'hatchery or waterbody'.
- Use the same language in lines 35-44 as what is used in the previous section.
- Lines 38-40: use the same language that is used in the previous analogous emergency section.
- Delete lines 41-44.

The following edits will be addressed at a later time:

- Consider adding a third group of pathogens ('Emerging') to address pathogens which don't really belong in the Restricted category (e.g., EEDv and Nucleospora). An alternative would be to address each pathogen one-by-one with management and testing recommendations.
- Discuss lake-to-lake transfers under the section 'Releasing Fish'.
- Check OIE and other sources for appropriate definitions for 'isolation' and 'quarantine'.
- Add 'quarantine facility' and 'isolation facility' to the definition list.

- Include a stress test in the document.
- Lines 31-33 will be parking-lotted until it is known why this is written here. The examples are not vertically transmitted and it was thought this should be in a different section.

4. Summary of Major Model Program Action Items

1. Define the quarantine procedure using Ontario's method as a model.
2. Determine how to incorporate the risk assessment once the document is more final.
3. Include a standardized protocol for egg disinfection.
4. Reference OIE, AFS, and FHPR for standard procedures.
5. Provide management advice when reliable screening is unavailable for pathogens.
6. Determine what the hatchery classification would be after an Emergency pathogen is discovered and consequently destroyed. Address this in the Classification section.
7. Consider vertical transmission and hatchery downgrades in the context of Restricted pathogen management.
8. Provide details on the difference between a Fish Health Inspector v. Official v. Officer. What are the qualifications of each? Do these all need to be defined in the document?
9. Define the word 'lot' and give details on how it is used and whether or not age is involved.
10. Define the word 'fish' and give details on how it is used.
11. Decide which pathogens belong on which lists: Emergency, Restricted, or Other. Use webinars to communicate thoughts before the next meeting.

5. Adjourn

1 **Introduction**

2
3 Fish disease management in the Great Lakes basin is the responsibility of those agencies
4 that manage the fisheries resources. The Great Lakes Fish Health Committee, GLFHC, of
5 the Great Lakes Fishery Commission (GLFC) developed a Model Program in 1980¹ to
6 unify and coordinate the fish disease management efforts of the GLFC member agencies.
7 The purpose of the Model Program is to assist efforts aimed at preventing introductions
8 and spread of serious fish pathogens, classifying disease status at fish hatcheries, and
9 establishing protocols for importation and risk assessments associated with fish
10 pathogens. The Model Program is revised as needed.

11
12 Each member agency is expected to work toward the management of fish diseases in the
13 Great Lakes basin by:

- 14
- 15 - developing legislative authority and regulations to enable fish disease management
16 and possible eradication of fish pathogens;
 - 17
 - 18 - minimizing the rearing and release of infected fish;
 - 19
 - 20 - preventing the release of clinically diseased fish;
 - 21
 - 22 - preventing the importation into the Great Lakes basin of fish infected with
23 emergency pathogens; and
 - 24
 - 25 - limiting the transfer within the Great Lakes basin of fish infected with restricted
26 pathogens.
 - 27

28 At the time of this most recent revision of the Model Program, both the Canadian and
29 U.S. federal governments began to implement their respective NAAHPs: the National

¹ In 1980 the committee was then called the Great Lakes Fish Disease Control Committee. It was renamed in 19XX to the Great Lakes Fish Health Committee.

30 Aquatic Animal Health Program in Canada and the National Aquatic Animal Health Plan
31 in the U.S. The objective of the Canadian NAAHP is to protect the Canadian fish/seafood
32 industries and activities that rely on aquatic resources against the introduction and spread
33 of serious infectious fish diseases. The U.S. National Aquatic Animal Health Plan was
34 developed to provide a framework for federal agencies to work together to protect aquatic
35 resources. The Model Program does not replace or duplicate the components or
36 obligations of member agencies to these federal NAAHPs, but rather should be viewed as
37 a complimentary program directed specifically at the activities of member agencies such
38 as the collection, rearing, release and transfers of hatchery and wild fish in the Great
39 Lakes basin. Nothing in Model Program shall derogate from the right of the member
40 agencies to apply additional measures of inspection, quarantine, depopulation and
41 pathogen eradication in efforts to prevent fish disease outbreaks.

42
43 All member agencies should anticipate that they could have detections of undesirable fish
44 pathogens and appropriate response plans should be developed for timely and effective
45 management actions to contain and if possible, eliminate the detected pathogen.
46 Response plans should include provisions on biosecurity, personnel needs, testing needs,
47 necessary legislative authority for depopulation and disinfection if necessary,
48 depopulation and disposal procedures, disinfection protocols, and communication needs
49 for a coordinated response that may require state, provincial and federal governments,
50 universities and/or private industry. The GLFHC may recommend steps to eradicate the
51 pathogen from a hatchery and adjacent waters following the best science available in
52 association with information provided in the Model Program.

Application

The recommendations of this Model Program apply to fish species that have the potential to harbor pathogens that could be transmitted to fish in the Great Lakes basin.

The recommendations of this Model Program shall **not** apply to:

- a) Fish in transit through the Great Lakes basin that are not released from original shipping containers, and
- b) Specimens of fish for purposes of diagnostic services and related laboratory tests provided that all necessary biological containment measures are taken to avoid any dissemination of fish pathogens.

Under this Model Program, member agencies include:

- Chippewa Ottawa Treaty Fishery Management Authority
- Fisheries and Oceans Canada
- Great Lakes Indian Fish and Wildlife Commission
- Illinois Department of Natural Resources
- Indiana Department of Natural Resources
- Michigan Department of Natural Resources and Environment
- Minnesota Department of Natural Resources
- New York State Department of Environmental Conservation
- Ohio Department of Natural Resources
- Ontario Ministry of Natural Resources
- Pennsylvania Fish and Boat Commission
- U.S. Fish and Wildlife Service
- Wisconsin Department of Natural Resources

1 **Amendment**

2
3 Model Program amendments may be proposed by the Council of Lake Committees (CLC) or by
4 the GLFHC member agencies. Any proposed amendment shall be submitted to the GLFHC
5 chairperson in writing with a short explanation documenting the rationale for the request. The
6 GLFHC chairperson will seek consensus from member agencies; if the GLFHC endorses the
7 amendment, it will present the proposed amendment to the CLC for consideration, approval, and
8 adoption.

DRAFT

1 **Definitions**

2 Definitions for some of the terms used in this document:

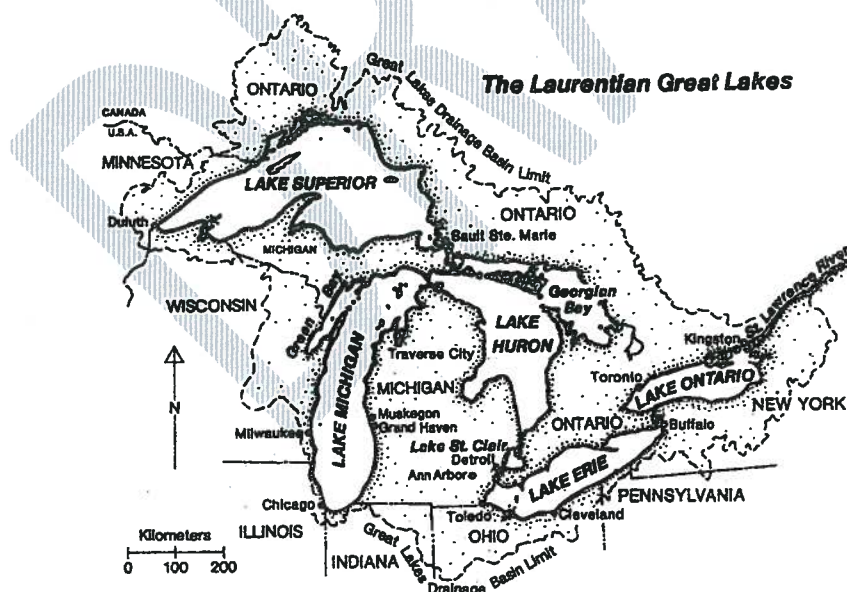
3
4 **Clinical sign:** visually apparent abnormalities of the body or organ.

5
6 **Disease:** a condition that impairs normal functioning of the fish and may be manifested
7 by distinguishing clinical signs.

8
9 **Fish Health Inspector:** any individual determined by a member agency to be
10 responsible for conducting fish hatchery inspections and issuing reports of test results.

11
12 **Gametes:** all sexual products of fish including milt, sperm, unfertilized eggs and
13 fertilized eggs.

14
15 **Great Lakes Basin:** the geographical area encompassing lakes Ontario (including the
16 St. Lawrence River from Lake Ontario to the 45th parallel of latitude), Erie, Huron, St.
17 Clair, Michigan, and Superior including their connected watersheds (Figure 1).



18
19 **Figure 1.** Great Lakes basin map from Taylor and Ferrari (1999).

21 **Hatchery:** is any source facility that holds and rears fish.

22

23 **Infection:** the occurrence of a pathogen in a fish.

24

25 **Intensity:** quantification of the number of pathogens found

26

27 **Lot:** a group of fish of the same species and age group that are reared on the same
28 water source.

29

30 **Member agency:** federal, provincial, tribal and state government fishery management
31 or conservation agency that is signatory to *A Joint Strategic Plan For Management of*
32 *Great Lakes Fisheries*¹.

33

34 **Non-secure water supply:** water source that may contain fish or fish pathogens such
35 as streams, lakes and unenclosed springs.

36

37 **Pathogen:** a causative agent of disease and may be a virus, bacterium, parasite, or
38 fungus.

39

40 **Prevalence:** total number of cases or incidences of the pathogen within a population at
41 a given time.

42

43 **Quarantine:** compulsory isolation and elimination of movement of fish to contain the
44 potential spread of a fish disease or pathogen

45

46 **Rearing unit:** a raceway, pond, tank or other holding container that is used to raise
47 fish.

48

49 **Secure water supply:** a water supply that is free of fish and fish pathogens (or treated
50 to remove pathogens) such as enclosed springs and wells.

¹ For a list of member agencies see Basic Obligation section.

51

52 **Source:** any point or place of origin of fish or gametes including a fish hatchery or free
53 ranging population.

54

55 **Transfer:** the movement of fish or gametes from one location to another.

56

57 **Vertical transmission:** transfer of a pathogen from adults to the egg, such that the
58 pathogen is included inside the egg wall. Any pathogen inside the egg wall will not be
59 destroyed during disinfection.

60

61 **Wild broodstock population:** free ranging adult fish generally from one spawning
62 location from which gametes are collected.

DRAFT

1 **Definitions**

2
3 Definitions for some of the terms used in this document:

4
5 **Emergency fish pathogen:** is a fish pathogen that is not known to exist in the Great
6 Lakes basin and is known to cause epizootic events.

7
8 **Enzootic:** constantly present in a locality

9
10 **Epizootic event:** affecting many fish of one or more species at the same time

11
12 **Restricted fish pathogen:** a fish pathogen that exists within the Great Lakes basin
13 within a limited geographic range and is known to cause epizootic events.

DRAFT

1 **Emergency Fish Disease/Pathogen Management**

2

3 **Importing Fish**

4 If a member agency seeks to import fish from outside the Great Lakes basin but NOT
5 from an area enzootic for an emergency pathogen, testing for emergency pathogens is
6 not required.

7

8 If a member agency seeks to import fish from outside the Great Lakes basin and from
9 within an area enzootic for an emergency pathogen:

- 10 • The source must be tested a minimum of 3 times in 2 years (initial test;
11 year 1 and year 2) without a positive detection for an emergency
12 pathogen. Testing at the 5% prevalence level in the population with 95%
13 confidence level.
- 14 • Fish imported from non-tested sources should be placed into isolation or
15 quarantine for 12 months.
 - 16 • Testing should be done on these fish for necessary
17 emergency pathogens such that three negative
18 inspections are recorded, with consecutive inspections
19 separated by at least four months before release from
20 isolation or quarantine occurs.
 - 21 • If isolation or quarantine facilities are not available, it is
22 recommended that the Great Lakes Fish Health
23 Committee (via the Chairperson) be consulted for a
24 recommended procedure for importation into the basin.

25

26 **Importing Gametes**

27 If a member agency seeks to import gametes from outside the Great Lakes basin and
28 from within an area enzootic for an emergency pathogen:

- 29 • If the emergency pathogen is NOT vertically transmitted, properly
30 disinfected fertilized eggs may be imported

- 31 • If the emergency pathogen IS vertically transmitted fertilized eggs may
32 be imported only if the adult broodstock population is tested a minimum
33 of 3 times in 2 years (initial test; year 1 and year 2) without a positive
34 detection for the emergency pathogen(s). Testing at the 5% prevalence
35 level in the population with 95% confidence level.
 - 36 ▪ Gametes imported from non-tested sources should be placed into
37 isolation or quarantine for 18 to 24 months.
 - 38 • Testing should be done on these gametes and their
39 subsequent offspring for necessary emergency pathogens
40 such that three negative inspections are recorded, with
41 consecutive inspections separated by at least four months
42 before release from isolation or quarantine occurs.
 - 43 • If isolation or quarantine facilities are not available, it is
44 recommended the Great Lakes Fish Health Committee
45 (via the Chairperson) be consulted for a recommended
46 procedure for importation into the basin.

48 **Emergency Pathogen Detections**

49 If an emergency path detected at a hatchery:

- 50 • Quarantine the source until testing of all lots of susceptible species can
51 be completed.
 - 52 • Test 3 times a minimum of 2 months apart (initial test;
53 month 2; month 4) with 2% prevalence level in
54 population with 95% at confidence level per lot sample
55 must not be positive prior to removal of quarantine
- 56 • Notify Great Lakes Fish Health Committee Chairperson, who will in
57 turn advise the Great Lakes Fish Health Committee and the Council of
58 Lakes Committee.
- 59 • Destroy all infected lots.
- 60 • Disinfect the area and gear that contained the infected lots.
- 61 • Determine origin of the pathogen, if possible.

- 62 • Determine if the pathogen is present in the effluent, if possible.
- 63 • Eradicate pathogen from origin and effluent water supply if possible.

64

65 **Detections in the wild**

66 If an emergency path detected in the wild:

- 67 • Notify Great Lakes Fish Health Committee Chairperson, who will in
68 turn advise the Great Lakes Fish Health Committee and the Council of
69 Lakes Committee.
- 70 • Confirm the detection by another laboratory following standard
71 procedures (AFS Blue Book).
- 72 • Employ all necessary/ reasonable means to contain the spread of the
73 pathogen, including limiting movement of fish and/or gametes from the
74 affected location.
- 75 • Determine the geographic and species distribution of the pathogen.
- 76 • Eradicate the pathogen, if possible. If eradication is not possible, change
77 classification of the pathogen from “emergency” to “restricted”.

78

79 When the guidance provided in this document concerning emergency pathogens is
80 superseded by additional information about the pathogen, the member agency should
81 immediately contact the Great Lakes Fish Health Committee Chairperson. The
82 Chairperson will use the most expedient way to provide appropriate recommendations
83 to the member agency. In the interim, the affected fish shall not be released or
84 transferred and every effort should be made to contain the pathogen.

1 **Restricted Fish Disease/Pathogen Management**

2 Reliable screening methods for restricted pathogens are not always available.
3 However, if the pathogen is detected during testing management procedures should be
4 employed. It is not recommended that screening for these pathogens take place until a
5 reliable screening method is developed. Two examples of pathogens that do not have
6 published reliable screening methods at the time of writing include epitheliotropic
7 disease virus, EEDv, and *Nucleospora salmonis* .

8
9 **Importing/Transferring Fish**

10 If a member agency seeks to import or transfer fish from a source with a restricted
11 pathogen the pathogen should be present at the receiving hatchery or will result in a
12 downgrading of the hatchery classification (see Section X). Fish should not be received
13 without a hatchery or wild broodstock population classification.

14
15 Fish from non-tested sources that are enzootic for a restricted pathogen should be
16 placed in isolation or quarantine for 12 months until appropriate testing can be done if
17 the restricted pathogen is not present at the receiving hatchery.

- 18 ◦ The fish should be tested a minimum of 3 times during the 12 month
19 period (minimum 4 months between tests) without a positive detection
20 for a restricted pathogen. Testing at the 5% prevalence level in the
21 population with 95% confidence level.
- 22 ◦ If isolation or quarantine facilities are not available, it is recommended
23 that the Great Lakes Fish Health Committee (via the Chairperson) be
24 consulted for a recommended procedure for importation/transfer.

25
26 **Importing/Transferring Gametes**

27 If the restricted pathogen is NOT vertically transmitted, properly disinfected fertilized
28 eggs may be imported or transferred regardless of whether the pathogen is present at
29 the receiving source.

30
31 If the restricted pathogen IS vertically transmitted, properly disinfected fertilized eggs

32 may be imported if the restricted pathogen detected is *Yersinia ruckeri* or *Aeromonas*
33 *salmonicida*.

34

35 If the gametes are from a non-tested source in an area enzootic for a restricted
36 pathogen that IS vertically transmitted (other than *Yersinia ruckeri* or *Aeromonas*
37 *salmonicida*) and that pathogen is not present at the receiving hatchery

- 38 • the gametes should be placed in isolation or quarantine for 18 – 24
39 months until testing can be done at the 5% prevalence level in the
40 population with 95% confidence level.
- 41 • if isolation or quarantine facilities are not available, it is recommended
42 that the Great Lakes Fish Health Committee (via the Chairperson) be
43 consulted for a recommended procedure for importing/transferring the
44 gametes.

45

46 **Releasing Fish**

47 Release of fish infected with restricted pathogens without clinical signs should take
48 place only when necessary and only into locations where the pathogen has been
49 detected, or in areas which have received infected fish within the last five years.

50

51 Release of fish into the Great Lakes basin should not be conducted if any of the
52 following situations exist:

- 53 • Fish exhibit clinical signs of any disease,
- 54 • A fish in one rearing unit with mortality rates deviating from normal
55 hatchery background levels until survival returns to normal (e.g., daily
56 mortality rate at or higher than 0.5% during the week prior to intended
57 release date for salmonid species; and XX% for non-salmonid species). It is
58 advisable to test these fish to determine if a pathogen is present, or
- 59 • Fish are infected with a restricted pathogen that is resistant to multiple
60 antibiotics.

61

62 **Restricted Pathogen Detections**

63 If a restricted path detected at hatchery:

- 64 • Limit spread of pathogen to other rearing units within the hatchery or to
65 other hatcheries.
 - 66 ▪ Treat infected rearing units to reduce number of infected fish, if
67 appropriate.
 - 68 ▪ Optimize rearing conditions
 - 69 ▪ If the detection represents a new detection, determine origin of
70 pathogen, if possible and take action to prevent further spread if
71 appropriate.

72

73 If a restricted path detected in the wild:

- 74 • Limit collection of fish and gametes from the location, if possible.
- 75 • Employ reasonable means to prevent the spread of the pathogen to new
76 locations where it previously has not been detected.
- 77 • Determine the geographic distribution of the pathogen.

78

79 When the guidance provided in this document concerning restricted pathogens is
80 superseded by additional information about the pathogen, the member agency should
81 contact the Great Lakes Fish Health Committee Chairperson. The Chairperson will use
82 the most expedient way to provide appropriate recommendations to the member
83 agency. In the interim, the affected fish shall not be released or transferred and efforts
84 should be made to contain the pathogen.

1 **Reporting**

2

3 Each member agency shall provide to the GLFHC Chairperson an annual report,
4 covering the calendar year January to December, describing the status of fish health
5 within the area managed by the member agency. Reports should be submitted to the
6 Chairperson by January 31 of the year following the reporting time period. Member
7 agency annual reports will be shared with the GLFHC. The annual report shall include
8 summaries of the following:

9

- 10 • The classification of agency fish hatcheries and wild broodstock populations,
11 • A list of known importations into the Great Lakes basin of fish and gametes from
12 outside the Great Lakes basin,
13 • Any measures adopted for pathogen management,
14 • Any detections of emergency or restricted pathogens within the member agency
15 jurisdiction including information pertinent to fish sample collection, testing
16 method(s), dates, and locations, etc,
17 • Any cases of high mortality in fish hatcheries or in wild populations, including
18 information on the causative pathogen(s) if detected,
19 • A summary of any fish disease issues for which the member agency requested
20 input from the GLFHC members, including final decisions made following
21 GLFHC input.

1 Hatchery/Wild Broodstock Classification

2
3 The classification system is designed to facilitate an awareness of fish disease status of
4 fish hatcheries and wild broodstock populations. For the purposes of this model
5 program, hatcheries and wild broodstock are considered to be a source of fish and are
6 treated similarly. It is recommended that all member agencies maintain and use this
7 classification system and provide the appropriate fish disease classification information
8 to other agencies/hatcheries when transferring fish and gametes.

9
10 By using this classification system, the disease risks associated with fish transfers and
11 imports of gametes into a hatchery will be better understood and member agencies can
12 take action to reduce pathogen and disease spread within the Great Lakes basin. It is
13 recommended that fish transfers not knowingly downgrade the classification of the
14 receiving hatchery.

15
16 Source population classifications should be updated annually at a minimum to reflect
17 the current reporting year (January to December). If a pathogen is detected between
18 regularly scheduled inspections/testing, the classification should be immediately
19 updated.

20
21 Each source population is classified based on pathogen detection and risk of pathogen
22 transfer through the available water source. The classification is given using a letter
23 and number combination.

24
25 I) Each source population is initially classified based on the presence/absence of
26 emergency and restricted pathogens:

27 **Class-A:** history of no listed emergency and restricted pathogens

28 **Class-B:** a detection of one or more emergency or restricted pathogens

29 **Class-C:** pathogen history unknown (i.e., no testing for a period of 2 years)

30
31 Initially, any new source population that has not undergone two years of health testing

32 will be Class C and is assumed to carry a greater risk of having and spreading a
33 pathogen.

34

35 II) Each hatchery is further classified based on the water supply used and therefore the
36 risk of acquiring a pathogen via the water supply:

37 **Class-1:** the water supply is secure (i.e., free of fish and fish pathogens (or treated
38 to remove pathogens)).

39 **Class-2:** the water supply is non-secure (i.e., may contain fish or fish pathogens)

40

41 **Class A-1.**

42 To obtain an A-1 classification, the hatchery would have:

- 43 • three inspections/testing (see Section X) with no detections of
44 emergency or restricted pathogens in a 12 to 24 month period, with
45 inspections/testing separated by at least 4 months.
- 46 • a secure water supply.

47

48 To maintain an A-1 classification, hatcheries must:

- 49 a) undergo annual inspections/testing at a minimum,
- 50 b) have no detections of emergency or restricted pathogens, and
- 51 c) ensure that all fish and gametes are obtained from sources classified as A-1.

52

53 **Class A-2**

54 To obtain an A-2 classification, the hatchery would have:

- 55 • three inspections/testing (see Section X) with no detections of
56 emergency or restricted pathogens in a 12 to 24 month period, with
57 inspections/testing separated by at least 4 months.
- 58 • a non-secure water supply.

59

60 To maintain an A-2 classification hatcheries must:

- 61 a) undergo annual inspections/testing at a minimum,
- 62 b) have no detections of emergency or restricted pathogens, and

63 c) ensure that all fish and gametes are obtained from sources classified as A-1 or
64 A-2.

65

66 **Class B**

67 Source populations that have one or more emergency or restricted pathogens will also
68 include information in the classification that identifies the pathogen(s) detected. The
69 letter codes corresponding to emergency and restricted pathogens are identified in
70 Table 1. Example: A Class B hatchery on a non-secure water source with a detection
71 of furunculosis on 6-20-2008 would be Class B-2-BF(6/2008).

72

73 **Class C**

74 Source populations without a history obtained from annual inspections/testing for
75 emergency and restricted pathogens will receive a C classification to indicate there is a
76 risk of pathogen transmission with the fish. All isolation and quarantine facilities will
77 be Class C.

78

79 **Exceptions for Gametes**

80 If fertilized eggs that originate from a source enzootic or positive for the pathogens
81 listed below AND the fertilized eggs are properly disinfected, the hatchery
82 classification will not change:

- 83 • *Ceratomyxa shasta*
- 84 • Infectious Salmon Anemia virus
- 85 • *Tetracapsuloides bryosalmonae*
- 86 • *Yersinia ruckeri*
- 87 • *Aeromonas salmonicida*
- 88 • Viral Hemorrhagic Septicemia virus (all genotypes) for salmonid eggs
89 only. Note: At the time of writing, there is no published disinfection
90 procedure for non-salmonid eggs documented to kill the VHS virus.

91

92 Fertilized eggs from sources that are enzootic or positive for all other vertically
93 transmitted emergency and restricted pathogens will retain the pathogen classification

94 when eggs are transferred. Transfer of unfertilized eggs and milt cannot be disinfected
95 and should only occur from sources with equal or greater classification to the receiving
96 hatchery.

97

98 **Exceptions for Antibiotic Resistant Bacteria**

99 If an antibiotic-resistant bacterium is isolated from a hatchery, the detection should be
100 noted on all inspection reports and annual reports.

101

102 **Downgrading Classifications**

103 If a transfer must be made from a source with a restricted pathogen that is not present
104 at the receiving hatchery, the receiving hatchery will, in addition to its current
105 classification, assume the source classification for a period of 12-24 months.

106

107 A hatchery cannot have a higher classification than its wild broodstock source, unless
108 source eggs are properly disinfected and no vertically transmitted pathogens are
109 present.

110 • Example 1. Class A-2 hatchery receives disinfected eggs from a source
111 population that is positive for *Aeromonas salmonicida salmonicida*.
112 Because the eggs are properly disinfected and no vertically transmitted
113 pathogen is present, the hatchery maintains Class A-2.

114

115 • Example 2. Class A-2 hatchery receives disinfected eggs from a source
116 population that is positive for *Renibacterium salmoninarum*. Although
117 the eggs are properly disinfected a vertically transmitted pathogen is
118 present, resulting in the hatchery being downgraded to Class B-2.

119

120 **Upgrading Classifications**

121 **Class B to Class A**

122 If, after 3 inspections/testing made over a period of 18 months (with a minimum of 4
123 months between inspections/testing) there are no detections of emergency or restricted
124 pathogens, the hatchery will be upgraded to a Class A hatchery.

125

126 **Class C to Class B or Class A**

127 The C classification will remain with the source population for the duration of the 12 to
128 24 month inspection/testing period (with a minimum 4 month period between
129 inspections/testing). At the end of the inspection/testing period if an emergency or
130 restricted pathogen is detected the source will become Class B. If no emergency or
131 restricted pathogens are detection following the inspection/testing period, the source
132 will become Class A.

DRAFT

1 Hatchery Depopulation and Disinfection

2
3 A hatchery that was depopulated and disinfected to eliminate an emergency or restricted
4 pathogen will initially become Class B following the disinfection. The hatchery must go through
5 the required 12 to 24 month inspection/testing period during which time it will be considered
6 suspect for the previously detected pathogen(s) and the disinfection date will be noted next to the
7 classification. The hatchery will be reclassified at the end of the inspection/testing period and the
8 disinfection date will no longer be required.

9
10 An example of this situation would be:

- 11 • Infectious hematopoietic necrosis virus was detected in fish at a Class A-1 hatchery (i.e.
12 no previous history of emergency or restricted pathogens and a secure water source). All
13 measures to depopulate and disinfect the hatchery were completed on 5-15-2008.
 - 14 ○ Classification: _____
- 15
16 • After 24 months and 3 inspections/testing, there were no detections of emergency or
17 restricted pathogens. The hatchery classification became: _____

1 **Inspection Procedures**

2 The most recent editions of “Suggested Procedures for the Detection and Identification
3 of Certain Fish and Shellfish Pathogens”, developed by the Fish Health Section (FHS)
4 of the American Fisheries Society, or the “Fish Health Protection Regulations Manual
5 of Compliance” (Miscellaneous Special Publication 31, Revised) of Fisheries and
6 Oceans Canada, and the World Organisation for Animal Health (OIE) Manual of
7 Diagnostic Tests for Aquatic Animals provide the basis for fish hatchery inspections
8 and certifications. More sensitive or definitive procedures may be used, but any
9 departures from the basic procedures set forth by these manuals must be noted on
10 reports. The Great Lakes Fish Health Committee encourages all efforts to employ the
11 most currently accepted methods for detection of pathogens not included in the
12 manuals listed above.

13
14 Moribund fish and fish with clinical signs of disease should be included in samples
15 collected during routine testing and inspections. The method of collecting subsamples
16 from rearing units to obtain a representative sample is left to the discretion of the fish
17 health inspector or member agency. Sampling of broodstock populations and
18 production fish should be done throughout the year using moribund and dying fish
19 whenever possible. Training should be provided to hatchery staff so that they can send
20 samples for the detection of pathogens to agency laboratories on a periodic basis. The
21 annual case history of each designated lot should be completed by the fish health
22 inspector using accumulated sampling data. The minimum number of samples is left
23 to the discretion of the fish health inspector or member agency.

Emergency Fish Pathogens

Emergency fish pathogen: is a fish pathogen that is not known to exist in the Great Lakes basin and is known to cause epizootic events.

Epizootic event: affecting many fish of one or more species at the same time

Disease	Pathogen	Disease Acronym	Pathogen Acronym
viral hemorrhagic septicemia	virus	VHS	VE
infectious hematopoietic necrosis	virus	IHN	VH
ceratomyxosis	<i>Ceratomyxa shasta</i>	CS	SC
proliferative kidney disease	<i>Tetracapsulodes bryosalmonae</i>	PKD	SP

Restricted Fish Pathogens

Restricted fish pathogen: a fish pathogen that exists within the Great Lakes basin within a limited geographic range and is known to cause epizootic events.

Epizootic event: affecting many fish of one or more species at the same time

Disease	Pathogen	Disease Acronym	Pathogen Acronym
whirling disease	<i>Myxobolus cerebralis</i>	WD	SW
infectious pancreatic necrosis	virus	IPN	VP
bacterial kidney disease	<i>Renibacterium salmoninarum</i>	BKD	BK
furunculosis	<i>Aeromonas salmonicida</i>	BF	BF
enteric redmouth	<i>Yersinia ruckeri</i>	ERM	BR
epizootic epitheliotropic disease	virus	EED	VL

* Inspections within the Great Lakes basin do not need to include these pathogens unless the facility being inspected harbors any fish imported from areas where these pathogens are enzootic.

** Field diagnostic test not available.

** Diagnostic test not available.

1 Pathogen descriptons

2

3 *Aeromonas salmonicida salmonicida*

4 *Aeromonas salmonicida salmonicida* infects numerous freshwater fish species. In salmonids this
5 bacterium causes the disease furunculosis, and the bacterium can cause disease in other fish
6 species. This bacterium is distributed worldwide, is enzootic throughout the Great Lakes basin.
7 Clinical signs include boil-like lesions (furuncles) on the skin and in the muscle tissue,
8 exophthalmia, bloody discharge from vent, and multifocal hemorrhages in the viscera and
9 muscle.

10

11 Asian Tapeworm, *Bothriocephalus achielognathi*

12 Originally from Asian, *Bothriocephalus achielognathi* is now found in Europe, Mexico, Puerto
13 Rico, the United States and Canada (Marcogliese 2008). The only detection of this parasite in the
14 Great Lakes basin was made from a fish collected in the Detroit River (Marcogliese 2008).
15 *Bothriocephalus achielognathi* is a segmented cestode with an arrowhead-shaped scolex (head)
16 that has two elongated sucking grooves. Marcogliese (2008) reported the fish hosts for this
17 parasite to be cyprinids, including the common carp, centrarchids including white bass, ictalurids
18 and salmonids, among other fish hosts. The parasite may cause anemia, intestinal inflammation,
19 weight loss and mortality, particularly in young fish.

20

21 *Ceratomyxa shasta*

22 *Ceratomyxa shasta* is a myxosporidian parasite that infects anadromous salmonids in the Pacific
23 northwest of the United States and Canada causing the disease Ceratomyxosis. *C. shasta*
24 initially infects the intestine but the infection generally becomes systemic over time. Ultimately,
25 the spores displace functional tissue in the organs and the fish die. Clinical signs of disease
26 include emaciation, lethargy, darkening of skin, ascites, and exophthalmia.

27

28 Cutthroat Trout Virus

29 Cutthroat trout virus was first identified in 1988 and has since been detected at several state and
30 national fish hatcheries in California, Colorado, Montana, and Wyoming and is reported to infect
31 cutthroat trout, rainbow trout, brown trout and brook trout. Although it infects fish and is thought

32 to be vertically transmitted (J. Winton, USGS-Western Fisheries Research Center, personal
33 communication), CTV has not been shown to cause disease on a macro or microscopic level in
34 salmonids. Chinook and coho salmon appear not to be susceptible to infection (Hedrick et al.
35 1991). There is currently no information available concerning the effects of CTV on warm or
36 cool water fish species. Cutthroat trout virus was recently detected at Ennis and Saratoga
37 National Fish Hatcheries in Montana and Wyoming respectively. Salmonid eggs from these
38 hatcheries have been imported in recent years into Ohio and Illinois hatcheries. CTV has not
39 been detected at hatcheries in the Great Lakes basin or in wild fish from the basin.

40

41 **Epizootic Epitheliotropic Disease Virus**

42 Epizootic epitheliotropic disease virus (EEDv) infects numerous salmonids, particularly lake
43 trout in North America. This virus has been detected in Lake Superior and in hatcheries in
44 California, Michigan, Pennsylvania, Wisconsin, and Wyoming. Clinical signs have only been
45 reported in juvenile lake trout and include lethargy, riding high in the water, hemorrhages of the
46 eye and gray-white mucoid blotches on the skin and fins.

47

48 ***Heterosporis* sp.**

49 *Heterosporis* sp. is a microsporidan parasite that infects the muscle of yellow perch walleye,
50 northern pike and other freshwater fish species. This parasite is known to occur in a limited
51 number of Wisconsin, Michigan and Minnesota lakes and has been occasionally reported in
52 yellow perch from the Canadian waters of lakes Ontario and Erie and from cisco in the U.S.
53 (Minnesota) waters of Lake Superior. It has not been reported from fish hatcheries. The parasite
54 causes disease to infected host fish in the form of infected flesh has patches of white, opaque
55 muscle with the appearance of “freezer-burn” that is unpalatable to the public. Mortality has
56 been induced in the laboratory but natural mortality has not been observed.

57

58 **Infectious Hematopoietic Necrosis Virus**

59 Infectious hematopoietic necrosis virus (IHNV) infects salmonids in fresh and salt water, in the
60 wild and in hatcheries. This virus is a pathogen of international concern. IHNV is present in
61 salmon and steelhead along the west coast of Canada and the United States. Clinical signs of
62 disease include exophthalmia, darkening of skin, petechiae on the skin, in the mouth, pale gills,

63 ascites, pale viscera with/without petechiae (including the swim bladder, body wall and
64 mesenteries). The virus is most likely vertically transmitted.

65

66 **Infectious Pancreatic Necrosis Virus**

67 Infectious Pancreatic Necrosis virus (IPNV) has been isolated from wide range of fish species
68 including salmonids, cyprinids and marine species. The pathogen has a wide geographic
69 distribution, occurring in North and South America, Europe, Asia, and South Africa. In the Great
70 Lakes basin IPNV has been found in Pennsylvania, Michigan and Wisconsin. Clinical signs
71 include darkened body coloration, exophthalmia, petechiae on the skin, cessation of feeding and
72 in the later stages show a loss of balance progressing to a corkscrew swimming motion.

73

74 **Infectious Salmon Anemia Virus**

75 Infectious salmon anemia virus (ISAV) infects primarily Atlantic salmon in wild and farmed fish
76 in the North Atlantic waters of Canada, the United States, Norway, the Faroe Islands and the
77 United Kingdom. This virus is a pathogen of international concern. Clinical signs of disease
78 include anemia, ascites, petechiae in the body wall and eye. This virus is suspected to be
79 vertically transmitted.

80

81 **Koi Herpesvirus**

82 Koi Herpesvirus (KHVv) infects carp, koi and goldfish causing the disease koi herpesvirus
83 (KHV) in carp and koi. The virus has been found worldwide and in the Great Lakes basin in
84 Michigan, New York State, Ontario. It is a pathogen of international concern. Clinical signs
85 include skin discoloration, increased respiratory frequency, skin lesions, appetite loss, erratic
86 swimming, sunken eyes, notch on the nose, and swollen, pale, rotting gills.

87

88 **Largemouth Bass Virus**

89 Largemouth bass virus (LMBv) infects centrarchids east of the Rocky Mountains in the United
90 States. In the Great Lakes basin, LMBv has been found in Lake St. Clair, western portion of
91 Lake Erie. The virus also has been found in Illinois and Wisconsin hatcheries. Most fish with
92 LMBv are carriers with no clinical signs. The mortality has only been found in largemouth bass.

93 Clinical signs include difficulty swimming, bloated abdomen, loss of buoyancy regulation,
94 hemorrhaging and discoloration of the swim bladder.

95

96 **Lymphosarcoma**

97 Lymphosarcoma is a malignancy of esocids in North America, the United Kingdom and Europe
98 and is believed to be caused by a retrovirus (Wolf 1988). It may take up to a year for infected
99 fish to show external signs of disease. Fish with lymphosarcoma do survive but the sores and
100 growths associated with severe infections are unpalatable to the public.

101

102 ***Myxobolus cerebralis***

103 *Myxobolus cerebralis* is a myxosporidean parasite of salmonids that causes whirling disease. It is
104 found in Europe, North America, and South Africa. *M. cerebralis* has been found in Great Lakes
105 tributary waters and in fish hatcheries in Michigan and inland waters in Pennsylvania, New
106 York, and Michigan. *M. cerebralis* requires a tubificid oligochaete to complete its life cycle.
107 Clinical signs include darkened tails, skeletal deformities, and “whirling” behavior in young fish.

108

109 ***Nucleospora salmonis***

110 *Nucleospora salmonis* is an intracellular microsporidian parasite reported from salmonid species
111 in Europe, South and North America. In the Great Lakes basin *N. salmonis* has been reported in
112 hatcheries in Michigan. *N. salmonis* infects blood leukocytes, hematopoietic tissues in the kidney
113 and spleen, and tubular and glomerular epithelium in kidneys. Clinical signs include anemia and
114 leukemia and can be associated with mortality.

115

116 ***Piscirickettsia* – like organism**

117 A *Piscirickettsia*-like bacterium was isolated from adult muskellunge in Lake St. Clair during the
118 2003 spawning period and is a likely contributing factor in epizootic events. Clinical signs
119 include quarter-sized rash-like skin lesions.

120

121 **Spring Viremia of Carp Virus**

122 Spring viremia of carp virus (SVCv) primarily affects carp and other species in the Cyprinidae
123 family, but has also been found in a few species of other fish families such as Centrarchidae and

124 Percidae. This virus causes the disease spring viremia of carp (SVC). It has been reported from
125 Europe, Asia, North and South America. It is a disease of international concern. In the Great
126 Lakes basin it has been found in healthy common carp from the Hamilton Harbor region of Lake
127 Ontario and has been associated with die-offs in several inland waters in Illinois, Ohio, New
128 York and Wisconsin. Clinical signs include darkened body coloration, pale gills, abdominal
129 distension, exophthalmia, inflammation of the vent, petechial hemorrhages of skin, gills and
130 eyes.

131

132 ***Renibacterium salmoninarum***

133 *Renibacterium salmoninarum* infects salmonids, especially rainbow trout, brown trout, brook
134 trout and coho salmon, Chinook salmon. This bacterium causes bacterial kidney disease (BKD).
135 It occurs in virtually all areas where salmonids occur, except Australia, New Zealand and Russia.
136 It is a serious problem in the northeast Pacific and Japan. *R. salmoninarum* is enzootic and
137 broadly distributed within the Great Lakes basin. Clinical signs include dark coloration,
138 exophthalmia, pale gills, ascites, skin lesions, white nodular masses in the kidney, abdominal
139 distension or hemorrhages at the vent or base of the fins. This bacterium is vertically transmitted.

140

141 ***Tetracapsuloides bryosalmonae***

142 *Tetracapsuloides bryosalmonae* is a myxosporidean parasite that infects salmonids in North
143 America and Europe causing Proliferative Kidney Disease (PKD). The parasite infects the
144 interstitial cells of the kidney and penetrates the lumen of the tubules. Clinical signs include
145 distended abdomen, enlargement of the kidney, exophthalmia and anemia. This parasite is not
146 vertically transmitted in eggs.

147

148 **Viral Hemorrhagic Septicemia (all genotypes except IVb)**

149 The viral hemorrhagic septicemia virus (VHSv) infects wild and farmed freshwater and marine
150 species of fish causing the disease viral hemorrhagic septicemia (VHS). There are four
151 genotypes of VHSv: VHS genotypes I, II, and III occur in Europe, genotype IVa occurs in
152 marine fish species in Japan and on the west coast of North America¹. This virus is a pathogen of

¹ VHS genotype IVb is present in the Great Lakes basin and therefore is listed as a restricted fish pathogen.

153 international concern. Clinical signs of disease include petechiae on the skin, in muscle, in and
154 on the surface of the viscera, ascites, exophthalmia.

155

156 **Viral Hemorrhagic Septicemia Virus (Genotype IVb)**

157 Viral hemorrhagic septicemia virus genotype IVb (VHSv-IVb) infects a wide range of freshwater
158 fish species including several species of Centrarchidae, Esocidae, Percidae, Salmonidae,
159 Coregonidae, Cyprinidae, Sciaenidae. Some species, such as muskellunge are quite susceptible
160 to disease and mortality however signs of disease have not been reported from other species such
161 as emerald shiner. VHS-IVb is enzootic and has now been found in all Great Lakes. It has been
162 detected inland in Michigan, New York, and Wisconsin and in the Ohio River basin in Ohio. It is
163 a pathogen of international concern². Clinical signs of disease include ascites, exophthalmia,
164 enlarged spleen, and petechiae in skin, muscle, and viscera.

165

166 **White Sturgeon Herpesvirus**

167 Two strains of white sturgeon herpesvirus, WSHv-1 and WSHv-2, occur in white sturgeon in
168 west coast of the United States. Both viruses cause moderate to high mortality in cultured fish.
169 No specific external clinical signs of disease. Fish continue to feed until death. Internally,
170 stomach and intestine filled with fluid, but other organs appear normal. Affected wild white
171 sturgeon become listless and appeared to have stopped eating. Other species of sturgeon,
172 including shovelnose and pallid sturgeon, are also susceptible to WSHv.

173

174 **White Sturgeon Iridovirus**

175 White sturgeon iridovirus (WSIv) is known to be pathogenic to the genus Acipenser in the
176 Pacific northwestern United States and to both cultured and wild white sturgeon and has been
177 detected in Russian sturgeon. The virus is also known to be mildly pathogenic to lake sturgeon.

178

179 ***Yersinia ruckeri***

180 *Yersinia ruckeri* (serotype I and II) infects marine and freshwater fish in North America,
181 Australia, Africa and Europe. Rainbow trout are especially susceptible. This bacterium causes

² VHS genotypes I, II, III, and IVa have not been detected in the Great Lakes basin and therefore are listed as emergency fish pathogens.

182 the disease enteric redmouth (ERM) and is broadly distributed in the Great Lakes basin. Clinical
183 signs include redness of the mouth, exophthalmia, pale liver, hemorrhages in the gills, skin and
184 fins, swollen kidney and spleen. Chronic cases may demonstrate partial or total blindness,
185 exophthalmia, distended abdomen, emaciation.

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