Viral Hemorrhagic Septicemia (VHS) Briefing Paper
February 26, 2007

General VHS Information

- *What is VHS?* VHS is viral hemorrhagic septicemia, a viral fish disease that has caused large scale mortalities in rainbow trout and turbot aquaculture operations in Europe and in Pacific herring and pilchard populations along the Pacific Coast of North America. The disease is caused by a rhabdovirus, Viral Hemorrhagic Septicemia Virus (VHSv). This virus has a number of identified isolates (unique genetic types) grouped in four types; three from Europe and one from North America. Each appears to have unique effects with specific pathogenicity on certain species. The isolate recently found in the Great Lakes Basin here is most similar to the VHS strain previously isolated from the Atlantic Coast in Eastern North America and has been labeled Type (isolate) IVb.

  VHSv is **not** a human pathogen. There are no concerns with respect to human health with this pathogen and it can not infect humans if they eat fish with the pathogen.

- *Is VHS a reportable or emergency disease?* VHS is a reportable animal disease that requires notification of Departments of Agriculture, United States Department of Agriculture – Animal and Plant Health Inspection Service (USDA-APHIS), Canadian Food Inspection Agency (CFIA), and the OIE (International Organization for Animal Health). The listing by the Great Lakes Fishery Commission - Great Lakes Model Fish Health Program is in the process of being changed to a restricted disease, as it is now endemic to the Great Lakes. If this disease gets into a fish production facility or hatchery in Michigan, the facility will have to at least destroy any infected lots and may have destroy all fish, depending on the infected lot's location in the hatchery, under new revisions to the Great Lakes Model Fish Health Program.

- *What does it do to fish?* VHSv Types I, II, III and IVa are known to cause mortalities in short periods of time, particularly in rainbow trout and turbot (Types I-III) and in marine herring species (Type IVa). The time of action is not known for Type IVb. The virus is more active in colder water (< 15 C) which is why mortalities are often seen in the spring. Fish exhibit hemorrhaging in the skin including large red patches, particularly on the sides and anterior portion of the head. However, infected fish will sometimes exhibit very minor external hemorrhaging (pin-point spots called petichia) or no external signs at all. Internally, all organs are often congested with multiple hemorrhages in the liver, spleen, and intestines. The swim bladders are also often extremely congested with hemorrhages, giving the otherwise transparent membrane a mottled appearance. The ultimate cause of death is usually internal organ failure, often the kidney, or the inability to osmoregulate which is the control and balance of chemical elements in the body versus the water. Sick fish will often appear

listless, swim in circles, or hang just below the surface based on staff observations made this past spring.

- *How is VHSv transmitted?* VHSv can be transmitted by urine, feces and sexual fluids. Reservoirs include clinically ill and carrier fish that do not show signs of the infection. The virus can be found on the surface of the salmonid eggs during spawning of infected female broodstock (sometimes at very high levels) and is capable of persisting for a sufficient time period to result in vertical (actually egg-associated) transmission between generations (adult to progeny). It is also likely to enter the body through the gills or through wounds, although oral transmission is unlikely. Experiments showed that blood sucking parasitic arthropods and leeches can transmit the infection physically.

- *Can fish or fish eggs be treated to reduce VHS transmission?* In the western United States, salmon eggs are routinely surface disinfected with iodophor (an iodine compound) at or after water hardening to eliminate vertical (parent to egg) VHSv transmission. The DNR has for a number of years been routinely using similar disinfection methods at all of our salmon and steelhead egg take stations. There are no treatments at this time to stop horizontal (fish to fish) transmission.

VHS – Great Lakes Information

- *Where has VHS been found within the Great Lakes basin?* As of this date, the VHSv has been confirmed from the Lake Huron (Cheboygan, Rogers City and Alpena), St. Clair River, Lake St. Clair, Lake Erie (all three basins), Niagara River, Lake Ontario (Bay of Quinte, Ontario and Rochester, NY area) and the St. Lawrence River.

- *Has VHS Isolate IVb caused mortalities in the Great Lakes?* In the eastern part of the Great Lakes Basin, a large scale mortality of freshwater drum occurred in 2005 in the Bay of Quinte, Lake Ontario in Ontario. In the spring of 2006, large fish mortalities were observed in Lake St. Clair (Great Lakes muskellunge and yellow perch), St. Clair River (gizzard shad), Detroit River (Great Lakes muskellunge and gizzard shad), Lake Erie (west basin -freshwater drum and white bass, and central basin-yellow perch), Lake Ontario (round goby) and St. Lawrence River (Great Lakes muskellunge). A Lake Huron - Thunder Bay (lake whitefish and walleye) fish kill in the fall of 2006 was likely related to VHSv.

- *When and how did VHS get here?* The earliest confirmed report is 2003 in a Great Lakes muskellunge from Lake St. Clair so it is likely to have been introduced here in 2002 or 2003. The virus was also confirmed from spring 2005 freshwater drum samples from Lake Ontario (Bay of Quinte) and from a lake whitefish from Lake Huron (Cheboygan) from a fall 2005 sample. At the time of the two Michigan collections, the samples were initially classified have an unknown rhabdovirus which had been subsequently confirmed as VHSv Type IVb, in 2006 for the Lake St. Clair and 2007 for the Lake Huron sample.

It is not known exactly how this virus arrived in the Great Lakes nor is it known how long the virus has been here. Ballast water discharge is considered as a likely vector given its distribution in the lakes and the likely origin of the virus, the Maritime Provinces of Canada.

- *Will VHS spread to the other Great Lakes and when?* While the exact timing is impossible to determine, it is highly likely that the virus will be found in Lake Michigan in the next 1-2 years. This is based on the large scale fish movements, particularly Chinook salmon, between lakes Michigan and Huron. If fish continue to be the key movement vector, the virus will likely take a long time to get established in Lake Superior as fish movement through the Soo Locks is limited.

  This situation could rapidly change if the key vector is ballast water exchange. Duluth Harbor in Western Lake Superior has the second highest ballast exchange rate in the Great Lakes and the Chicago area also has a very high ballast exchange rate. The virus could quickly be spread by this vector if the virus can remain alive for sufficient time to be transported by this method.

- *Which species are affected or infected by VHSv Type IVb in the Great Lakes?* VHSv has been confirmed in 16 coolwater and 3 coldwater species.

  To date VHSv has been implicated as a mortality factor in large fish kills in freshwater drum (lakes Ontario and Erie), Great Lakes muskies (Lake St. Clair), round gobies (Lake Ontario), gizzard shad (St. Clair River), white bass (Lake Erie) and yellow perch (lakes Erie and Lake St. Clair).

  VHSv has also been confirmed in smaller mortality events in lake whitefish (Lake Huron), walleye (Lake Huron), smallmouth bass (Lake St. Clair), black crappie (Lake St. Clair), and bluegill (Lake St. Clair).

  A number of other species in other collections have been identified as carrying VHSv: Chinook salmon (Lake Huron); rock bass (Lake St. Clair); silver redhorse (Lake St. Clair); northern pike (Lake St. Clair); shorthead redhorse (Lake St. Clair); burbot (Lake Ontario) silver redhorse (Lake St. Clair); spottail shiners (Lake St. Clair); and emerald shiners (Lake St. Clair, Lake Erie and the Niagara River). Mortalities have not been observed for any of these species.

- *What are the likely risks to Great Lakes fish populations?* Little is known about this particular isolate of the VHSv virus. The VHSv-European Types 1-3 isolates have caused large-scale mortalities in salmonid and turbot aquaculture facilities in Europe and mortalities have been documented in the Pacific Coast for herring species. Large mortalities from VHSv Type IVa have been documented in marine herring populations in and around Puget Sound, WA. Until the recent mortalities in the Great Lakes, the Type IVb isolate was not known to cause large disease

scale outbreaks on the East Coast of North America except for one potential and unconfirmed instance in mummichogs from New Brunswick.

It is very unclear what the risk is to our fish stocks from this pathogen as susceptibility and virulence studies have not been done on this isolate. It does clearly cause large scale mortalities in susceptible fish populations. The potential outcomes range from being a short term 1-time mortality factor to a pathogen that causes annual mortalities that will need to be factored into fisheries management plans. It also appears that there are a wide range of potential carriers for the pathogen which will need to be factored into fisheries management options.

- *What will be the pathogen management strategy in the Great Lakes?* Since this pathogen can clearly cause large scale mortalities of valuable adult fish and it has a wide range of potential carriers, it is critical to make every attempt to contain the pathogen and not allow a rapid spread of the disease to all Great Lakes and inland waters. It should be noted that once a pathogen gets into a wild fish community, it is impossible to effectively eliminate it and control is highly unlikely. All potential human caused movement vectors will be evaluated and steps taken to reduce the potential spread of this pathogen.

- *What additional information is needed on VHS Type IVb?* Basic information is lacking on the specificity and virulence of this pathogen. It is also unknown how long this virus can survive in the environment outside of a fish host, which has implications on ballast water as a vector and methods to disinfect boats and other equipment. This and other basic pathogen information will take time to develop and will greatly inform management decisions. Until that information is available, precautionary principles will be employed to attempt contain this pathogen to its current distribution. Great Lakes resource agencies are taking every opportunity to collect information on the current distribution of the pathogen.

  Additionally, VHSv is found in West Coast systems and management strategies used in those systems is being examined to determine which fish management and culture strategies are being employed in the Great Lakes region to prevent the spread of this pathogen.

- *What can anglers and boaters do to help stop the spread of this pathogen?* All of the recommended ways to prevent the movement of aquatic nuisance species (i.e. zebra mussels) will help prevent the spread of this pathogen. The use of a bleach solution (1 cup to 10 gallons) to disinfect and clean boats, bilges and gear is very effective in killing VHSv as is completely drying items in the sunlight for 4-6 hours. It is also critical not to move live fish between waterbodies, in particular baitfish, along with any water. These measures will help control the spread of this pathogen along with many other aquatic nuisance species.

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