

Viral Hemorrhagic Septicemia An Overview

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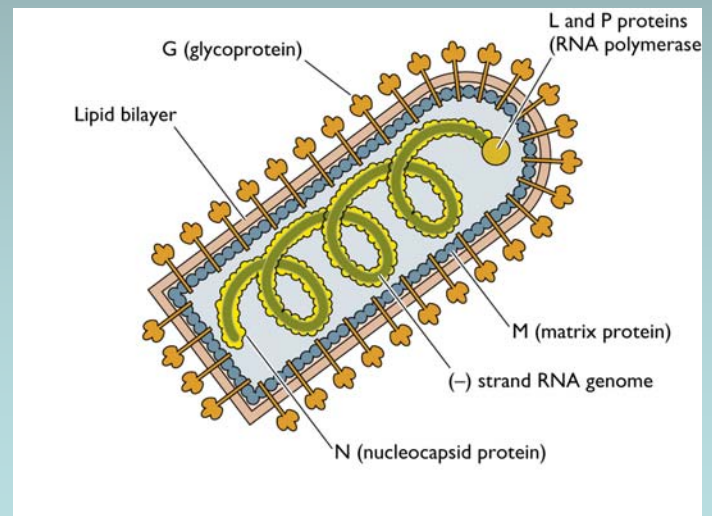
Viral Hemorrhagic Septicemia An Overview



Photo: USFWS

Viral Hemorrhagic Septicemia

- **What is it?**
 - The most serious fish disease world-wide
 - OIE reportable pathogen
 - Caused by a virus
 - No treatment
 - Rhabdovirus (RNA virus)
 - Broad host (fish) range



Diagnosis

- **OIE Reportable Disease**
 - **Standardized Protocols for Diagnosis**
 - **References**
 - OIE Manual
 - Blue Book (Fish Health Section/Amer. Fish. Soc.)
 - **2-Step Procedure**
 - Initial isolation in cell culture
 - Identification with RT-PCR
 - **Quantitative RT-PCR (qRT-PCR)**

History

- Known in Europe since the 1930's
- Most serious disease of fw reared rainbow trout
- Viral etiology proven in 1960's
- “Egdvjet Disease” in Denmark



History

- 1988-89
- Returning chinook and coho salmon found to harbor VHSV
- PANIC!
- Subsequent finding in marine fish species



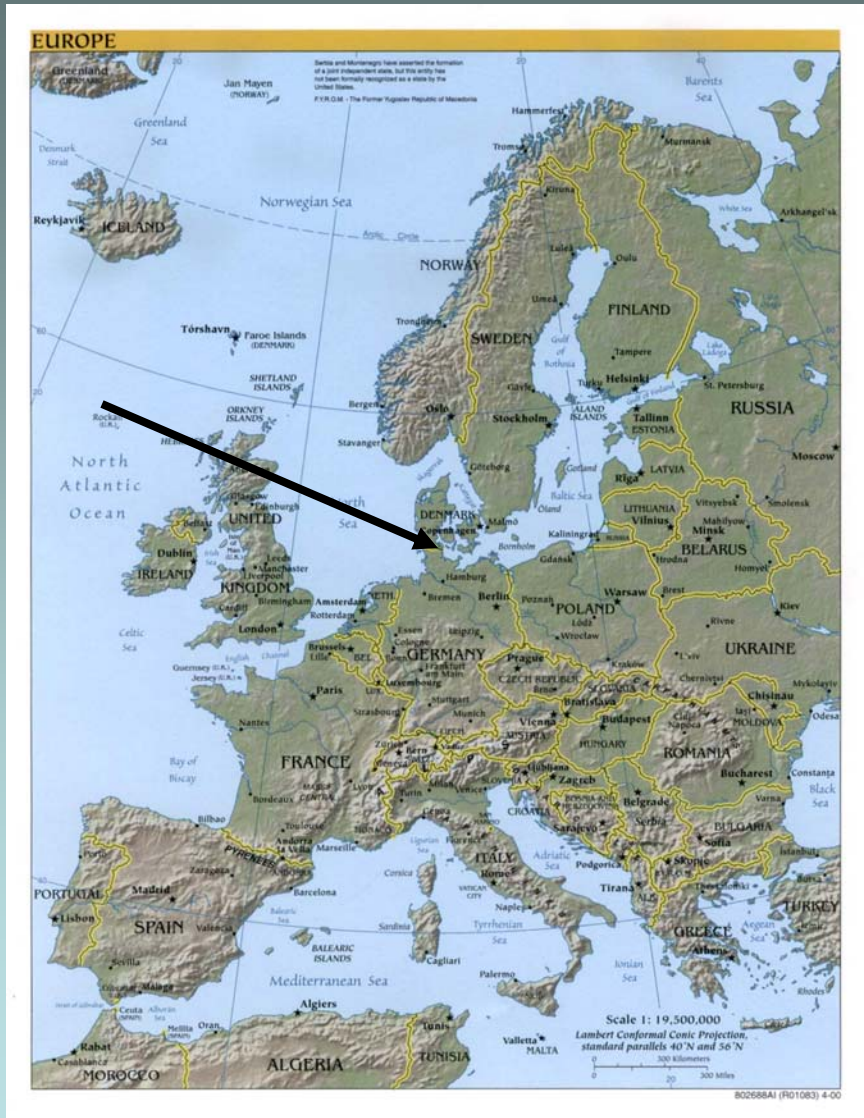
Columbia River goes to the Hagerman Valley of Idaho where 80% of commercially reared rainbow trout are located in the US.

www.mstp.washington.edu

History

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- Most serious disease of fw reared rainbow trout
- Viral etiology proven in 1960's

VHSV now thought to historically be a disease of marine fish
Entered the fw culture environment



VHSV Genotypes

- Genotype I
 - Europe
- Genotype II
 - Europe
- Genotype III
 - Europe
- Genotype IV
 - North America, Japan, Korea (marine fish) (IVa)
 - North America – Great Lakes (freshwater) (IVb) ←

Why is this Important?

**Economic
Value of Sport
Fishing in the
Great Lakes
Basin:
\$4.2 Billion/yr**



Aquatic Animal Health Program Cornell University

- **Diagnostics – fish kills**
- **Development of the qRT-PCR**
- **Surveillance**
- **Challenge Studies**
 - **Aquaculture species**
 - **Sport fish species**
- **Egg Disinfection**
- **Outreach**

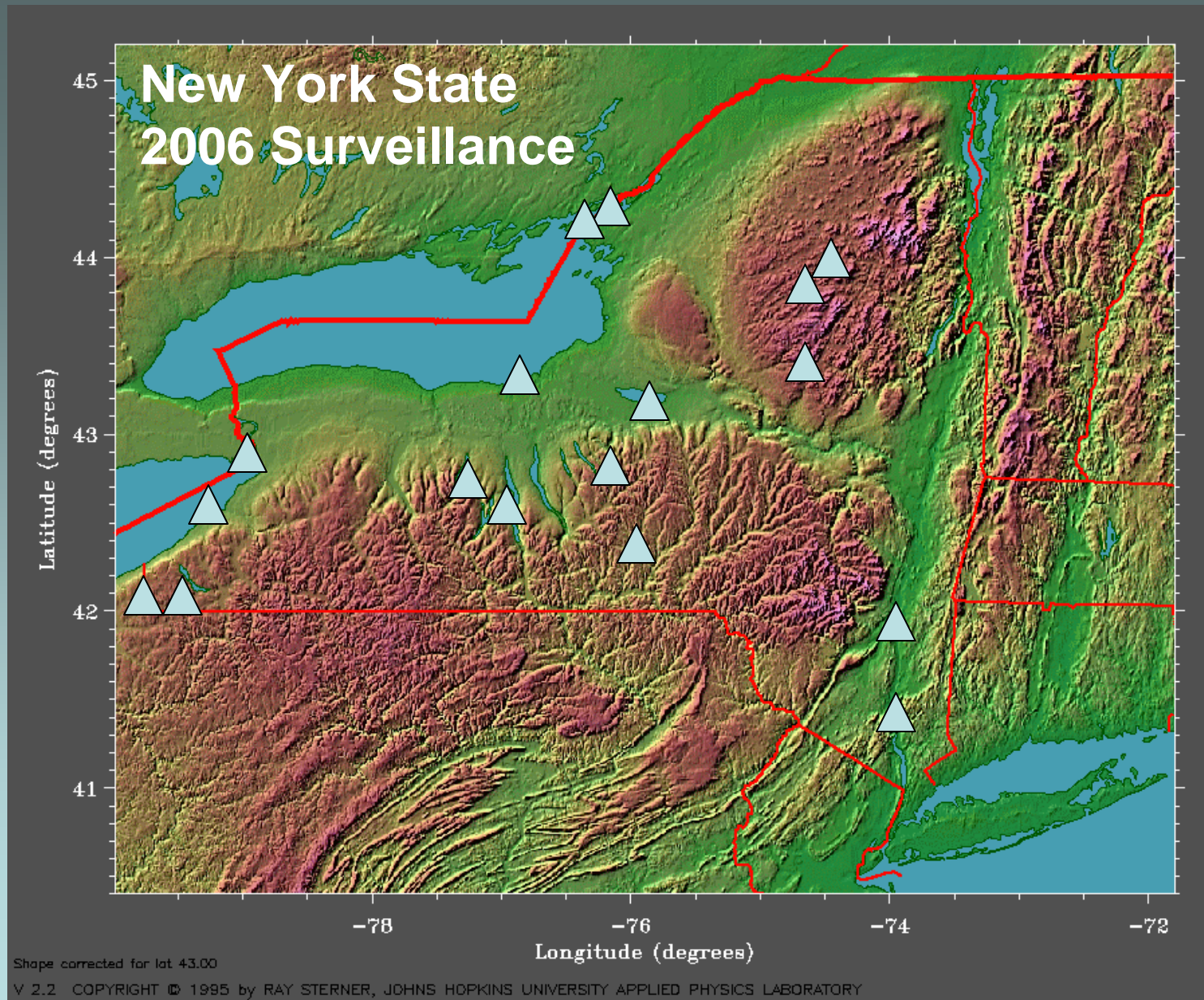
Diagnostics – Fish Kills

- **2006**
 - **Round Gobies, Muskellunge, Burbot, Smallmouth Bass, Walleye**

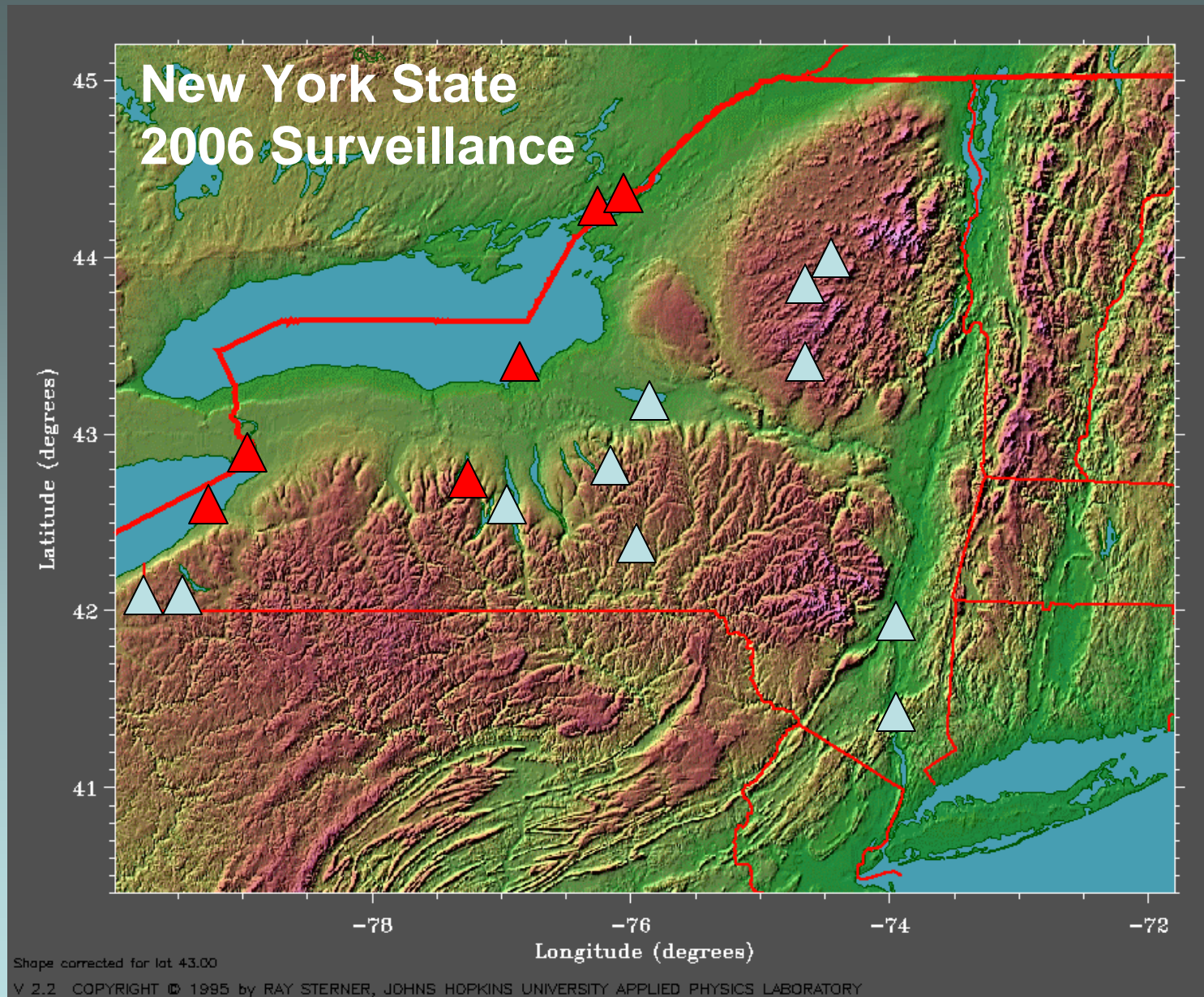
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From: <http://fermi.jhuapl.edu/states/maps1/ny.gif>



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Surveillance Samples – 2006

Cell Culture Positive

- **St. Lawrence River**

Bluegill

Rock Bass

Black Crappie

Pumpkinseed

Smallmouth Bass

Largemouth Bass

Northern Pike

White Perch

Brown Bullhead

Channel Catfish

Yellow Perch

Bluntnose Minnow

- **Lake Ontario**

Freshwater Drum

- **Niagara River**

Emerald Shiner

- **Lake Erie**

Emerald Shiner

Mortalities:

Round Gobies

Walleyes

Muskellunge

Burbot

Gizzard Shad

Smallmouth Bass

September 9, 2008

Species regulated by title 9 CFR Parts 83.1 through 83.7, 93.900 and 93.910 through 93.916 (the Viral Hemorrhagic Septicemia (VHS) Interim Rule)

The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Veterinary Services (VS) has identified the following species as having originated in freshwater locations in the United States and/or Canada, and as having been infected by VHS virus under natural (i.e. non-experimental) conditions of exposure; and from which VHS virus has been isolated by cell culture, with confirmation of strain identity through molecular detection. Anadromous fish species that have migrated into freshwater and from which VHS strain type IV(a) is isolated are excluded from this definition.

For regulatory purposes, presence of the viral pathogen and clinical expression of disease caused by the virus are considered synonymous.

Black crappie	<i>Pomoxis nigromaculatus</i>
Bluegill	<i>Lepomis macrochirus</i>
Bluntnose minnow	<i>Pimephales notatus</i>
Brown bullhead	<i>Amieurus nebulosus</i>
Brown trout	<i>Salmo trutta</i>
Burbot	<i>Lota lota</i>
Channel catfish	<i>Ictalurus punctatus</i>
Chinook salmon	<i>Oncorhynchus tshawytscha</i>
Emerald shiner	<i>Notropis atherinoides</i>
Freshwater drum	<i>Aplodinotus grunniens</i>
Gizzard shad	<i>Dorosoma cepedianum</i>
Lake whitefish	<i>Coregonus clupeaformis</i>
Largemouth bass	<i>Micropterus salmoides</i>
Muskellunge	<i>Esox masquinongy</i>
Shorthead redhorse	<i>Moxostoma macrolepidotum</i>
Northern Pike	<i>Esox lucius</i>
Pumpkinseed	<i>Lepomis gibbosus</i>
Rainbow trout	<i>Oncorhynchus mykiss</i>
Rock bass	<i>Ambloplites rupestris</i>
Round goby	<i>Neogobius melanostomus</i>
Silver redhorse	<i>Moxostoma anisurum</i>
Smallmouth bass	<i>Micropterus dolomieu</i>
Spottail shiner	<i>Notropis hudsonius</i>
Trout-Perch	<i>Percopsis omiscomaycus</i>
Walleye	<i>Sander vitreus</i>
White bass	<i>Morone chrysops</i>
White perch	<i>Morone americana</i>
Yellow perch	<i>Perca flavescens</i>

N = 28

The Current Federal List of Regulated Fish Species

VHSV

Cell Culture Isolation and Confirmation

Bluegill	Chinook Salmon	Redhorse Sucker
Rockbass	Brown Trout	White Sucker
Black Crappie	Rainbow Trout	
Pumpkinseed		Freshwater Drum
Smallmouth Bass	Channel Catfish	
Largemouth Bass	Brown Bullhead	Round Goby
Muskellunge	White Perch	Lake Whitefish
Northern Pike	White Bass	
		Gizzard Shad
Walleye	Emerald Shiner	
Yellow Perch	Bluntnose Minnow	Burbot
	Spottail Shiner	
Trout-Perch		N = 28 species
		(9 Sept 2008)

Diagnositics – Fish Kills

- **2006**
 - Round Gobies, Muskellunge, Burbot, Smallmouth Bass, Walleye
- **2007**
 - Smallmouth Bass, Rockbass, Bluegill, Rainbow Trout, Gizzard Shad, Common Carp*
- **2008**
 - Quiet (?)
- **2009**
 - Quiet (?)

2005-2007 Mortality Events



2008 Mortality Events



2009 Mortality Events



Did VHSV “go away?”



Surveillance 2008

- **Locations:**
 - Lake Ontario
 - Lake Erie
 - Lake Huron
- **10 sites each (commercial harbor, recreational harbor, undeveloped)**
- **Goal: 30 predator and 30 prey species per site**
- **Water sample (10L) from each site**
- **Approx. 1400 fish; processed individually**
- **qRT-PCR..... then qRT-PCR+ samples to cell culture**

Surveillance 2008

- **VHSV IVb detected in fish from 23 of 30 sites**
- **VHSV IVb detected in water from 8 sites**
- **No relationship to type of site**
 - **Commercial, Recreational, Undeveloped**
- **Overall prevalence: approx. 5%**
- **Isolated in cell culture from 4 of approx. 1400 fish (USGS, Seattle)**

Surveillance 2009

- **Lake Superior (approx. 950 fish, 7 sites)**
- **Lake Ontario (approx. 2000 fish, 10 sites)**

Surveillance 2009

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Preliminary Results:

- **qRT-PCR: Lake Ontario complete**
- **Six Lake Ontario sites: 21 - 53% prevalence**
- **Highest level: $>10^7$ genome copies**
- **Most positives were very low (10^0 to 10^1)**
- **Lake Superior: pending**

**VHSV is Still
in the
Great Lakes**

What can we do now?

- **Understand the pathogen**
 - Host fish range
 - Variability in ability to infect and cause disease by species
 - Vertical transmission
- **Surveillance**
 - Where it is
- **Prevention**
 - Effective means of control

Funding

- **New York Sea Grant (2)**
- **USDA Critical Issues (CSREES; now NIFA)**
- **USDA APHIS – surveillance (2)**
- **GLPF (w/ USGS WFRC and others)**
- **GLFT (w/USGS WFRC and Mich. St. Univ.)**
- **NRAC UDSA, NIFA (w/ NY, PA and Lake Champlain Sea Grant)**
- **USDA Hatch Funds (CU Agric. Expt. Station)**

People

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QUESTIONS



Dunkirk Harbor, NY – Lake Erie

Photo: A. Noyes, NYS DEC