



## U. S. Geological Survey's Western Fisheries Research Center (WFRC)



*A healthy juvenile trout.*

### Infectious hematopoietic necrosis virus (IHNV)

- IHNV is a significant viral pathogen that causes disease and death in Pacific salmon and trout in the Pacific Northwest.
- When IHNV infects hatchery fish juveniles experience high mortality and managers may decide to destroy them all to prevent spread of the virus.
- WFRC's IHNV surveillance program offers genetic typing and epidemiological analysis of samples sent in by state, federal, and tribal partner agencies.
- There are three related but distinct genetic groups of virus. The groups are called U, M, and L, and they vary in geographic and host ranges.
- By analyzing the virus genetic type and the case details of a given virus outbreak, the IHNV technical assistance program provides partner agencies scientifically rigorous information on the possible sources of transmission and the risks of virus spread.

### Using Molecular Techniques to Track a Deadly Virus in Pacific Salmon

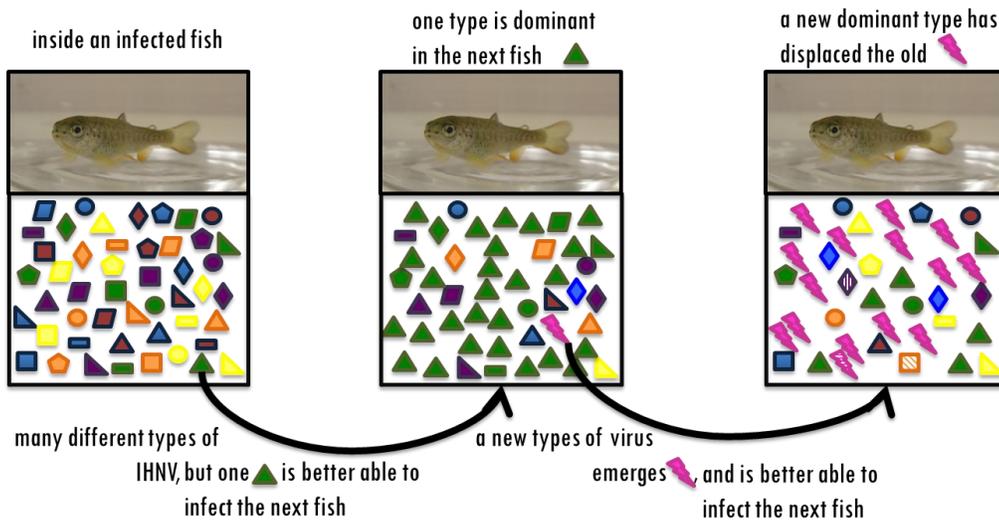
#### IHNV Types: Patterns of emergence and displacement

Recent genetic analysis provides clues that may help predict the rise of new strains of IHNV to dominance in local populations of steelhead trout. IHNV is an important fish virus that adapted to trout in the late 1970s, giving rise to the M group of IHNV, which has been detected in the Columbia River Basin for more than 30 years. Over time different strains of IHNV have dominated in the population, waxing and waning in prevalence due to ecological or evolutionary changes. During the last 30 years there have been three cycles of emergence and displacement of M group IHNV subtypes in the lower Columbia River Basin.

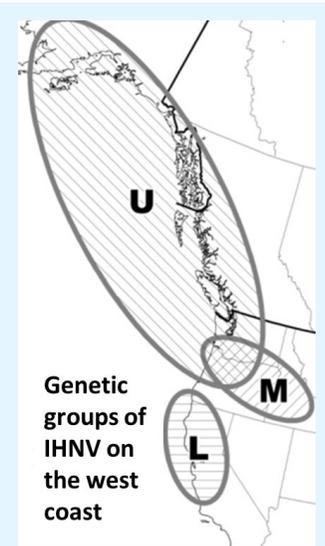
WFRC operates an IHNV technical assistance program to provide hatcheries and fish health agencies with rigorous information on the possible sources of IHNV transmission and risks of spread during outbreaks. All the virus types identified in the serial patterns of emergence/displacement have been associated with significant disease and death of young steelhead trout. All these types also traveled many miles after becoming dominant, and caused more widespread mortality in new populations of steelhead trout. These patterns have been detected due to the long term IHNV genetic and epidemiological surveillance program at WFRC. Keeping track of this ever-changing virus provides an unprecedented possibility of forecasting the next dominant strain of IHNV.



*WFRC conducting a field study with staff from U.S. Fish and Wildlife Service and the Northwest Indian Fisheries Commission.*



*Serial emergence and displacement of virus types, a process that can go on indefinitely.*



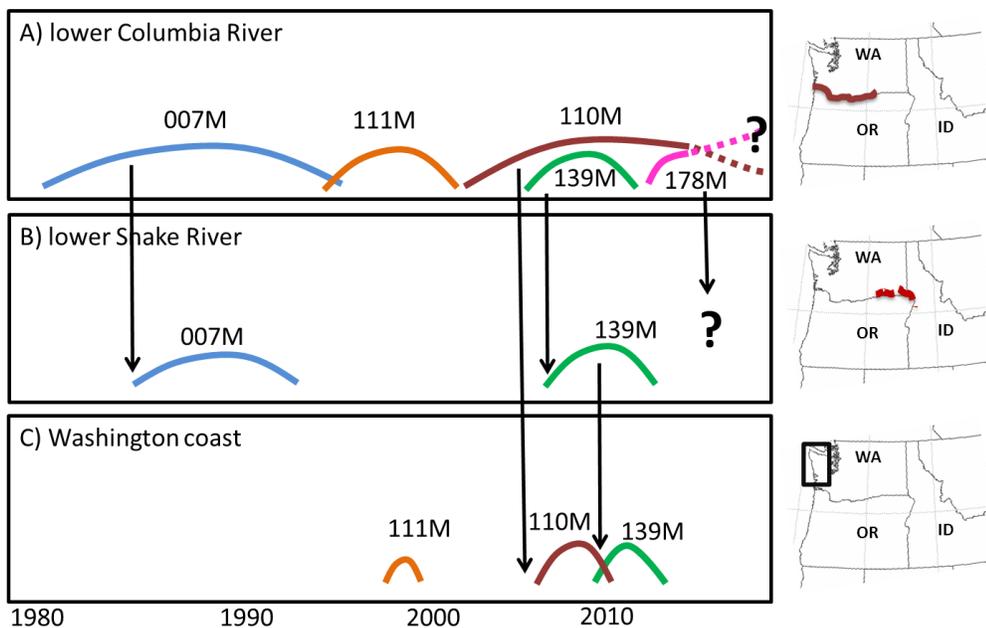
## IHN Types

Epidemiological and phylogenetic analysis conducted by WFRC's IHN surveillance program has shown that there are three related but distinct genetic groups of virus. These groups are called U, M and L because they generally occur in the upper, middle and lower portions of the geographic range of the virus on the Pacific coast. Within each group exist multiple sub-groups, the relative dominance of which changes over time. Predicting which subtype will next achieve dominance may help managers reduce the impacts of disease outbreaks over time.

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## Historical IHN Disease Dynamics

To date WFRC has tracked three cycles of emergence and displacement among the trout-adapted M group of IHN in the lower Columbia region. The first was sequence type 007 M, which dominated from the time it emerged in 1980 until 1994. In 1994 007 M was displaced by 111 M which dominated until 1999. Type 110 M emerged in 2002 and has dominated since then. Also since 2002 two new types have emerged and persisted without overturning 110 M's dominance. One of these types, 139 M, eventually traveled to the Washington coast and the lower Snake River where it became dominant. The second new type, 178 M, stayed within the local lower Columbia for years, but in 2012 was detected elsewhere. The patterns of emergence, persistence and recent spread of type 178M suggest that it has potential to become the new dominant strain in the Lower Columbia River Basin. If so, it will be detected by ongoing genetic surveillance.



*The M group of IHN has had at least three cycles of emergence and displacement in the lower Columbia. Each dominant type has killed fish in the lower Columbia (A) AND traveled to other regions and killed fish in those other areas (B and C). Time in years is indicated across the bottom, and the dominant type of IHN is indicated above the curved lines and in each panel. Black arrows indicate probable transmissions of each type from one region to another.*