ITEM 9b
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WASHINGTON STATE
DEPARTMENT OF FISH AND WILDLIFE

INFECTIOUS HEMATOPOIETIC NECROSIS VIRUS
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Infectious Hematopoietic Necrosis virus (IHNv) is a rhabdovirus that causes significant disease and associated economic loss in Pacific salmon (*Oncorhynchus spp*.), rainbow trout (*O. mykiss*) and Atlantic salmon (*Salmo salar*). This class of viruses is highly mutagenic and there are several dozen different known genetic strains. The virus is endemic from northern California, throughout the Pacific Northwest to eastern Russia (Kamchatka Peninsula) and Japan. In Washington State IHNv has been isolated from all species of Pacific salmon and steelhead.

The first reported observation of IHNv was from cultured sockeye salmon (Rucker et al, 1953) and IHNv was first isolated in cell culture by Wingfield (1963). The disease was named Infectious Hematopoietic Necrosis virus by Amend (1969) because it causes necrosis of the hematopoietic (blood forming) tissues. The pathogen is transmitted horizontally (fish to fish) and vertically (parent to progeny).

There is no vaccine approved for use in the United States. Once a salmonid contracts IHNv there is no cure but there can be survivors of an epidemic.

WDFW's fish health policy is an avoidance based policy that relies on a strong surveillance of hatchery broodstocks. WDFW first began sampling hatchery broodstocks for viral pathogens in the late 1970's. Currently we sample approximately 30,000 juvenile and adult salmonids annually for viral pathogens including IHNv. Every WDFW hatchery broodstock is tested annually for the presence of regulated finfish pathogens including IHNv.

For situations where not all of the broodstock is IHNv positive we routinely practice either isolation, segregation, or quarantine. Eggs from positive testing parents are incubated in isolation from those of negative testing parents. Eggs from parents that test positive and from those that test negative and are spawned on the same day can be segregated. These strategies minimize risk of horizontal transmission. Quarantine can be used in situations where eggs from a positive broodstock are shipped to another watershed with a negative history of the virus and the effluent is treated prior to discharge.

Epidemics in juvenile salmonids are initially diagnosed by clinical symptoms and confirmed through the use of cell culture assays and then serologically. Detection in adult salmonids is accomplished by sampling ovarian fluids and tissues (kidney/spleen) and the samples are placed on standard cell culture.

There are three known genetic strains, called clades, of IHNv. The clades are the "U", "M" and "L" clades and refer to the geographic area of the northeast Pacific Ocean where they are

located. Each clade is somewhat host specific but can cross over into other species. The "M" clade is somewhat host specific to steelhead and rainbow trout (*O. mykiss*) while the "U" clade is isolated primarily from sockeye and the "L" clade from chinook.

The first known isolations of the "M" clade were from rainbow trout reared in the Hagerman Valley (Idaho) in 1972. Some researchers believe that this strain of IHNv made its' way downstream and in to the Columbia River from these 1970 detections. The first known isolation of the "M" clade in Washington State was from juvenile steelhead at the Cowlitz and Skamania hatcheries in 1981. However, not all of the viral isolates WDFW has submitted have been genetically typed so it is possible there are older isolates.

In 1997 there was an epidemic in juvenile steelhead at the Quinault Nation's Salmon River rearing facility. IHNv was determined to be the cause of the mortality and the fish were euthanized. The isolate was genotyped and it was determined to be "M" clade. This represents the first known isolate from a steelhead on the Washington Coast.

During routine sampling of returning adult steelhead to WDFW hatchery facilities in the Chehalis River basin in 2007/08 IHNv was isolated from adult at the Bingham Creek, Lake Aberdeen, and Humptulips hatcheries. Juvenile steelhead at these three same facilities experienced epidemics in 2008. IHNv was also isolated from juvenile steelhead at the Quinault Nation's Salmon River Rearing Pond and immature rainbow trout at the Satsop Springs Coop rearing ponds. Since those early isolations we had additional detections of IHNv in returning adult steelhead, both culture and naturally produced, in the Quinault (2008, '2009, '2010, '2011), Hoh (2010), Queets (1997, 2007, 2010), Bogachiel (2009, 2010), and SolDuc river systems (2010).

IHNv can cause severe mortality in juvenile steelhead and in some cases loss can approach 99%. The level of mortality is dependent on several factors including age of the fish and pathogenicity of the virus strain.

WDFW employs several strategies to prevent IHNv epidemics. The virus particle appears to be associated with the eggs' surface so all salmonid eggs are required to be treated with an iodophor disinfectant at the time of spawning. This is successful in killing the virus in most cases. However, there have been isolated instances where despite this treatment juvenile salmonids have contracted IHNv even though they were on a water supply free of finfish pathogens. While the exact mechanism of transmission is not fully understood we believe that in these rare instances the virus particle somehow penetrates the egg, most likely through the eggs' micropile, during fertilization.

Strict adherence to hatchery bio-security protocols is also effective. This involves the use of disinfection barrels for equipment, movement of staff from "clean" areas of the hatchery to "areas of concern" or those with higher risk, separate equipment for each rearing vessel, and staff raingear and waders left at hatcheries where IHNv is known to be present.

Using well or spring water that is free of anadromous or resident fish to rear steelhead during susceptible time periods is also a successful strategy. This strategy was implemented at Bingham Creek Hatchery after the 2008 epidemic and we have not experienced a repeat epidemic since that time.

The IHNv that the Co-Managers began isolating from adult steelhead and salmon in river basins on the Washington coast side of the Olympic Peninsula in 2007 was primarily from hatchery origin adult steelhead. This can be attributed to a sampling bias where we access and screen for regulated pathogens all of our hatchery broodstocks. However, in 2010 IHNv was isolated from one immature naturally produced adult winter steelhead from the Hoh River. While we have seen the pathogen in these wild stocks we have never seen disease. The implications of IHNv to the naturally produced stocks of steelhead in these river basins is not understood.

IHNv was also isolated from adult winter steelhead held at the Snider Creek Coop Project. Eighteen (18) steelhead from that population were sampled and they were a mixture of naturally and hatchery produced steelhead. Because the fish were held together it is likely that horizontal (fish to fish) transmission occurred. All of the fish from that population tested positive for IHNv and it is not possible to determine the origin of the pathogen.