

# Infectious Hematopoietic Necrosis Virus (IHNV)

## *I. Causative Agent and Disease*

Infectious hematopoietic necrosis virus (IHNV) is a bullet-shaped novirhabdovirus that is enzootic to the North American Pacific Northwest but was inadvertently established in the US Snake River Valley in Idaho and in several countries of Asia and Europe. The three genetic clades of IHNV (U,M,L) can infect several salmonid species and have had severe economic impacts on intensively cultured salmon and trout. IHNV in Alaska (U clade) has been limited primarily to sockeye salmon and rarely Chinook and chum salmon when infected sockeye are present in their water supplies. Culture of sockeye salmon in Alaska by avoidance of IHNV has been successful through the rigorous use of the ADF&G sockeye salmon culture policy. The disease, infectious hematopoietic necrosis (IHN), is an acute, systemic infection causing necrosis of the kidney tissues and other visceral organs resulting in extensive mortality in hatchery reared sockeye salmon juveniles as well as in wild stocks of out-migrating sockeye salmon smolts.

## *II. Host Species*

Fish species susceptible to infection and disease by IHNV include: sockeye, Chinook, chum, amago, yamame and Atlantic salmon; cutthroat trout and rainbow/steelhead trout. Brook and brown trout are experimentally susceptible to infection and mortality while lake trout are intermediate in susceptibility. Arctic char and grayling are resistant while coho salmon are also resistant but can carry the virus when in the presence of other susceptible virus-infected fish species. Mortality is highest in young fish and resistance to infection and disease increases with age.

## *III. Clinical Signs*

Infected fish may exhibit: lethargy, whirling behavior, cranial swelling, abdominal swelling, exophthalmia, anemia and darkened body coloration; hemorrhaging of musculature and base of fins; fecal casts; pre-emergence in sac-fry; pale liver, spleen and kidney; stomach/intestine filled with milky or watery fluid with petechial hemorrhaging of mesenteries or visceral tissues. Gills are pale, moderately hyperplastic and blood smears often contain necrobiotic bodies.

## *IV. Transmission*

Horizontal transmission through water via feces or sex products or carcass degradation is the most common route of infection. Virus occurs commonly in ovarian fluids and on the surface of eggs. Rarely, vertical transmission can occur within eggs (internal) and possibly with adhesion of virus particles to sperm during fertilization. Incubation and course of the disease can be strongly influenced by water temperature as reported in the Lower 48. Optimum temperature is 10-12°C but IHN losses have been reported above 15°C. Mortalities occur within 4-6 days post-exposure peaking at 8-14 days. In Alaska, the disease can cause up to 100% mortality in sockeye salmon at water temperatures as low as 1-2°C where exponential mortality may take longer to occur. No natural reservoirs of IHNV have been confirmed other than those susceptible fish species that are carriers of the virus. However, transient detections of IHNV have been reported in organic sediments, invertebrates, and some forage species of marine fish when associated with ongoing or recent IHNV epizootics in susceptible salmonid species.

**V. Diagnosis**

Susceptible fish cell cultures are inoculated with kidney and spleen tissues (whole fry if small) or ovarian fluids from fish suspected of having IHNV. Presumptive diagnosis results from diffuse or plaqued lysis of inoculated cell monolayers (cytopathic effect). Virus is definitively identified by PCR.

**VI. Prognosis for Host**

Prognosis for infected fish is poor. Survivors of epizootics and subclinical infections become lifelong carriers of the virus. There is no known therapy for fish that have been infected with IHNV.

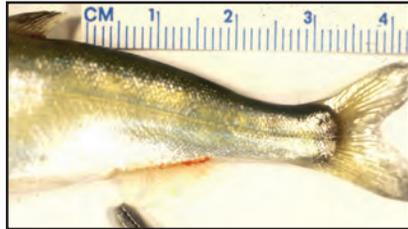
In Alaskan hatcheries, all infected lots of fish are destroyed. The occurrence of the disease is avoided through preventative measures including a virus-free water supply, rigorous disinfection, isolation of egg and fish lots and containment of diseased fish. There is an effective DNA vaccine used in Canada that is also licensed in the US but has been restricted commercially due to unlikely safety concerns regarding GMO products.

**VII. Human Health Significance**

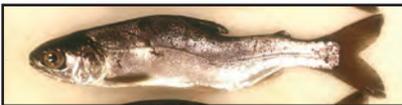
There are no human health concerns associated with IHN virus.



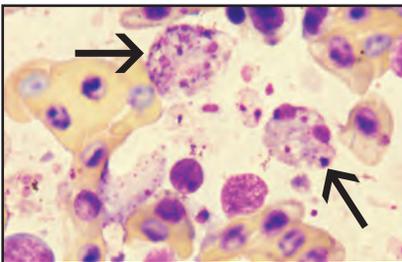
Exaggerated (top, middle) cephalic bumps on sockeye salmon fry commonly occur with IHN disease.



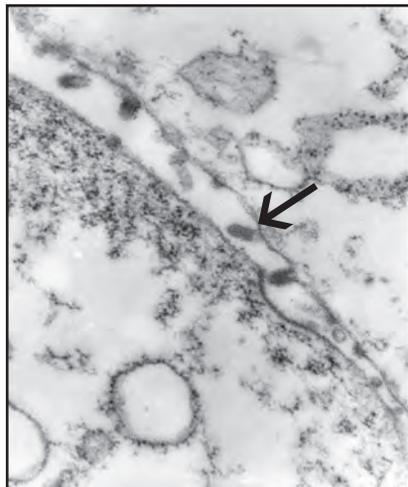
Hemorrhaging at the base of the fins is sometimes observed in IHN disease.



Scoliosis in sockeye salmon smolt surviving IHN.



Necrotic macrophages or kidney cells (necrobiotic bodies-arrows) with debris in peripheral blood, X 1000.



IHN virus particles (arrow) budding from cell membrane of an EPC cultured fish cell; TEM, X 34,000.