Salmon and Trout Diseases

By Stephen G. Newman

It is only in relatively recent times that coldwater fish, in particular salmon and trout, have been intensively reared, and the science of aquaculture came into existence. Along with the birth of this new area of agriculture came profit-limiting diseases. As with all other animals, these diseases are caused by various viruses, bacteria, protozoa and other parasites. The more important of these diseases are the subject of this section.

Viruses are extremely small infective agents capable of growth and multiplication only in living cells. Several of the viruses produce disease in epidemic proportions in hatchery-reared fish. They significantly impact commercial production and Government mitigation efforts.

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Infectious Pancreatic Necrosis (IPN) is an acute, highly contagious disease, affecting primarily juvenile salmonids. Fish less than two inches long usually are the most susceptible. The disease has been reported in most species of trout, Atlantic and coho salmon, and several species of char. It has been reported in most trout-producing areas of the United States as well as Canada, Europe, and Japan.

Typically, affected fish whirl, become dark in color, and have bulging eyes, swollen abdomens, and hemorrhaging. Losses may occur at all water temperatures normally encountered in rearing trout.

IPN is transmitted from fish to fish by contaminated feces, urine, and ovarian or seminal fluid. There is no way to treat the disease once it occurs. IPN can be controlled by improving husbandry tech-

niques—including disinfecting eggs, eliminating carrier females, destroying infected animals, and possibly selective breeding.

Sockeye Disease

Infectious Hematopoietic Necrosis (IHN) is also an acute, highly contagious disease affecting primarily juvenile (less than two inches long) salmonids. Known variously as Oregon Sockeye Disease, Sacramento River Chinook Disease, Columbia River Sockeye Disease and Leavenworth Sockeye Disease, IHN is a disease of Pacific salmon affecting chinook, and sockeye salmon in addition to rainbow trout.

IHN has been reported throughout the United States, Canada and Japan. It causes massive destruction of the blood-forming organs. Affected fish hemorrhage under the skin and at the base of the fins. They have protruding eyes, swollen abdomens, and darkening of skin. Unlike IPN, IHN outbreaks occur mostly at 45 to 55° F (8 to 13° C) with some evidence that the incidence may be reduced at temperatures above 58° F (15° C).

IHN is transmitted from fish to fish by contaminated feces, urine, and ovarian or seminal fluid. As with IPN, survivors become carriers.

IHN cannot be controlled once the disease occurs. Control is best by avoidance. Disinfecting eggs, separating brood fish from fry, disinfecting contaminated facilities, destroying infected animals—all are possible means of control.

Several other viral diseases—including Viral Hemorrhagic Septicemia (VHS), Viral Erythrocytic Necrosis (VEN), and *Herpesvirus salmonis* (HS)—also may significantly impact coldwater fish. VHS is a severe problem in Europe but has never been found in the United States, Canada or the Far East. Both VEN and HS, though responsible for severe disease, are of minor impact compared to IHN and IPN.

Bacteria are microscopic organisms living in soil, water, organic matter, plants or animals responsible for a wide variety of essential functions. They also are responsible for a wide range of diseases in all living creatures. Fish are no exception. In most cases, stress plays a role in predisposing fish to these bacterial diseases. Five of the most severe bacterial pathogens affecting coldwater fish in the United States are briefly discussed.

Vibriosis

Vibriosis is a severe disease caused by strains of *Vibrio anguillarum* and *Vibrio ordalii* affecting net pen reared salmon. All species of salmon reared in salt water are subject to infection. Vibriosis is worldwide, reported in the Americas, Europe, and the Far East. Large bloody lesions appear in skin and musculature. Hemorrhaged gills, eyes and fins also may occur.

Losses can occur at a wide range of temperatures, though the greatest generally take place at temperatures over 50° F (10° C). The disease is spread through the water column by infected fish or sediments, or by ingestion of infected materials.

Vibriosis can be prevented by immunization with commercially available bacterins (a type of vaccine). Bacterins have substantially reduced impact of this once devastating disease. The disease, when it does occur, usually responds to antibiotic treatment, although antibiotic resistance and failure of ill fish to eat are problems.

Furunculosis is another acute bacterial disease of cultured salmonid populations. Most species of salmonids and many species of non-salmonids reared in fresh, brackish and salt water are susceptible.

Furunculosis has been reported in most areas where fish are reared. As with other bacterial infections, symptoms vary somewhat with the fish's age and the severity of the disease. Chronically infected fish often display characteristic furuncles—dark, raised fluid-filled bumps—which ulcerate. Other signs include darkening, and loss of appetite.

The disease occurs at a wide range of temperatures and is transmitted through the water by diseased and carrier fish. Preventing contamination by carrier fish, and conscientious husbandry techniques, will help prevent spread of the disease. Sick animals may respond to treatment with antibiotics.

Rainbow Trout

Enteric Redmouth Disease (ERM) is a severe disease of commercially reared rainbow trout. The disease occurs largely in rainbow trout and has been reported throughout the United States and recently in Europe. Symptoms are like those in other bacterial diseases with a notable lack of lesions and a characteristic hemorrhage around the mouth and along the lateral line.

G. Camenisch

White spots in the kidney of a rainbow trout may be a sign of infection by Bacterial Kidney Disease (BKD).

ERM occurs primarily at temperatures above 50° F (10° C) and is transmitted through the water by diseased and carrier fish. The disease can be prevented by immunization and controlled by improved management. Treatment with sulfonamides and tetracycline has been found effective.

Bacterial Kidney Disease (BKD) is a systemic bacterial disease of salmonids. Its total impact on aquaculture is uncertain. BKD has been diagnosed in a wide variety of salmonids and has been reported in the United States, Canada and Europe. External signs are similar to those reported accompanying other systemic bacterial diseases: enlarged abdomens, bulging eyes, small cutaneous ulcers, and reddened fin bases.

The disease appears to be transmitted by infected fish and through the eggs. Susceptibility to BKD is controversial with evidence that water hardness, blood mineral and vitamin levels, and genetic makeup all affect susceptibility. Treatment is by oral application of antibiotics. Injection of erythromycin has been used to reduce BKD. Improved management practices help.

Other bacterial diseases also significantly affect the rearing of salmonids. They include columnaris disease due to strains of *Flexibacter columnaris*, bacterial hemor-

rhagic septicemia due to strains of *Aeromonas hydrophila*, and bacterial gill disease due to miscellaneous strains of myxobacteria.

Protozoa Problems

Protozoa are relatively large single-celled organisms that may proliferate externally or internally and occasionally are responsible for massive losses of intensively reared salmonids. Though many hundreds of different protozoa species may use fish or shellfish as hosts, three of the major protozoal diseases are discussed.

Ichthyophthirius multifiliis is the causative agent of white-spot disease or Ich, in freshwater fish. It affects all freshwater species and occurs worldwide. The disease rarely is a serious problem in coldwater fish, since it requires warmer water temperatures, greater than 65° F (18° C) to proliferate.

Ich appears as 0.5 to 1 millimeter white cottony spots covering the external surface of the fish and the gills. Each spot is one organism, that when mature escapes into the water where it attaches to a substrate and divides to produce up to 2,000 tomites which reinfect fish. Thus the disease is water-transmitted.

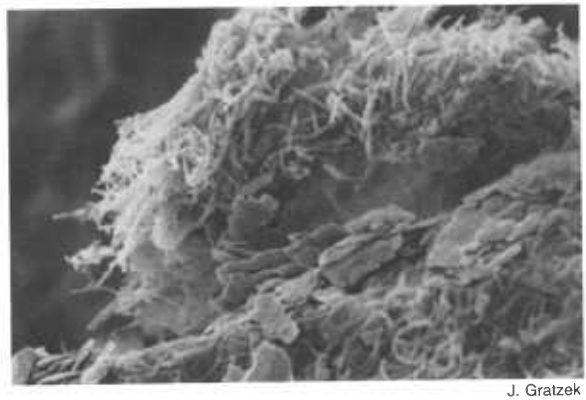
Treatment is by immersing infected fish in formalin, malachite green oxalate, or copper sulfate solutions. Elevated temperature also can be used. Treatments must be repeated for 3 to 10 days.

Ceratomyxa shasta is a protozoal parasite affecting juvenile salmonids. The agent of ceratomyxosis, it is widely distributed in juvenile salmonids in the Columbia River basin and commercially reared trout in the western United States. It is not found outside the western United States.

Signs include abdominal distention due to fluid and nodules in the gut, muscle and other organs, protrusion of the eyeballs, and hemorrhaging. Mortality is massive, with no treatment available. Irradiating spore-contaminated water supplies may help control the disease.

Whirling Disease

Whirling disease caused by *Myxosoma cerebralis* is perhaps the most important protozoan parasite of coldwater fish. Virtually all species of salmon, trout and grayling are susceptible, with severity of the disease depending on age and degree of exposure. Whirling disease is worldwide in distribution and has significantly affected rainbow trout



The small rod-like bacteria, Flexibacter columnaris, *as seen by the scanning electron microscope, cover the surface of a gill cell.*

J. Gratzek

culture in Europe and America.

Infected fish swim in a characteristic whirling manner. Since the organism invades the cartilage, it may also cause spine deformities. Mortality can be extensive, with survivors unmarketable. Carriers not showing disease signs may continue to contaminate the fish farm.

There is no treatment for this disease. Diseased animals should be destroyed. Nothing short of drying up the pond, removing the mud, or rearing animals in concrete troughs or raceways will control the disease.

The final group of organisms that significantly affect coldwater fish are the large parasites. These consist mainly of worms of various types (nematodes, cestodes, trematodes, etc.). They are globally distributed and difficult to control since no effective chemotherapy exists. Some tropical parasites are potentially parasitic to man; therefore, stringent quality control measures are required. The impact of large parasites on wild and cultured animals may be significant.

As is apparent, coldwater fish are susceptible to a host of viral, bacterial, protozoal and parasitic diseases. These significantly affect commercial rearing of coldwater fish. Most do not readily respond to chemotherapeutics. Improved management techniques—including lower densities, disinfecting eggs, rapid removal of moribund or dead animals, eliminating stress due to handling—are all desirable though not necessarily feasible methods of potentially minimizing effects of these diseases.