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BACTERIAL GILL DISEASE

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Bacterial gill disease (BGD) is a common external infection of hatchery-reared salmonids and occasionally of warm water species reared under intensive conditions. As defined by Wood (1974), the name of the disease describes the clinical signs of bacterial infections on the gills. The etiological agent of the disease is considered to be one or more species of filamentous bacteria including *Flavobacterium* sp. as most recently described by Wakabayashi et al. (1980). BGD is characterized by the presence of large numbers of filamentous bacteria on the gills accompanied by fusing and clubbing of the gill filaments. Acute or chronic forms of the disease may occur and acute outbreaks may involve daily mortality rates approaching 20% (Warren 1981). The onset of bacterial gill disease usually follows a deterioration of environmental conditions associated with overcrowding and increases in toxic metabolic waste products. According to Wood (1979), fish smaller than 90-100/lb are most susceptible to the disease. Successful treatment can only be accomplished through prompt therapy and alleviation of poor environmental conditions.

SIGNS OF INFECTION

Affected fish are usually lethargic and a loss of appetite occurs. Large numbers of diseased fish gather near the screen or outlet of the pond. Acute epizootics may result in a 20 to 50% mortality in 24 h (Warren 1981; McDaniel 1979). Microscopic examinations of wet mounts of the gills usually reveal extensive clubbing of the gill filaments, lamellar fusion, excess mucus, and detritus. Large numbers of filamentous bacteria adhering closely to the gills are evident but necrosis of the gill tissue is seldom present. This is in sharp contrast to

columnaris disease on the gills which may cause extensive necrosis and erosion of gill filaments.

DIAGNOSIS

Diagnosis of bacterial gill disease depends on the detection of large numbers of filamentous bacteria on the gills. Along with the clinical signs described above, this observation represents diagnostic evidence of the disease (Snieszko 1981). In the absence of large numbers of bacteria under gill wet mount examination, gills with signs of clubbing, filament fusion, etc., should be homogenized on a slide, streaked, stained with methylene blue, and examined under oil immersion. This technique will frequently reveal the presence of the filamentous organisms that might not have been observable in a wet mount. Isolation of a pure culture of the bacteria is not necessary for diagnostic purposes (Snieszko 1981).

EPIZOOTIOLOGY

GEOGRAPHIC AND HOST RANGES

Snieszko (1981) reported that bacterial gill disease is probably cosmopolitan in its distribution and that nearly all species of intensively cultured freshwater fish are potential hosts. All species of cultured salmonids are susceptible, as are such coolwater species as fingerling walleyes and tiger muskies (northern x muskellunge hybrids).

SOURCES AND RESERVOIRS OF INFECTION

Little is known about the biology and survival of the etiological organism. Carrier fish or contaminated water are considered to be sources of infection.

MODE OF TRANSMISSION

Carrier fish in the rearing units or a contaminated water source probably introduce the disease. However, epizootics are almost always associated with a deterioration of environmental conditions. Wood (1974) reported that bacterial gill disease in chinook salmon appears to be associated with pond loadings in excess of 5-6 lb of fish per gpm of inflow but he was unable to correlate outbreaks in fall chinooks to levels of unionized ammonia. This is contrary to information reported by Follet and Grischkowsky (1981) and Burrows (1964) who found that unionized ammonia was clearly a factor in epizootics.

SUSCEPTIBILITY AND RESISTANCE FACTORS

No species of freshwater fish are known to be resistant to the disease. Fingerlings less than 100/lb in size are particularly susceptible. However, Davis (1926) and Bullock (1972) reported that previously-infected fish and salmonids over one year of age, respectively, seldom develop the disease. Fingerling fish infected with bacterial gill disease will frequently become reinfected if crowding or other poor environmental conditions persist after treatment. Klontz (1979)

has proposed that certain chemical treatments, such as formalin and quaternary ammonium compounds, may have deleterious effects that predispose susceptible fish to bacterial gill disease.

INCUBATION PERIOD

Snieszko (1981) reported that the incubation period for bacterial gill disease may vary from a few days to several weeks. This required period depends upon environmental conditions, age of the fish, and virulence of the infecting organisms.

SEASONAL INCIDENCE

Bacterial gill disease is most prevalent in salmonids during the spring and early summer months. This coincides with the period when young fish are most abundant, when feeding rates are increasing, and crowding develops.

METHODS OF CONTROL

PREVENTION

Maintenance of a high quality environment is of utmost importance in the prevention of bacterial gill disease. According to Wood (1974), fish should be reared in a system with no reuse of water until they reach a size of at least 100 fish/lb. Population level should be kept at lowest feasible levels to reduce the effects of crowding. The application of good sanitation practices is important. Clean ponds provided with an adequate flow of clean water coupled with prompt removal of dead or weak fish will reduce incidence of the disease.

THERAPY

A number of compounds are effective for the treatment of bacterial gill disease. Wood (1974) recommended potassium permanganate ($KMnO_4$) with certain precautions at 1-2 ppm. Snieszko (1981) listed Hyamine 1622 and 3500, as well as Roccal, to be used at 1-2 ppm calculated on the basis of active ingredient. Diquat, at 8.4-16.8 ppm of the formulation, has also been recommended. Another quaternary ammonium compound, Purina Four Power, used at 3-4 ppm as one-hour flush treatments, has been found effective in situations where hardness has limited the use of other compounds. Chloramine-T used in a single treatment at 10 ppm in a one-hour flush has given good results in Europe, but its effectiveness and toxicity are greatly affected by water quality (From 1980). However, due to the carcinogenicity of Chloramine T, its use in this country is unlikely (Snieszko 1981). Most compounds require multiple applications for effective results.

KEY STEPS TO REMOVE THE DISEASE AND/OR AGENT FROM FISH POPULATIONS

IMMEDIATE

Avoid crowding and handling of fish during periods of high susceptibility. Practice good sanitation and keep waste products as low as possible. Avoid rearing fish smaller than 100 fish/lb in reused water or in ponds supplied with water from a source harboring carrier fish.

LONG TERM

Where possible, use closed, one-pass, water use systems to minimize the development of predisposing conditions. Disinfection of water by ultraviolet irradiation has also been shown to be effective in intensive culture conditions.

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