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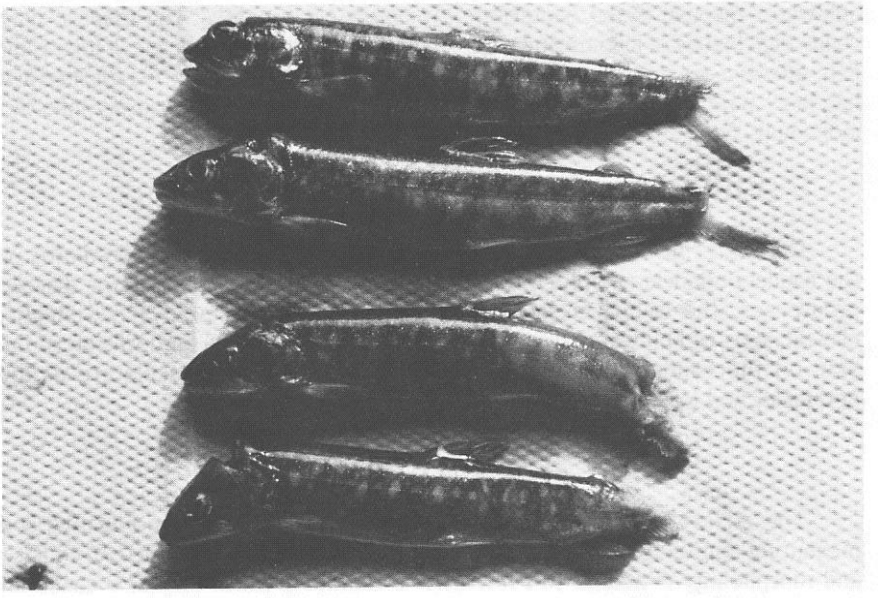
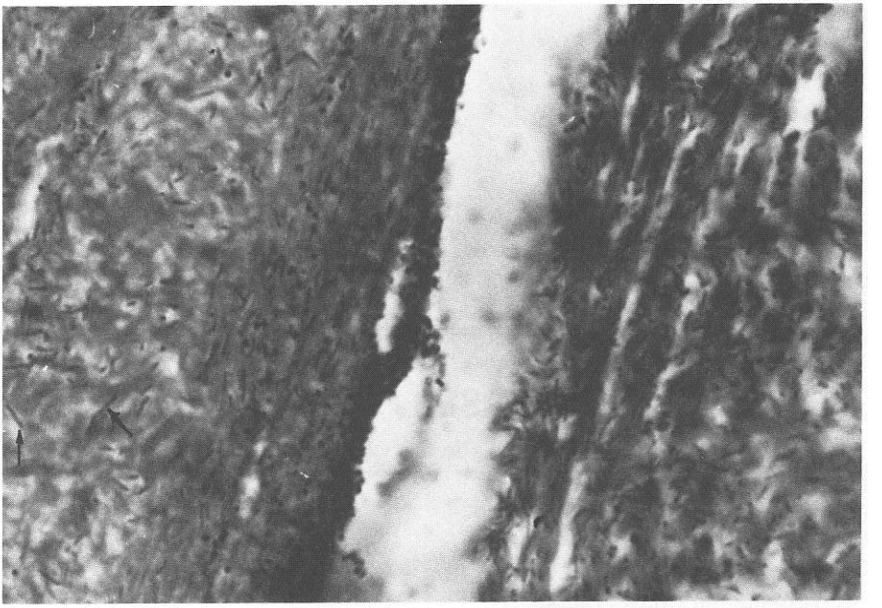
COLDWATER DISEASE

JOHN H. SCHACHTE
New York Department of
Environmental Conservation
Rome. NY

Coldwater disease, sometimes also referred to as peduncle or low temperature diseases, is a serious disease of coho salmon fry and yearlings (Amend 1970)



Lake trout fingerlings with progressive degrees of tail rot and caudal peduncle erosion due to coldwater disease, *Cytophaga psychrophila* (J. H. Schachte, Jr.)



Section (×1000) of lake trout muscle tissue infected with *Cytophaga psychrophila*. Arrows show typical long, rod-shaped bacterial cells associated with the disease (J. H. Schachte, Jr.)

and of other species of salmon and trout (Rocker et al. 1954: Bullock et al. 1971). In recent years, the disease has become a problem in cultured fingerling lake trout in the northeastern United States (Schachte 1980). The etiologic agent of coldwater disease is the bacterium *Cytophaga psychrophila.* The disease may cause high losses of salmon and trout fry and fingerlings. In the case of fingerling fish, effective treatment is difficult. Once the disease has become establishedina hatchery population, extensive treatment and the removal of grossly-infected individuals frequently yields only limited results.

SIGNS OF INFECTION

Coldwater disease is first manifested as a grey, patchy, discolored area on the caudal peduncle. In infected fish, the peduncle darkens and, as the disease progresses, the caudal fin becomes frayed and eroded. In advanced stages, clinical signs of coldwater disease may include open lesions and erosion of the skin on the caudal peduncle, complete erosion of the musculature of the peduncle, and loss of the caudal tin.

DIAGNOSIS

The coldwater disease bacterium is a long, slender Gram-negative rod measuring approximately .75 nm x 1.5 to 5 nm (Pacha and Ordal1970). Its size and morphology is similar to *Flexibacter columnaris* which may also cause fin erosion and "tail rot" signs. The pathogen causes disease at low temperatures (Pacha and Ordal1970); the optimum range is between 4.4-10.0°C. However,

Wood (1974) has pointed out that the optimum temperature for isolation on culture media is 15-20°C, which is considerably higher than the range at which clinical disease occurs. Even at appropriate temperatures, however, the isolation of C. psychrophila can be difficult. Diagnosis of the disease is achieved by isolation of butyrous yellow colonies of long, thin bacteria on Ordal's cytophaga medium. When time is short and isolation is difficult, the bacterium can be identified by the indirect fluorescent antibody test (IFAT) using smears taken directly from caudal lesions. The disease may also be systemic. However, as is frequently the case with columnaris disease, demonstration of the bacterium in tissues other than the skin and muscle of the caudal peduncle may not be possible (Wood 1974).

EPIZOOTIOLOGY

GEOGRAPHIC AND HOST RANGES

Bullock et al. (1971) reported that the geographic range of peduncle (coldwater) disease is confined primarily to the northwestern and northeastern United States, with a much higher incidence of the disease in the Pacific northwest. Coho salmon are the most susceptible species but significant infections occur in sockeye and chinook salmon. Bullock et al. (1971) report that the disease is confined primarily to brook trout in the northeast and that the disease is less of a problem in this species. Recent outbreaks of the disease in fingerling lake trout in New York (Schachte 1980) have provided additional concern for the disease in hatcheries in the northeastern United States.

SOURCES AND RESERVOIRS OF INFECTION

According to Bullock and Snieszko (1970), coldwater disease may be waterborne or transmitted from carrier fish. In the lake trout infections in New York, seriously infected fish with necrotic caudal peduncle areas were undoubtedly releasing tremendous numbers of organisms to infect other fish in the pond. Wood (1979) has indicated that the transovarian route may also be a factor.

SUSCEPTIBILITY AND RESISTANCE FACTORS

Coldwater disease is very serious in salmon sac fry. Fingerling coho salmon are readily affected and may suffer considerable mortality from the disease. Epizootics in the lake trout in New York State have been responsible for losses approaching 25% in 10-15 cm (4-6 in) fingerlings reared in hatchery raceways.

MODES OF TRANSMISSION

According to Wood (1979), the transmission of the disease is associated with the presence of carrier fish, vertical transmission of the disease to the offspring may also be a possibility. The recent diagnosis of coldwater disease during the winter of 1981 in the Cayuga Lake strain of landlocked salmon provides circumstantial evidence that New York epizootics may be tied to contaminated eggs of Finger Lake strains of lake trout. This information may provide further evidence

of vertical transmission as has been suggested by Wood (1979). Infected fish in a raceway with gross lesions probably release sufficient numbers of organisms to spread the disease throughout the population in that raceway. Asymptomatic carriers may also be responsible for some infections.

INCUBATION PERIOD

Coldwater disease develops at water temperatures between 7 and 10°C. The incubation period is considered to be less than 10 d (Bullock and Snieszko 1970). However, if as in the case of lake trout, the source of disease is related to contaminated eggs, the incubation period may be longer than that previously reported, or a latent period is involved.

METHODS OF CONTROL

PREVENTION

All efforts should be made to avoid contaminated stocks. If vertical transmission proves to be true, rigorous egg disinfection procedures should be administered. This can be accomplished by using organic iodine compounds at 100 ppm for 10 min (Amend 1974).

THERAPY

External infections may be treated early with water soluble Terramycin at 10-50 ppm or with quaternary ammonium compounds at 2 ppm (Hyamine 3500, Roccal, etc.). Oral administration of sulfonamides at 8-10 gm or oxytetracycline (Terramycin) at 2.5-3.5 gm per 100 lb of fish fed per day is also effective.

In the case of the lake trout epizootics, when the disease had progressed to the point where significant numbers of fish exhibited eroded peduncles, quaternary ammonium and/or antibiotic therapy did not provide control. At such advanced stages, antibiotics and a potassium permanganate ($KMnO_4$) flush at 2 ppm combined with removal of seriously infected fish were required to control mortality. $KMnO_4$ apparently will not only reduce the bacterial load but also hasten the demise of infected individuals that would otherwise die later, thereby facilitating the removal of these carriers from tanks or raceways.

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

IMMEDIATE

A strict program of egg disinfection should be applied. Wood (1979) suggests that fish should be reared in raceways at densities of no more than 4-5 pounds per gpm to minimize oxygen deficiency problems. According to Wood (1974), such limits on rearing environments reduced the incidence of the disease. Pacha and Ordal (1970) reported that raising the water temperature to above 12.8°C (55°F) generally caused a decrease in the severity of infection. However, Wood (1974) stated that temperature manipulation had little effect on an established infection.

LONG TERM

Long term measures should include careful screening and selection of broodstock that are free of the disease. Also, water sources that are free of the disease and of potential carrier fish should be developed.

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