

Bacterial Coldwater Disease (BCWD) and other freshwater flavobacteria

I. Causative Agent and Disease

The causative agent of BCWD, *Flavobacterium psychrophilum*, is a Gram-negative proteolytic bacterium causing systemic disease in colder waters. Clinical signs usually occur below 12°C and in Alaska often occur at extremely cold water temperatures of 1°C. The bacterium, originally classified to the genus *Cytophaga*, was changed to *Flexibacter* and later to *Flavobacterium*. The species name means “cold loving”. BCWD is characterized by tissue necrosis of the fins that progresses to complete destruction of the caudal peduncle exposing the vertebrae. Other common names for this condition are peduncle disease or low temperature disease. Infections by other freshwater species of flavobacteria are generally non-systemic causing similar erosive skin lesions that may occur anywhere on the surface of the fish host.

II. Host Species

BCWD is found in temperate salmonid producing regions worldwide. Juvenile coho and Chinook salmon are particularly susceptible. External infections by other freshwater flavobacteria also occur worldwide affecting several species of fish.

III. Clinical Signs

BCWD begins with darkening of the peduncle region when water temperatures are between 4-12°C with up to 50% mortality prior to the occurrence of more chronic peduncle erosion. When acute, lesions appear in the areas of increased pigmentation on the peduncle region, or elsewhere. Ulcers are deep and the caudal fin may erode completely exposing the vertebral column. When present, internal lesions may only consist of mild petechial hemorrhages within the adipose

tissues surrounding the pyloric caeca. Chronic BCWD can result in lordosis and scoliosis (“crinkle-back”) and an abnormal swimming posture from the destruction of muscle bundles adjacent to the vertebral column. Another sequella is bacterial invasion of the brainstem causing erratic swimming, darkened posterior body and sudden death from damage to nervous tissues, vertebral cartilage and bone. Other flavobacteria cause erosive skin lesions that may penetrate deeply into the underlying skeletal muscle.

IV. Transmission

Transmission of BCWD is horizontal through the water column and vertically through the eggs of infected adult salmonids. The bacteria have been isolated from internal organs and gonadal fluids of returning adult salmon suggesting they are carriers of the infection during their seawater phase but reinfection upon entering freshwater is also possible. All other *Flavobacterium* species are common inhabitants of aquatic ecosystems allowing for horizontal transmission.

V. Diagnosis

Presumptive diagnosis includes isolation of long, filamentous, Gram-negative bacteria that are non-motile or have gliding motility from kidney tissues or typical skin lesions of fish. The bacteria grow well on *Cytophaga* and TYES agars, with optimum growth at 15-16°C. Colonies are bright yellow, entirely convex or with convex centers and a spreading periphery resembling a “fried egg”. Colonies turn orange-red when KOH is added indicating flexirubin pigment. Growth of *F. psychrophilum* is inhibited by Congo red added to TYES agar or diffusion discs allowing rapid differentiation from other *Flavobacterium* species. Confirmatory

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diagnosis is done using PCR or monoclonal direct FAT.

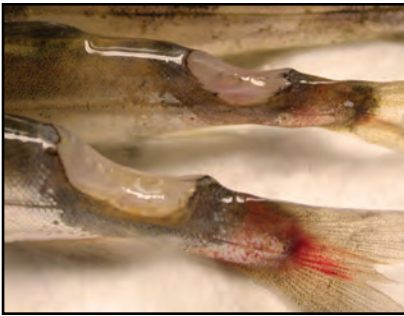
VI. Prognosis for Host

BCWD begins as an external infection that becomes systemic. External flavobacteria generally remain as such but either type of infection can result in fish mortality. Hatchery fish can be treated for the infections with external

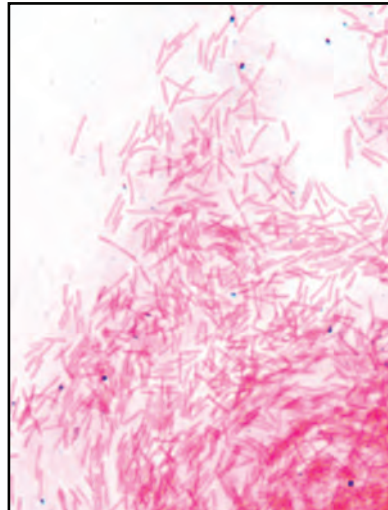
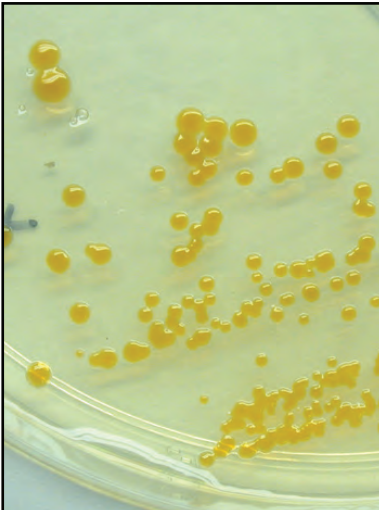
1 hr treatments of formalin and for BCWD antibiotic therapy may be necessary as well.

VII. Human Health Significance

There are no human health concerns associated with *Flavobacterium psychrophilum* or other flavobacteria.



Left: Deep ulcers with tissue liquefaction characteristic of flavobacterial infections; **Right:** Complete erosion (bottom fish) of caudal peduncle in coho salmon fingerling typical of bacterial coldwater disease .



Left: Typical yellow colonies of *Flavobacterium psychrophilum* on TYES agar; **Right:** Gram stain of filamentous bacteria from skin scrape of an external *Flavobacterium* sp. infection, X 400.