

Phaeohyphomycoses of Saffron Cod and Possibly Other Fish Species

I. Causative Agent and Disease

Large black, oval, external lesions of the skin and smaller foci on the gills have been reported by subsistence users in tomcod from the Norton Sound area in Alaska since 2005. The lesions are caused by at least eight different opportunistic ascomycete fungi including; *Alternaria* spp, *Cladosporium herbarum*, *Chaetomium globosum*, *Cadophora luteo-olivacea*, *Penicillium* spp., *Phoma herbarum*, *Pseudophacidium ledi* and *Valsa sordida*. These fungi typically infect the surface of the skin with shallow invasion of the underlying skeletal muscle. Mortality has not been reported but estimates of prevalence have been upwards of 1 in 200 fish.

II. Host Species

The black external lesions have been confirmed from tomcod and also reported in smelt (hooligan) from Norton Sound including estuarine waters of the Unalakleet, Nome and Snake Rivers.

III. Clinical Signs

Skin lesions caused by these fungi are typically large (1 X 2 cm), black, slightly raised circumscribed plaques that are firm and have rugose textured centers. Gill infection results in smaller black foci within the soft tissues of the filaments. No internal lesions are present and often there is food in the gut indicating that infected fish are feeding normally.

IV. Transmission

These fungi are pigmented brown to black, filamentous and ubiquitous in the soil, occur as plant pathogens, on paper products, wood, natural fiber textiles, in the air and on plant debris. Thus, the external nature of the fungal infections suggests that transmission is by ascospores contained in ambient seawater or sediments, possibly increased by rain and flooding, that require previous mechanical tissue injury as a portal of entry into the host. However, the actual mode of transmission is unknown. Reports of these black lesions on fish most commonly occur during the late fall and early winter months of October through December.

V. Diagnosis

Diagnosis is based on typical clinical signs of shallow, circular, black rugose plaques or foci on the skin and/or gills. *Chaetomium* is used as an example; wet mounts of lesion material show very fine septate, branching, fungal hyphae with no evidence of spores or spore producing structures. Histological sections stained with Grocott's method of methenamine-silver nitrate for fungi show black fungal hyphae throughout the epidermis and dermis with occasional shallow invasion of the underlying skeletal muscle. The fungus can be isolated by explant culture of lesion material on several media. After 4-11 days post-inoculation fungus growth is light on potato agar (PA) and heavy on cornmeal agar (CMA) and oatmeal agar (OA). Fungus growth exhibits olive-black obverse (front or top side) and reverse (bottom

side) on PA and buff obverse and reverse on CMA and OA becoming darker with age. More luxurious hyphal growth is apparent on media with added 1.5% NaCl but faster sporulation occurs on CMA and OA without added salt. Aerial hyphae are scanty on all media. Hyphae are fine, septate, and occasionally branching. Spore producing structures appear after 20 days incubation at 16°C and are large, grossly visible, black, pepper-like structures. Microscopically, the structures are globose perithecia 183-250 X 208-280 µm in diameter with numerous septate perithecial hairs (setae) with rounded ends; branching is not apparent. Setae are flexuous with opposite, alternating curvatures. Ascospores within are brown, 6 X 10 µm in diameter, lemon-shaped, single cells with thick walls; droplets are also present. Identification of fungal species is confirmed by genetic sequencing of cultured isolates.

VI. *Prognosis for Host*

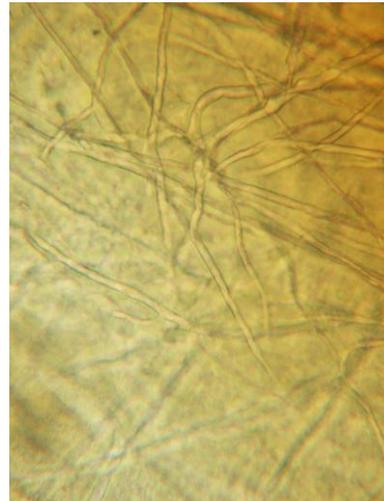
The prognosis for infected fish is unknown but the large skin plaques and/or involvement of the gill tissues suggest a chronic debilitating mycosis that may lead to death.

VII. *Human Health Significance*

Rarely, in immunosuppressed human hosts, several of these fungi, including *Chaetomium* sp., have caused fatal deep mycoses as well as brain abscess, sinusitis, peritonitis, cutaneous lesions, pneumonia and onychomycosis (nail infections). *Chaetomium globosum* also produces mycotoxins such as chaetomin and chaetoglobosin and commonly grows inside homes on water damaged roofs, ceilings, walls and carpets, possibly representing an allergenic threat to human health.



Black fungal plaque on skin of tomcod



Branching fungal hyphae in wet-mount of lesion material