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Ichthyophonus, a systemic mesomycetozoan pathogen of fish

Original by A. H. McVicar

Revised and updated by S. R. M. Jones



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Susceptible species

Ichthyophonus has low host specificity, with records from over 80 species of fish. Mainly marine fish are infected, but freshwater species are also affected. It occurs commonly in haddock, *Melanogrammus aeglefinus* (L.); plaice, *Pleuronectes platessa* L.; and Atlantic herring, *Clupea harengus* L. The apparent rarity of *Ichthyophonus* in elasmobranchs may be related to limited surveillance in this group. Infection with a morphologically similar agent, now referred to as *Amphibiocystidium*, has been reported from amphibians.

Disease name

Ichthyophonus, ichthyophoniasis, Taumelkrankheit, staggers

Aetiological agent

Previously considered a phycomycete fungus, *Ichthyophonus* is now placed within the Class Mesomycetozoa, a group of micro-organisms residing between the fungi and animals. Most isolates belong to the species *Ichthyophonus hoferi* Plehn and Mulsow, 1911 and genetic variants have been recognized. The morphologically distinct *Ichthyophonus irregularis* (Rand *et al.*, 2000) was described from yellowtail flounder, *Limanda ferruginea* (Storer, 1839).

Geographical distribution

Principally marine and widespread in coastal and open-ocean areas in northern and southern hemispheres. Localized high infection levels occur sporadically in seawater in all regions. Occurrence in freshwater has been associated with spawning migrations of anadromous fish, local adaptations in resident fish populations and feeding of cultured salmonids with infected tissue.

Associated environmental conditions

The release of infective spores from the skin of infected fish suggests a water-borne mode of transmission and that conditions in the water such as temperature and salinity may influence the viability of the infective stage. Epidemics in wild fish populations have not been reported in freshwater.

Significance

Despite its wide geographic distribution and broad host range, reports of epidemics associated with high mortality are restricted to Atlantic herring. In this host, ichthyophoniasis is one of the best documented cases of disease-associated population effects in marine fish species. A maximum prevalence of 78% was reported in adult herring from the Gulf of St Lawrence between 1954 and 1955, with an estimated mortality of 50%. Between 1991 and 1994, an outbreak in herring encompassing the Baltic Sea, the Skagerrak, the Kattegat and the North Sea caused mortality ranging from 1.9% to 8.9% in Swedish waters and between 12.8% and 36%

in Danish waters. The latter outbreak was associated with declines of 10% to 20% in catch or population size. The infection is common in Pacific herring, *Clupea pallasii* Valenciennes in Puget Sound, Washington (70% prevalence) and Prince William Sound, Alaska (27%); however outbreaks causing significant mortality have not been reported in this host. An outbreak in plaice may have caused an annual mortality of 50%. However, mortality in demersal fish may be less obvious than in pelagic species such as herring because dead fish are rarely observed. Ichthyophoniasis in adult Chinook salmon, *Oncorhynchus tshawytscha* (Walbaum) during freshwater migration in the Yukon River is associated with mortality and reduced fillet quality.

Gross clinical signs

Non-specific signs may include swimming abnormalities, lethargy, emaciation, colour abnormalities, abdominal distension, exophthalmos, and elevated mortality. The appearance and texture of the skin may be altered due to ulcers and a sandpaper roughness. Internally, white or cream-coloured nodules 1 to 5 mm in size may occur in the skeletal or cardiac muscle and in most well-vascularised organs and are most evident in heavily infected fish.

Control measures and legislation

None known. Infections in cultured fish can be prevented by avoiding feeding with untreated fresh fish or their products. Treating affected tissues by heating to 40°C or freezing to -20°C will kill the organism. *Ichthyophonus* is not an OIE-reportable disease.

Diagnostic methods

In fresh tissue, *Ichthyophonus* occurs as spherical bodies 10 to 250 µm in diameter. Heart muscle is preferentially affected in many fish species. Within hours of death, the spherical bodies germinate, producing hyphae that are visible by microscopic examination of tissue squashes (Figure 1). For this reason, tissue should be examined at intervals following death. Spherical bodies are observed in haematoxylin and eosin-stained histological sections of affected tissues (Figure 2). Inflammation may be induced in tissue adjacent to *Ichthyophonus* stages (Figure 3). Low level infections may be detected by the culture of suspect tissues in a suitable liquid medium for several days. Alternatively, molecular methods can be employed to detect the infection and provide information on the species or strain of *Ichthyophonus* involved.

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Figure 1. Hyphae-like structures emerging from tissues of Pacific herring (*Clupea pallasii*) infected with *Ichthyophonus*. Fresh preparation.

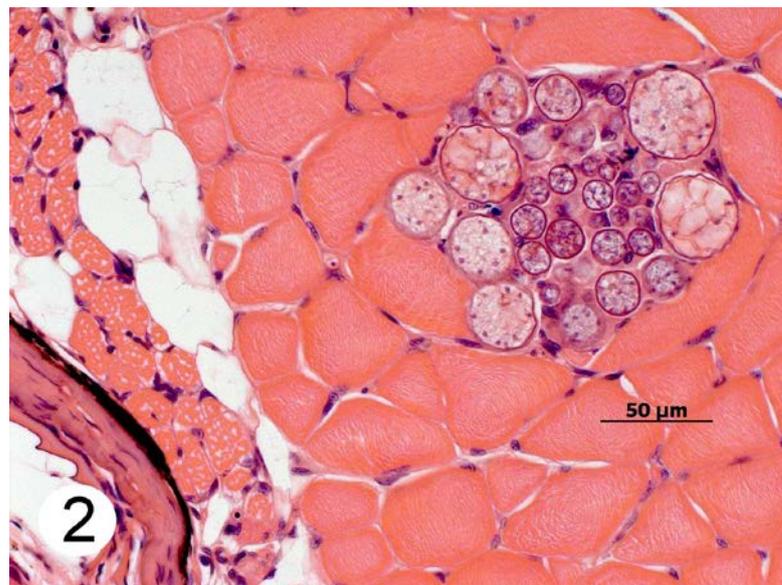


Figure 2. *Ichthyophonus* spherical bodies in skeletal muscle beneath skin of Chinook salmon (*Oncorhynchus tshawytscha*). Haematoxylin and eosin.

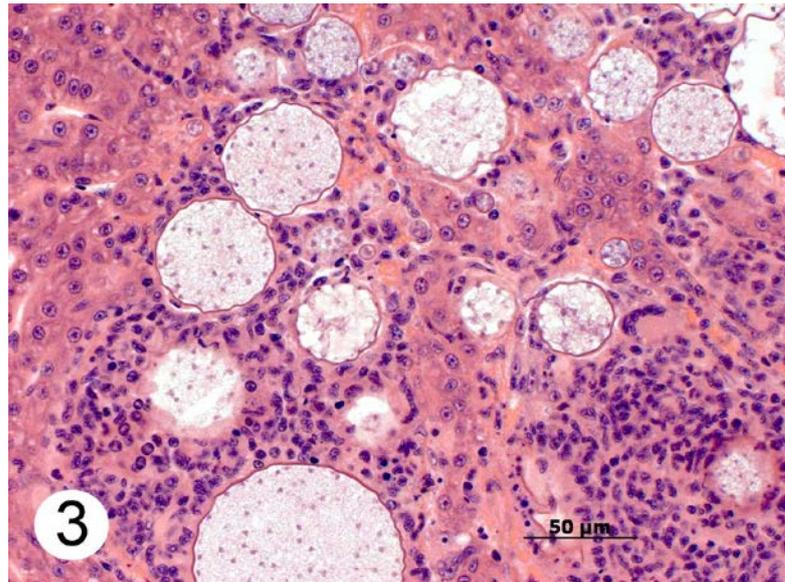


Figure 3. *Ichthyophonus* spherical bodies in liver of Chinook salmon (*Oncorhynchus tshawytscha*), with infiltration of inflammatory cells. Haematoxylin and eosin.

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