Infection with Exophiala salmonis

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Susceptible species................................................................. 1
Disease name........................................................................... 1
Geographical distribution................................................................ 1
Associated environmental conditions........................................... 1
Significance.................................................................................. 1
Gross clinical signs...................................................................... 1
Light microscopy.......................................................................... 2
Control measures and legislation............................................... 3
Key references.............................................................................. 3

Author contact details.................................................................. 5
Infection with *Exophiala salmonis*

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**Susceptible species**

*Exophiala salmonis* causes an internal systemic mycosis of marine-reared salmonids of a low prevalence e.g. Atlantic salmon, *Salmo salar*. Several species of *Exophiala* from the salmonis-clade have been noted in fish e.g. *E. aquamarina*, *E. pisciphila*, and *E. psychrophila*. In freshwater, *E. psychrophila* has been described from rainbow trout, *Oncorhynchus mykiss* and also in Atlantic salmon in salt water from Norway (Pederson and Langvad, 1989). *E. pisciphila* has occurred in Atlantic salmon from Australia (Langdon and McDonald, 1987).

**Disease name**

*Exophiala salmonis* is an anamorphic black fungus from the family *Herpotrichiellaceae* that is characterized by melanised cells and yeast-like growth states (multilateral and polar budding cells) in addition to hyphal growth. The Genus was introduced by Carmichael (1967).

**Geographical distribution**

*Exophiala salmonis* was first described from cerebral lesions in cutthroat trout, *Oncorhynchus clarki* (Carmichael, 1967) and since reported in farmed fish from Canada, Norway, Scotland, and Faroe Islands (Langvad *et al.*, 1985; Otis *et al.*, 1985; Richards *et al.*, 1978).

**Associated environmental conditions**

None identified.

**Significance**

Infection by *E. salmonis* is acknowledged as occurring occasionally in fish with a low morbidity and incidence, but sometimes these can result in high mortality among farmed fish. For example, epizootic proportions with up to 40% mortality have been reported in Atlantic salmon from Canada (Otis *et al.*, 1985). Similarly, Langvad *et al.* (1985) reported high losses over several years in farmed salmon from Norway. The fungus is considered thermo-intolerant, hence risk to humans is considered unlikely. However, a case of subcutaneous infection by *E. salmonis* was confirmed in a Korean diabetic patient who presented with a cystic mass of the ankle (Yoon *et al.*, 2012).

**Gross clinical signs**

Infected fish may continue to feed normally, but display erratic swimming movements, which can be followed by whirling behaviour. Distension of the abdomen is reported. Exophthalmia and cranial cutaneous ulcers are common, although these clinical signs are not considered pathognomonic. Internally, an opaque capsule and enlargement of the kidney is characteristic with large, raised, off-white nodules containing variable quantities of hyphae (Figure 1).
Figure 1. Atlantic salmon kidney showing distension and enlargement with characteristic off-white coloured nodules attributed to infection with *Exophiala* sp.

**Light microscopy**

Infected fish attempt to limit vascular invasion, with the development of a marked systemic granulomatous response, involving macrophages and multinucleate giant cells, despite the limited number of hyphae in any one location (Figure 2). Fibrosis and atrophy develop as the hyphae penetrate the kidney tubules and blood vessels, as well as other organs, such as the heart, liver, and spleen, where an acute multi-focal response can be observed. An eosinophilic gastritis and enteritis occur within the gut. In severe infections, the musculature may be discoloured. A cranial location for *E. psycrophila* has been reported for Atlantic salmon following movement of hyphae through the lateral line system. Healing lesions are fibrous in nature, and the pathology associated with *E. psycrophila* is similar to that described for *E. salmonis*. 
Control measures and legislation

Exophiala infection in farmed fish is not generally treated or subject to national legislation. Recent work has shown that the secondary metabolite Latrunculin B produced by a marine sponge Negombata magnifica displays potential as an antifungal agent and could be theoretically developed for use in aquaculture (Devi et al., 2013).

Diagnostic methods – A presumptive diagnosis of E. salmonis can be made from gross lesions and the presence of pigmented septate hyphae readily observed in H&E sections. Staining sections with periodic acid-Schiff’s or Grocott’s methenamine silver techniques is also useful for diagnosis (Alderman and Feist, 1985). Cultures of E. salmonis on Sabouraud’s agar are grey, with a darker reverse; abundant spores and colony growth of 5–8 mm occur at 25 °C, after approximately 14 days. Growth is not recorded at 37 °C. Direct ITS1 sequencing and RFLP of PCR-amplified ribosomal genes are published (Uijthof et al., 1997). Temperature-growth relationships, measured with a continuous temperature gradient incubator, have proven useful for the identification of the four taxa of Exophiala pathogenic on fish (Pederson and Langvad, 1989).

Key references


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