

ICES IDENTIFICATION LEAFLETS FOR DISEASES AND PARASITES OF FISH AND SHELLFISH

LEAFLET NO. 42

FEBRUARY 2016

Infection with *Exophiala salmonis*

Original by F. Langvad and K. Engjom
Revised and updated by D. W. Bruno



ICES

International Council for
the Exploration of the Sea

CIEM

Conseil International pour
l'Exploration de la Mer

International Council for the Exploration of the Sea Conseil International pour l'Exploration de la Mer

H. C. Andersens Boulevard 44–46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

Recommended format for purposes of citation:

Original by F. Langvad and K. Engjom. Revised and updated by D. W. Bruno. 2016.
*Infection with *Exophiala salmonis**. ICES Identification Leaflets for Diseases and Parasites
of Fish and Shellfish. Leaflet No. 42. 5 pp.

Series Editor: Stephen Feist. Prepared under the auspices of the ICES Working Group
on Pathology and Diseases of Marine Organisms.

The material in this report may be reused for non-commercial purposes using the recommended citation. ICES may only grant usage rights of information, data, images, graphs, etc. of which it has ownership. For other third-party material cited in this report, you must contact the original copyright holder for permission. For citation of datasets or use of data to be included in other databases, please refer to the latest ICES data policy on the ICES website. All extracts must be acknowledged. For other reproduction requests please contact the General Secretary.

ISBN 978-87-7482-182-3
<https://doi.org/10.17895/ices.pub.5213>
ISSN 0109–2510

© 2016 International Council for the Exploration of the Sea

Contents

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*

Original by F. Langvad and Engjom. Revised and updated by D. Bruno.

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. psychrophila* 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. psychrophila* is similar to that described for *E. salmonis*.

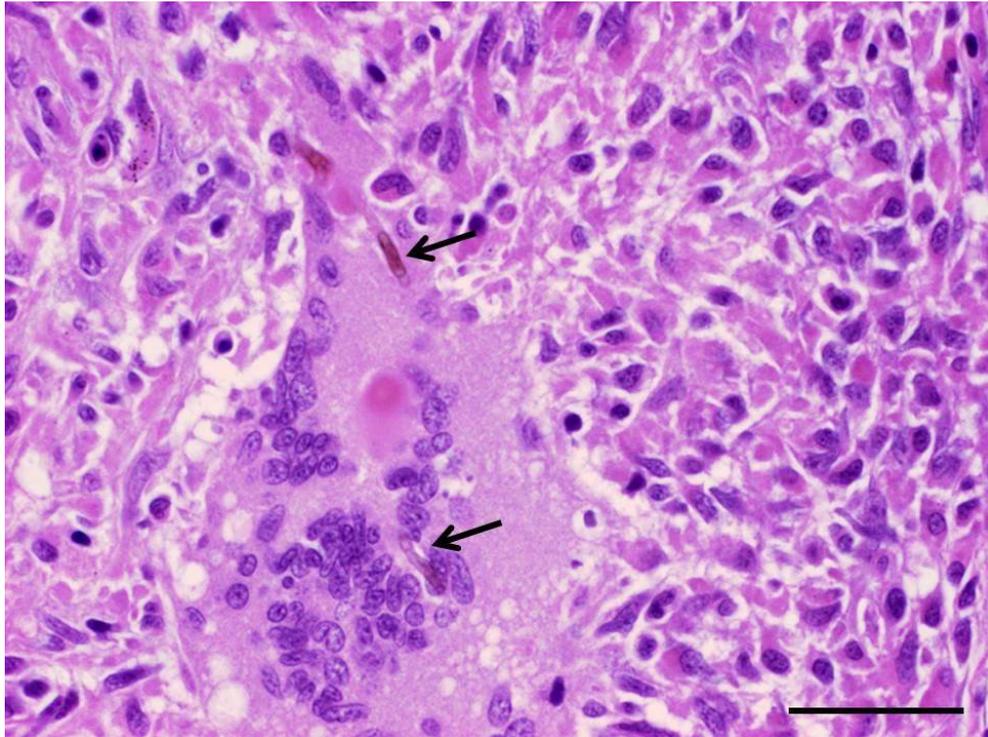


Figure 2. *Exophiala* hyphae (arrowed) in heart of Atlantic salmon. H&E. Bar scale = 40 μm

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

- Alderman, D. J., and Feist, S. W. 1985. *Exophiala* infection of kidney of rainbow trout recovering from proliferative kidney disease. *Transactions of the British Mycological Society*, 84(1): 157–159.
- Carmichael, J. W. 1967. Cerebral mycetoma of trout due to a *Phialophora*-like fungus. *Sabouraudia: Journal of Medical and Veterinary Mycology*, 5: 120–123.
- Devi, P., Ravichandran, S., Ribeiro, M., and Ciavatta, M. L. 2013. Antifungal potential of marine sponge extract against plant and fish pathogenic fungi. *Oceanography*, 1: 112. doi: 10.4172/2332-2632.1000112

- de Hoog, G. S., Vicente, V. A., Najafzadeh, M. J., Harrak, M. J., Badali, H., and Seyedmousavi, S. 2011. Waterborne *Exophiala* species causing disease in cold-blooded animals. *Persoonia Molecular Phylogeny and Evolution of Fungi*, 27:46–72. doi: 10.3767/003158511X614258.
- Langdon, J. S., and McDonald, W. L. 1987. Cranial *Exophiala pisciphila* infection in *Salmo salar* in Australia. *Bulletin of the European Association of Fish Pathologists*, 7: 35–36.
- Langvad, F., Pedersen, O., and Engjom, K. 1985. A fungal disease caused by *Exophiala* sp. nov. in farmed Atlantic salmon in Western Norway. *In Fish and Shellfish Pathology*. A. E. Ellis (Ed.) Academic Publishers, London. Pp. 323–328.
- Yoon, Y. A., Park, K. S., Lee, J. H., Sung, Ki-Sun., Ki, C. S., and Lee, N. Y. 2012. Subcutaneous phaeohyphomycosis caused by *Exophiala salmonis*. *Annals of Laboratory Medicine*, 32: 438–441.
- Otis, E. J., Wolke, R. E., and Blazer, V. S. 1985. Infection of *Exophiala salmonis* in Atlantic salmon (*Salmo salar* L.). *Journal of Wildlife Diseases*, 21: 61–64.
- Pedersen, O.A., and Langvad, F. 1989. *Exophiala psychrophila* sp. nov. a pathologic species of the black yeasts isolated from Atlantic salmon. *Mycological Research*, 92: 153–156.
- Richards, R. H., Holliman, A., and Helgason S. 2006. *Exophiala salmonis* infection in Atlantic salmon *Salmo salar* L. *Journal of Fish Diseases*, 1: 357–368.
- Uijthof, J. M. J., Figge, M. J., and de Hoog, G. S. 1997. Molecular and physiological investigations of *Exophiala* species described from fish. *Systematic and Applied Microbiology*, 20: 585–594.

Author contact details

David W. Bruno

Marine Scotland Science

375 Victoria Road

Aberdeen AB11 9DB

UK

david.bruno@gov.scot