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Anisakis larvae ("herringworm"; Nematoda) in fish

Original by John W. Smith and R. Wootten

Revised and updated by Matt Longshaw



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Susceptible species

Anisakis spp. larvae have a low host specificity. Fish hosts include herring, *Clupea harengus* L.; mackerel, *Scomber scombrus* L.; Atlantic salmon, *Salmo satar* L.; cod, *Gadus morhua* L.; whiting, *Merlangius merlangus* (L.); blue whiting, *Micromesistius poutassou* (Risso); Atlantic salmon (*Salmo salar*) and many other marine teleosts and cephalopod species. The parasite has a low host specificity and has been reported in most oceans.

Disease name

Anisakiasis, "herringworm"

Aetiological agent

Several species of *Anisakis* have been reported, and third-stage larval stages, a complex of sibling species in fish are often referred to as *Anisakis simplex sensu lato* (Nematoda, Superfamily Ascaridoidea, subfamily Anisakinae). The described species include *A. simplex* (Rudolphi, 1809, det. Krabbe, 1878) *sensu stricto*, *A. pegreffii* Campana-Rouget and Biocca, 1955, *A. typica* (Diesing, 1860), *A. ziphidarum* Paggi, Nascetti, Webb, Mattiucci, Cianchi and Bullini, 1998 *A. physeteris* (Baylis, 1923), *A. brevispiculata* Dollfus, 1968, *A. paggiae* Mattiucci, Nascetti, Dailey, Webb, Barros, Cianchi and Bullini, 2005, *A. kuekenthalii* Cobb, 1889 *A. rosmari* Baylis, 1916, *A. schupakovi* Mosgovoï, 1951 and *A. typica* (Diesing, 1860). Hybridization between *A. simplex sensu stricto* and *A. pegreffii* are known to occur.

The life cycle of *Anisakis* spp., in common with other nematodes is complex (Smith, 1978). Eggs produced by the adult females in mammalian hosts are shed into the water. Following development in the egg, second stage larvae hatch into the water column after which, invertebrate hosts, usually euphausiids, eat these larvae. Transmission to other hosts is possible via ingestion of infected euphausiids. Fish and cephalopods appear to be paratenic hosts as development from second to third stage larvae occurs in euphausiids. Marine mammals acquire infections through the ingestion of marine crustaceans, fish or cephalopods. Adult parasites occur in pinnipeds and cetaceans.

Geographical distribution

Widespread throughout the world's oceans. Likely to occur in most sea areas.

Associated environmental conditions

Rate of development of nematodes in seawater is temperature dependant. Furthermore, lower environmental temperatures reduce the numbers of larvae that penetrate into fish flesh. Larval worms in fish tend to be more prevalent in areas where the various hosts occur in large numbers such as in inshore waters.

Significance

Normally of limited significance as a pathogen of fish, with no known population level effects. Some reports show that the parasite can cause a localized inflammation of the lower gut and anal region of e.g. salmon but more usually only localized host response is noted, especially as a consequence of host inflammatory response following death of individual nematodes (Beck *et al.*, 2008; Hauck *et al.*, 1977). Significance of infection to host survival is unknown. In marine mammals *Anisakis* can be problematic causing gastritis, enteritis, anaemia, dehydration and diarrhoea in infected hosts. *Anisakis* can be a potential human pathogen if larvae are eaten alive with raw or inadequately cooked fish. Evidence of hypersensitivity in humans to remnants of *Anisakis* has been reported, even following cooking (Anadón *et al.*, 2010). There is therefore a potential risk to susceptible individuals. Aesthetically, severely affected fish are likely to be unattractive to the consumer. Processed fish are screened for the presence of parasites but this is a time consuming and costly process.

Gross clinical signs

Presence of larvae, especially in the visceral cavity. Larvae in fish are between 10 to 40 mm long, and off-white in colour. They lie coiled like a watch spring in capsules of irregular shape on the surface of the viscera. In salmon, reddened and protruding vent may indicate histozoic infections in this region.

Control measures and legislation

None feasible for fish. Adequate cooking or freezing kills larvae in fish flesh for human consumption. *Anisakis* is not an OIE-notifiable disease.

Diagnostic methods

Fish fillets can be screened using candling techniques. Dead nematodes in the flesh fluoresce in the presence of ultraviolet light. Parasites should initially be identified using morphological characters followed by molecular methods for discriminating sibling species such as DNA sequence analysis and use of allozyme markers (Chen *et al.*, 2008; D'Amelio *et al.*, 2000; Kijewska *et al.*, 2009; Kim *et al.*, 2006; Mattiucci *et al.*, 2005; Quiazon *et al.*, 2009).

Morphologically, *Anisakis simplex* larvae in fish are characterized by anterior boring tooth (bt) close to the opening of the excretory pore (ep). Nerve ring (nr) located anteriorly. The excretory duct (ed) runs back from the excretory pore and expands into the excretory canal. The oesophagus (oes) comprises a relatively long preventriculus (pv) and ventriculus (v). The intestine (int) narrows to enter the rectum which opens at the anus. The tip of the tail bears a small spine or mucron.

Histologically, parasites can be recognized by the presence of an external cuticle, a muscle layer and an intestine. The parasite causes local mechanical compression of tissues with a fibrous capsule of host origin surrounding larvae in some hosts.

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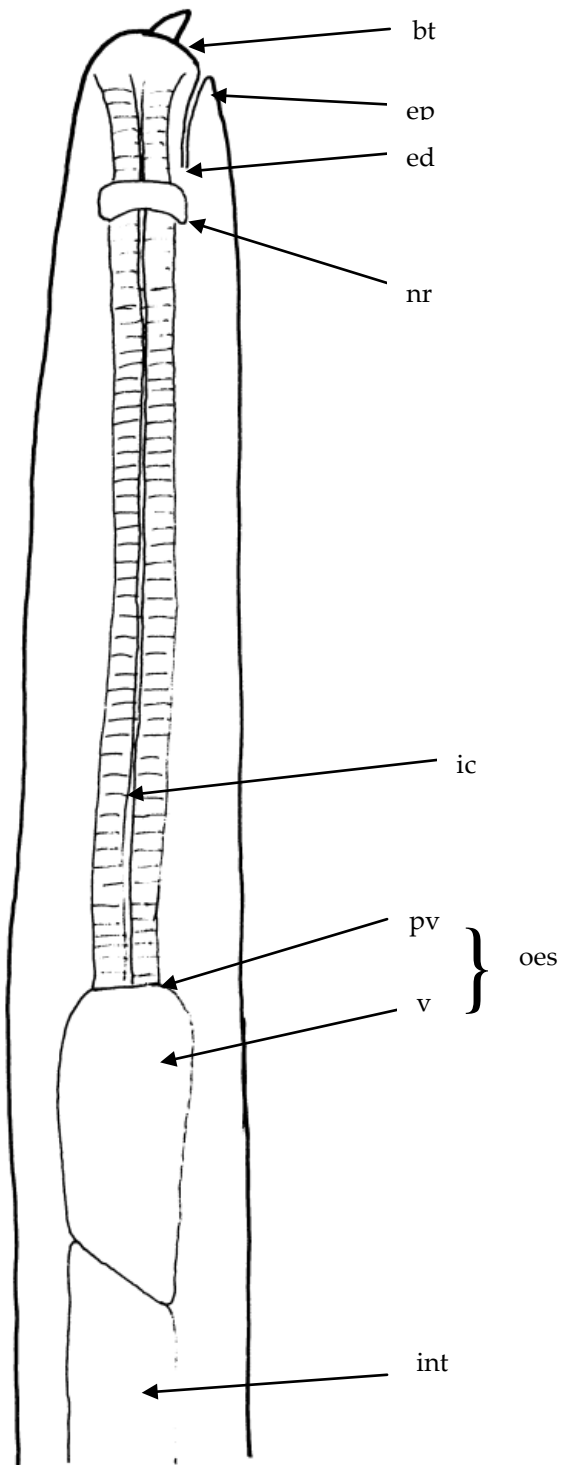


Figure 1. Line drawing of *Anisakis simplex* larvae from fish showing main diagnostic characteristics of the parasite. See section on "diagnostic methods" for explanation of the labelling.



Figure 2. Photograph showing many *Anisakis* worms present on the liver and in the viscera of a whiting.

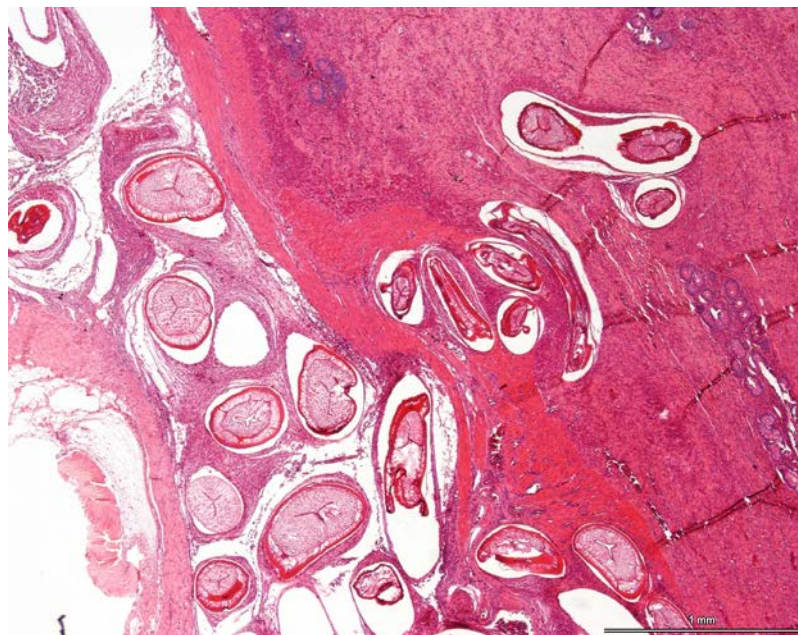


Figure 3. Histological section through the anus and hind gut of salmon infected with *Anisakis simplex sensu stricto*. Note localized inflammatory response.

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