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SCIENTIFIC OPINION

Re-evaluation of certain aspects of the EFSA Scientific Opinion of April 2010 on risk assessment of parasites in fishery products, based on new scientific data. Part 2

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Abstract

The objective of this opinion was to determine if any wild caught fish species, originating from specific fishing grounds and consumed in the EU/EFTA could be considered free of zoonotic parasites. In this Opinion the term 'fishery products' only refers to fresh finfish. As there are multiple fish species and numerous potential parasites, *Anisakis* sp. was used as an indicator of zoonotic parasites in marine areas. This parasite species is particularly suited as it is common in marine environments, capable of infecting multiple fish species and is the subject of the majority of published studies. On the rare occasion where *Anisakis* sp. data were not available, or all tests were negative, other parasites such as *Contracaecum osculatum* (s.l.) and/or *Phocanema* spp. were considered. In freshwater systems, all zoonotic parasites were investigated. Consumption, import and landing data were used to determine the most relevant fish species and, where possible, the source fishing areas were identified. The most commonly consumed wild caught fish species in the EU/EFTA include tuna, cod, Alaskan pollock, hake, herring, sardines, mackerel, trout and saithe. Although the majority of these fish are caught in the Atlantic Ocean, the Mediterranean and the Black Sea (37) as well as several areas in the Indian Ocean, imported fish may originate from any global fishing areas, with the exception of Antarctica. Based on the data, at least one zoonotic parasite has been reported in at least one fish species in each of the FAO marine fishing areas. Thus, due to relative low fish host specificity of the zoonotic parasites, the panel concluded that all wild caught fish species may be exposed to and infected with zoonotic parasites. The same applies to freshwater fishing areas, with many areas having multiple studies reporting the presence of zoonotic parasites in the wild caught fish species.

KEYWORDS

Anisakidae, epidemiology, finfish, fishery products, food safety, zoonotic parasites

CONTENTS

SUMMARY

The objective of this opinion was to determine if any wild caught fish species, originating from specific fishing grounds, and consumed in the EU/EFTA could be considered free of zoonotic parasites. Fish, an important part of European diets, may be infected with parasites that cause disease in humans. These zoonotic parasites belong to the Nematoda, Trematoda and Cestoda taxa, and infect both farmed and wild caught fish. Relevant parasites in farmed fish are described in the previously published EFSA Scientific Opinion (Part 1) arising from the same EC Mandate. However, wild caught fish are exposed to a greater range of zoonotic parasites including species in the Acanthocephala and Myxozoa taxa, all of which are described in this opinion.

The 'EU fish market' report is a comprehensive analysis of the EU fisheries and the aquaculture industry made by the European Market Observatory for Fisheries and Aquaculture (EUMOFA). According to the report for 2023, the most consumed wild caught fish species in the EU include tuna, cod, Alaskan pollock, hake, herring, sardines, mackerel, trout and saithe. Overall, data from the EUMOFA database suggests that the most consumed species are salmon, gilthead bream, hake, cod and sardines, although this data does not distinguish between farmed and caught fish and it is likely that the majority of salmon and gilthead seabream are supplied by aquaculture.

According to Eurostat (2022) the main fish species caught by European fishing vessels in 2021 included skipjack tuna, yellowfin tuna, bigeye tuna, mackerel, cod, halibut, herring, blue whiting, hake, swordfish, blue sharks, anchovy and pilchards. The EU catch was 3.5 million tonnes by live weight and the main fishing areas were in the Atlantic and Indian Oceans as well as in the Mediterranean and the Black Sea, specifically the Atlantic northeast (FAO area 27) (70%), Atlantic northwest (FAO area 21) (1%), Atlantic southeast (FAO area 47) (1%), Atlantic southwest (FAO area 41) (4%), Atlantic eastern central (FAO area 34) (7%), Mediterranean and Black Sea (FAO area 37) (10%) and Indian ocean western (FAO areas 51, 57 & 58) (7%).

Fish is also imported and the main countries exporting finfish products into the EU, based on volumes in 2023, were Norway (EFTA country), China, Ecuador, Morocco and Iceland (EFTA country) while based on value were Norway, Morocco, China, Ecuador and United Kingdom (EU Fish Market 2023).

The FAO major fishing areas include freshwater and marine areas. The former includes African inland waters (area 01), North America inland waters (02), South America inland waters (03), Asia inland waters (04), Europe inland waters (05), Oceania inland waters (06) and Antarctica inland waters (08). The marine areas are divided as follows: Arctic ocean (18), Northwest Atlantic (21), Northeast Atlantic (27), Western Central Atlantic (31), Eastern Central Atlantic (34), Mediterranean & Black Sea (37), Southwest Atlantic (41), Southeast Atlantic (47), Atlantic Antarctic (48), Western Indian Ocean (51), Eastern Indian Ocean (57), Indian Ocean Antarctic (58), Northwest Pacific (61), Northeast Pacific (67), Western Central Pacific (71), Eastern Central Atlantic (77), Southwest Pacific (81), Southeast Pacific (87) and Pacific Antarctic (88).

Anisakis sp. were reported in multiple wild caught fish species in all FAO marine fishing areas except for Indian Ocean Antarctic (58). However, *Phocanema decipiens* (s.l.) and *Contracaecum osculatum* were detected in multiple fish species caught in this area. Many different zoonotic parasites including *Dibothriocephalus* spp., *Opisthorchis* spp., *Metorchis* spp., *Haplorchis* spp., *Centrocestus* spp., *Gnathostoma* spp., *Clonorchis* spp., *Metagonimus* spp., *Cryptocotyle* spp., *Cyathocotylid* spp. and *Holostephanus* spp. were found in multiple fish species from all freshwater fishing areas, except from Antarctica inland waters (8), for which data is missing, probably because there are few if any fish in Antarctica inland waters and none that are imported into the EU.

It was therefore concluded that there are no particular species of wild caught fish originating from specific marine or freshwater fishing grounds, where the fish consumed in the EU/EFTA can be considered to be free of parasites of public health importance.

1 | INTRODUCTION

1.1 | Background and Terms of Reference as provided by the requestor

In 2010 EFSA published a scientific opinion on risk assessment of parasites in fishery products.[1] EFSA was requested in particular to analyse three aspects:

1. Assessment of food safety concerns due to possible allergic reactions from parasites in fishery products;
2. Alternative treatments for killing viable parasites and comparison with freezing method;
3. Criteria for when fishing grounds (wild-farmed) fishery products do not present a health hazard (Atlantic salmon in particular). EFSA conclusions were taken into account for modifying part D of Annex III, Section VIII, Chapter III to Regulation (EC) No 853/2004 (Commission Regulation (EU) No 1276/2011).

In fact, part D of Annex III, Section VIII, Chapter III to Regulation (EC) No 853/2004 establishes that:

1. Food business operators placing on the market the following fishery products derived from finfish or cephalopod molluscs:

   a. fishery products intended to be consumed raw; or
   b. marinated, salted and any other treated fishery products, if the treatment is insufficient to kill the viable parasite; must ensure that the raw material or finished product undergo a freezing treatment in order to kill viable parasites that may be a risk to the health of the consumer.

The freezing treatment is not carried out for fishery products:

a. that have undergone or are intended to undergo before consumption a heat treatment that kills the viable parasite. In the case of parasites other than trematodes the product is heated to a core temperature of 60°C or more for at least 1 min;
b. that have been preserved as frozen fishery products for a sufficiently long period to kill the viable parasites;
c. from wild catches, provided that: (i) there are epidemiological data available indicating that the fishing grounds of origin do not present a health hazard with regard to the presence of parasites; and (ii) the competent authority so authorises;
d. derived from fish farming, cultured from embryos and have been fed exclusively on a diet that cannot contain viable parasites that present a health hazard, and one of the following requirements is complied with:

   (i) have been exclusively reared in an environment that is free from viable parasites; or
   (ii) the food business operator verifies through procedures, approved by the competent authority, that the fishery products do not represent a health hazard with regard to the presence of viable parasites.

Before placing on the market fishery products which have not undergone the freezing treatment or which are not intended to undergo before consumption a treatment that kills viable parasites that present a health hazard, a food business operator must ensure that the fishery products originate from a fishing ground or fish farming which complies with the specific conditions referred to in one of those points. This provision may be met by information in the commercial document or by any other information accompanying the fishery products.

The ParaFishControl is an EU H2020-funded project that aims at increasing the sustainability and competitiveness of the European aquaculture industry by improving our understanding of fish-parasite interactions and by developing innovative solutions and tools for the prevention, control and mitigation of the most harmful parasitic species affecting the main European farmed fish species. The project started in 2015 and finished in 2020 and was involving a consortium of 29 partners (public and private) from 13 countries. Research related to that project demonstrated in farmed seabass, farmed seabream, turbot, and sea caged rainbow trout that no zoonotic parasites were found, concluding that the risk related to zoonotic Anisakidae appeared as negligible. The authors suggested that there is groundwork for amending the current legislation.

Other studies demonstrated that farmed fish were found to be less infected in comparison with wild fish (2%) but not Anisakis free. Farmed fish is in general reported to be considerably less infected and therefore representing a very limited food safety risk, but guaranteeing nematode free fish remains impossible.

In addition, the EFSA 2010 Opinion concluded that "no sea fishing grounds can be considered free of *A. simplex* larvae", and that "all wild caught seawater and freshwater fish must be considered at risk of containing viable parasites of human health hazard if these products are to be eaten raw or almost raw". Furthermore, the BIOHAZ Panel recommended the collection of systematic data on the complete life cycle, geographical and seasonal distribution, prevalence, intensity, and anatomical location of parasites of public health importance in wild caught fishery products.

[1] https://efsa.onlinelibrary.wiley.com/doi/pdf/10.2903/j.efsa.2010.1543

The European Union One Health 2020 Zoonoses report elaborated by EFSA and ECDC reports that in 2020, Anisakis caused two outbreaks, both reported by Spain, involving six individuals. No outbreaks were reported in 2019. The causative agent was not identified at the species level.

TERMS OF REFERENCE

EFSA is asked to update certain aspects of its Scientific Opinion of April 2010 on risk assessment of parasites in fishery products based on any new scientific evidence that may have become available since then. In particular, EFSA is requested to review and assess:

1. The occurrence of parasites of public health importance in fishery products derived from the most relevant farmed fish species in the EU (in particular, but not limited to, Atlantic salmon, seabass, farmed seabream and turbot).
2. Diagnostic methods for the detection of parasites of public health importance in fishery products from such farmed fish species.
3. Technical developments and new scientific data available in relation to killing viable parasites of public health importance in fishery products, in particular treatments other than freezing.
4. Whether any particular species of wild caught fish originating from specific fishing grounds could be regarded as not representing a health hazard with regards to the presence of parasites of public health importance.

TORs 1–3 (Part 1) are addressed in EFSA BIOHAZ Panel (EFSA BIOHAZ Panel, 2024), while TOR 4 is addressed in this opinion (Part 2).

1.2 | Interpretation of the Terms of Reference

ToR 4 was translated into the following assessment question (AQ):

AQ4: Are there any particular species of wild caught fish originating from specific fishing grounds, where fish consumed in the EU/EFTA are caught, that are free of parasites of public health importance?

To answer AQ4, the following was clarified with the requestor:

- While the previous EFSA scientific opinion from 2010 (EFSA BIOHAZ Panel, 2010) is considered, this opinion focuses on information and data generated since then. Accordingly, the information/literature/data to be revised covered the period from 2010 (inclusive) to 2024.
- Allergies are not covered by the current assessment.
- The FAO[2] categorisation of fishing grounds is used in this opinion which includes marine, brackish and freshwater.
- Although the legal definition for 'fishery products' covers all marine water or freshwater animals (except for live bivalve molluscs, live echinoderms, live tunicates and live marine gastropods, and all mammals, reptiles and frogs) whether wild or farmed and including all edible forms, parts and products of such animals (EC 853/2004), for the purposes of this opinion only wild caught finfish species are covered. Moreover, only fresh fish were considered and frozen fish were excluded as freezing in an effective method for killing parasites.
- Only zoonotic parasites that infect finfish are considered. Parasites that do not naturally infect finfish but are found in contaminated waters (e.g. *Cryptosporidium*, *Giardia*, *Toxoplasma, Blastocystis*) and may be present in their gastrointestinal tract and subsequently cross-contaminating fish during processing, are excluded.

Most of the parasites considered in this opinion infect multiple fish species but exceptions exist. Thus, most fish species are considered susceptible to some extent. Therefore, it was considered that the presence of at least one parasite of public health importance, in at least one fish species, indicated that the fishing areas in which that fish was caught were not parasite-free and all fish species from that fishing area could potentially be infected with zoonotic parasites.

As the vast majority of studies to date in the marine environment have focused on *Anisakis*, this was used as an 'indicator' parasite and the focus of the literature search was to identify and review scientific papers that examined wild caught fish for this parasite. If detected, it was considered that all fish from the fishing ground where this parasite occurs, represented a hazard with regards to the presence of parasites of public health importance. If there was no record of occurrence of *Anisakis* in fish from a fishing ground or all tests were negative, other parasites, including *Contracaecum osculatum* (s.l.) and/or *Phocanema* sp. were then considered. If there were still no records of parasite detection, all of the parasites described in Section 1.3.2 were considered.

As the entire life cycles of zoonotic *Anisakis* are usually not completed in freshwater ecosystems, these parasites are not used as an indicator for the presence of zoonotic parasites in freshwater fishing areas. Instead, the literature search was extended to cover other zoonotic parasites in all fish species caught in freshwater areas (see Section 1.3.2, Table 1).

[2]FAO. FAO Major Fishing Areas. [Cited 1 November 2020]. https://www.fao.org/fishery/en/area/search.

1.3 | Additional information

1.3.1 | Update to EFSA BIOHAZ 2010 scientific opinion

In the previous BIOHAZ Panel opinion (EFSA BIOHAZ Panel, 2010) data on the prevalence of zoonotic parasites was provided for several species of wild caught fish. Given that all tested fish from various fishing grounds were found to be positive for *A. simplex*, it was concluded that no sea fishing grounds could be confirmed as parasite-free.

However, it is important to note that to the best of our knowledge there is currently only one long term (since 2006) fish-parasite surveillance programme in Europe.[3] This is in operation in Norway where commercially important pelagic fish species (Atlantic cod, tusk, blue whiting, herring and Atlantic mackerel) are routinely tested for *A. simplex*.

While climate change (primarily increasing surface water temperatures) is driving changes in the geographical distribution of specific parasites in marine ecosystems, changes in occurrence seem to be largely associated with changes in definitive host population abundance (Selstad Utaaker & Robertson, 2015; van Weelden et al., 2021). The impact of climate change on fish-borne parasites in freshwater systems appears to be more complex and, thus, more difficult to assess.

Some widely distributed fish-borne zoonotic parasites such as the trematode *Opisthorchis viverrini* and the cestode *Dibothriocephalus latus*, for example, are both characterised by a two intermediate host life cycle and may benefit from higher ambient water temperatures which enhances their transmission efficiency (Poulin, 2006; Wicht et al., 2009). However, long-lasting droughts and loss of wetlands, events expected to occur in many parts of the world, may result in reduced freshwater snail and fish population size and distribution. This too may lower the transmission rate of some important zoonotic trematode species (e.g. *O. viverrini)* to humans due to the reduced availability of freshwater fish as part of the daily diet in some regions of southern Asia (Marks, 2011).

There is also evidence that the increasing population of marine mammals in the Baltic Sea, due to conservation efforts protecting these animals, is positively correlated with an observed increase of anisakid infections of various fish stocks (Buchmann, 2023; Zuo et al., 2018).

1.3.2 | Parasites in wild caught fish

As reported in EFSA BIOHAZ Panel (2010), the zoonotic parasites of public health relevance in fishery products include species belonging to nematodes, trematodes and cestodes. Information on their life cycle and the distribution of the parasites in the fish body/muscles, was included in that scientific opinion. An update of the information currently available on the parasites infecting farmed fish tested in European waters is provided by the EFSA BIOHAZ Panel in (EFSA BIOHAZ Panel, 2024) including the nematodes Anisakidae. Other relevant species belonging to the acanthocephalan genus *Bolbosoma* (i.e. *B. capitatum* and *B. nipponicum*) and the genus *Corynosoma* (i.e. *C. villosum* and *C. validum*), as well as the relevant species of myxosporidian genus *Kudoa* (i.e. *K. septempunctata* and *K. hexapunctata*) are also described in that document. Parasites of public health to which wild fish are exposed are summarised in Table 1. Information on these parasites, if not already covered in part 1 of this opinion, is provided below.

TABLE 1 Overview of the parasite species of public health importance found in wild caught fish.

Parasite phylum/class	Parasite family	Zoonotic parasite species
Nematoda/Chromadorea	Anisakidae	*Anisakis pegreffii*
		Anisakis simplex (s.s.)
		Anisakis typica sp. A
		Anisakis typica sp. B
		Phocanema decipiens (s.s.)
		Phocanema krabbei
		Phocanema bulbosa
		Phocanema azarasi
		Phocanema cattani
		Phocanema decipiens sp. E
		Contracaecum osculatum (s.s.)
		Contracaecum osculatum A
		Contracaecum osculatum B

[3] https://www.hi.no/en/hi/forskning/research-groups-1/fremmed-og-smittestoff-fres

TABLE 1 (Continued)

Parasite phylum/class	Parasite family	Zoonotic parasite species
Nematoda/Secernentea	Gnathostomatidae	*Gnathostoma spinigerum*
		Gnathostoma binucleatum
		Gnathostoma hispidum
		Gnathostoma doloresi
		Gnathostoma nipponicum
Nematoda/Enoplea	Capillaridae	*Paracapillaria philippinensis*
	Dioctophymatidae	*Dioctophyme renale*
		Eustrongylides excisus
Platyhelminthes/Trematoda	Opisthorchiidae	*Opisthorchis viverrini*
		Opisthorchis felineus
		Clonorchis sinensis
		Amphimerus pseudofelineus
		Metorchis conjunctus
		Metorchis orientalis
		Pseudamphistomum truncatum
	Heterophyidae	*Heterophyes heterophyes*
		Heterophyes nocens
		Metagonimus yokogawai
		Metagonimus takahashii
		Metagonimus miyatai
		Centrocestus formosanus
		Haplorchis taichui
		Haplorchis pumilio
		Haplorchis yokogawai
		Pygidiopsis summa
		Cryptocotyle lingua
	Clinostomidae	*Clinostomum complanatum*
	Echinostomatidae	*Echinostoma hortense*
		Echinochasmus perfoliatus
		Echinochasmus japonicus
		Echinochasmus liliputanus
		Echinochasmus fujianensis
	Nanophyetidae	*Nanophyetus salmincola*
	Cyathocotylidae	*Paracoenogonimus ovatus*
Platyhelminthes/Cestoda	Bothriocephalidae	*Dibothriocephalus latus*
		Dibothriocephalus dendriticus
		Dibothriocephalus nihonkaiensis
		Dibothriocephalus lanceolatus
		Adenocephalus pacificus (syn *Diphyllobothrium pacificum*)
Rotifera/Acanthocephala	Polymorphidae	*Bolbosoma nipponicum*
		Bolbosoma capitatum
		Corynosoma strumosum
		Corynosoma validum
		Corynosoma villosum
Cnidaria/Myxozoa	Kudoidae	*Kudoa hexapunctata*
		Kudoa septempunctata

1.3.2.1 | *Nematodes*

The phylum Nematoda includes the families Anisakidae, Gnathostomatidae, Capillaridae and Dioctophymatidae. *Gnathostoma* nematodes are heteroxenous parasites. The adult worms live and spawn in a tumour-like mass in the stomach of the definitive mammalian host. The eggs are released by the host's faeces into the freshwater environment, where they develop and hatch into the first-stage larvae (L1). These larvae are then ingested by the first intermediate host, a freshwater copepod, where they develop into the second-stage larvae (L2). When the infected copepods are preyed upon by the second intermediate host such as a fish or tadpole, L2 migrate into the host's muscular tissue where they develop into third-stage larvae (L3). Finally, L3 in the second intermediate, transport or paratenic host are ingested by a definitive host, where they migrate to the liver and the abdominal cavity after penetrating the gastric wall. Later they return to the gastric wall and develop into adults. The development from L3 to the adult stage usually takes 6–8 months. When L3 are eaten by paratenic hosts such as frogs, snakes, birds and mammals as well as humans, which may act as accidental host, they migrate through host tissues and remain encysted in their muscles. Human gnathostomiasis can occur through the ingestion of raw or undercooked meat of intermediate hosts, such as fish, frogs, snakes or poultry, which contains infective L3. Oral infection can also occur through drinking water, contaminated with infected copepods. Human gnathostomiasis is considered an emerging global zoonosis (Liu et al., 2020). To date, approximately 5000 cases of human gnathostomiasis have been reported worldwide, mainly from endemic areas in Japan and China, Thailand and other parts of Southeast Asia, as well as Mexico, Colombia and Peru in South America. Gnathostomiasis has also been reported, albeit less frequently, in travellers who have visited endemic areas. The most common clinical signs of the disease are migratory cutaneous swellings and eosinophilia. In severe cases, L3 also invades internal organs such as the liver, eyes, nerves, spinal cord and brain, resulting in blindness, nerve pain, paralysis, coma and even death (Nogrado et al., 2023).

Paracapillaria philippinensis, a pathogenic species originally isolated from human patients, is presumed to have a sylvatic life cycle, which involves birds that feed on fish, but the definitive natural host of this species remains unknown (Arumugam et al., 2024).

The most relevant genus of the Dioctophymatidae family are the *Eustrongylides*, which have a global distribution (Northern and Southern America, Europe, Asia) (Honcharov et al., 2022) and an indirect life cycle, involving a wide range of freshwater fish species and fish-eating birds. These act as definitive hosts, while oligochaetes, mainly annelids, act as first intermediate hosts, and benthic and planktivorous fish are the second intermediate hosts. In the second intermediate host the third-stage larva moults into the fourth stage (L4) and remains as L4 until ingestion by the definitive host (Moravec, 2013). L4 larvae can also be accumulated in predatory fish species, serving as paratenic hosts. Some fish species have been found infected in Europe, mainly in lakes from Italy (Castiglione et al., 2023). To date, there have been very few reports of human infection attributed to larval *Eustrongylides* and those that have occurred are from the USA and Sudan (Eberhard et al., 1989; Eberhard & Ruiz-Tiben, 2014). In the USA, cases have been characterised by abdominal pain within 24 h of eating either bait minnows or after the consumption of fresh fish used to prepare sushi and sashimi. In Sudan, the cutaneous finding of *Eustrongylides* in two patients was based on morphological identification (Eberhard & Ruiz-Tiben, 2014).

1.3.2.2 | *Trematodes*

There are at least 29 different fish-borne trematode species that infect humans. These belong to several genera including *Opistorchis, Clonorchis, Metagonimus, Heterophyes, Haplorchis, Centrocestus* and *Cryptocotyle* (*C. lingua*) and infect an estimated 7 million people annually (Chai & Jung, 2017). These digeneans are contracted by humans ingesting raw or improperly cooked freshwater or brackish water fish (Chai & Jung, 2024). Human infections are reported globally, but the major endemic areas are in Asian countries, including Korea, China, Taiwan, Vietnam, Laos, Thailand, Malaysia, Indonesia, the Philippines and India (Chai & Jung, 2017). In the case of *Opistorchis*, several outbreaks have been reported in Europe, especially Italy (Orlando et al., 2008).

Clinical manifestations may include abdominal pain, diarrhoea, lethargy, anorexia and weight loss (Chai & Jung, 2024). However, the severity of symptoms is variable, and it depends on the intensity of infection, immune status of the patient and previous history of infection with flukes (Chai & Jung, 2024). In addition, in immunocompromised patients the infection may have a severe clinical course, including ectopic migration of the flukes (i.e. extraintestinal heterophyiasis) in the heart and brain (Chai et al., 2000). *H. heterophyes* and *H. nocens*, for example, may cause cerebral damage, inducing epilepsy and brain cysts (Zhang, 1990).

The family Clinostomidae, genus *Clinostomum* includes digenean species with a complex life cycle. Freshwater gastropods act as first intermediate hosts, fish and amphibian species as second intermediate hosts harbouring the metacercariae, while fish-eating birds are the definitive hosts. Humans can be accidental hosts, after consumption of raw or undercooked freshwater fish (in some cases even brackish fish, such as mullet) infected with metacercariae, causing a fish-borne zoonosis responsible for a rare disease known as Halzoun syndrome. In human infections, *C. complanatum* metacercaria excysts in the stomach and then migrates and attaches to the throat causing pharyngitis or laryngitis. Ectopic migration may also occur. Tiewchaloern et al. (1999) reported a case of eye infection. Human clinostomiasis has been reported in America, Southeast Asia and Eastern Europe. The main source of infection are commercially important fish, such as European perch (*Perca fluviatilis*). Menconi, Manfrin, et al. (2020) reported a 18.75% prevalence in fish from a subalpine lake (Lake Endine) in North Italy, while a prevalence of 13.1% was reported in fish in Türkiye (Çolak, 2013). Kadlec et al. (2003)

reported a 15% prevalence in a study undertaken in the Morava River basin, Czech Republic. Soylu (2015) suggested that fish prevalence correlated with migratory routes of fish-eating birds hosting *Clinostomum complanatum*.

1.3.2.3 | *Cestodes*

Cestodes of the genus *Dibothriocephalus* (syn. *Diphyllobothrium*) include at least 13 species that infect humans. These cestodes are widely distributed in fish, mammal and bird hosts (EFSA BIOHAZ Panel, 2024) from temperate and cold-water environments. The species *D. latus* is the main species infecting humans in Europe (Kuchta et al., 2015). Human diphyllobothriosis due to *D. latus* has re-emerged in the subalpine region of Italy (Lago Maggiore and Lago di Como), Lake Geneva and from France, while it shows a decrease in other historically endemic areas, such as the Baltic countries (Kuchta et al., 2015). Raw fillets of perch (*P. fluviatilis*) are a major source of human infection. Sporadic cases of human diphyllobothriosis have also been reported in central and western European countries. As the latter countries are free of these parasites, the cases were attributed to the consumption of imported fish (Kuchta et al., 2015).

The Pacific broad tapeworm *A. pacificus* (syn. *D. pacificum*) is the causative agent of the third most common fish-borne cestodosis in humans. Although most of the nearly 1000 cases have been reported in South America (Peru, Chile and Ecuador), recently reported cases in Europe demonstrate the potential for the spread of this tapeworm globally, as a result of global trade of fresh or chilled marine fish, and travel or migration of humans. Moreover, these parasites have re-emerged in marine fish species, such as hake (Cantatore et al., 2023) that may now serve as a source of human infection when eaten raw or undercooked (Mondragón-Martínez et al., 2020).

1.3.2.4 | *Acanthocephalans*

Acanthocephalans of the genus *Corynosoma* use marine mammals (pinnipeds) as definitive hosts, in which the adult parasite attaches to the gastro-intestinal mucosa. Fish acts as paratenic hosts carrying the juvenile stage in mesenteries of the gastrointestinal tract. Human consumption of raw or semi-raw fish dishes may lead to infection and disease (Buchmann & Karami, 2024). A total of 50 species within the genus are recognised, but only few have been recovered from human patients. The first report of a human infected with a *C. strumosum* was from Alaska (Schmidt, 1971). Several other human infections were caused by *C. validum* (Takahashi et al., 2016) and/or *C. villosum* (Fujita et al., 2016) in Japan. The infections were all related to the consumption of raw marine fish.

1.3.3 | Consumption of wild caught finfish in the EU

Apparent consumption [AC = (catches + aquaculture production + imports) – exports, EUMOFA] of fishery and aquaculture products in the EU increased in 2021 as compared to 2020 by 10.60 million tonnes Live weight equivalent (LWE),[4] or by 2%, mainly linked to a growth in farmed production (European seabass) and imports (blue whiting and salmon).

The most consumed species in the EU (LWE per capita per year) are tuna (2.86 kg), salmon (2.60 kg), cod (1.75 kg), Alaskan pollock (1.68 kg), hake (1.02 kg), herring (1.00 kg), sardines (0.54 kg), mackerel (0.53 kg), trout (0.49 kg) and saithe (0.36 kg) (EUMOFA EU Fish Market, 2023).

According to EUMOFA database (2023)[5] the most consumed species by households as a percentage of total volume are salmon, gilthead seabream, hake, cod and sardine. Although no distinction between wild caught and aquaculture is provided, the majority of salmon and gilthead seabream were supplied by aquaculture (Figure 1).

[4]Live weight equivalent (LWE) means weight calculated based on conversion factors from the weight recorded on landing, or from the net weight of the various processed products.

[5]European Market Observatory for Fisheries and Aquaculture Products database. Available at: https://eumofa.eu/data.

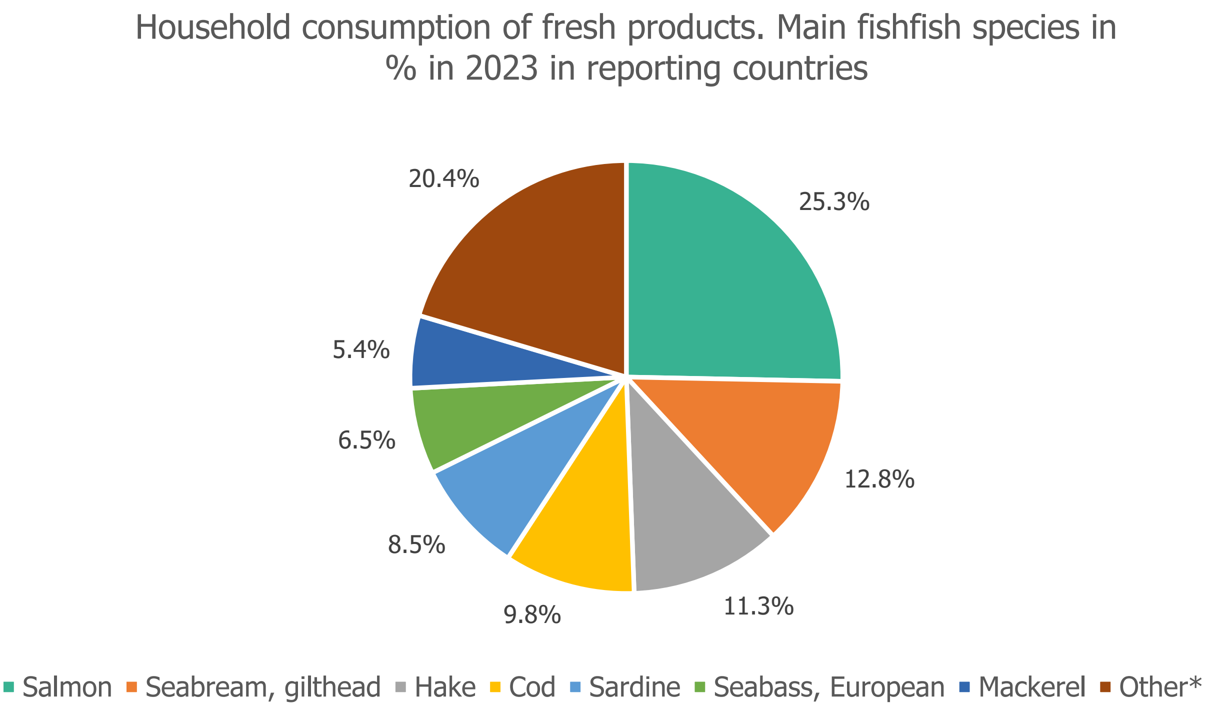

FIGURE 1 Household consumption of fish, in % of total volume, in 2023, for reporting countries. Graph built by EFSA based on EUMOFA database (https://eumofa.eu/household-consumption-of-fresh-products). *The category 'other' includes categories 'sole, other' (3,24%); 'trout' (2,80%); "tuna, miscellaneous (2,75%); 'monkfish' (2,01%); 'anchovy' (1,71%); 'saithe (also known as coalfish)' (1,71%); 'swordfish' (1,57%); 'carp' (1,05%); 'herring' (0,76%); 'other freshwater fish' (0,76%); 'whiting' (0,59%); 'Allskan pollock' (0,38%); 'pangasius' (0,29%); 'scabbardfish' (0,29%); 'plaice, other' (0,19%); 'haddock' (0,16%); 'flounder, other' (0,10%); 'other salmonids' (0,02%); 'halibut, other' (0,01%); 'pike-perch' (0,01%); 'dab' (0,00%).

1.3.4 | Landings of finfish in the EU

The total EU catch[6] in 2022 was an estimated 3.4 million tonnes live weight. The fishing fleets of Spain, France, Denmark and the Netherlands accounted for a about half of the total amount of aquatic organisms caught by Member States in 2022.

About 70% of all EU catches in the seven marine areas covered by EU statistics were taken in the Atlantic, Northeast area (FAO area 27). The key species caught in this area in 2022 were herring (19% of the live weight caught in this region), sprat (14%), blue whiting (11%) and mackerel (10%).

About 10% of the total EU catch was taken in the Mediterranean and Black Sea (FAO area 37), where the main species caught were sardines (22% of the EU catch in the area) and anchovies (18%).

About 7% of the total EU catch was taken in the Atlantic, Eastern Central area (FAO area 34), where the main catches were mackerel and yellowfin tuna.

About 7% of the total EU catch was taken in the Indian Ocean, Western area (FAO areas 51, 57 & 58), where the main catch was tuna, particularly skipjack, yellowfin and bigeye tuna.

Only 6% of the total EU catch was taken in three remaining marine areas. The main species caught in these areas were the following: hake in the Atlantic, Southwest area (FAO area 41) (4%); blue sharks and skipjack tuna in the Atlantic, Southeast area (FAO area 47) (1%); and redfish, cod and halibut in the Atlantic, Northwest area (FAO area 21) (1%).

The quantity of all aquatic organisms landed in the EU in 2022 is estimated to have been about 3.2 million tonnes product weight, representing no change from the estimated 3.2 million tonnes landed in 2021 (Figure 2).

[6]Fish catches cover fish, molluscs, crustaceans and other aquatic animals, residues and aquatic plants that are taken for all purposes, by all types and class of vessel, gear and fishermen, operated in all the seven marine areas legally covered by EU statistical regulations.
Source:https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Fisheries_-_catches_and_landings#:~:text=The%20total%20EU%20catch%20in,3.4%20million%20tonnes%20live%20weight.

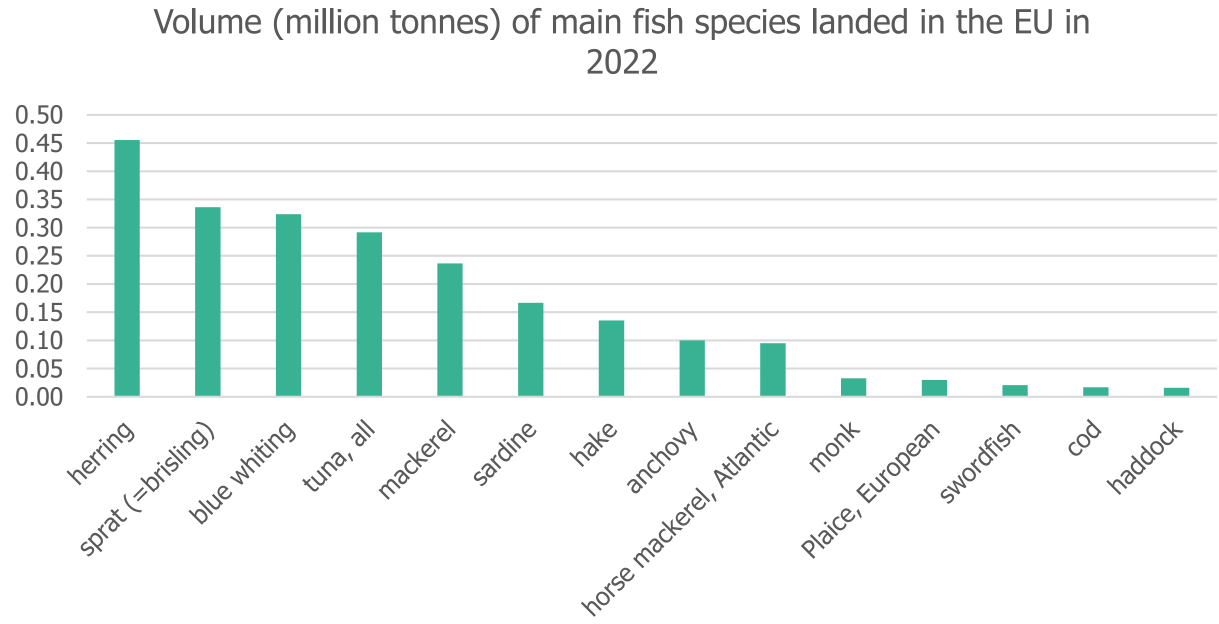

FIGURE 2 The main fish species landed in the EU by volume in 2022. The category 'tuna, all' includes categories 'tuna, albacore'; 'tuna, bigeye'; 'tuna, bluefin'; 'tuna, miscellaneous'; 'tuna, skipjack'; 'tuna, yellowfin'. Graph built by EFSA based on EUMOFA database (https://eumofa.eu/landings).

1.3.5 | Import of finfish into the EU

The volume of EU imports in 2022 is shown in Figure 3. The five top importing member states (MS) by volume were Spain, Denmark, Sweden, the Netherlands and France. The five top countries exporting finfish products into the EU were Norway, China, Ecuador, Morocco and Iceland, based on volume recorded in 2023 (EC DG-MARE, 2023). It should be noted that this data includes both farmed and caught fish.

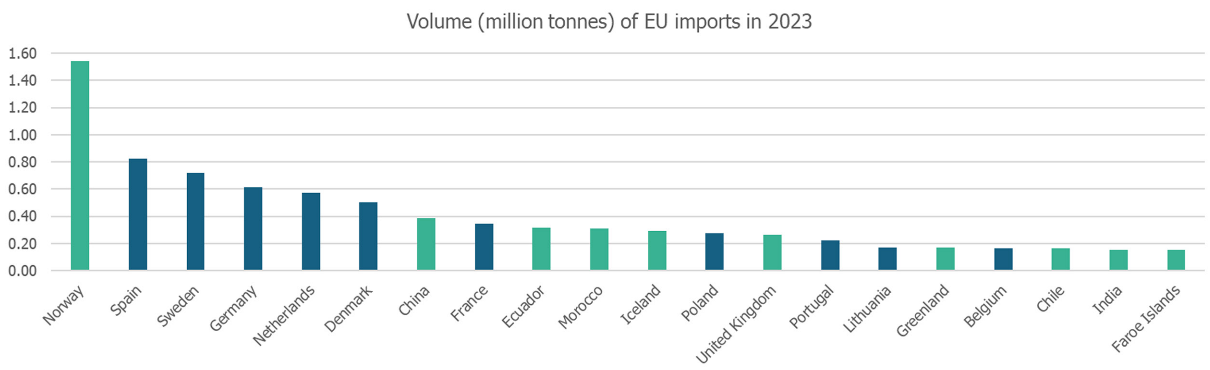

FIGURE 3 Volume (million tonnes) of fishery products imports by countries into the EU, 2023. Graph built by EFSA based on EUMOFA database (https://eumofa.eu/import-export).

Intra-EU trade reached 6 million tonnes in 2023. The most imported fish species were salmon (mostly from aquaculture) from Norway (FAO sub area 27.2), cod also mainly from Norway, Alaska pollock (a large amount was imported as frozen fillets, originating from China), tuna skipjack tuna and yellowfin tuna being the most commonly imported tunas, originating mostly from Ecuador (FAO area 87) and the Seychelles (FAO area 51), respectively. The most important exporting countries were harvesting fish from geographically dispersed locations that make it difficult to define the original fishing areas.

A summary of the available information is provided in Appendix A.

1.3.6 | Fishing grounds that are the source of fish imported, landed and/or consumed in the EU

The FAO 'Major Fishing Areas for Statistical Purposes' is the world largest and complete mapping systems of the marine and freshwater areas for fishing purposes. It includes 8 inland waters (freshwater fishing areas) and 19 major marine fishing areas Figure 4.

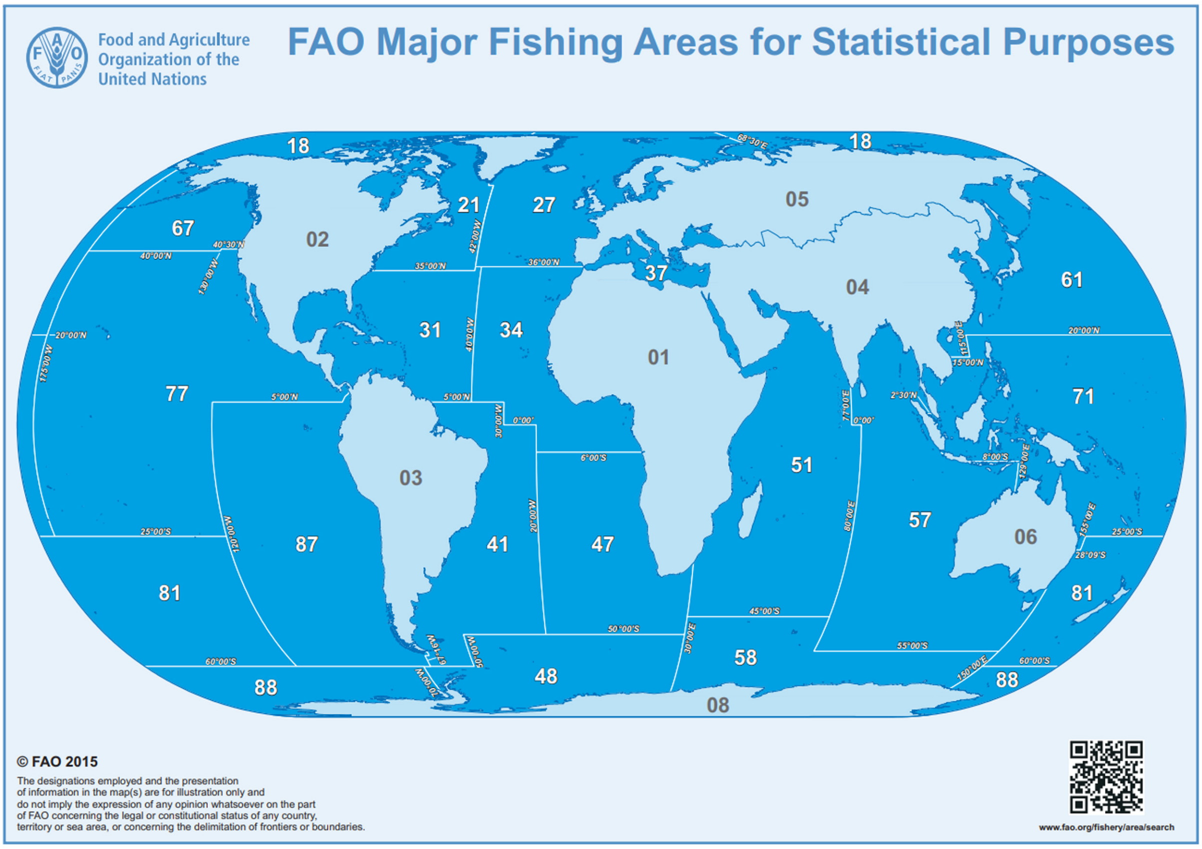

FIGURE 4 FAO major fishing areas.[7] Source: *Food and Agriculture Organization of the United Nations. Reproduced with permission*.

The main fishing grounds for the EU fishing fleet are located in FAO fishing areas 27 and 37 as detailed in Table 2. However, fish consumed in the EU may be caught and imported from a wide range of different fishing grounds as shown in Table 3.

TABLE 2 Main fishing ground for EU fishing vessels.

FAO area	Description	Fleet country of origin
27	North Sea and Eastern Arctic	Mostly Denmark, the Netherlands and Germany
27	Baltic Sea	Estonia, Finland, Latvia, Poland, Denmark, Germany, Lithuania, Sweden
27	North Western Waters	Mainly France and Ireland, followed by Belgium, Denmark, Spain and the Netherlands
27	South Western Waters	Spain, France, Portugal
37	Mediterranean Sea	Cyprus, Croatia, Greece, Italy, Malta and Slovenia
37	Black Sea	Bulgaria and Romania

[7]FAO fishing areas: Marine areas: 18-Arctic ocean, 21-Northwest Atlantic, 27-Northeast Atlantic, 31-Western Central Atlantic, 34-Eastern Central Atlantic, 37-Mediterranean & Black Sea, 41-Southwest Atlantic, 47-Southeast Atlantic, 48-Atlantic, Antarctic, 51-Western Indian Ocean, 57-Eastern Indian Ocean, 58-Indian Ocean, Antarctic, 61-Northwest Pacific, 67-Northeast Pacific, 71-Western Central Pacific, 77-Eastern Central Atlantic, 81-Southwest Pacific, 87-Southeast Pacific, 88-Pacific Antarctic. Freshwater areas: 01-African inland waters, 02-North America inland waters, 03-South America inland waters, 04-Asia inland waters, 05 Europe inland waters, 06 Oceania inland waters, 08-Antarctica inland waters The fishing area 07 ('Former USSR area – Inland waters') referred to the area that was formerly the Union of Soviet Socialist Republics. Starting with the data for 1988, information for each new independent Republic is shown separately. The new independent Republics are: Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan (statistics assigned to the fishing area 'Asia – Inland waters') and Belarus, Estonia, Latvia, Lithuania, Republic of Moldova, Russian Federation, Ukraine (statistics assigned to the fishing area 'Europe – Inland waters'). Source: https://www.fao.org/fishery/en/area (last accessed 22/10/2024).

TABLE 3 The FAO fishing areas where the main fish species imported into the EU are caught.

Fish	Imports to EU (million tonnes, 2023)*	FAO fishing area**
Tuna, all	0.915	Area 21 – Atlantic, Northwest
		Area 27 – Atlantic, Northeast
		Area 31 – Atlantic, Western Central
		Area 34 – Atlantic, Eastern Central
		Area 37 – Mediterranean and Black Sea
		Area 41 – Atlantic, Southwest
		Area 47 – Atlantic, Southeast
		Area 51 – Indian Ocean, Western
		Area 57 – Indian Ocean, Eastern
		Area 61 – Pacific, Northwest
		Area 67 – Pacific, Northeast
		Area 71 – Pacific, Western Central
		Area 77 – Pacific, Eastern Central
		Area 81 – Pacific, Southwest
		Area 87 – Pacific, Southeast
Cod	0.639	Area 21 – Atlantic, Northwest
		Area 27 – Atlantic, Northeast
		Area 31 – Atlantic, Western Central
		Area 37 – Mediterranean and Black Sea
		Area 41 – Atlantic, Southwest
Herring	0.521	Area 2 – America, North - Inland waters
		Area 21 – Atlantic, Northwest
		Area 27 – Atlantic, Northeast
		Area 31 – Atlantic, Western Central
		Area 5 – Europe – Inland waters
Mackerel	0.359	Area 21 – Atlantic, Northwest
		Area 27 – Atlantic, Northeast
		Area 31 – Atlantic, Western Central
		Area 34 – Atlantic, Eastern Central
		Area 37 – Mediterranean and Black Sea
Hake	0.281	Area 27 – Atlantic, Northeast
		Area 34 – Atlantic, Eastern Central
		Area 37 – Mediterranean and Black Sea
Saithe (=coalfish)	0.164	Area 18 – Arctic Sea
		Area 21 – Atlantic, Northwest
		Area 27 – Atlantic, Northeast
		Area 31 – Atlantic, Western Central
Sardine	0.162	Area 1 – Africa – Inland waters
		Area 27 – Atlantic, Northeast
		Area 34 – Atlantic, Eastern Central
		Area 37 – Mediterranean and Black Sea
		Area 4 – Asia – Inland waters
		Area 5 – Europe – Inland waters
Seabream, gilthead	0.126	Area 27 – Atlantic, Northeast
		Area 34 – Atlantic, Eastern Central
		Area 37 – Mediterranean and Black Sea
		Area 5 – Europe – Inland waters

(Continues)

TABLE 3 (Continued)

Fish	Imports to EU (million tonnes, 2023)*	FAO fishing area**
Seabass, European	0.0847	Area 1 – Africa – Inland waters
		Area 27 – Atlantic, Northeast
		Area 34 – Atlantic, Eastern Central
		Area 37 – Mediterranean and Black Sea
		Area 4 – Asia – Inland waters
		Area 5 – Europe – Inland waters

Sources
*https://eumofa.eu/import-export.
**The distribution of fish species per fishing area was taken from https://fish-commercial-names.ec.europa.eu/fish-names/home_en (species distribution and habitat).

2 | DATA AND METHODOLOGIES

2.1 | Literature search

The evidence on the presence of zoonotic parasites in wild caught fish from any fishing grounds was retrieved from studies published between 2010 and 2023 (inclusive).

Under the grant agreement GP/EFSA/BIOHAW/2023/05,[8] the Pathogens in Food (PIF) consortium performed a systematic review on anisakids and other zoonotic parasites. PIF conducted in Distiller[SR] a literature screening and data extraction (in Excel format) on anisakids and then, on anisakids/ other parasites in wild caught fish, from all countries and covering studies published in Spanish, English, Portuguese and French, between January 2010 and September 2023. The search protocol for the occurrence of anisakids and other zoonotic parasites in wild caught finfish was as described by Kooh et al. (2023). These data will be incorporated in the PIF database accessible through a web application (https://pif.esa.ipb.pt/). Overall, data from 274 studies/papers were extracted for anisakids and from 166 papers for other parasites.

In addition, a non-systematic literature search was performed to retrieve specific missing data for fishing areas without search results. The relevance of the records was assessed by screening the title, keywords and the abstract. The review included scientific review papers, book chapters, peer-review papers and other documents known by the experts or retrieved through non-systematic searches.

2.2 | Uncertainty analysis

As recommended by the EFSA guidance and related principles and methods on uncertainty analysis in scientific assessments (EFSA Scientific Committee, 2018a; EFSA Scientific Committee, 2018b), an uncertainty analysis was undertaken as described in the protocol which is available in the Supporting Information section of Part 1 of this opinion (EFSA BIOHAZ Panel, 2024, Annex A). The sources of the main uncertainties related to ToR4 were identified by the experts in the WG and their impact on the uncertainty of the answers to the AQ4 were discussed. Consensus expert judgement within the WG, informed by the collected evidence and expert knowledge, was used to assess the certainty of the answer to the AQ4.

3 | ASSESSMENT

3.1 | Assessment of the presence of zoonotic parasites in caught finfish in marine fishing areas

Anisakis sp. were reported to be detected in many wild caught fish species in all FAO marine fishing areas except area 58 (Indian Ocean, Antarctic), for which there was no data on the occurrence of *Anisakis* sp. (Table 4). However, *P. decipiens* (s.l.) and *C. osculatum* (s.l.) were found in multiple fish species from fishing area 58 (Lukashanets et al., 2021).

[8]EFSA's grant agreement GP/EFSA/BIOHAW/2023/05 (Pathogens in foods database: extension with Vibrio and parasites) with as beneficiaries Instituto Politécnico de Bragança (IPB) as coordinator and Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail (Anses) as co-beneficiary.

TABLE 4 Occurrence of zoonotic *Anisakis* species in finfish caught in FAO marine fishing areas. Full details are provided in Thébault et al., 2024

FAO marine fishing areas	Fish species	References
Area 18: Arctic Sea	*Boreogadus saida*	Køie (2009)
Area 21: Northwest Atlantic	*Merluccius bilinearis*	Fuentes, Madrid, Cuesta, et al. (2022)
	Gadus morhua	McClelland and Melendy (2011), Mouritsen et al. (2010), Münster et al. (2015), Severin et al. (2020)
	Gadus ogac	Mouritsen et al. (2010)
Area 27: Atlantic, Northeast	*Belone belone*	Rolbiecki et al. (2020)
	Clupea harengus	Bao et al. (2017), Levsen and Lunestad (2010), Levsen, Svanevik, et al. (2018), Mattiucci, Giulietti, et al. (2018), Shevchuk et al. (2020), Unger et al. (2014)
	Dicentrarchus labrax	Bernardi et al. (2011)
	Engraulis encrasicolus	Dessier et al. (2016), Domingo-Hernandez et al. (2023), Rodríguez, Abollo, et al. (2018), Rodríguez, González, et al. (2018)
	Gadus morhua	Gay et al. (2018), Hauksson et al. (2012), Karami et al. (2022), Klapper et al. (2018), Levsen et al. (2022), Mehrdana et al. (2014), Mercken et al. (2021), Münster et al. (2015), Nadolna-Altyn et al. (2022), Nadolna and Podolska (2014), Najda et al. (2018), Sobecka et al. (2011)
	Helicolenus dactylopterus	Sequeira et al. (2010)
	Lepidorhombus boscii	Levsen, Svanevik, et al. (2018), Rodríguez, Abollo, et al. (2018) Rodríguez, González, et al. (2018)
	Lophius budegassa, Lophius piscatorius	Rodríguez, Abollo, et al. (2018), Rodríguez, González, et al. (2018)
	Mallotus villosus	Levsen et al. (2016), Rolbiecki and Izdebska (2023)
	Melanogrammus aeglefinus	Levsen et al. (2022), Pierce et al. (2018)
	Merlangius merlangus	Gay et al. (2012), Pierce et al. (2018)
	Merluccius merluccius	Casti et al. (2017), Ceballos-Mendiola et al. (2010), Cipriani et al. (2015), Diez et al. (2022), Fuentes, Madrid, Cuesta, et al. (2022), Pascual et al. (2018), Rodríguez, Abollo, et al. (2018), Santos et al. (2022), Tejada et al. (2014)
	Micromesistius potassou	Dezfuli et al. (2021), Elena Ahuir-Baraja et al. (2021), Gómez-Mateos et al. (2016), Levsen, Svanevik, et al. (2018), Llarena-Reino et al. (2012), Madrid et al. (2012), Roca-Geronès et al. (2020), Rodríguez, Abollo, et al. (2018))
	Platichtys flesus	Marques et al. (2010)
	Pleuronectes platessa	Levsen, Svanevik, et al. (2018)
	Pollachius virens	Levsen et al. (2022)
	Reinhardtius hippoglossoides	Najda et al. (2018)
	Salmo salar	Kent et al. (2020), Mo et al. (2021), Noguera et al. (2015)
	Salmo trutta	Urquhart et al. (2010)
	Sardina pilchardus	Caballero-Huertas et al. (2023), Dessier et al. (2016), Fuentes, Madrid, Elena, et al. (2022), Molina-Fernández et al. (2015), Rodríguez, Abollo, et al. (2018)
	Scomber colias	Levsen, Svanevik, et al. (2018), Rodríguez, Abollo, et al. (2018)
	Scomber scombrus	Levsen, Cipriani, et al. (2018), Levsen, Svanevik, et al. (2018), Llarena-Reino et al. (2012), Madrid et al. (2016), Pekmezci (2014), Rodríguez, Abollo, et al. (2018)
	Sebastes mentella	Klapper et al. (2016), Klapper et al. (2015), Najda et al. (2018)
	Sprattus sprattus	Kleinertz, Klimpel, and Palm (2012)
	Trachurus picturatus	Vasconcelos et al. (2017)
	Trachurus trachurus	Debenedetti et al. (2020), Lopes et al. (2020), Roca-Geronès et al. (2020)
Area 31: Atlantic, Western-Central	*Mugil incilis*	Jaramillo-Colorado et al. (2015)
Area 34: Atlantic, Eastern Central	*Auxis thazard*	Martin-Carrillo et al. (2022)
	Dicologlossa cuneata	Buzo-Dominguez et al. (2021)
	Engraulis encrasicolus	Bouzid et al. (2023)
	Helicolenus dactylopterus	Sequeira et al. (2010)
	Katsuwonus pelamis	Hermida et al. (2018)
	Merluccius merluccius	Martin-Carrillo et al. (2022)
	Mugil cephalus	Dione et al. (2014)
	Sardinella maderensis	Ogbon et al. (2023)
	Scomber colias	Martin-Carrillo et al. (2022), Abattouy et al. (2011)
	Scomber scombrus	Biary et al. (2021), Martin-Carrillo et al. (2022)
	Trachurus picturatus	Costa et al. (2012), Costa et al. (2013), Vasconcelos et al. (2017)
	Trachurus trachurus	Abattouy et al. (2014)
	Zeus faber	Pekmezci (2019)

(Continues)

TABLE 4 (Continued)

FAO marine fishing areas	Fish species	References
Area 37: Mediterranean and Black sea	*Alosa immaculata*	Shevchuk et al. (2020)
	Conger conger	Akmirza (2012), Graci et al. (2017)
	Dicentrarchus labrax	Abouzaid et al. (2018)
	Diplodus annularis	Chaligiannis et al. (2012)
	Engraulis encrasicolus	Casti et al. (2017), Cavallero et al. (2015), Chaligiannis et al. (2012), Cipriani, Sbaraglia, Palomba, et al. (2018), Costa et al. (2016), De Liberato et al. (2013), Ferrer-Maza et al. (2016), Gazzonis et al. (2017), Goffredo et al. (2019), Guardone et al. (2017), Meloni et al. (2011), Mladineo and Poljak (2013), Ozuni et al. (2021), Pulleiro-Potel et al. (2015), Roca-Geronès et al. (2020), Serracca et al. (2014)
	Epinephelus aeneus	Bouderbala et al. (2022)
	Epinephelus marginatus	Bouderbala et al. (2022), De Benedetto et al. (2021)
	Lophius budegassa	Pulleiro-Potel et al. (2015)
	Lophius piscatorius	Costa et al. (2016)
	Merlangius merlangus	Mladineo and Poljak (2013)
	Merluccius merluccius	Casti et al. (2017), Chaligiannis et al. (2012), Cipriani, Sbaraglia, Paoletti, et al. (2018), Cipriani et al. (2015), Costa et al. (2016), Ferrer-Maza et al. (2014), Fuentes, Madrid, Cuesta, et al. (2022), Goffredo et al. (2019), Graci et al. (2017), Meloni et al. (2011), Mladineo and Poljak (2013) Ozuni et al. (2021), Pekmezci et al. (2014), Sharif and Negm-Eldin (2013)
	Micromesistius poutassou	Chaligiannis et al. (2012), Goffredo et al. (2019), Levsen, Svanevik, et al. (2018), Madrid et al. (2012), Meloni et al. (2011), Molina-Fernández et al. (2018), Pekmezci et al. (2014), Pulleiro-Potel et al. (2015), Roca-Geronès et al. (2020)
	Mullus barbatus	Chaligiannis et al. (2012), Goffredo et al. (2019), Graci et al. (2017), Ozuni et al. (2021), Pekmezci et al. (2014)
	Mullus surmuletus	Goffredo et al. (2019), Meloni et al. (2011), Pulleiro-Potel et al. (2015)
	Pagellus acarne	Benamara et al. (2020), Chaligiannis et al. (2012), Pulleiro-Potel et al. (2015)
	Pagellus erithrinus	Chaligiannis et al. (2012), Pulleiro-Potel et al. (2015)
	Sardina pilchardus	Bušelić et al. (2018), Caballero-Huertas et al. (2023), Cavallero et al. (2015), Chaligiannis et al. (2012), Costa et al. (2016), Fuentes, Madrid, Elena, et al. (2022), Goffredo et al. (2019), Graci et al. (2017), Levsen, Svanevik, et al. (2018), Meloni et al. (2011), Mladineo and Poljak (2013), Pulleiro-Potel et al. (2015)
	Sardinella aurita	Chaligiannis et al. (2012), Ozuni et al. (2021)
	Scomber colias	Casti et al. (2017), Gazzonis et al. (2017), Levsen, Svanevik, et al. (2018) Abattouy et al. (2011) Abdelsalam et al. (2020) Chaligiannis et al. (2012), Goffredo et al. (2019), Mladineo and Poljak (2013), Ozuni et al. (2021), Pekmezci et al. (2014)
	Scomber scombrus	Chaligiannis et al. (2012), Costa et al. (2016), Goffredo et al. (2019), Graci et al. (2017), Gutiérrez-Galindo et al. (2010), Levsen, Cipriani, et al. (2018), Levsen, Svanevik, et al. (2018), Madrid et al. (2016), Meloni et al. (2011), Ozuni et al. (2021), Pekmezci et al. (2014)
	Scorpaena scrofa	Aydin and Pekmezci (2023)
	Sphyraena sphyraena	Boussellaa et al. (2018)
	Sphyraena viridensis	De Benedetto et al. (2021)
	Spicara smaris	Chaligiannis et al. (2012)
	Thunnus thynnus	Mladineo et al. (2011)
	Trachurus mediterraneus	Casti et al. (2017), Meloni et al. (2011), Pekmezci et al. (2014), Tepe and Oguz (2013)
	Trachurus trachurus	Abattouy et al. (2014), Chaligiannis et al. (2012), Costa et al. (2016), Debenedetti et al. (2020), Eissa et al. (2018), Graci et al. (2017), Gutiérrez-Galindo et al. (2010), Macchioni et al. (2021), Meloni et al. (2011), Menconi et al. (2022), Ozuni et al. (2021), Roca-Geronès et al. (2020), Tantanasi et al. (2012))
	Trachurus picturatus	Meloni et al. (2011)
	Trisopterus minutus	Pulleiro-Potel et al. (2015)
	Trisopterus minutus capelanus	Goffredo et al. (2019)
	Xiphias gladius	Mattiucci et al. (2014)

TABLE 4 (Continued)

FAO marine fishing areas	Fish species	References
Area 41: Atlantic, Southwest	*Cynoscion guatucupa*	Crosi Martínez et al. (2022), Fontenelle et al. (2013)
	Lutjanus analis *Lutjanus jocu* *Lutjanus synagris* *Lutjanus vivanus*	Alves et al. (2020)
	Lutjanus purpureus	Cavalcanti et al. (2013)
	Macrodon ancylodon	Crosi Martínez et al. (2022)
	Merluccius hubbsi	Mattiucci, (2006)
	Micropogonias furnieri	Di Azevedo and Iñiguez (2018)
	Pagrus pagrus	Soares and Luque (2015)
	Plagioscion squamosissimus	Chagas de Souza et al. (2020), Rodrigues et al. (2015)
	Zenopsis conchifer	Lanfranchi et al. (2016), Lanfranchi et al. (2018)
Area 47: Atlantic, Southeast	*Brama brama* *Trachurus capensis* *Thyrsites atun* *Lophius vomerini* *Merluccius capensis* *Helicolenucs dactylopterus* *Lepidopus caudatus*	Mackintosh et al. (2018), Mattiucci, Cipriani, et al. (2018)
Area 48: Atlantic, Antarctic	*Gymnoscopelus nicholsi*	Klimpel, (2010)
Area 51: Indian Ocean, Western	*Trichiurus lepturus, Saurida undosquamis*	Cipriani et al. (2022)
	Merluccius merluccius lessepsianus	Abou-Rahma et al. (2016)
	Scomberomorus commerson	Adel et al. (2013)
Area 57: Indian Ocean, Eastern	*Epinephelus areolatus*	Kleinertz, Damriyasa, et al. (2012)
	Eupleurogrammus muticus	Bao et al. (2022)
	Johnius belangerii	Yun et al. (2022)
	Lutjanus malabaricus	Setyobudi (2011)
	Rastrelliger spp.	Setyobudi et al. (2019)
	Selar crumenophthalmus	Bao et al. (2022)
	Trichiurus lepturus	Bao et al. (2022), Setyobudi (2011)
Area 61: Pacific, Northwest	*Clupea pallasii*	Gordeev and Sokolov (2023)
	Conger myriaster	Chen et al. (2018)
	Coryphaenoides acrolepis	Kumagai and Nishino (2023)
	Gadus chalcogrammus Gadus macrocephalus	Gomes et al. (2020)
	Katsuwonus pelamis	Murata et al. (2021), Takano et al. (2021)
	Oncorhynchus gorbuscha	Gordeev and Sokolov (2023)
	Oncorhynchus keta	Gomes et al. (2020), Gordeev and Sokolov (2023), Setyobudi et al. (2011), Setyobudi et al. (2019)
	Sardinops sagax melanostictus	Gomes et al. (2020)
	Scomber australasicus	Chen and Shih (2015), Chou et al. (2011), Gomes et al. (2020), Ohnishi et al. (2023), Sonko et al. (2020)
	Scomber japonicus	Bak et al. (2014), Chen et al. (2015), Gomes et al. (2020), Hidano et al. (2021), Ohnishi et al. (2023), Suzuki et al. (2010)
	Scomberomorus niphonius	Zhao et al. (2016)
	Seriola quinqueradiata	Cho et al. (2012)
	Trachurus japonicus	Chen et al. (2015)
	Trichiurus lepturus	Chen et al. (2015), Sonko et al. (2020)
Area 67: Pacific, Northeast	*Gadus macrocephalus Sebastes alutus*	Oguz et al. (2021)
	Oncorhynchus gorbuscha *Oncorhynchus keta* *Oncorhynchus nerka*	Karl et al. (2011)

(Continues)

TABLE 4 (Continued)

FAO marine fishing areas	Fish species	References
Area 71: Pacific, Western central	*Auxis thazard* *Caranx* sp. *Katsuwonus pelamis* *Rastrelliger kanagurta*	Anshary et al. (2014)
	Carangoides malabaricus *Lutjanus johnii* *Megalaspis cordyla* *Decapterus macarellus*	Hien et al. (2021)
	Decapterus macrosoma	See et al. (2022)
	Euthynnus affinis	Anshary et al. (2014), Pambudi et al. (2021)
	Liza vaigiensis	Jabbar et al. (2012)
	Trichiurus lepturus	Hien et al. (2021), Setyobudi et al. (2023)
Area 77: Pacific, Eastern central	*Caranx caballus*	Violante-González et al. (2016)
	Clupea pallasii *Engraulis mordax* *Merluccius productus Oncorhynchus kisutch Oncorhynchus tshawytscha* *Sardinops sagax* *Trachurus symmetricus*	Jacobson et al. (2012)
	Scorpaena guttata	Rodriguez-Santiago et al. (2020)
	Sebastes miniatus	Rodríguez-Santiago et al. (2014)
Area 81: Pacific, Southwest central	*Chrysophrys auratus*	Hossen et al. (2021)
	Scomber australasicus	Hossen et al. (2023)
Area 87: Pacific, Southeast	*Brama australis*	Munoz-Caro et al. (2022), Oliva et al. (2016)
	Merluccius australis	Gonzalez-Poblete et al. (2022), Torres-Frenzel and Torres (2014)
	Mugil cephalus	Castellanos et al. (2017)
	Sarda chilensis *Scomber japonicus* *Trachurus murphyi*	Aco Alburqueque et al. (2020)
	Scomber japonicus peruanus *Trachurus symmetricus murphyi* *Merluccius gayi peruanus Brama japonica*	Martinez-Rojas et al. (2021)
Area 88: Pacific, Antarctic	*Dissostichus eleginoides*	Brickle, (2005)

3.2 | Assessment of the presence of zoonotic parasites in caught finfish in freshwater fishing areas

In freshwater fishing areas *D. latus* parasites were detected in *Pseudotolithus* spp. (ray-finned fish belonging to the family Sciaenidae) in area 1 (African inland waters) (Table 5). *Dibothriocephalus* spp. were reported in Arctic char (*Salvelinus alpinus*) caught in area 2 (North America inland waters) while *Dibothriocephalus* spp., including *D. dendriticus* and *Di. latus*, were detected in a range of fish species (*Oncorhynchus mykiss, Salmo trutta, Salvelinus fontinalis, Percichthys trucha, Salmo salar, Odontesthes mauleanum, Basilichthys australis, Oncorhynchs kisutch*) in area 3 (South America inland waters). Multiple fish species from fishing area 4 (Asia inland waters) were infected with a range of different zoonotic parasites including *Opisthorchis* spp. *Opisthorchis felineus*, *O. viverrini*, *Metorchis* spp., *M. orientalis*, *H. taichui*, *H. pumilio*, *H. yokogawai*, *Centrocestus* spp., *C. formosanus*, *H. yokogawai*, *Gnathostoma* sp., *Clonorchis* spp., *Metagonimus* spp., *D. latus*, *D. dendriticus*, *Cryptocotyle* sp., *C. sinensis*, *M. yokogawai*, cyathocotylid trematode (Trematoda: Digenea: Cyathocotylidae) and *Holostephanus* sp. Fish in area 5 (Europe inland waters) were infected with *Dibothriocephalus* spp., *D. endriticus*, *O. felineus*, *D. latus* and *Corynosoma* sp., while *Contracaecum bancrofti*, *Echinostoma* sp., *Clinostomum* sp. were reported in fish in area 6 (Oceania inland waters). There was no data for fishing area 8, possibly because there are few if any fish in Antarctica inland waters and none that are imported into the EU.

TABLE 5 Occurrence of zoonotic parasites in finfish caught in freshwater fishing areas. For presentation purposes the fish species have been omitted from this table but full details are available in Kooh et al., 2024.

FAO freshwater fishing areas	Parasites	References
Area 1: Africa – Inland waters	*Dibothriocephalus latus*	Bakare et al. (2023)
	Clinostomum sp.	Tesfaye et al. (2023)
Area 2: America, North – Inland waters	*Dibothriocephalus* spp.	Gallagher and Dick (2010)
Area 3: America, South – Inland waters	*Dibothriocephalus* spp.	Kuchta et al. (2019), Rauque et al. (2018), Torres and Puga (2011)
	Dibothriocephalus dendriticus	Rozas et al. (2012), Semenas et al. (2021), Yamasaki et al. (2023)
	Dibothriocephalus latus	Semenas et al. (2021), Torres et al. (2012), Yamasaki et al. (2023)
Area 4: Asia – Inland waters	*Opisthorchis* spp.	Labony et al. (2020), Marcus et al. (2012)
	Opisthorchis felineus	Aubakirov et al. (2022), Bonina et al., 2024, Karmaliyev et al. (2023), Liberman (2019), Liberman and Voropaeva (2018)
	Opisthorchis viverrini	Chai et al. (2019), Chai et al. (2020), Chai et al. (2014), Charoensuk et al. (2022), Dao et al. (2017), Eom et al. (2015), Kiatsopit et al. (2014), Laoprom et al. (2021), Manpratum et al. (2017), Namsanor et al. (2020), Nithikathkul et al. (2014), Nithikathkul et al. (2012), Ong et al. (2016), Onsurathum et al. (2016), Phyo Myint et al. (2020), Pinlaor et al. (2013), Pitaksakulrat et al. (2017), Prakobwong et al. (2017), Pumhirunroj et al. (2020), Rim et al. (2013), Sanpool et al. (2018), Sohn et al. (2012), Sohn, Choi, Jung, Hong, Ryoo, Chang, Lee, et al. (2021), Sohn, Jung, et al. (2019)
	Metorchis spp.	Bonina et al. (2024), Labony et al. (2020), Liberman (2019)
	Metorchis orientalis	Qiu et al. (2017), Sohn, Na, Cho, Ju, Kim, Hwang, No, and Park (2021), Yang et al. (2019)
	Haplorchis spp.	Hung et al. (2015)
	Haplorchis taichui	Chai et al. (2019), Chai et al. (2020), Nithikathkul et al. (2014), Phyo Myint et al. (2020), Rim et al. (2013), Sripa et al. (2016), Wongsawad et al. (2013)
	Haplorchis pumilio	Chai et al. (2019), Chai et al. (2020), Chai et al. (2014), Phyo Myint et al. (2020), Sripa et al. (2016)
	Haplorchis yokogawai	Abattouy et al. (2014), Chai et al. (2019), Chai et al. (2020), Chai et al. (2014), Rim et al. (2013)
	Centrocestus spp.	Chai et al. (2020)
	Centrocestus formosanus	Chai et al. (2019), Chai et al. (2014), Hung et al. (2015), Rim et al. (2013), Sripa et al. (2016)
	Gnathostoma sp.	Chai et al. (2020)
	Clonorchis spp.	Labony et al. (2020), Marcus et al. (2012)
	Metagonimus spp.	Labony et al. (2020), Sohn, Na, et al. (2019), Sohn et al. (2015)
	Dibothriocephalus latus	Liberman et al. (2019)
	Dibothriocephalus dendriticus	Nikulina and Polyaeva (2020)
	Clonorchis sinensis	Hung et al. (2015), Sohn and Na (2019), Sohn, Na, Cho, Lee, Ju, Lee, Lim, et al. (2021), Sohn, Na, Cho, Lee, Ju, Lee, Park, and Ahn (2021), Sohn et al. (2017), Wang et al. (2022), Yang et al. (2019)
	Metagonimus yokogawai	Qiu et al. (2017)
Area 5: Europe – Inland waters	*Dibothriocephalus* spp.	Bielat et al. (2015), Kuhn et al. (2017)
	Dibothriocephalus ditremum	Henriksen et al. (2016)
	Dibothriocephalus dendriticus	Borgstrøm et al. (2021), Henriksen et al. (2016), Kuhn et al. (2016)
	Dibothriocephalus latus	Dupouy-Camet and Yera (2015), Gustinelli et al. (2016), Menconi, Pastorino, et al. (2020), Menconi et al. (2021), Radačovská et al. (2019)
	Opisthorchis felineus	De Liberato et al. (2011), Drozdova et al. (2022), Simakova et al. (2022), Simakova et al. (2019), Simakova et al. (2021)
	Corynosoma sp.	Pilecka-Rapacz et al. (2017)
	Echinostoma sp. *Clinostomum* sp. Eustrongylides sp.	Wilson et al. (2019)
Area 8: Antarctica – Inland waters	No data available	No data available

Uncertainty

There are multiple sources of uncertainty associated with the data provided above. These are summarised in Table 6 including the impact they may have on the conclusions.

TABLE 6 Sources of uncertainty and their potential impact on the conclusions.

Sources of uncertainty	Impact of the uncertainty on the conclusions
It is assumed that the presence of anisakids or other zoonotic parasites in one fish species in a given marine fishing area is indicative that all fish species in that area may be infected. The absence of data covering the range of different zoonotic fish parasites that are found in all of the different fish species in marine fishing areas.	Minimum impact, because anisakids can infect all of the wild caught fish species that are consumed in the EU/EFTA. In the marine fishing areas where there were no reports of aniskaids in fish (area 58), other zoonotic parasites have been detected in the fish and reported. It is generally accepted, based on the data published to date that there is no evidence that any fish species consumed in the EU/EFSA is free of zoonotic parasites (i.e. all fish species are susceptible to infection with at least one zoonotic parasite).
It is assumed that the presence of any zoonotic parasite in one fish species in a given freshwater fishing area is indicative that all fish species in that area may be infected with that or other zoonotic parasites. The absence of data covering the range of different zoonotic fish parasites that are found in all of the different freshwater.	Minimum impact, as there is data available for all freshwater fishing areas and no studies to suggest that any particular fish species cannot be infected with at least one zoonotic parasite.
Although there are multiple studies reported for most fishing areas there are a few where the number of studies is limited. In the marine areas for *Anisakis*, for example Area 47 (Atlantic Southwest) had only one reported study, while Areas 67 (Pacific Northeast) and 71 (Pacific western central) had 2. There are considerably less data on Anisakis from areas 18, 31, 48 and 88), with each reliant on one published study. A similar issue arises for the freshwater areas with all except Area 5 (Europe – Inland waters) having one to three studies.	Minimum impact, as when the evidence is considered in its entirety and there are multiple publications covering freshwater systems and conditions are not sufficiently different between these bodies of water to suggest that zoonotic parasites are absent from one or more.

4 | CONCLUSIONS

AQ4: Are there any particular species of wild caught fish originating from specific fishing grounds, where fish consumed in the EU/EFTA are caught, that are free of parasites of public health importance?

It was concluded to be 99%–100% certain (almost certain) that there are no particular species of wild caught fish originating from specific marine fishing areas, where the fish consumed in the EU/EFTA are free of parasites of public health importance. Based on the data reported in the peer reviewed literature, at least one zoonotic parasite has been reported in at least one fish species in each of the FAO marine fishing areas (*Anisakis* spp. in all fishing areas, except area 58, but in which *P. decipiens* (s.l.) and *C. osculatum* (s.l.) were reported in multiple fish species). Thus, due to relative low fish host specificity of the zoonotic parasites, the panel concluded that all relevant fish species may be exposed to and infected with zoonotic parasites.

The same applies to freshwater fishing areas from which fish are consumed in the EU/EFTA, as all fishing areas, except for Antarctica, have some or multiple studies reporting the presence of a range of different zoonotic parasites in the caught fish species.

The conclusion on marine fishing areas is consistent with that of the 2010 opinion which stated that no sea fishing grounds could be considered to be free of *A. simplex* (s.l.) larva.

5 | RECOMMENDATIONS

It is recommended to implement routine surveillance of zoonotic parasites in wild caught fish, including niche products that are imported into the EU, using the most effective detection methods, as described in Part 1 of this Opinion.

It is also recommended that research be undertaken to address the dearth of surveillance data, especially for the most consumed wild caught fish in EU and EFTA countries, and that the effect of climate change on the zoonotic parasites' geographical distribution and risk to the consumer be assessed to evaluate the need for revised risk management practices in the future.

It is recommended that research is carried out to estimate the disease burden associated with zoonotic parasites in wild caught fish.

GLOSSARY AND/OR ABBREVIATIONS

AC	apparent consumption
AQ	assessment question
BIOHAZ	biological hazards

DV	deliverable
ECDC	European Centre for Disease Prevention and Control
EFTA	European Food Trade Association
EUMOFA	European market observatory for fisheries and aquaculture products
EUROSTAT	Statistical office of the European Union
FAO	Food and Agriculture Organization of the United Nations
LWE	Live weight equivalent means weight calculated based on conversion factors from the weight recorded on landing, or from the net weight of the various processed products
PIF	pathogens in food
ToR	Term of Reference

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MAP DISCLAIMER
The designations employed and the presentation of material on any maps included in this scientific output do not imply the expression of any opinion whatsoever on the part of the European Food Safety Authority concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

REFERENCES

Abattouy, N., López, A. V., Maldonado, J. L., Benajiba, M. H., & Martín-Sánchez, J. (2014). Epidemiology and molecular identification of *Anisakis pegreffii* (Nematoda: Anisakidae) in the horse mackerel Trachurus trachurus from northern Morocco. *Journal of Helminthology*, *88*(3), 257–263. https://doi.org/10.1017/S0022149X13000102

Abattouy, N., Valero, A., Benajiba, M. H., Lozano, J., & Martín-Sánchez, J. (2011). *Anisakis simplex* s.l. parasitization in mackerel (*Scomber japonicus*) caught in the north of Morocco-prevalence and analysis of risk factors. *International Journal of Food Microbiology*, *150*(2–3), 136. https://doi.org/10.1016/j.ijfoodmicro.2011.07.026

Abdelsalam, M., Attia, M. M., & Mahmoud, M. A. (2020). Comparative morphomolecular identification and pathological changes associated with *Anisakis simplex* larvae (Nematoda: Anisakidae) infecting native and imported chub mackerel (*Scomber japonicus*) in Egypt. *Regional Studies in Marine Science*, *39*, 101469. https://doi.org/10.1016/j.rsma.2020.101469

Abou-Rahma, Y., Abdel-Gaber, R., & Kamal Ahmed, A. (2016). First record of *Anisakis simplex* third-stage larvae (Nematoda, Anisakidae) in European hake *Merluccius merluccius* lessepsianus in Egyptian water. *Journal of Parasitology Research*, *2016*, 9609752. https://doi.org/10.1155/2016/9609752

Abouzaid, A., Kamal, E., Desouky, A., & Abou-Rawash, A.-R. (2018). Metazoan parasite fauna of wild sea bass; *Dicentrarchus labrax* (Linnaeus, 1758) in Egypt. *Life Science Journal*, *15*(6), 48–60. https://doi.org/10.7537/marslsj150618.06

Aco Alburqueque, R., Palomba, M., Santoro, M., & Mattiucci, S. (2020). Molecular identification of zoonotic parasites of the genus *Anisakis* (Nematoda: Anisakidae) from fish of the southeastern Pacific Ocean (off Peru coast). *Pathogens*, *9*(11), 910. https://doi.org/10.3390/pathogens9110910

Adel, M., Azizi, H., & Nematolahi, A. (2013). Scomberomorus Commerson, a new Paratenic host of Contracaecum sp. and Anisakis sp. (Nematoda: Anisakidae) from Persian gulf. *World Journal of Fish and Marine Sciences*, *5*, 310–314. https://doi.org/10.5829/idosi.wjfms.2013.05.03.71232

Akmirza, A. (2012). Metazoan parasite Fauna of conger eel (Conger conger L.) near Gökçeada, Northeasten Aegean Sea, Turkey. *Kafkas Universitesi Veteriner Fakultesi Dergisi*, *18*(5), https://doi.org/10.9775/kvfd.2012.6624

Alt, K. G., Cunze, S., Kochmann, J., & Klimpel, S. (2022). Parasites ofthree closely related Antarctic fish species (Teleostei: Nototheniinae) from Elephant Island. *Acta Parasitologica*, *67*(1), 218–232. https://doi.org/10.1007/s11686-021-00455-8

Alves, V. L. S., Souza, G. T. R., Takemoto, R. M., Melo, C. M., Madi, R. R., & Jeraldo, V. L. S. (2020). Anisakidae Skrjabin & Karokhin, 1945 and Raphidascarididae Hartwich, 1954 nematodes in lutjanidae (pisces: Perciformes) from the Brazilian northeast coast. *Brazilian Journal of Biology*, *80*, 255–265. https://doi.org/10.1590/1519-6984.190350

Anshary, H., Sriwulan, F., & Mark, A. (2014). Occurrence and molecular identification of *Anisaki*s Dujardin, 1845 from marine fish in southern Makassar Strait, Indonesia. *The Korean Journal of Parasitology*, *52*(1), 9–19. https://doi.org/10.3347/kjp.2014.52.1.9

Arumugam, U., Pandian, R. G., Jayasimhan, P., Sudarsanan, G. B., & Sornappan, G. (2024). First report of *Paracapillaria philippinensis* infection in flower-horn cichlid in India. *Parasitology Research*, *123*(3), 150. https://doi.org/10.1007/s00436-024-08175-4

Aubakirov, M. Z., Abdybekova, A. M., Khassanova, M. A., Issabayev, A. Z., Kaumenov, N. S., Tegza, A. A., Sapa, V. A., Domatsky, V. N., Erenko, E. N., & Namazbai, K. N. (2022). Epizootology and epidemiology of Opisthorchiasis in northern Kazakhstan. *OnLine Journal of Biological Sciences*, *22*(3), 340–346. https://doi.org/10.3844/ojbsci.2022.340.346

Aydin, C., & Pekmezci, G. Z. (2023). Molecular identification and infection levels of *Anisakis* species (Nematoda: Anisakidae) in the red scorpionfish Scorpaena scrofa (Scorpaenidae) from the Aegean Sea. *Parasitology International*, *92*, 102691. https://doi.org/10.1016/j.parint.2022.102691

Bak, T.-J., Jeon, C.-H., & Kim, J.-H. (2014). Occurrence of anisakid nematode larvae in chub mackerel (*Scomber japonicus*) caught off Korea. *International Journal of Food Microbiology*, *191*, 149. https://doi.org/10.1016/j.ijfoodmicro.2014.09.002

Bakare, O. C., Agboola, O. A., & Adegbehingbe, K. O. (2023). Gastrointestinal helminth parasites of *Pseudotolithus* species from Lagos lagoon, Lagos, Nigeria. *Nigerian*. *Journal of Parasitology*, *44*(2), 338–346. https://doi.org/10.4314/njpar.v44i2.6

Bao, M., Cipriani, P., Giulietti, L., Alam, M. A., Palomba, M., Mattiucci, S., & Levsen, A. (2022). Ascaridoid nematodes infecting commercially important marine fish and squid species from Bangladesh waters in the bay of Bengal. *Food and Waterborne Parasitology*, *27*, e00157. https://doi.org/10.1016/j.fawpar.2022.e00157

Bao, M., Strachan, N. J. C., Hastie, L. C., MacKenzie, K., Seton, H. C., & Pierce, G. J. (2017). Employing visual inspection and magnetic resonance imaging to investigate Anisakis simplex s.l. infection in herring viscera. *Food Control*, *75*, 40–47. https://doi.org/10.1016/j.foodcont.2016.12.030

Benamara, M. B., Hassani, M. M., Baaloudj, A., & Kerfouf, A. (2020). The parasitic fauna of pagellus acarne (Risso, 1827) (teleostei: Sparidae) of Béni Saf 's bight in the west coast of Algeria. *Egyptian Journal Of Aquatic Biology And Fisheries*, *24*(7-Special issue), 593–605. https://doi.org/10.21608/EJABF.2020.122968

Bernardi, C., Gustinelli, A., Fioravanti, M. L., Caffara, M., Mattiucci, S., & Cattaneo, P. (2011). Prevalence and mean intensity of *Anisakis simplex* (sensu stricto) in European sea bass (*Dicentrarchus labrax*) from Northeast Atlantic Ocean. *International Journal of Food Microbiology*, *148*(1), 55–59. https://doi.org/10.1016/j.ijfoodmicro.2011.04.027

Biary, A., Berrouch, S., Dehhani, O., Maarouf, A., Sasal, P., Mimouni, B., & Hafid, J. (2021). Prevalence and identification of *Anisakis* nematodes in fish consumed in Marrakesh, Morocco. *Molecular Biology Reports*, *48*(4), 3417–3422. https://doi.org/10.1007/s11033-021-06323-y

Bielat, I., Legierko, M., & Sobecka, E. (2015). Species richness and diversity of the parasites of two predatory fish species - perch (*Perca fluviatilis* Linnaeus, 1758) and zander (*Sander lucioperca* Linnaeus, 1758) from the Pomeranian Bay. *Annals of Parasitology*, *61*(2), 85–92.

Bonina, O., Efremova, E., Udaltsov, E., Zubareva, I. M., & Bortsova, M. (2024). Opisthorchids in Novosibirsk urban ecosystem. *Biology Bulletin*, *50*, 2804–2812. https://doi.org/10.1134/S1062359023100333

Borgstrøm, R., Mestrand, Ø., Brittain, J., & Lien, L. (2021). The helminth fauna of brown trout (*Salmo trutta*) from a sub-alpine lake revisited after 40 years with introduced European minnow (Phoxinus phoxinus). *Fauna Norvegica*, *41*, 15–26. https://doi.org/10.5324/fn.v41i0.3952

Bouderbala, K., Rangel, L. F., Santos, M. J., & Bahri, S. (2022). Molecular and pathological data of *Anisakis* spp. larvae (Nematoda: Anisakidae) in commercial fish *Epinephelus aeneus* and *Epinephelus marginatus* (Serranidae) caught off northern Tunisia (western Mediterranean Sea). *Cahiers de Biologie Marine*, *63*(3), 213–224. https://doi.org/10.21411/CBM.A.9381E8F5

Boussellaa, W., Neifar, L., Goedknegt, M. A., & Thieltges, D. W. (2018). Lessepsian migration and parasitism: Richness, prevalence and intensity of parasites in the invasive fish *Sphyraena chrysotaenia* compared to its native congener *Sphyraena sphyraena* in Tunisian coastal waters. *PeerJ*, *6*, e5558. https://doi.org/10.7717/peerj.5558

Bouzid, S., Saouini, H. E., Chiaar, A., Lioubi, J., Chakir, O., Benomar, M., Rhattas, C., Chbani, I., & Er-Raioui, H. (2023). Preliminary data on the occurrence of PAH and *Anisakis* spp. in Moroccan anchovies: Environmental parasitology and human health risk. *Marine Pollution Bulletin*, *194*(A), 115269. https://doi.org/10.1016/j.marpolbul.2023.115269

Brickle, P., MacKenzie, K., & Pike, A. (2005). Parasites of the Patagonian toothfish, Dissostichus eleginoides Smitt 1898, in different parts of the Subantarctic. *Polar Biol*, *28*, 663–671. https://doi.org/10.1007/s00300-005-0737-2

Buchmann, K. (2023). Seals, fish, humans and parasites in the Baltic: Ecology, evolution and history. *Folia Parasitologica (Praha)*, *70*,Article 2023.011 https://doi.org/10.14411/fp.2023.011

Buchmann, K., & Karami, A. M. (2024). Fish acanthocephalans as potential human pathogens. *Current Clinical Microbiology Reports*, *11*(2), 99–106. https://doi.org/10.1007/s40588-024-00226-9

Bušelić, I., Botić, A., Hrabar, J., Stagličić, N., Cipriani, P., Mattiucci, S., & Mladineo, I. (2018). Geographic and host size variations as indicators of *Anisakis pegreffii* infection in European pilchard (*Sardina pilchardus*) from the Mediterranean Sea: Food safety implications. *International Journal of Food Microbiology*, *266*, 126–132. https://doi.org/10.1016/j.ijfoodmicro.2017.11.021

Buzo-Dominguez, S., Morales-Yuste, M., Maria Domingo-Hernandez, A., Benitez, R., & Javier Adroher, F. (2021). Molecular epidemiology of Anisakis spp. in wedge sole, Dicologlossa cuneata (Moreau, 1881), from Fishmarkets in Granada (southern Spain), caught in two adjacent NE and CE Atlantic areas. *Pathogens*, *10*(10), 1302. https://doi.org/10.3390/pathogens10101302

Caballero-Huertas, M., Palomba, M., Frigola-Tepe, X., Munoz, M., Mattiucci, S., & Vinas, J. (2023). Ascaridoid parasites in European sardine throughout the annual cycle: Variability in parasitic load according to host stock features. *International Journal for Parasitology-Parasites and Wildlife*, *20*, 1–11. https://doi.org/10.1016/j.ijppaw.2022.12.001

Cantatore, D. M. P., Lanfranchi, A. L., Canel, D., Levy, E., & Timi, J. T. (2023). Plerocercoids of *Adenocephalus pacificus* in Argentine hakes: Broad distribution, low zoonotic risk. *International Journal of Food Microbiology*, *391-393*, 110142. https://doi.org/10.1016/j.ijfoodmicro.2023.110142

Castellanos, J. A., Tangua, A. R., & Salazar, L. (2017). Anisakidae nematodes isolated from the flathead grey mullet fish (*Mugil cephalus*) of Buenaventura, Colombia. *International Journal for Parasitology. Parasites and Wildlife*, *6*(3), 265–270. https://doi.org/10.1016/j.ijppaw.2017.08.001

Casti, D., Scarano, C., Piras, M. C., Merella, P., Muglia, S., Piras, F., Garippa, G., Spanu, C., & De Santis, E. P. L. (2017). Occurrence of nematodes of the genus *Anisakis* in Mediterranean and Atlantic fish marketed in Sardinia. *Italian Journal of Food Safety*, *6*(1), 6185. https://doi.org/10.4081/ijfs.2017.6185

Castiglione, D., Di Maggio, M., Guardone, L., Ricci, E., Tinacci, L., Guglielmone, G., Coltraro, M., Susini, F., & Armani, A. (2023). *Eustrongylides excisus* in fish species caught in the Massaciuccoli Lake (Northwest Tuscany, Italy): Implications for freshwater fish quality and public health. *Food Control*, *153*, 109894. https://doi.org/10.1016/j.foodcont.2023.109894

Cavalcanti, E. T. S., Alves, L. C., & Chellappa, S. (2013). Occurrence of endoparasites in the southern red snapper, *Lutjanus purpureus* (Osteichthyes: Lutjanidae) from the coastal waters of Rio Grande do Norte, Brazil. *Animal Biology Journal*, *4*(2), 129. https://www.proquest.com/openview/fc0a09abf2c11404b2ea01c160823b1d/1.pdf?pq-origsite=gscholar&cbl=2034892

Cavallero, S., Magnabosco, C., Civettini, M., Boffo, L., Mingarelli, G., Buratti, P., Giovanardi, O., Fortuna, C. M., & Arcangeli, G. (2015). Survey of *Anisakis* sp. and *Hysterothylacium* sp. in sardines and anchovies from the North Adriatic Sea. *International Journal of Food Microbiology*, *200*, 18–21. https://doi.org/10.1016/j.ijfoodmicro.2015.01.017

Ceballos-Mendiola, G., Valero, A., Polo-Vico, R., Tejada, M., Abattouy, N., Karl, H., De las Heras, C., & Martín-Sánchez, J. (2010). Genetic variability of *Anisakis simplex* s.s. parasitizing European hake (*Merluccius merluccius*) in the little sole Bank area in the Northeast Atlantic. *Parasitology Research*, *107*(6), 1399–1404. https://doi.org/10.1007/s00436-010-2009-5

Chagas de Souza, D., Eiras, J. C., Adriano, E. A., & Corrêa, L. L. (2020). Metazoan parasites of *Plagioscion squamosissimus* (Osteichthyes: Sciaenidae) of two rivers from the eastern Amazon (Brazil). *Annals of Parasitology*, *66*(2), 217–225. https://doi.org/10.17420/ap6602.257

Chai, J. Y., Han, E. T., Park, Y. K., Guk, S. M., Kim, J. L., & Lee, S. H. (2000). High endemicity of *Metagonimus yokogawai* infection among residents of Samchok-shi, Kangwon-do. *Korean Journal of Parasitology*, *38*(1), 33–36. https://doi.org/10.3347/kjp.2000.38.1.33

Chai, J.-Y., & Jung, B.-K. (2017). Fishborne zoonotic heterophyid infections: An update. *Food and Waterborne Parasitology*, *8-9*, 33–63. https://doi.org/10.1016/j.fawpar.2017.09.001

Chai, J.-Y., & Jung, B.-K. (2024). Epidemiology and geographical distribution of human trematode infections. In R. Toledo & B. Fried (Eds.), *Digenetic trematodes* (pp. 443–505). Springer International Publishing. https://doi.org/10.1007/978-3-031-60121-7_12

Chai, J. Y., Jung, B. K., Lee, K. H., Ryu, J. Y., Kim, H. S., Hong, S. J., Htoon, T. T., Tin, H. H., Na, B. K., & Sohn, W. M. (2020). Larval Gnathostomes and zoonotic trematode Metacercariae in fish from a local market in Yangon City, Myanmar. *Korean Journal of Parasitology*, *58*(6), 701–707. https://doi.org/10.3347/kjp.2020.58.6.701

Chai, J.-Y., Lee, S.-H., Rim, H.-J., Sohn, W.-M., & Phommasack, B. (2019). Infection status with zoonotic trematode metacercariae in fish from Lao PDR. *Acta Tropica*, *199*, 105100. https://doi.org/10.1016/j.actatropica.2019.105100

Chai, J. Y., Sohn, W. M., Na, B. K., Yong, T. S., Eom, K. S., Yoon, C. H., Hoang, E. H., Jeoung, H. G., & Socheat, D. (2014). Zoonotic trematode metacercariae in fish from Phnom Penh and Pursat, Cambodia. *The Korean Journal of Parasitology*, *52*(1), 35–40. https://doi.org/10.3347/kjp.2014.52.1.35

Chaligiannis, I., Lalle, M., Pozio, E., & Sotiraki, S. (2012). Anisakidae infection in fish of the Aegean Sea. *Veterinary Parasitology*, *184*(2–4), 362. https://doi.org/10.1016/j.vetpar.2011.09.007

Charoensuk, L., Ribas, A., Chedtabud, K., & Prakobwong, S. (2022). Infection rate of *Opisthorchis viverrini* metacercariae in cyprinoid fish from the markets and its association to human opisthorchiasis in the local community in the Northeast Thailand. *Acta Tropica*, *225*, 106216. https://doi.org/10.1016/j.actatropica.2021.106216

Chen, H.-X., Zhang, L.-P., Gibson, D. I., Lü, L., Xu, Z., Li, H.-T., Ju, H.-D., & Li, L. (2018). Detection of ascaridoid nematode parasites in the important marine food-fish *Conger myriaster* (Brevoort) (Anguilliformes: Congridae) from the Zhoushan fishery, China. *Parasites & Vectors*, *11*(1), 274. https://doi.org/10.1186/s13071-018-2850-4

Chen, H.-Y., & Shih, H.-H. (2015). Occurrence and prevalence of fish-borne Anisakis larvae in the spotted mackerel Scomber australasicus from Taiwanese waters. *Acta Tropica*, *145*, 61–67. https://doi.org/10.1016/j.actatropica.2015.02.011

Chen, Y.-J., Wu, C.-C., & Yang, J.-S. (2015). Occurrence of *Anisakis* larvae in commercial fish along the northern coast of Taiwan. *Research Journal of Parasitology*, *10*(3), 79–91. https://doi.org/10.3923/jp.2015.79.91

Cho, S.-H., Lee, S.-E., Park, O.-H., Na, B.-K., & Sohn, W.-M. (2012). Larval anisakid infections in marine fish from three sea areas of the Republic of Korea. *The Korean Journal of Parasitology*, *50*(4), 295. https://doi.org/10.3347/kjp.2012.50.4.295

Chou, Y.-Y., Wang, C.-S., Chen, H.-G., Chen, H.-Y., Chen, S.-N., & Shih, H.-H. (2011). Parasitism between *Anisakis simplex* (Nematoda: Anisakidae) third-stage larvae and the spotted mackerel *Scomber australasicus* with regard to the application of stock identification. *Veterinary Parasitology*, *177*(3), 324–331. https://doi.org/10.1016/j.vetpar.2010.12.003

Cipriani, P., Giulietti, L., Shayo, S. D., Storesund, J. E., Bao, M., Palomba, M., Mattiucci, S., & Levsen, A. (2022). Anisakid nematodes in *Trichiurus lepturus* and *Saurida undosquamis* (Teleostea) from the South-West Indian Ocean: Genetic evidence for the existence of sister species within *Anisakis typica* (s.l.), and food-safety considerations. *Food and Waterborne Parasitology*, *28*, e00177. https://doi.org/10.1016/j.fawpar.2022.e00177

Cipriani, P., Sbaraglia, G. L., Palomba, M., Giulietti, L., Bellisario, B., Bušelić, I., Mladineo, I., Cheleschi, R., Nascetti, G., & Mattiucci, S. (2018). *Anisakis pegreffii* (Nematoda: Anisakidae) in European anchovy *Engraulis encrasicolus* from the Mediterranean Sea: Fishing ground as a predictor of parasite distribution. *Fisheries Research*, *202*, 59–68. https://doi.org/10.1016/j.fishres.2017.03.020

Cipriani, P., Sbaraglia, G. L., Paoletti, M., Giulietti, L., Bellisario, B., Palomba, M., Bušelić, I., Mladineo, I., Nascetti, G., & Mattiucci, S. (2018). The Mediterranean European hake, *Merluccius merluccius*: Detecting drivers influencing the Anisakis spp. larvae distribution. *Fisheries Research*, *202*, 79–89. https://doi.org/10.1016/j.fishres.2017.07.010

Cipriani, P., Smaldone, G., Acerra, V., D'Angelo, L., Anastasio, A., Bellisario, B., Palma, G., Nascetti, G., & Mattiucci, S. (2015). Genetic identification and distribution of the parasitic larvae of *Anisakis pegreffii* and *Anisakis simplex* (s. s.) in European hake *Merluccius merluccius* from the Tyrrhenian Sea and Spanish Atlantic coast: Implications for food safety. *International Journal of Food Microbiology*, *198*, 1–8. https://doi.org/10.1016/j.ijfoodmicro.2014.11.019

Çolak, H. S. (2013). Metazoan parasites of fish species from Lake Sýðýrcý (Edirne, Turkey). *Turkish Journal of Veterinary and Animal Sciences*, *37*(2), 200–205. https://doi.org/10.3906/vet-1202-28

Costa, A., Cammilleri, G., Graci, S., Buscemi, M. D., Vazzana, M., Principato, D., Giangrosso, G., & Ferrantelli, V. (2016). Survey on the presence of a. simplex s.s. and A. Pegreffii hybrid forms in Central-Western Mediterranean Sea. *Parasitology International*, *65*(6, Part A), 696–701. https://doi.org/10.1016/j.parint.2016.08.004

Costa, G., Melo-Moreira, E., & Pinheiro de Carvalho, M. A. (2012). Helminth parasites of the oceanic horse mackerel *Trachurus picturatus* Bowdich 1825 (Pisces: Carangidae) from Madeira Island, Atlantic Ocean, Portugal. *Journal of Helminthology*, *86*(3), 368–372. https://doi.org/10.1017/S0022149X11000502

Costa, G., Santamaria, M. T. G., Vasconcelos, J., Perera, C. B., & Melo-Moreira, E. (2013). Endoparasites of *Trachurus picturatus* (Pisces: Carangidae) from the Madeira and Canary Islands: Selecting parasites for use as tags. *Scientia Marina*, *77*(1), 61–68. https://doi.org/10.3989/scimar.03707.07A

Crosi Martínez, M. T., Gonzalo, G., Federico, V., Gerardo, C., Ivette, M., Valentina, P., Pablo, V., Gustavo, G., Carina, T., Lucía, D., Santiago, F. D. K., Cristina, D., & José Pedro, A. F. (2022). Primer registro de nematodos zoonóticos de transmisión alimentaria (Nematoda: Anisakidae) en músculo de *Cynoscion guatucupa* (pescadilla de calada) y Macrodon ancylodon (pescadilla de red) comercializado en Uruguay, Revista FAVE. *Sección Ciencias Veterinarias*, *21*, 9. https://doi.org/10.14409/favecv.2022.0.e0009

Dao, H. T. T., Dermauw, V., Gabriël, S., Suwannatrai, A., Tesana, S., Nguyen, G. T. T., & Dorny, P. (2017). *Opisthorchis viverrini* infection in the snail and fish intermediate hosts in Central Vietnam. *Acta Tropica*, *170*, 120–125. https://doi.org/10.1016/j.actatropica.2017.02.028

De Benedetto, G., Arfuso, F., Ferrara, M. C., Brianti, E., & Gaglio, G. (2021). Parasite Fauna of the dusky grouper (*Epinephelus marginatus*, Lowe 1834) from the Central Mediterranean Sea. *Animals*, *11*(9), 2523. https://doi.org/10.3390/ani11092523

De Liberato, C., Bossù, T., Scaramozzino, P., Nicolini, G., Ceddia, P., Mallozzi, S., Cavallero, S., & Amelio, S. (2013). Presence of Anisakid larvae in the European anchovy, *Engraulis encrasicolus*, fished off the Tyrrhenian coast of Central Italy. *Journal of Food Protection*, *76*, 1643–1648. https://doi.org/10.4315/0362-028X.JFP-13-092

De Liberato, C., Scaramozzino, P., Brozzi, A., Lorenzetti, R., Di Cave, D., Martini, E., Lucangeli, C., Pozio, E., Berrilli, F., & Bossù, T. (2011). Investigation on *Opisthorchis felineus* occurrence and life cycle in Italy. *Veterinary Parasitology*, *177*(1–2), 67–71. https://doi.org/10.1016/j.vetpar.2010.11.042

Debenedetti, Á. L., Codes, F., Laza, S., Hernández, S., Madrid, E., Trelis, M., & Fuentes, M. V. (2020). Ascaridoid nematodes in horse mackerel, *Trachurus trachurus*, sold in Spanish supermarkets–factors able to diminish consumer risk. *Fisheries Research*, *230*, 105669. https://doi.org/10.1016/j.fishres.2020.105669

Dessier, A., Dupuy, C., Trancart, T., Audras, A., Bustamante, P., Gérard, C., Dessier, A., Dupuy, C., Trancart, T., Audras, A., Bustamante, P., & Gérard, C. (2016). Low diversity of helminth parasites in *Sardina pilchardus* and *Engraulis encrasicolus* (Clupeidae) from the Bay of Biscay. *Marine and Freshwater Research*, *67*(10), 1583–1588. https://doi.org/10.1071/MF15147

Dezfuli, B. S., Simoni, E., Bosi, G., Palomba, M., Mattiucci, S., Giulietti, L., Bao, M., Levsen, A., & Cipriani, P. (2021). Immunohistopathological response against anisakid nematode larvae and a coccidian in *Micromesistius poutassou* from NE Atlantic waters. *Journal of Helminthology*, *95*, e14. https://doi.org/10.1017/S0022149X20000942

Di Azevedo, M. I. N., & Iñiguez, A. M. (2018). Nematode parasites of commercially important fish from the southeast coast of Brazil: Morphological and genetic insight. *International Journal of Food Microbiology*, *267*, 29–41. https://doi.org/10.1016/j.ijfoodmicro.2017.12.014

Diez, G., Chust, G., Andonegi, E., Santurtun, M., Abaroa, C., Bilbao, E., Maceira, A., & Mendibil, I. (2022). Analysis of potential drivers of spatial and temporal changes in anisakid larvae infection levels in European hake, Merluccius merluccius (L.), from the north-East Atlantic fishing grounds. *Parasitology Research*, *121*(7), 1903–1920. https://doi.org/10.1007/s00436-022-07446-2

Dione, E., Diouf, M., Fall, J., & Bâ, C. (2014). Seasonal and spatial distribution of nematode larvae of the genera *Anisakis* and *Contracaecum* (Anisakidae) in two populations of *Mugil Cephalus* (Mugilidae) from Saloum and Senegal Rivers. *Journal of Biology and Life Science*, *5*, 41. https://doi.org/10.5296/jbls.v5i1.4685

Domingo-Hernandez, A. M., Morales-Yuste, M., Buzo-Dominguez, S., Adroher, F. J., & Benitez, R. (2023). *Anisakis* infection in anchovies (*Engraulis encrasicolus*) from Iberian waters, southwestern Europe: Post-mortem larval migration. *Research in Veterinary Science*, *157*, 26–34. https://doi.org/10.1016/j.rvsc.2023.02.007

Drozdova, L. S., Shemyakin, G. M., & Demin, F. A. (2022). Diversity of helminth fauna in teleost fish within the Tver region. *Acta Biologica Sibirica*, *8*, 167–174. https://doi.org/10.5281/zenodo.7700592

Dupouy-Camet, J., & Yera, H. (2015). Redécouverte de la diphyllobothriose dans la region des lacs sub-alpins français. *Bulletin de l'Académie Vétérinaire de France*, *168*, 172. https://doi.org/10.4267/2042/56870

Eberhard, M. L., Hurwitz, H., Sun, A. M., & Coletta, D. (1989). Intestinal perforation caused by larval *Eustrongylides* (Nematoda: Dioctophymatoidae) in New Jersey. *The American Journal of Tropical Medicine and Hygiene*, *40*(6), 648–650. https://doi.org/10.4269/ajtmh.1989.40.648

Eberhard, M. L., & Ruiz-Tiben, E. (2014). Cutaneous emergence of Eustrongylides in two persons from South Sudan. *The American Journal of Tropical Medicine and Hygiene*, *90*(2), 315–317. https://doi.org/10.4269/ajtmh.13-0638

EC DG-MARE. (2023). *The EU fish market* (2023rd ed.). Publications Office of the European Union.

EC DG-MARE (European Commission, Directorate- General for Maritime Affairs and Fisheries). (2023). *The EU fish market 2023 edition*. Publications Office of the European Union. Available online: https://data.europa.eu/doi/10.2771/38507

EFSA BIOHAZ Panel (EFSA Panel on Biological Hazards). (2010). Scientific Opinion on risk assessment of parasites in fishery products. *EFSA Journal*, *8*(4), 1543. https://doi.org/10.2903/j.efsa.2010.1543

EFSA BIOHAZ Panel (EFSA Panel on Biological Hazards), Koutsoumanis, K., Allende, A., Alvarez-Ordóñez, A., Bover-Cid, S., Chemaly, M., De Cesare, A., Herman, L., Hilbert, F., Lindqvist, R., Nauta, M., Nonno, R., Peixe, L., Ru, G., Simmons, M., Skandamis, P., Suffredini, E., Buchmann, K., Careche, M., … Bolton, D. (2024). Re-evaluation of certain aspects of the EFSA scientific opinion of April 2010 on risk assessment of parasites in fishery products, based on new scientific data. Part 1: ToRs1–3. *EFSA Journal*, *22*(4), e8719. https://doi.org/10.2903/j.efsa.2024.8719

EFSA Scientific Committee, Benford, D., Halldorsson, T., Jeger, M. J., Knutsen, H. K., More, S., Naegeli, H., Noteborn, H., Ockleford, C., Ricci, A., Rychen, G., Schlatter, J. R., Silano, V., Solecki, R., Turck, D., Younes, M., Craig, P., Hart, A., Von Goetz, N., … Hardy, A. (2018a). The principles and methods behind EFSA's guidance on uncertainty analysis in scientific assessment. *EFSA Journal*, *16*(1), e05122. https://doi.org/10.2903/j.efsa.2018.5122

EFSA Scientific Committee, Benford, D., Halldorsson, T., Jeger, M. J., Knutsen, H. K., More, S., Naegeli, H., Noteborn, H., Ockleford, C., Ricci, A., Rychen, G., Schlatter, J. R., Silano, V., Solecki, R., Turck, D., Younes, M., Craig, P., Hart, A., Von Goetz, N., … Hardy, A. (2018b). Guidance on uncertainty analysis in scientific assessments. *EFSA Journal*, *16*(1), e05123. https://doi.org/10.2903/j.efsa.2018.5123

Eissa, A. E., Showehdi, M. L., Ismail, M. M., El-Naas, A. S., Abu Mhara, A. A., & Abolghait, S. K. (2018). Identification and prevalence of Anisakis pegreffii and *A. pegreffii* × *A. simplex* (s.s.) hybrid genotype larvae in Atlantic horse Mackerel (*Trachurus trachurus*) from some North African Mediterranean coasts. *The Egyptian Journal of Aquatic Research*, *44*(1), 21–27. https://doi.org/10.1016/j.ejar.2018.02.004

Elena Ahuir-Baraja, A., Llobat, L., & Magdalena Garijo, M. (2021). Effectiveness of gutting blue whiting (*Micromesistius poutassou*, Risso, 1827), in Spanish supermarkets as an Anisakidosis safety measure. *Food*, *10*(4), 862. https://doi.org/10.3390/foods10040862

Eom, K. S., Park, H. S., Lee, D., Sohn, W. M., Yong, T. S., Chai, J. Y., Min, D. Y., Rim, H. J., Insisiengmay, B., & Phommasack, B. (2015). Infection status of zoonotic trematode Metacercariae in fishes from Vientiane municipality and Champasak Province in Lao PDR. *The Korean Journal of Parasitology*, *53*(4), 447–453. https://doi.org/10.3347/kjp.2015.53.4.447

Ferrer-Maza, D., Lloret, J., Muñoz, M., Elisabeth, F., Vila, S., & Sasal, P. (2014). Parasitism, condition and reproduction of the European hake (*Merluccius merluccius*) in the northwestern Mediterranean Sea. *ICES Journal of Marine Science*, *71*, 1088–1099. https://doi.org/10.1093/icesjms/fst217

Ferrer-Maza, D., Lloret, J., Muñoz, M., Faliex, E., Vila, S., & Sasal, P. (2016). Links between parasitism, energy reserves and fecundity of European anchovy, *Engraulis encrasicolus*, in the northwestern Mediterranean Sea. *Conservation*. *Physiology*, *4*(1), cov069. https://doi.org/10.1093/conphys/cov069

Fontenelle, G., Knoff, M., Felizardo, N. N., Lopes, L. M. S., & São Clemente, S. C. (2013). Nematodes of zoonotic importance in *Cynoscion guatucupa* (Pisces) in the state of Rio de Janeiro. *Revista Brasileira de Parasitologia Veterinária*, *22*, 281–284. https://doi.org/10.1590/S1984-29612013005000019

Fuentes, M., Madrid, V., Elena, M., Laia, V., Casan, F., Saez-Duran, S., Trelis, M., & Debenedetti, A. L. (2022). Nematode parasites of the European pilchard, *Sardina pilchardus* (Walbaum, 1792): A genuine human Hazard? *Animals*, *12*(15), 1877. https://doi.org/10.3390/ani12151877

Fuentes, M. V., Madrid, E., Cuesta, C., Gimeno, C., Baquedano-Rodriguez, M., Soriano-Sanchez, I., Bolivar, A. M., Saez-Duran, S., Trelis, M., & Debenedetti, A. L. (2022). Anisakid nematodes and potential risk of human Anisakiasis through the consumption of hake, *Merluccius* spp., sold fresh in Spanish supermarkets. *Pathogens*, *11*(6), 622. https://doi.org/10.3390/pathogens11060622

Fujita, T., Waga, E., Kitaoka, K., Imagawa, T., Komatsu, Y., Takanashi, K., Anbo, F., Anbo, T., Katuki, S., Ichihara, S., Fujimori, S., Yamasaki, H., Morishima, Y., Sugiyama, H., & Katahira, H. (2016). Human infection by acanthocephalan parasites belonging to the genus *Corynosoma* found from small bowel endoscopy. *Parasitology International*, *65*(5, Part A), 491–493. https://doi.org/10.1016/j.parint.2016.07.002

Gallagher, C. P., & Dick, T. A. (2010). Trophic structure of a landlocked Arctic char *Salvelinus alpinus* population from southern Baffin Island, Canada. *Ecology of Freshwater Fish*, *19*(1), 39–50. https://doi.org/10.1111/j.1600-0633.2009.00387.x

Gay, M., Bao, M., MacKenzie, K., Pascual, S., Buchmann, K., Bourgau, O., Couvreur, C., Mattiucci, S., Paoletti, M., Hastie, L. C., Levsen, A., & Pierce, G. J. (2018). Infection levels and species diversity of ascaridoid nematodes in Atlantic cod, *Gadus morhua*, are correlated with geographic area and fish size. *Fisheries Research*, *202*, 90–102. https://doi.org/10.1016/j.fishres.2017.06.006

Gay, M., Le Fur, B., Bourgau, O., Wacogne, D., & Malle, P. (2012). Localisation et détection des Anisakidae dans deux espèces de poissons: merlan (*Merlangus merlangius*) et maquereau (Scomber scombrus). *Bulletin épidémiologique, santé Animale et Alimentation*, *55*, 12–17. https://be.anses.fr/sites/default/files/BEP-mg-BE55-Art3.pdf

Gazzonis, A. L., Cavallero, S., Zanzani, S. A., Olivieri, E., Malandra, R., Ranghieri, V., D'Amelio, S., & Manfredi, M. T. (2017). Anisakis sp. and Hysterothylacium sp. larvae in anchovies (Engraulis encrasicolus) and chub mackerel (Scomber colias) in the Mediterranean Sea: Molecular identification and risk factors. *Food Control*, *80*, 366–373. https://doi.org/10.1016/j.foodcont.2017.05.004

Goffredo, E., Azzarito, L., Di Taranto, P., Mancini, M. E., Normanno, G., Didonna, A., Faleo, S., Occhiochiuso, G., D'Attoli, L., Pedarra, C., Pinto, P., Cammilleri, G., Graci, S., Sciortino, S., & Costa, A. (2019). Prevalence of anisakid parasites in fish collected from Apulia region (Italy) and quantification of nematode larvae in flesh. *International Journal of Food Microbiology*, *292*, 159–170. https://doi.org/10.1016/j.ijfoodmicro.2018.12.025

Gomes, T. L., Quiazon, K. M. A., Kotake, M., Itoh, N., & Yoshinaga, T. (2020). *Anisakis* spp. in fishery products from Japanese waters: Updated insights on host prevalence and human infection risk factors. *Parasitology International*, *78*, 102137. https://doi.org/10.1016/j.parint.2020.102137

Gómez-Mateos, M., Valero, A., Morales-Yuste, M., & Martín-Sánchez, J. (2016). Molecular epidemiology and risk factors for *Anisakis simplex* s.l. infection in blue whiting (*Micromesistius poutassou*) in a confluence zone of the Atlantic and Mediterranean: Differences between *a. simplex* s.s. And *A. Pegreffii*. *International Journal of Food Microbiology*, *232*, 111–116. https://doi.org/10.1016/j.ijfoodmicro.2016.05.026

Gonzalez-Poblete, L., Saavedra, J. C., Cespedes, R., & Canales, C. M. (2022). Parasites of *Merluccius australis* as biological tags to determine the hake ecological stocks in the sea channels of Chilean Patagonia. *Estuarine, Coastal and Shelf Science*, *278*, 108117. https://doi.org/10.1016/j.ecss.2022.108117

Gordeev, I. I., & Sokolov, S. G. (2023). Helminths of epipelagic fish in the western Bering Sea and southern Sea of Okhotsk. *Invertebrate Zoology*, *20*(2), 140–152. https://doi.org/10.15298/invertzool.20.2.02

Graci, S., Collura, R., Cammilleri, G., Buscemi, M. D., Giangrosso, G., Principato, D., Gervasi, T., Cicero, N., & Ferrantelli, V. (2017). Mercury accumulation in Mediterranean fish and cephalopods species of Sicilian coasts: Correlation between pollution and the presence of *Anisakis* parasites. *Natural Product Research*, *31*(10), 1156–1162. https://doi.org/10.1080/14786419.2016.1230119

Guardone, L., Nucera, D., Pergola, V., Costanzo, F., Costa, E., Tinacci, L., Guidi, A., & Armani, A. (2017). Visceral larvae as a predictive index of the overall level of fish batch infection in European anchovies (*Engraulis encrasicolus*): A rapid procedure for food business operators to assess marketability. *International Journal of Food Microbiology*, *250*, 12–18. https://doi.org/10.1016/j.ijfoodmicro.2017.03.011

Gustinelli, A., Menconi, V., Prearo, M., Caffara, M., Righetti, M., Scanzio, T., Raglio, A., & Fioravanti, M. L. (2016). Prevalence of *Diphyllobothrium latum* (Cestoda: Diphyllobothriidae) plerocercoids in fish species from four Italian lakes and risk for the consumers. *International Journal of Food Microbiology*, *235*, 109–112. https://doi.org/10.1016/j.ijfoodmicro.2016.06.033

Gutiérrez-Galindo, J. F., Osanz-Mur, A. C., & Mora-Ventura, M. T. (2010). Occurrence and infection dynamics of anisakid larvae in *Scomber scombrus, Trachurus trachurus, Sardina pilchardus*, and *Engraulis encrasicolus* from Tarragona (NE Spain). *Food Control*, *21*(11), 1550–1555. https://doi.org/10.1016/j.foodcont.2010.03.019

Hauksson, E., Karlsson, H., & Eliasson, K. (2012). Decreases in Anisakid nematodes abundance and density in cod, kept in On-growing Sea-cages. *Advanced Studies in Biology*, *4*, 217–230. http://www.m-hikari.com/asb/asb2012/asb5-8-2012/haukssonASB5-8-2012.pdf

Henriksen, E. H., Knudsen, R., Kristoffersen, R., Kuris, A. M., Lafferty, K. D., Siwertsson, A., & Amundsen, P.-A. (2016). Ontogenetic dynamics of infection with *Diphyllobothrium* spp. cestodes in sympatric Arctic charr Salvelinus alpinus (L.) and brown trout Salmo trutta L. *Hydrobiologia*, *783*(1), 37–46. https://doi.org/10.1007/s10750-015-2589-2

Hermida, M., Cavaleiro, B., Gouveia, L., & Saraiva, A. (2018). Parasites of skipjack, Katsuwonus pelamis, from Madeira, eastern Atlantic. *Parasitology Research*, *117*(4), 1025–1033. https://doi.org/10.1007/s00436-018-5778-x

Hidano, S., Mizukami, K., Yahiro, T., Shirakami, K., Ito, H., Ozaka, S., Ariki, S., Saechue, B., Dewayani, A., Chalalai, T., Soga, Y., Goto, M., Sonoda, A., Ozaki, T., Sachi, N., Kamiyama, N., Nishizono, A., Murakami, K., & Kobayashi, T. (2021). Analysis of the prevalence and species of *Anisakis* nematode in Sekisaba, *Scomber japonicus* caught in coastal waters off Saganoseki, Oita in Japan. *Japanese Journal of Infectious Diseases*, *74*(5), 387–391. https://doi.org/10.7883/yoken.JJID.2020.859

Hien, H. V., Dung, B. T., Ngo, H. D., & Doanh, P. N. (2021). First morphological and molecular identification of third-stage larvae of *Anisakis typica* (Nematoda: Anisakidae) from marine fishes in Vietnamese water. *Journal of Nematology*, *53*(1), 1–9. https://doi.org/10.21307/jofnem-2021-010

Honcharov, S. L., Soroka, N. M., Galat, M. V., Zhurenko, O. V., Dubovyi, A. I., & Dzhmil, V. I. (2022). *Eustrongylides* (Nematoda:Dioctophymatidae): Epizootology and special characteristics of the development biology. *Helminthologia*, *59*(2), 127–142. https://doi.org/10.2478/helm-2022-0013

Hossen, M. S., Suthar, J., Wassens, S., & Shamsi, S. (2023). Occurrence and molecular identification of nematodes from blue mackerel *Scomber australasicus* Cuvier in Australian waters. *Parasitology International*, *92*, 102664. https://doi.org/10.1016/j.parint.2022.102664

Hossen, M. S., Wassens, S., & Shamsi, S. (2021). Occurrence and abundance of zoonotic nematodes in snapper *Chrysophrys auratus*, a popular table fish from Australian and New Zealand waters. *Food and Waterborne Parasitology*, *23*, e00120. https://doi.org/10.1016/j.fawpar.2021.e00120

Hung, N. M., Dung Do, T., Lan Anh, N. T., Van, P. T., Thanh, B. N., Van Ha, N., Van Hien, H., & Canh Le, X. (2015). Current status of fish-borne zoonotic trematode infections in Gia Vien district, Ninh Binh province, Vietnam. *Parasites & Vectors*, *8*, 21. https://doi.org/10.1186/s13071-015-0643-6

Jabbar, A., Asnoussi, A., Norbury, L. J., Eisenbarth, A., Shamsi, S., Gasser, R. B., Lopata, A. L., Beveridge, I., Jabbar, A., Asnoussi, A., Norbury, L. J., Eisenbarth, A., Shamsi, S., Gasser, R. B., Lopata, A. L., & Beveridge, I. (2012). Larval anisakid nematodes in teleost fishes from Lizard Island, northern great barrier reef, Australia. *Marine and Freshwater Research*, *63*(12), 1283–1299. https://doi.org/10.1071/MF12211

Jacobson, K., Baldwin, R., & Reese, D. (2012). Parasite communities indicate effects of cross-shelf distributions, but not mesoscale oceanographic features on northern California current mid-trophic food web. *Marine Ecology Progress Series*, *454*, 19–36. https://doi.org/10.3354/meps09654

Jaramillo-Colorado, B. E., Arroyo-Salgado, B., & Ruiz-Garcés, L. C. (2015). Organochlorine pesticides and parasites in *Mugil incilis* collected in Cartagena Bay, Colombia. *Environmental Science and Pollution Research International*, *22*(22), 17475–17485. https://doi.org/10.1007/s11356-015-4986-5

Kadlec, D., Šimková, A., Jarkovský, J., & Gelnar, M. (2003). Parasite communities of freshwater fish under flood conditions. *Parasitology Research*, *89*(4), 272–283. https://doi.org/10.1007/s00436-002-0740-2

Karami, A. M., Marnis, H., Korbut, R., Zuo, S., Jaafar, R., Duan, Y., Mathiessen, H., Al-Jubury, A., Kania, P. W., & Buchmann, K. (2022). Absence of zoonotic parasites in salmonid aquaculture in Denmark: Causes and consequences. *Aquaculture*, *549*, 737793. https://doi.org/10.1016/j.aquaculture.2021.737793

Karl, H., Baumann, F., Ostermeyer, U., Kuhn, T., & Klimpel, S. (2011). *Anisakis simplex* (s.s.) larvae in wild Alaska salmon: No indication of post-mortem migration from viscera into flesh. *Diseases of Aquatic Organisms*, *94*, 201–209. https://doi.org/10.3354/dao02317

Karmaliyev, R., Nurzhanova, F., Sidikhov, B., Murzabaev, K., Sariyev, N., Satybayev, B., & Abirova, I. (2023). Epizootiology of Opisthorchiasis in carnivores, fish and mollusks in the West Kazakhstan region. *American Journal of Animal and Veterinary Sciences*, *18*(2), 147–155. https://doi.org/10.3844/ajavsp.2023.147.155

Kent, A. J., Pert, C. C., Briers, R. A., Diele, K., & Rueckert, S. (2020). Increasing intensities of *Anisakis simplex* third-stage larvae (L3) in Atlantic salmon of coastal waters of Scotland. *Parasites and Vectors*, *13*(1), 62. https://doi.org/10.1186/s13071-020-3942-5

Kiatsopit, N., Sithithaworn, P., Saijuntha, W., Pitaksakulrat, O., Petney, T. N., Webster, J. P., & Andrews, R. H. (2014). Analysis of the population genetics of *Opisthorchis viverrini* sensu lato in the Nam Ngum River wetland, Lao PDR, by multilocus enzyme electrophoresis. *Parasitology Research*, *113*(8), 2973–2981. https://doi.org/10.1007/s00436-014-3959-9

Klapper, R., Carballeda-Sangiao, N., Kuhn, T., Jensen, H. M., Buchmann, K., Gonzalez-Muñoz, M., & Karl, H. (2018). Anisakid infection levels in fresh and canned cod liver: Significant reduction through liver surface layer removal. *Food Control*, *92*, 17–24. https://doi.org/10.1016/j.foodcont.2018.04.029

Klapper, R., Kochmann, J., O'Hara, R., Karl, H., & Kuhn, T. (2016). Parasites as biological tags for stock discrimination of beaked redfish (*Sebastes mentella*): Parasite infra-communities vs. limited resolution of cytochrome markers. *PLoS One*, *11*, e0153964. https://doi.org/10.1371/journal.pone.0153964

Klapper, R., Kuhn, T., Münster, J., Levsen, A., Karl, H., & Klimpel, S. (2015). Anisakid nematodes in beaked redfish (Sebastes mentella) from three fishing grounds in the North Atlantic, with special notes on distribution in the fish musculature. *Veterinary Parasitology*, *207*(1–2), 72–80. https://doi.org/10.1016/j.vetpar.2014.11.017

Kleinertz, S., Damriyasa, I. M., Hagen, W., Theisen, D., & Palm, H. (2012). An environmental assessment of the parasite fauna of the reef- associated grouper *Epinephelus areolatus* from Indonesian waters. *Journal of Helminthology*, *88*, 1–14. https://doi.org/10.1017/S0022149X12000715

Kleinertz, S., Klimpel, S., & Palm, H. W. (2012). Parasite communities and feeding ecology of the European sprat (*Sprattus sprattus* L.) over its range of distribution. *Parasitology Research*, *110*(3), 1147–1157. https://doi.org/10.1007/s00436-011-2605-z

Klimpel, S., Busch, M. W., Kuhn, T., Rohde, A., & Palm, H. W. (2010). The Anisakis simplex complex off the South Shetland Islands (Antarctica): endemic populations versus introduction through migratory hosts. *Marine Ecology Progress Series*, *403*, 1–11.

Køie, M. (2009). Boreogadus saida (Lepechin) (Gadidae): a review of its metazoan parasite fauna from Greenland, eastern Canada, Alaska and the Russian Arctic. *Polar Biology*, *32*(10), 1399–1406. https://doi.org/10.1007/s00300-009-0650-1

Kooh, P., Gonzales-Barron, U., Cadavez, V., Talleu, R., El Metennani, S., Gay, M., & Thébault, A. (2023). Systematic review protocol for the "pathogens in foods" database: Occurrence of parasites of public health importance in fishery products (version 1). *Zenodo*. https://doi.org/10.5281/zenodo.10270810

Kooh, P., Carvalho, L., El Metennani, S., Reguieg, K., Cadavez, V., Gonzales-Barron, U., & Thébault, A. (2024). Data on the occurrence on anisakids and other parasites in fishery products from wild and farmed fish in all countries (Jan 2010 – Sept 2023) [Data set]. *Zenodo*. https://doi.org/10.5281/zenodo.14169622

Kuchta, R., Radačovská, A., Bazsalovicsová, E., Viozzi, G., Semenas, L., Arbetman, M., & Scholz, T. (2019). Host switching of zoonotic broad fish tapeworm (*Dibothriocephalus latus*) to salmonids, Patagonia. *Emerging Infection Disease*, *25*(11), 2156–2158. https://doi.org/10.3201/eid2511.190792

Kuchta, R., Scholz, T., Brabec, J., & Narduzzi-Wicht, B. (2015). Chapter 17. Diphyllobothrium, Diplogonoporus and Spirometra. In L. Xiao, U. Ryan, & Y. Feng (Eds.), *Biology of foodborne parasites: Section III important foodborne helminths* (1st ed., pp. 299–326). Food Microbiology Series. https://doi.org/10.1201/b18317

Kuhn, J. A., Frainer, A., Knudsen, R., Kristoffersen, R., & Amundsen, P. A. (2016). Effects of fish species composition on *Diphyllobothrium* spp. infections in brown trout - is three-spined stickleback a key species? *Journal of Fish Diseases*, *39*(11), 1313–1323. https://doi.org/10.1111/jfd.12467

Kuhn, J. A., Knudsen, R., Kristoffersen, R., & Amundsen, P. A. (2017). A simplified method to estimate *Diphyllobothrium* spp. infection in salmonids. *Journal of Fish Diseases*, *40*(7), 863–871. https://doi.org/10.1111/jfd.12566

Kumagai, T., & Nishino, Y. (2023). Occurrence and prevalence of third-stage larvae of the Anisakidae family in Macrouridae species captured from bathyal depths of Sagami Bay, Japan. *Deep-Sea Research Part I: Oceanographic Research Papers*, *200*, 104151. https://doi.org/10.1016/j.dsr.2023.104151

Labony, S. S., Alim, M. A., Hasan, M. M., Hossain, M. S., Islam, A., Alam, M. Z., & Tsuji, N. (2020). Fish-borne trematode infections in wild fishes in Bangladesh. *Pathogens and Global Health*, *114*(2), 91–98. https://doi.org/10.1080/20477724.2020.1727217

Lanfranchi, A., Braicovich, P., Cantatore, D., Alarcos, A., Luque, J., & Timi, J. (2016). Ecotonal marine regions - ecotonal parasite communities: Helminth assemblages in the convergence of masses of water in the southwestern Atlantic Ocean. *International Journal for Parasitology*, *46*, 809–818. https://doi.org/10.1016/j.ijpara.2016.07.004

Lanfranchi, A. L., Braicovich, P. E., Cantatore, D. M. P., Irigoitia, M. M., Farber, M. D., Taglioretti, V., & Timi, J. T. (2018). Influence of confluent marine currents in an ecotonal region of the south-West Atlantic on the distribution of larval anisakids (Nematoda: Anisakidae). *Parasites & Vectors*, *11*(1), 583. https://doi.org/10.1186/s13071-018-3119-7

Laoprom, N., Prathummang, S., Chuangchaiya, S., Navanesan, S., Munajat, M. B., Suwannatrai, A. T., & Idris, Z. M. (2021). Opisthorchis viverrini metacercarial infection in cyprinid fish in Nakhon Phanom Province, Northeastern Thailand. *Tropical Biomedicine*, *38*(2), 25–30. https://doi.org/10.47665/tb.38.2.033

Levsen, A., Cipriani, P., Mattiucci, S., Gay, M., Hastie, L. C., MacKenzie, K., Pierce, G. J., Svanevik, C. S., Højgaard, D. P., Nascetti, G., González, A. F., & Pascual, S. (2018). *Anisakis* species composition and infection characteristics in Atlantic mackerel, *Scomber scombrus*, from major European fishing grounds – Reflecting changing fish host distribution and migration pattern. *Fisheries Research*, *202*, 112–121. https://doi.org/10.1016/j.fishres.2017.07.030

Levsen, A., Cipriani, P., Palomba, M., Giulietti, L., Storesund, J. E., & Bao, M. (2022). Anisakid parasites (Nematoda: Anisakidae) in 3 commercially important gadid fish species from the southern Barents Sea, with emphasis on key infection drivers and spatial distribution within the hosts. *Parasitology*, *149*(14, SI), 1942–1957. https://doi.org/10.1017/S0031182022001305

Levsen, A., & Lunestad, B. (2010). Anisakis simplex third stage larvae in Norwegian spring spawning herring (*Clupea harengus* L.), with emphasis on larval distribution in the flesh. *Veterinary Parasitology*, *171*, 247–253. https://doi.org/10.1016/j.vetpar.2010.03.039

Levsen, A., Paoletti, M., Cipriani, P., Nascetti, G., & Mattiucci, S. (2016). Species composition and infection dynamics of ascaridoid nematodes in Barents Sea capelin (Mallotus villosus) reflecting trophic position of fish host. *Parasitology Research*, *115*(11), 4281–4291. https://doi.org/10.1007/s00436-016-5209-9

Levsen, A., Svanevik, C. S., Cipriani, P., Mattiucci, S., Gay, M., Hastie, L. C., Bušelić, I., Mladineo, I., Karl, H., Ostermeyer, U., Buchmann, K., Højgaard, D. P., González, Á. F., Pascual, S., & Pierce, G. J. (2018). A survey of zoonotic nematodes of commercial key fish species from major European fishing grounds–introducing the FP7 PARASITE exposure assessment study. *Fisheries Research*, *202*, 4–21. https://doi.org/10.1016/j.fishres.2017.09.009

Liberman, E. (2019). Sexual and age characteristics of the parasitofauna of *Abramis brama* (Cypriniformes, Cyprinidae) of the lower Irtysh (Russia). *Biosystems Diversity*, *27*, 200–204. https://doi.org/10.15421/011927

Liberman, E., Voropaeva, E., & Kozlov, S. (2019). Parasitofauna of pike *Esox lucius* of the lower Tobol (Russia). *Biosystems Diversity*, *27*, 214–220. https://doi.org/10.15421/011929

Liberman, E. L., & Voropaeva, E. L. (2018). New data on parasitic Fauna of bream *Abramis brama* (Linnaeus, 1758) of the lower Irtysh (acquired part of the range). *Russian Journal of Biological Invasions*, *9*(3), 232–236. https://doi.org/10.1134/S2075111718030098

Liu, G.-H., Sun, M.-M., Elsheikha, H. M., Fu, Y.-T., Sugiyama, H., Ando, K., Sohn, W.-M., Zhu, X.-Q., & Yao, C. (2020). Human gnathostomiasis: a neglected food-borne zoonosis. *Parasites & Vectors*, *13*(1), 616. https://doi.org/10.1186/s13071-020-04494-4

Llarena-Reino, M., González, Á. F., Vello, C., Outeiriño, L., & Pascual, S. (2012). The accuracy of visual inspection for preventing risk of *Anisakis* spp. infection in unprocessed fish. *Food Control*, *23*(1), 54–58. https://doi.org/10.1016/j.foodcont.2011.06.010

Lopes, P., Vilares, A., Cacador, T., Martins, S., Ferreira, I., Carvalho, L. M., & Gargate, M. J. (2020). Occurrence of larval anisakids in horse mackerel (*Trachurus trachurus*) caught in Portuguese waters. *Parasitology Research*, *119*(9), 2799–2811. https://doi.org/10.1007/s00436-020-06816-y

Lukashanets, D. A., Convey, P., Borodin, O. I., Miamin, V. Y., Hihiniak, Y. H., Gaydashov, A. A., Yatsyna, A. P., Vezhnavets, V. V., Maysak, N. N., & Shendrik, T. V. (2021). Eukarya biodiversity in the Thala Hills, East Antarctica. *Antarctic Science*, *33*(6), 605–623. https://doi.org/10.1017/S0954102021000328

Macchioni, F., Tedesco, P., Cocca, V., Massaro, A., Sartor, P., Ligas, A., Pretti, C., Monni, G., Cecchi, F., & Caffara, M. (2021). Anisakid and Raphidascaridid parasites in *Trachurus trachurus*: Infection drivers and possible effects on the host's condition. *Parasitology Research*, *120*(9), 3113–3122. https://doi.org/10.1007/s00436-021-07200-0

Mackintosh, A. L., Reed, C. C., Nunkoo, M. A. I., King, P. H., & van der Lingen, C. D. (2018). Macroparasites of angelfish *Brama brama* (Bonnaterre, 1788) in the southern Benguela current ecosystem. *African Journal of Marine Science*, *40*(3), 245–252. https://doi.org/10.2989/1814232X.2018.1499551

Madrid, E., Galán-Puchades, M. T., & Fuentes, M. V. (2012). Risk analysis of human anisakidosis through the consumption of the blue whiting, *Micromesistius poutassou*, sold at Spanish supermarkets. *Foodborne Pathogens and Disease*, *9*(10), 934–938. https://doi.org/10.1089/fpd.2012.1196

Madrid, E., Gil, F., García, M., Debenedetti, Á. L., Trelis, M., & Fuentes, M. V. (2016). Potential risk analysis of human anisakiasis through the consumption of mackerel, *Scomber scombrus*, sold at Spanish supermarkets. *Food Control*, *66*, 300–305. https://doi.org/10.1016/j.foodcont.2016.02.025

Manpratum, Y., Kaewkes, W., Echaubard, P., Sripa, B., & Kaewkes, S. (2017). New locality record for Haplorchoides mehrai and possible interactions with *Opisthorchis viverrini* metacercariae in cyprinid fishes in Northeast Thailand. *Parasitology Research*, *116*(2), 601–608. https://doi.org/10.1007/s00436-016-5324-7

Marcus, S., Maqbool, A., Khan, N., Iqbal, K., Ashraf, K., & Ahmad, N. (2012). Food borne parasitic zoonosis with special reference to metacercarial infection in fishes. *Journal of Animal and Plant Sciences*, *22*, 619–621.

Marks, D. (2011). Climate change and Thailand: Impact and response. In *Contemporary Southeast Asia* (Vol. *33*, pp. 229–258). Institute of Southeast Asian Studies. https://doi.org/10.1355/cs33-2d

Marques, J. F., Santos, M. J., & Cabral, H. N. (2010). Aggregation patterns of macroendoparasites in phylogenetically related fish hosts. *Parasitology*, *137*(11), 1671–1680. https://doi.org/10.1017/S0031182010000491

Martin-Carrillo, N., Garcia-Livia, K., Baz-Gonzalez, E., Abreu-Acosta, N., Dorta-Guerra, R., Valladares, B., & Foronda, P. (2022). Morphological and molecular identification of *Anisakis* spp. (Nematoda: Anisakidae) in commercial fish from the Canary Islands coast (Spain): Epidemiological data. *Animals*, *12*(19), 2634. https://doi.org/10.3390/ani12192634

Martinez-Rojas, R., Mondragon-Martinez, A., De-Los-Santos, E. R., Cruz-Neyra, L., Garcia-Candela, E., Delgado-Escalante, A., & Sanchez-Venegas, J. R. (2021). Molecular identification and epidemiological data of *Anisakis* spp. (Nematoda: Anisakidae) larvae from southeastern Pacific Ocean off Peru. *International Journal for Parasitology-Parasites and Wildlife*, *16*, 138–144. https://doi.org/10.1016/j.ijppaw.2021.09.001

Mattiucci, S., & Nascetti, G. (2006). Molecular systematics, phylogeny and ecology of anisakid nematodes of the genus Anisakis Dujardin, 1845: an update. *Parasite*, *13*(2), 99–113.

Mattiucci, S., Cipriani, P., Levsen, A., Paoletti, M., & Nascetti, G. (2018). Molecular epidemiology of *Anisakis* and Aisakiasis: An ecological and evolutionary road map. *Advances in Parasitology*, *99*, 93–263. https://doi.org/10.1016/bs.apar.2017.12.001

Mattiucci, S., Garcia, A., Cipriani, P., Santos, M. N., Nascetti, G., & Cimmaruta, R. (2014). Metazoan parasite infection in the swordfish, *Xiphias gladius*, from the Mediterranean Sea and comparison with Atlantic populations: Implications for its stock characterization. *Parasite (Paris, France)*, *21*, 35. https://doi.org/10.1051/parasite/2014036

Mattiucci, S., Giulietti, L., Paoletti, M., Cipriani, P., Gay, M., Levsen, A., Klapper, R., Karl, H., Bao, M., Pierce, G. J., & Nascetti, G. (2018). Population genetic structure of the parasite *Anisakis simplex* (s. s.) collected in Clupea harengus L. from north East Atlantic fishing grounds. *Fisheries Research*, *202*, 103–111. https://doi.org/10.1016/j.fishres.2017.08.002

McClelland, G., & Melendy, J. (2011). Use of parasites as tags in delineating stocks of Atlantic cod (*Gadus morhua*) from the southern gulf of St. Lawrence and the cape Breton shelf. *Fisheries Research*, *107*(1), 233–238. https://doi.org/10.1016/j.fishres.2010.10.022

Mehrdana, F., Bahlool, Q. Z. M., Skov, J., Marana, M. H., Sindberg, D., Mundeling, M., Overgaard, B. C., Korbut, R., Strøm, S. B., Kania, P. W., & Buchmann, K. (2014). Occurrence of zoonotic nematodes *Pseudoterranova decipiens, Contracaecum osculatum* and *Anisakis simplex* in cod (*Gadus morhua*) from the Baltic Sea. *Veterinary Parasitology*, *205*(3–4), 581–587. https://doi.org/10.1016/j.vetpar.2014.08.027

Meloni, M., Angelucci, G., Merella, P., Siddi, R., Deiana, C., Orrù, G., & Salati, F. (2011). Molecular characterization of *Anisakis* larvae from fish caught off Sardinia. *The Journal of Parasitology*, *97*(5), 908–914. https://doi.org/10.1645/GE-2742.1

Menconi, V., Manfrin, C., Pastorino, P., Mugetti, D., Cortinovis, L., Pizzul, E., Pallavicini, A., & Prearo, M. (2020). First report of *Clinostomum complanatum* (Trematoda: Digenea) in European perch (Perca fluviatilis) from an Italian subalpine Lake: A risk for public health? *International Journal of Environmental Research and Public Health*, *17*(4), 1389. https://doi.org/10.3390/ijerph17041389

Menconi, V., Pastorino, P., Canola, S., Pavoletti, E., Vitale, N., Scanzio, T., Righetti, M., Mugetti, D., Tomasoni, M., Bona, M. C., & Prearo, M. (2022). Occurrence and spatial variation of *Anisakis pegreffii* in the Atlantic horse mackerel *Trachurus trachurus* (Carangidae): A three-year monitoring survey in the western Ligurian Sea. *Food Control*, *131*, 108423. https://doi.org/10.1016/j.foodcont.2021.108423

Menconi, V., Pastorino, P., Momo, I., Mugetti, D., Bona, M. C., Levetti, S., Tomasoni, M., Pizzul, E., Ru, G., Dondo, A., & Prearo, M. (2020). Occurrence and spatial distribution of *Dibothriocephalus latus* (Cestoda: Diphyllobothriidea) in Lake Iseo (northern Italy): An update. *International Journal of Environmental Research and Public Health*, *17*(14), 5070. https://doi.org/10.3390/ijerph17145070

Menconi, V., Zoppi, S., Pastorino, P., Di Blasio, A., Tedeschi, R., Pizzul, E., Mugetti, D., Tomasoni, M., Dondo, A., & Prearo, M. (2021). Relationship between the prevalence of *Dibothriocephalus latus* (Cestoda: Diphyllobothriidea) and the load of Escherichia coli: New findings in a neglected fish-borne parasitic zoonosis. *Zoonoses and Public Health*, *68*(8), 965–972. https://doi.org/10.1111/zph.12891

Mercken, E., Van Damme, I., Soba, B., Vangeenberghe, S., Serradell, A., Lumain, J. P. L., De Sterck, T., Lalle, M., & Gabriel, S. (2021). High occurrence of Anisakidae at retail level in cod (*Gadus morhua*) belly flaps and the impact of extensive candling. *Food and Waterborne Parasitology*, *22*, e00108. https://doi.org/10.1016/j.fawpar.2020.e00108

Mladineo, I., & Poljak, V. (2013). Ecology and genetic structure of zoonotic *Anisakis* spp. from Adriatic commercial fish species. *Applied and Environmental Microbiology*, *80*, 1281–1290. https://doi.org/10.1128/AEM.03561-13

Mladineo, I., Šegvić, T., & Petrić, M. (2011). Do captive conditions favor shedding of parasites in the reared Atlantic bluefin tuna (*Thunnus thynnus*)? *Parasitology International*, *60*(1), 25–33. https://doi.org/10.1016/j.parint.2010.09.007

Mo, T. A., Fossøy, F., & Poppe, T. T. (2021). Increasing intensities of *Anisakis simplex* (Rudolphi, 1809 det. Krabbe, 1878) larvae with weight and sea age in returning adult Atlantic salmon, *Salmo salar* L., of coastal waters of Norway. *Journal of Fish Diseases*, *44*(8), 1075–1089. https://doi.org/10.1111/jfd.13369

Molina-Fernández, D., Malagón, D., Gómez-Mateos, M., Benítez, R., Martín-Sánchez, J., & Adroher, F. J. (2015). Fishing area and fish size as risk factors of *Anisakis* infection in sardines (Sardina pilchardus) from Iberian waters, southwestern Europe. *International Journal of Food Microbiology*, *203*, 27–34. https://doi.org/10.1016/j.ijfoodmicro.2015.02.024

Molina-Fernández, D., Rubio-Calvo, D., Adroher, F. J., & Benítez, R. (2018). Molecular epidemiology of *Anisakis* spp. in blue whiting *Micromesistius poutassou* in eastern waters of Spain, western Mediterranean Sea. *International Journal of Food Microbiology*, *282*, 49–56. https://doi.org/10.1016/j.ijfoodmicro.2018.05.026

Mondragón-Martínez, A., Martínez-Rojas, R., Garcia-Candela, E., Delgado-Escalante, A., Tantaleán-Vidaurre, M., & Cruz-Neyra, L. (2020). Molecular identification of *Adenocephalus pacificus* (Cestoda) from three human cases in Lima Province, Peru. *The Korean Journal of Parasitology*, *58*(4), 457–460. https://doi.org/10.3347/kjp.2020.58.4.457

Moravec, F. (2013). *Parasitic nematodes of freshwater fishes of Europe*. Academia. https://www.academiabooks.com/book/parasitic-nematodes-of-freshwater-fishes-of-europe/

Mouritsen, K., Hedeholm, R., Schack, H., Møller, L., Storr-Paulsen, M., Dzido, J., & Rokicki, J. (2010). Occurrence of anisakid nematodes in Atlantic cod (*Gadus morhua*) and Greenland cod (*Gadus ogac*), West Greenland. *Acta Parasitologica*, *55*(1), 81–89. https://doi.org/10.2478/s11686-010-0009-3

Munoz-Caro, T., Machuca, A., Morales, P., Verdugo, J., Reyes, R., Garcia, M., Rutaihwa, L., Schindler, T., Poppert, S., Taubert, A., & Hermosilla, C. (2022). Prevalence and molecular identification of zoonotic *Anisakis* and *Pseudoterranova* species in fish destined to human consumption in Chile. *Parasitology Research*, *121*(5), 1295–1304. https://doi.org/10.1007/s00436-022-07459-x

Münster, J., Klimpel, S., Fock, H. O., MacKenzie, K., & Kuhn, T. (2015). Parasites as biological tags to track an ontogenetic shift in the feeding behaviour of *Gadus morhua* off west and East Greenland. *Parasitology Research*, *114*(7), 2723–2733. https://doi.org/10.1007/s00436-015-4479-y

Murata, R., Suzuki, J., Kodo, Y., Kobayashi, K., Sadamasu, K., Takano, T., Iwaki, T., Waki, T., & Ogawa, K. (2021). Probable association between *Anisakis* infection in the muscle of skipjack tuna (*Katsuwonus pelamis*) and human anisakiasis in Tokyo, Japan. *International Journal of Food Microbiology*, *337*, 108930. https://doi.org/10.1016/j.ijfoodmicro.2020.108930

Nadolna, K., & Podolska, M. (2014). Anisakid larvae in the liver of cod (*Gadus morhua*) L. from the southern Baltic Sea. *Journal of Helminthology*, *88*(2), 237–246. https://doi.org/10.1017/S0022149X13000096

Nadolna-Altyn, K., Podolska, M., Pawlak, J., & Szostakowska, B. (2022). Distribution of anisakid nematodes in the muscle tissue of cod (*Gadus morhua*) from the Norwegian Sea. *Oceanologia*, *64*(3), 489–502. https://doi.org/10.1016/j.oceano.2022.03.003

Najda, K., Kijewska, A., Kijewski, T., Plauška, K., & Rokicki, J. (2018). Distribution of ascaridoid nematodes (Nematoda: Chromadorea: Ascaridoidea) in fish from the Barents Sea. *Oceanological and Hydrobiological Studies*, *47*(2), 128–139. https://doi.org/10.1515/ohs-2018-0014

Namsanor, J., Kiatsopit, N., Laha, T., Andrews, R. H., Petney, T. N., & Sithithaworn, P. (2020). Infection dynamics of *Opisthorchis viverrini* Metacercariae in cyprinid fishes from two endemic areas in Thailand and Lao PDR. *The American Journal of Tropical Medicine and Hygiene*, *102*(1), 110–116. https://doi.org/10.4269/ajtmh.19-0432

Nikulina, Y., & Polyaeva, K. (2020). Morphology, biology and parasite fauna of the least cisco (*Coregonus sardinella*) of the Yenisei River. *Biosystems Diversity*, *28*, 230–237. https://doi.org/10.15421/012030

Nithikathkul, C., Reungsang, P., Trivanich, A., Homchumpa, P., Tongsiri, S., & Wongsawad, C. (2014). Geographic information of fish-borne parasitic metacercaria in chi river, Mahasarakham, Thailand. *International Journal of Geoinformatics*, *10*, 25–29.

Nithikathkul, C., Wongsaroj, T., Buntilov, V., & Limsomboon, J. (2012). Geographic information system of fish-borne parasitic Zoonoses metacercaria from water reservoirs under his Majesty's recommended project, Phitsanulok, Thailand. *International Journal of Geoinformatics*, *8*, 53–57.

Nogrado, K., Adisakwattana, P., & Reamtong, O. (2023). Human gnathostomiasis: A review on the biology of the parasite with special reference on the current therapeutic management. *Food and Waterborne Parasitology*, *33*, e00207. https://doi.org/10.1016/j.fawpar.2023.e00207

Noguera, P., Pert, C., Collins, C., Still, N., & Bruno, D. (2015). Quantification and distribution of *Anisakis simplex* sensu stricto in wild, one sea winter Atlantic salmon, *Salmo salar*, returning to Scottish rivers. *Journal of the Marine Biological Association of the United Kingdom*, *95*(2), 391–399. https://doi.org/10.1017/S0025315414001374

Ogbon, A. M., Afoakwah, R., Mireku, K. K., Tossavi, N. D., & MacKenzie, K. (2023). Parasites of *Sardinella maderensis* (Lowe, 1838) (Actinopterygii: Clupeidae) and their potential as biological tags for stock identification along the coast of West Africa. *Biology-Basel*, *12*(3), 389. https://doi.org/10.3390/biology12030389

Oguz, M. C., Campbell, A. M., Bennett, S. P., & Belk, M. C. (2021). Nematode parasites of rockfish (*Sebastes* spp.) and cod (*Gadus* spp.) from waters near Kodiak Island Alaska, USA. *Diversity-Basel*, *13*(9), 436. https://doi.org/10.3390/d13090436

Ohnishi, T., Banzai, A., Hara-Kudo, Y., & Sugiyama, H. (2023). Prevalence and abundance of *Anisakis* larvae in ready-to-eat mackerel products in Japan. *International Journal of Food Microbiology*, *395*, 110181. https://doi.org/10.1016/j.ijfoodmicro.2023.110181

Oliva, M. E., Espinola, J. F., & Ñacari, L. A. (2016). Metazoan parasites of *Brama australis* from southern Chile: a tool for stock discrimination? *Journal of Fish Biology*, *88*(3), 1143–1148. https://doi.org/10.1111/jfb.12881

Ong, X., Wang, Y.-C., Sithithaworn, P., Grundy-Warr, C., & Pitaksakulrat, O. (2016). Dam influences on liver fluke transmission: Fish infection and human fish consumption behavior. *Annals of the American Association of Geographers*, *106*(4), 755–772. https://doi.org/10.1080/24694452.2015.1122508

Onsurathum, S., Pinlaor, P., Charoensuk, L., Haonon, O., Chaidee, A., Intuyod, K., Laummaunwai, P., Boonmars, T., Kaewkes, W., & Pinlaor, S. (2016). Contamination of Opisthorchis viverrini and Haplorchis taichui metacercariae in fermented fish products in northeastern Thailand markets. *Food Control*, *59*, 493–498. https://doi.org/10.1016/j.foodcont.2015.06.020

Orlando, A., Caterini, L., Marucci, G., Ferri, F., Bernardini, G., Natalini Raponi, G., Ludovisi, A., Bossù, T., Angeles, M., Morales, G., & Pozio, E. (2008). Human illnesses caused by Opisthorchis felineus flukes, Italy. *Emerging Infectious Diseases*, *14*, 1902–1905. https://doi.org/10.3201/EID1412.080782

Özesen Çolak, S. (2013). Metazoan parasites of fish species from Lake Siğirci (Edirne, Turkey). *Turkish Journal of Veterinary and Animal Sciences*, *37*, 200–205. https://doi.org/10.3906/vet-1202-28

Ozuni, E., Vodica, A., Castrica, M., Brecchia, G., Curone, G., Agradi, S., Miraglia, D., Menchetti, L., Balzaretti, C. M., & Andoni, E. (2021). Prevalence of *Anisakis* larvae in different fish species in southern Albania: Five-year monitoring (2016–2020). *Applied Sciences-Basel*, *11*(23), 11528. https://doi.org/10.3390/app112311528

Pambudi, M. R., Sulistiono, T., & Risa, K. (2021). Infection patterns of helminth parasites in mackerel tuna (*Euthynnus affinis* Cantor, 1849) from Banten waters, Indonesia. *Ilmu Kelautan: Indonesian Journal of Marine Sciences*, *26*(2), 117–124. https://doi.org/10.14710/IK.IJMS.26.2.117-124

Pascual, S., Rodríguez, H., Pierce, G. J., Hastie, L. C., & González, A. F. (2018). The NE Atlantic European hake: A neglected high exposure risk for zoonotic parasites in European fish markets. *Fisheries Research*, *202*, 69–78. https://doi.org/10.1016/j.fishres.2017.12.008

Pekmezci, G. Z. (2014). Occurrence of Anisakis simplex sensu stricto in imported Atlantic mackerel (Scomber scombrus) represents a risk for Turkish consumers. *International Journal of Food Microbiology*, *185*, 64–68. https://doi.org/10.1016/j.ijfoodmicro.2014.05.018

Pekmezci, G. Z. (2019). Occurrence of *Anisakis pegreffii* (Nematoda: Anisakidae) larvae in imported John dory (Zeus faber) from Senegalese coast sold in Turkish supermarkets. *Acta Parasitologica*, *64*(3), 582–586. https://doi.org/10.2478/s11686-019-00078-0

Pekmezci, G. Z., Onuk, E. E., Bolukbas, C. S., Yardimci, B., Gurler, A. T., Acici, M., & Umur, S. (2014). Molecular identification of *Anisakis* species (Nematoda: Anisakidae) from marine fishes collected in Turkish waters. *Veterinary Parasitology*, *201*(1–2), 82–94. https://doi.org/10.1016/j.vetpar.2014.01.005

Phyo Myint, E. E., Sereemaspun, A., Rocklöv, J., & Nithikathkul, C. (2020). Discovery of carcinogenic liver fluke Metacercariae in second intermediate hosts and surveillance on fish-borne trematode Metacercariae infections in Mekong region of Myanmar. *International Journal of Environmental Research and Public Health*, *17*(11), 4108. https://doi.org/10.3390/ijerph17114108

Pierce, G. J., Bao, M., MacKenzie, K., Dunser, A., Giulietti, L., Cipriani, P., Mattiucci, S., & Hastie, L. C. (2018). Ascaridoid nematode infection in haddock (Melanogrammus aeglefmus) and whiting (Merlangius merlangus) in Northeast Atlantic waters. *Fisheries Research*, *202*, 122–133. https://doi.org/10.1016/j.fishres.2017.09.008

Pilecka-Rapacz, M., Piasecki, W., Głoćko, M., Kesminas, V., Domagała, J., Wiśniewski, G., & Czerniawski, R. (2017). Parasitological survey of smelt, (Actinopterygii: Osmeridae), from five estuary sites along the southern coast of the Baltic Sea. *Oceanological and Hydrobiological Studies*, *46*(3), 314–324. https://doi.org/10.1515/ohs-2017-0033

Pinlaor, S., Onsurathum, S., Boonmars, T., Pinlaor, P., Hongsrichan, N., Chaidee, A., Haonon, O., Limviroj, W., Tesana, S., Kaewkes, S., & Sithithaworn, P. (2013). Distribution and abundance of *Opisthorchis viverrini* metacercariae in cyprinid fish in northeastern Thailand. *The Korean Journal of Parasitology*, *51*(6), 703–710. https://doi.org/10.3347/kjp.2013.51.6.703

Pitaksakulrat, O., Kiatsopit, N., Laoprom, N., Webster, B. L., Webster, J. P., Lamberton, P. H. L., Laha, T., Andrews, R. H., Petney, T. N., Blair, D., Carlton, E. J., Spear, R. C., & Sithithaworn, P. (2017). Preliminary genetic evidence of two different populations of Opisthorchis viverrini in Lao PDR. *Parasitology Research*, *116*(4), 1247–1256. https://doi.org/10.1007/s00436-017-5401-6

Poulin, R. (2006). Global warming and temperature-mediated increases in cercarial emergence in trematode parasites. *Parasitology*, *132*(Pt 1), 143–151. https://doi.org/10.1017/s0031182005008693

Prakobwong, S., Gunnula, W., Chaipibool, S., Nimala, B., Sangthopo, J., Sirivetthumrong, N., & Ribas, A. (2017). Epidemiology of Opisthorchis viverrini in an endemic area of Thailand, an integrative approach. *Helminthologia*, *54*, 298–306. https://doi.org/10.1515/helm-2017-0036

Pulleiro-Potel, L., Barcala, E., Mayo-Hernández, E., & Muñoz, P. (2015). Survey of anisakids in commercial teleosts from the western Mediterranean Sea: Infection rates and possible effects of environmental and ecological factors. *Food Control*, *55*, 12–17. https://doi.org/10.1016/j.foodcont.2015.02.020

Pumhirunroj, B., Aukkanimart, R., Boonmars, T., Sriraj, P., Boueroy, P., Artchayasawat, A., Songsri, J., Sripan, P., Chomphumee, K., Ratanasuwan, P., Laummaunwai, P., Khueangchaingkhwang, S., Suwannatrai, A., Aunpromma, S., Eamudomkarn, C., Khuntikeo, N., Loilome, W., Namwat, N., & Yongvanit, P. (2020). Liver fluke-infected cyprinoid fish in northeastern Thailand (2016–2017). *The Southeast Asian Journal of Tropical Medicine and Public Health*, *51*, 1–7.

Qiu, J. H., Zhang, Y., Zhang, X. X., Gao, Y., Li, Q., Chang, Q. C., & Wang, C. R. (2017). Metacercaria infection status of Fishborne zoonotic trematodes, except for *Clonorchis sinensis* in fish from the Heilongjiang Province, China. *Foodborne Pathogen Disease*, *14*(8), 440–446. https://doi.org/10.1089/fpd.2016.2249

Radačovská, A., Čisovská Bazsalovicsová, E., Blasco-Costa, I., Orosová, M., Gustinelli, A., & Králová-Hromadová, I. (2019). Occurrence of *Dibothriocephalus latus* in European perch from alpine lakes, an important focus of diphyllobothriosis in Europe. *Revue Suisse de Zoologie; Annales de la Société Zoologique Suisse et du Muséum d'histoire Naturelle de Genève*, *126*, 219–225. https://doi.org/10.5281/zenodo.3463453

Rauque, C., Viozzi, G., Flores, V., Vega, R., Waicheim, A., & Salgado-Maldonado, G. (2018). Helminth parasites of alien freshwater fishes in Patagonia (Argentina). *International Journal for Parasitology: Parasites and Wildlife*, *7*(3), 369–379. https://doi.org/10.1016/j.ijppaw.2018.09.008

Rim, H. J., Sohn, W. M., Yong, T. S., Eom, K. S., Chai, J. Y., Min, D. Y., Lee, S. H., Hoang, E. H., Phommasack, B., & Insisiengmay, S. (2013). Fishborne trematode metacercariae in Luang Prabang, Khammouane, and Saravane Province, Lao PDR. *The Korean Journal of Parasitology*, *51*(1), 107–114. https://doi.org/10.3347/kjp.2013.51.1.107

Roca-Geronès, X., Segovia, M., Godínez-González, C., Fisa, R., & Montoliu, I. (2020). Anisakis and Hysterothylacium species in Mediterranean and north-East Atlantic fishes commonly consumed in Spain: Epidemiological, molecular and morphometric discriminant analysis. *International Journal of Food Microbiology*, *325*, 108642. https://doi.org/10.1016/j.ijfoodmicro.2020.108642

Rodrigues, M. V., Pantoja, J. C. F., Guimarães, C. D. O., Benigno, R. N. M., Palha, M. D. C., & Biondi, G. F. (2015). Prevalence for nematodes of hygiene-sanitary importance in fish from Colares Island and Vigia, Pará, Brasil. *Revista Brasileira de Ciência Veterinária*, *22*(2), 124–128. https://doi.org/10.4322/rbcv.2015.364

Rodríguez, H., Abollo, E., González, Á. F., & Pascual, S. (2018). Scoring the parasite risk in highly-valuable fish species from southern ICES areas. *Fisheries Research*, *202*, 134–139. https://doi.org/10.1016/j.fishres.2017.06.019

Rodríguez, H., González, Á. F., Abollo, E., & Pascual, S. (2018). Re-evaluation of anchovies (Engraulis encrasicolus) as an important risk factor for sensitization to zoonotic nematodes in Spain. *Fisheries Research*, *202*, 49–58. https://doi.org/10.1016/j.fishres.2017.11.013

Rodríguez-Santiago, M. A., Rosales-Casián, J. A., & Grano-Maldonado, M. I. (2014). Dynamics of a parasite assemblage of the vermilion rockfish Sebastes miniatus from northwestern Baja California, México. *Helgoland Marine Research*, *68*(2), 299–306. https://doi.org/10.1007/s10152-014-0390-7

Rodriguez-Santiago, M. A., Rosales-Casian, J. A., Grano-Maldonado, M. I., Vazquez-Caballero, J. A., Laffon-Leal, S. M., & Nunez-Lara, E. (2020). Parasitological Records of Eight Rockfish Species (Scorpaeniformes: Scorpaenidae) from Pacific Baja California, Mexico. *Pacific Science*, *74*(4), 395–403.

Rolbiecki, L., & Izdebska, J. N. (2023). Anisakidae nematodes in capelin Mallotus villosus (Müller, 1776) (Actinopterygii: Osmeridae) caught for food purposes. *Annals of. Parasitology*, *69*(1), 43–47. https://doi.org/10.17420/ap6901.506

Rolbiecki, L., Izdebska, J. N., & Dzido, J. (2020). The helminthofauna of the garfish Belone belone (Linnaeus, 1760) from the southern Baltic Sea, including new data. *Annals of. Parasitology*, *66*(2), 237–241. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85087320846&partnerID=40&md5=e985ca5c8049062ab1d08c1ec19a67a1

Rozas, M., Bohle, H., Sandoval, A., Ildefonso, R., Navarrete, A., & Bustos, P. (2012). First molecular identification of *Diphyllobothrium dendriticum* Plerocercoids from feral rainbow trout (*Oncorhynchus mykiss*) in Chile. *Journal of Parasitology*, *98*(6), 1220–1226. https://doi.org/10.1645/JP-GE-3097.1

Sanpool, O., Aung, W. P. P., Rodpai, R., Maleewong, W., & Intapan, P. M. (2018). Human liver fluke *Opisthorchis viverrini* (Trematoda, Opisthorchiidae) in Central Myanmar: New records of adults and metacercariae identified by morphology and molecular analysis. *Acta Tropica*, *185*, 149–155. https://doi.org/10.1016/j.actatropica.2018.05.009

Santos, M. J., Matos, M., Guardone, L., Golden, O., Armani, A., Caldeira, A. J. R., & Vieira-Pinto, M. (2022). Preliminary data on the occurrence of *Anisakis* spp. in European hake (*Merluccius merluccius*) caught off the Portuguese coast and on reports of human Anisakiosis in Portugal. *Microorganisms*, *10*(2), 331. https://doi.org/10.3390/microorganisms10020331

Schmidt, G. D. (1971). Acanthocephalan infections of man, with two new records. *The Journal of Parasitology*, *57*(3), 582–584.

See, M. S., Harison, F. S., Zakeri, H. A., & Harun, N. O. (2022). *Anisakis typica* (DIESING, 1860), DOMINANT ANISAKID NEMATODE PRESENT IN SHORTFIN SCAD, *Decapterus macrosoma* (BLEEKER, 1851) FROM TERENGGANU WATERS, Malaysia. *Journal of Sustainability Science and Management*, *17*(7), 104–120. https://doi.org/10.46754/jssm.2022.07.008

Selstad Utaaker, K., & Robertson, L. J. (2015). Climate change and foodborne transmission of parasites: A consideration of possible interactions and impacts for selected parasites. *Food Research International*, *68*, 16–23. https://doi.org/10.1016/j.foodres.2014.06.051

Semenas, L., Viozzi, G., & Arbetman, M. (2021). A regional study of the zoonotic broad tapeworm *Dibothriocephalus* spp. in northwestern Patagonia (Argentina): Origin of fishes and coastal cities as factors affecting infection in fishes. *Parasitology Research*, *120*(7), 2415–2427. https://doi.org/10.1007/s00436-021-07150-7

Sequeira, V., Gordo, L. S., Neves, A., Paiva, R. B., Cabral, H. N., & Marques, J. F. (2010). Macroparasites as biological tags for stock identification of the bluemouth, *Helicolenus dactylopterus* (Delaroche, 1809) in Portuguese waters. *Fisheries Research*, *106*(3), 321–328. https://doi.org/10.1016/j.fishres.2010.08.014

Serracca, L., Battistini, R., Rossini, I., Carducci, A., Verani, M., Prearo, M., Tomei, L., De Montis, G., & Ercolini, C. (2014). Food safety considerations in relation to *Anisakis pegreffii* in anchovies (*Engraulis encrasicolus*) and sardines (*Sardina pilchardus*) fished off the Ligurian coast (cinque Terre National Park, NW Mediterranean). *International Journal of Food Microbiology*, *190*, 79–83. https://doi.org/10.1016/j.ijfoodmicro.2014.08.025

Setyobudi, E. (2011). Infection of *Anisakis* sp. larvae in some marine fishes from the southern coast of Kulon Progo, Yogyakarta. *Biodiversitas, Journal of Biological Diversity*, *12*, 34–37. https://doi.org/10.13057/biodiv/d120107

Setyobudi, E., Jeon, C. H., Lee, C.-H., Seong, K.-B., & Kim, J.-H. (2011). Occurrence and identification of *Anisakis* spp. (Nematoda: Anisakidae) isolated from chum salmon (*Oncorhynchus keta*) in Korea. *Parasitology Research*, *108*, 585–592. https://doi.org/10.1007/s00436-010-2101-x

Setyobudi, E., Murwantoko, U., & Ria. S., A. M. (2023). Anisakid nematodes from the largehead hairtail fish (*Trichiurus lepturus*) from the northern coast of Java, Indonesia. *Biodiversitas*, *24*(3), 1560–1568. https://doi.org/10.13057/biodiv/d240328

Setyobudi, E., Rohmah, I., Syarifah, R., Ramatia, L. I. S. A., Murwantoko, M., & Sari, D. (2019). Presence of *Anisakis* nematode larvae in Indian mackerel (*Rastrelliger* spp.) along the Indian Ocean southern coast of East Java, Indonesia. *Biodiversitas*, *20*, 313–319. https://doi.org/10.13057/biodiv/d200136

Severin, N. L., Yurchenko, M., Oslash, J. S., Rensen, Z., Shaozhi, K., Asma, M. K., & Per, W. B. (2020). Anisakid nematode larvae in the liver of Atlantic cod *Gadus morhua* L. from West Greenland. *Parasitology Research*, *119*(10), 3233–3242. https://doi.org/10.1007/s00436-020-06807-z

Sharif, M., & Negm-Eldin, M. (2013). Occurrence of *Anisakis* sp. larvae in *Merluccius merluccius* (Teleostei, Gadiformes) of the libyan north coast and evaluation of its zoonotic potential. *Institue Scientifique, Rabat, Série Zoologiel*, *49*, 29–32. http://www.israbat.ac.ma/wp-content/uploads/2015/02/04

Shevchuk, T., Kateryna, V., Seratko, M. S., Ovsyemko, M. N., & Novgorodska, V. (2020). The degree of residual invasion after infection with anisakiasis fish of various culinary processing. *Carpathian Journal of Food Science and Technology*, *12*(2), 125–133. https://doi.org/10.34302/crpjfst/2020.12.2.12

Simakova, A. V., Babkina, I. B., Chitnis, N., Katokhin, A. V., Babkin, A. M., & Fedorova, O. S. (2022). The role of non-commercial cyprinids in maintenance and spread of the opisthorchiasis focus in the middle Ob River basin (Tomsk region, Russia). *Food and Waterborne Parasitology*, *26*, e00146. https://doi.org/10.1016/j.fawpar.2022.e00146

Simakova, A. V., Babkina, I. B., Khodkevich, N. E., Babkin, A. M., & Interesova, E. A. (2019). Infestation of alien cyprinid fishes with trematode *Opisthorchis felineus* Rivolta, 1884 in the middle Ob River basin. *Russian Journal of Biological Invasions*, *10*(2), 178–180. https://doi.org/10.1134/S2075111719020115

Simakova, A. V., Chitnis, N., Babkina, I. B., Fedorova, O. S., Fedotova, M. M., Babkin, A. M., & Khodkevich, N. E. (2021). Abundance of Opisthorchis felineus Metacercariae in cyprinid fish in the middle Ob River basin (Tomsk region, Russia). *Food and Waterborne Parasitology*, *22*, e00113. https://doi.org/10.1016/j.fawpar.2021.e00113

Soares, I., & Luque, J. (2015). Seasonal variability of the composition and structure of parasite communities of red porgy, Pagrus pagrus (Perciformes: Sparidae) off Brazil. *Helminthologia*, *52*, 236–243. https://doi.org/10.1515/helmin-2015-0038

Sobecka, E., Łuczak, E., Wiecaszek, B., & Antoszek, A. (2011). Parasite community structure of cod from Bear Island (Barents Sea) and Pomeranian Bay (Baltic Sea). *Polish Polar Research*, *32*, 253–262. https://doi.org/10.2478/v10183-011-0016-6

Sohn, W. M., Choi, S. H., Jung, B. K., Hong, S., Ryoo, S., Chang, T., Lee, K. H., Na, B. K., Hong, S. J., Khieu, V., & Chai, J. Y. (2021). Prevalence and intensity of *Opisthorchis viverrini* Metacercarial infection in fish from Phnom Penh, Takeo, and Kandal provinces, Cambodia. *The Korean Journal of Parasitology*, *59*(5), 531–536. https://doi.org/10.3347/kjp.2021.59.5.531

Sohn, W. M., Jung, B. K., Hong, S. J., Lee, K. H., Park, J. B., Kim, H. S., Cho, S., Htoon, T. T., Tin, H. H., & Chai, J. Y. (2019). Low-grade Endemicity of Opisthorchiasis, Yangon, Myanmar. *Emerging Infection Disease*, *25*(7), 1435–1437. https://doi.org/10.3201/eid2507.190495

Sohn, W. M., & Na, B. K. (2019). Infections with digenetic trematode Metacercariae in freshwater fishes from two visiting sites of migratory birds in Gyeongsangnam-do, Republic of Korea. *The Korean Journal of Parasitology*, *57*(3), 273–281. https://doi.org/10.3347/kjp.2019.57.3.273

Sohn, W. M., Na, B. K., Cho, S. H., Ju, J. W., Kim, C. H., Hwang, M. A., No, K. W., & Park, J. H. (2021). Prevalence and infection intensity of zoonotic trematode Metacercariae in fish from Soyang-cheon (stream), in Wanju-gun, Jeollabuk-do, Korea. *The Korean Journal of Parasitology*, *59*(3), 265–271. https://doi.org/10.3347/kjp.2021.59.3.265

Sohn, W. M., Na, B. K., Cho, S. H., Lee, H. I., Ju, J. W., Lee, M. R., Lim, E. J., Son, S. Y., Ko, E., & Choi, J. (2021). Survey of zoonotic trematode Metacercariae in fish from Irrigation Canal of Togyo-jeosuji (reservoir) in Cheorwon-gun, Gangwon-do, Republic of Korea. *The Korean Journal of Parasitology*, *59*(4), 427–432. https://doi.org/10.3347/kjp.2021.59.4.427

Sohn, W. M., Na, B. K., Cho, S. H., Lee, H. I., Ju, J. W., Lee, M. R., Park, J. G., & Ahn, J. (2021). Endemicity of zoonotic trematode Metacercariae in fish from Deokcheon-gang (river) in Sancheong-gun, Gyeongsangnam-do, Republic of Korea. *The Korean Journal of Parasitology*, *59*(5), 523–529. https://doi.org/10.3347/kjp.2021.59.5.523

Sohn, W. M., Na, B. K., Cho, S. H., & Lee, S. W. (2019). Infection status with digenetic trematode Metacercariae in fishes from Coastal Lakes in Gangwon-do, Republic of Korea. *The Korean Journal of Parasitology*, *57*(6), 681–690. https://doi.org/10.3347/kjp.2019.57.6.681

Sohn, W. M., Na, B. K., Cho, S. H., Lee, S. W., Choi, S. B., & Seok, W. S. (2015). Trematode Metacercariae in freshwater fish from water Systems of Hantangang and Imjingang in Republic of Korea. *The Korean Journal of Parasitology*, *53*(3), 289–298. https://doi.org/10.3347/kjp.2015.53.3.289

Sohn, W. M., Na, B. K., Cho, S. H., Park, M. Y., Kim, C. H., Hwang, M. A., No, K. W., Yoon, K. B., & Lim, H. C. (2017). Prevalence of *Clonorchis sinensis* Metacercariae in fish from water Systems of Seomjin-gang (river). *The Korean Journal of Parasitology*, *55*(3), 305–312. https://doi.org/10.3347/kjp.2017.55.3.305

Sohn, W.-M., Yong, T.-S., Eom, K. S., Pyo, K.-H., Lee, M. Y., Lim, H., Choe, S., Jeong, H.-G., Sinuon, M., Socheat, D., & Chai, J.-Y. (2012). Prevalence of Opisthorchis viverrini infection in humans and fish in Kratie Province, Cambodia. *Acta Tropica*, *124*(3), 215–220. https://doi.org/10.1016/j.actatropica.2012.08.011

Sonko, P., Chen, S. C.-C., Chou, C.-M., Huang, Y.-C., Hsu, S.-L., Barcak, D., Oros, M., & Fan, C.-K. (2020). Multidisciplinary approach in study of the zoonotic *Anisakis* larval infection in the blue mackerel (Scomber australasicus) and the largehead hairtail (Trichiurus lepturus) in northern Taiwan. *Journal of Microbiology, Immunology, and Infection*, *53*(6), 1021–1029. https://doi.org/10.1016/j.jmii.2019.04.012

Soylu, E. (2015). Metazoan parasites of fish species from Lake gala (Edirne, Turkey) gala Gölü (Edirne)' ndeki balık türlerinin metazoan parazitleri. *Ege Journal of Fisheries and Aquatic Sciences*, *31*, 187–193. https://doi.org/10.12714/egejfas.2014.31.4.03

Sripa, J., Kiatsopit, N., & Piratae, S. (2016). Prevalence of trematode larvae in intermediate hosts: Snails and fish in KO ae sub-district of KHUEANG NAI, UBON RATCHATHANI province, Thailand. *The Southeast Asian Journal of Tropical Medicine and Public Health*, *47*(3), 399–409.

Suzuki, J., Murata, R., Hosaka, M., & Araki, J. (2010). Risk factors for human Anisakis infection and association between the geographic origins of *Scomber japonicus* and anisakid nematodes. *International Journal of Food Microbiology*, *137*(1), 88–93. https://doi.org/10.1016/j.ijfoodmicro.2009.10.001

Takahashi, K., Ito, T., Sato, T., Goto, M., Kawamoto, T., Fujinaga, A., Yanagawa, N., Saito, Y., Nakao, M., Hasegawa, H., & Fujiya, M. (2016). Infection with fully mature *Corynosoma* cf. *validum* causes ulcers in the human small intestine. *Clinical Journal of Gastroenterology*, *9*(3), 114–117. https://doi.org/10.1007/s12328-016-0646-7

Takano, T., Iwaki, T., Waki, T., Murata, R., Suzuki, J., Kodo, Y., Kobayashi, K., & Ogawa, K. (2021). Species composition and infection levels of Anisakis (Nematoda: Anisakidae) in the skipjack tuna *Katsuwonus pelamis* (Linnaeus) in the Northwest Pacific. *Parasitology Research*, *120*(5), 1605–1615. https://doi.org/10.1007/s00436-021-07144-5

Tantanasi, J., Diakou, A., Tamvakis, A., & Batjakas, I. (2012). Anisakis spp. burden in Trachurus trachurus. *Helminthologia*, *49*(1), 16–20. https://doi.org/10.2478/s11687-012-0003-4

Tejada, M., Karl, H., Heras, C., Vidacek, S., Solas, M. T., & Garcia, M. L. (2014). Does the intensity of Anisakis infection affect the quality of hake muscle? *Journal of Aquatic Food Product Technology*, *23*(3), 221–236. https://doi.org/10.1080/10498850.2012.710301

Tepe, Y., & Oguz, M. (2013). Nematode and acanthocephalan parasites of marine fish of the eastern Black Sea coasts of Turkey. *Turkish Journal of Zoology*, *37*, 753–760. https://doi.org/10.3906/zoo-1206-18

Tesfaye, Z., Hiko, A., Belina, D., & Firdisa, M. (2023). Assessments and identification of selected fish-borne zoonotic parasites in Nile tilapia and African catfish species in lakes of Haramaya District, Ethiopia. *Aquaculture Research*, *2023*(1), 2638123. https://doi.org/10.1155/2023/2638123

Thébault, A., El Metennani, S., Carvalho, L., Cadavez, V., Gonzales-Barron, U., & Kooh, P. (2024). Data on the occurrence of anisakids in fishery products from wild caught fish in all countries (Jan 2010 – Sept 2023) [Data set]. *Zenodo*. https://doi.org/10.5281/zenodo.14047972

Tiewchaloern, S., Udomkijdecha, S., Suvouttho, S., Chunchamsri, K., & Waikagul, J. (1999). Clinostomum trematode from human eye. *The Southeast Asian Journal of Tropical Medicine and Public Health*, *30*(2), 382–384.

Torres, P., Leyán, V., & Puga, S. (2012). Prevalence, intensity, and abundance of infection and pathogenesis caused by diphyllobothriosis in vulnerable, native fish and introduced trout in lake Panguipulli, Chile. *Journal of Wildlife Diseases*, *48*(4), 937–950. https://doi.org/10.7589/2011-08-235

Torres, P., & Puga, S. (2011). Comparative efficacy of candling and glass plate compression for detection of diphyllobothriosis in rainbow trout (*Oncorhynchus mykiss*) musculature. *Revue Scientifique et Technique*, *30*(3), 831–837. https://doi.org/10.20506/rst.30.3.2082

Torres-Frenzel, P., & Torres, P. (2014). Anisakid parasites in commercial hake ceviche in southern Chile. *Journal of Food Protection*, *77*(7), 1237–1240. https://doi.org/10.4315/0362-028X.JFP-13-538

Unger, P., Klimpel, S., Lang, T., & Palm, H. W. (2014). Metazoan parasites from herring (Clupea harengus L.) as biological indicators in the Baltic Sea. *Acta Parasitologica*, *59*(3), 518–528. https://doi.org/10.2478/s11686-014-0276-5

Urquhart, K., Pert, C. C., Fryer, R. J., Cook, P., Weir, S., Kilburn, R., McCarthy, U., Simons, J., McBeath, S. J., Matejusova, I., & Bricknell, I. R. (2010). A survey of pathogens and metazoan parasites on wild sea trout (Salmo trutta) in Scottish waters. *ICES Journal of Marine Science*, *67*(3), 444–453. https://doi.org/10.1093/icesjms/fsp271

van Weelden, C., Towers, J. R., & Bosker, T. (2021). Impacts of climate change on cetacean distribution, habitat and migration. *Climate Change Ecology*, *1*, 100009. https://doi.org/10.1016/j.ecochg.2021.100009

Vasconcelos, J., Hermida, M., Saraiva, A., González, J. A., & Gordo, L. S. (2017). The use of parasites as biological tags for stock identification of blue jack mackerel, *Trachurus picturatus*, in the North-eastern Atlantic. *Fisheries Research*, *193*, 1–6. https://doi.org/10.1016/j.fishres.2017.03.015

Violante-González, J., Gallegos-Navarro, Y., Monks, S., García-Ibáñez, S., Rojas-Herrera, A. A., Pulido-Flores, G., Villerías-Salinas, S., & Larumbe-Morán, E. (2016). Parasites of the green jack *Caranx caballus* (Pisces: Carangidae) in three locations from Pacific coasts of Mexico, and their utility as biological tags. *Revista Mexicana de Biodiversidad*, *87*(3), 1015–1022. https://doi.org/10.1016/j.rmb.2016.07.010

Wang, Y., Wang, X., Gong, P., Yu, Y., Zhang, N., Ren, Y., Ma, Y., Zhao, Z., Zhang, X., Li, X., & Li, J. (2022). Prevalence of fish-borne zoonotic trematode infection in Jilin Province, China. *International Journal for Parasitology: Parasites and Wildlife*, *18*, 52–60. https://doi.org/10.1016/j.ijppaw.2022.04.004

Wicht, B., Limoni, C., Peduzzi, R., & Petrini, O. (2009). Diphyllobothrium latum (Cestoda: Diphyllobothriidea) in perch (Perca fluviatilis) in three sub-alpine lakes: Influence of biotic and abiotic factors on prevalence. *Journal of Limnology*, *68*(2), 167–173. https://doi.org/10.4081/jlimnol.2009.167

Wilson, J. R., Saunders, R. J., & Hutson, K. S. (2019). Parasites of the invasive tilapia *Oreochromis mossambicus*: evidence for co-introduction. *Aquatic Invasions*, *14*(2), 332–349.

Wongsawad, C., Wongsawad, P., Anuntalabhochai, S., Chai, J.-Y., & Sukontason, K. (2013). Occurrence and molecular identification of liver and minute intestinal flukes metacercariae in freshwater fish from fang-Mae Ai Agricultural Basin, Chiang Mai province, Thailand. *Asian Biomedicine*, *7*, 97–104. https://doi.org/10.5372/1905-7415.0701.155

Yamasaki, H., Sato, M. O., Kuramochi, T., & Mercado, R. (2023). Genetic characterization of Dibothriocephalus latus and *Dibothriocephalus dendriticus* (Cestoda: Diphyllobothriidae) from Chile based on haplotype analysis using mitochondrial DNA markers. *Parasitology International*, *96*, 102767. https://doi.org/10.1016/j.parint.2023.102767

Yang, S., Pei, X., Yin, S., Yu, X., Mei, L., Zhao, W., Liang, H., Wang, Q., & Yang, D. (2019). Investigation and research of *Clonorchis sinensis* metacercariae and *Metorchis orientalis* metacercariae infection in freshwater fishes in China from 2015 to 2017. *Food Control*, *104*, 115–121. https://doi.org/10.1016/j.foodcont.2019.04.028

Yun, N. Q., Syarifah, R. F., & Murwantoko, S. (2022). *Anisakis* infection of Belanger's croaker (Johnius Belangerii Cuvier 1830) at the Indian Ocean coast of Yogyakarta, Indonesia. *Jordan*. *Journal of Biological Sciences*, *15*(1), 29–36. https://doi.org/10.54319/jjbs/150105

Zhang, S. L., & Fan, G. H. (1990). Case report: brain abscess caused by heterophyid eggs. *Chinese Journal of Parasitology and Parasitic Diseases*, *8*(8), 178.

Zhao, W.-T., Lü, L., Chen, H.-X., Yang, Y., Zhang, L.-P., & Li, L. (2016). Ascaridoid parasites infecting in the frequently consumed marine fishes in the coastal area of China: A preliminary investigation. *Parasitology International*, *65*(2), 87–98. https://doi.org/10.1016/j.parint.2015.11.002

Zuo, S., Kania, P. W., Mehrdana, F., Marana, M. H., & Buchmann, K. (2018). *Contracaecum osculatum* and other anisakid nematodes in grey seals and cod in the Baltic Sea: Molecular and ecological links. *Journal of Helminthology*, *92*(1), 81–89. https://doi.org/10.1017/S0022149X17000025

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APPENDIX A

Data on import, landings and consumption of finfish in the EU

The Tables A.1, A.2 below presents a summary of the data collated on finfish landings, imports and consumption in the EU.

TABLE A.1 Data on import, landings and consumption of freshwater finfish species in the EU.

Freshwater fish Common names	Latin names	Landings volume (kg), 2021	Imports to EU (kg, 2023)	Per capita consumption (kg, LWE) EU, 2021	Household consumption of fresh products, EUMOFA 2021
Carp	*Cyprinus carpio*	160,800	14,377,080	–	6,342,911
Catfish	Eg.: *Ictalurus puntactus, I. furcatus; Clarias* spp., *C. gariepinus, C. batrachus*	4710	70,624,813	–	–
Pike	*Esox lucius*	281,800	–	–	–
Pikeperch	*Sander lucioperca*	714,590	–	–	36,271

TABLE A.2 Data on import, landings and consumption of marine water finfish species in the EU.

Marine fishes common names	Latin names (family/species)	Landings volume (kg), 2021	Imports to EU (kg, 2023)	Per capita consumption of wild fish (kg, LWE) EU, 2021	Household consumption of fresh products, EUMOFA 2021
Anchovy	Engraulidae	104,776,120	52,565,535	–	10,323,964
Brill	*Scophthalmus rhombus*	1,828,600	–	–	
Cod	Gadidae	16,489,680	648,257,344	1.75	59,113,954
Dab	*Limanda limanda*	4,354,410	–	–	13,763
Eel, Cusk	*Genypterus blacodes*	1,012,340	4,825,508	–	–
Eel	Anguillidae	770,200	4,722,064	–	–
Flounder, European	*Platichthys flesus*	18,000,580	1,732,435	–	–
Grenadier	Macrouridae	1,112,270	15,869,999	–	–
Gurnard	Triglidae	10,011,030	–	–	–
Haddock	*Melanogrammus aeglefinus*	14,563,780	35,270,529	–	946,662
Hake	Merlucciidae	143,063,080	280,808,552	1.02	68,160,374
Halibut, Atlantic	*Hippoglossus hippoglossus*	299,420	3,808,625	–	–
Halibut, Greenland	*Reinhardtius hippoglossoides*	7,318,170	46,902,426	–	–
Herring	Clupeidae	492,290,670	520,769,903	1.00	4,601,847
Horse mackerel, Atlantic	*Trachurus trachurus*	76,929,490	26,109,454	–	–
John dory	*Zeus faber*	2,740,000	–	–	–
Ling	Lotidae	3,181,310	10,879,583	–	–
Mackerel	Scombridae	222,009,970	355,396,879	0.53	32,731,456
Megrim	*Lepidorhombus whiffiagonis*	15,074,920	10,825,031	–	–
Monk	Lophiidae	35,459,700	41,128,258	–	12,110,118
Mullet, Red	Mullidae	14,985,760	–	–	–
Picarel	*Spicara smaris*	1,988,110	–	–	–
Plaice, European	*Pleuronectes platessa*	37,230,580	32,294,527	–	–
Pollack	*Pollachius pollachius*	2,874,530	3,773,009	–	–
Pounting (=Bib)	*Trisopterus luscus*	5,606,340	–	–	–
Ray	Rajidae	15,533,030	5,346,570	–	–
Redfish	Berycidae, Sebastidae	11,625,700	66,081,879	–	–

TABLE A.2 (Continued)

Marine fishes common names	Latin names (family/species)	Landings volume (kg), 2021	Imports to EU (kg, 2023)	Per capita consumption of wild fish (kg, LWE) EU, 2021	Household consumption of fresh products, EUMOFA 2021
Saithe (=Coalfish)	*Pollachius virens*	12,707,860	163,051,674	0.36	10,315,553
Salmon	Salmonidae	–	–	0.15	
Sardine	*Sardina pilchardus*	170,590,560	162,945,428	0.54	51,112,532
Scabbardfish	Trichiuridae	5,028,800	–	–	1,750,880
Seabass, European	*Dicentrarchus labrax*	4,485,310	84,739,788	–	39,034,591
Seabream, Gilthead	*Sparus aurata*	3,397,350	124,167,733	–	77,233,743
Smelt	Osmeridae	5,294,750	–	–	–
Sole, common	*Solea solea*	17,122,230	13,437,914	–	–
Sprat	*Sprattus* spp.	319,583,330	60,477,577	–	–
Swordfish	*Xiphias gladius*	20,686,800	48,265,115	–	9,475,634
Toothfish	*Dissostichus mawsoni*	140,240	2,348,213	–	–
Trout	Salmonidae	–	–	0.01	
Tuna all species	Scombridae	297,007,240	912,412,724	2.84	–
Turbot	*Scophthalmus maximus*	3,729,710	10,230,750	–	–
Weever	Trachinidae	1,113,320	–	–	–
Whiting	*Merlangius merlangus*	15,737,430	8,088,909	–	3,585,404
Amberjack, Greater	*Seriola dumerili*	–	–	–	–
Wolffish, Atlantic	*Anarhichas lupus*	–	–	–	–
Barracuda	*Sphyraena*	–	–	–	–
Blue butterfish	*Stromateus fiatola*	–	–	–	–
Capellin	*Mallotus villosus*	–	–	–	–
Croaker	*Argyrosomus regius*	–	–	–	–
Cusk = tusk	*Brosme brosme*	–	–	–	–
Dentex, Large-eye	*Dentex macrophthalmus*	–	–	–	–
Dogfish	*Squalus acanthias*	–	–	–	–
Eel, Conger	*Conger conger*	–	–	–	–
Flounder, Arrowtooth	*Atheresthes stomas*	–	–	–	–
Greater Argentine	*Argentina silus*	–	–	–	–
Groupers	Epinephelidae	–	–	–	–
Hairtail, Largehead	*Trichiurus lepturus*	–	–	–	–
Horse mackerel, other	Carangidae	–	–	–	–
Kingklip	*Genypterus hubbsi*	–	–	–	–
Ling, Blue	*Molva dypterygia*	–	–	–	–
Ling, Common	*Molva molva*	–	–	–	–
Megrim, Four-spotted	*Lepidorhombus boscii*	–	–	–	–
Pollock, Alaska	*Gadus chalcogrammus*	–	–	–	–
Porgy, Red	*Pagrus pagrus*	–	–	–	–
Scorpionfish, black	*Scorpaena porcus*	–	–	–	–
Scorpionfish, Red	*Scorpaena scrofa*	–	–	–	–
Seabass, Argentine	*Acanthistius brasiliensis*	–	–	–	–
Seabream	*Pagrus pagrus*	–	–	–	–
Sole, Senegalese Common	*Solea senegalensis*	–	–	–	–
Weever, Greater	*Trachinus draco*	–	–	–	–
Whiting, Blue	Gadidae	–	–	–	–

Abbreviation: –, no data.