

NOTE

Larvae of *Contraecum* sp. among inshore fish species of southwestern Australia

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ABSTRACT: Larval nematode infections were investigated in 236 fish from 17 estuarine and near-shore species in southwestern Australia. Larvae of the genus *Contraecum* were found in 4 species of fish (*Acanthopagrus butcheri*, *Sillaginodes punctata*, *Mugil cephalus* and *Aldrichetta forsteri*). The prevalence and intensity of infection was highest in the 2 species of mullet: 81% infected and 9.8 ± 1.5 larvae fish⁻¹ for *M. cephalus*; 100% and 12.7 ± 3.7 larvae fish⁻¹ for *A. forsteri*. There was no evidence of post-mortem migration of worms from the visceral organs to the musculature of the fish.

KEY WORDS: Nematodes · Inshore fish · Anisakidae · *Contraecum*

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Nematodes of the family Anisakidae are commonly found in marine fish, and the most widespread genera, *Anisakis*, *Pseudoterranova* and *Contraecum*, have similar life cycles. Adult parasites live in the stomach or small intestine of piscivorous marine mammals and birds. Eggs shed in the faeces and larvae are ingested by an invertebrate (usually crustacean) intermediate or paratenic host. Various species of fish and cephalopods may also act either as a second intermediate host, or as a paratenic host (Anderson 1992, Køie & Fagerholm 1995, Køie et al. 1995). Anisakid nematodes are widely distributed, and their prevalence among a variety of fish species can be very high. Wharton et al. (1999), for example, found *Anisakis* larvae in 82% of 100 red gurnard *Chelidonichthys kumu*, in 84% of 100 tarakihi *Nemadactylus macropterus* and in 100% of 36 barracouta *Thyristes atun* in New Zealand waters.

There have been very few studies of anisakids in fish in Australia. Cannon (1977a,b) found 9 larval morphotypes of the genera *Anisakis*, *Contraecum*, *Terranova* and *Thynnascaris* in 47 species of marine fish

from Queensland, northeast Australia. As far as we are aware, no surveys have been conducted on the southern or western coasts of the country. The aim of this study was to survey the prevalence of anisakid larvae in marine fish in southwestern Australia. The survey was not comprehensive, and we concentrated on a number of inshore fish species that are commonly targeted by both recreational fishers and commercial operations for the local market.

Materials and methods. In all, 236 fish representing 17 species of estuarine and near-shore fish were sampled from routine demographic surveys conducted by Fisheries Western Australia and from a Perth metropolitan recreational fishing club. Whole fish were either immediately frozen or placed on ice prior to inspection. Fillets were thinly sliced and examined under white light, and the visceral organs, mesenteries, and peritoneum were disrupted before examination under white light. Larvae were counted, their location recorded, and stored in 70% ethanol. Worms were then immersed in lactophenol for 48 h, mounted, and examined microscopically for taxonomic identification. Larval nematode prevalence (percentage of fish infected), and mean intensity (mean number of parasites per infected fish) were calculated where specific sample sizes exceeded 10 fish.

Results and discussion. In contrast to previous studies of marine fish in eastern Australia and New Zealand (Cannon 1977a,b, Wharton et al. 1999), we found only 1 genus of anisakid: *Contraecum* (Ascaridida; Anisakidae). This may reflect the bias in our sampling towards estuarine and inshore habitats, where fish are principally bottom dwelling, benthic feeding species. Morphologically, all the isolates of *Contraecum* were identical to *Contraecum* type I (thick bodied third stage larvae, 19.0 to 26.8 mm in length, sharply pointed tail) described by Cannon (1977b). The species-level taxonomy of *Contraecum* is confused

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and just beginning to be addressed by molecular genetic techniques (Nadler et al. 2000, Zhu et al. 2000). We are collaborating in molecular studies to determine the taxonomic affiliations of anisakid nematodes in Australia. These studies should provide specific identification and life cycle confirmation of the *Contracaecum* isolates described here; in the meantime, type specimens have been lodged with Dr. L. Cannon at the Museum of Queensland (Accession Number G218789).

Sample sizes exceeded 10 individual fish for only 8 of the 17 species of fish examined. Larvae of *Contracaecum* sp. were found in 4 of these species (black bream, King George whiting, sea mullet and yellow-eyed mullet). The prevalence and intensity of *Contracaecum* infections was greatest in the 2 species of mullet (Table 1). Parasites were found on and in the liver (79% in sea mullet, 93% in yellow-eyed mullet), on the surface of the dorsal aorta (19.3% in sea mullet, 6.6% in yellow-eyed mullet), on the surface of the stomach (1.5% in sea mullet, 0.4% in yellow-eyed mullet), and in the mesenteries and peritoneum (0.2% in sea mullet, 0% in yellow-eyed mullet).

The high prevalence of *Contracaecum* infection in species of mullet, and the large number of worms in infected fish, may have implications for the health of the fish and also for the potential definitive and accidental hosts that eat infected fish. Our observations are that the most commonly infected organ in fish was the liver, and parasitised livers showed gross morphological changes. Previous studies have found reductions in weight and liver fat content in fish infected with *Contracaecum* (Acha & Szyfres 1987). A number of worms were also found adjacent to the dorsal aorta in infected fish, and invasion of the cardiac region has been associated with the death of young fish (Acha & Szyfres 1987).

Members of the genus *Contracaecum* mature in piscivorous birds or mammals (Anderson 1992). For the species found in this study, the definitive host is likely to be one or more species of piscivorous birds, possibly of the order Pelicaniformes (Cannon 1977b). Species of

Contracaecum have been reported from a number of species of cormorants *Phalacrocorax* spp. and pelicans *Pelecanus* spp. in Australia, Europe and North America (Johnston & Mawson 1941, Huizinga 1971, Pyrovetsi & Papazaharidou 1995). Many studies have suggested that heavy infections of *Contracaecum* in birds may cause haemorrhage and ulcers in the stomach, leading to illness and death, especially when associated with adverse environmental conditions or other stress factors (e.g. Oglesby 1960, Huizinga 1971, Pyrovetsi & Papazaharidou 1995, Fagerholm et al. 1996, Kuiken et al. 1999).

Mullet are a common and popular fish caught in recreational activities in Western Australia and are also fished commercially, with between 1 and 2 tonnes marketed locally in Perth each year. Although much less invasive than nematodes of the genera *Anisakis* and *Pseudoterranova*, larvae of *Contracaecum* species have been shown experimentally to be infective to mammals (Vidal-Martinez et al. 1994), and have occasionally been identified in people (see Beaver et al. 1984). Their preferred occurrence in visceral organs, rather than the flesh of fish, limits their zoonotic potential. We found no worms in the flesh of infected fish. Wharton et al. (1999) suggested that if fish are not frozen or filleted soon after capture, then larval nematodes may migrate into the flesh. Post-mortem migration was investigated by obtaining 20 sea mullet from the Perth wholesale fish market 6 h after capture. Whole dead fish were maintained at 4°C for 60 h and then dismantled for inspection; 75 worms were found and all were in the visceral organs, mesenteries, and peritoneum, with no evidence of post-mortem migration into fish flesh. Post-mortem migration has been described for larvae of *Anisakis* spp. in northern hemisphere herring *Clupea harengus* and mackerel *Scomber scombrus* (Smith & Wootten 1975, Smith 1984), but other studies have not been able to demonstrate the phenomenon in these or other fish species (Khalil 1969, Cattán & Carvajal 1984, Roepstorff et al. 1993).

Table 1. Prevalence (% infected) and intensity (mean number of larvae/fish \pm SE) of infections of inshore fish species in southwestern Australia with larvae of the nematode *Contracaecum*

Common name	Scientific name	Number examined	Prevalence	Intensity
Australian herring	<i>Arripis georgianus</i>	29	0	0
Black bream	<i>Acanthopagrus butcheri</i>	26	4	1
King George whiting	<i>Sillaginodes punctata</i>	32	6	1.5
Samson fish	<i>Seriola hippos</i>	13	0	0
Sand whiting	<i>Sillago</i> sp.	20	0	0
Sea mullet	<i>Mugil cephalus</i>	58	81	9.8 \pm 1.5
Yellow-eyed mullet	<i>Aldrichetta forsteri</i>	19	100	12.7 \pm 3.7
Yellow-finned whiting	<i>Sillago schomburgkii</i>	13	0	0

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