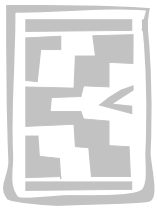

The occurrence of *Contracaecum* sp. larvae (Nematoda: Anisakidae) in the catfish *Clarias gariepinus* (Burchell) from Lake Chivero, Zimbabwe

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ABSTRACT

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Clarias gariepinus were collected from Lake Chivero, Zimbabwe, and examined for nematode parasites from November 2000 to May 2002. Of the 202 specimens collected, 42.6 % were infected with third-stage larvae of *Contracaecum* sp. in the body cavity. The intensity of the infection was 1–7 worms per fish (mean intensity = 2.2). Seasonal variation in the prevalence of the parasite was not obvious and there was no significant difference in the prevalence of infection between males and females ($\chi^2 = 2.228$; $P > 0.05$). No significant relationship between host size and prevalence was established. There was also no significant relationship between intensity and the body condition factor ($r = 0.11$; $P > 0.05$). The low parasite prevalence may have been caused by the disruption of the infection cycle since piscivorous birds, which are the final hosts of the parasite, do not feed on *C. gariepinus* in Lake Chivero.

Keywords: *Clarias gariepinus*, *Contracaecum*, fish, mean intensity, nematode, parasite, prevalence

INTRODUCTION

Freshwater fish can serve as definitive, intermediate or paratenic (transport) hosts in the life cycles of many species of protozoan, metazoan and crustacean parasites. The parasites usually affect the marketability of commercially produced fish, thus raising a lot of public health concerns, especially in areas where raw or smoked fish are eaten (Paperna 1996). In fish farming or aquaculture, parasites may be highly pathogenic, contributing to high fish mortalities and economic losses, while in natural systems, parasites may threaten the abundance and diversity of indigenous fish species (Douëllou 1992a; Paperna 1996).

Fish parasites have not been studied much in Zimbabwe. Some platyhelminthes were recorded by Beverly-Burton (1962) from Mazowe and Kadoma, while Khalil & Polling (1997) recorded a few nematode species from Zimbabwean fish. The only extensive study of fish parasites was done on fish from Lake Kariba (Chishawa 1991; Douëllou 1992a, b; Douëllou & Erlwanger 1993; Douëllou & Chishawa 1995). These publications reported the presence of larvae of *Contracaecum* Raillet and Henry, 1912, from the body cavity and intestines of siluriform and cichlid fishes, as well as the tigerfish, *Hydrocynus vittatus* Castelnau and the cornish jack, *Mormyrops anguilloides* (L.) (Khalil & Polling 1997).

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Contracaecum is an anisakid nematode that infects fish-eating birds and marine mammals. Larval stages of *Contracaecum* usually occur in the body cavity and mesenteries of fish while the adults occur in the gut of piscivorous birds, notably pelicans, cormorants, herons and darters (Whitfield & Heeg 1977). The occurrence of the parasite has been widely reported in cichlids and catfish from several African countries such as Egypt (Amin 1978), East Africa (Malvestuto & Ogambo-Ongoma 1978; Aloo 2001), and South Africa (Prudhoe & Hussey 1977; Mashego & Saayman 1981; Boomker 1982, 1994; Van As & Basson 1984). The life cycle of *C. multipapillatum* (Von Drasche 1882) was successfully demonstrated by Huizinga (1967). Eggs are shed into the water via the faeces of a definitive host, usually a bird, and they develop into second-stage larvae, which subsequently infect cyclopoid copepods. When the copepods are eaten by fish, the larvae develop into third-stage larvae (L3). The L3 larvae may penetrate the gut wall and encyst in the musculature, and will only develop into adults in the gut of a definitive host when it eats an infected fish, thus completing the life cycle.

Clarias gariepinus Burchell was selected for this investigation because of its wide distribution in Zimbabwe and throughout sub-Saharan Africa (Skelton 1993). It can survive adverse conditions such as muddy water and extremely low oxygen concentrations (Mashego 1989), and because it is omnivorous, *C. gariepinus* was, at least in Lake Kariba, one of the most heavily parasitised fish species (Chishawa 1991).

The aim of this investigation was to determine the occurrence of *Contracaecum* spp. in *C. gariepinus* from Lake Chivero, Zimbabwe, and to note its seasonal distribution, infection rate, variation with host size and sex, and the effect of the parasite on the health of the host. The lake is situated on the upper Manyame River, about 23 km southwest of Harare, the capital of Zimbabwe. It is the major source of drinking water for the city and is eutrophic because of sewage discharged into its tributaries (Moyo 1997).

MATERIALS AND METHODS

Fish were collected once a month for 18 months (November 2000 to May 2002) using a fleet of 8–10 cotton gill nets. The standard length, mass, and sex of each fish was recorded and they were then either examined immediately for parasites or frozen for later examination in the laboratory. In the laboratory, the entire digestive tract, together with the liver, spleen and gills of each fish was removed and preserved in 10 % formalin. The body cavity was examined for nematode larvae and cysts, which were excised and fixed in glacial acetic acid before being preserved in 70 % ethyl alcohol. The worms were stained with Horen's trichome stain, cleared in lactophenol and permanent mounts made in lactophenol or Canada balsam. The preserved organs were examined thoroughly for nematode larvae or cysts with the aid of an Olympus SZ 40 stereomicroscope. The parasites were identified to generic level using the keys of Bykhovskaya-Pavlovskaya (1964), based on their morphological features, under the Olympus CK 40 microscope.

The rates of infection were determined by calculating the prevalence (% infected) and mean intensity (average number of parasites per fish) for each month (Margolis, Esch, Holmes, Kuris & Schad 1982; Gregory & Blackburn 1991). The effect of the larval nematode parasites on the health of their host was determined by calculating the condition factor (K) of the host, in which

$$K = (W \times 100) / SL3$$

where W = mass (g), and SL = standard length (Aloo 1999).

The χ^2 test was used to compare the difference in the infection rate between males and females. Pearson's correlation factor was calculated to determine the relationship between parasite infection and the body condition of the host.

RESULTS

Of the 202 specimens of *C. gariepinus* collected over a period of 18 months, 86 (42.6 %) were infected with L3 larvae of *Contracaeum*, with a mean intensity of 2.2 worms per fish and a maximum intensity of seven worms per fish. There was no seasonal pattern in the prevalence of *Contracaecum* in *Clarias* (Table 1). Although more worms were recovered from females than males, there was no significant difference between the sexes in the prevalence of infection ($\chi^2 = 2.228$; $P > 0.05$) (Table 1). There was no significant relationship between the length of the host and the rate of infection in either male or female catfish (Table 2). The health of the fish, as measured by the condition factor, was not affected by the presence of this parasite (Fig. 1).

TABLE 1 The prevalence (% infected) of *Contracaecum* larvae in *C. gariepinus* from Lake Chivero (November 2000 to May 2002)

Date	Females		Males		Total	
	N	%	N	%	N	%
Nov. 2000	8	12.5	4	0.0	12	8.3
Dec. 2000	7	0.0	3	33.3	10	10.0
Jan. 2001	6	33.3	4	0.0	10	40.0
Feb. 2001	6	0.0	4	0.0	10	0.0
Mar. 2001	5	0.0	3	0.0	8	0.0
Apr. 2001	8	50.0	2	0.0	10	40.0
May 2001	8	62.5	3	66.7	11	63.6
Jun. 2001	3	0.0	4	0.0	7	0.0
Jul. 2001	1	0.0	2	0.0	3	0.0
Aug. 2001	6	0.0	4	0.0	10	0.0
Sep. 2001	6	0.0	4	0.0	10	0.0
Oct. 2001	3	0.0	4	25.0	7	28.6
Nov. 2001	6	33.3	10	20.0	16	31.3
Dec. 2001	4	50.0	9	30.0	13	38.5
Jan. 2002	5	60.0	4	75.0	9	66.7
Feb. 2002	–	–	–	–	–	–
Mar. 2002	10	60.0	10	30.0	20	45.0
Apr. 2002	3	66.7	13	53.8	16	56.3
May 2002	10	70.0	10	30.0	20	50.0
Total (N) / Mean (%)	105	43.8	97	30.9	202	42.6

N = number of fish sampled

TABLE 2 The prevalence (P, % infected) and mean intensity (MI, no. of parasites per fish) of *Contracaecum* larvae in *Clarias gariepinus* from Lake Chivero, in relation to the standard length of the host (cm)

Size class (cm)	Males			Females			Total	
	N	P	MI	N	P	MI	P	MI
22.5–27.5	4	25.0	4.0	3	33.3	1.0	28.6	2.5
27.6–32.5	6	0.0	0.0	7	57.1	1.0	30.8	1.0
32.6–37.5	16	56.3	1.2	20	70.0	2.1	63.9	1.7
37.6–42.5	12	16.7	3.0	12	41.7	2.0	29.2	2.3
42.6–47.5	17	52.9	2.1	17	41.2	2.3	47.1	2.2
47.6–52.5	10	10.0	1.0	8	37.5	2.3	22.2	2.0
52.6–57.5	7	42.9	4.0	1	0.0	0.0	37.5	4.0

N = number of fish

DISCUSSION

Contracaecum larvae could not be identified to species level because the reproductive organs of the worms, which are used for characterization, were not yet fully developed. The lack of any seasonal pattern in the infection rate of *Contracaecum* in *C. gariepinus* is consistent with the findings of other workers (Mashego & Saayman 1981; Aloo 2001). The monthly sample sizes were usually small (mean = 11.2), and during some months, prevalence values of zero were recorded, which, as Gregory & Blackburn (1991) point out, could indicate a low prevalence that can only be detected in larger samples.

With the exception of February and March 2002, prevalence was low during the winter months (June to August)(Table 2). This may reflect a reduced feeding activity of the fish at low temperatures, reducing the chances of infection via copepods. *Contracaecum* eggs hatch in water with an optimum temperature of 21 °C (Huizinga 1967), and the fact that the winter temperatures of the lake fall to < 16 °C (Marshall & Falconer 1973) might also account for the low parasite prevalence in winter.

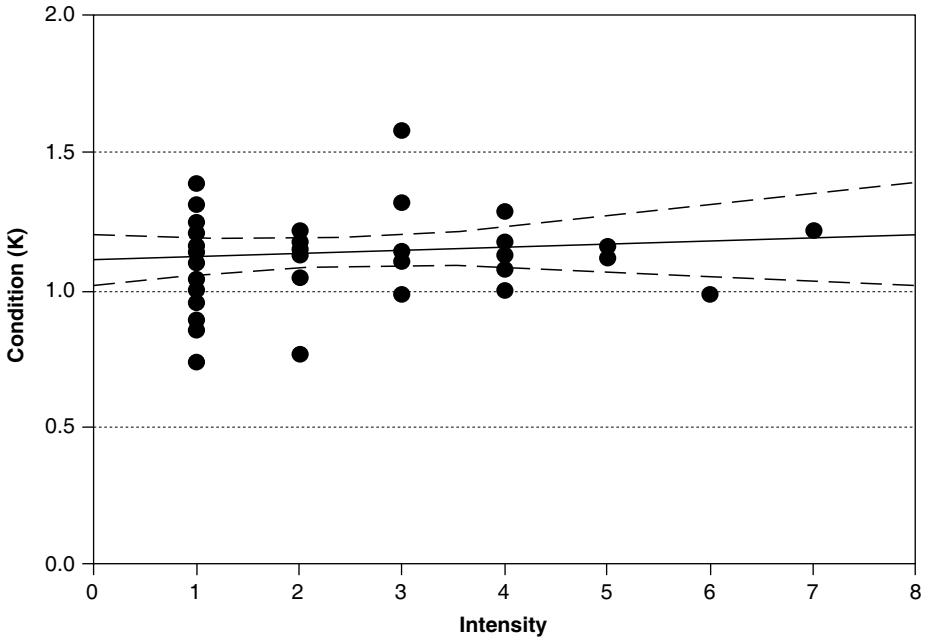

FIG. 1 The relationship between parasite load (intensity) and the condition factor (K) of *C. gariepinus* in Lake Chivero ($r = 0.11$, n.s.). Dotted lines indicate the 95% confidence limit range

The fish from Lake Chivero were not heavily infected, nor was their condition factor affected by the presence of these parasites, which suggests that the nematodes had little effect on their health. Chishawa (1991) showed that catfish from Lake Kariba were infected to a lesser extent ($P = 22\%$, I = 1–3) than those from Lake Chivero. However, when compared to data from the neighbouring South Africa, *Contracaecum* infection of Zimbabwean clariids is very low. For instance, Mashego & Saayman (1981) recorded a prevalence of 10–100% for the parasite in *Clarias* from ten dams in Lebowa, with intensities of up to 2 860 worms per fish; Boomker (1982) recorded a 95.3% prevalence from the Hartbeespoort Dam (I = 53–775), and Whitfield & Heeg (1977) recorded a prevalence of 46% from Lake St. Lucia.

In natural environments, the low infection rates are expected since parasites are normally in equilibrium with their hosts (Paperna 1996), which ensures that the parasite does not kill the intermediate host and reaches its final host to complete the life cycle. For *Contracaecum*, however, even very heavy infections of fish have not affected the condition of the host (Mashego & Saayman 1981; Aloo 1999, 2001), but may render the fish unsightly and unsuitable for human consumption especially if the larvae encyst in the muscle tissue. In Lake Naivasha, Kenya, the prevalence was higher in females than males (Aloo 1999), but this was not the case in Lake Chivero or elsewhere (Aloo 2001; Mashego & Saayman 1981).

Hartbeespoort Dam in South Africa is hypertrophic (National Institute of Water Research 1985), and high parasitic loads have been recorded from catfish there (Boomker 1982). Lake Chivero is also hypertrophic, but parasite prevalence and intensity in *C. gariepinus* from the lake were low. It is possible that the infection cycle might be affected at some stage because wading birds are unable to catch fish owing to the extensive mats of *Eichhornia crassipes* (water hyacinth) and *Hydrocotyle ranunculoides* (spaghetti weed) that extend from the shore. The gill nets used for sampling selected large fish (> 200 g), but most piscivorous birds, with the exception of the fish eagle, prefer small-sized prey (< 100 g) (Hustler 1995). Furthermore, reed cormorants and darters, which are abundant on Lake Chivero, mainly prey on cichlids (Donnelly & Hustler, 1986), and rarely on *Clarias*. These factors may reduce the chances that L3 larvae of *Contracaecum* will be transmitted to their definitive host, subsequently slowing the whole infection cycle.

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