



## Nematode parasites of *Clarias gariepinus* (Burchell, 1822) from the Rietvlei Dam, South Africa

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### ABSTRACT

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Catfish, *Clarias gariepinus*, from the Rietvlei Dam near Pretoria, South Africa were examined for nematode parasites. Two species, *Procamallanus laevisconchus* in the stomach and *Contraecaecum* spp. larvae in the abdominal cavity, were found. The morphology of these species, based on light and scanning electron microscopy, and how they compare with previously described specimens are discussed. Infection rates were mild compared to previous surveys although *Contraecaecum* spp. had a high prevalence of 86%.

**Keywords:** *Clarias gariepinus*, *Contraecaecum*, nematode, parasite, *Procamallanus*, Rietvlei Dam

### INTRODUCTION

The study of parasitic diseases of fish and other aquatic organisms in South Africa only started to gain attention over the past few decades as scientists began to realise their significance in fisheries and aquaculture (Safriel & Bruton 1984; Hoffman & Prinsloo 1996). Only a few researchers have published their work on nematode parasites in the country, and these include Prudhoe & Hussey (1977), Mashego (1977, 1982), Mashego & Saayman (1981), Boomker (1982, 1994a, b), Saayman, Mashego & Mokgalong (1991) and Mokgalong (1996). The results of this study will contribute to this existing body of knowledge.

The sharptooth catfish, *Clarias gariepinus* (Burchell, 1822), the host species investigated in this study, is widely distributed in Africa (Safriel & Bruton 1984; Skelton 2001) and is an excellent species for aquaculture and biological research (Hoffman & Prinsloo 1996).

The study was carried out as a reconnaissance survey of the internal parasites that are found in *C. gariepinus* from the Rietvlei Dam, which can be used in the fish health assessment index that has been developed for South African fish by Avenant-Oldewage (2001). The objectives of this paper were to specifically identify and classify the nematode parasites collected from *C. gariepinus* based on their morphological features, and to note their prevalence and mean intensity in the Rietvlei Dam.

### MATERIALS AND METHODS

#### Study area

The Rietvlei Nature Reserve (25°41'22" S; 26°37'48" E) lies between Pretoria and Johannesburg in Gauteng Province (Fig. 1). Developed out of the Rietvlei

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Water Scheme, it is solely responsible for conservation of the Sesmylspruit catchment area, and the Rietvlei Dam (25°32'30" S; 28°16'46" E) currently supplies 27% of Pretoria's water requirements (Wessels 1998). A smaller dam, the Marais Dam, lies approximately 4 km upstream, and the two are separated by a wetland (Fig. 1). Further upstream, just before the Sesmylspruit enters the reserve, the stream receives effluent from a number of industries and a wastewater treatment plant.

### Field collection of fish and parasites and identification

Fish were collected in May 2003 from the Rietvlei Dam using large mesh gill nets. The fish were dissected and the mesenteric cavity examined for parasites.

The gastrointestinal tract was then dissected from the rectum to the oesophagus and all nematodes encountered were carefully detached from the stomach or intestinal mucosa. The internal organs of each fish were also examined for parasites or cysts. The nematodes were fixed in glacial acetic acid and preserved in 70% ethyl alcohol. Some larval nematodes were stained with Horen's trichome stain according to the method of Khalil (1991). Specimens for scanning electron microscopy (SEM) examination were preserved in absolute alcohol after which they were processed for SEM as detailed by Barson & Marshall (2004).

The parasites were identified based on their observed morphology as well as from drawings. Light micrographs were taken with a Zeiss Axioplan micro-

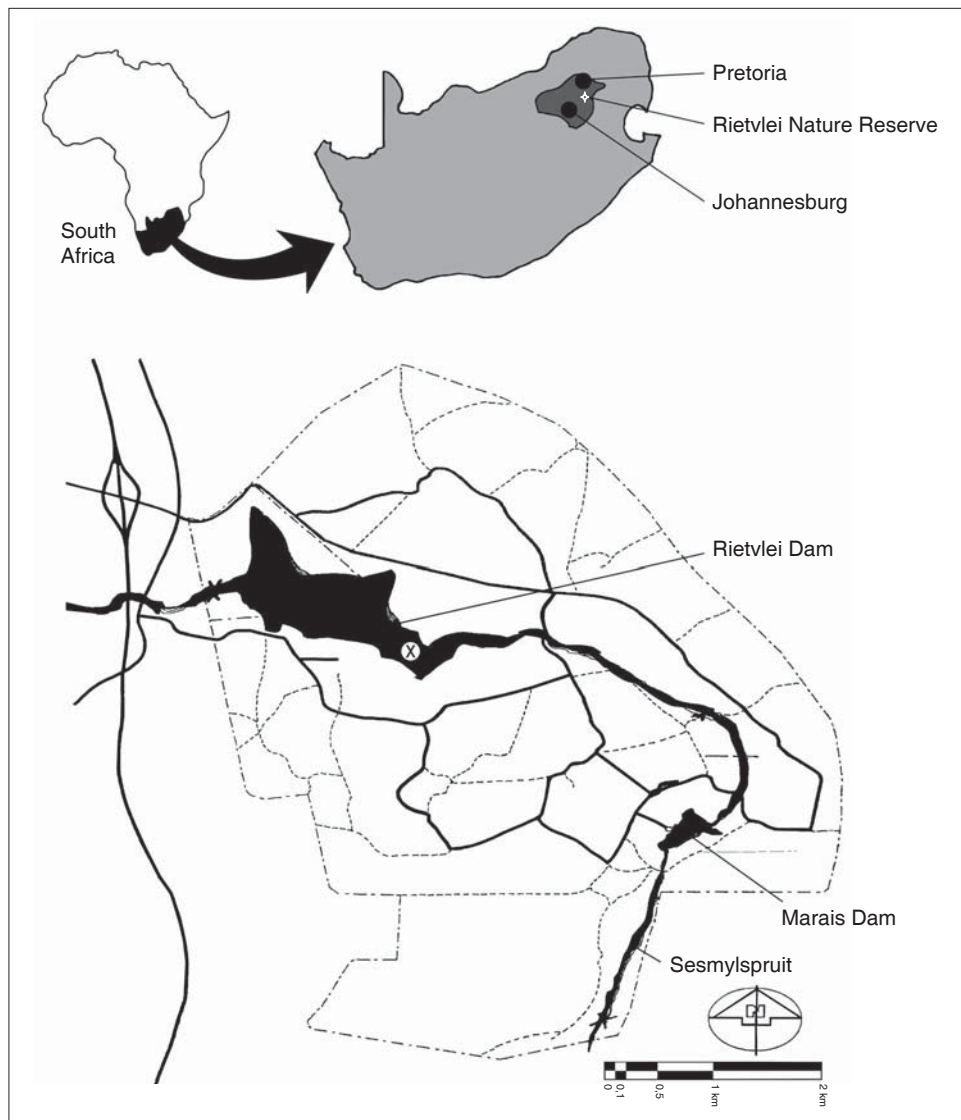


FIG. 1 The location of the Rietvlei Dam inside the Rietvlei Nature Reserve. X indicates point of sampling

scope, and scanning electron micrographs with a JEOL 6100 scanning microscope. Drawings and measurements were done with a Zeiss 25 standard light microscope equipped with a drawing tube. The descriptions by Yamaguti (1961), Chabaud (1974), Hartwich (1974) and Moravec (1975) were used to aid in the identification of the parasites. Parasite prevalence and mean intensities were measured and calculated as defined by Margolis, Esch, Holmes, Kuris & Schad (1982).

Voucher specimens were deposited in the zoological collection of the University of Johannesburg (formerly Rand Afrikaans University), South Africa.

## RESULTS AND DISCUSSION

Two nematode genera were found in *C. gariepinus* from the Rietvlei Dam, namely *Procamallanus laeviconchus* (Wedl, 1862) and larvae of *Contraecum* spp.

### *Procamallanus laeviconchus* (Wedl, 1862) (Fig. 2 and 3)

This is a small ovoviviparous nematode that is prevalent in most African freshwater fishes, notably in siluroids (Khalil 1970; Moravec 1975; Mashego 1977; Mashego & Saayman 1981; Boomker 1982, 1994a,

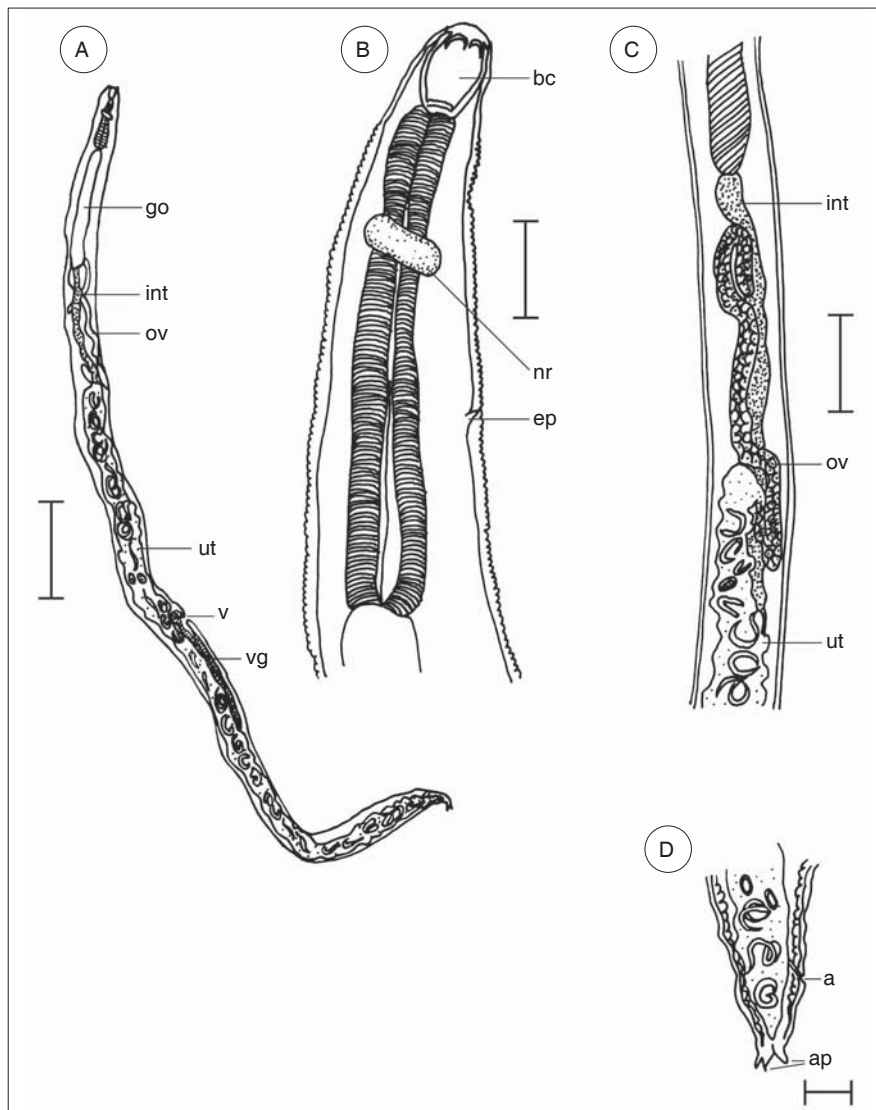


FIG. 2. *Procamallanus laeviconchus* female drawings. (A) whole worm. Scale bar = 400  $\mu$ m; (B) anterior end. Scale bar = 100  $\mu$ m; (C) mid-body. Scale bar = 200  $\mu$ m; (D) posterior end. Scale bar = 20  $\mu$ m. a = anus, ap = anal (tail) processes, bc = buccal capsule, ep = excretory pore, go = glandular oesophagus, int = intestine, nr = nerve ring, ov = ovary, ut = uterus, v = vulva, vg = vagina

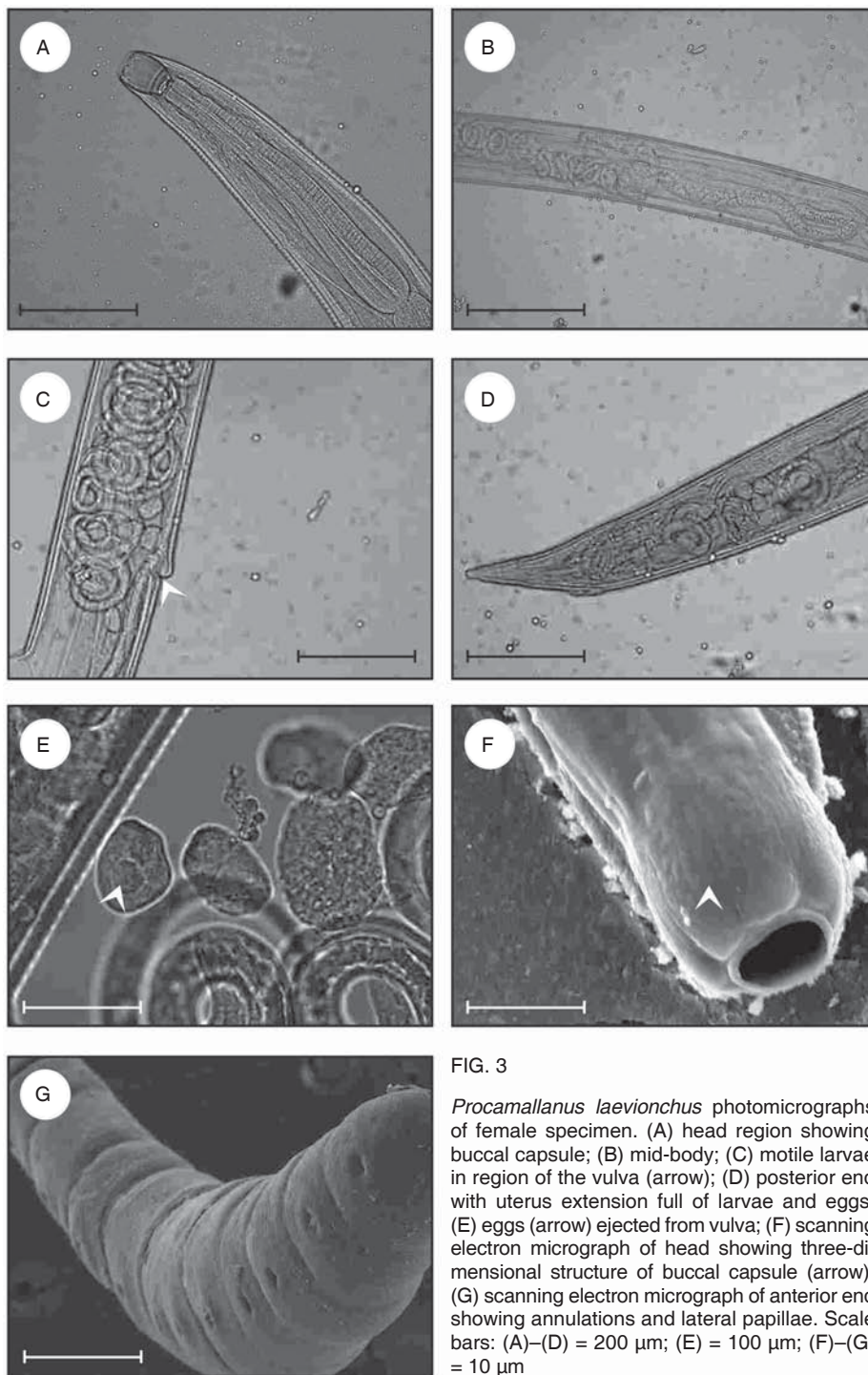


FIG. 3

*Procammallanus laevionchus* photomicrographs of female specimen. (A) head region showing buccal capsule; (B) mid-body; (C) motile larvae in region of the vulva (arrow); (D) posterior end with uterus extension full of larvae and eggs; (E) eggs (arrow) ejected from vulva; (F) scanning electron micrograph of head showing three-dimensional structure of buccal capsule (arrow); (G) scanning electron micrograph of anterior end showing annulations and lateral papillae. Scale bars: (A)–(D) = 200 µm; (E) = 100 µm; (F)–(G) = 10 µm

b; Chishawa 1991; Saayman *et al.* 1991; Douëllou 1992; Khalil & Polling 1997). One out of seven hosts was infected (prevalence 14%) with an intensity of 13 nematodes. Only female specimens were obtained and described, most of the characteristics matching those described by Moravec (1975) and Boomker (1982). Diagnostic measurements show that the Rietvlei Dam specimens have the same

size range as those described by Boomker (1982) although they were somewhat larger with respect to the distance of anus to tail and length of the glandular portion of oesophagus (Table 1).

This study additionally showed the three-dimensional aspect of the head of *P. laevionchus* with the SEM (Fig. 3F), the buccal capsule of which still fits the

TABLE 1 Comparative diagnostic measurements of *Procamallanus laevionchus* infecting *C. gariepinus* from the Rietvlei Dam (this study) and Hartbeespoort Dam (Boomker 1982), and in *Clarias* sp. from the Nile River, Egypt (Moravec 1975)

Measurement*	Rietvlei Dam (2003, this study) <i>n</i> = 7	Nile River (Moravec 1975) <i>n</i> = 8	Hartbeespoort Dam (Boomker 1982) <i>n</i> = 5
Length (mm)	6.2–8.9 (7.6)**	3.7–7.4	7.0–8.9
Maximum width	145–280 (222)	136–204	181–216
Buccal capsule length	60–90 (78)	(69)	83–96
Buccal capsule width	58–70 (62)	57–63	60–70
Length of muscular part of oesophagus	380–510 (441)	360–516	411–491
Length of glandular part of oesophagus	960–1020 (983)	666–990	775–927
Distance of nerve ring from anterior end	105–213 (173)	189–207	208–226
Distance of vulva to anus (mm)	2.0–3.3 (2.7)	–	3.0–3.5
Distance of anus to tail	140–340 (227)	–	117–138
Distance of vulva to tail (mm)	2.4–3.4 (2.9)	1.8–3.0	3.1–3.6

\* All measurements in  $\mu\text{m}$  unless otherwise stated

\*\* Mean values in parentheses

*n* number of specimens measured

TABLE 2 Diagnostic measurements of *Contraecaecum* sp. L3 larvae infecting *C. gariepinus* from the Rietvlei Dam

Measurement	Range <i>n</i> = 9	Mean
Body length (mm)	22.0–35.0	27.6
Body width	680–780	710
Head diameter	120–160	140
Ventricular appendix length	510–1 040	790
Ventricular appendix width	100–160	120
Intestinal caecum length (mm)	1.24–2.2	1.72
Intestinal caecum width	120–180	160
Length of tail from anus to tip	130–250	200

\* All measurements in  $\mu\text{m}$  unless otherwise stated

*n* number of specimens measured

description by Moravec (1975). Microscopical observation showed three terminal tail processes (Fig 2D), but these were, however, not observed on the SEM photograph of the posterior end of the worm (Fig. 3G); the specific specimen was probably still in its fourth larval stage. Eggs and motile larvae at various stages of development were observed, some eggs having been squeezed out through the genital opening (Fig. 3B and C). Measurements of L3 larvae are reflected in Table 2

*Procamallanus laevionchus* is always found deeply attached to the mucosa of pyloric region of the host's stomach wall and has been shown to cause severe pathological effects (Paperna 1996). Apart from the finding of Mashego & Saayman (1981) who recorded a total of 23 worms in one fish, the intensity of 13 worms in one fish from the Rietvlei Dam is considerably high when compared to the low numbers recorded by Boomker (1982, 1994a) from *C. gariepinus*. Moravec (1975) states that *P. laevionchus* infection is widespread in many African fish families.

In neighbouring Zimbabwe, Chishawa (1991) and Douëllou (1992) recorded it from the Clariidae and Schilbeidae from Lake Kariba. In Nigeria, Opara & Okon (2002) reported it from *Oreochromis niloticus* (Cichlidae) and Yakubu, Omoregie, Wade & Farin-goro (2002) from *C. gariepinus* (Clariidae) and *Tilapia zilli* (Cichlidae). Khalil (1970) recovered *P. laevionchus* from seven fish species from Ghana and belonging to the Mormyridae, Schilbeidae and Mochokidae.

The list of African helminths by Canaris & Gardner (1967) includes *Procamallanus mazabukae* Yeh, 1957 infecting homa fish from Zambia and *Procamallanus spiralis* infecting *Heterobranchus anguilaris* (Clariidae) from northern Africa. The former does not, however, appear in Khalil & Polling's (1997) updated checklists, while the latter has probably been renamed as *Spirocamallanus* (Santos, Cárdenas & Lent 1999). However, other *Procamallanus* species in Africa are known to infect amphibians (Canaris & Gardner 1967; Anderson 1992). Many species of *Pro-*

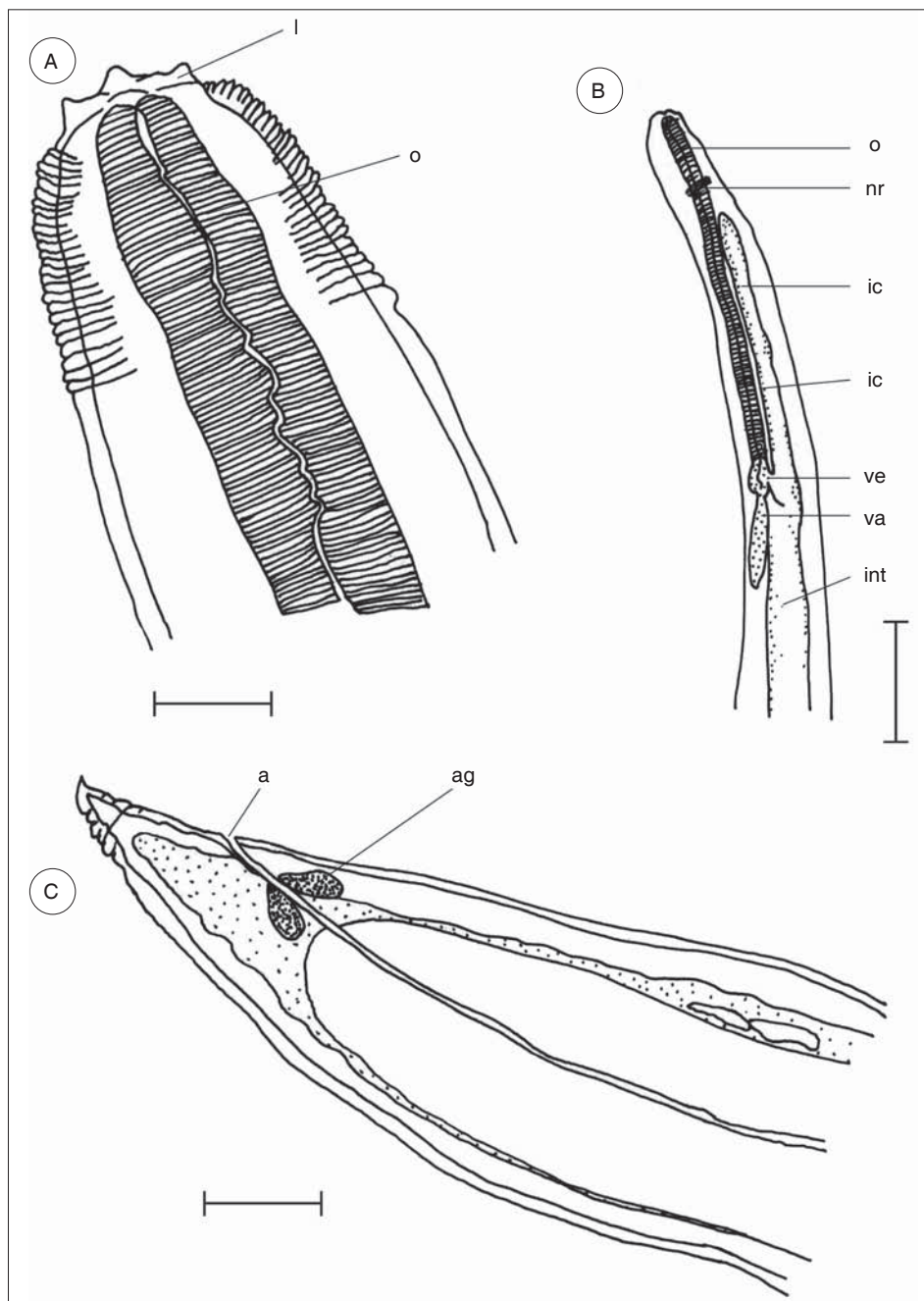


FIG. 4 *Contracaecum* sp. Larvae. (A) head. Scale bar = 200  $\mu$ m; (B) anterior end showing ventricular region. Scale bar = 500  $\mu$ m; (C) posterior end. Scale bar = 200  $\mu$ m. a = anus, ag = anal glands, ic = intestinal caecum, int = intestine, l = lip (labium), nr = nerve ring, o = oesophagus, va = ventricular appendix, ve = ventriculus

*camallanus* infecting freshwater fishes have also been recorded in Europe (Moravec 1994) and in the Neotropical region (Santos *et al.* 1999).

#### ***Contracaecum* spp. larvae (Fig. 4)**

Third-stage larvae (L3) with two blind caeca branching off from the intestinal tract at the junction of the

oesophagus and midgut (Fig 4B). Ventricular appendix shorter and pointing posteriorly; intestinal caecum longer and pointing anteriorly. Tail curved with terminal spine (Fig. 4C). Reproductive system not fully developed.

*Contracaecum* larvae have been recorded from catfish and other fish species from many water bodies

in South Africa (Whitfield & Heeg 1977; Mashego & Saayman 1981; Boomker 1982, 1994a, b; Saayman *et al.* 1991), Zimbabwe (Chishawa 1991; Douëllou 1992; Barson 2004), and East Africa (Malvestuto & Ogambo-Ongoma 1978; Aloo 2001). It is a cosmopolitan parasite of fish-eating birds and mammals (Hartwich 1974; Anderson 1992) and can reach alarming intensities without affecting the condition of the host (Mashego & Saayman 1981; Boomker 1982; Paperna 1996), an adaptation that probably ensures that the larvae survive to reach the final host without killing the intermediate host.

*Contracaecum* larvae are difficult to differentiate into species except when using molecular analysis or alternatively infecting experimental hosts to obtain adult worms. Adult *Contracaecum* species from fish-eating birds have only been studied and recorded by Ortlepp (1938, cited by Mokgalong 1996), Saayman *et al.* (1991) and Mokgalong (1996) in South Africa. Canaris & Gardner (1967) listed nine adult *Contracaecum* species from African waterbirds, while Barson & Marshall (2004) recorded four species from Zimbabwean birds.

While a high prevalence (86%) and a mean intensity of 16.3 (intensity range 3–44) were recorded from Rietvlei Dam, 100% infection levels are very common, with intensities as high as 700–2000 worms per fish (Mashego & Saayman 1981; Boomker 1982, 1994a). This makes *Contracaecum* one of the most prevalent fish parasites in South Africa and the fact that its life cycle involves migratory bird species (e.g. cormorants) can justify this observation. Paperna (1996) urges aquaculturists to control aquatic birds on fishponds as an effective means of reducing *Contracaecum* infection.

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