Research Article

Observations on the Occurrence of Subgenus *Procamallanus* (*Spirocamallanus*) (Nematoda: Camallanidae) Parasitizing Two Species of Freshwater Fishes from Sindh, Pakistan

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Abstract | Nematehelminthic examination of two species of freshwater fishes, *Mastacembelus armatus* and *Oreochromis niloticus* collected from the Indus river of Sindh Pakistan, revealed presence of subgenus *Spirocamallanus* of genus *Procamallanus*. The subgenus was characterized by the presence of spiral thickening in buccal capsule. The prevalence of subgenus was higher in *Mastacembelus armatus* (33.33%) than *Oreochromis niloticus* (7.69%). There is difference of mean intensity (3.66 and 4) and density (1.2 and 0.306) of *Sprirocamallanus* in both fishes. This subgenus is recorded for first time in *Mastacembelus armatus* and *Oreochromis niloticus* from the lower Indus river in Sindh province of Pakistan.

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1. Introduction

Subgenera of *Procamallanus* Baylis, 1923 including subgenus *Spirocamallanus*, consist of large number of species mainly recorded from tropical and subtropical marine water and freshwater fishes (Moravec and Van As, 2015). This genus was subdivided into five subgenera; *Denticamallanus* Moravec and Thatcher, 1997, *Procamallanus* Baylis, 1923, *Punctocamallanus* Moravec and Scholz, 1991, *Spirocamallanoides* Moravec and Sey, 1988 and *Spirocamallanus* Olsen, 1952 (Moravec and Thatcher, 1997) and Rigby and Rigby (2014) elevated the status of these subgenera to generic level. Many authors followed former subgeneric status and latter is dubbed as unnatural (Moravec and Van As, 2015). Moreover, the comparison of species on the basis of zoogeographic region have been accepted and preferred (Andrade-Salas *et al.*, 1994; Rigby and Adamson, 1997; Rigby and Font, 1997). Many species of subgenus *Procamallanus* (*Spirocamallanus*) (many authors consider it genus in IndoPak region but this study considers it subgenus) recorded time to time from IndoPak subcontinent (Sood, 1989; Soota, 1983; Akhtar and Bilqees, 2011). Its morphological study needs organized and meticulous approach. The ecological parameters have been ignored in previous studies. The present paper provides general morphology and ecological study of subgenus *Spirocammallanus* recorded in *Mastacembelus armatus* and *Oreochromis niolitcus* from the Indus river. The subgenus under study previously recorded from marine and freshwater fishes including *Tachysurus caelatus*, *Jhonius dussumeiri*, *Sillago sihama*, *Crossorhombus azureus*, *Argyrops spinifer, Otolithus argenteus*, *Otolithus ruber* and *Wallagu attu* (Soota, 1983; Akhtar and Bilqees, 2011).

2. Material and Methods

Eighteen specimens of *Mastacembelus armatus* and thirteen of *Oreochromis niloticus* were collected randomly with fixed fishing nets between April 2018 to January 2020 from the Indus river at Kotri barrage 25.4423° N, 68.3166° E and Sukkur barrage 27.6733° N, 68.8471° E. Both hosts collected from both localities. These localities are part of Sindh Province of Pakistan. Fish hosts were packed in plastic sacs and transported in ice box to Parasitology Laboratory, Department of Zoology, University of Sindh Jamshoro. Samples were dissected. Visceral organs were removed and placed separately in Petri plates. These organs were agitated and teased in normal saline. The visual and light microscopic observation noticed presence of nematodes in small intestine of some hosts. After collection of nematodes, they were preserved in 70% enthanol with few drops of glycerine. Semi-permanent slide was prepared for detail study on light microscopy. Photomicrographs were captured with Amscope trinocular microscope attached with 14 megapixel camera. Line drawings were made with drawing tube attached with Olympus microscope model Ch20i. All measurements taken in millimeter. Ecological parameters were followed as mentioned by Margolis *et al.* (1982) and Bush *et al.* (1997). Specimens were deposited in Zoology Museum, Department of Zoology, University of Sindh, Jamshoro.

3. Result and Discussion

A total of 26 specimens (16 male and 10 female) of subgenus *Spirocamallanus* were recorded from *Mastacembelus armatus* with prevalence of 33.33% and from *Oreochromis niloticus* with prevalence of 7.69%.

3.1 Description (Figures 1 and 2).

Medium sized nematodes measured 4.38-5.1 X 0.14-0.21 with transversely striated cuticle. Mouth aperture circular. Buccal capsule prominent, thick walled, barrel shaped, slightly longer than wide, with well developed basal rings. Buccal capsule measured, 0.083-0.091 X 0.07-0.011. Inner surface of buccal capsule provided with 10-13 horizontal spiral ridges. Esophagus long and divided into short muscular and long glandular esophagus, muscular esophagus measured, 0.44-0.53 X 0.06-0.09 and glandular esophagus measured 1-1.15 long. Both part of esophagus slightly expanded near their posterior ends. Posterior extremity of specimen bent ventrally, provided with alae and supported by ten pairs of pedunculated papillae. All papillae preanal in position. Spicule single, measured, 0.22-0.29 long, having stout gubernaculum measured 0.035-0.039 in size.

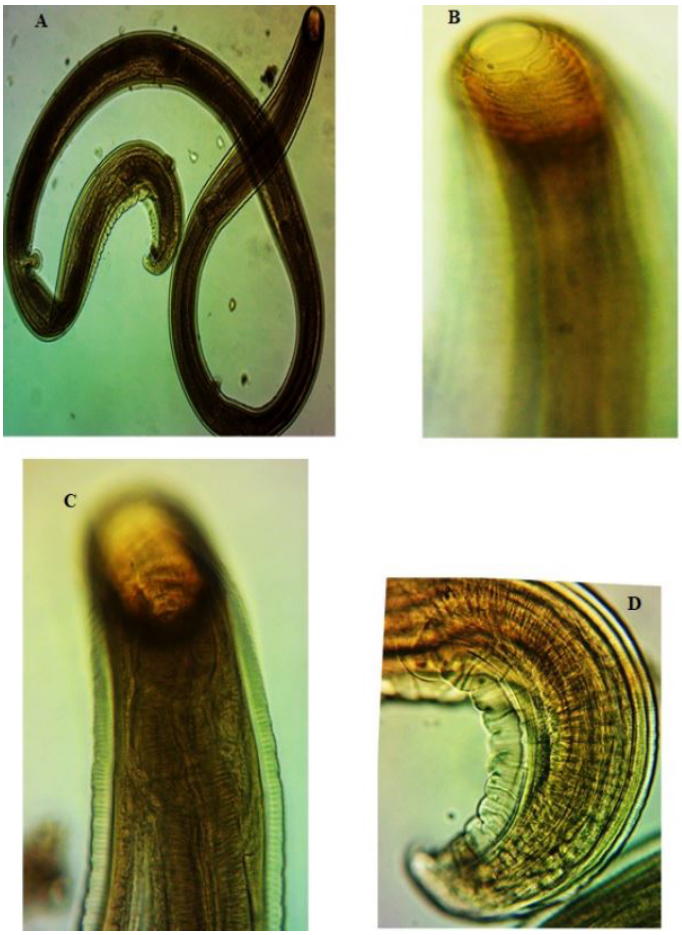

Figure 1: Procamallanus (*Spirocamllanus*) sp. A. Entire worm; B. Anterior extremity with buccal cavity; C. Anterior extremity with esophagus; D. Posterior extremity with spicule and Papillae.

Taxonomic summary

Family:	Camallanidae Railliet and Henery, 1915
Genus:	*Procamallanus (Spirocamallanus)* (Baylis, 1923)
Species:	*Procamallanus* (*Spirocamallanus*) sp.
No. of specimens collected:	26
Host:	*Mastacembelus armatus* (6/18*), Oreochromis niloticus* (1/13)
Prevalence:	*Mastacembelus armatus* 33.33%, *Oreochromis niloticus* 7.69 %
Site of infection:	Intestine
Locality:	Indus River at Sindh
Status:	New host record

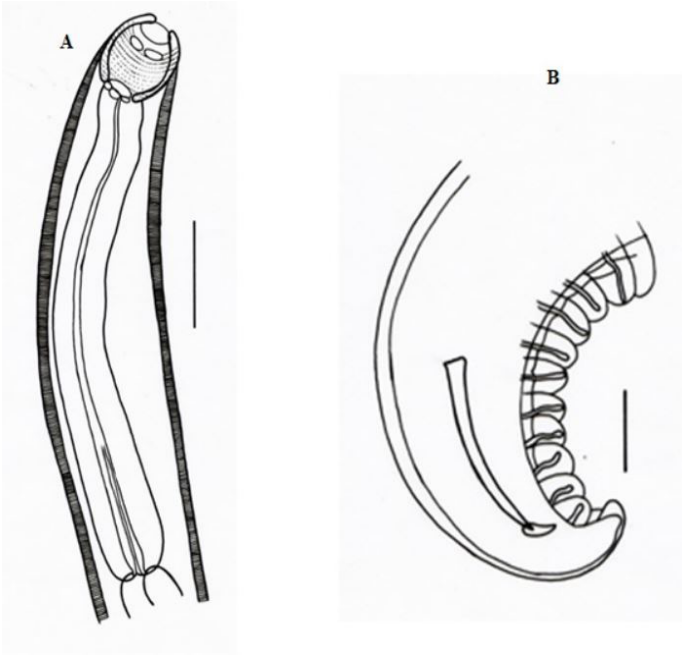

Figure 2: rocamallanus (*Spirocamallanus*) sp. A. Anterior extremity with buccal capsule and esophagus; B. Posterior extremity showing spicule and papillae. Scale Bar, A. 0.1 and B 0.5 mm

Present nematode morphologically belong to subgenus *Procamallanus* (*Spirocammlanus*) on basis of having spiral thickening in buccal capsule. This subgenus is previously reported from marine and freshwater fishes (Moravec and Van As, 2015). A good number of species reported from all over the world especially South Asia (Sood, 1989). Almost 10 species of subgenus *Spirocamallanus* recorded from Marine and freshwater fishes of Pakistan (Akhtar and Bilqees, 2011). Out of these, only few recorded from freshwater fishes including *S. gubenaculus* Khera, 1955 in *Rita rita*, *Mystus cavasius*, and *Notopterus notopterus*; *S. kalaria* Rehana and Bilqees, 1979 in *Wallagu attu* (Soota, 1983; Rehana and Bilqees, 1979).

Present study records this subgenus from two species of freshwater fishes from the Indus River. Previous studies recorded *Spirocammallanus* and two other subgenera (*Procamallanus* Baylis, 1923 *Denticamallanus* Moravec and Thatcher, 1997) of genus *Procamallanus* from freshwater water fishes of Africa, South America, North America, Australia, Asia and Europe (Moravec *et al.*, 2000, 2019; Ramallo *et al.*, 2017; Moravec and Scholz, 1991; Soota, 1983). A few study recorded species of *Spirocamallanus* from freshwater fishes of Pakistan (Rehana and Bilqees, 1979; Akhtar and Bilqees, 2011) and none has recorded this subgenus from *Mastacembelus armatus* and *Oreochromis niloticus*. Hence, it is first record of this nematode from hosts and locality.

The present study recorded 26 specimen of subgenus *Spirocamallanus* from *Mastacembelus armatus* and *Oreochromis niloticus*. Eighteen *Mastacembelus armatus* were examined 6 were found infected with 22 specimens of nematodes with prevalence (33.33%), intensity (3.660 and density (1.2) recorded. *Mastacembelus armatus* eats diverse food including Prawn, earthworms, small fishes, small crabs, fish eggs, crustaceans, aquatic insect larvae (Ali *et al.*, 2003; Sharifudin *et al.*, 1998; Gupta and Baneerjee, 2016). Therefore, this fish may be infected due to its feeding habits. Thirteen *Oreochromis niloticus* were examined only one was harboring four specimens of *Spirocamallanus* with prevalence (7.69%), intensity (4) and density (0.306). *Oreochromis niloticus* feeds on blue-green algae, aquatic invertebrates and plant materials (Getabu and Ngwala, 2014; Abari *et al.*, 2015).

The difference in prevalence of *Spirocamallanus* in both host (Table 1) suggest that both host eat variety of diet and forage in different water area. Consequently, they face different environment factors. Moreover, life cycle of intermediate host and its being part of definitive host di*et al*so determine prevalence of this nematode.

Table 1: Ecological parameters of *Procamallanus* (*Spirocamallanus*) population and feeding habits of host.

Host	Diet	Host examined	Found positive	Recorded Specimen	Prevalence	Mean Intensity	Relative density
Mastacembelus armatus	Prawn, Earthworm, Small fish, small crabs, Molluscs, Fish eggs (Ali *et al.*, 2003), crustacean, forage fish, annelids and aquatic insects (Sharifudin *et al.*, 1998), crustacean and insect larvae while the adults devour small fish and tadpoles (Gupta, 2016)	18	6	22	33.33%	3.66	1.2
Oreochromis niloticus	Blue-green algae, Green algae, Diatoms, Desmids, Aquatic invertebrates (Getabu and Abari, 2015) plant materials (Ngwala, 2014)	13	1	4	7.69%	4	0.306

The intensity shows opposite view from prevalence (3.66 in *Mastacembelus armatus* and 4 in *Oreochromis niloticus*. Which is less diverse feeder than *Mastacembelus armatus*.

The relative density of *Spirocamallanus* (1.2 in *Mastacembelus armatus* and 0.306 in *Oreochromis niloticus*) reflects similarity with prevalence. Therefore, the higher prevalence and density of *Spirocamallanus* in *Mastacembelus armatus* than *Oreochromis niloticus* is either due to diverse feeding habits (Table 1) of *Mastacembelus armatus*, availability of intermediate host or preference of this nematode for this host. The running water in the river is suitable for *Mastacembelus armatus* than *Oreochromis niloticus*.

Conclusions and Recommendations

Subgenus *Procamallanus* (*Spirocamallanus)* was first time recorded from *Mastacembelus armatus* and *Oreochromis niloticus* from the Indus river at Sindh. This nematode found more prevalent in *Mastacembelus armatus* than *Oreochromis niloticus*.

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Novelty Statement

Current research paper recorded nematode, Procamallanus (*Spirocamallanus*) for first time from the two freshwater fishes species of the Indus river at Sindh.

Author's Contribution

Muhammad Moosa Abro and Nadir Ali Birmani conceived, designed and performed the experiments and wrote the paper. Muhammad Bachal Bhutto contributed reagents and analysis tools.

Conflict of interest

The authors have declared no conflict of interest.

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