

# Helminth parasite spectrum of fishes in Meghalaya, Northeast India: a checklist

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**Abstract** Fish constitute a major component of diet for the people of Northeast India and they are extensively used as a protein-rich food for human consumption. The present studies incorporate the spectrum, composition and diversity of the parasitic species in freshwater fishes in Meghalaya, Northeast India, with a view to identifying the species recovered by morphological criteria based on light microscopy. The collection sites included sixteen foci from eleven districts of Meghalaya for parasites occurring in the common food fishes (Cypriniformes, Channiformes, Siluriformes, Symbranchiformes and Anguilliformes). The helminth parasite spectrum recovered from the various piscine host species in the study area comprised of a total of 19 taxa: 2 monogenean, 8 trematode (4 adult and 4 metacercarial stages), 12 cestode (11 adult and a metacercarial stage), 6 nematode (3 adult and 3 larval stages) and a single acanthocephalan species. A checklist of the parasite species with short remarks for each is provided herein.

**Keywords** Freshwater fish · Helminth · Parasite · Monogenea · Trematode · Cestode · Nematode · Acanthocephala · Meghalaya · India

## Introduction

Fish constitute a major component of diet for the people of Northeast India. Helminths are an important group of pathogens, which cause infection and diseases of fish both

in freshwater and marine environments, their importance being related directly to the fish that may affect the general public health (Hoffman 1967). As much as 30,000 helminth species have been estimated to be parasites of fishes, many of which are known to be serious menace to their hosts. Every parasite living in or on a fish extends some degree of harmful influence on its host (Williams and Jones 1994). Parasitic diseases of fish are very common throughout the world and are of particular importance in the tropics (Schmidt and Roberts 2000). The World Health Organization (WHO) has estimated that the number of people currently infected with fish-borne trematodes alone exceeds 18 million, and many more are at risk (WHO 2004). Several helminth parasites remain a subject matter of major public health concern, especially in Asia, since they can be transmitted to humans and domestic animals only through fish (Chai et al. 2005). In recent years diseases transmitted by fish have probably become more widely distributed and have greater economical and medical impacts than recognized earlier (Ko 1995). Most at risk, of course, are people who eat raw, lightly smoked, lightly salted, dried or pickled fish. Digenetic flukes may be used as biological tags to monitor fish migration routes and as indicators of quality of fish-stock composition (von Lothar 1970; Mackenzie 1983; Lester 1990). The richness of digenetic fauna reflects on the availability of the various host organisms it requires to complete its lifecycle (Malhotra and Banerjee 1990). Digenetic trematodes and their metacercariae (MC) have taken a great interest in most countries especially for the human care against the transmissible diseases (Taher 2009). Species diversity or richness of fish tapeworms appears to be greatest in subtropical and temperate regions. Nematodes of fish infective to humans are mostly in the tropics (Dick and Chaudhury 1995). Juvenile worms of many other species of

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acanthocephalan occur in the viscera, especially the mesentry and liver, of fishes that act as paratenic hosts (Nickol 1995).

The helminth parasite fauna of freshwater fishes, its frequency and distribution have been studied in many parts of the world (Fernando and Furtado 1963; Kennedy and Hine 1969; Khalil 1971; Kennedy 1974; Holmes and Price 1980; Ugwuzor 1987; Lim 1990; Okaka 1991; Salgado-Maldonado and Kennedy 1997; Lile 1998; Choudhury and Dick 2000; Nelson and Dick 2002; Aloo 2002; Madhavi, 2003; Pazooki and Masoumian 2007; Hernandez et al. 2007; Mwita and Nkwengulila 2008; Popiolek and Kotusz 2008; Alam et al. 2010; León et al. 2010). Workers like Aruna et al. (2011), Dhole et al. (2010), Farhaduzzaman et al. (2010), Gudivada and Vankara (2010), Hiware (2010), Jadhav et al. (2011), Patil et al. (2011), Rafique et al. (2002), Malhotra and Chauhan (1984), Madhavi and Sairam (2000), Nimbalkar et al. (2010), Vankara and Vijayalakshmi (2009), Vankara et al. (2011), Yousuf et al. (2011), etc. have worked on the parasitic fauna of freshwater fishes in India.

In the context of India, parasitic diseases are most common (about 78 %) and are encountered more frequently than microbial diseases; however the degree of severity and losses due to such diseases are highly variable (Abidi 2002). Various workers in different parts of the country have studied the diversity of helminth fauna in India. Significant contributions were made during the early and mid twentieth century (see refs. Yamaguti 1959, 1961, 1963a, b, 1971). Several workers have studied the helminth fauna of fish hosts describing many newer species or records from India and made further advancements in this field (Dayal 1949; Pal 1963; Madhavi 1979; Mehra 1980; Srivastava 1982; Soota 1983; Jha et al. 1992; Malik and Singh 1992; Shomorendra et al. 2005; Chakrabarti and Dutta 2006; Pandey and Agarwal 2008). A bibliography of fish pathogens of helminthic origin in India has been compiled by Abidi (2002).

The hilly region of northeastern India is considered to be one of the hot spots of freshwater fish biodiversity in the world; however, there is a glaring lack of data on the ecology of fishes (Kottelat and Whitten 1996; Mahapatra et al. 2004a, b). According to Sen (2000), of the nearly 806 species of freshwater fishes in India, the north eastern region is represented by 267 species belonging to 114 genera under 38 families and 10 orders, approximately one-third of the Indian freshwater fishes. Sen (2003) revised the list of ichthyofauna of northeastern India with 165 species belonging to 85 genera under 31 families and 9 orders.

Meghalaya has been blessed with a rich variety of ichthyofauna that has been largely documented. A survey on the ichthyofauna in eleven districts of Meghalaya has revealed 68 species of fishes belonging to 45 genera, 20

families and 6 orders, of which the family Cyprinidae is the most dominant group (Ramanujan et al. 2010). In the recently updated inventory of the State, a total of 175 fish species have been included, which belong to 86 genera under 32 families and 9 orders. Of them, almost all species are treated as food fish (Mahapatra et al. 2002). However, the spectrum of helminth parasites of piscine hosts has been scantily studied. There is limited information available on this aspect with regard to Northeast India in general and Meghalaya in particular (Gambhir et al. 2006; Geetarani et al. 2010, 2011; Puinyabati et al. 2010; Khaidem et al. 2011). Soota and Ghosh (1977) conducted a sporadic faunistic survey of parasites in fishes of Meghalaya and reported the occurrence of some trematodes in them. In another study, a rich diversity of caryophyllidean cestode parasites was reported to be occurring in siluroid fishes of the region (Chakravarty and Tandon 1988; Tandon et al. 2005). It is expected that a thorough and systematic survey would reveal many a hitherto unknown and new parasite species harboring the fish hosts in the region.

The present work was undertaken to study the species composition of the parasite spectrum occurring in the common food fishes (Cypriniformes, Channiformes, Siluriformes, Symbranchiformes and Anguilliformes) in Meghalaya.

## Materials and methods

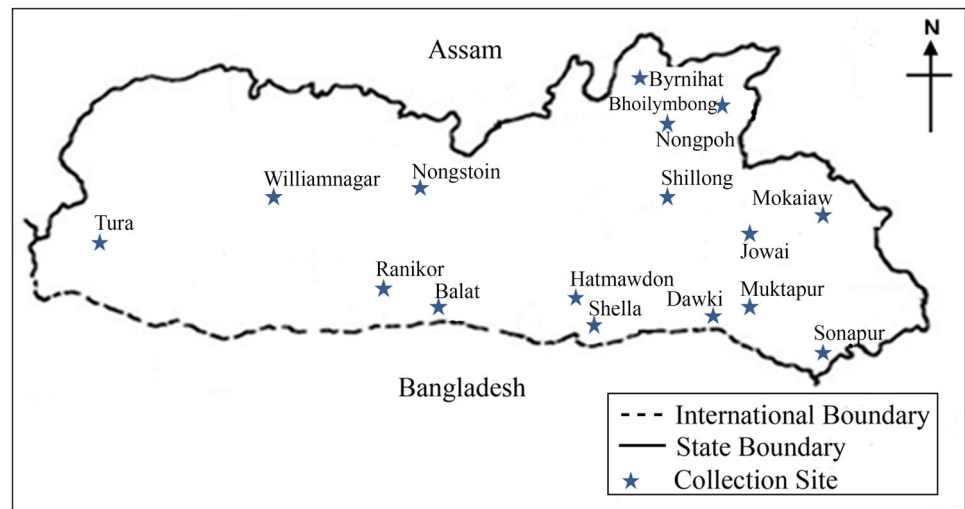
### Study area

Meghalaya is bound in the north and the east by Assam and in the south and the west by Bangladesh and covers an area of 22,429 km<sup>2</sup> lying between 20° and 26.5°E and 85.49° and 92.52°N. The main rivers of the eastern and central regions of Meghalaya plateau that flow towards the north are Umiam, Umkhri and Umtru those that flow towards the south are Kynchi (Jadukata), Myntdu and Umngot. The main rivers in the Garo Hills that form the northern system and flow from west to east are Simsang, Ringgri and Krishna.

### Survey and collection of fish hosts

Collections were made throughout the year on monthly basis during the year 2007 to 2010. Piscine hosts collected and examined for helminth infections during the study include 8 genera of Cypriniformes, 1 genus representing: Channiformes Symbranchiformes and Anguilliformes, and 7 genera representing Siluriformes. The survey and collection sites explored in the state of Meghalaya are depicted in the map (Fig. 1) and their geographical coordinates, in Table 1.

**Fig. 1** Map of Meghalaya showing different collection sites of piscine hosts



**Table 1** Different collection sites with their geographical locations

Sl. No.	Collection site	Geographical coordinates	District
1.	Hatmawdon	25.15°E–91.20°N	East Khasi Hills
2.	Sonapur	25.16°E–92.37°N	East Jaintia Hills
3.	Sheella	25.17°E–91.64°N	East Khasi Hills
4.	Dawki	25.18°E–92.02°N	West Jaintia Hills
5.	Balat	25.19°E–91.37°N	West Khasi Hills
6.	Muktapur	25.20°E–92.04°	West Jaintia Hills
7.	Ranikor	25.22°E–91.24°N	West Khasi Hills
8.	Jowai	25.44°E–92.20°N	West Jaintia Hills
9.	Williamnagar	25.47°E–90.62°N	East Garo Hills
10.	Tura	25.51°E–90.21°N	West Garo Hills
11.	Nongstoin	25.51°E–91.26°N	West Khasi Hills
12.	Mokaiaiw	25.52°E–92.42°N	East Jaintia Hills
13.	Shillong	25.57°E–91.87°N	East Khasi Hills
14.	Bhoilymbong	25.71°E–92.02°N	Ri Bhoi
15.	Nongpoh	25.89°E–91.88°N	Ri Bhoi
16.	Byrnihat	26.04°E–91.87°N	Ri Bhoi

#### Recovery of parasites

Fishes collected from different collection sites were brought to the laboratory. Their external body surface and organs such as scales, fins, gills, eyes, and buccal cavity were examined for the presence of ectoparasites; the peritoneal lining of the body cavity, internal organs such as heart, lungs, liver, gall bladder, spleen, stomach, intestine, swim bladder, kidneys, gonads and mesenteries etc. were scanned thoroughly for the presence of endoparasites. The locality-wise status of infection in the various fish hosts is depicted in Table 2. The helminth parasites recovered were counted, stretched and/or flattened in warm water, flattened and processed further following standard procedures of fixation, preservation and staining etc. as detailed below.

#### Light microscopy (LM)

**Monogenea, trematodes and cestodes:** The freshly recovered parasites were washed in saline solution and narcotized with few drops of 70 % ethyl alcohol. They were gently flattened between a glass slide and a cover slip and fixed overnight in 70 % ethyl alcohol. Whole mount preparations were made by staining in Borax carmine or Meyer's carmalum, dehydrating through ascending grades of alcohol, clearing in methyl benzoate and finally mounting in Canada balsam.

**Nematodes** The recovered worms were stretched and fixed in warm 70 % alcohol. For permanent mounting, the alcohol-fixed worms were cleared in ascending grades of glycerine till pure glycerine and finally double mounted

**Table 2** Fish hosts examined from different localities in Meghalaya and their status of infection

Host spp.	Locality															
	Dawki	Shella	Balat	Hatmawdon	Byrnihat	Nongpoh	Bhoilymbong	Nongstoin	Jowai	Sonapur	Tura	Muktapur	Mawkaia	Shillong	Williamnagar	Ranikor
<b>Cypriniformes</b>																
<i>Labeo pangusia</i>	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>L. rohita</i>	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>L. calbasu</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>L. gonius</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>L. boga</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Neolissocheilus hexagonolepis</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Cirrhinus reba</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>C. mrigala</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Puntius sarana</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Botio dario</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Garra sp.</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Cyprinus carpio</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Catla catla</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Channiformes</b>																
<i>Channa striatus</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>C. marulius</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>C. gachua</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>C. punctatus</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<b>Siluriformes</b>																
<i>Clarias batrachus</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>C. gariepinus</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Heteropneustes fossilis</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Mystus tengara</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>M. vittatus</i>	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>M. cavacius</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Rita rita</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Chaca chaca</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Bagarius bagarius</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Symbranchiiformes</b>																
<i>Monopterusuchia</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Anguilliformes</b>																
<i>Anguilla anguilla</i>	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

using Kaiser's glycerine jelly (50 ml water + 80 g gelatin + 50 ml glycerol + 0.1 g phenol); for temporary mounting, the specimens were immersed in lactophenol (20 ml lactic acid + 20 ml phenol + 40 ml glycerine + 20 ml distilled water) overnight and temporarily mounted using the same solution on the glass slide.

The permanent slides were observed and studied under Wild M5APO stereo microscope and Leitz Ortholux-2 research microscope. For taxonomic identification of the parasites, standard reference works of Yamaguti (1959, 1961, 1963a, b, 1971), Keys to the Trematoda Vols.1-3 (Gibson et al. 2002, Jones et al. 2005, Bray et al. 2008), CIH Keys to the Cestode Parasites of Vertebrates (Khalil et al. 1994); and CIH Keys to Nematodes nos. I-X (Anderson et al. 1974–1982; Anderson and Chabaud 1983) were followed.

#### Observation/Results

In the present study the spectrum of helminth parasites, recovered from the various piscine host species in the study area comprised a total of 19 taxa: 2 Monogenean, 8 trematode, 4 cestode, 4 nematode and a single acanthocephalan species.

#### Helminth parasite spectrum in fishes of Meghalaya

##### Plathyhelminthes

##### Monogenea

Order: Dactylogyridea Bychowsky, 1937

Family: Dactylogyridae Bychowsky, 1933

Genus: *Bifurcophaptor* Jain, 1958

1. *Bifurcophaptor indicus* Jain, 1958

Order: Mazocraeidea Bychowsky, 1957

Family: Diplozoidae

Genus: *Diplozoon* Nordmann, 1832

2. *Diplozoon cauveri* Tripathi, 1959

##### Trematoda: Digenea

Order: Strigeidida

Family: Bucephalidae Poche, 1907

Genus: *Bucephalus*

3. *Bucephalus* sp.

Order: Azygiida Schell, 1982

Family: Hemiuridae Lühe, 1901

Genus: *Genarchopsis* Ozaki, 1925

4. *Genarchopsis goppo* Ozaki, 1925

Family: Opecoelidae Ozaki, 1925

Subfamily: Opecoelinae Ozaki, 1925

Genus: *Neopodocotyle* Dayal, 1950

5. *Neopodocotyle* sp.

Order: Plagiorchiida

Family: Gorgoderidae Looss, 1899

Genus: *Phyllodistomum* Braun, 1899

6. *Phyllodistomum* sp.

Order: Strigeidida La Rue, 1926

Family: Clinostomidae Lühe, 1901

Genus: *Clinostomum* Leidy, 1856

7. *Clinostomum complanatum* (Rudolphi, 1819), Leidy, 1856

Genus: *Clinostomoides* Dollfus, 1950

8. *Clinostomoides brienii* Dollfus, 1950

Genus: *Euclinostomum* Travassos, 1928

9. *Euclinostomum heterostomum* (Rudolphi, 1809), Travassos, 1928

Family: Diplostomidae Poirier, 1886

Genus: *Tylodelphys* Diesing, 1850

10. *Tylodelphys* (metacercaria) sp.

##### Cestoda

Order: Caryophyllidea van Beneden in Carus, 1863

Family: Lytocestidae Hunter, 1927

Genus: *Lytocestus* Cohn, 1908

11. *Lytocestus indicus* (Moghe, 1925) Woodland, 1926

12. *Lytocestus birmanicus* Lynsdale, 1956

13. *Lytocestus clariae* Tandon, Chakravarty and Das, 2005

14. *Lytocestus filiformis* (Woodland, 1923) Fuhrmann and Baer, 1925

15. *Lytocestus longicollis* Ramadevi, 1973

16. *Lytocestus attenuatus* Tandon, Chakravarty and Das, 2005

17. *Lytocestus heteropneustii* Tandon, Chakravarty and Das, 2005

18. *Lytocestus* sp.

Genus: *Djombangia* Bovien, 1926

19. *Djombangia penetrans* Bovien, 1926

Order: Pseudophyllidea Carus, 1863

Family: Bothriocephalidae Blanchard, 1849

Genus: *Senga* Dollfus, 1934

20. *Senga* sp. 1

21. *Senga* sp. 2

Order: Trypanorhyncha Diesing, 1863

Family: Tetrarhynchidae Cobbold, 1864

22. Trypanorhyncha larva

##### Nematoda

Subclass: Secernentea

Order: Spiruridea Diesing, 1861

Superfamily: Camallanoidea

Family: Camallanidae Railliet and Henry, 1915

Genus: *Procamallanus* Baylis, 1923

23. *Procamallanus* sp.

Genus: *Paracamallanus* Yorke and Maplestone, 1926

24. *Paracamallanus* sp.

Genus: *Neocamallanus* Ali, 1957

25. *Neocamallanus singhi* Ali, 1957

Order: Enoplida

Family: Dioctophymatidae Railliet, 1915

Genus: *Eustrongylides* Jägerskiöld, 190926. *Eustrongylides* sp. (larval form)

27. Unidentified nematode larval stage. 1

28. Unidentified nematode larval stage. 2

**Acanthocephala**

Order: Gyraacanthocephala Van Cleave, 1936

Family: Quadrigyridae Van Cleave, 1920

Genus: *Pallisentis* Van Cleave, 192829. *Pallisentis ophiocephali* (Thapar, 1930) Bilqees, 1976**Monogenea**

Order: Dactylogyridea Bychowsky, 1937

Family: Dactylogyridae Bychowsky, 1933

**Genus: *Bifurcohaptor*** Jain, 19581. *Bifurcohaptor indicus* Jain, 1958

Materials: 61 specimens

Location: Gill filaments

Locality: Dawki, Byrnihat

Host: *Mystus vittatus*, *M. tengara*

**Remarks:** The genus *Bifurcohaptor* was erected by Jain (1958) with *B. indicus* as its type species from gill filaments of *Mystus vittatus* at Lucknow. The genus *Bagari-trema*, described by Tripathi (1959) from gill filament of *Bagarius bagarius*, is a synonym of *Bifurcohaptor* (ref. Yamaguti, 1963). Species of *Bifurcohaptor* so far reported from the Indian subcontinent include: *B. indicus* Jain, 1958 from *Mystus vittatus*; *B. giganticus* Jain, 1958 (= *Bagari-trema son* Tripathi, 1959) from *M. seengala* (= *Sperata seengala*); *B. minutum* Kulkarni, 1969 from *M. tengara*; *B. vishwanathai* Agarwal and Kumar, 1977 from *Bagarius bagarius*; *B. mulleri* Gupta and Sharma, 1981 from *B. bagarius*; *B. gorakhnathai* Kumar and Agarwal, 1982 from *B. bagarius*; *B. sohani* Agarwal and Singh, 1982 from *M. vittatus*; *B. hemlatae* Gupta, 1984 from *Rita rita*; *B. ramalingami* Swarup and Jain, 1984 from *M. vittatus* and *B. bagarius*; *B. kulkarnii* Swarup and Jain, 1984 from *Bagarius bagarius* and *B. chauhani* Agarwal and Sharma, 1986 from *B. bagarius*. Pandey and Singh (1989) studied the validity of Indian species of *Bifurcohaptor* and regarded only *B. indicus* as a valid species, with all others being its synonyms. However, Dubey et al. (1990) regarded *B. giganticus*, *B. son*, *B. tripathii* and *B. hemlatae* as valid species, whereas Lim et al. (2001) retained only *B. indicus*, *B. giganticus* and *B. son* as valid species and considered the rest as species inquirendae. Pandey et al. (2002) concluded that catfishes of the Indian sub-continent harbor only two species of *Bifurcohaptor*- *B. indicus* and *B. giganticus*.

*B. indicus* has been earlier reported from *Mystus tengara*, *M. keletius* and *M. nemurus* (= *Hemibagrus nemurus*)

besides its type host. Dawki and Byrnihat (Meghalaya) as reported herein, are new locality records for this species.

**Paratypes no.:** NEHU/Z-MF/1.1-1.10, in helminthological collection of Department of Zoology, NEHU, Shillong, India.

Order: Mazocraeidea Bychowsky, 1957

Family: Diplozoidae

**Genus: *Diplozoon*** Nordmann, 18322. *Diplozoon cauveri* Tripathi, 1959

Materials: 73 specimens

Location: Gill filaments

Locality: Dawki, Shella, Sonapur

Hosts: *Labeo pangusia*, *L. boga*

**Remarks:** The genus *Diplozoon*, with type species *D. paradoxum* Nordmann, 1832, was first described from the gills of *Abramis bramis brama*. The species of *Diplozoon* reported from India so far are: *D. indicum* Dayal, 1941 from *Barbus sarana*; *D. kashmirensis* Kaw, 1950 from *Schizothorax niger* and *S. esocinus*; *D. soni* Tripathi, 1957 from *Oxygaster bacaila*; *D. cauveri* Tripathi, 1959 from *Cirrhina cirrhosa*; *D. microclampi* Kulkarni, 1971 from *Barbus sarana*; *D. thapari* Gupta and Krishna, 1979 from *Tor tor* and *D. dasashwamedhai* Agarwal and Kumar, 1989 from *Barilius bola*. Fotedar and Parveen (1987) also recorded *D. nipponicum* from *Cyprinus carpio specularis* from Kashmir. However, Pandey et al. (2002) regarded *D. nipponicum* Goto, 1891 as a synonym of *D. kashmirensis*. Further, Pandey and Agarwal (2008) considered *D. indicum* and *D. nipponicum* as the only valid species.

The presence of eggs with a long coiled filament is a diagnostic characteristic of the genus *Diplozoon*. However, *D. cauveri* was described as having eggs without polar filament (Tripathi, 1959). The present observations of the diplozoid fluke under study tally with the original description of *D. cauveri* in having non filamented eggs. In view of this character, i.e., eggs without polar filaments, *D. cauveri* should be recognized as a valid species of the genus.

As reported herein, *Labeo pangusia* and *L. boga* are new host records and Meghalaya, a new locality record for *D. cauveri*.

**Paratypes no.:** NEHU/Z-MF/2.1-2.12**Trematoda: Digenea**

Order: Strigeidida

Family: Bucephalidae Poche, 1907

**Genus: *Bucephalus***3. *Bucephalus* sp.

Materials: 26 specimens

Location: Intestine

Locality: Dawki, Byrnihat

Host: *Mystus cavasius*

**Remarks:** In having the mouth situated in the middle of the body, the genus *Bucephalus* represents the Gasterostoma group of Digenea. A sac-like and not bifurcate intestine and a rhynchus (anchoring structure) with several tentacles are additional characters of the genus. This genus *B. polymorphus* was erected by von Baer (1826) with as the type species. Some species reported from the Indian subcontinent are *B. aoria* and *B. tridentacularia* Verma, 1936 from *Aoria aoria*; *B. jagannathai* Verma, 1936 from *Cymbium guttatum*; *B. tridentacularia* Verma, 1936 from *Aoria (Macrones) aoria*, *A. (M) seenghala* and *B. bagarius*; *B. barina* Srivastava, 1938a from *Scatophagus argus*; *B. gangeticus* Srivastava, 1938a from *Pseudotropius athenoides*; *B. indicus* Srivastava, 1938a in *Macrones seenghala*; *B. tridentacularis* Srivastava, 1963, *B. allahabadensis* Srivastava, 1963, *B. bagarius* Srivastava, 1963—all from *Bagarius bagarius*; *B. octotentacularis* Kakaji, 1969 from *Wallagonia attu*.

The present study is the first report of the occurrence of the genus *Bucephalus* from Meghalaya; Dawki, Byrnihat, as reported herein, are new locality records for this form.

**Paratypes no.:** NEHU/Z-TF/5.1-5.5

Order: Azygiida Schell, 1982

Family: Hemiuridae Lühe, 1901

**Genus:** *Genarchopsis* Ozaki 1925

4. *Genarchopsis goppo* Ozaki, 1925

Materials: 255 specimens

Location: Stomach

Locality: Dawki, Byrnihat, Bhoilymbong, Hatmawdon

Host: *Monopterusuchia*, *Channa striatus*, *C.punctatus*

**Remarks:** The genus *Genarchopsis* was erected by Ozaki (1925) with *G. goppo* as the type species from the intestine of *Mogurnda obscura* near Hiroshima, Japan. Several species of *Genarchopsis* have been reported from the Indian subcontinent: *G. lobata* (Srivastava, 1933) (syn. *Ophiocorchis lobatum* Srivastava, 1933) Yamaguti 1954; *G. singularis* Srivastava, 1933 in *Ophiocephalus striatus*; *G. ovocaudata* Srivastava, 1933, *G. indicus* Gupta, 1951 and *G. dasus* Gupta, 1951 all from *Ophiocephalus punctatus*; *G. faruquis* Gupta, 1951 from *Mastacembelus armatus*; *G. folliculate* Bhadauria and Dandotia, 1954 from *Mastacembelus* sp. and *Channa* sp. from Gwalior; *G. thapari* Dwivedi, 1965, *G. melanosticus* Dwivedi, 1965 both from *Bufo melanostictus*; Agarwal, 1966 from *Ophiocephalus punctatus*; *G. cameroi* Kakaji, 1969 from *Mystus seenghala*; *G. cuchiai* Kakaji, 1969 from *Amphipnous cuchia* from Muzaffarnagar. Hafizuddin and Khan (1973) reported *G. bashiri* from *Heteropneustes fossilis* from Bangladesh; Varma and Sahay (1983) described *G. avitellarium* from stomach of *Ophiocephalus punctatus* from Assam. Of the 12 Indian species of the genus

*Genarchopsis*, Rai (1972) synonymized 8 species (*G. piscicola*; *G. ovocaudata*; *G. lobata*; *G. indicus*; *G. dasus*; *G. singularis*; *G. melanostictus* and *G. faruquis*) with *G. goppo*. Pandey (1973) further synonymized the remaining Indian species as well as *G. ozakii* and *G. bangladesensis* Bashirullah and Elahi, 1972 from Bangladesh with *G. goppo*. The genus *Genarchopsis* includes 4 more species namely, *G. muelleri* Levinsen, 1881 in *Cottus scorpius*, *Gadus ovak* from Edgedesminde; *G. anguillae* Yamaguti, 1938 in *Anguilla japonica* and *Chaenogobius urotaenia* from Tutiura, Japan; *G. giggi* Yamaguti, 1939 in *Pelteobagrus nudiceps* from Lake Biwa, Japan and *G. macrocotyle* Coil and Kuntz, 1960 in *Ophiocephalus punctatus* from Dacca Bangladesh.

The present study is the first report of the occurrence of *G. goppo* from Meghalaya; Dawki, Byrnihat, Bhoilymbong and Hatmawdon as reported herein, are new locality records for this species.

**Paratypes no.:** NEHU/Z-TF/1.1-1.15

Family: Opecoelidae Ozaki, 1925

Subfamily: Opecoelinae Ozaki, 1925

**Genus:** *Neopodocotyle* Dayal, 1950

5. *Neopodocotyle* sp.

Materials: 20 specimens

Location: Intestine

Locality: Nongstoin

Hosts: *Labeo rohita*, *L. boga*

**Remarks:** The genus *Neopodocotyle* was proposed by Dayal (1950) under the family Opecoelidae Ozaki, 1925, with *N. indica* Dayal, 1950 as its type species from a freshwater fish, *Callichrous bimaculatus* from Lucknow. Pritchard (1966) considered the genus a synonym of *Allocreadium* (Family: Allocreadiidae) but Agarwal and Kumar (1986) continued to recognize the genus, principally for the wide separation of the ovary from the testes and the occupation of this space by the uterus. According to Agarwal and Kumar (1986), there are five species, all from Indian freshwater fish in the genus, these are *Neopodocotyle indica* Dayal, 1950 from *Callichrous bimaculatus* and *N. lucknowensis* Gupta and Chakrabarti, 1966 in *Barbus sarana* from Lucknow; *N. spinipora* Sircar and Sinha, 1969 in *Rita rita* from Patna; *N. mehrai* Rai, 1971 in catfish from Gorakhpur; and *N. gorakhpurensis* Agarwal and Kumar, 1986 in *Amphipnous cuchia*. Soota and Ghosh (1977) reported the occurrence of *N. indica* in *Tor tor* from Shillong, Meghalaya.

The parasite under the present study shows close resemblance to *Neopodocotyle* in all morphological characters, hence assigned to the genus *Neopodocotyle*. However, it could not be identified up to the species level due to unavailability of literature and want of comparison with the other known species of the genus.

**Paratypes no.:** NEHU/Z-TF/2.1-2.8

Order: Plagiorchiida

Family: Gorgoderidae Looss, 1899

**Genus:** *Phyllodistomum* Braun, 18996. *Phyllodistomum* sp.

Materials: 6 specimens

Location: Intestine

Locality: Hatmawdon

Host: *Channa punctatus*

**Remarks:** Braun (1899) erected the genus *Phyllodistomum* for *Distomum folium* Olfers, 1816 from the urinary bladder of fishes. Several species of the genus *Phyllodistomum* have been described so far from freshwater fishes of India; these are *P. spatulaeforme* Odhner, 1902 from *Amphipnous cuchia* from Muzaffarnagar; *P. lewisi* Srivastava, 1938b from *Belone strongylura*; *P. macronium* (Dayal, 1938) Yamaguti, 1958 from *Macrones tengara*; *P. callichrius* (Dayal, 1942) from *Callichrous pubda* from Lucknow; *P. vachius* Dayal, 1949 from *Eutropichthys vacha*; *P. loossi* Kaw, 1950 from *Schizothorax esocinus* from Kashmir; *P. singhiae* Gupta, 1951 from *Mastacembelus armatus*, *Belone cancala* and *Ophiocephalus marulius* from Lucknow; *P. vittatusi* Gupta, 1955 from *Macrones vittatus* from Assam; *P. parorchium* Jaiswal, 1957 from *Glossogobius giuris* from Hyderabad; *P. indianum* Jaiswal, 1957 from *Heteropneustes fossilis* from Hyderabad; *P. chauhani* Motwani and Srivastava, 1961 from *Mystus aor* and *M. seenghala* from Allahabad; *P. tripathi* Motwani and Srivastava, 1961 from *Bagarius yarrelli* and *Pseudotripius* and *P. srivastavi* Rai, 1964 from *Heteropneustes fossilis* and *Mystus cavasius*; and *P. cameroni* Agarwal, 1966 from *Rita rita* from Lucknow.

Based on the presence of a tapered forebody, broad foliate hindbody with crenulated margins and uterus occupying most space in the hindbody, the present form belongs to the genus *Phyllodistomum*. However, due to lack of sufficient number of specimens, it could not be identified up to the species level.

This is the first report of the occurrence of the genus *Phyllodistomum* from the northeastern region of India.

**Paratypes no.:** NEHU/Z-TF/3.1-3.4

Order: Strigeidida La Rue, 1926

Family: Clinostomidae Lühe, 1901

**Genus:** *Clinostomum* Leidy, 18567. *Clinostomum complanatum* Rudolphi, 1819

Materials: 60 specimens

Location: Body cavity, muscle tissue, oesophagus

Locality: Byrnihat

Host: *Heteropneustes fossilis*, *Channa striatus*, *C. punctatus*, *C. gachua*

**Remarks:** Leidy (1856) created the genus *Clinostomum* for Rudolphi's worm *Distoma complanatum* (1809).

The metacercaria of *C. complanatum* have been recorded from several species of fishes (Yamaguti 1933; Grabda-Kazubska 1974; Lo 1989; Aohagi et al. 1992, 1993, 1995). Species of *Clinostomum* described from the Indian subcontinent include *C. piscidium* Southwell and Prashad, 1918a from *Trichogaster fasciatus* and *Nandus nandus*; *C. dasi* and *C. gideoni* Bhalerao, 1942 from *Saccobranthus fossilis*, *Heteropneustes fossilis* and *Barbus sophare*; *Clinostomum* sp. Srivastava, 1950 from *C. punctatus*; *C. schizothoraxi* Kaw, 1950 from *Schizothorax esocinus* and *S. niger*; *C. mastacembeli* Jaiswal, 1957 and *C. progonum* Jaiswal, 1957. Agarwal (1959) described the morphology and life history of *C. giganticum* and Pandey and Baugh, 1970 redescribed *C. giganticum* adults.

The present study is the first report of the occurrence of *C. complanatum* from Meghalaya (Byrnihat) as reported herein, which is also a new locality record for this species.

**Paratypes no.:** NEHU/Z-MC(F)/2.1-2.15**Genus:** *Clinostomoides* Dollfus, 19508. *Clinostomoides brienii* Dollfus, 1950

Materials: 34 specimens

Location: Body cavity, muscle tissue, oesophagus

Locality: Byrnihat

Host: *Heteropneustes fossilis*

**Remarks:** *Clinostomoides brienii* was described by Dollfus (1950) as the type species from the oesophagus of *Ardea goliath* from Belgian Congo. The metacercaria was found encysted in gills of *Clarias lazero* from Belgian Congo by Prudhoe (1957). *C. dollfusii* Agarwal, 1959 is another species reported from Jabalpur (India), the larval stage of which occurs in the branchial region beneath the operculum in *Clarias* and *Saccobranthus* fishes.

The present study is the first report of the occurrence of this species from Meghalaya. Byrnihat, Meghalaya as reported herein, are new locality records for this species.

**Paratypes no.:** NEHU/Z-MC(F)/3.1-3.5**Genus:** *Euclinostomum* Travassos, 1928

9. *Euclinostomum heterostomum* (Rudolphi, 1809), Travassos, 1928

Materials: 52 specimens

Location: Liver

Locality: Byrnihat

Hosts: *Channa striatus*, *C. punctatus*

**Remarks:** Travassos (1928) created the genus *Euclinostomum* with *E. heterostomum* as its type species from *Ardea purpurea*. The metacercariae and adults of *E. heterostomum* have been frequently recorded from Indian freshwater fishes and birds (*E. indicum* Bhalerao, 1942 from *Channa punctatus*; *E. channi* Jaiswal, 1957 from *C. marulius*; and *E. heptacaecum* Jaiswal, 1957 from *C. punctatus*. Yamaguti (1958) created the subfamily



Euclinostominae with *Euclinostomum* as its only genus. Ukoli (1966) synonymised *E. bhagavantami*, *E. channi*, *E. heptacaecum* and *E. indicum* with *E. heterostomum*. Srivastava (1950) traced a part of the life-cycle of *E. heterostomum*; Agarwal (1958a, b) did further observations on *E. indicum*; Agarwal (1959) studied the egg and miracidium of *E. heterostomum*; and Gupta and Agarwal (1983b) studied the host-parasite relationship in *C. punctatus* and *E. heterostomum*. Sinha et al. (1988) reported *E. heterostomum* from the liver, spleen and kidney of *C. punctatus*.

**Paratypes no.:** NEHU/Z-MC(F) 1.1–1.10

Family: Diplostomidae Poirier, 1886

**Genus:** *Tylodelphys* Diesing, 1850

10. *Tylodelphys* (metacercariae)

Materials: 5280 specimens

Location: Body cavity, muscle tissue, oesophagus

Locality: Byrnihat

Host: *Heteropneustes fossilis*

**Remarks:** *Tylodelphys* was described by Diesing (1850) with *Tylodelphys clavata* (syn *Diplostomum clavatum* Nordmann, 1832) (syn *Proalaria clavata* Ciurea, 1928; *Prodiplostomum clavatum* Ciurea, 1930; *Tylodelphys excavata* Bezubik, 1956; *T. circibuteonis* Odening, 1962) in *Ardea cinerea* and *Circus aeruginosus*. The adult diplostomes are intestinal parasites of piscivorous birds. The species described from the Indian subcontinent are *Tylodelphys rauschi* Singh, 1956 (syn = *Diplostomum rauschi* Singh, 1956) from *Dissoura episcopus episcopus*; *T. duboisilla* Mehra, 1962 from the intestine of *Anhinga melanogaster*; *T. darteri* Mehra, 1962 (syn = *T. indica* Gupta, 1962; *T. indiana* Mehra, 1962) from *Anhinga melanogaster*; *T. chandrapali* Jain and Gupta, 1970 from Uttar Pradesh and *T. spinata* Gupta, 1962 from *Anastomus oscitans*.

The present study is the first report of the occurrence of this metacercarial form from Meghalaya (Byrnihat).

**Paratypes no.:** NEHU/Z-MC(F)/4.1-4.5

### Cestoda

Order: Caryophyllidea van Beneden in Carus, 1863

Family: Lytocestidae Hunter, 1927

**Genus:** *Lytocestus* Cohn, 1908

11. *Lytocestus indicus* (Moghe, 1925) Woodland, 1926

Materials: 256 specimens

Location: Intestine

Locality: Byrnihat, Dawki, Hatmawdon, Jowai, Tura, Balat

Host: *Clarias batrachus*

**Remarks:** The species, *L. indicus*, was first described by Moghe (1925) as *Caryophyllaeus indicus* from the common Indian siluroid fish, *Clarius batrachus*. Woodland (1926) raised a doubt regarding the presence of post-

ovarian vitelline follicles and maintained that they were in reality ovarian follicles, suggesting thereby shifting of the species from *Caryophyllaeus* to *Lytocestus*.

*Lytocestus indicus* was earlier reported by Chakravarty and Tandon (1988) from the same host from the region but from a different locality i.e., Guwahati (Assam). The present study is the first report of the occurrence of *L. indicus* from Meghalaya (Byrnihat, Dawki, Hatmawdon, Jowai, Tura, Balat).

**Paratypes no.:** NEHU/Z-CF/7.6-7.10

12. *Lytocestus birmanicus* Lynsdale, 1956

Materials: 732 specimens

Location: Intestine

Locality: Byrnihat, Dawki, Hatmawdon, Jowai, Tura, Balat

Host: *Clarias batrachus*

**Remarks:** *L. birmanicus* was first described by Lynsdale (1956) from the intestine of *Clarias batrachus* in Rangoon, Burma. This species was earlier reported by Chakravarty and Tandon (1988) from the same host from the region but from a different locality, Guwahati (Assam). The present study is the first report of the occurrence of *L. birmanicus* from Meghalaya; Byrnihat, Dawki, Hatmawdon, Jowai, Tura and Balat as reported herein, are new locality records for this species.

**Paratypes no.:** NEHU/Z-CF/5.6-5.10

13. *Lytocestus clariae* Tandon, Chakravarty and Das, 2005

Materials: 17 specimens

Location: Intestine

Locality: Byrnihat, Dawki, Hatmawdon, Tura

Host: *Clarias batrachus*

**Remarks:** This species was first described from *Clarias batrachus* from Guwahati (Assam) by Tandon, Chakravarty and Das, 2005.

The present study is the first report of the occurrence of *L. clariae* from Meghalaya; Byrnihat, Dawki, Hatmawdon as reported herein, are new locality records for this species.

**Paratypes no.:** NEHU/Z-CF/1.5-1.6

14. *Lytocestus filiformis* (Woodland, 1923) Fuhrmann and Baer, 1925

Materials: 16 specimens

Location: Intestine

Locality: Byrnihat, Dawki, Hatmawdon, Jowai, Tura, Balat

Host: *Clarias batrachus*

**Remarks:** *L. filiformis* was first described by Woodland (1923) as *Caryophyllaeus filiformis* from a mormyrid fish host, *Mormyrus cashive*, of the river Nile at Khatoum. Later, Fuhrmann and Baer (1925), on the basis of cortical

disposition of vitellaria and medullary disposition of testes, shifted it to the genus *Lytocestus*. Chakravarty and Tandon (1988) reported this species from the same fish host from Guwahati (Assam) and supplemented the original description by providing measurements of the various organs.

The present study is the first report of the occurrence of *L. filiformis* from Meghalaya; Byrnihat, Dawki, Hatmawdon, Jowai, Tura, Balat as reported herein, are new locality records.

**Paratypes no.:** NEHU/Z-CF/6.6-6.7

15. *Lytocestus longicollis* Ramadevi, 1973

Materials: 20 specimens

Location: Intestine

Locality: Byrnihat, Hatmawdon, Tura

Host: *Clarias batrachus*

**Remarks:** *L. longicollis* was originally described by Ramadevi (1973) from *Clarius batrachus* in Visakhapatnam district of Andhra Pradesh. The species was distinguished from the rest of the lytocestid types in having a receptaculum seminis, which is absent in the other species. The species derived its name from its long neck. This species was first reported by Chakravarty and Tandon (1988) from *C. batrachus* from Guwahati (Assam) in Northeast India. The present study is the first report of the occurrence of *L. longicollis* from Meghalaya; Byrnihat, Hatmawdon and Tura as reported herein, are new locality records.

**Paratypes no.:** NEHU/Z-CF/8.6-8.7

16. *Lytocestus attenuatus* Tandon, Chakravarty and Das, 2005

Materials: 3 specimens

Location: Intestine

Locality: Byrnihat, Hatmawdon

Host: *Clarias batrachus*

**Remarks:** *L. attenuatus* was first reported by Tandon, Chakravarty and Das, 2005 from Guwahati (Assam) in Northeast India.

The present study is the first report of the occurrence of *L. attenuatus* from Meghalaya; Byrnihat, Hatmawdon as reported herein, are new locality records.

**Paratypes no.:** NEHU/Z-CF/3

17. *Lytocestus heteropneustii* Tandon, Chakravarty and Das, 2005

Materials: 52 specimens

Location: Intestine

Locality: Byrnihat, Dawki, Hatmawdon, Jowai, Tura, Balat

Host: *Heteropneustes fossilis*

**Remarks:** *L. heteropneustii* was first reported by Tandon, Chakravarty and Das, 2005 from Guwahati (Assam) in Northeast India.

The present study is the first report of the occurrence of *L. heteropneustii* from Meghalaya; Byrnihat, Dawki, Hatmawdon, Jowai, Tura, Balat and Bhoilymbong, as reported herein, are new locality records.

**Paratypes no.:** NEHU/Z-CF/11.6-11.8

18. *Lytocestus* sp.

Materials: 2 specimens

Host: *Mystus cavasius*

Location: Intestine

Locality: Shella

**Remarks:** The deposition of vitellaria in the cortex and testes in the medullary zone ascertains the inclusion of the present form in the family Lytocestidae. Further, owing to the characters such as presence of undifferentiated scolex, absence of post-ovarian yolk glands, uterine coils and ejaculatory duct enclosed within a compact parenchymatous bulb, the present form belongs to the genus *Lytocestus* Cohn, 1908. The present forms differ from in having head undifferentiated, bluntly rounded and testes numerous, medullary, ovary wing like, vitellaria up to the utero vaginal pore. However, for want of more material (needed for histological studies) species identification of this taxon is kept in abeyance.

The present study is the first ever report of the occurrence of *Lytocestus* species from *Mystus cavasius*. All *Lytocestus* spp have so far been recorded from *Clarias* and *Heteropneustes* catfishes and not from any *Mystus* species.

**Paratypes no.:** NEHU/Z-CF/11.1

**Genus:** *Djombangia* Bovien, 1926

19. *Djombangia penetrans* Bovien, 1926

Materials: 117 specimens

Location: Intestine

Locality: Byrnihat, Dawki, Hatmawdon, Jowai, Tura, Balat, Bhoilymbong

Host: *Clarias batrachus*

**Remarks:** The genus *Djombangia* was established by Bovien (1926) with *D. penetrans* as its type species, with *C. batrachus* and Satpute and Agarwal (1980) described another species *D. indica* from *C. batrachus* from Raipur. Two more Indian species added to the genus are *D. caballeri* Sahay and Sahay, 1977 from *H. fossilis* in Bihar and *D. clariae* Kundu, Bhattacharya and Datta, 1985 from *C. batrachus* in West Bengal, both of which were reported to be having smooth, nonspinous eggs. In the opinion of Mackiewicz (1981), the genus *Djombangia* is represented by 2 species in India, viz., *D. penetrans* and *D. indica*.

*D. penetrans* has earlier been reported from *C. batrachus* from Guwahati (Assam) in Northeast India by Chakravarty and Tandon (1988). The present study is the first report of the occurrence of *D. penetrans* from Meghalaya; Byrnihat, Dawki, Hatmawdon, Jowai, Tura, Balat

and Bhoilymbong, as reported herein, are new locality records.

**Paratypes no.:** NEHU/Z-CF/9.1-9.7

Order: Pseudophyllidea Carus, 1863

Family: Bothriocephalidae Blanchard, 1849

**Genus:** *Senga* Dollfus, 1934

20. *Senga* sp. 1

Materials: 278 specimens

Location: Intestine

Locality: Byrnihat, Dawki, Hatmawdon, Jowai, Tura, Balat

Host: *Monopterusuchia*

**Remarks:** The genus *Senga* was established by Dollfus in 1934 based on the type species *S. besnardi* from *Betta splendens*. Several species of *Senga* have been described from India; these are: *Senga lucknowensis* Johri, 1956 in *Mastacembelus armatus*; *S. visakhapatnamensis* Ramadevi and Rao, 1973 in *Ophiocephalus punctatus* from Visakhapatnam; *S. khami* Deshmukh and Shinde, 1980 in *O. marulius* from Aurangabad; *S. aurangabadensis* and *S. godavarii* Shinde and Jadhav, 1980 in *M. armatus* from Aurangabad; *S. punctati* and *S. mastacembali* Gupta and Sinha, 1980 in *O. punctatus* and *M. armatus* from Lucknow; *S. paithanensis* Kadam, Jadhav and Shinde, 1981 in *M. armatus*; *S. raoi* and *S. jagannathae* Majid and Shinde, 1984 in *C. punctatus* from Jagannathpuri; *S. indica* Gupta and Parmar, 1986 in *M. armatus* from Lucknow; *S. gangeticus* Gairola and Malhotra, 1986a in *Mystus vittatus* from Allahabad; *S. vittati* Gairola and Malhotra, 1987 in *M. vittatus* from Allahabad; *S. yamunica* Gairola and Malhotra, 1986b in *M. vittatus* from Allahabad; *S. nayari* Malhotra, 1988 in *M. armatus* from Garhwal; *S. pathankotensis* Duggal and Harlean, 1989 in *Labeo rohita* from Punjab; *S. teleostei* Banerjee, Chaubey and Malhotra, 1990 in *C. punctatus* from Garhwal; *S. maharashtrii* and *S. gachuae* Jadhav, Ghavane and Jadhav, 1991 in *M. armatus* and *C. gachua* from Aurangabad; *S. chauhani* Hasnain, 1992 in *C. punctatus* from Bihar; *S. jhansiensis* Mathur, Srivastav, and Daisy 1994 in *M. armatus* from Uttar Pradesh; *S. mohekarai* Tat and Jadhav, 1997 in *M. armatus*; *S. armantusae* Hiware, 1999 in *M. armatus* from Pune; *S. tappi* Patil and Jadhav, 2003 in *M. armatus* from Dhule; *S. ayodhensis* and *S. baught* Pande, Tripathi and Mittal, 2006 in *Amphinousuchia* and *Rita rita* respectively; *S. jadhavae* Bhure, Padwal and Jadhav, 2007 in *M. armatus* from Aurangabad; *S. ticto* Srivastav, Khare, Khare, Sahu and Singh, 2007 in *Puntius ticto* from Jhansi; *S. nathsagarensis* Kankale, 2008 in *M. armatus*; *S. madhavae* Bhure, Nanware, Pathan, Dhondge, 2010 in *M. armatus*; and *S. rupchandensis* Pardeshi and Hiware, 2011 in *C. striatus* from Aurangabad). The present form differs from *S. ayodhensis* Pande,

Tripathi and Mittal 2006 in having conical scolex, testes numerous, vitellaria follicular.

The present form could not be compared with all the species of *Senga* that have been described from India, mainly because the original literature or type specimens are not accessible for comparison. Hence, species identification has been kept in abeyance for the present.

**Paratypes no.:** NEHU/Z-CF/10; 11.11-11.15

**Genus:** *Senga* Dollfus, 1934

21. *Senga* sp. 2

Materials: 24 specimens

Location: Intestine

Locality: Byrnihat

Host: *Channa striatus*, *C. punctatus*

**Remarks:** The present form differs from the above *Senga* sp. 1 and from *S. rupchandensis* Pardeshi and Hiware, 2011 in having scolex pear shape, bothria shallow, hooks 25-455 in numbers, neck absent and vitellaria follicular.

**Paratypes no.:** NEHU/Z-CF/10.1-10.5

Order: Trypanorhyncha Diesing, 1863

Family: Tetrarhynchidae Cobbold, 1864

22. Trypanorhyncha larva

Materials: 4 specimens

Location: Body cavity

Locality: Shillong

Host: *Clarias batrachus*

**Remarks:** Southwell and Prasad (1918b) found cysts of a trypanorhynchan cestode in the muscles of *Hilsa ilisa*, an estuarine fish well known for having anadromous migratory pattern. Saxena (1980) described the occurrence of trypanorhynchan larva in freshwater fish, *Silonia silodia* from a preserved material collected in 1948, which is the first report of a trypanorhynchan larva from a freshwater fish from India. The present metacestode representing the Order Trypanorhyncha from the catfish *Clarias batrachus* is the first report of the parasite occurring in Meghalaya (Shillong) and also forms a new host record for Trypanorhyncha; the latter are generally known to parasitize marine or estuarine fishes.

**Paratypes no.:** NEHU/Z-MCe(F)/1.1

**Nematoda**

Order: Spiruridea Diesing, 1861

Family: Camallanidae Railliet and Henry, 1915

**Genus:** *Procamallanus* Baylis, 1923

23. *Procamallanus* sp.

Materials: 9 specimens, all females

Location: Intestine

Locality: Byrnihat

Host: *Heteropneustes fossilis*

**Remarks:** The genus *Procamallanus* was created by Baylis (1923) considering *P. laeviconchus* Wedl, 1862 as its type species. Yamaguti (1961) listed about 34 species under the genus and Sood (1988) provided a key to the species of *Procamallanus* reported from fishes in South Asia. Lakshmi (2010) added a new species, *Procamallanus vysakhi* recovered from the intestine of *Johnius carutta* from the Bay of Bengal at Visakhapatnam.

Owing to non availability of any male specimens in the collection, identification up to the species level had to be kept in abeyance for want of enough material for the purpose of study.

The present study is the first report of the occurrence of this species from Meghalaya.

**Paratypes no.:** NEHU/Z-NF/4

**Genus:** *Paracamallanus* Yorke and Maplestone, 1926

24. *Paracamallanus* sp.

Materials: 1 female specimen

Location: Intestine

Locality: Hatmawdon

Host: *Channa punctatus*

**Remarks:** On the basis of morphological characters namely, buccal capsule with two lateral chitinous valves and presence of a trident, the present form could be assigned to the genus *Paracamallanus*. Yorke and Maplestone (1926) separated from the genus *Camallanus* those forms having a large chitinous buccal cavity or pharynx behind buccal valves and placed them under the genus.

However, for want of more female specimens and in the absence of male worms in the collection, the present form could not be identified at the species level.

**Paratypes no.:** NEHU/Z-NF/2

**Genus:** *Neocamallanus* Ali, 1957

25. *Neocamallanus singhi* Ali, 1957

Materials: 22 specimens

Location: Intestine

Locality: Byrnihat

Host: *Channa punctatus*, *C. striatus*

**Remarks:** The genus *Neocamallanus* was created by Ali (1957) for a nematode recovered from *Channa punctatus* from Hyderabad with the type species *N. singhi*. Yeh (1960) synonymized this genus with *Camallanus* Railliet and Henry 1915 as he did not give any importance to tridents. Yamaguti (1961) accepted this genus as valid. Sahay and Narayan (1967) also revived the genus *Neocamallanus*.

The present report provides a new locality record for *N. singhi*.

**Paratypes no.:** NEHU/Z-NF/1.1-1.10

Order: Enoplida

Family: Dioctophymatidae Railliet, 1915

**Genus:** *Eustrongylides* Jägerskiöld, 1909

26. *Eustrongylides* sp.—larval form

Materials: 53 specimens

Location: Body cavity

Locality: Byrnihat

Host: *Channa punctatus*, *C. striatus*

**Remarks:** Fernando and Furtado (1963) reported the occurrence of larvae of the genus *Eustrongylides* in *Heteropneustes fossilis*, *Ompak bimaculatus* and *Wallago attu* from Sri Lanka. These larvae were also reported by Kalyankar (1974) in *Mystus seenghala* from Nanded, Maharashtra and by Naidu and Thakare (1979) in *Mastacembelus armatus* also from Maharashtra. Jones (1978) reported for the first time the adults of this form from aquatic Australian snakes.

**Paratypes no.:** NEHU/Z-NF/3.1-3.10

27. Unidentified nematode species 1—larval stage

Materials: 255 specimens

Location: Body cavity

Locality: Byrnihat

Hosts: *Channa punctatus*, *C. striatus*, *C. gachua*, *Labeo rohita* and *L. boga*

28. Unidentified nematode species 2—larval stage

Materials: 6 specimens

Location: Mesenteries

Locality: Byrnihat

Host: *Monopterusuchia*

**Acanthocephala**

Order: Gyraacanthocephala Van Cleave, 1936

Family: Quadrigyridae Van Cleave, 1920

**Genus:** *Pallisentis* Van Cleave, 1928

29. *Pallisentis ophiocephali* (Thapar, 1930) Bilquees, 1976

Materials: 285 specimens

Location: Mysentery, intestine

Locality: Byrnihat, Shella, Dawki

Hosts: *Channa striatus*, *C. punctatus*, *C. gachua*

**Remarks:** Van Cleave (1928) erected the genus *Pallisentis* with *P. umbellatus* as the type species recovered from *Ophiocephalus argus*, *Siniperca* sp., *Cobitis decemcirrosus* and *Parasiturus arotus*. Several species of the genus were subsequently described from India; these include *P. ophiocephali* (Thapar, 1930) Baylis, 1933 in *Channa marulius* from Chittagong, Dhaka; *P. nagpurensis* Bhalerao 1931 in *Ophiocephalus striatus* from Maharashtra; *P. nandai* Sarkar, 1953 in *Nandus nandus* from Bengal; *P. colisai* Sarkar, 1956 in *Colisa fasciatus* from Delhi; *P. allahabadii* Agarwal, 1958a, b in *Ophiocephalus punctatus* from Uttar Pradesh; *P. basiri* Farooqi, 1958 in *Rhynchobdella aculeata* from Uttar Pradesh; *P. pandei* Rai, 1967 in *O. punctatus* from Uttar Pradesh; *P. gunteai* Sahay, Nath and Sinha, 1967 in *Lepidocephalichthys guntea* from Bi-

har; *P. fasciati*, *P. gontii* and *P. cavasii* Gupta and Verma, 1980 in *Trichogaster fasciatus*, *N. nandus* and *Mystus cavasius* from Lucknow; and *P. jagani* Koul, Raina, Bambroo and Koul, 1991 in *Channa channa* from Jammu. The present report provides a new host/locality record.

**Paratypes no.:** NEHU/Z-AF/1

## General remarks

The present studies incorporate the helminth parasite spectrum of edible freshwater fishes in Meghalaya, Northeast India. A total of 1674 piscine hosts were collected and examined for helminth infections during the study and are represented by 17 genera and 26 species that were collected from 15 different localities in Meghalaya for their platyhelminth parasite spectrum and load. These includes 5 species of *Labeo*; 2 species of *Cirrhinus*; a single species each of *Cyprinus*, *Puntius*, *Neolissocheilus*, *Botio*, *Garra* and *Catla* (Cypriniformes); 4 species of *Channa* (Channiformes); 2 species each of *Mystus* and *Clarias*, *Heteropneustes fossilis*, *Rita rita*, *Chaca chaca*, and *Bagarius bagarius* (Siluriformes); *Monopterusuchia* (Symbranchiformes); and *Anguilla Anguilla* (Anguilliformes). The helminth parasite spectrum recovered from the various piscine host species in the study area comprised a total of 19 taxa: 2 monogenean, 8 trematode (4 adult and 4 metacercarial stages), 12 cestode (11 adult and a metacestode stage), 6 nematode (3 adult and 3 larval stages) and a single acanthocephalan species.

It may be empirically concluded that the component of helminth communities of these (tropical) freshwater fishes is species-poor and that considerable proportion of fish from the region are uninfected or lightly infected (Chodhury and Dick 2000).

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