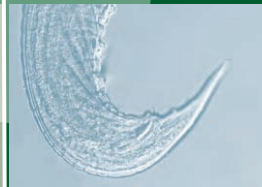
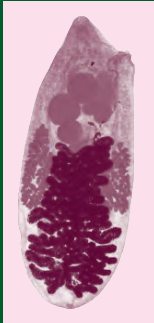




# Studies on the Helminth Parasites of district Dehradun

Anjum N. Rizvi and P .T. Bhutia



ZOOLOGICAL SURVEY OF INDIA





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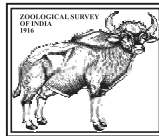
**Records of the  
Zoological Survey of India**

**STUDIES ON THE HELMINTH PARASITES OF  
DISTRICT DEHRADUN**

**ANJUM N. RIZVI & P. T. BHUTIA**

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## INTRODUCTION

Helminth is a general term meaning worm. The helminths are invertebrates characterized by elongated, flat or round bodies. The vast majority of metazoan parasites known to invade vertebrate hosts are mainly represented in three phyla: Platyhelminthes (Monogenea, Trematoda and Cestoda), Nematoda and Acanthocephala. Many of the parasitic members of these phyla are collectively known as helminths. Platyhelminthes includes three classes: Free-living Turbellaria (10 orders), parasitic Trematoda (3 orders) and parasitic Cestoda (13 orders). Order Digenea of Trematodes is mainly parasitic in vertebrates. Nematoda includes two classes: Adenophorea and Secernentea, while Acanthocephala comprises three classes namely, Archiacanthocephala, Eoacanthocephala and Palaeacanthocephala. Helminths are economically important group of organisms because they cause various diseases to different animal groups and are also found parasitizing human beings.

### *Work done on helminths from Dehradun*

First report on helminths of vertebrates from Dehradun was provided by Soota and Tripathi (1975). They reported 7 species of nematodes from birds and mammals from Dehradun. Later, Srivastava and Kumar (1983) studied monogenetic trematode from fishes. Work on trematodes parasites of fishes were done by Srivastava *et al.* (1983), Tripathi & Jauhari (1991), Juwantha (2009) and Saxena *et al.* (2010). Work on other vertebrates were reported by Chakrabarti & Ghosh (2009) on trematode from reptile and recently Chakrabarti and Ghosh(2010) reported three species from bats and one species from amphibian host.

The present paper records 45 species of helminth parasites from vertebrate hosts of district Dehradun belonging to two Phyla under 8 orders, 23 families and 35 genera. The study include five new species ( Rizvi, Bursey & Bhutia, 2012; 2013), three new records from India, seven new records from State Uttarakhand and seventeen new records from district Dehradun. Besides, community analysis of amphibian helminths have been also been studied for the first time from district Dehradun.

### *Generalized Life cycle pattern of Trematodes:*

The **eggs** are released into host's intestinal lumen through the genital pore and are later passed to the outside in the host's feces. The eggs hatch in water and from each egg a free-swimming **miracidium** emerges.

The miracidium penetrates the integument of molluscan host (the first intermediate host) and sheds its ciliated epidermis and forms the next stage, the **sporocyst**. In some species, the eggs are ingested by the host and the miracidium hatch out within the host's digestive tract.

The sporocyst contains germinal cells, which differentiate into germ balls. Each of these germ balls give rise to next larval stage called **redia**, which gives rise to tail bearing **cercaria**, the fourth larval stage. Cerceriae escape from their molluscan host and become free swimming. In some cases, the cerceriae remain in the molluscan host and enter the next host only if the infected mollusc is ingested.

When the free swimming cerceriae come in contact with a compatible second intermediate host, usually an arthropod (it could be some other invertebrate or even vertebrate), they actively penetrate the host's body and encyst. The encysted larva is known as **metacerceria**. When the second intermediate host is ingested by the vertebrate definitive hosts, the encysted metacerceria excysts in the host's intestine and gradually matures into the adult. (egg-miracidium-sporocysts- redia - cerceriae- metacerceriae - adult.).

*Morphological types of Digenetic Trematodes (Cheng, 1973):*

Mature adult digenetic trematodes are of six morphological types:

Sexually adult digenetic trematodes can be separated into following morphological types:

1. Distome: Both the anteriorly situated oral sucker and the acetabulum are present. The mouth is located in the centre of the oral sucker and the intestinal caeca usually are forked.
2. Amphistome: Acetabulum is located at the posterior terminal of the body and referred to as the posterior sucker. The ovary is located posterior to the testes.
3. Monostome: Only one sucker, the anteriorly located oral sucker is present.
4. Gasterostome: In this type the mouth is located in the middle of the ventral sucker, thus in this case the ventral sucker is the oral sucker,
5. Holostome: It is characterized by its peculiar body shape. The elongate body is divided into forebody and hindbody. The ventrally concave forebody bears the anterior sucker and the acetabulum.
6. Echinostome: It is a specialized distome with position of suckers as in distome, but a large collar of spines surrounds the oral sucker.

*Generalized Life cycle pattern of Cestodes (Tapeworms):*

*Adult Tapeworms:* Adult worms are found in the small intestine; these infections are usually well tolerated or asymptomatic, but may cause abdominal distress, dyspepsia, anorexia (or increased appetite), nausea, localized pain, and diarrhea.

*Larval Tapeworms:* Larvae locate in extra-intestinal tissues and produce systemic infections with clinical effects related to the size, number, and location of cysts. *Taenia solium* cysticercosis (infection with the cysticercus larval stage) is often asymptomatic and chronic; neurocysticercosis, ophthalmic cysticercosis, and subcutaneous and muscular cysticercosis are, however, frequently reported. *Echinococcus granulosus* hydatid larvae may form massive cysts in liver, lungs, and other organs, including long bones and the central nervous system.

Adults, which mature sexually in the definitive or final host, are ribbon-shaped, multisegmented, hermaphroditic flatworms; each segment has a complete male and female reproductive system. An anterior holdfast organ (the scolex) is followed by a germinative portion ("neck") and segments at successively later stages of development. Larvae encyst in various tissues of the intermediate host; larval cysts contain one or many scoleces of future adult worms.

The tapeworm's life cycle involves a definitive and one or more intermediate hosts (except for the one-host cycle of *Hymenolepis nana*). Each type of cycle has specialized larval forms (cysticercus, cysticercoid; coenurus, hydatid; coracidium, proceroid, plerocercoid).

*Morphological types of Cestodes (Cheng, 1973):*

Unfortunately, the complete representative developmental patterns of all cestode orders are yet not known. The patterns for five major orders are as below:

1. Trypanorhynch Life Cycle Pattern is again not completely known.

Eggs discharged by the adult tapeworms are passed in to seawater and a ciliated larva, coracidium is hatched from each egg. The coracidia are ingested by the copepod, the larval stage with the haemocoel of the copepod is the proceroid. It is a tailless form. Example is *Lacistorhynchus tenuis* an intestinal parasite of sharks.

2. Tetraphyllidean Life Cycle Pattern: Still not completely worked out.

It is reported in *Acanthobothrium coronatum* a parasite of the Elasmobranchs, developing proceroids occur in small crustaceans and the next larval stage, plerocercoids occur in sardines. When the latter are fed to sharks, adult cestode develop from them.

3. Proteocephalan Life Cycle Pattern:

Eggs containing larva known as onchospheres leave the host in feces. Generally these eggs are ingested by a copepod, in which the onchosphere escape and actively penetrate the gut wall, reaching the host's haemocoel and develop in to proceroid larva. When the intermediate host is ingested by a definitive host, the proceroid invade tissues of liver, muscles and intestine and develop into plerocercoid larva with invaginated scolices. These larvae migrate back into the lumen of the gut and metamorphosis in to adults.

*Generalized Life cycle pattern of Nematodes:*

There is diversity within the life cycles of different nematodes; however, all nematodes follow the same basic pattern of growth and reproduction. The nematode life cycle has seven stages, including an egg, four larval stages and two adult stages. Sexual reproduction is generally initiated by adult female nematodes that have attached themselves to a host organism. The female lays eggs that are passed by the host to the external environment where the eggs then pass through three developmental stages before becoming larvae.

Most nematodes have simple life cycles and undergo three main stages of development: egg, juvenile (immature stages of nematodes are called juveniles to avoid confusion with larval stages of insects) and adult. No morphological types of nematodes are recorded.

## MATERIALS AND METHODS

*Study Area:* Dehradun is one of the oldest cities of state Uttarakhand, situated in the foothills of the Great Himalayas. This is one of the 13 administrative districts of the state. The district is surrounded by the Himalayan Mountains in the north, Shivalik Hills in the south, the river Ganga in the east, and the river Yamuna in the west. The two pristine rivers Ganga and Yamuna pass through the district. Dehradun has many water bodies in the form of rivers, river streams and water canals which form wetland habitats.

### Some Facts & Figures of district Dehradun

Area	3088.00 sq. kms
Latitude	30.19° N
Longitude	78.04° E
Average Rainfall	2073.3 mm
Forest Land	2200.56 sq. km.
No. of Tehsils	4
No. of Villages	764

#### *Collection of host & parasites:*

The hosts collected were mainly anuran amphibians, fishes, few reptiles and house rats, which were brought live to the lab., fixed in 10% formalin and examined for helminths. The body cavity was opened by a longitudinal lateral incision and the gastrointestinal tract was removed. The esophagus, stomach, small intestine, large intestine and rectum of each host were examined, separately for helminths. The nematodes collected from the large intestine were fixed in formalin, dehydrated in glycerin alcohol and permanent wax sealed slides were prepared in dehydrated glycerin. Nematodes were studied and photomicrographed on BX51 DIC/BF Olympus research microscope with DP20 digital camera.

#### *Fixation:*

##### (a) Trematodes & Cestodes

Alcohol Formaldehyde Acetic acid (AFA)

95% Ethyl alcohol = 50 parts

Glacial acetic acid = 2 parts

Formaldehyde = 10 parts

Distilled water = 40 parts

##### (b) Nematodes

Formaldehyde = 8 ml

Acetic acid = 2 ml

Distilled water = 90 ml

*Permanent slide preparations:**(a) Trematodes & Cestodes**i. Staining: Semichon's carmine*

One volume of glacial acetic acid is mixed with an equal amount of distilled water in a flask. Carmine powder is added in excess of which it dissolves immediately and heated to 95-100°C for 15 minutes cooled and filtered. The filtrate is diluted with at least an equal amount of 70% alcohol. Helminths were kept in stain overnight. Next day they were treated with acid alcohol for destaining and basic alcohol for neutralizing the process.

*ii. Dehydration:* Helminths were passed through graded alcohol series from 70% ethanol-absolute ethanol for dehydration.

*iii. Clearing:* specimens were cleared in clove oil.

*iv. Mounting:* stained helminths were mounted in D.P.X. mountant.

*(c) Nematodes:*

The nematodes collected from the large intestine, lungs and rectum were fixed in formalin, dehydrated in glycerin alcohol and permanent wax sealed slides were prepared in dehydrated glycerin.

**SYSYTEMATIC LIST OF HELMINTHS**

Phylum NEMATODA

Class SECERNENTEA

Order SPIRURIDA

Superfamily SPIRUROIDEA

Family SPIRUROIDEA

Subfamily SPIRURINAE

Genus *Spirocerca* Railliet & Henry, 1911

- 1.
- Spirocerca lupi*
- (Rudolphi, 1809) Chitwood, 1933

Subfamily ASCARPOSINAE

Genus *Cylicospirura* Baylis, 1934

- 2.
- Cylicospirura felineus*
- (Chandler, 1925) Sandground, 1933

Superfamily DILOTRIAENOIDEA

Family DILOTRIAENIDAE

Subfamily DILOTRIAENINAE

Genus *Diplotriaena* Railliet & Henry, 1909

- 3.
- Diplotriaena doonensis*
- Soota & Chaturvedi, 1975

Subfamily DICHEILONEMATINAE

Genus *Hamatospiculum* Skrjabin, 1916

- 4.
- Hamatospiculum dubium*
- Soota & Chaturvedi, 1975

Suborder CAMALLANINA

Superfamily CAMALLANOIDEA

Family CAMALLANIDAE Railliet &amp; Henry, 1917

Subfamily CAMALLANINAE Railliet &amp; Henry, 1915

Genus *Camallanus* Railliet & Henry, 1915

- 5.
- Camallanus ranae*
- Khera, 1956

- 6.
- Camallanus tigrinis*
- Johnson, 1969

- 7.
- Camallanus alatae*
- Nama & Jain, 1974

Genus *Procamallanus* Baylis, 1923

- 8.
- Procamallanus*
- sp.

Order STRONGYLIDA

Superfamily TRICHOSTRONGYLOIDEA

Family MOLINEIDAE (Skrjabin &amp; Schulz, 1937)

Subfamily MOLINEINAE (Skrjabin &amp; Schulz, 1937)

Genus *Oswaldocruzia* Travassos, 1917

9. *Oswaldocruzia melanosticti* Gupta, 1960

Order RHABDITIDA

Superfamily RHABDITOIDEA

Family RHABDIASIDAE Railliet, 1915

Genus *Rhabdias* Stiles & Hassall, 190510. *Rhabdias bufonis* Schrank, 178811. *Rhabdias ranae* Walton, 192912. *Rhabdias himalayanus* Rizvi, Bursey & Bhutia, 201313. *Rhabdias dehradunensis* Rizvi, Bursey & Bhutia, 2013

Family STRONGYLOIDIDAE

Genus *Strongyloides* Grassi, 187914. *Strongyloides bufonis* Rao & Singh, 1968

Order ASCARIDIDA

Superfamily COSMOCERCOIDEA

Family COSMOCERCIDAE

Genus *Oxysomatium* Railliet & Henry, 191615. *Oxysomatium macintoshii* (Stewart, 1914) Karve, 192716. *Oxysomatium anurae* Biswas & Chakravarty, 1963Genus *Aplectana* Railliet & Henry, 191617. *Aplectana asiatica* Gupta, 1960Genus *Cosmocercoides* Wilkie, 193018. *Cosmocercoides multipapillata* Khera, 195819. *Cosmocercoides nainitalensis* Arya, 1979Genus *Cosmocerca* Diesing, 186120. *Cosmocerca parva* Travassos, 1925

Family TOXOCARIDAE

Genus *Toxocara* Stiles, 190521. *Toxocara cati* (Schranck, 1788) Brumpt, 1927.

Subfamily: ASCARIDINAE

Genus *Ascaridia* Dujardin, 184422. *Ascaridia columbae* (Gmelin, 1790) Travassos, 1913

Superfamily SUBULUROIDEA

Family SUBULURIDAE

Subfamily SUBULURINAE

Genus *Subulura* Molin, 1860

23. *Subulura* sp.

Genus ***Oxynema***

24. *Oxynema alata* (Mazhar, 1933) Inglis, 1955

Superfamily SEURATOIDEA

Family QUIMPERIIDAE

Genus ***Gendria*** Baylis, 1930

25. *Gendria chauhani* Nama, 1975

Genus ***Subulascaris*** Freitas & Dobbin, 1957

26. *Subulascaris cyanophlyctis* Deshmukh, 1968

Order OXYURIDA

Superfamily OXYUROIDEA

Family OXYURIDAE

Genus ***Dermatoxys*** Schneider, 1866

27. *Dermatoxys ruficaudata* Mirza, 1936

Order ENOPLIDA

Superfamily TRICHUROIDEA

Family TRICHURIDAE

Subfamily TRICHURINAE

Genus ***Trichurus*** Roederer, 1761

28. *Trichurus leporis* (Froelich, 1789) Hall, 1916

Phylum PLAYTHELMINTHES

Class TREMATODA

Order DIGENEA

Family LECITHODENDRIIDAE

Subfamily GANEONIAE

Genus ***Ganeo*** Klein, 1905

29. *Ganeo tigrinum* Mehra & Negi, 1928

Subfamily PLEUROGENETINAE

Genus ***Pleurogenoides*** Travassos, 1921

30. *Pleurogenoides gastroporus* (Luhe, 1901) Travassos, 1921

Subfamily PROSTHODENDRIINAE

Genus ***Prosthodendrium*** Dollfus, 1931

31. *Prosthodendrium longiforme* (Bhalerao, 1926) Dubois, 1931

Family PARAMPHISTOMIDAE

Subfamily DIPLODISCINAE

Genus ***Diplodiscus*** Cohn, 1904

32. *Diplodiscus mehrai* Pande, 1937

33. *Diplodiscus amphichrus* Tubangui, 1933

Subfamily GASTROTHYLACINAE

Genus *Fischoederius* Stiles et Goldberger, 1910

34. *Fischoederius cobboldi* (Poirier, 1833) Stiles et Goldberger, 1910

Subfamily PLAGIORCHINAE

Genus *Plagiorchis* Luhe, 1899

35. *Plagiorchis koreanus* Ogata, 1938.

Family BRACHYCOELIIDAE

Subfamily MESOCOELINAE

Genus *Mesocoelium* Odhner, 1910

36. *Mesocoelium monas* (Rudolphi, 1819) Freitas, 1958

Family ANCHITREMATIDAE

Genus *Anchitrema* Looss, 1899.

37. *Anchitrema sanguineum* (Sonsino, 1894) Looss, 1899

Family PLAGIORCHIIDAE

Subfamily ASTRIOTREMATINAE

Genus *Spinometra* Mehra, 1931

38. *Spinometra dehradunensis* Chakrabarti & Ghosh, 2009.

Family OPECOELIDAE

Genus *Dactylostomum* Woolcock, 1935

39. *Dactylostomum gayaprashadi* Tripathi & Jauhari, 1991.

Family BATRACHOTREMATIDAE

Genus *Batrachotrema* Dollfus et Williams, 1966

40. *Batrachotrema korbaensis* Rizvi, Bursey & Bhutia, 2012

Genus *Opisthioparorchis* Wang, 1980

41. *Opisthioparorchis nanoranae* Rizvi, Bursey & Bhutia, 2012

42. *Opisthioparorchis dehradunensis* Rizvi, Bursey & Bhutia, 2012

Subclass MONOGENEA

Family MICROCOTYLIDAE

Genus *Yogendrotrema*

43. *Yogendrotrema garhwalensis* Juwantha, 2009.

Family DIPLECTANIDAE

Genus *Lobotrema* Tripathi, 1959

44. *Lobotrema rajendrai* Srivastava & Kumar 1983

Class CESTODA

Order PROTOCEPHALIDEA

Family PROTEOCEPHALIDAE

Subfamily PROTEOCEPHALINAE

Genus *Proteocephalus* Weinland, 1853

45. *Proteocephalus tigrinus* Woodland, 1925

#### SYSTEMATIC ACCOUNT

Phylum NEMATODA

Class SECERNENTEA

Order SPIRURIDA

Superfamily SPIRUROIDEA

Family SPIRUROIDEA

Subfamily SPIRURINAE

Genus *Spirocerca* Railliet & Henry, 1911

1. *Spirocerca lupi* (Rudolphi, 1809) Chitwood, 1933

1809. Rudolphi, K. A. *Entozoorum, sive vermium intestinalium historia naturalis.*, **1**: 1-457.

*Material Examined*: Nil

*Remarks*: Reported by Soota & Tripathi (1975) from the esophagus of Jackal (*Canis aureas*) from Dehradun.

Family SPIRUROIDEA

Subfamily ASCARPOSINAE

Genus *Cylicospirura*

*Cylicospirura* Baylis, 1934

2. *Cylicospirura felineus* (Chandler, 1925) Sandground, 1933

*Material Examined*: Nil

*Remarks*: Reported by Soota & Tripathi (1975) from the stomach of the Jungle Cat (*Felis chaus*) from Rishikesh, Dehradun district.

Superfamily DIPLOTRIAENOIDEA

Family DIPLOTRIAENIDAE

Subfamily DIPLOTRIAENINAE

Genus *Diplotriaena* Railliet & Henry, 1909

**3. *Diplotriaena doonensis* Soota & Tripathi, 1975**

1975. *Diplotriaena doonensis* Soota & Tripathi, *Proc. zool. Soc. Cal.*, **28**: 103.

*Material Examined*: Nil

*Remarks*: This species was described by Soota & Tripathi (1975) from the coelomic cavity of Red billed Blue Magpie (*Cissa erythrorhyncha*) from Mussourie, district Dehradun.

Subfamily DICHEILONEMATINAE

Genus *Hamatospiculum* Skrjabin, 1916

**4. *Hamatospiculum dubium* Soota & Tripathi, 1975**

1975. *Hamatospiculum dubium* Soota & Tripathi, *Proc. zool. Soc. Cal.*, **28**: 105.

*Material Examined*: Nil

*Remarks*: This species was described by Soota & Tripathi (1975) from the coelomic cavity of Kingfisher (*Halcyon smyrnensis*) from Sahastradhara, district Dehradun.

Suborder CAMALLANATA

Superfamily CAMALLANOIDEA

Family CAMALLANIDAE

Subfamily CAMALLANINAE

Genus *Camallanus* Railliet & Henry, 1915

**5. *Camallanus ranae* Khera, 1956**

1954. *Camallanus ranae* Khera, *Indian J. Helminthol.*, **6**: 27.

*Material examined*: Kalsi, Dehradun, 22.xi.07, 2 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV 797.

*Description*: Female: Medium sized slender worms, 12.5-15.5mm long and 0.39- 0.45 mm wide blunt at both ends. Red and wire-like when living. Cuticle thin and finely striated. Mouth surrounded by six papillae, two laterals and four sub-medians. The buccal capsule 0.13-0.15 mm long and 0.17-0.18 mm wide, formed by two buccal valves, . The buccal valves strongly chitinized with 10 ridges on each side and with a small chitinized tooth-like projection between two longitudinal ridges. Buccal capsule separated from the esophagus by a small chitinous ring and a chitinous cavity. Well-developed trident present. Esophagus divisible in to anterior club-shaped muscular part 0.68-0.73 mm and posterior cylindrical glandular part, 0.57-0.61 mm long. Prominent esophago-intestinal valves present at the junction of esophagus and intestine. Intestine leads in to a very short rectum opening directly to the exterior at the anus. Vulva, pre-equatorial with oval slit-like vulval lips and 5.1-5.9 mm from anterior end. Muscular vagina runs posteriorly giving rise to two opposed uterine tubes. Tail, 0.10-0.12 mm, short and slightly bifid at the tip.

Male: Smaller in size than female and similar in general morphology. Length, 6.95-7.2 mm and width 0.27-0.3 mm. Tail, 0.13-0.14 mm long, bifid with a broad caudal alae. Caudal papillae 14 pairs, seven pairs pre-cloacal, two pairs cloacal and five pairs post-cloacal in position. The five pre-cloacal pairs are located at regular intervals and the last two pairs are close together near the cloaca. All the pre-cloacal papillae have knob-like terminal end. The two cloacal pairs are small and pedunculated. Of the five post-cloacal papillae, anterior three pairs are pedunculated and close together, fourth pair is isolated and pedunculated and the posterior most pair is isolated but sessile. All the caudal papillae are ventro-lateral except the cloacal pairs, which are lateral. Spicules two, right spicule alate, longer and stouter, measure 0.445 mm in length then the left spicule, which measures 0.31-0.33 mm in length. The distal tip of the spicule is simple.

*Distribution:* India: Uttar Pradesh, Haryana and Uttarakhand.

*Remarks :* The nematodes resemble the original description by Khera (1956) except for the worms being smaller in size and may be because the female worm was non-gravid (L = 23-24 mm). Buccal capsule longer in both male and female specimens (male = 0.094 mm and female = 0.125 mm). This species is being recorded for the first time from Dehradun.

### 6. *Camallanus tigrinis* Johnson, 1969

1969. *Camallanus tigrinis* Johnson, *Proc. Zool. Soc. Calcutta.*, **22**: 63.

*Material examined:* Asan river, Badonwala, Dehradun, 10.iv.08, 4 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV 798; Asan river, Badonwala, Dehradun, 23.xii.08, 3 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No ZSI/NRC/IV 799; Asan river, Badonwala, Dehradun, 28.i.09, 4 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV 800.

*Description:* Female: Medium sized worms, 15-17 mm long and 0.25-0.30 mm wide. Buccal capsule valves 7.5-11.5 mm long and 0.14-0.15 mm wide. Chitinous ring 0.085 mm in diameter. Left prong of trident 0.048, middle 0.025 and right 0.045 mm. Club-shaped muscular esophagus 0.65-0.71 mm and glandular esophagus 0.38-0.4 mm. Nerve ring at 0.24-0.25 mm from anterior end. Vulva pre-equatorial at 5.2 mm from anterior end. Uterine branches posteriorly.

Male: Body 7.5-8.5 mm, 0.17-0.19 mm wide. Buccal capsule valves 0.12-0.13 mm. Chitinous ring 0.07 mm in diameter. Tridents well developed, left prong of trident 0.055 middle 0.048 and right 0.052 mm. Club-shaped muscular esophagus 0.47-0.49 mm and glandular esophagus 0.33-0.38 mm. Nerve ring at 0.17-0.18 mm from anterior end. Caudal papillae 7+1+5=13 pairs. Caudal alae well developed. Single spicule, 0.39-0.41 mm. Accessory piece absent. A sucker like organ at 0.62-0.64 mm from posterior end. Tail short and bipid.

*Distribution:* India: Rajasthan Haryana and Uttarakhand.

*Remarks:* All the measurements are in conformity with the original work except for females being smaller in body size (female 18-20 mm long and 0.3-0.4 mm wide in original description). This species is being recorded for the first time from Dehradun.

### 7. *Camallanus alatae* Nama & Jain, 1974

1974. *Camallanus alatae* Nama & Jain, *J. Zool. Soc. India*, **26**: 19.

*Material examined:* Dandi village on Rishikesh road, Dehradun, 26.xi.08, 2 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV.801; Dandi village on Rishikesh road, Dehradun, 15.x.09, 2 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV. 802; Kalsi, Dehradun, 8.iii.11, 2 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV. 803.

*Description:* Female: Body 13.8-14.2 mm long and 0.31-0.34 mm wide. Head 0.20 in diameter. Buccal valves with 12 longitudinal ridges. Chitinous ring 0.12 mm in diameter. Tridents well developed, lateral prong of trident 0.05-0.06. Muscular esophagus 0.88-0.94 mm and glandular esophagus 0.49-0.65 mm. Nerve ring at 0.25-0.26 mm from anterior end. Vulva pre-equatorial at 6.55-6.75 mm from anterior end.

Male: Body medium sized, 5.8-8.5 mm, 0.22-0.29 mm wide. Head 0.12-0.16 mm in diameter. Buccal capsule valves 0.11-0.12 mm. Chitinous ring 0.03 mm in diameter. Tridents well developed, left prong of trident 0.055-0.058 mm. Club-shaped muscular esophagus 0.55-0.68 mm and glandular esophagus 0.25-0.48 mm. Nerve ring at 0.18-0.19 mm from anterior end. Caudal papillae 6+2+4= 12 pairs, one additional pair of sessile and isolated papillae also present. Caudal alae well developed. Single spicule, 0.41-0.58 mm. Accessory piece absent. A sucker like organ at 0.62-0.69 mm from posterior end.

*Distribution:* India: Rajasthan, Haryana and Uttarakhand.

*Remarks:* This species is being recorded for the first time from Dehradun.

Genus *Procamallanus* Baylis, 1923

### 8. *Procamallanus* sp.

*Material examined:* Asan river, Badonwala, Dehradun, 28.i.09, 4 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV. 804.

*Description:* Female: medium-sized worms with tapering anterior and posterior ends. Body 4.1- 5.2 mm long, 0.12-0.13 mm wide. Cuticle thick with fine transverse striations. Head dorsally bent and provide with a small dorsal cuticular tooth. Buccal capsule prominent 0.02-0.025 mm x 0.015 mm wide. Esophagus 0.385-0.40 mm. Vulva post-equatorial at 2.9 -3.3 mm from anterior end. Tail 0.150-0.20 mm tapering posteriorly.

*Remarks:* Worms could not be assigned to species level because only three female specimens were collected.

## Superfamily TRICHOSTRONGYLOIDEA

## Family MOLINEIDAE

## Subfamily MOLINEINAE

Genus *Oswaldocruzia* Travassos, 1917**9. *Oswaldocruzia melanosticti* Gupta, 1960**1960. *Oswaldocruzia melanosticti* Gupta, *Canadian J. Zool.*, **38**:745.

*Material examined*: Talai village, Thanu range, Dehradun, 14.x.10, 3 exs., from the intestine of *Hoplobatrachus tigrinus*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV. 805; Asan river, Badonwala, Dehradun, 23.xii.08, 2 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV. 806.

*Description*: Slender worms with tapering anterior and posterior ends. Head with a distinct cuticular inflation with transverse striations. Body marked by numerous cuticular ridges. Lips absent. Esophagus claviform. Cervical papillae absent.

Female: Body 7.5-10.4 mm long and 0.21-0.22 mm wide. Head inflation 0.03-0.04 mm long. Esophagus 0.44-0.47 mm long. Nerve ring at 0.16-0.21 mm from anterior end. Vulva pre-equatorial, situated at 2.6-4.2 mm from anterior end. Eggs 0.055-0.075 long and 0.05-0.06 mm wide. Tail including spike 0.17-0.19 mm.

Male: Body 6.5 -7.5 mm long and 0.13- 0.14mm wide. Anterior portion of cephalic inflation 0.03-0.04 mm long and posterior portion 0.06-0.07 mm long. Esophagus 0.43-0.47 mm long. Nerve ring at 0.15-0.19 mm from anterior end. Bursal rays characteristic of genus. Spicule equal , 0.16-0.19 mm long, terminal portions dividing into three terminal spike-like processes curved into hook-like structures.

*Distribution*: India: Uttarakhand.

*Elsewhere*: Bangladesh.

*Remarks*: This species is being recorded for the first time from India.

## Order RHABDITIDA

## Superfamily RHABDITOIDEA

## Family RHABDIASIDAE

Genus *Rhabdias* Stiles & Hassall, 1905**10. *Rhabdias bufonis* Schrank, 1788**1788. *Rhabdias bufonis* Schrank, *Munchen*, 25.

*Material examined*: Asan river, Badonwala, Dehradun, 29.v.08, 2 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV. 807; Talai village, Thanu range, Dehradun, 14.x.10, 3exs., from the intestine of *Hoplobatrachus tigrinus*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV. 808; Jagatpuri village, Thanu range, Dehradun, 12.x.10,

3exs., from the intestine of *Hoplobatrachus tigrinus*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV. 809.

*Description:* Head truncated, broader than posterior end. Three inconspicuous lips. Cuticle thin, loose with many folds and ridges both anteriorly and posteriorly. Mature worms 3.5-9.7 mm long, and 0.25-0.43mm wide. Buccal cavity, 0.022-0.026 mm deep. Esophagus 0.48-0.52 mm, slightly swollen in middle and club-shaped at basal end. Vulva post-equatorial. Two divergent uteri filled with embryonated eggs. Eggs, 0.08-0.1 mm x 0.05-0.06 mm. Tail pointed, sharply pointed behind anus.

*Distribution:* India: Jammu & Kashmir, Haryana and Uttarakhand.

*Elsewhere:* Germany.

*Remarks:* This species is being recorded for the first time from Uttarakhand.

### 11. *Rhabdias ranae* Walton, 1929

1929. *Rhabdias ranae* Walton, *J. Parasitol.*, **15**: 227.

*Material examined:* Guchchupani, Dehradun, 29.v.08, 1 ex., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV. 810; Nun river, Santladevi, Dehradun, 17.xi.09, 2 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV. 811; Lachchiwala, Dehradun, 24.ii.11, 1 ex., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV. 812.

*Description:* Head truncated, broader than posterior end. Mouth surrounded by six lips. Buccal cavity short with club-shaped swelling posteriorly. Cuticle thin, loose with many folds and ridges both anteriorly and posteriorly.

Mature worms 4.8-6.5 mm long and 0.25-0.35 mm wide. Esophagus 0.31-0.35 mm. Nerve ring at 0.158-0.182 mm from anterior end. One pair of cervical glands open near the posterior end of esophagus and extend along the entire intestine. Vulva post-equatorial at 1.9-2.8 mm from posterior end. Eggs elliptical and embryonated 0.090-0.100 x 0.055-0.06mm. Tail conical, 0.18-0.32 mm.

*Distribution:* India: Uttarakhand.

*Elsewhere:* Bangladesh.

*Remarks:* This species is being recorded for the first time from India.

### 12. *Rhabdias himalayanus* Rizvi, Bursey & Bhutia, 2013

2013. *Rhabdias himalayanus* Rizvi, Bursey & Bhutia, *J. Parasitol.*, **99**: 303-306.

*Material examined:* Branskhanda, Dehradun, 11.v.11, 35 exs., from the lungs of *Duttaphrynus himalayanus*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV.962-63.

*Description:* Measurements based on 35 gravid individuals; Anterior end truncated, posterior end tapered. Body length of parthenogenetic female  $11.2 \pm 8.5$  mm (8.8-13.7 mm), maximum

body width  $0.34 \pm 5$  (0.30-0.37 mm). Outer layer of cuticle inflated; cuticle inflation broader at the anterior end from head up to esophagus, near the vulva and at the tail region; fine longitudinal striations 2-3 apart. Oval oral opening, devoid of lips. Buccal capsule well developed, circular in optical cross-section,  $0.022 \pm 2$  (0.020-0.025 mm) in diameter; cup-shaped in lateral view,  $0.015 \pm 1$  (0.014-0.016 mm) deep. Clavicular esophagus  $0.59 \pm 2$  (0.57-0.61 mm) in length, maximum width  $0.070 \pm 3$  (0.063-0.075 mm) at posterior end, corporeal inflation absent. Nerve ring  $0.23 \pm 5$  (0.22-0.25 mm) and excretory pore  $0.39 \pm 4$  (0.39-0.40 mm) from anterior end. Width of intestine at esophageal-intestinal junctions  $0.09 \pm 2$  (0.085-0.095 mm). Intestine filled with thick black content. Vulva postequatorial,  $5.7 \pm 7.5$  mm (5.2-6.3 mm) from anterior end; non-salient lips although cuticle surrounding vulva greatly inflated. Amphidelphic, ovaries straight, lying along intestine. Uteri wide, thin-walled, filled with numerous eggs, egg shell thin, smooth, larvated eggs near vagina,  $0.081 \pm 5$  (0.075-0.088 mm) long,  $0.046 \pm 5$  (0.042-0.058 mm) wide. Tail a broad cone tapering to a fine tip,  $0.27 \pm 5$  (0.25-0.30 mm).

*Distribution:* India: Uttarakhand.

*Remarks:* *Rhabdias himalayanus* represents 80<sup>th</sup> species assigned to the genus and the 10<sup>th</sup> from the Oriental realm. This species was described from Dehradun as new to science by Rizvi, Bursey & Bhutia (2013).

### 13. *Rhabdias dehradunensis* Rizvi, Bursey & Bhutia, 2013

2013. *Rhabdias dehradunensis* Rizvi, Bursey & Bhutia, *J. Parasitol.*, **99**: 303-306.

*Material examined:* Doobda, Dehradun, 13.10.11, 3 exs., from the lungs of *Nanorana minica*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV.964-65.

*Descriptions:* Measurements based on three gravid individuals. Body length of parthenogenetic female 7.60 mm (7.0-8.2 mm), maximum body width 0.30 (0.30-0.31 mm). Anterior end truncated and posterior end terminating in bulbar swelling 0.99 (0.95-0.102 mm) long and 0.59 (0.55-0.65 mm) wide. Outer layer of cuticle inflated; fine longitudinal striations 2-3 apart. Oral opening devoid of lips. Buccal capsule cup-shaped, 0.019 (0.018-0.021 mm) in diameter; 0.015 (0.014-0.016 mm) deep. Clavicular esophagus 0.63 (0.61- 0.66 mm) in length, maximum width 0.072 (0.070-0.075 mm) at posterior end, corporal inflation absent. Nerve ring 0.203 (0.20-0.21 mm) and excretory pore 0.24 (0.22-0.25 mm) from anterior end. Width of intestine at esophageal-intestinal junction 0.107 (0.10-0.11 mm). Intestine filled with thick black content, which accumulates at posterior end, resulting in swollen posterior. Swelling is age related a small enlargement in the posterior intestine of young females and a significant enlargement in older females. Vulva post-equatorial, 3.9 (3.7- 4.3 mm) from anterior end and with non-salient lips. Amphidelphic, ovaries straight, lying along intestine. Uteri wide, thin walled, filled with numerous larvated eggs, egg shell thin, smooth, larvated eggs near vagina, 0.099 (0.092-0.10 mm) long, 0.045 (0.042-0.050 mm) wide. Tail conical 0.17 (0.17 – 0.180 mm, terminating in a small pointed tip; anus, a slit like opening.

*Distribution:* India: Uttarakhand.

*Remarks:* *Rhabdias dehradunensis* represents 81<sup>st</sup> species assigned to the genus and the 11<sup>th</sup> from the Oriental realm. This species was described from Dehradun as new to science by Rizvi, Bursey & Bhutia (2013).

Family STRONGYLOIDIDAE  
Genus *Strongyloides* Grassi, 1879  
**14. *Strongyloides bufonis* Rao & Singh, 1968**

1968. *Strongyloides bufonis* Rao & Singh, *Papeis avulses Departamento Zoologia Secretaria agric. Sao Paulo*, **21**: 111.

*Material examined:* Maldevta, Dehradun, 12.vi.08, 2 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV. 813. Asan river, Badonwala, Dehradun, 29.v.08, 2 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV. 807.

*Description:* Head truncated, broader than posterior end. Three inconspicuous lips. Cuticle thin, loose with many folds and ridges both anteriorly and posteriorly. Mature worms 3.5-9.7 mm long, and 0.25-0.43 mm wide. Buccal cavity, 0.022-0.026 mm deep. Esophagus 0.48-0.52 mm, slightly swollen in middle and club-shaped at basal end. Vulva post-equatorial. Two divergent uteri filled with embryonated eggs. Eggs, 0.08-0.1 mm x 0.05-0.06 mm. Tail sharply pointed behind the anus.

*Distribution:* India: Uttarakhand.

*Remarks:* This species is being recorded for the first time from Uttarakhand.

Order ASCARIDIDA  
Superfamily COSMOCERCOIDEA  
Family COSMOCERCIDAE  
Genus *Oxysomatium* Railliet & Henry, 1916  
**15. *Oxysomatium macintoshii* (Stewart, 1914) Karve, 1927**

1914. *Oxysoma macintoshii* Stewart, *Rec. Indian Museum*, **10**: 165.

1927. *Oxysomatium macintoshii* Karve, *Ann. Mag. Nat. Hist.*, **20**: 620.

*Material examined:* Asan river, Badonwala, Dehradun, 11.ix.07, 8 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV. 814.

*Description:* Body cylindrical, attenuated at both ends. Cuticle finely striated transversely. Head with three inconspicuous lips. Lips thickened at edges, slightly bent towards oral cavity. Three chitinized teeth at base of shallow oral cavity. Pharynx separated from esophagus by a transverse diaphragm.

Female: Body 2.8-4.5 mm long, 0.11-0.23 mm wide. Esophagus 0.32-0.45 mm long. Nerve ring at 0.18-0.24 mm and excretory pore at 0.22-0.38 mm from anterior end. Vulva almost equatorial at 1.6 -2.7 mm from anterior end. Uterine branches opposed, Viviparous. Tail 0.2-0.325 mm long.

Male: Body 1.8-2.2 mm long, 0.98-0.18 mm wide. Lateral alae present. Pharynx 0.25-0.31 mm long. Nerve ring at 0.18-0.21 mm and excretory pore at 0.24-0.3 mm from anterior end. Caudal papillae 9+0+18= 27 pairs. Spicules equal, 0.18 mm. Accessory piece 0.018-0.02 mm. Tail, 0.18-0.22 mm and curved ventrally.

*Distribution:* India: Uttar Pradesh, Jammu & Kashmir, West Bengal, Haryana and Uttarakhand.

*Remarks:* This species is being recorded for the first time from Uttarakhand.

### 16. *Oxysomatium anurae* Biswas & Chakravarty, 1963

1963. *Oxysomatium anurae* Biswas & Chakravarty, *Zeit. Parasitenk.*, **23**: 411.

*Material examined:* Raipur, Dehradun, 29.vii.08, 4 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV.815; NRC/ZSI campus, Dehradun, 24.vii.08, 2 exs., from the intestine of *Duttaphrynus melanostictus*, coll. A. N. Rizvi, Reg. No ZSI/NRC/IV.816.

*Description:* Small worms with faintly striated cuticle. Esophageal bulb globular.

Female: Body 3.5-4.5 mm long, 0.28-0.32 mm wide. Esophagus 0.42-0.49 mm long. Nerve ring at 0.17-0.19 mm from anterior end. Vulva almost equatorial at 1.8-2.5 mm from anterior end. eggs rounded, membranous, 0.04-0.06x 0.04-0.06 mm. Tail filamentous, 0.4-0.48 mm.

*Distribution:* India: Kolkata and Uttarakhand.

*Remarks:* Except for being slightly smaller in size, it is in conformity with the original description. This species is being recorded for the first time from Uttarakhand.

Genus *Aplectana* Railliet & Henry, 1916

### 17. *Aplectana asiatica* Gupta, 1960

1960. *Aplectana asiatica* Gupta, *Canadian J. Zool.*, **38**: 315.

*Material examined:* Talai village, Thanu range, Dehradun, 14.x.10, 4 exs., from the intestine of *Hoplobatrachus tigrinus*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV.817.

*Description:* Small nematodes tapering at both ends. Mouth with three lips, each bearing two papillae.

Female: Body 3.2-4.8 mm long, 0.26-0.38 mm wide. Esophagus 0.43-0.49 mm long. Nerve ring at 0.14-0.23 mm and excretory pore at 0.32-0.45 mm from anterior end. Vulva pre-equatorial, at 1.29-1.8 mm from anterior end. Tail 0.32-0.43 mm.

Male : Body 1.5-2.2 mm long, 0.18-0.21 mm wide. Esophagus 0.32-0.34 mm long. Nerve ring at 0.16-0.2 mm and excretory pore at 0.33-0.37 mm from anterior end. Caudal papillae 7+1+23=31 pairs. Spicules sub-equal, tubular, 0.24-0.29 mm long. Well developed crescentic accessory piece 0.06-0.08 mm long Tail 0.22-0.25 mm, tapering to a fine point and sharply curves ventrally.

*Distribution:* India: Haryana and Uttarakhand.

*Elsewhere:* Bangladesh.

*Remarks:* All the body measurements are in agreement with the original description by Gupta (1960). This species was recorded for the first time from India from KWLS by Rizvi & Bhutia (2013). It is being recorded from Uttarakhand for the first time.

Genus *Cosmocercoides* Wilkie, 1930

**18. *Cosmocercoides multipapillata* Khera, 1958**

1958. *Cosmocercoides multipapillata* Khera, *Indian J. Helminthol.*, **10**: 6.

*Material examined:* Asan river, Badonwala, Dehradun, 28.i.09, 4 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A.N.Rizvi, Reg. No.ZSI/NRC/IV. 81; NRC/ZSI campus, Dehradun, 24.vii.08, 2 exs., from the intestine of *Duttaphrynus melanostictus*, coll. A. N. Rizvi, Reg. No.ZSI/NRC/IV. 819.

*Description:* Small nematodes with a blunt anterior end and a pointed posterior end. Cuticle finely striated. Lateral alae well developed. Mouth simple, surrounded by three incobspicuous lips. Esophageal-intestinal valve trilobed. Three large, nucleated and glandular rectal glands present. Minute papillae throughout the body in both sexes, dorsally, ventrally and laterally at almost equal intervals.

Female: Body 5.5-6.8 mm long, 0.3-0.4 mm wide. Esophagus 0.68-0.72 mm long. Nerve ring at 0.28-.39 mm and excretory pore at 0.55-0.62 mm from anterior end. Vulva post-equatorial, at 2.6-2.9 mm from anterior end. Tail 0.18-0.21 mm.

Male : Body 3.5-4.5 mm long, 0.28-0.36 mm wide. Esophagus 0.65-0.68 mm long. Nerve ring at 0.27-0.32 mm and excretory pore at 0.42-0.49 mm from anterior end. Caudal papillae comprise two kinds, complex rosette types and simple papillae. Complex rosette types 11-13 preanal pairs including one single papilla. A single complex adanal pair present. Four pairs of complex postanal pair. Single papillae are arranged as five pairs postanal. Caudal alae absent. Spicules, equal, poorly chitinized and ridged, 0.120-0.23 mm long. Accessory piece heavily chitinized 0.12-0.13 mm long Tail 0.23-0.25 mm.

*Distribution:* India: Uttarakhand and Haryana.

*Remarks:* This species is being recorded for the first time from district Dehradun. Previously it was recorded from district Nainital by Khera (1958).

**19. *Cosmocercoides nainitalensis* Arya, 1979**

1979. *Cosmocercoides nainitalensis* Arya, *Rev. Brasileira Biol.*, **39**: 823.

*Material examined:* NRC/ZSI campus, Dehradun, 28.i.07, 5 exs., from the intestine of *Duttaphrynus melanostictus*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV. 820; Salawala, Dehradun, 10.ix.07, 10 exs., from the intestine of *Duttaphrynus melanostictus*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV.821; Talai village, Thanu range, Dehradun, 14.x.10, 8 exs., from the intestine of *Hoplobatrachus tigrinus*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV.822.

*Description:* Small nematodes with attenuated posterior end. Cuticle finely striated. Mouth simple, surrounded by three conspicuous lips, each with two very small papillae. Lateral alae present. Minute papillae throughout the body in both sexes, dorsally, ventrally and laterally at almost equal intervals.

Female: Body 5.8- 6.2 mm long, 0.28-0.33 mm wide. Esophagus 0.72-0.84 mm long. Nerve ring at 0.25-0.34 mm and excretory pore at 0.66-0.75 mm from anterior end. Vulva post-equatorial, at 1.98-2.10 mm from anterior end. Eggs oval, thin-walled and unembryonated, 0.048-0.056 mm Tail 0.20-0.23 mm.

Male: Body 4.2-5.2 mm long, 0.24-0.26 mm wide. Esophagus 0.69-0.72 mm long. Nerve ring at 0.27-0.29 mm and excretory pore at 0.58-0.69 mm from anterior end. Caudal papillae comprise two kinds, complex rosette types and simple papillae. Complex rosette types 13-16 +1+6= 0-23 pairs. Simple papillae 0+ 0 + 7=7 pairs. Spicules, sub-equal, swollen anteriorly, blunt posteriorly. Left spicule, 0.13-0.148 mm and right spicule, 0.122-0.133 mm long. Gubernaculum trifid, stout and heavily chitinized, 0.10-0.12 mm. Tail 0.23-0.25 mm.

*Distribution:* India: Uttarakhand and Haryana.

*Remarks:* This species is being recorded for the first time district Dehradun. Previously it was recorded from district Nainital by Khera (1958).

Genus *Cosmocerca* Diesing, 1861

## 20. *Cosmocerca parva* Travassos, 1925

1925. *Cosmocerca parva* Travassos, *Scientia Medica*, **3**: 673.

*Material examined:* Nun river, Santladevi, Dehradun, 17.xi.09, 2 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A.N.Rizvi, Reg.No. ZSI/NRC/IV.823; Raipur, Dehradun, 29.vii.08, 2 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A.N. Rizvi, Reg.No. ZSI/NRC/IV.824.

*Description:* Slender medium-sized worms attenuated at both ends. Cuticle finely striated. Lateral alae narrow. Mouth surrounded by three small lips, each with two papillae.

Female: Body 4.8-5.7 mm long, 0.32-0.36 mm wide. Esophagus 0.48-0.51 mm long. Nerve ring at 0.14-0.16 mm and excretory pore at 0.5-0.6 mm from anterior end. Vulva almost equatorial, at 0.28.29 mm from anterior end. Eggs oval, thin-walled and unembryonated, 0.075-0.084x0.05-0.062 mm Tail 0.052-0.055 mm.

Male : Body 2.1-2.3 mm long, 0.13-0.14 mm wide. Esophagus 0.32-0.33 mm long. Four rows of somatic papillae, 2 dorsolateral and two ventrolateral in position. Gubernaculum 0.085-0.095 mm. Spicules equal and shorter than gubernaculum, 0.07-0.08 mm. In addition to somatic papillae, 5-7 pairs of plectanes and 4 pairs of adanal papillae present. Tail 0.16-0.65 mm long.

*Distribution:* India: Uttarakhand.

*Elsewhere:* Argentina, South America, Brazil, Paraguay and Peru.

*Remarks:* All the measurements are in agreement with earlier descriptions except for the smaller eggs (eggs = 0.091-0.11x 0.057-0.078 mm ) and slightly longer esophagus in males (esophagus = 0.23-0.28 mm). *Euphlyctis cyanophlyctis* is a new host record for *Cosmocerca parva*. This species is a new record from India.

Family TOXOCARIDAE

Genus *Toxocara* Stiles, 1905

**21. *Toxocara mystax* (Zeder, 1800)**

*Material examined:* Nil

*Remarks:* Reported by Soota & Tripathi (1975) from the Intestine of the Jungle Cat (*Felis chaus*) from Dehradun district.

Subfamily: ASCARIDINAE

Genus *Ascaridia* Dujardin, 1844

**22. *Ascaridia columbae* (Gmelin, 1790) Travassos, 1913**

*Material examined:* Nil

*Remarks:* Reported by Soota & Tripathi (1975) from the intestine of Pigeon (*Columba livia*) from Rishikesh, Dehradun district.

Superfamily SUBULUROIDEA

Family SUBULURIDAE

Subfamily SUBULURINAE

Genus *Subulura* Molin, 1860

**23. *Subulura* sp.**

*Material Examined:* Nil

*Remarks:* This species was reported by Soota & Tripathi (1975) from the intestine of Cattle Egret (*Bubulcus ibis*) from Rishikesh, Dehradun district.

Genus *Oxynema*

**24. *Oxynema alata* (Mazhar, 1933) Inglis, 1955**

*Material Examined:* Nil

*Remarks:* This species was reported by Soota & Tripathi (1975) from the intestine of Fox (*Vulpes vulpes*) from Doiwala, Dehradun district

Superfamily SEURATOIDEA

Family QUIMPERIIDAE

Genus *Gendria* Baylis, 1930

### 25. *Gendria chauhani* Nama, 1975

1975. *Gendria chauhani* Nama, *Indian Biologist*, **7**: 57.

*Material examined*: Guchchupani, Dehradun, 9.xii.10, 3 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV.825.

*Description*: Cuticle finely striated transversely and inflated anteriorly in head region. Narrow lobulated, lateral alae. Mouth a shallow depression with inconspicuous lips. Two pairs of submedian and a single pair of papillae surround the mouth. A large dorsal tooth and two smaller subventral teeth project from anterior end of esophagus. Esophagus club-shaped, muscular forming a large globular swelling anteriorly.

Female: Body 15.8 mm long, 0.27 mm wide. Esophagus 0.47 mm long. Nerve ring at 0.20 mm from anterior end. Vulva post-equatorial at 0.85 mm from anterior end. Eggs unsegmented, 0.032 mm long. Tail 0.15 mm long with a sharp cuticular spine.

Male: Body 9.95 mm long and 0.24 mm wide. Esophagus 0.41 mm long. Nerve ring at 0.2 mm from anterior end. Caudal papillae 7+0+3 = 10 pairs. Caudal alae absent. Precloacal sucker without a chitinous rim, at 0.60 mm from cloaca. Spicules equal, curved, broader proximally, narrower and pointed distally, 0.24 mm long. Tail 0.21 mm long, curved ventrally with pointed conical extremity.

*Distribution*: Rajasthan and Uttarakhand.

*Remarks*: All measurements are in conformity with the original description except for a smaller tail in the present female specimen (tail = 0.20-0.23 mm long). This species is being recorded for the first time from Uttarakhand.

Genus *Subulascaris* Freitas & Dobbin, 1957

### 26. *Subulascaris cyanophlyctis* Deshmukh, 1968

1968. *Subulascaris cyanophlyctis* Deshmukh, *Riv. Parassitol.*, **29**: 29.

*Material examined*: Guchchupani, Dehradun, 29.v.08, 4 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV.826.

*Description*: medium-sized worms, elongated and attenuated posteriorly. Cuticle inflated anteriorly. Mouth surrounded by inconspicuous lips. A pair of teeth in stoma. Cuticle unstriated.

Female: Body 12.2 mm long, 0.17 mm wide. Head, 0.07 mm long, inflated cuticle 0.3 mm x 0.28 mm from anterior end. Esophagus, 0.47 mm long. Nerve ring at 0.26 mm and cervical papillae at 0.28 mm from anterior end. Vulva pre-equatorial, at 5.2 mm from anterior extremity. Eggs spherical, thin-walled, embryonated, 0.04 x 0.04 mm. Tail 0.15 mm long.

Male: Body 7.5 mm long, 0.128 mm wide. Head 0.07 mm, inflated cuticle 0.3 mm x 0.22 mm. Esophagus 0.45 mm. Nerve ring at 0.23 mm and cervical papillae at 0.29 mm from anterior end. Caudal sucker at 0.6 mm from posterior end. Sessile caudal papillae 10+0+6=16 pairs. Spicules equal, chitinized, club-shaped anteriorly and blunt posteriorly, 0.24 mm long. Tail 0.17 mm long.

*Distribution:* Maharashtra and Uttarakhand.

*Remarks:* This species is being recorded for the first time from district Dehradun.

Order OXYURIDA  
Superfamily OXYUROIDEA  
Family OXYURIDAE  
Genus *Dermatoxys* Schneider, 1866  
**27. *Dermatoxys ruficaudata* Mirza, 1936**

*Material Examined:* Nil

*Remarks:* This species was reported by Soota (1981) from the intestine of Indian Hare (*Lepus nigricollis ruficaudatus*) from Sahastradhara, Dehradun district.

Order ENOPLIDA  
Superfamily TRICHUROIDEA  
Family TRICHURIDAE  
Subfamily TRICHURINAE  
Genus *Trichurus* Roederer, 1761  
**28. *Trichurus leporis* (Froelich, 1789) Hall, 1916**

*Material Examined:* Nil

*Remarks:* This species was reported by Soota & Tripathi (1975) from the intestine of Indian Hare (*Lepus nigricollis ruficaudatus*) from Rishikesh, Dehradun district.

Phylum PLATHELMINTHES  
Class TREMATODA  
Order DIGenea  
Family LECITHODENDRIIDAE  
Subfamily GANEONIAE  
Genus *Ganeo* Klein, 1905  
**29. *Ganeo tigrinum* Mehra & Negi, 1928**

1928. *Ganeo tigrinum* Mehra & Negi, *Allahabad Univ. Stud.*, **4**: 63.

*Material examined:* Asan river, Badonwala, Dehradun, 10.iv.08, 20 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV.827; Maldevta, Dehradun, 12.vi.08, 20 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV.828; Maldevta, Dehradun, 20.viii.08, 2 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV.829; Maldevta, Dehradun, 19.ii.10, 3 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV.830; Asan river, Badonwala, Dehradun, 13.ii.09, 10 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV. 831; Jagatpur, Thanu range, Dehradun, 12.x.10, 7 exs., from the intestine of *Hoplobatrachus tigrinus*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV.832; Koti, Dehradun, 11.1.11, 10 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV.833; Hathyari, Dehradun, 10.ii.11, 4 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. IV. 834; Lachchiwala, Dehradun, 24.ii.11, 5exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. IV. 835.

*Measurements:* Body 1.7-4.1 mm long, 0.9-1.1 mm wide. Prepharynx 0.01-0.07 x 0.01-0.06 mm. Pharynx 0.02-0.13 x 0.03-0.11 mm. Esophagus 0.16-0.5 x 0.02-0.09 mm. Ventral sucker 0.10-0.22 x 0.09-0.2 mm. Anterior testis 0.18-0.44 mm, posterior testis 0.21-0.50 mm. Ovary 0.13-0.34 mm . Eggs 0.02-0.28 x 0.14-0.20 mm.

*Distribution:* India: Tripura, Meghalaya, West Bengal, Bihar, Uttar Pradesh, Andhra Pradesh, Arunachal Pradesh, Madhya Pradesh, Jammu & Kashmir, Uttarakhand and Haryana.

*Elsewhere:* Bangladesh, China and Vietnam.

*Remarks:* This species is being recorded for the first time from district Dehradun.

#### Subfamily PLEUROGENETINAE

#### Genus *Pleurogenoides* Travassos, 1921

#### **30. *Pleurogenoides gastroporus* (Luhe, 1901) Travassos, 1921**

1901. *Pleurogenes gastroporus* Luhe, *Zentbl. Bakteriell. Parasitkde.*, **30**: 166.

1921. *Pleurogenoides gastroporus* Travassos, *Arch. Ds. Esc. Sup. Agric. Med. Vet. Nichtheray*, **5**: 73.

*Material examined:* Asan river, Badonwala, Dehradun, 10.iv.08, 2 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV.836; Asan river, Badonwala, Dehradun, 23.xii.08, 2 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV.837; Raipur, Dehradun, 29.vii.08, 1 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV. 838.

*Measurements:* Body 0.83-1.34 mm long, 0.45-0.9 mm wide. Pharynx 0.07-0.09 x 0.08-0.09 mm. Esophagus 0.16-0.5 x 0.02-0.09 mm. Oral sucker subterminal, rounded and large than ventral sucker, 0.16-0.2 mm wide. Testis two symmetrical, left testis 0.09-0.24 mm, right testis 0.12-0.25 mm. Ovary 0.08-0.18 mm. Eggs 0.012-0.02 x 0.008-0.016 mm.

*Distribution:* India: Tripura, Meghalaya, West Bengal, Maharashtra, Uttar Pradesh, Andhra Pradesh, Arunachal Pradesh, Madhya Pradesh, Uttarakhand and Haryana.

*Elsewhere:* Brazil and Bangladesh.

*Remarks:* This species is being recorded for the first time from Dehradun.

Subfamily PROSTHODENDRIINAE

Genus *Prosthodendrium* Dollfus, 1931

**31. *Prosthodendrium longiforme*** (Bhalerao, 1926) Dubois, 1931

1926. *Iecithodendrium longiforme* Bhalerao, *J. Verma. Res. Soc.*, **15**: 181.

1931. *Prosthodendrium longiforme* Dubois, *Rev. Suisse. Zool.*, **67**: 50.

*Material examined:* Nil.

*Remarks:* Reported by Chakrabarti & Ghosh (2010) from intestine of Bat (*Tadarida aegyptica*) from Dehradun.

Family PARAMPHISTOMIDAE

Subfamily DIPLODISCINAE

Genus *Diplodiscus* Cohn, 1904

**32. *Diplodiscus mehrai*** Pande, 1937

1937. *Diplodiscus mehrai* Pande, *Proc. Indian. Acad. Sci.*, **6**: 109.

*Material examined:* Raipur, Dehradun, 26.xi.08, 2 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV.839; Asan river, Badonwala, Dehradun, 13.ii.09, 2 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV.840; Asan, Dehradun, 19.i.10, 2 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV. 841; Maldevta, Dehradun, 19.ii.10, 2 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV. 842.

*Measurements:* Body 2.2-3.3 mm long, 1.1-1.4 mm wide. Pharynx 0.07-0.09 x 0.08-0.09 mm. Esophagus 0.38-0.48 x 0.02-0.09 mm. Oral sucker, 0.34-0.36 x 0.2-0.33 mm wide. Acetabulum 0.56-0.68 x 0.8-1.1 mm. Testis single, 0.21-0.4 x 0.132-0.43 mm. Ovary spherical, 0.16-0.19 mm.

*Description:* Body stout, conical, aspinose, tapering anteriorly, broader posteriorly, maximum width in front of the acetabulum. Mouth sub-terminal, muscular, followed by fairly well developed sub-terminal, spherical or oval pharynx with a pair pharyngeal diverticula arising from its base. Ventral sucker (acetabulum) extremely large, conspicuous, cup-shaped, located at posterior extremely, provided with additional sucker-like elevation. Intestinal caeca more or less straight, running laterally, extending up to or little in front of anterior margin of acetabulum. Testis single, large, oval, situated roughly horizontally near middle half of body, pre-ovarian; Cirrus sac absent. Ovary globular, uterus passing posteriorly on right side of ovary, reaching anterior border of acetabulum, running forward dorsally to testis, occupying

entire intercaecal space, terminating in thick convoluted metraterm. Genital pore at junction of esophagus and intestinal caeca or above it. Vitellaria large, of varying size and shape, extending from little behind pharynx to anterior border of acetabulum, partly overlapping acetabulum. Eggs few, large.

*Distribution:* India: Meghalaya, West Bengal, Uttar Pradesh, Andhra Pradesh, Arunachal Pradesh, Jammu & Kashmir, Uttarakhand and Haryana.

*Remarks:* This species is recorded for the first time from Dehradun.

### 33. *Diplodiscus amphichrus* Tubangui, 1933

1933. *Diplodiscus amphichrus* Tubangui, *Philipp. J. Sci.*, **52**:167.

*Material examined:* Dandi village on Rishikesh Road, Dehradun, 26.xi.08, 2 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV. 843; Raipur, Dehradun, 26.xi.08, 2 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV.844; Hathyari, Dehradun, 11.1.11, 2 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV.845.

*Measurements:* Body 1.4-2.8 x 0.85-1.28 mm. Oral sucker 0.21-0.26x0.21-0.34 mm. Esophagus 0.46-0.51 mm. Acetabulum 0.68-0.92x0.38-0.68 mm. Testis 0.18-0.38x0.24-0.46 mm. Ovary 0.08-0.22x0.11-0.28 mm. Eggs 0.072-0.11x0.05-0.07 mm.

*Description:* Body stout, conical, aspinose, tapering anteriorly, border posteriorly, maximum width in front of acetabulum. Mouth sub-terminal, followed by fairly well developed, sub-terminal, spherical or oval pharynx with a pair of pharyngeal diverticula arising from its base. Ventral sucker or acetabulum extremely large, conspicuous, cup shaped, located at posterior extremity, provided with an additional sucker with depression in center. Intestinal caeca more or less straight, running laterally, extending up to or little in front of anterior border of acetabulum. Testis single, situated roughly horizontally near middle half of body, oval, irregularly notched, pre-ovarian and equatorial; two vasa efferentia arising from antero-lateral border of testis, later uniting to form vesicula seminalis externa. Cirrus sac elongated or sub-globular, containing vesicula seminalis interna, pars prostatica and ejaculatory duct. Genital pore just behind oesophageal bulb or extra-caecal, post-bifurcal. Ovary globular, inter-caecal, to right of median axis. Uterus situated posteriorly on right side of ovary, vitellaria large, forming compact masses of follicles extending from little distance in front of intestinal bifurcation posteriorly to acetabulum, partly overlapping its anterior border, mainly lateral in position but meeting medially in acetabular part to form a dorsally placed row.

*Distribution:* India: Uttar Pradesh, Maharashtra, Jammu & Kashmir, Arunachal Pradesh, Meghalaya, West Bengal, Tamil Nadu, Kerala and Uttarakhand.

*Elsewhere:* Burma, Sri Lanka, Japan, Korea and Philippines.

*Remarks:* This species is reported for the first time from Uttarakhand.

## Subfamily GASTROTHYLACINAE

Genus *Fischoederius* Stiles et Goldberger, 1910**34. *Fischoederius cobboldi*** (Poirier, 1833) Stiles et Goldberger, 19101910. *Fischoederius cobboldi* Stiles et Goldberger, *Hyg.Lab.Bull.No.* **60**:259.*Material examined*: Nil.*Remarks*: Reported by Chakrabarti & Ghosh (2010) from intestine of Pig (*Sus scrofa*) from Dehradun.

## Subfamily PLAGIORCHINAE

Genus *Plagiorchis* Luhe, 1899**35. *Plagiorchis koreanus*** Ogata, 1938.1938. *Plagiorchis koreanus* Ogata, *Ann. Zool Jap.*, **17**: 581.*Material examined*: Nil.*Remarks*: Reported by Chakrabarti & Ghosh (2010) from intestine of Bat (*Tadarida aegyptica*) from Dehradun.

## Family BRACHYCOELIIDAE

Subfamily MESOCOELINAE

Genus *Mesocoelium* Odhner, 1910**36. *Mesocoelium monas*** (Rudolphi, 1819) Freitas, 1958.1819. *Mesocoelium monas* Rudolphi *ent. Sys .cui. aceed. mant. duplex et. Indices Locopletissime Besol*, 811.*Material examined*: Nil.*Remarks*: Reported by Chakrabarti & Ghosh (2010) from intestine of toad (*Duttaphrynus melanostictus*) from Dehradun.

## Family ANCHITREMATIDAE

Genus *Anchitrema* Looss, 1899.**37. *Anchitrema sanguineum*** (Sonsino, 1894) Looss, 1899.1899. *Anchitrema sanguineum* Looss, *Zool. Jahrb. Syst.*, **12**: 521.*Material examined*: Nil*Remarks*: Reported by Chakrabarti & Ghosh (2010) from intestine of Bat (*Scotophilus* sp.) from Dehradun.

Family PLAGIORCHIIDAE  
 Subfamily ASTRIOTREMATINAE  
 Genus *Spinometra* Mehra, 1931

**38. *Spinometra dehradunensis*** Chakrabarti & Ghosh, 2009.

2009. *Spinometra dehradunensis* Chakrabarti & Ghosh, *Indian J. Helminth.*, **26**, 7-11.

*Remarks:* Described by Chakrabarti & Ghosh (2009) from Kachuga turtle from Dehradun.

Family OPECOELIDAE  
 Genus *Dactylostomum* Woolcock, 1935

**39. *Dactylostomum gayaprashadi*** Tripathi & Jauhari, 1991.

1991. *Dactylostomum gayaprashadi* Tripathi & Jauhari, *U.P. J. Zool.*, **22**: 70-72.

*Remarks:* Described by Tripathi & Jauhari (1991) from fresh water fish from Dehradun.

Family BATRACHOTREMATIDAE  
 Genus *Batrachotrema* Dollfus et Williams, 1966

**40. *Batrachotrema korbaensis*** Rizvi, Burseay & Bhutia, 2012

2012. *Batrachotrema korbaensis* Rizvi, Burseay & Bhutia, *Acta Parasitol.*, **57**(2), DOI: 10.2478/s11686-012-0023-8

*Material examined:* Korba village, Dehradun, Uttarakhand, India, 19.v.11. 7 exs., from the intestine of *Nanorana minica*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV. 855-856.

*Description:* Body oviform, 1.25-1.86 mm long, 0.67-0.96 mm wide at level of acetabulum, devoid of spines. Oral sucker subterminal, 0.20-0.26 × 0.15-0.22 mm; acetabulum 0.15-0.19 × 0.12-0.19 mm, located slightly anterior of midbody. Both suckers weakly muscular. Prepharynx absent; pharynx 0.11-0.12 mm in length, muscular; esophagus 0.087-0.12 mm in length, bifurcating anterior to acetabulum, each caecum blind, inflated, reaching level of posterior testis. Two testes, oblique, round, margin entire, near posterior end of body; anterior testis 0.21-0.36 × 0.2-0.43 mm, posterior testis 0.24-0.37 × 0.22-0.400 mm Ovary round, 0.18-0.20 × 0.17-0.21 mm, margin entire, slightly posteriodextral to acetabulum, pretesticular; oviduct, Mehlis' gland complex in region anteriorsinistrad of ovary; uterine coils limited to ovarian and postacetabular area, also separating ovary from anterior testis. Laurer's canal not found. Cirrus pouch 0.34-0.48 mm, claviform, reaches to anterior margin of acetabulum and containing internal seminal vesicle and pars prostatica. Genital pore sinistral, marginal, opening at level of oral sucker-pharynx junction, male and female pores opening into genital atrium. Vitellaria follicular, overlapping caeca, extending from mid-pharynx to posterior margin of posterior. Eggs ovoid, 0.038-0.040 × 0.013-0.015 mm. Excretory pore distinct, sphincter not elongating body wall; excretory vessel I-shaped.

*Remarks:* This species was described from Dehradun as new to science by Rizvi, Burseay & Bhutia (2012).

Genus *Opisthioparorchis* Wang, 1980**41. *Opisthioparorchis nanoranae* Rizvi, Bursey & Bhutia, 2012**

2012. *Opisthioparorchis nanoranae* Rizvi, Bursey & Bhutia, *Acta Parasitol.*, **57**(2), DOI: 10.2478/s11686-012-0023-8.

*Material examined:* Korba village, Dehradun, Uttarakhand, India, 2.vi.11., 25 exs., from the intestine of *Nanorana minica*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV. 857-858.

*Description:* Body oviform, 1.15-1.60 mm long, 0.73-0.78 mm wide at level of acetabulum, spinose; spines 0.010-0.012 mm in length. Oral sucker subterminal, 0.17-0.24 x 0.14-0.22 mm; acetabulum 0.16-0.18 x 0.16-0.18 mm, located slightly anterior of midbody. Both suckers weakly muscular. Prepharynx absent; pharynx 0.15-0.16 mm in length, muscular; esophagus 0.09-0.13 mm in length, bifurcating anterior to acetabulum, each caecum blind, inflated, reaching level of posterior testis. Testes round, margin entire, lying in tandem near posterior end of body, anterior testis 0.19-0.27 x 0.33-0.33 mm, posterior testis 0.22-0.25 x 0.15-0.18 mm. Ovary round, 0.19-0.20 x 0.27-0.28 mm, margin entire, posterior-dextral to acetabulum, pretesticular; oviduct, Mehlis' gland complex in region left of ovary; Laurer's canal not found. Uterine coils limited to ovarian and postacetabular area and separating ovary from anterior testis. Cirrus pouch 0.36-0.50 mm, claviform, containing internal seminal vesicle. Genital pore sinistral, level of oral sucker-pharynx junction, marginal, male and female pores opening into genital atrium. Vitellaria follicular, overlapping caeca, extending from mid-oral sucker to posterior end of body. Eggs 0.04-0.045 x 0.012-0.014mm. Excretory pore distinct, sphincter not elongating body wall; excretory vessel I-shaped.

*Remarks:* This species was described from Dehradun as new to science by Rizvi, Bursey & Bhutia (2012).

**42. *Opisthioparorchis dehradunensis* Rizvi, Bursey & Bhutia, 2012**

2012. *Opisthioparorchis dehradunensis* Rizvi, Bursey & Bhutia, *Acta Parasitol.*, **57**(2), DOI: 10.2478/s11686-012-0023-8.

*Material examined:* Korba village, Dehradun, Uttarakhand, India, 2.vi.11., 10 exs, from the intestine of *Nanorana minica*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV.859-860.

*Description:* Body pyriform, 0.9-1 mm long, 0.065-0.067 mm wide at level of anterior testis, spinose; spines 5-8  $\mu$ m in length. Oral sucker subterminal, 0.12-0.13 x 0.065-0.017 mm; acetabulum 0.13-0.14 x 0.11-0.12 mm, located anterior to midbody. Both suckers muscular. Prepharynx absent; pharynx 0.095-0.10 mm in length, muscular; esophagus 0.065-0.080 mm in length, bifurcating anterior to acetabulum, each caecum blind, inflated, reaching posterior end of body. Testes round, margin entire, oblique near posterior end of body, anterior testis 0.19-0.20 x 0.18-0.185 mm posterior testis 0.20-0.205 x 0.190-0.195 mm. Ovary round, 0.11-0.12 x 0.110-0.115 mm, margin entire, posteriodextral to acetabulum, pretesticular; oviduct, Mehlis' gland complex in region left of ovary; Laurer's canal not found. Uterine coils limited to ovarian and postacetabular area, overlapping intestinal caeca, also separating ovary from anterior testis. Cirrus pouch 0.25-0.37 mm, claviform, reaches dextral margin of acetabulum. Genital pore

sinistral, level of oral sucker-pharynx junction, marginal, male and female pores opening into genital atrium. Vitellaria follicular, overlapping caeca, extending from level of pharynx to posterior end of body. Eggs 0.040-0.047 x 0.012-0.015 mm. Excretory pore distinct; sphincter causing body protrusion, excretory vessel I-shaped.

*Remarks:* This species was described from Dehradun as new to science by Rizvi, Burseay & Bhutia (2012).

Subclass MONOGENEA  
Family MICROCOTYLIDAE  
Genus *Yogendrotrema*

**43. *Yogendrotrema garhwalensis* Juwantha, 2009.**

2009. *Yogendrotrema garhwalensis* Juwantha *Flora & Fauna*, 15: 137-138.

*Material examined:* Nil

*Remarks:* Described by Juwantha (2009) from fresh water fish from Dehradun.

Family DIPLECTANIDAE  
Genus *Lobotrema* Tripathi, 1959

**44. *Lobotrema rajendrai* Srivastava & Kumar 1983**

1983. *Lobotrema rajendrai* Srivastava & Kumar *Indian J. For.*, 6: 330-331.

*Material examined:* Nil

*Remarks:* Described by Srivastava & Kumar (1983) from fresh water fish from Dehradun.

Class CESTODA  
Order PROTOCEPHALIDEA  
Family PROTEOCEPHALIDAE  
Subfamily PROTEOCEPHALINAE  
Genus *Proteocephalus* Weinland, 1853

**45. *Proteocephalus tigrinus* Woodland, 1925**

1925. *Proteocephalus tigrinus* Woodland, *Parasit.*, 17: 370.

*Material examined:* Maldevta, Dehradun, 19.ii.10, 6 exs., from the intestine of *Euphlyctis cyanophlyctis*, coll. A. N. Rizvi, Reg. No. ZSI/NRC/IV. 846.

*Distribution:* India: Haryana and Uttarakhand.

*Remarks:* This species is being recorded for the first time from Uttarakhand.

**Table:** List of new species and new records of helminths from India and Dehradun

<b>New Species</b>	
1.	<i>Batrachotrema korbaensis</i> Rizvi, Bursey & Bhutia, 2012
2..	<i>Opisthioparorchis nanoranae</i> Rizvi, Bursey & Bhutia, 2012
3.	<i>Opisthioparorchis dehradunensis</i> Rizvi, Bursey & Bhutia, 2012
4.	<i>Rhabdias himalayanus</i> Rizvi, Bursey & Bhutia, 2013
5.	<i>Rhabdias dehradunensis</i> Rizvi, Bursey & Bhutia, 2013
<b>New records from India</b>	
1.	<i>Oswaldocruzia melanosticti</i> Gupta, 1960
2.	<i>Rhabdias ranae</i> Walton, 1929
3.	<i>Cosmocerca parva</i> Travassos, 1925
<b>First records from State Uttarakhand</b>	
1.	<i>Rhabdias bufonis</i> Schrank, 1788
2.	<i>Strongyloides bufonis</i> Rao & Singh, 1968
3.	<i>Oxysomatium macintoshii</i> (Stewart, 1914) Karve, 1927
4.	<i>Oxysomatium anurae</i> Biswas & Chakravarty, 1963
5.	<i>Aplectana asiatica</i> Gupta, 1960?
6.	<i>Gendria chauhani</i> Nama, 1975
7.	<i>Diplodiscus amphichrus</i> Tubanguui, 1933
<b>First records from district Dehradun</b>	
1.	<i>Camallanus ranae</i> Khera, 1956
2.	<i>Camallanus tigrinis</i> Johnson, 1969
3.	<i>Camallanus alatae</i> Nama & Jain, 1974
4.	<i>Rhabdias bufonis</i> Schrank, 1788
5.	<i>Strongyloides bufonis</i> Rao & Singh, 1968
6.	<i>Oxysomatium macintoshii</i> (Stewart, 1914) Karve, 1927
7.	<i>Oxysomatium anurae</i> Biswas & Chakravarty, 1963
8.	<i>Aplectana asiatica</i> Gupta, 1960
9.	<i>Cosmocercoides multipapillata</i> Khera, 1958
10.	<i>Cosmocercoides nainitalensis</i> Arya, 1979
11.	<i>Gendria chauhani</i> Nama, 1975
12.	<i>Subulascaris cyanophlyctis</i> Deshmukh, 1968
13.	<i>Ganeo tigrinum</i> Mehra & Negi, 1928
14.	<i>Pleurogenoides gastroporus</i> (Luhe, 1901) Travassos, 1921
15.	<i>Diplodiscus mehrai</i> Pande, 1937
16.	<i>Diplodiscus amphichurus</i> Tubanguui, 1933
17.	<i>Proteocephalus tigrinus</i> Woodland, 1925

## ECOLOGY OF HELMINTH PARASITES OF ANURAN AMPHIBIA IN DEHRADUN

### INTRODUCTION

Study on the ecology of Helminths of amphibia is not available from Dehradun, however, few studies are reported from other states of India (Devi & Rao, 1990; Kumari and Madhavi, 1996; Tandon *et al.*, 2001; Gupta *et al.*, 2004; Chandra & Gupta, 2007; Rizvi & Bhutia, 2010; Rizvi & Bhutia, 2011).

Helminth parasite communities in anuran amphibian were investigated from 18 different habitats in Dehradun. Five species of amphibian hosts were examined for helminthes, but only three species were found to harbour 17 genera of helminth parasites. The prevalence, intensity and abundance were studied. *Fejervarya limnocharis* and *Microhyla ornata* were free of helminth parasites. *Euphlyctis cyanophlyctis* harbored maximum parasite species followed by *Hoplobatrachus tigerinus* and *Duttaphrynus melanostictus*. In *E. cyanophlyctis*, among nematode parasites, most prevalent genera were *Camallanus* and *Rhabdias* and less prevalent were *Oswaldocruzia*, *Gendria*, *Aplectana* and *Strongyloides*. Among trematode parasites, the most prevalent genus was *Ganeo*, followed by *Diplodiscus* and *Pleurogenoides*. Cestode, *Proteocephalus* was recovered only twice. In *Hoplobatrachus tigerinus*, most prevalent nematodes were *Cosmocercoides* and *Oswaldocruzia* and less prevalent nematodes were *Aplectana* and *Rhabdias*. Only trematode found was *Ganeo*. In *D. melanostictus*, only two nematode genera were recovered of which *Cosmocercoides* was dominant followed by *Oxysomatium*. The Helminth parasite community in anuran amphibia of Dehradun comprised 64.7% nematodes (11genera), 29.5% trematodes (5 genera) and 5.8% cestodes (1 genus).

### MATERIAL AND METHODS

*Hosts collected / surveyed:* Caution was taken to collect minimum of host samples keeping in view their low population. Total 239 amphibian hosts were collected from 2007-2010.

*Collection of parasites and data analysis:* Live frogs were brought to the Lab. and autopsied and various organs examined for helminth parasites. Most of the parasites were collected from the gastrointestinal tract. The parasites collected were processed by standard methods of fixation and preservation. The data analysis was done following Tandon *et al.* (2001). **Prevalence** is the percentage of host individuals infected in a sample of host species examined.

**Intensity** is the number of individuals of a particular species in each infected host and **Abundance** is the mean number of individuals of a particular species per host examined.

**RESULTS**  
**(Table 1, 2, 3)**

**Table 1.** Host species examined for Helminth parasites in Dehradun

t Species	Localities surveyed														Total					
	Number of hosts examined																			
	ZSI cam wala pus	Sala wala	Mald evta Pond	Raipur Pond	Gucchu pani	Lachchi wala	Jagat pur	Bogh pur	Talai village dhai	Badon wala bridge	Asan river	Santla devi-Nun river	Rishi kesh (dandi village)	Koti	Katta pathan	Dooga Hath yari	Dhoo dhai village	Kaisi		
<i>Euphyctis cyanophlyctis</i>	-	-	30	20	20	14	-		1	45	10	8	30	4	6	10	13	2	5	<b>218</b>
<i>Hoplobatrachus tigrinus</i>							3		3											<b>06</b>
<i>Fejervarya limnocharis</i>											2								1	<b>03</b>
<i>Microhyla ornata</i>								1												<b>1</b>
<i>Duttaphrynus melanostictus</i>	5	4				2														<b>11</b>
<b>Total Hosts examined</b>	5	4	30	20	20	16	3	1	4	45	12	8	30	4	6	10	13	2	6	<b>239</b>

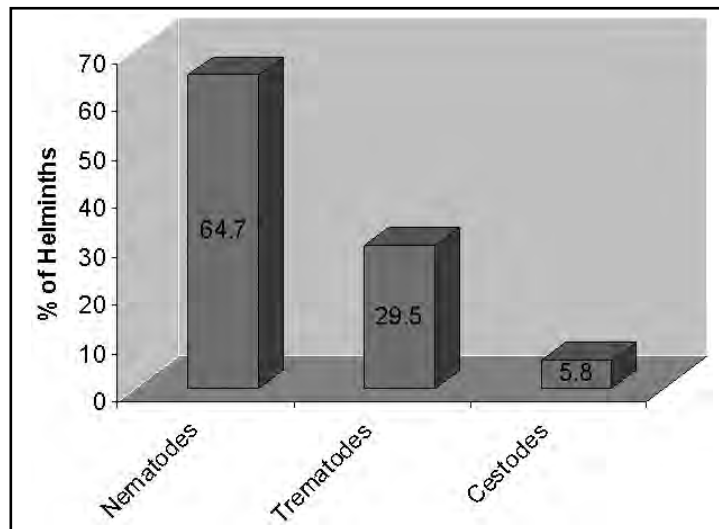
Table 2: Locality wise distribution of Helminth parasites in Dehradun

S.N.	Locality ( amphibian hosts)	Latitude(N)	Longitude(E)	Altitude (ft)	Helminth parasites	
					Trematode	Cestode
1.	Kattapathar ( <i>Euphlyctis cyanophlyctis</i> )	30° 29.928'	77° 52.339'	796	<i>Diplodiscus</i>	Nematode -
2.	Asan Barrage ( <i>Euphlyctis cyanophlyctis</i> ) ( <i>Fejervarya limnocharis</i> )	30° 25.970'	77° 40.196'	1287		<i>Oxysomatium</i>
3.	Lachniwala ( <i>Euphlyctis cyanophlyctis</i> )	30° 12.596'	78° 07.906'	1706	<i>Ganeo</i>	<i>Oxysomatium</i> <i>Cosmocerca</i>
4.	Kalsi ( <i>Euphlyctis cyanophlyctis</i> ) ( <i>Fejervarya limnocharis</i> )	30° 31.643'	77° 51.167'	1724	- - -	- - -
5.	Dandi on Rishikesh road ( <i>Euphlyctis cyanophlyctis</i> )	30° 10.644'	78° 13.857'	1818	<i>Ganeo</i> <i>Pleurogenoides</i> <i>Diplodiscus</i>	<i>Camallanus</i>
6.	Badonwala Bridge ( <i>Euphlyctis cyanophlyctis</i> )	30° 17.846'	77° 56.776'	1860	<i>Ganeo</i> <i>Pleurogenoides</i> <i>Diplodiscus</i>	- <i>Cosmocercoides</i> <i>Camallanus</i> <i>Rhabdias</i> <i>Oswaldoocruzia</i> <i>Procammallanus</i>
7.	Hathari ( <i>Euphlyctis cyanophlyctis</i> )	30° 31.413'	77° 53.216'	1950	<i>Ganeo</i> <i>Diplodiscus</i>	
8.	Bogpur ( <i>Microhyla ornata</i> )	30° 12.964'	78° 13.611'	2076	-	-
9.	Raipur pond ( <i>Euphlyctis cyanophlyctis</i> )	30° 18.850'	78° 06.082'	2143	<i>Ganeo</i> <i>Diplodiscus</i>	- <i>Cosmocerca</i>
10.	ZSI campus ( <i>Duttaphrynus melanostictus</i> )	30° 20.882'	78° 00.907'	2195	-	- <i>Cosmocercoides</i>

11.	Santla Devi, Nun river ( <i>Euphlyctis cyanophlyctis</i> )	30° 23.504'	78° 01.583'	2229	-	-	<i>Rhabdias Cosmocerca</i>
12.	Jagapur, Thanu range ( <i>Hoplobatrachus tigerinus</i> )	30° 12.577'	78° 13.884'	2258	<i>Ganeo</i>	-	<i>Cosmocercoides</i>
13.	Maldevta ( <i>Euphlyctis cyanophlyctis</i> )	30° 19.945'	78° 06.580'	2260	<i>Ganeo</i>	<i>Proteocephalus</i>	<i>Strongyloides</i>
14.	Salawala ( <i>Duttaphrynus melanostictus</i> )	30° 20.375'	78° 03.327'	2288	-	-	<i>Oxysomatium</i>
15.	Koti ( <i>Euphlyctis cyanophlyctis</i> )	30° 36.697'	77° 47.680'	2370	<i>Ganeo</i>	-	-
16.	Talai village, Thanu range ( <i>Hoplobatrachus tigerinus</i> )	30° 14.241'	78° 12.711'	2372	-	-	<i>Rhabdias Aplectana</i>
17.	Guchchipani ( <i>Euphlyctis cyanophlyctis</i> )	30° 22.513'	78° 03.570'	2375	-	-	<i>Rhabdias Gendria</i>
18.	Doonga ( <i>Euphlyctis cyanophlyctis</i> )	30° 25.119'	77° 57.165'	2726	-	-	-
19.	Dhoodhai village ( <i>Euphlyctis cyanophlyctis</i> )	30° 25.953'	77° 56.378'	2970	-	-	-

**Table 3.** Prevalence, intensity and abundance of helminth parasites in amphibia of Dehradun

Host (no examined)	Parasite (no.of hosts infected)	Prevalence %	Total no of parasites collected	Intensity	Abundance
<i>Euphlyctis cyanophlyctis</i> (218)	<i>Ganeo</i> (45)	20.6	298	6.6	1.36
	<i>Diplodiscus</i> (5)	2.29	10	2	0.045
	<i>Pleurogenoides</i> (3)	1.37	5	1.6	0.022
	<i>Camallanus</i> (5)	2.29	20	4	0.091
	<i>Oxysomatium</i> (3)	1.37	16	5.3	0.073
	<i>Cosmocercoides</i> (4)	1.83	14	3.5	0.064
	<i>Rhabdias</i> (5)	2.29	8	1.6	0.036
	<i>Oswaldocruzia</i> (2)	0.91	6	3	0.027
	<i>Subulascaris</i> (2)	0.91	5	2.5	0.022
	<i>Cosmocerca</i> (4)	1.83	13	3.2	0.059
	<i>Aplectana</i> (2)	0.91	5	2.5	0.022
	<i>Strongyloides</i> (2)	0.91	4	2	0.019
	<i>Procamallanus</i> (2)	0.91	3	1.5	0.013
	<i>Gendria</i> (2)	0.91	3	1.5	0.013
	<i>Proteocephalus</i> (3)	1.37	7	2.3	0.032
<i>Hoplobatrachus tigerinus</i> (6)	<i>Ganeo</i> (1)	16.6	5	5	0.8
	<i>Cosmocercoides</i> (2)	33.3	16	8	2.6
	<i>Aplectana</i> (1)	16.6	4	4	0.6
	<i>Oswaldocruzia</i> (2)	33.3	4	2	0.6
	<i>Rhabdias</i> (1)	16.6	2	2	0.3
<i>Duttaphrynus melanostictus</i> (11)	<i>Cosmocercoides</i> (6)	54.5	55	9.1	5.0
	<i>Oxysomatium</i> (1)	11.1	10	10	1.1

**Figure:** Helminth parasite communities in Amphibia of Dehradun

## DISCUSSION

The anuran amphibian population in Dehradun was found to comprise five species.

*Euphlyctis cyanophlyctis* was the most dominant host and harboured maximum helminth parasites comprising 15 genera and this may be because it is an aquatic species and opportunistic unselective feeder and this feeding favours more parasitic infection (Tandon *et al.*, 2001).

Further, the hosts collected were more females as they are larger in size and since they are larger, they feed more and acquire more parasites and this is in agreement with the studies on Newts by Muzzal (1991).

*Hoplobatrachus tigerinus* hosts were found in low population and harboured low parasitic infection with only five genera, while, *Duttaphrynus melanostictus* being ground dwelling and nocturnal were found to harbour only two nematode genera.

*Fejervarya limnocharis* was found only at two localities whereas; *Microhyla ornata* was collected from only one locality.

Both *F. limnocharis* and *M. ornata* were found in very low populations and were free of helminths.

## CONCLUSIONS

The Helminth parasite communities in anuran amphibian of Dehradun consists of 15 genera and are distributed as :

64.7% of nematodes,  
29.5% of trematodes ,  
5.8% of cestodes.

This is a first preliminary study on the helminth communities in amphibian of Dehradun and it open avenues for further studies on the host-parasite relationship for the better understanding of the occurrence of these helminth in amphibian hosts.

Potential sites for further studies are Korba village with three new species of helminths recovered, Badonwala Bridge with 9 helminth genera, Lachchiwala with 5 genera, Dandi on Rishikesh road with 5 genera and Maldevta, where four helminth genera were recorded.

## SUMMARY

The present paper records 45 species of helminth parasites from vertebrate hosts of district Dehradun belonging to three Phylum under 8 orders, 23 families and 35 genera. The study include five new species (Rizvi, Bursey & Bhutia, 2012; 2013), three new records from India, seven new records from State Uttarakhand and seventeen new records from district Dehradun. Besides, community analysis of amphibian helminths have been also been studied.

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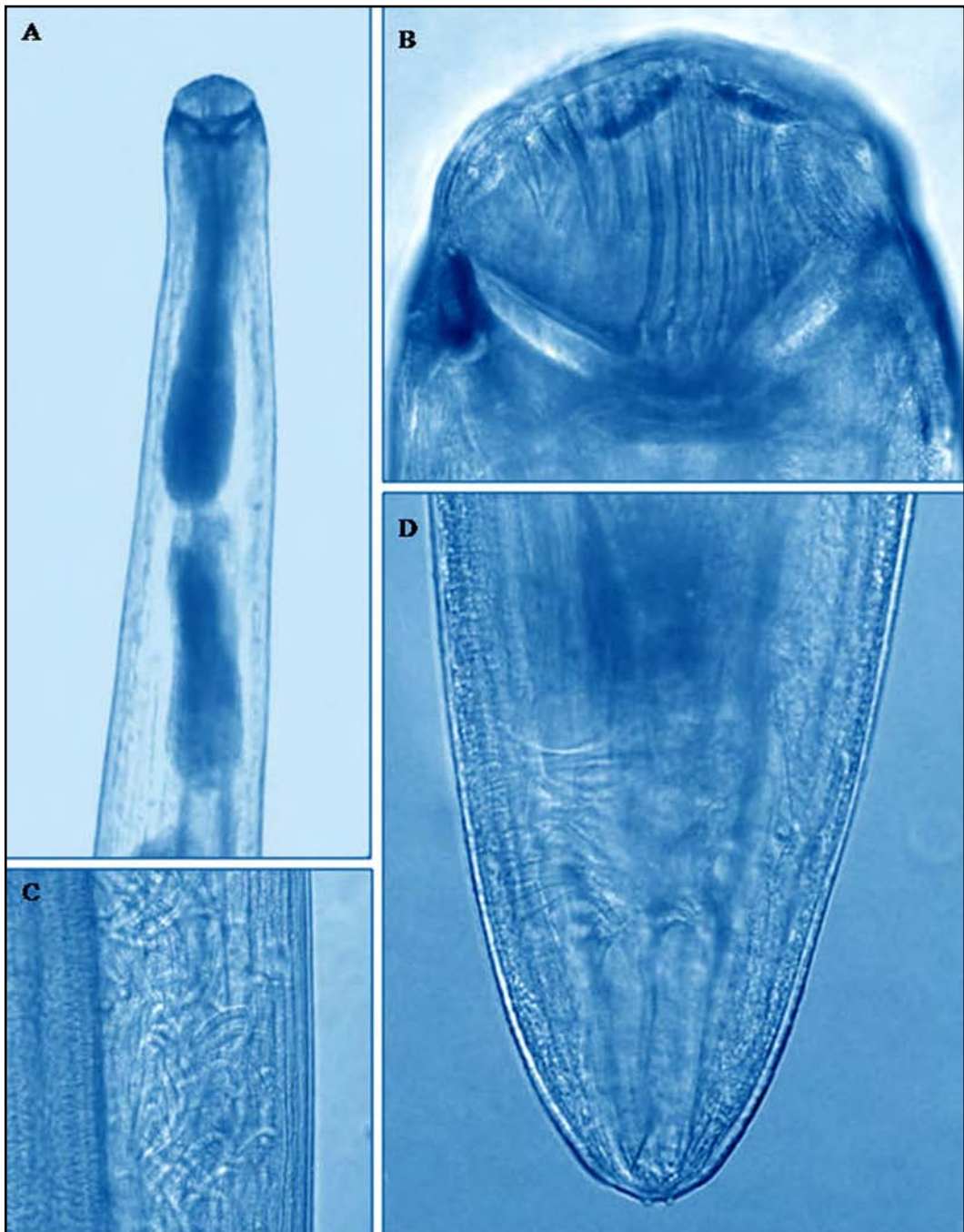
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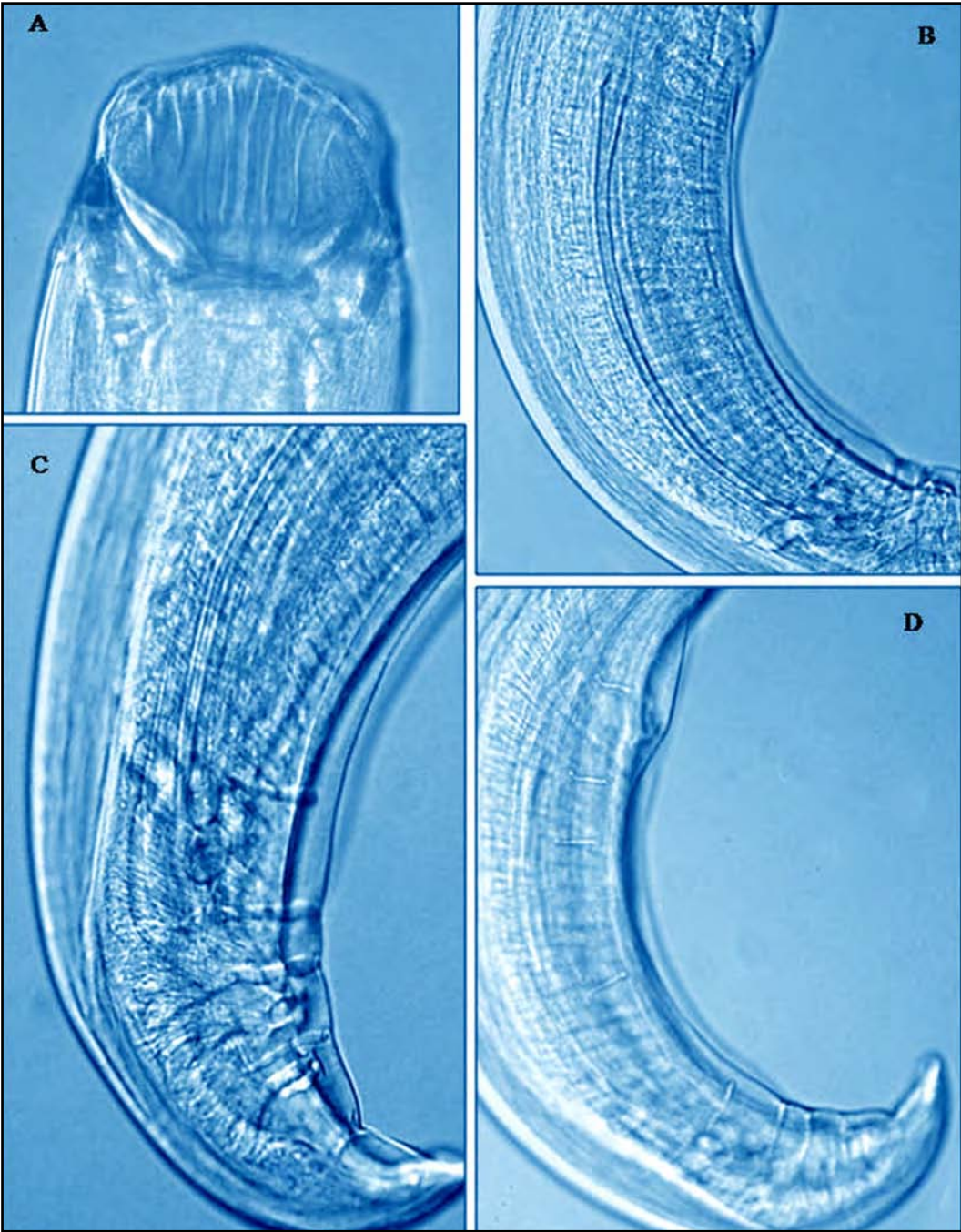




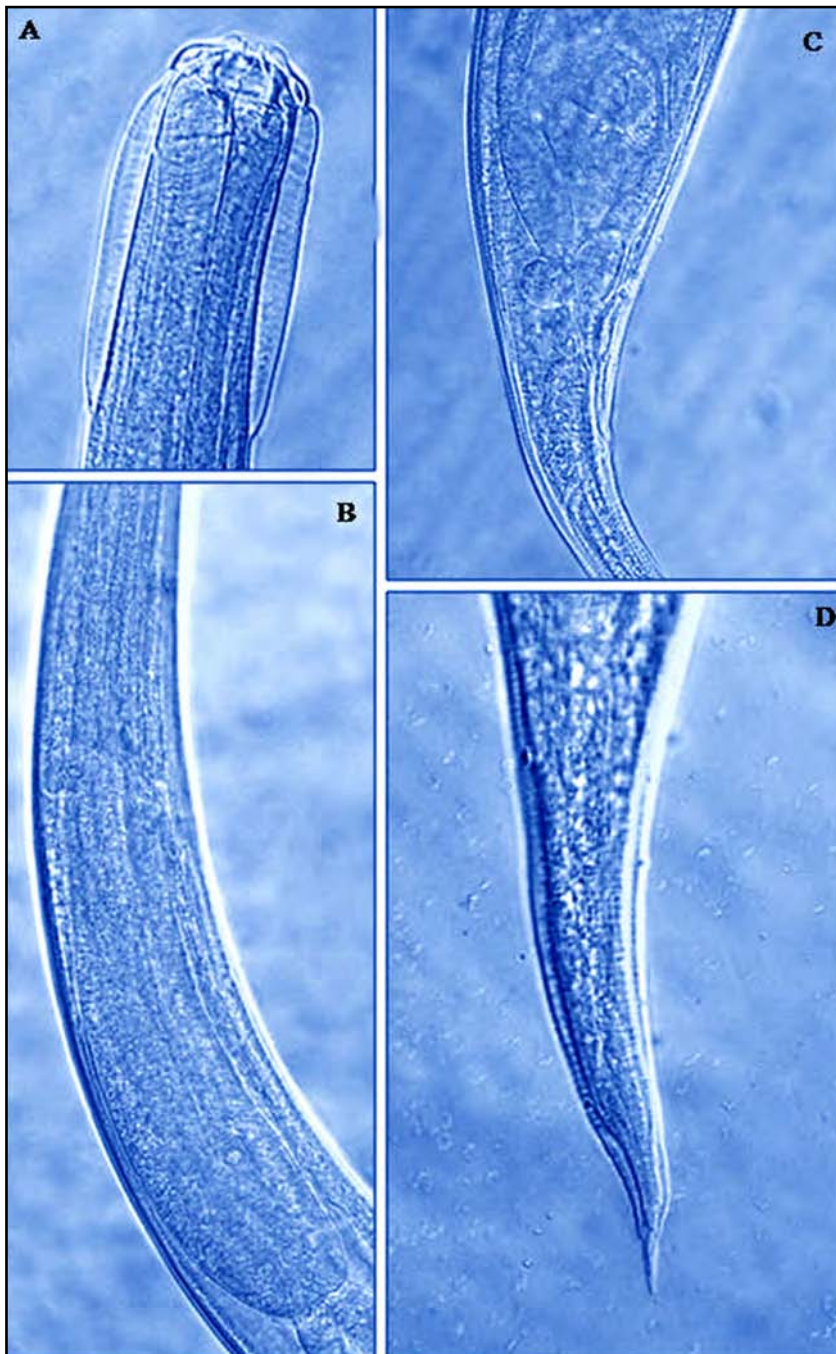
**Fig. 1:** *Camallanus tigrinis*  
A. Female anterior region B. Head C & D. Male posterior region



**Fig. 2:** *Camallanus alatae* (female)  
A. Anterior region B. Head C. Juveniles in uterus D. Tail



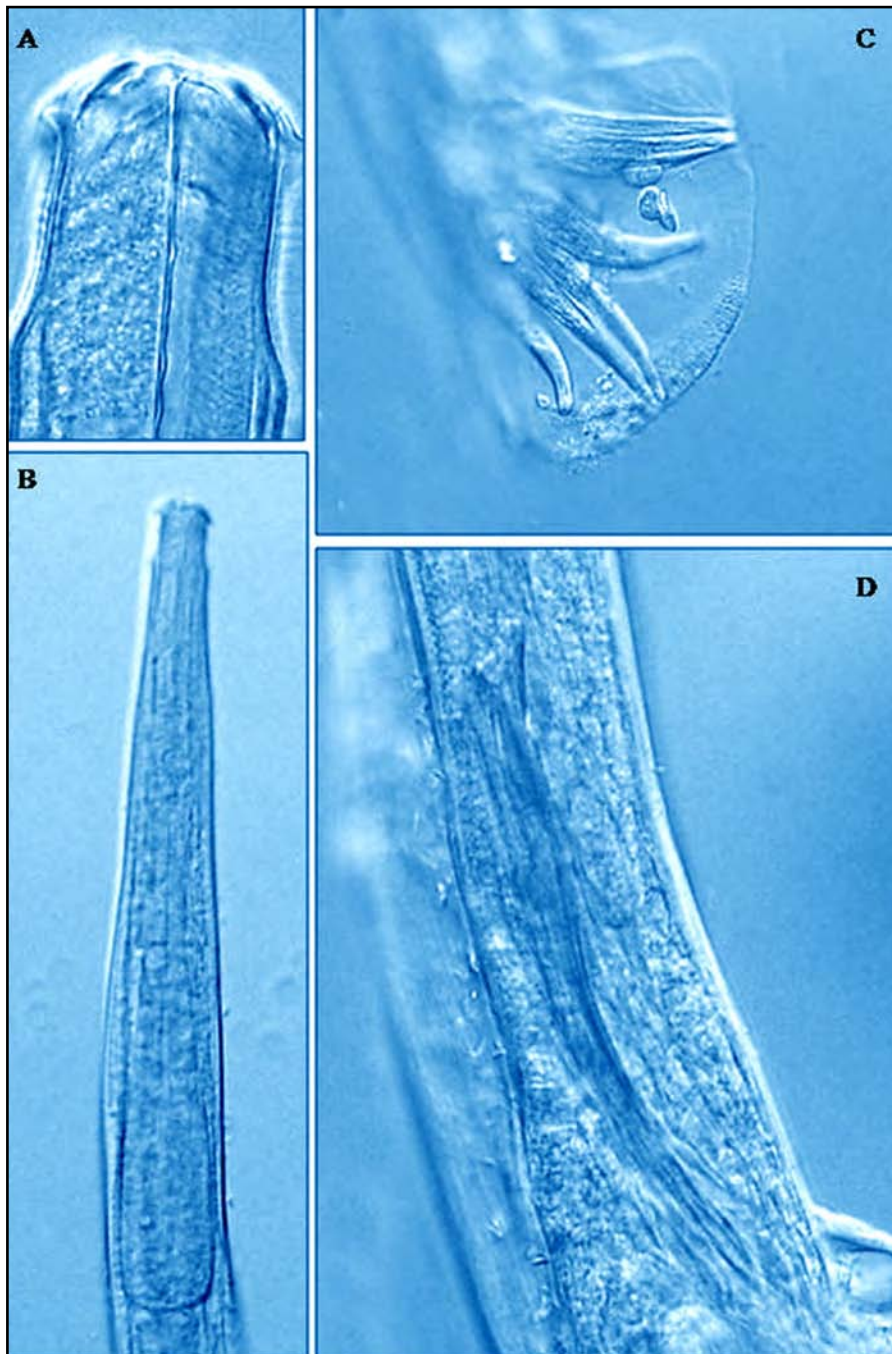
**Fig. 3:** *Camallanus alatae* (male)  
A. Head B. Spicule C & D. Posterior region



**Fig. 4:** *Procamlanus* sp. (female)  
A. Head region B. Anterior region C & D. Posterior region



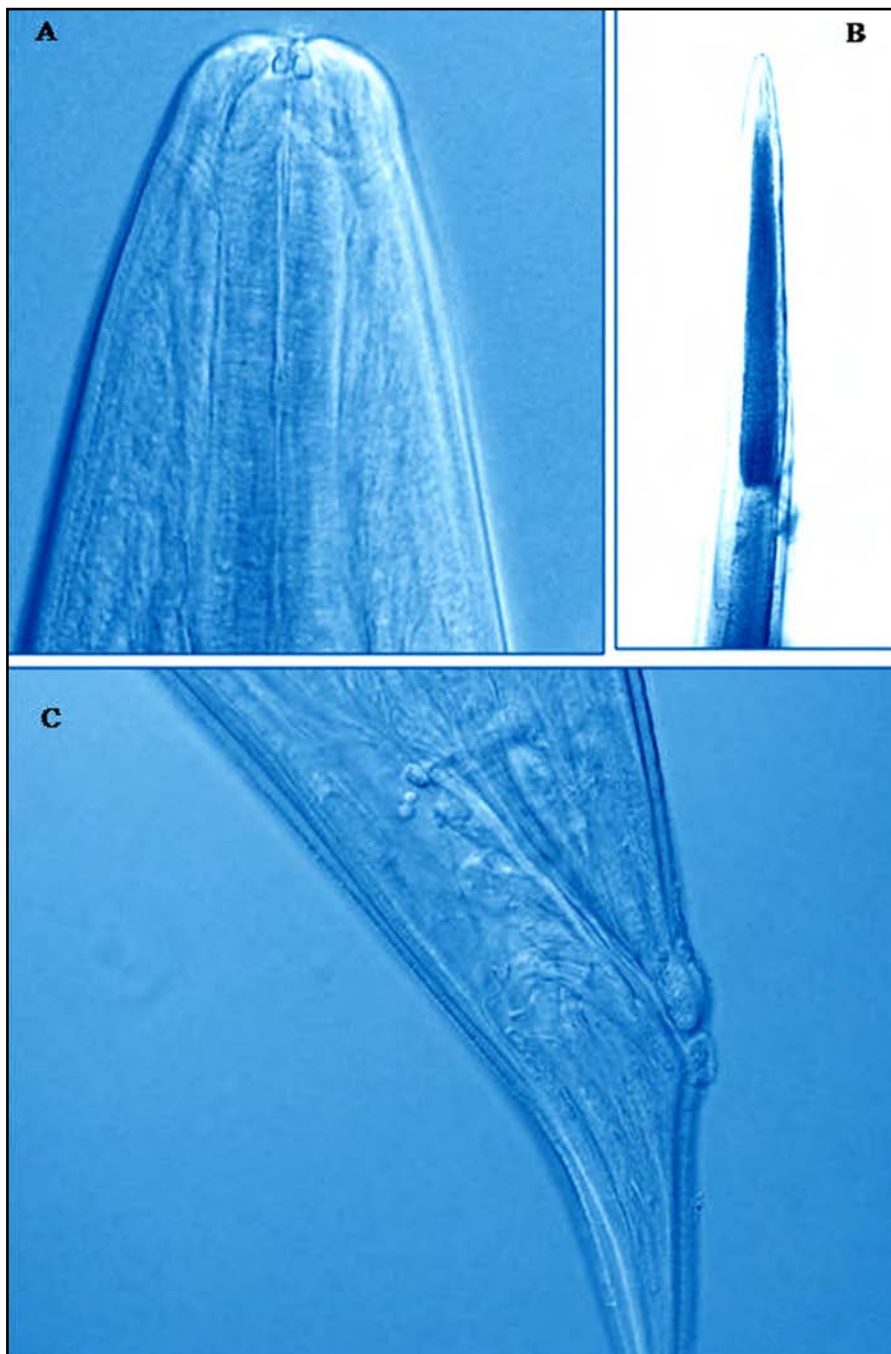
**Fig. 5:** *Oswaldocruzia melanosticti* (female)  
A. Head region B. Tail C. Gonad D. Vulva



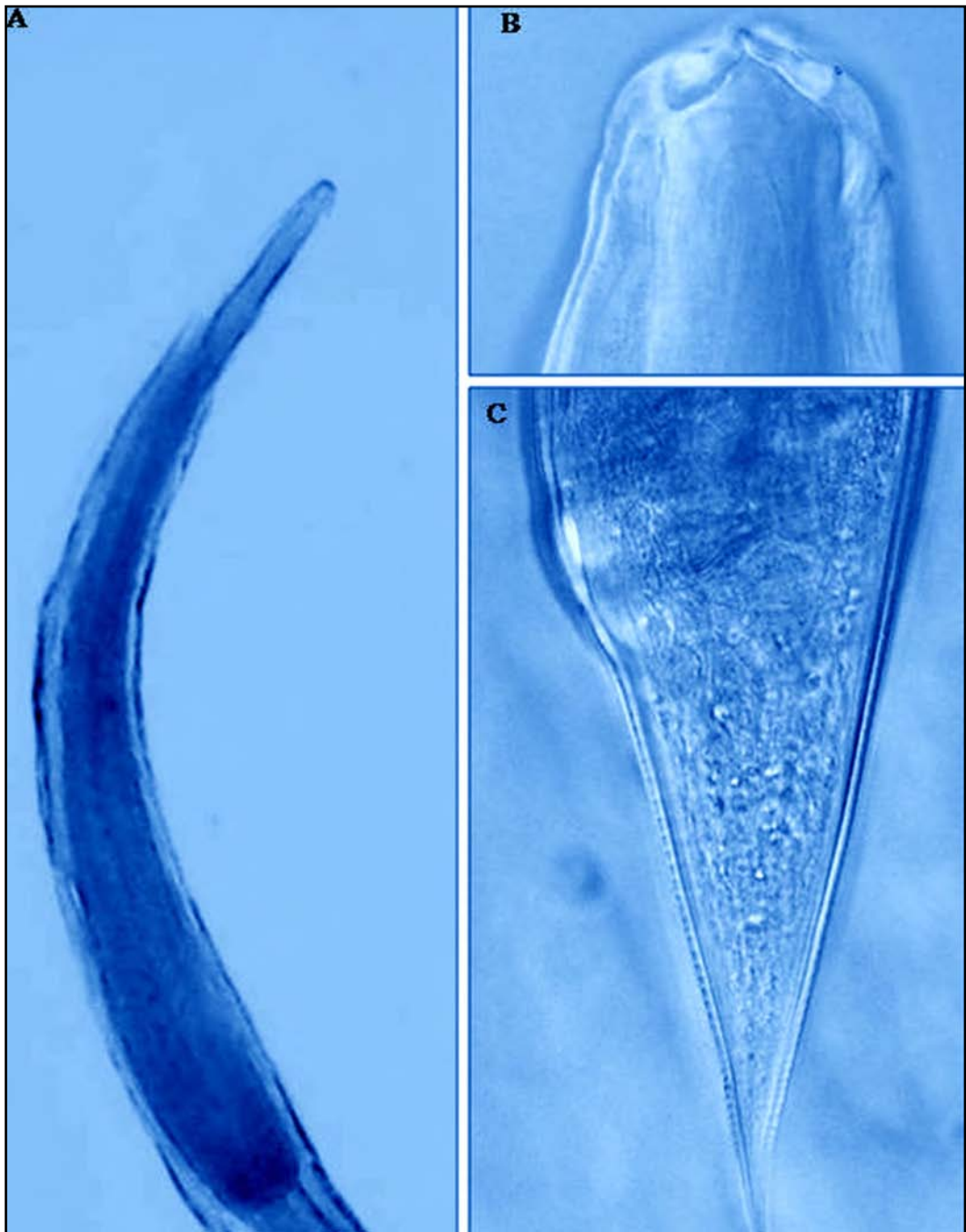
**Fig. 6:** *Oswaldocruzia melanosticti* (male)  
A. Head region B. Anterior region C. Bursa D. Spicules



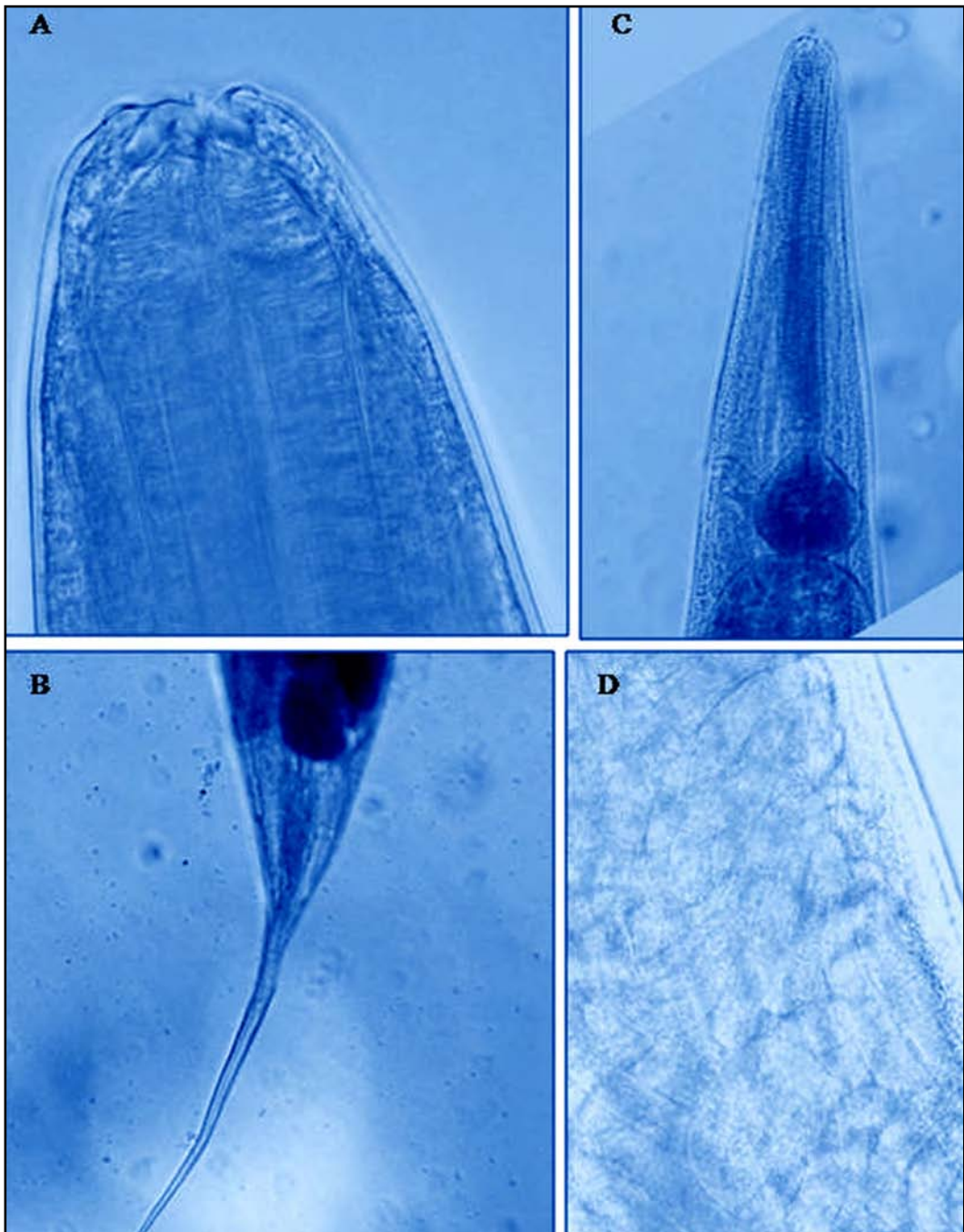
**Fig. 7:** *Rhabdias bufonis* (female)  
A. Anterior region B. Head C. Tail



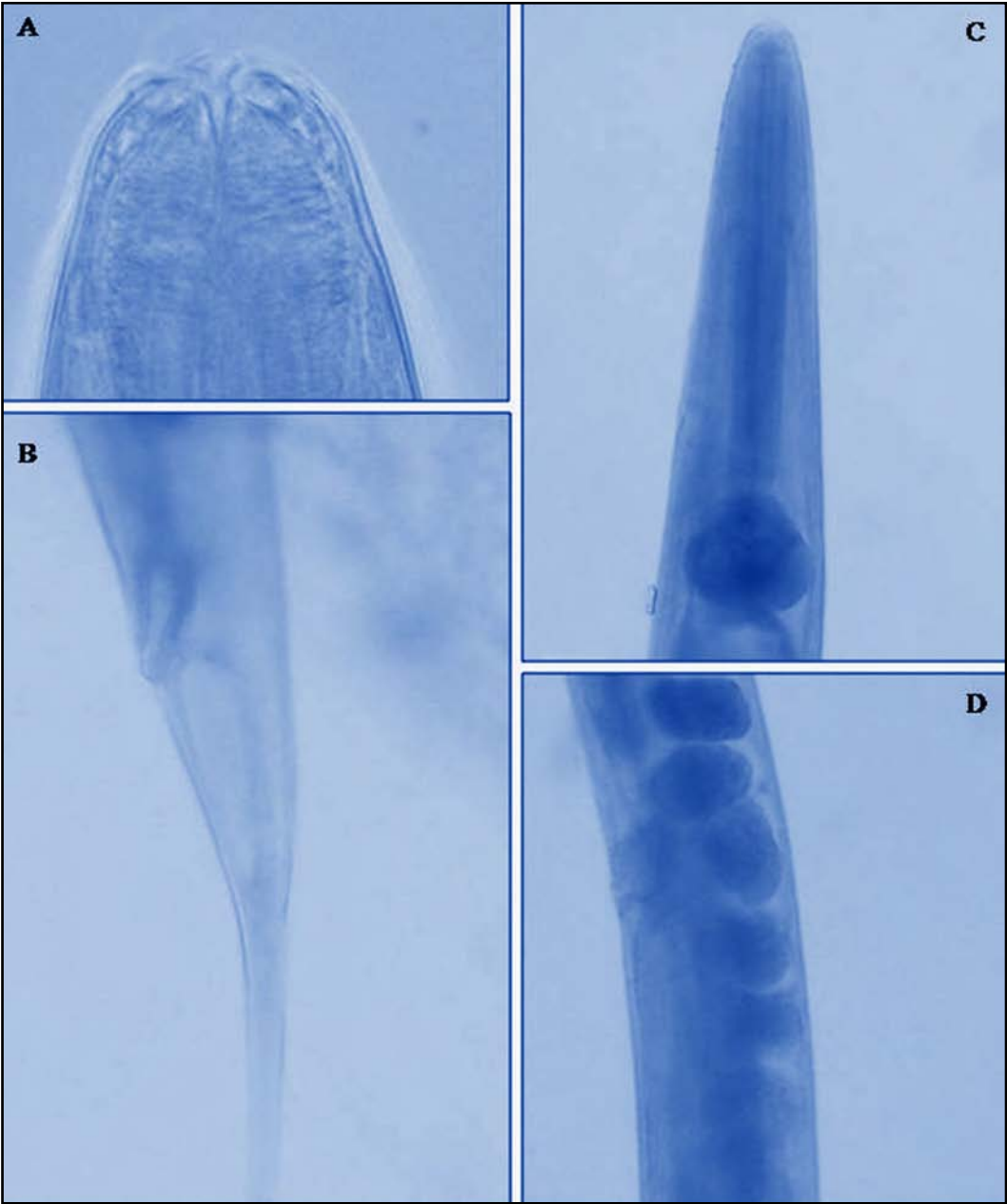
**Fig. 8:** *Rhabdias ranae* (female)  
A. Head region B. Anterior region C. Posterior region



**Fig. 9:** *Strongyloides bufonis* (female)  
A. Anterior region B. Head C. Tail region



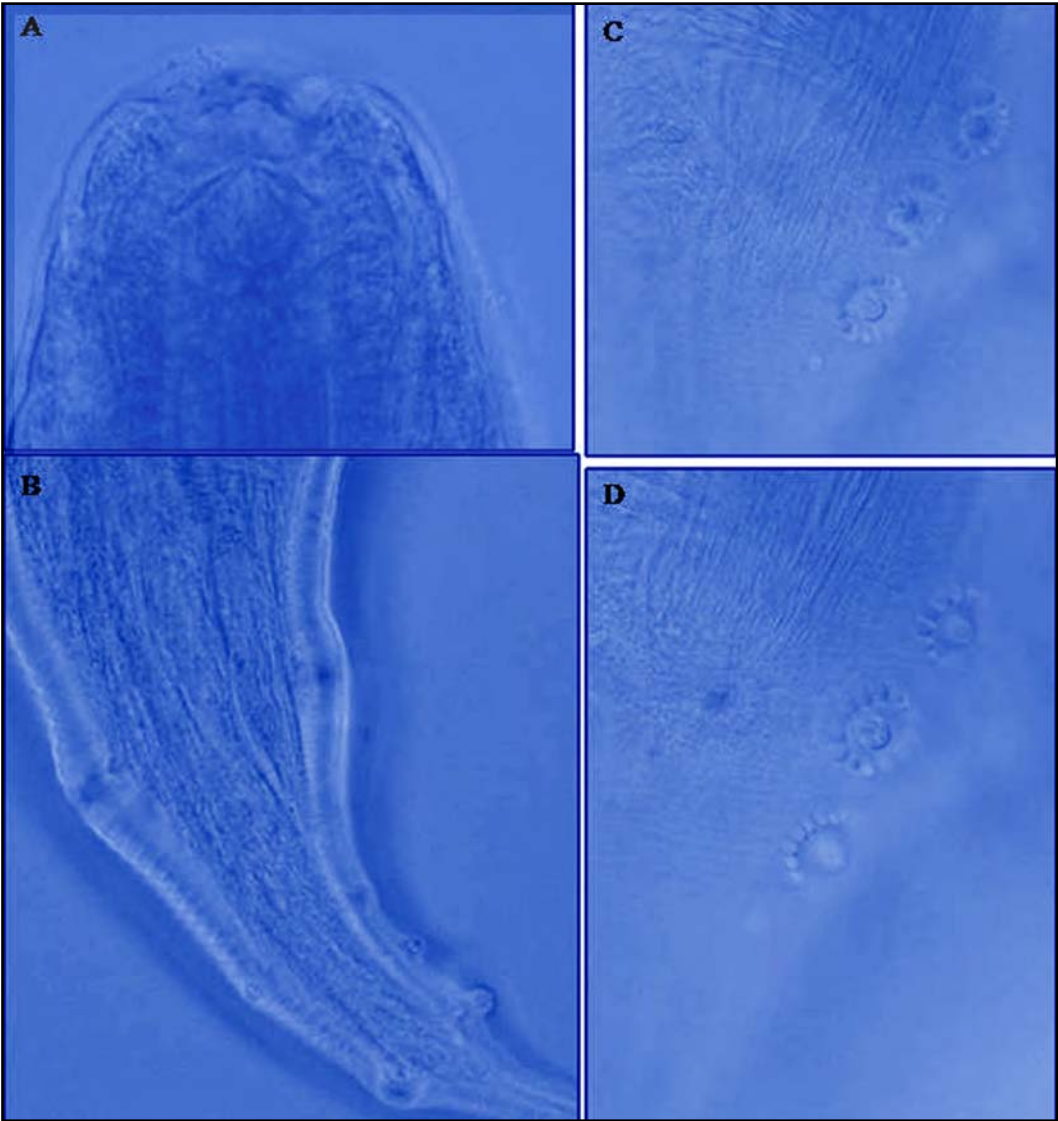
**Fig. 10:** *Oxysomatium macintoshii* (female)  
A. Head region B. Tail region C. Anterior end D. Juveniles in uterus



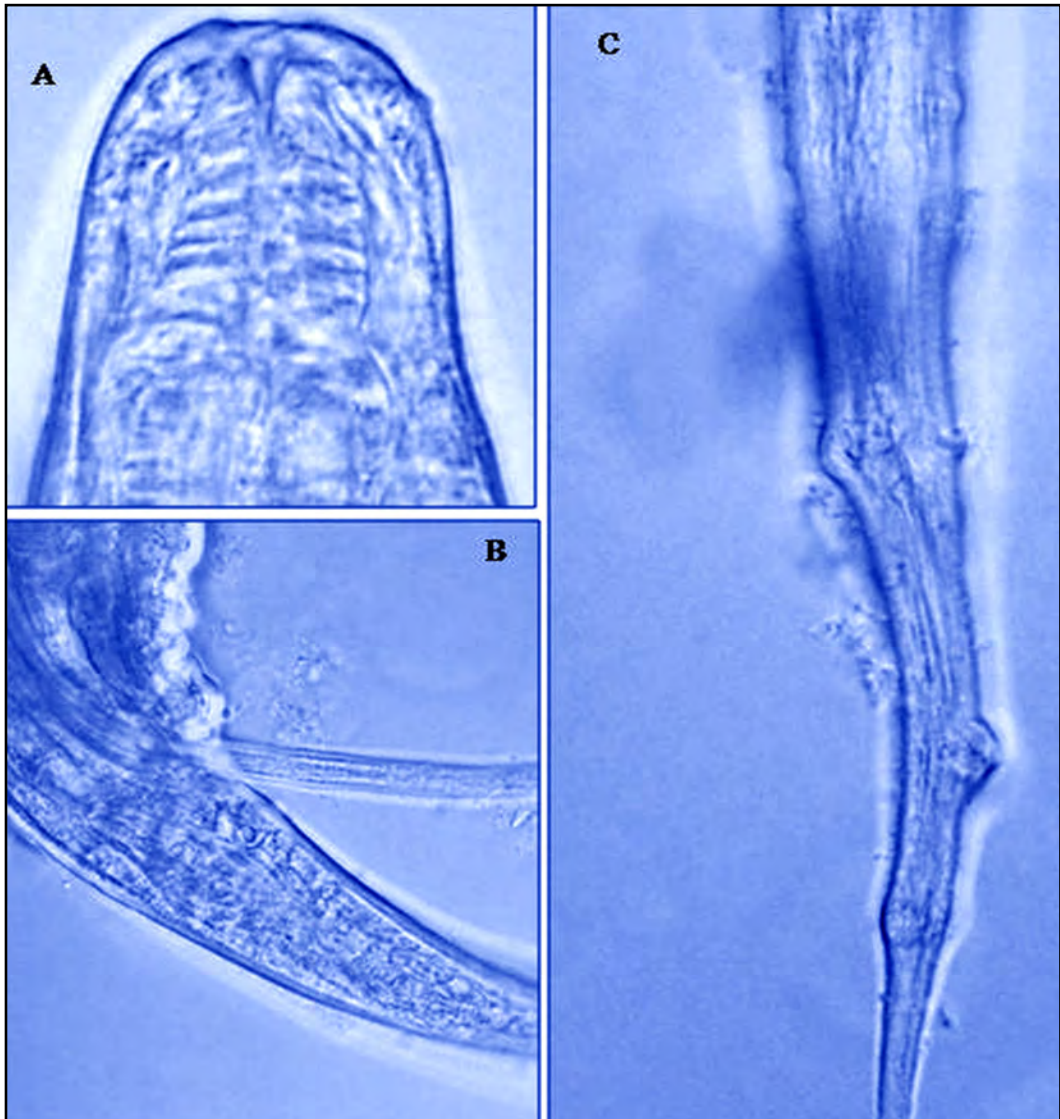
**Fig. 11:** *Oxyssomatium anurae* (female)  
A. Anterior region B. Tail region C. Anterior end D. Gonad



**Fig. 12:** *Aplectana asiatica* (female)  
A. Anterior region B. Head C. Tail region D. Eggs in Uterus



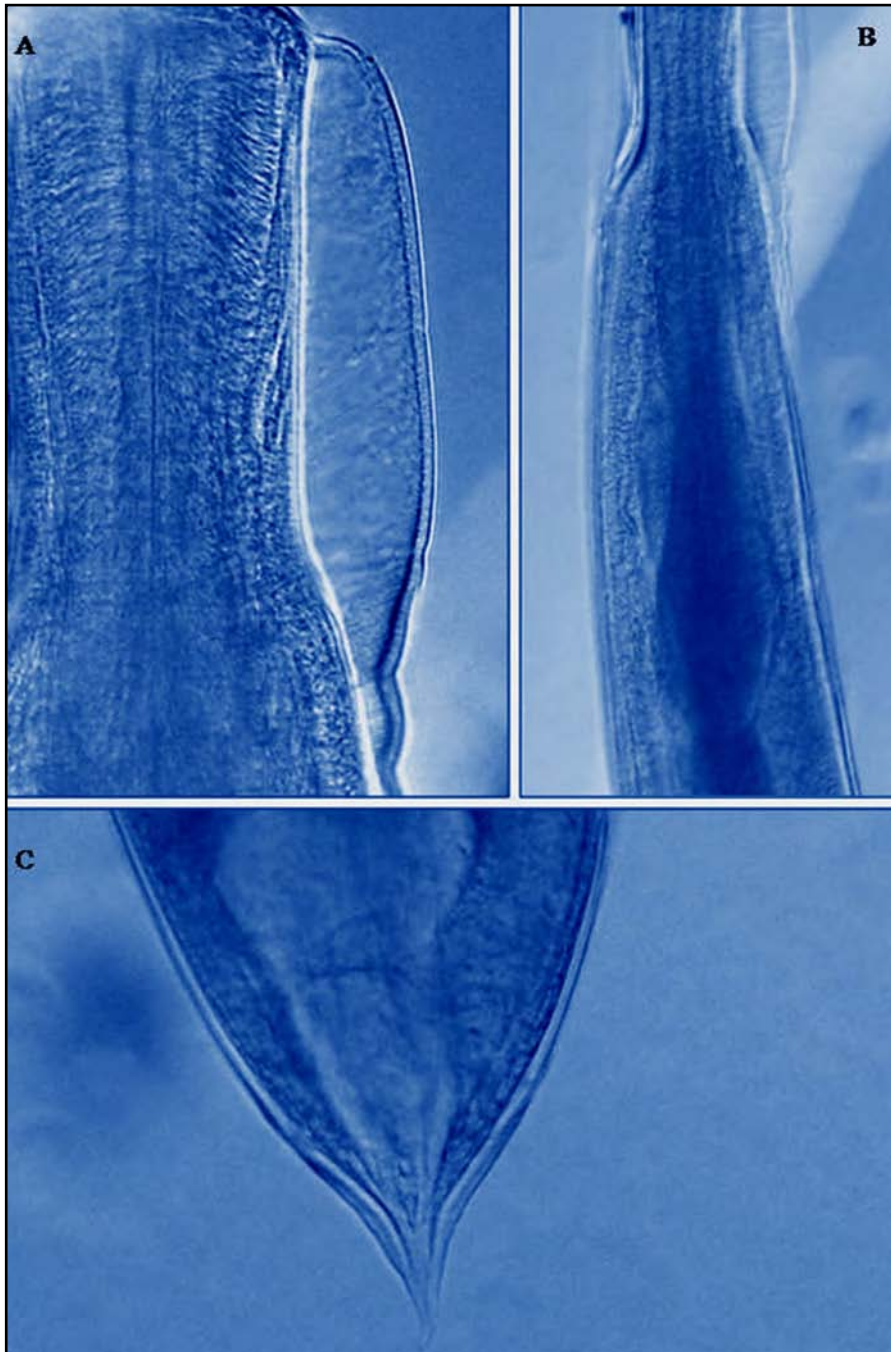
**Fig. 13:** *Cosmocercoides multipapillata* (female)  
A. Anterior region B. Tail C & D. preanal papillae



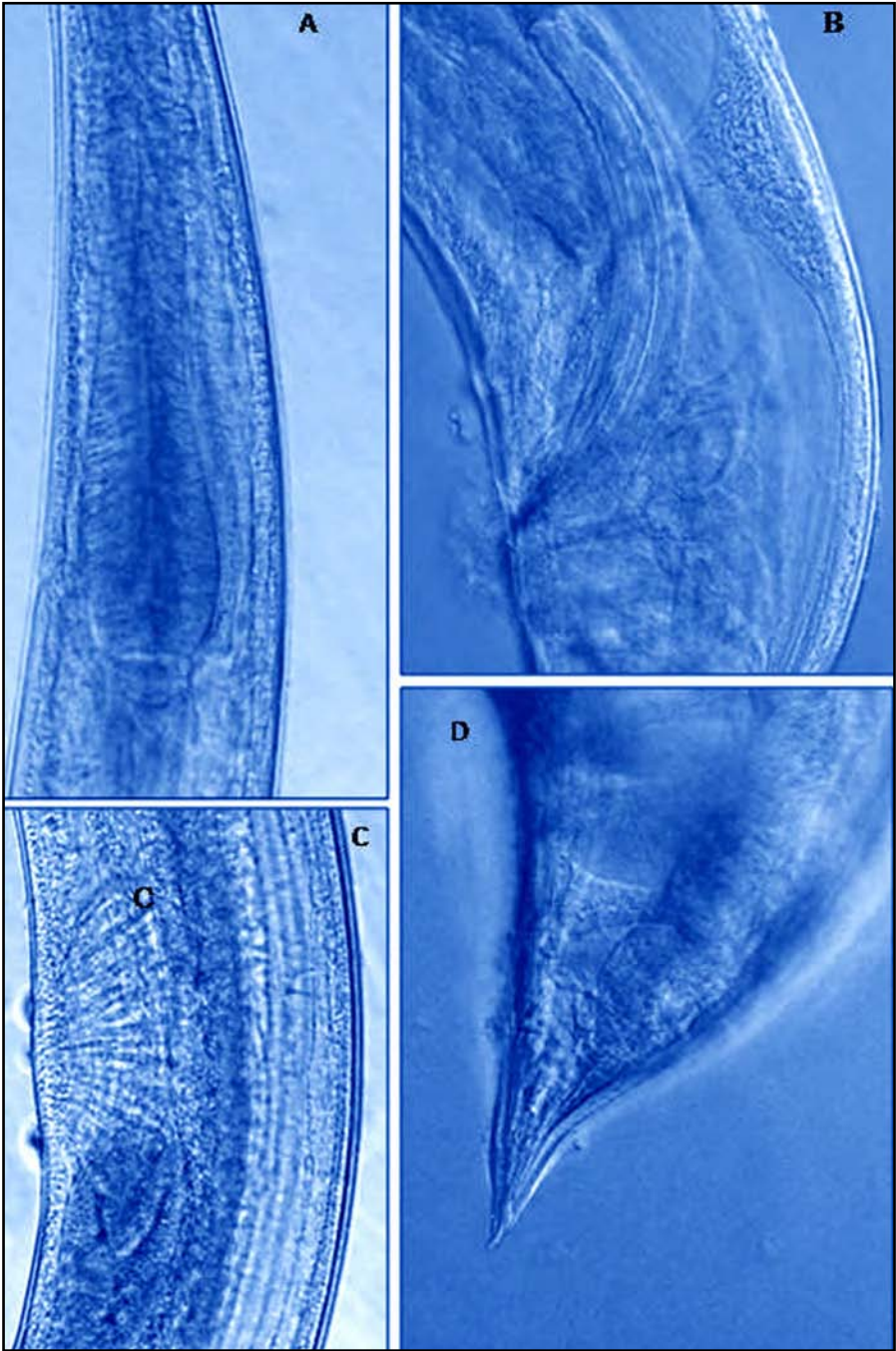
**Fig. 14:** *Cosmocercoides naitalensis* (male)  
A. Head region B. Spicule C. Tail papillae



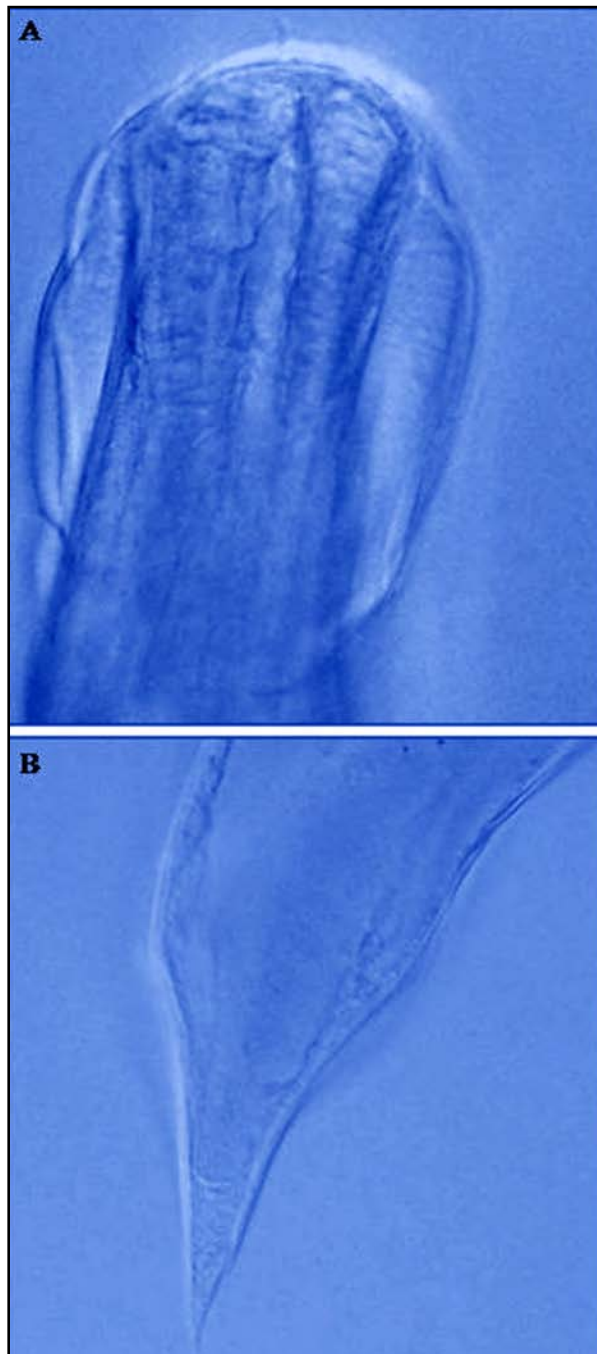
**Fig. 15:** *Cosmocerca parva* (male)  
A. Head region B. Anterior end C & D. Posterior end



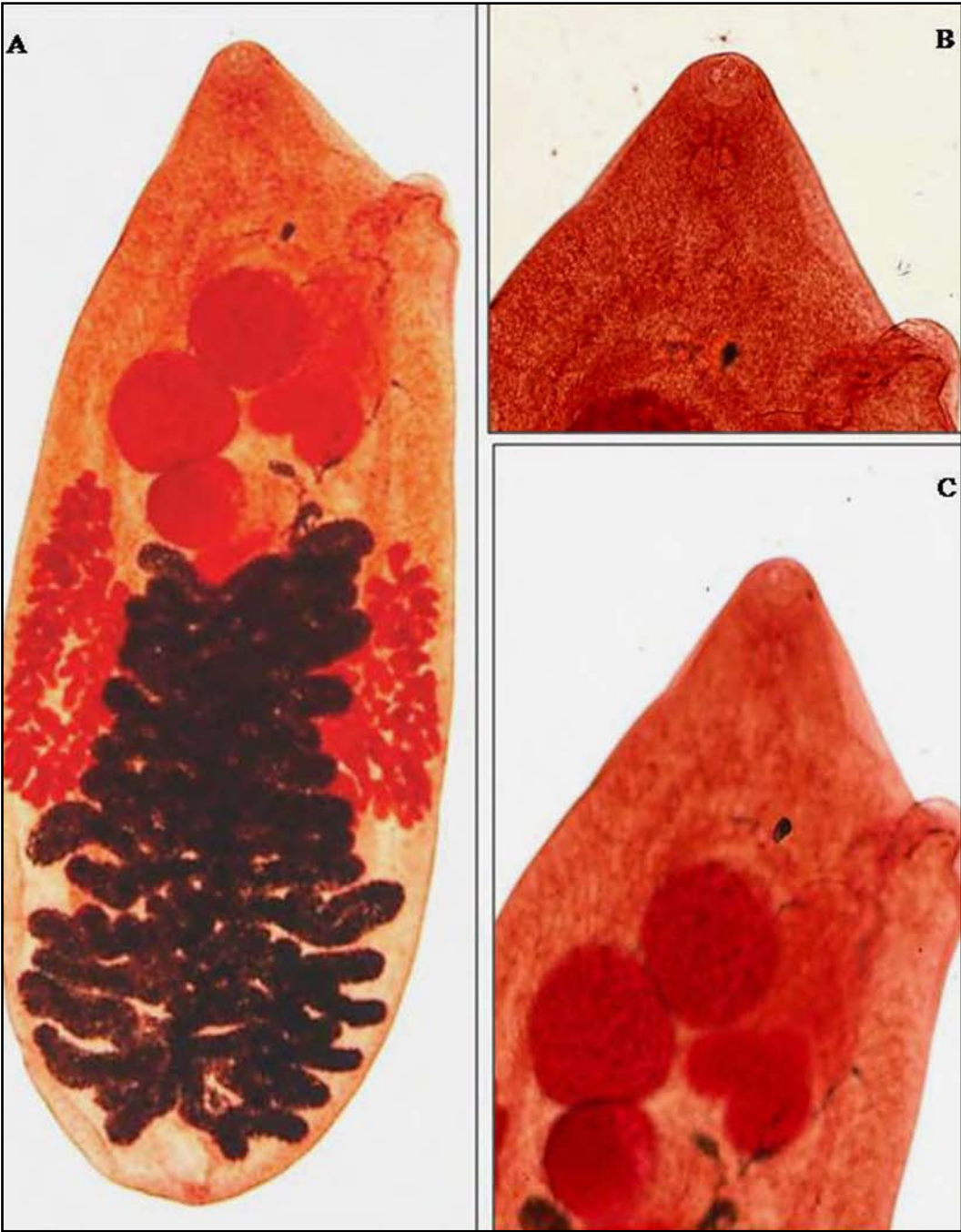
**Fig. 16:** *Gendria chauhani* (female)  
A. Cervical alae B. Anterior end C. Tail



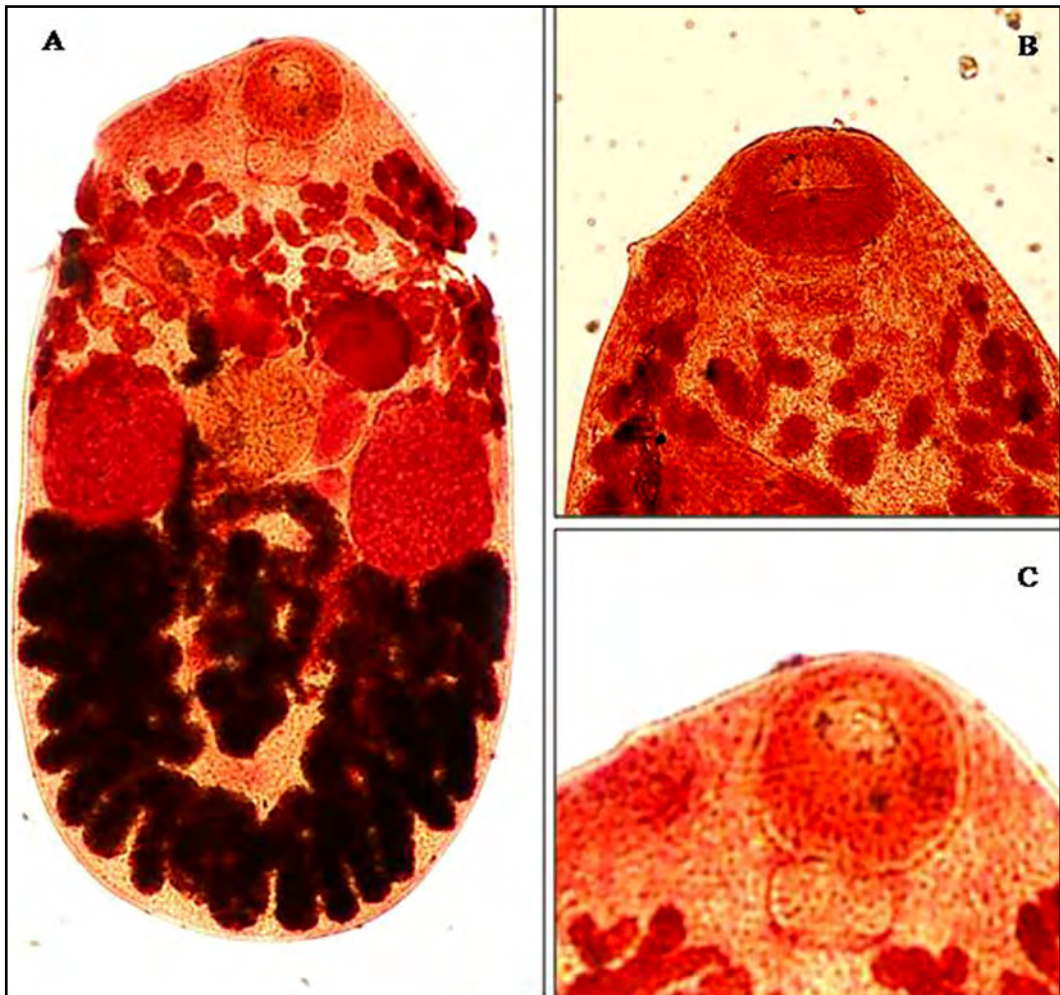
**Fig. 17:** *Gendria chauhani* (male)  
A. Anterior end B. Spicule C. Anal sucker D. Posterior end



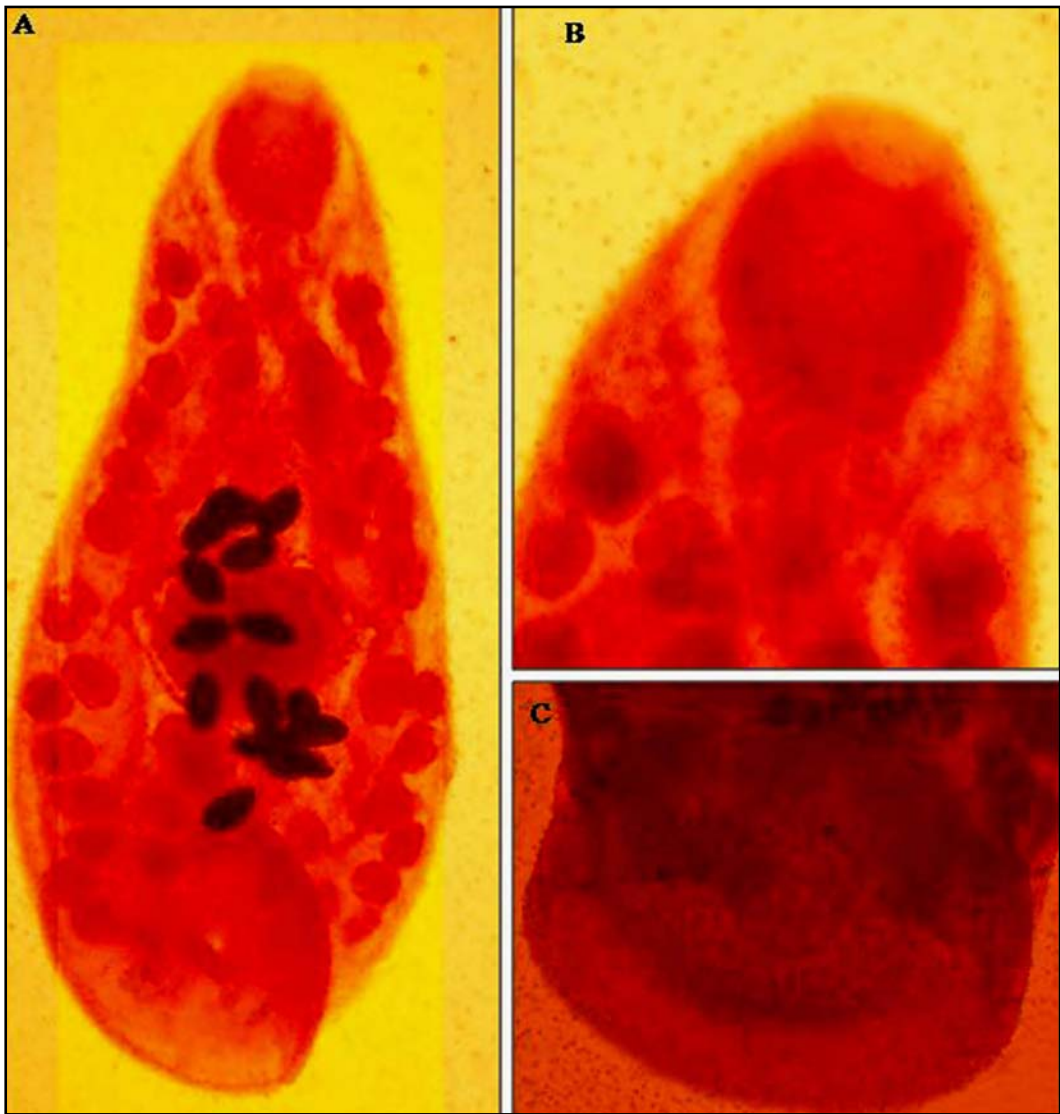
**Fig. 18:** *Subulascaris cyanophlyctis* (female)  
A. Head region B. Tail region



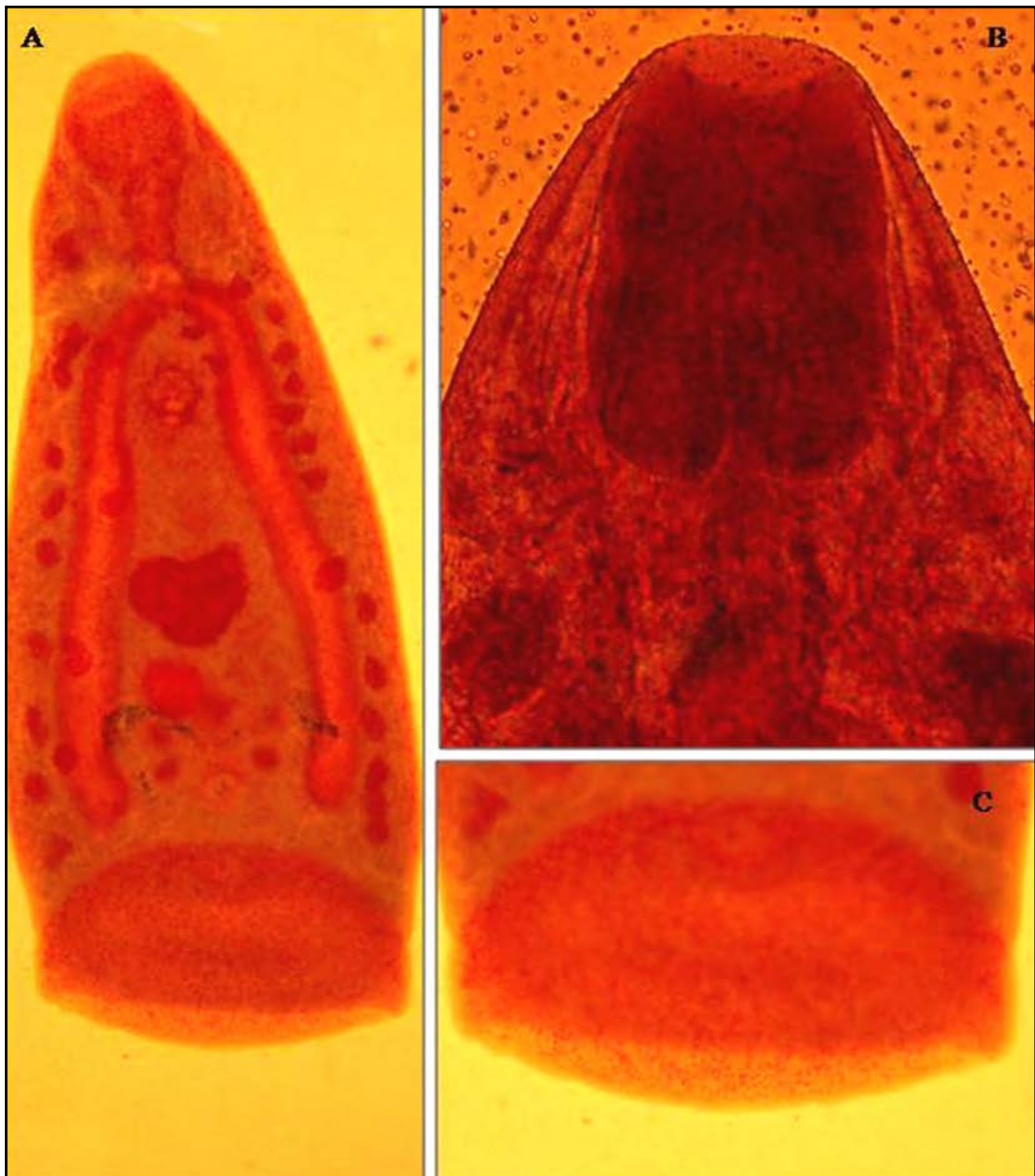
**Fig. 19:** *Ganeo tigrinum*  
A. Whole mount B. Gonopore C. Gonads



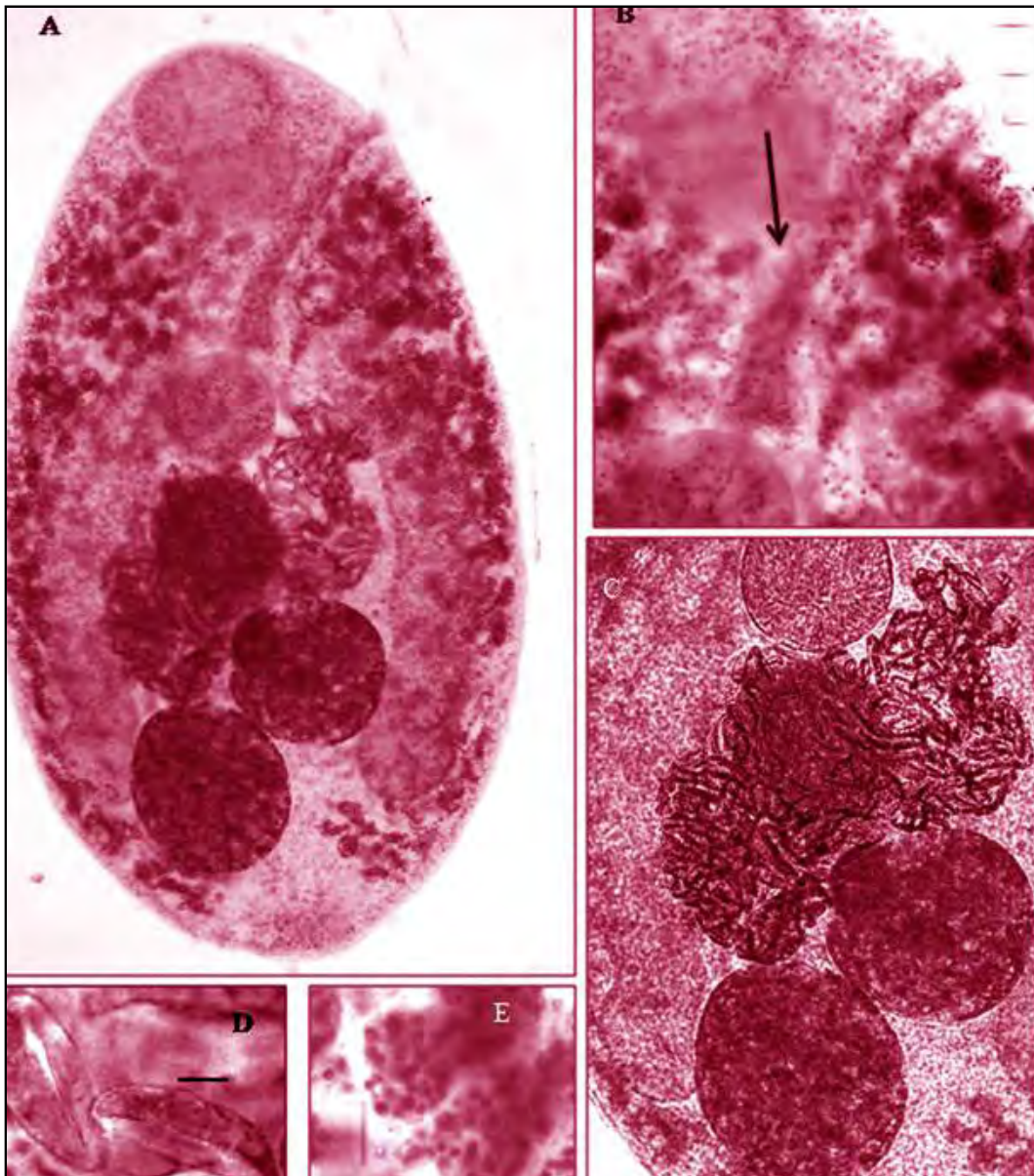
**Fig. 20:** *Pleurogenoides gastroporus*  
A. Whole mount B. Gonopore C. Anterior sucker



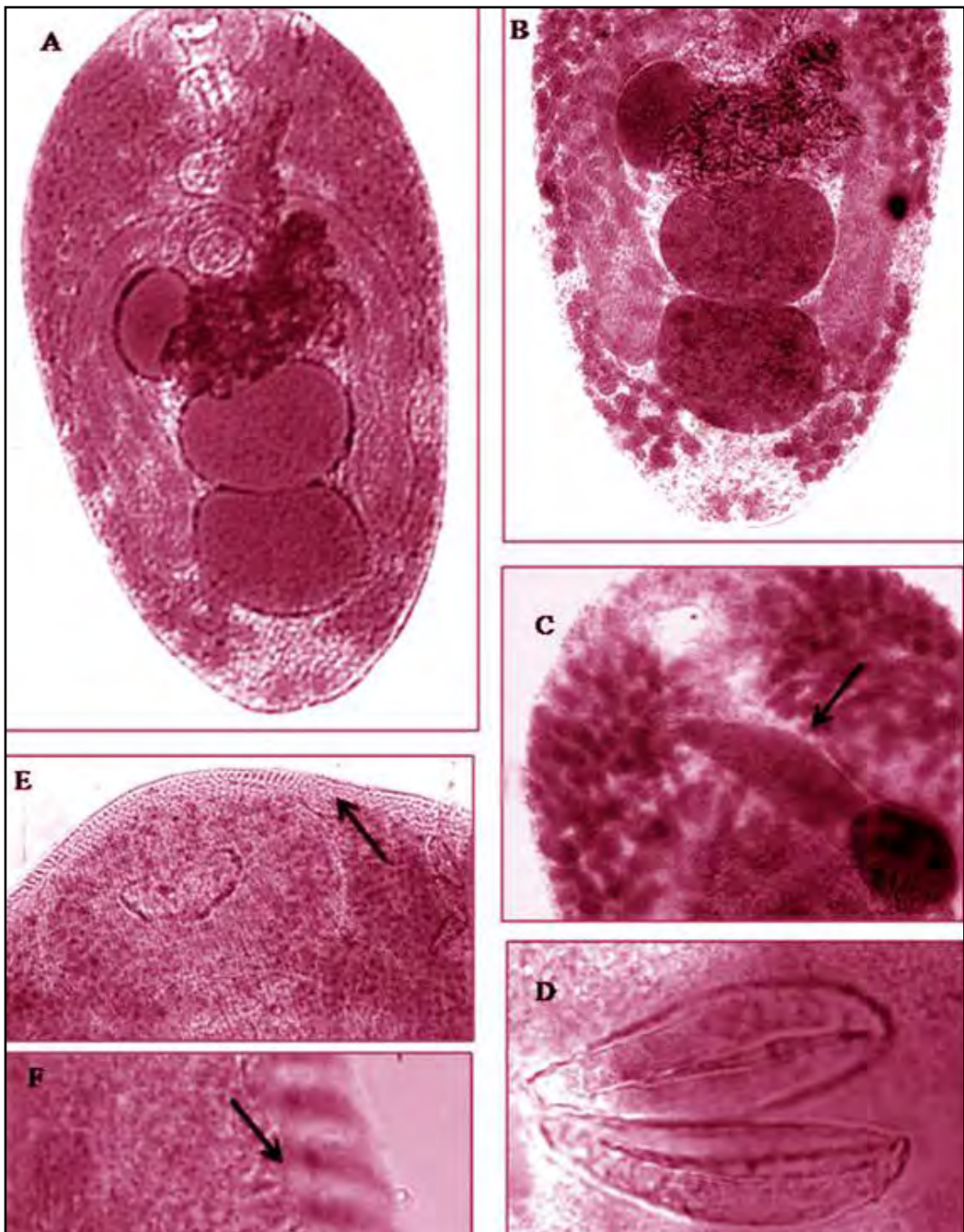
**Fig. 21:** *Diplodiscus mehrai*  
A. Whole mount B. Oral sucker C. Ventral sucker



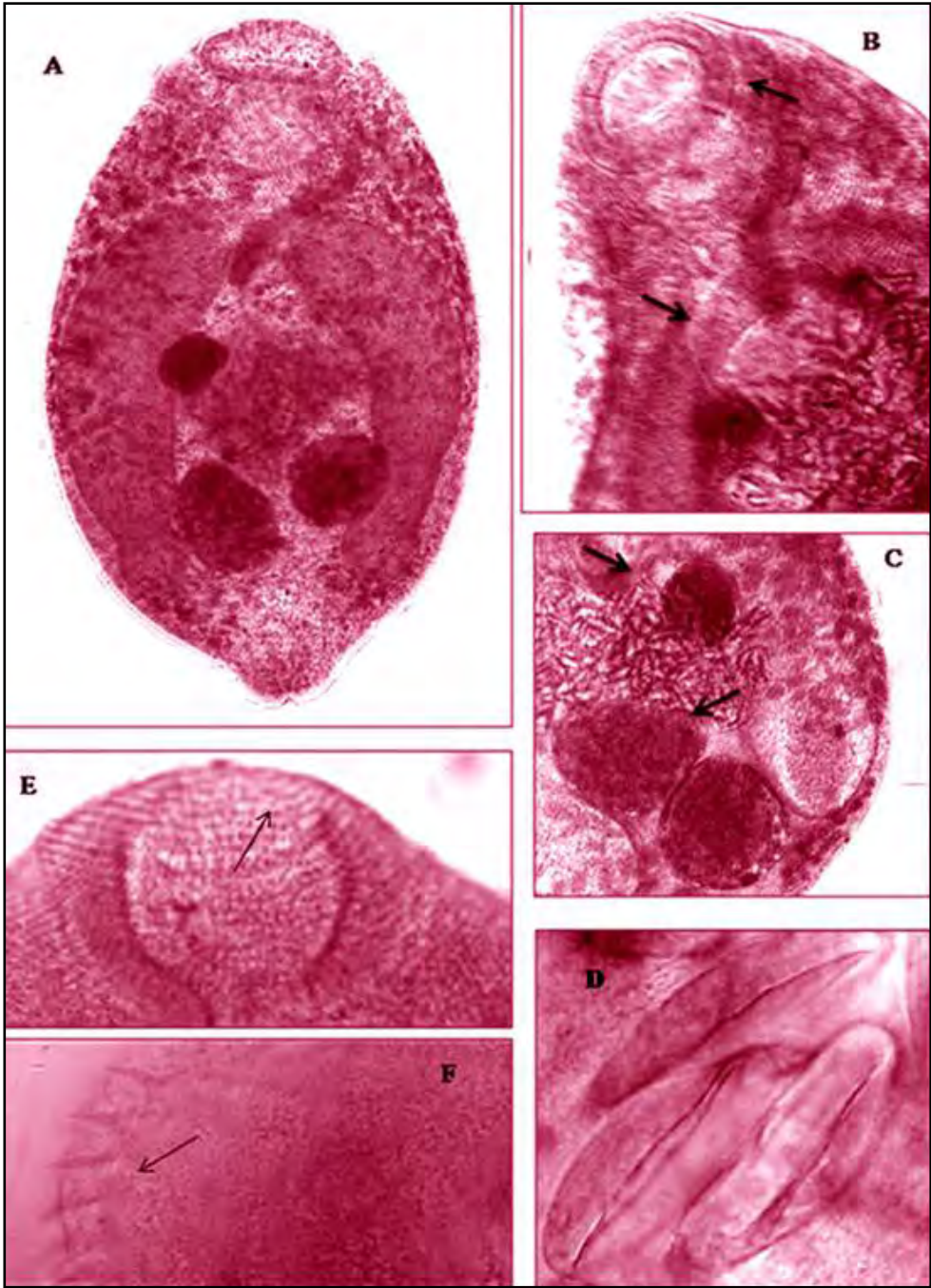
**Fig. 22:** *Diplodiscus amphichrus*  
A. Whole mount B. Oral sucker C. Ventral sucker



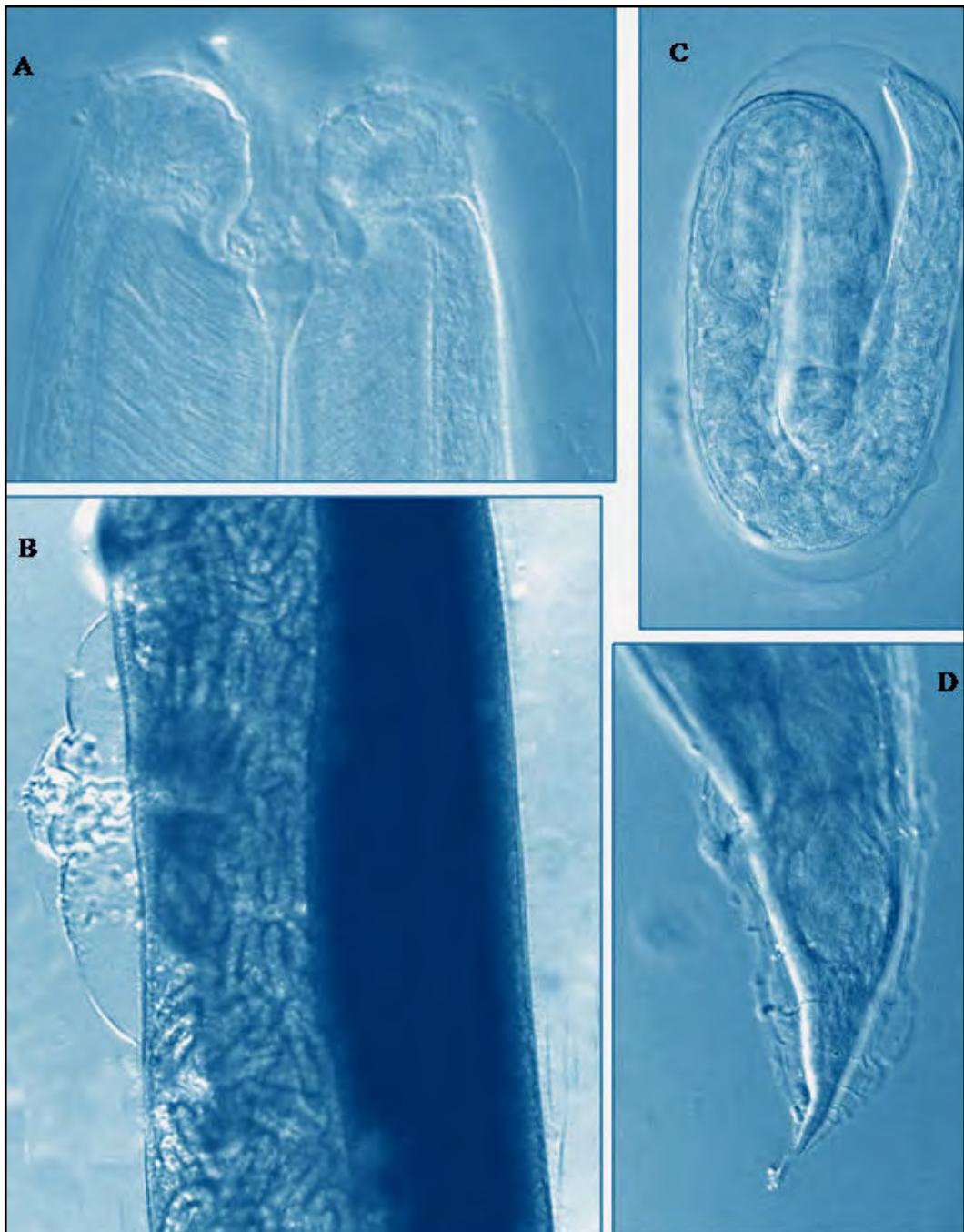
**Fig. 23:** *Batrachotrema korbaensis*  
A. Whole mount B. Cirrus Sac. C. Gonads D. Eggs E. Vitellaria



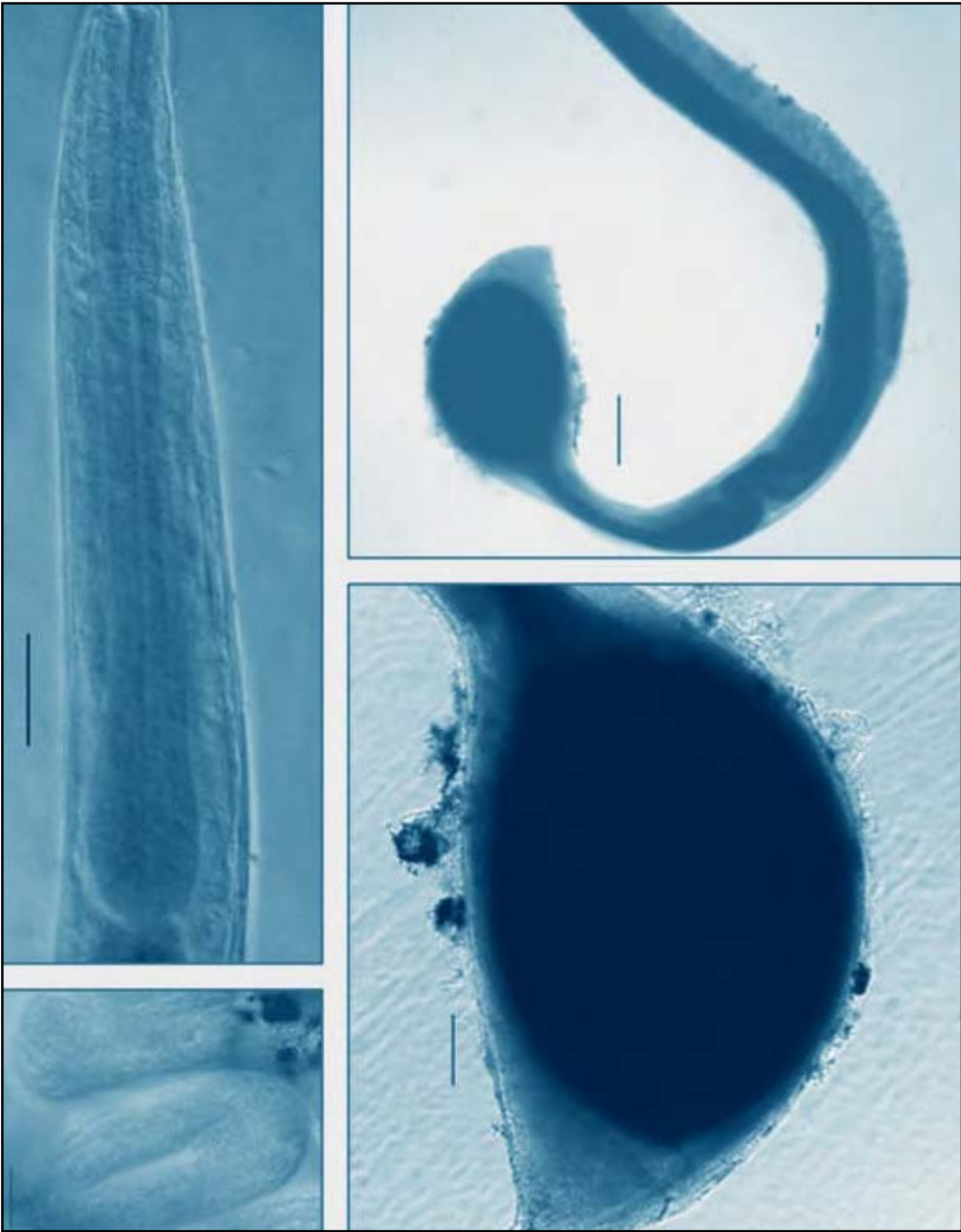
**Fig. 24:** *Opisthioparorchis nanoranae*  
A. Whole mount B. Gonads C. Cirrus Sac D. Eggs E & F. Body spines



**Fig. 25:** *Opisthioparorchis dehradunensis*  
A. Whole mount B. Suckers C. Gonads D. Eggs E & F. Body spines



**Fig. 26:** *Rhabdias himalayanus*  
A. Anterior region B. Vulva C. Egg. D. Tail



**Fig. 27:** *Rhabdias dehradunensis*  
A. Anterior region B. Egg. C. & D. Poaterior region



