



First record of *Echinochasmus prakashi* Gupta and Singh, 1988 (Digenea: Echinostomatidae) in *Nycticorax nycticorax* (Pelecaniformes: Ardeidae) From Hamal Lake, Sindh, Pakistan

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ABSTRACT: The main aim of this paper is to describe first record of *Echinochasmus prakashi* Gupta & Singh, 1988 which was recorded during the study on biodiversity of helminths of *Nycticorax nycticorax* from Hamal Lake, Sindh, Pakistan. Helminthological examination revealed a large number of specimens of genus *Echinochasmus* found in intestine of the host, of which 05 identified as *Echinochasmus prakashi* Gupta & Singh, 1988. They resemble with it in having spinose and medium sized body, oral sucker terminal, head collar reniform with single row of 22 spines, shape and position of cirrus pouch, testes, ovary and vitellaria. *Echinochasmus prakashi* is recorded first time from *Nycticorax nycticorax* and Pakistan is new locality for this species.

Keywords: Avian trematode, *Echinochasmus prakashi*, *Nycticorax nycticorax*, Hamal Lake, Sindh, Pakistan.

INTRODUCTION

Genus *Echinochasmus* Dietz, 1909 is found throughout the world in birds of family Podicipedidae, Ciconiidae, Ardeidae, Accipitridae, and Anatidae. It contains a number of species that are transmitted to human as food borne trematodes. It transmits infection by way of the ingestion of metacercarial cyst by humans with raw or improperly cooked freshwater fish. Human ingesting cercariae of this species of Echinostome may develop an intestinal trematodiasis referred to as Echinochasmiasis (Rim, 1982; Chai and Lee, 2002 and Ujan *et al.*, 2014).

In Pakistan very little work has been done on trematode parasites of birds. Species of genus *Echinochasmus* Dietz, 1909 reported from Pakistan by Ujan *et al.*, 2014, Dharejo *et al.*, 2010, Channa *et al.*, 2009, Dharejo *et al.*, 2007 and Bhutta and Khan, 1975. These were collected from the Bank Myna *Acridotheres ginginianus*, House Sparrow *Passer domesticus*, Pond Heron *Ardeola grayii* and Paddy Bird *Ardeola gyayii*. None of the researchers studied Black Crowned Heron *Nycticorax nycticorax*, therefore, the present study was planned.

The Black Crowned Night Heron *Nycticorax nycticorax* is a medium sized bird, commonly occurs in all biogeographic regions. It inhabits in swamps, streams, rivers, marshes, mud flats and the banks of

lakes (Davis, 1993). Black-Crowned Night Heron is an opportunistic bird which feeds on fishes, leeches, earthworms, insects, crayfish, mussels, squids, amphibians, lizards, snakes, rodents, birds, eggs, carrion, plant materials and garbage. It hunts alone and defends its feeding area. Black-Crowned Night Herons have been captured for food, but it is not favorite dish. At fish hatcheries, fishermen consider it as a destructive pest (Davis, 1993). As it is an aquatic bird which feeds and excretes in water or on shore of water body. The literature reveals that this bird harbors a variety of helminth parasites which release their eggs through the feces in the water. The excreted eggs and developmental stages of helminths are ingested by the fishes and other birds present in that habitat and become infected with particular helminth parasite and become infected. For these reasons, it was studied by many researchers in the world including Emily *et al.*, 2016; Lisitsyna, 2015; Sutili, 2014; Ortega-Olivares *et al.*, 2013; Sitko, 2012; Pilar *et al.*, 2005; Nogueserola, 2002; María *et al.*, 2002; Scholz and Salgado, 2001; Vanessa *et al.*, 2001; Amin, 1998; Schmidt, 1975; Yamaguti, 1971, 1941; Sogandares-Bernal, 1960; Sogandares-Bernal and Hutton, 1960; Mahon, 1956; Olsen, 1937; Witenberg, 1932; Travassos, 1928, 1926, 1917; Witenberg, 1926; Van Cleave, 1925; Seurat, 1920; Barker, 1911; Braun, 1899; Braun, 1899 and Stossich, 1890.

It was decided to find the incidence of helminths in Pakistan in birds and as a result, the present report dealing with the first record of host and locality record of *Echinochasmus prakashi* is presented here.

MATERIALS AND METHODS

A. Study area

Hamal Lake is the habitat of resident and migratory birds. It is located in Qambar Shahdadkot District in Sindh, Pakistan and spread over 2965 acres. The length of the lake is 25 km and the width is 10 km (https://en.wikipedia.org/wiki/Hamal_Lake). It is great nursery of wild life and attracts a lot of migratory and resident birds. Host under study is least concern bird on IUCN list and commonly found in Pakistan in every wetland (Roberts, 1991) especially in proposed study area, the Hamal Lake.

B. Host

Black Crowned Night Heron *Nycticorax nycticorax* is a medium sized with nocturnal feeding habits and commonly occurs in all biogeographic regions. It also migrates to favorable habitats. It inhabits in swamps, streams, rivers, marshes, mud flats and the banks of lakes (Davis, 1993). Adult Black-Crowned Night Heron is short-necked, short-legged, and stout with a primarily brown or gray plumage with black crown. Young one is brown, flecked with white. Black-Crowned Night Herons have been captured for food, but it is not favorite dish. At fish hatcheries, fishermen consider it as a destructive pest (Davis, 1993).

C. Helminthological examination

Black-Crowned Night Herons were brought alive from District Qambar Shahdadkot of Sindh, Pakistan during December 2016- July 2017, in the Parasitology laboratory of Department of Zoology, University of Sindh, Jamshoro. A total of twelve host birds were anesthetized and dissected. The visceral organs, including esophagus, gizzard, intestine, liver, heart and lungs were separated and kept in different petri dishes in normal saline. These organs were teased gently with needle. The samples were examined on stereomicroscope for the presence of helminth parasites. The collected trematodes were passed and fixed in 70% ethanol and pressed for overnight, stained with borax carmine, gradually dehydrated in alcohol series, cleared in clove oil and xylol. They were permanently mounted in Canada balsam. Olympus BH2-DA Drawing attachment was used to make drawing line and photograph was taken with OMAX Digital USB Microscope Camera. The measurements were taken in millimeter (mm) otherwise the unit is stated properly. The identification of specimens was

made accordance to keys given by Jones *et al.*, 2002, Yamaguti, 1971 and relevant literature.

RESULTS

During present study 12 Black-Crowned Night Herons were examined and two were infected with 05 specimens. These were recovered from the intestine of the hosts. The description of specimens is given below.

A. Description

Body spinose medium sized measuring 4.56 in length and 0.93 in width. Oral sucker is terminal measuring 0.18 in length and 0.18 in width. Head collar is kidney shaped and equipped with 22 hooks. Pre-pharynx short tube and 0.18 in length. Pharynx round and 0.12 in diameter. Esophagus slightly broader 0.56 in length. Ceca bifurcated in front of cirrus sac and ventral sucker and measuring 3.12 in length and 0.87 in width. Cirrus sac large 0.43 in length and 0.25 in width, lies between cecal arch and ventral sucker slightly overlapping ventral sucker. Ventral sucker is larger than the oral sucker and measuring 0.68 in length and 0.56 in width. Ovary small and round and 0.125 in diameter. Testes irregular shaped and contiguous. Anterior testis slightly lobed and 0.343 in length and 0.468 in width, whereas, posterior irregular shaped measuring 0.37 in length and 0.43 in width. Post testicular area is 0.75 in length.

Taxonomic summary

Family: Echinostomatidae

Subfamily: Echinochasminae

Genus: *Echinochasmus* Dietz, 1909

Species: *Echinochasmus prakashi* Gupta and Singh, 1988

No. of specimens recovered: 05

No. of hosts found positive: 02

Site of infection: Intestine

Locality: Hamal lake, Sindh, Pakistan

Status: First record

DISCUSSION

The Genus *Echinochasmus* Dietz, 1909 was proposed to accommodate trematodes collected from avian and mammalian host. The genus *Echinochasmus* is plump and sometime elongated body shaped trematode and broadest at hind body. It has well developed reniform head collar with single row of spines. Ventral sucker is considerably apart from oral sucker. Testes are rounded or irregular shaped, tandem and usually found about middle of hind body. Cirrus pouch is almost entirely anterior to acetabulum or partly overlapped. Ovary is round to oval, submedian or practically median, uterus short, vitellaria commencing at level of acetabulum or immediately behind it.

Description of present specimen resembles above diagnostic feature of genus. Hence placed in this genus.

Many species of genus are described from different parts and host of world (Table 1). We have separated them into different groups on the basis of number of spines. Those who have more or less than 22 head collar spines are exempted from discussion.

As present specimen has 22 spines in head collar so species with 22 spines are considered for discussion along with those which are collected from Pakistan and host (*Nycticorax nycticorax*).

Table 1: Species of genus *Echinochasmus* Dietz, 1909 with hosts and locality.

S. No.	Name of species	Name of Host	Locality
1	<i>E. accipiteri</i> Bhutta and Khan, 1975	<i>Accipiter badius</i>	Pakistan
2	<i>E. amphibolus</i> Kotlan, 1922	<i>Phalacrocorax carbo</i> , <i>Ardea cinerea</i> , <i>Botauruss tellaris</i> , <i>Nycticorax nycticorax</i> , <i>Podiceps griseigena</i> , <i>Gallinula chloropus</i>	Britain, Pakistan
3	<i>E. antigonus</i> Gupta, 1955	<i>Antigone antigone</i>	India
4	<i>E. bagulai</i> Verma, 1935,	<i>Ardeola grayii</i> , <i>Nycticorax nycticorax</i> , <i>Gorsakius goisagi</i> , <i>Ardea purpurea</i> , <i>Ardeola grayii</i>	India, Slovakia, Pakistan
5	<i>E. beleocephalus</i> Dietz, 1909	<i>Ardea cinerea</i> , <i>A. purpurea</i> , <i>A. comata</i> , <i>Egretta alba</i> , <i>Nycticorax nycticorax</i>	Europe, Siberia
6	<i>E. beleocephalus chankensis</i> Oshmarin et Dozenko, 1915	<i>Anas platyrhynchos</i> , <i>Ardea cinerea</i> ,	--
7	<i>E. botaui</i> Baer, 1923	<i>Botauruss tellaris</i>	Europe
8	<i>E. coaxatus</i> Dietz, 1909	<i>Colymbus cristatus</i> , <i>C. griseigena</i> , <i>C. nigricollis</i> , <i>C. caspicus</i> , <i>Ciconia ciconia</i> , <i>Anas platyrhynchos</i> ,	Europe, Central Asia, Siberia
9	<i>E. cohensi</i> Rao, 1951	<i>Larus argentatus</i>	Canada, Russia
10	<i>E. colymbi</i> Oshmarin, 1950	<i>Colymbus griseigena</i> , <i>Podiceps nigricollis</i>	Kamchatka, Kazakhstan
11	<i>E. dietzevi</i> Issaichikoff, 1927	<i>Colymbus cristatus</i> , <i>C. griseigena</i> , <i>C. ruficollis</i> , <i>Proctopus nigricollis</i> , <i>Mergus merganser</i> , <i>Larus</i> , <i>Aythya</i> , <i>Anas</i>	Russia, Poland
12	<i>E. donaldsoni</i> Beaver, 1941	<i>Podilymbus podiceps</i>	--
13	<i>E. euryporus</i> Looss, 1896	<i>Milvus parasiticus</i> , <i>M. parasiticus</i> , <i>M. korschun</i> , <i>Circus aeruginosus</i> , <i>C. macrourus</i> , <i>C. melanoleucus</i>	Egypt, Russia, Siberia, Central Asia, India
14	<i>E. recurvispinus</i> Oshmarin, 1956	<i>Milvus parasiticus</i> , <i>M. parasiticus</i> , <i>M. korschun</i> , <i>Circus aeruginosus</i> , <i>C. macrourus</i> , <i>C. melanoleucus</i>	Egypt, Russia, Siberia, Central Asia, India
15	<i>E. famelicus</i> Odhner, 1910	<i>Leptoptilos javanicus</i> , <i>Pseudotantalus ibis</i>	Colombo, White Nile
16	<i>E. gorsaki</i> Yamaguti, 1939	<i>Gorsakius goisagi</i> , <i>Capella gallinago gallinago</i> , <i>Rostratula b. bengalensis</i>	Japan
17	<i>E. haliasturis</i> Odening, 1962	<i>Haliastur indus</i>	Berlin Zoo
18	<i>E. jamshorensi</i> Channa et al., 2009	<i>Ardeola grayi</i>	Pakistan
19	<i>E. japonicus</i> Tanabe, 1926	<i>Egretta intermedia</i> , <i>Milvus migrans lineatus</i> , <i>Bucephala c. clangula</i> , <i>Nycticorax n. nycticorax</i>	Japan
20	<i>E. liliputanus</i> Looss, 1896	<i>Pernis apivorous</i> , <i>Milvus parasiticus</i> , <i>Ardea cinerea</i>	Egypt, Syria
21	<i>E. mazharuddini</i> Ujan et al., 2014	<i>Acridotheres ginginianus</i>	Pakistan
22	<i>E. megavitellus</i> Lal, 1939	<i>Ardeola grayii</i>	India
23	<i>E. mergipalaearticus</i> Odening, 1963	<i>Mergus m. merganser</i>	Berlin Zoo
24	<i>E. microacetabulum</i> Leonov, 1958	<i>Larus argentatus</i>	Russia
25	<i>E. militaris</i> Leonov, 1959	<i>Ardea cinerea</i> and <i>Egretta alba</i>	Russia
26	<i>E. milvi</i> Yamaguti, 1939	<i>Milvus migrans lineatus</i>	Japan

S. No.	Name of species	Name of Host	Locality
27.	<i>E. mirus</i> Mendheim, 1940	<i>Somateria mollissima</i>	
28.	<i>E. mohiuddini</i> Dharejo <i>et al.</i> , 2007	<i>Ardeola grayi</i>	Pakistan
29.	<i>E. mordax</i> (Looss, 1899)	<i>Pelecanus onocrotalus</i> , <i>P. crispus</i> , <i>Pelecanus rufescens</i> , <i>Podiceps auritus</i> , <i>Mergus serrator</i> ,	Egypt, Rumania, Russia Congo, Poland, Sweden
30.	<i>E. muraschkinzewi</i> Bashkistrova. 1941	<i>Pelecanus crispus</i> , <i>P. rufescens</i>	Russia, Bulgaria
31.	<i>E. muraschkinzewimilonis</i> Gretillat et Morel, 1961	<i>Pelecanus onocrotalus</i>	Afrique Noire
32.	<i>E. narayani</i> Mudaliar, 1938	<i>Milvus migrans govinda</i>	India
33.	<i>E. novalichesensis</i> Tubangui, 1932	<i>Hypotaenidia torquata</i>	Philippines
34.	<i>E. oligolecithosus</i> Mendheim, 1940	<i>Egretta alba</i>	Russia
35.	<i>E. passerii</i> Dharejo <i>et al.</i> , 2010	<i>Passer domesticus</i>	Pakistan
36.	<i>E. pelecani</i> Johnston et Simpson, 1944	<i>Pelecanus conspicillatus</i>	S. Australia
37.	<i>E. pitangi</i> (Lutz, 1924) Price, 1931	<i>Pitangus (Sauroctonus) sulfurous</i>	Brazil, Venezuela
38.	<i>E. podicepensis</i> Bhardwaj, 1962	<i>Podiceps sruficollis</i>	India
39.	<i>E. prakashii</i> Gupta & Singh, 1988	<i>Ardeola grayi</i> , <i>Nycticorax nycticorax</i>	India, Pakistan (Present study)
40.	<i>E. ruficapensis</i> Verma, 1935	<i>Podiceps ruficollis</i> var. <i>capensis</i> , <i>Nycticorax nycticorax</i>	India, Astrakhan
41.	<i>E. spinosus</i> (Odhner, 1910)	<i>Anhinga rufa</i>	North and East Africa
42.	<i>E. spinulosus</i> Rud., 1809	<i>Colymbus cristatus</i> , <i>C. griseigena</i> , <i>C. auritus</i> , <i>C. caspicus</i> , <i>Urinator arcticus</i> , <i>Fuligul amarila</i> , <i>Machetes pugnax</i>	Europe
43.	<i>E. squamatus</i> Mendheim, 1940	<i>Podiceps cristatus</i>	Europe
44.	<i>E. tobi</i> Yamaguti, 1939	<i>Milvus migrans lineatus</i>	Japan
45.	<i>E. zubedakhaname</i> Nasir, 1968	<i>Fluvicola pica</i>	

Present specimen has plump and elongated shaped body measuring 4.56×0.93 . Whereas, *Echinochasmus praskashi*, $0.97-1.62 \times 0.30-0.31$, *E. cohensi* 2.2 , *E. euryporus* $3-4 \times 0.85$, *E. gorsakii* $1.9-3.4 \times 0.32-0.54$, *E. microacetabulum* $0.70-0.93 \times 0.28-0.34$, *E. milvi* $0.7-1.2 \times 0.27-0.32$, *E. mirus* 2.08×0.48 , *E. mordax* $1.65 \times 0.3-0.35$, *E. muraschkinzewi* $1.72 \times 0.35-0.385$ in body size. These data show resemblance of present specimen with *E. euryporus* in body size. However, literature search reveals very scanty and inadequate information about this species and many other species with 22 head collar spines except *Echinochasmus praskashi*. It differs with present in size of body and various other organs, but resembles it in number of head collar spines shape and position of organs. The difference size may be due to different ecological and geographical factor and feeding behavior of host. Authors have decided to place specimen as *Echinochasmus praskashi* on the bases of head collar shape, number of head collar spine, shape and position

of various, the issue of diverging feature of size of body would be resolved in future and appropriate molecular study.

Furthermore, many species of *Echinochasmus* are so far described from *Nycticorax nycticorax* from Europe and Asia. These are: *E. amphibolus* Kotlan, 1922, *E. bagulai* Verma, 1935, *E. japonicus* Tanabe, 1926, *E. ruficapensis* Verma, 1935. The *E. amphibolus* is $4.16-5.16 \times 0.765$ in size of body and spines 24 head collar spines. It resembles with present specimen in size of body but differ in number of head collar spines. Therefore, on the basis of head collar spines present one cannot be placed with *E. amphibolus*. The *E. bagulai* Verma, 1935 differs from present in having smaller body size $0.77-1.35 \times 0.26-0.4$, and 24 head collar spines. The *E. japonicus* Tanabe, 1926 also varies in size of body, 0.76×0.19 and 24 head collar spines. *E. ruficapensis* Verma, 1935 is very close to present in size of body $2.5-3.5 \times 0.4-0.6$, but differ in having 24 number of head collar spine.

Therefore, these species which are collected from *Nycticorax nycticorax* differs with present in size of body, shape and position of organs and number of head collar spines, hence, *Echinchasmus prakashi* forms first host record in *Nycticorax nycticorax*. As, it is briefed above that some species of genus *Echinochasmus* Dietz, 1909 are collected from Pakistan. These include *E. mazharuddini* Ujan *et al.*, 2014, *E. passerii* Dharejo *et al.*, 2010, *E. jamshorensi* Channa *et al.*, 2009, *E. mohiuddini* Dharejo *et al.*, 2007, *E. accipiteri* Bhutta and Khan, 1975, *E. amphibolus* Kotlan, 1922 and *E. bagulai* Verma, 1935.

E. accipiteri was collected from *Accipiter badius*, differs from present specimen in body size 2.2×0.5 , and head collar spines (24). *E. amphibolus* was collected from *Gallinula chloropus* and resembles with present in body size, 2.575-4.029, but differ in having 24 head collar spines. *E. Bagulai* also reported from Pakistan in *Ardeola grayii* differs with present form in size of body 1.090-1.272, and number of head collar spines. *E. passerii* collected from *Passer domesticus* and differ in having smaller body size 0.725×0.285 , and 26 head collar spines. *E. jamshorensi* collected from *Ardeola grayi*, differ in having smaller body size 0.432×0.124 , and 24 head collar spines. *E. mohiuddini* also recorded in *Ardeola grayi* differs in body size 0.780–

1.613×0.215 –0.416 and number of head collar spines (24). *E. mazharuddini* Ujan *et al.*, 2014 reported from *Acridotheres ginginianus* differs in body size 0.810 – 0.886×0.395 –0.421, and head collar spines (28). Hence, present species also differs from *Echinochasmus* species which are reported from Pakistan in body size and number of head collar spine, which is 24-28, except *E. amphibolus* in shape and size of body. These features of resemblances are not sufficient to prove same of present species with it. Therefore, it is placed as *Echinochasmus prakashi* as mentioned in first part of discussion. None of these reported species from Pakistan collected from *Nycticorax nycticorax*. Therefore, it is also first locality record. Hence present paper is first record of *Echinochasmus prakashi* in *Nycticorax nycticorax* from Pakistan.

CONCLUSION

Echinochasmus prakashi is recorded for the first time from Hamal Lake, Sindh, Pakistan and the host bird *Nycticorax nycticorax*. It is identified on the basis of 22 head collar spines, shape and position of organs. Present paper will be helpful in further study on present host, parasite and locality.

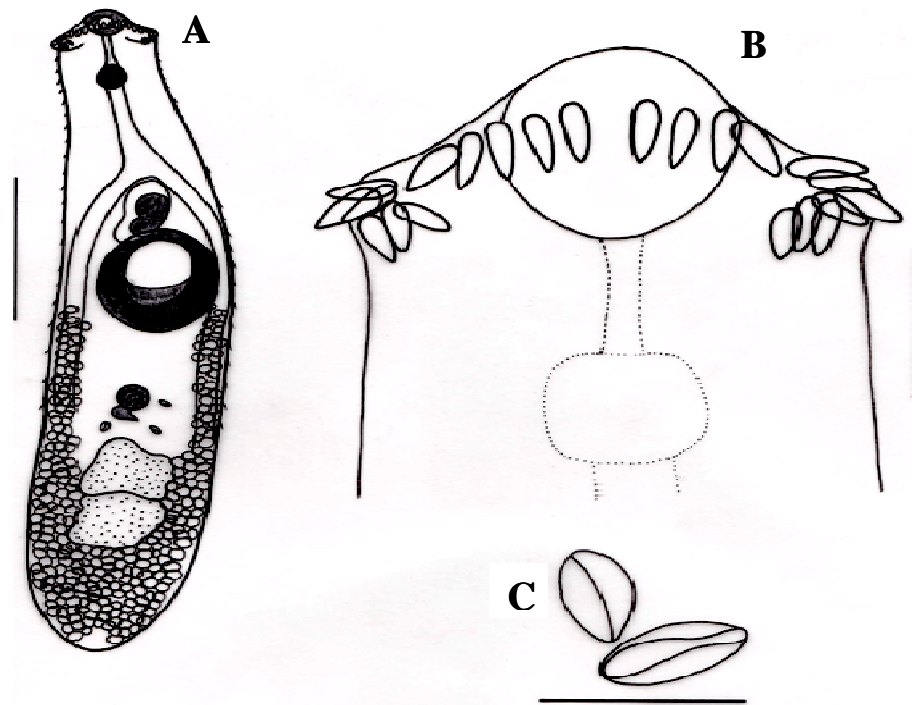


Fig. 1. *Echinochasmus prakashi* Gupta and Singh, 1988. A. Entire worm; B. Head Collar; C. Eggs. **Scale Bar:** A. 1mm, B. 0.2 mm, C. 0.05 mm.

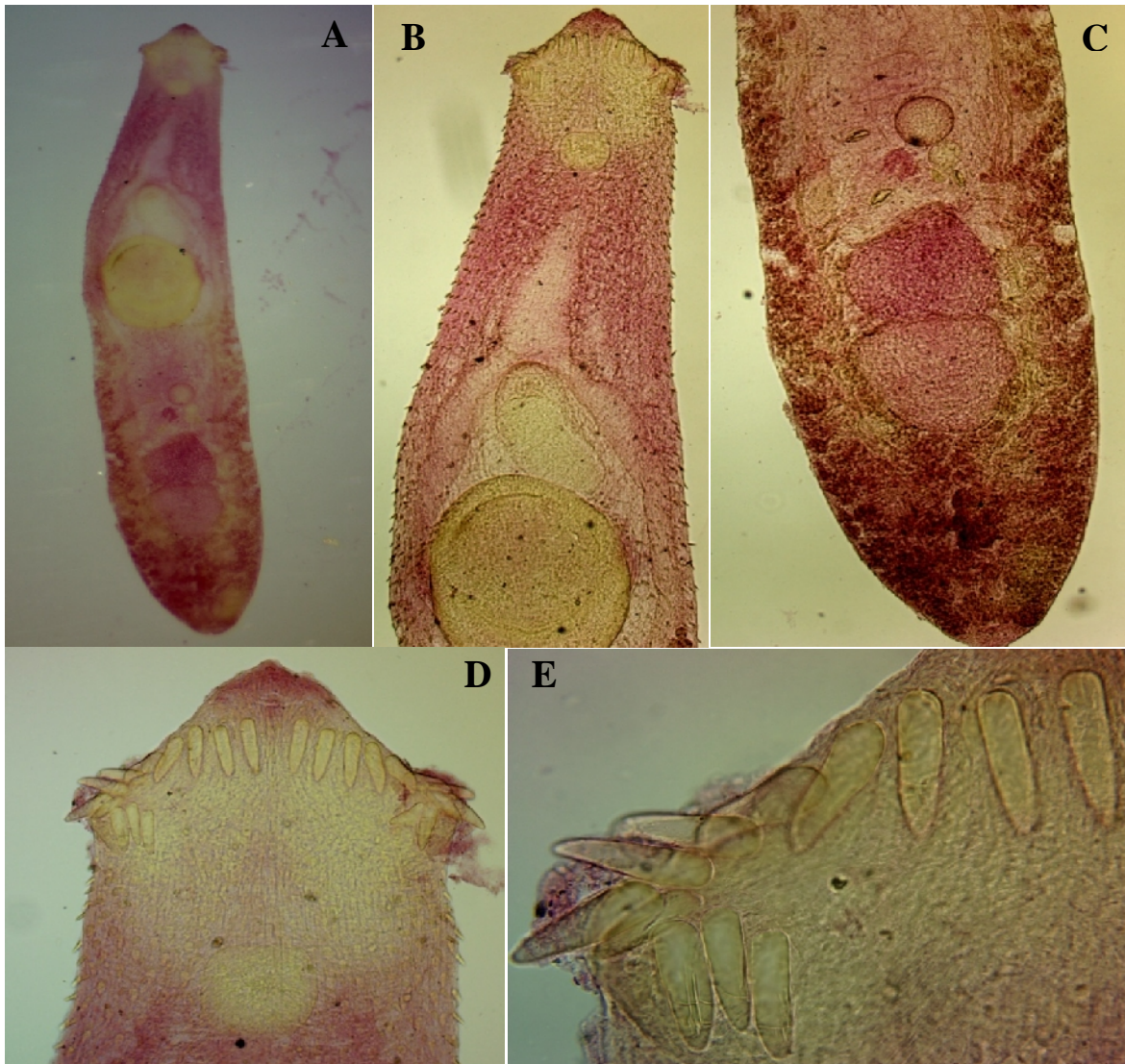


Fig. 2 (A-E). *Echinochasmus prakashi* Gupta and Singh, 1988. A. Entire worm; B. Forebody showing body spines, head collar, pharynx, esophagus, cecal fork, cirrus sac and ventral sucker; C. Hindbody showing eggs, ovary, testes, vitellaria and post-testicular space; D. Head collar enlarged; E. Collar hooks enlarged.

REFERENCES

- Amin, M.O. (1998). Marine Flora and Fauna of the eastern United States: Acanthocephala. NOAA/National Marine Fisheries Service, (NOAA Technical Report NMFS, 135.
- Anonymous. (2016). Hamal lake. https://en.wikipedia.org/wiki/Hamal_Lake
- Bhutta, M.S. and Khan, D. (1975). Digenetic trematodes of vertebrates from Pakistan. *Bulletin of department of Zoology University of Punjab* (new series), article, 8.
- Chai, J.Y. and Lee, S. H. (2002). Food borne intestinal trematode infections in the republic of Korea. *Parasitol Int.*, **51**: 129–154.
- Davis, W.E. (1993). Black-crowned night-heron (*Nycticorax nycticorax*). In *The Birds of North America*, No. 74 (Poole and Gill Eds.). Philadelphia: *The Acad Nat Sci*; Washington D.C.: The American Ornithologists' Union.
- Dharejo, A.M., Bilqees, F.M. and Khan, M.M. (2007). *Echinochasmus mohiuddini*, new species (Trematoda: Echinostomatidae) from Paddy Bird *Ardeola gyarpii* (Ardeidae) of Hyderabad, Sindh, Pakistan. *Proc of Parasitol.*, **39**: 285–288.

- Dharejo, A.M., Birmani, N.A. and Khan, M.M. (2010). *Echinochasmus passerii*, new species (Digenea: Echinostomatidae) from Gallbladder of House Sparrow, *Passer domesticus* (Aves: Passeridae) of Hyderabad, Sindh, Pakistan. *Proc of Parasitol.*, **50**: 139–145.
- Emily, R.H., John, M., Kinsella, D.M., Calhoun, M.B., Joseph and Pieter T.J. (2016). Endohelminths in bird hosts from Northern California and an Analysis of the Role of Life History Traits on Parasite Richness. *J of Parasitol.*, **102**(2): 199-207.
- Garcia, L.A. and Ash, L.R. (1979). Diagnostic Parasitology: Clinical laboratory manual. The CV Mosby Company. 11830 West line Industrial Drive, St. Louis, Missouri 63141.
- Gupta, P.C. and Singh, R.H. (1988). On two avian Echinostomes from Kanpur, India. *Proc of Parasitol.*, **5**: 46–52.
- Jones, A., Bray, R.A. and Gibson, D.I. (2005). Keys to the Trematoda Vol. 2. CABI Publishing and the Natural History Museum, London, UK.
- Lisitsyna, O.I. and Greben, O.B. (2015). Acanthocephalans of the genus *Centrorhynchus* (Palaeacanthocephala, Centrorhynchidae). *Vest Zool.*, **49**(3): 195-210.
- María, L.N., Pilar, N. and Javier, L. (2002). Helmintos parásitos de Ardeidae en Valencia (España). *Anales de Biología*, **24**: 139-144.
- Ortega-Olivares, M.P., Rosas-Valdez, R. and García-Varela, M. (2013). First description of adults of the type species of the genus *Glossocercus* Chandler, 1935 (Cestoda: Gryporhynchidae). *Fol Parasitol (Praha)*, **60**(1): 35-42.
- Olsen, W.O. (1937). A new species of cestode, *Dendrouterina nycticoracis* (Dilepidiidae), from the black-crowned night heron (*Nycticorax nycticorax hoactli* (Gmelin)). *Proc of Helminthol Soc wash.*, **4**: 30-32.
- Pilar, N., Javier, L. and Enrique, F. (2005). The component helminth community in six sympatric species of ardeidae. *J of Parasitol.*, **91**(4): 775-779.
- Rim, H.J. (1982). Echinostomiasis. CRC Handbook series in Zoonoses, Vol. III (Trematode Zoonoses). CRC press Inc., Boca Raton, Florida.
- Roberts, T.J. (1991). *The Birds of Pakistan*, vol. I and II, Oxford University Press, Karachi, Pakistan.
- Seo, B.S., Lee, S.H., Chai, J.Y. and Hong, S.J. (1985). Studies on intestinal trematodes in Korea XX. Four cases of natural human infection by *Echinochasmus japonicus*. *Kor J Parasitol.*, **23**: 214–220.
- Schmidt, G.D. (1988). Essentials of Parasitology 4th Edition. Wm. C. Brown Publishers 2460. Keper Boulevard, Dubuque, IA 52001, 294.
- Scholz, T. and Salgado, M. (2001). Metacestodes of the family Dilepididae (Cestoda: Cyclophyllidae). *Syst Parasitol.*, **49**: 23-40.
- Sitko, J. (2012). Trematodes of herons (Aves: Ciconiiformes) in the Czech Republic. *Helminthol.*, **49**(1): 33-42.
- Sogandares-Bernal and Hutton, R.F. (1960). A List of Parasites from Marine and Coastal Animals of Florida. *Trans of Ame Micro Soc.*, **79**(3): 287-292.
- Suttili, F.J., Gressler, L.T. and Pelegrini, V.L.F. (2014). *Clinostomum complanatum* (Trematoda, Digenea): a parasite of birds and fishes with zoonotic potential in Southern Brazil. A Review. *Rev Brasil de Hig San Ani.*, **8**(1): 99-114.
- Tanabe, H. (1926). Studies on trematodes with fresh water fishes as their intermediate host III. On a new species, *Echinochasmus japonicus* (n.s.). *Nip B GakKais*, **16**: 295–296.
- Ujan, H.M., Birmani, N.A. and Shaikh, A.M. (2014). *Echinochasmus mazharuddini* n.sp. (Digenea: Echinostomatidae) from the Bank Myna *Acridotheres ginginianus* L. (Passeriformes: Sturnidae) in Sindh province, Pakistan. *J of Ent and Zool Stud.*, **2**(6): 226–232.
- Vanessa, S., De Arruda, Roberto, M.P. and Luis, C.M. (2001). New host and geographical records for helminths parasites of Ardeidae (Aves, Ciconiiformes) in Brazil. *Rev Brasil de Zool.*, **18**(1): 225-232.
- Verma, S.C. (1935). Studies on the Indian species of the genus *Echinochasmus*. Part 1. And on the allied new genus *Episthochasmus*. *Proc Ind Acad of Sci.*, **1**: 837–856.
- Yamaguti S. (1958). Systema helminthum. Vol. I (Part I & II). The digenetic trematodes of vertebrates. Interscience Publishers Inc., New York and London.
- Yamaguti S. (1971). Synopsis of digenetic trematodes of vertebrates Vol. I and II. Keigaku Publishing Co. Tokyo, Japan.