

Distribution : India : Uttarakhand (Mundali, Jaunsar).

Genus *Arrhines* Schonh., 1834

1834. *Arrhines* Schonh., Gen. Curc., 2 : 465.

1916. *Arrhines*, Mshl., *The Fauna of British India including Ceylon and Burma*, Coleoptera : Rhynchophora : Curculionidae : 355-359.

Arrhines languides Gyllenhal

1834. *Arrhines languidus* Gyl., in *Schonh., Gen. Curc.*, 2 : 466.

1886. *Arrhines brunneus* Faust, *Stett. Ent. Zeit.*, : 142.

1916. *Arrhines languidus* Gyl., Mshl., *The Fauna of British India including Ceylon and Burma*, Coleoptera : Rhynchophora : Curculionidae : 356-357.

Material examined : Not examined.

Distribution : India : Uttarakhand (Dehradun), Delhi, West Bengal, Bihar, Kashmir.

SUMMARY

Present study includes 40 species under 34 genera of the family Cerambycidae and 26 species under 11

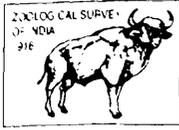
genera of the subfamily Brachyderinae & Otirrhynchinae of Curculionidae. Of Which 4 species under 4 general viz., *Pterolophia (Mimoron) brevigibbosa* Pic., *Xenolia asiatica* (Pic.), *Ropica rufescens* (Pic.) and *Derolus mauritanicus* Buquet and 14 species under 13 genera of the family Cerambycidae and 1 species viz. *Astycus lateralis* (F.) of the subfamily Brachyderinae are recorded for the first time from this state. Beside this synonymies and distribution of the species have also been included from the literature and actual study of the specimens.

ACKNOWLEDGEMENTS

Author is grateful to the Director, Zoological Survey of India for providing laboratory facilities. Thanks are also due to Dr. A.K. Sanyal, Scientist F and Dr. T.K. Pal Scientist F & O/C Entomology Division (A) for their encouragements. Thanks are also due to Sri R.K. Kushwaha, Lab Asstt., Shri H.S. Sah, Insect Setter and other staff of the Coleoptera Section for their co-operation and help.

REFERENCES

- Beeson, C.F.C. 1941. The Ecology and Control of Forest Insects of India and the adjoining countries. Govt. of India : 767.
- Breuning, S. 1960-62. Revision Systematique Des especes du genre Oberia Mulsant du globe. *Frustula Entomologica*, (1,2,3) : 1-232.
- Breuning, S. 1966. Revision der Agapanthiini der eurasiatisch – australischen Region (Coleoptera : Cerambycidae) *Entom. Abh. Mus. Tierk.*, 34 (1) : 1-144.
- Csiki, E. 1934. *Coleopterorum Catalogus* Part 134.
- Fahraeus, O.I. 1871. Coleoptera Caffraia, annis 1838-1854 a. J.A. Wahlberg Collecta, Curculionidae. *Oefv. Vet. AK.* 28 : 3-69-197-291.
- Faust, J. 1904. Revision der Gruppe Cleonides Vrais *Dtsch. ent. Z.*, : 177-284 (Coleoptera).
- Gahan, C.J. 1906. The Fauna Of British India including Ceylon and Burma. Coleoptera, 1 : Cerambycidae, : 1-329 (Tylor & Francis Ltd. London).
- Gyllenhal, L. 1843. In Schonherr, Genera at species Curculionidum, 7(2) : 1-461.
- Lacordaire, T. 1863. *Histoire Naturelles des Insectes, Genera des Coleoptera*, 6.
- Marshall, G.A.K. 1916. The Fauna of British India including Ceylon & Burma. Coleoptera : Rhynchophora : Curculionidae : xxiii + 367.
- Stebbing, E.P. 1914, Indian Insects of Economic Importance Coleoptera : 1-648 (Eyre & Hiswood Ltd. London).



Rec. zool. Surv. India : 111(Part -2) : 89-94, 2011

NEW RECORD OF MALE AND EPHIPPIAL FEMALE OF *CYCLESTHERIA HISLOPI* (BAIRD, 1859) (BRANCHIOPODA : DIPLOSTRACA : CYCLESTHERIIDAE) FROM A WETLAND IN KERALA, INDIA

¹SUBHASH BABU, K.K. AND S. BIJOY NANDAN²

Department of Marine Biology, Microbiology and Biochemistry, School of Marine sciences,
Cochin University of Science and Technology, Cochin 682016, Kerala, India.

1 : E-mail: kallikadavil@yahoo.com 2 : bijoynandan@yahoo.co.in (Corresponding Author)

INTRODUCTION

Kerala lying on the southern tip of peninsular India is blessed with a series of world renowned wetland systems popularly referred to as backwaters, lagoons, inlets and several others having immense biodiversity potential. Even though, we have some authentic work on the taxonomy of lower crustaceans, like cladocerans, copepods and ostracods but information on large branchiopods are very limited (Durga Prasad & Simhachalam, 2009). *C. hislopi* is considered a monotypic genus showing circumtropical distribution in which males are rarely reported (Olesen *et al*, 1996). However, males were reported from Australia (Sars, 1887; Dady, 1926) that from USA (Sisson, 1980) and also from Colombia (Roessler, 1995). Although Sars (1887) reported the males in *C. hislopi* from Australian population, but his description was based on an immature male from the brood pouch of a parthenogenetic female, however the descriptions were incomplete. Several specimens of *C. hislopi* also reported from South East Asian countries, but could not report any males or sexual females (Martin *et al*, 2003). Parthenogenetic females, males and sexual females (ephippial females) of *C. hislopi* were reported from Columbia (Olesen *et al*, 1996; Roessler, 1995) Moreover a comparative study on male prehensile organs of various diplostracans are also reported by Olesen *et al* (1996).

Although there are some available reports on *Cyclestheria hislopi* from India (Gurney, 1906; Nayar, 1968; Nayar and Nair, 1968; Paul & Nayar, 1977; Battish, 1981; Usha Balaraman, 2004), these studies were restricted to the parthenogenetic females. It was in this context that, present study gives a detailed account on

the morphological features of the male and ehippial female (sexual female) of *C. hislopi* in comparison with that of the published reports of the same specimen from Colombia. This is the first report on male and ehippial female (sexual female) of *C. hislopi* from India.

MATERIALS AND METHODS

Specimens for the study were collected from an isolated shallow irrigated paddy field (60 ha.) at Thommana, Trichur in Kerala (10° 20' 30" N, 76° 15' 23"E). Collections were made with a standard scoop net with mesh size 70mm having a mouth area of 8 inches diameter. After collection, the samples were brought to laboratory in live condition in order to observe its behavior and subsequently the specimens were fixed with 4% formalin and the male, ehippial females and parthenogenetic females were sorted out using wide mouthed pipettes under low power binocular microscope. The sex ratio of male and parthenogenetic females and ehippial females were computed and analyzed by Chi-square test using the SPSS package (version 16.0). The specimens were dissected with two fine tungsten needles under low power microscope and measurements were made using ocular micrometer. Then camera lucida diagrams were made. Nomenclature, species confirmation and morphological studies were done using standard literature and monographs (Baird, 1859; Dodson & Frey, 1991). The order "Conchostaca" in the recent updating has been reclassified as Diplostraca (Martin & Davis, 2001). For scanning electron microscopy (SEM) the material was treated with ethanol series and after the critical drying at 60°C for 24 hours, the material was coated with platinum 10nm and observed in a Jeol (JSM-6390). The specimens have

been deposited in the Marine Biology Museum, School of Marine Sciences, Cochin University of Science & Technology having Code: MBM/Ch/21/08.

RESULTS AND DISCUSSION

SYSTEMATICS

Order DIPLOSTRACA GERSTAECKER

Family CYCLESTHERIIDAE SARS

Genus *Cyclestheria*

Cyclestheria hislopi (Baird, 1859)

Male

Size : 3.64 ± .05mm (n=5)

Males slightly smaller than females with 3-4 lines of growth (Fig. 1A & Fig. 2A). Sexual dimorphism not very prominent in the species. Its shape is slightly oval with yellowish colour. In live condition, males could be distinguished from females based on their more active behavior. Head conical in shape with convex dorsal and concave ventral margin with very prominent serrations on its vertex region (Fig. 1E & Fig. 2B). Eye slightly bigger than ocellus and situated near dorsal margin (Fig. 1E). The first antenna (antennule) slender, elongated and more dilated than that of female with tufts of sensory hairs (sencille) on its tip (Fig. 1F). The post maxillary thoracopods, 15 in number and the first thoracopod modified as a prehensile organ (Claspers) (Fig. 1H & Fig. 2C). Right and left claspers similar in size and shape. Unlike other branchiopods, the second pair of thoracopod is not modified as prehensile organ. The distal 4 and 5 endites and endopod of first thoracopods modified into palm and the 6th endite as the finger (Figs. 1I & J, Fig. 2D). Palm and finger armed with two types of teeth like structures (Fig. 2E). The palm beset with multi-cusped teeth like structures and finger with single cusped terminal teeth (Fig. 1K & L). Apart from these teeth, there were many button like structures on the anterior region of palm (Fig. 1J). Only single plumose seta on the antero-dorsal area of moving finger whereas in the palm 8-9 plumose setae were present. A thick palp originated from the base of the finger carrying a few terminal setae on its distal end (Fig. 1I). The epipod was oval in shape (Fig. 1H). Rest of the thoracopods reduced in size towards its posterior end. Telson almost similar to female with 7-8 spines on its dorsal margin, distal spines elongated, claw like and serrated on concave margin. Number of basal spines on the base of the second claw 4-5 (Fig. 2F). Testis slightly yellowish and seen on both sides of the alimentary canal.

Ephippial female

Size : 4.20 ± .09mm (n=5)

Ephippial female are pale white and opaque with ephippium (egg case). They are modified form of parthenogenetic female itself, having size and shape almost similar to parthenogenetic female. Carapace thick and reinforced by chitinous material. Unlike in cladocerans, the ephippium is part of their body. Ephippial females were capable of producing a special kind of resting eggs (diapause eggs). Eggs dark in colour, slightly oval in shape, larger than parthenogenetic eggs. Outer covering of these eggs are hard without any ornamentation. Mean size of eggs was 4.2 mm and number of eggs/brood was 5.4 ± 1.7 (n=5). Unlike other large Branchiopods, in *C. hislopi* eggs were free and not glued. Eggs well encased within the modified form of carapace, the ephippium. After the formation of ephippium, the female settles at the bottom. The ephippium without eggs were also observed in the present study. Ephippial female is very similar to parthenogenetic female but looks slightly whitish in colour due to the presence of ephippia. Average ratio between male with ephippial female were 1: 4. The other details of ephippial female fully agree with description given by Roessler (1995) on Colombian population.

Parthenogenetic female

Size : 4.27 ± .14mm (n=10)

Carapace oval in shape with maximum height in the middle, laterally compressed and slightly yellowish in colour. The umbone situated close to the antero-dorsal side of the carapace. The shell with very specific shell gland had 4-5 growth lines (carapace lines). Head large and somewhat rounded in shape with serrated vertex (Fig. 1B). Eye slightly larger than ocellus and situated at antero-dorsal margin of the head whereas ocellus is central in position (in lateral view). Antennule (first antenna) slender elongated and distally dilated (spatula shaped) with a few terminal sensory hairs. (Fig. 1D). Antenna biramus, stout, seven segmented; each segment beset with setae and spine like structures. Body segmented, slightly arched in profile with 16 pairs of swimming appendages and each segment carries one pair of swimming legs. Ovary paired, one on either side of the alimentary canal as in cladocerans. Eggs spherical and slightly greenish in colour with mean size (0.34mm). The number of eggs in the brood varies from 3-21 depending on the age of the specimen. Eggs soft without any ornamentation. A large number of individuals were observed in which the brood contains developing embryos. In the sample collected male to

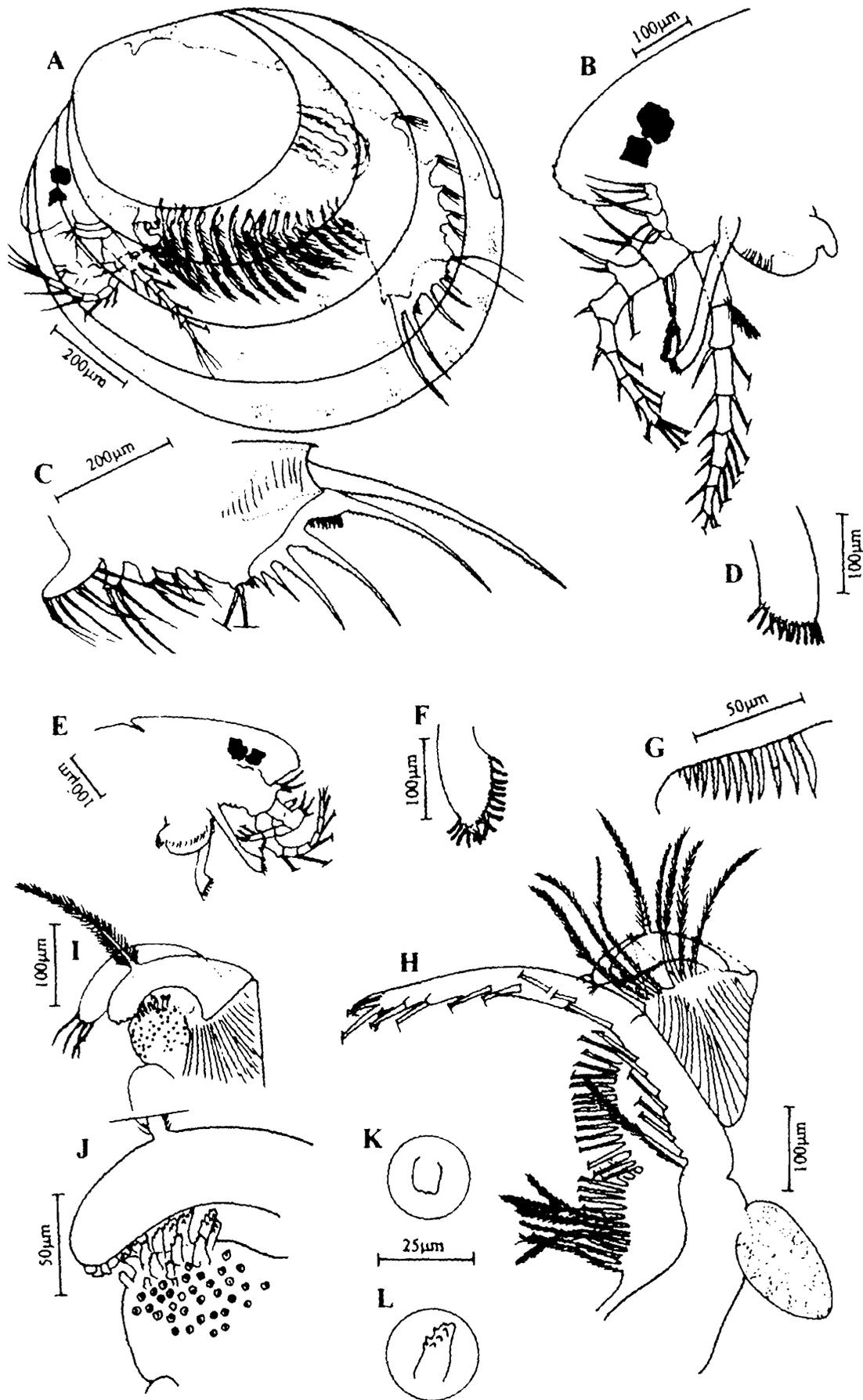


Fig. 1(A-L). 1A. *Cyclestheria hislopi* (male), 1B. Head of *C. hislopi* (female) 1C. Telson (fem-ale). 1D. Tip of the antennules (female). 1E. Head of the *C. hislopi* (male). 1F. Tip of the antennules (male). 1G. Basal spines on the second claw enlarged (female). 1H. First thoracopod with clasper (male). 1I. Clasper with palm and moving finger (male). 1J. Clasper enlarged (male). 1K. Single cusped tooth. (finger, male). 1L. Multi-cusped tooth (palm, male).

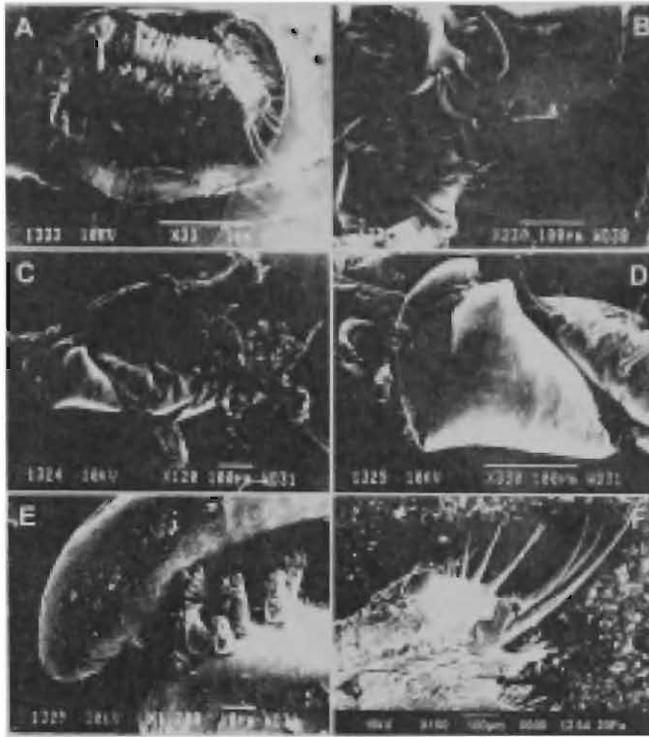


Fig. 2(A-F). 2A. (SEM) *Cyclestheria hislopi*, male (left side of the carapace removed). 2B. Serrated vertex (lateral view) 2C. First thoracopod (lateral view). 2D. First thoracopod with clasping organ. 2E. Clasping organ enlarged (lateral view). 2F. Telson showing 4 basal spinules on the base of the second claw (lateral view)

parthenogenetic female ratio was 1 : 46. Telson large with eight pair of strong and elongated claws; first pair large and slightly curved, serrated on its concave margin (Fig.1C). Second claw shorter than the first pair with a series of serrated spinules on its basal portion (Fig. 1G). The Pearson Chi Square test showed that the sex ratio between males and parthenogenetic females were significant at 1% level.

Remarks : *Cyclestheria hislopi* was first reported from Nagpur, India by Baird in 1859 and named the species after its collector, Rev. Hislop. Initially, the species was placed under the genus *Estheria* and later, the genus *Estheria* to *Cyclestheria* and family Cyclestheriidae (Sars, 1887). *C. hislopi* is a large Branchiopod, commonly seen in the wetlands of Kerala, associated with lush vegetation of aquatic weeds. The abundance of *C. hislopi* associated with vegetation in perennial habitats indicates the presence of certain survival strategies to overcome predatory pressures.

This agrees with the observations on Colombian population (Roessler, 1995).

The formation of male, ephippial female, resting eggs (diapause egg) and appearance of sexual phase within the life cycle of *C. hislopi* remained obscure for long time (Olesen, et. al., 1996). *C. hislopi* is the only diplostracan showing very indistinguishable sexual dimorphism and this was the reason why people overlooked the presence of males in its population. Majority of diplostracans normally reproduces parthenogenetically but under the drastic environmental conditions the animals can switch over from parthenogenetic life-cycle to sexual phase (Shan, 1969; Subhash Babu & Nayar, 1997) and this phenomenon is not very common in *C. hislopi* (Roessler, 1995).

In the present study the male to female ratio was 1:46, which was considerably high as compared to that reported from Colombia. In natural population of the African large branchiopods the marked fluctuations were observed in the male female ratio (Brendonck *et al.*, 1990). So far, no male and ephippial female are reported from the natural population of *C. hislopi* from India.

A close evaluation on the morphological feature of the first thoracopod of male, *C. hislopi* in the present study showed only a single seta on the dorsal side of the finger with button like projections on the anterior part of the palm. Whereas the same specimens reported from Columbian waters had 3 plumose setae on the dorsal side of the finger without any projections on the palm (Olesen *et al.*, 1996). The number of pores on the neck organ was two in both the present and the Columbian specimens, whereas its shape and size was different in the Columbian specimen (Usha Balaraman, 2004). The antennule (first antenna), of *C. hislopi* in the present study was tubular, elongated, spatula shaped, with highly dilated tip fringed with tuft of sensory hairs. However, in the Columbian specimen, it was club shaped, robust with distal end little dilated having sensory hairs not only on its tip but also on its lateral side (Olesen *et al.*, 1996). The number of basal spines on the second claw of telson was 4-5 in the male of the present specimen, but was 7-9 in the Columbian specimens. Therefore, the Columbian

specimens showed considerable level of variations with the *C. hislopi* collected from Kerala, India. Therefore, from the basic taxonomical characters investigated, it could be concluded that there is considerable variation with Colombian population of *C. hislopi*.

SUMMARY

The detailed morphological structure of the male, ehippial female (sexual female) and parthenogenetic female of the large branchiopod, *Cyclestheria hislopi* (Baird, 1859), from a wetland in India is presented with camera lucida diagrams and SEM. This is the first report of male and ehippial female (sexual female) of *C. hislopi* from the Indian sub-continent. The male antennule and prehensile organs (first thoracopod), a prominent distinguishing character, has been discussed in this context. The presence of male and ehippial female in the *C. hislopi* population indicates the presence of sexual mode of life cycle. The males displaying higher

sex ratio of 1 : 46 with parthenogenetic females were a characteristic observation. The morphological characters of male in the present study are compared with that reported from the Colombian waters.

ACKNOWLEDGEMENTS

Authors are thankful to the Head of the Department of Marine Biology, Biochemistry and Microbiology, Cochin University of Science and Technology (CUSAT), for providing necessary facilities. Thanks are also due to Prof. Dr. H.J. Dumont, Institute of Animal Ecology, University of Ghent, Belgium, and Sophisticated Test and Instrumentation Centre, CUSAT, for Scanning Electron Microscopy (SEM). Authors are also very much grateful to Dr. C.K.G. Nayar, Director, Kerala Limnological Research Institute, Christ College campus, Irinjalakuda, India for his constructive comments in preparing the manuscript. The Post-doctoral fellowship granted by CUSAT, to the first author is gratefully acknowledged.

REFERENCES

- Baird, W. (1859). Description of some new recent Entamostraca from Nagapur, collected by the Rev. S. Hislop. *Proc. R. Soc. Lond. (Biol)*, **63** : 231-234.
- Battish, S.K. (1981). On some conchostracans from Punjab with the description of three new species and a new sub-species. *Crustaceana*, **40**(2) : 178-196.
- Brendonck, L. (1990). Thiery, A. and Coomans, S., Taxonomy and biogeography of the Galapagos branchiopod fauna (Anostraca, Notostraca, Spinicaudata). *J. Crust. Biol.*, **10** : 676-694.
- Daday, E. (1926). Monographie systematique des Phyllopoeds Conchostraces. Troisieme Partie (suite) *Ann. sci. nat. Zool.* **10**(9) : 1-81.
- Dodson, S. and Frey, D.G. (1991). Cladocera and other Branchiopoda. In : J.H. THROP & A.P. COVICH (Eds), Ecology and Classification of North American Freshwater Invertebrates, 723-786.
- Durga Prasad, M.K and Simhachalam, G. (2009). Distribution of Indian clam shrimps (Branchiopoda : Crustacea). *Curr sci.*, **96**(1) : 71-73.
- Gurney, R. 1906. On some freshwater Entamostraca in the collection of the Indian Musium, Calcutta. *J. As. Soc. Beng.*, **2**(7) : 273-281.
- Martin, J.W. and Davis, G.E. (2001). An updated classification of recent Crustacea. *NHMLAC series*, **39** : 1-124.
- Martin, J.W., Sarah, L. Boyce and Grygier, M.J. (2003). New records of *Cyclestheria hislopi* (Baird, 1859) (Crustacea : Branchiopoda : Diplostraca : Cyclestherida) in South East Asia. *Raff. Bull. Zool.*, **51**(2) : 215-218.
- Nayar, C.K.G. and Nair, K.K.N. (1968). On a collection of Conchostraca (Crustacea : Branchiopoda) from south India with description of two new species. *Hydrobiologia*, **32**(1&2) : 219-224.
- Navar, C.K.G. (1968). Observation on the biology of *Cyclestheria hislopi* (Baird) (Conchostraca : Crustacea). *Archiv fur Hydrobiologie*, **651** : 96-99.
- Olesen, J., Martin, J.W. and Roessler, E.W. (1996). External morphology of the male of *Cyclestheria hislopi* (Baird, 1859) (Crustacea, Branchiopoda, Spinicaudata) with a comparison of male claspers among the Conchostraca and Cladocera and its bearing on phylogeny of the bivalved Branchiopoda. *Zoologica Scripta*, **25** : 291-316.