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TAXONOMIC NOTES ON SOME INTERESTING CLADOCERANS (CRUSTACEA : BRANCHIOPODA : CLADOCERA) FROM ASSAM (N.E. INDIA)

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INTRODUCTION

Taxonomic studies on the Indian Freshwater Cladocera began nearly one and a half century ago and since then these entomostraceous crustaceans have been documented from scattered localities from distant parts of this country (Sharma and Michael, 1987; Michael and Sharma, 1988; Sharma, 1991). The faunal investigations on cladocerans from different states of Northeastern India in general and that of Assam, in particular, are relatively fewer save for the studies by Patil (1976), Biswas (1980), Sharma and Sharma (1999, 2008) and Sharma (2008) while Michael and Sharma, 1988 referred to limited collections from N.E. region.

While working on zooplankton samples collected from the floodplain lakes (beels) of Assam, the authors came across nine interesting species of Cladocera, including four new records from North-Eastern India and five new records from Assam. All the recorded taxa are briefly diagnosed and illustrated, and remarks are made on their distribution.

MATERIALS AND METHODS

The present observations are based on plankton samples collected, during July, 2007-August, 2008, from floodplain lakes of Assam. All the samples were collected with nylobolt plankton net (No. 25) and preserved in 5% formalin. Individual collections were screened with a Wild-stereoscope binocular microscope. Various cladocerans and their disarticulated appendages were mounted in Polyvinyl alcohol-lectophenol mixture. The details of head pores and their arrangements in the Chydorids were studied following Megard (1965).

Various taxa are identified following the works of Smirnov (1971, 1996), Michael and Sharma (1988), Korovchinsky (1992) and Sharma and Sharma (1999). The drawings are made with Leitz-Dialux phase contrast microscope using a drawing-tube attachment and the measurements are indicated in millimeters (mm). The reference materials are deposited in the holdings of the Department of Zoology, North-Eastern Hill University, Shillong.

LIST OF THE EXAMINED TAXA

Superclass CRUSTACEA

Class BRANCHIOPODA

Superorder CLADOCERA (*s. str.*)

Order CTENOPODA

Family SIDIDAE

Diaphanosoma tropicum Korochinsky, 1998*

Sarsilatona serricauda (Sars, 1901)*

Order ANOMOPODA

Family MACROTHRICIDAE

Streblocerus serricaudatus (Fischer, 1849)**

Family CHYDORIDAE

Subfamily CHYDORINAE

Alonella clathratula Sars, 1886**

Chydorus ventricosus Daday, 1898*

Subfamily ALONINAE Frey, 1966

Alona guttata tuberculata (Kurz, 1875)**

A. monocantha tridentata (Stingelin, 1905)**

A. pulchella King, 1853**

A. verrucosa Sars, 1901*

TAXONOMIC NOTES

Diaphanosoma tropicum Korovchinsky, 1998

(Figs. 1-3)

1998. *Diaphanosoma tropicum* Korovchinsky, *Hydrobiologia,* **361**, p. 114-22, Figs. 1-35.

1981. *Diaphanosoma modigliani* Richard : Idris and Fernando, *Hydrobiologia,* **77**, p. 235-235, Figs. 2-4; Rajapaksa and Fernando, 1982, *Hydrobiologia,* **94**, Figs. 12-16.

Material examined : 4 exs., Anwa beel, Cachar district, Assam 26.02.2008, coll. B.K. Sharma.

Characters : Head large and cone-shaped, anterior part of head with a rounded bulge under the eye ventrally; eye located closer to ventral side of head. Antennae reaching posterior margin of valves. Antennal setae : 4-8/0-1-4; distal segment with prominent hook-like curved spine. Valves oblong, ventral margin with large inflexion and bearing 7-10 long feathered setae, posterior margin with 15-58 denticles, no dorsal spine at posterior margin of valves. Postabdomen prominent dorsally and, with groups of spinules laterally and distally; setae natatoriae long. Claws large, with three basal spines, distal edge with a row of spines.

Differential diagnosis : *D. tropicum* differs from *D. modigliani* by its larger cone-like head, curved apical spine of upper antennal branch, longer swimming antennae and setae natatoriae as well as fewer number of denticles along its ventro-posterior valve margins. In addition, it differs from *D. dubium* by its more massive head, longer swimming antennae, longer spine at the end of proximal segment of upper antennal branch and, by different form of posterior part of valves with prominent dorso-posterior angle and less numerous, smaller and sparsely distributed marginal denticles.

Distribution : India-Tamil Nadu. Elsewhere : Sri Lanka, Malayasia, Thailand, Indonesia, Philippines, Central-East China (Hubei province).

Remarks : Represents a new record from N.E. India.

Sarsilatona serricauda (Sars, 1901)

(Figs. 4-6)

1901. *Latonopsis serricauda* Sars, *Arch. Math. Naturvidensk. Christinia,* **23**, p. 6-19, Pl. 1, Figs. 1-6.

1905. *Latonopsis fasciculata* Daday, *Zoologica* **18**(44), p. 215-218, taf. 14, Figs. 13-17.

1985. *Sarsilatona serricauda* (Sars) Korovchinsky, *Int. Revue ges. Hydrobiol.* **70**, p. 406-418, Pl. III-VIII.

1990. *Latonopsis fernandoi* Rane : Sharma and Sharma, *Rev. Hydrobiol. trop.* **23**, 106, Figs. 1-5.

Material examined : 5 exs., Hilara beel, Cachar district, Assam, 20.10.2007, coll. B.K. Sharma.

Characters : Head high and separated from trunk by a small dorsal depression. Eye small and situated closer to dorsal side of head. Antennules relatively long, with large cylindrical base. Antennae massive with strong basipodite; thin sharp curved spine on dorsal side of antennal basipodite end. Thinner terminal spine of first segment of upper 2-segmented antennal branch much longer. Antennal setae : (8-9 – (10-12)/0-1-4. Ventral margin of valves with small sharp denticles, ventro-posterior corner with 11-12 long feathered setae and posterior margin with 4-5 dense clusters of minute spinules. Dorsal margin of postabdomen with 4-5 characteristic prominences; lateral sides with rows of 10-12 clusters of thin lanceolate anal teeth, with 2-4 teeth in each cluster. Claws thin and bearing three long basal spines; with thin setules on outer side and row of minute denticles along their dorsal side, inner basal side of claws with row of thin denticles.

Distribution : India : Madhya Pradesh. Elsewhere : Brazil, Paraguay, North America, Venezuela, Peru, Nicaragua, southern states of USA.

Remarks : Represents a new record from N.E. India.

Streblocerus serricaudatus (Fischer, 1849)

(Figs. 7-8)

1849. *Daphnia serricaudata* Fischer, *Bull. Soc. Imp. Nat. Moscow,* **22**, p. 45, tab. IV, Figs. II-III.

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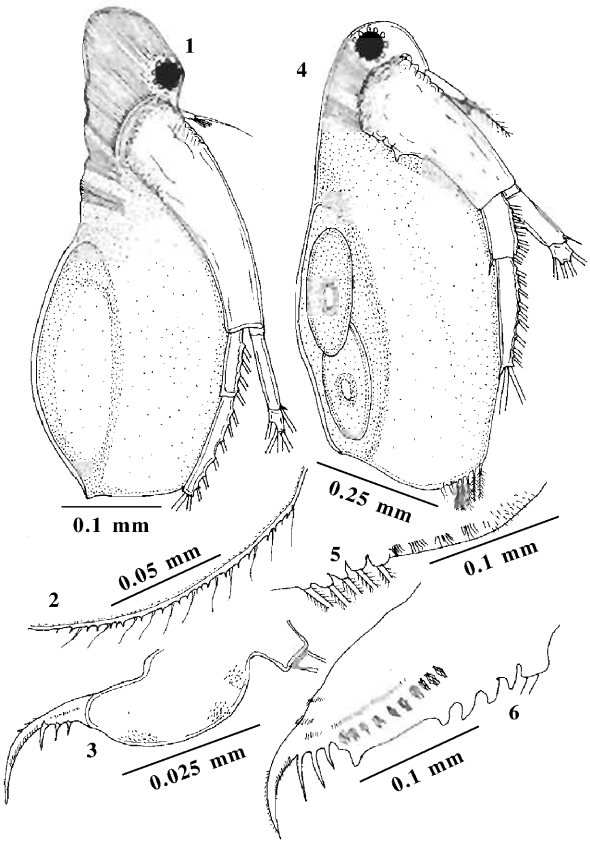
* New record from North-eastern India

** New record from Assam



Diaphanosoma tropicum Korovchinsky : **Fig. 1.** parthenogenetic female, **Fig. 2.** posterior ventral valve margin, **Fig. 3.** postabdomen; *Sarsilatona serricauda* (Sars) : **Fig. 4.** parthenogenetic female, **Fig. 5.** posterior valve margin, **Fig. 6.** postabdomen.

1862. *Streblocerus minutus* Sars, *Forhandl. Vidensk. Selesk. Christinia* (1861), p. 284-285.

1876. *Streblocerus serricaudatus* (Fischer) : Hundendroff, *Bull. Soc. Nat. Moscow,* **50**, p. 41, Tab. II. Fig. 2, a-c.

Material examined : 3 exs., Deepor beel, Kamrup district, Assam, 19.07.2008, coll. B.K. Sharma; 2 exs., Samuajan beel, Dhemaji district, Assam, 09.08.2007, coll. B.K. Sharma.

Characters : Body rounded-oval, dorsal surface evenly arched, ventral surface produced in middle region and posterior end with a small protuberance. Valves reticulate, dorsal margin smooth and ventral margin with setae. Antennules curved distally, each with a lateral seta near its base and several hairs on inner edge; olfactory setae unequal. Postabdomen bilobed; anal part rounded and with spines, pre-anal part serrate and with rows of fine hairs. Claw small, curved and with setae on its concave margin.

Distribution : India : Meghalaya, Manipur and Rajasthan. Elsewhere : Europe and North America.

Remarks : Represents a new record from Assam.

Alonella clathratula Sars, 1896

(Figs. 9-10)

1896. *Alonella clathratula* Sars, *Arch. Math. Naturvidensk. Christinia,* **18**, p. 43-45, figs. 7-8.

Material examined : 4 exs., Salchapra beel, Cachar district, Assam, 20.10.2007, coll. B.K. Sharma.

Characters : Body elongated; length : height ratio 1.8. Valves with polygons with longitudinal striations and with blunt indentation at posterior-ventral corner. Antennules not reaching the tip of rostrum. Labral plate cuneiform and with blunt apex. Postabdomen elongated and with small irregular anal teeth. Claw with two basal spines, the proximal spine smallest.

Differential diagnosis : *A. clathratula* differs from the closely related *A. excisa* in its relatively elongated body, valves with polygons with longitudinal striations, nearly straight posterior margin of valves and shape of postabdomen.

Distribution : India : Meghalaya and Bihar. Elsewhere : Australian, Ethiopian and Neotropical regions and, Java.

Remarks : Represents a new record from Assam.

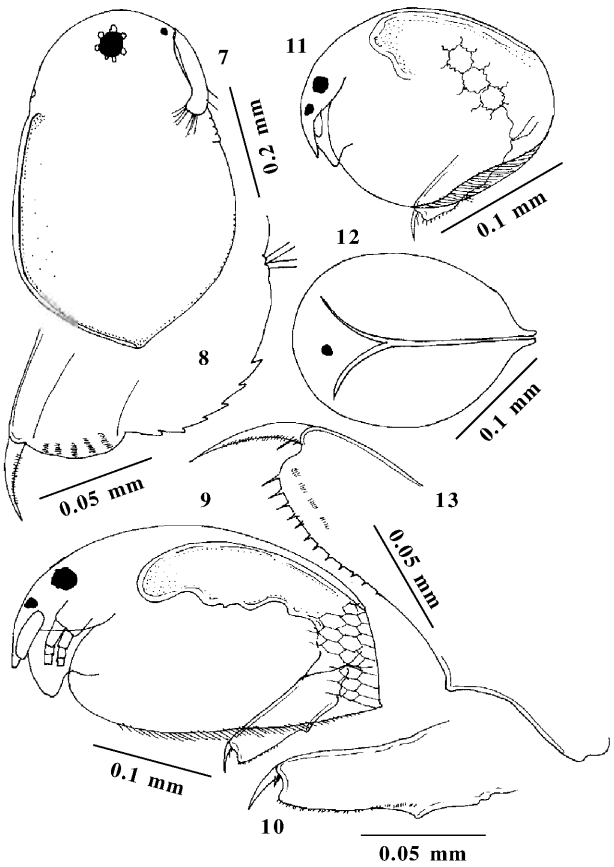
Chydorus ventricosus Daday, 1898

(Figs. 11-13)

1898. *Chydorus ventricosus* Daday, *Termes Füzetek,* **21**, p. 28-29, Figs. 10, a-d; Smirnov, 1971. *The World Chydorid Fauna.* USSR Acad. Sci. Zool. Inst. Nova ser. **101**, p. 298, Fig. 323; Michael and Sharma, 1988, *Indian Cladocera.* **Fauna of India series**, p. 151-152, Text-fig. 50, a-d; Smirnov, 1996. *Cladocera : The Chydorinae and Sayciinae (Chydoridae) of the World.* In : *Guides to identification of the Microinvertebrates of the Continental waters of the world,* **11**, p. 122, Figs. 500-507.

1966. *Chydorus brehmi* Biswas, *Crustaceana,* **11**, p. 113-114, Fig. 1, a-c; *Brehm,* 1971, *Rec. zool. Surv. India,* **63**, p. 136.

Material examined : 4 exs., Chatla beel, Cachar district, Assam, 20.10.2007, coll. B.K. Sharma; 3 exs., Salchapra beel, Cachar district, Assam, 20.10.2007, coll. B.K. Sharma.



Streblocerus serricaudatus (Fischer) : **Fig. 7.** parthenogenetic female, **Fig. 8.** postabdomen; *Alonella clathratula* Sars : **Fig. 9.** parthenogenetic female, **Fig. 10.** postabdomen; *Chydorus ventricosus* Daday : **Fig. 11.** parthenogenetic female, **Fig. 12.** parthenogenetic female (anterior view), **Fig. 13.** postabdomen.

Characters : Body sub-globular in outline; posterior ventral angle of valves without denticle, posterior ventral margins of valves bent outwardly, flattened and forming a kind of flange. Valves with faint polygons with wavy margins. Labral plate small and cuneiform. Postabdomen slightly narrowing distally, preanal corner district, anal margin slightly concave; with 9-10 marginal anal spines diminishing proximally and with groups of setae. Claw with setae on concave margin; with long slender basal spine and with seta attached sub-terminally on concave margin.

Differential diagnosis : This chydorid is differentiated from its allied species by the characteristic and peculiar outwardly bend posterior ventral margins of valves.

Distribution : India : Rajasthan, Kerala, Tamil Nadu, Maharashtra, Gujarat. Elsewhere : Sri Lanka, China, Java, East Africa and South America.

Remarks : Represents a new record from N.E. India.

Alona guttata tuberculata (Kurz, 1875)

(Figs. 14-15)

1875. *Alona tuberculata* Kurz, *Sitz. Ber. Math. Naturw. Kl. K.k. Akad. Wissench.* **70**, p. 51, Plate-II, Fig. 1.

1971. *Alona guttata tuberculata* (Kurz) : Smirnov, *The World Chydorid Fauna.* USSR Acad. Sci. Zool. Inst. Nova ser. **101**, p. 468, Fig. 456-457.

Material examined : 3 exs., Bor beel, Dibrugarh district, Assam, 11.05.2008, coll. B.K. Sharma.

Characters : Body oval in outline; valves with rounded posterior dorsal and ventral corners. Head shield and valves with rounded pits. Three main head pores with a narrow connection between them. Antennules reaching apex of rostrum. Labral plate rounded. Postabdomen with projecting pre-anal corner; distal dorsal end pointed and projecting beyond base of claws. Postabdomen with 8-10 anal spines. Claw with a basal spine and setae on its concave margin.

Differential diagnosis : It differs from *A. guttata s. str.* by rounded pits or tubercles on its head shield and valves.

Distribution : India : Meghalaya. Elsewhere : Europe, Columbia, Kunashir island (USSR).

Remarks : Represents a new record from Assam.

Alona monacantha tridentata (Stingelin, 1905)

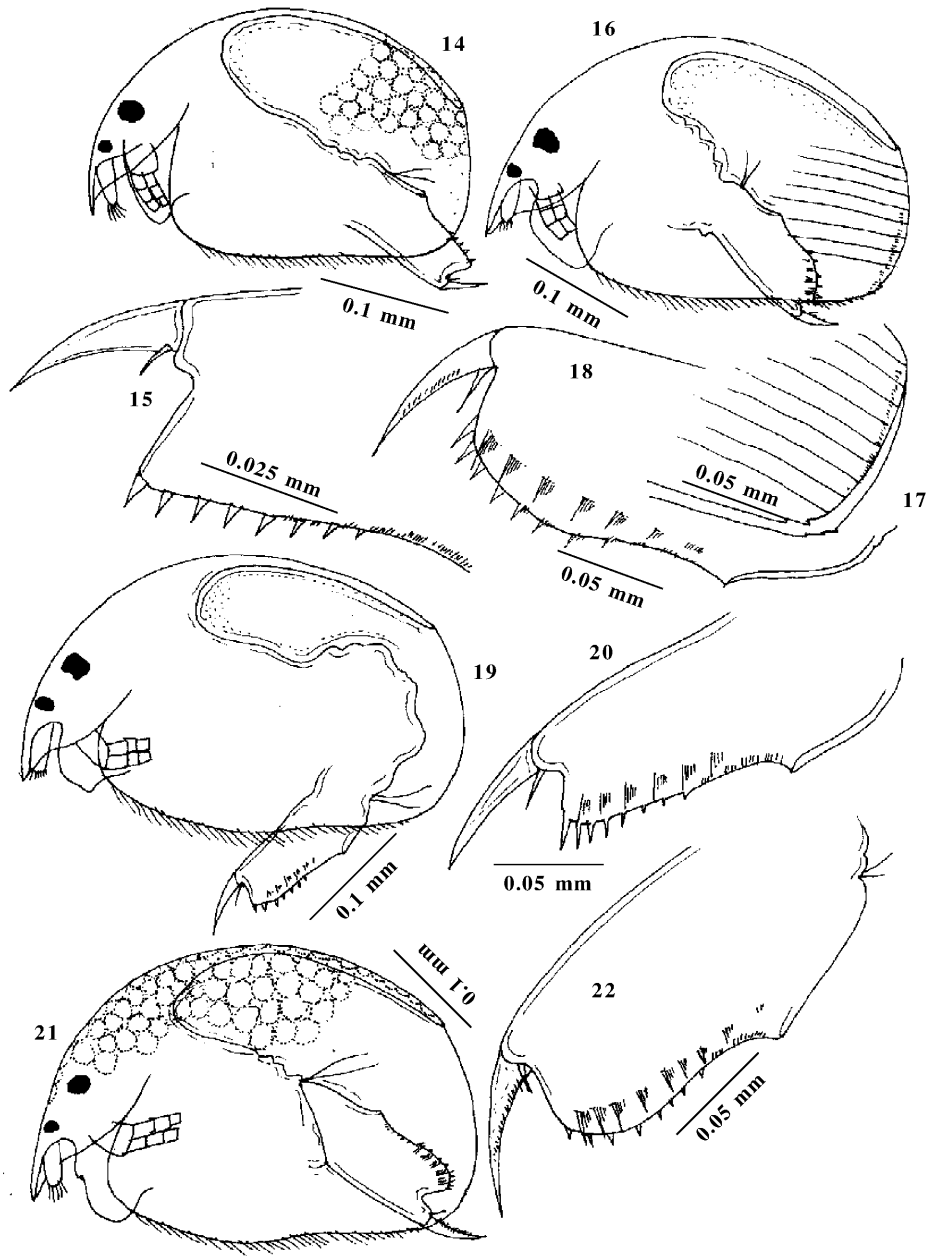
(Figs. 16-18)

1905. *Alona acuticostata* var. *tridentata* Stingelin, *Zool. Jb. Abt. Syst. Geogr und Biol.* **21**, p. 349-350, Pl. 12, Figs. 18-19.

1971. *Alona monacantha tridentata* (Stingelin) : Smirnov, *The World Chydorid Fauna.* USSR Acad. Sci. Zool. Inst. Nova ser. **101**, p. 440, Fig. 413.

Material examined : 4 exs., Maghuri beel, Tinsukia district, Assam, 11.05.2008, coll. B.K. Sharma.

Characters : Body oval, valves with longitudinal lines; posterior ventral corner of valves with 2-3 denticles. Rostrum long and blunt, antennules not reaching apex of rostrum. Postabdomen with distinct preanal corner, with about 10 anal spines and groups of lateral setae; distal seta in each group longest and a few distal setae projecting beyond dorsal margin of postabdomen. Claw with a basal spine and setae on concave margin.



Alona guttata tuberculata (Kurz); **Fig. 14.** parthenogenetic female, **Fig. 15.** postabdomen; *A. monacantha tridentata* (Stingelin) : **Fig. 16.** parthenogenetic female, **Fig. 17.** posterior ventral valve margins, **Fig. 18.** postabdomen; *A. pulchella* King : **Fig. 19.** parthenogenetic female, **Fig. 20.** postabdomen; A *verrucosa* Sars : **Fig. 21.** parthenogenetic female, **Fig. 22.** postabdomen.

Differential diagnosis : It is characterized by 2-3 denticles on posterior ventral corner of its valves.

Distribution : India : Meghalaya, Tamil Nadu and Bihar. Elsewhere : Thailand.

Remarks : Represents a new record from Assam.

Alona pulchella King, 1853
(Figs. 19-20)

1853. *Alona pulchella* King, *Pap. Proc. R. Soc. Tasmania,* **2**, p. 260, pl. VIII B.

Material examined : 3 exs, Amuri beel, Morigaon district, Assam, 09.06.2007, coll. B.K. Sharma.

Characters : Body broadly oval; valves punctuate, with rounded postero-dorsal and postero-ventral corners. Rostrum blunt, head-shield with three main head pores, not connected to one another. Labral plate with convex anterior margin and blunt apex. Antennules not reaching apex of rostrum. Postabdomen with nearly straight dorsal and ventral margins, preanal corner

distinct; 8-10 anal denticles increasing in size distally, lateral setae in groups and distal seta longest in each group. Claw with a basal spine.

Distribution : India : Meghalaya, Tripura, West Bengal, Gujarat, Rajasthan and Tamil Nadu. Elsewhere : Cosmotropical.

Remarks : Represents a new record from Assam.

Alona verrucosa Sars, 1901
(Figs. 21-22)

1901. *Alona verrucosa* Sars, *Arch. Math. Naturvidensk. Christinia,* **23**, p. 56-57, pl. IX, Fig. 7, 7a.

1971. *Biapertura pseudoverrucosa verrucosa* Smirnov, *The World Chydorid Fauna.* USSR Acad. Sci. Zool. Inst. Nova ser. **101**, p. 480-481, Fig. 606.

1974. *Biapertura verrucosa* (Sars) : Fernando, 1974, *Int. Rev. ges. Hydrobiol.,* **65**, Figs. 114-115, 171 H.

Material examined : 5 exs., Jogra beel, Dhubri district, Assam, 21.04.2008, coll., B.K. Sharma.

Characters : Body oval; valves with characteristic tubercles, posterior dorsal and ventral corners rounded. Labral plate with a denticle on its anterior end. Two main connected head pores; lateral pores elevated. Postabdomen short, with curved dorsal and rounded distal margins. Anal spines 6-8; lateral setae in groups, distal seta largest in each group. Claw with a basal spine and setae on the concave margin.

Differential diagnosis : *A. verrucosa* can be differentiated from its allied species by the distinct shapes of its labral plate and postabdomen as well as presence of characteristic tubercles on valves.

Distribution : India : West Bengal, Gujarat and Tamil Nadu. Elsewhere : Indo-Malayan, Ethiopian and Neotropical regions.

Remarks : Represents a new record from N.E. India.

DISCUSSION

Nine species of Cladocera belonging to four families and six genera are recorded here from Assam. Amongst these, four species namely *Diaphanosoma tropicum, Sarsilatona serricauda, Chydorus ventricosus* and *Alona verrucosa* are new records from Northeastern India while *Streblocerus serricaudatus, Alonella clathratula, Alona guttata tuberculata, A. monacantha tridentata* and *A. pulchella* are new records from Assam. Significantly, the documented taxa represent two phylogenetic stems of this group i.e., Ctenopoda and Anomopoda and form rare and interesting elements in our collections. The examined samples include only parthenogenetic females and no males are observed in the present study.

Diaphanosoma tropicum, an interesting member of the Sididae belonging to *D. modigliani-D. dubium* speices group, was described by Korovchinsky (1998) based on analyses of inter population morphological variability, duly supplemented by its geographical distribution. This species was erroneously identified under the name '*D. modigliani* Richard' by Idris and Fernando (1981), Rajapaksa (1981), Kanduru (1981) and Rajapaksa and Fernando (1982) from Malaysia, Sri Lanka and South India respectively. However, *D. tropicum* can be diagnosed correctly from *D. modigliani* by its characteristic features, geographical distribution and preference for different aquatic environs. In addition, this species is confused (Korovchinsky, 2000) with *D. dubium* Manuilova (= *D. dubia*, name amended by Korovchinsky and Mirabdullaev, 1994). Further, *D. tropicum* is a relatively large bodied species of the genus *Diaphanosoma*; its large size may negatively affect distribution of such taxa in tropical waters, with high predation pressure (Kerfoot and Lynch, 1987; Gliwicz, 1994). Nevertheless, its long swimming antenna and massive muscles testify to good swimming ability, which perhaps helps it to co-exist with predators (Korovchinsky 2000). Interestingly, *D. tropicum* is so far known to occur in India only from Tamil Nadu. The present study, the second confirmed report of this interesting species from India, considerably extends its distributional range to N.E. region and, hence, reflects presence of distant disjunct populations of the species in this country.

Sarsilatona is reported to occur in the tropics and subtropics (Korovchinsky, 1992; Negrea *et al.* 1999). The sole earlier report of this genus from Asia refers to *Latonopsis fernandoi*-a new species described by Rane (1983) from Madhya Pradesh which was, in turn, treated as a synonym of *Sarsilatona serricauda* (Sars) by Sharma and Sharma (1990). The specimens of *S. serricauda* examined from Assam, therefore, represent

its second record from the Asian continent and its present report, therefore, deserve special mention as an example of global biogeographical significance.

Chydorus ventricosus, an anomalous chydorid, was re-described by Rajapaksa and Fernando (1986). This species is known from Sri Lanka, Java, Africa and South America while it is so far observed in this country from Southern, Central and Western India. The present report of *C. ventricosus* extends its occurrence to N.E. India and indicates example of regional distributional interest.

Alona verrucosa is another interesting addition to the cladoceran fauna of Northeastern India. This species is so far represented by its disjunct Indian populations from Gujarat. Tamil Nadu, and West Bengal; the specimens from the last state, however, lacked the presence of diagnostic tubercles on their valves (= *A. verrucosa pseudoverrucosa*). On the other hand, the specimens examined from Assam belong to *A. verrucosa s. str.*

Alonella clathratula was formerly treated as a subspecies of *A. excisa* by Smirnov (1971) who subsequently (Smirnov, 1996) resurrected its specific status. These two species exhibit different distributional ranges; the former is reported from the Australian, Ethiopian and Neotropical regions and, Java while the later shows cosmopolitan distribution. *A. clathratula* is so far represented by its disjunct Indian populations examined from Bihar (Sharma and Sharma, 2001) and Meghalaya (Sharma, 2008). The present report further extends its distributional range to the adjoining state of Assam. Smirnov and Timms (1983) indicated occurrence of this species in acidic waters in Australia. Interestingly, it was collected earlier from an acidic wetland (pH : 6.0) from South Garo Hills district of Meghalaya (Sharma, 2008). The present report of *A. clathratula* in acidic waters from Assam affirms the acidophilus character of this chydorid.

Alona tuberculata was treated as a subspecies of *A. guttata* by Smirnov (1971). This subspecies is recorded so far only from Europe, Columbia and USSR as against the nominate *A. guttata s. str.* which apparently shows cosmopolitan distribution. *A. guttata tuberculata* is, however, recently documented in India from Meghalaya (Sharma, 2008). The present report of this rare and interesting taxon further extends its distributional range within Northeastern India.

Alona monacantha tridentata, a new record from Assam, has earlier been reported from this country from the states of Tripura (Venkataraman and Das, 2000) and Meghalaya (Sharma, 2008) of North-Eastern region. The cosmotropical *A. pulchella* is relatively widely distributed in India with records from West Bengal, Gujarat, Rajasthan and Tamil Nadu. It is known in Northeastern region from the state of Tripura (Venkataraman and Das, 2000); our observations extend its distributional range in the stated region. *Streblocerus serricaudatus,* another new record from Assam, is a lesser known Macrothricidae from India with reports from Meghalaya, Manipur and Rajasthan.

SUMMARY

Plankton samples examined from Assam reveal nine species of rare and interesting Cladocera belonging to four families and six genera. *Diaphanosoma tropicum, Sarsilatona serricauda, Chydorus ventricosus* and *Alona verrucosa* are new records from N.E. India. In addition, *Streblocerus serricaudatus, Alonella clathratula, Alona guttata tuberculata, A. monacantha tridentata* and *A. pulchella* are new records from Assam. Interestingly enough, *Diaphanosoma tropicum* and *Sarsilatona serricauda* are records of global biogeographical significance while the reports of other taxa are important from the view point of regional or local distribution.

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