Rec. zool. Surv. India : **109**(Part–3) : 41-60, 2009

BIODIVERSITY AND DISTRIBUTION OF FRESHWATER ROTIFERS (ROTIFERA : EUROTATORIA) OF TAMIL NADU

B.K. SHARMA
Freshwater Biology Laboratory, Department of Zoology,
North-Eastern Hill University, Umshing, Shillong-793 022, Meghalaya
e-mail : bksharma@nehu.ac.in
and
SUMITA SHARMA
Eastern Regional Station, Zoological Survey of India,
Risa Colony, Fruit Gardens, Shillong-793 003, Meghalaya,
e-mail : sumitazsi@hotmail.com

INTRODUCTION

Taxonomic studies on freshwater Rotifera of Tamil Nadu were initiated by Edmondson and Hutchinson (1934); about two dozen papers published during the time span of more than seven decades indicate that their faunal diversity is still inadequately explored. A large number of earlier works, however, deal with scattered reports of various taxa or record only planktonic species. The detailed faunal surveys from this state are yet lacking while samples from certain districts are examined by Daisy (2001) and Sivakumar and Altaff (2001). Raghunathan and Suresh Kumar (2006) compiled a list of the rotifers reported from Tamil Nadu based on the published literature; it reflects several nomenclatural anomalies, incorrect family allocations, obsolete names and records requiring confirmation and, hence, requires a critical analysis.

The present study, a part of our investigations on Fauna volume of Indian Freshwater Rotifera, documents 139 species (149 taxa) belonging to 38 genera and 20 families from Tamil Nadu and, includes 38 new records from this state and 20 new reports from the southern India. This study raises the micro-faunal diversity of Tamil Nadu Rotifera to 177 species (188 taxa); an up-dated systematic inventory is presented and, various interesting species are briefly diagnosed and illustrated. Remarks are made on nature and composition of the rotifer fauna of Tamil Nadu as well as on the biodiversity observed in the collections examined by the authors. In addition, comments are made on biogeographically important elements, occurrence and distribution of interesting species, taxonomic status of several taxa and validity of various earlier records.

MATERIALS AND METHODS

A total of 248 plankton samples collected from the following localities, spread over nine districts, of Tamil Nadu (Fig. 1, A-B) were examined in the present study :

Northern Tamil Nadu

Tiruvallur (13° 09′ N; 79° 57′ E)
Chennai (13° 04′ N; 80° 17′ E)
Vellore (12° 55′ N; 79° 11′ E),
Kanchipuram (12° 50′ N; 79° 45′ E)
Tiruvannamalai (12° 15′ N; 79° 07′ E)
Dharamapuri(12° 08′ N; 78° 13′ E)
Salem (11° 39′ N; 78° 12′ E)

Southern Tamil Nadu

Madurai (9° 58′ N 78° 10′ E)
Virudunagar (9° 35′ N; 77° 57′ E)
Tuticorin (8° 48′ N; 78° 11′ E)

The qualitative plankton samples were collected, on several occasions during 2005-2007, from various aquatic biotopes of the stated localities and their environs by nylobolt plankton net (No. 25) and were preserved in 5% formalin. Individual collections were screened with a Wild stereoscopic binocular microscope for isolation of different taxa. Permanent mounts of various species were prepared in Polyvinyl alcohol-lectophenol mixture. Illustrations of different taxa were drawn with a Leitz-Dialux phase contrast stereoscopic microscope using a drawing-tube attachment. All the measurements were given in micrometers (μm).

Rotifera species are identified following the works of Kutikova (1970), Koste (1978), Koste and Shiel (1987, 1989, 1990, 1991), Shiel and Koste (1992, 1993), Segers (1995), De Smet (1997), Sharma (1983, 1987, 1998b), Sharma and Sharma (1997, 1999, 2000), Nogrady and Pourriot (1995) and Nogrady and Segers (2002). The system of Rotifera classification followed in this account is after Segers (2002) and the remarks on their biogeography are made following Segers (2007). The percentage similarities between the rotifer communities are calculated by Sorenson's index. All the collections and reference materials are deposited in the holdings of the senior author (BKS) at Department of Zoology, North-Eastern Hill University, Shillong.

SYSTEMATIC ACCOUNT

One hundred seventy-seven species (188 taxa) of Rotifera, belonging to 56 genera and 25 families are recorded presently from Tamil Nadu. Of these, 139 species (149 taxa), spread over 38 genera and 20 families, are observed in the collections examined by the authors. A detailed systematic list of the recorded taxa is presented in Table 1 and their family-wise break-up is indicated in Table 2.

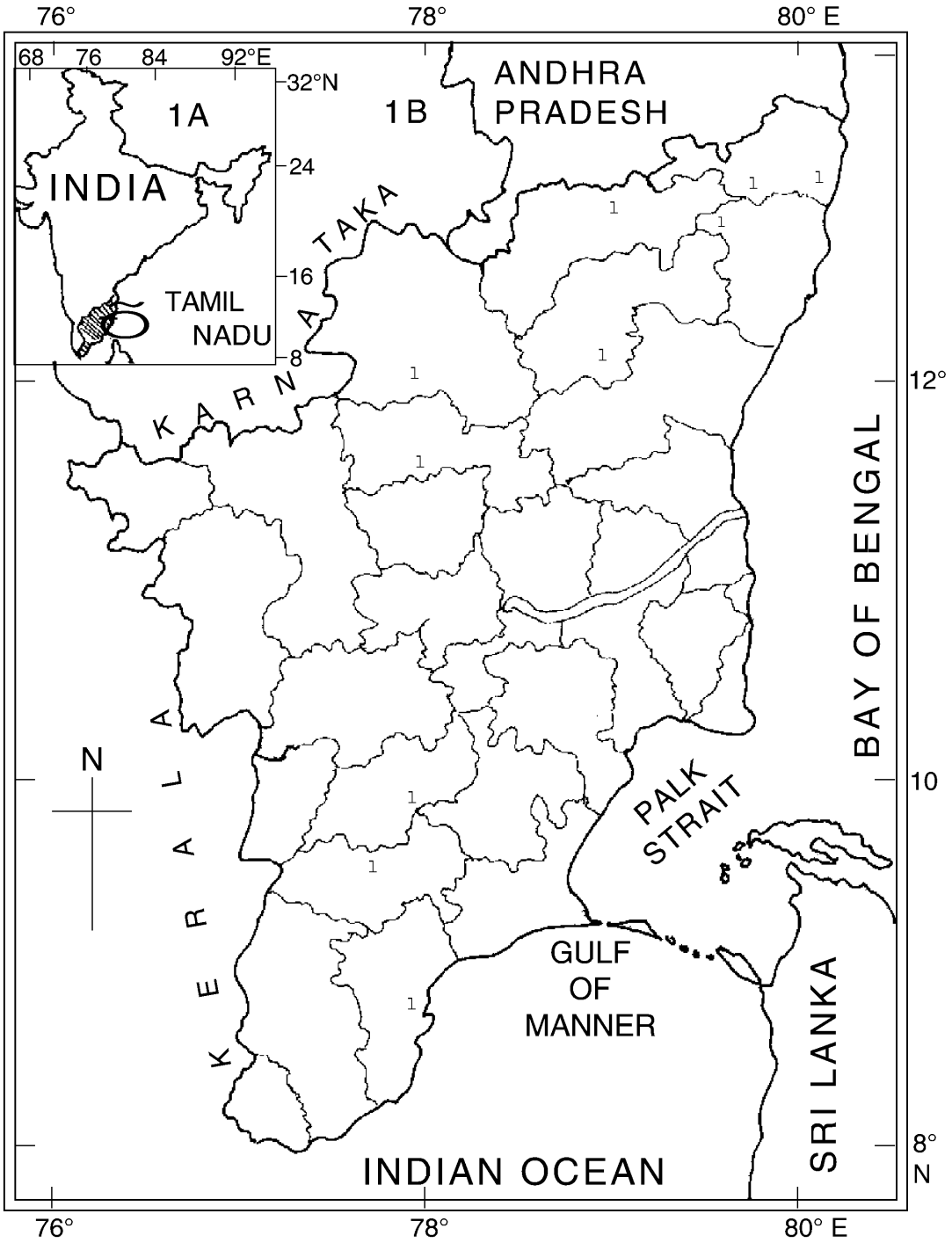

Fig. 1 : A (inset) : Map of India indicating location of Tamil Nadu; Fig. 1, B : Map of Tamil Nadu indicating sampled localities.

Table 1 : Systematic list of reported Rotifera taxa

Sr. No.	Families	Total taxa reported (present study)		Taxa examined in our collections	
		Species	Genera	Species	Genera
1	Brachionidae	31	6	27	5
2	Epiphanidae	4	1	1	1
3	Euchlanidae	9	5	5	3
4	Mytilinidae	3	2	3	2
5	Trichotriidae	5	3	4	2
6	Lepadellidae	19	3	19	3
7	Lecanidae	40	1	36	1
8	Proalidae	1	1	0	0
9	Notommatidae	9	5	5	3
10	Scaridiidae	1	1	1	1
11	Gastropodidae	2	2	1	1
12	Trichocercidae	12	1	12	1
13	Asplanchnidae	5	2	2	1
14	Synchaetidae	5	4	3	2
15	Dicranophoridae	3	3	1	1
Order	FLOSCULARIACEAE				
16	Flosculariidae	3	2	3	2
17	Conochilidae	2	1	2	1
18	Hexarthridae	2	1	1	1
19	Trochosphaeridae	7	3	7	3
20	Testudinellidae	4	2	4	2
Order	COLLOTHECACEAE				
21	Collothecidae	1	1	0	0
22	Atrochidae	1	1	0	0
Order	Bdelloidea				
23	Adinetidae	1	1	0	0
24	Habrotrochidae	1	1	0	0
25	Philodinidae	6	3	2	1
	Total taxa	**177**	**56**	**139**	**38**

Besides, some taxa with uncertain taxonomic status (*refer* Koste, 1978, Sharma, 1998a, Segers, 2007) reported from Tamil Nadu have been grouped into the following categories :

Genera and species *inquirendae*

Diplois daviesiae Gosse, 1886

Pseudoembata acutipoda Wycliffe & Michael, 1968

Species *inquirendae*

Conochilus arboreus Rajendran, 1971

C. madurai Michael, 1966

Table 2 : Family-wise break-up of the Rotifer fauna of Tamil Nadu.

Sr. No.	Families	Total taxa reported (present study)		Taxa examined in our collections	
		Species	Genera	Species	Genera
Order	PLOIMA				
1	Brachionidae	31	6	27	5
2	Epiphanidae	4	1	1	1
3	Euchlanidae	9	5	5	3
4	Mytilinidae	3	2	3	2
5	Trichotriidae	5	3	4	2
6	Lepadellidae	19	3	19	3
7	Lecanidae	40	1	36	1
8	Proalidae	1	1	0	0
9	Notommatidae	9	5	5	3
10	Scaridiidae	1	1	1	1
11	Gastropodidae	2	2	1	1
12	Trichocercidae	12	1	12	1
13	Asplanchnidae	5	2	2	1
14	Synchaetidae	5	4	3	2
15	Dicranophoridae	3	3	1	1
Order	FLOSCULARIACEAE				
16	Flosculariidae	3	2	3	2
17	Conochilidae	2	1	2	1
18	Hexarthridae	2	1	1	1
19	Trochosphaeridae	7	3	7	3
20	Testudinellidae	4	2	4	2
Order	COLLOTHECACEAE				
21	Collothecidae	1	1	0	0
22	Atrochidae	1	1	0	0
Order	BDELLOIDEA				
23	Adinetidae	1	1	0	0
24	Habrotrochidae	1	1	0	0
25	Philodinidae	6	3	2	1
	Total taxa	**177**	**56**	**139**	**38**

TAXONOMIC NOTES

Various interesting species examined in the present study as well as certain interesting elements reported earlier from Tamil Nadu are briefly commented and illustrated below :

Family BRACHIONIDAE

Brachionus donneri Brehm, 1951

Material examined : 5 examples, R/BKS/TN/08-12, Vandiyur tank, Madurai, 24.05.2006, coll. S. Krishnan; 3 examples, R/BKS/TN/13-15, pond close to Kuvum river, near NH-4, Chennai, 12.01.2007, coll. B.K. Sharma.

Distribution : India : Assam, Meghalaya, Tripura, West Bengal and Tamil Nadu.

Elsewhere : Oriental region.

Brachionus durgae Dhanapathi, 1974

Material examined : 3 examples, R/BKS/TN/16-18, wetland located east of Tiruvallur, vicinity of NH-205, 08.01.2007, coll. B.K. Sharma.

Distribution : India : Andhra Pradesh and Orissa.

Elsewhere : African, Neotropical, Oriental and Palearctic regions.

Remarks : This species is reported first time from Tamil Nadu.

Keratella edmondsoni Ahlstrom, 1943

Material examined : 3 examples, R/BKS/TN/31-33, pond in Poondi, Tiruvallur district, 09.01.2007, coll. B.K. Sharma; 2 examples, R/BKS/TN/34-35, wetland located north of Tiruvannamalai towards Turinjapuram, 31.06.2007, coll. A. Rajan.

Distribution : India : Assam, Rajasthan and Orissa.

Elsewhere : Oriental region.

Keratella lenzi Hauer, 1953

Material examined : 4 examples, R/BKS/TN/36-39, Vardaraja temple pond, Kanchipuram, 14.01.2007, coll. B.K. Sharma; 3 examples, R/BKS/TN/40-42, wetland located south of Salem towards Mallur, 22.08.2005, coll. A. Vijayan.

Distribution : India : Assam, Meghalaya, Tripura, West Bengal, Orissa and Punjab.

Elsewhere : Pantropical.

Remarks : This species is reported first time from southern India.

Platyias leloupi (Gillard, 1967)

Material examined : 2 examples, R/BKS/TN/50-51, wetland located north of Vellore towards Katpadi, 07.09.2005, coll. A. Vijayan.

Distribution : India : Assam and Kerala.

Elsewhere : Tropicopolitan.

Remarks : This species is reported first time from Tamil Nadu.

Family EUCHLANIDAE

Pseudoeuchlanis longipedes Dhanapathi, 1978

Material examined : not observed in the examined collections.

Characters : Body ovoid, truncate anterior at end and rounded posteriorly. Dorsal plate arched in cross-section, with anterior margin raised in middle into a small arched and non-retractable semicircular plate. Venter membranous, its posterior portion stiffened. Lateral sulci absent. Toes long. Slender, cylindrical, slightly broad at base and with tips curved outwards. Mastax modified malleate type.

Distribution : India : Andhra Pradesh.

Elsewhere : Endemic to India.

Remarks : This species is reported first time from Tamil Nadu.

Family MYTILINIDAE

Mytilina acanthophora Hauer, 1938

Material examined : 3 examples, R/BKS/TN/63-65, wetland located in Vedantagdal Bird sanctuary, Kanchipuram district, 15.01.2007, coll. B.K. Sharma; 2 examples, R/BKS/TN/66-67, wetland located near Virudunagar towards Palavanattam, 02.06.2007, coll. N. Murugan.

Distribution : India : Assam, West Bengal and Punjab.

Elsewhere : Pantropical.

Remarks : This species is reported first time from southern India.

Family TRICHOTRIIDAE

Macrochaetus longipes (Myers, 1934)

Material examined : 3 examples, R/BKS/TN/71-73, wetland located in Vedantagdal Bird sanctuary, Kanchipuram district, 15.01.2007, coll. B.K. Sharma.

Distribution : India : Assam and Meghalaya.

Elsewhere : Cosmopolitan.

Remarks : This species is reported first time from southern India.

Family LEPADELLIDAE

Lepadella biloba Hauer, 1958

Material examined : 2 examples, R/BKS/TN/80-81, wetland located north of Vellore towards Katpadi, 07.09.2005, coll. A. Vijayan; 2 examples, R/BKS/TN/82-83, wetland located east of Dharmapuri towards Mukhamur, 02.08.2006, coll. M. George; 3 examples, R/BKS/TN/84-86, paddy-field located in outskirt of Kanchipuram, 14.01.2007, coll. B.K. Sharma.

Distribution : India : Meghalaya.

Elsewhere : Cosmopolitan.

Remarks : This species is reported first time from southern India.

Lepadella dactyliseta (Stenroos, 1898)

Material examined : 3 examples, R/BKS/TN/94-96, wetland located south of Salem towards Mallur, 22.08.2005, coll. A. Vijayan.

Distribution : India : Assam, Meghalaya and Kerala.

Elsewhere : Palaeotropical.

Remarks : This species is reported first time from Tamil Nadu.

Lepadella eurysterna Myers, 1942

Material examined : 2 examples, R/BKS/TN/99-100, wetland located 5 km north of Tuticorin, 05.09.2005, coll. T. Jayaraman; 3 examples, R/BKS/TN/101-103, wetland located near Virudunagar towards Palavanattam, 02.06.2007, coll. N. Murugan; 2 examples, R/BKS/TN/104-105, paddy field located near Pennathur, Tiruvannamalai district, 31.06.2007, coll. A. Rajan.

Distribution : India : Meghalaya and Delhi.

Elsewhere : Cosmopolitan.

Remarks : This species is reported first time from southern India.

Family LECANIDAE

Lecane braumi Koste, 1978

Material examined : 3 examples, R/BKS/TN/122-125, wetland located in Maninagaram, Madurai, 25.05.2005, coll. S. Krishnan; 2 examples, R/BKS/TN/126-127, paddy-field located near Ambattur, Virudunagar district, 02.06.2007, coll. N. Murugan.

Distribution : India : Assam, Tripura and Tamil Nadu.

Elsewhere : Palaeotropical.

Lecane eswari Dhanapathi, 1976

Material examined : 3 examples, R/BKS/TN/133-135, wetland located east of Tiruvallur and in the vicinity of NH-205, 08.01.2007, coll. B.K. Sharma.

Distribution : India : Andhra Pradesh and Chandigarh (Union Territory).

Elsewhere : Palaeotropical.

Remarks : This species is reported first time from Tamil Nadu.

Lecane lateralis Sharma, 1978

Material examined : 4 examples, R/BKS/TN/141-144, wetland located near Adyar river in the vicinity of Nandanam, 12.01.2007, coll. B.K. Sharma; 3 examples, R/BKS/TN/145-147,

Ekambareswarar temple pond, Kanchipuram, 14.01.2007, coll. B.K. Sharma; 3 examples, R/BKSTN/148-150, wetland located in outskirt of Salem towards Surnamanglam, 22.08.2006, coll. A. Vijayan.

Distribution : India : Assam, Meghalaya, Tripura, Orissa and West Bengal.

Elsewhere : Palaeotropical.

Remarks : This species is reported first time from southern India.

Lecane simonneae Segers, 1993

Material examined : 3 examples, R/BKS/TN/168-170, wetland located in Vedantagdal Bird sanctuary, Kanchipuram district, 15.01.2007, coll. B.K. Sharma.

Distribution : India : Assam, Kerala and Tamil Nadu.

Elsewhere : Palaeotropical.

Lecane sola Hauer, 1936

Material examined : 4 examples, R/BKS/TN/171-174, wetland located in outskirt of Tuticorin vicinity of NH-7A, 05.09.2005, coll. T. Jayaraman; 3 examples, R/BKS/TN/175-177, wetland located near Virudunagar towards Palavanattam, 02.06.2007, coll. N. Murugan.

Distribution : India : Assam, Tripura and Tamil Nadu.

Elsewhere : Tropics and subtropics.

Lecane (Monostyla) acanthinula (Hauer, 1938)

Material examined : 3 examples, R/BKS/TN/181-184, wetland located in outskirt of Tuticorin in the vicinity of NH-7A, 05.09.2005, coll. T. Jayaraman.

Distribution : India : Assam, Tripura, Kerala and Orissa.

Elsewhere : Oriental region.

Remarks : This species is reported first time from Tamil Nadu.

Lecane (Monostyla) bulla diabolica (Hauer, 1936)

Material examined : not observed in the examined collections.

Characters : Lorica smooth, egg-shaped, without clear distinction between dorsal and ventral plates and with dorsal plate with a pair of characteristic anteriorly directed spines. Toe long, parallel-sided; claw relatively long.

Distribution : India : Tamil Nadu.

Elsewhere : Endemic to India.

Family GASTROPODIDAE

Ascomorpha ecaudis (Perty, 1850)

Material examined : 3 examples, R/BKS/TN/221-223, Kunnathur tank, Madurai, 24.05.2006, coll. S. Krishnan.

Distribution : India : Kashmir and Manipur.

Elsewhere : Cosmopolitan.

Remarks : This species is reported first time from southern India.

Family TRICHOCERCIDAE

Trichocerca bicristata (Gosse, 1887)

Material examined : 4 examples, R/BKS/TN/227-231, wetland located in Pudapet, Chennai, 12.01.2007, coll. B.K. Sharma.

Distribution : India : Assam, Bihar and Orissa.

Elsewhere : Cosmopolitan.

Remarks : This species is reported first time from southern India.

Trichocerca iernis (Gosse, 1887)

Material examined : 3 examples, R/BKS/TN/236-238, paddy-field located in outskirt of Vellore, 07.09.2005, coll. A. Vijayan.

Distribution : India : Assam and Kashmir.

Elsewhere : Cosmopolitan.

Remarks : This species is reported first time from southern India.

Trichocerca kostei Segers, 1993

Material examined : 3 examples, R/BKS/TN/239-241, paddy field located near Poondi, Tiruvallur district, 18.07.2005, coll. A. Rajan.

Distribution : India : Assam and Kerala.

Elsewhere : Palaeotropical.

Remarks : This species is reported first time from Tamil Nadu.

Trichocerca similis grandis Hauer, 1965

Material examined : 3 examples, R/BKS/TN/250-252, wetland located north of Vellore towards Katpadi, 07.09.2005, coll. A. Vijayan; 4 examples, R/BKS/TN/253-256, Vandiyur tank, Madurai, 24.05.2006, coll. S. Krishnan; 4 examples, R/BKS/TN/257-260, wetland located in Vedantagdal Bird sanctuary, Kanchipuram district, 15.01.2007, coll. B.K. Sharma.

Distribution : India : Assam.

Elsewhere : African, Australian and Neotropical regions.

Remarks : This species is reported first time from southern India.

Family ASPLANCHNIDAE

Asplanchnopus bhimavaramensis Dhanapathi, 1971

Material examined : not observed in the examined collections.

Characters : Body transparent, thin, sacciform; head separated from body. Corona as a circum-apical band of cilia. Retro-cerebral sac with a prominent eye. Mastax incudate, with short fulcrum, ramus without teeth on inner side, uncus reduced and attached to delicate trifid manubria. Vitellarium horse-shoe shaped. Flame cells 16-18. Gastric glands round. Foot glands long and club shaped. Foot two jointed; basal segment stout and terminal segment long and wrinkled. Toes broad at base and gradually tapering to conical tips.

Distribution : India : Andhra Pradesh.

Elsewhere : Endemic to India.

Family DICRANOPHORIDAE

Dicranophoroides caudatus (Ehrenberg, 1834)

Material examined : 2 examples, R/BKS/TN/287-288, paddy field located in outskirt of Tuticorin, 04.09.2005, coll. T. Jayaraman; 2 examples, R/BKS/TN/289-290, wetland located west of Tiruvannamalai towards Pennathur (NH-86), 31.06.2007, coll. A. Rajan.

Distribution : India : Assam and Andhra Pradesh.

Elsewhere : Cosmopolitan.

Remarks : This species is reported first time from Tamil Nadu.

Order FLOSCULARIACEAE

Family FLOSCULARIDAE

Sinantherina spinosa (Thorpe, 1893)

Material examined : 2 examples, R/BKS/TN/299-300, paddy-field located in outskirt of Virudunagar, 01.06.2007, coll. N. Murugan; 2 examples, R/BKS/TN/301-302, wetland located west of Tiruvannamalai towards Pennathur (NH-86), 31.06.2007, coll. A. Rajan.

Distribution : India : Assam and Tripura.

Elsewhere : Pantropical.

Remarks : This species is reported first time from southern India.

Family TROCHOSPHAERIDAE

Filinia brachiata (Rousselet, 1901)

Material examined : 2 examples, R/BKS/TN/309-310, Ambattur lake located 15 kms. South of Chennai, coll. A. Rajan, 19.07.2005; 3 examples, R/BKS/TN/311-313, Vardaraja temple pond, Kanchipuram, 14.01.2007, coll. B.K. Sharma.

Distribution : India : Assam and Meghalaya.

Elsewhere : Cosmopolitan.

Remarks : This species is reported first time from southern India.

Trochosphaera aequatorialis Semper, 1872

Material examined : 3 examples, R/BKS/TN/319-321, pond, Theppakulam, Madurai, 25.05.2006, coll. S. Krishnan; 4 examples, R/BKS/TN/322-325, Velachery lake located 12 kms. South of Chennai, 10.01.2007, coll. B.K. Sharma.

Distribution : India : Assam, West Bengal, Tripura and Bihar.

Elsewhere : Pantropical.

Remarks : This species is reported first time from southern India.

DISCUSSION

Plankton samples examined presently from Tamil Nadu reveal 139 species (149 taxa) of Eurotatoria and, hence, reflect their speciose and diverse taxocoenosis. Besides, our collections exhibit 38 new records from the state and 20 taxa are new records from southern India. The present findings notably raise the faunal diversity of freshwater Rotifera from Tamil Nadu to 177 species (188 taxa) which, in turn, represents the richest biodiversity of the Phylum known till date from any state of India and, is reasonably greater than the highest published report of 148 species from West Bengal (Sharma, 1998b). The overall richness currently documented from Tamil Nadu comprises about 47 % of the Indian Rotifera and it presents a notable increase over 120 species recognized by the authors following a critical review of earlier taxonomic works published from the state. The rotifer fauna of Tamil Nadu as well as species examined by the authors exhibit 53.4% and 55.3% community similarities (*vide* Sorenson's index) respectively with the fauna of Sri Lanka (*vide* Fernando, 1980), thereby, indicating significant divergence in their faunal diversity in spite of the geographical proximity with the island country. On the other hand, the rotifer fauna of Tamil Nadu shows 61.5 % similarity with the fauna of West Bengal (*vide* Sharma, 1998b) and 66.2% similarity with the fauna of Orissa (*vide* Sharma and Sharma, 2005b).

The rotifer fauna of Tamil Nadu is characterized by greater higher diversity. This generalization is endorsed by the fact that out of 67 genera of the Phylum recorded so far from India, 56 genera (83.6%) and all (25) families of Eurotatoria known from this country are represented in Tamil Nadu. The salient features of the rich species, generic and family diversity attach special biodiversity importance to the studied fauna and, reflect greater environmental heterogeneity as well as micro-habitat diversity of the aquatic environs of this state. The stated remarks are also endorsed by 139 species (149 taxa) examined by the authors from Tamil Nadu which, in turn, represent 20 families (80%). On the contrary, the relatively lower generic diversity (38 genera, 67.9%) noticed in our collections in general and lack of the representatives of five families namely Proalidae, Atrochidae, Collothecidae, Adinetidae and Habrotrochidae deserves comment and may be attributed to the planktonic and littoral-periphytonic nature of the presently observed collections.

Tamil Nadu Rotifera include seventeen biogeographically interesting elements (9.8%) belonging to the following categories :

1. Indian endemics: *Pseudoeuchlanis longipedis, Asplanchnopus bhimavaramensis* and *Lecane bulla diabolica.*
2. Oriental endemics : *Brachionus donneri, Keratella edmondsoni* and *Lecane acanthinula.*
3. Palaeotropical species: *Lecane braumi, L. eswari, L. lateralis, L. simonneae, L unguitata* and *Encentrum longipes.*
4. Nearctic and Palaearctic species: *Brachionus havanaensis, Keratella ticinensis, Lecane depressa, L. elasma* and *Wierzejskiella ricciae.*

Amongst the members of the first category, *Pseudoeuchlanis longipedis* deserves special mention; this endemic Indian genus of the Euchlanidae is represented by only one species described from Andhra Pradesh (Dhanapathi, 1978). Raghunathan and Suresh Kumar (2006) listed its occurrence of *Pseudoeuchlanis* sp. in Tamil Nadu and thus did not indicate any species determination. *Pseudoeuchlanis* was, however, included under the list of invalid Rotifera genera recognized by Segers (2002) while Segers (2007) subsequently considered it to be valid taxon. This rare and interesting euchlanid is not observed in our collections and, hence, its report still requires confirmation but the original description given by Dhanapathi (op cit.) indicates the need for its possible re-examination or re-description. *Asplanchnopus bhimavaramensis*, another interesting Indian endemic, was also described from Andhra Pradesh (Dhanapathi, 1975) and its distributional range is now extended to Tamil Nadu. In addition, *Lecane bulla diabolica* was described by Hauer (1936) from Almati reservoir, Chennai as a form of *L. bulla* and is not known so far elsewhere in India. The last two, nevertheless, are valid taxa but are not noticed in our collections.

Referring to the Oriental endemics, *Brachionus donneri* was described by Brehm (1951) based on the material examined from Almati reservoir, Chennai. Sharma and Sharma (2001, 2005a) considered it to be a Pantropical species while Segers (2007) believed it to be an Oriental element though there is single unconfirmed record of this brachionid from Panama canal waters (? introduction). This species is so far known in India from N. E. region (Assam, Meghalaya, Manipur, Tripura), West Bengal and Tamil Nadu. *Keratella edmondsoni*, another interesting Oriental endemic, was described from Tamil Nadu (Ahlstrom, 1943) as *K. quadrata* var. *edmondsoni* and was subsequently treated as a distinct species by Nayar (1965). It is now recorded from Rajasthan, Tamil Nadu, Northeast India and Northeast Thailand. *Lecane acanthinula*, a possible vicariant of *L furcata*, is reported in this country from Assam, Tripura, Kerala and Orissa and its distribution is presently extended to Tamil Nadu. The stated Oriental species are, however, observed in our collections and so far exhibit disjunct occurrence in India.

All palaeotropical species, except *Encentrum longipes* are observed by the authors in the samples from Tamil Nadu. Of these, Lecane *braumi, L. eswari, L. lateralis, L. simonneae* merit special global biogeographical interest. The first species, an erstwhile endemic to the floodplains of the river Niger (Segers *et al.*, 1993) is subsequently reported from Indonesia and Papua New Guinea.

This lecanid is characterized by its disjunct distribution in India with reports from Assam, Tripura and Tamil Nadu. *Lecane lateralis*, described by Sharma (1978) from West Bengal as an Indian endemic, is now a widely known palaeotropical species. *L. eswari*, described from Andhra Pradesh (Dhanapathi, 1976), is also recorded from Africa. The present report extends the distributional ranges of *L eswari* and *L. lateralis* to southern India.

A special mention is desired of certain new taxa described from Tamil Nadu namely *Brachionus caudatus aculeatus, Lecane sola, Trichocerca flagellata, T. tropis* (= *T. voluta*), *T. ruttneri, Pseudoembata acutipoda, Conochilus madurai* and *C. arboreus*. Amongst these, *P. acutipoda* is termed as "genus and species inquirendae" and, *C. madurai* and *C. arboreus* are 'species inquirendae" (refer Segers, 2007). *L. sola* is known from Neotropical and Oriental regions, *T. flagellata* is a tropicopolitan species while the rest are pantropical elements. Besides, *Brachionus durgae*, described from Andhra Pradesh (Dhanapathi, 1971) and recorded from Orissa (Sharma and Sharma, 2005b), is an interesting addition to the rotifer fauna of Tamil Nadu. This is now considered to be a Cosmo(sub)tropical species with reports from African, Neotropical, Oriental and Palaearctic regions.

Thirty-eight species (21.5%) reported from Tamil Nadu namely *Brachionus leydigii, Keratella lenzi, K. ticinensis, Platyias leloupi, Lophocharis oxysternon, Mytilina acanthophora, Macrochaetus longipes, Wolga spinifera, Lepadella cristata, L. dactyliseta, L. minuta, L. triba, L. quadricarinata, Lecane depressa, L. elasma, L. pusilla, L. thalera, Eosphora anthadis, E. najas, Itura aurita, Taphrocampa selenura, Ascomorpha ecaudis, Gastropus hyptopus, Trichocerca bicristata, T. kostei, T. iernis, T. tenuior, Pleosoma lenticulare, Asplanchna herricki, Harringia rousseleti, Filinia brachiata, F. pejleri, Testudinella parva, Trochosphaera aequatorialis, Horaella brehmi, Cupelopagis vorax, Collotheca ornata* and *Adineta vaga* indicate examples of regional or local distributional importance. The material examined by the authors, however, includes 24 of the listed species.

A number of species reported from Tamil Nadu require confirmation. Among these, *Keratella valga* presents a classical example of erroneous identification in several parts of the world. The validity of its occurrence in Indian waters has been questioned earlier by Sharma (1987), its dubious records from this country in fact belong to *K. tropica*. *K. ticinensis* occurs in Nearctic and Palaearctic; this species is so far known from Kashmir and Tamil Nadu and comments on its distribution in India are also made by Sharma (1991). *Brachionus havanaensis* occurs in Nearctic and Neotropical regions while it is believed (Segers, 2007) to be an introduced species in Oriental region. The authors recommend examination of specimens of *B. havanaensis* and *K. ticinensis* to validate their occurrence. This statement also holds true for *Notholca squamula* (misspelled as *N. scaphula* by Raghunathan and Suresh Kumar, 2006) in general and on the distribution of *Notholca* spp. in India in particular. Raghunathan and Suresh Kumar (loc cit.) indicated occurrence of *Trichocerca tortusa*, *Polyarthra multiappendiculata* and *Cathypna amban*. Referring to the first, it may be indicated

that no such valid species is listed in the global review of genus *Trichocerca* (*refer* Segers, 2003), the second species is a synonym of P. *vulgaris* (refer Koste, 1978) while the last species is a synonym of *Lecane depressa* (refer Segers, 2007). The authors, however, desire confirmation of earlier records of *Lecane depressa, L. elasma* and *L. thalera* from Tamil Nadu.

The cosmopolitan species comprise a major qualitative component (61.0%) of the rotifer fauna of Tamil Nadu. Besides, Pantropical (15.8%) > Tropicopolitan or cosmotropical (11.3%) species are well represented. The observed trends re-affirm our earlier remarks (Sharma and Sharma, 2001, 2005a; Sharma, 2005) and are in conformity with the general composition of the rotifer fauna of India (Sharma 1998b).

Lecanidae (40 species) > Brachionidae (31 species) > Lepadellidae (19 species) > Trichocercidae (12 species) form a dominant fraction (70.1%) of Rotifera examined presently from Tamil Nadu and also an important component of total number species recorded from this state (57.5%). Notommatidae (9 species) = Euchlanidae (9 species) are other notable families (27.8%). Hence, amongst 25 families of Eurotatoria recorded from this state, only six families contribute a significant fraction (120 species, 67.8 %) of the documented species. The qualitative importance of the stated families broadly concurs with the reports of Jose de Paggi (1993, 2001), Sanoamuang (1998), Sharma and Sharma (2001, 2005a, 2008) and Sharma (2005). Interestingly, majority of the listed families, except Brachionidae, are predominantly represented by littoral-periphytic taxa. In addition, Trochosphaeridae (7 species) > Philodinidae (6 species) > Asplanchnidae (5 species) = Synchaetidae (5 species), together, form a valuable sub-dominant component (23 species).

Latitudinal variations in the distribution of Rotifera, directly or indirectly induced by climatological factors, are reported by Green (1972), Pejler (1977), De Ridder (1981) Dumont (1983), Segers (1996, 2008). Segers (2001) stressed the role of thermophiles in the rotifer fauna of Southeast Asia and indicated the qualitative significance of two 'tropic-centered' genera namely *Lecane* and *Brachionus*. The biodiversity importance of these two genera is distinctly observed in the rotifer taxocoenosis of Tamil Nadu. *Lecane* (40 species, 22.6%) is the most speciose genus; its richness represents about 50% of total species so far known from India. In general, the lecanid dominance compares well with the reports of Segers *et al.* (1993, 1998), Sanoamuang (1998), Jose de Paggi (2001), Sharma and Sharma (2001, 2005a, 2008) and Sharma (2005). Among about two dozen *Brachionus* spp. known from the Indian inland waters (Sharma, 1983, 1998a), 17 species are recorded from Tamil Nadu while 16 species are observed in our collections; their richness corresponds with the report of 17 species from West Bengal (Sharma, 1998b) while it is marginally higher than 13 species each recorded from Orissa (Sharma and Sharma, 2001) and Assam (Sharma, 2005).

The qualitative significance of 'tropic-centered' *Lecane* and *Brachionus* as well as wider representation and distribution of several pantropical and cosmotropical species impart a 'tropical character' to the rotifer fauna of Tamil Nadu. This generalization concurs with the composition of

the tropical faunas from different parts of the globe (Green, 1972; Pejler, 1977; Fernando, 1980; Dussart et al. 1984; Segers, 2001; Sharma and Sharma, 2008). In addition, our observations show rich diversity of *Lepadella* (15 species) > *Trichocerca* (12 species). Hence, the mentioned five monogonont genera comprise the bulk of the reported species (92 species, 52.0 %); this salient feature corresponds with the remarks of (Sharma and Sharma, 2005a). Interestingly, the richness of the 'temperate-centered' *Keratella* is noteworthy and requires explanation while *Euchlanis, Filinia, Ephiphanes* and *Asplanchna*, together include 18 species. In general the most diverse genera, except *Brachionus* and to lesser degree *Keratella* and *Filinia*, include mainly the littoral-periphytonic taxa.

Twenty six species namely *Brachionus durgae, B. leydigii, B. donneri, Keratella edmondsoni, K. lenzi, Platyias leloupi, Tripleuchlanis plicata, Lophocharis oxysternon, Mytilina acanthophora, Lepadella dactyliseta, L. quadricarinata, L. minuta, L. triptera, Lecane braumi, L. eswari, L. hastata, L. lateralis, Taphrocampa selenura, Pleosoma lenticulare, Lacinularia flosculosa, Sinantherina spinosa, Filinia brachiata, Testudinella emarginula, T. parva, Horaella brehmi* and *Trochosphaera aequatorialis* are rare in our collections examined from Tamil Nadu. On the other hand, *Brachionus angularis, B. calyciflorus, B. falcatus, B. forficula, B. diversicornis, B. quadridentatus, B. rubens, Keratella tropica, Plationus patulus, Lepadella ovalis, L. patella, Lecane curvicornis, L. leontina, L. papuana, L. bulla, L. closterocerca, L. quadridentata, Asplanchna brightwelli, Polyarthra vulgaris, Filinia longiseta, F. terminalis* and *Testudinella patina* exhibit common occurrence and a majority of the members of this category often occur in eutrophic waters.

The scattered plankton samples examined by the authors as well as our limitations to the extent of extensive collections do not warrant comments on latitudinal and longitudinal variations of various taxa. Nevertheless, the present observations significantly enrich the status of faunal diversity of Tamil Nadu Rotifera and, provide useful information on biogeographically interesting elements and on status and validity of various species. Our results exhibit rich and diverse spectrum of monogonont rotifers in general and planktonic and semi-planktonic or the littoral-periphytonic elements in particular but still reflect certain lacunae with special reference to benthic, sessile, colonial and bdelloid taxa. The fauna, therefore, has scope for its up-dating based on analysis of specific communities involving special sampling techniques as well as emphasis on collections from different ecosystems. Our conservative estimate, however, expects occurrence over 250 species of Rotifera in Tamil Nadu.

SUMMARY

One hundred seventy-seven species (188 taxa) of Rotifera, belonging to 56 genera and 25 families recorded from Tamil Nadu exhibit the richest species and higher (generic and families) diversity known till date from any state of India. Amongst these, 139 species (149 taxa), spread over 38 genera and 20 families, are observed in our presently examined collections; 38 taxa are new records from the state and 20 taxa are new records from southern India. This study reports

seventeen biogeographically interesting elements including three Indian endemics, three endemic Oriental species, six Palaeotropical species and, five Nearctic and Palearctic elements. Besides, 38 species exhibit examples of regional or local distributional interest. The cosmopolitan species form a major qualitative component (61.0%) while Pantropical > Tropicopolitan or cosmotropical species are well represented. Lecanidae > Brachionidae > Lepadellidae > Trichocercidae > Notommatidae = Euchlanidae comprise a dominant fraction (67.8%) of the rotifer richness. The rotifer fauna of Tamil Nadu depicts 'tropical character' with the greater diversity of ,tropic-centered' genera namely *Lecane* (40 species) > *Brachionus* (17 species) and wider distribution of Pantropical and cosmotropical species. *Lepadella* (15 species) > *Trichocerca* (12 species) are other important genera while the richness of the 'temperate-centered' *Keratella* is noteworthy. Twenty six species are rare in our collections while 25 species show common occurrence and a majority of them often occur in eutrophic waters. The monogononts in general and planktonic and the littoral-periphytonic rotifers in particular are well documented while benthic, sessile, colonial and bdelloid taxa deserve specific analysis.

ACKNOWLEDGEMENTS

The senior author wishes to express gratitude to a number of colleagues and researchers for helping in the collection of plankton samples in various ways and on several occasions; without their generous help, support and kind co-operation this study would have not been possible. The senior author is also thankful to the Head, Department of Zoology, North-Eastern Hill University, Shillong for laboratory facilities. One of the authors (SS) is thankful to the Director, Zoological Survey of India and the Officer-in-charge, Eastern Regional Station, Zoological Survey of India, Shillong.

REFERENCES

Ahlstrom, E.H. 1943. A revision of the Rotatorian genus *Keratella* with description of three new species and five new varieties. *Bull. Am. Mus. Nat. Hist.,* **80** : 411-457.

Brehm, V. 1951. Einer neuer *Brachionus* aus Indien (*Brachionus donneri*). *Zool. Anz.,* **146** : 54-55.

Daisy, R.R. 2001. *Taxonomy and resting egg morphology of freshwater rotifers*. Ph. D thesis, Manonmaniam Sundaranar University, Tirunelveli. 140 pp.

De Ridder, M. 1981. Some considerations on the geographical distribution of Rotifera. *Hydrobiologia,* 85 : 209-235.

De Smet, W.H. 1997. Rotifera : 5. The Dicranophoridae (Monogononta). In : *Guides to the identification of the microinvertebrates of the continental waters of the world.* Vol. **12.** SPB Academic Publishing bv, Amsterdam, the Netherlands, 325 pp.

Dussart, B.H., Fernando, C.H., Matsumura-Tundisi, J. and Shiel, R.J. 1984. A review of systematics, distribution and ecology of tropical freshwater zooplankton. *Hydrobiologia,* **113** : 77-91.

Dumont, H.J. 1983. Biogeography of rotifers. *Hydrobiologia,* **104** : 19-30.

Dhanapathi, M.V.S.S.S. 1971. Rotifers from Andhra Pradesh, India-I. *Hydrobiologia,* **45** : 357-372.

Dhanapathi, M.V.S.S.S. 1975. Rotifers from Andhra Pradesh, India. *Zool. J. Linn. Soc.,* **57** : 85-94.

Dhanapathi, M.V.S.S.S. 1976. New species of rotifer from India belonging to the family Brachionidae. *Zool. J. Linn. Soc.,* **62** : 305-308.

Dhanapathi, M.V.S.S.S. 1978. A new lecanid rotifer from India. *Hydrobiologia,* **50** : 191-192.

Edmondson, W.T. and Hutchinson, G.E. 1934. Report on Rotatoria. Article IX. Yale North India expedition. *Mem. Conn. Acad. Arts Sci.,* **10** : 153-186.

Fernando, C.H. 1980. The freshwater zooplankton of Sri Lanka, with a discussion of tropical freshwater zooplankton composition. *Int. Rev. ges. Hydrobiol.,* **65** : 411-426.

Green, J. 1972. Latitudinal variation in associations of planktonic Rotifera. *J. Zool. London* **167** : 31-39.

Hauer, J. 1936. Neue Rotarien aus Indien I. *Zool. Anz.,* **116** : 77-80.

José de Paggi S. 1993. Composition and seasonality of planktonic rotifers in limnetic and littoral region of a floodplain lake (Parana River System). *Rev Hydrobiol trop,* **26** : 53-64.

José de Paggi S. 2001. Diversity of Rotifera (Monogononta) in wetlands of Rio Pilcomayo national park, Ramsar site (Formosa, Argentina). *Hydrobiologia,* **462** : 25-34.

Koste, W. 1978. *ROTATORIA Die Rädertiere Mitteleuropas, begründet von Max Voigt. Überordnung Monogononta.* Gebrüder Borntaeger, Berlin, Stuttgart. **I.** Text (673 pp) U. **II.** Tafelbd. (T. 234).

Koste, W. and Shiel, R.J. 1987. Rotifera from Australian inland waters. II. Epiphanidae and Brachionidae (Rotifera : Monogononta). *Invertebr. Taxon.,* **7** : 949-1021.

Koste, W. and Shiel, R.J. 1989. Rotifera from Australian inland waters. IV. Colurellidae (Rotifera : Monogononta). *Trans. R. Soc. S. Aust.,* **113** : 119-143.

Koste, W. and Shiel, R.J. 1990. Rotifera from Australian inland waters. V. Lecanidae (Rotifera : Monogononta). *Trans. R. Soc. S. Aust.,* **114** : 1-36.

Koste, W. and Shiel, R.J. 1991. Rotifera from Australian inland waters. VII. Notommatidae (Rotifera : Monogononta). *Trans. R. Soc. S. Aust.,* **115** : 111-159.

Kutikova, L.A. 1970. The rotifer fauna of the USSR. *Fauna SSSR* **104**, Academia Nauk, 744 pp (in Russian).

Nayar, C.K.G. 1965. Taxonomic notes on Indian species of *Keratella* (Rotifera). *Hydrobiologia,* **26** : 457-462.

Nogrady, T. and Pourriot, R. 1995. Rotifera : 3. The Notommatidae. In : *Guides to the identification of the microinvertebrates of the continental waters of the world.* Vol. **8.** Backhuys Publishers, Leiden, the Netherlands, 248 pp.

Nogrady, T. and Segers, H. 2002. Rotifera : 6. Asplanchnidae, Gastropodidae, Lindiidae, Microcodidae, Synchaetidae, Trochosphaeridae and *Filinia.* In : *Guides to the identification*

of the microinvertebrates of the continental waters of the world. Vol. **18.** Backhuys Publishers, Leiden, the Netherlands, 264 pp.

Pejler, B. 1977. On the global distribution of the family Brachionidae (Rotatoria). *Arch. Hydrobiol. Suppl.* **53** : 255-306.

Raghunathan, M.B. and Suresh Kumar, R. 2006. Diversity of rotifers of Tamil Nadu. *Rec. zool. Surv. India,* **106** : 67-78.

Sanoamuang, L. 1998. Rotifera of some freshwater habitats in the floodplains of the River Nan, northern Thailand. *Hydrobiologia,* **387/388** : 27-33.

Segers, H. 1995. Rotifera 2 : Lecanidae. *Guides to identification of the Microinvertebrates of the Continental waters of the world.* H.J. Dumont & T. Nogrady (eds.). Vol. **6.** SPB Academic Publishing bv. Amsterdam, The Netherlands, 226 pp.

Segers, H. 1996. The biogeography of littoral *Lecane* Rotifera. *Hydrobiologia,* **323** : 169-197.

Segers, H. 2001. Zoogeography of the Southeast Asian Rotifera. *Hydrobiologia,* **446/447** : 233-246.

Segers, H. 2002. The nomenclature of the Rotifera : annotated checklist of valid family- and genus-group names. *J. nat. Hist. London,* **36** : 621-640.

Segers, H. 2003. A biogeographical analysis of rotifers of the genus *Trichocerca* Lamarck, 1801 (Trichocercidae, Monogononta, Rotifera), with notes on taxonomy. *Hydrobiologia,* **500** : 103-114.

Segers, H. 2007. Annotated checklist of the rotifers (Phylum Rotifera), with notes on nomenclature, taxonomy and distribution. *Zootaxa,* **1564** : 1-104.

Segers, H. 2008. Global diversity of rotifers (Rotifera) in freshwater. *Hydrobiologia,* **595** : 49-59.

Segers, H., Ferrufino, N.L. and De Meester, L. 1998. Diversity and Zoogeography of Rotifera (Monogononta) in a flood plain lake of the Ichilo river, Bolivia, with notes on little known species. *Int. Rev. Hydrobiol.,* **83** : 439-448.

Segers, H., Nwadiaro, C.S. and Dumont, H.J. 1993. Rotifera of some lakes in the floodplain of the river Niger (Imo State, Nigeria). II. Faunal composition and diversity. *Hydrobiologia,* **250** : 63-71.

Sharma, B.K. 1978. Contributions to the rotifer fauna of West Bengal. Part I. Family Lecanidae. *Hydrobiologia,* **57** : 143-153.

Sharma, B.K. 1983. The Indian species of the genus *Brachionus* (Eurotatoria : Monogononta : Brachionidae). *Hydrobiologia,* **104** : 31-39.

Sharma, B.K., 1987. Indian Brachionidae (Eurotatoria : Monogononta) and their distribution. *Hydrobiologia,* **144** : 269-275.

Sharma, B.K. 1991. On the status and distribution of some new records of freshwater rotifers (Rotifera : Eurotatoria) from India. *Rec. zool. Surv. India,* **89** : 95-99.

Sharma, B.K. 1998a. Faunal Diversity in India : Rotifera. In : *Faunal Diversity of India*. Pp 57-70 (Eds. J.R.B. Alfred, A.K. Das & A.K. Sanyal). ENVIS Centre, Zoological Survey of India, Calcutta.

Sharma, B.K. 1998b. Freshwater Rotifers (Rotifera : Eurotatoria). In : *Fauna of West Bengal. State Fauna Series*, **3**(11) : 341-461. Zool. Surv. India, Calcutta.

Sharma, B.K. 2005. Rotifer communities of floodplain lakes of the Brahmaputra basin of lower Assam (N.E. India) : biodiversity, distribution and ecology. *Hydrobiologia*, **533** : 209-221.

Sharma, B.K. and Sharma, Sumita, 1997. Lecanid rotifers (Rotifera : Monogononta : Lecanidae) from North-Eastern India. *Hydrobiologia* **356** : 159-163.

Sharma, B.K. and Sharma, Sumita, 1999. Freshwater Rotifers (Rotifera : Eurotatoria). In : *State Fauna Series : Fauna of Meghalaya* **4**(9) : 11-161. Zool Surv. India, Calcutta.

Sharma, B.K. and Sharma, Sumita, 2000. Freshwater Rotifers (Rotifera : Eurotatoria). In : *State Fauna Series : Fauna of Tripura* **7**(4) : 163-224. Zool. Surv. India, Kolkata.

Sharma, B.K. and Sharma, Sumita, 2001. Biodiversity of Rotifera in some tropical floodplain lakes of the Brahmaputra river basin, Assam (N.E. India). *Hydrobiologia,* **446/447** : 305-313.

Sharma, B.K. and Sharma, Sumita, 2005a. Biodiversity of freshwater rotifers (Rotifera : Eurotatoria) from North-Eastern India. *Mitt. Mus. Nat. kd. Berl. Zool. Reihe,* **81** : 81-88.

Sharma, B.K. and Sharma, Sumita, 2005b. Freshwater rotifer taxocoenosis (Rotifera : Eurotatoria) of Orissa, with remarks on composition and distribution. *Rec. zool. Surv. India,* **104** : 41-55.

Sharma, Sumita and Sharma, B.K. 2008. Zooplankton diversity in floodplain lakes of Assam. *Rec. zool. Surv. India, Occ. Paper* No. **290** : 1-307.

Shiel, R.J. and Koste, W. 1992. Rotifera from Australian inland waters VIII. Trichocercidae (Monogononta). *Trans. R. Soc. S. Aust.,* **116** : 1-27.

Shiel, R.J. and Koste, W. 1993. Rotifera from Australian inland waters. IX. Gastropodidae, Synchaetidae, Asplanchnidae (Rotifera : Monogononta). *Trans. R. Soc. S. Aust.,* **117** : 111-139.

Sivakumar, K. and Altaff, K. 2001. Diversity of freshwater rotifers of Dharmapuri district, Tamilnadu. *Convergence,* **3** : 25-30.