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ZOOPLANKTON STUDIES ON KEOLADEO GHANA NATIONAL PARK, BHARATPUR, RAJASTHAN, WITH SPECIAL REFERENCE TO ROTIFERA AND CLADOCERA

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INTRODUCTION

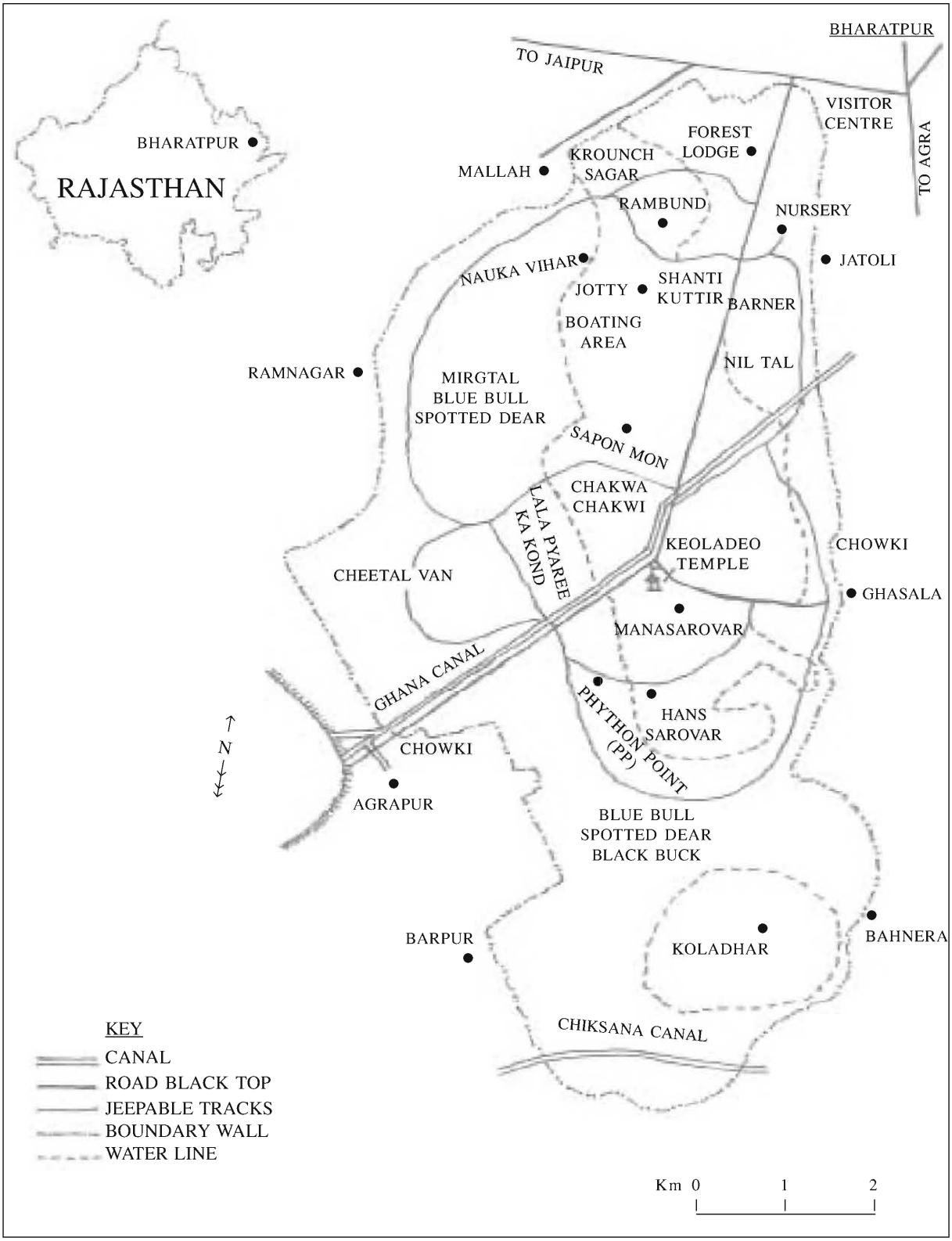
This paper deals with the zooplankton components of some selected wetlands of Keoladeo Ghana National Park, Bharatpur (Rajasthan). It includes nine wetlands from the park. The occurrence and diversity of species from these selected nine wetlands are dealt with special reference to Rotifera and Cladocera indicating the occurrence of each species during the survey period (1998 and 1999). The study of the rotifer and cladoceran diversity of Rajasthan state was initiated by Nayar during 1968 and 1971 *i.e.,* before the Ramsar convention, 1971.

Zooplankton considered as secondary producers, forms a major component of any aquatic ecosystem. The presence and dominance of zooplankton species are clearly related to the physico-chemical and biological regime of the aquatic environments. The freshwater zooplankton consists mainly of three groups *i.e.,* protozoans, rotifers and crustaceans. However, in most of the water bodies rotifers, limnetic crustacens, protozoans and larval insects constitute the dominant component of zooplankton. Nayar (1968) has worked on Rotifers of Rajasthan and reported 36 species out of 325 available in India (Sharma, 1997). Since no study had been done so far on Rotifers of Keoladeo Ghana National Park, the present study on Rotifers of the park, is the first report on the group. Nayar (1971) has studied the cladocerans (17 species) of Rajasthan, where as Venkataraman (1992) reported 39 species of cladocerans from Keoldeo Ghana National Park, Rajasthan, out of the 190 species available in India (Raghunathan and Suresh Kumar, 2003). Realising the importance of zooplankton aspects with reference to the Rotifera and Cladocera, the present study had been undertaken while studying the limnological studies on the wetlands of the system.

Keoladeo Ghana National Park : Keoladeo Ghana is the most famous wetland in India, situated (27°07´-27°12´N, 79° 29´-79°33´E) 2 km south-east of Bharatpur in the Bharatpur district of Rajasthan and 50 km west of Agra of Uttar Pradesh. It is a shallow, natural depression at the western edge of Gangetic plains, at about 50 km west of the Yamuna river, with an inundated land of *Ca* 1000 *ha* in the National Park having an area of 2873 *ha*. Keoladeo Ghana which is popular for avian diversity (about 332 species), was established as a National Park in March, 1982 though priorly designated as a Bird Sanctuary in March, 1956. It was designated as a Wetland of International Importance under the Ramsar Convention in October, 1981 and was nominated as a World Heritage Site in 1985.

MATERIALS AND METHODS

During the course of limnological Investigations of the wetlands in Keoladeo Ghana National Park, during the years 1998 and 1999 zooplankton samples were collected from nine selected sites *viz.,* Saponman (SM), Nauka Vihar (NV), Rambund (RB), Krunch Sagar (KS), Python Point (PP), Mansarovar (MS), Hansarovar (HS), Chiksana Canal (CC) and Ghana canal (GC) of the wetland in the park. These samples were collected using plankton net (No. 25) at the subsurface regions of the water body. The collections were preserved in 4% formaldehyde solution and the methodology



Map of Keoladeo National Park, Bharatpur

categorization employed based on the works of Michael and Sharma (1988), Battish (1992), Dhanapathi (1974, 1975, 1976, 1978), Sharma (1997). The measurements of each species of rotifers and cladocerans are given in millimeters.

RESULTS AND DISCUSSION

The present study on Zooplankton of Keoladeo Ghana National Park, Bharatpur with reference to rotifers and cladocerans has yielded information on 24 species under of Rotifera 7 genera and 4 families in two orders and 28 species of Cladocera belonging to 19 genera in 6 families (Table-I).

The presence and dominance of zooplankton species play a very significant role in the functioning of freshwater ecosystems. The seasonal changes in zooplankton diversity is clearly related to the water quality. Among the rotifers in the park in the present study, *Keratella tropica* appeared predominant having been found in most of the localities followed by *Brachionus calyciflorus, B. falcatus, B. quadridentatus,* found more or less equally in all the localities. The remaining species were not so well distributed in the seven localities. Among the cladocerans, *Ceriodaphnia cornuta* appeared more dominant having been and found in most of the localities followed by *Daphnia lumholtzi* and *Alona rectangula rectangula* (dominated). Locality wise Mansarovar and Hansarovar have shown comparatively maximum species diversity (both Rotifera and Cladocera) and Chiksana Canal the minimum. Out of the 39 cladoceran species observed by Venkataraman (1987, 1988, 1992), eleven species *viz., Latonopsis australis, Daphnia similis, Moina weismanni, Guernella raphaelis, Grimaldina brazzai, Dunhevedia crassa, D. serrata, Alona holdeni, A. monacantha, Notoalona globulosa,* and *Leydigia acanthocercoides* have not been found by the author in the present study.

Although zooplankton exists under a wide range of environmental conditions, yet many species are limited by temperature, Disolved Oxygen, Salinity and other physico-chemical factors. Pollution levels can further alter species composition and community structure like presence and absence of certain fish species. The changes in physico-chemical *milieu,* interspecific and intraspecific competition, pollution level and presence and absence of planktivorus and piscivorus fish are some of the factors influencing zooplankton species composition in any aquatic ecosystem. According to Mahajan (1981), the species (found in the present study) *Anuraepsis fissa, Brachionus angularis, B. calyciflorus, B. quadridentatus, Keratella cochlearis, Filinia longiseta* among rotifers and species of *Diaphanosoma, Simocephalus, Ceriodaphnia* among crustaceans are the indicators of eutrophication. Mary Bai (1993) in studies on Cooum river, stated that the rotifers (found in the present study) like *Brachionus calyciflorus, B. quadridentatus, B. rubens* and *Filinia longiseta* are the indicators of pollution.

In the present study on the wetlands of Keoladeo Ghana National Park, the species like *Brachionus calyciflorus* and *B. quadridentatus* among rotifers are found more or less in all the localities *i.e.,* KS, MS, HS, NV & RB and NV, RB, PP, GC & MS respectively. In the case of cladocerans, genera like *Ceriodaphnia, Diaphanosoma & Simocephalus* which are popularly known as pollution indicators have been observed in most of the localities *viz.,* SM, RB, KS, GC, HS, CC., SM, PP, GC, RB, NV, MS, & HS and SM, RB, GC, CC, KS, & MS respectively. By going through the above and presence of these biological indicators, the author is concluding that most of the wetlands in Keoladeo Ghana National Park are polluted.

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Table-I : The qualitative list of Rotifera and Cladocera of Keoladeo Ghana National Park, Bharatpur (Rajasthan).

Sl. No.	Species	Material examined	Distribution
I	II	III	IV
		Phylum ROTIFERA Subclass EUROTATORIA Order PLOIMIDA	
		Family BRACHIONIDAE	
1	*Anuraeopsis fissa* (Gosse, 1851)	SM, RB; 15.XII.1998, 16.XII.1998; Total length : 82-88, maximum width 42-44 mm	Andhra Pradesh, Assam, Gujarat, Haryana, Kerala, Meghalaya, Orissa, Punjab, Rajasthan and West Bengal.
2	*Brachionus angularis* Gosse, 1851	PP, GC, RB; 16.XII.1998, 18.XII. 1998, 2.XII.1999; Lorica length 0.1-0.2, maximum width 0.076-0.16, anterior spine 0.01-0.05 mm	Andhra Pradesh, Assam, Delhi, Haryana, Kashmir, Madhya Pradesh, Maharashtra, Orissa, Punjab, West Bengal.
3	*Brachionus calyciflorus* Pallas, 1776	KS, MS, HS, NV, RB; 17.XIII.1998, 22.IV.1999, 22.XII.1999, 16.XII.1998, 2.XII.1999; Lorica length 0.16-0.2; maximum width 0.13-0.22 mm	Assam, Bihar, Kashmir, Maharashtra, Manipur, Meghalaya, Orissa, Punjab and Rajasthan.
4	*Brachionus caudatus* Barrois, 1894	RB, MS, PP, GC, HS; 16.XIII.1998, 18.XIII.1998, 18.XIII.1998, 20.IV. 1999, 22.IV.1999; Lorica length 0.09-0.12, maximum width 0.076-1.0, antero-lateral spine 0.014-0.028, antero-medium spine 0.072-0.08, posterior spine 0.04-0.06 mm	Andhra Pradesh, Assam, Bihar, Delhi, Maharashtra, Meghalaya, Orissa, Rajasthan and Tamil Nadu.
5	*Brachionus diversicornis* (Daday, 1883)	SM, MS; 15.XIII.1998, 22.IV.1999; Lorica length 0.22-0.32, Maximum width 0.12-0.2 mm	Andhra Pradesh, Assam, Orissa, Punjab and West Bengal.
6	*Brachionus falcatus* Zacharias, 1898	MS, GC, HS, CC, RB; 18.XIII.1998, 20.IV.1998, 22.IV.1999, 22.IV.1999, 2.XII.1999; Lorica length 0.1-0.13, maximum width 0.1-0.19, length of antero-lateral spine 0.014-0.02, length of intermediate spine 0.12-0.14, length of median spine 0.006-0.02, posterior spine 0.09-0.38 mm	Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Kerala, Madhya Pradesh, Orissa, Punjab, Rajasthan and West Bengal.
7	*Brachionus patulus* (Muller, 1786)	NV, PP, MS; 16.XII.1998, 18.XII.1998, 22.XII.1999; Total length 0.22-0.24, maximum width 0.15-0.16 mm	Andhra Pradesh, Gujarat, Kashmir, Kerala, Orissa, Punjab, Rajasthan, Tamil Nadu and West Bengal.
8	*Brachionus plicatilis* Muller, 1786	SM 15.XII.1998; Total length 0.18, maximum width 0.13 mm	Andhra Pradesh, Assam, Rajasthan, Punjab and West Bengal.

Table-I : *Cont'd.*

Sl. No.	Species	Material examined	Distribution
I	II	III	IV
9	*Brachionus quadridentatus* Hermann, 1783	NV, RB, PP, GC, MS; 16.XII.1998, 16.XII.1998, 18.XII.1998, 20.XII.1999, 22.IV.1999, 4.XII.1999; Lorica Length 0.07, maximum width 0.11, antero-lateral spines 0.02, antero-median spines 0.04, antero-intermediate spines 0.016, posterior spines 0.08 mm	Andhra Pradesh, Bihar, Maharashtra, Meghalaya, Kerala, Orissa and West Bengal.
10	*Brachionus rubens* Ehrenberg, 1838	KS MS, RB; 17.XII.1998, 18.XII.1998, 2.XII.1999; Total length 0.19-0.26, maximum width 0.14-0.18 mm	Assam, Haryana, Punjab, Orissa, Rajasthan and West Bengal. Elsewhere – cosmopolitan.
11	*Keratella cochlearis* Gosse, 1851	KS, MS, GC; 17.XII.1998, 8.XII.1998, 20.IV.1999; Total length 0.18-0.2, maximum width 0.06-0.08 mm	Andhra Pradesh, Assam, Kashmir, Kerala, Ladak, Punjab, Rajasthan and West Bengal.
12	*Keratella procurva* (Thorpe, 1891)	NV, MS, HS; 16.XII.1998, 22.IV.1999, 22.IV.1999; Total length 0.16, maximum width 0.068 mm	Andhra Pradesh, Kashmir, Kerala, Orissa and West Bengal.
13	*Keratella tropica* (Apstein, 1907)	NV, RB, PP, KS, GC, MS, SM; 16.XII.1998, 16.XII.1998, 17.XII. 1998, 18.XII.1998, 20.XII.1999, 22.IV.1999, 1.XII.1999; Lorica length 0.18-0.2, maximum width 0.08-0.09, posterior right spine 0.01-0.13, posterior left spine 0.045-0.06 mm	Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Kashmir, Kerala, Ladakh, Madhya Pradesh, Punjab, Rajasthan and West Bengal.
14	*Platyias quadricornis* (Ehrenberg, 1832)	MS, C; 18.XII.1998, 22.IV.1999; Lorica length 0.19-0.3, maximum width 0.15-0.2 mm.	Andhra Pradesh, Assam, Haryana, Kashmir, Kerala, Ladakh, Orissa, Punjab, Rajasthan and West Bengal. Elsewhere – cosmopolitan.
	Family MYTILINIDAE		
15	*Mytilina ventralis* Ehrenberg, 1832	NV, PP, CC; 16.XII.1998, 18.XII. 1998, 22.IV.1999; Lorica length 0.17-0.19, maximum width 0.08-0.1, toes 0.06-0.07 mm	Andhra Pradesh, Assam, Gujarat, Kerala, Kashmir, Madhya Pradesh, Punjab, Tamil Nadu and West Bengal.
	Family LECANIDAE		
16	*Lecane (Lecane) luna* (Muller, 1776)	MS, CC; 22.IV.1999, 22.IV.1999; Lorica length 0.14-0.23, width 0.13-0.15, toes 0.045-0.05, claws 0.08-0.1 mm	Andhra Pradesh, Kashmir, Gujarat, N.E. India, Orissa, Punjab, Rajasthan and West Bengal.

Table-I : *Cont'd.*

Sl. No.	Species	Material examined	Distribution
I	II	III	IV
17	*Lecanel (L) nana* (Murray, 1913)	SM, NV; 15.XII.1998, 16.XIII.1998; Length 0.5-0.6, toes 0.2-0.3 mm	Gujarat, Rajasthan and West Bengal, Elsewhere – cosmopolitan.
18	*Lecane (L) papuana* (Murray, 1913)	PP, MS, GC, CC, NV; 18.XII.1998, 18.XII.1998, 20.IV.1999, 22.IV.1999, 2.XII.1999; Lorica length 0.15-0.17, maximum width 0.07-0.1, length of toes 0.04-0.05, length of claw 0.009-0.01 mm	Andhra Pradesh, Mizoram, Rajasthan, Tamilnadu, Kashmir and West Bengal.
19	*Lecane (Monostyla) bulla* (Gosse, 1851)	KS, MS 17.XII.1998, 22.XII.1999; Dorsum 0.1-0.14, ventral 0.12-0.14, Dorsal width 0.079-0.09, ventral 0.76-0.08, toe 0.46-0.5.	Andhra Pradesh, N.E. Region, Gujarat, Rajasthan, Punjab, Tamil Nadu, Kashmir, Orissa and West Bengal.
20	*Lecane (M) closterocerca* (Schmarda, 1898)	PP, GC, HS; 18.XII.1998, 20.IV.1999, 22.IV.1998; Lorica length 0.4-0.5, toe 0.2-0.3 mm	Andhra Pradesh, Gujarat, Kashmir, Orissa, Punjab, Rajasthan, Tamil Nadu and West Bengal.
21	*Lecane (M) hamata* (Stokes, 1896)	GC, CC 20.IV.1999, 22.IV.1999; Lorica 0.6-0.7, toe 0.23-0.3 mm	Assam, Gujarat, Kashmir, Meghalaya, Mizoram, Orissa, Punjab, Rajasthan, Tamil Nadu and West Bengal. Elsewhere – cosmopolitan.
		Order GNESIOTROCHA Suborder FLOSCULARIACEA	
		Family FILINIDAE	
22	*Filinia longiseta* Ehrenberg, 1834	SM, RB, MS, HS; 15.XII.1998, 16.XII.1998, 22.IV.1999, 4.XII.1999; Body length 0.2-0.25, lateral spine 0.12-0.25, posterior setae 0.15-0.16 mm	Andhra Pradesh, Assam, Gujarat, Haryana, Madhya Pradesh, Orissa, Punjab, Rajasthan and West Bengal.
23	*Filinia opolensis* (Zacharis, 1898)	HS, CC; 22.IV.1999, 22.IV.1999; Body length 0.17-0.2, anterior setae 0.25-0.3, Posterior long setae 0.25-0.27, posterior short setae 0.07-0.08 mm	Andhra Pradesh, Assam, Gujarat, Haryana, Madhya Pradesh, Orissa, Punjab, Rajasthan and West Bengal.
24	*Filinia pejleri* Hutchinson, 1964	PP 18.XII.1998; Body length 0.14-0.15, width 0.04-0.05, Posterior seta 0.025-0.029, left anterior seta 0.03-0.035, right anterior seta 0.033-0.034 mm	Assam, Punjab, Rajasthan, Tamil Nadu and West Bengal.
		CLADOCERA	
		Class CRUSTACEA Subclass BRANCHIOPODA Order CLADOCERA	
		Family SIDIDAE	
1	*Pseudosida bidentata* Herrick, 1884	RB, CC, PP; 15.XII.1998, 22.IV.1998, 1.XII.1999; Female, size 1.0-1.2 mm	Andhra Pradesh, Kerala, Rajasthan, Tripura, Tamil Nadu and West Bengal.

Table-I : *Cont'd.*

Sl. No.	Species	Material examined	Distribution
I	II	III	IV
2	*Diaphanosoma sarsi* Richard, 1894	SM, PP, GC, RB; 15.XII.1998, 18.XII.1998, 20.IV.1999, 2.XII.1999; Female, 1.0-1.5 mm	Andhra Pradesh, Bihar, Meghalaya, Tamil Nadu, Uttar Pradesh, West Bengal.
3	*Diaphanosoma excism* Sars, 1885	NV, MS, HS; 16.XII.1998, 18.XII.1998, 22.XII.1999; Female, size 1.1-1.2 mm	Bihar, Meghalaya, Rajasthan, Tamil Nadu, Tripura and West Bengal.
4	*Ceriodaphnia cornuta* Sars. 1885	SM, RB, KS, GC, HS, CC; 15.XII.1998, 16.XII.1998, 17.XII.1998, 3.XII.1999, S 20.IV.1999, 22.IV.1999, 22.IV.1999; Female, size 0.35-0.5 mm	Andhra Pradesh, Bihar, Haryana, Karnataka, Kerala, Madhya Pradesh, Meghalaya, Punjab, Rajasthan, Tamil Nadu.
5	*Ceriodaphnia reticulata* (Jurine, 1820)	MS, CC; 18.XII.1998, 22.IV.1999; Female, size 0.79 mm	Bihar, Madhya Pradesh and Rajasthan.
6	*Daphnia lumholtzi* Sars, 1885	SM, RB, PP, GC, CC; 15.XII.1998, 16.XII.1998, 18.XII.1998, 3.XII.1999, 20.IV.1999, 22.IV.1999; Female, size 1.2-1.3 mm	Andhra Pradesh, Orissa, Bihar, Rajasthan and Tamil Nadu.
7	*Simocephalus vetulus* (O.F. Muller, 1776)	SM, RB, GC, CC; 15.XII.1998, 16.XII.1998, 20.IV.1999, 22.IV.1999; Female : size 1.1.-1.24 mm	Punjab, Kashmir, Rajasthan, Bihar, West Bengal.
8	*Simocephalus exspinosus* (Koch, 1841)	KS, MS; 17.XII.1998, 22.IV.1999; Female, size 0.75-0.9 mm	Meghalaya, Rajasthan, West Bengal, Elsewhere – cosmopolitan.
9	*Scapheloberis kingi* Sars, 1903	SM, RB, HS, NV; 15.XII.1998, 16.XII.1998, 22.IV.1999, 2.XII.1999; Female : size 0.5-0.55 mm	Assam, Kashmir, Meghalaya, Rajasthan, Tamil Nadu and West Bengal
		Family MOINIDAE	
10	*Moina micrura* Kurz, 1874	KS, HS, CC; 17.XII.1998, 22.IV.1999, 22.IV.1999; Female, size 0.75 mm	Andhra Pradesh, Bihar, Kerala, Punjab, Rajasthan, Tamil Nadu, Tripura, West Bengal.
11	*Moina macropa* (Straus, 1820)	KS; 17.XII.1998; Female, size 1.2-1.3 mm	Delhi, Rajasthan and Tamil Nadu, Elsewhere – Tropics and subtropics.
12	*Moinadaphnia macleayii* (King, 1853)	SM, KS, GC, HS; 15.XII.1998, 17.XII.1998, 20.IV.1999, 22.IV.1999, 4.XII.1999; Female, size 0.8-1.0 mm	South India, Andman and Nicobar Islands, Rajasthan and West Bengal.
		Family MACROTHRICIDAE	
13	*Macrothrix spinosa* king, 1853	KS, MS, GC; 17.XII.1998, 18.XII.1998, 20.IV.1999; Female, size 0.39-0.42 mm	Rajasthan, Tamil Nadu, Tripura, Elsewhere – Cosmopolitan.
14	*Macrothrix goeldi* Richard, 1897	RB, HS; 16.XII.1998, 22.IV.1999, 4.XII.1999; Female, size 0.54-0.56 mm	Rajasthan and West Bengal.
15	*Macrothrix laticornis* (Jurine, 1820)	PP, GC; 18.XII.1998, 20.IV.1999; Female, size 0.4-0.42 mm	Ladakh, Kerala, Tamil Nadu.

Table-I : *Cont'd.*

Sl. No.	Species	Material examined	Distribution
I	II	III	IV
16	*Echinisca triserialis* Brady, 1886	SM, RB, MS; 15.XII.1998, 16.XII.1998, 2.XII.1999, 22.IV.1999; Female, size 0.52-0.54 mm	Kerala, Rajasthan, Tamil Nadu and West Bengal.
17	*Ilyocryptus spinifer* Herrick, 1882	KS, GC, CC; 17.XII.1998, 20.IV.1999, 22.IV.1999; Female, size 0.76-0.78 mm	Kerala, Meghalaya, Rajasthan, Tamil Nadu, Tripura and West Bengal.
	Family BOSMINIDAE		
18	*Bosminopsis deitersi* Richard, 1895	RB, PP, CC; 16.XII.1998, 18.XII.1998, 22.IV.1999; Female, size 0.4-0.6 mm	Delhi and Rajasthan.
	Family CHYDORIDAE Subfamily CHYDORINAE		
19	*Pleuroxus aduncus* (Jurine, 1820)	SM, MS, HS; 15.XII.1998, 4.XII.1999, 18.XII.1998, 22.IV.1999; Female, 0.5-0.7 mm	Andhra Pradesh, Rajasthan, Punjab, Elsewhere – cosmopolitan.
20	*Pleuroxus similes* Vavra, 1900	NV, KS, GC; 16.XII.1998, 17.XII.1998, 20.IV.1999; Female, size 0.4-0.7 mm	Kashmir, Meghalaya, Rajasthan and West Bengal.
21	*Chydorus ventricosus* Daday, 1898	PP, HS, CC; 18.XII.1998, 22.IV.1999; Female, size 0.5-0.54 mm	Gujarat, Kerala, Rajasthan, Tamil Nadu.
22	*Chydorus reticulatus* Daday, 1898	KS, GC; 17.XII.1998, 20.IV.1999; Female, size 0.28-0.30 mm	Rajasthan.
23	*Chydorus barroisi* Richard, 1894	SM, NV, MS, CC; 15.XII.1998, 16.IV.1998, 22.IV.1999; Female, size 0.38-4.0 mm	Andhra Pradesh, Kerala, Gujarat, West Bengal, Tamil Nadu.
	Subfamily ALONINAE		
24	*Alona rectangula rectangula* Sars, 1862	SM, RB, PP, GC, MS; 15.XII.1998, 1.XII.1999, 16.XII.1998, 18.XII.1998, 4.XII.1999, 20.IV.1999, 22.IV.1999; Female, size 0.54-0.56 mm	Andhra Pradesh, Gujarat, Kashmir, Ladakh, Meghalaya, Rajasthan and West Bengal.
25	*Biapertura karua* (King, 1853)	KS, GC, HS; 17.XII.1998, 20.IV.1998, 3.XII.1999, 22.IV.1999; Female, size 0.36-0.4 mm	Meghalaya, Rajasthan, West Bengal. Elsewhere – cosmotropical.
26	*Oxyurella singalensis* (Daday, 1898)	NV, MS, CC; 16.XII.1998, 18.XII.1998, 22.IV.1999; Female, 0.78-0.8 mm	Kerala, Rajasthan and Tamil Nadu and West Bengal.
27	*Kurzia longirostris* (Daday, 1898)	SM, MS, HS; 15.XII.1998, 18.XII.1998, 22.IV.1999, 4.XII.1999; Female, size 0.48-0.5 mm	Andhra Pradesh, Rajasthan, Tamil Nadu and West Bengal.
28	*Euryalona orientalis* (Daday, 1898)	GC, CC; 20.IV.1999, 22.IV.1999; Female, 0.88-0.9 mm	Andhra Pradesh, Rajasthan, Tamil Nadu and West Bengal.

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