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Systematic account on rotifers of the genus *Brachionus* from Cochin Backwaters

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Abstract

The results of an investigation carried out during August 2000 to July 2002 on different species of *Brachionus* in nine selected stations along Cochin backwater system in the southwest coast of India are reported in this paper. A total of 13 species of *Brachionus*, viz. *Brachionus plicatilis, B.rotundiformis, B.angularis, B.urceolaris, B.rubens, B.calyciflorus, B.caudatus, B.falcatus, B.forficula, B.quadridentatus, B.patulus, B.bidentata* and *B.mirabilis* were recorded from this area for the first time. The detailed descriptions and photographs of each species are presented.

Keywords: Rotifer, *Brachionus*, Cochin backwaters.

Introduction

Rotifers especially *Brachionus* spp. are considered to be an excellent and indispensable food for the larvae of many finfishes and crustaceans. Ito (1960) was the first to culture *Brachionus plicatilis* for feeding marine fish larvae and now it is being extensively used as live-feed in hatcheries all over the world. Their slow swimming habits, ability to tolerate a wide range of salinities, parthenogenetic mode of reproduction and ability - get enriched easily make *Brachionus* spp. an ideal live-feed organism. Realising their importance as an excellent live feed organism, several workers have studied the availability of different species of *Brachionus* in varying ecosystems in the world including India. Among them those of Edmondson (1959), Ruttner-Kolisko (1974), Koste (1978), Sudzuki (1998 and 1999), Pasha (1961), Arora (1963), Nayar (1968), Vasisht and Battish (1971), Sharma (1980a, 1980b, 1983 and 1987), Battish (1992), Dhanapathi (2000), Nayar and Nair (1969), Gopakumar (1998) and Anitha (2003) are the major works. Most of the above works were carried out in freshwater habitats and only very little attention was given to the studies on *Brachionus* spp. of Kerala, when compared to that of other states in India. Studies of rotifers in the brackish water habitats of Kerala were confined only to the southern region of the state. No attempt was made so far to study the *Brachionus* spp. of the brackishwater environments in the central part of Kerala. Hence, an attempt is made here to study different species of *Brachionus* available in nine varying habitats along the Cochin backwater system in the central part of Kerala.

Materials and methods

The Cochin Backwaters and certain canals adjoining the system extending to around 50 km were selected for the study during August, 2000 to July, 2002. Monthly collections of rotifers were made from nine stations viz. Vypeen, Puthuvypu, Narakkal, Cherai, Eloor, Fisheries Harbour, Ernakulam market canal, Mangalavanam and Poothotta (Fig.1).

The plankton samples were taken from each station by filtering 500 litres of water through conical plankton net made up of bolting silk having a mesh size of 40 microns. In order to avoid sampling errors, care was taken to collect the samples from an area, instead of taking from a particular point. The filtered plankton samples were preserved using 4% formaldehyde. The rotifers were identified using a number of taxonomic papers and keys published by various authors, especially Edmondson (1959), Nayar (1968), Koste (1978), Sharma (1983), Battish (1992), Gopakumar (1998) and Sudzuki (1998 and 1999). A typical rotifer, showing characters of taxonomic value as given by Battish (1992) is shown in Figure 2. The length and width of specimens were

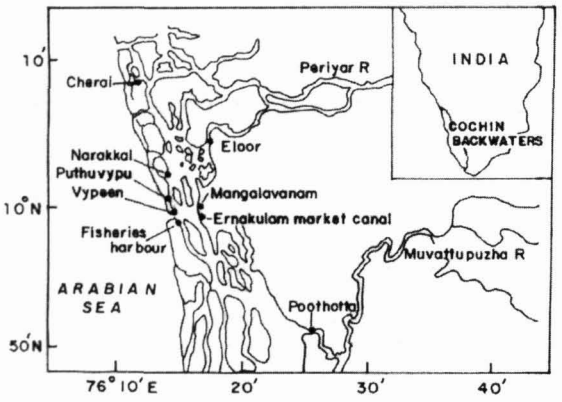

Fig.1. Map showing the location of stations

measured. For illustrations, photographs of specimens were taken using Zeiss Axiostar microscope fitted with SVMICRO Soundvision Camera and image captured using the software Axiovision 2.05.

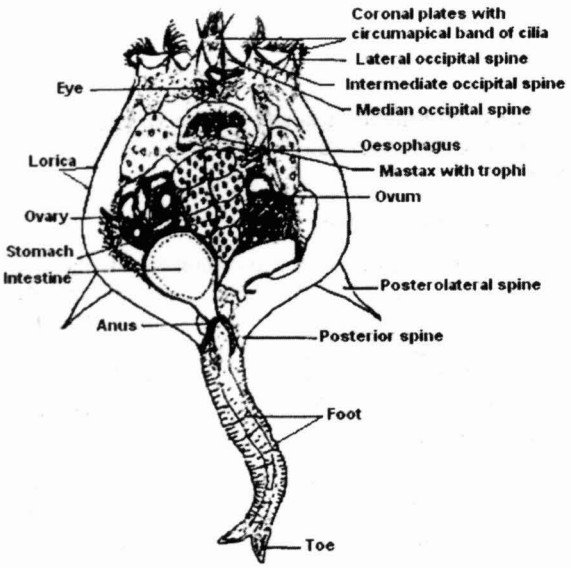

Fig.2. Characters of taxonomic value in Rotifers (Reproduced from Battish, 1992)

Results

A total of 13 species under the genus *Brachionus* were identified and described. They are *Brachionus plicatilis, B.rotundiformis, B.angularis, B.urceolaris, B.rubens, B.calyciflorus, B.caudatus, B.falcatus, B.forficula, B.quadridentatus, B.patulus, B.bidentata* and *B.mirabilis.*

Brachionus plicatilis Muller, 1786

Material: Several specimens from Vypeen, Puthuvypu, Narakkal, Cherai, Eloor, Harbour, Market canal, Mangalavanam and Poothotta (Fig.3)

Lorica flexible, lightly stippled, more or less oval, greater width about two-thirds length of lorica from anterior end, it narrows anteriorly and not sharply separated into dorsal and ventral plates, slightly compressed dorso-ventrally; antero-dorsal margin with six broad based saw-toothed spines, nearly equal in length; posterior spines wanting; mental margin four lobed; foot opening with small subsquare aperture dorsally and longer V-shaped aperture ventrally.

Measurements

Length of lorica : 150 – 252 μm

Maximum width of lorica : 105-182 μm

Brachionus rotundiformis Tschugunoff, 1921

Material: Several specimens from Vypeen, Puthuvypu, Narakkal, Cherai, Eloor, Harbour, Market canal, Mangalavanam and Poothotta (Fig. 4)

Lorica rather flexible, small, more rounded, not sharply separated into dorsal and ventral plates, but little compressed dorso-ventrally, anterior dorsal margin with six acutely pointed spines, nearly equal in length, mental margin rigid, separated into four lobes with considerable variations, lorica without posterior spines, foot opening with small subsquare aperture dorsally and longer V-shaped aperture ventrally, lorica smooth or lightly stippled.

Measurements

Length of lorica : 60-196 μm

Maximum width of lorica : 52-154 μm

Brachionus angularis (Gosse, 1851)

Material: Several specimens from Vypeen, Puthuvypu, Narakkal, Cherai, Eloor, Harbour, Market canal and Mangalavanam (Figs. 5, 6, 7)

Lorica firm, lightly or heavily stippled, divided into dorsal and ventral plates; dorsal plate with pattern of cuticular ridges, moderately compressed dorso-ventrally; antero-dorsal margin with two median spines flanking a V-shaped notch; lateral and intermediate spines usually obliterated, intermediate spines may be present in some; mental margin rigid, somewhat elevated with a shallow median notch; foot opening rather large, somewhat vari-

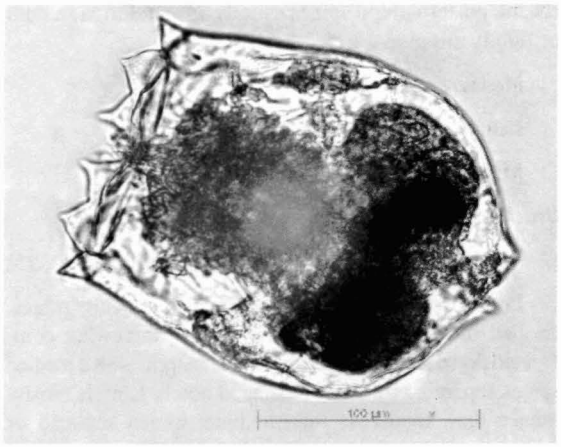

Fig. 3. *Brachionus plicatilis*

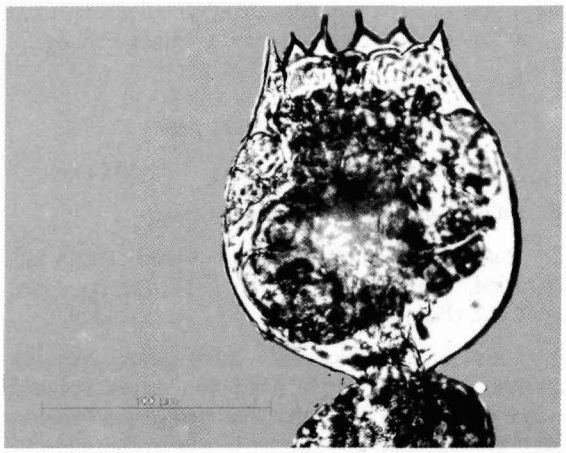

Fig. 4. *Brachionus rotundiformis*

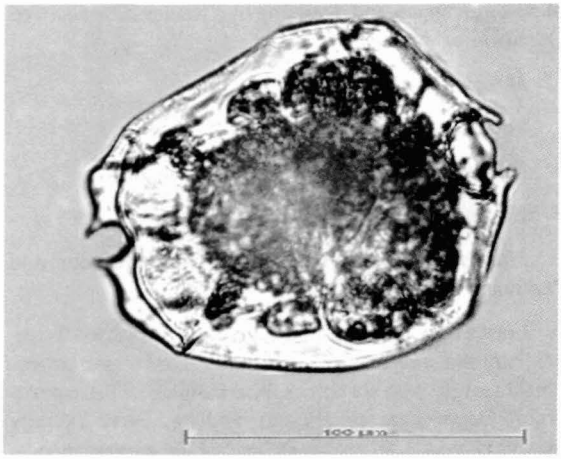

Fig. 5. *Brachionus angularis*

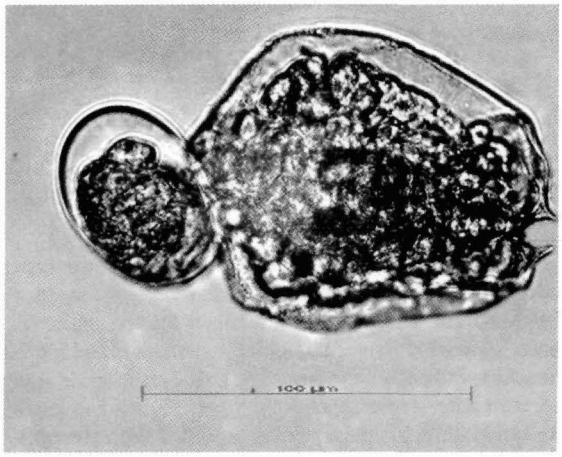

Fig. 6. *Brachionus angularis*

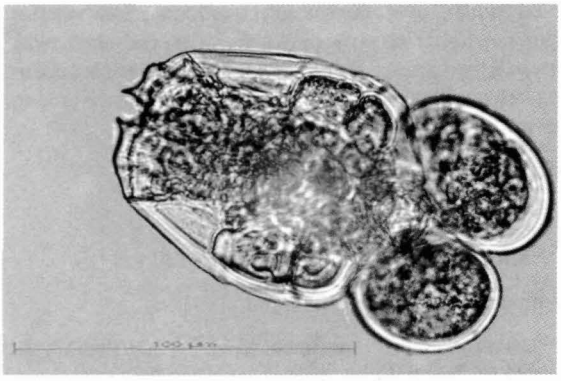

Fig. 7. *Brachionus angularis*

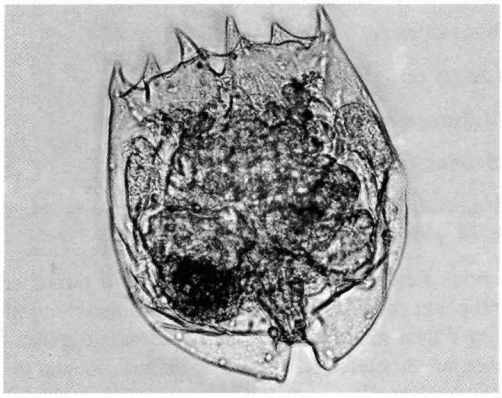

Fig. 8. *Brachionus urceolaris*

able in shape; larger foot aperture in ventral plate flanked by cuticular protuberances; posterior spines wanting.

Measurements

Length of lorica : 63-128 μm

Maximum width of lorica : 42-105 μm

Brachionus urceolaris (Muller,1773)

Material: Several specimens from Vypeen, Puthuvypu, Narakkal, Cherai, Eloor, Harbour, Market canal and Poothotta (Figs. 8, 9, 10)

Lorica broad, dorsal and ventral plates separated, anterior margin of ventral plate with ridges, occipital spines six, medians longer than intermediates and laterals; basal plate is absent, no posterior spines, foot opening with small lateral projections.

Measurements

Length of lorica : 112-231 μm

Maximum width of lorica : 84-182 μm

Brachionus rubens Ehrenberg, 1838

Material: Several specimens from Vypeen, Puthuvypu, Narakkal, Cherai, Eloor, Market canal, Mangalavanam and Poothotta (Fig. 11)

Lorica firm, oval, smooth, compressed dorso-ventrally and composed of dorsal and ventral plates, anterior dorsal margin with six spines, medians longest, intermediates somewhat longer than laterals; medians and intermediates with peculiar asymmetric shape, each spine with a narrow anterior part, then rounding outwards and forming broad base; all these spines provided with strengthening ridges; mental margin serrated and markedly elevated towards the centre with a central notch; posterior spines absent; foot opening subsquare and small.

Measurements

Length of lorica : 112-210 μm

Maximum width of lorica : 84-140 μm

Brachionus calyciflorus Pallas, 1776

Material: Several specimens from Cherai (Figs. 12, 13 & 14 – different forms)

Lorica flexible, oval, not separated into dorsal and ventral plates; body slightly compressed dorso-ventrally, anterior dorsal margin with four broad-based spines of variable length, medians longer than laterals; mental margin flexible, usually somewhat elevated, with shallow V- or U-shaped notch, unflanked; posterior spines present or absent; posterolateral spines usually absent; lorica smooth or lightly stippled.

Measurements

Length of lorica : 168-228 μm

Maximum width of lorica : 105-154 μm

Brachionus caudatus Barrois and Daday,1894

Material: Many specimens from Narakkal (Fig. 15)

Lorica firm, stippled, with a pattern of cuticular ridges, divided into dorsal and ventral plates, somewhat compressed dorso-ventrally; antero-dorsal margin with 2 median spines separated by V- or U-shaped notch; laterals mostly longer than medians; intermediate spines reduced or wanting; rarely all six occipital spines present; mental margin more or less straight or wavy; generally, posterolateral spines well developed; foot opening between bases of posterior spines and overhung by a triangular or rounded extension of dorsal plate.

Measurements

Length of lorica : 84-168 μm

Maximum width of lorica : 77-134 μm

Brachionus falcatus Zacharias, 1898

Material: Several specimens from Harbour and Poothotta (Fig. 16)

Lorica firm, lightly stippled, greatly compressed dorso-ventrally and composed of dorsal and ventral plates; antero-dorsal margin with six spines, intermediate spines considerably larger than laterals and medians, curve laterally outwards or ventrally towards head of the animal; median spines mostly equal to laterals but sometimes smaller; mental edge firm and wavy without spine and without elevation towards the centre; posterior spines widely separated basally, long, their width much more than anterior spines, parallel or bow outwards, converge, then twist towards their apices, thus completing full arch; foot opening between bases of posterior spines, subsquare hole in ventral plate; foot opening unflanked.

Measurements

Length of lorica : 126-182 μm

Maximum width of lorica : 110-140 μm

Brachionus forficula Wiezejski, 1891

Material: Several specimens from Vypeen, Puthuvypu, Narakkal, Cherai, Eloor, Market canal and Poothotta (Figs. 17, 18)

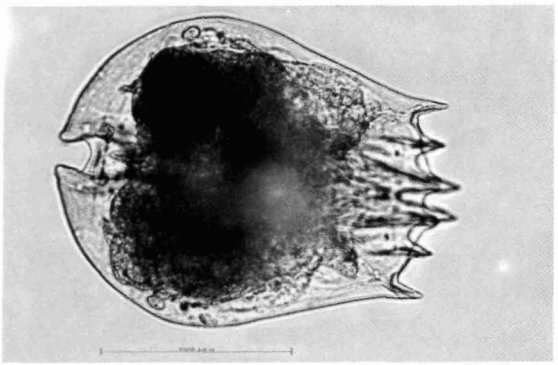

Fig. 9. *Brachionus urceolaris*

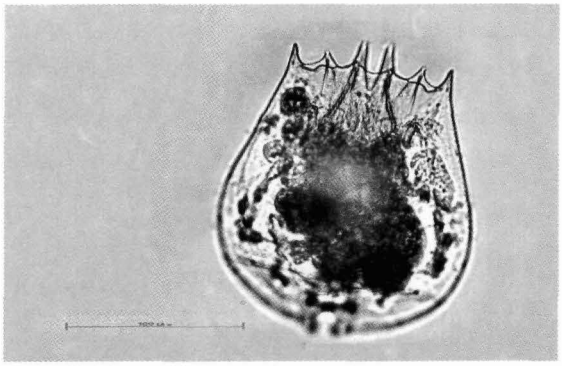

Fig. 10. *Brachionus urceolaris*

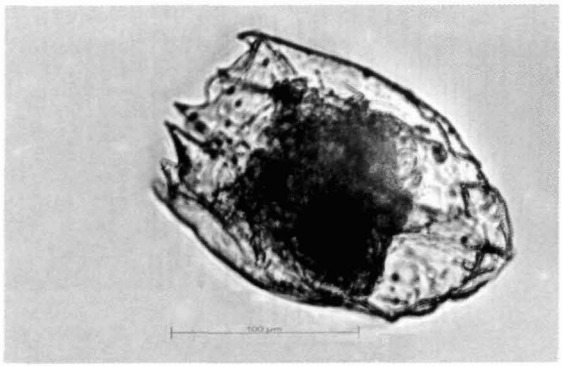

Fig. 11. *Brachionus rubens*

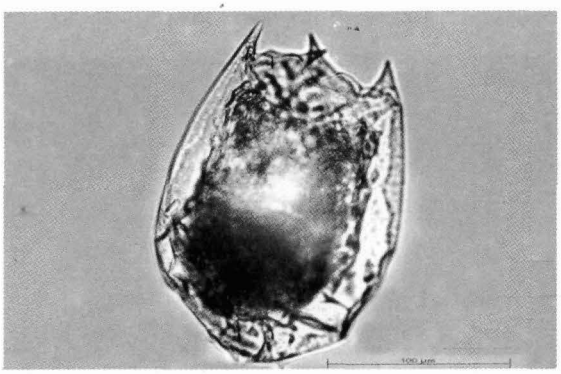

Fig. 12. *Brachionus calyciflorus*

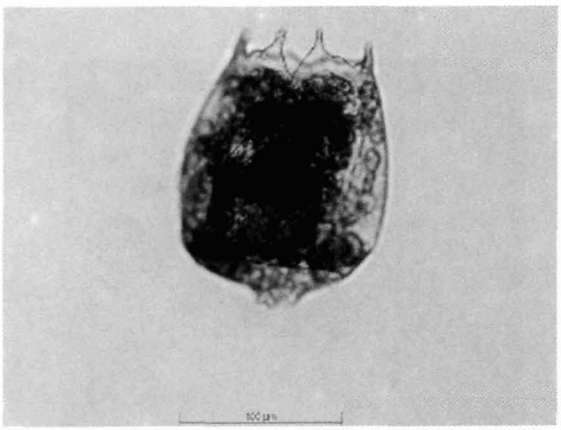

Fig. 13. *Brachionus calyciflorus*

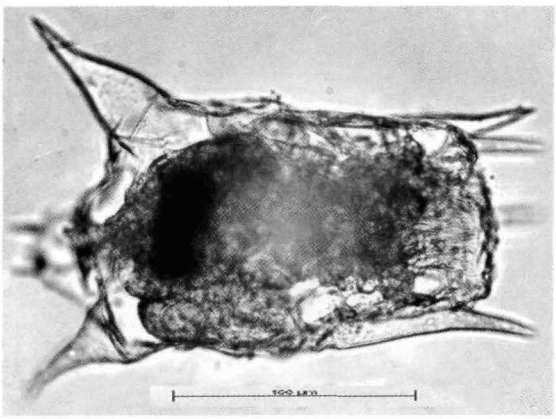

Fig. 14. *Brachionus calyciflorus*

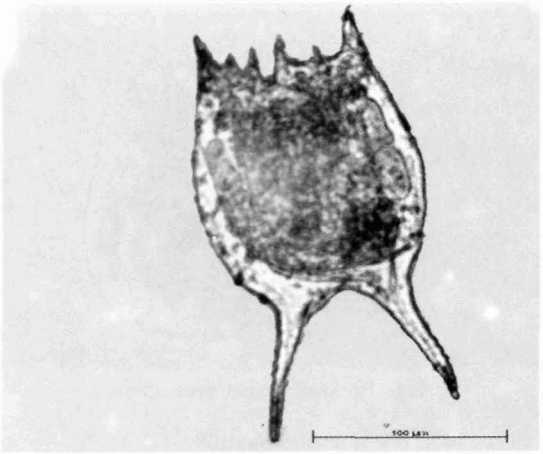

Fig. 15. *Brachionus caudatus*

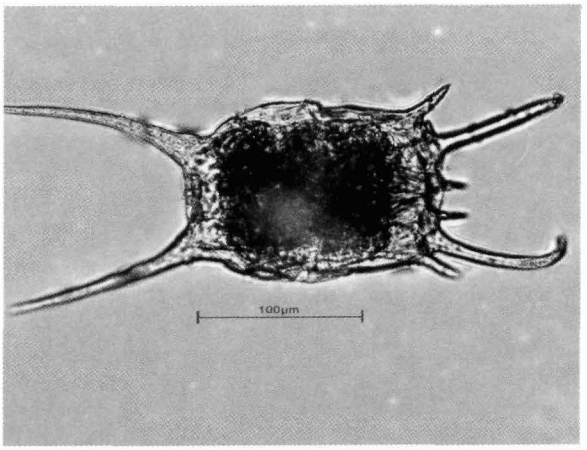

Fig. 16. *Brachionus falcatus*

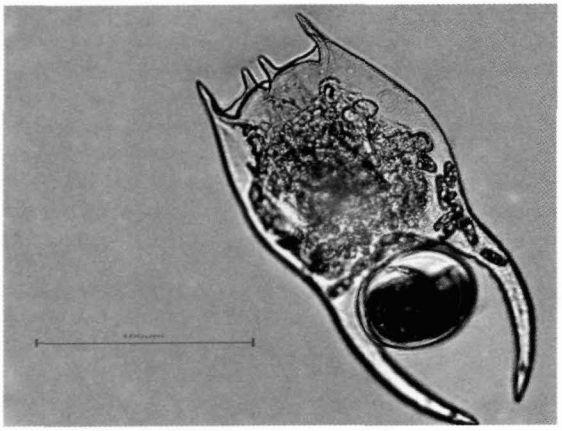

Fig. 17. *Brachionus forficula*

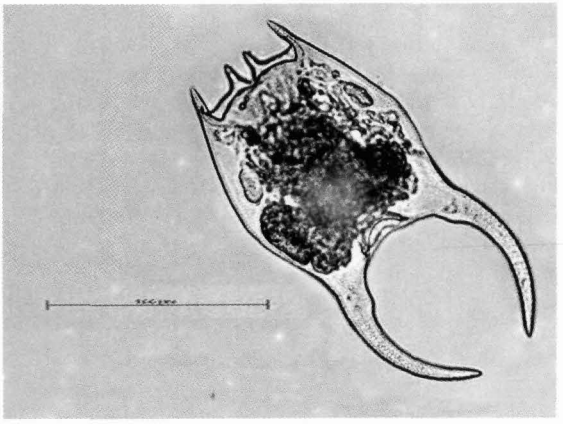

Fig. 18. *Brachionus forficula*

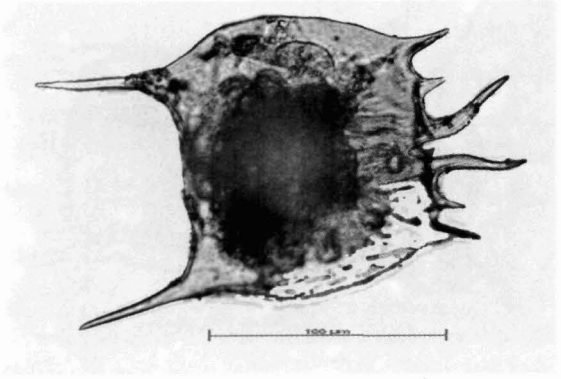

Fig. 19. *Brachionus quadridentatus*

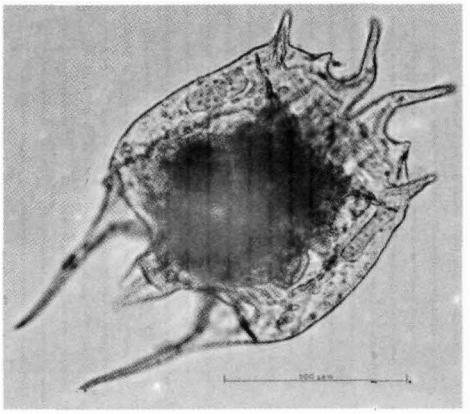

Fig. 20. *Brachionus quadridentatus*

Lorica firm, stippled, divided into dorsal and ventral plates, moderately compressed dorso-ventrally; occipital margin with four spines; laterals always longer than medians; intermediate spines wanting; all occipital spines rounded at tips, rarely pointed; mental margin rigid with two well-marked lobes; lorica terminates posteriorly in two stout, long and sub square spines, widely separated basally and tapering to blunt points; geniculate swellings present at bases of posterior spines; foot opening between bases of posterior spines.

Measurements

Length of lorica : 84-119 μm

Maximum width of lorica : 63-112 μm

Brachionus quadridentatus Hermann, 1783

Material: Several specimens from Eloor, Harbour, Market canal and Mangalavanam (Figs. 19, 20 – different forms)

Lorica firm, moderately compressed dorso-ventrally, and divided into dorsal and ventral plates; occipital margin with six spines, medians longest, curved outwards, and when extra long bent downwards over the head; laterals longer than intermediates; mental margin rigid, wavy, elevated, with median notch flanked on either side by a small tooth-like papilla; postero-lateral spines usually present but their length varies; ventro-posterior portion of lorica prolonged in the form of tubular foot-sheath around base of retractile foot; sheath on dorsal side with well-defined sub square piece.

Measurements

Length of lorica : 126-203 μm

Maximum width of lorica : 98-182 μm

Brachionus patulus Muller, 1786

Material: Several specimens from Eloor and Poothotta (Figs. 21, 22 – different forms)

Lorica firm, sub rectangular, somewhat compressed dorso-ventrally, with a pattern of reticulate areolation as well as a simple pattern of ridges on the dorsal plate, both antero-dorsal and antero-ventral margins with spines, ten in number; occipital medians longest and curve overhead ventrally; pectoral medians shortest, straight; intermediates on both margins and laterals about equal in length; median notch between pectoral medians broader than notch separating occipital median spines; posteriorly, lorica terminates in two spines, foot opening bounded by two short spines, equal in length to postero-laterals or somewhat shorter; foot opening present in ventral plate, asymmetric in shape and position; posterior portion of lorica asymmetrical.

Measurements

Length of lorica : 128-154 μm

Maximum width of lorica : 98-112 μm

Brachionus bidentata Anderson, 1889

Material: Several specimens from Cherai, Market canal and Poothotta (Fig. 23)

Lorica firm, stippled, with definite pattern of plaques, divided into dorsal , ventral and basal plates; dorsal and ventral plates soldered together for three-fifths length of lorica, where they diverge and are united to a third plate, the basal plate; dorsal margin with six spines; lateral always longer than medians, medians longer than intermediates; mental margin flexible, elevated in the middle; posterior spines vary in length and position of origin but may be absent; foot opening with foot-sheath.

Measurements

Length of lorica : 161-196 μm

Maximum width of lorica : 126-170 μm

Brachionus mirabilis Daday, 1897

Material: Many specimens from Eloor (Figs. 24, 25, 26)

Lorica barrel-shaped, anterior dorsal margin with six well developed spines, medians longest and bent outwards, laterals slightly divergent; antero-median, postero-median, postero-lateral spines very long.

Measurements

Length of lorica : 147-230 μm

Maximum width of lorica : 87-131 μm

Discussion

The taxonomic investigations on rotifers in general and *Brachionus* spp. in particular, date back to 18th century. Researchers in the past have recorded many species, subspecies and different ecomorphs from varying habitats. The number of *Brachionus* spp. recorded all over the world reached 55 (Segers, 2002).

During the present study, 13 species of *Brachionus* are reported. It is worthwhile to mention that Gopakumar (1998) reported 12 species, while Anitha (2003) documented 14 species under the genus *Brachionus* from southern part of Kerala. The abundance of *Brachionus* species in tropical rotifer fauna has been pointed out by

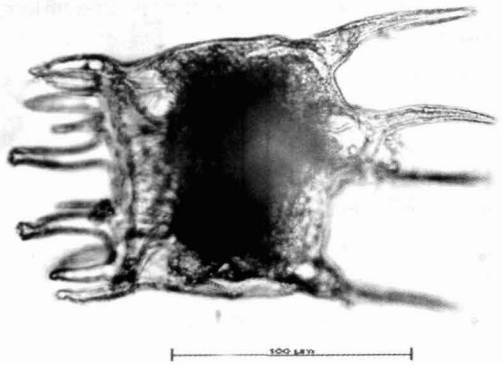

Fig. 21. *Brachionus patulus*

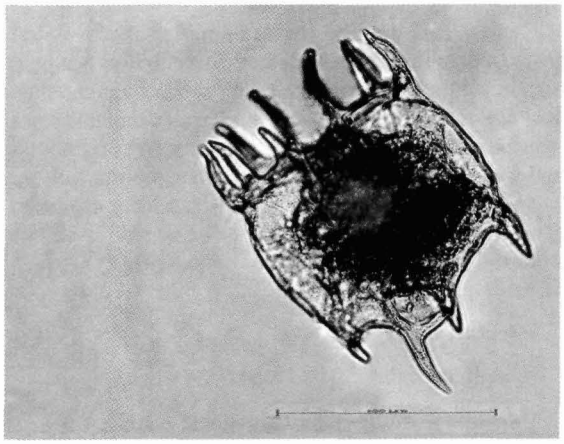

Fig. 22. *Brachionus patulus*

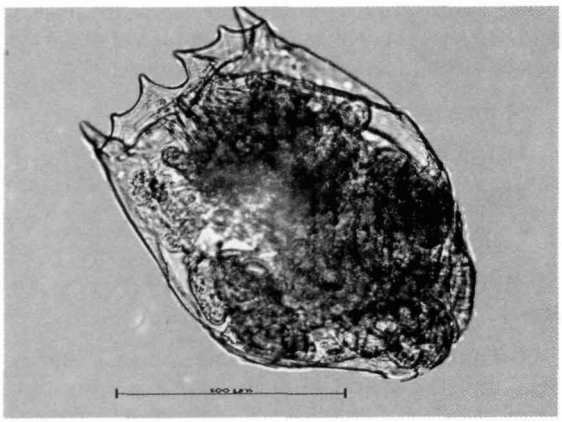

Fig. 23. *Brachionus bidentata*

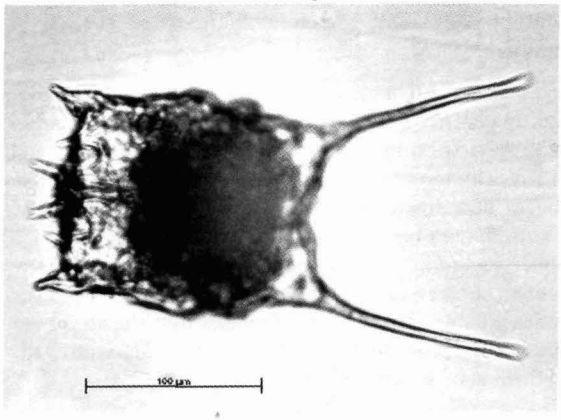

Fig. 24. *Brachionus mirabilis*

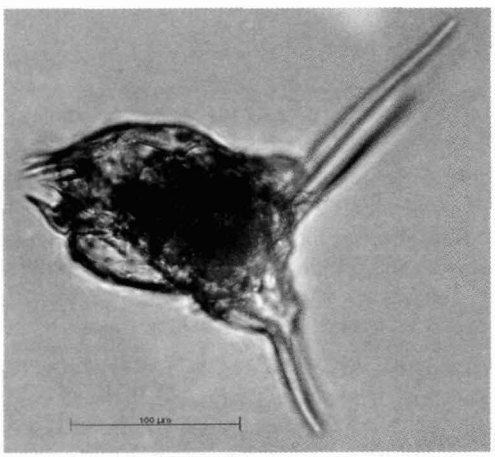

Fig. 25. *Brachionus mirabilis*

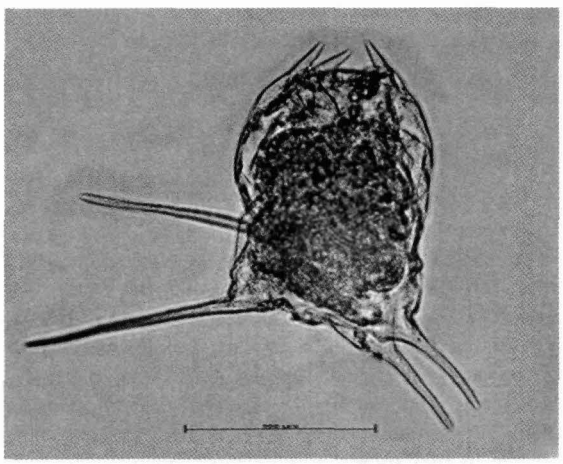

Fig. 26. *Brachionus mirabilis*

Green (1972), Chengalath *et al.* (1974), Pejler (1977) and Fernando (1980). According to Sharma (1983), "twenty species of *Brachionus* have so far been reported from India which is the highest number from south-east Asia". Thus, there are chances for the availability of more number of species from Kerala.

Among the 13 species of *Brachionus* recorded during the present study, *B. angularis* was the smallest in size. The smaller size and its shape may enable them to be used as suitable live feed for the larvae having small mouth opening, which in turn may lead to higher survival rate and enhanced fish production. Hence, further studies in this direction are recommended. As the state of Kerala is having several water bodies ranging from freshwater to brackishwater, and their numerous tributaries suitable for the growth of rotifers, and most of the water bodies are unexplored in relation to systematic studies on rotifers, further studies in this direction are highly necessitated.

Acknowledgements

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