Bull. Nat. Inst. Ocn. & Fish., A.R.E. 1993. (19): 249-275

DISTRIBUTION OF SOME ROTIFERS IN THE EGYPTIAN INLAND WATERS

By

SHOUKRY KAMEL GUERGUESS*

*National Institute of Oceanography & Fisheries, Alexandria, ARE.

Key Words: Rotifers Distribution, Inland waters, Egypt.

ABSTRACT

Rotifers are one of the most important components of Egyptian inland zooplankton especially in organically polluted waters. The present survey yielded thirty species from the various localities investigated. The distribution, the relative abundance and the morphological features are given for each species. The common species in Egyptian inland waters are also common in the lake sources of the River Nile.

INTRODUCTION

Rotifers are among the major components of the zooplankton of Egyptian inland waters, especially in eutrophic waters. Ehrenberg (1839), Schmarda (1854), Barrois and Daday (1894) and Daday (1910) (in Klimowicz, 1961 a), recorded 39 species and forms from Egyptian waters of which 21 species are mentioned in Klimowicz (1961 a). No further work was done on the rotifera of Egyptian inland waters for about half a century. El Hawary (1960) mentioned only one genus from lake Maryut. Klimowicz (1961 a, b & 1962) recorded 100 species & varieties of rotifers in the Nile, Nile canals in the Cairo environs and in the water bodies of Cairo Botanical Garden. His work was followed by Elster and Vollenweider (1961), El Maghraby *et al* (1963), Samaan & Aleem (1972), Samaan (1976), Zaghloul (1976, 1985 & 1988), Guerguess (1979, 1983, 1986 a, b & c, 1988 a, b, 1990 & 1992), Halim & Guerguess (1981), Helal (1981), Gharib (1983 & 1991), Soliman (1983), Aboul Ezz (1984), Abd El Aziz (1987), El-Sherif & Aboul Ezz (1988) and Iskaros (1993).

The present study deals with the distribution of rotifers in a wide range of different Egyptian inland water environments of different trophic levels.

MATERIALS AND METHODS

Eight sites were investigated, two of which were surveyed for the first time: El Khobiza fish farm, in addition to El Mahmoudia canal, which was sampled once.

Samples were collected from the following localities either by filtration of 100 liters through phytoplankton net, by sedimentation of 5 liters or by surface net hauls. The samples were fixed with 4% formalin:

1- Lake Manzalah: Monthly from September 1971 to January 1973 (Guerguess, 1979 & 1992) and again in June 1981 (Guerguess, 1986 b).

2- Lake Borullos: In June 1991.

3- Lake Edku:

(a): El Khobiza fish farm monthly from June 1987 to June 1988 (Guerguess, 1990).

(b): Western lake, monthly from August 1989 to May 1991 (Guerguess, 1992).

4- Lake Maryut: Inlets and outlets of the lake, monthly from August 1986 to November 1987 (Guerguess, 1988 a,b & 1992).

5- Lake Qaroun: August 1990, and February 1992.

6- Wadi El Rayan depression: August 1990.

7- Lake Nasser: August 1983 (Guerguess, 1986 a), composite sample from 12 localities.

8- El-Mahmoudia canal: March 1990.

Most of the figures and all microphotographs are original, unless indicated.

RESULTS

The distribution, the relative abundance and the main morphological features for the thirty species recorded during the investigation are given for each species, unless described by the author in earlier works.

Brachionus calyciflorus Pallas
(Figures: 1 - 3)

The local specimens have been described by Guerguess (1986 a). Average length 0.226 (without spines), Volume 0.0068 mm³.

Records: The species has a wide zoogeographical distribution and is one of the commonest planktonic species. The major rotifer in lake Manzalah (Guerguess, 1992) but rare in lake Nasser in August 1983 (Guerguess, 1986 a & b) while it was frequent at other times (Zaghloul 1985 & Iskaros 1993), It is also rare in the inlets of lake Maryut, but more common in its outlet (Guerguess, 1988), lake Maryut (Abd El Aziz, 1987). One of the dominant rotifers in lake Borullos (El-Sherif & Aboul El-Ezz, 1988). Frequent in lake Edku (Guerguess, 1992 & Soliman, 1983), El Boughaz (Gharib, 1983). El-Khobiza fish farm, El-Mahmoudia canal and Wadi El-Rayan (present observations). One of the dominant species in the Rosetta estuary (Zaghloul, 1988). Damietta Nile branch (Helal, 1981), Nile water and Botanical Garden, Cairo (Klimowicz, 1961, a, b & 1962).

Brachionus urceus L. = *B. urceolaris (Muller)*
(Figures: 4A & 4B)

The local specimens have been described by Guerguess (1986 a). Lorica length 0.20 mm., volume 0.003 mm .

Records: It is a common species in lake Maryut (Elster & Vollenweider, 1961, Samaan & Aleem, 1972 & Abd El Aziz 1987). Less common and with irregular appearance in lake Manzalah (Guerguess, 1992). Frequent in the inlets and outlets of lake Maryut (Guerguess. 1988 a & b). El-Khobiza fish farm. (Guerguess, 1990), lake Edku (Guerguess, 1992) and lake Borullos (Aboul Ezz, 1984), but rare in Wadi El-Rayan. Common in lake Qaroun in summer and winter (present observations). Rare in lake Nasser (Guerguess, 1986 a), Damietta Nile branch (Helal, 1981), in Nile water and Botanical Garden, Cairo (Klimowicz, 1961 a, b, & 1962).

Brachionus caudatus Barrois and Daday
(Figures: 5A - 5C)

Local specimens has a depressed lorica, dorsally concave, blunt from the anterior margin, 2 small spines arise from the middle of the anterior end, and 2 posterior spines are greatly extended and may reach 2/3 of body length. Cyclomorphosis in Brachionus angularis & B. caudatus was established by Hutchinson (1966) and Ruttner-Kolisko (1974) within the angularis group.

Lorica length 0.130 mm., volume 0.00067 mm³.

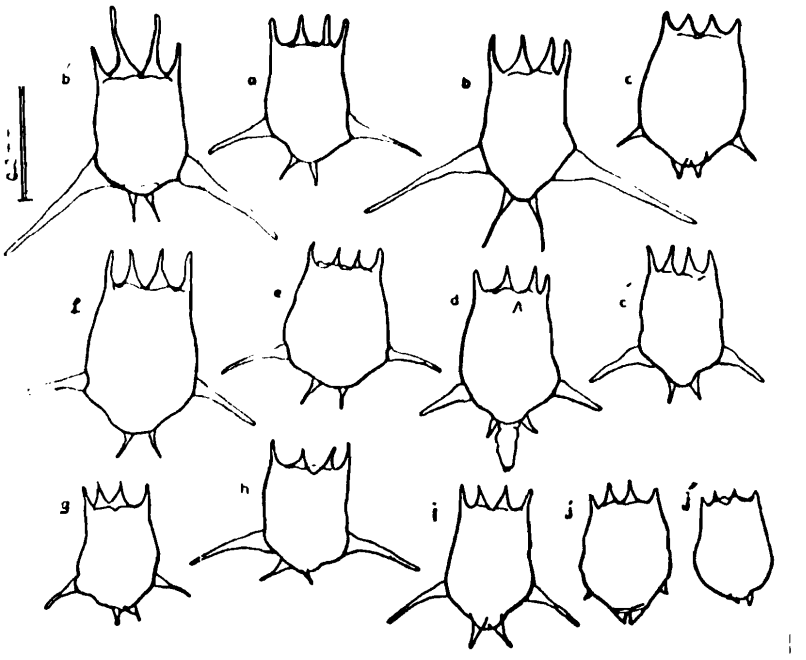


Figure 1: Different forms of Brachionus calyciflorus (Cyclomorphosis).

(a) Forma Spinosus (b′) (b) Forma amphiceros (a-i & c′)
(c) Forma typica or calyciflorus (j′)

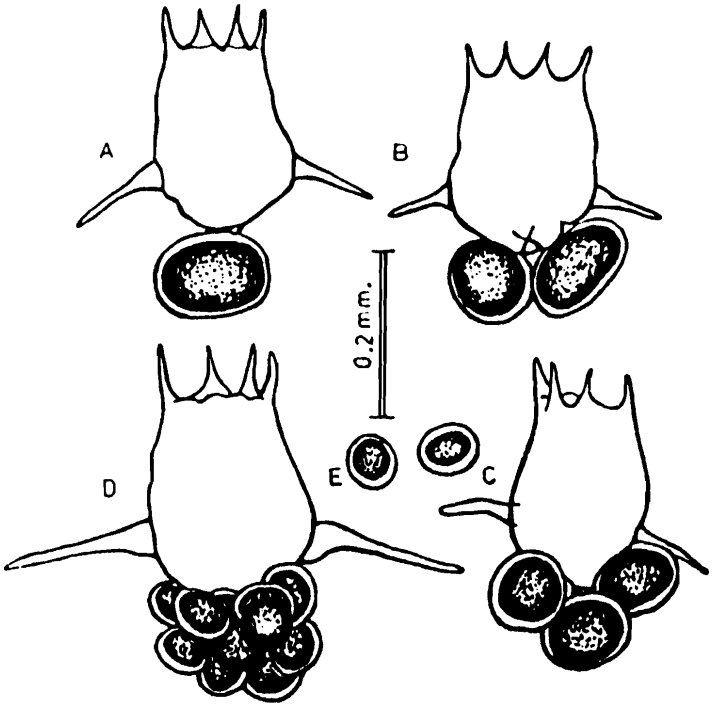
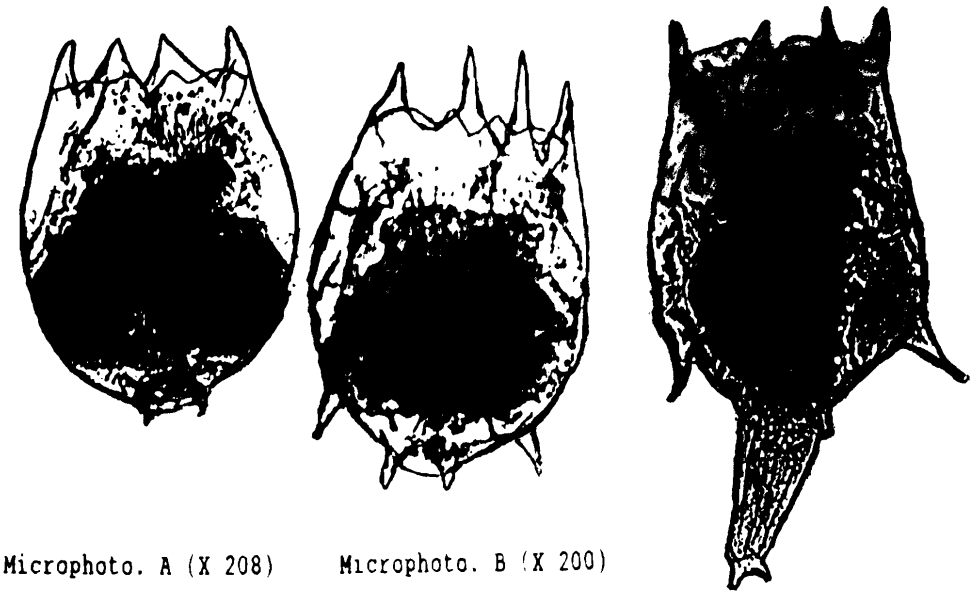
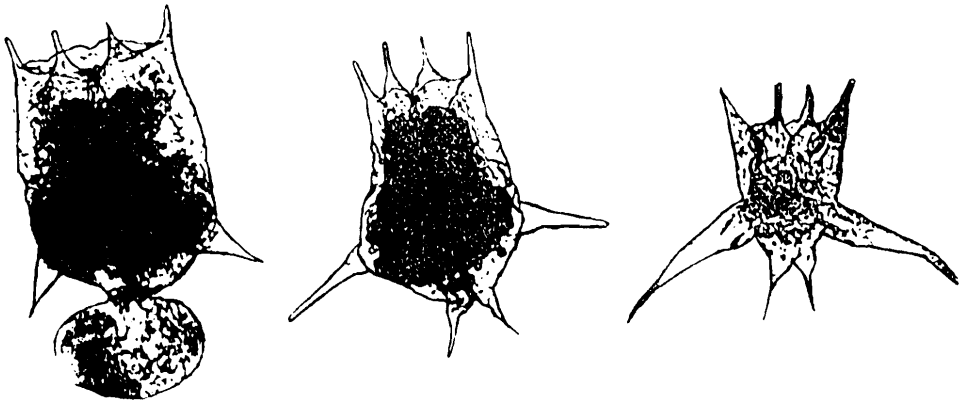


Figure 2: B. calyciflorus carrying eggs A to C, summer, D, winter.



Microphoto. A (X 208) Microphoto. B (X 200) Microphoto. C (X 208).



Microphoto. D (X 206) Microphoto. E (X 170) Microphoto. F (X 116).

Figure 3: Microphotos (A-F) show different forms of Brachionus calyciflorus during cyclomorphosis.

Microphot (A) Forma. typica or calyciflorus

Microphot (B-F) Forma. amphiceros

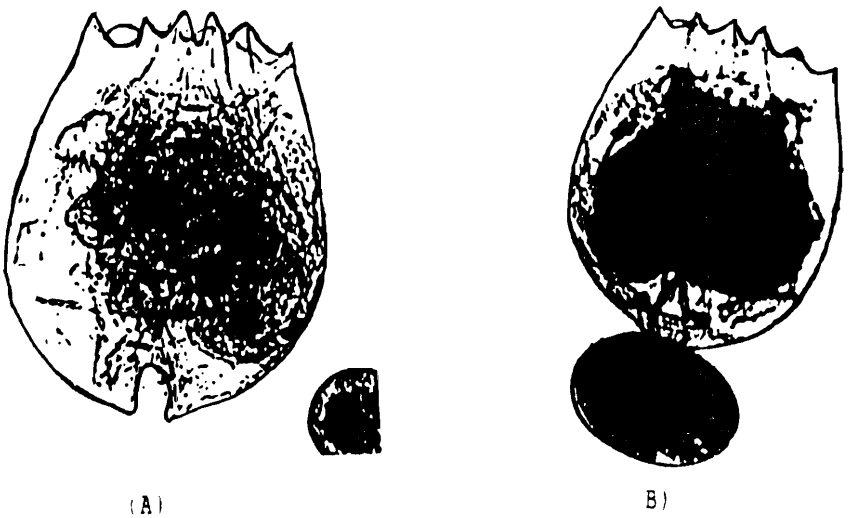


Figure 4: Microphoto of body shape of:
(A) Brachionus urceus
(B) B. urceus (X290) carrying egg.

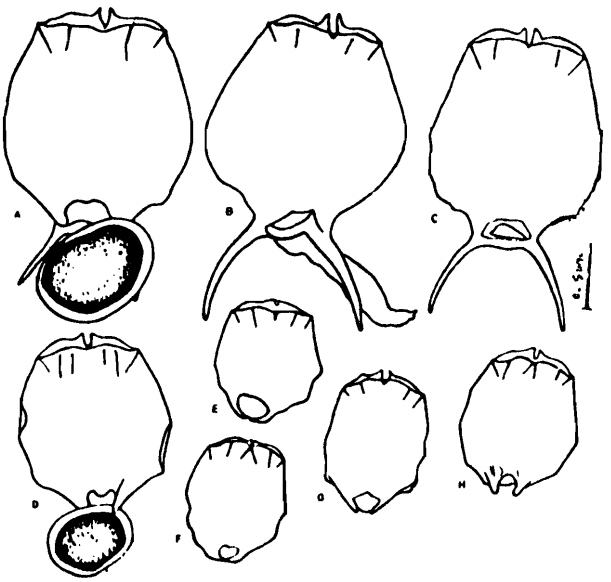


Figure (5): Different lorica forms,
A-C Brachionus caudatus
D-H B. angularis.

Records: B. caudatus was restricted to the western part of lake Manzalah., (Guerguess, 1979). It is rare in lake Borullos (Aboul Ezz, 1984), Lake Maryut (Abd El Aziz, 1987), Nozha Hydrodrome (Gharib, 1991). Very rare in El-Khobiza fish farm (present observations). It was recorded in Rosetta estuary downstream from the barrage (Zaghloul, 1988). In Damietta Nile branch (Helal, 1981) and in Nile water & Botanical Garden, Cairo (Klimowicz, 1961 a & b & 1962).

Brachionus angularis (Gosse)
(Figures: 5D - 5H)

Local specimens have a depressed lorica, ovoid and variable in shape. Anterior margin blunt, from the middle arise 2 spines, variable in length and directions according to cyclomorphosis. The two posterior spines, directed to each other and sometimes form a ring. Lorica length 0.104 mm., volume 0.00047 mm^3.

Records: B. angularis has a wide zoogeographical distribution. It was recorded in lake Maryut (Elster & Vollenweider, 1961, Samaan & Aleem, 1972 & Abd El Aziz, 1987). In small numbers in lake Manzalah (Guerguess, 1979). Rare in lake Maryut inlet, but frequent in its outlets (Guerguess, 1988 a & b). Rare in El-Khobiza fish farm (Guerguess, 1990), lake Edku (present observations & Samaan, 1976), lake Borullos (present observations & Aboul Ezz, 1984), lake Nasser (Zaghloul, 1985 & Iskaros, 1993) and in River Nile & Botanical Garden, Cairo (Klimowicz, 1961 a, b & 1962).

Brachionus budapestinensis (Daday)
(Figure: 6)

Local specimens have a rectangular lorica, slightly shortened tapering posteriorly, 2 pairs of spines arise from the anterior. The variations are in the direction of the inner 2 spines and in the length of the 2 outer spines., Lorica length 0.14 mm.

Records: Very rare in lake Manzalah (Guerguess, 1979), also in the outlet of lake Maryut (Guerguess, 1988 b), in lake Edku and El-Khobiza fish farm (present observations).

Brachionus falcatus (Zacharias)
(Figure 7)

Lorica of local specimens ovoid, 3 pairs of spines, arise from the anterior, inner and outer pairs small, the intermediate long and equal to posterior spines. There is variability in the direction and degree of curvature of the posterior spines. Total length 0.35 mm.

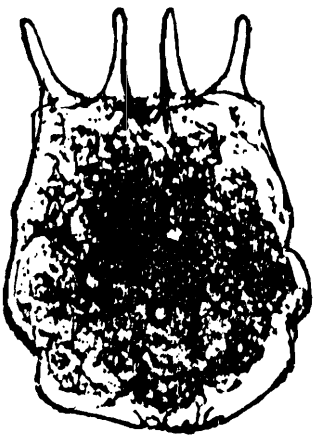


Figure 6: Microphoto body shape of: B. budapestinensis (X400).

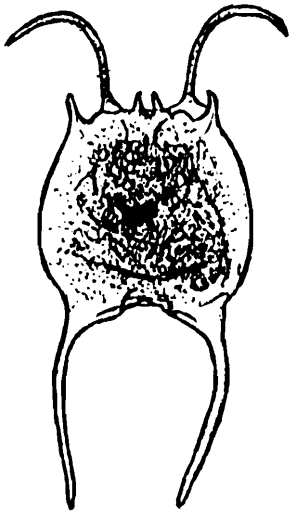


Figure 7: Microphoto of Brachionus falcatus (X 200).

Records: Very rare in lake Manzalah (Guerguess, 1979) and also in lake Edku (present observations). Recorded in Nozha. Hydrodrome (Gharib 1991) and lake Nasser (Iskaros, 1993), River Nile & Botanical Gerdan, Cairo (Klimowicz 1961 a & 1962).

Brachionus quadridentata (Hermann)
(Figure: 8B)

The species morphological characters are most variable, 14 varieties have been recorded by Sudzuki (1964). Lorica of the local specimens quadrangular enlarged in the middle or at the posterior. 3 pairs of small spines arise from the anterior. The 2 inner spines show variation. The 2 lateral margins of lorica extend to different degrees to form the shape of spines. Lorica length 0.18 mm.

Records: Very rare in lake Menzalah (Guerguess, 1979), also in the outlet of lake Maryut (Guerguess, 1988 b), in El Khobiza fish farm, (present observations) and lake Edku (present observations, Samaan, 1976 & Soliman 1983), recorded in lake Maryut (Elster & Vollenweider, 1961 & Samaan and Aleem, 1972 & Abd El Aziz, 1987), Nozha Hydrodrome (Gharib, 1991). lake Borullos (Aboul Ezz, 1984) and in Rosetta estuary (Zaghloul, 1988), Damietta Nile branch (Helal, 1981), River Nile & Botanical Garden, Cairo (Klimowicz 1961 a, b & 1962).

Brachionus plicatilis (Muller)
(Figure: 9a)

Body of local specimens oval, slightly compressed dorsoventrally, lorica soft with 6 short conical spines on the anterior margin. It is distinguished from Brachionus urceus by the shape of the anterior margin. Lorica length 0.350 mm.

Records: Lake Maryut (Elster & Vollenweider, 1961, Samaan & Aleem 1972 & Abd El Aziz, 1987). Frequent in the Nubariah canal inlet & El-Umum outlet, but rare in the other inlet of lake Maryut (Guerguess, 1988 b), Nozha Hydrodrome (Gharib, 1991). Also, rare in El Khobiza fish farm (present observations) and lake Edku (present observations and Samaan, 1976 & Soliman 1983) El Boughaz of lake Edku (Gharib, 1983). One of the common species in Rosetta estuary (Zaghloul, 1988) and in Damietta Nile branch (Helal, 1981). It is also recorded in the brackish Ainasyra pool, Cairo (Klimowicz, 1962).

Brachionus (Platyias) patulus (Muller)
(Figure: 9b)

For the morphological description of the local specimens see Guerguess (1986 a). Lorica length 0.190 mm.

Records: Very rare in lake Nasser (Guerguess, 1986 a & b, Iskaros, 1993), and Damietta Nile branch (Helal, 1981) River Nile & Botanical Garden (Klimowicz, 1961 a, b & 1962).

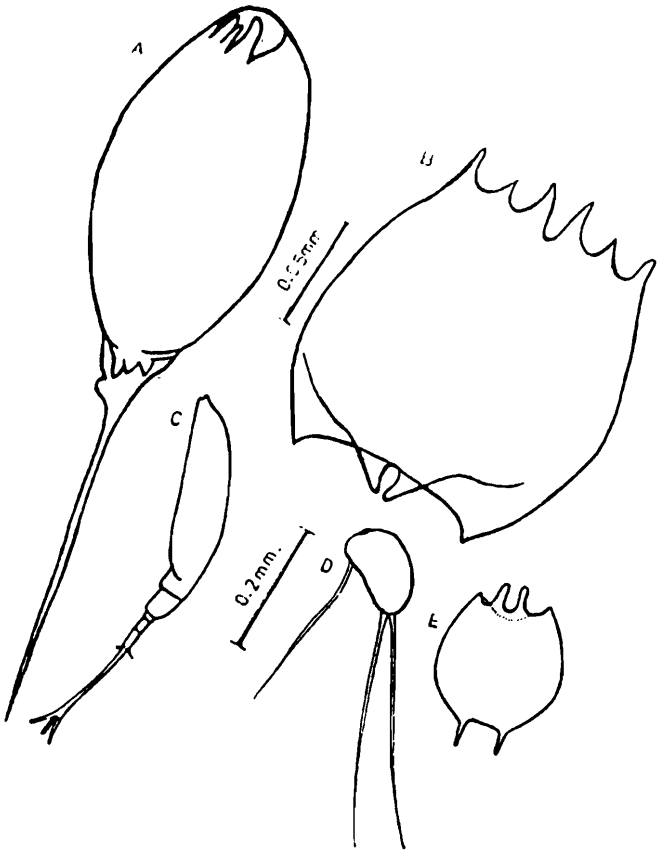


Figure 8: Body shape of:
(A) Trichocerca sp. (B) Brachionus quadridentata.
(C) Rotaria neptunia (D) Filinia longiseta.
(E) Platyias quadricornis.

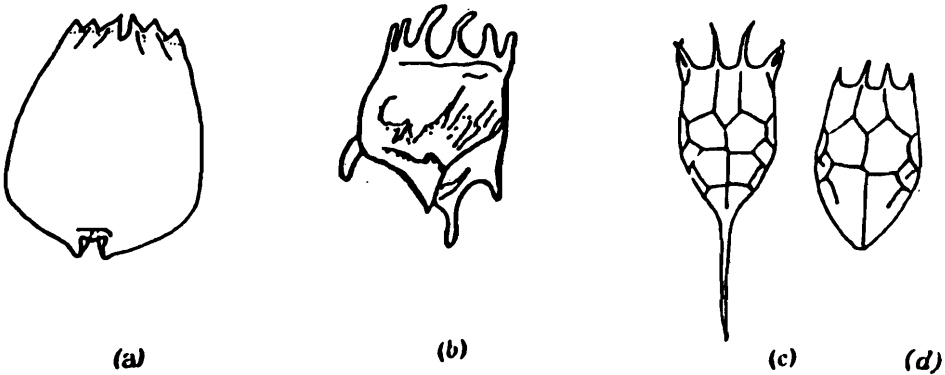


Figure 9: Body shape of:
(a) Brachionus plicatilis (b) B. patulus (X 110).
(c-d) Keratella cochlearis.
(a,c & d after Ahlstrom in Edmondson, 1959 and (b) after Guerguess, 1986a).

Keratella quadrata (O.F. Muller)
(Figure: 10)

Lorica of local specimens boxlike, composed of 2 plates. The 2 plates are joined by flexible membranes at the anterior and posterior ends permitting extensions of head and eggs. Without foot or attachment disc. Two posterior spines. Cyclomorphosis by shortening or complete disappearance of one or both spines. Average length 0.129 mm., Volume 0.0005 mm3.

Records: K. quadrata occurred in small numbers in all seasons, but common in winter in lake Manzalah (Guerguess, 1979). One of the dominant species in lake Borullos (El-Sherif & Aboul-Ezz, 1988). Rare in the outlet of lake Maryut (Guerguess, 1988 b). Rare also in El Khobiza fish farm, (present observations) and in lake Edku, (Present observations & Soliman, 1983) El Boughaz (Gharib, 1983) frequent in Mahmoudia canal (present observations). It was recorded in Rosetta estuary down the barrage (Zaghloul, 1988). Damietta Nile branch (Helal, 1981), Lake Nasser (Iskaros, 1993).

Keratella cochlearis (Gosse)
(Figures: 9c - 9d)

Lorica of local specimens broadest in front, tapering to a point, with only one caudal spine of varying length. Dorsal plate with median ridge or keel, at each side of median keel 2 closed hexagonal facets. Lorica length 0.107 mm.

Records: One of the common species in Mahmoudia canal (present observations). It is recorded in lake Nasser (Zaghloul, 1985 & Iskaros, 1993), Damietta Nile branch (Helal, 1981) and in River Nile & Botanical Garden Cairo (Klimowicz, 1961 a, b & 1962). In lake Borullos (Aboul Ezz, 1984), lake Edku (Soliman, 1983) and Nozha Hydrodrome (Gharib, 1991).

Platyias quadricornis (Ehrenberg)
(Figure: 8E)

Local specimens have an oval lorica, truncate anteriorly with 2 spines in the middle. Two posterior smaller spines. Foot jointed, not retractable within body. Foot and toes shorter than lorica. Lorica length (without spines) 0.195 mm.

Records: Very rare in lake Manzalah (Guerguess, 1979), also in El- Khobiza fish farm & in lake Edku (present observations). Also recorded in Damietta Nile branch (Helal, 1981) River Nile & Botanical Garden, Cairo (Klimowicz, 1961 a & b and 1962).

Manfredium eudactylotum Gallagher
(Figure: 11a)

Body of local specimens pear-shaped, dorsum bulging & not twisted. Foot & toes together longer than lorica. Body length 0.226mm.

Records: Rare in El-Nubariah inlet and Umum outlet of lake Maryut (Guerguess, 1988 b). Very rare in El Khobiza fish farm (present observations). Recorded in Damietta Nile branch (Helal, 1981).

Lepadella c.f. ovalis (Muller)
(Figure 12D)

For the morphological description of local specimens see Guerguess (1986 b).

Records: Very rare in Lake Manzalah (Guerguess, 1986 b), rare in outlet of lake Maryut (Guerguess, 1988 b), also in El Khobiza fish farm (present observations) and lake Edku (Soliman, 1983), El Boughaz of lake Edku (Gharib, 1983). River Nile of Botanical Garden Cairo, (Klimowicz, 1961 a & b and 1962).

Monostyla (= Lecane) bulla Gosse
(Figure: 13)

Lorica of local specimens spindle shaped. Foot projects through hole in ventral plate, with one toe, the foot and toe shorter than lorica. Total length 0.186 mm.

Records: Very rare in lake Manzalah (Guerguess, 1979), also in the inlet & outlet of lake Maryut (Guerguess, 1988 b), lake Maryut (Abd El Aziz, 1987) and Nozha Hydrodrome (Gharib, 1991). Less frequent in lake Borullos (El-Sherif & Aboul Ezz, 1988), very rare in El-Khobiza fish farm (Guerguess, 1990), lake Edku (present observations & Soliman, 1983), El Boughaz (Gharib, 1983), Rosetta estuary (Zaghloul, 1988), Damietta Nile branch (Helal, 1981), River Nile & Botanical Garden, Cairo (Klimowicz, 1961 a, b & 1962).

Monostyla closterocerca Schmarda
(Figure: 14a)

Body of local specimens ovoid, foot projects through hole in ventral plate, with one toe. Body length 0.105 mm.

Records: Rare in the outlet of lake Maryut (Guerguess, 1988 b). Rare also in El Khobiza fish farm (Guerguess, 1990) and in El- Mahmoudia canal (present observations). Recorded in lake Edku and in Boughaz (Soliman, 1983, & Gharib, 1983) in lake Borullos (Aboul Ezz, 1984) and in lake Nasser (Iskaros, 1993) and River Nile & Botanical Garden, Cairo (Klimowicz 1961 a & 1962).

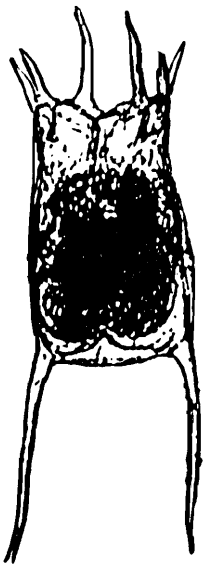


Figure 10: Microphoto of Keratella quadrata (X 270).

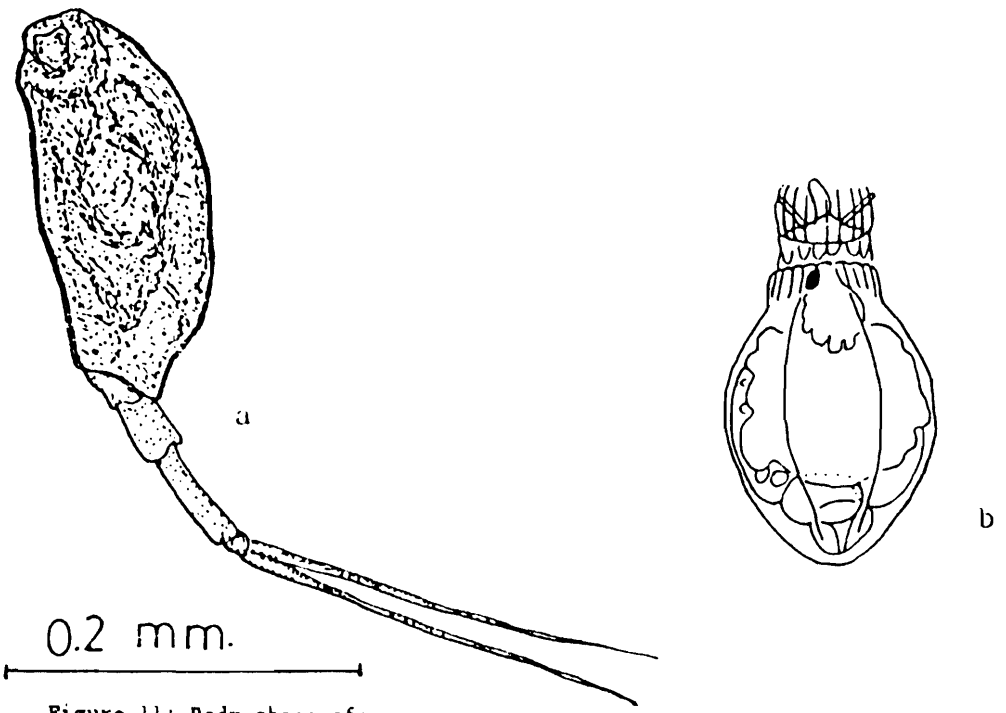


Figure 11: Body shape of:
(a) Manfredium eudactylotum.
(b) Ascomorpha saltans (X275), (after Beauchamp in Edmondson 1959).

Lecane luna (Muller)
(Figure: 15)

Local specimens with oval lorica. The shape of anterior margin depends somewhat on the state of contraction, consisting of dorsal and ventral plates, separated by flexible membranes. Foot and toes shorter than lorica. The toes are two separate. Lorica length 0.26mm.

Records: Rare in lake Manzalah (Guerguess, 1979), lake Borullos (Aboul Ezz, 1984). Recorded in lake Edku (Samaan, 1976, Soliman 1983 & present observations) El Boughaz (Gharib, 1983) and only in the Nubariah inlet of lake Maryut (Guerguess, 1988 b), lake Maryut (Abd El Aziz, 1987), Nozha Hydrodrome (Gharib, 1991), El Khobiza fish farm (Guerguess, 1990), lake Nasser (Zaghloul, 1985 & Iskaros, 1993) Damietta Nile branch (Helal, 1981), Rosetta estuary (Zaghloul, 1988) and in River Nile & Botanical Garden, Cairo (Klimowicz, 1961 a, b, & 1962).

Lecane depressa
(Figure: 14b)

Body of local specimens spindle shaped with 2 separate toes. Body length 0.120 mm.

Records: Rare in El-Nubariah canal inlet of lake Maryut (Guerguess, 1988 b). Nozha Hydrodrome (Gharib, 1991), very rare in El-Khobiza fish farm and in Mahmoudia canal (present observations). Recorded in lake Edku (Soliman, 1983) lake Borullos (Aboul Ezz, 1984) and in lake Nasser (Iskaros, 1993).

Lecane elasma
(Figure: 14c)

Body of local specimens spindle shaped, with 2 toes partly fused at their base. Body length 0.10 mm.

Records: Very rare in El-Khobiza fish farm and Wadi El-Rayan (present observations) and in lake Borullos (Aboul Ezz, 1984).

Lecane ohioensis (Harrick)
(Figure: 14d)

Body of local specimens spindle shaped protruded at the posterior margin, with 2 toes. Body length 0.125 mm.

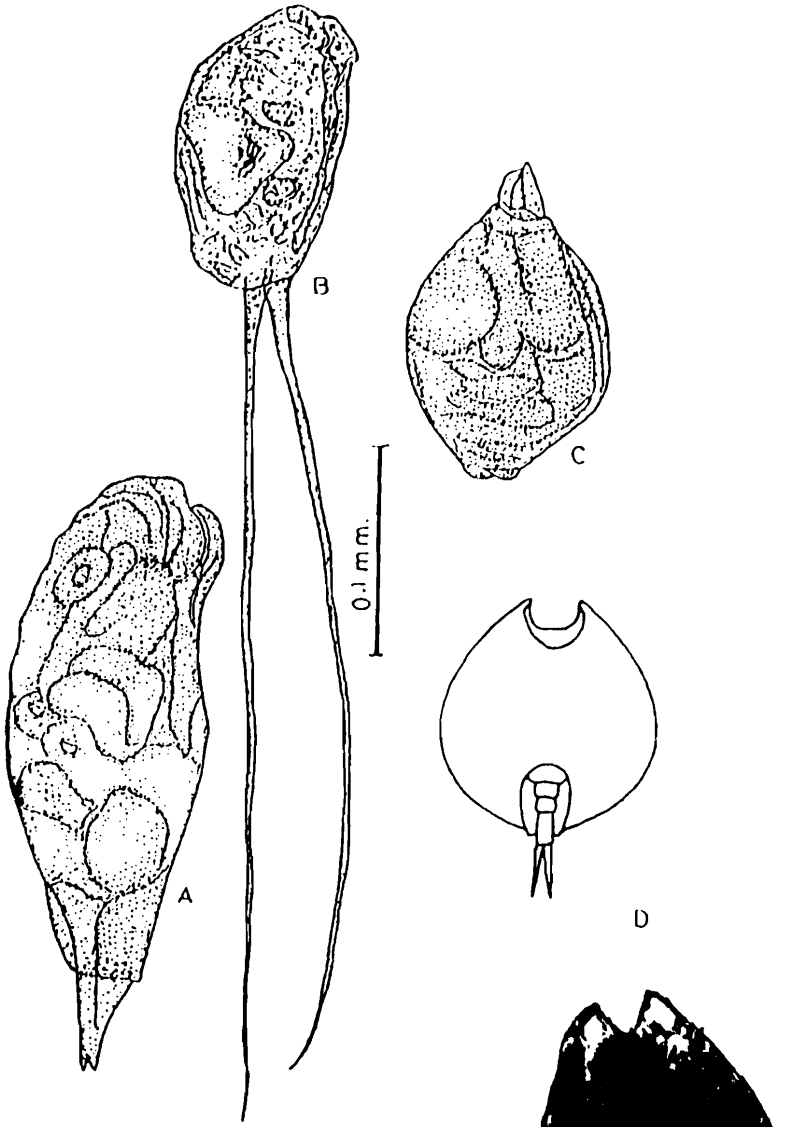


Figure 12: Body shape of:
(A) Synchaeta okai
(B) Monommata grandis.
(C) Horaella brehmi
(D) Lepadella ovalis.

(A-C, after Guerguess, 1986 b)
(D, after Harring in Edmondson, 1959).

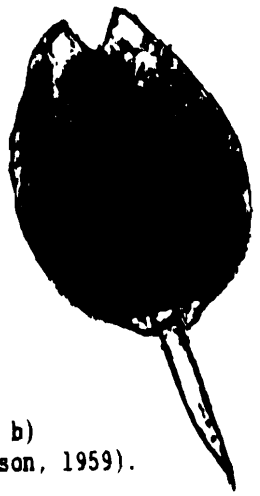


Figure 13: Microphoto of Monostyla bulla (X 375).

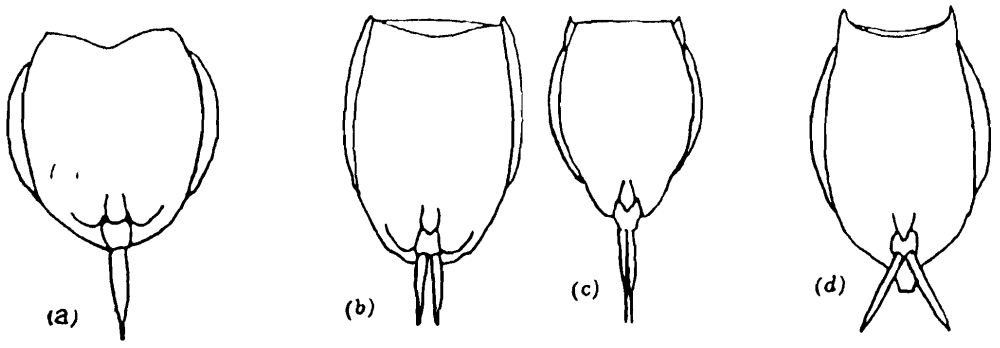


Figure 14: Body shape of:
(a) Monostyla closterocera (b) Lecane depressa (c) L. elasma
(d) L. ohioensis (After Harring and Myers in Edmondson, 1959. About X270-300).

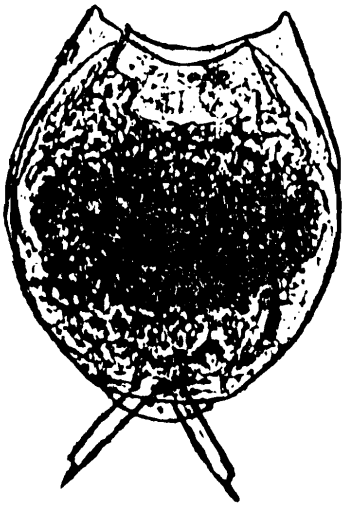


Figure 15: Microphoto of Lecane luna (X 200).

Records: Rare in El-Umum external outlet of lake Maryut (Guerguess, 1988 b) and also rare in El Khobiza fish farm (present observations). Recorded in lake Edku (Soliman, 1983), in lake Borullos (Aboul Ezz, 1984) and in Damietta Nile branch (Helal, 1981).

Monommata grandis Tessin
(Figure: 12B)

For the morphological description of local specimens see Guerguess (1986 b).

Records: Very rare in lake Manzalah (Guerguess, 1986 b). Unrecorded from elsewhere.

Trichocerca sp.
(Fig. 8A)

Lorica of local specimens spindle shape, body twisted, toes unequal. Foot ends in 1 or 2 toes. Trophi virgate. Length 0.177 mm.

Records: Rare in lake Manzalah (Guerguess, 1979), also in El Umum outlet of lake Maryut (Guerguess, 1988 b), also in El Khobiza fish farm and El Mahmoudia canal (present observations).

Ascomorpha saltans (Bartsch)
(Figure: 11b)

Lorica of local specimens composed of two plates, joined by a flexible cuticle, forming sulci, dorsal plate less than 3/4 the width of ventral plate. Body length 0.178 mm., volume 0.00155 mm3.

Records: Rare in lake Manzalah (Guerguess, 1979) and also in lake Edku (present observations).

Polyarthra c.f. vulgaris (Carlin)
(Figure: 16)

Body of local specimens elongated, with flattened cuticular appendages attached in 4 groups. Trophi virgate. Without foot or attachment disc. Body length 0.102 mm.

Records: Relatively rare in lake Manzalah (Guerguess, 1979), lake Maryut (Abd El Aziz, 1987), Nozha Hydrodrome (Gharib, 1991), also in the outlet of lake Maryut (Guerguess, 1988 b). Rare in El Khobiza fish farm, Mahmoudia canal and lake Edku (present observations), in Damietta Nile branch (Helal, 1981), River Nile & Botanical Garden, Cairo (Klimowicz, 1961 a, b & 1962).

Figure 16: Microphoto of Polyarthra vulgaris (X 320).

Figure 18: Microphoto of Rotaria neptunia (X, 130).

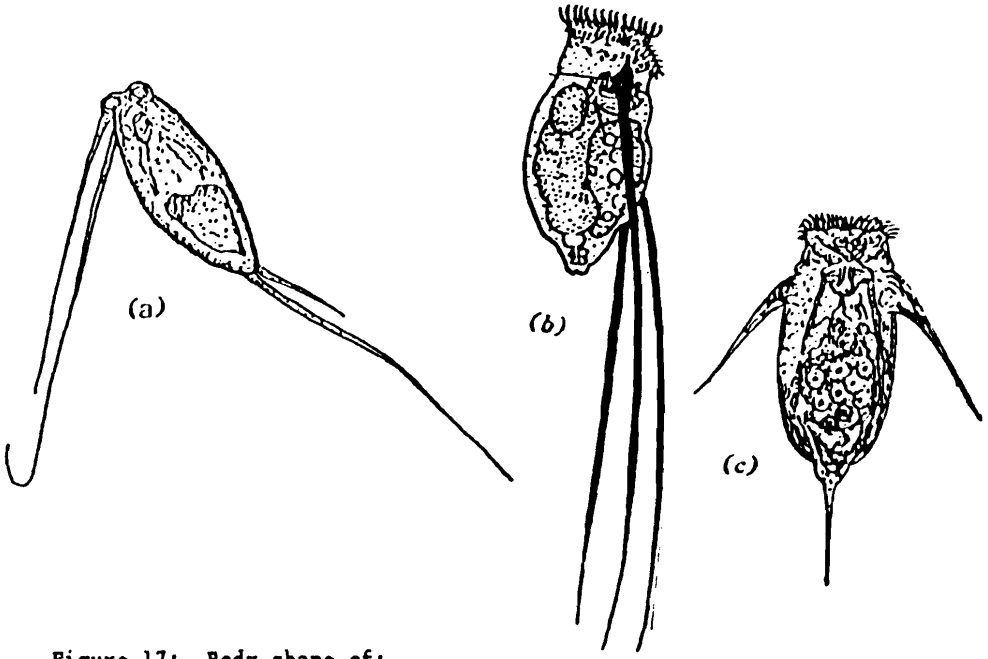


Figure 17: Body shape of:
(a) Filinia opoliensis (After Guerguess, 1986 a) x 150.
(b) F. longiseta (modified by Edmondson from Donner) X210.
(c) F. brachiata (after Rousselet in Edmondson,1959) X250.

Synchaeta okai Sudzuki
(Figure: 12A)

For the morphological description of local specimens see Guerguess (1986 b).

Records: Rare in lake Manzalah (Guerguess, 1986 b), El Nubariah inlet and Umum outlet of Lake Maryut (Guerguess, 1988 b), less frequent in lake Borullos (El Sherif & Aboul Ezz, 1988). Rare in El Khobiza fish farm (present observations).

Filinia longiseta (Ehrenberg)
(Figure: 8D & 17b)

Body of local specimens spindle shaped, without foot or attachment disc. Appendages 3 are setiform extensions of cuticle, relatively long, 2 lateral and the third near the posterior margin. Body length 0.148 mm.

Records: Rare in El Nubariah but frequent in lake Maryut outlet (Guerguess, 1988 b), in lake Maryut (Abd El Aziz, 1987), in Nozha Hydrodrome (Gharib, 1991) also in El Khobiza fish farm (present observations) & in lake Edku (Soliman, 1983). One of the common species in Rosetta estuary downstream (Zaghloul, 1988). Recorded also in Damietta Nile branch (Helal, 1981), in lake Nasser (Zaghloul, 1985 & Iskaros, 1993), in River Nile & Botanical Garden, Cairo (Klimowicz, 1961 a, b & 1962).

Filinia opoliensis (Zacharias)
(Figure: 17a)

For the morphological description of local specimens see Guerguess (1986 a). Body length 0.273 mm.

Records: Very rare in lake Nasser (Guerguess, 1986 a & Iskaros, 1993) and in Damietta Nile branch (Helal, 1981).

Filinia brachiata (Rousselet)
(Figure: 17c)

Body of local specimens spindle shaped with 3 short appendages, 2 lateral and the third at the posterior margin. Body length 0.136 mm.

Records: Rare in lake Maryut outlet (Guerguess, 1988 b). One of the common species in Rosetta estuary downstream (Zaghloul, 1988) and also Damietta Nile branch (Helal, 1981).

Horaella brehmi (Donner)
(Figure: 12C)

For the morphological description of local specimens see Guerguess (1986 b). Body length 0.132 mm.

Records: Rare in lake Manzalah (Guerguess, 1986 b), also in El Nubariah inlet and Umum outlet of lake Maryut (Guerguess, 1988 b), also in El Khobiza fish farm (Guerguess, 1990), lake Edku and El Mahmoudia canal (present observations).

Rotaria c.f. neptunia (Ehrenberg)
(Figure: 8C & Fig. 18)

Eyes of local specimens, if present, in rostrum. Foot with 3 toes. Corona with 2 separate trochal circles on pedicles. Body length 0.370 mm., total length 0.63 mm.

Records: Nearly limited to grossly polluted waters, few specimens or absent in other regions of lake Manzalah (Guerguess, 1979). Appeared common in certain periods (June, 1987 and May & June 1988) others periods rare in El Khobiza fish farm (present observations). Lake Edku (Soliman, 1983), Damietta Nile branch (Helal, 1981) & in River Nile & Botanical Garden (Klimowicz, 1961 b & 1962).

DISCUSSION

Rotifers constitute an important link in the food-chain of inland waters. Rotifers and their eggs are preyed upon by Mugil spp. fries in lake Manzalah (Guerguess, 1979). Rotifers are also important components in nutrient cycling and secondary production in lakes. They are the preferred first food of a variety of fish larvae and important agents in the transfer of energy from primary producers to higher trophic levels (Stemberger, 1990). The size of the different species falls in wide range from 0.100 to 0.370 mm. (Halim & Guerguess, 1981) which allows their population to feed efficiently on food particles of different sizes.

Rotifers are of freshwater origin. Most of the common species recorded in Egyptian inland waters were also recorded in the lake sources of the White Nile (Green, 1967) they are:

Brachionus calyciflorus, B. quadridentata, B. budapestinensis, Lecane luna, Platyias quadricornis, Polyarthra vulgaris, Rotaria neptunia. B. urceus (= B. urceolaris) B. falcatus B. caudatus Monostyla bulla Trichocerca sp. Filinia longiseta and

Brachionus calyciflorus, a worldwide species, is recorded from the African lakes, lake Edward, lake Albert, lake George, lake Kyoga and lake Victoria (Green 1967). It is the most common rotifer species in Egyptian inland waters especially in the Delta lakes. It is frequent in lake Nasser but was absent from lake Qaroun (August 1990, February, 1992). Brachionus urceus, second in abundance is frequent in the Delta lakes, common in lake Qaroun but rare in lake Nasser. Both species are known to prefer organically polluted and colder waters (Arora 1966 b, Guerguess 1979 & 1992).

The species not recorded in the lake sources of the White Nile are mostly rare except for Keratella quadrata which also increases in abundance in eutrophic environments and in colder waters. Although rotifers increase in species richness and in abundance in organically polluted and in colder waters, salinity is not a barrier to their distribution (Aboul Ezz et al, 1990). Brachionus calyciflorus & B. urceus can withstand high salinity. The former was recorded in the Eastern Harbour in Alexandria at salinities ranging from 30‰. to 38.5‰. (Aboul Ezz 1990 et al) and the latter in lake Qaroun at salinities of 30‰ (present investigation).

There are some exceptions, B. caudatus, B. falcatus and Platyias quadricornis have very low brackish affinities. B. falcatus and B. quadridentata occur in greater abundance in clean waters, While Rotaria neptunia is restricted to grossly polluted waters (Arora, 1966 b).

Four different environments were compared depending on the degree of eutrophication (table 1):

1- Lake Edku is relatively clean of organic pollution (present observations).

2- Lake Manzalah a eutrophied lake and El Genka Basin grossly polluted (Guerguess, 1979).

3- Lake Maryut inlets (Nubariah canal & Umum drain (Guerguess, 1988 a & b).

4- Lake Maryut outlet (Umum drain after draining lake Maryut polluted waters (Guerguess, 1988 a & b).

The highest contribution of rotifers to the zooplankton standing crop was in the outlet of Lake Maryut, the most eutrophic of the coastal lakes, followed by El Genka basin of lake Manzalah.

The effect of pollution is also shown by the results of Kowalczyk and Radwan (1982) on 3 lakes of different eutrophic level in Poland. They found that (1) in a eutrophic lake, there were 30 species of rotifers contributing 65% to the zooplankton standing crop, in (2) a mesotrophic lake, there were 29 species

contributing 57.3% and (3) in a dystrophic lake, 28 species contributing 54.4% to the zooplankton crop. Keratella cochlearis was the most dominant in the three lakes (33.5-53%), a species also recorded in Egyptian waters (see above).

Table 1: Number of rotifer species, monthly average zooplankton (organisms per.m^3.) and Rotifers percent to the total zooplankton in five different environments.

	Lake Edku	Lake Manzalah		Lake Maryut	
		average total lake	El-Genka Basin	inlets	outlets
No Species of Rotifers	17	23	14	13	22
Zooplankton organisms m^3	$33x10^3$	$63x10^3$	$93x10^3$	$4.7x10^3$	$73x10^3$
Rotifers percent	10 %	24 %	56.5 %	30 %	65 %

Effect of food, temperature and predation on growth, reproduction & cyclomorphosis of rotifers in Egyptian inland waters.

The most widespread characteristic of the rotifer life cycles has been shown to be the duration of the embryonic development, which was found to be temperature dependent (according to several authors in Schmid-Araya, 1991). Studies on the effect of food supply, both quality and quantity, upon duration of the phases of rotifer life cycles are less numerous and showed some divergences.

In Egyptian inland waters (lake Menzalah), there is a dependance between the predominating rotifer Brachionus calyciforus and phytoplankton especially with the diatoms Cyclotella spp. (C. meneghiniana & C. glomerata). For the Egyptian lakes are eutrophic areas charachterized by continuous bloom of phytoplankton which may affect the duration and the life cycle of the recorded rotifers.

The effect of food quantity as reviewed by Schmid-Araya (1991) were found to be:

a- Prolonged juvenile period at low food levels in Euchlanis dilatata and Brachionus rubens.

b- Reduction in life span and fertility in both low & high algal densities in Brachionus calyciflorus.

c- Reduced reproductive rate and prolongation of the of first reproduction in Asplanchna girodi when fed at low food level.

d- Reduction of the duration of the period of egg production of B. rubens at "deficient" algal concentrations.

It has been suggested (Schmid-Araya, 1991) that prolonged developmental phases are due to a combined effect of temperature and food concentrations.

Schmid-Araya (1991) found experimentally that the lowest amount of food at which individuals of Brachionus plicatilis were able to survive was 0.53 ug C/ml (2 x 10^3 cells/ml) of the Chlorophycean Brachiomonas submarina var. *pulsifera*. Up to a food level of 0.79 ug C/ml (3 x 10^3 cells/ml), the non-laying females reached 40%. A high percentage of egg mortality (31.7%) was detected at the highest food concentrations of 26.32 ug C/ml (100 x 10^3 cells/ml). At this food level a large number of eggs did not hatch. Bosselmann (1978 in Siegfried, 1991) mentioned that the birth rates are generally more strongly correlated to temperature. If food is not limiting, there should be strong correlations between birth rate and temperature, weak correlations are attributed to food limitation.

In a hydrobiological study carried out in an anthropogenic reservoir in Poland, Bielanska-Grajnar (1983/1984) found a dependance between the occurrence of pelagic rotifers and phytoplankton and some species of rotifers were connected with certain groups of algae. She also found a dependence between vertical distribution of rotifers, the water temperature and the amount of dissolved oxygen.

Rotifer population growth parameters can be affected by the type of algae available (Rothhaupt, 1990 in Siegfried, 1991).Lorica size is determined by a complex interaction of environmental factors including food, predators and physical & chemical conditions. The large spines of Keratella taurocephala are thought to help minimiza sinking and allow it to remain in the food rich column (MacIsaak et al, 1987 in Siegfried, 1991). Lorica size of K. taurocephala in Silver lake was significently positively correlated with chlorophyl concentrations and weakly negatively with temperature (Siegfried, 1991).

MacIsaak et al (1987 in Siegfried, 1991) suggest that K. taurocephola can dominate the plankton because its large spines render it invulnerable to predation by invertebrate predators that may dominate in lakes. The loss of crustacean grazers is thought to increase food availability for rotifers and their dominance in lake plankton communities (Yan & Geiling, 1985 in Siegfried loc.cit). Zooplanktivorous fish preferring large bodied zooplankton can indirectly promote high standing stocks of rotifers by eliminating their invertebrate predators and competitors. Species of rotifers having behavioral or morphological defenses can coexist with their potential predators and mechanically interfering competitors. Consequently, many species have evolved defensive spines, rigid loricas or escape responses which increase survivorship in interaction with potentially harmful species. Soft-bodied forms without defenses often were abundant during periods when predator populations were low. (according to several authors in Stemberger, 1990).

Cyclomorphosis or seasonal polymorphism is an adaptation to lower viscosity in summer, by increasing form resistance due to changes in water temperature. There are however different views about cyclomorphosis. Sudzuki (1964) in Japan found that Brachionus calyciflorus, tends to have a larger body with shorter spines in winter. While in summer, it tends to diminish its size and lengthen its spines. In early & late summer, mixed forms appear. He attributed these changes to water condition and food beside temperature. Nayar (1965) in India attributed cyclomorphosis of B. calyciflorus, one of the commonest rotifers in India to the quantity of food. Arora (1966a) in India also mentioned that cyclomorphosis is caused by variations in temperature. Recent experimental evidence indicates that low food conditions led to the production of long spined Brachionus calyciflorus specimens and that the threshold food levels for reproduction are reduced in the long spined forms (Stemberger 1990b in Siegfried, 1991).

In Egyptian inland waters, in lake Manzalah in particular, the body size of B. calyciflorus, the commonest species, generally increases in winter with decreased temperature but there was also a trend for small sized forms to appear. With the rise in temperature in summer, the body size decreased, but there is also a trend for larger forms to appear. This was associated with phytoplankton density. It appears therefore that two factors govern the variations in body size, and in abundance, the quantity of phytoplankton and water temperature. Cyclomorphosis of B. calyciflorus in lake Menzalah therefore appears to be governed by more than one factor. Three different forms were observed:

1- B. calyciflorus forma amphiceros, where the posterolateral spines are relatively long (Figures: 1 (a-i & c) & 3B-3F

2- B. calyciflorus forma typica or calyciflorus without posterolateral spines (Figure: 1-j´ & Fig. 3 A).

3- B. calyciflorus forma spinosus, the anteromedian spines of amphiceros forma are greatly elongated (Figure: 1b´)

Most of the spined rotifers show cyclomorphosis in the direction of anterior spines and shortening or disappearance of the posterior spines. This is due to the effect of several other factors combined with temperature, as the 3 different forms appeared under various environmental conditions.

ACKNOWLEDGEMENTS

The author is greatful to Prof. Dr. Youssef Halim Professor of the Biological Oceanography, Faculty of Science, Alexandria University, for his encouragements and for the revision of the manuscript.

REFERNCES

Abd El Aziz, N. El - Sayed, 1987. Limnological studies of the zooplankton and benthos in the main basin of lake Maryut. M.Sc thesis. Fac. Sci. Alex. Univ. PP. 247.

Aboul Ezz, S.M. 1984. Limnological investigations on zooplankton and benthos of lake Borullos Ph. D. thesis, Fac. Sci., Mansoura Univ. PP. 340.

Aboul-Ezz, S.M., M.M. Hussien and N.A. Sallam. 1990. Effect of Domestic sewage discharge on the distribution of zooplankton organisms in the Eastern Hrabour of Alexandria (Egypt). Bull. High Inst. Public Health. vol.xx(4): 861-874.

Arora, H.C. 1966a. Cyclomorphosis (form variations) in some species of Indian planktonic Rotatoria. Int. Revue ges. Hydrobiol. 51 (4): 545-621.

Arora, H.C. 1966b. Rotifers as indicator to trophic nature of environmets. Hydrobiologia 27 (1-2): 146-159.

Bielanska-Grajner, I. 1983/1984. The effect of biotic and abiotic factors on the occurrance of plankton rotifers (Rotatoria) in the Plawniowice Duze reservoir (Upper Silesia, Poland). Acta. Hydrobiol. 25/26(2): 173-180.

Edmondson, W.T., 1959. Rotifera in: Fresh-water Biology Edit. Edmondson, 2 nd edit. John Wiley & Sons Inc. New York: 420-494.

El-Hawary; M. A. 1960. The zooplankton of Egyptian lakes. A preliminary study on the zooplankton of lake Maryut and lake Edku. Notes Mem., Alex. Inst. Hydrobiol. 52:1 -12.

El-Maghraby, A.M.,S.D. Wahby & A.H. Shaheen, 1963. The ecology of zooplankton in lake Manzalah. Notes. Mem. , Alex. Inst. Hydrobiol. 70:1-43.

El-Sherif, Z.M. & S.M. Aboul-Ezz. 1988. Preliminary study on phytoplankton-zooplankton relationship in lake Borullos, Egypt. Bull. Inst. Oceanogr. & Fish ARE 14(1): 23-30.

Elster, H.J. & R. Vollenweider, 1961. Beitrage zur limnologie Agyptens. Arch Hydrobiol. 57 (43): 241-343.

Gharib, S.M. 1983. Hydrobiological studies at Boughaz El-Maadiya region near Alexandria. M.Sc. thesis, Fac. Sci. Alex. Univ. PP. 282.

Gharib, S.M. 1991. Study of the biological productivity of Nozha Hydrodrome as a model of artificially fertilized fish farm. Ph.D. thesis, Fac. Sci El-Mansoura Univ. PP. 453.

Green, J. 1967. Associations of rotifera in the zooplankton of the lake sources of the White Nile Proc. Jour. Zool. Soc. Lond. 151: 343-378.

Guerguess, Sh.K. 1979. Ecological study of zooplankton and distribution of macrofauna in lake Manzalah. Ph. D. thesis. Fac. Sci., Alex. Univ. PP. 361

Guerguess, Sh.K. 1983. Zooplankton distribution in lake Manzalah Rapp. Comm. Int. Mer Medit. 28(6): 245-246.

Guerguess, Sh.K. 1986a. Notes in the zooplankton of lake Nasser Bull. Fac. Sci., Alex. Univ. 26 (4): 103-122.

Guerguess, Sh. K. 1986b. Check-List and additions to the rotifera of Egyptian waters. Bull. Fac. Sci., Alex. Univ. 26(4): 123-129.

Guerguess, Sh. K. 1986c. Rotifers of lake Menzalah. Rapp. Comm. Int. Mer Medit. V 30 Fasc 2. PP. 51.

Guerguess, Sh. K. 1988a. Plankton of lake Maryut outlet (West from Alexandria). Rapp. Comm. Int. Mer Medit. 31(2): 70.

Guerguess, Sh. K. 1988b. Plankton of lake Maryut outlet, West from Alexandria. Bull, Nat. Inst. Oceanogr. & Fish, ARE, 14(2): 153 171.

Guerguess, Sh. K. 1990: Plankton and macrophyte epibiota in the fish diet in a brackish lagoon near Alexandria. Rapp. Comm. Int. Mer Medit. 32(1): Y14.

Guerguess, Sh. K., 1992. Planktonic rotifers as indicators of pollution in Mediterranean coastal lagoons of Egypt. Rapp. Comm. Int. Mer Medit. 33:95.

Halim, Y. and Sh. K. Guerguess. 1981. Coastal lakes of the Nile Delta, Lake Menzalah. Symposium on coastal lagoons, Duke University, Marine science 33: 135-172.

Helal, H.A., 1981. Studies on the zooplankton of Damietta branch of the River Nile north of El Mansoura. M.Sc. thesis, Fac. Sci, Mansoura Univ. PP. 231.

Hutchinson, G.E. 1966. A treatise of Limnology. John Wiley edit. New York. 2. pp. 1115.

Iskaros, I.A. 1993. Ecological studies on the distribution of zooplankton and benthos fauna in Khor Kalabsha in lake Nasser. Ph. D. thesis, Fac. Sci. Mansoura Univ. PP. 304.

Klimowicz, H. 1961a. Differentiation of rotifers in various zones of Nile near Cairo. Polsk. Arch. Hydrobiol. 9 (22). 223-242.

Klimowicz, H. 1961b. Rotifers of the Nile canals in the Cairo environs. Polsk. Arch. Hydrobiol. 9(22): 203-221.

Klimowicz, H. 1962. Rotifers of the small water bodies of Cairo Botanical Garden. Polsk. Arch. Hydrobiol. 10 (23): 241-270.

Kowalczyk C & S. Radwan. 1982. Groops of pelagic zooplankton in three lakes of different trophy. Acta. Hydrobiol. 24(1): 39-51.

Nayar C.K.G.. 1965. Cyclomorphosis of Brachionus calyciflorus Pallas. Hydrobiologia. 25(3-4): 538-455.

Ruttner-Kolisko, A. 1974. Plankton Rotifers, Biology and Taxonomy. Die Binnengewasser. E. Schweizerbart sche Verlagsbuchhandlung Suppl 16(1) 1-146.

Samaan, A.A. 1976. Distribution of zooplankton in lake Edku. Bull. Inst. Ocean.& Fish.Cairo 6:157-196.

Samaan, A.A. & A.A. Aleem, 1972. The ecology of zooplankton in lake Maryut. Bull. Inst. Ocean. & Fish. Cairo 2: 339-373.

Schmid-Araya, J.M. 1991. The effect of food concentration on the life histories of Brachionus plicatilis (O.F.M.) and Encentrum linnhei Scott Arch. Hydrobiol. 121(1): 87-102.

Siegfried, C.A. 1991. The pelagic rotifer community of an acid clearwater lake in the Adronback mountains of New York state. Arch. Hydrobiol. 122 (4): 441-462.

Soliman, A.M. 1983. Quantitative & qualitative studies of the plankton of lake Edku in relation to the local environmental conditions and to fish food M.Sc. thesis, Fac. Sci., Alex. Univ. PP. 220.

Stemberger, R.S. 1990. An inventory of rotifer species diversity of northern Michigan inland lakes. Arch. Hydrobiol. 118 (3):283-302.

Sudzuki, M., 1964. New systematic aproach to the Japanese plankton Rotatoria. Hydrobiologia. 23(1-2): 1-124.

Zaghloul, F.A. 1976. Plankton production and composition in the Nile water between Edfina and Rashid in relation to environmental conditions. M.Sc. thesis, Fac. Sci., Alex. Univ. PP. 340.

Zaghloul F.A. 1985. Seasonal variations of plankton in lake Nasser. Ph.D. thesis, Fac. Sci, Suez Canal University. PP. 364.

Zaghloul, F.A. 1988. Distribution of zooplankton community in the Rosetta estuary. Proc Zool. Soc. ARE. 16: 53-62.