

Free-Living Marine Interstitial Hypotrichid Ciliates from Jubail Marine Wildlife Sanctuary in the Arabian Gulf

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الهديات الخالية البحرية هيپوتريكيڊو (Hypotrichida) حرة المعيشة من محمية الجبيل البحرية في الخليج العربي

الملخص : تم جمع عينات من الترسبات البحرية من محمية الجبيل في الخليج العربي عند حالات المد الدنيا من عدة مواقع لدراسة الهديات الخالية البحرية في المحمية عدة مرات خلال عامي ٩٦ - ١٩٩٧ م ، وتم تصنيف الهديات القاطنة ، ووصف ٢٣ نوعا من الهديات الخالية البحرية (المتعلقة بالرمال القاعية) التابعة لرتبة هيپوتريشيدا (Hypotrichida) من شواطئ المحمية. تنتمي الأنواع التي تم تسجيلها إلى ١٢ جنسا من ٤ فصائل، ٢٠ منها تسجل لأول مرة كأنواع ضمن الوجود الحيواني لكل من الخليج العربي والمملكة العربية السعودية . هذا وقد تم مقارنة توزيع كل نوع من الأنواع الموصوفة ضمن المحمية ومقارنته بالتوزيع العالمي له . بهذه الدراسة يرتفع العدد الكلي لهديات رتبة هيپوتريشيدا (Hypotrichida) في المملكة العربية السعودية إلى ٤٠ نوعا .

ABSTRACT: Sediment samples were collected at low tide from various localities of the Jubail Marine Wildlife Sanctuary in the Arabian Gulf on several occasions during 1996-1997 for the study of the marine interstitial ciliate fauna of the Sanctuary. Twenty three species belonging to the order Hypotrichida were identified after protargol impregnation, 20 of which represent new records of the fauna of Saudi Arabia, and of the Arabian Gulf at large. The distribution of each species is compared to those in similar habitats worldwide. The present study increases the total known number of hypotrichid ciliates species in Saudi Arabia to 40 species.

An environmental rehabilitation plan, and the establishment of the Jubail Marine Wildlife Sanctuary (JMWS) north of the Industrial City of Jubail, along the eastern seaboard of Saudi Arabia were proposed by the concerned agencies in Saudi Arabia in conjunction with a Task Force from the European Union, following the 1991 Gulf War (Krupp and Khushaim, 1996). One of the aims of the project, besides assessing the ecological effects of the huge oil spill, is to assess and document biological diversity of various fauna and flora to generate baseline information of species and species assemblages, and to monitor the rehabilitation of the coastal and marine habitats (Abuzinadah and Krupp, 1994).

Protozoa are widely distributed in aquatic environments, and because of their position near the

bottom of the food chain, they serve as food for many aquatic higher animals (Fenchel, 1969). Amongst these, ciliated protozoans are most sensitive to pollutants and can be assayed as biological indicators through their disappearance from protozoan communities according to exposure time and toxic concentration (Al-Rasheid and Sleight, 1995).

Great attention has been paid to the distribution of interstitial ciliates in sediments of coastal and estuarine localities, and many surveys have been undertaken worldwide (for reviews, see Hartwig, 1980a; Patterson *et al.*, 1989; Carey, 1992). However, systematic studies of the marine interstitial ciliates of Saudi Arabia have been neglected, and no detailed reports exist. Few recent efforts have been conducted to study the ecology and taxonomy of ciliate fauna of Saudi Arabia

(AL-Rasheid 1996, 1997a, b; 1998). Despite these efforts, it is clear that the ciliate fauna of Saudi Arabia remains fairly poorly known. The establishment of JMWS has provided an excellent opportunity to investigate the interstitial ciliates of the Sanctuary. The present paper is part of that effort and deals with the taxonomy of some ciliates belonging to the order Hypotrichida. Ecological data of some members of this order from parts of JMWS can be found in AL-Rasheid (1996).

Materials and Methods

Samples were collected during 1996 and 1997 from coastlines of Jubail Marine Wildlife Sanctuary (JMWS, geographic coordinates from 26°58' to 27°29'N and from 48°57' to 49°43'E) - (see AL-Rasheid, 1998 for complete description, map of the study area and outlined methodology). Undisturbed sediment samples were collected from the topmost 1-3 cm of submerged intertidal areas of the Sanctuary, between high and low tide marks and transferred to the laboratory in thermal containers. In the laboratory, ciliates were detached from the sand grains by the addition of about 5 ml of a 12% MgCl₂ solution to about 20 ml sand and sea water taken from the surface of the sample (Fauré-Fremiet, 1951). The mixture was then gently rotated in a petri dish so that the sand could collect in the center, and the ciliates could be picked up individually with a capillary pipette from the clear supernatant. Ciliates were studied *in vivo* in hanging drops over depression slides, and under cover slips supported by Vaseline rings. Intravital and specific stains were employed to observe the structure of organisms (Foissner, 1991). The infraciliature was revealed by Wilbert's (1975) method of protargol impregnation. Stained cells were studied and photographed with a Nikon® Photomicrographic System attached to Nikon Alphaphot® microscope. The characteristics of each species were then compared to descriptions in the publications of Carey (1992) and Kahl (1932).

Results and Discussion

The present study revealed the presence of 23 species of hypotrichid ciliates, 20 of which are new records to the fauna of Saudi Arabia and the Arabian Gulf at large. The holotype specimens, as slides of protargol impregnated cells of each species, have been deposited in the Museum of the Zoology Department, College of Science, King Saud University, Riyadh, Saudi Arabia. The following is a checklist of the recorded species arranged systematically according to Corliss (1979), each species is followed by a brief

description and compared to descriptions of Carey (1992), Kahl (1932) and some previous worldwide interstitial ciliate records. Lists of synonymy can be found in Kahl (1932) and Carey (1992). Micrographs of each species presented in Figures 1-23.

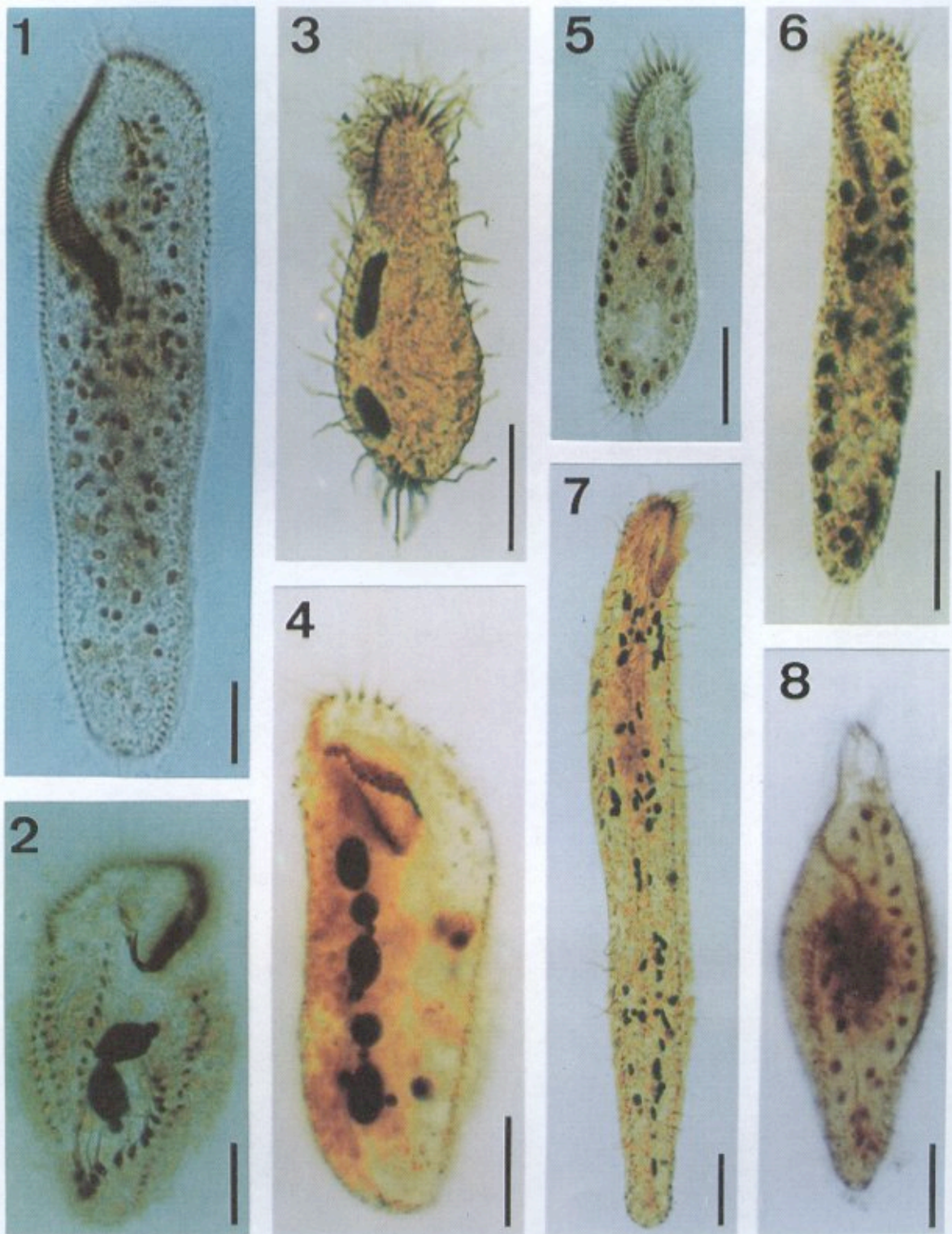
Phylum: Ciliophora Doflein, 1901;
Class: Polyhymenophorea Jankowski, 1967;
Subclass: Spirotrichia Bütschli, 1889;
Order: Hypotrichida Stein, 1859;
Family: Holostichidae Fauré-Fremiet, 1961.

1. *Bakuella marina* Agamaliev and Alekperov, 1976. (Figure 1). Elongated, 130-180 μm in length. Adoral zone of membranelles (AZM) occupies one-third of body length. Ventral surface covered with 10 rows of oblique cirri. Longitudinal rows of cirri present. Frontal cirri three, transverse cirri J-shaped. Macronuclei many, 5-7 μm in diameter. See Song *et al.* (1992) for species taxonomy and revision of the genus. Distribution: Caspian Sea (Agamaliev, 1983), Saskatchewan saline Lake in Canada (Wilbert, 1986; 1995).

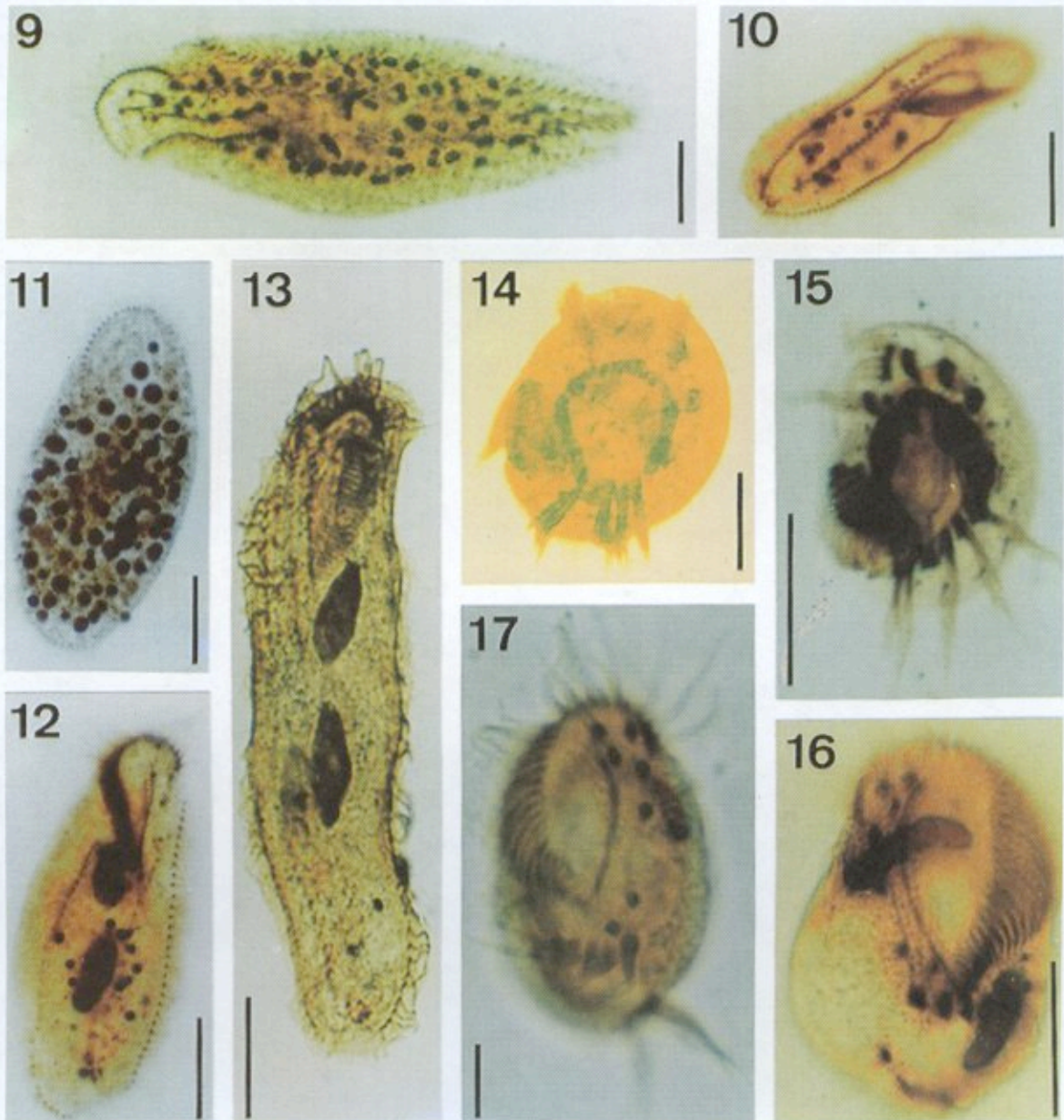
2. *Holosticha camerounensis* Dragesco, 1970. (Figure 2). Elongated, 100-150 μm in length. Peristome broad. Marginal cirri rows two. Frontal cirri large. Mid-ventral cirri rows two, along mid-line of cell (slightly distorted in the Figure). Transverse cirri row of posterior, large, V-shaped. Macronuclei two, ovoid, 20-25 μm in diameter. Micronuclei two, 5-7 μm in diameter, each attached to a macronucleus. Distribution: Atlantic coast of Cameroon (Dragesco, 1970), Atlantic coast of Benin (Dragesco and Dragesco-Kernéis, 1986).

3. *Holosticha diademata* (Rees, 1884) Kahl, 1932 (Figure 3). Elongated, ca 100 μm in length. AZM occupies one-third of body length. Frontal, stout cirri seven, long. Marginal cirri rows two. Mid-ventral cirri rows two, along mid-line of cell. Transverse cirri row at posterior, V-shaped. Macronuclei two, ovoid to elongate in shape (10-21 X 4-6 μm in size). Distribution: Baltic Sea (Bock, 1960), Gulf of Mexico (Borror, 1962, Aladro-Lubel *et al.*, 1990), Alligator Harbor in US (Borror, 1963b), White Sea (Burkovsky, 1970), New Hampshire coast in US (Borror, 1992), Island of Sylt in the German Bight (Hartwig, 1973; Küsters, 1974), Mobile Bay in USA (Jones, 1974), Louisiana Salt Marshes in US (Elliott and Bamforth, 1975), Red Sea (Wilbert and Kahan, 1981), Saskatchewan saline Lake in Canada (Wilbert, 1986; 1995), Black Sea (Detcheva, 1992), Mediterranean Sea (Dini *et al.*, 1995), Lake Qarun in Egypt (Wilbert, 1995), Barents Sea (Azovsky, 1996).

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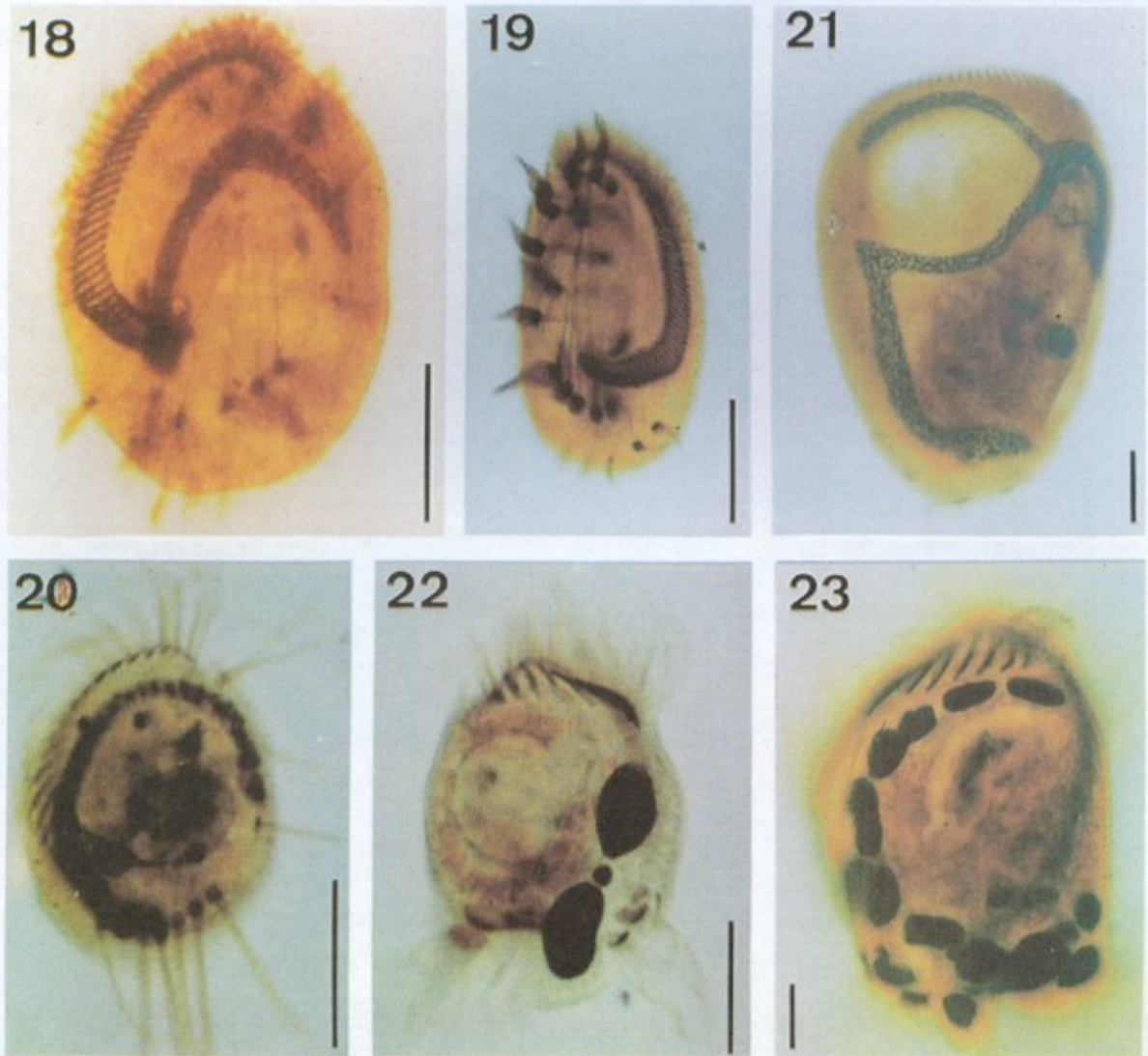


Figures 1-8. Micrographs of protargol stained ciliates species reported from Jubail Marine Wildlife Sanctuary. 1) *Bakuella marina*; 2) *Holosticha camerounensis*; 3) *Holosticha diademata*; 4) *Holosticha monilata*; 5) *Holosticha multistilata*; 6) *Keronopsis longissima*; 7) *Pseudokeronopsis rubra*; 8) *Trachelostyla caudata*. AZM - Adoral Zone of Membranelles, FC - Frontal Cirri, LMR - Left Marginal Row of Cirri, Ma - Macronucleus, Mi - Micronucleus, MVR - Mid-ventral Row of Cirri, RMR - Right Marginal Row of Cirri, TC - Transverse Cirri. Bars = 25 μ m.



Figures 9-17. Micrographs of protargol stained ciliates species reported from Jubail Marine Wildlife Sanctuary. 9) *Trichotaxis crassa*; 10) *Uroleptopsis viridis*; 11) *Oxytricha chlorelligera*; 12) *Gastrostyla pulchra*; 13) *Tachysoma rigescens*; 14) *Aspidisca aculeata*; 15) *Aspidisca dentata*; 16) *Diophrys appendiculata*; 17) *Diophrys scutum*. AZM - Adoral Zone of Membranelles, CC - Caudal Cirri, DT - Dorsal Thorn, FC - Frontal Cirri, FM - Frontal Membranelles, FVC - Fronto-ventral Cirri, LMR - Left Marginal Row of Cirri, Ma - Macronucleus, Mi - Micronucleus, MVR - Mid-ventral Row of Cirri, RMR - Right Marginal Row of Cirri, TC - Transverse Cirri, Z - Zoochlorellae. Bars = 25 μ m.

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Figures 18-23. Micrographs of protargol stained ciliates species reported from Jubail Marine Wildlife Sanctuary. 18) *Euplotes crenosus*; 19) *Euplotes minuta*; 20) *Euplotes quinquecarinatus*; 21) *Euplotes woodruffi*; 22) *Uronychia setigera*; 23) *Uronychia transfuga*. AZM - Adoral Zone of Membranelles, BF - Buccal Field, CC - Caudal Cirri, DK - Dorsal Kinety, FC- Frontal Cirri, FVC - Fronto-ventral Cirri, Ma - Macronucleus, Mi - Micronucleus, TC - Transverse Cirri, S - Spur, VC- Ventral Cirri. Bars = 25 μ m.

4. *Holosticha monilata* Kahl, 1928 (Figure 4). Elongated cylindrical, 150-200 μm in length. AZM occupies less than one-quarter of body length. True frontal cirri present. Marginal cirri rows two. Mid-ventral cirri rows two, along mid-line of cell. Transverse cirri row at posterior, V-shaped. Macronucleus moniliform, each segment ca. 10-17 μm in size, lying in line along length of body, micronuclei several, 3-5 μm in diameter. See Foissner *et al.* (1991) for taxonomy and further description of this species. Distribution: French Atlantic coast (Dragesco, 1960; 1966), Alligator Harbor in US (Borror, 1963b), Atlantic coast of Cameroon (Dragesco, 1970), German Bight (Hartwig, 1973; 1974; Bartsch and Hartwig, 1984), Mobile Bay in US (Jones, 1974), Atlantic west African coasts (Dragesco and Dragesco-Kernéis, 1986).

5. *Holosticha multistilata* Kahl, 1928. (Figure 5). Elongated, 100-120 μm in length. AZM well developed. True frontal cirri present. Marginal cirri rows two. Mid-ventral cirri rows two, along mid-line of cell. Transverse cirri row at posterior, V-shaped. Macronuclei many, 3-5 μm in diameter. See Foissner *et al.* (1991) for taxonomy and description. Distribution: Baltic Sea (Bock, 1960), Western Norway (Reuter, 1963), Caspian Sea (Agamaliev, 1983), Atlantic west African coasts (Dragesco and Dragesco-Kernéis, 1986).

6. *Keronopsis longissima* Dragesco and Dragesco-Kernéis, 1986 (Figure 6). Elongated, 100 μm in length. Marginal cirri rows two. Mid-ventral cirri rows two. Transverse cirri row at posterior. Macronuclei many, 4-6 μm in diameter. Distribution: Atlantic west African coasts (Dragesco and Dragesco-Kernéis, 1986).

7. *Pseudokeronopsis rubra* (Ehrenberg, 1838) Kahl, 1932 (Figure 7). Slender, 250-300 μm in length, red to orange in color. Peristome occupies less than quarter of body length. Anterior frontal cirri 6, posterior frontal cirri 6, buccal cirrus present, marginal cirri rows two. Mid-ventral cirri rows two, along mid-line of cell. Transverse cirri row at posterior, V-shaped. Many small spheroid to ovoid macronuclei, 5-7 μm in diameter. See Foissner (1984) for description and Wirnsberger *et al.* (1987) for taxonomy and revision of the species. Distribution: Yellow Sea (Wang and Nie, 1932), Gulf of Florida (Bullington, 1940), Dee Estuary in UK (Webb, 1956), French Atlantic coast (Dragesco, 1960), Gulf of Mexico (Borror, 1962), Barents Sea (Raikov, 1960; Kovaleva, 1967), Japan Sea at Ussuri (Raikov, 1963) and at Posjet Gulf (Raikov and Kovaleva, 1968), Alligator Harbor in US (Borror, 1963b), Baltic Sea (Fenchel, 1969), Bay of

Bengal (Rao, 1969), White Sea (Burkovsky, 1970), North Sea (Küsters, 1974), The Mediterranean Sea (Ghidoni, 1975; Foissner, 1984; Dini *et al.* 1995), Matumbe Island in the Tanzanian coast of the Indian Ocean (Walker, 1975), Black Sea (Kovaleva and Golemansky, 1979; Detcheva, 1992), Caspian Sea (Agamaliev, 1983), Indopacific region (Winsberger *et al.*, 1987), Saudi Arabian Gulf Islands of Al-Batinah and Abu Ali (AL-Rasheid, 1996).

8. *Trachelostyla caudata* (Kahl, 1932) Maeda and Carey, 1984. (Figure 8). Elongated, 150 μm in length. Neck region present, posterior narrow. Peristome long. Frontoventral cirri four, two rows of marginals, oblique row of long transverse cirri. Dorsal cirri fine, long. Macronuclei many, 3-5 μm in diameter. See Maeda and Carey (1984) for species taxonomy and revision of the genus. Distribution: Baltic Sea (Fauré-Fremiet, 1950), Norwegian coast (Fjeld, 1955), Mediterranean Sea (Nobili, 1957; Ghidoni, 1975; Dini *et al.*, 1995), French Atlantic coast (Dragesco, 1960), Barents Sea (Raikov, 1960; Kovaleva, 1967; Azovsky, 1996), White Sea (Raikov, 1962), Japan Sea (Raikov, 1963), Black Sea (Petran, 1971; Kovaleva and Golemansky, 1979, Detcheva, 1992), Island of Sylt in the German Bight (Hartwig, 1973; Küsters, 1974), Chichester Harbor in UK (Carey and Maeda, 1985), Caspian Sea (Agamaliev, 1986).

9. *Trichotaxis crassa* (Claparede and Lachmann, 1858) Kahl, 1932 (Figure 9). Elongated, 150 μm in length. Posterior narrow, AZM large, occupying one-third of body length. Marginal cirri rows two. Mid-ventral cirri rows two. Transverse cirri row at posterior, short. Macronuclei many, 3-5 μm in diameter. Distribution: Caspian Sea (Agamaliev, 1983).

10. *Uroleptopsis viridis* (Perejaslwzewa, 1885) Kahl, 1932 (Figure 10). Elongated, 80-110 μm in length. Posterior wide, AZM occupying one-third body length. Marginal cirri rows two, mid-ventral rows two. Macronuclei many 4-5 μm in diameter. Distribution: Caspian Sea (Agamaliev, 1983), Hamburg Harbour in German Bight (Bartsch and Hartwig, 1984).

Suborder : Sporadotrichina Fauré-Fremiet, 1961
Family: Oxytrichidae Ehrenberg, 1838

11. *Oxytricha chlorelligera* Kahl, 1932 (Figure 11). Ovoid, 100 μm in length. Marginal cirri rows two. Cirri: 8 frontals, 5 ventrals, 5 transverse, 3 caudals. Macronuclei two, 7-10 μm in diameter, micronucleus intercalated. Contractile vacuole centrally located. Contains zoochlorellae, 3-5 μm in diameter. Distribution : Kiel coast in German Bight (Ax and Ax,

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1960), Atlantic west African coasts (Dragesco, and Dragesco-Kernéis, 1986), Caspian Sea (Agamaliev, 1986).

12. *Gastrostyla pulchra* (Perejaslawzewa, 1885) Kahl, 1932 (Figure 12). Ellipsoidal, 120-160 μm long. AZM occupying one-third of body length. Marginal cirri rows two, confluent posteriorly. Frontal cirri 3, ventral cirri 11-15, transverse cirri 5. Macronuclei two, oval, 26-17 x 10-14 μm . Macronuclei 4-5. Distribution: Baltic Sea (Kahl, 1932), Gulf of Mexico (Borror, 1962), Alligator Harbor in US (Borror, 1963a), White Sea (Burkovsky, 1970), Brazilian coast (Kattar, 1970), New Hampshire coast in the US (Borror, 1972), North Sea (Küsters, 1974), Mobile Bay in US (Jones, 1974), Japan Sea (Myskova, 1976), Mediterranean Sea (Dini *et al.*, 1995).

13. *Tachysoma rigescens* Kahl, 1932 (Figure 13). Cylindrical, 130-180 μm in length. AZM occupies one-third of body length. Marginal cirri rows two. Dorsal cirri long. Macronuclei two, large, oval to spindle shaped, 25-31 X 6-10 μm . Distribution : Caspian Sea (Agamaliev, 1983), Gulf of Mexico (Aladro-Lubel *et al.*, 1990), Black Sea (Detcheva, 1992).

Family: Aspidiscidae Ehrenberg, 1838.

14. *Aspidisca aculeata* (Ehrenberg, 1838) Kahl, 1932 (Figure 14). Ovoid, 50 μm in length, slightly convex on right side. Peristome large. Dorsal ornamentation consists of four ribs; second rib from left carries sharp backwardly curving thorn. Anterior cilia five. Frontoventral cirri seven, transverse cirri five. Macronucleus horseshoe-shaped. Distribution: Kiel coast in German Bight (Ax and Ax, 1960), Gulf of Mexico (Borror, 1962; Aladro-Lubel *et al.*, 1990), New Hampshire coast in US (Borror, 1972), Mobile Bay in US (Jones, 1974), North Sea (Küsters, 1974), Louisiana Salt Marshes in US (Elliott and Bamforth, 1975), Caspian Sea (Agamaliev, 1983), Lake Qarun in Egypt (Wilbert, 1995).

15. *Aspidisca dentata* Kahl, 1928 (Figure 15). Ovoid, 40 μm in length. Large peristomial spur present on left posterior side. Four ribs and a thorn on dorsal surface. Anterior cilia four. Frontoventral cirri seven, transverse six. Macronucleus horseshoe-shaped. Distribution : Baltic Sea (Bock, 1960), Mediterranean coast of Marseill (Vacelet, 1961), White Sea (Burkovsky, 1970), Caspian Sea (Agamaliev, 1983), Black Sea (Detcheva, 1992), Saskatchewan saline Lake in Canada (Wilbert, 1995).

Family: Euplotidae, Ehrenberg, 1838

16. *Diophrys appendiculata* (Ehrenberg, 1838) Kahl, 1932. (Figure 16). Ovoid, 50-70 μm long. Anterior rounded with well-developed AZM occupying ca. half of the body. Posterior lateral concavity not ornamented. Three caudal cirri, 7-8 frontoventral cirri, 5 transverse, three cirri on left marginal. Two macronuclei. See Hill and Borror (1992) for revision of the genus. Distribution : Yellow Sea (Wang and Nei, 1932; Song and Packroff, 1996), Black Sea (Czapik, 1952; Kovaleva and Golemansky, 1979; Detcheva, 1992), Dee Estuary in UK (Webb, 1956), Baltic Sea (Bock, 1960; Fenchel, 1969; Hartwig, 1974, Czapik and Jordan, 1967; Czapik and Fyda, 1992), Mediterranean Sea (Vacelet, 1961; Dini *et al.*, 1995), Western Norway (Reuter, 1961), Gulf of Mexico (Borror, 1962; Aladro-Lubel *et al.*, 1990), Alligator Harbor in US (Borror, 1963b), Bay of Bengal (Rao, 1969), Brazilian Coast (Kattar, 1970), Island of Sylt in the German Bight (Hartwig, 1973; Küsters, 1974), Caspian Sea (Agamaliev, 1983), Chichester Harbor in UK (Carey and Maeda, 1985), Atlantic coast of Benin (Dragesco and Dragesco-Kernéis, 1986), Saskatchewan saline Lake in Canada (Wilbert 1986, 1995), Barents Sea (Azovsky, 1996), Saudi Arabian Gulf Island of Al-Batinah and Abu Ali (AL-Rasheid, 1996).

17. *Diophrys scutum* Dujardin, 1842 (Figure 17). Ellipsoidal, 130-180 μm in length. Peristome wide, AZM extensive, extending to over one-half of body length. Frontoventral cirri eight, transverse five, left marginals two, curving caudal cirri three, emerging from right side of cell. Macronuclei two, elongated. Distribution : French Atlantic coast (Fauré-Fremiet, 1948; Dragesco, 1960; 1963), Baltic Sea (Fauré-Fremiet, 1950; Czapik, 1952; Bock, 1960; Czapik and Fyda, 1992), Dee Estuary in UK (Webb, 1956), Mediterranean Sea (Nobili, 1957; Vacelet, 1961; Dini *et al.*, 1955), Barents Sea (Raikov, 1960; Kovaleva, 1967; Azovsky, 1996), Western Norway (Reuter, 1961), Gulf of Mexico (Borror, 1962; Aladro-Lubel *et al.*, 1990), White Sea (Raikov, 1962), Alligator Harbor in US (Borror, 1963b), Japan Sea (Raikov, 1963), Plymouth coast in UK (Lackey and Lackey, 1963), Atlantic coast of Mauritania (Dragesco, 1965), Brazilian coast (Kattar, 1970), New Hampshire coast in US (Borror, 1972), Island of Sylt in the German Bight (Hartwig, 1973), Louisiana salt marshes (Elliott and Bamforth, 1975), Bermuda (Hartwig, 1977; 1980b), Black Sea (Kovaleva and Golemansky, 1979), Chichester Harbor in UK (Carey and Maeda, 1985), Caspian Sea (Agamaliev, 1986), British Isles and North Sea (Wright and Knight-Jones, 1990), Lake Qarun in Egypt (Wilbert, 1995), Yellow Sea (Song and Packroff, 1996).

18. *Euplotes crenosus* Tuffrau, 1960 (Figure 18). Ovoid, 50-80 μm in length. Prominent notch at anterior end of body, aligned with longitudinal depression on ventral surface. Peristome small, occupies one-half of body length. Frontoventral cirri 10, transverse 5, caudal 4. Macronucleus C-shaped. Distribution: New Hampshire coast in US (Borrer, 1972), Caspian Sea (Agamaliev, 1983), Mediterranean Sea (Dini *et al.*, 1995).

19. *Euplotes minuta* Yocum, 1930 (Figure 19). Ovoid, 70 μm in length. AZM extends three-quarter of body length. Frontoventral cirri 10, transverse 5, caudal 4. Macronucleus C-shaped. Distribution: Brazilian coast (Kattar, 1970), New Hampshire coast in US (Borrer, 1972), Caspian Sea (Agamaliev, 1983), Gulf of Mexico (Aladro-Lubel *et al.*, 1990), Mediterranean Sea (Dini *et al.*, 1995), Southampton Estuary in UK (AL-Rasheid and Sleigh, 1995), China Sea (Song and Wilbert, 1997).

20. *Euplotes quinquecarinatus* Gelei, 1950 (Figure 20) Ovoid, 50 μm in length. Body ornamented by wing-like extension originating from four of the dorsal ciliary rows. Peristome extends one-half of body length. Frontoventral cirri 9, transverse 5, caudal cirri 4. Macro nucleus C-shaped. Distribution: New Hampshire coast in US (Borrer, 1972), Caspian Sea (Agamaliev, 1983), Atlantic coast of Benin (Dragesco and Dragesco-Kernéis, 1986).

21. *Euplotes woodruffi* Gaw, 1939 (Figure 21). Ovoid, 150 μm in length. Peristomial collar well-developed. Dorsal surface ornamented with 8-10 grooves, equipped with fine dorsal cilia. Peristome large, wide, triangular-shaped, extending two-thirds of body length. Frontoventral cirri 9, transverse 5, rigid caudals 4. Macronucleus is Y- to T-shaped. See Song and Bradbury (1997) for revision of this species. Distribution: Gulf of Mexico (Borrer, 1962; Aladro-Lubel *et al.*, 1990), Alligator Harbor in US (Borrer, 1963b), Mobile Bay in US (Jones, 1974), Atlantic west African coasts (Dragesco and Dragesco-Kernéis, 1986), Lake Qarun in Egypt (Wilbert, 1995), Mediterranean Sea (Dini *et al.*, 1995), South Creek Estuary in US (Song and Bradbury, 1997).

22. *Uronychia setigera* Calkins, 1902 (Figure 22). Ovoid, 50-80 μm long. Peristome large, AZM with 15 membranelles. Frontal cirri 4, ventral cirri 2, transverse cirri 5, left marginal cirri 3, caudal cirri 3. Dorsal kinetics 6. Spurs present. Macronuclei two, band-like, 13-22 X 10-14 μm . Micronucleus in-between, 3-4 μm in diameter. Distribution: Woods Hole in US (Lackey, 1936), Plymouth in UK (Lackey

and Lackey, 1963), Brazilian Coast (Kattar, 1970), Norfolk salt marshes in UK (Barnes *et al.*, 1976), Suez Canal in Egypt (El-Serehy, 1992), Southampton Estuary in UK (AL-Rasheid and Sleigh, 1995), Saudi Arabian Gulf Islands of Al-Batinah and Abu Ali and Al-Hassa Oasis (AL-Rasheid, 1996; 1997a), China Sea (Song and Wilbert, 1997).

23. *Uronychia transfuga* (Müller, 1786) Stein, 1859. (Figure 23). Oblong to rectangular, 170-200 X 90-140 μm in length. Peristome large, extending almost to posterior. AZM consists of 15 membranelles. Buccal field large, with buccal cirrus. Undulating membrane large. Frontal cirri 4, transverse cirri 5, left marginal cirri 3, caudal cirri 3 and 5-8 ventral cirri. Dorsal surface with 4 dorsal kinetics. Macronuclear nodules beaded, consists of 7-10 beads forming a C-shape, 20-31 μm in size. Micronucleus 4-6 μm in diameter. Distribution: Yellow Sea (Wang and Nie, 1932), Black Sea (Czapik, 1952; Kovaleva and Golemansky, 1979; Detcheva, 1992), Whitstable in UK (Maghraby and Perkins, 1956), Dee Estuary in UK (Webb, 1956), Mediterranean Sea (Nobili, 1957), Barents Sea (Raikov, 1960; Kovaleva, 1967; Azovsky, 1996), French Atlantic coast (Dragesco, 1960), Western Norway (Reuter, 1961), Gulf of Mexico (Borrer, 1962; Aladro-Lubel *et al.*, 1990), Plymouth coast in UK (Lackey and Lackey, 1963), Alligator Harbor in US (Borrer, 1963), Japan Sea (Raikov and Kovaleva, 1968), Bay of Bengal (Rao, 1969), White Sea (Burkovsky, 1970), Brazilian coast (Kattar, 1970), New Hampshire coast in US (Borrer, 1972), Island of Sylt in the German Bight (Hartwig, 1973; Küsters, 1974), Norfolk salt marshes in UK (Barnes *et al.*, 1976), Baltic Sea (Czapik and Jordan, 1976), Bermuda (Hartwig, 1980b), Red Sea (Wilbert and Kahan, 1981), Caspian Sea (Agamaliev, 1983), Atlantic west African coasts (Dragesco and Dragesco-Kernéis, 1986), Suez Canal in Egypt (El-Serehy, 1992), Lake Qarun in Egypt (Wilbert, 1995).

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