

## DATA REGARDING THE QUALITATIVE COMPOSITION OF THE CILIATES FROM THE MURAT RIVER (AĞRI REGION, TURKEY) ACCORDING TO THE NEW TAXONOMIC SYSTEM PROPOSED BY LYNN

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**Abstract.** The ciliates from the aquatic ecosystems of Turkey are poorly known; however, there have been identified 164 forms so far. Protistological literature does not offer information regarding the ciliate species from the water and sediments of the Murat River. We started our researches in 2011 and there have been identified 31 species till now; 13 forms were identified only to genus. The ciliate species have a cosmopolite origin; 26 are also found on the list proposed by Çapar for the Turkish fauna; 12 species are also common with the ciliates from the paralittoral lakes of the Black Sea coast.

In the present scientific paper, it is presented the actual qualitative composition of the ciliates from the Murat River (Ağrı region) according to the new taxonomical system proposed by Lynn, as well as some considerations regarding the former and actual taxonomical system of Protozoa.

**Keywords:** Murat River, Ciliates, Taxonomy.

**Rezumat. Date privind compoziția calitativă a ciliatelor din Râul Murat (regiunea Ağrı, Turcia) conform noului sistem taxonomic propus de Lynn.** Ciliatele din ecosistemele acvatice ale Turciei sunt puțin cunoscute, fiind identificate până în prezent 164 de forme. Literatura protistologică nu oferă informații privind speciile de ciliate din apă și sedimentele râului Murat; cercetările noastre au demarat în 2011 și au fost identificate până în prezent 31 de specii; 13 forme au fost identificate până la gen. Speciile de ciliate au o origine comopolită, 26 se regăsesc de asemenea pe lista propusă de Çapar pentru fauna Turciei; 12 specii sunt de asemenea comune cu ciliatele din lacurile paralittorale de pe coasta Mării Negre. În actuala lucrare este prezentată compoziția calitativă actuală a ciliatelor din râul Murat conform sistemului taxonomic propus de Lynn ca și câteva considerații privind sistemele taxonomice vechi și noi ale protozoarelor.

**Cuvinte cheie:** Râul Murat, ciliate, taxonomie.

### INTRODUCTION

The Protozoa fauna of the aquatic ecosystems, especially ciliates, dominate the other groups by species richness and density.

In most of the European countries, ciliate, fauna of aquatic and terrestrial ecosystems was rigorously investigated: in France by DRAGESCO (DRAGESCO, 1998), in Germany by Bick (BICK, 1972a; 1972b), Wilbert (WILBERT, 1975) which discovered a special variant for silver impregnations; other scientists, in Romania, in the last 30 years, made researches regarding the ciliates fauna of the Black Sea coast and paramarine lakes: Petran (PETRAN, 1976a; 1976b) and KERKMANN (KERKMANN 2003; 2007; 2011). However, there is another situation for the countries of Asia, especially for Turkey, where the researches about benthic ciliates intensified during the last 20-30 years. The most detailed studies were performed by ŞENLER et al. (1998), ŞENLER & YILDIZ (1998, 1999, 2004) who worked especially on rivers, small ponds and sewage treatment plants and by ÇAPAR (1997, 2005, 2007) on free living pond and wetland ciliates (ÇAPAR, 2007).

ÇAPAR proposed a list of ciliates including 164 species (ÇAPAR, 2007). In her list, there are not given information-about the free ciliates of the Murat River; it is a poorly known ecosystem, except for some geological and fish parasites (ASLAN, 2009; DEMİR et al., 2008). The investigations about the ciliate fauna of the river were initiated in 2011 by Kerkmann (KERKMANN, 2012; KERKMANN et al., 2012).

### MATERIAL AND METHODS

Since the summer of 2011 water and sediments samples have been monthly collected from the stations situated along the Murat River, in Ağrı town and outside (KERKMANN, 2012; KERKMANN et al., 2012).

The collected samples were thermally conditioned analysed in the laboratory. The extraction of the ciliates from sediments was made by Uhlig and Webb method (UHLIG, 1964; WEBB, 1956) or directly collected from Petri dishes using fine glass handmade capillary tubes by Bunsen burner (DRAGESCO & DRAGESCO-KERNEIS, 1986) (Photo 1-5).

Some species were determined 'in live', another were subject to vital colorations with red-neutral and postvital with methyl green. For most of the species, there were applied special techniques to obtain permanent slides (Bodian method – Wilbert version and Chatton - Lwoff method) (DRAGESCO & DRAGESCO-KERNEIS, 1986; WILBERT, 1975). The importance of these techniques consists in emphasizing some infrastructural elements with taxonomic relevance.

In order to establish the taxonomical diagnosis, there were used the main protistological determinators of DRAGESCO, CORLISS, FOISSNER and colab. (DRAGESCO & DRAGESCO-KERNEIS, 1986; CORLISS & LOM, 1985; CURDS, 1982; FOISSNER, 1984; FOISSNER et al., 1991).

To compare the qualitative composition of ciliates from many ecosystems, there were also consulted the articles published by the Turkish protistologists especially ÇAPAR (ÇAPAR, 2007).

## RESULTS AND DISCUSSIONS

The research activity regarding the ciliate fauna of the Murat River during the years led to the elaboration of a list, which contains so far 31 species; however, we mention that their number enriched during the last years (KERKMANN, 2012; KERKMANN et al., 2012) (Table 1). From 31 species, a number of 13 forms were identified only to genus.

The ciliates from the Murat River appear to have a cosmopolite origin; so, 26 are common to the list proposed by ÇAPAR for the Turkish fauna and 12 are identical with the ciliates from the Romanian paramarine lakes of the Black Sea (DUMÎTRACHE-KERKMANN, 2004).

The distribution of the ciliate species into the sediments of the two stations is relatively balanced, as 20 respectively 23 species were found; 11 forms are common to both stations (Table 1). The arrangement of species in table 1. was made according to the new taxonomic system proposed by LYNN (LYNN, 2003 in: ÇAPAR, 2007). Concerning the different taxonomic categories, 7 of the ciliate species identified in the Murat River belong to the class SPİROTRICHEA (BÜTSCHLI, 1859) and PROSTOMATEA (SCHEWIAKOFF, 1896) and 9 species to a superior class OLİGOHYMENOPHORA (de PUYTORAC *et al.*, 1974). In terms of order, most of the species belongs to the order PRORODONTİNA (CORLISS, 1974).

The old taxonomic systems for ciliates relied exclusively on taxonomic criteria, most of them established after performing some sketches 'in vivo' of the ciliates. They were gradually completed with infrastructural elements emphasized after applying the techniques of obtaining permanent preparations (CHATTON - LWOFF and BODIAN techniques and their further variants) (DRAGESCO & DRAGESCO-KERNEİS, 1986).

The comparative analysis of these different taxonomic systems (Table 2) shows the maintenance of the main groups of ciliates according to the specific arrangement of the somatic and cytostomial ciliature with some variations of the taxonomic rank; for example, the Order SPİROTRİCHA from KAHL system became Subclass SPİROTRİCHA in the system proposed by HONIGBERG *et al.* (HAUSMANN, 1985; LEVİNE *et al.*, 1980).

The penultimate taxonomic system accepted by Protistological Society represents an interesting interference between other systems proposed by de PUYTORAC, CORLISS, LEVINE and it is well synthetized in the monograph of DRAGESCO (PUYTORAC *et al.*, 1974; CORLISS, 1979; LEVİNE *et al.*, 1980; DRAGESCO & DRAGESCO-KERNEİS, 1986). However, there are a lot of differences between them and the new taxonomic system, taxonomic categories being completed by genetic criteria.

Thus, the number of classes was extended into the LYNN system from 3 to 11 and the number of subclasses from 5 to 10. Some taxonomic categories were not changed: Class OLİGOHYMENOPHORA (PUYTORAC *et al.*, 1974), Subclass HYMENOSTOMATA (TİA) (DELAGE *et al.*, HEROUARD, 1986).

Other taxonomic categories acquired a higher taxonomic rank: Order KARYORELİCTİDA (CORLISS, 1974); Class KARYORELİCTEA (CORLISS, 1974); Order HETEROTRİCHİDA (STEIN, 1859); Subclass HYPOTRİCHİA (STEIN, 1859) (Table 3).

In the taxonomic system proposed by LYNN (2003 in ÇAPAR, 2007), there is 1 Subphylum, 3 classes, 2 subclasses, 3 orders, 3 suborders and 2 families that were described or re-described by Lynn and his colleagues.

## CONCLUSIONS

1. In the aquatic ecosystems of Turkey, there were identified 164 ciliates according to the list proposed by Çapar.
2. The qualitative composition of the ciliate fauna from the Murat River (Ağrı region) was for the first time researched by Kerkmann, who proposed a list containing 31 species so far.
3. Most of them have a cosmopolite origin; 12 species are common with the fauna of the paramarine lakes of the Romanian Black Sea coast.
4. The actual taxonomic system for ciliates is characterized by a higher complexity, as the taxonomic infrastructural elements were completed by genetic researches.

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Photo 1 - Station 2 Sewerage system.



Photo 2 - Station 1 The Murat River bridge.



Photo 3 - The Murat River in winter (Ağrı town).



Photo 4 - Detail of the Murat River sediments.



Photo 5 - The Murat River outside of Ağrı town.

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Table 1. The qualitative composition of ciliates from the Murat River (Agri Region).

NO	SUBPHYLUM	CLASSIS	SUBCLASSIS	ORDO	SUBORDO	FAMILIA	KERKMANN (2014)	1	2	ÇAPAR (2007)
1	POSTCILJODESMATOPHORA	HETEROTRICHIA	-	HETEROTRICHIDA	-	Blepharismidae	<i>Spirostomum teres</i> CLAPAREDE et LACHMANN, 1858-1859	+	+	+
2	INTRAMACRONUCLEATA	SPIROTRICHIA	HYPOTRICHIA	EUPLOTIDA	EUPLOTINA	Euplotidae		+	-	+
3	INTRAMACRONUCLEATA	SPIROTRICHIA	HYPOTRICHIA	EUPLOTIDA	EUPLOTINA	Aspidiscidae		+	+	+
4	INTRAMACRONUCLEATA	SPIROTRICHIA	STICHOTRICHIA	SPORADOTRICHINA	-	Oxytrichidae	<i>Oxytricha saprobia (pelionella) (?)</i> O. F. MÜLLER, 1786	+	+	-
5	INTRAMACRONUCLEATA	SPIROTRICHIA	STICHOTRICHIA	SPORADOTRICHINA	-	Oxytrichidae	<i>Oxytricha</i> sp.1	-	+	+
6	INTRAMACRONUCLEATA	SPIROTRICHIA	STICHOTRICHIA	SPORADOTRICHINA	-	Oxytrichidae	<i>Oxytricha</i> sp.2	+	+	+
7	INTRAMACRONUCLEATA	SPIROTRICHIA	STICHOTRICHIA	SPORADOTRICHINA	-	Oxytrichidae	<i>Spylomychia</i> sp.	+	+	+
8	INTRAMACRONUCLEATA	SPIROTRICHIA	STICHOTRICHIA	UROSTYLIDA	-	Urostylidae	<i>Holosticha</i> sp.	+	+	+
9	INTRAMACRONUCLEATA	ARMOPHOREA	-	ARMOPHORIDA	-	Metopidae	<i>Metopus</i> spp.	+	+	+
10	INTRAMACRONUCLEATA	LITOSTOMATEA	HAPTORIA	HAPTORIDA	-	Lacrymaridae	<i>Lacrymaria</i> sp.	-	+	+
11	INTRAMACRONUCLEATA	LITOSTOMATEA	HAPTORIA	HAPTORIDA	-	Trachelidae	<i>Lagynophrya rostrata</i> KAHL, 1930	-	+	-
12	INTRAMACRONUCLEATA	LITOSTOMATEA	HAPTORIA	PLEURONEMATIDA	-	Litonotidae	<i>Litonotus lamella</i> (EHRENBERG, 1838) SCHEWIAKOFF, 1896	-	+	+
13	INTRAMACRONUCLEATA	LITOSTOMATEA	HAPTORIA	PLEURONEMATIDA	-	Litonotidae	<i>Loxophyllum</i> sp.	+	-	+
14	INTRAMACRONUCLEATA	COLPODEA	-	COLPODIDA	-	Colpodidae	<i>Colpoda steinii</i> (MAUPAS, 1883)	-	+	+
15	INTRAMACRONUCLEATA	PROSTOMATEA	-	PRORODONTIDA	-	Prorodontidae	<i>Prorodon viridis</i> EHRENBERG, 1840	-	+	-
16	INTRAMACRONUCLEATA	PROSTOMATEA	-	PRORODONTIDA	-	Prorodontidae	<i>Prorodon</i> sp.	-	+	-
17	INTRAMACRONUCLEATA	PROSTOMATEA	-	PRORODONTIDA	-	Prorodontidae	<i>Plagiocampa rouxi</i> KAHL, 1932	-	+	-
18	INTRAMACRONUCLEATA	PROSTOMATEA	-	PRORODONTIDA	-	Prorodontidae	<i>Coleps</i> sp.	+	-	+
19	INTRAMACRONUCLEATA	PROSTOMATEA	-	PRORODONTIDA	-	Urotrichidae	<i>Urotricha globosa</i> CLAPAREDE et LACHMANN, 1857	+	+	+
20	INTRAMACRONUCLEATA	PROSTOMATEA	-	PRORODONTIDA	-	Urotrichidae	<i>Urotricha</i> sp.1	+	-	+
21	INTRAMACRONUCLEATA	PROSTOMATEA	-	PRORODONTIDA	-	Urotrichidae	<i>Urotricha</i> sp.2	+	-	+
22	INTRAMACRONUCLEATA	PLAGIOPYLEA	-	PLAGIOPYLIDA	-	Plagiopylidae	<i>Plagiopyla nasuta</i> STEIN, 1860	+	-	+
23	INTRAMACRONUCLEATA	OLIGOHYMENOPHOREA	PENICULIA	PENICULIDA	PARAMECINA	Paramecidae	<i>Paramecium aurelia-complex</i> EHRENBERG, 1838	+	+	+
24	INTRAMACRONUCLEATA	OLIGOHYMENOPHOREA	PENICULIA	PENICULIDA	PARAMECINA	Paramecidae	<i>Paramecium caudatum</i> EHRENBERG, 1838	+	+	+
25	INTRAMACRONUCLEATA	OLIGOHYMENOPHOREA	PENICULIA	PENICULIDA	-	Paramecidae	<i>Paramecium putrinum</i> (HILL, 1752) CLAPAREDE and LACHMANN, 1859	+	+	+
26	INTRAMACRONUCLEATA	OLIGOHYMENOPHOREA	SCUTICOCILIATIA	PHILASTERIDA	-	Uronematidae	<i>Uronema nigricans</i> (MÜLLER, 1786) FLORENTIN, 1901	-	+	+
27	INTRAMACRONUCLEATA	OLIGOHYMENOPHOREA	SCUTICOCILIATIA	PLEURONEMATIDA	-	Cyclidiidae	<i>Cyclidium glaucoma</i> MÜLLER, 1773	-	+	+
28	INTRAMACRONUCLEATA	OLIGOHYMENOPHOREA	HYMENOSTOMATIA	HYMENOSTOMATIDA	TETRAHYMENINA	Turanelliidae	<i>Colpidium colpoda</i> (LOSANA, 1829) STEIN, 1860	+	-	+
29	INTRAMACRONUCLEATA	OLIGOHYMENOPHOREA	HYMENOSTOMATIA	HYMENOSTOMATIDA	TETRAHYMENINA	Turanelliidae	<i>Dextostoma campylum</i> FOCKE, 1836 DUJ. 1841, STOKES, 1886	+	-	+
30	INTRAMACRONUCLEATA	OLIGOHYMENOPHOREA	PERITRICHIA	SESSILIDA	-	Vorticellidae	<i>Vorticella campanula</i> EHRENBERG, 1833	+	+	+
31	INTRAMACRONUCLEATA	OLIGOHYMENOPHOREA	PERITRICHIA	SESSILIDA	-	Vorticellidae	<i>Vorticella microstoma-complex</i> EHRENBERG, 1830	-	+	+
32	TOTAL = 2	8	7	15	3	18		26	20	23

Legend: 1 - Station 1 The Murat River bridge ; 2 - Station 2 Sewerage system



Table 2. Comparative analysis between different taxonomic systems.

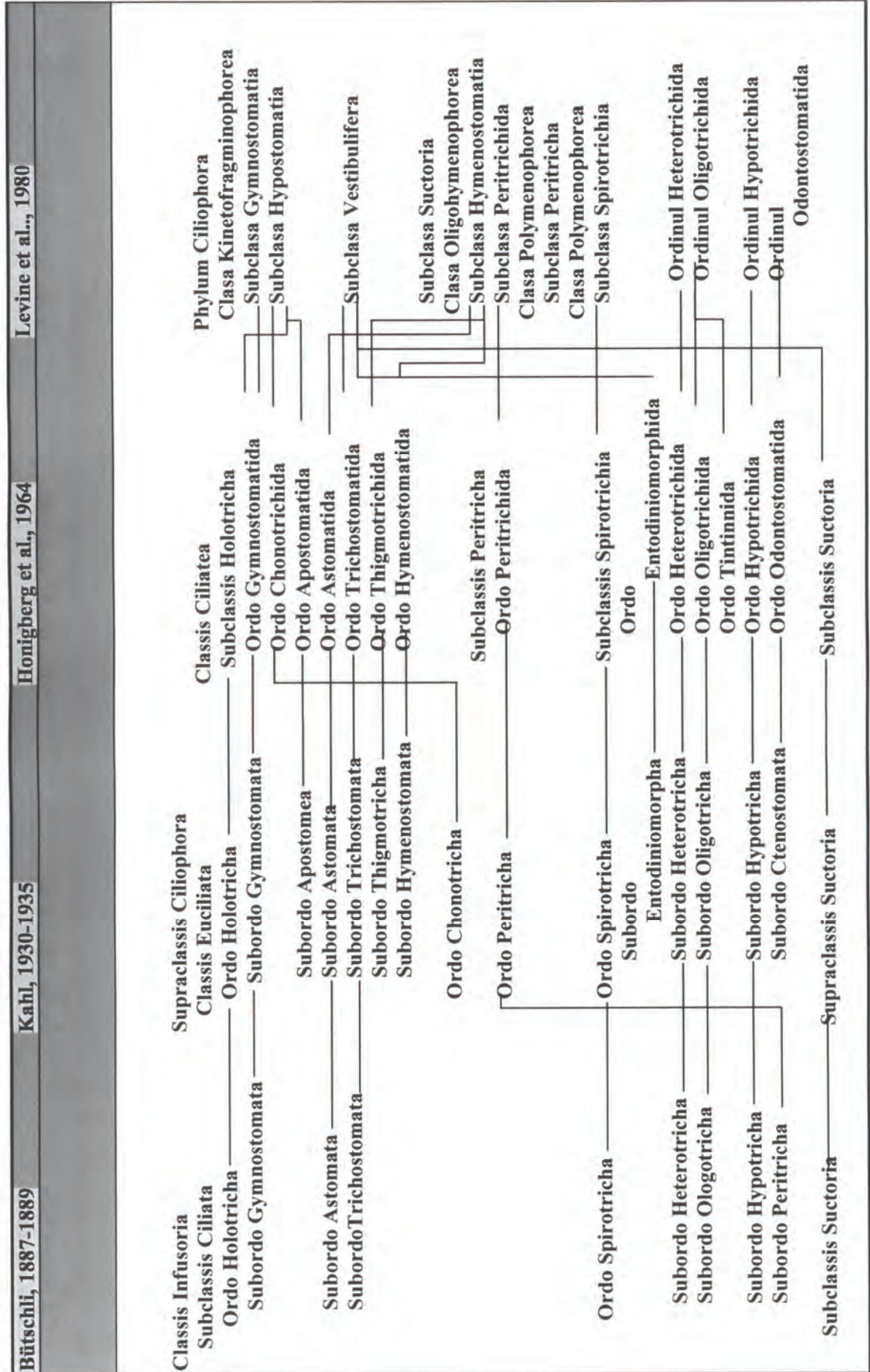




Table 3. Comparative analysis between the last taxonomic system Lynn (LYNN,2003) and old taxonomic system (de PUYTORAC and colab. in: DRAGESCO et DRAGESCO – KERNEIS, 1986).

1 PHYLUM CILİOPHORA (in DRAGESCO et DRAGESCO – KERNEIS, 1986)
2 CLASSIS KINETOFRAGMINOPHORA de Puytorac et al., 1974
3 Subclassis GYMNOSTOMATA Bütschli, 1885
4 Ordo PROSTOMATIDA Schewiakoff, 1896
5 Ordo PLEUROSOMATIDA Schewiakoff, 1896
6 Incertae sedis: Ordo KARYORELICTIDA Corliss, 1974
7 Subclassis VESTIBULIFERA de Puytorac et al., 1974
8 Ordo TRICHOSOMATIDA Bütschli, 1883
9 Ordo COLPODIDA de Puytorac et al., 1974
10 CLASSIS OLIGOHYMENOPHORA de Puytorac et al., 1974
11 Subclassis HYMENOSTOMATA Delage et Herouard, 1896
12 Ordo HYMENOSTOMATIDA Delage et Herouard, 1896
13 Ordo SCUTICOCILIATA Small, 1967
14 Subclassis PERITRICHIA Stein, 1859
15 CLASSIS POLYHYMENOPHORA Jankowski, 1967
16 Subclassis SPIROTRICHIA Bütschli, 1889
17 Ordo HETEROTRICHIDA Stein, 1839
18 Ordo ODONTOSTOMATIDA Sawaya, 1940
19 Ordo HYPOTRICHIDA Stein, 1859
20 Ordo OLIGOTRICHIDA Bütschli, 1997
21 Subclassis HYPOSTOMATA Schewiakoff, 1896
22 Supraordo NASSULIDA Jankowski, 1967
23 Ordo CYRTOPHORIDA Faure – Fremiet (in Corliss, 1956)

1 PHYLUM CILİOPHORA (in LYNN, 2003)
2 SUBPHYLUM POSTCILİODESMATOPHORA Gerassimova and Seravin, 1976
3 CLASSIS KARYORELICTEA Corliss, 1974
4 Ordo LOXODIDA Jankowski, 1980
5 CLASSIS HETEROTRICHIA Stein, 1859
6 Ordo HETEROTRICHIDA Stein, 1859
7 SUBPHYLUM INTRAMACRONUCLEATA Lynn, 1996
8 CLASSIS SPIROTRICHIA Bütschli, 1859
9 Subclassis HYPOTRICHIA Stein, 1859
10 Ordo EUPLOTIDA Small and Lynn, 1985
11 Subordo EUPLOTINA Small and Lynn, 1985
12 Subclassis CHOREOTRICHIA Small and Lynn, 1985
13 Ordo TINTINNIDA Koloid and Campbell, 1929
14 Ordo CHOROTRICHIDA Small and Lynn, 1929
15 Subclassis STICHOTRICHIA Small and Lynn, 1929
16 Ordo STICHOTRICHIDA Faure-Fremiet, 1961
17 Ordo SPORADOTRICHINA Faure-Fremiet, 1961
18 Ordo UROSTYLIDA Jankowski, 1979
19 Subclassis OLIGOTRICHIA Bütschli, 1887
20 Ordo HALTERIDA Petzund -Foissner, 1982
21 Ordo STROMBIDIDA Petzund -Foissner, 1970
22 CLASSIS ARMOPHOREA Jankowski, 1964
23 Ordo ARMOPHORIDA Jankowski, 1964
24 CLASSIS LITOSTOMATEA Small and Lynn, 1981
25 Subclassis HAPTORIA Corliss, 1974
26 Ordo HAPTORIDA Corliss, 1974
27 CLASSIS PHYLLOPHARINGEA de Puytorac et al., 1974
28 Subclassis PHYLLOPHARINGIA de Puytorac et al., 1974
29 Ordo CHLAMYDODONTINA Deroux, 1976
30 Ordo DYSTERIIDA Deroux, 1976
31 Subclassis SUCTORIA Claparede et lachmann, 1858
32 Ordo EXOGENID Colin, 1912
33 CLASSIS NASSOPHOREA Small and Lynn, 1987
34 Ordo MICROTHORACIDA Jankowski, 1967
35 CLASSIS COLPODEA Small and Lynn, 1981
36 Ordo BRYOMETOPIDA Foissner, 1985
37 Ordo COLPODIDA de Puytorac et al., 1974
38 Ordo CYRTOLOPHOSIDIDA Foissner, 1978
39 CLASSIS PROSTOMATEA Schewiakoff, 1896
40 Ordo PROSTOMATIDA Schewiakoff, 1896
41 Ordo PRORODONTIDA Corliss, 1974
42 CLASSIS PLAGIOPYLEA Small and Lynn, 1985
43 Ordo PLAGIOPYLIDA Small and Lynn, 1985
44 CLASSIS OLIGOHYMENOPHOREA de Puytorac et al., 1974
45 Subclassis PENICULIA Faure – Fremiet in Corliss, 1956
46 Ordo PENICULIDA Faure – Fremiet in Corliss, 1956
47 Subordo FRONTONINA Small and Lynn, 1985
48 Subordo PARAMECINA Jankowski in Small and Lynn, 1985
49 Subclassis SCUTICOCILIATIA Small, 1967
50 Ordo PHILASTERIDA Small, 1967
51 Ordo PLEURONEMATIDA Faure – Fremiet in Corliss, 1956
52 Subclassis HYMENOSTOMATIA Delage and Herouard, 1896
53 Ordo HYMENOSTOMATIDA Delage and Herouard, 1896
54 Subordo TETRAHYMENINA Faure – Fremiet (in Corliss, 1956)
55 Subclassis PERITRICHIA Stein, 1859
56 Ordo SESSILIDA Kahl, 1933 Ordo MOBILIDA Kahl, 1933