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 paralitoral 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 puţin cunoscute, fiind identificate până în prezent 164 de forme. Literatura protistologică nu oferă informaţii privind speciile de ciliate din apă şi sedimentele râului Murat; cercetările noastre au demarat în 2011 şi 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 paralitorale de pe coasta Mării Negre. În actuala lucrare este prezentată compoziţia calitativă actuală a ciliatelor din râul Murat conform sistemului taxonomic propus de Lynn ca si câteva consideraţii privind sistemele taxonomice vechi şi 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 (BİCK, 1972a; 1972b), Wilbert (WİLBERT, 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 (UHLİG, 1964; WEBB, 1956) or directly collected from Petri dishes using fine glass handmade capillary tubes by Bunsen burner (DRAGESCO & DRAGESCO-KERNEİS, 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-KERNEİS, 1986; WİLBERT, 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, CORLİSS, FOİSSNER and colab. (DRAGESCO & DRAGESCO-KERNEİS, 1986; CORLİSS & LOM, 1985; CURDS, 1982; FOİSSNER, 1984; FOİSSNER 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 (DUMİTRACHE-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 SPİROTRİCHEA (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; CORLİSS, 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 (Ağrı Region).

NO	SUBPHYLUM	CLASSİS	SUBCLASSİS	*ORDO*	SUBORDO	FAMİLİA	KERKMANN (2014)	1	2	ÇAPAR (2007)
1	POSTCİLİODESMATOPHORA	*HETEROTRİCHEA*	-	*HETEROTRİCHİDA*	-	Blepharismidae	*Spirostomum teres* CLAPAREDE et LACHMANN, 1858-1859	+	+	+
2	İNTRAMACRONUCLEATA	*SPİROTRİCHEA*	HYPOTRİCHİA	*EUPLOTİDA*	*EUPLOTİNA*	Euplotidae	*Euplotes* sp.	+	-	+
3	İNTRAMACRONUCLEATA	*SPİROTRİCHEA*	HYPOTRİCHİA	*EUPLOTİDA*	*EUPLOTİNA*	Aspidiscidae	*Aspidisca* sp.	+	+	+
4	İNTRAMACRONUCLEATA	*SPİROTRİCHEA*	STİCHOTRİCHİA	*SPORADOTRİCHİNA*	-	Oxytrichidae	*Oxytricha saprobia (pelionella) (?)* O. F. MÜLLER,1786	+	+	-
5	İNTRAMACRONUCLEATA	*SPİROTRİCHEA*	STİCHOTRİCHİA	*SPORADOTRİCHİNA*	-	Oxytrichidae	*Oxytricha* sp.1	-	+	+
6	İNTRAMACRONUCLEATA	*SPİROTRİCHEA*	STİCHOTRİCHİA	*SPORADOTRİCHİNA*	-	Oxytrichidae	*Oxytricha* sp.2	+	+	+
7	İNTRAMACRONUCLEATA	*SPİROTRİCHEA*	STİCHOTRİCHİA	*SPORADOTRİCHİNA*	-	Oxytrichidae	*Stylonychia* sp.	+	+	+
8	İNTRAMACRONUCLEATA	*SPİROTRİCHEA*	STİCHOTRİCHİA	*UROSTYLİDA*	-	Urostylidae	*Holosticha* sp.	+	+	+
9	İNTRAMACRONUCLEATA	*ARMOPHOREA*	-	*ARMOPHORİDA*	-	Metopidae	*Metopus* spp.	+	+	+
10	İNTRAMACRONUCLEATA	*LİTOSTOMATEA*	HAPTORİA	*HAPTORİDA*	-	Lacrymariidae	*Lacrymaria* sp.	-	+	+
11	İNTRAMACRONUCLEATA	*LİTOSTOMATEA*	HAPTORİA	*HAPTORİDA*	-	Tracheliidae	*Lagynophrya rostrata* KAHL, 1930	-	+	-
12	İNTRAMACRONUCLEATA	*LİTOSTOMATEA*	HAPTORİA	*PLEURONEMATIDA*	-	Litonotidae	*Litonotus lamella (*EHRENBERG, 1838) SCHEWIAKOFF, 1896	-	+	+
13	İNTRAMACRONUCLEATA	*LİTOSTOMATEA*	HAPTORİA	*PLEURONEMATIDA*	-	Litonotidae	*Loxophyllum* sp.	+	-	+
14	İNTRAMACRONUCLEATA	*COLPODEA*	-	*COLPODIDA*	-	Colpodidae	*Colpoda steinii* (MAUPAS,1883)	-	+	+
15	İNTRAMACRONUCLEATA	*PROSTOMATEA*	-	*PRORODONTID*	-	Prorodontidae	*Prorodon viridis* EHRENBERG, 1840			
16	İNTRAMACRONUCLEATA	*PROSTOMATEA*	-	*PRORODONTIDA*	-	Prorodontidae	*Prorodon* sp.	-	+	-
17	İNTRAMACRONUCLEATA	*PROSTOMATEA*	-	*PRORODONTIDA*	-	Prorodontidae	*Plagiocampa rouxi KAHL, 1932*	-	+	-
18	İNTRAMACRONUCLEATA	*PROSTOMATEA*	-	*PRORODONTIDA*	-	Prorodontidae	*Coleps* sp.	+	-	+
19	İNTRAMACRONUCLEATA	*PROSTOMATEA*	-	*PRORODONTIDA*	-	Urotrichidae	*Urotricha globosa* CLAPAREDE et LACHMANN, 1857	+	+	+
20	İNTRAMACRONUCLEATA	*PROSTOMATEA*	-	*PRORODONTIDA*	-	Urotrichidae	*Urotricha* sp.1	+	-	+
21	İNTRAMACRONUCLEATA	*PROSTOMATEA*	-	*PRORODONTIDA*	-	Urotrichidae	*Urotricha* sp.2	+	-	+
22	İNTRAMACRONUCLEATA	*PLAGIOPYLEA*	-	*PLAGIOPYLIDA*	-	Plagyopilidae	*Plagioyla nasuta* STEIN, 1860	+	-	+
23	İNTRAMACRONUCLEATA	*OLIGOHYMENOPHOREA*	PENICULIA	*PENİCULİDA*	*PARAMECINA*	Paramecidae	*Paramecium aurelia-complex* EHRENBERG, 1838	+	+	+
24	İNTRAMACRONUCLEATA	*OLIGOHYMENOPHOREA*	PENICULIA	*PENİCULİDA*	*PARAMECINA*	Paramecidae	*Paramecium caudatum* EHRENBERG, 1838	+	+	+
25	İNTRAMACRONUCLEATA	*OLIGOHYMENOPHOREA*	PENICULIA	*PENİCULİDA*	-	Paramecidae	*Paramecium putrinum* (HILL, 1752) CLAPAREDE and LACHMANN, 1859	+	+	+
26	İNTRAMACRONUCLEATA	*OLIGOHYMENOPHOREA*	SCUTICOCILIATIA	*PHILASTERIDA*	-	Uronematidae	*Uronema nigricans* (MÜLLER, 1786) FLORENTIN, 1901	-	+	+
27	İNTRAMACRONUCLEATA	*OLIGOHYMENOPHOREA*	SCUTICOCILIATIA	*PLEURONEMATIDA*	-	Cyclidiidae	*Cyclidium glaucoma* MÜLLER, 1773	-	+	+
28	İNTRAMACRONUCLEATA	*OLIGOHYMENOPHOREA*	HYMENOSTOMATIA	*HYMENOSTOMATIDA*	*TETRAHYMENINA*	Turaniellidae	*Colpidium colpoda* (LOSANA, 1829) STEIN, 1860	+	-	+
29	İNTRAMACRONUCLEATA	*OLIGOHYMENOPHOREA*	HYMENOSTOMATIA	*HYMENOSTOMATIDA*	*TETRAHYMENINA*	Turaniellidae	*Dexiostoma campylum* FOCKE, 1836 DUJ. 1841,STOKES,1886	+	-	+
30	İNTRAMACRONUCLEATA	*OLIGOHYMENOPHOREA*	PERITRICHIA	*SESSILIDA*	-	Vorticellidaee	*Vorticella campanula* EHRENBERG, 1833	+	+	+
31	İNTRAMACRONUCLEATA	*OLIGOHYMENOPHOREA*	PERITRICHIA	*SESSILIDA*	-	Vorticellidae	*Vorticella microstoma –complex* 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.

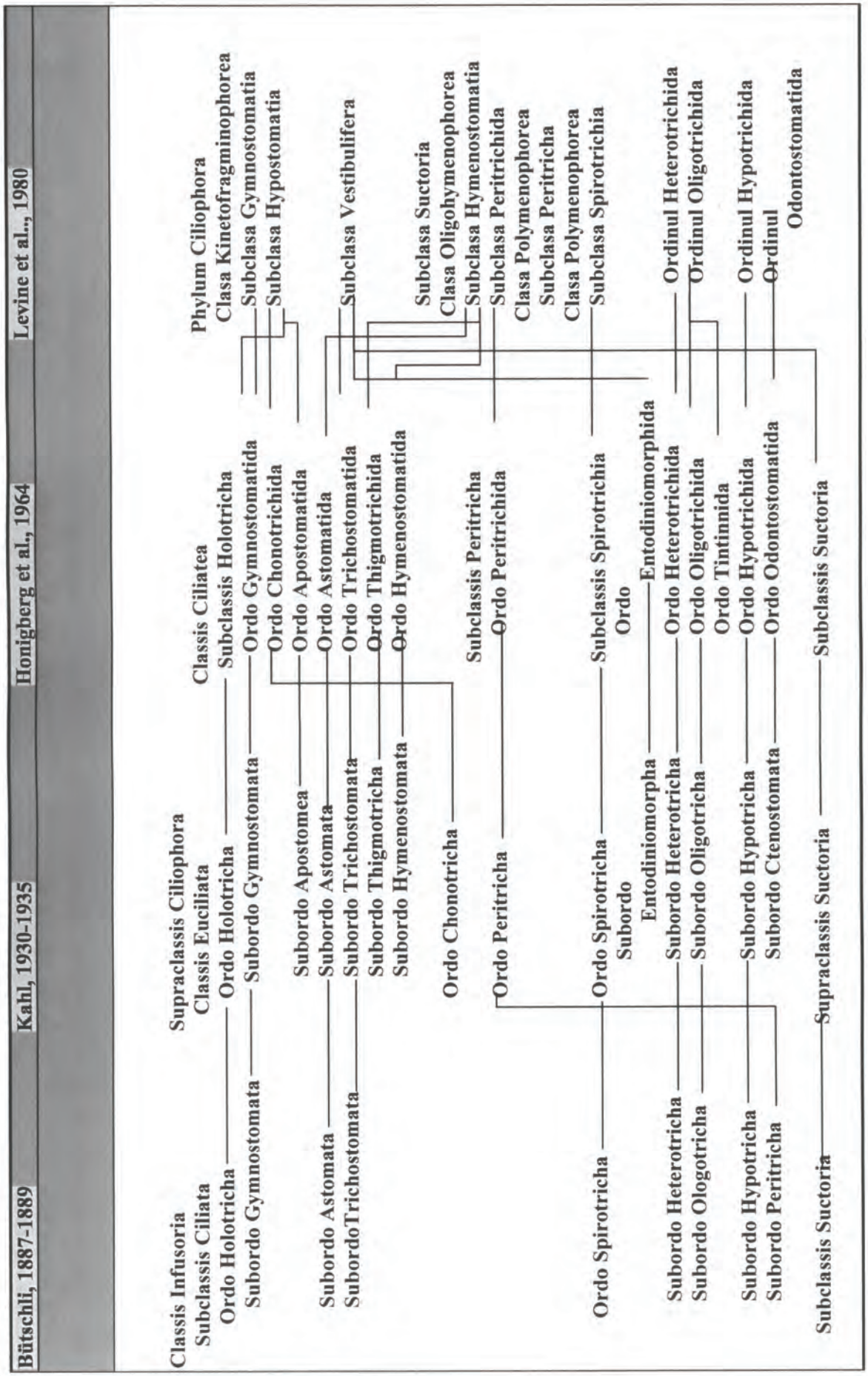

Table 3. Comparative analysis between the last taxonomic system Lynn (LYNN,2003) and old taxonomic system (de PUYTORAC and colab. in: DRAGESCO et DRAGESCO – KERNEIS, 1986).

1 PHYLUM CILIOPHORA (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 PLEUROSTOMATIDA* Schewiakoff, 1896
6 Incertae sedis: *Ordo KARYORELICTIDA* Corliss, 1974
7 Subclassis VESTIBULIFERA de Puytorac et al.,1974
8 *Ordo TRICHOSTOMATIDA* Bütschli, 1883
9 *Ordo COLPODIDA* de Puytorac et al.,1974
10 CLASSIS OLIGOHYMENOPHORA de Puytorac et al.,1974
11 Subclassis HYMENOSTOMATA Delage et Herovard, 1896
12 *Ordo HYMENOSTOMATIDA* Delage et Herovard, 1896
13 *Ordo SCUTICOCILIATIDA* Small, 1967
14 Subclassis PERITRICHA Stein, 1859
15 *CLASSIS POLYHYMENOPHORA* Jankowski, 1967
16 Subclassis SPIROTRICHA 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 CILIOPHORA (in LYNN, 2003)
2 SUBPHYLUM POSTCILIODESMATOPHORA Gerassimova and Seravin, 1976
3 *CLASSIS KARYORELICTEA* Corliss,1974
4 *Ordo LOXODIDA* Jankowski, 1980
5 *CLASSIS HETEROTRICHEA* Stein, 1859
6 *Ordo HETEROTRICHIDA* Stein, 1859
7 SUBPHYLUM INTRAMACRONUCLEATA Lynn, 1996
8 *CLASSIS SPIROTRICHEA* 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 CHORFOTRICHIDA* 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 STROMBIDIIDA* 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 *OrdoPLEURONEMATIDA* 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