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A Check-List of Tintinnids (Protozoa: Ciliophora) in the Coastal Zone of Turkey

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Abstract.- In the last ten years, it was more clearly understood that in marine ecosystems members of Protozoa play a significant role in the flow of energy and biochemical cycles of carbon. It is known that tintinnids, also known as lorica-bearing ciliates, are the most important assistants of the cycle. In Turkey, which has coastlines of notable length in the Black Sea, Aegean Sea and Levantine Sea as well as harbors the Marmara Sea within the Straits Complex, tintinnids have been studied according to mainly their lorica shapes. In this study we used a lorica based classification and organized 109 tintinnid morpho-species from previously published works and we aimed to provide for the first time a reliable check-list of the region following the International Code of Zoological Nomenclature rules.

Keywords: Tintinnids, Protozoa, Ciliophora.

INTRODUCTION

Among the Protozoa groups ciliates, which show a wide distribution thanks to their ability to move fast, play a significant role in the flow of energy and biochemical cycles of carbon due to their small bodies, high metabolic rate, high reproduction rate and their ability to consume food fast (Dolan, 1997; Godhantaraman, 2001; Bachy *et al*., 2012). Tintinnids, which belong to the group Ciliophora, constitute a principal component of marine microzooplankton and are major consumers of nanoplankton in the pelagic food web. These organisms, which show cosmopolitan distribution in seas and oceans, are widely found in seas and also live in fresh waters (Marshall, 1969).

One of the notable characteristics of tintinnids is their vase-shaped lorica that covers their protoplasts and acts as a shell. Lorica is not an ordinary structure for organisms that comprise plankton; however, tintinnids are usually distinguished by the shape and the texture of the lorica (Laval-Peuto, 1981, 1983; Wasik and Mikolajczyk, 1994). The structure and shape of lorica differ due to three important factors. One of these factors is the quality and quantity of lorica material, another is biotic and abiotic factors during their growth and the other is their cell cycles (Agatha *et al*., 2013).

In recent years, with the start of phylogenetic studies it was emphasized that there could be changes in species taxonomies and various species that were previously identified as different species according to their lorica shapes could be different forms of the same species (Agatha and Strüder-Kypke, 2007, 2012; Sacca *et al*., 2008; Agatha, 2010; Bachy *et al*., 2012). It should be noted that the loricas of tintinnid species show high levels of polymorphism (Laval-Peuto and Brownlee, 1986).

In the studies conducted in Turkish waters until today, tintinnids were identified according to their lorica shapes. Tintinnids were first referred in a study conducted by Acara and Nalbandoğlu (1960) in the Izmir Bay in order to report red-tide occurrence. The genus *Tintinnus lusus-undae* Entz. described in the study was later changed to *Eutintinnus* in Kofoid and Campbell (1939). In the following years, the number of related studies increased in the Aegean Sea, especially in the Izmir Bay and other studies were conducted in Turkish seas in order to report Tintinnid species composition and abundance and their relation with the phytoplankton.

The study deals with the taxonomic survey on

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Tintinnids from samples collected in Turkish Seas. The aim of this paper is to cover all tintinnid taxa recorded so far from the Turkish coastline in the Black and the Mediterranean Sea, bringing together all available data from previously published works.

MATERIALS AND METHODS

According to the literature, tintinnids were collected from the Turkish marine waters (Fig. 1) using plankton nets or water samplers and preserved in Lugol's solution or neutralized formaldehyde. Most researchers referred to Trégouboff and Rose (1957), Balech (1959), Marshall (1969), Koray and Özel (1983), Chihara and Murano (1997), Alder (1999), Thomson *et al.* (1999), Polat *et al.* (2001), Balkıs (2004), Urrutxurtu (2004) and Abboud-Abi Saab (2008) for identifying tintinnid morpho-species. Alder (1999) and Lynn (2008) were used in the systematics of the species reported in this study and MarBEF data system (http://www.marbef.org/data/erms.php) was also used as a source for current species names.

Fig. 1. Geographical map and sampling sites in the coastal zone of Turkey.

RESULTS

In the related studies conducted in Turkish seas until today, 109 tintinnid morpho-species were reported. The list and biogeographical distribution of these species are shown below.

Kingdom: Protista
Subkingdom: Protozoa
Phylum: Ciliophora Doflein, 1901
Class: Spirotrichea Butschli, 1889
Subclass: Choreotrichia Small and Lynn, 1985
Order: Tintinnida Kofoid and Campbell, 1929
Family: Tintinnidiidae Kofoid and Campbell, 1929
Genus: *LEPROTINTINNUS* Jörgensen, 1900
Leprotintinnus nordqvistii (Brandt) Kofoid and Campbell, 1929
Family: Codonellidae Kent, 1881
Genus: *CODONELLA* Haeckel, 1873
Codonella amphorella Biedermann, 1893
Codonella aspera Kofoid and Campbell, 1929
Codonella galea Haeckel, 1873
Genus: *CODONARIA* Kofoid and Campbell, 1939
Codonaria cistellula (Fol) Kofoid and Campbell, 1929 (syn.*Codonaria dadayi*)
Genus: *TINTINNOPSIS* Stein, 1867
Tintinnopsis beroidea Stein, 1867
Tintinnopsis bütschlii Daday, 1887
Tintinnopsis campanula (Ehrenberg) Daday, 1887
Tintinnopsis compressa Daday, 1887
Tintinnopsis corniger Hada, 1964
Tintinnopsis cylindrica Daday, 1887
Tintinnopsis lobiancoi Daday, 1887
Tintinnopsis nana Lohmann, 1908
Tintinnopsis nucula (Fol) Brandt, 1906
Tintinnopsis plagiostoma Daday, 1887
Tintinnopsis radix (Imhof) Brandt, 1907
Tintinnopsis strigosa Meunier, 1919
Tintinnopsis tocantinensis Kofoid and Campbell, 1929
Genus: *POROECUS* Cleve, 1902
Poroecus apiculatus (Cleve) Cleve, 1902
Family: Codonellopsidae Kofoid and Campbell, 1929
Subfamily: Codonellopsinae Campbell, 1954
Genus: *CODONELLOPSIS* Jörgensen, 1924
Codonellopsis longa Kofoid and Campbell, 1929
Codonellopsis morchella (Cleve) Jörgensen, 1924
Codonellopsis orthoceras (Haeckel) Jörgensen, 1924
Codonellopsis schabi (Brandt) Kofoid and Campbell, 1929
Subfamily: Stenosemellinae Campbell, 1954
Genus: *STENOSEMELLA* Jörgensen, 1924

Stenosemella nivalis (Meunier) Kofoid and Campbell, 1929
Stenosemella ventricosa (Claperede and Lachmann) Jörgensen, 1924
Family: Dictyocystidae Kent, 1881
Genus: *DİCTYOCYSTA* Ehrenberg, 1854
Dictyocysta dilatata Brandt, 1906
Dictyocsta elegans Ehrenberg, 1854
Dictyocsta lepida Ehrenberg, 1854
Dictyocysta mitra Haeckel, 1873
Dictyocysta reticulata Kofoid and Campbell, 1929
Dictyocysta speciosa Kofoid and Campbell, 1929
Family: Metacylididae Kofoid and Campbell, 1929
Genus: *METACYLIS* Jörgensen, 1924
Metacylis corbula Kofoid and Campbell, 1929
Metacylis joergensenii (Cleve) Kofoid and Campbell, 1929
Metacylis mediterranea (Mereschkowsky) Jörgensen, 1924
Metacylis mereschkowskii Kofoid and Campbell, 1929
Genus: *HELICOSTOMELLA* Jörgensen, 1924
Helicostomella edentata (Fauré-Framiet, 1924)
Helicostomella kiliensis (Laackmann, 1906)
Helicostomella subulata (Ehrenberg) Jörgensen, 1924
Genus: *CLIMACOCYLIS* Jörgensen, 1924
Climacocylis scalaria Brandt, 1906
Family: Ptychocylididae Kofoid and Campbell, 1929
Genus: *Favella* Jörgensen, 1924
Favella adriatica (Imhof) Jörgensen, 1924
Favella azorica (Cleve) Jörgensen, 1924
Favella campanula (Schmidt) Jörgensen, 1924
Favella ehrenbergii (Claparede and Lachmann) Jörgensen, 1924
(=*Coxliella annulata*, = *C.decipiens*, var. *helgolandica*)
Favella fistulicauda Jörgensen, 1924
Favella markusovszkyi (Daday) Kofoid and Campbell, 1929
Favella serrata (Möbius) Jörgensen, 1924
Family: Epiplocylididae Kofoid and Campbell, 1939
Genus: *EPİPLOCYLİS* Jörgensen, 1924
Epiplocylis acuminata (Daday) Jörgensen, 1924
Epiplocylis blanda (jörgensen) Kofoid and Campbell, 1939
Epiplocylis constricta Kofoid and Campbell, 1929
Epiplocylis undella (Ostenfeld and Schmidt) Jörgensen, 1927
Genus: *EPIPLOCYLOIDES* Hada, 1938
Epiplocyloides reticulata (Ostenfeld and Schmidt) Hada, 1938
(=*Epiplocylis acuta*)
Family: Ascampbelliellidae Corliss, 1960
Genus: *ACANTHOSTOMELLA* Jörgensen, 1927
Acanthostomella norvegica Kofoid and Campbell, 1929
Family: Cyttarocylididae Kofoid and Campbell. 1929
Genus: *CYTTAROCYLIS* Fol, 1881
Cyttarocylis ampulla (Kent) Bachy, Dolan and Lopez-Garcia, 2012
(=*Petalotricha ampulla=Petalotricha serrata*)
Cyttarocylis brandti Kofoid and Campbell, 1929
Cyttarocylis cassis (Haeckel) Fol, 1881
Cyttarocylis conica (Brandt) Kofoid and Campbell, 1929
Cyttarocylis eucecryphalus (Haeckel) Kofoid, 1912
Cyttarocylis magna (Brandt) Kofoid and Campbell, 1929
Family: Rhabdonellidae Kofoid and Campbell. 1929
Genus: *RHABDONELLA* Brandt, 1906
Rhabdonella amor (Cleve) Brandt, 1907
Rhabdonella brandti Kofoid and Campbell, 1929
Rhabdonella elegans Jörgensen, 1924
Rhabdonella hydria Jörgensen, 1924
Rhabdonella spiralis (Fol) Brandt, 1906
Genus: *PROTORHABDONELLA* Jörgensen, 1924
Protorhabdonella curta (Cleve) Jörgensen, 1924
Protorhabdonella simplex (Cleve)

Jörgensen, 1924
Family: Xystonellidae Kofoid and Campbell, 1929
Genus: *PARUNDELLA* Jörgensen, 1924
Parundella aculeata (Jörgensen) Kofoid and Campbell, 1929
Parundella lohmanni (Jörgensen) Kofoid and Campbell, 1929
Parundella longa Jörgensen, 1924
Genus: *XYSTONELLA* Brandt, 1906
Xystonella lohmanni (Brandt) Kofoid and Campbell, 1929
Xystonella longicauda (Brandt) Brandt, 1906
Xystonella treforti (Daday) Laackmann, 1909
Genus: *XYSTONELLOPSIS* Jörgensen, 1924
Xystonellopsis cyclas Kofoid and Campbell, 1929
Xystonellopsis cymatica (Brandt, 1906) Jörgensen, 1924
Xystonellopsis paradoxa (Cleve) Jörgensen, 1924
Family: Undellidae Kofoid and Campbell, 1929
Genus: *UNDELLA* Daday, 1887
Undella hyalina Daday, 1887
Genus: *UNDELLOPSIS* Kofoid and Campbell, 1929
Undellopsis marsupialis (Brandt) Kofoid and Campbell, 1929
Undellopsis tricollaria Kofoid and Campbell, 1929
Genus: *AMPLECTELLA* Kofoid and Campbell, 1929
Amplectella collaria (Brandt) Kofoid and Campbell, 1929
nomen inquirendum: *PROPLECTELLA* Kofoid and Campbell, 1929
Proplectella acuta (Jörgensen) Kofoid and Campbell, 1929
Proplectella angustior (Jörgensen) Kofoid and Campbell, 1929
Proplectella claparedei (Entz) Kofoid and Campbell, 1929
Proplectella ellipsoida Kofoid and Campbell, 1929
Proplectella fastigata (Jörgensen) Kofoid and Campbell, 1929
Proplectella ovata Jörgensen, 1924
Proplectella subacuta Kofoid and Campbell, 1929
Family: Tintinnidae Claus, 1876
Subfamily: Salpingellinae Kofoid and Campbell, 1939
Genus: *EUTINTINNUS* Kofoid and Campbell, 1939
Eutintinnus apertus Kofoid and Campbell, 1929
Eutintinnus dilatatus Massuti
Eutintinnus elegans (Jörgensen) Kofoid and Campbell, 1939
Eutintinnus fraknoi (Daday) Kofoid and Campbell, 1939
Eutintinnus inquilinus Müller, 1776 (=*Tintinnus inquilinus*)
Eutintinnus latus (Jörgensen) Kofoid and Campbell, 1939
Eutintinnus lusus-undae (Entz) Kofoid and Campbell, 1939 (=*Tintinnus lusus-undae*)
Eutintinnus macilentus (Jörgensen) Kofoid and Campbell, 1939
Eutintinnus pinguis (Kofoid and Campbell) Kofoid and Campbell, 1939
Eutintinnus tubulosus (Ostenfeld) Kofoid and Campbell, 1939
Genus *SALPINGELLA* Jörgensen, 1924
Salpingella acuminata (Claparède and Lachmann) Jorgensen, 1924
Salpingella attenuata Jörgensen, 1924
Salpingella curta Kofoid and Campbell, 1929
Salpingella decurtata Jörgensen, 1924
Salpingella gracilis Kofoid and Campbell, 1929
Salpingella minutissima Kofoid and Campbell, 1929
Subfamily: Tintinninae Kofoid and Campbell, 1939
Genus: *BURSAOPSIS* Kofoid and Campbell, 1929
Bursaopsis striata (Daday) Kofoid and Campbell, 1929
Genus: *STEENSTRUPIELLA* Kofoid and Campbell, 1929
Steenstrupiella steenstrupii (Claparède and Lachmann) Kofoid and Campbell,

1929

Genus: *AMPHORIDES* Strand, 1926

Amphorides amphora (Claparède and Lachmann) Strand, 1926

Amphorides quadrilineata (Claparède and Lachmann) Strand, 1926

Genus: *AMPHORELLOPSIS* Kofoid and Campbell,1929

Amphorellopsis tetragona (Jørgensen) Kofoid and Campbell, 1929

Genus: *DADAYIELLA* Kofoid and Campbell, 1929

Dadayiella ganymedes (Entz) Kofoid and Campbell, 1929

nomen inquirendum: *COXLIELLA* Brandt, 1907

Coxliella ampla (Jörgensen) Brandt, 1907

Coxliella laciniosa (Brandt) Kofoid and Campbell, 1929

Of the 109 tintinnid morpho-species obtained in this study, Tintinnidae (22 species, 20.18%) and Codonellidae (18 species, 16.51%) families have the highest species number (Table I). 13 species that belong to the genus *Tintinnopsis* were identified and this genus was followed by the genera *Eutintinnus* with 10 species, *Favella* and *Proplectella* both with 7 species.

Table I.- Genus, species numbers and percentage (%) distributions of Tintinnida families from the Turkish seas

Family	Genera	Species	%
Tintinnidiidae	1	1	0.92
Codonellidae	**4**	**18**	**16.51**
Codonellopsidae	2	6	5.50
Dictyocystidae	1	6	5.50
Metacylididae	3	8	7.34
Ptychocylididae	1	7	6.42
Epiplocylididae	2	5	4.59
Ascampbelliellidae	1	1	0.92
Cyttarocylididae	1	6	5.50
Rhabdonellidae	2	7	6.42
Xystonellidae	3	9	8.26
Undellidae	3	4	3.67
Tintinnidae	**7**	**22**	**20.18**
nomen inquirendum	2	9	8.26

The Tintinnid morpho-species reported from Turkish seas are shown in Table II. The highest number of species was found in the Aegean Sea, probably due to the more intense sampling effort.

DISCUSSION

Until today, 90 ciliate species were reported from Turkish territorial waters (Koray *et al*., 1999). Since the species *Coxliella annulata* and *C. decipiens* reported in the studies are the phenotypic variations of *Favella ehrenbergii* (Laval-Peuto, 1981, 1983), the members of the genus *Coxliella* were identified as *F. ehrenbergii*. Besides, at the latest molecular study (Bachy *et al*., 2012) the species *Petalotricha ampulla* and *P. serrata* were identified as *Cyttarocylis ampulla*, and they were given in the list and at Table 2. From the Turkish territorial waters of the Black Sea, Öztürk (1999) reported 17 tintinnid morpho-species; however, only 16 of these were listed in this study. The reason is that *Metacylis pontica* and *Tintinnopsis mediterraneus pontica* which were cited as two different species by Öztürk (1999) were reported as *Metacylis mediterranea* in the list and at Table 2. Similarly Benli (1987) reported 10, Türkoğlu and Koray (2000) 17 and Koray *et al*. (2000) 17 from the Black Sea. With these four studies, totally 23 morpho-species were identified in the Black Sea. This number is 21% of the species obtained from Turkish seas. In addition, 27 tintinnid morpho-species were reported from the Ukrainian coastline of the Black Sea, 15 from the Romanian, 23 from the Bulgarian and 9 from the Georgian (Petranu, 1997; Zaitsev and Alexandrov, 1998; Konsulov, 1998; Komakhidze and Mazmanidi, 1998).

Only three studies were conducted in the Marmara Sea and 15 species were identified (Balkıs, 2004; Toklu-Alıçlı *et al*., 2010; Durmuş *et al*., 2011). This number is only 13.8% of the total species number. In two of the three studies, new species for Turkish territorial waters were reported. Although it is possible to find both brackish water and sea water forms in the Marmara Sea due to the existence of lower salinity waters in the upper layer and typical Mediterranean waters in the lower layer, a few species were identified, which is due to the insufficient number of studies in the Marmara Sea. This finding points to the need for further comprehensive studies to be conducted in the sea.

Table II.- Tintinnid species reported from Turkish seas.

		Black Sea	Marmara Sea	Aegean Sea	Levantine Sea
1	*Acanthostomella norvegica*				15
2	*Amphorellopsis tetragona*		19		
3	*Amphorides amphora*		16	3,5,7,9,17,18	14,15
4	*Amphorides quadrilineata*			3,5,7,9,12,13,17,18	12,14,15
5	*Amplectella collaria*			7	14
6	*Bursaopsis striata*			In this study	
7	*Climacocylis scalaria*			7,8	
8	*Codonaria cistellula*			7	14,15
	(=Codonaria dadayi)				14,15
9	*Codonella amphorella*			7,17	14,15
10	*Codonella aspera*	10,11,12		3,5,7,8,9,12,17	15
11	*Codonella galea*			17	
12	*Codonellopsis longa*			7	
13	*Codonellopsis morchella*	10,11		5,7	
14	*Codonellopsis orthoceras*		16	3,5,7,17	14,15
15	*Codonellopsis schabi*		16	3,5,9,12,13,17,18	12,14,15
16	*Coxliella ampla*			13	
17	*Coxliella laciniosa*			7	14,15
18	*Cyttarocylis ampulla*				
	(=Petalotricha ampulla)	4,10,11,12		2,5,7,8,12	12,14,15
	(=Petalotricha serrata)			7	14
19	*Cyttarocylis brandti*			7,8	
20	*Cyttarocylis cassis*			2	
21	*Cyttarocylis conica*			7	
22	*Cyttarocylis eucecryphalus*			3	14,15
23	*Cyttarocylis magna*			22	
24	*Dadayiella ganymedes*			3,5,7,8,9,17	14,15
25	*Dictyocysta dilatata*			7,8	
26	*Dictyocsta elegans*			5,7	14
27	*Dictyocysta lepida*				
	(=D.elegans var. lepida)			3,5	
28	*Dictyocysta mitra*	11,12		3,5,7,12,17	14
29	*Dictyocysta reticulata*			13	14
30	*Dictyocysta speciosa*			7,9	
	(=D.elegans var. speciosa)			3,5	
31	*Epiplocylis acuminata*			7,8	
32	*Epiplocylis blanda*				14
33	*Epiplocylis constricta*			In this study	
34	*Epiplocylis undella*			7,8,17,18	14,15
35	*Epiplocyloides reticulata*				
	(=Epiplocylis acuta)				14
36	*Eutintinnus apertus*		16	3,5,7,8,9,13,17,18	14,15
37	*Eutintinnus dilatatus*			5,7	
38	*Eutintinnus elegans*			3,5,9,13	
39	*Eutintinnus fraknoi*		16	3,5,7,8,13,17	14
40	*Eutintinnus inquilinus*				
	(=Tintinnus inquilinus)			5	
41	*Eutintinnus latus*			3,5,9	15
42	*Eutintinnus lusus-undae*		16	3,5,7,8,9,17,18	14,15
	(=Tintinnus lusus-undae)			1	
43	*Eutintinnus macilentus*			3,5,9,12,17	12,14,15
44	*Eutintinnus pinguis*			5	

Continued

		Black Sea	Marmara Sea	Aegean Sea	Levantine Sea
45	*Eutintinnus tubulosus*			17	
46	*Favella adriatica*				15
47	*Favella azorica*	11,12		3,5,12,13,17,18	15
48	*Favella campanula*	11,12	16	3,5,6,7,9,12,13,17	12
49	*Favella ehrenbergii*	10,11,12	16	2,3,5,7,9,12,13,17,18	14,15
	(=Coxliella annulata)	11,12	16	3,5,7,9,12,13,18	
	(=C.decipiens)			7,8	
	(var. helgolandica)			1	
50	*Favella fistulicauda*			3,5,7,8,9,12,13	12,14
51	*Favella markusovszkyi*			2,3,5,7,13,17	14,15
52	*Favella serrata*	11,12	16	2,3,5,7,9,12,13,17,18	14
53	*Helicostomella edentata*			5,13	
54	*Helicostomella kiliensis*			13	
55	*Helicostomella subulata*	4,10,11,12	16	2,3,5,6,9,12,13,17	
56	*Leprotintinnus nordqvisti*			21	15
57	*Metacylis corbula*			5	
58	*Metacylis jörgensenii*	11,12	16	3,5,7,12,18	12,15
59	*Metacylis mediterranea*	4,10			
60	*Metacylis mereschkowskii*	11,12		5,7,12,13	
61	*Parundella aculeata*			17	14
62	*Parundella lohmanni*			7,17	
63	*Parundella longa*			3,5,7,8,13,17	
64	*Poroecus apiculatus*			2	
65	*Proplectella acuta*			13	
66	*Proplectella angustior*			7,8	
67	*Proplectella claparedei*			3,5,7,9,13,17	14,15
68	*Proplectella ellipsoida*			7	
69	*Proplectella fastigata*			7	
70	*Proplectella ovata*			7	14,15
71	*Proplectella subacuta*			7	
72	*Protorhabdonella curta*			17	
73	*Protorhabdonella simplex*			2,3,5,7,9,13,17	14,15
74	*Rhabdonella amor*			In this study	
75	*Rhabdonella brandti*			7,8	14
76	*Rhabdonella elegans*				15
77	*Rhabdonella hydria*			7	
78	*Rhabdonella spiralis*			3,5,7,8,9,12,13,17,18	12,14
79	*Salpingella acuminata*			3,5,7,8,9,13,17,18	14,15
80	*Salpingella attenuata*			7,8,13	15
81	*Salpingella curta*			3,5,7,9	
82	*Salpingella decurtata*			7,13,17	
83	*Salpingella gracilis*				14,15
84	*Salpingella minutissima*			7	
85	*Steenstrupiella steenstrupii*		16	3,5,7,9,13,17,18	14
86	*Stenosemella nivalis*	10,11,12		3,5,12,13	
87	*Stenosemella ventricosa*	10,11,12		3,5,12	12
88	*Tintinnopsis beroidea*	4,10,11,12		2, 3,5,7,12,13	12,14,15
89	*Tintinnopsis bütschlii*			2, 3,5,7	15
90	*Tintinnopsis campanula*	4,10,11,12		1,2,3,5,7,8,12,13,18	12,14,15
91	*Tintinnopsis compressa*	11,12		3,5,12	12,15
92	*Tintinnopsis corniger*		20	21	
93	*Tintinnopsis cylindrica*	4,10,11,12		2,3,5,6,7,8,9,12,13,17,18	12,14,15
94	*Tintinnopsis lobiancoi*	4,10		2,3,5,7,13	15
95	*Tintinnopsis nana*			3,5	15

Continued

		Black Sea	Marmara Sea	Aegean Sea	Levantine Sea
96	*Tintinnosis nucula*	4,10			
97	*Tintinnopsis plagiostoma*			3,5	15
98	*Tintinnopsis radix*	4,10	16	3,5,9,12,13,17,18	12,14,15
99	*Tintinnopsis strigosa*	4,10			
100	*Tintinnopsis tocantinensis*				15
101	*Undella hyalina*			3,5,7,12,13,17	12,14
102	*Undellopsis marsupialis*				14
103	*Undellopsis tricollaria*			8	14
104	*Xystonella lohmanni*	10		7,17	
105	*Xystonella longicauda*			3,5,7,8,9,13	14
106	*Xystonella treforti*			7,8,17	14,15
107	*Xystonellopsis cyclas*			7	
108	*Xystonellopsis cymatica*				15
109	*Xystonellopsis paradoxa*			7	14,15

Abbreviations used: **1**, Acara and Nalbantoğlu, 1960; **2**, Ergen, 1967; **3**, Koray and Özel, 1983; **4**, Benli, 1987; **5**, Koray, 1987; **6**, Koray *et al.*, 1992; **7**, Koray and Kesici, 1994; **8**, Koray *et al.*, 1994; **9**, Koray *et al.*, 1999; **10**, Öztürk, 1999; **11**, Türkoğlu and Koray, 2000; **12**, Koray *et al.*, 2000; **13**, Çolak-Sabancı and Koray, 2001; **14**, Polat *et al.*, 2001; **15**, Polat *et al.*, 2002; **16**, Balkıs, 2004; **17**, Balkıs and Wasik, 2005; **18**, Balkıs and Toklu-Alıçlı, 2009; **19**, Toklu-Alıçlı *et al.*, 2010; **20**, Durmuş *et al.*, 2011; **21**, Yurga, 2012.

The highest number of tintinnid morpho-species were obtained from Aegean and Levantine seas. Ninety six morpho-species (88%) were reported from the Aegean Sea and 62 (56.9%) from the Mediterranean (Levantine Sea). Of these species, *F. campanula, F. ehrenbergii, F. serrata, M. jörgenseni* and *T. radix* were the ones found in all seas (Table II). Both these 5 species and 10 species (*Codonella aspera, Cyttarocylis ampulla, Dictyocysta mitra, Favella azorica, Stenosemella ventricosa, Tintinnopsis beroidea, T. campanula, T. compressa, T. cylindrica, T. labiancoi*) reported from both the Black Sea (approximately 17 ‰) and the Mediterranean (approximately 38 ‰) were able to adapt to large salinity variabilities. In a study in the Aegean Sea (Pitta and Ginnakourou, 2000), 82 ciliate species were reported and it was stated that the south of the Aegean Sea (70 species) was richer in species variety than the north (50 species) and tintinnids were represented with 18% in the north. On the other hand, 174 species were reported from the Mediterranean until today (Trégouboff and Rose, 1957). Pitta *et al.* (2001) recorded 55 species in this sea in a study which was performed in the west-east line. Also Balech (1959) reported 60 species, Travers and Travers (1975) 82 and Gomez and Gorsky (2003) 19 from Western Mediterranean Sea while El-Maghraby and Halim (1965) reported 17 species and Kimor and Wood (1975) 10 in the studies which they performed in Eastern Mediterranean Sea. In a study in Lebanon waters, Abboud-Abi Saab *et al.* (2012) recorded 75 species from 28 genera and stated that the temporal distribution of these species depended on the typical Mediterranean system which occurs in spring and late summer.

According to this study, most of the species (47 species) showed cosmopolitan distribution. In addition, 30 of the species consisted of the ones found in neritic waters and 24 in temperate waters. On the other hand, species of the genus *Proplectella* Kofoid and Campbell, 1939 (nomen inquirendum) consist of eupelagic and tropical-subtropical species (Hada, 1937) (7 species). However, there is still no clear record about the distribution of the genus *Bursaopsis*.

To sum up, the changes in species compositions from one region to another were affected by the fact that most of the studies conducted in Turkish seas were local, the material collection methods and periods were different and the number of studies in some regions was higher than other regions. In addition, if we consider that the two nonindigenous species (*L. nordqvisti, T. corniger*) reported in the studies were carried to these waters by currents and ballast tanks of vessels, increases could be expected in the species number of tintinnid in forthcoming years.

REFERENCES

ABBOUD-ABI SAAB, M., 2008. *Tintinnids of the Lebanese coastal waters (Eastern Mediterranean)*. CNRS-Lebanon/UNEP/MAP/PAC/SPA, Lebanon.

ABBOUD-ABI SAAB, M., FAKHRİ, M. AND KASSAB, M.T., 2012. Effect of chemical input on the temporal and spatial abundance of tintinnid ciliates in Lebanese coastal waters (Eastern Mediterranean). *J. Black Sea/Mediterranean Environment*, **18(3):** 299-328.

ACARA, A. AND NALBANDOĞLU, Ü., 1960. Preliminary report on the red tide outbreak in the Gulf of Izmir. *Comm. Int. Explor. scient. Mer. Mediterr.*, **15:** 33-38.

AGATHA, S., 2010. A light and scanning electron microscopic study of the closing apparatus in tintinnid ciliates (Ciliphora, Spirotricha, Tintinnina): a forgotten synamorphy. *J. Eukaryot. Microbiol.*, **57:** 297-307.

AGATHA, S. AND STRÜDER-KYPKE, M.C., 2007. Phylogeny of the Order Choreotrichida as inferred from morphology, ultrastructure, ontogenesis, and SSrRNA gene sequences. *Eur. J. Protistol.*, **43:** 37–63.

AGATHA, S. AND STRÜDER-KYPKE, M.C., 2012. Reconciling cladistic and genetic analyses in choreotrichid ciliates (Protists, Spirotricha, Oligotrichea). *J. Eukaryot. Microbiol*., **59:** 325-350.

AGATHA, S., LAVAL-PEUTO, M. AND SIMON, P., 2013. The tintinnid Lorica. In: *The biology and ecology of tintinnid ciliates: Models for marine plankton* (eds. J.R. Dolan, D.J.S. Montagnes, S. Agatha, D.W. Coats, D.K. Stoecker), A John Wiley and Sons, Ltd. publication, Oxford, pp. 17-41.

ALDER, V.A., 1999. Tintinnoinea. In: *South Atlantic zooplankton* (ed. D. Boltovskoy), Vol. 1, Backhuys Publishers, Leiden, pp. 321-384.

BACHY, C., GOMEZ, F., LOPEZ-GARCIA, P., DOLAN, J.R. AND MOREIRA, D., 2012. Molecular phylogeny of tintinnid ciliates (Tintinnida, Ciliophora). *Protist*, **163:** 873-887.

BALECH, E., 1959. *Tintinnoinea del Mediterraneo*. Trabajos del intitudo Espanol de oceanografia, 28, Madrid.

BALKIS, N., 2004. Tintinnids (Protozoa: Ciliophora) of the Büyükçekmece Bay in the Sea of Marmara. *Sci. Mar.*, **68:** 33-44.

BALKIS, N. AND WASIK, A., 2005. Species composition of tintinnids in the neritic water of Bozcaada Island, Aegean Sea, Turkey. *Fresen. Environ. Bull.*, **14:** 327-333.

BALKIS, N. AND TOKLU-ALIÇLI, B., 2009. Tintinnid (Protozoa: Ciliophora) species in the Edremit Bay. *IUFS J. Biol.*, **68:** 47-53.

BENLI, H.A., 1987. Investigation of plankton distribution in the Southern Black Sea and its effects on particle flux. *Mitt. Geol. Palaeontol. Inst. Univ. Hamburg*, **62:** 77-87.

CHIHARA, M. AND MURANO, M., 1997. *An illustrated guide to marine plankton in Japan*. Tokai University Press, Tokyo.

ÇOLAK-SABANCI, F. AND KORAY, T., 2001. İzmir Körfezi (Ege Denizi) mikroplankton'unun vertical ve horizontal dağılımına kirliliğin etkisi. *Ege Üniv. Su Ürünleri Dergisi*, **18:** 187-202.

DOLAN, J.R., 1997. Phosphorus and ammonia excretion by planktonic Protists. *Mar. Geol.*, **139:** 109-122.

DURMUŞ, T., BALCI, M. AND BALKIS, N., 2011. Species of genus Tintinnopsis Stein, 1867 in Turkish coastal waters and new record species: *Tintinnopsis corniger* Hada, 1964. *Pakistan J. Zool.*, **44:** 383-388.

EL-MAGHRABY, A.M. AND HALİM, Y., 1965. A quantitative and qualitative study of the plankton of Alexandria waters. *Hydrobiologia*, **2:** 221-238.

ERGEN, Z., 1967. The main planktonic organisms found in the Bay of İzmir. *Scient. Rep. Facul. Sci. Ege University*, **47:** 3-27.

GODHANTARAMAN, N., 2001. Seasonal variations in taxonomic composition, abundance and food web relationship of microzooplankton in estuarine and mangrove waters, Parangipettai Region, Southeast Coast of India. *Indian J. mar. Sci.*, **30:** 151-160.

GOMEZ, F. AND GORSKY, G., 2003. Annual microplankton cycles in Villefranche Bay, Ligurian Sea, NW Mediterranean. *J. Plankt. Res.*, **25:** 323-339.

HADA, Y., 1937. The fauna of Akkeshi Bay. IV The pelagic ciliata. *J. Faclt. Sci. Hokkaido Imp. Univ. Ser., 6*, **5:** 143-216.

KIMOR, B. AND WOOD, E.J.F., 1975. A plankton study in the Eastern Mediterranean Sea. *Mar. Biol.*, **29:** 321-333.

KOMAKHIDZE, A. AND MAZMANIDI, N., 1998. *Black Sea biological diversity, Georgia*. Black Sea Environmental Series, 8, United Nations Publications, New York.

KONSULOV, A., 1998. *Black Sea biological diversity, Bulgaria*. Black Sea Environmental Series, 5, United Nations Publications, New York.

KOFOID, C.A. AND CAMPBELL, A.S., 1939. The Tintinnoinea of the Eastern Tropical Pacific. *Bull. Mus. Comp. Zool. Harvard Coll.*, **84:** 1-473.

KORAY, T. AND ÖZEL, İ., 1983. İzmir Körfezi planktonundan saptanan Tintinnoinea türleri. I. Ulusal Deniz ve Tatlısu Araştırmaları Kongresi Tebliğleri. 15-17 Ekim 1981, İzmir. *Ege Üniv. Fen Fakült. Dergisi*, Ser. B, I: 221-244.

KORAY, T., 1987. One-celled microplankton species of İzmir Bay (Aegean Sea): A species list and a comparison with the records of adjacent regions. *DOĞA Turk. J. Biol.*, **11:** 130-146.

KORAY, T., BÜYÜKIŞIK, B., BENLİ, H.A. AND GÖKPINAR, Ş., 1992. Phytoplankton blooming and zooplankton swarms in eutrophied zones of Aegean Sea (İzmir Bay). *Rapp. Comm. İnt. Mer. Médit.,* 33.

KORAY, T. AND KESICI, U.Y., 1994. Bodrum Körfezi'nin

(Ege Denizi) fitoplankton ve protozooplankton tür kompozisyonu. *Ege Üniv. Fakült. Dergisi*, Seri B, Ek **16/1:** 971-980.

KORAY, T., BENLI, H.A. AND SEVER, T.M., 1994. Gökova Körfezi (Ege Denizi)'nin fitoplankton ve protozooplankton türleri üzerine bir araştırma. *Ege Üniv. Su Ürünleri Dergisi*, **11:** 42-43., 9-15.

KORAY, T., GÖKPINAR, Ş. AND YURGA, L., 1999. İzmir Körfezi (Ege Denizi) mikroplankton topluluklarının dağılımı üzerine kirliliğin etkileri. *Ege Üniv. Su Ürünleri Dergisi*, **16:** 421-431.

KORAY, T., GÖKPINAR, Ş., POLAT, S., TÜRKOĞLU, M., YURGA, L., ÇOLAK, F., BENLI, H.A. AND SARIHAN, E., 2000. Türkiye denizlerinin (Karadeniz, Ege Denizi ve Kuzeydoğu Akdeniz) mikroplankton (bir hücreliler. topluluklarının kalitatif özelliklerinin karşılaştırılması. *Ege Univ. Su Ürünleri Dergisi*, **17:** 231-247.

LAVAL-PEUTO, M., 1981. Construction of the lorica in Ciliata Tintinnina. *In vivo* study of *Favella ehrenbergii*: variability of the phenotypes during the cycle, biology, statistics, biometry. *Protistologica*, **17:** 249-272.

LAVAL-PEUTO, M., 1983. Sexual reproduction in *Favella ehrenbergii* (Ciliophora, Tintinnina). Taxonomical implications. *Protistologica*, **29:** 503-512.

LAVAL-PEUTO, M. AND BROWNLEE, D.C., 1986. Identification and systematics of the Tintinnina (Ciliophora): evaluation and suggestions for improvement. *Annal. Inst. Oceanogr.*, **62:** 69-84.

LYNN D.H., 2008. *The ciliated protozoa. Characterization, classification, and guide to the literature*. 3rd ed. Springer, Dordrecht.

MarBEF DATA SYSTEM, 2013. http://www.marbef.org/data/erms.php.

MARSHALL, S.M., 1969. Order: Tintinnida, Conseil International Pour L'exploration de la Mer. Zooplankton Sheet, 117-127.

ÖZTÜRK, B., 1999. *Black Sea biological diversity, Turkey*. Black Sea Environmental Series, 9, United Nations Publications, New York.

PETRANU, A., 1997. *Black Sea biological diversity, Romania*. Black Sea Environmental Series, 4, United Nations Publications, New York.

PITTA, P. AND GIANNAKOUROU, A., 2000. Planktonic ciliates in the oligotrophic Eastern Mediterranean: vertical, spatial distribution and mixotrophy. *Mar. Ecol. Prog. Ser.*, **194:** 269-282.

PITTA, P., GIANNAKOUROU, A. AND CHRISTAKI, U., 2001. Planktonic ciliates in the oligotrophic Mediterranean Sea: longitudinal trends of standing stocks, distributions and analysis of food vacuole contents. *Aquat. Microb. Ecol.*, **24:** 297-311.

POLAT, S., TOKLU, B. AND PERÇIN-PINER, M., 2001. Babadıllimanı Koyu: Silifke-İçel. tintinnid: Ciliata türleri. XI. Ulusal Su Ürünleri Sempozyumu, 04-06 Eylül, Hatay, 504-512.

POLAT, S., TOKLU, B. AND SARIHAN, E., 2002. Seasonal distribution of protozooplankton in İskenderun Bay: Northeastern Mediterranean. In: *Oceanography of the Eastern Mediterranean and Black Sea: Similarities and differences of two interconnected basins* (ed. Yılmaz, A.), TÜBİTAK, pp. 839-844.

SACCA, A., GUGLIELMO, L. AND BRUNI, V., 2008. Vertical and temporal microbial community patterns in a meromictic coastal lake influenced by the straits of Messina upwelling system. *Hydrobiologia*, **600:** 89-104.

THOMPSON, G.A., ALDER, V.A., BOLTOVSKOY, D. AND BRANDINI, F., 1999. Abundance and biogeography of tintinnids (Ciliophora) and associated microzooplankton in the Southwestern Atlantic Ocean. *J. Plankt. Res.*, **21:** 1265-1298.

TOKLU-ALIÇLI, B., BALKIS, N., TOKLU, A.S. AND HÖBEK, A., 2010. First record of *Amphorellopsis tetragona* (Protozoa: Ciliophora: Tintinnina) from the Sea of Marmara. *IUFS J. Biol.*, **69:** 103-106.

TRAVERS, A. AND TRAVERS, M., 1975. Catalogue du microplankton du golfe de Marseille. *Int. Rev. gesamt. Hydrobiol. Hydrogr.*, **60:** 251-276.

TRÉGOUBOFF, G. AND ROSE, M., 1957. *Manuel de planctonologie Méditerranéenne, I, II.* Centre National de la Recherche Scientifique, Paris.

TÜRKOĞLU, M. AND KORAY, T., 2000. Ecological and geographical distributions of the planktonic protista in the southern parts of the Black Sea: neritic waters of Sinop peninsula, Turkiye, *Su Ürünleri Dergisi*, **17:** 161-178.

URRUTXURTU, I., 2004. Seasonal succession of tintinnids in the Nervión River estuary, Basque Country, Spain. *J. Plankt. Res.*, **26:** 307-314.

WASIK, A. AND MIKOŁAJCZYK, E., 1994. Annual cycle of tintinnids in the Admiralty Bay with an emphasis on seasonal variability in Cymatocylis affinis/convallaria lorica morphology. *J. Plankt. Res.*, **16:** 1-8.

YURGA, L., 2012. İzmir Körfezi için 2 yeni Tintinnid (Oligotrichida) türü: *Leptotintinnus nordqvisti* Brandt, 1906 ve *Tintinnopsis corniger* Hada, 1964. *Ege J. Fish. Aquat. Sci.*, **29:** 69-72.

ZAITSEV, Y.P. AND ALEXANDROV, B.G., 1998. *Black Sea biological diversity, Ukraine*. Black Sea Environmental Series, 7, United Nations Publications, New York.

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