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An Updated Checklist of Tintinnids (Order: Choreotrichida) in the North Western Coast of the Red Sea at Hurghada

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ABSTRACT

The present study aims to provide an updated check list of tintinnid species in the north western Red Sea of Egypt. Plankton samples were taken monthly from 12 stations of Hurghada coast of the Egyptian Red Sea during the period from August 2014 to July 2015. Plankton nets of 20 µm mesh size were used in collecting samples, then samples fixed on board in 4% buffered formalin. A total of 149 species of tintinnids belonging to 12 families and 36 genera of the order Choreotrichida were identified based on the morphological features. Families Codonellidae, Tintinnidae, and Codonellopsidae had the higher number of species (40, 28 and 20 species, respectively), constituting collectively around 60% of the total number of recorded species. The highest number of genera was represented in Family Tintinnidae (8), while the highest number of species was representedin Genus *Tintinnopsis* (34).Further studies are needed to explore the species composition of this important group of zooplankton that helps to understand dynamics of zooplankton community and the food chain in the marine environment.

Keywords
tintinnids, zooplankton, Hurghada, Red Sea.

1. INTRODUCTION

Tintinnids areloricate ciliates of the order Choreotrichida.They are important components in the aquatic environments, constituting a principal part of zooplankton [29].They are ranged from 20 to 200µm in size.

Some other planktons also have loricae (e.g. pteropods), but the loricae of tintinnid species are different in structure. The loricae have various shapes, represented by vase -shaped, bowl-like

and simple tube [4]. The different shapes of loricae are used to identify tintinnid species that are over 1,000 species[11].

Tintinnids play a vital role in the food web andare considered significant second trophic level consumers numerically that consume mainly nano and pico-plankton[7]. They are in turn, food source for higher trophic levels, thus acting as trophic intermediates that can transfer energy from the lower trophic levels to the higher ones [12,16].

Many studies are conducted on the different zooplankton groups in the Red Sea some of which investigated tintinnids[8,9,18,22,23].Kimor and Golandsky-Baras (1981) recorded 42 tintinnid species[21] .Khalil and Abd El-Rahman (1997) recorded six species of tintinnids[20]. El-Sherif and Aboul-Ezz (2000) stated that only 25 tintinnid species were found[14]. AbouZaid and Hellal (2012) revealed the presence of 92 tintinnid species [3].Galal (2017) recorded only 2 species of tintinnids[15]. Further studies are needed to explore the species composition of tintinnids in the Egyptian coast of the Red Sea. The current study aims to provide a recent and updated checklist of tintinnids in the north western Red Sea.

2. MATERIALS AND METHODS

Study area

The present study was carried out in Hurghada northern coast of the Red Sea and extended 10 km seaward covering an area of about 300 km^2 from coastline to the borders of Big Gifton Island. Study area was divided into four sectors and at each sector, three seaward sites were chosen resulting in 12 sites. The sites from north to south are as follow: sites 1-3 at Arabia village, 4-6 at marina of Hurghada, 7-9 at Sheraton village, and 10-12 at Magawish Island (control), representing different habitats such as coral reefs, seagrass and shallow lagoons (Fig. 1). The coordinates of each site were represented in Table (1).

Table 1: Coordinations of study stations.

Sector	Station	**Latitudes (N)**	**Longitudes (E)**
Arabia Village	1	27°14.362′	33° 51.235′
	2	27° 14.427′	33° 51.556′
	3	27° 14.467′	33° 52.285′
HurghadaMarina	4	27° 13.320′	33° 50.554′
	5	27° 13.335′	33° 51.122′
	6	27° 13.345′	33° 51.280′
Sheraton Village	7	27° 11.284′	33° 50.749′
	8	27° 11.926′	33° 51.473′
	9	27° 10.479′	33° 51.235′
Magawish Island	10	27° 8.356′	33 ° 50.509′
	11	27° 8.362′	33 ° 50.146′
	12	27° 8.371′	33° 51.235′

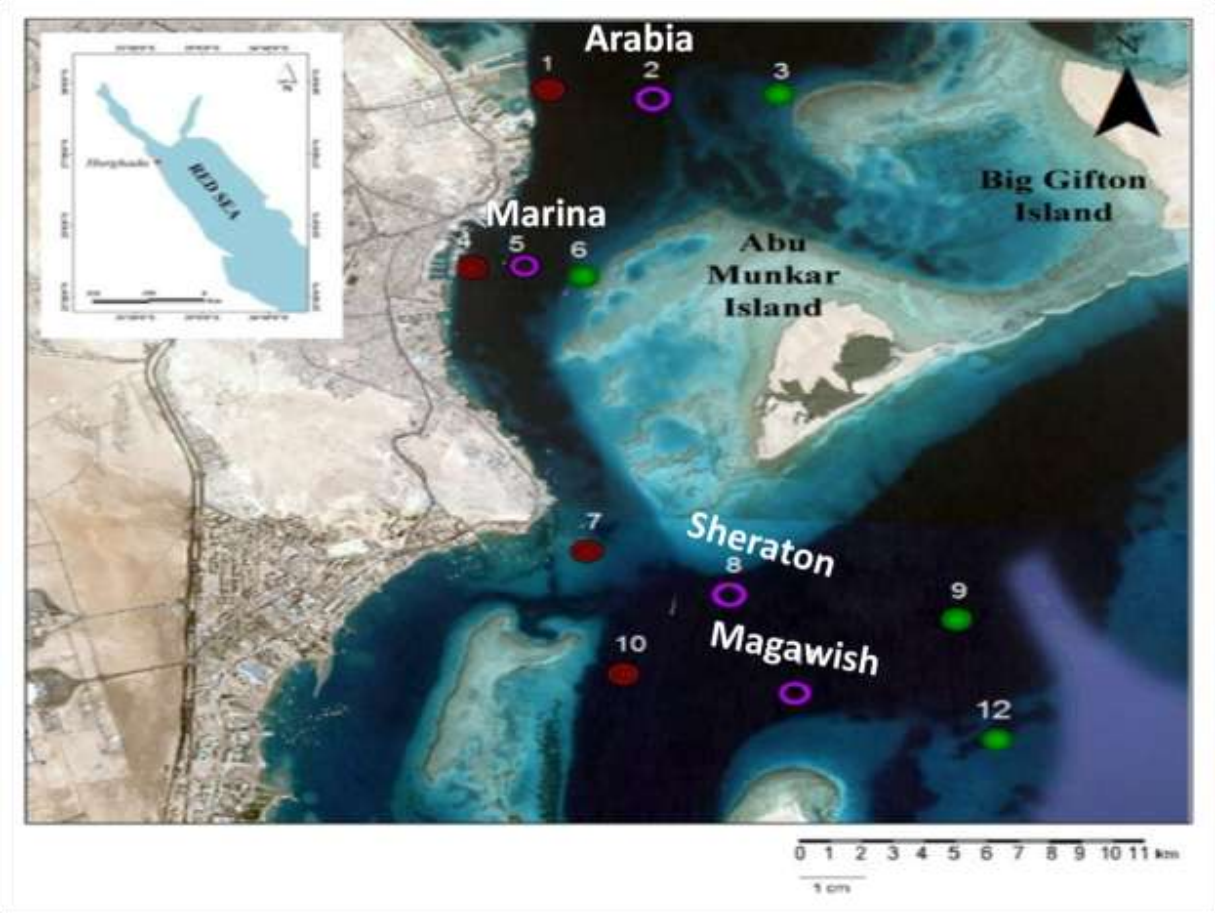

Figure 1: Study area showing selected sites at Hurghada, Red Sea.

Sampling and identification

Monthly tintinnid samples were collected from August 2014 to July 2015 at selected sites. The sampling was carried out during morning and afternoon to avoid the vertical migration of zooplankton. A micro-zooplankton net of 20 µm mesh size (20 cm mouth diameter and 60 cm length) was used for sampling. Samples were immediately preserved in 4% buffered formalin. Tintinnids were taxonomically categorized with the help of identification catalogues according to Meunier (1919); Kofoid and Campbell (1929, 1939), Marshall(1969); and Al-Yamani *et al* (2011).The obtained tintinnids were then validated with the help of database sites, WoRMS (World Register of Marine Species) and PCP (Planktonic Ciliate Project)and named according to the latest taxonomical nomenclature

3. RESULTS AND DISCUSSION

A total of 149 species of tintinnids belonging to 36 genera and 12 families was recorded in the present study (Table, 2). In terms of number of species, families Codonellidae, Tintinnidae, and Codonellopsidae were the most diversified families represented by 40, 28 and 20 species, respectively, constituting collectively around 60% of the total number of recorded species. Family Tintinnidae was represented with

the highest number of genera (8). Genus *Tintinnopsis* included the highest number of species (34) followed by *Codonellopsis* (15 species).

Table 2: Number of families, genera and species of tintinnids recorded in Hurghada, Red Sea

Families	*Genera*	*Species*	*%*
Ascampbelliellidae	3	4	2.68
Codonellidae	3	40	26.85
Codonellopsidae	3	20	13.42
Cyttarocylididae	1	1	0.67
Epiplocylididae	3	9	6.04
Metacylididae	5	16	10.74
Ptychocylididae	2	5	3.36
Rhabdonellidae	3	11	7.38
Tintinnidae	8	28	18.79
Tintinnidiidae	1	4	2.68
Undellidae	2	9	6.04
Xystonellidae	2	2	1.34

The present study added 132 species to the study of Kimor and Golandsky-Baras(1981) [21] ,147 species to the study of Khalil and Abd El-Rakman(1997) [20], 138 species to the review conducted by El-Sherif and Aboul-Ezz (2000) [14], 98 species to the review of Abou Zaid and Hellal (2012) [3]; while Galal (2017) studied the Prevalence of Protozoa in Hurghada recording only two species[15]. This study indicates that, about 89 species were found to be new to the proper Red Sea.

Many studies were conducted in the Mediterranean Sea [1,2]. Dolan (2000) recorded a total of 90 tintinnid species of which 27 are recorded in the present work [10]. Heneash *et al.* (2015) recorded 29 species of which 14 species are collected during the present study [19]. Moreover, a total of 87 species were recorded by Zakaria *et al*. (2018) [28], of which 32 are found in the Red Sea. Modigh *et al*. (2003) recorded 85 species[24] of which 25 are found in the present study(34 species in the Mediterranean Sea of which 15 are found in the current study,21 species in the Red Sea of which 13 are found in our study, 22 species in the Arabian Sea of which 11are found in the present study,13 species in the Tasman Sea of which 5 are found in the present study and 58 species in the Indian Ocean of which 22 are found in the present study) A total of 55 species were found to be common in the Arabian Sea (Al-Yamani *et al*.,2011[6])and the Red Sea (Table 2).

Table 2: List of the tintinnids species recorded in the present study with comparison to the recorded species in the previous studies.

family	**Tintinid species**	Present study	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Ascampbelliellidae	*Acanthostomella norvegica*	+											
Tintinnidae	*Amphorellopsis acuta*	+				+			+		+		
	Amphorides amphora	+							+		+	+	+
	A.brandti	+				+							
	A. minor	+							+			+	
	A.quadrilineata	+	+			+	+			+	+	+	+

Ascampbelliellidae	*Ascampbelliella obscura* **	+									+		
	A.urceolata	+			+								
Tintinnidae	*Canthariella brevis*	+											
Metacylididae	*Climacocylis scalaria*	+	+			+	+						
Codonellidae	*Codonella apicata* **	+										+	
	C. cratera	+											
	C. cuspidata	+											
	C. nationalis	+				+	+			+			
	C.perforata	+	+							+			
Codonellopsidae	*Codonellopsis aleutiensis*	+											
	C.biedermanni	+											
	C. borealis	+											
	C.brasiliensis	+											
	C.curta	+											
	C.erythraensis	+				+							
	Codonellopsisglobosa	+											
	C.morchella	+	+	+		+		+		+	+		
	C.obconica	+											
	C.obesa	+											
	C.orthoceras	+	+			+				+			+
	C.ostenfeldi	+				+					+		
	C.pusilla	+											
	C.robusta	+											
	C.schabi	+				+						+	
Metacylididae	*Coxliella annulata* *	+						+			+		
	C.declivis *	+	+										
	C.frigida *	+											
	C. longa *	+											
	C. mariana *	+											
Ptychocylididae	*Cymatocylis convallaria*	+											
Cyttarocylididae	*Cyttarocylis ampulla*	+	+							+	+		
Tintinnidae	*Dadayiella cuspis*	+									+		
	D.ganymedes	+				+	+			+	+	+	+
Epiplocylididae	*Epiorella curta*	+	+										
	E.healdi	+					+						
	Epiplocylis constricta	+										+	
	E.inconspicuata	+											
	E.inflata	+											
	E.ralumensis	+				+							
	E.sargassensis	+											
	E.undella	+	+		+	+	+	+		+			
	Epiplocyloides reticulata	+				+							+

Tintinnidae	*Eutintinnus apertus*	+			+	+			+		+	+	+
	E. birictus	+											
	E. elongatus	+				+			+				+
	E.fraknoii	+			+	+	+		+	+	+	+	+
	E.lusus-undae	+				+	+	+	+	+	+	+	+
	E.macilentus	+					+			+	+	+	+
	E.similis	+											
	E.stramentus	+										+	+
	E.tenuis	+					+				+		
	E.tubulosus	+					+			+		+	+
	E.turgescens	+										+	
Ptychocylididae	*Favella adriatica*	+						+	+	+	+	+	
	F.azorica	+	+	+		+	+	+	+	+		+	
	F. campanula	+				+			+		+	+	
	F.composita	+											
Metacylididae	*Helicostomella edentata*	+				+			+	+			
	H. longa	+									+		
	H.subulata	+				+		+	+	+		+	
Codonellopsidae	*Laackmanniella navicularaefera*	+											
Tintinnidiidae	*Leprotintinnus elongatus*	+									+		
	L.nordqvisti	+				+			+		+		
	L.pellucidus	+				+							
	L. bubiyanicus	+									+		
Metacylididae	*Metacylis corbula*	+				+							
	M.jorgensenii	+				+	+				+	+	
	M.lucasensis	+									+		
	M.oviformis	+											
	M.sanyahensis	+											
	M.tropica	+									+		
Ascampbelliellidae	*Niemarshallia aperta*	+											
Xystonellidae	*Parundella aculeata*	+	+			+							
Codonellidae	*Poroecus curtus*	+				+							
Undellidae	*Proplectella claparedei*	+	+		+							+	+
	P.globosa	+					+			+			
Rhabdonellidae	*Protorhabdonella curta*	+				+	+				+	+	+
	P.mira	+										+	
	P. simplex	+	+			+	+	+			+		+
	Rhabdonella amor	+				+	+			+		+	+
	R.conica	+			+					+	+		
	R. cornucopia	+											+
	R.elegans	+			+		+			+		+	
	R.poculum	+				+							+
	R.spiralis	+	+		+	+	+	+		+		+	
	R.striata	+									+		
	Rhabdonellopsis apophysata	+											

Tintinnidae	*Salpingacantha ampla*	+				+				+			
	Salpingella acuminata	+				+				+		+	+
	S.attenuata	+			+	+				+	+	+	+
	S.glockentogeri	+										+	
	S.laackmanni	+											
	S.rotundata	+									+		
	Steenstrupiella gracilis	+				+	+						+
	S.intumescens	+	+			+	+						+
	S.steenstrupii	+				+	+			+		+	+
	Stenosemella avellana	+											
	S.nivalis	+					+					+	
	S. steini	+					+						
	S. ventricosa	+										+	
Metacylididae	*Stylicauda platensis*	+											
Codonellidae	*Tintinnopsis acuminat a*	+							+		+		
	T.amoyensis	+											
	T.ampla	+									+		
	T.angusta	+									+		
	T. baltica	+									+		
	T.brevicollis	+											
	T. beroidea	+	+		+			+	+	+	+	+	
	T. campanula	+			+	+		+	+			+	
	T.compressa	+				+		+	+		+	+	
	T.conus	+											
	T.cylindrica	+				+		+	+	+		+	+
	T.dadayi	+									+		
	T.digita	+											
	T.directa	+									+		
	T.failakkaensis **	+									+		
	T. fimbriata	+											
	T.gracilis	+				+			+		+		
	T.karajacensis	+							+		+		
	T.lobiancoi	+				+		+	+	+	+		
	T.lohmanni	+									+		
	T. nana	+				+					+	+	
	T.orientalis	+				+				+	+		
	T.parva	+					+				+		
	T.plagiostoma	+							+				
	T. radix	+				+			+	+	+	+	
	T.rara	+											
	T.rotundata	+				+			+		+		
	T.sacculus	+									+		
	T.tocantinensis	+				+					+		
	T.undella	+									+		
	T.urnula	+									+		
	T. vasculum	+											
	T. turbo	+									+		
	Tintinnopsis sp.	+											

Undellidae	*Undella dilatata*	+									+		
	U.hadai	+											
	U.minuta	+											
	U. dohrnii	+								+			
	U. hemispherica	+											
	U. subacuta	+				+	+						
	Undella sp.	+											
Xystonellidae	*Xystonella treforti*	+	+			+	+			+	+		+

* nomeninquirendum, ** taxoninquirendum

1, Kimor and Golandsky-Baras,1981 Gulf of Aqaba, [21]; 2, Khalil &Abd El-Rakman,1997 Gulf of Aqaba (1994-1995) [20]; 3, El-Sherif and Aboul Ezz ,2000 (1993-1994)northern Red Sea [14]; 4, Abou Zaid and Hellal 2012 (2009) Hurghada[3];5, Dolan,2000(1996) Mediterranean Sea[10]; 6, Heneash *et al*. ,2015(2012) Egyptian Mediterranean Sea[19]; 7, Abo-Taleb *et al* ,2016(2011-2012) west of Alexandria Mediterranean Sea[2]; 8, Zakaria *et al*. 2018 (2008–2010) South eastern Mediterranean, [28]; 9, Al-Yamani *et al*. ,2011 (1999-2010) Kuwait waters (the north western corner of the Arabian Gulf) [6] ; 10, Abi Saab *et al.* ,2012(2001-2003) Lebanese coastal waters (Eastern Mediterranean) [1] ; 11, Modigh *et al*. ,2003 from 42◦ N to 43◦ S through the Indian Ocean passing through the Eastern Mediterranean, the Red Sea, the Arabian Sea, the Indian Ocean and the Tasman Sea[24].

It is worth to mention that, the same tintinnid species has different loricae shapes and sizes which made identification very difficult. The species *Petalotricha ampulla* (Fol, 1881) Kent, 1882was identified as *Cyttarocylis ampulla*; while species of *Tintinnopsis davidoffi* and *Tintinnopsis levigata* are represented as *Tintinnopsis cylindrica* .So further researches will be needed for identifying tintinnid species using genetic tools for more potential accuracy.

The authors believe that the reason for the great species diversity in the current study is due to several factors, including the methods of collection, the quality of the plankton nets, and that samples were collected monthly, not on seasonal basis, also the examination and definition process that was carried along period of time to be done correctly. Also some new species may be introduced through ballast water.

4. CONCLUSION

In the present study, 12families are recorded including 36 genera and 149 species. Codonellidae (40 species, 26.85%) ,Tintinnidae (28 species, 18.79%) and Codonellopsidae(20 species, 13.42%) families have the highest species number . Eighty nine species were added to the studies conducted by Kimor and Golandsky-Baras(1981), Khalil and Abd El-Rahman(1997), El-Sherifand Aboul-Ezz (2000), AbouZaid and Hellal (2012), and Galal (2017).Changing in composition of tintinnid species is expected so an updated check list is continuslly needed using genetic tools for identification .

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