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First Records of Tintinnid (Protozoa: Ciliophora: Tintinnina) Species in Manila Bay

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Abstract: The goal of this study is to have an updated list of tintinnid species living in Manila Bay and to determine their spatio-temporal distribution. Bi-monthly survey of zooplankton was done from January to December 2014 within 16 stations. A total of 26 large tintinnid species (>40 µm) were recorded in this study by identification based on their lorica shape. Among the said species, eighteen (18) of them are first reports in Manila bay and added to the regional check list of the Philippine Sea. On the other hand, high concentrations of tintinnids are found in the northern side of the bay where shallow waters are located. A higher number of species and greatest abundance were observed during the dry season of May where highest temperature was also noted.

Key Words: Tintinnids; Protozoa; Manila Bay; Microzooplankton

1. INTRODUCTION

The main role of tintinnids in the marine community is they serve as the link between micro- and macro- zooplanktons (Pierce and Turner, 1993). The ability of tintinnids to have fast reproduction rates and high abundance combined with high grazing impact (Laval-Peuto and Brownlee, 1986), success for culturing specimens (Verity, 1984) and a potential bio-indicators of water masses (Lee and Kim, 2010), heighten the importance of studies for tintinnids.

In spite the fact that tintinnids have significance to marine ecosystem, they have been given less attention in the Philippines. Taniguchi (1977) has reported the existence of tintinnids in the Philippine Sea but only as a group of ciliates and without specific list of species. The only taxonomical study of tintinnids in the Philippines was made by Roxas (1941) within Manila Bay (former Bacoor Bay) and Puerto Galera.

Therefore, the aim of this study is to have an updated list of tintinnid species living in Manila Bay and to determine their spatio-temporal distribution and its relationship with environmental factors namely: Temperature, Salinity, Chlorophyll- a concentration, pH, Phosphate, dissolved oxygen, nitrate, nitrite, silicate and total dissolve solids.

2. METHODOLOGY

This study was carried out in Manila Bay within the months of January, March, May, July, September and November in 2014. The basic hydrographic conditions of the environment were measured using YSI MDS 6600. Chlorophyll –a concentration samples was first filtered through cellulose nitrate membrane filter, then chlorophyll –*a* was extracted using 90% acetone solution and was subjected to spectophometry.

Zooplanktons were collected in 16 stations by vertically towing a plankton net with 64 µm mesh size. Seawater samples were preserved with 4% formaldehyde solution. Tintinnids were observed and counted using Sedgewick-Rafter cell under Olympus compound light microscope equipped with an Infinity and Motic camera. References used to identify the tintinnids were Cleve (1899), Jörgensen (1924), Kofoid and Campbell (1929, 1939). Surfer 11 was used in bi-plot analysis of tintinnids distribution. Canoco 5 was utilized in performing multivariate analysis of tintinnid samples with its environmental factors.

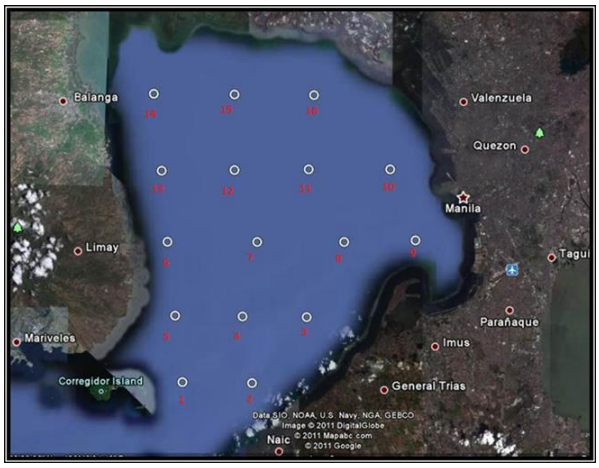

Fig. 1. Manila Bay Study site

3. RESULTS AND DISCUSSION

The only study in the Philippines that reported tintinnids up to species level was made by Roxas in 1941, wherein he noted twenty-one species in Manila bay (former Bacoor bay) and twelve species in Puerto Galera Bay. Among the specimens identified by Roxas (1941), a total of eight species in this study has been found. The six species that was same seen in Manila bay are *Tintinnopsis butschlii, Tintinnopsis gracilis, Tintinnopsis radix, Tintinnopsis tocantinensis, Favella ehrenbergii* and *Leprotintinnus nordqivisti.* The other two species, *Epiplocyclis undella* and *Rhabdonella spiralis,* was formerly recorded in Puerto Galera Bay. Therefore, the remaining eighteen species in this study has been reported for the first time from Manila Bay and added to the regional check-list of plankton species of Philippines Sea.

Table 1. Morphometrics of tintinnid species

Species	Lorica Length in µm (n=5)	Lorica Oral Diameter in µm (n=5)
*Codonellopsis morchella**	81-112	30-36
*Codonellopsis orthoceras**	177-190	51-53
Epiplocyclis undella	101-123	36-41
*Eutintinnus fraknoi**	175-197	34-38
*Eutintinnus lusus-undae**	278-377	43-86
Favella ehrenbergii	196-239	84-89
*Helicostomella longa**	40-71	17-21
Leprotintinnus nordqivisti	182-243	36-49
*Metacyclis jörgensenii**	56-60	38-50
*Metacyclis tropica**	55-60	34-36
*Rhabdonella conica**	294-303	53-56
*Rhabdonella sanyahensis**	101-130	33-36
Rhabdonella spiralis	230-285	50-56
*Tintinnopsis beroidea**	88-101	34-37
Tintinnopsis bustchlii	80-94	98-137
*Tintinnopsis chinglanensis**	109-137	47-56
*Tintinnopsis corniger**	155-215	30-32
*Tintinnopsis cylindrica**	235-270	34-41
*Tintinnopsis directa**	75-105	43-47
Tintinnopsis gracilis	115-130	35-45
Tintinnopsis radix	181-346	35-113
*Tintinnopsis rotundata**	69-88	45-51
Tintinnopsis tocantinensis	95-192	22-38
*Tintinnopsis uruguaynensis**	68-75	27-31
*Wangiella dicollaria**	48-65	25-30
*Undella claparedei**	77-81	32-38

*First Records of this study in Manila Bay

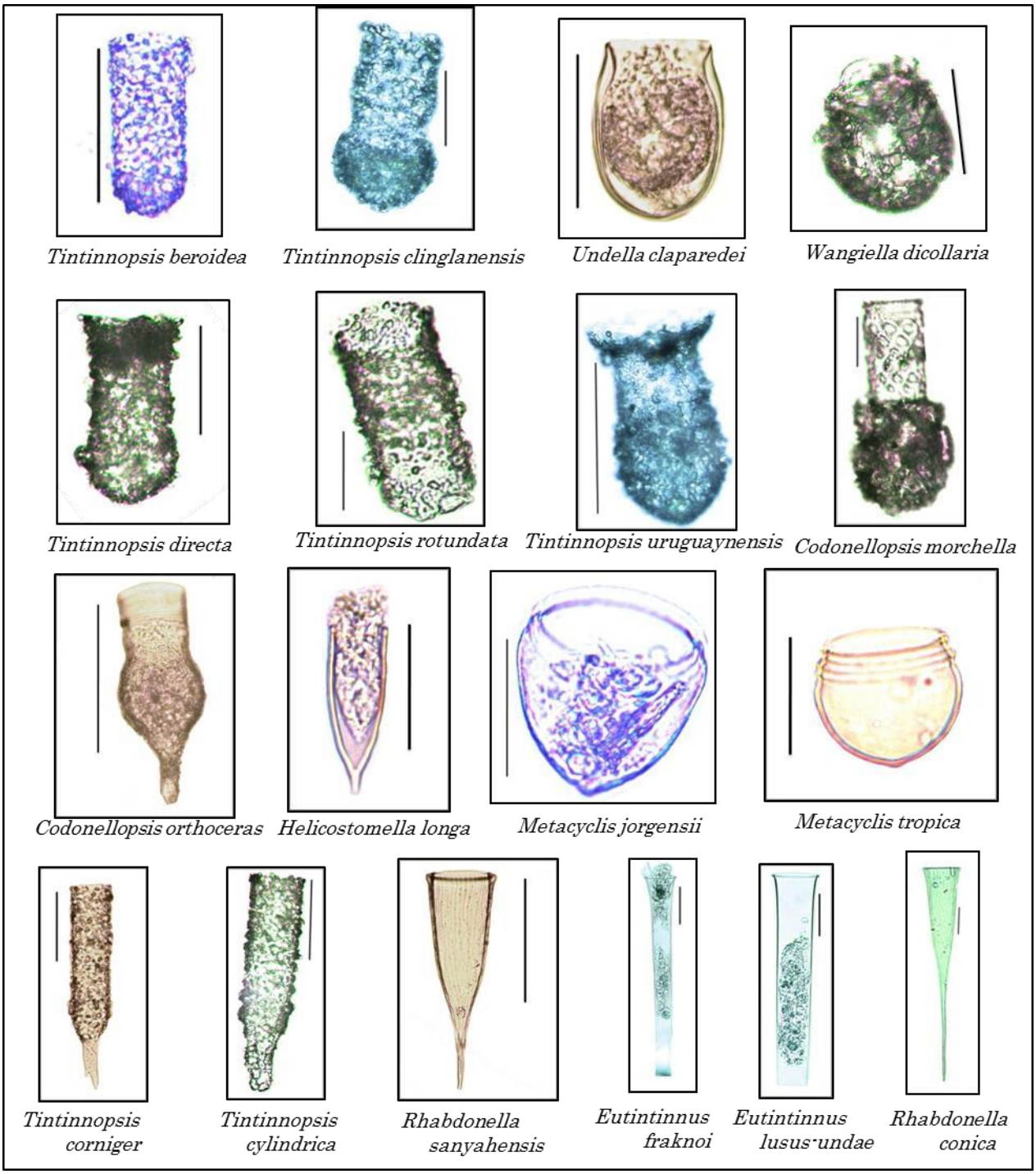

Fig. 2. First records of tintinnid species in Manila Bay (scale: 50 μm)

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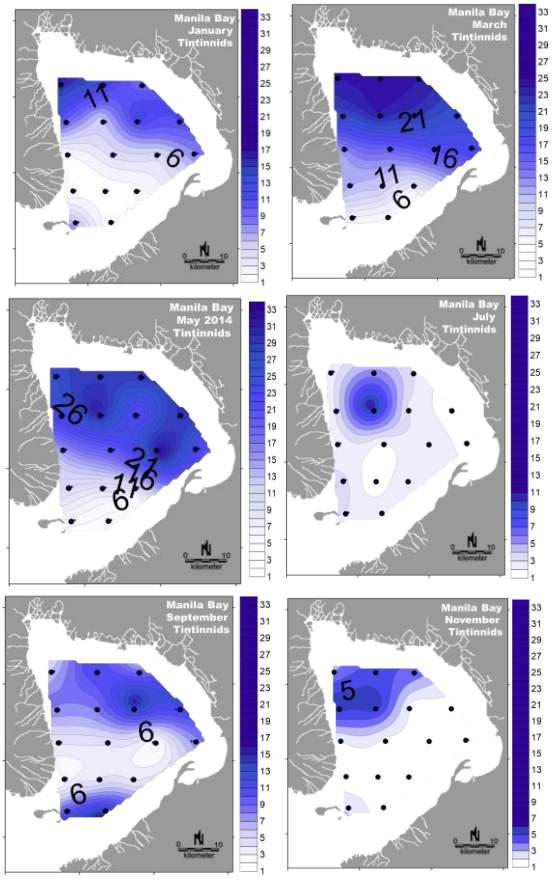

Fig. 3. Spatio-temporal distibution of tintinnids abundance (ind/m^3). (Dots indicate the position of sampling stations)

Manila Bay is a mildly sloping basin with the depth increasing from interior to the entrance, on the contrary, the observed tintinnids abundance distribution pattern decreases from interior to the entrance. Consistently in all sampling periods, high number and concentrations of tintinnids are mostly found in northern side of the bay where shallow waters are located. The tintinnid spatial pattern could be explained considering that the dominant species are mostly agglutinated tintinnids which have ample amounts of attached non-biogenic and biogenic particles (Gold and Morales, 1976). Agglutinated tintinnids are restricted to near shore areas where they easily access the minerals that they need in forming their lorica. This results could support that tintinnids can be utilized as bio-indicators of water masses due to the restriction and abundance of agglutinated species in neritic areas.

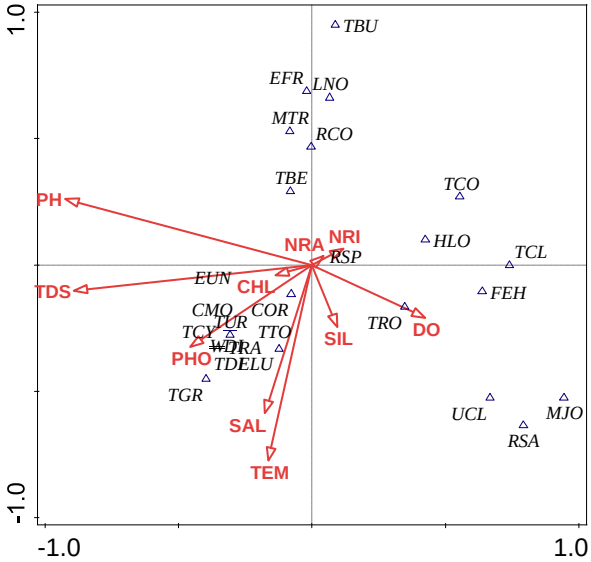

Fig. 4. Redundancy Analysis of tintinnid species (black labeled) in Manila bay with environmental parameters (red labeled).

Table 2. Monte Carlo Test of Significance

Analysis 'RDA' Conditional Tem Effects			
Name	Explains %	Pseudo-F	P
Temperature (TEM)	8.3	8.1	0.002
pH	4.4	4.4	0.002
Total Dissolved Solids (TDS)	1.8	1.8	0.032
Salinity (SAL)	3.6	3.8	0.002
Dissolved Oxygen (DO)	1.6	1.7	0.058
Nitrate (NRA)	1.5	1.6	0.138
Phosphate (PHO)	1.3	1.4	0.158
Silicate (SIL)	0.9	1.0	0.436
Nitrite (NRI)	0.8	0.9	0.57
Chlorophyll-a (CHL)	0.8	0.8	0.514

Temperature, pH, total dissolved solids, salinity and dissolved oxygen have a significant relationship with the tintinnids abundance (see Fig.4 and Table 2) that could suggest that these environmental factors are mostly affecting the species composition and variation of tintinnids in the bay. The maximum density of the tintinnids was recorded in May with highest recorded temperature while low densities of tintinnids were observed with low temperature months, particularly in July and November. Complementary temporal variations have also been noted by other studies in marine coastal and estuarine waters (Capriulo and Carpenter, 1983; Verity, 986; Godhantaraman, 2002).

Moreover, in other studies, chlolrophyll-a has a significant relationship with tintinnids abundance (Verity, 1985; Godhantaraman, 2001), yet in this study, they have no significant relationship (Table 1). A research by Capriulo and Carpenter (1983) stated that there is a weak relationship between tintinnids abundance and total concentration of phytoplankton. They also mentioned that although the occurrence of small food alone is necessary, it is not sufficient factor for high tintinnids abundance. Futhermore, Thompson et. al. (1999, 2001) indicated that tintinnids abundance is seemingly affected by abiotic factors rather than food availability.

4. CONCLUSIONS

This paper provides a baseline knowledge about tintinnids community in Manila Bay. A correlation and its grazing impact to the phytoplankton community can be a next step in understanding other importance of tintinnids in Manila Bay.

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