Species check-list for Tintinnids of the Philippines Archipelago (Protozoa, Ciliophora)

Jane Abigail Santiago¹, Maria Carmen Lagman¹

¹ De La Salle University, Taft Avenue, Manila

Corresponding author: Maria Carmen Lagman (ma.carmen.lagman@dlsu.edu.ph)

Academic editor: P. Stoev | Received 5 March 2018 | Accepted 17 May 2018 | Published 5 July 2018

Abstract
Tintinnids are an essential link between nano- and macro- planktons in the food webs of the marine environment. It is also known that tintinnids are one of the major components of marine planktonic ciliates and has a cosmopolitan character. In the Philippine archipelago, which is recognized as a center of marine biodiversity, tintinnids checklist has not been done or published. Therefore, a checklist is presented in this study based on a compilation of previous tintinnids studies conducted at the Philippines waters. As a result of the studies done since 1941 up to present, a total of 114 taxa belonging to 14 families and 37 genera were listed. The Philippines coastal waters record a total of 50 species while the open seas document 72 species to date.

Keywords
Ciliates, list, Manila Bay, Philippine Sea, plankton, zooplankton

Introduction
Microzooplankton (20–200µm) constitute a major component of the marine plankton community. Previously, the significance of microzooplankton (MZP) was commonly linked with microbial loop and corresponding microbial web (Calbet and Landry 2004, Calbet et al. 2008), but recent studies have shown that they also play a key
role in the herbivorous food web (Dolan et al. 2007, Putland and Iverson 2007). MZP graze a wide variety of particles from bacteria to nano- and phytoplankton as well as other similar organisms. They have a crucial role in the first feeding of the larval fishes (Stoecker and Capuzzo 1990, Fukami et al. 1999) and thus should be valued in the aquaculture industry. The awareness of the dynamic role of MZP in marine ecosystem resulted in the increase of scientific interest in the factors affecting their abundance and distribution. Research on microzooplankton arises as one of the vital parts of biological oceanography. In order to fully understand MZP behavior in different environments, a systematic qualitative study that includes listing of the species in a region is an essential step in exploring these organisms.

One of the best-known groups of marine microzooplanktonic ciliates is tintinnid (Kato and Taniguchi 1993). The distinctive characteristic of the tintinnid is its lorica, which has been the basis of their identification and classification. The easiness in identifying tintinnids based on their morphological features made them model specimens for research on species distributions, diversity, and variations in the structure of microzooplankton communities (Dolan and Gallegos 2001). Studies about the tintinnid distribution are essential due to the fact that they have been used as bio-indicators of different water masses (Kim et al. 2012). For example, the tintinnid species named *Epiploocyloides reticulata* (Ostenfeld & Schmidt, 1901) has been acknowledged as the Kuroshio water current indicator (Lee and Kim 2010). Records of *E. reticulata* are important to know the geographic extension of the warm Kuroshio current and the possible areas it can affect. A documentation of the tintinnid distribution is recognized as one of the best method to trace the flow of the water mass in open oceans and coastal waters (Lee and Kim 2010). In an archipelagic country such as Philippines, conducting tintinnid studies can be helpful in tracing different water masses and can aid in the assessment and management of its marine environment. However, tintinnids are poorly studied in the Philippines, a place which has been recognized as the center of the center of marine shore fish biodiversity (Carpenter and Springer 2005). A species- checklist for tintinnids specific for the Philippines can be a good starting point for any researcher who wants to conduct a tintinnid survey or any type of investigation in the country. In order to assist other possible and future tintinnids studies in the Philippines, this present work aims to present the first and current checklist of tintinnid species in the Philippines. The authors also made this list to encourage other researcher to increase tintinnid studies in the Philippines. This study is based on a compilation of the literature to date.

**Materials and methods**

The Philippines archipelago is bound by the Bashi Channel to the north, the Philippine Sea to the east and northeast, the Celebes Sea to the south, the Sulu Sea to the southwest, and the South China Sea to the west and northwest side.

In this study, all published literature from 1941 to 2017 was examined. Taxonomical species and author names were written according to Roxas (1941), Gómez (2007),
Kim et al. (2012) and Santiago et al. (2017). The study of Taniguchi (1977) was not included as a reference in enumerating tintinnid species since he only referred tintinnids as a group and his paper does not contain any detailed list of tintinnid species. The WoRMS (World Register of Marine Species) data system (Warren 2018) was used for classification and basis of the current species name. The species checklist in this study is alphabetically ordered.

**Results**

In related studies conducted in the Philippines, 114 tintinnid species belonging to 14 families and 37 genera have been recorded. The families Codonellidae (22 species, 19.30%) and Tintinnidae (21 species, 18.42%) have the highest recorded species (Table 3). The systematic list and biogeographical distribution of the species are presented below:

**Kingdom: Chromista**
Subkingdom: Harosa
Phylum: Ciliophora Doflein, 1901
Class: Oligotrichia Bütschli, 1887
Subclass: Oligotrichia Bütschli, 1887
Order: Choreotrichida Small & Lynn, 1985
Family: *Ascampbelliellidae* Corliss, 1960
   Genus: *Acanthostomella* Jørgensen, 1927
      *Acanthostomella conicoides* Kofoid & Campbell, 1929
      *Acanthostomella minutissima* Kofoid & Campbell, 1929

Figure 1. Map of the Philippines. Dots indicate the sites with recorded tintinnid species. Key: green dots: coastal water; red dots: open sea.)
Genus: *Ascampbelliella* Corliss, 1960
- *Ascampbelliella acuta* (Kofoid & Campbell, 1929)
- *Ascampbelliella armilla* (Kofoid & Campbell, 1929)
- *Ascampbelliella retusa* (Hada, 1935)
- *Ascampbelliella urceolata* (Ostenfeld, 1899)

Genus: *Craterella* Kofoid & Campbell, 1929
- *Craterella aperta* Marshall

Family: **Codonellidae** Kent, 1881
Genus: *Codonaria* Kofoid & Campbell, 1939
- *Codonaria oceanica* (Brandt, 1906)

Genus: *Codonella* Haeckel, 1873
- *Codonella amphorella* Biedermann, 1893

Genus: *Poroecus* Cleve, 1902
- *Poroecus annulatus* Kofoid & Campbell, 1929
- *Poroecus apicatus* Kofoid & Campbell, 1929

Genus: *Tintinnopsis* Stein, 1867
- *Tintinnopsis bacoornensis* Roxas, 1941
- *Tintinnopsis beroidea* Stein, 1867
- *Tintinnopsis buetschlii* Dayad, 1887
- *Tintinnopsis campanula* Ehrenberg, 1840
- *Tintinnopsis chinglanensis* Nie & Cheng, 1947
- *Tintinnopsis corniger* Hada, 1964
- *Tintinnopsis cylindrica* Dayad, 1887
- *Tintinnopsis directa* Hada, 1932
- *Tintinnopsis gracilis* Kofoid & Campbell, 1929
- *Tintinnopsis loricata* Brandt, 1906
- *Tintinnopsis major* Meunier, 1910
- *Tintinnopsis manilensis* Roxas, 1941
- *Tintinnopsis mortensenii* Schmidt, 1902
- *Tintinnopsis radix* (Imhof, 1886)
- *Tintinnopsis rotundata* Kofoid & Campbell, 1929
- *Tintinnopsis tocaninensis* Kofoid & Campbell, 1929
- *Tintinnopsis turgida* Kofoid & Campbell, 1929
- *Tintinnopsis uruguayensis* Balech, 1948

Family: **Codonellopsidae** Kofoid & Campbell, 1929
Genus: *Codonellopsis* Jörgensen, 1924
- *Codonellopsis morchella* (Cleve) Jörgensen, 1924
- *Codonellopsis orthoceras* (Haeckel, 1873) Jörgensen, 1924
- *Codonellopsis ostenfeldi* (Schmidt, 1902) Kofoid & Campbell, 1929
- *Codonellopsis pusilla* (Cleve) Jörgensen, 1924
- *Codonellopsis schabi* (Brandt, 1906) Kofoid & Campbell, 1929

Family: **Cyttarocylididae** Kofoid & Campbell, 1939
Genus: *Cyttarocylis* Fol, 1881
- *Cyttarocylis cassis* (Haeckel, 1837)
Family: **Dictyocystidae** Haeckel, 1873  
Genus: Wangiella Nie, 1934  
*Wangiella dicollaria* Nie, 1934  
Genus: *Dictyocysta* Ehrenberg, 1854  
*Dictyocysta elegans* Ehrenberg, 1854  
*Dictyocysta mitra* Haeckel, 1873  
Family: **Epiplcyclididae** Kofoid & Campbell, 1939  
Genus: *Epiplcylis* Jörgensen, 1924  
*Epiplcylis calyx* (Brandt, 1906)  
*Epiplcylis exquisita* Kofoid & Campbell, 1929  
*Epiplcylis undella* (Ostenfeld & Schmidt) Jörgensen, 1927  
Genus: *Epiplcyloides* Hada, 1938  
*Epiplcyloides acuta* (Kofoid & Campbell, 1929)  
*Epiplcyloides reticulata* (Ostenfeld & Schmidt, 1901)  
Family: **Metacylididae** Kofoid & Campbell, 1929  
Genus: *Coxliella* Brandt  
*Coxliella longa* Kofoid & Campbell, 1929  
*Coxliella mariana* Hada, 1938  
Genus: *Metacylis* Jörgensen, 1924  
*Metacylis hemisphaerica* Roxas, 1941  
*Metacylis jörgensennii* (Cleve) Kofoid & Campbell, 1929  
*Metacylis kofoidi* Roxas, 1941  
*Metacylis tropica* Duran, 1957  
Genus: *Helicostomella* Jörgensen, 1924  
*Helicostomella longa* (Brandt, 1906)  
Genus: *Climacocyris* Jörgensen, 1924  
*Climacocyris elongata* Kofoid & Campbell, 1929  
*Climacocyris cf. leospiralis* Kofoid & Campbell  
*Climacocyris scalaria* Brandt, 1906  
*Climacocyris sipho* (Brandt, 1906) Kofoid & Campbell, 1929  
Family: **Petalotrichidae** Kofoid & Campbell, 1929  
Genus: *Petalotricha* Kent, 1881  
*Petalotricha major* Jörgensen, 1925  
Family: **Ptychocyclididae** Kofoid & Campbell, 1929  
Genus: *Favella* Jörgensen, 1924  
*Favella ehrenbergii* (Claparède & Lachmann, 1858) Jörgensen, 1924  
*Favella simplex* Roxas, 1941  
*Favella philippinensis* Roxas, 1941  
*Favella elongata* Roxas, 1941  
*Favella azorica* (Cleve, 1900) Jörgensen, 1924  
Family: **Rhabdonellidae** Kofoid & Campbell, 1929  
Genus: *Rhabdonella* Brandt, 1906  
*Rhabdonella amor* (Cleve, 1900) Brandt, 1907
Rhabdonella apophysata Jörgensen, 1924
Rhabdonella brandti Kofoid & Campbell, 1929
Rhabdonella conica Kofoid & Campbell, 1929
Rhabdonella cornucopia Kofoid & Campbell, 1929
Rhabdonella elegans Jörgensen, 1924
Rhabdonella exilis Kofoid & Campbell, 1929
Rhabdonella sanyahensis Nie & Cheng, 1947
Rhabdonella fenestrata Roxas, 1941
Rhabdonella valdestriata (Brandt) Kofoid & Campbell, 1929
Rhabdonella spiralis (Fol, 1881)

Genus: Protorhabdonella Jörgensen, 1924
  Protorhabdonella curta Cleve, 1900
  Protorhabdonella simplex (Cleve) Jörgensen, 1924
  Protorhabdonella striatura Kofoid & Campbell, 1929

Family: Tintinnidae Claparède & Lachmann, 1858

Genus: Amphorellopsis Kofoid & Campbell, 1929
  Amphorellopsis acuta (Schmidt, 1902)

Genus: Amphorides Strand, 1928
  Amphorides amphora (Claparède & Lachmann, 1858)
  Amphorides quadrilineata (Claparède & Lachmann, 1858)
  Amphorides minor Jörgensen, 1924

Genus: Brandtiella Kofoid & Campbell, 1929
  Brandtiella palliata (Brandt, 1906) Kofoid & Campbell, 1929

Genus: Canthariella (Kofoid & Campbell, 1929)
  Canthariella pyramidata (Jörgensen, 1924) Kofoid & Campbell, 1929

Genus: Dadayiella Kofoid & Campbell, 1929
  Dadayiella ganymedes (Entz, 1884) Kofoid & Campbell, 1929
  Dadayiella pachytoecus (Dendy, 1924)

Genus: Eutintinnus Kofoid & Campbell, 1939
  Eutintinnus apertus Kofoid & Campbell, 1929
  Eutintinnus fraknoii (Daday, 1887)
  Eutintinnus lusus-undae (Entz, 1885)
  Eutintinnus stramentus (Kofoid & Campbell, 1929)

Genus Ormosella Kofoid & Campbell, 1929
  Ormosella haeckeli Kofoid & Campbell, 1929

Genus: Salpingella Jörgensen, 1924
  Salpingella acuminata (Claparède & Lachmann, 1858) Jörgensen, 1924
  Salpingella acuminatoides (Laackmann) Kofoid & Campbell, 1929
  Salpingella attenuata Kofoid & Campbell, 1929
  Salpingella decurtata Jörgensen, 1924
  Salpingella subconica Kofoid & Campbell, 1929
Genus: Steenstrupiella Kofoid & Campbell, 1929
  *Steenstrupiella intumescens* (Jörgensen, 1924) Kofoid & Campbell, 1929
  *Steenstrupiella steenstrupii* (Claparède & Lachmann, 1858) Kofoid & Campbell, 1929

Genus: *Tintinnus* Schrank, 1803
  *Tintinnus perminutus* Kofoid & Campbell, 1929

Family: *Tintinnidiidae* Kofoid & Campbell

Genus: *Tintinnidium* Kent, 1881
  *Tintinnidium primitivum* Busch, 1923
  *Tintinnidium cylindrica* Daday, 1886
  *Tintinnidium ampullarium* Roxas, 1941

Genus: *Leprotintinnus* Jörgensen, 1899
  *Leprotintinnus nordqvistii* (Brandt, 1906) Kofoid & Campbell, 1929
  *Leprotintinnus tubulosus* Roxas, 1941

Family: *Undellidae* Kofoid & Campbell, 1929

Genus: *Undella* Daday, 1887
  *Undella claparedei* (Entz) Daday, 1887
  *Undella clevei* Jörgensen, 1924
  *Undella hyalina* Daday, 1887
  *Undella subcaudata* Jörgensen, 1924

Family: *Xystonellidae* Kofoid & Campbell, 1929

Genus: *Parundella* Jörgensen, 1924
  *Parundella aculeata* (Joergensen, 1924)
  *Parundella caudata* (Ostenfeld, 1899) Jörgensen, 1924
  *Parundella inflata* Kofoid & Campbell, 1929
  *Parundella longa* Joergensen, 1924

Genus: *Xystonella* Brandt, 1907
  *Xystonella treforti* (Daday, 1887)

Genus: *Xystonellopsis* Jörgensen, 1924
  *Xystonellopsis brandti* (Laackmann) Jörgensen, 1924
  *Xystonellopsis cymatica* (Brandt, 1906) Jörgensen, 1924
  *Xystonellopsis dahlia* (Brandt, 1906) Kofoid & Campbell, 1929
  *Xystonellopsis paradoxa* (Cleve, 1900) Jörgensen, 1924

The study of Roxas (1941) contained the first recorded tintinnid species in the Philippines. Roxas (1941) documented 32 tintinnid species wherein ten were newly discovered species (Table 2). *Favella simplex*, *Favella philippinensis*, and *Favella elongata* were the only accepted and registered species in the WoRMS database (Warren 2018) among the said newly discovered species. The other newly discovered species are still included in this present checklist due to the scarcity of tintinnid studies in the Philippines. The other newly discovered species were not recorded in any other studies and
we took into consideration that they might be endemic in the area where Roxas (1941) collected them. Roxas also misspelled *Leproninntinus norqvistii*, which he recorded as *Leproninntinus nordquisti*.

Since 1941, only three other studies (Gómez 2007, Kim et al. 2012, Santiago et al. 2017) were made in the Philippines that identified tintinnids to species level. The paper of Roxas (1941) and Santiago et al. (2017) recorded a total of 50 tintinnid species from coastal waters of Manila Bay (39 species) and Puerto Galera Bay (11 species). On the other hand, Gómez (2007) and Kim et al. (2012) conducted their sample collection within the Philippines open seas, which amounted to 72 tintinnid species.

*Tintinnopsis, Codonellopsis, Coxliella, Metacylis, Rhabdonella, Epiplocylis* and *Eutintinus* were the genera that both appeared in coastal and open waters (Table 1). There were eight genera that were only recorded in coastal waters and a total of 24 genera were solely found in the open seas (Table 1). *Epiplocylis undella* and *Rhabdonella spiralis* were the only species common to all of four tintinnid studies in the Philippines (Table 2).

**Discussion**

Presently, there are only four related studies (Roxas 1941, Gómez 2007, Kim et al. 2012, Santiago et al. 2017) that contain tintinnid species in the Philippines. Roxas (1941) and Santiago et al. (2017) conducted their zooplankton collection within the Philippines coastal waters while Gómez (2007) and Kim et al. (2012) had cruises along the open seas. Table 1 and 2 showed the tintinnids distribution between open seas and coastal waters. This is an important data because some of the tintinnids were categorized into biogeographical groups (Pierce and Turner 1993). The studies (Lee and Kim 2010, Kim et al. 2012) that utilized tintinnids as indicator species used their biogeographical groups to assess water quality and mass movements. In this present study, there are species and genera that were only recorded in one area and some both appeared in open seas and coastal waters. Hence, the variation of the tintinnids distribution between open seas and coastal waters in this current work might help in further classification of tintinnid species to their biogeographical groups.

It should also be noted that each of the said four studies had a different sampling technique and effort. Roxas (1941) towed a no. 20 plankton net with 176 mesh per inch which means that it has an aperture of 0.076 mm or 76 µm. The plankton net that Santiago et al. 2017 used has 64 µm mesh size. These can indicate that the majority of the collected species of Roxas (1941) and Santiago et al. 2017 were large tintinnid species (>64 µm). Microzooplankton size range from 20 to 200 µm, thus, collecting tintinnids through plankton net with a relatively larger aperture size can result in loss of most of the smaller-sized tintinnids.

In the studies conducted in Philippines open seas, Gómez (2007) used Niskin bottles while Kim et al. (2012) towed a 20 µm mesh-plankton-net. The differences in methodologies and lack of standardization of sampling technique on tintinnid collection (Gómez 2007) can add complication on the analysis and comparison of
Table 1. Summary of the tintinnid appearance between coastal and open seas by genus.

| Taxon          | Coastal | Open sea | Both  |
|----------------|---------|----------|-------|
| Favella        | Acanthostomella | Codonellopsis |
| Helicostomella | Amphorellopsis | Coxiella |
| Leprotintinnus | Amphorides | Epiplocylys |
| Petalotricha   | Ascampbelliella | Eutintinnus |
| Tintinnidium   | Brandtiella | Metacylis |
| Tintinnus      | Canthariella | Rhabdonella |
| Wangiella      | Climacocylis | Tintinnopsis |

| Taxon         | Coastal | Open sea |
|---------------|---------|----------|
| Codonaria     |         |          |
| Codonella     |         |          |
| Craterella    |         |          |
| Cyttarocylis  |         |          |
| Dadayiella    |         |          |
| Dictyocysta   |         |          |
| Epiplocyliidae|         |          |
| Epiplocyloides|         |          |
| Ormosella     |         |          |
| Parundella    |         |          |
| Poroecus      |         |          |
| Protorhabdonella|       |          |
| Salpingella   |         |          |
| Steenstrupiella|         |          |
| Undella       |         |          |
| Xystonella    |         |          |
| Xystonellopsis|         |          |

Total: 7 | 24 | 7

Table 2. Distribution of tintinnid species reported in the Philippines. The open sea has records from the southwest (SW) seas that include Sulu, Celebes and South China Sea (Gómez 2007). The northeast (NE) was based on the study of Kim et al. (2012) in the Philippine Sea. The species in the Coastal areas were from Manila bay (MB) (Roxas 1941, Santiago et al. 2017) and Puerto Galera Bay (PG) (Roxas 1941). An asterisk (*) denotes new species.

| Taxon                        | Open sea | Coastal |
|------------------------------|----------|---------|
| 1. Acanthostomella conicoides|          | +       |
| 2. Acanthostomella minutissima| +        |         |
| 3. Amphorellopsis acuta      |          | +       |
| 4. Amphorides amphaora       | +        | +       |
| 5. Amphorides minor          |          | +       |
| 6. Amphorides quadrilineata  | +        | +       |
| 7. Ascampbelliella acuta     |          | +       |
| 8. Ascampbelliella armilla   |          | +       |
| 9. Ascampbelliella retusa    |          | +       |
| 10. Ascampbelliella urceolata|          | +       |
| Taxon                          | Open sea | Coastal |
|-------------------------------|----------|---------|
|                               | SW       | NE      | MB | PG |
| 11. Brandtiella palliata      | +        |         |    |    |
| 12. Canthariella pyramidata   | +        | +       |    |    |
| 13. Climacocylis cf. leospiralis | +    |         |    |    |
| 14. Climacocylis elongata     | +        |         |    |    |
| 15. Climacocylis scalaria     | +        | +       |    |    |
| 16. Climacocylis sipho        | +        |         |    |    |
| 17. Codonaria oceanica        | +        |         |    |    |
| 18. Codonella amphorella      | +        |         |    |    |
| 19. Codonellopsis morchella   | +        |         |    |    |
| 20. Codonellopsis orthoceras  | +        | +       |    |    |
| 21. Codonellopsis ostenfeldi  | +        |         |    |    |
| 22. Codonellopsis puilla      | +        |         |    |    |
| 23. Codonellopsis schabi      | +        |         |    |    |
| 24. Cordiella longa           | +        |         |    |    |
| 25. Cordiella mariana         | +        |         |    |    |
| 26. Craterella aperta         | +        |         |    |    |
| 27. Cyttarocylis cassis       | +        |         |    |    |
| 28. Dadayiella ganymedes      | +        | +       |    |    |
| 29. Dadayiella pachytoecus    | +        |         |    |    |
| 30. Dicyocysta elegans        | +        | +       |    |    |
| 31. Dicyocysta mira           | +        |         |    |    |
| 32. Epiplocylys calyx         | +        |         |    |    |
| 33. Epiplocylys exquisita     | +        |         |    |    |
| 34. Epiplocylys undella       | +        | +       | +  | + |
| 35. Epiplocyloides acuta      | +        |         |    |    |
| 36. Epiplocyloides ralumensis | +        |         |    |    |
| 37. Epiplocyloides reticulata | +        |         |    |    |
| 38. Eutintinnus apertus       | +        |         |    |    |
| 39. Eutintinnus fraknoii      | +        | +       | +  |    |
| 40. Eutintinnus lusus-undae   | +        | +       | +  |    |
| 41. Eutintinnus stramentus    | +        | +       |    |    |
| 42. Favella azorica           |          | +       |    |    |
| 43. Favella ehrenbergii       | +        |         |    |    |
| 44. Favella elongate*         | +        |         |    |    |
| 45. Favella philippinensis*   | +        |         |    |    |
| 46. Favella simplex*          | +        |         |    |    |
| 47. Helicostomella longa      | +        |         |    |    |
| 48. Leprotintinnus nordqvistii| +        |         |    |    |
| 49. Leprotintinnus tubulosus* | +        |         |    |    |
| 50. Metacylis hemipteraeica*   | +        |         |    |    |
| 51. Metacylis jörgensenii     | +        |         |    |    |
| 52. Metacylis kofoidi*         | +        |         |    |    |
| 53. Metacylis tropica         | +        |         |    |    |
| 54. Ormosella baekeldi        | +        |         |    |    |
| 55. Parundella aculeata       | +        |         |    |    |
| 56. Parundella caudata        | +        |         |    |    |
### Species check-list for Tintinnids of the Philippines Archipelago (Protozoa, Ciliophora)

| Taxon                          | Open sea | Coastal |
|-------------------------------|----------|---------|
|                               | SW | NE | MB | PG |
| 57. Parundella inflata         |     |     |    |    |
| 58. Parundella longa           |     |     |    |    |
| 59. Petostricha major          |     |     |    |    |
| 60. Poroecus annulatus         |     |     |    |    |
| 61. Poroecus apicatus          |     |     |    |    |
| 62. Protorhabdonella curta     |     |     |    |    |
| 63. Protorhabdonella simplex   |     |     |    |    |
| 64. Protorhabdonella striatula |     |     |    |    |
| 65. Rhabdonella amor           |     |     |    |    |
| 66. Rhabdonella apophysata     |     |     |    |    |
| 67. Rhabdonella brandti        |     |     |    |    |
| 68. Rhabdonella conica         |     |     |    |    |
| 69. Rhabdonella cornucopia     |     |     |    |    |
| 70. Rhabdonella elegans        |     |     |    |    |
| 71. Rhabdonella exilis         |     |     |    |    |
| 72. Rhabdonella fenestrata*    |     |     |    |    |
| 73. Rhabdonella sanuhebensis   |     |     |    |    |
| 74. Rhabdonella spiralis       |     |     |    |    |
| 75. Rhabdonella valdestriata   |     |     |    |    |
| 76. Salpingella acuminata      |     |     |    |    |
| 77. Salpingella acuminatoides  |     |     |    |    |
| 78. Salpingella attenuata      |     |     |    |    |
| 79. Salpingella decurtata      |     |     |    |    |
| 80. Salpingella subconica      |     |     |    |    |
| 81. Steenstrupiella intumescens|     |     |    |    |
| 82. Steenstrupiella steenstrupi |     |     |    |    |
| 83. Tintinnidium ampullarium*  |     |     |    |    |
| 84. Tintinnidium cylindrica    |     |     |    |    |
| 85. Tintinnidium primitivum    |     |     |    |    |
| 86. Tintinnopsis bacoornensis* |     |     |    |    |
| 87. Tintinnopsis beroidea      |     |     |    |    |
| 88. Tintinnopsis buetschlii     |     |     |    |    |
| 89. Tintinnopsis campanula     |     |     |    |    |
| 90. Tintinnopsis chinglanensis |     |     |    |    |
| 91. Tintinnopsis corniger      |     |     |    |    |
| 92. Tintinnopsis cylindrica    |     |     |    |    |
| 93. Tintinnopsis directa       |     |     |    |    |
| 94. Tintinnopsis gracilis      |     |     |    |    |
| 95. Tintinnopsis loricata      |     |     |    |    |
| 96. Tintinnopsis major         |     |     |    |    |
| 97. Tintinnopsis manilensis*   |     |     |    |    |
| 98. Tintinnopsis mortenseni    |     |     |    |    |
| 99. Tintinnopsis radix         |     |     |    |    |
| 100. Tintinnopsis rotundata    |     |     |    |    |
| 101. Tintinnopsis tocantinensis|     |     |    |    |
| 102. Tintinnopsis turgida      |     |     |    |    |
### Table 3. Percentage (%) Distribution of Tintinnids families from the Philippines.

| Family                  | Genus | Species | %  |
|-------------------------|-------|---------|----|
| Ascampbelliellidae      | 3     | 7       | 6.14 |
| **Codonellidae**        | **4** | **22**  | **19.30** |
| Codonellopsidae         | 1     | 5       | 4.39 |
| Cyttarocylididae        | 1     | 1       | 0.88 |
| Dictyocystidae          | 2     | 3       | 2.65 |
| Epiplocylididae         | 2     | 6       | 5.26 |
| Metacylididae           | 4     | 11      | 9.65 |
| Petalotrichidae         | 1     | 1       | 0.88 |
| Ptychocylididae         | 1     | 5       | 4.39 |
| Rhabdonellidae          | 2     | 14      | 12.28 |
| **Tintinnidae**         | **10**| **21**  | **18.42** |
| Tintinnidiidae          | 2     | 5       | 4.39 |
| Undellidae              | 1     | 4       | 3.51 |
| Xystonellidae           | 3     | 9       | 7.89 |

**Taxon**

| Open sea | Coastal |
|----------|---------|
|          | SW | NE | MB | PG |
| 103. *Tintinnopsis uruguayensis* | + |     |     |     |
| 104. *Tintinnus perminutus* | + |     |     |     |
| 105. *Undella claparedi* | + | + |     |     |
| 106. *Undella clevei* | + |     |     |     |
| 107. *Undella hyalina* | + |     |     |     |
| 108. *Undella subcaudata* | + |     |     |     |
| 109. *Wangiella dicollaria* | + |     |     |     |
| 110. *Xystonella treforti* | + | + |     |     |
| 111. *Xystonellopsis brandti* | + |     |     |     |
| 112. *Xystonellopsis cymatica* | + | + |     |     |
| 113. *Xystonellopsis dahli* | + |     |     |     |
| 114. *Xystonellopsis paradoxa* | + |     |     |     |
| 108. *Undella subcaudata* | + |     |     |     |
| 109. *Wangiella dicollaria* | + |     |     |     |
| 110. *Xystonella treforti* | + | + |     |     |
| 111. *Xystonellopsis brandti* | + |     |     |     |
| 112. *Xystonellopsis cymatica* | + | + |     |     |
| 113. *Xystonellopsis dahli* | + |     |     |     |
| 114. *Xystonellopsis paradoxa* | + |     |     |     |
| 108. *Undella subcaudata* | + |     |     |     |
| 109. *Wangiella dicollaria* | + |     |     |     |
| 110. *Xystonella treforti* | + | + |     |     |
| 111. *Xystonellopsis brandti* | + |     |     |     |
| 112. *Xystonellopsis cymatica* | + | + |     |     |
| 113. *Xystonellopsis dahli* | + |     |     |     |
| 114. *Xystonellopsis paradoxa* | + |     |     |     |

**Table 3.** Percentage (%) Distribution of Tintinnids families from the Philippines.
their biogeographical distribution. Apparently, more studies on tintinnids in the Philippines and a standard of methodology should be established. The authors executed this current work to serve as a starting point for other researchers and encourage them to conduct studies on tintinnids in a center of marine biodiversity such as the Philippines.

References

Calbet A, Landry MR (2004) Phytoplankton growth, microzooplankton grazing, and carbon cycling in marine systems. Limnology and Oceanography 49: 51–57. https://doi.org/10.4319/lo.2004.49.1.0051

Calbet A, Trepa I, Almeda R, Salo V, Saiz E, Movilla J, Alcaraz L, Yebra L, Simo R (2008) Impact of micro- and nanograzers on phytoplankton assessed by standard and size-fractionated dilution grazing experiments. Aquatic Microbial Ecology 40: 145–156. https://doi.org/10.3354/ame01171

Dolan JR, Gallegos CL (2001) Estuarine diversity of tintinnids (planktonic ciliates). Journal of Plankton Research 23: 1009–1027. https://doi.org/10.1093/plankt/23.9.1009

Dolan JR, Ritchie ME, Ras J (2007) The “neutral” community structure of planktonic herbivores, tintinnid ciliates of the microzooplankton, across the SE Tropical Pacific Ocean. Biogeosciences Discuss 4: 561–593. https://doi.org/10.5194/bg-4-297-2007

Gómez F (2007) Trends on the distribution of ciliates in the open Pacific Ocean. Acta Oelogica 32: 188–202. https://doi.org/10.1016/j.actao.2007.04.002

Kato S, Taniguchi A (1993) Tintinnid ciliates as indicator species of different water masses in the western North Pacific Polar Front. Fisheries Oceanography 2: 166–174. https://doi.org/10.1111/j.1365-2419.1993.tb00132.x

Carpenter KE, Springer VG (2005) The center of the center of marine shore fish biodiversity: the Philippine Islands. Environmental Biology of Fishes 72: 467–480. https://doi.org/10.1007/s10641-004-3154-4

Fukami KA, Watanabe A, Fujita S, Yamaoka K, Nishijima T (1999) Predation on naked protozoan microzooplankton by fish larvae. Marine Ecology Progress Series 185: 285–291. https://doi.org/10.3354/meps18528

Kim YO, Shin K, Jang PG, Choi HW, Noh JH, Yang EJ, Kim E, Jeon D (2012) Tintinnid species as biological indicators for monitoring intrusion of the warm oceanic waters into Korean coastal waters. Ocean Science Journal 47: 161–172. https://doi.org/10.1007/s12601-012-0016-4

Lee JB, Kim YH (2010) Distribution of Tintinnids (Loricate Ciliates) in East Asian Waters in Summer. In: Ishimatsu A, Lie H-J (Eds) Coastal Environmental and Ecosystem Issues of the East China Sea. 173–180.

Pierce RW, Turner JT (1993) Global biogeography of marine tintinnids. Marine Ecology Progress Series 94: 11–26. https://doi.org/10.3354/meps094011
Putland JN, Iverson RL (2007) Microzooplankton: major herbivores in an estuarine planktonic food web. Marine Ecology Progress Series 345: 63–73. https://doi.org/10.3354/meps06841

Roxas HA (1941) Marine protozoa of the Philippines. Philippine Journal of Science 74: 91–139.

Santiago JA, Furio EF, Borja VM, Gatdula NC, Santos MD (2017) First records of tintinnid (Protozoa: Ciliophora: Tintinnina) species in Manila Bay. DLSU Research Congress 2017: The ASEAN Ecosystem @50: Change for a more inclusive growth, June 20–22, 2017, Manila, Philippines CENSER-II-032.

Stoecker DK, Capuzzo JM (1990) Predation on protozoa: its importance to zooplankton. Journal of Plankton Research 12:891–908. https://doi.org/10.1093/plankt/12.5.891

Taniguchi A (1977) Distribution of microzooplankton in the Philippine Sea and the Celebes Sea in summer, 1972. Journal of the Oceanographical Society of Japan 33: 82–89. https://doi.org/10.1007/BF02110013

Warren A (2018) World Ciliophora Database: WoRMS (World Register of Marine Species). http://www.marinespecies.org/aphia.php?p=taxdetails&id=415082 [on 2018-02-21]