Abstract: A review of the Mexican rotifer species diversity is presented here. To date, 402 species of rotifers have been recorded from Mexico, besides a few infraspecific taxa such as subspecies and varieties. The rotifers from Mexico represent 27 families and 75 genera. Molecular analysis showed about 20 cryptic taxa from species complexes. The genera *Lecane*, *Trichocerca*, *Brachionus*, *Lepadella*, *Cephalodella*, *Keratella*, *Ptygura*, and *Notommata* accounted for more than 50% of all species recorded from the Mexican territory. The diversity of rotifers from the different states of Mexico was highly heterogeneous. Only five federal entities (the State of Mexico, Michoacán, Veracruz, Mexico City, Aguascalientes, and Quintana Roo) had more than 100 species. Extrapolation of rotifer species recorded from Mexico indicated the possible occurrence of more than 600 species in Mexican water bodies, hence more sampling effort is needed. In the current review, we also comment on the importance of seasonal sampling in enhancing the species richness and detecting exotic rotifer taxa in Mexico.

Keywords: rotifera; distribution; checklist; taxonomy

1. Introduction

Taxonomical studies involving species richness provide information on the global patterns of species distribution and are helpful to detect changes associated with climate or global trade. For example, in Mexico, the number of exotic and thus invasive species has been steadily increasing during the last two decades [1,2]. The existence of taxonomic checklists is helpful to confirm this.

Mexico is one of the megadiverse countries and accounts for about 10% of the world’s biodiversity [3]. Despite well-classified geographical regions of Mexico [4], the description of the distribution of different groups of animal species is still fragmentary, especially with reference to invertebrates, including rotifers. Freshwater zooplanktonic groups are mainly composed of ciliates, rotifers, cladocerans, and copepods. Rotifers, being important trophic links in aquatic ecosystems, have been the focus of basic research, such as taxonomy and autecology, and applied aspects, such as ecotoxicology, aquaculture, and water quality indicators [5].

Studies on the rotifer species richness in Mexico have been steadily gaining importance during the last 25 years. Earlier studies were mainly sporadic and, at times, biased, with a limnological perspective [6]. Species checklists of rotifers from the Mexican territory are available only for selected regions. For example, information about the distribution of rotifers exists for the State of Mexico, Aguascalientes, Michoacán, Mexico City, and a few regions of the Yucatan Peninsula [7–13]. However, larger parts of the Mexican territory still lack such information. The first national checklist of rotifers from Mexico was produced during the late 1990s [14]. Since then, considerable progress has been made on the distribution of rotifers in different regions, although no attempts have been made to update the checklist.
Numerous models and computer programs are available to predict the possible number of species in a region or nation based on species accumulation and rarefaction curves, the presence or absence of given taxa, etc. For example, for understanding the state of biodiversity, models such as ICE, Chao 2, Jackknife, and Bootstrap are traditionally used to obtain species estimates for different groups of organisms [15]. Significant errors may still occur if the published reports of species are not corrected or weak data with large sampling gaps are used. In Mexico, the National Commission for the Knowledge and Use of Biodiversity (Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, CONABIO) contains data on the biodiversity of different groups of organisms, yet information on patterns of distribution of groups such as rotifers within its territorial jurisdiction are limited.

This work aimed to provide a comprehensive list of rotifer species recorded and document their distributional patterns from different regions of Mexico.

2. Materials and Methods

A bibliographic review of rotifer diversity studies from Mexico was conducted using the standard databases in the Web of Science using the search words “rotifer*”, “Mexic*” and “diversity” during the entire period available in each database (retrieved during May 2021). The records were then consulted in the full text, and we checked each work for the records of rotifer species. We also consulted works from other non-indexed journals but avoided contributions that contained only genus-level descriptions for rotifers. The data were sorted out into Excel files according to the geographical entities of Mexico. In addition, the documents available from CONABIO were also considered. For species nomenclature, we followed standard works on Rotifera [16,17]. The checklist provided here does not contain a listing of the infraspecific taxa. Therefore, only species were enumerated. However, infraspecific taxa were reported in the checklist without assigning an additional number.

Due to the increased accessibility of molecular tools in the study of systematics of rotifers, several cryptic taxa of commonly distributed species within genera such as Brachionus, Keratella, Asplanchna, and Lecane have been documented. However, cryptic species without formal description were not included in the checklist, although references to such studies are made in a separate table. When a known species was already reported from Mexico (e.g., Philodina roseola), the same taxon with conferatur status (e.g., Philodina cf. roseola) was not numbered. However, if a taxon was reported only with conferatur, it was considered for numbering (e.g., Notholca cf. liepetterseni). Further, taxa that have been identified as having potential species status but not described are not included here, for example, Brachionus sp. “Mexico” [18] and Hexarthra sp. [19]. In addition, as far as possible, we used published reports of species. When necessary, we checked the species identifications based on the illustrations provided in the articles with those from standard literature [20–23]. Yet, some taxa with species inquirenda status (e.g., Polyarthra trigla) were retained as such pending further studies. The species checklist was not arranged based on phylogeny of Rotifera. Rotifer families were arranged alphabetically, and within each family and genus, the species were all in alphabetic order. This facilitated reporting new records in future research.

A nonparametric analysis of species richness of Rotifera reported from Mexico was performed using the updated checklist. Models/computer simulations based on Chao 2, Jackknife 2, and Bootstrap were performed using Estimates S9 [24]. From the diversity estimators, we derived the efficiency percentage of each estimator with the following formula:

\[
\frac{S_{\text{observed}}}{S_{\text{estimated}}} \times 10
\]

3. Results

Mexico has 31 states and a capital, Mexico City. The total number of rotifer species reported from Mexico was 402, besides a few infraspecific taxa such as subspecies and
varieties. The list of consulted works is available in Supplementary 1 with coordinates for each federal entity obtained from the Mexican National Institute of Statistics and Geography (INEGI). The database, created using published works from Mexican Rotifera, is presented in Supplementary 2. Rotifers from Mexico represented 27 families and 75 genera (Table 1). Only eight genera, viz., *Lecane*, *Trichocerca*, *Brachionus*, *Cephalodella*, *Lepadella*, *Keratella*, *Ptygura*, and *Notommata*, of rotifers had more than 50% of the total species recorded from the Mexican territory. Each of these genera had at least 10 species, while the remaining genera had less than 10 species each. Of the 15 species recorded with *conferatur* status, 11 were from Chihuahua and Quintana Roo. To date, molecular analysis has revealed the existence of 17 taxa as species complexes consisting of cryptic species (Table 2).

**Table 1.** Checklist of rotifer species recorded from Mexico.

| Subclass: Bdelloidea Hudson, 1884 |
|-----------------------------------|
| Order: Adinetida Melone & Ricci, 1995 |
| Family: Adinetidae Hudson & Gosse, 1886 |
| 1. *Adineta vaga* (Davis, 1873) |
| Order: Philodinida Melone & Ricci 1995 |
| Family: Philodinidae Ehrenberg, 1838 |
| 2. *Dissotrocha aculeata* (Ehrenberg, 1830) |
| 3. *Macrotachela sonorensis* Orstan, 1995 |
| 4. *Philodina acuticornis* Murray, 1902 |
| 5. *Philodina megalotrocha* Ehrenberg, 1832 |
| 6. *Philodina roseola* Ehrenberg, 1832 |
| 7. *Pleuretra africana* Murray, 1911 |
| 9. *Rotaria elongata* (Weber, 1888) |
| 10. *Rotaria magnacalcarata* (Parsons, 1892) |
| 11. *Rotaria neptuni* (Ehrenberg, 1830) |
| 12. *Rotaria rotatoria* (Pallas, 1766) |
| Subclass: Monogononta Plate, 1889 |
| Order: Collothecacea Harring, 1913 |
| Family: Atrochidae Harring, 1913 |
| 13. *Atrochus tentaculatus* Wierzejski, 1893 |
| 14. *Cupelopagis vorax* (Leidy, 1857) |
| Family: Collothecidae Harring, 1913 |
| 15. *Collotheca ambigua* (Hudson, 1883) |
| 16. *Collotheca campanulata* (Dobie, 1849) |
| 17. *Collotheca coroneta* (Cubitt, 1869) |
| 18. *Collotheca crateriformis* Offord, 1934 |
| 19. *Collotheca ornata* (Ehrenberg, 1832) |
| 20. *Collotheca pelagica* (Rousselet, 1893) |
| 21. *Collotheca riverai* Vilaclara & Sládeček, 1989 |
| 22. *Collotheca tenulobata* (Anderson, 1889) |
| 23. *Collotheca trilobata* (Collins, 1872) |
| 24. *Stephanoceros millsii* (Kellicott, 1885) |
| Order: Flosculariacea Harring, 1913 |
| Family: Conochilidae Harring, 1913 |
| 25. *Conochilus coenobasis* (Skorikov, 1914) |
| 26. *Conochilus dossuartius* Hudson, 1885 |
| 27. *Conochilus hippocrepis* (Schrank, 1803) |
| 28. *Conochilus natans* (Seligo, 1900) |
| 29. *Conochilus unicornis* Rousselet, 1892 |
| Family: Flosculariidae Ehrenberg, 1838 |
| 30. *Beauchampia crucigere* (Dutrochet, 1812) |
| 31. *Floscularia melicerta* (Ehrenberg, 1832) |
| 32. *Limnias ceratophylli* Schrank, 1803 |
| 33. *Limnias melicerta* Weisse, 1848 |
| 34. *Octotrocha speciosa* Thorpe, 1893 |
Table 1. Cont.

|   | Species                                      | Author, Year       |
|---|---------------------------------------------|--------------------|
|35 | Ptygura beauchampi                           | Edmondson, 1940    |
|36 | Ptygura brachiata                           | (Hudson, 1886)     |
|37 | Ptygura brevis                               | Rousselet, 1893    |
|38 | Ptygura crystallina                         | (Ehrenberg, 1834)  |
|39 | Ptygura furcillata                          | (Kellicott, 1889)  |
|40 | Ptygura libera Myers                        | (Myers, 1934)      |
|41 | Ptygura cf. linguata                        | Edmondson, 1939    |
|42 | Ptygura longicornis                         | (Davis, 1867)      |
|43 | Ptygura melicerta                            | Ehrenberg, 1832    |
|44 | Ptygura pedunculata                         | Edmondson, 1939    |
|45 | Ptygura tacita                               | Edmondson, 1940    |
|46 | Ptygura tridorsicornis                      | Summerfield-Wright, 1957 |
|47 | Ptygura velata                              | (Gosse, 1851)      |
|48 | Sinantherina arripres                        | Edmondson, 1939    |
|49 | Sinantherina semibullata                     | (Thorpe, 1893)     |
|50 | Sinantherina socialis                        | (Linnaeus, 1758)   |
|51 | Hexarthra fennica                            | (Levander, 1892)   |
|52 | Hexarthra intermedia                         | (Wiszniewski, 1929) |
|   | Hexarthra intermedia f. braziliensis         | Hauer, 1953        |
|53 | Hexarthra jenkinae                           | (de Beauchamp, 1932) |
|54 | Hexarthra mira                               | (Hudson, 1871)     |
|55 | Hexarthra oxyuris                            | (Sernov, 1903)     |
|56 | Hexarthra polyodonta                         | (Hauer, 1957)      |
|57 | Pompolyx complanata                          | Gosse, 1851        |
|58 | Pompolyx sulcata                             | Hudson, 1885       |
|59 | Testudinella caca                           | Parsons, 1892      |
|60 | Testudinella emarginula                      | Stenroos, 1898     |
|61 | Testudinella incisa                          | Ternetz, 1892      |
|62 | Testudinella mucronata                       | Gosse, 1886        |
|63 | Testudinella paroa                          | Ternetz, 1892      |
|64 | Testudinella patina                          | (Hermann, 1783)    |
|65 | Testudinella reflexa                         | (Gosse, 1887)      |
|66 | Filinia brachiata                            | (Rousselet, 1901)  |
|67 | Filinia cornuta                              | Weisse, 1847       |
|68 | Filinia longiseta                            | (Ehrenberg, 1834)  |
|69 | Filinia opolensis                            | Zacharias, 1898    |
|70 | Filinia pejleri                              | Hutchinson, 1964   |
|71 | Filinia saltator                             | (Gosse, 1886)      |
|72 | Filinia terminalis                           | (Plate, 1886)      |
|73 | Horaella thomassoni                          | Koste, 1973        |
|74 | Trochosphaera reflexa                        | (Gosse, 1887)      |

Order: Plloima Hudson & Gosse, 1886

Family: Asplanchnidae Eckstein, 1883

|   | Species                                      | Author, Year       |
|---|---------------------------------------------|--------------------|
|75 | Asplanchna brightwellii                     | Gosse, 1850        |
|76 | Asplanchna girodi de Guerne                 | (Gosse, 1888)      |
|77 | Asplanchna herrickii de Guerne              | (Gosse, 1888)      |
|78 | Asplanchna intermedia                       | Hudson, 1886       |
|79 | Asplanchna priodonta                       | Gosse, 1850        |
|80 | Asplanchnia sieboldii                       | Leydig, 1854       |
|81 | Asplanchnia silvestrii                      | Daday, 1902        |
|82 | Asplanchnopus multicorps                    | (Schrank, 1793)    |

Family: Brachionidae Ehrenberg, 1838

|   | Species                                      | Author, Year       |
|---|---------------------------------------------|--------------------|
|83 | Anuraeopsis fissa                           | Gosse, 1851        |
|84 | Anuraeopsis quadriantennata                 | (Koste, 1974)      |
|85 | Brachionus ahlstromi                        | Lindeman, 1939     |
|86 | Brachionus angularis                        | Gosse, 1851        |
Table 1. Cont.

|   | Taxon                                                                                                     |
|---|-----------------------------------------------------------------------------------------------------------|
| 87| Brachionus araceliae Silva-Briano, Galván-De la Rosa, Pérez-Legaspi & Rico-Martínez, 2007                 |
| 88| Brachionus bidentatus Anderson, 1889                                                                     |
| 89| Brachionus budapestinensis Daday, 1885                                                                   |
| 90| Brachionus calyciflorus Pallas, 1766                                                                      |
| 91| Brachionus caudatus Barrois & Daday, 1894                                                                 |
| 92| Brachionus dimidiatus Bryce, 1931                                                                        |
| 93| Brachionus dolabratus Harring, 1914                                                                       |
| 94| Brachionus durgae Dhanapathi, 1974                                                                        |
| 95| Brachionus falcatus Zacharias, 1898                                                                      |
| 96| Brachionus forficula Wierzejski, 1891                                                                     |
| 97| Brachionus havanaensis Rousselet, 1911                                                                    |
| 98| Brachionus josefinae Silva-Briano & Segers, 1992                                                          |
| 99| Brachionus leydigii Cohn, 1862                                                                           |
| 100| Brachionus paranguensis Guerrero-Jiménez, Vannucchi, Silva-Briano, Adabache-Ortiz, Rico-Martínez, Roberts, Neilson & Elías-Gutiérrez, 2019 |
| 101| Brachionus plicatilis Müller, 1786                                                                        |
| 102| Brachionus pterodinoides Hermann, 1783                                                                     |
| 103| Brachionus quadridentatus quadridens herman, 1783                                                          |
| 104| Brachionus rotundiformis Tschugunoff, 1921                                                                |
| 105| Brachionus rubens Ehrenberg, 1838                                                                         |
| 106| Brachionus urceolatis Müller, 1773                                                                         |
| 107| Brachionus variabilis Hempel, 1896                                                                        |
| 108| Kellicottia bostoniensis (Rousselet, 1908)                                                                  |
| 109| Kellicottia longispina (Kellicott, 1879)                                                                   |
| 110| Keratella americana Carlin, 1943                                                                          |
| 111| Keratella cochlearis (Gosse, 1851)                                                                         |
| 112| Keratella hiemalis Carlin, 1943                                                                           |
| 113| Keratella irregularis (Lauterborn, 1898)                                                                   |
| 114| Keratella lenzi Hauer, 1953                                                                               |
| 115| Keratella mexicana Kutikova & Silva-Briano, 1995                                                           |
| 116| Keratella morenoi Modenutti, Diéguez & Segers, 1998                                                        |
| 117| Keratella procura Thorpe, 1891                                                                             |
| 118| Keratella quadra (Müller, 1786)                                                                            |
| 119| Keratella serrulae (Ehrenberg, 1838)                                                                       |
| 120| Keratella taurocephala Myers, 1938                                                                         |
| 121| Keratella tecta Gosse, 1851                                                                                |
| 122| Keratella ticinensis (Callerio, 1921)                                                                      |
| 123| Keratella tropica (Apstein, 1907)                                                                          |
| 124| Keratella valga (Ehrenberg, 1834)                                                                          |
| 125| Notholca acuminata (Ehrenberg, 1832)                                                                        |
| 126| Notholca bipalium Müller, 1786                                                                             |
| 127| Notholca foliaceae (Ehrenberg, 1838)                                                                       |
| 128| Notholca cf. liepetterseni Godske Björklund, 1972                                                          |
| 129| Notholca squamula (Müller, 1786)                                                                           |
| 130| Notholca striata (Müller, 1786)                                                                            |
| 131| Platynus patulus (Dayad, 1905)                                                                              |
| 132| Platynus patulus macracanthus (Müller, 1786)                                                                |
| 133| Platynus polyacanthus (Ehrenberg, 1834)                                                                    |
| 134| Platyias leloupi Gillard, 1967                                                                             |
| 135| Aspelta angusta Harring & Myers, 1928                                                                      |
| 136| Aspelta curvidactyla Bérzinš, 1949                                                                          |
| 137| Aspelta lestes Harring & Myers, 1928                                                                        |

Family: Dicranophoridae Harring, 1913
Table 1. Cont.

| No. | Genus and Species                          | Author(s) and Year |
|-----|------------------------------------------|--------------------|
| 138 | Dicranophoroides caudatus                  | Ehrenberg, 1834    |
| 139 | Dicranophoroides claviger                 | Hauer, 1965        |
| 140 | Dicranophorus epicharis                    | Harring & Myers, 1928 |
| 141 | Dicranophorus forcipatus                  | Müller, 1786       |
| 142 | Dicranophorus grandis                      | Ehrenberg, 1832    |
| 143 | Dicranophorus prionacis                   | Harring & Myers, 1928 |
| 144 | Dicranophorus robustus                     | Harring & Myers, 1928 |
| 145 | Encentrum cf. cruentum                     | Harring & Myers, 1928 |
| 146 | Encentrum saundersae                       | Hudson, 1885       |
| 147 | Encentrum uncinatum                        | Milne, 1886        |
| 148 | Paradicranophorus sordidus                 | Donner, 1968       |
| 149 | Cyrtonia tuba                              | Ehrenberg, 1834    |
| 150 | Epiphanes brachionus                       | Ehrenberg, 1837    |
| 151 | Epiphanes clavulata                        | Ehrenberg, 1832    |
| 152 | Epiphanes macronota                        | Barrois & Daday, 1894 |
| 153 | Epiphanes senta                            | Müller, 1773       |
| 154 | Prolides subtilis                          | Rodewald, 1940     |
| 155 | Prolides tentaculatus                      | de Beauchamp, 1907 |
| 156 | Beuchampiella eudactylota                  | Gosse, 1886        |
| 157 | Dipleuchlanis elegans                      | Wierzejski, 1893   |
| 158 | Dipleuchlanis propatula                    | Gosse, 1886        |
| 159 | Euchlanis calpida                          | Myers, 1930        |
| 160 | Euchlanis deflexa                          | Gosse, 1851        |
| 161 | Euchlanis dilatata                         | Ehrenberg, 1832    |
| 162 | Euchlanis incisa                           | Carlin, 1939       |
| 163 | Euchlanis lyra                             | Hudson, 1886       |
| 164 | Euchlanis cf. mikropous                    | Koch-Althaus, 1962 |
| 165 | Euchlanis oropha                           | Gosse, 1887        |
| 166 | Euchlanis pyriformis                       | Gosse, 1851        |
| 167 | Euchlanis triquetra                        | Ehrenberg, 1838    |
| 168 | Tripleuchlanis plicata                     | Levander, 1894     |
| 169 | Ascomorpha ecaudis                         | Perty, 1850        |
| 170 | Ascomorpha ovalis                          | Bergendal, 1892    |
| 171 | Ascomorpha saltans                         | Bartsch, 1870      |
| 172 | Gastropus hyptopus                         | Ehrenberg, 1838    |
| 173 | Gastropus stylifer                         | Imhof, 1891        |
| 174 | Itura aurita                              | Ehrenberg, 1830    |
| 175 | Itura chamadis                             | Harring & Myers, 1928 |
| 176 | Itura myersi                               | Wulfert, 1935      |
| 177 | Lecane aculeata                            | Jakubski, 1912     |
| 178 | Lecane aeganea                             | Harring, 1914      |
| 179 | Lecane arculata                            | Bryce, 1891        |
| 180 | Lecane arcula                              | Harring, 1914      |
| 181 | Lecane aspasia                             | Myers, 1917        |
| 182 | Lecane bifurca                             | Bryce, 1892        |
| 183 | Lecane bulla                               | Gosse, 1851        |
| 184 | Lecane candida                             | Harring & Myers, 1926 |
| 185 | Lecane clara                               | Bryce, 1892        |
| 186 | Lecane closterocerca                       | Schmarda, 1859     |
| 187 | Lecane cornuta                             | Müller, 1786       |
| 188 | Lecane crepida                             | Harring, 1913      |
| 189 | Lecane crepida                             | Harring, 1914      |
| 190 | Lecane curvicornis                         | Murray, 1913       |
Table 1. Cont.

|   |   |
|---|---|
|191| Lecane decipiens (Murray, 1913) |
|192| Lecane doryssa Harring, 1914 |
|193| Lecane elasma Harring & Myers, 1926 |
|194| Lecane elegans Harring, 1914 |
|195| Lecane elsa Hauer, 1931 |
|196| Lecane flexilis (Gosse, 1886) |
|197| Lecane furcata (Murray, 1913) |
|198| Lecane grandis (Murray, 1913) |
|199| Lecane haliclysta Harring & Myers, 1926 |
|200| Lecane hamata (Stokes, 1896) |
|201| Lecane hastata (Murray, 1913) |
|202| Lecane cf. hastata (Murray, 1913) |
|203| Lecane hornemanni (Ehrenberg, 1834) |
|204| Lecane inermis (Bryce, 1892) |
|205| Lecane inopinata Harring & Myers, 1926 |
|206| Lecane latissima Yamamoto, 1955 |
|207| Lecane leontina (Turner, 1892) |
|208| Lecane ludwigii (Eckstein, 1883) |
|209| Lecane luna (Müller, 1776) |
|210| Lecane lunaris (Ehrenberg, 1832) |
|211| Lecane margaretae Segers, 1991 |
|212| Lecane monostyla (Daday, 1897) |
|213| Lecane nana (Murray, 1913) |
|214| Lecane nelsoni Segers, 1994 |
|215| Lecane obtusa (Murray, 1913) |
|216| Lecane ohiensis (Herrick, 1885) |
|217| Lecane papuana (Murray, 1913) |
|218| Lecane perpusilla (Hauer, 1929) |
|219| Lecane pertica Harring & Myers, 1926 |
|220| Lecane punctata (Murray, 1913) |
|221| Lecane pyriformis (Daday, 1905) |
|222| Lecane quadridentata (Ehrenberg, 1830) |
|223| Lecane rhenana Hauer, 1929 |
|224| Lecane rhymida Harring & Myers, 1926 |
|225| Lecane rugosa (Harring, 1914) |
|226| Lecane ruttneri Hauer, 1938 |
|227| Lecane satyrus Harring & Myers, 1926 |
|228| Lecane scutata (Harring & Myers, 1926) |
|229| Lecane signifera (Jennings, 1896) |
|230| Lecane sola Hauer, 1936 |
|231| Lecane spinulifera Edmondson, 1935 |
|232| Lecane stenroosi (Meissner, 1908) |
|233| Lecane stichaea Harring, 1913 |
|234| Lecane stokesii (Pell, 1890) |
|235| Lecane subtilis Harring & Myers, 1926 |
|236| Lecane subulata (Harring & Myers, 1926) |
|237| Lecane tenuiseta Harring, 1914 |
|238| Lecane thalera (Harring & Myers, 1926) |
|239| Lecane thienemanni (Hauer, 1938) |
|240| Lecane uenoi Yamamoto, 1951 |
|241| Lecane undulata Hauer, 1938 |
|242| Lecane unguiculata (Padoev, 1925) |
|243| Lecane unguiculata (Gosse, 1887) |
|244| Lecane venusta Harring & Myers, 1926 |
|245| Lecane yatseni Wei & Xu, 2010 |

Family: Lepadellidae Harring, 1913

|   |   |
|---|---|
|246| Colurella adriatica Ehrenberg, 1831 |
|247| Colurella colurus (Ehrenberg, 1830) |
|   | Species                                                                 | Author          |
|---|-------------------------------------------------------------------------|-----------------|
|248| Colurella hindenburgi Steinecke, 1917                                    |                 |
|249| Colurella oblonga Donner, 1943                                           |                 |
|250| Colurella obtusa (Gosse, 1886)                                           |                 |
|251| Colurella uncinata (Müller, 1773)                                        |                 |
|   | Colurella uncinata bicuspidata (Ehrenberg, 1832)                         |                 |
|252| Lepadella acuminata (Ehrenberg, 1834)                                   |                 |
|253| Lepadella apsidula Harring, 1916                                         |                 |
|254| Lepadella astacicolona Hauer, 1926                                       |                 |
|255| Lepadella benjamini Harring, 1916                                        |                 |
|256| Lepadella biloba Hauer, 1958                                             |                 |
|257| Lepadella cf. cornuta Koste & Shiel, 1989                                |                 |
|258| Lepadella cristata (Rousselet, 1893)                                     |                 |
|259| Lepadella dactyliseta (Stenroos, 1898)                                   |                 |
|260| Lepadella discoidea Segers, 1993                                         |                 |
|261| Lepadella donneri Koste, 1972                                            |                 |
|262| Lepadella ehrenbergii (Perty, 1850)                                      |                 |
|263| Lepadella heterostyla (Murray, 1913)                                     |                 |
|264| Lepadella latusinus (Hilgendorf, 1899)                                   |                 |
|265| Lepadella ovalis (Müller, 1786)                                          |                 |
|266| Lepadella patella (Müller, 1773)                                         |                 |
|   | Lepadella patella patella (Müller, 1786)                                 |                 |
|267| Lepadella punctata Wulfert, 1939                                         |                 |
|268| Lepadella quadricarinata (Stenroos, 1898)                                |                 |
|269| Lepadella quinquecostata (Lucks, 1912)                                   |                 |
|   | Lepadella quinquecostata quinquecostata (Lucks, 1912)                    |                 |
|270| Lepadella rhomboidea (Gosse, 1886)                                       |                 |
|271| Lepadella triba Myers, 1934                                              |                 |
|272| Lepadella triptera (Ehrenberg, 1832)                                     |                 |
|273| Squatinella lamellaris (Müller, 1786)                                    |                 |
|   | Family: Lindiidae Harring & Myers, 1924                                  |                 |
|274| Lindia ecela Myers, 1933                                                 |                 |
|275| Lindia tecusa Harring & Myers, 1922                                      |                 |
|276| Lindia turulosa Dujardin, 1841                                          |                 |
|277| Lindia truncata (Jennings, 1894)                                         |                 |
|   | Family: Mytilinidae Harring, 1913                                         |                 |
|278| Lophocharis oysternon (Gosse, 1851)                                      |                 |
|279| Lophocharis salpina (Ehrenberg, 1834)                                   |                 |
|280| Mytilina acanthophora Hauer, 1938                                        |                 |
|281| Mytilina bisulcata (Lucks, 1912)                                         |                 |
|282| Mytilina mucronata (Müller, 1773)                                        |                 |
|   | Mytilina mucronata spinigera (Ehrenberg, 1830)                           |                 |
|283| Mytilina ventralis (Ehrenberg, 1830)                                     |                 |
|   | Mytilina ventralis brevispina (Ehrenberg, 1830)                          |                 |
|   | Mytilina ventralis ventralis (Ehrenberg, 1830)                           |                 |
|   | Family: Notommatidae Hudson & Gosse, 1886                                |                 |
|284| Cephalodella apocolea Myers, 1924                                        |                 |
|285| Cephalodella calosa Wulfert, 1956                                        |                 |
|286| Cephalodella catellina Müller, 1786                                       |                 |
|287| Cephalodella exigua (Gosse, 1886)                                        |                 |
|288| Cephalodella forficula (Ehrenberg, 1830)                                 |                 |
|289| Cephalodella gibba (Ehrenberg, 1830)                                     |                 |
|290| Cephalodella gigantea Remane, 1933                                       |                 |
|291| Cephalodella globata (Gosse, 1887)                                       |                 |
|292| Cephalodella gracilis (Ehrenberg, 1830)                                  |                 |
|293| Cephalodella cf. graciosa Wulfert, 1956                                  |                 |
|294| Cephalodella hoodii (Gosse, 1886)                                        |                 |
|295| Cephalodella macroductyla (Stenroos, 1898)                               |                 |
|296| Cephalodella cf. marina Myers, 1924                                      |                 |
|297| Cephalodella megalocephala (Glascott, 1893)                              |                 |
|298| Cephalodella misgurnus Wulfert, 1937                                     |                 |
| Page | Name                                      | Author       | Year     |
|------|------------------------------------------|--------------|----------|
| 299  | Cephalodella panarista                    | Myers, 1924  |          |
| 300  | Cephalodella physalis                     | Myers, 1924  |          |
| 301  | Cephalodella rotunda                      | Wulfert, 1937|          |
| 302  | Cephalodella stenroosi                    | Wulfert, 1937|          |
| 303  | Cephalodella sterea                       | Gosse, 1887  |          |
| 304  | Cephalodella tenuiseta                    | Burn, 1890   |          |
| 305  | Cephalodella ventripes                    | Dixon-Nuttall, 1901 |          |
| 306  | Enteroplea lacustris                       | Ehrenberg, 1830|        |
| 307  | Eosphora anthadis                         | Harring & Myers, 1922 |           |
| 308  | Eosphora ehrenbergi                       | Weber & Montet, 1918 |          |
| 309  | Eosphora najas                            | Ehrenberg, 1830|          |
| 310  | Eosphora thou                            | Harring & Myers, 1830 |          |
| 311  | Eosphora thoides                         | Wulfert, 1935|          |
| 312  | Eosphora carogaensis                      | Myers, 1937  |          |
| 313  | Eosphora elongata                        | Ehrenberg, 1832 |          |
| 314  | Monommata actices                         | Remane, 1933  |          |
| 315  | Monommata diaphora                        | Myers, 1930  |          |
| 316  | Notommata aurita                         | Müller, 1786  |          |
| 317  | Notommata cerberus                        | Gosse, 1886  |          |
| 318  | Notommata copreus                         | Ehrenberg, 1834 |          |
| 319  | Notommata cyrtopus                        | Gosse, 1886  |          |
| 320  | Notommata falcinella                      | Harring & Myers, 1922 |          |
| 321  | Notommata glyphura                        | Wulfert, 1935|          |
| 322  | Notommata haueri                         | Wulfert, 1939|          |
| 323  | Notommata pachyra                         | Gosse, 1886  |          |
| 324  | Notommata saccigera                       | Ehrenberg, 1830|          |
| 325  | Notommata tripus                          | Ehrenberg, 1838|          |
| 326  | Pleurotrocha petromyzon                   | Ehrenberg, 1830|          |
| 327  | Reticula gelida                           | Harring & Myers, 1922 |          |
| 328  | Reticula melanocus                        | Gosse, 1887  |          |
| 329  | Reticula nyssa                            | Harring & Myers, 1924 |          |
| 330  | Sphagrias lofauna                         | Rousselet, 1910 |          |
| 331  | Taphrocampia annulosa                     | Gosse, 1851  |          |
| 332  | Taphrocampia sealenura                    | Gosse, 1887  |          |

Family: Proalidae Harring & Myers, 1924

| Page | Name                                      | Author       | Year     |
|------|------------------------------------------|--------------|----------|
| 333  | Proales cognitaa                         | Myers, 1940  |          |
| 334  | Proales daphnicola                       | Thompson, 1892|          |
| 335  | Proales decipiens                        | Ehrenberg, 1832 |          |
| 336  | Proales fallacioida                      | Wulfert, 1937|          |
| 337  | Proales globulifera                      | Hauer, 1921  |          |
| 338  | Proales sigmoidea                        | Skorikov, 1896|          |
| 339  | Proales similis de Beauchamp             | 1907         |          |
| 340  | Proales sordida                          | Gosse, 1886  |          |
| 341  | Proales cf. wesenbergi                   | Wulfert, 1960|          |
| 342  | Wulfertia ornata                         | Donner, 1943 |          |

Family: Scaridiidae Manfredi, 1927

| Page | Name                                      | Author       | Year     |
|------|------------------------------------------|--------------|----------|
| 343  | Scaridium botsjani                       | Daems & Dumont, 1974 |          |
| 344  | Scaridium longicaudatum                  | Müller, 1786  |          |

Family: Synchaetidae Hudson & Gosse, 1886

| Page | Name                                      | Author       | Year     |
|------|------------------------------------------|--------------|----------|
| 345  | Ploesoma hudsoni                         | Imhof, 1891  |          |
| 346  | Polyarthra dolichoptera                  | Idelson, 1925|          |
| 347  | Polyarthra euryptera                     | Wierzejski, 1891|         |
| 348  | Polyarthra lingiremis                    | Carlin, 1943 |          |
| 349  | Polyarthra luminosa                      | Kutikova, 1962|          |
| 350  | Polyarthra major                         | Burckhardt, 1900|         |
| 351  | Polyarthra remata                        | Skorikov, 1896|          |
| 352  | Polyarthra trigla                        | Ehrenberg, 1834 (species inquirenda) |
| Page | Species                                      | Authors            |
|------|---------------------------------------------|--------------------|
| 353  | *Polyarthra vulgaris* Carlin, 1943           |                    |
| 354  | *Synchaeta bicornis* Smith, 1904            |                    |
| 355  | *Synchaeta elsteri* Hauer, 1963             |                    |
| 356  | *Synchaeta hyperborea* Smirnov, 1932        |                    |
| 357  | *Synchaeta longipes* Gosse, 1887            |                    |
| 358  | *Synchaeta oblutra* Ehrenberg, 1832         |                    |
| 359  | *Synchaeta pectinata* Ehrenberg, 1832       |                    |
| 360  | *Synchaeta stylata* Wierzejski, 1893        |                    |
| 361  | *Synchaeta tremula* (Müller, 1786)          |                    |
| 362  | *Synchaeta tremuloida* Pourriot, 1965       |                    |
|      | **Family: Tetrasiphonidae Harring & Myers, 1924** |        |
| 363  | *Tetrasipho hydrocora* Ehrenberg, 1840      |                    |
|      | **Family: Trichoceridae Harring, 1913**     |                    |
| 364  | *Ascomorphella volvocicola* (Plate, 1886)   |                    |
| 365  | *Trichocerca bicristata* (Gosse, 1887)      |                    |
| 366  | *Trichocerca bidens* (Lucks, 1912)          |                    |
| 367  | *Trichocerca brachyura* (Gosse, 1851)       |                    |
| 368  | *Trichocerca braziliensis* (Murray, 1913)   |                    |
| 369  | *Trichocerca capucinu* (Wierzejski & Zacharias, 1893) |                  |
| 370  | *Trichocerca collaris* (Rousselet, 1896)    |                    |
| 371  | *Trichocerca cylindrica* (Imhof, 1891)      |                    |
| 372  | *Trichocerca dixonnuttalli* (Jennings, 1903) |                 |
| 373  | *Trichocerca elongata* (Gosse, 1886)        |                    |
| 374  | *Trichocerca iennis* (Gosse, 1887)          |                    |
| 375  | *Trichocerca insignis* (Herrick, 1885)      |                    |
| 376  | *Trichocerca insulana* (Hauer, 1937)        |                    |
| 377  | *Trichocerca cf. intermedia* (Stenroos, 1898) |             |
| 378  | *Trichocerca longiseta* (Schrank, 1802)     |                    |
| 379  | *Trichocerca marina* (Daday, 1890)          |                    |
| 380  | *Trichocerca mollis* Edmondson, 1936        |                    |
| 381  | *Trichocerca mucosa* (Stokes, 1896)         |                    |
| 382  | *Trichocerca multirinis* (Kellicott, 1897)  |                    |
| 383  | *Trichocerca musculus* (Hauer, 1937)        |                    |
| 384  | *Trichocerca porcellus* (Gosse, 1851)       |                    |
| 385  | *Trichocerca pusilla* (Jennings, 1903)      |                    |
| 386  | *Trichocerca ratus* (Müller, 1776)          |                    |
| 387  | *Trichocerca rosea* (Stenroos, 1898)        |                    |
| 388  | *Trichocerca rousseleti* (Voigt, 1902)      |                    |
| 389  | *Trichocerca ruttneri* Donner, 1953         |                    |
| 390  | *Trichocerca similis* (Wierzejski, 1893)    |                    |
| 391  | *Trichocerca stylista* (Gosse, 1851)        |                    |
| 392  | *Trichocerca tenuior* (Gosse, 1886)         |                    |
| 393  | *Trichocerca tigris* (Müller, 1786)         |                    |
| 394  | *Trichocerca vernalis* (Hauer, 1936)        |                    |
| 395  | *Trichocerca weberi* (Jennings, 1903)       |                    |
|      | **Family: Trichotriidae Harring, 1913**     |                    |
| 396  | *Macrochaetus collinsii* (Gosse, 1867)       |                    |
| 397  | *Macrochaetus longipes* Myers, 1934         |                    |
| 398  | *Macrochaetus sericus* (Thorpe, 1893)       |                    |
| 399  | *Macrochaetus subquadratus* (Perty, 1850)   |                    |
| 400  | *Trichotria pocillum* (Müller, 1776)        |                    |
| 401  | *Trichotria tectatis* (Ehrenberg, 1830)     |                    |
| 402  | *Wolga spinifera* (Western, 1894)           |                    |
The faunal diversity of rotifers from the different states of the country was highly heterogeneous. Only five federal entities (the State of Mexico, Michoacán, Veracruz, Mexico City, and Quintana Roo) had more than 100 species. The total number of genera per state followed the same trend of species richness (Table 3). Thus, seven federal entities (the State of Mexico, Michoacán, Veracruz, Mexico City, Quintana Roo, Aguascalientes, and Chihuahua) had more than 30 genera.

Table 3. Number of genera and species of rotifers reported from different States of Mexico. The states are represented by bold numbers. 1: Aguascalientes, 2: Campeche, 3: Chiapas, 4: Chihuahua, 5: Colima, 6: Guanajuato, 7: Guerrero, 8: Hidalgo, 9: Jalisco, 10: Mexico City, 11: Michoacán, 12: Morelos, 13: Nayarit, 14: Oaxaca, 15: Puebla, 16: Quintana Roo, 17: San Luis Potosí, 18: Sinaloa, 19: Sonora, 20: State of Mexico, 21: Tabasco, 22: Tlaxcala, 23: Veracruz, 24: Yucatán, 25: Zacatecas. Other states do not have published records of rotifers, and these were not included.

| Species/States | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|----------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Ascomorpha ovalis [25] | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asplanchna brightwelli [26] | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asplanchna girodi [27] | | | | | | | | | | | | | | | | | | | | | | | | | |
| Brachionus calyciflorus [25] | | | | | | | | | | | | | | | | | | | | | | | | | |
| Brachionus plicatilis [18,28] | | | | | | | | | | | | | | | | | | | | | | | | | |
| Brachionus quadridentatus [25] | | | | | | | | | | | | | | | | | | | | | | | | | |
| Euchlanis dilata | | | | | | | | | | | | | | | | | | | | | | | | | |
| Keratella cochlearis | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lecane bulbula | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lecane cornuta | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lecane crepida | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lecane curvicornis | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lecane hastata | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lecane lunaris | | | | | | | | | | | | | | | | | | | | | | | | | |
| Mytilina ventralis | | | | | | | | | | | | | | | | | | | | | | | | | |
| Platyiias quadricornis | | | | | | | | | | | | | | | | | | | | | | | | | |
| Testudinella patina | | | | | | | | | | | | | | | | | | | | | | | | | |

Table 2. Some species complexes and cryptic species of rotifers reported from Mexico.
Table 3. Cont.

| Species/States | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|----------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Plationus      | 2 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 2  | 0  | 0  | 1  | 0  |
| Phyllosoma     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| Planorhabda    | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| Polyarthra     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| Ptychura       | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| Rotaria        | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| Proales        | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1  | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Proalides      | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| Taphrocampa    | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| Testudinella   | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1  | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Trochosphaera  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| Wolga          | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1  | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wulfertia      | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |

Seasonally collected samples offered a higher number of species than those collected sporadically. Data on the species richness of rotifers collected seasonally from selected water bodies are presented in Table 4.

Table 4. The number of rotifer species reported from selected waterbodies through seasonal sampling.

| Waterbody                        | Total Species | Reference |
|---------------------------------|---------------|-----------|
| Valle de Bravo Reservoir (Mexico) | 50           | [31]      |
| Madin reservoir (Mexico)        | 28           | [32]      |
| Llano reservoir (Mexico)        | 84           | [33]      |
| Iturbide reservoir (Mexico)     | 55           | [34]      |
| Lake Zumpango (Mexico)          | 33           | [35]      |
| Chimaliapan wetland (Mexico)    | 75           | [36]      |
| Lake Xochimilco (Mexico City)   | 81           | [37]      |
| Lake Cantera Oriente (Mexico City) | 68         | [38]      |
| Benito Juarez Reservoir (Mexico City) | 80     | [39]      |
| River Antigua (Veracruz State)  | 125          | [40]      |
| Amacuzac River Basin (Morelos)  | 65           | [41]      |
| Valero Trujano Reservoir (Guerrero State) | 64    | [42]      |

Biogeographic distribution of selected species recorded from Nearctic and Neotropical regions of Mexico showed some of them to be out of known range based on global patterns. More than 20 taxa distributed in Palearctic region were reported from Nearctic or Neotropical regions (Table 5).
Table 5. Out of known range distribution of Rotifera recorded from Mexico. The known range from different geographical regions was based on [16], and for the national biogeographic provinces, Ref. [4] was followed. Afr: Afrotropical region; Ant: Antarctic region; Aus: Australian region; Nea: Nearctic region; Neo: Neotropical region; Ori: Oriental region; Pac: Pacific region and Pal: Palearctic region.

| Species and Distribution | Records from Mexico |
|--------------------------|---------------------|
| *Adineta vaga*           | African - Tlaxcala: Neo; Mexico City: Nea |
| *Atrochus tentaculatus*  | Australian - Pacific, Pal; Morelos, Veracruz and Nayarit: Neo, Guanajuato: Neo |
| *Collotheca crateriformis*| African - Chihuahua: Neo; Tlaxcala: Neo; Morelos, Veracruz and Nayarit: Neo |
| *Colurella colurus*      | African - Baja California: Neo; Mexico City: Nea; Morelos, Veracruz and Nayarit: Neo |
| *Colurella oblonga*      | African - Baja California: Neo; Mexico City: Nea; Morelos, Veracruz and Nayarit: Neo |
| *Dicranophorus forcipatus*| African - Baja California: Neo; Mexico City: Nea; Morelos, Veracruz and Nayarit: Neo |
| *Epiphanes brachionus*   | African - Baja California: Neo; Mexico City: Nea |
| *Horaella thomassoni*    | African - Baja California: Neo |
| *Keratella procurva robusta*| African - Baja California: Neo; Mexico City: Nea; Morelos, Veracruz and Nayarit: Neo |
| *Lecane unguiculata*     | African - Baja California: Neo; Mexico City: Nea; Morelos, Veracruz and Nayarit: Neo |
| *Lepadella discoides*    | African - Baja California: Neo; Mexico City: Nea; Morelos, Veracruz and Nayarit: Neo |
| *Lepadella punctata*     | African - Baja California: Neo; Mexico City: Nea; Morelos, Veracruz and Nayarit: Neo |
| *Mytilina mucronata spinigera* | African - Baja California: Neo; Mexico City: Nea; Morelos, Veracruz and Nayarit: Neo |
| *Mytilina ventralis*     | African - Baja California: Neo; Mexico City: Nea; Morelos, Veracruz and Nayarit: Neo |
| *Notholca acuminata*     | African - Baja California: Neo; Mexico City: Nea; Morelos, Veracruz and Nayarit: Neo |
| *Notommata baueri*       | African - Baja California: Neo; Mexico City: Nea; Morelos, Veracruz and Nayarit: Neo |
| *Paradicranophorus sordidus* | African - Baja California: Neo; Mexico City: Nea; Morelos, Veracruz and Nayarit: Neo |
| *Philodina acuticornis*  | African - Baja California: Neo; Mexico City: Nea; Morelos, Veracruz and Nayarit: Neo |
| *Plotionus polyacanthus* | African - Baja California: Neo; Mexico City: Nea; Morelos, Veracruz and Nayarit: Neo |
| *Proales globulifera*    | African - Baja California: Neo; Mexico City: Nea; Morelos, Veracruz and Nayarit: Neo |
| *Ptygura brevis*         | African - Baja California: Neo; Mexico City: Nea; Morelos, Veracruz and Nayarit: Neo |
| *Ptygura tridorsicornis* | African - Baja California: Neo; Mexico City: Nea; Morelos, Veracruz and Nayarit: Neo |
| *Sphyrias lofana*        | African - Baja California: Neo; Mexico City: Nea; Morelos, Veracruz and Nayarit: Neo |
| *Squatinella lamellaris* | African - Baja California: Neo; Mexico City: Nea; Morelos, Veracruz and Nayarit: Neo |
| *Synchaeta elsteri*      | African - Baja California: Neo; Mexico City: Nea; Morelos, Veracruz and Nayarit: Neo |
| *Synchaeta hyperborea*   | African - Baja California: Neo; Mexico City: Nea; Morelos, Veracruz and Nayarit: Neo |
| *Synchaeta tremuloides*  | African - Baja California: Neo; Mexico City: Nea; Morelos, Veracruz and Nayarit: Neo |

Different estimators of species diversity indicated the asymptote in all cases (Figure 1). The efficiency percentage of species estimates varied between 62% and 86% (Chao 2 and Bootstrap, respectively). In addition, these estimators indicated that the potential richness of rotifers from Mexico could be from 450 to 600 species.
4. Discussion

Taxonomical studies on Mexican rotifers date back more than 100 years. However, increased awareness of their role in limnological studies began only during the last 25 years. Figure 2 shows some of the interesting rotifer species from Mexico. Conventional limnological investigations in Mexico included rotifers as part of plankton [6], yet rarely quantified their abundances. One of the earliest studies on the seasonal variations of freshwater rotifers showed just seven rotifer taxa [43]. Thereafter, many studies on the seasonal variations of rotifers have been carried out from different water bodies such as ponds, lakes, reservoirs, and rivers. For certain freshwater ecosystems, zooplankton sampling was carried out for many years, for example, in the Valle de Bravo reservoir [44]. Long-term studies of riverine plankton are rare in Mexico, although the country has more than 200 rivers. Seasonal studies from River Antigua in the State of Veracruz have revealed 125 species REF. The importance of seasonal studies in understanding the rotifer species richness began receiving considerable attention after it became clear that certain exotic taxa appear only in certain months of the year. For example, *Notholca* cf. *liepetterseni* and *Lecane yatseni* have been recorded in River Antigua, Veracruz sporadically [40], although these species are native to the Scandinavian region and China, respectively.
The first comprehensive list of Mexican rotifers was documented about 3 decades ago and contained 283 species [14]. Since then, many studies on Mexican freshwaters have reported the presence of 120 additional rotifer taxa. This, however, does not include close to 20 cryptic taxa, which require formal description. From the mean of species estimators, it appears that there is a possibility of encountering more than 600 species in Mexico. This may be a sub-estimation of the actual reality, since it is based on the diversity of rotifers which have been well studied only in 5–7 of the 32 federal entities in the country. This number is not unreasonable if one considers the numerous habitats that exist in Mexico which confer it a megadiverse status (CONABIO), as well as the existence of cryptic taxa within Rotifera. For example, the *Brachionus plicatilis* complex has as many as 15 cryptic species [45]. Several species complexes have already been reported in Mexico [25,28–30]. The geographic location of Mexico (as a corridor between South and North America) [46] also supports the possible occurrence of diverse rotifer species in different federal entities. This is further evidenced by the poor sampling in certain regions, especially in states such as Baja California, Durango, and Coahuila. Mexico has 70 large lakes (area: 1000 to 10,000 hectares), 14,000 reservoirs (85% with <10 hectares), and >200 rivers [6]. The rotifer species list presented in this work was based on only a handful of waterbodies and many more are yet to be studied.

Desert temporary ponds, rivers, and marine ecosystems have great potential for enhancing the species richness of rotifers to the Mexican fauna. For example, ephemeral waterbodies from the desert states in Mexico have yielded more than 100 rotifer species [47]. Yet, many temporary water bodies in Mexico have not been sampled even once. Rotifer fauna in riverine habitats have been rarely studied, although the species richness in these aquatic systems is high [40]. Mexico is bestowed with 9330 km of coastline. Yet, knowledge on the marine rotifers from Mexico is more fragmentary than inland saline waters [48]. For example, seasonal sampling efforts from the brackish water ecosystem in the State of Tabasco showed the presence of more than 35 rotifer species [49]. Of the three classes of rotifers, Bdelloidea, Monogononta, and Seisonacea, the last is represented by two marine genera, *Seison* and *Paraseison*. *Seison* is epizoic on the crustacean genus *Nebalia* but has not been so far reported from marine waters of Mexico, although *Nebalia* occurs in these waters [50]. Therefore, further studies on marine rotifers may be oriented for identifying *Seison* from *Nebalia*.

Figure 2. Some interesting rotifers from Mexico. (1) *Lecane yatseni*, (2) *Lecane rhytida*, (3) *Notholca cf. liepetterseni*, (4) *Brachionus bidentatus*, (5) *Dipleuchlanis propatula*; (6) *Euchlanis cf. mikropous*, (7) *Brachionus dimidiatus*, (8) *Plationus patulus macracanthus* and (9) *Testudinella patina*. All photos from authors’ previous works.
An aspect often overlooked in taxonomic studies is the culture of rotifer species, which is important for many reasons. The first is that, when studying the molecular taxonomy of predatory taxa, prey in the stomach contents may interfere with the analysis [26]. The second reason is that culturing species may reveal the presence of different phenotypes from the same genotype as observed in the case of Euchlanis cf. mikropous [51]. Third, some descriptions are vague and incomplete. For example, culturing a rare taxon with appearance of Collotheca monerosus [52] resolved the issue, showing that it was a regeneration by Stephanoceros millsii. Fourth, cryptic species have different life histories which cannot be identified from fixed samples [53]. Finally, for certain analysis of taxonomic characters such as measurements of trophi on SEM, culturing is needed to obtain sufficient quantity for the description of size range [54].

The occurrence of some rotifer species known from the geographic regions such as the Palearctic, Afrotropical, and Oriental were reported from Nearctic region and Neotropical regions of Mexico. For example, Lecane yatseni, typical to the Oriental region, was recorded from Mexico. Similarly, Sphyrias lofauna, common to Afrotropical and Pacific regions, was documented from Nearctic region of Mexico [14]. This suggests not only extensive sampling, but also distributional aspects, including the possible roles that global climatic changes and trade involving aquatic species play a role in the dispersion of rotifers.

5. Conclusions

A taxonomic survey of rotifers so far has revealed the occurrence of about 400 species of rotifers from Mexico. Many Mexican states still do not have formal rotifer checklists. Only a few states in Mexico have some information on the diversity of rotifers. Yet, the species richness reported in this work is based on only a few selected water bodies. Species estimators have predicted the possible occurrence of about 600 rotifer species within the Mexican territory. Thus, further studies are still needed to understand rotifer diversity in Mexico.

Supplementary Materials: The following are available online at https://www.mdpi.com/article/10.3390/d13070291/s1, supplementary 1. List of consulted works for works on rotifer taxonomy and supplementary 2. Database compiled by the authors on the occurrence of different rotifer species from Mexico.

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