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Diversity of Rotifera (Subclass: Monogononta) from Inland Water Bodies in Greece: An Updated Checklist

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Abstract: Biodiversity records are recognized as important for both diversity conservation and ecological studies under the light of global threats faced by aquatic ecosystems. Here, the checklist of Greek rotifer species is presented based on a literature review, as well as current data from 38 inland water bodies. A total of 172 Monogononta rotifer species were recorded to belong to 21 families and 44 genera. The most diverse genera were *Lecane*, *Brachionus*, and *Trichocerca*, accounting for 34% of the recorded species. *Trichocerca similis*, *Brachionus angularis*, *Filinia longiseta*, *Asplanchna priodonta*, *Keratella tecta*, *Keratella quadrata*, and *Keratella cochlearis* were the most frequent species with a high frequency of occurrence over 60%, with *K. cochlearis* being the most frequently recorded (86%). Furthermore, we used rarefaction indices, and the potential richness was estimated at 264 taxa. More sampling efforts aiming at littoral species, as well as different habitats such as temporary pools, ponds, and rivers, are expected to increase the known rotifer fauna in Greece. We expect that additional molecular analyses will be needed to clarify the members of species complexes, likely providing additional species.

Keywords: diversity; distribution; rotifers; taxonomy

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1. Introduction

Biodiversity is globally recognized as an important component to protect nature and reverse the degradation of ecosystems [1,2]. Because molecular approaches are widely used in constructing a genome atlas of biodiversity, including the description of cryptic species complexes from the phylum Rotifera [3–8], the importance of taxonomic lists that accurately note the biogeographic distribution of species has become critical. This is of great importance in areas where taxonomic studies are scarce and ecological studies rely on poorly known community assemblages. Moreover, with the global increase in invasive species [9,10] and the concomitant threat faced by aquatic ecosystems due to changes in species composition and food web relationships [11–13], the knowledge of the fauna of an area seems more imperative than ever.

Phylum Rotifera (*sensu stricto*) is a large phylum of microscopic animals found mainly in freshwaters [14,15] containing two major groups: Subclass Monogononta and Subclass Bdelloidea [16,17]. As components of the base of the food web, rotifers shape community energy flow linking the classical food web with the microbial loop; as a result, these micrometazoans are very import in the functioning of aquatic ecosystems [18,19]. However, their study is hindered by several features, and their taxonomic identification requires a level of taxonomical qualification possessed by a few specialists around the world. (1) The phylum possesses a large number of cryptic species complexes [20]. Thus, the identification of a species in two distant regions may actually represent two distinct populations. (2) Nevertheless, rotifers possess a remarkable ability to disperse via anemochory, hydrochory and zoochory [21]. (3) Proper taxonomic identification of rotifer species is difficult because of their microscopic size and the morphological traits are difficult to examine, especially in species that contract when preserved [22]. (4) The keys that exist for species

identification are often regional in nature, out of print, and are written in languages unavailable to many. Thus, rotifer taxonomy has been confusing, with names of species that are no longer recognized being used. Recently, taking advantage of the possibilities provided by the International Code of Zoological Nomenclature (ICZN), the List of Available Names (LAN) partim Phylum Rotifera has established a list of names of species that clears up many long-standing misconceptions such as incorrect spelling and the same species identified with two names (e.g., *Trichocerca birostris* and *Trichocerca similis*) [22–25]. Still, it is important for everybody to have access to all up-to-date information, including nomenclature or taxonomic changes and new species (re)description [26] for all studies to be based on the most accurate knowledge regarding the species composition of an ecosystem.

As part of the Balkan Peninsula, Greece contains many ancient lakes that are recognized globally for their ecological importance. Studies concerning zooplankton in Greece date back to the end of the 19th century [27,28], but studies on rotifers began much later [29,30]. These studies focused on subclass Monogononta, while Donner [31] later studied rotifers (Bdelloidea and Monogononta) from soil ecosystems. The majority of ecological studies overlook Bdelloidea due to difficulties in the identification of preserved individuals. A compilation of the historic data from 1956 up to 1987 only from inland aquatic water bodies, including mainly lakes, was presented in a checklist for Rotifera from Greece published by Zarfdjian and Economidis [32]. In this checklist, only 3 species of Bdelloidea (*Philodina citrina*, *P. megalotropha*, and *P. roseola*) and 76 species of Monogononta were reported [32]. Since then, several studies reporting species lists of Monogononta species have been published. Herein, we present an up-to-date checklist of Monogononta rotifer species that extends the checklist with both published and current data.

2. Materials and Methods

Here, we provide data from 38 inland water bodies: 23 natural lakes, 9 reservoirs, 2 artificial urban ponds, a man-made water channel connecting lakes Mikri Prespa and Megali Prespa, a river, a lagoon, and a saltwork pond (Figure 1). Morphometric characteristics, trophic state, and salinity for each water body are presented in Table S1.

The checklist of rotifers recorded in inland water bodies from Greece compiled herein is based on already published data and data of the present study. A bibliographic review of rotifers' diversity was conducted using the databases Google Scholar and Web of Science using the search words "rotifer", "Greece", and "diversity" during the entire period available in each database (retrieved during January 2022) and the National Archive of PhD Theses of Greece. Grey literature including bachelor and master theses and technical reports conducted by members of the Department of Zoology of School of Biology of Aristotle University of Thessaloniki are also presented. Moreover, historic data from 1956 to 1987 included in the previous checklist [32] not available in the databases are cited as Zarfdjian and Economidis (1989) in Table S1. In compiling our dataset, we did not include studies that provided only genus-level identifications or did not mention the sampled water body. The list of consulted works per water body is available in Table S1.

Data were sorted into an Excel file according to the water body (Table S2). The checklist provided here does not contain a listing of the infraspecific taxa in order to avoid subjectivity in species diversity estimation since we do not know which of the 'subspecies' are proper species and which ones are cyclomorphs. Currently valid species names, authorships, synonyms, and spelling were verified and updated using the Rotifer World Catalog [17] according to the recent List of Available Names (LAN) of International Commission on Zoological Nomenclature for rotifer species [22–25]. When necessary, we checked the species identifications based on available samples and pictures and we updated the species complexes of *Brachionus calyciflorus* and *Brachionus plicatilis* based on the literature [5,33,34]. The species checklist was not arranged based on the phylogeny of Monogononta, but rotifers genera and species were arranged in alphabetic order.

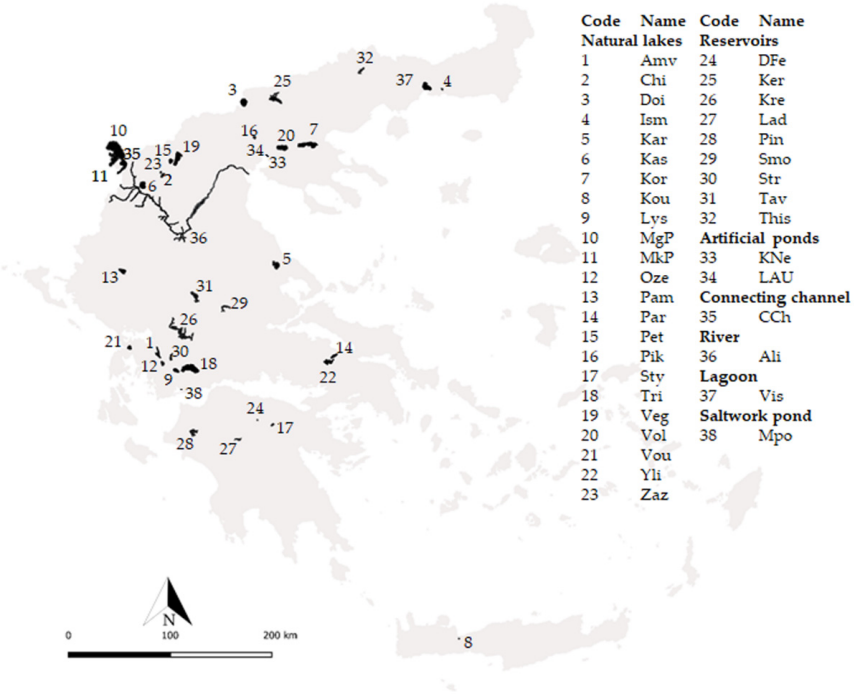

Figure 1. Map of Greece showing the locations of the 38 water bodies included in the study. Abbreviations: Amv: Amvrakia; Chi: Chimaditida; Doi: Doirani; Ism: Ismarida; Kar: Karla; Kas: Kastoria; Kor: Koronia; Kou: Kournas; Lys: Lysimaxeia; MgP: Megali Prespa; MkP: Mikri Prespa; Oze: Ozeros; Pam: Pamvotis; Par: Paralimni; Pet: Petron; Pik: Pikrolimni; Sty: Stymfalia; Tri: Trichonis; Veg: Vegoritis; Vol: Volvi; Vou: Voulkaria; Yli: Yliki; Zaz: Zazari; DFe: Doxa-Feneou; Ker: Kerkini; Kre: Kremasta; Lad: Ladona; Pin: Pineiou; Smo: Smokovo; Str: Stratos; Tav: Tavropou; This: Thisavros; KNe: Kipos nerou pond; LAU: Limnoula auth; CCh: Connecting Channel (between the Megali and Mikri Prespa); Ali: Aliakmon; Vis: Vistonis; Mpo: Messolonghi pond.

The relative frequency of occurrence (i.e., the number of times a certain species occurred in all examined water bodies) was calculated for all species. Two estimators of species richness Chao2 and 2nd-order jackknife (Jackknife2) were calculated using EstimateS 9 [35]. From the diversity estimators, we derived the efficiency percentage of each estimator with the following formula:

$$\text{Efficiency} = \frac{S_{\text{observed}}}{S_{\text{estimated}}}$$

where S_{observed} is the number of the observed species, and $S_{\text{estimated}}$ is the number of the estimated species.

3. Results and Discussion

The total number of rotifer species reported from Greece was 172 (Table 1). These species have been classified into 1 class of Eurotatoria, 2 superorders, 3 orders, 21 families, and 44 genera (Table 2). The most diverse genera were *Lecane* (24 species) and *Brachionus* (20 species) followed by *Trichocerca* (15 species) (Table 2). For the remaining genera, less than 10 species were recorded, while for 13 of them only 1 species was recorded in Greece.

Based on the so-called "Rotiferologist Effect", our knowledge of rotifer biodiversity across the globe is highly biased toward the areas where taxonomists live and work or go on holiday or for fieldwork [36,37]. At a regional scale, Fontaneto et al. [37] compiled a database of Monogononta up to 1992, highlighting the low diversity in the South Balkan region. This low diversity is a misestimation based on the lack of knowledge for species from this area due to low sampling intensity. Specifically for Greece, Zarfdjian and Economidis [32] published the first checklist for rotifers, reporting 76 Monogononta based on

published and grey literature up to 1987. The number of studies on rotifers has increased, and currently, updated checklists are being published around the world (e.g., [38–41]). According to the updated checklists of neighboring countries, Italy has 362 Monogononta [41], followed by Greece (172 species) and Albania with 132 species [38]. Greece and Albania share a high number of common species, which was expected because they are located within the same geographical region and because they share freshwater ecosystems: Lake Mikri Prespa and Lake Megali Prespa (Figure 1).

Rotifer taxonomy has been used in index development for the assessment of water bodies. Rotifers are known to be useful indicators of trophic states in oligotrophic and hypertrophic lakes and have been used for the development of indices using various metrics, including the use of indicator species [42]. Even though rotifer-based indices have also been developed in the Mediterranean region, indicator species were not found to be applicable [43,44]. The indicator species proposed by Karabin [42] for oligotrophic or hypertrophic waters dominating only in either low or high trophic state have been recorded in water bodies of all trophic types in Greece. Only rotifers known to have salinity tolerance [17,45] (i.e., *Brachionus asplanchnoidis*, *B ibericus*, *B. plicatilis*, *B. rubens*, *Filinia cornuta*, *Hexarthra oxyure*, *H. polyodonta*, *Lecane lamellate*, *Macrochaetus collinsii*, and *Notholca salina*) were indicative of the water bodies with increased salinity (oligohaline to hyperhaline).

Table 1. List of rotifer species recorded in the 38 water bodies of Greece (abbreviations according to Figure 1).

Species	Where
Anuraeopsis fissa (Gosse, 1851)	CCh, Doi, Ism, Kas, Kne, Kor, LAU, MgP, MkP, Pam, Pet, Thi, Tri, Veg, Vis, Vol, Vou, Yli
Ascomorpha ecaudis Perty, 1850	Ali, CCh, Kas, Lad, MkP, Pam, Pet, Vol, Vou, Yli, Zaz
Ascomorpha ovalis (Bergendal, 1892)	Kre, Par, Thi, Tri
Ascomorpha saltans Bartsch, 1870	Doi, Kas, Kou, Kre, MkP, Par, Veg, Vol, Vou
Asplanchna brightwellii Gosse, 1850	Doi, Kor, Kou
Asplanchna girodi Guerne, 1888	Chi, Doi, Kas, Pet Veg, Vol, Vou, Zaz
Asplanchna priodonta Gosse, 1850	Ali, Amv, CCh, Chi, Ism, Kas, Ker, Kre, Kor, Kou, Lad, Lys, MgP, MkP, Oze, Pam, Par, Pet, Pin, Smo, Str, Sty, Tav, Thi, Tri, Veg, Vol, Yli, Zaz
Asplanchna sieboldii (Leydig, 1854)	Ism, Kar, Kas, Lys, Veg, Vou
Brachionus angularis Gosse, 1851	Ali, Amv, CCh, Chi, Doi, Ism, Kar, Kas, KNe, Kor, LAU, Lys, MgP, MkP, Oze, Pam, Par, Pet, Smo, Thi, Tri, Veg, Vis, Vol, Vou, Yli, Zaz
Brachionus asplanchnoidis Charin, 1947	Kor
Brachionus bidentatus Anderson, 1889	Kas
Brachionus budapestinensis Daday, 1885	Ism, LAU, Vol, Vou
Brachionus calyciflorus Pallas, 1766	CCh, Kor, Vol, KNe
Brachionus calyciflorus group *	Amv, MgP, Pam, Str, Tav, Tri, Veg, Vis, Yli, Zaz
Brachionus cf. *caudatus* Barrois & Daday, 1894	Lad
Brachionus dorcas Gosse, 1851	Lys, Oze
Brachionus dimidiatus Bryce, 1931	Doi, Kas, Kor, Vol
Brachionus diversicornis Daday, 1883	Amv, CCh, Chi, Doi, Ism, Kas, Ker, Kor, Kre, LAU, Lys, MgP, MkP, Oze, Pam, Pet, Tav, Tri, Veg, Vol, Vou, Zaz
Brachionus elevatus Michaloudi, Papakostas, Stamou et al., 2018	Chi, Doi, Kar, Kas, Ker, Kor, Lys, Pet, Vou
Brachionus falcatus Zacharias, 1898	Ism, Lys, Tri, Vou
Brachionus fernandoi Michaloudi, Papakostas, Stamou et al., 2018	Ism, LAU, Pet
Brachionus forficula Wierzejski, 1891	Chi, Ism, Kar, Kas, LAU, MkP, Pam, Pet, Thi, Vou, Zaz
Brachionus ibericus Ciros-Pérez, Gómez, Serra, 2001	Ism, Kor, Pik, Vou
Brachionus plicatilis Müller, 1786	Kar, Kor, Pik
Brachionus plicatilis group *	Kar, Kor, Mpo, Pik, Smo, Thi
Brachionus quadridentatus Hermann, 1783	Ali, CCh, Ism, Kas, Kor, LAU, MgP, Pik, Sty, Vol, Vou, Zaz
Brachionus rubens Ehrenberg, 1838	Chi, Kor
Brachionus sessilis Varga, 1951	Doi, Par
Brachionus urceolaris Müller, 1773	Ali, CCh, Chi, Ism, Kar, Kas, Kor, LAU, MkP, Zaz
Brachionus variabilis Hempel, 1896	Kar, Kor, Oze, Par, Veg
Cephalodella catellina (Muller, 1786)	Ali, Kor, Pik
Cephalodella exigua (Gosse, 1886)	Kou

Table 1. *Cont.*

Species	Where
Cephalodella forficula (Ehrenberg, 1838)	Vol
Cephalodella gibba (Ehrenberg, 1830)	Ali, CCh, Kar, Kas, Kor, Kou, LAU, Lad, MgP, MkP, Vou
Cephalodella hiulca Myers, 1924	Kor
Cephalodella licina Wulfert, 1961	KNe, LAU
Cephalodella misgurnus Wulfert, 1937	Pik
Cephalodella stenroosi Wulfert, 1937	KNe
Cephalodella xenica Myers, 1924	Vou
Collotheca libera (Zacharias, 1894)	Vol
Collotheca mutabilis (Hudson, 1885)	Vol
Colurella adriatica Ehrenberg, 1831	Ali, Kor, Kou, Vol, Zaz
Colurella anodonta Carlin, 1939	LAU
Colurella colurus (Ehrenberg, 1830)	Ali
Colurella obtusa (Gosse, 1886)	Kou, Sty, Vol
Colurella salina Althaus, 1957	Vou
Colurella uncinata (Müller, 1773)	Ali, Kas, KNe, Kou, LAU, Zaz
Conochilus dossuarius Hudson, 1885	Kas, Veg, Vol, Vou
Conochilus hippocrepis (Schrank, 1803)	CCh, MkP
Conochilus unicornis Rousselet, 1892	Amv, Chi, Lys, Oze, Str, Tri, Zaz
Dicranophorus hercules Wiszniewski, 1932	Lad
Dicranophorus forcipatus (Müller, 1786)	Sty
Dicranophorus grandis (Ehrenberg, 1832)	Kas, LAU
Dicranophorus luetkeni (Bergendal, 1892)	Ali
Encentrum putorius Wulfert, 1936	Ali
Encentrum uncinatum (Milne, 1886)	Ali
Eosphora anthadis Harring & Myers, 1922	CCh
Eosphora ehrenbergi Weber, 1918	Kas, Kor, Pik
Eothinia elongata (Ehrenberg, 1832)	Kou, Vou
Epiphanes brachionus (Ehrenberg, 1837)	MgP
Epiphanes macroura (Barrois & Daday, 1894)	Chi, Kor, Lys, Vou, Zaz
Epiphanes senta (Müller, 1773)	Tav
Euchlanis deflexa Gosse, 1851	Ali
Euchlanis dilatata Ehrenberg, 1830	Ali, Chi, Ism, Kas, Kor, Lad, MkP, Pam, Par, Pet, Tav, Tri, Veg, Vol, Vou, Zaz
Euchlanis lyra Hudson, 1886	Ali
Euchlanis parva Rousselet, 1892	Kou
Filinia cornuta (Weisse, 1848)	Ism
Filinia longiseta (Ehrenberg, 1834)	Amv, CCh, Chi, Doi, Kar, Kas, Ker, Kor, Lad, LAU, Lys, MgP, MkP, Oze, Pam, Par, Pet, Pin, Smo, Str, Tav, Tri, Veg, Vis, Vol, Vou, Yli, Zaz
Filinia opoliensis (Zacharias, 1898)	Lys, Oze, Tri
Filinia terminalis (Plate, 1886)	Amv, Ism, Lys, Pam, Smo, Tri, Veg, Vou
Gastropus hyptopus (Ehrenberg, 1838)	MkP, Thi
Gastropus stylifer Imhof, 1891	DFe, Kas, Kre, Lad, MgP, MkP, Pin, Str, Sty, Thi, Tri, Vol
Hexarthra bulgarica (Wiszniewski, 1933)	Kas, Kor
Hexarthra intermedia (Wiszniewski, 1929)	Oze, Tri
Hexarthra mira (Hudson, 1871)	Amv, Chi, Doi, Kas, Kor, Lys, MkP, Oze, Pam, Par, Pet, Str, Tri, Veg, Vis, Vol, Vou, Zaz
Hexarthra oxyure (Zernov, 1903)	Kou, Vou
Hexarthra polyodonta (Hauer, 1957)	Kor
Kellicottia longispina (Kellicott, 1879)	Ali, Amv, Kas, Ker, LAU, MgP, MkP, Oze, Pam, Smo, Tav, Thi, Tri, Veg, Vol, Vou
Keratella cochlearis (Gosse, 1851)	Ali, Amv, CCh, Chi, DFe, Doi, Ism, Kar, Kas, Ker, KNe, Kor, Kre, Lad, LAU, Lys, MgP, MkP, Oze, Pam, Par, Pet, Pik, Smo, Str, Tav, Thi, Tri, Veg, Vol, Vou, Yli, Zaz
Keratella quadrata (Müller, 1786)	Ali, Amv, CCh, Chi, Doi, Ism, Kar, Kas, Ker, KNe, Kor, Kou, LAU, Lys, MgP, MkP, Oze, Pam, Par, Pet, Pik, Smo, Sty, Tav, Thi, Tri, Veg, Vis, Vol, Vou, Yli, Zaz
Keratella tecta (Gosse, 1851)	Ali, Amv, CCh, Chi, Doi, Ism, Kar, Kas, Ker, KNe, Kor, Lad, LAU, Lys, MgP, MkP, Oze, Pam, Par, Pet, Smo, Tav, Thi, Tri, Veg, Vol, Vou, Yli, Zaz
Keratella tropica (Apstein, 1907)	Amv, Doi, Kar, Kas, Kor, Kre, Lys, Oze, Pam, Par, Tri, Veg, Vis, Vou, Yli
Lecane arcula Harring, 1914	Kas, KNe, LAU
Lecane bifurca (Bryce, 1892)	LAU
Lecane bulla (Gosse, 1851)	Ali, Amv, CCh, Kas, KNe, Kor, Kre, LAU, MgP, MkP, Oze, Par, Veg, Vol, Vou
Lecane cf. *nana* (Murray, 1913)	LAU
Lecane closterocerca (Schmarda, 1859)	Ali, Chi, Ism, Kar, Kas, KNe, Kor, LAU, Veg, Vol, Vou, Zaz
Lecane curvicornis (Murray, 1913)	Kas
Lecane elsa Hauer, 1931	CCh, KNe, Lys, MgP, MkP, Vol
Lecane flexilis (Gosse, 1886)	Kas, LAU, Pet
Lecane furcata (Murray, 1913)	CCh, Kas, KNe, Kor, MkP, Vou
Lecane hamata (Stokes, 1896)	Kas, KNe, Kor, LAU, Vou
Lecane inopinata Harring & Myers, 1926	Vou
Lecane lamellata (Daday, 1893)	Kor
Lecane ludwigii (Eckstein, 1883)	Kas

Table 1. *Cont.*

Species	Where
Lecane luna (Müller, 1776)	Ali, Amv, CCh, Kas, KNe, Kor, Kou, LAU, Lys, MkP, Oze, Sty, Veg, Vol, Vou, Zaz
Lecane lunaris (Ehrenberg, 1832)	Ali, CCh, Chi, Kas, KNe, Kor, MgP, MkP, Sty, Veg, Zaz
Lecane mira (Murray, 1913)	MkP
Lecane niothis Harring & Myers, 1926	LAU
Lecane quadridentata (Ehrenberg, 1830)	Ali, CCh, Ism, Kas, KNe, Kor, MgP, Str, Tri
Lecane spinulifera Edmondson, 1935	MkP
Lecane stenroosi (Meissner, 1908)	LAU
Lecane stichaea group	KNe, LAU
Lecane subtilis Harring & Myers, 1926	Kar, LAU
Lecane subulata (Harring & Myers, 1926)	Kou
Lecane ungulata (Gosse, 1887)	Oze
Lepadella acuminata (Ehrenberg, 1834)	Kas, KNe, Kre, LAU, Sty
Lepadella ehrenbergii (Perty, 1850)	CCh, MkP, Vou
Lepadella glossa Wulfert, 1960	CCh
Lepadella ovalis (Müller, 1786)	Ali, KNe, MkP
Lepadella patella (Müller, 1773)	CCh, Kar, Kas, KNe, Kor, Kou, LAU, MgP, MkP, Pik
Lindia torulosa Dujardin, 1841	Ali
Lophocharis salpina (Ehrenberg, 1834)	Kor, LAU
Macrochaetus altamirai (Arévalo, 1918)	CCh
Macrochaetus collinsii (Gosse, 1867)	Kou
Monommata actices Myers, 1930	CCh, MkP
Mytilina bisulcata (Lucks, 1912)	Ali, KNe, LAU
Mytilina mucronata (Müller, 1773)	Ali, Zaz
Mytilina ventralis (Ehrenberg, 1830)	Kas, Kor, Thi
Notholca acuminata (Ehrenberg, 1832)	Ali, Chi, Doi
Notholca foliacea (Ehrenberg, 1838)	Ali
Notholca salina Focke, 1961	Kor, Kou, Pik
Notholca squamula (Müller, 1786)	Ali, Kas, Lad, MgP, MkP, Par, Pet, Veg, Vol
Notholca striata (Müller, 1786)	Doi, Ism, Kar
Notommata pseudocerberus Beauchamp, 1908	Ali
Plationus patulus (Müller, 1786)	Amv, Kas, Vou
Platyias quadricornis (Ehrenberg, 1832)	Ali, Kas, MkP, Oze, Pam, Veg, Vol, Vou
Pleurotrocha petromyzon Ehrenberg, 1830	Ali
Ploesoma hudsoni (Imhof, 1891)	Ali, Kre, Oze, Str
Ploesoma truncatum (Levander, 1894)	Amv, Kas, Kre, Lys, MgP, Oze, Pet, Str, Tri
Polyarthra dolichoptera Idelson, 1925	Ali, Chi, Doi, Kar, LAU, Lys, Oze, Pam, Tav, Tri, Veg, Vol, Vou
Polyarthra euryptera Wierzejski, 1891	Doi, Kas, Kor, Par, Pet, Veg, Vol
Polyarthra luminosa Kutikova,1962	Amv, Kas, Kre, Par, Tri, Veg
Polyarthra major Burckhardt, 1900	Ali, Amv, Kas, Ker, Kor, Kou, Pet, Pin, Tri, Veg, Vol, Vou
Polyarthra minor Voigt, 1904	Doi, Kas, MkP, Vol, Vou
Polyarthra remata Skorikov, 1896	Amv, Kor, LAU, Smo, Sty, Tri, Vol, Vou
Polyarthra vulgaris Carlin, 1943	Ali, Amv, CCh, Doi, Kas, Kre, Kor, Kou, Lad, Lys, MgP, MkP, Oze, Pam, Str, Tav, Tri, Veg, Vol, Vou, Zaz
Pompholyx complanata Gosse, 1851	Amv, Kas, Kor, Par, Pet, Smo, Veg, Vol
Pompholyx sulcata Hudson, 1885	Doi, CCh, Kar, Kas, Kor, LAU, MgP, MkP, Par, Pet, Tav, Thi, Tri, Veg, Vol, Yli, Zaz
Proales theodora (Gosse, 1887)	Ali
Proalides subtilis Rodewald, 1940	Ism, Kar, LAU, Vou, Zaz
Proalides tentaculatus Beauchamp, 1907	Kor
Resticula melandoca (Gosse, 1887)	Vou
Scaridium longicauda (Müller, 1786)	Ali, CCh, Kas, Lad, MkP
Squatinella lamellaris (Müller, 1786)	CCh, Kas, Kne, LAU, MgP, MkP
Squatinella rostrum (Schmarda, 1846)	Zaz
Synchaeta kitina Rousselet, 1902	Vou
Synchaeta littoralis Rousselet, 1902	Ali
Synchaeta monopus Plate, 1889	LAU
Synchaeta oblonga Ehrenberg, 1832	Ali, LAU, Vol, Vou
Synchaeta pectinata Ehrenberg, 1832	Ali, Amv, Doi, Kas, MkP, Pet, Pin, Tav, Vol, Yli
Synchaeta stylata Wierzejski, 1893	CCh, Kas, Lad, Lys, MgP, MkP, Oze, Thi, Tri, Veg
Synchaeta tremula (Muller,1786)	LAU
Testudinella aspis Carlin, 1939	Kas
Testudinella patina (Hermann, 1783)	Ali, Kas, Kor, Oze
Testudinella truncata (Gosse, 1886)	Kou, Lad, Sty
Trichocerca bicristata (Gosse, 1887)	LAU, Sty
Trichocerca capucina (Wierzejski & Zacharias, 1893)	Amv, CCh, Chi, Doi, Kas, Ker, Kor, Kre, LAU, MgP, MkP, Pam, Par, Pet, Tav, Thi, Tri, Veg, Vol, Yli, Zaz
Trichocerca cylindrica (Imhof, 1891)	CCh, Chi, Kas, Ker, Kor, LAU, MgP, MkP, Pam, Pet, Smo, Thi, Zaz
Trichocerca dixonnuttalli (Jennings, 1903)	Pam, Vou

Table 1. *Cont.*

Species	Where
Trichocerca elongata (Gosse, 1886)	Ali, Kas, KNe, MkP
Trichocerca longiseta (Schrank, 1802)	Ali
Trichocerca porcellus (Gosse, 1851)	Kou, Thi
Trichocerca pusilla (Jennings, 1903)	Ali, CCh, Chi, Doi, Kas, KNe, Kor, LAU, MgP, MkP, Par, Pet, Veg, Vol, Vou
Trichocerca rattus (Müller, 1776)	Ali, Kas, Lad, MkP, Tri, Veg
Trichocerca ruttneri Donner, 1953	Lys, Oze
Trichocerca similis (Wierzejski, 1893)	Amv, CCh, Chi, Doi, Kar, Kas, Kor, Kre, Lys, MgP, MkP, Oze, Pam, Smo, Str, Tav, Thi, Tri, Veg, Vol, Vou, Yli, Zaz
Trichocerca stylata (Gosse, 1851)	Kas, Kor, MgP, MkP, Pam, Par, Pet, Vol, Vou
Trichocerca tenuior (Gosse, 1886)	Lad
Trichocerca tigris (Müller, 1786)	Kas, Lad
Trichocerca weberi (Jennings, 1903)	Kas, MkP, Pet, Veg
Trichotria pocillum (Müller, 1776)	CCh, Kas, Lad, Sty, Vou
Trichotria tetractis (Ehrenberg, 1830)	Ali, KNe, Lad, LAU, Vou
Tripleuchlanis plicata (Levander, 1894)	Kor

* *Brachionus calyciflorus* and *Brachionus plicatilis* groups have not been counted into the total number of species. They most probably represent one of the already mentioned species of the respective complex but were not properly identified.

The frequency of occurrence varied from 2.6% (for 58 species recorded only from one water body) to 86.84% (for *Keratella cochlearis* recorded from 33 water bodies). *Asplanchna priodonta*, *Brachionus angularis*, *Filinia longiseta*, *Keratella cochlearis*, *K. quadrata*, *K. tecta*, and *Trichocerca similis* were the most frequent species, with a frequency of occurrence over 60% (Figure 2). These seven species are known to be cosmopolitan, common in freshwater lakes, reservoirs, ponds, and in potamoplankton and can be encountered both in littoral habitats and in open water [17]. Molecular studies from different regions have shown that the above-mentioned *Keratella* species may possibly be species complexes [8,20,46]. Therefore, the further investigation of cryptic species in the studied water bodies is recommended. Of course, it is being generally accepted that cosmopolitan species may actually represent cryptic species complexes [3,4,47], and their delineation will eventually further diversify the world's Rotifera fauna.

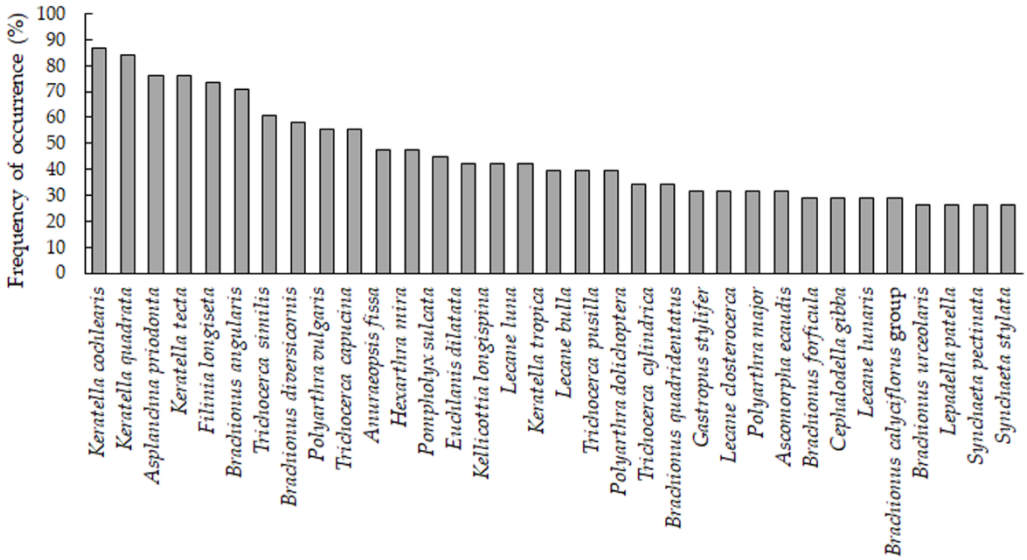

Figure 2. Species of rotifers recorded in Greek waterbodies having a frequency of occurrence over 25%.

Table 2. Number of species per genus.

Superorder	Order	Family	Genus	No Species
Gnesiotrocha	Collothecacea	Collothecidae	*Collotheca*	2
	Flosculariacea	Conochilidae	*Conochilus*	3
		Hexarthridae	*Hexarthra*	5
		Testudinellidae	*Pompholyx*	2
			Testudinella	3
		Trochosphaeridae	*Filinia*	4
Pseudotrocha	Ploima	Asplanchnidae	*Asplanchna*	4
		Brachionidae	*Anuraeopsis*	1
			Brachionus	20
			Kellicottia	1
			Keratella	4
			Notholca	5
			Plationus	1
			Platyias	1
		Dicranophoridae	*Dicranophorus*	4
			Encentrum	2
		Epiphanidae	*Epiphanes*	3
		Euchlanidae	*Euchlanis*	4
			Tripleuchlanis	1
		Gastropodidae	*Ascomorpha*	3
			Gastropus	2
		Lecanidae	*Lecane*	24
		Lepadellidae	*Squatinella*	2
			Colurella	6
			Lepadella	5
		Lindidae	*Lindia*	1
		Mytilinidae	*Lophocharis*	1
			Mytilina	3
		Notommatidae	*Cephalodella*	9
			Eosphora	2
			Eothinia	1
			Monommata	1
			Notommata	1
			Pleurotrocha	1
			Resticula	1
		Proalidae	*Proales*	1
			Proalides	2
		Scaridiidae	*Scaridium*	1
		Synchaetidae	*Ploesoma*	2
			Polyarthra	7
			Synchaeta	7
		Trichocercidae	*Trichocerca*	15
		Trichotriidae	*Macrochaetus*	2
			Trichotria	2

Acknowledging that sampling effort can strongly influence species numbers, we evaluated our dataset with the two estimates of species richness Chao2 and Jackknife2. These two estimates of total species richness showed that the potential species richness should account for 250 species based on the classic Chao2 estimator or even 264 species based on Jacknife2 (Figure 3). Therefore, the efficiency percentage of species estimated varied from 65 to 69% (Jackknife2 and Chao2, respectively).

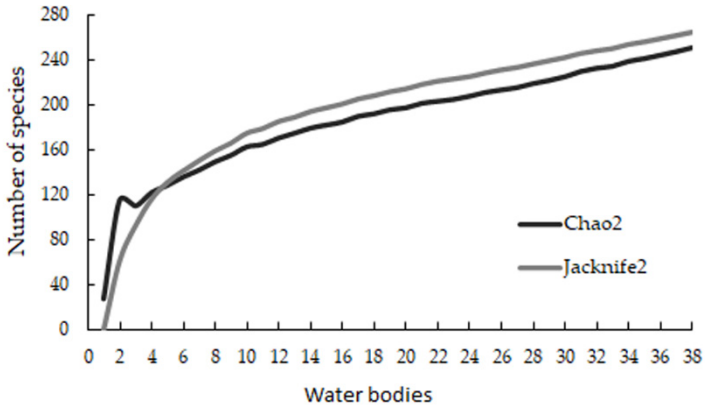

Figure 3. Estimation of diversity of rotifers in Greek waterbodies using the estimators Chao2 and Jackknife2.

Our underestimation of species diversity can be justified by various factors. First, the sampling effort is not the same for all water bodies. Studies with long timeseries are missing, while many studies have sparce samplings, usually limited to the summer-autumn season (e.g., [44]). In addition, not all habitats have been evenly sampled in the studied water bodies; normally, samplings are conducted at the deepest part of the lakes [44,48], so littoral species and sessile rotifers have been underestimated. Other important habitats for rotifer biodiversity, such as littoral zones, temporary pools, swamps, ditches, and puddles or even marine water bodies, have not been explored while rivers and ponds are not well studied so far; thus, additional species are expected to be found in future studies.

Moreover, the identification skills of the personnel and the preservation of the samples in formalin solution have led to the identification of specimens down to the genus level (Table 3). Thus, one extra family Flosculariidae and two extra genera *Ptygura* and *Sinatherina* have been recorded for the Greek fauna based on Table 3. Seven more species, namely *Collotheca ornata*, *Colurella hindenburgi*, *Enteroplea lacustris*, *Floscularia ringens*, *Keratella testudo*, *Lecane cornuta*, and *Ptygura brevis*, are reported from the islands [31,32]; however, the specific water body was not mentioned. Thus, they were not included in the present checklist.

When molecular analysis is more widely used, more information will become available on which species actually comprise complexes of cryptic species. We expect that the numbers of species of any area will increase. Only three studies exist so far for the Greek rotifera fauna by identifying rotifer species using molecular tools: Proios et al. [49] for *Brachionus sessilis*, Michaloudi et al. [34] for *B. asplanchnoidis*, and Zhang [50] for *B. calyciflorus*. However, more species complexes have been identified worldwide accompanied by proper species descriptions, while others have yet to be described. One example is *K. cochlearis*, which has been proposed as a species complex of eight putative species based on molecular analysis; however, further morphological analysis is needed for those species to complete the proper taxonomical procedure to make already described morphological forms valid species and describe new ones [8]. From the known varieties *Keratella cochlearis*, var *hispida* has been recorded based on morphological characteristics in Greece (e.g., Lake Mikri Prespa [51]). Furthermore, phylum Rotifera is replete with species well known for their morphological plasticity. This characteristic has resulted in groups of species that have not yet been taxonomically or molecularly identified. Thus, the effort placed toward the integrative taxonomy, using molecular mapping of diversity combined with morphological analysis and classical taxonomy, will yield many more 'new' species.

Table 3. List of taxa identified down to the genus level.

Taxa	Where
Cephalodella spp.	Ali, Kas, KNe, LAU, Zaz
Collotheca spp.	Amv, CCh, Chi, Doi, Kas, Kre, Kor, Kou, Lad, LAU, MgP, MkP, Pam, Par, Pin, Smo, Thi, Tri, Vol, Vou, Zaz
Colurella sp.	Mpo
Conochilus sp.	DFe, Lad, Lys, Oze, Smo, Thi, Veg
Epiphanes sp.	Ali, Mpo
Euchlanis sp.	CCh, MgP, MkP, Oze, Sty, Veg, Zaz
Hexarthra sp.	Ism, Mpo, Smo
Lecane sp.	Kas, MkP, LAU
Lepadella sp.	Chi, Ism, Kas, KNe, MkP, Pet, Veg
Lindia sp.	LAU, Mpo
Monommata sp.	LAU, Smo, Tri
Notholca sp.	Chi, Kar, Pam
Pleurotrocha sp.	Ali
Polyarthra spp.	Chi, Doi, Ism, Kas, MgP, MkP, Par, Pet, Smo, Tav, Thi, Veg, Yli, Zaz
Proalides sp.	Chi, Kne
Ptygura sp.	Ali, Kas, KNe, LAU, Pik
Sinantherina sp.	Ali
Synchaeta spp.	Chi, Ism, Kas, Kor, Lad, MgP, Oze, Pam, Par, Pet, Pin, Smo, Str, Tav, Thi, Vou, Yli, Zaz
Testudinella sp.	Mpo
Trichocerca spp.	Ism, Pet, Pin, Smo, Vol, Vou
Trichotria sp.	MkP, Yli

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/d14060451/s1, Table S1: Water bodies' characteristics; Table S2: Rotifers raw data.

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