Rotifers as indicators of water quality

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Abstract

Six hundred and twenty species and lower taxonomical units of Rotatoria found in Czechoslovakia and surrounding countries are listed alphabetically and classified according to water quality. The numerical characteristics include the saprobic valence in 10 balls, the indicative weight of species, I_i, and the individual saprobic index, S_i. Rotifers are considered to be good indicators and some of them are figured on Plates 1–3. The situation is illustrated by four graphs and the relation to BOD_5 values is stressed. All rotifers are aerobic organisms and occur only within limnosaprobity. They can also serve as indicators of trophic conditions. To characterize the situation in standing and slowly flowing waters a *Brachionus:Trichocerca* quotient is proposed. Rotifers can also be used as test organisms in toxicity experiments.

General characteristics

Rotifera or wheel animalcules are one of the most interesting groups of freshwater invertebrates. They belong to the subphylum Trochhelminthes, i.e. they are worms, although their bodies share no resemblance with typical worms such as oligochaets. Remane (1929–33) believed they were larvae of unknown worms that remained in the larval stage, but recent investigators (Clement 1980) see their origin in Platyhelminthes. Having no paleontological evidence, we presume that rotifers are a very old group of invertebrates, a product of the aerobic phase in the development of our planet.

Rotifers are characterized by a corona (a ciliated area or a funnel-shaped structure at the anterior end) and a specialized pharynx called a mastax, which serves as a jaw. Their size ranges between 45 μm and about 2.5 mm, the most common length being 100–500 μm. The rotifers ordinarily encountered are amictic females, i.e. they parthenogenetically produce diploid eggs. Usually in the autumn mictic haploid eggs are formed from which, without fertilization, males appear. They are known only in a minority of species, and are reduced in size and in organs. A digestive system is totally absent and males perish within some hours or few days. From the fertilized eggs special resting ('winter') eggs evolve, having a thick protective cover resistant to desiccation, freezing and other unfavourable factors. The next spring, females hatch from these resting eggs and start a new amictic generation. Species having males once per year are monocyclic, twice per year, dicyclic and several times per year, polycyclic. In the order Bdelloidea, where no males occur, they are acyclic.

Rotifers possess no respiratory organs, and respire by their whole body surface. For this reason they are unable to live in an anaerobic milieu. Only few very resistant species tolerate microaerobic habitats, e.g. *Rotaria neptunia* and *R. rotatoria.*

There exist about 2 000 species of rotifers. Pennak (1953) indicated 1 700 species, less than 5% of which are restricted to brackish and marine environments. In the second edition of Limnofauna europaea Berzins (1978) listed 1 588 taxa, 1 330 of

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which he considered as valid species and the remaining as lower taxonomical units. In comparison with the first edition (Berzins 1967) there was an increase of 70 species. Although many rotifers show a cosmopolitan distribution, all local faunas comprise fewer species. For Czechoslovakia Bartoš (1959) listed about 500 species, including those living in the edaphon, in mosses and a few commensals and parasites.

For decades the most important guide to rotifers was the Süsswasserfauna by Collin *et al.* (1912) and of course, the Synopsis of Rotatoria by Harring (1913). Now we have modern keys (Bartoš 1959; Donner 1965; Koste 1978; Kutikova 1970; Rudescu 1960; Voigt 1957), enabling a reliable identification of species and varieties. This is very important in the genera *Brachionus* and *Keratella*. A long series of publications deal with individual genera or species, and contain detailed keys (Ahlstrom 1940, 1943; Carlin 1943; Berzins 1951; Gillard 1947, 1948, 1952; Hauer 1924). General treatises have been published by Pennak (1953), Edmondson (1959), Donner (1962), Remane (1929–32), Pontin (1978), Weber & Montet (1918), Wesenberg-Lund (1939), Wulfert (1969), Ruttner-Kolisko (1972), etc.

General ecology

Rotifers mainly live among aquatic vegetation in the littorial zone of lakes, artificial reservoirs, fishponds, rivers, canals, pools and various small waterbodies like dendrothelms, cemetery flower urns etc. Pennak (1953) states that about 75% of rotifers belong to the littoral zone and only about 100 species are typically pelagic, forming a substantial part of the zooplankton. Carlin (1945) found 69 species as true planktons in Sweden. Few species are benthic, dwelling among mud and detritus on the bottom of the aphotic zone. Bdelloidea are most characteristic for mosses, sphagnum and humus-containing soil. Many species (but not all) are able to desiccate and survive for months or years. Pennak (1953) writes about one bdelloid rotifer that was revived from moss that was kept dry for 27 years.

Rotifers are also found in wells, underground waters and in mineral and thermal springs. Underground, their presence demonstrates an imperfect filtration effect of the soil and possibly contamination of underground water from the surface. They play a significant part as inhabitants of the psammon. In the wet interstices of sandy beaches Pennak (1940) found up to 1 155 000 individuals per liter of damp sand in Wisconsin lakes.

Most plankton communities show 50 to 500 individuals of rotifers per liter, but mountain lakes may have less than 20. The most dense population in unpolluted water reached 5 800 per liter (Pennak 1953). In a polluted and eutrophicated standing water body rotifers reached 23 900 individuals per liter at a depth of 1 m in July, whereas 8 900 were at the surface, 14 500 in 0.5 m, 600 at 1.5 m and 100 at 2 m (bottom). This population consisted of *Pompholyx sulcata* (up to 11 200 at 1 m), *Keratella cochlearis* (up to 9 200), *Keratella quadrata* (up to 4 100) and a few other species. This pond served as a lagoon for treating beet-sugar wastes from autumn till spring, and converted by an aided self-purification into a very eutrophic fishpond in summer (Sládeček *et al.* 1958).

Bacteria, small algae, flagellates and detritus filtered from the water are the most common food. In polluted waters the main sources are suspended solids and even colloids from the waste waters together with bacteria decomposing the organic matter. Plankton species of the genera *Keratella, Kellicottia, Filinia, Hexarthra, Conochilus*, all Bdelloidea and some sessile species of the genera *Floscularia* and *Collotheca* only take particles smaller than 10 μm. The genus *Asplanchna* feeds on even larger algae, protozoa, other rotifers (*Keratella*) and small cladocera like *Bosmina*, catching them individually. The genera *Ascomorpha, Ascomorphella* and *Chromogaster* suck the plasmatic content of bigger algae and species of the families Notommatidae and Dicranophoridae eat periphytic algae, protozoa and other rotifera (some *Encentrum, Aspelta, Dicranophorus*). The few parasites were omitted from our list.

Excessive growth of the blue-green algae (= Cyanobacteria) inhibits the development of the majority of sedimentators among rotifers by eliminating the fine micro-algae which serve as the basic food of the phytophagous sedimentators (Edmonson 1965; Pourriot 1977; Dumont 1977). Dumont (1977) suggested that some extra-cellular substances (external metabolites) of blue-greens may be toxic to planktonic rotifers and limit their fertility. The population density of *Asplanchna priodonta* feeding on *Keratella cochlearis* in Polish lakes is regulated by the abundance of their prey (Radwan 1980).

Notholca squamula feeds on the planktonic diatom *Asterionella formosa* by breaking the cell frustules and removing the plasmatic content. The broken empty frustules remain in the diatom colony and demonstrate the grazing effect of this rotifer (May 1980).

Some representatives of *Brachionus* may adhere to the surface of cladocera, especially *Daphnia* and *Moina*. They use cladocera as an easy means of transport, but are not parasites. Such cases are common in highly eutrophicated waters, stabilization ponds and fishponds.

The effect of pH was summarized by Pennak (1953) as follows: 'In general, alkaline waters (above pH 7.0) contain few species but large numbers of individuals, while acid waters contain large numbers of species and few individuals (thus a high diversity). In the hard-water lakes around Madison, Wisconsin, Myers identified 100 species in a week of collecting, but he found the same number of species in only one hour of collecting in a small acid lake in northern Wisconsin. In the alkaline Yahara basin in southern Wisconsin he collected 138 species, but in the acid waters of Mount Desert Island in Maine he collected 497 species (Myers 1931–1934).' Myers thus distinguished three ecological groups with reference to pH: (1) alkaline water species (*Asplanchna, Asplanchnopus, Mytilina, Brachionus, Filinia, Lacinularia, Sinantherina, Eosphora, Notholca*), (2) transition species that occur in both alkaline and acid waters (the large majority of rotifers), and (3) acid water species (*Cephalodella, Lepadella, Lecane, Monostyla, Trichocerca, Dicranophorus*, but some genera also show transition and alkaline species). Bdelloidea are apparently all transitional and are able to tolerate a wide range of ecological conditions (Pennak 1953).

Special conditions of sessile rotifers were studied and summarized by Edmondson (1944, 1945), Wallace (1980) and with respect to pollution by, Sládečková & Sládeček (1963, 1977).

An experimental approach to rotifer ecology was undertaken by Pourriot (1965) on the basis of their feeding on algae, detritus and bacteria.

Because rotifers are very easily transported by water and air, their distribution is usually regarded as potentially cosmopolitan and many species show a world-wide distribution. However, some species show a distinctly restricted geographical distribution, e.g. *Trichocerca platessa, Pseudoploesoma formosa* and *Kellicottia bostonensis* in North America (Edmondson 1959). A number of brachionids are restricted to warmer climates, while on the other hand *Keratella cochlearis* is absent from the tropics, although it is one of the most common planktonic species in temperate regions. Thus, it makes sense to undertake biogeographical studies of rotifers (Dumont 1980). In general, the rotifer fauna of high altitudes and high latitudes is composed of relatively few species of wide distribution (Edmondson 1959). Thermal pollution promotes the tropical species in temperate zone. Lair (1980) found three tropical rotifers in the river Loire in France under the influence of heated water from nuclear plants.

Saprobiology

Rotifers are good indicators of saprobity (= organic pollution manifested by BOD_5, dissolved oxygen content and specific communities of indicator organisms). The rotifers are distinctly aerobic invertebrates and indicate the situation only within limnosaprobity, not within eusaprobity (sewage and industrial wastes in an anaerobic state). They occur in purification plants, where the waste water is treated biologically and usually aerated (biofilters, activated sludge, stabilization ponds). Investigations of polluted and waste waters are often made by students not familiar with rotifers, so that we find only rarely rotifer determinations in the literature on the biological treatment. Sládeček (1957), for example, studied for two years an activated sludge plant in Praha-Hostivař, found an *Encentrum* sp. there but was not able to determine it until several years after. It proved to be *Encentrum lupus* Wulfert, a species which readily adapts to the conditions in the activated sludge, where an abundant supply of food is available, together with a good aeration reaching a D.O. content of 5–6 mg l^{-1}.

Rotifers of activated sludge were studied in detail by Godeanu (1966) in Rumania, Klimowicz, (1970, 1972, 1973, 1977) in Poland, Doohan (1975) in Great Britain and Sudzuki (1981) in Japan. They occur especially in purification plants with a long detention time as in the classical activated sludge process. Their reproduction rate is relatively slow (days till weeks) so that they cannot persist in plants with a shorter detention time. A smaller number of species (especially Bdelloidea) dwell in biofilters. A rich rotifer fauna is very often present in different types of stabilization ponds and in polluted rivers and standing water bodies like village ponds with an inlet of liquid manure (dung-water).

Rotifers were first used as indicators by Kolkwitz & Marsson (1902, 1909). Kolkwitz (1935) listed two species as polysaprobic (*Rotaria neptunia* and *R. rotatoria*), six taxa as alpha-mesosaprobic, seven as beta-mesosaprobic and three as oligosaprobic. Similar lists appear in Dolgov & Nikitinskij (1927) and Žadin & Rodina (1950). The revisions of Liebmann (1951, 1962) brought several changes with additions and deletions. Wetzel (1969) listed *Rotaria neptunia* and *Diplax trigona* as polysaprobic, no alpha-mesosaprobic species, *Brachionus ureceolaris* as beta-mesosaprobic and *Filinia longiseta, Polyarthra 'platyptera', Kellicottia longispina* and *Keratella cochlearis* as oligosaprobic. Sládeček (1956) considered 82 rotifers as good indicators.

A new approach – the saprobic valence – was introduced by Zelinka *et al.* (1959) and Zelinka & Marvan (1961). Every aquatic organism was considered as an indicator and its saprobic valence was expressed in 10 balls (points) distributed over the 5 degrees of limnosaprobity. Thirty-six rotifers were classified in this way and their numbers rose in the subsequent editions (Cyrus & Sládeček (1969), Sládeček (1973, 1976, 1981). As a new criterion, the individual saprobic index according to the method of Pantle & Buck (1955) was added. Donner (1978) brought very important supplements by analysis of the Danube and its Austrian tributaries. He observed the changes of saprobity in space and time and found that euryvalent species (among them a majority of rotifers) reacted slowly to the changing conditions. Many of them were able to adapt to the changing environment and survived in the worsened conditions.

Water quality

The modern meaning of the term water quality comprises all factors affecting the use of water by man. We distinguish drinking water, water for recreation and sports, water for industry (including cooling water, washing water, water for irrigation), polluted water (which cannot be used directly for any human activity), as well as sewage and industrial wastes which should be purified before entering the receiving water bodies (brooks, rivers, lakes, ponds, the sea).

From the biological point of view the following features have to be considered (Sládeček 1966, 1973, 1981):

(1) Saprobity – the content of putrescible organic matter, decomposed by aquatic microorganisms forming different communities in the open water, among the littoral vegetation and on the muddy bottom. The organisms are named saprobes, their environment saprobity.

(2) Toxicity – the effect of toxic material poisoning aquatic organisms. Toxicity levels are proportioned to the concentration of the toxic matter. A system of acute toxicity was proposed by Sládeček (1981).

(3) Radioactivity – the effects of radionuclides, with a weak influence on primitive bacteria, protista, plants and invertebrates but with a strong effect on man.

(4) Physical factors (= cryptosaprobity) – mechanical and other physical effects of inert matter (inorganic powders, coal powder, mineral oil, too low or too high temperatures) causing no saprobity and no toxicity.

(5) Eutrophication – enrichment of the water in mineral nutrients and subsequent development of water blooms, vegetative colourings obnoxious odours, masses of filamentous algae, dense growths of aquatic weeds. Such phenomena cause problems in water supply and in recreation. Eutrophication is sometimes synonymous with saprobity (Sládeček 1977, 1978).

(6) Salinity – effects of increased concentrations of salts, reducing the species array of freshwater communities. Brackish waters and marine environment are usually dealt separately from freshwater science (limnology).

(7) Unknown factors, developing with the progress of science and technology.

The biological analysis of water quality deals first of all with saprobity. After the beginnings in the 19th century, a system of saprobic organisms was first formulated by Kolkwitz & Marsson (1902, 1908, 1909). They distinguished three phases in the biological self-purification of waste water: (1) phase with a predominance of reduction processes = polysaprobic, (2) end of reduction and start of oxidation processes = mesosaprobic, and (3) phase of completing the oxidation = oligosaprobic. Because they further divided mesosaprobity into two stages (alpha and beta) and added a category of pure water (= katharobity), they obtained a scale of 5 degrees (levels, stages, zones, phases) corresponding to a gradual decrease in pollution and increase in water purity.

The system of saprobic organisms has been criticized (e.g. Hynes 1960; Caspers & Karbe 1966; Elster 1962, 1966; summary in Sládeček 1973), revised (e.g. Liebmann 1951, 1962) and supplemented by adding new phases, especially in the sewage and industrial wastes (Thomas 1944; Cyrus & Cyrus 1947; Šrámek-Hušek 1956; Fjerdingstad 1964; Sládeček 1959–1981 and others).

Substantial progress was made by the introduction of the saprobic valence by Zelinka *et al.* (1959) and of the saprobic index by Pantle & Buck (1955). These numerical values are now the major criteria characterizing each species as an indicator organism. They can be written in one line and long tables can be formed. The saprobic index can be calculated by computer (Hradil & Dospíšlová 1973).

Figure 1 shows 10 examples of the saprobic valence. The vertical axis indicates the 10 balls of the saprobic valence, the horizontal one degrees of saprobity within limnosaprobity (katharobity and eusaprobity are omitted). An ideal situation is demonstrated by *Keratella paludosa*, an extremely good indicator for oligosaprobity, showing a very high and acute Gaussian curve, which can be easily visualized inside the histogram. Other histograms show cases of less perfect indicators. The worst case shown is *Keratella cochlearis*, and several authors in the literature state that this is no indicator at all. The saprobic valence can effectively differentiate between good, medium and bad indicators.

Figure 2 shows part of the scale of saprobity formed by the saprobic index 'S' (abscissa), with 7 curves of saprobic valence. Balls of the saprobic valence lie on the ordinate. The apex of each curve is identical with the individual saprobic index, e.g. $S_i = 0.5$ for *Elosa woralii* or $S_i = 3.8$ for *Rotaria neptunia*. The indicative weight of species is also on the ordinate, showing half the values of the saprobic valence. The combination of species on this figure is impossible in a real case.

Figure 3 shows the quadrant of limnosaprobity (L) of the circular scheme of water quality (Sládeček 1965, 1973). Individual degrees x, o, b, a, p and

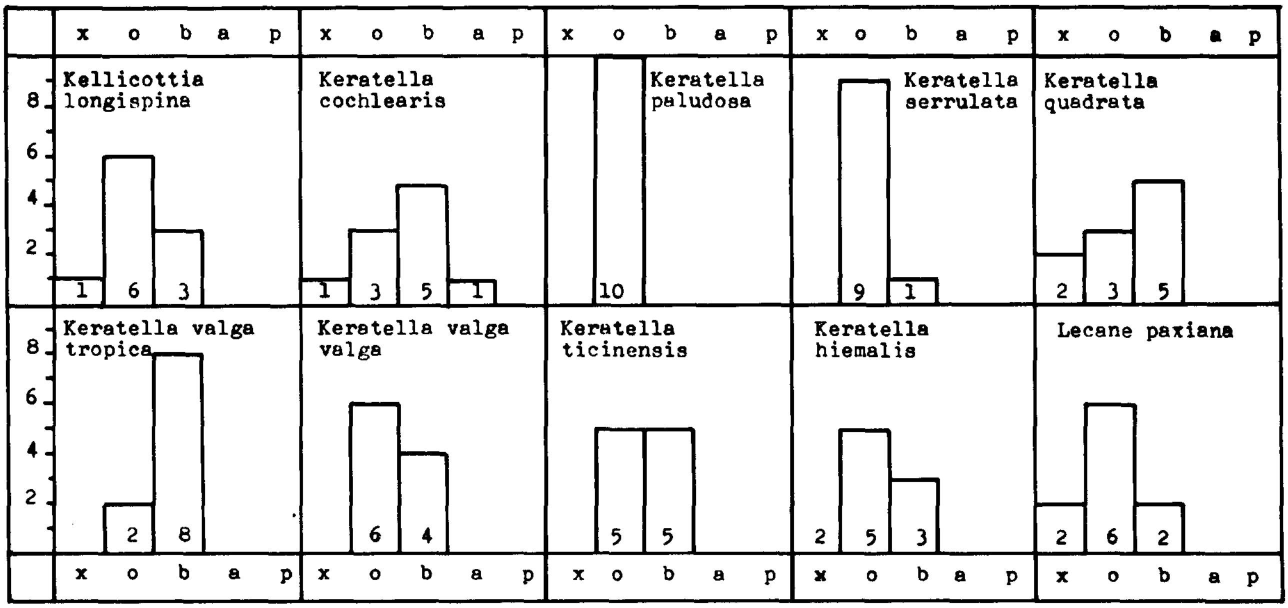

Fig. 1. Histograms of the saprobic valence of 10 species of Rotatoria. The numerals written at the bases of the histograms show a per cent distribution (×10) of the species in each of the 5 degrees of limnosaprobity and form the base of the classification used in Table 1.

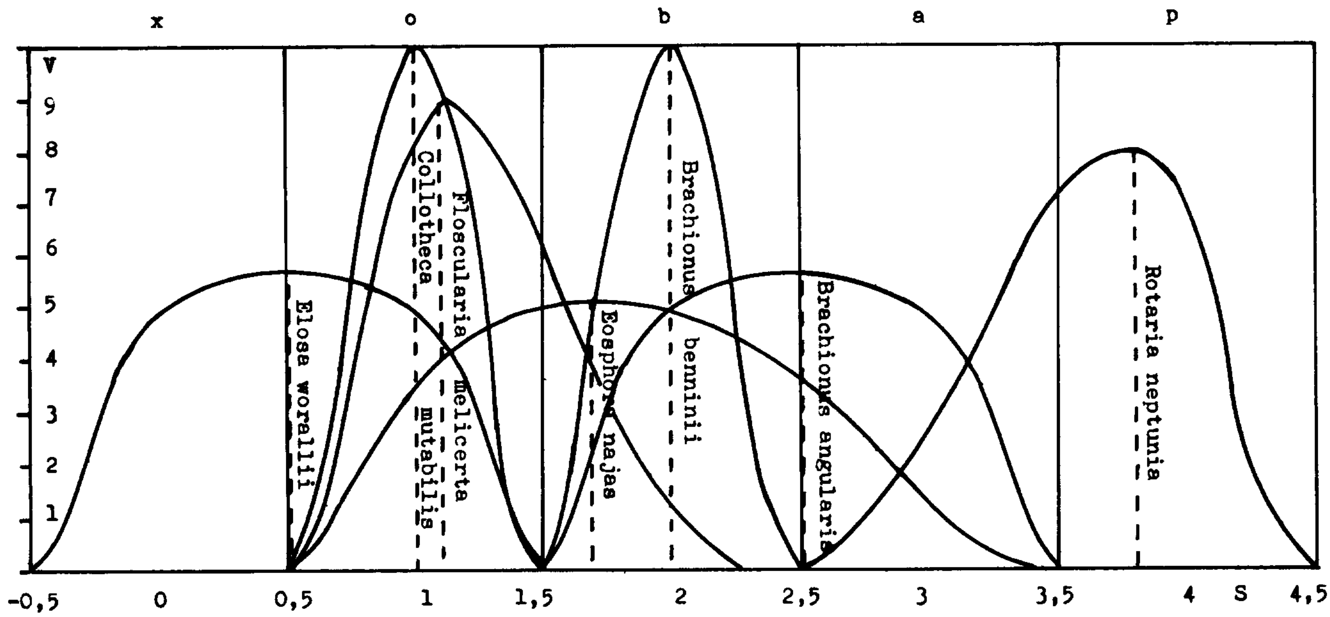

Fig. 2. A part of the scale of saprobity represented by the saprobic index 'S' with position of 7 rotifer species. V = saprobic valence, S = saprobic index, identical with the apex of the distribution curve. A co-existence of all figured species within one community is impossible.

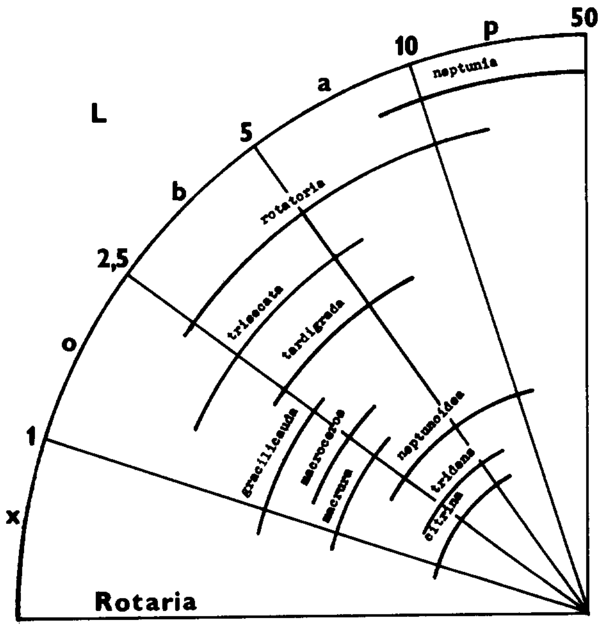

Fig. 3. Position of 10 species belonging to the genus *Rotaria* within limnosaprobity (L). On the periphery abbreviations of the limnosaprobic degrees xenosaprobity (x), oligosaprobity (o), beta-mesosaprobity (b), alpha-mesosaprobity (a) and polysaprobity (p), as well as the approximate mean BOD_5 values in mg l^{-1} are given. Instead of lines, Gaussian curves could be drawn.

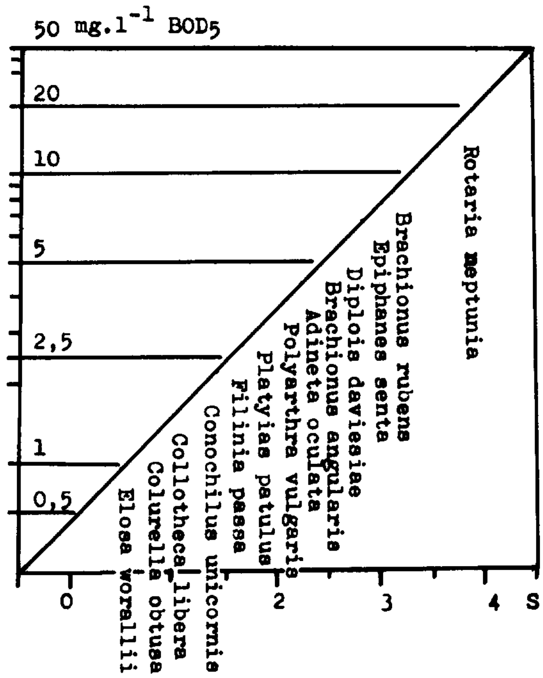

Fig. 4. Relation of BOD_5 in mean values (mg l^{-1}) to the saprobic index 'S' with a position of 13 rotifer species. Modified from Sládeček & Tuček, 1975.

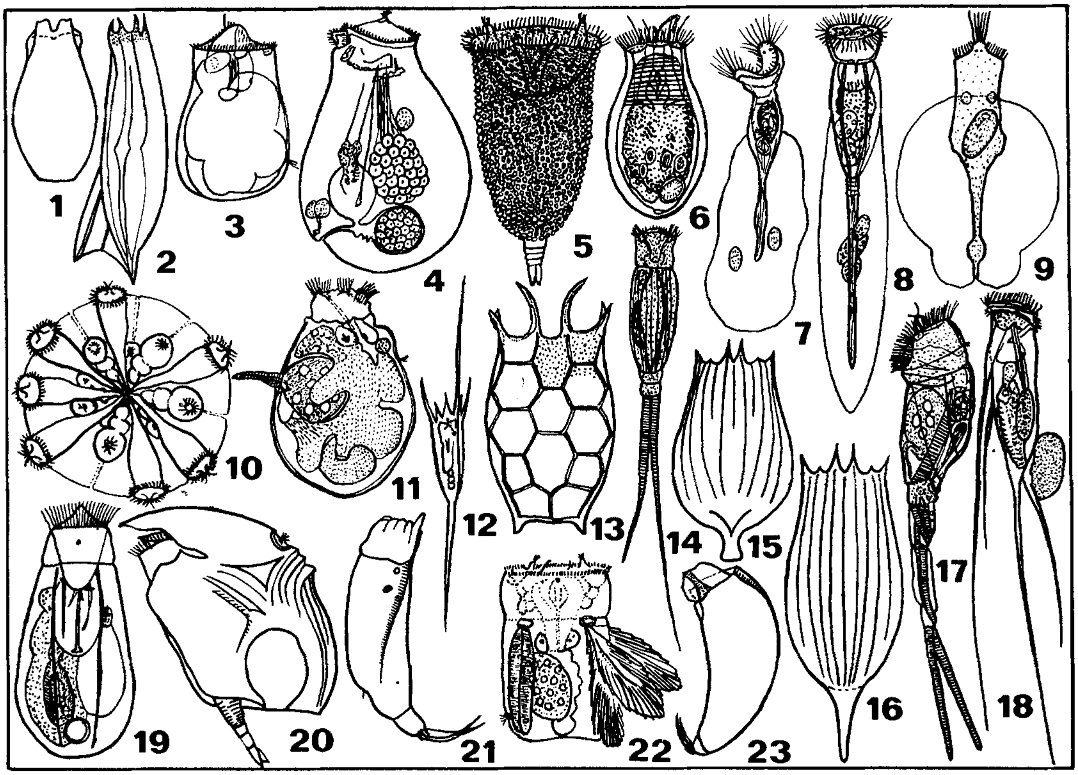

Plate 1. Oligosaprobic rotifers: 1 - *Anuraeopsis fissa*, 2 - *Argonotholca foliacea*, 3 - *Ascomorpha ecaudis*, 4 - *Asplanchna herricki*, 5 -*Bipalpus hudsoni*, 6 - *Chromogaster ovalis*, 7 - *Collotheca mutabilis*, 8 - *Collotheca pelagica*, 9 - *Collotheca libera*, 10 - *Conochilus unicornis*, 11 - *Gastropus stylifer*, 12 - *Kellicottia longispina*, 13 - *Keratella surrulata*, 14 - *Monommata longiseta*, 15 - *Notholca labis*, 16 - *Notholca acuminata*, 17 - *Scaridium longicaudum*, 18 - *Tetramastix opoliensis opoliensis*, 19 - *Elosa worallii*, 20 - *Ploeosoma lenticulare*, 21 - *Trichocerca tigris*, 22 - *Polyarthra euryptera*, 23 - *Trichocerca vernalis*. Figures according to Bartoš (1959), Kutikova (1970) and Sládeček, various publications.

corresponding approximate BOD_5 values lie on the periphery. The interval of the saprobic valence of 10 species of the genus *Rotaria* is shown by lines.

Figure 4 demonstrates the relation of mean BOD_5 values (ordinate) to the saprobic index S (abscissa). The position of 13 rotifer species is indicated.

Plates 1-3 illustrate the most common indicators for oligosaprobic, beta-mesosaprobic and alpha-mesosaprobic conditions in standing and running waters with emphasis on planktonic and semi-planktonic species. *Brachionus urceolaris* is figured twice, because it occurs in two degrees of saprobity, as do some other species. This fact can be best expressed by the saprobic valence as given in Table 1.

The main part of this contribution is Table 1. It lists 620 species and lower taxonomical units of rotifers. Each line contains a taxon (binomen or trinomen, and its author), the numerals of the saprobic valence (giving a total of 10 balls) distributed over 5 saprobic degrees, the indicative weight of species I_i (in German this is 'G' = Indikationsgewicht, Sládeček 1964) and the individual saprobic index S_i of Pantle & Buck (1955). The saprobic valence shows the (Gaussian) distribution of the species, with I_i the height of the curve in values 5, 4, 3, 2, 1, and S_i the position of the apex of the distribution on the conventional scale of saprobity, as shown in Fig. 2. It must be noted that the saprobic valence is a subjective value given by an investigator according to his experience and to data in the literature. The values in Sládeček (1973) were revised according to new knowledge, especially the papers by Mauch (1976) and Donner (1978). In the following text some remarks on the ecology and saprobiology of selected species are given.

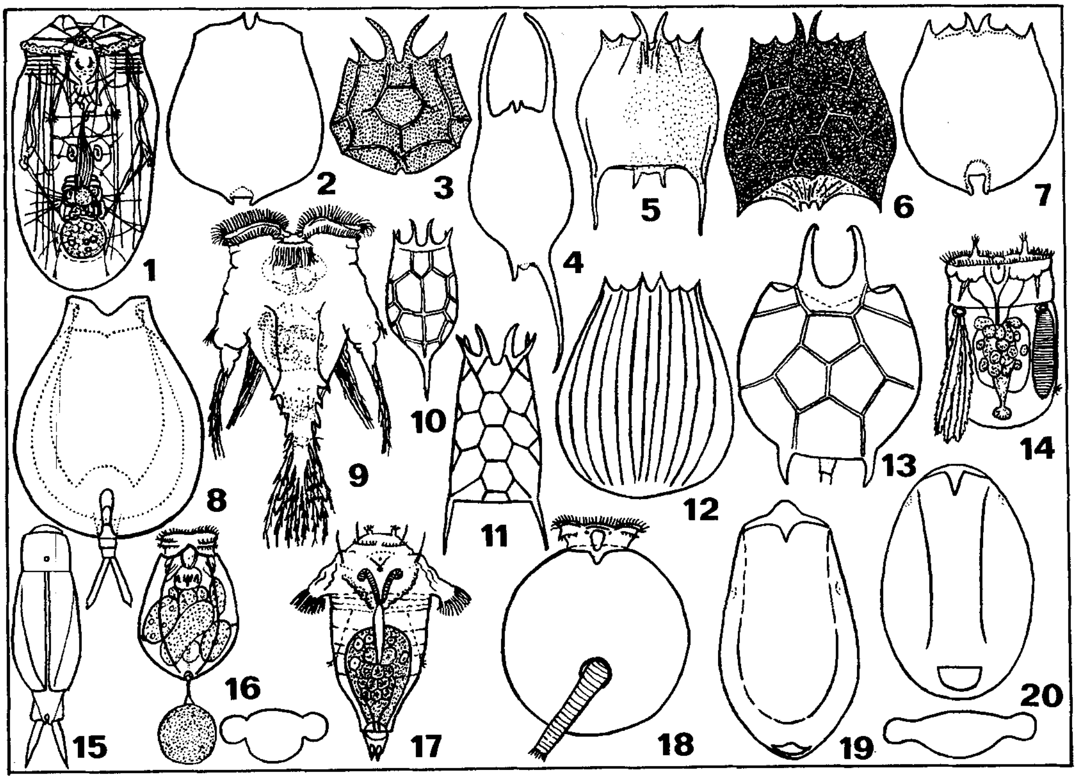

Plate 2. Beta-mesosaprobic rotifers: 1 - *Asplanchna priodonta priodonta*, 2 - *Brachionus angularis bidens*, 3 - *Brachionus budapestinensis budapestinensis*, 4 - *Brachionus diversicornis diversicornis*, 5 - *Brachionus quadridentatus quadridentatus*, 6 - *Brachionus leydigii*, 7 - *Brachionus urceolaris*, 8 - *Euchlanis dilatata*, 9 - *Hexarthra mira*, 10 - *Keratella cochlearis cochlearis*, 11 - *Keratella quadrata*, 12 - *Notholca squamula*, 13 - *Platyias quadricornis quadricornis*, 14 - *Polyarthra vulgaris*, 15 - *Cephalodella sterea mutata*, 16 - *Pompholyx sulcata*, 17 - *Synchaeta pectinata*, 18 - *Testudinella patina patina*, 19 - *Testudinella truncata ecornis*, 20 - *Testudinella elliptica*. Figures according to Bartoš (1959), Kutikova (1970) and Sládeček, various publications.

Notes on selected species

Adineta oculata (Milne) is the only representative of the genus, possessing two large red eyspots. It dwells in the littoral, especially among *Potamogeton* and was discovered in a laboratory model of activated sludge tank together with *Lecane pyriformis* and other rotifers (Sládeček 1968).

Adineta vaga vaga (Davis) is a littoral species living among macrophytes, mosses, Hepaticae and in sphagnum. Four forms were described. In activated sludge it was found by Klimowicz (1970, 1972, 1973, 1977) in small numbers, with a maximum of 3 ind. ml^{-1} at a good and medium purification effect. Doohan (1975) found it in Britain in activated sludge.

Asplanchna brightwelli Gosse (Plate 3/1) is a cosmopolitan species inhabiting the plankton of large and small water bodies. Sládeček *et al.* (1958) found it in an accumulation pond after successful treatment of beet-sugar wastes. It occurred from early May till September, with a maximum 1 400 ind. l^{-1} at a depth of 1 m on 19 May. At the same time is was present in ponds and brooks in the vicinity, all showing worser beta-mesosaprobic conditions.

Asplanchna priodonta priodonta Gosse (Plate 2/1) is one of the most common cosmopolitan planktonic predators. Its development is dependent on the development of its prey (*Keratella cochlearis*) (Radwan 1980). Sládeček & Vošahlík (1979) found it in a stabilization pond at Pelhřimov (Bohemia) and Doohan (1975) in British purification plants.

Brachionus angularis angularis Gosse (Plate 3/2) is perennial in alkaline waters like village ponds

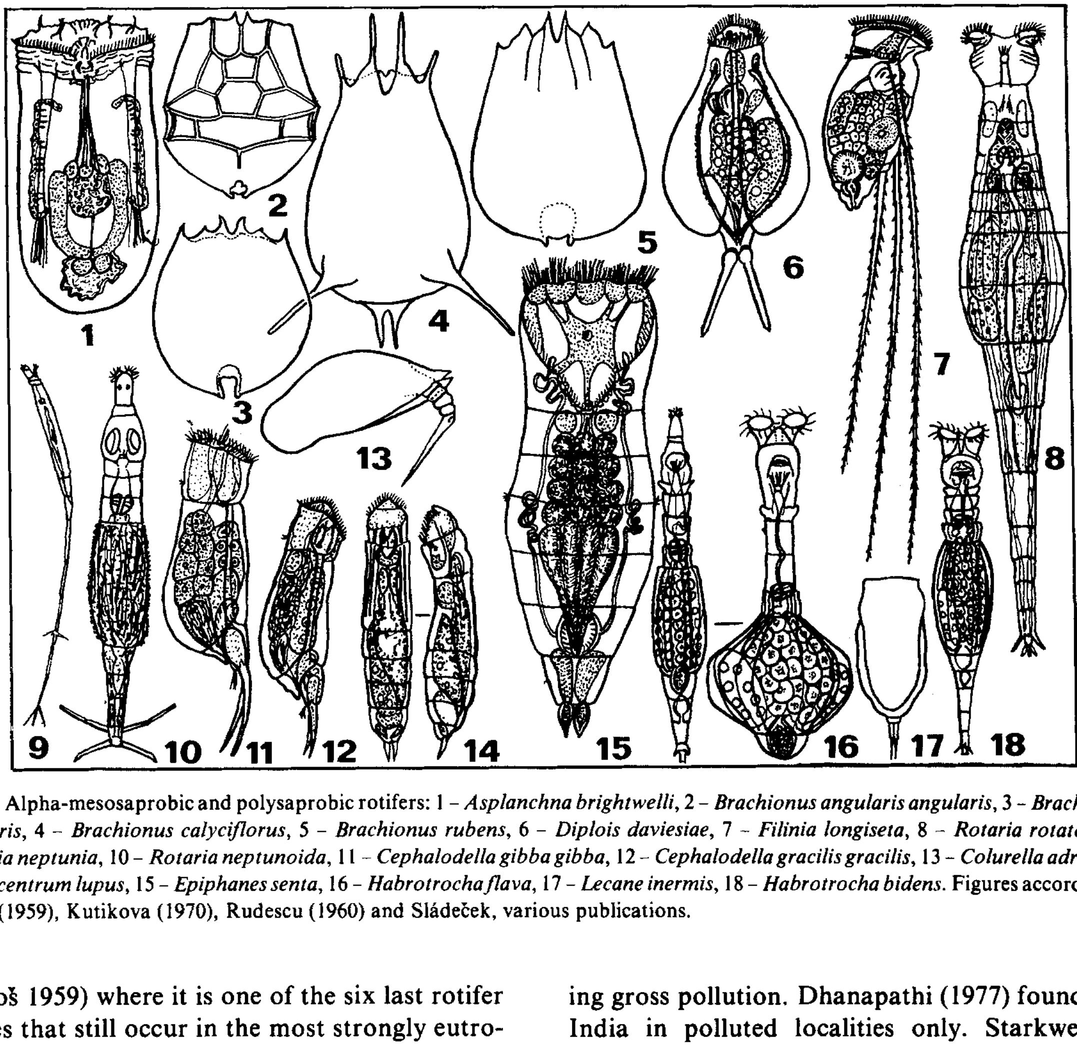

Plate 3. Alpha-mesosaprobic and polysaprobic rotifers: 1 - *Asplanchna brightwelli*, 2 - *Brachionus angularis angularis*, 3 - *Brachionus urceolaris*, 4 - *Brachionus calyciflorus*, 5 - *Brachionus rubens*, 6 - *Diplois daviesiae*, 7 - *Filinia longiseta*, 8 - *Rotaria rotatoria*, 9 - *Rotaria neptunia*, 10 - *Rotaria neptunoida*, 11 - *Cephalodella gibba gibba*, 12 - *Cephalodella gracilis gracilis*, 13 - *Colurella adriatica*, 14 - *Encentrum lupus*, 15 - *Epiphanes senta*, 16 - *Habrotrocha flava*, 17 - *Lecane inermis*, 18 - *Habrotrocha bidens*. Figures according to Bartoš (1959), Kutikova (1970), Rudescu (1960) and Sládeček, various publications.

(Bartoš 1959) where it is one of the six last rotifer species that still occur in the most strongly eutrophicated water: *Brachionus urceolaris, B. rubens, Filinia longiseta, Rotaria rotatoria, R. neptunia.* Sometimes it also appears in the plankton of fishponds and lakes, where it dwells among littoral vegetation. At population maximum (June--August) there occur in Czechoslovakia two sizes of individuals: 160–200 μm and about 100 μm, without intermediary sizes. Within both groups there is polymorphism. It is again a cosmopolitan with a broad distribution. In the stabilization pond at Pelhřimov this species occurred abundantly in summer, with a maximum of 5 100 ind. l^{-1} (Sládeček & Vošahlík 1979). It was also recorded by Doohan (1975).

Brachionus calyciflorus Pallas (Plate 3/4) is a common cosmopolitan species of alkaline waters. Wilkens (1972) considers it as planktonic, tolerating gross pollution. Dhanapathi (1977) found it in India in polluted localities only. Starkweather (1980, 1981) discovered that it eats filaments of *Anabaena flos-aquae*. Sládeček *et al.* (1958) found it in the accumulation pond in Vinoř from April onwards, with a maximum of 2 600 ind. l^{-1}. Sládeček & Vošahlík (1979) observed it in the stabilization pond at Pelhřimov with a maximum of 8 700 ind. l^{-1}. It was found in activated sludge by Klimowicz (1973, 1977), and in British purification plants by Doohan (1975).

Brachionus leydigii Cohn (Plate 2/6) lives in eutrophicated village ponds in spring till May (Bartoš 1959). It probably also occurs in stabilization ponds.

Brachionus quadridentatus Hermann (Plate 2/5) inhabits alkaline waters, especially small field and village ponds. It is widely distributed but in small numbers. Usually, several varieties live together.

This cosmopolitan species was found in small numbers in an activated sludge plant in Praha--Štvanice (Dvořákova, in litt.) and in the stabilization pond at Pelhřimov, again with few individuals (Sládeček & Vošahlík 1979). Doohan (1975) found it in Great Britain.

Brachionus rubens (Ehrenberg) (Plate 3/4) is known from highly eutrophicated and polluted village ponds, where it adheres on the carapax of the cladocera *Daphnia magna, D. pulex, Moina* spp. and rarely on *Daphnia longispina* and *Corixa* sp. In cleaner water it swims in the plankton. A cosmopolite. Schlüter (1980) experimentally studied the algal species eaten by this species, and demonstrated that a concentration of dissolved oxygen of 1-2 mg l^{-} did not affect its reproduction. Wilkens (1972) considers it as a littoral species transgressing to the plankton in polluted waters. Sládeček *et al.* (1958) detected it regularly after mid-April in the accumulation pond at Vinoř, but in small numbers. On the other hand, in the stabilization pond of Pelhřimov, it occurred regularly in spring and summer, peaking at 21 000 ind. l^{-1} (Sládeček & Vošahlík 1979). Klimowicz (1972, 1973, 1977) found it in activated sludge in medium numbers at a good function and in weak numbers at a poor purification. Doohan (1975) found it in British plants.

Brachionus urceolaris O. F. Müller (Plate 2/7, 3/3) is a monocyclic species with a maximum in April or May in the littoral of village ponds and small water bodies. It is lacking in bigger lakes and fishponds, and is cosmopolitan. Wilkens (1973) is of the opinion that it is a littoral species, invading the plankton in polluted waters. Sládeček *et al.* (1958) observed it in small numbers in the accumulation pond at Vinoř after mid-April. Sládeček & Vošahlík (1979) recorded small numbers in the stabilization pond at Pelhřimov. Doohan (1975) recorded it from British purification plants.

Cephalodella catellina (O. F. Müller) is found among aquatic weeds in fishponds and pools (Bartoš 1959). It is psammophilic and cosmopolitan. In activated sludge in Poland it was found by Klimowicz (1972, 1977) in low numbers with a maximum of 4 ind. ml^{-1} in October. It occurred here, irrespective of whether the plant worked properly, in a range of BOD_5 of the effluent from 0 to 30 mg l^{-1}. The specimens showed a length of 87–165 μm, whereas other investigators found 105–150 μm. Doohan (1975) recorded it from British purification plants.

Cephalodella gibba (Ehrenberg) (Plate 3/11). According to Bartoš (1959) this is an inhabitant of fishponds and weedy pools, of mineral springs, sphagnum, and of the psammon. It has thus a broad ecological valence. Dvořáková (in litt.) found it in low numbers in an activated sludge plant in Prague, Doohan (1975) in British purification plants and Klimowicz (1970-1977) in activated sludge in Warsaw. Maximum numbers were 93 (summer), 140 (May), 450 (May) per ml in successive years. This was the most frequent representative of the genus and held second position among rotifers during Klimowicz's studies. It occurred at good function in greater numbers, at poor purification in lesser ones.

Cephalodella gracilis gracilis (Ehrenberg) (Plate 3/12) lives in the littoral zone among aquatic vegetation and also in the psammon. It is cosmopolitan. It adapted to life in activated sludge, where it was detected by Godeanu (1966) in Rumania, by Doohan (1975) in Great Britain and by Klimowicz (1972, 1973, 1977) in Poland, year round. Maximum numbers appeared in January (120) and June (317 ind. ml^{-1}). The activated sludge showed a medium purification effect with BOD_5 in the effluent between 10 and 20 mg l^{-1}. The better purification effect was preferred; at a poor effect, *Cephalodella gracilis* was rare.

Cephalodella gracilis lenticulata Wulfert is known from springs and thermal waters, but its wide ecological valence allows it to dwell also in activated sludge plats with a good purification effect. It is rare here, as proved by Doohan (1975) in Great Britain and Klimowicz (1977) in Poland.

Cephalodella megalocephala compressa Donner and *Cephalodella megalocephala rotunda* Donner are littoral species tolerating alpha-mesosaprobic conditions, at least for some time, if the environment deteriorates (Donner 1978).

Collotheca ornata ornata (Ehrenberg) is a typical sessile littoral species inhabiting the aquatic macrovegetation and algae in lakes, fishponds, pools, ditches and other small water bodies with a maximum abundance from May to November. It is a cosmopolitan species preferring *Utricularia intermedia*. According to Pejler (1962) a pelatic form of it is able to live in the plankton. Sládečková & Sládeček (1963) found it from October, through winter, till May in the Reservoir Sedlice, Bohemia, where it colonized glass slides exposed in the water.

Table 1. Rotifers as indicators of saprobity. Evaluation of saprobic valency, indicative weight of species and individual saprobic index. s = abbreviation of the saprobic degree, x, o, b, a, p = saprobic degrees, i.e. xenosaprobity, oligosaprobity, beta-mesosaprobity, alpha-mesosaprobity, polysaprobity, I_i = indicative weight of the species, S_i = individual saprobic index.

Taxon	s	x	o	b	a	p	I_i	S_i
Acyclus trilobus (LUCKS)	o	–	10	–	–	–	5	1.0
Adineta barbata JANSON	o	–	10	–	–	–	5	1.0
Adineta elongata RODEWALD	o	–	10	–	–	–	5	1.0
Adineta glauca WULFERT	x	8	2	–	–	–	4	0.2
Adineta gracilis JANSON	o–b	–	5	5	–	–	3	1.5
Adineta oculata (MILNE)	b	–	–	7	3	–	4	2.3
Adineta v. vaga (DAVIS)	o–b	–	3	5	2	–	2	1.9
Adineta vaga minor BRYCE	o	–	10	–	–	–	5	1.0
Albertia typhlina HARRING & MYERS	o	–	10	–	–	–	5	1.0
Anuraeopsis fissa (GOSSE)	o	–	8	2	–	–	4	1.2
Argonotholca foliacea (EHRENBERG)	o	–	8	2	–	–	4	1.2
Ascomorpha ecaudis PERTY	o	–	7	3	–	–	4	1.3
Ascomorpha minima HOFSTEN	b	–	3	7	–	–	4	1.7
Ascomorpha saltans BARTSCH	o	–	10	–	–	–	5	1.0
Ascomorphella volvocina (PLATE)	o–b	–	5	5	–	–	3	1.5
Aspelta cincinator (GOSSE)	o	–	10	–	–	–	5	1.0
Aspelta lestes HARRING & MYERS	o	–	10	–	–	–	5	1.0
Asplanchna brightwelli GOSSE	b	–	+	7	3	–	4	2.3
Asplanchna girodi DE GUERNE	o–b	–	6	4	–	–	3	1.4
Asplanchna herricki DE GUERNE	o	–	8	2	–	–	4	1.2
Asplanchna intermedia HUDSON	o–b	–	5	5	–	–	3	1.5
Asplanchna priodonta henrietta LANGHANS	o	–	10	–	–	–	5	1.0
Asplanchna p. priodonta GOSSE	o–b	1	4	4	1	–	1	1.5
Asplanchna sieboldi (LEYDIG)	o–b	–	5	5	–	–	3	1.5
Asplanchnopus multiceps (SCHRANK)	o	–	7	3	–	–	4	1.3
Atrochus tentaculatus WIETZEJSKI	b	–	–	9	1	–	5	2.1
Bdelloidea g.sp.	b	–	1	6	3	–	3	2.2
Beauchampia crucigera (DUTROCHET)	b	–	1	9	–	–	5	1.9
Bipalpus hudsoni (IMHOF)	o	–	8	2	–	–	4	1.2
Brachionus a. angularis GOSSE	b–a	–	–	5	5	–	3	2.5
Brachionus angularis bidens PLATE	b	–	1	7	2	–	4	2.1
Brachionus bennini LIESSLING	b	–	–	10	–	–	5	2.0
Brachionus bidentata jírovci BARTOŠ	b	–	–	10	–	–	5	2.0
Brachionus b. budapestinensis DADAY	b	–	–	10	–	–	5	2.0
Brachionus budapestinensis lineatus SKORIKOV	b	–	–	10	–	–	5	2.0
Brachionus calyciflorus PALLAS	b–a	–	–	5	5	–	3	2.5
Brachionus d. diversicornis (DADAY)	b	–	–	10	–	–	5	2.0
Brachionus diversicornis homoceros (WIERZEJSKI)	b	–	–	10	–	–	5	2.0
Brachionus falcatus ZACHARIAS	b	–	–	10	–	–	5	2.0
Brachionus f. forficula (WIERZEJSKI)	b	–	–	10	–	–	5	2.0
Brachionus leydigii COHN	b	–	–	8	2	–	4	2.2
Brachionus plicatilis O. F. MÜLLER	b	–	–	10	–	–	5	2.0
Brachionus quadridentatus HERMANN	b	–	–	8	2	–	4	2.2
Brachionus rubens EHRENBERG	a	–	–	1	6	3	3	3.2
Brachionus sericus ROUSSELET	o	–	10	–	–	–	5	1.0
Brachionus sessilis VARGA	b	–	3	7	–	–	4	1.3
Brachionus urceolaris O. F. MÜLLER	b	–	–	8	2	–	4	2.2
Bryceela stylata (MILNE)	o	–	10	–	–	–	5	1.0
Bryceela tenella (BRYCE)	o	–	10	–	–	–	5	1.0
Cephalodella apocolea MYERS	o	–	10	–	–	–	5	1.0
Cephalodella auriculata (O. F. MÜLLER)	o–b	–	5	5	–	–	3	1.5
Cephalodella biungulata WULFERT	o–b	–	5	5	–	–	3	1.5
Cephalodella catellina (O. F. MÜLLER)	b–o	–	4	5	1	–	2	1.7
Cephalodella deformis DONNER	b	–	–	10	–	–	5	2.0

Table 1 (Continued).

Taxon	s	x	o	b	a	p	I_i	S_i
Cephalodella delicata WULFERT	b	–	–	10	–	–	5	2.0
Cephalodella derbyi (DIXON-NUTALL & FREEMAN)	o	–	10	–	–	–	5	1.0
Cephalodella eva (GOSSE)	o–b	–	5	5	–	–	3	1.5
Cephalodella exigua (GOSSE)	o	–	8	2	–	–	4	1.2
Cephalodella forceps DONNER	b	–	–	10	–	–	5	2.0
Cephalodella forficata (EHRENBERG)	o–b	–	5	5	–	–	3	1.5
Cephalodella forficula (EHRENBERG)	b	–	2	8	–	–	4	1.8
Cephalodella g. gibba (EHRENBERG)	b	+	3	4	3	–	2	2.0
Cephalodella gibboides WULFERT	x–o	5	5	–	–	–	3	0.5
Cephalodella globata (GOSSE)	b	–	–	10	–	–	5	2.0
Cephalodella glypha WULFERT	o–b	–	5	5	–	–	3	1.5
Cephalodella g. gracilis (EHRENBERG)	b	–	2	5	3	–	2	2.1
Cephalodella gracilis lenticulata WULFERT	o–b	1	4	4	1	–	1	1.5
Cephalodella gracilis sigmoides WULFERT	o	–	10	–	–	–	5	1.0
Cephalodella hoodi (GOSSE)	o–b	–	5	5	–	–	3	1.5
Cephalodella hyalina MYERS	o	–	10	–	–	–	5	1.0
Cephalodella incilla WULFERT	b	–	–	10	–	–	5	2.0
Cephalodella intuta MYERS	o	–	10	–	–	–	5	1.0
Cephalodella jakubskii WISZNIEWSKI	o	2	5	2	1	–	1	1.1
Cephalodella limosa WULFERT	b–o	–	4	6	–	–	3	1.6
Cephalodella megalocephala compressa DONNER	b	–	3	5	2	–	2	1.9
Cephalodella megalocephala rotunda DONNER	b	–	3	5	2	–	2	1.9
Cephalodella misgurnus WULFERT	b	–	–	10	–	–	5	2.0
Cephalodella nana MYERS	o	–	10	–	–	–	5	1.0
Cephalodella obvia DONNER	b	–	–	10	–	–	5	2.0
Cephalodella plicata MYERS	o	–	10	–	–	–	5	1.0
Cephalodella reimanni DONNER	b	–	–	10	–	–	5	2.0
Cephalodella remanei WISZNIEWSKI	o	–	10	–	–	–	5	2.0
Cephalodella rigida DONNER	o–b	–	5	5	–	–	3	1.5
Cephalodella stenroosii WULFERT	b	–	–	10	–	–	5	2.0
Cephalodella sterea dentata DONNER	o–b	–	5	5	–	–	3	1.5
Cephalodella sterea minor DONNER	b	–	–	10	–	–	5	2.0
Cephalodella sterea mutata DONNER	b	–	–	10	–	–	5	2.0
Cephalodella s. sterea (GOSSE)	o–b	–	5	5	–	–	3	1.5
Cephalodella tantilla MYERS	o	–	10	–	–	–	5	1.0
Cephalodella tecta DONNER	b	–	–	10	–	–	5	2.0
Cephalodella tenuior limosa WULFERT	b	–	–	10	–	–	5	2.0
Cephalodella tenuior pigmentata WULFERT	o	–	10	–	–	–	5	1.0
Cephalodella t. tenuior (GOSSE)	o	–	8	2	–	–	4	1.2
Cephalodella tenuiseta americana DONNER	b	–	–	10	–	–	5	2.0
Cephalodella t. tenuiseta (BURN)	b	–	–	10	–	–	5	2.0
Cephalodella tinca conspicua DONNER	b	–	–	10	–	–	5	2.0
Cephalodella t. tinca WULFERT	b	–	–	10	–	–	5	2.0
Cephalodella ventripes angustior DONNER	o–b	–	5	5	–	–	3	1.5
Cephalodella v. ventripes (DIXON-NUTALL)	o–b	–	5	5	–	–	3	1.5
Cephalodella volvocicola (ZAVADOVSKIJ)	b	–	3	6	1	–	3	1.8
Ceratotrocha cornigera (BRYCE)	o	–	10	–	–	–	5	1.0
Chromogaster ovalis (BERGENDAL)	o	–	8	2	–	–	4	1.2
Chromogaster testudo LEUTERBORN = Ch. ovalis	o	–	8	2	–	–	4	1.2
Collotheca a. algicola (HUDSON)	o–b	–	5	5	–	–	3	1.5
Collotheca ambigua (HUDSON)	o–b	–	5	5	–	–	3	1.5
Collotheca atrochoides (WIERZEJSKI)	b	–	–	10	–	–	5	2.0
Collotheca b. balatonica VARGA	o	–	8	2	–	–	4	1.2
Collotheca balatonica rodewaldi SLÁDEČEK	o–b	–	5	5	–	–	3	1.5
Collotheca breviciliata BERZINS	o	–	10	–	–	–	5	1.0
Collotheca calva (HUDSON)	o	–	10	–	–	–	5	1.0

Table 1 (Continued).

Taxon	s	x	o	b	a	p	I_i	S_i
Collotheca c. campanulata (DOBIE)	o–b	–	5	5	–	–	3	1.5
Collotheca campanulata longicaudata (HUDSON)	o–b	–	5	5	–	–	3	1.5
Collotheca coronetta (CUBITT)	o	–	10	–	–	–	5	1.0
Collotheca gracillipes EDMONDSON	o–b	–	5	5	–	–	3	1.5
Collotheca heptabrachiata diadema (PETR)	o	–	10	–	–	–	5	1.0
Collotheca h. heptabrachiata (SCHOCH)	o	–	10	–	–	–	5	1.0
Collotheca libera (ZACHARIAS)	o	–	10	–	–	–	5	1.0
Collotheca mutabilis (HUDSON) BOLTON	o	–	10	–	–	–	5	1.0
Collotheca edentata (COLLINS)	o	–	10	–	–	–	5	1.0
Collotheca ornata cornuta (DOBBIE)	o	–	10	–	–	–	5	1.0
Collotheca o. ornata (EHRENBERG)	b–a	–	1	5	4	–	2	2.3
Collotheca pelagica ROUSSELET	o	–	10	–	–	–	5	1.0
Collotheca trifidlobata (PITTOCK)	o	–	10	–	–	–	5	1.0
Collotheca undulata SLÁDEČEK	o–b	–	5	5	–	–	3	1.5
Colurella adriatica (EHRENBERG)	b–o	1	3	4	2	–	1	1.8
Colurella colurus (EHRENBERG)	o	1	5	2	2	–	1	1.3
Colurella dicentra GOSSE	b–a	–	–	5	5	–	3	2.5
Colurella geophila DONNER	b	–	3	4	3	–	3	2.0
Colurella hindenburgi gastracantha HAUER	o–b	–	5	5	–	–	3	1.5
Colurella h. hindenburgi STEINECKE	o	1	7	2	–	–	3	1.1
Colurella obtusa aperta HAUER	o–b	–	5	5	–	–	3	1.5
Colurella obtusa clausa HAUER	o	–	9	1	–	–	5	1.1
Colurella o. obtusa (GOSSE)	o–b	1	4	4	1	–	1	1.5
Colurella oblonga DONNER	o–b	–	5	5	–	–	3	1.5
Colurella paludosa CARLIN	o–b	–	5	5	–	–	3	1.5
Colurella tesselata (GLASCOTT)	o	–	9	1	–	–	5	1.1
Colurella uncinata bicuspidata (EHRENBERG)	b–o	–	4	5	1	–	2	1.7
Colurella u. uncinata (O. F. MÜLLER)	o	–	7	3	–	–	4	1.3
Colurella uncinata deflexa (EHRENBERG)	b	–	3	7	–	–	4	1.7
Conochiloides dossuarius (HUDSON)	o	–	8	2	–	–	4	1.2
Conochiloides natans (SELIGO)	o	–	10	–	–	–	5	1.0
Conochilus hippocrepis (SCHRANK)	o	2	5	3	–	–	2	1.1
Conochilus unicornis ROUSSELET	o	–	7	3	–	–	4	1.3
Cupelopagis vorax (LEIDY)	o–b	–	6	4	–	–	3	1.4
Cyrtonia tuba (EHRENBERG)	o–b	–	5	5	–	–	3	1.5
Dicranophorus caudatus (EHRENBERG)	b	–	–	7	3	–	4	2.3
Dicranophorus forcipatus (O. F. MÜLLER)	o	–	6	3	1	–	3	1.4
Dicranophorus grandis (EHRENBERG)	o	–	6	3	1	–	3	1.4
Dicranophorus hauerianus brachygnathus (WISZNIEWSKI)	o	3	4	3	–	–	2	1.0
Dicranophorus h. hauerianus WISZNIEWSKI	o	3	4	3	–	–	2	1.0
Dicranophorus hercules WISZNIEWSKI	o	–	8	2	–	–	4	1.2
Dicranophorus longidactylum FADEEV	x–o	6	4	–	–	–	3	0.4
Dicranophorus lütkeni (BERGENDAL)	o	–	9	1	–	–	5	1.1
Dicranophorus rostratus (DIXON-NUTALL)	o	–	9	1	–	–	5	1.1
Dicranophorus sidleckii WISZNIEWSKI	o	1	8	1	–	–	4	1.0
Dicranophorus sigmoides WULFERT	o	–	10	–	–	–	5	1.0
Dicranophorus uncinatus (MILNE)	o	–	10	–	–	–	5	1.0
Dipleuchlanis propatula GOSSE	b	–	–	10	–	–	5	2.0
Diplois daviesiae GOSSE	a	–	+	3	7	–	4	2.7
Dissotrocha a. aculeata (EHRENBERG)	b–o	–	4	6	–	–	3	1.6
Dissotrocha aculeata crystallina MURRAY	o	–	9	1	–	–	5	1.1
Dissotrocha m. macrostyla (EHRENBERG)	o	1	6	2	1	–	1	1.2
Dissotrocha macrostyla tuberculata (GOSSE)	x–o	5	5	–	–	–	3	0.5
Dorystoma caudata (BILFINGER)	o	–	10	–	–	–	5	1.0
Drilophaga judayi HARRING & MYERS	o	–	10	–	–	–	5	1.0
Elosa worallii LORD	x–o	5	5	–	–	–	3	0.5

Table 1 (Continued).

Taxon	s	x	o	b	a	p	I_i	S_i
Embata commensalis (WESTERN)	b–a	–	1	4	5	–	2	2.4
Embata laticeps MURRAY	o	2	6	2	–	–	3	1.0
Embata parasitica (GIGLIOLI)	o	3	4	3	–	–	2	1.0
Encentrum arvicola WULFERT	o	–	7	3	–	–	4	1.3
Encentrum asellicola BARTOŠ	a	–	–	2	8	–	4	2.8
Encentrum diglandula (ZAVADOVSKIJ)	b	–	–	10	–	–	5	2.0
Encentrum felis (O. F. MÜLLER)	o–b	–	5	5	–	–	3	1.5
Encentrum kulmatyckii WISZNIEWSKI	b–a	–	–	5	5	–	3	2.5
Encentrum lupus WULFERT	a–b	–	1	4	5	–	2	2.4
Encentrum lutra WULFERT	o	–	9	1	–	–	5	1.1
Encentrum mariae KONIAR	o	–	10	–	–	–	5	1.0
Encentrum marinum (DUJARDIN)	b	–	–	10	–	–	5	2.0
Encentrum martes WULFERT	o–b	–	5	5	–	–	3	1.5
Encentrum martoides FOTT	o	–	10	–	–	–	5	1.0
Encentrum minax DONNER	o–b	–	5	5	–	–	3	1.5
Encentrum moldavicum SLÁDEČEK	b	–	1	9	–	–	5	1.9
Encentrum mucronatum WULFERT	o	2	8	–	–	–	4	0.8
Encentrum mustella (MILNE)	b	–	1	9	–	–	5	1.9
Encentrum parvum DONNER	b	–	–	10	–	–	5	2.0
Encentrum putorius armatum DONNER	b	–	–	10	–	–	5	2.0
Encentrum putorius externum DONNER	b	–	–	10	–	–	5	2.0
Encentrum p. putorius WULFERT	b	–	–	10	–	–	5	2.0
Encentrum putoroides WULFERT	o	–	10	–	–	–	5	1.0
Encentrum rapax (DONNER)	o–b	–	5	5	–	–	3	1.5
Encentrum sorex WULFERT	o–b	–	5	5	–	–	3	1.5
Encentrum sutor WISZNIEWSKI	o	–	10	–	–	–	5	1.0
Encentrum sutoroides WULFERT	o	–	9	1	–	–	5	1.1
Enteroplea lacustris EHRENBERG	o	–	7	3	–	–	4	1.3
Eosphora ehrenbergii WEBER	o–b	–	5	5	–	–	3	1.5
Eosphora najas EHRENBERG	b–o	–	4	5	1	–	2	1.7
Eothinia elongata (EHRENBERG)	o	–	10	–	–	–	5	1.0
Eothinia lucens (GLASCOTT)	o–b	–	5	5	–	–	3	1.5
Epiphanes b. brachionus (EHRENBERG)	o–b	–	5	5	–	–	3	1.5
Epiphanes brachionus spinosus (ROUSSELET)	b	–	–	10	–	–	5	2.0
Epiphanes clavulata (EHRENBERG)	o–b	–	5	5	–	–	3	1.5
Epiphanes senta (O. F. MÜLLER)	a	–	–	1	8	1	4	3.0
Erignatha clastopis (GOSSE)	o–b	–	6	4	–	–	3	1.4
Euchlanis alata VORONKOFF	b	–	–	10	–	–	3	1.5
Euchlanis deflexa GOSSE	o–b	–	5	5	–	–	3	1.5
Euchlanis dilatata EHRENBERG	o–b	–	3	5	2	–	2	1.9
Euchlanis incisa CARLIN	o–b	–	5	5	–	–	3	1.5
Euchlanis lucksiana HAUER	o	–	10	–	–	–	5	1.0
Euchlanis meneta MYERS	o	–	10	–	–	–	5	1.0
Euchlanis oropha GOSSE	b	–	3	5	2	–	2	1.9
Euchlanis parva ROUSSELET	b	–	3	5	2	–	2	1.9
Euchlanis pyriformis GOSSE	o–b	–	5	5	–	–	3	1.5
Euchlanis triquetra EHRENBERG	o–b	–	5	5	–	–	3	1.5
Eudactylota eudactylota (GOSSE)	o	–	8	2	–	–	4	1.2
Filinia brachiata (ROUSSELET)	o	–	9	1	–	–	5	1.1
Filinia cornuta (WEISSE)	o	–	10	–	–	–	5	1.0
Filinia longiseta limnetica (ZACHARIAS)	o–b	–	5	5	–	–	3	1.5
Filinia l. longiseta (EHRENBERG)	b–a	–	1	5	4	–	2	2.3
Filinia maior (COLDITZ)	b	–	–	10	–	–	5	2.0
Filinia passa (O. F. MÜLLER)	b–o	–	4	6	–	–	3	1.6
Filinia terminalis (PLATE)	o–b	–	6	4	–	–	3	1.4
Floscularia conifera (HUDSON)	o	–	10	–	–	–	5	1.0

Table 1 (Continued).

Taxon	s	x	o	b	a	p	I_i	S_i
Floscularia janus (HUDSON)	o	–	9	1	–	–	5	1.1
Floscularia melicerta (EHRENBERG)	o	–	9	1	–	–	5	1.1
Floscularia ringens LINNÉ	b	–	1	9	–	–	5	1.9
Gastropus stylifer IMHOF	o	–	10	–	–	–	5	1.0
Habrotrocha a. angusticollis (MURRAY)	o	–	8	2	–	–	4	1.2
Habrotrocha angusticollis attenuate (MURRAY)	o	–	8	2	–	–	4	1.2
Habrotrocha annulata (MURRAY)	o	–	10	–	–	–	5	1.0
Habrotrocha bidens (GOSSE)	b	–	2	5	3	–	2	2.1
Habrotrocha collaris (EHRENBERG)	b	–	2	7	1	–	3	1.9
Habrotrocha constricta (DUJARDIN)	b	–	3	5	2	–	2	1.9
Habrotrocha crenata sphagnophila PAWLOWSKI	o	–	10	–	–	–	5	1.0
Habrotrocha elegans (MILNE)	o	–	10	–	–	–	5	1.0
Habrotrocha flava BRYCE	b	–	2	6	2	–	3	2.0
Habrotrocha gracilis MONTET	o–b	–	5	5	–	–	3	1.5
Habrotrocha lata (BRYCE)	o	–	8	2	–	–	4	1.2
Habrotrocha longula BRYCE	o	–	10	–	–	–	5	1.0
Habrotrocha microcephala (MURRAY)	o–b	–	5	5	–	–	3	1.5
Habrotrocha munda BRYCE	o–b	–	5	5	–	–	3	1.5
Habrotrocha pulchra (MURRAY)	o–b	–	5	5	–	–	3	1.5
Habrotrocha reclusa (MILNE)	o	–	10	–	–	–	5	1.0
Habrotrocha roeperi (MILNE)	o	–	10	–	–	–	5	1.0
Habrotrocha rosa DONNER	b	–	2	5	3	–	2	2.1
Habrotrocha sylvestris BRYCE	o	–	10	–	–	–	5	1.0
Habrotrocha thermalis PAX & WULFERT	x	10	–	–	–	–	5	0.0
Habrotrocha thienemanni HAUER	b	–	3	6	1	–	3	1.8
Habrotrocha tridens globigera DONNER	o–b	–	5	5	–	–	3	1.5
Habrotrocha t. tridens (MILNE)	o	–	8	2	–	–	5	1.2
Habrotrocha tripus (MURRAY)	b	–	3	5	2	–	2	1.9
Hexarthra fennica LEVANDER	b	–	3	7	–	–	4	1.7
Hexarthra intermedia WISZNIEWSKI	o	–	8	2	–	–	4	1.2
Hexarthra mira (HUDSON)	b	–	2	8	–	–	4	1.8
Hexarthra mollis BARTOŠ	o–b	–	5	5	–	–	3	1.5
Hexarthra oxyuris ZERNOW	o	–	10	–	–	–	5	1.0
Hexarthra propinqua BARTOŠ	o–b	–	5	5	–	–	3	1.5
Hexarthra reducens BARTOŠ	o–b	–	5	5	–	–	3	1.5
Itura a. aurita (EHRENBERG)	o–b	–	6	4	–	–	3	1.4
Itura aurita intermedia WULFERT	o–b	–	5	5	–	–	3	1.5
Itura myersi WULFERT	b	–	–	10	–	–	5	2.0
Kellicottia longispina (KELLICOTT)	o	1	6	3	–	–	3	1.2
Keratella c. cochlearis (GOSSE)	b–o	1	3	5	1	–	1	1.7
Keratella cochlearis hispida LAUTERBORN	o	2	5	3	–	–	2	1.1
Keratella cochlearis leptacantha (LAUTERBORN)	o	2	5	3	–	–	2	1.1
Keratella cochlearis robusta LAUTERBORN	o	2	5	3	–	–	2	1.1
Keratella hiemalis CARLIN	o	2	5	3	–	–	2	1.1
Keratella irregularis (LAUTERBORN)	o	2	5	3	–	–	2	1.1
Keratella paludosa (LUCKS)	o	–	10	–	–	–	5	1.0
Keratella quadrata (O. F. MÜLLER)	o–b	2	3	5	+	–	2	1.5
Keratella serrulata (EHRENBERG)	o	–	9	1	–	–	5	1.1
Keratella testudo (EHRENBERG)	o	2	5	3	–	–	2	1.1
Keratella ticinensis (CALLERIO)	o–b	–	5	5	–	–	3	1.5
Keratella v. valga EDMONDSON & HUTCHINSON	o–b	–	6	4	–	–	3	1.4
Keratella valga tropica APSTEIN	b	–	2	8	–	–	4	1.8
Lacinularia flosculosa (O. F. MÜLLER)	o–b	–	5	5	–	–	3	1.5
Lecane (Hemimonostyla) agilis (BRYCE)	o	–	10	–	–	–	5	1.0
Lecane (H.) bryophila BARTOŠ	o	–	10	–	–	–	5	1.0
Lecane (H.) paxiana HAUER	o	2	6	2	–	–	3	1.0

Table 1 (Continued).

Taxon	s	x	o	b	a	p	I_i	S_i
Lecane (Lecane) arcula HARRING	o	–	10	–	–	–	5	1.0
Lecane (L.) affinis (LEVANDER)	o	–	10	–	–	–	5	1.0
Lecane (L.) brachydactyla (STENROOS)	o	–	10	–	–	–	5	1.0
Lecane (L.) clara (BRYCE)	o-b	–	4	4	2	–	2	1.8
Lecane (L.) elasma HARRING & MYERS	o	–	10	–	–	–	5	1.0
Lecane (L.) elongata HARRING & MYERS	o	–	10	–	–	–	5	.10
Lecane (L.) elsa HAUER	o	–	10	–	–	–	5	1.0
Lecane (L.) flexilis GOSSE	o	–	9	1	–	–	5	1.1
Lecane (L.) gissensis (ECKSTEIN)	o	–	10	–	–	–	5	1.0
Lecane (L.) hornemanni (EHRENBERG)	o-b	–	5	5	–	–	3	1.5
Lecane (L.) hospes DONNER	o	–	10	–	–	–	5	1.0
Lecane (L.) inermis (BRYCE)	b	–	3	5	2	–	2	1.9
Lecane (L.) intrasinuata (OLOFSON)	o	–	10	–	–	–	5	1.0
Lecane (L.) jessupi HARRING	o	–	10	–	–	–	5	1.0
Lecane (L.) lauterborni HAUER	o	–	10	–	–	–	5	1.0
Lecane (L.) ligona (DUNLOP)	o	–	10	–	–	–	5	1.0
Lecane (L.) ludwigii (ECKSTEIN)	o	–	10	–	–	–	5	1.0
Lecane (L.) luna O. F. MÜLLER	o-b	1	4	4	1	–	1	1.5
Lecane (L.) magna (STENROOS)	o-b	–	5	5	–	–	3	1.5
Lecane (L.) mira (MURRAY)	o	–	10	–	–	–	5	1.0
Lecane (L.) nana (MURRAY)	o	–	10	–	–	–	5	1.0
Lecane (L.) pumila (ROUSSELET)	o	–	10	–	–	–	5	1.0
Lecane (L.) signifera ploenensis VOIGT	o	–	9	1	–	–	5	1.1
Lecane (L.) stichaea HARRING	b-o	–	4	5	1	–	2	1.7
Lecane (L.) subtilis HARRING & MYERS	o	–	10	–	–	–	5	1.0
Lecane (L.) sulcata (GOSSE)	o	–	10	–	–	–	5	1.0
Lecane (L.) tenuiseta HARRING	b	–	3	5	2	–	2	1.9
Lecane (L.) tryphema HARRING & MYERS	o	–	10	–	–	–	5	1.0
Lecane (L.) ungulata (GOSSE)	o-b	–	5	5	–	–	3	1.5
Lecane (Monostyla) acus HARRING	o	–	10	–	–	–	5	1.0
Lecane (M.) arcuata (BRYCE)	o-b	–	4	4	2	–	2	1.8
Lecane (M.) bifurca (BRYCE)	o	–	10	–	–	–	5	1.0
Lecane (M.) bulla (GOSSE)	o-b	+	3	5	2	–	2	1.9
Lecane (M.) closterocerca (SCHMARDA)	b	+	2	5	3	–	2	2.1
Lecane (M.) cornuta (O. F. MÜLLER)	b	–	2	8	–	–	4	1.8
Lecane (M.) decipiens (MURRAY)	b	–	2	6	2	–	3	2.0
Lecane (M.) furcata (MURRAY)	o	–	10	–	–	–	5	1.0
Lecane (M.) galeata (BRYCE)	b	–	3	5	2	–	2	1.9
Lecane (M.) hamata (STOKES)	o	+	6	3	1	–	3	1.4
Lecane (M.) lunaris (EHRENBERG)	o-b	+	3	4	3	–	3	2.0
Lecane (M.) pideis HARRING & MYERS	b	–	2	5	3	–	2	2.1
Lecane (M.) pygmaea (DADAY)	o	–	10	–	–	–	5	1.0
Lecane (M.) pyriformis (DADAY)	b	–	2	6	2	–	3	2.0
Lecane (M.) quadridentata (EHRENBERG)	o-b	–	5	5	–	–	3	1.5
Lecane (M.) scutata HARRIS & MYERS	o	–	10	–	–	–	5	1.0
Lecane (M.) stenroosi (MEISSNER)	o-b	–	5	5	–	–	3	1.5
Lecane (M.) subulata HARRIS & MYERS	o	–	10	–	–	–	5	1.0
Lepadella (Heterolepadella) ehrenbergii PERTY	o-b	–	5	5	–	–	3	1.5
Lepadella (H.) nympha DONNER	o-b	–	5	5	–	–	3	1.5
Lepadella (Lepadella) a. acuminata (EHRBG)	o	–	7	3	–	–	4	1.3
Lepadella (L.) acuminata sexcostata BARTOŠ	o-b	–	5	5	–	–	3	1.5
Lepadella (L.) adjuncta DONNER	b	–	–	10	–	–	5	2.0
Lepadella (L.) costata WULFERT	o	–	10	–	–	–	5	1.0
Lepadella (L.) cristata (ROUSSELET)	o-b	–	5	5	–	–	3	1.5
Lepadella (L.) dactyliseta STENROOS	o-b	–	5	5	–	–	3	1.5
Lepadella (L.) elliptica WULFERT	o	–	10	–	–	–	5	1.0

Table 1 (Continued).

Taxon	s	x	o	b	a	p	I_i	S_i
Lepadella (L.) koniari BARTOŠ	o	–	10	–	–	–	5	1.0
Lepadella (L.) minuta (WEBER & MONTET)	o–b	–	5	5	–	–	3	1.5
Lepadella (L.) oblonga (EHRENBERG)	b–a	–	2	4	4	–	2	2.2
Lepadella (L.) ovalis (O. F. MÜLLER)	o	1	6	3	–	–	3	1.2
Lepadella (L.) parvula (BRYCE)	o–b	–	5	5	–	–	3	1.5
Lepadella (L.) patella (O. F. MÜLLER)	o–b	+	6	4	–	–	3	1.4
Lepadella (L.) quadricarinata octocarinata WULFERT	b	–	5	5	–	–	3	1.5
Lepadella (L.) q. quadricarinata (STENROOS)	o–b	–	5	5	–	–	3	1.5
Lepadella (L.) quinquecostata (LUCKS)	o–b	–	5	5	–	–	3	1.5
Lepadella (L.) rhomboides haueri BARTOŠ	o	–	10	–	–	–	5	1.0
Lepadella (L.) r. rhomboides (GOSSE)	o	–	8	2	–	–	4	1.2
Lepadella (L.) rottenburgi (LUCKS)	o	–	10	–	–	–	5	1.0
Lepadella (L.) similis (LUCKS)	o–b	–	5	5	–	–	3	1.5
Lepadella (L.) triptera (EHRENBERG)	o	–	7	3	–	–	4	1.3
Lepadella (Xenolepadella) borealis HARRING	o	3	4	3	–	–	2	1.0
Lepadella (X.) branchicola HAUER	o	3	4	3	–	–	2	1.0
Lepadella (X.) parasitica HAUER	o	3	4	3	–	–	2	1.0
Limnias c. ceratophylli SCHRANK	o–b	–	5	5	–	–	3	1.5
Limnias ceratophylli sphagnicola ZACHARIAS	o	–	9	1	–	–	5	1.1
Limnias melicerta WEISSE	o	–	10	–	–	–	5	1.0
Lindia torulosa DUJARDIN	o	–	10	–	–	–	5	1.0
Lophocharis gracilis DVOŘÁKOVÁ	o–b	–	5	5	–	–	3	1.5
Lophocharis oxysternon (GOSSE)	o	–	8	2	–	–	4	1.2
Lophocharis rubens WULFERT	o–b	–	5	5	–	–	3	1.5
Lophocharis salpina (EHRENBERG)	o–b	–	7	3	–	–	4	1.3
Macrochaetus subquadratus PERTY	o	–	10	–	–	–	5	.10
Macrotrachella concinna (BRYCE)	o–b	–	6	3	1	–	3	1.4
Macrotrachella crucicornis (MURRAY)	o–b		6	4	–	–	3	1.4
Macrotrachella decora (BRYCE)	o	–	10	–	–	–	5	1.0
Macrotrachella habita (BRYCE)	o	–	10	–	–	–	5	1.0
Macrotrachella m. multispinosa THOMPSON	o	–	10	–	–	–	5	1.0
Macrotrachella muricata (MURRAY)	o–b	–	5	5	–	–	3	1.5
Macrotrachella musculosa MILNE	o	–	10	–	–	–	5	1.0
Macrotrachella papillosa THOMPSON	o	–	10	–	–	–	5	1.0
Macrotrachella p. plicata (BRYCE)	o	–	10	–	–	–	5	1.0
Macrotrachella quadricornifera ligulata BERZINS	o	–	9	1	–	–	5	1.1
Macrotrachella q. quadricornifera MILNE	o	1	9	–	–	–	5	0.9
Macrotrachella quadricorniferoides (BRYCE)	o	–	10	–	–	–	5	1.0
Macrotrachella šámali BARTOŠ	o	–	10	–	–	–	5	1.0
Metadiaschiza trigona (ROUSSELET)	o	–	10	–	–	–	5	1.0
Microcodides chlaena (GOSSE)	o	–	8	2	–	–	4	1.2
Microcodides robustus (GLASCOTT)	o	–	8	2	–	–	4	1.2
Microcodon clavus EHRENBERG	x–o	5	5	–	–	–	3	0.5
Mniobia armata (MURRAY)	o	–	8	2	–	–	4	1.2
Mniobia frankenbergeri BARTOŠ	o	–	10	–	–	–	5	1.0
Monommata actices HARRING & MYERS	o	–	10	–	–	–	5	1.0
Monommata aequalis (EHRENBERG)	o–b	–	5	5	–	–	3	1.5
Monommata astia HARRING & MYERS	o	–	10	–	–	–	5	1.0
Monommata dentata WULFERT	o	–	10	–	–	–	5	1.0
Monommata dissimile BERZINS	o	–	10	–	–	–	5	1.0
Monommata grandis TESSIN	o	–	9	1	–	–	5	1.1
Monommata longiseta (O. F. MÜLLER)	o	–	9	1	–	–	5	1.1
Monommata phoxa HARRING & MYERS	o	–	10	–	–	–	5	1.0
Myersinella tetraglena (WISZNIEWSKI)	o	1	8	1	–	–	4	1.0
Mytilina bicarinata (PERTY)	b–o	–	4	6	–	–	3	1.6
Mytilina bisulcata (LUCKS)	b–o	–	7	3	–	–	4	1.3

Table 1 (Continued).

Taxon	s	x	o	b	a	p	I_i	S_i
Mytilina compressa (GOSSE)	b–a	–	–	5	5	–	3	2.5
Mytilina crassipes (LUCKS)	o–b	–	5	5	–	–	3	1.5
Mytilina m. mucronata O. F. MÜLLER	b	–	3	6	1	–	3	1.8
Mytilina mucronata spinigera (EHRENBERG)	b	–	2	7	1	–	3	1.9
Mytilina mutica (PERTY)	o–b	–	5	5	–	–	3	1.5
Mytilina trigona (GOSSE)	a–b	–	1	5	4	+	3	2.3
Mytilina ventralis brevispina (EHRENBERG)	o–b	–	5	5	–	–	3	1.5
Mytilina ventralis macracantha (GOSSE)	b	–	2	8	–	–	4	1.8
Mytilina v. ventralis (EHRENBERG)	o	–	10	–	–	–	5	1.0
Notholca acuminata (EHRENBERG)	o–b	–	6	4	–	–	3	1.4
Notholca labis GOSSE	o	–	7	3	–	–	4	1.3
Notholca squamula (O. F. MÜLLER)	o–b	–	5	5	–	–	3	1.5
Notommata allantois WULFERT	o	–	10	–	–	–	5	1.0
Notommata aurita (O. F. MÜLLER)	b–a	–	2	4	4	–	2	2.2
Notommata brachyota EHRENBERG	o–b	–	5	5	–	–	3	1.5
Notommata cerberus (GOSSE)	o	–	10	–	–	–	5	1.0
Notommata copeus EHRENBERG	o	–	8	2	–	–	4	1.2
Notommata cyrtopus GOSSE	b	–	3	4	3	–	2	2.0
Notommata diasema MYERS	o	–	10	–	–	–	5	1.0
Notommata falcinella HARRING & MYERS	o–b	–	5	5	–	–	3	1.5
Notommata glyphura WULFERT	o	–	6	3	1	–	3	1.4
Notommata groenlandica BERGENDAL	o	–	10	–	–	–	5	1.0
Notommata pachyura (GOSSE)	o–b	–	5	5	–	–	3	1.5
Notommata pseudocerberus BEAUCHAMP	o	–	10	–	–	–	5	1.0
Notommata saccigera EHRENBERG	o	–	10	–	–	–	5	1.0
Notommata tripus EHRENBERG	o	–	10	–	–	–	5	1.0
Notommata voigti DONNER	o	–	10	–	–	–	5	1.0
Otostephanus annulatus KONIAR	x–o	6	4	–	–	–	3	0.4
Otostephanus auriculatus bilobatus HAUER	o–b	–	5	5	–	–	3	1.5
Otostephanus donneri (DONNER)	b	–	2	6	2	–	3	2.0
Otostephanus monteti MILNE	b	–	2	6	2	–	3	2.0
Paracolurella pertyi (HOOD)	o	–	10	–	–	–	5	1.0
Paradicranophorus hudsoni (GLASCOTT)	b	–	2	8	–	–	4	1.8
Parencentrum longidens (DONNER)	o–b	–	5	5	–	–	3	1.5
Parencentrum lutetiae HARRING & MYERS	o	–	10	–	–	–	5	1.0
Parencentrum plicatum (EYFERTH)	o	–	10	–	–	–	5	1.0
Parencentrum semiplicatum (WULFERT)	o–b	–	4	6	–	–	3	1.6
Parencentrum saundersiae (HUDSON)	b–a	–	–	5	5	–	3	2.5
Philodina a. acuticornis MURRAY	x–o	6	4	–	–	–	3	0.4
Philodina acuticornis minor PAX & WULFERT	x	10	–	–	–	–	5	0.0
Philodina acuticornis odiosa MILNE	b	–	2	6	2	–	3	2.0
Philodina brevipes MURRAY	o–b	–	6	4	–	–	3	1.4
Philodina citrina EHRENBERG	o–b	1	5	2	2	–	1	1.3
Philodina convergens MURRAY	o	–	10	–	–	–	5	1.0
Philodina erythropthalma EHRENBERG	b	–	–	7	3	–	4	2.3
Philodina flaviceps BRYCE	o–b	–	4	5	1	–	2	1.7
Philodina lepta WULFERT	x	9	1	–	–	–	5	0.1
Philodina megalotrocha EHRENBERG	o–b	–	4	5	1	–	2	1.7
Philodina nitida MILNE	b	–	3	6	1	–	3	1.8
Philodina plena (BRYCE)	a	–	–	1	9	–	5	2.9
Philodina roseola EHRENBERG	b	–	3	4	3	–	2	2.0
Philodina rugosa coriacea BRYCE	o	–	9	1	–	–	5	1.1
Philodina r. rugosa BRYCE	o	–	10	–	–	–	5	1.0
Philodina striata RODEWALD	o	–	9	1	–	–	5	1.1
Philodina tranquilla WULFERT	x	8	2	–	–	–	4	0.2
Philodina tridentata RODEWALD	o	–	8	2	–	–	4	1.2

Table 1 (Continued).

Taxon	s	x	o	b	a	p	I_i	S_i
Philodinavus paradoxus (MURRAY)	x–o	7	3	–	–	–	4	0.3
Platyias patulus O. F. MÜLLER	b	–	2	8	–	–	4	1.8
Platyias polyacanthus (EHRENBERG)	b	–	2	8	–	–	4	1.8
Platyias quadricornis brevispinus (DADAY)	b	–	1	9	–	–	5	1.9
Platyias q. quadricornis (EHRENBERG)	b	–	2	8	–	–	4	1.8
Pleuretra brycei (WEBER)	o–x	4	6	–	–	–	3	0.6
Pleuretra intermedia (BARTOŠ)	o	–	8	2	–	–	4	1.2
Pleurotrocha petromyzon EHRENBERG	b	–	3	5	2	–	2	1.9
Pleurotrocha robusta (GLASCOTT)	o	–	8	2	–	–	4	1.2
Ploeosoma hudsoni (IMHOF)	o	–	8	2	–	–	4	1.2
Ploeosoma lenticulare HERRICK	o	–	10	–	–	–	5	1.0
Ploeosoma triacanthum (BERGENDAL)	o	–	10	–	–	–	5	1.0
Ploeosoma truncatum (LEVANDER)	o	–	7	3	–	–	4	1.3
Polyarthra dissimulans NIPKOW	o–b	–	8	2	–	–	4	1.2
Polyarthra dolichoptera brachyptera BARTOŠ	o–b	–	7	3	–	–	4	1.3
Polyarthra d. dolichoptera IDELSON	o–b	–	5	5	–	–	3	1.5
Polyarthra euryptera WISZNIEWSKI	o	–	8	2	–	–	4	1.2
Polyarthra longiremis CARLIN	o	–	10	–	–	–	5	1.0
Polyarthra major BURCKHARDT	o	–	8	2	–	–	4	1.2
Polyarthra minor VOIGT	o–x	4	6	–	–	–	3	0.6
Polyarthra proloba WULFERT	o–b	–	5	5	–	–	3	1.5
Polyarthra pseudoproloba ALBERTOVÁ	o–b	–	5	5	–	–	3	1.5
Polyarthra remata SKORIKOV	o–b	–	5	5	–	–	3	1.5
Polyarthra vulgaris CARLIN	b	–	2	5	3	–	2	2.1
Pompholyx complanata GOSSE	o–b	–	5	5	–	–	3	1.5
Pompholyx sulcata HUDSON	b	–	2	8	–	–	4	1.8
Postclausa hyptopus (EHRENBERG)	o	–	9	1	–	–	5	1.1
Postclausa minor (ROUSSELET)	o–b	–	5	5	–	–	3	1.5
Proales alba WULFERT	o–b	–	6	4	–	–	3	1.4
Proales daphnicola THOMPSON	b	–	2	5	3	–	2	2.1
Proales decipiens (EHRENBERG)	o–b	–	4	4	2	–	2	1.8
Proales doliaris (ROUSSELET)	o	–	10	–	–	–	5	1.0
Proales fallaciosa WULFERT	b	–	3	5	2	–	2	1.9
Proales latrunculus PENARD	o	–	8	2	–	–	4	1.2
Proales micropus (GOSSE)	o	–	10	–	–	–	5	1.0
Proales minima MONTET	o	–	10	–	–	–	5	1.0
Proales parasita (EHRENBERG)	o–b	–	5	5	–	–	3	1.5
Proales provida (WULFERT)	x	9	1	–	–	–	5	0.1
Proales reinhardtii (EHRENBERG)	b	–	–	8	2	–	4	2.2
Proales similis DE BEAUCHAMP	a	–	–	–	10	–	5	3.0
Proales sordida (GOSSE)	o–b	–	5	5	–	–	3	1.5
Proales theodora (GOSSE)	x–b	4	3	3	–	–	2	0.9
Proales uroglenae DE BEAUCHAMP	o–b	–	6	4	–	–	3	1.4
Proales werneckii (EHRENBERG)	o–b	1	4	4	1	–	1	1.5
Proalides tentaculatus DE BEAUCHAMP	o–b	–	5	5	–	–	3	1.5
Proalinopsis caudatus (COLLINS)	o	–	10	–	–	–	5	1.0
Proalinopsis lobatus (RODEWALD)	o	–	10	–	–	–	5	1.0
Ptygura beauchampi EDMONDSON	o–b	–	5	5	–	–	3	1.5
Ptygura brachiata (HUDSON)	o	–	7	3	–	–	4	1.3
Ptygura crystallina (EHRENBERG)	b	–	1	7	2	–	3	2.1
Ptygura longicornis (DAVIS)	b	–	1	9	–	–	5	1.9
Ptygura longipes (WILLSON)	o–b	–	5	5	–	–	3	1.5
Ptygura melicerta (EHRENBERG)	b	–	2	6	2	–	3	2.0
Ptygura mucicola (KELLICOTT)	o	–	10	–	–	–	5	1.0
Ptygura pilula (CUBITT)	o	–	10	–	–	–	5	1.0
Ptygura stygis (GOSSE)	o–b	–	5	5	–	–	3	1.5

Table 1 (Continued).

Taxon	s	x	o	b	a	p	I_i	S_i
Ptygura velata (GOSSE)	o	–	10	–	–	–	5	1.0
Resticula gelida HARRING & MYERS	o–b	–	5	5	–	–	3	1.5
Resticula melandocus (GOSSE)	o	–	10	–	–	–	5	1.0
Resticula plicata WULFERT	o	–	10	–	–	–	5	1.0
Rhinoglena fertöensis VARGA	o	–	9	1	–	–	4	1.1
Rhinoglena frontalis EHRENBERG	b	–	–	10	–	–	5	2.0
Rotaria citrina (EHRENBERG)	o–b	1	4	3	2	–	1	1.4
Rotaria elongata (WEBER)	o–b	–	5	5	–	–	3	1.5
Rotaria gracilicauda (BORY)	o	1	8	1	–	–	4	1.0
Rotaria haptica (HUDSON & GOSSE)	b	–	2	6	2	–	3	2.0
Rotaria macroceros (GOSSE)	o–b	–	6	4	–	–	3	1.4
Rotaria macrura (EHRENBERG)	b	+	3	5	2	–	2	1.9
Rotaria magnacalcarata (PARSSONS)	b	–	2	6	2	–	3	2.0
Rotaria neptunia (EHRENBERG)	p	–	–	–	2	8	4	3.8
Rotaria neptunoida HARRING	b–a	–	1	4	4	1	1	2.5
Rotaria quadrioculata (MURRAY)	o–b	–	5	5	–	–	3	1.5
Rotaria rotatoria (PALLAS)	a	–	+	1	6	3	3	3.2
Rotaria socialis (KELLICOTT)	b	–	2	6	2	–	3	2.0
Rotaria s. sordida (WESTERN)	o	–	8	2	–	–	4	1.2
Rotaria tardigrada (EHRENBERG)	b–a	–	+	6	4	–	3	2.4
Rotaria tridens (MONTET)	b–o	–	4	5	1	–	2	1.7
Rotaria trisecata (WEBER)	o–b	–	3	5	2	–	2	1.9
Scaridium longicaudum (O. F. MÜLLER)	o	–	7	3	–	–	4	1.3
Scephanotrocha corniculata BRYCE	o	–	8	2	–	–	4	1.2
Scephanotrocha rubra BRYCE	o	–	9	1	–	–	5	1.1
Sinantherina semibullata (THORPE)	o	–	8	2	–	–	4	1.2
Sinantherina socialis (LINNÉ)	b	–	3	7	–	–	4	1.7
Squatinella aurita WULFERT	o	–	10	–	–	–	5	1.0
Squatinella bifurca (HUDSON)	o	–	10	–	–	–	5	1.0
Squatinella lamellaris (O. F. MÜLLER)	o	–	10	–	–	–	5	1.0
Squatinella leydigii (ZACHARIAS)	o	–	10	–	–	–	5	1.0
Squatinella longispinata (TATEM)	b–o	–	4	6	–	–	3	1.6
Squatinella mutica (EHRENBERG)	o	–	7	3	–	–	4	1.3
Squatinella rostrum (SCHMARDA)	o	–	10	–	–	–	5	1.0
Squatinella tridentata (FRESENIUS)	o	–	9	1	–	–	5	1.1
Stephanoceros fimbriatus (GOLDFUSS)	b	–	1	7	2	–	3	2.1
Synchaeta grandis ZACHARIAS	o	–	9	1	–	–	5	1.1
Synchaeta kitina ROUSSELET	o–b	–	6	4	–	–	3	1.4
Synchaeta longipes GOSSE	o	–	10	–	–	–	5	1.0
Synchaeta oblonga EHRENBERG	b	–	3	6	1	–	3	1.8
Synchaeta pectinata EHRENBERG	o–b	–	4	5	1	–	2	1.7
Synchaeta stylata WIERZEJSKI	o	–	10	–	–	–	5	1.0
Synchaeta tremula O. F. MÜLLER	o	–	8	2	–	–	4	1.2
Taphrocampa annulosa GOSSE	o–b	–	6	4	–	–	3	1.4
Taphrocampa selenura GOSSE	b–o	–	4	6	–	–	3	1.6
Testudinella aspis CARLIN	o–b	–	5	5	–	–	3	1.5
Testudinella bidentata (TERNETZ)	o	–	8	2	–	–	4	1.2
Testudinella caeca (PARSONS)	b–a	–	–	6	4	–	3	2.4
Testudinella clypeata (O. F. MÜLLER)	a	–	+	3	6	1	3	2.8
Testudinella elliptica (EHRENBERG)	b	–	1	8	1	–	4	2.0
Testudinella emarginula (STENROOS)	o–b	–	6	4	–	–	3	1.4
Testudinella incisa (TERNETZ)	o	–	7	3	–	–	4	1.3
Testudinella mucronata (GOSSE)	o	–	8	2	–	–	4	1.2
Testudinella patina intermedia ANDERSON	b–o	–	4	6	–	–	3	1.6
Testudinella p. patina HERMANN	b	–	2	7	1	–	3	1.9
Testudinella patina trilobata ANDERSON & SHEPARD	b	–	4	6	–	–	3	1.6

Table 1 (Continued).

Taxon	s	x	o	b	a	p	I_i	S_i
Testudinella parva (TERNETZ)	o–b	–	5	5	–	–	3	1.5
Testudinella parva bidentata (TERNETZ)	o	–	8	2	–	–	4	1.2
Testudinella pseudoelliptica BARTOŠ	o–b	–	5	5	–	–	3	1.5
Testudinella reflexa (GOSSE)	b	–	–	10	–	–	5	2.0
Testudinella sculpturata BARTOŠ	o–b	–	5	5	–	–	3	1.5
Testudinella truncata ecornis WISZNIEWSKI	b	–	2	6	2	–	3	2.0
Testudinella t. truncata (GOSSE)	o	–	8	2	–	–	4	1.2
Tetramastix opoliensis brevispina AHLSTROM	o	–	7	3	–	–	4	1.3
Tetramastix o. opoliensis (ZACHARIAS)	o–b	–	4	6	–	–	3	1.6
Trichocerca antilopaea (PETR)	o	–	7	3	–	–	4	1.3
Trichocerca barsica (VARGA & DUDICH)	o	–	10	–	–	–	5	1.0
Trichocerca bicristata (GOSSE)	o	–	10	–	–	–	5	1.0
Trichocerca bidens (LUCKS)	o–b	–	7	3	–	–	4	1.3
Trichocerca birostris (MINKIEWICZ)	o–b	–	5	5	–	–	3	1.5
Trichocerca brachyura (GOSSE)	o	–	9	1	–	–	5	1.1
Trichocerca capucina (WIERZEJSKI & ZACHARIAS)	o	–	8	2	–	–	4	1.2
Trichocerca cavia (GOSSE)	o–b	–	7	3	–	–	4	1.3
Trichocerca collaris (ROUSSELET)	o–b	–	6	4	–	–	3	1.4
Trichocerca cylindrica (IMHOF)	o	–	8	2	–	–	4	1.2
Trichocerca dixon-nutalli JENNINGS	o	–	10	–	–	–	5	1.0
Trichocerca elongata (GOSSE)	o	–	10	–	–	–	5	1.0
Trichocerca iernis (GOSSE)	o	–	7	3	–	–	4	1.3
Trichocerca inermis (LINDER)	o	–	7	3	–	–	4	1.3
Trichocerca intermedia (STENROOS)	o–b	–	6	4	–	–	3	1.4
Trichocerca jenningsi VOIGT	o	–	10	–	–	–	5	1.0
Trichocerca longiseta (SCHRANK)	o	–	8	2	–	–	4	1.2
Trichocerca lophoëssa (GOSSE)	o	–	8	2	–	–	4	1.2
Trichocerca macera (GOSSE)	o	–	10	–	–	–	5	1.0
Trichocerca musculus (HAUER)	o	–	7	3	–	–	4	1.3
Trichocerca myersi (HAUER)	o	–	10	–	–	–	5	1.0
Trichocerca parvula CARLIN	o	–	10	–	–	–	5	1.0
Trichocerca porcellus (GOSSE)	o	–	8	2	–	–	4	1.2
Trichocerca pusilla (JENNINGS)	o	–	7	3	–	–	4	1.3
Trichocerca rattus carinata (GOSSE)	o	–	9	1	–	–	5	1.1
Trichocerca r. rattus (O. F. MÜLLER)	o	–	10	–	–	–	5	1.0
Trichocerca relicta DONNER	o	–	7	3	–	–	4	1.3
Trichocerca rosea (STENROOS)	o	–	9	1	–	–	5	1.1
Trichocerca rousseleti (VOIGT)	o	–	10	–	–	–	5	1.0
Trichocerca ruttneri DONNER	o	–	8	2	–	–	4	1.2
Trichocerca sejunctipes (GOSSE)	o	–	9	1	–	–	5	1.1
Trichocerca scipio (GOSSE)	o	–	10	–	–	–	5	1.0
Trichocerca similis (WIERZEJSKI)	o	–	7	3	–	–	4	1.3
Trichocerca stylata (GOSSE)	o	–	7	3	–	–	4	1.3
Trichocerca sulcata (JENNINGS)	o	–	9	1	–	–	5	1.1
Trichocerca taurocephala (HAUER)	o	–	10	–	–	–	5	1.0
Trichocerca tenuior (GOSSE)	o–b	–	6	4	–	–	3	1.4
Trichocerca tigris (O. F. MÜLLER)	o	–	8	2	–	–	4	1.2
Trichocerca uncinata (VOIGT)	o	–	10	–	–	–	5	1.0
Trichocerca vernalis (HAUER)	o	–	10	–	–	–	5	1.0
Trichocerca weberi (JENNINGS)	o	–	9	1	–	–	5	1.1
Trichotria pocillum (O. F. MÜLLER)	b–o	–	4	6	–	–	3	1.6
Trichotria similis (STENROOS)	o	–	9	1	–	–	5	1.1
Trichotria spinifera (WESTERN)	o–b	–	6	4	–	–	3	1.4
Trichotria tetractis paupera (EHRENBERG)	o	–	9	1	–	–	5	1.1
Trichotria t. tetractis (EHRENBERG)	b–o	–	4	6	–	–	3	1.6
Trichotria tetractis turfacea (PETR)	o	–	10	–	–	–	5	1.0

Table 1 (Continued).

Taxon	s	x	o	b	a	p	I_i	S_i
Trichotria truncata (WHITELEGGE)	o	–	8	2	–	–	4	1.2
Wierzejskiella sabulosa (WISZNIEWSKI)	o	1	8	1	–	–	4	1.0
Wierzejskiella vágneri KONIAR	o	–	9	1	–	–	5	1.1
Wierzejskiella velox WISZNIEWSKI	o	–	8	2	–	–	4	1.2
Wigrella depressa WISZNIEWSKI	o	–	10	–	–	–	5	1.0
Wulfertia ornata DONNER	o	–	10	–	–	–	5	1.0

It grew abundantly while the reservoir was polluted by starch waste waters, up to the alpha-mesosaprobic degree.

Colurella adriatica Ehrenberg (Plate 3/13) is known from the littoral zone of lakes, ponds, small water bodies and rivers. It was even detected in mineral springs. Rarely, at a very good functioning of a purification plant, it occurs in activated sludge (Doohan 1975; Klimowicz 1973, 1977).

Colurella uncinata bicuspidata (Ehrenberg) is one of the most common species of aquatic vegetation in fishponds and small water bodies, and sometimes of littoral plankton. It adapted to life in activated sludge, showing a very good purification effect at BOD_5 values in the effluent of less than 10 mg l^{-1}. Its abundance there was low.

Colurella colurus (Ehrenberg) is another typical littoral inhabitant of ponds, pools and thermal springs with a cosmopolitan distribution, and which has been found in activated sludge with a long detention time (Dvořáková in litt.; Rogovskaya 1967; Doohan 1975; Klimowicz 1970, 1972, 1973, 1977). Maximum values were 2 280 ind. per ml^{-1} in Warsaw (May–June), otherwise there were values of tens up to hundreds. It occurred at a good purification effect with less than 10 mg l^{-1} BOD_5. Few specimens were detected even at lower efficiency of the purification plant.

Colurella dicentra (Gosse) inhabits the littoral of fishponds and small water bodies, where there is an inflow of organic pollution (Bartoš 1959). We anticipate its presence in stabilization ponds, where similar conditions are found.

Colurella geophila Donner was noted from Great Britain (Doohan 1975) and Poland (Klimowicz 1972, 1977) in purification plants. In Warsaw it occurred year-round with a winter maximum of 430 ind. ml^{-1}, but only at a perfect purification effect, when the effluent did not exceed 10 mg l^{-1} BOD_5.

Colurella obtusa obtusa (Gosse) is a littoral species able to survive for days in an alpha-mesosaprobic environment in waters adjacent to the Danube in Vienna (Donner 1978).

Dicranophorus forcipatus (O. F. Muller) is a predator of the littoral zone of alkaline and acid water bodies throughout the world. It was found by Doohan (1975) in British and by Klimowicz (1977) in Polish purification plants. It appeared rarely, when there was around 30 mg l^{-1} BOD_5 in the effluent and had a length of 220 up to 500 μm, whereas in clean waters its length attains only 300 μm.

Dicranophorus grandis (Ehrenberg) is a predator of Bdelloids in pools, ditches and other small water bodies (Bartoš 1959). In British purification plants it was recorded by Doohan (1975) and in Polish ones by Klimowicz (1972, 1977). Maximum numbers attained 5 ind. ml^{-1} in properly working plants. Its length ranged in Poland between 370 and 430 μm; in clean waters it was only 370 μm (Bartoš 1959).

Diplois daviesiae Gosse (Plate 3/6) lives in peatbogs (Bartoš 1959). It is known also from polluted waters and it was assigned an individual saprobic index of 2.7 corresponding to alpha-mesosaprobity.

Dissotrocha macrostyla (Ehrenberg) is a Bdelloid rotifer from wetlands, fishponds, and pools, found among aquatic macrophytes and in mosses and sphagnum. It has a wide distribution. Adaptation to life in purification plants was recorded by Doohan (1975) in Britain and by Klimowicz (1977) in Poland. It occurred very rarely at an excellent work of activated sludge with an effluent of less than 10 mg l^{-1} BOD_5.

Encentrum lupus Wulfert (Plate 3/14) is a predator of Ciliates, tearing big pieces from their bodies (Wulfert 1969). It was found very often, but in low numbers in the classical activated sludge plant at Praha-Hostivař (Sládeček 1957). Doohan (1975) and Klimowicz (1972, 1973, 1977) found it in other activated sludge plants. Maximum abundance in Warsaw was 4 ind. ml^{-1} in winter.

Eosphora najas Ehrenberg dwells in waters overgrown with aquatic weeds. Pourriot (1960) showed that it eats rotifers of the species *Brachionus calyciflorus* and *Rotaria rotatoria*. In purification plants this predator was detected by Cooke (1959) and Doohan (1975).

Epiphanes senta (O. F. Müller) (Plate 3/15) usually occurs in small astatic waters between March and October. It is a typical vernal rotifer. Wilkens (1972) considers it a littoral species, invading the plankton of polluted waters. In the accumulation pond for treating beet-sugar wastes in Vinoř it occurred from Mid-April till mid-May with a maximum of 1 800 ind. l^{-1} (Sládeček *et al.* 1958). In spring it was also present in the stabilization pond in Pelhřimov (Sládeček & Vošahlík 1979). In another stabilization pond in Praha-Jinonice it occurred *en masse* in April and May. Records from activated sludge were published by Godeanu (1966), Doohan (1975), and Klimowicz (1972, 1973, 1977).

Euchlanis dilatata Ehrenberg (Plate 2/8) is a cosmopolitan littoral species of aquatic vegetation, found both in acid and alkaline waters (Bartoš 1959). Cooke (1959) detected it in biofilters in Britain, and Klimowicz (1973, 1977) in activated sludge in Poland where it was present in medium numbers at the good work of the plant. Other records are by Doohan (1975).

Euchlanis oropha Gosse tolerates alpha-mesosaprobic conditions, at least for some days, as documented by Donner (1978).

Filinia longiseta (Ehrenberg) (Plate 3/7) is a cosmopolitan species inhabiting fishponds, village ponds, pools and small lakes. It sometimes forms a considerable part of the zooplankton. Sládeček *et al.* (1959) found it in the accumulation pond at Vinoř from early May till late August. A first maximum in May reached 600 ind. l^{-1} at a depth of 0.5 m, a second one in mid-July was 4 800 ind. l^{-1}. The species also lived in three other ponds in the vicinity. In the stabilization pond at Pelhřimov it occurred only sporadically (Sládeček & Vošahlík 1979). Ruttner-Kolisko (1980) demonstrated the occurrence of *Filinia terminalis* and *F. longiseta* in different types of lakes and presented a graphical scheme. A change in the population of both species was noted also by De Maeseneer *et al.* 1978.

Habrotrocha bidens Gosse is common in wet moss, sphagnum, among aquatic vegetation and in soil humus from April to December. Bartoš (1959) listed many localities in Czechoslovakia and confirmed the findings of Donner (1956). Godeanu (1966) was the first to detect it in activated sludge. Sládeček (1969) found it in a model of activated sludge together with *Adineta oculata* and *Lecane pyriformis*. Klimowicz (1970–1977) considers it a constant component of the rotifer fauna of activated sludge, but with a low abundance (maximum density 7 ind. ml^{-1}). The species is quoted also by Doohan (1975) from British purification plants.

Habrotrocha collaris (Ehrenberg) is a relatively rare species inhabiting sphagnum, mosses, Hepaticae and wetlands, sometimes epizoic on the cases of caddis-fly larvae in forest brooks. (Bartoš 1959). The only record from activated sludge, Klimowicz (1977), deals with a perfect treatment with less than 10 mg l^{-1} BOD_5 in its effluent. The Bdelloid rotifer occurred here sparsely.

Habrotrocha constricta (Dujardin) inhabits mosses, sphagnum, littoral vegetation of fishponds and has also been found epizootically. Records from activated sludge (Godeanu 1966; Doohan 1975; Sudzuki 1981; Klimowicz 1977) are situated at a poor purification effect, with 20–30 mg l^{-1} BOD_5 in the effluent.

Habrotrocha flava Bryce (Plate 3/16) dwells in aerophytic mosses and in Hepaticae from May to August. It moves slowly and may change its body form as shown on our figure. In activated sludge it was recorded by Doohan (1975) and Klimowicz (1977), always in low numbers even at poor performance of the purification plant (BOD_5 values up to 30 mg l^{-1}).

Habrotrocha rosa Donner usually lives in soil humus, among decaying leaves and in aerophytic mosses, even in high mountains (Bartoš 1950). Plasota *et al.* (1980) isolated it from activated sludge in an axenic culture and fed it a bacterial suspension of *Micrococcus* sp. They applied penicilin which is not toxic to rotifers. They ascertained an individual life-span of about 20 days, divided into three periods: immaturity 2–3 days, maturity 6–9 days and senescence 10–14 days, when no eggs are laid any more, but the rotifer is still active. A small percentage dies as early as the mature period, apparently by a disruptance of the reproduction process, because eggs accumulate inside the body. The total production of eggs amounted to about 30, with a maximum daily production of 6. The development of the embryo from egg laying to hatching lasts an average of 30–33 h. If hatching is delayed for some hours, the embryo dies in the egg. The species was detected in activated sludge by Godeanu (1966), Doohan (1976), and Klimowicz (1977). It occurred in badly performing activated sludge (BOD_5 values over 30 mg l^{-1}).

Habrotrocha thienemanni Hauer is well known from dentrohelmae in hollow trees (*Fagus, Quercus, Acer, Carpinus* etc.), attainning large densities in these small spaces. In activated sludge it was recorded by Doohan (1975) and Klimowicz (1977), in small numbers, at different purification levels, even over 30 mg l^{-1} BOD_5 in the outlet.

Habrotrocha tripus (Murray) inhabits aerophytic mosses, dentrothelms, and soil under manure (Bartoš 1959). In activated sludge it was found by Godeanu (1966), Doohan (1975) and Klimowicz (1977), always in low numbers, and at different purification levels.

Keratella cochlearis (Gosse) (Plate 2/10) is one of the most common planktonic rotifers with a wide distribution in standing and slowly running waters. In Czechoslovakia Bartoš (1959) found it in large numbers in winter and spring, while later in the year lesser densities were encountered, especially in large fishponds. Gilbert & Morgan (1981) showed that it does not select between flagellates and algae as food. Hofmann (1980, 1981) expressed his doubts on the existence of Lauterborn cycles in the development of this species. A systematic account was published by Pejler (1980). Sládečeket *al.* (1958) observed it in an accumulation pond at Vinoř between May and September with a maximum abundance of 9 200 individuals per liter. In the stabilization pond Pelhřimov it occurred only rarely (Sládeček & Vošahlík 1979). Doohan (1975) and Klimowicz (1973, 1977) mentioned few individuals in purification plants. It must be noted that for a positive record a lorica with a living rotifer inside is required, since empty loricae can passively reach a purification plant. The same holds true for the genus *Brachionus* and other loricates. Loricae persist in the water for several days after the death of the rotifer, while their chitin is slowly decomposed by chitinivorous bacteria.

Lecane (Lecane) clara (Bryce) is a littoral species of fishponds and weedy pools and of sphagnum, sometimes psammon (Bartoš 1959). Godeanu (1966) found it in activated sludge in Rumania, Sládeček (1969) in a laboratory model in Prague, but determined it incorrectly as *Dicranophorus* sp. because of its resemblance in extended shape with that genus. Doohan (1975) found it in British purification works and Klimowicz (1977) in Polish ones. Activated sludge had a medium or negative effect between 10 and over 30 mg l^{-1} BOD_5, with the rotifer in low abundance. Its length reached 170–200 μm, while under normal conditions it is only about 120 μm.

Lecane (Lecane) inermis (Bryce) lives in the littoral of fishponds and small water bodies (Bartoš 1959; Rudescu 1960). In the outlets of properly biologically treated sewage in Japan Sudzuki (1981) detected a variety with a modified caudal part. Doohan (1975) reported it from British purification plants and Klimowicz (1970, 1972, 1977) from Polish ones. Maximum densities were 100 and 177 individuals per ml in autumn, at good, medium and even low efficiency of the plant. Its length was 92–154 μm, as compared to a usual measurement of ca. 115 μm.

Lecane (Lecane) stichaea Harring occurs in sphagnum and among aquatic vegetation in pools and ponds. It was recorded from purification plants by Doohan (1975) and Klimowicz (1972, 1973, 1977), with a maximum of 41 ind. ml^{-1}. At a good performance of activated sludge it was present in higher numbers, at poor efficiencies (BOD_5 20–30 mg l^{-1} in the outlet) it was rare. The length was 125–145 μm, while in clean waters it is 102–145 μm.

Lecane (Lecane) tenuiseta Harring can be found in sphagnum (Bartoš 1959). Occurrence in activated sludge was noted by Godeanu (1966), Doohan (1975) and Klimowicz (1973, 1977). In activated sludge in Warsaw individuals attained 88–117 μm in length (in clean waters 106 μm) and occurred in low numbers in properly and moderately working purification plants (BOD_5 10–30 mg l^{-1}).

Lecane (Monostyla) arcuata (Bryce) lives among aquatic vegetation, especially in sphagnum. Few specimens were found in purification plants in Rumania (Godeanu 1966) and Britain (Doohan 1975).

Lecane (Monostyla) bulla (Gosse) is a cosmopolitan inhabitant of the vegetation in the littoral of lakes, ponds and pools (Voigt 1957; Bartoš 1959; Rudescu 1960). It was detected in low abundance in the activated sludge in Praha-Štvanice (Dvořáková in litt.), in Great Britain (Doohan 1975) and in big numbers in Poland (Klimowicz 1970, 1972, 1977). In Warsaw a maximum of 2 300 ind. ml^{-1} appeared in autumn, in another case 117 in December, always at a top purification effect of the plant (10–20 mg l^{-1} BOD_5).

Lecane (Monostyla) closterocerca (Schmarda) is a common species in ponds and pools overgrown with macrophytes. An occurrence in activated sludge in Rumania was noted by Godeanu (1966), in England by Doohan (1975) and in Poland by Klimowicz (1972, 1973, 1977). Maximum abundance was 426 in December, 406 in May and, the next year, 168 ind. ml^{-1} in June. This strong development was connected to a very good purification (10–20 mg l^{-1} BOD_5); at lower effects the rotifer was sporadic. It was noted also from Japanese purification plants near Tokyo (Sudzuki 1981).

Lecane (Monostyla) decipiens (Murray) lives in small water bodies and mosses (Kutikova 1970). In purification plants it was noted by Doohan (1975) and by Klimowicz (1977), but only rarely at good purification levels.

Lecane (Monostyla) galeata (Bryce) is sometimes synonymized with L. pygmaea Daday (see Voigt 1957). A good description and differential diagnosis was given by Rudescu (1960). The species dwells in sphagnum and in the littoral of small waters. In activated sludge it was detected by Godeanu (1966), Doohan (1975) and Klimowicz (1977), but in insignificant numbers at good or medium ranges of purification. Polish specimens had a length of 90–125 μm.

Lecane (Monostyla) hamata (Stokes) is a common cosmopolitan species of ponds, pools, mosses, Hepaticae and occasionally of the plankton. It was found in activated sludge by Dvořáková (in litt.), Doohan (1975), and Klimowicz (1972, 1973, 1977). The maximum density was 11 ind. ml^{-1} in June. It preferred well or medium working plants, and rarely occurred at BOD_5 values above 30 mg l^{-1}.

Lecane (Monostyla) lunaris (Ehrenberg) belongs to the most common cosmopolitan littoral species in fishponds, pools and small water bodies. It was detected by Rogovskaya (1967) in models of purification plants in Moscow, in similar conditions in Britain by Doohan (1975) and in the activated plants of Warsaw by Klimowicz (1970, 1972, 1977). Maximum abundances were 114 (in autumn) and 1 171 ind. ml^{-1} in December next year, if purification proceeded properly. At values above 30 mg l^{-1} BOD_5 in the outlet, this rotifer did not occur at all.

Lepadella acuminata acuminata (Ehrenberg) is abundant among aquatic vegetation, in wetlands and sphagnum, sometimes also in plankton, exceptionally also as an epizoite. It is cosmopolitan. Doohan (1975) and Klimowicz (1970, 1972, 1977) found it in activated sludge at a maximum density of 127 ind. ml^{-1} in December. The highest values were noted at good purification levels.

Lepadella oblonga (Ehrenberg) is a common cosmopolitan species. It has a broad ecological and saprobic valency, which was changed several times (Sládeček 1973, 1976, 1981). Its occurrence in alpha-mesosaprobity indicates a possibility to live in stabilization ponds and similar polluted and eutrophicated waters.

Lepadella patella O. F. Müller is another common cosmopolitan species found among vegetation, mosses and even in plankton. That it shows a preference for saprobic habitats is shown by the classification of Buck (1971): $S_i = 2.51 \pm 0.33$. In purification plants it was recorded by Doohan (1975) and by Klimowicz (1970, 1972, 1973, 1977). It showed maxima of 158 ind. ml^{-1} in October, 143 ind. ml^{-1} in September of the next year and over 200 ind. ml^{-1} in June–July. It did not distinguish between periods of good and bad function of the purification plant (within the limits of 30 mg l^{-1} BOD_5 at the outlet).

Lepadella rhomboides carinata Donner was described from South Moravia, but was omitted in the book of Bartoš (1959). Sudzuki (1981) noted it commonly in biologically purified sewage in Japan.

Macrotrachela concinna (Bryce) occurs in aerophytic mosses, and in sphagnum rich in organic material. It was detected in biological purification plants by Doohan (1975) and in activated sludge plants, even at bad function of the plant, when the outlet exhibited more than 30 mg l^{-1} BOD_5 (Klimowics 1977).

Notommata cyrtopus Gosse is well known as a cosmopolitan inhabitant of ponds and pools overgrown with aquatic weeds. In purification plants it was discovered by Doohan (1975) and Klimowicz (1970, 1972, 1977). It occurred in low numbers (4 and 5 ind. ml^{-1} as a maximum in autumn and in December). There was a good or moderate purification effect, while this rotifer appeared. These specimens were larger than usual (150–175 μm) and attained 150–250 μm in length.

Notommata glyphura Wulfert is present in pools, ditches and in the littoral of rivers. Doohan (1975) ascertained it in British purification works and Klimowicz (1977) in Polish purification works. In activated sludge it tolerated medium success of purification (20–30 mg l^{-1} BOD_5 in the outlet) and measured 325–480 μm in length (normally only 450 μm).

Otostephanus donneri (Donner) and *O. monteti* Milne tolerate alpha-mesosaprobic pollution, as shown by Donner in standing water bodies around the Danube in Vienna.

Parencentrum saundersiae (Hudson) was found in Austria in a beta-mesosaprobic to alpha-mesosaprobic environment (Donner 1978).

Philodina acuticornis odiosa Milne appears in soil, in mosses and epizootically on different aquatic crustaceans and insect larvae. Doohan (1975) and Klimowicz (1977) found it rarely in activated sludge, while BOD_5 did not exceed 10 mg l^{-1} in the outlet. Sudzuki (1981) discovered the nominal form in Japanese purification plants.

Philodina citrina Ehrenberg persists year-round among aquatic algae and higher vegetation in standing and slowly flowing waters, in sand, where it is considered as psammoxenic, and in activated sludge (Godeanu 1966; Doohan 1975 and Klimowics 1977). It remained present, even if the effluent exceeded 30 mg l^{-1} BOD_5. Sudzuki (1981) recorded it from purified sewage in Japan.

Philodina flaviceps Bryce dwells in mosses, among aquatic vegetation and epizootically on aquatic arthropods and their larvae. Records from activated sludge are by Doohan (1975) and Klimowicz (1977), but only from perfect purification to 10 mg l^{-1} BOD_5.

Philodina megalotrocha Ehrenberg occurs in littoral vegetation, in pseudo-plankton and in psammon. The only record from activated sludge is by Doohan (1975).

Philodina nitida nitida Milne is living in mosses. The only record from purified sewage is by Sudzuki (1981) in Japan.

Philodina roseola Ehrenberg inhabits all waters with aquatic vegetation. Sometimes it occurs in pseudo-plankton and on the aquatic arthropods and insect larvae. This cosmopolitan species can also inhabit the psammon. Occurrence in biofilters was recorded by Cooke (1959), in activated sludge by Godeanu (1966), Rogovskaya (1967) and Klimowicz (1970). Here, it appeared in small numbers, usually 3–48 ind. ml^{-1} with a maximum of 457 ind. ml^{-1} in autumn. Klimowicz quotes this species also in publications of 1972, 1973, 1977 and considers it the most frequent rotifer in activated sludge. It was present at all purification levels and was most abundant at BOD_5 values in the outlet up to 20 mg l^{-1}. Its length was 320–540 μm, whereas in clean waters it attains 500 μm. In British purification plants it was noted by Doohan (1975).

Philodina erythropthalma Ehrenberg is sometimes considered a mere form of *Ph. roseola* (Bartoš 1959), but Donner (1955, 1965) is of the opinion that it is a valid species. It was recorded by Doohan (1975) from British purification plants.

Philodina tenicolor was detected in Japanese activated sludge by Sudzuki (1981a, b), but omitted from our Table.

Pleurotrocha petromyzon Ehrenberg is a cosmopolitan species living in the weedy littoral. It was found by Klimowicz (1970–1977) in activated sludge, but in very small numbers with maximum 0.5 in autumn and 2 ind. ml^{-1} in June, if the effluent was below 30 mg l^{-1} BOD_5. Its length was 220–280 μm (in clean waters 225–250 μm). Doohan (1975) records it in British biological purification plants.

Polyarthra vulgaris Carlin (Plate 2/14) is a permanent inhabitant of all types of fresh-waters, with maximum occurrence in summer. In winter the body and appendages are longest. Before Carlin (1943) it was lumped under the collective name *P. trigla*. Gilbert & Bogdan (1981) found in experiments that it prefers flagellates to algae as food. Sládeček *et al.* (1958) observed it in the accumulation pond near Vinoř from the beginning of May till September. Maximum was 3 400 up to 5 100 ind. l^{-1} in surfce water layers (centrifugation method). Parallel samples filtered through phosphorbronze with meshes 80–90 × 80–90 μm contained only 616 ind. l^{-1}. The species was observed in lesser numbers in the stabilization pond of the sewage plant at Pelhřimov (Sládeček & Vošahlík 1979).

Proales daphnicola Thompson lives on the surface of *Daphnia* spp. and feeds on periphytic algae adhering there. Dvořáková (in litt.) found it on *Daphnia pulex* in the purification plant of the penicillin factory in Roztoky in October and November. Its presence in other stabilization ponds appears likely.

Proales decipiens (Ehrenberg) appears in the vegetation and in sphagnum. Godenau (1966) found it in activated sludge in Rumania, Doohan (1975) in Great Britain and Klimowicz (1972, 1973, 1977) in Poland. It was rare with a maximum 2 ind. ml^{-1} in April and May. Individuals were smaller than in the littoral, only 120–170 μm in length (in clean waters 175–200 μm).

Proales fallaciosa Wulfert occupies pools and small fishponds, sometimes in large numbers. It cleans the carapaces of dead cladocera and rotifers and then changes its body shape (swells). It was found in Japanese activated sludge near of Tokyo (Sudzuki 1981).

Ptygura crystallina (Ehrenberg) is a sessile rotifer, found on aquatic plants in the littoral zone. Sládečková & Sládeček (1963) detected it on glass slides submerged in the reservoir Sedlice in October, while this reservoir was polluted by starch wastes up to alpha-mesosaprobity. We can presume its occurrence in stabilization ponds.

Ptygura melicerta Ehrenberg occurs on aquatic plants in lakes and ponds from May to August. Sládečková & Sládeček (1963) found it on glass slides submerged in December into the polluted reservoir Sedlice (Bohemia).

Rotaria citrina (Ehrenberg) is very common from April to October in ponds, pools and springs among aquatic vegetation. Sometimes it can be found also in plankton. From activated sludge it was recorded by Godeanu (1966), Doohan (1975) and Klimowicz (1977), rarely, at poor efficiencies of purification plants (more than 30 mg l^{-1} BOD_5 in the effluent).

Rotaria haptica (Hudson & Gosse) inhabits sphagnum. In Japan it was found in activated sludge (Sudzuki 1981).

Rotaria neptunia (Ehrenberg) (Plate 3/9) dwells among littoral vegetation, among detritus and mud on the bottom of pools and polluted ponds. It sometimes occurs in sphagnum, in Hepaticae and in the psammon. Buck (1971) classified it as $S_i = 2.51 \pm 0.24$. Sládeček & Vošahlík (1979) found it in the stabilization pond in Pelhřimov and Sudzuki (1981) in activated sludge in Japan. This species can be easily identified, even in the contracted state, in contrast to other Bdelloidea.

Rotaria neptunoida Harring (Plate 3/10) can be found in fishponds, small water bodies and in sphagnum under alpha-mesosaprobic and polysaprobic conditions (Bartoš 1959). Its presence in stabilization ponds is very probable, but it may be misidentified as *Rotaria neptunia*.

Rotaria rotatoria (Pallas) (Plate 3/8) is one of the most common cosmopolitan ubiquists. It occurs in lakes, ponds, pools, wetlands, epizootically on the surface of aquatic insects, in village ponds where it is found in greater numbers than the other rotifers, sometimes in sphagnum, in Hepaticae, psammon and even in plankton. Its ecological and saprobic valences are broad. Buck (1971) classified it as $S_i = 3.0 \pm 0.81$. Sládeček *et al.* (1958) found it in small numbers in an accumulation pond treating beet-sugar wastes, Cooke (1959) in biofilters, Sládeček & Vošahlík (1979) in stabilization pond for sewage of the town of Pelhřimov, Godeanu (1966), Doohan (1975) and Klimowicz (1972, 1973, 1977) in activated sludge in moderate numbers at a good functioning and in small numbers at a bad functioning.

Rotaria tardigrada (Ehrenberg) dwells among aquatic weeds in lakes, fishponds, pools, sphagnum and in constantly wet mosses in the inundation area of rivers. Buck (1971) classified it $S_i = 2.70 \pm 0.28$. Sládeček *et al.* (1958) found it in April in an accumulation pond for treating beet-sugar wastes, Godeanu (1966), Doohan (1975) and Klimowicz (1972, 1977) in activated sludge. Here is occurred rarely at BOD_5 values 20–30 mg l^{-1} in the effluent.

Rotaria tridens Montet is a littoral but fairly rare species dwelling among aquatic vegetation (Voigt 1957; Bartoš 1959; Rudescu 1960). In Japanese activated sludge plants it was detected by Sudzuki (1981).

Rotaria trisecata (Weber) lives on the bottom of pools and ponds among detritus and vegetation. It moves very slowly. Godeanu (1966), Doohan (1975) and Klimowicz (1977) identified it in activated sludge at medium and low performances (20–30 and more mg l^{-1} BOD_5 in the outlet).

Stephanoceros fimbriatus (Goldfuss) is an interesting sessile species on different aquatic plants (often on *Nuphar*), found year round in rivers, back-waters, fishponds, lakes and wetlands. It is cosmopolitan. Sládečková & Sládeček (1963) detected it on glass slides exposed in the reservoir Sedlice (Bohemia) in November, while it was polluted to the alpha-mesosaprobical degree by starch wastes. An occurrence in stabilization ponds is very probable.

Rotifers as indicators of trophic conditions

Trophic conditions are related to saprobic ones (Kolkwitz 1935; Sládeček 1978) sometimes directly, but sometimes there are discrepancies. Generally, all rotifers listed in Table 1 as xenosaprobic and oligosaprobic can be considered as oligotrophic, on the other hand all species listed as beta-mesosaprobic and alpha-mesosaprobic are indicators of eutrophic conditions.

Because the genus *Brachionus* is connected with eutrophic waters (except *B. sericus* which is typically acidophilic and *B. plicatilis* from brackish waters) and the genus *Trichocerca* is nearly purely oligotrophic, we can establish a *Brachionus:Trichocerca* quotient $Q_{B/T}$:

$$Q_{B/T} = \frac{\text{Number of species of } \textit{Brachionus}}{\text{Number of species of } \textit{Trichocerca}}.$$

This quotient can be established for individual water bodies of standing or slowly-flowing character or even for individual samples, if representatives of at least one of these genera are present. It is an analogon of the 5 phytoplankton quotients proposed by Thunmark (1945) and Nygaard (1949) and often applied in limnology (see Höhne & Klose 1966; Breitig & Tümpling 1982 a.o.).

Values of $Q_{B/T}$ less than 1.0 mean oligotrophy, values between 1.0 and 2.0 mesotrophy, and values over 2.0 eutrophy, in agreement with the phytoplankton quotients. Some exemples from Czechoslovakia are given in Table 2. The $Q_{B/T}$ is valid for limnoplankton and littoral plankton, but cannot be used for periphyton, because both genera are lacking there.

Communities of freshwater rotifers analogous to those of Cladocerans and Copepods (see e.g. Šrámek-Hušek 1962) have not yet been described. It is clear that they are very dependent on their food organisms: algae, flagellates and bacteria, as far as the filtrators are concerned.

Rotifers and toxicity

Toxic compounds inhibit, damage and kill all aquatic organisms except spores, cysts and resting stages. Individual degrees and a system of acute toxicity were proposed by Sládeček (1981).

Toxicity is estimated by laboratory toxicity tests (see e.g. Breitig & Tümpling (1982); Sládeček *et al.* (1982), but bioassays using rotifers were not included. They are, however, possible as shown by Erben (1978) or Halbach *et al.* (1981). It is necessary to select species which can be easily cultured in the laboratory in a small volume of water, preferably

Table 2. Quotient $Q_{B/T}$ of some Czechoslovakian standing waters

Locality, year	$Q_{B/T}$	Type of water	Reference
Padrť, 1948–50	4:14 = 0.3	two large oligotrophic fishponds	Sládeček, 1951
Máchovo jezero, 1948	1:4 = 0.25	large fishpond, oligotrophic	Sládeček, 1951
Novozámecký, 1948	2:1 = 2.0	eutrophic fishpond	Sládeček, 1951
Břehyňský, 1948	1:3 = 0.3	oligotrophic pond	Sládeček, 1951
Vrané, 1949	2:0 = 2.0	mesotrophic reservoir on Vltava R.	Sládeček, 1962
Vinoř-Podolánka, 1950	5:1 = 5.0	accumulation pond, since spring fishpond	Sládeček, Cyrus & Borovičková, 1958
Nový Stav, Heřmanský, 1950–51	3:0 = 3.0	two oligohaline fishponds in Silesia	Sládeček, 1955
Sedlice, 1953	2:0 = 2.0	artificial reservoir, mesotrophic	Sládeček, 1959
Husinec, 1957	0:1 = 0.1	artificial reservoir, oligotrophic	Sládeček & Sládečková, 1958
Seč, 1957	1:0 = 1.0	artificial reservoir, mesotrophic	Sládečková & Sládeček, 1960
Pařížov, 1957	1:0 = 1.0	artificial reservoir, oligotrophic	Sládeček, 1960
Hamry, 1957	0:1 = 0.1	artificial reservoir, oligotrophic	Sládeček, 1960
Hamry, 1960	0:1 = 0.1	artificial reservoir, oligotrophic	Sládeček & Sládečková, 1962
Pastviny, 1957	0:0 –	artificial reservoir, oligotrophic	Sládeček, Fiala & Sládečková, 1959
Pelhřimov, 1971–74	5:0 = 5.0	stabilization pond, highly eutrophic	Sládeček & Vošahlík, 1979
Brno, 1967–68	3:0 = 3.0	stabilization pond, highly eutrophic	Borovičková, Effenberger & Sladká, 1970

without sexual reproduction, e.g. Bdelloidea. The organisms must react very clearly and their death must be clearly seen.

Conclusions

Rotifers were considered as indicators of water quality. They are very convenient indicators of saprobity, i.e. of the content of putrescible organic matter as expressed by BOD_5. These relations are shown in Fig. 4. Rotifers as indicators are summarized in Table 1 showing for each taxon its saprobic valence, indicative weight and individual saprobic index. Six hundred and twenty taxa found in Czechoslovakia and vicinity were classified.

Xenosaprobic and oligosaprobic rotifers are considered as indicators of oligotrophic conditions, beta-mesosaprobic and alpha-mesosaprobic as indicators of eutrophy.

The *Brachionus:Trichocerca* quotient $Q_{B/T}$ is proposed and is shown in Table 2 as an analogon of 5 phytoplankton quotients by Thunmark (1945) and Nygaard (1949), distinguishing oligotrophic, mesotrophic and eutrophic conditions.

Rotifers can also be used as test organisms in toxicity tests.

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