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Review

An Updated Compilation of World Soil Ciliates (Protozoa, Ciliophora), with Ecological Notes, New Records, and Descriptions of new Species

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Summary

This review compiles and analyses the taxonomic and biogeographical information available on soil ciliates. Key literature (257 references) is tabulated for each species. Furthermore, about 500 new records are reported from hundreds of samples collected world-wide, and four new species are described from Kenyan soils, including the new genus *Apobryophyllum*; *Metopus ovalis* Kahl, 1927 is redescribed. 643 ciliate species were originally described or reliably recorded from about 1000 soil samples world-wide, 49 (7.6%) of them were later recognized as junior synonyms, and 78 (13.2%) have been poorly described, leaving a total of 516 well-known species. However, the studied samples contained about 700 new species, most of which (about 500) have not yet been described. Thus, the total number of soil ciliates amounts to at least 1000 species. The overwhelming portion of soil ciliates belongs to three systematic assemblages, viz. the hypotrichs (39%), gymnostomatids (26%) and colpodids (13%) if the undescribed species are taken into account. Most soil ciliates feed on bacteria (39%) or are predatory (34%) or omnivorous (20%). Some are strictly mycophagous and highly characteristic for terrestrial habitats; and a few (mainly metopids) are anaerobic. Only about one fourth of the soil ciliate species has been reliably reported from freshwater habitats and from more than three out of five main biogeographical regions, indicating a high specificity of the soil ciliate biota and a limited distribution of at least some species. This is supported by the observation that some very conspicuous species, such as *Krassniggia auxiliaris* and *Bresslauides discoideus*, have so far been found only in Gondwanan, respectively, Laurasian soils.

Key words: Biodiversity; Community structure; Geographic distribution; New species; Soil ciliates; Taxonomy.

Introduction

The last comprehensive review on diversity and ecology of soil ciliates was published in 1987 [73]. It listed almost 300 species and showed that the soil ciliate community is different from freshwater and other ciliate assemblages. Since then many new species and records of soil ciliates have been described. The present review summarises and analyses these and older taxonomic and biogeographical data. Furthermore, about 500 new records are listed from hundreds of samples collected world-wide. During these studies, more than 500 new species, a few of which are described here, were found, confirming a previous estimation that there are at least 1330–2000 species of soil ciliates [96].

Material and Methods

Areas and sampling

About 817 samples were collected and analysed from countries world-wide, including all main biogeographic regions (Tab. 1, Fig. 1). Generally, collections were made from a variety of biotopes covering most principal soil and vegetation types of the respective region. Detailed site descriptions for the new records will be provided in later publications.

The material collected usually included mineral top soil (0–5 cm depth) with fine plant roots, the humic layer, and the deciduous and/or grass litter from the soil surface. Furthermore, many samples contained some terrestrial or arboricolous mosses with adhering soil and/or bark from trees. All these habitats are referred to as "terrestrial", as opposed to freshwater, because they contain, although in varying amounts, true humic and mineral soil [73]. Usually, about 10 small subsamples were taken from an area of about 100 m^2 and mixed to a composite sample. All samples were air-dried for at least one month and then sealed in plastic bags. Such samples can be stored for years without any significant loss of species [73, and unpubl. results].

Sample processing and community analysis

All collections were analysed with the non-flooded Petri dish method as described in [73, 83]. Briefly, this simple method involves placing 10–50 g terrestrial material in a Petri

Table 1. Origin and number of samples investigated.

Biogeographic region	Number of samples investigated
HOLARCTIS	
Austria	about 300 [1,3]
Germany	about 10 [1,3]
Denmark	12 [2]
Finland	10
Iceland	11 [2]
Portugal	2
Italy	2
Greece	10 [2]
Japan	23 [2]
	subtotal 380
PALAEOTROPIS	
Kenya	56 [2]
Tanzania	6
Cameroon	8
Namibia (Etosha Pan)	12
Republic of South Africa	10
	subtotal 92
AUSTRALIS	
Australia and Tasmania	158 [2]
NEOTROPIS	
Costa Rica	33 [2]
Venezuela	16
Brazil	5 [2]
Peru	4
Chile	29
	subtotal 87
ARCHINOTIS	
Continental and maritime Antarctis	about 73 [1]
Gough & Marion Islands	27 [1]
	subtotal 100
Total number of samples investigated	817

[1] Taxonomic and faunistic data almost completely published, e.g. [2, 9, 12–14, 16, 62–65, 69, 70, 73–75, 77, 81, 94, 95, 108, 111, 113, 161, 162, 183, 184, 189].

[2] Taxonomic and faunistic data partially published, e.g. [8, 11, 20, 21, 49, 71, 72, 73, 75, 78, 87, 93, 97]. Note, however, that almost all colpodids from all samples investigated so far have been published [84– 86, 89, 90, 93].

[3] Many sites were investigated several times during a period of 1–3 years; all samples from the other countries are from different sites. Details of these sites will be provided in later papers.

dish (10–15 cm in diameter) and saturating but not flooding it with distilled water. Such cultures were analysed for ciliates by inspecting about 2 ml of the run-off on days 2, 7, 14, 21, and 28. The non-flooded Petri dish method is selective, that is probably only a small proportion of the resting cysts present in a sample is reactivated, and undescribed species or species with specialized demands are very likely undersampled [96]. Thus, the real number of species, described and undescribed, in the samples investigated is probably much higher. Unfortunately, a better method for broad analysis of soil ciliates is not known.

Identification of species and species concept

Identification of species was according to the literature cited in this paper. Most of the species found were either new or described or redescribed by my students and myself. Thus, identification was mainly of live specimens using a high-power oil immersion objective and differential interference contrast. However, all "difficult", new or supposedly new, species were treated with the silver staining techniques described in [82]. Usually, these methods yield permanent slides which have been or will be deposited in the Oberösterreichische Landesmuseum in Linz (LI).

The species concept, of course, influences the number of species found and/or recognised as "undescribed". I usually apply the morphospecies concept which is, according to Finlay et al. [55], as valid as any, and probably more pragmatic than any other. I do not consider myself a splitter, that is I classify new species as such only when populations can be separated from their nearest relatives by at least one distinct (non-morphometric) morphological character. For examples, see papers cited and species described in this review.

Species descriptions

The species described were found in soils from Kenya, equatorial Africa. The soils of this region contain a very rich ciliate community. 507 species were found in 92 samples, 240 of them were undescribed [96].

Protospathidium terricola: Grassland soil (0–3 cm) from Mt. Kenya near the lodge "The Ark", about 2300 m above sea level. Soil reddish, humic, pH 6.4. Collected on 1. 7. 1985, investigated on 25. 7. 1986.

Apobryophyllum terricola and *Tachysoma humicola longisetum*: Litter, humus, and mineral soil from a small plant island within young (some hundred years) lava masses of the Shetani vulcano, a black and almost bare, fascinating area in the Tsavo National Park. Soil brownish, pH 7.6. Collected on 8. 7. 1985, investigated on 1. 4. 1986.

Metopus ovalis and *Keronopsis dieckmanni*: Grassland soil from shore of Lake Baringo, one of the highly saline, outstanding Flamingo lakes in Kenya. Soil brownish, humic and saline (salt crystals were formed when a drop of the soil water evaporated on the slide), pH 7.3. Collected on 2. 7.1985, investigated in October 1985.

Methods follow those used in my previous papers [e.g. 82, 84, 95]. Two or three type slides (1 holotype and 1 to 2 paratypes) each of the new species described and two voucher slides of the species redescribed have been deposited in the Oberösterreichische Landesmuseum in Linz (LI), Austria. The slides usually contain many protargol-impregnated cells, with relevant specimens marked by a black ink circle on the cover glass.

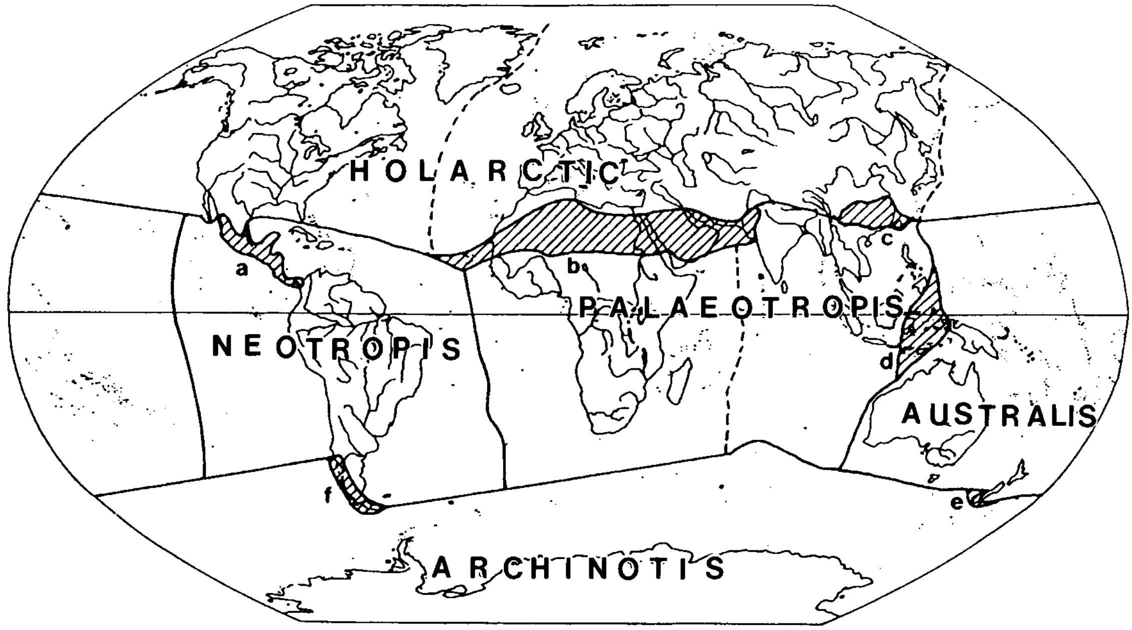


Fig. 1. Biogeographic regions according to [174]. Hatched areas are transition zones.

Results and Discussion

The data are summarized in Tables 2–4, as in my previous review [73]. The present compilation is more complete, considers extensively the older literature, and includes many new records from soils world-wide (Tab. 2). Furthermore, the quality of species descriptions was analysed and detailed taxonomic literature compiled for each species (Tab. 3).

The new compilation largely confirms and strengthens the conclusions from my previous review [73], for instance, that soil ciliates are on average smaller and more slender than freshwater ciliates (Tab. 4). I believe that these are adaptations to the film-like distribution of the water and the narrowness of the habitat, that is the soil pores. Thus, the following sections concentrate on aspects which could not be successfully treated in 1987 [73] due to the limited data available, for instance, concerning geographic distribution.

A special note is necessary on my unpublished taxonomic material which is occasionally referred to. It amounts to about 500 new species, including many new genera and some new families. These species, the full description of which will require years of work, were found in the samples listed in Table 1 and in about 150 other samples not included in this review because the data have not been sufficiently checked.

Uniqueness of the soil ciliate biota

Only 25% (16% if the undescribed species are included) of the described species have been reliably recorded from both soil and freshwater habitats (Tab. 4). Thus, there would appear to be a high proportion of species which occur only or mainly in terrestrial environments and very likely evolved in such habitats [73]. The most characteristic soil ciliates are colpodids, but many autochthonous genera and species occur also among hypotrichs (e.g., *Circinella* spp., *Hemisincirra* spp., *Erniella filiformis*, *Terricirra* spp.) and gymnostomatids (e.g., *Coriplites terricola*, *Pleuroplitoides smithi*, *Spathidium* spp., *Epispathidium* spp.).

Community structure

Most soil ciliates belong to three systematic assemblages (Tab. 4), that is hypotrichs (36%), colpodids (22%) and gymnostomatids (17%). However, these proportions change considerably if the as yet undescribed species mentioned above are included (Tab. 4): 39% hypotrichs, 26% gymnostomatids, 13% colpodids. The dominance of colpodids in the published material is caused by the fact that nearly all new species found have been described [84–86, 89, 90, 93; Tab. 4]. However, even if the lower, more realistic figure (13%) is taken, the diversity of colpodids is much higher in soil than in freshwater (13% vs. 5% [73]). The reason for the high diversity of colpodids in terrestrial environments is not well understood. Possibly, their ability to evolve diverse feeding strategies (bacterivory, fungivory, omnivory, predatoriness) and body sizes (10–1000 µm) favoured colonization of and adaptive radiation in such habitats, as indicated by the high proportion of autochthonous species [84, 92]. The overwhelming diversity of hypotrichs is more easily explained. All are ciliated only on the ventral (oral) surface and most are very slender and/or strongly flattened. Such organisation is pre-adaptive in terrestrial habitats, where water is frequently available only as a thin film covering soil particles and pores. The same structural organisation is found in cyrtophorid ciliates, a conspicuous and diverse group in the Aufwuchs (periphyton) of freshwaters [114]. Their low diversity (2.2%) in soils is possibly related to food: most cyrtophorids prefer diatoms which are, compared to freshwaters, rare in soil. The considerable number of gymnostomatids, most of which are rapacious carnivores, indicates that the soil ciliate community is well-structured.

The compilation contains also some planktonic (e.g., *Linostoma vorticella*, *Hastatella radians*) and anaerobic (*Metopus* spp., *Brachonella* spp.) species (Tab. 2). These were mainly found in soils from swamps and/or floodplains. Most were recorded in few samples only, except for some *Metopus* species, which are rather common and excellent indicators of anaerobic conditions [115].

The number of ciliate species living in soil

Table 2 lists 643 species found in 817 samples analysed by my group (Tab. 1) and in an unknown number of collections investigated by others, especially Greeff [135], Penard [177–179], Kahl [152–157], Gellért [126–130], Buitkamp [26–28], and Hemberger [138]. Supposing that these authors probably studied about 200 samples, the compilation would be based on roughly 1000 collections.

Of the 643 ciliate species originally described or reliably recorded from terrestrial habitats, 49 (7.6%) were later recognized as junior, subjective synonyms, and 78 (13.2%) have been poorly described (Tab. 2–4), leaving a total of 516 well-known species. If we add 500 new, not yet described species mentioned above, we obtain roughly 1000 species of soil ciliates, that is about half the number recently estimated to be present by a probability calculation [96]. The synonymy rate is low (7.6%) as compared, for instance, to insects, where rates between 20–50% have been reported [121, 122, 168], and to ciliates in general, for which Finlay et al. [55] estimated a rate of 20–30%. The low synonymy rate in soil ciliates is very likely caused by the limited number of specialists working in this field, the distinctiveness of the biota, and the fortunate situation that more than half of the species were rather recently and thoroughly described using appropriate techniques like silver impregnation.

Further progress and a distinct rise in species number may be expected when specialists will begin to investigate the epizoic ciliate biota of euterrestrial invertebrates, an almost unexplored field, with a few exceptions, viz. *Pyxidium longicollum* attached to shells of testate amoebae [19] and *P. tardigradum* living on tardigrades [233]. Likewise, ciliates attached to soil particles and moss leaves via a stalk are poorly known because they are usually not found with the non-flooded Petri dish method. Few of the sessile, muscicolous peritrichs and suctoria described by Penard [177, 178] have been rediscovered.

Another rise in the number of species can be expected when the large floodplains of the world are explored for soil ciliates. Twenty-one new species were found in two samples from the Amazon floodplain near Manaus [97].

Geographic distribution

The high ciliate diversity in terrestrial environments remained unrecognised for a long time because of the lack of an appropriate isolation method (still a great problem [96]) and the view of many ecologists that soil ciliates are common invaders from freshwaters and activated sludge (for reviews, see [73, 91, 92]). Thus, most of the older faunistic and ecological literature is burdened with misidentifications and is almost useless. Accordingly, it has been excluded from this review.

The reliable information on geographic distribution of soil ciliates is compiled in Table 2, and includes about 500 new records mainly from tropical soils in Africa, Australia, Costa Rica, and South America. A rough framework of only five widely recognised biogeographic regions (Holarctic, Palaeotropis, Australis, Neotropis, Archinotis; Fig. 1) has been used because of the very limited data available. Substantial biogeographic information has been extracted mainly from the following studies, most of which concern the Holarctic region: [2, 16, 17, 20, 26, 27, 30, 35, 62, 71–74, 78, 84–86, 93–95, 97, 108, 113, 128, 129, 132, 143, 152, 154, 155, 157, 161, 162, 182, 185, 189, 190, 195, 198, 199, 205, 206, 229, 230, 240].

While ecologists tend to consider protozoa as cosmopolitan [55], taxonomists have argued for a restricted distribution of at least some genera and species [73, 91, 92, 96]. In my experience, many morphological species of soil ciliates are cosmopolitan, depending mainly on appropriate habitats. This is also indicated by the rather limited genetic differentiation found among 15 isolates from three continents of a common soil ciliate, *Colpoda inflata* [24].

The present review cannot provide a definite conclusion on the extent of endemism in soil ciliates because

Table 2. Taxonomic and ecological summary of world soil ciliate fauna[1]. For statistics (number of species, percentage of synonyms, etc.), see Table 4.

Species[2]	Taxonomic group[3]	Biomass of 10^6 indiv. (mg)[4]	Food[5]	Geographic distribution[6] H	P	A	N	Ar	Degree of autochthonism[7]
Acaryophrya collaris (Kahl, 1926) Dingfelder, 1962	GY	113	B,C	+	+	–	–	–	*
Acineria uncinata Tucolesco, 1962	GY	10	C,F	+	+	–	+	+	*
Acineta flava Kellicott, 1885	SU	30	C?	+	–	–	–	–	*
Acropisthium mutabile Perty, 1852	GY	35	C	+	–	+	+	–	*
Actinobolina vorax (Wenrich, 1929) Kahl, 1930	GY	250	C,R	–	+	–	–	–	*
Alinostoma multivacuolatum Alekperov, 1993	CY	700	?	+	–	–	–	–	**
Amphibotrella enigmatica Grandori & Grandori, 1934	?	1750	?	+	–	–	–	–	**
Amphisiella binucleata (Hemberger, 1985) Foissner, 1988	HY	96	F?	–	+	–	+	–	**
Amphisiella magnigranulosa Foissner, 1988	HY	90	C,G,H	+	+	+	+	–	**
Amphisiella polycirrata Berger & Foissner, 1989	HY	120	C,F	–	+	–	+	–	**
Amphisiella quadrinucleata Berger & Foissner, 1989	HY	70	C	+	–	–	–	–	**
Amphisiella raptans Buitkamp & Wilbert, 1974	HY	1280	C,N	+	–	–	–	–	***
Amphisiella terricola Gellért, 1955	HY	100	C	+	+	+	+	–	***
Amphisiella vitiphila (Foissner, 1987) Foissner, 1988	HY	92	C,F	–	+	–	+	–	**
Amphisiellides atypicus (Hemberger, 1985) Foissner, 1988	HY	184	?	–	–	–	+	–	**
Amphisiellides illuvialis Eigner & Foissner, 1994	HY	38	B,C	+	–	–	–	–	*
Apoamphisiella tihanyiensis (Gellért & Tamás, 1958) Foissner, 1997	HY	300	C,E,F,H,N, R,T	–	–	–	+	–	*
Apobryophyllum terricola Foissner (this paper)	GY	30	C?	–	+	–	–	–	***
Apocolpoda africana Foissner, 1993	CO	16	B	–	+	–	–	–	***
Archinassula muscicola Kahl, 1935	NA?	77	B	+	–	–	–	–	**
Arcuospathidium atypicum (Wenzel, 1953) nov. comb.	GY	20	C,H	+	+	+	+	–	**
Arcuospathidium australe Foissner, 1988, synonym with *A. atypicum*									
Arcuospathidium cooperi Foissner, 1996	GY	38	C?	–	–	–	–	+	**
Arcuospathidium cultriforme (Penard, 1922) Foissner, 1984	GY	180	C	+	+	+	+	–	***
Arcuospathidium japonicum Foissner, 1988	GY	23	C	+	–	–	+	–	**
Arcuospathidium lionotiforme (Kahl, 1930) Foissner, 1984	GY	400	C	+	+	+	+	–	***
Arcuospathidium muscorum (Dragesco & Dragesco-Kernéis, 1979) Foissner, 1984	GY	87	C,H	+	+	+	+	–	**
Arcuospathidium vermiforme Foissner, 1984	GY	28	C?	+	+	–	–	–	***
Aspidisca cicada (Müller, 1786) Claparède & Lachmann, 1858	HY	5	B	+	–	–	–	–	*
Aspidisca lynceus (Müller, 1773) Ehrenberg, 1830	HY	6	B	+	–	+	–	–	*
Australocirrus octonucleatus Foissner, 1988	HY	720	B,C,F,G,H	+	+	+	+	–	**
Australocirrus oscitans Blatterer & Foissner, 1988	HY	990	C,F,G,H,T	+	+	+	+	–	***
Australothrix alwinae Blatterer & Foissner, 1988	HY	1200	B,C,F,H,R,T	–	–	+	–	–	**
Australothrix australis Blatterer & Foissner, 1988	HY	1120	C,F,H,R,S,T	–	–	+	–	–	**
Australothrix simplex Shen, Liu, Song & Gu, 1992	HY	270	?	+	–	–	–	–	**
Australothrix steineri Foissner, 1995	HY	81	B,F,H	–	–	+	+	–	***
Avestina acuta (Buitkamp, 1977) Jankowski, 1980	CO	4	B	+	+	–	–	–	**
Avestina ludwigi Aescht & Foissner, 1990	CO	5	H	+	–	+	+	–	***
Bakuella edaphoni Song, Wilbert & Berger, 1992	HY	600	B,C,D,F,T	+	–	–	–	–	**
Bakuella pampinaria Eigner & Foissner, 1992	HY	80	C,F,H	+	–	–	–	–	**
Balantidioides bivacuolata Kahl, 1932	HE	280	C	+	–	–	–	–	***
Balantidioides corbifera (Fryd-Versavel & Tuffrau, 1978)									***
Foissner, Adam & Foissner, 1982	HE	360	C,G	+	–	–	–	–	**
Balantidioides dragescoi Foissner, Adam & Foissner, 1982	HE	135	C	+	+	+	–	–	***
Balantidioides muscicola (Penard, 1922) Penard, 1930 in Kahl (1930)	HE	120	R	+	–	–	–	–	***
Bardeliella pulchra Foissner, 1984	CO	8	B	+	+	–	–	–	***
Bicoronella costaricana Foissner, 1995	HY	260	C,E,H,T	–	–	–	+	–	**
Birojimia muscorum (Kahl, 1932) Berger & Foissner, 1989	HY	100	C,F,H,S	+	+	+	+	+	**
Birojimia terricola Berger & Foissner, 1989	HY	140	C,F,H	+	–	–	–	–	**
Blepharisma americanum Suzuki, 1954	HE	640	B,C,F	–	–	–	+	–	*
Blepharisma biancae Lepsi, 1948	HE	10	?	+	–	–	–	–	**

Table 2. continued.

Species[2]	Taxonomic group[3]	Biomass of 10^6 indiv. (mg)[4]	Food[5]	Geographic distribution[6] H	P	A	N	Ar	Degree of autochthonism[7]
Blepharisma bimicronucleatum Villeneuve–Brachon, 1940	HE	42	B	+	+	+	+	+	*
Blepharisma hyalinum Perty, 1849	HE	11	B,H	+	+	+	+	+	*
Blepharisma ichthyoides Gelei, 1939, synonym with *B. lateritium*									
Blepharisma lateritium (Ehrenberg, 1831) Kahl, 1932	HE	525	B,G	+	–	–	–	–	*
Blepharisma ovatum (Stokes, 1884) Penard, 1922	HE	750	C,D,G	–	+	–	–	–	*
Blepharisma steini Kahl, 1932	HE	69	B	+	+	+	+	+	*
Blepharisma undulans Stein, 1867	HE	225	B	+	+	+	–	–	*
Brachonella cydonia (Kahl, 1927) Jankowski, 1964	HE	113	B	–	–	–	+	–	*
Bresslaua insidiatrix Claff, Dewey & Kidder, 1941	CO	192	C,F	+	+	–	–	–	**
Bresslaua sicaria Claff, Dewey & Kidder, 1941	CO	200	C,H	+	–	–	+	–	**
Bresslaua vorax Kahl, 1931	CO	113	B,C,F,G,H	+	+	+	+	–	**
Bresslauides australis Blatterer & Foissner, 1988	CO	320	B,C,F,G,H,N	–	–	+	–	–	***
Bresslauides discoideus (Kahl, 1931) Foissner, 1993	CO	9000	C,E,R	+	–	–	–	–	***
Bresslauides terricola (Foissner, 1987) Foissner, 1993	CO	2200	C,H	+	+	+	+	–	***
Bryometopus alekperovi nov. comb., nov. nom.[10]	CO	3200	?	+	–	–	–	–	**
Bryometopus atypicus Foissner, 1980	CO	45	B,F,G	+	+	+	+	–	*
Bryometopus balantidioides Foissner, 1993	CO	30	B	–	–	+	–	–	**
Bryometopus edaphonus Foissner, 1980	CO	24	B?	+	–	–	–	–	**
Bryometopus hawaiiensis Foissner, 1994	CO	30	B,F,G,S	+	–	+	–	–	*
Bryometopus pseudochilodon Kahl, 1932	CO	22	B,G	+	+	+	+	+	**
Bryometopus sphagni (Penard, 1922) Kahl, 1932	CO	198	B,C,D,G	+	+	+	–	+	*
Bryometopus triquetrus Foissner, 1993	CO	10	B,E,F	+	+	+	+	–	**
Bryophrya bavariensis (Kahl, 1931) Wenzel, 1953	CO	85	E	+	–	–	–	–	***
Bryophrya rubescens (Penard, 1922) Foissner, 1993	CO	150	E	+	–	–	–	–	**
Bryophyllum loxophylliforme Kahl, 1931	GY	252	C,E,H,R	+	+	+	+	+	**
Bryophyllum tegularum Kahl, 1931	GY	100	C,R	+	–	+	–	–	**
Buitkampia angusta Foissner, 1985, synonym with *Platyophrya vorax*									
Bursaria truncatella Müller, 1773	CO	50000	C,D,F,G,R,T	+	+	+	+	–	*
Chaenea clavata Grandori & Grandori, 1934	GY	50	?	+	–	–	–	–	**
Chaenea humicola Gellért, 1957	GY	4	?	+	–	–	–	–	**
Chilodon geographicus Penard, 1922, synonym with *Odontochlamys gouraudi*									
Chilodonella aplanata Kahl, 1931	CY	10	?	+	–	–	–	–	*
Chilodonella pigra Lepsi, 1951	CY	?	?	+	–	–	–	–	**
Chilodonella uncinata (Ehrenberg, 1838) Strand, 1928	CY	13	B	+	+	+	+	–	*
Chilodonella uncinata (Ehrenberg) in Gellért [126], synonym with *Pseudochilodonopsis mutabilis*									
Chilodontopsis muscorum Kahl, 1931	NA	15	?	+	+	–	–	–	***
Chilophrya terricola Foissner, 1984	PR	9	C?	+	–	–	–	–	**
Chlamydonella alpestris Foissner, 1979	CY	4	B,D	+	–	–	–	–	*
Cinetochilum margaritaceum (Ehrenberg, 1830) Perty, 1852	HM	10	B,D,G	+	+	+	+	–	*
Cinetochilum marinum Pomp & Wilbert, 1988	HM	5	B	–	–	+	–	–	**
Circinella arenicola Foissner, 1994	HY	120	B	+	–	–	–	–	***
Circinella filiformis (Foissner, 1982) Foissner, 1994	HY	5	?	+	+	+	–	–	***
Circinella vettersi (Berger & Foissner, 1989) Foissner, 1994	HY	23	?	+	+	–	+	–	***
Cirrophrya australis Foissner, 1993	CO	20	?	–	–	+	–	–	***
Cirrophrya haptica Gellért, 1950	CO	25	B,G	+	–	–	–	–	***
Cirrophrya terricola Foissner, 1987	CO	20	C	+	–	–	–	–	***
Cladotricha australis Blatterer & Foissner, 1988	HY	20	B,H	–	–	+	–	–	**
Colpoda aspera Kahl, 1926	CO	6	B	+	+	+	+	+	**
Colpoda atra Alekperov, 1993	CO	1600	B,F	+	–	–	–	–	**
Colpoda augustini Foissner, 1987	CO	20	B	+	+	+	+	–	***
Colpoda bifurcata Alekperov, 1993, synonym with *C. lucida*									
Colpoda californica Kahl, 1931	CO	5	?	+	–	–	+	–	**
Colpoda cavicola Kahl, 1935	CO	240	B,G,H	+	–	–	+	–	**
Colpoda colpidiopsis Kahl, 1931	CO	12	B,F	+	+	–	–	–	*
Colpoda cucullus (Müller, 1773) Gmelin, 1790	CO	74	B,F,G	+	+	+	+	+	*

Table 2. continued.

Species[2)]	Taxonomic group[3)]	Biomass of 10^6 indiv. (mg)[4)]	Food[5)]	Geographic distribution[6)] H	P	A	N	Ar	Degree of autochthonism[7)]
Colpoda duodenaria Taylor & Furgason, 1938, synonym with *C. steinii*									
Colpoda ecaudata (Liebmann, 1936) Foissner, Blatterer, Berger & Kohmann, 1991	CO	9	B	+	+	+	+	+	*
Colpoda edaphoni Foissner, 1980	CO	10	B	+	+	+	+	–	***
Colpoda elliotti Bradbury & Outka, 1967	CO	5	B	+	+	+	+	–	**
Colpoda eurystoma Gellért, 1950, synonym with *Kalometopia duplicata*									
Colpoda fastigata Kahl, 1931, synonym with *C. maupasi*									
Colpoda flavicans (Stokes, 1885) Foissner, 1993	CO	80	B,E	+	+	+	+	–	*
Colpoda henneguyi Fabre-Domergue, 1889	CO	122	B,H	+	+	+	+	+	**
Colpoda inflata (Stokes, 1884) Kahl, 1931	CO	40	B,F	+	+	+	+	+	*
Colpoda irregularis Kahl, 1931	CO	72	?	+	+	–	–	–	*
Colpoda lucida Greeff, 1888	CO	230	B	+	+	+	+	+	**
Colpoda magna (Gruber, 1879) Lynn, 1978	CO	1400	B,C,F,G	+	+	+	+	–	*
Colpoda maupasi Enriques, 1908	CO	39	B	+	+	+	+	+	**
Colpoda minima (Alekperov, 1985) Foissner, 1993	CO	420	B	+	+	+	+	–	*
Colpoda orientalis Foissner, 1993	CO	300	B	+	+	–	+	–	**
Colpoda praestans Penard, 1922	CO	750	B,E,H	+	–	–	+	–	**
Colpoda reniformis Kahl, 1931	CO	180	E?	+	–	–	–	–	**
Colpoda simulans Kahl, 1931	CO	70	?	+	–	–	–	–	**
Colpoda spiralis Novotny, Lynn & Evans, 1977, synonym with *C. cavicola*									
Colpoda steinii Maupas, 1883	CO	5	B,E,G,H	+	+	+	+	+	*
Colpoda tripartita Kahl, 1931	CO	240	B	+	+	+	+	–	***
Colpoda variabilis Foissner, 1980	CO	300	B,G	+	+	–	+	+	*
Colpodidium caudatum Wilbert, 1982	NA	30	B	+	+	+	+	–	***
Colpodidium viridis (Mirabdullaev, 1986) Jankowski, 1992	NA	80	?	–	+	–	+	–	*
Condylostoma terricola Foissner, 1995	HE	70	C,F,H,S	–	–	–	+	–	**
Corallocolpoda grelli (Foissner, 1993) Foissner, 1993	CO	20	C,H	–	–	+	–	–	***
Corallocolpoda pacifica Alekperov, 1991	CO	280	C	–	+	+	+	–	***
Coriplites terricola Foissner, 1988	GY	7	C,F	+	+	+	+	–	**
Corticocolpoda kaneshiroae Foissner, 1993	CO	1050	C	–	–	+	–	–	***
Cosmocolpoda naschbergeri Foissner, 1993	CO	75	B	–	–	–	+	–	***
Cothurnia minutissima (Penard, 1914) Kahl, 1935	PE	15	B	+	–	–	–	–	**
Cothurnia regalis Penard, 1914, synonym with *Thuricola innixa*									
Cothurnia richtersi (Penard, 1914) Kahl, 1935	PE	12	B	+	–	–	–	+	**
Cothurniopsis elastica Penard, 1914, synonym with *C. valvata*									
Cothurniopsis valvata Stokes, 1893	PE	8	B	+	–	–	–	–	*
Cyclidium glaucoma Müller, 1773	HM	2	B,G	+	+	–	+	+	*
Cyclidium muscicola Kahl, 1931	HM	1	B	+	+	+	+	+	**
Cyclidium opisthostoma Grandori & Grandori, 1934, synonym with *Homalogastra setosa*									
Cyclidium terricola Kahl, 1931	HM	3	B	+	+	+	–	–	**
Cyrtohymena australis Foissner, 1995	HY	1330	C,H,T	–	–	+	+	–	**
Cyrtohymena balladynula (Kahl, 1932) Foissner, 1989	HY	4	?	+	–	–	–	–	**
Cyrtohymena candens (Kahl, 1932) Foissner, 1989	HY	150	B,C,F,N	+	+	+	+	+	**
Cyrtohymena candens depressa (Gellért, 1942) Foissner, 1989	HY	120	B,D,F	+	+	+	+	–	**
Cyrtohymena citrina (Berger & Foissner, 1987) Foissner, 1989	HY	54	C,D,H,T	+	+	+	+	–	**
Cyrtohymena dubia (Gellért, 1956) nov. comb., synonym with *C. muscorum*									
Cyrtohymena gracilis (Kahl, 1932) Foissner, 1989	HY	60	?	+	–	–	–	–	**
Cyrtohymena granulata (Kahl, 1932) Foissner, 1989	HY	40	?	+	–	–	–	–	**
Cyrtohymena muscorum (Kahl, 1932) Foissner, 1989	HY	225	C,D,F,H,T	+	+	–	–	–	***
Cyrtohymena primicirrata (Berger & Foissner, 1987) nov. comb.	HY	77	C,D,F,H	+	+	+	+	–	**
Cyrtohymena quadrinucleata (Dragesco & Njiné, 1971) Foissner, 1989	HY	81	C	+	+	+	+	+	*
Cyrtohymena tetracirrata (Gellért, 1942) Foissner, 1989	HY	150	B,C,F	+	+	+	–	–	***
Cyrtolophosis acuta Kahl, 1926	CO	1	B	+	+	+	–	+	*

Table 2. continued.

Species[2]	Taxonomic group[3]	Biomass of 10^6 indiv. (mg)[4]	Food[5]	Geographic distribution[6] H	P	A	N	Ar	Degree of autochthonism[7]
Cyrtolophosis colpidiformis Foissner, 1993	CO	7	B	+	–	–	–	–	**
Cyrtolophosis elongata (Schewiakoff, 1892) Kahl, 1931	CO	1	B	+	+	+	+	+	*
Cyrtolophosis minor Vuxanovici, 1963	CO	1	B	–	–	+	+	–	*
Cyrtolophosis mucicola Stokes, 1885	CO	2	B	+	+	+	+	+	*
Dapedophrya flexilis (Penard, 1922) Foissner, 1995	CO	36	B,H	+	–	–	+	–	***
Deviata bacilliformis (Gelei, 1954) Eigner, 1995	HY	47	B,G	+	+	+	–	–	*
Didinium nasutum (Müller, 1773) Stein, 1859	GY	500	C,G	+	+	–	–	–	*
Dileptus alpinus Kahl, 1931[11]	GY	23	C	+	+	+	+	+	**
Dileptus americanus Kahl, 1931[11]	GY	63	C,F	+	+	+	–	–	**
Dileptus anguillula Kahl, 1931[11]	GY	15	C	+	+	+	+	–	**
Dileptus binucleatus Kahl, 1931[11]	GY	158	C	+	–	–	–	–	**
Dileptus breviproboscis Foissner, 1981, synonym with *D. anguillula*									
Dileptus conspicuus Kahl, 1931[11]	GY	168	C,D,F	+	–	+	–	–	***
Dileptus conspicuus telobivacuolatus Gellért, 1955[11]	GY	81	C	+	–	–	–	–	***
Dileptus costaricanus Foissner, 1995[11]	GY	198	C	–	–	–	+	–	**
Dileptus edaphoni Song, 1994[11]	GY	82	C	+	–	–	–	–	**
Dileptus falciformis Kahl, 1931[11]	GY	247	C	+	–	–	–	–	**
Dileptus gracilis Kahl, 1931[11]	GY	43	C	+	+	+	–	–	**
Dileptus kahli Srámek-Hušek, 1957[8][11]	GY	180	C	+	–	–	–	–	*
Dileptus margaritifer (Ehrenberg, 1838) Wirnsberger, Foissner & Adam, 1984[11]	GY	500	C,F,G,N,R	+	+	–	–	–	*
Dileptus mucronatus Penard, 1922[11]	GY	456	C	+	+	+	–	–	*
Dileptus orientalis Song, Packroff & Wilbert, 1988[11]	GY	31	B	+	–	–	–	–	**
Dileptus polyvacuolatus Foissner, 1989[11]	GY	212	C	+	+	–	+	–	*
Dileptus similis Foissner, 1995[11]	GY	314	C	–	–	–	+	–	**
Dileptus tenuis Penard, 1922[11]	GY	7	C	+	–	–	–	–	**
Dileptus terrenus Foissner, 1981[11]	GY	226	C	+	+	–	+	–	**
Dileptus visscheri Dragesco, 1963[11]	GY	64	C	+	–	+	–	–	*
Dimacrocaryon amphileptoides (Kahl, 1931) Jankowski, 1967	GY	127	G,H,T	+	+	+	+	+	**
Drepanomonas borzai Lepsi, 1948, synonym with *D. revoluta*									
Drepanomonas dentata Fresenius, 1858	NA	5	B	–	–	–	+	–	*
Drepanomonas exigua Penard, 1922	NA	1	B	+	–	–	+	–	***
Drepanomonas muscicola Foissner, 1987	NA	1	B	+	+	+	+	+	**
Drepanomonas pauciciliata Foissner, 1987	NA	1	B	+	+	+	+	+	**
Drepanomonas revoluta Penard, 1922	NA	1	B,F	+	+	+	+	+	*
Drepanomonas sphagni Kahl, 1931	NA	1	B	+	+	+	+	+	**
Enchelydium piliforme (Kahl, 1930) Foissner, 1984	GY	100	C	+	–	–	–	–	*
Enchelydium polynucleatum Foissner, 1984	GY	255	C	+	+	+	+	+	**
Enchelydium terrenum Foissner, 1984	GY	57	C	+	–	+	+	–	**
Enchelyodon californicus Kahl, 1935	GY	110	C?	+	–	–	–	–	**
Enchelyodon lagenula (Kahl, 1930) Blatterer & Foissner, 1988	GY	10	C?	+	+	+	+	–	**
Enchelyodon longinucleatus Foissner, 1984	GY	63	C?	+	+	+	+	–	**
Enchelyodon nodosus Berger, Foissner & Adam, 1984	GY	367	C?	+	+	–	–	–	**
Enchelyodon terrenus Foissner, 1984	GY	132	C?	+	+	–	–	–	***
Enchelyodon tratzi Foissner, 1987	GY	23	C?	+	+	–	+	–	**
Enchelyomorpha vermicularis (Smith, 1899) Kahl, 1930	SU	2	C?	+	–	–	–	–	*
Enchelyotricha binucleata Foissner, 1987	GY	16	C	+	–	–	–	–	**
Enchelys agricola Horváth, 1956, synonym with *Platyophrya spumacola*									
Enchelys multimicronucleata Alekperov, 1993	GY	3	?	+	–	–	–	–	**
Enchelys multinucleata (Dragesco & Dragesco-Kernéis, 1979) Berger, Foissner & Adam, 1984	GY	141	C	+	+	+	+	–	**
Enchelys terricola Foissner, 1987	GY	99	C	+	–	–	–	–	**
Enchelys tokkuri Shibuya, 1930	GY	157	?	+	–	–	–	–	**
Enchelys vermiformis Foissner, 1987	GY	50	C?	+	–	–	–	–	***
Engelmanniella mobilis (Engelmann, 1862) Foissner, 1982	HY	34	B	+	+	+	–	–	*

Table 2. continued.

Species[2]	Taxonomic group[3]	Biomass of 10^6 indiv. (mg)[4]	Food[5]	Geographic distribution[6] H	P	A	N	Ar	Degree of autochthonism[7]
Epispathidium amphoriforme (Greeff, 1888) Foissner, 1984	GY	180	C	+	+	+	+	–	**
Epispathidium ascendens (Wenzel, 1955) Foissner, 1987	GY	64	C	+	+	+	+	+	**
Epispathidium papilliferum (Kahl, 1930) Foissner, 1984	GY	135	C	+	–	+	+	–	**
Epispathidium regium Foissner, 1984	GY	360	C	+	+	–	–	–	**
Epispathidium terricola Foissner, 1987	GY	101	C	+	+	+	+	+	**
Epistylis alpestris Foissner, 1978	PE	79	B	+	+	+	+	–	*
Erniella filiformis Foissner, 1987	HY	100	B?,C	–	+	–	–	–	***
Eschaneustyla brachytona Stokes, 1886	HY	146	C,D,G,H	+	+	–	+	–	**
Eschaneustyla terricola Foissner, 1982, synonym with *E. brachytona*									
Euplotes corsica Berger & Foissner, 1989[11]	HY	8	B?	+	–	–	–	–	**
Euplotes finki Foissner, 1982[11]	HY	17	B	+	–	–	+	–	**
Euplotes labiatus Ruinen, 1938[11]	HY	15	B?	+	–	+	–	–	*
Euplotes muscicola Kahl, 1932[11]	HY	49	B,E	+	+	+	+	–	**
Euplotes muscorum Dragesco, 1970, synonym with *E. muscicola*									
Euplotes terricola Penard, 1922[11]	HY	36	B?	+	–	–	–	–	**
Frontonia depressa (Stokes, 1886) Kahl, 1931	HM	95	C,G,H,N	+	+	+	+	+	*
Frontonia parameciiformis Wenzel, 1953	HM	20	?	+	–	–	–	–	**
Frontonia parvula Penard, 1922, synonym with *F. depressa*									
Frontonia solea Foissner, 1987	HM	120	E	–	+	–	–	–	*
Frontonia terricola Foissner, 1987[8]	HM	192	C	+	+	–	–	–	**
Furgasonia trichocystis (Stokes, 1894) Jankowski, 1964	NA	72	B	–	+	–	–	–	*
Fuscheria lacustris Song & Wilbert, 1989	GY	23	C?	+	–	+	–	+	*
Fuscheria nodosa Foissner, 1983	GY	42	C	–	+	+	–	–	*
Fuscheria terricola Berger, Foissner & Adam, 1983	GY	20	C	+	+	–	+	+	***
Gastronauta derouxi Blatterer & Foissner, 1992	CY	48	B?,H?	+	+	–	+	+	***
Gastronauta membranaceus Bütschli, 1889	CY	15	B	+	–	–	–	–	*
Gastrostyla dorsicirrata Foissner, 1982	HY	96	C,H	+	–	–	–	–	**
Gastrostyla minima Hemberger, 1985	HY	195	B,D,G	–	–	–	+	–	*
Gastrostyla muscorum Kahl, 1932	HY	380	C,G	+	–	–	–	–	**
Gastrostyla philippinensis Shibuya, 1931, synonym with *G. steinii*									
Gastrostyla steinii Engelmann, 1862	HY	122	C	+	+	+	+	–	*
Glaucoma gigantea Grandori & Grandori, 1934	HM	420	E	+	–	–	–	–	**
Glaucoma terricola Gellért, 1957, synonym with *Tetrahymena rostrata*									
Gonostomum affine (Stein, 1859) Sterki, 1878	HY	39	B,F,S	+	+	+	+	+	*
Gonostomum algicola Gellért, 1942, synonym with *G. affine*[9]									
Gonostomum andoi Shibuya, 1929, synonym with *G. affine*									
Gonostomum bryonicolum Gellért, 1956, synonym with *G. affine*[9]									
Gonostomum ciliophorum Gellért, 1956, synonym with *G. affine*[9]									
Gonostomum geleii Gellért, 1957, synonym with *G. affine*[9]									
Gonostomum kuehnelti Foissner, 1987	HY	30	B,F	+	+	+	+	+	***
Gonostomum spirotrichoides Gellért, 1956, synonym with *G. affine*[9]									
Gonostomum strenua (Engelmann, 1862) Sterki, 1878	HY	60	B,G	+	–	–	–	–	**
Grandoria aculeata (Grandori & Grandori, 1934) Corliss, 1960	CO	5	?	+	–	–	–	–	**
Grossglockneria acuta Foissner, 1980	CO	5	H	+	+	+	+	+	***
Grossglockneria hyalina Foissner, 1985	CO	4	H	+	+	+	+	–	***
Halteria decemsulcata Szabó, 1934, synonym with *H. grandinella*									
Halteria grandinella (Müller, 1773) Dujardin, 1841	OL	12	B,F,G	+	+	+	+	+	*
Halterioforma caudata Horváth, 1956	PR?	2	B	+	–	–	–	–	**
Haplocaulus terrenus Foissner, 1981	PE	5	B	+	+	+	–	+	**
Hastatella radians Erlanger, 1890	PE	30	B	–	+	–	–	–	*
Hausmanniella discoidea (Gellért, 1956) Foissner, 1984	CO	67	B,C,G,H	+	+	+	+	–	***
Hausmanniella patella (Kahl, 1931) Foissner, 1984	CO	192	C,G	+	+	+	+	–	***
Hausmanniella quinquecirrata (Gellért, 1955) Foissner, 1993	CO	440	G,H	+	–	–	–	–	***
Hemiamphisiella granulifera (Foissner, 1987) Foissner, 1988	HY	52	F,H,N	+	+	+	–	–	**

Table 2. continued.

Species[2)]	Taxonomic group[3)]	Biomass of 10^6 indiv. (mg)[4)]	Food[5)]	Geographic distribution[6)] H	P	A	N	Ar	Degree of autochthonism[7)]
Hemiamphisiella quadrinucleata (Foissner, 1984) Foissner, 1988	HY	42	F,G,H	+	–	–	–	–	**
Hemiamphisiella terricola Foissner, 1988	HY	192	C,D,F,H	+	+	+	+	–	**
Hemiamphisiella wilberti (Foissner, 1982) Foissner, 1988	HY	152	T	+	+	+	–	–	**
Hemisincirra gellerti (Foissner, 1982) Foissner, 1984	HY	10	B	+	+	+	+	+	***
Hemisincirra gracilis (Foissner, 1982) Foissner, 1984	HY	11	B?H	+	+	+	+	–	***
Hemisincirra heterocirrata Hemberger, 1985	HY	26	?	–	–	–	+	–	***
Hemisincirra inquieta Hemberger, 1985	HY	7	B	+	+	+	+	–	***
Hemisincirra interrupta (Foissner, 1982) Foissner, 1984	HY	8	?	+	+	+	–	–	***
Hemisincirra kahli (Buitkamp, 1977) Hemberger, 1985	HY	8	B	+	+	–	–	–	***
Hemisincirra muelleri Foissner, 1986	HY	11	B	+	–	–	–	–	***
Hemisincirra octonucleata Hemberger, 1985	HY	24	?	–	–	–	+	–	***
Hemisincirra polynucleata Foissner, 1984	HY	30	?	+	+	–	–	+	***
Hemisincirra pori (Wilbert & Kahan, 1986) Foissner, 1987	HY	19	B,G	+	–	–	–	–	***
Hemisincirra quadrinucleata Hemberger, 1985	HY	26	?	–	–	–	+	–	***
Hemisincirra similis (Foissner, 1982) Foissner, 1984	HY	32	B?	+	+	+	+	–	***
Hemisincirra vermiculare Hemberger, 1985	HY	24	?	–	–	–	+	–	***
Hemisincirra wenzeli Foissner, 1987	HY	14	B,F	+	–	+	+	–	***
Histriculus similis (Quennerstedt) in Buitkamp [27], synonym with *Sterkiella cavicola*									
Holophrya bimacronucleata Grandori & Grandori, 1934	PR	69	?	+	–	–	–	–	**
Holosticha adami Foissner, 1982	HY	66	C,D,R,S,T	+	–	+	–	–	**
Holosticha australis Blatterer & Foissner, 1988	HY	65	C,T	+	+	+	+	–	**
Holosticha bergeri Foissner, 1987	HY	10	E,F	+	+	+	–	+	***
Holosticha distyla Buitkamp, 1977	HY	136	F,T	–	+	–	–	–	**
Holosticha islandica Berger & Foissner, 1989	HY	30	B,H	+	–	–	–	–	**
Holosticha longiseta Lepsi, 1951	HY	30	?	+	–	–	–	–	**
Holosticha manca mononucleata Gellért, 1955	HY	10	F,H	+	–	–	–	–	**
Holosticha manca plurinucleata Gellért, 1955	HY	26	B,H,S	+	–	–	–	–	**
Holosticha monilata Kahl, 1928	HY	52	B,D,E	+	+	–	–	–	*
Holosticha multistilata Kahl, 1928	HY	109	C,D,E,F,T	+	+	+	+	+	*
Holosticha muscicola Gellért, 1956	HY	60	B,S	+	–	–	–	–	**
Holosticha muscorum (Kahl, 1932) Foissner, 1982	HY	360	C,D,T	+	+	+	+	–	*
Holosticha sigmoidea Foissner, 1982	HY	38	B,H	+	–	+	+	+	**
Holosticha stueberi Foissner, 1987	HY	525	C,F,H,N	+	+	+	–	–	**
Holosticha sylvatica Foissner, 1982	HY	181	C,E,H,S	+	+	+	+	–	***
Holosticha tetracirrata Buitkamp & Wilbert, 1974	HY	39	B,C,D,G,H	+	+	+	+	+	**
Holostichides chardezi Foissner, 1987	HY	63	E,H,S	+	+	+	–	–	**
Holostichides terricola Foissner, 1988	HY	33	B,H,S	+	+	+	+	–	**
Holostichides typicus (Song & Wilbert, 1988) Eigner, 1994	HY	170	?	+	–	–	–	–	**
Holostichides wilberti (Song, 1990) Eigner, 1994	HY	27	B?	+	–	–	–	–	**
Homalogastra setosa Kahl, 1926	HM	1	B	+	+	+	+	+	*
Idiocolpoda pelobia Foissner, 1993	CO	3	B	–	–	+	–	–	**
Ilsiella palustris Foissner, 1993	CO	65	B	+	+	+	–	–	**
Ilsiella venusta Foissner, 1987	CO	20	B	–	+	–	–	–	**
Jaroschia sumptuosa Foissner, 1993	CO	100	C?F?	–	–	+	–	–	***
Kahliella acrobates (Horváth, 1932) Corliss, 1960	HY	?	B,C,G	+	–	–	–	–	**
Kahliella simplex (Horváth, 1934) Corliss, 1960	HY	157	B,D,F,H	+	+	–	–	–	**
Kahlilembus attenuatus (Smith, 1897) Foissner, Berger & Kohmann, 1994	HM	1	B	+	+	+	+	–	*
Kahlilembus fusiformis (Kahl, 1926), synonym with *K. attenuatus*									
Kalometopia duplicata (Penard, 1922) Foissner, 1993	CO	400	C,G,S	+	–	–	–	–	***
Keronella gracilis Wiackowski, 1985	HY	300	C,E,G,H	+	–	–	–	–	**
Keronopsis algivora (Gellért, 1942) nov. comb.	HY	64	G	+	–	–	–	–	**
Keronopsis dieckmanni Foissner (this paper)	HY	300	C,F	–	+	–	–	–	**
Keronopsis helluo Penard, 1922	HY	800	C,R	+	–	–	–	–	**

Table 2. continued.

Species[2]	Taxonomic group[3]	Biomass of 10^6 indiv. (mg)[4]	Food[5]	Geographic distribution[6]					Degree of autochthonism[7]
				H	P	A	N	Ar	
Keronopsis tasmaniensis Blatterer & Foissner, 1988	HY	260	C,H	–	+	+	–	–	**
Keronopsis wetzeli Wenzel, 1953	HY	90	C,G	+	–	–	–	–	**
Keronopsis alpestris Kahl, 1932	HY	96	C,G	+	–	–	–	–	**
Krassniggia auxiliaris Foissner, 1987	CO	880	C	–	+	+	–	–	***
Kreyella muscicola Kahl, 1931	CO	5	?	+	–	–	–	–	**
Kuehneltiella muscicola Foissner, 1993	CO	115	C	+	+	–	+	–	***
Kuehneltiella terricola Foissner, 1990	CO	384	C,F	–	–	+	–	–	***
Kuklikophrya ougandae (Dragesco, 1972) Foissner, 1993	CO	195	E	+	+	–	–	–	*
Lacrymaria cohni Kent in Buitkamp & Wilbert (1974), synonym with *Phialina terricola* Foissner, 1984									
Lacrymaria pulchra Wenzel, 1953	GY	5	?	+	–	–	–	–	**
Lagynophrya armata Kahl, 1935	GY	20	?	+	–	–	–	–	**
Lagynophrya geleii Foissner, 1981	GY	25	C?	+	–	+	–	–	**
Lagynophrya trichocystis Foissner, 1981	GY	3	C?	+	–	–	–	–	**
Lamtostyla abdita Foissner, 1997	HY	27	B,F,H,N	–	–	+	–	–	**
Lamtostyla australis (Blatterer & Foissner, 1988) Petz & Foissner, 1996	HY	50	B,C,F,G,H	+	+	+	+	–	***
Lamtostyla edaphoni Berger & Foissner, 1987	HY	11	B	+	+	+	+	+	***
Lamtostyla granulifera Foissner, 1997	HY	90	C,F,N	+	+	+	+	–	***
Lamtostyla hyalina (Berger, Foissner & Adam, 1984) Berger & Foissner, 1987	HY	4	?	+	–	–	+	+	***
Lamtostyla islandica Berger & Foissner, 1988	HY	20	B,F	+	+	+	+	+	***
Lamtostyla kirkeniensis Berger & Foissner, 1988	HY	20	B,C,F,H	+	–	+	–	–	***
Lamtostyla lamottei Buitkamp, 1977	HY	26	C,D	–	+	–	–	–	***
Lamtostyla longa (Hemberger, 1985) Berger & Foissner, 1988	HY	135	?	–	–	–	+	–	***
Lamtostyla perisincirra (Hemberger, 1985) Berger & Foissner, 1987	HY	7	?	+	+	–	–	+	***
Lamtostyla raptans (Hemberger, 1985) Foissner, 1997	HY	150	?	–	–	–	+	–	***
Laurentiella strenua (Dingfelder, 1962) Berger & Foissner, 1989	HY	3000	B,C,D	+	–	+	–	–	*
Leptopharynx costatus Mermod, 1914	NA	5	B,F	+	+	+	+	+	*
Leptopharynx eurystoma (Kahl, 1931) nov. comb.	NA	10	E?	+	–	+	+	–	*
Leptopharynx macrostoma Njine, 1979, synonym with *L. eurystoma*									
Leptopharynx minimus Alekperov, 1993, synonym with *L. costatus*									
Leptopharynx stenostoma (Gellért, 1942) nov. comb., synonym with *L. costatus*									
Linostoma vorticella (Ehrenberg, 1833) Jankowski, 1978	HE	1000	C,D,G	–	+	–	–	–	*
Litonotus crinitus Grandori & Grandori, 1934	GY	40	C?	+	–	–	–	–	**
Litonotus digitatus Grandori & Grandori, 1934	GY	39	C?	+	–	–	–	–	**
Litonotus muscorum (Kahl, 1931) Blatterer & Foissner, 1988	GY	12	C	+	+	+	+	–	**
Maryna acuminata (Gellért, 1955) Foissner, 1993	CO	1	B	+	–	–	–	–	**
Maryna antarctica Foissner, 1993	CO	7	B	+	–	–	–	+	**
Maryna atra (Gelei, 1950) Foissner, 1993	CO	180	B	+	+	–	–	–	*
Maryna lichenicola (Gelei, 1950) Foissner, 1993	CO	9	B	+	+	–	–	–	**
Maryna minima (Gelei, 1950) Foissner, 1993	CO	7	?	+	–	–	–	–	*
Maryna ovata (Gelei, 1950) Foissner, 1993	CO	40	B	+	+	–	+	–	*
Maryna pinguis Dingfelder, 1962	CO	270	?	+	–	–	–	–	**
Maryna rotunda Dingfelder, 1962	CO	113	?	–	+	–	–	–	*
Maryna socialis Gruber, 1879	CO	830	?	+	–	–	–	–	**
Maryna umbrellata (Gelei, 1950) Foissner, 1993	CO	523	B,S?	–	+	–	–	–	*
Metacineta micraster (Penard, 1914) Batisse, 1967	SU	33	C	+	–	–	–	–	**
Metacineta mystacina (Ehrenberg, 1831) Bütschli, 1889	SU	65	C	+	–	–	–	–	*
Metopus contractus Penard, 1922	HE	100	B	–	–	–	+	–	*
Metopus es (Müller, 1776) Lauterborn, 1916	HE	95	B,E,F,S	–	+	–	+	–	*
Metopus hasei Sondheim, 1929	HE	14	B	+	+	+	+	–	**
Metopus ovalis Kahl, 1927	HE	240	B	–	+	–	+	–	*
Metopus palaeformis Kahl, 1927	HE	10	B	–	–	–	+	–	*

Table 2. continued.

Species[2]	Taxonomic group[3]	Biomass of 10^6 indiv. (mg)[4]	Food[5]	Geographic distribution[6] H	P	A	N	Ar	Degree of autochthonism[7]
Metopus rectus (Kahl, 1932) Foissner, 1980	HE	72	B	+	–	–	–	–	*
Metopus setosus Kahl, 1927	HE	32	B	–	–	–	+	–	*
Metopus setosus minor Kahl, 1927	HE	18	B	–	–	–	+	–	*
Microdiaphanosoma arcuatum (Grandori & Grandori, 1934) Wenzel, 1953	CO	0.5	B	+	+	+	+	+	***
Microdiaphanosoma terricola Foissner, 1993	CO	0.5	?	+	–	+	–	–	***
Microthorax simulans (Kahl, 1926) Kahl, 1931	NA	0.7	B	+	+	+	+	+	**
Monodinium balbiani Fabre-Domergue, 1888	GY	55	C,G	+	+	–	+	–	*
Mycterothrix tuamotuensis (Balbiani, 1887) Kahl, 1931	CO	20	B	+	–	+	–	–	***
Mykophagophrys terricola (Foissner, 1985) Foissner, 1995	CO	3	H	+	+	+	+	+	***
Nassula citrea Kahl, 1930	NA	150	E	+	+	–	–	–	*
Nassula picta Greeff, 1888	NA	224	E	+	+	–	–	+	*
Nassula protectissima Penard, 1922	NA	40	E	+	–	–	–	–	**
Nassula terricola Foissner, 1989	NA	180	E	+	–	–	–	–	**
Nassula tumida obscura Lepsi, 1951	NA	50	?	+	–	–	–	–	**
Neogeneia hortualis Eigner, 1995	HY	38	B	+	–	–	–	–	**
Nivaliella plana Foissner, 1980	CO	0.5	H	+	+	+	+	+	***
Notohymena antarctica Foissner, 1996	HY	45	B?C,F	–	–	–	–	+	**
Notohymena australis (Foissner & O'Donoghue) Blatterer & Foissner, 1988	HY	45	B	–	–	–	+	–	*
Notohymena rubescens Blatterer & Foissner, 1988	HY	40	F,H,N	+	–	+	+	–	**
Notohymena selvatica (Hemberger, 1985) Blatterer & Foissner, 1988	HY	560	?	–	+	–	+	–	**
Notoxoma parabryophryides Foissner, 1993	CO	10	B	+	+	+	+	–	***
Notoxoma sigmoides Foissner, 1993	CO	3	B	–	+	–	–	–	***
Obertrumia kahli Foissner, 1989	NA	180	E	+	–	–	–	–	**
Odontochlamys alpestris Foissner, 1981	CY	10	B,F	+	+	+	+	–	*
Odontochlamys convexa (Kahl, 1931) Blatterer & Foissner, 1992	CY	9	B?	+	+	+	+	–	***
Odontochlamys gouraudi Certes, 1891	CY	13	B	+	+	+	+	–	*
Odontochlamys wisconsinensis (Kahl, 1931) Petz & Foissner, 1997	CY	6	B,G?	+	–	–	–	+	**
Onychodromopsis flexilis Stokes, 1887	HY	80	B,C,F	+	–	–	–	+	*
Opercularia arboricola (Biegel, 1954) Foissner, 1981, synonym with *O. curvicaule*									
Opercularia arenicola Greeff, 1873	PE	?	?	+	–	–	–	–	**
Opercularia asymmetrica (Biczok, 1956) Aescht & Foissner, 1992	PE	13	B	+	–	–	–	–	*
Opercularia curvicaule (Penard, 1922) nov. comb.	PE	48	B	+	+	+	+	+	**
Ophryoglena marginata Greeff, 1888	HM	?	?	+	–	–	–	–	**
Opisthonecta minima Foissner, 1975	PE	143	B	+	+	–	+	–	*
Opisthotricha elongata Grandori & Grandori, 1934	HY	20	?	+	–	–	–	–	**
Opisthotricha procera Kahl, 1932	HY	20	?	+	–	–	–	–	**
Opisthotricha terrestris Horváth, 1956, synonym with *Sterkiella histriomuscorum*									
Opisthotricha terricola Gellért, 1957	HY	24	B	+	–	–	–	–	**
Orthoamphisiella franzi (Foissner, 1982) Eigner, 1995	HY	30	B,F,S	+	–	–	–	–	*
Orthoamphisiella grelli Eigner & Foissner, 1993	HY	20	B,F	–	–	–	–	+	**
Orthoamphisiella stramenticola Eigner & Foissner, 1991	HY	60	B?C,E,H	+	–	–	+	–	**
Orthokreyella schiffmanni Foissner, 1984	CO	0.2	B?	+	–	–	–	–	***
Oxytricha auripunctata Blatterer & Foissner, 1988	HY	40	C,F,H	–	+	+	+	–	**
Oxytricha bimembranata Shibuya, 1929	HY	300	?	+	–	–	–	–	**
Oxytricha crassistilata Kahl in Alekperov [4], synonym with *Sterkiella histriomuscorum*									
Oxytricha gigantea Horváth, 1933	HY	270	B,C,F,H	+	+	–	–	–	*
Oxytricha granulifera Foissner & Adam, 1983	HY	72	B,F,H	+	+	+	+	+	**
Oxytricha granulifera quadricirrata Blatterer & Foissner, 1988	HY	30	B,F,H	–	+	+	+	–	**
Oxytricha hengshanensis Shen, Liu, Song & Gu, 1992	HY	252	G,N	+	–	–	–	–	**

Table 2. continued.

Species[2]	Taxonomic group[3]	Biomass of 10^6 indiv. (mg)[4]	Food[5]	Geographic distribution[6]					Degree of autochthonism[7]
				H	P	A	N	Ar	
Oxytricha histrioides Gellért, 1957	HY	175	B	+	–	–	–	–	**
Oxytricha islandica Berger & Foissner, 1989	HY	70	N	+	–	–	+	–	**
Oxytricha lanceolata Shibuya, 1930	HY	70	B,F,G	+	+	+	+	+	**
Oxytricha longigranulosa Berger & Foissner, 1989	HY	120	C,F,H	+	+	+	+	+	**
Oxytricha nauplia Berger & Foissner, 1987	HY	26	F,G,H	+	+	+	+	–	**
Oxytricha opisthomuscorum Foissner et al., 1991	HY	27	B,F,G	+	–	–	+	+	**
Oxytricha ottowi Foissner, 1996	HY	40	B,E,F	–	–	–	–	+	**
Oxytricha proximata Shibuya, 1930	HY	150	S	+	–	–	–	–	**
Oxytricha pseudosimilis Hemberger, 1985	HY	180	?	–	–	–	+	–	**
Oxytricha quercineti Lepsi, 1948	HY	45	B	+	–	–	–	–	**
Oxytricha rubra Buitkamp, 1977, synonym with *Cyrtohymena muscorum* [76]									
Oxytricha rubripuncta Berger & Foissner, 1987	HY	200	B,C,D,G,T	–	+	–	–	–	**
Oxytricha setigera Stokes, 1891	HY	8	B,F	+	+	+	+	–	*
Oxytricha siseris Vuxanovici, 1963	HY	30	B?	+	+	+	+	–	*
Oxytricha tricirrata Buitkamp, 1977	HY	56	C,N	–	+	–	–	–	**
Papillorhabdos multinucleatus Foissner, 1984	GY	44	C	+	–	–	–	–	*
Parabryophrya penardi (Kahl, 1931) Foissner, 1985	CO	28	B	+	+	+	+	+	***
Paracineta lauterborni Sondheim, 1929	SU	11	C	+	+	+	+	–	**
Paraenchelys terricola Foissner, 1984	GY	49	C	+	+	+	+	+	**
Paraenchelys wenzeli Foissner, 1984	GY	89	C?	+	+	+	+	–	**
Parafurgasonia sorex (Penard, 1922) Foissner & Adam, 1981	NA	56	G,H?N	+	+	+	+	–	***
Paragastrostyla lanceolata Hemberger, 1985	HY	120	?	–	–	–	+	–	**
Paraholosticha lichenicola Gellért, 1955	HY	63	G,S	+	–	–	–	–	**
Paraholosticha muscicola Kahl, 1932	HY	210	C,F,G,H	+	–	–	–	+	**
Paraholosticha nana Gellért, 1955	HY	30	G	+	–	–	–	–	**
Parakahliella haideri Berger & Foissner, 1989	HY	112	C,F	+	–	–	+	–	**
Parakahliella macrostoma (Foissner, 1982) Berger, Foissner & Adam, 1986	HY	168	C,N	+	–	–	–	–	**
Parakahliella terricola (Buitkamp, 1977) Berger, Foissner & Adam, 1986	HY	504	C	+	–	–	–	–	**
Paramphisiella acuta (Foissner, 1982) Foissner, 1988	HY	18	?	+	+	–	–	–	***
Paramphisiella caudata (Hemberger, 1985) Foissner, 1988	HY	300	B,C,F	–	+	+	+	–	*
Paraurostyla granulifera Berger & Foissner, 1989	HY	490	F,H,N,T	+	–	–	–	–	**
Paraurostyla polynucleata Alekperov, 1993	HY	380	?	+	–	–	–	–	**
Paraurostyla pulchra Buitkamp, 1977	HY	300	C,D	+	–	–	–	–	**
Pattersoniella vitiphila Foissner, 1987	HY	1000	C,F,G,H,S,T	+	–	+	–	–	***
Pedohymena australiense Foissner, 1995	NA	15	B	–	+	+	+	–	***
Pelagotrichidium tisiae (Gelei, 1929) Jankowski, 1978	HY	396	C,D,F,H	+	–	–	–	–	*
Pentahymena corticicola Foissner, 1994	CO	470	C	–	–	–	+	–	***
Periholosticha acuminata Hemberger, 1985	HY	56	?	–	–	–	+	–	***
Periholosticha lanceolata Hemberger, 1985	HY	30	?	–	–	–	+	–	***
Phacodinium metchnicoffi (Certes, 1891) Kahl, 1932	HE	280	B,C,G,S	+	+	+	+	–	***
Phialina binucleata Berger, Foissner & Adam, 1984	GY	8	C	+	+	+	+	–	**
Phialina flagellifera (Gellért, 1957) nov. comb.	GY	16	C	+	–	–	–	–	**
Phialina terricola Foissner, 1984	GY	5	C	+	+	–	–	–	**
Phialinides australis Foissner, 1988	GY	8	C	–	+	+	+	–	**
Plagiocampa atra Grandori & Grandori, 1934	PR	4	?	+	–	–	–	–	**
Plagiocampa caudata Alekperov, 1993	PR	2	B,F	+	–	–	–	–	**
Plagiocampa difficilis Foissner, 1981	PR	11	B,F	+	+	+	–	+	**
Plagiocampa rouxi Kahl, 1926	PR	7	B,G	+	+	+	+	–	*
Platycola longicollis Kent, 1881	PE	45	?	+	–	–	–	–	*
Platycola steineri (Penard, 1914) Kahl, 1935	PE	20	B	+	–	–	–	–	**
Platyophrya angusta Kahl, 1926, synonym with *P. vorax*									
Platyophrya binucleata Foissner, 1987	CO	10	H	+	+	–	–	–	***
Platyophrya fissistoma Lepsi, 1948, synonym with *P. spumacola*									

Table 2. continued.

Species[2]	Taxonomic group[3]	Biomass of 10^6 indiv. (mg)[4]	Food[5]	Geographic distribution[6]					Degree of autochthonism[7]
				H	P	A	N	Ar	
Platyophrya macrostoma Foissner, 1980	CO	1.5	B	+	+	+	+	+	**
Platyophrya paoletti Foissner, 1997	CO	3	B	–	–	–	+	–	***
Platyophrya similis (Foissner, 1980) Foissner, 1987	CO	180	C,D,F,G	+	–	+	+	–	**
Platyophrya spumacola Kahl, 1927	CO	40	B,C,E,F,G, H,R,T	+	+	+	+	+	**
Platyophrya vorax Kahl, 1926	CO	12	B,F,G,H	+	+	+	+	+	*
Platyophryides dragescoi Foissner, 1987	CO	64	C	+	–	+	+	+	***
Platyophryides latus (Kahl, 1930) Foissner, 1987	CO	108	C,G,H	+	–	+	+	–	***
Platyophryides magnus Foissner, 1993	CO	700	C	–	+	–	–	–	***
Pleuroplites australis Foissner, 1988	GY	8	C,F	+	+	+	+	+	***
Pleuroplitoides smithi Foissner, 1996	GY	56	C	+	+	+	+	+	***
Podophrya halophila Kahl, 1934	SU	17	C	–	–	+	+	–	*
Protocyclidium terrenum Alekperov, 1993	HM	2	B	+	–	–	–	–	**
Protospathidium bonnetti (Buitkamp, 1977) Foissner, 1981	GY	5	C	+	+	+	+	–	***
Protospathidium muscicola Dragesco & Dragesco-Kernéis, 1979	GY	7	F	+	+	–	+	–	**
Protospathidium serpens (Kahl, 1930) Foissner, 1981	GY	5	C?	+	+	+	+	+	**
Protospathidium terricola Foissner (this paper)	GY	28	C?	–	+	–	–	+	**
Pseudocarchesium claudicans (Penard, 1922) Foissner, 1989	PE	3	B	+	–	+	+	–	**
Pseudochilodonopsis mutabilis Foissner, 1981	CY	8	B	+	+	+	+	+	**
Pseudochilodonopsis polyvacuolata Foissner & Didier, 1981	CY	30	B	+	+	–	–	–	*
Pseudocohnilembus marinus Thompson, 1966	HM	3	B?	–	–	+	–	–	*
Pseudocohnilembus persalinus Evans & Thompson, 1964, synonym with *P. pusillus*									
Pseudocohnilembus pusillus (Quennerstedt, 1869) Foissner & Wilbert, 1981	HM	3	B	+	–	–	–	–	*
Pseudocohnilembus putrinus (Kahl, 1928) Foissner & Wilbert, 1981	HM	2	B	+	+	+	+	–	*
Pseudocohnilembus veisovi Alekperov & Musaev, 1988, synonym with *P. pusillus*									
Pseudocristigera hymenofera Horváth, 1956, synonym with *Drepanomonas revoluta*									
Pseudocyrtolophosis alpestris Foissner, 1980	CO	2	B	+	+	+	+	+	**
Pseudocyrtolophosis terricola Foissner, 1993	CO	3	B	–	+	+	+	–	**
Pseudoglaucoma muscorum (Kahl, 1931) Wenzel, 1953	CO	1	?	+	–	–	–	–	**
Pseudoholophrya terricola Berger, Foissner & Adam, 1984	GY	32	C?	+	+	+	+	+	**
Pseudokreyella terricola Foissner, 1985	CO	3	B?	+	+	+	–	+	***
Pseudokreyella australis Foissner, 1993	CO	3	B	+	–	+	–	–	***
Pseudomicrothorax agilis Mermod, 1914	NA	14	B,E,G	–	+	–	+	–	*
Pseudomicrothorax dubius (Maupas, 1883) Penard, 1922	NA	50	B,E	–	+	–	–	–	*
Pseudoplatyophrya nana (Kahl, 1926) Foissner, 1980	CO	3	H	+	+	+	+	+	***
Pseudoplatyophrya saltans Foissner, 1988	CO	2	H	+	+	+	+	+	***
Pseudothuricola dionysii (Penard, 1922) Kahl, 1935	PE	9	B	+	–	–	–	–	**
Pseudouroleptus buitkampi (Foissner, 1982) Berger & Foissner, 1987	HY	72	B,C,S	+	–	–	–	–	***
Pseudouroleptus procerus Berger & Foissner, 1987	HY	120	C,F,G,N	+	+	–	–	–	***
Pseudouroleptus terrestris Hemberger, 1985	HY	330	?	–	–	–	+	–	**
Pseudourostyla franzi Foissner, 1987	HY	375	C,H,N,T	–	+	+	+	–	**
Pseudovorticella mutans (Penard, 1922) Foissner, 1979	HY	14	B	+	–	–	–	–	*
Pseudovorticella sphagni Foissner & Schiffmann, 1974	PE	14	B	+	+	+	+	–	*
Psilotricha succisa (Müller, 1786) Foissner, 1983	HY	66	G	–	–	+	–	–	*
Pyxidium invaginatum muscorum Kahl, 1935, synonym with *Opercularia curvicaule*									
Pyxidium longicollum Biegel, 1954	PE	7	?	+	–	–	–	–	**
Pyxidium tardigradum Van der Land, 1964	PE	7	B?	+	–	–	–	–	**
Reticulowoodruffia terricola Foissner, 1993	CO	54	?	+	–	–	–	–	***
Rhabdostyla (?) arborea Greeff, 1888	PE	?	?	+	–	–	–	–	**
Rhabdostyla muscorum Kahl, 1935	PE	6	?	+	–	–	–	–	**
Rhabdotricha terricola Greeff, 1888	HY	?	?	+	–	–	–	–	**

Table 2. continued.

Species[2]	Taxonomic group[3]	Biomass of 10^6 indiv. (mg)[4]	Food[5]	Geographic distribution[6] H	P	A	N	Ar	Degree of autochthonism[7]
Rhopalophrya elegans Horváth, 1956	GY	2	B,F	+	–	–	–	–	**
Rhopalophrya pentacerca Grandori & Grandori, 1934	GY	4	?	+	–	–	–	–	**
Rostrophrya camerounensis (Njine, 1979) Foissner, 1993	CO	640	D,E	–	+	–	–	–	*
Rostrophrya terricola Foissner, 1993	CO	360	?	+	–	+	–	–	***
Rostrophryides africana Foissner, 1987	CO	14	?	+	+	–	+	–	***
Rostrophryides australis Blatterer & Foissner, 1988	CO	30	B,G,H	+	–	+	+	–	***
Sagittaria australis Pomp & Wilbert, 1988	CO	9	?	–	–	+	–	–	**
Sagittaria hyalina Foissner, Czapik & Wiackowski, 1981	CO	4	B	+	+	+	+	–	*
Sagittaria poligonalis Grandori & Grandori, 1934	CO	5	?	+	–	–	–	–	**
Sathrophilus muscorum (Kahl, 1931) Corliss, 1960	HM	12	B	+	+	+	+	+	**
Sathrophilus simonis (Lepsi, 1948) Corliss, 1960	HM	6	?	+	–	–	–	–	**
Semiplatyophrya foissneri Wilbert & Kahan, 1986	CO	13	B	+	+	+	–	–	**
Solenophrya flavescens Penard, 1914	SU	33	C	+	–	–	–	–	**
Solenophrya massula Penard, 1914	SU	3	C	+	–	–	–	–	**
Solenophrya sacculus Penard, 1914	SU	5	C	+	–	–	–	–	**
Sorogena stoianovitchae Bradbury & Olive, 1980	CO	54	C	+	+	+	+	–	**
Spathidium alpinum Gellért, 1956	GY	30	C	+	–	–	–	–	**
Spathidium anguilla Vuxanovici, 1962	GY	25	C?	+	+	+	+	–	*
Spathidium bavariense Kahl, 1930	GY	130	C	+	+	+	+	–	**
Spathidium claviforme Kahl, 1930	GY	31	C	+	+	+	+	–	**
Spathidium falciforme (Penard, 1922) Kahl, 1930	GY	4	?	+	–	–	–	–	**
Spathidium furcatum Shibuya, 1930	GY	60	C?	+	–	–	–	–	**
Spathidium geobium Lepsi, 1951	GY	10	C?	+	–	–	–	–	**
Spathidium holsatiae Kahl, 1930	GY	45	C?	+	–	–	–	–	**
Spathidium lagyniforme Kahl, 1930	GY	34	C?	+	–	–	–	–	*
Spathidium longicaudatum (Buitkamp & Wilbert,1974) Buitkamp,1977	GY	18	C,N	+	+	+	+	–	***
Spathidium metabolicum Pomp & Wilbert, 1988, synonym with *S. anguilla*									
Spathidium multinucleatum Gellért, 1955	GY	23	C	+	–	–	–	–	**
Spathidium muscicola Kahl, 1930	GY	84	C	+	+	+	+	–	**
Spathidium procerum Kahl, 1930	GY	15	C?	+	+	+	+	–	**
Spathidium rusticanum Foissner, 1981	GY	25	C?	+	+	–	–	–	**
Spathidium scalpriforme (Kahl, 1930) Kahl, 1930	GY	220	C?F	+	–	–	–	–	**
Spathidium seppelti Petz & Foissner, 1997	GY	65	C	–	–	–	–	+	**
Spathidium spathula (Müller, 1773) Moody, 1912	GY	45	C	+	+	+	+	–	*
Spathidium spathuloides Gellért, 1955	GY	6	C	+	–	–	–	–	**
Spetazoon australiense Foissner, 1994	GY	200	C	–	+	+	–	–	**
Sphaerophrya parva Greeff, 1888	SU	?	?	+	–	–	–	–	**
Sphaerophrya terricola Foissner, 1986	SU	8	C	+	+	+	+	+	**
Spirofilopsis tubicola (Gruber, 1879) Dingfelder, 1962	HY	30	?	+	–	–	–	–	**
Stammeridium kahli (Wenzel, 1953) Wenzel, 1969	NA	0.6	B	+	+	+	+	–	***
Stegochilum smalli Alekperov, 1993, synonym with *Tetrahymena rostrata*									
Steinia platystoma (Ehrenberg, 1831) Diesing, 1866	HY	175	C,F,G,D	+	+	–	–	–	*
Sterkiella cavicola (Kahl, 1935) Foissner et al., 1991 (formerly *Histriculus*)	HY	540	C,N	+	+	+	+	–	**
Sterkiella histriomuscorum (Foissner et al., 1991) Foissner et al., 1991 (formerly *Histriculus muscorum*)	HY	72	B,C,F,N	+	+	+	+	+	*
Sterkiella similis f. *tricirrata* (Buitkamp, 1977) nov. comb.	HY	234	B,E	–	+	–	–	–	**
Sterkiella thompsoni Foissner, 1996	HY	90	B,D,F,G	–	–	–	–	+	*
Stichotricha aculeata Wrześniowski, 1866	HY	20	B,G	+	+	+	–	–	*
Stichotricha socialis Gruber, 1879	HY	63	?	+	–	–	–	–	*
Strongylidium californicum Kahl, 1932	HY	100	?	+	–	–	–	–	**
Strongylidium muscorum Kahl, 1932	HY	30	?	+	–	–	–	–	**
Stylonychia bifaria (Stokes, 1887) nov. comb.[8]	HY	100	B,C	+	–	–	+	–	*
Stylonychia mytilus (Müller, 1773) Ehrenberg, 1830	HY	70	B,C,G,Z	+	–	+	+	–	*

Table 2. continued.

Species[2]	Taxonomic group[3]	Biomass of 10^6 indiv. (mg)[4]	Food[5]	Geographic distribution[6]					Degree of autochthonism[7]
				H	P	A	N	Ar	
Stylonychia pustulata (Müller, 1786) Ehrenberg, 1835	HY	80	B,C,F,G	–	+	+	–	–	*
Stylonychia quadrinucleata Alekperov & Musaev, 1988	HY	3500	C	+	–	–	–	–	**
Stylonychia stylomuscorum (Foissner, Blatterer, Berger & Kohmann, 1991) Foissner, Blatterer, Berger & Kohmann,1991	HY	30	D,F,G	+	–	–	–	–	*
Tachysoma granulifera Berger & Foissner, 1987	HY	26	F,G,H,N	+	+	+	–	–	***
Tachysoma humicola Gellért, 1957	HY	9	B,T	+	+	+	+	–	***
Tachysoma humicola longisetum Foissner (this paper)	HY	12	B	–	+	–	+	–	***
Tachysoma terricola Hemberger, 1985	HY	45	?	–	–	–	+	–	***
Tectohymena terricola Foissner, 1993	CO	10	B	+	+	–	–	–	***
Telostomatella ferroi (Grandori, 1935) Foissner, 1985	CO	11	E,F	+	–	–	–	–	**
Telotrochidium cylindricum Foissner, 1978	PE	66	B	+	+	–	–	–	*
Terricirra livida (Berger & Foissner, 1987) Berger & Foissner, 1989	HY	24	B	+	+	+	–	–	***
Terricirra matsusakai Berger & Foissner, 1989	HY	45	B	+	+	+	+	–	***
Terricirra viridis (Foissner, 1982) Berger & Foissner, 1989	HY	33	B	+	+	+	–	–	***
Territricha stramenticola Berger & Foissner, 1988	HY	100	C,H	+	–	–	–	–	**
Tetrahymena edaphoni Foissner, 1987	HM	8	B	+	–	–	–	–	**
Tetrahymena rostrata (Kahl, 1926) Corliss, 1952	HM	12	B,G	+	+	+	+	–	**
Thuricola innixa Stokes, 1882	PE	70	B	+	–	–	–	–	*
Thuricola kellicottiana (Stokes, 1887) Kahl, 1935	PE	200	E	+	–	–	–	–	*
Thylakidium macrostomum Alekperov, 1991, synonym with *Bryometopus sphagni*									
Thylakidium typicum Gellért, 1955	CO	175	B	+	–	–	–	–	**
Tokophrya muscicola Penard, 1914	SU	7	C	+	–	–	+	–	**
Trachelochaeta gonostomoida Hemberger, 1985	HY	204	?	–	–	–	+	–	**
Trachelophyllum apiculatum (Perty,1852) Claparède & Lachmann,1859	GY	39	C	+	+	+	+	–	*
Trachelostyla canadensis Buitkamp & Wilbert, 1974, synonym with *Gonostomum algicola*									
Transitella lichenicola Gellért, 1950, synonym with *Balantidioides bivacuolata*									
Tricoronella pulchra Blatterer & Foissner, 1988	HY	540	C,F,H,N,S,T	–	–	+	–	–	***
Trihymena terricola Foissner, 1988	CO	2	B?	+	+	+	+	–	***
Trithigmostoma bavariensis (Kahl, 1931) Foissner, 1987	CY	96	B	+	+	–	+	–	**
Urliella terricola Foissner, 1989	NA	6	B	+	–	–	–	–	**
Uroleptoides kibni Wenzel, 1953	HY	15	?	+	–	–	–	–	*
Uroleptoides qingdaoensis Song & Wilbert, 1989, synonym with *Hemiamphisiella terricola*									
Uroleptus humicola Gellért, 1956	HY	37	S	+	–	–	–	–	**
Uroleptus lepisma (Wenzel, 1953) nov. comb.	HY	120	B,C,F,H,N,T	+	+	+	+	–	**
Uroleptus matthesi Wenzel, 1953	HY	15	?	+	–	–	–	–	**
Uroleptus musculus (Kahl, 1932) Foissner et al., 1991	HY	214	B,C,G	–	+	–	–	–	*
Uroleptus notabilis (Foissner, 1982) nov. comb.	HY	32	F,H,T	+	+	+	+	+	**
Uronema nigricans (Müller, 1786) Florentin, 1901	HM	5	B,F	+	+	–	–	+	*
Urosoma acuminata (Stokes, 1887) Kahl, 1932	HY	73	D,H,G	+	+	+	+	–	*
Urosoma cienkowskii Kowalewski, 1882	HY	34	B,C,F,H	+	+	–	–	–	*
Urosoma karinae Foissner, 1987 nom. corr.	HY	60	B?F	+	+	+	–	–	**
Urosoma macrostoma Gellért, 1957	HY	14	S	+	–	–	–	–	**
Urosoma macrostyla (Wrześniowski, 1866) Kahl, 1932	HY	41	B	+	+	+	+	–	*
Urosoma octonucleata Berger & Foissner, 1989	HY	67	B	+	–	–	–	–	**
Urosomoida agiliformis Foissner, 1982	HY	30	B,C	+	+	+	+	–	**
Urosomoida agilis (Engelmann, 1862) Hemberger, 1985	HY	30	B,D,N,S,T	+	+	+	+	–	*
Urosomoida antarctica Foissner, 1996	HY	25	B,F?N?	–	–	–	–	+	**
Urosomoida dorsiincisura Foissner, 1982	HY	38	B,C,N	+	+	–	+	–	**
Urosomoida granulifera Foissner, 1996	HY	28	B?	–	–	–	–	+	**
Urosomoida minima Hemberger, 1985	HY	12	?	–	–	–	+	–	**
Urostyla grandis Ehrenberg, 1830	HY	500	C,G,R,T	+	–	–	–	–	*
Urostyla muscorum Kahl, 1932	HY	630	C,R	+	–	–	–	–	**
Urotricha atypica Alekperov, 1993	PR	44	?	+	–	–	–	–	**

Table 2. continued.

Species[2)]	Taxonomic group[3)]	Biomass of 10^6 indiv. (mg)[4)]	Food[5)]	Geographic distribution[6)] H	P	A	N	Ar	Degree of autochthonism[7)]
Urotricha mamilla Lepsi, 1951	PR	2	?	+	–	–	–	–	**
Urotricha terricola Alekperov & Musayev, 1988	PR	20	?	+	–	–	–	–	**
Vaginicola chaperoni (Penard, 1914) Kahl, 1935	PE	30	B	+	–	–	–	–	**
Vaginicola doliolum (Penard, 1914) Kahl, 1935	PE	9	B	+	–	–	–	–	**
Vaginicola terricola Greeff, 1888	PE	22	B	+	–	–	–	+	**
Vaginicola virgula (Penard, 1914) Kahl, 1935	PE	8	B	+	–	–	–	–	**
Vorticella astyliformis Foissner, 1981	PE	13	B,S	+	+	+	+	+	**
Vorticella coeni Lepsi, 1948	PE	160	?	+	–	–	–	–	**
Vorticella infusionum Dujardin, 1841	PE	18	B	+	+	+	–	+	*
Vorticella lichenicola Greeff, 1888	PE	23	B	+	–	–	–	–	**
Vorticella microstoma Ehrenberg, 1830	PE	30	B,G	+	–	–	+	–	*
Vorticella muralis Penard, 1922	PE	63	B	+	–	–	–	–	**
Vorticella operculariformis Foissner, 1979	PE	40	B	+	+	–	–	–	*
Vorticella pileolata Lepsi, 1948	PE	20	?	+	–	–	–	–	**
Vorticella similis Stokes, 1887	PE	75	B	+	+	+	+	–	*
Wallackia bujoreani (Lepsi, 1951) Berger & Foissner, 1989	HY	15	B	+	–	–	–	–	**
Woodruffia australis Foissner, 1993	CO	25	B?	–	+	+	+	–	***
Woodruffia lichenicola Gellért, 1955, synonym with *Platyophryides latus*									
Woodruffia rostrata Kahl, 1931	CO	126	C	+	–	+	–	–	*
Woodruffia sinistromembranellata Gellért, 1955, synonym with *Platyophrya spumacola*									
Woodruffides metabolicus (Johnson & Larson, 1938) Foissner, 1987	CO	1000	C	+	+	+	+	–	**
Woodruffides terricola Foissner, 1987	CO	110	?	+	+	–	–	–	***

1) This list contains (i) all species *originally* described from terrestrial habitats (soil, litter, terrestrial mosses etc.) and (ii) species originally described from freshwater habitats but later *reliably* recorded (by silver impregnation) from terrestrial environments. True *Sphagnum* species and species from ephemeral puddles were excluded, if not later reliably recorded from terrestrial habitats. Colpodids were selected from Foissner's [84] monograph. As far as it concerns my papers, this summary supersedes my earlier species lists.

2) For literature of original species descriptions, recent combinations, important redescriptions, and synonymies (most subjective), see Table 3.

3) Classification mainly after [34], that of colpodids after [84]. CO = colpodid, CY = cyrtophorid, GY = gymnostomatid (haptorid), HE = heterotrich, HM = hymenostome, HY = hypotrich, NA = nassulid, OL = oligotrich, PE = peritrich, PR = prostomatid, SU = suctorian.

4) Rough estimation obtained by reducing the shape of the cells to simple geometric figures and assuming a specific gravity of 1.

5) Food items were determined mainly by examination of the food vacuoles. B = bacteria, C = ciliates, D = diatoms, E = blue green algae (cyanobacteria), F = colourless flagellates, G = green algae, including autotrophic flagellates, H = hyphae and/or spores of fungi and yeasts, N = naked amoebae, R = rotifers and/or nematodes, S = inorganic and organic soil particles ("detritus"), T = testate amoebae.

6) Classification of biogeographic regions, see Fig. 1. H = Holarctis (North America, Greenland, Eurasia with Iceland, Canary Islands, Korea, Japan, and north Africa), P = Palaeotropis (Africa south of Sahara desert, Madagascar, India), A = Australis (mainly Australia), N = Neotropis (Central and South America), Ar = Archinotis (Antarctica and islands in the southern oceans). Most are original records published here for the first time (see text). Note that freshwater and/or marine records are not included.

7) * low, reliably recorded also from freshwater habitats; ** probably strong; includes most of the new species and many moss inhabitants; *** probably found exclusively in true terrestrial habitats (litter, soil, humus under and in moss etc.). Only species with specific food requirements or very characteristic morphological adaptations have been classified to this level; furthermore, species belonging to genera known from soil only, were usually also classified to this level.

8) Misidentified as *Dileptus monilatus* Stokes, 1886 by Song [205] according to [98]; misidentified as *Stylonychia vorax* by [245]; misidentified by Song [206] as *Frontonia acuminata*.

9) Synonymy questionable.

10) For *Thylakidium magnum* Alekperov, 1991 [3], which becomes, after transfer to *Bryometopus*, a secondary homonym of *B. magnus* Foissner, 1980 [61], which is, however, very likely a junior synonym of *B. sphagni* Penard, 1922 [84].

11) Note that the genera *Dileptus* and *Euplotes* were split in several genera by some authors [98, 256].

Table 3. Quality of descriptions (+ poor; ++ incomplete, i.e. either life aspect or infraciliature insufficiently described; +++ excellent, i.e. original description and/or redescriptions include morphometry and appropriate figures from live and silver prepared specimens) and key literature. Usually, the original reference is provided, except for those species treated in our recent monographs [84, 114–117].

Species
Acaryophrya collaris +++ [38, 68, 148, 149, 152, 191]
Acineria uncinata +++ [107, 117, 207, 232]
Acineta flava +++ [117]
Acropisthium mutabile +++ [69, 152, 181]
Actinobolina vorax ++ [117, 152]
Alinostoma multivacuolatum ++ [4]
Amphibotrella enigmatica + [132, 133]
Amphisiella binucleata +++ [11, 78, 138]
Amphisiella magnigranulosa +++ [78]
Amphisiella polycirrata +++ [11]
Amphisiella quadrinucleata +++ [11]
Amphisiella raptans ++ [28]
Amphisiella terricola +++ [69, 128]
Amphisiella vitiphila +++ [75, 78]
Amphisiellides atypicus ++ [78, 138]
Amphisiellides illuvialis +++ [49]
Apoamphisiella tihanyiensis +++ [97, 131]
Apobryophyllum terricola +++ (this paper)
Apocolpoda africana +++ [84]
Archinassula muscicola + [157]
Arcuospathidium atypicum +++ [78, 240]
Arcuospathidium cooperi +++ [94]
Arcuospathidium cultriforme +++ [69, 152, 179]
Arcuospathidium japonicum +++ [78]
Arcuospathidium lionotiforme +++ [69, 152, 179]
Arcuospathidium muscorum +++ [13, 41, 69]
Arcuospathidium vermiforme +++ [69]
Aspidisca cicada +++ [114]
Aspidisca lynceus +++ [114]
Australocirrus octonucleatus +++ [78]
Australocirrus oscitans +++ [20]
Australothrix alwinae +++ [20]
Australothrix australis +++ [20]
Australothrix simplex ++ [252]
Australothrix steineri +++ [93]
Avestina acuta ++ [26, 84]
Avestina ludwigi +++ [84]
Bakuella edaphoni +++ [23, 212]
Bakuella pampinaria +++ [23, 47]
Balantidioides bivacuolata +++ [111, 119, 127, 155, 230, 240]
Balantidioides corbifera +++ [111, 119]
Balantidioides dragescoi +++ [111]
Balantidioides muscicola + [152, 179]
Bardeliella pulchra +++ [69, 84]
Bicoronella costaricana +++ [93]
Birojimia muscorum +++ [11, 65, 155]
Birojimia terricola +++ [11]
Blepharisma americanum +++ [107, 139, 226]
Blepharisma biancae + [163]
Blepharisma bimicronucleatum +++ [81, 139, 234]
Blepharisma hyalinum +++ [27, 81, 139, 180]
Blepharisma lateritium +++ [81, 115, 124, 139, 155, 160]
Blepharisma ovatum + [139, 155, 179, 219]
Blepharisma steini +++ [4, 20, 81, 139, 155]
Blepharisma undulans +++ [81, 139, 155, 216]
Brachonella cydonia ++ [144, 150, 155]
Bresslaua insidiatrix +++ [84]

Species
Bresslaua sicaria + [84]
Bresslaua vorax +++ [84, 154]
Bresslauides australis +++ [20, 84]
Bresslauides discoideus +++ [84, 154]
Bresslauides terricola +++ [75, 84]
Bryometopus alekperovi ++ [3]
Bryometopus atypicus +++ [61, 84]
Bryometopus balantidioides +++ [84]
Bryometopus edaphonus + [28, 61, 84]
Bryometopus hawaiiensis +++ [89]
Bryometopus pseudochilodon +++ [84, 155]
Bryometopus sphagni +++ [3, 84, 155, 179]
Bryometopus triquetrus +++ [84]
Bryophrya bavariensis +++ [84, 154, 240]
Bryophrya rubescens ++ [84, 179]
Bryophyllum loxophylliforme ++ [154]
Bryophyllum tegularum +++ [69, 154]
Bursaria truncatella +++ [84]
Chaena clavata + [132]
Chaenea humicola + [130]
Chilodonella aplanata + [154]
Chilodonella pigra + [164]
Chilodonella uncinata +++ [114, 154]
Chilodontopsis muscorum +++ [69, 154]
Chilophrya terricola +++ [69]
Chlamydonella alpestris +++ [114]
Cinetochilum margaritaceum +++ [116]
Cinetochilum marinum ++ [185]
Circinella arenicola +++ [88]
Circinella filiformis +++ [65, 88]
Circinella vettersi +++ [11, 88]
Cirrophrya australis ++ [84]
Cirrophrya haptica ++ [84]
Cirrophrya terricola +++ [77, 84]
Cladotricha australis +++ [20]
Colpoda aspera +++ [4, 84, 148, 154]
Colpoda atra + [4]
Colpoda augustini +++ [75, 84]
Colpoda californica + [84, 154]
Colpoda cavicola +++ [84, 157]
Colpoda colpidiopsis ++ [4, 84, 154]
Colpoda cucullus +++ [4, 84, 154]
Colpoda ecaudata +++ [84, 114]
Colpoda edaphoni +++ [84]
Colpoda elliotti +++ [4, 84]
Colpoda flavicans +++ [84]
Colpoda henneguyi +++ [84, 154]
Colpoda inflata +++ [4, 84, 154, 206]
Colpoda irregularis ++ [84, 154]
Colpoda lucida +++ [4, 84, 135]
Colpoda magna +++ [84, 137]
Colpoda maupasi +++ [84, 154]
Colpoda minima +++ [84]
Colpoda orientalis +++ [84]
Colpoda praestans ++ [84, 179]
Colpoda reniformis + [84, 154]
Colpoda simulans + [84, 154]

Table 3. continued.

Species
Colpoda steinii +++ [84, 154]
Colpoda tripartita +++ [20, 84, 154, 230]
Colpoda variabilis +++ [84]
Colpodidium caudatum +++ [93, 243]
Colpodidium viridis +++ [147, 170]
Condylostoma terricola +++ [93]
Corallocolpoda grelli +++ [84]
Corallocolpoda pacifica +++ [84]
Coriplites terricola +++ [78]
Corticocolpoda kaneshiroae +++ [86]
Cosmocolpoda naschbergeri +++ [84, 105]
Cothurnia minutissima ++ [157, 177, 239]
Cothurnia richtersi ++ [157, 177, 179, 239]
Cothurniopsis valvata ++ [157, 224, 239]
Cyclidium glaucoma +++ [95, 116, 154]
Cyclidium muscicola +++ [93, 154]
Cyclidium terricola + [154]
Cyrtohymena australis +++ [93]
Cyrtohymena balladynula ++ [81, 155]
Cyrtohymena candens +++ [65, 81, 155]
Cyrtohymena candens depressa ++ [81, 126]
Cyrtohymena citrina +++ [8, 81]
Cyrtohymena gracilis + [81, 155]
Cyrtohymena granulata + [81, 155]
Cyrtohymena muscorum +++ [11, 26, 65, 81, 129, 155, 254]
Cyrtohymena primicirrata +++ [8, 69]
Cyrtohymena quadrinucleata +++ [43, 69, 81]
Cyrtohymena tetracirrata +++ [8, 81, 126]
Cyrtolophosis acuta +++ [84, 148]
Cyrtolophosis colpidiformis +++ [84]
Cyrtolophosis elongata +++ [27, 84, 154, 230]
Cyrtolophosis minor +++ [84]
Cyrtolophosis mucicola +++ [84, 154]
Dapedophrya flexilis +++ [84, 93, 179]
Deviata bacilliformis +++ [8, 45, 125]
Didinium nasutum +++ [69, 117, 152]
Dileptus alpinus +++ [39, 81, 154, 240]
Dileptus americanus ++ [39, 154]
Dileptus anguillula +++ [39, 64, 69, 154]
Dileptus binucleatus ++ [39, 154]
Dileptus conspicuus +++ [39, 81, 154]
Dileptus conspicuus telobivacuolatus ++ [39, 128]
Dileptus costaricanus +++ [93]
Dileptus edaphoni +++ [205]
Dileptus falciformis ++ [39, 154]
Dileptus gracilis +++ [39, 81, 154]
Dileptus kahli +++ [98, 205, 214]
Dileptus margaritifer +++ [39, 117]
Dileptus mucronatus +++ [39, 69, 179, 206]
Dileptus orientalis +++ [211]
Dileptus polyvacuolatus +++ [81]
Dileptus similis +++ [93]
Dileptus tenuis ++ [39, 154, 179]
Dileptus terrenus +++ [64, 69]
Dileptus visscheri ++ [39]
Dimacrocaryon amphileptoides +++ [39, 69, 145, 154, 240]
Drepanomonas dentata ++ [118, 154, 179, 186]
Drepanomonas exigua ++ [154, 179]
Drepanomonas muscicola +++ [77, 250]
Drepanomonas pauciciliata +++ [77]

Species
Drepanomonas revoluta +++ [27, 77, 129, 143, 154, 163, 240]
Drepanomonas sphagni +++ [77, 154]
Enchelydium piliforme +++ [69, 102, 152, 153]
Enchelydium polynucleatum +++ [69, 103]
Enchelydium terrenum +++ [69]
Enchelyodon californicus + [157]
Enchelyodon lagenula +++ [20, 152, 153]
Enchelyodon longinucleatus +++ [69]
Enchelyodon nodosus +++ [14]
Enchelyodon terrenus +++ [69]
Enchelyodon tratzi +++ [74]
Enchelyomorpha vermicularis +++ [6, 106, 132, 152, 153, 200]
Enchelyotricha binucleata +++ [77]
Enchelys multimicronucleata ++ [4]
Enchelys multinucleata +++ [14, 41]
Enchelys terricola +++ [77]
Enchelys tokkuri + [193]
Enchelys vermiformis +++ [77]
Engelmanniella mobilis +++ [51, 65, 246, 247]
Epispathidium amphoriforme +++ [69, 128, 135, 152, 179]
Epispathidium ascendens +++ [77, 241]
Epispathidium papilliferum +++ [69, 152, 153]
Epispathidium regium +++ [69]
Epispathidium terricola +++ [77]
Epistylis alpestris +++ [57, 59]
Erniella filiformis +++ [75]
Eschaneustyla brachytona +++ [44, 65, 220]
Euplotes corsica +++ [11]
Euplotes finki +++ [65, 257]
Euplotes labiatus +++ [20, 188]
Euplotes muscicola +++ [40, 65, 155, 204]
Euplotes terricola + [179]
Frontonia depressa +++ [77, 126, 154, 179, 221]
Frontonia parameciiformis + [240]
Frontonia solea ++ [77]
Frontonia terricola +++ [77]
Furgasonia trichocystis +++ [81, 144, 154, 225]
Fuscheria lacustris +++ [210]
Fuscheria nodosa +++ [68, 107]
Fuscheria terricola +++ [4, 13, 104]
Gastronauta derouxi +++ [21]
Gastronauta membranaceus +++ [4, 21, 76, 114]
Gastrostyla dorsicirrata +++ [65]
Gastrostyla minima +++ [98, 138]
Gastrostyla muscorum ++ [155]
Gastrostyla steinii +++ [51, 65, 155, 194]
Glaucoma gigantea + [132, 133]
Gonostomum affine +++ [26, 28, 65, 126, 129, 130, 165, 192, 213, 215, 217, 240]
Gonostomum kuehnelti +++ [77]
Gonostomum strenua +++ [51, 165, 202, 217]
Grandoria aculeata + [33, 84, 132]
Grossglockneria acuta +++ [84]
Grossglockneria hyalina +++ [84]
Halteria grandinella +++ [114, 155, 227]
Halterioforma caudata + [143]
Haplocaulus terrenus +++ [63]
Hastatella radians +++ [57, 115, 157]
Hausmanniella discoidea +++ [69, 84, 129]
Hausmanniella patella +++ [69, 84, 154]

Table 3. continued.

Species
Hausmanniella quinquecirrata + [84, 128]
Hemiamphisiella granulifera +++ [75, 78]
Hemiamphisiella quadrinucleata +++ [69, 78]
Hemiamphisiella terricola +++ [20, 44, 49, 69, 75, 209]
Hemiamphisiella wilberti +++ [65, 78]
Hemisincirra gellerti +++ [65, 69]
Hemisincirra gracilis +++ [65, 69]
Hemisincirra heterocirrata ++ [138]
Hemisincirra inquieta +++ [8, 11, 138]
Hemisincirra interrupta +++ [65, 69]
Hemisincirra kahli ++ [26, 138]
Hemisincirra muelleri +++ [71]
Hemisincirra octonucleata ++ [138]
Hemisincirra polynucleata +++ [69]
Hemisincirra pori ++ [73, 244]
Hemisincirra quadrinucleata ++ [138]
Hemisincirra similis +++ [65, 69]
Hemisincirra vermiculare ++ [138]
Hemisincirra wenzeli +++ [75]
Holophrya bimacronucleata + [132, 133]
Holosticha adami +++ [65]
Holosticha australis +++ [20]
Holosticha bergeri +++ [75]
Holosticha distyla ++ [27]
Holosticha islandica +++ [11]
Holosticha longiseta + [164]
Holosticha manca mononucleata + [23, 128]
Holosticha manca plurinucleata ++ [23, 128]
Holosticha monilata +++ [23, 102, 114, 151, 155]
Holosticha multistilata +++ [23, 27, 65, 114, 151, 155, 195]
Holosticha muscicola ++ [23, 129]
Holosticha muscorum +++ [23, 65, 155]
Holosticha sigmoidea +++ [23, 65, 69]
Holosticha stueberi +++ [74]
Holosticha sylvatica +++ [11, 23, 65, 195]
Holosticha tetracirrata +++ [20, 23, 28, 65]
Holostichides chardezi +++ [75]
Holostichides terricola +++ [78]
Holostichides typicus +++ [44, 208]
Holostichides wilberti +++ [44, 203]
Homalogastra setosa +++ [27, 112, 132, 154, 185]
Idiocolpoda pelobia +++ [85]
Ilsiella palustris +++ [84]
Ilsiella venusta +++ [75, 84]
Jaroschia sumptuosa +++ [84]
Kahliella acrobates ++ [33, 140]
Kahliella simplex +++ [8, 33, 142]
Kahlilembus attenuatus +++ [112, 116, 136, 154]
Kalometopia duplicata +++ [84, 179]
Keronella gracilis +++ [242]
Keronopsis algivora ++ [126]
Keronopsis dieckmanni +++ (this paper)
Keronopsis helluo ++ [155, 179]
Keronopsis tasmaniensis +++ [20]
Keronopsis wetzeli +++ [8, 240]
Keronopsis alpestris + [155]
Krassniggia auxiliaris +++ [75, 84]
Kreyella muscicola + [84, 154]
Kuehneltiella muscicola +++ [84]
Kuehneltiella terricola +++ [84]

Species
Kuklikophrya ougandae +++ [42, 84]
Lacrymaria pulchra ++ [240]
Lagynophrya armata + [157]
Lagynophrya geleii +++ [64]
Lagynophrya trichocystis +++ [64]
Lamtostyla abdita +++ [97]
Lamtostyla australis +++ [20, 78, 183, 255]
Lamtostyla edaphoni +++ [8, 9, 183]
Lamtostyla granulifera +++ [97]
Lamtostyla hyalina +++ [9, 14]
Lamtostyla islandica +++ [9]
Lamtostyla kirkeniensis +++ [9]
Lamtostyla lamottei ++ [9, 27]
Lamtostyla longa ++ [9, 138]
Lamtostyla perisincirra +++ [9, 14, 138]
Lamtostyla raptans ++ [97, 138]
Laurentiella strenua +++ [11, 38]
Leptopharynx costatus +++ [4, 81, 116, 126, 154, 169, 175, 240]
Leptopharynx eurystoma +++ [154, 175]
Linostoma vorticella +++ [115, 146]
Litonotus crinitus + [132]
Litonotus digitatus + [132]
Litonotus muscorum +++ [20, 154]
Maryna acuminata ++ [84, 128]
Maryna antarctica +++ [84]
Maryna atra +++ [84]
Maryna lichenicola +++ [84]
Maryna minima ++ [84]
Maryna ovata +++ [84]
Maryna pinguis + [38, 84]
Maryna rotunda ++ [38, 84]
Maryna socialis + [84, 137]
Maryna umbrellata ++ [84]
Metacineta micraster ++ [7, 166, 178]
Metacineta mystacina +++ [117, 166]
Metopus contractus + [155, 179]
Metopus es +++ [115, 144, 155]
Metopus hasei +++ [63, 155, 201]
Metopus ovalis +++ [150, 155, this paper]
Metopus palaeformis ++ [144, 150, 155]
Metopus rectus ++ [61, 155]
Metopus setosus ++ [144, 150, 155]
Metopus setosus minor ++ [61, 150, 155]
Microdiaphanosoma arcuatum +++ [63, 84, 132, 240]
Microdiaphanosoma terricola +++ [84]
Microthorax simulans +++ [70, 148, 154]
Monodinium balbiani +++ [117]
Mycterothrix tuamotuensis ++ [84, 154]
Mykophagophrys terricola +++ [84, 93]
Nassula citrea +++ [50, 154]
Nassula picta +++ [81, 116, 179, 230]
Nassula protectissima + [154, 179]
Nassula terricola +++ [81]
Nassula tumida obscura + [164]
Neogeneia hortualis +++ [45]
Nivaliella plana +++ [84]
Notohymena antarctica +++ [95]
Notohymena australis +++ [20, 107]
Notohymena rubescens +++ [20, 253]
Notohymena selvatica ++ [20, 138]

Table 3. continued.

Species
Notoxoma parabryophryides +++ [84]
Notoxoma sigmoides +++ [84]
Obertrumia kahli +++ [81]
Odontochlamys alpestris +++ [21, 64, 184]
Odontochlamys convexa +++ [21, 154, 230]
Odontochlamys gouraudi +++ [27, 29, 80, 154, 179, 240]
Odontochlamys wisconsinensis +++ [154, 184]
Onychodromopsis flexilis +++ [183, 222]
Opercularia arenicola + [134]
Opercularia asymmetrica +++ [1, 18]
Opercularia curvicaule +++ [19, 63, 157, 179]
Ophryoglena marginata + [135]
Opisthonecta minima +++ [56]
Opisthotricha elongata + [132]
Opisthotricha procera + [155]
Opisthotricha terricola + [130]
Orthoamphisiella franzi +++ [10, 45, 65]
Orthoamphisiella grelli +++ [48]
Orthoamphisiella stramenticola +++ [46, 48]
Orthokreyella schiffmanni +++ [69, 84]
Oxytricha auripunctata +++ [20]
Oxytricha bimembranata + [192]
Oxytricha gigantea +++ [8, 10, 141]
Oxytricha granulifera +++ [101]
Oxytricha granulifera quadricirrata +++ [20]
Oxytricha hengshanensis ++ [252]
Oxytricha histrioides + [130]
Oxytricha islandica +++ [11]
Oxytricha lanceolata +++ [8, 11, 95, 193]
Oxytricha longigranulosa +++ [11]
Oxytricha nauplia +++ [8]
Oxytricha opisthomuscorum +++ [114, 155, 184]
Oxytricha ottowi +++ [94]
Oxytricha proximata + [193]
Oxytricha pseudosimilis ++ [138]
Oxytricha quercineti + [163]
Oxytricha rubripuncta +++ [8]
Oxytricha setigera +++ [27, 42, 65, 114, 210]
Oxytricha siseris +++ [65, 237]
Oxytricha tricirrata ++ [27]
Papillorhabdos multinucleatus +++ [69]
Parabryophrya penardi +++ [84, 154]
Paracineta lauterborni +++ [93, 201]
Paraenchelys terricola +++ [69]
Paraenchelys wenzeli +++ [69]
Parafurgasonia sorex +++ [42, 99, 179]
Paragastrostyla lanceolata ++ [138]
Paraholosticha lichenicola ++ [128]
Paraholosticha muscicola +++ [36, 37, 75, 155]
Paraholosticha nana + [128]
Parakahliella haideri +++ [12]
Parakahliella macrostoma +++ [15, 65]
Parakahliella terricola ++ [15, 26]
Paramphisiella acuta +++ [65, 78]
Paramphisiella caudata +++ [49, 78, 138]
Paraurostyla granulifera +++ [11]
Paraurostyla polynucleata ++ [4]
Paraurostyla pulchra ++ [26]
Pattersoniella vitiphila +++ [75]
Pedohymena australiense +++ [93]

Species
Pelagotrichidium tisiae +++ [42, 114, 146]
Pentahymena corticicola +++ [90]
Periholosticha acuminata ++ [138]
Periholosticha lanceolata ++ [138]
Phacodinium metchnicoffi +++ [29, 40, 42, 54, 155, 196]
Phialina binucleata +++ [14]
Phialina flagellifera + [130]
Phialina terricola +++ [28, 69]
Phialinides australis +++ [78]
Plagiocampa atra + [132, 133]
Plagiocampa caudata + [4]
Plagiocampa difficilis +++ [64]
Plagiocampa rouxi +++ [58, 148, 152]
Platycola longicollis ++ [157, 158, 238]
Platycola steineri ++ [157, 177, 238]
Platyophrya binucleata +++ [75, 84]
Platyophrya macrostoma +++ [84]
Platyophrya paoletti +++ [97]
Platyophrya similis +++ [84]
Platyophrya spumacola +++ [27, 84, 143, 149, 152, 163]
Platyophrya vorax +++ [84, 148, 152]
Platyophryides dragescoi +++ [75, 84]
Platyophryides latus +++ [41, 84, 128, 152]
Platyophryides magnus +++ [84]
Pleuroplites australis +++ [78]
Pleuroplitoides smithi +++ [95]
Podophrya halophila +++ [20, 156]
Protocyclidium terrenum ++ [4]
Protospathidium bonnetti +++ [27, 42, 64]
Protospathidium muscicola +++ [14, 41, 184]
Protospathidium serpens +++ [64, 95, 152, 184]
Protospathidium terricola +++ (this paper and [184])
Pseudocarchesium claudicans +++ [81, 179]
Pseudochilodonopsis mutabilis +++ [64, 79, 126, 184]
Pseudochilodonopsis polyvacuolata +++ [98, 102]
Pseudocohnilembus marinus +++ [110, 228]
Pseudocohnilembus pusillus +++ [5, 53, 110, 116, 185, 187]
Pseudocohnilembus putrinus +++ [110, 151, 154]
Pseudocyrtolophosis alpestris +++ [84]
Pseudocyrtolophosis terricola +++ [84]
Pseudoglaucoma muscorum + [84, 154, 240]
Pseudoholophrya terricola +++ [14]
Pseudokreyella terricola +++ [84]
Pseudokreyella australis +++ [84]
Pseudomicrothorax agilis +++ [32, 116, 169, 176, 213, 240]
Pseudomicrothorax dubius +++ [32, 116, 167, 176, 179]
Pseudoplatyophrya nana +++ [84, 148]
Pseudoplatyophrya saltans +++ [78, 84]
Pseudothuricola dionysii ++ [157, 179, 231]
Pseudouroleptus buitkampi +++ [8, 65]
Pseudouroleptus procerus +++ [8]
Pseudouroleptus terrestris ++ [138]
Pseudourostyla franzi +++ [75]
Pseudovorticella mutans +++ [60, 179]
Pseudovorticella sphagni +++ [60, 93, 109]
Psilotricha succisa +++ [67, 173]
Pyxidium longicollum + [19]
Pyxidium tardigradum ++ [233]
Reticulowoodruffia terricola +++ [84]
Rhabdostyla arborea + [135]

Table 3. continued.

Species
Rhabdostyla muscorum + [157]
Rhabdotricha terricola + [135]
Rhopalophrya elegans + [143]
Rhopalophrya pentacerca + [132]
Rostrophrya camerounensis +++ [42, 84, 98]
Rostrophrya terricola +++ [84]
Rostrophryides africana +++ [75, 84]
Rostrophryides australis +++ [20, 84]
Sagittaria australis +++ [84, 185]
Sagittaria hyalina +++ [84]
Sagittaria poligonalis + [84, 132, 133]
Sathrophilus muscorum +++ [27, 33, 112, 116, 154]
Sathrophilus simonis + [33, 163]
Semiplatyophrya foissneri +++ [84, 244]
Solenophrya flavescens ++ [166, 178]
Solenophrya massula ++ [166, 178]
Solenophrya sacculus ++ [166, 178]
Sorogena stoianovitchae +++ [84]
Spathidium alpinum ++ [129]
Spathidium anguilla +++ [6, 69, 185, 235]
Spathidium bavariense ++ [152, 153, 230, 240]
Spathidium claviforme +++ [77, 152, 153]
Spathidium falciforme + [152, 179]
Spathidium furcatum + [193]
Spathidium geobium + [164]
Spathidium holsatiae ++ [152, 153]
Spathidium lagyniforme +++ [69, 152]
Spathidium longicaudatum +++ [26, 28, 64]
Spathidium multinucleatum + [128]
Spathidium muscicola ++ [4, 14, 27, 152, 153, 185, 206]
Spathidium procerum +++ [4, 69, 152, 153]
Spathidium rusticanum ++ [64]
Spathidium scalpriforme ++ [152, 153]
Spathidium seppelti +++ [184]
Spathidium spathula +++ [69, 126, 152, 171, 172, 240]
Spathidium spathuloides + [128]
Spetazoon australiense +++ [87]
Sphaerophrya parva + [135, 166]
Sphaerophrya terricola ++ [71, 166]
Spirofilopsis tubicola + [38, 137]
Stammeridium kahli +++ [70, 240]
Steinia platystoma ++ [27, 114]
Sterkiella cavicola +++ [8, 27, 114, 157]
Sterkiella histriomuscorum +++ [6, 15, 65, 114, 143, 155, 184]
Sterkiella similis f. *tricirrata* ++ [27]
Sterkiella thompsoni +++ [95]
Stichotricha aculeata +++ [61, 114, 248]
Stichotricha socialis ++ [137]
Strongylidium californicum + [155]
Strongylidium muscorum + [155]
Stylonychia bifaria +++ [222, 245]
Stylonychia mytilus +++ [65, 114, 172]
Stylonychia pustulata +++ [114, 173]
Stylonychia quadrinucleata ++ [5]
Stylonychia stylomuscorum ++ [114, 155]
Tachysoma granulifera +++ [8]
Tachysoma humicola +++ [69, 130]
Tachysoma humicola longisetum +++ (this paper)
Tachysoma terricola ++ [138]
Tectohymena terricola +++ [84]

Species
Telostomatella ferroi + [84, 133]
Telotrochidium cylindricum +++ [14, 59]
Terricirra livida +++ [9, 11]
Terricirra matsusakai +++ [11]
Terricirra viridis +++ [11, 65]
Territricha stramenticola +++ [9]
Tetrahymena edaphoni +++ [77]
Tetrahymena rostrata +++ [4, 31, 77, 130, 148, 154]
Thuricola innixa ++ [157, 177, 218, 223, 231, 239]
Thuricola kellicottiana ++ [115, 157, 223, 231]
Thylakidium typicum + [84, 128]
Tokophrya muscicola ++ [166, 178]
Trachelochaeta gonostomoida ++ [138]
Trachelophyllum apiculatum +++ [68, 69, 117, 181, 206]
Tricoronella pulchra +++ [20]
Trihymena terricola +++ [78, 84]
Trithigmostoma bavariensis +++ [73, 76, 79, 154, 230]
Urliella terricola +++ [81]
Uroleptoides kihni + [22, 240]
Uroleptus humicola ++ [129]
Uroleptus lepisma +++ [11, 240]
Uroleptus matthesi + [240]
Uroleptus musculus +++ [69, 114, 155]
Uroleptus notabilis +++ [8, 20, 65, 95]
Uronema nigricans +++ [4, 116, 173]
Urosoma acuminata +++ [65, 155, 222]
Urosoma cienkowskii +++ [65, 69, 155, 159]
Urosoma karini +++ [74]
Urosoma macrostoma ++ [130]
Urosoma macrostyla +++ [65, 66, 155, 248, 249]
Urosoma octonucleata +++ [11]
Urosomoida agiliformis +++ [65, 100, 120]
Urosomoida agilis +++ [25, 51, 65, 138]
Urosomoida antarctica +++ [95]
Urosomoida dorsiincisura +++ [65]
Urosomoida granulifera +++ [95]
Urosomoida minima ++ [138]
Urostyla grandis +++ [114, 213]
Urostyla muscorum ++ [155]
Urotricha atypica ++ [4]
Urotricha mamilla + [164]
Urotricha terricola ++ [5]
Vaginicola chaperoni ++ [157, 177, 179, 239]
Vaginicola doliolum ++ [157, 177, 179, 239]
Vaginicola terricola ++ [135, 177, 179]
Vaginicola virgula ++ [157, 177, 179, 239]
Vorticella astyliformis +++ [63, 115]
Vorticella coeni + [163]
Vorticella infusionum +++ [115]
Vorticella lichenicola ++ [135, 179]
Vorticella microstoma +++ [115]
Vorticella muralis ++ [179]
Vorticella operculariformis +++ [60]
Vorticella pileolata + [163]
Vorticella similis +++ [63, 115]
Wallackia bujoreani +++ [11, 164]
Woodruffia australis +++ [84]
Woodruffia rostrata +++ [75, 84, 154]
Woodruffides metabolicus +++ [84]
Woodruffides terricola +++ [75, 84]

Table 4. Statistics and ecological characteristics of the soil ciliate community (extracted from Tables 2 and 3).

Characteristics	According to Tables 2, 3		According to Tables 2, 3 plus 500 undescribed species[1]	
	number of species	%	number of species	%
Total number of species described	643	100.0	–	–
Valid species	594	92.4	1092	100.0
Synonyms	49	7.6		not determined
Excellently described species	409	68.9		not determined
Sufficiently described species	107	17.9		not determined
Poorly described species	78	13.2	none	
Colpodids	129	21.8	146	13.4
Cyrtophorids	14	2.2	16	1.5
Gymnostomatids	105	17.8	289	26.5
Heterotrichs	24	4.1	35	3.2
Hymenostomes	23	4.0	35	3.2
Hypotrichs	214	36.0	429	39.2
Nassulids	26	4.4	50	4.6
Oligotrichs	1	0.1	3	0.3
Peritrichs	35	5.9	40	3.7
Prostomatids	10	1.7	22	2.0
Suctorians	12	2.0	26	2.4
Small species (biomass ≤100mg/10^6cells)	416	70.9		not determined
Large species (biomass ≥400mg/10^6 cells)	48	8.2		not determined
Mean Biomass of 10^6 specimens	241	–		not determined
Omnivores[2]	103	20.2		not determined
Mainly bacteriovorous	196	38.5		not determined
Mainly predaceous	172	34.1		not determined
Mainly (filamentous) cyanobacteria	18	3.6		not determined
Mainly mycophagous	8	1.6		not determined
Aerobics	582	98.3	1074	98.4
Anaerobics	10	1.7	18	1.6
Occurring only in terrestrial habitats (***)	133	22.5	397	36.4
Probably occurring only in terrestrial habitats (**)	310	52.2	519	47.6
Occurring in soil and freshwater (*)	151	25.3	174	16.0
Recorded from 1 geographical region only	265	44.5		not determined
Recorded from 2 geographical regions only	95	16.0		not determined
Recorded from 3 geographical regions only	64	10.8		not determined
Recorded from 4 geographical regions	103	17.4		not determined
Recorded from all (5) geographical regions	67	11.3		not determined
Species recorded from Holarctis	483	81.2		not determined
Species recorded from Palaeotropis	290	49.0		not determined
Species recorded from Australis	251	42.4		not determined
Species recorded from Neotropis	259	43.9		not determined
Species recorded from Archinotis	101	17.1		not determined

[1] I have not yet described these species, which I found in about 1000 soil samples worldwide, but fully studied in live and silver slides. Many belong to new genera or to genera as yet known from soil only.
[2] Feeding on ≥ than three items.

the reliable biogeographic information is still much too incomplete and most of the rare species possibly have not yet been discovered due to methodological problems [96]. In spite of this, the present data set is probably the most complete and reliable available, not only for soil ciliates but also for ciliates in general. Thus, some preliminary conclusions should be possible.

Only about 30% of the soil ciliate species have been found in more than three out of five biogeographical regions, and 44% have been recorded from one region only (Tab. 4). These figures suggest a high degree of endemism. However, they are very likely strongly biased due to the very limited data available. To mention only two examples: When *Trihymena terricola* was discovered in African soils in 1988, I supposed that it could be endemic because of the unique organisation of its oral apparatus. Later it was found in many soils world-wide [16, 84; Tab. 2], indicating that we previously overlooked or misidentified this minute creature. Likewise, the bipolar biogeography of the genus *Colpoda*, suggested by Smith [197], did not withstand a more detailed analysis and was caused by methodological shortcomings [95].

Thus, it is probably more accurate to select the data very rigorously, that is to look at conspicuous species ("flagships" with large size or other very distinct characters) which are easily recognised and identified. Such species are, for example, *Apobryophyllum terricola*, *Australothrix* spp., *Bresslauides australis*, *Cosmocolpoda naschbergeri*, *Erniella filiformis*, *Jaroschia sumptuosa*, *Keronopsis tasmaniensis*, *Krassniggia auxiliaris*, *Periholosticha* spp. and *Tricoronella pulchra*, which have so far been found only in the Palaeotropis and/or Australis, whereas, e.g., *Amphisiella quadrinucleata*, *Bresslauides discoideus*, *Chilophrya terricola*, *Hemiamphisiella quadrinucleata*, *Kalometopia duplicata*, *Keronopsis wetzeli*, *Orthoamphisiella franzi* and *Wallackia bujoreani* have been found only in the Holarctic. These data, especially the limited distribution of the two most conspicuous species, viz. *Krassniggia auxiliaris* and *Bresslauides discoideus*, both belonging to the order Colpodida, suggest that at least some species have a limited Gondwanan or Laurasian distribution. However, even this example is not entirely convincing because both species are very rare and the limited distribution could thus be caused by undersampling.

Description of new and insufficiently known species

Protospathidium terricola nov. spec. (Figs. 2–13, Tab. 5)

Diagnosis: Size in vivo about 90×25 µm. Elongate saccular with anterior portion usually slightly narrowed and curved. Macronucleus elongate reniform (3.5:1). Extrusomes rod-shaped, about 5 µm long. On average 21 somatic kineties with 40 basal bodies each, 3 of them anteriorly differentiated to distinct brush on dorsal side.

Type location: Grassland soil from Mt. Kenya near the lodge "The Ark", Mount Kenya National Park, Kenya, equatorial Africa (about 37° E, 0° N).

Etymology: *terricola* because living in soil.

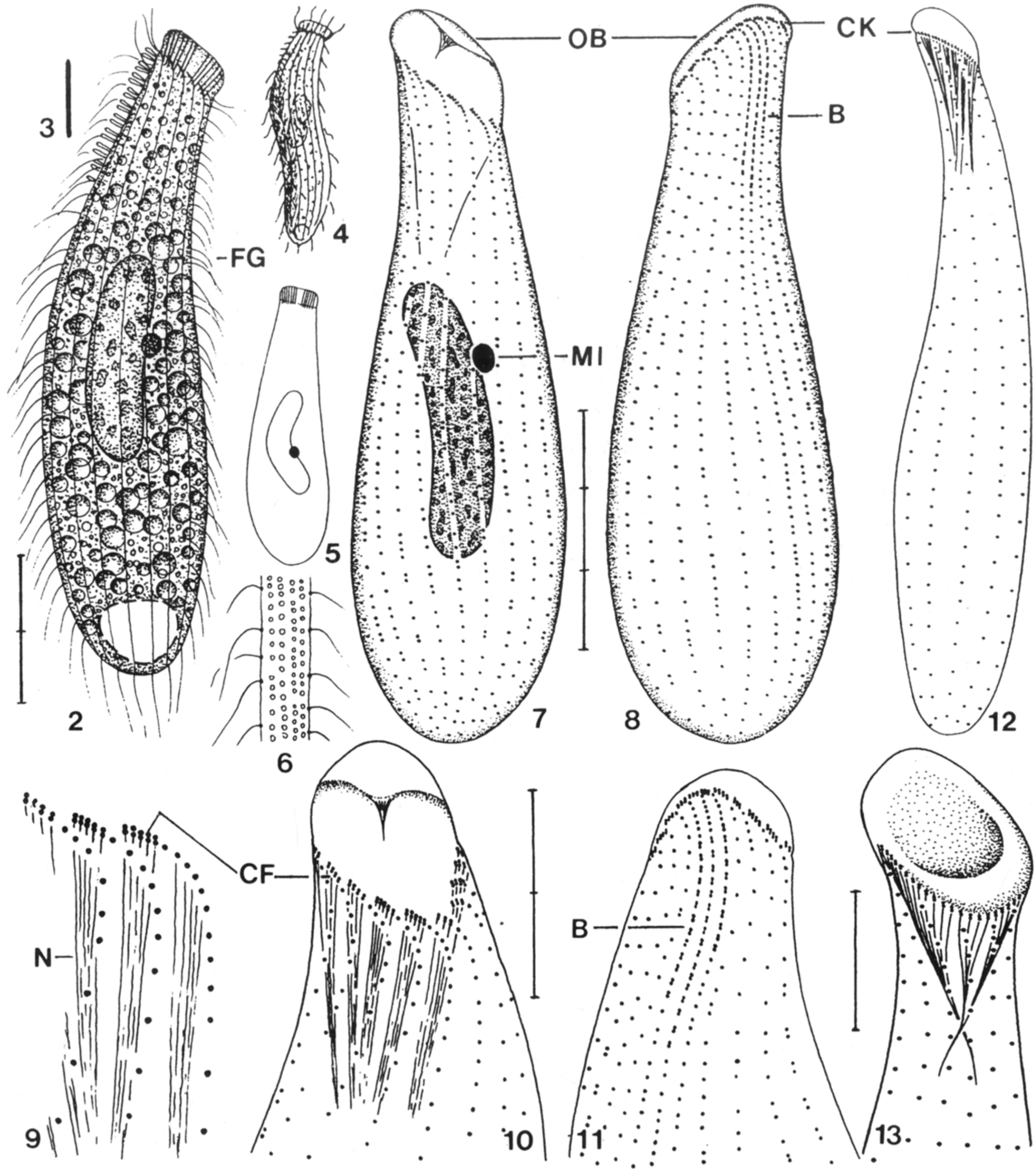
Description: Size in vivo 70–100×20–30 µm. Elongate saccular, usually looking like a swimming sausage, anterior portion frequently slightly curved, middle and posterior portion more or less distinctly inflated, depending on nutritional state (Figs. 2, 5). Unflattened, except for slightly compressed anterior third. Macronucleus in mid-body, elongate reniform, rarely slenderly ellipsoidal, contains many tiny nucleoli. Micronucleus globular, attached to macronucleus, but not in fixed position. Contractile vacuole in posterior end. Extrusomes mainly in oral bulge, rod-shaped, about 5 µm long (Fig. 3). Cortex flexible, contains about four rows of minute, colourless granules between each two kineties (Fig. 6). Cytoplasm usually packed with fat globules 0.5–3 µm across. Swims moderately fast by rotation about longitudinal body axis.

Cilia 10–12 µm long, rather unevenly spaced. Somatic kineties evenly spaced, extend meridionally, anterior ends conspicuously curved and composed of 3–6 distinct dikinetids associated with long, fine nematodesmata. Dorsal brush of usual structure, i.e. composed of narrowly spaced dikinetids having short, slightly inflated cilia; at anterior end of each brush kinety 2–6 monokinetids (Figs. 7–11).

Oral bulge conspicuous, although indistinctly set off from neck, because rather high and refractile due to the extrusomes contained. Bulge centre depressed funnel-like. Circumoral kinety discontinuous because anterior dikinetidal fragments adhering to their respective somatic kineties separated by small gaps (Figs. 2, 7, 9–11).

Generic classification and comparison with related species: *Protospathidium terricola* has the typical generic character of *Protospathidium* [41], viz. a discontinuous circumoral kinety composed of small dikinetidal fragments. These fragments adhere to the anterior end of the somatic kineties and are separated from each other by a narrow gap (Figs. 9–11), unlike in *Spathidium* (Figs. 12, 13) and *Arcuospathidium* [69], where the fragments are fused to a single, continuous row [69].

Protospathidium terricola is a difficult species because it has few distinct characters and is thus, in life, easily confused with several congeners and with *Spathidium claviforme*, which have a similar size, shape and macronucleus; in fact, it was only a fortunate chance that I did not confuse it with *S. claviforme* during the routine inspection of the sample, i.e. recognised the discontinuous circumoral kinety! *Spathidium clavi-*



Figs. 2–13. *Protospathidium terricola* (2, 3, 5–11), *Spathidium vermiculus* (4, from [148]), and *S. claviforme* (12, 13, from [77]) from life (2–6) and after protargol impregnation (7–13). **2.** Right lateral view of typical specimen packed with fat globules. **3.** Extrusome (5 µm) at high magnification. **4.** *Spathidium vermiculus*, length 40–50 µm. **5.** Saccular shape variant of *P. terricola*. **6.** Surface view showing cortical granules. **7, 8, 12.** Infraciliature of right (7, 12) and left (8) side of *P. terricola* (7, 8) and *S. claviforme* (12). **9.** Oral kinetofragments at high magnification. The fragments do not form a continuous circumoral kinety, as they do in *S. claviforme* (13). **10, 11.** Infraciliature of anterior ventral and dorsal side. **13.** Infraciliature of anterior ventral side of *S. claviforme*, where the oral kinetofragments form a continuous circumoral kinety. B = dorsal brush, CF = (circum)oral kinetofragments, CK = circumoral kinety, FG = fat globules, MI = micronucleus, N = nematodesmata, OB = oral bulge. Scale bar division 10 µm.

Table 5. Morphometric data from *Protospathidium terricola* (upper line) and *Apobryophyllum terricola* (lower line).

Character[1)]	x̄	M	SD	SE	CV	Min	Max	n
Body, length	80.7	82.0	9.6	3.0	11.9	65.0	93.0	10
	154.0	155.0	22.1	7.0	14.3	125.0	190.0	10
Body, maximum width	22.5	22.0	3.6	1.1	16.1	16.0	28.0	10
	21.2	20.5	5.9	1.9	28.0	16.0	35.0	10
Oral bulge, length	14.3	15.0	1.7	0.6	11.6	12.0	17.0	10
	–	–	–	–	–	–	–	–
Macronuclear figure, length	28.1	26.5	4.2	1.3	15.0	22.0	35.0	10
	60.4	61.0	12.8	4.0	21.1	40.0	80.0	10
Macronucleus, width	7.6	8.0	0.8	0.3	11.1	6.0	9.0	10
	3.9	4.0	1.2	0.4	30.7	2.0	6.0	10
Macronuclei, number	1.0	1.0	0.0	0.0	0.0	1.0	1.0	10
	1.0	1.0	0.0	0.0	0.0	1.0	1.0	10
Micronucleus, largest diameter	3.5	3.5	–	–	–	3.0	4.0	10
	2.3	2.1	–	–	–	2.0	3.0	10
Micronuclei, number	1.0	1.0	0.0	0.0	0.0	1.0	1.0	10
	8.8	8.0	2.8	1.2	31.5	6.0	13.0	5
Somatic kineties, number in mid-body	21.3	21.0	1.6	0.5	7.7	19.0	25.0	10
	16.0	16.0	2.3	0.7	14.1	13.0	19.0	10
Basal bodies in right lateral kinety, number	42.2	39.5	7.3	2.3	17.3	35.0	55.0	10
	63.3	65.0	–	–	–	55.0	70.0	3
Dorsal brush rows, number	3.0	3.0	0.0	0.0	0.0	3.0	3.0	10
	4.2	4.0	–	–	–	4.0	5.0	10
Circumoral kinety to end of brush row 1, distance	15.0	15.0	2.6	0.9	17.0	11.0	18.0	9
	19.1	20.0	1.9	0.6	10.1	15.0	22.0	10
Circumoral kinety to end of brush row 2, distance	18.0	18.0	2.1	0.7	11.5	15.0	21.0	9
	35.8	35.0	5.0	1.6	13.9	30.0	48.0	10
Circumoral kinety to end of brush row 3, distance	10.8	10.0	1.7	0.6	15.9	8.0	14.0	9
	40.3	40.0	5.6	1.8	14.0	35.0	55.0	10
Circumoral kinety to end of brush row 4, distance	–	–	–	–	–	–	–	–
	39.8	39.0	5.9	1.9	14.8	35.0	55.0	10

1) Data based on protargol-impregnated and mounted specimens from field. Measurements in µm. Abbreviations: CV = coefficient of variation in %, M = median, Max = maximum, Min = minimum, n = number of individuals investigated, SD = standard deviation, SE = standard deviation of mean, x̄ = arithmetic mean.

forme has fewer ciliary rows than *P. terricola* (10–13 vs. 19–25) and is a "true" *Spathidium* because the anterior kinetofragments are fused to a continuous circumoral kinety (Figs. 12, 13 [77]). This was confirmed by a reinvestigation of the neotype slides.

As concerns the congeners, *P. serpens* has fewer ciliary rows (11–13 vs. 19–25) and its macronucleus is longer and usually distinctly coiled and/or nodulated [64, 95, 184]. *Protospathidium muscicola* [41] has many small macronuclear nodules and only 10–12 ciliary rows.

Protospathidium terricola also resembles *Spathidium vermiculus* [148] which, however, is smaller (40–60 µm) and has a more cylindroid shape and only about 10 somatic kineties (Fig. 4 [148, 152, 251]).

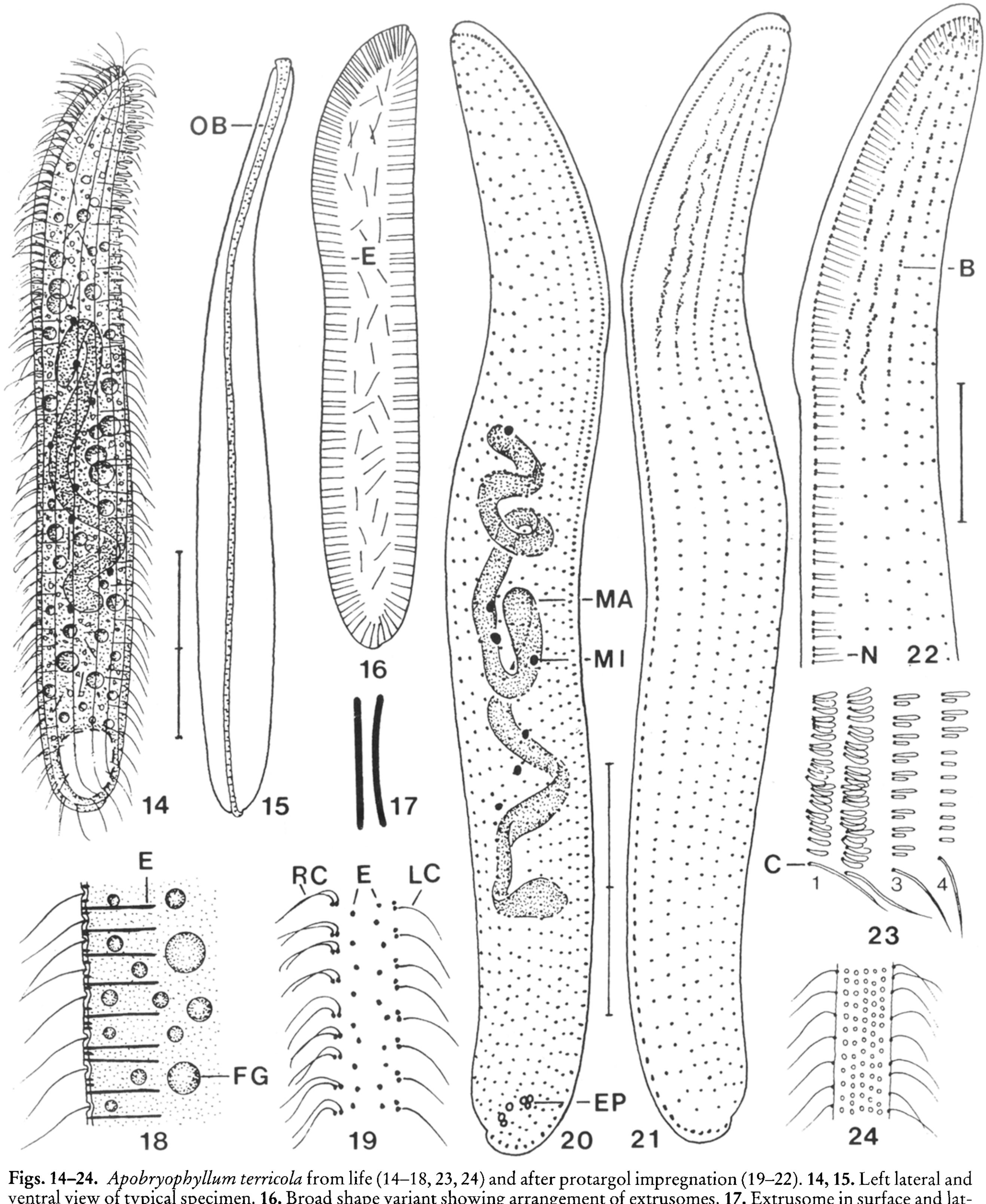
Apobryophyllum nov. gen.

Diagnosis: Spathidiidae with oral bulge extending to and around posterior end of organism. Dorsal brush on anterior left side of cell, left brush kineties regular and dikinetidal, right brush kineties fragmented and very likely monokinetidal.

Type species: *Apobryophyllum terricola* nov. spec.

Etymology: Composite of *apo* (derived), *bryon* (moss), and *phyllon* (leaf). Neuter gender.

Comparison with related genera: Gymnostome ciliates have a fascinating variety of brush structures, often separating species at genus level which otherwise look very much alike [69]. *Apobryophyllum* certainly has a new type of brush, and is closely related to *Bryophyllum*, as indicated by the typical oral bulge and lateral flattening. *Bryophyllum tegularum* has, like *Spathidium* spp., three brush kineties of usual structure [69]. However, the *Bryophyllum* species described by Gelei [123] have, like *Apobryophyllum*, a more complicated, bipartited brush composed of many short kineties near the organism's anterior end and three to five long rows in mid-body. Unfortunately, the details provided by Gelei [123] are insufficient to decide



Figs. 14–24. *Apobryophyllum terricola* from life (14–18, 23, 24) and after protargol impregnation (19–22). **14, 15.** Left lateral and ventral view of typical specimen. **16.** Broad shape variant showing arrangement of extrusomes. **17.** Extrusome in surface and lateral view. **18.** Optical section of cell periphery showing arrangement of cortical granules (cp. Fig. 24) and extrusomes, which form a fringe around the cell (cp. Fig. 16). **19.** Frontal view of oral bulge showing orientation and ciliation of circumoral dikinetids. **20, 21.** Infraciliature of right and left side and nuclear apparatus. **22.** Infraciliature of anterior left side showing the genus-specific brush, which consists of four rows, in detail. **23.** Posterior end of brush rows (numbers 1–4), which have a highly differentiated ciliation. **24.** Surface view showing cortical granules. B = dorsal brush, C = normal somatic cilium, E = extrusomes, EP = pores of contractile vacuole, FG = fat globule, LC = left branch of circumoral kinety, MA = macronucleus, MI = micronucleus, N = nematodesmata, OB = oral bulge, RC = right branch of circumoral kinety. Scale bar division 20 µm.

whether his species have fragmented brush rows like *Apobryophyllum*.

The monokinetidal (?) fragments in the brush of *Apobryophyllum* are reminiscent of those found in *Paraenchelys* which, however, has a very small, apical oral opening and lacks dikinetidal brush rows [69].

Apobryophyllum has, unlike all *Bryophyllum* species known, a slightly bipartite oral bulge and circumoral kinety, composed of a slightly concave and relatively short, cuneate, densely ciliated anterior part and a long, straight, loosely ciliated posterior portion. The anterior part is highly reminiscent of the oral bulge of *Arcuospathidium*, indicating that *Apobryophyllum*, *Bryophyllum* and *Arcuospathidium* might have a common ancestor.

Apobryophyllum terricola nov. spec. (Figs. 14–24, Tab. 5)

Diagnosis: Size in vivo about 160×25 µm. Slenderly knife-shaped to spatulate. Macronucleus filiform and tortuous. Extrusomes rod-shaped, about 5 µm long, form peripheral fringe. 16 somatic kineties on average, 4 of them differentiated to distinct brush on anterior left side.

Type location: Soil from Shetani volcano area, Tsavo National Park, Kenya, equatorial Africa (about 38° E, 2°55' N).

Etymology: *terricola* because living in soil.

Description: Size in vivo 130–200×20–55 µm, length: width ratio 5:1 to 9:1, usually near 7:1. Slenderly spatulate to knife-shaped, i.e. anterior ventral third rather distinctly curved and gradually narrowing to form bluntly pointed dorsal anterior end; blade leaf-like flattened and sometimes slightly broadened, handle evenly rounded posteriorly and flattened up to 2:1 (Figs. 14–16). Macronucleus in middle body portion, filiform and tortuous, with many small nucleoli. Micronuclei globular, near or attached to macronucleus. Contractile vacuole in posterior end, about 6 excretory pores on right posterior surface of cell (Fig. 20). Extrusomes rod-shaped, slightly curved, about 5 µm long, more narrowly spaced in anterior third than posteriorly, attached to oral bulge in two indistinct rows and to dorsal side, forming conspicuous peripheral fringe (Figs. 14–18). Cortex flexible, fragile, contains about five rows of colourless granules between each two ciliary rows (Fig. 24). Cytoplasm usually packed with colourless fat globules 2–6 µm across and many scattered extrusomes very similar to those found in oral bulge. Glides slowly on slide surface and soil particles.

Cilia rather loosely spaced, arranged in meridional rows distinctly separate from circumoral kinety. Dorsal brush at anterior end of first four kineties of left side, about as long as blade of knife; rows 1 and 2 composed of many short, rather irregular fragments having about 4 µm long, distinctly inflated cilia; rows 3 and 4 regularly dikinetidal with anterior cilium slightly inflated and longer (3 µm) than posterior (2 µm); row 4 has a monokinetidal tail with short bristles extending to level of posterior end of row 3 (Figs. 21–23).

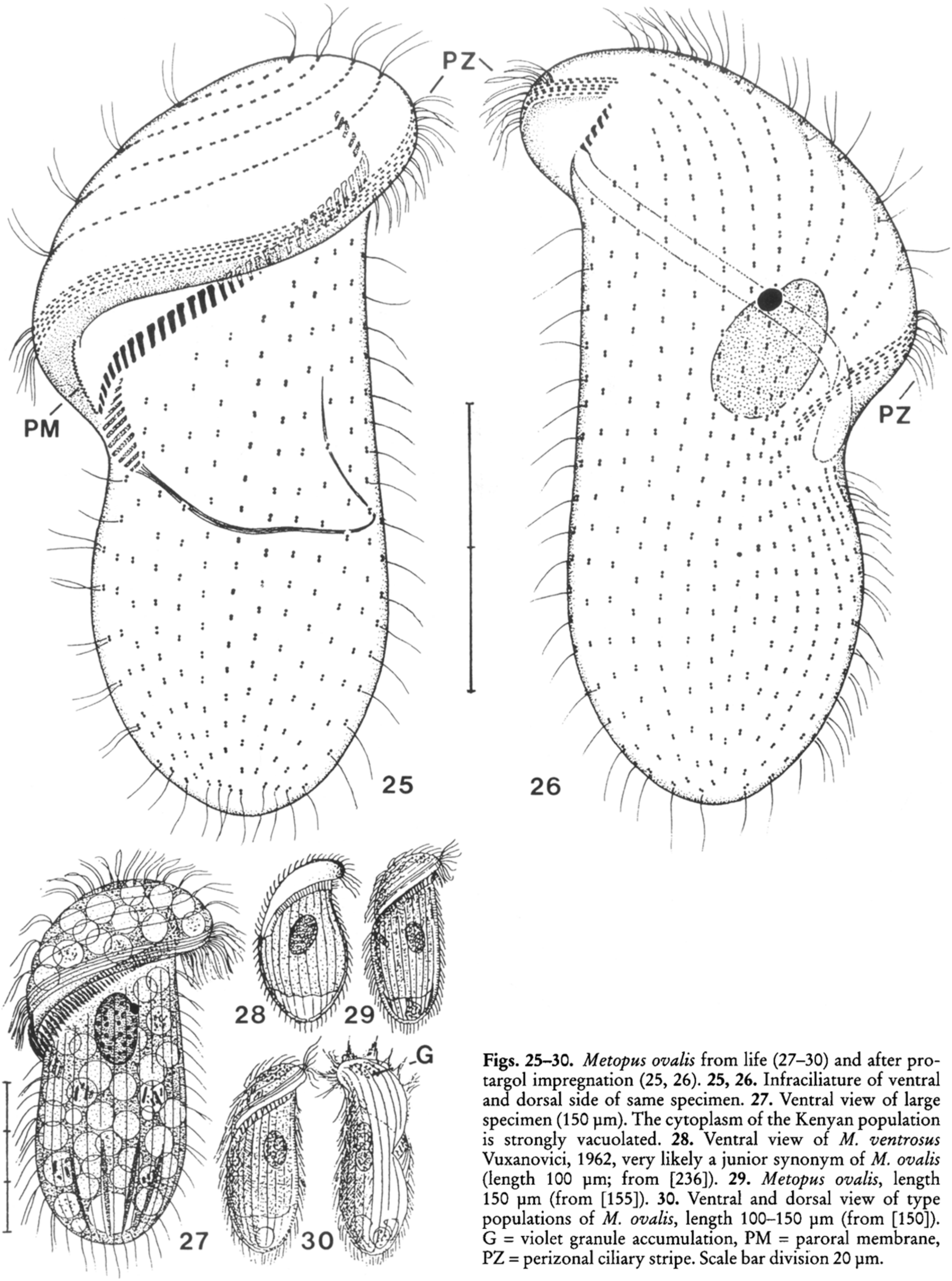
Oral bulge very inconspicuous, hardly distinct from body proper and thus almost invisible in live specimens, extends from anterior dorsal end to posterior dorsal end, bordered by dikinetidal circumoral kinety associated with very fine nematodesmata; circumoral dikinetids on right side very likely ciliated and orientated transversely to longitudinal axis of cell, those on left side, having very likely only the posterior basal body ciliated, longitudinally to slightly obliquely arranged (Figs. 14, 19–22).

Comparison with related species: No species has been found in the literature which might be identical with *A. terricola*. It is easily distinguished from the *Bryophyllum* species known by its very slender shape and inconspicuous oral bulge. However, live specimens of *A. terricola* are easily confused with large *Arcuospathidium* species, especially *A. lionotiforme*, which has a very similar size, shape and nuclear apparatus [69]. The best in vivo character for separating these species is the arrangement of the extrusomes, which are restricted to the oral bulge in *Arcuospathidium*, and distributed in a peripheral girdle in *A. terricola*. Some *Prorodon* and *Cranotheridium* species, especially *P. armatides* [98], also look very much alike *A. terricola*. However, all *Prorodon* and *Cranotheridium* species known live in freshwater.

Metopus ovalis Kahl, 1927 (Figs. 25–30)

Redescription: Like Kahl [150, 155], I found only few specimens. Thus, the morphometric analysis is rather incomplete and summarised here: length 102–145 µm ($\bar{x}$ = 123.8, SD = 16.9, n = 6), postoral width 42–57 µm ($\bar{x}$ = 47.6, SD = 6.0, n = 5), distance anterior end to macronucleus 24–45 µm ($\bar{x}$ = 33.3, SD = 8.2, n = 6), distance anterior end to proximal end of adoral zone 53–80 µm ($\bar{x}$ = 64.2, SD = 10.2, n = 6), length of macronucleus 20–34 µm ($\bar{x}$ = 25.7, SD = 5.6, n = 6), width of macronucleus 13–22 µm ($\bar{x}$ = 16.0, SD = 3.1, n = 6), largest diameter of micronucleus 3–5 µm ($\bar{x}$ = 4.0, SD = 0.6, n = 6), number of perizonal kineties 5 (n = 5), number of somatic kineties in postoral body portion 23–29 ($\bar{x}$ = 25.8, SD = 2.5, n = 4), number of adoral membranelles 46–55 ($\bar{x}$ = 50.6, SD = 3.8, n = 4).

Size in vivo about 120–170×50–60 µm. Cells reddish at low (< X100) magnification, as also mentioned by Kahl [150], possibly due to minute cytoplasmic granules and food vacuole contents. Preoral dome conspicuous, occupies about 1/3 of body length, projects



Figs. 25–30. *Metopus ovalis* from life (27–30) and after protargol impregnation (25, 26). **25, 26.** Infraciliature of ventral and dorsal side of same specimen. **27.** Ventral view of large specimen (150 µm). The cytoplasm of the Kenyan population is strongly vacuolated. **28.** Ventral view of *M. ventrosus* Vuxanovici, 1962, very likely a junior synonym of *M. ovalis* (length 100 µm; from [236]). **29.** *Metopus ovalis*, length 150 µm (from [155]). **30.** Ventral and dorsal view of type populations of *M. ovalis*, length 100–150 µm (from [150]). G = violet granule accumulation, PM = paroral membrane, PZ = perizonal ciliary stripe. Scale bar division 20 µm.

sharply above ventral side and left margin when cell is viewed ventrally. Postoral portion elongate to slightly saccular, broadly rounded and slightly flattened posteriorly, wrinkled by longitudinal folds after release of contractile vacuole content (Figs. 25, 27). Macronucleus slightly ellipsoidal, usually close underneath preoral dome, contains many small nucleoli. Micronucleus globular, in small indentation of macronucleus (Figs. 26, 27). Contractile vacuole in posterior end. Cortex flexible, contains loosely arranged, pale disks about 1.5 μm across, possibly mitochondria and/or fat globules, and some 0.5 μm sized granules (extrusomes ?), which do not stain with methyl green-pyronin. Cytoplasm distinctly vacuolated, possibly due to the saline environment, contains large food vacuoles with bacterial residues; no anterior granule accumulation, but cytoplasmic vacuoles often contain some granular material. Moves slowly by rotation about longitudinal body axis.

Somatic infraciliature composed of dikinetids throughout, anterior cilium lacking in many postoral and dorsal kinetids. Cilia about 15 μm long, form about 5 oblique, sigmoidal rows on preoral dome and longitudinal rows on postoral trunk. Perizonal ciliary rows on proximal edge of preoral dome, exactly S-shaped like adoral zone of membranelles, separated from first dome kinety by a distance about twice as wide as between somatic kineties, narrowly spaced with dikinetids arranged in curious, arrow-like pattern (Figs. 25, 26). About 7 postperistomial kineties. No caudal cilia.

Adoral zone of membranelles exactly S-shaped, commences on left dorsal end of preoral dome and extends sigmoidally to right side, plunging into an inconspicuous cytopharynx supplied with a long, narrow bundle of fibres. Individual membranelles cuneiform, largest bases near proximal end of zone in vivo about 5 μm wide. Paroral membrane inconspicuous because short and near proximal end of membranellar zone, consists of narrowly spaced, zigzagging, ciliated dikinetids (Figs. 25–27).

Comparison with original description and related species: My population strongly resembles the original figures (Figs. 29, 30) and description [150]. There are, as usual, some small differences, viz. the strong vacuolation of the cytoplasm and the lack of an accumulation of violet granules in the preoral dome, which seems to be more distinct in my specimens than in that figured by Kahl (Figs. 27, 30). However, these differences are small compared to the conformities, and might be related to the rather saline environment my specimens lived in. Thus, I have few doubts about the identification, but suggest that further populations should be studied.

Metopus ovalis is easily identified by its rather large size (110–200 μm) and elliptical to slightly oval shape, the lack of caudal cilia and distinct extrusomes, the ellipsoidal macronucleus left of the cytostome, and the relatively short and little spiralized adoral zone of membranelles, which thus extends only to mid-body and terminates on the right side. *Metopus ventrosus* Vuxanovici [236] differs from *M. ovalis* only by its more distinct oval shape, resembling that of my specimens, and the greenish colour of the anterior granule accumulation (Fig. 28). Thus, I agree with Esteban et al. [52] that these species should be synonymized. *Metopus fuscus* Kahl [150, 155] also resembles *M. ovalis* in size (180–300×40–60 μm), shape, and absence of caudal cilia. However, it has 45–50 somatic kineties [144] and a thick (2 μm) ectoplasm containing blunt protrichocysts [150, 155]. *Brachonella elongata* Jankowski [144] is smaller (100×42 μm) than *M. ovalis* and its adoral zone of membranelles extends almost to the posterior body end.

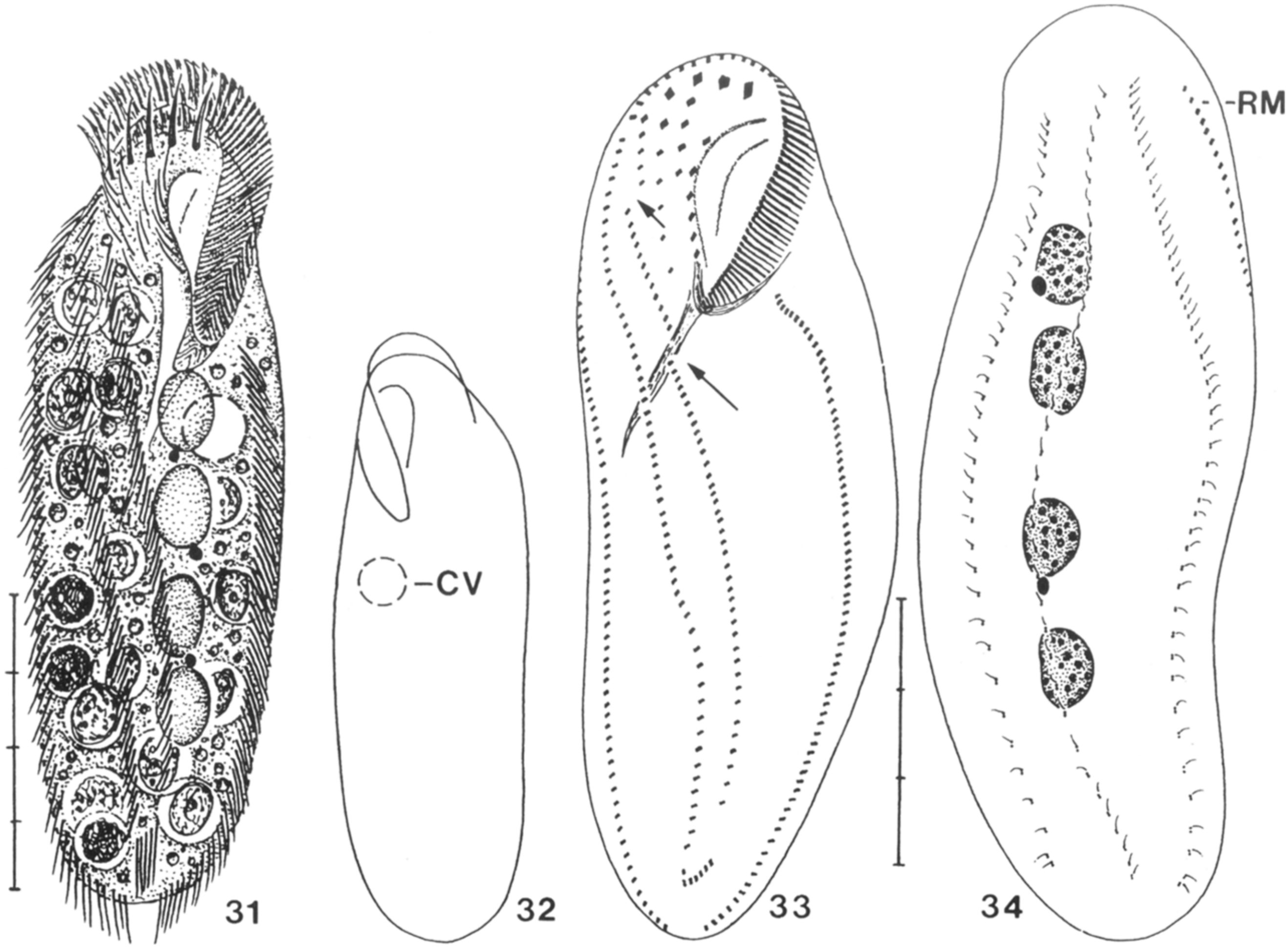
Keronopsis dieckmanni nov. spec. (Figs. 31–34, Table 6)

Diagnosis: Size in vivo about 220×70 μm, elliptical with oral area usually slightly narrowed and set off head-like. 4 macronuclear nodules. 3 short and 2 long rows of frontoventral cirri. On average 52 adoral membranelles, 61 right marginal cirri, 60 left marginal cirri, 51 cirri in right long ventral row, 53 cirri in left long ventral row, 5 cirri in frontal corona, 6 buccal cirri, 5 transverse cirri, and 3 dorsal kineties. Buccal cavity deep and semicircularly curved anteriorly.

Type location: Saline soil at shore of Lake Baringo, Kenya, equatorial Africa (about 36° E, 0°45' N).

Dedication: Named in memory of my friend and colleague Josef Dieckmann (1948–1996).

Description: Size in vivo 180–260×50–100 μm. Slenderly to moderate broadly elliptical, rarely almost parallel-sided, oral portion slightly cephalized because narrowed and due to conspicuously short adoral zone of membranelles occupying only about 25% of body length (Figs. 31, 32). Flexible and dorsoventrally flattened up to 2:1. Usually four roughly ellipsoidal macronuclear nodules one after the other in middle portion of cell slightly left of midline, sometimes indistinctly grouped forming an anterior and posterior pair, contain many globular nucleoli. Micronuclei almost spherical, compact and thus well recognizable in live specimens, near or in small indentations of macronuclei (Figs. 31, 34). Contractile vacuole distinctly above mid-body. Cortex colourless, flexible, without special granules. Cytoplasm colourless, contains some 1–3 μm sized, yellowish fat globules and, usually, many food vacuoles with large heterotrophic flagellates (*Polytoma* sp.) and/or small ciliates (*Cyclidium*, *Halteria grandinella*). Movement without peculiarities, rather slowly gliding.



Figs. 31–34. *Keronopsis dieckmanni* from life (31, 32) and after protargol impregnation (33, 34). **31.** Ventral view of typical specimen packed with food vacuoles containing small ciliates and heterotrophic flagellates. **32.** Dorsal view of shape variant. **33, 34.** Infraciliature of ventral and dorsal side. Arrows mark breaks in left long ventral row. CV = contractile vacuole, RM = right marginal cirral row extending on dorsal side. Scale bar division 20 µm.

Cirri fine and very narrowly spaced, marginal rows almost confluent posteriorly, right row extends on dorsal side anteriorly. Frontal corona comparatively inconspicuous because composed of only five enlarged cirri, three rightmost cirri of corona at end of short frontal rows composed of cirri gradually decreasing in size posteriorly; rightmost row possibly belongs to long left ventral row. Long ventral rows extend from anterior end to transverse cirri; cirri of same size throughout, left row possibly composed of three fragments, as indicated by two small breaks in anterior half of most specimens. Buccal cirral row conspicuous. Transverse cirri inconspicuous, hardly projecting above posterior body margin. Dorsal bristles in vivo about 3 µm long, arranged in three rows almost as long as body. No caudal cirri (Figs. 31, 33, 34).

Oral apparatus of usual structure, adoral zone of membranelles, however, conspicuously short, as described above. Buccal cavity rather narrow but deep, strongly curved anteriorly. Paroral membrane almost semicircular, consists of at least three rows of basal bodies, distinctly separate from endoral membrane obliquely crossing buccal cavity. Pharyngeal fibres inconspicuous (Figs. 31, 33).

Comparison with related species and generic classification: *K. dieckmanni* resembles *K. tasmaniensis* Blatterer & Foissner [20] which, however, has only 2 macronuclear nodules, 1–2 buccal cirri, and 2 short frontal cirral rows. *Keronopsis helluo* [179], type of genus, is also rather similar to *K. dieckmanni* because it has 5–6 macronuclear nodules, many buccal cirri, a similar size (250–300 µm) and buccal field, and lives in

Table 6. Morphometric data from *Keronopsis dieckmanni.*

Character[1)]	x̄	M	SD	SE	CV	Min	Max	n
Body, length	201.8	197.5	26.8	8.5	13.3	165.0	245.0	10
Body, width	67.8	68.5	11.8	3.7	17.4	48.0	91.0	10
Anterior somatic end to proximal end of adoral zone, distance	50.5	50.0	5.2	1.6	10.2	42.0	60.0	10
Anterior somatic end to posterior end of right long ventral row, distance	182.5	175.0	24.6	7.8	13.5	150.0	225.0	10
Anterior somatic end to posterior end of left long ventral row, distance	169.4	162.0	29.0	9.2	17.1	138.0	221.0	10
Anterior somatic end to transverse cirri, distance	181.5	176.0	23.3	7.4	12.8	150.0	225.0	10
Macronuclear nodules, length	19.9	19.0	4.3	1.4	21.8	15.0	26.0	10
Macronuclear nodules, width	12.4	12.5	1.7	0.5	13.8	10.0	16.0	10
Macronuclear figure, length	103.5	96.0	18.8	5.9	18.2	80.0	138.0	10
Macronuclear nodules, number	3.9	4.0	0.9	0.3	22.5	2.0	5.0	10
Micronuclei, length	4.2	4.0	0.6	0.2	14.0	3.5	5.0	10
Micronuclei, width	3.6	3.5	–	–	–	3.0	4.0	10
Micronuclei, number	3.1	3.0	1.1	0.4	33.9	1.0	4.0	9
Adoral membranelles, number	50.7	52.5	6.1	1.9	12.0	40.0	60.0	10
Right marginal cirri, number	64.2	61.0	7.0	2.3	10.9	55.0	75.0	9
Left marginal cirri, number	62.3	60.0	8.7	2.9	14.0	51.0	74.0	9
Anterior frontal cirri, number	5.0	5.0	0.0	0.0	0.0	5.0	5.0	10
Buccal cirri, number	5.6	6.0	–	–	–	5.0	6.0	8
Cirri in right ventral row, number	50.3	51.0	5.6	1.9	11.2	42.0	58.0	9
Cirri in left ventral row, number[2)]	54.0	53.0	9.4	3.3	17.4	41.0	68.0	8
Transverse cirri, number	5.2	5.0	1.0	0.3	19.9	4.0	7.0	10
Dorsal kineties, number	3.0	3.0	0.0	0.0	0.0	3.0	3.0	9

[1)] Data based on protargol–impregnated and mounted specimens from field. Measurements in µm. Abbreviations: CV = coefficient of variation in %, M = median, Max = maximum, Min = minimum, n = number of individuals investigated, SD = standard deviation, SE = standard deviation of mean, x̄ = arithmetic mean.

[2)] Including rightmost short row of frontal cirri.

mosses. However, *K. helluo* lacks short frontal rows and has at least 10 cirri in the frontal cirral corona.

Both *Keronopsis* and *Paraholosticha* have a frontal cirral corona and a very similar general organization. However, I agree with Dieckmann [36] that the presence (*Keronopsis*), respectively, absence (*Paraholosticha*) of transverse cirri is sufficient to maintain both genera. The frontal cirral corona of *K. dieckmanni* and *K. tasmaniensis* is rather inconspicuous because it consists of only 5–7 cirri, whereas it is composed of 10–20 cirri in the other members of the genus [8, 36, 37, 75]. Thus, the generic classification of *K. dieckmanni* and *K. tasmaniensis* might be questioned. However, both have, like the other *Keronopsis* and *Paraholosticha* species, 3 dorsal kineties and lack caudal cirri.

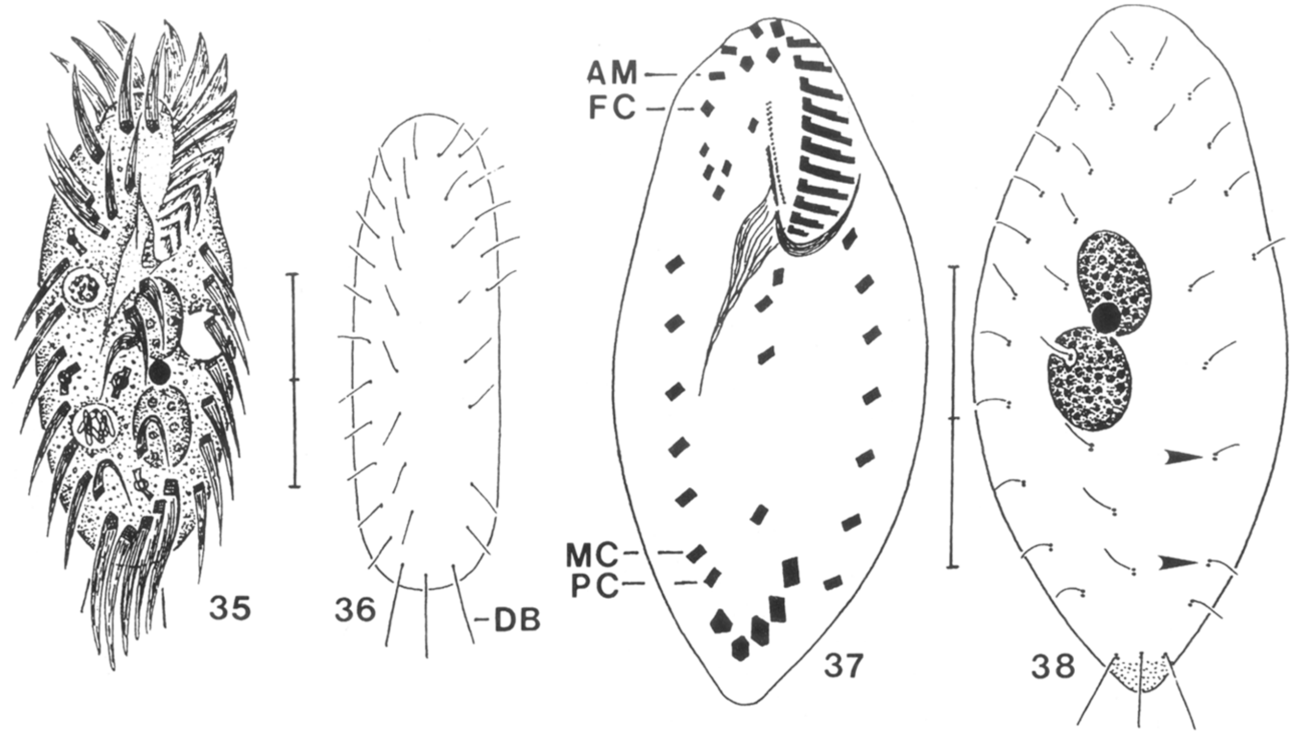
Tachysoma humicola longisetum nov. subspec. (Figs. 35–38, Table 7)

Diagnosis: Like *T. humicola* Gellért, 1957, but posteriormost bristles of dorsal kineties 1–3 distinctly elongated (10 µm).

Type location: Soil from Shetani volcano area, Tsavo National Park, Kenya, equatorial Africa (about 38° E, 2°55' N).

Etymology: *longisetum* (long bristles) refers to the main subspecies character, viz. the elongated cilia of the posteriormost dorsal kinetids.

Description: Size in vivo 40–55×20–30 µm, usually about 45×25 µm. Shape conspicuous because of its regularity, i.e. slenderly to broadly elliptical (Figs. 35, 36), often fusiform after protargol impregnation (Figs. 37). Rather inflexible like, e.g. *Sterkiella histriomuscorum*, and dorsoventrally flattened up to 2:1. Macronuclear nodules slightly ellipsoidal, in middle third of cell to left of midline, contain many granular nucleoli. Micronucleus globular, invariably between macronuclear nodules (Figs. 35, 38). Contractile vacuole in mid-body near left margin, without distinct collecting canals. Cortex colourless, rather inflexible, without special granules. Cells usually very transparent, contain 10–20 curved crystals (3 µm) and some 3–4 µm sized food vacuoles with bacterial residues; posterior end often darkly granulated after protargol impregnation (Fig. 38).



Figs. 35–38. *Tachysoma humicola longisetum* from life (35, 36) and after protargol impregnation (37, 38). **35.** Ventral view of typical specimen. **36.** Dorsal view of slender shape variant. **37, 38.** Infraciliature of ventral and dorsal side. Arrowheads mark two dorsal bristles between which the distance is slightly increased. AM = distalmost adoral membranelle, DB = elongated dorsal cilia, FC = rightmost frontal cirrus, MC = last marginal cirrus of right row, PC = pretransverse cirrus. Scale bar division 10 µm.

Movement conspicuous due to long periods of gliding interrupted by short, fast jumps.

Cirri conspicuously thick compared to size of cell, about 10 µm long; transverse cirri, however, about 15 µm long and distinctly projecting above posterior body margin, conspicuously enlarged and slightly sigmoidal. Marginal rows widely open at both ends, posterior gap occupied by transverse cirri; remarkably short because commencing at level of proximal end of adoral zone of membranelles and terminating at level of uppermost transverse cirri. Right pretransverse cirrus difficult to identify because usually almost in line with right marginal row; likewise, rightmost anterior frontal cirrus difficult to recognize because in line with distalmost adoral membranelles (Figs. 35, 37). Dorsal cilia in vivo about 3 µm long, those of posteriormost kinetid in kineties 1–3, however, elongated to 10 µm; arranged in four rows with row 4 terminating in mid-body; one kinetid frequently lacking near posterior end of kinety 3 (Figs. 36, 38).

Adoral zone of usual structure, distalmost three to four membranelles, however, slightly separate from rest of zone and with cilia more distinctly curved rightwards than those of other anterior membranelles; occupies about 34% of body length, bases of largest membranelles about 5 µm wide. Buccal cavity narrow and flat. Undulating membranes almost straight and side by side, paroral shorter than endoral, forms thick line along its posterior half; endoral composed of dikinetids separated slightly Y-like in anterior third of membrane (Figs. 35, 37).

Comparison with related species: *T. humicola longisetum* highly resembles *T. humicola* Gellért [130] as redescribed by Foissner [69], both in general morphology and morphometry (Tab. 7). For instance, both have the right pretransverse cirrus close to the last cirrus of the right marginal cirral row. The only significant difference concerns the posteriormost dorsal bristles, which are distinctly elongated in the African population. Admittedly, this is a fairly indistinct character. However, I found such populations at several sites in Africa and South America, indicating that they are stable modifications. Thus, separation at subspecies rank seems appropriate.

Table 7. Morphometric data from *Tachysoma humicola longisetum* (upper line) and *T. humicola humicola* (lower line; from [69]).

Character[1)]	x̄	M	SD	SE	CV	Min	Max	n
Body, length	44.0	45.0	3.9	1.1	8.8	37.0	50.0	13
	42.4	41.0	4.3	1.3	10.0	38.0	50.0	11
Body, width	21.2	21.0	2.4	0.7	11.2	18.0	27.0	13
	21.0	20.0	2.6	0.8	12.4	18.0	27.0	11
Anterior somatic end to proximal	14.6	15.0	0.7	0.2	5.3	13.0	15.0	13
end of adoral zone, distance	14.0	14.0	0.9	0.3	6.4	13.0	16.0	11
Anterior somatic end to anterior	14.2	14.0	1.2	0.3	8.2	12.0	16.0	13
end of right marginal row, distance	14.0	14.0	0.6	0.2	4.5	13.0	15.0	11
Anterior somatic end to anterior	14.2	14.0	1.2	0.3	8.6	12.0	16.0	13
end of left marginal row, distance	13.1	13.0	1.0	0.3	8.0	11.0	15.0	11
Macronuclear nodules, length	7.2	7.0	1.3	0.4	18.8	6.0	10.0	13
	7.8	7.0	1.8	0.5	22.9	5.6	10.0	11
Macronuclear nodules, width	5.4	5.0	0.7	0.2	14.3	4.0	7.0	13
	5.7	5.6	0.4	0.1	6.3	4.8	6.0	11
Micronucleus, diameter	2.3	2.2	0.3	0.1	11.8	2.0	3.0	13
	2.3	2.4	0.4	0.1	15.1	1.6	2.8	11
Macronuclear nodules, number	2.0	2.0	0.0	0.0	0.0	2.0	2.0	13
	2.0	2.0	0.0	0.0	0.0	2.0	2.0	11
Micronuclei, number	1.0	1.0	0.0	0.0	0.0	1.0	1.0	13
	1.1	1.0	–	–	–	1.0	2.0	11
Adoral membranelles, number	15.0	15.0	0.0	0.0	0.0	15.0	15.0	13
	14.8	15.0	0.6	0.2	4.1	14.0	16.0	11
Right marginal cirri, number	6.0	6.0	0.0	0.0	0.0	6.0	6.0	13
	6.4	6.0	0.7	0.2	10.7	6.0	8.0	11
Left marginal cirri, number	7.1	7.0	–	–	–	7.0	8.0	13
	7.2	7.0	–	–	–	7.0	8.0	11
Anterior frontal cirri, number	3.0	3.0	0.0	0.0	0.0	3.0	3.0	13
	3.0	3.0	0.0	0.0	0.0	3.0	3.0	11
Posterior frontal cirri, number	4.0	4.0	0.0	0.0	0.0	4.0	4.0	13
	4.0	4.0	0.0	0.0	0.0	4.0	4.0	11
Buccal cirri, number	1.0	1.0	0.0	0.0	0.0	1.0	1.0	13
	1.0	1.0	0.0	0.0	0.0	1.0	1.0	11
Postoral cirri, number	3.0	3.0	0.0	0.0	0.0	3.0	3.0	13
	3.0	3.0	0.0	0.0	0.0	3.0	3.0	11
Pretransverse cirri, number	2.0	2.0	0.0	0.0	0.0	2.0	2.0	13
	2.0	2.0	0.0	0.0	0.0	2.0	2.0	11
Transverse cirri, number	5.0	5.0	0.0	0.0	0.0	5.0	5.0	13
	5.0	5.0	0.0	0.0	0.0	5.0	5.0	11
Dorsal kineties, number	4.0	4.0	0.0	0.0	0.0	4.0	4.0	13
	4.0	4.0	0.0	0.0	0.0	4.0	4.0	11

[1)] Data based on protargol–impregnated and mounted specimens from field. Measurements in µm. Abbreviations: CV = coefficient of variation in %, M = median, Max = maximum, Min = minimum, n = number of individuals investigated, SD = standard deviation, SE = standard deviation of mean, x̄ = arithmetic mean.

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