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SPATIAL DISTRIBUTION OF CILIATES (PROTISTA, CILIOPHORA) IN THE RIVER BITYZA (DNIEPER BASIN)

R. V. Babko[1], T. M. Kuzmina[2]

[1]*Institute of Hydrobiology, Pr. Geroiv Stalingrada, 12, Kyiv-210, 04210 Ukraine*
[2]*Sumy State University, vul. Rimsky-Korsakow, 2, Sumy, 244007 Ukraine*

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Spatial Distribution of Ciliates (Protista, Ciliophora) in the River Bityza (Dnieper Basin). Babko R. V., Kuzmina T. M. — The investigations of the spatial distribution of ciliated protozoa were performed on the River Bityza and on the attendant bodies. Samples were taken from the water column and from the natural substrates (sand, clay, sapropel, submerged vegetation). A total of 140 ciliate taxa were identified. A highest species number was found on the surfaces of macrophytes. Three types of ciliate assemblages were recorded: 1) the sapropelic assemblage, 2) the epiphytic assemblage, 3) the assemblage which combines the ciliates from oxygenated bottom sediments and from water column.

Key words: ciliates, species assemblage, habitats.

Пространственное распределение инфузорий (Protista, Ciliophora) в реке Битица (бассейн Днепра). Бабко Р. В., Кузьмина Т. Н. — Изучено распределение инфузорий в русле реки и сопутствующих водоемах на природных субстратах (песок, глина, сапропель, погруженные высшие водные растения) и в толще воды. В целом было идентифицировано 140 таксонов. Наибольшее количество видов было найдено на поверхности макрофитов. Показано существование в исследованных водоемах 3 типов ассамблей инфузорий: 1) сапропелевая, 2) эпифитонная, 3) единая ассамблея толщи воды и кислородсодержащих донных отложений.

Ключевые слова: инфузории, ассамблея видов, местообитание.

Introduction

It is well known that many ciliate species are tolerant to wide range of environment. Thus, they are of widespread occurrence in the hypervolumes of the aquatic ecosystems thereby give the impression of their continual distribution. However, the investigations which cover the major habitats within a water body simultaneously are extremely sparse (Foissner, Unterweger, Henschel, 1992). This is because the correct and quick treatment of sufficiently great number of samples is difficult (Cairns, 1982; Fenchel, 1987). Thus, many authors focus the attention mostly on a single habitat. However, a correlation between the results which have been obtained at different time from different bodies gives but a rough idea about the distribution of the species throughout the habitats within an aquatic ecosystem. This is particularly true for the species which do not show special morphological and physiological adaptations. Thus, the present view of the patterns in populations distribution remains uncertain. Its prevents the understanding of a communities structure. Therefore the changes in the community structure under the influence of one or another factors has not been adequately predicted. The simultaneous investigations of different habitats can be carried out by the group of workers, as approach is in common practice in the complex investigations. We have been associated with a study aimed at understanding the patterns in distribution of ciliate populations throughout the major habitats within the aquatic ecosystem. Results have been obtained from a short-term investigation.

Material and methods

Study sites. The investigations were performed during 4 days in November 1996 on the River Bityza. The Bityza inflow into the River Psyol from the right bank above the Sumy (Ukraine). At the study sites the floodplain is forestry. Thus, the river is free from any pollution. The water of the River Bityza belongs to hydrocarbonate class. Some shallow iron-rich streams empty into the river about 300 m above the study area.

There is a dam reservoir in the middle reaches of the river. The reservoir has been in existence for about 100 years. It covers an area of 54000 m^2, and has a maximum deep of 3,0 m. The shoals are coated with the submerged vegetations, principally *Potamogeton perfoliatus* L. and *Ceratophyllum demersum* L.

Some floodplain marshes are localized above the reservoir. These are the shallow bodies, which occasionally merge with the river bed. The surfaces of water was partially covered with *Lemna minor* L.

Station 1. The marsh at the left bank of the river, about 100 m above the reservoir. Water about 0,2–0,4 m deep. Bottom consists of mud and leaf-litter. The samples of bottom were taken together with the samples of water.

Station 2. Like station 1, but about 200 m above the reservoir. The samples of bottom were taken together with the samples of water and *L. minor.*

Station 3. River Bityza, about 150 m above the reservoir. Current velocity more than 0,5 m/s. River bed is 2–3 m wide, water about 0,5–1,0 m deep. Bottom consists of clay and is rarely overgrown with *Potamogeton pectinatus* L. The samples of bottom, water and macrophytes were taken separately.

Station 4. The upper area of the reservoir. Bottom consists of mud (sapropel) and is overgrown with the macrophytes (*C. demersum*). The deep is 0,1–0,2 m. Samples were thus taken from the bottom and much muddy macrophytes only.

Station 5. The middle area of the reservoir. Bottom consists of sand and is rarely overgrown with macrophytes (*P. perfoliatus* and *C. demersum*). Water about 1,5 m deep. The samples of bottom, water and macrophytes were taken.

Station 6. The lower area of the reservoir. Like station 5. Sample were taken from the macrophytes only.

Station 7. River Bityza, about 100 m below the reservoir. Current velocity more than 0,5 m/s. River bed is 2–3 m wide, water about 0,2–0,5 m deep. Bottom consists of sand. The samples of bottom and water were taken.

Sampling. During the investigation period there are 16 samples were collected (each sample was taken in 3 replications). The samples from water column were collected by a 1-liter Ruttner bottle, and the samples from bottom were taken with the use of microbenthometer (Babko, 1989). The samples of submerged vegetation were collected with the use of glass tubes (Ø 3 cm). The samples were treated immediately after collection.

Species identification. Most species were pre-determined using of the silver impregnation method (Foissner, 1991) during the preliminary investigation period. The specific taxonomic literature include recently published monographs and papers were used (Foissner, Berger, Kohmann, 1992, 1994; Foissner et al., 1991, 1995; Foissner & Wolfl, 1994; Jankowski, 1964; Kahl, 1930–1935; Warren, 1986, 1987; Wu & Curds, 1979 et al.).

Similarity analysis. Similarity between the ciliates in each sample was calculated with the Jaccard's index (Magurran, 1992). The similarity values obtained were summarized by clustering (complete linkage, Euclidean distance).

Results and discussion

During the investigation period a total of 140 taxa of ciliates belonging to 87 genera were found (tabl. 1). Follow genera were presented by maximum species number (5): *Metopus* Claparède & Lachmann, 1858, *Stylonychia* Ehrenberg, 1830, *Urotricha* Claparède & Lachmann, 1859; 4 species had the genera *Coleps* Nitzsch, 1827, *Litonotus* Wrzesniowski, 1870, *Prorodon* Ehrenberg, 1833. Some uncommon species such as *Caenomorpha sapropelica* Kahl, 1927, *Dactylochlamys pisciformis* Lauterborn, 1901, *Discomorphella pectinata* (Levander, 1894), *Enchelydium virens* Kahl, 1930, *Epalxella antiquorum* (Penard, 1922), *Holophrya vesiculosa* Kahl, 1926, *Homalozoon caudatum*, Kahl, 1935, *H. vermiculare* (Stokes, 1887), *Phialina vertens* (Stokes, 1885), *Platyophrya vorax* Kahl, 1926, *Pseudovorticella chlamydophora* (Penard, 1922), *Trachelophyllum vestitum* Stokes, 1884 were found.

Owing to the short sampling period a good indication of the actual species distribution throughout the hypervolume of the aquatic ecosystem has been obtained. The saturation of habitats with the ciliate species is shown at the figure 1. The greatest species number was noted for the surfaces of macrophytes and for the bottom sediments in the reservoir. The high species richness in the river down the reservoir is the result of ciliate's carrying out from the reservoir. This is evident from the fact that the ciliate species found in the river down the dam are almost similar to those found in the reservoir.

Table 1. Ciliata species found in the River Bityza and in the attendant bodies (7.11–10.11.1996)

Таблица 1. Список инфузорий, обнаруженных в р. Битица и сопутствующих водоемах (7.11–10.11.1996)

Species	Marshes	River bed above the reservoir			Reservoir				River bed below the reservoir	
	I	II	III	IV	V	VI	VII	VIII	IX	X
1	2	3	4	5	6	7	8	9	10	11
Acaryophrya sphaerica (Gelei, 1934)	–	–	–	–	–	+	–	–	–	+
*Actinobolina radians (*Stein, 1867)	–	–	–	–	–	+	–	–	–	+
Amphileptus carchesii Stein, 1867	–	–	–	–	–	+	–	–	–	–
Amphileptus pleurosigma (Stokes, 1884)	–	–	–	–	–	–	+	–	–	–
Apsiktrata gracilis Penard, 1922	–	–	–	–	+	–	–	–	–	–
Askenasia volvox (Eichwald, 1852)	–	–	–	–	–	–	–	+	–	+
Askenasia sp.	–	–	–	–	–	–	+	–	–	–
Aspidisca cicada (Müller, 1786)	–	–	–	–	–	+	+	+	–	–
Aspidisca lynceus (Müller, 1773)	+	–	+	–	–	–	+	–	+	–
Brachonella campanula (Kahl, 1932)	–	–	–	–	+	–	–	–	–	–
Brachonella spiralis (Smith, 1897)	+	–	–	–	+	–	–	–	–	–
Bursaria truncatella Müller, 1773	+	–	–	–	–	–	–	–	–	–
Bursellopsis gargamellae Fauré-Fremiet, 1922	–	–	–	–	–	–	–	+	–	+
Caenomorpha medusula Perty, 1852	+	–	–	–	+	–	–	–	–	–
Caenomorpha sapropelica Kahl, 1927	–	–	–	–	+	–	–	–	–	–
Campanella umbellaria (Linnaeus, 1758)	–	–	–	–	–	–	+	–	–	–
Carchesium polypinum (Linnaeus, 1758)	–	–	–	–	–	–	+	–	–	–
Chilodonella uncinata (Ehrenberg, 1838)	–	–	+	–	–	–	+	+	–	–
Chilodontopsis depressa (Perty, 1852)	–	–	–	+	–	–	–	–	–	–
Cinetochilum margaritaceum (Ehrenberg, 1831)	+	–	+	–	–	–	+	+	–	+
Coleps amphacanthus Ehrenberg, 1833	–	–	–	–	–	–	+	–	–	–
Coleps elongatus Ehrenberg, 1830	–	–	–	–	–	–	–	+	–	+
Coleps hirtus (Müller, 1786)	+	–	+	–	+	+	+	+	+	+
Coleps nolandi Kahl, 1930	–	–	+	+	–	–	+	–	–	–
Colpidium colpoda (Losana, 1829)	–	–	+	–	–	–	–	–	+	–
Colpoda sp.	–	–	–	–	–	–	+	–	–	–
Cristigera setosa Kahl, 1928	–	–	–	–	+	–	+	–	–	–
Cristigera sp.	–	–	–	–	–	–	+	–	–	–
Ctedoctema acanthocryptum Stokes, 1884	–	–	–	–	–	–	–	+	+	+
Cyclidium citrullus (Cohn, 1866)	–	–	–	–	+	+	–	–	–	–
Cyclidium glaucoma Müller, 1773	+	+	–	+	–	–	+	–	–	–
Cyclidium sp.	–	–	–	–	–	–	–	–	–	+
Dactylochlamys pisciformis Lauterborn, 1901	–	–	–	–	+	–	–	–	–	–
Dexiotricha granulosa (Kent, 1881)	–	+	–	–	–	–	–	–	–	–
Discomorphella pectinata (Levander, 1894)	–	–	–	–	+	–	–	–	–	–
Enchelus sp.	–	–	–	+	–	–	–	–	–	–
Enchelydium virens Kahl, 1930	+	–	–	–	–	–	+	–	–	–
Epalxella antiquorum (Penard, 1922)	–	–	–	–	+	–	–	–	–	–
Epalxella mirabilis (Roux, 1899)	+	–	–	–	–	–	–	–	–	–
Epalxella triangula Kahl, 1932	–	–	+	–	–	–	–	–	–	–
Euplotes patella (Müller, 1773)	–	–	+	–	–	–	+	–	–	–
Euplotes sp.	+	–	–	–	–	–	–	–	–	–
Frontonia acuminata (Ehrenberg, 1833)	–	–	–	–	–	+	–	–	–	+
Frontonia leucas (Ehrenberg, 1833)	–	–	–	–	–	–	+	–	–	+
Frontoniella complanata Wetzel, 1927	–	+	+	–	–	–	–	–	–	–
Glaucoma scintillans Ehrenberg, 1830	–	–	–	+	–	–	–	–	–	–
Halteria grandinella (Müller, 1773)	+	–	–	–	+	+	–	–	+	+
Halteria minuta (Gelei, 1954)	+	–	–	–	–	–	–	–	–	–
Holophrya nigricans Lauterborn, 1908	–	–	–	–	+	–	–	–	–	–
Holophrya vesiculosa Kahl, 1926	–	–	–	–	–	+	–	–	–	+
Holosticha monilata Kahl, 1928	–	–	–	+	–	–	–	–	–	–
Holosticha multistilata Kahl, 1928	–	+	+	–	–	–	–	–	–	–
Holosticha pullaster (Müller, 1773)	–	–	+	–	–	+	+	+	–	+
Homalozoon caudatum, Kahl, 1935	–	–	–	–	–	+	–	–	–	–
Homalozoon vermiculare (Stokes, 1887)	–	–	–	–	–	–	+	–	–	–

1	2	3	4	5	6	7	8	9	10	11
Lacrymaria filiformis Maskell, 1886	+	−	−	−	−	+	−	+	+	−
Lacrymaria olor (Müller, 1786)	+	−	+	−	−	−	−	−	−	−
Lagynus elegans (Engelmann, 1862)	−	−	−	−	+	−	−	−	−	−
Lembadion bullinum (Müller, 1786)	−	−	+	−	−	−	−	−	−	+
Lembadion magnum (Stokes, 1887)	−	−	+	+	−	−	+	−	−	−
Linostoma sp.	−	−	−	−	+	−	−	−	−	−
Litonotus armillatus Penard, 1922	−	−	−	−	−	−	+	+	−	−
Litonotus fasciola (Müller, 1773)	−	−	−	+	−	−	−	−	−	+
Litonotus fusidens (Kahl, 1926)	−	−	−	−	−	−	+	−	−	−
Litonotus hirundo (Penard, 1922)	−	−	−	−	−	−	−	+	−	−
Longifragma obliqua (Kahl,1926)	−	−	−	−	−	+	−	+	−	+
Loxocephalus luridus Eberhard, 1862	−	−	−	−	+	−	−	−	−	−
Loxodes penardi Dragesco, 1960	−	−	−	−	−	+	−	−	−	+
Loxodes magnus Stokes, 1887	−	−	−	−	+	−	+	−	−	−
Loxodes striatus (Engelmann, 1862)	−	−	−	−	+	−	+	−	−	+
Loxophyllum meleagris (Müller, 1773)	−	−	+	−	−	−	+	−	−	−
Meseres sp.	+	−	−	−	−	−	−	−	−	−
Mesodinium pulex (Claparède, Lachmann,1859)	−	−	−	+	−	−	−	−	−	−
Metopus caudatus Da Cunha, 1915	−	−	−	−	−	−	+	−	−	−
Metopus es (Müller, 1786)	+	−	−	−	+	−	−	−	−	−
Metopus laminarius Kahl, 1927	+	−	−	−	−	−	−	−	−	−
Metopus pulcher Kahl, 1927	−	−	−	−	+	−	−	−	−	−
Metopus striatus McMurrich, 1884	+	−	−	−	+	−	+	−	−	−
Monochilum elongatum Mermod, 1914	−	−	−	−	−	−	+	+	+	−
Oxytricha (setigera?) Stokes, 1891	−	−	−	−	−	−	+	−	−	−
Parablepharisma sp.	−	−	−	−	+	−	−	−	−	−
Paramecium caudatum Ehrenberg, 1833	−	−	+	−	−	−	+	−	+	+
Paraurotricha discolor (Kahl,1930)	+	−	+	+	−	+	+	−	−	−
Pelagohalteria cirrifera (Kahl, 1932)	−	−	−	−	−	−	−	+	−	+
Phascolodon vorticella Stein, 1859	−	−	−	−	−	+	−	−	−	−
Phialina pupula (Müller, 1773)	−	−	+	−	+	+	+	−	−	−
Phialina vertens (Stokes, 1885)	−	−	−	−	+	−	−	−	−	−
Plagiocampa c.f. posticeconica Kahl,1930	−	−	−	−	−	+	−	−	−	−
Plagiocampa metabolica Kahl,1930	−	−	+	−	−	−	−	−	−	−
Plagiocampa rouxi Kahl,1926	−	−	+	−	−	−	−	−	−	−
Plagiopyla nasuta Stein, 1860	+	−	−	−	+	−	−	−	−	−
Platyophrya vorax Kahl, 1926	−	−	+	−	−	−	−	−	−	−
Pleuronema coronatum Kent, 1881	−	+	+	−	−	+	+	+	+	+
Prorodon cinereus Penard 1922	−	−	−	−	−	−	+	−	−	−
Prorodon ovum Ehrenberg, 1831	−	−	−	−	−	+	−	−	+	−
Prorodon teres Ehrenberg, 1833	−	−	−	−	−	+	−	+	+	−
Prorodon viridis (Kahl, 1927)	−	−	+	−	−	−	+	−	−	−
Pseudocohnilembus pusillus (Quennerstedt, 1869)	−	−	−	−	−	+	−	−	+	+
Pseudocohnilembus sp.	+	−	−	−	−	−	−	−	−	−
Pseudovorticella chlamydophora (Penard, 1922)	−	−	−	−	−	−	+	−	−	−
Rhagadostoma completum Kahl,1926	+	−	+	−	+	−	+	−	+	+
Saprodinium dentatum Lauterborn, 1908	−	−	−	−	+	−	−	−	−	−
Sathrophilus sp.	−	−	−	+	−	−	−	−	−	−
Spathidium distoma Kahl, 1926	−	−	−	−	+	−	−	−	−	−
Spirostomum minus Roux, 1901	−	−	−	−	−	−	+	−	−	−
Spirostomum teres Claparède , Lachmann, 1858	−	−	−	−	−	−	+	−	−	−
Stentor coeruleus (Pallas, 1766)	−	−	−	−	+	−	−	−	−	−
Stentor polymorphus (Müller, 1773)	−	−	−	−	−	−	+	−	−	−
Stentor roeseli Ehrenberg, 1835	−	−	−	−	−	−	+	−	−	−
Stokesia vernalis Wenrich, 1929	−	−	−	−	−	−	−	−	−	+
Strobilidium caudatum (Fromentel, 1876)	−	−	−	+	−	−	+	−	+	+
Strobilidium humile Penard, 1922	−	−	−	−	+	−	−	−	−	−
Strobilidium sp.	−	−	−	−	−	−	−	+	−	+
Stylonychia fissiseta Claparède , Lachmann, 1858	+	−	−	−	−	−	−	−	−	−
Stylonychia mytilus-Complex	+	+	+	+	−	−	+	−	+	+
Stylonychia pustulata (Müller, 1786)	−	−	+	−	−	−	−	−	−	−
Stylonychia putrina Stokes, 1885	−	−	−	−	−	−	+	−	+	−
Stylonychia stylomuscorum (Foissner et al., 1991)	−	−	−	−	−	−	+	−	−	−
Tachysoma pellionellum (Müller, 1773)	−	−	+	−	−	−	+	−	−	+
Tintinnidium fluviatile (Stein, 1863)	−	−	−	−	−	+	−	+	−	−

1	2	3	4	5	6	7	8	9	10	11
Trachelius ovum (Ehrenberg, 1831)	–	–	+	+	–	–	+	–	–	–
Trachelophyllum vestitum Stokes, 1884	–	–	–	+	–	–	–	–	–	–
Trichodina pediculus Ehrenberg, 1831	–	–	–	–	–	–	+	–	–	–
Trithigmostoma cucullulus (Müller, 1786)	–	+	+	–	–	–	–	+	–	–
Tropidoatractus acuminatus Levander, 1894	–	–	+	–	–	–	–	–	–	–
Urocentrum turbo (Müller, 1786)	–	–	+	–	+	–	+	–	+	+
Uroleptus piscis (Müller, 1773)	–	–	–	–	–	–	+	–	–	–
Uronema halophila (Kahl, 1931)	+	–	+	–	+	+	+	–	+	–
Uronema sp.	–	–	–	–	–	–	–	+	–	+
Urosoma sp.	–	–	–	–	–	–	–	+	–	–
Urostyla grandis Ehrenberg, 1830	–	–	+	–	–	–	+	–	–	–
Urotricha agilis (Stokes,1886)	–	–	–	+	–	–	–	–	–	–
Urotricha farcta Claparède, Lachmann, 1859	–	–	–	–	–	+	–	–	–	–
Urotricha furcata Schewiakoff, 1892	–	–	+	–	–	–	–	–	–	–
Urotricha ovata Kahl, 1926	–	–	–	–	–	–	+	–	+	–
Urotricha pelagica Kahl, 1935	–	–	–	–	–	–	–	+	–	+
Urozona bütschlii Schewiakoff, 1889	+	–	–	–	–	–	+	–	–	–
Vorticella convallaria (Linnaeus, 1758)	+	–	+	–	–	–	+	–	–	+
Vorticella sp.	–	–	+	–	–	–	+	+	–	–
Zoothamnium simplex Kent, 1881	–	–	–	–	–	–	+	–	–	–

Note. + — found, – — not found; I — mud, macrophytes; II — clay; III, VII — macrophytes; IV, VIII, X — water; V — mud; VI, IX — sand.

A cluster analysis was used to distinguish the cenotic structures in the species continuum. As illustrated (fig. 2), the ciliates fauna in the river and in the attendant bodies is divided into 3 clusters. Cluster I has pooled the samples of mud and much muddy macrophytes. The occurrence of true sapropelic ciliate fauna in freshwater anaerobic environments has been mentioned by Fenchel (1987), Fenchel, Finlay (1991). The differences between these samples derive from the habitat non-uniformity which results in the variations of sapropelic assemblage. In our case the sapropelic assemblage is represented by *Apsiktrata gracilis* Penard, 1922, *Brachonella campanula* (Kahl, 1932), *B. spiralis* (Smith, 1897), *Caenomorpha medusula* Perty, 1852, *C. sapropelica*, *D. pectinata*, *E. antiquorum*, *E. mirabilis* (Roux, 1899), *E. triangula* Kahl, 1932, *Lagynus elegans* Engelmann, 1862, *Loxocephalus luridus* Eberhard, 1862, *Metopus caudatus* Da Cunha, 1915, *M. es* (Müller, 1786), *M. laminarius* Kahl, 1927, *M. pulcher* Kahl, 1927,

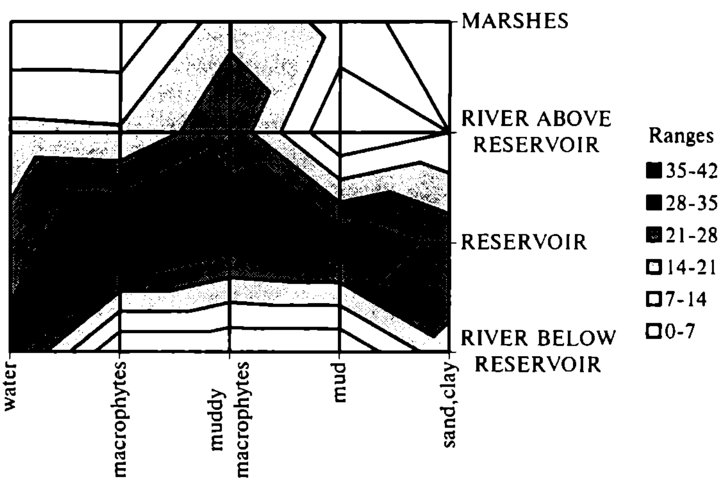

Fig. 1. The saturation of habitats with the ciliata species.

Рис. 1. Насыщенность видами инфузорий основных биотопов в исследованых водоемах.

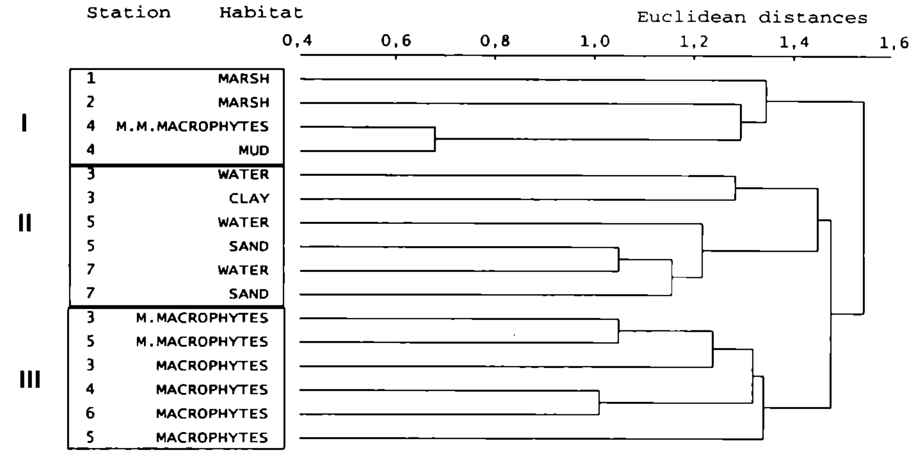

Fig. 2. Clusters of Jaccard similarity indices for the ciliates sampled from the different habitats.
Notes. M. Macrophytes – muddy macrophytes; M. M. Macrophytes – much muddy macrophytes.

Рис. 2. Дендрограмма сходства между образцами из различных мест обитания на основании индекса Жакарра.
Обозначения. M. Macrophytes – заиленные макрофиты; M. M. Macrophytes – сильно заиленные макрофиты.

M. setifer Kahl, 1932, *M. striatus* McMurrich, 1884, *Plagiopyla nasuta* Stein, 1860, *Saprodinium dentatum* Lauterborn, 1908, *Tropidoatractus acuminatus* Levander, 1894.

Another cluster (II) involves the samples from the water and from the oxygenated bottom sediments (sand and clay). This corresponds to the view expressing the lack of the characteristic interstitial and planktonic ciliate assemblages in freshwater ponds (Fenchel, 1987). Probably the distinguishing of individual planktonic ciliate communities (e. g. Nebrat, 1985, 1994), or benthic ciliate communities from the sandy bottom sediments (e. g. Kovalchuk, 1999) have not enough reasons. There is little doubt that the species found into and on the surfaces of muddy sand bottom sediments are something other than the individual assemblage, because most if not all of those species are common for the water column in meso- and eutrophic water bodies. Moreover, muddy bottom is unstable substrata which is dependent on seasonal changes of biochemical activity in the aquatic ecosystems. Likewise, some planktonic ciliates found in water column are not evidence for the existence of a planktonic assemblage. Indeed, planktonic ciliates found in shallow freshwater bodies are mainly adopted to littoral as well as to pelagic niches. In our case these are *Askenasia volvox* (Eichwald, 1852), *Pelagohalteria cirrifera* (Kahl, 1932), *Phascolodon vorticella* Stein, 1859, *Stokesia vernalis* Wenrich, 1929, *Tintinnidium fluviatile* (Stein, 1863), *Urotricha pelagica* Kahl, 1935. Thus, the species from the oxygenated bottom sediments and from the water column are combined within a single assemblage what is probably typical for the shallow freshwater bodies.

Another clearly defined cenotic structure is the epiphytic ciliate assemblage. (fig. 2, Cluster III). The significant species of this assemblage are the sessile species such as *Campanella umbellaria* (Linnaeus, 1758), *Carchesium polypinum* (Linnaeus, 1758), *P. chlamydophora*, *Stentor coeruleus* (Pallas, 1766), *S. polymorphus* (Müller, 1773), *S. roeseli* Ehrenberg, 1835, as well as some vagile species such as *Amphileptus carchesii* Stein, 1867, *A. pleurosigma* (Stokes, 1884), *Euplotes patella* (Müller, 1773), *Litonotus armillatus* Penard, 1922, *L. fasciola* (Müller, 1773), *Loxophyllum meleagris* (Müller, 1773).

Notice that the surfaces of macrophytes were covered to a greater or lesser extent with a detritus or a mud which is common to the fall. In this situation the ciliates are extend to the muddy macrophytes from the bottom mud which results in the forming of sapropelic assemblage on the muddy surfaces. Similar extension of the benthic meso- and macroinvertebrates to the solid substrates from the bottom was observed by Protasov (1994). The sapropelic community is thought to be unbounded on the bottom. It's may occurs universally where the sapropel is localized. Because of this the sample of much muddy macrophytes was combined with the sample of bottom mud (fig. 2, Cluster I).

Thus, only three individual ciliate assemblages were recorded in the investigated water bodies: (1) the sapropelic assemblage, (3) the epiphytic assemblage (2), the assemblage which combines the ciliates from oxygenated bottom sediments and from water column.

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