J. Appl. Environ. Biol. Sci., 5(5)178-183, 2015
© 2015, TextRoad Publication
ISSN: 2090-4274
Journal of Applied Environmental and Biological Sciences
www.textroad.com

Species Composition of the Free Living Ciliates of the Forest Soils of the Samur-Yalama National Park of Azerbaijan

I.Kh. Alekperov, V.F.Mamedova

Institute of Zoology of Azerbaijan National Academy of Sciences,
Pass.1128, block 504, Baku, AZ 1073, Azerbaijan

Received: January 24, 2015
Accepted: March 23, 2015

ABSTRACT

Currently, with the support of the German Government preparations for implementation of a project to create a Samur-Yalama National Park, which will cover in addition to the land, about 100 thousand hectares of sea area are in progress. Taking into consideration the fact that the fauna of free-living protozoa of this region of Azerbaijanis almost not studied, in recent years we have carried out systematic studies of soil protozoa of the forest zone areas, which should to join the Samur-Yalama National Park in the near future.
KEYWORDS: Freeliving ciliates, forest soils, National park, Azerbaijan

1.INTRODUCTION

It is known that free-soil-ciliates play important role in soil biological processes, in particular in the processes of production and destruction of organic matters, which leads to an increase in the general fertility of the soil. Being active consumers of bacteria, ciliates in abundance of bacterial food reach high density and in turn are consumed by other groups of pedobionts as food organisms.

2. MATERIALS AND THE METHODS OF STUDY

Based on the foregoing, in the period 2009-2011 we have studied the soil ciliates in the forest zone of the region. Totally 480 soil samples were collected and processed during the research. The collection points are shown in Figure 1. Soil samples were processed according to standard methods (Alekperov, 2005). To determine the species composition the methods of impregnation of infraciliature with silver nitrate (Chatton et Lwoff, 1930) and protargol were used widely (Alekperov, 1992). Environmental analysis was carried out on the basis of standard environmental indices - Simpson's index of dominance, Margalef's index of species diversity and Czekanowski-Sorensen's index of similarity of species composition. Data processing was carried out using the computer program «Biodiversity, Professional».

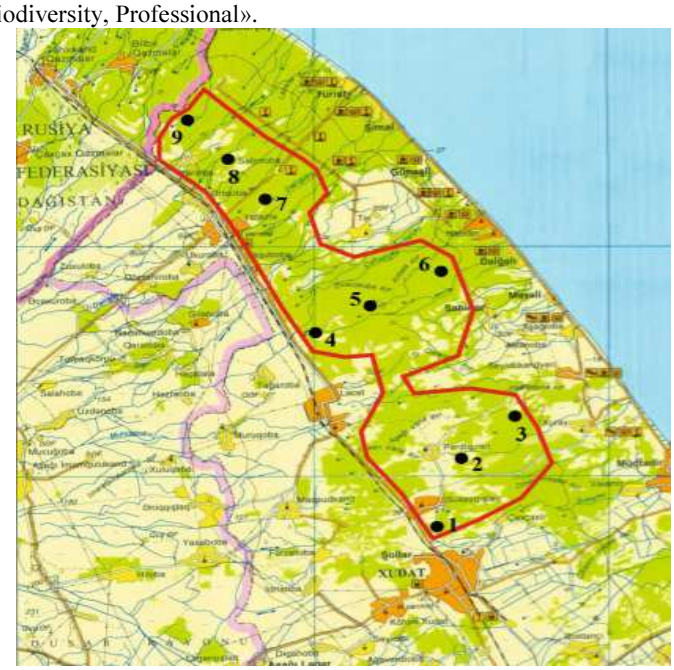


Fig. 1. Soil samples collection points

***Corresponding Author:** I.Kh. Alekperov, Institute of Zoology of Azerbaijan National Academy of Sciences, Pass.1128, block 504, Baku, AZ 1073, Azerbaijan

3. RESULTS AND THEIR DISCUSSION

In all 71 species of free-living ciliates were recorded in the forest soils during research, of which 4 species are new to the fauna of Caucasus.

Table 1.
The Soil Ciliates Species Contribution in the Northern-Coast Azerbaijan.

Species composition of ciliates	Sample points number								
	1	2	3	4	5	6	7	8	9
Fam. Blepharismidae Jankowski in Small and Lynn, 1985									
1 ***Blepharismasteini*Kahl, 1932**		+			+		+	+	
2 ***B.lateritium* Steins, 1859**		+			+		+	+	
3 ***B.bimicronucleatum*Villeneve-Brachon, 1940**		+			+		+	+	
Fam. Phacodiniidae Corliss, 1979									
4 ***Phacodiniummetchnikoffi*Prowazek, 1900**					+			+	
Fam. Aspidiscidae Stein, 1859									
5 ***A.poljanski*Alekperov, 1985**	+				+			+	
6 ***A.leptaspis*Fresenius, 1865**		+			+		+	+	
7 ***A.aculeata (*Ehrb., 1838)**	+	+							+
Fam.Urostylidae Bütschli, 1889									
8 ***Paraurostylaweissei (*Stein,1859)**		+				+		+	
9 ***P.caudata (*Stokes, 1886)**	+	+			+			+	+
10 ***P.herbicola* Kahl, 1932**		+			+	+		+	
11 ***Periholostichalanceolata*Hemberger, 1982**	+	+			+	+			+
12 ***P.acuminata*Hemberger, 1980**		+				+		+	
13 ***Birojimaterricola* Berger and Foissner, 1989***		+		+	+		+		+
14 ***Bakuella polycirrata* Alekperov, 1988**		+						+	
15 ***H.azerbaijanica*Alekperov and Asadullayeva, 1999**		+			+				
16 ***H.interrupta*Dragesco, 1966**			+	+					+
17 ***Histriculusmuscorum*Kahl, 1939**					+	+	+	+	+
18 ***H.admirabilis*Foissner, 1980**	+								+
Fam. Amphisiellidae Jankowski, 1979									
19 ***Hemiamphisiellaterricola*Foissner, 1988***						+	+		+
20 ***A.acuta*Foissner, Agatha, Berger, 1989**	+	+	+						
21 ***Cladotrichakoltrowii*Gajewskaja, 1925**	+	+						+	
Fam. Oxytrichidae Ehrenberg, 1838									
22 ***O.immemorata*Alekperov,1984**	+		+		+				
23 ***O.elegans*Foissner, 1999**		+		+			+		+
24 ***O.formosa*Alekperov, 1984**	+	+	+	+	+		+	+	
25 ***Australocirruszechmeisterae*Foissner et al., 2005***							+	+	+
26 ***A.oscitans*Blatterer and Foissner, 1988**					+		+		+
27 ***G.minima*Hemberger, 1982**			+						+
Fam. FuscheriidaeFoissner, Agatha et Berger, 2002									
28 ***Fuscheriaterricola* Berger, Foissner, Adam, 1983**	+	+						+	+
Fam. Tracheliidae Ehrenberg, 1838									
29 ***D.terrenus*Foissner, 1981**			+			+			
30 ***D.gracilis*Kahl, 1931**		+		+	+				+
Fam. ChilodonellidaeDeroux, 1970									
31 ***Chlamydonellapseudochilodon*Deroux, 1970***	+	+	+	+	+	+	+	+	+
Fam. Orthodonellidae Jankowski, 1968									
32 ***Zosterodasysdebilis*Alekperov, 1984**	+				+			+	
33 ***Z.cantabrica* Fernandez-Leborans and Alekperov, 1996**		+		+				+	+
Fam. Nassulidae de Fromentel, 1874									
34 ***N.terricola*Foissner, 1989***	+		+	+			+		
Fam.MicrothoracidaeWrześniowski, 1870									
35 ***L.margaritata*Alekperov, 2005**	+				+				+
36 ***Drepanomonasmuscicola*Foissner, 1986**		+		+			+		
37 ***D.revoluta*Penard, 1922**			+			+			
38 ***Stammeridiumkahli* (Wenzel, 1953)**	+			+					
Fam. Colpodidae Ehrenberg, 1838									
39 ***Bresslauadissimilis*Alekperov, 1985**	+				+			+	
40 ***B.sidiatrix* Graff, Dewey and Kidder,**		+		+			+		

	1941									
41	***T.minor*Alekperov, 1985**		+		+			+		
42	***Colpodacucullus* Müller, 1786**	+	+	+	+	+	+	+	+	+
43	***C.inflata* (Stokes, 1885)**	+	+	+	+	+	+	+	+	+
44	***C.colpidiopsis*Kahl, 1930**	+	+	+	+	+	+	+	+	+
45	***C.bifurcata*Alekperov, 1993**	+		+		+			+	
46	**C.*atra*Alekperov, 1993**	+		+	+					
47	***C.maupasi*Enriques, 1908**	+	+	+	+	+	+	+	+	+
48	***C.steini*Maupas, 1883**	+	+	+	+	+	+	+	+	+
49	***C.ellioti*Bredbery and Outka, 1967**	+	+	+	+	+	+	+	+	+
50	***C.aspera*Kahl, 1926**	+	+	+	+	+	+	+	+	+
Fam. Cirtolophosididae Stokes, 1888										
51	***Cirtolophosismuscicola* Stokes, 1888**	+	+	+	+				+	
52	***C.elongata* (Schewiakoff, 1896)**						+			+
Fam. GrossglockneridaeFoissner, 1980										
53	***Grossglockneriaacuta*Foissner, 1980**	+			+					
54	***Pseudoplatyophryaterricola*Foissner, 1985**		+					+		
55	***P.leningradica*Alekperov, 2005**	+							+	+
Fam. Urotrichidae Small and Lynn, 1985										
56	***Urotricha macrostoma,* Tucolescu, 1963**	+		+		+	+			+
57	***U.furcata* Schewiakoff, 1892**	+	+			+				
Fam. PlagiocampidaeKahl, 1926										
58	***Plagiocampacaudata*Alekperov, 1993**	+				+			+	
59	***P.ovata*Gelei, 1954**	+				+			+	
Fam. FrontoniidaeKahl, 1926										
60	***Frontoniaterricola*Foissner, 1986**	+	+	+		+			+	
61	***F.solea*Foissner, 1986**			+	+		+	+		+
Fam. Uronematidae Thompson, 1964										
62	***Uronemellafilicium* (Kahl, 1931)**	+		+				+		
63	***U.acutum*Buddenbrock, 1920**	+	+	+	+	+	+	+	+	+
64	***U.nigricans* (Müller, 1786)**	+	+	+		+		+	+	+
Fam. Cyclidiidae Ehrenberg, 1838										
65	***Cyclidiumglaucoma* Müller, 1856**	+	+	+	+	+	+	+	+	+
66	***C. muscicola* (Kahl, 1931)**		+			+	+			+
67	***Protocyclidiumterrenum*Alekperov, 1993**	+				+			+	
68	***P.terricola* (Kahl)**	+			+					
Fam.Tetrahymenidae Corliss, 1952										
69	***Stegochilumsmalli*Alekperov, 1953**		+			+	+	+		+
70	***T.edaphoni*Foissner, 1986***	+		+	+				+	
71	***Colpidiumkleini*Foissner**	+	+							+

Note; Species marked with star are new to the Caucasus fauna

It is known that heterogeneity of conditions in soil appears clearly in the vertical direction since depending on depth a number of important environmental factors that affect the lives of the inhabitants of the soil are changed sharply: the size of the cavities between the soil particle sand their density is changed. Depending on depth the content and the concentration of carbon dioxide in the air composition increased in the lower soil horizons (Nikitina, 1997).

Our studies have shown that the greatest diversity of species and the total number of ciliates were observed in the upper levels of 0-15 cm. This is due to high humidity of the surface layers of forest soil in the shade of the trees. Its mean if soil moisture is high, most ciliates species from passive cysts phase pass to active trofont stage. On the other hand in the surface layers of soil there is the greatest concentration of decaying organic matter, and consequently common microorganisms, many of which are food objects for a number of ciliates - bacteriophages. As already noted the vast majority of ciliates recorded in the forest area reach their mass development in the 0-15 cm of the soil layer, with consequent reduction of species diversity and total number at the depth. At the same time, our research has shown that many of observed species of ciliates have clear localizations in certain soil layers. For example, such eurybiont background species as *Avestina acuta, Colpoda inflata, Tillina minor* and others are mainly found only in the surface layers. On the other hand small representatives of the genera *Stammeridium, Drepanomonas s*et al.as a rule, in detectable concentrate ions found only in the deep layers of 10-25 cm and deeper. Similar results were obtained in the study of soil ciliates of the forest zones in other regions of Azerbaijan.

In addition, we noted another pattern. Studies have shown that medium and large sized ciliates (from 100 to 380 microns) are more common in the upper layers of the (0-5 cm) soil litter. It should also be noted that there is often met facultative soil ciliates, i.e usually fresh water species. These are *Zosterodasys debilis, Z.cantabrica, Frontonia solea, F.terricola, Blepharisma steini, Aspidisca leptaspis, Paraurostyla wessei, Holostycha azerbaijanica, Oxytricha formosa* ciliates species. We can explain this fact with the rain water and extremely high water content (50-70%) in the surface layers of soil, particularly in spring-autumn period, i.e. during time of maximum rainfall. At this time, almost due to the high humidity of litter and surface layers of soil, the

environmental conditions in the upper layers of the forest soil at the simplest living space of the free-living ciliates (a few cm^3 of humidity) do not differ from the conditions of their existence in fresh waters. It was in the period of maximum moisture content of forest soils when we found the vast majority of freshwater species of ciliates, which did not occur at lower soil moisture in drier summers.

On the other hand, in the deeper soil layers (10-25 cm) where the size of soil air holes is much less,only typical small soil inhabitants, the representatives of the genera, *Uronema, Cyclidium, Colpoda* et al were registered by us.

Thus, even in the same type of soil, in this case, the forest soil, there is a clearly marked stratification by horizons of soil ciliates when the community of the surface layers ofsoil, including litter, and community of ciliates in the deeper (10-25 cm) layers are distinguished by the sizing features, and by species diversity.

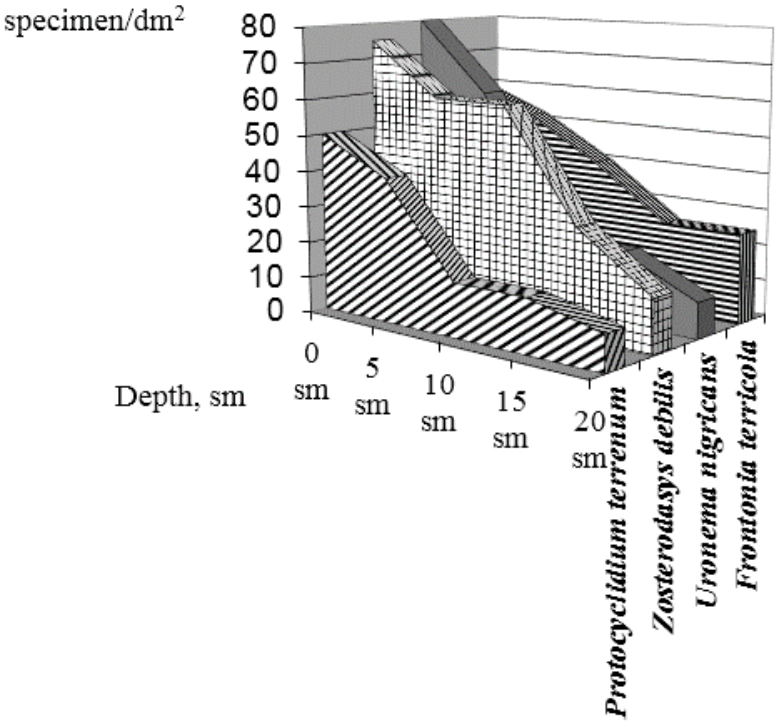
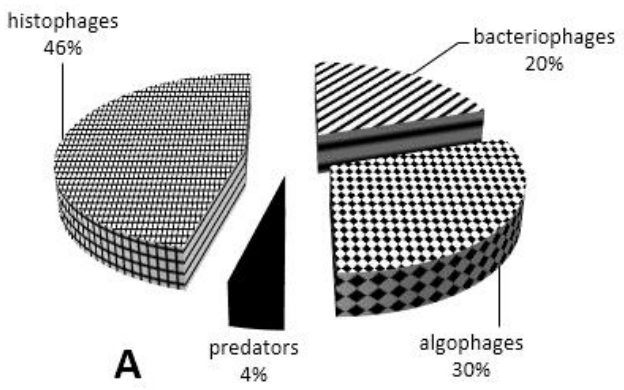


Fig. 2.The main type of distribution of free-living ciliates in the forest soils of the Samur-Yalama National Park

Typical vertical distribution of the most characteristic species of ciliates in forest soils of the Samur-Yalama National Park is shown in Fig. 2.

Within the bounds of our research work analysis of data on the ratio of the different trophic groups of free-living ciliates in the surface layers of soil (0-5 cm) and deeper layers of forest soils was done. As it can be seen from the data presented in Fig. 3, there are observed depth depending substantial differences in the ratio of trophic groups of free-living ciliates of forest soils.



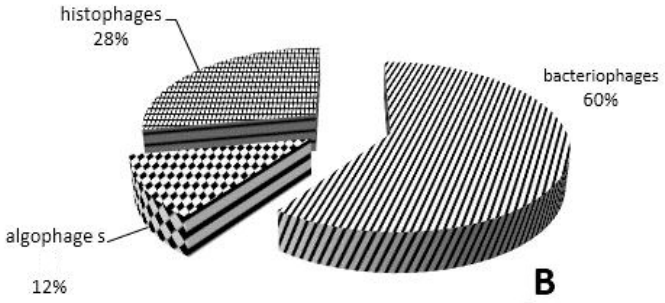


Fig. 3. The ratio of the trophic groups of the free-living ciliates (%) in the surface (A) and deep layers (B) of the forest soils of the Samur-Yalama National Park

For example, in the surface layers (Fig.3. A) there are all 4 major trophic groups present in the community of soil ciliates, from which histophages (46%) and algophages (30%) predominated. We explain the dominance of the two groups with abundance of food items on the surface layers of forest soils. As is generally known, here, in wet environments there is always the highest concentration of decaying organic remains of dead plants and animals, which creates favorable conditions and light, contribute to a rapid development of small algae, diatoms, blue-green algae, etc., being the basis of the food spectrum of ciliates - algophages. Later, in the surface layers of forest soils there was recorded 20% of ciliates – bacteriophages and 4% of predators feeding both on ciliates of other species, and animals from other taxonomic groups, including small metazoans. The ratio of trophic groups of free- living ciliates in the deep layers of forest soils (Fig. 3 B) has strong differences. For example, there are not any trophic groups of predatory ciliates here. We should note the full dominance of bacteriophages forming 60% of all groups. This is followed by a group of ciliates histophages forming 28% of all groups and algophages, which accounted for only 12%. These differences are explained by the greater density of the soil in the deeper layers, and the absence of light. Both of these factors impede the development of algal flora, but they make a contribution to the development of many bacteria.

Thus, summing up the data on primary survey of free ciliates of the forest soils of the future territory of the Samur-Yalama NP we can draw the following conclusions:

1. In forest soils of the studied region there are found 71 species of free-living ciliates, of which 4 species are new to the fauna of the Caucasus.
2. It is established that the species diversity and the total number of soil ciliates sequentially decreases down from the surface layers to deep. On the other hand it was revealed that in the uppermost horizons of forest soils with high humidity there is a large number of facultative species which commonly found in fresh waters. This is due to the similarity of their habitat conditions at continuous high moisture of soil. True pedobiont species of small size (10-20 microns) inhabit the deeper (10-20 cm) soil horizons.
3. The study of quantitative distribution of the free-living ciliates in the soil stratum has revealed two main types - distribution with a maximum number in the uppermost (0-5 cm) layers, which is typical for the facultative species, and distribution with the maximum number in the deep horizons (10-20 cm) whichis observed in true soil inhabitants.
4. The study of the ratio of the trophic groups of the free- living ciliates in the surface and deep layers of the forest soil has shown that all 4 trophic groups (histophages, bacteriophages, algophages and predators) are present in the surface layers, from which histophages(46%) and algophages(30%) are dominants.

There were observed the representatives of three trophic groups only (histophages, bacteriophages and algophages) in the deep layers,from which bacteriophageswas dominated, forming 60%.

CONCLUSION

The forest soils of Samur-Yalama National Park were investigated in the 2009-2011 years. A total of 89 species of free-living ciliates were recorded, of which 4 species are new to the fauna of Caucasus.

Trophic relations, numbers and vertical distribution of the free-living ciliates inhabiting the different soil horizons were has been studied.

REFERENCES

1. Alekperov I.Kh. New modification of the ciliates kinetom impregnation with silver proteinate. //Zool. J. Moscow, 1992, №2, p.130-133 (in Russian)
2. Alekperov I.Kh. An Atlas of the Freeliving Ciliates (Classes, Kinetofragminophora, Colpodea, Olygohymenophora, Polyhymenophora). // Publ.H. “Borchali”, Baku, 2005, 310 p.(in Russian)

3. Chatton E., Lwoff A. 1930. Impregnation, par diffusion argentique, del'infraciliature des Ciliès marins et d”eaudouce, après fixation cytologique et sans dessication. // C.R.Soc.Biol. Paris, V.104, p.834-836.

4. Nikitina L.I. The Soil Ciliates of the Middle Amur region. //P.H. XGPU,1997, 101 p.(in Russian)