

**PLANKTONIC CILIATES POPULATION CHANGES IN THE BUKAN DAM RESERVOIR (ZARRINEH RIVER, IRAN)****ALI MOHSENPOUR AZARI, F.G.AGAMALIYEV***Baku State University**s\_irada 64@mail.ru*

*The abundance and species composition of ciliates were analysed in the Bukan Dam reservoir (western Azerbaijan, Iran) from January to December 2007. Surface water samples were collected at monthly intervals at two different points, open water (Station 1, 3) and in the shallowest area of the reservoir (Station 2, 4) and examined for planktonic protozoa composition and density. Chlorophyll a was analyzed and a few ecological parameters such as dissolved oxygen, pH, turbidity and temperature were measured. Totally 50 ciliates species were found in the Bukan dam reservoir. Concerning the protozoa density, a high-density period was detected from January to April with a mean number of  $2.86 \times 10^3$  cells.l<sup>-1</sup> protozoa at Stations 1,3 and  $4.16 \times 10^3$  cells.l<sup>-1</sup> protozoa at shallowest areas at Stations 2,4 thanks to disappearance of phytoplankton in winter. The summer development of protozoa was possible thanks to the development of bacteria and moderate metazooplankton densities due to the appearance of non-edible algae. The density of ciliates was low during the rest of the year. The mean number of organisms at the high-density period was approximately 4-fold more than that obtained during the low-density one. The ciliates occurring at the highest densities were *Coleps tessellatus*, *Paradileptus elephantinus*, *Zosterograptus labiatus*, *Cyclidium citrullus*.*

Bukan dam reservoir is located in the south part of western Azerbaijan, with the total length of 17 km. It was formed by the building of the dam, 48m high in 1969. The total volume of the reservoir is  $650 \times 10^6$  m<sup>3</sup> and useful volume is  $486 \times 10^6$  m<sup>3</sup> and total area is  $45 \times 10^6$  m<sup>2</sup>. The complex hydrobiological examinations with monthly sampling have been taken to study the pelagic ciliates on this reservoir, because the ecological role of planktonic ciliates as trophic links between bacteria and pelagic zooplankton has been increasingly appreciated during recent years (7). Protozoa are known to play an important role by consuming bacteria and thus reducing their numbers in environments rich in organic matter (11). They also consume phytoplankton (4) and are consumed by Cladocera, Copepoda and Rotifera (15) in addition to being highly efficient in releasing phosphorus (14). The study of the zooplankton cycle in a marine environment showed that protozoa act as a link in the food chain of the sea between small planktonic organisms to the large metazooplanktonic herbivores (16). Ciliates graze on autotrophic and heterotrophic pico and nanoplankton and functioning as prey for larger zooplankton, contribute to the remineralization and cycling of nutrients (3). They play a pivotal role in the indication of pollution degree in lakes (17). The present investigation was undertaken to study the abundance and frequency of planktonic ciliates and some ecological parameters in deep and shallow

environment of the Bukan dam reservoir.

### MATERIALS AND METHODS

Three samples were taken in the middle water column by means of a 5-litre sampler (2), 200 ml of this sample was fixed immediately with 8.6 ml of a saturated HgCl<sub>2</sub> solution and stained with 0.04% bromophenol blue (12,13). Three subsamples were counted in a chamber and examined with a microscope (400 x). Protozoa were identified according to the work by 6,9 and 13. Taxonomic identifications were based mostly on Foissner et al, (6,7,9). Additionally the following physical and chemical factors were studied: visibility, pH, O<sub>2</sub>, conductivity, and biogens (TN, PO<sub>4</sub>, N-NH<sub>4</sub>, N-NO<sub>3</sub>). Visibility, pH, O<sub>2</sub> and conductivity were determined *in situ* using the Secchi disc and electrode Jenway 3405 and remaining factors were analysed in the laboratory, according to Hermanownicz et al (8).

### RESULTS

The seasonal variations of water transparency, dissolved oxygen, chlorophyll a, PH and water temperature are shown in table 1.

Table 1: Physical properties of water on the Bukan reservoir-2007

	Turbidity (m)	Dissolved Oxygen(mg.l <sup>-1</sup> )	Chlorophyll a (µg.l <sup>-1</sup> )	Water Temperature (°C)	PH
Jan	1.4	12	6.2	6	8.4
Feb	1.5	14.4	3.8	4.8	7.6
March	1.8	11.3	5.3	7.8	7.7
April	1.7	11.8	2.3	14.5	8.1
May	1.6	9.6	10.4	17	8.3
June	1.7	12.8	1.8	20	8.4
July	1	8	1.6	24	8
Aug	1.5	10.1	1.7	27.5	7.7
Sep	1.5	7.8	2.6	25	7.3
Oct	1.4	8	1	18	8.1
Nov	1.5	5.5	3.8	14	8.6
Dec	1.4	13.9	2.9	13	8.4

Chlorophyll a fluctuation showed two distinct phases : a period from May to June which showed values higher than those observed at a period from July to October which the opposite occurred. The maximum chlorophyll a value observed at the reservoir water was 10.4 µg.l<sup>-1</sup> being obtained in May with a minimum value of 1 µg.l<sup>-1</sup> in October. The maximum Dissolved Oxygen value observed at the reservoir water was 14.4 mg.l<sup>-1</sup> being obtained in Feb with a minimum value of 5.5 mg.l<sup>-1</sup> in November. The maximum Turbidity value observed at the reservoir water was 1.8 m being obtained in March with a minimum value of 1 m in July. The highest temperatures were recorded from July to September, with a maximum value of 27.5 °C and the minimum values were observed in February, with values of 4.8 and PH was between 7.3 and 8.6 during the study period at the reservoir. The chemical properties

of water including hardness, conductivity, PO<sub>4</sub>, TN, and BOD, N-NO<sub>3</sub>, N-NH<sub>4</sub> were different among months and their particular values are presented in table 2.

Table 2

**Chemical properties of water the Bukan reservoir-2007**

	<b>Hardness</b>	<b>Ec</b>	<b>PO4</b>	<b>TN</b>	<b>BOD</b>	<b>N-No3</b>	<b>N-NH4</b>
Jan	150,40	61,40	0,14	1,09	6,42	1,60	0,20
Feb	159,20	229,80	0,16	1,58	2,92	1,13	0,10
March	145,71	281,57	0,06	1,24	2,65	1,42	0,15
April	156,80	219,00	0,32	1,62	1,54	1,67	0,06
May	147,00	212,25	0,22	1,14	2,51	1,38	0,03
June	158,33	150,10	0,34	1,19	1,41	1,00	0,16
July	145,67	48,12	0,37	1,70	4,77	1,00	0,23
Aug	141,75	46,65	0,14	1,39	2,19	1,00	0,12
Sep	161,50	53,79	0,34	1,10	6,59	1,60	0,18
Oct	173,00	73,09	0,29	1,22	5,69	1,00	0,15
Nov	140,40	230,40	0,41	1,07	7,37	1,40	0,26
Dec	172,80	53,64	0,55	1,73	4,87	1,14	0,15

These parameters confirmed mesotrophic status of the reservoir and were similar to that observed in other mesotrophic lakes (5).

The composition of the major ciliates taxa in open water and shallowest areas of the Bukan reservoir are presented in table 3

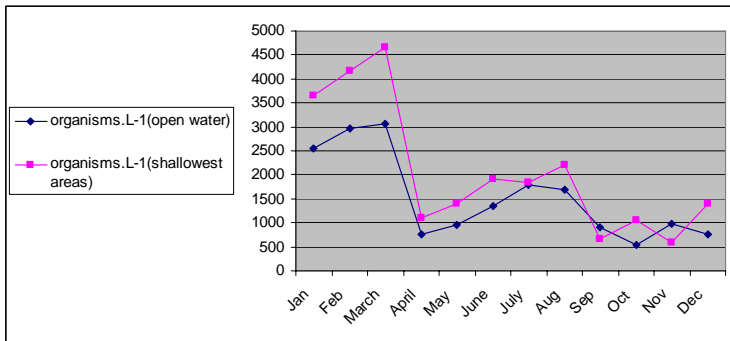
Table 3

**Ciliates taxa in open water and shallowest areas in the Bukan reservoir**

<b>Ciliates species groups</b>		
Class.1.Kinetofragminophora	Class.2.Oligohymenophora	Class.3.Polyhymenophora
Order 1.Prostomatida	Order 1.Hymenostomatida	Order 1.Heterotrichida
Coleps hirtus Nitzsch.	Tetrahymena pyriformis Schew.	Metopus es Müll.
C.tesselatus Kahl	Glaucoma chattoni Corliss	Stentor polymorphus Ehrb.
Holophrya atra Svec.	Paramecium aurelia Ehrb.	S.roeseli Ehrb.
H.hextricha Savi.	P.caudatum Ehrb.	Condylostoma rugosum Kahl
Prorodon brachyodon Kahl	P.bursaria Focke.	Order 2.Oligotrichida
P.viridis Ehrb.Kahl	Frontonia acuminata Kahl	Halteria grandinella Müll.
P.ovum Kahl	F.leucas Fabr.-Dom.	Strombidium viride Stein
P.teres Ehrb.	F.elliptica Beard.	S.mirabile Penard
Order 2 .Haptorida	Urosentrum turbo Müll.	S.fallax Zach.
Enchelys pupa Müll.-Ehrb.	Stokesia vernalis Wenrich.	Strombilidium gyrans (Stok.)
Didinium nasutum Müll.	Order 2.Scuticociliatida	S.velox F.-Fr.
Paradileptus elephantinus (Svec.)	Pleuronema coronatum Kent	Tintinnidium pusillum Entz.
P.conicus Wenrich	Cyclidium glaucoma Müll.	Tintinnopsis cylindrata Kof.-Camp.
Lacrymaria olor Müll.	C.citrullus Cohn.	Order 3.Hypotrichida

Order 3.Pleurostomatida	Vorticella nebulifera Müll.	Oxytricha minor Kahl
Litonotus lamella Ehrb.	V.campanula Ehrb.	O.pellionella Müll.
Order 4 .Nassulida	——	Stylonychia mytilus (Müll.)
Nassula citrea Kahl	——	Euplotes patella Müll.
Zosterograptus labiatus Kahl	——	E.eurystomus Wrz.
Trithigmostoma cucullulus(Müll.)	——	Aspidisca costata Duj.

A total number of 50 ciliates species were found in plankton samples .The most abundant species belonged to Hymenostomatida (10 species) and the least species belonged to Pleurostomatida (1 species). The seasonal distribution of Ciliates populations in the Bukan reservoir is presented graphically in fig. 1. Three different periods can be observed with respect to the density of protozoa detected, i.e. a high-density period from January to April and from July to August, and a low-density period from September to December.



**Fig. 1:** Seasonal distribution of Ciliates population in the Bukan reservoir-2007

The mean number of organisms detected during the low-density period at autumn was about 1000 protozoa  $l^{-1}$  at the shallowest areas and 700 protozoa  $l^{-1}$  at open water. During the high-density period, the mean number at the shallowest areas was about 4000 protozoa  $l^{-1}$  while at the open water it was 2800 protozoa  $l^{-1}$ . Thus, during the high density period the mean number of organisms was approximately 4-fold that obtained during the low density period. The densities of ciliates showed clearly marked seasonal changes in the Bukan reservoir. They fluctuated from 1 ind.  $ml^{-1}$  in April to 5 ind.  $ml^{-1}$  in March. During this period Prostomatida (*Coleps tessellatus*), Haptorida (*Paradileptus elephantinus*), Nassulida (*Zosterograptus labiatus*), Scuticociliatida (*Cyclidium citrullus*), Heterotrichida (*Metopus.sp*) and Oligotrichida (*Strombidium gyrans*) constituted 60% of the total number of the ciliates.

## DISCUSSION

Among the physico-chemical variables investigated at the Bukan Reservoir, temperature showed a pattern commonly observed in shallow and turbulent aquatic ecosystems. pH varied little around 7.5 and 8.5; the concentration of dissolved oxygen was between 5.75  $mg\ l^{-1}$  and 14  $mg\ l^{-1}$ , corresponding to 65 to 152 percent saturation, with the environment being well oxygenated throughout the study period.

Chlorophyll a concentration, measured from January to December 2007, was relatively low with a maximum of 10.39  $\mu\text{g l}^{-1}$ . The highest densities of planktonic protozoa in the Bukan reservoir were observed from January to April. The densities of ciliates showed clearly marked seasonal changes in the reservoir. Also the peaks in the winter and the summer were probably determined by abiotic water factors. They were also observed in other eutrophic (19) and hypertrophic lakes. Protozoan abundance tended to increase with increasing lake productivity (1). The present study clearly showed that ciliates abundance correlated with the reservoir productivity, too. The concentration of appropriate food (bacteria, nanoflagellates and algae) is probably the major regulator of abundance, biomass and diversity of planktonic ciliates. Very high densities of ciliates in late winter in the Bukan reservoir might have been caused by the phytoplankton density. It seems that with the death of these organisms there is greater decomposition and consequently, a larger number of bacteria and amount of detritus available for the protozoa, which in turn increase in density. A similar situation relating a large abundance of protozoa after the death of the phytoplankton and simultaneous bacterial growth has been previously observed in Lake Dalnee-USSR (18). The small bacterivorous ciliates, mainly Scuticociliatida are typical of mesotrophic lake individuals in each sample (1). Also omnivorous *Coleps tesselatus* and *Vorticella sp.* dominated in pelagial of lakes in  $\text{pH} > 7$  and their importance increases with eutrophication (10). The highest density occurrence of *Coleps tesselatus*, *Paradileptus elephantinus*, *Zosterograptus labiatus*, *Cyclidium citrullus* in the late winter showed increasing of eutrophication in the reservoir that happened with increased water entrance at this season. Totally, we may conclude that the Bukan dam reservoir was mesotrophic at the study period.

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## **BUKAN SU ANBARININ PLANKTON İNFUZORLARI (ZƏRRİNƏ ÇAYI, İRAN)**

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### **XÜLASƏ**

İlk dəfə olaraq Zərrinə çayı üzərində yerləşən Bukan su anbarında plankton infuzorlar öyrənilmiş və 3 sinfə, 9 dəstəyə mənsub olan 50 növ infuzor aşkar edilmişdir. Material su anbarının 4 nöqtəsindən toplanmışdır. Müəyyən olunmuşdur ki, infuzorların sıxlığı 1,3-cü nöqtələrdə  $2 \cdot 86 \times 10^3$ ; 2,4 nöqtələrdə isə  $4 \cdot 16 \times 10^3$  fərd təşkil etmişdir. Siliofaunanın fəsilələr üzrə öyrənilməsi nəticəsində aşkar olunmuşdur ki, onlar ən yüksək inkişafa mart ayında çatırlar. Burada *Coleps tesselatus*, *Paradileptus elephantinus*, *Zosterograptus labiatus*, *Cyclidium citrullus* və b. kütləvi populyasiya əmələ gətirmişlər.

## **ПЛАНКТОННЫЕ ИНFUZОРИИ БУКАНСКОГО ВОДОХРАНИЛИЩА (РЕКА ЗАРРИНА, ИРАН)**

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### **РЕЗЮМЕ**

Впервые подробно проанализирована фауна планктонных инфузорий Буканского водохранилища и обнаружено 50 видов инфузорий, относящихся к 3 классам и 9-ти отрядам. Выявлено, что плотность инфузорий ( $4 \cdot 16 \times 10^3$ ) преобладает на станциях 2 и 4 водохранилища, 4 вида (*Coleps tesselatus*, *Paradileptus elephantinus*, *Zosterograptus labiatus*, *Cyclidium citrullus*) на этих станциях образовали массовые популяции.