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SPECIES COMPOSITION AND ECOLOGY OF THE DIATOMS IN THE GAVKHUNI WETLAND (IRAN)

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Islamic Azad University, Falavarjan Branch
(Esfahan, Iran)

Data on ecology of 109 species (120 infraspecific taxa) of diatomic algae, which revealed in the Gavkhuni Wetland (Esfahan Province, Iran), are submitted. It is cited information about temperature, the EC, pH for each species; there is pointed halotolerance and ecotope. The original interpretation concerning halotolerance is suggested for species of *Achnanthes thermalis*, *Amphora delicatissima*, *Caloneis permagna*, *Achnanthes brevipes*, *Neidium binodis*. Comparative analysis of composition species for investigated stations in the different time of collection and on the whole are carried out.

Key words: *Bacillariophyta, species composition, ecology, delta of Zayandehrud River, Gavkhuni Wetland, Iran*

The Gavkhuni Wetland is situated on alkali soils in 168 kilometers on the southeast from Esfahan at height of 1476 m above sea level (Moiniyan, 2000). This wetland is water body which was originally formed as the closed salty lake in an intermountain valley tacking flow of the Zayandehrud River and numerous temporary currents. Depth of the Gavkhuni is 1 m on average. The Gavkhuni's area makes 475 kilometers square but it widely fluctuates. In the summer time, its area generally makes 120 kilometers square. Fluctuations of a level are concerned with: temporary seasonal water-flows (waters from melted snow); evaporation of water during the dry period.

The considerable volume of the suspended matters (river takes sewage of settlements and enterprises as well as surface run-off with irrigable area) and river alluvium are result in swamping of delta of river and considerable part of adjacent area of water. In this connection, water body is often named swamp (wetland). Unfortunately, water gathers only in the river delta because of a small amount of falling of atmospheric precipitation and regulated stream in the last years.

This lagoon is also a wintering place of migrant bird like flamingo (*Phoenicopterus ruber*), wild ducks (*Anas platyrhynchos*), wild-goose (*Ardea cinerea*) and other.

First, hydrobiological surveys of this wetland have been only carried out at the beginning of the sixties of XX century (Loffler, 1961). Unfortunately, any algae species is not mentioned in his work from this lagoon; there is only cited a quantity of species for the Zayandehrud River. Our investigated of the Gavkhuni Wetland has been carried for the first time in May of 2002 (Zarei-Darki, 2004); the water body was surveyed repeatedly in February, 2009.

The aim of present paper is analysis of species composition and ecological characteristic of *Bacillariophyta* inhabited on water section of the Gavkhuni that is immediately adjacent to river delta.

MATERIAL AND METHODS

The eighteen samples of phytoplankton and microphytobentos collected at the three stations of the delta of the Zayandehrud River and at the section which immediately adjoining to delta, served as ma-

Adress: Zarei-Darki Behrouz, Department of Biology, Islamic Azad University, Falavarjan Branch, St. Hakimshafai aval 78, Av. Sorush, Esfahan, Iran;
e-mail: zarei@mail.ru & zareidarki@iaufala.ac.ir

terials for the present study (Fig. 1). Unfortunately, most of the Gavhuni region is difficult of access and to remains not surveyed and studied in algological respect hitherto.

Methods of sampling, processing, and storage of the algological material are those generally accepted in algology (Vodorosli … , 1989). Each sample was collected in the three repetitions: alive and fixed samples for microscopy as well, sample for diatomic analyze (Diatomovye … , 1974). Parameters like temperature, salinity, the EC, DO, pH were taken during sampling. Analysis of the collected specimens was carried out in the Laboratory of Phycology, Biological Faculty of V.N. Karazin Kharkov National University (Ukraine) and at the Biology Laboratory of Falavarjan Islamic Azad University (Iran). Identification of the species composition of algae was carried out using the basic systematic reports (Zabelina et al., 1951; Krammer, Lange-Bertalot, 1986; 1988; 1991; Round et al., 1992). Present report (Barinova et al., 2006) was used for composition of ecological characteristics. Authors of *Bacillariophyta* species is cited in compliance with recommendation on standardization (Tsarenko, 2010). Zhakkar factor (K_j) was used when comparing *Bacillariophyta* species composition in different collected stations of water body.

RESULTS AND DISCUSSION

As a result of processing the materials of double investigated on the Gavkhuni Wetland, 109 species represented by 120 infraspecific taxa of *Bacillariophyta* belonging 3 classes and 38 genera were revealed (Table 1).

Number of *Bacillariophyta* species which were found at the investigated stations in the different periods, differed great extent (Table 2). The most significant differences in species number were recorded for the station 1 that is located practically on the border of the Zayandehrud River and the Gavhuni (notional boundary Gavhuni at maximum water level). In May 2002, at the station 1, it was noted 89 species and varieties most of which were indifferent *Cyclotella radiosa*, *Stephanodiscus hantzschii*, *Asterionella formosa*, *Diatoma vulgare*, *Cymbella amphicephala*, *C. helvetica*, *Gomphonema acuminatum*, *Ulnaria acus*, *Sellaphora bacillum* but halophiles were present following: *Melosira varians*, *Fragilariforma virescens* var. *subsalina*, *Diatoma anceps*, *D. tenue*, *Sellaphora pupula*, *Proschkinia bulnheimii*. It is interesting to note that during this period in the samples was also noted halophobous as *Stenopterobia curvula* (at the temperature of water 20°C, pH 8.2 and EC 10.8). During the second inspection of this point (February, 2009), 35 taxa was found and at the same time halophiles prevailed over the indifferent. Among them are *Fragilaria crotonensis*, *Catacombas gaillonii*, *Anomoeoneis sphaerophora*, *Navicula cincta*. Apparently, these changes in the ratio of groups of salinity arisen because of entrance increase of sewage and irrigable agricultural waters and reduce the degree of dilution by river waters. As a result, presence of mesohalobous species like *Tabularia tabulata* (C.A. Agardh) Snoeijs, *Achnanthes thermalis* (Rabenhorst) Schönfeldt, *Gyrosigma strigilis* (W. Smith) Griffith et Henfrey, *Tryblionella apiculata* Gregory, *T. hungarica* (Grunow) D.G. Mann in Round et al., *T. levidensis* W. Smith has also increased. Species of *Cylindrotheca closterium* (Ehrenberg) Reiman and Lewin was characterized by most cell number (at the temperature of water 5°C, pH 6,5-6,9 and EC=30,4 μs/cm).

At the station 2, in May 2002, 52 taxa were revealed and in February 2009, 34 taxa were found. Among them were common seven taxa (*Catacombas gaillonii*, *Placoneis elginensis, Gomphonema parvulum, Achnanthes brevipes*, *Pinnularia gibba, Gomphonema acuminatum* var. *coronatum, Amphora coffeaeformis* var. *angularis*) in two investigations. In this time, the widespread species both plankton and benthos were indifferent: *Stephanodiscus hantzschii, Fragilaria danica, Navicula menisculus, Nitzschia acicularis, Nitzschia palea*. During the second inspection of the point typical species were from halophiles of *Gomphonema parvulum* (Kützing) Grunow var. *micropus* (Kützing) P.T. Cleve from indifferents, *Cocconeis pediculus* Ehrenberg and *Cosmioneis pusilla* and from mesohalobous forms of *Amphiprora paludosa* W. Smith. that may be evidence of an unstable salt regime.

At the third station, on the whole 68 species were found, 40 of them – in May (2002) and 36 taxa – in February (2009). For two investigations of this point eight taxa were common, are follow: *Navicula radiosa, N. rhynchocephala, Gyrosigma strigilis, Amphora coffeaeformis, A. coffeaeformis* var. *angularis, Bacillaria paxillifer, Tryblionella levidensis, Nitzschia clausii.* In May, Usual widespread species were indifferent: *Caloneis ventricosa, Navicula cryptotenella, Surirella angustata* и *Cymatopleura solea*. During second collection when EC makes 49.7 and temperature was 7°C, species *Amphora coffeaeformis* was frequent occurrence both in plankton and in the benthos. Moreover, overwhelming majority of mesohalobous species were revealed just at this station in this time: *Caloneis permagna*, *Navicula incerta, Bacillaria paxillifer*, *Surirella striatula* and other.

Only three taxa like *Achnanthes brevipes, Pinnularia gibba, Amphora coffeaeformis* var. *angularis* were common at all investigated stations in a given time.

Table 1. The taxonomic composition and ecological characteristics of diatoms in the Gavkhuni Wetland

Taxa	Ecology*				
	1	**2**	**3**	**4**	**5**
Coscinodiscophyceae					
Cyclotella radiosa (Grunow) Lemmerm.	20	8,2	10,8	Pl-B	i
C. schroeteri Lemmerm.	20	8,2	10,8	Pl-B	i
Melosira varians C.Agardh	20	8,2	10,8	Pl-B	hl
Stephanodiscus hantzschii Grunow	20	8-8,2	10,8-12,2	Pl-B	i
S. minutulus (Kütz.) Cleve & V.Möller	20	8-8,2	10,8-12,2	Pl-B	i
Fragilariophyceae					
Asterionella formosa Hassall	20	8,2	10,8	Pl-B	i
Catacombas gaillonii (Bory) Williams & Round	5-21	6,5-8,2	10.8-49.4	Pl-B	hl
Diatoma anceps (Ehrenb.) Kirchner	20	8.2	10.8	B	hl
Diatoma sp.	20	8.2	10.8	B	-
Diatoma tenue C.Agardh	20	8.2	10.8	B	hl
D. vulgare Bory var. *vulgare*	20	8.2	10.8	Pl-B	i
D. vulgare Bory var. *breve* Grunow	20	8.2	10.8	Pl-B	i
D. vulgare Bory var. *ovalis* (Fricke) Hustedt	20	8.2	10.8	B	i
Fragilaria capucina Desm.	20	8-8.2	10.8-12.2	Pl-B	i
F. crotonensis Kitton	5	6.5	49.4	B	hl
F. danica (Kütz.) Lange-Bert.	20-21	8-8.1	12.2	Pl-B	i
Fragilariforma virescens (Ralfs) Williams & Round var. *virescens*	20-21	8-8.2	10.8-12.2	Pl-B	i
F. virescens (Ralfs) Williams & Round var. *subsalina* Grunow	5-20	6.5-8.2	10.8-49.4	Pl-B	hl
Martyana martyi (Hérib.) Round	5	6.5	49.4	Pl-B	i
Staurosira construens Ehrenb.	20	8-8.2	10.8-12.2	Pl-B	i
Tabularia tabulata (C.Agardh) P.J.M.Snoeijs	5	6.5-6.8	49.4-49.6	Pl-B	mh
Bacillariophyceae					
Achnanthes brevipes C.Agardh	20	8-8.2	10.8-12.2	B	hl
A. inflata Grunow	20	8.2	10.8	B	hl
A. thermalis (Raben.) Schönfeldt	5	6.5	49.4	B	mh
Amphiprora paludosa W.Sm.	5	6.8	49.6	Pl	mh
Amphora coffeaeformis C.Agardh var. *coffeaeformis*	5-21	6.8-8.1	12.13-49.6	Pl-B	mh
A. coffeaeformis C.Agardh var. *angularis* Cleve	7-21	6.9-8.2	10.8-49.7	Pl-B	mh
A. delicatissima Krasske	5	6.8	49.6	B	mh
A. holsatica Hustedt	20	8-8.2	10.-12.2	B	hl
A. veneta Kütz.	20	8-8.2	10.8-12.2	Pl-B	i
Anomoeoneis sphaerophora (Kütz.) Pfitzer	5-7	6.5-6.9	49.4-49.7	B	hl
Bacillaria paxillifer (O.Müll.) Hendey	7-21	6.9-8,1	12.1-49.7	Pl-B	mh
Caloneis amphisbaena (Bory) Cleve	20	8-8.2	10.8-12.2	B	hl
C. latiuscula (Kütz.) Cleve var. *rostrata* Skvortsov	20	8.2	10.8	B	i
C. permagna (J.W.Bailey) Cleve	7	6.9	49.7	B	mh
C. ventricosa (Ehrenb.) F.Meister	21	8.1	12.13	B	i
Cocconeis pediculus Ehrenb.	5	6.8	49.6	B	hl
C. placentula Ehrenb. var. *intermedia* (Hérib. & Perag.) Cleve	20	8.2	10.8	B	i
Cosmioneis pusilla (W.Sm.) D.G.Mann & Stickle	5	6.8	49.6	B	hl
Craticula ambigua (Ehrenb.) D.G.Mann	20	8.2	10.8	B	i
C. cuspidata (Kütz.) D.G.Mann	20	8.2	10.8	B	i
C. halophila (Grunow ex van Heurck) D.G.Mann	20	8-8.2	10.8-12.2	B	i
Cylindrotheca closterium (Ehrenb.) Reiman & Lewin	5-7	6.5-6.9	49.4-49.6	Pl-B	mh
Cymatopleura elliptica (Bréb. ex Kütz.) W.Sm.	20	8	12.2	B	i
C. librile (Ehrenb.) Pant.	20	8.2	10.8	B	i
C. solea (Bréb.) W.Sm.	20-21	8.1-8.2	10.8-12.13	B	i
Cymbella affinis Kütz.	20	8-8.2	10.8-12.2	B	i
C. amphicephala Nägeli	20	8.2	10.8	B	i
C. cistula (Ehrenb.) Kirchn.	20	8.2	10.8	B	i
C. cymbiformis C.Agardh	5-20	6.8-8.2	10.8-49.6	B	hl
C. helvetica Kütz. var. *helvetica*	21	8.1	12.13	B	i
C. helvetica Kütz. var. *curta* Cleve	20	8.2	10.8	B	i
C. lanceolata (Ehrenb.) Kirchn.	20	8.2	10.8	B	i
C. pusilla Grunow	5-7	6.8-6.9	49.6-49.7	B	mh
C. tumidula Grunow	20	8-8.2	10.8-12.2	B	i
C. turgida Hassall	20	8.2	10.8	B	i
C. turgidula Grunow	20	8.2	10.8	B	i
Encyonema minutum (Hilse in Rabenh.) D.G.Mann	20	8.2	10.8	B	i
E. prostratum (Berk.) Kütz.	20	8-8.2	10.8-12.2	B	i
Gomphonema acuminatum Ehrenb. var. *acuminatum*	20	8-8.2	10.8-12.2	B	i

G. acuminatum Ehrenb. var. *coronatum* (Ehrenb.) W.Sm.	20	8.2	10.8	B	i
G. brasiliense Grunow	20	8.2	10.8	B	i
G. clavatum Ehrenb.	20	8.2	10.8	B	i
G. olivaceum (Lyngb.) Kütz. var. *olivaceum*	20	8.2	10.8	B	i
G. olivaceum (Lyngb.) Kütz. var. *calcareum* (Cleve) Cleve	20	8-8.2	10.8-12.2	B	i
G. parvulum (Kütz.) Grunow var. *parvulum*	20	8	12.2	Pl-B	i
G. parvulum (Kütz.) Grunow var. *micropus* (Kütz.) Cleve	20	8	12.2	B	i
G. truncatum Ehrenb.	20	8.2	10.8	B	i
Gyrosigma acuminatum (Kütz.) Rabenh.	20	8.2	10.8	B	i
G. strigilis (W.Sm.) J.W.Griff. & Henfr.	5-21	6.5-8.1	12.13-49.7	B	mh
Hantzschia amphioxys (Ehrenb.) Grunow	20	8.2	10.8	B	i
Navicula arenaria Donkin	20	8-8.2	10.8-12.2	B	hl
N. cari Ehrenb.	20	8.2	10.8	B	i
N. cincta (Ehrenb.) Ralfs	5	6.5-6.9	49.4-49.7	B	hl
N. cryptocephala Kütz.	5-21	6.5-8.2	10.8-49.4	B	hl
N. cryptotenella Lange-Bert.	21	8.1	12.13	B	i
N. exigua (W.Greg.) O.Müll. var. *exigua*	20	8.2	10.8	Pl-B	i
N. exigua (W.Greg.) O.Müll. var. *elliptica* Hustedt	20	8-8.2	10.8-12.2	Pl-B	i
N. incerta Grunow	7	6.9	49.7	B	mh
N. lanceolata (C.Agardh) Ehrenb.	20	8-8.2	10.8-12.2	B	i
N. menisculus Schum.	20	8-8.2	10.8-12.2	Pl-B	i
N. radiosa Kütz.	7-21	6.9-8.2	10.8-49.7	B	hl
N. rhynchocephala Kütz.	7-21	6.9-8.2	10.8-49.7	B	hl
N. tripunctata (O.Müll.) Bory	20-21	8.1-8.2	10.8-12.13	Pl-B	i
N. veneta (Kütz.) Grunow	7	6.9	49.7	B	hl
Neidium binodis (Ehrenb.) Hustedt	20	8.2	10.8	Pl-B	hl
Nitzschia acicularis (Kütz.) W.Sm.	20	8-8.2	10.8-12.2	Pl-B	i
N. clausii Hantzsch	7-21	6.9-8.1	12.13-49.7	B	mh
N. linearis (C.Agardh) W.Sm.	20	8-8.2	10.8-12.2	B	i
N. obtusa W.Sm.	5-7	6.8-6.9	49.6-49.7	B	mh
N. ostenfeldii Hustedt	20	8-8.2	10.8-12.2	Pl-B	i
N. palea (Kütz.) W.Sm.	20	8-8.2	10.8-12.2	Pl-B	i
N. sigmoidea (Ehrenb.) W.Sm.	20	8.2	10.8	Pl-B	i
Nitzschia sp.	20	8.2	10.8	B	-
N. sublinearis Hustedt	21	8.1	12.13	Pl-B	i
N. subtilis (Kütz.) Grunow	20	8-8.2	10.8-12.2	B	i
N. umbonata Lange-Bert.	20	8-8.2	10.8-12.2	B	i
N. vermicularis (Kütz.) Hantzsch	5	6.5	49.4	B	hl
Pinnularia gibba Ehrenb.	20	8-8.2	10.8-12.2	B	i
P. leptogongyla Ehrenb.	20-21	8-8.2	10.8-12.2	Pl-B	-
P. mesolepta (Ehrenb.) W.Sm.	20	8-8.2	10.8-12.2	B	i
P. microstauron (Ehrenb.) Cleve	20	8-8.2	10.8-12.2	B	i
P. viridis (Nitzsch) Ehrenb.	20	8.2	10.8	B	i
Placoneis elginensis (Gregory) E.J.Cox	20	8-8.2	10.8-12.2	B	i
Proschkinia bulnheimii (Grunow) Karaeva	20	8.2	10.8	Pl-B	hl
Sellaphora bacillum (Ehrenb.) D.G.Mann	20	8.2	10.8	B	i
S. pupula (Kütz.) Mereschk.	20-21	8.1-8.2	10.8-12.13	Pl-B	hl
Stenopterobia curvula (W.Sm.) Krammer	20	8.2	10.8	B	hb
Surirella angustata Kütz.	20-21	8.1-8.2	10.8-12.13	B	i
S. minuta Brébisson	5	6.5	49.4	B	hl
S. striatula Turpin	7	6.9	49.7	B	mh
Tryblionella apiculata Gregory	5-7	6.5-6.9	49.4-49.7	Pl-B	mh
T. hungarica (Grunow) D.G.Mann	5-7	6.5-6.9	49.4-49.7	B	mh
T. levidensis W.Sm.	5-21	6.5-8.1	12.13-49.7	Pl-B	mh
T. obtusiuscula Grunow	20	8.2	10.8	Pl-B	i
Ulnaria acus (Kütz.) Aboal	20	8-8.2	10.8-12.2	Pl-B	i
U. biceps (Kütz.) Compère	20	8-8.2	10.8-12.2	B	i
U. oxyrhynchus (Kütz.) Aboal	20	8.2	10.8	Pl-B	i
U. ulna (Nitzsch) Compère var. *ulna*	20	8.2	10.8	Pl-B	i
U. ulna (Nitzsch) Compère var. *amphirhynchus* (Ehrenb.) Aboal	20	8-8.2	10.8-12.2	B	i

*** Note.** 1 – range of temperature, °C, 2 – pH, 3 – electrical conductivity, ms/cm, 4 – ecotope (Pl – plankton, B – benthos), 5 – halotolerance (hb – oligohalobous-halophobous; i – oligohalobous-indiferents; hl – oligohalobous-halophilous; mh – mesohalobous)

Table 2. Allocation of *Bacillariophyta* species composition for Gavhuni stations of sample collection in the investigated time.

Stations	Years	Found taxa	Total in the station	Common taxa for two investigations.	Typical taxa
1	2002	89	105	19	70
	2009	35			16
2	2002	52	79	7	45
	2009	34			27
3	2002	40	68	8	32
	2009	36			28

Using calculated values K_j maximal similarity, schemes for total Bacillariophyta species diversity (Fig. 2, I) revealed at the three station of water body in all time of investigations as well as separately for each investigation – May 2002 (Fig. 2, II), February 2009 (Fig. 2, III) have been composed. General correlation pleiad is built by connection level of 0,43 (I). For May (2002) the presence of a small number of species that are common for first and second stations, allows us to construct a united pleiad at the level of 0,3 (II) that indicates the predominance of distinctions over the similarities. For February 2009 at the level of 0,4 (III) internal connections between the first and third stations get broken in the pleiad. Maximal similarity for all stations of material collection has been determined in May 2002 between first and second points at the level 0,53 that is, the similarity prevailed over distinction in their species composition; in February 2009, between second and third stations.

By analyzing the distribution of diatoms into salinity groups for each investigated station, it is possible to see that the number of indifferent species decreases with the movement from the delta Zayandehrud River to section wetland, and the number of mesohalobous species increases (Fig. 3). On the whole, indifferents turned out most numerous groups with respect to halotolerance (Fig. 4). But high content of salts in wetland waters has

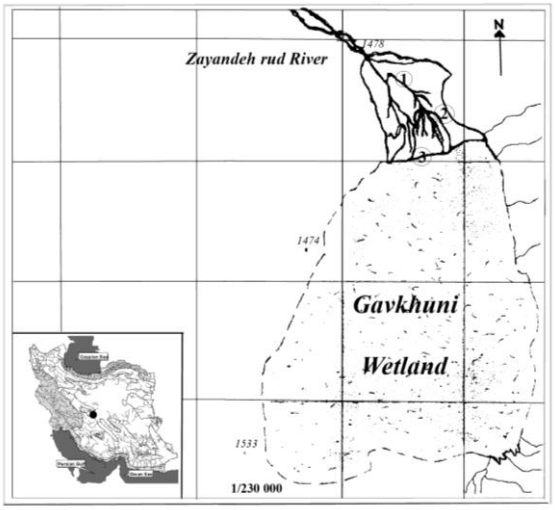

Fig. 1. A schematic map showing the location of sampling stations on the Gavkhuni Wetland. O – stations of sample collection.

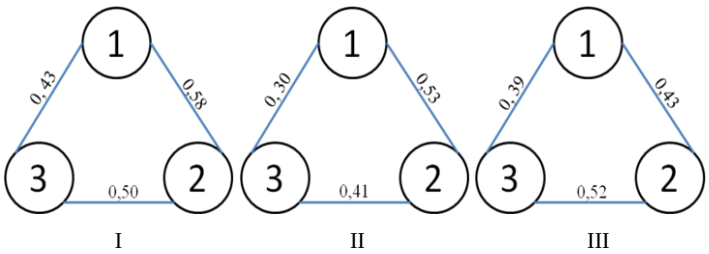

Fig. 2. Diagram of maximal similarity of *Bacillariophyta* species diversity for all investigated time (I), for May 2002 (II), for February 2009 (III).
1, 2, 3 – investigated stations.

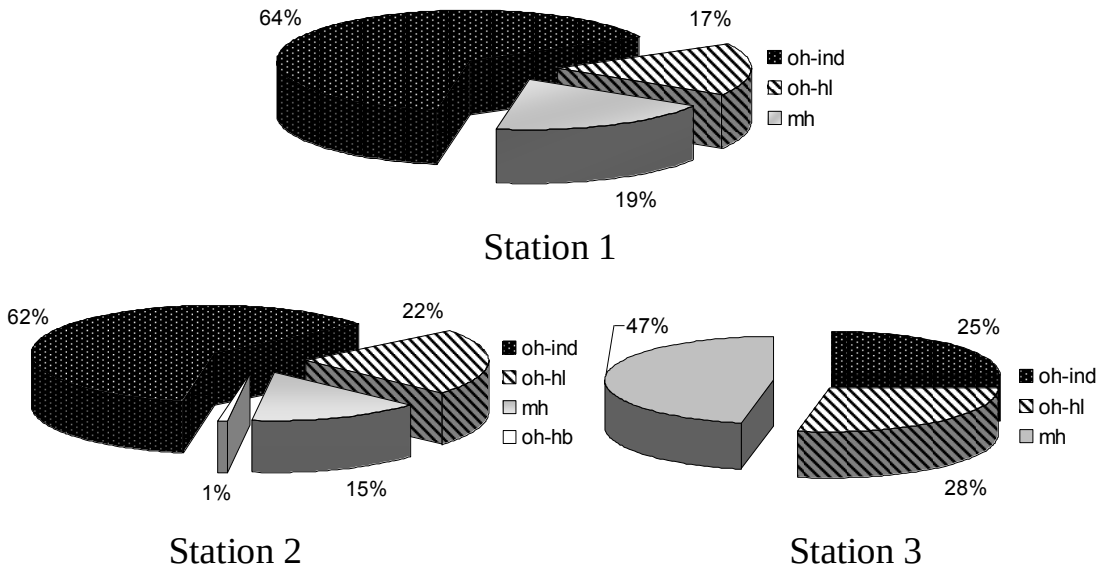

Fig. 3. Contribution of groups of salinity to *Bacillariophyta* species composition in each investigated station.

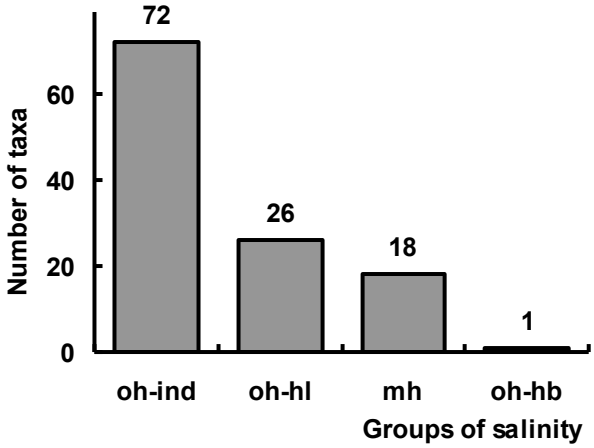

Fig. 4. Allocation of total *Bacillariophyta* species composition of wetland algal flora for groups of salinity.

determined rather high rate both halophilous forms (24%) and mesohalobous species (13%). There is no consensus concerning the ecology of *Achnanthes brevipes, A. thermalis, Amphora delicatissima, Caloneis permagna* и *Neidium binodis*; some authors regard them as halophilous species with the exception of *Neidium binodis* (it regards as indifferent) (Barinova et al., 2006), while others as mesohalobous ones (Proshkina-Lavrenko, Makarova, 1968; Zabelina et al., 1951). Taking into account the salinity values in the wetland at the time of survey, we grouped species of *Achnanthes thermalis, Amphora delicatissima, Caloneis permagna* with mesohalobous forms and species of *Achnanthes brevipes* и *Neidium binodis* with oligohalobous-halophilous forms.

At the analysis of results of our surveys of Gavkhuni Wetland's algal flora were revealed 109 species represented by 120 infraspecific taxa of Bacillariophyta belong to 38 genera. Distribution of specific composition of Bacillariophyta is established concerning halotolerance in different investigated years and on the different locations. The original interpretation concerning halotolerance is suggested for species of *Achnanthes thermalis, Amphora delicatissima, Caloneis permagna, Achnanthes brevipes, Neidium binodis*. The data obtained should be considered preliminary. The specificity of the water body and the conditions developed in it require the continuation of algofloristic monitoring and further studies.

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ВИДОВОЙ СОСТАВ И ЭКОЛОГИЯ ДИАТОМОВЫХ ВОДОРОСЛЕЙ БОЛОТА ГАВХУНИ (ИРАН)

Б. Зареи-Дарки

Исламский Флаварджанский Азад университет
(Исфахан, Иран)

Представлены сведения об экологии 109 видов (120 внутривидовых таксонов) *Bacillariophyta*, выявленных в болоте Гавхуни (остан Исфахан, Иран). Для каждого вида приводятся данные температуры, pH, удельной электропроводности воды; указывается группа галобности и местообитание. Для видов *Achnanthes thermalis, Amphora delicatissima, Caloneis permagna, Achnanthes brevipes, Neidium binodis* предложена оригинальная трактовка группы галобности. Проведен сравнительный анализ видового состава для исследуемых станций в разные периоды сбора и в целом.

Ключевые слова: *Bacillariophyta, видовой состав, экология, дельта реки Зайендеруд, болото Гавхуни, Иран*

ВИДОВИЙ СКЛАД І ЕКОЛОГІЯ ДІАТОМОВИХ ВОДОРОСТЕЙ БОЛОТА ГАВХУНІ (ІРАН)

Б. Зареї-Даркі

Ісламский Флаварджанський Азад університет
(Ісфахан, Іран)

Подано відомості про екологію 109 видів (120 внутрішньовидових таксонів) *Bacillariophyta*, виявлених в болоті Гавхуні (остан Ісфахан, Іран). Для кожного виду наводяться дані температури, pH, питомої електропровідності води; вказується група галобності і місцепроживання. Для видів *Achnanthes thermalis, Amphora delicatissima, Caloneis permagna*, *Achnanthes brevipes, Neidium binodis* запропоноване оригінальне трактування групи галобності. Проведено порівняльний аналіз видового складу для досліджуваних станцій в різні періоди збору і в цілому.

Ключові слова: *Bacillariophyta, видовий склад, екологія, дельта річки Зайендеруд, болото Гавхуні, Іран*