

Diatom diversity of Western Khentey Mountain area, Mongolia

Разнообразие диатомовых водорослей в горах Восточного Хентэя, Монголия

Bukhchuluun Tsegmid¹, Baigal-Amar Tuulaikhuu²

Бухчулуун Цегмид¹, Байгал-Амар Туулайхуу²

¹Laboratory of Flora and Plant Systematics, Botanical Garden and Research Institute, MAS, Ulaanbaatar, Mongolia. E-mail: bukhchuluunts@mas.ac.mn

¹Лаборатория флоры и систематики растений, Ботанический сад и исследовательский институт, МАН, Улан-Батор, Монголия

²School of Agro-Ecology, Mongolian University of Life Sciences, Ulaanbaatar, Mongolia. E-mail: tbaigalamar@muls.edu.mn

²Школа агро-экологии, Монгольский университет наук о живом, Улан-Батор, Монголия

Summary. The main objective of this study was to quantify the diatom flora richness and analyze the diversity structure in the aquatic habitats in Western Khentey Mountain area. During the diatom study of some streams and rivers namely Barchuluut, Huder, Ichleg, Shariin gol, and Sharlan rivers, which are located in western part of Khentey mountains, 98 species of diatoms were registered and the result compared with literature sources. In the water bodies in the western part of Khentey mountains totally 673 species and subspecies of algae were registered (Bacillariophyceae (640), Coscinodiscophyceae (20), Mediophyceae (13)). They represent 35 percent of Mongolian algae flora.

Key words. Diatom, diversity, Huder, Ichleg, Khentey.

Реферат. Основной целью данного исследования стало количественное определение богатства диатомовой флоры и анализ структуры разнообразия водных местообитаний в районе Западного Хентэя. В ходе исследования диатомовой флоры некоторых ручьев и рек, а именно: Барчулуут, Худер, Ичлег, Шарийн-голь и Шарлан, которые расположены в западной части Хенейских гор, было зарегистрировано 98 видов диатомовых водорослей, полученные результаты сравнивались с литературными источниками. В водоемах западной части Хентойских гор зарегистрировано 673 вида и подвида водорослей (Bacillariophyceae (640), Coscinodiscophyceae (20), Mediophyceae (13)). Они составляют 35 % флоры монгольских водорослей.

Ключевые слова. Диатомовые водоросли, Ичлег, разнообразие, Хентэй, Худер.

Introduction. The Khentey Mountain range extends from south-west to north-east and separates Arctic from Pacific Ocean basins. The west side of Khentey is bordered by the rivers Tuul and Orkhon and the biggest satellite mountains in the west are the Small Khentey range, it separates the Eroo and Kharaa river basins from the Tuul river basin. The Tuul, Kharaa, Eroo and Minj rivers start from the western slopes of the Khentey range. In the south and east Khentey mountain 615 diatom taxa were investigated and among that Kharaa (19 taxa) and Barchuluut (12) rivers consisted 31 taxa of diatom (Metzeltin et al., 2009).

The western Khentey is one of the hydrographical plan of Mongolia which catchment area of Selenge river and its tributaries flowing down western and southwestern Khentey ridges. Greatest diatom taxa (501) are revealed in Khentey Mountain (Dorofeyuk, Kulikovskiy, 2012). A total of 345 diatom species were recorded in Yeroo and Kharaa river basin (Bukhchuluun, 2016).

Even though seeing the above works, it can be seen that many diatom researches have been conducted in the rivers and streams of the Khentey mountain system, but there are several streams, where no diatom study was conducted. The aim of this study is to identify species composition of some rivers, which are not included in the above mentioned previous studies, and to compile the diatom species composition of Western Khentey.

Material and Methods. A total of 19 algae samples were studied. Field information is filled in table 1. In 2007–2011, algae samples were collected from bottom mud and stone surfaces and plant habitats using standard methodology (Hohn, Hellerman, 1963) and 19 samples were checked from algae collection of Laboratory of flora and plant taxonomy, Botanic Garden and Research Institute, Mongolian Academy of Sciences. All samples were oxidized in concentrated nitric acid for an hour at 110 °C to remove organic materials. Oxidation by products were removed by rinsing material six times with distilled water. The remaining material and diatoms were dried onto coverslips. Coverslips were mounted on microscope slides with Zrax mounting medium.

Table 1

Study location and samples

Location name	Latitude	Longitude	Sampling year	Samples
Barchuluut river	N49.009027	E106.956861	2008	3
Huder river	N49.79697	E107.39331	2011	4
Ichleg river	N49.091138	E107.402	2008	3
Shariin gol/river	N49.18592	E106.66025	2011	5
Sharlan river	N49.083611	E107.414194	2007	4

Slides were examined under light microscope with 1000× magnification and species were identified using Patrick, Reimer, 1966, 1975; Krammer, Lange-Bertalot, 1991, 1997a, 1997b, 2000a, 2000b; Metzeltin et al., 2009. All collected taxonomic data was adopted to the modern taxonomic system with the help of AlgaeBase (Guiry, Guiry, 2020).

Results. The data compilation and analysis of the floristic surveys conducted in the field have allowed us to identify 673 species belonging to 3 classes (Bacillariophyceae – 95 %, Coscinodiscophyceae – 2.9 %, Mediophyceae – 1.9 %), 21 orders, 37 families, 98 genera. The order *Naviculales* and *Cymbellales* were 36.8 and 17.2 percent respectively of the total species composition.

The following ten families, namely Bacillariaceae Ehrenberg., Naviculaceae Kützing., Gomphonemataceae Kützing., Pinnulariaceae D. G. Mann., Eunotiaceae Kützing., Cymbellaceae Kützing., Stauroneidaceae D.G.Mann., Achnanthesiaceae D. G. Mann., Surirellaceae Kützing., Fragilariaceae Kützing are the richest with genera, and they constitute of 56.1 % (55 genera) of all the recorded genera during our research. Species of these families also compose of 57.3 % (386 species) of all species recorded, with more than 20 species (Table 2).

Discussion. Here we are illustrating diatom species composition of western Khentey region of Mongolia, where we have done diatom studies for five years between 2007–2011. Diatom investigation of Kharaa, Yeroo, Zagdal, Bayangol, Sugnugur, Shivert Rivers are manation from Khentey Mountain and there a total of 345 species belonging to 59 genera was recorded during the study 2006–2008 (Bukhchuluun, 2016). Metzeltin et al., 2009, in the work, only a single sample from the Kharaa River in the western part of the Khentii Mountains was studied and a few species were recorded; in the Dorofeyuk et al. (2012) have not yet recorded diatom from these major rivers. Research on aquatic ecosystems and its biodiversity of Selenge River Basin has been performed intensively and in the consequent publication by Dgebuadze, 2009, in the fourth chapter more than 100 species of algae were newly recorded in the Mongolian algae flora, and a new class Rhabdophyceae was added to the Mongolain algae record (Dorofeyuk, 2009; Korneva, 2009).

In this paper species list is firstly registered Huder, Ichleg and Shariin gol and Sharlan rivers.

Conclusion. In the streams and rivers of Western Khentey Mountain area 98 species of diatoms were recorded. Here we presented compilation of the species list both from previous studies (published) and from our study in 2007–2011. Totally, 673 species of diatom were recorded. Within them genera *Pinnularia* and *Navicula* contained extremely large numbers of species 63 and 58 respectively.

Table 2

Diversity of higher taxon and belonging species number

class	order	family/genera number/ species number	genera	species number	percent
Bacillariophyceae	Bacillariales/76	Bacillariaceae/5/76	<i>Denticula</i>	4	0.6
			<i>Hantzschia</i>	9	1.3
			<i>Nitzschia</i>	52	7.7
			<i>Psammodictyon</i>	1	0.1
			<i>Tryblionella</i>	10	1.5
	Cocconeidales/38	Achnanthidiaceae/6/30	<i>Achnanthidium</i>	7	1.0
			<i>Eucoconeis</i>	2	0.3
			<i>Karayevia</i>	3	0.4
			<i>Lemnicola</i>	1	0.1
			<i>Planothidium</i>	8	1.2
			<i>Psammothidium</i>	9	1.3
		Cocconeidaceae/8	<i>Cocconeis</i>	8	1.2
	Cymbellales/116	Anomoeoneidaceae/4	<i>Adlafia</i>	2	0.3
			<i>Anomoeoneis</i>	2	0.3
		Cymbellaceae/6/39	<i>Cymbella</i>	18	2.7
			<i>Cymbellafalsa</i>	1	0.1
			<i>Cymbopleura</i>	16	2.4
			<i>Didymosphenia</i>	1	0.1
			<i>Navicymbula</i>	1	0.1
			<i>Paraplaconeis</i>	2	0.3
		Gomphonemataceae/6/72	<i>Encyonema</i>	13	1.9
			<i>Geissleria</i>	2	0.3
			<i>Gomphoneis</i>	3	0.4
			<i>Gomphonema</i>	42	6.2
			<i>Placoneis</i>	11	1.6
	<i>Reimeria</i>		1	0.1	
	Rhoicospheniaceae/1	<i>Rhoicosphenia</i>	1	0.1	
	Eunotiales/47	Eunotiaceae/47	<i>Eunotia</i>	47	7.0
	Fragilariales/37	Fragilariaceae/6/24	<i>Fragilaria</i>	18	2.7
			<i>Fragilariforma</i>	2	0.3
			<i>Neosynedra</i>	1	0.1
			<i>Punctastriata</i>	1	0.1
			<i>Synedra</i>	1	0.1
<i>Tabularia</i>			1	0.1	
Staurosiraceae/13		<i>Pseudostaurosira</i>	6	0.9	
		<i>Staurosira</i>	4	0.6	
		<i>Staurosirella</i>	3	0.4	
Licmophorales/12	Ulnariaceae/12	<i>Ctenophora</i>	1	0.1	
		<i>Hannaea</i>	3	0.4	
		<i>Ulnaria</i>	8	1.2	

Table 2 (continuation)

class	order	family/genera number/ species number	genera	species number	percent		
Bacillariophyceae	Mastogloiales/5	Achnantheaceae/5	<i>Achnanthes</i>	3	0.4		
			<i>Platessa</i>	1	0.1		
			<i>Skabitschewskia</i>	1	0.1		
	Naviculales/248	Amphipleuraceae/8		<i>Frustulia</i>	5	0.7	
				<i>Halamphora</i>	3	0.4	
		Bacillariophyta familia incertae sedis/9zuil/3			<i>Navigeia</i>	3	0.4
					Brachysiraceae/5		
		<i>Nupela</i>	3	0.4			
		Cavinulaceae/3			<i>Cavinula</i>	3	0.4
					Cosmioneidaceae/1		
		Diadesmidaceae/8			<i>Luticola</i>	8	1.2
					Diploneidaceae/3		
		Naviculaceae/6/76			<i>Caloneis</i>	6	0.9
					<i>Gyrosigma</i>	4	0.6
					<i>Hippodonta</i>	5	0.7
					<i>Navicula</i>	58	8.6
					<i>Naviculadicta</i>	2	0.3
					<i>Pulchella</i>	1	0.1
		Naviculales incertae sedis/5/15			<i>Boreozonacola</i>	1	0.1
					<i>Chamaepinnularia</i>	8	1.2
					<i>Eolimna</i>	1	0.1
					<i>Kobayasiella</i>	1	0.1
					<i>Mayamaea</i>	4	0.6
		Neidiaceae/13			<i>Neidiomorpha</i>	2	0.3
					<i>Neidium</i>	11	1.6
		Pinnulariaceae/63			<i>Pinnularia</i>	63	9.4
		Pleurosigmataceae/1			<i>Pleurosigma</i>	1	0.1
		Sellaphoraceae/18			<i>Fallacia</i>	1	0.1
					<i>Sellaphora</i>	17	2.5
		Stauroneidaceae/4/31			<i>Craticula</i>	11	1.6
	<i>Fistulifera</i>				1	0.1	
	<i>Prestauroneis</i>				2	0.3	
	<i>Stauroneis</i>				17	2.5	
Rhopalodiales/13	Rhopalodiaceae/13		<i>Epithemia</i>	9	1.3		
			<i>Rhopalodia</i>	4	0.6		
Surirellales/26	Surirellaceae/5/26		<i>Campylodiscus</i>	1	0.1		
			<i>Cymatopleura</i>	4	0.6		
			<i>Iconella</i>	5	0.7		
			<i>Stenopterobia</i>	1	0.1		
			<i>Surirella</i>	15	2.2		

Table 2 (end)

class	order	family/genera number/ species number	genera	species number	percent
Bacillariophyceae	Tabellariales/16	Tabellariaceae/5/16	<i>Diatoma</i>	8	1.2
			<i>Distrionella</i>	1	0.1
			<i>Meridion</i>	2	0.3
			<i>Tabellaria</i>	3	0.4
			<i>Tetracyclus</i>	2	0.3
	Thalassiophysales/6	Catenulaceae/6	<i>Amphora</i>	6	0.9
Coscinodiscophyceae	Aulacoseirales/14	Aulacoseiraceae/14	<i>Aulacoseira</i>	14	2.1
	Coscinodiscales/3	Coscinodiscaceae/2	<i>Lindavia</i>	2	0.3
		Orthoseiraceae/1	<i>Orthoseira</i>	1	0.1
	Melosirales/2	Melosiraceae/2	<i>Angusticopula</i>	1	0.1
			<i>Melosira</i>	1	0.1
Paraliales/1	Radialiplicataceae/1	<i>Ellerbeckia</i>	1	0.1	
Mediophyceae	Stephanodiscales/12	Stephanodiscaceae/5/12	<i>Cyclostephanos</i>	3	0.4
			<i>Cyclotella</i>	3	0.4
			<i>Discostella</i>	1	0.1
			<i>Pantocsekiella</i>	1	0.1
			<i>Stephanodiscus</i>	4	0.6
	Thalassiosirales/1	Thalassiosiraceae/1	<i>Conticribra</i>	1	0.1

REFERENCES

- Bukhchuluun Ts.** Diatoms in Yeroo and Kharaa river basin, Mongolia // Journal of Institute of General and Experimental Biology, MAS, 2016. – N. 32. – P. 140–151.
- Dorofeyuk N. I.** 4.1. Algal flora of Mongolian part of the Selenge drainage basin // Aquatic ecosystems of the Selenga drainage basin. Biological resources and conditions of Mongolia. Trans. Joint Russian-Mongolian Complex Biol. Exp. / J. J. Dgebuadze (ed). – Moscow: Nauka, 2009. – 55: 62–118 p.
- Dorofeyuk N. I., Kulikovskiy M. S.** Diatoms of Mongolia. – Moscow: Nauka, 2012. – 367 p.
- Guiry M. D., Guiry G. M.** AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. URL: <https://www.algaebase.org> (accessed 21 May 2020).
- Hohn M. H., Hellerman J.** The taxonomy and structure of the diatom populations from three Eastern North American Rivers using three sampling methods // Trans. Amer. Microsc. Soc., 1963. – Vol 82. – P. 250–329.
- Korneva L. G.** 4.2. Phytoplankton of several lakes of the Selenge River drainage basin. – In: Dgebuadze, J.J. (ed): Aquatic ecosystems of the Selenga drainage basin. Biological resources and conditions of Mongolia. Trans. Joint Russian-Mongolian Complex Biol. Exp. – Moscow: Nauka, 2009. – 55: 118–136.
- Krammer K., Lange-Bertalot H.** Bacillariophyceae. Teil 4: Achnanthaceae. Kritische Ergänzungen zu *Navicula* (Lineolata) und *Gomphonema* Gesamtliteraturverzeichnis Teil 1–4. Susswasserflora von Mitteleuropa, Band 2. – Germany: Gustav Fischer, Stuttgart; Jena, 1991. – 437 p.
- Krammer K., Lange-Bertalot H.** Bacillariophyceae (Naviculaceae). Teil 1: Naviculaceae. Susswasserflora von Mitteleuropa, Band 2. – Germany: Gustav Fischer, Jena, 1997a. – 876 p.
- Krammer K., Lange-Bertalot H.** Bacillariophyceae. Teil 2: Bacillariaceae, Epithemiaceae, Surirellaceae. Susswasserflora von Mitteleuropa, Band 2. – Germany: Gustav Fischer, Jena, 1997b. – 610 p.
- Krammer K., Lange-Bertalot H.** Bacillariophyceae. Part 5: English and French translation of the keys. Susswasserflora von Mitteleuropa, Band 2. – Berlin: Spektrum, Akademischer, Heidelberg, 2000a. – 311 p.
- Krammer K., Lange-Bertalot H.** Bacillariophyceae. Teil 3: Centrales, Fragilariaceae, Eunotiaceae. Susswasserflora von Mitteleuropa, Band 2. – Berlin: Spektrum, Akad., Heidelberg, 2000b. – 598 p.

Metzeltin D., Lange-Bertalot H., Soninkhishig N. Diatoms in Mongolia // *Iconographia Diatomologica*, 2009. – Vol. 20. – Germany: Koeltz. – 703 p.

Patrick R., Reimer C. W. The diatoms of the United States, exclusive of Alaska and Hawaii, Volume 1 –Fragilariaceae, Eunotiaceae, Achnanthaceae, Naviculaceae. – Academy of Natural Sciences of Philadelphia Monograph, 1966. – 688 p.

Patrick R., Reimer C. W. The diatoms of the United States, exclusive of Alaska and Hawaii, Volume 2, Part 1 – Entomoneidaceae, Cymbellaceae, Gomphonemaceae, Epithemaceae. – Academy of Natural Sciences of Philadelphia Monograph, 1975. – 213 p.