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Original Article

Contribution to the Lake Algal Flora and Microcrustacean Fauna of the Great Lakes Depression, Mongolia

Miguel Alonso[1], Soninkhishig Nergui[2], Ana Garcia-Murcia[3] & Sergi Pla-Rabes[4]

[1]*Ecology Section, Department of Evolutionary Biology, Ecology and Environmental Sciences, Faculty of Biology, University of Barcelona, Avda, Diagonal 643. 08028 Barcelona, Spain. E-mail: malonso@ub.edu*
[2]*Department of Biology, School of Science, National University of Mongolia POB 535, 46A, Ulaanbaatar Mongolia. E-mail: soninkhishig@num.edu.mn*
[3]*AECOM URS SLU, Compte Urgell 143, 08036. Barcelona, Spain. E-mail: ana.garcia@aecom.com*
[4]*CREAF. Autonomous University of Barcelona. Campus UAB. Edifici C. 08193 Bellaterra (Barcelona), Spain. E-mail: sergiplarabes@gmail.com*

Abstract

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Correspondence:
soninkhishig@num.edu.mn

In this paper the taxonomic composition of phytoplankton, diatoms and microcrustaceans (cladocerans and copepods) in lakes of the Great Lakes Depression (Mongolia) is examined. The inventories were based on samples collected in seven lakes and in one small reservoir between 2005 and 2009. Four lakes and the reservoir are of fresh water, (110 - 300 µS/cm of water conductivity) and the three remaining lakes are endorheic and with more mineralized water (5,270 – 9,550 µS/cm of water conductivity). In the phytoplankton 136 taxa were identified, where 29 species and 10 genera are the new records for Mongolia. In case of Diatoms 122 species were identified and 48 of them are the new records for Mongolia. Thirty-nine species of cladocerans and 9 species of copepods were identified, 13 species of cladocerans and one copepod are new for Mongolian fauna. In general, the taxa belonging to the different analyzed groups (pytoplankton, diatoms and microcrustaceans) are known throughout the Palaearctic region. Most taxa of all the analyzed taxonomic groups take place in the lakes with low mineralization, while lakes with more mineralized waters had significantly lower species richness.

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Introduction

Lakes and river systems in Mongolia are relatively untouched compared with heavily populated world. Total 500 km^3 water volume of lakes is a valuable resource for Mongolia where total river flow estimated as 38.9 km^3 in this dry land.

There are four main landscape regions in Mongolia: Altai Mountain Region (MR), Khangai and Khentii MR, Gobi Desert and East Mongolian steppe regions. Although Gobi region is characterized by only 150 mm annual mean precipitation and high level of evaporation (900-1500 mm), its northwestern part hosts the Great Lakes Depression (GLD), which contains biggest lakes in Mongolia, including Uvs, Khar-Us, Khar, Durgun, Khyargas, Airag and Dalai lakes.

GLD covers more than 100 thousand km^2 of land stretching from north-west to south-east in the western part of Mongolian territory. It is surrounded by Altai MR in the north, west and south, and by Khangai MR in the east. The GLD is rich in glacial originated lakes including range of lakes system, which we emphasize in this paper. This system includes the lakes Khar-Us, Khar, Durgun, Airag and Khyargas. The lakes are connected together through short anabranches or short rivers. Khar-Us Lake sourced by Khovd, Buyant and Tsenkher rivers from the Altai Mountains. An anabranch named Chonokharaikh runs out from Khar-Us and reaches to the Khar Lake. Khar Lake has two outlets: first anabranch named Nogoon Lake goes-out from the south-east shore of the lake and reaches the Durgun Lake, which has no outlet; second anabranch runs out from the north east shore and joins the Zavkhan river, which comes from Khangai Mountains and gives place to the Airag Lake, which connect by means of a short anabranch named Airgiin Hooloi with Khyargas lake, which is the final water body of this system. The first (Khar-Us) and last (Khyargas) lakes of this system are two of the four lakes with more than thousand square kilometers surface area in Mongolia. Besides the Khar-Us and Khyargas lakes GLD hold the biggest in Central Asia saline water lake Uvs with 3518 km^2 surface area and many other minor lakes, which we will not discuss in this paper. All lakes in the basin belong to the Central Asian closed basin, and are representative of the water level decreases, and relics of enormous lakes.

Har-Us Lake, Har Lake, Durgun Lake and Uvs Lake belong to the Annotated Ramsar List of Wetlands of International Importance. The three former ones constitute the Har-Us Lake National Pak (Ramsar site no. 976). Uvs Lake and its surrounding wetlands belong to the UNESCO Biosphere Reserve (Ramsar site no. 1379).

The aquatic biodiversity of Mongolia has received scientific attention for more than 100 years. Algal flora of Mongolia composed of 1574 taxa (Dorofeyuk & Tsetsegmaa, 2002), and recent soft algal conspectus covers 793 taxa (Bukhchuluun & Baigal-Amar 2018).

Diatom and planktonic flora of Mongolia have been studied since early last century. Dorogostaisky (1904) reported 34 species and Østrup (1908) reported 179 species and varieties from the Lake Hövsgöl region. Planktonic diatoms reported further by national scientists since 1960s in the eastern lakes (Dulmaa *et al*., 1966, 1967), lake Terkhiin Tsagaan in central part (Dulmaa & Nansalmaa 1969), and Gobi lakes in south of the country (Dulmaa & Nansalmaa 1970). In Lake Hövsgol, phytoplankton taxa list comprises 152 species (Kozhova & Kobanova, 2006).

Recent studies listed a big number of new phytoplankton taxa. In aquatic ecosystems of Selenge River Basin, more than 100 new species of algae were identified (Dorofeyuk, 2009; Korneva, 2009). Afonina (2018) listed 35 phytoplankton taxa in Onon-Torey plain, two of them being new species for Mongolia. Phytoplankton flora of GLD including Terkhiin Tsagaan Lake composed of 179 taxa (Dorofeyuk & Tsetsegmaa 2014). In the deep, fresh water lakes, *Cyclotella* and *Discostella* were most common diatoms in the planktonic community (Shinneman, 2008).

Mongolian diatom diversity and distribution knowledge extended in the last decades due to extensive exploration by the national and international scientists. Flora of some regions like Buir Lake (Soninkhishig & Edlund 2001), Khogno Khaan Protected Area (Soninkhishig *et al*., 2002), and sphagnum bogs (Kulikovskiy *et al*., 2010) have been investigated. First diatom monograph for Mongolia covering water bodies of south and east Khentii region covered 615 species and described 64 new taxa to science from Mongolia (Metzeltin *et al*., 2009).

Diatom survey of western Mongolia received more recent attention compared with other regions of the country. Hence, Edlund *et al*. (2010) identified 300 diatom species being nearly 100 of them new distributional records. Community structure were linked strongly with both salinity and trophic index (Shinneman *et al*., 2009).

Central Asian microcrustaceans have been studied for more than a century. One of the most acknowledged pioneers was G.O. Sars who described a good number of Branchiopods, Copepods and Ostracods laying the foundations of this science in the world (Sars, 1903). Particularly in Mongolia, the most important studies of cladocerans and copepods have been focused to the lake Hövsgöl, the first one made by Daday (1913), and afterwards dealing mainly with zooplankton, by Dulmaa (1971), Pomazkova and Sheveleva (2000; 2006). There are also a good contributions made by Flößner *et al*. (2005) in the Uvs Lake Basin with 38 references of Cladocerans and 16 of Copepods, and by Alonso (2010) listing Branchiopods and Copepods appearing in 107 saline lakes over several parts of Mongolia. But the most appropriate contribution related to the present work is that of Krylov (2012), which constitutes the first approach to the knowledge of the communities of Cladocerans (22 species) and Copepods (11 species) of the GLD.

The microcrustaceans section in this paper contributes to the knowledge of the hydrobiology of the lakes of the GLD with new data related to Cladocerans and Copepods. This is interesting due to the fact that these organisms are closely related to the characteristics of each kind of aquatic environments (defined by hydrological cycle, mineralization, trophic level, water transparency), making it possible to use them as indicators to evaluate if the lakes maintain their environmental characteristics in an appropriate level.

Materials and Methods

Field studies were conducted in the GLD between 2005 and 2009 and sampled Shar, Har-Us, Dalai, Khar, Durgun, Airag and Khyargas lakes and the Durgun Power Reservoir (PR). Abbreviate descriptions of all the lakes and pictures can be seen at http://geodata.es/mongolian_lakes/. The surveys of organisms phytoplankton, benthic diatoms and microcrustaceans (cladocerans and copepods) were conducted in September, after rainy season and before freezing of the lake surface. Water mineralization was measured using a handheld conductivity meter. Geographic coordinates, sampling date and water conductivity of the sampling localities are presented in Table 1.

Phytoplankton samples were obtained in littoral area of each lake, in one zone with enough depth to avoid vegetation or substrate influence. Samples for quantitative and qualitative analysis were taken in Khar Us, Dalai, Khar lakes and Durgun PR. Quantitative samples were taken manually, stored in dark glass bottles and preserved with Lugol's solution. Phytoplankton counts were performed following Utermöhl procedures (Lund, 1951) and biovolume for each taxon was calculated (Rott, 1981; Hillebrand *et al*., 1999). Qualitative samples were collected with a plankton net with aperture size 20 µm, also preserved with Lugol's solution. Identifications in qualitative samples contributed to complete taxa inventory for each lake. The amount of species overlap between the communities was measured using the Chao–Jaccard abundance-based similarity index (corrected for unseen shared species) (Chao *et al*., 2005), as implemented in ESTIMATES (Colwell, 2004).

Benthic diatom samples from the littoral zone were obtained from Khar-Us, Dalai, Khar and Durgun lakes collecting the upper thin layer of organic sediment and brushing the surface of submerged stones. The sediment and the material retained in the brush were transported to the laboratory as an aqueous suspension with 4% formalin. Diatom samples were treated with 33% hydrogen peroxide (H_2O_2) and mounted in Naphrax (R.I.=1.7) following the method described in Battarbee *et al*. (2001). At least 425 diatoms valves were counted under oil immersion at 1000x magnification using a Zeiss Axio Imager A1 microscope (Carl Zeiss Inc., Germany) equipped with a 100x_ objective (Zeiss Plan-Apo 1.4 numeric aperture) and differential interference contrast optics. Diatom identification followed

Table 1. Sampled lakes, their geographic coordinates, sampling date and water conductivity.

Lakes	Geographic coordinates		Dates	Water Conductivity (µS cm^{-1})
Shar nuur	E 92.159833	N 48.303883	13/9/2008	140
Khar-Us	E 92.212067	N 48.345350	13/9/2008	110
Khar-Us	E 92.366528	N 48.369500	29/9/2009	170
Khar-Us	E 92.068074	N 47.748257	29/9/2005	236
Khar-Us	E 92.025916	N 47.841281	29/9/2006	240
Dalai	E 92.642583	N 48.330450	13/9/2008	150
Khar	E 93.006633	N 48.055450	14/9/2008	310
Khar	E 93.035783	N 48.139750	14/9/2008	330
Durgun	E 93.349800	N 47.738833	14/9/2008	6,320
Durgun	E 93.449000	N 47.570983	14/9/2008	5,270
Durgun	E 93.390444	N 47.634056	28/9/2009	6,680
Airag	E 93.331267	N 48.903333	23/9/2008	5,880
Khyargas	E 93.330283	N 48.960200	23/9/2008	8,230
Khyargas	E 92.803333	N 49.289700	23/9/2008	9,550

mainly regional taxonomic references (Metzeltin *et al*., 2009). We estimate species diversity by extrapolation up to 850 valves, following Chao *et al*. (2014) and using the iNEXT library (2.0.9) in R software (R Development Core Team 2016). Sorensen similarity was calculated using the SpadeR package (version 0.1.1) run on R software (version 3.5.1).

Microcrustacean samples were obtained from representative habitats in each lake (littoral areas mainly, open water, among aquatic vegetation) using a handheld net with aperture size of 100 µm. Specimens were preserved in 4% formaldehyde. In the laboratory, most taxa were identified at species level.

Results

Characteristics of the lakes of the GLD.

According to the information provided by the Ministry of Water Resources and Utilization (1983) the Great Lakes Basin is a landlocked area covering an area of approximately 288.000 km^2. The average altitude is of about 2000 m. a.s.l., ranging between 4.000 m (Mongolian Altai) and 760 m (Uvs Lake). This basin is divided into two main sub-basins ending in Uvs Lake and Khyargas Lake. The studied lakes belong to the Khyargas sub-basin and appear in two lacustrine systems. The first one is feeded by the Khovd River and constituted by the Khar-Us, Shar, Dalai, Khar and Durgun lakes. The second one is feeded mainly by the Zavkhan River and constituted by the Airag and Khyargas lakes. Water mineralization in lakes varies considerably according to the way of local drainage, ranging from very low (dominance of exorheism) to very high (dominance of endorheism). Aquatic vegetation is more developed in low mineralized lakes. In all lakes has been reported the presence of fishes, the most significant species belonging to the Mongolian endemic, *Oreoleuciscus* genus (*O. angusticephalus*, *O. dsapchynensis* and *O. potanini*).

Shar Lake. N 48º18’12”, E 92º09’32”. Dystrophic shallow lagoon of 1 ha located in the north-east shore of the Khar -Us lake, surrounded by littoral reed beds (*Phragmites communis* and *Scirpus* sp.). Low mineralized water (conductivity 140 µS cm^{-1}). Dense development of submerged aquatic plants (*Myriophyllum spicatum*, *Polygonum amphibium*, *Hippuris* sp., and *Batrachium* sp.).

Khar-Us Lake. N 48º03’36”, E 92º15’29”. 1,157 m. a.s.l. Mesotrophic lake of 1.578 km^2 and 2.2 m of average depth. Low mineralized water (conductivity 110 -236 µS cm^{-1}). Extensive areas covered by reed beds (*Phragmites communis*) mainly in the south area of the lake, in the east bay contacting with Dalai Lake, and in the extension delta formed by the Khovd river outlet. Great abundance of submerged aquatic plants (*Potamogeton crispus*, *Polygonum amphibium*, *Utricularia intermedia*).

Dalai Lake. N 48º13’09”, E 92º44’30”. 1.157 m.a.s.l. Shallow mesotrophic lake of 400 km^2. Low mineralized water (conductivity 150 µS cm^{-1}). Almost 80% of the lake surface covered by reed beds (*Phragmites communis*). Great abundance of submerged aquatic plants (*Elodea* sp., *Myriophyllum spicatum*, *Potamogeton* sp.).

Khar Lake. N 48º05’42”, E 93º12’14”. 1,132 m. a.s.l. Mesotrophic lake of 617 km^2 and 4 m of average depth. Low mineralized water (conductivity 310 - 330 µS cm^{-1}). Reed beds (*Phragmites communis*) limited to the delta formed by the Chonokharaikh River incoming from Dalai Lake. Great abundance of submerged aquatic plants (*Chara* sp., *Myriophyllum spicatum*, *Elodea* sp.).

Durgun Lake. N 47º39’52”, E 93º27’47”. 1,128 m. a.s.l. Oligotrophic lake of 347 km^2 and 14 m of average depth. This lake is located at the end of the lakes system feeded by the Khovd River and working as an endorheic waterbody, which explains its high mineralization level (conductivity 5,270 - 6,680 µS cm^{-1}). With very scarce reed beds (*Phragmites communis*) and aquatic vegetation.

Airag Lake. N 48º53’17”, E 93º27’38”. 1,030 m. a.s.l. Mesotrophic lake of 186 km^2 and 6 m of average depth. Endorheic. Highly mineralized water (conductivity 5,880 µS cm^{-1}). Hardly without aquatic vegetation.

Khyargas Lake. N 49º11’19”, E 93º15’53”. 1,030 m.a.s.l. Oligotrophic lake of 1,466 km^2 and 47 m of average depth (80 m maximum depth). Endorheic. Highly mineralized water (conductivity 8,230 - 9,550 µS cm^{-1}). Hardly without aquatic vegetation.

Phytoplankton. High species richness characterized by the phytoplankton of studied lakes. A total of 136 phytoplankton taxa were recorded in all quantitative and qualitative samples. The largest group in number of species was Chlorophyta (45), followed by Cyanobacteria (30), Bacillariophyta (23), Streptophyta (14), Ochrophyta (11), Dinophyta (5), Cryptophyta (4), Euglenophyta (2), Haptophyta (1) and Xanthophyta (1) (Table 2). In the four low mineralized mesotrophic lakes Khar, Khar-Us, Dalai and Durgun, species richness was high, although most species showed low abundances. On the contrary, in the oligotrophic, highly mineralized, deep Durgun Lake, species richness was very low, since only two species were accounted. Abundance and biovolume were low in all the lakes, ranging from 600 individuals/mL and 0,178 mm^3/L in Khar Lake to 6.642 individuals/mL and 0,964 mm^3/L in Dalai Lake. These results lay in oligotrophy level (Willen, 2000; OCDE, 1982).

Algae communities were different in every lake, but overall, according the Chao-Jaccard index, there was more similarity between Khar, Khar-Us and Durgun PR, Jabd>0.6, than between any of these lakes and Dalai Lake, Jabd<0.2, indicating that in this last lake phytoplankton composition was more influenced by the shallowness and the great amount of reed rooted in the basin.

Even though that similarity was high, what means that many species were present in several lakes, at specific level dominant taxa were different for each lake. In Durgun PR, diatoms were the main contributors to biomass, in particular the centric *Cyclotella radiosa* accounted for more than 43% of total biovolume. The second most dominant taxa belonged to cyanobacteria *Dolichospermum ellipsoides* (Nostocales) and *Planktolyngbya limnetica* (Oscillatoriales). In Khar-Us Lake, the most contributing species to biomass were

Table 2. List of phytoplankton taxa identified in the studied lakes of the Great Lakes Basin. Contribution of each taxa to the total biovolume (mm^3/L): * illustrates <5%; ** illustrate 5-25%; *** illustrate >25% in the quantitative samples. + illustrates taxa found only in qualitative samples and ● illustrates new records of the taxa.

TAXA	Khar-Us	Dalai	Khar	Durgun PR
Observed species number	67	59	55	79
Cyanobacteria	**16**	**14**	**11**	**21**
Anathece clathrata (W. West & G.S. West) Komárek, Kastovsky & Jezberová	*		*	*
Aphanizomenon flos-aquae Ralfs ex Bornet & Flahault	+			
●*Aphanizomenon skujae* Komárková-Legnerová & Cronberg	**			*
●*Aphanocapsa delicatissima* West & G. S. West	*	*	*	*
Aphanocapsa elachista West & G. S. West	*		*	*
Aphanocapsa sp. Nägeli	+	+		*
Aphanothece elabens (Brébisson ex Meneghini) Elenkin		+		*
Chroococcus minutus (Kützing) Nägeli			*	
Chroococcus obliteratus Richter		*		
Coelosphaerium kuetzingianum Nägeli	+	*	**	*
●*Cyanodictyon planctonicum* Mayer			*	*
Cylindrospermum maius Kützing ex Bornet & Flahault				+
●*Dolichospermum ellipsoides* (Bolochoncev ex Woronichin) Wacklin, Hoffmann & Komárek	*			**
●*Dolichospermum* sp. (Ralfs ex Bornet & Flahault) Wacklin, Hoffmann & Komárek	*	*		
Cylindrospermum maius Kützing ex Bornet & Flahault				+
●*Gloeothece* cf. *subtilis* Skuja	*	*		*
Gomphosphaeria virieuxii Komárek & Hindák		+		
●*Lemmermanniella pallida* (Lemmermann) Geitler	+			
Limnococcus limneticus (Lemmermann) Komárková, Jezberová, O.Komárek & Zapomelová	+			
●*Merismopedia marssonii* Lemmermann		*		+
Merismopedia punctata Meyen		*		+
Merismopedia tenuissima Lemmermann		*		*
Microcystis aeruginosa (Kützing) Kützing	+		*	
Microcystis flos-aquae (Wittrock) Kirchner			+	
●*Microcystis* Kützing et Lemmermann		+		+

Table 2. (continued)

●*Microcystis wesenbergii* (Komárek) Komárek in Kondrateva	+			+
Planktolyngbya contorta (Lemmermann) Anagnostidis & Komárek	*	+	*	*
Planktolyngbya limnetica (Lemmermann) Komárková-Legnerová & Cronberg	*		*	**
Pseudanabaena sp. Lauterborn		*		*
●*Snowella litoralis* (Häyrén) Komárek & Hindák			*	+
Ochrophyta	**5**	**4**	**6**	**4**
●*Bitrichia ochridana* Fott (Bourrelly)			*	
●*Chrysolykos planctonicus* Mack			*	
Dinobryon bavaricum Imhof	*		*	*
●*Dinobryon crenulatum* West & G.S. West				*
Dinobryon divergens Imhof	*	+	*	*
Dinobryon sertularia Ehrenberg		*		
Mallomonas sp. Perty		**		
Ochromonas sp. Vysotskii		**		
●*Pseudokephyrion entzii* Conrad	*		*	
●*Pseudopedinella gallica* Bourrelly	*			*
●*Pseudopedinella pyriforme* Carter	*		*	
Haptophyta	**1**		**1**	
●*Chrysochromulina parva* Lackey	*		*	
Xanthophyta	**1**		**1**	
●*Nephrodiella semilunaris* Pascher	*		*	
Bacillariophyta	**11**	**9**	**7**	**19**
Achnanthidium minutissimum (Kützing) Czarnecki	+			+
Asterionella formosa Hassall	*	*		*
●*Brebissonia lanceolata* (Agardh) Mahoney & Reimer				+
Cyclotella radiosa (Grunow) Lemmermann		**	***	***
Cyclotella sp. (Kützing) Brébisson	*			
Cymatopleura solea (Brébisson) W. Smith	+			
Encyonema minutum (Hilse) Mann				+
Epithemia argus (Ehrenberg) Kützing				+
Epithemia sorex Kützing				+
Fragilaria capucina Desmazières	+	+		
Fragilaria crotonensis Kitton	+	*		+
Fragilaria nanana Lange-Bertalot	**	*	*	*
Fragilaria Lyngbye	+		+	
Mastogloia smithii var. *lacustris* Grunow			+	+
Navicula radiosa Kützing				+
Navicula spp. Bory				*
Nitzschia acicularis (Kützing) Smith	*		*	+
Nitzschia recta Hantzsch ex Rabenhorst		*	*	*
Nitzschia sigma (Kützing) Smith				+
Nitzschia spp. Hassall	+	*	*	+
Rhopalodia gibba (Ehrenberg) Müller		*		*
Ulnaria acus (Kützing) Aboal		*		*
Ulnaria ulna (Nitzsch) Compère	+			+
Cryptophyta	**4**	**2**	**2**	**1**
Cryptomonas marssonii Skuja	*	*	*	
●*Cryptomonas rostratiformis* Skuja	**			
Cryptomonas sp. Ehrenberg	*			
Plagioselmis nannoplanctica (Skuja) Novarino, Lucas & Morrall	**	*	*	*
Euglenophyta		**1**		**1**
Euglena sp. Ehrenberg		*		
Trachelomonas hispida (Perty) Stein				*
Dinophyta	**2**	**3**	**4**	**1**
Ceratium hirundinella (Müller) Dujardin	+	*	*	*
Dinophyceae indet.			*	
Gymnodinium sp. Stein	*		*	
Peridiniopsis borgei Lemmermann		+		
Peridinium willei Huitfeldt-Kaas		*	+	
Chlorophyta	**19**	**20**	**21**	**27**

Table 2. (continued)

●*Acutodesmus obliquus* (Turpin) Hegewald & Hanagata				+
●*Ankistrodesmus stipitatus* Komárková-Legnerová		+		*
Botryococcus braunii Kützing	+	*	*	*
●*Chlamydomonas* Ehrenberg				+
Coelastrum astroideum De notaris				+
Coelastrum microporum Nägeli				*
Crucigeniella rectangularis (Nägeli) Komárek	*			
●*Desmodesmus abundans* (Kirchner) Hegewald				+
●*Dictyosphaerium chlorelloides* (Nauman) Komárek & Perman	+	*	*	
Pseudodidymocystis planctonica (Korshikov) Hegewald & Deason			*	
●*Hariotina reticulata* Dangeard	+		*	
Hindakochloris nygaardii (Komárek) Comas	*	*		*
Lagerheimia genevensis (Chodat) Chodat			*	
Lagerheimia subsalsa Lemmermann	*	*		*
Monoraphidium arcuatum (Korshikov) Hindák		*	*	*
Monoraphidium circinale (Nygaard) Nygaard			*	
Monoraphidium griffithii (Berkeley) Komárková-Legnerová	+			
Monoraphidium irregulare (Smith) Komárková-Legnerová	*	*	*	*
●*Monoraphidium komarkovae* Nygaard		*	*	*
Monoraphidium minutum (Nägeli) Komárková-Legnerová		*	*	
●*Monoraphidium nanum* (Ettl) Hindák				*
Oocystis marssonii Lemmermann		+		
Oocystis parva West & G.S. West	*	*	*	*
Oocystis submarina Lagerheim	+		+	
Pandorina morum (Müller) Bory		*		
Pediastrum duplex Meyen	+			+
●*Pedinomonas minor* Korshikov		+	*	
Planctonema lauterbornii Schmidle			*	
Pseudopediastrum boryanum (Turpin) Hegewald			*	
Scenedesmus acutus Meyen		*		*
Scenedesmus armatus (Chodat) Chodat				+
Scenedesmus brevispina (Smith) Chodat	+			
●*Scenedesmus calyptratus* Comas	*	*	*	*
●*Scenedesmus* cf. *aldavei* Hegewald	*			
Scenedesmus ellipticus Corda				*
Scenedesmus quadricauda (Turpin) Brébisson				+
●*Scenedesmus serratus* (Corda) Bohlin				+
Scenedesmus spinosus Chodat		*		*
Stauridium tetras (Ehrenberg) Hegewald				+
Tetraedron caudatum (Corda) Hansgirg	**		**	*
Tetraedron minimum (Braun) Hansgirg	*	*	**	*
Tetraedron triangulare Koršhikov		*	*	+
●*Tetraselmis* sp. Stein	*	**	**	
●*Tetrastrum triangulare* (Chodat) Komárek	+			
●*Willea vilhelmii* (Fott) Komárek	+	*	+	*
Streptophyta	**8**	**6**	**2**	**5**
Cosmarium bioculatum var. *depressum* (Schaarschmidt) Schmidle		*		+
●*Cosmarium didymoprotupsum* West & G.S. West	+	+		
Cosmarium formosulum Hoff		*		
Cosmarium sp. Corda			*	
Cosmarium reniforme (Ralfs) Archer	+	+		
●*Cosmarium truncatellum* (Perty) Rabenhorst	*			
Cosmarium venustum (Brébisson) W. Archer		*		+
Elakatothrix gelatinosa Wille				*
Euastrum verrucosum Ehrenberg ex Ralfs	+			
Mougeotia sp. Agardh	**			*
Staurastrum cf. paradoxum Meyen ex Ralfs	+			
Staurastrum muticum Brébisson ex Ralfs		+		
●*Staurastrum smithii* Teiling	+		*	*
Staurodesmus dejectus (Brébisson) Teiling	+			

cryptomonads (*Plagioselmis nannoplanctica* (Skuja) Novarino, Lucas & Morrall, and *Cryptomonas rostratiformis* Skuja), followed by the green algae, *Tetraedron caudatum* and *Mougeotia* sp., the cyanobacteria, *Aphanizomenon skujae* (Nostocales) and the pennate diatom, *Fragilaria nanana*. In Khar Lake green algae (*Tetraedron caudatum*, *Tetraedron minimum* and *Tetraselmis* sp.) were the main components to biomass, together with *Cyclotella radiosa* and the coccal cyanobacteria, *Coelosphaerium kuetzingianum* and *Aphanocapsa elachista*. Dalai Lake showed the most different composition between low mineralized lakes. Phytoplankton was dominated firstly by chrysophycean flagellates (*Ochromonas* sp., *Mallomonas* sp.) and second by *Cyclotella radiosa* and *Tetraselmis* sp.

All dominant species and most of the secondary species are usually found in shallow mixed lakes. That is just the case of *Cyclotella radiosa* and *Fragilaria nanana*, the most abundant diatoms. Cyanobacteria living in the four low mineralized waters are also adapted to shallow mixed environments, but while *Planktolyngbya limnetica* and *Planktolyngbya contorta* are shade-adapting species, *Aphanizomenon skujae* is favoured by high light intensities (Noges *et al*., 2003) reflecting light availability differences between Durgun PR and Khar-Us Lake. Also, coccal picoplanktonic cyanobacteria are typical in mixed nutrient rich lakes (Fonseca & Bicudo, 2008), but while *Aphanocapsa*, *Aphanothece* or *Cyanodictyon* are typical in shallow lakes or summer epilimnia in deep lakes, *Coelosphaerium* and *Merismopedia* are usually found at lower trophic levels in larger lakes (Romo & Villena, 2005). This difference is appreciated being the second group of species more abundant in the deeper Khar Lake. Coccal green algae present in studied lakes together with *Tetraselmis* sp. are found usually in mixed environments at high trophic levels. The presence of *Mougeotia* sp. and desmids, such as *Cosmarium* spp. or *Staurastrum* sp., very common also in qualitative samples, seems to be more related to the littoral character of the samples considering that these green algae are commonly related to submerged macrophytes. In qualitative samples, appeared a number of typical benthic diatoms (*Mastogloia*, *Rhopalodia gibba*, *Navicula* spp. *Epithemia* spp. etc), especially in Durgun PR, these algae are considered tychoplanktonic and stirred up from benthos due to low depth of sampling site. Cryptomonads are known to live in a wide range of physical conditions being only sensitive to grazing.

Finally, species composition found in Dalai Lake was more influenced by the physical characteristics of the lake (shallowness and covered by submersed vegetation) rather than by chemical variables or trophic status. Whereas *Ochromonas* sp. is linked to shallow well-mixed oligotrophic environments (Salmaso, 2002), *Mallomonas* sp. is related to mixotrophy (Devercelli, 2006), what is linked with the big amounts of organic matter available in Dalai Lake coming after degradation of submerged vegetation.

Benthic diatoms. Diatom flora recovered from the littoral within the 4 studied lakes was rich. A total of 122 diatom species were recorded, 48 of them were new for Mongolia and among them 9 taxa were not able to be identified at species level in frame of the current regional literature. In western Mongolian lakes, more than 300 diatom taxa had been identified, 24 of them received provisional names (Edlund *et al*., 2010). Diatom assemblages were dominated by cosmopolitan species, although we identified few species that were described from Mongolia (e.g., *Sellaphora mongolocollegarum* Metzeltin & Lange-Bertalot, Table 3). This results point on the high diversity of Mongolian diatom flora. Hence 615 species were identified in Khentii mountain region with 64 new taxa for science and 114 species with provisional names (Metzeltin *et al*., 2009).

Water mineralization was the main community structuring factor and a main environmental gradient across the 4 studied lakes. Similar results were obtained in previous surveys in western Mongolia (Shinneman, 2008). The lower diatom diversity was observed in the higher conductivity lakes (Durgun Lake), which was the lake with more different species assemblages. The higher similarity was observed between Dalai Lake and Khar Lake (0.491, Table 3). The three most frequent species in the higher conductivity lake were *Amphipleura rutilans* var. *dillwynii* (Agardh) Cleve-Euler, *Nitzschia* cf. *acidoclinata* Lange-Bertalot and *Navicymbula pusilla* (Grunow) K. Krammer, which were almost absent in the other three lakes with lower conductivity. These lakes were dominated by *Pseudostaurosira* cf. *brevistriata* (Grunow) Williams et Round although the dominant species in Khar Lake was *Encyonopsis krammeri* Reichardt (Table 2).

Table 3. List of diatom taxa identified in the studied lakes of the Great Lakes Basin.
Contribution of each taxon to the total abundance: + illustrates < 2%; * illustrates >2<5%; ** illustrate >5 <10%; *** illustrate >10 <20%; **** illustrate >20% of relative adundance;
● illustrates new records of the taxa.

#	TAXA	Khar-Us	Dalai	Khar	Durgun
	Observed species number	69	53	45	25
	Richness Estimator	79.9	57	54.2	25.8
	Richness Lower 95% confidence interval	69.6	51.5	43.8	22.8
	Richness Upper 95% confidence interval	90.3	62.5	64.6	28.9
1	●*Aneumastus apiculata* (Østrup) Lange-Bertalot	+			
2	*Aneumastus laetus* (Ant.Mayer) Lange-Bertalot				+
3	*Aneumastus tuscula* (Ehrenberg) Mann et Stickle	+		+	
4	*Achnanthidium minutissimum* (Kützing) Czarnecki sensu lato	**	**	+	+
5	●*Achnanthidium pyrenaicum* (Hustedt) Kobayasi	*	*		
6	●*Achnanthidium* cf. *rosenstockii* (Lange-Bertalot) H. Lange-Bertalot	+		+	
7	*Amphipleura rutilans* var. *dillwynii* (Agardh) Cleve-Euler				****
8	*Amphora affinis Kützing*			+	
9	●*Amphora alpestris* var. *densistriata* Metzeltin & Levkov		+	+	
10	*Amphora copulata* (Kützing) Schoeman et Archibald	+			
11	●*Amphora inariensis* Krammer			*	
12	●*Amphora mira* Krasske				+
13	●*Amphora oligotraphenta* Lange-Bertalot	+	+	+	+
14	*Amphora pediculus* (Kützing) Grunow	+	+	**	
15	●*Asterionella* sp.	+			
16	*Brachysira* cf. *aponina* Kützing				*
17	*Brachysira liliana* Lange-Bertalot			+	
18	●*Brachysira styriaca* (Grunow in Van Heurck) R. Ross				*
19	*Caloneis* sp1	*	+		
20	●*Cymbopleura hercynica* (A. Schmidt) K. Krammer	+			
21	*Cocconeis placentula* var. *euglypta* (Ehrenberg) Grunow	+	*	+	
22	●*Cymbella compacta* Østrup	+			+
23	●*Cymbella lange-bertalotii* Krammer			+	
24	*Cymbella neocistula* Krammer	+	+		
25	●*Cyclostephanos* sp.				+
26	●*Cavinula jaernefelti* (Hustedt) Mann et Stickle	+			
27	*Cavinula pseudoscutiformis* (Grunow ex Schmidt) Mann et Stickle	*			
28	●*Cavinula vincentii* sp1	+			
29	*Diatoma tenuis* Agardh			+	**
30	*Encyonema caespitosum* Kützing	+	+	+	+
31	*Encyonema minutum* (Hilse) Mann			+	
32	●*Eolimna minima* (Grunow in Van Heurck) H. Lange-Bertalot	+			
33	*Epithemia adnata* (Kützing) Brébisson	+	+		
34	*Epithemia smithii* Carruthers		+		
35	*Epithemia sorex* Kützing		*	+	
36	*Epithemia* sp.	+			
37	●*Encyonopsis delicatissima* (Hustedt) Krammer	+		**	
38	●*Encyonopsis krammeri* Reichardt	+	+	***	
39	●*Encyonopsis minuta* Krammer et Reichardt		+		
40	●*Encyonopsis ruttneri* (Hustedt) Krammer	+		*	
41	●*Encyonopsis subminuta* Krammer et Reichardt	+		*	
42	*Encyonopsis thienemannii* (Hustedt) Krammer	+			
43	*Fallacia pygmaea* (Kützing) Stickle et Mann		+		
44	●*Fragilaria* cf. *capucina* (complex) Desmazières	+			
45	*Fragilaria capucina* Desmazières			+	
46	*Fragilaria mesolepta* Rabenhorst	+			
47	●*Fragilaria radians* (Kützing) Petersen		+		
48	*Fragilaria tenera* (Smith) Lange-Bertalot	*	+	**	

Table 3. (continued)

49	*Gomphonema* cf. *olivaceum* (Lyngbye) Kützing			+	
50	*Gomphonema* cf. *pumilum* (Grunow) Reichardt et Lange-Bertalot	*			
51	*Gomphonema* sp2				+
52	*Gomphonema* sp3	+			
53	*Hippodonta capitata* (Ehrenberg) Lange-Bertalot, Metzeltin et Witkowski		+		
54	*Hippodonta hungarica* (Grunow) Lange-Bertalot, Metzeltin et Witkowski	+			
55	●*Craticula buderi* (Hustedt) Lange-Bertalot				+
56	*Craticula cuspidata* (Kützing) Mann		+		
57	*Mastogloia braunii* Grunow				+
58	*Mastogloia* sp1	*	+	**	+
59	●*Mayamaea agrestis* (Hustedt) Lange-Bertalot	+			
60	*Navicula cincta* (Ehrenberg) Ralfs				+
61	*Navicula cryptotenella* Lange-Bertalot ex Krammer et Lange-Bertalot	*	+	*	
62	*Navicula gottlandica* Grunow			+	
63	*Navicula libonensis* Schoeman		**	+	
64	*Navicula menisculus* Schumann			+	+
65	●*Navicula oblongella* Nägeli	+			
66	●*Navicula oligotraphenta* Lange-Bertalot et Hofmann	+	+	+	
67	*Navicula radiosa* Kützing	+	+	+	
68	●*Navicula seibigiana* Lange-Bertalot			+	
69	●*Navicula subalpina* Reichardt	+		*	
70	●*Navicula tuulensis* D. Metzeltin, H. Lange-Bertalot & S. Nergui		+		
71	*Navicula veneta* Kützing		*		
72	*Navicula vulpina* Kützing	+			
73	*Navicymbula pusilla* (Grunow) K.Krammer				***
74	●*Nitzschia* cf. *acidoclinata* Lange-Bertalot		+		***
75	●*Nitzschia alpinobacillum* Lange-Bertalot		*	+	
76	*Nitzschia angustata* (Smith) Grunow	+	+	+	
77	●*Nitzschia brunoi* Lange-Bertalot		+		
78	●*Nitzschia bryophila* (Hustedt) Hustedt		+		
79	*Nitzschia communis* Rabenhorst				*
80	*Nitzschia denticula* Grunow	+	*	*	
81	*Nitzschia dissipata* (Kützing) Grunow			+	
82	*Nitzschia hungarica* Grunow		+		
83	*Nitzschia intermedia* Hantzsch ex Cleve et Grunow	+	*		
84	*Nitzschia liebethruthii* Rabenhorst		**		
85	*Nitzschia linearis* (Agardh ex Smith) Smith		+		
86	●*Nitzschia linearis* var. *subtilis* Hustedt	+			
87	*Nitzschia palea* (Kützing) Smith			+	+
88	*Nitzschia perminuta* (Grunow) Peragallo	+	+	+	
89	●*Nitzschia plicatula* Hustedt		+		+
90	*Nitzschia pura* Hustedt	+	+	+	
91	●*Nitzschia radicula* Hustedt	+	*		
92	*Nitzschia sublinearis* Hustedt	+			
93	●*Nitzschia supralitorea* Lange-Bertalot		*		+
94	*Placoneis clementis* (Grunow) Cox	+			
95	*Placoneis* sp2	+			
96	*Pseudostaurosira* cf. *brevistriata* (Grunow) Williams et Round	***	***	**	
97	*Pseudostaurosira* sp2	**	*	*	
98	*Pinnularia* sp		+		
99	*Punctastriata* sp1	**	*		
100	●*Psammothidium daonense* (Lange-Bertalot) Lange-Bertalot	+			
101	●*Psammothidium helveticum* (Hustedt) Bukhtiyarova et Round	+			
102	*Planothidium dubium* (Grunow) Round et Bukhtiyarova	+			
103	*Planothidium lanceolatum* (Brébisson ex Kützing) Lange-Bertalot	+			
104	●*Planothidium minutissimum* (Krasske) Lange-Bertalot	+			
105	●*Planothidium peragalloi* (J.Brun & Héribaud-Joseph) Round & L.Bukhtiyarova	+			
106	*Planothidium* sp1	+			
107	●*Puncticulata* cf. *comta* (Kützing) H.Hakansson	+		+	**
108	*Reimeria sinuata* (Gregory) Kociolek et Stoermer	+			

Table 3. (continued)

109	*Rhopalodia gibba* (Ehrenberg) Otto Müller		+		
110	*Staurosirella pinnata* (Ehrenberg) Williams et Round	**		+	
111	*Staurosirella pinnata* var. *lancettula* cf. (Schumann) Siver et Hamilton	+	+		
112	●*Scoliopleura pavlovii* Skvortzow				+
113	●*Sellaphora ellipticolanceolata* Metzeltin, Lange-Bertalot & Nergui	+	+		
114	●*Sellaphora kusberi* Metzeltin, Lange-Bertalot & Nergui		+		
115	●*Sellaphora mongolocollegarum* Metzeltin & Lange-Bertalot			+	
116	*Sellaphora parapupula* Lange-Bertalot		+		
117	●*Sellaphora schrothiana* Metzeltin, Lange-Bertalot & Nergui			+	
118	*Staurosira construens* var. *binodis* (Ehrenberg) Hamilton	+			
119	*Staurosira* af. *construens* Ehrenberg	+			
120	*Staurosira construens* Ehrenberg	*	+		
121	*Staurosira venter* (Ehrenberg) Grunow	+	+	+	
122	*Synedra parasitica* (Smith) Hustedt		+		

The observed pattern in diversity that is decreasing with increasing conductivity have been for diatoms and other algae elsewhere, and is forcing a main shift in the algae community (Battarbee & Berglund 1986; Anderson *et al*., 2001, Pla & Anderson, 2005).

Cladocerans and copepods. A total of 39 species of Branchiopods and 9 species of Copepods were recorded in the lakes under study (Table 4). Almost all the species are widely distributed in the Palaearctic region. Branchiopods belong to the widespread Eurasian faunistic complex defined by Kotov (2016) although most of them are in need of reviewing. As majority of the samples were collected in the littoral, the inventory is dominated by benthic species.

The most important factors determining the composition and nature of the communities of Cladocerans and Copepods are the presence and density of submerged aquatic macrophytes and the water mineralization. The largest number of species (between 13 - 31 Cladocerans and 2 - 6 copepods) was recorded in the freshwater lakes Shar, Khar-Us, Dalai and Khar, which hold a rich and diverse amount of macrophytes favoured by a low depth extense areas and relatively high water transparency. In these lakes the most frequent species were: *Sida crystallina*, *Simocephalus vetuloides*, *S. serrulatus*, *Ceriodaphnia pulchella*, *Scapholeberis mucronata*, *Pleuroxus truncatus*, *Alonella excisa*, *Chydorus sphaericus*, Coronatella *rectangula*, *Alona costata*, *Acroperus angustatus, Graptoleberis testudinaria*, *Eucyclops macruroides* and *E. dumonti*.

In the lakes Durgun, Airag and Khyargas water is significantly more mineralized and also aquatic vegetation is much less developed, which results in a smallest number of species (between 3-8 Cladocerans and 3 Copepods), coinciding with the observations of Krylov (2012) in the same lakes. Some species, namely *C. sphaericus*, C. *rectangula*, *A. costata*, *A. angustatus*, *Monospilus dispar, Megacyclops viridis* and *E. dumonti* are also in the previous freshwater lakes. Other, as *Leptodora kindtii*, *Diaphanosoma mongolianum*, *Daphnia galeata*, *Oxurella tenuicaudis*, *Arctodiaptomus salinus* and *Eucyclops serrulatus* appear only in these lakes, being *L. kindtii, O. tenuicaudis* and *A. salinus* of which their tolerance to high mineralization has been pointed out (Chambers *et al*., 1970 for *L. kindtii*; Margalef, 1951 for *O. tenuicaudis*; Kiefer, 1978, Dussart, 1967 and Alonso, 2010 among others for *A. salinus*).

Showing up next, remarks on some species:

Simocephalus vetuloides has been determined according to the shape of posterior valve prominence, which has a very wide base and small diameter; also dorsal valve margin not protruding backward. According to Flößner *et al* (2005) this characteristic is not enough to separate it from *S. vetulus* and *S. mixtus* due to that the length and shape of posterior shell protuberance is not a discontinuous morphological feature, suitable for characterizing species boundaries. But in our case, the morphology of the analysed populations is consistent enough to consider them as belonging to *S. vetuloides* what does not mean that future deeper studies including genetic analysis should be conducted to fix the taxonomic status of this species group.

Simocephalus serrulatus is considered a cosmopolitan species and has been regarded as synonymous of several species from different countries; however, Orlowa-Bienkowskaja (2001)

Table 4. List of Cladocera and Copepoda species identified in the studied lakes of the Great Lakes Basin. + illustrates taxa found in the samples and ● illustrates new records of the taxa.

#	TAXA	Shar	KharUs	Dalai	Khar	Durgun	Airag	Khyargas
	Observed species number	16	38	16	19	11	9	6
	Haplopoda						+	
1	*Leptodora kindtii* (Focke 1844)						+	
	Ctenopoda							
2	●*Sida crystallina* (O.F. Müller 1776)		+	+	+			
3	*Diaphanosoma brachyurum* (Liévin 1848)			+				
4	*Diaphanosoma mongolianum* (Uéno, 1938)					+	+	+
	Anomopoda							
5	*Daphnia curvirostris* Eylmann 1887		+					
6	*Daphnia galeata* Sars 1864					+		
7	*Daphnia rosea* Sars 1862		+					
8	*Daphnia longispina* (O.F. Müller 1776)		+					
9	*Daphnia magna* Straus 1820		+					
10	●*Simocephalus vetuloides* Sars 1899		+	+	+			
11	●*Simocephalus serrulatus* (Koch 1841)	+	+	+	+			
12	*Ceriodaphnia pulchella* Sars 1862		+	+	+			
13	*Ceriodaphnia reticulata* (Jurine 1820)		+					
14	*Scapholeberis mucronata* (O.F. Müller 1776)	+	+	+	+			
15	*Moina brachiata* (Jurine 1820)		+					
16	*Macrothrix rosea* (Jurine 1820)	+						
17	●*Macrothrix tabrizensis* Dumont, Silva Briano et Subhash Babu 2002			+				
18	*Bosmina fatalis* Burckhardt 1924		+	+				
19	●*Eurycercus lamellatus* (O.F. Müller 1776)	+	+					
20	●*Picripleuroxus striatus* (Schöedler 1862)		+					
21	●*Pleuroxus uncinatus* (Baird 1850)		+					
22	*Pleuroxus aduncus* (Jurine 1820)		+		+			
23	*Pleuroxus truncatus*(O.F. Müller 1785)	+	+		+			
24	*Chydorus sphaericus* (O.F. Müller 1776)	+	+	+	+	+	+	+
25	●*Pseudochydorus globosus* (Baird 1843)		+		+			
26	*Alonella excisa* (Fischer 1854)	+	+	+	+			
27	*Alonella nana* (Baird 1843)	+	+					
28	*Phrixura rostrata* (Koch 1841)		+					
29	*Coronatella rectangula* (Sars 1861)	+	+	+	+	+	+	+
30	●*Alona guttata* Sars 1862		+	+	+			
31	*Alona costata* Sars 1862	+	+	+		+		
32	*Alona affinis* (Leydig 1860)		+					
33	*Alona affinis* var. *dentata* Werestschagin 1911	+	+					
34	*Alona quadrangularis* (O.F. Müller 1776)	+	+					
35	*Acroperus angustatus* Sars 1863	+	+		+	+		
36	*Oxurella tenuicaudis* (Sars 1862)					+	+	
37	●*Camptocercus rectirostris* Schöedler 1862		+		+			
38	●*Graptoleberis testudinaria* (Fischer 1848)	+	+		+			
39	●*Monospilus dispar* Sars 1862		+			+		
	Diaptomidae							
40	*Arctodiaptomus bacillifer* (Koelbel 1885)		+					
41	*Arctodiaptomus salinus* (Daday 1885)					+	+	+
42	*Eudiaptomus graciloides* (Lilljeborg 1888)		+	+				
	Cyclopidae							
43	*Cyclops vicinus* Uljanin 1875		+		+			

Table 4. (continued)

44	●*Macrocyclops albidus* (Jurine 1820)	+			+			
45	*Megacyclops viridis* (Jurine 1820)		+			+	+	+
46	*Eucyclops serrulatus* (Fischer 1851)						+	+
47	*Eucyclops macruroides* (Lilljeborg 1901)	+	+	+	+			
48	*Eucyclops dumonti* Alekseev 2000		+	+	+	+		

considers that this species is very consistent and has no subspecies. Nevertheless, an accurate taxonomic study of the Mongolian populations would be advisable.

Bosmina fatalis is considered by Kotov (2016) as belonging to the endemic eastern Asian complex. Specimens of Khar-Us and Dalai lakes agree with the descriptions of Korinek (1971) and Flößner *et al*. (2005) in the location of the lateral head pores more or less in the middle, or little displaced posteriorly, between the posterior branches of the bifurcated fornix line. Also, the ventral side of the mucro lacks serration in adult individuals, and the small triangular bucklers in the base of the aesthetascs are acute and protruding.

Macrothrix tabrizensis, was described from a population in Iran (Dumont *et al*., 2002). This is a very interesting species considered taking part of the Mountainous Endemic Faunistic complex in Eastern Siberia and the Russian Far East (Kotov, 2016). This species is easily recognizable by the male antennule with a very long aesthetasc located ventro-laterally in its proximal third and the resting seven terminal aesthetascs, one much longer than the others.

Alona affinis is a relatively common species in Mongolia. In Shar and Khar-Us lakes appear specimens with 1-3 denticles at the posteroventral corner of the carapace and/or without the fine striae between the ridges of the carapace so characteristic of the species. The specimens with this characteristic were considered as subspecies, however after recording a mix of the mentioned characteristics in the same lake and noticing also variability in a same individual, it has been preferred consider them as variety (Sinev, 1997); in this case the var. *dentata*.

Discussion

Phytoplankton. Phytoplankton of Mongolian lakes received less attention except the Lake Hövsgöl and composition of the taxa extended by the fragmented projects (Dorofeyuk & Tsetsegmaa, 2014), which is specially true for the GLD. In the Uvs Lake Basin, 63 new species were recorded for Mongolia (Paul, 2012). Summer season phytoplankton flora of GLD including Terkhiin Tsagaan Lake was composed of 179 taxa in 2010-2011 (Dorofeyuk and Tsetsegmaa, 2014). The present work contributes to increase the knowledge of phytoplankton composition and distribution in Mongolia and, in particular, in GLD region. From the 136 phytoplankton taxa found, 29 species and 10 genera are new for Mongolia. All of the new records are cosmopolitan taxa, widespread worldwide in the corresponding habitats. It is expected that the number of new phytoplankton taxa will increase as new studies are carried, especially given the high number of unstudied aquatic ecosystems existing in Mongolia, covering a wide range of aquatic habitats.

Benthic diatoms. The new reported records and the occurrence of few unknown diatom species remarks the need for accurate taxonomic identification. New distributional records and species of diatoms are quite often reported in Mongolia when a new survey is taking place. For instance, in Khugnu Khaan Protected Area, 79 species were reported, and 24 of them were new to Mongolia (Soninkhishig *et al*., 2002). In Lake Buir, 263 species were reported, and 60 taxa were new to Mongolia (Soninkhishig & Edlund, 2001). In Khentii mountain region, 615 species were reported, 64 of them were new for science, and 114 taxa got provisional names (Metzeltin *et al*., 2009). The present survey reports 122 diatom taxa being 48 of them new for Mongolia and, among them, nine taxa were impossible to be identified at the species level in the frame of the current regional literature. All this information indicate that the new records and new species will continue to be reported in the future for Mongolia, and mean that precise taxonomic identification is needed to use diatoms for the ecological and environmental applied analysis in this region.

Cladocerans and copepods. Our results show a rich community of microcrustaceans in which 13 species of Branchiopods and one Copepod are new for the Mongolian fauna. The community is made up by approximately 80% of benthic species. This is what is expected in this kind of lakes with high environmental diversity of microhabitats. It is interesting the comparison of our inventories with those of Krylov (2012) in the same lakes. This author found 17 cladocerans and 8 copepods, which is also a rich inventory, but several of these species (5 cladocerans and 4 copepods) were not present in our samples, what means that studies programmed in longer periods could still reveal richer communities of these organisms in the GLD lakes. The high species richness and the specific composition of the cladoceran community in the fresh-water lakes Shar, Khar-Us, Dalai and Khar is the characteristic of the mountain oligotrophic lakes in the Palaearctic, what means that these lakes are in a very good condition as expected due to the absence of anthropic pressures. This conclusion can be extended to the lakes with more mineralized waters which, although with less species, what must be considered usual, hold characteristic species in high mineralized waters not present in the other fresh-water lakes, such as *Arctodiaptomus salinus* and *Oxurella tenuicaudis*.

On the other hand, according to Kotov (2016), most of the Cladocerans found in this study are considered "Widespread Unrevised Species" mainly in Eurasia. This opens an interesting scientific field, since most probably deep taxonomic studies combined with genetic analysis could reveal specific regional faunas and new species for Mongolia.

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