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CONTENTS

The role of <i>Cyanophyta</i> in nature <i>L.A. Sirenko & N.V. Kondratyeva</i>	1
Diversity of algae in the continental part of Israel <i>P.M. Tsarenko, O.N. Vinogradova, V.V. Stupina, S.P. Wasser & E. Nevo</i>	20
<i>Bacillariophyta</i> in biomonitoring of river ecosystems. Current state and prospects for their use <i>L.N. Bukhtiyarova</i>	40
Periphyton biomass related to water pollution in the Pinang River basin, Malaysia <i>Wan Maznah, Mashhor Mansor & Ho Sinn Chye</i>	57
Taxonomic structure of the algoflora of Sikhote-Alin'sky Biosphere Reserve (Primorsky region, Russia) <i>L.A. Medvedeva</i>	71
Infraspecific variability of the rare species <i>Carteria abiscoensis</i> Skuja (<i>Chlamydomonadaceae</i>, <i>Chlorophyta</i>) in the flora of Ukraine <i>N.P. Masyuk & G.G. Lilitskaya</i>	80
Phytoplankton of Gölbaşı Lake (Adiyaman, Turkey) and their seasonal variations <i>A. Kadri Çetin</i>	87
New representatives of fossil algae (<i>Chlorophyta</i>) from the Paleozoic of Ukraine <i>O.I. Berchenko</i>	97
Modeling of actively ramifying columnar stromatolites <i>V.K. Orleansky & M.E. Raaben</i>	103
Study of chemical composition of storm flings in hypergaline reservoirs of Sivash Lake as a source for production of stabilizers <i>D.V. Mikulich, G.D. Lukina & S.P. Lipovetskaya</i>	109
Species composition of bacteria accompanying microalgae in culture (review of literature) <i>E.V. Borisova</i>	115

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Taxonomic structure of the algoflora of Sikhote-Alin'sky Biosphere Reserve (Primorsky region, Russia)*

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ABSTRACT

Results of long-term investigations of the algoflora of Sikhote-Alin'sky Biosphere Reserve located in the Primorsky Region of Russia are presented. Totally 670 species of algae represented by 847 varieties and forms, including those containing the nomenclature type of species, were found. Their taxonomic structure is discussed.

KEYWORDS: *algae, algoflora, family, genus, reserve.*

INTRODUCTION

In the context of the permanent increase of anthropogenic impact on water bodies investigation of natural non-disturbed aquatic ecosystems, which are present mainly in protected areas, is urgent. Sikhote-Alin'sky Biosphere Reserve, due to a rather gentle disturbance of natural complexes, as well as remoteness from industrial and agricultural centers, is a unique area in the southern part of the Far East.

Sikhote-Alin'sky Biosphere Reserve is located in the middle part of the Primorsky Region. The Sikhote-Alin' mountain ridge passes in the north-east direction and divides the territory of the reserve into western and eastern slopes. The rivers form a very dense and extensive network (Vetrennikov, 1976). The largest flows of the eastern slope are the submontane rivers Serebryanka and Dzigitovka. The largest river of the western slope is the plain Columbe River (Amur water system). The numerous streams of the reserve are mainly rivers and springs of montane and submontane types with narrow V-shaped valleys,

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rather narrow river-beds (from 2-10 m), steep slopes and fast current velocity (1-3 m/s). The temperature of water is within the range of 4.5 to 13 °C. The shallow brackish Blagodatnoe Lake in Blagodatnaya Bay is still connected with the sea. Golubichnoe Lake is also situated in Golubichnaya Bay on the seashore; however, it has long been desalinated. The lake is small, rich in biogenic matter due to decaying vascular aquatic plants, in summer its water warms up to 21 °C. In the upper reaches of the Solontsovsky stream, five montane Solontsovskie lakes are situated. They were formed by damming of the stream bed by a large-stone landslides. The lakes, swamped to various degrees, are arranged at altitudes from 500 up to 800 m above sea level.

Data on algae of different water bodies of Sikhote-Alin'sky Biosphere Reserve are given in a number of publications (Medvedeva, 1981, 1984, 1986a, b, 1987a-c, 1990, 1992a, b, 1994). The aim of the present publication is to generalize the data obtained, and to discuss the taxonomic structure of the studied flora.

MATERIAL AND METHODS

The collecting of algae was conducted from 1976 till 1982 in Sikhote-Alin'sky Reserve and adjacent areas according to the generally accepted techniques (Vodorosli ..., 1989). In 76 flowing and stagnant water bodies, 765 algological samples of epilithon, epiphyton, epipelton, metaphyton and plankton were collected. All main water bodies of the reserve were investigated: lakes Blagodatnoe, Golubichnoe, mountain Solontsovskie lakes (Tzarskoe, Sohatinoe, Krugloe, Kamennoe and Mutnoe), and also the rivers Serebrianka, Dzigitovka, Columbe, Zabolochennaya, Yasnaya and their numerous tributaries. The general list of species was composed according to the classification system of algae adopted in the book "Vodorosli ..." (1989).

RESULTS AND DISCUSSION

The taxonomic structure of any flora is always valuable, as it is least subjected to influences of incompleteness of inventory, difference of areas sizes, and floristic richness of regions (Malyshev, 1972; Jurtsev et al., 1978; Getsen, 1985). In analysis of the taxonomic structure, the share and order of arrangement of the taxa of different ranks (families, genera) leading in taxonomic diversity are applied.

The flora of algae of Sikhote-Alin'sky Reserve includes 670 species (847 infraspecific taxa)¹. The recorded taxa belong to 9 divisions, 14 classes, 34 orders, 80 families and 167 genera (Table 1). It is the most rich and diverse of the studied floras of algae of reserves of the Far East of Russia.

¹Hereinafter in the text in brackets the number of infraspecific taxa is given, including those containing the nomenclatural type of species.

Bacillariophyta lead in taxonomic and species diversity; they are represented by 326 species (452 infraspecific taxa). The most abundant species of the alga flora of the reserve are also diatoms: *Hannea arcus* (Ehr.) Part., *Diatoma mesodon* (Ehr.) Kütz., *Meridion circulare* (Grev.) Ag., *Synedra ulna* (Nitzsch.) Ehr., *S. inaequalis* H. Kob., *Cymbella minuta* Hilse ex Rabh., *Cocconeis placentula* Ehr., and *Achnanthes minutissima* Kütz.

TABLE 1. Taxonomic composition of the algal flora of Sikhote-Alin'sky Reserve

Division	Number, units				
	Classes	Orders	Families	Genera	Species (infr. taxa)
CYANOPHYTA	3	5	15	26	77(1)
EUGLENOPHYTA	1	1	2	6	18(21)
DINOPHYTA	1	1	1	1	1(1)
CHRYSOPHYTA	1	3	3	4	6(6)
BACILLARIOPHYTA	2	6	21	52	326(452)
XANTHOPHYTA	2	3	5	6	16(16)
RHODOPHYTA	1	1	2	3	3(3)
PHAEOPHYTA	1	2	2	2	2(2)
CHLOROPHYTA	2	12	29	67	221(255)
In total	14	34	80	167	670(847)

The green algae include 221 species (255 infr. taxa) and occupy second place in the structure of alga flora. Representatives of this division, except filamentous forms from genera *Spirogyra* Link, *Mougeotia* Ag., *Zygnema* Ag., *Oedogonium* Link, are not so abundant as diatoms. In third place by number of species and infraspecific diversity are *Cyanophyta*: 77 species (91 infr. taxa). Some species played a noticeable role in the structure of periphyton: *Phormidium autumnale* (Ag.) Gom., *P. uncinatum* (Ag.) Gom., *Oscillatoria tenuis* Ag., *Homoeothrix simplex* Woronich. Among representatives of other divisions of algae, only *Hydrurus foetidus* Kirchn., *Batrachospermum moniliforme* Roth and some species of the genus *Tribonema* Derb. et Sol. had mass numbers.

The leading families are the main subject of the analysis of flora. They include more than 65 % of all species composition of algae of the reserve (Table 2). *Naviculaceae* and *Desmidiaceae* occupy top positions in the structure of the algal flora. Our data coincide with the data obtained for large regions (water bodies of Bol'shezemel'skaya tundra, flora of algae of Yakutia, Ukraine, and Western Siberia) and for a number of small particular floras of the Primorsky Region (Palamar-Mordvintseva, 1982; Safonova, 1983; Getsen, 1985; Vasilieva, 1989; Barinova, 1990; Dogadina & Kukharensko, 1990), which testifies,

apparently, to common features of their genesis and formation. As a whole, similar ratios with dominance of families of diatoms and desmids (Table 2) are characteristic for boreal and nemoral floras of algae.

TABLE 2. The spectrum of leading families in the flora of algae of Sikhote-Alin'sky Reserve

Rank position	Family	Number of species (infr. taxa), units	% of number of the infraspecific taxa
1	<i>Naviculaceae</i>	110(162)	19.1
2	<i>Desmidiaceae</i>	95(113)	13.3
3	<i>Nitzshiaceae</i>	41(50)	5.9
4	<i>Fragilariaceae</i>	23(43)	5.1
5	<i>Closteriaceae</i>	29(41)	4.8
6	<i>Eunotiaceae</i>	26(37)	4.4
7	<i>Cymbellaceae</i>	28(29)	3.4
8	<i>Achnantheaceae</i>	21(29)	3.4
9	<i>Oscillatoriaceae</i>	21(26)	3.1
10	<i>Surirellaceae</i>	17(25)	3.0

TABLE 3. The spectrum of leading genera in the flora of algae of Sikhote-Alin'sky Reserve

Rank position	Genus	Number of species (infr. taxa), units	% in the flora
1	<i>Navicula</i> Bory	47(65)	7.7
2	<i>Nitzschia</i> Hass.	38(45)	5.3
3	<i>Closterium</i> Ralfs	29(41)	4.8
4	<i>Pinnularia</i> Ehr.	23(39)	4.6
5	<i>Cosmarium</i> Ralfs	33(38)	4.5
6	<i>Eunotia</i> Ehr.	26(37)	4.4
7	<i>Cymbella</i> Ag.	22(23)	2.7
8	<i>Gomphonema</i> Ag.	17(22)	2.6
9	<i>Surirella</i> Turp.	14(22)	2.6
10	<i>Achnanthes</i> Bory	16(21)	2.5

The greatest similarity in the composition of leading families is exhibited in the algoflora of water bodies of Bol'shezemel'skaya tundra. *Fragillariaceae*, *Closteriaceae*, *Eunotiaceae* and *Achnantheaceae* also belong to families typical of northern territories. According to Getsen, the species diversity of these families reflects Holarctic features of floras of the Northern Hemisphere (Getsen, 1985).

We assessed the relative importance of species in the flora according to species diversity. Thus, the leading role of genera *Navicula* Bory, *Nitzschia* Hass. and *Pinnularia* Ehr. (Table 3) testifies to common features with floras of algae of Bol'shezemel'skaya

tundra, Yakutia, and Chukotka. Genera of *Cyanophyta* are not among the leading genera of the algal flora. As to a generic spectrum of green algae, *Cosmarium* Corda, *Closterium* Nitzsch. and *Staurastrum* Meyen occupy the three top positions. By some indices (leading positions of the genera *Cosmarium*, *Navicula* and *Closterium*) the generic structure of the flora of algae of Sikhote-Alin'sky Reserve is close to those of Yakutia water bodies (Vasilieva, 1989).

TABLE 4. List of *Cyanophyta* genera of Sikhote-Alin'sky Reserve

N	Genus	Number of species (infr. taxa)	N	Genus	Number of species (infr. taxa)
1	<i>Dactylococcopsis</i> Hansg.	1(1)	14	<i>Cylindrospermum</i> (Kütz.) ex Born. et Flah.	4(4)
2	<i>Cyanoarcus</i> Pasch.	1(1)	15	<i>Aulosira</i> Kirchn. ex Born. et Flah.	1(1)
3	<i>Merismopedia</i> (Meyen) Elenk.	4(5)	16	<i>Microchaete</i> Thur. ex Born. et Flah.	1(1)
4	<i>Microcystis</i> (Kütz.) Elenk.	3(7)	17	<i>Scytonema</i> Ag. ex Born. et Flah.	1(1)
5	<i>Aphanothece</i> Näg.	4(4)	18	<i>Tolypothrix</i> Kütz. ex Born. et Flah.	2(3)
6	<i>Gloeocapsa</i> Kütz.	4(4)	19	<i>Hydrocoryne</i> Schwabe ex Born. et Flah.	1(1)
7	<i>Gomphosphaeria</i> Kütz.	1(2)	20	<i>Calothrix</i> Ag. ex Born. et Flah.	4(4)
8	<i>Clastidium</i> Kirschn.	1(1)	21	<i>Rivularia</i> Ag. ex Born. et Flah.	2(2)
9	<i>Chamaesiphon</i> Näg.	2(2)	22	<i>Gloeotrichia</i> J. Ag. ex Born. et Flah.	1(1)
10	<i>Hapalosiphon</i> Näg. ex Born. et Flah.	1(2)	23	<i>Osillatoria</i> Vauch. ex Gom.	5(5)
11	<i>Amorphonostoc</i> Elenk.	2(3)	24	<i>Phormidium</i> Kütz.	9(10)
12	<i>Stratonostoc</i> Elenk.	2(2)	25	<i>Lyngbya</i> Ag.	7(10)
13	<i>Anabaena</i> Bory	12(13)	26	<i>Homoeothrix</i> J. Ag.	1(1)

The lists of species of blue-green, diatom and green algae of the reserve are presented in Tables 4-6. As was noted by a number of authors, the increase of the number of families represented by one species, as well as genera poor in species, is most typical for northern floras (Kharitonov, 1981; Getsen, 1985). In the studied flora of algae the one-species families (*Hydrocorynaceae*, *Hydruraceae*, *Rhoicospheniaceae*) shared 26.3 % of

the total number of families. Monospecific and poor-in-species (2-5 taxa) genera comprise about 32 % of the total number of recorded taxa. These indices are higher than those of water bodies of Bol'shezemel'skaya tundra, and are practically identical with the data on reservoirs of Yakutia.

TABLE 5. List of *Bacillariophyta* genera of Sikhote-Alin'sky Reserve

N	Genus	Number of species (infr. taxa)	N	Genus	Number of species (infr. taxa)
1	<i>Thalassiosira</i> Cl.	2(2)	27	<i>Caloneis</i> Cl.	6(10)
2	<i>Stephanodiscus</i> Ehr.	2(2)	28	<i>Diploneis</i> Ehr.	6(8)
3	<i>Cyclotella</i> Kütz.	5	29	<i>Neidium</i> Pfitz.	7(13)
4	<i>Melosira</i> Ag.	3	30	<i>Amphipleura</i> Kütz.	1(1)
5	<i>Aulacoseira</i> Ehr.	5	31	<i>Frustulia</i> Ag.	2(4)
6	<i>Actinocyclus</i> Ehr.	1	32	<i>Brebissonia</i> Grun.	1(1)
7	<i>Arachnoidiscus</i> Deane ex Schadb.	1	33	<i>Mastogloia</i> Thw.	3(50)
8	<i>Bacteriastrum</i> Schadb.	1	34	<i>Cocconeis</i> Ehr.	5(8)
9	<i>Fragilaria</i> Lyngb.	11(21)	35	<i>Achnanthes</i> Bory	16(21)
10	<i>Synedra</i> Ehr.	6(13)	36	<i>Eunotia</i> Ehr.	26(37)
11	<i>Tabelaria</i> Ehr. ex Kütz.	1(1)	37	<i>Rhoicosphenia</i> Grun.	1(1)
12	<i>Stenophora</i> Ehr.	1(1)	38	<i>Cymbella</i> Ag.	22(23)
13	<i>Opephora</i> Petit	2(2)	39	<i>Amphora</i> Ehr.	6(6)
14	<i>Asterionella</i> Hass	1(1)	40	<i>Gomphonema</i> Ag.	17(22)
15	<i>Hannaea</i> Patrick	1(4)	41	<i>Gomphoneis</i>	1(1)
16	<i>Diatoma</i> Bory	5(6)	42	<i>Didymosphenia</i> M. Schm.	1(1)
17	<i>Meridion</i> Ag.	1(2)	43	<i>Entomoneis</i> Ehr.	2(3)
18	<i>Tabelalaria</i> Ehr. ex Kütz.	2(2)	44	<i>Epithemia</i> Bréb.	2(5)
19	<i>Rhabdonema</i> Kütz.	1(1)	45	<i>Denticula</i> Kütz.	2(2)
20	<i>Licmophora</i> Ag.	2(2)	46	<i>Rhopalodia</i> O. Müll.	3(4)
21	<i>Navicula</i> Bory	47(65)	47	<i>Nitzschia</i> Hass.	38(45)
22	<i>Anomoeoneis</i> Pfitz.	2(2)	48	<i>Hantzschia</i> Grun.	2(4)
23	<i>Stauroneis</i> Ehr.	5(7)	49	<i>Bacillaria</i> Gmel.	1(1)
24	<i>Gyrosigma</i> Hass.	4(4)	50	<i>Surirella</i> Turp.	14(22)
25	<i>Pleurosigma</i> W. Sm.	3(3)	51	<i>Campylodiscus</i> Ehr. ex Kütz.	2(2)
26	<i>Pinnularia</i> Ehr.	23(39)	52	<i>Stenopterobia</i> Bréb. ex V.H.	1(1)

TABLE 6. List of *Chlorophyta* genera of Sikhote-Alin'sky Reserve

N	Genus	Number of species (infr. taxa)	N	Genus	Number of species (infr. taxa)
1	<i>Pandorina</i> Bory	1(1)	35	<i>Aphanochaete</i> A.Br.	1(1)
2	<i>Eudorina</i> Ehr.	1(1)	36	<i>Microspora</i> Thur.	2(2)
3	<i>Volvox</i> L.	1(1)	37	<i>Oedogonium</i> Link.	4(4)1*
4	<i>Tetraspora</i> Link. ex Desv.	3(3)	38	<i>Bulbochaete</i> Ag.	3(3)1*
5	<i>Sphaerocystis</i> Chod.	3(3)	39	<i>Rhizoclonium</i> Kütz.	2(2)
6	<i>Rhopalosolen</i> Fott.	1(1)	40	<i>Cladophora</i> Kütz.	1(1)
7	<i>Characium</i> A.Br.	1(1)	41	<i>Acrosiphonia</i> J.Ag.	1(1)
8	<i>Pseudocharacium</i> Korsch.	1(1)	42	<i>Spirotaenia</i> Bréb. ex Ralfs	1(1)
9	<i>Korschikovella</i> Silva	1(1)	43	<i>Cylindrocystis</i> Menegh.	1(1)
10	<i>Pediastrum</i> Meyen	4(5)	44	<i>Netrium</i> (Näg.) Itz. et Rothe	2(3)
11	<i>Sorastrum</i> Kütz.	1(1)	45	<i>Gonatozygon</i> Vologd. et Drosdova	1(2)
12	<i>Golenkinia</i> Chod.	1(1)	46	<i>Zygnema</i> Ag.	1*
13	<i>Dictyosphaerium</i> Näg.	3(3)	47	<i>Mougeotia</i> Ag.	1*
14	<i>Botryosphaera</i> Chod.	1(1)	48	<i>Spirogyra</i> Link.	2(2)1*
15	<i>Chlorella</i> Beijer.	1(1)	49	<i>Penium</i> Bréb. ex Ralfs	3(3)
16	<i>Tetraedron</i> Pasch.	3(3)	50	<i>Closterium</i> Ralfs	29(41)
17	<i>Lagerheimia</i> Chod.	2(2)	51	<i>Pleurotaenium</i> Näg.	3(4)
18	<i>Oocystis</i> Näg. ex A.Br.	3(3)	52	<i>Euastrum</i> Ehr. ex Ralfs	12(12)
19	<i>Nephrocytium</i> Näg.	1(1)	53	<i>Micrasterias</i> Ag.	5(5)
20	<i>Eresmosphaera</i> De Bary	1(1)	54	<i>Actinotaenium</i> (Näg.) Teil.	2(2)
21	<i>Closteriopsis</i> Lemm.	1(1)	55	<i>Cosmoastrum</i> Pal.-Mordv.	9(11)
22	<i>Monoraphidium</i> Kom.-Legn.	3(3)	56	<i>Raphidiastrum</i> Pal.-Mordv.	1(1)
23	<i>Kirchneriella</i> Schmidle	3(3)	57	<i>Staurodesmus</i> Teil.	5(7)
24	<i>Ankistrodesmus</i> Corda	2(2)	58	<i>Staurastrum</i> Meyen ex Ralfs	12(16)
25	<i>Coelastrum</i> Näg.	2(2)	59	<i>Cosmarium</i> Ralfs	33(38)
26	<i>Crucigenia</i> Morren	3(3)	60	<i>Pachyphorum</i> Pal.-Mordv.	1(10)
27	<i>Tetrastrum</i> Chod.	1(10)	61	<i>Xanthidium</i> Ehr. ex Ralfs	2(4)
28	<i>Scenedesmus</i> Meyen	8(9)	62	<i>Spondilosium</i> Bréb. ex Kütz.	2(2)
29	<i>Ulothrix</i> Kütz.	3(3)	63	<i>Sphaeroszma</i> Corda ex Ralfs	1(2)
30	<i>Enteromorpha</i> Link.	3(3)	64	<i>Teilingia</i> Bourr.	1(1)
31	<i>Stigeoclonium</i> Kütz.	1(1)	65	<i>Hyalotheca</i> Ehr. ex Ralfs	2(3)
32	<i>Chaetophora</i> Schrank	1(1)	66	<i>Desmidium</i> Ag. ex Ralfs	3(3)
33	<i>Draparnaldia</i> Bory	2(2)	67	<i>Bambusina</i> Kütz. ex Kütz.	1(1)
34	<i>Trentepohlia</i> Martius	1(1)			

Note. Asterisk marks species found in sterile state and not identified to species.

Though the general taxonomic structure, the spectra of leading families and genera of the flora of algae of the reserve have common features with the algal floras of the regions mentioned above, however they have some peculiarities, apparently reflecting an originality of ecological conditions of the water bodies of the reserve, and probably its more southern location. As such a peculiarity we may mention, for example, the third position of the genus *Closterium* in the generic spectrum, and also records of red algae *Sirodotia* and *Chantransia*.

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REFERENCES

- Barinova, S.S. 1990. Analysis of the algoflora of the Artemovsky reservoir (Primorsky Region). Pp. 29-44 in: *Kriptogamicheskie issledovaniya na Dal'nem Vostoke* [Cryptogamic studies in Far East]. Far East Branch Acad. Sci. USSR Press, Vladivostok. [Rus.]
- Dogadina, T.V. & L.A. Kukhareno. 1990. Algae. Pp. 10-34 in: *Flora, miko- i likhenobiota Lazovskogo zapovednika (Primorskiy Krai)* [Flora, myco- and lichenobiota of Lazovsky Reserve (Primorsky Region)]. Far East Branch Acad. Sci. USSR Press, Vladivostok. [Rus.]
- Getsen, M.V. 1985. *Vodorosli v ekosistemakh Kraynego Severa (na primere Bol'shezemel'skoy tundry)* [Algae in ecosystems of Far North (on the example of Bol'shezemel'skaya tundra)]. Nauka Press, Leningrad. [Rus.]
- Jurtsev, B.A., A.I. Tolmachev & O.V. Rebrystaya. 1978. Floristic borders and subdivision of Arctic. Pp. 9-164 in: *Arctic floristic district*. Leningrad. [Rus.]
- Kharitonov, V.G. 1981. *Diatoms of the Anadyr River basin (Chukotskiy Autonomous District)*. Abstr. Ph. D. (Biol.). Thesis. Leningrad. [Rus.]
- Malyshev, L.I. 1972. Floristic spectra of the Soviet Union. Pp. 17-40 in: *Istoriya flory i rastitel'nosti Evrasii* [History of the flora and vegetation of Eurasia]. Nauka Press, Leningrad. [Rus.]
- Medvedeva, L.A. 1981. Materials to the flora of freshwater algae of Sikhote-Alin'sky State Reserve. Pp. 10-20 in: *Sistematika, ekologiya i geografiya sporovykh rasteniy Dal'nego Vostoka* [Systematics, ecology and geography of spore plants of Far East]. Far East Branch Acad. Sci. USSR Press, Vladivostok. [Rus.]
- Medvedeva, L.A. 1984. Material to the flora of algae of the Peshchernaya River and some of its tributaries (Sikhote-Alin'sky Reserve). Pp. 76-82 in: *Sistematiko-floristicheskie issledovaniya sporovykh rasteniy Dal'nego Vostoka* [Systematical and floristic studies of the spore plants of Far East]. Far East Branch Acad. Sci. USSR Press, Vladivostok. [Rus.]
- Medvedeva, L.A. 1986a. The algoflora of the Serebryanka River basin (Primorsky Region). *Bot. Zhurn.* (Leningrad) 71(5): 634-637. [Rus.]
- Medvedeva, L.A. 1986b. The Algoflora of Golubichnoe Lake (Sikhote-Alin'sky Reserve). Pp. 22-35 in: *Flora i sistematika sporovykh rasteniy Dal'nego Vostoka* [Flora and systematics of spore plants of Far East]. Far East Branch Acad. Sci. USSR Press, Vladivostok. [Rus.]

- Medvedeva, L.A. 1987a. The alga flora of Solontsovskie lakes in Sikhote-Alin'sky Reserve. Pp. 49-70 in: *Sikhote-Alin'sky biosfernyi rayon: fonovoye sostoyanie prirodnykh komponentov* [Sikhote-Alin'sky biosphere region: the background state of natural components]. Far East Branch Acad. Sci. USSR Press, Vladivostok. [Rus.]
- Medvedeva, L.A. 1987b. Species of algae new to Far East. *Novit. Syst. Pl. non Vasc.* 24: 55-58. [Rus.]
- Medvedeva, L.A. 1987c. On the record of *Sirodotia suecica* Kylin in Sikhote-Alin'sky Reserve. *Novit. Syst. Pl. non Vasc.* 24: 58-60. [Rus.]
- Medvedeva, L.A. 1990. Materials to the flora of algae of the Serebrianka River and some of its tributaries (Sikhote-Alin'sky Reserve). Pp. 23-28 in: *Kriptogamicheskie issledovaniya na Dal'nem Vostoke* [Cryptogamic studies in Far East]. Far East Branch Acad. Sci. USSR Press, Vladivostok. [Rus.]
- Medvedeva, L.A. 1992a. Algae of Blagodatnoe Lake (Sikhote-Alin'sky Reserve, Russia). *Algologia* 2(3): 61-67. [Rus.]
- Medvedeva, L.A. 1992b. On species of *Cyanophyta* new to Russia. *Algologia* 2(4): 56-63. [Rus.]
- Medvedeva, L.A. 1994. Diatom algae of the Serebrianka River basin (Sikhote-Alin'sky Reserve). *Bot. Zhurn.* (Leningrad) 79(3): 46-56. [Rus.]
- Palamar-Mordvintseva, G.M. 1982. Green algae. Class *Conjugatophyceae*. Order *Desmidiaceae*. 2. In: *Opredelitel' presnovodnykh vodorosley SSSR* [Manual of freshwater algae of the USSR]. Issue 11, part 2. Nauka Press, Leningrad. [Rus.]
- Safonova, T.A. 1983. The modern state of knowledge on the algal flora of Western Siberia. Pp. 96 in: *VII Congress of the USSR Botanical Society* (Donetsk, 11-14 May 1983). [Rus.]
- Vasilieva, I.I. 1989. *Analiz vidovogo sostava i dinamiki razvitiya vodorosley v vodoemakh Yakutii* [Analysis of species composition and dynamics of development of algae in water bodies of Yakutia]. Preprint / Publ. House Yakut. Sci. Center, Siber. Branch Acad. Sci. USSR. [Rus.]
- Vetrennikov, V.V. 1976. *Geologicheskoe stroenie Sikhote-Alin'skogo gosudarstvennogo zapovednika i central'nogo Sikhote-Alinya* [Geological structure of Sikhote-Alin'sky State Reserve and the Central Sikhote-Alin']. Dal'nevostochnoye Press, Vladivostok. [Rus.]
- Vodorosli ... 1989. *Vodorosli: Spravochnik* [Algae: Reference book] / Ed. S.P. Wasser. Naukova Dumka Press, Kiev. [Rus.]