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Zoobenthos of the Upper Ob River tributaries (English resume).

Barnaul: Altai state University press., 2008. - 186 p.

Abstract Composition, structure and functioning of zoobenthos in tributaries of the Upper Ob River were investigated. To do research standard hydrobiological methods were used. Data on structure of zoobenthos resided in flat areas of tributaries of the Upper Ob are presented. Its taxonomic compound that includes 177 species of benthic invertebrates from 11 classes was specified. Characteristics of structure and production of bottom communities were investigated, typification of the Upper Ob River ecosystems by biocenotic attributes was made.

Introduction

Zoobenthos, one of major elements of continental reservoirs and waterways ecosystems, has been studied poorly yet. It is caused first of all by variety of its taxonomic compound and complexity of precise identification of some taxon species that requires the use of special methods, for example, research of morphological characteristics at the basic stages of ontogenesis and karyologycal analysis.

Three tributaries of different dimensional class running through the flat part of the Upper Ob basin were chosen as the object of study: Bolshaya Cheremshanka R. of small size, mid size – Barnaulka R., big – Chumysh R. Tributaries of Barnaulka R. – Butun, Vlasikha, Zemlyanukha, Kur'ya, Pan'shikha, Pivovarka, Rozhnya and tributaries of Bolshaya Cheremshanka R. – Malaya Cheremshanka, Zudilikha, and stream in Inyushovo Village were also investigated (Fig. 1).

The Barnaulka R. that is the left tributary of Ob R. has length of 208 km, the area of its basin is 5720 км^2. Bolshaya Cheremshanka R. (that is the right tributary of Ob River) is 62 km long including Zudilikha R. tributary, the area of its basin is 717 км^2. Chumysh R. that is the right tributary of the Ob has the area of basin 23900 км^2, length – 644 km.

All investigated basins are located in a flat forest-steppe part of Altai Krai (Russia). Rivers' feeding is a of mixed type, it is carried out due to subsoil waters and atmospheric precipitation. Water is of average mineralization (200-700 mg/l), hydrocarbonate class, calcium group.

Water communities of the studied rivers have some distinctions: in phytoplankton of Barnaulka R. green and diatomic algae dominate, while in Bolshaya Cheremshanka R. – diatomic and in Chumysh R. – green and euglenic ones. The zooplankton of Barnaulka R. is introduced basically by Cladocera and

Rotifera, Bolshaya Cheremshanka R. – Rotifera, and Chumysh – Cladocera and Copepoda. The zoobenthos of these rivers practically has not been investigated previously. The fish fauna of Barnaulka and Bolshaya Cheremshanka R. is rather scarce – 8-9 species (mostly Cyprinidae, less often – Percidae, Esocidae and Cobitidae). In Chumysh R. 25 species of fishes among which sturgeon and salmon are marked (Silantyeva, 2000; Silantyeva et al., 2002; Vesnina et al., 2002).

Ecological state of Upper Ob R. tributaries is unsatisfactory, often their ecosystems do not cope with high anthropogenic loads. Stronger pollution of Barnaulka and Bolshaya Cheremshanka R. is observed in the direction from riverheads to mouths, while Chumysh R. waters, on the contrary, are polluted more intensively in the upper and middle sections.

Materials and methods

In 1996-2003 all in all 31 water objects in Barnaulka, Bolshaya Cheremshanka and Chumysh R. basins were surveyed including 1 big, 1 mid, 11 small rivers and also 18 reservoirs linked to them. It is selected and analyzed 393 zoobenthos samples (250 quantitative and 143 qualitative), 39 samples of imago amphibiotic insects, karyotypes of 7 species of chironomids and three stages of a life cycle of two chironomids species.

In 1996-2003 at 8 monitoring stations in the Barnaulka R. basin monthly sampling was made during characteristic hydrological phases of the open water season (Fig. 1). In summer of 1996-2003 2 small water ponds, 7 basic tributaries, namely Butun, Vlasikha, Zemlyanukha, Kurya, Pan'shikha, Pivovarka, Rozhnya and 10 lakes, i.e. Bakhmatovskoye, Sukhoye, Pes'yanoye, Lebyazh'e, Zerkalnoye, Urlapovskoye, Sredneye, Serebryannikovskoye, Peschanoye and Myaskovo linked with Barnaulka R. were surveyed. Sampling in Bolshaya Cheremshanka R. and its tributaries (Malaya Cheremshanka, Zudilikha, stream in Inyushovo Village), Sorochye-Logovskoye pond was performed in the summer and autumn of 1999 and in downstream of Chumysh R. – in the summer and autumn of 2001.

Material was collected and processed according to standard methods (Wetzel & Likens, 2000). Qualitative collections of zoobenthos were made by means of a scraper and a net while quantitative ones – by Peterson and bar dredgers. Manual collecting was used as well. Production of populations of all taxonomic zoobenthos groups was calculated with the use of specific day production value. To do exact taxonomic identification of the most important zoobenthos group i.e. larves of chironomids, raise of pupas and imago were undertaken. The acet-orcein method of making pressed preparations of chironomids' salivary glands was applied to kariologic analysis performance (Keyl & Keyl, 1959).

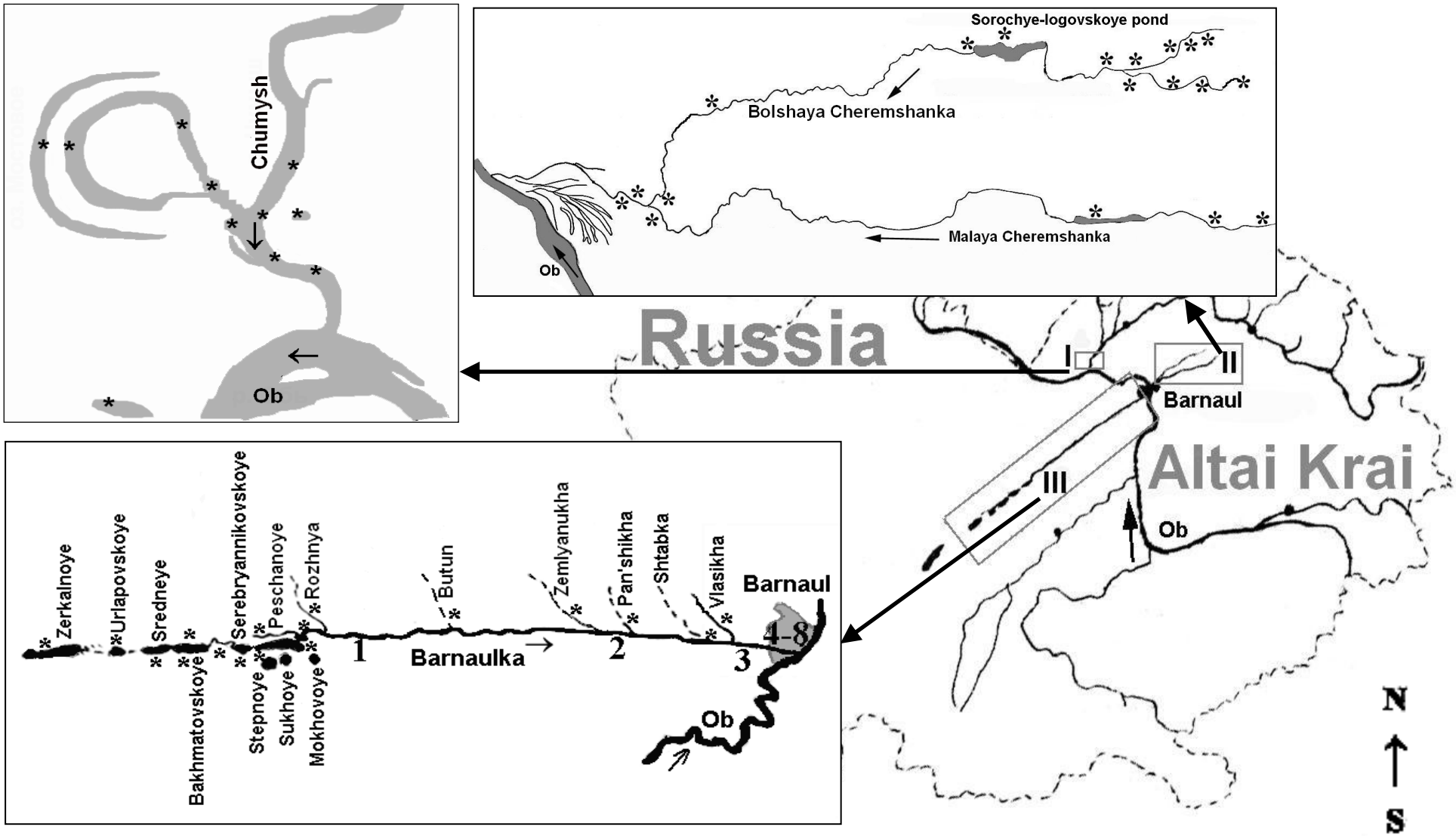

Fig. 1 The map-scheme of location of objects of under study. Rivers' basins: I – Chumysh downstream, II – Bolshaya Cheremshanka, III – Barnaulka; 1-8 – monitoring researches sites, * – one-time sampling sites

Results

In a benthofauna of the investigated Upper Ob R. tributaries 177 species of benthic invertebrates from 11 classes were found (Appendix). The greatest number of species falls on insects – 69.4% with predominance of chironomids – 25.2% in all species of zoobenthos. Molluscums (15.3%) and annlides (8.8%) took the second and third place in all zoobenthos species.

Zoogeographical analysis of the fauna of bottom-dwelling invertebrates in Upper Ob R. tributaries has shown predominance of palearctic (74.2-78.1%) and holarctic species (19.5-20.7%); among palearctic species western-palearctic ones dominated (31.4-33.3% of total fauna). The share of representatives of other faunistic complexes didn't exceed more than 1.1-2.2% of species (Table 1).

Table 1 Zoogeographical spectrum of zoobenthos (% of total species) in the Upper Ob River tributaries

Zoogeographical groups	**Barnaulka**	**Bolshaya Cheremshanka**	**Chumysh (downstream)**
Holarctics and Cosmopolitans	19.5	20.7	20.0
Transpalearctics	44.8	41.4	45.7
Western-palearctics	33.3	32.8	31.4
East-palearctics	2.3	3.4	0
Southern-palearctics	0	1.7	2.9

The greatest value (by quantity, biomass and number of species) falls on chironomids, molluscums and oligochaetes in Barnaulka R. zoobenthos (Table 2). Benthos biomass and abundance fluctuated from its full absence in the majority of hydrogen sulphide odor samples (below the runoff from the Altai Aggregates Plant) and Socialistichesky Avenue) up to 26.9 g/m^2 (Lesnoy pond) and 449,8 $spec./m^2$ (Cheremnoye Village). Within Barnaul City territory oligochaetes dominated by quantity and biomass, chironomids – by quantity in the upstreams and molluscums – by biomass (Bezmaternykh & Eidukaitene, 2003). As this takes place, quantity and biomass significantly decreased from headstreams to the mouth that is probably a result of river pollution observed just in this direction. According to the level of zoobenthos development upper and mid section of Barnaulka R. are considered to be mesotrophic and eutrophic ones by the Kitaev's scale (1986) depending on the type of a prevailing soil (silty sand and silt, correspondingly).

Table 2 Average biomass (g/m^2) from April – October, 2000 of zoobenthos basic taxons on various Barnaulka River section

No sites	Oligohaeta	Mollusca	Chironomidae	Others	Total
1	0.18	23.8	0.77	2.17	26.9
2	0.09	8.65	1.28	0.13	10.1
3	0.02	7.48	0.23	1.99	9.72
4	0.01	0.00	0.17	0.00	0.18
5	0.16	0.03	0.00	0.00	0.19
6	0.38	0.00	0.00	0.00	0.38
7	0.08	0.00	0.00	0.00	0.08

Zoobenthos quantity and biomass of Bolshaya Cheremshanka R. were determined basically by chironomids and small molluscums (Table 3). Bloodsuckers and oligochaetes had smaller value. The zoobenthos biomass changed from 0.2 up to 23.0 g/m^2; on average it made up 8.7 g/m^2. By the level of zoobenthos development Bolshaya Cheremshanka R. can be referred to mesotrophic type (Vesnina et al., 2002).

Table 3 Average biomass and predominant zoobenthos taxons on various grounds of Bolshaya Cheremshanka

Ground	Biomass, $g/м^2$	Predominant taxons
Silty sand	10.8	Chironomidae, Chaoborus
Silt	8.00	Mollusca, Hirudinea
Sand	4.70	Chironomidae, Oligochaeta, Coleoptera

By quantity and biomass in the zoobenthos of Chumysh R. downstream gasteropods molluscums and larvae of chironomids prevailed (Table 4). The first dominated in stagnant, and the second in running waters. The level of development of zoobenthos varied greatly, i.e. from 0.3 thousand spec./m^2 and 0,72 g/m^2 (Chumysh R. channel), up to 1,1 thousand spec./m2 (floodplain lakes) and 92.0 g/m^2 (anabranches of Chumysh R.) (Silantyeva et al., 2002).

Table 4 Average biomass and predominant zoobenthos taxons of aquatic ecosystems of basin of Chumysh River downstream

Aquatic ecosystems	Ground	Biomass, $g/м^2$	Predominant taxons
Inundated lakes	silt	26.8	Mollusca, Chironomidae
Branches of Chumysh	detritus	92.0	
Channel of Chumysh	clay	0.00	–
	silty clay	0.03	Chironomidae
	detritus	1.00	Chironomidae, Mollusca
	silty sand	2.50	Chironomidae
	sand	0.05	Limoniidae

For Barnaulka R. zoobenthos production during the open water season (from April till October) was estimated. Zoobenthos production value for the river outside Barnaul (27.6-42.81 kJ/m^2) was ten times higher than the production in the urban zone (1.11-4.94 kJ/m^2). Such a difference can be explained only by benthos depressed state in Barnaul R. within the urban area caused by high concentrations of industrial and household pollutants. The greatest production in the upper and middle section of the river had molluscums and others, and in the downstream – oligochaetes and chironomids (Table 5).

Table 5 Zoobenthos production (P) on the various sites of Barnaulka River in April - October, 2000

No sites	P, g/м^2	P, kJ/м^2
1	19.7	42.8
2	13.4	33.8
3	9.50	27.6
4	0.64	1.76
5	0.84	3.46
6	1.18	4.94
7	0.26	1.11

According to the Abakumov classification (1992), water communities dwelling in the upper and mid sections of Barnaulka R. are characterized by a "background" state while the ones living in the downstream – by "ecological and metabolic regress" state. Ecosystems of Bolshaya Cheremshanka R. are basically characterized by "background" state. Nevertheless, in places of organic matter accumulation (Sorochye-Logovskoye pond) "metabolic progress" state is observed but in the downstream sites with «ecological regress» (land fills, shunts) are met. The Chumysh R. downstream is characterized by "background" state.

Discussion

Species quantity allocation by taxons observed in the Upper Ob tributaries under study is typical for zoobenthos of other Ob tributaries, like Alei, Ket', Tom', Chulym and for rivers of the Volga basin, i.e. small rivers of Middle Volga and Gorki Zavolzhye basin, waterways of right-bank of Middle Volga, Kotorosl', Kama and Dnieper rivers. Zhadin & Gerd (1961) has already pointed to resemblance of hydrobiological characteristics of these basins. At the same time significant differences in benthofauna between the investigated rivers and compound of the bottom-dwelling population of Yenisei basin waterways are observed (Fig. 2).

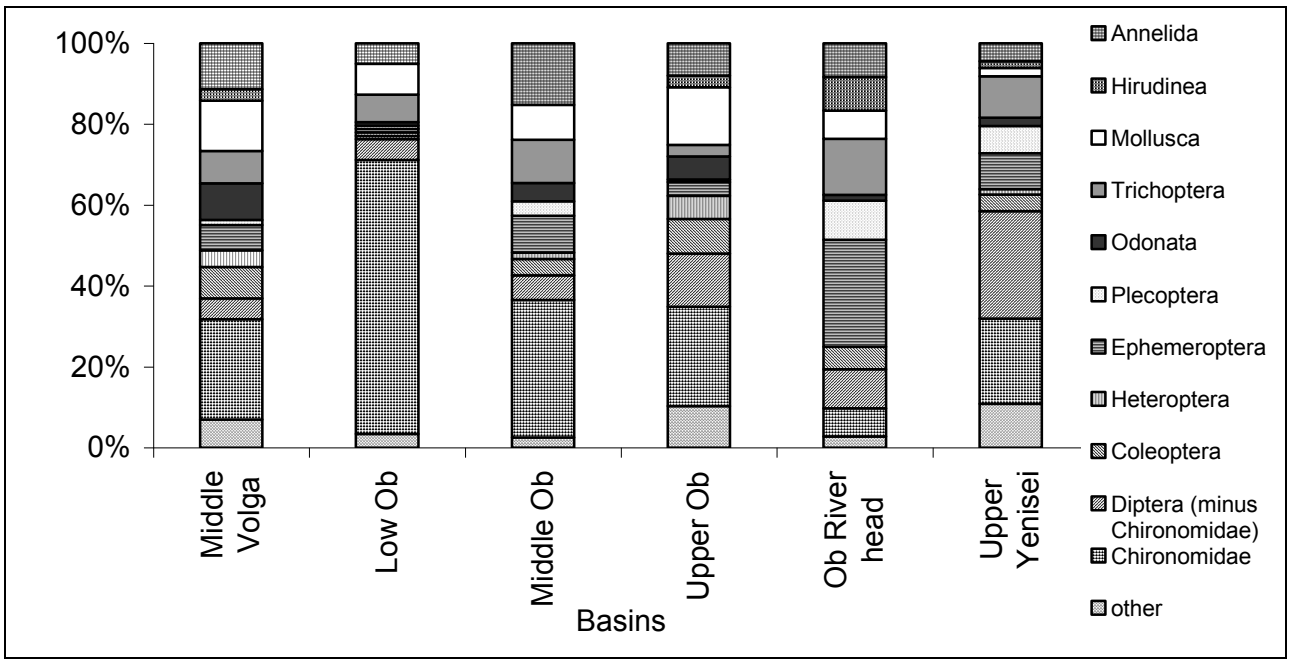

Fig. 2 Taxonomic fauna spectrum of bottom-dwelling invertebrates in tributaries of Volga, Ob and Yenisei rivers

The results of zoogeographical analysis agree with the data on the Ob-Irtysh basin zoobenthos obtained earlier by Ioffe (1947), Ruzanova (1984) – on chironomids, Patrusheva (1982) – on simuliids, Starobogatov (1970), Andreev & Vinarsky (2001) – on molluscums, Belyshev (1973-1974) – on dragonflies and Zalozny (1973) – on oligochaetes and bloodsuckers. These authors noted that the most of aquatic organisms of the West Siberian lowland are species widely spread in Palearctics and Holarctics. The share of Siberian endemics is insignificant. The territory under study can be referred to the Europe-Siberian subarea of Palearctics according to the zoogeographical zoning.

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Appendix. List of bottom invertebrates species dwelling in Upper Ob River tributaries basins

Taxons	Barnaulka	Bolshaya Cheremshanka	Chumysh r. downstream
1	2	3	4
SPONGIA			
Spongilla lacustris Linne	+	+	
COELENTERATA			
Chlorohydra viridissima Pallas		+	
Hydra vulgaris Pallas	+		
NEMATODA			
Nematoda sp.	+		
OLIGOCHAETA			
Eiseniella tetraedra Savigni	+		
Enchytraeus sp.	+		
Fridericia sp.	+		
Isochaetides sp.	+		
Lumbriculus variegatus O. F. Müller	+	+	
Limnodrilus claparedeanus Ratzel	+	+	
L. hoffmeisteri Clap.	+	+	
Spirosperma ferox Eisen	+		
Tubifex tubifex O. F. Müller	+	+	
HIRUDINEA			
Erpobdella octoculata Linne	+	+	+
E. nigricollis Brandes	+		
Haementeria costata O. F. Müller		+	
Haemopis sanguisuga Linne	+		
Helobdella stagnalis Linne	+		+
Glossiphonia complanata (Linne)	+		
BRYOZOA			
Plumatella fungosa Pallas	+	+	
P. repens Linne		+	
BIVALVIA			
Anadonta anatina (Linne)			+
A. stagnalis Gmelin	+		
Euglesa ostroumovi Pirogov et Starob.	+		
E. pulchella Jenyns	+		
E. supina A. Shmidt	+		
E. sp.		+	+
Sphaerium corneum Linne	+	+	
Musculium creplini Dunker	+		
GASTROPODA			
Anisus acronicus Ferussac	+		
A. contortus (Linne)	+		
A. stroemi Westerlund	+		
A. vortex Linne	+		

1	2	3	4
Anisus sp.			+
Bithynia tentaculata Linne		+	
Choanomphalus rosmaessleri Schm.	+		
Choanomphales sp.		+	
Lymnaea auricularia Linne	+	+	
L. glutinosa O.F. Müller	+		
L. intermedia Lamarck	+		
L. lagotis Schranck	+	+	
L. ovata Draparnaud	+	+	+
L. palustris O. F. Müller	+		
L. peregra (O.F. Müller)	+		
L. stagnalis Linne	+		+
L. truncatula (O.F. Müller)			+
Planorbarius corneus (Linne)			+
Planorbis carinatus O.F. Müller		+	
P. planorbis Linne	+	+	
Valvata klinensis Milachevitch	+		
V. piscinalis O.F. Müller	+	+	+
CRUSTACEA			
Asellus sp.	+		
Gammarus lacustris Linne	+		
G. pulex Linne	+		
Ostracoda sp.	+		
Potastacus leptodactilus Esch.	+		
ACARINA			
Eylais undulosa Koenike		+	
Limnochares aquaticus Linne		+	
ARANEI			
Argyroneta aquatica Cl.	+	+	+
Dolomedes fimbriatus Cl.	+	+	+
INSECTA			
COLLEMBOLA			
Podura aquatica Linne			+
Proisotoma ripicola Linnan	+		
TRICHOPTERA			
Anabolia furcata Brauer	+	+	
Annitella obscurata (MacLachlan)		+	
Ceratopsychae nevae Kolenati		+	
Hydropsyche angustipennis Curtis	+		
Limnephilus marmoratus Curtis	+		
NEUROPTERA			
Sisyra fuscata (Fabr.)		+	
MEGALOPTERA			
Sialis fuliginosa Pictet		+	+
ODONATA			
Anax sp.			+
Brachitron pratense O.F. Müller	+		
Coenagrion armatum Charpentier	+		

1	2	3	4
Gomphus flavipes Charpentier	+		
Erythromma najas (Hans.)			+
Libellula quadrimaculata Linne			+
Leucorrhinia rubicunda Linne	+	+	
Ophiogomphus cecilia Four.	+		
Somatochlora flavomakulata (Vanderlinden)			+
Sympetrum sanguineum O.F. Müller			+
PLECOPTERA			
Perlodes sp.	+		
EPHEMEROPTERA			
Baetis rhodani Pictek		+	
B. sp.	+	+	
Cloen dipterum Linne	+	+	+
Ephemerella ignita Poda	+		
E. sp.		+	
Potamanthus luteus Linne	+	+	
HETEROPTERA			
Aquarius paludum Fabr.			+
Ilyocoris cimicoides Linne	+		+
Gerris odonatogaster (Zetterstedt)			+
Limnoporus rufoscutellata Latreille	+	+	
Micronecta minutissima Linne	+	+	
Nepa cinerea Linne	+	+	+
Notonecta glauca Linne	+	+	+
N. lutea O.F. Müller	+		
Ranatra linearis Linne	+	+	
Sigara striata Linne	+	+	+
COLEOPTERA			
Acilius sulcatus Linne	+	+	
Agabus sp.		+	
Chrysomelidae sp.	+		
Coelostoma orbiculare Fabr.	+		
Cyphon variabilis Thanb.		+	
Dytiscus circumflexus Fabr.	+		
Graphoderes sp.			+
Gyrinus minutus Fabr.			+
G. notator Linne	+	+	
Haliplus ruficollis DeGeer			+
Helodidae sp.	+		
Helophorus aquaticus Linne		+	
Hydrophilus caraboides Linne		+	
Laccophilus sp.	+		
Limnebius sp.		+	
DIPTERA			
Antherix sp.	+		
Ceratopogon str. sp.	+		
Chrysozona italica Meigen			+
Cnephia sp.		+	

1	2	3	4
Culicoides sp.	+		
Dicranomiya autumnalis Staeger			+
Eloephila maculata Meigen		+	
Erioptera lutea Meigen			+
Eristalis tenax Linne		+	
Eusimulium aureum Fries		+	
Nilobezzia formosa Loew	+	+	
Odontomyia angulata (Panzer)		+	+
Palpomyia spinipes Meigen		+	
Ptychoptera sp.	+		
Sciomysidae sp.	+		
Stratiomyia longicornis Scopol	+	+	
Syrphidae sp.			+
Tipula sp.1	+		
Tipula sp.2	+		
Tabanus autumnalis autumnalis Linne		+	+
T. leleani leleani Austen		+	
T. sp.	+		
Wilhelmia equina Linne		+	
f. Chironomidae			
Anatopynia plumipes Fries	+		
Chironomus acutiventris Wülker et al.	+		
C. cingulatus Meigen	+	+	
C. gr. plumosus	+	+	+
C. novosibiricus Kiknadze et al	+		
C. obtusidens Goetegh.	+		
C. pallidivittatus Malloch	+	+	
C. solitus Linevitsh et Erbaeva	+		
C. sp.		+	
C. tentans Fabr.	+		
Cladotanytarsus №1 Zvereva	+		
Cricotopus gr. algarum		+	
C. bicinctus Meigen	+	+	
C. gr. dizonias		+	
C. gr. silvestris	+	+	
Cryptochironomus gr. defectus	+	+	
Endochironomus albipennis Meigen	+	+	
E. tendens Fabr.	+		
Harnischia curtelamellata Malloch	+		
Hydrobaenus gr. pilipes			+
Glyptotendipes barbipes Staeger	+	+	
G. glaucus Meigen	+	+	+
G. paripes Edwards	+	+	
G. sp.		+	
Limnochironomus nervosus Staeg.	+		
Lipiniella arenicola Shilova			+
L. moderata Kalugina	+		+
Microtendipes rezvoi Tshernovskiy		+	

1	2	3	4
Ortocladius gr. saxicola	+	+	
Parachironomus arcuatus Goet.			+
Paratendipes gr. albimanus		+	
Paratrichocladius inaeqalis Kiefer	+		
Polypedilum exectum Kieffer		+	+
P. nubeculosum Schrank	+	+	
P. scalaenum Schrank	+		+
P. sordens Van der Wulp		+	
P. pedestre Meigen			+
Procladius ferrugineus Kieffer	+	+	
Prodiamesa olivacea Meigen		+	
Psectrotanypus sibiricus Tshernovskiy	+		
Reotanytarsus sp.	+		
Tanypus punctipennis Meigen	+		
Tanytarsus gr. holochlorus		+	
Total: 177	115	82	44

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