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AMPHIBIOTIC INSECT EPHEMEROPTERA, PLECOPTERA, TRICHOPTERA ORDERS IN THE BASTAK NATURE RESERVE

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Abstract

The article presents some results of the Hydrobiological Expeditions 2018-2019 carried out under “Russian Clean Water Project” in the Bastak Nature Reserve (Jewish Autonomous Region). The main goal of the research was to study freshwater biota of the Bastak Nature Reserve, identify the main types of benthic communities characteristic of various landscape-geographical complexes and longitudinal zones of watercourses, determine the composition and structure of benthic communities, as well as identify indicator groups and species, and estimate their bioindication significance. In the paper is represented data of faunistic study of the air phases of three amphibiotic insect orders Ephemeroptera, Plecoptera and Trichoptera, referred to as the "EPT indicator complex", which is considered as the very sensitive to pollution groups of macroinvertebrates. Information about the fauna of amphibiotic insects of the EPT complex in the Bastak Nature Reserve was practically absent until the regular hydrobiological studies, which was begun in 2018. As a result, the first data about the Ephemeroptera and Plecoptera was obtained, and the list of Trichoptera was significantly expanded. By now the list of revealed EPT taxa includes 141 species belonging to 66 genera, 29 families: Ephemeroptera is represented by 35 species, 11 genera from 6 families, Plecoptera – 18 species, 12 genera from 5 families, and Trichoptera – 88 species, 43 genera from 18 families. In the article is considered the possibility of applying a new metrics – the taxonomic structure of the EPT adult-complex as characteristic the type of habitats in various sections of the longitudinal profile of watercourses.

Keywords: EPT adult-complex, fauna, freshwater bioassessment, SPNA

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1. Introduction

Special Protected Natural Areas (SPNA) (also named as a natural reserve, wildlife refuge, wildlife sanctuary, biosphere reserve or bioreserve, natural or nature preserve, or nature conservation area), are protected areas of importance for biota, which is reserved and managed for purposes of conservation and to provide special opportunities for study or research. Protected areas are widely considered essential for biodiversity conservation. The global study of terrestrial protected areas worldwide showed that species richness is 10.6% higher and abundance 14.5% higher in samples taken inside protected areas compared with samples taken outside (Gray et al., 2016). Thus, protected areas remain a kind of "islands" (refugees) that allow preserving the natural (pristine) complexes of flora and fauna. For ecologists who study the anthropogenic impacts on developed territories, these are "reference points", background territories, when compared with which it is possible to determine the impact levels and its trends in communities changes under the human activity influence. This is why studies of the species composition, structure, and functioning of terrestrial and freshwater ecosystems in SPNA are so important for biological monitoring.

The need to study aquatic (amphibiotic) insects and the structural characteristics of their communities in the natural conditions of SPNA is because the fact that many of them are very sensitive to pollution and therefore widely used as indicators in freshwater biomonitoring. Especially important are the amphibiotic insects of the mayfly (Ephemeroptera), stonefly (Plecoptera), and caddisfly (Trichoptera) orders, often abbreviated as EPT and naming “EPT indicator complex”. These three orders are very sensitive to many stressors and are commonly used in bioassessment programs to characterize clean, unpolluted water (Morse et al., 2007).

In Russia, freshwater biological monitoring programs have not yet been developed and put into practice at the state level, and there are no General Bioassessment Protocols and protocols adapted for different ecoregions. Due to regional differences in the characteristics of freshwater macroinvertebrate assemblages, it is not possible to simply adopt existing global bioassay programs (such as EPA USA Bioassessment Protocols) for use in Russian streams and rivers. Therefore, it is necessary to evaluate the effectiveness of biotic metrics and indices and modify them in accordance with regional biota and conditions. In the Russian Far East, work began since 2003 on the development of regional freshwater bioassessment protocols under “Russian Clean Water Project” (RCWP) (Vshivkova et al., 2019), and some protected areas of the Russian Far East were selected as model reference territories.

The Bastak Nature Reserve, one of the SPNA chosen for the RCWP aim, is located in the Lower Amur basin, remained a "white spot" for freshwater fauna until recently. Regular studies of aquatic invertebrates began here since 2018 (Vshivkova & Makarenko, 2019). The main scientific interest was the study of freshwater biota, identification of the main types of benthic communities characteristic of various landscape-geographical complexes and longitudinal zones of watercourses, identification of the composition and structure of bottom communities, as well as revealing of indicator groups and species, and estimation of their bioindication significance. That is, the study of the most important parameters necessary for developing the basics of a regional freshwater biomonitoring system for the Jewish Autonomous Region.

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2. Problem Statement

The protection of freshwater resources is impossible without a well-developed system for monitoring and controlling the ecological state of the environment. Of particular importance is the development of reliable, adequate and inexpensive methods for assessing water quality. Such methods are biological assessment methods using aquatic macroinvertebrates. However, for their successful application, it is necessary to adapt the known systems of bioanalysis to the conditions of various ecoregions, taking into account the regional fauna. Since the fauna of aquatic invertebrates in the Jewish Autonomous region is still insufficiently studied, the authors have initiated regular studies of the freshwater biota of the region since 2018, with an emphasis on the reference area – the Bastak Nature Reserve.

3. Research Questions

Biological monitoring of fresh water is mainly based on the use of benthic macroinvertebrates, among which the immature stages (larvae and pupae) of amphibiotic insects play an important role, especially representatives of three orders: mayflies (Ephemeroptera), stoneflies (Plecoptera) and caddisflies (Trichoptera) (Morse, 2017). Air phases (mature stages, adults or imagoes) are attracted mainly for association with hard-to-identify larvae or in faunistic researches, and not used in assessing water quality, as they are not considered strictly tied to the habitats they came from, and may fly far away from the "home stream". In our work, we decided to test whether groups of aquatic insects of the EPT complex caught in light traps are specific to the habitats near which they gather, and whether they can be used as indicators of stream habitat conditions when monitoring water quality.

4. Purpose of the Study

The main goal of this work was to study the species composition of three amphibiotic insect orders: Ephemeroptera, Plecoptera, and Trichoptera based on imago stages collected at 9 sampling sites located at Bastak River main channel and its tributaries, and Glinyanka River with Ikura River – other streams of Bastak Nature Reserve. To determining the high taxa structural composition and species richness of the *EPT adult-complexes* at 9 sampling sites located in 4 different longitudinal zones: epirithral (sites 1A and 4B), middle metharithral (sites 2A, 3A, 4A), upper metharithral (sites 1B, 2B, 3B) and hyporithral (site 5A), and evaluate the potential significance of this metrics for use in freshwater biomonitoring.

5. Research Methods

Air phases of aquatic insects were collected by T.S. Vshivkova and V.P. Makarenko in two ways: the active method using a white screen (sheet) installed near the watercourse and equipped with an ultraviolet lamp, and the passive method (pan-trap method) using a white tray filled with 85% alcohol, which was installed at the water's edge along with an ultraviolet lamp located on the tray top. The 20-volt ultraviolet lamps (Aspectek Ultraviolet Tube 20W) was used as source of light.

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The exposure time of both light traps was from 21:00 to 24:00. Light traps in each sampling sites were set so that their light was shielded from each other.

The collection of insects was carried out over two series: series A from 11 to 14 July 2018, and series B from 4 to 6 August 2019. At each station, samples were taken once, except for station 1-B (at Kordon Dubovaya Sopka), which included also material on caddis collected with a screen light trap in that site 27 June to 5 July 2012 by Petr Osipov.

Adults were fixed with 85% alcohol, initial identification of caught adults was carried out in the field, and the final determination of the species was made in the laboratory.

The definition of Ephemeroptera was made by T.M. Tiunova, Plecoptera – V.A. Teslenko, and Trichoptera – T.S. Vshivkova. The lists of revealed species, genera, and families are arranged in alphabetical order and are presented in Table 01. The table 01 also shows the Family Tolerance Value for calculation of the Far Eastern Family Biotic index and Family Tolerance Score for calculation of the Far Eastern BMWP Index. The Tolerance Values and Tolerance Scores for calculating the corresponding indices were modified from the original ones in accordance with the ecological valences of the Far East Russian representatives of the EPT families (Vshivkova et al., 2019).

6. Findings

Study Area. The Bastak Nature Reserve is a strict nature reserve located in the Middle Amur River basin in the Russian Far East. The territory of the reserve covers the Southeastern spurs of the Bureysky Massif and the northern edge of the Middle Amur Lowland. The reserve is represented by two clusters: the mid-mountain forest main cluster "Bastak", and the lowland steppe cluster "Zabelovsky". The research was conducted mainly on the territory of the Bastak Cluster in the basins of two major rivers: the In River basin (Bastak River with tributaries – Bolshoy Sorennak, Sredny Sorennak Rivers, 39th Kordon Stream, Tigrovy Stream, and Glinyanka River), and the Bira River basin (Ikura River). The main part of the basins of the studied rivers is located within the Khingano-Bureinsky mountain system. The largest rivers are: the Bastak (53 km), In (64 km), and Bolshoy Sorennak (43 km). All rivers belong to the left-bank catchment system of the Amur River.

Sampling Sites. The sampling sites were established on various sections of rivers, in the epirithral (sites 1-A, 4-B), upper metharithral (1B, 2B, 3B), metharithral (sites 2–4-A), and hyporithral zones (site 5-A). Below are represented short characteristics of the sampling sites with geographical coordinates; in parentheses are recorded the Locality Codes in accordance with the East Russian Aquatic Invertebrates Data Base (ERAIDB).

Site 1-A: the 39th km Kordon Stream, a tributary of Bolshoy Sorennak River (In River basin), stony bottom with boulders, the bed of the stream is completely shaded by trees; 49.102710 N; 133.105796 E (RS001233).

Site 2-A: Sredny Sorennak River, a tributary of Bolshoy Sorennak River (In River basin), stony bottom, the streambed is not completely shaded by trees; 49.070123 N; 133.062967 E (RS001234).

Site 3-A: Bolshoy Sorennak River, a tributary of the In River (Urmi River basin), stony bottom, the streambed is not completely shaded by trees; 49.106941 N; 133.108960 E (RS001235).

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Site 4-A: Bastak River, 24,5 km lower of its source (In River basin), stony bottom with boulders, the medial part of stream bed is never shaded by trees; 49.024044 N; 133.022461 E (RS001236).

Site 5-A: Glinyanka River, a tributary In River (Urmi River basin); lowland section of the river, soft bottom with sand and silt, trees along banks are almost absent; 48.866214 N; 133.023081 E (RS001237).

Site 1-B: Dubovaya Sopka Stream, a tributary of Ikura River (Bira River basin); stony bottom with small sandy parts, the streambed is almost shaded by trees; 48.987943 N; 132.884351 E (RS001245).

Site 2-B: Ikura River at Kordon Ryabinovy, a tributary of Bira River (Amur River basin), stony bottom with sandy parts, the streambed is almost shaded by trees; 49.026502 N; 132.939731 E (RS001247).

Site 3-B: Bastak River, 9 km lower its source, a tributary of In River (Urmi River basin); stony bottom, the streambed is not completely shaded by trees; 49.042044 N; 133.001078 E (RS001248).

Site 4-B: Tigrovy Stream at Kordon Ryabinovy, a tributary of Bastak River (In River basin); stony bottom, with some small swampy places at the channel, the streambed is completely shaded by trees; 49.001573 N; 133.012875 E (RS001251).

EPT Adult-Complex Structure and Composition. The general list of EPT species collected at 9 research sites is presented in Table 01 and includes 141 species from 66 genera and 29 families. Order Ephemeroptera is represented by 35 species, 11 genera from 6 families; Plecoptera – 18 species, 12 genera from 5 families; Trichoptera – 88 species, 43 genera from 18 families.

The high taxa taxonomic structure of EPT adult-complexes at 9 sampling sites of Bastak Nature Reserve streams and rivers is shown in Table 02.

Table 1. List of Ephemeroptera, Plecoptera and Trichoptera species collected from 9 sampling sites located along streams and rivers of the Bastak Nature Reserve

№	Taxons	Sampling Sites								
		1-A	2-A	3-A	4-A	5-A	1-B	2-B	3-B	4-B
	ORDER EPHEMEROPTERA									
	I. Family Ameletidae	FE FBI Tolerance Value = 0				FE BMWP Tolerance Score = 10				
1	*Ameletus cedrensis* Sinitshenkova, 1977			+						
2	*Ameletus montanus arlecchino* Kluge, 2007			+					+	+
3	*Ameletus* sp.							+		
	II. Family Baetidae	FE FBI Tolerance Value = 4				FE BMWP Tolerance Score = 6				
4	*Acentrella sibirica* Kazlauskas, 1963									+
5	*Baetis bicaudatus* Dodds, 1923							+		
6	*Baetis fuscatus* Linnaeus, 1761			+						
7	*Baetis pseudothermicus* Kluge, 1983		+	+				+	+	
8	*Baetis vernus* (Curtis, 1834)							+		+
9	*Baetis* sp.		+	+						
	III. Family Heptageniidae	FE FBI Tolerance Value = 4				FE BMWP Tolerance Score = 10				
10	*Cinygmula kurenzovi* Bajkova, 1962		+							
11	*Cinygmula levanidovi* Tschernova et Belov, 1982								+	
12	*Cinygmula* spp.	+	+	+	+			+	+	+

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13	*Epeorus ninae* Kluge, 1995?							+	+	+
14	*Epeorus pellucidus* Brodsky, 1930			+					+	
15	*Epeorus alexandri* Kluge et Tiunova, 1989?								+	+
16	*Epeorus maculatus* Tshernova, 1949							+		
17	*Epeorus* sp.			+						
18	*Rhithrogena bajkovae* Sowa, 1973		+	+						
19	*Rhithrogena lepnevae* Brodsky, 1930				+					
20	*Rhithrogena* sp.		+	+						+
	IV. Family Ephemerellidae	FE FBI Tolerance Value = 2				FE BMWP Tolerance Score = 10				
21	*Drunella lepnevae* Tschernova, 1949								+	
22	*Drunella triacantha* Tschernova, 1949		+	+	+					
23	*Drunella* sp.				+					
24	*Ephemerella aurivillii* Bengtsson, 1908		+	+	+		+	+	+	+
25	*Ephemerella dentata* Bajkova, 1967								+	
26	*Ephemerella kozhovi* Bajkova, 1967								+	
27	*Ephemerella nuda* f. *verrucosa* Kluge, 1995			+				+	+	+
28	*Ephemerella thymalli* Tshernova, 1952			+				+	+	
29	*Ephemerella* spp.	+	+	+	+			+		
30	*Seratella sp.*									+
	V. Family Leptophlebiidae	FE FBI Tolerance Value = 2				FE BMWP Tolerance Score = 10				
31	*Neoleptophlebia chocolata* Imanishi, 1937			+						
32	*Neoleptophlebia japonica* Tiunova et Kluge, 2016							+	+	
	VI. Family Siphlonuridae	FE FBI Tolerance Value = 5				FE BMWP Tolerance Score = 6				
33	*Siphlonurus lacustris* Eaton, 1870								+	
34	*Siphlonurus zhelochovtsevi* Tshernova, 1952				+				+	
35	*Siphlonurus* sp.		+	+	+	+	+	+	+	+
	ORDER PLECOPTERA									
	I. Family Chloroperlidae	FE FBI Tolerance Value = 1				FE BMWP Tolerance Score = 10				
36	*Alascaperla longidentata* Rauser, 1968		+	+				+	+	
37	*Haploperla lepnevae* Zhiltzova et Zwick, 1971		+	+						
38	*Haploperla maritima* Zhiltzova, 1978		+	+	+					
39	*Haploperla ussurica* Navas, 1934				+					
	II. Family Nemouridae	FE FBI Tolerance Value = 2				FE BMWP Tolerance Score = 8				
40	*Amphinemura borealis* Morton, 1894				+	+				
41	*Amphinemura verrucosa* Zwick, 1973		+	+	+					
42	*Amphinemura* sp.							+		
43	*Nemoura* sp.1			+						
44	*Nemoura* sp. (F)		+							
45	*Nemoura* sp. (L)							+		
	III. Family Perlidae	FE FB Tolerance Value = 1				FE BMWP Tolerance Score = 10				
46	*Oyamia nigribasis* Banks, 1920		+							
47	*Neoperla ussurica* Sivec et Zhiltzova, 1996					+	+			
48	*Paragnetina flavotincta* McLachlan,					+				

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	1872									
	IV. Family Perlodidae	FE FBI Tolerance Value = 2				FE BMWP Tolerance Score = 10				
49	*Isoperla eximia* Zapekina-Dulkeit, 1975			+						
50	*Kaszabia nigricauda* Navas, 1922				+					
51	*Megarcys ochracea Klapálek,* 1912								+	
52	*Pictetiela asiatica* Zwick et Levanidova, 1971								+	
	V. Family Pteronarcyidae	FE FBI Tolerance Value = 0				FE BMWP Tolerance Score = 10				
53	*Pteronarcys sachalina* Klapálek, 1908				+					
	ORDER TRICHOPTERA									
	I. Family Arctopsychidae	FE FBI Tolerance Value = 2				FE BMWP Tolerance Score = 10				
54	*Arctopsyche palpata* Martynov, 1934	+	+	+	+		+	+	+	
	II. Family Brachycentridae	FE FBI Tolerance Value = 1				FE BMWP Tolerance Score = 10				
55	*Brachycentrus americanus* Banks, 1899	+	+	+	+		+	+	+	+
56	*Micrasema gelidum* McLachlan, 1876		+	+	+		+	+	+	
	III. Family Dipseudopsidae	FE FBI Tolerance Value = 5				FE BMWP Tolerance Score = 7				
57	*Hyalopsyche sakhalinica* Martynov, 1910						+			
	IV. Family Ecnomidae	FE FBI Tolerance Value = 6				FE BMWP Tolerance Score = 6				
58	*Ecnomus tenellus* Rambur, 1842					+				
	V. Family Glossosomatidae	FE FBI Tolerance Value = 0				FE BMWP Tolerance Score = 10				
59	*Agapetus inaequispinosus* Schmid, 1970	+								
60	*Agapetus sibiricus* Martynov, 1918					+	+			
61	*Agapetus* sp.				+		+		+	+
62	*Glossosoma altaicum* Martynov, 1914		+	+	+					
63	*Glossosoma intermedium* Klapalek, 1892	+	+	+	+	+	+	+	+	+
64	*Padunia bikinensis* Martynov, 1934					+				
	VI. Family Goeridae	FE FBI Tolerance Value = 3				FE BMWP Tolerance Score = 10				
65	*Goera curvispina* Martynov, 1935						+			
66	*Goera squamifera* Martynov, 1909		+				+			
67	*Goera tungusensis* Martynov, 1909		+					+		
68	*Goera* sp. (F) ("yellow")			+						
69	*Goera* sp.						+			
	VII. Family Hydropsychidae	FE FBI Tolerance Value = 5				FE BMWP Tolerance Score = 5				
70	*Amphipsyche proluta* McLachlan, 1872	+	+	+	+	+	+			
71	*Cheumatopsyche chinensis* Martynov, 1930		+				+			
72	*Cheumatopsyche infascia* Martynov, 1934		+	+	+	+	+	+		
73	*Hydromanicus feminalis* Martynov, 1934					+	+			
74	*Hydropsyche kozhantchikovi* Martynov, 1924						+			
75	*Hydropsyche newae* Kolenati, 1858						+			
76	*Hydropsyche orientalis* Martynov, 1934	+	+	+	+		+			
77	*Hydropsyche* sp. 3		+			+			+	
78	*Hydropsyche* sp. (F)			+						

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79	*Potamyia chinensis* Ulmer, 1915						+			
80	*Potamyia czekanowskii* Martynov, 1910						+			
	VIII. Family Hydroptilidae	FE FBI Tolerance Value = 4				FE BMWP Tolerance Score = 6				
81	*Hydroptila chinensis* Xue et Yang, 1990		+	+		+	+			
82	*Hydroptila dampfi* Ulmer, 1929					+				
83	*Orthotrichia costalis* Curtis, 1834					+				
84	*Orthotrichia tragetti* Mosely, 1930					+				
85	*Oxyethira* sp. N.1					+				
86	Hydroptilidae gen. sp. 1					+				
	IX. Family Lepidostomatidae	FE FBI Tolerance Value = 1				FE BMWP Tolerance Score = 10				
87	*Lepidostoma albardanum* Ulmer, 1906					+	+	+	+	
88	*Lepidostoma elongatum* Martynov, 1935	+	+	+	+		+	+	+	+
89	*Lepidostoma sinuatum* Martynov, 1935							+		
	X. Family Leptoceridae	FE FBI Tolerance Value = 4				FE BMWP Tolerance Score = 10				
90	*Ceraclea excisa* Morton, 1904				+					
91	*Ceraclea* aff. *hastata* Botosaneanu, 1970					+				
92	*Ceraclea lobulata* Martynov, 1935		+	+	+	+	+		+	
93	*Ceraclea riparia* Albarda, 1874				+	+	+			
94	*Ceraclea shuotsuensis* Tsuda, 1942				+					
95	*Ceraclea sibirica*? Ulmer, 1906		+	+	+	+	+			
96	*Ceraclea* sp.		+	+	+	+				
97	*Leptocerus moselyi* Martynov, 1935		+	+		+	+			
98	*Mystacides bifida* Martynov, 1924								+	
99	*Mystacides longicornis* Linnaeus, 1758					+				
100	*Oecetis antennata* Martynov, 1935						+			
101	*Oecetis brachiura* Yang et Morse, 1997						+			
102	*Oecetis lacustris* Pictet, 1834					+				
103	*Oecetis nigropunctata* Ulmer, 1908						+			
104	*Oecetis testacea kumanski* Yang et Morse, 2000						+			
105	*Oecetis testacea testacea* Curtis, 1834		+	+	+		+			
106	*Setodes obscurus* Schmid et Levanidova, 1986						+		+	
107	*Setodes* sp.				+		+			
108	*Triaenodes pellectus* Ulmer, 1908					+	+			
109	*Triaenodes rufescens* Martynov, 1935						+			
110	*Triaenodes unanimis* McLachlan, 1877					+				
111	*Triaenodes jakutanus* Martynov, 1910					+				
112	*Triaenodes levanidovae* Morse et Vshivkova, 1977						+			
	XI. Family Limnephilidae	FE FBI Tolerance Value = 4 (Limnephilidae sensu stricto), FE FBI Tolerance Value = 3 (Dicosmoecinae) FE BMWP Tolerance Score = 7 (Limnephilidae (part); FE BMWP Tolerance Score = 10 (Dicosmoecinae)								
113	*Anabolia concentrica* Zetterstedt, 1840						+			

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114	*Asynarchus amurensis* Ulmer, 1905					+				
115	*Dicosmoecus jozankeanus* Matsumura, 1931	+		+						
116	*Ecclisomyia kamtshatica* Martynov, 1914							+	+	+
117	*Hydatophylax soldatovi* Martynov, 1914		+	+	+		+	+	+	
118	*Limnephilus quadratus* Martynov, 1914						+			
119	*Limnephilus sericeus* Say, 1824						+			
120	*Pseudostenophylax amurensis* McLachan, 1880		+							
	XII. Family Molannidae	FBI Tolerance Value = 5				FE BMWP Tolerance Score = 10				
121	*Molanna moesta* Banks, 1906					+	+	+		
	XIII. Family Phryganeidae	FBI Tolerance Value = 4				FE BMWP Tolerance Score = 10				
122	*Agrypnia picta* Kolenati, 1848						+			
123	*Hagenella sibirica* Martynov, 1909					+				
	XIV. Family Polycentropodidae	FBI Tolerance Value = 6				FE BMWP Tolerance Score = 7				
124	*Neucentropus mandjuricus* Martynov, 1907					+				
125	*Neureclipsis* sp. 1						+			
126	Polycentropodidae gen. sp.		+	+	+	+	+			
	XV. Family Psychomyiidae	FBI Tolerance Value = 2				FE BMWP Tolerance Score = 8				
127	*Lype daurica* Ivanov et Levanidova, 1996		+	+	+	+				
128	*Psychomyia flavida* Hagen, 1861	+				+	+			
129	*Psychomyia forcipata* Martynov, 1934						+			
130	*Psychomyia* sp.						+			+
	XVI. Family Rhyacophilidae	FBI Tolerance Value = 0				FE BMWP Tolerance Score = 10				
131	*Rhyacophila lata* Martynov, 1918						+			
132	*Rhyacophila lenae* Martynov, 1910							+		
133	*Rhyacophila mjohjangsanica* Botosaneanu, 1970								+	
134	*Rhyacophila mongolica* Levanidova, 1993			+						
135	*Rhyacophila retracta* Martynov, 1914		+	+	+			+		
136	*Rhyacophila* sp. 1		+	+	+		+			
137	*Rhyacophila* sp. L (“setal”)			+						
138	*Rhyacophila* sp.		+	+	+			+		+
	XVII. Family Stenopsychidae	FBI Tolerance Value = 1				FE BMWP Tolerance Score = 8				
139	*Stenopsyche marmorata* Navas, 1920		+							
	XVIII. Family Thremmatidae	FBI Tolerance Value = 3				FE BMWP Tolerance Score = 10				
140	*Neophylax relictus* Martynov, 1935			+	+					
141	*Neophylax ussuriensis* Martynov, 1914								+	

Total Number of EPT Species: 141
Total Number of EPT Genera: 66
Total Number of EPT Families: 29

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Table 2. High taxa taxonomic structure of EPT adult-complexes at 9 sampling sites of Bastak Nature Reserve streams and rivers (EPI – epirithral, E-MET – upper metharithral, MET – middle metharithral, HYP – hyporithral)

EPT Orders	Sampling Sites								
	1-A EEPI	2-A MET	3-A MET	4-A MET	5-A HYP	1-B E-MET	2-B E-MET	3-B E-MET	4-B EPI
Order Ephemeroptera									
Number of Species	2	10	17	8	1	2	12	16	11
Number of Genera	2	6	9	5	1	2	7	7	9
Number of Families	2	4	6	3	1	2	6	5	5
Order Plecoptera									
Number of Species	0	6	6	6	3	1	3	3	0
Number of Genera	0	5	5	4	3	1	3	3	0
Number of Families	0	3	3	4	2	1	2	2	0
Order Trichoptera									
Number of Species	9	26	27	25	34	49	16	14	7
Number of Genera	9	19	18	16	27	28	12	13	7
Number of Families	7	13	13	13	12	15	10	8	6
TAXA RICHNESS									
Total number of EPT Species	11	42	48	39	37	52	31	33	11
Total number of EPT Genera	11	30	32	25	30	31	22	23	9
Total number of EPT Families	9	20	22	20	14	18	18	15	5

Note: EPI – epirithral, E-MET – upper metharithral, MET – middle metharithral, HYP – hyporithral

Analyzing the taxonomic richness of the EPT adult-complex at 9 sampling sites, we note that the richest species composition is found in the sites of metharithral (39–48 species) and hyporithral (38 species) zones; the highest number of species at sampling site 1-B (52 species) we explain its better investigation (here, samples were taken 3 times, while the other sites were sampled only once).

A greater number of genera is also noted in the areas of metharithral (25–32 genera) and hyporithral (31 genera). But the number of EPT families is the highest only in areas of metharithral (20–22 families), in the area of hyporithral it is noticeable low (15 families), whereas in upper metharithral number of families ranged from 15 to 18 families.

Analyzing the taxonomic richness of the orders separately, we note that the species richness of Ephemeroptera shows high values both in some zones of the epirithral and in upper and middle metharithral, while in the lowland area (hyporithral) mayflies are poorly represented.

The taxonomic richness of stoneflies species, genera and families are high only in the area of metharithral.

The Trichoptera taxonomic richness of species and genera is high in the metharithral zones, however even higher in lowland part of Glinyanka River (hyporithral zone).

Analyzing the distribution of EPT species at 9 stations, it can be noted that some species are found in almost all the studied habitats, such as, mayflies *Ephemerella aurivillii* (7 sites, except hyporithral site 5-A, and epirithral site 1-A), *Siphlonurus* sp. (8 sites, except epirithral site 1-A), caddisflies *Arctopsyche palpata* (7 sites, except hyporithral zone), *Brachycentrus americanus*, *Lepidostoma elongatum* (8 sites, except hyporithral), *Cheumatopsyche infascia* (7 sites, except epirithral and some upper metharithral parts), and *Glossosoma intermedium* which was collected on all sites. Other species although numerous in collections, but found only in few habitats. And some species such as stoneflies *Neoperla ussurica, Paragnetina flavotincta,* caddisflies *Ecnomus tenellus Padunia bikinensis, Neucentropus mandjuricus, Hydroptila dampfi, Orthotrichia costalis, Orthotrichia tragetti* were found only at hyporithral zone of Glinyanka River.

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7. Conclusion

As a result of the research, the species composition of the orders Ephemeroptera and Plecoptera was revealed for the first time for the Bastak Nature Reserve. Significantly updated knowledge about the Trichoptera fauna. Up to now, the EPT list is presented by 141 species from 66 genera and 29 families. Order Ephemeroptera includes 35 species, 11 genera from 6 families; Plecoptera – 18 species, 12 genera from 5 families; Trichoptera – 88 species, 43 genera from 18 families.

The high taxa structure of EPT adult-complex in various longitudinal zones of undisturbed watercourses was studied. The information received will be useful in comparative studies of watercourses outside SPNA and in impacted streams.

The specificity of EPT adult-complex for various longitudinal zones was revealed. Therefore, EPT adult-complex studies can be recommended for freshwater monitoring along with traditional methods of benthic communities studies as an additional approach for assessing the ecological state of the water environment.

When organizing the comparative study of EPT adult-complexes, a standardized procedure for collecting insects should be applied; the same traps should be used at studied sites, the same time and duration of the light traps exposure must be maintained, as well as the frequency of sampling. It is also necessary to take into account seasonal changes in the composition of flying insects and, accordingly to this, plan sampling.

The results obtained during this study will be used to develop the basics of a regional fresh water biomonitoring system in the Jewish Autonomous region.

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