ISSN 1995-4255, Contemporary Problems of Ecology, 2013, Vol. 6, No. 6, pp. 622–626. © Pleiades Publishing, Ltd., 2013.
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Comparison of Zoobenthos and Zooperiphyton of Large and Medium Rivers

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Received December 27, 2012

Abstract—The results of a study of zoobenthos and zooperiphyton of two rivers of the Ob' River middle reaches are shown. A comparative analysis of the composition and abundance values of two ecological groups of zoobenthos and zooperiphyton hydrobionts has revealed the difference in their taxonomic compositions and dominant complexes. The similarity in total number and biomass of zoobenthos and zooperiphyton in the large river and the higher values of zooperiphyton quantitative development in a medium river have been identified.

Keywords: zoobenthos, zooperiphyton, abundance, biomass, rivers, Western Siberia
DOI: 10.1134/S1995425513060097

INTRODUCTION

The concept of ecological groups is one of the most crucial concepts in hydrobiology. In recent years, the determination of criteria and methods for defining the ecological groups of hydrobionts, their classification, specific features, and interactions have been rather widely discussed (Zdanovskii et al., 1996; Railkin, 1998; Skal'skaya et al., 2003; Protasov, 2005; Protasov, 2008; Railkin, 2008; Protasov, 2010; Protasov, 2011). The largest part of discussions concerns peryphiton, its taxonomic and trophic structure, and its similarity to and difference from benthos (Stepanova, Sharapova, 2001; Protasov, 2005; Skal'skaya et al., 2006; Skal'skaya et al., 2006; Sharapova, Volkogonova, 2009; Protasov, 2010; Protasov, Silaeva, 2012). Benthos and peryphiton belong to the system of conturobion which forms at the division of "water–soft substrate" and "water–hard substrate" stages (Protasov, 2008). A simultaneous study of zoobenthos and zooperiphyton allows us to reveal the characteristics of hydroecosystems spatial structure and the peculiarities of energy-flow distribution across various ecological groups. The largest part of such studies was carried out in artificially created waterbodies–reservoirs and cooling ponds; the living environment of hydrobionts of these hydroecosystems depend both on natural and anthropogenic factors (Protasov, Silaeva, 2012). The aim of this work is to reveal the peculiarities of structural organization of benthos and peryphiton ecotypic groups in large and medium rivers.

MATERIALS AND METHODS

Studies of zoobenthos and zooperiphyton were carried out simultaneously in two rivers: Bol'shoi Yugan (length 1063 km; basin area 34700 km^2) and its tributary Nyogus"yakh (298 km; basin area 3100 km^2). The rivers are left-bank tributaries of the Ob' River; they are characterized by high mouth sinuosity and a slow current caused by a feeble surface slope under conditions of almost impeccable flat relief (Lyozin, 1995; Pereyaslovets et al., 2001).

At the same time, at the end of August, samples of zoobenthos and zooperiphyton were collected at two stations of the Bol'shoi Yugan River (1 and 2) and two stations of Nyogus"yakh River (3 and 4): three samples at each station. During the study, the water temperature was 13–15°C. The current velocity of the Bol'shoi Yugan River is between 0.45 (station 2) and 0.55 m/s (station 1), the depth fluctuating from 1.5 to 4 m; the dominant grounds are sandy and silty. The current velocity of the Nyogus"yakh River varies from 0.5 (station 3) to 0.54 m/s (station 4), the depths ranging 3–4 m at station 3 and 1.5–2 m at station 4; the ground is sandy and silty, with sandy ground prevailing at station 4. The samples of zoobenthos were collected using the generally accepted methods (*Methods of study*, 1975) by Petersen bottom sampler with a grab area of 0.025 m^2 by two extractions. The samples of zooperiphyton were collected directly from the sunken willow while taking into account the area of substrates (Sharapova, 2007) from a depth of 0.3–0.5 m from the water surface. Only macrofaunal organisms whose size exceeded 2 mm were taken into consideration while comparing zoobenthos and zooperiphyton.

Zoobenthos of the Bol'shoi Yugan River	Zoobenthos of the Nyogus"yakh River	Zooperiphyton of the Bol'shoi Yugan River	Zooperiphyton of the Nyogus"yakh River	Group: River
1	0.68	0.08	0.12	Zoobenthos of the Bol'shoi Yugan River
	1	0.22	0.25	Zoobenthos of the Nyogus"yakh River
		1	0.69	Zooperiphyton of the Bol'shoi Yugan River
			1	Zooperiphyton of the Nyogus"yakh River

Fig. 1. Species similarity index of zoobenthos and zooperiphyton of the Bol'shoi Yugan and Nyogus"yakh rivers.

RESULTS AND DISCUSSION

During the study, 60 taxa of invertebrates were found in zoobenthos and zooperiphyton of the Bol'shoi Yugan and Nyogus"yakh Rivers: 44 in the Bol'shoi Yugan River (23 taxa each) and 69 in Nyogus"yakh River (30 in zoobenthos and 26 in zooperiphyton). The hydrobionts were made up of hydroids; flatworms; roundworms; annelids; leeches (2 species); bivalvia (4) and gastropods (1); water mites; larvae of stoneflies, mayflies (2), and caddisflies (5). Diptera were represented by families Tabanidae, Simuliidae, Ceratopogonidae, and Chironomidae. The diptera were most widely represented by the family Chironomidae, which accounted for 35 species and forms.

Despite similar taxa values, the compositions of zoobenthos and zooperiphyton are considerably different. Only five common species of zoobenthos and zooperiphyton were identified. Oligochetes of the families Tubififcidae and Lumbriculidae, leeches, bivalve mollusks, and larvae of horseflies were found solely in zoobenthos. Hydroids, oligochetes of family Naididae, gastropod *Acroloxus lacustris* (L.), water mites, and larvae of stoneflies and blackflies were revealed only in zooperiphyton samples.

The diptera of family Chironomidae are most diversely represented in zoobenthos and zooperiphyton of the studied rivers. The species and forms of chironomid larvae in benthos and periphyton are similar in terms of the total number. Zoobenthos and zooperiphyton of the Bol'shoi Yugan River contained 14 species each; 11 species were revealed in zoobenthos and 13 in zooperiphyton of the Nyogus"yakh River. The composition difference of zoobenthos and zooperiphyton chironomids is pronounced in terms of the quantity ratio of species of the two main subfamilies: Chironominae and Orthocladiinae. Chironominae is dominant among the species in zoobenthos of both rivers (93–100% of all species), while the zooperiphyton is most diversely represented by the Orthocladiinae subfamily (54–71%).

The species composition similarity of chironomid larvae estimated using the Sörensen index is quite low for these two ecological groups (0.07–017); the similarity between zoobenthos and zooperiphyton chironomids of two rivers is 0.64 and 0.67, respectively. The same trend is preserved while comparing the entire species composition of zoobenthos and zooperiphyton. The species composition similarity between the compared ecological groups (Fig. 1) estimated using the Sörensen index has low values (0.08–0.25); high similarity was revealed between the zoobenthos and zooperiphyton of two rivers: 0.66 and 0.68, respectively. The same low similarity in species composition was revealed in Volga reservoirs (Skalskaya et al., 2003; Skalskaya et al., 2006).

The quantitative development of zoobenthos and zooperiphyton of the Bol'shoi Yugan River is only slightly different. The abundance of zoobenthos and zooperiphyton is 800–1047 and 3653–4805 specimens/m^2, respectively, with the biomass ranging from 1.46 to 4.29 g/m^2 for zoobenthos and 1.68–3.87 g/m^2 for zooperiphyton. The composition of dominants represents the biggest difference. The larvae of chironomids (60–70%) (Table 1), mainly species of the genus *Cryptochironomus*, dominate in river zoobenthos. Zooperiphyton is widely presented by chi-

Table 1. Ratio of main zoobenthos and zooperiphyton taxonomic groups in the Bol'shoi Yugan River

Taxonomic group	Number, specimens/m^2				Biomass, g/m^2			
	zoobenthos		zooperiphyton		zoobenthos		zooperiphyton	
stations	1	2	1	2	1	2	1	2
Oligochaeta	13	7	15	118	0.04	0.02	0.01	0.08
Hirudinea	0	7	0	0	0	0.02	0	0
Bivalvia	200	53	0	0	3.87	0.69	0	0
Ephemeroptera	0	20	40	18	0	0.02	0.01	0.02
Trichoptera	14	60	2310	782	<0.01	0.05	0.64	2.20
Chironomidae	620	560	2390	2404	0.21	0.35	0.92	0.78
Others	0	93	10	331	0	0.31	0.10	0.79

Table 2. Ratio of main zoobenthos and zooperiphyton taxonomic groups in the Nyogus"yakh River

Taxonomic group	Number, specimens/m^2				Biomass, g/m^2			
	zoobenthos		zooperiphyton		zoobenthos		zooperiphyton	
stations	3	4	3	4	3	4	3	4
Oligochaeta	100	0	116	445	0.32	0	0.08	0.16
Hirudinea	0	40	0	0	0	0.06	0	0
Bivalvia	420	40	0	0	2.78	0.17	0	0
Ephemeroptera	0	7	299	114	0	<0.01	0.18	0.03
Trichoptera	233	333	11454	11891	0.19	0.61	19.53	39.03
Chironomidae	2440	793	12096	11077	0.35	0.21	5.45	3.81
Others	354	100	128	572	0.10	0.26	0.27	1.41

ronomids as well (50–65%); however, the larvae *Dicrotendipes nervosus* (Staeg.) have the largest value. The second position by abundance in tree fouling is occupied by the caddisfly larvae (21–48%), mainly *Neureclipsis bimaculata* L. The nucleus of biomass of river zoobenthos is composed of bivalve mollusks (47–90%), which are for the most part represented by the tiny Euglesiade, *Pisidium amnicum* (Mull.), *Amesoda asiatica* (West.), and *Sphaerium*. The larvae of caddisflies (38–56%) and chironomids (20–55%) prevailed in the biomass of zooperiphyton.

The feeblest quantitative development of the Nyogus"yakh River zoobenthos was revealed on the sand bar (station 4) with the mean number of 1313 specimens/m^2, the biomass being 1.31 g/m^2. The abundance is 2.7 times higher on the sandy and silty ground of station 3, the biomass being 2.8 times higher. The mean abundance and biomass of the Nyogus"yakh River zooperiphyton at two stations were 24000 specimens/m^2 and 25.51–44.44 g/m^2, respectively, the maximum biomass being revealed over the sand bar (station 4). The chironomid larvae, mainly species of the families *Stictochironomus* sp. and *Cryptochironomus*, dominated in zoobenthos (60–69%) (Table 2), while the zooperiphyton was mostly represented by the caddisfly larvae (48–49%), with *Brachycentrus subnubilus* Curt. being the most abundant, as well as the chironomid larvae (46–50%), primarily *Reotanytarsus* sp. and *Dicrotendipes nervosus*. The complexes of zoobenthos and zooperiphyton prevailing in terms of biomass were considerably different at two stations. On the sand bar (station 4), the nucleus of benthos biomass was composed of larvae of caddis flies (47%), horse flies (20%), and chironomids (16%); bivalve mollusks representing the same complex as the one typical for the Bol'shoi Yugan River—tiny Euglesiade, *Pisidium amnicum*, *Amesoda asiatica*, and *Sphaerium*—dominated on the sandy and silty grounds (74%). The taxa complexes prevailing in terms of biomass in zooperiphyton of both stations are similar, with the dominance of caddis flies larvae (75–85%), the largest value being held by the *Brachycentrus subnubilus* larvae while chironomid larvae play a considerably inferior role (8–21%). The difference in composition of the dominant complexes was revealed while comparing zoobenthos and zooperiphyton of Volga reservoirs (Skalskaya et al., 2006).

Among species composing both benthos and periphyton, the highest value is represented by the caddisfly larvae: *Neureclipsis bimaculata* in the Bol'shoi Yugan River and *Brachycentrus subnubilus* in the Nyogus"yakh River. A comparison of the density of these two

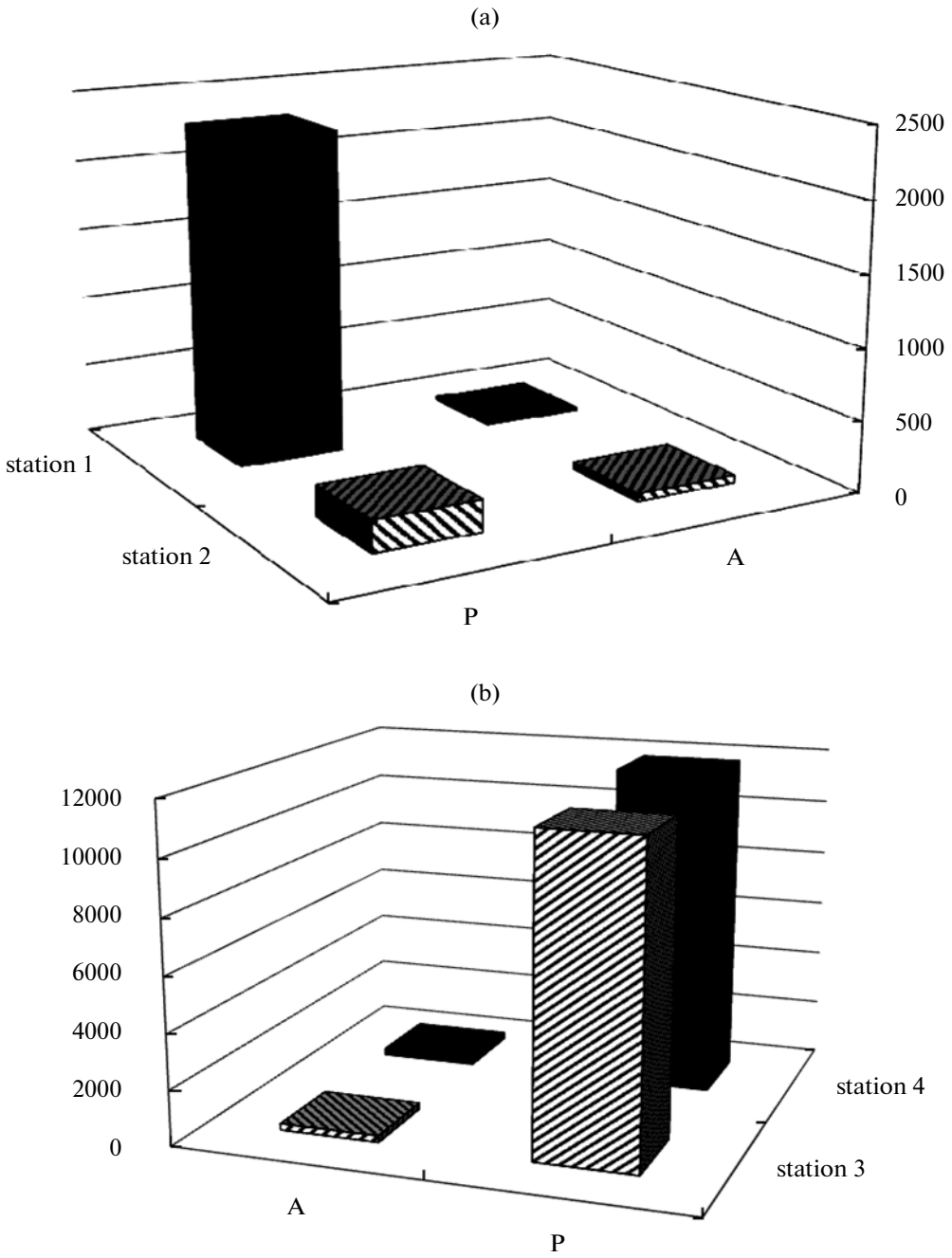

Fig. 2. Abundance (specimens/m^2) of caddisfly larvae *Neureclipsis bimaculata* (a) in zoobenthos (A) and periphyton (P) of the Bol'shoi Yugan River and caddisflies *Brachycentrus subnubilus* (b) in the Nyogus"yakh River.

caddisfly species (Fig. 2) revealed their maximum quantitative development in zooperiphyton; the average number of *Neureclipsis bimaculata* and *Brachycentrus subnubilus* in zoobenthos is 4–85 and 41–48 times lower, respectively. The optimal living environment for the caddisfly larvae is in periphyton; therefore, they are more adapted to live on hard substrates (Protasov, 2005). A similar distribution of bivalve mollusks of the genus *Dreissena* is identified in the hydroecosystems of the European part of Russia, Ukraine, and Poland (Zdanovsky et al., 1996; Protasov, 2005; Skalskaya et al., 2006; Protasov, Silaeva, 2012). This mollusk is included in both zoobenthos and zooperiphyton dominant complexes, its abundance being even much higher in foulings.

CONCLUSIONS

Despite similar taxa values, the difference in zoobenthos and zooperiphyton species compositions is well pronounced, with quite a few species inhabiting both

ecological groups. The quantitative development of zoobenthos is higher in the Bol'shoi Yugan River, while the zooperiphyton dominates in the Nyogus"yakh River. The compositions of zoobenthos and zooperiphyton dominant complexes are different. This can be observed in rivers of the studied area, with the zoobenthos being dominated by the chironomid larvae and bivalve mollusks, whereas the zooperiphyton is represented mostly by the larvae of caddisflies and chironomids (Stepanova, Sharapova, 2001; Sharapova, 2007). The density of chironomid and caddisfly larvae is higher in zooperiphyton, while bivalve mollusks prevail in zoobenthos.

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Translated by S. Korobkova