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SPECIES COMPOSITION AND BIOTOPICAL DISTRIBUTION OF BLACKFLIES (DIPTERA, SIMULIIDAE) ON THE SOUTH-WESTERN MACROSLOPE OF THE UKRAINIAN CARPATHIANS

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Species Composition and Biotopical Distribution of Blackflies (Diptera, Simuliidae) on the South-Western Macroslope of the Ukrainian Carpathians. Tepluk, A. M. — The blackflies on the south-western macroslope of the Ukrainian Carpathians are represented by 45 species. Forty of them are registered in the rivers (Simpson's diversity index (I_s) equals to 0.019), and 29 species in the streams (I_s — 0.090). Twenty-four simuliid species are common for both types of water ways (Czekanowski/Sørensen similarity index (I) is 0.4). Only 16 species develop in the rivers, and 5 types of blackflies live only in the streams. Mass development of the following species in hydrobiocoenoses on the south-western macroslope of the Ukrainian Carpathians: *Simulium trifasciatum* and *S. ornatum*. Species such as *S. ornatum*, *S. reptans* and *S. trifasciatum* are widespread here. Simuliid faunas of main regional altitudinal plant groups differed in composition and quantitative correlation of species. *Simulium argyreatum*, *S. intermedium*, *S. ornatum*, *S. trifasciatum* and *S. variegatum* were eurytopic. The richest species composition (29) was recorded in Rakhiv subdistrict in the district of spruce-fir-beech, spruce-beech-fir and spruce-beech Transcarpathian forests, and the poorest composition (15) is in the beech forests of southern megaslope of the Polonynian Beskyd, subdivision of beech Carpathian forests.

Key words: blackflies, species composition, hydrobiocoenoses, south-western macroslope of the Ukrainian Carpathians.

Introduction

The Ukrainian Carpathians have various biocoenoses and each of them is characterized by the specific unique taxonomic complex of habitants. A high biodiversity served a base for stability of the Carpathian mountain ecosystems for a long time. However, anthropic pressure on natural resources significantly disturbed the environmental stability in this region for the last decades. Identification of spatial distribution patterns of organisms within various biotypes offers an opportunity to maintain their species diversity, contributes to detecting mechanisms of rare species increase in size and control over deleterious species.

Imago of blackflies, as representatives of the amphibiont insect group, is the structural elements of most air land ecosystems and the preimaginal stages are indicative of the Ukrainian Carpathians river ecosystems. Simuliids provide the exchange of biogens between water and terrestrial environments. They enter into the composition of most trophic chains as typical and even as mass inhabitants. Blackflies are also the natural vectors of parasites (Rubtsov, 1956).

Results of detailed surveys of blackflies on the south-western macroslope of the Ukrainian Carpathians have not been published yet. Some data on species diversity and bionomics of simuliid species occurring here were provided by Usova, Panchenko (1972, 1973, 1978), Panchenko (1986, 1998, 1999), Sukhomlin et al. (2008), and others. The Simuliidae fauna of the south-western macroslope of the Ukrainian Carpathians contains 37 species (Panchenko, 2004).

Simuliidae as well as other groups of living organisms influenced by anthropic pressure require an integrated study and continuous monitoring over their taxonomic composition, number and distribution.

Material and methods

This paper is based on preimaginals of blackflies collected on the south-western macroslope of the Ukrainian Carpathians from March to November 2015–2017. As a part of this study the main right-bank tributaries of Tysa River flowing along the south-western macroslope of the Ukrainian Carpathians were examined as follows: Bila Tysa, Chorna Tysa, Kosivska River, Shopurka, Teresava, Tereblia, Rika, Latorytsia, Uzh and some smaller rivers and streams feeding them. In total 480 samples were collected, and over 70 000 blackfly larvae and pupae studied. Techniques of collecting, fixation and preparing slides of the Simuliidae water stages follow Rubtsov (1956). Collecting were done monthly in early April — late September. The keys by Knoz (1965) and Rubsov (1956) were used for identification, and nomenclature follows Adler, Crosskey (2017). The index of dominance (ID), the index of expansion (IE) (Beklemishev, 1970), similarity index by Czekanowski/Sørensen (I), and Simpson's diversity index (I_s) were used (Shitikov et al., 2003).

According to dominance of woody plants species, three main geobotanical subdivisions are distinguished in this territory (Holubets, 2003), each of them located in a certain altitude belt.

The subdivision of oak-beech and oak submontane Transcarpathian forests runs a narrow belt along southern slopes of the Volcanic Range and in Khust-Solotvyna Basin with the elevation of 150–600 m a. s. l. It is located in the warm climate zone where the vegetative season lasts 172 days, and the annual precipitation comes up to 800–900 mm. The largest rivers of the region flow along this territory in their middle reach (Uzh, Latoritsia) or lower reach (Rika, Tereblia, Teresava) and fall into Tysa. There have relatively little slow water courses.

The subdivision of beech forests of the south-western macroslope of the Ukrainian Carpathians coincides with the borders of the beech belt and is located at heights of 300–1450 meters above sea level. It is situated in the warm-temperate zone where the vegetative season lasts 140–165 days, the annual precipitation comes up to 800–1300 mm. The subdivision includes four districts. The district of fur-beech Verkhovuzhski forests occupies the smallest area in comparison with others and is located in the most north-eastern part of the south-western macroslope of the Ukrainian Carpathians. Headwaters of the rivers Uzh and Zhdenivka flow along this territory and there is a dense network of streams that feed them. The district of hornbeam-beech and beech Dubrynychi-Svaliava forests runs a narrow band from the Ukrainian-Polish border between districts of fur-beech Verkhovuzhski forests and beech-oak and oak-beech submontane forests of the Volcanic Range and it reaches and includes the basin of the river Latorytsia. The territory is rich in rivers (Uzh, Zhdenivka, Liuta) and streams that supply them. The district of the beech forests of southern megaslopes of the Polonynian Beskyd encircles the largest in area massifs of three districts of the subdivision. Some large rivers flow along the territory in their middle reaches (the Rika, the Tereblia, the Teresava, the Shopurka), there is also a great number of streams and shallow rivers some of which dry up in summer. The district of spruce-fir-beech, spruce-beech-fir and spruce-beech Transcarpathian forests comprises 2 subdistricts: Mizhhirskiy and Rakhiv. The hydrological network of the Mizhhirskiy subdistrict consists of sources of the rivers Rika, Tereblia, Teresava with a great number of streams flowing down from high-mountain slopes. The Rakhiv subdistrict is located in the sources of Tysa. The rivers Chorna and Bila Tysa with their numerous tributaries flow along its territory. The water temperature does not exceed +12 °C in summer in some streams flowing swiftly from the mountain tops while the water gets warmed to +20 °C and more in the main waterways of the region where these streams run into. These dissimilarities of hydrothermal mode in the waterways partly define higher abundance of blackflies species in the region.

The subdivision of spruce Carpathian mountain forests occupies the highest forest belt of the south-western macroslope of the Ukrainian Carpathians, on the upper parts of slopes of Chornohora and Marmarosh mountains. It is located at heights of 700–1450 meters above sea level. The climate here is boreal, the vegetation period lasts 136 days, the annual precipitation comes up to 1500 mm. The hydrological network is dense and includes waterways that feed the upper reaches of the rivers Bila and Chorna Tysa and Lazeshchyna basin. The subdivision is represented by the subdistrict of Upper Tysa beech-fir-spruce forests of the district of Chornohora-Marmarosh spruce forests.

Results and discussion

Forty-five species of blackflies of two genera were found to occur in hydrobiocoenoses on the south-western macroslope of the Ukrainian Carpathians (table 1). The genus *Simulium* Latreille, 1802, prevails in quantitative terms and comprises 40 species of 5 subgenera: *Nevermannia* Enderlein, 1921 (8 species), *Eusimulium* Roubaud, 1906 (2 species), *Wilhelmia* Enderlein, 1921 (5 species), *Obuchovia* Rubtsov, 1947 (2 species) and *Simulium* Latreille, 1802 (23 species). The genus *Prosimulium* Roubaud, 1906 is represented only by five species.

In general, each water type is characterized by a certain simuliid complexity (table 1). However, the greater part of the registered species (53.3 %) develop in both water types. Four species of genus *Prosimulium* and 20 species of genus *Simulium* are common for rivers and streams ($I = 0.4$). Representatives of *Nevermannia* (3 species), *Eusimulium* (1 species), *Obuchovia* (one species) and *Simulium* (15 species) develop in both types of water courses, and only representatives of subgenus *Wilhelmia* are confined entirely to rivers.

The Simuliidae richness of streams is formed by 29 species, among which species of the genus *Simulium* (25 species) prevail in quantity over *Prosimulium* (4 species) (table 1, fig. 1). The genus *Simulium* is represented by four subgenera: *Nevermannia* (24.1 % from all registered species), *Eusimulium* (3.5 %), *Obuchovia* (6.9 %), and *Simulium* (51.7 %). In total, over half species of blackflies (15) living in the streams belong to subgenus *Simulium*.

The abundance of river blackflies species is higher in comparison with streams and it is represented by 40 species from two genera: *Prosimulium* (5 species) and *Simulium* (35 species) (table 1, fig. 2). Species of subgenus *Simulium* also dominate here (57.5 % from all registered species). In addition to them the development of blackflies from 4 subgenera is registered: *Nevermannia* (10.0 %), *Eusimulium* (5.0 %), *Wilhelmia* (12.5 %) and *Obuchovia* (2.5 %).

On account of qualitative correlation all registered Simuliidae species are divided into four groups: large, or dominant (ID is over 10.00 %), numerous, or subdominant (ID = 5.00–9.99 %), non-numerous (ID = 1.00–4.99 %) and rare (ID = up to and including 0.99 %) (table 1). Two species of the genus *Simulium*, *S. trifasciatum* and *S. ornatum* predominate in hydrobiocoenoses on the south-western macroslope of the Ukrainian Carpathians, the relative fraction of these species comes up to 23.22 % from all collected water stages of Simuliidae (fig. 3). The subdominant group comprises four species of the same genus (*S. argyreatum*, *S. baracorne*, *S. intermedium*, *S. reptans*), in total to 28.70 %.

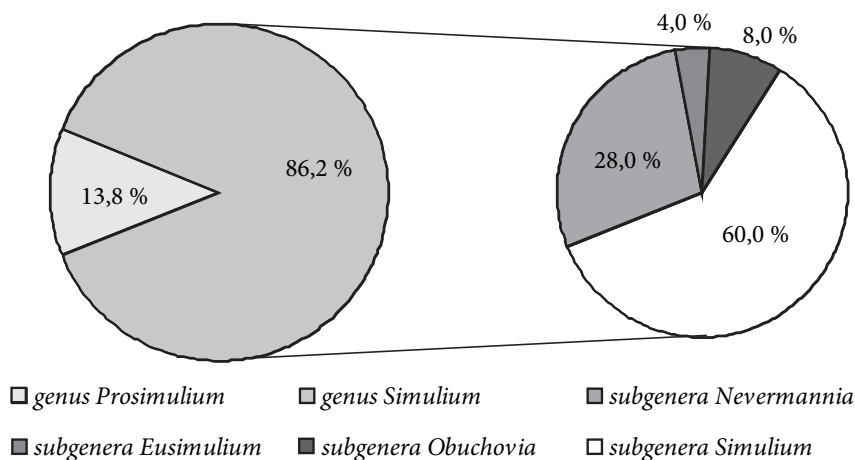


Fig. 1. Correlation of Simuliidae species developing in streams on the south-western macroslope of the Ukrainian Carpathians.

Table 1. Quantitative and qualitative characteristics of Simuliidae groups in hydrobiocoenoses on the south-western macroslope of the Ukrainian Carpathians

Species of blackflies	Streams	Rivers	ID, %	IE, %
<i>Prosimulium hirtipes</i> Fries, 1824	+	+	2.04	6.25
<i>P. latimucro</i> Enderlein, 1925	+	+	0.14	1.46
<i>P. petrosum</i> Rubtsov, 1955	-	+	0.02	1.25
<i>P. rufipes</i> Meigen, 1818	+	+	0.02	1.04
<i>P. tomosvaryi</i> Enderlein, 1921	+	+	0.23	3.54
<i>S. (Nevermannia) angustitarse</i> Lundström, 1911	+	+	0.23	1.46
<i>S. (N.) bertrandi</i> Grenier et Dorier, 1959	+	-	0.02	0.83
<i>S. (N.) brevidens</i> Rubtsov, 1956	+	+	3.41	6.46
<i>S. (N.) carthusiense</i> Grenier et Dorier, 1959	+	-	1.52	2.08
<i>S. (N.) codreanui</i> Serban, 1958	-	+	0.18	1.88
<i>S. (N.) cryophilum</i> Rubtsov, 1959	+	+	0.35	1.67
<i>S. (N.) lundstromi</i> Enderlein, 1921	+	-	0.41	1.25
<i>S. (N.) vernum</i> Macquart, 1826	+	-	0.30	2.92
<i>S. (Eusimulium) aureum</i> Fries, 1824	+	+	0.72	2.71
<i>S. (E.) velutinum</i> Santos Abreu, 1922	-	+	0.39	0.63
<i>S. (Wilhelmia) balcanicum</i> Enderlein, 1924	-	+	4.87	7.50
<i>S. (W.) equinum</i> Linnaeus, 1758	-	+	0.11	0.42
<i>S. (W.) lineatum</i> Meigen, 1804	-	+	0.74	4.17
<i>S. (W.) paraequinum</i> Puri, 1933	-	+	0.25	1.67
<i>S. (W.) pseudoequinum</i> Sequy, 1921	-	+	0.39	1.04
<i>S. (Obuchovia) auricoma</i> Meigen, 1818	+	+	0.82	3.13
<i>S. (O.) brevifile</i> Rubtsov, 1956	+	-	0.01	0.42
<i>S. (Simulium) argenteostriatum</i> Strobl, 1898	-	+	0.11	1.04
<i>S. (s. str.) argyreatum</i> Meigen, 1838	+	+	5.33	15.00
<i>S. (s. str.) baracorne</i> Smart, 1944	+	+	7.70	8.13
<i>S. (s. str.) bezzii</i> Corti, 1914	+	+	3.09	6.67
<i>S. (s. str.) fontanum</i> Terteryan, 1952	+	+	4.30	6.04
<i>S. (s.str.) frigidum</i> Rubtsov, 1940	+	+	2.30	4.38
<i>S. (s. str.) ibariense</i> Zivkovitch et Grenier, 1959	-	+	0.93	0.42
<i>S. (s. str.) intermedium</i> Roubaud, 1906	+	+	6.61	9.38
<i>S. (s. str.) kiritshenkoi</i> Rubtsov, 1940	+	+	1.97	3.96
<i>S. (s. str.) maximum</i> Knoz, 1961	+	+	1.60	8.96
<i>S. (s. str.) monticola</i> Friederichs, 1920	+	+	1.88	5.63
<i>S. (s. str.) murmanum</i> Enderlein, 1935	-	+	1.49	5.00
<i>S. (s. str.) noelleri</i> Friederichs, 1920	-	+	0.12	1.04
<i>S. (s. str.) ornatum</i> Meigen, 1818	+	+	10.88	24.38
<i>S. (s. str.) paramorsitans</i> Rubtsov, 1956	-	+	0.15	0.63
<i>S. (s. str.) reptans</i> Linnaeus, 1758	+	+	9.06	21.67
<i>S. (s. str.) rostratum</i> Lundström, 1911	-	+	0.01	0.21
<i>S. (s. str.) rotundatum</i> Rubtsov, 1940	+	+	3.20	1.46
<i>S. (s. str.) trifasciatum</i> Curtis, 1839	+	+	12.34	21.25
<i>S. (s. str.) tuberosum</i> Lundström, 1911	-	+	0.16	0.63
<i>S. (s. str.) variegatum</i> Meigen, 1818	+	+	4.98	11.88
<i>S. (s. str.) voilense</i> Serban, 1960	-	+	1.92	3.96
<i>S. (s. str.) vulgare</i> Dorogostaisky, Rubtsov et Vlasenko, 1935	+	+	2.70	3.75

+ — registered species.

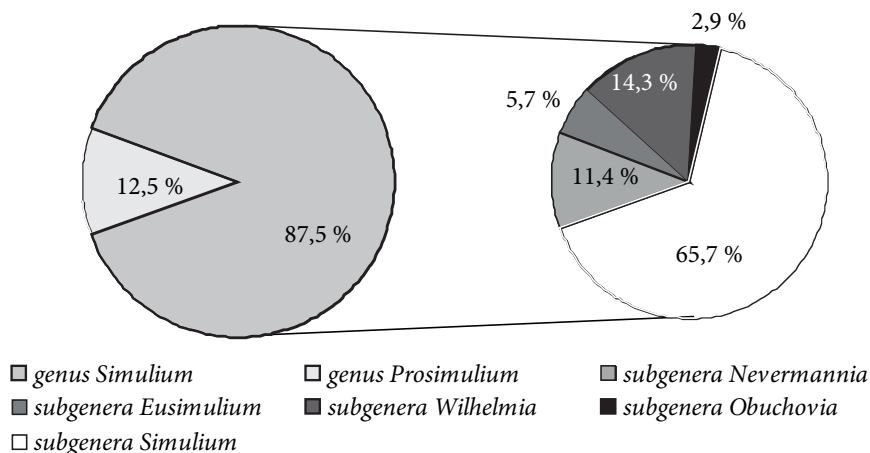


Fig. 2. Correlation Simuliidae species developing in rivers on the south-western macroslope of the Ukrainian Carpathians.

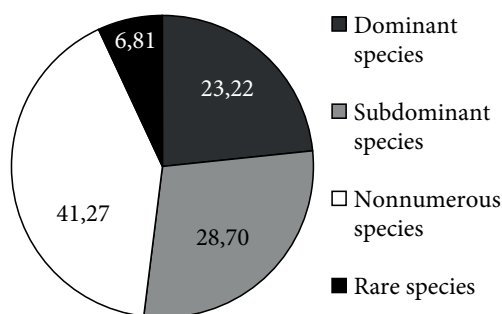


Fig. 3. Correlation of different groups of blackflies in hydrobiocoenoses on the south-western macroslope of the Ukrainian Carpathians.

Fifteen species are non-numerous and they give 41.27 % from the total number of collected larvae and pupae. The group of rare species turns out to be the most abundant (24 species) in species correlation, but the relative fraction of their members in the region hydrobiocoenosis is quite low (6.81 %). Some of them (*P. petrosum*, *P. rufipes*, *S. bertrandii*, *S. brevifile*, *S. rostratum*) are found in amounts of 2–5 flies in a sample.

According to the index of expansion four Simuliidae groups were distinguished: widespread (IE is over 20.00 %), spread (IE — 10.00–19.99 %), unexpanded (IE — 1.00–9.99 %) and locally spread (IE — up to and including 0.99 %) (table 1). Three species of blackflies, namely *S. ornatum*, *S. reptans* and *S. trifasciatum*, are widely spread in hydrobiocoenoses on the south-western macroslopes of the Ukrainian Carpathians. Two species *S. argyreatum* and *S. variegatum* are related to the spread group. The basis of Simuliidae fauna species diversity in the region (32 species) comprises members of the unexpanded group species (71.11 % from all registered species). The local distribution is characteristic for 8 blackfly species. The development of some species was found only in certain running-water habitats, in particular, *S. rostratum* was registered only in one water course (the River Tiachivets), *S. equinum* (the rivers Latorytsia and Zhdenivka), *S. brevifile* (streams Kyzy and Bredetsel) and *S. ibariense* (the rivers Trostenets and Chorna Tysa) respectively in two ones.

Despite the fact that the number of Simuliidae species registered in the rivers is for 11 species more than in the streams, Simpson's diversity index for this running-water habitat is smaller (I_s — 0.019). For the streams I_s is 0.090. It can be explained by the fact that the sizable amount of species (*P. rufipes*, *P. tomosvaryi*, *P. petrosum*, *S. cryophilum*, *S. auricoma*, *S. rostratum*) developing in the rivers, have very low abundance (1–3 individuals/dm²), while

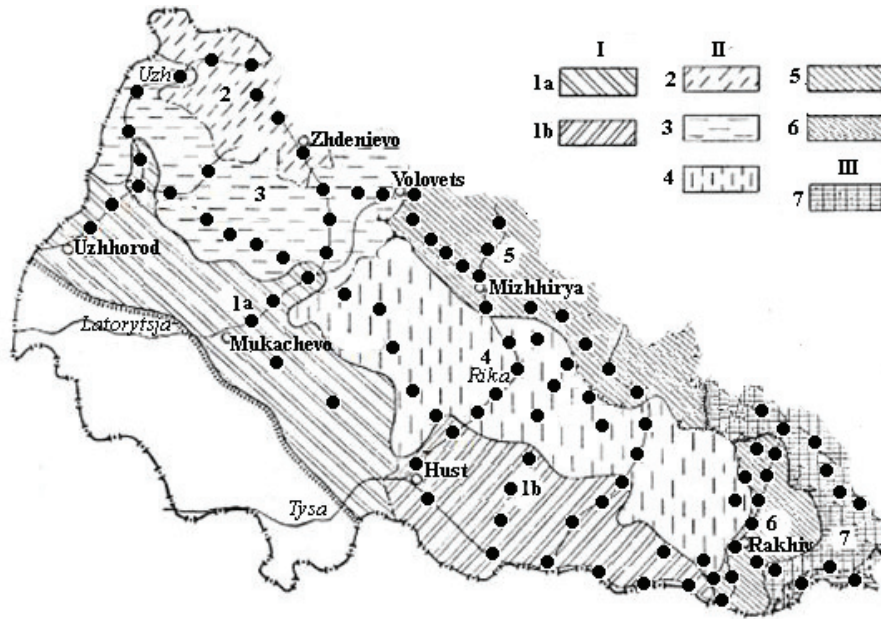


Fig. 4. Geobotanical subdivision of the Ukrainian Carpathians (Holubets, 2003). I — subdivision of oak-beech and oak submontane Transcarpathian forests (1): 1a — district of beech-oak and oak-beech submontane forests of the Volcanic Range, 1b — district of oak-beech and beech-oak forests of Marmaros basin; II — subdivision of beech Carpathian forests: 2 — district of fur-beech Verkhovuzhotski forests, 3 — district of hornbeam-beech and beech Dubrynychi-Svaliava forests, 4 — districts of the beech forests of southern megaslope of the Polonynian Beskyd, 5 — Mizhhirskiy (Intermountain) and 6 — Rakhiv subdistricts in the district of spruce-fir-beech, spruce-beech-fir and spruce-beech Transcarpathian forests; III — subdivision of spruce Carpathian mountain forests: 7 — subdistrict of the Upper Tysa beech-fir-spruce forests of the district of Chornohora-Marmaros forests. • — places of sample collection.

the total number of dominant (*S. ornatum*, *S. reptans*, *S. trifasciatum*) and subdominant (*S. balcanicum*, *S. argyreatum*) species comes up to 150–250 individuals/dm².

The south-western macroslope of the Ukrainian Carpathians is characterized by various vegetation types that in a certain way determine the faunal composition of blackflies in the particular areas as well as in the whole region. Each altitudinal belt is marked by its own Simuliidae species complex (fig. 4).

The subdivision of oak-beech and oak submontane Transcarpathian forests consolidates two districts where the species composition of blackflies has much in common. The Simuliidae richness of this subdivision is composed by 18 species of two genera (table 2). Mostly they are members of subgenus *Simulium* (two-thirds from all species abundance). The species of this subgenus predominate (69.62 %) in respect to the relative fraction of their blackflies numbers in the groupings. Among them *S. reptans*, *S. voilense* and *S. ornatum* develop massively here. Subgenus *Wilhelmia* was poor in species richness (16.7 %), but *S. balcanicum* dominated in population size (23.80 %) among blackflies. Subgenus *Eusimulium* was not numerous (2.95 %). Rare *P. petrosus* was found locally in the water courses. The abundant species *S. voilense* is developing only in the hydrobiocoenoses of this subdivision, *S. velutinum* and *S. tuberosum* were numerous and *S. rostratum* was rare.

The Simuliidae richness of fur-beech Verkhovuzhotski forests is formed by 16 species (table 2). The genus *Prosimulium* wasn't numerous, only 2 species were registered. The rest of species were from genus *Simulium*. Blackflies from subgenus *Simulium* are dominant here both in the abundance of species ($\frac{3}{4}$ from all species) and in the amount (96.7 %). Among them *S. ornatum*, *S. trifasciatum*, *S. baracorne*, *S. rotundatum* and *S. bezzii* were the most abundant. The species of subgenus *Nevermannia* are not common, they are found in the streams with the total amount of not more than 3–7 individuals per sample.

Table 2. Quantitative distribution of blackflies in the altitudinal vegetative groups of the south-western macroslope of the Ukrainian Carpathians

Species of blackflies	Natural altitude-zonal vegetation groups						
	1	2	3	4	5	6	7
<i>Prosimulium hirtipes</i>	–	2.12	5.85	–	2.18	–	–
<i>P. latimicro</i>	–	–	–	–	–	0.16	2.21
<i>P. petrosum</i>	0.13	–	–	–	0.02	–	–
<i>P. rufipes</i>	–	0.11	–	–	–	–	0.07
<i>P. tomosvaryi</i>	–	–	0.07	–	0.07	1.26	–
<i>S. (Nevermannia) angustitarse</i>	–	0.96	–	–	0.47	–	–
<i>S. (N.) bertrandi</i>	–	–	–	–	–	0.13	–
<i>S. (N.) brevidens</i>	–	0.11	8.82	–	0.25	5.71	10.29
<i>S. (N.) carthusiense</i>	–	–	–	–	–	9.07	2.35
<i>S. (N.) codreanui</i>	–	–	0.28	–	–	–	1.03
<i>S. (N.) cryophilum</i>	–	–	–	0.25	–	2.15	–
<i>S. (N.) lundstromi</i>	–	–	–	5.04	–	–	0.22
<i>S. (N.) vernum</i>	–	–	0.60	0.16	0.61	0.05	–
<i>S. (Eusimulium) aureum</i>	0.44	–	–	–	1.67	–	4.34
<i>S. (E.) velutinum</i>	2.51	–	–	–	–	–	–
<i>S. (Wilhelmia) balcanicum</i>	23.80	–	4.28	–	1.05	0.18	–
<i>S. (W.) equinum</i>	–	–	0.52	–	–	–	–
<i>S. (W.) lineatum</i>	2.09	–	0.06	1.56	1.16	–	–
<i>S. (W.) paraequinum</i>	1.41	–	0.15	–	–	–	–
<i>S. (W.) pseudoequinum</i>	–	–	1.79	–	–	–	0.15
<i>S. (Obuchovia) auricoma</i>	–	–	2.93	1.01	–	0.58	0.37
<i>S. (O.) brevifile</i>	–	–	–	–	–	0.08	–
<i>S. (Simulium) argenteostriatum</i>	–	–	–	–	–	0.73	–
<i>S. (s. str.) argyreatum</i>	1.26	1.31	1.07	13.11	9.26	6.92	8.60
<i>S. (s. str.) baracorne</i>	–	15.89	19.16	–	5.17	2.72	1.54
<i>S. (s. str.) bezzii</i>	–	10.26	–	3.58	3.29	5.29	0.22
<i>S. (s. str.) fontanum</i>	–	0.92	2.67	12.10	10.08	1.13	–
<i>S. (s. str.) frigidum</i>	–	1.20	–	–	8.15	1.00	0.07
<i>S. (s. str.) ibariense</i>	–	–	–	–	–	6.03	–
<i>S. (s. str.) intermedium</i>	2.14	0.28	2.79	21.23	9.18	14.33	12.21
<i>S. (s. str.) kiritshenkoi</i>	2.67	1.45	–	0.35	5.04	0.81	–
<i>S. (s. str.) maximum</i>	2.90	1.27	0.77	–	–	4.35	3.31
<i>S. (s. str.) monticola</i>	–	–	5.64	–	–	3.62	3.09
<i>S. (s. str.) murmanum</i>	7.27	–	–	–	0.82	1.13	–
<i>S. (s. str.) noelleri</i>	–	–	–	0.16	–	0.73	–
<i>S. (s. str.) ornatum</i>	10.49	23.60	8.64	7.11	12.47	4.58	14.34
<i>S. (s. str.) paramorsitans</i>	–	–	–	–	0.61	–	–
<i>S. (s. str.) reptans</i>	22.44	–	0.88	9.23	13.58	3.46	14.85
<i>S. (s. str.) rostratum</i>	0.05	–	–	–	–	–	–
<i>S. (s. str.) rotundatum</i>	–	15.36	–	–	–	9.49	–
<i>S. (s. str.) trifasciatum</i>	4.89	20.45	18.84	13.97	10.75	5.50	10.96
<i>S. (s. str.) tuberosum</i>	1.07	–	–	–	–	–	–
<i>S. (s. str.) variegatum</i>	1.99	4.71	2.06	11.14	4.12	8.73	8.38
<i>S. (s. str.) voilense</i>	12.45	–	–	–	–	–	–
<i>S. (s. str.) vulgare</i>	–	–	12.13	–	–	0.08	1.40

Note. The numeration of altitudinal vegetative groups corresponds to that one given in fig. 4.

The species composition of blackflies in the district of hornbeam-beech and beech Dubrynichi-Svaliava forests is represented by 22 species of two genera (table 2). The members of subgenus *Simulium* make up the half the abundance of species (50.0 %) and are dominant in number (74.65 %) in the hydrobiocoenoses. Among them *S. baracorne*, *S. trifasciatum* and *S. vulgare* develop massively. All five species of the subgenus *Wilhelmia* (22.7 % of the abundance of species) have been registered in this district and all of them were recorded before as a characteristic of the south-western macroslope of the Ukrainian Carpathians, although the greater part of them is rare. We should mention *S. brevidens* and *P. hirtipes* as subdominant species. A rare species *S. equinum* develops only in the district hydrobiocoenosis.

Despite the large area and dense hydrologic network in the district of the beech forests of southern megaslopes of the Polonynian Beskyd, only 15 species of blackflies from genus *Simulium* have been registered here (table 2). Two-thirds of species abundance is formed by the members of subgenus *Simulium* that occupy a dominant position in the groupings (91.98 %). Among them *S. intermedium*, *S. trifasciatum*, *S. argyreatum*, *S. fontanum*, and *S. variegatum* are abundant. Other species are represented by 1 (*Wilhelmia*, *Obuchovia*) or 3 (*Nevermannia*) species, the abundance of which is small in water courses of the district.

The district of spruce-fir-beech, spruce-beech-fir and spruce-beech Transcarpathian forests comprises 2 subdistricts: Mizhhirskiy and Rakhiv. The Simuliidae richness of the Mizhhirskiy subdistrict contains 22 species here (table 2). The genus *Prosimulium* was represented only by *P. hirtipes*, individuals of which are not numerous in the groupings of blackflies water stages. Over half (59.1 %) the species richness include representatives of the subgenus *Simulium* dominating in hydrobiocoenoses (92.52 %). Among them *S. reptans*, *S. ornatum*, *S. trifasciatum* and *S. fontanum* develop massively. The species of subgenera *Eusimulium* and *Wilhelmia* are not numerous, and *Nevermannia* is rare. The rare species *S. paramorsitans* is registered only in the Mizhhirskiy subdistrict hydrobiocoenoses.

Twenty-nine species of Simuliidae were recorded in the Rakhiv subdistrict (table 2). The genus *Prosimulium* was represented by two species, all the rest belong to genus *Simulium*. Representatives of subgenus *Simulium* form the basis of species diversity (65.5 %) and take a dominant position as to their abundance (80.63 %). *S. intermedium* is dominant. From 5 species of subgenus *Nevermannia* registered here *S. carthusiense* and *S. brevidens* are numerous. In streams you can find single representatives (1–3 blackflies/dm²) of two rare species of subgenus *Obuchovia*. The abundant species *S. ibariense* is registered only in the Rakhiv subdistrict hydrobiocoenoses as well as rare *S. argenteostriatum*, *S. bertrandi* and *S. brevifile*.

The species composition of blackflies in the subdivision of spruce Carpathian mountain forests is represented by 21 species (table 2). 2 species have been registered from genus *Prosimulium*, and the rest belong to genus *Simulium*. Representatives of subgenus *Simulium* are also dominant here in species ratio (57.1 %) and in numerical ratio (78.97 %). Among them *S. reptans*, *S. ornatum*, *S. intermedium* and *S. trifasciatum* are abundant. The subgenera *Wilhelmia* and *Obuchovia* have been registered only in the amount of one rare species that occur in number of only 2–4 blackflies per a sample. The subgenus *Nevermannia* is represented by 4 species, the abundant of which is *S. brevidens*.

In the hydrobiocoenoses of all main vertical zonal vegetative groups of the south-western macroslope of the Ukrainian Carpathians the following species develop such as *S. argyreatum*, *S. intermedium*, *S. ornatum*, *S. trifasciatum* and *S. variegatum*, they can be referred to common eurytopic species, which have a sufficient ecological flexibility and are found in various types of waterways.

Bray-Curtis's cluster analysis showed the greatest similarity between the species composition of blackflies developing in the hydrobiocoenoses of the district of fur-beech Verkhovuzhotski forests and Mizhhirskiy subdistrict of the district of spruce-fir-beech, spruce-beech-fir and spruce-beech Transcarpathian forests, subdivision of beech Carpathian forests (fig. 5). They have in common 13 Simuliidae species from the 25 registered. The Simuliidae richness of Rakhiv subdistrict (the district of spruce-fir-beech,

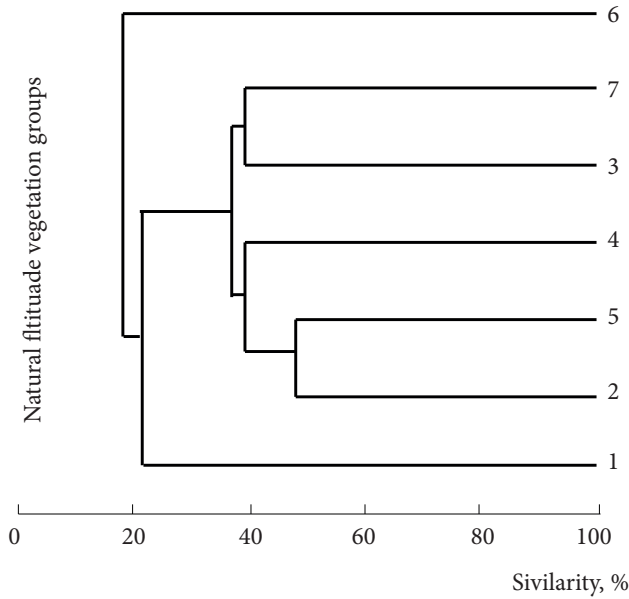


Fig. 5. Cluster analysis of similarity of blackflies species composition in altitudinal vegetation groupings on the south-western macroslope of the Ukrainian Carpathians. (The numeration of altitudinal vegetative groups corresponds to that one given in fig. 4).

spruce-beech-fir and spruce-beech Transcarpathian forests) is the largest as to the species composition, in our opinion, it is caused by the comparatively warmer, milder and wetter climate and significant differences in the temperature range of various water ways.

According to Simpson's index the greatest species diversity (I_s is 0.160 in the district of fur-beech Verkhovuzhotski forests, subdivision of beech Carpathian forests) is peculiar for the Simuliidae complexes of altitudinal vegetation groupings in the north-eastern part of the south-western macroslope of the Ukrainian Carpathians (fig. 6). The value of this index is decreasing southwards (up to 0.071 in Rakhiv subdisrict, the district of spruce-fir-beech, spruce-beech-fir and spruce-beech Transcarpathian forests, subdivision of beech Carpathian forests). Despite the fact that the number of blackflies species is greater in the biotopes, but the species abundance in most of them is quite low while the total amount of blackflies in abundant species is often two-order bigger than in rare species.

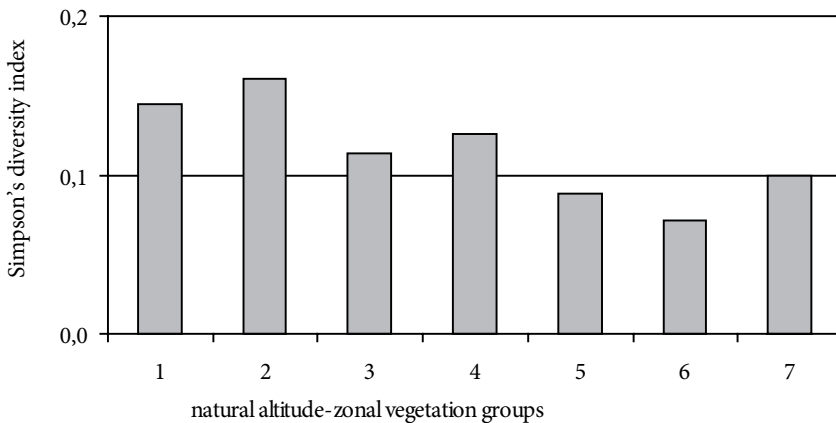


Fig. 6. Species diversity of blackflies (according to Simpson's index) on the south-western macroslope of the Ukrainian Carpathians. (The numeration of altitudinal vegetative groups corresponds to that one given in fig. 4.)

In general, the Simuliidae richness in the subdivision of beech Carpathian forests (the south-western macroslope of the Ukrainian Carpathians) makes up the greatest figure of species (41 species) (table 2). It is due to existence of biotopes that are diverse in hydro physical conditions. The species abundance of blackflies in the two other subdivisions is much poorer: 21 species are registered for the subdivision of spruce mountain Carpathian forests and 18 species are in the subdivision of oak-beech and oak submontane Transcarpathian forests.

Conclusions

Forty-five Simuliidae species from two genera develop in hydrobiocoenoses on the south-western macroslope of the Ukrainian Carpathians. The species diversity of blackflies is made up of 40 species in the rivers ($I_s = 0.019$), and in the streams correspondingly by 29 species ($I_s = 0.090$). Species *S. trifasciatum* and *S. ornatum* are abundant in the water-running habitats. Species *S. ornatum*, *S. reptans* and *S. trifasciatum* are highly prevalent. Species *S. argyreatum*, *S. intermedium*, *S. ornatum*, *S. trifasciatum* and *S. variegatum* develop in the waterways of all main altitudinal vegetation groupings. The highest Simuliidae richness (29 species) was found in Rakhiv subdistrict, the district of spruce-fir-beech, spruce-beech-fir and spruce-beech Transcarpathian forests, and the least abundant one (15 species) is in the beech forests of southern megaslope of the Polonynian Beskyd, subdivision of beech Carpathian forests.

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