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Heteroptera (Insecta: Hemiptera) of the peat bogs of Belarusian Lakeland

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Abstract: The first overview on the Heteroptera of peat bogs of the Belarusian Lakeland is presented. Five natural oligotrophic peat bogs were studied in 2012–2014 by entomological sweep-net. A total of almost 2,612 true bugs were sampled, representing 83 species of 13 families. Ten species (12.11–36.72% of the individuals) were tyrphobiontic or tyrphophilous. The five most abundant species represented 71.39–82.30% of the individuals. The most common species were *Stictopleurus crassicornis* (14.56–59.63%) and *Stephanitis oberti* (10.25–36.21%). The number of individuals of adult Heteroptera in peat bogs was low in spring and high in July-August. The natural peat bog offered favorable conditions to phytophagous (72.29%) polyphagous (60.00%) true bugs species. The most preferred host plants were ericales shrubs.

Key words: Heteroptera; peat bogs; tyrphobiont; tyrphophil; ecological groups; Belarusian Lakeland

Introduction

Bogs are peatlands with a high water table and low levels of nutrients (oligotrophic); they are always acidic and are dominated by *Sphagnum* mosses. The classification of peatland habitats (mires) differs somewhat in Europe and North America, but the distinctive character of peatlands has been well recognized in both places (Spitzer & Danks 2006).

In Europe a large number of natural peatlands can be found in northern part of the continent, but they are among the most threatened habitats and very rare in Central Europe. Belarus, located in the geographic centre of Europe, is one of Europe's key peatland countries. Before drainage and peat extraction started, peatlands covered 29,390 km^2, equal to 14 percent of the country's total land area (Bambalov & Rakovich 2005; Joosten et al. 2012).

Abiotic factors that influence the life of animals close to the ground in a peat bog are, amongst others, a pronounced amplitude of daily temperatures because of direct insolations and very low pH values as a result of the cation exchange capacity of the peat moss. Owing to these conditions peat bogs are inhabited by a specialized fauna, called tyrphobionts (Spitzer & Danks 2006).

Heteroptera are among the most abundant animal groups in peatlands. Unfortunately, knowledge of their species composition in peat bogs is sparse. Very few papers so far have been dedicated to the true bugs of peat bogs (Peus 1928; Maavara 1957; Rampazzi & Dethier 1997; Montagna et al. 2008; Spungis 2008; Friess & Korn 2013; Frieß et al. 2013).

The aim of the current work was to investigate the ecological groups and species composition of the true bugs of natural peat bogs in Belarus.

Material and methods

Study area

The study sites are located in the north of Belarus. They are shown in Fig. 1 and characterized in Tables 1 and 2. Five typical oligotrophic peat bog sites of the Belarusian Lakeland were studied in 2012–2014.

Heteroptera sampling

Heteroptera relative abundances were estimated by using a transect method. All study plots were placed in loops, and within a band of 1 m (total observed area per plot: 250 m^2). Surveys were conducted during the main activity period of adult true bugs between April and October. For the collection of true bugs entomological sweep-net (diameter 30 cm) was used. One sample consisted of five subsamples. Each consisted of 50 net sweeps. Subsamples were taken in different habitats on five parallels in between lines. Catches were studied during the vegetation period. The periodicity of sampling was usually two weeks.

The nomenclature of Heteroptera follows Aukema & Rieger (1995–2006). The food plants, diet width and ecological types follow Puchkov (1962–1986) and the Database of Insects and their Food Plants (https://www.brc.ac.uk/DBIF/).

The ecological terminology is that of Spitzer & Danks (2006): tyrphobiontic species are stenotopic and obligatory associated with peat bogs in the temperate zone, tyrphophilous taxa are more abundant in bogs than in adjacent habitats, and tyrphoneutral species are eurytopic and widely distributed in various habitats. Habitat preferences of heteropterans referred to Puchkov (1962–1986) and Sushko & Lukashuk (2011).

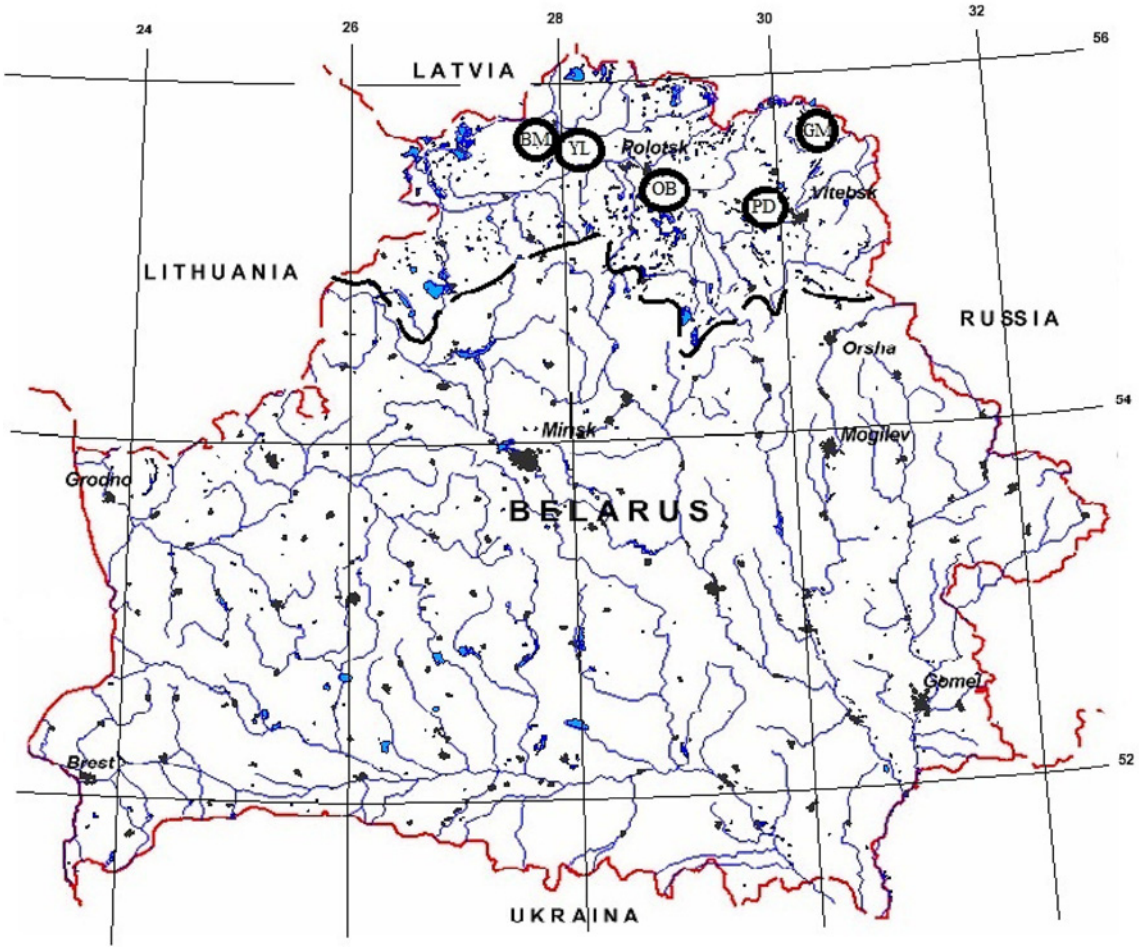

Fig. 1. Location of the sampling sites in the Belarusian Lakeland (Northern Belarus). Samling sites: YL – Yelnia, OB – Obol, BM – Boloto Moh, PD – Pridvinie, GM – Glodanski Moh.

Table 1. Study sites, coordinates and site descriptions.

Code	Site name	Coordinates	Area (ha)	Site description
YL	Yelnia	55°33′5″N 27°50′57″E	19984	oligotrophic peat bog of national importance
OB	Obol	55°27′12″N 29°22′36″E	4900	oligotrophic peat bog of national importance
BM	BolotoMoh	55°38′2″N 27°29′29″E	4602	oligotrophic peat bog of national importance
PD	Pridvinie	55°10′19″N 29°57′59″E	0.5	oligotrophic peat bog
GM	Glodanski Moh	55°17′5″N 30°48′9″E	2180	oligotrophic peat bog, partially drained

Results

In total 83 true bugs species belonging to 13 families were sampled (Table 3). Miridae were represented by 22 species, 17 Pentatomidae species were recorded. Lygaeidae were represented by 15 species. Other families included even smaller numbers of species: Nabidae – 6, Rhopalidae – 6, Reduviidae – 4, Acanthasomatidae – 3, Saldidae – 2, Scutelleridae – 2, Tingidae – 3, Aradidae – 1, Berytidae – 1 and Coreidae – 1.

The five most abundant species (*Stephanitis oberti, Lygus pratensis, Stictopleurus crassicornis, Kleidocerys resedae, Cymus grandicolor*) represented 71.39–82.30% of the individuals. The most common species were *Stictopleurus crassicornis* (14.56–59.63%) and *Stephanitis oberti* (10.25–36.21%) (Table 4).

Ten species (12.11–36.72% of the individuals) were tyrphobiontic or tyrphophilous (Table 4). Majority of specialized species were rare. Their relative abundances in different bogs were less than 1%, excluding *Globiceps*

Table 2. Vegetation and management of the study sites.

Code	Site name	Vegetation	Site management
YL	Yelnia	Patchy mixture of *Eriophorum vaginatum* L., 1753 – *Sphagnum angustifolium* (C.E.O. Jensen, 1896), *Rhynchospora alba* (L.) Vahl (1805) – *Andromeda polifolia* (L., 1753)– *Sphagnum cuspidatum* Ehrhart ex G.F. Hoffmann, 1796, *Pinus sylvestris* L., 1753– *Eriophorum vaginatum* – *Ledum palustre* (L., 1753) – *Oxycoccus palustris* (Persoon, 1805) – *Chamaedaphne calyculata* (L.) Moench, 1794 – *Empetrum nigrum* L., 1753 – *Vaccinium uliginosum* L., 1753 – *Sphagnum magellanicum* Bridel, 1798, *Eriophorum vaginatum* – *Calluna vulgaris* (L.) Hull, 1808 – *Sphagnum fuscum* Klinggräff, 1872	no management
OB	Obol	Patchy mixture of *Eriophorum vaginatum* – *Sphagnum angustifolium, Rhynchospora alba* – *Andromeda polifolia* – *Sphagnum cuspidatum, Pinus sylvestris* – *Eriophorum vaginatum* – *Ledum palustre* – *Oxycoccus palustris* – *Chamaedaphne calyculata* – *Empetrum nigrum* – *Vaccinium uliginosum* – *Sphagnum magellanicum, Eriophorum vaginatum* – *Calluna vulgaris* – *Sphagnum fuscum*	no management
BM	Boloto Moh	Patchy mixture of *Eriophorum vaginatum* – *Sphagnum angustifolium, Rhynchospora alba* – *Andromeda polifolia* – *Sphagnum cuspidatum, Pinus sylvestris* – *Eriophorum vaginatum* – *Ledum palustre* – *Oxycoccus palustris* – *Chamaedaphne calyculata* – *Empetrum nigrum* – *Vaccinium uliginosum* – *Sphagnum magellanicum, Eriophorum vaginatum* – *Calluna vulgaris* – *Sphagnum fuscum*	no management
PD	Pridvinie	Patchy mixture of *Eriophorum vaginatum* – *Rhynchospora alba* – *Andromeda polifolia* – *Sphagnum cuspidatum, Pinus sylvestris* – *Eriophorum vaginatum* – *Ledum palustre* – *Oxycoccus palustris* – *Chamaedaphne calyculata* – *Empetrum nigrum* – *Vaccinium uliginosum*– *Sphagnum magellanicum*	no management
GM	Glodanski Moh	Patchy mixture of *Eriophorum vaginatum* – *Sphagnum angustifolium, Pinus sylvestris* – *Eriophorum vaginatum* – *Ledum palustre* – *Oxycoccus palustris* – *Chamaedaphne calyculata* – *Vaccinium uliginosum* – *Sphagnum magellanicum, Eriophorum vaginatum* – *Calluna vulgaris* – *Sphagnum fuscum*	parts of the peat bog formerly used for peat ditching; no management today

Table 3. Overview on Heteroptera collected in five peat bogs in the Belarusian Lakeland.

	YL	OB	BM	PD	GM	Total
Total number of adult specimens	474	707	686	423	322	2612
Total number of species	36	35	50	40	23	83
Total number of families	9	10	12	9	7	13
Number of tyrphobiontic and tyrphophilous individuals	152	266	148	102	39	707
Number of tyrphobiontic and tyrphophilous species	8	5	7	4	5	10
Percentage of peat bog specialists (individuals)	32.06	37.62	21.57	24.11	12.11	27.06
Percentage of peat bog specialists (species)	22.22	14.28	14.00	10.00	21.73	12.04

Explanations: YL – Yelnia, OB – Obol, BM – Boloto Moh, PD – Pridvinie, GM – Glodanski Moh.

salicicola. Only *Stephanitis oberti* had a high abundance in all studied sites (Table 4).

Twelve species could be found in all sites, among them two peat bog specialists (*Stephanitis oberti* and *Globiceps salicicola*). Thirty one species (37.34% of the total number of species) were recorded only in one site.

The numbers of individuals of adult Heteroptera in peat bogs were low in spring, increased in the second half of summer (July and August) and slowly decreased afterwards (Fig. 2).

As the first, in April–May, *Dolycoris baccarum, Stenodema calcarata, Lygus pratensis, Nabis ferus, Stictopleurus crassicornis, Aelia acuminata, Eurydema oleracea* and *Cymus grandicolor* were found. In the first half of summer (primarily in June) only *Kleitocerys resedae* occurred in a high number. In the second half of summer *Stephanitis oberti* and *Cymus grandicolor* were the most active species.

Among the true bugs phytophagous species prevailed in raised bogs (72.29%). The proportions of zoophagous (24.10%) and phyto-zoophagous (3.61%) species were lower (Fig. 3).

Polyphagous species (60.00%) dominated in all sites (Fig. 4). These were such species as *Lygus pratensis, Kleidocerys resedae, Rhyparochromus pini, Stictopleurus crassicornis, Dolycoris baccarum* and others. *Stenodema calcarata, Stephanitis oberti* and *Cymus grandicolor* (35.00%) were ranked among oligophagous species. Monophagous species (5.00%) comprised only *Orthotylus ericetorum* and *Chlorochroa pinicola*.

The majority of the Heteroptera species were feeding on ericales shrubs (27 species) (Fig. 5). The peat bog specialists (*Stephanitis oberti, Orthotylus ericetorum* and *Nysius helveticus*) were among them. The most preferable host plant was *Calluna vulgaris* (13 species). The most abundant polyphagous species *Stictopleurus*

Table 4. Heteroptera species of peat bogs in the Belarusian Lakeland.

Families/Species	Relative abundances (%)				
	YL	OB	BM	PD	GM
Saldidae					
Chartoscirta elegantula (Fallén, 1807)			0.24		
Saldula fucicola (J. Sahlberg, 1870)		0.15			
Tingidae					
Agramma femorale (Thomson, 1871)	0.84	0.29			
A. tropidopterum (Flor, 1860)*	0.21			0.14	
Stephanitis oberti (Kolenati, 1857)*	26.79	19.83	23.17	36.21	10.25
Miridae					
Deraeocoris scutellaris (F., 1794)				0.14	
Stethoconus cyrtopeltis (Flor, 1860)*	0.21		0.24		
Adelphocoris lineolatus (Goeze, 1778)			0.24		
A. quadripunctatus (F., 1794)			0.24		
Closterotomus fulvomaculatus (De Geer, 1773)			0.24		
Lygus pratensis (L., 1758)	7.38	3.79	12.77	1.56	8.07
L. punctatus (Zetterstedt, 1838)		0.15			
L. rugulipennis Poppius, 1911	0.84	0.87	1.18	0.57	0.93
Phytocoris pini (Kirschbaum, 1856)	0.21				
Stenotus binotatus (F., 1794)				0.14	
Leptopterna dolabrata (L., 1758)	0.21				
Megaloceroea recticornis (Geoffroy, 1785)			0.24		
Notostira erratica (L., 1758)		0.15			
N. elongata (Geoffroy, 1785)	0.21				
Stenodema calcarata (Fallén, 1807)	0.84	0.29	1.42	0.42	0.62
S. holsata (F., 1787)					0.62
S. laevigata (L., 1758)		0.15	0.24		0.62
S. trispinosa Reuter, 1904					0.31
Globiceps salicicola (Reuter, 1880)**	2.53	0.44	0.47	0.99	0.31
Orthotylus ericetorum (Fallén, 1807)*	1.05	0.15		0.14	0.31
Amblytylus nasutus (Kirschbaum, 1856)				0.14	
Psallus betuleti (Fallén, 1826)		0.15			
Nabidae					
Nabis brevis (Scholz, 1847)		0.15	0.24		
N. ericetorum (Scholtz, 1847)*	0.84	0.44			
N. ferus (L., 1758)	2.95	1.60	6.15	2.40	1.86
N. flavomarginatus (Scholtz, 1847)	0.21				
N. limbatus (Dahlbom, 1851)		0.29			
N. pseudoferus Remane, 1949	0.21		0.24		
Reduviidae					
Phymata crassipes (F., 1775)			0.47		
Coranus woodroffei P.V. Putshkov, 1982**	0.21	0.15			0.62
Coranus aethiops Jakovlev, 1893		0.15		0.14	
Rhynocoris annulatus (L., 1758)			0.24		
Aradus cinnamomeus (Panzer, 1806)		0.15		0.14	
Lygaeidae					
Nithecus jacobaeae (Schilling, 1829)				0.14	
Nysius helveticus (Herrich-Schaffer, 1850)*	0.21	0.29			
Nysius thymi (Wolff, 1804)				0,14	
Kleidocerys resedae (Panzer, 1797)	10.97	13.99	2.60	8.06	3.11
Cymus aurescens (Distant, 1883)			0.24		0.31
C. grandicolor (Hahn, 1832)	15.40	17.64	11.58	12.45	1.24
Eremocoris plebejus (Fallén, 1807)			0.24		
Scolopostethus decoratus (Hahn, 1833)	0.42	1.75	0.24	0.14	
S. pilosus (Reuter, 1875)	0.21				
Macrodema microptera (Curtis, 1836)		0.15			
Peritrechus nubilus (Fallén, 1807)				0.14	
Pterotmetus staphyliniformis (Schilling, 1829)	0.84	0.29		0.14	
Pachybrachius luridus (Hahn, 1826)		0.15		0.28	
Rhyparochromus pini (L., 1758)	2.32	3.06	1.65	2.12	1.55
Ligyrocoris sylvestris (L., 1758)	0.42	0.29			
Berytidae					
Neides tipularius (L., 1758)		0.15			
Rhopalidae					
Corizus hyoscyami (L., 1758)			0.24		
Rhopalus maculatus (Fieber, 1837)	0.21	0.15		0.28	1.24
R. parumpunctatus (Schilling, 1829)	0.42			0.42	2.48
Stictopleurus abutilon (Rossi, 1790)		0.29			
S. crassicornis (L., 1758)	14.56	22.45	21.28	23.62	59.63
S. punctatonervosus (Goeze, 1778)			0.24		0.31

Table 4. (continued)

Families/Species	Relative abundances (%)				
	YL	OB	BM	PD	GM
Coreidae					
Coreus marginatus (L., 1758)		0.15			
Acanthasomatidae					
Elasmostethus interstinctus (L., 1758)				0.14	
Elasmucha ferrugata (F., 1787)	0.42	0.87		0.42	
Elasmucha grisea (L., 1758)	0.42	0.58			
Scutelleridae					
Eurygaster maura (L., 1758)			0.47		
Eurygaster testudinarius (Geoffroy, 1785)	1.48	1.31	0.47	0.42	
Pentatomidae					
Arma custos (F., 1794)		0.29	0.24	0.28	
Jalla dumosa (L., 1758)*		0.29	0.24	0.14	
Picromerus bidens (L., 1758)	0.84	0.15	0.47	0.28	
Rhacognatus punctatus (L., 1758)		0.15			1.24
Aelia acuminata (L., 1758)	1.48	1.60	4.26	5.09	2.17
Neottiglossa pusilla (Gmelin, 1789)				0.14	
Antheminia aliena (Reuter, 1891)*					0.62
Carpocoris fuscispinus (Boheman, 1849)		0.15			
C. purpureipennis (De Geer, 1773)		0.15	0.24		
Chlorochroa pinicola (Mulsant et Rey, 1852)	0.42	0.44	0.47	0.14	
Dolycoris baccarum (L., 1758)	2.74	2.48	4.02	1.84	1.55
Holcostethus vernalis (Wolff, 1804)		0.15	0.71		
Palomena prasina (L., 1761)		0.58	0.47		
P. viridissima (Poda, 1761)		0.29			
Piezodorus lituratus (F., 1794)		0.15	0.47		
Sciocoris umbrinus (Wolff, 1804)			0.24		
Eurydema oleraceŕ (L., 1758)	0.42	0.29	0.95		

Explanations: YL – Yelnia, OB – Obol, BM – Boloto Moh, PD – Pridvinie, GM – Glodanski Moh. **tyrphobionts, * tyrphophils.

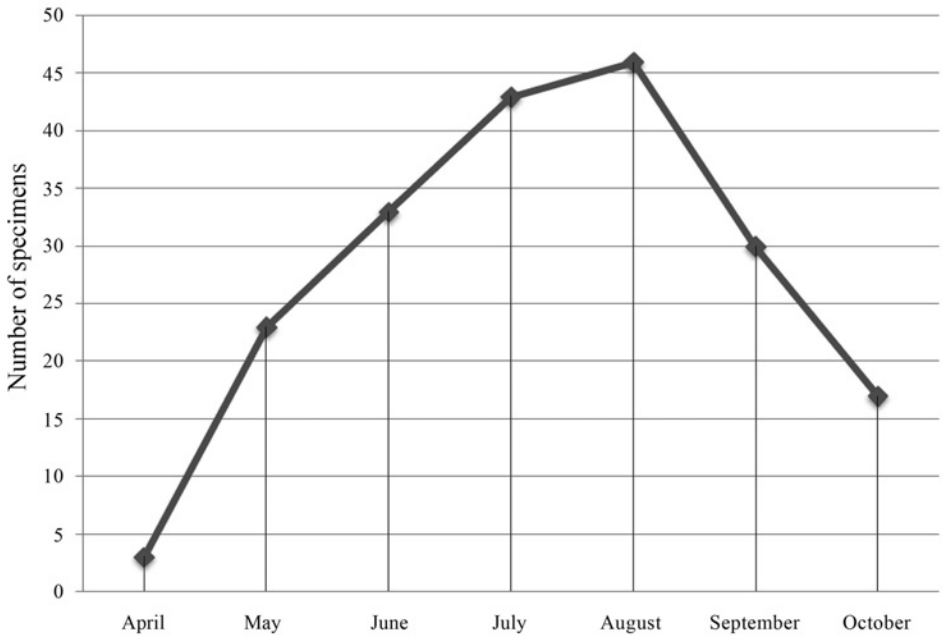

Fig. 2. Seasonal mean numbers of Heteroptera specimens in the peat bogs of the Belarusian Lakeland.

crassicornis in the peat bogs occurred most often on Labrador tea and on blueberry. On the other hand, in this study the tyrphophil *Stephanitis oberti* preferred *Vaccinium* spp., *Ledum palustre* and *Chamaedaphne calyculata*.

Discussion

The number of collected Heteroptera species was not very high. In total, 83 species were recorded in Belarusian peat bogs. It is only about 18.5% of all true bugs

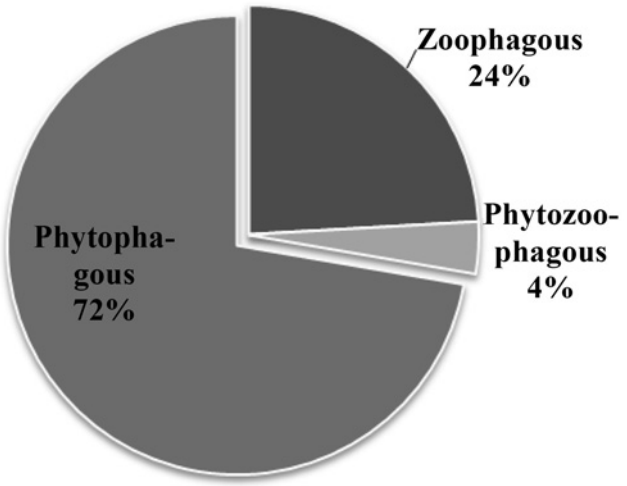

Fig. 3. Functional group composition of Heteroptera species in the peat bogs of the Belarusian Lakeland.

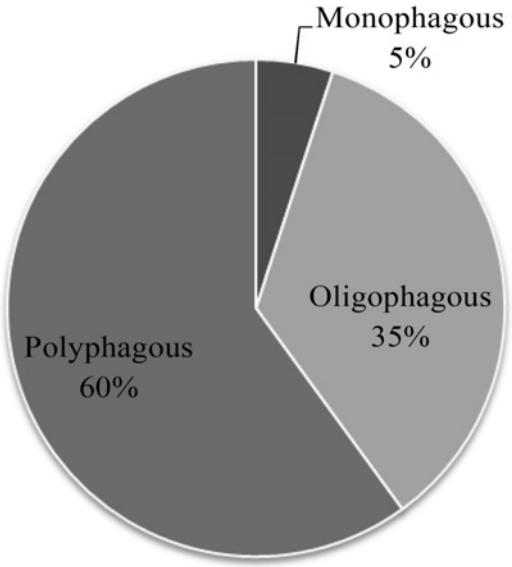

Fig. 4. The dietwidth of Heteroptera species in the peat bogs of the Belarusian Lakeland.

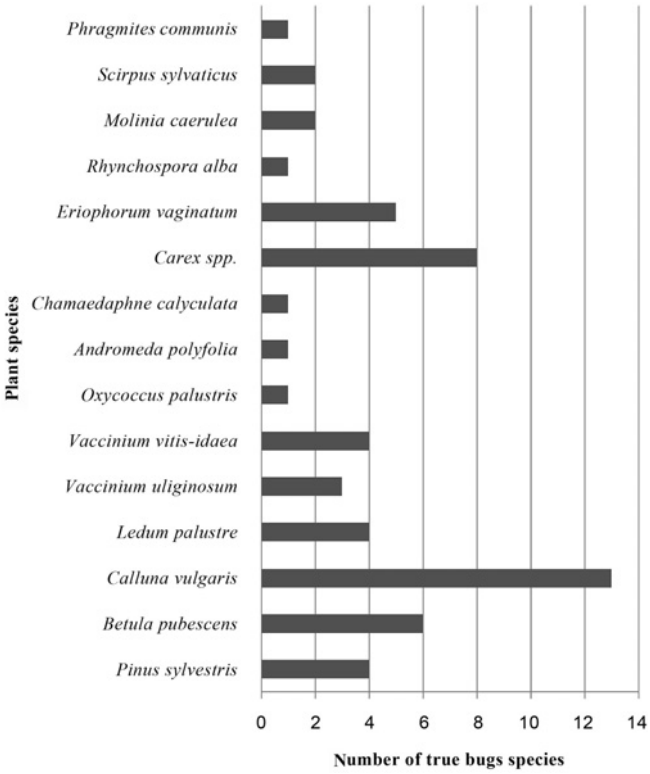

Fig. 5. The hostplants of Heteroptera species in the peat bogs of Belarusian Lakeland

species known in this country (Lukashuk 1997). Raised bogs are known as extreme habitats for plants and certain groups of animals (Främbs et al. 2002; Spitzer & Danks 2006; Dapkus & Tamutis 2008).

Ten recorded true bug species (12.11–36.72% of the individuals) are peat bog specialists. Among them *Coranus woodroffei* and *Orthotylus ericetorum* are tyrphobiontic species. They are obligatorily associated with peat bogs in Belarus.

Most species in this study were recorded in low numbers. A few abundant species were dominating. That is typical for peat bogs in other European countries as well (Peus 1928; Maavara 1955; Rampazzi & Dethier 1997; Montagna et al. 2008; Spungis 2008; Friess & Korn 2012). Among them were the tyrphophilous *Stephanitis oberti* and the tyrphoneutral *Lygus pratensis, Stictopleurus crassicornis, Kleidocerys resedae* and *Cymus grandicolor. Lygus pratensis* in Belarus is an eurytopic polyphagous species (Sushko & Lukashuk 2011). In this study, it constantly occurred in the sites with *Calluna vulgaris* and other ericaceous shrubs.The species is also known from the peat bogs of Germany (Peus 1928), Estonia (Maavara 1955), Latvia (Spungis 2008) and Austria (Friess & Korn 2012).

Kleidocerys resedae is common in moist or even wet meadows and mires (Sushko & Lukashuk 2011). In the peat bogs, adults were abundant on *Eriophorum vaginatum, Rhynchospora alba* and *Carex* sp. The species was also recorded from peat bogs of Germany (Peus 1928), Estonia (Maavara 1955), Latvia (Spungis 2008) and Austria (Friess & Korn 2012).

Cymus grandicolor is common in mires, wet meadows and forests (Sushko & Lukashuk 2011). In the studied peat bogs, adults were abundant on *Carex* sp. The species was also recorded from peat bogs of Germany (Peus 1928), Estonia (Maavara 1955), Latvia (Spungis 2008) and Austria (Friess & Korn 2012).

Stictopleurus crassicornis in Belarus inhabits meadows, heath and raised bogs (Sushko & Lukashuk 2011). In this study, this polyphagous species was recorded predominantly on *Calluna vulgaris* and *Ledum palustre.* The species is also known from peat bogs of Germany (Peus 1928), Estonia (Maavara 1955), Latvia (Spungis 2008) and Austria (Friess & Korn 2012).

Among the specialized peat bog species, only *Stephanitis oberti* was recorded in high numbers. This tyrphophilous species was mainly recorded in peat bogs, but also occurred in adjacent habitats with ericales

dwarf shrubs. *Stephanitis oberti* feeds on*Ledum palustre, Vaccinium spp.* and *Calluna vulgaris* (Sushko & Lukashuk 2011). The species is known from peat bogs of Germany (Peus 1928), Estonia (Maavara 1955), Latvia (Spungis 2008) and Austria (Friess & Korn 2012).

In conclusion, the natural peat bogs of the Belarusian Lakeland offer favorable conditions to phytophagous species. The most preferred host plants are ericales shrubs. The number of individuals of adult Heteroptera in the peat bogs was low in spring and high in July – August. That is typical of peat bogs in Estonia and Latvia as well (Maavara 1957; Spungis 2008).

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