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Beetles (Coleoptera) of Raised Bogs in North-Western Belarus (Belarusian Land O'Lakes)

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The article deals with the comparison of Coleoptera of peatlands of Belarusian Land O˙Lakes (the area of Wurm glaciation). The research was carried out in 17 peat bogs during 1997-2006. 245 Coleoptera species were recorded in the natural raised bog. 209 species at meliorated bogs were recorded as well. 10 species are tyrphobiontic and 33 are tyrphophilous. There is low beetle species diversity however the species that are present are highly abundant. *Agonum ericeti* (Panzer, 1809), *Cyphon congsbergensis* Munster, 1924, *C. padi* (Linnaeus, 1758), *Drusila canaliculata* (Fabricius, 1787), *Lochmaea suturalis* (Thomson, 1866) are very common. The majority of species were recorded in open raised bogs. The maximum number and diversity of imago-beetles were recorded in May – early June. The overwhelming majority of beetles comprise of species with spring-summer type of reproduction and that, which hibernate on the imago-stage.

Key words: beetles, Coleoptera, raised peat bog, Belarusian Land O˙Lakes.

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INTRODUCTION

Belarusian Land O˙Lakes is situated in North-western Belarus and borders on Lithuania, Latvia and Russia. The region differs from the rest of the country˙s territory because during the last glaciation (Wurm) it was covered with ice (Yakushko 1971).

Peat bogs are unique ecosystems, the development of which has lasted for thousands of years. Mires and bogs of all types cover about 15% of the whole territory of Land O˙Lakes. Oligotrophic post-glacial peat bogs occupy 184,200 hectares, which makes nearly 5% of Land O˙Lakes (Anoshko at al. 1992). The age of these bogs **is** approximately of 11 thousand years (Belenki & Kurzo 1988).

Peat bogs are island-like isolated communities having characteristic microclimatic conditions, specific vegetation and fauna. The insect fauna of raised bogs in Europe is unique in having a considerable portion of relict boreal and subarctic species (Mikkola & Spitzer 1983).

The Coleopteran fauna of European peat bogs has been quite extensively investigated however there are few studies of Coleopteran communities. The study of Coleoptera in raised bogs was of great scientific interest in Europe during the XX century. Beetles on the bogs in Middle Eu-

rope (Peus 1928, 1932; Gossakowski 1971, 1977), Central Europe (Roubal 1934; Heikal 1990), Eastern Europe (Skwarra 1929; Maavara 1955; Zajanchkauskas & Pileckis 1968) and Northern Europe (Rennkonen 1938; Krougerus 1960) were researched.

Until recently there had been no specific research on the beetles living in the Belarusian Land O˙Lakes raised bogs although these ecosystems occupy a large territory of the region. Some bogs stretch several thousands of hectares. For example, peat bogs "Yel˙nya" (19,984 hectares), "Osvejskoje" (5,117 hectares), "Obol˙ II" (4,900 hectares) (Kuhartschik 1996). Some species living in peat bogs are highly stenotopic. Even minimal interference in a peat bog has a negative influence on some insect species. The relict tyrphobiontic and some tyrphophilous Coleoptera species are considered to be good indicators of the quality and change of isolated post-glacial peat bogs. For this reason their fauna needs to be researched in detail.

MATERIAL AND METHODS

The research was carried out on 16 peat bogs during 1997-2006 (Fig. 1.), from April until November. Bogs with different areas (from 85 to 19,984 hectares) were researched.

Two sampling methods were used – individual sampling (the manual entomological net) and pitfall traps (the plastic cups (250 cm^3) with a fixation liquid – 4 % formaldehyde solution). Every biotope (habitat) had 10 traps.During the sampling period traps were checked and beetles were collected at 10-14-day intervals.

Species were characterised in the following way: tyrphobiontic species (tyrphobionts) are stenotopic and obligatorily associated with peat bogs, usually boreal or subarctic components; tyrphophilous taxa are more abundant in bogs than in adjacent habitats; and tyrphoneutral species are eurytopic, widely distributed and usually not very abundant in peatlands. Reviews of this terminology are given by Peus (Peus 1932) (in English by Mikkola & Spitzer, 1983).

The dominance of species in families is indicated according to Rennkonen (1938): dominants – more than 5% from the whole number of species; subdominants – 2-5%; recedents – 1-2%; subrecedents – less than 1%.

Vegetation structure was evaluated at all study sites. The vegetation of the researched bogs

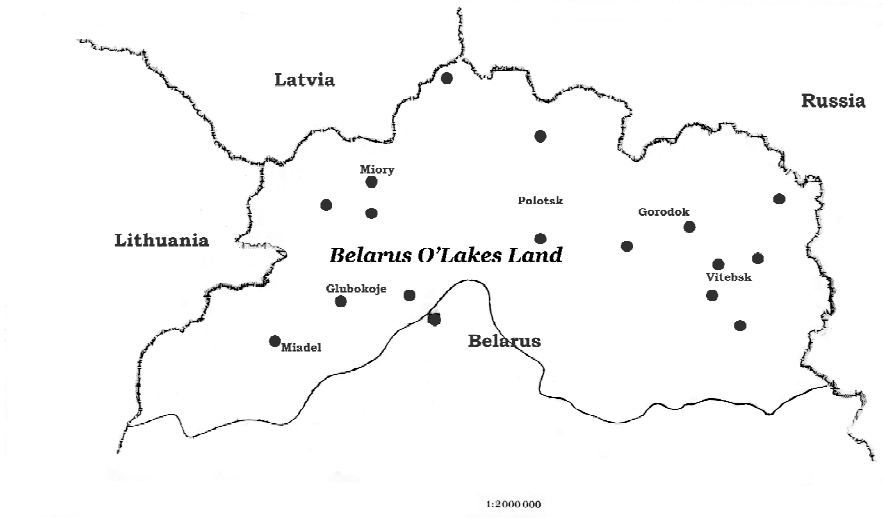

Figure 1. Location of the sampling stations of the peat bogs in Belarusian Land O˙Lakes

comprises of *Pinus silvestris, Betula spp.*, *Chamaedaphne calyculata, Andromeda polyfolia, Ledum palustre, Vaccinium uliginosum, Calluna vulgaris*, *Eriophorum vaginatum*, *Oxycoccus quadripetalus*, *Drosera rotundifolia, Empetrum nigrum*.

Description of the main study sites: ą) moist areas on bogs˙ borders (*Eriophorum vaginatum* + *Sphagnum magellanicum*), b) open raised bogs (*Calluna vulgaris* + *Sphagnum fuscum*), ń) pine forests (*Pinus silvestris* + *Ledum palustre* + *Sphagnum spp.*), d) burnt-out land (*Betula pubescens* + *Calluna vulgaris* + *Polytrichum strictum*), å) water saturated ground (*Rhynchospora alba* + *Sphagnum ńuspidatum*), f) lakes.

RESULTS

During the 9-year study 245 species of 27 Coleoptera families were recorded. 209 species from 34 families at meliorated bogs (Sushko 2006) were recorded as well. The largest number of species is in the family *Carabidae* (43). They comprise of 17,5% of all species. The family *Staphylinidae* (37 species) is the second most abundant (15,1%). *Curculionidae*, comprises of 31 species from 21 genera (12,6%) is the third most abundant. Slightly fewer species were recorded in the families *Dytiscidae* – 30 (12,2%) and *Crysomelidae* – 23 (9,5%). The families which were left consist of not more than 10 species (Tab. 1).

The spatial distribution of beetles was recorded as follows; on the moss surface - 99 species from 9 families, on undershrubs – 98 species from 17 families, on trees – 17 species from 9 families, in ponds – 45 species from 3 families. The most species were recorded in open raised bogs – 65 species from 13 families. The number of species in pine forests is less – 50 species from 14 families, at water saturated areas on bog borders it is even less – 48 species from 13 families.

In raised bogs the number of species recorded is not high but the quantity of some of these is very high. The dominants in the majority of the researched bogs are: *Agonum ericeti, Drusila canaliculata, Pterostichus diligens, Lochmaea suturalis, Cyphon kongsbergensis, Ń. padi.* The species *Carabus clathratus, Pterostichus*

Table 1. Composition of beetle families in the peat bogs of Belarusian Land O˙Lakes

Family	Number of species	Percentage of species, %
Carabidae	43	17,2
Dytiscidae	30	11,4
Gyrinidae	2	0,8
Hydrophilidae	10	4,1
Leiodidae	3	0,8
Silphidae	7	3,2
Cholevidae	1	0,4
Staphylinidae	37	14,8
Scirtidae	3	1,6
Scarabaeidae	4	1,6
Cantharidae	7	2,8
Elateridae	6	2,4
Throscidae	1	0,4
Buprestidae	1	0,4
Byrrhidae	2	0,8
Melyridae	2	0,8
Nitidulidae	1	0,4
Phalacridae	2	0,8
Coccinellidae	8	3,8
Lathridiidae	2	0,8
Oedemeridae	1	0,4
Ciidae	1	0,4
Anaspidae	1	0,4
Cerambycidae	2	0,8
Crysomelidae	23	9,5
Bruchidae	1	0,4
Apionidae	8	3,7
Curculionidae	31	12,3
Scolytidae	5	2,0

Table 2. Dominance structure of Coleoptera in large raised bogs of Belarusian Land O˙Lakes

Species	Abundance, %			
	"Yelna"	"Osvejskoje"	"Obol' II"	"Chistick"
The Moss layer				
Carabus clathratus (Linnaeus, 1761)	4,44	2,64	3,75	0
Pterostichus diligens (Sturm, 1824)	5,30	6,40	9,73	5,23
P. rhaeticus Heer, 1838	3,71	2,64	2,08	4,76
Agonum ericeti (Panzer, 1809)	46,68	48,58	33,33	20,00
Ocypus fuscatus (Gravenhorst, 1802)	2,01	6,57	4,05	5,71
Drusila canaliculata (Fabricius, 1787)	20,88	25,36	17,08	8,57
others	14,98	7,87	30,34	55,73
The Shrub layer				
Cyphon kongsbergensis Munster, 1924	14,58	9,30	10,35	20,00
C. padi (Linnaeus, 1758)	6,81	5,35	9,29	12,28
Cantharis quadripunctata (Müller, 1764)	4,77	5,05	3,68	6,00
Actenicerus sjaelandicus (Müller, 1764)	2,73	5,22	5,08	3,42
Meligethes aeneus aeneus (Fabricius, 1775)	3,31	2,50	2,10	2,57
Coccinella hieroglyphica Linnaeus, 1758	3,80	3,34	4,03	4,85
Plateumaris discolor (Herbst, 1795)	3,64	2,27	6,11	5,14
Lochmaea suturalis (Thomson, 1866)	16,38	24,09	29,89	46,20
others	43,98	42,88	29,47	10,00

rhaeticus, Meligethes aeneus aeneus, Coccinella hieroglyphica can generally be referred to as subdominants (Tab. 2).

The maximum quantity and diversity of imago-beetles were recorded in May to early June. Some species were recorded in August and September, but their quantity was not high. The exception comprises of families on bog borders where there is a high share of migrants from the neighboring ecosystems. In these parts of the bog the next most active species were: *Oxypselaphus obscurus* (Herbst, 1784), *Epaphius secalis* (Gyllenhal, 1810), *Pterostichus niger* (Schaller, 1783). The overwhelming majority of beetles comprise of species with a spring-summer type of reproduction which hibernate on the imago-stage (Tab. 3).

DISCUSSION

The main beetle families in raised bogs comprises of a small number of species, evolved to the specific ecological conditions of the given ecosystems. These are representatives of tyrphophilous

Comments to Table 3:
ą) moist areas on bogs˙ borders (*Eriophorum vaginatum* + *Sphagnum magellanicum*), b) open raised bogs (*Calluna vulgaris* + *Sphagnum fuscum*), ń) pine forests (*Pinus silvestris* + *Ledum palustre* + *Sphagnum spp.*), d) burnt-out land (*Betula pubescens* + *Calluna vulgaris* + *Polytrichum strictum*), å) water saturated ground (*Rhynchospora alba* + *Sphagnum ńuspidatum*), f) lakes.

Table 3. Tyrphobiontic and tyrphophilous Coleoptera species recorded on Belarusian Land O˙Lakes

Species	Abundance	Period of imago-activity	Habitat
Tyrphobiontic			
Agonum ericeti (Panzer, 1809)	very common	IV-IX	a, b, c, d
Bradycellus ruficollis (Stephens, 1828)	sporadic	V-VI	b, d
Dicheirotrichus cognatus (Gyllenhal, 1827)	sporadic	V-VI	b, d
Hydroporus obscurus Sturm, 1835	very rare	IV-V	f
H. morio Aube, 1838	rare	V-VIII	f
Cyphon congsbergensis Munster, 1924	very common	V-IX	a, b, c
Cantharis quadripunctatus (Müller, 1764)	common	V-VII	a, b, c, d
Coccinella hieroglyphica Linnaeus, 1758	common	V-IX	a, b, c, d
Plateumaris discolor (Herbst, 1795)	common	V-VII	a, b, c, d
Aphthona erichsoni (Zetterstedt, 1838)	sporadic	VI-VIII	a, b, c
Tyrphophilous			
Cicindela campestris Linnaeus, 1758	sporadic	V-IX	b
Carabus clathratus Linnaeus, 1761	common	IV-IX	a, b, c, d
C. nitens Linnaeus, 1758	sporadic	V-VIII	b
Poecilus cupreus (Linnaeus, 1758)	common	V- X	b, d
Pterostichus diligens (Sturm, 1824)	common	V- X	a, b, c, d
P. nigrita (Fabricius, 1792)	common	V-VIII	b, d
P. rhaeticus Heer, 1838	common	V-IX	a, b, d
Amara communis (Panzer, 1797)	sporadic	V-IX	a, b, d
Dytiscus lapponicus Gyllenhal, 1808	rare	V-VI	e
Anacaena lutescens (Stephens, 1829)	rare	V-IX	e, f
Enochrus minutus (Fabricius, 1801)	very common	VII-X	e
Amphicyllis globus (Fabricius, 1792)	sporadic	V-VIII	a, b
Agathidium atrum (Paykull, 1798)	sporadic	V-VIII	a, c
Staphylinus erythropterus Linnaeus, 1758	sporadic	V-IX	b, c, d
Ocypus fuscatus (Gravenhorst, 1802)	common	V-IX	a, b, c, d
Quedius molochinus (Gravenhorst, 1806)	sporadic	V-IX	a
Xantholinus tricolor (Fabricius, 1787)	sporadic	V-VII	a, c
Ischnosoma splendidum (Gravenhorst, 1806)	sporadic	V-VIII	b, c, d
Drusila canaliculata (Fabricius, 1787)	very common	V-X	a, b, c, d
Gymnusa brevicornis (Paykull, 1800)	sporadic	V-VII	b, d
Cyphon padi (Linnaeus, 1758)	very common	V-VIII	a, b, c, d
Absidia schoenherri (Dejean, 1837)	sporadic	V-VII	b, c
Actenicerus sjaelandicus (Muller, 1764)	common	V-VIII	b, c, d
Sericus brunneus (Linnaeus, 1758)	common	V-VIII	b
Byrrhus pilula (Linnaeus, 1758).	common	V-VIII	a, b, c, d
Meligethes aeneus aeneus (Fabricius, 1775)	common	V-VIII	a, b, d
Olibrus aeneus (Fabricius, 1792)	common	V-VIII	b, d
Chilocorus bipustulatus (Linnaeus, 1758)	common	V-VIII	b, c, d
C. renipustulatus (Scriba, 1790)	common	V-VIII	a, d
Lochmaea suturalis (Thomson, 1866)	very common	IV-IX	a, b, c, d
Hypera meles (Fabricus, 1792)	common	V-VI	a, b
H.nigrirostris (Fabricius, 1775)	common	V-VI	c
Micrelus ericae (Gyllenhal, 1813)	sporadic	V-IX	a, b

and tyrphobiontic groups. The tyrphobionts are inherent to raised bog species, the whole development cycle of which occurs mainly in raised bogs, of which there are 10 species. The share of tyrphobionts is 3,67%. The most numerous of them are: *Agonum ericeti, Cyphon congsbergensis, Cantharis quadripunctatus, Plateumaris discolor.* Some species, specified as tyrphobionts in Northern and Middle Europe, *Agonum gracile* Sturm, 1824*, Miscodera arctica* (Paykull, 1798) (Lindroth 1985; Frambs 1982), were not recorded in oligotrophic bogs in Belarusian Land O˙Lakes. Species *Notiophilus germinyi, Bembidion humerale, Lagria hirta***,** often found at bogs of Central Europe (Roubal 1934), were recorded by us only at meliorated bogs.

In damaged bogs the number of tyrphobiont species decreases by more than half. These species remain only in areas where sphagnum mosses and shrubs are left. More sensitive to changes are moss-dwellers. At meliorated bogs they were not recorded. Only certain species trophically bound to subshrubs, *Cyphon congsbergensis, Coccinella hieroglyphica, Plateumaris discolor*, remain (Sushko 2006).

Twenty-five species can be referred to as tyrphophils, dwellers of raised bogs and other ecosystems. There are several times more tyrphophils than tyrphobionts. Their proportion is more than half of all the beetles (55,10%) and as a rule, they are hydrophils. The most numerous of them were *Carabus clathratus, Poecilus cupreus, Pterostichus diligens, P. nigrita, P. rhaeticus, Staphylinus erythropterus, Ocypus fuscatus, Drusila canaliculata, Cyphon padi, Actenicerus sjaelandicus, Meligethes aeneus aeneu and Lochmaea suturalis.*

Species with wide ecological flexibility were recorded at many bogs, *Carabus cancellatus, Epaphius secalis, Pterostichus niger, Acilius canaliculatus, A. sulcatus, Byrrhus pilula, Ampedus balteatus, Sericus brunneus, Apion apricans, A. fulvipes, Sitona lineatus.* At recovered bog the number of species of tyrphophils slightly decreased. They only remain in areas where sphagnum mosses and shrubs are left (Sushko 2006).

The tyrphoneutral species (41,22%) are random species which have moved to the bog from adjacent territories and live there temporarily. The number of these species is higher in small-area bogs. In large bogs there is a higher quantity of tyrphophils and tyrphobionts (Sushko 2006).

Many glacial relict species which are going extinct or becoming rare live on the oligotrophic bogs. These species are *Dicheirotrichus cognatus, Bradycellus ruficollis, Dytiscus lapponicus, Hydroporus glabriusculus.*

According to the fauna composition families of Coleoptera in the raised bogs of Belarusian Land O˙Lakes are close to the families of Northern, Eastern and Middle Europe (Peus 1928, 1932. Çossakowski 1971, 1977. Roubal 1934. Heikal 1990. Renkonnen 1934. Lindroth 1985). There are also differences. We did not record species, such as *Pelophila borealis* (Paykull, 1790), ***Blethisa*** *multipunctata* (Linnaeus, 1758), ***Dyschirius*** *nigricornis* Motschulsky, 1844 and *Agonum consimile* (Gyllenhal, 1810), spread in raised bogs in Scandinavia (Frambs 1982. Lindroth 1985). The species *Carabus clathratus* and *C. nitens*, rare in Middle Europe, are common in the bogs of Belarusian Land O˙Lakes. The majority of dominant species recorded by us are also present in raised bogs in southern Belarus although they do not have a glacial origin. *Carabus violąceus* (Linnaeus, 1758) was recorded in the bogs which is not typical of the region (Alexandrovich 1996. Hot˙ko 1993).

CONCLUSIONS

A specific complex of beetles was recorded in raised bogs of Belarusian Land O˙Lakes. The specific composition of the region˙s bogs in general is close to the families of Northern, Eastern and Central Europe. It comprises of a small number of species highly specialized to the bog˙s ecological condition (tyrphobionts and

tyrphophils). These species are good indicators of any change in the specific ecological conditions. The majority of species were recorded in open raised bogs. The maximum number and diversity of imago-beetles were recorded in May – early June. The overwhelming majority of beetles comprises ~~of~~ species with spring-summer type of reproduction which hibernate on the imago-stage. There is low beetle species diversity but the species that are present are highly abundant.

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