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Materials to the knowledge of beetles (*Coleoptera*) of aquatic habitats in the Suwalski Landscape Park

Materiały do poznania chrząszczy (*Coleoptera*) siedlisk wodnych w Suwalskim Parku Krajobrazowym

SUMMARY

The authors discuss the material collected in the Suwalski Landscape Park in the years 2009 and 2011–2013, almost exclusively obtained from standing waters. At 29 study sites, 1 204 individuals representing 109 species from 12 families were caught, of which 55 species have been recorded for the first time in the examined area. The most valuable were: *Gyrinus distinctus*, *Haliplus fulvicollis*, *H. variegatus*, *Ilybius erichsoni*, *Graphoderus austriacus*, *Hydroporus glabriusculus*, *H. incognitus*, *Hydrochus ignicollis*, *H. megaphallus*, *Spercheus emarginatus*, *Anacaena globulus*, *Berosus frontifoveatus*, *Enochrus melanocephalus*, *Hydrophilus aterrimus*, *Cercyon quisquilius*, *C. unipunctatus*, *Limnebius aluta*, *Dryops anglicanus*, *Heterocerus fenestratus* and *Cyphon pubescens*. The most species were found in small water bodies and lakes. The collected material was ecologically diversified; dominating groups were eurytopes as well as tyrphobionts and tyrphophiles, rheophilous species were also numerous. Taking into consideration data discussed in this paper and literature as well as the lack of complex studies, in waters of the Suwalski Landscape Park 139 beetle species have been recorded so far, of which 136 species represent true aquatic beetles (the authors provide

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the list of them). This number is similar or even higher than the one recorded in well studied, the most valuable and diversified habitats in protected areas of Poland. The Suwalski Landscape Park is also the place of the occurrence of many species under protection, from the Red List of Animals in Poland or regarded as rarely occurring in Poland. It is also a refuge of many seriously threatened species in neighbouring countries. This confirms a great, overregional role of this area in the protection of aquatic beetles and their habitats.

Key words: *Coleoptera*, beetles, aquatic habitats, NE Poland, Lithuanian Lake District, landscape park, faunistics, protection

STRESZCZENIE

Autorzy omawiają materiał zebrany w Suwalskim Parku Krajobrazowym w latach 2009 i 2011–2013, prawie wyłącznie w wodach stojących. Na 29 stanowiskach złowiono 1204 osobniki reprezentujące 109 gatunków z 12 rodzin, z których pierwszy raz z terenu badań podano 55. Najcenniejsze były: *Gyrinus distinctus*, *Haliplus fulvicollis*, *H. variegatus*, *Ilybius erichsoni*, *Graphoderus austriacus*, *Hydroporus glabriusculus*, *H. incognitus*, *Hydrochus ignicollis*, *H. megaphallus*, *Spercheus emarginatus*, *Anacaena globulus*, *Berosus frontifoveatus*, *Enochrus melanocephalus*, *Hydrophilus aterrimus*, *Cercyon quisquilius*, *C. unipunctatus*, *Limnebius aluta*, *Dryops anglicanus*, *Heterocerus fenestratus* i *Cyphon pubescens*. Najwięcej gatunków stwierdzono w drobnych zbiornikach wodnych i jeziorach. Zebrany materiał był zróżnicowany ekologicznie; grupami dominującymi były eurytopy oraz tyrfobionty i tyrfofile, liczne były też reofile. Biorąc pod uwagę dane omówione w tej pracy i literaturowe, mimo braku kompleksowych badań, z wód w Suwalskim Parku Krajobrazowym wykazano już 139 gatunków chrząszczy, w tym 136 gatunków należących do właściwych chrząszczy wodnych (autorzy podają ich wykaz). Jest to liczba podobna a często większa, jak ta odnotowana w dobrze zbadanych, najcenniejszych i najbardziej zróżnicowanych siedliskowo obszarach chronionych Polski. Suwalski Park Krajobrazowy jest też miejscem występowania wielu gatunków chronionych, z Czerwonej Listy Zwierząt Polski i uważanych za rzadko występujące w Polsce. Jest też ostoją wielu gatunków poważnie zagrożonych w krajach sąsiednich. Wskazuje to na dużą, ponadregionalną rolę tego obszaru w ochronie chrząszczy wodnych i ich siedlisk.

Słowa kluczowe: *Coleoptera*, chrząszcze, siedliska wodne, Polska północno-wschodnia, Pojezierze Litewskie, park krajobrazowy, faunistyka, ochrona

INTRODUCTION

The Suwalski Landscape Park (SLP) protects natural values of significantly diversified landscapes and habitats of the Wschodniosuwalskie Lake District. It belongs to the most valuable areas under protection in north-eastern Poland (24). However, data on its nature is still far from complete. This also refers to the beetles which have been studied at limited areas only or with regard to the occurrence of a few families (46). It is an essential gap in the knowledge about the park. Due to the good condition of the environment, the fauna with the elements being in regress in Poland and Central Europe can be expected. Data on the beetles is also of practical importance: due to their taxonomic and ecological diversity, they can be used in conservation planning and monitoring of its effects.

In the recent years, a few scientific projects concerning aquatic insects have been undertaken in the SLP. The side effect of these enterprises is the creation of the collection of beetles, rich in species and making significant contribution to the knowledge about the fauna of the park. This material

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comes mainly from standing waters, especially from small water bodies as well as fens and peat bogs. Data from Lake Hańcza is also valuable and rich. Except for the discussion of the occurrence of 6 species from small water bodies (14) as well as rather general information about 8 species numerously dominating in Lake Hańcza (48), this data has not been published. Our purpose is the presentation and analysis as well as the summary of current faunistic knowledge about the beetles of aquatic habitats of the SLP. A lot of attention is paid to the species that have been recorded for the first time in the Mazurskie Lake District, that are on the edge of their distribution areas, under protection, included on the Red List of Animals in Poland as well as regarded as rare in Poland.

The object of our study were true water beetles but we also took into account those collected on the occasion and represented by single specimens and species: *Scirtidae* – belonging to False Water Beetles, associated with water at preimaginal stages only, and *Heteroceridae* – Shore Beetles (38). Due to the fact that their basic zone of the occurrence is the borderland between aquatic and land environment, they are rarely studied and a deficit of knowledge on their subject is particularly large.

STUDY AREA

The SLP is situated north of Suwałki, in the Lithuanian Lake District, and within its borders in the Wschodniosuwalskie Lake District. It is the part of Poland with the most continental climate, severe and cold (41).

The area of the SLP is 6 284 ha, the area of buffering zone: 2 333 ha. The park protects early post-glacial landscape with rich terrain and big differences in altitudes (146–275 m a.s.l.) in which moraine uplands and river valleys are dominating. Forests cover only ca. 20% of the park, a considerable area is occupied by meadows and pastures. Areas used for agricultural purposes comprise 60% of the SLP area. The park is rich in surface waters. These are: streams and rivers, 24 lakes of different trophy, numerous small water bodies. Peat bogs and fens are also frequent: *Sphagnum* peat bogs in depressions, fens – around lakes and in river valleys. Seepages and springs are also numerous. At some places, valuable spring-fed fen have been formed (24).

STUDY SITES

We have studied 29 sites, 26 in the SLP and three in the buffering zone, very close to the borders of the park (Fig. 1). These are: 1. Przełomka, a small water body on meadows (54°15’58” N, 22°47’46” E); 2. Stara Hańcza, a small pond in the park which formerly belonged to the manor (54°17’00” N, 22°48’48” E); 3. Stara Hańcza-Błaskowizna, Lake Hańcza (54°14’35”-54°16’55” N, 22°47’44”-22°49’33” E); 4. Błaskowizna, a peat excavation on a fen meadow (54°15’07” N, 22°49’11” E); 5. Błaskowizna, a transitional peat bog (54°15’22” N, 22°49’19” E); 6. Cisówek, a small water body in forests (54°16’03” N, 22°50’01” E); 7. Dzierwany, a small water body on meadows (54°17’03” N, 22°50’04” E); 8. Udziejek Górny, a small water body on meadows (54°14’49” N, 22°51’49” E); 9. Udziejek Dolny, a small water body on fields (54°15’35” N, 22°51’58” E, FF21); 10. Smolniki, transitional peat bog (54°16’16” N, 22°52’30” E, FF21); 11. Kojle, a small water body in forests (54°16’35” N, 22°52’43” E); 12. Smolniki, a peat excavation on a fen meadow (54°17’08” N, 22°53’17” E); 13. Kleszczówek, peat excavations on a high peat bog grown with trees between Lake Kojle and Perty (54°16’30” N, 22°53’44” E); 14. Gulbieniszki, a small water body on fields (54°14’54” N, 22°54’42” E); 15. Sidory, a small water body on meadows (54°15’52” N, 22°55’20” E); 16. Jałowo, a small water body on meadows (54°17’21” N, 22°57’20” E); 17. Malesowizna-Turtul, a peat excavation on a fen meadow (54°13’11” N, 22°48’39” E); 18. Malesowizna-Turtul, a stream flowing out of Turtul Pond (54°13’17” N, 22°48’37” E); 19. Malesowizna-Turtul, Turtul Pond (dam reservoir on the River Czarna Hańcza) (54°13’19”–54°13’36” N, 22°48’21”–22°48’39” E); 20. Malesowizna-Turtul, Turtul Esker, trapping *ad lucem*

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(54°13'22" N, 22°48'42" E); 21. Malesowizna-Turtul, spring-fed fen of the River Szeszupa (54°13'16" N, 22°48'56" E); 22. Szeszupka, a small water body on the edge of the forest (54°13'45" N, 22°49'24" E); 23. Szeszupka, a small water body by an abandoned farmyard (54°13'11" N, 22°50'19" E); 24. Szeszupka, a small water body on meadows (54°13'47" N, 22°50'06" E); 25. Szeszupka, Lake Linówek (54°13'28" N, 22°50'21" E); 26. Szeszupka, a small water body on meadows (54°13'28" N, 22°50'38" E); 27. Wodziłki, a small water body in forests (54°14'17" N, 22°49'12" E); 28. Jegłówek, a small water body on meadows (54°14'04" N, 22°53'11" E); 29. Sidorówka, drying up Lake Karaśnik (54°13'37" N, 22°54'46" E).

The sites were situated in UTM squares: FF11 (no. 1–6, 16–23) and FF21 (no. 7–15, 25–28). In case of the site 24, the boundary of both squares runs through the centre of the lake.

METHODS AND MATERIAL

The material from Lake Hańcza was collected on July 17, 2011; September 26, 2011 and April 30, 2012. Other materials were obtained during the multiple-day field studies in the years: 2009 (June 28–July 5, studies on small water bodies), 2011 (July 4–July 10, studies on peat bogs and fens) and 2013 (May 1–May 3 and July 21–July 23, studies of Turtul Pond and adjacent habitats). We were collecting imagines and larvae of the beetles with the use of a kick net sampler (semiquantitative samples). During the studies in the years 2011 and 2013, imagines were also caught in a light trap (screen type), with a mercury-vapour lamp of 250 W.

The collected material consists of 1 204 individuals: 1 138 imagines and 66 larvae. This documentary material is placed in the collection of: Department of Systematic Entomology of UAM in Poznań, Department of Ecology and Environmental Protection of UWM in Olsztyn and the Department of Zoology of UMCS in Lublin.

In the analysis of quantitative structure, the index of dominance (D) was used, with the division into 5 quantitative categories: eudominants (>10.0%), dominants (5.1–10.0%), subdominants (2.1–5.0%), recedents (1.1–2.0%) and accessory species (≤1.0%) [Tischler 1949].

RESULTS

We have found 109 beetle species from 12 families: *Gyrinidae* (6), *Haliplidae* (7), *Noteridae* (1), *Dytiscidae* (49), *Helophoridae* (4), *Hydrochidae* (5), *Spercheidae* (1), *Hydrophilidae* (26), *Hydraenidae* (5), *Dryopidae* (2), *Heteroceridae* (1) and *Scirtidae* (2).

Data about all of the species is provided in Table 1. Below we give detailed information about the beetles that are the most interesting due to faunistic, zoogeographical and sozological reasons, except for the species that have already been discussed by Buczyński et al. [14]: *Ilybius erichsoni*, *Hydroporus glabriusculus*, *Hydrochus ignicollis*, *H. megaphallus*, *Spercheus emarginatus* and *Hydrophilus aterrimus*. Material was collected with a kick net sampler unless it is described differently in the text. The abbreviation "ex." is the number of the collected imagines, in square brackets the numbers of sites are given:

– *Gyrinus distinctus*: [3] Lake Hańcza, 14 VII 2011, 5 exx., 23 IX 2011, 7 exx., 1 V 2012, 20 exx., in shallow places with the sandy bottom of gravel or stones,

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detritus in some places, usually among loose swamp vegetation, mostly with the domination of *Carex* sp. and/or *Phragmites australis* (Cav.) Trin. ex Steud.

– *Haliplus fulvicollis*: [27] Wodziłki, a small water body in forests, 1 VII 2009, 1 ex. in flooded grasses by the shore.

– *Haliplus variegatus*: [5] Błaskowizna, a transitional peat bog in the depression to the east of Lake Boczniel (Boczne), 4 VII 2011, 2 exx. in canals created by European beavers (*Castor fiber* L.) in floating mats of *Sphagnum* sp.

– *Graphoderus austriacus*: [3] Lake Hańcza, 1 V 2012, 1 ex. in sedges and flooded grasses on the bottom of gravel and stones; [17] Malesowizna-Turtul, a peat excavation on a fen meadow in the valley of the River Czarna Hańcza, 3 V 2013, 1 ex. among shore swamp vegetation.

– *Hydroporus incognitus*: [10] Smolniki, a *Sphagnum* peat bog near the eastern shore of Lake Jaczno, 3 VII 2011, 1 ex. each in canals created by beavers and water squeezed from hydrated *Sphagnum* sp.; [11] Kojle, a small water body in a mixed forest, 30 VI 2009, 2 exx.; [13] Kleszczówek, peat excavations on a high peat bog grown with trees between Lake Kojle and Perty, 3 VII 2011, 14 exx.; [17] Malesowizna-Turtul, a peat excavation on a fen meadow in the valley of the River Czarna Hańcza, 3 V 2013, 1 ex. among shore swamp vegetation; [19] Malesowizna-Turtul, Turtul Pond, 3 V 2013, 1 ex.; [21] Malesowizna-Turtul, spring-fed fen of the River Szeszupa, 5 VII 2011, 1 ex.

– *Anacaena globulus*: [10] Smolniki, a *Sphagnum* peat bog near the eastern shore of Lake Jaczno, 3 VII 2011, 1 ex. in water squeezed from hydrated *Sphagnum* sp.

– *Berosus frontifoveatus*: [20] Malesowizna-Turtul, Turtul Esker, trapping *ad lucem*, 6 VII 2011, 1 ex., 7 VII 2011, 1 ex., 8 VII 2011, 2 exx.

– *Enochrus melanocephalus*: [20] Malesowizna-Turtul, Turtul Esker, trapping *ad lucem*, 8 VII 2011, 4 exx., 27 VII 2013, 1 ex.

– *Cercyon quisquilius*: [20] Malesowizna-Turtul, Turtul Esker, trapping *ad lucem*, 7 VII 2011, 1 ex., 26 VII 2013, 13 exx.

– *Cercyon unipunctatus*: [20] Malesowizna-Turtul, Turtul Esker, trapping *ad lucem*, 7 VII 2011, 5 exx., 8 VII 2011, 1 ex., 26 VII 2013, 9 exx., 27 VII 2013, 2 exx.

– *Limnebius aluta*: [5] Błaskowizna, a transitional peat bog in the depression to the east of Lake Boczniel (Boczne), 4 VII 2011, 1 ex. in canals created by beavers.

– *Dryops anglicanus*: [5] Błaskowizna, a transitional peat bog in the depression to the east of Lake Boczniel (Boczne), 4 VII 2011, 2 exx. in canals created by beavers in floating mats of *Sphagnum* sp.

– *Heterocerus fenestratus*: [20] Malesowizna-Turtul, Turtul Esker, trapping *ad lucem*, 26 VII 2013, 1 ex.

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– *Cyphon pubescens*: [21] Malesowizna-Turtul, a spring-fed fen of the River Szeszupa, 21 VII 2013, 1 ex.

The quantitative structure of the collected material was balanced. We found only one eudominant (*Hyphydrus ovatus*, D=19.9%) as well as a dominant (*Platambus maculatus*, D=5.2%). To the subdominants belonged: *Hygrotus versicolor*, *Haliplus flavicollis*, *Laccobius minutus*, *Gyrinus distinctus*, *Hygrotus decoratus*, *Anacaena lutescens*, *Enochrus coarctatus* and *Helochares obscurus*. We also noted 15 recedents and as many as 84 accessory species.

Haliplus ruficollis was recorded at the highest numbers of sites – 13. To the species with the wide distribution belonged also: *Enochrus coarctatus* (11 sites), *Noterus crassicornis*, *Helochares obscurus* and *Anacaena lutescens* (each 9 sites), *Helophorus aquaticus* (8 sites), *Porhydrus lineatus* (7 sites). At the same time, as many as 86 species were present at 1–3 sites only.

Among 6 types of the studied water bodies, the most beetles were caught in small water bodies (55) and lakes (50), less – in waters of *Sphagnum* peat bogs (26) and in waters of fens (20). In the dam reservoir – Turtul Pond, 12 species were collected. Only one species was found in streams but this habitat was marginally examined.

24 beetle species were attracted to a light trap. Their species composition and the contribution of different ecological elements (Fig. 2) show that they come from several adjacent aquatic habitats: the dam reservoir (Turtul Pond), rivers (Czarna Hańcza and Szeszupa), small water bodies and peat bogs in the valleys of rivers. Some *Hydrophilidae* might have been obtained from animal faeces from nearby meadows.

The collected material is ecologically diversified. Among the synecological elements, eurytopes were dominating – they comprised 52.2% of the recorded species and 58.6% of the collected specimens. Tyrphobionts and tyrphophiles (29.6% and 17.9% respectively) as well as rheophiles (8.7% and 12.7%) were relatively numerous. The elements represented by small numbers of species and specimens were: psammophiles (3.5% and 7.8%), hylophiles (3.5% and 1.3%), argilophiles (0.9% and 0.5%), steppicoles (0.9% and 0.2%) and halophiles (0.9% and 0.1%).

Eurytopes occurred in all of the habitats and dominated in most of them, except for *Sphagnum* peat bogs. This habitat was clearly dominated by tyrphobionts and tyrphophiles which were also found in all of the habitats, often numerously or quite numerously. The habitat distribution of other synecological elements was uneven. Argilophiles were recorded in lakes only, halophilous *Berosus frontifoveatus* was caught in a light trap only in small numbers. Hylophilous species were the most numerous in small water bodies. Psammophilous species were found in lakes, outside this habitat they were caught *ad lucem* only. Rheophiles preferred

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lakes and the dam reservoir. Only one steppicole (*Haliplus variegatus*) was collected on a *Sphagnum* peat bog (Fig. 2).

DISCUSSION

The number of the species given in this paper comprises ca. 40% of the national fauna of aquatic beetles (51, 52, 53). This number is high, especially when we take into consideration that: 1. this material does not come from systematic studies encompassing the whole area of the SLP, 2. practically only standing waters were examined. This shows high species richness of the fauna of the SLP and indirectly confirms its high natural values. It is also clear when summing up new data as well as this from literature.

Data on aquatic beetles of the SLP is included in four papers only. Majewski (45) gave 15 species collected during the studies on fungal parasites on insects. Buczyński et al. (5) studied aquatic insects of the basin of Lake Jaczno providing 66 beetle species. Buczyński et al. (14) discussed 6 particularly interesting species collected during the evaluation of small water bodies on the basis of dragonflies (*Odonata*). Pakulnicka et al. (48) mentioned 8 quantitatively dominating species in Lake Hańcza on the margins of the study devoted to the ecology of beetles.

The papers mentioned above contain data about 84 beetle species. Taking into consideration the material discussed in this article, the list of the beetles recorded in waters of the SLP encompasses 139 species from 12 families:

– Gyrinidae – *Gyrinus aeratus* Steph.; *G. distinctus* Aubé; *G. marinus* Gyll.; *G. minutus* Fabr.; *G. natator* (L.); *G. paykulli* Ochs; *G. substriatus* Steph.; *Orectochilus villosus* (O.F. Müll.).

– Haliplidae – *Haliplus confinis* Steph.; *H. flavicollis* Sturm; *H. fluviatilis* Aubé; *H. fulvicollis* Er.; *H. fulvus* (Fabr.); *H. heydeni* Wehncke; *H. immaculatus* Gerh.; *H. lineatocollis* (Marsh.); *H. ruficollis* (De G.); *H. sibiricus* Motsch.; *H. variegatus* Sturm.

– Noteridae – *Noterus crassicornis* (O.F. Müll.).

– Dytiscidae – *Agabus affinis* (Payk.); *A. bipustulatus* (L.); *A. didymus* (Ol.); *A. guttatus* (Payk.); *A. sturmii* (Gyll.); *A. uliginosus* (L.); *A. undulatus* (Schrank); *Ilybius ater* (De G.); *I. erichsoni* (Gemm. et Har.); *I. fenestratus* (Fabr.); *I. fuliginosus* (Fabr.); *I. quadriguttatus* (Lacord.); *I. similis* Thoms.; *I. subaeneus* Er.; *I. subtilis* (Er.); *Platambus maculatus* (L.); *Colymbetes fuscus* (L.); *C. paykulli* Er.; *C. striatus* (L.); *Rhantus grapii* (Gyll.); *R. frontalis* (Marsh.); *R. latitans* Sharp; *R. notaticollis* (Aubé); *R. suturalis* (Mac L.); *R. suturellus* (Harr.); *Liopterus haemorrhoidalis* (Fabr.); *Acilius canaliculatus* (Nic.); *A. sulcatus* (L.); *Graphoderus austriacus* (Sturm); *G. cinereus* (L.); *Cybister lateralimarginalis* (De G.); *Dytiscus dimidiatus* Bergstr.; *D. marginalis* L.; *Hydaticus continentalis* Balf.-Browne; *H. seminiger* (De G.); *H. transversalis* (Pontopp.); *Hydroglyphus geminus* (Fabr.);

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Graptodytes pictus (Fabr.); *Hydroporus angustatus* Sturm; *H. elongatulus* Sturm; *H. erytrocephalus* (L.); *H. glabriusculus* Aubé; *H. gyllenhalii* Schiödte; *H. incognitus* Sharp; *H. melanarius* Sturm; *H. obscurus* Sturm; *H. palustris* (L.); *H. scalesianus* Steph.; *H. striola* (Gyll.); *H. tristis* (Payk.); *H. umbrosus* (Gyll.); *Nebrioporus depressus* (Fabr.); *Porhydrus lineatus* (Fabr.); *Suphrodytes dorsalis* (Fabr.); *Hygrotus decoratus* (Gyll.); *H. impressopunctatus* (Schall.); *H. inaequalis* (Fabr.); *H. versicolor* (Schall.); *Hyphydrus ovatus* (L.); *Laccornis oblongus* (Steph.); *Laccophilus hyalinus* (De G.); *L. minutus* (L.); *L. poecilus* Klug.

– Helophoridae – *Helophorus aquaticus* (L.); *H. brevipalpis* Bed.; *H. dorsalis* (Marsh.); *H. granularis* (L.); *H. griseus* Herbst; *H. minutus* Fabr.; *H. nubilus* Fabr.

– Hydrochidae – *Hydrochus brevis* (Herbst); *H. crenatus* (Fabr.); *H. elongatus* (Schall.); *H. ignicollis* Motsch.; *H. megaphallus* Berge H.

– Spercheidae – *Spercheus emarginatus* (Schall.).

– Hydrophilidae – *Anacaena globulus* (Payk.); *A. limbata* (Fabr.); *A. lutescens* (Steph.); *Berosus frontifoveatus* Kuw.; *B. luridus* (L.); *Chaetarthria seminulum* (Herbst); *Enochrus affinis* (Thunb.); *E. coarctatus* (Gredl.); *E. melanocephalus* (Ol.); *E. ochropterus* (Marsh.); *E. quadripunctatus* (Herbst); *E. testaceus* (Fabr.); *Helochares obscurus* (O.F. Müll.); *Hydrobius fuscipes* (L.); *Hydrochara caraboides* (L.); *Hydrophilus aterrimus* Eschsch.; *H. piceus* (L.); *Laccobius minutus* (L.); *L. striatulus* (Fabr.); *Coelostoma orbiculare* (Fabr.); *Cercyon bifenestratus* Küst.; *C. convexiusculus* Steph.; *C. laminatus* Sharp; *C. lateralis* (Marsh.); *C. marinus* Thoms.; *C. quisquilius* (L.); *C. unipunctatus* (L.); *Cryptopleurum minutum* (Fabr.).

– Hydraenidae – *Limnebius aluta* Bed.; *L. atomus* (Duftschm.); *L. crinifer* Rey; *L. papposus* Muls.; *L. parvulus* (Herbst); *L. truncatellus* (Thunb.); *Ochthebius minimus* (Fabr.).

– Dryopidae – *Dryops anglicanus* Edw.; *D. auriculatus* (Geoffr.); *D. ernesti* Goz.; *D. griseus* (Er.).

– Heteroceridae – *Heterocerus fenestratus* (Thunb.).

– Scirtidae – *Cyphon padi* (L.), *C. pubescens* (Fabr.).

Data about the beetles of the SLP can be compared to the information about other areas under protection in Poland which were more systematically studied (mountain and submountain areas are not taken into consideration since their fauna is different). On this background, the fauna of the SLP is very rich. For example, in the Ojcowski National Park (the Krakowsko-Częstochowska Upland), 116 aquatic beetle species were recorded (49), in the Krzczonowski Landscape Park (the Lublin Upland) and the Wdzydzki Landscape Park (Tuchola Forests) – 113 species each area (9, 11), in the Poleski National Park – 108 (7, 8, 32), in the Łomża Landscape Park of the River Narew valley – 105 (1), in the Kozłowiecki Landscape Park – 100 (13), in the Rogalin Landscape Park – 89 (62, 63, 56), in the "Tuchola Forests" National Park – 65 (20, 22, 47, 64, 65, 66). The number of al-

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most 140 species recorded in the SLP is much higher. Taking into account that this number is far from complete, the role of the small SLP in maintaining the species richness of the beetles seems to be almost as great as in very important and bigger areas – e.g., the valley of the middle River Bug on the stretch between Włodawa and Kodeń (250 km of the river course) (15, 55) or the whole Roztocze region (16). The occurrence of so many aquatic beetle species testifies high diversity of the habitats in the SLP and, above all, the great condition of their preservation.

The high natural values of the SLP are also emphasized by the fact that the material provided in this paper encompasses:

– one species legally protected – *Hydrophilus aterrimus* (58);

– three species from the Red List of Animals in Poland – *Haliplus variegatus* (EN category – the species strongly endangered), *Hydrophilus aterrimus* (VU – vulnerable species), *Spercheus emarginatus* (CR – critically endangered species) (50);

– 13 species regarded as rare to different degrees in Poland, in which 5 species are very rare (*Hydrochus ignicollis*, *H. megaphallus*, *Berosus frontifoveatus*, *Limnebius aluta*, *Spercheus emarginatus*), 7 are rare (*Gyrinus distinctus*, *Haliplus fulvicollis*, *Graphoderus austriacus*, *Hydroporus incognitus*, *Hydrochus elongatus*, *Dryops anglicanus*) and two are locally rare (*Enochrus melanocephalus*, *Hydrophilus aterrimus*) (51, 52, 53).

The species distinguished above comprise as much as 14% of all species recorded by us previously (5). The next species worth mentioning were given from the same reasons: *Haliplus fulvus* and *H. immaculatus* – rare in Poland (51), *Hydroporus gyllenhalii* – vulnerable in Poland (VU) (50), *Hydrophilus piceus* – nearly threatened in Poland (NT) (50), rare in the country (52), legally protected (58).

The threat of aquatic beetles in Poland is lower than in other countries of Europe, especially those in the west and middle of the continent. On the other hand, it is believed that the Red List of the beetles in Poland (50) is underrepresented and some species need to be corrected as for their threat assessment (10). Thus, taking into account the national Red List (50), it gives the incomplete picture of the role of the particular area in the protection of beetles. This can be completed by the insight into the Red Lists of the neighbouring countries, showing the wider perspective. And so, taking into account all available information (5, 14, 45, 48, data in this paper), as many as 43 threatened or nearly threatened species in Germany, the Czech Republic and Slovakia occur in the SLP. In case of Germany, these are 35 species (in which 27 represent high risk categories) (28), in case of the Czech Republic – 26 (22) (2, 3, 4, 33, 34, 71), in case of Slovakia – 6 (6) (37). These numbers show that the study area and wider – the lake districts of northern Poland – are important refugia of many species on a central-European scale.

Noteworthy are also the species that have been recorded for the first time in the Mazurskie Lake District considered as a faunistic region according to "the

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Catalogue of the Fauna of Poland" (17, 18, 19). These are: *Anacaena globulus*, *Berosus frontifoveatus*, *Cercyon quisquilius*, *C. unipunctatus* and *Heterocerus fenestratus*. However, these species are widely distributed and the current lack of their recordings indicates mainly the low level of faunistic penetration of north-eastern Poland. In fact, only *Berosus frontifoveatus* can be regarded as a really rare species – it is described as a halobiont (40) inhabiting coastal areas and inland saline habitats. However, Ruta et al. (61) suggest, on the basis of numerous records in fresh waters and from light traps situated far from salt waters, that this species can be halotolerant only. Our data can confirm this.

An interesting discovery is also the record of tyrphophilous *Cyphon pubescens* (40), the species that has been known so far from a few sites in southern Poland and regarded as an extremely rare one (18). In the Mazurskie Lake District it was caught only by Katschak (39) in phytolittoral of Lake Klebarskie. However, in the recent years this species has been recorded at numerous sites in 11 regions (21, 30, 31, 39, 57, 60, 61). It was also collected in the countries sharing borders with the study area: Lithuania (25, 69) and Belarus (67, 68). In that case, this species is rather less frequently collected than the really rare one, due to methodological reasons (living environment, a few specialists dealing with the family Scirtidae). This species probably will turn out to be a widely distributed beetle and perhaps even quite frequently found.

The species that are endangered, protected and rare in Poland (5, 14, 45, 48, data in this paper) recorded in the SLP, represent different ecological elements: tyrphophiles (10 species), eurytopes (5 species) as well as halobionts, rheophiles and steppicoles (one species each). The high number and qualitative domination of tyrphophiles in this group show good condition of peat bogs and dystrophic waters in the SLP as well as their significant importance for nature protection. At the same time, there is also the reflection of the threats of fauna of these habitats in Poland which results in disproportionate high share of these species in the national Red List (23, 50). This situation is of frequent occurrence in Europe (26, 27, 29, 35).

Among valuable species recorded in the SLP, rheophilous ones were in small numbers – they were represented only by *Gyrinus distinctus* which was found in lakes. This results from the poor knowledge on the assemblages of beetles of running waters. So far, only some small streams have been studied in the park (5, data in this paper) and the main rivers of the SLP – Czarna Hańcza and Szeszupa have not been examined at all. Taking into account the natural character of long stretches of these rivers and their high natural values (24), which was also confirmed by data about other groups of organisms (e.g., 6, 42, 43, 44, 46, 72), it can be expected that there are the beetle assemblages typical of these habitats and qualitatively rich in species, including endangered and rare species. The studies on these rivers would enrich the list of the species recorded in the SLP. At this

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moment, there are no representatives of the family Elmidae which are strongly associated with running waters and we can expect at least several species which were found in the Czarna Hańcza and Szeszupa Rivers outside the SLP (54). This refers to rheophilous species from other families as well (12, 36).

The habitats that need more attention in the future are also the lakes: numerous, varied in regard to trophy and other habitat conditions, usually in good ecological condition (24). Data on their fauna is fragmentary, except for Lake Hańcza (48, data in this paper) and two water bodies in the basin of Lake Jaczno (5). Similarly like in the rivers, in the lakes of the SLP we can expect high number of beetle species, including rare and endangered ones.

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Tab. 1. Beetles (*Coleoptera*) collected in the waters of the Suwalski Landscape Park in the years 2009 and 2011–2013. L – larvae, I – imagines, N – sum of the collected specimens, %S – % share of a particular species in the number of the collected specimens.

No.	Species	Sites	Material			
			L	I	N	%S
Gyrinidae						
1.	*Gyrinus aeratus* Steph.	3	–	20	20	1.7
2.	*G. distinctus* Aubé	3	–	32	32	2.7
3.	*G. natator* (L.)	7, 15, 19, 20, 28	–	9	9	0.7
4.	*G. paykulli* Ochs	3	–	14	14	1.2
5.	*G. substriatus* Steph.	3, 7, 15–17	–	10	10	0.8
6.	*Orectochilus villosus* (O.F. Müll.)	3	–	17	17	1.4
Haliplidae						
7.	*Haliplus confinis* Steph.	3	–	6	6	0.5
8.	*H. flavicollis* Sturm	3	–	38	38	3.2
9.	*H. fluviatilis* Aubé	17, 19	–	9	9	0.7
10.	*H. fulvicollis* Er.	27	–	1	1	0.1
11.	*H. immaculatus* Gerh.	3, 19, 22	–	16	16	1.3
12.	*H. ruficollis* (De G.)	1, 2, 4–6, 8, 10, 11, 16, 19, 24, 27, 29	–	24	24	2.0
13.	*H. variegatus* Sturm	5	–	2	2	0.2
Noteridae						
14.	*Noterus crassicornis* (O.F. Müll.)	1, 3, 5, 6, 11, 14, 19, 25, 26	–	14	14	1.2
Dytiscidae						
15.	*Agabus affinis* (Payk.)	10, 13	–	9	9	0.7
16.	*A. sturmii* (Gyll.)	13	–	1	1	0.1
17.	*A. undulatus* (Schrank)	14, 29	–	6	6	0.5
–.	*Agabus* sp.	13, 24	5	–	5	0.4
18.	*Ilybius ater* (De G.)	2, 11, 13, 27	–	4	4	0.3
19.	*I. erichsoni* (Gemm. et Har.)	1	–	1	1	0.1
20.	*I. fenestratus* (Fabr.)	3, 19	–	7	7	0.6
21.	*I. fuliginosus* (Fabr.)	20, 22, 24, 27	–	5	5	0.4
22.	*I. quadriguttatus* (Lacord.)	20, 24	–	2	2	0.2
23.	*I. subaeneus* Er.	4, 5, 15, 24	–	4	4	0.3
24.	*Platambus maculatus* (L.)	3	–	63	63	5.2
25.	*Colymbetes paykulli* Er.	11	–	1	1	0.1

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26.	*C. striatus* (L.)	29	–	1	1	0.1
27.	*R. frontalis* (Marsh.)	20	–	1	1	0.1
28.	*Rhantus grapii* (Gyll.)	3	–	1	1	0.1
29.	*R. latitans* Sharp	18	–	1	1	0.1
30.	*R. suturalis* (Mac L.)	5, 20	–	3	3	0.2
–.	*Rhantus* sp.	4	1	–	1	0.1
31.	*Liopterus haemorrhoidalis* (Fabr.)	24	–	1	1	0.1
32.	*Acilius canaliculatus* (Nic.)	3, 11, 14, 19, 26, 29	1	5	6	0.5
33.	*A. sulcatus* (L.)	2-4	–	3	3	0.2
34.	*Graphoderus austriacus* (Sturm)	3, 17	–	2	2	0.2
35.	*G. cinereus* (L.)	3, 5, 26	–	5	5	0.4
–.	*Graphoderus* sp.	10	2	–	2	0.2
36.	*Cybister lateralimarginalis* (De G.)	3, 4, 15, 19, 25	14	2	16	1.3
37.	*Dytiscus marginalis* L.	3	–	1	1	0.1
–.	*Dytiscus* sp.	1, 4, 7, 8, 12, 14, 24, 27	14	–	14	1.2
38.	*Hydaticus seminiger* (De G.)	5, 10, 24	–	3	3	0.2
39.	*H. transversalis* (Pontopp.)	2	–	1	1	0.1
–.	*Hydaticus* sp.	4, 12, 14, 24, 29	8	–	8	0.7
40.	*Graptodytes pictus* (Fabr.)	3	–	5	5	0.4
41.	*Hydroporus angustatus* Sturm	10, 11, 13	–	3	3	0.2
42.	*H. elongatulus* Sturm	22	–	1	1	0.1
43.	*H. erytrocephalus* (L.)	11	–	3	3	0.2
44.	*H. glabriusculus* Aubé	11	–	1	1	0.1
45.	*H. incognitus* Sharp	10, 11, 13, 17, 19, 21	–	21	21	1.7
46.	*H. melanarius* Sturm	10	–	1	1	0.1
47.	*H. obscurus* Sturm	10	–	1	1	0.1
48.	*H. palustris* (L.)	1, 3,16, 24	–	4	4	0.3
49.	*H. scalesianus* Steph.	5, 10	–	4	4	0.3
50.	*H. striola* (Gyll.)	20,27	–	2	2	0.2
51.	*H. tristis* (Payk.)	10	–	22	22	1.8
52.	*H. umbrosus* (Gyll.)	5, 10	–	7	7	0.6
53.	*Nebrioporus depressus* (Fabr.)	3	–	3	3	0.2
54.	*Porhydrus lineatus* (Fabr.)	4, 15, 16, 19, 20, 24, 26	–	10	10	0.8
55.	*Suphrodytes dorsalis* (Fabr.)	28	–	3	3	0.2

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56.	*Hygrotus decoratus* (Gyll.)	6, 8, 10, 11, 17, 27	–	32	32	2.7
57.	*H. impressopunctatus* (Schall.)	3, 20, 26	–	4	4	0.3
58.	*H. inaequalis* Fabr.	3, 4, 14, 22, 26	–	13	13	1.1
59.	*H. versicolor* (Schall.)	3	–	49	49	4.1
60.	*Hyphydrus ovatus* (L.)	1-3, 15, 19	–	239	239	19.9
61.	*Laccornis oblongus* (Steph.)	10	–	1	1	0.1
62.	*Laccophilus hyalinus* (De G.)	19	–	12	12	1.0
63.	*L. minutus* (L.)	3, 14, 16	–	6	6	0.5
–.	*Laccophilus* sp.	14, 16	6	–	6	0.5
Helophoridae						
64.	*Helophorus aquaticus* (L.)	2, 7, 9, 23, 24, 26, 28, 29	–	12	12	1.0
65.	*H. granularis* (L.)	7, 14-16, 24, 28	–	16	16	1.3
66.	*H. griseus* Herbst	23	–	6	6	0.5
67.	*H. minutus* Fabr.	3, 7	–	3	3	0.2
Hydrochidae						
68.	*Hydrochus brevis* (Herbst)	6-8, 11	–	4	4	0.3
69.	*H. crenatus* (Fabr.)	4, 15, 24, 29	–	10	10	0.8
70.	*H. elongatus* (Schall.)	15, 16, 24	–	5	5	0.4
71.	*H. ignicollis* Motsch.	4, 15, 26	–	3	3	0.2
72.	*H. megaphallus* Berge H.	4	–	1	1	0.1
Spercheidae						
73.	*Spercheus emarginatus* (Schall.)	15	–	2	2	0.2
Hydrophilidae						
74.	*Anacaena globulus* (Payk.)	10	–	1	1	0.1
75.	*A. limbata* (Fabr.)	17, 19	–	3	3	0.2
76.	*A. lutescens* (Steph.)	3, 8, 10, 11, 13, 17, 22, 24, 28	–	29	29	2.4
77.	*Berosus frontifoveatus* Kuw.	20	–	4	4	0.3
78.	*B. luridus* (L.)	1	–	1	1	0.1
79.	*Enochrus affinis* (Thunb.)	2, 3, 20, 24, 26, 29	–	12	12	1.0
80.	*E. coarctatus* (Gredl.)	3, 5, 8, 10, 11, 14, 17, 20, 23, 25, 27	–	27	27	2.2
81.	*E. melanocephalus* (Ol.)	20	–	5	5	0.4
83.	*E. ochropterus* (Marsh.)	25	–	1	1	0.1
83.	*E. quadripunctatus* (Herbst)	3, 20	–	17	17	1.4
84.	*E. testaceus* (Fabr.)	3	–	1	1	0.1

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85.	*Helochares obscurus* (O.F. Müll.)	2, 3, 8, 14-17, 22, 24, 26	–	26	26	2.2
86.	*Hydrobius fuscipes* (L.)	3, 13, 20, 23	–	5	5	0.4
87.	*Hydrochara caraboides* (L.)	3, 22, 24	–	4	4	0.3
–.	*Hydrochara* sp.	1, 6-8, 23, 24	14	–	14	1.2
88.	*Hydrophilus aterrimus* Eschsch.	3, 16	–	2	2	0.2
–.	*Hydrophilus* sp.	4, 8	2	–	2	0.2
89.	*Laccobius minutus* (L.)	3, 17	–	37	37	3.1
90.	*L. striatulus* (Fabr.)	3	–	1	1	0.1
91.	*Coelostoma orbiculare* (Fabr.)	3	–	7	7	0.6
92.	*Cercyon bifenestratus* Küst.	3, 20	–	5	5	0.4
93.	*C. convexiusculus* Steph.	3, 20	–	8	8	0.7
94.	*C. laminatus* Sharp.	20	–	8	8	0.7
95.	*C. lateralis* (Marsh.)	20	–	5	5	0.4
96.	*C. marinus* Thoms.	20	–	22	22	1.8
97.	*C. quisquilius* (L.)	20	–	14	14	1.2
98.	*C. unipunctatus* (L.)	20	–	16	16	1.3
99.	*Cryptopleurum minutum* (Fabr.)	20	–	3	3	0.2
–.	*Hydrophilidae* n.det.	5, 14	3	–	3	0.2
Hydraenidae						
100.	*Limnebius aluta* Bed.	5	–	1	1	0.1
101.	*L. atomus* (Duftschm.)	28	–	1	1	0.1
102.	*L. crinifer* (Rey)	3	–	1	1	0.1
103.	*L. parvulus* (Herbst)	15, 24, 28	–	6	6	0.5
104.	*Ochthebius minimus* (Fabr.)	28	–	1	1	0.1
Dryopidae						
105.	*Dryops anglicanus* Edw.	5	–	2	2	0.2
106.	*D. auriculatus* (Geoffr.)	28	–	1	1	0.1
Heteroceridae						
107.	*Heterocerus fenestratus* (Thunb.)	20	–	1	1	0.1
Scirtidae						
108.	*Cyphon padi* (L.)	19	–	1	1	0.1
109.	*C. pubescens* (Fabr.)	21	–	1	1	0.1

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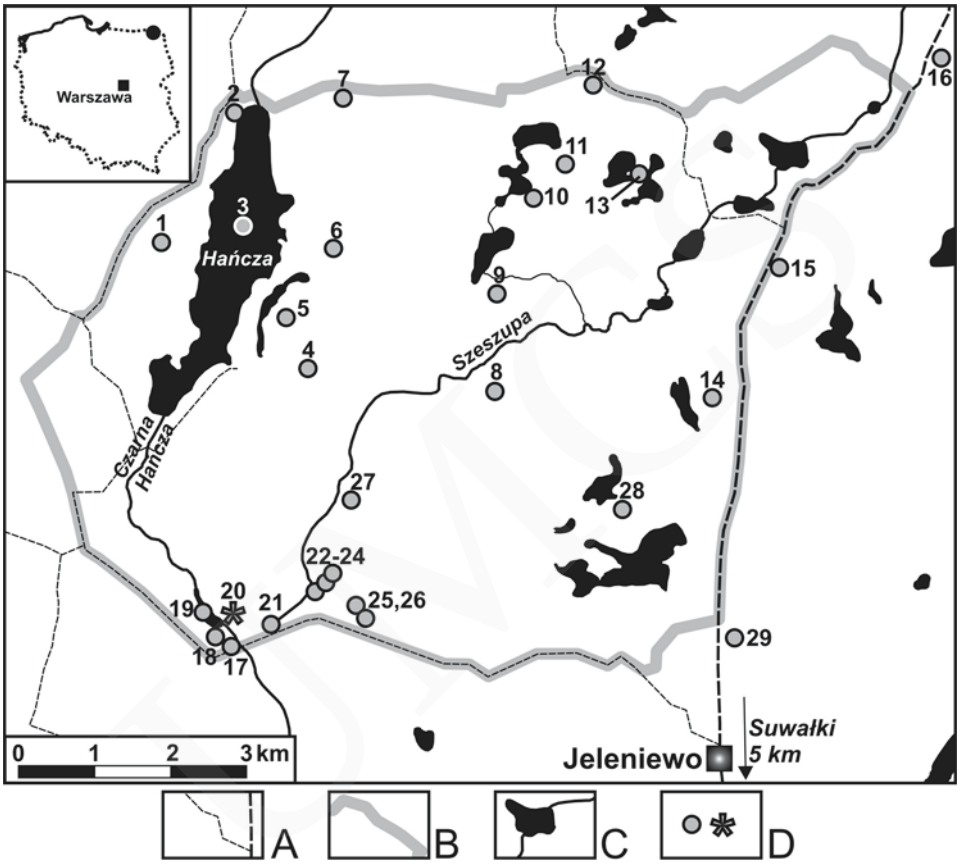


Fig. 1. Study area. A – main roads, B – borders of the SLP, C – bigger running and standing waters, D – sites (circles – locations of hydrobiological studies, asterisk – the location of a light trap).

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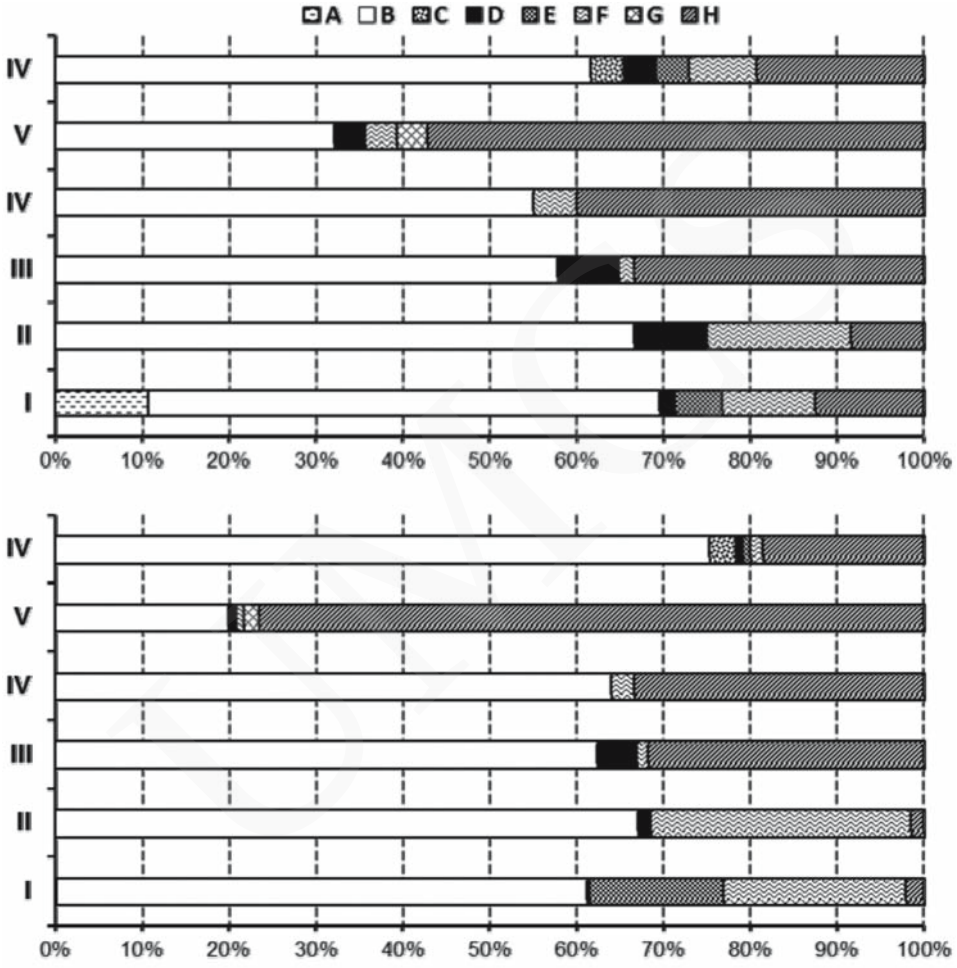


Fig. 2. The share of synecological elements in the material collected in particular habitats (streams were omitted due to the unrepresentativeness of data). Upper diagram – qualitative data, lower diagram – quantitative data, I – lakes, II – dam reservoir, III – small water bodies, IV – fens, V – *Sphagnum* peat bogs, VI – material from a light trap, A – argilophiles, B – eurytopes, C – hylophiles, D – psammophiles, E – rheophiles, 6 – steppicoles, F – tyrphobionts and tyrphophiles.