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Aquatic beetles (Coleoptera) of Wdzydze Landscape Park (Tuchola Forests, N Poland)

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Abstract: The aquatic beetle fauna was studied in 80 localities in Wdzydze Landscape Park (N Poland) in the years 2004 and 2007-2009. The landscape park was chosen as a typical fragment of Tuchola Forest, which belongs to the most valuable nature areas in Poland. 113 species were recorded. The most interesting ones were: *Haliplus fulvicollis*, *H. varius*, *Agabus fuscipennis*, *Rhantus suturellus*, *Dytiscus lapponicus*, *Hydroporus discretus* and *Dryops anglicanus*. The composition of faunas of particular habitats was analysed. Rivers, fens and peat bogs were found as the most valuable habitats.

Key Words: Coleoptera aquatica, aquatic beetles, landscape park, Tuchola Forests, Poland

Introduction

Northern Poland is a very important area for the conservation of the general diversity of species and the conservation of endangered species of aquatic beetles. There are still biotopes that remain in good conditions, such as: lakes and other water bodies with standing water, *Sphagnum* bogs, and clean rivers running in a morphologically diversified landscape. Studies of this part of Poland are necessary to pinpoint the important areas for beetle diversity and to plan actions for its conservation. The research is also a source of valuable zoogeographical data (geographical ranges). Meanwhile, the data referring to the substantial part of northern Poland are only historical or they are very fragmentary (Buczyński and Przewoźny 2009).

Tuchola Forest is an area considered as one of the most valuable in northern Poland. However, water beetles of this area are poorly known. Except Pakulnicka's (2006) paper

about Tuchola National Park, as a matter of fact based only on a very small material (343 specimens, 43 species), there is a lack of complete works. The rest of works are only contributions or preliminary studies of different areas (e.g. Buczyński and Przewoźny 2005, 2008, 2009; Gutowski et al. 2005; Jaskuła and Przewoźny 2009; Klukowska and Tończyk 2002). The purpose of those studies, which results are presented in this paper, was a comprehensive analysis of the occurrence of water beetles in a selected area of Tuchola Forest – Wdzydze Landscape Park (WLP).

Study area

Wdzydze Landscape Park is situated about 50 km to the south-east of Gdansk, between Kościerzyna and Wiele (Fig. 1). The area of the landscape park is 178,32 km^2, the area of the buffer zone is 152,08 km^2 (Czechura 2008).

The study area is placed in the South Pomeranian Lake District, Tuchola Forest mesoregion, on a sandur of the Pomeranian phase of glaciations in the Wda River basin (Kondracki 2002). This sandy bed is covered with thick pine forests planted here ca. 200-300 years ago. Natural forest ecosystems are preserved only locally. The development of settlements is very little intensified; moreover, present villages are small and dispersed. The percentage of forest areas in the WLP accounts for 64%, agricultural areas constitute only 12% of the area of the landscape park (Czechura 2008; ZMiDZW 2009).

Surface water makes up about 11% of the landscape park area (Czechura 2008). The axis of WLP, so called cross of the Wdzydze lakes, is formed by four ribbon lakes which come together in the vicinity of Wdzydze Kiszewskie. Those lakes are: Radolne Lake, Jeleń Lake, Wdzydze Lake and Gołuń Lake (Fig. 1). Moreover, there are several dozens of lakes and hundreds of small water bodies in WLP. The bigger lakes are mostly oligo- and mesotrophic, smaller are dystrophic or occur frequently as peat bog lakes. In the vicinity of those water bodies and as remains of some of them *Sphagnum* bogs are formed there numerously.

The main river of the landscape park is the Wda River (Czarna Woda), running through the part of the lakes. In the northern part of the WLP the Trzebiocha River flows into the Wda River. Both rivers have a very natural character. From the western side, through Lakes Słupino and Lake Słupinko, flows the Przerębel River into the Wda River. There are also small streams in many parts of the landscape park. The ones situated in meadows are frequently regulated and transformed into drainage ditch systems. Meadows in valleys of rivers and streams (as also on shores of some lakes) have the character of fens.

Based on our observations, WLP is characterised by good quality of surface waters, but there is still only a few data about it. The Voivodeship Inspection of Environmental Protection (WIOŚ) in Gdańsk has been studying the Wda River only in one locality, far beyond the landscape park. Other rivers and streams have not been studied. The monitoring of the lakes of the landscape park is conducted only on Lake Schodno which is ranked as IV class water because of the eutrophication index (Czechura 2008).

More complete but older data (from the year 2001) come from a report based on research conducted by the Scientific Circle of Chemists of the Gdańsk University of Technology (Blaszke and Babul 2001). In the Wda River, the Trzebiocha River and Rów Płocicki most of the water quality indexes were around the values of I water quality class. All watercourses were characterised by a slightly raised concentration of sulfides (III

water quality class). Moreover, the Wda River, in the part after flowing out form lakes had slightly raised $ChZT_5$ index (II or III water quality class).

In the national outline of environmental monitoring four lakes were studied: Lake Schodno and Wyrówno – Osty – Bielawy lake complex (Blaszke, Babul 2001). The value of $ChZT_5$ index and concentration of sulfides indicated III water quality class; however others indexes indicated I water quality class.

In respect of the climate, the research area lies in the East Pomerania region (Woś 1996). It is characterised by the biggest number of cold or very cold days and a small number of very warm days in Poland. An average air temperature in January is –2 ºC, in July 16-17 ºC. Annual precipitation is circa 700 mm and the growing season lasts about 190 days.

Methods and material

The material was collected in the years: 2004 and 2007-2009. The studies were conducted every time in a different month (July, August, June, and May respectively) and each expedition lasted one week. This time schedule was aimed at collecting all important phenological aspects of the analysed fauna. In the year 2004, during preliminary research, the studies were concentrated on the northern part of the landscape park. In the next years all area of WLP was studied.

Localisation of the studies sites was recorded with GPS Garmin 71 and Garmin GPS60Map.

The main method of collecting samples was based on gathering semiquantitives samples with a hydrobiological net. 124 samples were taken. The material was sorted in the study place and conserved in 70% ethyl alcohol. Moreover, in some bogs, bottle traps with bait (freezed- dried cat food) were used. 1111 imagines and 98 larvae were collected altogether.

The indexes used in the material analysis were as follows: domination, frequency (in samples), qualitative similarity (Jaccard's Coefficient), quantity similarity index (Biesiadka's formula) (Biesiadka 1977; Kasprzak and Niedbała 1981; Szujecki 1983). The value of faunistic similarity was organized with short dendrite method.

The method of the division of beetles into ecological elements was performed in accordance with Przewoźny et al. (2006), and the division of unclassified species – on the basis of reference articles for this topic (Galewski 1990; Galewski and Tranda 1976).

A method proposed by Buczyński et al. (2007) was used in sozological analyses and in the evaluation of the importance of the area to studies about protection of beetles. On the basis of these data, following categories of species found in the collected material were distinguished: endangered on the country scale, of high importance (categories VU-CR), giving it 5 points; endangered on the country scale, of low importance (LC and NT) – 4 points; endangered on the region scale only, of high importance – 3 points; endangered on the region scale only, of low importance – 2 points; having only indicator – 1 point. Summing up the points for particular sites and habitats the data of high importance to specific protection of beetles was obtained.

Study sites

Studies were carried out in 80 sites representative for the study area. Two of them were placed in the landscape park's buffer zone but very near its border. They were chosen

because of the poor representation of sand mines and lack of big canals in WPL. The localities list with UTM codes (squares 10x10 km) and geographical coordinates are presented below.

1. Płocice, a meadow stream (so called Rów Płocicki) (XV89; 54°04’00” N, 17°50’47” E); **2.** Płocice, the Wda River (in forest part) (XV89; 54°04’14” N, 17°50’05” E); **3.** Płocice, a temporary water body in a meadow in valley of the Wda River (XV89; 54°05’06” N, 17°49’51” E); **4.** Szwedzki Ostrów, a lake without a name (XV89; 54°03’49” N, 17°49’50” E); **5.** Szwedzki Ostrów, the Wda River (a meadow part) (XV89; 54°03’40” N, 17°50’20” E); **6.** Szwedzki Ostrów, a stream with a source in a spring in an alder grove (XV89; 54°03’38” N, 17°50’14 E); **7.** Szwedzki Ostrów, springs (helocrenes) in meadow in valley of the Wda River (XV89; 54°03’33” N, 17°50’12 E); **8.** Wyrówno, Lake Wyrówno (XV89; 54°03’48” N, 17°49’22” E); **9.** Kalisz, water bodies in sand mine in a village (XV 89; 54°02’54” N, 17°47’36” E); **10.** Kalisz, a stream (part in urban area) (XV 89; 54°02’47” N, 17°47’53” E); **11.** Kalisz, Lake Szmytkowo (XV 89; 54°02’55” N, 17°48’37” E); **12.** Kalisz, a *Sphagnum* bog near Lake Szmytkowo (XV 89; 54°02’55” N, 17°48’37” E); **13.** Kalisz, a lake without a name NE from Lake Szmytkowo (XV 89; 54°03’02” N, 17°48’13” E); **14.** Kalisz, a *Sphagnum* bog in a forest NE from a village (XV 89; 54°02’42” N, 17°48’45” E); **15.** Kalisz, a stream in a meadow 1 km E from a village (XV 89; 54°02’33” N, 17°47’06” E); **16.** Biała Góra, a small water body in a field (XV 89; 54°02’00” N, 17°48’53” E); **17.** Belfort, canals in meadow S from Lake Bielawy (XV 89; 54°02’37” N, 17°50’03” E); **18.** Belfort, a water body in a sand mine on a meadow edge SE from Lake Bielawy (XV 89; 54°02’02” N, 17°49’40” E); **19.** Belfort, a peat excavation in a meadow fen (XV 89; 54°02’27” N, 17°50’32” E); **20.** Belfort, a lake without a name (XV 89; 54°02’23” N, 17°50’39” E); **21.** Belfort, a lake without a name (XV 89; 54°02’25” N, 17°50’18” E); **22.** Belfort, a *Sphagnum* bog (“Żôbińsczich Błoto” ecological ground) (XV 89; 54°02’18” N, 17°51’03” E); **23.** Kula, a small meadow water body (XV 89; 54°03’26” N, 17°50’27” E); **24.** Kula, a *Sphagnum* bog in a forest E from a village (XV 89; 54°03’35,5” N, 17°30’42,0” E); **25.** Schodno, a *Sphagnum* bog in a forest W from a village (XV 89; 54°02’55,6” N, 17°50’36,7” E); **26.** Schodno, the Wda River above Lake Schodno (XV 89; 54°03’14,4” N, 17°50’49,6” E); **27.** Schodno, Lake Schodno – W part (XV 89; 54°02’57,3” N, 17°51’06,7” E); **28.** Schodno, meadow streams W from a field school (XV 89; 54°02’56,4” N, 17°50’51,0” E); **29.** Schodno, Lake Schodno – E part (XV 89; 54°02’48” N, 17°51’53” E); **30.** Schodno, the Wda River below Lake Schodno (a meadow part) (XV 89; 54°02’33” N, 17°51’44” E); **31.** Schodno, an oxbow of of the Wda River below Lake Schodno (a meadow part) (XV 89; 54°02’33” N, 17°51’44” E); **32.** Loryniec, a fen near Lake Jezierzno (XV 89; 54°02’32” N, 17°52’20” E); **33.** Loryniec, two lakes with *Sphagnum* bog (“Wësków Bagna” ecological ground) (XV 89; 54°02’46” i 54°02’45” N, 17°52’42” i 17°52’45” E); **34.** Loryniec, the Wda River above the Trzebiocha River outlet (the edge of a forest and a meadow) (XV 89; 54°02’40” N, 17°52’53” E); **35.** Loryniec, a pond in valley of the Trzebiocha River (XV 89; 54°03’40” N, 17°53’52” E); **36.** Loryniec, the Trzebiocha River (a forest stretch) (XV 89; 54°03’09” N, 17°53’31” E); **37.** Czaplewo, the stream Debrzyca (Rosocha) (a meadow stretch) (XV 89; 54°03’07” N, 17°54’12” E); **38.** Wąglikowice, a spring (helocrene) in valley of the Trzebiocha River (XV 89; 54°03’00” N, 17°53’27” E); **39.** Wąglikowice, the Trzebiocha River (a meadow stretch near the outlet to the Wda River) (XV 89; 54°02’55” N, 17°53’31” E); **40.** Wąglikowice, the Wda River below the outlet of the Trzebiocha River (tree-covered belt in a village) (XV 89; 54°02’24” N, 17°53’16” E); **41.** Juszki, Lake Głęboczko (XV99; 54°02’28” N, 17°57’26” E); **42.**

Juszki, Lake Mieliste (XV99; 54°02’31” N, 17°57’18” E); **43.** Juszki, Lake Strupino (XV99; 54°02’26” N, 17°58’14” E); **44.** Juszki, Strupino bog (a small *Sphagnum* bog with a disappearing lake) (XV99; 54°02’28” N, 17°58’01” E); **45.** Piechowice, Lake Cheb (XV89; 54°00’42” N, 17°47’56” E); **46.** Piechowice, a canal from Lake Cheb (XV89; 54°00’35” N, 17°48’48” E); **47.** Słupinko, the Przerębel River (XV88; 54°01’18” N, 17°51’08” E); **48.** Słupinko, meadow drainage in valley of the Przerębel River (XV88; 54°01’17” N, 17°51’09” E); **49.** Słupinko, the oxbow of the Przerębel River (XV88; 54°01’17” N, 17°51’09” E); **50.** Przerębska Huta, Lake Zdradzonko (XV88; 54°00’55” N, 17°51’28” E); **51.** Przerębska Huta, an alder grove in the “Przerębska Huta” ecological ground (XV88; 54°00’49” N, 17°52’21” E); **52.** Przerębska Huta, the Wda River near the outlet to Lake Radolne (XV88; 54°01’05” N, 17°53’34” E); **53.** Przerębska Huta, Lake Radolne – W part (XV88; 54°00’13” N, 17°51’34” E); **54.** Czarlina Osada, Lake Radolne – the central part (XV88; 54°00’29” N, 17°54’14” E); **55.** Czarlina, the Wda River above a village (XV99; 54°01’26” N, 17°54’40” E); **56.** Czarlina, an overflow area in a meadow in valley of the Wda River (XV99; 54°01’26” N, 17°54’40” E); **57.** Czarlina, a peat excavation in a fen meadow (XV99; 54°01’12” N, 17°54’55” E); **58.** Czarlina, Lake Jelenie (XV99; 54°01’27” N, 17°55’19” E); **59.** Wdzydze Kiszewskie, a stream spring N from a village (reohelocrene) (XV98; 54°01’41” N, 17°57’53” E); **60.** Wdzydze Kiszewskie, a stream N from a village (XV98; 54°01’25” N, 17°56’57” E); **61.** Wdzydze Kiszewskie, Lake Wałachy (XV98; 54°00’42” N, 17°57’13” E); **62.** Wdzydze Kiszewskie, a small water bodies in a forest with *Sphagnum* shores E from Lake Wałachy (XV98; 54°00’42” N, 17°57’37” E); **63.** Wdzydze Kiszewskie, a small *Sphagnum* bog in the “Kiszewskie Bagno” ecological ground (XV98; 54°00’27” N, 17°57’33” E); **64.** Wdzydze Kiszewskie, Lake Gołuń (XV98; 54°00’24” N, 17°57’30” E); **65.** Gołuń, Lake Kotel (CE08; 54°00’57” N, 18°00’31” E); **66.** Gołuń, a peat excavation in a fen W from Lake Kotel (CE08; 54°00’59” N, 18°00’27” E); **67.** Olpuch, a sand pit in a meadow near Lake Kotel (CE08; 54°00’35” N, 18°01’11” E); **68.** Kruszynia, a small *Sphagnum* bog in the “Torfowisko przy Jez. Gołuń” ecological ground (XV98; 53°57’57” N, 17°59’07” E); **69.** Kloc, Lake Lipino (XV88; 53°59’40” N, 17°49’04” E); **70.** Czarne, an oval lake near NE shore of Lake Motowęże (Małowęże) (XV88; 53°58’36” N, 17°50’07” E); **71.** Jastrzębie, Lake Jastrzębie (XV89; 53°58’37” N, 17°48’07” E); **72.** Joniny Wielkie, Lake Zmarłe (XV88; 53°58’29” N, 17°52’14” E); **73.** Rów, a regulated meadow stream (XV88; 53°59’24” N, 17°52’24” E); **74.** Joniny Małe, a small *Sphagnum* bog with a disappearing lake (XV88; 53°58’24” N, 17°53’38” E); **75.** Wdzydze Tucholskie, Lake Głuchówko (XV98; 53°58’39” N, 17°55’59” E); **76.** Wdzydze Tucholskie, a small *Sphagnum* bog near Lake Głuchówko (XV98; 53°58’42” N, 17°56’00” E); **77.** Wdzydze Tucholskie, Lake Czyste (XV98; 54°01’32” N, 17°55’23” E); **78.** Borsk, a stream N from a village (XV98; 53°57’35” N, 17°55’23” E); **79.** Borsk, the Wda River below Lake Wdzydze (XV98; 53°57’19” N, 17°55’05” E); **80.** Borsk, the Wda River canal (Czarnowodzki) S from a village (XV98; 53°56’29” N, 17°56’08” E).

Results

113 species from 10 families were found. Some of larvae determination was carried out only at genus and subfamily level. The review of species is given in the Tab. 1.

More thorough data about species recorded in the studied area which are rare, protected and endangered in Poland are presented below (Ex./Exx. – adult/adults, LL – larvae):

- *Haliplus fulvicollis*
  [68] Kruszynia, a small *Sphagnum* bog near the south shore of Lake Gołuń – without distinguished water bodies, with a *Carex* sp. swamp and with strongly hydrated *Sphagnum* sp.; material: 12 V 2009, 4 exx.;
- *Haliplus varius*
  [17] Belfort, a drainage ditch flowing from a meadow fen near the south shore of Lake Bielawy, with stagnant water, 1 m wide, shallow, with muddy bottom, with rich wetland vegetation, edges with discontinuous belt of willow shrubs; material: 16 VII 2004, 1 ex.
  [25] Schodno, a small *Sphagnum* bog in a forest, eutrophic water on the edge of a forest, with the common reed and the lesser bulrush; material: 17 VII 2004, 1 ex.;
- *Agabus fuscipennis*
  [37] Wąglikowice, the Rosocha Stream meandering through a poor fen meadow; circa 2 m wide, 20-40 cm depth, bottom sandy-muddy, slow running, clear water; material: 13 VII 2004, 1 ex. in a belt of slightly sunk grasses near shore;
- *Rhantus suturellus*
  [25] Schodno, a small peatbog (see localities of *Haliplus varius*); material: 15 V 2009, 1 ex. in *Carex* sp. tufts on the shore;
- *Dytiscus lapponicus*
  [22] Belfort, peat excavations and "Żôbińsczich Błoto" Bog: in a forest, with two peat bogs with overgrowing *Sphagnum*; material: 17 VII 2004, 1 ex. in a bottle trap, 11 V 2009, 7 LL between sedges on a peat bog shore;
- *Hydroporus discretus*
  [59] Wdzydze Kiszewskie, a spring in a small fen meadow, in a depression circa 5x20 m in size, with peaty bottom, overgrown by mosses, in some places with an iron ochre; material: 31 VII 2008, 2 exx. between mosses;
  [73] Rów, a regulated stream in a drained fen meadow, in an artificially straightened river bed surrounded by discontinuous belt of alder trees; up to 0,5 m wide, up to 10 cm depth, slow running, sandy-muddy bottom, clear water; material: 12 V 2009, 1 ex. between roots of shore grasses;
- *Dryops anglicanus*
  [63] Wdzydze Kiszewskie, "Kiszewskie Bagno" – a small peat bog in a forest, without distinguished water bodies, with strongly hydrated *Sphagnum* sp., with *Carex* sp. tufts and small Scots pines (*Pinus silvestris*), in some years drying out; material: 2 VIII 2007, 1 ex., 11 V 2009, 2 exx., always on strongly hydrate *Sphagnum* sp. on edges.

The most common species were: *Noterus crassicornis* and *Platambus maculatus* (with 24 localities), *Ilybius fuliginosus* (22), *Cybister lateralimarginalis* (18) and *Anacaena lutescens* (16). In at least 10% localities 12 species were also recorded (Tab. 1). Frequency structure was similar to species classification based on the number of localities.

The domination structure of collected material was balanced (Tab. 1). There were no eudominants and there were only two dominants: *Platambus maculatus* and *Noterus crassicornis*. There were also distinguished: 14 subdominants, 11 recendents and as many as 86 accidents species.

The biggest number of individuals were representing eurytopic species (52,7% species / 50,4% individuals). The second in number were tyrphophilous and tyrphobiontic species (33,0% / 24,5%), third – reophilous species (9,8% / 20,9%). The remaining ecological elements were represented by a small number of species: psammophilous (1,8% / 2,9%), hylophilous (2,7% / 1,0%), crenophilous (0,9% / 0,2%) and argilophilous (0,9% / 0,1%).

In particular biotopes from 17 to 46 species were collected. The most diverse fauna was present in small water bodies in open area, mires and also in streams. The least diverse were springs, small water bodies in forests, small ditches and canals (Tab. 1).

Faunas of particular biotopes were very distinctive (Fig. 2) The biggest values of the index of faunistic quality similarity reached 35,7%. The most specific was the fauna of springs. Rivers and streams with all types of standing waters presented the biggest level of similarity (>30% in quality analysis and >12% in quantity analysis).

Participation of eurytopic species in fauna of individual biotopes ranged from circa 20% to almost 80%. Lakes and small water bodies were the most eurytopic biotopes. In other biotopes, there were mostly stenotops (reophilous, tyrphobiontic and tyrphophilous species). It mostly concerned springs, rivers and mires (Fig. 3).

Three species from the Red List of Threatened Animals in Poland were recorded: *Haliplus fulvicollis* (VU category), *H. varius* (EN) and *Dytiscus lapponicus* (VU). Moreover, some umbrella species were recorded: *Ilybius fenestratus*, *I. fuliginosus*, *Platambus maculatus* and *Dytiscus lapponicus*. Endangered and indicator species were recorded in 30 localities. There was always one of them present. In sozological classification four localities had five points (no. 17, 22, 25, 68) and 26 localities with only one point (no. 5, 9, 15, 23, 26, 27, 29, 30, 31, 34, 35, 36, 39, 40, 42, 43, 46, 47, 52, 54, 55, 60, 65, 70, 71, 77).

Endangered and indicator species were recorded in all biotopes excluding springs (Fig. 4). The biggest number of points in sozological classification had mires (15) and rivers (9). All running waters (three different types) had altogether 17 points.

Discussion

113 species recorded from the WLP constitute about 40% of the total number of aquatic beetles species from studied families that were recorded in Poland (Bogdanowicz et al. 2004). It is a high number comparing to other studied of landscape parks. For example, in Kozłowiecki Landscape Park 100 species of water beetles were recorded (Buczyński et al. 2007), in Łomżyński Landscape Park of Valley of the Narew River – 105 (Biesiadka and Pakulnicka 2004), in Krzczonowski Landscape Park – 113 (Buczyński and Przewoźny 2002).

It is the good quality of environment that influenced such a great diversity of water beetles fauna in WPL. However, the diversity is restricted by the forest nature of this area. Many water beetles prefer water bodies placed in open, sunny area, with rich vegetation and not acidified (Galewski 1990; Galewski and Tranda 1976; Klausnitzer 1996). Such biotopes are not numerous in WPL; as a result, such beetles families as *Helophoridae* family are poorly represented comparing to the data from the Bug River valley (Przewoźny et al. 2006).

Among the most precious, from the faunistic and sozological point of view, species recorded in the WLP, the most numerous were tyrphophilous and tyrphobiontic species: *Haliplus fulvicollis*, *Rhantus suturellus*, *Dytiscus lapponicus*, *Dryops anglicanus* (Galewski

and Tranda 1976; Klausnitzer 1996; Przewoźny et al. 2006). They are known only from few regions in Poland (Burakowski et al. 1976, 1983), moreover, from few or a dozen or so localities in our age (after publishing Catalogus faunae Poloniae). They are found mostly or exclusively in northern and eastern Poland. It is typical of this synecological species group, of which biotopes had disappeared in bigger part of Poland (Balana et al. 2006; Biesiadka 1996; Biesiadka and Pakulnicka 2004; Buczyński et al. 2001, 2006, 2009; Buczyński and Przewoźny 2002, 2008; Buczyński and Zawal 2004; Klukowska and Tończyk 2002; Przewoźny et al. 2006; Przewoźny and Lubecki 2004; Zawal et al. 2004). That is why, the area of WLP is precious for protection of the beetles.

Hydroporus discretus is a crenophile (Klausnitzer 1996). Thought, with a very large area of occurrence in Poland (15 regions) it is very rarely recorded in Poland. It is also a result of a very small interest about springs by coleopterologists (Pakulnicka 1999).

Eurytopic *Haliplus varius* has been always a rarely collected species in Poland. In present, it is recorded only from a few localities in Pomeranian Lake District, Podlasie and Lubelska Upland (Buczyńska and Buczyński 2007; Buczyńska et al. 2007, and data in this paper). Because of its population regress, this species was recognised as endangered in Poland (EN) (Pawłowski et al. 2002) and all present data about it are very precious. Similar in terms of biotopes and distribution is *Agabus fuscipennis.* However, this species has not been considered as endangered in the Polish Red List, because of a bigger number of present records (Buczyńska and Buczyński 2006; Buczyński and Przewoźny 2009; Buczyński and Piotrowski 2002; Buczyński and Staniec 1998; Czachorowski et al. 1993; Kordylas 1994; Pakulnicka and Bartnik 1999; Pakulnicka and Zawal 2007; Przewoźny et al. 2006; Tończyk and Pakulnicka 2004). However, it is still a species which should be continuously monitored.

A noticeable big quantity of *Cybister lateralimarginalis* was collected in the material from WPL. This species is relatively widely distributed in Poland. It has been recorded from 15 regions (Burakowski et al. 1976 and numerous later works). However, it has been recorded in a small number of individuals and only in few localities. In many studies it has not been even recorded, probably as a result of applied research methods. Predatory, big and heavy adults of *C. lateralimarginalis* are dispersed and occur in small numbers. The larvae are also frequently cannibalistic; therefore, a big mortality rate is present among them. In this circumstances whenever entomologists look for adults (many are doing this also nowadays) very little records are obtained. However, nowadays good keys to determine Dytiscidae larvae are available, of which the key to Dytiscinae (Galewski 1995) is the easiest to use. The larva of *C. lateralimarginalis*, because of its size and reduction of appendices of the last segment of the abdomen, is easy to recognize in nature. Others larvae of Dytiscinae can be also determine but it is more complex. It includes the use of stereomicroscope and frequently the measurements of some body parts (for example width and length of the head). That is why not only adults but also larvae of Dytiscidae are worth collecting.

Significant presence of eurytopic species in beetle fauna is typical of lowland areas (Buczyński et al. 2007). In WLP the number of eurotopic species was small in comparison to other areas (Biesiadka and Pakulnicka 2004; Przewoźny et al. 2006) and even in comparison to areas where mire biotopes dominate (Buczyńska and Buczyński 2006). That is probably due to the forest type drainage basin in the studied area and small fertility of the water which is also frequently acidified. Those speculations are confirmed by a large number of species with big oxygen needs as well as tyrphobiontic

and tyrphophilous species followed by a small number of beetles preferring biotopes rich in algae.

An interesting aspect of presented results refers to an also large faunistic separation of biotopes, seen also at localities level. Value of similarity, which biotopes are grouped on dendrites, are about 100% lower than usually for qualitative similarities and at least 50% for quantitative similarities (Biesiadka and Pakulnicka 2004; Buczyński et al. 2007; Przewoźny et al. 2006). It is also not common that biotopes on both dendrites are placed almost identically. It means that migration between the localities is very restricted. It can be also associated with the forest character of the studied area and a big degree of isolation of many sites. Most of the compared data are from more open areas (op. cit.)

The results of sozological analyses show that WLP has, at least, a country-scale meaning for the protection of water beetles, especially for the fauna of small rivers and mires. The valuable elements were recorded from different parts of the landscape park. A slight preponderance of its northern fragment is probably a result from a denser hydrographical web and conclusively, a larger number of potential biotopes. The condition of all fauna and the occurrence of special treatment species and indicator species show the rightness in outlined areas of protection and also good work of WLP service, which efficiently protects the most valuable parts of the nature.

The WLP was chosen to study as the representative part of the Tuchola Forest. The obtained data allow the authors to state that this region, in terms of water beetles fauna and its protection, is one of most valuable in Poland. It also coincides with other data about its ecosystems and also with results of other preliminary studies of water beetles in Tuchola Forest National Park (Banaszak and Tobolski 2006; Pakulnicka 2006)

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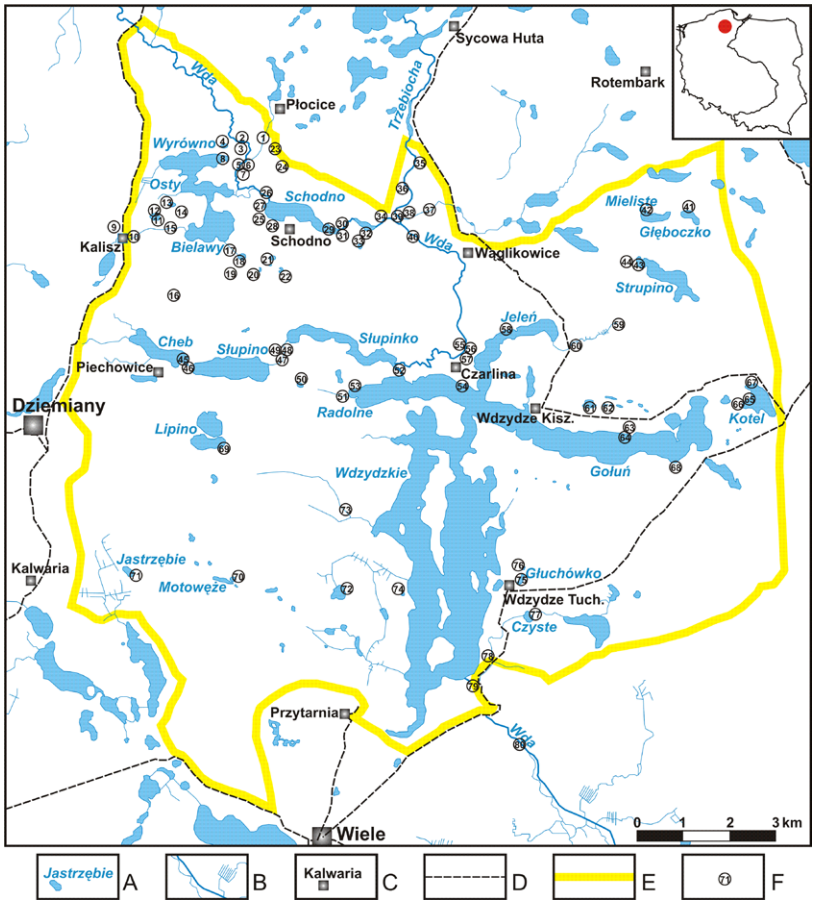

Fig. 1. Study area. A – lakes and larger small water bodies; B – rivers, streams, channels and ditches; C – larger villages; D – main roads; E – borders of the Wdzydzki Landscape Park; F – study sites.

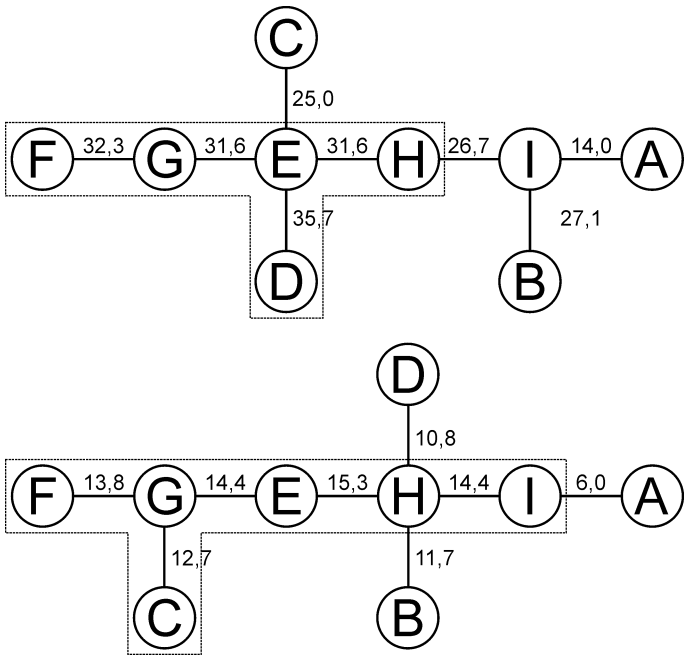

Fig. 2. Faunistic similarities between studied habitats (symbols of habitats like in the Table 1). Upper diagram – quantitative data, lower diagram – quantitative data.

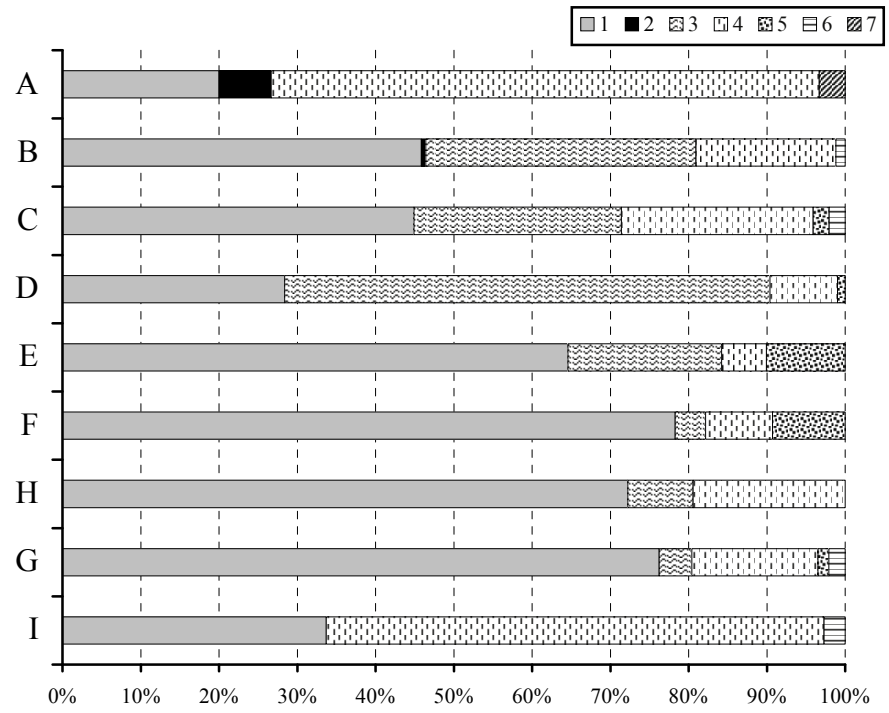

Fig. 3. Ecological composition of material collected in studied habitats (quantitative data). A-I – habitats (symbols of habitats like in the Table 1), 1-7 – ecological elements (1 – eurytopes, 2 – crenophiles, 3 – reophiles, 4 – tyrfophiles i tyrfobiontes, 5 – psammophiles, 6 – hylophiles, 7 – argilophiles).

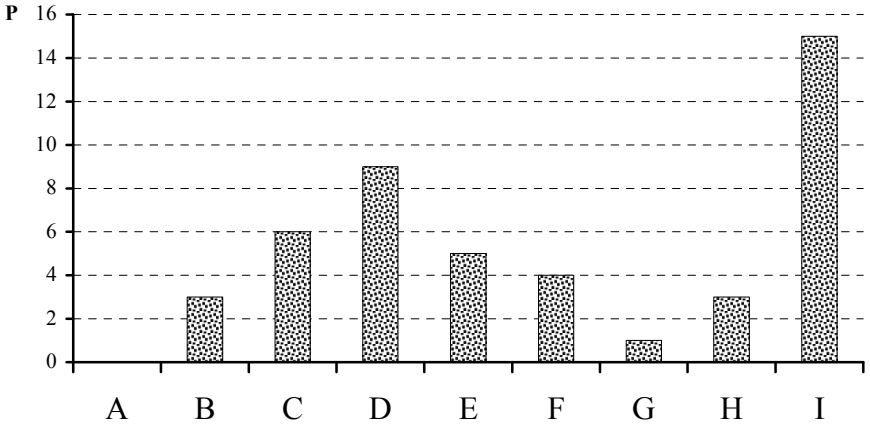

Fig. 4. Sozological importance of studied habitats. P – points, A-I – habitats (symbols of habitats like in the Table 1).

Tab. 1. Aquatic beetles recorded in Wdzydze Landscape Park. N – number of specimens collected, D – dominance [%], F – frequency [%]. Habitat distribution – numbers of specimens collected in particular habitats (A – sprigs, B – streams, C – small ditches and channels, D – rivers and the Czarnowodzki Channel, E – harmonic lakes, F – dystrophic lakes, G – small water bodies in a forest, H – small water bodies in an open landscape, I – fens and peat bogs)

Species		Material collected													
		Study sites no.	General data			Habitat distribution									
			N	D	F	A	B	C	D	E	F	G	H	I
Gyrinidae															
1.	*Gyrinus aeratus* Steph.	13, 29, 50, 64	35	2,9	3,4					32	3			
2.	*G. marinus* Gyll.	2, 20, 29, 57, 65	29	2,4	4,2				10	1	10		8	
3.	*G. minutus* Fabr.	50, 69, 70	7	0,6	2,5						7			
4.	*G. natator* (L.)	15, 60	2	0,2	1,7		2							
5.	*G. substriatus* Steph.	5, 6, 9, 15, 18, 22, 28, 29, 33, 37, 60, 73, 74	59	4,9	13,4		43		2	5			7	2
6.	*Orectochlus villosus* (O.F. Müll.)	1, 2, 26, 34, 36, 39, 40, 49, 55, 64	29	2,4	9,3		1		24	2			2	
Haliplidae															
7.	*Haliplus flavicollis* Sturm	11, 17, 27, 42, 43, 58, 64, 65, 77, 79	35	2,9	9,2				2	20	12			
8.	*H. fluviatilis* Aubé	1, 5, 17, 21, 23, 27, 28, 29, 33, 34, 47, 64, 79	23	1,9	12,6		7	2	3	10	1		1	
9.	*H. fulvicollis* Er.	68	4	0,3	0,8									4
10.	*H. heydeni* Wehncke	17, 28, 35	3	0,2	2,5		1	1				1		
11.	*H. immaculatus* Gerh.	57, 58, 80	6	0,5	2,5				4	1			1	
12.	*H. lineatocollis* (Marsh.)	47	1	0,1	0,8		1							
13.	*H. obliquus* (Fabr.)	79	1	0,1	0,8				1					
14.	*H. ruficollis* (De G.)	19, 42, 62, 73	7	0,6	3,4		4			1		1	1	
15.	*H. sibiricus* Motsch.	79, 80	14	1,2	1,7				14					
16.	*H. varius* Nic.	17, 25	2	0,2	1,7			1						1
Noteridae															
17.	*Noterus clavicornis* (De G.)	2, 22, 57	3	0,2	2,5				1				1	1
18.	*N. crassicornis* (O.F. Müll.)	11, 12, 13, 16, 22, 25, 28, 30, 31, 33, 44, 45, 46, 57, 61, 62, 66, 68, 69, 70, 71, 72, 74, 75	75	6,2	31,9		3	4	4	15	18	3	10	19
Dytiscidae															
19.	*Agabus affinis* (Payk.)	12, 25, 68	10	0,8	2,5									10
20.	*Agabus bipustulatus* (L.)	37	1	0,1	0,8		1							
21.	*A. congener* (Thunb.)	37	1	0,1	0,8		1							
22.	*A. fuscipennis* (Payk.)	37	1	0,1	0,8		1							

23.	*A. paludosus* (Fabr.)	1, 60, 73	4	0,3	2,5		4							
24.	*A. sturmii* (Gyll.)	78	2	0,2	0,8		2							
25.	*A. uliginosus* (L.)	28, 38	4	0,3	1,7	2	2							
26.	*A. undulatus* (Schrank)	23	2	0,2	0,8								2	
–.	*Agabus* sp.	72	1	0,1	0,8						1			
27.	*Ilybius aenescens* Thoms.	22	1	0,1	0,8									1
28.	*I. ater* (De G.)	9, 17, 30, 31, 37	7	0,6	5,0		1	2	1				3	
29.	*I. chalconatus* (Panz.)	1, 7, 10, 23, 48	9	0,6	5,0	1	7						1	
30.	*I. fenestratus* (Fabr.)	27, 29, 31, 34, 35, 42, 43, 54, 65, 70, 71, 77	30	2,5	12,6				2	13	10	3	2	
31.	*I. fuliginosus* (Fabr.)	1, 2, 5, 6, 9, 15, 17, 23, 26, 27, 28, 30, 31, 34, 35, 37, 47, 48, 53, 72, 73, 78	55	4,5	20,2		22	5	21	2	1	1	3	
32.	*I. guttiger* (Gyll.)	22, 23, 25, 37, 63	6	0,5	4,2		1						1	4
33.	*I. neglectus* (Er.)	7	1	0,1	0,8	1								
34.	*I. quadriguttatus* (Lacord.)	17, 23, 33, 62	8	0,7	3,4			1		3		1	1	
35.	*I. similis* (Thoms.)	13	1	0,1	0,8						1			
–.	*Ilybius* sp.	69	2	0,2	0,8						2			
36.	*Platambus maculatus* (L.)	1, 5, 6, 8, 15, 26, 29, 30, 34, 36, 39, 40, 42, 45, 46, 47, 52, 53, 54, 55, 58, 60, 77	86	7,1	23,5		18	1	47	17	3			
–.	*Agabinae* n.det.	68	1	0,1	0,8									1
37.	*Colymbetes striatus* (L.)	23	1	0,1	0,8								1	
38.	*Rhantus exsoletus* (Forst.)	45	2	0,2	0,8					2				
39.	*R. frontalis* (Mash.)	13	1	0,1	0,8						1			
40.	*R. latitans* Sharp	13	1	0,1	0,8			1						
41.	*R. notaticollis* Aubé	23, 25, 28	3	0,2	2,5		1						1	1
42.	*R. suturalis* (MacL.)	62	1	0,1	0,8							1		
43.	*R. suturellus* (Harr.)	25	1	0,1	0,8									1
44.	*Liopterus ruficollis* (Fabr.)	30	3	0,2	0,8				3					
45.	*Acilius canaliculatus* (Nic.)	17, 22	4	0,3	1,7			1						3
46.	*A. sulcatus* (L.)	18, 22, 48	3	0,2	2,5		1						1	1
–.	*Acilius* sp.	22, 62, 68	8	0,7	2,5							1		6
47.	*Graphoderus austriacus* (Sturm)	62	1	0,1	0,8							1		
48.	*G. cinereus* (L.)	22, 35, 72	4	0,3	3,4						1	1	1	1
49.	*G. zonatus* (Hoppe)	22, 25	4	0,3	2,5									4
50.	*Cybister lateralimarginalis* (De G.)	4, 13, 16, 22, 33, 41, 44, 45, 50, 57, 61, 62, 65, 69, 70, 71, 72, 75	51	4,2	21,8					2	31	5	4	19

51.	*Dytiscus circumcintus* Ahr.	28, 69	3	0,2	1,7		1				2			
52.	*D. dimidiatus* Bergstr.	22, 37, 60	3	0,2	2,5		2							1
53.	*D. lapponicus* Gyll.	22	8	0,7	1,7									8
54.	*D. marginalis* (L.)	18, 22, 33, 40, 45, 50, 78	7	0,6	5,9		1		1	1	1		1	2
55.	*Dytiscus* sp.	19, 22, 25, 28, 51, 62, 67, 68, 71, 78	15	1,2	9,2		4				1	3	2	5
56.	*Hydaticus continentalis* Balfour-Browne	25	1	0,1	0,8									1
57.	*H. seminiger* (De G.)	4, 17, 23, 38, 63, 68	10	0,8	6,8	1		3			1		1	4
58.	*H. transversalis* (Pontopp.)	23	2	0,2	0,8								2	
59.	*Bidessus unistriatus* (Schrank)	22	1	0,1	0,8									1
60.	*Graptodytes pictus* (Fabr.)	17, 23, 27, 28, 51, 69, 79	13	1,1	6,7		5	2	1	1	2	1	1	
61.	*Hydroporus angustatus* Sturm	63	1	0,1	0,8									1
62.	*H. discretus* Fairm. et Bris.	59, 73	3	0,2	1,7	2	1							
63.	*H. erythrocephalus* (L.)	12, 22, 50, 68	7	0,6	4,2						1			6
64.	*H. fuscipennis* (Schaum)	23	1	0,1	0,8								1	
65.	*H. incognitus* Sharp	38, 73	4	0,3	1,7	3	1							
66.	*H. melanarius* Sturm	68	1	0,1	0,8									1
67.	*H. memnonius* (Nic.)	7	5	0,4	1,7	5								
68.	*H. neglectus* Schaum	38	1	0,1	0,8	1								
69.	*H. obscurus* Sturm	12, 17, 22, 25, 30, 31, 33, 38, 68, 74, 76	44	3,6	11,8	1		1	10				1	31
70.	*H. palustris* (L.)	7, 17, 18, 23, 24, 31	20	1,7	5,1	1		9					8	2
71.	*H. rufifrons* (Duftschm.)	23	21	1,7	0,8								21	
72.	*H. striola* (Gyll.)	7, 23, 63	9	0,7	2,5	3							2	4
73.	*H. tristis* (Payk.)	7, 22, 24, 25, 30, 63, 76	16	1,3	8,4	1			2					13
74.	*H. umbrosus* (Gyll.)	25, 63, 68	10	0,8	2,5									10
75.	*Nebrioporus depressus* (Fabr.)	80	3	0,2	0,8				3					
76.	*Scarodytes halensis* (Fabr.)	59	1	0,1	0,8	1								
77.	*Suphrodytes dorsalis* (Fabr.)	18, 25, 66	6	0,5	2,5								3	3
78.	*Hygrotus decoratus* (Gyll.)	18, 63, 68	11	0,9	2,5								1	10
79.	*H. impressopunctatus* (Schall.)	23, 30	2	0,2	1,7				1				1	
80.	*H. inaequalis* (Fabr.)	17, 25, 28, 31, 33, 42	7	0,6	5,9		1	2		2			1	1
81.	*H. versicolor* (Schall.)	17, 23, 42	4	0,3	2,5			1		1			2	
82.	*Hyphydrus ovatus* (L.)	17, 27, 35, 49, 65, 69, 70, 71	16	1,3	8,4			1		1	12	1	1	
83.	*Laccophilus hyalinus* (De G.)	26, 27, 30, 34, 35, 37, 39, 46, 55, 58, 79, 80	47	3,9	11,8		2	5	28	10		2		
84.	*L. minutus* (L.)	17, 22, 34	4	0,3	2,5			2	1					1

Helophoridae														
85.	*Helophorus aquaticus* (L.)	28	1	0,1	0,8		1							
86.	*H. flavipes* Fabr.	3, 17, 25, 38, 63	25	2,1	4,2	1		1					4	19
87.	*H. granularis* (L.)	17	1	0,1	0,8			1						
88.	*H. nanus* Sturm	47	1	0,1	0,8		1							
Hydrochidae														
89.	*Hydrochus crenatus* (Fabr.)	23	2	0,2	0,8								2	
90.	*H. elongatus* (Schall.)	23	3	0,2	0,8								3	
Hydrophilidae														
91.	*Anacaena globulus* (Payk.)	26, 47, 73	4	0,3	2,5		3		1					
92.	*A. limbata* (Fabr.)	38, 73	5	0,4	1,7	3	2							
93.	*A. lutescens* (Steph.)	6, 14, 15, 25, 26, 29, 30, 38, 51, 61, 62, 63, 65, 68, 73	48	4,0	14,3	2	13		2	11	2	3		15
94.	*Cymbiodyta marginella* (Fabr.)	13, 15	2	0,2	1,7		1				1			
95.	*Enochrus affinis* (Thunb.)	14, 25, 30, 62, 63, 69	34	2,8	10,1				3		1	2		28
96.	*E. coarctatus* (Gredl.)	31, 50, 62	3	0,2	2,5						1	1	1	
97.	*E. melanocephalus* (Ol.)	25, 45	3	0,2	1,7					1				2
98.	*E. ochropterus* (Marsh.)	14, 20, 21, 22, 50, 62	11	0,9	5,9						4	1		6
99.	*E. quadripunctatus* (Herbst)	25	1	0,1	0,8									1
100.	*E. testaceus* (Fabr.)	27, 29, 31, 32, 35, 45	17	1,4	5,9					14		1	1	1
101.	*Helochares obscurus* (O.F. Müll.)	14, 22, 25, 28, 31, 50, 57, 62	17	1,4	8,4		1				1	3	3	9
102.	*Hydrobius fuscipes* (L.)	3, 23, 27, 28, 38, 51, 68	18	1,5	5,9	1	1			1		3	9	3
103.	*Hydrochara caraboides* (L.)	17, 23, 48, 57	15	1,2	4,2		1	2			1		11	
104.	*Laccobius bipunctatus* (Fabr.)	28, 31, 42, 73	7	0,6	3,4		4			1			2	
105.	*L. minutus* (L.)	26, 27, 28, 29, 30, 52, 53, 58	46	3,8	7,6		1		6	39				
106.	*L. striatulus* (Fabr.)	73	1	0,1	0,8		1							
108.	*Coelostoma orbiculare* (Fabr.)	22, 45	2	0,2	1,7					1				1
108.	*Cercyon convexiusculus* Steph.	55, 68	8	0,7	1,7								7	1
Hydraenidae														
109.	*Limnebius atomus* Duftschm.	23	1	0,1	0,8								1	
110.	*Elmis maugetti* Latr.	2	1	0,1	0,8				1					
111.	*Limnius volcmari* (Panz.)	36	1	0,1	0,8				1					
112.	*Oulimnius tuberculatus* (P.W.J. Müll.)	47	1	0,1	0,8		1							
Dryopidae														
113.	*Dryops anglicanus* Edw.	63	3	0,2	0,8									3

Bibliography

Balana M., Buczyński P., Czarniawski W., Dembicka A., Grądziel T., Ptaszyńska A., Stączek Z. 2006. Uroczysko Lipnik w Lublinie – cenny przyrodniczo wąwóz lessowy. Chrońmy Przyr. ojcz. 62 (1): 42-52.

Banaszak J., Tobolski K. (eds) 2006. Park Narodowy „Bory Tucholskie". Bydgoszcz, Wydawnictwo Uniwersytetu Kazimierza Wielkiego, 318 pp.

Biesiadka E. 1977. Coleoptera. In: A. Wróblewski (ed.), Bottom fauna of the heated Konin lakes: 259-280. PWN, Warszawa – Kraków.

Biesiadka E. 1996. Nowe stanowiska *Dytiscus lapponicus* Gyll. (Coleoptera, Dytiscidae) w Polsce. Przeg. zool. 30 (1-2): 83-85.

Biesiadka E., Pakulnicka J. 2004. Chrząszcze wodne (Coleoptera) Łomżyńskiego Parku Krajobrazowego Doliny Narwi. Parki nar. Rez. Przyr. 23 (3): 427-447.

Blaszke A., Babul P. 2001. Ocena stanu czystości rzeki Wdy na odcinku od Jeziora Lubiszewskiego i Karpno do dopływu Trzebiochy. Sprawozdanie z letniego obozu naukowego Koła Chemików Politechniki Gdańskiej „Schodno 2001". Naukowe Koło Chemików Politechniki Gdańskiej, Klub „Czyste Sudomie i Okolice", Gdańsk – Kościerzyna, 40 pp. (Internet: *www.technologia.gda.pl/nkch/pliki/raport_2001.pdf*)

Bogdanowicz W., Chudzicka E., Pilipiuk I., Skibińska E. (eds) 2004. Fauna Polski. Charakterystyka i wykaz gatunków. Tom I – Annelida; Arthropoda pro parte; Insecta pro parte (Coleoptera, Hemiptera, Hymenoptera, Lepidoptera). Muzeum i Instytut Zoologii PAN, Warszawa, 509 pp.

Buczyńska E., Buczyński P. 2006. Aquatic insects (Odonata, Coleoptera, Trichoptera) of the central part of the „Krowie Bagno" marsh: the state before restoration. Annals Univ. M. Curie-Skłodowska (C) 61: 71-88.

Buczyńska E., Buczyński P., Lechowski L., Stryjecki R. 2007. Fish pond complexes as refugia of aquatic invertebrates (Odonata, Coleoptera, Heteroptera, Trichoptera, Hydrachnidia): A case study of the pond complex in Zalesie Kańskie (Central-East Poland). Nature Conserv. 64: 39-55.

Buczyński P., Buczyńska E., Przewoźny M., Lechowski L. 2009. 8.1. Wybrane owady wodne (Odonata, Heteroptera, Coleoptera, Trichoptera, Lepidoptera). In: J. Herbich, M. Ciechanowski (eds), Przyroda rezerwatów Kurze Grzędy i Staniszewskie Błoto na Pojezierzu Kaszubskim: 169-198. Fundacja Rozwoju Uniwersytetu Gdańskiego, Gdańsk.

Buczyński P., Czachorowski S., Lechowski L. 2001. Niektóre grupy owadów wodnych (Odonata, Heteroptera, Coleoptera, Trichoptera) proponowanego rezerwatu „Torfowiska wiszące nad jeziorem Jaczno" i okolic: wyniki wstępnych badań. Rocz. nauk. Pol. Tow. Ochr. Przyr. „Salamandra" 5: 27-42.

Buczyński P., Przewoźny M. 2002. Wodne chrząszcze (Coleoptera) Krzczonowskiego Parku Krajobrazowego. Parki nar. Rez. Przyr. 21 (3): 283-297.

Buczyński P., Przewoźny M. 2005. Uwagi o niektórych chrząszczach wodnych (Coleoptera: Gyrinidae, Haliplidae, Dytiscidae, Spercheidae, Hydrophilidae) uważanych za zagrożone w Polsce. Wiad. entomol. 24 (2): 69-76.

Buczyński P., Przewoźny M. 2008. New data on the occurrence of *Dryops anglicanus* Edwards, 1909 in Poland (Coleoptera: Dryopidae). Nature J. (Opole Sci. Soc.) 41: 53-57.

Buczyński P., Przewoźny M. 2009. Materiały do poznania chrząszczy wodnych (Coleoptera) Polski północnej. Wiad. entomol. 28 (1): 43-52.

Buczyński P., Piotrowski W. 2002. Materiały do poznania chrząszczy wodnych (Coleoptera) Poleskiego Parku Narodowego. Parki nar. Rez. Przyr. 21(2): 185-194.

Buczyński P., Przewoźny M., Guz M. 2007. Chrząszcze wodne (Coleoptera: Hydradephaga, Hydrophiloidea, Staphylinoidea, Byrrhoidea) Kozłowieckiego Parku Krajobrazowego. Parki nar. Rez. Przyr. 26 (2): 93-111.

Buczyński P., Przewoźny M., Zięba P. 2006. O znaczeniu obszarów niechronionych dla ochrony chrząszczy wodnych, na przykładzie Roztocza. In: P. Buczyński (ed.), IV Ogólnopolska Konferencja Naukowa Ochrona owadów w Polsce „Badania entomologiczne a obecna sytuacja prawna i organizacyjna ochrony przyrody". Materiały konferencyjne. Zwierzyniec, 3-4 lipca 2006: 22-23. Polskie Towarzystwo Entomologiczne, Poznań.

Buczyński P., Staniec B. 1998. Waloryzacja godnego ochrony torfowiska Krugłe Bagno (Pojezierze Łęczyńsko-Włodawskie) w oparciu o wybrane elementy jego fauny. Rocz. nauk. Pol. Tow. Ochr. Przyr. „Salamandra" 2: 95-107.

Buczyński P., Zawal A. 2004. Nowe stwierdzenia *Dytiscus lapponicus* Gyll. (Coleoptera: Dytiscidae) na Pobrzeżu Bałtyku i Pojezierzu Pomorskim. Wiad. entomol. 23 (1): 55-56.

Burakowski B., Mroczkowski M., Stefańska J. 1976. Katalog fauny Polski 23, 4. Chrząszcze – Coleoptera. Adephaga prócz Carabidae, Myxophaga, Polyphaga: Hydrophiloidea. PWN, Warszawa, 309 pp.

Burakowski B., Mroczkowski M., Stefańska J. 1983. Katalog fauny Polski 23, 9. Chrząszcze – Coleoptera. Scarabaeoidea, Dascilloidea, Byrrhoidea i Parnoidea. PWN, Warszawa, 294 pp.

Czachorowski S., Lewandowski K., Wasilewska A. 1993. The importance of aquatic insects for landscape integration in the catchment area of the River Gizela (Masurian Lake Districts, northeastern Poland). Acta hydrobiol. 35 (1): 49-64.

Czechura S. (ed.) 2008. Raport o stanie środowiska w województwie pomorskim w 2007 roku. Biblioteka Monitoringu Środowiska, Gdańsk, 137 pp.

Galewski K. 1990. Fauna słodkowodna Polski, Zeszyt 10 A. Chrząszcze (Coleoptera). Kałużnicowate (Hydrophilidae). PWN, Warszawa, 261 pp.

Galewski K. 1995. Klucze do oznaczania owadów Polski. XIX, zeszyt 7f. Pływakowate – Dytiscidae. Larwy z podrodziny Dytiscinae. Oficyna wydawnicza Turpress. Toruń, 38 pp.

Galewski K., Tranda E. 1976. Fauna słodkowodna Polski, Zeszyt 10. Chrząszcze (Coleoptera). Rodziny: Pływakowate, (Dytiscidae), Flisakowate (Haliplidae), Mokrzelicowate (Hygrobiidae), Krętakowate (Gyrinidae). PWN, Warszawa, 396 pp.

Gutowski J.M., Kubisz D., Buchholz L. 2005. Chrząszcze (*Coleoptera*) drzewostanów sosnowych w Borach Tucholskich. In: K. Gwoździński (ed.), Bory Tucholskie III Zasoby ich ochrona: 113-135. Wydawnictwa Uniwersytetu Łódzkiego, Łódź.

Jaskuła R., Przewoźny M. 2009: Elmidae (Coleoptera) Zaborskiego Parku Krajobrazowego. In: Materiały dotyczące XVI Ogólnopolskich Warsztatów Bentologicznych. Zeszyt Parku Narodowego „Bory Tucholskie". Lobelia 1: 21

Kasprzak K., Niedbała W., 1981. Wskaźniki biocenotyczne stosowane przy porządkowaniu i analizie danych w badaniach ilościowych. In: M. Górny, L. Grum (eds), Metody stosowane w zoologii gleby: 397-416. PWN, Warszawa.

Klausnitzer B. 1996. Käfer im und am Wasser. Westarp Wissenschaften, Spektrum Akademische Verlag, Magdeburg – Heidelberg – Berlin – Oxford, 237 pp.

Klukowska M., Tończyk G. 2002. Materiały do znajomości bezkręgowców wodnych Tucholskiego Parku Krajobrazowego. In: M. Ławrynowicz, B. Rózga (eds), Tucholski Park Krajobrazowy 1985-2000, stan poznania: 441-450. Wydawnictwo Uniwersytetu Łódzkiego, Łódź.

Kondracki J. 2002. Geografia regionalna Polski. PWN, Warszawa, 441 pp.

Kordylas A. 1994. An investigation of the water beetles of Polish springs. Latissimus 4: 9-11.

Pakulnicka J. 1999. Stan badań nad poznaniem chrząszczy wodnych (Coleoptera aquatica) źródeł Polski. In: E. Biesiadka, S. Czachorowski (eds), Źródła Polski. Stan badań, monitoring i ochrona: 149-155. Wyższa Szkoła Pedagogiczna, Olsztyn.

Pakulnicka J. 2006. Chrząszcze wodne (Coleoptera) Parku Narodowego „Bory Tucholskie". In: J. Banaszak, K. Tobolski (eds), Park Narodowy Bory Tucholskie: 294-307. Bydgoszcz, Wydawnictwo Uniwersytetu Kazimierza Wielkiego.

Pakulnicka J., Bartnik W. 1999. Changes in the fauna of aquatic beetles (*Coleoptera aquatica*) in Lake Luterskie (Olsztyn Lake District) in 1981-1993. Fragm. faun. 42 (8): 71-93.

Pakulnicka J., Zawal A. 2007. Chrząszcze wodne (Coleoptera) rezerwatu „Jezioro Szare" i zbiorników usytuowanych w jego sąsiedztwie. Parki nar. Rez. Przyr. 25 (4): 121-133.

Pawłowski J., Kubisz D., Mazur M. 2002. Coleoptera Chrząszcze. In: Z. Głowaciński (ed.), Czerwona lista zwierząt ginących i zagrożonych w Polsce. Instytut Ochrony Przyrody PAN, Kraków: 88-110.

Przewoźny M., Buczyński P., Mielewczyk S. 2006. Chrząszcze wodne (Coleoptera: Adephaga, Hydrophiloidea, Byrrhoidea) doliny Bugu w województwie lubelskim (południowo-wschodnia Polska). Nowy Pam. fizj. 4 (1-2): 23-54.

Przewoźny M., Lubecki K. 2004. Nowe stanowiska rzadziej spotykanych przedstawicieli wodnych chrząszczy (Coleoptera: Dytiscidae, Spercheidae, Hydrophilidae) w Polsce. Wiad. entomol. 23 (4): 215-220.

Szujecki A. 1983. Ekologia owadów leśnych. PWN, Warszawa, 603 pp.

Tończyk G., Pakulnicka J. 2004. Wstępna analiza wybranych grup owadów wodnych (*Odonata*, *Heteroptera* i *Coleoptera*) Łodzi. In: P. Indykiewicz, T. Barczak (eds), Fauna miast Europy Środkowej 21. wieku: 95-101. Wydawnictwo LOGO, Bydgoszcz.

Woś A. 1996. Zarys klimatu Polski. Wydawnictwo Naukowa UAM, Poznań, 301 pp.

Zawal A., Buczyński P., Pietrzak L. 2004. Aquatic invertebrates of the lowland peatbog Krępskie Bagno (Northern Poland). In: L. Wołejko, J. Jasnowska (eds), The future of Polish mires: 199-204. Agriculture University of Szczecin, Szczecin.

ZMiDZW [Związek Miast i Gmin Zlewni Wdy] 2009. Parki i rezerwaty. Internet: http://www.rzekawda.pl/index.php?s=10

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