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## FAUNISTIC AND ECOLOGICAL CHARACTERIZATION OF CLICK BEETLES (COLEOPTERA: ELATERIDAE) OF THE LASY JANOWSKIE RESERVE

Krzysztof Pawłęga

Zoology, Animal Ecology and Wildlife Management, University of Life Sciences in Lublin  
Akademicka str. 13, 20-950 Lublin, Poland, e-mail: krzysztof.pawlega@up.lublin.pl

**Abstract.** In a study on the click beetles (Coleoptera: Elateridae) of selected plant communities of the Lasy Janowskie Reserve, 21 species of these beetles were recorded – 10 each in riparian forests and a sub-Atlantic mesic coniferous forest, 11 in a continental mixed coniferous forest, and 6 in wet grassland communities. The numbers of species in the communities was similar to numbers recorded in other, comparable areas of Poland, with the exception of the wet grasslands. Forest species that can also occur outside of forests – *Athous subfuscus* and *Dalopius marginatus* – were dominant. The biodiversity of the click beetle fauna in the communities was at an average level. An ecological and zoogeographical analysis was carried out as well.

**Key words:** Elateridae, Coleoptera, Lasy Janowskie Landscape Park, reserve, species diversity, zoogeography, faunistics, ecology, plant communities

### INTRODUCTION

The Lasy Janowskie Landscape Park is a fairly well-researched area in terms of the fauna inhabiting it [Łętowski and Grądziel 2009]. Click beetles, however, were not studied until the late 1990s, and publications began to appear after the year 2000. The first data, from 1993, were published in the form of a short faunistic note by Buchholz and Ossowska [1993] concerning *Ampedus nigerrimus*. In subsequent years, faunistic and ecological studies of this group of beetles were carried out by Pawłęga [2002, 2003, 2004a, 2004b, 2010, 2011], and concerned the Elateridae of wetland and grassland habitats in the park.

Previous studies on the click beetles of some of the plant communities of the Lasy Janowskie Landscape Park have described this group of beetles with respect to the entire area of the park. There are, however, no detailed studies covering the special sections of Lasy Janowskie which are reserves. For this

reason, a study was undertaken on the Elateridae of the Lasy Janowskie Reserve. This reserve was chosen because it is the largest of all the reserves in the park and thus includes a variety of valuable habitat types. Moreover, the analysis and publication of data from a dozen or so years ago can be a valuable base point for monitoring changes in click beetle fauna, and on that basis, changes in habitats. Furthermore, descriptions of the click beetle fauna of protected areas taking the form of reserves are scarce.

#### STUDY AREA

The Lasy Janowskie Reserve is located in south-eastern Poland, in the south-central part of the Lasy Janowskie Landscape Park. In terms of physical geography, the reserve is located in the Biłgoraj Plain, which constitutes the northern mesoregion of the Sandomierz Basin [Radwan *et al.* 1997, Kondracki 2000]. The reserve was established in 1984. It has the largest area of the nine reserves of the park, at 2672.82 ha [Radwan *et al.* 1997]. It covers a fragment of Lasy Janowskie with pine forests, mixed forests and alder carrs. The reserve is characterized by interesting landscape and habitat features. Under protection in the reserve are forested chains of dunes in the area of the Porytowe Hill, the most interesting part of the Branew River valley, pond complexes in the vicinity of the village Momoty, and peatlands. The most interesting communities include an upland mixed fir forest (*Abietetum polonicum*).

In the present study of adult click beetles of the Lasy Janowskie Reserve, beetles were collected in the dominant types of plant communities in the reserve, i.e. riparian forests (*Circaeo-Alnetum* and *Salicetum triandro-viminalis*), a sub-Atlantic mesic coniferous forest (*Leucobryo-Pinetum*), a continental mixed coniferous forest (*Quercus roboris-Pinetum*), and wet grasslands (of the class *Molinio-Arrhenatheretea*). A precise floristic description of these communities can be found in a work by Fijałkowski [1997]. Beetles were collected at the following sites:

1. Bank of the Branew River – UTM FB00, 50°38'03"N and 22°27'43"E (riparian forest)
2. Porytowe Hill – UTM FB00, 50°38'06"N and 22°27'43"E (riparian forest)
3. Porytowe Hill – UTM FB 00, 50°38'06"N and 22°27'48"E (continental mixed coniferous forest)
4. Porytowe Hill, wet grassland in the Branew River valley – UTM FB00, 50°38'07"N and 22°27'55"E (wet grassland)
5. Division 228 – UTM FB00, 50°37'00"N and 22°27'10"E (sub-Atlantic mesic coniferous forest)

## RESEARCH METHODS

Adult click beetles were collected in 1998–2000, on average once a month, during the growing season from April to August, inclusive.

Adult forms were collected from green plants and shrubs using a sweep net. One quantitative sample consisted of 100 strokes of the net (4 series of 25 sweeps each). For qualitative sampling, repetitions of 25 strokes of the net were used. The second method of click beetle collection was to shake the insects from trees and shrubs with a beating umbrella. For each quantitative sample, branches were shaken on five trees and/or shrubs characteristic of the habitat.

The nomenclature and systematics of the taxa followed Burakowski *et al.* [1985] and Tarnawski [2000], while using current names.

The biocoenotic indicators used in the analysis of the material were dominance (D), constancy of occurrence in the samples (C), ecological significance (Q), species diversity according to Margalef (d), and qualitative similarities according to Jaccard's first formula, using Biodiversity Pro statistics software [Kasprzak and Niedbała 1981, Neil McAleece *et al.* 1997]. Classes D, C and Q were defined according to Kasprzak and Niedbała [1981].

## RESULTS

As a result of the research on the click beetles of the Lasy Janowskie Reserve, 21 species of these beetles were recorded, representing 15.9% of the Poland's click beetle fauna. The species diversity index (d) of the click beetle fauna of the reserve was 6.25. There were 16 species in the quantitative samples and 6 in the qualitative samples (Table 1), with the *Ampedus balteatus* common to both. The species from the qualitative samples were saproxylobiontic, associated through their development cycle with a rotting wood microbiotope and obtained from decayed or decaying tree stumps and trunks. *Athous subfuscus* (D5 = 48.1%) and *Dalopius marginatus* (D5 = 26.2%), the eudominants, were the most abundant species in all the click beetle fauna of the reserve. These species also had the highest C and Q values: C3 = 52.5% and Q5 = 50.3% for the former and C4 = 52.5% and Q4 = 37.1% for the latter. Five subdominant species, one dominant, two recedents and six subrecedents were found (Table 1).

In the click beetle fauna of the reserve, three of the four ecological groups distinguished according to development microbiotope had similar qualitative shares (Fig. 1). The smallest share – only three species – was noted for species that develop mainly in the microbiotopes of rotting wood but can also develop in the soil. Their quantitative share was low as well, while the dominant species were those that mainly develop in the soil but can also develop in rotting wood microbiotopes (Fig. 1). Regarding the groups distinguished according to habitat

Tab. 1. List of species and biocenotic indices (in percentage) of Elateridae found in the examined communities of “Łasy Janowskie” Reserve

No.	Species	J	L	D%	C%	Q%	1	2				3				4
								L	D%	C%	Q%	L	D%	C%	Q%	
1	<i>Agrypnus murinus</i> (Linnaeus, 1758)		4	1,7	10,0	4,1		1	1,0	12,5	3,5	1	1,4	5,9	2,9	+
2	<i>Cidnopus aeruginosus</i> (Olivier, 1790)		1	0,4	2,5	1,0						1	1,4	5,9	2,9	
3	<i>Hemicrepidius niger</i> (Linnaeus, 1758)		2	0,8	5,0	2,0	+									+
4	<i>Athous subfuscus</i> (Müller, 1764)		114	48,1	52,5	50,3	+	80	80,0	50,0	63,2	30	41,7	70,6	54,3	+
5	<i>Denticolis linearis</i> (Linnaeus, 1758)		3	1,3	7,5	3,1	+									+
6	<i>Actenicerus sjaelandicus</i> (Müller, 1764)		9	3,8	7,5	5,3										+
7	<i>Prosternon tessellatum</i> (Linnaeus, 1758)		5	2,1	12,5	5,1		2	2,0	25,0	7,1	3	4,2	17,6	8,6	
8	<i>Ampedus praeustus</i> (Fabricius, 1792)	5						*				*				
9	<i>Ampedus balteatus</i> (Linnaeus, 1758)	4	7	3,0	15,0	6,7		3	3,0	12,5	6,1	4	5,6	17,6	9,9	
10	<i>Ampedus sanguineus</i> (Linnaeus, 1758)	5						*								
11	<i>Ampedus nigerrimus</i> (Lacordaire, 1835)	1										*				
12	<i>Ampedus pomorum</i> (Herbst, 1784)	1						*								
13	<i>Ampedus erythrogonus</i> (Müller, 1821)	1										*				
14	<i>Melanotus villosus</i> (Geoffroy, 1785)		2	0,8	5,0	2,0		1	1,0	12,5	3,5	1	1,4	5,9	2,9	
15	<i>Melanotus castanipes</i> (Paykull, 1840)		1	0,4	2,5	1,0	+									
16	<i>Synaptus filiformis</i> (Fabricius, 1781)		12	5,1	5,0	5,05	+									+
17	<i>Adrastus pallens</i> (Fabricius, 1792)		8	3,4	5,0	4,1	+									
18	<i>Dalopius marginatus</i> (Linnaeus, 1758)		62	26,2	52,5	37,1	+	12	12,0	62,5	27,4	29	40,3	64,7	51,1	
19	<i>Ectinus aterrimus</i> (Linnaeus, 1761)		5	2,1	10,0	4,6	+	1	1,0	12,5	3,5	3	4,2	5,9	4,9	
20	<i>Agriotes pilosellus</i> (Schönher, 1817)		1	0,4	2,5	1,0	+									
21	<i>Agriotes lineatus</i> (Linnaeus, 1767)		1	0,4	2,5	1,0	+									
Total		individuals	17	237			39	100				72				26
		species	6	16			10	10				11				6

1 – riparian forest, 2 – continental mixed coniferous forest, 3 – sub-Atlantic mesic coniferous forest, 4 – wet grassland, J – overall number of individuals of Elateridea in qualitative samples, L – overall number of individuals of Elateridea in quantitative samples, D – dominance, C – constancy of occurrence in samples, Q – ecological significance

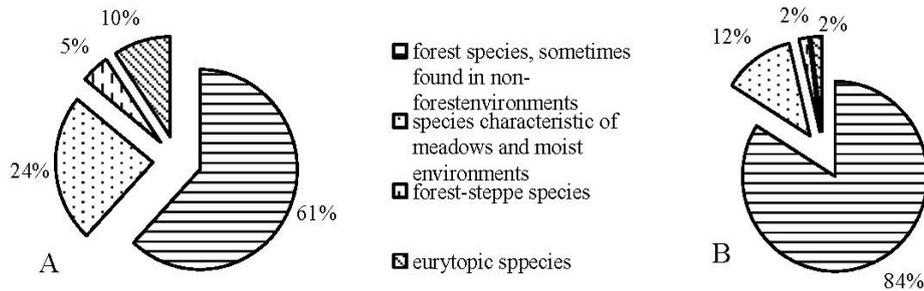


Fig. 1. Percentage of quantitative (A) and qualitative (B) share of particular ecological groups distinguished on the base of habitat preferences of the species in click-beetles fauna of "Lasy Janowskie" Reserve

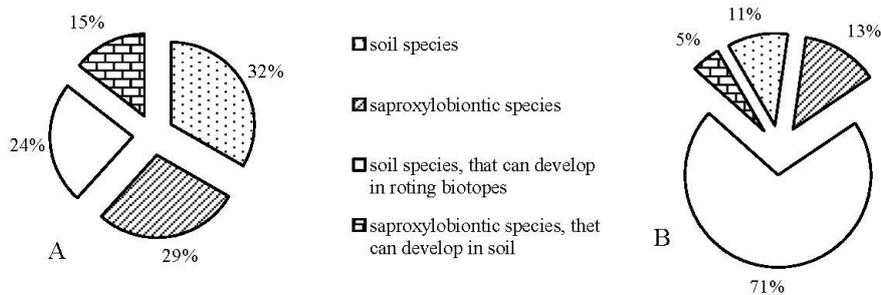


Fig. 2. Percentage of quantitative (A) and qualitative (B) share of particular ecological groups distinguished on the base of microhabitat preferences of the species development in click-beetles fauna of "Lasy Janowskie" Reserve

preference, forest species that may sometimes occur in non-forest environments were, of course, dominant both qualitatively and quantitatively (Fig. 2). The second group comprised species characteristic of grassland and wetland habitats. Eurytopic and forest/steppe species accounted for the remaining, small share (Fig. 2).

The zoogeographical analysis showed that most of the species in the Lasy Janowskie Reserve were species with a wide range (80% of the qualitative share), among which the greatest number of species were Euro-Siberian and the fewest Euro-Caucasian (one species in the sub-Atlantic mesic coniferous forest). The wide-range species also included Holarctic, Eurasian and Palearctic species. The other four were narrow-range European species. The share of Elateridae species from various zoogeographical groups was balanced; generally 2–3 species per group were recorded.

The number of Elateridae species caught in individual plant communities was similar. Ten each were recorded in the riparian forest and sub-Atlantic me-

sic coniferous forest communities and 11 in the continental mixed coniferous forest, while only 6 species were found in the wet grassland communities. A list of the species in the communities and the D, C and Q values for each of them is shown in Table 1. In the case of the riparian forest and wet grassland communities, these indicators were not calculated due to the small number of specimens caught; the presence of the species is indicated in the table by a plus sign. In the riparian forest community, mainly forest species and species associated with grasslands and wetlands were present, dominated by *Dalopius marginatus*, a forest species, and *Adrastus pallens*, a species characteristic of grasslands and wetlands. Other species were caught mainly in single numbers. Most of the species were soil species or soil species that can also develop in rotting wood microbiotopes. In the wet grassland community, *Synaptus filiformis* and *Actenicerus sjaelandicus* were most abundant. These and most of the others were species characteristic of grasslands and wetlands, mainly developing in the soil. Other species were represented by one or two specimens. In the coniferous forest communities, the shares of species from the various ecological groups were similar. Species whose development cycle is associated with rotting wood microbiotopes (soil-saproxylbiontic or saproxylbiontic) and forest species were predominant.

Bray-Curtis Cluster Analysis (Single Link)

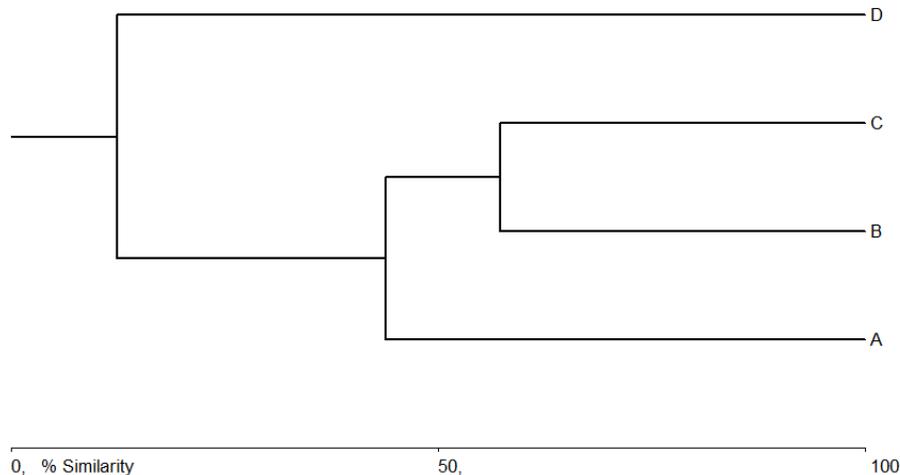


Fig. 3. Faunistic similarities between Elateridae of the examined plant communities in the “Łasy Janowskie” Reserve (A – riparian forest, B – continental mixed coniferous forest, C – sub-Atlantic mesic coniferous forest, D – wet grassland)

The species diversity of the click beetle fauna of the communities was at an average level. As in the case of the number of species, the assemblage of click beetles in the wet grasslands also showed the lowest species diversity ( $d = 3.5$ ). The indices for the remaining plant communities were 5.7 for the riparian forests,

5.4 for the continental mixed forest and 4.5 for the sub-Atlantic mesic coniferous forest.

Comparison of the species composition of the click beetle fauna of the plant communities revealed the highest qualitative similarity between the click beetles of the sub-Atlantic mesic coniferous forest and the continental mixed coniferous forest, and the lowest between the wet grassland and the coniferous forest communities (Fig. 3).

## DISCUSSION

As a result of the research on the Elateridae of selected plant communities of the Lasy Janowskie Reserve, 21 species of these insects were identified. Factors influencing the occurrence of click beetles included the type and edaphic conditions of the plant community, the presence of microhabitats suited to their development, the size of the plant community, and how well its original character was preserved. From the entire area of the Lasy Janowskie Landscape Park, within which the Lasy Janowskie Reserve is located, thus far 31 species from coniferous forest communities and 34 from wetland communities (riparian forests, alder carrs, wet grasslands and peatlands) have been identified [Pawłęga 2003, 2004a, 2004b, 2010a]. A comprehensive study of the Elateridae of other reserves in Poland is found in the work of Kornalewicz [1977], which describes the click beetles of the Muszkowski Las Bukowy forest reserve.

The highest numbers of species were found in closed communities – coniferous forests and riparian forests, and the fewest in wet grassland. Honczarenko [1956, 1962] reported 14 and 10 soil species of click beetle in wet grasslands of the Szczecin and Lublin areas, respectively. Pawłęga [2010b] recorded 13 species of adult click beetles in the riparian forest communities of Polesie National Park and 10 in wet grassland and peatland communities. The click beetle fauna also exhibited greater species diversity in the forest communities of the reserve. The preference of this group of beetles for forest habitats was demonstrated by Burakowski [1971]. Confirmation of the preference of most click beetles for forest environments is also found in a work by Nowakowski [1981]. This is linked to the fact that in these communities beetles find many types of microhabitats (soil, rotting trunks and stumps, and hollows with rotting wood, as well as the ground cover, undergrowth, and tree crowns) suitable for their development and life. This was especially true in the case of the riparian forests, where the click beetle fauna was the most diverse. This was undoubtedly due to the forest character of this community, as well as the proximity to grassland communities, which was evident in the qualitative similarities of the click beetle fauna of these communities. These factors contributed to a high proportion of forest species, especially *Dalopius marginatus*, as well as species charac-

teristic of grasslands and wetlands. Similarly, the shares of individual ecological groups of Elateridae in the communities were determined by the biotic and abiotic characteristics of these communities. Click beetles do not prefer very wet or flooded habitats, and for this reason few species were recorded in the wet grassland communities.

Ten species of adult Elateridae were recorded in the continental mixed coniferous forest community. For comparison, Nowakowski [1981] recorded 10 species of larvae from a mixed coniferous forest in Białołęka Dworska, and Kornalewicz [1979] reported 6 soil species in a mixed coniferous forest in the vicinity of Wrocław. Nine species of adult Elateridae were found in the mixed coniferous forests of the Kozłowski Landscape Park and, as in the Lasy Janowskie Reserve, forest species were dominant. However, the click beetle fauna there was less diverse, with a biodiversity index of 1.12 [Pawłęga *et al.* 2012].

In the Lasy Janowskie Reserve, the greatest species similarities in the click beetle fauna were found between the coniferous forest communities. This high species similarity seems to be due to the floristic similarity of these plant communities and to the physical properties of the soil. The admixture of broad-leaved trees in the continental mixed coniferous forest and the similar type of community (forest) may explain the high similarity of the click beetle fauna of the coniferous forests and that of the riparian forests.

The qualitative share of zoogeographical elements in the click beetle fauna of the Lasy Janowskie Reserve showed that species with a wide range were predominant (80.0%). Thus the general dominance of zoogeographical elements prevailing in the click beetle fauna of Poland was preserved, with wide-range species predominating, as among the Elateridae assemblages previously described in Lasy Janowskie Landscape Park or other landscape parks – Kozłowiecki Landscape Park or Polesie National Park [Tarnawski 2000, Pawłęga 2003, 2004a, 2004b, 2010a, 2010b, 2012].

## CONCLUSIONS

1. The species richness of the Elateridae of the Lasy Janowskie Reserve amounted to slightly over 15% of Polish click beetle fauna.
2. The click beetle fauna of the plant communities of the Lasy Janowskie Reserve had an average level of species diversity.
3. The species composition of the click beetles of the communities in the reserve was influenced by the habitat characteristics of these communities, the proximity of other habitat types, and the presence and diversity of microhabitats suitable for development.
4. In terms of species richness, the click beetle fauna of the reserve communities was similar to that of the same types of communities in other areas.

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CHARAKTERYSTYKA FAUNISTYCZNO-EKOLOGICZNA  
CHRZĄSZCZY SPREŻYKOWATYCH (COLEOPTERA: ELATERIDAE)  
REZERWATU „LASY JANOWSKIE”

**Streszczenie.** W wyniku przeprowadzonych badań nad sprężykowatymi (Coleoptera: Elateridae) wybranych zbiorowisk rezerwatu „Lasy Janowskie” stwierdzono 21 gatunków tych chrząszczy – po 10 w łągach i suboceanicznym borze świeżym, 11 w kontynentalnym borze mieszanym i 6 w zbiorowiskach łąki wilgotnej. Liczba gatunków w badanych zbiorowiskach w porównaniu z innymi adekwatnymi obszarami Polski była zbliżona, z wyjątkiem wilgotnych łąk. Dominowały gatunki leśne, mogące występować w środowiskach pozaleśnych – *Athous subfuscus* i *Dalopius marginatus*. Bioróżnorodność elaterofauny badanych zbiorowisk kształtowała się na średnim poziomie. Przeprowadzono także analizę ekologiczną i zoogeograficzną.

**Słowa kluczowe:** sprężykowate, Elateridae, Coleoptera, Park Krajobrazowy „Lasy Janowskie”, rezerwat, różnorodność gatunkowa, zoogeografia, faunistyka, ekologia, zbiorowiska roślinne