

## FAUNISTIC AND ECOLOGICAL CHARACTERIZATION OF THE CLICK BEETLES OF SELECTED OPEN BIOTOPES IN POLESIE NATIONAL PARK

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**Summary.** In the years 2006–2008 research was carried out on the Elateridae fauna of several open biotopes in Polesie National Park: fresh meadows, dry meadows, xerophilous grasses of non-calcareous sands (psammophilic communities) and non-calcareous thermophilic ruderal communities. Owing to this research the number of known click-beetle species in the park was increased to 25. Quantitative samples were taken with a sweep net. A total of 15 species of these beetles were recorded, and in the above-mentioned communities, 6, 9, 6 and 6, respectively. In comparison with the species richness of the click beetles of other parks in the Lublin region, the number here is the lowest, but varied depending on the plant community. The click-beetle assemblage of the biotopes of the park had moderately high species diversity ( $d = 7.1$ ), but it was lower in individual biotypes (from 3.5 to 4.1). Eurytopic species and species characteristic of meadows and wet environments (*Agrypnus murinus*, *Hemicrepidius niger* and *Selatosomus aeneus*), together with soil species, were dominant. In terms of zoogeographic classification, species with a broad range of occurrence predominated, with several times fewer narrow-range species and the fewest intermediate-range species.

**Key words:** Elateridae, click-beetles, Poleski National Park, ecology, species diversity, zoogeography, open plant communities

### INTRODUCTION

Polesie National Park is a relatively young park, established in 1990. It has been and continues to be an area of interest for researchers specializing in various animal taxa [Radwan *et al.* 2002, Łętowski and Grądziel 2009]. Many studies have been published on the fauna of the park [Radwan *et al.* 2002, Łętowski and Grądziel 2009], but few of these have concerned Elateridae. The first data pertaining to the click-beetle (Elateridae) fauna of Polesie National Park did not appear until 2010 [Pawłęga 2010a], in a study presenting the results of research

on the click beetles of selected wet plant communities of the park, recording 20 species of these beetles.

It should be noted that the click-beetle fauna of the Polesie region, within which Polesie National Park is situated (according to the zoogeographic classification by Burakowski *et al.* [1985]), has not been well researched. The few data are limited to a list of species recorded mainly by Burakowski *et al.* [1985] from the Jata reserve near Łuków and a few localities in the vicinity of Międzyrzec Podlaski, Radzyń Podlaski, Bezwola and Siemiatycze. These authors list 35 Elateridae species from the Polesie region.

The present study is a continuation of research on the click-beetle fauna of Polesie National Park. Its objective was to present the species richness and the qualitative and quantitative structure of the Elateridae of selected open plant communities, as well as a faunistic and ecological and zoogeographical analysis.

#### STUDY AREA

Polesie National Park is situated in central-eastern Poland. In terms of physiography it belongs to Polesie Lubelskie [Radwan 2002]. The park occupies an area of exceptional natural value retaining a high degree of naturalness and ecosystem diversity, in which aquatic/peat-bog ecosystems are dominant (about 46.9%). A fairly large percentage of the park is occupied by open biotopes, and among these, meadows and pastures (about 19%) [Radwan 2002]. Research on the click beetles of open biotopes was carried out in four types of plant communities: fresh meadows (*Molinietum caeruleae* association) (study sites: 1, 3, 5, 6, 9, 10), dry meadows (the class *Artemisietalia vulgaris*) (study sites: 1, 2, 4, 7, 8, 12), xerophilous grasses of non-calcareous sands (the class *Koelerio glaucae-Corynepherea*) (study sites: 7, 8, 11) and non-calcareous thermophilic ruderal communities (the class *Artemisietalia vulgaris*) (study sites: 6, 7, 8, 11) (Tab. 1).

#### METHODS

Research on the click-beetle fauna of open biotopes of Polesie National Park was carried out in the years 2006–2008 during the growing season, from May to mid-August at 12 study sites. Adult forms were collected from herbaceous plants using a sweep net. One quantitative sample consisted of 4 series of 25 sweeps each.

The following biocenotic indicators were used to analyse the material collected: dominance (D), constancy of occurrence in samples (C), ecological importance (Q), Margalef species diversity index, and qualitative similarity between the click-beetle fauna of plant communities according to Jaccard's formula [Kas-

przak and Niedbała 1981, McAleece *et al.* 1997]. The analyses were performed using Biodiversity Pro software. Classes D, C and Q were adopted according to Kasprzak and Niedbała [1981]. Indicators taking into account the abundance of species (D, C, Q) were calculated for the material as a whole. They were not used to characterize the click-beetle populations of the communities studied (except for the value D for the most abundant species), so as not to blur the true picture of the assemblages of the beetles in these communities due to their relatively low abundance. Ecological characterization of click-beetle assemblages was based on habitat preferences and development microbiotope. A zoogeographical analysis was performed as well.

## RESULTS

As a result of the research conducted on the click-beetle fauna of selected open plant communities of Polesie National Park, 15 species were recorded. They represented four subfamilies – Agrypninae Candèze, 1857, Negastrinae Nakane et Kashii, 1956, Athoinae Candèze, 1859 and Elateridae Candèze, 1857. Eurytopic species and groups of species characteristic of open communities – meadows and wet environments – were dominant. These species, forming the class of eudominants, were *Agrypnus murinus* (D = 39.1%), *Hemicrepidius niger* (D = 17.3%) and *Selatosomus aeneus* (D = 13.0%). These species were also the most frequently caught; they had the highest values for constancy of occurrence in samples and ecological importance (Tab. 1). Two species formed the class of dominants and four the class of subdominants. Single or few individuals of the remaining 5 species were caught (the recedents), and their dominance indices ranged from 1.1% to 6.5% (Tab. 1). The species diversity index (d) for the click-beetle assemblage of the open biotopes was 7.1.

In the analysis of the percentage shares of species classified according to development microbiotope, the dominance of soil species, both qualitative and quantitative (87.7% and 89.1%) was unsurprising. The remaining species were two that prefer soil environments but are capable of developing in microbiotopes of rotting wood and one saproxylobiontic species, *Procræus tibialis*, found only in ruderal communities. It was caught at a site with a few isolated maple and oak trees in Karczunek Wały. Analysis of habitat preferences showed that the qualitative shares of ecological groups were fairly similar: forest habitats – 5 species (33.3%), meadow and hygrophilous habitats – 4 sp. (26.7%), xerothermic grasses – 3 sp. (20%) and eurybionts – 3 sp. (20%). Eurybionts (53.3%) and meadow species (33.7%) dominated quantitatively, while forest and xerothermic species occurred in small numbers, with quantitative shares of 7.6% and 5.4%, respectively.

Tabela 1 - pozioma

The greatest number of Elateridae species (9) was noted in the dry meadow community. *Hemicrepidius niger* was most abundant (D = 37.9 %), followed by *Agrypnus murinus* (D = 20.7%). There were 2–3 specimens each of *Cidnopus pilosus*, *Athous haemorrhoidalis*, *Actenicerus sialeandicus* and *Selatosomus aeneus*. Single specimens of the remaining species were noted: *Oedostethus quadripustulatus*, *Dalopius marginatus* and *Agriotes lineatus*. The species diversity index was 5.5. The click-beetle assemblage of the dry meadows consisted of soil species (77.9%) and soil species capable of developing in rotten wood (22.2%). In terms of habitat preferences, most prevalent were eurytopic (3) and meadow (3) species. These also dominated quantitatively (a combined 82.8% share). The remaining species were forest species (2) and one xerothermic species.

An equal number of species was noted in the click-beetle assemblages of the remaining communities studied – 6 in each – and their species diversity was similar. The 'd' index was 3.9 for the Elateridae of fresh meadows, 4.1 for xerophilous grasses of non-calcareous sands and 3.5 for thermophilic ruderal communities. The click-beetle populations of these communities were not rich in individuals. Similar species abundance structure was noted for these communities (Fig. 1).

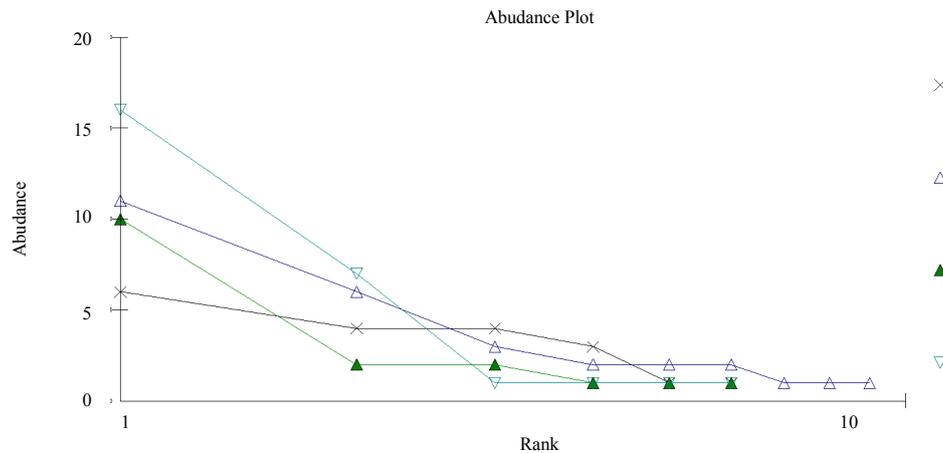


Fig. 1. The structure of species abundance of click-beetles in the examined plant communities in the Poleski National Park (a – fresh meadows, b – dry meadows, c – xerophilous grasses of non-calcareous sands, d – non-calcareous thermophilic ruderal communities)

*Agrypnus murinus* and *Hemicrepidius niger* were noted in all of them. The former was most numerous in communities of xerophilous grasses of non-calcareous sands and in thermophilic ruderal communities (over 50%). *Prosternon tessellatum*, *Procræus tibialis* and *Agriotes ustulatus* were noted (singly) only in thermophilic ruderal communities. Apart from these, *Selatosomus aeneus* occurred as well (7 individuals). In fresh meadow communities *Actenicerus*



The Elateridae assemblage of the open biotopes of Polesie National Park consisted mainly of species with a broad range of occurrence (78.6% of species). There were several times fewer species with a narrow range (20%, 3 species), and the fewest intermediate-range species (one species). Eurasian and Eurosiberian species (28.6% each) accounted for the largest share, followed by Holarctic and Pontic-Mediterranean species (2 species each) and Palearctic and Mediterranean species (one species each).

#### DISCUSSION

In the literature concerning click beetles, particularly those of meadow communities, descriptions of larval populations predominate, which limits the possibilities for broader discussion due to the specific character of these populations. For this reason the discussion here focuses exclusively on data concerning adult forms.

As a result of the research on the Elateridae of four types of open plant communities 15 species of these beetles were recorded. This adds 5 species to the list of known click beetle species in Polesie National Park. Taking into account data recorded by Pawłęga [2010a], 25 species have thus far been noted in the park.

As the division of Poland into zoographical regions given in Catalogues of the fauna of Poland] [Burakowski *et al.*, e.g. 1985] is regarded as temporary and imprecise, different authors adopt different interpretations regarding whether the territory of the park belongs to a given region. Some include its northern part in Podlasie and its southern part in the Lublin Upland, while others include the entire park in Podlasie. If the park is considered to be part of Podlasie, the research described allowed two new Elateridae species to be recorded for this region. These were *Hemicrepidius hirtus* and *Procræus tibialis*.

Conducting further research on click beetles in Polesie National Park would undoubtedly increase the number of known species. Research on the click-beetle fauna of the park is justified by the fact that species new to the zoographic regions of eastern Poland were recorded and data on the click-beetle fauna of the region is still inadequate. In comparison with the species richness of click beetles in other parks of the Lublin region, the number of species recorded here is the lowest. There are slightly more known species, 28, in Kozłówka Landscape Park [Pawłęga 2006, Pawłęga *et al.* 2012], and many more, 38, in Lasy Janowskie (Janów Forests) Landscape Park [Pawłęga 2003, 2004a, 2004b, 2010b, 2011a, Pawłęga and Kowalczyk-Pecka 2011]. In open biotopes alone 22 species have been noted in Lasy Janowskie Landscape Park (fresh meadow, ruderal and segetal communities) and 6 in Kozłówka Landscape Park (fresh

meadow communities) [Pawłęga 2010b, 2011a, Pawłęga and Kowalczyk-Pecka 2011, Pawłęga *et al.* 2012].

In the present study in the open communities of Polesie National Park the most click-beetle species were noted in the dry meadow communities (9). The literature indicates that this data is similar to the number of species in Elateridae assemblages of the dry meadows of other regions of Poland [Burakowski 1971, Pawłęga 2011b]. The same number of species was recorded by Pawłęga [2011b] in the dry meadows of the Włodawa Kodeń stretch of the Bug River valley. Burakowski [1971] found 8 species of adult Elateridae in the dry meadows of the Bieszczady Mountains. The click-beetle assemblages of the dry meadows of Polesie National Park and the Bug River valley were also similar in terms of species diversity ('d' indices of 5.5 and 5.3, respectively). In the case of the Bieszczady Mountains the author did not provide this index or quantitative data. The click-beetle population of the dry meadows of Polesie National Park retained a certain distinctiveness in terms of species, manifested as an intermediate level of qualitative similarity to the populations of analogous biotopes in the Bieszczady Mountains and part of the Bug River valley ( $J = 38.4\%$  and  $J = 30.8\%$ ). The dominance of eurytopic species and those typical of meadows and wet environments can be explained by the characteristics of this community. Dry meadows are a poorer type of meadow, so it was these species that found favourable conditions here.

In the case of the fresh meadows of the Polesie National Park, the assemblage of adult click-beetle forms generally had fewer species in comparison with other areas of Poland. Fresh meadows of *Molinietum caeruleae* are currently present in the park in the form of small patches [Baryła and Urban 2002]. This may translate to some extent to the formation and preservation of greater species richness, or to migration of species from other habitats. A similar tendency was reported by Pawłęga *et al.* [2012] in the case of the fresh meadows of Kozłówka Landscape Park, where the same number of click-beetle species was noted (6). The Elateridae assemblages of the two parks had similarly low species diversity. The pattern was different in the case of Lasy Janowskie Landscape Park, where Pawłęga [2010b] found 18 species of adult Elateridae in fresh meadows. In Polesie National Park the greatest number of individuals was noted for the species *Actenicerus siaelandicus*, associated more with wet areas [Tarnawski 2000]. This can be explained by the proximity of the fresh meadows in some of the study sites to wet habitats (Pawłęga 2010b, Pawłęga *et al.* 2012). This is a characteristic shared by the click-beetle fauna of the above-mentioned parks. This species was also most abundant in the fresh meadow communities of Kozłówka Landscape Park and was one of the eudominants of the fresh meadows of Lasy Janowskie Landscape Park [Pawłęga 2010b, Pawłęga *et al.* 2012]. Burakowski [1971] found 11 species of adult click beetles in meadow and pasture habitats of the Bieszczady Mountains, the most abundant of which were the

eurytopic *Selatosomus aeneus* and the heliophilic *Agriotes ustulatus*. The qualitative composition of the Elateridae assemblage of the fresh meadows of Polesie National Park was most similar to that of the fresh meadows of Lasy Janowskie Landscape Park ( $J = 45\%$ ). A common feature of the click-beetle fauna of the fresh meadows of Polesie National Park and the other biotopes mentioned was the occurrence of only soil species and soil species capable of development in rotting wood, which is to be expected in this type of biotope (lacking microbiotopes of rotten wood). In the case of habitat preferences, meadow species and species associated with wet environments dominated in the fresh meadows of Polesie National Park, with few eurytopic and forest species. The pattern was similar in Kozłówka Landscape Park and Lasy Janowskie Landscape Park, except that in these parks there was a large percentage of forest species as well. The differences in the percentage of forest species can be explained by the close proximity of the fresh meadows to forest communities in these parks [Pawłęga 2010b, Pawłęga *et al.* 2012].

As in the case of the fresh meadows, six Elateridae species each were noted in the communities of xerophilous grasses of non-calcareous sands and the non-calcareous thermophilic ruderal communities (a combined 9 species). These habitats are situated in the park on the edges of roads passing through forests and fields and on sandy elevations within meadows. They are characterized by distinctive thermal conditions and edaphic factors, which undoubtedly narrows the species richness of these beetles. The specificity of these communities is also reflected in the species of the Elateridae that were found in these habitats. Most abundant were species that are unspecialized in terms of habitat, i.e. eurytopic species (*Agrypnus murinus* and *Selatosomus aeneus*). Species originally associated with steppes and preferring xerothermic environments were caught here as well, which was linked to high-temperature conditions favourable to these species. Burakowski [1971, 1979] also drew attention to the influence of the characteristics and genesis of this type of habitat on the faunistic and ecological structure of click-beetle assemblages. In the ruderal communities of Lasy Janowskie Landscape Park Pawłęga and Kowalczyk-Pecka [2011] found 9 click-beetle species. Eurytopic species dominated here as well. Despite the difference in the number of species, the click-beetle assemblages had identical, low species diversity indices ( $d = 3.5$  in each). In habitats that are not identical but have an elevated thermal spectrum, i.e. the xerothermic grasses and the dry pastures of Pieniny National Park, Burakowski [1979] recorded 16 and 8 Elateridae species.

The qualitative similarities between the click-beetles fauna of the plant communities studied could be the consequence of biotic and abiotic conditions of these habitats, as well as their proximity, as in the case of the fresh meadows and the xerophilous grasses of non-calcareous sands.

In the click-beetle fauna of the open biotopes of Polesie National Park, species with a wide range of occurrence were dominant, followed by intermediate-

range and narrow-range species. In this respect the zoographic pattern of the click-beetle fauna of the Polesie National Park was similar to that of the regions to which it was compared, with clear dominance of broad-range species and a very low percentage of narrow-range species [Burakowski 1971, 1979, Pawłęga 2003, 2004a, 2004b, 2006, 2010a, 2010b].

### CONCLUSIONS

1. The click-beetle fauna of Polesie National Park at the current stage of research is characterized by lower species diversity than the other parks studied in the Lublin region. This varied, however, among particular plant communities.

2. The click-beetle fauna of the open biotopes of Polesie National Park had similar ecological and zoogeographic structure to analogous biotopes in other areas of eastern Poland.

3. The species richness and quantitative structure of the Elateridae assemblages of Polesie National Park, as well as the percentages of ecological groups, were determined by the characteristics and location of the habitats and to a high some extent by their size.

4. Continuation and expansion of the research could potentially add to the list of Elateridae species in the park.

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#### CHARAKTERYSTYKA FAUNISTYCZNO-EKOLOGICZNA SPRĘŻYKOWATYCH WYBRANYCH BIOTOPÓW OTWARTYCH POLESKIEGO PARKU NARODOWEGO

**Streszczenie.** W latach 2006–2008 prowadzono badania nad fauną Elateridae w kilku biotopach otwartych Poleskiego Parku Narodowego (PPN): łąkach świeżych, łąkach suchych, kserofilnych murawach piasków niewapiennych (psammofilnych) i ciepłolubnych ruderalnych nawapiennych. Badania te pozwoliły poszerzyć liczbę znanych obecnie z obszaru Parku gatunków sprężyków do 25. Próby ilościowe pobierano czerpakiem entomologicznym. Ogółem wykazano 15 gatunków tych chrząszczy, a w danych zbiorowiskach odpowiednio: 6, 9, 6 i 6. W porównaniu z bogactwem gatunkowym sprężykowatych innych parków Lubelszczyzny liczba ta jest najmniejsza. Różnie przedstawiało się to w przypadku poszczególnych zbiorowisk roślinnych. Zgrupowanie sprężykowatych biotopów PPN cechowała umiarkowanie duża różnorodność gatunkowa ( $d = 7,1$ ), chociaż w poszczególnych zbiorowiskach była ona niższa (od 3,5 do 4,1). Dominowały gatunki z grupy eurytopów oraz gatunków charakterystycznych dla łąk i środowisk wilgotnych (*Agrypnus murinus*, *Hemicrepidius niger* i *Selatosomus aeneus*) oraz gatunki glebowe. Pod względem zoogeograficznym przeważały gatunki o szerokim zasięgu występowania, kilkakrotnie mniej było gatunków wąskiego, a najmniej średniego zasięgu.

**Słowa kluczowe:** Elateridae, sprężykowate, Poleski Park Narodowy, ekologia, różnicowanie gatunkowe, zoogeografia, otwarte zbiorowiska roślinne