

Eligiusz NOWAKOWSKI

***Elateridae* (Coleoptera) of linden-oak-hornbeam and thermophilous oak forests of the Mazovian Lowland**

[With 3 Tables and 2 Figures in the text]

Abstract. The present paper provides an analysis of species composition, zoogeographical and ecological elements as well as dominance structure of click beetle communities in linden-oak-hornbeam and thermophilous oak forests on the Mazovian Lowland. 18 species were found to occur on the studied areas, including *Cidnopus parvulus* and *Ampedus erythrogonus*, which so far had not been reported from the Mazovian Lowland. In linden-oak-hornbeam forests there was recorded one basic type of wireworm community, dominated by *Dalopius marginatus* and *Athous subfuscus*. Also in thermophilous oak forests *D. marginatus* was a eudominant, but instead of *A. subfuscus*, *A. haemorrhoidalis* and *Prosternon tessellatum* occurred.

INTRODUCTION

Click beetles are one of more significant families of beetles in land biocoenoses. Their larvae, which develop for several years, inhabit either dead wood in various stage of decay (dendrophilous species), or soil habitats (soil species). Dendrophilous species are pre-eminently predators and, to a smaller extent, pantophages, which makes them important regulators of abundance of several groups of xylophagous insects. Soil species are more diversified as regards their trophic preferences. A majority of species rank among pantophages. Some of them, however, along with a couple of rhizophagous species may cause severe damage to field and forest crops. Only a few species of this group may be regarded as typical predators. Soil click beetles constitute a significant part of the soil macrofauna, e.g. their contribution to the macrofauna of the studied habitats ranged from 5 to 32.5%.

Polish literature dealing with click beetle communities in linden-oak-hornbeam forests (*Tilio-Carpinetum*) is limited to three works only. Two papers examining the area of the Mazovian Lowland were contributed by NOWAKOWSKI (1979, 1981). The first of the quoted papers reported seven species from natural forests on the habitat of the linden-oak-hornbeam forests (Ursynów, Bielany) and nine species from paranatural treestands on this habitat (the Arcadia Park, the Kaskada Park, the a site). The other paper discussed the species composition and structure of an wireworm community from a small treestand — the remainings of an old country park — on the linden-oak-hornbeam habitat, from where 11 species were reported. The structure of this community was compared to that of the community from a natural linden-oak-hornbeam forests at Radziejowice. KORNALEWICZ (1977) supplied species composition of an *Elateridae* community from a forest area on the linden-oak-hornbeam habitat on the Lower Silesia. A few other works dealing with forest habitats examined *Elateridae* communities of coniferous forests and of pine forests in particular.

The aim of the present paper was an extensive analysis of species composition and structure of click beetle communities from linden-oak-hornbeam and thermophilous oak forests on the Mazovian Lowland.

THE SITE, METHODS AND MATERIAL

The studies were conducted on eight stands located on six study sites. In the Dębina reserve near Klembów the studies were carried out on two stands, i.e. on a moist one, classified as a moist variant of typical linden-oak-hornbeam forests and on a much drier stand defined as a typical linden-oak-hornbeam forest. The study site in the Modrzewina reserve near Belsk was marked for presence of larch trees towering over the treestand and a considerable contribution of acidophilous elements to the herb layer. The site at Radziejowice was located in a managed forest. Its herb layer was noted for a large admixture of acidophilous elements. The sites located on the area of the Cyganka reserve near the Truskaw village in the Kampinos National Park and in the King Jan III Sobieski reserve, both under legal protection, formed small plots of forests of *Tilio-Carpinetum* type, surrounded with treestands of different character, namely, in case of the Cyganka reserve — with a mixed pine forest at the top and with a fen in a hollow with no outflow at the bottom, while in case of the King Jan III Sobieski reserve the studied site was surrounded with a thermophilous oak forest. Thus the two sites were of a clearly ecotonic character. The last two study sites, i.e. in a managed forest at Radziejowice and in the Bolesław Hryniewiecki reserve in Podkowa Leśna, were located on plots of thermophilous oak forests.

The aim as well as the range of the studies and the applied methods were comprehensively discussed in the introductory paper by BAŃKOWSKA

and GARBARCZYK (1989), whereas detailed data on the localization of the selected study sites and their phytosociological characteristics may be found in the introductory work by KOTOWSKA and NOWAKOWSKI (1989).

The timing of studies on particular sites was as follows: the Dębina reserve — 1980–1981, the Modrzewina reserve — 1981–1982, the Cyganka reserve — 1979–1980 and the B. Hryniewiecki reserve — 1983–1984. The material for the present studies came from 10 soil samples of 1 m² area in total, collected three times (and five times in the Cyganka reserve in 1980) in a vegetative season (spring, late summer, autumn). The soil samples were subsequently extracted in a large funnel extractor of the Tullgren type. The studies on the plot of linden-oak-hornbeam forest at Radziejowice were completed in 1976–1978 and turned over the material coming from 200 soil samples taken with a soil sampler of 20 cm² cross-sectional area (0.4 m² in total) and collected twice a vegetative season. The samples were subsequently extracted in an extractor of the Tullgren type.

Moreover, the present studies took into account all the material of *Elateridae* sampled on certain sites simultaneously or at longer intervals with additional methods, such as litter sifting, pitfall traps, entomological sweep net and Moericke traps distributed in the herb layer and hung on lindens, hornbeams, oaks and in the Modrzewina reserve also on larches. Additional material was the basis for analyses of species composition of the *Elateridae* communities from the plot of linden-oak-hornbeam forest at the King Jan III Sobieski reserve and from the plot of thermophilous oak forest at Radziejowice. There were not applied any distinctly special methods for sampling click beetles developing in wood, so the list of dendrophilous species presented in the paper was compiled on the basis of individually collected imagines and therefore it is far from being complete.

A total of 1800 specimens were collected including 1400 larval forms. The sampled material was identified to species level and only in case of five larvae it was not possible to determine their species classification.

The comparison of structure of the studied click beetle fauna from linden-oak-hornbeam and thermophilous oak forests to that of the whole *Elateridae* fauna from the Mazovian Lowland considered also supplementary data coming from the works by BURAKOWSKI and NOWAKOWSKI (1981) and by BURAKOWSKI, MROCZKOWSKI and STEFAŃSKA (1985).

RESULTS

Species composition

In the studied Mazovian forests 18 click beetle species were found to occur, comprising 13 soil species and 5 dendrophilous species. 16 species were reported from the six stands in the plots of linden-oak-hornbeam forests (*Tilio-Car-*

Table I. Click beetle communities (*Coleoptera, Elateridae*) in linden-oak-hornbeam forests (*Tilio-Carpinetum*) and thermophilous oak forests (*Potentillo albae-Quercetum*) of Mazovian Lowland (*n* — number of individuals per m²; + — data obtained by other methods)

No.	Species	Association													
		<i>Tilio-Carpinetum</i>										<i>Potentillo albae-Quercetum</i>			
		Study area													
		Dębina res.				Modrzewina res.		Cyganka res.		Radziejowice		King J. III Sobieski res.	Radziejowice	B. Hryniewiecki res.	
humid	var.	typical	var.	n	%	n	%	n	%	n	%				
1	<i>Adelocera murina</i> (L.)					0.25	0.78					+		+	
2	<i>Selatosomus latus</i> (F.)					4.00	12.40								
3	<i>Selatosomus cruciatus</i> (F.)			+									+		
4	<i>Prosternon tessellatum</i> (L.)									3.75	10.34	+		1.00	12.50
5	<i>Actenicerus sjaelandicus</i> (MÜLL.)							0.13	0.19						
6	<i>Cidnopus aeruginosus</i> (OL.)					+								+	
7	<i>Cidnopus minutus</i> (L.)													+	
8	<i>Cidnopus parvulus</i> (PANZ.)													+	
9	<i>Athous vittatus</i> (F.)	0.27	1.37												
10	<i>Athous haemorrhoidalis</i> (F.)	1.37	6.96	0.33	1.71	<0.25	<0.78	0.13	0.19	+		+		1.00	12.50
11	<i>Athous subfuscus</i> (MÜLL.)	1.64	8.34	3.17	16.40	10.75	33.33	44.15	65.90	3.75	10.34	+			
12	<i>Ectinus aterrimus</i> (L.)			0.83	4.29	3.00	9.30	2.70	4.02	0.63	1.72		+	+	
13	<i>Dalopius marginatus</i> (L.)	16.16	82.16	15.00	77.59	14.25	44.18	19.38	28.93	27.50	75.86	+	+	6.00	75.00
14	<i>Calambus bipustulatus</i> (L.)					+									

15	<i>Melanotus erythropus</i> (GMEL.)				+									
—	<i>Melanotus</i> sp.							0.63	1.72					
16	<i>Ampedus erythrogonus</i> (MÜLL.)				+									
17	<i>Ampedus pomorum</i> (HERBST)				+									
18	<i>Ampedus sanguinolentus</i> (SCHRANK)										+			
	undetermined material	0.27	1.37				0.51	0.77						
Total		19.71		19.33		32.25		67.00		36.25		—	—	8.00
<i>N</i> species		4		5		11		5		6		6	3	8

pinetum), including all the distinguished dendrophilous species (Tab. I). The compiled list of species should be expanded by *Dicronychus cinereus* (HERBST), recorded by NOWAKOWSKI (1979) in two other linden-oak-hornbeam forests on the Mazovian Lowland. An accidental alien element was higrophilous *Actenicerus sjaelandicus*, found solely in the ecotonic plot of linden-oak-hornbeam forest in the Cyganka reserve. On the two stands in plots of thermophilous oak forests (*Potentillo albae-Quercetum*) nine elater species occurred, none of them ranking among dendrophilous species (Tab. I). In comparison to the studied linden-oak-hornbeam forests, the plots of thermophilous oak forests were marked for the occurrence of *Cidnopus minutus* and *C. parvulus* and the absence of *Athous subfuscus*, numerous occurring in linden-oak-hornbeam forests.

The presented list of species found in the studied forests on the Mazovian Lowland includes two species new to the region (BURAKOWSKI, MROCZKOWSKI and STEFAŃSKA 1985). One is a stenothermal soil species *Cidnopus parvulus* sampled in the Hryniewiecki reserve at Podkowa Leśna in the period from April 17 to May 8, 1984, by means of yellow dishes hung on an oak tree. The other is dendrophilous *Ampedus erythrogonus*; one specimen of this species was found in litter sifts from the Modrzewina reserve near Belsk on April 28, 1981.

The site most abundant in species was the stand in the Modrzewina reserve, where 11 species occurred, including seven soil species and four dendrophilous species. In the typical linden-oak-hornbeam forests at the Dębina and Cyganka reserves 5-6 soil species were collected, while in the King Jan III Sobieski reserve and at Radziejowice five soil species and one dendrophilous species were found. The least number of species, namely, four, was recorded to occur in the moist variant of typical linden-oak-hornbeam forest at the Dębina reserve. On the plots of thermophilous oak forest at the Hryniewiecki reserve in Podkowa Leśna, there were found eight elater species. Since no dendrophilous species were sampled in this habitat, hence this plot was the most abundant in soil species out of all the studied sites. On the other stand, in thermophilous oak forest at Radziejowice merely three species occurred (Tab. I).

According to the four degree Tischler scale, the species absolutely constant ($C > 75.0\%$) in the studied zoocoenoses of Mazovian linden-oak-hornbeam forests, considering all the six stands and the two from an earlier work by NOWAKOWSKI (1979), were *Athous haemorrhoidalis* and *Dalopius marginatus*, found to occur everywhere. The constant species ($50.0\% < C \leq 75.0\%$) were *Athous subfuscus* (75.0%) and *Ectinus aterrimus* (62.5%); *Adelocera murina* was the only accessory species ($25.0\% < C \leq 50.0\%$), while the remaining 11 species as well as *Dicronychus cinereus* included in the counts on the basis of data from literature, ranged among accidental species ($C \leq 25.0\%$). A similar analysis could not be carried out for thermophilous oak forests due to the negligible number of stands. However, it was possible to distinguish species of a large degree of stability of occurrence in this habitat, namely,

Dalopius marginatus and *Ectinus aterrimus*, both of them having been found on the two study sites. The remaining seven species occurred solely on one of the two stands, hence the degree of stability of their occurrence could not be representative for the whole habitat in question. Moreover, a feature characteristic for click beetle communities of thermophilous oak forests may be the absence of *Athous subfuscus*, i.e. the constant species of the communities in linden-oak-hornbeam forests.

Similarity of species composition of click beetle communities on the studied sites was estimated on the basis of the SÖRENSEN formula. The analysis considered the soil species only, disregarding the accidentally sampled dendrophilous species. Generally it may be assumed that the communities of wireworms in the studied linden-oak-hornbeam forests were relatively homogeneous, which was evidenced by high values of the similarity index (Fig. 1). The core of the community was constituted by four species which were classified above as the absolutely constant or constant species for the studied forest

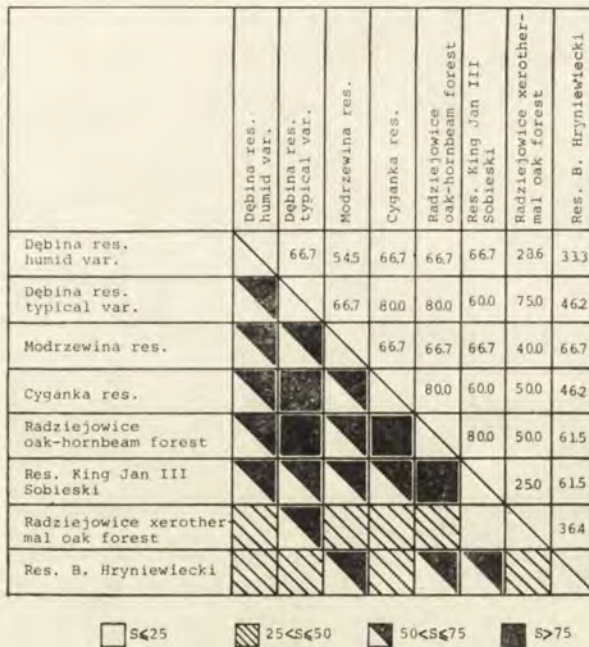


Fig. 1. A diagram of similarity in species composition (S) of the click beetle communities in linden-oak-hornbeam forests (*Tilio-Carpinetum*) and thermophilous oak forests (*Potentillo albae-Quercetum*) of the Mazovian Lowland.

type. A movable element of the community comprised 1–2 accidental species, which, in some cases as, e.g. *Actenicerus sjaelandicus*, were alien to the examined community. The two sites in thermophilous oak forests were marked for a slightly different species composition of *Elateridae* communities as compared

to the communities from linden-oak-hornbeam forests, which was clearly captured in notably lower values of the similarity index when compared to the other study sites (Fig. 1).

Zoogeographical analysis

All the click beetle species found in the studied forest habitats are natural elements of fauna on the Mazovian Lowland. The following zoogeographical elements were distinguished in the sampled material: in the linden-oak-hornbeam forests there occurred Holarctic, Palaearctic, Euro-Siberian and European elements, while stenothermal elements, such as southern Euro-Siberian and sub-Mediterranean were absent; in the thermophilous oak forests there were found Holarctic, Palaearctic, Euro-Siberian and stenothermal southern Euro-Siberian elements, while European and Submediterranean elements were missing (Tab. II).

Table II. Zoogeographical composition of analysed forest elaterofauna and elaterid species of Mazovia (*N* — number of species)

Element	Mazovian Lowland		<i>Tilio-Carpinetum</i>		<i>Potentillo albae-Quercetum</i>	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
Holarctic	5	7.81	2	11.76	1	11.11
Palaearctic	12	18.75	3	17.65	1	11.11
European	19	29.68	4	23.52	—	—
Euro-Siberian	24	37.50	8	47.50	6	66.67
South-Euro-Siberian	2	3.13	—	—	1	11.11
Submediterranean	2	3.13	—	—	—	—
Total	64	100.00	17	100.01	9	100.00

On the basis of analysis of proportional contribution of particular zoogeographical groups to the total number of species found in the studied linden-oak-hornbeam forests, it may be ascertained that the obtained data did not essentially differ from the values estimated for the whole fauna of click beetles on the Mazovian Lowland. It should be emphasized, however, that in the studied communities there were not recorded any stenothermal elements, whose contribution to the click beetle fauna of Mazovia amounted to 6.26%. As regards the examined plots of thermophilous oak forests, the obtained data on the contribution of particular elements to the *Elateridae* communities differed from those calculated for the whole Mazovian fauna. The contribution of Euro-Siberian element, which accounted for 66.7% of thermophilous oak forest communities, was almost two times higher than in case of the Mazovian

click beetle fauna. The striking feature of *Elateridae* communities in thermophilous oak forests was the lack of European element, which accounted for 37.5% of the whole Mazovian click beetle fauna, as well as the occurrence of one southern Euro-Siberian species (11.1%) (Tab. II).

Quite a different picture was obtained while the proportional contribution of zoogeographic elements was analyzed taking into account abundance of particular species in the community. On all the sites except for the Cyganka reserve, the most numerous species was Palaearctic *Dalopius marginatus* (Tab. I) and, consequently, Palaearctic element accounted for 80% of the community abundance. In the Cyganka reserve, where the most numerous species was Euro-Siberian *Athous subfuscus*, Euro-Siberian element contributed 70.1%, while Palaearctic one — merely 28.9%. In case of thermophilous oak forests, the contribution of all the other distinguished elements, i.e. European, Holarctic and southern European, did not exceed 2% in all the studied communities.

Ecological analysis

In connection with the division of click beetles according to the represented scale of ecological plasticity (BURAKOWSKI and NOWAKOWSKI 1981, NOWAKOWSKI 1981, 1989), the following ecological groups were singled out in the *Elateridae* material coming from the studied forest habitats: ubiquitous (eurytopic) species, politopic and stenotopic forest species and, moreover, in the studied linden-oak-hornbeam forests also an oligotopic species of open areas, i.e. *Selatosomus latus* and a stenotopic species of open areas, i.e. *Actenicerus sjaelandicus*. The ecological analysis took into account the soil species only.

As compared to the data for the whole Mazovian Lowland, the proportional share of particular ecological elements in the wireworm fauna of the studied forest habitats was notably different. Apart from an intelligible decrease in the contribution of the group of species of open areas, which dwindled from 42.5% estimated for the whole wireworm fauna of Mazovia, down to 16.7% for linden-oak-hornbeam forests (this group was not represented in the thermophilous oak forests), the contribution of politopic forest species and ubiquitous species increased 2.5–3 times. The proportional share of stenotopic forest species in communities of linden-oak-hornbeam forests was almost two times smaller (16.7% as compared to 31% for Mazovia), while in case of the communities in a thermophilous oak forests it remained approximately the same (33.3% as compared to 31% for Mazovia) (Tab. III). Considering abundance of species in the studied communities, the contribution of politopic forest species exceeded 80% in all the communities (Tab. I).

The complex problem of trophic preferences of wireworm larvae was profoundly discussed in earlier papers mentioned above. There were noticed

Table III. Ecological composition of analysed forest soil elaterofauna and elaterid species of Mazovia (*N* — number of species)

Criterion	Element		Mazovian Lowland		<i>Tilio-Carpinetum</i>		<i>Potentillo albae-Quercetum</i>	
			<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
Ecological amplitude	Ubiquitous (Eurytopic)		4	9.52	3	25.00	3	33.33
	of forest	Polytopic	6	14.29	5	41.67	3	33.33
		Stenotopic	13	30.95	2	16.67	3	33.33
	of open areas	Polytopic	6	14.29	—	—	—	—
		Oligotopic	4	9.52	1	8.33	—	—
		Stenotopic	9	21.43	1	8.33	—	—
Trophic type	Predators		6	14.29	2	16.67	2	22.22
	Pantophagous		27	64.29	9	75.00	6	66.67
	Rhizophagous		9	21.43	1	8.33	1	11.11
Abundance	Locally abundant		2	4.76	—	—	—	—
	Numerous		8	19.05	5	41.67	5	55.56
	Scarce		14	33.33	5	41.67	2	22.22
	Sporadic		18	42.86	2	16.67	2	22.22
Expansiveness	Expansive		1	2.38	—	—	—	—
	Stable		40	95.24	12	100.00	9	100.00
	Recessive		1	2.38	—	—	—	—

certain slight differences between percentage contribution of certain trophic groups of wireworms to the communities of the studied forest habitats and to that of the whole click beetle fauna on the Mazovian Lowland. Pantophages had the greatest share in the studied communities and accounted for 75.0% in linden-oak-hornbeam forests and 66.7% in thermophilous oak forests, as compared to 64.3% on the Mazovian Lowland. Also a higher contribution was noted of predators, especially in thermophilous oak forests; on the other hand, the contribution of rhizophages was 2–3 times smaller (from 21.4% on Mazovia down to 11.1% in linden-oak-hornbeam forests and 8.3% in thermophilous oak forests) (Tab. III). With regard to abundance of species in communities, the proportional contribution of pantophages was even greater, exceeding 80% on all the studied sites.

The last issue in the ecological analysis of the present studies was species abundance and expansiveness. In the wireworm communities of the studied linden-oak-hornbeam and thermophilous oak forests on the Mazovian Lowland, five species were classified as abundant in these two habitats. In case of linden-oak-hornbeam forests five species were scarce and two species — occurred sporadically, while in case of thermophilous oak forests two species were scarce and two — sporadic. In both types of the studied forests there were not observed any locally mass-occurring species. The proportion of abundant species was 2–3 times greater on the studied sites, i.e. it increased from 19.1% calcu-

lated for the whole Mazovian fauna, to 41.7% in linden-oak-hornbeam forests and 55.6% in thermophilous oak forests. The contribution of rare species occurring scarce and sporadically was larger in case of the Mazovian Lowland, namely 76.2%, while the values estimated for linden-oak-hornbeam and thermophilous oak forests amounted to 58.3% and 44.4% respectively (Tab. III).

Dominance structure

The analysis of dominance structure in wireworm communities of the studied linden-oak-hornbeam forests and thermophilous oak forests on the Mazovian Lowland, took into account only these groups of species for which sufficient quantitative data had been gathered, i.e. all the soil species. All the remaining species collected by means of non-quantitative supplementary methods, fell into the category of accompanying species.

The following dominance classes were distinguished: eudominant (over 50%), dominant (15.01–50.00%), subdominant (5.01–15.00%) and recedent (accompanying species) (less than 5%). The ranges of particular classes were set larger than usual due to a specific character of the group.

In order to capture similarity of dominance structure in wireworm communities of the studied sites, the MORISITA index (c) modified by HORN was applied. It was found out that in soil of the studied plots of linden-oak-hornbeam forests there occurred, on the whole, one type of community. In the moist variant of typical linden-oak-hornbeam forest and in typical linden-oak-hornbeam forest in the Dębina reserve, in the linden-oak-hornbeam forest



Fig. 2. A diagram of similarity in dominance structure (c) of elaterid communities in the linden-oak-hornbeam forests (*Tilio-Carpinetum*) and thermophilous oak forests (*Potentillo albae-Quercetum*) of the Mazovian Lowland.

at Radziejowice and in the Modrzewina reserve as well as in the plot of thermophilous oak forest in the Hryniewiecki reserve at Podkowa Leśna, the community eudominant was *Dalopius marginatus* (Tab. I), which was evidenced by very high values of the similarity index of dominance structures, ranging 0.73–0.99 (Fig. 2). However, contrary to the first four sites, the plot of thermophilous oak forest was significantly different as its community lacked *Athous subfuscus*, which was subdominant or even dominant, in communities of the mentioned linden-oak-hornbeam forests, accounting there for 8.34–33.33%. The type of community *Dalopius marginatus* – *Athous subfuscus* was characteristic not only for linden-oak-hornbeam forests. The same type of community was also recorded in a alder swamp (*Circaeo-Alnetum*) as well as in mixed and continental pine forest of the Kampinos Forest (NOWAKOWSKI 1981).

A reversed dominance pattern, namely, eudominant *Athous subfuscus* and dominant *Dalopius marginatus*, was noted in the click beetle community from the linden-oak-hornbeam forest of an ecotonic character in the Cyganka reserve near Truskaw (Tab. I), which was reflected in considerably lower values of the similarity index, ranging 0.39–0.83 (Fig. 2).

Abundance

Abundance of *Elateridae* in soil of the studied linden-oak-hornbeam forests was rather small, ranging on a majority of stands from 19.3 to 36.2 specimen/1 m² (Tab. I). Exceptionally numerous was only the community in the Cyganka reserve, whose abundance amounted to 67.0 specimen/1 m². In soil of the thermophilous oak forest in the Hryniewiecki reserve at Podkowa Leśna, abundance of larvae was very low amounting barely to 8.0 specimen/1 m² (Tab. I).

SUMMARY

A total of 16 click beetle species was recorded to occur in linden-oak-hornbeam forests on the Mazovian Lowland, including 11 soil species and 5 dendrophilous species. Hence the *Elateridae* fauna of linden-oak-hornbeam forests, analyzed on the basis of material collected with standard sampling methods, was undoubtedly richer than that of the formerly thoroughly studied Mazovian continental pine forests (NOWAKOWSKI 1981, SZUJECKI and PERLIŃSKI 1975). The core of the studied communities was made up of four species classified as absolutely constant or constant, i.e. *Athous haemorrhoidalis*, *Dalopius marginatus*, *Ectinus aterrimus* and *A. subfuscus*, while as regards dominance structure, there occurred only one type of community with

the eudominant *D. marginatus* and the subdominant or dominant *A. subfuscus*. *Elateridae* communities of linden-oak-hornbeam forests were much alike those of mixed and continental pine forests of the Mazovian Lowland with respect to the community dominance structure, nevertheless, there were noted significant differences in the distribution of absolutely constant and constant species. In pine forests *Athous haemorrhoidalis* and *Ectinus aterrimus* were replaced by at least two species — *Selatosomus aeneus* (L.) and *Sericus brunneus* (L.) (NOWAKOWSKI 1981, SZUJECKI and PERLIŃSKI 1975). Other characteristic traits of the studied communities was an overwhelming prevalence of unspecialized pantophages, both in the total number of species as well as in the species abundance, at a small share of rhizophages in the community and, furthermore, a relatively little abundance of communities. These two features pronouncedly distinguished wireworm communities of the studied forests from communities inhabiting meadows set on these habitats (NOWAKOWSKI 1981, 1986), which pointed to a different function performed by *Elateridae* in forest habitats than in meadow zoocoenoses.

A small area and ecotonic character of the site resulted in certain modifications in the community structure, which were palpable in the community from linden-oak-hornbeam forest at the Cyganka reserve. This community was marked not only for the occurrence of elements alien to linden-oak-hornbeam forests (higrophilous *Actenicerus sjaelandicus*), but also for the eudominant position of *Athous subfuscus* and for a great community abundance, almost two times greater than the maximum abundance estimated on sites in other linden-oak-hornbeam forests. Despite a notable stability of, e.g. dominance structure in forest communities, the structural divergencies pointed out above corroborate to the fact that *Elateridae* may be a sensitive indicator of changes in environmental factors and, above all, of the effect of anthropoppression, as evidenced by NOWAKOWSKI (1981).

In *Elateridae* communities of thermophilous oak forests there occurred nine soil species, which should be regarded in terms of a high number, especially in the view of a much smaller number of stands (two study sites as compared to nine stands, including the ones from literature in linden-oak-hornbeam forests) and a smaller number of the applied methods of material sampling. The species absolutely constant or constant included *Dalopius marginatus* and *Ectinus aterrimus*, while the striking feature of these communities was the absence of *Athous subfuscus*. The community eudominant was *Dalopius marginatus*, while *Prosternon tessellatum* and *Athous haemorrhoidalis* ranked among the subdominants. The former subdominant represented the pine wood element in the community of thermophilous oak forests, the latter correlated this click beetle community to that of carrs (NOWAKOWSKI 1981). As regards the remaining features of community structure, the *Elateridae* community of thermophilous oak forests did not vary much from the communities of linden-oak-hornbeam forests, however, a specific trait was its very small abundance.

REFERENCES

- BURAKOWSKI B., MROCZKOWSKI M., STEFAŃSKA J. 1985. Chrząszcze — *Coleoptera*. *Buprestoidea, Elateroidea, Cantharoidea*. Katalog Fauny Polski, **23**, 10, 40. Warszawa, pp. 87–237.
- BURAKOWSKI B., NOWAKOWSKI E. 1981. Click beetles (*Coleoptera, Elateridae*) of Warsaw and Mazovia. In: Species composition and origin of the fauna of Warsaw. I. Memorabilia zool., Warszawa, **34**: 161–180.
- KORNALEWICZ W. 1977. Larwy *Elateridae* (*Coleoptera*) w glebach rezerwatu Muszkowicki Las Bukowy. Pol. Pismo ent., Wrocław, **47**: 105–111.
- KOTOWSKA J., NOWAKOWSKI E. 1989. Geobotanical characteristic of study areas of linden-oak-hornbeam and thermophilous oak forests of the Mazovian Lowland. *Fragm. faun.*, Warszawa, **32**: 13–31.
- NOWAKOWSKI E. 1979. Skarpa warszawska jako teren ostojowy dla fauny — na przykładzie sprzążków glebowych (*Coleoptera, Elateridae*). *Fragm. faun.*, Warszawa, **23**: 335–341.
- NOWAKOWSKI E. 1981. Sprzążki glebowe (*Elateridae, Coleoptera*). In: Zoocenologiczne podstawy kształtowania środowiska przyrodniczego osiedla mieszkaniowego Białoleka Dworska w Warszawie. I. Skład gatunkowy i struktura fauny terenu projektowanego osiedla mieszkaniowego. *Fragm. faun.*, Warszawa, **26**: 229–247.
- NOWAKOWSKI E. 1985. Structure of soil click beetle (*Coleoptera, Elateridae*) communities in urban green areas of Warsaw. In: Structure of the fauna of Warsaw. I. Memorabilia zool., Warszawa, **41**: 81–101.
- NOWAKOWSKI E. 1989. Click beetles (*Coleoptera, Elateridae*) of moist meadows of the Mazovian Lowland. *Memorabilia zool.*, Warszawa, **43**: 127–139.
- SZUJECKI A., PERLIŃSKI S. 1975. Metodyka pobierania prób do oceny zasiedlania leśnych środowisk niejednorodnych przez chrząszcze ściółkowe. *Prace Kom. nauk. PTG*, Warszawa, **3**: 25–42.

Instytut Zoologii PAN
00-679 Warszawa, Wilcza 64

STRESZCZENIE

[Tytuł: *Elateridae* (*Coleoptera*) lasów grądowych i dąbrów świetlistych Niziny Mazowieckiej]

W pracy omówiono skład gatunkowy, profil zoogeograficzny i ekologiczny, strukturę dominacyjną oraz liczebność zgrupowań sprzążkowatych lasów grądowych i dąbrów świetlistych Niziny Mazowieckiej. Stwierdzono występowanie 11 gatunków glebowych, 5 dendrofilnych w lasach grądowych i 9 gatunków glebowych w dąbrowach, w tej liczbie *Cidnopus parvulus* i *Ampedus erythrogonus*, nie wykazywane dotąd z Niziny Mazowieckiej. Podstawowy zrząd zgrupowania tworzyły 4 gatunki — *Athous haemorrhoidalis*, *Dalopius marginatus*, *Ectinus aterrimus* i *Athous subfuscus* — określone jako absolutnie stałe lub stałe dla zgrupowań lasów grądowych, natomiast w dąbrowach ga-

tunkami takimi były *Dalopius marginatus* i *Ectinus aterrimus*, przy całkowitym braku *Athous subfuscus*. W ramach analizy zoogeograficznej stwierdzono, że w ogólnej liczbie gatunków przeważający udział ma element eurosyberyjski, natomiast uwzględniając liczebność gatunku w zgrupowaniu, zdecydowanie przeważa element palearktyczny. W odróżnieniu od zgrupowań grądów zgrupowania dąbrów charakteryzują się brakiem elementu europejskiego oraz obecnością ciepłolubnego elementu południowo-euro-syberyjskiego. Przeważający udział zarówno w ogólnej liczbie gatunków, jak i przy uwzględnieniu liczebności, mają pantofagi, natomiast udział ryzofagów jest znikomy. W ramach analizy struktury dominacyjnej stwierdzono (w grądach) zasadniczo jeden typ zgrupowania *Dalopius marginatus*-*Athous subfuscus*. W dąbrowach występuje natomiast zgrupowanie z eudominantem *D. marginatus*, a na pozycję subdominantów, wobec braku *A. subfuscus*, wysuwają się *Prosternon tessellatum* i *Athous haemorrhoidalis*. Liczebność analizowanych zgrupowań, zwłaszcza w dąbrowach, nie była wysoka i wynosiła 8,00–36,25 osobn./1 m²; jedynie w niewielkim grądzie o charakterze ekotonowym zagęszczenie *Elateridae* było wysokie, wynosząc 67,00 osobn./1 m².

РЕЗЮМЕ

[Заглавие: *Elateridae* (Coleoptera) лесов гряда и дубрав Мазовецкой низменности]

В разработке обсужден видовой состав, зоологический и экологический профиль, структура доминации и численность сообществ жуков-щелкунов липово-грабовых лесов и дубрав Мазовецкой низменности. Констатировано в гряде 11 почвенных видов и 5 дендрофильных, в дубравах 9 почвенных видов, в том числе *Cidnopus parvulus* и *Ampedus erythrogonus* не известные до настоящего времени с Мазовецкой низменности. Основной стержень сообщества составляли 4 вида: *Athous haemorrhoidalis*, *Dalopius marginatus*, *Ectinus aterrimus* и *Athous subfuscus*, обозначенные как абсолютно постоянные или постоянные в сообществах лесов гряда. В дубравах к таким видам относились *Dalopius marginatus* и *Ectinus aterrimus* при полном отсутствии *Athous subfuscus*. Зоогеографический анализ показал, что в общем числе видов имело превосходство содержание европейско-сибирского элемента; но, если принять во внимание численность видов, в сообществе решительное превосходство приходится на палеарктический элемент. В отличие от сообществ лесов гряда сообщества дубрав характеризуются отсутствием европейско-сибирского элемента и наличием теплолюбивого южноевропейско-сибирского элемента. Большинство рассматриваемых *Elateridae* как по общему числу видов, так и при принятии

во внимание численности относится к пантофагам, содержание ризофагов крайне незначительно. В рамках анализа структуры доминанции констатировали, что в гудах встречается в принципе один тип сообщества — *Dalopius marginatus*-*Athous subfuscus*. В дубравах встречается сообщество с евдоминантным видом *D. marginatus*, на позиции же субдоминантов в связи с отсутствием *A. subfuscus* выдвигаются *Prosternon tessellatum* и *Athous haemorrhoidalis*. Численность анализируемых сообществ, особенно в дубравах, не была высокой, составляя 8,00–36,25 особ./1 м². Только в одном небольшом гуде, носящем характер экотона плотность *Elateridae* была высокая, составляя 67,00 особ./1 м².
