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CLICK BEETLES (*COLEOPTERA, ELATERIDAE*) OF WARSAW AND MAZOVIA

ABSTRACT

There are 59 elaterid species known from Mazovia. In the suburbs of Warsaw 49 species were recorded, i.e. a complete set of the species known from Warsaw, while in urban green areas only 18 species were found. These are mostly Palaearctic species. Urban pressure eliminates firstly dendrophilous species, and, among soil species, pantophages. The proportion of predators was maintained at a more or less stable level. As a result, the elaterid community occurring in urban green areas consists almost exclusively of soil species, mostly rhizophages feeding on live root tissues and underground storing organs. Moreover, they show a high ecological tolerance (being ubiquitous and polytopic species of open areas), they are abundant or locally abundant in Mazovia, and established in this area for a long time. A rhizophage, *Agriotes sputator*, is the absolute dominant as it found optimum conditions in the town.

INTRODUCTION

The *Elateridae*, though rather abundantly represented in the fauna of Poland, belong to poorly known groups of the beetles. In Poland 120 species have been recorded so far, but particular regions of the country were not evenly covered with the studies of this group. Most intense studies were conducted in southern regions, first of all in Lower Silesia where 82 species were recorded, Upper Silesia — 87 species, West Sudeten Mountains — 75 species, East Beskids — 84 species, and West Beskids — 78 species. The whole central and northern part of the country was little studied.

The information on the elaterids of Mazovia is very scarce. Generally, short contributions are available on one or several species, included to faunistic check-lists [2, 3, 11, 12, 24, 26—32], ecological publications [1, 5, 6, 9, 14, 16—18, 20, 23, 25, 35], or articles dealing with plant protection [8, 10, 15, 21, 22]. The earliest data on single species living in Mazovia date from the beginning of this century [11, 12], while the first information from Silesia was published a hundred years earlier. The elaterids of Mazovia are still waiting for a comprehensive review. None of the 27 publications issued so far considers more than 11 species, a total of 43 species being recorded in sum. A poor state of knowledge on this topic in this region can be illustrated by the fact that 21 species new to Mazovia were

recorded during the present study, and the occurrence of some other, rare species was confirmed.

This analysis of the elaterids of Mazovia is based on the materials from the collection of the Institute of Zoology PAS in Warsaw. Large majority of specimens, particularly the species inhabiting forests, were collected by Burakowski, Nowakowski has paid particular attention to soil elaterids since 1972. Moreover, scarce older materials from the collection of the Institute of Zoology were used, derived mainly from the collection of a known coleopterologist, Tenenbaum.

The check-list of elaterids recorded from urban green areas of Warsaw is based on the materials collected in 1974—1978 in the studies carried out at the Institute of Zoology PAS, and entitled "The effect of urban pressure on the fauna of Warsaw". The major premises of the study, habitat characteristics and methods of material collection, are presented in preliminary contributions [7, 13, 19, 33]. During the 5-year period of the study, 18 elaterid species were recorded from urban green areas, including 16 in urban parks, 8 in green areas of housing estates, and 9 in the centre of the town. These data are supplemented by the results of the study conducted in a seminatural woodland of the Vistula escarpment in Warsaw [18].

The objective of the work was to set up the data known so far on the occurrence of elaterids in Mazovia, and to analyse the effect of urban pressure on this group of insects.

SPECIES COMPOSITION

On the basis of literature data and museum collections 64 species have been recorded from Mazovia so far. Only 59 of them are considered to be native to the fauna of Mazovia. The other 5 species were either wrongly identified or the site of collection was wrongly noted. Thus, they are deleted from the check-list of the species occurring in Mazovia (Tab. 8), and are listed below.

Selatosomus affinis [20]. Boreal-mountain species occurring in mountains of Central Europe, Finland and Scandinavia including northernmost parts, and in Siberia. In Poland some stands were recorded in the Sudetes, West Beskids, Tatras, and Bieszczady. The general distribution of the species and habitat requirements imply that it cannot occur in the lowland.

Fleutiauxellus tenuicornis [24]. In the collections there are no evidential specimens. Some stands of this species are located in southern Poland where it inhabits gravel on water margins. From here it can be carried with flood waters to lower stands in which it casually occurs. It is not likely to be established in Mazovia.

Athous villosus [26]. The evidential specimen was included in the collection

of the Museum of Industry and Agriculture in Warsaw, destroyed during the war, in 1939. The species associated with forests, known from western part of the country (Pomerania, Silesia). It lives in old, decaying trunks and stumps of broad-leaved trees on warm stands. Its occurrence in Mazovia is dubious.

Agriotes gallicus [12]. The species known from southern part of West Europe. In Poland very rarely recorded. Noted in Silesia, West Sudetes, and Lubusz region more than a hundred years ago, in Poznań early in this century, and recently found in the Pieniny. The occurrence of this species in Mazovia is not probable. In old collections there are no specimens from this region, and the present search in the stands generally rich in elaterids, of the genus *Agriotes* Eschsch. failed.

Idolus picipennis [30]. The species closely associated with calcareous soils. Some of its stands are located in southern Poland (calcareous rocks in Ojców, alpine meadows in Bieszczady). Since a well identified specimen is included in the collection of the Institute of Zoology PAS, it should be expected that the site of finding was wrongly defined.

Within the administrative boundaries of Warsaw 49 species accounting for 83.1% of the fauna of Mazovia, were recorded. All the species found in the town were also present in suburban areas. Thus, there were no species the occurrence of which would be restricted to urban green areas. In urban green areas 18 species were recorded. They account for 30.5% of the fauna of Mazovia and for 36.7% of the fauna of Warsaw. Thus, urban pressure reduced the number of species in urban green areas to one-third of those occurring in suburbs. The following numbers of species were recorded in particular types of urban green areas:

— urban parks — 16 species (27.1% of the fauna of Mazovia and 32.7% of the fauna of Warsaw),

— green areas of housing estates — 8 species (13.6 and 16.3% respectively),

— the centre of the town — 9 species (15.3 and 18.4% respectively).

Also *Melanotus rufipes* is classified as a typical representative of the elaterid fauna of urban verdure, though it has not been recorded from any of the types of urban green areas given above. Its occurrence in urban parks is highly probable, and recently it has been found in the new housing estate Jelonki (Warsaw-Wola).

A complete check-list of the *Elateridae* of Mazovia and Warsaw is set up in Table 8. The occurrence of new and rare species in Mazovia is described in the Appendix.

ZOOGEOGRAPHICAL ANALYSIS

All elaterid species recorded from Mazovia are natural elements of the fauna of this region. Some of them are relicts. The relicts associated with

forests involve such species as *Lacon querceus*, *Anostirus castaneus*, *Calambus bipustulatus*, *Athous rufus*, *A. mutilatus*, *Ampedus hjorti*, *A. cardinalis*, and *Cardiophorus rufipes*. The species of the genus *Agriotes* Eschsch. probably colonized this area with the development of settlements. The only species likely to be expansive now is *Adrastus rachifer*. Not recorded from Mazovia so far, this species is a constant component of the fauna of Warsaw on the left bank of the Vistula, being probably carried there from southern Poland with flood. Finally, this species was not classified as occurring in isolated stands (exclusively in urban green areas) in Mazovia, since it has also been recorded from suburban areas (Ursynów).

The elaterids of Mazovia are composed of the following zoogeographical elements [7]: Holarctic, Palaearctic, European, Euro-Siberian, south-Euro-Siberian, and submediterranean. Cosmopolitan, boreal, subatlantic, and Mediterranean species were not recorded there.

Tab. 1. Proportions of zoogeographical elements in elaterids of Warsaw and non-urban habitats of Mazovia (N — number of species)

| Zoogeographical element | Mazovia | | Warsaw | | | | | | | | | | | |
|-------------------------|---------|------|---------|------|-------------------|------|-----------------|-------|-------------|------|---|------|---|---|
| | | | Suburbs | | Urban green areas | | | | | | | | | |
| | Total | | | | Parks | | Housing estates | | Town centre | | | | | |
| | | | N | % | | | | | | | N | % | N | % |
| Holarctic | 4 | 6.8 | 4 | 8.2 | — | — | — | — | — | — | — | — | — | — |
| Palaearctic | 11 | 18.6 | 9 | 18.4 | 7 | 38.9 | 5 | 31.25 | 5 | 62.5 | 3 | 33.3 | — | — |
| European | 19 | 32.2 | 16 | 32.7 | 5 | 27.8 | 5 | 31.25 | 1 | 12.5 | 3 | 33.3 | — | — |
| Euro-Siberian | 22 | 37.3 | 18 | 36.7 | 5 | 27.8 | 5 | 31.25 | 2 | 25.0 | 3 | 33.3 | — | — |
| South-Euro-Siberian | 1 | 1.7 | 1 | 2.0 | — | — | — | — | — | — | — | — | — | — |
| Submediterranean | 2 | 3.4 | 1 | 2.0 | 1 | 5.6 | 1 | 6.25 | — | — | — | — | — | — |

The dominant group of the elaterids of Mazovia consists of Euro-Siberian and European species. The proportion of thermophilous species with south-Euro-Siberian and submediterranean ranges did not exceed 4%. Very similar proportions of particular elements were observed in suburbs of Warsaw.

The proportion of particular groups in suburbs and urban green areas indicates that urban pressure eliminates Euro-Siberian elements and, to a lesser extent, European ones. Instead, the proportion of Palaearctic species, thus generally eurytopic, highly tolerant of environmental conditions, markedly increased (Tab. 1). Palaearctic elements were dominants particularly in green areas of housing estates, in soils of open lawns and, to a lesser degree, in the centre of the town. This coincides with the fact that the absolute dominant in soils of urban lawns (66—100% of the larvae) is *Agriotes sputator*, the Palaearctic element. In urban green areas there were no

Holarctic and thermophilous south-Euro-Siberian elements. Submediterranean species were found only in parks (Tab. 1). The elimination of thermophilous species shows that environmental conditions of the urban habitat are not suitable for these species, although on the average, humidity is lower and temperature higher [19].

ECOLOGICAL ANALYSIS

Elaterids are one of most important groups of beetles in terrestrial biocoenoses. Larvae and adults are two different components of the zoocoenosis. Larvae live several years and inhabit soil or wood of tree trunks and stumps in different stages of decomposition. Adults live 2—3 weeks and are epigeal animals. The ecological characteristics of some groups of elaterid species are based only on the occurrence of larval forms in specified biotopes.

Among the representatives of this family, two groups can be readily distinguished: dendrophilous species and soil species. The former group consists of *Denticollis linearis*, *Lacon querceus*, *Calambus bipustulatus*, *Athous rufus*, *A. mutilatus*, *Ectamenogonus megerlei*, *Procræus tibialis*, *Elater ferrugineus*, and species of the genera *Melanotus* Eschsch. and *Ampedus* Dejean. Larvae of some of them can occasionally or shortly before pupation move to soil, particularly this with high content of humus (larvae *Melanotus* sp. and *Ampedus* sp., particularly *A. balteatus*, which is often found in soils of coniferous forests) [25, and the author's own study]. Most of these species are associated with forests, some of them, however, inhabit also single trees growing on balks between crop fields, along roadsides, etc.

The proportions of these two groups are similar in Mazovia and in the suburbs of Warsaw. Dendrophilous species contributed to 35% of the total number of species, and the soil species to 65%. The effect of urban pressure on the proportion of these two groups in urban green areas is well pronounced. The proportion of dendrophilous species (*Melanotus rufipes* and *Ectamenogonus megerlei*) dropped to 11%, in parks (only *E. megerlei*) amounting to 6.3%, in the centre of the town to 11.1%, while being absent in the green areas of housing estates (Tab. 2). Dendrophilous species are eliminated from urbicoenoses as a result of the destruction of their natural habitats by cultivation treatments (cutting down old trees, concreting and pitching holes, removal of deadwood), as well as because of the reduction of their food resources by elimination of many xylophages, e.g. cerambycids [4].

The effect is that the elaterid fauna of urbicoenoses includes almost exclusively soil species. In this relation, the analysis of environmental requirements is limited to this group only. Three groups of soil elaterids can be distinguished with respect to the range of occupied habitats:

Tab. 2. Proportions of groups with different habitat preferences in elaterids of Warsaw and non-urban habitats of Mazovia (N — number of species)

| Group | Mazovia | | Warsaw | | | | | | | | | |
|-------|---------|------|---------|------|-------------------|------|-----------------|------|-------------|-------|---|------|
| | | | Suburbs | | Urban green areas | | | | | | | |
| | Total | | | | Parks | | Housing estates | | Town centre | | | |
| | N | % | N | % | N | % | N | % | N | % | N | % |
| Xylem | 21 | 35.6 | 17 | 34.7 | 2 | 11.1 | 1 | 6.3 | — | — | 1 | 11.1 |
| Soil | 38 | 64.4 | 32 | 65.3 | 16 | 88.9 | 15 | 93.8 | 8 | 100.0 | 8 | 88.9 |

ubiquitous, associated with forests, and associated with open spaces. To the group of ubiquitous species inhabiting both open spaces and forests, thus with the largest range of environmental tolerance (eurytopic), belong such species as *Adelocera murina*, *Cidnopus aeruginosus*, *Athous niger*, and *Athous haemorrhoidalis*. The proportions of ubiquitous species in suburbs of Warsaw and in Mazovia were 10.5 and 12.5% respectively, of the total number of species, while in urban green areas they were twice as high (up to 25%). But these species are dominants neither in urbicoenoses nor in many natural habitats.

The number of species of the two other groups, i.e., the species associated with forests and those associated with open areas, was the same in Mazovia and in the suburbs of Warsaw (Tab. 3). In urban green areas the proportion of the species associated with forests markedly dropped from 44% in suburbs to 19%. In parks this group was represented by three polytopic species: *Dalopius marginatus* [18], *Prosternon tessellatum* [18], and *Dicronychus cinereus*. In the green areas of housing estates (a lawn in the Wierzbnio estate), only one species of this group, *D. marginatus*, was recorded. One specimen caught there (an adult) was probably carried there with peat used to fertilize urban lawns.

Tab. 3. Proportions of group with different ecological requirements in soil elaterids of Warsaw and non-urban habitats of Mazovia (N — number of species)

| Group | | Mazovia | | Warsaw | | | | | | | | | |
|------------------------|------------|---------|------|---------|------|-------------------|------|-----------------|------|-------------|------|---|------|
| | | | | Suburbs | | Urban green areas | | | | | | | |
| | | Total | | | | Parks | | Housing estates | | Town centre | | | |
| | | N | % | N | % | N | % | N | % | N | % | N | % |
| Ubiquitous (eurytopic) | | 4 | 10.5 | 4 | 12.5 | 4 | 25.0 | 4 | 26.7 | 2 | 25.0 | 2 | 25.0 |
| Living in forest | Polytopic | 6 | 15.8 | 6 | 18.8 | 3 | 18.8 | 3 | 20.0 | 1 | 12.5 | — | — |
| | Stenotopic | 11 | 28.9 | 8 | 25.0 | — | — | — | — | — | — | — | — |
| Living in open areas | Polytopic | 6 | 15.8 | 6 | 18.8 | 5 | 31.3 | 5 | 33.3 | 2 | 25.0 | 4 | 50.0 |
| | Oligotopic | 4 | 10.5 | 4 | 12.5 | 3 | 18.8 | 2 | 13.3 | 3 | 37.5 | 2 | 25.0 |
| | Stenotopic | 7 | 18.4 | 4 | 12.5 | 1 | 6.3 | 1 | 6.7 | — | — | — | — |

Since the species associated with forests have been eliminated from urban areas, the proportion of the species associated with open areas increased there (from 44% in suburbs to 56.4%). For parks this value was a little lower (53.3%) than for the total of the urban green areas. In the green areas of housing estates and in the centre of the town these proportions were considerably higher (62.5 and 75%, respectively). Urban green areas are almost exclusively inhabited by polytopic and oligotopic species (Tab. 3). The only stenotopic species recorded from urban green areas, *Cidnopus pilosus*, occurring in soils of warm fertile meadows and pastures, was found in the Łazienki park. The elimination of the other stenotopic species from urban green areas, in particular hygrophilous species such as *Actenicerus sjaelandicus* and *Paracardiophorus musculus*, also the absence of the thermophilous species *Agriotes ustulatus* and a limited occurrence of *Cidnopus pilosus*, polytopic *Adrastus limbatus* and *A. pallens*, indicate a considerable overdrying of the urban habitat on the one hand, and a small range of microhabitat conditions in urban green areas on the other.

Species composition and dominance structure of soil elaterids enable us not only to determine the degree of the urban habitat degradation, but also to reconstruct the history of the town development. In the Łazienki park, the number of soil elaterids is the highest (12), two polytopic species associated with forests, *Dalopius marginatus* [19] and *Dicronychus cinereus*, are present there, and the species composition of the community is similar to natural, the dominant species being *Agriotes sputator* and *Cidnopus pilosus*. These facts indicate, in accordance with the historical data, that this park was established in a forest area, and the succession of fauna occurred gradually, following the thinning of the tree stand. Other parks, and also lawns in housing estates and in the centre are largely dominated by only one species, *Agriotes sputator* (90–100%), the species composition of the community being much simplified. They are inhabited by 0–4 species, except for the Cemetery of Soviet Soldiers where 7 species were recorded. These data indicate that they were established in open areas used as crop fields, and that the urban habitat is largely degraded, this being particularly the case of the Saxon Garden. A different dominance structure was found only in the allotments of Służewiec. The material captured by Barber's pitfall traps was largely predominated by *Agriotes obscurus*. This change in the dominant should be related to the fact that these areas are more shaded, more humid, contain more humus in soil, and are covered with the vegetation of a different type from that of the urban green areas.

Food habits of larval elaterids are not sufficiently known. There are no comprehensive works on this subject and bionomics of many species is inadequately studied. Living in soil, larvae of some species often aggregate within the root zone, thus they are taken for rhizophages. But this phenomenon can also be related to a higher moisture content in this zone,

or to searching for phytophagous nematodes or dipteran larvae. The complexity of the problems of food habits of larval elaterids can be illustrated by the fact that in sound stalks of mushrooms there were found predatory larvae of *Prosternon tessellatum*, pantophagous larvae of *Selatossomus aeneus*, and phytophagous larvae of *Agriotes obscurus*. In this paper three trophic groups of larval elaterids are distinguished: predatory polyphages (they attack only larvae of other insects weakened during moulting, and pupae), pantophages (without food preference, also necro- and mycophages), and phytophagous polyphages, feeding mostly on live root tissues and on underground storing organs such as tubers and bulbs.

Since the dendrophilous species consist only of predators and pantophages, urban pressure has a different effect on the whole elaterid community of Mazovia than on the group of soil species. As dendrophilous species were eliminated from urbicoenoses, the proportion of predatory species dropped (from 38.8% in suburbs to 22.2% in urban green areas), while the proportion of pantophages was maintained at an almost the same level (44.4%). The proportion of rhizophagous species markedly increased (from 16.3 to 33.3%) (Tab. 4). In the group of soil species the proportion

Tab. 4. Proportions of trophic groups in larval elaterids of Warsaw and non-urban habitats of Mazovia
(N — number of species)

| Group | Mazovia | | Warsaw | | | | | | | | | |
|--------------------------------------|---------|------|---------|------|-------------------|------|-----------------|------|-------------|------|---|------|
| | | | Suburbs | | Urban green areas | | | | | | | |
| | Total | | | | Parks | | Housing estates | | Town centre | | | |
| | N | % | N | % | N | % | N | % | N | % | N | % |
| Predators and carnivorous polyphages | 24 | 40.7 | 19 | 38.8 | 4 | 22.2 | 3 | 18.8 | 2 | 25.0 | 1 | 11.1 |
| Pantophages | 26 | 44.1 | 22 | 44.9 | 8 | 44.4 | 8 | 50.0 | 2 | 25.0 | 3 | 33.3 |
| Rhizophagous polyphages | 9 | 5.3 | 8 | 16.3 | 6 | 33.3 | 5 | 31.2 | 4 | 50.0 | 5 | 55.6 |

of pantophages dropped (from 62.5 to 43.7%), while the proportion of predatory and rhizophagous species increased. The increase in the proportion of rhizophages was particularly pronounced in the green areas of housing estates and in the centre of the town (Tab. 5). This indirectly shows that unfavourable biocoenotic changes occurred in urban green areas of these types.

Other criteria of the ecological role of the species in the biocoenosis, discussed in this paper, involve numbers and expansiveness of the species. In Mazovia there occur 3 species locally abundant (*Agriotes obscurus*, *Adrastus pallens*, and *Ectamenogonus megerlei*), 10 numerous species, 20 scarce species, and 26 sporadic species. The proportion of locally abundant and numerous species increased from 22% in the suburbs to 55.6% in the

Tab. 5. Proportions of trophic groups in larval elaterids living in soil of Warsaw and non-urban habitats of Mazovia
(N — number of species)

| Group | Mazovia | | Warsaw | | | | | | | | | |
|--------------------------------------|---------|------|---------|------|-------------------|------|-----------------|------|-------------|------|---|------|
| | | | Suburbs | | Urban green areas | | | | | | | |
| | Total | | | | Parks | | Housing estates | | Town centre | | | |
| N | % | N | % | N | % | N | % | N | % | N | % | |
| Predators and carnivorous polyphages | 5 | 13.2 | 4 | 12.5 | 3 | 18.8 | 3 | 20.0 | 2 | 25.0 | 1 | 12.5 |
| Pantophages | 24 | 63.2 | 20 | 62.5 | 7 | 43.7 | 7 | 46.7 | 2 | 25.0 | 2 | 25.0 |
| Rhizophages | 9 | 23.7 | 8 | 25.0 | 6 | 37.5 | 5 | 33.3 | 4 | 50.0 | 5 | 62.5 |

urban green areas, while the proportion of scarce species did not change (38.8%). The number of species in the latter group was markedly reduced only in the lawns in the centre of the town. The sporadic species were eliminated from the urban green areas (Tab. 6), except for one species, *Adrastus limbatus*, recorded in the Łazienki park on the lower Vistula terrace.

Among the *Elatridae* of Mazovia, one species is expansive (*Agriotes sputator*) and six species are recessive (*Lacon quercus*, *Anostirus castaneus*, *Calambus bipustulatus*, *Athous rufus*, *A. mutilatus*, *Ampedus cardinalis*). Other species are classified as stable (including *Adrastus rachifer*). The recessive species did not occur in the urban green areas, thus the proportions of the expansive and stable species correspondingly increased (Tab. 7).

CONCLUSIONS

In the urban green areas, an increase was observed in the proportion of Palaearctic species (mainly at the expense of the Euro-Siberian elements) and polytopic species associated with open areas, as compared with their

Tab. 6. Proportions of groups with different abundances in elaterids of Warsaw and non-urban habitats of Mazovia
(N — number of species)

| Group | Mazovia | | Warsaw | | | | | | | | | |
|------------------|---------|------|---------|------|-------------------|------|-----------------|------|-------------|------|---|------|
| | | | Suburbs | | Urban green areas | | | | | | | |
| | Total | | | | Parks | | Housing estates | | Town centre | | | |
| N | % | N | % | N | % | N | % | N | % | N | % | |
| Locally abundant | 3 | 5.1 | 3 | 6.1 | 3 | 16.7 | 3 | 18.8 | 1 | 12.5 | 3 | 33.3 |
| Numerous | 10 | 16.9 | 10 | 20.4 | 7 | 38.9 | 7 | 43.8 | 4 | 50.0 | 4 | 44.4 |
| Scarce | 20 | 33.9 | 19 | 38.8 | 7 | 38.9 | 5 | 31.3 | 3 | 37.5 | 2 | 22.2 |
| Sporadic | 26 | 44.1 | 17 | 34.7 | 1 | 5.6 | 1 | 6.3 | — | — | — | — |

Tab. 7. Proportions of groups with different expansiveness in elaterids of Warsaw and non-urban habitats of Mazovia (N — number of species)

| Group | Mazovia | | Suburbs | | Warsaw | | | | | | | |
|-----------|---------|------|---------|------|-------------------|------|-------|------|-----------------|------|-------------|------|
| | | | | | Urban green areas | | | | | | | |
| | N | % | N | % | Total | | Parks | | Housing estates | | Town centre | |
| N | | | | | % | N | % | N | % | N | % | |
| Expansive | 1 | 1.7 | 1 | 2.0 | 1 | 5.6 | 1 | 6.3 | 1 | 12.5 | 1 | 11.1 |
| Stable | 52 | 88.1 | 43 | 87.8 | 17 | 94.4 | 15 | 93.8 | 7 | 87.5 | 8 | 88.9 |
| Recessive | 6 | 10.2 | 5 | 10.2 | — | — | — | — | — | — | — | — |

proportions in the suburbs. The species associated with forests and stenotopic species associated with open areas were eliminated from the urban green areas. The elaterids of urban green areas are represented by the species locally abundant and numerous in Mazovia and, to a lesser extent, by the scarce species. Moreover, these are expansive species and stable in relation to environmental changes.

The most important process occurring in the elaterid community of urban green areas is a decrease in the number of species living in wood. Dendrophilous species were eliminated by cultivation treatments in urban tree stands. The number of soil species was less reduced, but the structure of their community is changed. Pantophagous species are replaced by rhizophages. This tendency can be illustrated by the fact that a rhizophagous species, *Agriotes sputator*, is the only dominant in soil of urban lawns.

The communities of soil elaterids occurring in the urban green areas of Warsaw should be considered as degraded, except for those living in the Łazienki park. The number of species is low, ranging from zero to four, and the dominance of *Agriotes sputator* very high (90—100%).

Since environmental conditions for *Agriotes sputator* are optimal in urban green areas, an attempt can be made to characterize urban conditions by an ecological characteristic of this species. This is a polytopic species associated with open areas, typical of fertile warm meadows and pastures. It has a little smaller range of ecological requirements than *Agriotes obscurus*. For this reason *A. sputator* is replaced by this species in soils of moderately wet meadows and moors, as well as in dry mineral soils of forest clearings, also in crop fields, orchards (allotments) and in gardens. *A. sputator* occurs more often than *A. obscurus* in neutral and slightly alkaline soils [34], and such reaction is characteristic of the soil of urban lawns [19].

A relatively narrow range of habitat conditions in urban green areas is also indicated by a limited occurrence of hygrophilous polytopic species such as *Adrastus limbatus* and *A. pallens*, as well as *Cidnopus pilosus*, the latter being a thermophilous stenotopic species.

SPECIES NEW TO MAZOVIA

Among 21 elaterid species not recorded from Mazovia so far, 9 need special attention. They are either rare in Poland or their biology is poorly known. Their stands in Mazovia are given below.

Ampedus hjorti (Rye).

Warsaw-Bielany, Jąlonna. Inhabits only red-brown decaying wood of oaks. So far known from Silesia.

Ampedus cardinalis (Schiodte).

Warsaw-Bielany, larvae and adults in old, decaying oaks; Buchnik near Jabłonna. In Poland known so far only from Silesia.

Ampedus nigrinus (Herbst).

Kampinos Forest, Klembów, Celestynów, several specimens in largely decayed dark-brown wood of stumps. Rarely and occasionally met because of its hidden way of life. Noted in the region of Koszalin and in few localities of southern Poland.

Ectamenogonus megerlei (Lac.).

Warsaw-centre, Mokotów, Łazienki, Botanical Garden, Agrykola Park, Żoliborz, Bielany; Jabłonna. In general, rarely and singly met, while larvae can be abundant in reproduction sites (trees with holes or bored by larvae of *Scarabaeidae*). So far known from the Great Poland-Kujavian Lowland, Silesia, and Przemyśl region.

Adrastus rachifer (Fourcr.).

Warsaw-Ursynów, Wierzbno, Rakowiec, Stawki, MDM, Łazienki park. Not recorded from other areas of the Mazovian Lowland; it is likely to be restricted now to the area of Warsaw. Known in Poland from southern regions; in general, rarely and singly captured.

Cardiophorus gramineus (Scop.).

Czersk, 1 specimen; Warsaw-Bielany, several specimens reared from larvae found in dry decayed wood of old oaks. In Poland known from the Great Poland-Kujavian Lowland and from few stands in the southern part of the country.

Cardiophorus rufipes (Goeze).

Winiary near Płock, Urle, Warsaw-Bielany, Warsaw-Młociny. Known from the region of Koszalin and from southern Poland.

Dicronychus equiseti (Herbst).

Siennica, Otwock, Śródborów, Zalesie Dolne, Chojnów Forest. Singly caught in late April, in May, and in June. Known from the western part of the country.

Paracardiophorus musculus (Er.).

Zegrze, 5 specimens caught on 24 June, 1936. Inhabits sandy margins of water. In Poland rarely met, recorded from few stands in the northern part of the country, as well as from Silesia, the West Beskids, and Przemyśl.

Tab. 8. Check list of *Elateridae* species occurring in Warsaw and Mazovia

| No. | Species | Mazovia | Warsaw | | | | |
|-----|---|---------|----------------|-------|--------------------------------|-------------|----------------------|
| | | | suburban areas | parks | green areas in housing estates | town centre | other sampling areas |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1 | <i>Denticollis linearis</i> (L.) | ● | + | - | - | - | - |
| 2 | <i>Adelocera murina</i> (L.) | ● | ● | ● | + | + | + |
| 3 | <i>Lacon querceus</i> (Herbst) | ○ | + | - | - | - | - |
| 4 | <i>Ctenicera pectinicornis</i> (L.) | + | - | - | - | - | - |
| 5 | <i>Anostirus castaneus</i> (L.) | + | + | - | - | - | - |
| 6 | <i>Selatosomus aeneus</i> (L.) | ● | ● | - | - | - | - |
| 7 | <i>Selatosomus latus</i> (F.) | ● | + | + | + | - | + |
| 8 | <i>Selatosomus cruciatus</i> (L.) | + | ● | - | - | - | - |
| 9 | <i>Selatosomus impressus</i> (F.) | ○ | - | - | - | - | - |
| — | <i>Selatosomus affinis</i> (Payk.) | ? | - | - | - | - | - |
| 10 | <i>Calambus bipustulatus</i> (L.) | + | + | - | - | - | - |
| 11 | <i>Actenicerus sjaelandicus</i> (Müll.) | ● | + | - | - | - | - |
| 12 | <i>Prosternon tessellatum</i> (L.) | ● | ● | ● | - | - | - |
| 13 | <i>Negastrius pulchellus</i> (L.) | ● | + | - | - | - | - |
| 14 | <i>Negastrius sabulicola</i> (Boh.) | ● | - | - | - | - | - |
| 15 | <i>Fleutiauxellus quadripustulatus</i> (F.) | ○ | ○ | - | - | - | + |
| — | <i>Fleutiauxellus tenuicornis</i> (Germ.) | - | ? | - | - | - | - |
| 16 | <i>Cidnopus pilosus</i> Leske | + | + | + | - | - | - |
| 17 | <i>Cidnopus aeruginosus</i> (Oliv.) | ● | ● | + | - | - | - |
| 18 | <i>Cidnopus minutus</i> (L.) | - | + | - | - | - | - |
| 19 | <i>Athous rufus</i> (Deg.) | ○ | - | - | - | - | - |
| — | <i>Athous villosus</i> (Geoffr.) | ? | - | - | - | - | - |
| 20 | <i>Athous hirtus</i> (Herbst) | - | ● | + | - | + | - |
| 21 | <i>Athous niger</i> (L.) | ● | ● | + | + | - | - |
| 22 | <i>Athous vittatus</i> (F.) | - | + | - | - | - | - |
| 23 | <i>Athous haemorrhoidalis</i> (F.) | ● | ● | ● | - | + | - |
| 24 | <i>Athous subfuscus</i> (Müll.) | ● | + | - | - | - | - |
| 25 | <i>Athous bicolor</i> (Goeze) | ○ | + | - | - | - | - |
| 26 | <i>Athous mutilatus</i> Rosenh. | ○ | ● | - | - | - | - |
| 27 | <i>Melanotus rufipes</i> (Herbst) | ● | + | - | - | - | + |
| 28 | <i>Melanotus castanipes</i> (Payk.) | + | - | - | - | - | - |
| 29 | <i>Ampedus sanguineus</i> (L.) | + | + | - | - | - | - |
| 30 | <i>Ampedus pomonae</i> Steph. | + | + | - | - | - | - |
| 31 | <i>Ampedus sanguinolentus</i> (Schrank) | + | + | - | - | - | - |
| 32 | <i>Ampedus nigroflavus</i> (Goeze) | + | ● | - | - | - | - |
| 33 | <i>Ampedus pomorum</i> (Herbst) | ● | ● | - | - | - | - |
| 34 | <i>Ampedus hjorti</i> (Rye) | + | + | - | - | - | - |
| 35 | <i>Ampedus elegantulus</i> (Schönh.) | ● | ● | - | - | - | - |
| 36 | <i>Ampedus balteatus</i> (L.) | ● | + | - | - | - | - |
| 37 | <i>Ampedus praeustus</i> (F.) | ○ | - | - | - | - | - |
| 38 | <i>Ampedus cardinalis</i> (Schiödt) | + | + | - | - | - | - |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|----|---|---|---|---|---|---|---|
| 39 | <i>Ampedus nigrinus</i> (Herbst) | + | - | - | - | - | - |
| 40 | <i>Ectamenogonus megerlei</i> (Lac.) | + | + | + | - | + | - |
| 41 | <i>Procaerus tibialis</i> (Lac.) | - | ● | - | - | - | - |
| — | <i>Idolus picipennis</i> (Bach) | ? | - | - | - | - | - |
| 42 | <i>Elater ferrugineus</i> L. | + | ● | - | - | - | - |
| 43 | <i>Ectinus aterrimus</i> (L.) | ● | ● | - | - | - | - |
| 44 | <i>Agriotes ustulatus</i> (Schall.) | ○ | - | - | - | - | - |
| 45 | <i>Agriotes sputator</i> (L.) | ● | ● | ● | + | + | - |
| 46 | <i>Agriotes lineatus</i> (L.) | ● | + | - | + | + | - |
| 47 | <i>Agriotes obscurus</i> (L.) | ● | ● | + | + | + | + |
| — | <i>Agriotes gallicus</i> (Boisd. et Lac.) | - | - | - | - | - | ? |
| 48 | <i>Dalopius marginatus</i> (L.) | ● | ● | ● | + | - | - |
| 49 | <i>Sericus brunneus</i> (L.) | ● | ● | - | - | - | - |
| 50 | <i>Synaptus filiformis</i> (F.) | + | + | - | - | - | - |
| 51 | <i>Adrastus limbatus</i> (F.) | ● | ○ | + | - | - | - |
| 52 | <i>Adrastus pallens</i> (F.) | + | + | + | - | + | - |
| 53 | <i>Adrastus rachifer</i> (Fourcr.) | - | + | + | + | + | + |
| 54 | <i>Cardiophorus ruficollis</i> (L.) | ● | ● | - | - | - | - |
| 55 | <i>Cardiophorus gramineus</i> (Scop.) | + | + | - | - | - | - |
| 56 | <i>Cardiophorus rufipes</i> (Goeze) | + | + | - | - | - | - |
| 57 | <i>Dicronychus cinereus</i> (Herbst) | + | ● | + | - | - | - |
| 58 | <i>Dicronychus equiseti</i> (Herbst) | + | - | - | - | - | - |
| 59 | <i>Paracardiophorus musculus</i> (Er.) | + | - | - | - | - | - |

The other species not recorded from Mazovia so far (*Ctenicera pectinicornis*, *Anostirus castaneus*, *Calambus bipustulatus*, *Cidnopus pilosus*, *C. minutus*, *Athous vittatus*, *Melanotus castanipes*, *Ampedus sanguineus*, *A. pomonae*, *A. sanguinolentus*, *Synaptus filiformis*, and *Adrastus pallens*) are analysed by Burakowski [2]. Here only their occurrence in Mazovia and the suburbs of Warsaw is noted (Tab. 8). The occurrence of *Cidnopus pilosus* and *Adrastus pallens* in urban green areas is also discussed in the text.

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SPRĘŻYKI (*COLEOPTERA, ELATERIDAE*) WARSZAWY I MAZOWSZA

STRESZCZENIE

W ramach badań terenów zielonych aglomeracji warszawskiej przeprowadzono analizę występowania sprężyków w zieleni miejskiej — parkach, osiedlach i centrum miasta. Stwierdzono występowanie 18 gatunków chrząszczy z tej rodziny wobec 59 zanotowanych z Mazowsza i 49 z terenu aglomeracji warszawskiej (w granicach administracyjnych).

Stwierdzono, obok ponad 2,5-krotnie mniejszej liczby gatunków w zieleni miejskiej w porównaniu z obszarem podmiejskim Warszawy, także określone zmiany strukturalne zespołu. Zaobserwowano eliminację gatunków dendrofilnych, głównie wskutek niszczenia ich naturalnych siedlisk przez zabiegi pielęgnacyjne takie jak usuwanie starodrzewu, betonowanie i smołowanie dziupli itp. Faunę *Elateridae* zieleni miejskiej stanowią niemal wyłącznie gatunki glebowe, spośród których ustępują pod wpływem presji urbanizacyjnej gatunki pantofagiczne, natomiast wyraźnie wzrasta udział gatunków rizofagicznych.

Zespół sprężyków zieleni miejskiej charakteryzuje się ponadto następującymi cechami: są to w przeważającej liczbie gatunki o zasięgu palearktycznym, ubikwistyczne (eurytopowe) i politopowe terenów otwartych, licznie lub masowo lokalnie występujące na Nizinie Mazowieckiej, jednocześnie stabilne w stosunku do zmian środowiska wywołanych gospodarką ludzką.

Na podstawie liczby gatunków występujących w poszczególnych obiektach badawczych i struktury zespołów stwierdzono znaczną degradację środowiska miejskiego. Jedynym wyjątkiem jest Park Łazienki Królewskie, gdzie obok dwóch politopowych gatunków leśnych, zachowały się także niektóre wilgocio- i ciepłolubne gatunki terenów otwartych (również stenotopowe).

W związku z dominującą rolą w urbicenozach gatunku *Agriotes sputator* podjęto w zakończeniu pracy próbę ogólnej charakterystyki środowiska miejskiego poprzez analizę ekologiczną tego gatunku.

ЩЕЛКУНЫ (COLEOPTERA, ELATERIDAE) ВАРШАВЫ И МАЗОВИИ

РЕЗЮМЕ

Из Мазовии известно 59 видов *Elateridae*. На перифериях Варшавы констатировали 49 видов, то-есть все те которые отметили на территории варшавской агломерации; в городских же зелёных насаждениях только 18 видов. Это преимущественно виды с палеарктическим ареалом. Под влиянием урбанизационного пресса элиминируются прежде всего дендрофильные виды, а среди почвенных пантофаги, в то время, как содержание хищников удерживается более менее на постоянном уровне. В результате этих явлений сообщество щелкунов городской зелени составляют почти исключительно почвенные виды, преимущественно ризофаги, питающиеся живыми растительными тканями корней и подземных запасных органов. Кроме того эти виды обладают большим диапазоном экологической терпимости (убиквисты и политопные виды открытых пространств), встречаются в Мазовии многочисленно, в некоторых местах массово, характеризуются давно устоявшимся распространением на этой территории. Абсолютно доминирующим видом является ризофаг *Agriotes sputator*, который находит в урбанизации оптимальные условия развития.