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SPHECIDAE (HYMENOPTERA) OF WARSAW AND MAZOVIA

ABSTRACT

There are 139 species of *Sphecidae* recorded from Mazovia. In Warsaw 73 species occur, which account for 52.5% of the species known from Mazovia.

The town is inhabited mostly by Holarctic, Palaearctic, and European species. The species with smaller geographical ranges do not occur in urban green areas.

The species occurring in the town have large ecological tolerance. Psammophilous species and those associated with open areas are almost completely lacking in urban habitats. The town is mostly inhabited by *Sphecidae* making their nests in wood, while the species nesting in earth do not occur there, except for *Mellinus arvensis* (L.), which occurs on all the study plots in Warsaw and dominates on most of them. The *Sphecidae* of Warsaw are largely predominated by the species feeding their offspring on aphids and various dipterans.

INTRODUCTION

Sphecidae belong to rather abundant families of *Aculeata* in Poland. About 200 species have been recorded so far. *Sphecidae* of some regions of Poland are not sufficiently known. Few research workers were interested in them, thus the literature on the *Sphecidae* is relatively poor and mostly restricted to faunal lists.

The first lists of this family were prepared by Wierzejski [46, 47] for the species occurring in southern Poland. Then Nasonov prepared a list of wasps from different areas, including Mazovia [28]. Several lists of *Sphecidae* occurring in central Poland are due to Drogoszewski, who conducted faunal studies near Lowicz in 1932—1938 [13—15]. Relatively well known are the *Sphecidae* of Silesia and Great Poland, where they were studied by Szulczewski and German workers [42, 43]. Noskiewicz and Chudoba, who conducted the study in 1939—1948, supplemented the list of the species occurring in Silesia [31]. The *Sphecidae* of Pomerania were studied by Paul [34]. In the 1950s, the *Sphecidae* of Poland were studied by Noskiewicz and Puławski [31].

In the present paper there are data on the *Sphecidae* of Mazovia, which are little known so far. The literature data are used and the

materials collected in this study. This is a part of the comprehensive work on "The species composition and origin of the fauna of Warsaw" [44]. The data from the following papers were used: Nasonov [28], Drogoszewski [13, 14], Głowacki [16], and Noskiewicz and Puławski [31]. The present materials were collected in 1974–1977. Insects were quantitatively caught by means of Moericke's traps suspended in tree crowns [10, 25].

The study plots can be classified into three categories:

1. Non-urban areas, not subject or little subject to human pressure.
2. Suburban areas, adjoining urban areas.
3. Urban areas, subject to heavy urban pressure.

In non-urban and suburban areas, the study plots covered different habitats such as moist coniferous forests, mixed coniferous forests, oak-hornbeam forests, carrs, and rural parks.

The quantitative materials from the areas of category 1 were mostly collected at Łomna, Radziejowice, Hamernia, Wola Mrokowska, and Młochów [33]. The quantitative materials from the areas of category 2 were collected in Białoleka Dworska, Ursynów, and Jelonki. The materials of category 3 were collected in urban parks, green areas of housing estates and in green of the centre of the town.

In Warsaw such parks were under study as Łazienki, Cemetery of Soviet Soldiers, Saxon Garden, and Praga park. The species composition of *Sphecidae* in green areas of housing estates was examined in Wierzbno and at Stawki street. In the centre of Warsaw, the material was collected from tree crowns at the Konstytucji Square and in courtyards at Wilcza and Koszykowa streets.

The present materials were collected mostly from tree crowns since adult *Sphecidae* are most abundant in this layer. In lower vegetation layers such as the herb layer they are much less abundant. Moericke's traps could be used in the herb layer of only some plots since in the town they were frequently destroyed or removed. As a result, in only two plots, in a rural park at Radziejowice and in a courtyard at Wilcza street, the material was collected from both the herb layer and the tree crowns at the same time.

In addition, some insects were caught by a sweep net, but the materials collected by this method are scarce and rather poor in species as compared with those collected by Moericke's traps.

Data on urban and suburban areas are based almost exclusively on the materials collected in the present study, since the scarce literature data on the urban fauna cannot be classified to particular types of urban green areas. The literature data and author's data from the areas that cannot be classified to any of the three categories (e.g. from allotments) are shown in column 8 of Table 4.

A total of 139 species of *Sphecidae* have been recorded from Mazovia,

including urban areas of Warsaw. In non-urban areas, 118 species have been recorded, and in suburban areas 74 species. Urban parks were inhabited by 64 species, green areas of housing estates by 26, and the centre of the town by 45 species. The data from non-urban areas are supplemented by the literature data, thus they are more complete than those from suburban and urban areas.

ZOOGEOGRAPHICAL ANALYSIS

On the basis of geographical ranges of particular species, the following geographical elements have been distinguished in the *Sphecidae* of Mazovia: boreal, Holarctic, Palaearctic, Euro-Siberian, subatlantic, European, south-Euro-Siberian, and submediterranean. Geographical ranges of these insects have been determined from many available papers [1—12, 17—21, 27, 28, 30, 33, 35—40, 45, 48].

The bulk of the *Sphecidae* of Mazovia consists of Palaearctic and European species. These two zoogeographical elements account for almost 75% of the *Sphecidae* of Mazovia (Tab. 1). The proportion of these species is high in all the study habitats both urban and non-urban.

Of the other zoogeographical elements, only the proportion of Holarctic species increased with urban pressure, this increase being particularly pronounced in green areas of housing estates and in the centre of the town.

The proportion of the other geographical elements dropped with increasing urban pressure. Even submediterranean species, which reach a rather high proportion of more than 11% of the *Sphecidae* of Mazovia, only sporadically occupy urban areas, except for parks. They are completely lacking in green areas of housing estates, and in the centre only two submediterranean species have been recorded. A small proportion of thermophilous submediterranean species in the *Sphecidae* of urban green areas in Warsaw, though mean annual temperatures are higher there than in non-urban areas, is caused by the lack of nests sites, most of these species being psammophilous.

In addition, the *Sphecidae* of Mazovia include boreal, Euro-Siberian, subatlantic, and south-Euro-Siberian elements but their proportion is relatively low, less than 6%.

The town is not colonized or scarcely colonized by the Euro-Siberian, subatlantic, and submediterranean elements. In the town the European species occur only in parks (Tab. 1). In green areas of housing estates only three zoogeographical elements have been recorded: Holarctic, Palaearctic, and European. In the centre of Warsaw, there are only four species with smaller geographical ranges. These are *Crabro* (*Crossocerus*) *assimilis*, a boreal species, *Crabro* (*Crabro*) *zonatus*, a south-Euro-Siberian species, *Gorytes* (*Lestiphorus*) *bicinctus* and *Crabro* (*Entomognathus*) *brevis*, submediterranean species. It should be noted however, that the boreal species is represented

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

Zoogeographical element	Mazovia		Warsaw									
			Suburbs		Urban green areas							
	N	%			N	%	Total		Parks		Housing estates	
			N	%			N	%	N	%	N	%
Boreal	2	1.7	2	2.7	2	2.7	1	1.6	—	—	1	2.2
Holarctic	9	7.6	8	10.8	7	9.6	7	10.9	5	19.2	7	15.6
Palearctic	44	37.3	30	40.6	25	34.2	22	34.4	13	50.0	16	35.6
Euro-Siberian	3	2.5	2	2.7	2	2.7	2	3.1	—	—	—	—
Subatlantic	1	0.8	—	—	—	—	—	—	—	—	—	—
European	46	39.0	24	32.4	30	41.1	26	40.6	8	30.8	18	40.0
South-Euro-Siberian	—	—	1	1.3	1	1.4	1	1.6	—	—	1	2.2
Submediterranean	13	11.1	7	9.5	6	8.2	5	7.8	—	—	2	4.4

by only one specimen caught on a lime growing at the Konstytucji Square, thus its contribution to the fauna of *Sphecidae* in the centre of the town is insignificant. Also the other species with small geographical ranges are poorly represented in the centre of the town.

BIONOMIC CHARACTERISTICS

Analysis of the distribution of *Sphecidae* in the study area shows that particular taxonomic groups (genera and subgenera) occur in zones, depending on the intensity of urban pressure. Usually all species belonging to a given taxonomic unit have a similar range. They can occur only in non-urban areas (e.g. *Astata* Latr.), or also in the suburbs (e.g. *Ammophila* Kirby), or in all the three zones, including urban areas (e.g. *Passaloecus* Shuck). It is a relatively rare case that only one species of a genus rich in species occur on many sites in the town. Since the biology of different species of the same genus is generally similar, it seems to be useful to analyse the biology of *Sphecidae* to find possible reasons for which some of them cannot live in the town.

Analysing the feeding habits of *Sphecidae*, the diet of larvae and adults should be considered separately. Adult *Sphecidae* are melliphages feeding mostly on flower nectar or honeydew, thus the abundance of flowers is an important factor of their habitat. Larvae, instead, are zoophages. *Sphecidae* care for their offspring. They build nests and provide them with food, mostly insects and spiders. Therefore, they must have suitable nest sites available in the habitat and food for larvae, in addition to the food for adults.

The food of larval *Sphecidae* occurring in Mazovia mostly consists of insects of such groups as *Aphidoidea* and other *Homoptera*, *Heteroptera*, *Diptera*, *Lepidoptera*, *Symphyla*, and *Thysanoptera*, as well as of *Aranei*. The diet of some *Sphecidae* includes such groups as *Hymenoptera* parasitica, *Apoidea*, *Ephemeroptera*, *Orthoptera*, *Curculionidae* and *Staphylinidae*, but of the species recorded in Mazovia only few feeds on them and these are not abundant species.

Generally, it can be stated that the diet is characteristic of particular genera of *Sphecidae* but it involves large taxonomic units, e.g. dipterans or spiders, or even larger units, e.g. it can consist of spiders and aphids. Instead, the diet of particular species is limited to a genus and even to a species. For example, the diet of *Sphecidae* of the subgenus *Crabro* s. str. consists of dipterans of the suborder *Brachycera*, but the diet of *Crabro* (*Crabro*) *zonatus* is restricted to dipterans of the families *Syrphidae* and *Calliphoridae*, and that of *Crabro* (*Crabro*) *lituratus* to *Muscidae* and *Cordiluridae* [22—24].

The available data on the diet of larvae of particular species or even genera of *Sphecidae* are fragmentary and the diet of some species

is not known. As a result, it is difficult to classify them into specific trophic groups.

The nests of *Sphecidae* can be divided into two main categories, depending on the material used for their building and on their location. The first category consists of the nests made of earth, built in soils of different types such as loose sand, gravel, clay, loess, or even hard compact earth. The nests of the second category are built of wood in branches of trees and shrubs and sometimes in stems of herbaceous plants. Most often they are constructed in dry dead branches, sometimes in decaying wood, or the corridors made by xylophagous insects are used and in this case nests can be located in wooden walls of buildings, in fences, etc. The nests of the two categories are located in dry, insolated sites since *Sphecidae*, like most of wasps, are thermophilous insects.

In Mazovia, the most abundant genera are *Pemphredon* Latr., *Crabro* Fabr. (subgenera *Crossocerus* Lep. et Brul. and *Crabro* s. str.), *Psenulus* Kohl, *Mellinus* Fabr., *Passaloecus* Schuck., *Stigmus* Panz., and *Trypoxylon* Latr.

Insects of the genus *Pemphredon* nest in dry branches of shrubs and trees, and also in stems of herbaceous plants. In all the study plots, two species occurred — *P. (P.) lugubris* and *P. (C.) shuckardi*. In most of the study plots, *P. (P.) lugubris* is one of the dominant species. *Sphecidae* of this genus feed their offspring on aphids.

The genus *Crabro* consists of many species, which are abundant in both non-urban and urban areas in all the study plots.

Sphecidae of the subgenus *Crabro* s. str. nest in trees and shrubs. They locate nests in live or dead branches. They use the corridors of xylophages or they made themselves corridors and caves in decaying wood. All the species recorded from Mazovia feed their offspring on dipterans of the suborder *Brachycera*. Such species as *C. (C.) quadricinctus*, *C. (C.) nigrifrons*, and *C. (C.) continuus* are widespread and occurred in almost all the study plots.

The next subgenus of the genus *Crabro*, abundant and rich in species in Mazovia and in urban green areas, is *Crossocerus*. The diet and nest sites of the species of this subgenus are largely diversified, much more than in other subgenera and genera. Among the species recorded from Mazovia there are some constructing their nests in sand, hard compact earth, in branches of trees and shrubs, or using corridors made by xylophages. They feed offspring mostly on dipterans, but the diet of some species also includes bugs and mayflies. In all the study plots, six species of this subgenus have been recorded. These are *C. (Cr.) elongatulus*, feeding their offspring mostly on small dipterans and aphids, nesting in earth, or in branches of trees and also in corridors made by xylophages, dominating in some plots; *C. (Cr.) wesmaeli*, nesting in earth, feeding offspring on homopterans and small flies, rarerly met and *C. (Cr.) elon-*

gatulus; *C. (Cr.) varius*, nesting in sand, sometimes in branches of old trees, feeding their offspring on small flies such as *Drosophilidae* or *Simuliidae*; *C. (Cr.) ambiguus*, nesting in decaying wood, in dead branches of trees and shrubs, feeding offspring on heteropterans mostly of the family *Typhlocybidae* and on homopterans mostly of the family *Miridae*; *C. (Cr.) quadrimaculatus*, generally nesting in sand but also in wood, feeding offspring on flies, lepidopterans, and caddis flies; *C. (Cr.) distinguendus*, probably occurring also on all the study plots. Its biology is not known so far.

Only few species of the subgenus *Crossocerus* restrict their occurrence to non-urban or suburban areas. These are *C. (Cr.) tarsatus*, *C. (Cr.) walkeri*, *C. (Cr.) styrius*, and *C. (Cr.) tarsatus*. All of them, except for *C. (Cr.) tarsatus*, belong to rare species in Poland.

The two species of the genus *Mellinus* recorded from Mazovia occur in Warsaw. One of them, *M. arvensis*, is a dominant and abundantly occurs on almost all the study plots. Only in the centre of Warsaw it is sporadic. *M. crabroneus* is very rare. In the literature both of them are generally considered as equally abundant, but they are very similar to each other and the intraspecific variability is large. Here only the specimens showing extremely clearly pronounced features of *M. crabroneus* are classified as this species, while all the other specimens, differing in any of the features, are considered as an aberration of *M. arvensis*. Beaumont is of a similar opinion, and he considers *M. arvensis* as a common species and *M. crabroneus* as a sporadic species [4]. These two species build their nests in earth and feed their offspring on dipterans such as *Muscidae*, *Calliphoridae*, *Sarcophagidae*, *Scatophagidae*, *Anthomyidae*, and *Syrphidae*.

Of the genus *Trypoxylon*, three species, *T. figulus*, *T. attenuatum* and *clavicerum*, are relatively abundant, though not so much as *M. arvensis*. They were frequently met on almost all the study plots. Only *T. kalazyi* belongs to rare species. They feed their offspring on spiders, and *T. clavicerum*, the most abundant species, on spiders and aphids. They nest in branches of trees and shrubs, in corridors made by xylophages, and probably also in stems of herbaceous plants since they are met in agrocoenoses.

Almost all species of the genera *Passaloecus* and *Stigmaeus* occur in the town on almost all the study plots. They have rather similar biology. They nest in branches of trees and shrubs, and feed their larvae on aphids stored in breeding caves of their nests.

Sphecidae of the genus *Psenulus* nest in branches of trees and shrubs, feed offspring on aphids and also on other homopterans (mostly on their larvae). All the species recorded so far from Mazovia occur in urban areas of various types. Only one species, *Ps. fuscipennis*, have not been recorded from the centre of the town.

In the family *Sphecidae*, a group of species can be distinguished which

in urban habitats occupy only parks, or sporadically other types of green areas. These are representatives of the genera *Nitela* Latr., *Spilomena* Schuck., *Psen* Latr., *Diodontus* Curt., *Gorytes* Latr., *Nysson* Latr., and *Crabro* of the subgenera *Thyreopus* Lep. and *Ceratocolus* Lepel., et Brul.

Of the genus *Nitela*, one species was found in the town. These insects nest in branches of trees and shrubs, most frequently using the corridors made by xylophagous insects. They feed their offspring on aphids.

The *Sphecidae* of the genus *Spilomena* nest in branches of trees and shrubs. They feed their offspring on aphids, aspidiotus, and thrips. Representatives of this genus are rarely met but they are likely to occur in all the study plots. They are relatively frequent in the centre of the town.

The available literature data show that insects of the genus *Diodontus* nest in earth, while in the present study the nests of *Diodontus minutus* were found in corridors made by xylophages. They feed their offspring on aphids. In the town they occupy parks. They are rather lacking in urban green areas of other types, e.g. in green areas of housing estates, where urban pressure is more pronounced. In the centre of the town they are sporadic.

Representatives of the genus *Psen* are relatively rare in Mazovia. In green areas of housing estates and in the centre of the town no species of this genus were recorded. They nest in branches of trees and shrubs, most frequently using corridors made by xylophages. They feed their larvae on homopterans.

Of the genus *Gorytes*, nine species have been recorded in Mazovia. Only four of them occur in the town. All of them feed their offspring on homopterans, and nest in earth, most often in sand.

The species of the genus *Nysson* constitute a biologically distinct group of *Sphecidae*. They do not build their nests themselves, nor they collect food for their offspring. They utilize the work of other insects of the family *Sphecidae*. A female lays an egg in a nest of other species, containing stored food and an egg of the host. *Sphecidae* of the genus *Nysson* live at the expense of the genera *Gorytes* and *Argogorytes*, and *N. scalaris* live at the expense of the genus *Tachytes*. This type of parasitism is called a labour parasitism. The most frequent species of the genus *Nysson* is *N. trimaculatus*. It occurs also in the town.

The species of the genus *Crabro* (*Thyreopus*) nest in sand, sometimes in more compact earth, and they feed offspring on dipterans. They occur in the town, though they have not been recorded from centre of the town. Generally their occurrence is restricted to parks, only one species being recorded in green areas of housing estates.

Sphecidae of the genus *Crabro*, subgenus *Ceratocolus* are rarely met in Mazovia. They occur mostly in non-urban habitats. In the town only one species, *C. (C.) clypeatus*, has been recorded in parks. Its diet mainly consists of lepidopterans and probably also of dipterans. It nests

in wood, mostly in corridors made by xylophages. *Crabro* (*C.*) *alatus* has a similar diet but nests in sand. This species has not been recorded from the town.

The following genera almost do not occur in the town: *Ammophila* Kirby, *Sphex* L., *Philantus* Fabr., *Cerceris* L., *Alyson* Jur., *Bembix* Fabr., *Bembecinus* Costa, *Argogorytes* Ashm., *Astata* Latr., *Miscophus* Jur., *Dinetus* Jur., *Tachysphex* Kohl, *Tachytes* Panz., and *Oxybelus* Latr.

Of the genus *Ammophila*, only one species, *A. sabulosa*, has been found in Warsaw. It occurs on the wasteland located on former allotments. The species of the genus *Ammophila* are generally restricted to non-urban and suburban areas. They nest in sand, and feed offspring on caterpillars of lepidopterans and *Symphyta*.

Similarly, the genus *Sphex* inhabits only non-urban habitats. These insects nest in sand or loose earth and feed on crickets, grasshoppers, etc.

The genus *Astata* is the next one recorded only from non-urban areas so far. These insects nest in sand, most readily on sandy elevations. They feed offspring on homopterans, mostly of the family *Pentatomidae*.

The genus *Miscophus* nests in sand and feeds offspring on spiders. It has not been recorded from Warsaw.

Of the genus *Dinetus*, one species, *D. pictus*, has been recorded from Mazovia. It nests also in earth, preferring sandy areas. It does not colonize the town, its occurrence being restricted to non-urban habitats. It feeds offspring on homopterans.

Of the genus *Philantus*, one species have been recorded from Mazovia and from Poland. According to Noskiewicz and Puławski it is common in Poland [32]. It nests in loose earth, in gorge walls, etc. In the present study this genus has not been recorded.

Of the six species of the genus *Cerceris* recorded from Mazovia, two have been found in urban habitats. These are *C. cunicularia* and *C. quadrifasciata*, feeding their offspring on the beetles of the family *Curculionidae*. They nest in earth.

Insects of the genera *Alyson* and *Argogorytes* feed their offspring on *Auchenorrhyncha*, nest in earth, sometimes in clay, particularly *Argogorytes*. They occur only in non- and suburban areas.

Sphexidae of the genera *Bembix* and *Bembecinus* build their nests in loose sand. *Bembix* feeds offspring on dipterans of the suborder *Brachycera*, and *Bembecinus* on homopterans. These two genera occur in non-urban and suburban but not in urban habitats.

Of the genus *Tachysphex*, three species have been recorded from Mazovia, which do not inhabit urban areas. They feed their offspring on insects of the order *Orthoptera*, mostly of the family *Acrididae*. They nest in earth near to the surface.

Tachytes europaeus, the only species of the genus *Tachytes* recorded

Table 2. Factors determining the possibility of the occurrence of particular genera of *Sphecidae* in the town

Abundance: +++ very numerous, ++ numerous, + sporadic

Genus	Nest site		Diet								Habitat	
	Earth	Branches	Aphids	Other homopterans	Heteroptera	Diptera	Lepidoptera Symphyta	Othoptera	Aranei	Others	Non- and suburban areas	Urban areas
<i>Ammophila</i>	+						+				++	
<i>Sphex</i>	+						+				+	
<i>Pemphredon</i>		+									++	+++
<i>Psen</i>		+		+							+	+
<i>Psenulus</i>		+	+	+							++	+++
<i>Diodontus</i>	+	+	+								+	+
<i>Passaloecus</i>		+	+								++	+++
<i>Stigmus</i>		+	+								++	+++
<i>Spilomena</i>		+	+							+	+	++
<i>Philantus</i>	+									+	+	
<i>Cerceris</i>	+									+	+	
<i>Alyson</i>	+			+							+	
<i>Bembix</i>	+					+					+	
<i>Bembecinus</i>	+			+							+	
<i>Argogorytes</i>	+			+							+	
<i>Gorytes</i>	+			+							+	+
<i>Mellinus</i>	+					+					+++	+++
<i>Trypoxylon</i>		+							+		++	+++
<i>Astata</i>	+				+						+	
<i>Miscophus</i>	+								+		+	
<i>Dinetus</i>	+			+							+	
<i>Nitela</i>		+	+									+
<i>Tachysphex</i>	+							+			+	
<i>Tachytes</i>	+							+			+	
<i>Crabro (Crabro)</i>		+				+					++	+++
<i>C. (Crossocerus)</i>	+	+	+			+					++	+++
<i>C. (Ceratoocolus)</i>	+	+				+	+				+	+
<i>C. (Lindenius)</i>	+				+	+				+	++	++
<i>C. (Entomognatus)</i>	+								+		+	+
<i>C. (Rhopalum)</i>		+	+	+		+			+		++	++
<i>C. (Thyreopus)</i>	+					+					++	++
<i>Oxybelus</i>	+					+					++	

from Poland so far, has a similar biology to that of the *Sphecidae* of the genus *Tachysphex*. It does not occur in the town.

The genus *Oxybelus* generally occurs in non-urban and suburban habitats. In the town only single specimens of two out of ten species known from Mazovia have been recorded. *Sphecidae* of this genus feed their offspring on dipterans of the suborder *Brachycera*. They nest almost exclusively in sand.

This analysis shows that habitat requirements, nest sites in this case, are the most important factors determining the occurrence of *Sphecidae* in the town. All the genera of *Sphecidae* not occurring in urban areas of Warsaw nest in earth, mostly in sand or in loose earth, on sandy or loess sides of embankments, gullies and ravines (Tab. 2). The town, the main elements of which are buildings and paved or asphalt streets, does not provide suitable conditions for these insects. In urban green areas, the structure of soil is not suitable (no sand) and man-made transformations of soil are destructive. The development of a tract of land and a system of heating pipes heavily disturb water relations and affect soil temperature. Soil of urban green areas is heavily polluted with various chemicals, intensively managed, supplied with fertilizers, turned over, etc. Consequently, many species nesting in earth are eliminated, independent of their diet (Tab. 2).

However, a few genera of the *Sphecidae* nesting in earth occur in the town, but only one species reaches high numbers and inhabits all the study areas. This is *Mellinus arvensis*, the dominant species in many plots. *M. arvensis*, though it nests in earth, mainly occurs in tree crowns where it searches for food. Its food consists of dipterans abundant in Warsaw, such as *Fania canicularis* L., *Muscina pabulorum* Fall., *Pollenia rudis* Fabr., *Lucilia caesar* L., and others (Draber-Mońko and Górska — personal communication).

All the genera of *Sphecidae* recorded from Mazovia and nesting in tree crowns, in branches of trees and shrubs, occur in the town. Some of them, like *Pemphredon*, *Passaloecus*, *Stigmus*, *Psenulus*, *Trypoxylon*, *Crabro* (*Crabro*) and *Crabro* (*Crossocerus*) are abundant in urban green areas, and they belong to the group of dominants in *Sphecidae* communities. Their occurrence in large numbers is enhanced by their diet which consists of invertebrates abundant in the town, such as aphids, dipterans, and spiders.

To sum up, it may be stated that the basic factors limiting the occurrence of *Sphecidae* in the town include:

1. Lack of suitable nest sites, the species nesting in sand, loose earth, on sandy or loess sides of elevations or gullies being mostly eliminated.
2. Lack or scarcity of insects fed to larval *Sphecidae*, the species the larvae of which feed on aphids and dipterans being dominants.

ECOLOGICAL ANALYSIS

No ecological studies on the family *Sphecidae* have so far been conducted in Poland. There are no literature data on habitat preferences of particular species of *Sphecidae*. Another difficulty arises from a poor knowledge of the biology of many species belonging to this family.

Adult *Sphecidae* are well flying insects. Searching for food, they visit various plant layers in different habitats. *Sphecidae*, like other wasps, prefer dry, insolated sites, covered with melliferous plants. They generally avoid wet and shady sites. Thus though it is not possible to find a relation of adult *Sphecidae* to a specific habitat, it is possible to observe that they avoid wet habitats such as carrs, where only some species are sporadically found. The larvae of *Sphecidae*, because they permanently stay in their nests, are associated with a specific vegetation layer (nests can be made in earth, in herbaceous plants, or in branches of trees and shrubs). We have no data, however, on the plant communities in which *Sphecidae* nest.

Of the total number of 139 species of *Sphecidae* recorded from Mazovia, for 33 species we have no data on their occurrence and habitat preferences. In further analysis, only a group of 106 species will be considered, the habitat preferences of which are known, at least in part. For some species we have only fragmentary data on their occurrence in a habitat. Such data are not sufficient. They can be even misleading because of their incompleteness. For example, some species have been recorded only from mown meadows, or from agrocoenoses but it is not known whether they are really associated with open habitats and do not occur in wooded areas, or rather they have not been caught in the latter habitat type. This is mostly the case of rare species. In author's opinion, fragmentary data can be reliable when they are supported by detailed information on the biology of a species. And so it is very probable that the *Sphecidae* of the genera *Tachysphex* Kohl and *Tachytes* Panz. belong to the species associated with open habitats. They have been recorded only from open areas, nest in earth, and feed their larvae on *Orthoptera*. Therefore both the nesting site and the diet composition indicate they prefer open habitats. The species of the genus *Cerceris* are likely to belong to the same group. So far they have been recorded only from open habitats. *Cerceris cunicularia* occurs in meadows, *C. interrupta* and *C. quinquefasciata* in rape fields. *C. cunicularia* is the most common species in large open habitats of Mohelnské Hadcové Stepi in Slovakia [41]. In addition, two other species of the genus *Cerceris*, *C. quadrifasciata* and *C. quinquefasciata*, have been recorded from the same region. All the species of the genus *Cerceris* nest in earth.

At the present state of knowledge, the species of the genera *Tachysphex*, *Tachytes* and *Cerceris* are considered as associated with open habitats.

In Mazovia, ten such species have been recorded, thus they form a relatively small group (Tab. 3).

The most abundant group in Mazovia consists of the species occurring in different habitats, both wooded and open, thus showing high ecological tolerance. This group is made up of 49 species, accounting for 46.2% of the *Sphecidae* of Mazovia. Out of this number, 11 species nest in earth, 25 in wood, and two species nest in both wood and earth. For ten species there are no data on their nesting sites.

In Mazovia, 16 species of *Sphecidae* have been recorded from different wooded habitats (moist coniferous forest, mixed coniferous forest, oak-hornbeam forest). All the species nesting in wood can be included to the group of species associated with wooded areas. Thus, when the species the habitats of which are not known are added, the group of the species associated with wooded areas will contain 21 species, that is, 19.9% of the *Sphecidae* of Mazovia. In the group associated with wooded areas, there are species nesting in wood or in earth. Thus it is probable that at least some of them can occur also in open habitats.

In the *Sphecidae* of Mazovia there is only one group with clearly determined habitat requirements. This is the group of 26 psammophilous species. They nest in sand, some of them in loose sand, other in coarse sand, sometimes in sand and gravel. They can probably occupy different biotopes but always with a definite soil type and, consequently, soil moisture. Thus these are oligotopic species [10]. The psammophilous species account for 24.5% of the *Sphecidae* of Mazovia and consist of such genera as *Ammophila* Kirby, *Spheg* L., *Bembix* Fabr., *Bembecinus* Costa, *Philantus* Fabr., *Miscophus* Jur., *Dinetus* Jur., *Astata* Latr., and *Oxybellus* Latr.

At present it is not possible to state whether in the group of psammophilous species there are some preferring habitats of a specific type, i.e., either open or wooded, although some of them (*Ammophila campestris*, *Oxybellus uniglumis*, *O. quatuordecimnotatus*) have been recorded only from open habitats and other (*Ammophila luffi*, *Oxybelus bipunctatus*, *O. dissectus*) only from coniferous forests.

In the town there are mostly species with large ecological amplitude thus living both in open and wooded areas. The town has a diversified plant cover, trees and shrubs (including those of foreign origin, not occurring in natural habitats, and at the same time relatively little diversified habitats). Lack of sandy areas eliminates psammophilous species from urban green areas. Only in parks single specimens of two psammophilous species were recorded. They account for less than 8% of the psammophilous species recorded in Mazovia. This group is completely eliminated from green areas of housing estates and of the centre of the town. In turn, lawns, frequently mown and raked, do not provide suitable conditions for the species occurring in open habitats such as meadows, etc. Thus

Table 3. Ecological elements in the *Sphecidae* of Warsaw and non-urban habitats of Mazovia (N—number of species)

Species associated with	Mazovia		Warsaw								All habitats	
			Suburbs		Urban green areas							
	Parks				Housing estates		Town centre					
	N	%	N	%	N	%	N	%	N	%	N	%
Wooded and open habitats	43	45.7	40	64.5	36	70.6	21	84.0	28	73.7	49	46.2
Wooded habitats	16	17.0	12	19.4	12	23.5	4	16.0	10	26.3	29	19.9
Open habitats	9	9.6	3	4.8	1	2.0	—	—	—	—	10	9.4
Sandy areas	26	27.7	7	11.3	2	3.9	—	—	—	—	26	24.5

they are also eliminated from Warsaw. So far only one species associated with open areas, *Cerceris quadrifasciata*, has been recorded from parks of Warsaw.

Of species of the family *Sphecidae* recorded in Mazovia, 73 species occur in the town, this accounting to more than 52% of the *Sphecidae* of Mazovia. The group of 66 species recorded from Mazovia but not occurring in Warsaw includes nine species associated with open areas and 24 psammophilous species. It also includes species of the genus *Nysson*. So far only one species of this genus, *N. trimaculatus*, have been recorded from urban green areas of Warsaw. The absence of other species of this genus is probably related to the lack of their host insects of the genus *Tachysphex* and scarce occurrence of insects of the genus *Gorytes* in urban green areas.

Since the biology of the other *Sphecidae* is little known, the reasons for which they are absent in the town cannot be specified now.

Some species adapted to urban conditions, often reach higher abundance in the town than in suburban and non-urban areas. These are *Mellinus arvensis*, *Passaloecus monilicornis*, *P. gracilis*, *Pemphredon* (*Pemphredon*) *lugubris*, *Stigmus pendulus*, *S. solskyi*, *Trypoxylon clavicerum*, *Crabro* (*Crabro*) *nigrifrons*, *C. (Crossocerus) elongatulus*, and the species of the genus *Psenulus*. *Mellinus arvensis*, which is the dominant species in most of the study plots in Warsaw, and can occur in large masses, sometimes is equally abundant in suburban and also non-urban areas. Its mass occurrence has been recorded in the moist coniferous forest in Białołęka Dworska.

CONCLUSIONS

Sphecidae are insects the larvae of which have a distinct biology from adult forms. Their larvae develop in nests, need protein food, their diet being composed of insects and spiders. Adults are free-living melliphages. They have a well developed instinct to care for offspring, for which they build nests and provide food.

Nests of the *Sphecidae* recorded from Mazovia can be built in different places. There are species making nests in earth (in loose sand, hard compact earth, in clay, etc.), other species nest in wood (in dry branches of trees and shrubs, in decaying trunks, in corridors made by xylophagous insects, etc.).

The diet of larval *Sphecidae* occurring in Mazovia consists of insects of almost all orders and of spiders.

Sphecidae can occur in a specific habitat only when their living requirements can be satisfied there, thus if they can find suitable nesting sites in it, as well as food supply for larvae. In addition, this habitat has to satisfy living requirements of adults, thus it should be well insolated and abound in melliferous plants.

Urban green areas are inhabited by the *Sphecidae* which can find suitable conditions there. This is not the case of psammophilous species or the species associated with open habitats.

Warsaw is mostly inhabited by the species with large ecological tolerance, i.e., occurring in both open and wooded areas, and by the species recorded only in wooded areas so far.

Firstly the species nesting in wood occur in urban green areas. Of a large number of species recorded from Mazovia which nest in earth, only one, *Mellinus arvensis*, occurs in all the types of urban green areas under study. Instead, the species nesting in wood are represented by many species of such genera as *Passaloeus* Shuck, *Pemphredon* Latr., *Stigmus* Panz, *Trypoxylon* Latr., and *Crabro* Fabr. They occur in all types of urban green areas and often in greater numbers than in non-urban areas.

Sphecidae of urban green areas are predominated by the species preying upon aphids and dipterans. The species preying upon insects of the orders *Lepidoptera*, *Orthoptera*, and *Ephemeroptera* do not colonize the town or are sporadic there.

Warsaw is mostly inhabited by the species with large geographical ranges. Only in parks there are some species with small geographical ranges.

SPECIES NEW TO MAZOVIA

Pemphredon (Pemphredon) lugens Dahlb.

Białoleka Dworska (mixed coniferous forest), Łomna (moist coniferous forest), Warsaw (parks); caught from July to September.

Pemphredon (Pemphredon) montanus Dahlb.

Białoleka Dworska (mixed coniferous forest), Ursynów and Białoleka Dworska (mixed coniferous forest, oak-hornbeam forest, carr), Hamernia (oak-hornbeam forest), Wola Mrokowska and Warsaw (parks, green areas of housing estates, green of the centre of the town, allotments); caught from May to September.

Pemphredon (Cenomus) unicolor Panz.

Hamernia (carr), Warsaw (green of the centre), caught in July and August.

Pemphredon (Ceratophorus) morio Lind.

Białoleka Dworska (oak-hornbeam forest), Warsaw (parks); caught from June to August.

Psen (Mimumesa) dahlbomi (Wesm.)

Białoleka Dworska (moist coniferous forest); one female caught in August.

Psen (Mimesa) shuckardi (Wesm)

Ursynów; caught in August and September.

Psenulus concolor (Dahlb.)

Wola Mrokowska and Radziejowica (parks), Białoleka Dworska (oak-hornbeam forest), Ursynów, Radość and Warsaw (green in the centre); caught from May to October.

Psenulus schencki (Tourn.)

Ursynów, Jelonki and Warsaw (parks, green of the centre); caught from May to October.

Psenulus laevigatus (Schrk.)

Łomna (moist coniferous forest, mixed coniferous forest), Radość and Hamernia (oak-hornbeam forest, carr), Wola Mrokowska and Białoleka Dworska (moist coniferous forest,

mixed coniferous forest, oak-hornbeam forest), Młochów (park), Ursynów and Warsaw (parks, green areas of housing estates, allotments); caught from May to October.

Passaloecus gracilis (Curt.)

Wola Mrokowska and Białoleka Dworska (moist coniferous forest, mixed coniferous forest, oak-hornbeam forest), Warsaw (parks, green areas of housing estates, centre of the town, allotments); caught from May to September.

Passaloecus monilicornis Dahlb.

Wola Mrokowska nad Młochów (park), Hamernia (oak-hornbeam forest), Łomna (moist coniferous forest, mixed coniferous forest), Białoleka Dworska (moist coniferous forest, mixed coniferous forest, oak-hornbeam forest, carr), Ursynów and Warsaw (parks, green of the centre, allotments); caught from May to October.

Passaloecus corniger Shuck.

Wola Mrokowska and Warsaw (parks, green of the centre, allotments); caught from May to September.

Stigmus solskyi A. Mor.

Łomna (mixed coniferous forest), Hamernia (oak-hornbeam forest, carr), Radość, Ursynów and Warsaw (parks, green of the centre, allotments); caught from May to October.

Spilomena differens Blüthg.

Hamernia (oak-hornbeam forest), Warsaw (parks, green of the centre); caught in August.

Spilomena enslini Blüthg.

Warsaw (park); one male caught in June.

Spilomena mocsaryi Kohl.

Wola Mrokowska; one female caught in July.

Spilomena punctatissima Blüthg.

Hamernia (carr); one male caught in August.

Spilomena beata Blüthg.

Warsaw (parks, green of the centre); caught from June to August.

Spilomena troglodytes (Lind.)

Warsaw (parks); caught in July and August.

Cerceris quadrifasciata (Panz.)

Warsaw (park); one male caught in June.

Alyson (Didineis) lunicornis (Fabr.)

Białoleka Dworska (mixed coniferous forest); one female caught in August.

Bembecinus tridens (Fabr.)

Białoleka Dworska (mixed coniferous forest); one male caught in July.

Gorytes (Gorytes) quinquefasciatus (Panz.)

Wola Mrokowska; one male caught in July.

Gorytes (Lestiphorus) bicinctus (Rossi)

Wola Mrokowska, Ursynów and Warsaw (parks, green of the centre); caught from May to August.

Nysson trimaculatus (Rossi)

Ursynów, Jelonki, Warsaw (parks, green of the centre); caught from June to August.

Trypoxylon attenuatum Smith.

Łomna (mixed coniferous forest), Wola Mrokowska, Białoleka Dworska (mixed coniferous forest, oak-hornbeam forest), Warsaw (parks, green areas of housing estates, green of the centre, allotments).

Trypoxylon kolazyi Kohl.

Warsaw (park); one female caught in August.

Nitela spinolae Latr.

Warsaw (parks, green of the centre); caught from June to August.

Tachysphex pompiliformis (Panz.)

Wola Mrokowska; caught in August.

Crabro (Crabro) lituratus (Panz.)

Białoleka Dworska (moist coniferous forest, mixed coniferous forest), Ursynów and Warsaw (parks, green of the centre); caught from June to September.

Crabro (Crabro) zonatus Panz.

Białoleka Dworska (oak-hornbeam forest), Warsaw (parks, green of the centre); caught from June to August.

Crabro (Crabro) nigrifrons Cresson

Hamernia (oak-hornbeam forest), Białoleka Dworska (moist coniferous forest, oak-hornbeam forest), Ursynów and Warsaw (parks, green areas of housing estates, green of the centre); caught from May to August.

Crabro (Crabro) cavifrons Thoms.

Lomna (moist coniferous forest, mixed coniferous forest), Wola Mrokowska and Białoleka Dworska (moist coniferous forest, mixed coniferous forest, oak-hornbeam forest); caught from May to October.

Crabro (Crabro) continuus Fabr.

Lomna (moist coniferous forest), Białoleka Dworska (moist coniferous forest, mixed coniferous forest, oak-hornbeam forest), Ursynów, Jelonki and Warsaw (parks, green of housing estates, green of the centre); caught from May to October.

Crabro (Crabro) clypeatus Schreb.

Warsaw (park); one male caught in July.

Crabro (Ceratocolus) subterraneus Fabr.

Chotomów (edge of a birch wood); males and females caught in July.

Crabro (Thyreopus) scutellatus (Schev.)

Warsaw (park); one female caught on the turn of July and August.

Crabro (Thyreopus) loevi Dahlb.

Warsaw (park); one female caught in July.

Crabro (Crossocerus) quadrimaculatus Fabr.

Hamernia (oak-hornbeam forest), Białoleka Dworska (oak-hornbeam forest, moist coniferous forest, mixed coniferous forest), Wola Mrokowska and Młochów (park), Ursynów and Warsaw (parks, green of housing estates and of the centre); caught from May to October.

Crabro (Crossocerus) palmipes (L.)

Hamernia (oak-hornbeam forest), Wola Mrokowska and Białoleka Dworska (moist coniferous forest, oak-hornbeam forest); caught in July and August.

Crabro (Crossocerus) tarsatus Shuck.

Wola Mrokowska; one male caught in August.

Crabro (Crossocerus) anxius Wesm.

Hamernia (oak-hornbeam forest), Wola Mrokowska, and Białoleka Dworska (moist coniferous forest), Ursynów and Warsaw (parks, green of the centre); caught from May to August.

Crabro (Crossocerus) varius Lep. et Brul.

Hamernia (oak-hornbeam forest), Wola Mrokowska and Młochów (park), Radziejowice (park), Białoleka Dworska (mixed coniferous forest, oak-hornbeam forest, carr), Ursynów and Warsaw (parks, green of housing estates and of centre); caught from June to October.

Crabro (Crossocerus) exiguus Lind.

Warsaw (park, green of housing estates, green of the centre); caught from June to September.

Crabro (Crossocerus) wesmaeli Lind.

Wola Mrokowska, Ursynów and Warsaw (parks, green of housing estates and of the centre); caught from June to September.

Crabro (Crossocerus) distinguendus A. Mor.

Wola Mrokowska and Warsaw (parks, green of housing estates and of the centre); caught from June to September.

Crabro (Crossocerus) assimilis Smith.

Młochów (park), Ursynów and Warsaw (green of the centre); caught from May to August.

Crabro (Crossocerus) walkeri Shuck.

Łomna (moist coniferous forest), Hamernia (oak-hornbeam forest, carr); caught from June to August.

Crabro (Crossocerus) styrius Kohl.

Hamernia (carr); one female caught in June.

Crabro (Crossocerus) cetratus Shuck.

Ursynów; two females caught on the turn of August and September.

Crabro (Crossocerus) pubescens Shuck.

Hamernia (carr), Wola Mrokowska and Białoleka Dworska (moist coniferous forest, mixed coniferous forest, oak-hornbeam forest, Młochów (park), Warsaw (parks, green of the centre); caught from June to October.

Crabro (Lindenius) panzeri Lind.

Łowicz, Białoleka Dworska (moist coniferous forest, oak-hornbeam forest), Ursynów and Warsaw (parks); caught from June to September.

Crabro (Lindenius) pygmaeus armatus Lind.

Hamernia (carr), Wola Mrokowska, Ursynów and Warsaw (parks, green of housing estates); caught from July to September.

Crabro (Rhopalum) tibialis Fabr.

Hamernia (oak-hornbeam forest, carr), Łomna (mixed coniferous forest), Wola Mrokowska and Młochów (park), Ursynów and Warsaw (parks, green of the centre); caught from May to September.

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Table 4. Check-list of *Sphecidae* (Hymenoptera) species occurring in Warsaw and Mazovia

No.	Species	Mazovia	Suburban areas	Warsaw			
				Parks	Green areas in housing estates	Town centre	Other sampling areas
1	2	3	4	5	6	7	8
1	<i>Ammophila (Ammophila) campestris</i> Latr.	●	-	-	-	-	-
2	<i>Ammophila (Ammophila) sabulosa</i> (L.)	●	+	-	-	-	●
3	<i>Ammophila (Podalonia) affinis</i> Kirby	●	+	-	-	-	-
4	<i>Ammophila (Podalonia) viatica</i> (L.)	●	-	-	-	-	-
5	<i>Ammophila (Podalonia) luffi</i> Saund.	●	+	-	-	-	-
6	<i>Sphex maxillosus</i> Fabr.	●	-	-	-	-	-
7	<i>Pemphredon (Pemphredon) lugens</i> Dahlb.	+	+	+	-	-	-
8	<i>Pemphredon (Pemphredon) montanus</i> Dahlb.	-	+	-	-	-	-
9	<i>Pemphredon (Pemphredon) lugubris</i> (Fabr.)	●	+	+	+	+	+
10	<i>Pemphredon (Cenomus) shuckardi</i> (A. Mor.)	+	+	+	+	+	+
11	<i>Pemphredon (Cenomus) lethifer</i> (Shuck.)	●	+	-	+	-	+
12	<i>Pemphredon (Cenomus) unicolor</i> (Panz.)	+	-	-	+	+	-
13	<i>Pemphredon (Cenomus) austriacus</i> Kohl.	●	+	-	+	+	-
14	<i>Pemphredon (Ceratophorus) morio</i> Lind.	-	+	-	-	-	-
15	<i>Pemphredon (Ceratophorus) clypealis</i> Th.	○	-	-	-	-	-
16	<i>Psen (Mimemesa) dahlbomi</i> (Wesm.)	-	+	-	-	-	-
17	<i>Psen (Mimesa) shuckardi</i> (Wesm.)	-	+	-	-	-	-
18	<i>Psen (Mimesa) bruxellensis</i> (Bondr.)	-	-	+	-	-	-
19	<i>Psen (Mimesa) equestris</i> (Fabr.)	●	-	-	-	-	-
20	<i>Psenulus concolor</i> (Dahlb.)	+	+	+	-	+	-
21	<i>Psenulus schencki</i> (Tourn.)	-	+	+	+	+	-
22	<i>Psenulus laevigatus</i> (Scheck.)	+	+	+	+	+	+
23	<i>Psenulus pallipes</i> (Panz.)	●	+	+	+	+	+
24	<i>Psenulus fuscipennis</i> (Dahlb.)	●	+	+	-	-	○
25	<i>Diodontus minutus</i> (Fabr.)	●	+	+	-	+	-
26	<i>Diodontus luperus</i> Shuck.	●	+	+	-	-	-
27	<i>Diodontus tristis</i> (Lind.)	●	+	+	-	+	+
28	<i>Passaloecus gracilis</i> (Curt.)	+	+	+	+	+	+
29	<i>Passaloecus monilicornis</i> Dahlb.	+	+	+	+	+	-
30	<i>Passaloecus corniger</i> Shuck.	+	-	+	-	+	+
31	<i>Passaloecus insignis</i> (Lind.)	●	+	+	+	+	+
32	<i>Stigmaeus pendulus</i> Panz.	●	+	+	+	+	+
33	<i>Stigmaeus solskyi</i> A. Mor.	+	+	+	+	+	+
34	<i>Spilomena differens</i> Blüthg.	+	-	+	-	+	-
35	<i>Spilomena enslini</i> Blüthg.	-	-	+	-	-	-
36	<i>Spilomena mocsaryi</i> Kohl.	+	-	-	-	-	-
37	<i>Spilomena punctatissima</i> Blüthg.	+	-	-	-	-	-
38	<i>Spilomena beata</i> Blüthg.	+	-	+	-	+	-
39	<i>Spilomena troglodytes</i> (Lind.)	-	-	+	-	-	-

1	2	3	4	5	6	7	8
40	<i>Philantus triangulum</i> (Fabr.)	●	-	-	-	-	-
41	<i>Cerceris rybyensis</i> (L.)	●	+	-	-	-	-
42	<i>Cerceris cunicularia</i> (Schrk.)	●	-	-	-	-	+
43	<i>Cerceris interrupta</i> (Panz.)	●	-	-	-	-	-
44	<i>Cerceris arenaria</i> (L.)	●	+	-	-	-	-
45	<i>Cerceris quadrifasciata</i> (Panz.)	-	-	+	-	-	-
46	<i>Cerceris quinquefasciata</i> (Rossi)	●	-	-	-	-	-
47	<i>Alyson (Alyson) fuscatus</i> (Panz.)	●	+	-	-	-	-
48	<i>Alyson (Didineis) lunicornis</i> (Fabr.)	-	+	-	-	-	-
49	<i>Bembix rostrata</i> (L.)	●	-	-	-	-	+
50	<i>Bembecinus tridens</i> (Fabr.)	+	+	-	-	-	-
51	<i>Argogorytes mystaceus</i> (L.)	●	-	-	-	-	-
52	<i>Argogorytes fargei</i> (Schuck.)	○	+	-	-	-	-
53	<i>Gorytes (Gorytes) albidulus</i> (Lep.)	○	-	-	-	-	-
54	<i>Gorytes (Gorytes) quadrifasciatus</i> (Fabr.)	●	+	-	-	+	-
55	<i>Gorytes (Gorytes) laticinctus</i> (Lep.)	○	+	+	-	-	-
56	<i>Gorytes (Gorytes) quinquecinctus</i> (Fabr.)	●	+	+	-	-	-
57	<i>Gorytes (Gorytes) quinquefasciatus</i> (Panz.)	+	-	-	-	-	-
58	<i>Gorytes (Hoplisoides) punctatus</i> (Kirsch)	-	-	-	-	-	○
59	<i>Gorytes (Lestiphorus) bicinctus</i> (Rossi)	+	+	+	-	+	-
60	<i>Gorytes (Dienoplus) laevis</i> (Latr.)	○	-	-	-	-	-
61	<i>Gorytes (Dienoplus) elegans</i> (Lep.)	○	-	-	-	-	-
62	<i>Nysson spinosus</i> (Forst.)	●	-	-	-	-	-
63	<i>Nysson interruptus</i> Illig.	●	-	-	-	-	-
64	<i>Nysson trimaculatus</i> (Rossi)	-	+	+	-	+	-
65	<i>Nysson scalaris</i> Illig.	○	-	-	-	-	-
66	<i>Nysson maculatus</i> (Fabr.)	●	+	-	-	-	-
67	<i>Mellinus arvensis</i> (L.)	●	+	+	+	+	+
68	<i>Mellinus crabrona</i> Thunb.	●	+	+	-	-	-
69	<i>Trypoxylon figulus</i> (L.)	●	+	-	+	+	+
70	<i>Trypoxylon attenuatum</i> Smith	+	+	+	+	+	+
71	<i>Trypoxylon kolazyi</i> Kohl.	-	-	+	-	-	-
72	<i>Trypoxylon clavicerum</i> Lep. et Serv.	●	+	+	+	+	+
73	<i>Astata (Astata) boops</i> (Schrank)	●	-	-	-	-	-
74	<i>Astata (Astata) minor</i> Kohl	○	-	-	-	-	-
75	<i>Astata (Dryudella) stigma</i> (Panz.)	●	-	-	-	-	-
76	<i>Miscophus postumus</i> Bisch.	○	-	-	-	-	-
77	<i>Miscophus bicolor</i> Jur.	○	-	-	-	-	-
78	<i>Miscophus spurius</i> (Dahlb.)	●	-	-	-	-	-
79	<i>Dinetus pictus</i> (Fabr.)	●	-	-	-	-	-
80	<i>Nitela spinolae</i> Latr.	-	-	+	-	+	-
81	<i>Tachysphex panzeri</i> (Lind.)	●	+	-	-	-	-
82	<i>Tachysphex pompiliformis</i> (Panz.)	+	-	-	-	-	-
83	<i>Tachysphex nitidus</i> (Spin.)	●	-	-	-	-	-
84	<i>Tachytes europaeus</i> Kohl	●	-	-	-	-	-
85	<i>Crabro (Crabro) quadricinctus</i> Fabr.	●	+	+	+	+	○
86	<i>Crabro (Crabro) lituratus</i> Panz.	-	+	+	-	+	-
87	<i>Crabro (Crabro) lapidarius</i> Panz.	●	-	+	-	-	-
88	<i>Crabro (Crabro) zonatus</i> Panz.	-	+	+	-	+	-
89	<i>Crabro (Crabro) nigrifrons</i> Cresson	+	+	+	+	+	-
90	<i>Crabro (Crabro) cavifrons</i> Thoms.	+	+	+	-	-	+

1	2	3	4	5	6	7	8
90	<i>Crabro (Crabro) cavifrons</i> Thoms.	+	+	+	-	-	+
91	<i>Crabro (Crabro) rugifer</i> Dahlb.	●	+	-	-	-	-
92	<i>Crabro (Crabro) dives</i> (Lep. et Brul.)	●	+	-	-	-	-
93	<i>Crabro (Crabro) guttatus</i> Lind.	●	-	-	-	-	-
94	<i>Crabro (Crabro) continuus</i> Fabr.	+	+	+	+	+	-
95	<i>Crabro (Crabro) rubicola</i> Duf. et Perr.	●	-	-	-	-	-
96	<i>Crabro (Ceratocolus) clypeatus</i> (Schreb.)	-	-	+	-	-	-
97	<i>Crabro (Ceratocolus) alatus</i> Panz.	●	-	-	-	-	-
98	<i>Crabro (Ceratocolus) subterraneus</i> Fabr.	+	-	-	-	-	-
99	<i>Crabro (Thyreopus) cribrarius</i> (L.)	●	+	-	-	-	-
100	<i>Crabro (Thyreopus) peltarius</i> (Schreb.)	●	+	-	+	-	-
101	<i>Crabro (Thyreopus) scutellatus</i> (Schev.)	+	-	+	-	-	-
102	<i>Crabro (Thyreopus) loevis</i> Dahlb.	-	+	+	-	-	-
103	<i>Crabro (Crossocerus) quadrimaculatus</i> Fabr.	+	+	+	+	+	-
104	<i>Crabro (Crossocerus) vagabundus</i> Panz.	●	-	+	-	-	-
105	<i>Crabro (Crossocerus) dimidiatus</i> Fabr.	+	+	-	-	-	-
106	<i>Crabro (Crossocerus) palmipes</i> (L.)	+	+	-	-	-	-
107	<i>Crabro (Crossocerus) tarsatus</i> Shuck.	+	-	-	-	-	-
108	<i>Crabro (Crossocerus) anxius</i> Wesm.	+	+	+	-	+	-
109	<i>Crabro (Crossocerus) varius</i> Lep. et Brul.	+	+	+	+	+	-
110	<i>Crabro (Crossocerus) exiguus</i> Lind.	-	-	+	+	-	-
111	<i>Crabro (Crossocerus) wesmaeli</i> Lind.	+	+	+	+	+	-
112	<i>Crabro (Crossocerus) elongatulus</i> Lind.	●	+	+	+	+	●
113	<i>Crabro (Crossocerus) distinguendus</i> A. Mor.	+	-	+	+	+	-
114	<i>Crabro (Crossocerus) assimilis</i> Smith.	+	+	-	-	+	-
115	<i>Crabro (Crossocerus) podagricus</i> Lind.	●	-	+	-	-	-
116	<i>Crabro (Crossocerus) walkeri</i> Shuck.	+	-	-	-	-	-
117	<i>Crabro (Crossocerus) ambiguus</i> Dahlb.	●	+	+	+	+	+
118	<i>Crabro (Crossocerus) styrius</i> Kohl	+	-	-	-	-	-
119	<i>Crabro (Crossocerus) leucostomoides</i> Rich.	●	+	+	-	+	-
120	<i>Crabro (Crossocerus) cetratus</i> Shuck.	-	+	-	-	-	-
121	<i>Crabro (Crossocerus) capitosus</i> Shuck.	●	-	+	-	-	-
122	<i>Crabro (Crossocerus) pubescens</i> Shuck.	+	+	+	-	+	-
123	<i>Crabro (Crossocerus) leucostomus</i> (L.)	●	+	+	-	-	-
124	<i>Crabro (Lindenius) albilabris</i> Fabr.	●	+	+	-	-	-
125	<i>Crabro (Lindenius) panzeri</i> Lind.	+	+	+	-	-	-
126	<i>Crabro (Lindenius) pygmaeus armatus</i> Lind.	+	+	+	-	+	-
127	<i>Crabro (Entomognatus) brevis</i> Lind.	●	+	-	-	+	-
128	<i>Crabro (Rhopalum) tibialis</i> Fabr.	+	-	+	-	+	-
129	<i>Crabro (Rhopalum) clavipes</i> (L.)	●	-	+	-	+	-
130	<i>Oxybelus latro</i> Ol.	○	-	-	-	-	-
131	<i>Oxybelus latidens</i> Gerst.	●	-	+	-	-	-
132	<i>Oxybelus lineatus</i> (Fabr.)	○	-	-	-	-	-
133	<i>Oxybelus bipunctatus</i> Ol.	●	+	-	-	-	-
134	<i>Oxybelus trispinosus</i> (Fabr.)	●	-	-	-	-	-
135	<i>Oxybelus mandibularis</i> Dahlb.	●	+	+	-	-	-
136	<i>Oxybelus argentatus</i> Curt.	○	-	-	-	-	-
137	<i>Oxybelus uniglumis</i> (L.)	●	-	-	-	-	○
138	<i>Oxybelus dissectus</i> Dahlb.	●	+	-	-	-	-
139	<i>Oxybelus quatuordecimnotatus</i> Jur.	●	-	-	-	-	-

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GRZEBACZOWATE (*HYMENOPTERA, SPHECIDAE*) WARSZAWY I MAZOWSZA

STRESZCZENIE

Na terenie Niziny Mazowieckiej stwierdzono, na podstawie danych literaturowych oraz materiałów własnych, występowanie 139 gatunków grzebaczowatych, w tym 57 gatunków nowych dla Mazowsza. Najpospolitsze gatunki *Sphecidae* na Mazowszu (również na terenach zurbanizowanych) należą do rodzajów: *Pemphredon* Latr., *Psenulus* Kohl, *Passaloecus* Shuck, *Stigmus* Panz., *Mellinus* Fabr., *Trypoxylon* Latr., *Crabro* Fabr. (niektóre podrodzaje).

W zieleni terenów zurbanizowanych Warszawy stwierdzono 73 gatunki, co stanowi 52.5% gatunków wykazanych z Mazowsza.

Do Warszawy wkraczają głównie gatunki o szerokim zasięgu geograficznym. W parkach występuje kilka gatunków o mniejszym zasięgu, natomiast w zieleni osiedlowej prawie wyłącznie gatunki szerokich zasięgów geograficznych.

Analiza rozmieszczenia fauny grzebaczowatych na badanym terenie wykazuje wyraźną strefowość występowania poszczególnych rodzajów, bądź podrodzajów, w zależności od nasilenia presji urbanizacyjnej. Zwykle wszystkie gatunki z danej jednostki taksonomicznej mają podobną strefę występowania: ograniczoną tylko do terenów pozamiejskich (np. *Astata*), obejmującą także suburbia (np. *Ammophila*) lub występują we wszystkich trzech strefach tzn. łącznie z terenami zurbanizowanymi (np. *Passaloeus*).

Larwy i formy dorosłe grzebaczowatych mają odrębną biologię. Larwy rozwijają się w gniazdach, dla ich rozwoju konieczny jest pokarm białkowy i w związku z tym ich dietę stanowią różne owady i pająki. Imagines *Sphecidae* są wolnożyjące i melitofagiczne.

Z wymagań środowiskowych poszczególnych gatunków *Sphecidae* wynika szereg ograniczeń w możliwości zasiedlania przez nie zieleni terenów zurbanizowanych. Jednym z ważniejszych czynników ograniczających jest brak odpowiednich miejsc do budowy gniazd. Czynnikiem ten jest głównym powodem niewkraczania do Warszawy np. gatunków psammofilnych, budujących gniazda w piasku. Drugim czynnikiem ograniczającym jest brak pokarmu dla larw, ewentualnie dla form dorosłych (na niektórych powierzchniach). Na terenach zurbanizowanych nie występują, bądź sporadycznie są spotykane gatunki, których larwy odżywiają się owadami z następujących grup: *Orthoptera*, *Heteroptera*, *Ephemeroptera*, *Lepidoptera*.

Do Warszawy wkraczają głównie gatunki o szerokiej tolerancji ekologicznej, tj. występujące w środowiskach naturalnych zarówno na terenach otwartych, jak i zadrzewionych oraz gatunki terenów zadrzewionych.

W zieleni miejskiej występują głównie gatunki budujące gniazda w drewnie. Na przykład cały szereg gatunków z rodzajów: *Passaloeus*, *Pemphredon*, *Stigmus*, *Trypoxylon*, *Crabro* — występujących we wszystkich typach badanej zieleni miejskiej, niejednokrotnie w liczebności większej niż na terenach pozamiejskich. Natomiast ze znacznej liczby gatunków z Mazowsza, które budują gniazda ziemne, występuje tylko jeden gatunek — *Mellinus arvensis*.

W zieleni miejskiej wyraźnie dominują gatunki polujące na mszyce i różne muchówki.

РОЮЩИЕ ОСЫ (HYMENOPTERA, SPHECIDAE) ВАРШАВЫ И МАЗОВИИ

РЕЗЮМЕ

В фауне роющих ос Мазовии констатировано 139 видов. На территории варшавского городского комплекса — 73 вида, что составляет 52,2% фауны Мазовии.

К жизни в городе приспособились главным образом виды: голарктические, палеарктические и европейские. Виды с более узким географическим ареалом в зеленых насаждениях урбанизированных районов не встречаются.

В город входят виды с большей экологической толеранцией. Виды открытых пространств и псаммофильные в городской зелени в принципе не встречаются. Городская фауна роющих ос представлена главным образом видами которые строят гнезда в дереве, в то время, как гнездящиеся в земле избегают городской зелени. Исключением является *Mellinus arvensis* (L.), который встречается на всех исследованных площадках в варшавском городском комплексе, где в большинстве случаев был доминирующим видом. В фауне *Sphecidae* Варшавы решительное большинство составляют виды, выкармливающие свое потомство тлями и различными двукрылыми.