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HARVESTMEN (*ARACHNOIDEA*, *OPILIONES*) OF WARSAW AND
MAZOVIA

ABSTRACT

There were 16 *Opiliones* species recorded in Warsaw and 17 in the whole Mazovia area. 13 species inhabit managed urban green areas. Most tolerant of urbanization process are the species with large geographical ranges (Holarctic), high ecological amplitude (eurytopic), xerophilous, and showing a tendency to synanthropization. In all the habitats of urban green, *Phalangium opilio* L. was the dominant.

INTRODUCTION

So far 31 species of *Opiliones* were recorded in Poland [8], if the data not fully reliable are excluded. Particular regions of the country have not been evenly covered with the studies of this group. *Opiliones* occurring in Mazovia have received little attention and they were studied only in Warsaw and the nearest surroundings. However, the terrains adjoining Warsaw are largely diversified. In fact, all main habitat types characteristic of Mazovia occur there. Thus this terrain may be considered as representative of the whole region.

The first, and for more than a century the only one species recorded from Mazovia was *Trogulus tricarinatus* (L.) [6, 10]. Staręga [7], who made a basic contribution to the study of the fauna of this region, recorded 15 species, including the already known *T. tricarinatus*, living in Warsaw and its surroundings. Not so long ago this list was enriched with another species. *Nelima semproni* Szal. [1, 8], which was also new to Poland. Up to the present, 16 species of harvestmen are known from Mazovia. This paper reports the occurrence of the 17th species. *Opilio dinaricus* Šilh., unknown here so far.

Our contribution is one of the set of papers entitled "Species composition and origin of the fauna of Warsaw". These papers provide faunistic information obtained so far on the invertebrate fauna of Warsaw, and present it against the background of the invertebrate fauna of Mazovia. Bibliographical data are supplemented by the results of the studies carried out at the Institute of Zoology, Polish Academy of Sciences, Warsaw, in

1974—1977. These were zoocoenotic studies conducted under the project "The effect of urban pressure on fauna". Their programme, methods, and also characteristics of the environments under study, etc., are presented in separate introductory articles [3—5, 9].

SPECIES COMPOSITION

According to the present state of knowledge, 17 species of *Opiliones* occur in the Mazovia region including Warsaw, which account for 55% of the *Opiliones* occurring in Poland. In surroundings of Warsaw 15 species were recorded, and within the administrative boundaries of Warsaw 16 species. Among the species inhabiting the town, 14 occurred in suburban quarters, 12 in parks, 3 in green areas of housing estates, and 3 species in green areas of the centre. Two species occurring in Warsaw (*Nelima semproni* Szal. and *Mitopus morio* (Fabr.)) have not been found in non-urban regions of Mazovia (Tab. 4).

In the typical managed urban green areas such as parks, verdure of housing estates, squares and lawns of the centre of Warsaw, the distinctly dominant species was *Phalangium opilio*. This is a xerophilous species, which is an advantage in the overdried urban habitat. The next species, *Oligolophus tridens*, is considerably less abundant. It mostly occurs among shrubs in parks.

Among the other species, particular attention should be paid to *N. semproni*. Its occurrence in Poland was recorded in 1974 [8]. *N. semproni* is a central-European species, the close range of which covers northern Italy, Yugoslavia, western Hungary, Austria, and Czechoslovakia. It has probably been brought to Warsaw casually, with seedlings, as one of scarce stands of this species is located near the Botanical Garden [1].

Trogulus tricarinatus belongs to common species in the mountains and on uplands. It is rare and not numerous in lowlands [8]. *Mitopus morio* is also common in the mountains. A relatively rare species in Poland is *Opilio saxatilis*, probably reaching here the northwestern limit of occurrence [8].

Opilio dinaricus — a new species to Mazovia — has been found in the settlement of Podkowa Leśna, near Warsaw. In Poland it is known from less than twenty stands dispersed over the country. The possibility of its occurrence near Warsaw was earlier predicted on the basis of its general distribution in Poland [7].

The remaining *Opiliones* found in Warsaw or Mazovia are common species, almost all over the country.

ZOOGEOGRAPHICAL ANALYSIS

Among 17 species of *Opiliones* found in the Mazovia, 13 belong to the European element. The following species are largely distributed in Europe: *Trogulus tricarinatus*, *Mitostoma chrysomelas*, *Leiobunum rotundum*, *Rilaena*

triangularis, *Lophopilio palpinalis*, and *Opilio saxatilis*. The species specific of central Europe are *Lacinius ephippiatus*, *Leiobunum rupestre*, and *Nelima semproni*. The central-eastern-European species is *Nemastoma lugubre*; *Leiobunum blackwalli* is a western-central-European species; *Lacinius horridus* and *Opilio dinaricus* are southeastern-European species. One species, *Oligolophus tridens*, represents the Euro-Siberian element.

There is a relatively large number of 3 rare Holarctic species: *Mitopus morio*, *Phalangium opilio*, and *Opilio parietinus*. *O. parietinus*, now largely distributed all over the world, derives probably from the region of the Caucasus [8].

It follows from the data set up in Table 1 that there were no significant differences in the proportion of particular zoogeographical elements between the fauna of urban green areas as a whole, and the fauna of Mazovia and Warsaw suburbs. But this approach does not reflect the actual effect of urban pressure on the fauna of *Opiliones*. Among all types of urban green areas, parks were inhabited by the greatest number of species of this group. And parks are habitats most similar to non-urban habitats as fragments of primary tree stands are often preserved in them. They are refuges of the fauna of invertebrates in Warsaw [2]. Due to this, the fauna living parks is similar to the fauna characteristic of non-urban habitats. Thus the general effect of urban pressure on the fauna of *Opiliones* will be better characterized by average proportions of particular elements (zoogeographical, ecological, etc.) for different types of urban green areas. In this case, a distinct predominance of the species with largest ranges, that is, Holarctic and Euro-Siberian, can be observed. Their percentage proportions increased in the areas subjected to heaviest urban pressure, such as housing estates and the centre of the town (Tab. 1). The proportion of Holarctic species in the fauna of *Opiliones* occurring in urban green areas of all types, was on the average almost three times as high as in non-urban habitats. And a Holarctic species (*Phalangium opilio*) predominated by number in all the habitats of Warsaw. In most strongly transformed habitats of the centre of the town, the fauna of *Opiliones* did not contain European species which were most abundant in non-urban habitats of Mazovia, and also in suburbs and in parks of Warsaw (Tab. 1).

The species with large geographical distribution inhabit several different biomes, thus they must show a respectively high ecological amplitude. And probably due to this they have an advantage over the species with smaller ranges (more specialized ecologically) in heavily transformed environments.

ECOLOGICAL ANALYSIS

Majority of the *Opiliones* have a high ecological amplitude, that is, they are not associated with specified types of habitats. Such eurytopic species dominate the fauna of *Opiliones* in Warsaw. The species associated with

Tab. 1. Proportions of zoogeographical elements in harvestmen 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	%	N	%	N	%	N	%
Holarctic	2	13.3	3	21.4	2	15.4	1	8.3	1	33.3	2	66.7
Euro-Siberian	1	6.7	1	7.1	1	7.7	1	8.3	1	33.3	1	33.3
European	12	80.0	10	71.5	10	76.9	10	83.4	1	33.3	—	—

particular habitat types, e.g. *Trogulus tricarinatus*, *Nemastoma lugubre*, or *Mitostoma chrysomelas*, all typical of coniferous forests, either did not occur at all in closely built-up areas (*M. chrysomelas*), or occasionally occurred but only in parks (Tab. 4).

Most *Opiliones* belong to hygrophilous species, the other are xerophilous. Their individual developments usually takes place in litter or on soil surface. Therefore, young individuals generally belong to epigeal forms. Adults, depending on the species, often change the layer in which they live. Some of them are more or less associated with the soil surface, others move on herbaceous plants or colonize shrubs and tree crowns. Many *Opiliones* show more or less distinct tendency to synanthropization (Tab. 2). Due to

Tab. 2. Ecological requirements in harvestmen of Warsaw

Occurrence	Species	Habitat		Layer			Degree of synanthropization	
		Wet	Dry	a	b	c		
Suburbs	<i>Mitostoma chrysomelas</i>	×		×				
	<i>Leiobunum rotundum</i>	×				×	++	
	<i>Mitopus morio</i>		×	×	×	×	++	
Urban green areas	A	<i>Trogulus tricarinatus</i>	×		×			
		<i>Nemastoma lugubre</i>	×		×			
		<i>Leiobunum rupestre</i>	×				×	++
		<i>Leiobunum blackwalli</i>	×				×	+
		<i>Lacinius horridus</i>		×	×	×	×	+
		<i>Lacinius ephippiatus</i>	×		×	×	×	
		<i>Rilaena triangularis</i>	×				×	
		<i>Lophopilio palpinalis</i>	×		×	×		
	<i>Opilio saxatilis</i>		×	×	×		+	
	B	<i>Nelima semproni</i>	×			×		
<i>Oligolophus tridens</i>		×		×	×		+	
<i>Phalangium opilio</i>			×	×	×	×	++	
C	<i>Opilio parietinus</i>		×				+++	

Vertical distribution (only for adult forms): a — litter and soil surface; b — short herbaceous plants; c — tall herbaceous plants, trunks and crowns of trees and shrubs. Degree of synanthropization: + — the species occurring near dwellings; ++ — the species visiting dwellings; +++ — strictly synanthropic species. Occurrence in urban green areas: A — only in parks, B — in parks and other habitats, C — only in the centre of the town.

this, they are relatively resistant to transformations of the environment in urban areas. Only the fauna of *Opiliones* in extremely urbanized areas is considerably changed, as compared with that of non-urban areas.

It is difficult to follow specific tendencies in the ecological transformation of *Opiliones* communities with increasing urban pressure, since the number of species is low, particularly in the most urbanized parts of the town. It is possible, however, to show some directions.

There were no substantial ecological differences between the fauna of *Opiliones* in the suburban and non-urban areas. This probably resulted from a similar habitat diversity in the areas of these two categories. Also relatively little modified is the fauna of *Opiliones* in the urban parks. But the opilionid fauna of housing estates and central part of the town was of a different character. The increasing urban pressure was followed by increment in the proportion of xerophilous species in the local fauna. The proportion of xerophilous species in the centre of Warsaw was 2.5 times as high as in the non-urban habitats of Mazovia (Tab. 3).

There were considerable differences in the opilionid fauna of different types of urban green areas with reference to the layer occupied. In parks the proportion of species occurring on soil surface and on low herbaceous plants was equal to the proportion of arboreal forms. The latter group involves both the species closely associated with tree crowns and the species that can occur in any of the layers distinguished (Tab. 2). The former group includes the species associated with litter, such as *Trogulus tricarinatus* and *Nemastoma lugubre* (Tab. 2), occurring only in parks and not in other types of urban green areas. They found a refuge in original tree stands preserved in the parks where litter is not removed, unlike in the remaining areas. In the green areas of housing estates, the species associated with low herbaceous plants predominated. Gardening treatments on the lawns are there much less intense than in parks. The grass is mown less frequently and herbicides are generally not applied. As a result, herbaceous plants grow better in housing estates than in parks, which is favourable for the associated fauna. Instead, trees are generally young in housing estates, and the associated fauna has not developed yet. These are theoretical considerations, however. It should be noted once again that only three species of *Opiliones* occur in the centre of Warsaw and in the housing estates. One of them, *Opilio parietinus*, is an obligatory synanthropic species which cannot be classified in to any of the distinguished groups. The other species are represented by two groups (Tab. 3).

The percentage contribution of the species showing some tendencies to synanthropization¹ increased with urban pressure. In the centre of Warsaw asynanthropic species were absent (Tab. 3). Instead, an obligatory synanthropic species, *Opilio parietinus*, occurred there and was absent in the other urban green areas (Tab. 4).

¹ Interior of the buildings was not studied

Tab. 3. Proportions of groups with different habitat preferences in harvestmen 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	%
Hygrophilous	11	73.3	10	71.4	9	69.2	9	75.0	2	66.7	1	33.3
Xerophilous	4	26.7	4	28.6	4	30.8	3	25.0	1	33.3	2	66.7
Epigean	6	40.0	5	35.7	6	46.2	6	50.0	2	66.7	1	33.3
Arboreal	8	53.3	8	57.1	6	46.2	6	50.0	1	33.3	1	33.3
Asynanthropic	7	46.7	6	42.9	6	46.2	6	50.0	1	33.3	—	—
Synanthropic	8	53.3	8	57.1	7	53.8	6	50.0	2	66.7	3	100.0

CONCLUSIONS

Urbanization of the environment has a significant effect on the number and species composition of the opilionid fauna. But only urban pressure of a high degree can cause a substantial transformation of the communities of these animals. Opilionid fauna of suburban areas and even urban parks does not differ much from that of non-urban areas. Fundamental changes were observed in housing estates and in the centre of the town.

The species most tolerant of the urban pressure are those with wide geographical ranges (Holarctic), high ecological amplitude (eurytopic), as also xerothermal species and those showing a tendency to synanthropization.

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Tab. 4. Check list of *Opiliones* species occurring in Warsaw and Mazovia

No.	Species	Mazovia	Warsaw				
			suburban areas	parks	green areas in housing estates	town centre	other sampling areas
	○ — literature data ● — proved literature data + — unpublished data						
1	<i>Trogulus tricarinatus</i> (L.)	○	○	●	—	—	○
2	<i>Nemastoma (Lugubrostoma) lugubre</i> (Müll.)	○	●	+	—	—	—
3	<i>Mitostoma (Mitostoma) chrysomelas</i> (Herm.)	○	●	—	—	—	—
4	<i>Leiobunum rotundum</i> (Latr.)	○	○	—	—	—	—
5	<i>Leiobunum rupestre</i> (Herbst)	○	○	○	—	—	—
6	<i>Leiobunum blackwalli</i> Meade	○	●	○	—	—	—
7	<i>Nelima semproni</i> Szal.	—	—	●	+	—	—
8	<i>Mitopus morio</i> (Fabr.)	—	○	—	—	—	—
9	<i>Oligolophus (Oligolophus) tridens</i> (C.L. Koch)	○	●	●	+	+	—
10	<i>Lacinius horridus</i> (Panz.)	○	●	○	—	—	—
11	<i>Lacinius ephippiatus</i> (C. L. Koch)	○	●	+	—	—	—
12	<i>Phalangium opilio</i> L.	○	○	●	+	●	—
13	<i>Rilaena triangularis</i> (Herbst)	○	●	+	—	—	○
14	<i>Lophopilio palpinalis</i> (Herbst)	○	●	—	—	—	—
15	<i>Opilio parietinus</i> (De Geer)	○	○	—	—	○	—
16	<i>Opilio saxatilis</i> C. L. Koch	○	—	●	—	—	—
17	<i>Opilio dinaricus</i> Šilh.	+	—	—	—	—	—

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KOSARZE (*ARACHNOIDEA OPILIONES*) WARSZAWY I MAZOWSZA

STRESZCZENIE

W Warszawie występuje 16 gatunków kosarzy (17 na całej Nizinie Mazowieckiej). 13 gatunków zasiedla środowiska zagospodarowanej zieleni miejskiej (parki, osiedla mieszkaniowe, centrum Warszawy). Istotne zmiany składu gatunkowego i charakterystyki ekologicznej fauny *Opiliones*, wywoływane przez urbanizację, występują na obszarach podlegających szczególnie silnej presji (osiedla mieszkaniowe, centrum miasta). W dzielnicach peryferyjnych, a nawet w parkach miejskich, zmiany nie są wyraźne. Urbanizację środowiska najłatwiej znoszą gatunki o szerokich zasięgach geograficznych (holarktyczne), znacznej plastyczności ekologicznej (eurytopowe), sucholubne i wykazujące skłonność do synantropizacji.

Gatunkiem dominującym we wszystkich środowiskach zieleni miejskiej w Warszawie jest *Phalangium opilio* L.

СЕНОКОСЦЫ (*ARACHNOIDEA, OPILIONES*) ВАРШАВЫ И МАЗОВИИ

РЕЗЮМЕ

В Варшаве встречается 16 видов сенокосцев (17 видов на всей Мазовецкой низменности). 13 видов населяет биотопы благоустроенной городской зелени (парки, жилые районы, центр Варшавы). Существенные изменения, касающиеся видового состава и экологической характеристики фауны сенокосцев, вызванные урбанизацией, происходят на территориях, подлежащих особенно сильному прессу (жилые районы, центр города). В периферических районах и даже в городских парках изменения в фауне сенокосцев не проявляются так четко. Легче всего урбанизационный пресс переносят виды с широким географическим ареалом (голарктические), затем обладающие значительной экологической пластичностью (эвритопные), ксерофильные и отличающиеся склонностью к синантропизации.

Доминирующим видом во всех биотопах городской зелени в Варшаве является *Phalangium opilio* L.