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ISOPODS (*ISOPODA*) OF WARSAW AND MAZOVIA

ABSTRACT

In Mazovia and Warsaw 22 isopod species were recorded including 20 in Warsaw. Isopods of Warsaw and Mazovia belong to four geographical elements: cosmopolitan, Holarctic, European, and southeastern. They represent three basic ecological elements: ubiquitous, synanthropic and forest. An increase in the urban pressure was followed by an increase in the proportion of cosmopolitan and synanthropic species.

INTRODUCTION

In the studies carried out so far on terrestrial isopods (*Isopoda*, *Oniscoidea*) of Poland, mostly natural environments were examined. Dominiak [3] summed up the literature data and supplemented them with his own results. More or less sparse information on the occurrence of isopods in Warsaw is dispersed in the papers concerned with different regions of the country. One of them was prepared by Dyduch [4], who quotes several isopod species caught in the Bielany Wood. The richest data are reported by Dominiak [2, 3]. On the basis of the materials collected by the Institute of Zoology PAS, and other sources, this author reports many species from Warsaw but without a detailed location.

This contribution is a part of the comprehensive studies of the fauna of Warsaw, carried out at the Institute of Zoology PAS in 1974—1978. Theoretical assumptions, habitat characteristics, and methods, are described in separate papers [1, 8—10].

Some additional sites were under study, such as hothouses of the Botanical Garden, University of Warsaw, a belt of wasteland near the settlement „Przyjaźń” in Jelonki quarter, Bielany Wood, allotments, a belt of undergrowth by the Vistula, and the Vistula escarpment. Also the material collected in rooms was used. In sum, the material of more than 4200 specimens was analysed.

SPECIES COMPOSITION

In Poland 36 isopod species inhabiting terrestrial habitats have been recorded so far, including 12 in Mazovia. Since more detailed ecological data are lacking, it is not possible to analyse the relationship between the occurrence of particular species and habitat types of Mazovia.

The isopods of Warsaw are represented by 19 terrestrial species, which account for more than 50% of the total number of species in Poland, and considerably exceed the number of species known from Mazovia, where 13 species were recorded. Isopods show a distinct tendency to synanthropization, and that is why they are rich in species in Warsaw. Many isopod species require a high content of calcium carbonate in soil. Hence, the soils of towns containing much rubble, provide a favourable habitat for them.

Isopods are sensitive to overdrying, thus they are most abundant in shady and humid environments, such as different types of alder swamps, carrs, and oak-hornbeam forests. They are also richest in species in these habitats.

Most of the isopod species occurring in Warsaw can also be found in Mazovia. There are marked differences in their communities between the suburban area and the centre of the town. Suburbs include some species characteristic of broad-leaved forests (*Armadillidium opacum*, *A. pulchellum*) and never met in parks or housing estates. A specific fauna is also associated with old buildings. Humid cellars, walls covered with cracked plaster, are the habitat of *Porcellio scaber*, *P. spinicornis*, *Oniscus asellus*, and *Protracheoniscus major*. In urban parks, the species composition of isopods depends on the age of an object and on the kind of treatments. Old parks such as the Saxon Garden and Łazienki are inhabited by more species than young parks (e.g. Cemetery of Soviet Soldiers) or green areas of modern housing estates.

The isopods occurring in Warsaw have large species diversity at low densities, as compared with those inhabiting natural environments. A large proportion of them are synanthropic species which can find suitable conditions in towns, although they are beyond the range of their natural occurrence.

Among different types of urban green areas in Warsaw, particular attention should be paid to enclaves of paranatural vegetation growing on the Vistula escarpment, including fragments of the Ursynów park, the park between the Citadel and Vistula highway, and the Bielany wood. They are refuges of the fauna which, affected by urban pressure, can survive there. In particular, the species inhabiting forests (*A. opacum* and *A. pulchellum*) can find suitable conditions in these areas. They are absent in the nearest surrounding of Warsaw, except in the Bielany Wood.

ZOOGEOGRAPHICAL ANALYSIS

The isopods of Warsaw and Mazovia belong to four major zoogeographical elements.

Cosmopolitan element accounts for 33.3% of all the species known from Mazovia and Warsaw. These are *Hyloniscus riparius*, *Trichorhina tomentosa*, *Metoponorthus pruinosus*, *Trachelipus rathkei*, *Porcellio scaber*, *P. dilatatus*, *P. spinicornis*, and *Armadillidium vulgare*.

The percentage proportion of the cosmopolitan element in particular types of green areas varied according to the degree of urban pressure (Tab. 1). In Mazovia 2 species of this element were recorded, in suburbs 4 species, and totally in Warsaw 7 species. In the green areas of the centre and housing estates where the urban pressure is most pronounced, cosmopolitan species predominate, or are the only geographical element. The species of this group are very expansive.

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

Zoogeographical element	Mazovia		Warsaw									
			Suburbs		Urban green areas							
	N				%		Total		Parks		Housing estates	
			N	%			N	%	N	%	N	%
Cosmopolitan	2	16.7	4	40.0	7	41.2	4	44.4	1	100.0	2	75.0
Holarctic	4	33.3	3	30.0	5	29.4	4	44.4	—	—	1	25.0
European	5	41.7	3	30.0	—	—	1	11.2	—	—	—	—
Southeastern	1	8.3	—	—	1	5.8	—	—	—	—	—	—

Holarctic element accounts for 28.5% of the total number of species. They include *Trichoniscus pusillus pusillus*, *Haplophthalmus danicus*, *Oniscus asellus*, *Cylisticus convexus*, and *Armadillidium nasatum*. In most of the study plots, the Holarctic element was represented by 4—5 species. Only in the green areas of housing estates there are no representatives of this element, and in the centre only one species was recorded.

European element contributes to 33.3% of all the species. Here there are such species as *Ligidium hypnorum*, *Platyarthus hoffmansseggi*, *Protracheoniscus politus*, *Trachelipus waechteri*, *Porcellium conspersum*, *Armadillidium opacum*, and *A. pulchellum*. In Mazovia this element is represented by 5 species, while in the green areas of housing estates and in the centre of the town, European species do not occur at all.

Southeastern element is represented by only one species, *Protracheoniscus major*. In Poland it occurs only in buildings [7].

The isopods of Warsaw and Mazovia belong to the species of European

origin, with a rather large range. *Trichorhina tomentosa* is an exception here as it has been brought from tropical forests of Central America. These species, due to their high ecological amplitude and tendency to synanthropization, colonized large areas, forming elements with wide ranges [5, 6].

ECOLOGICAL ANALYSIS

The terrestrial isopods occurring in Warsaw and Mazovia belong to saprophages breaking off and feeding on dead plant parts. They are usually hidden under stones, pieces of wood, and in litter. They generally avoid open spaces. Only few species occur in lawns, using various depressions filled with dead plant material. They avoid sunlight, and are active at night or during rainfall.

Most of the isopod species are susceptible to overdrying, thus they prefer humid habitats such as leaves decaying in the shadow of trees and shrubs, or old humid cellars. Only few species such as *Trachelipus rathkei* and *Armadillidium vulgare* successfully adapted themselves to lower humidity. They often occur in open spaces, forming abundant colonies under stones. *Trachelipus rathkei* as a ubiquitous species can also live under detached bark of standing dead trees.

The isopods occurring in Warsaw and Mazovia belong to three major ecological elements. These are ubiquitous species such as *Ligidium hypnorum*, *Trichoniscus pusillus*, *Hyloniscus riparius*, *Platyarthrus hoffmannseggii*, and *Trachelipus rathkei*. Then synanthropic species: *Haplophthalmus danicus*, *Trichorhina tomentosa*, *Oniscus asellus*, *Cylisticus convexus*, *Protracheoniscus major*, *Metoponorthus pruinosis*, *Porcellio scaber*, *P. dilatatus*, *P. spinicornis*, *Armadillidium nasatum*, and *A. vulgare*. And finally the species inhabiting forests: *Protracheoniscus politus*, *Trachelipus waechterli*, *Porcellium conspersum*, *Armadillidium opacum*, and *A. pulchellum*.

The proportion of these elements in particular plots is shown in Table 2. In Mazovia there were not large differences in the percentage of particular elements. Within the administrative boundaries of Warsaw most abundant were synanthropic species (64.7%), then ubiquitous species (29.4% of the total number of isopod species). In some urban habitats, synanthropic species are often the only ecological element (green areas of housing estates, centre), or largely predominating (66.7% in parks). With increasing urban pressure the proportion of synanthropic species increased, while that of forest species dropped.

The classification of isopods into ecological elements, presented above, is of approximate character as most of the literature data do not specify ecological conditions in the study sites. Many species change their habitat requirements within their geographical range. *Porcellio scaber*, which is a subatlantic element (genetically), is characteristic of beech forests in Po-

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

Group	Warsaw											
	Mazovia				Urban green areas							
	Suburbs				Total		Parks		Housing estates		Town centre	
	N	%	N	%	N	%	N	%	N	%	N	%
Ubiquitous	3	25.0	4	40.0	5	29.4	3	33.3	—	—	—	—
Synanthropic	5	41.7	4	40.0	11	64.7	6	66.7	1	100.0	3	100.0
Living in forests	4	33.3	2	20.0	1	5.9	—	—	—	—	—	—

merania, and in other regions of Poland it occurs in parks, gardens, and flats as a typical synanthropic species.

It may be expected that further field studies will enable us to specify ecological conditions required by isopods and, as a result, the classification given above will be largely modified.

Most of the isopod species tend to aggregate. Such a population structure makes it difficult to estimate numbers in particular plots.

Among the habitats under study, the Bielany Wood was the richest in isopods. The largest number of individuals was caught here. The dominant species was *Armadillidium opacum*, characteristic of broad-leaved and mixed forests. *Trachelipus rathkei* was most often captured in lawns of different types and in managed parks. Near buildings and in allotments, *Porcellio scaber*, a typical synanthropic species in this part of the country, was numerous. These three species formed the bulk of the isopod biomass in Warsaw. The other species were represented by single individuals. Under favourable conditions they can form colonies, e.g. *Oniscus asellus* and *Cylisticus convexus* occurring in old cellars in the Ursynów quarter, *Ligidium hypnorum* in moist sites near water in the Bielany Wood and in meadows of the Ursynów quarter.

Large majority of isopod species occurring in Warsaw belong to expansive synanthropic species common almost all over Europe and often dispersed all over the world.

CONCLUSIONS

Warsaw and its suburban areas form a mosaic of habitats providing favourable conditions for many isopod species. In this respect it is much richer than the surrounding areas of Mazovia. Most species are synanthropic animals common almost in the whole Europe. An alien element, of the neotropical origin, is *Trichorhina tomentosa*, found in the hothouses of the Botanical Garden, University of Warsaw [7]. The Bielany Wood and old parks located on the Vistula escarpment are richest in isopod species.

NEW SPECIES TO THE FAUNA OF MAZOVIA AND RARE SPECIES

The results of faunistic studies are shown in Table 3. The particularly interesting species, marked with asterisk in the table, are discussed in detail.

Trichorhina tomentosa (B.-L.)

This species has been found in the hothouse of the Botanical Garden, University of Warsaw [7]. It lives in the palm house, where there is high humidity and a temperature of more than 20°C over the year. The animals (exclusively females) were found in peat and under plant pots.

Protracheoniscus major (Dollfus)

It was caught in flats at Bracka street. It may be expected that this species is common in the centre of the town and in quarters with old buildings preserved.

Metoponorthus pruinosus (Brandt)

Two specimens of this species were caught by means of pitfall traps at

Tab. 3. Check list of *Isopoda* species occurring in Warsaw and Mazovia

No.	Species	Mazovia	Warsaw				
			suburban areas	parks	green areas in housing estates	town centre	other sampling areas
1	<i>Asellus aquaticus</i> (L.)	●	-	-	-	-	+
2	<i>Ligidium hypnorum</i> (Cuv.)	●	+	-	-	-	○
3	<i>Trichoniscus pusillus pusillus</i> (Brdt.)	●	+	-	-	-	○
4	<i>Hyloniscus riparius</i> (C. L. Koch)	-	+	+	-	-	○
5	<i>Haplophthalamus danicus</i> B.-L.	-	-	+	-	-	○
6	<i>Trichorhina tomentosa</i> (B.-L.)*	-	-	-	-	-	+
7	<i>Platyarthrus hoffmannseggii</i> Brdt.	-	-	+	-	-	-
8	<i>Oniscus asellus</i> L.	○	+	+	-	-	○
9	<i>Cylisticus convexus</i> (De Geer)	●	+	+	-	-	○
10	<i>Protracheniscus major</i> (Doll.)*	○	-	-	-	+	○
11	<i>Protracheniscus politus</i> (C. L. Koch)	+	-	-	-	-	○
12	<i>Trachelipus rathkei</i> (Brdt.)	○	+	+	-	-	○
13	<i>Trachelipus waechteri</i> (Srouh.)	○	-	-	-	-	○
14	<i>Porcellium conspersum</i> (C. L. Koch)	●	-	-	-	-	-
15	<i>Metoponorthus pruinosus</i> (Brdt.)*	-	-	+	-	-	○
16	<i>Porcellio scaber</i> Latr.	○	+	+	+	+	○
17	<i>Porcellio dilatatus</i> Brdt.*	-	-	-	-	-	●
18	<i>Porcellio spinicornis</i> Say	○	-	+	-	+	○
19	<i>Armadillidium nasatum</i> B.-L.*	-	-	-	-	-	●
20	<i>Armadillidium opacum</i> (C. L. Koch)	●	+	-	-	-	-
21	<i>Armadillidium vulgare</i> (Latr.)*	-	+	-	-	-	-
22	<i>Armadillidium pulchellum</i> (Zenck.)	-	+	-	-	-	-

the orangery in the Łazienki park. They were outside the building probably by chance.

Porcellio dilatatus Brandt

It was found in the hothouses of the Botanical Garden, University of Warsaw, under flower-pots. The temperature there exceeds 20°C and humidity is high.

Armadillidium nasatum B.-L.

It was caught in large numbers in all hothouses of the Botanical Garden, University of Warsaw. In Poland this species does not occur outside hothouses.

Armadillidium vulgare (Latreille)

A numerous colony of this species inhabits a belt of ruderal plants between the railway and the settlement „Przyjaźń” in the Jelonki quarter. This isopod forms abundant aggregations under stones and rubble covering all the area.

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RÓWNONOGI (*ISOPODA*) WARSZAWY I MAZOWSZA

STRESZCZENIE

W oparciu o badania prowadzone w latach 1974—1978 opracowano skład gatunkowy *Isopoda* w Warszawie (tab. 3). Na Mazowszu i w Warszawie występują łącznie 22 gatunki równonogów. W samej aglomeracji warszawskiej występuje 20 gatunków. Najbogatszymi środowiskami są suburbia skupiające 10 gatunków *Isopoda* a najuboższa jest zieleń osiedlowa, w której występuje tylko 1 gatunek.

Równonogi Mazowsza i Warszawy należą do czterech zasadniczych elementów zoogeograficznych: kosmopolitycznego, holarktycznego, europejskiego i południowo-wschodniego. Udział elementu kosmopolitycznego na badanych powierzchniach wzrasta wraz ze wzrostem presji urbanizacyjnej.

Badane równonogi należą do trzech elementów ekologicznych: ubikwistycznego, synantropijnego i leśnego. Urbanizacja wpływa na wyeliminowanie gatunków leśnych i zwiększa procentowy udział synantropów.

РАВНОНОГИЕ (*ISOPODA*, *ONISCOIDEA*) ВАРШАВЫ И МАЗОВИИ

РЕЗЮМЕ

На Мазовии и в Варшаве встречается 22 вида равноногих (*Isopoda*). На территории агломерации Варшавы живет 20 видов. Равноногие Варшавы и Мазовии относятся к следующим четырем зоогеографическим элементам: космополитические, голарктические, европейские и юго-восточные. Экологически исследованные равноногие принадлежат к трём основным группам: убиквисты, синантропы и лесные. Рост урбанизационного пресса ведет к повышению процентного содержания космополитического и синантропного элементов.