The terrestrial isopod fauna of South Transdanubia (Hungary)

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Abstract: Extensive investigations between 1996 and 2004 yielded 31 terrestrial isopod species from South Transdanubia (SW-Hungary). The records originated from hand and pitfallsampling of characteristic habitats in 343 sites that are situated in 175 UTM squares covering the whole territory. The most common species are Armadillidium vulgare, Porcellium collicola, Hyloniscus riparius and Trachelipus rathkii. The rare species are Protracheoniscus franzi and Porcellium recurvatum. Significant share of the species (29 %) are distributed in Central and SE-Europe while the proportion of Ilyrean and Alpine elements is low. The amount of introduced isopods is 23 %. Using IndVal statistical method, the next species were found to be characteristic of typical habitats: Armadillidium zenckeri (marshes), Protracheoniscus politus, (dry oak woodlands), Lepidoniscus minutus (fresh oak woodlands), Trachelipus nodulosus, Porcellium collicola, (black locust plantations), Androniscus roseus, Haplophthalmus mengii, Cylisticus convexus, Platyrhurs hoffmannseggi, Porcellio scaber, Porcellionides pruinosis and Proporcellio vulcainus (synanthropic habitats). No characteristic species was found in riverine and swamp woodlands.

Keywords: Isopoda; Oniscidea; woodlice; Hungary; South Transdanubia; biogeography; habitat preference

Introduction

Studies on the Hungarian Isopoda fauna started over 150 years ago but there had been hardly any information on the common, rare or characteristic species and their distribution in the country up to 1996. Records of 42 species were known from the approximately five percent of the UTM squares that cover the country (FORRÓ and FARKAS 1998). The isopod fauna of Hungary or at least a part of the country has not been analysed from zoogeographical point of view yet. After the political changes in 1989, the importance of nature conservation became stronger and the new governments initiated the establishment of many new preserves in Hungary. The first step of natural protection measures was the precise appraising of the species richness. As a part of this process, a systematic eco-faunistical research has been started in 1996 to collect data on the isopod fauna and the distribution of the species. The three southern counties (Somogy, Baranya and Tolna: „South Transdanubia”; 14,227 km²; 15.3 % of Hungary) belonged to the less researched areas: distribution records of only 16 species were known from here (FORRÓ and FARKAS 1998). This area was sampled during the last eight years, aiming to discover the isopod fauna and to describe the assemblages in the main habitat types of the region. The surveys resulted several, mainly faunistical (FARKAS 1998a, FARKAS 1998b, FARKAS 2004a, FARKAS 2004b) and ecological (FARKAS 1998c, FARKAS 1999) publications. This paper has three main aims: (i) to give the complete list of species in the region and to point the common and rare species; (ii) to analyse the isopod fauna from zoogeographical point of view; (iii) and to describe the characteristic species for typical habitats of South Transdanubia, such as marshes, riverine, swamp and oak woodlands, black locust plantations and synanthropic sites.
Material and methods

Investigated area

South Transdanubia is situated in the southern part of Hungary, west from the River Danube. (Fig.1). The Croatian territory called „Baranya triangle” is situated between the Rivers Drava and Danube, and also part of South Transdanubia from a geomorphological point of view. The macroclimate of the area is influenced by atlantic, continental and mediterranean effects (PÉCSI 1989). The moderate atlantic effects bring relatively high annual precipitation (650 – 800 mm) to the western border of the region. Average mean temperature is

Fig. 1. Map of Hungary (top) and map of South Transdanubia, showing the sample sites (dots) in a UTM grid square (10 × 10 km²). Overlapping sites are represented by one dot.
9.5 – 10 °C. The eastern territories have a more continental climate with 550–650 mm precipitation and an average temperature of 10 – 11 °C. The southern slopes of the Mecsek and Villanyi Mts. have a sub-mediterranean climate. On the other hand, submontane effects are noticeable on the peaks and the northern slopes of the mountains. The researched area involves lowlands and hill rows with heterogeneous vegetation (Table 1.). The UTM grid was used as the basis for pointing out the sampling sites. The whole territory is covered by 175 UTM squares of 10 × 10 km² and on average two locations (a total of 343) were investigated in every square (Fig. 1.). The sampling sites were chosen in the characteristic biotopes of the area (marshes, riverine and swamp woodlands, fresh and dry oak woodlands, black locust plantations) easy of access. The fauna of cities, suburbs, villages and disturbed habitats was also examined in several cases.

Table 1. The investigated habitats and HGHC codes

<table>
<thead>
<tr>
<th>First order HGHC code</th>
<th>First order Habitat</th>
<th>Number of samples</th>
<th>Second order habitats</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Marshes</td>
<td>44</td>
<td>Non-tussock beds of large sedges; water-fringing helophyte beds with Butomus, Eleocharis and Alisma; Reed and Typha beds; Tussock sedge communities;</td>
</tr>
<tr>
<td>D</td>
<td>Rich fens and tall herb communities</td>
<td>10</td>
<td>Rich fens; water-fringing and fen tall herb communities;</td>
</tr>
<tr>
<td>G</td>
<td>Dry, open grasslands</td>
<td>2</td>
<td>Open sand steppes;</td>
</tr>
<tr>
<td>H</td>
<td>Dry and semi-dry closed grasslands</td>
<td>3</td>
<td>Slope steppes;</td>
</tr>
<tr>
<td>I</td>
<td>Non ruderal pioneer habitats</td>
<td>2</td>
<td>Amphibious communities on river gravel and sand banks;</td>
</tr>
<tr>
<td>J</td>
<td>Riverine and swamp woodlands</td>
<td>94</td>
<td>Willow and birch mire woodlands; alder swamp woodlands; riverine willow scrub; riverine willow-poplar woodlands; riverine ash-alder woodlands; riverine oak-elm-ash woodlands;</td>
</tr>
<tr>
<td>K</td>
<td>Fresh deciduous woodlands</td>
<td>36</td>
<td>Lowland oak-hornbeam and closed sand steppe oak woodlands; Pannonic oak-hornbeam woodlands; Illyrian beech and oak-hornbeam woodlands; Pannonic neutral colline and montane beech woodlands;</td>
</tr>
<tr>
<td>L</td>
<td>Closed dry deciduous woodlands</td>
<td>55</td>
<td>Turkey oak - sessile oak woodlands;</td>
</tr>
<tr>
<td>M</td>
<td>Open dry deciduous woodlands</td>
<td>9</td>
<td>White oak scrub woodlands; thermophilous woodland fringes</td>
</tr>
<tr>
<td>N</td>
<td>Coniferous woodlands</td>
<td>1</td>
<td>Spruce woodlands;</td>
</tr>
<tr>
<td>O</td>
<td>Secondary and degraded marshes and grasslands</td>
<td>12</td>
<td>Ruderal riverine and marsh communities; semi-natural road verges; embankments and flood-control dams;</td>
</tr>
<tr>
<td>P</td>
<td>Semi-natural, often secondary woodland-grassland mosaics</td>
<td>5</td>
<td>Grasslands with spontaneously colonizing trees and shrubs;</td>
</tr>
<tr>
<td>S</td>
<td>Forestry plantations</td>
<td>25</td>
<td>Hybrid poplar plantations; scotch fir plantations; other non-native coniferous plantations;</td>
</tr>
<tr>
<td>T</td>
<td>Agricultural habitats</td>
<td>4</td>
<td>Artificial grasslands;</td>
</tr>
<tr>
<td>U</td>
<td>Synanthropic habitats</td>
<td>28</td>
<td>Cities; suburbs; villages; large parks and botanical gardens with surviving native vegetation; vineyards and orchards;</td>
</tr>
</tbody>
</table>
Collected material

Pitfall trapping (0.2 l plastic glasses, 65 % ethylene glycol and five traps / site) and random hand sampling were used as collecting methods. The traps were used in a sampling site between March and November and emptied ten times during a year. The material was determined by GRUNER’s (1966) and SCHMÖLZER’s (1965) keys. Taxonomy and nomenclature followed SCHMALFUSS (2003). The collected specimens are deposited in the isopod collection of University of Kaposvár.

Data analysis

The analysis of species’ distribution was based on the presence – absence data in the UTM squares and 343 sampling sites. Zoogeographical evaluation was based on FLASAROVÁ (1995), GRUNER (1966) and SCHMALFUSS (2003). Characteristic species of the habitats were pointed out using IndVal statistical computer program (DUFRÈNE and LEGENDRE 1997). Differences obtained at levels of P < 0.01 were considered significant. Cluster analysis (complete link; Euclidean distance) by the percentage occurrence of species in the first-order habitat classes was applied to draw the hierarchical tree of habitats using Syn-Tax program package (PODÁNI 2001). Habitat classification followed the Hungarian General Habitat Category System (HGHCS) (MÖLNÁR 1997). Applying the HGHCS, the 343 sampling sites were divided over 15 first-order classes (Table 1.). Some of them (D, G, H, I, M, N, O, P, T) were omitted from the analysis because of the low number of samples.

Results

Species list and distribution

In the period 1996–2004 110,039 terrestrial isopod specimens were sampled in the South Transdanubia region, and belonged to 31 species (Table 2.). The frequencies of the species in the UTM squares are given in Table 3. The most frequent species, Armadillidium vulgare and Porcellium collicola were found in 81 % of the investigated UTM squares, Hyloniscus riparius in 77 %, and Trachelipus rathkii in 58 %. Nine species were discovered in only one to three UTM squares, all of them are introduced species, except Porcellium recurvatum and Protracheoniscus franzii that live in natural habitats.

Fig. 2. Hierarchical tree of the first order habitats. 1: marsh; 2: riverine and swamp woodlands; 3: fresh oak woodlands; 4: closed, dry oak woodlands; 5: black locust plantations; 6: synanthropic habitats.
Zoogeography

Overall distribution of the species is given in Table 2. Twenty-three percent of the species (Armadillidium nasatum, Platyrarthrus schoblii, Porcellio laevis, Porcellonides pruinosis, Proporcellio vulcanius, Protracheoniscus major and Trichorina tomentosa) are undoubtedly introduced isopods. Distribution area of Armadillidium versicolor, Armadillidium zenkeri, H. riparius, Lepidoniscus minutus, Ligidium germanicum, P. collicola, Porcellium recurvatum, Protracheoniscus politus and Trachelipus nodulosus extends from Central Europe to the Balkans (29%). Haplophthalomus danicus, Haplophthalomus mengii, Platyrarthrus hoffmannseggii and Trachipniscus provisorius are holomediterranean species (13%). The remainder 11 species (35%) constitute a heterogeneous group: Hyloliscus vividus is known only from Slovenia and Bosnia-Herzegovina so this species was considered as an Illyrean
element. *Calconiscellus karawankianus* and *P. franzi* are East-Alpine species. *Trachelipus ratzeburgii* and *Armadillidium opacum* could be apostrophized as Alpine-Central European species. The Sarmata-Caucasian *T. rathkii* and the Ponto-Caucasian *Cylisticus convexus* are widely distributed in Europe except the Mediterranean. *Androniscus roseus* has a restricted distribution area, ranging from eastern France to Romania, north to southern Germany. The cosmopolitan *A. vulgare* is autochthonous in the Mediterranean.

**Characteristic species of the first order habitats**

The average number of species per sampling site was 4.53 (std.: 2.32), the maximum and minimum numbers were 12 and 1, respectively. The accumulated number of species ranged between 18 (black locust plantation) and 23 (wetland woodlands) so no differences were found in diversity between the first order habitat classes. In all biotopes, two-thirds of the species (ranging between 57% and 71%; AVG 65% ± 7) occurred in less than 30% of the samples. By IndVal evaluation, *A. zenckeri* proved to be a typical species in marshes. No character species was found in the riverine and swamp wetland forests. Typical species of oak woodlands are *P. politus* (dry oak forests) and *L. minutus* (fresh oak forests). *P. collicola* and *T. nodulosus* revealed characteristic in the black locust plantations. Seven species (*A. roseus, C. convexus, H. mengii, P. hoffmannseggii, P. scaber, P. pruinuosus, P. vulcanius*) connect significantly to the synanthropic habitats.
Discussion

Species list and distribution in Hungary

The 31 species which were collected during this study from South Transdanubia constitute 60% of the Hungarian terrestrial isopod fauna. Three of them (P. franzii, P. vulcanius and A. nasatum) were new to the country (FARKAS 2003, FARKAS 2004c, FARKAS and VADKERTI 2002). The macroclimate and the vegetation of the Central European countries do not differ significantly. Under the moderated wet continental conditions similar isopod faunas have evolved. The majority of the species and their number correspond to each other in the fauna of Germany (ALLSPACH 1992, GRUNER 1966), Poland (DOMINIAK 1970) and the Czech Republic (FRANKENBERGER 1959). A. vulgare, P. collicola, H. riparius and T. rathkii are the most common species as they frequently occur in all kinds of habitats. While there are many information on the extraordinary wide tolerance of A. vulgare (SCHMALFUSS 2003), the ecology of P. collicola is less known. The latter was collected mainly in wet habitats (alder woodlands, riverine forests) in the Czech Republic (FLASAROVÁ 1995, TAJOVSKÝ 1998). In an earlier research, it proved to be one of the dominant species of the dry, thermophilous white oak scrub woodlands in Hungary (Loksa 1966). According to my study, it occurred in the highest amount in two habitats extremely differed: in the wet marshes and dry black locust plantations. These facts suggest that P. collicola has a good ability to tolerate the different moisture conditions of habitats.

Zoogeography

The high amount of introduced and synanthropic species shows the significant effect of human activity on the isopod fauna. The species distributed from Central Europe to the Balkan Peninsula compose the biggest homogeneous group. Two of the most common (H. riparius, P. collicola) and four characteristic species (A. zenckeri, L. minutus, P. politus and T. nodulosus) belong to this class. The relation of the different Alpine and Illyrean species is low (5 species; 15 %). Probably these facts could be explained by both climatic and historical reasons. After the last glacial period, significant amount of the present Hungarian fauna came from the Balkans to the Carpathian basin. It was pointed out in case of several taxonomic groups (VARGA 2003). The remaining, heterogeneous part of the species is distributed in different parts of Europe (H. danicus, T. rathkii, etc.) or cosmopolite (A. vulgare).

Characteristic species of first order habitats

The association of A. zenckeri with the definitely damp, open habitats was revealed by VERHOEFF (1931). In Hungary, the species was mentioned as a common and abundant isopod of „wet fields” (KESSELYÁK 1936), but in contradiction with this statement, there were only two distribution data of A. zenckeri all over the country (FORRÓ and FARKAS 1998). The present research made perfectly clear that this species is not rare and could be find in the majority of marshy habitats like non tussock beds of large sedges (Carex sp.) in South Transdanubia. TAJOVSKÝ (1998) proved the negative impact of spring flood on terrestrial isopod assemblages in the wet, riverine woodlands. Only T. rathkii was able to survive the inundation while the other species were annihilated. After every flood, „empty” biotopes come into being that will be colonised soon by the most dispersive species, i.e. by the four most frequent woodlice. The frequency of P. collicola, H. riparius and T. rathkii peaked in this habitat, but these species still are not real characteristic species of wetland forests since they are high presented in other habitats, too. Their good colonisation ability and wide ecological tolerance make possible their high frequency and abundance in riverine woodlands. P. politus is considered as a woodlands and shrubberies inhabiting species (GRUNER 1966). It lives primarily in different oak woodlands in Hungary (LOKSA 1966). In our study, its frequency was higher in the fresh oak woodlands than in the dry forests, the species is characteristic in the latter habitat by the statistical analysis, after all. KESSELYÁK (1936) ranged L. minutus among the common but never abundant isopods of the Hungarian woodlands, but distribution data
did not support his statement (FORRÓ and FARKAS 1998). It is one of the rarest species throughout the country. During my survey, a few specimens were pointed out from several sites and proved to be characteristic species of the fresh, hazy oak woodlands. In Hungary the natural woodlands had often been replaced by the introduced black locust plantations and due to this process the original fauna annihilated in these sites. Its species set consists of roaming isopods of the neighbouring biotopes. Probably this could be the reason that unexpectedly many species (17) were sampled in this dry habitat type. The characteristic isopod species for this habitat type, \textit{T. nodulosus} is a xerophyl species that usually inhabits the dry, warm habitats (GRUNER 1966). The black locust plantation may be suitable for this species because of its loose canopy that transmits more light to the ground level than compared to other woodland habitats. All introduced species live exclusively in synanthropic habitats. However, only two of them (\textit{P. pruinosus, P. vulcanius}) proved characteristic that could be explained by the inconsiderable distribution data of the other species. Although, \textit{P. hoffmannseggii} belongs to this group, it does not still connect to the artificial habitats but lives in ant nests that usually occur around houses and in backyards. By GRUNER (1966), the eastern border of occurrence in natural habitats of \textit{P. scaber} extends from the Baltic states to the North Balkan. Probably the continental climate of South Transdanubia could be the main reason that does not allow the survival of the species in natural biotopes. \textit{H. vividus, C. karawankianus, P. franz} and \textit{P. recurvatum} may also have special habitat preferences but to answer this question requires more investigations.

Conclusions

Thirty-one terrestrial isopod species were pointed out from a poorly known area of Hungary. \textit{P. franz}, \textit{P. vulcanius} and \textit{A. nasatum} proved to be new species for the Hungarian fauna. The most common isopods in South Transdanubia are \textit{A. vulgare, T. rathkii, P. collicola} and \textit{H. riparius}, while the rarest non synanthropic species are \textit{P. recurvatum} and \textit{P. franz}. The distribution area of the majority of species that live in natural habitats extends from Central Europe to the Balkans. Twenty-nine percentage of the species are synanthropic. The following species have significant habitat preference: \textit{A. zenckeri} (marshes), \textit{L. minutus} (fresh, humid oak woodlands), \textit{P. politus} (closed, dry oak woodlands), \textit{P. collicola} and \textit{T. nodulosus} (black locust plantations), \textit{A. roseus, C. convexus, H. mengii, P. hoffmannseggii, P. scaber, P. pruinosus} and \textit{P. vulcanius} (synanthropic sites).

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References


Dél-Dunántúl szárazföldi ászkarák (Isopoda: Oniscidea) faunája

SÁNDOR FARKAS


A fajok 29 %-ának elterjedési adatai Közép- és Délkelet-Európára esnek, míg az illírus és alpi faunaelemek aránya alacsony. A fajok közül negyedét (23 %) behurcolt elemek alkotják, közük néhány közmopolitával (Armadillidi um vulgare, Porcellionides pruinosus), melyek több kontinensról is ismertek.

A fajok élőhelytípusokhoz való kötődésének IndVal módszerrel történt elemzése szerint az Armadillidi um zenckeri erős preferenciáit mutat a mocsaras élőhelyekhez, míg a Protracheoniscus politus a száraz és nedves, a Lepidoniscus minutus a nedves tögyeseket kedveli. Szignifikánsan magas volt a Trachelipus nodulosus és a Porcellium collicola előfordulásának aránya az akácosokban. A szinantrop élőhelyeken várható az Androniscus roseus, Haplothalmus mengii, Cylisticus convexus, Platyarthus hoffmannseggi, Porcellio scaber, Porcellionides pruinosus és Proporcellio vulcanius felbukkanása. Az ártéri- és láperdőhöz az elemzés szerint nem kötődnek karkterfajok.