Entomologica romanica **18**: 5-10, 2013 ISSN 1224-2594 / article no.: ER18201301

Data upon the terrestrial isopod fauna from the western slope of Oas Mountains, Romania

Sára Ferenţi, Éva-Hajnalka Sas-Kovács,
István Sas-Kovács & Severus-Daniel Covaciu-Marcov

Summary: In the western slope of Oas Mountains we identified 16 terrestrial isopod species: *Ligidium germanicum*, *L. hypnorum, Hyloniscus riparius, H. transsilvanicus, Trichoniscus sp., Cylisticus convexus, Protracheoniscus politus, Porcellium collicola, P. conspersum, Trachelipus difficilis, T. arcuatus, T. nodulosus, T. rathkii, Porcellio scaber, Armadillidium vulgare* and *A. versicolor.* The terrestrial isopod assemblages are typical for mountain regions. The species composition proved to be similar with the ones previous identified in the neighboring plain areas, suggesting their common history. The most favorable habitats were wetlands and coppices. Even in natural habitats the terrestrial isopods can use artificial shelters, fact that suggests their opportunistic behavior in the case if the habitat's characteristics are optimal. The disturbed habitats show a relatively rich isopod fauna, they sheltering both generalists and species with narrow ecological valance.

Key words: terrestrial isopods, habitats, connectivity, human impact, forest, wetlands

Introduction

The mountain zone of north-western Romania seems to be one of the most intense studied regions of the country in terms of terrestrial isopods (e.g. Hotea *et al*. 2003, Vilisics 2008, Hotea and Hotea 2008, 2009, 2010, Ferenti *et al*. 2012a, 2013, Ferenti and Covaciu-Marcov 2012). Although, the number of the studies about the region is high, with two exceptions (Vilisics 2008, Ferenti *et al.* 2013) they were realized with pitfall traps, focusing on ecological aspects. The intense research of the region seems to be righteous by the particularities of the terrestrial isopod assemblages, characterized by the presence of some mountain species at low altitudes, but also by the presence of an extremely rare, endemic species for Romania (Ferenti *et al*. 2013). In addition, the region is distinguished by the native terrestrial isopod assemblages linked to humid and afforested zones (Ferenti *et al*. 2013). These assemblages are also present at low altitudes from the vicinity of Oas Mountains, being probably present there as a consequence of the contact, which exists or had exist until recently between the forests of the two regions (Ferenti *et al*. 2013). Although this is plausible, till now, to our knowledge, there were not published any faunistic data about terrestrial isopod assemblages from Oas Mountains, though this kind of data exists both from low areas situated to west (Ferenti *et al.* 2013, Tomescu *et al*. 2008), and from Maramures Depression located east of these (Vilisics 2008). Thus, this study aimed to fill the gap in knowledge about the distribution of terrestrial isopods from the western slope of Oas Mountains, north-western Romania. Also, we intended to verify if mountain species from Tur river natural protected area are indeed present in mountain natural habitats too.

Materials and methods

Faunistic data collection was carried out between the years 2008-2012. The limits of the investigated area are represented east by Huta Pass, south by Tur respectively Somes rivers, north and west by the country border and Tur River natural protected area. There were investigated 26 localities from the western slope of Oas and partially Ignis Mountains, from Satu-Mare and Maramures counties (Table 1). From these localities we collected isopods from different habitats and microhabitats. From most of the localities, we collected more than one sample (a total of 55 samples), depending on the locality's habitat richness. Thus, we investigated 11 habitat types: oak forest, beech forest, wetland, stream, coppices, semi natural wetlands, abandoned construction, road margin, orchard, canals and distilleries. Regarding the terrestrial isopods shelters, we grouped them into

Table. 1. The distribution and the frequency of terrestrial isopod species from Oas Mountains (Lg-L. *germanicum*, Lh-*L. hypnorum*, Hr-*H. riparius*, Ht-*H. transsilvanicus*, T-*Trichoniscus* sp., Cc-*C. convexus*, Ppo-*P. politus*, Pc-*P. collicola*, Pcm-*P. conspersum*, Td-*T. difficilis*, Ta-*T. arcuatus*, Tn-*T. nodulosus*, Trk-*T. rathkii*, Ps-*P. scaber*, Avu-*A. vulgare*, Ave-*A. versicolor*, N- number of species, N loc- number of localities, F-frequency of occurrence, SM-Satu Mare county, MM-Maramures county).

Locality	**Lg**	**Lh**	**Hr**	**Ht**	**Tc**	**Cc**	**Ppo**	**Pc**	**Pcm**	**Td**	**Ta**	**Tn**	**Trk**	**Ps**	**Avu**	**Ave**	**N**
Handalu Ilbei (MM)		×		×			×									×	**4**
Sabisa (MM)			×	×								×				×	**4**
Seini (MM)	×			×													**2**
Viile Apei (MM)													×		×		**2**
Aliceni (SM)				×				×					×				**3**
Babesti (SM)			×										×		×		**3**
Baile Puturoasa (SM)		×		×	×		×			×							**5**
Batarci (SM)	×	×		×	×		×	×									**6**
Bi×ad (SM)			×										×	×			**3**
Camarzana (SM)		×		×							×				×		**4**
Certeze (SM)		×	×	×				×									**4**
Comlausa (SM)								×						×	×		**3**
Gherta Mare (SM)		×															**1**
Huta Certeze (SM)	×		×	×		×	×			×					×		**7**
Huta Pass (SM)	×		×	×	×		×	×		×				×			**8**
Negresti Oas (SM)	×	×		×			×										**4**
Negresti Oas – Luna (SM)	×	×		×		×	×	×	×	×					×		**9**
Orasu Nou Vii (SM)				×				×					×		×		**4**
Tarna Mare (SM)							×								×	×	**3**
Tarsolt (SM)				×									×				**2**
Tur (SM)				×									×		×		**3**
Turt (SM)			×			×		×				×		×	×		**6**
Turt Bai (SM)	×	×	×	×	×	×	×	×	×	×		×	×				**12**
Valea Mariei (SM)		×	×				×	×						×	×		**6**
Valea Seaca (SM)			×	×				×									**3**
Vama (SM)				×						×		×	×				**4**
N loc	**7**	**10**	**10**	**18**	**4**	**4**	**10**	**11**	**2**	**6**	**1**	**4**	**9**	**5**	**11**	**3**	
F (%)	**26.92**	**38.46**	**38.46**	**69.23**	**15.38**	**15.38**	**38.46**	**42.30**	**7.69**	**23.07**	**3.84**	**15.38**	**34.61**	**19.23**	**42.30**	**11.53**	

seven groups: fallen logs, barks, stones, humid soil and vegetation neighbouring wetlands, debris, trash cardboards or clothes.

The collecting method was the direct one, with tweezers. In the case of small sized isopods we used blade of grass for not destroying them. In some cases, especially in forests, we used the litter sieve. The collected isopods were stored in alcohol, and the species were determined in laboratory using the specialty literature (e.g. Radu 1983, 1985).

Results

After investigating 26 localities from Oas Mountains, we identified 16 terrestrial isopod species: *Ligidium germanicum*, *L. hypnorum, Hyloniscus riparius, H. transsilvanicus, Trichoniscus sp., Cylisticus convexus, Protracheoniscus politus, Porcellium collicola, P. conspersum, Trachelipus difficilis, T. arcuatus, T. nodulosus, T. rathkii, Porcellio scaber, Armadillidum vulgare* and *A. versicolor*. We collected 751 terrestrial isopods individuals from 55 samples, so the average number of individuals / sample was 13.47. By their frequency (Table 1), the terrestrial isopod species can be classified into three groups: frequent species, common species and rare species. Thus, *H. transsilvanicus* is the most frequent species in the area, being identified in 18 localities from 26. This species is followed by *L. germanicum, H. riparius, P. politus, P. collicola, A. vulgare*, etc., which were identified in approximately 10-11 localities from the total of 26. The species richness is different by the localities, and it is influenced by the number of microhabitats that could be investigated in each of the localities. Thus this value varies between 1 and 12 (Table 1), the average number of the species / locality being 4.42.

Most of the species were identified in areas neighboring natural and semi natural wetlands or streams, without or with forest (Table 2). In this case it is evident that the most common species were the typical ones for wetlands, like *H. riparius,* Table. 2. Habitats of the isopod species from Oas Mountains (1 – oak forest; 2 – beech forest; 3 – swamp; 4 – stream; 5 – coppices; 6 – semi natural wetlands; 7 – abandoned constructions, 8 – road margin; 9 – orchard; 10 – canals; 11 – distilleries, N – number of the species)

Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Total**
L. germanicum		×		×	×							3
L. hypnorum	×	×		×	×	×						5
H. riparius	×	×	×	×	×	×	×				×	8
H.transsilvanicus		×	×	×	×	×	×			×	×	8
Trichoniscus sp.		×		×	×	×						4
C. convexus		×		×			×				×	4
P. politus	×	×		×	×	×			×			6
P. collicola	×			×	×	×	×			×	×	7
P. conspersum				×	×							2
T. difficilis		×		×	×		×					4
T. arcuatus						×						1
T. nodulosus				×	×					×		3
T. rathkii	×			×	×	×				×		5
P. scaber	×			×			×				×	4
A. vulgare	×		×	×		×	×	×			×	7
A. versicolor			×				×	×				3
N	7	8	4	14	11	9	8	2	1	4	6	

H. transsilvanicus or *P. collicola*. Another common species present in the 11 habitat types was *A. vulgare,* which appears both in natural and human influenced habitats. The lowest species richness was not registered in the strongly affected artificial habitats. Regarding the species preference to the shelters, the species that use the most varied shelters are *H. riparius, H. transsilvanicus* and *A. vulgare*. The highest species richness was registered under the moist soil and litter neighboring streams. Surprisingly, this is followed by the debris, which was located very frequently near wetlands (Table 3).

Discussion

The terrestrial isopod fauna of the studied region presents a similar composition to that identified in the Tur River natural protected area (Ferenti *et al.* 2013), situated in the plain zones neighbouring to the west Oas Mountains. In the Tur protected area

Table. 3. The shelters used by terrestrial isopods from Oas Mountains (1 – fallen logs, 2 – bark, 3 – rocks, 4 – humid soil and vegetation near wetland, 5 – debris, 6 – trash cardboards, 7 – trash clothes, 8 – litter sieve, N – numbes of species under the shelters).

Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**
L. germanicum	×		×	×				×	4
L. hypnorum			×	×					2
H. riparius	×		×	×	×		×		5
H.transsilvanicus	×		×	×	×			×	5
Trichoniscus sp.				×		×	×		3
C. convexus	×			×	×				3
P. politus	×			×				×	3
P. collicola				×	×				2
P. conspersum				×					1
T. difficilis	×	×		×	×				4
T. arcuatus				×					1
T. nodulosus	×			×	×				3
T. rathkii				×	×		×		3
P. scaber			×		×	×			3
A. vulgare			×	×	×		×	×	5
A. versicolor				×	×				2
N	7	1	6	15	10	2	4	4	

were identified mountain species at the plain, like *H. transsilvanicus*, their presence being considered to be a consequence of the mountains neighborhood without an altitudinal transition, as well as the presence of humid and forested habitats in the Tur river protected area (Ferenti *et al*. 2013). Thus, in the zone are present numerous species like *H. transsilvanicus* and *P. conspersum*, which are tied to humid and afforested zones from mountain areas (e.g. Radu 1985, Kontschán 2003, Vilisics *et al*. 2008, Tomescu *et al.* 2012). The resemblance of species composition between the two areas shows clearly the origin of the mountain species in the plain, where in addition to these species are some typical ones for plain swamps (Ferenti *et al*. 2013). Even if the direct collecting method have permitted the collection of some species like *Trichoniscus* sp., overall the terrestrial isopod assemblages from the studied region are similar with those described previously in the zone and neighbouring areas using pitfall traps (e.g. Hotea *et al*. 2003, Hotea and Hotea 2008, 2009, 2010, Ferenti and Covaciu-Marcov 2012, Ferenti *et al*. 2012a). Also, the terrestrial isopod fauna is alike with that previously identified in Maramures Depression (Vilisics 2008).

Our results prove resemblance between the terrestrial isopod fauna of the mountain zone of north-western Romania and the neighbouring plain areas. Probably in the case of terrestrial isopods the contact between Oas Mountains and plain areas permits the existence of this resemblance as well as in the case of other groups (see in: Covaciu-Marcov *et al.* 2008a). Probably, in the present, the forests from Oas Mountains are a refuge for terrestrial isopods, but in the past this role had had firstly the plains from the vicinity, where some species of other groups, considered glacial relicts, survive (Covaciu-Marcov *et al*. 2008b). Sometimes short term environmental changes can influence the composition of the fauna (Purger *et al*. 2007), the attribution of recent biological trends to climate change becoming complicated (Parmesan and Yohe 2003). In the case on north-western Romania the past's climate changes marks the entire area, both on the ecosystems' (see in: Ardelean and Karacsonyi 2005), groups' (e.g. Ferenti *et al*. 2012b) or species level (e.g. Covaciu-Marcov *et al.* 2008a).

We investigated mostly natural habitats, both wetlands and forests, but also semi natural and artificial ones. The maximum number of species was registered in non-opened, humid, natural and semi natural habitats (coppices or semi natural canals with shrubbery and tree vegetation) and some of the artificial ones. Thus, the species richness / locality were quite low, fact also registered in other cases (Hornung *et al*. 2008). There were cases when isopod diversity was not reduced once with habitat disturbance increase (Hassall *et al*. 2006, Hornung *et al*. 2007). Thus, the artificial habitats prove to be benefit for the species richness, fact that does not support in this case the ecological general rule which affirms that species richness indicates the ecosystem's stability (see in: Schwartz *et al*. 2000, Cleland 2012). In the western slope of Oas Mountains artificial habitats often shelter a high number of species, similar to the forests. These artificial habitats either were affected in the past and now are abandoned and invaded partially with vegetation (e.g. abandoned constructions ordinarily surrounded by forests or natural habitats), or they are influenced in the present by human (e.g. distilleries). However, in the orchard the species` number is extremely low, even if it seems it is not more influenced in the present then distilleries for example. Thus, we cannot conclude that human presence itself is the main responsible factor for the terrestrial isopods dispersion shape. Indeed, there were registered significant changes in diversity and species richness along urbanization gradient for terrestrial isopod assemblages (Hornung *et al*. 2007, 2008), these studies being rather general, not emphasizing on different human activities` effects. Different human activities produce different spatial, microclimatic or chemical changes in habitats (see in: Nogues-Bravo *et al*. 2008). Thus, terrestrial isopods are influenced furthermore directly by the negative effect of the microclimatic / microhabitats` changes that are induced by the macro habitat resulted from a certain group of human activities. Summarizing on our case, partially re-naturalized constructions and distilleries with abundant organic matter and humidity, thus artificial habitats, which does not contain potentially harmful chemical or microclimatic conditions for terrestrial isopods, are the same beneficial than natural ones. Distilleries also proved to shelter a high species richness and diversity of isopod species in Tur river natural protected area (Ferenti *et al*. 2013). Instead, orchard, a habitat with potentially large negative chemical influences (insecticides, pesticides, etc.), represent an unfavourable habitat for isopod assemblages. The negative effect of chemicals resulted from different agricultural activities on terrestrial isopods was previously reported (e.g. Staak *et al*. 1998). Also, it is possible that in orchards the scarcity of terrestrial isopod species to be caused by habitat's uniformity and regular disturbance.

Shelter types used by terrestrial isopods are not ordinarily closely related to habitat types. Thus, often shelters with anthropogenic origin are situated in natural habitats. In Oas Mountains the highest number of species shelters in the humid soil and vegetation near wetlands but an important amount of species was found under debris situated mostly in natural habitats. This fact proves an opportunistic refuge behaviour of terrestrial isopods, they being influenced only by the conditions offered by the shelter. The available shelters and microhabitats proved to be important elements for sheltering native terrestrial isopod species, even in urban areas (Magura *et al*. 2008, Vilisics and Hornung 2009). At the same time, it proves the fact that natural habitats are also, at least partly, affected by human.

References

ARDELEAN G. and KARÁCSONYI K. (2005) Flora, vegetaţia, fauna şi ecologia nisipurilor din nord-vestul României. [The flora, vegetation, fauna and ecology of the sands from north-western Romania]. Editura Daya, Satu Mare, 732 pp. (in Romanian)

CLELAND E. (2012) Biodiversity and Ecosystem Stability. *Nature Education Knowledge* 3 (10): 14.

COVACIU-MARCOV S.-D., CICORT-LUCACIU A.-S., FERENTI S. and DAVID A. (2008a) The distribution of lowland *Zootoca vivipara* populations in North-Western Romania. *North-Western Journal of Zoology* 4 (1): 72-78.

COVACIU-MARCOV S-D., SAS I., CICORT-LUCACIU A- Ş., BOGDAN H.V., KOVACS E.-H. and MAGHIAR C. (2008b) The Herpetofauna of the Natural Reservation from the Inferior Course of the Tur River and Its Surrounding Areas. In: SIKE T. and MÁRK NAGY J. (ed.): Biharian Biologist, supplement, Flora şi Fauna Rezervaţiei Naturale “Râul Tur” / The flora and Fauna of the Tur River Natural Reserve.

FERENTI S. and COVACIU-MARCOV S.-D. (2012) Comparison of terrestrial Isopod (Isopoda, Oniscidea) Assemblages from Two Types of Forests from North Western Romania. *Ecologia Balkanica* 4 (2): 61-67.

FERENTI S., SAS-KOVACS E.-H., CUPSA D. and IANC, R. (2012a) Some data on the terrestrial isopod assemblages from Livada Forest, northwestern Romania. *Entomologica Romanica* 17: 13-19.

FERENŢI S., CUPSA D. and COVACIU-MARCOV S.-D. (2012b) Ecological and zoogeographical significance of terrestrial isopods from the Carei Plain Natural Reserve (Romania). *Archives of Biological Sciences, Belgrade* 64 (3): 1029-1036.

FERENŢI S., CUPŞA D., SAS-KOVÁCS E.-H., SAS-KOVÁCS I. and COVACIU-MARCOV S.-D. (2013) The importance of forests and wetlands from the Tur River natural protected area in conservation of native terrestrial isopod fauna. *North-Western Journal of Zoology* 9 (1): 139-144.

HASSALL M., JONES D.T., TAITI S., LATIPI Z., SUTTON S.L. and MOHAMMED M. (2006) Biodiversity and abundance of terrestrial isopods along a gradient of disturbance in Sabah, East Malaysia. *European Journal of Soil Biology* 42: S197-S207.

HORNUNG E., TÓTHMÉRÉSZ B., MAGURA T. and VILISICS F. (2007) Changes of isopod assemblages along an urban-suburban-rural gradient in Hungary. *European Journal of Soil Biology* 43: 158-165.

HORNUNG E., VILISICS F. and SÓLYMOS P. (2008) Low α- and high β-diversity in terrestrial isopod assemblages in the Transdanubian region of Hungary. In: ZIMMER M., CHARFI-CHEIKHROUHA F. and TAITI S. (ed.): Proceedings of the International Symposium of Terrestrial Isopod Biology – ISTIB-07., I. Biodiversity & Systematics.

HOTEA R. and HOTEA M. (2008) Faunistic and ecological study concerning the terrestrial isopods in the riversides of the Baia Mare basin area and the neighboring areas (Maramures, Romania). *Acta Oecologica Carpatica* 1: 63-76.

HOTEA R. and HOTEA M. (2009) Contributions to the knowledge of the terrestrial isopod fauna in Oas Depression and Ignis Mountain mass (Romanian Carpathians). *Acta Oecologica Carpatica* 2: 175-182.

HOTEA R. and HOTEA M. (2010) The faunistic and ecologic characterization of the terrestrial isopod species found in four meadows of the Baia Mare Depression (Maramureş, Romania). *Acta Oecologica Carpathica* 3: 83-96.

HOTEA R., TOMESCU N., MURESAN D. and HOTEA M. (2003) Cercetari faunistice si ecologice asupra izopodelor terestre de pe versantul sudic al Muntilor Gutai. [Faunistic and ecological research on terrestrial isopods of the southern slope of Gutai Mountains]. *Analele Universitatii din Oradea, Fascicula Biologie* 10: 33-37. (in Romanian)

KONTSCHÁN J. (2003) Néhány ritka ászkarák (Crustacea: Isopoda: Onsicidea) újabb előfordulási adatai Magyarországról. [New records of some rare woodlice (Crustacea: Isopoda: Oniscidea) from Hungary]. *Foila Historico Naturalia Musei Matraensis* 27: 43-48. (in Hungarian)

MAGURA T., HORNUNG E. and TÓTHMÉRÉSZ B. (2008) Abundance patterns of terrestrial isopods along an urbanization gradient. *Community Ecology* 9 (1): 115-120.

NOGUES-BRAVO D., ARAUJO M.B., ROMDAL T. and RAHBEK C. (2008) Scale effects and human impact on the elevational species richness gradients. *Nature* 453: 216-219.

PARMESAN C. and YOHE G. (2003) A globally coherent fingerprint of climate change impacts across natural ecosystems. *Nature* 421: 37-42.

PURGER J.J., FARKAS S. and DÁNYI L. (2007) Colonisation of post-mining recultivated area by terrestrial isopods (Isopoda: Oniscidea) and centripedes (Chilopoda) in Hungary. *Applied Ecology and Environmental Research* 5 (1): 87-92.

RADU V.G. (1983) Fauna R. S. R. Crustacea. Ordinul Isopoda, Subordinul Oniscoidea, Oniscoidee inferioare. [Fauna of R. S. R. Crustacea. Order Isopoda, Suborder Oniscoidea, Inferior Oniscoidea] Ed. Academiei R. S. R. Bucharest, Vol. IV, Fasc. 13. (in Romanian)

RADU V. G. (1985) Fauna R. S. R.. Crustacea. Ordinul Isopoda, Subordinul Oniscoidea, Crinochaeta. [Fauna of R. S. R. Crustacea, Order Isopoda, Suborder Oniscoidea, Crinocheta] Ed. Academiei R. S. R. Bucharest, Vol. IV, Fasc. 14. (in Romanian)

SCHWARTZ M.W., BRIGHAM C.A., HOEKSEMA J.D., LYONS K.G., MILLS M.H. and VAN MANTGEM P.G. (2012) Linking biodiversity to ecosystem function: implications for conservation ecology. *Oecologia* 122: 297-305.

STAAK A., FROST M. and KRATZ W. (1998) Ecotoxicological studies on the impact of the herbicide trifluralin on *Porcellio scaber* (Isopoda). *Applied Soil Ecology* 9 (1-3): 405-409.

TOMESCU N., BOGDAN H., PETER V.I., COVACIU-MARCOV S.-D. and SAS I. (2008) Terrestrial isopods from the western and north-western Romania. *Studia Universitatis Babes-Bolyai, Biologia* 53 (2): 3-15.

Tomescu N., Teodor L.A. and Ferenţi S. (2012) Three *Porcellium* species (Isopoda: Oniscidea, Trachelipodidae) in Romanian fauna: the variability of some specific morphological characters. *North-Western Journal of Zoology* 8 (2): 257-267.

Vilisics F. (2008) The terrestrial isopods (Crustacea, Isopoda: Oniscidea) of Maramures (Romania). *Studia Universitatis `Vasile Goldis`, Seria Stiintele Vietii* 18: 177-179.

Vilisics F. and Hornung E. (2009) Urban areas as hot-spots for introduced and shelters for native isopod species. *Urban Ecosystems* 12: 333-345.

Sára Ferenţi
University of Oradea,
Faculty of Sciences,
Department of Biology,
Universităţii str. 1,
Oradea 410087, Romania

Iosif Vulcan National College,
Jean Calvin str. nr. 3,
Oradea, Romania
ferenti_sara@yahoo.com

Éva-Hajnalka Sas-Kovács
Babes-Bolyai University,
Faculty of Biology and Geology,
Department of Biology,
Gheorghe Bilascu (Republicii) str. 44,
Cluj-Napoca 400015, Romania

István Sas-Kovács
University of Oradea,
Faculty of Sciences,
Department of Biology,
Universităţii str. 1,
Oradea 410087, Romania

Severus-D. Covaciu-Marcov
University of Oradea,
Faculty of Sciences,
Department of Biology,
Universităţii str. 1,
Oradea 410087, Romania

Received: 11.12.2013
Accepted: 21.12.2013
Published online: 20.12.2013
Published: 30.01.2014
Online article number: ER18201301