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Comparison of Terrestrial Isopod (Isopoda, Oniscidea) Assemblages from Two Types of Forests from North Western Romania

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Abstract. In 2008 we compared the terrestrial isopod assemblages from two different habitats, a beech forest and a mixed beech and spruce forest, from north western Romania (Huta Certeze locality). The samples were taken from April to September using pitfall traps. We identified a total of 7 species: *Ligidium germanicum, Trichoniscus sp., Hyloniscus transsilvanicus, Protracheoniscus politus, Porcellium collicola*, *Trachelipus difficilis* and *Porcellio scaber*. A greater diversity and species richness were noticed in the beech forest. The poverty of species in the mixed forest was a consequence of the forest type, the anthropogenic impact and the dry environment. High surface activity of individuals was noticed in the summer months. Even if the species compositions of the two compared isopod assemblages were not identical, there weren't statistically significant differences between them.

Keywords: Huta Certeze, Isopoda, Oniscidea, woodlice, beech forest, mixed forest, microhabitat, surface activity.

Introduction

The diversity of terrestrial isopod species is in direct connection with the number of microhabitats, which allow the coexistence of several species (LOPES *et al.*, 2005). Small scale differences of the terrestrial isopod fauna are extremely relevant, their composition depending on the characteristics of the existing microhabitats (VILISICS *et al.*, 2011). In Romania, studies of terrestrial isopods ecology were usually made from a large scale group of habitats, showing how the general characteristics of the area influences the terrestrial isopods (e.g. MURESAN *et al.*, 2003; HOTEA *et al.*, 2003; TOMESCU *et al.*, 2002, 2005, 2008, 2011). In this context we intended to analyse and compare two assemblages of terrestrial isopods from two neighbouring habitats located in Oas Mountains, Huta Certeze (north western Romania). Some studies on terrestrial isopods were carried out in the volcanic mountains from the same region of Romania (HOTEA *et al.*, 2003; HOTEA & HOTEA, 2009; VILISICS, 2008). One of these analyzed the isopod fauna of the Maramures Depression, including Huta Certeze locality, where from only one species was reported (VILISICS, 2008). Our objective was to analyze the

ecology of the terrestrial isopod assemblages from Huta Certeze, based on the populated habitat type and sampling season.

Material and Methods

The samplings were carried out near Huta Certeze locality, in Huta Pass region (Satu Mare County, north western Romania). The investigated habitats are situated in the eastern part of Oas Mountains, one of the volcanic mountains in the Eastern Carpathians (POSEA & BADEA, 1984). The samples were taken using pitfall traps from April to September 2008. Five traps were settled in a row in each habitat, put at the distance of 5 m from each other, collected monthly from april to september. The content of 49 pitfall traps were analyzed. The individuals were identified in the laboratory using the speciality literature (RADU, 1983, 1985) and the currently accepted nomenclature (SCHMALFUSS, 2003).

Samples were taken from two habitat types, located at a distance of approximately 300 m between them. The first habitat (47°57'30,48"N/23°30'22,56"E) was represented by a typical beech forest, situated at an altitude of 579 m a.s.l. This habitat was devoid of herbaceous vegetation, with a thick layer of litter. The second habitat (47°57'26,16"N/23°30'38,63"E) was represented by a mixed spruce and beech forest, located at 584 m a.s.l. This habitat is located near a quarry, being affected by human activities. The forest's substrate presents only a thick carpet of dead leaves.

The results were analyzed comparatively to seasons and habitats by the next parameters: number of species, relative abundance and species frequency in traps. Diversity of species was calculated by the Shannon-Wiever diversity index (SHANNON & WIEVER, 1949). Kruskal-Wallis test was used to estimate the significance of the differences between the sampling periods (ZAR, 1999) and Mann-Whitney test (ZAR, 1999) to compare the habitats.

Results

A total of 751 individuals of the next seven species were identified in the two habitats: *Ligidium germanicum*, *Trichoniscus sp.*, *Hyloniscus transsilvanicus*, *Protracheoniscus politus*, *Trachelipus difficilis*, *Porcellium collicola* and *Porcellio scaber*. The traps captured only two female specimen of *Trichoniscus sp.*, which were insufficient to determine exactly this species. Six species (401 specimen) were identified in the beech forest, and four species (350 specimen) in the mixed forest. Some of them were common for both of the habitats.

The greater abundance of individuals was recorded in the second half of the sampling period in the beech forest (Table 1). The high value of abundance was due to the large number of *P. politus* and *T. difficilis* individuals. *L. germanicum* appeared only in spring. The presence of the other species didn't influence the relative abundance. The highest diversity was observed in May. For this, an important role is that of the species represented by few individuals that only appear in spring. According to the Kruskal-Wallis test, in the beech forests the differences between the species composition in different time periods are not significant (H (5, N=36)=1.008475, p=0.96).

The relative abundance and diversity values in the mixed forest are presented in Table 1. The abundance depended on the parameters of *P. politus* population, the highest represented species. The highest abundance and diversity values occurred in July and August (Table 1). As in the case of the beech forest, the seasonal differences of the species composition in terrestrial isopods were not significant (H(5, N=24)=2.370010, p=0,79).

The species abundance was higher in the beech forest due to *T. difficilis*, while in the mixed forest *P. politus* has the higher abundance. The differences between the diversity of the terrestrial isopod assemblages from the two habitats are really high (Table 2). However the difference between the species composition of the two habitats is not significant (Mann–Whitney test: p=0.66).

The composition and species' ratio within the assemblage of terrestrial isopods from the two forests differs depending on the period of the year. In the beech forest in the first two months the predominant species were *L. germanicum* and *P. politus*.

Table 1. Relative abundance and species diversity of terrestrial isopods depending on the period of the year in the beech forest (L g – *L. germanicum*, H t – *H. transsilvanicus,* Tr – *Trichoniscus* sp., T d – *T. difficilis*, P p – *P. politus*, P c – *P. collicola*, P s – *P. scaber,* H – diversity)

	Beech forest								**Mixed forest**					
	Relative abundance							H	Relative abundance					H
	Total	*L g*	*Tr*	*P p*	*P c*	*T d*	*P s*		Total	*L g*	*H t*	*Tr*	*P p*	
April	5.48	29.17	-	4.90	66.67	0.96	100	1.44	9.42	-	-	-	9.70	0
May	6.98	58.33	-	3.68	33.33	3.38	-	1.14	8.57	100	12.50	-	8.23	0.29
June	18.70	8.33	100	22.7	-	16.91	-	0.86	10	-	12.50	-	10.00	0.13
July	26.43	4.16	-	33.13	-	24.64	-	0.74	28.29	-	50	-	27.94	0.17
August	18.70	-	-	24.54	-	16.91	-	0.69	38.86	-	25	100	39.12	0.12
September	23.69	-	-	11.04	-	37.2	-	0.49	4.85	-	-	-	5.00	0

Table 2. Abundance, frequency and diversity of species in both habitats (L g – *L. germanicum*, Tr – *Trichoniscus* sp., H t – *H. transsilvanicus*, P p – *P. politus*, T d – *T. difficilis*, P c – *P. collicola*, P s – *P. scaber*, H – diversity, A – relative abundance, F - frequency)

Habitat		***L g***	***Tr***	***H t***	***P p***	***P c***	***T d***	***P s***	**H**
Beech forest	A	5.98	0.24	-	40.65	0.74	51.62	0.74	0.96
	F	21.43	3.57	-	85.71	7.14	89.29	3.57	
Mixed forest	A	0.28	0.28	2.28	97.14	-	-	-	0.15
	F	4.76	4.76	23.81	100	-	-	-	

Table 3. Numerical abundance (N) and relative abundance (A%) of species in the terrestrial isopod assemblages in the two forests (Sept. - September)

Habitat			**April**	**May**	**June**	**July**	**August**	**Sept.**
Beech forest	*L. germanicum*	N	7	14	2	1	-	-
		A%	31.82	50	2.667	0.943	-	-
	Trichoniscus sp.	N	-	-	1	-	-	-
		A%	-	-	1.333	-	-	-
	P. politus	N	8	6	37	54	40	18
		A%	36.36	21.43	49.33	50.94	53.33	18.95
	P. collicola	N	2	1	-	-	-	-
		A%	9.091	3.571	-	-	-	-
	T. difficilis	N	2	7	35	51	35	77
		A%	9.091	25	46.67	48.11	46.67	81.05
	P. scaber	N	3	-	-	-	-	-
		A%	13.64	-	-	-	-	-
Mixed forest	*L. germanicum*	N	-	1	-	-	-	-
		A%	-	3.333	-	-	-	-
	H. transsilvanicus	N	-	1	1	4	2	-
		A%	-	3.333	2.857	4.04	1.471	-
	Trichoniscus sp.	N	-	-	-	-	1	-
		A%	-	-	-	-	0.735	-
	P. politus	N	33	28	34	95	133	17
		A%	100	93.33	97.14	95.96	97.79	100

This ratio changes from June, when along with *P. politus*, *T. difficilis* prevail, *L. germanicum* presenting only a small percentage (Table 3). *P. politus* dominated all sample in the mixed forest (Table 3).

Discussion

The composition of isopod assemblages differed in the two forests, despite their relatively small spatial distance. There are species present in both habitats (*P. politus, L. germanicum, Trichoniscus sp.*) and characteristic species for each habitat. Two of these are typical for forest habitats (*T. difficilis* and *P. collicola*) and one is euritopic (*P. scaber*) (RADU, 1985). Deciduous forests are generally more favorable than coniferous forests for terrestrial isopods, the leaves of conifers being inefficient for the isopods' development (SOUSA *et al*., 1998). Previously TOMESCU *et al*. (2002) noticed a lower number of species in mixed forests. This is the case of Huta-Certeze too, where the species richness and diversity were higher in the beech forest than in the other habitat. The mixed forests were more exposed to anthropogenic impact, due to the quarry and also to the dryness. ALMERAO *et al*., (2006) pointed out similarly the negative effect of the anthropogenic impact on invertebrate assemblages, especially terrestrial isopods. Only species with wide ecological valence appear in affected areas (VILISICS *et al*., 2011). A higher richness and a diversity of species have been reported in the natural areas and in the wetlands (HORNUNG *et al*., 2008). This poverty of species in mixed forests doesn't appear to be caused exclusively to one reason (mixed forest with conifers, degree of degradation, dryness), but appears to be a result of their aggregation. Also, the method of collecting with pitfall traps led to the capture of few species with more activity at the surface (ARNDT & MATTERN, 2005; TOMESCU *et al*., 2008; MAGRINI *et al*., 2011). Species with low mobility lack from the traps (MESSINA *et al*., 2011). Also, in other cases the obtained results using pitfall traps were considered to be influenced by the isopods` mobility (IVANOV, 2011).

Species common to the two habitats are represented by a different number of individuals depending on habitat and period. *L. germanicum* prefers wetland forests (RADU, 1983). Thus its presence in the forest from Huta Certeze was expectable, since it was previously reported in the volcanic mountains from north western Romania (RADU, 1983; HOTEA *et al*., 2003; VILISICS, 2008). *L. germanicum*`s high frequency in the beech forest suggests its preference for natural areas. Some authors consider this species as relict, specific to areas with low anthropogenic impact (TUF & TUFOVA, 2008), being common to natural areas from higher altitudes (HORNUNG *et al*., 2009). *P. politus* is the most common isopod species from Huta Certeze, being a forest species (MURESAN *et al*., 2003; HOTEA *et al*., 2003; TOMESCU *et al*., 2008, 2011). Its presence in large number of individuals in both forest types suggests that this species is able to use a variety of habitats, as it was previously reported (TUF & TUFOVA, 2008). *P. politus* is also considered a common species for natural and semi-natural areas (HORNUNG *et al*., 2009; VILISICS & LAPANJE, 2005).

Besides the common species in both habitats, in the mixed forest *H. transsilvanicus* also occurs. The presence of this species exclusively in this dry habitat is unusual, because it is considered to prefer forest wetlands (RADU, 1983). In other beech forests it was recorded along with *P. politus* and *T. wachtleri* (TOMESCU *et al*., 2002) (now synonimized with *T. difficilis*, see Schmalfuss 2003). For smaller species with soft bodies the preferences towards the microhabitat are satisfied by the existence of small places of shelter, regardless of general characteristics of the habitat (VILISICS *et al*., 2005, 2011). Thus, the small number of captured individuals indicates the scarcity of favorable microhabitats, althought the species recently was identified even in the plains from north-western Romania (FERENTI *et al*., 2012). *H. transsilvanicus* was identified in several

periods that indicates that this species is constantly present in the region.

The exclusive presence and high abundance of *T. difficilis* in the beech forest suggests that the species is linked to natural forests. In the surrounding areas in Maramures, this is the most common terrestrial isopod species, being found even in coniferous forests (VILISICS, 2008). The other two species, *P. collicola* and *P. scaber*, also appear in the beech forest. The presence of *P. scaber* in the beech forest can be explained by the adjacent motel and other buildings which are favorable habitats to a synanthropic species (TOMESCU *et al*., 2005). Perhaps it may entered into the forest from this habitat, being easily accommodated due to its euritopic nature (TUF & TUFOVÁ, 2008). Its continuous migration between wet and dry habitats has been previously observed (DEN BOER, 1962). *P. scaber*`s absence from the mixed forest, is probably a consequence of the fact that this forest is surrounded by relatively natural beech forests. So, the species is present in the areas near the buildings, but it can not spread inside the forest. The human impact from the mixed forest only reduced the abundance of the native species, linked to natural areas, because synantropic species can not pass the beech forest.

The high relative abundance of representative species occured in summer, fact recorded in other areas, too (SFENTHOURAKIS, 1992; VADKERTI & FARKAS, 2002). This can be a consequence of the increased surface activity of the gravid females, which are looking for shelters for their descendants in this period (DANGERFIELD & HASSALL, 1994).

The diversity of terrestrial isopod assemblages increases up to 500-600 m, after which it decreases (LOPES *et al*., 2005). The values were high in the beech forest of Huta Certeze compared to other areas from Romania located in similar or higher altitudes (TOMESCU *et al*., 2002). The differences of diversity values between the two habitats are a consequence of the uniformity of the terrestrial isopods assemblage from the mixed forest. Furthermore, *P. politus* prevailing in both habitats determined the differences between them to be not significant.

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