Opusc. Zool. Budapest, XXV, 1992

On the soil-inhabiting macrofauna of Nagy-Szénás, with special reference to the isopods, diplopods and chilopods

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Abstract. A total of 23 species from the soil-living macrofauna of Nagy-Szénás have been indentified, 5 isopods (Oniscidea), 10 diplopods and 8 chilopods. Apart from the extremely abundant *Porcellium collicola*, isopods (Oniscidea) were present in small numbers in the various plant associations. From the other two groups, almost all species were present in all plant associations, although in varying, usually in low numbers. From among the diplopods, *Julus scandinavius* and *Leptoiulus saltuvagus* may be considered as relic species, and with reservations, the isopod *Porcellio spinicornis* may also be mentioned.

Objectives of the study

Nagy-Szénás was faunistically poorly known when the study reported here was commenced. This report is primarily concerned with the description of the soil-living macrofauna. The aims of the study were to collect, identify and compare the animal species living in three different plant associations. Besides, as a result of the complex processes known as dolomite phenomenon, due to the relief conditions relic animal species may have survived in the covert habitats of so-called tertiary and glacial relic plant species and plant associations.

Geography

The Szénás hill group of lie northeast of Budapest, surrounded by the villages of Nagykovácsi, Solymár, Pilisszentiván, Piliscsaba, Tinnye and Perbál. The underlying rock is upper triassic dolomite, which has a marked effect on the climate, the hydrology, edaphic and vegetation conditions of the area.

Climate

Similarly to all hills, due to the inclination of the slopes the imminent angle of insolation is great. The total number of sunny hours is high, 2000 hrs annually. The annual precipitation is between 600 and 700 mm.

The characteristic feature of the climate of Nagy-Szénás is the diversity of minor areas with different meso- and microclimate as a result of the variable relief. The average elevation of the area is 300—500 m a.s.l., yet its mesoclimate resembles to that of the higher mountains. The circadian variation in the temperature is extremely high, the insolation is strong, and the daytime heat is great. On the top heat loss at night is also great. The wind is usually strong and often changes its direction.

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The vegetation of Nagy-Szénás is very rich in species, mainly due to the characteristics of the underlying dolomite. Its properties are peculiar, both in physical and chemical aspects. It is not very soluble instead, physical weathering is important. Many million years of weathering has resulted in variable forms, which is a general characteristic for dolomite hills. Hence two slopes facing the same direction in the same area may differ considerably. As a result of the varied relief, diverse microclimate and a rich vegetation has developed.

Due to the fine mosaic of different habitats relicts have also managed to survive.

Plant associations

a) Closed dolomite rocky grassland (Festuco pallenti-Brometum pannonici)

The steep northern slopes of the dolomite hill have quite a uniform cool microclimate. The accumulation of humus is comparatively strong under the almost completely closed grass and moss layer. *Thalictrum pseudominus*, a tertiary-interglacial relic species lives in this habitat. The commonest grass species are *Bromus erectus*, *Carex humilis* and *Festuca pallens*.

b) Mixed karstic woodland (Fago-Ornetum)

This is the characteristic forest association of the steep northern slopes. It developes from the cool dolomite grasslands rich in Carpathian species, composed mainly of *Festuca pallens* and *Bromus erectus*. The sparse foliage layer has a cover of 50—70%. The trees often begin to branch out 1—2 m above the ground. The presence of two characteristic species of mixed karstic woodlands, the existence of the psychrophil beech and the thermophil *Fraxinus ornus* indicates the postglacial relic character of the association. Besides the common species the shrubs of the higher rocks of the southern Alps also appear, in the shrub layer, especially in the rockier parts. In the cool grass layer relicts from the end of the last glaciation, have been survived, e. g. *Carex alba*, *Festuca amethystina* which occur only in the Carpathians today.

c) Hornbeam-oakwood (Querco-Carpinetum)

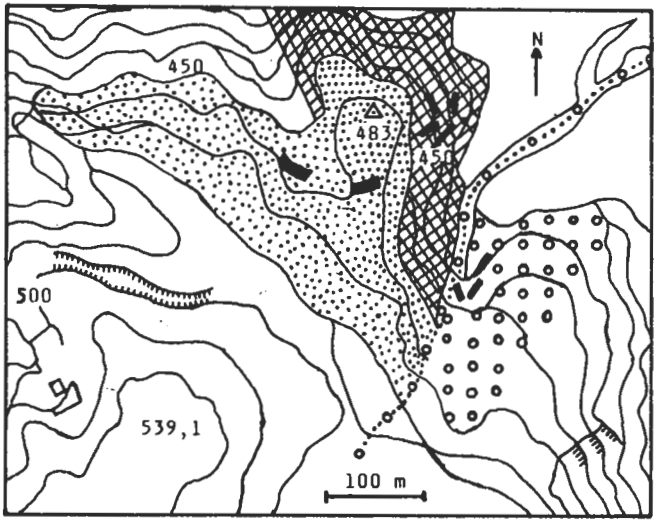
This is a closed canopy woodland, which is often mixed with single individuals of beech, hornbeam, or other tree species. The shrub layer is moderately developed.

The studied animal groups

Isopoda (Oniscidea): Crustaceans adapted to terrestrial habitats. Favour damp, humid habitats. Live in soil, beneath rocks, in cellars, caves, beneath tree bark and litter which at the same time serve both as food and as hiding places for them. They play an important part in litter decomposition.

Diplopoda: Similarly to terrestrial isopods, these animals also feed on decaying plants, fallen leaves. They also live on the ground in litter, beneath tree bark and stones.

Chilopoda: Nocturnal, fast-moving predators, which, similarly to the previous two groups, live in litter, beneath tree bark and stones.



Fault-line trench

Outcrop of dolomite rock

Dolomite rock ledge

Festuco pallenti - Brometum pannonici

Fago-Ornetum

Querco-Carpinetum

traps

elevation contour lines in 10 m

Fig. 1. Map of the studied plant associations

Methods

So-called Barber traps were used. These are smooth-walled plastic cups of 200 ml, filled with approximately 70 ml ethylene-glycol, dug into the soil with their mouths at ground level. An aluminium sheet was placed above the trap so that unwanted debris would not get into the trap but animals could fall into it. The first traps were set in October, 1982, then checked in November and left out during the winter. Subsequently, traps were checked in March, in the summer and in October of 1983, and in January of 1984. As it can be seen in the analysis, some of the deposited traps were destroyed, so the material of several areas had to be pooled.

Table 1. Species, individual numbers and dominance values in various plant associations trapped from 1982 to 1984).
(I. Festuco pallenti-Brometum pannonici; II. Fago-Ornetum; III. contact zone of site I and II; IV. Querco-Carpinetum (with Melica uniflora), V. Querco-Carpinetum, subnudum. Ex=number of specimens trapped from 1982 to 1984. D=dominance value in percentage)

	I		II		III		IV		V	
	Ex	D	Ex	D	Ex	D	Ex	D	Ex	D
ISOPODA										
Porcellium collicola Verh.	271	98,55	1875	98,06	380	95,23	66	100	198	97,05
Orthometopon planum B. I.	4	1,45	35	1,83	11	2,75	—	—	5	2,45
Protracheoniscus amoenus C. L. Koch	—	—	1	0,052	—	—	—	—	—	—
Trachelipus nodulosus C. L. Koch	—	—	1	0,052	—	—	—	—	1	0,49
DIPLOPODA										
Megaphyllum projectum Verh.	6	11,32	134	40,24	42	42	4	10,25	18	36
Megaphyllum unilineatum C. L. Koch	1	1,88	—	—	—	—	—	—	8	16
Polydesmus complanatus L.	1	1,88	9	2,70	7	7	4	10,25	2	4
Mastigona bosniense Verh.	43	81,13	31	9,30	9	9	10	25,64	15	30
Julus scandinavius Latz.	2	3,77	87	26,12	21	21	7	17,94	3	6
Leptoiulus saltuvagus Verh.	—	—	48	14,41	2	2	9	23,07	1	2
Ophiulus pilosus Newp.	—	—	6	1,80	2	2	—	—	—	—
Cylindroiulus boleti C. L. Koch	—	—	12	3,60	6	6	3	7,69	2	4
Glomeris hexasticha Brandt.	—	—	6	1,80	—	—	—	—	—	—
Strongylosoma stigmatosum Eich.	—	—	—	—	11	11	2	5,12	1	2
CHILOPODA										
Lithobius mutabilis C. L. Koch	19	45,23	3	7,69	1	5,88	—	—	1	4
Lithobius muticus C. L. Koch	17	40,47	14	35,89	5	29,41	5	55,55	5	20
Lithobius forficatus L.	2	4,76	19	48,71	9	52,94	2	22,22	17	68
Cryptops hortensis Leach	2	4,76	—	—	—	—	—	—	—	—
Monotarsobius austriacus Verh.	2	4,76	—	—	—	—	—	—	—	—
Lithobius erythrocephalus C. L. Koch	—	—	1	2,56	2	11,76	1	11,11	—	—
Geophilus proximus Verh.	—	—	1	2,56	—	—	1	11,11	2	8
Scolioplanes acuminatus Bröl.	—	—	1	2,56	—	—	—	—	—	—

Trapping in the plant associations as follows: a) Festuco pallenti-Brometum pannonici: 1., area 1/a: The first 5 traps were set in a slope of ca. 5°, the second 5 in a slope of 20°. — b) Fago-Ornetum: areas 2., 3., 4. Five traps in each, the fifth area was in the contact zone of two plant associations, also with 5 traps. — c) Querco-Carpinetum: areas 6., 7., 7/a., 8., Xy 5 traps in each.

Results

Isopoda (Oniscidea), Diplopoda, Chilopoda: A total of 3555 individuals of the three groups have been collected during trapping, 2848 of them were isopods, 575 diplopods and 132 chilopods.

Table 1. contains the species list, the number of individuals (Ex), and the dominance values (D%) over the study period in all plant associations.

Isopoda (Oniscidea):

The dominant species of this group in all plant associations was *Porcellium collicola*, a Central-European species. Generally it does not favour rocky grasslands, though it occured in the closed grassland of the study area. The total number of Oniscidea individuals was 2848, on of which there were 2787 *Porcellium collicola*. This number greatly exceeds the combined numbers of diplopods and chilopods. In the summer period 50—75% of the females were carrying eggs, and such animals could also be found in "overwintered" material (naturally in small numbers). Mature males may differ considerably in size. This may be due to individual variation or because isopods continuously throughout their life. It would be worthwhile to study this phenomenon. Other species besides *Porcellium collicola* occurred in very low numbers and the number of species was also low.

The second most abundant species was *Orthometopon planum* with 55 specimens. It was found in all plant associations with the exception of disturbed Querco-Carpinetum with *Melica uniflora*. It is a South-European species which penetrates into the central part of the Danube valley. It occurs sporadically in rocky grasslands but does not favour open habitats. Most individuals (35) were found in the Fago-Ornetum plant association.

Two *Trachelipus nodulosus* specimens were also canght one of which was in the Fago-Ornetum, the other in the Querco-Carpinetum subnudum association. It is an interesting record because this species favours open, sunny places. Since only two specimens were trapped, the species was of sporadic occurrence.

A further species is *Protracheoniscus amoenus*. It occurs in Southeast and Central Europe, in the Eastern and Southeastern Alps, on the Istria peninsula, in Croatia, Bosnia-Hercegovina and Hungary. It prefers woodlands where it lives in the litter. A single specimen was captured in the Fago-Ornetum association.

A couple of *Porcellio spinicornis*, a male and a female have also been found. It is a species living in the cooler parts of Northern and Central Europe and it is able to tolerate extreme temperatures and low humidity. Its occurrence in the study area can not be taken unequivocally since it might have been spread (anthropogenically) by man, since it was found about 500 m from a demolished tourist lodge, in the Fago-Ornetum association.

Table 2. shows the results of the analysis of the occurrence of isopods in the various plant associations (Jaccard-index).

There were two species of isopods found in area I, 4 in area II, 2 in area III, 1 in area IV, and 3 in area V (see Table 1. for the areas and the plant associations).

Table 2. Jaccard-index of similarity between the study sites for the various animal groups

Oniscidea

1	2	3	4	5	
100	50,0	100	50,0	66,6	1
	100	50,0	25,0	75,0	2
		100	50,0	66,6	3
			100	33,3	4
				100	5

Diplopoda

1	2	3	4	5	
100	44,4	44,4	50,0	62,5	1
	100	77,7	66,6	60,0	2
		100	87,5	77,7	3
			100	87,5	4
				100	5

Chilopoda

1	2	3	4	5	
100	37,5	50,0	28,5	50,0	1
	100	66,6	66,6	66,6	2
		100	60,0	60,0	3
			100	60,0	4
				100	5

The most similar (100%) areas were I and III, both having two species, *Porcellium collicola* and *Orthometopon planum*. Comparing area I with area II and area IV, 50% of the species were found in both pairs, whereas areas I and V had 66.6% of their species common. The pairs of areas II and III, and III and IV had 50% similarities. Areas II and IV had 25% of the species in common, while this figure was 66.6% for area III and area V, 33.3% for area IV and area V.

The lowest number, of species shared by plant associations were found in the Fago-Ornetum and disturbed Querco-Carpinetum with *Melica uniflora* (25%), and between the two Querco-Carpinetum sites (area IV and area V).

Diplopoda

The dominant species of this group was *Mastigona bosniense* in areas I and IV, *Megaphyllum projectum* in areas II, III and V. Most specimens were *Megaphyllum projectum*, followed by the other above-mentioned species. Both species were common elements of the fauna, occurring in all plant associations, naturally in variable proportions. *Megaphyllum projectum* prefers shady, cool, damp closed sites, whereas *Mastigona bosniense* shows preference for sunny, warm, dry, open habitats.

The two diplopod species proof of the relic fauna of Nagy-Szénás and substantiated the results of botanical researches.

Julus scandinavius is a western species, a characteristic element of the lowland of Central Europe surrounding the Alps. It occurs from Central France to Hungary, in Scotland and Southern Sweden in the north. It prefers cooler, camp climate. It was found in all plant association on the Nagy-Szénás.

Leptoiulus saltuvagus is an alpine species which occurs in the Eastern Alps, in the northern limestone Alps, from Bregenzwald through Hungary to Bosnia. In Hungary it had previously been known only from the Kőszeg Hills. On Nagy-Szénás it was found in all sites except area I.

Table 3. Dominance values (D%) of the relic diplopod species in the studied plant associations (e = Ex = number of specimens)

	Julus scandinavius		Leptoiulus saltuvagus	
I.	2 e	3,77%	—	—
II.	87 e	26,12%	48 e	14,41%
III.	21 e	21,00%	2 e	2,00%
IV.	7 e	17,94%	9 e	23,07%
V.	3 e	6,00%	1 e	2,00%

Julus scandinavius was found in the largest number in Fago-Ornetum, where this species predominated *Leptoiulus saltuvagus*. Table 3. contains the numbers and dominance values of the two species in the various plant associations.

A species occurring in all plant associations was *Polydesmus complanatus*, which is common all over Europe. It prefers mainly damp deciduous forest. The largest number was found in Fago-Ornetum and in the contact zone (III).

Meghaphyllum unilineatum occurred in trapping sites I and V. This species it is a central, southeast-European typical steppe inhabitant, it prefers warm, dry sites.

Cylindroiulus boleti occurred in all sites except no. I. It is a south, southeast-European species which on the Nagy-Szénás occurred in the largest number in the Fago-Ornetum (!).

Ophiulus pilosus was trapped in the Fago-Ornetum and the contact zone (III) association, with more specimens in the former one.

Glomeris hexasticha was found in the Fago-Ornetum.

Strongylosoma stigmatosum was found in three sites, in the contact zone, and in two Querco-Carpinetum sites.

The most similar associations were III and IV, and IV and V which shared 87.5% of the species. Sites III and V had a 77.7% similarity, just as the pair of area II and area III. The pair of area II and area IV had 66.6%, site II and site V 60%, site I and site V 62.5%, site I and site IV 50%, shereas the value 44.4% was found for both with the pairs of site I and site II, and site I and site III. The number of species was 5 in association I, 8 in sites II, III and V, and 7 in area IV.

Chilopoda

There were few chilopods in comparison with the number of individuals of the previous groups, which can be explained by the predatory habits of these species.

Lithobius forficatus was predominant in sites II, III and V, but found in all associations.

In area I *Lithobius mutabilis*, in area IV *Lithobius muticus* were the commonest, only 1—2 individuals were found from the other species. As regards to species similarity, site II had 66.6% with wites III, IV and V. It was 60% between site V, III and IV, and IV and V. Sites I and III, I and V had 50% similarity, the pair of site I and site II had 37.5%, site I and site IV 28.5%. The number of species was 5 in site I, 6 in site II, and 4 in site III, IV and V.

Summary

The primary aim of the study was to compile a fauna list, with the anticipation of recording relic animal species. It was also aimed to record what similarities and differences would be observed in the contact zone of the Festuco pallenti-Brometum

pannonici and the Frago-Ornetum plant associations, and in what way the latter relic association differed or was similar to the other associations. The species list can be found in Table 1. The relic Diplopoda species were *Julus scandinavius* and *Leptoiulus saltuvagus*, Oniscidea while it was presumably *Porcellio spinicornis* from among. The relic species occurred in greater number in the relic Fago-Ornetum plant association (Table 3), where the single specimen of the relic (?) isopod species was also trapped.

Studying the contact zone, it was interesting to find that the similarity in the isopod species composition was 100% with site I, and 50% with site II. For diplopods the contact zone had 44.4% similarity, with site I, and 77.7% with site II, with chilopods these values were 50% and 66.6%. For the latter two groups the species composition was more similar to that of the Fago-Ornetum association. It was interesting to find that for diplopods one of the greatest species similarity (87.5%) was found between sites III and IV.

The Fago-Ornetum association is remarkable in several respects. It is a suitable habitat for relic species, where they were found in greatest number. Most isopods (Oniscidea) and chilopods, and the most diverse diplopod fauna was found in this association probably due to the fact that this association is situated between one of the dryest and warmest karstic woodlands and the completely different beech wood with cool, wet microclimate. The species diversity was also enhanced by the fact that the Fago-Ornetum association was the result of natural succession from the dolomite rocky grasslands of the northern slopes.

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