VERSITA

Biologia, Bratislava, **62**/2: 222—224, 2007
Section Zoology
DOI: 10.2478/s11756-007-0034-3
Short Communication

Soil rotifers (Rotifera) of the Kokořínsko Protected Landscape Area

Miloslav Devetter

Institute of Soil Biology, Academy of Sciences of the Czech Republic, Na sádkách 7, CZ-37005 České Budějovice, Czech Republic; e-mail: devetter@upb.cas.cz

Abstract: Soil rotifers of the Kokořínsko Protected Landscape Area (Central and Northern Bohemia, Czech Republic) were investigated in August, 2004. This is the first investigation of the soil rotifers in the area. Altogether 25 rotifer taxa were found at five sites. *Mniobia symbiotica*, *M. variabilis*, *Macrotrachela habita*, *M. oblita*, *Habrotrocha flaviformis*, *H. bidens* and *Ceratotrocha cornigera* were the most abundant species. These are the first findings of *Mniobia variabilis* and *Macrotrachela oblita* in the Czech Republic. Total rotifer abundances varied from 67 to 647 $\times$ 10^3 ind. m^{-2}.

Key words: Bdelloidea; soil rotifers; Kokořínsko; Czech Republic

Introduction

There are more than 350 species of bdelloid Rotifers in the class Bdelloidea. These are very common rotifers not only in aquatic, but also terrestrial habitats (Donner 1965; Ricci & Balsamo 2000; Fontaneto & Melone 2003). Soil rotifers, although very rarely studied because of significant taxonomical and handling problems, are essentially present in practically all types of soils (Donner 1951, 1972; Schulte 1954; Sohlenius 1979, 1982; Steiner 1994; Varga 1959, 1961). These rotifers are hydrobionts of semiaquatic living mode and are able to undergo anhydrobiosis to withstand drought (Ricci 2001). The role and importance of rotifers in soil communities have not been entirely appreciated yet, but they probably impact soil bacterial communities through their filtration activity (Pourriot 1979; Donner 1965).

Terrestrial rotifers have not been studied for a long time in the Czech Republic nor in the rest of the world. The aim of this study was to investigate terrestrial rotifer communities in different habitats in the Kokořínsko Protected Landscape Area, which offers a lot of very different habitats within a small territory.

Methods

Kokořínsko Protected Landscape Area is located in north-central Bohemia, Czech Republic. The region is characterized by a moderately warm climate with long-term average air temperatures of 7.7–8.1 °C and mean precipitation between 450–550 mm per year. The subsoil of the area is composed mainly of sandstone while there are areas of volcanic rocks. Five sites with different subsoil and vegetation characteristics were investigated for soil rotifer communities.

Sampling sites:

P1: Cinibulkova stezka – Vyhlídky (50°20′16″ N, 14°37′32″ E), forested ravine edge, vegetated by *Genisto germanicae–Quercion* with *Pinus sylvestris* and *Betula pendula*. Dry sandy soil with very thin humus layer.

P2: Černá díra u Jestřebic (50°27′36″ N, 14°34′37″ E), bottom part of forested sandstone ravine, vegetated by *Melampyro nemorosi-Carpinetum* with *Fagus sylvatica* and *Picea abies*. Moderately moistured sandy soil with regular layer of needle and leaf litter.

P3: Mrzínov (50°26′05″ N, 14°32′47″ E), relict steppe with chernozem soil type on loess subsoil, vegetated by *Bromion erecti/Festucion valesiacae* association. Protected area.

P4: Vlhošť – sedlo (50°35′47″ N, 14°27′25″ E), rock outcrop, covered by sand with a low proportion of organic matter. The area is vegetated by *Cladonio rangiferinae – Pinetum sylvestris* with *Calluna vulgaris*.

P5: Ronov (50°37′09″ N, 14°24′53″ E), a hillside forest on phonolite subsoil composed by *Tilio-Acerion* association with *Quercus petraea* and *Carpinus betulus*. Dry hillside soil bellow the summit of the hill.

Quantitative soil samples were taken with a prismatic soil probe dug in a 5 or 10 cm^2 area down to a depth of 10 cm. Therefore the upper soil layers were primarily sampled. Seven replicate samples were taken at each site on either 26 or 27 August 2004, during a dry weather period. Modification of Baermann's funnel method (Baermann 1917) was used for extraction of soil rotifers from thoroughly mixed 14–40 g soil samples (Overgaard-Nielsen 1949) using distilled water. Living specimens were identified using the diagnostic keys of Bartoš (1959), Donner (1965) and Ricci & Melone (2000). The taxonomic status of dead or not active animals was computed proportionally based on active animals data.

Springer

Table 1. Total abundance and Shannon diversity index (H') of soil rotifer communities on five sites in the Kokořínsko Protected Landscape Area. The last column shows the proportion of specimens identified to species level.

Site	Total abundance (ind. × 10^3 m^{-2}) ± SD	Number of species	H'	% identified
P1	318 ± 49	7	1.66	40.0
P2	67 ± 21	7	1.24	33.8
P3	399 ± 141	9	1.42	48.8
P4	647 ± 136	10	1.75	30.6
P5	293 ± 100	11	1.75	24.9

Table 2. Check list of soil rotifers and their abundances (ind. × 10^3 m^{-2}) found on five sites in the Kokořínsko Protected Landscape Area.

Species/Site	P1	P2	P3	P4	P5	Distribution	Typical of	References
Monogononta								
Encentrum mustela (Milne, 1885)		2.4				cosmopolitan	soils	Varga (1959, 1960)
Encentrum cf. *martes* Wulfert, 1939			1.2			Europe	bottoms and periphytic in waters	Bartoš (1959)
Encentrum sp.	1.1				0.8			
Bdelloidea								
Adineta barbata Janson, 1893	17.9			1.8		cosmopolitan	wet mosses and *Sphagnum*	Bartoš (1959), Donner (1965)
Adineta steineri Bartoš, 1951			9.2			Germany, Switzerland, Italy, Australia		Donner (1965, 1970), Fontaneto & Melone (2003), Ricci et al. (2003)
Adineta vaga (Davis, 1873)		0.5	4.6	7.7	3.8	cosmopolitan		Donner (1965)
Ceratotrocha cornigera (Bryce, 1893)				30.7		cosmopolitan*	soils and moses	Bartoš (1959), Donner (1965), Ricci et al. (2003)
Habrotrocha bidens (Gosse, 1851)					29.9	cosmopolitan	mosses, litter and meadow soils	Bartoš (1959), Donner (1965), Varga (1962)
Habrotrocha flaviformis de Koning, 1947			110.6			Europe, Brazil, New Zealand	soils	Donner (1965, 1972, 1980), Fontaneto & Melone (2003)
Habrotrocha rosa Donner, 1949		1.9				Europe, New Zealand, Jamaica, Canada		Fontaneto & Melone (2003), Varga (1961), Koste et al. (1991)
Habrotrocha sp.	19.1		2.3	60.8	2.3			
Macrotrachela habita (Bryce, 1894)	32.0	1.4				cosmopolitan	soils, needle and leaf litter, dry mosses	Donner (1965), Bartoš (1959)
Macrotrachela libera Donner, 1949			27.6			Germany, Austria, Czech and Slovak republics	soils and litter	Bartoš (1959), Donner (1965)
Macrotrachela multispinosa Thompson, 1892		0.9		0.6		cosmopolitan		Donner (1965)
Macrotrachela oblita Donner, 1949				31.9	19.2	Austria**	dry soil	Donner (1965)
Macrotrachela papillosa Thompson, 1892				0.6	2.3	cosmopolitan	soils and litter, aerophytic mosses	Donner (1965), Ricci et al. (2003), Bartoš (1959)
Macrotrachela plicata (Bryce, 1894)	6.7		8.1			cosmopolitan	mosses, soils and litter	Donner (1965)
Macrotrachela vesicularis (Murray, 1906)					1.5	Europe, North America, Argentina		Donner (1965)
Macrotrachela sp.					2.3			
Mniobia russeola (Zelinka, 1891)		3.3				cosmopolitan	soils and mosses	Donner (1965)
Mniobia symbiotica (Zelinka, 1886)	40.9					cosmopolitan	aerophytic and submerged mosses	Bartoš (1959), Donner (1965)
Mniobia tentans Donner, 1949			5.8			Czech Republic, Austria, Brazil**	soils	Donner (1965, 1980)
Mniobia variabilis Donner, 1949				30.7	6.1	Austria, Italy	moorland soil	Donner (1965), Fontaneto & Melone (2003)
Mniobia sp.	9.5	12.3	25.3	33.0	2.3			
Rotaria sordida (Western, 1893)				0.6	2.3	cosmopolitan		Donner (1965)
Sum of abundance of identified animals	227	48	169	336	95			

Notes: * In a thin humus layer on sandy soil; the species is easy to identify according to its typical shape during whirling behaviour; rarely found species. ** This is the first record of the species since Donner (1965).

Results and discussion

Three species of monogonont and 22 species of bdelloid rotifers were found. From 7 to 11 rotifer species were found per site. The total abundance of the rotifer community ranged from 67 to 647 thousands of ind. m^{-2} (Table 1), with 24.9–48.8% of animals identified to species level. The Shannon diversity index was highest in communities of sites P4 and P5 (1.75 both); these sites had also the highest number of species (10 and 11, respectively). The values of Shannon diversity index are tentative, because they can be affected by relatively high proportion of unidentified specimens. Samples from forested ravines had the lowest species numbers. As expected, filter feeder species (*Habrotrocha*, *Ceratotrocha*, *Macrotrachela* and *Mniobia*) were much more common than scrapers (*Encentrum* and *Adineta*). Tables 1 and 2 show the relatively low proportion of identified animals due to difficulty in identification. Although all specimens of *Encentrum*, *Adineta*, *Macrotrachela multispinosa* or *Rotaria sordida* extracted from the soil samples were identified, only a smaller part of the remaining species could be identified well. From 24 to 49% of the specimens was identified to the species or genus level.

The presence and abundance of each species are shown in Table 2. The samples were dominated mainly by *Mniobia symbiotica*, *M. variabilis*, *Macrotrachela habita*, *M. oblita*, *Habrotrocha flaviformis*, *H. bidens* and *Ceratotrocha cornigera*. Although Varga (1959, 1960, 1961, 1962) reported usually higher numbers of species and abundances in his samples, the data from this study generally agree with his findings. Also the species numbers and abundances found in this study are within the same range as in Donner (1951, 1970, 1972).

Acknowledgements

The project was supported by research grant AV0Z No. 60660521, grant GAČR No. 206/06/P405 and administration of the Kokořínsko Protected Landscape Area. I thank K. Edwards for revision of the English text.

References

Baermann G. 1917. Eine einfache Methode zur Auffindung von *Ankylostomum* (Nematoden) Larven in Erdproben. Geneesk. Tijdschr. Ned. Indie **57:** 131–137.

Bartoš E. 1959. Vířníci – Rotatoria, Fauna ČSR, Vol. 15, Prague, 969 pp.

Donner J. 1951. Erste Übersicht über die Rotatorienfauna einiger Humusboden. Öster. Zool. Z. **3:** 175–240.

Donner J. 1965. Ordnung Bdelloidea (Rotatoria). Akademie Verlag, Berlin, 297 pp.

Donner J. 1970. Rotatorien aus einigen Boden und Moosen Spaniens und seiner Inseln. Rev. Ecol. Biol. Sol **7:** 501–532.

Donner J. 1972. Rotatorien aus einigen Boden des östlichen Österreich. Rev. Ecol. Biol. Sol **9:** 671–682.

Donner J. 1980. Einige neue Forschungen über bdelloide Rotatorien, besonders in Boden. Rev. Ecol. Biol. Sol **17:** 125–143.

Fontaneto D. & Melone G. 2003. On some rotifers new for the Italian fauna. Ital. J. Zool. **70:** 253–259.

Koste W., Janetzki W. & Vareschi E. 1991. Über die Rotatorienfauna in Bromelien-Phytotelmen in Jamaika. Osnabr. Naturwiss. Mitt. **17:** 143–170.

Overgaard-Nielsen, C. 1949. An apparatus for quantitative extraction of nematodes and rotifers from soil and moss. Nat. Jutland **1:** 271–277.

Pourriot R. 1979. Rotiferes du sol. Rev. Ecol. Biol. Sol **16:** 279–312.

Ricci C. 2001. Dormancy patterns in rotifers. Hydrobiologia **446:** 1–11.

Ricci C. & Balsamo M. 2000. The biology and ecology of lotic rotifers and gastrotrichs. Freshwater Biol. **44:** 15–28.

Ricci C. & Melone G. 2000. Key to the identification of the genera of bdelloid rotifers. Hydrobiologia **418:** 73–80.

Ricci C., Shiel R., Fontaneto D. & Melone G. 2003. Bdelloid rotifers recorded from Australia with description of *Philodinavus aussiensis* n. sp. Zool. Anz. **242:** 241–248.

Schulte H. 1954. Beiträge zur Ökologie und Systematik der Bodenrotatorien. Zool. Jb. **82:** 497–652.

Sohlenius B. 1979. A carbon budget for nematodes, rotifers and tardigrades in a Swedish coniferous forest soil. Holarctic Ecology **2:** 30–40.

Sohlenius B. 1982. Short-term influence of clear-cutting on abundance of soil-microfauna (Nematoda, Rotatoria and Tardigrada) in a Swedish pine forest soil. J. Appl. Ecol. **19:** 349–359.

Steiner W. A. 1994. The influence of air pollution on moss-dwelling animals: 4. Seasonal and long-term fluctuations of rotifer, nematode and tardigrade populations. Rev. Suisse Zool. **101:** 1017–1031.

Varga L. 1959. Untersuchungen über die Mikrofauna der Waldstreu einiger Waldtypen im Bükkgebirge (Ungarn). Acta Zool. Hung. **4:** 443–478.

Varga L. 1960. Über die Mikrofauna der Waldstreu einiger auf Szikboden angelegter Waldtypen. Acta Zool. Hung. **6:** 211–225.

Varga L. 1961. Beiträge zur Kenntnis der streubewohnenden Mikrofauna des Aszofoer Waldes sowie zur Anabiose dieser Mikrofauna. Ann. Biol. Tihany **28:** 203–209.

Varga L. 1962. Über die Mikrofauna der Waldstreu von zwei Waldtypen des Durmitor-Gebirges (Jugoslawien). Bull. Mus. Hist. Nat. Belgrad Ser. B **18:** 145–158.

Received February 16, 2006
Accepted November 15, 2006