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Oribatid mites (Acari, Oribatida) of bushy patches in steppe vegetation of cape Tarkhankut in Crimea (Ukraine)

STANISŁAW SENICZAK[1], SŁAWOMIR KACZMAREK[2] and ANNA SENICZAK[1]

[1]Department of Ecology, University of Technology and Life Sciences, Kordeckiego 20, 85-225 Bydgoszcz, Poland
[2]Department of Zoology, Kazimierz Wielki University, Ossolińskich 12, 85-092 Bydgoszcz, Poland
Corresponding author: Stanisław Seniczak, stseni@utp.edu.pl

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Abstract: The density, species number, and age structure of oribatid mites were investigated in bushy patches (elm, hawthorn, hawthorn with rose) in steppe vegetation of cape Tarkhankut (Crimea). In these patches, the density of mites in shrub litter, herbs and moss was higher, but species number was similar like in open steppe vegetation. Hawthorn increased the density distinctly more than hawthorn with rose or bushy elms. In bushy patches, the samples of moss were richer in mites than samples of shrub litter alone or with herbs. Among oribatid mites, *Chamobates* c.f. *spinosus* and *Trhypochthonius tectorum* were most abundant, but relatively abundant and common were also *Tectocepheus velatus*, *Oribatula* sp. 1, *Achipteria nitens*, and *Brachychthonius berlesei*. In oribatid mite communities, adults dominated, but the age structure of populations greatly depended on vegetation type.

Keywords: Crimea, Tarkhankut, bushy patches, Oribatida, juveniles

INTRODUCTION

Oribatid mites in steppe vegetation of Crimea Peninsula are still known insufficiently, and the investigations concern mainly zoogeographical and faunistic aspects (Gordeeva 1973, 1980, 1983; Karppinen et al. 1987; Gordeeva & Karppinen 1988; Gordeeva et al. 1998). This fauna is relatively rich, but only few species achieve a higher density and dominance index there (Seniczak et al. 2009). This makes the area interesting for ecological research on populations of oribatid species, including their age structure.

The density and species number of mites highly depend on vegetation type (Rajski 1967, 1968). Crimean Peninsula is covered by steppe vegetation and has a Mediterranean climate, with a warm or hot season (May–October, 23–25°C, total precipitation 290 mm), and a cool season (November–April, 5–14°C, total precipitation 490 mm), with 250–300 sunny days per year. However, a fresh sea breeze slightly

lowers the coastal temperature and increases air humidity, increasing the density of oribatid mites (Seniczak et al. 2009). The patches of bushes additionally protect the vegetation and soil against intensive solar radiation, improving the living conditions for mites. The steppe oribatid fauna is influenced by geographic expansion of species from the Mediterranean region, Middle Asia and Europe.

In this paper we investigated the density and species composition of oribatid mites in selected microhabitats of bushy patches with elm trees, hawthorn, and hawthorn with rose, on cape Tarkhankut (Crimea), with particular reference to the age structure of some species, which is rarely investigated in acarological papers from that region.

MATERIAL AND METHODS

Samples of 500 cm^3 each were taken on 15–20 July 2004, in 3 replicates, from the following microhabitats under steppe bushes: (1) herbs under elm bushes (*Ulmus* sp.); (2) herbs, moss, and shrub litter alone under hawthorn (*Crataegus pojarcoviae* L.); and (3) herbs under hawthorn with rose (*Rosa* sp.). Obviously, the litter of herbs was partly mixed with leaves and other organs shed by the shrubs growing above them.

The mites were extracted in Tullgren funnels, and next conserved and determined to species or genus, including juveniles. In total, 40 404 individuals were investigated. Oribatid species were characterized with the abundance (*A*) and dominance (*D*) indices, while the mite communities were compared with the Shannon index *H'* (Odum 1971). Names of oribatid species follow Subías (2004, online version 2011) and partly Weigmann (2006).

RESULTS

The herbs, moss, and shrub litter in bushy patches of steppe vegetation of cape Tarkhankut were rather rich in oribatid mites, but their density greatly depended on vegetation type. Most oribatid mites preferred the hawthorn patches, where the den-

Table 1. Characteristics of oribatid mite communities in selected microhabitats under steppe bushes of Crimea: mean density (individuals per sample, i. e. 500 cm^3, $n = 3$), number of species, and Shannon index of diversity (*H'*)

Community parameters	Elm, herbs	Hawthorn			Hawthorn+ rose, herbs
		herbs	moss	litter alone	
Mean density of Oribatida	515	1646	7484	2487	1336
Mean density of juvenile Oribatida	114	974	4050	837	534
Number of species of Oribatida	32	28	28	32	33
Shannon index *H'* of Oribatida	2.42	2.11	1.40	1.94	2.29

sity was 3.2-fold higher, or hawthorn with rose, where it was 2.6-fold higher than in elm patches. Considering the types of samples, in moss the density was 4.5-fold higher, and in shrub litter alone it was 1.5-fold higher than in the litter alone of herbs mixed with shrub litter (Table 1).

In most microhabitats, the number of species of oribatid mites was similar (32–33 species), except for herbs and moss in hawthorn, where it was lower (Table 1). In oribatid mite communities, 3–4 species were abundant, and therefore the Shannon index *H*' was rather low; it achieved the highest value in herbs under elm bushes, and the lowest value in moss.

In the investigated bushy patches, the most abundant were *Chamobates* c.f. *spinosus* Sellnick, 1928, and *Trhypochthonius tectorum* (Berlese, 1896), especially in moss (Table 2), but relatively abundant and common were also *Tectocepheus velatus* (Michael, 1880), *Oribatula* sp. 1, *Achipteria nitens* (Nicolet, 1855) and *Brachychthonius berlesei* Willmann, 1928. Moreover, *Pillogalumna crassiclava* (Berlese, 1914) was rather abundant in herbs under hawthorn, *Metabelba macerochaeta* Bulanova-Zachvatkina, 1967 in shrub litter under hawthorn, *Sphaerochthonius splendidus* (Berlese, 1904) in herbs under hawthorn with rose and *Jacotella neonominata* Subías, 2004 in herbs under elms.

In most oribatid communities, adults dominated, except for herbs and moss under hawthorn, where the juveniles were more abundant. This was mainly due to high densities of *Trhypochthonius tectorum*, *Oribatula* sp. 1 and *Pillogalumna crassiclava*, which were rich in juveniles. The age structure of species greatly depended on the type of vegetation (Table 2), which was well observed under hawthorn. In herbs, the density of juveniles of *Oribatula* sp. 1 was over 6-fold higher and in moss it was 2-fold higher than the density of adults, while in shrub litter the adults dominated. The very abundant *Trhypochthonius tectorum* was rich in juveniles, while *Chamobates* c.f. *spinosus* was represented mostly by adults, which constituted 57–67% of its population.

DISCUSSION

The number of oribatid species in the coastal steppe vegetation of Crimea is relatively low (25–33 species), in comparison to the more elevated Crimean areas covered by forests, investigated by Gordeeva (1973). She found 82 species in pine forest and 89 species in oak forest. The number of species of oribatid mites in coastal steppe is limited mainly by the dry steppe climate and vegetation, but the bushy patches protect to some degree the soil against intensive solar radiation, and increase the density of oribatid mites, as compared to open steppe vegetation (Seniczak et al. 2009). For example, in moss under hawthorn the density was 11.6-fold higher than in moss under no cover. However, the species number of oribatid mites, and their Shannon index *H*' in bushes were comparable with those in open steppe vegetation. A fresh sea breeze lowers the coastal temperature and increases air humidity. This is important to oribatid mites, and therefore the oribatid mite communities of steppe vegetation of Crimea were richer in species than those from Rhodes Island, southern Andalusia, and Italy (Subías et al. 1985; Seniczak & Seniczak 2006, 2010, 2011).

Table 2. Characteristics of oribatid species in selected microhabitats under steppe bushes of Crimea: abundance (A = individuals per mean sample, i. e. 500 cm^3, n = 3) and dominance (D = % of the total number of oribatid mites in the mean sample). Species with maximum $A \leq 10$ are listed below the table

Taxon		Elm, herbs	Hawthorn			Hawthorn+ rose, herbs
			herbs	moss	litter alone	
Achipteria nitens (Nicolet, 1855)	*A*	2.0	351.0	107.0	403.0	257.3
	D	0.4	21.3	1.4	16.2	19.3
Pillogalumna crassiclava (Berlese, 1914)	*A*	35.7	168.7	7.0	7.0	21.7
	D	6.9	10.3	0.1	0.3	1.6
Jacotella neonominata Subías, 2004	*A*	68.0	0.3	0	0	10.3
	D	13.2	<0.1	0	0	0.8
Brachychthonius berlesei Willmann, 1928	*A*	0	126.0	4.0	126. 7	249.0
	D	0	7.7	0.1	5.1	18.6
Chamobates c.f. *spinosus* Sellnick, 1928	*A*	0.7	15.3	2980.0	926.0	2.7
	D	0.1	0.9	39.8	37.2	0.2
Licnodamaeus costula Grandjean, 1931	*A*	56.0	4.7	0.3	0.3	0
	D	10.9	0.3	<0.1	<0.1	0
Metabelbella macerochaeta Bulanova-Zachvatkina, 1967	*A*	7.3	48.3	8.3	83.7	69.7
	D	1.4	2.9	0.1	3.4	5.2
Oppiella sp. 1	*A*	121.3	124.7	1. 7	45.3	98.7
	D	23.5	7.6	<0.1	1.8	7.39
Oribatula sp. 1	*A*	66.3	539.7	480.7	242.3	152.3
	D	12.9	32.8	6.4	9.7	11.4
Passalozetes africanus Grandjean, 1932	*A*	0	19.7	0	0	0
	D	0	1.2	0	0	0
Scheloribates laevigatus (C. L. Koch, 1835)	*A*	32.7	66.0	7.0	4.7	3.3
	D	6.3	4.0	0.1	0.1	0.3
Sphaerochthonius splendidus (Berlese, 1904)	*A*	20.3	60.7	11.0	131.3	122.0
	D	4.0	3.7	0.2	5.3	9.1
Tectocepheus velatus (Michael, 1880)	*A*	44.3	52.3	1767.0	402.7	208.7
	D	8.6	3.2	23.6	16.2	15.6
Trhypochthonius tectorum (Berlese, 1896)	*A*	0	0.7	2033.3	6.0	0
	D	0	<0.1	27.2	0.2	0

Bushy elms, herbs: *Anachipteria* sp. 1; *Arthrodamaeus hispanicus* Grandjean, 1928; *Camisia horrida* (Hermann, 1804); *Cosmochthonius ponticus* Gordeeva, 1980; *C. reticulatus* Grandjean, 1947; *Ceratoppia quadridentata* (Haller, 1882); *Ceratozetes* sp. 1; *Cultroribula* sp. 1; *Damaeus* sp. 1; *Dorycranosus curtipilis* (Willmann,

1935); *Eniochthonius minutissimus* (Berlese, 1903); *Eupelops acromios* (Hermann, 1804); *Eupelops* sp. 1; *Galumna* sp. 1; *Lucoppia burrowsi* (Michael, 1890); *Microppia minus* (Paoli, 1908); *Oppiella nova* (Oudemans, 1902); *Papillacarus aciculata* (Berlese, 1905); *Rhysortritia duplicata* (Grandjean, 1953); *Suctobelba* sp. 1; *Trichoribates incisellus* (Kramer, 1897).

Hawthorn, herbs: *Ceratoppia quadridentata*; *Ceratozetes* sp. 1; *Cosmochthonius ponticus*; *C. reticulatus*; *Eniochthonius minutissimus*; *Eupelops acromios*; *Eupelops* sp. 1; *Foseremaeus laciniatus* (Berlese, 1905); *Hermaniella punctulata* (Berlese, 1908); *Lucoppia burrowsi*; *Nothrus* sp. 1; *Passalozetes hispanicus* Mihelčič, 1953; *Scutovertex* sp. 1; *Synchthonius elegans* Forsslund, 1957.

Hawthorn, moss: *Camisia horrida*; *Cosmochthonius ponticus*; *C. reticulatus*; *Dorycranosus curtipilis*; *Eniochthonius minutissimus*; *Eupelops acromios*; *Eupelops* sp. 1; *Fosseremaeus laciniatus*; *Galumna* sp. 1; *Hermaniella punctulata*; *Micreremus brevipes* (Michael, 1888); *Oppiella* sp. 2; *Oribatula* sp. 2; *Phauloppia* sp. 1; *Trichoribates trimaculatus* (C. L. Koch, 1835); *Synchthonius elegans.*

Hawthorn litter alone: *Camisia segnis* (Hermann, 1804); *Chamobates* sp. 1; *Cosmochthonius ponticus*; *C. reticulatus*; *Dorycranosus curtipilis*; *Eniochthonius minutissimus*; *Eupelops* sp. 1; *Fosseremaeus laciniatus*; *Galumna* sp. 1; *Hypochthonius rufulus* C. L. Koch, 1835; *Nothrus* sp. 1; *Papillacarus aciculata*; *Passalozetes hispanicus*; *Phthiracarus* 1; *Rhysortritia duplicata*; *Suctobelba* sp. 1; *Suctobelba* sp. 2; *Synchthonius elegans*; *Trichoribates trimaculatus*; *Trimalaconothrus* sp. 1.

Hawthorn with rose, herbs: *Aphelacarus acarinus* (Berlese, 1910); *Arthrodamaeus hispanicus*; *Austrocarabodes* sp. 1; *Ceratoppia quadridentata*; *Compactozetes* sp. 1; *Cosmochthonius ponticus*; *Dorycranosus curtipilis*; *Eniochthonius minutissimus*; *Eupelops acromios*; *Eupelops* sp. 1; *Galumna* sp. 1; *Hermaniella punctulata*; *Hypochthonius rufulus*; *Lucoppia burrowsi*; *Oppiella* sp. 2; *Papillacarus aciculata*; *Passalozetes hispanicus*; *Protoribates capucinus* Berlese, 1908; *Punctoribates* sp. 1; *Rhysortritia duplicata*; *Suctobelba* sp. 1; *Synchthonius elegans*.

In communities of oribatid mites, 3–4 species achieved high densities and dominance indices. This indicates, in the light of Thienemann's (1939) principles, a rather low soil fertility, probably due to a low precipitation. For example, in moss, 3 most abundant species (*Chamobates* c.f. *spinosus*, *Tectocepheus velatus* and *Trhypochthonius tectorum*) comprised over 90% of total oribatid mites, while in shrub litter, *Chamobates* c.f. *spinosus*, *Tectocepheus velatus* and *Achipteria nitens* comprised nearly 70% of all oribatid mites.

In open steppe vegetation, *T. velatus* usually dominated, *Trhypochthonius tectorum* was abundant only in patches of *Sedum*, *Oribatula* spp. was rather abundant in moss and other grasses, while *Chamobates* c.f. *spinosus* was absent (Seniczak et al. 2009). *Tectocepheus velatus* is a cosmopolitan species (Nübel-Reidelbach 1994), and can be abundant both in extremely dry and extremely wet habitats (Rajski 1968), very much like *Trhypochthonius tectorum*. Genus *Oribatula* was also abundant in cypress litter in Caserta (Italy) and in moss from forest floor in Korčula (Croatia) (Seniczak & Seniczak 2011; Seniczak et al. 2011).

In populations of most species of oribatid mites, the adults dominated, but the age structure depends on vegetation type. The participation of juveniles of *Oribatula* spp. and *Trhypochthonius tectorum* was higher than in open steppe vegetation (Seniczak et al. 2009), but in *Tectocepheus velatus* it was similar, which well demonstrates the adaptation of *T. velatus* to arid climate (Rajski 1968).

All the species listed in Table 2 were already earlier recorded from Caucasus and Crimea (Karppinen et al. 1987; Seniczak et al. 2009), but *Dorycranosus curtipilis* Willmann, 1935 and *Papillacarus aciculata* (Berlese, 1905) are new species for Crimea. All the papers included the endemic Crimean species *Cosmochthonius ponticus* Gordeeva, 1980.

Table 3. Age structure of some oribatid species in selected microhabitats under steppe bushes of Crimea: mean density (individuals per 500 cm^3, n = 3) of juveniles (Juv) and adults (Ad)

Species	Microhabitat	Juv	Ad	Total
Achipteria nitens	Hawthorn litter alone	174.0	229.0	403.0
	Hawthorn, herbs	181.7	169.3	351.0
	Hawthorn, moss	73.0	34.0	107.0
Pillogalumna crassiclava	Hawthorn, herbs	144.0	24.7	168.7
	Elm, herbs	24.7	11.0	35.7
Brachychthonius berlesei	Hawthorn and rose, herbs	128.3	120.7	249.0
	Hawthorn litter alone	72.7	54.0	126.7
Chamobates c.f. *spinosus*	Hawthorn, moss	1296.0	1684.0	2980.0
	Hawthorn litter alone	306.7	619.3	926.0
Metabelbella macerochaeta	Hawthorn litter alone	21.4	62.3	83.7
	Hawthorn and rose, herbs	14.0	55.7	69.7
	Hawthorn, herbs	3.3	45.0	48.3
Oribatula sp. 1	Hawthorn, herbs	465.4	74.3	539.7
	Hawthorn, moss	322.7	158.0	480.7
	Hawthorn litter alone	119.3	123.0	242.3
Sphaerochthonius splendidus	Hawthorn litter alone	26.0	105.3	131.3
	Hawthorn and rose, herbs	36.7	85.3	122.0
Tectocepheus velatus	Hawthorn, moss	540.7	1226.3	1767.0
	Hawthorn litter alone	116.4	286.3	402.7
	Hawthorn and rose, herbs	99.4	109.3	208.7
Trhypochthonius tectorum	Hawthorn, moss	1776.0	257.3	2033.3

CONCLUSIONS

1. The density of oribatid mites in bushy patches of cape Tarkhankut was distinctly higher, but the species number was similar like in open steppe vegetation. Hawthorn increased the density distinctly more than hawthorn with rose or elms; moss was richer in mites than patches of shrub litter alone or herbs.
2. In bushy patches the most abundant were *Chamobates* c.f. *spinosus* and *Trhypochthonius tectorum,* but relatively abundant and common were also *Tectocepheus velatus*, *Oribatula* sp. 1, *Achipteria nitens* and *Brachychthonius berlesei*.
3. In oribatid mite communities the adults usually dominated, but the age structure of species greatly depended on vegetation type.

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