Acarina 11 (2): 247–252

COMMUNITIES OF ARBOREAL ORIBATID MITES (ACARIFORMES: ORIBATIDA) OF ASPEN-BIRCH FORESTS OF WEST SIBERIA. COMMUNICATION 2. SEASONAL DYNAMICS PATTERNS

НАСЕЛЕНИЕ АРБОРЕАЛЬНЫХ ПАНЦИРНЫХ КЛЕЩЕЙ (ACARIFORMES: ORIBATIDA) ОСИНОВО-БЕРЕЗОВЫХ ЛЕСОВ ЗАПАДНОЙ СИБИРИ СООБЩЕНИЕ 2. ОСОБЕННОСТИ СЕЗОННОЙ ДИНАМИКИ

A.V. Tolstikov[1], E.A. Bragin[2], I.V. Kuzmin[1], A.L. Nekrasov[1]
А.В. Толстиков[1], Е.А. Брагин[2], И.В. Кузьмин[1], А.Л. Некрасов[1]

[1] Tyumen State University, Tyumen, 625003 Russia; e-mail: atolus@yahoo.com
[2] V.I. Shpilman Research and Analytical Center of Rational Land-Use, Tyumen, 625003 Russia
[1] Тюменский государственный университет, Тюмень, 625003 Россия
[2] Научно-аналитический центр рационального недропользования им. В.И. Шпильмана, Тюмень, 625003 Россия

Key words: Oribatida, seasonal dynamics patterns, West Siberia
Ключевые слова: Oribatida, сезонная динамика, Западная Сибирь

ABSTRACT

Seasonal dynamics of arboreal oribatid mites inhabiting bark, twigs and leaves of three species of trees (pine, birch and linden) was studied in West Siberia. Seasonal patterns of oribatid mite communities on trees are as follows: the high species diversity of mites in summer, the population density increase early in sping and summer and the following decrease early in autumn.

РЕЗЮМЕ

Проведено изучение сезонной динамики населения арбореальных панцирных клещей, населяющих кору, ветви, листья трех видов деревьев (сосны, березы и липы) в Западной Сибири. Для населения панцирных клещей деревьев характерно наибольшее видовое богатство в летний период, увеличение численности в весенне-летний период и её снижение в начале осени.

INTRODUCTION

The population density seasonal dynamics of phytophagous mites and the Phytosejidae is well studied [Spider mites..., 1985]. It is known that seasonal changes in the mite populations are influenced by overwintering conditions [Chant, 1963]. The high mortality rate of predatory mites in winter can be followed by the higher population densities of spider mites in the early vegetation season [Overmeer, 1985].

Seasonal changes of oribatid mite populations on trees are known only for a few species [Murphy, Balla, 1971; Wunderle, 1992]. It is known that *Humerobates rostrolamellatus* can migrate along the apple tree trunk, and the maximum density is reached in the upper parts of the tree crown in the middle of the summer [Murphy, Balla, 1971].

On the contrary, the dynamics of soil-inhabiting oribatid mite populations during seasons of the year is extensively studied. In the temperate regions two peaks are usually observed, one being in summer, and another one in autumn [Sitnikova, 1961, 1963; Chistyakov, 1971; Piven, 1972; Yaroshenko, 1975, Krivolutsky, 1980; Lyaschev, 1989; Grishina, Stebaeva et al., 1991; Knor, 1998, etc.]. Some differences can be noted for mites inhabiting marshes [Eitminaviciute, 1966] or fresh-water littoral zone [Tolstikov, 1997], when the population dynamics curve could be one-peaked.

The temperate climate conditions influence greatly the life cycle of oribatid mites, arboreal ones inclusive. Many biological phenomena such as the developmental phase of oribatids to overwinter, the physiological state of mites under such conditions remain subjects to study. The changes in taxonomic composition and abundance of oribatid mites on deciduous and coniferous trees were traced in the south of West Siberia and are subject to report in the present paper.

MATERIAL AND METHODS

The research was done in the vicinities of the Biological Station "Lake Kuchak", the Nizhnetavdinsky district of Tyumen Province, in 1999–2002. Mites were collected year-round, in spring (1.05–10.05), summer (15.06–29.08), autumn (15.09–

20.10) and winter (10.02–10.03). An early spring was also referred to as a "winter".

The arboreal oribatid mite population seasonal dynamics was studied for three species of trees: common pine (*Pinus sylvestris* L.), linden (*Tilia cordata* Mill.), and birch (*Betula pendula* (L.) Roth.). The mite collecting was done according to earlier described methods [Bragin, Tolstikov, 2002]. The samples taken were exposed to lower temperatures in winter time up to 4 hours thus making some limitations for the following data extrapolation in case of the bark that was lately processed using Berlese funnels.

RESULTS AND DISCUSSION

The fluctuations of the species composition of oribatid mites were noted on all trees studied. The high diversity of oribatid mites was found in summer, and the low one was recorded in autumn (Table 1). As the data presented suggest the portion of species, which are more often confined to the tree trunk basis, or "komel", is high in the winter time. One of the reason can be high level of the snow cover (up to 0,8–1,6 m) that provided favorable thermoisolation of this zone [Krivolutsky, 1980]. Besides many adaptations to resist cold are known [Tarba, 1977; Block, 1990].

The only species that was recorded throughout the year was *M.gracilior*. Other species of oribatids were recorded only in certain periods of the year and on different trees. That is also a case with *Phauloppia* sp. and *Scheloribatidae* gen.sp. The first species was found only in spring and summer on all trees studied whilst the second one was reported only in summer from pine and birch trees.

The characteristics of arboreal oribatid mite summer communities were discussed in the communication 1 [Bragin, Tolstikov, 2002], whilst those for other seasons are given heretoafter (Table 1, 2, Fig.1).

Common Pine

Ten species of oribatid mites were recorded on pine-trees in spring. Eight of them were found only in the "komel" zone (*L.undulatus*, *E.oblongus*, *C.c.f.bicultrata*, *C.areolatus*, *T.velatus*, *Phauloppia* sp., *Z.exilis*, *S.laevigatus*).

Two species of oribatid mites were found on pine in September-October, *M.gracilior* in 1 – 2 canopy zones (twigs and needles) and *L.singularis* in the first "komel" subzone. The average number of *M.gracilior* on twigs was 54 ind./m^2, the abundance of mites on needles (7 ind./m^2) was 8 times less than that on twigs. The abundance of *L.singularis* on komel was 5 ind./m^2.

In the winter time 8 species of oribatid mites were found on pine (*C.c.f.bicultrata*, *T.velatus*, *D.cylindrica*, *S.c.f.opistodentata*, *M.gracilior*, *O.tibialis*, *S.laevigatus*, *L.singularis*), 4 of which were recorded on "komel" (*T.velatus, D.cylindrica, M.gracilior,L.singularis*), and only in its first sub-

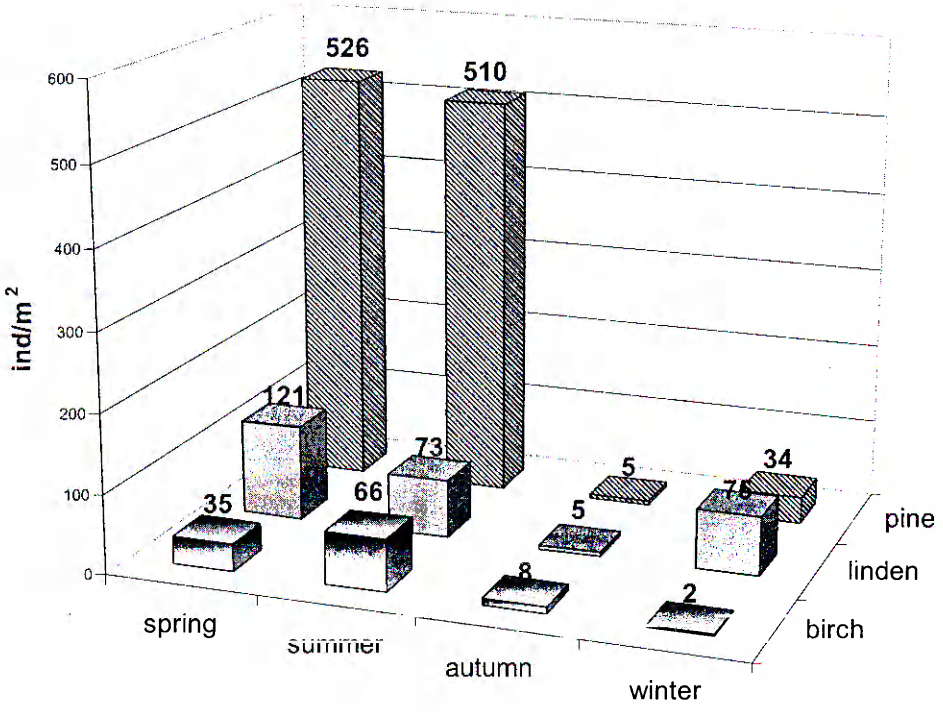

Fig. 1. Seasonal dynamics of *M. gracilior* population density in the canopies of trees, West Siberia, 2000–2002.

Table 1
Taxonomic composition of arboreal oribatid mites (bark, twigs and leaves) in various seasons of the year, south West Siberia, 1999–2002

Taxon	common pine				birch				linden			
	A	B	C	D	A	B	C	D	A	B	C	D
Camisia segnis (Hermann, 1804)		+								+		
Camisia spinifer (Koch, 1835)		+										
Licnodamaeus undulatus (Paoli, 1908)	+	+										
Licnobelba alestenensis Grandjean, 1931		+										
Belba sp.										+		
Epidamaeus kamaensis (Sellnick, 1925)		+				+		+		+		
Epidamaeus sp.		+				+				+		
Euremaeus oblongus (Koch, 1835)	+	+				+			+			
Cultroribula dentata Willmann, 1950		+										
Cultroribula c.f. *bicultrata* (Berlese, 1905)	+	+	+									
Gustavia microcephala (Nicolet, 1855)		+										
Ceratoppia bipilis (Hermann, 1804)		+				+				+		
Carabodes areolatus Berlese, 1916	+	+				+		+		+		
Tectocepheus velatus (Michael, 1880)	+	+	+			+	+				+	
Oppia cylindrica Perez-Inigo, 1964		+	+		+	+				+		
Oppia tuberculata B.-Z., 1964										+		
Oppiella nova (Oudemans, 1902)		+										
Quadroppia quadricarinata (Michael, 1885)											+	
Suctobelbella c.f. *opistodentata* (Golosova, 1970)		+	+			+				+		
Scapheremaeus palustris (Sellnick, 1924)	+	+				+				+		
Micreremus gracilior (Willmann, 1931)	+	+	+	+	+	+	+	+	+	+	+	+
Licneremaeus licnophorus (Michael, 1882)		+				+		+				
Passalozetes rugosus Sitnikova, 1975		+				+						
Oribatula tibialis (Nicolet, 1855)		+	+			+	+			+		
Phauloppia sp.	+	+			+	+				+	+	
Zygoribatula exilis (Nicolet, 1855)	+	+			+	+	+	+		+		
Zygoribatula frisiae (Oudemans, 1902)		+			+	+		+		+		
Liebstadia similis (Michael, 1888)												
Scheloribates laevigatus (Koch, 1835)	+	+	+			+	+	+	+	+		
Scheloribatidae gen. sp.		+				+						
Parakalumma sp.		+										
Trichoribates trimaculatus (Koch, 1835)		+				+				+		
Punctoribates sphaericus Shaldybina, 1987												
Oribatella berlesei (Michael, 1898)										+		
Oribatella reticulata Berlese, 1916										+		
Oribatella calcarata (Koch, 1835)										+		
Parachipteria sp.												
Lepidozetes singularis Berlese, 1910		+	+	+		+	+	+	+	+		
Galumna obvia (Berlese, 1914)				+		+				+		
Ptyctima	+	+										
Total (Ptyctima excluded)	10	29	8	3	5	21	6	8	4	22	4	1

A — spring; B — summer; C — autumn; D — winter

Table 2

Seasonal dynamics of species richness and population density of oribatid mites on trees, 2000–2002

		Spring		Summer		Autumn		Winter	
		species number	abundance, ind/m2	species number	abundance, ind/m2	species number	abundance, ind/m2	species number	abundance, ind/m2
Pine	twigs	3	499±138	11	555±128	2	60±36	2	43±33
	leaves	2	31±3	9	34±10	X	X	1	8±5
	bark	7	42±11	26	79±24	1	> 1	7	15±5
Birch	twigs	2	40±5	4	67+36	1	7±3	1	2+1
	leaves	2	65±16	3	37±27	1	2±1	*	*
	bark	4	99±36	16	68±13	8	6±3	5	9±4
Linden	twigs	1	121±66	7	77±56	1	5±3	1	75±60
	leaves	*	*	6	8±4	*	*	*	*
	bark	3	7±3	19	52±8	X	X	4	10±7

* — leaves were absent; X — mites were not present in samples taken.

zone. *L.singularis* was responsible for 56% (63 ind./m^2) of the total abundance in the first "komel" subzone. *C.*c.f.*bicultrata*, *S.*c.f.*opistodentata*, *M.gracilior* and *S.laevigatus* were found in second and third zones of the trunk. *M.gracilior* eudominated in canopy, its average density on twigs was 30 ind./m^2, on needles — 7 ind./m^2.

Birch

Five species of oribatid mites were found on birch-tree in spring: *O.cylindrica*, *M.gracilior*, *Phauloppia* sp., *Z.exilis* and *Z.frisiae*. The highest taxonomic diversity was shown for trunk where 4 species were found: *O.cylindrica*, *Phauloppia* sp., *Z.exilis* and *Z.frisiae*. Maximum abundances were shown for *Z.exilis* (150 ind./m^2) in the first "komel" subzone, for *Phauloppia* sp. in the second zone (25 ind./m^2) and in the third one (125 ind./m^2).

In autumn 8 species of oribatid mites were recorded: *E.kamaensis*, *C.areolatus*, *M.gracilior*, *L.licnophorus*, *Z.exilis*, *Z.frisiae*, *S.laevigatus* and *L.singularis*. Most of them were found in the first "komel" subzone. *M.gracilior* was the only species in the birch-tree canopy found. Its average abundance equaled 9 ind./m^2 on twigs and 1 ind./m^2 in the foliage.

Both taxonomic diversity and abundance of oribatid mites in the winter time were lower than that in autumn. Three species of oribatids (*O.tibialis*, *S.laevigatus* and *L.singularis*) were found in the first "komel" subzone. Two species of oribatid mites (*T.velatus* and *Z.exilis*) were found at heights exceeding 2 m. The only species, *M.gracilior*, was found in the canopy (3 ind./m^2).

Linden

Both spring and winter communities were found to be close. The abundance of mites is much higher in spring. In total 4 species of oribatid mites (*E.oblongus*, *M.gracilior*, *S.laevigatus*, *L.singularis*) were found on linden. The density of *M.gracilior* on twigs was around 135 ind./m^2.

The only species, *M.gracilior*, was found on twigs of the first canopy zone (25 ind./m^2).

Taxonomic diversity and abundance of arboreal mites in the winter time is higher than in autumn. Three species of oribatid mites (*T.velatus*, *Q.quadricarinata*, *Phauloppia* sp.) were found. More than 60% were comprised by *T.velatus* that reached maximum in the third canopy zone (67 ind./m^2). Similar to the autumn, the only dominant species found was *M.gracilior*. The average density of *M.gracilior* is 14 times higher than that in autumn (84 ind./m^2).

***

The population density dynamics curve had one peak irrespective of the tree surveyed (Table 2). The number of oribatid mites increased in spring and summer periods, and decreased in the early autumn (P>0,01). In general the dynamics of mites followed the dynamics of the only species, *M.gracilior* (Fig. 1). Our data well correspond to those found by Murphy, Balla [1971], which recorded maximum densities of *H.rostrolamellatus* in the mid-summer.

The vertical and horizontal migrations of mites on trees can be referred to as the main factors of the arboreal mite species composition seasonal chang-

es [Aoki, 1971; Murphy, Balla, 1971]. In spring oribatid mites move from soils to the bark and phyllosphere of trees reaching maximum abundances in the middle of the summer. Besides as it seen from the present research some oribatid mites may possibly overwinter in the bark crevices. Lately in spring oribatid mites migrate first to twigs and then to leaves.

The data obtained pose many interesting questions, which are still remain unanswered. Can arboreal mites be active in winter, including periods of thawing weather? Findings of oribatid mites on pine needles, which do not have places for oribatids to hide making them exposed to unfavorable environmental factors, suggest in favor of the idea that some mites can remain active at least at certain parts of winter. However, the probability that mites have a dormancy period in the bark cracks and cavities is also high, and mites can become active when they are brought to a room temperature in the laboratory and the Berlese funnel system is being applied.

It still remains questionable if some oribatid mites, which predominantly inhabit trees, overwinter in soil and soil litter. Theoretically there are no great obstacles to it. Surprisingly the most numerous species of oribatid mites on trees, *M.gracilior*, was not found in soil in the limits of the projective coverage of the tree canopy. The salt flotation showed, however, that armors of this mite species were regularly found in large numbers in the soil. The literature data also show that this species was occasionally found in soil and litter, and never was a dominant or a subdominant species [for finding records see Golosova, Karppinen, Krivolutsky, 1993; Oribatid mites..., 1995; Ryabinin, Pan'kov, 2002]. As this species was not found in soil alive in our study or was rarely found in soil by other authors a question is arose if these mites migrate from soil and litter to trees and vice versa similarly to spider mites and their enemies, the Phytosejidae [Spider mites..., 1985].

SUMMARY

The seasonal population dynamics of arboreal oribatid mites in the south West Siberia is one-peaked. The number of oribatid mites on trees increases in spring and goes down in the early autumn. The data obtained correspond well to the arboreal mite dynamics general picture shown by Aoki, 1971 and Murphy, Balla, 1971.

ACKNOWLEDGEMENTS

The authors are thankful to Drs. Adelaida D. Petrova-Nikitina (Department of Entomology, Moscow Lomonosov State University, Moscow) for many helpful suggestions and Roy A. Norton (SUNY, Syracuse, New York) for drawing their interest to arboreal oribatid mites. Many thanks should be extended to the Tyumen State University Department of Zoology students who actively participated in the project: Svetlana Petunkina and Dina Khrabrova.

REFERENCES

Aoki J. 1971. Soil mites (Oribatids) climbing trees. *In*: Proceedings of the 3rd International Congress of Acarology (Prague), pp.59–65.

Block W. 1990. Cold tolerance of insects and other arthropods. *Phil. Trans. R. Soc. Lond. B.*, 326: 613–633.

Bragin E.A., Tolstikov A.V. Communities of arboreal oribatid mites (Acariformes, Oribatida) of aspen-birch forests of West Siberia. Communication 1. Species diversity and abundance. *Acarina,* 10: 175–187.

Chant D.A. 1963. Some mortality factors and the dynamics of orchard mites. *Mem. Entomol. Soc. Can.*, 32: 33–40.

Chistyakov M.P. 1971. [Seasonal dynamics of abundance of oribatid mites on used turf-fields of Gorkovskaya Province]. *Ecologiya,* 6: 78–83. [In Russian]

Eitminavicute I.S. 1966. [Oribatids of the shores of boggy lakes. 1. Lower bog]. *In*: Trudy Akademii Nauk Litovskoy SSR, 1 (39): 53–62. [In Russian]

Golosova L., Karppinen E., Krivolutsky D. List of oribatid mites (Acarina, Oribatei) of northern palaearctic region. II. Siberia and Far East. *Acta Entomol. Fennica,* 43: 1–14.

Grishina L.G., Stebaeva S.K., Lapshina E.I., Vagina T.A., Pan'ko V.A., Sen'kova L.A. 1991. [Microarthropods of Soil, Vegetation in the Conditions of Fluctuated Precipitation (Karasuk Valley Taken as an Example)]. Publisher: Nauka, Novosibirsk. 166 pp. [In Russian]

Knor O.I. 1998. [Fauna of oribatid mites (Sarcoptiformes, Oribatei) of pine forests of the south West Siberia]. *In*: Bespozvonochnye zhivotnye Yuzhnogo Zauralia i prilezhshchikh territory. Materialy Vserossiyskoy Konferentsii, Kurgan, pp. 187–192. [In Russian]

Krivolutsky D.A. 1980. [Influence of temperature regime and soil frosting on complexes of oribatid mites]. *In*: Adaptatsii zhivotnykh k zimnim usloviyam. Publisher: Nauka, Moscow, pp. 38–44 [In Russian]

[*Oribatid mites: morphology, development, phylogeny, ecology, methods of research, characteristics of the model species Nothrus palustris C.L. Koch, 1839*]. D.A. Krivolutsky (Ed.). Publisher: Nauka, Moscow. 224 pp. [In Russian]

Lyashchev A.A. 1989. [Seasonal dynamics of abundance of oribatid mites of the island Sakhalin]. *In*: Pochvennye bespozvonochnye yuga Dalnego Vostoka. Sbornik nauchnykh rabot. Publisher: DVO AN SSSR, Khabarovsk, pp. 69–80 [In Russian]

Murphy P.W., Balla A.N. 1971. The bionomics of *Humerobates rostrolamellatus* Grandjean (Cryptostigmata — Ceratozetidae) on fruit trees. *In*: Proc. 3rd. Int. Congress Acarology (Prague), pp. 97–104.

Overmeer W.P.J. 1985. Diapause. Spider Mites. Their Biology, Natural Enemies and Control, 1A. *In*: W. Helle and M.W. Sabelis (Eds.). Publisher: Elsevier, Amsterdam, pp. 95–102.

Piven V.B. 1972. [Peculiarities of seasonal fluctuations of abundance of microarthropods (Oribatei and Collembola) on wheat fields of the forest-steppe of West Siberia]. *In*: Zoologicheskiye problemy Sibiri. Publisher: Nauka, Novosibirsk, pp. 161–162. [In Russian]

Ryabinin N.A., Pan'kov A.N. 2002. [*Catalog of oribatid mites of the Far East. Part II. Continental part of the Far East*]. Publisher: DVO-RAN, Vladivostok-Khabarovsk. 92 p. [In Russian]

Sitnikova L.G. 1961. [Vertical distribution and fluctuations of abundance of oribatid mites in sod-podzol soils in the vicinities of Leningrad, Communication I. Meadow associations]. *In*: Parazitologicheskiy sbornik, 20. Publisher: Nauka, St. Petersburg, pp. 283–298. [In Russian]

Sitnikova L.G. 1963. [The vertical distribution and fluctuations of abundance of oribatid mites in sod-podzol soils in the vicinities of Leningrad. Communication II. Forest associations]. In: Parazitologicheskiy sbornik, 21. Publisher: Nauka, St. Petersburg, pp. 83–95. [In Russian]

Spider Mites. Their Biology, Natural Enemies and Control, 1A. 1985. W. Helle and M.W. Sabelis (Eds.). Publisher: Elsevier, Amsterdam. 403 pp.

Tarba Z.M. 1977. [Adaptation of soil oribatid mites to temperature and other environmental factors]. In: Adaptatsii pochvennykh zhivotnykh k usloviyam sredy. Sbornik nauchnykh rabot. Publisher: Nauka, Moscow, pp. 145–150. [In Russian]

Tolstikov A.V. 1997. [Hydrophilous mites of the Order Acariformes A. Zachv. (taxonomic diversity and community structure)]. Abstract of the Candidate of Biological Sciences thesis. Moscow. 24 pp. [In Russian]

Wunderle I. 1992. Die Oribatiden-Gemeinschaften (Acari) der verschiedenen Habitate eines Buchenwaldes. Carolinea, 50: 79–144.

Yaroshenko N.N. 1975. [Oribatid mites (Acariformes, Oribatei) of the original steppe of Priazovye]. Vestnik Zoologii, 4: 63–67. [In Russian]