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COMMUNITIES OF ARBOREAL ORIBATID MITES (ACARIFORMES: ORIBATIDA) OF ASPEN-BIRCH FORESTS OF WEST SIBERIA COMMUNICATION 1. SPECIES DIVERSITY AND ABUNDANCE

НАСЕЛЕНИЕ АРБОРЕАЛЬНЫХ ПАНЦИРНЫХ КЛЕЩЕЙ (ACARIFORMES: ORIBATIDA) ОСИНОВО-БЕРЕЗОВЫХ ЛЕСОВ ЗАПАДНОЙ СИБИРИ СООБЩЕНИЕ 1. ВИДОВОЕ РАЗНООБРАЗИЕ И ОБИЛИЕ

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Ключевые слова: Oribatida, видовое разнообразие и обилие, Западная Сибирь

ABSTRACT

The arboreal orbatid mites inhabiting bark, twigs, leaves and epiphytes of three species of trees were studied in West Siberia. Forty species of mites from 31 genera and 17 families were found, 3 of which could be referred to as being the arboreal mites *per se*: *Micreremus gracilior*, *Phauloppia* sp., Scheloribatidae gen.et sp.sp. The vertical distribution of oribatid mites on the trunk and in the canopy (twigs and leaves) and microbiotopic preferences of particular species were revealed.

РЕЗЮМЕ

Проведено изучение населения арбореальных панцирных клещей, населяющих кору, ветви и листья, а также эпифиты трех видов древесных растений в Западной Сибири. Зарегистрировано 40 видов клещей из 31 рода и 17 семейств, из них 3 вида могут рассматриваться как арбореальные *per se*: *Micreremus gracilior*, *Phauloppia* sp., Scheloribatidae gen.et sp.sp. Были изучены вертикальное распределение панцирных клещей по стволу и в кроне (ветви и листья) деревьев и микробиотопические предпочтения отдельных видов.

INTRODUCTION

The starting point for arboreal mite research was probably the work of Charleton [1668, cited by Kevan, 1985], where there were mentioned oribatid mites inhabiting the bark of trees. In the late XIX century Michael [1883] and Berlese [1882, 1886] listed species of oribatid mites collected from mosses and lichens, which grew on cliffs and tree trunks. It has long been thought that oribatid mites are not the constant part of the arboreal fauna but rather migrants from the soil that was reflected even in the paper titles like "Soil mites (Oribatids) climbing trees" by Aoki [1971]. Consiquently the researchers' attention was mostly drawn to epiphytes [Andre, 1980, 1984; Tarba, 1992; Shtanchaeva, 1997; Byazrov, Melekhina, 1992, 1994], bird nests [Bulanova-Zakhvatkina, 1967], and tree holes [Fashing, 1975, 1980, 1998], the habitats supposedly having the most favorable conditions for oribatid mites.

The classical research works of Trave [1963], Andre [1975, 1980, 1984] and lately those of Wunderle [1992a] and Behan-Pelletier [1998, 2000] have convincingly demonstrated that oribatid mites are the permanent element of the arboreal environments. The high diversity of arboreal oribatids was also shown for tropical latitudes [Perez-Inigo, Perez-Inigo, 1993; Wunderle, 1992b; Walter, 1996; Walter, Proctor, 1999].

It was shown recently that oribatid mites can be a reliable bioindicator of the air pollution in a system of ecological monitoring together with the epiphytic lichens [Dabrowski et al., 1996; Seniczak, 1997].

The arboreal oribatid mites have not been sufficiently studied in Russia that set up the major goal of the present work: to reveal the taxonomic diversity and structural organization of the communities of arboreal oribatid mites using the forests of West Siberia as an example.

MATERIAL AND METHODS

The research has been done in the vicinities of the Tyumen State University Biological Station "Lake Kuchak", which is located in the Lower-Tavda region of Tyumen Province, in 1999–2002. The samplings were done year-round.

Three species of arboreal plants were surveyed: heart-leafed linden *(Tilia cordata)*, common birch *(Betula pendula)*, and the Scots pine *(Pinus silvestris)*. Two habitats were distinguished on each tree: the trunk and the canopy, which were, in their turn, divided into three zones (Fig.1) [Tolstikov, Bragin, 2001]. The trunk was divided into "komel" (butt or tree basis: 0–2 m), the middle part of the trunk (2–7 m), and the upper part of the trunk (7 m and higher). Additionally the "komel" was divided into three sub-zones: lower (0–0.4 m), middle (0.4–1 m) and upper (1–2 m) ones. The canopy was also divided into lower (3–7 m), middle (7–11) and upper (11 and higher) parts.

To climb the trees one of the local Siberian modifications of the tree-climbing "claws", which are fixed to the boots, were selected. Such claws are used by aborigenous people of the North to collect nuts of the Siberian pine *(Pinus sibirica)*.

There were sampled mites from the bark, twigs, leaves and epiphytes, which were collected at various heights from the soil surface.

Bark. The samples were taken at various heights along the trunk. To make the quantitative analysis the metal frame 10 × 10 cm (100 square cm) was used. It was positioned on the tree trunk, and the knife was used to cut off the piece of the bark within the metal frame.

Twigs. In each vertical zone 10 cm pieces of twigs, 10 in total, were collected. The surface square of each twig piece was calculated as the side surface of the cylinder. For 10 cm twigs the side surface was calculated using the formula:

$S = 0.4\ \pi dh$, where d is the diameter of the twig in its central part, and h — its length.

Leaves. Twenty-five leaves were taken from each vertical level. The leaf surface square was calculated by direct methods, using millimeter paper. When dealt with coniferous trees their leaves were collected by weight (20–35g). The abundance of mites was estimated indirectly, by the ratio weight/square. The square of the coniferous tree needle was determined by using the formula offered by Miralles and Slafer [1991]:

$S=0.835\ LA$,

where L is the length of the needle and A is its breadth in the widest part.

The mites were extracted out of bark, twigs and leaves by heptane flotation method [Tolstikov, Bragin, 2001].

Epiphytes. The epiphytes were sampled from the whole tree following the earlier mentioned scheme of the tree division into several parts. The metal frame 5 × 5 cm was used. The extraction of microarthropods was done using the Berlese-Tullgren funnels, the method that is often used for the mite extraction from the lichen and moss cover of the ground [Oribatid mites..., 1995].

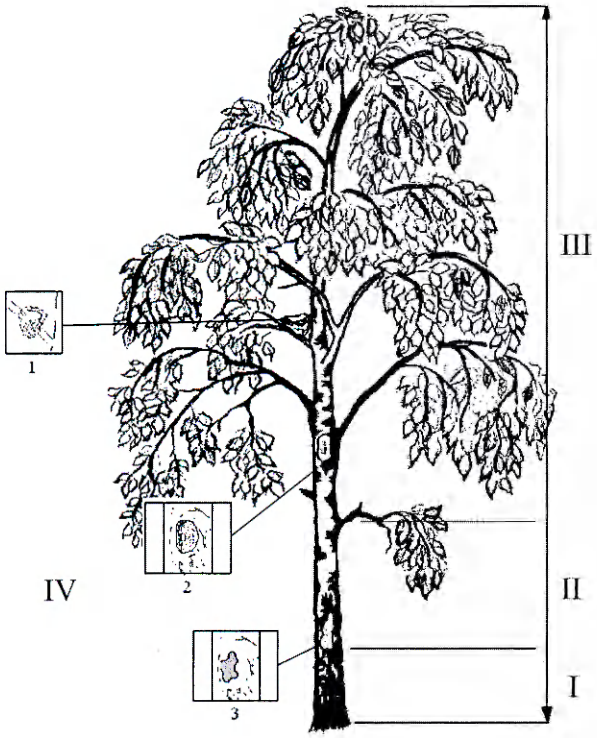

Fig.1. Microhabitats of oribatid mites on the tree (scheme). I — "komel", or tree butt; II — trunk; III — canopy; IV — non-specific microhabitats: 1 — nests; 2 — tree-holes; 3 — epiphytes.

Рис.1. Местообитания панцирных клещей на дереве (схема): I — комель; II — ствол; III — крона; IV — неспецифические местообитания: 1 — гнезда; 2 — дупла; 3 — эпифиты.

The authors followed Engelmann [1978] to separate the dominance groups and to reveal the dominance structure in the oribatid mite community: eudominants (40–100%), dominants (12.5–39.9%), subdominants (4–12.4%), residents (1.3–3.9%), subresidents (less than 1.3%).

Statistical analysis was made using the programs "Statan-97" and "Statistica".

RESULTS AND DISCUSSION

Species Diversity of Arboreal Oribatid Mites

Forty species of oribatid mites from 31 genera and 17 superfamilies were recorded on the trees studied. Of this number three species of oribatid mites can be referred to as the arboreal mites *per se*. It means they were found only on trees (bark, twigs and leaves) and were not found in the soil

samples. These species are as follows: *Micreremus gracilior*, *Phauloppia* sp., Scheloribatidae gen.et sp.sp. (Table 1).

Table 1.
The species list of oribatid mites found in arboreal situations in the West Siberia south
Таблица 1.
Панцирные клещи арбореальных местообитаний юга Западной Сибири

s.fam. HYPOCHTHOINIOIDEA
fam. HYPOCHTHONIIDAE
Hypochthonius rufulus
s.fam. CROTONIOIDEA
fam. CAMISIIDAE
Camisia segnis
Camisia spinifer

s.fam. PLATEREMAEOIDEA
fam. PLATEREMAEIDAE
Licnodamaeus undulatus
fam. LICNOBELBIDAE
Licnobelba alestensis

s.fam. DAMAEOIDEA
fam. DAMAEIDAE
Belba sp.
Epidamaeus kamaensis
Epidamaeus sp.

s.fam. EREMAEOIDEA
fam. EREMAEIDAE
Eueremaeus oblongus

s.fam.GUSTAVIOIDEA
fam. ASTEGISTIDAE
Cultroribula dentata
Cultroribula c.f. bicultrata
fam. GUSTAVIIDAE
Gustavia microcephala
fam. PELOPPIDAE
Ceratoppida bipilis

s.fam. CARABODOIDEA
fam. CARABODIDAE
Carabodes areolatus
fam. TECTOCEPHEIDAE
Tectocepheus velatus

s.fam. OPPIOIDEA
fam. OPPIIDAE
Oppia cylindrica
Oppia tuberculata
Oppiella nova
fam. QUADROPPIIDAE
Quadroppia quadricarinata
fam. SUCTOBELBIDAE
Suctobelbella c.f. opistodentata

s.fam. CYMBAEREMAEOIDEA
fam. CYMBAEREMAEIDAE
Scapheremaeus palustris
fam. MICREREMIDAE
Micreremus gracilior

s.fam. LICNEREMAEOIDEA
fam. LICNEREMAEIDAE
Licneremaeus licnophorus
fam. PASSALOZETIDAE
Passalozetes rugosus

s.fam. ORIPODOIDEA
fam. ORIBATULIDAE
Oribatula tibialis
Phauloppia sp.
Zygoribatula exilis
Zygoribatula friziae
fam. PROTORIBATIDAE
Liebstadia similis
fam. SCHELORIBATIDAE
Scheloribatidae gen.et sp.sp.
Scheloribates laevigatus
fam. PARAKALUMMIDAE
Parakalumna sp.

s.fam. CERATOZETOIDEA
fam. CERATOZETIDAE
Trichoribates trimaculatus
fam. MYCOBATIDAE
Punctoribates sphaericus

s.fam. ORIBATELLOIDEA
fam. ORIBATELLIDAE
Oribatella berlesei
Oribatella reticulata
Oribatella calcarata

s.fam. ACHIPTERIOIDEA
fam. ACHIPTERIIDAE
Parachipteria sp.
fam. TEGORIBATIDAE
Lepidozetes singularis

s.fam. GALUMNOIDEA
fam. GALUMNIDAE
Galumna obvia

PTYCTIMA

The representatives of the superfamily Oripodoidea were quite often recorded from arboreal plants in temperate climate, for instance in France [Andre, 1975, 1980, 1984; Trave, 1963], Germany [Wunderle, 1992a, 1992b] and Poland [Niedbala, 1970] (Table 2). Most of the species from this superfamily found have a wide range of tolerance and were earlier reported from soils of the southern part of the Tyumen region [Golosova, 1977; Lyashchev, 1998]. Two of the species found (*Phauloppia* sp. and Scheloribatidae gen.et sp.sp.) are new for science.

According to the literature [Trave, 1963; Wunderle, 1992a, 1992b; Andre, 1980, 1984; Aoki, 1967, 1971; Tarba, 1992; Byazrov, Melekhina, 1994] the oribatid mites of the superfamilies Crotonioidea, Carabodoidea, Cymbaeremaeiodea are most often recorded on trees. In our material the mites of these superfamilies were represented by 5 species: *Camisia segnis*, *C.spinifer*, *Carabodes areolatus*, *Scapheremaeus palustris*, *M.gracilior*. *M.gracilior* — the species earlier known from the Europe and the Far East [Oribatid mites..., 1995; Ryabinin, Pankov, 2002]. It is first time recorded in Tyumen Province.

There were found many species of soil-dwelling oribatid mites on trees. Their migrations on trees from soil were often discussed in the literature: *Belba* sp., *Epidamaeus kamaensis*, *Trichoribates trimaculatus*, *Punctoribates sphaericus*, *Oribatella berlesei*, *Oribatella reticulata*, *O.calcarata* [Potemkina, 1941; Shaldybina, 1956; Pavlichenko, 1994]. These species can be found in all types of soil in West Siberia [Lyashchev, 2000; Golosova, 1977; Piven, 1972]. Oribatid mites from the superfamilies Hypochthonioidea, Gustavioidea, and Oppioidea were also present in our material. The species from the latter two superfamilies were reported from trees by several authors [Trave, 1963; Andre, 1980, 1982, 1984; Byazrov, Melekhina, 1992, 1994; Tarba, 1992; Wunderle, 1992a, 1992b].

Table 2.

Number of species of oribatid mites from selected superfamilies found on trees in temperate climate zone (according to various authors)

Таблица 2.

Виды панцирных клещей некоторых надсемейств, найденные на деревьях в зоне умеренного климата, (по разным авторам)

Superfamily	Andre*	Seniczak et al.**	Niedbala***	Our data****
Hypochthonioidea				1
Crotonioidea	2	1	3	2
Plateremaeoidea				2
Damaeoidea			1	3
Eremaeoidea	1	1	1	1
Gustavioidea	1			4
Carabodoidea	2	1	1	2
Oppioidea	1	1	4	5
Cymbaeremaeoidea	2	1	2	2
Licneremaeoidea				2
Oripodoidea	3	2	7	8
Ceratozetoidea	2	2	1	2
Oribatelloidea	1	1	1	3
Achipterioidea				2
Galumnoidea			1	1

*Andre, 1975, 1980, 1982, 1984

**Seniczak et al., 1993a, 1993b, 1995, 1997

***Niedbala, 1970

****Bragin, Tolstikov, 2002; Tolstikov, Bragin, 2002; Tolstikov, Bragin, Nekrasov, 2002; present paper

Abundance and Structural Organization of the Communities of Arboreal Oribatid Mites

Scots Pine

The complex of arboreal oribatid mites on the pine included 29 species from 21 families. The basis of the oribatid mite fauna on the pine was consisted of species inhabiting soil of the region: *C.segnis, E.kamaensis, E.oblongus, C.dentata, C.cf.bicultrata, C.bipilis, C.areolatus, T.velatus, O.cylindrica, O.nova, C.cf.opistodentata, O.tibialis, Z.exilis, Sch.laevigatus and L.singularis. Z.exilis* was the most abundant and was encountered along the whole tree trunk. However it was not numerous in the canopy (Table 3).

The greatest species diversity of oribatid mites (70%) was noted in the lowest part of the tree trunk, "komel", where 20 species of oribatid mites were recorded. Of those, *Z.exilis* comprised 55.5% (209

Table 3.

Species composition and abundance (ind/m^2) of arboreal oribatid mites inhabiting the Scots pine at various heights from the ground

Таблица 3.

Видовой состав и числеиность(экз/м^2) арбореальных панцирных клещей-обитателей сосны на разной высоте от поверхности почвы

Species	canopy						trunk			komel		
	zone 1		zone 2		zone 3							
	twigs	leaves	twigs	leaves	twigs	leaves	1	2	3	1	2	3
Camisia segnis							1		1	3		
Camisia spinifer							1			7		
Licnodamaeus undulatus							5			27		
Licnobelba alestensis							1			7		
Epidamaeus kamaensis							3					6
Epidamaeus sp.							3					6
Eueremaeus oblongus				1			6		2	7		3
Cultroribula dentata					2							
Cultroribula c.f. bicultrata							7			3	17	
Gustavia microcephala								4				
Carabodes areolatus							22			33	50	
Tectocepheus velatus			3	1	1		4	4		7		6
Oppia cylindrica					1	2	9	8		5		17
Oppiella nova							1			7		
Suctobelbella c.f. opistodentata							1	4		7		
Scapheremaeus palustris			10	1	20	1	2			10		
Micreremus gracilior	474	22	461	26	563	31	2	46	10	5		3
Licneremaeus licnophorus							2			8		
Passalozetes rugosus							3	2				7
Oribatula tibialis					2	1	3					6
Phauloppia sp.			3	2	38	5	3	8	1	3		3
Zygoribatula exilis			4		4	1	151	10	2	209	23	161
Zygoribatula friziae				2		1	7	8		7		12
Scheloribatidae gen.et.sp	4		3									
Scheloribates laevigatus					3		1			3		
Parakalumna lydia							3					6
Trichoribates trimaculatus					2		4	8		12		
Lepidozetes singularis	2						27	23		24	67	6
Larvae			21	4	5	12						
Nymphs	289	24	269	15	296	33	8	6	2	10		11

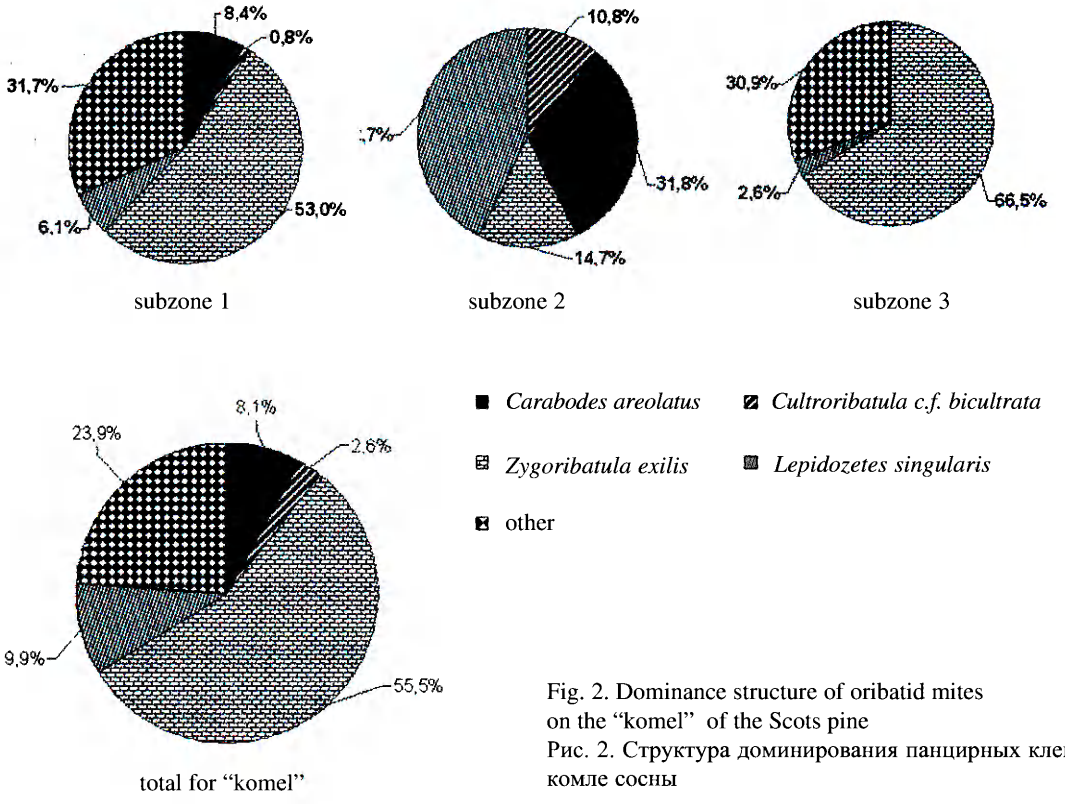

Fig. 2. Dominance structure of oribatid mites on the "komel" of the Scots pine
Рис. 2. Структура доминирования панцирных клещей на комле сосны

ind/m^2), *C.areolatus* — 8.1% (33 ind/m^2), and *L.singularis* — 9.9% (24 ind/m^2) (Table 3, Fig. 2). In all sub-zones of the "komel" these species presented the nucleus of the oribatid mite community. However, their abundance ratios were not constant. In the second "komel" sub-zone *L.singularis* had 42.7% (67 ind/m^2) and *C.areolatus* — 31.8%, whereas in the upper "komel" *Z.exilis* (66.5%) predominated. The abundance values of other species of oribatid mites were not high. Most of them can be attributed as residents and subresidents. At heights more than 2 m the abundance of *Z.exilis, C.areolatus* and *L.singularis* is getting low. In the upper parts of the tree two latter species were not found when *Z.exilis* abundance was only 2 ind/m^2. The only species, *M.gracilior*, was acquiring the dominant position at higher heights.

The species diversity and abundance values of oribatid mites in the Scots pine canopy were not similar to those on the trunk. In total 14 species of oribatid mites were found on twigs and leaves: *E.oblongus, C.dentata, T.velatus, O.cylindrica, S.palustris, M.gracilior, O.tibialis, Phauloppia* sp., *Z.exilis, Z.friziae, Sch.laevigatus,* Scheloribatidae gen.et sp.sp., *T.trimaculatus, L.singularis. M.gracilior* played the dominant role outnumbering other species (92.6% of the total oribatid mite abundance). Its abundance was not the same and was higher on twigs (474–563 ind/m^2) than on needles (22–31 ind/m^2) with the average values 510 ind/m^2 and 24 ind/m^2, respectively. Two supposedly new species were found in the phyllosphere: *Phauloppia* sp. and Scheloribatidae gen.et sp.sp. As it is seen from the Table 3, *Phauloppia* sp. was encountered both on the trunk (4%) and in the canopy (14%). The maximum abundance was recorded in the upper parts of the canopy (38 ind/m^2). The abundance of Scheloribatidae gen.et sp.sp. is very low (3–4 ind/m^2), with the frequency level being only 1%.

The pine-tree trunks were poorly covered by epiphytes, which were represented by 4 species of lichens: *Parmelia caperata, Hypogymnia tubulosa, Peltigera canina*, and *Evernia furfuracea (scobicena)*. Nine species of oribatid mites were recorded in the pine epiphytes (*E.kamaensis, C.areolatus, T.velatus, M.gracilior, Z.exilis, Z.friziae, T.trimaculatus, P.sphaericus*. The highest species diversity and abundance were discovered in the talli of *H.tubulosa* (7 species), and the lowest — in *P.canina* (1 species only). The average abundance of oribatid mites in epiphytes equaled 10 ind/m^2.

Common Birch

The species diversity of oribatid mites on the birch was 21 species out of 16 families. Fifteen species of oribatid mites were recorded on its

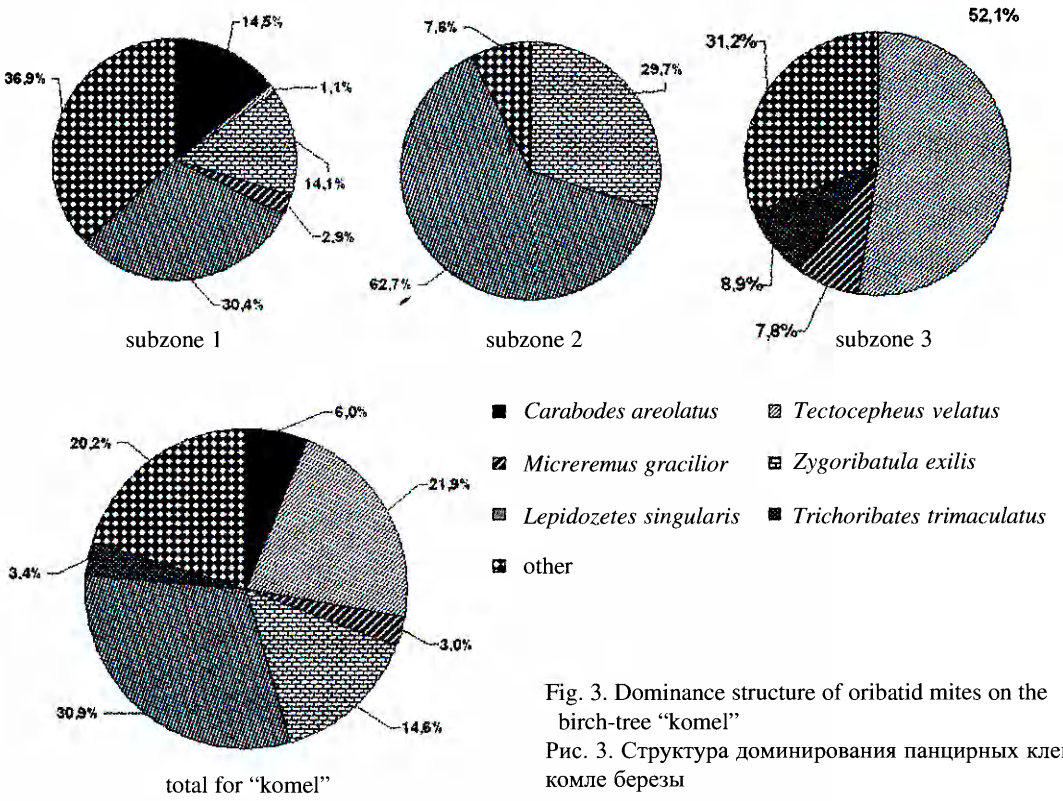

Fig. 3. Dominance structure of oribatid mites on the birch-tree "komel"
Рис. 3. Структура доминирования панцирных клещей на комле березы

"komel" where significant part of the oribatid mite community is made up by the typical forest litter-inhabiting species such as *E.kamaensis, C.bipilis, C.areolatus, T.velatus, L.licnophorus, P.rugosus, O.tibialis, Z.exilis, Z.firiziae, Sch.laevigatus, L.singularis* etc. (Table 4). Most these species were distributed only till the height 40 cm. In the middle part of the "komel" many species were not met anymore, several species became residents (*E.kamaensis, O.tibialis*). *L.singularis* (62.7%) and *Z.exilis* (29.7%) had the dominant position, composing 92.5% of the total oribatid mite abundance (Fig. 3). The abundance of these species varied from 10 ind/m^2 to 133 ind/m^2 for *L.singularis* and from 5 ind/m^2 to 63 ind/m^2 for *Z.exilis*. Unlike the Scots pine, *Z.exilis* (12 ind/m^2) presents together with *M.gracilior* (10 ind/m^2) in the upper parts of the birch tree trunk.

In the birch canopy *M.gracilior* comprised 98.5% of the total oribatid mite abundance. Its abundance was significantly low comparing to that of the pine tree (66 ind/m^2 on twigs and 6 ind/m^2 on leaves), which is possibly can be explained by the peculiarities of the plant itself. The maximum abundance of *M.gracilior* was recorded in zone 1 where it was 99 ind/m^2 on twigs and 5 ind/m^2 on leaves. The abundance levels of *Phauloppia* sp. and Scheloribatidae gen.et sp.sp. is low (about 1 ind/m^2).

Twenty-one species of oribatid mites were found in epiphytic mosses *(Bryum caespiticum, Brachytecium meldiana, Plagiothecium denticulatum)* and lichens *(Parmelia caperata and Hypogymnia tubulosa)* (Table 3). The greatest species diversity and abundance of oribatid mites were found in mosses comparing to lichens where there were recorded 19 species total. The highest value of species diversity (12 species) was noted for the epiphytic moss *B.caespiticum. C.areolatus, O.tuberculata* and *Z.exilis* are the dominant species, *E.kamaensis, S.c.f.opistodentata, P.sphaericus* are subdominant, and the rest are residents and subresidents.

Six species of oribatid mites were recorded in lichens: *C.areolatus, M.gracilior, Phauloppia* sp., *Z.exilis, Z.friziae, L.similis.* Quite often the only species dominated in the epiphytic lichen oribatid mite community, for example, *Z.exilis* in *P.caperata* (88%), *Z.friziae* in *H.tubulosa* (54%).

Heart-leafed Linden

The fauna of oribatid mites was represented by 20 species out of 14 families. Seventeen species of oribatids were found on "komel" (Table 5). Most of them are characteristic species of the soil litter. Several dominance groups can be attributed to the "komel" community: dominants *(E.kamaensis, C.areolatus, Z.exilis),* subdominants *(C.bipilis,*

Table 4.

Species composition and abundance (ind/m^2) of arboreal oribatid mites inhabiting the birch-tree at various heights from the ground

Таблица 4.

Видовой состав и числеииость(экз/м^2) арбореальиых панцирных клещей-обитателей березы на разной высоте от поверхности почвы

Species	canopy						trunk			komel		
	zone 1		zone 2		zone 3							
	twigs	leaves	twigs	leaves	twigs	leaves	1	2	3	1	2	3
Epidamaeus kamaensis							5				8	5
Epidamaeus sp.							2			4		3
Eueremaeus oblongus										6		
Ceratoppia bipilis							5					10
Carabodes areolatus							14			40		8
Tectocepheus velatus							51		2	3		100
Oppia cylindrica								3	1			
Suctobelbella c.f. opistodentata							1			4		
Scapheremaeus palustris									2			
Micreremus gracilior	99	5	49	12	56	4	7	23	10	8		15
Licneremaeus licnophorus							5			13		
Passalozetes rugosus							2			10		
Oribatula tibialis			1				4			5	8	
Phauloppia sp.			1					2				
Zygoribatula exilis				1			34	13	12	39	63	5
Zygoribatula friziae							6			18		
Scheloribatidae gen.et.sp					2							
Scheloribates laevigatus						1	9	2	5	22		8
Trichoribates trimaculatus							8					17
Lepidozetes singularis							72	25	1	84	133	10
Galumna obvia							8			20		11
Larvae			1		1		6	3	5	13		8
Nymphs	77	8	15	3	29	5	24	10	3	17	23	21

S.cf.opistodentata, S.palustris, Sch.laevigatus, O.reticulata), residents and subresidents. The most abundant species of the "komel" were *E.kamaensis* — 14.3% (30 ind/m^2), *Z.exilis* — 24.8 (25 ind/m^2) and *C.areolatus* — 13.8% (14 ind/m^2) (Fig. 4). Only 5 species of oribatid mites were found at heights higher than 2 m: *C.bipilis, S.palustris, M.gracilior, Z.exilis, Z.friziae*. The most abundant were *Z.exilis* (18 ind/m^2), *C.bipilis* (5–7 ind/m^2) and *Z.friziae* (6 ind/m^2).

M.gracilior was the dominant species composing 95% of the total mite abundance. Its average abundance was 73 ind/m^2 on twigs and 7 ind/m^2 on leaves. The greatest abundance of *M.gracilior* was recorded in the lower part of the canopy on twigs where it was 125 ind/m^2. There was a trend noted of decreasing the abundance of *M.gracilior* with the height from the soil litter. Several other species of oribatid mites were also present on twigs and leaves of the linden (*E.kamaensis, O.cylindrica, O.tuberculata, S.palustris, O.tibialis, Phauloppia* sp., *Z.exilis, O.reticulata, L.singularis, Galumna* sp.) but their abundance was significantly low comparing to *M.gracilior* (1 ind/m^2 total). They can be attributed as subresidents.

Sixteen species of oribatid mites were recorded in the epiphytes associated with linden: *E.kamaensis, E.oblongus, C.bipilis, C.areolatus, O.cylindrica, Q.quadricarinata, O.tibialis, Z.exilis, L.similis, Sch.laevigatus, P.sphaericus, O.berlesei, Parachipteria* sp., *L.singularis, Galumna* sp., Ptyctima. The maximum species richness of oribatid mites was found in the moss *B.caespiticum* where *Z.exilis* (36.1%), *Sch.laevigatus* (17.4%), *O.tibialis* (11%)

Table 5.
Species composition and abundance (ind/m^2) of arboreal oribatid mites inhabiting the heart-leafed linden at various heights from the ground
Таблица 5.
Видовой состав и численность(экз/м^2) арбореальных панцирных клещей-обитателей липы на разной высоте от поверхности почвы

Species	Canopy						trunk		komel		
	zone 1		zone 2		zone 3						
	twigs	leaves	twigs	leaves	twigs	leaves	2	3	1	2	3
Camisia segnis									11		
Belba sp.									9	3	5
Epidamaeus kamaensis				1					94	14	13
Epidamaeus sp.									5	4	7
Ceratoppia bipilis							5	7	11	11	9
Carabodes areolatus									3	50	25
Oppia cylindrica					1				2		
Oppia tuberculata					1						
Suctobelbella c.f. opistodentata									5		25
Scapheremaeus palustris				1				2	6		28
Micreremus gracilior	125	6	86	6	35	9	2	1			
Oribatula tibialis				1							
Phauloppia sp.					1						3
Zygoribatula exilis			4	1				18	59	29	60
Zygoribatula frisiae							6		11		
Scheloribates laevigatus									3	30	
Oribatella berlesei									183	4	
Oribatella reticulata				1					46		
Oribatella calcarata									2		
Trichoribates trimaculatus									6		
Lepidozetes singularis			4						13	4	
Galumna obvia			4							4	
Larvae									11	4	
Nymphs	82	2	85	1	23	3			13	9	19

and *C.areolatus* (9%) were dominating. Five species of oribatids (*E.kamaensis, C.areolatus, Sch.laevigatus, O.berlesei,* Ptyctima) were found in lichens. There were no significant differences in the dominance structure revealed in various species of lichens. The mite abundance values were also similar.

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The comparison of oribatid mite communities on different trees showed some differences as well as similarities between them. The maximum oribatid mite abundance values were shown for the Scots pine. The shared feature of the oribatid mite communities on all trees is the decrease of species diversity and abundance of oribatid mites with the height from the ground to the tree top. Each vertical zone has different characteristics of the species richness and abundance. Consequently, all tree-inhabiting oribatid mites can be divided into two groups: mites inhabiting tree trunk and those showing preference for the canopy (twigs and leaves).

The greatest species diversity was found in the lower part of the trunk (butt, or "komel") where 2/3 of all species were found. The nucleus of the "komel" communities was composed of three oribatid mite species irrespective of the tree species surveyed: *C.areolatus, Z.exilis* and *L.singularis*. However the frequency level and the dominance of these species are different. For example, *Z.exilis* is the most abundant species both on the pine-tree (56%) and the linden (25%) whilst *L.singularis* is most abundant species on the birch (30.9%). These

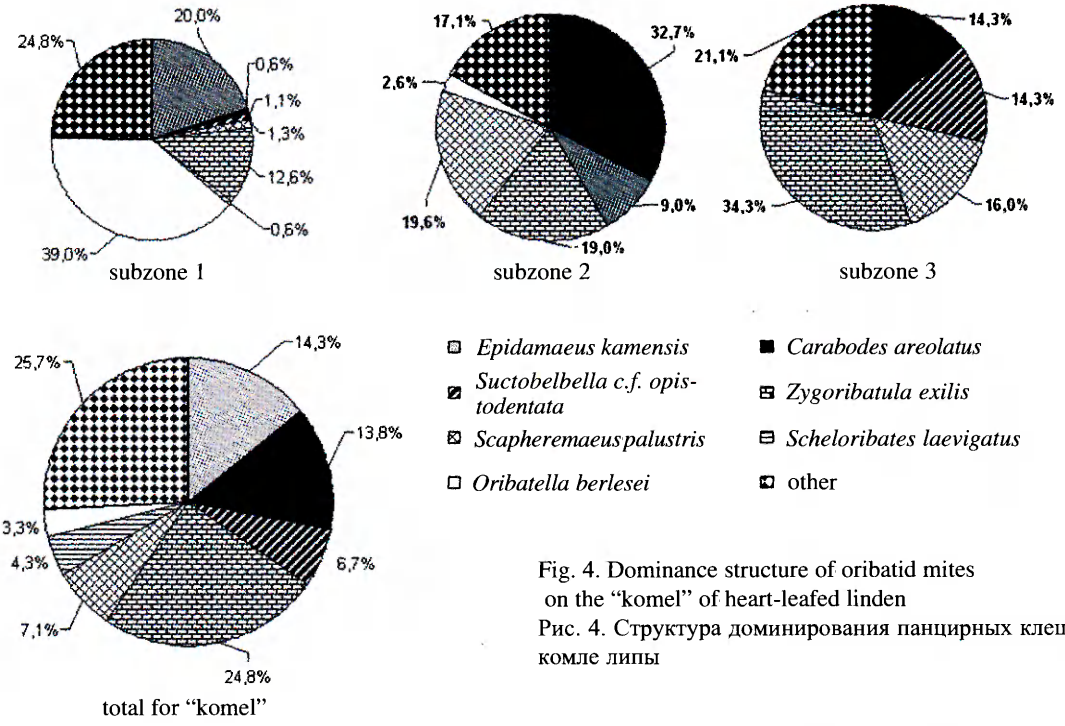

Fig. 4. Dominance structure of oribatid mites on the "komel" of heart-leafed linden

Рис. 4. Структура доминирования панцирных клещей на комле липы

data well correspond to those obtained by Seniszak and Dabrowski [1993, 1995, 1997], Dabrowski and Seniszak [2000] which showed that oribatid mite communities of the Scots pine include two dominant species: *Z.exilis* and *C.areolatus*. Most species of oribatid mites found on "komel" are represented by species, which are very common in the soil litter [Potemkina, 1941; Trave, 1963; Aoki, 1971; Shaldybina, 1956; Pavlichenko, 1994; Wunderle, 1992a]. In the spectrum of the "life forms" the non-specialized ubiquitous species predominate. At the heights exceeding 2 m most species of the "komel" cannot be found anymore, and two species, *M.gracilior* and *Z.exilis*, predominate.

According to Nicolai [1986, 1987, 1989, 1993] the high diversity of arthropods on the tree trunk can be explained by physical properties of the bark. The more cracks and scales are on the bark, the more favorable conditions are for the mite populations. Hypothetically the mite diversity should follow the raw: pine — linden — birch. Our data showed similar pattern: 29 species of mites were found on the Scots pine, 20 — on the linden, and 21 — on the birch-tree.

The canopy had the low species richness of oribatid mites. Fourteen species of oribatids were found in the pine canopy, 11 in the linden and 6 in the birch ones. The "face" of the oribatid mite community is represented by the single species of oribatid mites, *M.gracilior*, which accounts for 92 to 98% of the whole oribatid mite abundance. In some years its abundance reached 1144 ind/m^2 (2001). The density of mites on twigs was higher than that on leaves. Andre [1982] showed that the abundance value of *Camisia carrolli* is in the backward proportion to the squared distance to the tree top with the highest abundance of mites on the younger twigs.

Epiphyte mosses and lichen provide favorable conditions for oribatid mites supporting hygrothermic regime, which is close to that in the soil [Blum, 1965]. Twenty-nine oribatid mite species out of 15 superfamilies were recorded in epiphytes. The taxonomic composition of oribatid mites associated with different species of epiphytes was not the same. Most species of oribatid mites (21) were found in the *B.caespiticum* synusium, and the lowest species richness characterized the lichen *P.canina* (4). Highest values of the species richness were characteristic of the 1–2 sub-zones of the zone 1. With the higher positioning of the epiphyte on the tree trunk, the number of oribatid mite decreases. The species diversity of oribatid mites confined to epiphytes decreases in a raw: birch (21) > linden (19) > pine (9). The dominance structure of oribatid mites inhabiting epiphytic lichens and mosses is very similar. Most often *C.areolatus* and *Z.exilis* predominate. These species are often reported from the soil and litter [Krivolutsky, 1965], as well as on plants and epiphytes [Trave, 1963; Andre, 1975; Tarba, 1992]. The dominance of 1–2 species in epiphytes was earlier noted by Byazrov [1992],

Byazrov and Melekhina [1992, 1994] and Shtanchaeva [1997]. As it appears, the morphology of the epiphyte plays significant role in the mite community formation. This statement is supported by numerous works [Andre, 1975, 1982; Byazrov, Melekhina, 1992, 1994; Melekhina, 1999].

SUMMARY

Arboreal oribatid mites are the constant component of the arthropod communities associated with arboreal plant. The taxonomic composition and abundance of oribatid mites decrease with the height. The highest species richness and abundance of arboreal oribatid mites were recorded in the lower butt part of the tree, or "komel", where the arboreal mite community included many species migrating from the soil. The canopy community of oribatid mites was characterized by low species richness and the superdominance of the only species, *M.gracilior,* which accounted for more than 80% of the total oribatid mite abundance.

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