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# SPECIES COMPOSITION AND DISTRIBUTION OF ORIBATIDS (ACARI, ORIBATEI) IN URBANIZED BIOTOPES OF KYIV

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**Species Composition and Distribution of Oribatids (Acari, Oribatei) in Urbanized Biotopes of Kyiv. Shevchenko, O. S., Kolodochka, L. A.** — Species composition and dominance structure of oribatid species complexes on chosen plots in urbanized biotopes of Kyiv are established. Species sensitivity to anthropogenic factors is discussed.

K e y w o r d s: soil mites, species complexes, city.

**Видовой состав и распространение орибатид (Acari, Oribatei) в урбанизированных биотопах г. Киева. Шевченко А. С., Колодочка Л. А.** — Установлен видовой состав и структура доминирования видовых комплексов орибатид на выбранных участках в урбанизированных биотопах Киева. Обсуждаются вопросы чувствительности видов к влиянию антропогенных факторов.

К л ю ч е в ы е  с л о в а: панцирные клещи, видовые комплексы, город.

## Introduction

Oribatid mites (Acari, Oribatei) are one of the indicator groups in soil quality assessment. They are mostly soil dwelling arthropod detritophags, various and numerous in soil and plant litter. By far more than 12 thousand oribatid species (Norton, Behan-Pelletier, 2009) are described, 736 of them known in Ukraine (Yaroshenko, 2000). Soil mites are active in soil cover throughout the year and are organized into communities in occupied habitats. In each community there are increases and recessions in numbers of every species that should be considered in descriptions of their species composition.

Oribatids of urban parks and suburban woods were studied in Budapest, Hungary (Honciuc, 2009), of urban and suburban green areas in Warsaw, Poland (Niedbala et al., 1990) and in similar biotopes in Nizhny Novgorod, Russia (Ermilov, 2004), etc. There is a not insignificant amount of research of species composition and community structure of oribatids in urban coenoses of Ukraine (Yaroshenko, 2000; Shtirts, 2009; Ilika, 2010; Kononenko, 2010; Kolodochka, Shevchenko, 2013 a, b, etc.). Shared impoverishment of species diversity concerning oribatid mites is shown for cities from different climate zones (Ermilov, Chistiakov, 2005; Kononenko, 2010, etc.). Seasonal changes of oribatid communities were studied in different biotopes (e. g., Grishina, 1970; Badejo, 1990).

Considering the economic value (including indicator one) of oribatid mites, this research aimed to study their species composition and structure of species complexes in Kyiv urban coenoses.

## Material and methods

Samples of soil and litter were taken in April–September 2011, in local plots of Kyiv territory in several types of green areas.

Six plots were chosen in mixed forests (large green areas) on the outskirts of the city: forest of Puscha-Voditsa; Syretsky Dendrological Park; Golosiivsky National Nature Park; Park of Partizanska Slava; Nature Objects “Suhi Gory” and “Theofania” (the latter three are mostly coniferous).

Fourteen plots were in small parks and squares. Some of the parks (T. Shevchenko, Mariinsky, “Nyvky”, “KPI”) and squares (at Gongadze str., Herzen str., Mostitsky str., Smilansky str., as well as near the “Spartak” stadium and at the “Kyivska Rus” cinema theatre) are situated at or near the city center. Two other areas are relatively recently established on the outskirts of the city: Molodizhny park (installed in 1988 at housing area

"Troeschina"), Druzhby Narodiv square (planted in 1983 at housing area "Obolon"). Also plots in green area alongside subway station "Darnitsa" and a nearby park of Darnitsky silk factory are included in this group.

Six plots were chosen in roadside lawns in Sviatoshin district, previously assessed for heavy metal soil pollution (Zhovinskij, Kuraeva, 2002).

Four plots were chosen in Kyiv cemeteries of different age: Bajkove, Darnitske, Lisove and Lukjanivske.

And lastly, samples were taken from the A. V. Fomin Botanical Garden and the M. M. Gryshko National Botanical Garden.

The mites were extracted from samples using Berlese funnels into 70 % ethanol or 30 % glycerine and mounted on slides with Hoyer's liquid using microscopes MBS–9 (USSR) and MPI–5 (Poland). Species were identified with (Key…, 1975; Pavlichenko, 1994; Sergienko, 1994).

Statistical analysis was carried out in Microsoft Excel 2003 and PAST. To compare total species diversity cluster analysis was used. For quantitative comparison of species status in a community, Paliy–Kovnatsky index (relative dominance of a species in a community) was applied: more than 10 % — dominant species; from 1 to 10 % — subdominant; from 0.1 to 1 % — subdominant of the first order; less than 0.1 % — secondary member of community (Shitikov et al., 2003). Morphoecological types were ascertained according to Krivolutsky (1965).

## Results and discussion

In total, about 26,000 adult mites were identified to species or genus level (in case of Oppioidea) resulting in 123 species of 81 genera of 50 families. Of course, it is not the total real species composition and distribution of oribatids that would require further studies. Samples from forest plots contained the majority of species diversity (117); samples from parks and squares and from cemeteries were distinctly poorer (77 and 72 oribatid species respectively). Oribatid diversity in soil and litter samples from roadside lawns and botanical gardens were 25 and 32 species. The reason for unexpectedly low species diversity of soil mites in botanical gardens is possibly that the samples were taken in dry hot May and July 2011 at the time of depressed activity of mites.

Groups of species that were similarly distributed in five types of green areas (see Material and methods) were identified using cluster analysis (fig. 1). Data on Lower Oribatida out-of-Kyiv distribution taken from Sergienko (1994).

1. Species found everywhere: *Epilohmannia cylindrica cylindrica*; *Tectocepheus velatus*; *Oribatula tibialis*; *Protoribates capucinus*; *Oppia* spp.; *Suctobelbella* spp.; *Trichoribates novus*; *Ceratozetes mediocris*; *Chamobates cuspidatus*. Most of them are eurytopic. In this study, they are dominant or subdominant in communities. *E. cylindrica cylindrica* is partial to steppe biotopes, woodland belts and parks of southern and Lviv Region of Ukraine (according to study cited above).
2. Oribatids not registered in roadside lawns: *Furcoribula furcillata*; *Hermaniella dolosa*; *Hypodamaeus riparius*; *Metabelba papillipes*; *Eporibatula rauschenensis*; *Protoribates longior*; *Zygoribatula frisiae*; *Scheloribates laevigatus*; *Liacarus brevilamellatus*; *Cymbaeremaeus cymba*; *Quadroppia quadricarinata*; *Eupelops torulosus*; *Peloptulus phaenotus*; *Punctoribates mundus*; *Galumna* spp. Some of these species are dwellers of thick layers of litter not found in lawns that lack suitable amount of detritus. The genera *Zygoribatula*, *Protoribates*, *Punctoribates* are presented by other species (of same genera) in the soils of lawns. Some species (*S. laevigatus*, *Galumna* spp., *Z. frisiae*) are dominant or subdominant in their communities. mites
3. In forests, parks, squares, cemeteries and lawns, *Euphthiracarus monodactylus*, *Steganacarus personatus*, *Mesotritia nuda*, *Liochthonius brevis*, *Acrotritia ardua affinis*, *Trhypochthonius conspectus*, *Zygoribatula terricola ucrainica*, *Tectoribates ornatus*, *Punctoribates punctum*, *Neoribates auranthiacum*, *Pilogalumna allifera*, *Acrogalumna longipluma* and *Scutovertex sculptus* are detected. Some of them, *Z. t. ucrainica* (eurytopic cosmopolite), *P. punctum* (small soil pores dweller) and *P. allifera* (litter dweller) are frequently dominants or subdominants in communities.
4. In forests, parks, squares and botanical gardens *Hypochthonius rufulus rufulus*, *Arthrodamaeus femoratus*, *Eupelops acromios*, *Achipteria coleoptrata* and *Ceratozetes gracilis* are spotted. The former is non-specific in choice of substrate and is common in forests

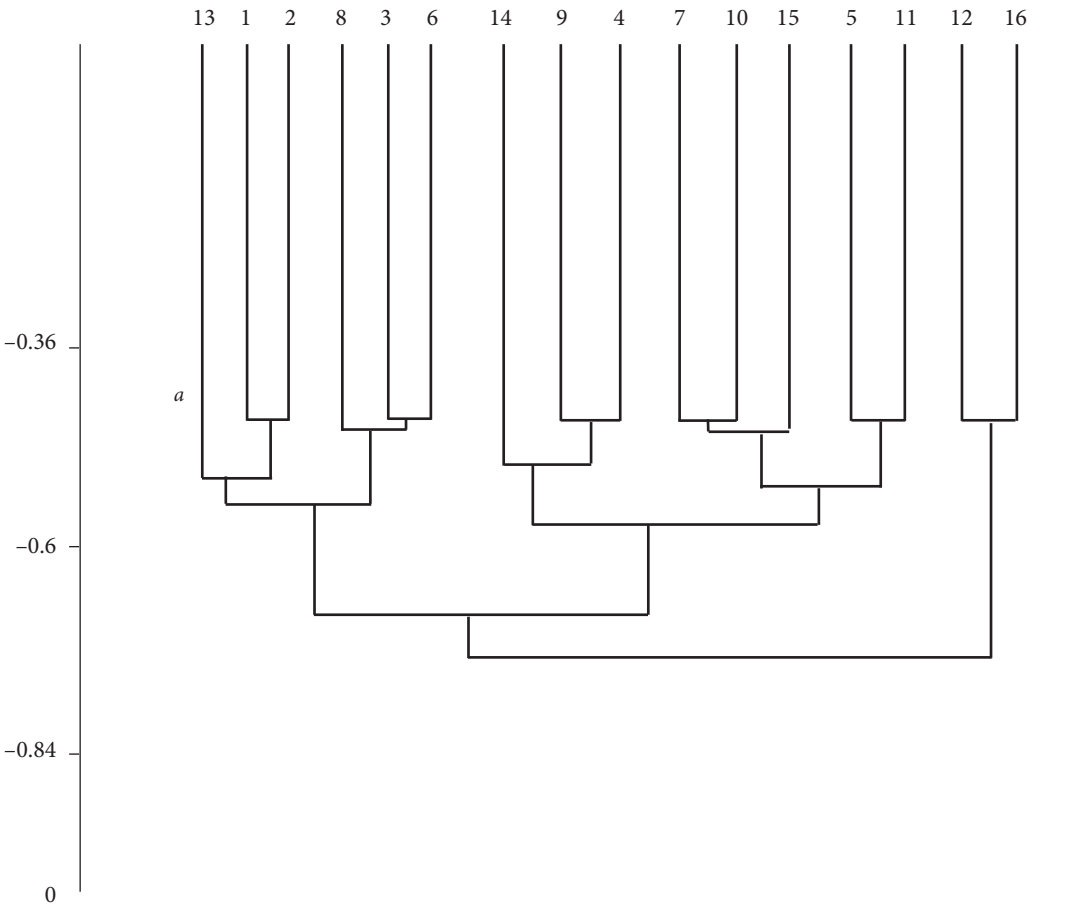


Fig. 1. Cluster analisys of oribatid species composition in urbanized biotopes of Kyiv, Ukraine (groups 1—16 are given in Results and discussion).

Рис. 1. Кластерный анализ видового состава орибатид урбанизированных биотопов г. Киева (группы 1—16 расшифрованы в рубрике Результаты и обсуждение).

and forest parks. Other species are of the litter dwelling forms. The most common of them is panphytophagous *A. coleoptrata*.

5. Forests, botanical gardens and cemeteries share only *Dorycranosus moraviacus*.
6. In forests, parks, squares and lawns, *Brachychochthonius furcatus* is recorded. Previously, G. Sergienko (1994) found this species in pine litter in Puscha-Voditsa forest.
7. In forests, lawns and cemeteries, *Microppia* (*Oppia*) *minus* is detected. The presence of this species (a dweller of small soil pores) possibly indicates sandy surface horizons of soil.
8. In forests, parks, squares and cemeteries, common *Phthiracarus pallidus* and *Sellnickochthonius immaculatus* are found, along with *Hipochthoniella minutissima*, *Liochthonius propinquus*, *Microtriria minima*, *Nothrus biciliatus*, *Camisia biverrucata*, *Gimnodamaeus bicostatus*, *Micreremus gracilior*, *Autogneta longilamellata*, *Eremaeus silvestris*, *Spatiodamaeus subverticillipes*, *Liacarus coracinus*, *Xenillus tegeocranus*, *Chamobates pusillus*, *Chamobates subglobulus*, *Xiphobates kieviensis*, *Xiphobates spinosus*, and *Carabodes areolatus*. *M. minima* is known to prefer more decomposed litter than *Phthiracarus* sp.
9. Only in forests, parks, and squares, a lot of the Lower Oribatida *(Euphthiracarus cribratus*, *Liochthonius horridus*, *Nothrus borussicus*, *Steganacarus punctulatus*, *Steganacarus serratus*, *Nanhermannia nana)* and some of the Liacaroidea (*Gustavia microcephala*,

*Liacarus vombi*, *Xenillus discrepans*), along with *Punctoribates zachvatkini*, *Carabodes forsslundi* and arboreal *Scapheremaeus palustris*, are recorded.

10. Only in forests and cemeteries, *Nothrus silvestris*, *Platynothrus peltifer*, *Hafenrefferia gilvipes*, *Cultrotibula bicultrata*, *Adoristes poppei*, *Birsteinius perlongus*, *Licnodamaeus pulcherrimus*, *Ceratozetes macromediocris*, *Fosseremeus laciniatus* and eurytopic *Oppiella nova* were found.
11. In forests and botanical gardens, *Mesoplophora pulchra* (previously classified by G. Sergienko as rare) along with (?) *Phthiracarus laevigatus* are discovered.
12. In cemeteries and lawns, *Oribatella calcarata* is found.
13. In parks, squares and botanical gardens, *Ctenobelba pectinigera* occurs.
14. Only in parks and squares, *Oribatella berlesei* and (?) *Ceratozetes helenae* are found.
15. Only in forests, a lot of Lower Oribatida species (*Ephuthiracarus reticulates*, (?) *Phthiracarus spadix*, *Liochthonius plumosus*, *Liochthonius sellnicki*, *Brachychochthonius hungaricus*, *Brachychochthonius subcricoides*, *Brachychochthonius suecicus*, *Steganacarus carinatus*, *Steganacarus striculus*, *Malaconothrus egregius*, *Hermannia gibba*) and *Liodes theleproctus*, *Poroliodes farinosus*, *Birsteinius clavatus*, *Ceratoppia quadridentata*, *Zetorchestes micronichus*, *Zetorchestes saltator*, *Belorchestes sp.*, *Belorchestes planatus*, *Suctobelba* sp., *Suctobelba aliena*, *Oribatella ornata*, *Oribatella sexdentata*, *Minunthozetes pseudofusiger*, *Licnodamaeus undulatus*, *Licneremaeus licnophorus*, *Carabodes minusculus* and *Cepheus cepheiformes* were registered.
16. Only in cemeteries *Fuscozetes fuscipes* and *Multioppia* sp. are found.

Similarity of species compositions of ecological groups of oribatids that are associated with green areas of urbanized Kyiv biotopes (in PAST) is given on fig. 1.

Oribatid species diversity in urban greenery depends firstly on habitat characteristics as in natural coenoses. Klausnitzer (1990) described for several taxa decrease in species diversity from outskirts of a city inwards, which is also true in this case. The poorest species diversity for this group was in our case found in plots in small green areas and lawn-like habitats.

All in all, maximal levels of species diversity are observed in July–August. In May and September decreasing numbers of oribatid mite species are registered. It cannot be explained only by withdrawal of litter because the trends remained the same in plots in forests, where no such relocation occurs. Numbers of species in small green areas nearer to the city centre during sampling did not exceed the level of species diversity in Syretsky Dendrological Park (a large green area) in May.

In this study, the species composition of oribatids from forests is considered primary. With transformation of forests into various urbanized biotopes, the rich species complex loses some species or their groups (or they become undetectable due to low numbers). Thus there are several transformation levels of oribatid community in the city.

1. Semi–natural "forest park" level is located on the outskirts of the city in areas under least anthropogenic pressure. The level is characterized by high diversity of the Lower Oribatida and representatives of the Higher Oribatida families (Carabodidae, Suctobelbidae, Zetorchestidae, Liacaridae and Oribatellidae). There are also representatives of rare and species-poor families of Cepheidae, Liodidae, Licneremaeidae, and Ceratoppiidae. All of the morphoecological forms of oribatids were found here. In the dominance structure, there are subdominants, subdominants of the first order and secondary community members; in half of the cases, there are dominants.
2. "Meadow" level is observed in parks, squares and on cemeteries characterized by middle oribatid species diversity. However, there are certain differences between "meadow" oribatid communities of parks and squares and these of cemeteries. In the first case, species diversity of the Lower Oribatida is higher. Also, the superfamily Liacaroidea is represented by different species spectra in these communities. At last in parks and squares, a surface dwelling *Oribatella berlesei* can be found, whereas in cemeteries, the

genus is represented by *O. calcarata*. Dominance structures always included dominant and subdominant species. Only the oribatid communities of relatively large parks contained secondary community members. There were not many species common for all of the plots while species diversity ranged from 9 to 49, which is similar to findings on oribatid mites from parks of Budapest (Honciuc, 2009).

Of species common for "forest park" and "meadow" biotopes, *M. gracilior* is arboreal, whereas *C. areolatus*, *C. pusillus*, *C. subglobulus*, *G. bicostatus*, *E. silvestris*, *S. subverticillipes*, *L. coracinus* and *X. tegeocranus* are litter dwellers.

3. "Lawn" level of transformation of oribatid communities has the lowest species diversity. Morphoecological forms are represented by soil pores dwellers, litter dwellers and secondarily unspecialized cosmopolites. There was no presupposed correlation between species composition, dominance structure of oribatid communities and varying levels of total soil pollution previously mapped by Zhovinskij, Kuraeva (2002).

   Secondary community members are present in that dominance structure only if there is a thick litter layer in the habitat; typically, there are subdominants and dominants or subdominants of the first order.
4. Oribatid communities of botanical gardens would need further research. Due to regulated litter accumulation in uncharacteristic plant species complexes, botanical gardens are disturbed habitats with environmentally unique fragmented microbiotopes. Thus research of their soil fauna is complicated and requires more primary data for analysis, particularly from different seasons.

Level of urbanization of the habitat determines the dominance structure of oribatid communities. In "forest park" communities as in forests if the habitat is mostly undisturbed all of the dominance ranks would be filled. In "meadow" and "lawn" oribatid communities secondarily community members tend to disappear if there are dominant species.

Seasonal changes in species complexes were studied on the third of plots and revealed the instability of dominance structures. The secondarily unspecialized forms dominated. Increase of species diversity in July and August was followed by growing numbers of subdominant, subdominant of the first order and secondary community members.

## Conclusion

Oribatid species complexes in natural and mostly replanted forests surrounding Kyiv city are characterized by the highest species diversity. There are both eurytopic species that rate dominant and subdominant in communities and numerous species of other preferences that are subdominant of the first order and secondary community members. Every morphoecological form is represented by several species.

Soil mite communities of small green areas topographically isolated by megapolis development maintain lesser species diversity. The dominant species are frequently present even in times of highest species activity (spring and autumnal months) in their dominance structures. Species diversity of these communities is meadow-like. Oribatid species that are representatives of forest litter are in these communities divided into three groups: 1 — specific to parks, squares and cemeteries; 2 — specific to parks and squares; 3 — specific to cemeteries.

Lawns and lawn habitats host the least oribatid species diversity, comprised of soil pores dwellers, litter dwellers capable of digging soil and secondarily unspecialized forms. No correlation between oribatid species diversity and level of total soil pollution were found. It seems more likely that air pollution and thickness of litter layer play more important role in functioning of oribatid communities than heavy metal soil pollution.

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