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ON THE FAUNA OF GAMASID MITES OF THE GENERA *ANYSTIPALPUS* AND *ANTENNOSEIUS* (MESOSTIGMATA, ASCIDAE) OF THE EASTERN UKRAINE

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On the Fauna of Gamasid Mites of the Genera *Anystipalpus* and *Antennoseius* (Mesostigmata, Ascidae) of the Eastern Ukraine. Trach V. A. — The local fauna of mites of the genera *Anystipalpus* and *Antennoseius* in "Streltsovskaya steppe" branch of Lugansk Nature Reserve was studied. The aspects of phoresy mites on carabids and the quantitative data of phoresy are reviewed. 334 specimens of 36 carabid species were examined. Seven species of mites of these genera (*Anystipalpus livshitsi*, *A. stepposus*, *Antennoseius bullitus*, *A. dungeri*, *A. kamalii*, *A. pannonicus*, *A. ponticus*) were found on 16 species of carabids. *A. kamalii* are recorded for the first time for Europe and Ukraine. *A. livshitsi* collected from 13 species of carabids, other species of mites were found on 1–6 species of beetles. The index of dominance of certain species of mites is 0.2–81.4 %, the index of occurrence — 0.4–20.6 %. The maximum values of the intensity of mites invasion (phoresy) was observed for *A. livshitsi* (8.0) and *A. bullitus* (8.2). Up to 72 mite specimens were observed on one specimen of beetle. Simultaneous phoresy (synphoresy) of mites of these genera are registered for the first time. It is suggested that mites are weakly associated with certain taxa of ground beetles, and more associated with certain size group of carabids and probably with their habitats.

Key words: Mesostigmata, *Anystipalpus*, *Antennoseius*, Ukraine, phoresy, Carabidae.

К фауне гамазовых клещей родов *Anystipalpus* и *Antennoseius* (Mesostigmata, Ascidae) Восточной Украины. Трач В. А. — Изучена локальная фауна клещей родов *Antennoseius* и *Anystipalpus* на территории отделения «Стрельцовская степь» Луганского природного заповедника. Рассмотрены особенности форезии клещей на жуках-жужелицах и количественные показатели форезии. Изучено 334 экз. жужелиц 36 видов. На 16 видах жужелиц выявлено 7 видов клещей этих родов (*Anystipalpus livshitsi*, *A. stepposus*, *Antennoseius bullitus*, *A. dungeri*, *A. kamalii*, *A. pannonicus*, *A. ponticus*). Впервые для фауны Украины и Европы отмечается *A. kamalii*. *A. livshitsi* был собран на 13 видах жужелиц, другие виды клещей обнаружены на 1–6 видах жуков. Индекс доминирования отдельных видов клещей составлял 0,2–81,4 %, индекс встречаемости — 0,4–20,6 %. Максимальные значения индекса инвазии (форезии) наблюдались у *A. livshitsi* (8,0) и *A. bullitus* (8,2). На одном экземпляре жука отмечено до 72 экз. клещей. Впервые зарегистрирована совместная форезия клещей данных родов. Сделано предположение, что клещи слабо связаны с конкретными таксонами жуков-жужелиц, а больше связаны с конкретными размерными группами жужелиц и, возможно, их местами обитания.

Ключевые слова: Mesostigmata, *Anystipalpus*, *Antennoseius*, Украина, форезия, Carabidae.

Introduction

Taxonomic position of the genera *Anystipalpus* Berlese, 1911 and *Antennoseius* Berlese, 1916 was a subject of discussion for a long time. *Anystipalpus* and *Antennoseius* were considered by most authors worldwide to be members of the family Ascidae currently (Lindquist, Moraza, 2009; Lindquist et al., 2009). This family comprises 17 genera and 338 species (Beaulieu et al., 2011) worldwide. Ascid mites occur in soil-litter habitats, compost, under tree bark, bracket fungi. Many species and genera are closely associated with arthropods. Most species of the family are predators, but some are mycophagous (Gwiazdowicz, 2007; Lindquist et al., 2009).

The genera *Anystipalpus* and *Antennoseius* are similar in morphology (by the presence of two dorsal shields, chaetotaxy of legs, absence of prominent posterolateral tubercles on opisthonotal shield, absence of pretarsus and claws on the legs I in most species) and biology (phoresy on insects). These genera together include about 65–70 species. Probably, some *Antennoseius* species must be transferred to the genus *Anystipalpus*. Mites of these genera were reported from soil-litter habitats (soil, moss, humus, salt marshes, and nests

of rodents), females of many species are phoretic under the elytra of carabid beetles and very rarely on other insects (earwigs, leaf beetles). Some species are found both on insects and in the soil. Some Nearctic species of the subgenus *Vitzthumia* Thor, 1930 of the genus *Antennoseius* and some Palaearctic species of the nominative subgenus show dimorphism of free-living edaphic and phoretic females (Lindquist, Walter, 1989; Beaulieu et al., 2008; personal observations). This suggests the presence of conspecific forms of mites and synonymy in this genera.

Fauna of the genera *Anystipalpus* and *Antennoseius* of Ukraine is rich and studied in comparison with the faunas of other world countries due to researches several acarologists, especially M. M. Eidelberg. Currently, 3 species of the genus *Anystipalpus* and 17 species of the genus *Antennoseius* are known to occur in Ukraine: *Anystipalpus livshitsi* (Eidelberg, 1989), *A. percicola* Berlese, 1911, *A. stepposus* Trach, 2012, *Antennoseius* (*Vitzthumia*) *multisetus* Eidelberg, 2000, *A.* (*V.*) *ovaliscutalis* Eidelberg, 2000, *A.* (s. str.) *avius* (Karg, 1976), *A.* (s. str.) *bacatus* Athias-Henriot, 1961, *A.* (s. str.) *borussicus* Sellnick, 1945, *A.* (s. str.) *bullitus* Karg, 1969, *A.* (s. str.) *dungeri* Karg, 1965, *A.* (s. str.) *longisetosus* Eidelberg, 2000, *A.* (s. str.) *maltzevi* Eidelberg, 1994, *A.* (s. str.) *masoviae* Sellnick, 1943, *A.* (s. str.) *ponticus* Tratsch et Makarova, 2008, *A.* (s. str.) *pseudospinosus* Eidelberg, 1990, *A.* (s. str.) *sharonovi* Eidelberg, 1989, *A.* (s. str.) *vysotskajae* Skljar, 1994 (Bregetova, 1977; Balan; 1980; Eidelberg, 1989, 1990, 1994, 2000; Sklyar, 1994, 2001; Trach, Makarova, 2008; Trach, 2012).

Most of the publications about genera *Anystipalpus* and *Antennoseius* are the descriptions of new species. Information about phoresy on the beetles, particularly about their phoronts species, about quantitative data of phoresy, etc. is occasional.

The aim of this work was to study the local fauna of mites of the genera *Anystipalpus* and *Antennoseius* (on example of "Streltsovskaya steppe" branch of Lugansk Nature Reserve), and aspects of phoresy mites on carabid beetles. The quantitative data of phoresy mites of the genera *Antennoseius* and *Anystipalpus* considered for the first time.

Material and methods

Carabid beetles were collected in July 2010 in the «Streltsovskaya steppe» branch of Lugansk Nature Reserve (vicinity of Krinichnoe village, Melovskoj district, Lugansk Region; 49°18′ N 40°-+05′ E). Most of the beetles were sampled using an UV lamp (mercury tungsten blended lamp or mercury vapor lamp), some specimens were collected using Barber traps. Ground beetles transferred into vials containing 70 % ethyl alcohol, later they were examined with aid of a microscope MBS−9. A total of 334 specimens of 36 carabid species were examined for mites. Most mites were located on the inner side of the elytra of beetles and, rarely, in the folds of the wings or on the tergites. Collected mites were mounted on slides in Hoyer's medium. 80 permanent preparations of 562 mite specimens were made. Morphology of mites was studied with aid of a stereomicroscope Mikmed-1 Lomo with binocular head AU−12. Microslides are deposited in the collections of the Department of Zoology, I. I. Mechnikov Odessa National University, host beetles in the author's collection and the collection of Schmalhausen Institute of Zoology, NAS of Ukraine (Kyiv, Ukraine). The quantitative data of phoresy (the index of dominance, the index of occurrence, and the intensity of invasion (phoresy)) was derived by Beklemishev (1961). Carabids taxonomy follows Kryzhanovskij et al. (1995).

Results and discussion

Seven species of mites of the genera *Anystipalpus* and *Antennoseius* were found on 334 specimens of carabid beetles.

Mites were found on 16 species of carabids (the number of recorded species of mites indicated in parentheses): *Amara consularis* (Duftschmid, 1812) (3), *Curtonotus aulicus* (Panzer, 1797) (1), *Calathus fuscipes* (Goeze, 1777) (2), *C. halensis* (Schaller, 1783) (1), *Harpalus anxius* (Duftschmid, 1812) (1), *H. atratus* Latreille, 1804 (1), *H. calceatus* (Duftschmid, 1812) (4), *H. caspius* (Steven, 1806) (1), *H. distinguendus* (Duftschmid, 1812) (2), *H. froelichi* Sturm, 1818 (4), *H. griseus* (Panzer, 1796) (1), *H. rufipes* (De Geer, 1774) (1), *H. zabroides* (Dejean, 1829) (3), *Ophonus azureus* (Fabricius, 1775) (3), *O. diffinis* Dejean, 1829 (4), *O. sabulicola* (Panzer, 1796) (1).

Mites were not found on 20 species of carabid beeles (the number of examined carabid specimens indicated in parentheses): *Agonum lugens* (Duftschmid, 1812) (1), *A. nigrum* Dejean, 1828 (1), *A. thoreyi* Dejean, 1828 (2), *Amara aenea* (De Geer, 1774) (7), *A. bifrons* (Gyllenhal, 1810) (3), *Brachinus crepitans* (Linnaeus, 1758) (2), *Calosoma auropunctatum* (Herbst, 1874) (1), *C. denticolle* Gebler, 1833 (1), *Carabus errans* Fischer von Waldheim, 1823 (6), *C. hungaricus* Fabricius, 1792 (4), *C. violaceus* Linnaeus, 1758 (1), *Harpalus affinis* (Schrank, 1781) (5), *H.* sp. (2), *Omophron limbatus* (Fabricius, 1777) (1), *Ophonus puncticeps* (Stephens, 1828) (7), *O. rupicola* (Sturm,

1818) (2), *Pterostichus macer* (Marsham, 1802) (1), *P. melanarius* (Illiger, 1798) (1), *Stenolophus proximus* Dejean, 1829 (5), *Zabrus spinipes* (Fabricius, 1798) (4).

The mite species of the genera *Anystipalpus* and *Antennoseius* are listed below.

Anystipalpus Berlese, 1911
Anystipalpus livshitsi (Eidelberg, 1989)

Material. 458 ♀, collected from 13 species of carabids (*Amara consularis*, *Curtonotus aulicus*, *Calathus fuscipes*, *C. halensis*, *Harpalus atratus*, *H. calceatus*, *H. caspius*, *H. distinguendus*, *H. froelichi*, *H. griceus*, *H. rufipes*, *H. zabroides*, *Ophonus diffinis*).

The species is known from Ukraine (Crimea, Donetsk and Poltava Regions), Moldova, Kazakhstan and Iran. Mites were found on 29 species of 16 genera of carabid beetles (*Acinopus*, *Amara*, *Anisodactylus*, *Brachinus*, *Broscus*, *Calathus*, *Chlaenius*, *Curtonotus*, *Cymindis*, *Dinodes*, *Harpalus*, *Licinus*, *Ophonus*, *Poecilus*, *Pterostichus*, *Zabrus*) (Eidelberg, 1989; Sklyar, 1994; Lindquist, Moraza, 2009).

Anystipalpus stepposus Trach, 2012

Material. 9 ♀, collected from 4 species of carabids (*Harpalus calceatus*, *Ophonus azureus*, *O. diffinis*, *O. sabulicola*).

This species is known only from the type series of 9 these specimens (Trach, 2012).

Antennoseius Berlese, 1916
Antennoseius* (*Vitzthumia*) *kamalii Moraza et Kazemi, 2009

Material. 1 ♀, collected from *Ophonus diffinis*.

The species known only from the type series from Iran previously. Mites were found on *Bembidion* cf. *turkestanicum* Fassati, 1957 and *Harpalus distinguendus* (Duftschmid, 1812) (Moraza, Kazemi, 2009). The species is new to the fauna of Europe and Ukraine.

Antennoseius* (s. str.) *bullitus Karg, 1969

Material. 74 ♀, collected from 5 species of carabids (*Calathus fuscipes*, *Harpalus anxius*, *H. froelichi*, *H. zabroides*, *Ophonus azureus*).

This species is known from soil-litter habitats from the Central Europe, Ukraine (Cherkasy Region), Kazakhstan, Siberia (Balan, 1980; Karg, 1993; Gwiazdowicz, 2007, and others).

Antennoseius* (s. str.) *dungeri Karg, 1965

Material. 16 ♀, collected from 6 species of carabids (*Amara consularis*, *Harpalus calceatus*, *H. distinguendus*, *H. froelichi*, *H. zabroides*, *Ophonus azureus*).

This species is known from soil-litter habitats and carabid beetles (without specifying the species) from the Central and North Europe, Ukraine (Donetsk Region) (Karg, 1993; Sklyar, 2001 et al.).

Antennoseius* (s. str.) *pannonicus Willmann, 1951

Material. 3 ♀, collected from 3 species of carabids (*Amara consularis*, *Harpalus calceatus*, *Ophonus diffinis*).

This species is known from soil-litter habitats and carabid beetles (without specifying the species) from the Central Europe, Ukraine (Poltava Region), Moldova, the North America (Eidelberg, 1989; Lindquist, Walter, 1989; Karg, 1993; Sklyar, 1994).

Antennoseius* (s. str.) *ponticus Tratsch et Makarova, 2008
Material. 2 ♀, collected from *Harpalus froelichi.*

The species known only from the type series from Odessa and Mykolaiv Regions of Ukraine previously. Mites were found on carabids (*Harpalus serripes* (Quensel, 1806), *Amara* sp.) and leaf beetle *Chrysolina gypsophilae* (Küster, 1845) (Trach, Makarova, 2008).

The quantitative data of phoresy mites on carabid beetles presented on the tables 1–3. On 8 of the 16 species of carabids which were found mites of genera *Antennoseius* and *Anystipalpus*, registered only one mite species, on two species of carabids were recorded two species of mites, on three species of carabids — three species of mites, on the other three species of carabids — four species of mites.

The maximum value of the index of dominance was observed for mite *Anystipalpus livshitsi* (81.4 %), the next value was observed for *Antennoseius bullitus* — 13.2 %. The values of the index of dominance of other species stood from 0.2 to 2.8 %. *Anystipalpus livshitsi* collected from 13 species of carabids. Other species of mites was found on 1–6 species of beetles (table 1).

The index of occurrence of certain species of mites stood from 0.4 % at *Antennoseius kamalii* and *A. ponticus* to 20.6 % at *Anystipalpus livshitsi*. For certain species of mites on the eight most abundant species of beetles (n > 10), the index of occurrence stood from 1.1 to 33.3 % (table 2).

The intensity of mites invasion (phoresy) of carabids stood from 1.0 to 8.2. The maximum values was observed for mites *Anystipalpus livshitsi* (8.0) and *Antennoseius bullitus* (8.2). On the one specimen of beetle (*Harpalus rufipes*) was observed up to 72 specimens of the mites (*Anystipalpus livshitsi*) (table 3).

In 91.25 % of cases (73 of 80) only one species of mite was found on the beetle, in 8.75 % of cases (7 of 80) simultaneous phoresy of two species of mites (*Anystipalpus livshitsi* and *Antennoseius dungeri*, *A. livshitsi* and *Antennoseius bullitus*, *Antennoseius pannonicus*

Table 1. Number of studied specimens of carabids, mites and the index of their dominance
Таблица 1. Количество изученных жуков-жужелиц, клещей и индекс их доминирования

Species of carabids	Number of carabid specimens (total number/ with mites)	Number of mites species							
		A. livshitsi	*A. stepposus*	*A. kamalii*	*A. bullitus*	*A. dungeri*	*A. pannonicus*	*A. ponticus*	All species of mites
Amara consularis	9 / 2	2	–	–	–	1	1	–	4
Calathus fuscipes	19 / 5	66	–	–	1	–	–	–	67
C. halensis	6 / 1	1	–	–	–	–	–	–	1
Curtonotus aulicus	8 / 1	1	–	–	–	–	–	–	1
Harpalus anxius	13 / 1	–	–	–	2	–	–	–	2
H. atratus	5 / 1	1	–	–	–	–	–	–	1
H. calceatus	93 / 30	128	2	–	–	10	1	–	141
H. caspius	1 / 1	1	–	–	–	–	–	–	1
H. distinguendus	19 / 3	12	–	–	–	2	–	–	14
H. froelichi	18 / 6	47	–	–	8	1	–	2	58
H. griceus	18 / 5	25	–	–	–	–	–	–	25
H. rufipes	8 / 2	73	–	–	–	–	–	–	73
H. zabroides	30 / 13	96	–	–	10	1	–	–	107
Ophonus azureus	19 / 4	–	3	–	53	1	–	–	57
O. diffinis	9 / 4	5	1	1	–	–	1	–	7
O. sabulicola	2 / 1	–	3	–	–	–	–	–	3
Σ	277 / 80	458	9	1	74	16	3	2	562
The index of dominance, %		81.4	1.6	0.2	13.0	2.8	0.5	0.4	100.0

Table 2. The index of occurrence of mites on the carabids
Таблица 2. Индекс встречаемости клещей на жужелицах

Species of carabids	Number of carabid specimens	Index of occurrence of mites						
		A. livshitsi	*A. stepposus*	*A. kamalii*	*A. bullitus*	*A. dungeri*	*A. pannonicus*	*A. ponticus*
Amara consularis	9	11.1 % (1)	–	–	–	11.1 % (1)	11.1 % (1)	–
Calathus fuscipes	19	21.1 % (4)	–	–	5.3 % (1)	–	–	–
C. halensis	6	16.7 % (1)	–	–	–	–	–	–
Curtonotus aulicus	8	12.5 % (1)	–	–	–	–	–	–
Harpalus anxius	13	–	–	–	7.7 % (1)	–	–	–
H. atratus	5	20.0 % (1)	–	–	–	–	–	–
H. calceatus	93	25.8 % (24)	1.1 % (1)	–	–	6.5 % (6)	1.1 % (1)	–
H. caspius	1	100.0 % (1)	–	–	–	–	–	–
H. distinguendus	19	15.8 % (3)	–	–	–	5.3 % (1)	–	–
H. froelichi	18	16.7 % (3)	–	–	5.6 % (1)	5.6 % (1)	–	5.6 % (1)
H. griceus	18	27.8 % (5)	–	–	–	–	–	–
H. rufipes	8	25.0 % (2)	–	–	–	–	–	–
H. zabroides	30	33.3 % (10)	–	–	16.7 % (5)	3.3 % (1)	–	–
Ophonus azureus	19	–	10.5 % (2)	–	5.3 % (1)	5.3 % (1)	–	–
O. diffinis	9	11.1 % (1)	11.1 % (1)	11.1 % (1)	–	–	11.1 % (1)	–
O. sabulicola	2	–	50.0 % (1)	–	–	–	–	–
Σ	277	20.6 % (57)	1.8 % (5)	0.4 % (1)	3.2 % (9)	4.0 % (11)	1.1 % (3)	0.4 % (1)

Note. Number of beetles with mites are given in parentheses.

and *A. dungeri* were found together) was registered. This is the first registration of simultaneous phoresy (synphoresy) of mites of the genera *Anystipalpus* and *Antennoseius*.

The intensity of invasion (phoresy) among the most common three mite species considered more detailed (fig. 1). They are characterized by the presence of a small number of mite specimens on the beetles (1–5), more mites are rarely recorded.

The mites of the genera *Anystipalpus* and *Antennoseius* were found on 16 species of carabids. Their sizes vary from 6–8 mm at *Ophonus azureus* to 16–21 mm at *Calathus halensis* (measurements according to Kryzhanovskij, 1965). However, most finds (70 %)

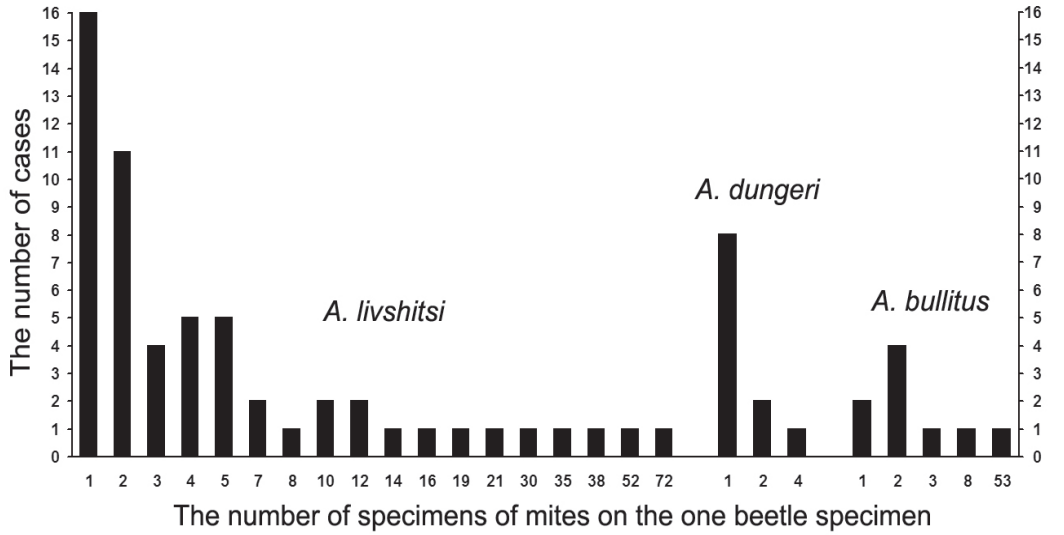

Fig. 1. The frequency of the intensity of mites invasion (phoresy) of carabids.

Рис. 1. Частота показателей интенсивности инвазии жужелиц клещами.

Table 3. The intensity of mites invasion (phoresy) of carabids
Таблица 3. Интенсивность инвазии (форезии) жужелиц клещами

Species of carabids	Intensity of mites invasion						
	A. livshitsi	*A. stepposus*	*A. kamalii*	*A. bullitus*	*A. dungeri*	*A. pannonicus*	*A. ponticus*
Amara consularis	2.0 (2)	–	–	–	1.0 (1)	1.0 (1)	–
Calathus fuscipes	16.5 (1–52)	–	–	1.0 (1)	–	–	–
C. halensis	1.0 (1)	–	–	–	–	–	–
Curtonotus aulicus	1.0 (1)	–	–	–	–	–	–
Harpalus anxius	–	–	–	2.0 (2)	–	–	–
H. atratus	1.0 (1)	–	–	–	–	–	–
H. calceatus	5.3 (1–21)	2.0 (2)	–	–	1.7 (1–4)	1.0 (1)	–
H. caspius	1.0 (1)	–	–	–	–	–	–
H. distinguendus	4.0 (1–10)	–	–	–	2.0 (2)	–	–
H. froelichi	15.7 (3–30)	–	–	8.0 (8)	1.0 (1)	–	2.0 (2)
H. griceus	5.0 (1–12)	–	–	–	–	–	–
H. rufipes	36.5 (1–72)	–	–	–	–	–	–
H. zabroides	9.6 (1–38)	–	–	2.0 (1–3)	1.0 (1)	–	–
Ophonus azureus	–	1.5 (1–2)	–	53.0 (53)	1.0 (1)	–	–
O. diffinis	5,0 (5)	1.0 (1)	1.0 (1)	–	–	1.0 (1)	–
O. sabulicola	–	3.0 (3)	–	–	–	–	–
Σ	8.0 (1–72)	1.8 (1–3)	1.0 (1)	8.2 (1–53)	1.4 (1–4)	1.0 (1)	2.0 (2)

Note. Minimum and maximum values are given in parentheses.

are associated with species of the beetles, whose sizes are 10–16 mm. Both on smaller species of the ground beetles (species of genera *Agonum*, *Brachinus*, *Omophron*) and on larger (*Calosoma*, *Carabus*, *Pterostichus*, *Zabrus*) mites were not registered. Previously, other researchers were found these species of mites on the carabids of the same genera and of the same size groups. This indicates that mites are weakly associated with certain taxa of ground beetles, and more associated with certain size group of carabids.

Furthermore, they may be associated with the biotopes of ground beetles, in which probably developed free-living edaphic stages of mites. Because most of ground beetles were collected using an ultraviolet lamp information about the habitat preferences of mites of genera *Anystipalpus* and *Antennoseius* are missing.

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