INITIAL DATA ON ARBOREAL ORIBATID MITES (ACARI, ORIBATIDA) FROM VIETNAM

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ABSTRACT: Our study is based on oribatid mite materials collected from the *Dipterocarpus alatus*, *Haldina cardifolia* and *Ochrocarpos siamensis* tree species in the Cat Tien National Park, southern Vietnam. A list of identified taxa includes 44 species/subspecies from 31 genera and 22 families. Of these, seven species are recorded for the first time from Vietnam, and two species are recorded for the first time from the Oriental region. Sixteen species of oribatid mites were collected from tree boles, 36 species, from tree crowns. The Jaccard index, measuring faunistic similarity, was equal to 0.18 for the mite communities of both zones.

KEY WORDS: arboreal mite fauna, tree bark, new records, distribution, Cat Tien National Park, Oriental region

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INTRODUCTION

Arboreal oribatid mites (Acari, Oribatida) make a significant contribution to the biodiversity of forest ecosystems; in some cases, this contribution is comparable to that of forest litter (Winchester *et al*. 1999; Proctor *et al*. 2002; Karasawa and Hijii 2006; Lindo and Stevenson 2007). However, arboreal mites remain poorly studied, likely, due to the inaccessibility of sampling sites and the difficulty of extracting mites from trees. To date, there are less than twenty regions in the world where taxonomic and ecological-faunal studies of arboreal mites have been conducted (e.g., Aoki 1971; Winchester *et al*. 2008; Salavatulin 2019).

Data on the tropical arboreal oribatid mite fauna are available from several countries. In particular, in Australia, acarofauna from the upper crown leaves has been described (38 species have been identified; Walter *et al*. 1994). In Japan, oribatids from several tree species from four locations have been studied (with 21 species identified; Aoki 1971). Additionally, in Japan, the influence of the presence of bird's nest ferns on the species richness of forest mites has been established (Karasawa and Hijii 2006). In Peru, a qualitative comparison of soil and arboreal mite communities has been carried out, as a result of which about 120 arboreal species have been recorded (Wunderle 1992a).

The fauna of the arboreal oribatid mites of Vietnam has not been studied (Corpuz-Raros and Ermilov 2020); however, occasional species finds have been noted on trees (e.g., Ermilov and Anichkin 2014).

The goal of our work in the Cat Tien National Park was to test the prospects of studying arboreal oribatid mites in southern Vietnam. An additional goal of our work was to test the methods of selecting and processing wood samples in a tropical climate.

MATERIALS AND METHODS

Oribatid mites were collected from eleven samples that came from three species of trees: Vietnam, Dong Nai Province, Dong Nai Biosphere Reserve, Cat Tien National Park (Fig. 1), about 130 m a.s.l., 20.06.2021–04.07.2021 (V.M. Salavatulin and A.A. Kudrin). Localities:

1-1: 11°25′40″N, 107°25′34″E, *Haldina cardifolia*, height: 0.5 m;
1-3: same locality (and the same tree) as 1-1, but height: 25 m;
2-1: 11°25′40″N, 107°25′34″E, *Ochrocarpos siamensis*, height: 0.5 m;
4-3: 11°25′39″N, 107°25′34″E, *Haldina cardifolia*, height: 23 m;
7-3: 11°25′43″N, 107°25′36″E, *Ochrocarpos siamensis*, height: 12 m;
8-1: 11°25′45″N, 107°25′38″E, *Haldina cardifolia*, height: 0.5 m;
8-3: same locality (and the same tree) as 8-1, but height: 20 m;
13-1: 11°26′30″N, 107°25′56″E, *Dipterocarpus alatus*, height: 0.5 m;

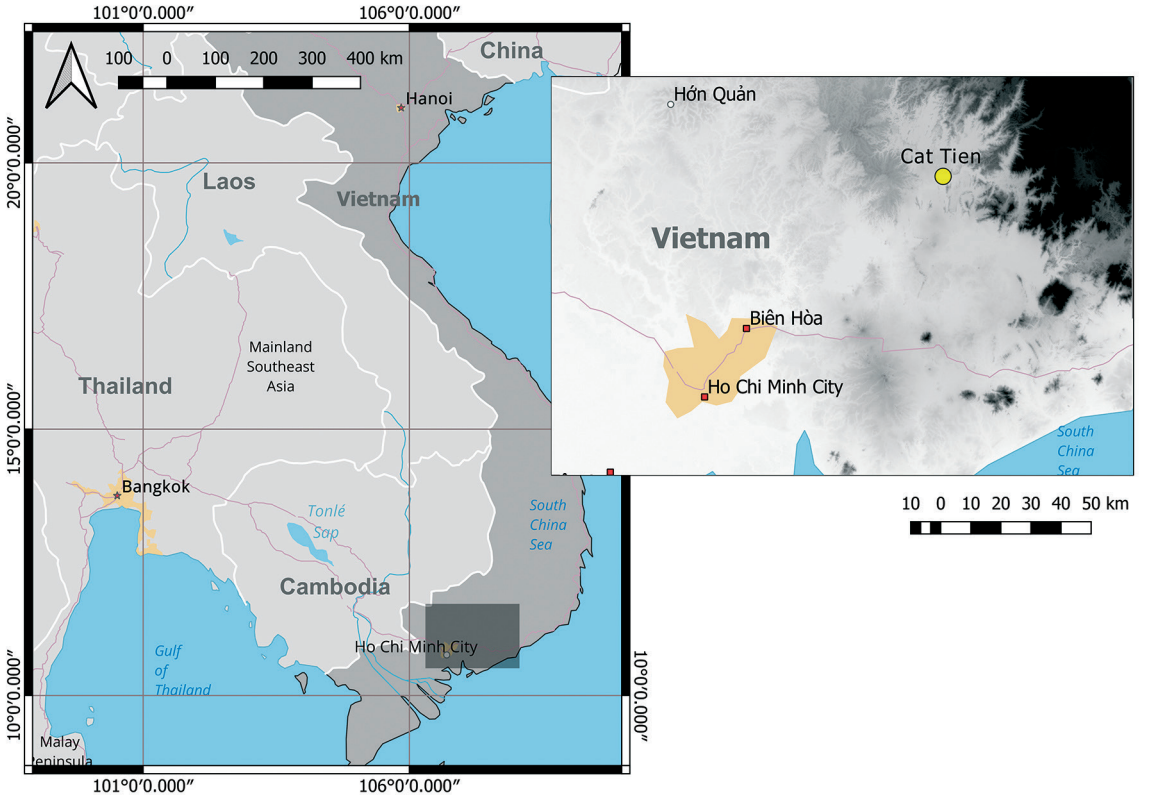

Fig. 1. Collection site of arboreal mites (Cat Tien National Park, Vietnam).

13-3: same locality (and the same tree) as 13-1, but height: 25.5 m;
14-3: 11°26′35″N, 107°26′1″E, *Dipterocarpus alatus*, height: 22 m;
15-3: 11°26′35″N, 107°26′2″E, *Dipterocarpus alatus*, height: 18.5 m.

Overall, the National Park can be classified as a lowland monsoon tropical forest. The climate is subequatorial monsoon. According to the amount of precipitation, one can identify two seasons: the wet rainy season, from May to October (440 mm of precipitation per month), and the dry season, from November to April (10–15 mm of precipitation per month). The average temperature varies from 24°C in January to 28°C in April (Deshcherevskaya *et al*. 2013).

Each examined tree was conditionally divided by us into two zones: 1—the bole (at the height of 0.5 m from the ground), 2—the upper part of the crown. Samples of the bark, branches and leaves were collected via climbing trees (using spikes and other special equipment) and removing the outer bark as well as cutting off branches and leaves. Mites were subsequently extracted by high-pressure flushing and heptane flotation in laboratory conditions. Detailed descriptions of arboreal acarofauna collection and extraction techniques are presented in Salavatulin (2019).

Specimens were mounted in lactic acid, on temporary cavity slides for identification which was made with a camera lucida using a Leica transmission light microscope "Leica DM 2500".

The Jaccard index was calculated as follows: $J = c / (a + b - c)$, where a—the number of species in the first community, b—the number of species in the second community, c—the number of common species. To calculate and plot the Venn diagram, we used the R programming language with the ggVennDiagram package (Gao 2021).

LIST OF IDENTIFIED TAXA*

Lohmanniidae

Meristacarus sundensis Hammer, 1979. Localities: 1-1 (4 ex.), 2-1 (4 ex.), 8-1 (2 ex.), 13-1 (1 ex.). Distribution: Oriental region.

* Distribution: mostly from Subías (2022). Ptyctimous mites not included.

Trhypochthoniidae

Trhypochthonius javanus Csiszár, 1961. Locality: 4-3 (2 ex.). Distribution: Java, Japan. First record of the species from Vietnam.

Malaconothridae

Malaconothrus sp. Locality: 1-3 (1 ex.).

Hermanniidae

Phyllhermannia bimaculata (Hammer, 1979). Localities: 1-3 (5 ex.), 2-1 (3 ex.), 8-1 (3 ex.), 8-3 (1 ex.), 13-3 (2 ex.). Distribution: Oriental region.

Microtegeidae

Microtegeus reticulatus Aoki, 1965. Locality: 8-3 (1 ex.). Distribution: Oriental region.

Oppiidae

Neoamerioppia vietnamica (Mahunka, 1988). Locality: 13-1 (2 ex.).

Subiasella extrema Mahunka, 2008. Locality: 15-3 (1 ex.). Distribution: Thailand. First record of the species from Vietnam.

Tectocepheidae

Tegeozetes tunicatus breviclava Aoki, 1970. Localities: 7-3 (14 ex), 8-3 (7 ex.). Distribution: Oriental region.

Licneremaeidae

Licneremaeus exornatus Grandjean, 1931. Locality: 1-3 (2 ex.). Distribution: Venezuela. First record of the species from the Oriental region.

Cymbaeremaeidae

Scapheremaeus ascissuratus Ermilov et Anichkin, 2015. Localities: 7-3 (1 ex.), 8-3 (1 ex.). Distribution: Vietnam.

Scapheremaeus digitatus Wang, 1998. Localities: 4-3 (1 ex.), 14-3 (1 ex.). Distribution: southern China. First record of the species from Vietnam.

Scapheremaeus sp. Localities: 4-3 (1 ex.), 7-3 (17 ex.), 14-3 (18 ex.).

Eremellidae

Eremella vestita Berlese, 1913. Locality: 14-3 (1 ex.). Distribution: Oriental region.

Scutoverticidae

Arthrovertex sp. Locality: 1-3 (2 ex.).

Micreremidae

Micreremus macrofissura Hammer, 1979. Locality: 14-3 (1 ex.). Distribution: Java. First record of the species from Vietnam.

Unknown gen. and sp. Locality: 1-3 (1 ex.).

Carabodidae

Austrocarabodes falcatus Hammer, 1973. Localities: 1-3 (14 ex.), 2-1 (6 ex.), 8-1 (1 ex.), 8-3 (1 ex.), 13-3 (1 ex.), 14-3 (7 ex.), 15-3 (10 ex.).

Diplobodes kanekoi Aoki, 1958. Locality: 8-1 (1 ex.). Distribution: Japan, Oriental region.

Carabodes (*Klapperiches*) *samoensis* Balogh and P. Balogh, 1986. Locality: 7-3 (3 ex.), 8-3 (8 ex.), 14-3 (1 ex.).

Otocepheidae

Pseudotocepheus sp. Locality: 13-3 (3 ex.).

Eremaeozetidae

Eremaeozetes cf. costulatus Mahunka, 1977. Localities: 13-3 (24 ex.), 14-3 (10 ex.), 15-3 (3 ex.). Distribution: Oriental region, Ethiopia. First record of the species from Vietnam.

Eremaeozetes cf. lineatus Mahunka, 1985. Locality: 14-3 (18 ex.). Distribution: Neotropical and Oriental regions.

Eremaeozetes sp. Locality: 14-3 (13 ex.).

Oribatulidae

Phauloppia adjecta Aoki and Ohkubo, 1974. Locality: 14-3 (4 ex.). Distribution: Japan. First record of the species from the Oriental region.

Scheloribatidae

Scheloribates latipes (Koch, 1844). Locality: 4-3 (1 ex.). Distribution: Semicosmopolitan.

Scheloribates papillaris Tseng, 1984. Locality: 14-3 (1 ex.). Distribution: Oriental region.

Scheloribates praeincisus praeincisus (Berlese, 1910). Localities: 7-3 (1 ex.), 13-1 (1 ex.). Distribution: Tropics, subtropics.

Scheloribates praeincisus interruptus (Berlese, 1916). Localities: 1-3 (2 ex.), 7-3 (2 ex.), 13-3 (2 ex.), 15-3 (1 ex.). Distribution: Tropics, southern Palaearctic region.

Tuberemaeus perforatoides Hammer, 1979. Locality: 1-3 (1 ex.). Distribution: Oriental and Australasian regions.

Tuberemaeus singularis Sellnick, 1930. Localities: 4-3 (1 ex.), 7-3 (3 ex.), 8-3 (2 ex.). Distri-

bution: Oriental and eastern Palaearctic regions, Hawaii.

Haplozetidae

Peloribates rangiroaensis Hammer, 1972. Locality: 13-1 (6 ex.). Distribution: Polinesia, Oriental region.

Peloribates spiniformis Ermilov and Anichkin, 2011. Locality: 13-1 (7 ex.). Distribution: Vietnam.

Mochlozetidae

Unguizetes asiaticus Ermilov and Anichkin, 2012. Localities: 1-3 (1 ex.), 2-1 (1 ex.), 8-3 (1 ex.), 14-3 (1 ex.). Distribution: Oriental region.

Unguizetes cattienensis Ermilov and Anichkin, 2011. Localities: 1-1 (3 ex.), 2-1 (5 ex.), 8-1 (18 ex.), 13-1 (27 ex.), 13-3 (2 ex.). Distribution: Oriental region.

Oripodidae

Oripoda canagaratnami (Balogh, 1970). Localities: 4-3 (8 ex.), 14-3 (3 ex.). Distribution: Sri Lanka. First record of the species from Vietnam.

Oripoda luminosa (Hammer, 1979). Localities: 1-3 (4 ex.), 8-3 (1 ex.), 13-3 (10 ex.), 14-3 (1 ex.), 15-3 (11 ex.). Distribution: Java. First record of the species from Vietnam.

Punctoribatidae

Lamellobates molecula (Berlese, 1916). Localities: 1-1 (7 ex.), 2-1 (5 ex.), 4-3 (1 ex.), 8-1 (3 ex.), 13-1 (2 ex.), 14-3 (1 ex.). Distribution: Tropics, subtropics.

Paralamellobates misella (Berlese, 1910). Locality: 8-3 (10 ex.). Distribution: Tropics, subtropics.

Galumnidae

Flagellozetes (*Cosmogalumna*) sp. 1. Localities: 2-1 (1 ex.), 8-3 (1 ex.).

Flagellozetes (*Cosmogalumna*) sp. 2. Localities: 1-1 (3 ex.), 8-1 (4 ex.).

Galumna khoii Mahunka, 1989. Localities: 1-1 (32 ex.), 8-1 (1 ex.), 8-3 (2 ex.), 13-1 (4 ex.). Distribution: Oriental region.

Pergalumna bimaculata Hammer, 1973. Locality: 1-1 (1 ex.). Distribution: Australasian and Oriental regions.

Pergalumna indistincta Ermilov and Anichkin, 2011. Locality: 1-1 (2 ex.). Distribution: Vietnam.

Trichogalumna nipponica (Aoki, 1966). Locality: 8-3 (1 ex.). Distribution: Semicosmopolitan.

RESULTS

In the course of our taxonomic identification, we have found 44 species/subspecies from 31 genera and 22 families (see the list of taxa above). Of these, seven species (*Trhypochthonius javanus*, *Subiasella extrema*, *Scapheremaeus digitatus*, *Micreremus macrofissura*, *Eremaeozetes costulatus*, *Oripoda canagaratnami*, *O. luminosa*) are recorded for the first time from Vietnam; and two species (*Licneremaeus exornatus*, *Phauloppia adjecta*) are recorded for the first time from the Oriental region. The unidentified species (sp.) are potentially new to science. The families Scheloribatidae and Galumnidae were the most numerous in terms of the number of recorded species (six species each). The most numerous genus was *Scheloribates* Berlese, 1908 (four species/subspecies); the genera *Eremaeozetes* Berlese, 1913 and *Scapheremaeus* Berlese, 1910 were represented by three species each. Representatives of some genera (e.g., *Scapheremaeus*; *Oripoda* Banks, 1904) have previously been recorded from trees (Bragin and Tolstikov 2003; Karasawa and Hijii 2008; Salavatulin 2019), which indicates that these genera contain sets of arboreal species.

Thirty-six species of oribatid mites have been recorded from crowns, and 16 species—from boles. The share of common species for these two zones was 18%, while the shares of unique species were 20 and 62% for the boles and the crowns, respectively (Fig. 2). The Jaccard index calculated for the arboreal oribatid communities of the crown and the root collar (the lowest thickest part of the trunk just above the ground) was 0.18.

Because our study was of exploratory nature and it did not involve sophisticated statistical analysis, the sampling sites, the species and the number of trees were chosen randomly, without prior planning. However, we can, nonetheless, draw some preliminary conclusions: e.g., the qualitative composition of oribatid mites inhabiting the crown and the bole zones showed significant differences, confirmed by the low value of the Jaccard index. The data obtained by us are similar to those of Lindo and Winchester (2007), Karasawa and Hijii (2008) and Salavatulin (2019). Additionally, the species richness of crowns turned out to be much higher compared to boles. These data contradict all previously published works (Wunderle 1992a; Lindo and Winchester 2007; Karasawa and Hijii 2008). Most likely, this is due to a relatively small number of bole samples in our study, as well as to

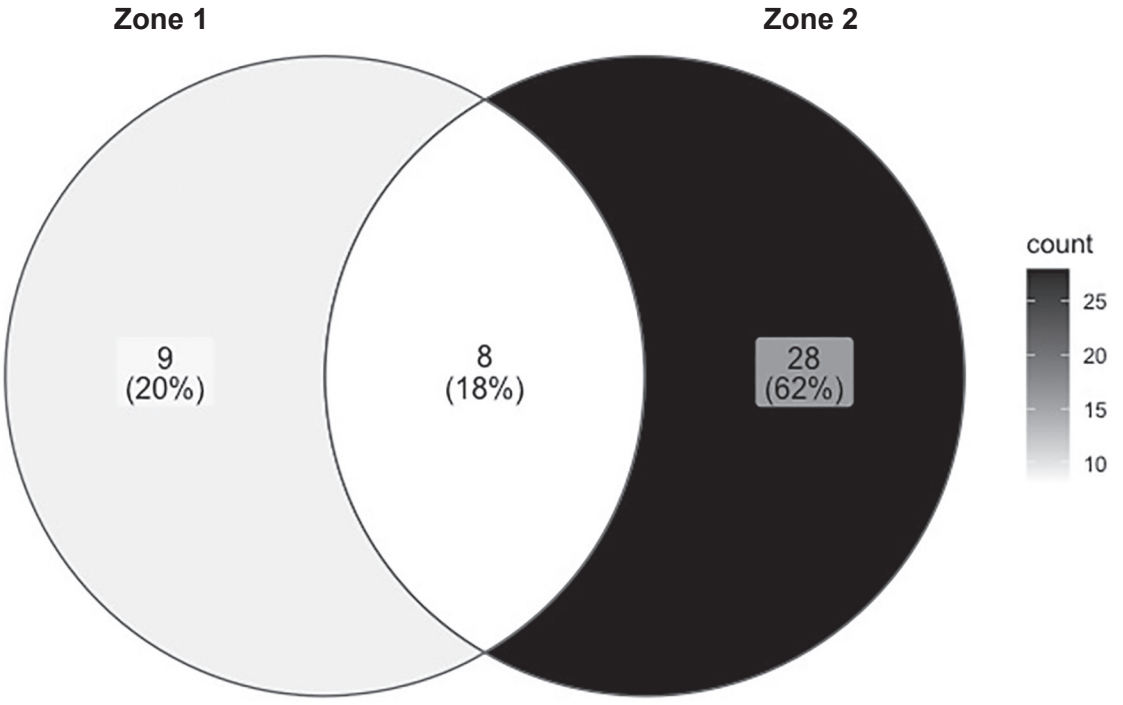

Fig. 2. Venn diagram showing the ratio of common and unique species for arboreal oribatid communities in the bole and the crown zones.

the differences in the climatic and plant habitat conditions.

Despite our study being exploratory, we were able to identify a significant number of oribatid species that are potentially new to science (and new to the fauna of Vietnam). We were also able to identify preliminary patterns in the vertical distribution of mites on trees. The above considerations suggest that studying both the taxonomic and the ecological aspects of Vietnam's arboreal mite fauna has great potential.

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