

**BULGARIAN ACADEMY OF SCIENCES
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ECOLOGY**



VU QUANG MANH
Professor of Zoology, PhD.

**THE ORIBATIDA FAUNA
(ACARI: ORIBATIDA) OF VIETNAM -
SYSTEMATICS, ZOOGEOGRAPHY AND
ZONATION, FORMATION AND ROLE IN THE
SOIL ECOSYSTEM**

A B S T R A C T

A thesis submitted for the Degree
“Doctor of Biological Sciences”
01.06.02 - Zoology

Sofia, December 2013

The DSc. research work is a synthesis of the author's studies carried out in Vietnam during the period of 1979-2013, and based on the Oribatida materials obtained throughout the country. Data and material analyses were carried out mainly in Vietnam: Center for Biodiversity Resources Education and Development (**CEBRED**) & Department of Zoology, Hanoi National University of Education (**HNUE**), and in Bulgaria: Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences (**IBER: BAS**).

The author is a professor of Zoology, Biological Faculty, Center's Director of **CEBRED**, Hanoi National University of Education (**HNUE**), Vietnam, & a visiting scientist to **IBER**, Bulgaria.

The DSc. research consists of 205 pages, including 14 figures, and 16 tables with 133 colored micro morphological images. The list of citations includes 254 sources, including 227 Latin and 25 Slavic sources, 1 Chinese and 1 Japanese source.

The dissertation has been targeted to be defended by the Department of Animal Biodiversity and Resources, IBER.

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The dissertation and its related documents are deposited at IBER's library for public assessment.

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Reviewers:

Acad. Vasil Golemanky, DSc.
Prof. Dr. Pavel Stoev, PhD.
Assoc. Prof. Dr. Petar Beron, PhD.

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1. INTRODUCTION

Oribatid mites (Acari: Oribatida) are among the most diverse and abundant soil living arthropods, the second numerous arthropod group, after insect. They are an important component in all biological processes in the soil ecosystem, including the improvement of soil fertility. They influence decomposition and soil structure by shredding and feeding on dead organic matter and fungi. Oribatida have been studied throughout the World, by Gilyarov (1949), Kuhnelti (1950), Delamare-Deboutteville (1951), Franz (1951), Grandjean (1953), Balogh (1958), Jeleva (1966), Gilyarov et Krivolutsky (1975), Norton (1990), Haq (1996), Aoki (1999), Behan-Pelletier (1999), Wenying et al. (2000), Beron (2011). In order to evaluate the bioindicator's role in a sustainable development of natural, agricultural and urban soil ecosystems, the Oribatida community structures and distribution, are widely analyzed by researchers, from Europe, America, Asia, to Ocean and Polar areas.

In Vietnam, after the first study of Balogh and Mahunka (1967), the study on the Oribatida fauna was starting in the 1980's years. It is suggested that understanding Oribatida community as well as soil animal community in general, is of scientifical and practical importance for soil improvement processes. It is hoped that a means for sustainable management of soil ecosystem can be proposed.

This DSc. research work "**The Oribatida fauna (Acari: Oribatida) of Vietnam - Systematics, Zoogeography and Zonation, Formation and Role in the soil ecosystem**" is a synthesis of the author's studies carried out in Vietnam during the period of 1979-2013, and based on the Oribatida materials obtained throughout the country. Data and material analyses were carried out in Vietnam: Center for Biodiversity Resources Education and Development (**CEBRED**) & Department of Zoology, Hanoi National University of Education (**HNUE**), in Bulgaria: Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences (**IBER: BAS**) & Faculty of Bioology, Sofia University St. Kliment Ohridski, Bulgaria (**SU**), Germany: National Museum of Natural History of Karlsruhe, Germany (**NMNHK**) & Georg-August-Universitat Gottingen: Friedrich Blumenbach Institute of Zoology and Anthropology (**UG**), in the USA: The University of Arizona: College of Agriculture & Life Sciences, Tucson, and in India: Jawaharlal Nehru Advanced Research Center: Indian Academy of Sciences, Bangalore (**JNAI**).

2. AIMS AND TASKS

The research work is aiming:

To study the biodiversity of Oribatida fauna (Acari: Oribatida) of Vietnam, its zoogeographical character and zonation, as well as to evaluate the role of the Oribatida fauna in the soil ecosystem under a main natural and anthropogenic factors.

Its main tasks are:

1. To make an inventory of the Oribatida species diversity, and to characterize the Oribatida fauna of Vietnam including description of new species.
2. To study the Oribatida systematic structure of Vietnam; and to present a review of the genus *Papillacarus* Kuns 1959 (Lohmanniidae), and a key to nine species, as well as remarks on taxonomic status of *P. arboriseta* Jeleva et Vu, 1987.
3. To analyze the zoogeographical character of the Oribatida fauna of Vietnam, according to the World zoogeographical regions.
4. To analyze the distribution and zoogeographical zonation of the Oribatida fauna, according to natural geographical regions of Vietnam.
5. To introduce the initial description of selected Oribatida species obtained from Vietnam, by giving their morphological images.
6. To investigate initially the formation of the Oribatida community structures in relation to

changes of the main natural and anthropogenic factors in Vietnam

7. To evaluate primarily the role of the Oribatida communities for soil quality improvement, as bioindicators of climate environmental changes, as well as vectors of tapeworm (Cestoda), in the tropical soil ecosystem of Vietnam.

3. LITERATURE REVIEW

2.1. A brief outline of the studies on Oribatida of the World

The Oribatida mites have been studied throughout the World by Grandjean (1953), Balogh (1958), Jeleva (1966), Gilyarov & Krivolutsky (1975), Norton (1990), Haq (1996), Aoki (1999), Behan-Pelletier (1999), Wenying et al. (2000), Beron (2011). Recently, the World Oribatida fauna is known with 10,342 species and subspecies, belonging to 1,249 genera and 163 families (Balogh J., P. Balogh 2002; Schatz et al. 2011, Subias 2013).

The higher phylogenetic classification of the Oribatida is still in the process of development and reconstruction (Dugés 1834, Koch C. L. 1878; Michael 1898; Willmann 1931; Edward & Wharton 1952; Grandjean 1954, 1956; Balogh 1961, 1963; Dubinin 1959; Bulanova-Zachvakina 1967; Balogh & Mahunka 1983, 1988; Balogh J. et P. Balogh 1992, 2002; van der Hammen 1961, 1968; Gilyarov & Krivolutsky 1975; Kranzt & Water 1978, 2009; Schatz et al. 2011; Woolley & Tyler 1988; Norton & Benhan - Pelletier 2009; and Subias 2013). The order Oribatida is divided into six subdivisions, including the Palaeosomata, Enarthronota, Parhyposomata, Mixonomata, Desmonomata and Circumdehiscentiae (Edward & Wharton 1952, Grandjean 1953, Evans et al. 1961, Travé et al. 1996). It is suggested that the Astigmata are derived from some Desmonomata. In fact, a phylogenetic reconstruction obtained from 14 morphological traits regarded as synapomorphies of both Oribatida and Astigmata revealed that ‘glandulate’ oribatids (i.e. the Parhyposomata, Mixonomata, Desmonomata and Circumdehiscentiae) form a clade (Norton 1990, 1998; Domes Katja et al. 2007). Conversely, the Palaeosomata and Enarthronota constituted a second clade (Grandjean 1969).

The Oribatida community parameters are still insufficiently studied in ecological research, especially from tropical ecosystems (Pokarjevsky, Vu et al. 1985; Thai, Vu et al. 1986; Ohkubo et al. 1993; Yin et al. 2000; Noti Mundon-Izay et al. 2003; Aoki et al. 2004; Arroyo et al. 2005; Corpuz-Raros 2005; Wu et al. 2005; Hasegawa & Kitayama 2006; Berch et al. 2007; Minor et Cianciolo 2007; Illig et al. 2008). The DNA analyzes in sexual and parthenogenetic lineages of the Oribatida mites are applied recently to indicate their ancient separation (Maraun et al. 2004, Domes Katja et al. 2007, Birky et al. 2010, Dabert et al. 2010).

In the Southeast Asia, the Oribatida fauna of Indonesia was firstly studied by Berlese (1913) and Sellnick (1925). After that, there are a number of studies on oribatids of Indonesia (Berlese 1913; Csiszar 1961; Balogh, Mahunka 1968, 1974; Hammer 1979), Malaysia (Balogh, Mahunka 1974), the Philippines (Corpus-Raros 1979a, b, 1980, 1992, 2005), and Thailands (Aoki 1965, 1967; Mahunka 1994, 1995; Funangarworn, Norton 2013). Studies on the Oribatida fauna of the Pacific Islands of Fiji, Tonga, Viti Levu, Tahiti, Upolu, Western Samoa; of northern China, of Hongkong, and of Taiwan; and of Korea also were carried out by Hammer (1971, 1972, 1973), Mahunka (1971, 1976, 1981), Aoki (1974), Ohkubo et al. (1993), Aoki et al. (2000), Bayartogtokh et al. (2009), respectively.

2.2. Studies on Oribatida of Vietnam

For the first time, two international specialists have identified 33 oribatid species recovered from Vietnam, including 29 species and 4 genera identified were new for science (Balogh, Mahunka 1967).

In the MSc. thesis “*Mite (Acari, Oribatei) and Collembolan (Apterygota, Collembola) community structures in the soil ecosystems of Tu Liem, Hanoi (Red River Delta) and An Khe, Tay Nguyen (Central Vietnam)*”, the author has found that the soil microarthropod Oribatida and Collembola are diverse and poorly known in Vietnam (Vu 1980). In 1985, in his PhD. work “*Faunal - Ecological Studies on Oribatid (Acarina: Oribatei) community in northern Vietnam*”, Vu has identified 73 Oribatida

species from northern Vietnam, including 39 not recorded before for the fauna of Vietnam, and 7 species described new for science.

Studies on soil fauna of agricultural, forest and seaside ecosystems are carried out by Vu and his collaborators. It is indicated that the soil Oribatida fauna is diverse and has high bioindication potentiation. (Vu 1990, 2000, 2003, 2007; Nguyen, Vu 1983; Vu et al. 1985, 1995 1987, 2002; Krivolutsky, Vu, Phan 1997; Vu et al. 2010, 2011, 2012, 2013; Dao, Vu 2012, 2013; Nguyen, Vu, 2011, 2012a, b, 2013). The monograph "*Fauna of Vietnam. v. 21: Acari: Oribatida*" includes 150 Oribatida species and subspecies known for Vietnam, with 44 species represent new records for the fauna of the country (Vu 2007).

Ecological studies based on the Oribatid mite community structure have also been conducted according to the landscape, altitudinal zonations, soil and habitat type, and season. They were carried out in a number of national parks (NP) Xuan Nha, province of Son La; NP Xuan Son, Phu Tho; NP Tam Dao, Vinh Phuc; NP Cuc Phuong, Ninh Binh; NP Ba Vi, Ha Noi; NP Cat Ba, Hai Phong; in uplands and the Delta of the Hong River; NP Ben En, Thanh Hoa; NP Phong Nha – Ke Bang, Quang Binh, as well as in some places in Central and Southern Vietnam (Vu, Nguyen 2000; Vu et al. 2002; Dao, Vu 2010, 2011; Nguyen, Vu 2012a, b; Vu, Nguyen 2008, 2010, 2011). Their results are an important base for furthermore studies on Oribatida community structure as a bioindicator of the changes in the soil ecosystem of Vietnam (Vu 2004, Vu et al. 2006, Vu et al. 2007a, b, Vu 2008, Vu et al., 2008).

Very important contributions to the knowledge of the Oribatida fauna of Vietnam were achieved by foreign authors (Rajski, Szudrowicz 1974; Golosova 1983, 1984; Krivolutsky, Vu et al. 1985; Jeleva, Vu 1987; Zonev, Vu 1987; Mahunka 1987, 1988, 1989; Behan - Pelleier 1989; Pavlichenko 1991, 1994; Stary 1993; Ermilov, Vu et al. 2010, 2011; Ermilov, Vu 2012; Ermilov 2011, 2012, 2013; Ermilov, Anichkin 2011, 2012, 2013; and Niedbala et al. 2013).

It has been shown that, the Oribatid mites community parameters can be used as bioindicators of changes in natural and anthropogenic conditions, contributing to sustainable management of the soil ecosystem (Vu 2004a, b, 2006, 2008; Vu et al., 2002a, b, 2003, 2009, 2010, 2012; Vu, Nguyen 2000; Dao, Vu 2010; Nguyen, Vu 2012; Nguyen, Vu et al. 2013; Vu et al. 2013). It has been found also that, some oribatids can play an important role as a vector of tapeworm - parasites (Cestoda) through the soil environment (Krivolutsky, Vu, Phan 1997).

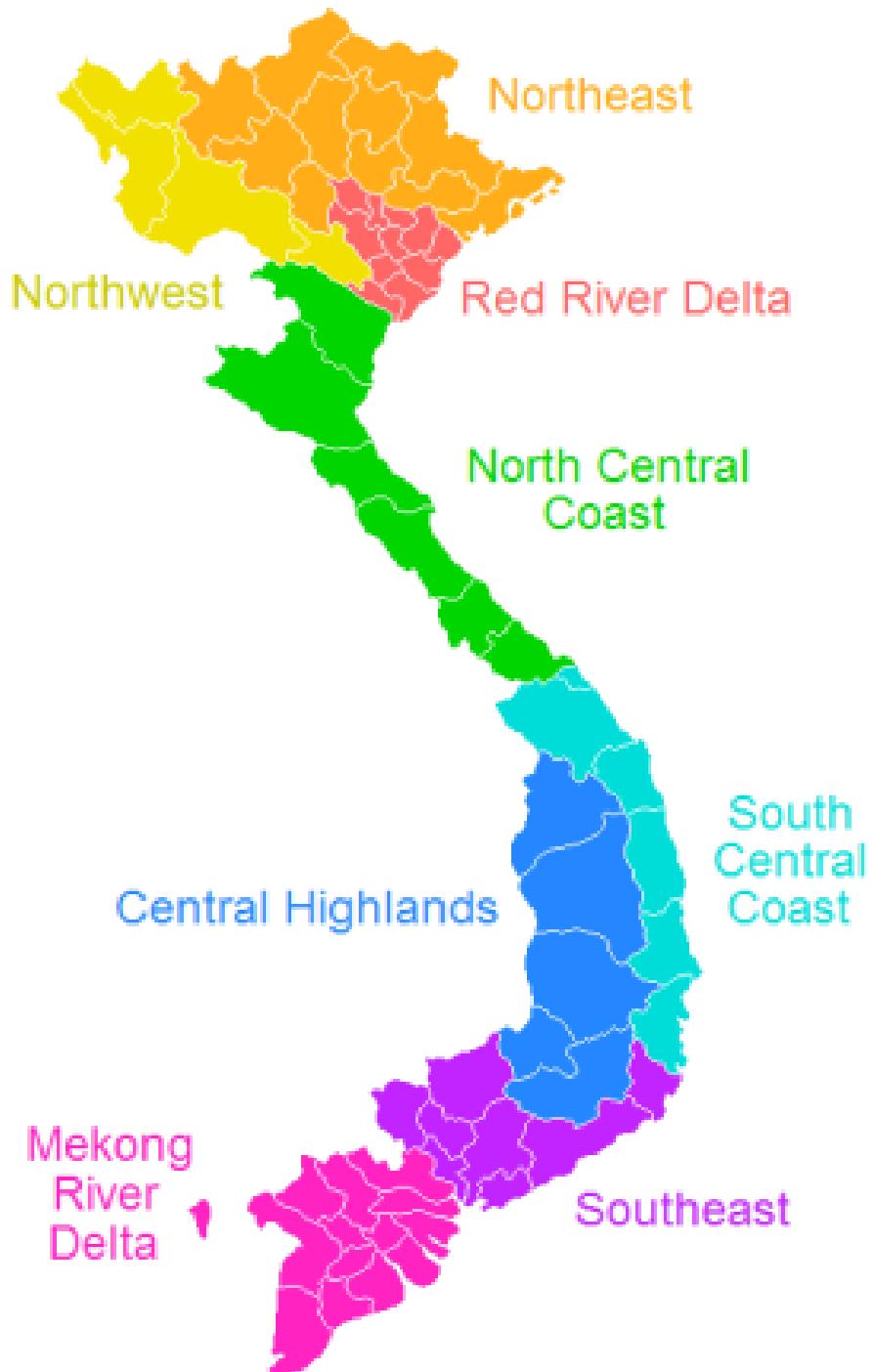
In conclusion, studies on the Oribatida fauna of Vietnam and its community parameters lead to important results, however they are still not completed for such diverse fauna of the tropical soil ecosystem. The obtained results are significant contributions to understanding of animal biodiversity as well as of sustainable management of the soil ecosystem in the country.

4. NATURAL FEATURES OF VIETNAM

4.1. Natural landscape and climate

Vietnam is in the Southeast Asia, between 8°-24°N X 102°-110°E. Its total area is 331,210 km², length is 4,630 km, and coastline is 3,400 km. Its nature is very diverse. Apart from geology and topography, the most conservative elements, climate plays a decisive role in the shaping of natural landscapes and the biological characteristics of the inhabitants. The Vietnam's landscapes are consisted of mountains, hills, deltas and coastal plains. Mountains and hills, >500 meters a.s.l., cove two thirds of the mainland. The 3,143m-high Fansipan, on Hoang Lien Son mountainous range, Lao Cai province (Northwest mountainous region) is the

Figure 1. The Vietnamese eight natural geographical regions



highest Mountain in Vietnam, and in the Indochina. Vietnam has many limestone mountains, under which a number of wonderful caves have been created, Bich Dong in Ninh Binh province (North Vietnam), or Phong Nha - Ke Bang National Park in Quang Binh province (Central Vietnam). At the two heads of the country, they are two vast plains: the Red River Delta (Northern Vietnam), and the Mekong River Delta (Southern Vietnam). Between them are series of narrow plains distributed along the coast of central Vietnam.

The Mekong River Delta carries so much sediment that the delta advances about 60-90 meters into the sea every year. The number of islands of Vietnam with an area more than 1 km² is 84, plus 14

islands with an area over 10 km². Offshore there are numerous islands and archipelagos, particularly the Ha Long Bay area, where there is a collection of approximately 2,700 islands. Far away are the Hoang Sa and Truong Sa archipelagos.

Vietnam can be divided into two major climatic zones: (1) North zone four distinct seasons and high humidity, and (2) South zone has only two distinct seasons, dry and rainy. There are also a number of climatic sub-zones with a temperate climate (Sa Pa mount, Northern Vietnam; Da Lat, Southern Vietnam), and others with a continental climate (Lai Chau and of Son La, Northern Vietnam). Long and narrow in shape, Vietnam has the features of a peninsula as the oceanic influence can be felt everywhere, perhaps except for Fansipan and Annamites. Vietnam lies in the inter-tropical zone, with high temperatures and humidity all year round. Because of differences in latitude and the marked variety in topographical relief, the climate tends to vary considerably from place to place (Vu T. L., Taillard 1993, Vietnam Ministry of Agricultural and Development 2006).

4.2. Soil types and hydrological features

Vietnam has 14 main soil groups and 30 units. They can be grouped into two big combinations: (1) The Mountainous and hilly soils, most are Acrisoils, Ferralsols, or Alisols, and (2) The Delta Soils. Vietnam has as about 2,290 rivers and streams. On average, there is a river mouth every 20km along the coast. The annual rainfall in Vietnam is estimated at 640 billion cubic meters, and about 48.43% of which flow into rivers. In the country, there are seven major systems of rivers (Vietnam Soil Society 2000, Vietnam National Institute for Soils and Fertilizers 2002, Vietnam Ministry of Agricultural and Development 2006).

4.3. Natural regions and biodiversity

Vietnam lies on the Indo-Malayan zoogeographical region, belonging to Oriental Region. The country has 4 biodiversity centers, and 8 natural geographical regions. Vietnam is ranked 16th worldwide in biological diversity, being home to approximately 16% of the world's species. The country is one of the world's twelve original cultivar centers. The Vietnamese government has established 126 conservation areas, including 28 national parks. Vietnam is one of the world's twelve original cultivar centers (National Environmental Report 2005, Huynh Thi Mai 2009, Vo Quy 2009) (Figure 1).

5. MATERIALS AND METHODS

5.1. Study regions

The studied regions and some data of the Oribatida materials obtained throughout Vietnam, during the period of 1978-2013, are presented in The figure 2. They were 50 studied places located on 27 provinces, from all of the 8 natural geographical regions of Vietnam.

5.2. Oribatida sampling

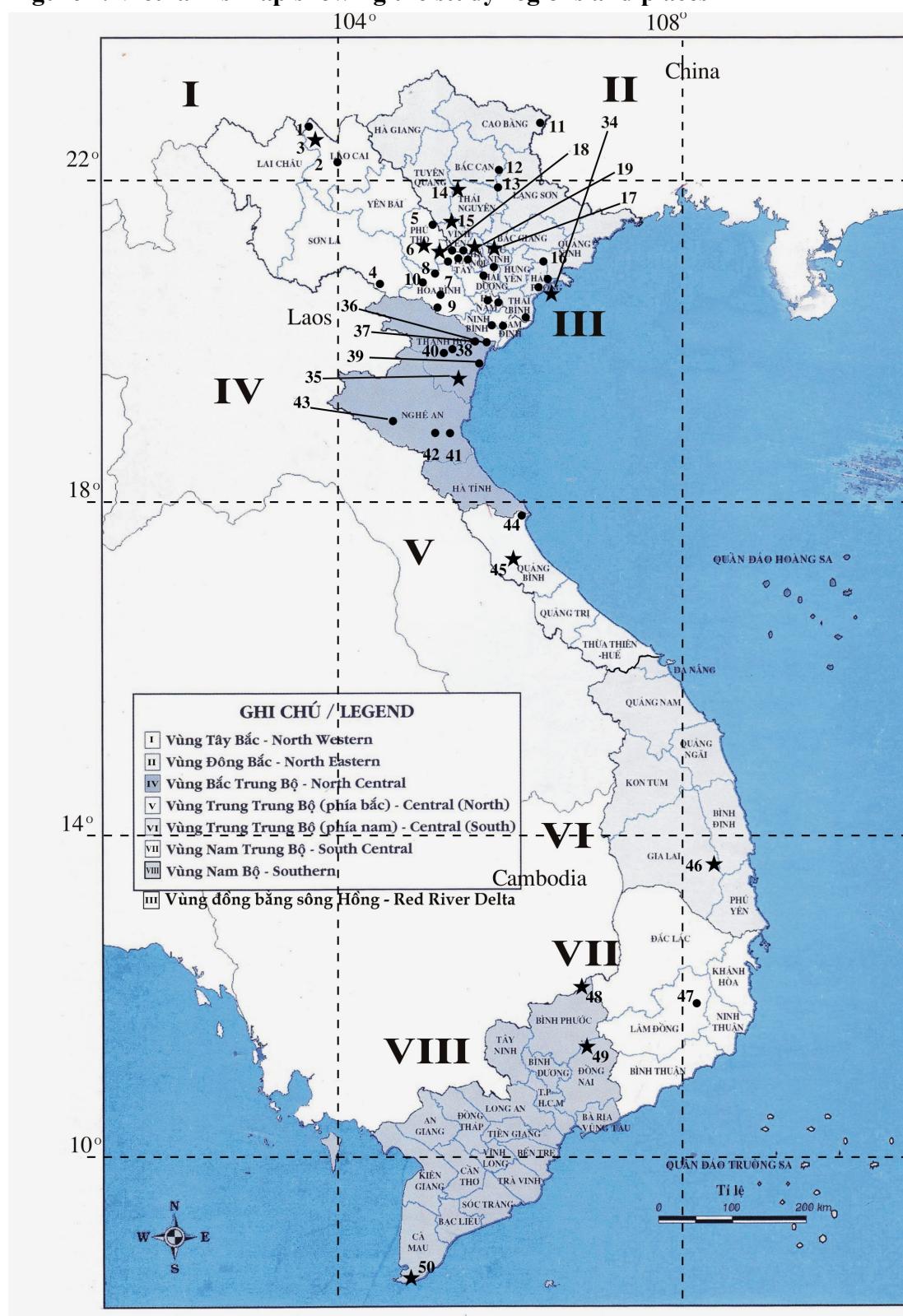
The study places were classified into 6 types, and soil studied were 6 types (Table 1). Soil samples were taken according to vertical soil layers and to seasons; by rectangular metal sampler, with 5X5 cm² surface area, 20 cm in depth. Additionally, forest litter samples were taken also. The Berlese-Tullgren funnels were used for extraction of soil oribatid mites.

5.3. Species identification

Body length was measured in dorsal view, from the tip of the rostrum to the posterior edge of the ventral plate. The terminology used in the text is following to Balogh, Mahunka (1983). Oribatida materials are identified mainly after Balogh (1972, 1992), Balogh J. & Balogh P. (1988, 1989, 2002), and Subias (2013), as well as to related literatures.

5.4. Data analysis

Figure 2. Vietnam's map showing the study regions and places



Data analysis was conducted mainly in Vietnam: **CEBRED** & Department of Zoology, **HNUE**, Bulgaria: **SU and IBER**, Germany: **NMNHK** and **UG**, India: **JNAI**, and the USA: **UA**. The frequency of occurrence (I/n) of each species was calculated as a percentage of soil samples contained that species,

i. e. number of occurrence (I) divided by the total study number of samples (n).

Species similarity indices between the oribatid communities were calculated by Jaccard index (J), and then analyzed by “Trellis diagram method”. For study the formation, and the zoogeographical divination of the Oribatida fauna formed in relation to main natural and anthropogenic factors in Vietnam, used are the Microsoft

Office Excel 2010, and the multivariate ecological research version 6 (PRIMER 6).

6. RESULTS AND DISCUSSIONS

Chapter 1. Oribatida Systematical Structure

1.1. Species biodiversity

1.2. Analyses of systematical structures

1.3. Description of thirteen (13) new species

1.4. A review of the Genus *Papillacarus* (Lohmanniidae) of Vietnam, remarks on taxonomic status of *P. arboriseta* Jeleva et Vu, 1987, and a key to nine species recorded

1.5. Morphological images of the selected Oribatida species

Table 1. The Oribatida (Acari: Oribatida) Fauna of Vietnam: Species diversity, Distribution and Zoogeographical region (Below)

1.6. General remarks and conclusions

1. The oribatid mite fauna of Vietnam is recorded with three hundred and twenty (320) species (including 4 subspecies), belonging to 163 genera, 60 families and 2 subfamilies, 28 superfamilies, and 5 suborders. This Oribatida fauna is much diversified, with a high number of specific species, 34.68% of the total number probably endemic species. It is not investigated throughout.

2. One hundred fifty and five (155) species, occupying 48.44% of the total number of the Oribatida fauna, were found first from Vietnam, as well as thirteen (13) Oribatida species were described new for science.

3. According to the number of superfamilies, of families, of genera, and of species and subspecies recorded, The Oribatida systematical structure of Vietnam is diverse. However, the number of genera per family, as well as the number of species and subspecies per genus are not high. Almost of the families consist of 1, and of 2-3 species, 41.94% and 38.71% of the total 62 families and subfamilies; as well as almost of the genera consist of one species, 68.10% of the total 163 genera. Only two genera consist of more than 10 species: *Galumna* Heyden, 1826 and *Pergalumna* Grandjean, 1936, recorded with 13 and 11 species, respectively. Only one genus consists of more than 10 species, particularly the family Oppiidae Grandjean, 1954 consisting of 23 genera.

4. Thirteen (13) Oribatida species described new for science, including: (1) *Papilacarus arboriseta* Jeleva et Vu, 1987, (2) *Papilacarus benenensis* Vu, Ermilov et Dao, 2010, (3) *Aokiella xuansoni* Vu, Ermilov et Dao, 2010, (4) *Gibbicepheus baccanensis* Jeleva et Vu, 1987, (5) *Leobodes monstruosus* Jeleva et Vu, 1987, (6) *Kokoppia dendricola* (Jeleva et Vu, 1987), (7) *Perxylobates thanhhoaensis* Ermilov, Vu, Trinh et Dao, 2010, (8) *Perxylobates vietnamensis* (Jeleva et Vu, 1987), (9) *Scheloribates cruciseta* Jeleva et Vu, 1987, (10) *Austrachipteria phongnhae* Ermilov et Vu, 2012, (11) *Lamellobates ocularis* Jeleva et Vu, 1987, (12) *Galumna kebangica* Ermilov et Vu, 2012, and (13) *Galumna tenensis* Ermilov, Vu et Nguyen, 2011, are provided.

5. A review of the oribatid mites genus *Papillacarus* Kunst, 1959 (Oribatida: Lohmanniidae) of Vietnam is given, with a remarks on taxonomic status of *P. arboriseta* and a key to nine species recorded in Vietnam, namely (1) *P. arboriseta* Jeleva et Vu, 1987, (2) *P. benenensis* Vu, Ermilov et Dao, 2010, (3) *P. cornutus* (Sarkar et Subias, 1984), (4) *P. hirsutus* (Aoki, 1961), (5) *P. indistinctus* Ermilov, Anichkin et Wu, 2012, (6) *P. polygonatus* Ermilov et Anichkin, 2011, (7) *P. polysetosus* Ermilov, Anichkin et Wu, 2012, (8) *P. ramosus* Balogh, 1961 and (9) *P. undirostratus* Aoki, 1965. The species

key is also provided. It is proved that, the oribatid species *P. arboriseta* is clearly differs from *P. hirsutus*.

6. The morphological images of the selected one hundred thirty and three (133) Oribatida species recorded from Vietnam, occupying 41.56% of the total number, mostly including pictures of dorsal, ventral and lateral image, and the body measurements, are provided. They can be used as useful images – identification for the common Oribatida species of Vietnam.

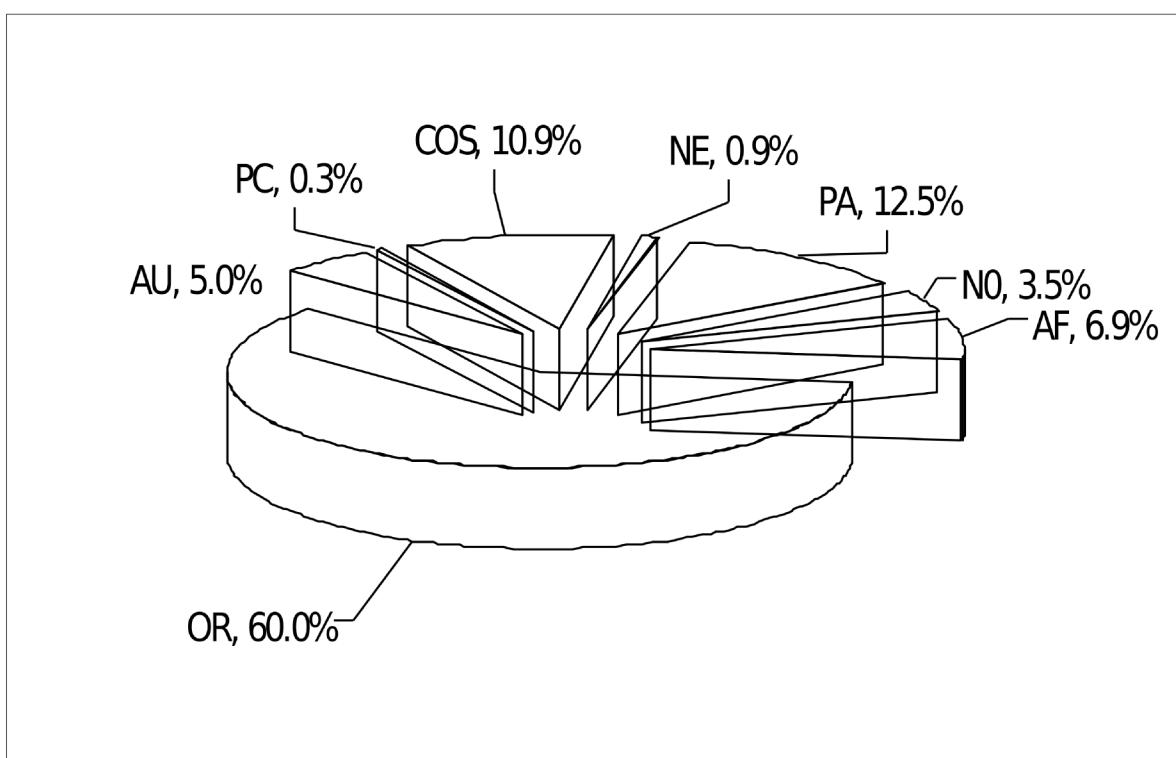
Chapter 2. Zoogeographical character and zonation of the Oribatida fauna of Vietnam

2.1. The Zoogeographical character of the Oribatida fauna of Vietnam

2.2. The distribution and zoogeographical zonation of the Oribatida fauna in Vietnam

Figure 3. Zoogeographical elements of the Oribatida fauna of Vietnam.

Legends. As in the Table 1.



2.3. General remarks and conclusions

1. The zoogeographical character of the Vietnamese Oribatida fauna is diverse. It consists of all World eight zoogeographical elements, except only the Antarctic. The World zoogeographical elements participating in the Oribatida fauna of Vietnam are arranged according to following order: (1) Oriental region occupies 60% of the total 320 species >(2) Palaearctic – 12.5% >(3) Cosmopolite – 10.9% >(4) Afrotropical – 6.9% >(5) Australian – 5.0% >(6) Neotropical – 3.5%, >(7) Nearctic - 0.9% >(8) Pacific – 0.3%.

Table 2. Distribution of Oribatida families, genera and species in the studied natural regions

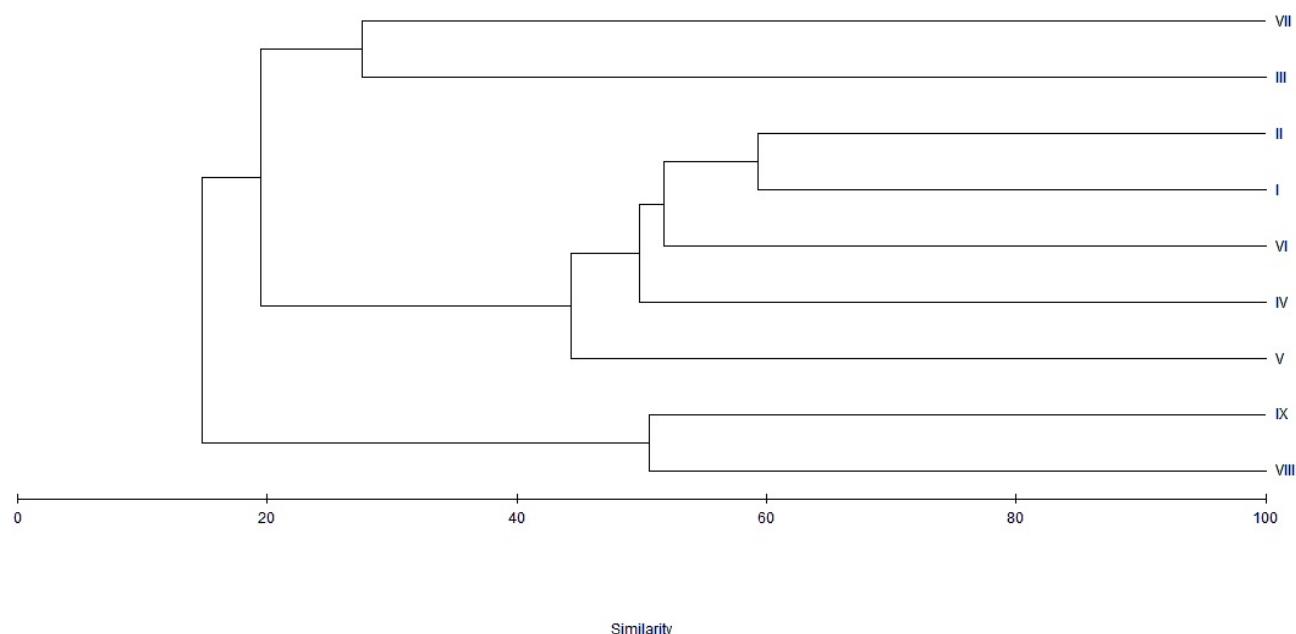
Legends. As in the Table 1.

Natural geographical regions Taxons	I	II	III	IV	V	VI	VII	VIII	IX
Number of families	40	31	16	28	26	25	33	30	42
Number of genera	63	51	28	45	37	41	59	43	78
Number of species	119	81	31	65	49	58	85	57	121

2. The main zoogeographical component of the Oribatida fauna of Vietnam are the Oriental species, occupying 60% of the total 320 species, with 192 species recorded. This Oribatida fauna has a high specialty, with 111 species, occupying 34.68% of the total, recorded only from Vietnam (probably endemic species). The Oribatida fauna of Vietnam includes also the Palaearctic, with 40 species recorded, and Cosmopolite - 35 species, occupying 12.5% and 10.9% of the total, respectively.

Figure 4. Cluster of similarity of Oribatida species diversity between the studied natural regions

Legends: As in the Table 1.



3. The Oribatida fauna of Vietnam is grouped in three main regions: Northern, Central and Southern. There are differences between Northern, Central and Southern part of the country, and even between different sub-regions of these parts. From North to South of Vietnam, the distribution and zoogeographical zonation of the Oribatida fauna can be divided into six (6) sub-regions, as follows:

- (i) Region between (I) Northwest and (II) Northeast (North Vietnam), with eight characteristic species.
- (ii) Region of Red River Delta (IV) (North Vietnam), with five characteristic species
- (iii) Region of NP Cat Ba Island (V) of the Red River Delta (North Vietnam), with two characteristic species.
- (iv) Region between (III) the Uplands of the Red River Delta, and (VII) NP Phong Nha - Ke Bang: Central North (North Vietnam and Central North Vietnam), with four characteristic species.
- (v) Region of (VI) NP Ben En: North Central (North Central Vietnam), with seven characteristic species.

(vi) Region between (VIII) Southern - Mekong River Delta: NP Bu Gia Map and (IX) Southern - Mekong River Delta: NP Cat Tien (South Vietnam), with eight characteristic species.

Chapter 3. Formation of the Oribatida community structures in relation to main natural and anthropogenic factors in Vietnam

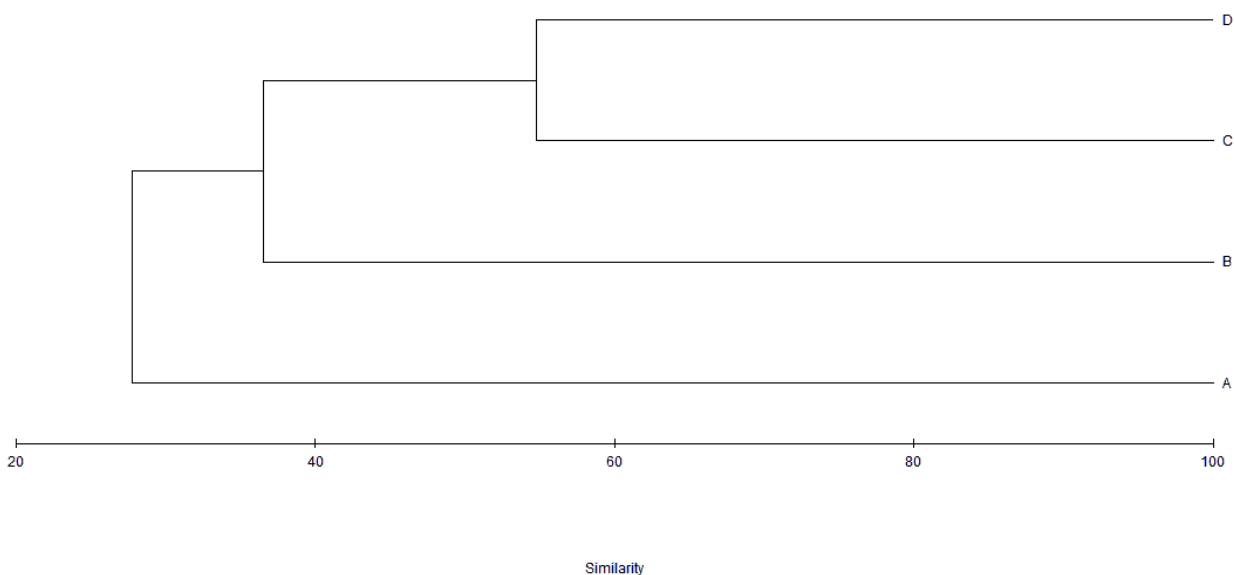
3.1. Oribatida Community Structures in relation to forest plant succession in Tam Dao National Park, Northeast Vietnam

3.2. Oribatida Community Structures in relation to soil and habitat type, Red River Delta

3.3. Oribatida community parameters in relation to natural geographical region, soil and habitat type, Northern Vietnam

3.4. Discussions

Figure 5: Similarity cluster of oribatid mite species diversity between the studied geographical regions. (A) Northwest, (B) Northeast, (C) Red river delta and (D) Thanh Nghe Tinh delta.



Analysis of the species diversity of Oribatida communities in relation to the studied natural geographical regions of northern Vietnam showed that, at the regional scale, the Oribatida species diversity is divided into three units: (1) Oribatida communities of (A) Northwest mountainous region, (2) Oribatida communities of (B) Northeast mountainous region, and (3) Oribatida communities of (C) Red River delta and (D) Thanh Nghe Tinh delta. A remark can be made on the formation of the Oribatida community between the studied natural geographical regions of northern Vietnam, is that: the main soil type investigated in (C) Red River delta, and in (D) Thanh Nghe Tinh delta is the alluvial soil; in (A) Northwest mountainous region is the ferralitic brownish soil derived from limestone; and in (B) Northeast mountainous region is the ferralitic reddish brown soil (Figure 5). It means that, may be a soil type, but not geographical regions, is the natural factor, which plays a major role in formation of the Oribatida species diversity.

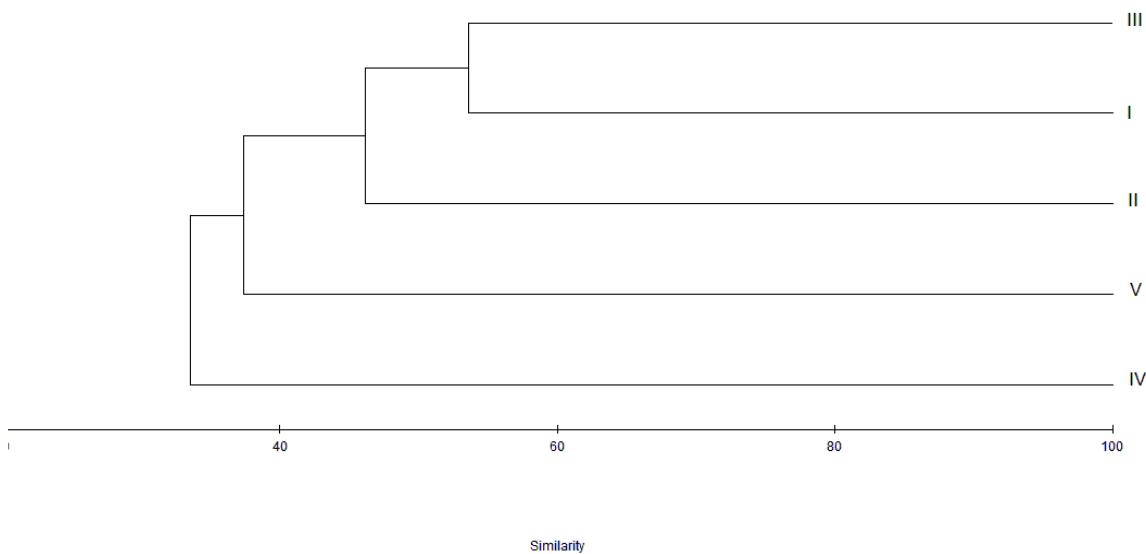
The results analyzed given in the Figure 6 showed that, according to soil type, the Oribatida communities form three main complexes: (1) Oribatida communities of (V) ferralitic brownish soil derived from limestone, (2) Oribatida communities of (IV) ferralitic reddish brown soil, (3) Oribatida communities of (I) coastal saline-acid soil, (II) acid alluvial soil, and (III) neutral alluvial soil. The result showed that the Oribatida species diversity is clearly related to the studied soil types, particularly in (IV) Ferralitic reddish brown soil, (V) Ferralitic brownish soil derived from limestone, and in the group of Alluvial soils (I, II & III).

3.5. General remarks and conclusions

1. In Tam Dao National Park, a subtropical evergreen broad leaf alpine forest of northeast Vietnam, the species diversity of the Oribatida species diversity is closely related to forest decline, so that, it can be used as bioindicators of forest plant succession.

Figure 6. Similarity cluster of oribatid mite species diversity between the studied soil types.

Legends: As in the Table 1.



2. In northern Vietnam, according to habitat types, the formation of Oribatida community structures is starting to form in the natural forests; then under the agricultural intensification on soil ecosystem, it changes in the human-disturbed habitats, through intermediate community in the grassland and shrubs. It is proposed that, the habitat type of grassland and scrubs can play as a transformational ecosystem for reestablishment of the soil Oribatida mite community.

3. Three Oribatida species, namely (1) *Tectocepheus velatus* (Michael, 1880), (2) *Scheloribates praeincisus* (Berlese, 1916) and (3) *Lamellolobates oocularis* Jeleva et Vu, 1987, are the most widespread and most persisting species of northern Vietnam. They can be considered as bioindicators of disturbed soil ecosystems.

4. Species diversity and population densities of the Oribatida communities are clearly related to natural geographical region, as well as to soil type and to agricultural activities (habitat type); so that they can be used as bioindicators of natural and anthropogenic impact on soil ecosystem. Shrub and grassland habitat can allow the re-establishment of the soil Oribatida species diversity.

5. A tendency of formation of two separate Oribatida communities on two main soil types studied is registered: the alluvial and the ferralitic soils. It could be suggested that, soil type plays a major role in formation of the taxonomy structure of the Oribatida communities.

Chapter 4. Role of the Oribatida community in the soil ecosystem of Vietnam

- 4.1. Oribatida community contributing to soil formation and improvement
- 4.2. Oribatida community structures as a bioindicator of the climate environmental changes
- 4.3. Oribatida community structures as a vector of transmission of tapeworms (Cestoda)
- 4.4. General remarks and conclusions

Table 3. Anoplocephalidae species (Cestoda) using Oribatida as intermediate hosts and their hosts

Tapeworm species Anoplocephalidae (Cestoda) using Oribatida as intermediate hosts	Animal species - Hosts of Anoplocephalidae species
1. <i>Anoplocephala manubriata</i> Railliet, Henry & Bauche 1914 2. <i>Anoplocephala perfoliata</i> (Goeze, 1782) 3. <i>Bertiella studeri</i> (Blanchard, 1891) 4. <i>Bertiella anapolitica</i> Baylis, 1934 5. <i>Moniezia benedeni</i> (Moniez 1879) 6. <i>Moniezia expansa</i> (Rudolph, 1810) 7. <i>Mosgovoyia pectinata</i> (Goeze 1782) 8. <i>Paronia bocki</i> Schmelz, 1941 9. <i>Paronia pycnonoti</i> Yamaguti, 1935 10. <i>Pseudanoplocephala crawfordi</i> Baylis, 1927	1. <i>Elephas indicus</i> : 1 host. 2. <i>Equus caballus</i> : 1 host. 3. <i>Macacus cynomolqus</i> , <i>Macaca mubata</i> , <i>Pygatbrix nemaeus</i> , <i>Hylobates concolor</i> : 4 hosts. 4. <i>Rutus ruttus</i> , <i>R. exulans</i> : 2 hosts. 5. <i>Cervus unicolor</i> , <i>Bos indicus</i> : 2 hosts. 6. <i>Bos indicus</i> , <i>Capra biscus</i> , <i>Ovis aries tragulus</i> : 3 hosts. 7. <i>Lepus peguensis</i> : 1 host. 8. <i>Magalaema faiosticta</i> , <i>M. laglanfieri</i> , <i>M. asiatica</i> : 3 hosts. 9. <i>Pycnonotus sinensis</i> , <i>P. jacosus</i> , <i>Criniger pallidus</i> : 3 hosts. 10. <i>Sus scrofa</i> : 1 host.
Total: 10 Anoplocephalidae species	Total: 21 Animal species

1. The Oribatida are one of the most important groups in the soil microfauna responsible for the processes of decomposition of vegetal remains. The soil microarthropod community structures and their changes are clearly related to the use of different compositions of organic and chemical fertilizers in agricultural production. Therefore, these structures can be used as potential bioindicators for agricultural sustainability of soil ecosystem in Vietnam.

2. Tendency of formation of the diverse relation, including a decrease of species biodiversity and an increase of population densities of soil Oribatida, can be used for bioindication of the increase of human impacts on natural forest ecosystem.

3. The soil Acari community (Oribatida, Uropodina) structures, especially the population densities proportion between the Oribatida and Uropodina, can be used as a bioindicator of the impact of the use of different fertilizers.

4. Change of the soil microarthropod community (Oribatida, Collembola) structures, including the gradual decrease of species diversity of Oribatida community (Acari: Oribatida) and the gradual increase of this of Collembola community (Apterygota: Collembola) is an important bioindicator showing the decline of natural forest as well as increase of human impact on natural environment.

5. In relation to the climate changes, it is found a clear difference in the soil microarthropod community (Oribatida, Collembola) structures, particularly of population densities proportion of Oribatida / Collembola and of Oribatida / Uropodina. Those proportions can be used as bioindicators of the climate change.

6. Recorded are 10 important tapeworm species (Cestoda: Anoplocephalidae) parasitizing 21 animal species of Vietnam and using Oribatida mites as an intermediate hosts.

7. GENERAL CONSLUSSIONS

1. The Oribatida mite fauna (Acari: Oribatida) of Vietnam is recorded with three hundred and twenty (320) species (including 4 subspecies), belonging to 163 genera, 60 families and 2 subfamilies, 28 superfamilies, and 5 suborders. This Oribatida fauna is diverse, representing 3.09% (320 vs. 10,342 species), 13.05% (163 vs. 1,249 genera), and 36.80% (60 vs. 163 families) of the World Oribatida fauna species, genera and families, respectively.

2. One hundred and fifty five (155) Oribatida species, or 48.44% of the Oribatida fauna, were new geographical records for Vietnam. Thirteen (13) new for science species were described, including (1) *Papilacarus arboriseta* Jeleva et Vu, 1987, (2) *Papilacarus benenensis* Vu, Ermilov et Dao, 2010, (3) *Aokiella xuansonii* Vu, Ermilov et Dao, 2010, (4) *Gibbicepheus baccanensis* Jeleva et Vu, 1987, (5) *Leobodes monstruosus* Jeleva et Vu, 1987, (6) *Kokoppia dendricola* (Jeleva et Vu, 1987), (7) *Perxylobates thanhhoaensis* Ermilov, Vu, Trinh et Dao, 2010, (8) *Perxylobates vietnamensis* (Jeleva et Vu, 1987), (9) *Scheloribates cruciseta* Jeleva et Vu, 1987, (10) *Austrachipteria phongnhae* Ermilov et Vu, 2012, (11) *Lamellolobates oocularis* Jeleva et Vu, 1987, (12) *Galumna kebangica* Ermilov et Vu, 2012, and (13) *Galumna tenensis* Ermilov, Vu et Nguyen, 2011, are provided.

3. Oribatida systematical structure of Vietnam is diverse in terms of number of superfamilies, families, genera, species and subspecies recorded. However, the number of genera recorded per family, as well as the number of species and subspecies recorded per genus are not high. Almost of the families consisted of 1 (41.94%), and 2-3 genera, (38.71% of the total 62 families and subfamilies), only one family of Oppidae Grandjean, 1954 consisted of 23 genera; as well as almost of the genera consisted of 1 species(68.10% of the total 163 genera), and two genera consisted of more than 10 species, including *Galumna* Heyden, 1826 and *Pergalumna* Grandjean, 1936, recorded with 13 and 11 species, respectively.

4. A review of the Oribatida mites genus *Papillacarus* Kunst, 1959 (Oribatida: Lohmanniidae), and a key to nine species recorded from Vietnam, namely (1) *P. arboriseta* Jeleva et Vu, 1987, (2) *P. benenensis* Vu, Ermilov et Dao, 2010, (3) *Papillacarus cornutus* (Sarkar et Subias, 1984), (4) *P. hirsutus* (Aoki, 1961), (5) *P. indistinctus* Ermilov, Anichkin et Wu, 2012, (6) *P. polygonatus* Ermilov et Anichkin, 2011, (7) *P. polysetosus* Ermilov, Anichkin et Wu, 2012, (8) *P. ramosus* Balogh, 1961 and (9) *P. undirostratus* Aoki, 1965, are presented. It is proved that, the Oribatida species *P. arboriseta* is clearly differs from *P. hirsutus*.

5. The zoogeographical character of the Vietnamese Oribatida fauna is diverse, consisted of all World eight zoogeographical elements, except only the Antarctic. The World zoogeographical elements participating in the Oribatida fauna of Vietnam are arranged according to following order: (1) Oriental component occupying 60% of the total 320 species, >(2) Palaearctic – 12.5%, >(3) Cosmopolite – 10.9%, >(4) Afrotropical – 6.9%, >(5) Australian – 5.0%, >(6) Neotropical – 3.5%, >(7) Nearctic - 0.9%, and >(8) Pacific – 0.3%.

6. The main zoogeographical character of the Oribatida fauna of Vietnam is the Oriental region. This Oribatida fauna has a high specialty, with 111 species, occupying 34.68% of the total, recorded only from Vietnam, probably endemic species. The Oribatida fauna of Vietnam includes also the Palaearctic, with 40 species recorded, and Cosmopolite - 35 species, occupying 12.5% and 10.9% of the total, respectively.

7. The morphological images of the selected one hundred thirty and three (133) Oribatida species recorded from Vietnam, mostly including pictures of dorsal, ventral and lateral image, and the body measurements, occupying 41.56% of the total number, are provided. They can be used as useful images – identification for the common Oribatida species of Vietnam.

8. According to habitat types, the formation and change of Oribatida community structures is starting to form in the natural forests; then under the agricultural intensification on soil ecosystem, it changes in the human-disturbed habitats, through intermediate community in the grassland and scrubs. It is proposed that, the habitat type of grassland and scrubs can play as a transformational ecosystem for

reestablishment of the soil Oribatida mite community. Three Oribatida species (1) *Tectocepheus velatus* (Michael, 1880), (2) *Scheloribates praeincisus* (Berlese, 1916) and (3) *Lamellolobates oocularis* Jeleva et Vu, 1987, are the most widespread and most persisting species of northern Vietnam, and can be considered as bioindicators of disturbed soil ecosystems.

9. A tendency of formation of two distinct Oribatida communities is revealed according to soil type: (1) the alluvial, and (2) the ferralitic soils. It could be suggested that, soil type plays a major role in formation of the species diversity of the Oribatida mites community.

10. The Oribatida fauna of Vietnam is grouped in three main regions, in Northern, Central and Southern Vietnam. From north to south of the country, the distribution and zoogeographical zonation of the Oribatida fauna can be divided into six (6) sub-regions, as follows:

(i) Region between (I) Northwest, and (II) Northeast (North Vietnam), with eight characteristic species.

(ii) Region of (IV) Red River Delta (North Vietnam), with five characteristic species

(iii) Region of (V) NP Cat Ba Island of the Red River Delta (North Vietnam), with two characteristic species.

(iv) Region between (III) the Uplands of the Red River Delta, and (VII) NP Phong Nha - Ke Bang of Central North (North Vietnam and Central North Vietnam), with four characteristic species.

(v) Region of (VI) NP Ben En of North Central (North Central Vietnam), with seven characteristic species.

(vi) Region between (VIII) NP Bu Gia Map of Southern - Mekong River Delta:, and (IX) NP Cat Tien

of Southern - Mekong River Delta (South Vietnam), with eight characteristic species.

11. Recorded are ten (10) tapeworm species (Cestoda: Anoplocephelidae), parasitizing on 21 animal species of Vietnam, using Oribatida mites as an intermediate hosts.

12. In relation to agricultural activities and to climate environment changes, found are a different and clear changes in Oribatida mite community structures, so that they can be used as bioindicators of natural and anthropogenic influencing on soil ecosystem.

8. ACCOUNT OF CONTRIBUTIONS CONNECTED WITH THE THESIS

1. The Oribatida mite fauna (Acari: Oribatida) of Vietnam is known with 320 species (including four subspecies), belonging to 163 genera, 60 families and 2 subfamilies, 28 superfamilies, and 5 suborders. This Oribatida fauna is diverse, representing 3.09%, 13.05%, and 36.80% of the World's Oribatida fauna species, genera and families, respectively.

2. The Oribatida systematical structure of Vietnam is diverse by a number of families, genera, species and subspecies recorded. However, the number of genera recorded per family as well as the number of species and subspecies recorded per genus is not high. 41.94% and 38.71% of the total families and subfamilies consisted of 1 and of 2-3 genera, respectively; and 68.10% of the total 163 genera consisted of 1 species.

3. It is given a review of the Oribatida mites genus *Papillacarus* Kunst, 1959, and a key to nine species known from Vietnam, including five species regarded as conditionally endemic. Proved is that *P. arboriseta* clearly differs from *P. hirsutus*.

4. Thirteen Oribatida species were described as a new for science, and 155 species recorded were new geographical records for Vietnam. The morphological images of 133 Oribatida species, consisted of 41.56% of the total number, and their measurements are introduced

5. It is found that the zoogeographical character of the Vietnamese Oribatida fauna is diverse, consisted of all World eight zoogeographical elements, except only the Antarctic. Its main zoogeographical character is the Oriental region, consisted of 60% of the total 320 species. It has a high specialty, with 111 species, consisted of 34.68% of the total number, classified as conditionally endemic.

6. Grassland and scrubs can play as a transformational ecosystem for reestablishment of the soil Oribatida community. *Tectocepheus velatus*, *Scheloribates praeincisus* and *Lamellobates ocularis* are the most widespread and persisting Oribatida species from northern Vietnam, and can be considered as bioindicators of disturbed soil ecosystems.

7. It is suggested that the soil type plays a major role in formation of the species diversity of the Oribatida community.

8. Indicated that the Oribatida fauna of Vietnam is grouped in three main regions, of Northern, Central and Southern, and it can be divided into 6 sub-regions.

9. Recorded are 10 tapeworm species (Cestoda: Anoplocephelidae), parasitizing on 21 animal species of Vietnam, using Oribatida mites as an intermediate hosts.

9. LIST OF SELECTED PUBLICATIONS CONNECTED TO THE THESIS

A. Monograph

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Table 2. The Oribatida (Acaria: Oribatida) Fauna of Vietnam: Species diversity, Distribution and Zoogeographical regions

World Zoogeographical Regions: (1) NE. Nearctic, (2) PA. Palaearctic, (3) NO. Neotropical, (4) AF. Afrotropical (Ethiopian), (5) OR. Oriental, (6) AU. Australian, (7) PC. Pacific, (8) AN. Antarctic, (9) CO. Cosmopolitan. (10) Vietnamese (Endemic).

VIETNAMESE natural geographic regions: I. **Northwest**: Northwest hilly mountainous region: Sa Pa, Lao Cai; National Park (NP) Xuan Son, Phu Tho province and others, II. **Northeast**: Northeast hilly mountainous region: Dong Hy, Thai Nguyen; NP Tam Dao, Vinh Phuc and others, III. **Red River Delta**: Che Uplands, Bac Ninh, IV. **Red River Delta**: Tu Liem; NP Ba Vi, Hanoi and others, V. **Red River Delta**: NP Cat Ba Island, Hai Phong City, VI. **North Central**: NP Ben En, Thanh Hoa and others, VII. **Central North**: NP Phong Nha - Ke Bang, Quang Binh and others, VIII. **Southern - Mekong River Delta**: NP Bu Gia Map, Binh Phuoc. IX. **Southern - Mekong River Delta**: NP Cat Tien, Dong Nai.

Systematical Taxon: f. Family, g. Genus, s. Species.

Soil types: (I) Coastal saline-acid soil, (II) Acid alluvial soil, (III) Neutral alluvial soil, (IV) Ferralitic reddish brown soil, (V) Ferralitic brownish soil derived from limestone, (VI) Reddish brown soils derived from basic and intermediate magmatic rocks.

Regions Suborders,	I		II		III		IV		V		VI		VI I		VI II		IX		X		
	f	g	s	f	g	s	f	g	s	f	g	s	f	g	s	f	g	s	f	g	s
I. ENARTHRONOTA Grandjean, 1947																					
1. HYPOCHTHONOIDEA Berlese, 1910																					
1. Hypochthoniidae Berlese, 1910	x				x								x		x		x				Cosmopolitan (except Antarctica).
1. <i>Malacoangelia</i> Berlese, 1913					x								x								Pantropical and subtropical.
1. * <i>Malacoangelia remigera</i> Berlese, 1913					x								x								OR: India (Assam).
2. <i>Eohypochthonius</i> Jacot, 1938													x		x		x				Pantropical and subtropical.
2. <i>Eohypochthonius crassisetiger</i> Aoki, 1959																x		x		x	PA: Southern Palaearctic: Caucasus, Oriental Palaearctic (except North), Oriental Australian.
3. * <i>Eohypochthonius gracilis</i> (Jacot, 1936)													x								PA: Pantropical (except Ethiopica); common, subtropical, Oriental (India).
3. <i>Eniochthonius</i> Grandjean, 1933		x																			Cosmopolitan (except Antarctica).
4. * <i>Eniochthonius minutissimus</i> Berlese, 1904)			x																		CO: Cosmopolitan (except Antartica).

11. <i>Atropacarus cucullatus</i> (Ewing, 1909)																x	AF: Patropical and subtropical.
12. <i>Atropacarus hamatus</i> (Hammer, 1973)																x	PA: Polynesia, Japan, Malagasy (I. Reunion).
13. <i>Atropacarus vitrinus</i> (Berlese, 1913)																x	OR: Patropical and subtropical.
10. <i>Austrophthiracarus</i> Balogh et Mahunka, 1978																x	Tropical (Australian and Neotropical) and subtropical.
14. <i>Austrophthiracarus evexus</i> (Niedbała, 2000)																x	OR: Vietnamese (2)
11. <i>Plonaphacarus</i> Niedbała, 1986													x	x			Cosmopolitan (except Antartica).
15. <i>Plonaphacarus insignitus</i> Niedbała, 1989													x				OR: Vietnamese (3).
16. <i>Plonaphacarus kugohi</i> (Aoki, 1959)																x	PA: Pantropical and Southern Palaearctic.
6. Phthiracaridae Perty, 1841		x	x					x	x				x				Cosmopolitan.
12. <i>Hoplophorella</i> Berlese, 1923			x	x				x	x								Pantropical and subtropical.
17. <i>Hoplophorella cuneiseta</i> Mahunka, 1988			x					x									OR: Vietnamese (4).
18. * <i>Hoplophorella finitima</i> (Niedbała, 2002)											x						OR: Vietnamese (5).
19. * <i>Hoplophorella floridæ</i> Jacot, 1933					x												OR: Pantropical and subtropical.
20. * <i>Hoplophorella pakistanensis</i> Hammer, 1977											x						PA: Himalaya.
13. <i>Phthiracarus</i> Perty, 1841													x				Cosmopolitan (except Antartica).
21. <i>Phthiracarus pygmaeus</i> Balogh, 1958													x				PC: Pantropical and subtropical: I. Galapagos.
4. EUPHTHIRACAROIDEA Jacot, 1930																	
7. Oribotritiidae Grandjean, 1954					x	x		x			x		x		x		Cosmopolitan.

14. <i>Indotritia</i> Jacot, 1929	x	x	x	x	x	x	x	x	x	x	x	x	x	Cosmopolitan.
22. <i>Indotritia completa</i> Mahunka, 1987 (= <i>Oribotritia mollis</i> Aoki, 1959).			x		x			x						CO: Cosmopolitan: Oriental, Australian (Nueva Guinea), North Palaearctic oriental and subantarctica (I. Amsterdam).
15. <i>Oribotritia</i> Jacot, 1924											x			Cosmopolitan (except Antarctica).
23. <i>Oribotritia bulbifer</i> (Mahunka, 1987)											x			OR: Oriental.
16. <i>Sabahtritia</i> Mahunka, 1987										x				Oriental.
24. <i>Sabahtritia dongnaiensis</i> Niedbala, 2013										x				OR: Vietnamese (6).
8. Euphthiracaridae Jacot, 1930	x	x	x	x	x	x	x	x	x	x	x	x	x	Cosmopolitan.
17. <i>Rhysotritia</i> Markel et Meyer, 1959	x	x	x	x	x	x	x	x	x	x	x	x	x	Cosmopolitan.
25. <i>Rhysotritia aokii</i> (Niedbała, 2000)										x		x		OR: Oriental and North Palearctic oriental.
26. * <i>Rhysotritia ardua</i> (C.L. Koch, 1841)		x	x						x	x			x	CO: Cosmopolitan.
27. * <i>Rhysotritia duplica</i> (Grandjean, 1953)			x											PA: Palearctic and Vietnamese.
28. * <i>Rhysotritia hauseri</i> (Mahunka, 1991)				x										CO: Holartic, Ethiopian: Somalia, Oriental and Neotropical: Panama.
29. <i>Rhysotritia proxima</i> (Niedbala, 2013)											x			OR: Vietnamese (7).
30. * <i>Rhysotritia rasile</i> Mahunka, 1982					x		x	x		x				PA: Pantropical (except Neotropical) and subtropical (Southern Palaearctic).
5. LOHMANOIDEA Berlese 1916														
9. Lohmannidae Berlese, 1916	x	x	x	x	x	x	x	x	x	x	x	x	x	Pantropical and subtropical.
18. <i>Haplacarus</i> Wallwork, 1962			x						x					Pantropical.

31. * <i>Haplacarus pairathi</i> Aoki, 1965					x						x						OR: Oriental: Thailand and Taiwan (Formosa).
19. <i>I. Javacarus</i> Balogh, 1961	x		x			x	x	x			x	x	x			Pantropical.	
32. * <i>I. Javacarus kuehnelti</i> Balogh, 1961		x		x			x	x	x		x		x		x	OR: common in Oriental, and Australia, Pacific Islands and Egypt.	
20. <i>Lohmannia</i> Michael, 1898	x					x										Pantropical and subtropical.	
33. * <i>Lohmannia I. javana</i> Balogh, 1961		x				x										PA: Eastern Palaearctic, Oriental and Melanesia (I. Fiji).	
21. <i>Meristacarus</i> Grandjean, 1934											x	x				Pantropical.	
34. <i>Meristacarus sundensis</i> Hammer, 1979											x		x			OR: Oriental: Indonesia (I. Java) and Thailand.	
22. <i>Mixacarus</i> Balogh, 1958												x		x		Pantropical (except Australian) subtropical (Southern Holarctic).	
35. <i>Mixacarus exilis</i> Aoki, 1970												x				PA: Japanese.	
36. <i>Mixacarus follifer</i> Golosova, 1984												x				OR: Vietnamese: Gia Lai (8).	
23. <i>Papillacarus</i> Kunst, 1959	x		x	x	x		x		x	x	x	x				Pantropical and subtropical.	
37. * <i>Papillacarus aciculatus</i> (Berlese, 1905)		x				x										PA: Palaearctic Central.	
38. ** <i>Papillacarus arboriseta</i> Jeleva et Vu, 1987		x		x												OR: Vietnamese (9).	
39. ** <i>Papillacarus benenensis</i> Vu, Ermilov et Dao 2010		x							x							OR: Vietnamese (10).	
40. <i>Papillacarus cornutus</i> (Sarkar et Subías, 1984)													x			OR: Oriental: India (Tripura).	
41. * <i>Papillacarus hirsutus</i> (Aoki, 1961)					x						x			x		PA: Southeastern Palaearctic, Ethiopian, Oriental, Polynesia.	
42. <i>Papillacarus polygonatus</i> Ermilov et Anichkin, 2011											x		x		x	OR: Vietnamese (11).	

11. Nothridae Berlese, 1896	x			x	x	x								Cosmopolitan (except Antarctica).
27. Nothrus Koch, 1836		x		x	x	x	x							Cosmopolitan (except Antarctica).
52. <i>Nothrus baviensis</i> Krivolutsky, 1998		x				x								OR: Vietnamese (13).
53. * <i>Nothrus gracilis</i> (Hammer, 1961)				x										NO: Neotropical and North East India.
54. <i>Nothrus montanus</i> Krivolutsky, 1998		x					x							OR: Vietnamese (14).
55. <i>Nothrus shapensis</i> Krivolutsky, 1998		x												OR: Vietnamese (15).
12. Trhypochthonidae Willmann, 1931	x			x	x			x	x	x				Cosmopolitan (except Antarctica).
28. Afronothrus Wallwork, 1961									x					Pantropical.
56. <i>Afronothrus incisivus</i> Wallwork, 1961										x				AU: Pantropical.
29. Allonothrus Hammer, 1953								x						Pantropical and subtropical.
57. * <i>Allonothrus russeolus</i> Wallwork, 1960								x						AF: Pantropical and subtropical: Ghana.
30. Archegozetes Grandjean, 1931	x			x	x				x	x				Pantropical.
58. * <i>Archegozetes longisetosus</i> Aoki, 1965		x		x	x	x			x		x		x	OR: Pantropical (except Ethiopian): common in Oriental (Thailand) and Neotropical.
8. NANHERMANNOIDEA Sellnick, 1928														
13. Nanhermanniidae Sellnick, 1928	x	x							x	x				Cosmopolitan (except Antarctica).
31. Cosmohermannia Aoki et Yoshida, 1970									x	x	x			Southern Palaearctic and Oriental Australian.
59. <i>Cosmohermannia robusta</i> Aoki, 1994									x		x		x	AU: Australian - Oriental: Micronesia (I. Marianas).
32. Cyrthermannia Balogh, 1958									x	x				Pantropical and subtropical.

60. <i>Cyrthermannia vicinicornuta</i> Aoki, 1965												x		x	OR: Oriental and Brazil.
33. <i>Masthermannia</i> Berlese, 1913													x		Pantropical and subtropical.
61. <i>Masthermannia mammillaris</i> (Berlese, 1904)													x		CO: Pantropical and subtropical.
34. <i>Nanhermannia</i> Berlese, 1913	x		x										x		Cosmopolitan (except Antartica).
62. * <i>Nanhermannia thainensis</i> Aoki, 1965		x		x									x		OR: Oriental: Thailand.
9. HERMANNOIDEA Sellnick, 1928															
14. Hermanniidae Sellnick, 1928	x			x		x			x		x		x		Cosmopolitan (except Antartica).
35. <i>Phyllhermannia</i> Berlese, 1916		x			x		x		x		x		x		Pantropical, subtropical and subantarctica.
63. * <i>Phyllhermannia gladiata</i> Aoki, 1965		x			x			x				x		x	OR: Oriental: Thailand.
64. * <i>Phyllhermannia javensis</i> (Hammer, 1979)										x					OR: Oriental: Indonesia (I. Java).
65. <i>Phyllhermannia similis</i> Balogh et Mahunka, 1967		x				x									OR: Vietnamese (16).
IV. BRACHYPYLINA Hull, 1918															
10. HERNIELLOIDEA Grandjean, 1934															
15. Hermanniellidae Grandjean, 1934	x														Cosmopolitan (except Antartica).
36. <i>Hermannella</i> Berlese, 1908		x													Cosmopolitan (except Neotropical and Antartica).
66. <i>Hermannella thani</i> Mahunka, 1987		x													OR: Vietnamese (17).
11. LIODOIDEA Grandjean, 1954															
16. Liodidae Grandjean, 1954	x		x			x			x		x				Cosmopolitan (except Antartica).
37. <i>Liodes</i> Heyden, 1826		x		x			x			x		x			Cosmopolitan (except Antartica).

67. * <i>Liodes theleproctus</i> (Hermann, 1804)		x	x		x		x	x				CO: Palaearctic: Less common in the North Oriental, and Australian: New Guinea and Hawaii.
38. Platyliodes Berlese, 1916							x					Holartica
68. * <i>Platyliodes japonicus</i> Aoki, 1979							x					PA: East Palaearctic, Oriental and Southeast China.
12. GYMNODAMAEOIDEA Grandjean, 1954												
17. Gymnodamaeidae Grandjean, 1954							x	x				Cosmopolitan (except Australia and Antarctica).
39. Arthrodamaeus Grandjean, 1954							x	x				Holartica and Paleotropical.
69. <i>Arthrodamaeus Vietnameseicus</i> Ermilov et Anichkin, 2011							x		x			OR: Vietnamese (18).
13. PLATEREMAEOIDEA Traegardh, 1931												
18. Pedrocortesellidae Paschoal, 1987							x					Cosmopolitan.
40. Hexachaetoniella Paschoal, 1987							x					Oriental Australian and Holartica meridional.
70. * <i>Hexachaetoniella dispersa</i> (Balogh P., 1985)							x					AU: Australian.
41. Pedrocortesella Hammer, 1961							x					Cosmopolitan: Palaearctic, Ethiopian, Australian and Neotropical.
71. * <i>Pedrocortesella pulchra</i> Hammer, 1961							x					NO: Neotropical (Peru and Chile) and Eastern Asian, Russia.
72. * <i>Pedrocortesella temperata</i> P. Balogh, 1985							x					AU: Australian.
14. DAMAEAOIDEA Berlese, 1896												
19. Damaeidae Berlese, 1896	x				x							Cosmopolitan (except Antarctica).
42. Belba Heyden, 1826	x											Holartica, Oriental and Australian.

47. Berlesezetes Mahunka, 1980	x	x	x	x	x	x			x	x	x	x	x	x	x	Cosmopolitan.
81. * <i>Berlesezetes auxiliaris</i> (Grandjean, 1936)		x		x	x		x		x	x						CO: Pantropical and subtropical (common).
82. <i>Berlesezetes ornatissimus</i> (Berlese, 1913)												x		x		CO: Pantropical and subtropical (common).
48. Caucasiozetes Shtanchaeva, 1984													x			Oriental and Southern Palaearctic.
83. <i>Caucasiozetes frankeae</i> Ermilov et Anichkin, 2011													x			OR: Vietnamese (20).
49. Kaszabozetes Mahunka, 1988	x		x						x							Oriental.
84. <i>Kaszabozetes velatus</i> Mahunka, 1988		x		x					x							OR: Vietnamese (21).
50. Schalleriella Balogh, 1962													x			Neotropical.
85. <i>Schalleriella Vietnameseica</i> Ermilov et Anichkin, 2011													x			OR: Vietnamese (22)
17. AMEROBELBOIDEA Grandjean, 1954																
24. Amerobelidae Grandjean, 1954																Palaearctic and Paleotropical.
51. Roynortonia Ermilov, 2011													x			Vietnamese.
86. <i>Roynortonia Vietnameseica</i> Ermilov, 2011													x			OR: Vietnamese (23)
25. Eremulidae Grandjean, 1965	x					x		x		x		x	x			Cosmopolitan.
52. Austroeremulus Mahunka, 1985										x						Ethiopian.
87. * <i>Austroeremulus glabrus</i> Mahunka, 1985											x					AF: South Africa.
53. Eremulus Berlese, 1908	x					x		x		x		x	x	x	x	Cosmopolitan (except Antartica).
88. * <i>Eremulus evenifer</i> Berlese, 1913		x					x		x		x		x	x	x	CO: Southern Palaearctic (Italia and Palaearctic meridional, Oriental (commone)

99. * <i>Eremobelba hamata</i> Hammer, 1961											x					NO: Neotropical.
58. <i>Fenestrella</i> Mahunka, 1987		x		x												Oriental and subtropical.
100. <i>Fenestrella bifurcata</i> Mahunka, 1987		x		x												OR: Vietnamese (26).
28. Heterobelbidae Balogh, 1961												x				Pantropical (except Australia).
59. <i>Heterobelba</i> Berlese, 1913												x				Pantropical (except Australian) and Paleatica meridional.
101. <i>Heterobelba stellifera</i> Okayama, 1980												x				PA: Japanese.
29. Basilobelbidae Balogh, 1961												x				Pantropical.
60. <i>Basilobelba</i> Balogh, 1958												x				Pantropical.
102. <i>Basilobelba parmata</i> Okayama, 1980												x				PA: Japanese and Oriental (Taiwan: Formosa).
18. ZETORCHESTOIDEA Balogh, 1961																
30. Zetorchestidae Michael, 1898	x		x			x	x	x	x	x	x	x	x	x		Cosmopolitan (except Antarctica).
61. <i>Zetorchestes</i> Berlese, 1888	x		x			x	x	x	x	x	x	x	x	x		Cosmopolitan (except Antarctica).
103. * <i>Zetorchestes saltator</i> Oudemans, 1915		x		x			x	x	x	x	x	x	x	x		OR: Oriental (common) and Palaearctic: Ucrania (Crimea) and Corea.
104. * <i>Zetorchestes transvaalensis</i> Coetzee, 1989											x					AF: South Africa.
19. GUSTAVIOIDEA Oudemans, 1900																
31. Astegistidae Balogh, 1961	x											x				Cosmopolitan (except Antartica).
62. <i>Cultroribula</i> Berlese, 1908	x											x				Cosmopolitan (except Antartica)..
105. <i>Cultroribula bicuspidata</i> Mahunka, 1978												x				CO: Ethiopian (Madagascar and Congo), Oriental and Central America.

115. <i>Chistyakovella insolita</i> , Ermilov, Aoki et Anichkin, 2013																	x	OR: Vietnamese (31)
68. <i>Gibbicepheus</i> Balogh, 1958		x		x					x		x							Pantropical and subtropical (Southern Palaearctic).
116. ** <i>Gibbicepheus baccanensis</i> Jeleva et Vu, 1987			x		x				x		x							OR: Vietnamese (32).
69. <i>Pentabodes</i> P. Balogh, 1984											x							Neotropical and Oriental.
117. * <i>Pentabodes inpinatus</i> (Mahunka, 1985)											x							NO: Leeward Islands.
70. <i>Carabodes (Phyllocarabodes)</i> Balogh et Mahunka, 1969											x							Neotropical and Oriental.
118. * <i>Phyllocarabodes ornatus</i> P. Balogh, 1986											x							NO: Neotropical North.
34. Nipobodidae Aoki, 1959			x															Oriental and Southern Palaearctic.
71. Leobodes Aoki, 1965				x														Oriental.
119. ** <i>Leobodes monstruosus</i> Jeleva et Vu, 1987				x														OR: Vietnamese (33).
35. Tectocepheidae Grandjean, 1954	x		x				x		x		x		x		x		x	Cosmopolitan.
72. <i>Tectocepheus</i> Berlese, 1896		x		x			x		x		x		x		x		x	Cosmopolitan.
120. * <i>Tectocepheus cuspidatus</i> Knulle, 1954		x		x					x		x		x					CO: Western Palaearctic: Less common in the North, and Japan, USA (Virginia), and tropical (except Ethiopian).
121. * <i>Tectocepheus velatus</i> (Michael, 1880)		x		x			x							x		x		CO: Cosmopolitan.
73. <i>Tegeozetes</i> Berlese, 1913								x										Pantropical and subtropical (Paleartica meridional).
122. * <i>Tegeozetes tunicatus</i> <i>breviclava</i> Aoki, 1970 (Sub-species)									x									PA: Japanese.
36. Otocepheidae Balogh, 1961	x		x				x		x		x		x		x		x	Pantropical and subtropical.

74. <i>Otocepheus (Acrotocepheus)</i> Aoki, 1965	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	Australian - Oriental and subtropical (Southern Palaearctic).
123. <i>Acrotocepheus duplicornutus</i> (Aoki, 1965)		x		x				x		x		x				OR: Oriental: Thailand.
124. <i>Acrotocepheus duplicornutus</i> <i>discrepans</i> Balogh et Mahunka, 1967 (Sub-species)		x		x				x			x		x	x	x	OR: Vietnamese (34).
125. <i>Acrotocepheus triplicornutus</i> Balogh et Mahunka, 1967		x		x	x											OR: Vietnamese (35).
126. <i>Acrotocepheus (Otocepheus)</i> <i>Vietnamesicus</i> (Ermilov et Anichkin, 2011)													x	x	x	OR: Vietnamese (36).
75. <i>Archegotocepheus</i> (<i>Megalotocepheus</i>) Mahunka, 1988										x						Oriental and Palaearctic.
127. * <i>Archegotocepheus</i> (<i>Megalotocepheus</i>) <i>singularis</i> Mahunka, 1988										x						OR: Vietnamese (37).
76. <i>Dolicheremaeus</i> Jacot, 1938	x		x			x		x		x	x	x	x	x	x	Pantropical and subtropical.
128. <i>Dolicheremaeus aokii</i> (Balogh et Mahunka, 1967)		x		x					x		x		x	x	x	OR: Vietnamese (38).
129. <i>Dolicheremaeus bartkei</i> Rajska et Szudrowice, 1974		x						x								OR: Vietnamese (39).
130. <i>Dolicheremaeus bugiamapensis</i> Ermilov, Anichkin, Wu, 2012												x				OR: Vietnamese (40).
131. * <i>Dolicheremaeus capillatus</i> (Balogh, 1959)											x					AF: Ethiopian.
132. <i>Dolicheremaeus inaequalis</i> Balogh et Mahunka, 1967		x		x			x			x		x				OR: Vietnamese (41).
133. <i>Dolicheremaeus lineolatus</i> Balogh et Mahunka, 1967		x		x			x									OR: Vietnamese (42).
134. <i>Dolicheremaeus ornata</i> (Balogh et Mahunka, 1967)		x		x				x		x						OR: Vietnamese (43).
135. * <i>Dolicheremaeus sabahnus</i> (Mahunka, 1988)											x					OR: Borneo and India (Tripura).

77. Eurostocephus Aoki, 1965															x	Pantropical and subtropical.
136. <i>Eurostocephus aquilinus</i> Aoki, 1965															x	OR: Oriental: ThaiLand.
21. OPPIOIDEA Grandjean, 1954																
37. Eremellidae Balogh, 1961	x		x					x								Pantropical and subtropical.
78. Eremella Berlese, 1913		x		x				x								Oriental.
137. * <i>Eremella vestita</i> Berlese, 1913		x		x				x							x	OR: Oriental: Indonesia.
38. Granuloppiidae Balogh, 1983											x			x		Pantropical and subtropical.
79. Gigantoppia Mahunka, 2008														x		Oriental.
138. <i>Gigantoppia zryanini</i> Ermilov et Anichkin, 2011															x	OR: Vietnamese (44).
80. Granuloppia Balogh, 1958										x						Paleotropical.
139. * <i>Granuloppia kamerunensis</i> (Mahunka, 1974)										x						AF: Cameroon.
39. Oppidae Grandjean, 1954	x		x	x	x	x	x	x	x	x	x	x	x			Cosmopolitan.
81. Acroppia Balogh, 1883									x							Pantropical.
140. <i>Acroppia processigera</i> (Balogh et Mahunka, 1967)									x							AF: Congo Basin.
82. Arcoppia Hammer, 1977	x		x			x		x	x	x			x			Pantropical and subtropical.
141. * <i>Arcoppia arcualis</i> (Berlese, 1913)		x		x			x		x	x	x			x		OR: China (Hong Kong), Indonesia, New Zeland, Tongo, Brazil.
142. * <i>Arcoppia baloghi</i> Rodriguez et Subias, 1984		x					x		x	x						OR: Vietnamese (45).
143. * <i>Arcoppia corniculifera</i> (Mahunka, 1978)									x	x			x			AF: Ethiopian (Malagasy: I. Mauritius and Uganda), Central America and Australia (I. Fiji).

154. <i>**Kokoppia dendricola</i> (Jeleva et Vu, 1987)				x			x								OR: Vietnamese (47).
91. <i>Lanceoppia</i> Subías, 1989											x				Pantropical and austral.
155. <i>*Lanceoppia becki</i> Hammer, 1968											x				AU: New Zealand.
92. <i>Lasiobelba</i> Aoki, 1959	x		x			x									Cosmopolitan (except Antarctica).
156. <i>*Lasiobelba kuehnelti</i> (Csiszar, 1961)				x			x								OR: Tropical: Oriental (Indonesia: Komodo, common) and Australian (Hawaii) and Ethiopian (Congo and Ethiopia).
157. <i>*Lasiobelba remota</i> Aoki, 1959	x		x												CO: Cosmopolitan (except Antarctica).
93. <i>Lineoppia</i> J et P. Balogh, 1983											x				Pantropical.
158. <i>Lineoppia microseta</i> Ermilov et Anichkin, 2011											x				OR: Vietnamese (48).
94. <i>Multioppia</i> Hammer, 1961															Cosmopolitan (except Antarctica).
159. <i>Multioppia tamdao</i> Mahunka, 1988	x		x									x		x	OR: Vietnamese (49).
95. <i>Neoamerioppia</i> Subías, 1989			x								x		x		Pantropical and subtropical.
160. <i>Neoamerioppia Vietnameseica</i> (Mahunka, 1988)				x							x		x		OR: Vietnamese (50).
96. <i>Oppia</i> Wallwork, 1961			x	x	x			x		x					Pantropical and subtropical.
161. <i>*Oppia arcualis</i> (Berlese, 1913)				x					x						OR: Oriental: Southeast China.
162. <i>*Oppia yodai</i> Aoki, 1965					x		x								OR: Tropical: Oriental (Indonesia: Komodo, common), Australian (Hawaii) and Ethiopian (Congo and Ethiopia).
97. <i>Opiella</i> Jacot, 1937	x		x			x					x		x		Cosmopolitan.
163. <i>*Opiella nova</i> (Oudermans, 1902)	x		x			x		x			x		x		CO: Cosmopolitan.

98. <i>Oxybrachioppia</i> Subías, 1989																					Palaearctica oriental.
164. <i>Oxybrachioppia barbata</i> (Choi, 1986)																		x	PA: Korea.		
99. <i>Pseudoamerioppia</i> Subias, 1989			x						x		x	x								Pantropical, subtropical (Southern Palaearctic) and Nearctica.	
165. <i>Pseudoamerioppia Vietnameseica</i> (Mahunka, 1988)				x					x	x	x								OR: Vietnamese (51).		
100. <i>Pulchroppia</i> Hammer, 1979	x		x						x		x					x				Oriental.	
166. <i>Pulchroppia elegans</i> Hammer, 1979																x			OR: Oriental: Indonesia (I. Java).		
167. <i>Pulchroppia granulata</i> Mahunka, 1988		x		x												x			OR: Oriental: Southeast China.		
168. <i>Pulchroppia roynortoni</i> Ermilov et Anichkin, 2011																x			OR: Vietnamese (52).		
169. * <i>Pulchroppia simillis</i> Hammer, 1979											x								OR: Oriental: Indonesia (I. Java).		
170. <i>Pulchroppia Vietnameseica</i> (Balogh et Mahunka, 1967)		x							x										OR: Vietnamese (53).		
101. <i>Ramusella</i> Hammer, 1962	x					x									x				Cosmopolitan (except Antarctica).		
171. * <i>Ramusella clavipectinata</i> (Michael, 1885)		x					x												CO: Cosmopolitan: Palaearctic, Neatctic (USA: California), Malagasy, Oriental and Hawaii).		
172. <i>Ramusella elliptica</i> (Berlese, 1908)															x				CO: Western Palaearctic (common in Mediterranean), Iran and USA (New Mexico), Neotropical (Costa Rica) and Oriental.		
173. <i>Ramusella pocsi</i> (Balogh et Mahunka, 1967)		x																	OR: Vietnamese (54).		
102. <i>Ramuselloppia</i> Subías et Rodríguez, 1986														x					Southern Palaearctic and Oriental.		
174. <i>Ramuselloppia Vietnameseica</i> Ermilov et Anichkin, 2013														x					OR: Vietnamese (55).		

103. <i>Striatoppia</i> Balogh, 1958		x				x		x											Pantropical and subtropical.
175. * <i>Striatoppia madagascarensis</i> (Balogh, 1960)						x													AF: Madagascar.
176. <i>Striatoppia opuntiseta</i> Balogh et Mahunka, 1968			x					x											OR: Pantropical (except Australia) and Japan.
177. * <i>Striatoppia papillata</i> Balogh et Mahunka, 1966								x											AF: Congo and Egypt.
104. <i>Taiwanoppia</i> Tseng, 1982				x								x		x		x			Pantropical and subtropical.
178. <i>Taiwanoppia (Viettoppia)</i> <i>hungarorum</i> (Mahunka, 1988)				x								x		x		x			OR: Oriental and Mexico.
40. <i>Suctobelbidae</i> Jacot, 1938	x		x		x			x		x		x		x		x			Cosmopolitan.
105. <i>Suctobelba</i> Paoli, 1908					x							x							Cosmopolitan.
179. * <i>Suctobelba finlayi</i> Balogh et Mahunka, 1980												x							NE: Cuba, and Vietnam (?).
180. * <i>Suctobelba longicuspis</i> (Jacot, 1937)						x						x							CO: Neartica oriental, Europe and I. Kuriles, El Salvador and New Zealand.
181. * <i>Suctobelba subtrigona</i> (Oudemans, 1916)						x													PA: Palaearctic: common in Western Palaearctic, Nearctic north, and Mexico.
106. <i>Suctobelbila</i> Jacot, 1937					x							x							Pantropical and subtropical.
182. * <i>Suctobelbila transrugosa</i> Mahunka, 1986					x							x							AF: Tanzania.
107. <i>Suctobelbella</i> Jacot, 1937	x		x					x		x			x		x				Cosmopolitan.
183. <i>Suctobelbella elegantula</i> (Hammer, 1958)								x							x				CO: Neotropical, Oriental and Holartica meridional (Southern Palaearctic and USA.: Luisiana).
184. * <i>Suctobelbella latirostris</i> (Strenzke, 1950)		x		x									x		x		x		PA: Palaearctic: Europe and western Siberia.

204. <i>Unguizetes sphaerula</i> (Berlese, 1905)															x	x	OR: Oriental and Japanese.
114. <i>Uracobates</i> Balogh et Mahunka, 1967						x			x								Pantropical (except Neotropical).
205. <i>Uracobates magniporus</i> Balogh et Mahunka, 1967					x				x								OR: Oriental and Taiwan (Formosa).
47. Xylobatidae J. et P. Balogh, 1984	x		x	x	x	x	x	x	x	x			x			Cosmopolitan.	
115. <i>Brazilobates</i> Pérez-Íñigo et Baggio, 1980			x														Pantropical and subtropical.
206. <i>Brazilobates maximus</i> Mahunka, 1988				x													OR: Vietnamese (65).
116. <i>Perxylobates</i> Hammer, 1972	x		x			x	x	x	x	x			x			Pantropical and subtropical.	
207. <i>Perxylobates brevisetus</i> Mahunka, 1988		x		x													OR: Vietnamese (66).
208. <i>Perxylobates crassisetosus</i> Ermilov et Anichkin, 2011													x				OR: Vietnamese (67).
209. * <i>Perxylobates guehoi</i> Mahunka, 1978											x						PA: Malagasy.
210. ** <i>Perxylobates thanhhoaensis</i> Ermilov, Vu, Trinh et Dao, 2010		x								x							OR: Vietnamese (68)
211. * <i>Perxylobates vermiseta</i> (Balogh et Mahunka, 1968)		x		x		x	x	x									OR: Tropical: Malagasy, Oriental, Pacific Islands and Leeward Islands.
212. ** <i>Perxylobates Vietnameseensis</i> (Jeleva et Vu, 1987)		x		x		x											OR: Vietnamese (69).
117. <i>Setoxylobates</i> Balogh et Mahunka, 1967	x		x	x	x	x	x	x	x	x	x	x	x			Australianoriental.	
213. <i>Setoxylobates foveolatus</i> Balogh et Mahunka, 1967		x		x	x	x	x	x	x	x	x	x				OR: Oriental and Northeast India.	
118. <i>Vilhenabates</i> Balogh, 1963												x					Palaeotropical.
214. <i>Vilhenabates sinatus</i> (Aoki, 1965)												x					OR: Oriental.

119. <i>Xylobates</i> Jacot, 1925		x		x		x		x		x		x		x		x		x		Cosmopolitan (except Antarctica).
215. * <i>Xylobates capucinus</i> (Berlese, 1908)			x		x				x			x								CO: Cosmopolitan (except Antarctica).
216. * <i>Xylobates duoseta</i> Hammer, 1979						x								x						OR: Oriental: Indonesia (I. Java and Borneo).
217. * <i>Xylobates gracilis</i> Aoki, 1962			x		x					x		x								PA: Japanese.
218. * <i>Xylobates lophotrichus</i> (Berlese, 1904)			x		x				x		x		x		x					CO: Cosmopolitan: common in Holarctic, Ethiopian (Senegal and I. Santa Helena), Southeast China and Hawaii.
219. * <i>Xylobates monodactylus</i> (Haller, 1804)		x		x			x													PA: Holartica, Oriental (Philippines).
220. * <i>Xylobates paracapucinus</i> Mahunka, 1988													x		x		x			PA: Palaearctic oriental (Iran), Oriental and Ethiopian (Congo).
48. Protoribatidae J. et P. Balogh, 1984	x												x		x					
Protoribatinae J. et P. Balogh, 1984 (Sub-family)														x						Cosmopolitan.
120. Protoribates Berlese, 1908															x					Cosmopolitan (except Antarctica).
221. <i>Protoribates cattienensis</i> Ermilov et Anichkin, 2011															x					OR: Vietnamese (70).
222. <i>Protoribates heterodactylus</i> Ermilov et Anichkin, 2011															x					OR: Vietnamese (71).
223. <i>Protoribates maximus</i> (Mahunka, 1988)															x					OR: Vietnamese (72).
Liebstadiinae J. et P. Balogh, 1984 (Sub-family)	x																			Cosmopolitan.
121. Liebstadia Oudemans, 1906		x																		Cosmopolitan: Holartica, Oriental, Ethiopian and Australian.
224. * <i>Liebstadia humerata</i> Sellnick, 1928			x																	CO: common in Western Palaearctic, Asia and Nearctic.
49. Oribatulidae Thor, 1929	x		x		x								x			x				Cosmopolitan.

122. <i>Cordiozetes</i> Mahunka, 1983		x		x															Tropical (Oriental and Neotropical).
225. <i>Cordiozetes olahi</i> Mahunka, 1987			x		x														OR: Vietnamese (73).
123. <i>Oribatula</i> Berlese, 1896												x							Cosmopolitan.
226. * <i>Oribatula gracilis</i> Hammer, 1958						x						x							NO: Neotropical.
124. <i>Sellnickia</i> Oudemans, 1927															x				Oriental Australian.
227. <i>Sellnickia caudata</i> (Michael, 1898)															x				AU: Australian (New Zealand and Australia), and Oriental (Sumatra).
125. <i>Zygoribatula</i> Berlese, 1916					x							x			x				Cosmopolitan.
228. * <i>Zygoribatula longiporosa</i> (Hammer, 1952)					x														AF: Pantropical (except Neotropical) and subtropical.
229. * <i>Zygoribatula pennata</i> Grobler, 1993												x							AF: South Africa.
230. <i>Zygoribatula prima</i> Ermilov et Anichkin, 2011															x				OR: Vietnamese (74).
50. Haplozetidae Grandjean, 1936	x		x	x		x		x	x	x	x	x	x	x	x				Cosmopolitan (except Antarctica).
126. <i>Cosmobates</i> Balogh, 1959																			Ethiopian.
231. <i>Cosmobates nobilis</i> Glosova, 1984 (Gia Lai)																			OR: Vietnamese (75).
127. <i>Indoribates</i> Willmann, 1935															x				Oriental.
232. <i>Indoribates microsetosus</i> Ermilov et Anichkin, 2011															x				OR: Vietnamese (76).
233. <i>Indoribates vindobonensis</i> (Willmann, 1935).															x				PA: Palaearctic, Arabian Peninsula and Mexico.
128. <i>Magnobates</i> Hammer, 1967		x		x							x								Pantropical (except Ethiopian).

234. * <i>Magnobates flagellifer</i> Hammer, 1967			x		x						x								AU: New Zealand.
129. <i>Peloribates</i> Berlese, 1908		x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	Cosmopolitan (except Antartica).	
235. <i>Peloribates gressitti</i> Balogh et Mahunka, 1967		x		x	x		x	x	x									OR: Oriental: Philippines.	
236. <i>Peloribates kaszabi</i> Mahunka, 1988		x		x				x	x				x		x			OR: India.	
237. * <i>Peloribates paraguayensis</i> Balogh et Mahunka, 1981												x						NO: Neotropical: Paraguay, and Oriental: India (Bengala).	
238. * <i>Peloribates pseudoporosus</i> Balogh et Mahunka, 1967		x					x			x								OR: Vietnamese (77)	
239. <i>Peloribates rangiroaensis</i> Hammer, 1972													x		x			PA: East Oriental Palaeartic and Southeast China.	
240. <i>Peloribates spiniformis</i> Ermilov et Anichkin, 2011													x		x			OR: Vietnamese (78).	
241. <i>Peloribates stellatus</i> Balogh et Mahunka, 1967		x					x	x	x	x	x							OR: Vietnamese (79).	
130. <i>Rostrozetes</i> (<i>Trachyribates</i>) Sellnick, 1925	x				x	x	x	x	x	x	x	x	x	x	x	x	x	Pantropical and subtropical.	
242. * <i>Rostrozetes areolatus</i> (Balogh, 1958)	x		x			x	x	x										OR: Common in Pantropical, and subtropical.	
243. * <i>Rostrozetes foveolatus</i> Sellnick, 1925	x																	OR: Common in Pantropical, and subtropical.	
244. <i>Rostrozetes punctulifer</i> Balogh et Mahunka, 1979	x			x	x				x	x								OR: Common in Pantropical, and subtropical.	
245. * <i>Rostrozetes trimorphus</i> Balogh et Mahunka, 1979	x					x				x								OR: Common in Pantropical, and subtropical.	
246. <i>Rostrozetes</i> (<i>Trachyribates</i>) <i>ovulum</i> (Berlese, 1908)													x		x			OR: Pantropical, and subtropical.	
51. Scheloribatidae Grandjean, 1953	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	Cosmopolitan.	
131. <i>Euscheloribates</i> Kunst, 1958			x						x									Oriental Australian.	
247. * <i>Euscheloribates samsinaki</i>				x						x								PA: Europa: Checoslovaquia, and	

Kunst, 1958																					Oriental: India.
132. Fijibates Hammer, 1971																		x			Pantropical (except Ethiopian).
248. <i>Fijibates aelleni</i> (Mahunka, 1988).																	x			AU: Borneo.	
133. Ischeloribates Corpuz-Raros, 1980					x									x							Pantropical and subtropical.
249. * <i>Ischeloribates luteus</i> (Hammer, 1962)					x									x							NO: Neotropical: Chile and Venezuela.
134. Nanobates Balogh et Mahunka, 1980			x						x					x							Oriental Australian.
250. <i>Nanobates clavatus</i> Mahunka, 1988			x					x													OR: Vietnamese (80).
135. Philoribates L.A.Corpuz-Raros, 1980 (Bischeloribates Mahunka, 1980)																					Oriental: Philippines.
251. * <i>Philoribates heterodactylus</i> (Mahunka, 1988)														x							OR: Oriental: Malaysia.
136. Rhabdoribates Aoki, 1967	x					x															Oriental.
252. * <i>Rhabdoribates siamensis</i> Aoki, 1967		x					x		x												OR: Oriental: Thailand.
137. Scheloribates Berlese, 1908	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	Cosmopolitan.	
253. ** <i>Scheloribates cruciseta</i> Vu et Jeleva, 1987		x		x																	OR: Vietnamese (81).
254. * <i>Scheloribates fimbriatus</i> Thor, 1930							x				x		x	x	x	x	x	x	x	CO: Cosmopolitan: Southern Palaearctic, Nearctic and Pantropical.	
255. <i>Scheloribates kraepelini</i> (Berlese 1908)																		x			OR: Oriental: Indonesia (I. Java).
256. * <i>Scheloribates laevigatus</i> (C.L.Koch, 1836)		x		x	x		x		x		x		x								CO: Cosmopolitan: Holartic and Palaeotropical.

257. * <i>Scheloribates latipes</i> (C.L.Koch, 1841)			X		X				X			X			X		X		CO: Cosmopolitan.
258. * <i>Scheloribates pallidulus</i> (C.L.Koch, 1840)			X		X				X		X	X		X		X			CO: Cosmopolitan (except Antartica).
259. * <i>Scheloribates praeincisus</i> (Berlese, 1916)			X		X		X		X			X		X		X		X	CO: Cosmopolitan: Oriental: common, Pacific Islands: common, and Neotropical: Panama and I. Galapagos, and Horlatica Southern: Egypt, Iran, and USA: Texas.
260. * <i>Scheloribates vulgaris</i> Hammer, 1961														X					NO: Neotropical (Peru and Chile).
138. <i>Tuberemaeus</i> Sellnick, 1930												X		X					Pantropical (Except Neotropical) and subtropical (Southern Palaearctic).
261. * <i>Tuberemaeus lineatus</i> Balogh, 1970														X					OR: New Guinea and Philippines.
262. <i>Tuberemaeus sculpturatus</i> Mahunka, 1987													X						OR: Oriental: Philippines.
52. Oripodidae Jacot, 1925	X		X						X		X	X				X			Cosmopolitan.
139. <i>Cosmopirnodus</i> Balogh, 1970				X					X										Australian-Oriental and Southern Palaearctic.
263. <i>Cosmopirnodus tridactylus</i> Mahunka, 1988					X														OR: Vietnamese (82).
140. <i>Oripoda</i> Bank, 1904				X					X										Cosmopolitan (except Antartica)
264. <i>Oripoda excavata</i> Mahunka, 1988					X					X									OR: Vietnamese (83).
141. <i>Subpirnodus</i> Mahunka, 1988				X															Oriental.
265. <i>Subpirnodus mirabilis</i> Mahunka, 1988					X														OR: Vietnamese (84).
142. <i>Truncopes</i> Grandjean, 1956	X		X						X		X	X			X				Southern Palaearctic, Oriental and Neotropical

266. <i>Truncopes orientalis</i> Mahunka, 1987		x	x					x	x	x				OR: Vietnamese (85).
53. Birobatidae J. et P. Balogh, 1984											x			Palaearctic.
143. <i>Brachyoripoda</i> Balogh, 1970											x			Paleotropical and Southern Palaearctic.
267. <i>Brachyoripoda foveolata</i> Balogh, 1970											x			OR: Oriental: Sri Lanka.
26. CERATOZETOIDEA Jacot, 1925														
54. Ceratozetidae Jacot, 1925	x								x	x				Cosmopolitan.
144. <i>Allozetes</i> Berlese, 1913	x								x	x				Paleotropical and Southern Palaearctic.
268. * <i>Allozetes pusillus</i> Berlese, 1914	x								x		x			OR: Oriental.
145. <i>Ceratozetes</i> Berlese, 1908														Cosmopolitan.
269. * <i>Ceratozetes gracilis</i> (Michael, 1884)	x													CO: Holarctic (common), I. Helena, Oriental, New Zealand, Neotropical (Chile and Panama) and Antarctica (South Shetland I.).
270. * <i>Ceratozetes mediocris</i> Berlese, 1908	x													CO: Holarctic (common in Palaearctic), Oriental and Australian (New Zealand).
146. <i>Fuscozetes</i> Sellnick, 1928	x													Holartica, Oriental and Neotropical.
271. * <i>Fuscozetes fusipes</i> (C.L.Koch, 1844)	x													PA: Horlatica (less common in the South), Costa Rica.
55. Austrachipteriidae Luxton, 1985	x	x			x	x	x	x	x	x	x			Tropical and subtropical.
147. <i>Austrachipteria</i> Balogh et Mahunka, 1966								x						Australia-Oriental and Southern Palaearctic.
272. ** <i>Austrachipteria phongnhae</i> Ermilov et Vu, 2012									x					OR: Vietnamese (86).
148. <i>Lamellobates</i> Hammer, 1958	x	x			x	x	x	x	x	x	x			Pantropical (common) and subtropical.

158.	<i>Galumna</i> Heyden, 1826	x	x	x	x	x	x	x	x	x	x	x	x	x	Cosmopolitan.
291.	<i>Galumna aba</i> Mahunka, 1989 (Đà lạt, Lâm Đồng)		x								x				OR: Vietnamese (93).
292.	<i>Galumna acutirostrum</i> Ermilov et Anichkin, 2010													x	OR: Vietnamese (94).
293.	* <i>Galumna discifera</i> Balogh, 1960				x						x				AF: Ethiopian: Congo and South Africa.
294.	* <i>Galumna flabellifera</i> Hammer, 1958		x				x	x	x					x	OR: Pantropical and subtropical.
295.	* <i>Galumna flabellifera orientalis</i> Aoki, 1965 (Sub-species)		x				x	x							OR: Pantropical (common) and subtropical.
296.	** <i>Galumna kebangica</i> Ermilov et Vu, 2012										x				OR: Vietnamese (95).
297.	<i>Galumna khoii</i> Mahunka, 1989 (Đà lạt, Lâm Đồng)		x			x					x		x	x	OR: Vietnamese (96).
298.	* <i>Galumna lanceata</i> Oudemans, 1900		x	x											PA: Palaearctic (common).
299.	<i>Galumna levisensis</i> Ermilov et Anichkin, 2010										x		x		OR: Vietnamese (97).
300.	* <i>Galumna obvia</i> (Berlese, 1915)		x												OR: Northeast China.
301.	<i>Galumna pseudokhoii</i> Ermilov et Anichkin, 2010										x		x		OR: Vietnamese (98).
302.	** <i>Galumna tenensis</i> Ermilov, Vu et Nguyen 2011			x						x					OR: Vietnamese (99).
303.	* <i>Galumna triqueta</i> Aoki, 1965			x											OR: Oriental: Thailand.
159.	<i>Globogalumna</i> P. et J. Balogh, 1990											x			Neotropical and Oriental.
304.	<i>Globogalumna biporosa</i> Ermilov et Anichkin, 2012											x			OR: Vietnamese (100).
160.	<i>Leptogalumna</i> Balogh, 1960											x			Pantropical.

305. <i>Leptogalumna ciliata</i> Balogh, 1960															x	AF: Ethiopian, Polynesia (Tahiti) and Cuba.
161. <i>Neogalumna</i> Hammer, 1973														x	x	Pantropical.
306. <i>Neogalumna seniczaki</i> Ermilov et Anichkin, 2010													x	x	x	OR: Vietnamese (101).
162. <i>Pergalumna</i> Grandjean, 1936	x		x		x	x	x			x		x	x	x		Cosmopolitan (except Antatica).
307. * <i>Pergalumna altera</i> (Oudemans, 1915)		x							x							CO: Cosmopolitan; Holarctic; common in Europe, South Africa, Southeast China, Micronesia (I. Marianas).
308. * <i>Pergalumna capillaris</i> Aoki, 1961		x														OR: Oriental: Japanese and Vietnamese.
309. <i>Pergalumna cattienica</i> Ermilov et Anichkin, 2011													x			OR: Vietnamese (102).
310. <i>Pergalumna granulata</i> Balogh et Mahunka, 1967		x	x		x	x	x									OR: Oriental and Japanese.
311. <i>Pergalumna indistincta</i> Ermilov et Anickin, 2011												x		x		OR: Vietnamese (103).
312. <i>Pergalumna kotschyi</i> Mahunka, 1989 (Đà lạt, Lâm Đồng)		x					x									OR: Vietnamese (104).
313. <i>Pergalumna margaritata</i> Mahunka, 1989		x					x				x		x			OR: Vietnamese (105).
314. <i>Pergalumna paraelongata</i> Ermilov et Anickin, 2012				x		x								x		OR: Vietnamese (106).
315. <i>Pergalumna punctulata</i> Balogh et Mahunka, 1967				x												OR: Vietnamese (107).
316. <i>Pergalumna pseudosejugalis</i> Ermilov et anichki, 2012											x					OR: Vietnamese (108).
317. <i>Pergalumna yurtaevi</i> Ermilov et Anickin, 2011										x		x	x			OR: Vietnamese (109).
163. <i>Trichogalumna</i> Balogh, 1960	x					x				x		x	x			Pantropical (except Antartica).

318. <i>Trichogalumna nipponica</i> (Aoki 1966)														x	x	PA: Southern Palaearctic: Caucasus and Eastern Palaearctic (common), Oriental and Ethiopian (Zambia).
319. <i>Trichogalumna subnudus</i> Balogh et Mahunka, 1967		x								x						OR: Vietnamese (110).
320. <i>Trichogalumna Vietnameseica</i> Mahunka, 1987		x		x												OR: Vietnamese (111).
Suborders: 5																1. NE: 3 – 0.9%.
Super Families: 28																2. PA: 40 – 12.5%.
Families: 60 (+2 subfam)																3. NO: 11 – 3.5%.
Genera: 163																4. AF: 22 – 6.9%.
Species and subspecies: 320 (316 + 4)																5. OR: 192 – 60.0%.
Species described new for science, from Vietnam: 120 (37,50%)	40	6 3	1 1	3 1	5 1	2 8	4 5	3 7	4 9	4 5	5 9	4 3	7 8	1 2	1 2	6. AU: 16 – 5.0%.
Species new for science, recorded only from Vietnam (probably endemic): 111 (34.68%)		1 9	8 1	1 6	2 8	2 8	5 6	6 6	2 9	2 5	3 8	3 5	3 0	5 7	4 2	7. PC: 1 – 0.3%.
Species described new for science by Vu et al.: 13																8. AN: 0 – 0.0%.
Species recorded new for the fauna of Vietnam by Vu et al.: 155 (48.44%)																9. COS: 35 – 10.9%.
																10. VIETNAMESE (PROBABLY ENDEMIC SPECIES): 111 - 34.68%.