# Gamasida (Acari) in the soil of some forest habitats in South Korea

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Abstract. Research on soil gamasid mites was carried out in coniferous stands with the dominating *Pinus koraiensis* and *P. rigida*, in deciduous forests with *Quercus mongolica*, and in mixed forests with the participation of *Fraxinus rhynchophylla*, *Quercus aliena* and *Pinus densiflora* in the area of Jumbong Mountains and in the urban and suburban zone of Seoul (Namsan and Kwangreung) in South Korea. A total of 77 species of gamasid belonging to 21 families were identified. The highest species number of these mites (18) were found in the Ascidae, and slightly less in the Parholaspididae (13) and Zerconidae (11). The most frequent were *Holaspina ochraceus* (ISHIKAWA), *H. dentatus* (ISHIKAWA) and *H. alstoni* (EVANS), and in some habitats also *Asca aphidioides* (LINNAEUS), *Colpothylax exilis* (BERLESE), *Veigaia ashizuriensis* ISHIKAWA and *Zercon szeptyckii* BŁASZAK. Exclusive and rare species included: *Antennoseius imbricatus* ISHIKAWA, *Cheiroseius phalangioides* (EVANS et HYATT), *Discourella ishikawai* HIRAMATSU, *Evimirus uropodinus* (BERLESE), *Iphidinychus manicatus* BERLESE, *Lasioseius tomokoae* ISHIKAWA and *Metazercon rafalskii* BŁASZAK, KACZMAREK et LEE.

Key words: Gamasida, forest habitats, faunistic, Korea.

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## I. INTRODUCTION

Earlier studies of free-living soil gamasid mites (Acari) of the Korean Peninsula were concerned with a few taxonomic groups. Those works referred to the families: Parasitidae, Parholaspididae, Uropodidae and Zerconidae (BŁASZAK 1975, 1976a, 1976b, 1979; ATHIAS-HENRIOT 1977, 1980; HALAŠKOVÁ 1979; HIRSCHMANN & WIŚNIEWSKI 1993; LEE & LEE 1996; BŁASZAK et al. 1997).

The presented study is the first one involving such a comprehensive faunistic analysis of gamasid mites in South Korea.

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## II. MATERIAL AND METHODS

Samples for acarological analysis were taken from 1993 till 1995 in the Nature Reserve in Mt. Jumbong (38°00-38°05' N, 128°20'-128°30' E), in the central part of Seoul in the Namsan quarter (37°32' N, 126°58' E), and in the suburban zone in Kwangreung (37°45' N, 127°10' E) (Map. 1). The areas in Mt. Jumbong were covered with a coniferous stand with the dominating *Pinus koraiensis* at the altitude of 900 m, a mixed forest with *Fraxinus rhynchophylla*, *Quercus aliena* and *Pinus densiflora* at 1100 m, and a deciduous forest with *Quercus mongolica*, *Kalopanax pictus*, *Carponus cordata* and *Acer pseudosieboldii* at 1000 m. The coniferous forests in the area of Namsan and Kwangreung consisted mainly of *Pinus rigida* and *P. koraiensis*, while the deciduous forests were dominated by *Quercus mongolica* and *Carpinus laxiflora*, mixed with *Sorbus alnifolia*, *Acer pseudosieboldii*, *Quercus aliena*, *Q. variabilis* and *Rhododendron mucrunulatum*.



Map1. Sampling sites in Mt. Jumbong, Namsan and Kwangreung.

#### Gamasida in South Korea

The mites were extracted from the samples during 3 days in a highgradient Tullgren funnel and then they were preserved in 70% ethyl alcohol and subsequently prepared in Marck-Andre's II liquid. All in all, the analysis included over 13000 gamasid mites. The collected Gamasida were identified to the species level on the basis of keys to identification and papers on the particular taxonomic groups (EVANS 1956; FARRIER 1957; KRANTZ 1960, 1975; HURLBUTT 1963, 1971; EHARA 1964, 1980; ISHIKAWA 1966, 1969a, 1969b, 1972, 1979, 1987; AOKI 1968; BŁASZAK 1975, 1976a, 1976b, 1979; KARG 1971; ATHIAS-HENRIOT 1977, 1980; GILAROVA & BREGIETOVA 1977; HIRAMATSU 1978, 1979a, 1979b; HALAŠKOVÁ 1979; TSENG 1981; HIRSCHMANN & WIŚNIEWSKI 1982; BŁASZAK et al. 1997). The taxonomic classification of gamasid mites used is that of EVANS & TILL 1978 and FARRIER & HENNESEY 1993.

#### III. RESULTS

### Review of the selected species

### Ameroseiidae

# *Epicriopsis stellata* ISHIKAWA, 1972

It was earlier reported only from Japan (ISHIKAWA 1972). In the present study, *E. stellata* was found in leaf litter in a coniferous forest with the dominating *Pinus koraiensis*, and in deciduous and mixed forests at altitudes of 900-1100 m in Mt. Jumbong (Tab. 1). Only several, less than 10 individuals of *E. stellata* were found, and the majority of them colonized with strongly decayed litter. Therefore, this species can be considered very rare in the investigated forests, and its populations, except for some microhabitats, can be regarded as strongly dispersed.

## Ascidae

# Antennoseius imbricatus ISHIKAWA, 1969

This species, so far, has been recorded only from Japan (ISHIKAWA 1969a). It inhabited litter in natural forest at the altitude of 1100 m. In the collected research material, *A. imbricatus* was present on the area of Mt. Jumbong in the litter of deciduous stand at the alt. 1000 m. Only several individuals of this species were found also in the litter of both types of stands on the areas of Kwangreung and in the deciduous forest in Namsan. Totally, less than 10 individuals of *A. imbricatus* were collected representing both the adult and juvenile stages. This species, due to its great dispersion of population can be counted to very rare ones in investigated forests.

# Asca aphidioides (LINNAEUS, 1758)

This is a species with a wide zoogeographic range. The settlement by *A. aphidioides* of different ecosystems indicates its eurytopic preferences. It was found among others in the litter and soil of deciduous and mixed forests, in coniferous stands, in agrocenoses and in the perennial arable land (AOKI 1968; KARG 1971; GILAROVA & BREGIETOVA 1977; KACZMAREK & SENICZAK 1996). In the present studies, *A. aphidioides* occurred on all areas, and this species was the most numerous representative of Asca genus. The obtained results indicate that *A. aphidioides* belongs to the once numerously occurring on the area of Korea. Therefore, in groups of gamasid mites living there, this species will frequently occupy the dominating positions. A definitely smaller number was reached by the remaining species belonging to Asca genus: *A. sculptrata* AOKI 1968 and *A. garmani* HURL-BUTT 1963. On the other hand, *A. evansis* GENIS, LOOTS & RYKE 1969 was found in a smaller number than 10 individuals in the litter of a coniferous forest in Kwangreung.

# The faunistic list of gamasid mites (Acari) in South Korea. Explanations: + present, \* recorded for the first time in Korean Peninsula

Name of family and species	Mt. Jumbong	Namsan	Kwangreung
1	2	3	4
Ameroseiidae		Hereite (1964)	
Epicriopsis stellata ISHIKAWA, 1972	+	neen Mederaa	
Ascidae	· · · · · · · · · · · · · · · · · · ·		aria daer asal
* Antennoseius imbricatus ISHIKAWA, 1969	+	+	+
Asca aphidioides (LINNAEUS, 1758)	+	+	+
* Asca evansi GENIS, LOOTS et RYKE, 1969			+
Asca garmani HURLBUTT, 1963	+	+	+
Asca sculptrata AOKI, 1968	+		
* Blattisocius dentriticus (BERLESE, 1918)	+		0.2
* Cheiroseius nepalensis (EVANS et HYATT, 1960)	+		
Cheiroseius phalangioides (EVANS et HYATT, 1960)			+
* Iphidozercon corticalis EVANS, 1958	+	+	de la companya de la
* Lasioseius lasiodactyli ISHIKAWA, 1969	+		
* Lasioseius tomokoae ISHIKAWA, 1969		+	
* Leioseius brevisetosus ISHIKAWA, 1969	+	+	+
* Leioseius insignis HIRSCHMANN, 1963		+	+
* Leioseius minusculus (BERLESE, 1905)	+		
* Neojordensia planata ISHIKAWA, 1972	+		
* Panteniphis mirandus WILLMANN, 1949	+		
* Platyseius triangralis ISHIKAWA, 1969			+
* Zerconopsis sinuata ISHIKAWA, 1969	+		
Digamasellidae			
* Dendrolaelaps fukikoae ISHIKAWA, 1977	+		
Eviphididae		1. A	
* Evimirus uropodinus BERLESE, 1904		+	
Gamasellidae			States of Linutes
* Gamasellus humosus ISHIKAWA, 1969	+		and the second sector of
Laelapidae	TT		inner skillings
* Hypoaspis aculeifer (CANESTRINI, 1883)		+	helevel and the large
* Hypoaspis cuneifer (MICHAEL, 1891)	+	SP Berne and	
* Hypoaspis pavlovskii (BREGIETOVA, 1955)			+
* Hypoaspis vacua (MICHAEL, 1891)	+	+	+
Macrochelidae	1		
* Macrocheles depuncta PETROVA, 1967	+		
* Macrocheles merdarius (BERLESE, 1889)	+	in a suite liter	and a second the
Macrocheles muscaedomesticae (SCOPOLI, 1772)		in the second second	+
Ologamasidae			
* Gamasiphis pulchellus (BERLESE, 1887)	+	+	+
Pachylaelapidae	· · · · · · · · · · · · · · · · · · ·		
* Neoparasitus scleoides ISHIKAWA, 1969	+		+
* Pachylaelaps kievati DAVYDOVA, 1971	+		
Parholaspididae			
Euparholaspulus primoris PETROVA, 1967	+		
Gamasholaspis akimotoi (ISHIKAWA, 1966)	+	+	
Gamasholaspis asiaticus PETROVA, 1967	+	+	+

## Gamasida in South Korea

	1		
Gamasholaspis browningi (BREGIETOVA et KOROLEVA, 1960)	+	+	
Gamasholaspis communis PETROVA, 1967	+	+	+
Holaspina alstoni (Evans, 1956)	+	+	+
<i>Holaspina dentatus</i> (ISHIKAWA, 1969)	+	+	+
Holaspina hiasmaticus (PETROVA,)	+	+	+
Holaspina ochraceus (ISHIKAWA, 1966)	+	+	+
Holaspina shigaensis (ISHIKAWA, 1969)	+		+
* Neparholaspis arcuatus PETROVA, 1977	+		Generation in the second
* Neparholaspis cardioides PETROVA, 1977	+		Luiopok. ese bi
Neparholaspis shinanonis ISHIKAWA, 1979	+		+
Phytoseiidae			ALC 14 14 1000
* Amblyseius ishizuchiensis ISHIKAWA, 1967			+
Podocinidae			
* Podocinum aokii ISHIKAWA, 1970	+		
Podocinum catenum ISHIKAWA, 1970	+		+
Rhodacaridae	A REAL PROPERTY.	a standarda an	
* Rhodacarellus silesiacus WILLMANN, 1936	+		
* Rhodacarus denticulatus BERLESE, 1920	+	+	+
Veigaiidae	REAR ALL STREET		
* Gamasolaelaps ctenisetiger ISHIKAWA, 1978	+	+	+
Veigaia ashizuriensis ISHIKAWA 1969	+	+	+
* Veigaia tihbetsi FARRIER, 1957	+	+	+
* Veigaia venoi ISHIKAWA 1969	+	+	+
Enicriidae			1
Enicrius nemorosus ISHIKAWA 1060	+		+
Parasitidae		1	Т
Colnothylar axilis (BERLESE 1883)	+		+
Cucetogamasus corculatus ATHAS HENDIOT 1080	1	+	+
Cycelogamasus diviortus (ATHIAS HENDIOT, 1980		+	T
Cycelogamasus insolitus (ATHIAS-HENRIOT, 1907)		+	
Naogamasus Jaciniatus ATHIAS HENDIOT 1077	+		
Neogamasus tikhomiuwi ATHAS HENDIOT 1077	+		
Dinvehidae			
* Dimychud kamoggi HIDAMATCH 1079	+		
Disgourollidoo			
* Discoursella iskihaani Hup MATTON 1070			
* Discourella isnikawai HIRAMATSU, 1979		1	+
Discoureita morikawai HIRAMATSU, 1979	T	<u>т</u>	+
Polyaspinidae			
* Iphiainychus manicatus BERLESE, 1913	+		
Urodinychidae	<u></u>		
* Uroobovella tokyoensis HIRAMATSU, 1979	+	+	
Echinozercon orientalis BŁASZAK, 1975	+		
Eurozercon pacificus HALASKOVA, 1979			+
Koreozercon bacatus HALASKOVA, 1979	+	+	+
Eurozercon aquilonis HALASKOVA, 1979	+		
Kaikiozercon mamillosus HALASKOVA, 1979	+		
Kaikiozercon peregrinus HALAŠKOVÁ, 1979	+		
Mesozercon coreanus BŁASZAK, 1975	+		+
Mesozercon plumatus (AOKI, 1966)	+		+
Metazercon mahunkai HALAŠKOVÁ, 1979	+		
Metazercon rafalskii BŁASZAK, KACZMAREK et LEE, 1997	+		
Zercon szeptyckii BŁASZAK, 1976	+		

#### Lasioseius tomokoae ISHIKAWA, 1969

So far, *L. tomokoae* was found only in decaying wood in Japan (ISHIKAWA 1969a). In the studies on gamasid mites of Korea, only one female of this species was found in the litter of a deciduous forest in Namsan. *Lasioseius tomokoae* has to be counted to very rarely occurring gamasid mites species.

## Platyseius triangralis ISHIKAWA, 1969

It is known only from Japan, where it occurred in the litter and in humus of a natural forest (ISHI-KAWA 1969). In the present studies, only one female was found in the litter of a deciduous stand in Kwangreung. It can be counted to very rarely occurring species.

### Gamasellidae

#### Gamasellus humosus ISHIKAWA, 1969

Until now, it was reported only from Japan, where it settled the sub-level of litter and humus in a natural deciduous forest (ISHIKAWA 1969b). In the gamasid mites fauna of Korea, *G. humosus* occurred rather numerously (about 60 individuals), particularly in a natural deciduous stand of Mt. Jumbong at the altitude of 1000 m.

### Ologamasidae

## Gamasiphis pulchellus (BERLESE, 1887)

It belongs to widely spread species in Europe, America, Africa, in the basin of Black Sea, in Japan and China (GILAROVA & BREGIETOVA 1977). In Korea, *G. pulchellus* occurred in small numbers in the majority of the investigated habitats.

## Parholaspididae

## Holaspina ochraceus (ISHIKAWA, 1966)

It was found in the gamasid mites fauna in Japan and Korea (ISHIKAWA 1966, 1979; LEE & LEE 1996). On the investigated areas, *H. ochraceus* belonged to the most frequently and most numerously occurring representatives of gamasid mites. It settled numerously the litter and soil in coniferous and deciduous forests, and the peak of its density occurred most frequently in autumn. It can be assumed that this species frequently reaches a dominating position among the soil gamasid mites on the area of Korea.

## Holaspina dentatus (ISHIKAWA, 1969)

It was found on the area of Japan and Korea (ISHIKAWA 1966; LEE & LEE 1996). On the investigated areas, *H. dentatus* settled mainly the sub-level of litter, both in the coniferous and in the deciduous forests where it reached a high number. *Holaspina dentatus* was also a frequent dominant or codominant with *H. ochraceus* and *H. alstoni* (EVANS, 1956) in the associations of soil gamasid mites. The high number of the discussed species of mites found in different types of forests indicates the important role played by *H. ochraceus*, *H. dentatus* and *H. alstoni* in the gamasid mites associations of that region.

## Phytoseiidae

#### Amblyseius ishizuchiensis ISHIKAWA, 1967

It is known only from Japan, where it was found on Kamegamori Mt. On the area of Korea, more than ten individuals, males and females, were found in the litter of deciduous and coniferous forests

in Kwangreung. The low density of *A. ishizuchiensis* population indicates that it belongs to rare species in the gamasid mites fauna on investigated stands.

#### Rhodacaridae

#### Rhodacarellus silesiacus WILLMANN, 1936

It belongs to species with a wide reach of occurrence including Europe, North Africa, Asia and Australia (GILAROVA & BREGIETOVA 1977). It is encountered mainly in the lower horizons of soil, where it feeds most frequently on nematods (KARG 1971). *Rhodacarellus silesiacus* settled both the soils of coniferous and deciduous forests, meadows and agrocenoses. It is a species showing a high resistance to the increased concentration of calcium compounds in the soil (SENICZAK et al. 1999; KACZMAREK 2000). It is counted also to the pioneer species settling in the first phase of secondary succession in the forest on areas with strong anthropogenic transformations (MADEJ 1996). In the present studies, less than 10 individuals of *R. silesiacus* were found in the soil under a coniferous forest at 900 m on Mt. Jumbong.

#### Veigaiidae

#### Veigaia ashizuriensis ISHIKAWA, 1969

This species has not been, so far, anywhere beyond Japan. On the investigated areas, *V. ashizuri*ensis occurred comparatively numerously in all types of stands. Next *V. ashizuriensis*, a high number was shown also by *V. uenoi* ISHIKAWA 1969 and both species of this family penetrated mainly the sub-level of litter.

#### Parasitidae

### Colpothylax exilis (BERLESE, 1883)

This species was found in earlier studies in the norhtern part of Korean Peninsula (ATHIAS-HEN-RIOT 1980). *Colpothylax exilis* occurred numerously in the litter under *Pinus koraiensis* at the altitude of 900 m on Mt. Jumbong, particulary in summer season. The high density of *C. exilis* population, mainly in the coniferous forests indicates its great role in the maintaining of the stability of soil zoocenoses in investigated habitats.

#### Discourellidae

#### Discourella morikawai HIRAMATSU, 1979

So far, it was found only in Japan (HIRAMATSU 1979a). During the present studies, about 100 individuals of *D. morikawai* were found on all investigated forest areas. It must be stressed that the studied population was characterized by a comparatively high variability in the length of dorsal setae on the idiosome. This variability was mainly in deutonymphs that made about 85% of the collected mites of this species.

# Discourella ishikawai HIRAMATSU, 1979

So far, it was reported only from Japan (HIRAMATSU 1979b). In the present study, less than 10 individuals of *D. ishikawai* were found in the litter of a deciduous forest in Kwangreung. This species can be counted to very rare one.

### Polyaspinidae

## Iphidinychus manicatus BERLESE, 1913

It belongs to very rare species. In the present investigations, less than 10 individuals of this species were recorded, mainly in the litter of a stand with *Pinus koraiensis* in Mt. Jumbong.

#### Zerconidae

## Echinozercon orientalis BŁASZAK, 1975

It was found in moss, litter and black rotting wood in North Korea (BŁASZAK 1976, 1979; HALAŠKOVÁ 1979). About 70 individuals of *E. orientalis* were collected in the present investigations from the litter and soil of a deciduous forest in Mt. Jumbong at the altitude of 1000 m. This species can be counted to the rather numerously occurring ones in the gamasid mites fauna on investigated areas.

### Metazercon rafalskii BŁASZAK, KACZMAREK et LEE, 1997

The members of the genus Metazercon BŁASZAK, 1976 are known, so far, only from the Korean Peninsula. *Metazercon rafalskii* is rare in the investigated forests, and in the collected research material there were only 10 individuals of this species. They colonized the litter of a deciduous forest (1000 m) and mixed forest (1100 m) only on Mt. Jumbong.

### Zercon szeptyckii BŁASZAK, 1976

It was earlier reported only from the northern part of the Korean Peninsula. It was found in the litter of a mixed forest on Mt. Manmur-san at the altitude of 550 m (BŁASZAK 1976; HALAŠKOVÁ 1979). In the Natur Reserve Mt. Jumbong *Z. szeptyckii* occurred in the litter of a coniferous stand, and in a mixed and a deciduous forest, at altitudes of 900-1100 m. *Zercon szeptyckii* belonged to the species occurring in these habitats comparatively numerously and it belonged to the most numerous representatives of Zerconidae family in Korea.

## IV. CONCLUSIONS

The faunistic analysis revealed a high similarity of the gamasid mites fauna of Korea and the fauna of these mites living in Japan. This is justifiable because Korea belongs to the same zoogeographical region (AOKI 1968; EHARA 1980; ISHIKAWA 1966, 1969a, 1969b, 1972, 1979). The forest areas on Mt. Jumbong were colonized by 62 gamasid mites species. Of this number, 32 were exclusive, e.g.: Epicriopsis stellata ISHIKAWA, 1972, Panteniphis mirandus WILLMANN, 1949, Zerconopsis sinuata ISHIKAWA, 1969, Gamasellus humosus ISHIKAWA, 1969, Euparholaspulus primoris PETROVA, 1967, Neparholaspis cardioides PETROVA, 1977, Podocinum aokii ISHIKAWA, 1970, Neogamasus laciniatus Athias-Henriot, 1977, Dinychus kurosai Hiramatsu, 1978, Iphidinychus manicatus BERLESE, 1913 and Metazercon rafalskii BŁASZAK, KACZMAREK et LEE, 1997. In the coniferous and deciduous forests in the urban area of Namsan, 30 gamasid mite species were recorded. There, the exclusive species included: Cycetogamasus insolitus ATHIAS-HENRIOT 1980, Cycetogamasus diviortus (ATHIAS-HENRIOT, 1967), Evimirus uropodinus (BERLESE, 1904) and Hypoaspis aculeifer (CANESTRINI, 1883). On the other hand, in the area of Kwangreung, in stands growing in habitats of the same type, 37 mite species of the discussed group were found. Among the exclusive species there were: Cheiroseius phalangioides (EVANS et HYATT, 1960), Platyseius triangralis ISHIKAWA, 1969, Hypoaspis pavlovskii (BREGIETOVA, 1955), Macrocheles muscaedomesticae (SCOPOLI, 1772), Discourellaishikawai HIRAMATSU, 1979, Amblyseius ishizuchiensis ISHIKAWA, 1967 and Eurozercon pacificus HALAŠKOVÁ, 1979. Only 19% of gamasid mites species were found in all the studied areas and most of them were members of Veigaiidae and Parholaspididae. This group included also Asca aphidioides (LINNAEUS, 1758), Leioseius brevisetosus ISHI-KAWA, 1969, Hypoaspis vacua (MICHAEL, 1891), Gamasiphis pulchellus (BERLESE, 1887), Discourella morikawai HIRAMATSU, 1979 and Koreozercon bacatus HALAŠKOVÁ, 1979.

In studied forest types the highest densities were reached by species belonging to the Parholaspididae particularly *Holaspina ochraceus*, *H. dentatus* and *H. alstoni*. In autumn these species sometimes constituted over 60% of all collected gamasid mites. Distinctly less numerous were Gamasholaspis spp., while Neparholaspis and Euparholaspulus spp. were infrequent. However, the total number of species of the Parholaspididae family frequently reached a very high value. The high share of these mites in the Gamasida, amounting to 26% was, also recorded in the forest environments in Japan (ISHIKAWA 1966). Therefore, species belonging to the family Parholaspididae, and Holaspina and Gamasholaspis may be of great importance for research on the ecology of forest ecosystems of that region.

In the soils of deciduous forests, high densities were also reached by *Asca aphidioides*. On the other hand, among the representatives of the Parasitidae, *Neogamasus laciniatus* and *Colpothylax exilis* were numerous, particularly in coniferous stands in summer. Noteworthy is the wide occurrence of surface predators *Veigaia ashizuriensis* and *V. uenoi* which were found in all types of the investigated stands, as well as *Zercon szeptyckii* which was the most numerous member of the family Zerconidae. Therefore, the above mentioned species can be regarded as the most frequent and the most typical of the fauna of soil gamasid mites in these types of forest habitats in Korea.

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