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Ptyctimous mites of South Korea (Acari: Oribatida)

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ABSTRACT. The total number of ptyctimous species identified in the material studied was 20, including three new to science: *Rhysotritia hallasanensis* NIEDBAŁA, *Hoplophthiracarus sangumburiensis* NIEDBAŁA, *Austrophthiracarus jumbongiensis* NIEDBAŁA. They represent 11 genera: 1 Mesoplophoroidae, 5 Euphthiracaroidea and 5 Phthiracaroidea. The most abundant species *R. sinensis* was represented by 45.5 % of all the specimens. The contribution of *R. aokii* was also high – 11.7%. The contribution of other species in the samples studied did not exceed 10%. The most abundantly represented genus was *Rhysotritia*, including 64.8% of all collected ptyctimous mites. The genus represented by the greatest number of species (6) was *Phthiracarus*. From among the Euphthiracaroidea the genus *Rhysotritia* was represented by 4 species. Ptyctimous mites were found in 62.5% of all samples collected. The species most often identified in the region was *R. aokii* (42% samples). Analysis of the species found has confirmed that South Korea belongs to the Palearctic region. Apart from two widespread semicosmopolitan species, as many as 11 belong to the holarctic and palearctic elements, and three are endemic species. The influence of oriental elements is manifested by the presence of two oriental species among the 4 originating from the south, the other two are pantropical. The fauna of ptyctimous mites of South Korea is poorer in species (20) than that of North Korea (26 species), they have species 8 in common. Despite a low value of the similarity index and great difference in species composition, the faunas of South and North Korea have some common characteristics, like the number of genera represented, proportions of zoogeographical elements and a small contribution of oriental species. Results of the cluster analysis did not reveal any ecological correlations of the ptyctimous mite species and any relations implied by the topographic distribution of localities.

Key words: acarology, taxonomy, zoogeography, Acari, Oribatida, ptyctimous mites, Korea.

1. INTRODUCTION

The Korean Peninsula is located at the margin of the Palearctic. According to the hitherto data collected from the neighbouring regions (Japan, Far East of Russia), in the Korean fauna a mixture of the palearctic and oriental elements can be expected. The fauna of South Korea has been a subject of interest of few acarologists. KACZMAREK and LEE (1998, 2000) reported a comprehensive analysis of diversity of the gamasid mite species and the rate of colonisation by them of the forest litter in the Biosphere Reserve Mt. Jumbong. The oribatid mites from South Korea are poorly recognised and the ptyctimous mites have not been studied at all. The fauna of ptyctimous mites of North Korea has already been studied (NIEDBAŁA 2000).

The aim of this study was to describe and analyse the ptyctimous mite fauna from the hitherto unexplored region and to perform a zoogeographical analysis of the fauna from the region at the margin of the Palearctic.

All types of new species are deposited at the Department of Animal Taxonomy and Ecology, Adam Mickiewicz University in Poznań.

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2. MATERIAL AND METHODS

Samples of moss, forest litter, roting leaves, soil, rotting tree trunks, rot from tree hollows and bark with insect feeding sites were collected by the first author from May 10th to August 5th, 1996, in South Korea from Mt. Jumbong to the Chejudo island. The total number of samples collected was 75, and in 46 representatives of Ptyctimous mites were found. The samples were kept in foil bags and transported to the Entomological Laboratory, Department of Agricultural Biology, Seoul National University, in Suwon, South Korea. The mites were extracted in Tullgren apparatus for 5 days and preserved in 70% alcohol, then transported to Poland. All ptyctimous mites were selected and subjected to taxonomic analysis. The total number of specimens collected was 364 and they represented 20 species and 11 genera. The ptyctimous assemblage ordering according to the qualitative-quantitative similarity was made by the cluster method based on Bray-Curtis index of similarity (SNEATH & SOKAL 1973).

LIST OF LOCALITIES:

Mt. Jumbong (N 38^0- 38^{0}05'- E 128^{0}20'- 128^{0}30')
1. roting litter in deciduous forest, 10.05.1996
2. moss and bark in deciduous forest, 10.05.1996

3. moss and bark in deciduous forest, 10.05.1996
4. moss growing on a tree trunk in deciduous forest, 10.05.1996
5. raw humus level in deciduous forest, 10.05.1996
6. deciduous forest litter, 10.05.1996

Seoul – Namsan (N 37^{0}32'- E 126^{0}58')
7. litter in deciduous forest with dominant *Quercus mongolica*, 5.07.1996
8. litter in deciduous forest with dominant *Quercus mongolica*, 5.07.1996
9. litter in deciduous forest with dominant *Quercus mongolica*, 5.07.1996
10. litter in deciduous forest with dominant *Quercus mongolica*, 5.07.1996

Suwon (N 37^{0}20' – E 127^{0}00')
11. litter and soil in deciduous forest, 7.07.1996
12. rot of *Pinus densiflora* tree with ant nest in mixed forest, 7.07.1996
13. soil from a garden with *Chamaecyparis pisifera* cv. *Filifera Aurea*, 7.07.1996
14. rot of *Pinus densiflora* trunk with ant nest in mixed forest, 11.07.1996
15. rot of a fallen log in mixed forest, 13.07.1996
16. rotten log in deciduous forest, 19.07.1996
17. bark of *Pinus densiflora* in coniferous forest, 19.07.1996
18. rot from a tree hollow in *Quercus acutissima*, mixed forest, 19.07.1996

Suwon (N 37^{0}19' – E 126^{0}50')
19. litter in coniferous forest with *Pinus rigida*, 6.07.1996
20. bark of *Pinus rigida* in coniferous forest, 6.07.1996
21. soil in coniferous forest with *Pinus rigida*, 6.07.1996

The Tebu-do Peninsula (N 37^{0}30' - E 127^{0}50').
22. litter in deciduous forest with *Kalopanax pictus*, *Robinia pseudoacacia*, *Peuraria thunregiana*, 18.06.1996

Polan Myoung, Kyoungki-do (N 37^{0}00' - E 126^0 51')
23. litter and soil in deciduous forest with *Pueraria thunbergiana*, *Quercus serrata*, *Q. variabilis* and *Symphocus chinensis*, 3.07.1996

Pusan (N 35^{0}05' – E 129^{0}07')
24. litter under *Pinus densiflora* in the zoo, 2.08.1996

The Cheju-do Island (N 33^{0}12'-33^{0}35' – E 126^{0}10'-126^{0}60')
25. Halla-san National Park, litter and soil in deciduous forest, 3.08.1996
26. Halla-san National Park, litter and soil in deciduous forest, 3.08.1996
27. Halla-san National Park, litter in deciduous forest, 3.08.1996
28. Halla-san National Park, moss on rock in deciduous forest, 3.08.1996
29. Sogi-po City, rot of a deciduous tree in deciduous forest, 3.08.1996

30. Sogi-po City, rot of a deciduous tree in deciduous forest, 3.08.1996
31. Sogi-po City, rot of a deciduous tree in deciduous forest, 3.08.1996
32. Sogi-po City, rot of a deciduous tree in deciduous forest, 3.08.1996
33. Sogi-po City, bark of *Pinus* sp with insects foraging sites in mixed forest, 3.08.1996
34. Sogi-po City, moss on moist soil in mixed forest, 3.08.1996
35. Sogi-po City, litter in deciduous forest, 3.08.1996
36. Pijarim Forest, rot of a deciduous tree, 4.08.1996
37. Pijarim Forest, rot of a deciduous tree, 4.08.1996
38. Pijarim Forest, litter and soil in deciduous forest, 4.08.1996
39. Pijarim Forest, litter in deciduous forest, 4.08.1996
40. San-Gumburi Crater, litter raw humus and soil in deciduous forest, 5.08.1996
41. San-Gumburi Crater, moss on rock in deciduous forest, 5.08.1996
42. San-Gumburi Crater, black rot in tree hollow, deciduous forest, 5.08.1996
43. San-Gumburi Crater, rot in fallen tree hollow in deciduous forest, 5.08.1996
44. San-Gumburi Crater, moss on rock in deciduous forest, 5.08.1996
45. San-Gumburi Crater, litter in deciduous forest, 5.08.1996
46. San-Gumburi Crater, rot of fallen tree in deciduous forest, 5.08.1996

3. DESCRIPTIONS OF NEW SPECIES.

Rhysotritia hallasanensis NIEDBAŁA, n. sp.

(Figs 1, 2)

ETYMOLOGY

This species is named after the Halla-san mountains.

DIAGNOSIS

The new species is similar to cosmopolitan species *Rhysotritia ardua* (C.L. KOCH, 1841) and distinguished by the reticulation of body and difference of chaetome of legs (4 setae on genua, 5 setae on tibiae I and 2 setae on genua IV). Another species with body reticulation originating from Tanzania – *Rhysotritia reticulata* MAHUNKA, 1988 has the tarsi tridactylous.

DESCRIPTION

Measurements of holotype: prodorsum: length 217, width 149, height 86.0, sensillus 63.2, setae: interlamellar 93.6, lamellar 65.8, rostral 53.1, exobothridial 10.1; notogaster: length 414, width 268, height 278, setae: c_1 68.3, h_1 75.9, ps_1 68.3; genitoaggenital plate 131x70.8, anoadanal plate 182x53.1.

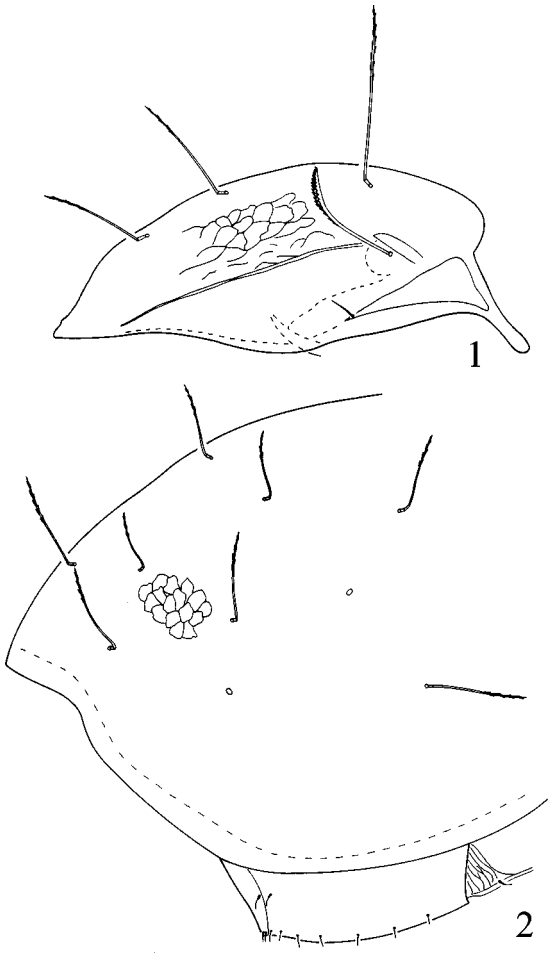
Colour brown. Surface of body covered with polygonal reticulation.

Prodorsum with one pair of lateral carinae; sensilli with distinctly dilated head covered with spines; setae robust, erect, covered with small spines in distal half (except minute exobothridial setae).

Notogaster with 14 pairs of setae fairly short ($c_1 < c_1$-d_1) covered with small spines in distal half. Setae c_3 closer to anterior margin than setae c_1, setae c_2 far from margin. Five pairs of lyrifissures and two pairs of vestigial setae present.

Ventral region. Setae *h* of mentum longer than distance between them. 9 pairs of minute genital and 2 pairs of aggenital setae present, located longitudinally. 3 pairs of anal setae, an_1 and an_2 robust, smooth, an_3 minute, 3 pairs of robust adanal setae covered with small spines in distal half, lyrifissures *iad* located between ad_3 and an_3 setae.

Legs setation and solenidiotaxy (without tarsi): I: 1-3-4(2)-5(1), II: 1-3-3(1)-4(1), III:2-2-2(1)-3(1), IV: 2-1-1-2(1), tarsi monodactylous.



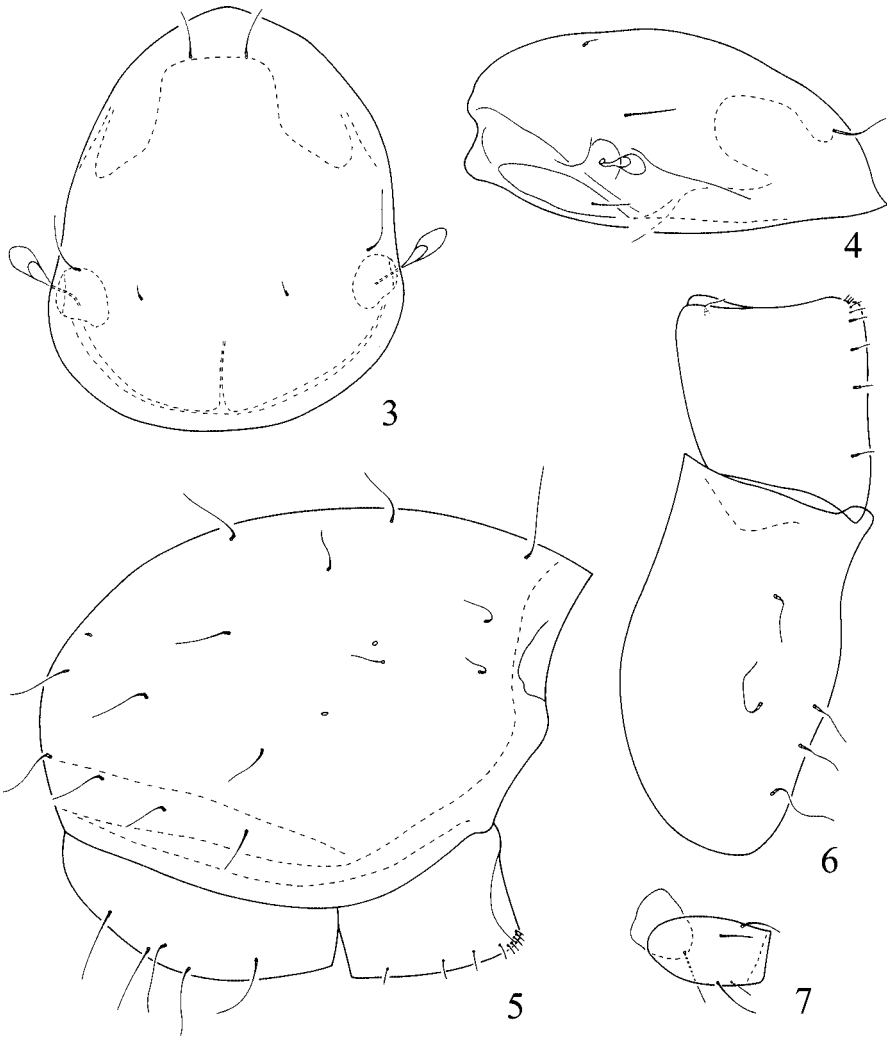
1, 2. *Rhysotritia halassanensis* n. sp.: 1 – prodorsum, lateral view; 2 – anterior part of notogaster

TYPE MATERIAL

Holotype: South Korea, Cheju-do Island, Halla-san National Park, litter in deciduous forest, 3. 08. 1996, leg. S. KACZMAREK.

***Hoplophthiracarus sangumburiensis* NIEDBAŁA, n. sp.**

(Figs 3-7)



3-7. *Hoplophthiracarus sangumburiensis* n. sp.: 3 – prodorsum, dorsal view, 4 – prodorsum, lateral view, 5 – notogaster, 6 – genitoaggenital and anoadanal plates, 7 – trochanter and femur of leg I

ETYMOLOGY

The name of the new species refers to the habitat of this species in Mt. Gumburi.

DIAGNOSIS

The new species differs from other members of the genus by the presence of minuscule interlamellar setae. Furthermore it is distinguishable by the following combination of features: large median sigillar field of prodorsum, rounded head of sensilli, fine setae, absence of vestigial setae f_2 and setae of genua IV.

DESCRIPTION

Measurements of holotype prodorsum: length 195, width 157, height 91.1, sensillus 22.8, setae: interlamellar 5.1, lamellar 27.8, rostral 25.3, exobothridial 17.7; notogaster: length 323, width 247, height 222, setae: c_1 37.9, h_1 30.4, ps_1 35.4; genitoaggenital plate 88.5x75.9, anoadanal plate 164x96.1.

Colour yellow, pale. Body surface covered with puncturation.

Prodorsum with median sigillar field large and lateral fields short, lateral carinae present. Sensilli with narrow stalk and rounded head. Setae fine, short, interlamellar setae minuscule.

Notogaster with 15 pairs of fine, short ($c_1 < c_1$-d_1), setae, similar in shape to interlamellar setae. Setae of row *c* remote from anterior margin, setae c_1 less so than setae c_2 and c_3. Vestigial setae f_1 situated anteriorly of h_1 setae, setae f_2 absent. Two pairs of lyrifissures *ia* and *im* present.

Ventral region. Setae *h* of mentum almost equal to distance between them. Arrangement of genital setae: 6: 3. Anoadanal plate with five short, flexible setae, almost equal in length.

Chaetome of legs incomplete, genae IV without setae. Setae *d* on femora I distinctly remote from distal end.

TYPE MATERIAL

Holotype and one paratype: South Korea, Cheju-do Island, San-Gumburi Crater, moss on rock in deciduous forest, 5. 08. 1996, leg. S. KACZMAREK.

Austrophthiracarus jumbongiensis NIEDBAŁA, n. sp.

(Figs 8-12)

ETYMOLOGY

The specific epithet refers to the known localities of this species in the Mt. Jumbong.

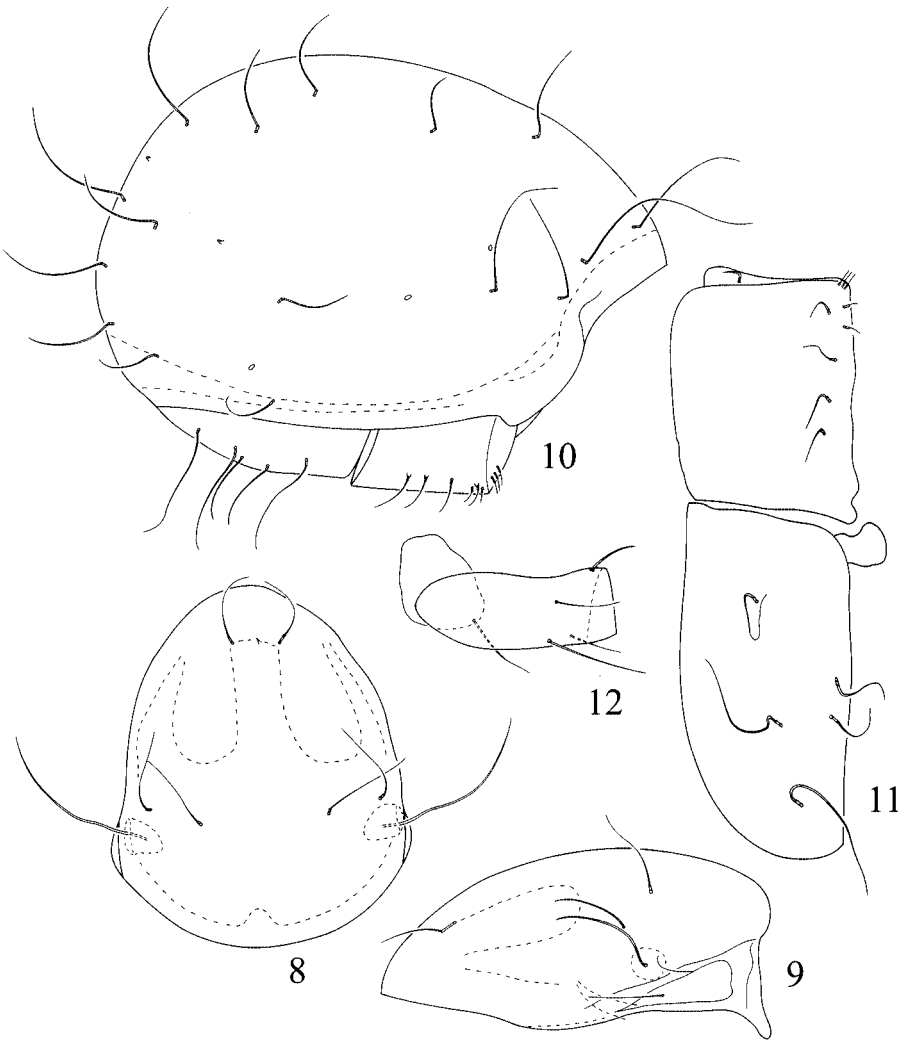
COMPARISON

This species is very similar to the sister species *Austrophthiracarus inusitatus* (NIEDBAŁA, 1983) known from Far East of Russia and North Korea. It is distin-

guishable by absence of lateral carinae, smooth all setae of prodorsum, longer exobothridial setae and presence of lyrifissures *ips*. I suppose that both species are examples of recent speciation.

DESCRIPTION

Measurements of holotype prodorsum: length 328, width 232, height 136, sensillus 101, setae: interlamellar 50.6, lamellar 53.1, rostral 60.7, exobothridial



8-12. *Austropthiracarus jumbongiensis* n. sp.: 8 – prodorsum, dorsal view, 9 – prodorsum, lateral view, 10 – notogaster, 11 – genitoaggenital and anoadanal plates, 12 – trochanter and femur of leg I

65.4; notogaster: length 646, width 475, height 434, setae: c_1 157, c_2 228, h_1 and ps_1 159; genitoaggenital plate 151x111, anoadanal plate 222x106.

Colour yellow. Surface of body punctate.

Prodorsum with narrow sigillar fields, lateral carinae absent. Sensilli long, narrow, setiform. Setae flexible, not very long, exobothridial setae the longest.

Notogaster with 16 pairs of heterotrichous setae, setae of row *c* smooth, flexible, longest than other robust, rough setae; setae c_{1-3} slightly remote from anterior margin border. Vestigial setae f_1 situated posteriorly of h_1 setae. Three pairs of vestigial setae *ia*, *im* and *ips* present.

Ventral side. Setae *h* of mentum longer than distance between them. Arrangement of genital setae: 6(4+2): 3. Five pairs of setae on anoadanal plates, adanal setae longer than anal setae.

Chaetome of legs complete. Setae *d* on femora I situated at distal end of article

TYPE MATERIAL

Holotype: South Korea, Mt. Jumbong, in roting litter of deciduous forest, 10. 05. 1996, leg. S. KACZMAREK.

4. ECOLOGICAL - FAUNISTIC ANALYSIS

In 46 samples of the material collected the total number of 20 species belonging to ptyctimous mites were identified. They represented 11 genera: 1 Mesoplophoroidae, 5 Euphthiracaroidea and 5 Phthiracaroidea.

The most abundant species was *R. sinensis* represented by 45.5% of all specimens collected. The proportion of *R. aokii* was also large – 11.7%. The other species were represented by less than 10% of the specimens in the assemblages (table 1). From among the genera, the genus *Rhysotritia* was represented by the greatest number of specimens, reaching as much as 64.8% of all ptyctimous mites collected. A high percentage of *Rhysotritia* from 54% to 77%, was found in the ptyctimous mite assemblages collected in litter and soil in deciduous and coniferous forests in the area of the Biosphere Reserve Mt. Jumbong (KANG 1996), with *R.ardua* as the dominant species. This species was also dominant in deciduous forests of Kwangreung, and in the coniferous forests with *Pinus rigida* and *P. koraiensis* the dominant species was *Atropacarus striculus* (PARK 1995). In the area of Namsan the most abundant was the occurrence of *M. minima*, whose proportion reached from 62.7% to 70.1% (PARK 1995, JUNG 1996).

Taking into regard the species representation of genera, *Phthiracarus* was represented by 6 species, and *Rhysotritia* of the Euphthiracaroidea by 4 species (tab. 1). It should be noted that these two genera of ptyctimous mites were also represented by the greatest number of species in North Korea (NIEDBAŁA 2000).

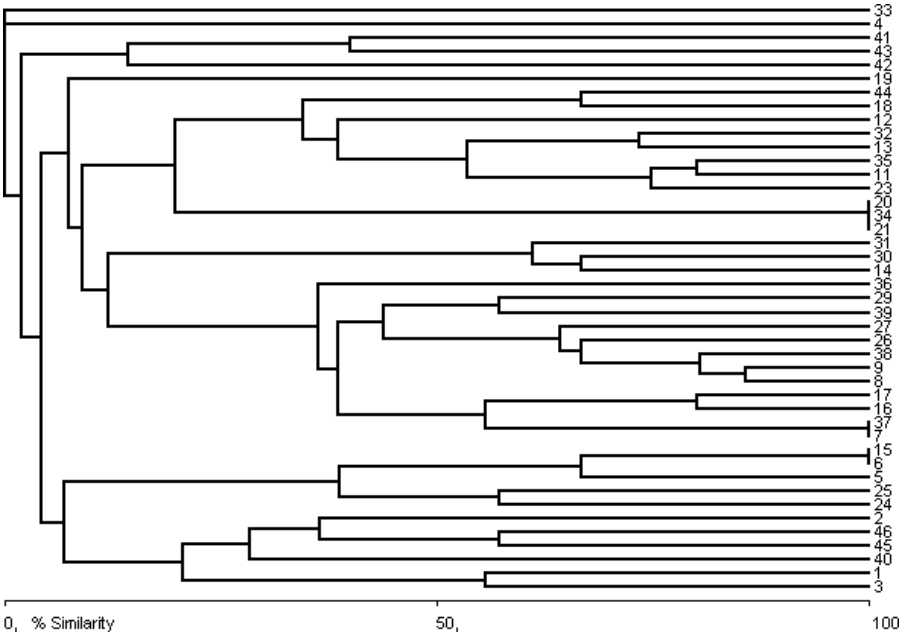
Tab. Abundance of ptyctimous mites in localities of South Korea

SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	4
Mesoplophora japonica Aoki, 1970	26	2	6																																							
Oribotritia gigas Bayoumi et Mahunka, 1979																												1							1							
Austrotritia dentata Aoki, 1970																																							7		
Euphthiracarus cribarius (Berlese, 1904)	9		10	1						1																															
Rhysotritia aokii Niedbała, 2000	1						1	4	3	4				2	1		1					3			1	4	3			2						1	1	3	2			
Rhysotritia ardua (C.L.Koch, 1841)		1			1	1						14						1						4	2					1							1				
Rhysotritia sinensis (Jacot, 1923)											4	6	11			2	1	3	104	1	1		7			2		1				13		1	5				4		
Rhysotritia hallasanensis n. sp.																												1													
Microtritia minima (Berlese, 1904)										4				7																5	12				1							
Phthiracarus bryobius Jacot, 1930		2																																							
Phthiracarus clemens Aoki, 1963																																						1			
Phthiracarus compressus Jacot, 1930					1																																				
Phthiracarus japonicus Aoki, 1958																																	1								
Phthiracarus membranifer Parry, 1979																																1									
Phthiracarus pygmaens Balogh, 1958																																							1		
Plonaphacarus kugoki (Aoki, 1959)																																									1
Hoplophthiracarus sangumburiensis n. sp.																																									
Austrophthiracarus jumbongiensis n. sp.		1																																							
Atropacarus (H.) cucullatus (Ewing, 1909)																																1			1				2	1	
Atropacarus (A.) striculus (C.L.Koch, 1836)	1	1																											1													2
TOTAL	37	7	16	1	2	1	1	4	3	9	4	20	11	9	1	2	2	4	104	1	1	3	7	4	3	6	3	3	1	8	12	15	1	1	7	2	1	4	3	14	1	1

Ptyctimous mites were found in 62.5% of all samples collected. In 22 samples (48 %) the presence of a single species was identified, in only 2 samples the mites found represented 4 and 5 species (tab. 1). The most frequently found species in the area studied was *R. aokii* (42% samples), then *R. sinensis* (30% samples) and *R. ardua* (22% samples).

In the continental part of South Korea the presence of the following 5 species was established: *M.*(*P.*) *japonica*, *E. cribarius*, *P. bryobius*, *P. compressus* and *A. jumbongi*. The following species: *O. gigas*, *A. dentata*, *R. hallasanensis*, *P. clemens*, *P. japonicus*, *P. membranifer*, *P. pygmaeus*, *P. kugohi*, *H. sambungur-iensis* and *A.* (*H.*) *cucullatus* were found exclusively on the Cheju-do Island. In the continental part and on the islands the presence of : *R. aokii*, *R. ardua*, *R. sinensis*, *M. minima* and *A* (*A.*) s*triculus* was established.

The analysis of similarity (Bray-Curtis cluster analysis) (Fig. 13) did not reveal significant correlations between the assemblages of ptyctimous mites and the microenvironments distinguished or their geographical distribution in the area of South Korea. In other words, no ecological correlations or those related to the topographic distribution of localities were detected.



13. Cluster dendrogram of ptyctimous assemblages based on Bray-Curtis index of similarity

5. ZOOGEOGRAPHICAL ANALYSIS

South Korea which formally belongs to Palearctic lies at the margin of this region, so it is reasonable to suspect that the oriental fauna reaches the area studied which thus assumes a character of a faunistically transitional region.

The ptyctimous mite species found in the area of South Korea represent the following zoogeographical elements:

semicosmopolitan: *R. ardua* and *A.*(*H.*) *cucullatus*.
pantropical: *P. pygmaeus* and *P. kugohi*.
holarctic: *M. minima*, *E. cribarius*, *P. bryobius* and *P. compressus*.
holarctic element reaching the Orient: *A.* (*A.*) *striculus*.
palearctic element occurring only on the eastern fringe of the range: *M.* (*P.*) *japonica* and *P. japonicus*.
palearctic element occurring only on the southern fringe of the range: *A. dentata*, *P. clemens* and *O. gigas*.
palearctic element reaching the Orient: *P. membranifer*.
oriental element reaching the eastern or south-eastern Palearctic: *R. aokii* and *R. sinensis*.
endemic: *Rhysotritia hallasanensis* n. sp., *Hoplophthiracarus sangumburiensis* n. sp., *Austrophthiracarus jumbongiensis* n. sp.

The above analysis has conformed that South Korea belongs to the Palearctic region. Except two widespread semicosmopolitan species as many as 11 are holarctic and palearctic elements, and three are endemic species. However, the influence of oriental elements is manifest – from among 4 species of southern origin, two are pantropical and two are oriental species.

6. COMPARISON OF THE FAUNAS OF SOUTH AND NORTH KOREA

The fauna of ptyctimous mites of South Korea is poorer in species (20) than that of North Korea (26) (NIEDBAŁA 2000), the faunas have 8 species in common: *M.* (*P.*) *japonica*, *E. cribarius*, *R. aokii*, *R. ardua*, *M. minima*, *P. kugohi*, *A.*(*H.*) *cucullatus* and *A.* (*A.*) *striculus*; except the oriental *R. aokii* the others are widespread. Despite a low value of the faunistic similarity index (w/a+b-w = 0.14) and differences in the species composition in the ptyctimous mite faunas of South and North Korea, there are certain common elements like the number of species represented, proportions of zoogeographical elements and a small contribution of oriental species.

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