

**Acerentomid Proturans (Insecta), with Two New Species
and Two New Records for Korea**

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韓國産 낮발이목(昆蟲綱)의 2新種과 2未記錄種

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적 요

남한의 8개 지역에서 채취한 토양시료에서 Acerentomidae 과에 속하는 낮발이목(곤충강) 8종이 동정되었다. 이 가운데에는 2개의 신종으로 *Filientomon bipartitei* n. sp.와 *F. imadatei* n. sp. 그리고 2개의 한국 미기록종으로 *Kenyentulus japonicus* (Imadaté, 1961)와 *Baculentulus nipponicus* Nakamura, 1985가 포함되어 있다. 따라서 한국산 낮발이는 모두 3과 10속 20종이 되는데 거의가 일본과 한국에 모두 서식하거나 두나라 사이에 최근연종을 공유하고 있다는 점에서 두나라는 생물지리학적으로 매우 가까운 관계에 있음을 나타내고 있다.

Key words: Acerentomidae, Proturans, Taxonomy, Korea.

INTRODUCTION

The first record of Korean Protura was made by Imadaté (1966b) with *Nipponentomon nippon* Yoshii, 1938 from a limestone cave in the mid-east of the peninsula. The report was followed by a few additional papers of Imadaté (1973b), Imadaté and Szeptycki (1976), Tuxen and Paik (1979), and Szeptycki and Imadaté (1987) enumerating 16 species in 9 genera, 3 families, including 7 species endemic to Korea. Most of them were based on the collections made by the Institute of Systematic and Experimental Zoology, Poland, and the Hungarian Natural History Museum, through their expeditions

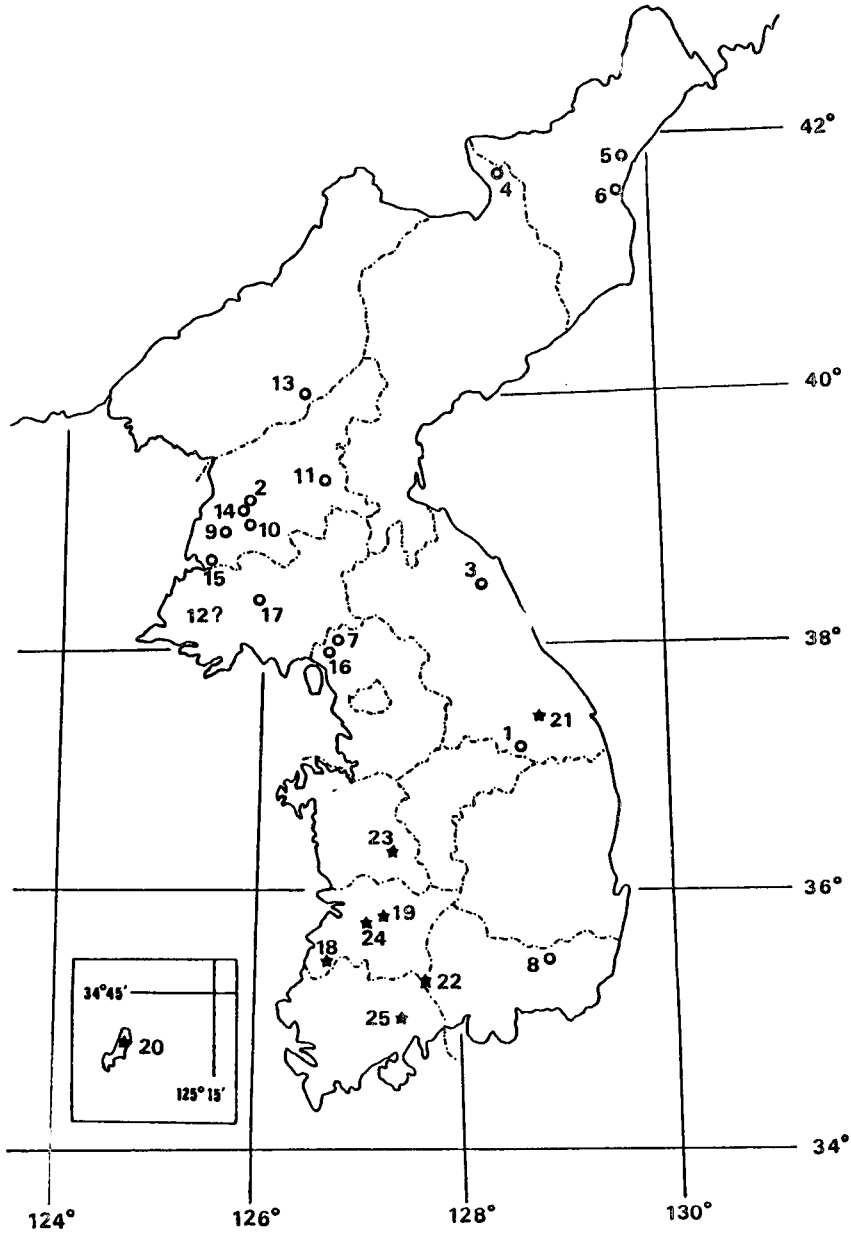


Fig. 1. Collection localities of Protura from Korea. 1, Gossi-gul Cave (Imadaté, 1966); 2, Sa-gam po (Imadaté, 1973); 3, Mt. Geumgang-san (Imadaté, 1973); 4, Mt. Nampotae-san (Imadaté and Szeptycki, 1976); 5, Susongchon (Imadaté and Szeptycki, 1976); 6, Chuul-onbo-ri (Imadaté and Szeptycki, 1976); 7, Mt. Cheonma-san (Imadaté and Szeptycki, 1976); 8, Mt. Hwahag-san (S.L. Tuxen and W.H. Paik, 1982); 9, Kangsø (Szeptycki and Imadaté, 1987); 10, Pjônggiang-si (Szeptycki and Imadaté, 1987); 11, Pyongsong (Szeptycki and Imadaté, 1987); 12, Kwail (Szeptycki and Imadaté, 1987), Short of information available its exact location not indicated in the map.; 13, Mt. Mjohjang-san (Szeptycki and Imadaté, 1987); 14, Sunan (Szeptycki and Imadaté, 1987); 15, Nampo (Szeptycki and Imadaté, 1987); 16, Kesøng Town (Szeptycki and Imadaté, 1987); 17, Pongsan (Szeptycki and Imadaté, 1987); 18, Seonun-sa Temple; 19, Jeonju; 20, Hong-do Island of different scale from that of the peninsula.; 21, Sanhodong-gul Cave; 22, Mt. Jiri-san; 23, Mt. Gyeryong-san; 24, Geumcheon; 25, Song-gwang-sa Temple. Asterisks indicate collection sites of the present materials.

to North Korea.

The present paper deals with Acerentomidae group from eight different localities in South Korea (Fig. 1). The specimens were extracted from soil samples using Berlese funnels.

The type series will be deposited in the Insect Collections of the Department of Biology Education, Jeonbuk National University, Jeonju 560-756 Korea.

DESCRIPTIONS

1. *Filientomon bipartitei*, n. sp.

(Fig. 2 A-I)

Body length 1410 to 1700 μ in expanded adults. Mouthparts rather large. Maxillary palp and labial palp with terminal tuft. Rostrum slightly protruding. Pseudoculus longer than broad, PR=17-21. Filamento di sostegno of the maxilla with a verrucose calyx and the proximal part rather short. A pair of additional setae present on the head tergite (Fig. 2A).

Foretarsus 111 to 118 μ and its claw without inner flap; TR=2.8-3.4. Empodium relatively short; EU=0.08-0.12. Position and shape of foretarsal sensillae similar to those of *F. kurosai*. Dorsal sensilla

Table 1. Chaetotaxy of *Filientomon bipartitei*, n. sp.

Dorsal	Formula	Composition of setae	Ventral	Formula	Composition of setae
Thorax I	4	1, 2	Thorax I	$\frac{4-4}{6}$	A1, 2, M1, 2 P1, 2, 3
II	$\frac{8}{16}$	A2, 3, 4, M P1, 1a, 2, 2a, 3, 4, 5, 5a	II	$\frac{5-2}{4}$	Ac, 2, 3, M P1, 2
III	$\frac{10}{16}$	A2, 3, 4, 5, M P1, 1a, 2, 2a, 3, 4, 5, 5a	III	$\frac{7-2}{4}$	Ac, 2, 3, 4, M P1, 2
Abdomen I	$\frac{6}{14}$	A1, 2, 3 P1, 1a, 2, 2a, 3, 4, 5	Abdomen I	$\frac{3}{4}$	Ac, 2 P1, 2
II-III	$\frac{10}{18}$	A1, 2, 3, 4, 5 P1, 1a, 2, 2a, 3, 3a, 4, 4a, 5	II-III	$\frac{5}{5}$	Ac, 2, 3 Pc, 2, 3
IV-V	$\frac{10}{18}$	A1, 2, 3, 4, 5 P1, 1a, 2, 2a, 3, 3a, 4, 4a, 5	IV-V	$\frac{6}{8}$	A1, 2, 3 P1, 1a, 2, 3
VI	$\frac{10}{18}$	A1, 2, 3, 4, 5 P1, 1a, 2, 2a, 3, 3a, 4, 4a, 5	VI	$\frac{6}{9}$	A1, 2, 3 Pc, 1, 1a, 2, 3
VII	$\frac{12}{18}$	A1, 2, 3, 4, 4', 5 P1, 1a, 2, 2a, 3, 3a, 4, 4a, 5	VII	$\frac{5}{9}$	Ac, 2, 3 Pc, 1, 1a, 2, 3
VIII	$\frac{8-7}{8}$	A1, 2, 4, 5, Mc, 2, 3, 4 P2, 3, 4, 5	VIII	4	
IX	14		IX	4	
X	10		X	4	
XI	6		XI	6	
XII	9		XII	6	

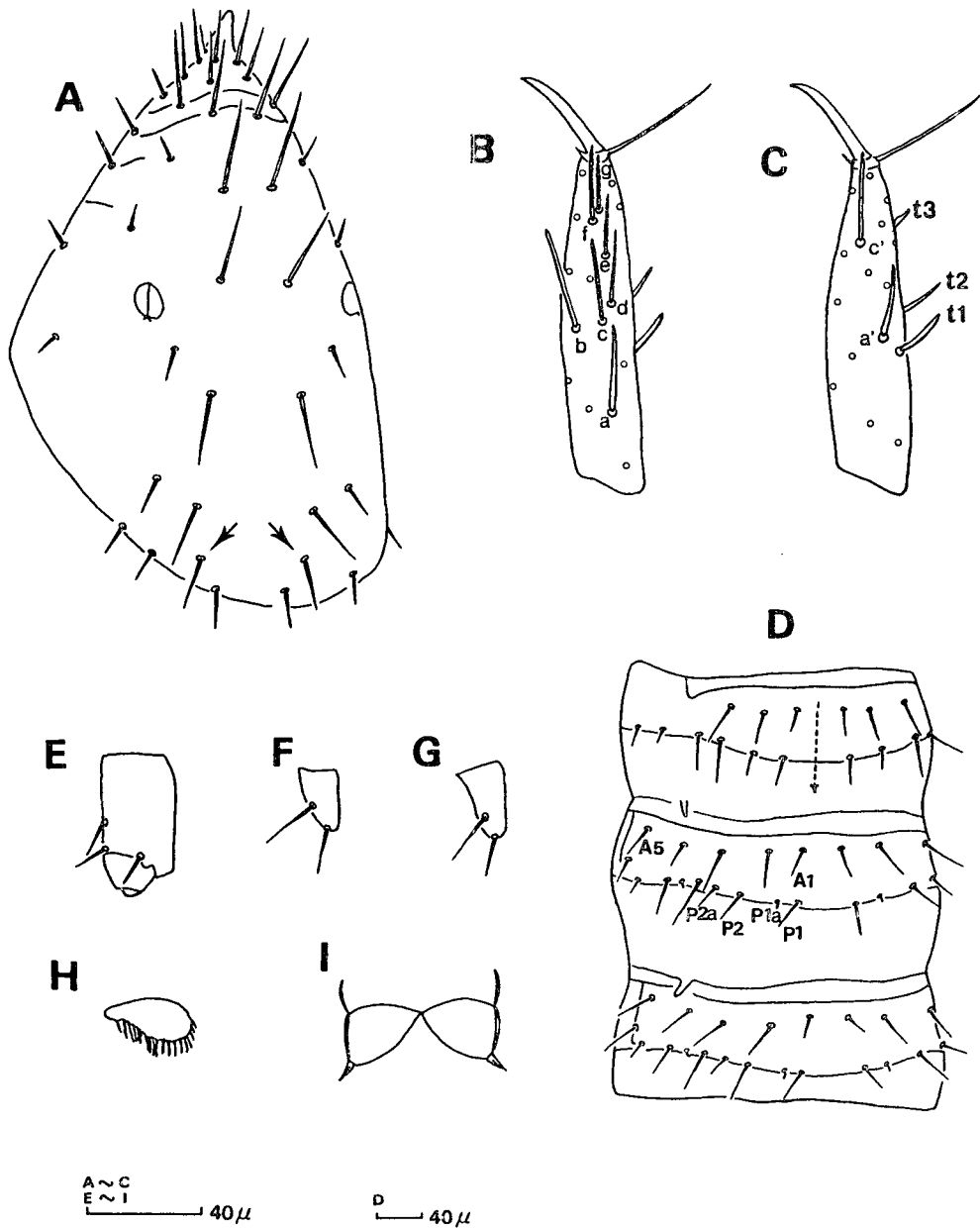


Fig. 2. *Filientomon bipartitei*, n. sp. A, dorsal view of head, arrows indicating additional setae; B, foretarsus, exterior side; C, foretarsus, interior side; D, tergal chaetotaxy of abdomen I-III; E, abdominal appendage I; F, abdominal appendage II; G, abdominal appendage III; H, comb on abdomen VIII; I, female squama genitalis.

t-1 filiform, BS=0.73-0.86; t-2 thin; t-3 small and lanceolate (Fig. 2C). Exterior sensilla a slightly broadened and long; b extremely long, its apex almost reaching the base of f; b and c placed in the same row; d slightly nearer to c than to e; f and g very close together (Fig. 2B). Interior sensilla a' little broad; b' missing; c' thin and long, surpassing the tarsus (Fig. 2C).

Dorsal accessory setae p1a, p2a on Thoraces, p1a on Abd. Terg. I, p2a and p4a on Abd. Terg. II-III

(Fig. 2D), pla, p2a, p3a on Terg. VII, all seta-like, pointed and longer than 1/3 of the principal setae p1 in length; pla and p3a on Terg. II-III, all posterior accessory setae on Terg. IV-VI blunt and short, sensilla-like subequal to 1/7 of p1 in length. Comb on Abd. VIII provided with about 20 teeth and its posterior margin rounded and protrudes distinctly backwards (Fig. 2H). Female squama genitalis with a bipartite acrostylus (Fig. 2I). Margin of Abd. Terg. XII with a pectinated structure.

Holotype: 1 ♀, Jeonnam Province, Suncheon, Song-gwang-sa Temple forest. Collection No. 87-11-3. 13 III 1987.

Paratypes: 1♂, 7♀, the same data as holotype.

Remarks: The present new species is similar to *F. kurosai* (Imadaté) and *F. lubricum* (Imadaté) from Japan in the body chaetotaxy and in the shape and position of foretarsal sensillae. It is, however, distinguished by the peculiar chaetotaxy of Abd. Terg. II-III, by the bipartite acrostylus as well as by the long foretarsal sensilla c'. Asymmetric abnormalities in chaetotaxy are not rare in the present form.

2. *Filientomon imadatei*, n. sp.

(Fig. 3A-K)

Body length 1300 to 1460 μ in expanded adults. Mouthparts rather large. Both maxillary and labial palps with terminal tufts (Fig. 3B, C). Rostrum rather shorter than that of *F. bipartitei* n. sp. Pseudoculus broader than long, PR = 16-18. Filamento di sostegno of the maxilla with a verrucose calyx and the proximal part rather short, additional seta absent (Fig. 3A).

Foretarsus 105 to 110 μ and its claw with one inner flap; TR = 2.3-2.7. Empodium relatively short; EU = 0.10-0.16. Dorsal sensilla t-1 filiform, BS = 0.61-0.65; t-2 thin; t-3 small and lanceolate (Fig. 3E). Exterior sensilla a long, its apex reaching the base of d or a little passing the base of d; b extremely long, its apex surpassing the base of g; d about half way between c and e; f and g very close together (Fig. 3D). Interior sensilla a' thin and placed distal to t-1; b' missing; c' thin and long, surpassing the tarsus (Fig. 3E).

All the posterior accessory setae on Thoraces II-III, Abd. Terg. I, VII and Stern. IV-VII pointed and seta-like, longer than 1/3 of the principal setae p1 in length; all the posterior accessory setae on Terg. II-VI short and blunt, sensilla-like, less than 1/5 of p1 in length. Comb on Abd. VIII with about 13 teeth and its posterior margin rounded and protrudes backwards (Fig. 3J). Female squama genitalis with a pointed acrostylus (Fig. 3K). Margin of Abd. Terg. XII with a pectinated structure.

Holotype: 1♂ Jeonnam Prov., Hong-do is., Collection No. 86-25-1, 27 IX 1986.

Paratypes: 1♂, 5♀♀, the same data as holotype.

Remarks: The present form is similar to the former species and to two Japanese forms, *F. lubricum* (Imadaté) and *F. kurosai* (Imadaté). It is, however, distinguishable from the former by the shape of acrostylus, by the long foretarsal sensilla b and by the chaetotaxial pattern of Abd. Terg. II-III, from the latter two by the relative length of the foretarsal sensilla c' and by the absence of the additional accessory setae pla' on Abd. Terg. VI-VII. Asymmetric abnormalities in chaetotaxy are fairly common in the present species. This species is dedicated to professor G. Imadaté who kindly assisted in identifying the materials dealt with in the present paper.

3. *Nipponentomon nippon* (Yosii, 1938)

Acerentomon nippon Yoshii, 1938 (pp. 398-400)

Nipponentomon nippon: Imadaté et Yosii, 1959 (pp. 24-30); Imadaté, 1965 (pp. 33-39, 50), 1966a (pp. 300-303);

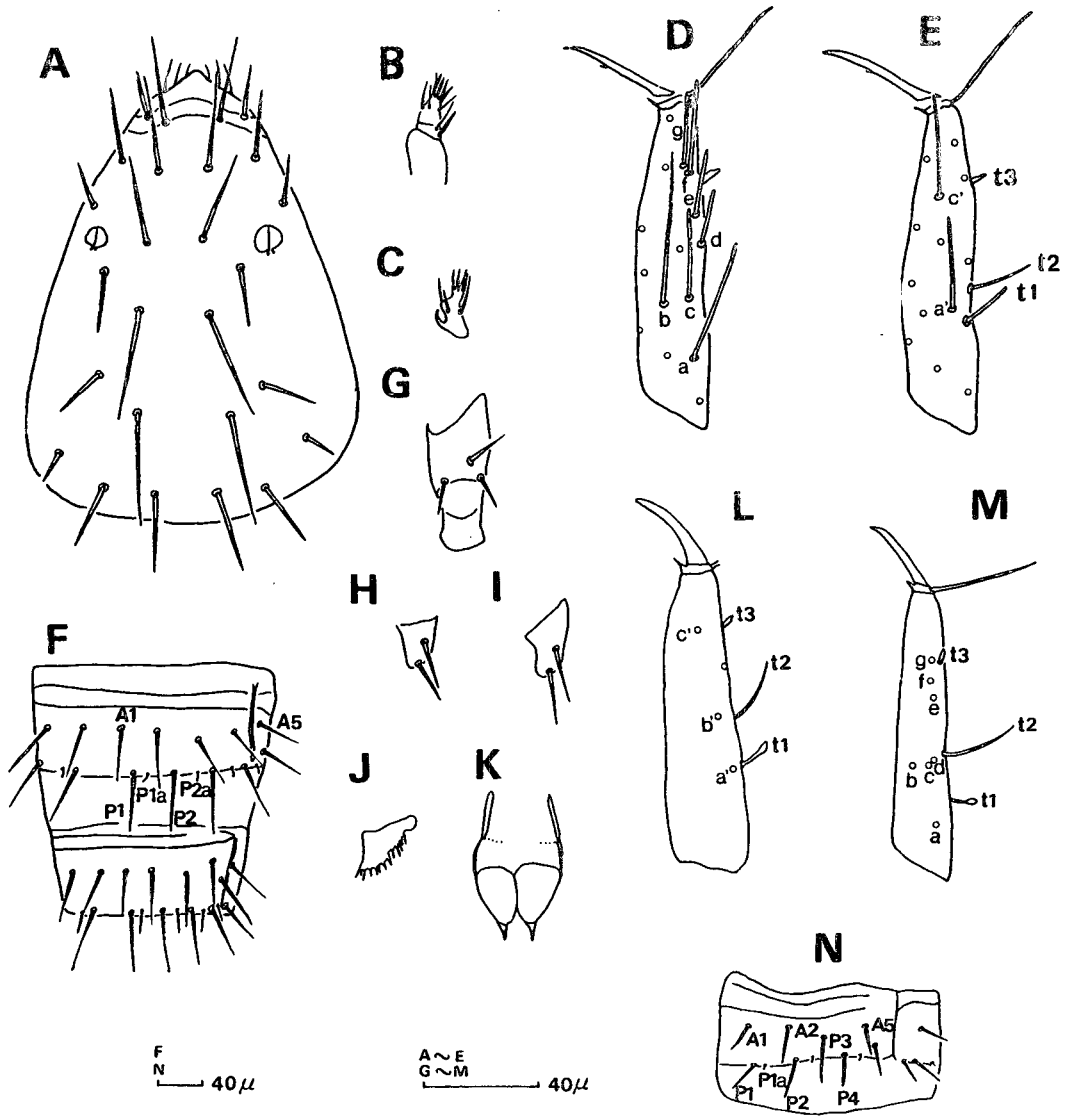


Fig. 3. A-K, *Filientomon imadatei*, n. sp. A, dorsal view of head; B, maxillary palpus; C, labial palpus; D, foretarsus, exterior side; E, foretarsus, interior side; F, tergal chaetotaxy of abdomen VI-VII; G, abdominal appendage I; H, abdominal appendage II; I, abdominal appendage III; J, comb on abdomen VIII; K, female squama genitalis. L, *Kenyentulus japonicus*, foretarsus, interior side. M and N, *Baculentulus nipponicus*, M, foretarsus, exterior side; N, tergal chaetotaxy of abdomen V.

1966b (pp. 537-540), 1973a (pp. 620-621); 1973b (p. 152), 1974 (pp. 143-152), 1980 (pp. 46-49); Imadaté & Szeptycki, 1976 (p. 269); 1987 (pp. 179-180); Rusek, 1974 (pp. 268-269).

Acerentomon sawadai Imadaté, 1956 (pp. 23-27).

Nipponentomon sawadai: Imadaté & Yosii, 1959 (pp. 30-32).

Nipponentomon dimorphum: Imadaté & Yosii, 1959 (pp. 32-33).

Specimen examined: 2♀♀, Gang-weon Prov., Jeongseon-gun, Bug-myeon, Mt. Banryun-san, Sanhodong-gul Cave (Alt. 1014m). Coll. No. 86-29-1, 27 XI 1986.

Table 2. Chaetotaxy of *Filientomon imadatei*, n. sp.

Dorsal	Formula	Composition of setae	Ventral	Formula	Composition of setae
Thorax I	4	1, 2	Thorax I	4-4 6	A1, 2, M1, 2 P1, 2, 3
II	8 16	A2, 3, 4, M P1, 1a, 2, 2a, 3, 4, 5, 5a	II	5-2 4	Ac, 2, 3, M P1, 2
III	10 16	A2, 3, 4, 5, M P1, 1a, 2, 2a, 3, 4, 5, 5a	III	7-2 4	Ac, 2, 3, 4, M P1, 2
Abdomen I	6 14	A1, 2, 3 P1, 1a, 2, 2a, 3, 4, 5	Abdomen I	3 4	Ac, 2 P1, 2
II	10 16	A1, 2, 3, 4, 5 P1, 1a, 2, 2a, 3, 3a, 4, 4a, 5	II	3 5	Ac, 2 Pc, 2, 3
III	10 16	A1, 2, 3, 4, 5 P1, 1a, 2, 2a, 3, 3a, 4, 4a, 5	III	5 5	Ac, 2, 3 Pc, 2, 3
IV-VI	10 18	A1, 2, 3, 4, 5 P1, 1a, 2, 2a, 3, 3a, 4, 4a, 5	IV-VI	5 8	Ac, 2, 3 P1, 1a, 2, 3
VII	12 18	A1, 2, 3, 4, 4', 5 P1, 1a, 2, 2a, 3, 3a, 4, 4a, 5	VII	5 9	Ac, 2, 3 Pc, 1, 1a, 2, 3
VIII	8-7 8	A1, 2, 3, 5, Mc, 2, 3, 4 P2, 3, 4, 5	VIII	4	
IX	14		IX	4	
X	10		X	4	
XI	6		XI	6	
XII	9		XII	6	

Foretarsus 98-105 μ , PR=21-23, TR=3.2-3.4, EU=0.14, BS=0.8.

In the present material the number of ventral anterior setae on Th.III is 9 instead of 7. Chaetotaxical asymmetry was found rather usual. No other differences were noticed and so was also North Korean form.

Distribution: Japan, North America, North Korea, South Korea

4. *Nipponentomon uenoi paucisetosum* Imadaté, 1965

Nipponentomon uenoi paucisetosum : Imadaté, 1965(pp. 28-33,50), 1966a (p.315), 1974 (pp. 162-168); Imadaté & Szeptycki, 1976 (pp. 269-270).

Specimen examined: 3♂♂, Jeonbug Prov., Cochang-gun, Seonun-sa Temple forest, Collection No. 86-5-1, 1 III 1986.

Foretarsus 118-125 μ , PR=20-21, TR=2.7-2.9, EU=0.19-0.22, BS=0.65-0.70. They were in good agreement with Japanese form but were slightly different from North Korean population (Imadaté et Szeptycki, 1976) by having p3a in Abd. Terg. IV-VI.

Distribution: Japan, North Korea, South Korea.

5. *Kenyentulus japonicus* (Imadaté, 1961)

Acerentulus japonicus Imadaté, 1961 (pp. 230-232).

Gracilentulus japonicus: Imadaté, 1964 (pp. 71-72), 1974 (pp. 185-190), Yin, Ren, Jin and Peifu, 1981 (p. 128).

Specimen examined: 3♀, Jeonnam Prov., Hong-do Is., Coll.No. 86-25-1, 27 IX 1986.

Foretarsus 67-73 μ , PR=15-17, TR=3.4-4.6, EU=0.17-0.21, BS=0.5. Interior sensilla b' and dorsal sensilla t-2 are placed in the same row, but in the Japanese form b' is about half way between t2 and α 4 (Fig.3L).

Distribution: Japan, China, Korea (new record).

6. *Baculentulus nipponicus* Nakamura, 1985

Baculentulus nipponicus Nakamura, 1985 (pp. 721-728).

Specimen examined: 3♀, 1♂, Jeonbug Prov., Namweon-gun, Mt. Jiri-san, Coll. No. 87-7-2, 31 I 1987.

Foretarsus 94-101 μ , PR=13-17, TR=3.4-4.1, EU=0.24-0.33, BS=0.43-0.48. In the present specimens exterior sensilla f is about half way between e and g (Fig.3M). Posterior accessory seta p3a on Abd. Terg. V is absent on both sides (Fig.3N). Those may be regarded, however, as infraspecific variations.

Distribution: Japan, Korea (new record).

7. *Baculentulus weinerae* Szeptycki et Imadaté, 1987.

Baculentulus weinerae: Szeptycki & Imadaté, 1987 (pp. 179-181).

Specimen examined: 2♂♂, 4♀♀, Chungnam Prov., Mt. Gyeryong-san, Coll. No. 87-8-2, 6 II 1987; 1♂, 1♀, Jeonbug Prov., Jeonju, Mt. Namgo-san, Coll. No. 86-6-1, 8 III 1986.

Foretarsus 84-94 μ , PR=11-15, TR=4.0-4.6, EU=0.15-0.23, BS=0.45-0.51. Some differences are found between the present material and the North Korean form (Szeptycki and Imadaté, 1987). Exterior sensilla d a little surpassing the base of e, do not reaches the base of f. In the North Korean form, however, the apex of d comes up to the base of α 5. Female squama genitalis in the present materials are also with a pointed acrostylus instead of bipartite one in the northern specimens. These differences are regarded as infraspecific variations.

Distribution: North Korea, South Korea.

8. *Baculentulus morikawai* (Imadaté et Yosii, 1956)

Acerentulus morikawai Imadaté et Yosii, 1956 (pp. 14-16).

Acerentulus montanus Imadaté et Yosii, 1959 (pp. 16-18).

Berberentulus morikawai: Imadaté, 1964 (pp. 74-77), 1966a (p. 308), 1973b (p. 152), 1974 (pp. 195-204); Imadaté & Szeptycki, 1976 (p. 270).

Baculentulus morikawai: Szeptycki & Imadaté, 1987 (p. 175).

Specimens examined: 3♂♂, 1♀, Jeonbug Prov., Jeonju, Mt. Namgo-san, Coll. No. 86-6-1, 8 III 1986; 1♂, 3♀♀, Jeonbug Prov., Jeonju, Mt. Taegug-san, Coll., No. 86-13-2, 8 VII 1986; 1♂, 2♀♀, Jeonbug Prov., Jeonju, Mt. Geonji-san, Coll. No. 86-28-2, 13 XI 1986; 2♂♂, 2♀♀, Jeonbug Prov., Gimje-gun, Geumcheon, Coll. No. 87-10, 22 II 1987.

Foretarsus 83-96 μ , PR=13-18, TR=3.6-5.5, EU=0.13-0.22, BS=0.41-0.52. They corresponded well with Japanese form.

DISCUSSION

It has been revealed that the two new *Filientomon* species as well as two new records, *Kenyentulus* and *Baculentulus* species, each for Korea, have their allied taxa or type localities all in Japan.

The remaining four species were found to occur also in North Korea and the collection of three of them, *Nipponentomon uenoi paucisetosum*, *Baculentulus morikawai* and *B. weinerae* Imadaté et Szeptycki, 1987 comprises all new findings for the southern half of the peninsula, South Korea. Our detailed examination, however, of the first of the three, *N. uenoi paucisetosum* from South Korea, has revealed a slight difference from its northern counterpart by having an additional P3a seta on tergites of Abd. I-VII, and it came to resemble thus more the original Japanese form than the North Korean one after their descriptions. Further studies will have to be made to be sure of any possible differentiation which might have occurred in Koreo-Japanese populations as opposed to the North Korean one. The difference, if consistent, may deserve to be validated as a separate taxon at subspecific level as alluded already by Imadaté and Szeptycki in their study of the North Korean individuals (Imadaté & Szeptycki, 1976, Szeptycki & Imadaté, 1987).

The present study thus brings up additional four species to the Korean Protura fauna, giving 20 species in 10 genera, 3 families, list of which is given below.

List of Korean Protura

Acerentomidae 낫발이과

1. *Verrucoentomon shirampa* (Imadaté, 1964) 아이누낫발이
2. *Filientomon takanawanum* (Imadaté, 1956) 금강낫발이
3. *Filientomon bipartitei* n. sp. 갈쭈기낫발이(신칭)
4. *Filientomon imadatei* n. sp. 이마다떼낫발이(신칭)
5. *Yamatentomon yamato* (Imadaté et Yosii, 1956) 야마또낫발이
6. *Yamatentomon breviseta* Szeptycki et Imadaté, 1987 작은털낫발이(신칭)
7. *Nipponentomon nippon* (Yoshii, 1938) 일본낫발이
8. *Nipponentomon uenoi uenoi* Imadaté et Yoshii, 1959 우에노낫발이
8. *Nipponentomon uenoi paucisetosum* Imadaté, 1965 주머니털우에노낫발이
9. *Kenyentulus japonicus* (Imadaté, 1961) 구슬낫발이(신칭)
10. *Amphientulus durumagi* (Imadaté, 1973) 두루마기낫발이
11. *Baculentulus samchonri* Imadaté et Szeptycki, 1976 삼천리낫발이
12. *Baculentulus morikawai* (Imadaté et Yosii, 1956) 모리카와낫발이
13. *Baculentulus tosanus* (Imadaté et Yosii, 1959) 진다리낫발이
14. *Baculentulus nipponicus* Nakamura, 1985 나라히낫발이(신칭)
15. *Baculentulus weinerae* Szeptycki et Imadaté, 1987 바이너낫발이(신칭)
16. *Chosonentulus chosonicus* Imadaté et Szeptycki, 1976 진낫발이

Eosentomidae 옛낫발이과

17. *Eosentomon udagawai* Imadaté, 1961 옛낫발이
18. *Eosentomon sakura* Imadaté et Yosii, 1959 옛벚낫발이(신칭)

19. *Eosentomon yinae* Szeptycki et Imadaté, 1987 인옛낫발이(신칭)

Sinentomidae 검은낫발이과

20. *Sinentomon chui* Tuxen and Paik, 1982 검은낫발이(신칭)

At the moment it must be too early to draft any general picture characterizing the Korean Proturan fauna. These data, however, may be suggestive of rather high endemism of the fauna, 9 species being unique to the peninsula(45%), as well as an over-all close biogeographical affinity of the Korean and Japanese faunas as represented by the remaining 11, occurring in both countries. Further studies of the present subject will make it clear whether the projection would remain valid or not.

ABSTRACT

Eight species of Acerentomidae (Protura, Insecta) were identified from soil collections of eight different localities in South Korea. They include two new species, *Filientomon bipartitei* n. sp. and *F. imadatei* n. sp. as well as two new records for the Korean peninsula, *Kenyentulus japonicus* (Imadaté, 1961) and *Baculentulus nipponicus* Nakamura, 1985. This study, therefore, brings up four species to the Korean Protura fauna, listing 20 species in 10 genera, 3 families in total and the list newly drafted reveals a strong biogeographical affinity of the faunas of Korea and Japan by either sharing common occurrence concerned or having the most allied taxa in each of the two countries.

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