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Original article

Pararhabdepyris Gorbатовskii (Hymenoptera: Bethyridae), new to Korea and the first host record of *Allobethylus* Kieffer

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ABSTRACT

Pararhabdepyris Gorbатовskii (Hymenoptera: Bethyridae) is newly recognized from South Korea. The genus can be easily recognized from other genera in Scleroderminae by having the head wider than it is long, the antenna with 10 flagellomeres, the clypeus with short projected median lobe, and the metasomal tergite II longer than the combined length of remained tergites. Description and illustrations of diagnostic characteristics of *Pararhabdepyris paradoxus* Gorbатовskii are provided. In addition, the present paper provides the first host record of *Allobethylus* Kieffer of Scleroderminae from the world. A revised key to genera and species of South Korean Scleroderminae is also presented.

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Introduction

Lanes and Azevedo (2008) inferred the phylogenetic relationships and proposed generic delimitations within a tribe Sclerodermini of Epyrinae. Most recently, Alencar and Azevedo (2013) studied the phylogeny of epyrine genera and revalidated the two tribes, Epyrini and Sclerodermini as separated subfamilies and Cephalonomiini *sensu* Evans (1964) was involved in Scleroderminae.

Twenty-two genera of Scleroderminae have been recorded worldwide (Alencar and Azevedo, 2013) and four species in three genera, *Allobethylus* Terayama, *Cephalonomia* Westwood, *Sclerodermus* Latreille, have been recorded in Korea (Lim et al., 2006, 2007, 2010), since Terayama (1999) first recorded *Sclerodermus harmandi* (Buysson).

Members of Scleroderminae are known as the ectoparasitoid of immature stages of Coleoptera insects (e.g. Buprestidae, Cerambycidae, Cucujidae, Curculionidae, and Scolytidae) in concealed habitats (Flinn, 1991; Krombein, 1996; Lauzière et al., 2001; Lim et al., 2007; Rahman et al., 2008; Yang et al., 2012).

Pararhabdepyris is a small genus with just three species: one from East Russia (Palearctic region), one from Thailand (Oriental region), and one from Australia (Australian region) (Gorbатовskii 1995; Azevedo and Barbosa, 2010).

The aims of the present paper were to record a genus *Pararhabdepyris* Gorbатовskii from South Korea, based on a female of *Pararhabdepyris paradoxus* Gorbатовskii with redescription and illustrations of diagnostic characters, to provide a new host record of *Allobethylus* Kieffer for the first time, and to provide a key to genera and species of Korean Scleroderminae.

Materials and methods

The examined specimen was borrowed from Professor Jongwook Lee (Yeungnam University, Gyeongsan, South Korea).

Morphological terms and methods for biometric measurements in the present study follow Azevedo and Barbosa (2010): total body length, maximum length from the apex of clypeus to the posterior margin of the apex of metasoma; LH, length of head, maximum length in full-face view, from vertex crest to median apical margin of clypeus; WH, maximum width of head including eyes in full-face view; WF, minimum width of frons in full-face view; HE, maximum height (length) of eye in lateral view; OOL, ocello-ocular line, minimum width latero-dorsal view, from eye top to posterior ocellus; WOT, width of ocellar triangle, maximum width in full-face

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view, including posterior ocelli; DAO, diameter of anterior ocellus in full-face view; distance of ocellar triangle to vertex, was measured in dorso-posterior view, distance from posterior ocellus to vertex crest; LFW, maximum length of forewing.

Terms on integument sculptures follow Eady (1968) and Harris (1979).

For the illustrations, we used a Leica Microsystems M 205A Stereozoom (Leica, Solms, Germany), which was connected with a digital camera, Leica Microsystems DE/DFC 49 (Heebrug, Switzerland). Images were manipulated with LAS version 4.1.0. (Leica Microsystems), in the Korea National Arboretum (Pocheon, South Korea).

The specimen examined is deposited at the Entomological Collection of Yeungnam University (YNU, Gyeongsan, South Korea).

Systematic accounts

Family Bethyridae Haliday, 1839

(Korean name: Chim-beol-gwa)

Subfamily Scleroderminae Kieffer, 1914

(Korean name: Ho-ri-chim-beol-a-gwa)

Genus *Pararhabdepyris* Gorbatovskii, 1995

(Korean name: Neob-jeok-chim-beol-sok)

Pararhabdepyris Gorbatovskii, 1995: 188. Type species: *Pararhabdepyris paradoxus* Gorbatovskii. Type-locality: Glazkovka (Russian Far East).

Diagnosis. Head wider than long. Clypeus with short projected median lobe. Antenna with 10 flagellomeres. Malar space with longitudinal groove. Occipital carina absent. Pronotal disc wider than long, trapezoidal. Forewing elongate with three closed cells. Metasoma with tergite II longer than remains, tergites III–VI with few posterior transverse setae (Azevedo and Barbosa, 2010).

Pararhabdepyris paradoxus Gorbatovskii, 1995 넓적침벌

(Figures 1A–H)

Pararhabdepyris paradoxus Gorbatovskii, 1995: 188.

Pararhabdepyris paradoxus Gorbatovskii: Azevedo and Barbosa, 2010: 56.

Description. Female.

Color. Body black. Head: mandible, maxillary and labial palpi yellow; antenna castaneous except scape and pedicel light castaneous, ventral side light castaneous. Mesosoma: forewing subhyaline, veins light castaneous; legs light castaneous.

Morphology. Total body (Figure 1A). Body length 2.33 mm; LFW 1.45 mm.

Head (Figures 1B–1D). Coriaceous, LH 0.9 × WH. Vertex slightly convex with obtuse corner. Mandible with one sharpened apical tooth. Clypeus with shortly projected median lobe, anterior margin truncated. Distance inter-torular shorter than scape. Antenna with first five antennal segments in ratio of 2.9: 1.7: 1.0: 1.1: 1.1 in length; scape, pedicel, flagellomere I–III and XI 2.9, 2.1, 1.5, 1.5, 1.4 and 2.2 × as long as wide, respectively. Compound eye 0.42 mm long, 1.4 × as long as wide with sparse short hairs; LE 1.6 × OOL; WF 2.6 × WOT. Frontal angle of ocellar triangle obtuse, POL 1.3 × AOL; OOL 1.2 × WOT; posterior ocellus separated from posterior margin by 1.0 × DAO in dorsal view.

Mesosoma (Figures 1E–G). Pronotal disc 0.5 × as long as wide, trapezoidal, lateral margin straight in dorsal view. Mesoscutum coriaceous; notauli complete, convergent posteriorly; parapsidal furrow present. Scutellum coriaceous; scutellar groove conspicuous, median area transverse, each side dilated and curved backward. Propodeal disc 0.7 × as long as wide, anterior 3/4 areolate with the rest smooth, median discal carina and lateral carina present, posterior carina present, distinctly concave in the middle with

obtuse angle. Declivity of propodeal disc areolate. Lateral surface of propodeum weakly strigate. Forewing without pterostigma; medial flexion line divided into two lines.

Metasoma (Figure H). Polish and largely smooth. Tergite II 3.0 × as long as tergite I.

Material examined. SOUTH KOREA: female, Mukdong-ri, Haksan-myeon, Yeongam-gun, Jeollanam-do, Malaise trap, 22.v.–31.vii.2010, J. K. Kim leg. (YNU).

Distribution. South Korea (new record), Russian Far East (Primorskiy Krai).

The First Record on Host Insect of *Allobethylus* Kieffer

Allobethylus currently contains 10 species worldwide (Barbosa and Azevedo 2011) and only one species, *Allobethylus tomoae*, has been recorded in South Korea (Lim et al. 2010).

To date, we do not have any ecological information of the genus since no host of *Allobethylus* has been recorded. Here, we report the first host record of the genus (Figures 2A–2D).

1. Bethyridae: *Allobethylus tomoae* Terayama.
2. Host: *Rhopaloscelis bifasciata* Kraatz (Coleoptera: Cerambycidae) in a stem of *Morus alba* L. (Urticales: Moraceae).
3. Locality: Ulleung islands (Gyeongsangbuk-do, South Korea).
4. Collector: Eui-Young Kang.
5. Collection date (observation in a laboratory): 10.i.2012.

Key to genus and species of South Korean Scleroderminae

1. Antenna with 10 flagellomeres 2
- 1'. Antenna with 11 flagellomeres 4
2. Metasomal tergite II longer than combined length of following tergites Genus *Pararhabdepyris* Gorbatovskii *P. paradoxus* Gorbatovskii
- 2'. Metasomal tergite II distinctly shorter than combined length of following tergites Genus *Cephalonomia* Westwood 3
3. Body pale castaneous; female without wings and frontal angle of ocelli acute *Cephalonomia gallicola* (Ashmead)
- 3'. Body black; female with wings and frontal angle of ocelli obtuse *Cephalonomia tarsalis* (Ashmead)
4. Mandible long and sickle-shaped with few small teeth apically; both sexes fully winged; forewing with radial vein Genus *Allobethylus* Terayama *Allobethylus tomoae* Terayama
- 4'. Mandible shorter, more or less triangular; males fully winged, females apterous or fully winged; forewing without radial vein Genus *Sclerodermus* Latreille *Sclerodermus harmandi* (Buysson)

Discussion

The Lazovsky Nature Reserve (Glazkovka, Russia), the type locality of the genus *Pararhabdepyris* and the species *P. paradoxus*, is located in Russian Far Eastern area and the reserve occupies almost 25% of the territory of the district. Even though Sundukov (2009) inferred that *P. paradoxus* is endemic to the region, the species newly discovered from the Jeonnam province, the most south-eastern part of the Korean peninsula, ~1200 km away in a straight line from the type locality. This indicates the possibility of more wide distribution of the taxa, and Azevedo and Barbosa (2010) also

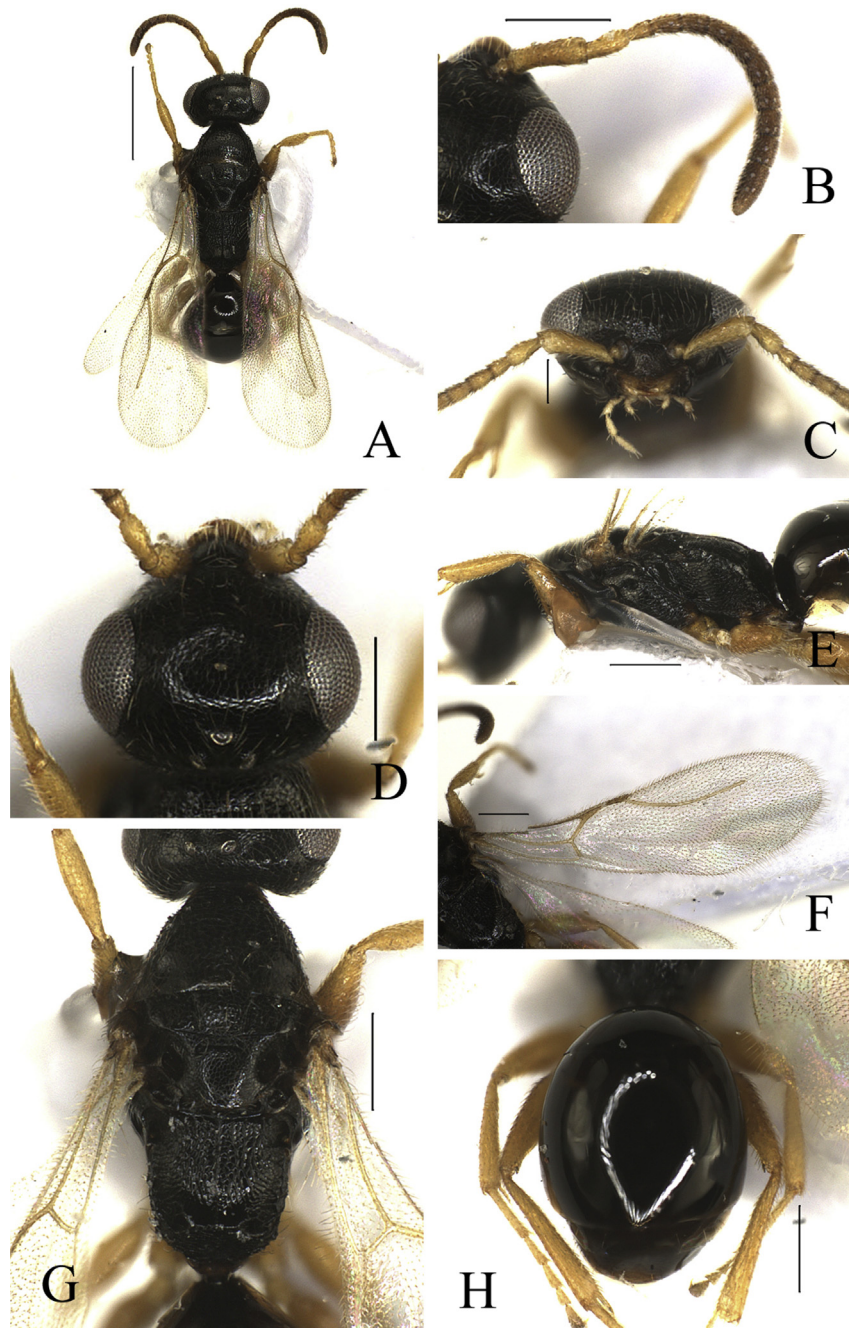


Figure 1. Diagnostic characters of *Pararhabdopyris paradoxus* Gorbатовskii (female). (A) habitus in dorsal view, (B) antenna, (C) head in frontal view, (D) head in dorsal view, (E) mesosoma in lateral view, (F) forewing, (G) mesosoma in dorsal view, (H) metasoma in dorsal view. Scale bar: 0.10 mm for C; 0.20 mm for B, D–H; 0.50 mm for A.

recently proved the wider distribution of the genus by describing two additional species from Australia (Australian region) and Thailand (Oriental region).

In East Asia, 143 species in eight genera of Scleroderminae have been recorded from five countries (Table 1) and among them, six species of five genera have been found in South Korea. The number of recorded Korean Scleroderminae species is ~4% of the total number of species in East Asia.

The knowledge of fauna of Scleroderminae of East and Southeast Asia has been improved recently with many additions of records and new species: Xiao and Wu (1983) and Xiao (1995) described three species of *Sclerodermus* from China; Terayama and Tachikawa (1987) began to describe Scleroderminae with

Plastanoxus from Japan and oriental countries; Gorbатовskiy (1995, 1998) summarized the Far Eastern Russian bethylids including Scleroderminae; Lim et al. (2006, 2007, 2010) and Lim and Lee (2011) recorded many species from East Asia (mainly South Korea) to find useful ectoparasitoids against *Monochamus* species (Coleoptera: Cerambycidae), the vectors of the pine wilt disease in East Asia (Lim et al. 2006); and most recently, Barbosa and Azevedo (2011) began to describe oriental Scleroderminae (*Allobethylus*) species. However, the frequency of describing species is irregular and there are no comprehensive studies on the fauna of Bethyloidea from these regions. In addition, as shown in Table 1, there are not any faunal investigations on Bethyloidea in several

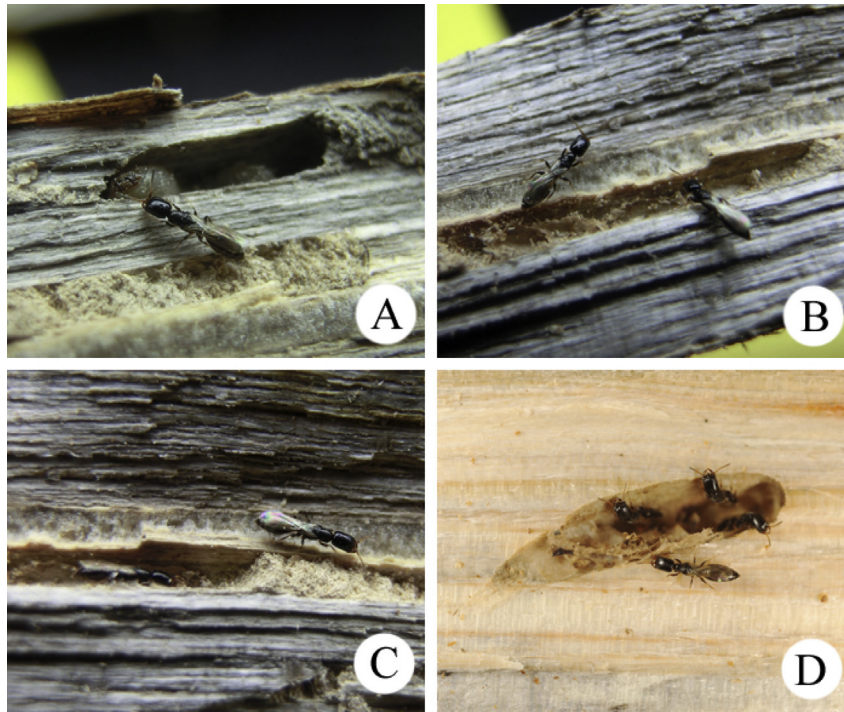


Figure 2. The ecological pictures of *Allobethylus tomoae* Terayama with host. (A) a female of *A. tomoae* is finding a host, a larva of *Rhopaloscelis bifasciatus* Kraatz. (B–C) two females are finding hosts in a gallery, (D) emergence of fresh adults from a host in the heartwood (the host was not identified).

countries, such as Hong Kong, North Korea, Macau and Mongolia in East Asia.

The ecological features of Scleroderminae are not enough to understand their relationships with the hosts. Nevertheless, some genera (e.g. *Sclerodermus*, *Plastanoxus* and *Prorops*) are related with the hosts that live in heartwood, and some others (e.g. *Cephalonomia*) are related to insect pests of stored agricultural products (Tachikawa 1980). Lim et al. (2006, 2007, 2010) reported and considered the relationships between three bethylids (*Cephalonomia gallicola*, *Cephalonomia tarsalis* and *Sclerodermus harmandi*) and their host. In addition, Xu et al. (2008) and Yang et al. (2012) described new species of *Sclerodermus*, as a natural enemy of insect pests of stored agricultural products or ones in forest in China.

These ecological habitats make it hard to collect the samples from the field. For instance, Azevedo et al. (2010) analyzed the bethylid genera of United Arab Emirates and Scleroderminae accounted for only 0.8% of all materials. Mugrabi and Azevedo (2010) examined 18,916 Madagascan bethylid specimens that

were collected by 10 different methods, including Malaise traps and Pitfall traps from 1998 to 2006, however, just 82 Scleroderminae specimens (0.4%) were found. In addition, most of Scleroderminae have normally reduced and simplified wing veins, compare to other subfamilies of Bethyidae for adapting to the habitus of their hosts.

To understand the limitations and evolutionary history of bethylids between East and Southeastern Asia, we needed to do intensive and continuous faunal investigations in these areas.

From the present study, the host of *Allobethylus* is newly discovered from South Korea. To date, 10 species of *Allobethylus* have been recorded worldwide, however, most of them were based on females that were mainly collected by using insect traps (e.g. Malaise traps). By using traps for collection, we can recognize the diversity and numerous samples of parasitoids; otherwise it is impossible to know their ecological features. As mentioned previously, it is well known that most Scleroderminae attack the coleopteran insects in concealed situations and in case of *Allobethylus*, the genus is not common and the number of genera is also not so diverse compared to other taxa in Bethyidae. Therefore, we think

Table 1
Genera of Scleroderminae from East Asia and number of species for each country.

No.	Genus	World	JPN	CHN	KOR	TWN	RUS FE	HKN	PKR	MAC	MNG
1	<i>Allobethylus</i> Kieffer	10	1	–	1	–	–	–	–	–	–
2	<i>Alloplastanoxus</i> Terayama	1	1	–	–	–	–	–	–	–	–
3	<i>Cephalonomia</i> Westwood	39	4	5	2	2	–	–	–	–	–
4	<i>Discleroderma</i> Kieffer	4	2	–	–	–	–	–	–	–	–
5	<i>Pararhabdepyris</i> Gorbatovsky	3	–	–	1	–	1	–	–	–	–
6	<i>Plastanoxus</i> Kieffer	8	3	–	1*	–	1	–	–	–	–
7	<i>Prorops</i> Waterston	7	2	–	–	–	–	–	–	–	–
8	<i>Sclerodermus</i> Latreille	71	3	4	1	2	1	–	–	–	–
Total		143	16	9	6	4	3	0	0	0	0

CHN = China; HKN = Hong Kong; JPN = Japan; KOR = South Korea; MAC = Macau; MNG = Mongolia; PKR = North Korea; RUS FE = Russia Far Eastern; TWN = Taiwan. Bold number indicate the total number of recorded species for each genus from the world, Korea and the total number of recorded species from each country.

* In preparation.

that the foundation of host of *Allobethylus* can be useful fundamental information to know the genus and the family.

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