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Systematic Position of the Genus *Keibaris* Chûjô, with Notes on the Definitions of the Related Taxa Having the Ascended Mesepimera (Coleoptera: Curculionidae)

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Abstract. An aberrant genus *Keibaris* Chûjô (= *Abaris* Voss) in Baridinae is newly transferred to Menemachini of Conoderinae (=Zygopinae) based on the comparisons of the morphological features with the related weevils having the mesepimera ascended upwards. The genus and the type species, *K. babai* are redescribed.

Key words: Taxonomy, morphology, *Keibaris*, Conoderinae, Baridinae

Megadiversity of the superfamily Curculionoidea ('weevils'), which include the largest family Curculionidae among organisms is distinguished. Presently itself includes 60,000 species, of which about 80% (slightly less than 50,000 species) are belonging to the single family Curculionidae (Anderson, 1995). Weevils are so diverse that the taxonomy is rather chaotic especially in the family Curculionidae, and the number of the subfamilies accepted range between nearly 100 to less than 10 among researchers. Thus, various taxonomic problems are still pending from species to higher-level classification. Due to the extraordinary diversity exceeding the handling capacity of single taxonomist and the lack of adequate definitions of the higher taxa such as subfamilies and tribes, many genera must be left unaware in the wrong systematic position.

Weevils of the Baridinae generally include small, oblong-ovate species and the larvae bore into stems and roots of various living plants. The genus *Keibaris* Chûjô (= *Abaris* Voss) was established in the tribe Madarini under the subfamily (Chûjô, 1960). Then, the genus has been classified in it by a number of subsequent authors though the position assigned to Madarini was not fixed (Voss, 1962, 1963; Morimoto, 1962a, c,

1984; Morimoto & Yoshihara, 1996; Alonso-Zarazaga & Lyal, 1999 and Hong et al., 2000). The habitus of *Keibaris* such as the oblong-ovate body and a flat ventral surface from pro-, meso- to metasternum resembles a certain member of Baridinae.

In the course of our revisional study of the Japanese Baridinae, however, we concluded that *Keibaris* is not true Baridinae, but is a member of Conoderinae (=Zygopinae) generally known as wood-feeders. In this paper we will discuss on the systematic position of *Keibaris* from the viewpoint of comparative morphology with the related taxa having the ascended mesepimera between the bases of the pronotum and the elytra.

This study was begun at a doubt on the systematic position by the senior author. It may be unaware unless the senior author studied the wide range of collections of the Old World Conoderinae in the Natural History Museum, London.

We dedicated this paper with our gratitude to Dr. Junichi Yukawa, Professor of Entomology and Director of the Kyushu University Museum, Kyushu University on the occasion of his retirement and for praising his remarkable career in entomology.

Systematic Position

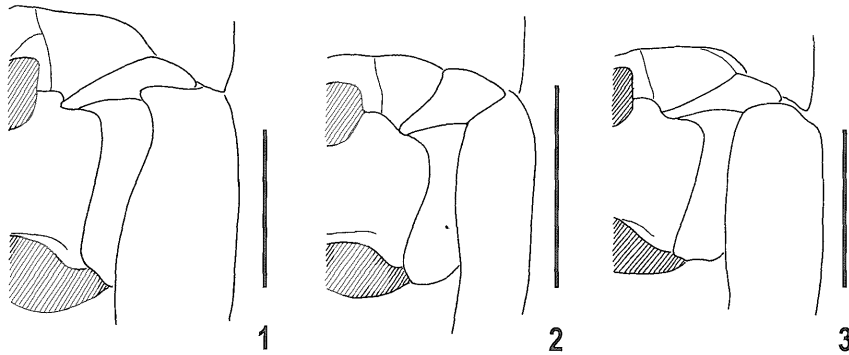
Comparisons.

After Chûjô (1960) established *Keibaris* in Baridinae, this treatment has been followed subsequently though the position within the subfamily was not confirmed. Voss (1958) had a doubt to classify the genus into Baridinae when he established his genus *Abaris* (= *Keibaris*). And he mentioned the possibility of affinity with Coryssomerini of Conoderinae (=Zygopinae). However, this may be not proof since the procoxae are contiguous with each other in Coryssomerini, whereas they are separated in *Keibaris*. And the mesepimeron and metasternum of Coryssomerini also differ from *Keibaris*, and are interestingly similar to Baridinae in condition as mentioned below.

Keibaris differs from the true Baridinae in the following features:

Head: The eyes are dorso-lateral in the position and the forehead between the eyes is much narrower than the base of the rostrum. In Baridinae, the eyes are usually placed in latero-ventral and the forehead between them is the width of the base of the rostrum.

Thorax: The mesepimeron is usually as large as the mesepisternum, ascended upwards and seen dorsally between the bases of the pronotum and the elytra in Baridinae (Fig. 2) and also in Coryssomerini. But, it is much smaller than the latter and narrow in *Keibaris* though it can be seen dorsally but narrowly as in Baridinae (Fig. 1). The median sulcus of the metasternum is almost in entire length in many Baridinae (cf. Morimoto & Yoshihara, 1996, figs. 70, 74, 87, 96) and also in Coryssomerini, however it is not so in *Keibaris* (Fig. 15). The strongly dentate and clavate fore femora of *Keibaris* are



Figs. 1-3. Lateral parts of meso- and metathoraces, latero-ventral view. 1. *Keibaris babai*; 2. *Baris ezoana* (Baridinae); 3. *Macrotelephae ichihashii* (Conoderinae: Menemachini). Scale = 1 mm.

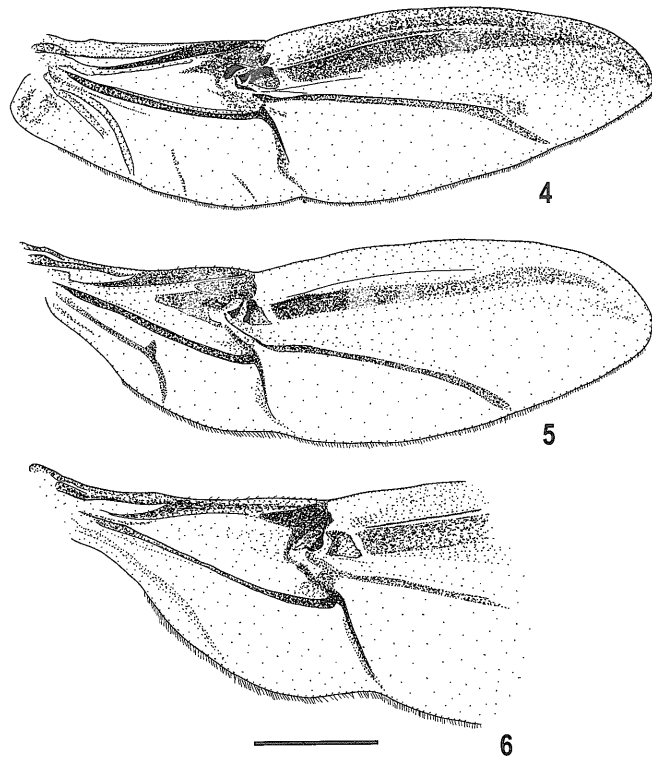
uncommon feature among Baridinae (Fig. 19). The tibiae are keeled externally with a fine sulcus bordered with two fine carinae (Fig. 21) and the outer setose fringe of each middle and hind tibiae ascended upwards in *Keibaris* (Fig. 19). Such features are not seen in Baridinae. The metendosternite has a pair of anterior tendons, which are widely separated in Baridinae (Fig. 8; cf. Morimoto & Yoshihara, 1996, fig. 111), but it is not so separated widely in *Keibaris* (Fig. 24).

Abdomen: The abdominal tergite is characteristic in Baridinae. It is well sclerotized and can be recognized the three sclerites: median, spiracular and lateral sclerites (cf. Morimoto, 1962b, figs 8, 9), and the wing holding spiculate patches are present on the 3rd or 4th to 7th segments (cf. Morimoto & Yoshihara, 1996, figs. 86, 109). In *Keibaris*, the tergite is completely different from the state of Baridinae and less sclerotized as in the other Curculionidae and the wing holding spiculate patches are present on the 5th to 7th segments (Fig. 22). The posterior margins of the abdominal ventrites 2-4 are usually broadly curved posteriorly at sides in Baridinae though the curvature seems to depend on the degree of the exposure of the pygidium (Fig. 11; cf. Morimoto & Yoshihara, 1996, figs. 66, 68, 70, 74 etc). However, the posterior margins of them are angulately curved posteriorly at side in *Keibaris* (Fig. 15).

Terminalia: The sternite 8 in male is divided into a pair in Baridinae (cf. Morimoto & Yoshihara, 1996, figs. 84, 106, 127), but it is not divided in *Keibaris* (Fig. 29). The bladal part of the sternite 9 in male sometimes has the median sclerite, which is divided into a pair in Baridinae (Yoshihara & Kojima, unpublished. data). Such a median sclerite is absents in *Keibaris* (Fig. 29).

Those differences lead to suspect *Keibaris* assigned in Baridinae, and indicate the affinities with Menemachini or possibly Campyloscelini of Conoderinae (=Zygopinae).

Before going ahead, the definitions of the concerned subfamilies Baridinae and



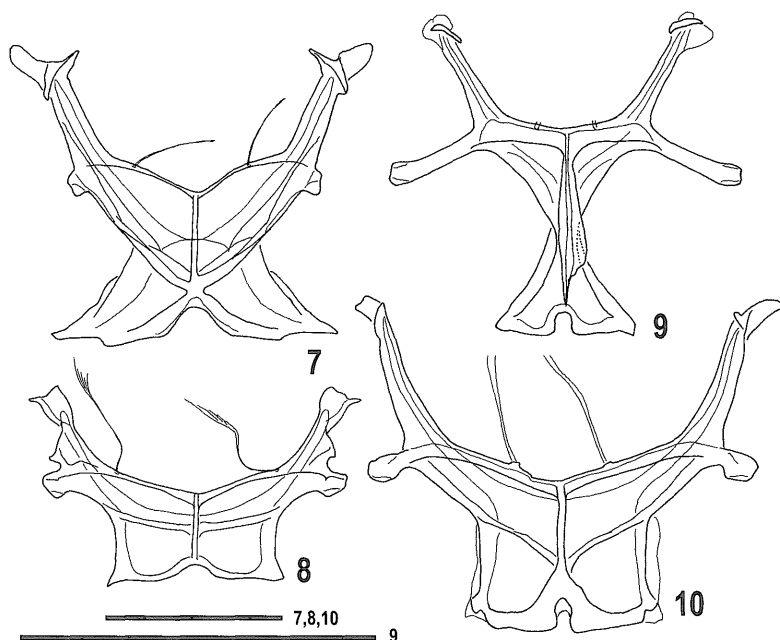
Figs. 4-6. Hind wings. 4. *Osphilia* sp. from W. Malaysia (Conoderinae: Coryssomerini); 5. *Podeschrus* sp. from Hong Kong (Conoderinae: Menemachini); 6. *Keibaris babai*. Scale = 1 mm.

Conoderinae are made to clear. These taxa and Ceutorhynchinae, Trigonocolinae and Orobolinae (=Orobolidinae) are amalgamated into a single subfamily Baridinae (Zherikhin & Egorov, 1990) and then elevated to family rank as the Barididae (Zherikhin & Gratshev, 1995), but the idea was not followed by Alonso-Zarazaga & Lyal (1999) in the classification system of their recent catalogue.

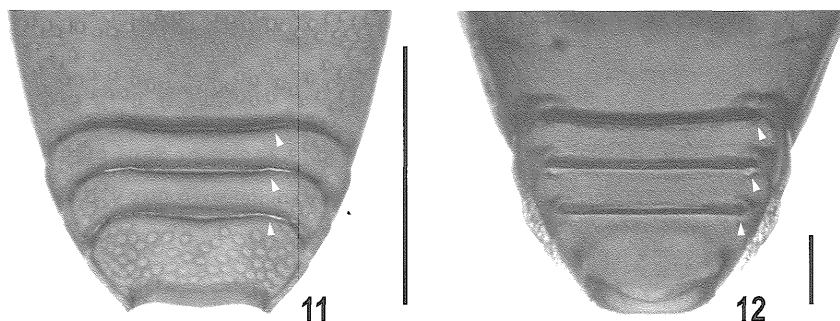
Weevils of the Baridinae, Ceutorhynchinae and some tribes of Conoderinae (Coryssomerini, Menemachini and Campyloscelini) bear the ascended mesepimera, which can be seen dorsally between the bases of the pronotum and the elytra. Comparisons will be focused upon these taxa. Among them, Ceutorhynchinae are well distinguished from others by Morimoto (1962c) in having the metasternum, which is contiguous with the ventrite 1 between the hind coxae and the metepisterna, the tibiae are unarmed or mucronate, and the corbel is opened. The Ceutorhynchinae may also be characteristic by the almost obliterated sternite 8 of the male terminalia. Whereas the metasternum is separated from the ventrite 1, the tibiae are mucronate and/or uncinat,

the corbel is provided with inner carina and the sternite 8 of the male terminalia is complete in Baridinae and Conoderinae. They may be separable by the following key:

- 1(4): Mesepimera large, rhomboidal and convex, nearly as great as mesepisterna, suture between them often indefinite. Metasternum with a median sulcus entire in length in general. Tibiae not or simply carinate externally. Hind wing with anal angle distinct (Fig. 4; cf. Zherikhin & Gratshev, 1995, figs. 108-111, 122-132). Metendosternite with anterior tendons each located beyond half way from centre to base of anterior arm (Figs. 7, 8). Tegmen of male terminalia generally with parameres. Fore coxae separated or contiguous. Antennal club with sutures between segments 1 and 2 and that of between 2 and 3 both distinct.
- 2(3): Middle and hind tibiae each with outer setose fringe terminal, not ascended. Femora generally unarmed or denticulate, but not distinctly as large triangular tooth. Fore coxae separated each other. Sclerolepidia present. Posterior margins of abdominal ventrites 2-4 broadly curved at sides externally and fulcrum of each ventrite articulation apart from side margin in internal view (Fig. 11). Abdominal tergite well sclerotized, and divided into three sclerites: median, spiracular and lateral sclerites, and median sclerite further subdivided on tergite



Figs. 7-10. Metendosternites. 7. *Osphilia* sp. from W. Malaysia (Conoderinae: Coryssomerini); 8. *Pteridobaris maritima* (Baridinae); 9. *Phaenomerus foveipennis* (Conoderinae: Campyloscerini); 10. *Podeschrus* sp. from Hong Kong (Conoderinae: Menemachini). Scale = 0.05 mm.



Figs. 11,12. Abdominal ventrites, internal view. 11. *Pteridobaris maritima* (Baridinae); 12. *Oosphilia* sp. from W. Malaysia (Conoderinae: Coryssomerini). The triangular mark (\triangle) indicates the position of the fulcrum of the ventrite articulation. Scale = 1 mm.

1. Sternite 8 of male terminalia paired, often with median sclerite generally paired on basal part of spiculum gastrale. Eyes generally latero-ventral in position, not approximated dorsally..... Baridinae
- 3(2): Middle and hind tibiae each with outer setose fringe rather oblique to axis, often ascended upwards. Femora dentate, often with large triangular tooth. Fore coxae contiguous with each other. Sclerolepidia absent. Posterior margin of abdominal ventrites 2-4 angulately curved at side externally and fulcrum of each ventrite articulation close to side margin in internal view (Fig. 12). Abdominal tergite weakly sclerotized and undivided into several sclerites unlike in Baridinae. Sternite 8 of male terminalia unpaired or paired, without median sclerite on basal part of spiculum gastrale. Eyes dorso-lateral in position, approximated dorsally..... Conoderinae: Coryssomerini
- 4(1): Mesepimera not convex, much narrower than mesepisterna, suture between them distinct. Metasternum with a median sulcus not entire in length. Tibiae keeled externally with a fine sulcus bordered with two fine carinae at least in fore pair. Hind wing with anal angle obliterated (Figs. 5, 6; cf. Zherikhin & Gratshev, 1995, fig. 112). Abdominal ventrites and articulation structures and tergite as in Coryssomerini. Metendosternite with anterior tendons each located between center and half way to base of anterior arm. Tegmen of male terminalia generally without paramere. Fore coxae more or less separated. Antennal club with suture between segments 1 and 2 distinct, that of between 2 and 3 is indistinct.
- 5(6): Sclerolepidia present. Middle and hind tibiae each with outer setose fringe ascended upwards. Male terminalia with sternite 8 not paired. Body generally ovate, more or less flattened dorsally. Prosternum canaliculated before coxae

- (Isorhynchini auct).....Conoderinae: Menemachini
 6(5): Sclerolepidia absent. Middle and hind tibiae each with outer setose fringe eliminated. Male terminalia with sternite 8 paired. Body generally cylindrical adopting to enter tunnels of ambrosia beetles (*Phaenomerina*).
 Conoderinae: Campyloscerini

Conclusion.

According to the definitions given above, the features of *Keibaris* are well concordant with those of Menemachini. The separated eyes, the very minute scutellum difficult to recognize and the visibly two-segmented antennal club in *Keibaris* also share with *Phaenomerus* of Campyloscelini. However, the distance between eyes is variable among Menemachini, the sclerolepidia are not recognized and the outer setose fringes of the middle and hind tibiae are eliminated in *Phaenomerus* as well as Campyloscerini in general. Thompson (1996) suggested that it may be possible to distinguish campyloscelines from other zygopines (=conoderines) by differences in the suture of the antennal club. Namely, in campyloscelines the suture between segments 1 and 2 of the club is transverse and distinct, whereas that between segments 2 and 3 is distorted and indistinct. In other zygopines the sutures of club are parallel to one another and are either both distinct or both indistinct. As far as we have ever examined, however, the feature is seen not only in campyloscerine but also in *Keibaris* as well as other Menemachini of Conoderinae generally. As a result, we concluded that *Keibaris* is most appropriate to settle in Menemachini at present.

Biology

Biology of Menemachini is little known, but is probably regarded as wood-feeder. The senior author found larvae, pupae and newly emerged adults of *Podeschrus* or its ally of Menemachini under bark of a fallen dead tree in Malaysia. He also observed many species of several genera of Menemachini have come to a standing dead tree and fled away in fast moving, and had rested under leaves of herbaceous plants around the tree. They seemed to be flying between the leaves and the tree repeatedly.

Biology of *Keibaris* is not known except for some collecting records of adults that a number of them were found on leaves of *Morus* sp. (Moraceae) and visited the flower of *Mallotus japonicus* (Euphorbiaceae). Feeding trace of the weevil was not found on leaves of *Morus* sp. Thus, if *Keibaris* is also regarded a wood-feeder as expected by other menemachine, the adults may have just rested on the leaves. The fast moving generally seen in other Conoderinae was not observed in *Keibaris*.

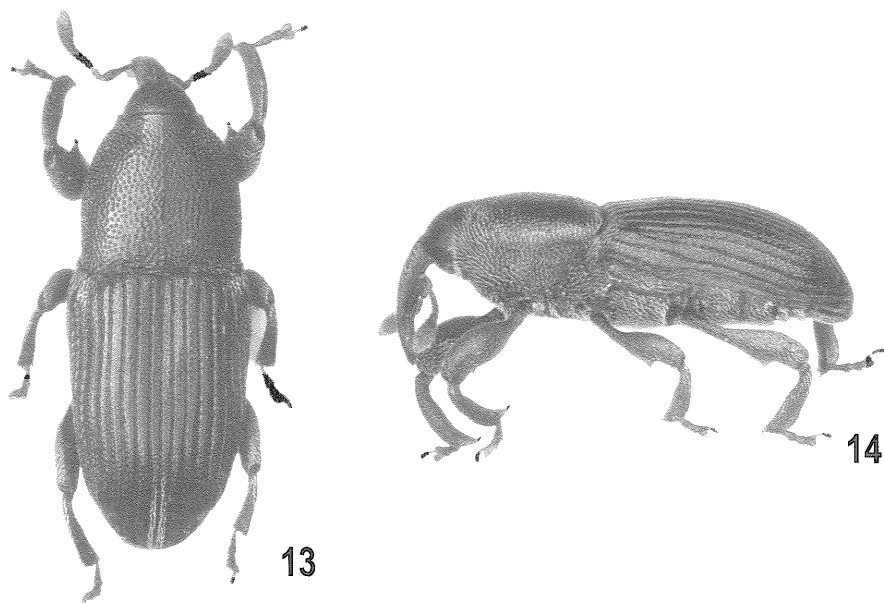
Genus *Keibaris* Chûjô

Keibaris Chûjô, 1960: 1 (type species: *Keibaris babai* Chûjô, 1960). –Morimoto, 1962c: 46. –Alonso-Zarazaga & Lyal, 1999: 96.
Abaris Voss, 1958 (non Dejean, 1831): 87 (type species: *Abaris fortidens* Voss, 1958). –Voss, 1962: 11. –Voss, 1965: 110 (comp. w. *Baridiomorphus*, Barinae). –Morimoto, 1984: 309. –Morimoto & Yoshihara, 1996: 6, 19.

Redescription.

Forehead between eyes about half as wide as base of rostrum. Rostrum separated from head by a faint impression, shorter than pronotum, weakly curved; antennal scrobes extend anteriorly beyond antennal insertion. Antennae inserted around middle of rostrum; scape a little shorter than funicle; club weakly depressed laterally, 1st segment less than half of club.

Prothorax nearly as long as broad. Scutellum invisible. Elytra about 1.5 times as long as broad, a little wider than pronotum at shoulders; stria 10 complete. Legs with femora swollen, especially on fore pair, each arms with triangular tooth, which is largest in fore pair, hind pair not reaching apices of elytra; tibiae carinate along inner and outer margins, curved in fore pair, uncinat, but not mucronate, uncus arisen near inner apical corner, outer setose fringes ascending upwards in middle and hind pairs; claws toothed simple. Pygidium concealed.



Figs. 13, 14. Habitus photographs of *Keibaris babai* Chûjô, male. 13. dorsal; 14. lateral.

Prosternum not canaliculated before coxae, which are separated less than half the breadth of it, sternellum enlarged and flattened on a same level with area in front of fore coxae, and produced caudad at sides. Mesosternal process almost as wide as a middle coxa. Metasternum between middle and hind coxae a little longer than ventrite 1 behind coxa; metepisternum tapered posteriorly. First abdominal ventrite behind coxa a little longer than 2nd, which is nearly as long as 3rd and 4th combined at side.

Remarks. *Keibaris* is separable from other menemachinae genera by the combination of the following features: forehead between eyes half as wide as base of rostrum, pronotum without lateral calli, scutellum invisible, fore femora greater than posteriors, claws simple and prosternal canal absent.

Distribution. Oriental region: Japan (Is. Tsushima), Korea, China, Ethiopian region: Tanzania.

Following three species are known and a key to the species was given by Voss (1962).

***Keibaris babai* Chûjô**

(Figs. 1, 6, 13-33)

Keibaris babai Chûjô, 1960: 1. –Morimoto, 1962a: 196. –Hong, Egorov & Korotyaev, 2000: 85.

Abaris babai: Voss, 1962: 12. –Morimoto, 1984: 311, pl. 61, fig. 17. –Morimoto & Yoshihara, 1996: 53, fig. 54 (mandible).

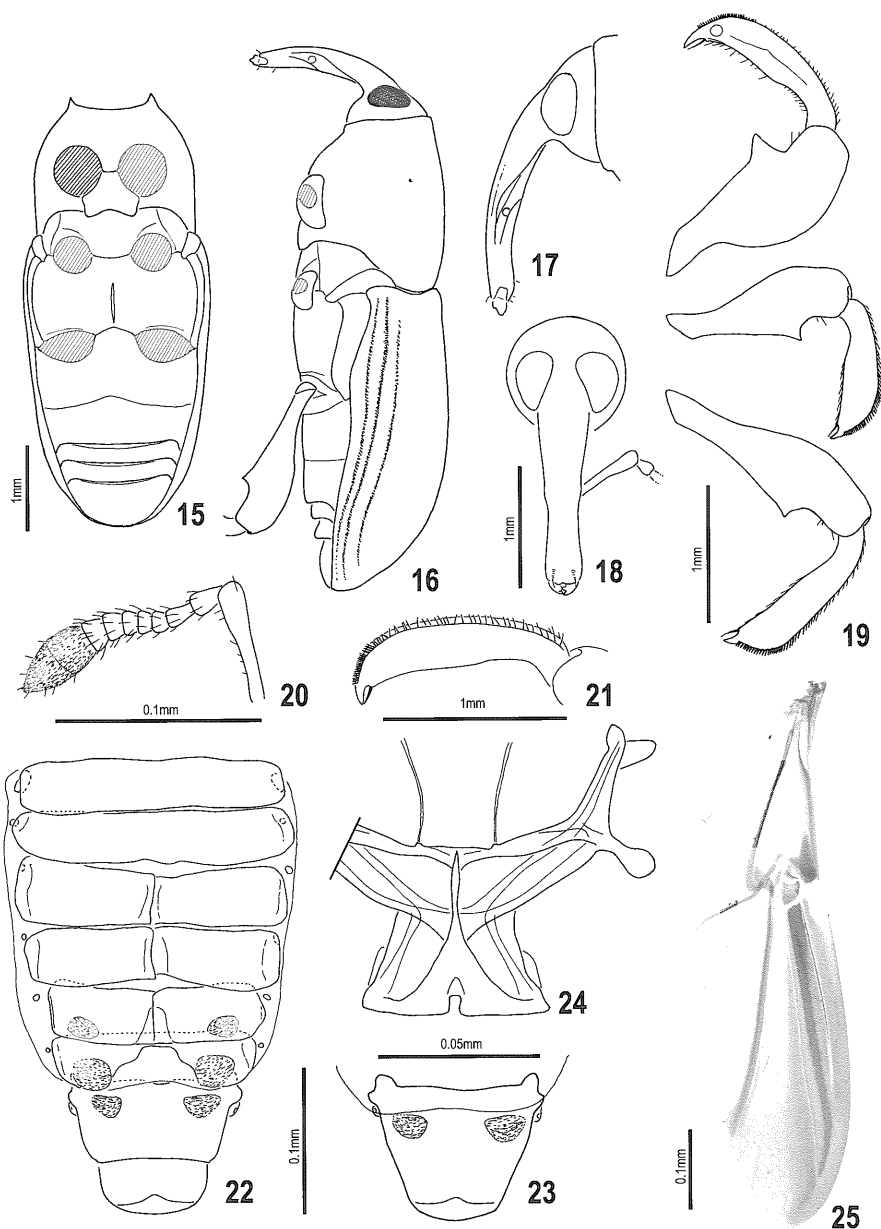
Redescription.

Male.

Length: 4.5-5.8 mm. Blackish to dark red-brown, pronotum darkest, antennae and legs lighter; hairy scales yellowish grey, clothed on underside, lateral parts, legs and dorsum along basal margins of pronotum and elytra, and at apical 1/3 of 1st interval of elytra.

Head with rostrum 0.7 times as long as pronotum, weakly becoming thinner toward apex, wider than knee of fore femur at base; upper surface indistinctly pluricarinate behind antennae. Antennae inserted a little beyond middle of rostrum; funicle with 2nd segment a little shorter than 1st, 3rd to 7th transverse; club about as long as 3rd to 7th segments of funicle combined.

Prothorax as long as broad, sides subparallel in basal half, then rounded in a curve to weak subapical constriction, subtruncate at base; pronotum densely punctate, interstices between them narrower than their diameter, generally with fine median impunctate line in entire length. Elytra 1.5 times as long as broad and 1.76 times as long as pronotum;

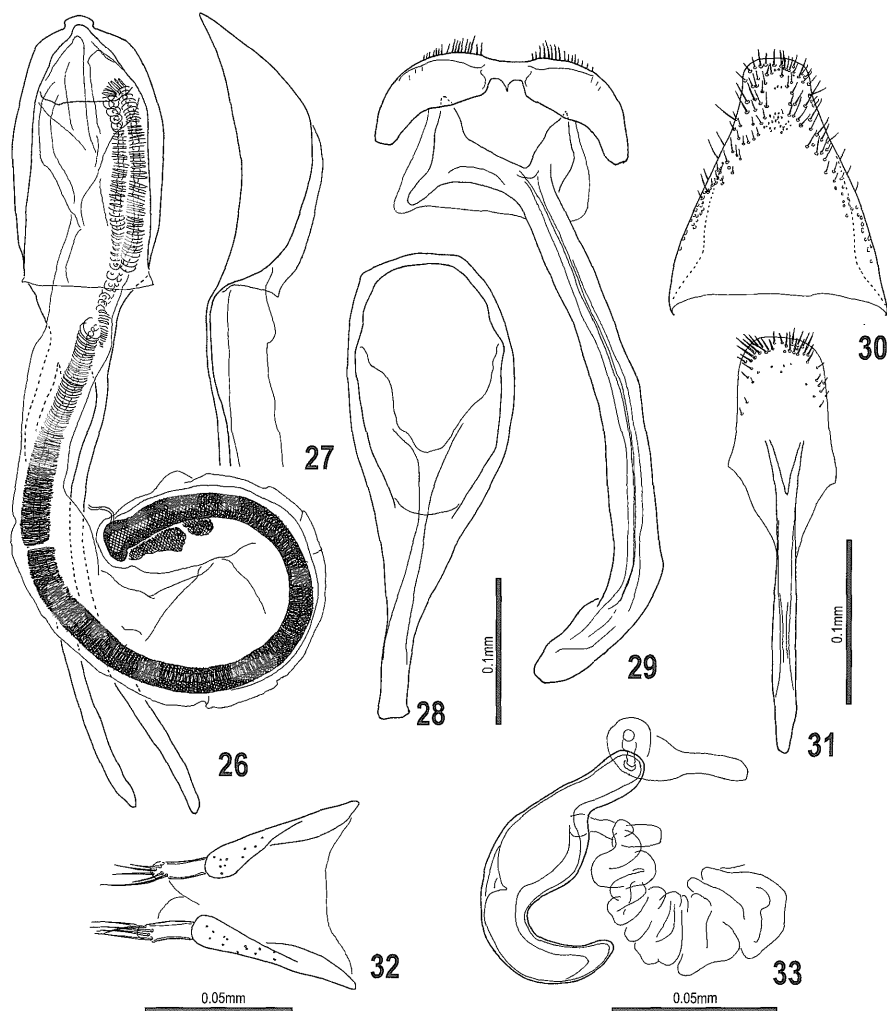


Figs. 15-25. Characters of *Keibaris babai* Chûjô (15, 16, 19-22, 24, 25: male; 17, 18, 23: female). 15. body, ventral; 16. ditto, lateral; 17. head, lateral; 18. ditto, frontal; 19. tibiae and femora; 20. antenna; 21. fore femur, dorso-lateral; 22. tergite; 23. 7th tergite; 24. metendosternite; 25. hind wing.

intervals each irregularly with two rows of punctures. Legs with hind femora barely reaching posterior margin of 4th ventrite; fore tibiae weakly dilated internally before middle.

Venter with basal two ventrites weakly depressed at middle.

Terminalia as illustrated (Figs. 26-29), aedeagus with long flagellum; tegmen without paramere.



Figs. 26-33. Terminalia of *Keibaris babai* Chûjô (26-29: male; 30-33: female). 26. aedeagus, dorsal; 27. ditto, lateral; 28. tegmen; 29. sternite 8 and spiculum gastrale; 30. tergite 8; 31. sternite 8; 32. hemisternites; 33. spermatheca.

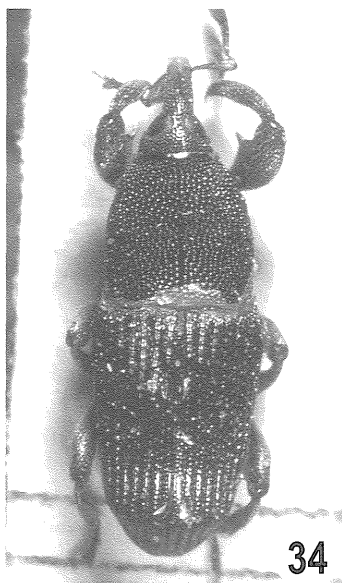
Female.

Length: 4.7-5.9 mm. Resembles male except rostrum slightly slenderer, 0.75 times as long as pronotum, and more constricted laterally beyond antennal insertions, and venter with basal two ventrites not depressed at middle. Terminalia as illustrated (Figs. 30-33), spermatheca with long duct.

Specimens examined. JAPAN: Tsushima. 1 male, Uchiyama, 26.v.1957, K. Baba (holotype, Chûjô Collection, Kyushu University). 1 male, Sasuna, 24.v.1961, Y. Kimura. 1 male, Hidakatsu, 25.v.1961, Y. Kimura. 1 female, Azamo-Mt. Tatera, 10.vi.1961, I. Nagao. 1 male and 1 female, Azamo, 16.v.1993, K. Yoshihara. 1 female, Mt. Ariake, 18.v.1978, S. Hisamatsu; 1 male, 1.vi.1995, H. Kojima. 1 male, Izuhara, 15.v.1971, H. Irie; 5 males and 9 female, 31.v.1995, H. Kojima (on *Morus* sp.). 1 male, Hikage, Izuhara, 2.vii.1983, J. Okuma. 2 males, Kamizaka-Sasutouge, 3.vii.1983, J. Okuma. 1 male and 1 female, Mt. Ohboshiyama, Mine, 5-9.vii.1983, H. Makihara; 1 male, 22-24.vii.1985, H. Makihara. 1 male and 1 female, Uchiyama-Tsutsu, 28-29.v.1995, H. Kojima.

Distribution. Japan (Is. Tsushima), Korea (south).

Biology. A number of adults were found on leaves of *Morus* sp. (Moraceae) in Tsushima. Another adult collecting record is known to have been taken on flower of *Mallotus japonicus* (Akamegashiwa in Japanese) (H. Hirano, personal communication). But the larval host is not yet confirmed.

***Keibaris fortidens* (Voss, 1958)**

(Fig. 34)

Abaris fortidens Voss, 1958: 87. –Voss, 1962: 12.

Specimens examined. 1 ex., Holotype (Alexander Koenig Museum, Bonn). 1 ex., Allotype? (Naturhistoriska Riksmuseet, Stockholm).

Distribution. China (Fukien).

This species is very similar to *K. babai*, but the prothorax is widest behind middle and the apical scaly patch on 1st interval of elytra absent.

***Keibaris lindemannae* (Voss, 1962)**

Abaris lindemannae Voss, 1962: 11.

Fig. 34. Habitus photograph of *Keibaris fortidens* (Voss), holotype.

Distribution. Tanzania.

According to the original description, the antennal scape is strongly clavate, nearly twice as wide as rostrum, the 2nd to 7th funicular segments are transverse, and the prothorax is bisinuate at base.

Acknowledgments

The senior and second authors wish to express their cordial thanks to Drs. Christopher H. C. Lyal and Richard T. Thompson of the Natural History Museum, London for their kind support during our stay in their museum. We thank Mr. Hijiri Hirano of Kyushu University for his kindness providing the field information for us on *Keibaris babai*. Our thanks are also extended to Prof. Junichi Yukawa, Kyushu University for his kind favor in various ways. This study is partly funded by grants from the JSPS Postdoctoral Research Fellow, the British Council, the Kyushu University Supporters' Association and KAKENHI (14255016) (to Kojima).

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