

## A New, Well-Preserved Species of Glaresidae (Coleoptera: Scarabaeoidea) from the Jehol Biota of China

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**Abstract:** *Glaresis orthochilus* sp. nov. (Scarabaeoidea: Glaresidae), the best preserved glaresid fossil, is described and illustrated from the Yixian Formation of western Liaoning province, north-east China. Glaresidae, the sister group of all extant Scarabaeoidea was established in the Upper Jurassic/Lower Cretaceous and contained larger species than those found today.

**Key words:** Coleoptera, fossil, Glaresidae, Yixian Formation, *Glaresis*, Scarabaeoidea, new species, China

### 1 Introduction

Glaresidae are a small, virtually cosmopolitan (absent in Australia), uniform family of Scarabaeoidea with approximately 50 extant species in one genus (Scholtz et al., 1994). Apart from the fact that some species were found in sandy soil and are attracted to light at night, nothing is known about the ecology of these beetles (Scholtz and Grebennikov, 2005). *Glaresis* is commonly considered to represent the shape of an ancestral scarabaeoid beetle, having retained a number of ground plan character states (Scholtz et al., 1994), although most of those assumed ancestral characters are derived from a single body part, the hind wings and their articulation, whereas the rest of the body shows many derived characters. Nevertheless, in a phylogenetic analysis based on morphology, *Glaresis* was found to be the sister to remaining Scarabaeoidea (Browne & Scholtz, 1999), and as such, Mesozoic fossils were expected. The taxon was unknown in the fossil record (Krell, 2006) until three extinct species of Glaresidae were recently described by Nikolajev (2007): *Glaresis cretacea* Nikolajev, based on a single hind leg, and *Cretoglaresis nana* Nikolajev and *Lithoglaresis ponomarenkoi* Nikolajev, from incomplete body fossils. Nikolajev described a second *Cretoglaresis* species, *Cretoglaresis ovalis*, from a fairly complete body fossil (Nikolajev, 2009). The new fossil we describe is almost complete and well preserved, and confirms the presence of Glaresidae in the Mesozoic.

### 2 Material and Methods

This study is based on one specimen collected near Chaomidian village, Beipiao city, from the Yixian Formation of

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western Liaoning, China (Wang and Zhou, 2008). The age of the Yixian Formation was proven to be contentious, as three opinions have been produced: Late Jurassic (Ren et al., 1997), the transition from Late Jurassic to Early Cretaceous (Chen et al., 2004; Wang et al., 2005), and Early Cretaceous (Swisher et al., 1999). The specimen was examined with a LEICA MZ 12.5 dissecting microscope (Wetzlar, Germany) with a drawing tube attachment, and deposited in the fossil insect collection of the Key Laboratory of Insect Evolution and Environmental Changes, the College of Life Science, Capital Normal University, Beijing, China (CNUB).

### 3 Systematic Paleontology

Order Coleoptera Linnaeus, 1758

Family Glaresidae Kolbe, 1905

Genus *Glaresis* Erichson, 1848

Type species: *Glaresis rufa* Erichson, 1848

#### *Glaresis orthochilus* Bai, Krell et Ren sp. nov. (Fig. 1)

**Description:** Body length 8.5 mm; width 3 mm. Broadly oval and compact.

Head slightly wider than long, broadest at eyes, clypeus front margin straight, shorter than the base of the head; eye partly divided by the *Cretoglaresis ovalis*; deep incision between the canthus and clypeus (Plate I: arrow); labium transverse, internal margin of the mandibles with teeth. Pronotum largely rectangular with lateral margins slightly convex, 1.4 times wider than long, distinctly wider than the head, widest just cranial to the apparently rounded posterior angles; anterior margin of pronotum concave; basal margin almost straight; lateral sides appear serrate or denticulate. Scutellum triangular and 1.8 times wider than long. Elytron widest in the middle; slightly constricted to the basis, largely parallel in the middle, convexly

constricted to the apex in the apical quarter; 3.3 times longer than wide medially, 0.5 times as wide as prothorax; nine visible striae formed by regular, big punctures (only visible in the outer seven striae). In the legs, procoxa approximately two times wider than long, mesocoxa 1.1–1.3 times longer than wide, mesocoxal cavities oval, narrowly separated; metafemur distinctly broad, 1.5 times wider than mesofemur; metafemora separated (might be caused by dislocation, since the area between them is poorly preserved); protibia dilated apically and with three teeth on outer margin, one spur on the end of protibia, mesotibia and metatibia strongly dilated at the apex, pre-apical surfaces of mesotibia broadened concave, two spurs on the end of mesotibia almost equal in length, pre-apical surfaces of metatibia with one transverse ridge; mesotarsus relative length of each segment (base to apex) 15:9:8:10:13. Abdomen: sternum 5-segmented, apex of pygidium flatly rounded; seven tergites visible. In the aedeagus, basal plate and parameters nearly equal in length, parameres truncate with one broad, deep notch in lateral view.

**Materials examined:** Holotype: male, a well-preserved body with left elytron and legs, registration no. CNU-C-LB2008002, collected from the Yixian Formation, near Chaomidian village, Beipiao city, Liaoning province, China; specimen housed in the Key Laboratory of Insect Evolution and Environmental Changes, the College of Life Science, CNUB.

**Diagnosis:** Large glaresid (8.5 mm long); clypeus front margin straight; pronotum shape largely rectangular: 1.4 times wider than long, no surface sculpture visible; protibiae with three large denticles; mesocoxal cavities oval; mesofemora not broadened; femora without teeth; tibiae slender for a *Glaresis*; two spurs on the end of mesotibia nearly equal in length, pre-apical surfaces of metatibia with one transverse ridge; mesotarsus relative length of each segment (base to apex) 15:9:8:10:13; parameres truncate, with one broad, deep notch in lateral view.

**Etymology:** From ὀρθός (Greek), meaning straight, and τὸ χεῖλος (Greek), meaning lip, referring to the straight front margin of the clypeus.

#### 4 Discussion

The only two identified unique autapomorphies of Glaresidae are reductions in the wing venation (Scholtz et al., 1994). Hind wings are neither preserved in our specimen nor in the other fossil Glaresidae described by Nikolajev (2007, 2009). Another apomorphy are five abdominal sternites, which also occur in the Trogidae, Passalidae, and Lucanidae (Browne and Scholtz, 1999). The fossil shows five abdominal sternites and a deep

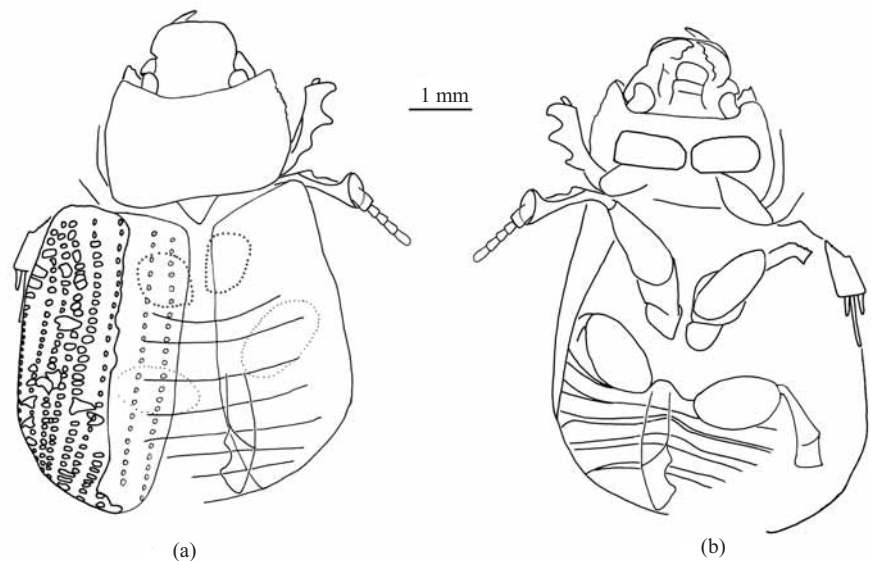


Fig. 1. *Glaresis orthochilus* Bai, Krell et Ren sp. nov.

(a) Dorsal view; (b) ventral view.

incision between the genal canthus and clypeus, which is characteristic of Glaresidae (Semenov-Tian-Shanskij and Medvedev, 1932; Martínez et al., 1961; Gordon, 1970). The combination of both characters gives a strong indication that the fossil specimen belongs to Glaresidae. The incision between the canthus and clypeus has never been considered in a phylogenetic analysis of scarabaeoid families, thus remaining unpolarized. Since it is conspicuous in almost all Glaresidae and missing in other Scarabaeoidea, it might well turn out to be a glaresid apomorphy.

Nikolajev (2007) recorded three glaresid genera from the Lower Cretaceous of Baysa, Russia, two of which are described by Nikolajev as new. *Lithoglaresis* Nikolajev was described as having thin mesotibia, but broad mesofemora, broader than in any other glaresid (Nikolajev, 2007, 2009). The mesofemora of our specimen are of regular glaresid shape, which excludes its inclusion in *Lithoglaresis*. According to Nikolajev, mesotibiae and metatibiae of *Cretoglaresis* were much more slender than in *Glaresis*, with the apex of the metatibiae dilated (Nikolajev, 2007, 2009). Nikolajev did not provide an explicit differential diagnosis of *Cretoglaresis* from *Glaresis*. Although it is true that in most *Glaresis* species the metatibia are much broader than in *Cretoglaresis*, the shape of the tibiae is rather variable within extant *Glaresis*. For example, the hind tibia of *Glaresis rufa* Erichson, *Glaresis howdeni* Gordon, *Glaresis obscura* (Petrovitz), and *Glaresis pardoalcaidei* Martínez, Pereira, and Vulcano are relatively slender (Gordon, 1970; Martínez et al., 1961; Petrovitz, 1968; Semenov-Tian-Shanskij and Medvedev, 1931). We are unable to find diagnostic characters that would clearly differentiate *Cretoglaresis* from *Glaresis*. The character that might separate *Glaresis orthochilus* from other *Glaresis* (and *Cretoglaresis*) (and *Glaresis*, cf. Nikolajev, 2009) species are the separated mesocoxae and metacoxae. However, the mesocoxae are only slightly separated, which can easily happen through

compression during fossilization; the poor preservation of the area between the metafemora does not allow excluding dislocation of the hind legs. We tentatively include our new species in the genus *Glaresis* because we did not find characters that would contradict this classification.

With an 8.5 mm body length, *Glaresis orthochilus* is larger than any extant Glaresidae species which measure between 2.5 and 6 mm (Scholtz and Grebennikov, 2005). The imprint of *Lithoglaresis ponomarenkoi* Nikolajev, 2007 is 6.5 mm long, but since the main part of the abdomen is missing, the beetle might have been of similar size as *Glaresis orthochilus*. Both *Cretoglaresis nana* Nikolajev, 2007, measuring 2.55 mm (with the head and abdomen missing), and *Cretoglaresis ovalis*, with a 4.9 mm body length, are much smaller, but match the size range of larger, extant glaresid species. The Cretaceous Glaresidae indicate that the ancestral species of this family were on average larger than those of today. The small size of extant Glaresidae is a probably derived condition in this family.

*Glaresis orthochilus* sp. nov., the fourth and best-preserved Mesozoic glaresid, confirms that the hypothesized sister group of all extant Scarabaeoidea (Scholtz et al., 1994) was already established during the Lower Cretaceous or even the Upper Jurassic. The apparent similarity of the new fossil with extant *Glaresis* indicates morphological stasis of Glaresidae since the Mesozoic and corroborates former assumptions that the first scarabs might have looked like large Glaresidae (Scholtz et al., 1994; Scholtz and Grebennikov, 2005; Krell, 2006).

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**Plate I**

1. *Glareis orthochilus* Bai, Krell et Ren sp. nov., holotype, no. CNU-C-LB2008002; 2. elytra (part); 3. aedeagus; 4. protibia. Scale bars represent 1 mm. Black arrow indicates deep incision between canthus and clypeus.

