Zootaxa 2337: 63–68 (2010)
www.mapress.com/zootaxa/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

Mud shrimp associated with burrows from the Oligocene Ashiya Group, northern Kyushu, Japan, with description of a new species of *Upogebia* (Decapoda: Gebiidea)

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Abstract

Upogebia hibiki **sp. nov.** (Gebiidea: Upogebiidae) is described from the Oligocene of northern Kyushu, Japan. The new species closely resembles *U. mizunamiensis* Karasawa 1989, but differs in having an arched ridge on the dorso-distal mesial surface of the palm of pereiopod 1. Additionally, the new species has a triangular rostrum and a narrow gastric region. The specimens are associated with fossil burrows assigned to the ichnogenus *Psilonichnus* Fürsich, 1981. Therefore, *Psilonichnus* described herein is thought to be formed by *U. hibiki* **sp. nov.**

Key words: Mud shrimp, *Upogebia hibiki* **sp. nov.**, Burrow morphology, *Psilonichnus*, Paleoecology

Introduction

Upogebia, a burrowing mud shrimp genus of the family Upogebiidae (Gebiidea), has a robust record in the present oceans (Sakai 2007). However, only twenty-one species are known from the fossil record (Fraaije *et al.* 2007; Garassino *et al.* 2009). The Japanese fossil records of *Upogebia* comprises six species, *Upogebia mizunamiensis* Karasawa 1989, *U. striata* Karasawa & Kishimoto 1996, *U. tanegashimensis* Karasawa & Inoue 1992, *U.* cf. *imperfecta* Sakai (Kato 2001), *U.* sp. (Kato 1996), and *U.* sp. (Kato & Koizumi 1992) . Among these, *U.* cf. *imperfecta* Sakai, and *U.* sp. (Kato & Koizumi 1992) are known from Pleistocene deposits whereas the others are of Miocene age.

During our field work in 2008 and 2009, the authors collected numerous specimens of *Upogebia* from the Oligocene Ashiya Group, northern Kyushu. Interestingly, these specimens are associated with abundant fossil burrows in these strata. The previously known records lack data on burrow morphology associated with *Upogebia*. The purpose of the present paper is to describe a new species of *Upogebia* as well as these burrows, and to discuss paleoecology of the species.

The described specimens are deposited in the Mizunami Fossil Museum (MFM).

Locality and geological Setting

The specimens described here were collected from the Honjo Formation of the Ashiya Group in Sakamizu, Wakamatsu-ku, Kitakyushu City, Fukuoka Prefecture, Japan (Fig. 1). The fossil-bearing horizon is the uppermost part of the Honjo Formation (Fig. 2). This formation consists of sandy mudstone, mudstone, and sandstone, which yield shallow-marine mollusks (Sakakura 2002), decapod crustaceans (Kato & Karasawa 1994), and calcareous nannoplankton (Okada 1992). Ozaki *et al.* (1993) showed the geologic age of the Honjo Formation to be late Oligocene, based upon fission track data and calcareous nannoplankton. The specimens

Accepted by S. Ahyong: 14 Dec. 2009; published: 18 Jan. 2010

occurred within sandy mudstone of this formation, associated with burrows and the crab *Minohellenus macrocheilus* Kato and Karasawa 1994 (Fig. 3H). Most of them were included within nodules. Some specimens were found in cemented burrows.

Systematics

Family Upogebiidae Borradaile 1903

Subfamily Upogebiinae Borradaile 1903

Genus *Upogebia* Leach 1814

***Upogebia hibiki* sp. nov.**
(Fig. 3A–G)

Diagnosis. Rostrum triangular, about as long as wide at the base, with rounded tip; dorsal surface with weak median depression. Gastric region much longer than wide with shallow median groove extending to mid-length; 3 rows of tubercles present, parallel to lateral groove; lateral ridge strong, slightly divergent posteriorly, posterior half tuberculate; lateral groove deep. Pereiopods 1 subchelate, equal, similar in shape. Dactylus slender, elongate; occludent margin with low, broad tooth on proximal third; dorsolateral and ventrolateral ridges smooth; dorsal ridge ornamented with minute tubercles proximally. Fixed finger short. Palm about 2/3 times as long as dactylus, much longer than high; lateral surface moderately convex longitudinally, bearing 3 or 4 rows of minute, conical tubercles medially; 2 dorsolateral grooves present, shallow with small setal pits; dorsal margin gently convex, rimmed, with minute setal pits; ventral margin gently concave; mesial surface slightly convex longitudinally, bearing 12–15 oblique ridges on ventral half, strong, arched ridge along dorsal margin on dorso-distal part, and short transverse ridges on dorsal half.

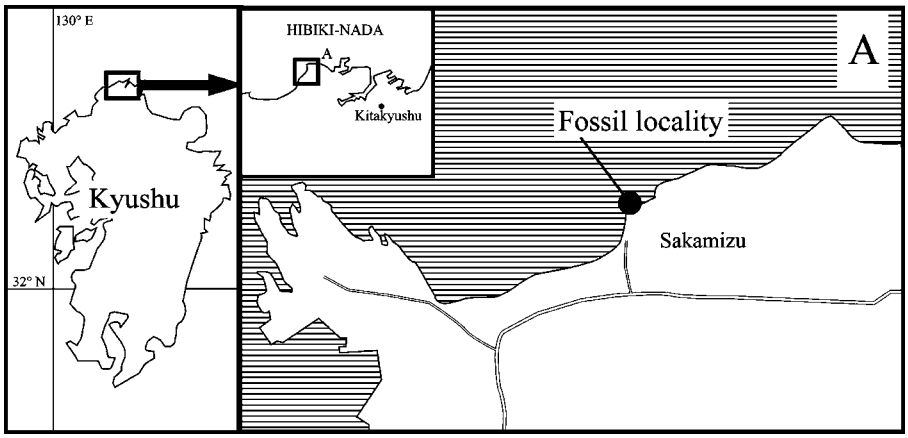

FIGURE 1. Map showing the fossil locality.

Etymology. The trivial name is derived from "Hibiki-Nada". The name hibiki is an arbitrary combination of letters.

Description. Rostrum triangular, about as long as wide at the base, with rounded tip; lateral margin nearly straight; dorsal surface with weak median depression. Gastric region much longer than wide, about half as wide as long, with shallow median groove extending to mid-length; 3 rows of tubercles present, parallel to lateral groove; lateral ridge strong, slightly divergent posteriorly becoming narrower posteriorly, posterior half tuberculated; lateral groove deep, sinuous. Cervical groove well defined. Cardiac region poorly preserved, smooth.

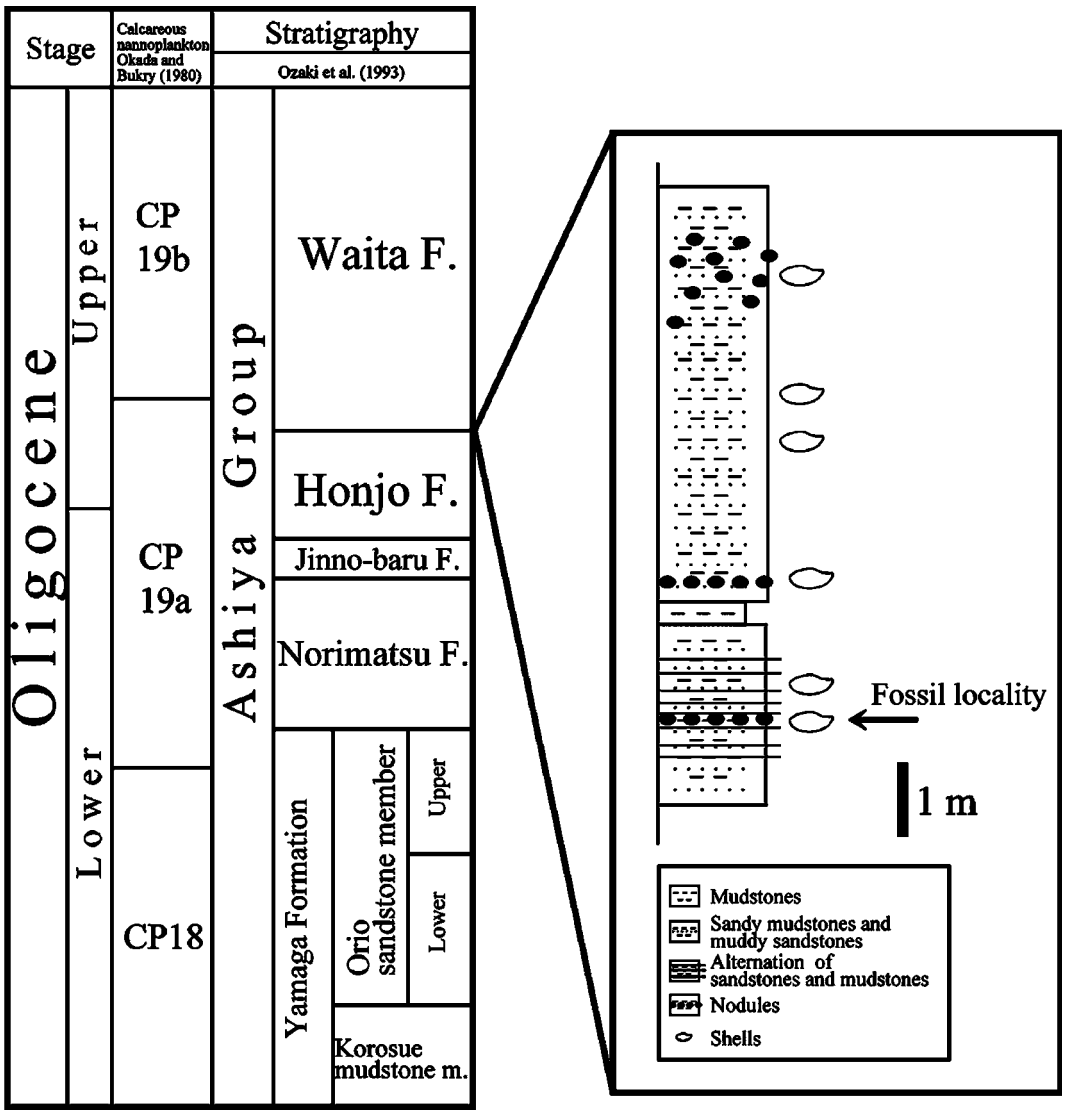

FIGURE 2. Oligocene chronostratigraphy, lithostratigraphy and columnar section of the fossil locality in the Ashiya Group.

Pereiopods 1 subchelate, equal, similar in shape. Dactylus slender, elongate, gently curved ventrally, with acutely pointed tip; occludent margin with low, broad tooth on proximal third; dorsolateral and ventrolateral ridges smooth; dorsal ridge ornamented with minute tubercles proximally. Fixed finger short about 15% dactylus length, with acutely pointed tip. Palm about 2/3 as long as dactylus, about 2 times longer than high; lateral surface moderately convex longitudinally, bearing 3 or 4 rows of minute, conical tubercles medially; 2 dorsolateral grooves present, shallow, parallel to dorsal margin, with small setal pits; dorsal margin gently convex, rimmed, with minute setal pits; ventral margin gently concave; mesial surface slightly convex longitudinally, bearing 12–15 oblique ridges on ventral half, strong, arched ridge along dorsal margin on dorso-distal part, and short transverse ridges on dorsal half. Carpus short, about 1/3 palm length, triangular, tapering distally, with granulated dorsal margin.

Abdominal somites 5–6 and telson poorly preserved. Exopod of uropod subtriangular with marginal ridge; posterior margin slightly sinuous.

Remarks. *Upogebia hibiki* **sp. nov.** is closest to *Upogebia mizunamiensis*, from the lower Miocene Mizunami Group in having oblique ridges on the mesial surface of the palm of pereiopod 1. However, the new species differs from *U. mizunamiensis* in having a strong, arched ridge on the dorso-distal part of the mesial surface of the palm and in having the carapace with a narrow gastric region and a triangular rostrum. The new species also resembles *Upogebia striata*, from the middle Miocene Katsuta Group, but differs in having a

strong, arched ridge on the dorso-distal part of the mesial surface of the palm. Adittionally, *Upogebia striata* has a slender, elongate palm.

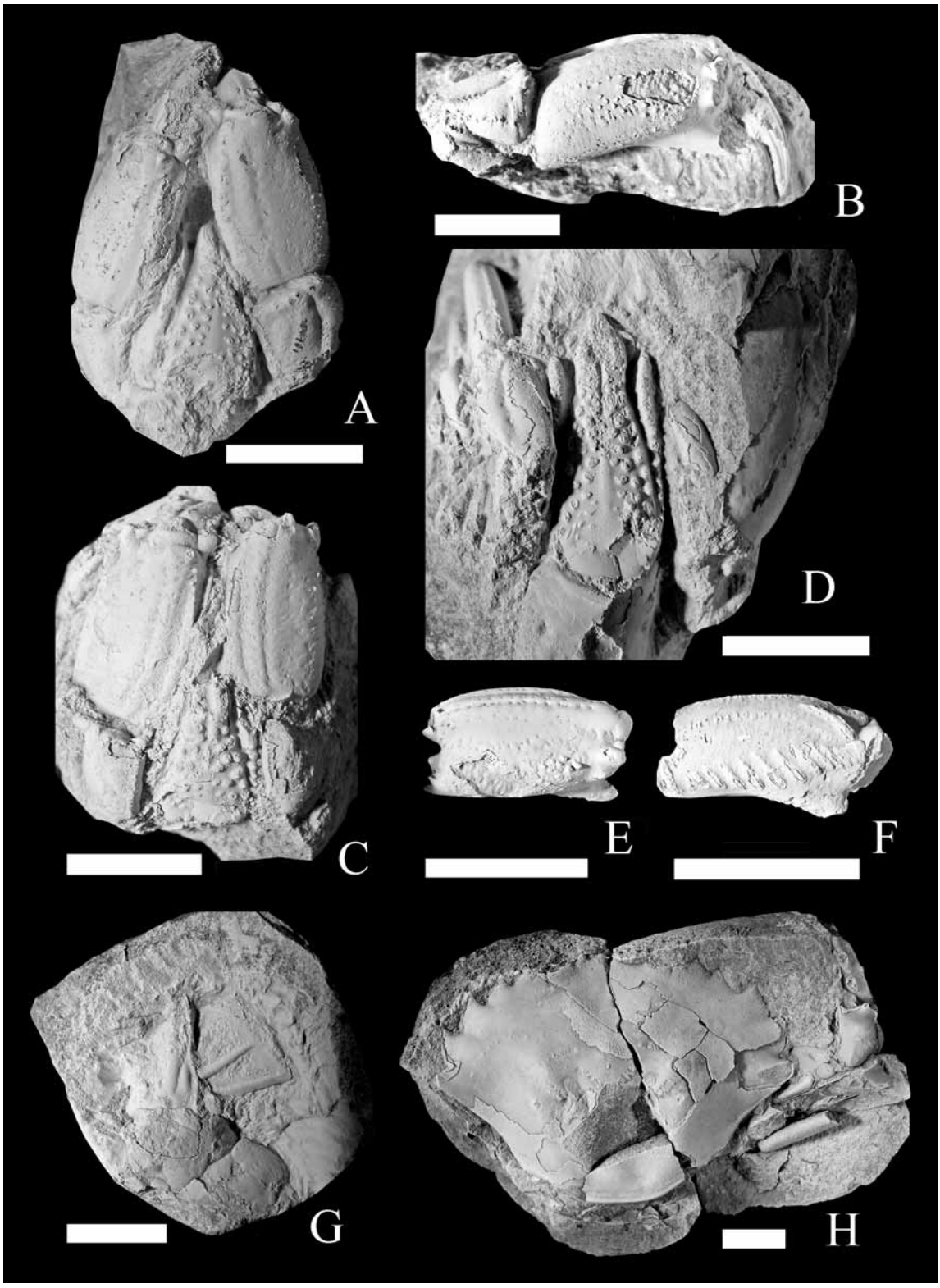

FIGURE 3. **A–G**, *Upogebia hibiki* **sp. nov. A,** MFM218520 (paratype), carapace and pereiopods 1, dorsal view. **B,** MFM218520 (paratype), right pereiopod 1, lateral view. **C**, MFM218521 (paratype), carapace and pereiopods 1, dorsal view. **D**, MFM218522 (holotype), carapace and pereiopods 1, dorsal view. **E**, MFM218523 (paratype), right pereiopod 1, lateral view. **F**, MFM218523 (paratype), right pereiopod 1, lateral view. **G**, MFM218524 (paratype), abdomen, telson, and uropod, dorsal view. **H**, *Minohellenus macrocheilus* Kato & Karasawa 1994, collected from the same locality. All scale bars represent 10 mm.

This new species is the first record of the genus in Oligocene deposits of Japan.

Material examined. MFM218520 (paratype), MFM218521 (paratype), MFM218522 (holotype), MFM218523 (paratype), MFM218524 (paratype) and additional referred 20 specimens.

Description of Burrows

(Fig. 4)

Burrows are straight, gently inclined, and branched to form Y-shaped outline. The cross section is semicircular and about 3 cm in diameter. Burrows have neither mud wall nor bioglyph. These characters suggest that these burrows can be assigned to the ichnogenus *Psilonichnus* Fürsich, 1981.

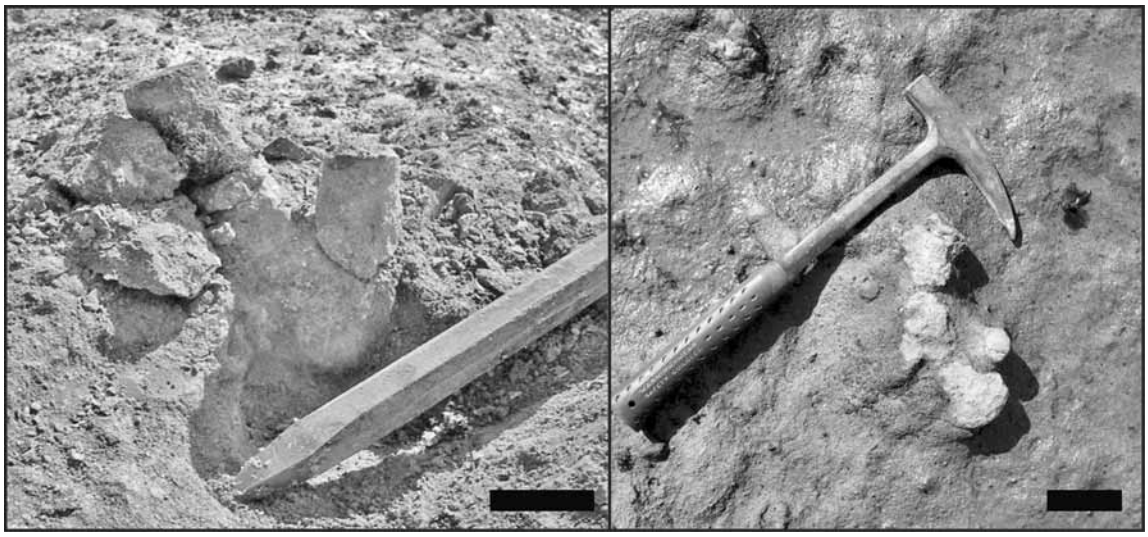

FIGURE 4. *Psilonichnus*, upper part of the Honjo Formation, Wakamatsu-ku, Kitakyushu City, Fukuoka Prefecture, Japan. All scale bars represent 5 cm.

Discussion

Fossil members of *Upogebia* associated with burrows are rare in Japan (Karasawa & Inoue 1992; Kato & Koizumi 1992; Kato 1996), and detailed data on burrow morphology are scanty. *Upogebia hibiki* **sp. nov.** and *Psilonichnus* are abundant in the studied sediments and other fossils are extremely rare. Additionally, fragments of pereiopods and abdomen are rarely preserved within burrows of *Psilonichnus* type. Nesbitt & Campbell (2006) summarized that *Psilonichnus* have been attributed to thalassinoid shrimp and ocypodid crabs. Therefore, *Psilonichnus* described herein is thought to have been formed by *Upogebia hibiki* **sp. nov.**

Acknowledgements

We thank A. Ujihara and T. Ichihara (Nagoya University) for helping us to collect fossils, Y. Iryu, S. Hayashi, I. Suto (Nagoya University), M. Kawase (Aichi Mizuho University), and U. Nishioka (Kyoto University) for providing valuable comments. We would also like to thank R.M. Feldmann (Kent State University) and John W.M. Jagt (Natuurhistorisch Museum Maastricht) for critical comments to the manuscript.

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