

# First Record of *Gammarus koreanus* (Crustacea, Amphipoda, Gammaroidea) from Japan, Based on Morphology and 28S rRNA Gene Sequences

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*Gammarus koreanus* Uéno, 1940, which was originally described from the Korean Peninsula, is recorded from freshwaters of the Gotô Islands, Japan. This is the first record of its occurrence in Japan. Molecular analyses using partial sequences of the 28S rRNA gene strongly support the identity of Japanese populations with *G. koreanus*. The Japanese specimens differ from the original description of this species in the following features: antenna 2 lacking calceoli, inner margins of inner and outer rami of uropod 3 with plumose setae, and outer margin of outer ramus of uropod 3 without plumose setae. These differences are regarded as intraspecific variation.

**Key Words:** *Gammarus koreanus*, Amphipoda, first record, 28S rRNA, Japan, taxonomy, Gotô Islands, interspecific variation.

## Introduction

The genus *Gammarus* Fabricius, 1775 is widely distributed in fresh, estuarine, and marine waters in the northern hemisphere, and more than 200 species have been described to date (Väinölä *et al.* 2007; Hou *et al.* 2009). Two species, *G. nipponensis* Uéno, 1940 and *G. sobaegensis* Uéno, 1966, have been reported from Japan. *Gammarus nipponensis* is endemic to Japan, and occurs in mountain streams or spring brooklets of Honshu, Shikoku, and Kyushu (including Tsushima and Iki islands) (Uéno 1940, 1941; Tomikawa, unpublished data). The other species, *G. sobaegensis*, recorded in Japan only from Akiyoshido Cave, Yamaguchi Prefecture (Karaman 1986), was originally described from the Korean Peninsula.

*Gammarus koreanus* Uéno, 1940 was first described as *G. (Rivulogammarus) pulex koreanus* by Uéno (1940) based on specimens collected from Kainei (Hoeryong) and Zenkyori (present-day name unknown) in the northeastern part of the Korean Peninsula. It was elevated to full specific rank by Karaman (1984, 1991). Hou *et al.* (2007) investigated phylogenetic relationships among species of *Gammarus* using molecular data and indicated that *G. koreanus* collected from China is closely related to *G. electrus* Hou and Li, 2003, *G. nekkensis* Uchida, 1935, *G. nipponensis*, and two undescribed species designated as *Gammarus* sp. 3 ZH-2007 and *Gammarus* sp. 4 ZH-2007.

During a field survey of freshwater amphipods in the Gotô Islands, Nagasaki Prefecture, Japan, made in 2010, *G. koreanus* was collected from two islands, Fukue Island and

Nakadôri Island. In this study, we report the occurrence of this species in Japan based on these newly collected specimens. In addition, molecular phylogenetic analyses were used to clarify phylogenetic relationships among populations of *G. koreanus*.

## Materials and Methods

**Samples.** Specimens of *Gammarus koreanus* were collected from six localities of two islands, Nakadôri Island and Fukue Island, in the Gotô Islands, Nagasaki Prefecture (Fig. 1). They were collected by scooping with a fine-mesh handnet, and preserved in 99% ethanol at the site. Two anisogammarids, *Jesogammarus (Annanogammarus) debilis* Hou and Li, 2005 and *J. (Jesogammarus) hebeiensis* Hou and Li, 2004 were used as outgroup taxa (Table 1).

**Morphological observation.** All appendages of the specimens were dissected under a stereomicroscope (Olympus SZX7) in 99% ethanol and mounted in gum-chloral medium on glass slides. These slides and remaining bodies of the amphipods were examined using a compound microscope (Olympus BH2) and illustrated with the aid of a camera lucida. The body length from the tip of the rostrum along the dorsal curvature to the base of the telson was measured to the nearest 0.1 mm. The nomenclature of setal patterns on the mandibular palp follows Stock (1974). The specimens are deposited in the National Museum of Nature and Science, Tokyo (NSMT).

**DNA extraction, PCR amplification, and DNA sequencing.** Total genomic DNA was extracted from the