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## Taxonomic relationship between two *Gammarus* species, *G. nipponensis* and *G. sobaegensis* (Amphipoda: Gammaridae), with description of a new species

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### Abstract

To assess the taxonomic relationship between *G. nipponensis* and *G. sobaegensis*, morphological features and molecular phylogenetic relationships using the nuclear 28S rRNA and the mitochondrial COI genes were examined. Detailed morphological observations revealed that *G. nipponensis* and *G. sobaegensis* were clearly distinguishable. In addition to the morphological differences, these two species were genetically diverged. In the course of this study, an undescribed species was found from Tsushima and Iki Islands and described here as *G. mukudai*. In the molecular phylogenetic analyses, monophyletic relationships of *G. nipponensis*, *G. sobaegensis*, and *G. mukudai* were shown but relationships among three species were unclear due to low statistical supports. Phylogeography of *G. nipponensis*, *G. sobaegensis*, and *G. mukudai* were discussed.

**Key words:** *Gammarus*, Amphipoda, new species, Taxonomy, phylogeny, Japan, Korea

### Introduction

The genus *Gammarus* Fabricius, 1775 has been recorded from fresh, estuarine, and marine waters of the northern hemisphere, and is currently composed of more than 200 species (Karaman & Pinkster 1977a, b, 1987; Väinölä *et al.* 2007; Hou *et al.* 2007; Tomikawa *et al.* 2012). The diversity of *Gammarus* is high in freshwaters of the Korean Peninsula, Japan, and adjacent islands, 11 species have been recorded up to date (Lee & Kim 1980; Lee 1986; Lee & Seo 1990, 1992; Tomikawa *et al.* 2012). This species richness in this area is possibly arisen from complicated geological history in the Tertiary or Quaternary period, with repeat of reduction and expansion of the land by the marine transgression and the regression, respectively.

*Gammarus nipponensis* was firstly described as *G. (Rivulogammarus) nipponensis* by Uéno (1940) based on the specimens from Kiyotaki, Kyoto Prefecture, Japan. Subsequently, Uéno (1966) described *G. (Rivulogammarus) pulex sobaegensis* based on the specimens from caves in the Korean Peninsula. Later, the latter species was elevated to full specific rank by Lee & Kim (1980). Though *G. nipponensis* and *G. sobaegensis* are morphologically similar to each other, neither Uéno (1966) and Lee & Kim (1980) compared these two species. Karaman (1984, 1986) suggested that *G. nipponensis* differs from *G. sobaegensis* by the absence of long setae on the anterior margins of pereopods 5–7 and by the presence of plumose setae on the outer margin of the outer ramus of uropod 3 based on the original descriptions of these two species. However, Karaman (1986) recorded *G. nipponensis* from Omiya River, Shiga Prefecture, Japan, without plumose setae on the outer margin of the outer ramus of uropod 3. In addition, length of setae on the anterior margins of pereopods 5–7 of *G. nipponensis* are variable (Tomikawa & Morino 2012). Therefore, the taxonomic validity of *G. sobaegensis* remains dubious, but no study has been conducted to reassess the taxonomic relationship between *G. nipponensis* and *G. sobaegensis*.

Kitamura & Kimoto (2004) suggested the presence of the land bridge between southern Kyushu and the Eurasian Continent before 1720000 years ago. When considering the species migration around the Eurasian Continent, the Korean Peninsula, and the Japanese Archipelago, this land bridge could have important roles. Two subterranean amphipods, *Pseudocrangonyx asiaticus* Uéno, 1934 and *P. coreanus* Uéno, 1966, are distributed in both the Korean Peninsula and Tsushima Island acrossing the Korea Strait. The latter species occurs also in Gotô Islands and Honshu (Shimane Prefecture). Many species inhabiting Japan are considered to have migrated from the Eurasian Continent (Motokawa 2009). *Pseudocrangonyx asiaticus* and *P. coreanus* might migrate from the Eurasian Continent to Japan through the southern land bridge before 1720000 years ago suggested by Kitamura & Kimoto (2004).

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