

Geothelphusa amagui, a New Species of the True Freshwater Crab (Decapoda: Brachyura: Potamidae) from Kerama Group and Kume Island, Central Ryukyu Islands, Japan

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Abstract A new species of the true freshwater crab genus *Geothelphusa* Stimpson, 1858 is described from four islands of Kerama Group and Kume Island, Ryukyu Islands, Japan. The new species is morphologically most similar to *G. aramotoi* Minei, 1973 and in fact, it has been heretofore referred to the latter species. However, the structure of the male first gonopod clearly distinguishes it from the latter. Variations in relative length of the ambulatory legs between insular populations of both species are documented.

Key words: Crustacea, Decapoda, Brachyura, Potamidae, *Geothelphusa*, new species, Kerama Group, Kume Island, Ryukyu Islands, Japan

Among the 19 true freshwater crab species known from the Ryukyu Islands (Kasai and Naruse, 2003; Naruse *et al.*, 2004, 2006, 2007), *Geothelphusa aramotoi* Minei, 1973, is distinctive in the short and stout ambulatory legs, and low, wide and rugose carapace. Although *G. aramotoi* has been recorded from a total of seven islands, *viz.*, Okinawa (type locality), Iheya, Kume islands, and four islands of the Kerama Group (Tokashiki, Zamami, Aka and Geruma islands) (Fig. 1) (Minei, 1973, 1981; Kasai and Naruse, 2003; Naruse, 2005), no morphological comparison between the insular populations has been conducted. Our preliminary examination revealed that the populations from Kume Island and the Kerama Group differed from the Okinawa and Iheya populations in the structure of the male first gonopod. Minor variations in relative length of the ambulatory legs were also found within each species. The aim of the pre-

sent study is to describe a new species for the population in Kume Island and Kerama Group, and to document morphological variation.

Specimens examined are deposited in the Kumejima Natural and Cultural Center, Kumejima, Okinawa (KNCC); the National Museum of Nature and Science, Tokyo (NSMT); Ryukyu University Museum, Fujukan, Okinawa (RUMF); National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM); Zoological Laboratory, Kyushu University, Fukuoka, Japan (ZLKU) (ZLKU specimens have been transferred to the Kitakyushu Museum of Natural History and Human History, Fukuoka, Japan); and the Zoological Reference Collection of the Raffles Museum of Biodiversity Research, National University of Singapore (ZRC). The terminology and measurements follow Ng (1988), Dai (1999), and Shy and Yu (1999). Measurements provided are of the carapace length and carapace

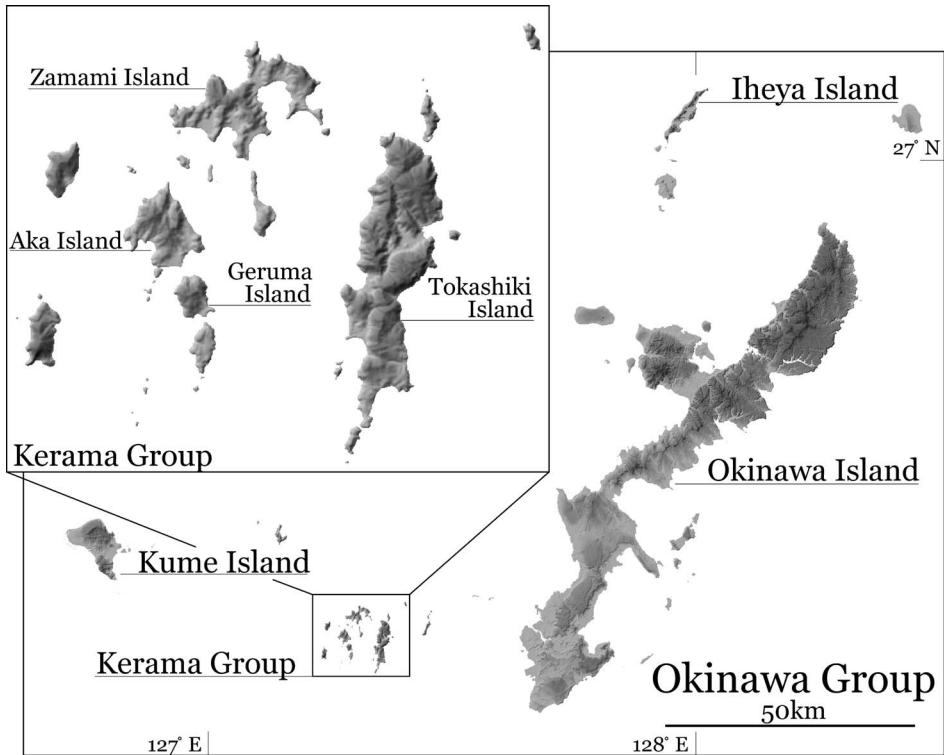


Fig. 1. Location of the Kerama Group and Kume Island within the Okinawa Islands. Inset: close-up of Kerama Group.

width, respectively.

For comparative purposes, the following specimens were examined.

Geothelphusa aramotoi Minei, 1973. Holotype: ZLKU m. 1106, male (23.7×30.2 mm), Taminato, Ohgimi, Okinawa Island, coll. Y. Aramoto, 29 January 1972.

Paratypes: ZLKU m. 1095, 2 males (16.7×21.6, 18.2×24.1 mm), 2 females (14.4×18.1, 22.4×28.6 mm), Genga River, Okinawa Island, coll. Y. Nakasone and H. Minei, 29 June 1972; ZLKU m. 1096, 26 males (12.7×16.5 to 24.8×32.0 mm), 11 females (14.2×18.5–25.7×33.1 mm), Taminato, Ohgimi, Okinawa Island, coll. Y. Nakasone and H. Minei, 2 July 1972. Other specimens: RUMF-ZC-857, 1 male (17.9×22.8 mm), 1 female (20.1×25.7 mm), south of Mt. Ishikawa, Okinawa Island, coll. T. Naruse, 27 June 2001; RUMF-ZC-858, 1 male (14.2×18.1 mm), 2 females (14.1×18.9, 17.8×

22.9 mm), Oura River, Okinawa Island, coll. members of Shokita Laboratory, 27 November 2001; RUMF-ZC-859, 1 female (11.5×14.7 mm), 1 juvenile (5.6×7.2 mm), Tima River, Okinawa Island, coll. members of Shokita Laboratory, 27 November 2001; RUMF-ZC-860, 2 males (17.5×23.2, 21.3×27.2 mm), 3 females (13.3×17.6 to 19.4×25.1 mm), stream on the southeastern side of Mt. Gayou, Iheya Island, coll. T. Naruse, 30 April 2001; KNCC, 1 female (23.4×31.2 mm), Mt. Gayou, Iheya Island, coll. F. Sato, 3 June 2001; ZRC 2008.0019, 1 male (17.6×22.6 mm), 1 female (22.2×29.3 mm), western side of Mt. Gayou, Iheya Island, coll. T. Naruse, 30 April 2001.

?*Geothelphusa aramotoi* or ?*Geothelphusa amagui* (see “Remarks”). Two females (22.8×29.5, 22.9×29.4 mm), USNM 20644, Loo Choo Island, definite locality not indicated, coll. Mr. F. Sakamoto, no date.

Taxonomy

Geothelphusa amagui sp. nov.

[New Japanese name: kerama-sawa-gani]

(Figs. 2, 3, 4a–c)

Geothelphusa aramotoi – Shokita, 1990: 4, table 2 (part); anonymous, 1991: 218 (part); anonymous, 1996: 369 (part); Yoshigou, 1999: 21, pl. I–H (part); Segawa, 2000: 243, table 1, figs. 1, 2 (part); Kasai and Naruse, 2003: 284, table 7 (part); Naruse, 2005: 224 (part).

Geothelphusa aff. *aramotoi* – Naruse *et al.*, 2007: 414.

Material examined. Holotype: RUMF-ZC-843, male (22.1×29.3 mm), substream of Tokashiki River, Tokashiki Island, Kerama Group, coll. T. Naruse and H.-T. Shih, 16 April 2002.

Paratypes: Kerama Group: RUMF-ZC-844, 1 female (22.6×29.3 mm), same data as holotype; KNCC, 3 males (12.9×16.8 to 17.4×22.4 mm), Tokashiki Island, coll. F. Sato, 20 May 2001; KNCC, 2 males (19.1×24.8, 19.8×25.5 mm), Tokashiki River, Tokashiki Island, coll. F. Sato, 23 May 2001; NSMT-Cr 19551, 2 females (23.4×30.6, 24.0×31.6 mm), headwater of Ohkawa River, Tokashiki Island, coll. members of Shokita Laboratory, 12 March 1997; RUMF-ZC-845, 4 males (16.6×21.5 to 20.4×25.6 mm), 1 female (21.0×27.2 mm), 1 juvenile (5.7×7.7 mm), upstream of Zamami Dam, Zamami Island, coll. T. Naruse, 3 October 2001; RUMF-ZC-846, 2 males (13.3×16.8, 14.2×18.6 mm), 2 females (12.6×16.1, 21.5×27.9 mm), Asa, Zamami Island, coll. T. Naruse, 3 October 2001; RUMF-ZC-847, 1 female (24.2×30.8 mm), Ama, Zamami Island, coll. T. Naruse, 3 October 2001; RUMF-ZC-848, 3 males (11.4×15.2 to 18.8×24.9 mm), 3 females (18.5×24.3 to 18.7×24.1 mm), Aka Island, coll. T. Naruse, 2 October 2001; RUMF-ZC-849, 2 females (12.9×16.5, 14.8×19.0 mm), south of Takehara, Aka Island, coll. H. Tamura, 4 November 2005; RUMF-ZC-850, 3 females (13.6×17.3 to 19.4×25.2 mm), west of Mt. Ufu-dake, Aka Island, coll. T. Naruse, 29 March 2000; RUMF-ZC-851, 1 female (17.6×22.6 mm), Aka Island, coll. T. Naruse; RUMF-ZC-852, 1 male (14.4×18.4

mm), upstream of Utaha Dam, Aka Island, coll. T. Naruse, 30 March 2000; KNCC, 2 males (15.3×19.4, 17.6×23.5 mm), Aka Island, coll. F. Sato, 29 October 1996; ZRC 2008.0017, 2 males (15.0×19.7, 16.5×21.4 mm), 3 females (10.8×14.0 to 20.7×27.4 mm), south of Kubo-dake, Aka Island, coll. T. Naruse, 4 November 2005; ZRC 2008.0018, 2 males (10.6×13.6, 16.2×20.6 mm), Aka Island, coll. Shokita Laboratory, 13 March 1997; RUMF-ZC-853, 1 female (20.0×26.6 mm), coll. stream on the northern slope of Geruma Island, coll. K. Kinjo, 31 March 2000; RUMF-ZC-854, 1 male (13.9×18.1 mm), 1 female (18.3×24.0 mm), stream on the northern slope of Geruma Island, coll. T. Naruse, 2 October 2001; RUMF-ZC-855, 1 male (13.1×17.2 mm), stream on the northern slope of Geruma Island, coll. K. Kinjo, 5 November 2005; Kume Island: RUMF-ZC-856, 2 males (11.9×15.7, 18.6×24.7 mm), 5 females (13.7×18.3 to 21.2×28.3 mm), 1 juvenile (8.8×11.4 mm), Suhara River, coll. T. Naruse and H. Kasai, 11 February 2002; KNCC, 2 males (17.8×23.0, 13.1×17.5 mm), 3 females (15.1×20.0 to 18.4×25.0 mm), Kume Island, coll. F. Sato, 21 October 1995; KNCC, 3 males (11.6×15.1 to 16.3×21.0 mm), 3 females (8.9×11.3 to 13.8×18.0 mm), vicinity of Self Defense Force base, coll. F. Sato, 7 November 1994; KNCC, 6 males (13.4×17.3 to 20.6×27.6 mm), 7 females (10.8×14.2 to 19.5×26.1 mm), 4 juveniles (4.0×4.9 to 7.5×9.7 mm), Shimajiri, coll. F. Sato, 5 November 1994; NSMT-Cr 19552, 4 males (12.6×16.7 to 18.1×23.9 mm), 4 females (12.6×16.5 to 21.5×28.6 mm), upstream of Shirase River, coll. T. Naruse and H. Kasai, 10 February 2002.

Description. Carapace (Fig. 2) oval, width 1.26–1.36 times length (mean=1.31, n=59); dorsal surface uneven, slightly convex longitudinally and transversely. Epigastric crista distinct, postorbital crista indistinct, postfrontal to lateral regions rugose; cervical groove indistinct, H-shaped gastric groove distinct. Frontal margin concave medially, cristate; orbital margins also cristate, infraorbital and outer third of supraorbital margins granulated. Suborbital and ptery-



Fig. 2. *Geothelphusa amagui* sp. nov. Holotype, male (22.1×29.3 mm; RUMF-ZC-843), entire animal in dorsal view, showing coloration in life.

gostomial regions uneven, but not granulated. External orbital angle obtuse; anterolateral margin convex laterally, distinctly cristate, granulated, epibranchial tooth absent.

Epistome concave laterally, with median triangular lobe.

Cornea of eye slightly narrower than base of eyestalk.

Third maxilliped (Fig. 3a) rectangular. Ischium with shallow median groove, midlength about two times of merus. Lateral margin of merus slightly projected medially. Exopod reaching lateral projection of merus, with long flagellum.

Thoracic sternites II–III and III–IV demarcated by shallow grooves, grooves lined with short setae; distinct sternal condyle present on distal third of thoracic sternite V; penis coxal.

Male chelipeds unequal, minor cheliped generally similar to major cheliped except for proportionally small chela. Major cheliped with merus rugose on outer and ventral surfaces; carpus with strong inner angle, with a few small teeth inferior to inner angle; palm (Fig. 3b) high, height greater

than length of immovable finger, outer surface uneven, with slight, reticulated embossed pattern; cutting edge of both fingers lined with regularly spaced large teeth, gape between fingers narrow. Minor chela only slightly higher than half height of major chela. Female chelipeds subequal, proportionally smaller than male minor cheliped.

Ambulatory legs (second to fifth pereopods) relatively short, combined length of merus to dactylus of third pereopod 1.43–1.61 times carapace length (mean=1.51, n=33) in Kerama population, 1.58–1.88 times (mean=1.69, n=15) in Kume population (Fig. 5); legs setose, long setae along four rows of spines on dactyli of all legs and ventral surfaces of propodi of second and third pereopods. Meri stout, without subdistal angle on anterior margins. Propodi depressed, rectangular in cross section, extensor dorsal and ventral margins slightly cristate, flexor dorsal and ventral margins and extensor ventral margin spinous. Dactyli slightly longer than respective propodi in second to fourth pereopods (Fig. 3c), shorter in fifth pereopod (Fig. 3d); terminal claw

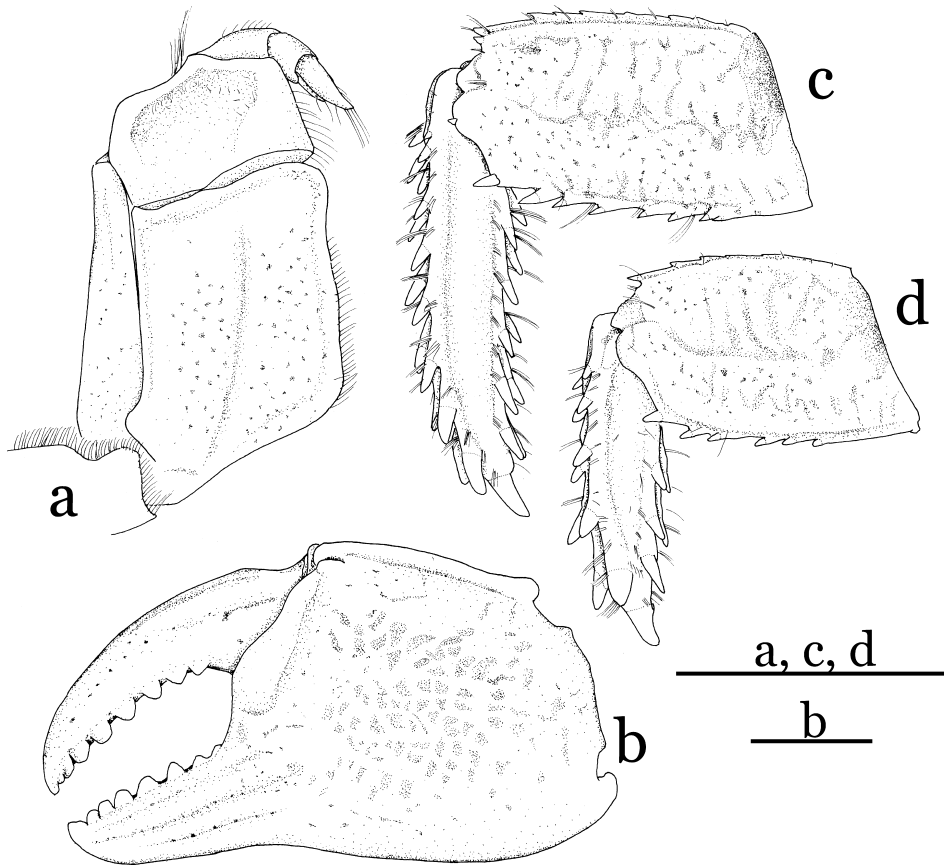


Fig. 3. *Geothelphusa amagui* sp. nov. Holotype, male (22.1×29.3 mm, RUMF-ZC-843). a, right third maxilliped; b, major chela (left); c, propodus and dactylus of left fourth pereopod; d, propodus and dactylus of left fifth pereopod. Scales: 5 mm.

of fifth pereopod stout, terminating bluntly; subterminal spine on extensor dorsal margin of fifth pereopod blunt, as strong as or stronger than terminal claw, subterminal spine placed inner to outer dorsal margin (Fig. 3d), subterminal spine of extensor dorsal margin of fourth pereopod only slightly smaller than terminal tooth (Fig. 3c).

Male abdomen 6-segmented, lateral margins of male third to sixth segments straight, sixth segment longer than fifth segment; telson triangular, longer than sixth segment, reaching level of distal fifth of coxae of chelipeds. Female abdomen without distinctive feature.

G1 (Fig. 4a, b) slender, subterminal segment straight, outer proximal angle with very low

knob; terminal segment curved inwards.

Habitat. Found under stones in water of narrow (e.g. 0.5–2 m), shallow (e.g. 5–20 cm) streams.

Distribution. Kerama Group (Tokashiki, Zamami, Aka and Geruma islands) and Kume Island, Ryukyu Islands, Japan

Remarks. *Geothelphusa amagui* sp. nov., is closest to *G. aramotoi*. With regard to males, the new species can be easily distinguished from *G. aramotoi* by its incurved distal segment of the G1 (Fig. 4a, b). In contrast, the distal segment of the G1 of *G. aramotoi* is slightly curved outwards (Fig. 4d). Females of the two species are very similar, and we did not identify any diagnostically reliable characters for discriminating female

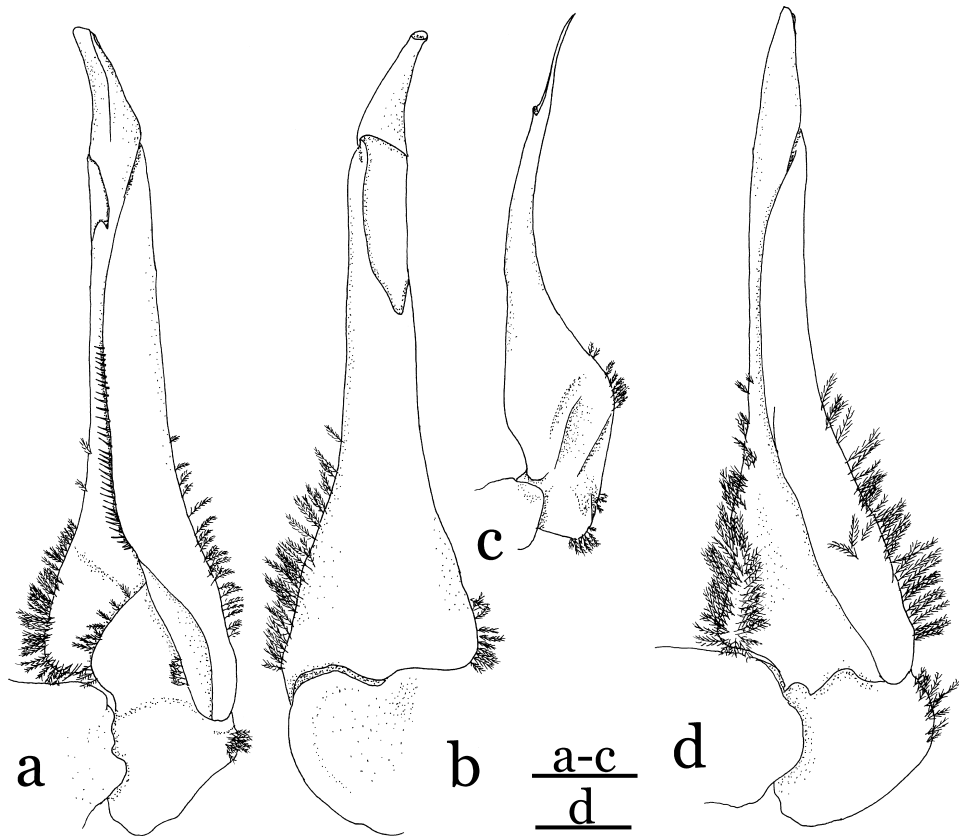


Fig. 4. Male gonopods. a–c, *Geothelphusa amagui* sp. nov., holotype, male (22.1×29.3 mm; RUMF-ZC-843); d, *G. aramotoi* Minei, 1973, holotype, male (23.7×30.2 mm), ZLKU m. 1106. a, d, left first gonopod, ventral view; b, left first gonopod, dorsal view; c, left second gonopod, ventral view. Scales: 1 mm.

specimens.

Insular populations of *G. amagui* show slight morphological variation in relative lengths of the ambulatory legs (Fig. 5). The Kume Island population has longer ambulatory legs [combined length of merus to dactylus of third pereopod leg 1.58–1.88 times carapace length (mean=1.69, n=15)] than that of the Kerama Group population (alluding to the proximity of the four islands to one another) [1.43–1.61 times carapace length (mean=1.51, n=33)]. Similar variation is also seen in *G. aramotoi*. The Iheya Island population has longer ambulatory legs [combined length of merus to dactylus of third pereopod 1.60–1.70 times carapace length (mean=1.64, n=4)] than that of the Okinawa Island population [1.46–1.60 times carapace length (mean=1.56, n=16)].

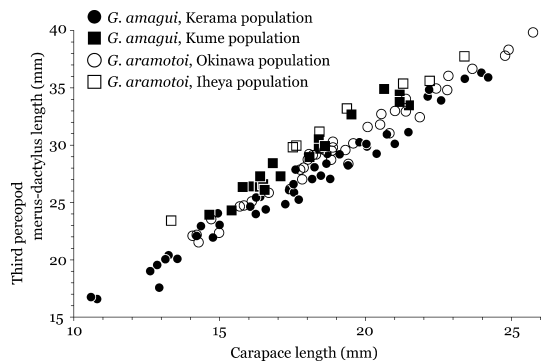


Fig. 5. Allometric growth of the merus to dactylus of the third pereopod of *Geothelphusa amagui* sp. nov. and *G. aramotoi* Minei, 1973.

These differences, however, can easily be attributed to geographic variation. Similar minor variations in the leg lengths have been known from

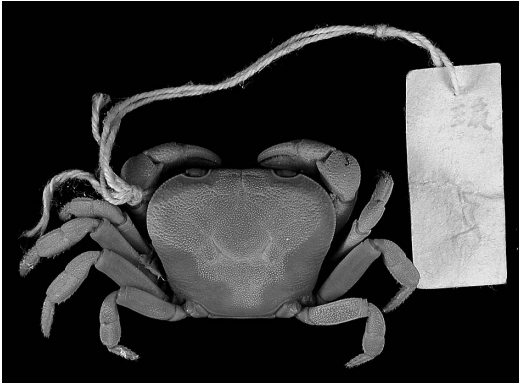


Fig. 6. *Geothelphusa aramotoi* or *G. amagui*, female (22.9×29.4 mm; USNM 20644), Ryukyu Islands, recorded by Rathbun (1905) as *G. obtusipes* Stimpson, 1858.

potamid crabs [e.g. *Geothelphusa tenumanus* (Miyake and Minei, 1965), see Naruse *et al.*, 2005b] as well as from sesarmid crabs [e.g. *Karstarma boholano* (Ng, 2002), see Naruse *et al.*, 2005a]. Several authors have recorded *G. aramotoi* from the Kerama Group and Kume Island (see synonymy). Our examination of a good series of male specimens from the central Ryukyus, including those examined by Minei (1973), Segawa (2000), Kasai and Naruse (2003), Naruse (2005) and Naruse *et al.* (2007), revealed that *G. amagui* exclusively occurs in the Kerama Group and Kume Island, while *G. aramotoi* is found only on Okinawa and Iheya islands.

Rathbun (1905) identified three female specimens sent by a Japanese collector, Mr. F. Sakamoto, from Loo-Choo Islands (=Ryukyu Islands) as *Geothelphusa obtusipes* Stimpson, 1858. Minei (1973) and Sakai (1976), however, suspected Rathbun's (1905) specimens to be *G. aramotoi* instead. Our examination of Rathbun's specimens confirmed that they are not *G. obtusipes*, and that they are either *G. aramotoi* or *G. amagui* (Fig. 6). Unfortunately, since the examination of the male first gonopod is necessary to distinguish *G. aramotoi* from *G. amagui*, we are unable to ascertain based on morphology which of the two species Rathbun's (1905) specimens represent.

Etymology. The species is named after the Okinawan dialect word, “amagui”, meaning “praying for rain”. It is surprising that *G. amagui* has survived in the small islands that appear to have experienced frequent water shortages (especially in summer at Kerama Group). Furthermore, one of the inhabited islands (Geruma Island) only has a land area of 1.15 km²! The specific epithet is used as a noun in apposition.

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