

REFERENCES

- Balss, H., 1913. *Zool. Anz.*, **42**: 234.
——— 1914. *Abh. Bayer. Ak. Wiss.*, suppl., **2(10)**: 1.
Borradaile, L. A., 1917. *Trans. Linn. Soc. Lond. Zool.*, (2), **17**: 397.
Bruce, A. J., 1970. *Crustaceana*, **19**: 273.
Edmondson, C. H., 1923. *Bull. Bishop Mus., Honolulu*, **5**: 1.
Holthuis, L. B., 1952. *Siboga Exped. Monogr.*, **39(a10)**: 1.
——— 1955. *Zool. Verh.*, **26**: 1.

A New Fresh-water Prawn of the Genus *Macrobrachium*
(Crustacea, Decapoda, Caridea) from
Iriomote Island of the Ryukyus

With 4 Text-figures

Takahiro FUJINO

Zoological Laboratory, Faculty of Agriculture, Kyushu University, Fukuoka 812, Japan

and

Keiji BABA

Biological Laboratory, Faculty of Education, Kumamoto University, Kumamoto 860, Japan

ABSTRACT A new species of the fresh-water prawn was found at Iriomote Island of the Ryukyus, and is here described as *Macrobrachium shokitai* sp. nov. The new species is closely related to *Macrobrachium formosense* Bate, from which it differs in having a smaller number of lower rostral teeth, the orbital angle produced as a round convexity, and many tubercles on the surface of the second pereopod chela, etc. This species is confined to fresh-water of the upper reaches of two rivers, and is characterized by bearing large and few eggs.

The genus *Macrobrachium* Bate of the Palaemonidae includes many varied species inhabiting chiefly brackish and fresh waters. From the Okinawa and the Yaeyama Groups of the Ryukyus, seven species of this genus have so far been recorded by Parisi (1919), Ohshima (1935) and Kubo (1940, 1941): *Macrobrachium equidens* (Dana), *M. formosense* Bate, *M. grandimanus* (Randall), *M. japonicum* (de Haan), *M. lar* (Fabricius), *M. latimanus* (von Martens), and *M. gracilirostre* (Miers). Mr. S. Shokita has recently carried out ecological investigations of fresh-water shrimps and prawns in the Yaeyama Group, and has secured a number of specimens of an undescribed species of this genus, which were examined and are described here as *M. shokitai* sp. nov.

As will be seen in the next report by Shokita (1973), this species occurs in the upper parts of both the Urauchi and the Mera Rivers in Iriomote Island, the largest of the Yaeyama Group, and is very remarkable for carrying large and few ova and for having a completely suppressed larval development. This paper provides only the morphological description of the new prawn, and the reader is referred to the

following paper by Shokita for the larval development, ecology and distribution.

The holotype and allotype specimens will be kept in the collection of the Rijksmuseum van Natuurlijke Historie, Leiden, and the others are in the Zoological Laboratory, Faculty of Agriculture, Kyushu University.

Macrobrachium shokitai sp. nov.

(Figs. 1-4)

Material examined. River head, Urauchi River, Iriomote I., Ryukyu Is., May 29, 1971, S. Shokita leg.—98 ♂♂, 10 ovig. ♀♀, 96 ♀♀ (holotype, male, R. M. N. H. reg. no. Crust. D. 28432; allotype, ovigerous female, R. M. N. H. reg. no. Crust. D. 28433); Jun. 15, 1970, S. Shokita leg.—180 ♂♂, 8 ovig. ♀♀, 237 ♀♀.

Description of holotype. A palaemonid shrimp of robust form with equal, large and elongate chelae.

The rostrum is lanceolate in profile, being highest just before the middle, with the tip acutely pointed and feebly upcurved. It is almost horizontal, reaching the middle of the third antennular segment. On the slightly convex upper border there are ten subequal teeth, of which the proximal two are situated on the carapace behind the orbit. The foremost tooth is small and placed close to the apex; the interval between the second and the third teeth is the shortest. The hindmost (first) tooth is more widely separated from the second than the second is from the third. The interspaces between the other teeth are subequal. The lower border bears only two teeth on the anterior third. The lateral carina is distinct.

The carapace is entirely glabrous. The anterolateral angle is broadly convex. The hepatic spine is much smaller than the antennal spine and is placed on a somewhat lower level.

The pleura of all the abdominal somites are smooth, and those of the first three somites are broadly rounded. The fifth somite has the pleuron almost rectangular at the posterior angle. The pleuron of the sixth somite is very small and terminates in an acute point.

The telson is elongate, much longer than the sixth abdominal somite. The lateral margins are slightly convex near the middle. The dorsal surface bears two pairs of minute spines on the posterior half; the anterior pair somewhat behind the middle, and the posterior pair closer to the anterior pair than to the posterior end of the telson. The posterior margin ends in a median process which is flanked by two pairs of small spines; the inner pair is much stouter and longer than the outer. More than ten long, feathered setae are present between the inner spines.

The eyes are typical. The peduncle is short, with the cornea globular and reniform. The ocellus is rather large.

The basal segment of the antennular peduncle is broad. The lateral margin is slightly convex, its anterolateral angle being broadly expanded forwards, it is rounded without a terminal tooth. A slender stylocerite is present. The distal

two segments are subequal in length, though the second is much broader than the third. The two branches of the outer antennular flagellum are fused basally for five joints, the first of which is the longest.

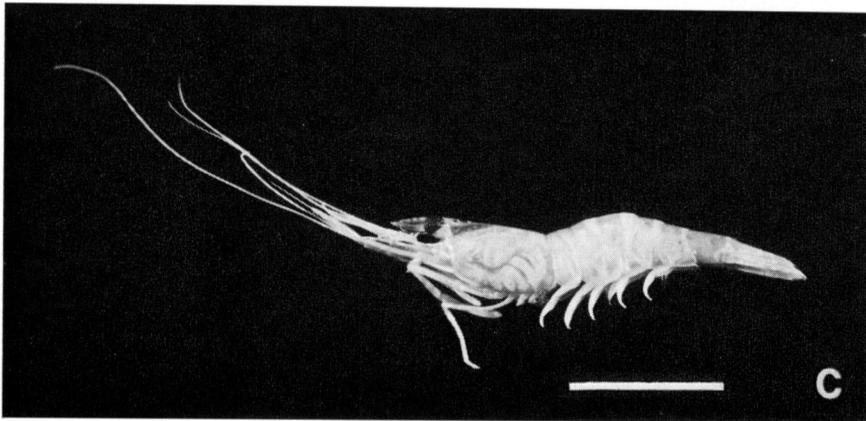
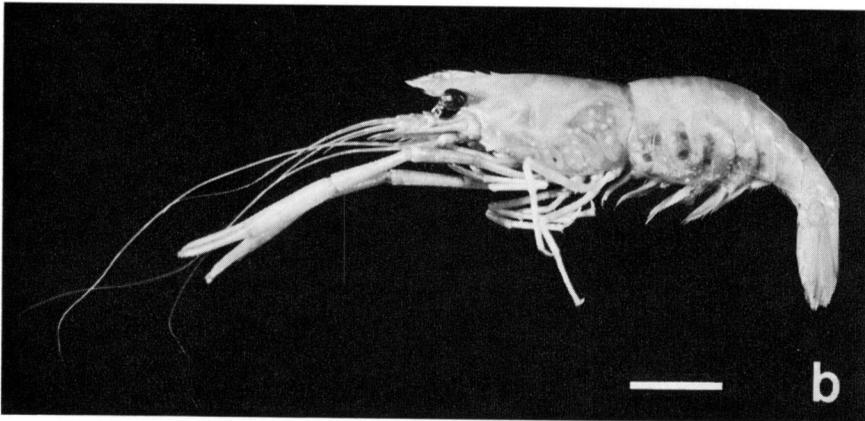
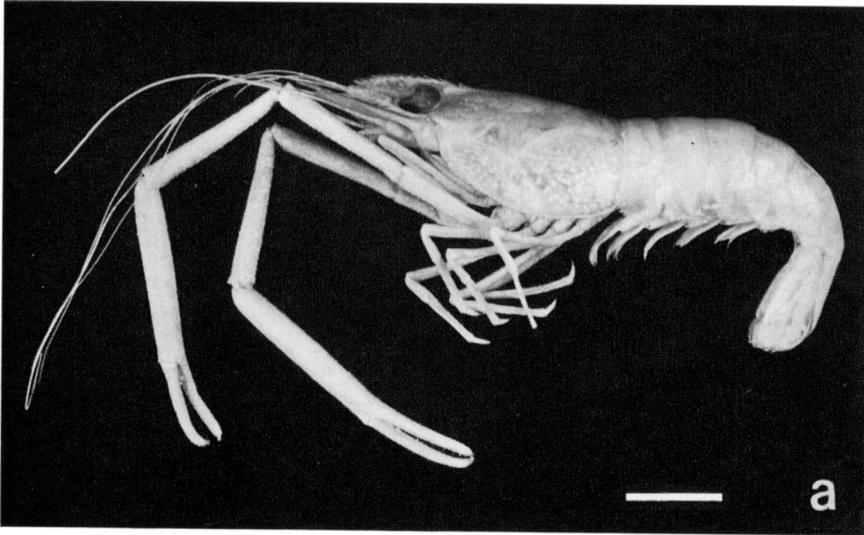
The antennal scale is broad, about two and a half times as long as the maximum breadth. The lateral margin is feebly convex, tipping with a strong final tooth. The anterior margin of the lamella is broadly expanded and more or less produced anterointernally, far overreaching the lateral tooth. The basicerite of the antennal peduncle is armed with a strong external tooth. The carpopocrite is broad and short.

The mouthparts are normal. The palp of the maxillula is distinctly divided into two lobes; the outer lobe is narrower and setose, and the inner hook-shaped distally. The endite of the maxilla is well developed and deeply cleft. A thumb-like palp is present. The scaphognathite is rather elongate. The first maxilliped has the endite separated into coxa and basis by a distinct notch. The exopod is well developed with a rather broad caridean lobe. The epipod is broad and distinctly bilobed. The third maxilliped is slender and pediform. It nearly reaches the end of the second antennular peduncle. The ultimate segment is two-thirds the length of the penultimate with a curved claw terminally. The basal segment is two-thirds the length of the penultimate segment. The moderately developed exopod fails to reach the distal end of the basal segment.

The first pereiopods are slender, reaching beyond the final tooth of the antennal scale by the length of the chela. The fingers are as long as the palm. The movable finger is curved distally to a pointed end. The cutting edges of the fingers are entire, without any tooth. Several tufts of setae are distributed over the surface of the fingers. At the lower surface of the palm there is a group of stiff setae. The carpus is slender and subcylindrical, and distinctly longer than the chela, with a bunch of long stiff setae distoventrally. The merus is equal in length to the carpus.

The second pereiopods are equal, large and elongate. They reach with the chela and the carpus beyond the end of the antennal scale. The fingers are slightly shorter than the palm. The tips of the fingers are curved and crossed when the fingers are closed. The cutting edge of the movable finger bears two ill-defined triangular teeth proximally, the concavity between which receives a tooth of similar size on the cutting edge of the immovable finger. Distally to these teeth the edges are thin and smooth entirely. Along the outer side of the cutting edges of the fingers a row of minute tubercles lies in an irregular arrangement. Irregularly arranged small tubercles as well as large ones are visible along the inner side of the cutting edge. The palm of the chela is subcylindrical and slightly compressed; it is covered with small tubercles on both the dorsal and the ventral surfaces as well as on the fingers, on which they are most dense ventrally. Both single and

Fig. 1. *Macrobrachium shokitai* sp. nov.— a, paratype, male; b, paratype, ovigerous female; c, paratype, young.
All scales equal to 1.0 cm.



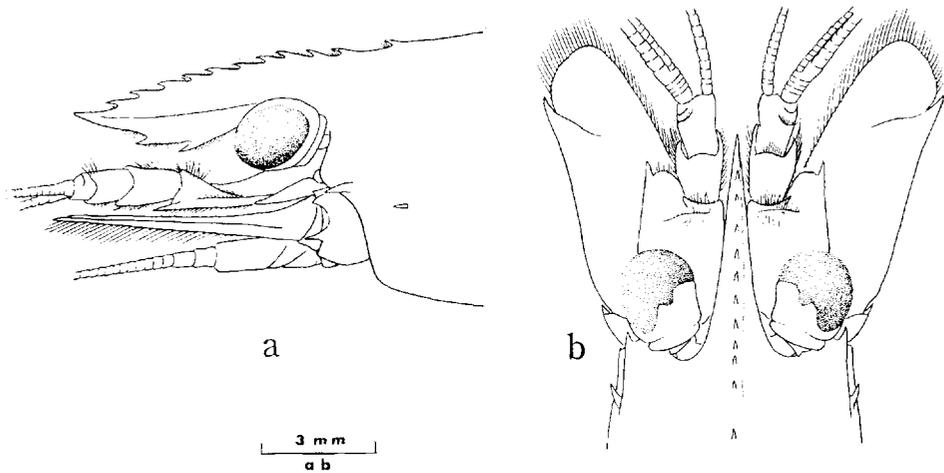


Fig. 2. *Macrobrachium shokitai* sp. nov., paratype, female.—a, anterior part of body in lateral view; b, anterior part of body in dorsal view.

tufts of setae are distributed on the chela, especially on the distal portion of the fingers. The carpus is slender and subcylindrical, and about as long as the palm: the arrangement of the tubercles is the same as in the chela: dorsally are present rather small tubercles, while on both the inner and the outer surfaces tubercles are larger and thicker. The merus is somewhat shorter than the carpus; in this segment tubercles become more or less fewer than in the carpus. In the ischium the distribution of the tubercles is rather restricted to the ventral surface and the number is much smaller.

The last three pereopods are similar in structure. The dactylus is stout and gently curved, with the tip pointed. Several tufts of coarse setae are present anteriorly. The propodus carries a row of both single and paired spines at the posterior border. The merus is longer than the propodus, with five spines and setae posteriorly. In the fifth pereopod the propodus is provided with some groups of long coarse spinose setae posterodistally.

The endopod of the first pleopod is elongate and ovate, with marginal setae, measuring half as long as the exopod. The second pleopod has a strong appendix masculina with stiff setae externally along the whole length; it is much longer than the slender appendix interna.

The uropods are typical.

Description of allotype. In general appearance the allotype closely resembles the holotype. The body is smaller and less slim than in the holotype, and the second pereopods are unequal, shorter and more slender than in the holotype. The morphological characteristics of the allotype are noted below in comparison with those of the holotype.

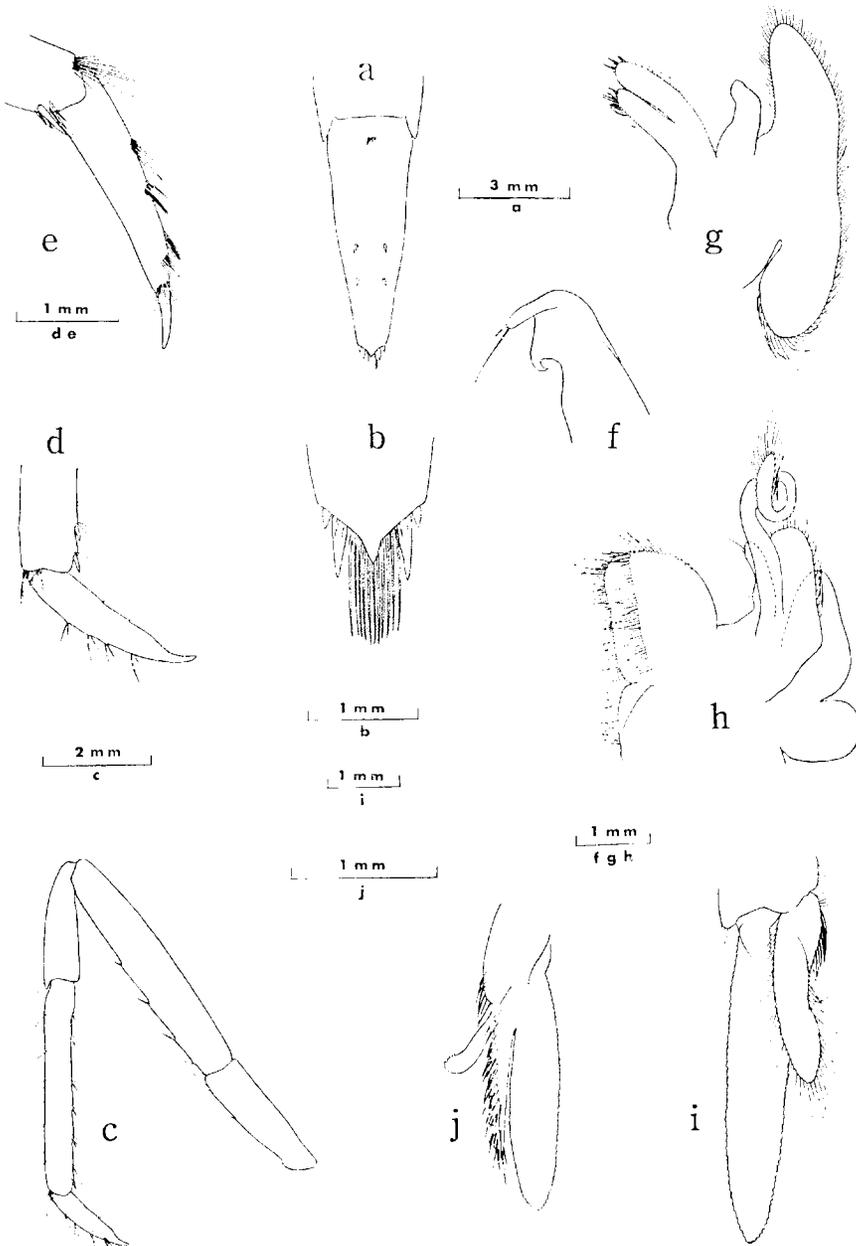


Fig. 3. *Macrobrachium shokitai* sp. nov., paratypes, a-d, e: ovigerous female; f-h: female; i, j: male.—a, telson; b, posterior end of telson; c, third pereopod; d, e, dactylus of third pereopod; f, palp of maxillula; g, maxilla; h, first maxilliped; i, first pleopod; j, endopod of second pleopod.

The rostrum exceeds the middle of the third antennular segment. The upper and the lower borders are provided with nine and three subequal teeth, respectively. The lateral carina is more strongly defined than in the holotype. The two pairs of dorsal spines of the telson are closer to each other. The inner pair of spines on the posterior margin of the telson is longer and more slender.

The basal segment of the antennular peduncle has a marked lateral final tooth which overreaches the anterior margin of the same segment.

The first pereopods are slender, reaching beyond the antennal scale by the length of the chela.

The second pereopods are much shorter and more slender than in the holotype. They are unequal in size, though the form is almost equal. The major pereopod reaches with the chela and half the length of the carpus beyond the antennal scale. The fingers are slightly shorter than the palm. The cutting edges are entirely smooth except for one and two triangular teeth in the proximal portion of the movable and the immovable finger respectively. Both dorsally and ventrally the chela is mainly provided with small tubercles. Tubercles are present along the cutting edges. On the lateral side they are much fewer and smaller. Short thin hairs are visible on the surface of the chela. The carpus is shorter than the palm; the surface is rather rugged, and arrangement of the tubercles is the same as in the chela. The merus is as long as the carpus; in this segment tubercles are vestigial and restricted to the dorsal and ventral borders. In the minor pereopod the end of the carpus approximately reaches the level of the end of the antennal scale. Tubercles are fewer and smaller than in the major pereopod.

The dactylus of the last three pereopods is slightly curved and pointed. The propodus is two and a half times the length of the dactylus. Anteriorly it bears several long tufts of setae.

The endopod of the first pleopod is comparatively short and ovate with marginal setae, reaching the proximal third of the exopod.

The ova are large, about 2.0×1.5 mm, and few, numbering about 50.

Variation. Morphologically, considerable variation are found in such characters as the form of the rostrum, the number of the rostral teeth, the length and breadth of the terminal spines on the telson, the size and form of the second pereopods, and the shape and proportional length of the dactylus. These variations are to some degree due to the differences in either sex or age, apart from variability among individuals. The rostrum of most specimens exceeds the third antennular segment, but in some cases it fails to reach as far as the end of this segment. In the young specimens the rostrum has the tendency of being somewhat elongate and downcurved. The number of teeth usually varies from ten to twelve on the upper and two or three (mostly two) on the lower border. The teeth on the upper border are rather equally spaced, except that the hindmost tooth is more remote than the others. The inner pair of the terminal spines on the telson in the adults is short and stout with the basal portion somewhat swollen. In the young these spines

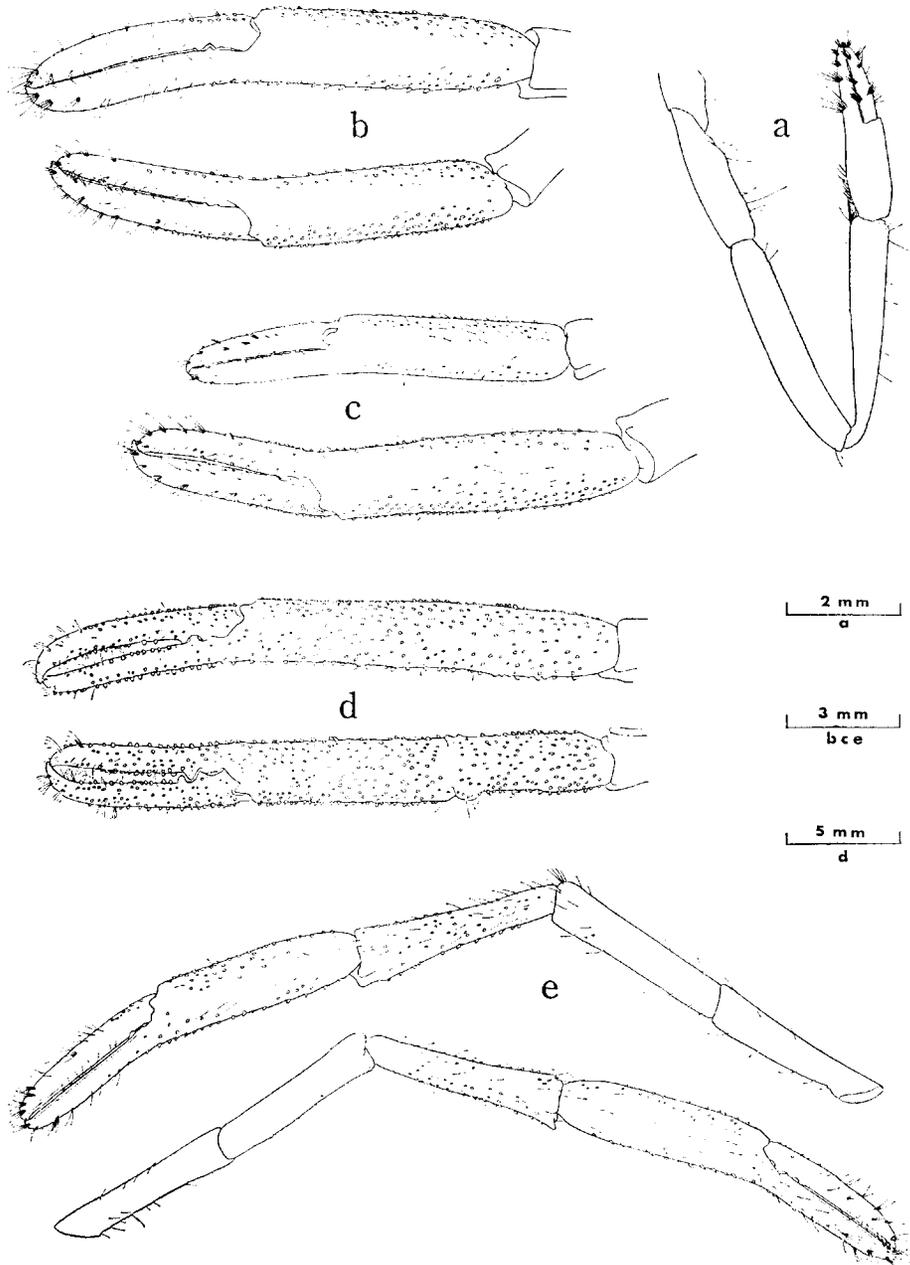


Fig. 4. *Macrobrachium shokitai* sp. nov., paratypes, a, e: female; b: ovigerous female; c, d: male.—a, first pereiopod; b-d, chelae of second pereiopods; e, second pereiopod.

are more slender and longer, measuring one-sixth or a little more the length of the telson.

The second pereiopods are considerably variable among individuals. They are mostly equal and symmetrical. In the young the pereiopods are short and slender, at most overreaching the antennal scale by the length of the chela. The fingers are equal to the palm in length, compressed, slender and have a smooth surface without any tubercle. The cutting edges are nearly entire or only with one or two ill-defined teeth. The carpus is sometimes elongate and somewhat longer than the palm. The merus is cylindrical and slightly shorter than the carpus. These segments are almost glabrous without tubercles. In young stages no noticeable differences are observed between both sexes. In pre-full-grown specimens the chela is much more elongate than in the juveniles. The fingers overreach the end of the antennal scale by the length of the whole chela and half the carpus together. The fingers are as long as the carpus or slightly shorter than the palm, the surface of the chela is somewhat rugged with small denticular teeth on both the dorsal and the ventral borders. The lateral surface is smooth except for short sparse hairs. The palm, carpus and merus are subequal in length. These segments are provided with obscure tubercles both dorsally and ventrally. In the full-grown males the pereiopods become much more elongate and larger, and their calcification is more advanced. All the segments are roundish, with marked tubercles all over the surface. On the dorsal and ventral surfaces of the chela tubercles are large and strong and concentrated, and they are smaller and less dense laterally. The fingers are shorter than the palm. The tips are more strongly curved. Along the cutting edges there are sometimes irregularly arranged, marked tubercles. The tubercles on the cutting edges are distinct, strong and triangular. The palm is slightly longer than the carpus. In the case of unequal second pereiopods, the tubercles and the teeth on the fingers of the minor pereiopod are less well developed. In the ovigerous females the pereiopods are much shorter and somewhat broader than in the males. The condition of the tubercles on the surface of the chela is similar to that of the pre-full-grown males. The fingers are equal to the palm in length. Anterior to the teeth on the cutting edges the fingers are almost entire. The tubercles are distinct on the palm. The carpus is as long as the palm.

In the last three pereiopods the young has the dactylus slender, with some tufts of thin setae at the anterior margin, while in the adults the dactylus is stout and short with thicker setae.

<i>Measurements</i> (in mm).	Holotype (♂)	Allotype (ovig. ♀)
Carapace length	16.5	14.0
Rostrum length	8.0	6.5
Telson length	8.5	7.0
Length of major second chela	9.5	15.0
Length of minor second chela	9.5	7.0

Colour in life. According to Shokita's information, most of the specimens are blackish brown in both sexes. The prawn living in shallow and rapid streams tends to be of brown colour. Albino prawns also occur at a very low percentage (1 or 2%), and according to Shokita's investigation, the same is likely to be true in a certain species of the fresh-water shrimp which belongs to a group carrying large eggs.

Ecology and distribution. See Shokita's account in the next article (Shokita, 1973).

Remarks. From Iriomote Island the following four species have hitherto been reported: *Macrobrachium formosense* Bate, *M. equidens* (Dana), *M. lar* (Fabricius) and *M. gracilirostre* (Miers). Kubo (1940, 1941) also recorded two other species, *M. philippinensis* Cowles and *M. riukiensis* Kubo from this island. Kubo's specimens of the former species are probably identified with the females of *M. formosense* Bate (Holthuis, 1950). In connection with the latter, it is presumable that this species was established on the juvenile specimen of such species as *M. formosense* Bate or *M. grandimanus* (Randall). In the Urauchi River, the type-locality of the present new species, the occurrence of the above-mentioned three species except for *M. gracilirostre* is now well ascertained (Shokita, pers. comm.).

Morphologically, the new species shows the closest resemblance to *M. formosense* which most commonly occurs throughout the Ryukyu Islands including the Yaeyama Group. The general appearance of both the species is very similar, but the differences between them are enumerated below.

1. The lower rostral teeth are mostly two in the new species instead of usually three in *M. formosense*.
2. The orbital angle of the new species is produced as a round convexity, while it is broad and rather truncated in *M. formosense*.
3. The antennal and hepatic spines are much less strong in the new species than in *M. formosense*. The carina following the antennal spine is more distinct in the latter.
4. In the new species the ocellus is ill-defined, whereas it is marked as a black spot in *M. formosense*.
5. The first pereopods are stouter and somewhat shorter in the new species than in *M. formosense*. Especially the chela of *M. formosense* is slender and subcylindrical, but it is somewhat compressed and broad in the new species.
6. The carpus of the second pereopods is proportionately longer and more slender in *M. formosense*. In the adults of *M. formosense* the surface of the chela is thickly covered with spinules. Ventrally are present two or three rows of larger spines. The fingers are rather smooth save for tufts of setae and spines that are sparsely distributed. In the new species the surface of the chela is provided with many tubercles instead of spines,

which are not so thickly present as in *M. formosense*. Adult males have the fingers with many marked tubercles along or on the cutting edges, and the teeth on the proximal portion of the cutting edges are much broader.

7. The proportional length of the propodus of the ambulatory pereiopods is somewhat larger in *M. formosense* than in the new species.
8. The ova are much larger in size and smaller in number in the new species (20–60 in number, ca. 2.0×1.4 mm in diameter) than in *M. formosense* (6,000–12,000 in number, ca. 0.7×0.5 mm in diameter).

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REFERENCES

- Holthuis, L. B., 1950. The Decapoda of the Siboga Expedition. Part X. The Palaemonidae collected by the Siboga and Snellius Expeditions with remarks on other species. I. Subfamily Palaemoninae. *Siboga Exped., Monogr.*, **39a**(9): 1–268.
- Kubo, I., 1940. Studies on Japanese palaemonoid shrimps. I. *Palaemon*. *J. Imp. Fish. Inst. Tokyo*, **34**: 5–30, pls. 1, 2.
- 1941. On some fresh-water shrimps from the Ryukyu Islands. *Trans. biogeogr. Soc. Jap.*, **3**(3): 1–8.
- Ohshima, H., 1935. A glimpse on animals of the Yaeyama Group, Riukiu (5). *Bot. Zool., Tokyo*, **3**: 963–976. (In Japanese).
- Parisi, B., 1919. Decapodi giapponesi del Museo di Milano. VII. Natantia. *Atti Soc. Ital. sci. nat.*, **58**: 59–99, pls. 3–6.
- Shokita, S., 1973. Abbreviated larval development of the fresh-water prawn, *Macrobrachium shokitai* Fujino et Baba (Decapoda, Palaemonidae) from Iriomote Island of the Ryukyus. *Annot. zool. Japon.*, **46**: 111–126.