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New Record of a Semi-terrestrial Hippolytid Shrimp, *Merguia oligodon* (De Man) (Crustacea: Decapoda: Caridea) from Japan and Thailand

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Abstract The hippolytid shrimp, *Merguia oligodon* (De Man, 1888) is reported from Iriomote Island, Ryukyu Islands, Japan, the first certain record of this species from East Asian waters. The material from Phuket also represents a new record of this species for Thailand. This species has been previously known from Kenya, Mergui Archipelago in the eastern Indian Ocean, and Indonesian waters. The occurrence in Iriomote Island represents considerable range extension for this remarkable shrimp, only semi-terrestrial caridean species. Brief note on biology of the species is provided.

Key words: Crustacea, Decapoda, Caridea, Hippolytidae, *Merguia oligodon*, new records, Japan, Thailand, mangrove swamps, semi-terrestrial.

During private expeditions to Yaeyama Group, Ryukyu Islands, in 1997–2001, carried out by the author, an interesting shrimp from a semi-terrestrial habitat was collected in mangroves and an estuary on Iriomote Island. Subsequent examination has revealed that the specimens represent *Merguia oligodon* (De Man, 1888), so far known only from Mergui Archipelago (De Man, 1888; Kemp, 1925), Indonesian waters (Holthuis, 1947, 1958), and Kenya, eastern Africa (Bruce, 1993). Although the published information suggests that this species is distributed widely in the Indo-West Pacific, there has been no certain record of it from East Asian waters. Further, four specimens of the same species from Phuket, Thailand, have been also available for study. They represent the first record of this species for the west coast of the Malay Peninsula, as well as Thai waters. In this paper, a detailed description based on the specimens from Iriomote Island and Phuket is provided in order to show clearly the identity and to give some details not mentioned in previous literature. A brief note on biology is also given.

Materials and Methods

The specimens examined are deposited in the Natural History Museum and Institute, Chiba (CBM, with code of ZC). The carapace length (cl) represents the specimen size, measured from the posterior margin of the orbit to the midpoint of the posterior margin of the carapace. The illustrations were prepared with the aid of a drawing tube mounted on LEICA MZ8 stereomicroscope. The specimens were stained with methylene blue for detailed observation.

Taxonomic Account

Genus *Merguia* Kemp, 1914

Merguia oligodon (De Man, 1888)

(Figs. 1–3)

Hippolyte oligodon De Man, 1888: 277, pl. 28, figs 1–6 (type locality: Elphinstone Island, Mergui Archipelago).

Merguia oligodon-Kemp, 1914: 121, pl. 7, figs 8–9; 1925: 338; Holthuis, 1947: 75, fig. 15; 1958: 231, figs 1–7; Bruce, 1993: 180, figs 1–2, 3A–C; Vannini and Oluoch, 1993: fig. 1; Chace, 1997: 80, fig. 22a–b.

Material examined. **Japan.** Iriomote Island,

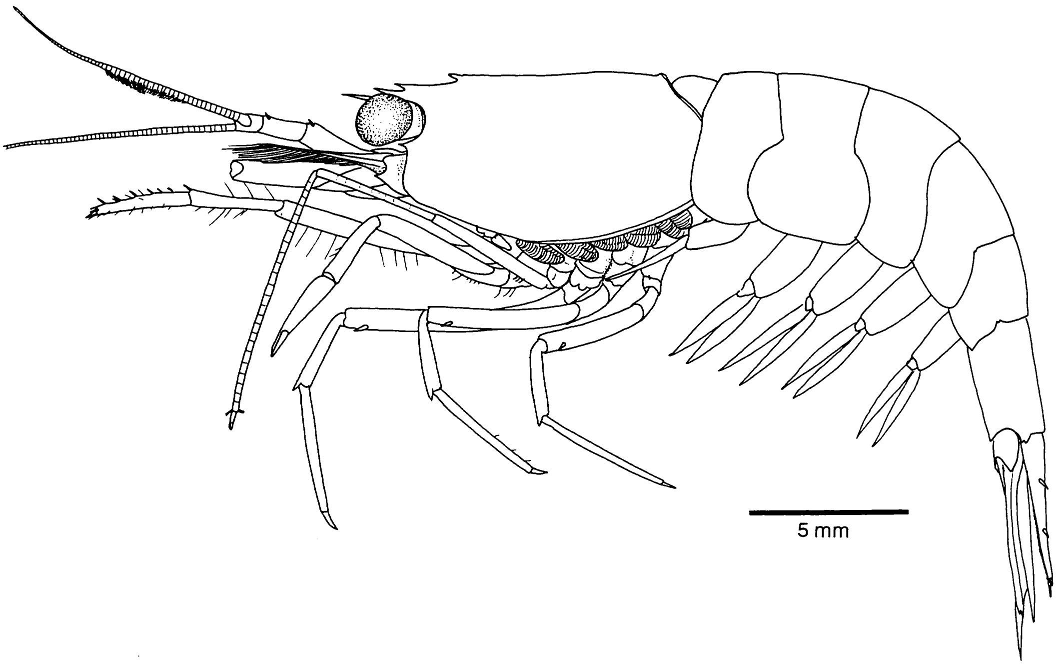


Fig. 1. *Merguia oligodon* (De Man, 1888). Ovigerous female from Yonada-gawa estuary, Iriomote Island (cl 7.3 mm, CBM-ZC 6119). Entire animal in lateral view, eggs omitted.

Yaeyama Group, Ryukyu Islands: Nakama-gawa estuary, under stone on sand flat, 21.III. 1997, hand, coll. T. Komai, 1 male (cl 3.2 mm) (CBM-ZC 3722); Nadara-gawa estuary, mangrove swamps, under stone, 8.VII.1998, hand, coll. T. Komai, 1 male (cl 4.3 mm) (CBM-ZC 6118); Yonada-gawa estuary, mangrove swamps, under boulders, 10.VII.2001, hand, coll. T. Komai, 1 male (cl 5.5 mm), 2 ovig (cl 7.3, 7.4 mm), (CBM-ZC 6119).

Thailand. Phuket: Ao Tang Khen mangroves, hiding among roots of Rhizophora wood, X.1995, hand, coll. T. Komai, 4 males (cl 2.9–4.0 mm), 1 ovig (cl 6.8 mm) (CBM-ZC 5525).

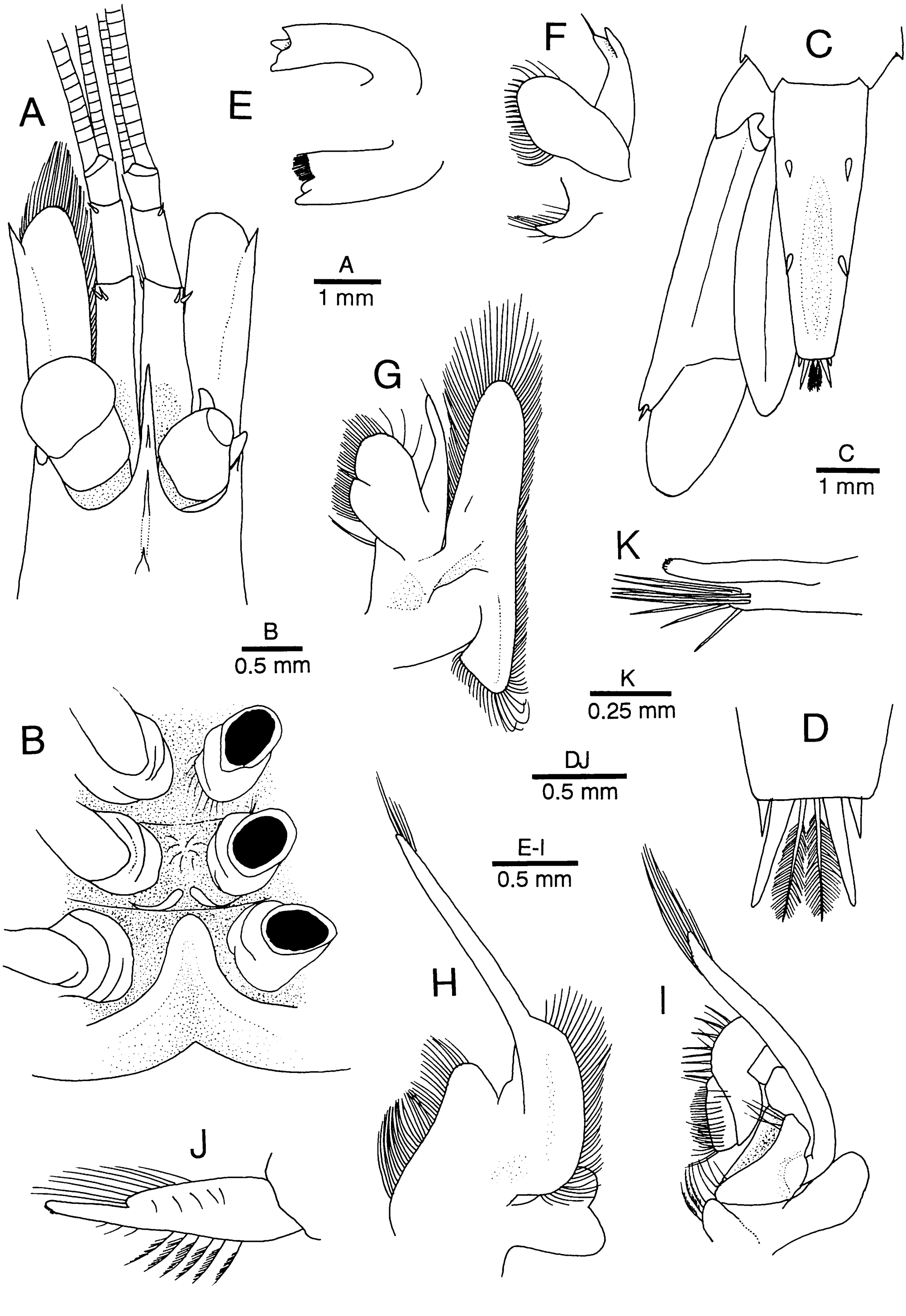
Description. Body (Fig. 1) moderately slender; integument firm, apparently glabrous to naked eye, but microscopically with scattered minute setae dorsally on carapace.

Rostrum (Figs 1, 2A) not reaching distal margin of basal segment of antennular peduncle, 0.33–0.45 times as long as carapace, devoid of lateral carina; dorsal margin armed with 2–3 teeth, including one on carapace arising about 0.15 of its length; ventral margin unarmed. Carapace (Figs 1, 2A) with postrostral median ridge low, disappearing just posterior to median tooth; antennal tooth small, but conspicuous; no suborbital lobe separated from antennal tooth; pterygostomian angle rounded; no longitudinal carina on lateral surface.

Abdomen (Fig. 1) smooth dorsally. Pleura of first to fourth abdominal somites rounded ventrally or posteroventrally; pleuron of fifth somite with small posterolateral tooth. Sixth abdominal somite 1.4 times as long as fifth somite, 1.7 times as long as proximal depth;

Fig. 2. *Merguia oligodon* (De Man, 1888). A, B, E-J, male from Yonada-gawa estuary, Iriomote Island (cl 5.5 mm, CBM-ZC 6119); C, D, same lot, ovigerous female (cl 7.3 mm). Appendages dissected from left. A, anterior part of carapace and cephalic appendages, dorsal, right eye presumably in process of regeneration after injury; B, sixth to eighth thoracic sternite, ventral, left pereopods removed; C, telson and left uropod, dorsal, setae omitted; D, posterior margin of telson, dorsal; E, mandible, external and internal; F, maxillule, external, coxal endite detached; G, maxilla, external; H, first maxilliped, external; I, second maxilliped, external; J, endopod of first pleopod, ventral; K, appendix masculina and appendix interna of second pleopod, dorsomesial.

posterolateral process terminating in 2 small, blunt or acute teeth; posteroventral corner acutely or subacutely pointed. Telson (Fig. 2C) 1.3 times as long as than sixth abdominal somite, armed with 2 pairs of dorsolateral spines; dorsal surface shallowly sulcate medially in posterior 0.7; posterior margin truncate, with 2 pairs of spines (mesial pair 2.5–3.0 times as long as than lateral pair) and 1 pair of densely plumose submedian setae.



Thoracic sternum (Fig. 2B) broadened posteriorly. Seventh thoracic sternite posteriorly with pair of short, obliquely transverse ridges. Eighth sternite with distally rounded median process, extending to level of suture between eighth and seventh sternites; ventral surface of sternal process concave. Abdominal sternites unarmed.

Eye (Fig. 2A) with cornea somewhat inflated, wider than eye-stalk, maximal diameter 0.22–0.24 of carapace length; ocellus absent.

Antennular peduncle (Fig. 2A) stout, overreaching distal margin of antennal scaphocerite by length of ultimate segment; basal segment distinctly longer than distal 2 segments combined, overreaching midlength of scaphocerite, with 2 submarginal spines at distolateral angle; ultimate segment with 1 submarginal spine at distolateral angle; stylocerite short, reaching proximal 0.25–0.30 of basal segment, terminating in blunt point. Flagella not longer than body; outer flagellum with thickened aesthetasc-bearing portion 0.6–0.7 times as long as carapace.

Antennal scaphocerite (Fig. 2A) 0.5–0.6 times as long as carapace and 3.2–3.3 times as long as broad; lateral margin nearly straight, terminating in moderately strong tooth not reaching somewhat produced, rounded distal margin of blade. Basicerite with acute ventrolateral tooth. Carpocerite elongate, reaching distal margin of antennular peduncle. Flagellum longer than body.

Mandible (Fig. 2E) stout, lacking incisor process and palp; molar process with mesial face dentate marginally, internally bearing row of dense setae. Maxillule (Fig. 2F) with basial endite subovate in shape, with double row of spines on mesial margin; coxal endite curved, tapering distally, with stiff setae distally; palp bilobed distally, internal lobe with apical setae, external lobe unarmed. Maxilla (Fig. 2G) with shallowly bilobed basial endite; coxal endite very narrow, with few setae distally; palp not reaching anterior margin of scaphognathite, weakly curved mesially, with short apical seta; scaphognathite moderately broad, with short, rounded posterior lobe. First maxilliped (Fig. 2H) with coxal and basial endites fused in single lobe; palp short; caridean lobe moderately broad; exopod long, flattened; epipod rather small, weakly bilobate. Second maxilliped (Fig. 2I) with ischium and basis fused, with low, but distinct elevation at base of exopod on external surface; exopod moderately long, flattened; epipod subrectangular, devoid of podobranch. Third maxilliped (Fig. 3A) long, overreaching distal margin of scaphocerite by length of ultimate segment and more than half of penultimate segment; ultimate segment 1.1 times as long as ultimate segment, terminating in strong corneous spine, with row of spaced single or paired corneous spines on dorsal surface; penultimate segment with 1 corneous spine at dorsodistal corner; antepenultimate segment without spine, with 2 sparse row of stiff setae on ventral surface; coxa with hooked projection on lateral face; exopod and epipod absent.

First pereopod (Fig. 3B) moderately slender, overreaching distal margin of scaphocerite by about half length of chela; chela (Fig. 3 C) subequal in length to carpus; dactylus 0.55–0.60 times as long as palm; palm subcylindrical, without concavity of mesial face; merus unarmed; ischium (Fig. 3D) with minute spinules on ventral surface. Second pereopods (Fig. 3E) slender, subequal or slightly unequal with right slightly longer than left, left overreaching distal margin of scaphocerite by length of chela and 0.7–0.8 of carpus; dactylus slightly shorter than palm; carpus slightly longer than merus and ischium combined, divided in 22–24 articles; merus slightly longer than ischium, with annulation; ischium with obscure annulation in distal half and with 2–3 curved stout setae on ventral margin subproximally; ischium with 2–3 curved stout setae on ventral margin. Third to fifth pereopods moderately slender, similar in structure, but successively becoming shorter. Third pereopod (Fig. 3F) overreaching distal margin of scaphocerite by length of dactylus, propodus and 0.2–0.3 of carpus; dactylus (Fig. 3G) 3.0–4.2 times as long as proximal depth, terminating in simple unguis, with 2 (rarely 1) widely spaced accessory spinules on flexor margin; propodus with spaced spinules on flexor margin; carpus 0.65–0.70 times as long as propodus, devoid of spine; merus deepest at about midlength, with 1 subdistal lateroven-

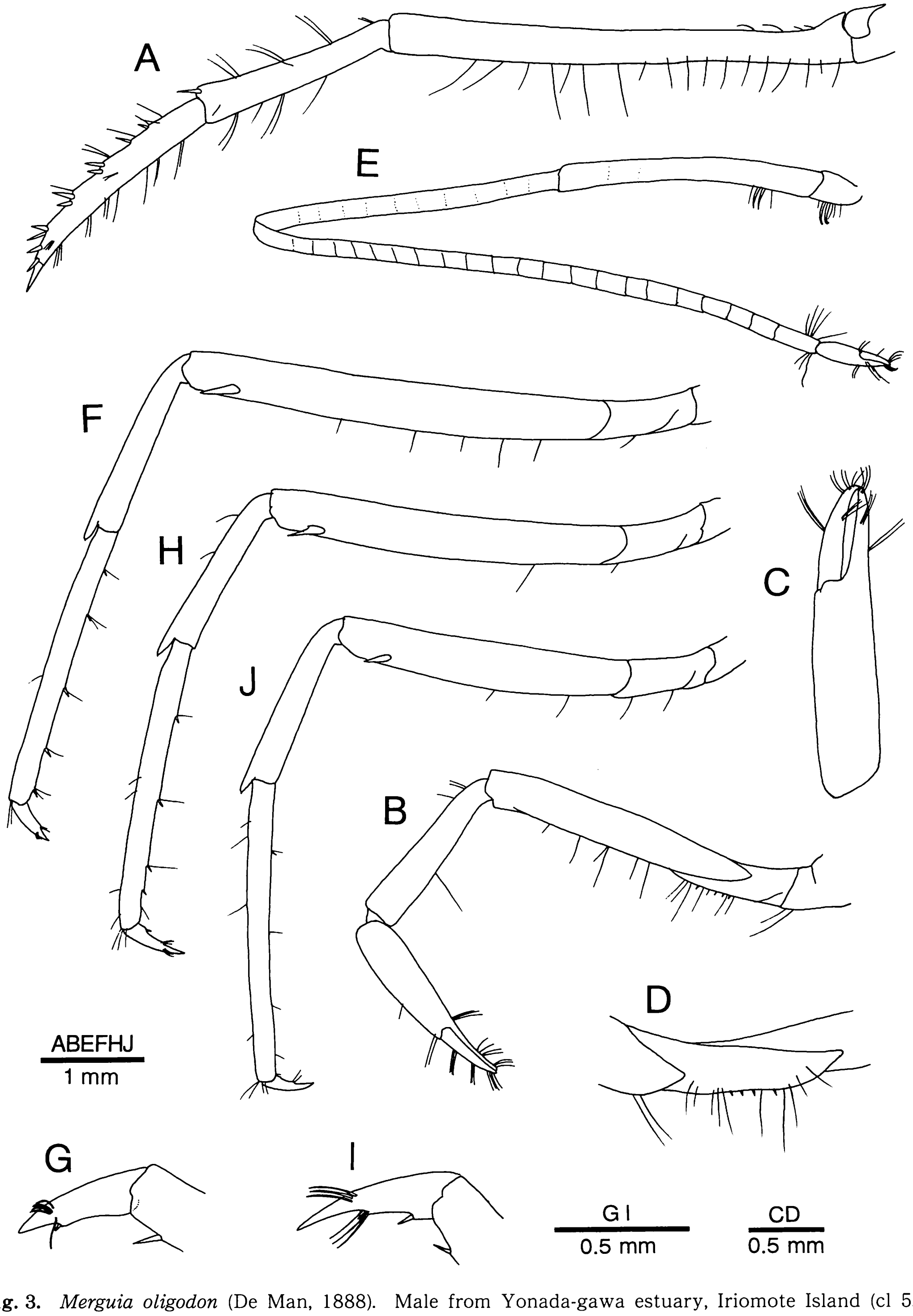


Fig. 3. *Merguia oligodon* (De Man, 1888). Male from Yonada-gawa estuary, Iriomote Island (cl 5.5 mm, CBM-ZC 6119). Left appendages. A, third maxilliped, lateral; B, first pereopod, lateral; C, chela of first pereopod, extensor; D, ischium of first pereopod, mesial; E, second pereopod, lateral; F, third pereopod, lateral; G, dactylus of third pereopod, lateral, setae on propodus omitted; H, fourth pereopod, lateral; I, dactylus of fourth pereopod, lateral, setae on propodus omitted; J, fifth pereopod, lateral.

Table 1. *Merguia oligodon* (De Man, 1888). Gill formula.

Thoracic somites	1	2	3	4	5	6	7	8
	Maxillipeds			Pereopods				
	1	2	3	1	2	3	4	5
Pleurobranchs	–	–	–	1	1	1	1	1
Arthrobranch	–	–	1	–	–	–	–	–
Podobranch	–	–	–	–	–	–	–	–
Epipods	+	+	–	–	–	–	–	–
Setobranchs	–	–	–	–	–	–	–	–
Exopods	+	+	–	–	–	–	–	–

tral spine; ischium unarmed. Fourth pereopod (Fig. 3H, I) overreaching distal margin of scaphocerite by length of dactylus and 0.1–0.2 of propodus. Fifth pereopod (Fig. 3J) not reaching distal margin of scaphocerite.

Gill formula summarized in Table 1. Arthrobranch on third maxilliped small, but distinctly lamellate.

Male first pleopod with endopod (Fig. 2J) bearing elongate appendix interna separated from endopod proper by weak notch, ventral surface with row of stiff setae on ventral surface adjacent to lateral margin. Female first pleopod with endopod tapering distally, devoid of appendix interna. Male second pleopod with appendix masculina (Fig. 2K) distinctly shorter than appendix interna, bearing about 10 apical or subapical spiniform setae. Protopods of first to fifth pleopods (Fig. 1) broad. Uropod (Fig. 2C) with endopod overreaching posterior margin of telson by 0.2 length; exopod elongate, far overreaching endopod, its lateral margin nearly straight, posterolateral part strongly produced (=posterolateral projection), terminating in small bifid teeth flanking movable spine; diaeresis distinct; posterior lamellar part of exopod freely separable from posterolateral projection; posterolateral corner of protopod subacutely pointed.

Coloration. In life. Entirely dark brown; tail fan with white transverse band basally.

Biological note. The specimens were all collected during low tide in daytime. It was found that the shrimps hide in shelters under stones or boulders or narrow crevices formed by *Rhizophora* roots.

Many individuals were seen in the boulder area at Yonada-gawa estuary in Iriomote Island. When the shrimps were disturbed by removal of boulders, they escaped by actively-walking or leaping from boulder to boulder, or boulder to my legs or arms, and were even seen to climb up trunks of trees adjacent to their shelters. It was not very difficult to collect specimens at the boulder area, because the shrimps were easily picked up even by hand. In the same habitat, many individuals of a sesarmine crab, *Chiromantes villosum* (A. Milne Edwards), were found, although it remains unknown whether they share the same shelter.

At Nakama-gawa estuary in Iriomote Island, one specimen of *M. oligodon* was collected. It was seen to hide in a small hole on limestone on a coarse sand flat area outside the mangrove swamps. The abundant holes in the limestone also provide suitable refuges for the shrimps.

Nocturnal observation was not carried out. It is known that *M. oligodon* is active largely at night (Vannini and Oluoch, 1993).

Distribution. Mergui Archipelago (De Man, 1888; Kemp, 1925); eastern Indonesia (Holthuis, 1947; 1958); Kenya, eastern Africa (Bruce, 1993); Phuket, Thailand (new record); Iriomote Island, Ryukyu Islands, Japan (new record).

Remarks. The present specimens from Japan and Thailand closely agree with the previous accounts of *Merguia oligodon* in their morphological features and the characteristic semi-terrestrial habitat in life (cf. De Man, 1888; Holthuis, 1958; Bruce, 1993). Among the Indo-Pacific hippolytids, this species is easily recognizable by the short, ventrally unarmed rostrum, the absence of epipods on the third maxilliped through third pereopod, and the noticeably elongate posterolateral projection of the uropod, which is freely separated from the posterior lamellar part, as well as the semi-terrestrial habitat in mangrove swamps or estuary.

The genus *Merguia* is represented by two species, *M. oligodon* and *M. rhizophorae* (Rathbun, 1900). The latter is known from Panama to Brazil in the western Atlantic and Nigeria in the eastern Atlantic (Bruce, 1993). Holthuis (1959) mentioned that the two species were different in the shape and spinulation of the ambulatory dactyli in males. Bruce (1993) supported the subtle difference in the shape and spinulation of the ambulatory dactyli mentioned by Holthuis (1959), and further indicated that the overall body size was larger in *M. oligodon* than in *M. rhizophorae*. However, Chace (1997) failed to detect differences discriminating the two species. In the present specimens, the dactylus of the third pereopod is 3.0–4.2 times as long as the proximal depth; the flexor margin is armed usually with two small, but distinct accessory spinules. Only in the ovigerous female from Iriomote Island (cl 7.3 mm, CBM-ZC 6119), the distal spinule is absent on the dactylus of the left third pereopod. The present observation supports the significance of the features of the ambulatory dactyli in distinguishing the two species of *Merguia* mentioned by Holthuis (1959) and Bruce (1993).

Holthuis (1959) mentioned the presence of an epipod on the third maxilliped in *M. rhizophorae*, although no strap-like epipod on the third maxilliped is illustrated (Holthuis, 1959, Fig. 16e). The present examination has shown that the strap-like epipod is absent on the third maxilliped in *M. oligodon*. It is reasonable to consider that Holthuis (1959) might attribute the coxal lateral process on the third maxilliped to an epipod.

Abele (1970) has remarked that *Merguia* species show little special morphological adaptation to semi-terrestrial life, save that the ambulatory pereopods are somewhat more robust than in related marine shrimps. However, in comparison with *Lysmata vittata* (Stimpson), Bruce (1993) has commented that there is no significant difference in the structure of the ambulatory pereopods between *Merguia* species and *Lysmata vittata*. Bruce enumerated some remarkable features of *Merguia*, including the noticeably elongate antennal carpocerite and third maxilliped, marked diminution in the number of accessory spinules on the ambulatory dactyli, and the absence of epipod through third maxilliped to third pereopod. In addition to these features, as mentioned by Christoffersen (1987), the peculiar structure of the uropodal exopod is also remarkable. The uropodal exopod is provided with a strongly produced posterolateral projection, which is freely separated from the elongate lamellar part posterior to the diaeresis. The structure seems to give flexibility to the exopod, and may enable shrimps to effectively jump backward in terrestrial environment.

It has been found that *M. oligodon* inhabits cryptic shelters formed by limestones, boulders and/or roots of mangrove trees during daytime, as previous authors reported. Recently, Gillikin *et al.* (2001) reported the occurrence of the shrimps in burrows of a sesarmine crab, *Neosarmatium smithi* (H. Milne Edwards). Further, as Vannini and Oluoch (1993) suggested, mangroves are not the only suitable habitat for the species. Holthuis (1958) found *M. oligodon* under the bark of a piece of wood at a river estuary.

Bruce (1993) suggested that further search in suitable mangrove habitats may well indicate that *Merguia* species are much more broadly distributed than currently recorded. The present specimens from Iriomote Island, Japan, greatly extend the known geographical range of *M. oligodon* to north, although no specimen has been collected from intervening localities. Cryptic habitat during daytime prevents us from easily recognizing the shrimp in mangroves or other suitable environment. Careful obsevation will be necessary for discovery of it. At night, specimens can be easily caught by the use of a knockdown insecticide pressure can spray, especially if the shrimps are illuminated by torchlight, when the eyes of the shrimps are clearly visible (see Vannini and Oluoch, 1993: 282).

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日本およびタイ初記録のキノボリエビ（新称）*Merguia oligodon* (De Man)（甲殻上綱：十脚目：コエビ下目）

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八重山諸島西表島とタイのプーケットから採集された標本に基づき，モエビ科キノボリエビ属（新称）*Merguia* のキノボリエビ（新称）*Merguia oligodon* (De Man, 1918) を新たに記録し，種の特徴を示すため，記載と図を与えた．本種は，これまでにアフリカのケニア，インド洋東部のマーグイ諸島（タイプ産地が含まれる），およびインドネシア東部より知られていたが，本研究により，新たな産地が記録された．特に西表島からの記録は，本種の分布範囲を大きく更新し，現時点では分布北限となる．本種は，マングローブ沼沢地に主に生息し，半陸性というコエビ類としては特異な生活様式をもつことが知られていたが，今回採集された標本も同様な生息様式を示した．さらに，本種は夜行性であることが知られており，昼間は，石の下やヒルギの根などによって形成されるシェルターに潜んでいる．そのため，その発見には注意深い採集が必要である．本種の分布が広範囲であるにもかかわらず，記録が少ないのは，研究者により見逃されてきたことによる可能性が高いと考えられる．今後の調査が期待される．