A New Species of the Genus *Melita* (Crustacea: Amphipoda) from a High Tide Pool at Shirahama, on the West Coast of the Kii Peninsula, Japan

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With Text-figures 1–4

Abstract A new amphipod crustacean, *Melita shiodamari*, is described from a high tide rock pool at Shirahama, on the west coast of the Kii Peninsula in Japan. The new species is very different from many *Melita* species, but resembles *M. plumulosa* Zeidler, 1989, *M. awa* Barnard, 1972b and *M. matilda* Barnard, 1972a from the Southern Hemisphere in the general morphology, and especially in the peculiar morphology of the gnathopods 1 and 2. *Tegano seticornis* (Bousfield, 1970), *Sriha vagabunda* (Karaman, 1984) and *Fiha schminkei* Stock, 1988 are also similar to the new species, and should be transferred to the genus *Melita*. All of these species possibly constitute a subgroup, *awa*-complex, of the genus *Melita*. Taxonomy of other related genera from the Indo-Pacific, most of which are monotypic, are also considered. The relationship and evolution of these allied species and genera are briefly discussed.

Key words: Crustacea, amphipods, *Melita*, *awa*-complex, Indo-Pacific, monotypic genera

So far, 15 species of the amphipod genus *Melita* have been reported from Japanese waters (Ishimaru, 1994). Amphipods collected from a high tide rock pool at Shirahama on the west coast of the Kii Peninsula were found to belong to a previously undescribed species, which seemed to resemble species of *Melita* from the Southern Hemisphere more closely than other Japanese species of the genus. Therefore, a detailed morphological study of the newly discovered animals was conducted and comparisons were made with related amphipods.

Abbreviations used in the figures. A, antenna; CX, coxa; EPI, epimeral plate; G, gnathopod; H, head; IP, inner plate; L, left; LL, lower lip; MD, mandible; MX, maxilla; MXP, maxilliped; OP, outer plate; OS, oostegite; PA, palp; PL, pleopod; PR, pereopod; R, right; T, telson; U, uropod; UL, upper lip; d, dorsal view; i, inner surface; v, ventral view.

Melita shiodamari n. sp.

(Figs 1–4)

(Japanese name: shiodamari-merita yokoebi, new)

Material examined. Holotype: male, 5.6 mm (SMBL Type No. 386). Paratypes (SMBL Type No. 387): allotype, ovigerous female, 4.7 mm; male, 5.7 mm, dissected; 3 males and 7 females without dissection. All the specimens were collected on 5 May 1992 at the type locality. The type series is

deposited in the collection of the Seto Marine Biological Laboratory.

Type locality: A high tide pool (about 10 m in width, 1m in depth) on the beach, Nishitani (33°38'N, 135°24'E), near the mouth of the Tonda-gawa River, Shirahama, Wakayama. The pool is a fissure-like depression between two small rock hills, and is connected to the open sea only at high spring tide. The leaves of land plants and stranded algae were accumulating and decaying in the pool, making the water smell slightly of hydrogen sulfide. The salinity of the water in the pool measured on another day was 32 ‰, slightly lower than that of the open sea. *Melita nagatai*, *Corophium* sp. and *Jassa* sp. were collected from the pool.

Description of holotype male.

Body (Fig. 1): Head (Fig. 2–H) with sub-round lateral cephalic lobes; post-antennal sinus shallow, without notch. Eyes medium in size. Pleosomites 1–2 and urosomite 1 with strong dorsal median tooth on posterior margin; pleosomite 3 with minute median tooth, urosomite 2 with one small spine on each side. Epimeral plates 1–3 (Fig. 3–EPI1–3) weakly produced and bearing minute seta at posteroventral corner; epimeral plates 2–3 with one spine on ventral margin.

Antenna 1: Peduncular article 1 robust, with two spines ventrally, one bunch of setae on sub-apical part, groups of long setae along ventral margin; article 2 elongate, longer than article 1, with many groups of long setae marginally; article 3 short; main flagellum with 22+ articles; accessory flagellum with 3 articles.

Antenna 2: Peduncular article 1 round; article 2 with one small triangular projection on dorsal side of inner surface; article 3 with one spine on dorsodistal corner, round projection on inner surface and triangular process at posteroventral corner; articles 4 and 5 without spines, setose marginally; flagellum setose, with 9 articles.

Upper lip (Fig. 2–UL) almost hexagonal, tapered and truncated distally, setulose along ventral margin. Lower lip (Fig. 2–LL) setulose on medial to ventral part, with small inner lobe and paired small accessory lobes medially.

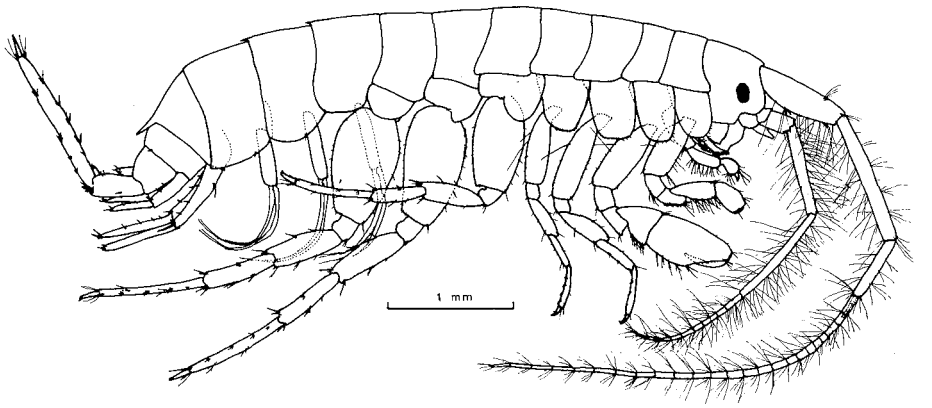

Fig. 1. *Melita shiodamari* n. sp. Holotype, male, 5.6 mm

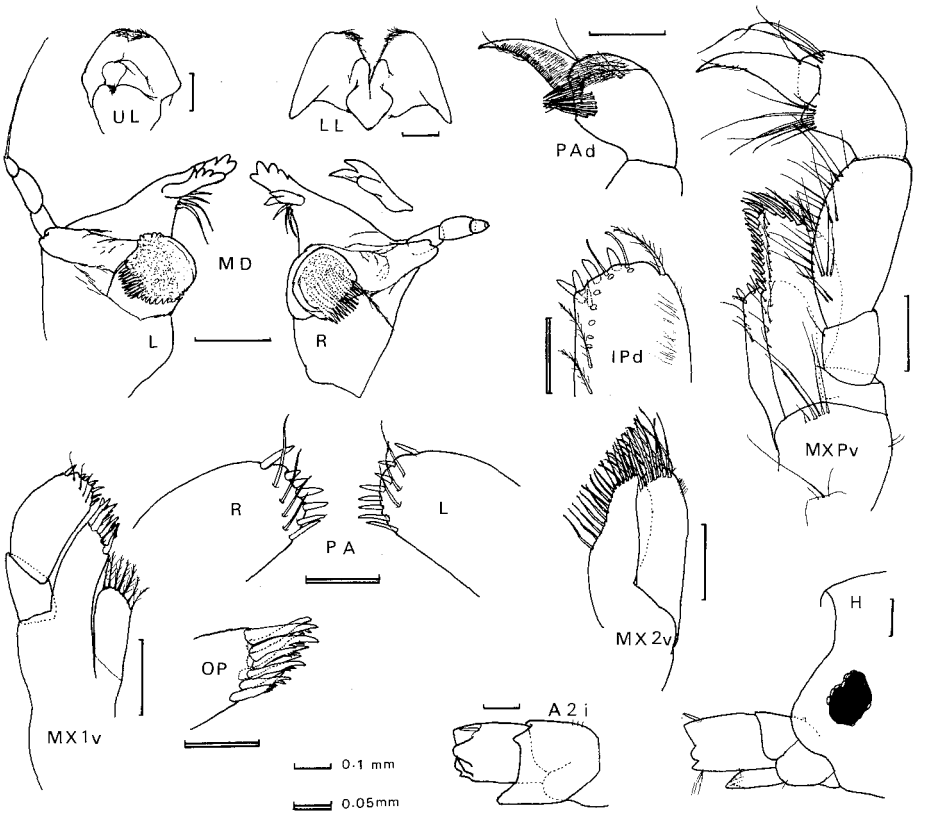

Fig. 2. *Melita shiodamari* n. sp. Holotype, male, 5.6 mm

Mandible (Fig. 2–MD): Incisor 5-dentate; right lacinia mobilis 3-lobed; left lacinia mobilis 4-dentate; spine row composed of four(left) or three (right) pectinate blades; molar process well developed, with one pinnate seta and longitudinal ridge extending to basal part of palp; cutting surface square, without accessory plates. Palp very short, 3-articulate; first palpar article as long as second; third article very short, with one long apical seta.

Maxilla 1 (Fig. 2–MX1): Inner plate quadrate, with 7 terminal plumose setae. Outer plate (Fig. 2–OP) with 9 multi-dentate spines, without bifurcate spines. Palp biarticulate; first article without setae; second article slightly dilated, with thin subterminal spines on ventral surface and strong terminal spines which are somewhat asymmetrical, i.e., right ones slightly more robust than those on left.

Maxilla 2 (Fig. 2–MX2): Both plates with two rows of terminal setae; inner plate with one row of pectinate medial setae, lacking dorsal oblique rows of setae.

Maxilliped (Fig. 2–MXP): Inner plate (Fig. 2–IP), with terminal and subterminal robust spines and simple terminal setae on ventral surface, with row of medial and terminal plumose setae on dorsal surface. Outer plate with setae on submedial

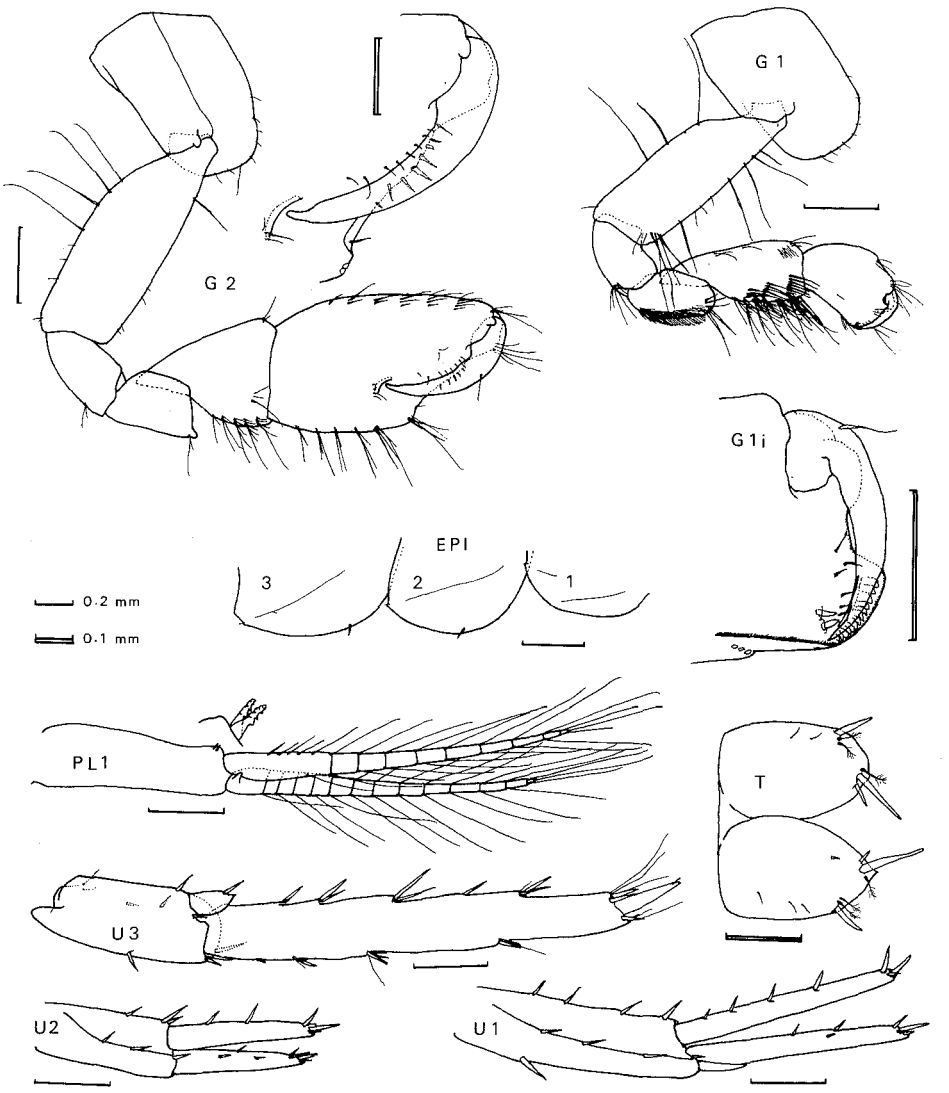

Fig. 3. *Melita shiodamari* n. sp. Holotype, male, 5.6 mm

margin of ventral surface and row of spatulate spines along medial to terminal margin; these spatulate spines successively increasing in length distally; distal spines pinnate. Palp 4-articulate, with setae on ventral surface and along medial margin; article 3 slightly dilated, setulose anterodistally, with bunch of pectinate spines on dorsal surface and many long setae on apical margin; article 4 setulose on dorsal surface, with short setae along medial margin of sub-apical part.

Coxae 1–4 almost same length; ventral margin subround, with minute setae; coxa 4 not concave along posterior margin; coxae 5 and 6 with round anterior lobe; coxa 7 unlobed. Coxal gills 2–6 round, simple.

Gnathopod 1 (Fig. 3–G1): Article 2 with sparse long setae marginally; article 3 short, with bunch of setae at posterodistal margin; article 4 quadrate, with setae on posterodistal margin and dense setules on posterior margin; article 5 long, dilated distally, with several setae on anterior margin, robust pectinate setae on posterior margin and inner surface, pubescent but lacking row of pectinate setae on anterodistal corner; article 6 (Fig. 3–G1i) slightly dilated distally, marginally with sparse setae, with hump at middle of anterior margin; palm produced, defined by two spines, with minute setae; posterodistal corner minutely serrate, slightly bending inwards; dactyl with seta on lateral margin and setae at base of nail.

Gnathopod 2 (Fig. 3–G2): Article 2 with sparse setae marginally; article 3 short; article 4 short, bluntly pointed at posterodistal corner; article 5 short, cup-shaped, with clusters of setae along posterior margin and at anterodistal corner. Article 6 trapezoid; anterior and posterior margins with clusters of setae; palmar margin concave, not defined by any spines, with two rows of short setae; inner surface with hollow for receiving apex of dactyl. Dactyl fitting into hollow of article 6.

Pereopods 3 and 4 similar to each other; article 2 of pereopods 3–4 almost straight, slightly recurved at basal part, article 3 short; articles 4–6 with short setae marginally; article 4 slightly produced anterodistally; articles 5–6 linear; dactyl simple, without process, with simple seta on inner margin, minute subapical seta and plumose seta on outer margin.

Pereopods 5–7 similar to each other; pereopods 6–7 larger than pereopod 5. Article 2 of pereopods 5–7, tapered distally, not lobed posterodistally, serrate and bearing minute setae along posterior margin, with spines along anterior margin; article 3 short; article 4 slightly robust, with groups of spines marginally; articles 5–6 linear, with groups of spines marginally; dactyl as in pereopods 3 and 4.

Pleopods 1–3 (Fig. 3–PL1) similar to each other; peduncle of pleopods 1–3 with two coupling spines; outer ramus slightly shorter than inner; basal article of each inner ramus with some relatively shorter, non-bifurcate plumose setae on medial margin. Basal article of each outer ramus with triangular process.

Uropods 1 and 2 (Figs 3–U1, U2) with spines on dorsal surfaces of peduncles and of both rami and at apices of rami; peduncle of uropod 1 with basofacial spine, and with long distolateral spine.

Uropod 3 (Fig. 3–U3): Peduncle much shorter than outer ramus, with spines on outer surface, on dorsal surface, and on apical margin of ventral surface. Inner ramus short, scale-like, pointed apically, with one apical spine. Outer ramus 2-articulate, slender, with groups of spines marginally; distal article short, surrounded by smaller distal spines of proximal article, with minute setule subapically.

Telson (Fig. 3–T) incised to base; each lobe short, rather broad, with two spines and one pinnate seta at apex, one spine and two pinnate setae at distolateral corner, some minute setae on dorsal surface.

Female.

Smaller than male.

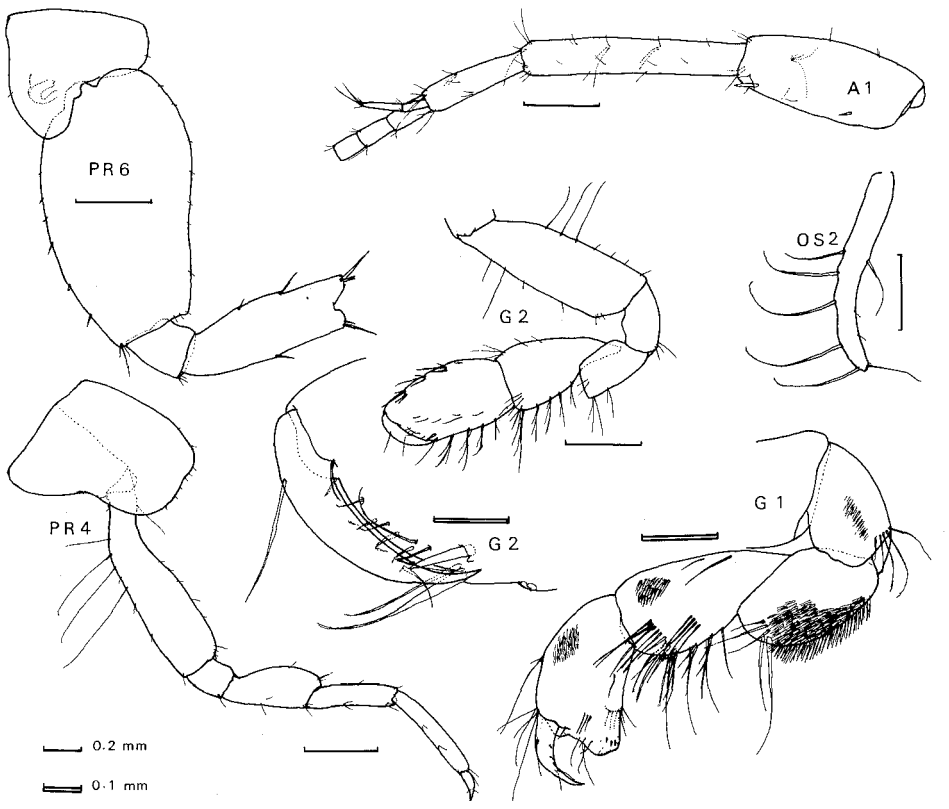

Fig. 4. *Melita shiodamari* n. sp. Allotype, female, 4.7 mm

Antennae (Fig. 4–A1): Number of flagellar articles less than in male (in allotype, 2, 17 and 7 articles in accessory, main flagellum of antenna 1, and flagellum of antenna 2, respectively), shorter and less setose than in male.

Gnathopod 1 (Fig. 4–G1): Articles 2–5 as in male, but more distinctly pubescent than in male; article 6 without hump on anterior margin.

Gnathopod 2 (Fig. 4–G2): Much smaller than in male; article 5 more elongate than in male. Article 6 ovoid, with sparse setae on inner surface and slightly robust setae on anterior and posterior margin; palmar margin oblique, defined by one spine, with two rows of setae; dactyl with seta on anterior margin, minute setae along medial margin, two setae at subapical part.

Pereopod 6 (Fig. 4–PR6): Article 2 broad basally, tapered distally; anterior lobe of coxa 6 slightly elongate, not hooked; apical part round, forming shallow hollow on inner surface.

Telson: Each lobe with one spine and one pinnate seta each at apex and distolateral corner.

Oostegites (Fig. 4–OS2) 2–5 narrow, with long setae.

Variation. Some larger specimens with strong dorsal median tooth on pleosomites 1–3 and urosome 1; smaller specimens with tooth only on urosome 1.

Etymology. The specific name of this new species means "tide pool" in Japanese; as noun in apposition.

Remarks. This new species is unique among the Japanese *Melita* species and is easily distinguishable by the following characteristics: pleosomes 1–3 and urosome 1 with median dorsal tooth; postantennal sinus without notch; antennae setose; coxal plates shallow; posterior margin of coxa 4 not excavated; article 6 of male gnathopod 1 not excavate on inner surface, with hump on anterior margin, its palm produced, its posterodistal margin serrate, bending inwards; gnathopod 2 not setose on inner surface of article 6, with hollow for receiving tip of dactyl; article 2 of pereopods 5–7 not lobed posterodistally; telsonic lobes short, their apex not elongate. Moreover, the mouthpart morphology also shows peculiar characteristics in the short mandible palp with only one seta at the apex, the 3-lobed right lacinia mobilis, the absence of accessory plates on its molar, the inner plate of maxilla 2 with only a single row of setae along medial margin, the small inner lobe of the lower lip.

This new species resembles three species from the Southern Hemisphere. *Melita plumulosa* Zeidler, 1989 from Australia is characteristic in bearing many plumose setae on most of the appendages. Aside from the setosity, few differences distinguish *M. plumulosa* from *M. shiodamari*; these include the long palpar article 3 as long as its article 2 and the absence of a dorsal tooth on pleosomes 1–3. *Melita awa* Barnard, 1972b from New Zealand differs from *M. shiodamari* in the longer mandible palp and the absence of dorsal tooth on pleosomes 1–3 and urosome 1. *Melita matilda* Barnard, 1972a from Australia is less similar and is different from *M. shiodamari* in the absence of a hump on gnathopod 1, the presence of a deeper hollow on gnathopod 2 and long setation on pereopods 5–7.

Discussion

Melita shiodamari, *M. plumulosa*, *M. awa* and *M. matilda* are quite distinct from other *Melita* species. Most of the differences between *M. shiodamari* and other Japanese *Melita* species are also pertinent to the other three species. It is possible that *M. shiodamari* and the three southern species constitute a closely related subgroup in the genus *Melita*, and I call it tentatively the *awa*-complex hereafter.

The strong affinity between *awa*-complex and species of other related genera is noticeable. They are *Tegano seticornis* (Bousfield, 1970) and *Sriha vagabunda* (Karaman, 1984). The former species was reported at first as *Melita seticornis* from the Solomon Islands and the Bismarck Archipelago (also see Bousfield, 1971), and then moved to a monotypic new genus *Tegano* by Barnard & Karaman (1982). The latter species was first reported as *Quadrus vagabundus* from Sri Lanka, but its generic name was replaced by the new name *Sriha* by Stock (1988), due to junior homonymy. These two genera are diagnosed mainly by the reduced condition of the mandible palp:

2-articulate in *Tegano*; 1-articulate in *Sriha*. However, these two genera share many common characteristics with the *awa*-complex, such as the setose antennae and the morphology of the gnathopods and pereopods. *Fiha schminkei* Stock, 1988 from Fiji, which bears a vestigial, 1-articulate mandible palp, also resembles the *awa*-complex, though only females are known for this species. If the reduced condition of the mandible palp were not emphasized as a taxonomic character, these three genera would be recognized as *Melita*. It is true that the mouthpart morphology has traditionally been emphasized for the higher taxonomy of amphipods, but dividing genera only by the reduced articulation of the mandible palp is too simplistic. I think that all three species constituting the monotypic genera *Tegano*, *Sriha* and *Fiha* should be transferred to the genus *Melita* and placed in the *awa*-complex at the present stage.

In addition to these genera, there are several genera that show a general resemblance to the *awa*-complex, but differ in a few features by which they are placed in separate genera. Two genera, *Rotomelita* Barnard, 1977 which includes two species from Hawaii and *Nainaloa* Karaman & Barnard, 1979 (for *Melita latimerus* Bousfield, 1971) from the Bismarck Archipelago, are possibly related to the *awa*-complex, particularly in the distally dilated and minutely serrate palm of gnathopod 1. *Nainaloa* differs from all other species compared above in the broad and posterodistally lobed article 2 of pereopods 5–7. Both genera are diagnosed chiefly by the quadrate telsonic lobe. However, this characteristic is not so unusual, because the telsonic lobe of the *awa*-complex is shorter than that of other *Melita* species. Moreover, *Psammoniphargus* Ruffo, 1956 from Madagascar, *Phreatomelita* Ruffo, 1979 from Iran and *Spiniferopisella* Karaman, 1984 (for *Eriopisella spinosa* Ledoyer, 1979 from Java) also resemble the *awa*-complex in the morphology of gnathopod 1 and mouthparts, but differ in the broad article 2 of pereopods 5–7.

Although the relationship between these genera has been discussed by several authors (e.g. Karaman, 1984; Stock, 1988), the affinity to *Melita* has been rarely considered. Notenboom (1988) applied numerical phylogenetic methods to *Pseudoniphargus* and related genera of the Hadzioidea, in which only three European species of *Melita* were investigated. The analyses supported a close relationship among the genera mentioned above, but did not arrive at a complete solution of the phylogenetic relationships. Among these genera, only *Melita* (*sensu lato*) includes more than 80 species, which are possibly divided into subgroups; however, their relationships within the genus still remain to be studied. On the other hand, many monotypic genera have been created, based on a few characters. These small taxa seemingly obscure the relationship among the species. In this circumstance, it is rather better to treat most of them together within the genus *Melita* for further consideration, and not to make hasty election of a new taxon for the *awa*-complex at the present stage.

It is instructive that almost all of these genera, except *Phreatomelita*, have a 2-articulate uropod 3 which is one of the two major diagnoses for separating *Abludomelita* from *Melita* by Karaman (1981); thus, *M. awa* and *M. matilda* were

placed in the *Abludomelita* in his paper. I have indicated that both 1- and 2-articulate uropods 3 are encountered in *Melita* (*sensu* Karaman, 1981) (Yamato, 1987, 1990). Zeidler (1989) rightly pointed out that the 2-articulate uropods 3 is plesiomorphic. The common possession of a 2-articulate uropod 3 among the *awa*-complex is just symplesiomorphy.

If the *awa*-complex is really a group of closely related species, it is very interesting that they are reported mostly from more or less brackish water habitats, such as pools, rivers, lakes, springs; in the cases that their habitats were reported to be almost freshwater, the authors suspected the some influence of the sea or the anchialine water. While these kinds of habitat are separated by open sea water, these related species are distributed over the Indo-Pacific. Stock & Vonk (1992) presented a scenario for the evolution of the freshwater species, *Melita cognata* and *M. dulcicola*, in different mid-Atlantic islands. They presumed that these two species evolved independently and recently from different marine ancestors. This scenario seems to be inapplicable to the case of the *awa*-complex, because it is difficult to find marine relatives for the *awa*-complex. Perhaps the species of the *awa*-complex were derived from a wide-ranging Tethyan group and subsequent radiation over a short distance or recent invasion of less saline habitats might have happened.

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