Explorations of the systematics and deep history of stygobiont amphipods
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PSAMMOGAMMARUS LONGIDACTYLYUS N. SP., A NEW CAVE
AMPHIPOD (CRUSTACEA) AND OTHER STYGOBIONT
AMPHIPODS FROM BONAIRE

BY

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SUMMARY

Psammogammarus longidactylus, a new species from an anchihaline cave in the island of Bonaire
(Netherlands Antilles) is described. It resembles very closely Psammogammarus longiramus found
in a similar habitat on a Red Sea island.
Psammogammarus caesicolus Stock, 1980 and Saliweckelia emarginata Stock, 1977 are recorded for
the first time from Bonaire.

RÉSUMÉ

On décrit Psammogammarus longidactylus, espèce nouvelle d’Amphipodes, d’une grotte
anchihaline de l’île Bonaire (Antilles Néerlandaises). L’espèce est fort proche de P. longiramus,
d’un habitat similaire d’une île de la Mer Rouge. Les Amphipodes Psammogammarus caesicolus
Stock, 1980, et Saliweckelia emarginata Stock, 1977, sont pour la première fois mentionnés de
Bonaire.

INTRODUCTION

Members of the genus Psammogammarus S. Karaman, 1955 are characteristic
for anchihaline inland, and for marine interstitial habitats. The new species
described in the present paper was found in an anchihaline collapse cavern in
Bonaire (Netherlands Antilles). It occurs in relatively salty waters, not far from
the coast (ca. 550 m), where it was observed both free-swimming and under
stones.

Its capacity to swim around, its general morphology, and its habitat resemble the situation found in Psammogammarus longiramus (Stock & Nijssen, 1965),
known from a land-locked salty waterhole on the Red Sea island of Entedebir
(Ethiopia).

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Records of other stygobiont Amphipoda in Bonaire are provided as well: *Psammogammarus caesicolus* Stock, 1980, *Saliweckelia emarginata* Stock, 1977 and *S. holsingeri* Stock, 1977. The first two are new to the island, being previously known from Curaçao only.

In total 129 groundwater samples from Bonaire have been examined. It is noteworthy that members of the genus *Metaniphargus*, the most common hypogean amphipod in Curaçao and Aruba, are completely absent in Bonaire.

**Psammogammarus longidactylus** n. sp.

Diagnosis. — Maximum length slightly more than 4 mm. Uropod 3 with large inner ramus, exceeding article 1 of outer ramus. Dorsal margin of inner ramus of uropods 1 and 2 rugose. Coxal plate 5 with large anterior lobe. Pereopods 5-7 and dactyls very long and slender.

Material examined. —

Bonaire: 1 ♂ holotype (fig. 2), 18 paratypes (both sexes), Amsterdam Expeditions to the West Indian Islands Sta. 84-214, Estate Bolivia, karst collapse cave near “Spelonk” (12°13′23″N 68°13′12″W). Animals caught with a handnet in semi-dark, water-filled tunnels radiating from a central basin which is fully exposed to daylight; chlorinity 19657 mg/l; April 10, 1984, leg. J. H. Stock & J. J. Vermeulen (Zoölogisch Museum Amsterdam, coll. no. ZMA Amph. 108.270a-b).

Four specimens, damaged, Sta. 80-39, same locality; chlorinity 14060 mg/l; May 29, 1980, leg. L. Botosaneanu & J. Notenboom (ZMA coll. no. Amph. 108.271).


Description. —

Largest male 3.1 mm, largest female 4.2 mm. Life colour greyish white. Some females carry 1 egg.

Body slender, laterally compressed; pleon segments with 2-3 very small dorsal setules.

Coxal plates 1-4 longer than wide, with some overlap, distal margin rounded, with a few setules; coxal plate 1 (fig. 2d) slightly anterodistally expanded; plate 5 strongly anterolobate (fig. 5d); plates 6 and 7 rather small (fig. 5a, b).

Epimeral plates 1-3 (fig. 5f) with acute posterodistal corners.

Head (fig. 3b) without inferior antennal sinus. No eyes or rudiments of eyes.

Antennae 1 and 2 (fig. 3b) of normal length, slightly setose. Antenna 1 about twice as long as 2; accessory flagellum 2-articulate; peduncle article 2 longer than 1, with two distal groups of setae; flagellum 14- to 17-articulate, most articles with 1 very narrow and long aesthetasc. Antenna 2 peduncle articles 4 and 5 subequal; flagellum moderately setose, 6-articulate.

Upper lip (fig. 4f) trapezoid.

Pars molaris (fig. 3c, 3d) small, not triturative, molar setae present on both sides; corpus mandibulae with a row of 8-9 barded spines; left lacinia mobilis
with 4 teeth, right lacinia mobilis forked and finely serrate; palp 3-articulate, article 2 slightly longer than 3, article 3 with 3 terminal and 3 ventral setae.

Lower lip (fig. 3e) with distinct inner and outer lobes, setulose.

Maxilla 1 (fig. 3a): Palp 2-articulate, symmetrical, armed with 7 terminal spines and 1 seta; outer lobe with 9 multidenticulate spines; inner lobe triangular, broad, with up to 14 setae.

Maxilla 2 (fig. 3f): Inner lobe with long transversal row of about 12 setae and about 10 distal setae; outer lobe with about 10 distal setae.

Maxilliped (fig. 5e): Distal palp segment large; dactylus slender, long; outer lobe with 6 distal spines, 4 of them barbed; inner lobe with 3 spines and some setae.
Fig. 2. *Psammogammarus longidactylus* n. sp., ♂ holotype, ♀ paratype: a, second gnathopod, ♂ (scale B); b, second gnathopod, ♀ (B); c, oostegite of fourth pereopod, ♀ (B); d, first gnathopod, ♂ (B).
Fig. 3. *Psammogammarus longidactylus* n. sp., ♂ holotype, ♀ paratype: a, left first maxilla, ♀ (scale C); b, cephalic lobe and antennae, ♂ (A); c, left masticatory part of mandible, (C); d, right mandible with palp, ♂ (C); e, lower lip, ♂ (B); f, second maxilla, ♂ (C).
Gnathopod 1 (fig. 2d) generally similar in both sexes; basis elongate; merus strongly rugose; carpus about equal in size to propodus, posterior margin convex with several long setae; propodus longer than wide, palm convex, moderately oblique; 3 palmar angle spines, palmar margin minutely serrate, with a row of small bifid spinules implanted at small distance from margin; dactylus with a plumose setule on anterior margin.

Gnathopod 2 (fig. 2a,b) larger than 1; merus not rugose; carpus smaller than propodus with irregular groups of setae on posterior margin; propodus elongate oval, palm delimited by obtuse angle and 2 palmar angle spines, of which 1 short and 1 long, and 2 setae of which at least 1 bifid, palmar margin minutely serrate, hyaline, with a regular row of bifid spinules; dactylus with 1 setule on anterior margin. In female more spinules on palmar margin (but this may well be due to size difference).

Pereopods 3-4 (fig. 5g) similar; articles poorly setose; dactylus straight with setule on anterior margin; coxal plate 4 non-emarginate.

Pereopod 5 (fig. 5b) shorter than 6; basis not strongly lobate; propodus with several groups of spines on posterior margin; dactylus long and straight, ungulus small.

Pereopods 6-7 (fig. 5c,a) extremely long, 6 slightly shorter than 7; basis weakly lobate (P6) or non-lobate (P7); carpus and propodus about equal in length, in P6 with groups of long setae on posterior margin; dactylus straight and long with very small ungulus and setule on posterior margin.

Pleopods (fig. 4a) biramous, normally segmented, not transformed; 2 anchor-shaped retinacula per pleopod.

Uropod 1 (fig. 4d) with 1 basofacial spine; no interramal spine; outer ramus as long as inner ramus, with a few distomarginal spines and a group of apical spines, dorsal margin of inner ramus finely rugose.

Uropod 2 (fig. 4e): Inner ramus with 2, outer ramus with 1, marginal spines; dorsal margin of inner ramus finely rugose; outer ramus shorter than inner ramus.

Uropod 3 (fig. 4b) projecting strongly beyond the others; inner ramus long, flattened, slightly longer than article 1 of outer ramus; outer ramus 2-articulate, article 2 slightly more than half as long as article 1; margins with low number of spines; peduncle with few spines.

Telson (fig. 4c) long, flattened, deeply emarginate, apices irregular, each lobe having 2 lateral and 2 apical spines and 2 plumose dorsal setae.

Coxal gills (fig. 2a, 5g) on coxae 2-6; elongate on coxa 2, subrounded on coxa 3 to 6, all on a small stalk.

Oostegites (fig. 2c) linear, on gnathopod 2 and pereopods 3 to 5, with 4 long apical setae, in some cases 1 marginal setule.

No secondary sexual differences observed

Derivatio nominis. — The epithet longidactylus refers to the remarkably long claws on pereopods 5-7.
Fig. 4. *Psammogammarus longidactylus* n. sp., ♂ holotype: a, third pleopod, (scale B); b, third uropod, (B); c, telson (C); d, first uropod, (B); e, second uropod, (B); f, upper lip, ♂ (B).
Fig. 5. *Psammogammarus longidactylus* n. sp., ♂ holotype, ♂, ♀ paratypes: a, seventh pereopod, ♂ (scale A); b, fifth pereopod, ♂ (A); c, sixth pereopod, ♂ (A); d, coxal plate of fifth pereopod, ♂ (A); e, maxilliped, ♂ (C); f, epimer I-III, from the right, ♂ (A); g, fourth pereopod, ♂ (A); h, coxal plate of sixth pereopod, ♂ (A).
Distinction. —

The new species resembles *Psammogammarus longiramus* (Stock & Nijssen, 1965) very closely. Differences are of the following nature: (1) telson deeply emarginate but not entirely cleft as in *longiramus*; (2) article 2 of outer ramus of uropod 3 longer in *longiramus*; (3) coxal plates 5-6 without produced lobes in *longiramus*; (4) setae of inner lobe of maxilla 1 with setules toward the tip in *longiramus*; (5) dactyl of pereopods 5-7 more strongly elongate in *longidactylus*; (6) palm Gn. 2 longer in *longidactylus*; (7) telson lobes with medial armature in *longramus*; (8) setae/spines more numerous and longer on merus, carpus and propodus of P6-7 of *longramus*.

Other West Indian members of *Psammogammarus*: *Ps. caesicolus* Stock, 1980 from Curacao and Bonaire, and *Psammogammarus scopulorum* Stock, 1983 from Los Roques, differ from *Ps. longidactylus* in the following respects: (1) They both have fewer setae on the inner lobe of maxilla 1 and 2 than *longidactylus*; (2) *Ps. caesicolus* has shorter and *Ps. scopulorum* much shorter pereopods 5-7 than *longidactylus*; (3) uropod 3 in both species with a longer outer ramus article 2 than *longidactylus*; (4) accessory flagellum longer in *longidactylus*.

*Ps. caesiculos* and *Ps. scopulorum* live in a habitat different from that of *Ps. longidactylus*, i.e. the interstitial waters of gravel and coral debris near the sea. The Californian *Ps. garthi* (Barnard, 1952) and *Ps. gracilis* (Rufo & Schiecke, 1976) from Malta are both interstitial marine species.

Their uropod 3 is less adapted to a natatory function than in *Ps. longidactylus* and *Ps. longiramus*.

Remarks. —

Karaman (1984) erected the genus *Confodiopisa* in which *Psammogammarus caesicolus* Stock, 1980, *Psammogammarus scopulorum* Stock, 1983 and *Eriopisa garthi* Barnard, 1952 were brought together. This was done because of the triangular labrum and the absence of lateral spines on the outer lobe of the maxilliped.

In our opinion these minor — and in the case of the maxilliped poorly defined — differences are unsuitable for distinction on the generic level. In this paper the definition of the genus *Psammogammarus* by Stock, 1980 has been followed.

**Other stygobiont Amphipoda, recently found on Bonaire** (see map, fig. 6).

Two species, known from Curacao, have been found in the interstices of coral rubble in several coastal areas of Bonaire, viz. *Psammogammarus caesicolus* Stock, 1980 and *Saliweckelia emarginata* Stock, 1977. Furthermore new records of *Saliweckelia holsingeri* Stock, 1977, a species previously recorded from Bonaire, are presented. The three species were found in the following stations:
Fig. 6. Distribution of stygobiont Amphipoda in Bonaire: Psammogammarus longidactylus (asterisk); other species discussed in the text (dots).

84-209, Salinj a Bartol (12°28'01"N, 68°23'46"W) BR * depth below surface 50 cm in coral rubble. Chlorinity 33.327 mg/l; June 9, 1984; 62 specimens of Ps. caesicolus (ZMA Amph. 108.272) and ca. 600 specimens of Saliweckelia holsingeri (ZMA Amph. 108.276).

84-205, Playa Funchi (12°17'08"N, 68°24'41"W), seepage of seawater behind wall of coral rubble, grey sand, BR depth below surface 50 cm. Chlorinity 25.104 mg/l; June 9, 1984; ca. 50 specimens of Ps. caesicolus (ZMA Amph. 108.273) and 11 specimens of S. emarginata (ZMA Amph. 108.278).

* BR = Bou-Rouch biophysical pump.
84-201, Slagbaai (12°16’01”N, 68°24’41”W), seepage of seawater in coral rubble and sand, BR depth below surface 50 cm. Chlorinity 25471 mg/l; June 8, 1984; 5 specimens of S. holsingeri (ZMA Amph. 108.277).

84-202, 1.50 m more inland of previous station, BR depth below surface 50 cm. Chlorinity 25987 mg/l; June 8, 1984; 1 specimen of P. caesiculus (ZMA Amph. 108.274).

84-239, Playa Grandi (12°16’28”N, 68°24’41”W), coarse sand near waterline, BR in brownish underlayer. Chlorinity 28832 mg/l; June 12, 1984; 2 specimens of P. caesiculus (ZMA Amph. 108.275).

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PSAMMOMELITA UNCINATA N.G., N. SP. (CRUSTACEA, AMPHIPODA, MELITIDAE) FROM INFRALITTORAL SAND INTERSTICES ON CURAÇAO

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SUMMARY

Psammomelita uncinata n. g., n. sp. is described from infralittoral sand interstices off the South coast of Curacao. The new genus is characterized by ventral hooks, a remarkable apomorphous feature.

RÉSUMÉ

On décrit un genre nouveau et une espèce nouvelle d’Amphipodes provenant d’un milieu interstitiel infralittoral marin du Sud de Curacao. Le genre se caractérise par la présence de crochets ventraux, ce qui est un caractère remarquable et apomorphe.

INTRODUCTION

This study and following reports concentrate on interstitial amphipods living in coastal marine sediments in the West Indies. The work contributes to the idea that some marine benthic faunal elements can evolve, via the salty and brackish groundwater, into freshwater stygofauna. This idea is not new, for authors as Schellenberg (1933), Sket (1958), Gurjanova (1965), Stock (1977), Notenboom (1986) and others have published on this particular subject.

However, the sampling in sand and coral rubble of the circa- and infralittoral crevicular zone (the first clearly distinguishable habitat in the series; marine infaunal — brackish interstitial — freshwater interstitial and cavernicole habitat) has been sparse compared to that being done in inland groundwaters.

Curacao already rendered two new species from infralittoral sand interstices (Nuuanu curvata Vonk, 1988, and Melita leiotelson Vonk, 1988) which are in the process of penetrating inland groundwaters. This can be inferred from their phylogenetic affinities with well known marine benthic species.

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Psammomelita uncinata n. sp., a clear K-strategist, is not a true stygobiont for it has small eyes. It shows a close resemblance to members of Netamelita Barnard, 1962 and Eriopisella Chevreux, 1920, but differs from those by a remarkable and unique feature: three conspicuous hooks on the venter between the pleopods.

Psammomelita n. g.

Diagnosis. — Small melitid amphipods (length up to 3.2 mm). Epimeral plate 1 with large hook-shaped spine on lower margin, pointing anteriad. Other such spines implanted on fleshy triangular processes, positioned midventrally between pleopods 1-3. Antenna 2 shorter than 1, 1 equal to half body length; accessory flagellum uniarticulate. Gnathopods small, mitten-form, 1 slightly smaller than 2, no sexual dimorphism. Basis of pereopods 5-7 with serrate posterior margins, basis of 7 very wide. Maxilliped of male bearing curved keel, midventrally, near base. Brood lamellae linear. Uropod 3: outer ramus 1-articulate, extending well beyond end of uropods 1 and 2.

Type-species. — Psammomelita uncinata n. sp.

Etymology. — The genus name Psammomelita refers to a fossorial mode of living and suggests a relation to Melita Leach. The epitheton uncinata means ‘provided with a hook’.

Psammomelita uncinata n. sp.

Material examined. — Curacao: 1♂ holotype (fig. 1), 1♀ allotype, 21 paratypes (both sexes), Amsterdam Expeditions to the West Indian Islands Sta. 84-135, Piscadera Bay, at Hilton-buoy (12°07'42"N 68°58'20"W), depth 6.5 m. Animals caught in sand*. May 31, 1984; leg. J.H. Stock & J.J. Vermeulen (Zoologisch Museum Amsterdam, coll. no. ZMA Amph. 108.429, 108.430).

Sta. 84-130, same locality, depth 13-15 m, in coarse sand, slightly H2S producing. May 30, 1984; 32 specimens (ZMA Amph. 108.435).

Sta. 84-122, West of Piscadera Bay (12°07'42"N 68°58'17"W), depth 2.5 m, in coral rubble and sand. May 28, 1984; 21 specimens (ZMA Amph. 108.433).

Sta. 84-106, Piscadera Bay, at first buoy (12°07'45"N 68°58'27"W), depth 6.5 m, in coral sand. May 26, 1984; 3 specimens (ZMA Amph. 108.432).

Sta. 84-129, same locality, depth 13 m, in coarse sand. May 29, 1984; 6 specimens (ZMA Amph. 108.434).

Sta. 84-57, same locality, depth 4 m, in coarse and fine coral sand. May 16, 1984; 3 specimens (ZMA Amph. 108.431).

Description. — Largest male 2.9 mm, largest female 3.2 mm. Most females ovigerous with 1-3 large eggs (fig. 6G).

Body slender, slightly cylindrical, pleon segments with 2-3 dorsal setules (fig. 1); colour in alcohol a transparant light brown.

* The interstitial water was pumped up with a motorpump placed in a boat. A Bou-Rouch probe was driven in the seabottom and connected to the pump with a hose.
Coxal plates 1-7 rather small, without much overlapping, distal margins rounded, with setules; coxal plate 1 anterodistally pointed; plate 4 not excavate posteriorly; plates 5 and 6 anterolobate, 6 having a spine on the anterior margin (fig. 6E); plate 7 small, unlobed and with most setules on the hind margin.

Epimeral plates 1-3 large and overlapping; plate 1 with a conspicuous hooked spine (fig. 5E) on a small anteroventral lobe; plate 2 (fig. 4G) with a small, pointed, upward curving posterodistal corner; plate 3 (fig. 5D) with a large, pointed, upward curving posterodistal corner; all plates with setules, sometimes plumose, on posterior and distal margin.

Head with lateral lobes broadly convex, leaving buccal mass greatly uncovered; eyes small, ommatidia scattered.

Antennae (fig. 1, 4B, C) of normal length, slightly setose, antenna 1 twice as long as 2; accessory flagellum uniarticulate (fig. 4H); antenna 1 peduncle article 1 robust, with distally two groups of spines, article 2 as long as 1, article 3 smaller; flagellum about 12- to 15-articulate, the last 6-7 articles with very narrow elongate aesthetascs; antenna 2 peduncle articles 4 and 5 elongate; flagellum moderately setose, 5-articulate.

Upper lip (fig. 4I) entire, margin rounded.

Mandibular body (fig. 5H, I) without spine-row, molar distinct, not triturative; palp 3-articulate, article 1 short, article 2 unarmed, article 3 with 3 terminal setae. Lacinia mobilis asymmetrical, left 4-dentate, right figured in fig. 5I.

Lower lip (fig. 4A) with inner and outer lobes distinct, setulose.

Maxilla 1 (fig. 4D, F) inner plate very small with 2 setae, outer plate with 7 spines, medially spine 5-denticulate, other spines unidenticulate; palps symmetrical, 2-articulate, article 2 slightly widened distally and with 7 terminal spines.

Maxilla 2 (fig. 4E) inner plate with several setae distally, and a row of setules on the inner margin; outer plate longer than inner, distal margin fringed with several long setae, one of which plumose.

Maxilliped (fig. 3F) inner plate short, with more than 6 spines; outer plate elongate oval, inner margin with spines standing in pairs, marginal spines increasing in length distally; palp 4-articulate, setose. On the posterior side, midventrally, the male appendage bears a curved keel (fig. 5K, L).

Gnathopod 1 (fig. 3A) generally similar in male and female; basis elongate, narrow proximally; merus with distal a small rugose patch; carpus about equal in size to propodus, posterior margin convex with several long spines of which some striated and bifid; propodus oval, palm convex and poorly defined from posterior margin, dactylus with small spine on anterior margin.

Gnathopod 2 (fig. 3B) little larger than 1, especially the basis; carpus with an angularly lobed posterior margin, slightly serrate on the posterior side; propodus oval, palm delimited by obtuse angle and two bifid spines, dactylus with small spine on anterior margin and 2 spines at base of unguis.
Pereopods 3-4 (fig. 1, 6C, F) basis robust; merus broad distally with long spines on posterior margin; carpus short; propodus about half length of merus; dactylus straight with distoanterior spine.

Pereopod 5 (fig. 2C) short; basis with serrate posterior margin; merus, carpus and propodus short, dactylus straight and narrow with a long anterodistal spine.

Pereopods 6-7 (fig. 2B, A) much longer than 5; basis with heavily serrated posterior margin, basis of 7 much broader than that of 6; merus, carpus and propodus about equal in length, with long spines on margins and distal edge of propodus; dactylus straight and long with anterodistal spine.

Pleopods (fig. 3E, D) biramous, normally segmented, not transformed; 2 retinacula per pleopod, hook-shaped; between each pleopod pair a fleshy triangular projection is present, with an apical hook (fig. 5J).

Uropod 1 (fig. 5A) peduncle with two heavy distal spines and several smaller dorsal ones; inner ramus as long as outer, both having a group of apical spines only.

Uropod 2 (fig. 5B) peduncle with 3 distal spines; inner ramus with 1 dorsal spine and several distal ones; outer ramus equal to length of inner, with apical spines only.

Uropod 3 (fig. 5C) projecting strongly beyond the others; outer ramus uniaxial, rather wide, much longer than inner; inner ramus scale-like, with one apical spine; peduncle with several distal spines.

Fig. 1. Psammometella uncinata n. gen., n. sp., male holotype 2.2 mm.
Fig. 2. *Psammodia uncinata*, ♀ paratype 2.3 mm: A, seventh pereopod (scale b); B, sixth pereopod (b); C, fifth pereopod (b); D, fourth pereopod (b).
Fig. 3. *Psammomelita uncinata*, ♂ paratype 2.3 mm: A, first gnathopod (scale b); B, second gnathopod (b); C, third pereopod (b); D, second pleopod (b); E, third pleopod (b); F, maxilliped (c); G, telson (c).
Telson (fig. 3G) small, fleshy, deeply emarginate, apices irregularly rounded, each lobe having one large upward pointing spine and a pair of mid-lateral plumose setules.

Genital papillae (fig. 5F) of male, midventrally on pereon segment 7, rounded and relatively large.

Coxal gills (fig. 6C, F) on coxae 2-6; not stalked, rounded in male, larger and rectangular on top on coxae 3-4 of female.

Brood lamellae (fig. 6a) on coxae 2-5; linear, with 3-4 long apical setae, sometimes 1 implanted more proximal on margin.

**DISTINCTION.** — According to Gurjanova (1965) and Nagata (1965) *Netamelita* is synonymous with *Eriopisella*. *Netamelita*, however, shows one important difference; a uniarticulate outer ramus of uropod 3, and can therefore be retained as a valid genus.

*Psammomelita uncinata* also has a uniarticulate outer ramus of uropod 3, but differs from *Netamelita* in the following respects: (1) large midventral hooks on the venter between the pleopods; (2) a curved keel on the male maxilliped; (3) a less produced lobe on the carpus of gnathopod 2; (4) heavy serrations on the posterior margin of the basis of pereopods 5-7. At least characters 1, 2 and 4 are to be considered apomorphous.

There are no lateral accessory nails on the dactylus of pereopods 5-7 as in *Netamelita cortada* Barnard, 1962, neither is there a very strongly produced anterior lobe on coxa 1 as in *N. barnardi* McKinney et al., 1978.

Accompanying fauna. — Of several amphipod species only *Idunella sketi* Karaman, 1984, could be identified with certainty. This species was previously recorded from Walsingham cave, Bermuda.

Other groups of marine organisms present were: Actiniaria, Oligochaeta, Polychaeta, Nematoda, Harpacticoida, Calanoida, Ostracoda, Isopoda Sphaeromatidae, Isopoda Microparasellidae, Isopoda Asellota, Tanaidacea, Brachyura, Anomura, Natantia, Pycnogonida, *Amphioxus*.

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Fig. 4. *Psammomelita uncinata*, A-H: σ paratype 2.3 mm, I: Φ paratype 2.5 mm, J, σ paratype 2.9 mm. A, lower lip (scale b); b, second antenna (c); C, accessory flagel (c); D, first maxilla, outer lobe (d); E, second maxilla (c); F, first maxilla (c); G, second epimeral plate (b); H, first antenna, aesthetasc (c); I, upper lip, Φ (b); J, eye, σ (b).
Fig. 5. Psammomelita uncinata, A-J: ♂ paratype 2.3 mm, K: ♀ paratype 2.5 mm, L-M: ♂ paratype 2.9 mm. A, first uropod (b); B, second uropod (b); C, third uropod (b); D, third epimeral plate (b); E, first epimeral plate (c); F, male genital papillae (free hand sketch); G, coxal plate of fifth pereopod (b); H, masticatory part of left mandible (c); I, masticatory part of right mandible (c); J, ventral hooks (a); K, maxilliped, ♀, lateral (a); L, maxilliped, ♂, lateral (a); M, coxal plate of sixth pereopod, ♂ (a).
Fig. 6. *Psammomelia uncinata*, A, ♀ paratype 2.6 mm, brood lamellae of fifth pereopod (b); B, ♀ paratype 2.6 mm, basis of first pleopod with ventral hook (b); C, ♀ paratype 2.5 mm, third pereopod (b); D, ♀ paratype 2.5 mm, sixth pereopod, and e, coxal plate (a); F, ♂ paratype 2.9 mm, third pereopod (a); G, ♀ paratype 2.6 mm, egg (b).


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**SUMMARY**

Two new amphipod species were found in coarse sand interstices of beaches, mainly on the heavily exposed northcoast of Curacao (Netherlands Antilles). They still possess small eyes but are not found in marine surface waters. Both species are described and remarks are made about their taxonomic position.

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**RÉSUMÉ**

On décrit deux espèces nouvelles d’Amphipodes, d’un milieu interstitiel marin très exposé de quelques plages au Nord de Curaçao (Antilles Néerlandaises). Elles possèdent encore des petits yeux, mais n’ont pas été recueillies dans les eaux marines de surface.

**Genus Nuuanu** Barnard, 1970

**Karaman & Barnard** (1979) combined the genera *Gammarella* Bate, 1857, *Nuuanu* Barnard, 1970, and *Cottesloe* Barnard, 1974 into one genus: *Gammarella*. They remarked that no discontiguity existed between the three genera.

However, the differences within the enlarged genus between *Nuuanu amikai* Barnard, 1970 on the one hand, and *Gammarella fucicola* (Leach, 1814) on the other, are too large to make the use of such a genus workable. Therefore the genus *Nuuanu* is retained.
Nuuanu curvata n. sp.

Material examined – All from Curaçao, Netherlands Antilles.
Sta. 84-27, Boca Tabla beach, BR in sand near the waterline; May 9, 1984 (ZMA Amph. 108.344), 3 specimens. Accompanying amphipods: 3 specimens of Metaniphargus curasavicus ssp.
Sta. 84-145, Boca Tabla beach, east side, coarse sand and rubble in surf-eroded excavation, BR depth below surface 55 cm; June 2, 1984 (ZMA Amph. 108.343), 1 specimen. Accompanying amphipods: 5 specimens of Saliweckelia Stock, 1977.

Sex of all specimens uncertain.

Diagnosis
Maximum length 2.8 mm. Epimeral plate 1 with midventral hook. Head with typical, extended cephalic lobes. Rostrum short. Mandible palp 3-articulate with 3 apical setae. Antenna 1 geniculate.

Description
Largest animal 2.8 mm. Live colour greyish white. Body laterally compressed, pleon segments smooth.

Coxal plates 1–3 (Fig. 1a): longer than wide, overlapping, distal margin rounded with very small posterovenral notch (Fig. 3a, b, d) and few setules; coxal plate 4 (Fig. 3c) large and deeply excavated; plate 5 (Fig. 3e) with midventral notch; plate 6 (Fig. 3f) posterodistally expanded; plate 7 (Fig. 3g) small, with small anterodistal lobe.

Epimeral plates (Fig. 1a, b, c): Plate 1 midventrally hookshaped; plate 2 with regular row of setules on lower margin, posterodistal corner slightly rounded; plate 3 with subacute posterodistal corner.

Head (Fig. 1a) with small rostrum and rounded lateral cephalic lobes with notch (dotted line) in lower margin. Eyes rudimentary.

Antennae 1 and 2 (Fig. 2a, b): short, slightly setose. Antenna 1 about one third longer than 2; accessory flagellum 3-articulate; peduncle article 1 robust, articles 2 and 3 geniculate; flagellum 5-articulate. Antenna 2 peduncle articles 4 and 5 subequal in length; flagellum 4-articulate; gland cone well developed.

* = Bou-Rouch biophysical pump.
Fig. 1. *Nuuanu curvata* n. sp., sex uncertain. a, entire animal (scale A); b, pleopod 1 (A); c, pleopod 3 (A); d, upper lip (B); e, sternal gill (C); f, telson (C); g, lower lip (B).
Fig. 2. *Nuuanu curvata* n.sp., sex uncertain. a, antenna 1 (scale B); b, antenna 2 (B); c, maxilliped (B); d, uropod 2 (B); e, maxilla 1 (C); f, maxilla 2(C); g, uropod 1 (B); h, uropod 3 (B); i, left mandible (C); j, right mandible, palp omitted (C).
Upper lip (Fig. 1d) trapezoid.

Pars molaris (Fig. 2i, j) well developed, not triturative, molar seta present on either side; corpus mandibulae with a row of 7–9 spines; left lacinia mobilis with 4 teeth, right lacinia mobilis forked; palp 3-articulate, article 2 longer than 1 and 3, article 3 with 4 terminal setae.

Lower lip (Fig. 1g) with indistinct inner lobes; outer lobes slightly pubescent.

Maxilla 1 (Fig. 2e): Palp 2-articulate, symmetrical, armed with 6 terminal spines; outer lobe with 9 multidenticulate spines; inner lobe triangular, with 10–15 irregularly scattered setae.

Maxilla 2 (Fig. 2f): Inner lobe with long transversal row of 10–14 setae and about 9 distal setae; outer lobe with about 10 distal setae.

Maxilliped (Fig. 2c): Palp 4-articulate; dactylus slender; outer lobe with 3 slender distal and 7 short medial spines; inner lobe with 5 distal setae.

Gnathopod 1 (Fig. 3d) basis elongate; merus with comb row of 5 setae; carpus longer than propodus, posterior margin straight with about 10 groups of setae and 4 lateral groups of setae; propodus oblong, small; 2 groups of 3 and 4 palmar angle spines; dactylus with setule on anterior margin.

Gnathopod 2 (Fig. 3a): much stronger than 1; basis, ischium and merus with distally small horn-like extensions; carpus short; propodus mitten-shaped with 8 groups of long setae on posterior margin; palmar margin coarsely serrate with 1 palmar angle spine.

Pereopods 3–4 (Fig. 3b, c): similar; articles poorly setose; dactylus small and straight.

Pereopod 5 (Fig. 3e): shorter than 6; basis lobate with concave posterior margin lined with 8 setules; merus, carpus and propodus short and strong; dactylus small with setules on anterior margin, ungulus small; spiniform process (sternal gill?) on either side of sternum (Fig. 1a, e).

Pereopod 6 (Fig. 3f): basis lobate, distal part of posterior margin concave and with 2 spinules; merus, carpus and propodus short and strong; dactylus broad, ungulus small.

Pereopod 7 (Fig. 3g): shorter than 6; basis very broad, shield-like, posterior margin serrate without spines; merus, carpus and propodus short and strong; dactylus and ungulus very small.

Pleopods (Fig. 1a, b, c) biramous, normally articulate, not transformed; 2 retinacula per pleopod; pleopods 1 and 3 with 3 long setae on first article of inner ramus.
Fig. 3. *Nuuanu curvata* n. sp., sex uncertain. a, gnathopod 2; b, pereopod 3; c, pereopod 4; d, gnathopod 1; e-g, pereopods 5–7 (all to scale A).
Uropod 1 (Fig. 2g): Peduncle with 1 large subapical dorsomedial spine; no interramal spine; rami subequal, both having 3 distomarginal spines and a group of short apical spines; dorsal margin of outer ramus with second row of small spines.

Uropod 2 (Fig. 2d): Peduncle with two apical spines; rami subequal with few distomarginal spines and a group of apical spines.

Uropod 3 (Fig. 2h): Short, not exceeding beyond the others; inner ramus small and scale-like; outer ramus longer than peduncle, 2-articulate, second article very short, unarmed; margins of article 1 with several paired spines; peduncle with few distal spines.

Telson (Fig. 1f): Small, flattened, deeply emarginate, cleft very narrow, apices with 1 spine in notch; 3 sensory hairs submarginally on each lobe.

Coxal gills (Fig. 3a, b, c, e) on coxae 2–6, all on indistinct stalk.

Oostegites and genital papillae not found.

Variations

Some paratypes have a straight palmar edge on the propodus of gnathopod 2 (sexual difference?).

Remarks

The new species is generally similar to *Nuuanu amikai* (Barnard, 1970) from the Hawaiian Islands, but differs most noticeably in the shape of the lower lip, the absence of a comb row of setae on the third article of the mandibular palp, the absence of serrations on the basis of pereopod 6, and the form of epimeral plate 1. The crooked shape of this epimeral plate is slightly indicated in *Cottesloe cyclodactyla* Hirayama, 1978 (this species is not mentioned by Karaman & Barnard, 1979, in their revision of *Gammarella*).

A remarkable trait is the presence of a process (sternal gill?) on the sternum at the basis of pereopod 5. This character has been recorded also in *Nuuanu numbadi* (Barnard, 1974) and in the related genus *Tabatzius*, viz. in *Tabatzius muelleri* (Ortiz, 1976), but it is not described as a sternal gill.

McKinney & Barnard (1977) record a species of the *Nuuanu*-group, found in dimly lit anchialine waters of Hawaii. They conclude that members of this group are therefore preadapted for lightless environments. *N. curvata* confirms this idea and shows that also another part of the stygohabitat, i.e. macroporous interstitia, are invaded by this group. This is
compatible with the theory that some amhipod inhabitants of macroporous interstitia of the infra- and circalittoral zone form a link between fully marine ancestors and Recent freshwater cavernicoles (Stock, 1986).

**Etymology.** The specific name, *curvata*, refers to the curved point on the lower margin of epimeral plate 1.

**Melita leiotelson** sp. n.


**Description**

Material examined - All from Curaçao, Netherlands Antilles.

Sta. 84-147, Boca Wandomi (12°22′31″ N, 69°07′12″ W) BR depth below surface 35 cm in coarse sand near high water mark. June 2, 1984 (ZMA Amph. 108.336); 1 ♂ holotype, 1 ♀ allotype, 3 paratypes.

Sta. 84-146, Boca Wandomi, 40 cm lower on the beach than 86-147; BR depth below surface 35 cm in coarse sand near waterline; June 2, 1984 (ZMA Amph. 108.339); ca. 87 specimens.

Sta. 84-38A, Westpuntbaai, Playa Forti (12°22′12″ N, 69°09′07″ W); KARAKMAN-Chappuis* method near waterline, coarse sand; May 11, 1984 (ZMA Amph. 108.340); 10 specimens.

Sta. 84-48, Playa Forti, east side (12°22′09″ N, 69°09′03″ W); BR depth below surface 30 cm in coarse sand near waterline; May 14, 1984 (ZMA Amph. 108.340); 4 specimens.

Sta. 84-148, as previous station, 5 cm below watersurface. BR depth 30 cm; June 2, 1984 (ZMA Amph. 108.341); 7 specimens.

Sta. 78-307, Playa Forti, washed from sublittoral sand, depth ca. 1 m; May 19, 1978 (ZMA Amph. 108.337); 29 specimens.

**Diagnosis**

Maximum length 2.7 mm. Telson without armature. Accessory flagellum 2-articulate. Mandible palp of variable form, 3-articulate. Rami of uropods 1 and 2 pointed and finely serrate.

**Description**

Largest male 2.4 mm, largest female 2.7 mm. Life colour greyish white. Females carry 1–2 eggs.

* = collected in inflowing groundwater after digging a hole.
Fig. 4. *Melita leiotelson* n.sp. a, entire animal, ♀; b-d, pereopods 5-7; e, pereopod 4; f, antenna 2; g, antenna 1 (all to scale A).
Body slender, laterally compressed; pleon segments without dorsal setae.  
Coxal plates 1–4 (Fig. 4a, 5a, b, c) longer than wide with some overlap, 
distal margin rounded, lined with regularly implanted setules; coxal plate 4 
with slight excavation (Fig. 5k); plates 5 and 6 anterolobate (Fig. 4a), plate 
7 posterolobate.

Epimeral plates 1–3 (Fig. 4a, 6g) with acute tooth on corner.

Head (Fig. 4a) without inferior antennal sinus. Ommatids of eyes sometimes small and numerous, sometimes large and few (Fig. 6i).

Antennae 1 and 2 (Fig. 4g, f) of normal size, slightly setose. Antenna 1 about one third longer than antenna 2; accessory flagellum 2-articulate; peduncle article 2 as long as 1, 3 shorter; flagellum 10- to 13-articulate; aesthetascs not observed. Antenna 2 peduncle articles 4 and 5 subequal; flagellum 6-articulate.

Upper lip (Fig. 5i) trapezoid to rounded.

Pars molaris (Fig. 6a, d) well developed, semi-triturative, small molar seta present on both sides; corpus mandibulae with a row of 4–5 spines; left lacinia mobilis with 4 teeth, right lacinia mobilis forked and finely serrate; palp (Fig. 6b, j, k) 3-articulate, of variable form, in some cases with small article 3, 2 terminal setae.

Lower lip (Fig. 5j) with distinct inner and outer lobes, setulose.

Maxilla 1 (Fig. 6e): Palps 2-articulate, symmetrical, armed with 6 terminal spinules and 1 seta; outer lobe with 7 spines of which 6 forked and innermost multidenticulate; inner lobe with 4 setae.

Maxilla 2 (Fig. 6f): Inner lobe with only medial and distal setae, no transverse row; outer lobe with distal setae only.

Gnathopod 1 (Fig. 5a) generally similar in both sexes, of melitid form; basis elongate, merus with comb of stiff setae; carpus longer than propodus, posterior margin convex with scattered groups of long setae; propodus oblong, palmar angle with irregular groups of setae; dactylus small. No sexual differences.

Gnathopod 2 (Fig. 5b, c) larger than 1; merus not rugose; carpus shorter than propodus with 4 bundles of setae and a distal row of long setae.  
Gnathopod 2 in male distinctly larger than in female; in male propodus with double row of short spines on palmar margin and carpus with more setae. Both sexes with 2 groups of palmar angle spines and setae; 1 long and 1 short spine on medial side of propodus and 3 setae on margin.

Pereopods 3–4 (Fig. 4a, e) similar; articles poorly setose; dactylus very small.
Fig. 5. *Melita leiotelson* n. sp.: a, gnathopod 1, ♀; b, gnathopod 2, ♀; c, gnathopod 2, ♂; d, uropod 3, ♀; e, uropod 1, ♀; f, uropod 2, ♀; g, telson, ♀; h, oostegite of pereopod 4; i, upper lip, ♀; j, lower lip, ♀; k, fourth coxal plate, ♀ (all to scale B).
Pereopod 5 (Fig. 4b) shorter than 6; basis weakly lobate, posterior margin with 7 short setae; dactylus straight, ungulus bent.

Pereopods 6–7 (Fig. 4c, d) about equal in size; basis weakly lobate, posterior margin with 7 short setae; dactylus straight, ungulus bent.

Pleopods (Fig. 4a, 6g) biramous, normally segmented, not transformed; 2 toothed retinacula per pleopod.

Uropod 1 (Fig. 5e) without basofacial peduncular spine, but with prepe-duncular spine; no interramal spine; outer ramus as long as inner, each with 1 marginal spinule and a distal group of spinules; dorsal margin of outer ramus finely rugose.

Uropod 2 (Fig. 5f): Outer ramus with 1, inner ramus with 2 marginal spines; dorsal and ventral margins of inner ramus finely rugose, of outer ramus only medial margin rugose; outer ramus slightly shorter than inner one.

Uropod 3 (Fig. 5d) projecting strongly beyond the others; inner ramus very short, scale-like, outer ramus 1-articulate.

Telson (Fig. 5g, 6h) small, deeply emarginate; cleft wide, v-shaped; lobes smooth, apices pointed.

Coxal gills (Fig. 4e) on coxae 2–6, subrounded, on a small stalk.

Oostegites (Fig. 5b, h) linear, on pereopods 2–5, with 4–5 apical and lateral setae.

Pleon (Fig. 4a) completely devoid of teeth or spines.

Remarks

_Melita leiotelson_ is a small species (under 3 mm). It differs from _M. valesi_ in having a longer second article of the accessory flagellum, a double row of small spines on the palmar margin of Gn 2 (♂), a smooth telson, fine serrations on the rami of U1 and U2, more developed eyes although this differs throughout a population (see Figs. 4a, 6i), and a more reduced Md-palp (especially the third article, also with variation).

_M. leiotelson_ differs from _M. bulla_ in having a normal propodus of Gn1 ♂, a smooth telson, a longer second article of the accessory flagellum, serrations on U1 and U2, a smaller Md-palp, straight edges on the lower margin of the epimeral plates 1–3, and a more club-shaped outer lobe of Mx 1 without serrations.

So, after the very useful division of _Melita_ Leach, 1814, into _Melita_ and _Abludomelita_ by _Karaman_ (1981), now three stygobiont species have been
Fig. 6. *Melita leiotelson* n. sp., ♀. a, right mandible (scale C); b, j, k, mandibular palp of different specimens (C); c, maxilliped (C); d, left mandible (C); e, maxilla 1 (C); f, maxilla 2 (C); g, pleopod 3 (A) with retinacula; h, telson (C); i, eye (C).
recognized in Melita. It is remarkable that here also an Amphiatlantic
distribution is found for stygobiont species within one genus.

Etymology. – The specific name, leiotelson, refers to the completely bald telson.

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Thalassostygius exigus n. g., n. sp., a new marine interstitial melitid (Crustacea, Amphipoda) from Curacao and Klein Bonaire (Netherlands Antilles)

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Keywords: Amphipoda, marine interstitial, Antilles

Abstract

Thalassostygius exigus n. g., n. sp. is described from the marine interstitial of permanently immersed sediments off the coasts of Curacao and Klein Bonaire. The best matching phenetic similarity is met in Dumosus atari Thomas & Barnard, 1985, from Belize.

Résumé

On décrit Thalassostygius exigus n. g., n. sp. de l’interstitiel marin de sédiments immergés de façon permanente au large des côtes de Curacao et de Klein Bonaire. Du point de vue de la similarité phénétique la forme la plus proche connue serait Dumosus atari Thomas & Barnard, 1985, de Belize.

Introduction

Thalassostygius exigus n. g., n. sp. is found in what seems to be a very rich spot (due to extensive sampling?) for various amphipod species: the interstitial of Piscadera bay, Curacao. Later it was also found in coral sand in shallow water off the coast of Klein Bonaire during the 1988 Caribbean expedition of the Dutch research vessel “Plancius” to several Venezuelan Islands and the Netherlands Antilles.

T. exigus shares most characters with Dumosus Thomas & Barnard, 1985, a monotypic genus with probably also a cryptic habitat. However, both genera differ strongly in the form of the second gnathopod and the third uropod. This last feature points in the direction of Elasmopus, whereas Dumosus is believed to have affinities with Maera (Thomas & Barnard, 1985).

Descriptive part

Thalassostygius n. g.


Type-species. – Thalassostygius exigus n. sp., by monotypy.

Etymology. – The genus name Thalassostygius refers to a marine infaunal mode of living. The epitheton exigus stands for “minute”.

Thalassostygius exigus n. sp.

Material examined. – Curacao: 1 ♀ holotype, 1 ♂ allotype, 16 paratypes (both sexes), Amsterdam Expeditions to the West In-


Sta. 88–225, Klein Bonaire, northern beach (12°09'49"N, 67°17'38"W) 2 m. below sea level in coral sand, in washing of sand. March 19, 1988, leg. R. Vonk (ZMA Amph. coll. no. 108.602), 1 paratype (damaged).

Description. — Body laterally compressed, unpigmented. Eyes reduced, with few ommatidia, in anterior position. Pleon segments smooth.

Coxal plates 1–3 (Figs. 1a, 2a, b, d) longer than wide, distal margin with 3 small setules; plate 4 (fig. 2c) slightly excavate; plates 5–6 (Fig. 1a) shallow, anterolobate; plate 7 (Fig. 1a) non-lobate.

Epimeral plates (Fig. 1a) without setules; plates 1 and 2 with shallow anterodistal excavation, postero-distally acute; plate 3 with subacute postero-distal corner.

Antennae (Fig. 1f, e). Antenna 1 (Fig. 1f) of medium length, with 3 aesthetasc, flagellum moderately setose, 6- to 7-articulate; accessory flagellum 2-articulate. Antenna 2 (Fig. 1e) shorter than A1, flagellum 4-articulate, gland cone present.

Mandibular body (Fig. 3c, f, g) with distinct molar, no molar seta; palp 3-articulate, articles 1 and 2 unarmed, article 3 with 2 terminal setae; lacina mobilis and 3–4 rakers present on both sides but more produced on left side; incisors toothed; Upper lip entire, margin rounded; lower lip with inner lobes (Fig. 3h).

Maxilla 1 (Fig. 3e) inner plate with 1 apical setae, outer plate with 6 spines; palps symmetrical, 2-articulate with 4-5 terminal spines.

Maxilliped (Fig. 3a) inner plate short with about 6 setae; outer plate with 2 apical spines and several setae; palp poorly setose.

Gnathopod 1 (Fig. 2b) similar in male and female; basis elongate; ischium, merus, carpus and propodus distally slightly serrate; propodus rectangular, with two spines on posterior margin; palm with straight angle and 5 spines, 1 long, 4 short; 1 spine on palmar margin halfway between dactylus and palmar corner.

Gnathopod 2 (Fig. 2a) also without sexual dimorphism; basis elongate; ischium, merus, carpus and propodus distally slightly serrate; carpus as long as propodus; propodus with 3 spines on posterior margin; 5 palmar angle spines, 1 long, 4 short; 1 spine on palmar margin halfway between dactylus and palmar corner.

Pereopods 3–4 (Fig. 2c, d) slender, with few spines; pereopods 5–7 (Fig. 1c, d, b) short; basis large, posteroventrally lobate, posterior margin smooth with few spinules.

Pleopods (Fig. 2i, j) rather well developed, rami 4-articulate; peduncle with small lobe on latero-distal margin with 2 lateral spines in female but 1 in male; 2 retinacula present.

Uropod 1 (Fig. 1a, 2e) with basofacial spine; strong apical spines implanted in partly hollow tip; interramal spine present.

Uropod 2 (Fig. 2f) with interramal spine; strong apical spines on both rami.

Uropod 3 (Fig. 2h) short; outer ramus 1-articulate, slightly longer than inner, both having 2 apical spines.

Telson (Fig. 2g) short, deeply cleft, apices with few tiny spinules and a subapical lateral setule set.

Genital papillae (Fig. 3b) of male midventrally on pereon segment 7.

Coxa gills (Fig. 2a, c, d) present on coxae 2–6; indistinctly stalked.

Oostegites (Fig. 2a, d) present on coxae 2–5; linear, with 2–4 apicomarginal spines.

Distinctive features. — *Thalassostygus exigus* n. g., n. sp. differs from *Dumosus atari* in the following respects: Gnathopod 2 much smaller; epimeral
Fig. 1. Thalassostygia exigua n. g., n. sp.: a, ♂ paratype 1.2 mm, b–e, ♀ holotype 1.7 mm, f, ♀ paratype 1.1 mm; b, seventh pereopod; c, fifth pereopod; d, sixth pereopod; e, second antenna; f, first antenna.
Fig. 2. *Thalassostygius exigus* n. g., n. sp.: a–h, ♀ holotype, i–j, ♀ paratype 1.2 mm; a, second gnathopod; b, first gnathopod; c, fourth pereopod; d, third pereopod; e, first uropod; f, second uropod; g, telson; h, third uropod; i, first pleopod; j, second pleopod.
Fig. 3. Thalassostygius exiguus n. g., n. sp: a, ♂ paratype 1.0 mm, b, ♂ paratype 1.1 mm, c, ♀ holotype, f, ♂ paratype 1.1 mm; a, maxilliped; b, genital papillae, freehand sketch; c, mandibular body; d, second maxilla; e, first maxilla; f, right incisor and molar; g, left ditto; h, lower lip; i, sketch of ovigerous female, carrying one single egg.

Plate 3 not posteroventrally serrate; uropod 3 rami not lanceolate or pointed; telson without strong spines or bifid apex; basis of pereopods 6–7 without serrate posterior margin; maxilla 1 inner lobe with 1 apical seta against 2, outer lobe with 6 spines against 7 and accessory flagellum with 2 against 3 articles in D. atari.

Accompanying fauna. — The amphipods Psammomelita uncinata Vonk, 1988, Idunella sketi Karaman, 1980, some specimens of the suborder Ingolfiellidea and some unidentified benthic amphipods. Other relevant groups of marine organisms present, were: Amphioxus and Microparasellidae (Isopoda).
Remarks. — *Elasmopus* is a circumtropical genus with members living in the infralittoral zone among algae, on sandy and muddy bottoms and on coral rubble. Like some other widely distributed genera as *Melita*, *Eriopisa* and *Nuuanu*, now *Elasmopus* also seems to represent a lineage with, up to now, one "satellite" (*Thalassostygius exiguis*) inhabiting the marine interstitial.

However, the relation of the new genus with *Elasmopus* is only very superficial. The shape of the gnathopods, the large coxal plates, the chaetotaxy of the mouthparts and the spatulate third uropod of *Thalassostygius* bear faint resemblances to *Elasmopus molokai* Barnard, 1970, from Hawaii.

The problem often encountered when searching for affinities is that the stygohabitat, and in this case the marine interstitial, requires certain adaptive modifications which are of general occurrence through many distantly related groups and are therefore of no phylogenetic significance (Notenboom, 1988).

One can recognize, roughly, two amphipod forms (the suborder Ingolfiellidae excluded) inhabiting the interstices of permanently immersed sediments along marine coasts:

1) The Hadzioïd/Melitoid group (Melitidae sensu Bousfield, 1973; emend. Stock, 1986), the Bogidiellid group (Coineau & Stock, 1986) and one member of Aoridae ("L'Hardy & Truchot, 1964), all with relatively slender bodies and long appendages *(i.e. Psammodamarus, Salweckelia, Eriopisella, Actogidiella, etc.)*, and

2) The Nuuanuid-Liljeborgiid-Salentinellid form with relatively small and compressed bodies and short appendages.

The current state of affairs is that the second group of coastal interstitial dwellers does not seem to have used the marine interstitial as an "entrance habitat" toward inland groundwaters. Examples are *Nuuanu curvata* Vonk, 1988 and *Idunella sketi* Karaman, 1980. An exception to this "rule" is formed by *Salentinella angeli* Ruffo & Delamare Deboutteville, 1952, which is found in stygial habitats in coastal regions with raised chlorinity as well as in freshwater conditions more inland (Platvoet, 1987).

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**Two marine interstitial *Metaniphargus* species (Crustacea, Amphipoda) from Hawaii and the Cayman Islands**

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**Abstract**

Two marine interstitial *Metaniphargus* species are studied, one from Oahu (Hawaii), another from Grand Cayman in the Caribbean. The male of the Hawaiian species was earlier described by Barnard (1970) as *Eriopisa laakona*.

*Metaniphargus sabuionis* n. sp. and *M. laakona* are characterized by a protruding lobe on the endopodite of the third pleopod of the male and by a long distal peduncular spine on the first uropod. A comparison with *Pseudoniphargus* is made, showing the tendency in marine interstitial species of having larger distributional ranges than their inland subterranean congeners.

**Résumé**


**Introduction**

The stygobiont hadzioid genus *Metaniphargus* Stephensen, 1933, occurs on many islands in the Caribbean and on the Venezuelan mainland (Stock, 1986). The genus consists of 23 described species and subspecies and inhabits a wide ecological range of subterranean waters, from the marine interstitial through brackish water to freshwater hypogean habitats. Normally, the ranges of close relatives are geographically adjacent. This is observed in *Metaniphargus* species from the Caribbean islands of Guadeloupe (Stock & Vermeulen, 1984) and Marie-Galante (Stock, 1980) and in the four species from Jamaica (Stock, 1983).

The marine interstitial species from Oahu (Hawaii) and Grand Cayman (Cayman Islands, Caribbean) are widely separated by the land-mass of Central America and show another pattern which will be commented upon later.

The material on which the description of *Metaniphargus sabuionis* is based is scanty, damaged, and the animals may not even be fully mature. Nevertheless, a description seems useful because this species, as the species from Hawaii, are important in respect to hadzioid distribution and phylogeny. Some additions to the description of *Metaniphargus laakona*, earlier described by Barnard (1970) as *Eriopisa laakona*, but transferred to *Metaniphargus* by Stock (1986), are given, based on 4 type specimens.

*Metaniphargus sabuionis* n. sp. (Figs. 1–4)

Material examined. – 1 ♂ holotype, 1 ♀ allotype, Amsterdam Expeditions to the West Indian Islands Sta. 79–83, Grand Cayman: S. coast, W. of Savannah, John Bodden’s Bay, 19°16’

Fig. 1. *Metaniphargus sabulonis* n. sp., ♀ holotype; a, third uropod (scale A, Fig. 4); b, fifth pereopod (C); c, seventh pereopod (C); d, sixth pereopod (C); e, maxilliped (A); f, telson, left lobe, m = medial (A); g, second antenna (C); h, third pereopod (C).

Description. - Body length 2.1 mm. Blind, unpigmented.

First antenna (Fig. 2f): Peduncle segment 1 with 1 ventral spine; segment 2 as long as segment 1; segment 3 half as long as segment 2. Accessory flagellum (Fig. 2g) as long as flagellum segment 1, 2-segmented, armed with 3 + 3 setules. Flagellum 14-segmented; aesthetascs found on segments 8 to 13.

Second antenna (Fig. 1g) with rounded gland cone. Flagellum broken off. Peduncle segment 3 with 1 strong distal spine.

Mandibles asymmetrical. Right mandible (Fig. 3e) with a bifid, finely toothed lacinia mobilis, followed proximad by a strong spine and a strong plumose spine. Left mandible with a lacinia mobilis armed with 4 lateral teeth, followed proximad by 5 plumose setae. Pars molaris with 1 seta. Palp with 2 seta on segment 2; segment 3 with 4 short setae on ventral margin and 2 long distal setae.

Labium (Fig. 3i) without distinguishable inner lobes.

First maxilla (Fig. 3g) with asymmetrical palps, left one being more slender, the 4 distal spines on the left palp also being more slender than those on the right palp. Outer lobe with 7 distal spines of which the 3 lateralmost without denticles. Inner lobe rounded, armed with 5 setae.

Second maxilla (Fig. 3h): Outer lobe with 10–12 distal setae; inner lobe with 7–10 distal setules and an oblique row of 5 robust setae.

Maxilliped (Fig. 1e): Inner lobe short with 3 wide distal spines; outer lobe with 3 short barbed spines on medial margin and 3 longer, finely toothed distal setae.

First gnathopod (Figs. 2b, 3b): Heavier setation in male; palmar corner σ with 3 spinules of which 1 longer and bifid, in Ψ several more spinules but more slender and without a bifid one. Propodus oblong with erratically scattered groups of setae, more in male than in female. Carpus subequal to propodus, with many long setae, some barbed in male. Merus with rugose patch. Ischium with one long spine and a few setules. Basis elongate, 2 posterior spines in male, 1 lateral in female.

Second gnathopod (Figs. 2c, 3a, c) also dimorphic. In male the dactylus is conspicuously longer relative to the proximal margin of the propodus; palmar margin lined with pairs of bifid spinules, not so in female; propodus ovate; carpus smaller than propodus, in male with 4 groups of 3 setae, in female with 3 such groups.

Third (Fig. 1h) and fourth pereopods similar. Slender, with 1 long seta on posterior margin of basis. Rather small, rounded coxal plates (Fig. 4g).

Fifth pereopod (Fig. 1b) shorter than sixth. Basal segment with straight to convex posterior margin, armed with 4–5 spinules. Distal spines on propodus exceed length of dactylus. Coxal plate anterolobate (Fig. 4g).

Sixth and seventh pereopods (Figs. 1d, 1c) of about equal length and form. Posterior margin of basal segment nearly straight with 5–6 spines. Sixth pereopod with longer propodal spines than seventh. Sixth coxal plate slightly anterolobate; seventh small, non-lobate.

Pleopods: Third male pleopod (Fig. 3f) with strongly produced, recurved lobe on the first segment of the endopodite whereas the female (Fig. 2d) lacks this feature completely. All pleopods with 2 retinacula.

Epimeral plates (Fig. 4g) with an acute ventro-posterior corner and a posterior setule.

First uropod (Fig. 2e): Peduncle with subbasal spine and a very long distal spine; exopodite slightly shorter than exopodite; endopodite with 1 marginal spine.

Second uropod (Fig. 2a): Peduncle with a small row consisting of 1 longer and 3 shorter spines at the base of the endopodite; endopodite with 2 marginal spines.

Third uropod (Fig. 1a) without plumose setae. Exopodite 2-segmented; endopodite small.

Telson (Fig. 1f) completely cleft. Each lobe with 1 long distolateral spine, 1 short distomedial spine. Coxal gills (Fig. 4f) present on coxae 2–6, with a small stalk.

Oostegites not observed.

Etymology. - the specific name, sabulonis, refers to coarse sand and gravel, the habitat of the species.
Fig. 2. *Metaniphargus sabulonis* n. sp., ♀ holotype, ♂ allotype; a, second uropod, ♂ (scale A, Fig. 4); b, first gnathopod, ♀ (A); c, second gnathopod, ♂ (A); d, third pleopod, ♀ (A); e, first uropod, ♂ (A); f, first antenna, ♂ (D); g, accessory flagellum (B).
Fig. 3. *Metaniphargus sabulonis* n. sp., ♂ holotype, ♀ allotype; a, second gnathopod, ♂ (scale C, Fig. 4); b, first gnathopod, ♂ (A); c, propodus and dactylus of second gnathopod, ♀ (B); d, left mandibular body, ♀ (A); e, right mandibular body, ♀ (A); f, third pleopod, ♂ (A); g, right first maxilla, ♂ (B); h, second maxilla, ♂ (B); i, labium, ♂ (A).
Fig. 4. *Metaniphargus laakona* (Barnard, 1970), ♂ and ♀ paratypes; a, right first maxilla, ♀ (scale B); b, second maxilla, ♀ (B); c, right mandibular body, ♀ (B); d, fourth coxal plate, ♀ (A); e, third pleopod, ♂ (B). *Metaniphargus sabulosus* n. sp., ♀ allotype; f, gill of third pereopod (A); g, coxal and epimeral plates (C).
Distinctive features. — *Metaniphargus sabulonis* differs from *M. laakona* (vide infra) only in minor aspects: spines present on the palmar margin of the propodus of the second gnathopod in the male of *M. sabulonis* (versus absent in *M. laakona*), 4 D-setae on the mandibular palp (vs. 7), 4 distal spines on palp of first maxilla (vs. 5).

Both species are differing from other species in *Metaniphargus* s. 1. by the long distolateral peduncular spine on uropod 1 and low number of setae on the inner lobe of maxilla 1. Their resemblance to one of the subgenera created by Stock (1985) is best matched in *Guadzia* but remains superficial. The strongly produced lobes on the proximomedial part of the endopodite of the third pleopod in the male, the different spination on the palmar edge of the second gnathopod in male and female, and the long peduncular spine on uropod 1 prevent a ranking with *Guadzia*. Comments on the polarity of the earlier mentioned character states seem premature: more marine interstitial species of *Metaniphargus* may help elucidate this matter.

In *Saliweckelia*, a genus consisting of 3 species recorded from Curaçao, Bonaire and the Venezuelan island of Tortuga, a morphology of the σ third pleopod similar to that in *M. sabulonis* and *M. laakona* is encountered. This corroborates the view of Holsinger et al. (1986), who hypothesized a sister-group relation between *Saliweckelia* and *Metaniphargus*.

*Metaniphargus laakona* (Barnard, 1970) (Fig. 4)

*Eriopisa laakona* Barnard, 1970: 141–143, Figs. 85, 86
*Metaniphargus laakona*; Stock, 1986: 512

Material examined. — 4 paratypes (1 σ, 3 Φ) from the intertidal of Kawela bay, Oahu, Hawaiian Islands, 24 May 1967. Deposited in the B.P. Bishop Museum, Honolulu, catalog number 7274, JLB Hawaii 12, 17.

Descriptive notes additional to the original description. — First maxilla (Fig. 4a) with asymmetrical palps, left palp more slender than right one; left palp armed with 5 slender distal spines, right palp armed with 5 robust distal spines. Outer lobe with 8 spines, 3 lateralmost spines without denticles. Inner lobe small, with 7 setae.

Second maxilla (Fig. 4b) inner lobe with oblique row of 7 spines.

Mandibles (Fig. 4c): Right mandible with finely toothed lacinia mobilis followed proximad by a stiff, hollow spine with several thin setules protruding from it, and laterally accompanied by 2 shorter spines.

Second gnathopod in male with a slightly wider propodus and longer dactylus, without row of spinules along palmar edge. Inner margin of dactylus with 4 spinules in male, 2 in female.

Fourth coxal plate (Fig. 4d) oblong, without excavation.

Gills stalked, oostegites not found.

Third pleopod σ (Fig. 4e) with a well-produced lobe on lateral margin of the first segment of the endopodite, lacking in Φ, and a bulbous swelling on the medial margin of the first segment of the exopodite; 2 retinacula.

Remarks. — The morphological similarity between *M. sabulonis* from Grand Cayman in the Caribbean and *M. laakona* from one of the Hawaiian islands is quite remarkable. Several authors, whose opinions on Caribbean paleogeography are summarized in Rosen (1985), estimate the closing of the Isthmian corridor to have happened in the late Miocene. From that time onward tropical Atlantic and Pacific marine organisms were genetically separated. However, this seems to have had but little influence on the morphology of marine interstitial *Metaniphargus*.

A comparison in colonization history with another hadzioid genus, *Pseudoniphargus* Chevreux, 1901, can be relevant. Members of this genus have a western Mediterranean/amph-Atlantic distributional range (Notenboom, 1990), occur in marine, anchialine and freshwater hypogean habitats and are mostly endemic to small areas but for one marine/polyhaline species. This species, *P. adriaticus* S. Karaman, 1955, is the only wide-spread species although the distant populations are phenotypically differentiated. Notenboom (1988: 199) presumes that *P. adriaticus* “is a rather young expanding and euryoecious species that penetrated into the Mediterranean basin in a later stage of the history of the genus.” He also notes (Notenboom, 1989:10) that
"species distributed in coastal or littoral habitats have more extended distributions than their inland congeners (e.g., Hadzia fragilis S. Karaman, 1932, Metaniphargus haitianus Stock, 1985, and Pseudoniphargus adriaticus ...)." His remarks may also pertain to the marine metaniphargus from Oahu and Grand Cayman although their expansion must have taken place before the closing of the Isthmian corridor, while the settlement of P. adriaticus in the Mediterranean seems to be of a rather recent and probably post-Messinian date.

When observed on a global scale it might be possible that the two metaniphargids had an ancestor which not only inhabited the tropical coasts of the America's but also those of the Paratethys in an eastward direction. The disruption of the Paratethys through the landbridge between Eurasia and Africa is situated in the upper Miocene (Rögl & Steininger, 1983) and coincides roughly with the closing of the Isthmian corridor.

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