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ANAMIXIDAE (AMPHIPODA: CRUSTACEA) FROM THE ANDAMAN SEA, NORTH-EASTERN INDIAN OCEAN

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ABSTRACT

Anamixidae (Amphipoda) are here reported for the first time in the Andaman Sea. Specimens were obtained using SCUBA and from the Reference Collection at Phuket Marine Biological Center. Of the Anamixidae collected from oysters, live coral, and coral rubble at depths not exceeding 20 m we record here one known species: *Anamixis kateluensis* and three, possibly undescribed species: *Paranamixis* sp. A, *Paranamixis* sp. B, and *Nepanamixis* sp. A. Illustrations and discussion of the characters that differentiate these species from resembling known species are provided.

INTRODUCTION

The amphipod family Anamixidae comprises three genera: *Anamixis* with 19 species, *Paranamixis* with 11 species, and *Nepanamixis* with four species. The taxonomy, ecology and phylogeny of the Anamixidae were revised by Thomas (1997), who, in a comprehensive monograph, also provided a key to the 33 valid species. Thomas (1997) regarded *Anamixis torrida* Barnard, 1970 as invalid because the original description was based on leucomorphs and 'probably represents several species of possibly *Anamixis* and *Paranamixis*'. More recently Ortiz and Lalana (1997) described *Paranamixis ledoyeri* from Bunaken, Sulawesi, and Lyon and Myers (1990) reported a single specimen of a potentially new species of *Paranamixis* from the Gulf of Aqaba, Red Sea.

The Anamixidae are mainly tropical and subtropical species, occurring in shallow waters of the Indian Ocean, Pacific Oceans, and the Caribbean, with only one species recorded from deeper cold water (Thomas, 1997).

Anamixids have a cryptic life style on coral reefs, living concealed in coral rubble and among boulders and algae tufts (Moore, 1987; Lyons and Myers, 1990; Thomas, 1997). Anamixid species are often found in samples of various sponges and ascidians, which live attached to algae and hard bottom faces (Moore, 1987; Thomas, 1997). The few anamixid species that have been studied alive inhabit asconoid sponges as well as solitary and compound colonial ascidians (Thomas, 1979, 1997; Thomas and Taylor, 1981). Although they have been found to live as commensals, suspension feeding using the host-generated water current (Thomas, 1979; 1981; Thomas and Taylor, 1981), other feeding habits may occur (Thomas and Taylor, 1981; Thomas, 1997).

Thomas and Barnard (1983) described the remarkable life cycle shown by anamixids. This involves two highly different developmental stages, in which males pass through a single moult from

an initial 'leucomorph' stage (males and females) into a hyperadult 'anamorph' stage (terminal males only). Anamorphs exhibits many morphological characters of great taxonomic value, and can readily be identified to species. At the leucomorph developmental stage, anamixids species are nearly identical, and according to Thomas (1997) the extreme morphological dissimilarities from the anamorph developmental stage explain the assignment of leucomorphs to *Leucothoides* (family Leucothoidae) prior to Thomas and Barnard (1983). To date studies of the developmental stages by *in situ* rearing experiments have resolved the leucomorph–anamorph relationship of only four anamixid species (Thomas and Barnard, 1983; Thomas, 1997).

We give here the first account of Anamixidae collected from the Andaman Sea, providing records of one named species and three potentially new species. Illustrations of character states deviating from similar known species are provided.

Abbreviations and terminology

BIOSHELF = The Thai–Danish Scientific Cooperation Program Biodiversity of marine fauna of Continental Shelf in the Andaman Sea between Phuket Marine Biological Centre (PMBC), Phuket, Thailand and Zoological Museum, University of Copenhagen (ZMUC), Denmark.

G1–2 = Gnathopod 1–2.

MATERIALS AND METHODS

The material examined comes from: 1. The PMBC Reference Collection, PMBC; 2. Material collected by the authors during the BIOSHELF Crustacea Workshop December 1998. Collections were made by hand while SCUBA diving, notably from heavily encrusted oysters, *Hyotissa hyotis* (Linnaeus, 1758) attached to corals and boulders. Material was sieved (mesh size 1 mm) and fixed in a 4% formaldehyde borax-neutralised seawater solution and transferred to 70% ethanol after one week.

Oysters were identified from Oliver (1992). Anamixid specimens were examined under dissecting microscope and compound light microscopes and drawn using a camera lucida. Anamixids were identified from Walker (1904), Schellenberg (1938), Ledoyer (1982), Myers (1985), Moore (1987), Lyons and Myers (1990). Barnard and Karaman (1991), Ortiz and Lalana (1997) and Thomas (1997). At present we have not had the opportunity to compare the potential new species with type material of the most similar described species. This is needed before verification can be provided in form of valid new species descriptions or redescriptions.

Stations

The BIOSHELF stations are listed elsewhere in this volume. The stations referred to in the text from the 1981–82 collection by Jorgen Hylleberg and Anuwat Nateewathana and sorted by Somchai Bussarawit at Patong, Surin Island and Similan Islands have the following data: 1981–82,coll-7, Surin, mangrove bay, 3 m, on/in oyster; 1981–82, coll-8, Surin, strait, 0.5 m, dead *Goniastrea retiformis* (Lamarck); 1981–82, coll-9, Surin, 3 m, oyster shell; 1981–82, coll-10, Surin, mangrove bay, 5 m, old coral block; 1981–82, coll-11, Surin, mangrove bay, porous live coral; 1981–82, coll-12, Surin, mangrove bay, in *Goniastrea retiformis;* 1981–82; coll-14, Surin, 0.5 m, dead coral; 1981–82, coll-15, Surin, mangrove bay, on/in oyster; 1981–82, coll-17, Surin, strait, 0.5 m, dead *Goniastrea retiformis* 1981–82, coll-19, Surin, N-S strait, 3 m, oyster; 1981–82, coll-20, Similan W, 5 m, dead coral and *Montipora;* 1981–82, coll-21, Similan, 5 m, dead *Acropora* sp.; 1981–82, coll-22, Similan, mangrove bay, 5 m, in *Goniastrea retiformis;* 1981–82, coll-23, Surin, 3 m, oyster shell.

RESULTS

Family Anamixidae Stebbing, 1897

Material examined

***Anamixidae* spp. (leucomorphs):** PMBC 14917, 1 specimen, 1981–82, coll-8; PMBC 14918, 1 specimen, 1981–82, coll-12; PMBC 14919, 5 specimens, 1981–82, coll-12; PMBC 14920, 2 specimens, 1981–82, coll-14; PMBC 14921, 2 specimens, 1981–82, coll-17.

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***Anamixis–Paranamixis* spp. (leucomorphs):** PMBC 14926, 3 specimens, Racha Yai Island, southern point, 07º35.21´N, 098º21.48´E, SCUBA max. depth 30 m, coll. G. Dinesen and T. Jansen, 5.12.1998; PMBC 14927, 13 specimens, Hi Island, southern bay, 07º44.38´N, 098º22.10´E , SCUBA max. depth 12 m, coll. G. Dinesen and T. Jansen, 9.12.1998; PMBC 14912, 6 specimens, 1981–82, coll-7; PMBC 14913, 4 specimens (in poor state), 1981–82, coll-9; PMBC 14914, several specimens, 1981–82, coll-10; PMBC 14915, 5 specimens (in poor state), 1981–82, coll-15; PMBC 14916, 1 specimen, near PMBC pier, 07º48.048´N, 098º24.440´E, intertidal flats, coll. A. Myers, 06.12.1998.

Remarks

Leucomorph specimens of most *Anamixis* and *Paranamixis* are currently indistinguishable from each other (Thomas, 1997).

Leucomorph specimens in PMBC 14926 were found together with four terminal males of *Paranamixis* sp. B, while leucomorphs in PMBC 14927 were found together with one terminal male of *Paranamixis* sp. B. and one terminal male of *Paranamixis* sp. A.

Genus *Anamixis* Stebbing, 1897

Anamixis kateluensis Thomas, 1997

Anamixis kateluensis Thomas, 1997: 57–59, fig. 10.
Anamixis stebbingi J.L. Barnard, 1965: 488–489, fig. 4.

Material examined

Anamorphs: PMBC 14922, 3 specimens, 1981–82, coll-19; PMBC 14923, 1 specimen, 1981–82, coll-20; PMBC 14924, 1 specimen, 1981–82, coll-21; PMBC 14925, 3 specimen, 1981–82, coll-23.

Remarks

The three specimens in 1981–82, coll-19 differ minutely from the drawings and descriptions given by Thomas (1997, fig. 10 “K” C and fig. 10 “K” B). Coxa 1 bears teeth on the ventral side and lacks the anterodistal projection. According to Thomas (1997) the leucomorphs are unknown.

Habitat and Distribution

Surin Island and Similan Islands, Andaman Sea. From oyster shells and dead coral. Previously reported from coral rubble in the central Pacific Ocean, Ifaluk Atoll, Falarik Island, Caroline Islands, 0–1 m (Thomas, 1997).

Genus *Paranamixis* Schellenberg, 1938

Paranamixis sp. A
(Fig. 1a–b)

Material examined

Anamorphs: PMBC 14928, 1 specimen, PMBC near pier, 07º48.048´N, 098º24.440´E, intertidal flats, coll. A. Myers, 06.12.1998; PMBC 14928, 1 specimen, Hi Island, southern bay; PMBC 14929, 2 specimens, PMBC pumping station, 07º47.938´N, 098º24.533´E, SCUBA 2–4 m, coll. T. Jansen, 09.12.1998.

Remarks

Paranamixis sp. A. differs from *Paranamixis* sp. B. by the small rounded process on the anterodistal margin of coxa 2. *Paranamixis* sp. A. differs from the other species in the genus (including the undescribed species found by Lyons and Myers, 1990) by the combination of following characters: coxa 2 anterodistal margin with small rounded process; G2 basis anterior margin smooth; G2 dactylus posterior margin with 3 small teeth medially, and 1 large tooth 1/3 from apex, margin smooth on distal third.

Paranamixis sp. B
(Fig. 1c)

Material examined

Anamorphs: PMBC 14930, 4 specimens, Racha Yai Island, southern point, 07º35.21´N, 098º21.48´E, SCUBA max. depth 30 m, coll. G. Dinesen and T. Jansen, 05.12.1998; PMBC 14931,

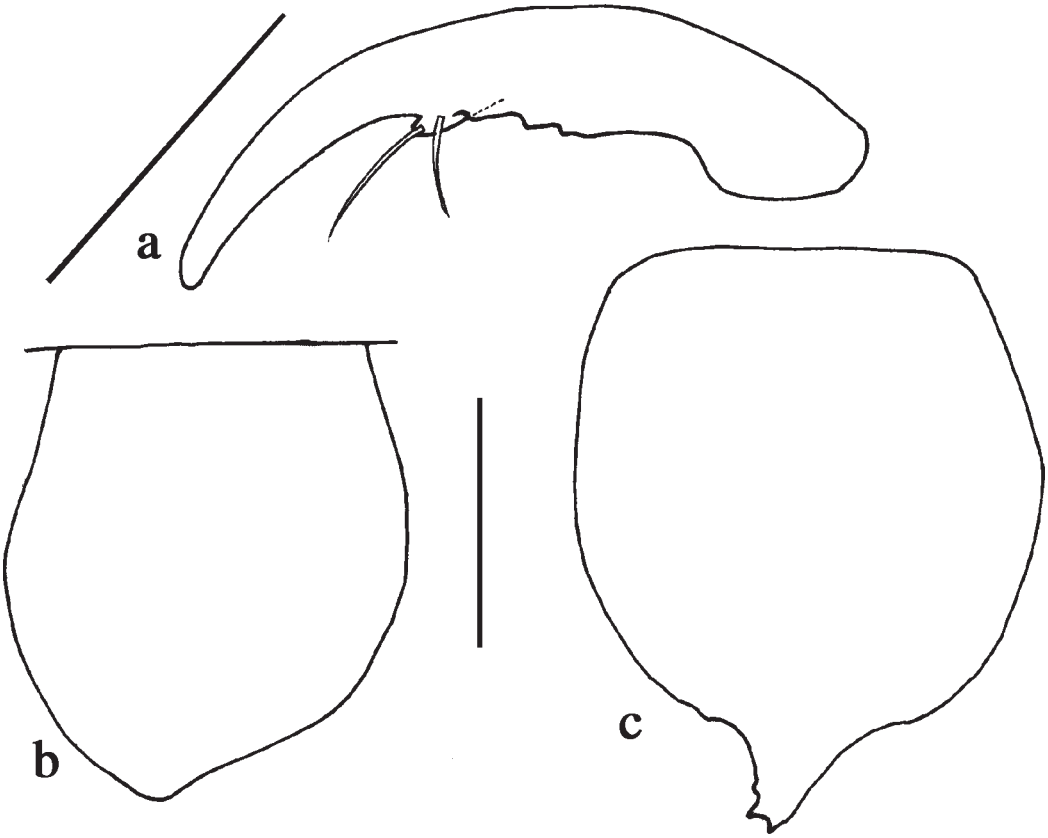

Figure 1 *Paranamixis* sp. A (anamorph). (c) *Paranamixis* sp. B (anamorph)
(a) G2 dactylus. (b) Coxa 2. (c) Coxa 2. (a) upper bar = 0.2 mm. (b–c) lower bar = 0.2 mm.

1 specimen, Hi Island, southern bay, 07º44.38´N, 98º22.10´E, SCUBA max. depth 12 m, coll. G. Dinesen and T. Jansen, 09.12.1998.

Remarks

Paranamixis sp. B. differs from *Paranamixis* sp. A. by the large denticulate process on the anterodistal margin of coxa 2. *Paranamixis* sp. B. differs the other species in the genus (including the undescribed species found by Lyons and Myers, 1990) by the combination of following characters: coxa 2 anterodistal margin with large denticulated process; G2 basis anterior margin smooth; G2 dactylus posterior margin with 3 small teeth medially, and 1 large tooth one-third from apex, margin smooth on distal third.

Genus *Nepanamixis* Thomas, 1997

Material examined

***Nepanamixis* spp. (leucomorphs):** PMBC 14935, 1 specimen, Hae Island, southern bay, 07º44.38´N, 098º22.10´E, SCUBA max. depth 12 m, coll. G. Dinesen and T. Jansen, 09.12.1998; PMBC 14932, 25 specimens, 1981–82-coll-10.

Remarks

The 25 specimens were found together with one anamorph specimen of *Nepanamixis* sp. A.

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Nepanamixis sp. A
(Fig. 2a–c)

Material examined

Anamorphs: PMBC 14933, 1 specimen, 1981–82-coll-10; PMBC 14934, 1 specimen, 1981–82-coll-22.

Remarks

The shape of G1 carpus and propodus, together with the 13 (rather than 9) ommatidea, distinguishes this species from the other species of *Nepanamixis*, although the authors have not yet had the opportunity to examine the type material of *N. grossimana* (Ledoyer, 1978). *Nepanamixis* sp. A is most closely related to *N. grossimana* (as figured in Thomas, 1997), but it differs from this species in several details: ventral margin of coxa 1 bears a triangular process; palm of G1 carpus lacks tubercles and cusps; apex of propodus is without the "thick spine". *Nepanamixis* sp. A shares at least two characters with *N. grossimana* separating them from all other species in the genus namely: one very robust setae on the apex of G1 carpus and a nodulose inner margin of G1 propodus. *Nepanamixis* sp. A shares at least two characters with *N. grossimana* and *N. dianthus* Thomas, 1997, separating these three species from the remaining species in the genus namely: emarginate ventral margin of coxa 4; general shape of G2.

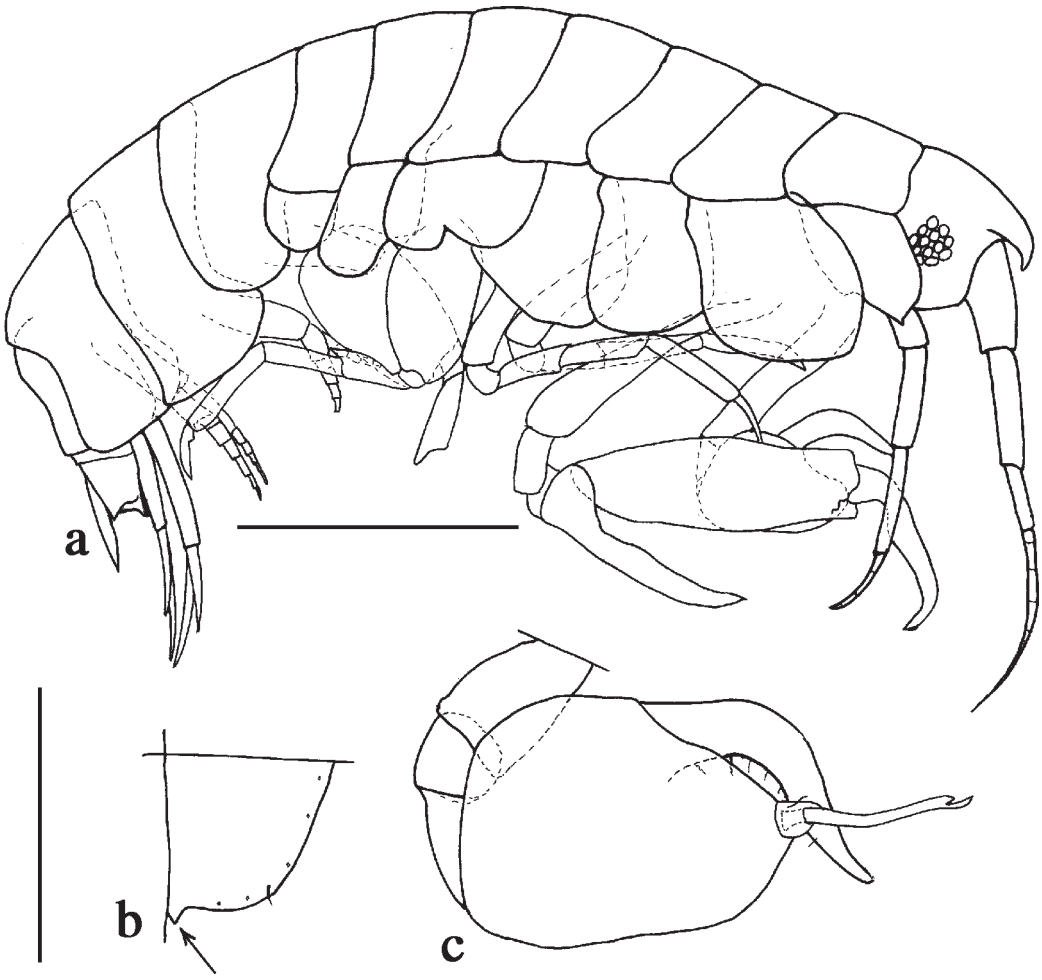

Figure 2 *Nepanamixis* sp. A (anamorph).
(a) Whole specimen. (b) Coxa 1. (c) G1. (a) upper bar = 1.0 mm. (b–c) lower bar = 0.2 mm.

DISCUSSION

A total number of 19 anamorph specimens of three, possibly four anamixid species have been recorded from Surin Island, the Similan Islands and Phuket Island. The small number of SCUBA samples from coral reef and coral rubble in the Andaman Sea contributes to the low numbers recorded from this area. Our limited sampling does show that anamixid amphipods are common in these habitats. Anamixids were found together with live oysters (*Hyotissa hyotis*) and coral (*Montipora* sp., and *Goniastrea retiformis*) as well as oyster shells and coral rubble (*e.g.* from *Acropora*). This agrees with the usual types of substrata from which anamixids are collected. The oysters and corals are not the true anamixid hosts. Instead they are likely to provide a substrate for sessile animals such as ascidians and asconoid sponges, the only organisms so far known to act as host for anamixid amphipods. Additional local sampling on this type of substratum is therefore likely to reveal additional species of these cryptic-living amphipods. Ship-operated sampling techniques are not practical on rocky bottoms, and sampling shallow water using SCUBA is strongly recommended for collecting anamixids. This technique allows selective and precise sampling of potential invertebrate hosts (epiphytic and epizoic sponges and ascidians) and could thereby provide valuable information on the host relationships of the commensal Anamixidae.

The species identification of the anamixids is based entirely on anamorph males, as leucomorphs cannot be assigned to any species. As Thomas and Barnard (1983) and Thomas (1997) indicated, only *in vitro* rearing of sponges and ascidians hosting leucomorph anamixids will allow male leucomorphs to moult to their anamorph stage, which would help to establish the leucomorph–anamorph species correlation.

The two *Paranamixis* species recorded here are only separated by one morphological difference, a difference that could easily be within the variation range of one species. Although the 10 (5 of each) examined specimens showed no intermediate forms, it would be preferable to analyse the variation more thoroughly by examining a more numerous material. At present the authors have not yet had the opportunity to compare the potentially undescribed species with type material of the most similar species, and a final determination of their identity has not been made.

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REFERENCES

Barnard, J.L. and G.S. Karaman 1991. The families and genera of marine Gammaridean Amphipoda (except marine Gammaroids) Part 1. Records of the Australian Museum, Supplement **13** (Part 1): 1–417.

Ledoyer, M. 1982. Crustacés Amphipodes Gammariens. Familles des Acanthonotozomatidae à Gammaridae. Faune de Madagascar **59**(1): 1–598, figs. 226.

Lyons, J. and A.A. Myers 1990. Amphipoda Gammaridea from coral rubble in the Gulf of Aqaba, Red Sea: Families Acanthonotozomatidae, Ampeliscidae, Ampithoidae, Anamixidae, Aoridae and Colomastigidae. Journal of Natural History **24**: 1197–1226.

Moore, P.G. 1987. Taxonomic studies on Tasmanian phytal amphipods (Crustacea): The families Anamixidae, Leucothoidae and Sebidae. Journal of Natural History **21**(1): 239–262.

Myers, A.A. 1985. Shallow-water, coral reef and mangrove Amphipoda (Gammaridea) of Fiji. Records of the Australian Museum, Supplement **5**: 1–143, figs. 109.

Oliver, P.G. 1992. Bivalved seashells of the Red Sea. Hemmen, Weisbade and National Museum of Wales, Cardiff. 330 p.

Ortiz, M. and Lalana R. 1997. Amphipoda. **In**: Modest Gutu (ed.). Results of the zoological expedition organized by Grigore Antipa Museum in the Indonesian Archipelago (1991). I. Peracarida (Crustacea) pp. 29–114*,* Travaux du Museum National d´Histoire Naturelle Grigore Antipa **38**.

Schellenberg, A. 1938. Litorale amphipoden des tropischen pazifiks. Kungliga Svenska Vetenskabsakadamiens Handlingar, Serie 3, **16**(6): 1–105.

Thomas, J. D. 1997. Systematic, ecology and phylogeny of the Animixidae (Crustacea: Amphipoda). Records of the Australian Museum **49**: 35–98.

Thomas, J.D. 1979. Occurrence of the amphipod *Leucothoides pottsi* Shoemaker in the tunicate *Ecteinascidia turbinata* Herdman from Big Pine Key, Florida, U.S.A. Crustaceana **37**: 107–109.

Thomas, J.D. and J.L. Barnard 1983. Transformation of the *Leucothoides* morph to the *Anamixis* morph (Amphipoda). Journal of Crustacean Biology **3**: 154–157.

Thomas, J.D. and G.W. Taylor 1981. Mouth part morphology and feeding strategies of the commensal amphipod, *Anamixis hanseni*. Bulletin of Marine Sciences **31**: 462–467.

Walker, A.O. 1904. Report on the Amphipoda collected by professor Herdman, at Ceylon, in 1902. Ceylon Pearl Oyster Fisheries, Supplementary Reports **17**: 299–300, pls. 8.

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