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Species and distribution of gammarid amphipods associated with macro-algae at Samaesan Island, Chon Buri Province, Thailand

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Abstract

The Gammarid amphipod is one of the major benthic invertebrates associated with macro-algae in the coastal area. This work aimed to study the species diversity of gammarid amphipods inhabited macro-algae hosts at Samaesan Islands, Chon Buri Province, in February and October 2023. A total of 19 species in ten families were identified. *Cymadusa cavimana* (Sivaprakasam, 1970), *Cymadusa tattersalli* Peart, 2004; *Paragrubia vorax* Chevreux, 1901; *Elasmopus nanshaensis* Ren, 1998; *Apolochus likelike* (Barnard, 1970); *Ericthonius brasiliensis* (Dana, 1853); and *Gammaropsis longiseta* Ren, 2006 are reported for the first time from Thai waters. Five species are apparently unidentified. These shallow-water species represent mostly those associated with algae. The most diverse family in this study is Amphithoidae (five species), followed by Maeridae and Photidae. Illustrations and descriptions of each species are provided.

Keywords
amphipoda, biodiversity, upper Gulf of Thailand

Introduction

The amphipod is one of the major benthic invertebrate crustaceans in Superorder Peracaridea (Calman, 1904). They are commonly known as scuds, sandhoppers, land-hoppers, or side swimmers, which are classified into six suborders, namely, Amphilochidea, Colomastigidea, Hyperiidea, Hyperiopsidea, Pseudingolfiellidea, and Senticaudata (includes species formerly part of Gammaridea and Caprellidea) (Lowry and Myers, 2013). There are almost 10,000 described species of 221 families, 444 subfamilies, and 1,664 genera of Amphipoda. Of those genera, 300 terrestrial, 1,900 freshwater, and 7,800 marine species exist, which are benthic. Amphipoda inhabits coastal ecosystems in the hard bottom, *i.e.*, coral reefs, algal beds, rocky shores, and soft bottom, *i.e.*, mangrove forests,

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seagrass beds, sandy beaches, and mud flats. They were reported from tropical to polar, deep-sea, or hydrothermal vents (Arfianti and Costello, 2020). In algal beds, most amphipods are free-living, either burrowing in sandy and soft sediment areas, residing among seaweeds, or taking shelter under rocks. Among these, most are herbivores. The Ampithoidae, Hyalidae, and Aoridae are commonly found on algal fronds and branches. Certain groups bore into the stipes and thallus of fucoid algae, such as the Melitidae, Maeridae, and Liljeborgiidae. Caprellids and podocerids are frequently observed clinging to seagrasses, seaweed, and other marine surfaces subject to water currents. Subtidal soft sediments often host oedicerotids, phoxocephalids, and ampeliscids (Hughes and Ahyong, 2016). Amphipoda is a crucial component in trophodynamics, not only link the primary to secondary production but also link benthic pelagic communities. They are major food sources for juvenile and adult fish, including the economic species. Moreover, amphipods also play an important role in bioturbation, increasing the sediments' oxygen level and reducing the ecosystems' organic material (Pelegrí and Blackburn, 1994; Mermillod-Blondin *et al.,* 2004)

The Samaesan Island is located in the upper Gulf of Thailand, southward of Sattahip District, Chon Buri Province. The islands are surrounded by coral communities and algal beds, including four species of *Sargassum* (*S. aquifolium, S. oligocystum, S. polycystum* and *S. swartzii*) with other seaweeds such as *Turbinaria conoide*s, *Padina australis, Padina santae-crucis, Lobophora*, that provide suitable habitats for amphipods (Noiraksar *et al*., 2017). However, the research on amphipod diversity is still rare. Only the previous reports of Wongkamhaeng *et al*. (2009) and Wongkamhaeng *et al*. (2013) reported seven species of amphipods from the Southern Sea Islands and one species from Samaesan Island. This study aims to determine the amphipod species associated with algae found in the islands' intertidal/ shallow subtidal zone and their occurrence and diversity, emphasizing algal substrates.

Materials and methods

Sampling and sorting of amphipods

The study area is in Samaesan Island, Chon Buri Province, in the upper Gulf of Thailand (Figure 1). The sampling sites included Samaesan Villa, Nang Rong Beach, Phra Island, Chorakhe Island, and the *Caulerpa lentillifera* cultural pond in Samaesan Island. The amphipods were sampled from different macro-algae, including *Sargassum* (*S. aquifolium, S. oligocystum, S. polycystum*, and *S. swartzii*), *Turbinaria conoide*s, *Padina australis, Padina santae-crucis,* and *Lobophora* (Noiraksar *et al*., 2017) from February to October 2023. The sites were visited at low tide, and samples were collected from intertidal and shallow-subtidal zones. The substrates were transferred to plastic bags, fixed by 70% ethanol and transported to the laboratory. Ethanol was used as an irritant and a poison, causing animals to release their hold on substratum (Barnard, 1976)

Samples were washed by tap water, and were then poured over a 30-cm diameter sieve with a mesh size of 0.5 mm. The sieve was then placed in a tray that contained sufficient water over the sediments and was agitated vigorously. Because of vertical agitation of the sieve and aeration of the submerged sample, the amphipods float to the surface. The animals were then picked up by forceps and transferred to vials containing 70% ethanol. The procedure was repeated 5 times to ensure that all amphipods were collected. Algal surfaces were checked for amphipods that might have remained on them. The animals were dissected by the technique outlined by Barnard and Karaman (1991) and identification was made, based on some of the guidelines set by Ren (2006, 2012). The species are reported following the superfamily classification of amphipod families given by Horton *et al*. (2023).

Results

A total of 19 species belonging to 16 genera and ten families were identified (Table 1). Of these seven species are new records to Thai waters, and five were unidentified. Most of them were previously reported as algal-associated species. The dominant family is family Amphithoidae (5 species) followed by Maeridae and Photidae (3 species).

Table 1 A list of amphipods found in the study area. New species recorded Thai Waters are marked with "*".

Family	Taxa	Sites				
		Samaesan Villa	Nang rong Beach	Phra Island	Cho rake Island	Samaesan Island
Ampithoidae	*Ampithoe ramondi*	+	+	+	-	-
	Ampithoe sp.	+	-	-	-	-
	Cymadusa cavimana	+	+	+	+	-
	*Cymadusa tattersalli**	+	+	-	+	-
	*Paragrubia vorax**	-	+	-	-	-
Amphilochidae	*Apolochus likelike**	-	+	-	+	-
Aoridae	*Bemlos* sp.	+	+	+	+	-
	Grandidierella halophila	+	-	-	-	+
Ischyroceridae	*Ericthonius brasiliensis**	+	-	+	-	-
Hyalidae	*Hyale* sp.	+	+	+	-	-
Leucothoidea	*Leucothoe spinicarpa*	+	+	+	-	-
Maeridae	*Elasmopus nanshaensis**	+	+	+	-	-
	Maeropsis paphavasitae	-	+	+	-	-
	Ceradocus sp.	-	+	-	+	-
Melitidae	*Dulichiella pattaniensis*	+	-	+	-	-
Photidae	*Photis longisetis*	+	+	-	-	-
	Gammaropsis sp.	+	-	-	-	-
	*Gammaropsis longiseta**	-	-	-	+	-
Podoceridae	*Podocerus andamanensis*	+	+	+	+	-
Total number of species		14	13	10	7	1

Studies of morphological characteristic and geographical distribution

Suborder Senticaudata Lowry & Myers, 2013

Family Ampithoidae

***Ampithoe ramondi* Audouin, 1826**
(Figure 2A)

Ampithoe ramondi Audouin, 1826: 93 Type locality: Egypt
Ampithoe ramondi: Barnard, 1965: 28; Barnard, 1970: 50, fig 18, 19; Nagata, 1965: 315; Hirayama, 1983: 116; Rabindranath, 1972: 162, figs 1,2; Wongkamhaeng, 2010:5, figs 5, 6.

Diagnosis: Antenna 1 longer than 2, accessory flagellum absent. Antenna 2 peduncular article 3 of antenna 1 much shorter than 1, article 2-3 longest. The outer lobe of mandible with notched, inner lobe well developed. Maxilla 1 triangular. Gnathopod 1 smaller than 2; male gnathopod 1 carpus produced at the posterodistal corner into a triangular process; propodus with protrusion of inner palmer corner. Uropod 3 biramous, both rami short, outer ramus with two distal hook spines, inner ramus longer than outer ramus.

Distribution: Black Sea, Gulf of Thailand, Indian Ocean, Japan Sea/East Sea, Mediterranean Sea, Red Sea.

Remarks: *Ampithoe* has a number of species, is widespread, and has several species complexes (Peart 2007). Our specimens are congruent to what Nagata (1985) reported from the Japan Sea, Barnard (1970) reported from Hawaii, and Wongkamhaeng (2010) except the propodus of gnathopod 2 is blunter than both. The excavate of ganthopod 2 is shallower than those of India and Africa.

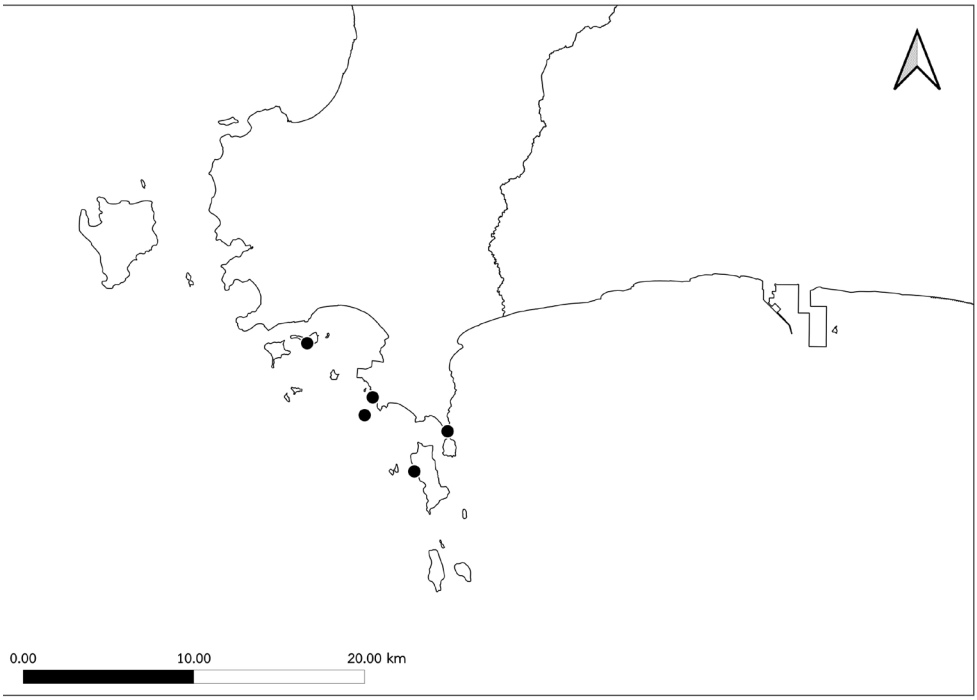

Figure 1. The sampling sites in the Samaesan Islands, Chon Buri Province.

***Ampithoe* sp.**
(Figure 2B)

Diagnosis: Antenna 1 longer than 2, accessory flagellum absent. The outer lobe of mandible with notched, inner lobe well developed. Notched lower lip outer plate state. Gnathopod 1 smaller than 2, palmer margin of gnathopod 1 oblique, palm convex without

mid-palmmer tooth. Coxa 1 large and visible; coxa 4 not excavate postero-dorsally. Gnathopod 2 basis longer than Coxa; the palm covex without mid-palmmer tooth; dactylus shorter than the palm; Uropod 3 biramous, outer ramus with two distal hook spines. Telson cusps small with lateral slender setae.

Remarks: *Ampithoe* sp. is similar to *Ampithoe geographe* Peart, 2007 form Yallingup, Western Australia, except *Ampithoe* sp. Gnathopod 2 palm is without midmedial tooth (vs gnathopod 2 palm with midmedial tooth). Gnathopod 2 dactylus shorter than the palm (vs gnathopod 2 dactylus overeaching the palm). The Specimen may not yet be an adult, because our specimen was smaller than *A. geographe* (*Ampithoe* sp. 4 mm., *A. geographe* 6 mm.).

***Cymadusa cavimana* (Sivaprakasam, 1970)**
(Figure 2C)

Ampithoe cavimana Sivaprakasam, 1970: 65, fig. 1. Type locality: India, Gulf of Manaar, Kilakkarai. [Transferred to *Cymadusa* by Appadoo and Myers, 2004: 343]
Ampithoe cavimana: Ledoyer 1982: 116, fig. 37.
Cymadusa cavimana: Appadoo and Myers. 2004: 343; Hughes and Lowry, 2009: 174 figs 13–14; Milne and Griffiths, 2013: 62.

Diagnosis: Antenna 1 longer than 2, accessory flagellum present. The outer lobe of mandible with notched. Gnathopod 1 smaller than 2. Gnathopod 1 with 1.25 times as long as propodus, posterior margin long and lamellar. The propodus of gnathopod 2 propod large and oblong, with 1.5 times as long as carpus and also its own width, followed by a deep and widening concavity, which with posterior margin forms defining tooth. Palm and posterior margin with densely setose. Uropod 3 biramous, outer ramus with two distal hook spines.

Distribution: Indian Ocean, Australian Sea, Indonesian Sea, Madagascar and Mauritius Islands.

Remarks: This is a new record for Thai waters. *Cymadusa cavimana* has been found in India, Australia, Indonesia, South Africa, Madagascar, and Mauritius. The specimen in this study agrees perfectly with the descriptions of *C. cavimana* by Sivaprakasam, 1970, except the previous work reported the amphipod living on sea grass, while this study's amphipod was living on algae. This work extends the distribution of *C. cavimana*, shape of gnathopod 2 of male specimen entity are deeply excavate palm.

***Cymadusa tattersalli* Peart, 2004**
(Figure 2D)

Grubia setosa Tattersall, 1922: 1–19.
Cymadusa filosa: Ledoyer, 1982: 130–135, figs 44–46.
Cymadusa tattersalli Peart, 2004: 314-316, figs 8-11. Type locality: Cockburn Sound, Western Australia, Australia.
Cymadusa tattersalli Peart, 2007: 33, figs 26–28.

Diagnosis: Antenna 1 longer than 2, with a two-articulated accessory flagellum. Antenna 2 with densely plumose setose margins. Inner plate of axilla 1 with 5 slender setae. Gnathopod 1 smaller than 2; basis short than coxa; merus produced to form a small, subacute; carpus broad robust and subtriangular, with densely plumose setose margins. Gnathopod 2 with densely plumose setose margins; mid-palmer has a small subacute tooth at posterolateral corner; dactylus shorter than palm. Uropod 3 biramous, outer ramus with two distal hook spines.

Figure 2. Species of amphipod from this study. A. *Ampithoe ramondi* Audouin, 1826, B. *Ampithoe* sp., C. *Cymadusa cavimana* (Sivaprakasam, 1970), D. *Cymadusa tattersalli* Peart, 2004, E. *Paragrubia vorax* Chevreux, 1901, F. *Apolochus likelike* (J. L. Barnard, 1970), G. *Bemlos* sp.,H. *Grandidierella halophila* Wongkamhaeng, Pholpunthin & Azman, 2012, I. *Ericthonius brasiliensis* (Dana, 1853), J. *Protohyale (Diplohyale) didendactyla* (Hirayama, 1980), K. *Leucothoe spinicarpa* (Abildgaard, 1789), L. *Elasmopus nanshaensis* Ren, 1998, M. *Maeropsis paphavasitae* Wongkamhaeng, Pholpunthin & Azman, 2012, N. *Ceradocus* sp., O. *Photis longisetis* Ren, 2000, P. *Dulichiella pattaniensis* Wongkamhaeng, Pattaratumrong & Puttapreecha, 2014, Q. *Gammaropsis longiseta* Ren, 2006, R. *Gammaropsis* sp., S. *Podocerus andamanensis* (Giles, 1890).

Distribution: Australian Sea, Madagascar Island

Remarks: This species has a new record in Thai waters. The specimen in this study agrees perfectly with the descriptions of Peart 2004, 2007 reported from Australia, except the previous work reported the amphipod living on algae, for instance *Dictyotales* sp., *Padina* sp. and *Lobophora* sp., as well as this study's amphipod living on macro-algae. *Cymadusa tattersalli* differs *Cymadusa cavimana* by antenna 1 with two-articulated accessory flagellum (vs antenna 1 with one-articulated accessory flagellum); gnathopod2 dactylus tapering evenly (vs gnathopod 2 dactylus blunt not tapering); gnathopod 2 with densely setose margins (vs gnathopod 2 with sparsely setose margins).

***Paragrubia vorax* Chevreux, 1901**
(Figure 2E)

Paragrubia vorax Chevreux, 1901: 427, figs 50–55, Type locality: Mahé, Seychelles, Indian Ocean.

Paragrubia vorax Walker, 1905: 930; Walker, 1909: 343; Schellenberg, 1938: 90; Ruffo, 1938: 173, fig. 5; Ruffo, 1969: 63; Barnard, 1955: 31, fig. 17; Barnard, 1970: 61, fig. 32; Griffiths, 1973: 278, fig. 5; Griffiths, 1976: 25; Ledoyer, 1967: 135, fig. 23; Ledoyer, 1982: 138, fig. 48; Myers, 1986:287; Myers, 1989: 66; Myers, 1990: 151, 156; Myers, 1995: 38; Myers, 1997: 108; Appadoo and Myers, 2004: 347; Ren, 2001: 72; Ren, 2006: 232, fig. 89; Hughes and Peart, 2013: 93, fig. 60; Peart and Hughes, 2014: 833, figs. 71–74, not *P. vorax:* Myers, 1985: 33, figs 24–25 (accepted as *P. latipoda*, following Ren, 2006).

Diagnosis: Antenna 1 longer than 2, accessory flagellum presents with five articles. Gnathopod 1 larger than 2; basis straight, anterior margin oblique; carpus shorter than wide, bearing dorsal spines. Gnathopod 2 with carpus with robust setae; propodus trapezoid shape with robust setae. Uropod 3 rami broad, outer ramus with strongly recurved distal robust setae.

Distribution: South China Sea, Indonesian Sea, China Sea, Spratly Islands, Fiji, Madagascar, North Pacific Ocean, Mauritius Islands.

Remarks: *Paragrubia vorax* Chevreux, 1901 has been widely reported throughout the Indo-Pacific, but this species is recorded for the first time in Thai waters. The specimen in this study agrees perfectly with the descriptions of *P. vorax* by Ren (2006). The previous work reported the amphipod living both coral rubble and algae as well as this study amphipod living on algae.

Distribution: Australia, Fiji, Madagascar, North Pacific Ocean, Mauritius Islands, South China Sea, Hong Kong, Singapore, Indonesia, China

Family Amphilochidae

***Apolochus likelike* (Barnard, 1970)**
(Figure 2F)

Amphilochus likelike Barnard, 1970: 33, fig. 4; Barnard and Karaman, 1991: 96. Ren, 2006.

Diagnosis: Antenna 1 as long as antenna 2; one-article accessory flagellum. Mandibular molar vestigial, triturating surface weak. Coxae 2-4 lower margin smooth. Basis of gnathopods 1-2 with stout posterodistal spine. Gnathopod 1 carpus extending about halfway along propodus. Gnathopod 2 with slender lobe extending fully along propodus; dactylus of gnathopods not pectinate besides major tooth. Peraeopods 3-7 ordinary, ambulatory. Telson shape rounded.

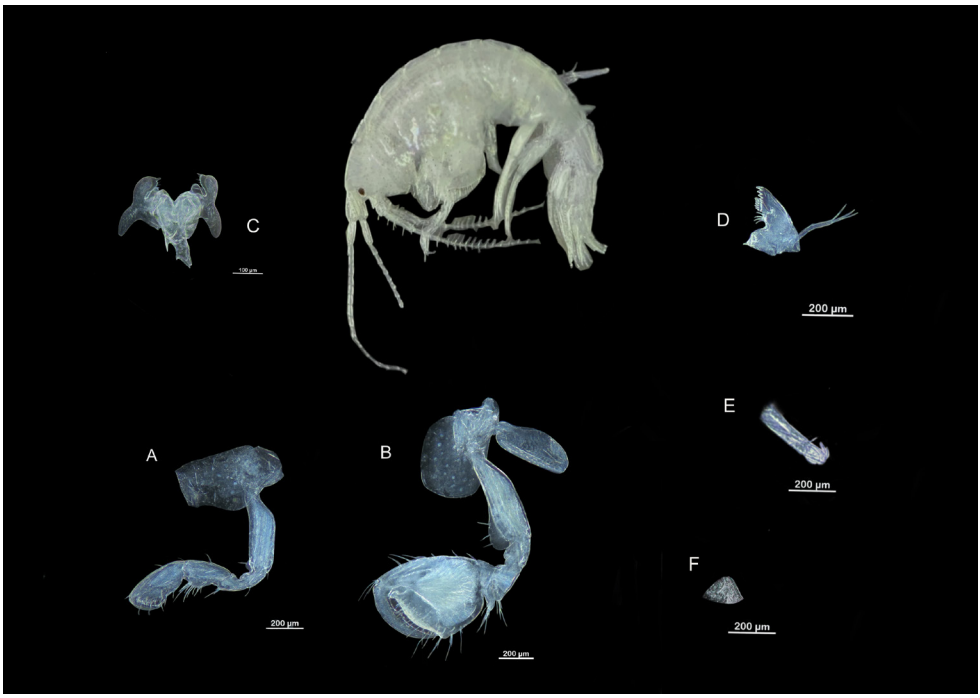

Figure 3. *Cymadusa cavimana* A) Gnathopod 1, B) Gnathopod 2, C) Mandible, D) Lower lip, E) Uropod 3.

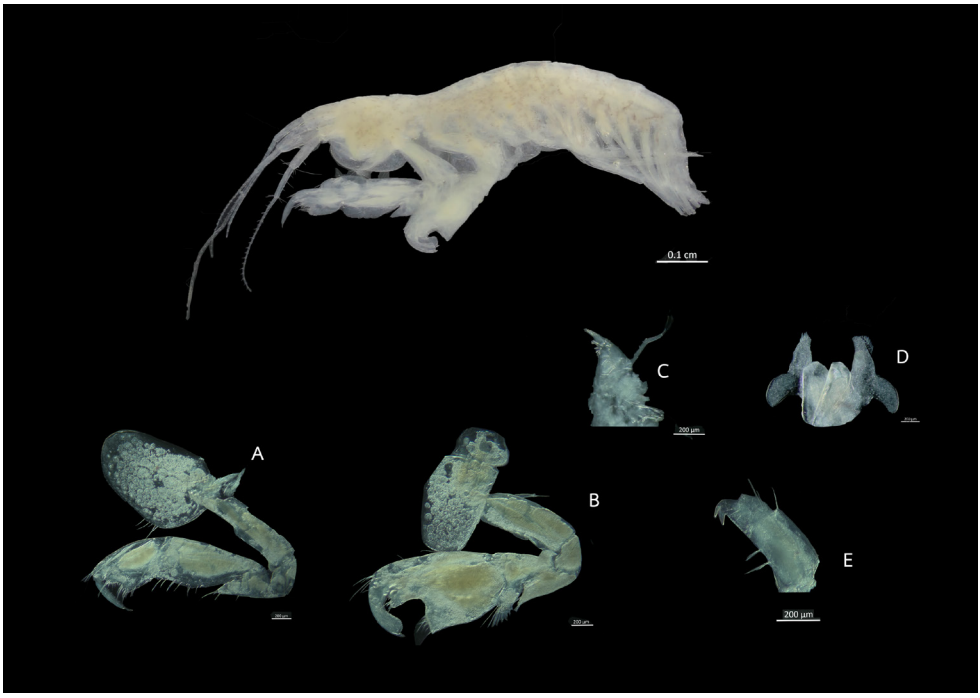

Figure 4. *Paragrubia vorax* A) Antenna 1, B) Mandible, C) Gnathopod 1, D) Gnathopod 2, E) Uropod 3.

Distribution: South China Sea, China, Hong Kong

Remarks: The specimens found in this work resembled those of Ren (2006) from the China Sea by having a Ventrodistal corner of the basis of gnathopod 2 with strong spines, a ventrodistal corner of merus with a weak spine, molar with a large trituative surface.

***Bemlos* sp.**
(Figures 2G and 5)

Diagnosis: Head without acute process on the insertion of first antenna, lateral cephalic lobe truncated. Coxa 1 anteroventral corner did not exceed the anterodoral corner. Pereopod 7 basis posterior margin scarcely setose in comparison with the other pereopod segments. Sternal processes unifid. Gnathopod 1 carpus shorter than propodus without posteroventral spine; propodus palm without a medial acute process. Gnathopod 2 carpus anterior margin densely setose; propodus subquadrate, subequal to carpus. Pereopods 3 and 4 weakly setose; basis without long facial setae. Uropod 3 outer ramus one-articulated. Telson without a deep distal slit.

Remarks: The specimens belong to the genus *Bemlos* in having: 1) article 3 of mandibular palp with posterior margin weakly concave, 2) male gnathopod 1 with propodus very enlarged and carpus generally short, cup-shaped, 3) uropod 3 peduncle short, expanded, with outer ramus with small second article and long marginal setae and extremely long distal setae. *Bemlos* sp. is closely related to *Bemlos hainanensis* from the China Sea in the following characteristics: male gnathopod 1 larger than in female, with basis and ischium with dorso-terminal lobe and carpus without ventral protrusion. However, the Thai *Bemlos* differs *B. hainanensis* in gnathopod 1 without a triangular lobe on outer terminal corner of the basis and the ischium.

***Grandidierella halophila* Wongkamhaeng, Pholpunthin & Azman, 2012**
(Figure 2H)

Grandidierella halophilus Wongkamhaeng, Pholpunthin & Azman, 2012: 434, figs 2–10.
Grandidierella halophila Ariyama, 2020: 16–21, figs 13–17.

Diagnosis: Antenna 1 longer than 2; accessory flagellum present with 1 article. Coxae are small. Outer lobe of the lower lip with arborescent setae on inner surface. Ventral of body of gnathopod 1 and 2 has a sternal spine. Gnathopod 1 larger than 2. Gnathopod 1 basis of male slender; capus with a tooth; posterior margin of propodus distally expanded; subchelate. Gnathopod 2 basis slender; propodus subchelate. Pereopods 6–7 dactylus elongate. Uropods 1–2 biramous. Uropod 3 uniramous. Telson entire.

Distribution: Gulf of Thailand, the lagoons at Pantai Sri Tujuh in Kelantan, Malaysia.

Remarks: *Grandidierella halophila* was first reported as a new species of the family Aoridae from saltpans of the Samut Sakon Province, Inner Gulf of Thailand, the hypersaline habitat (~80 ppt) and associated with seagrass. *G. halophila* recorded from the lagoons at Pantai Sri Tujuh in Kelantan, Malaysia by dragging

scoop nets along the vegetation at the water's edge (with 7 ppt salinity). While this study, amphipods living on algae (~30 ppt) that it can tolerate a wide range of salinity and various microhabitats.

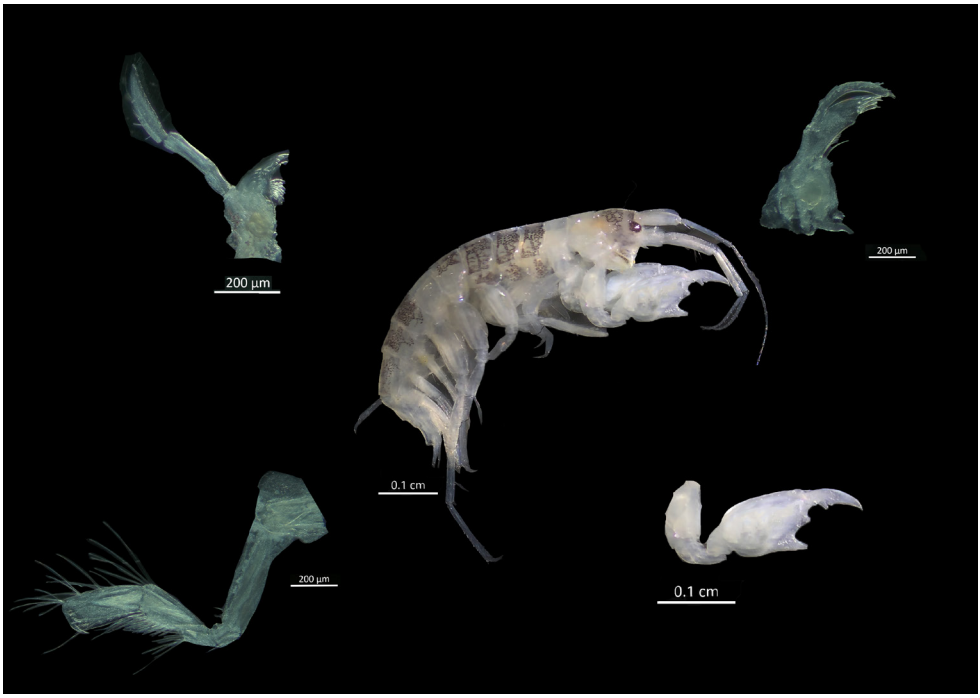

Figure 5. *Bemlos* sp. A) Mandible, B) Maxilla 2, C) Gnathopod 1, D) Gnathopod 2.

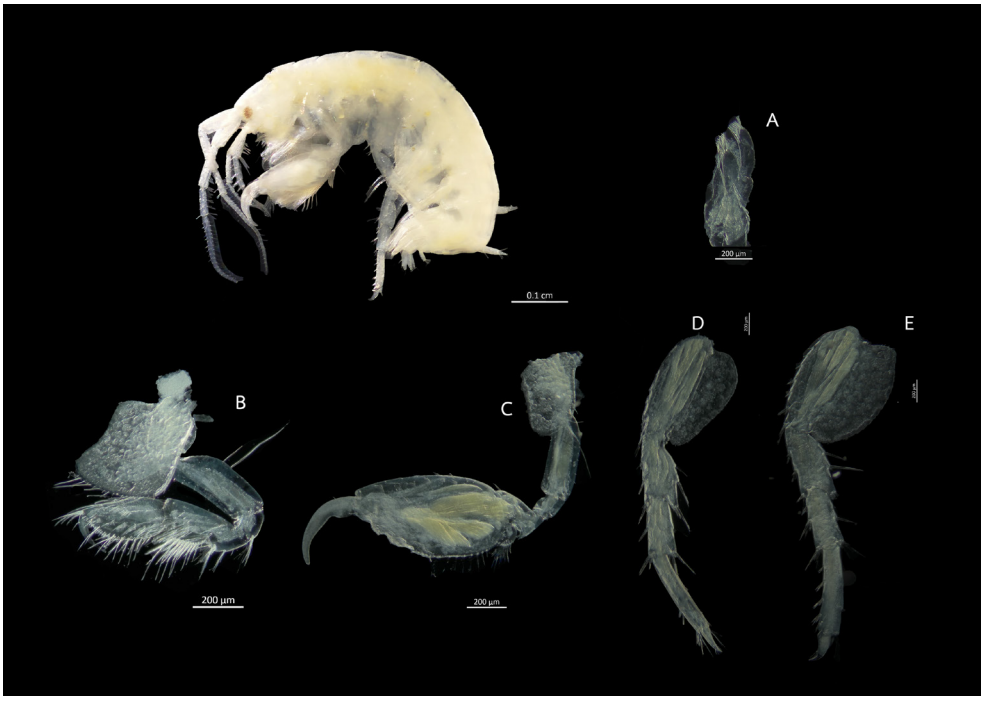

Figure 6. *Elasmopus nanshaensis* A) Maxilla2, B) Gnathopod 1, C) Gnathopod 2, D) Pereopod 6, E) Pereopod 7.

Family Ischyroceridae

***Ericthonius brasiliensis* (Dana, 1853)**
(Figure 2I)

Pyctilus brasiliensis Dana, 1853, 1855. U. S. Explor. Exped. Vol. 14. pt. 2, Amphipoda: p. 976, pl. 67, figs. 5a–h (not seen).
Ericthonius brasiliensis (Dana): Stebbing, 1906: 67 1; Shoemaker,1942: 48; Nayar,1959: 42, pl. 15, figs. 1-13; Ledoyer, 1986: 624, fig. 237; Ren, 1994: 251, fig. 4.; Ren, 2012: 56–58, fig 24.

Diagnosis: Antenna 1 without accessory flagellum; article 3 of antenna 1 longer than article 1, flagellum subequal to peduncle; antenna 2 slender, equal to antenna 1, flagellum as long as peduncle; mandibular palp three-articulated; coxa short, scarcely touching serially. Male gnathopod 2 larger than 1, carpochelate, article 6 simple; female gnathopods normally subchelate. Uropod 2 biramous; uropod 3 with medium length, uncinate ramus shorter than peduncle.

Distribution: China Sea, Japan Sea, East Indies, Sulu Sea, and New Zealand.

Remarks: The specimens found in this work resembled those of Ren (2012) from the China Sea by having a posterior lobe of the basis of male pereopod 5 not acutely projected. They were similar to those reported by Nayar (1959) in having the middle of the basis widened.

Family Hyalidae

***Hyale* sp.**
(Figure 2J)

Diagnosis: Antenna 1 with 1/3 of body and shorter than 2. The head lateral cephalic lobe truncated vertically, eyes large. Gnathopod 1 anterior distal margin with two spines of propodus; propodus margin with stout spine fitting between bifurcation of dactylus; carpus deep. Gnathopod 2 dactylus bearing setae regularly on inner margin as long as palm; propodus oblique with setae. Carpus of gnathopod 2 without projecting lobe between merus and propodus. Uropod 3 with small scale-like inner ramus. Telson with cleft.

Remarks: All specimens in this study were female and could not be identified. The specimens were closely related to *Hyale nuda* from Japan by having Gnathopod 1, carpus lobe lacking serration; coxae 1–4 lacking posteriorly cusps or with weakly cusps and outer rami of uropods I and 2 lacking dorsal spines. They are different from *H. nuda* in Pereopods 3–7, each propodus without locking spine.

Family Leucothoidea

***Leucothoe spinicarpa* (Abildgaard, 1789)**
(Figure 2K)

Gammarus spinicarpus Abildgaard, 1789. pl. 119, figs. 1-4, 17 (not seen).
Leucothoe spinicarpa (Abildgaard): Sars, 1895: 283, pls. 100,101, fig. 1; Stebbing, 1906: 165. Type Locality: Trondhjemsfjorden, Norway
Walker, 1907: 18; Chilton, 1912: 478; K. H. Barnard, 1916: 148; 1930: 338, 449; 1932: 106;

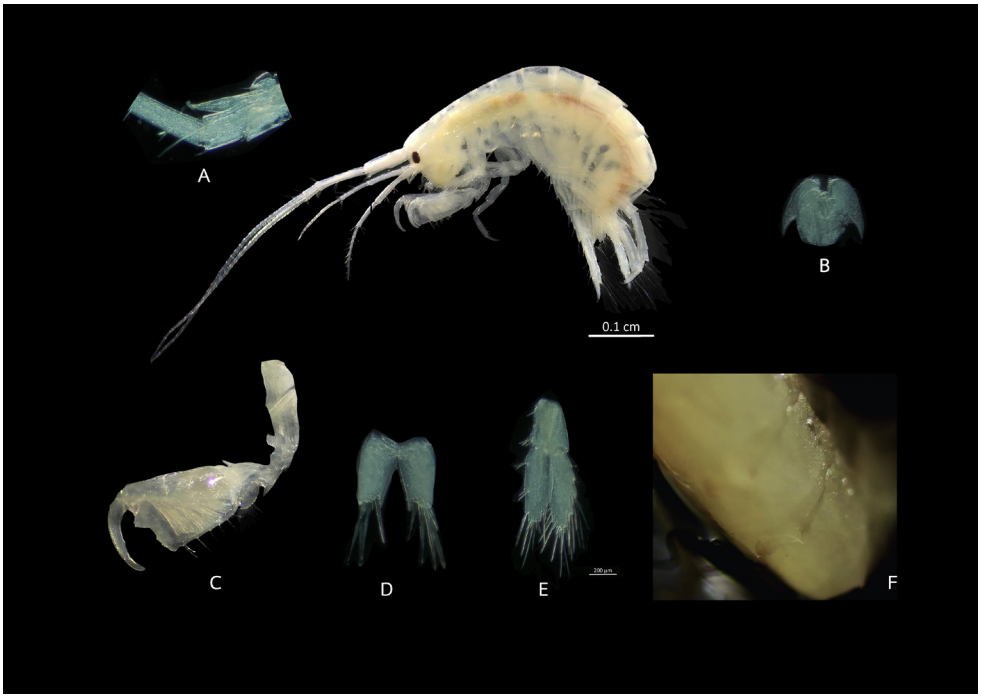

Figure 7. *Ceradocus* sp. A) Antenna 2, B) Lower lip, C) Gnathopod 2, D) Telson, E) Uropod 3, F) Dorsal.

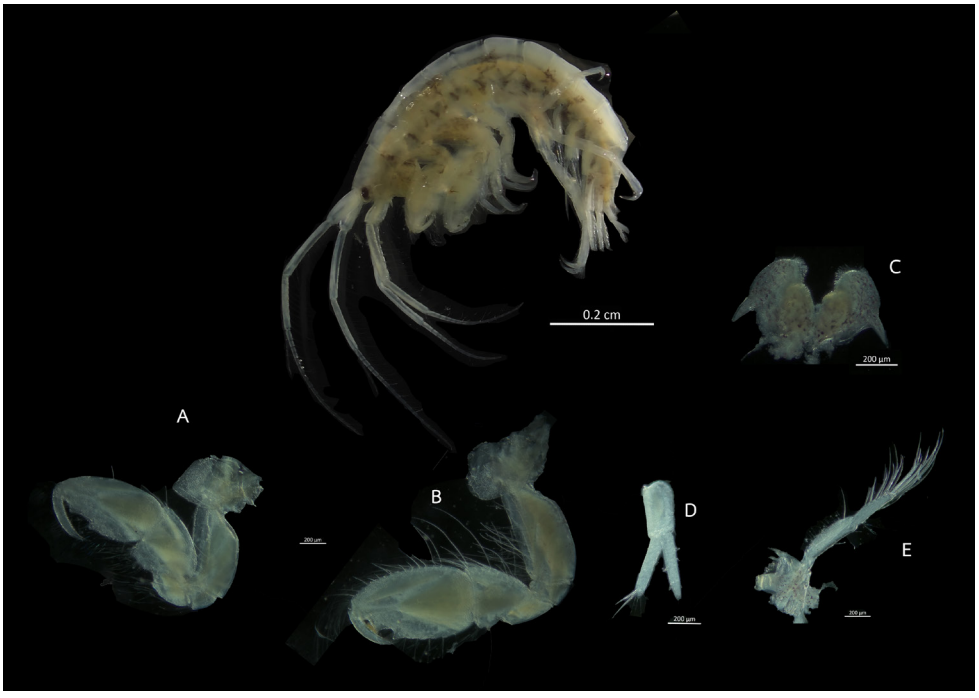

Figure 8. *Gammaropsis (Gammaropsis) longiseta* A) Gnathopod 1, B) Gnathopod 2, C) Lower lip, D) Uropod 3, E) Mandible.

Chevreux and Fage, 1925: 122, figs. 118, 119; Schellenberg, 1931: 92; Shoemaker, 1933: 8; Pirlot, 1936: 293; Nayar, 1959: 16, pl. 5, figs. 1–6; 1967: 142, fig. 5b-c; Sivaprakasam, 1966: 93; 1967: 385, fig. 1; Ledoyer, 1986: 676, figs. 246–260; Ruffo, 1989: 454, fig. 309; Barnard and Karaman, 1991: 412.

Diagnosis: Head without conical projection. Mandibular molar present, not triturative. Basis of gnathopod 1 elongate. Merus of gnathopod 2 not elongate; propodus longer than wide; carpus densely setose. Anteroventral angle of coxae 1–2 bluntly rounded, depth shorter than long. Posteroventral angle of coxa 3 without hook teeth. Basis of pereopods 5–7 broad. Lateral cephalic lobe bluntly rounded palmer marginal teeth inconspicuous. Urosomites separate. Uropod 3 biramous.

Distribution: Circumtropical.

Family Maeridae

***Elasmopus nanshaensis* Ren, 1998**
(Figures 2L and 6)

Elasmopus nanshaensis Ren, 1998: 199, fig. 4; 2012: 202–203, fig 87, Type locality: Xinyi reef, Nansha Islands, China

Diagnosis: Article 3 of mandible palp falcate. Inner plate of maxilla 2 without oblique facial row of setae. Posterior margin of basis of male of pereopod 6 without comb-shaped tooth; pereopod 6 and 7 with flat-topped. Uropod 3 with equally biramous, inner ramus shorter than outer.

Distribution: South China Sea.

Remarks: The specimens found in this work were like *E. namshaensis* found in the South China Sea in having posterior margins of basis of pereopods 6 and 7 with flat-topped teeth, rami of uropod 3 equal to peduncle, and inner ramus shorter than outer. *E. nanshaensis* from a previous study occurred in a coral reef, while in this study, it lived together with *Turbinaria* sp. This work extended the habitats of *E. nanshsensis.*

***Maeropsis paphavasitae* Wongkamhaeng, Coleman & Pholpunthin, 2013**
(Figure 2M)

Maeropsis paphavasitae Wongkamhaeng, Coleman & Pholpunthin, 2013: 18–24, figs 2–6.

Diagnosis: Antenna 1 longer than antenna 2, accessory flagellum with three articles. The inner lobe of lower lip small; outer lobe with setae; mandibular process well developed. Gnathopod 1 palm without clear palmar corner. Gnathopod 2 palm transverse with six blunt teeth and a large defining tooth; merus not produced into a posterodistal tooth, subtriangular. Uropod 3 inner ramus with only one proximal setae, truncated at its end. Telson deeply cleft.

Distribution: Gulf of Thailand

Remarks: The specimens found in this work were like *M. paphavasitae* found in the Southern Gulf of Thailand in having gnathopod 2, merus not produced into a posterodistal tooth; propodus of gnathopod 2 subtriangular, palm inner surface with 1 subposterodistal robust seta; dactyli of pereopods 3-7 curved and smooth; uropod 3 inner ramus with only 1 proximal seta and telson longer than broad. The previous record of *M. paphavasitae* was reported from a seagrass bed, while in this study, the amphipods lived in an algal bed.

***Ceradocus* sp.**
(Figures 2N and 7)

Diagnosis: Accessory flagellum three-articulated. Lower lip with distinct inner lobes. Inner plate of maxilla 1 densely setose medially, of maxilla 2 moderately to strongly setose medially. Palp article 3 of mandible half as long as article 2; article 1 with medial process. Gnathopod 2 propodus subtriangular, with medial tooth. Uropod 3 exceeding uropod 1, rami equal, lanceolate, broad; outer rami one-articulated. Telson with deep cleft.

Remarks: *Ceradocus* sp. is very similar to *Ceradocus (Denticeradocus) cotoensis* from the Indian Ocean in having: 1) the male with symmetrical gnathopod 2 and palm transverse, 2) urosomite 1 and 2 with smooth dorsal surface. However, the *Ceradocus* sp. can be distinguished from *C. (D.) cotoensis* by having: 1) a distomedial tooth (vs a medial excavation), 2) telson with deeper cleft to about 80% of its length andtelsonic lobs distally truncate (vs about 60% of its length, anterior and posterior margin of telsonic lobes produced)

Family Melitidae

***Dulichiella pattaniensis* Wongkamhaeng, Pattaratumrong & Puttapreecha, 2014**
(Figure 2O)

Diagnosis: Peduncle of antenna 1 article 2 largest, accessory flagellum with five articles. Male gnathopod 1 coxa anterior margin straight. Gnathopod 2 larger than 1. Gnathopod 1 carpus longer than propodus. Gnathopod 2 with four spines on distolateral crown. Pereopods 3-4 dactyli with one or two spines. Pereopods 6-7 with bunch of long setae on merus, carpus, and propodus. Article 2 of outer ramus of uropod 3 shorter than half as long as article 1. Uropod 3 ramus unequal.

Distribution: Gulf of Thailand.

Family Photidae

***Photis longisetis* Ren, 2000**
(Figure 2P)

Photis longisetis Ren, 2000: 136, fig. 2, Type locality: Northern part of the South China Sea.
Photis longisetis Ren, 2006: 400–403, fig 172.

Diagnosis: Accessory flagellum absent. Inner plate of maxilla 2 with setae. Coxa 2 not covered coxa 1. Lower margins of coxae 1 - 4 with dense long setae, lower margins of posterior lobes of coxae 5-7 with long setae. Gnathopod 1 with slender setae; merus as long as propodus; propodus subchelate. Gnathopod 2 with slender setae; merus and carpus of gnathopod 2 ordinary; propodus subchelate; dactylus congruous to the palm; palm margins with long setae. Uropod 2 present. Uropod 3 biramous, significantly shortened; outer ramus shorter than peduncle; inner ramus much shorter than outer ramus.

Distribution: South China Sea

Remarks: *Photis longisetis* found in this study resembled those reported from the South China Sea (Ren 2006) by having propodus of male gnathopod 2 not more than twice as long as wide, uropod 3 not calabash shaped. Lower margins of coxae 1–4 with dense long setae, each plate with more than 10 setae, lower margins of posterior lobes of coxae 5–7 with long setae, antennae slender**.**

***Gammaropsis (Gammaropsis) longiseta* Ren, 2006**
(Figures 2Q and 8)

Gammaropsis (*Gammaropsis*) *longiseta* Ren, 2006: 400, fig 172, Type locality: Coral Reef and seaweed in Sanyam, Hainan, China Sea.

Diagnosis: Antenna 1 subequal to antenna 2, both with comb setae, accessory flagellum five-articulated; article 3 of antenna 1 subequal article 1. Gnathopods subchelate, with dense long setae; carpus subequal to propodus; palmar margin slightly, arched, with a palmar angular spine. Gnathopod 2 strong; propodus long and broad; palmar margin short, triangular, and truncated, with 2 teeth; palmar angular tooth stout, reached to apical margin, almost forming a chela; dactylus stout, medial part wider. Pereopods 3-4 simple. Pereopods 5-7 similar in shape; basis narrow and long; propodus longest, and dactylus claw shaped. Uropod 3 biramous with setae, distal end of inner ramus with three spines.

Distribution: South China Sea, China, Hong Kong.

Remarks: The amphipods found in this work were similar to *G. (Gammaropsis) longiseta* in having male carpus of male gnathopod 1 shorter than twice of propodus; gnathopod 2 bearing dense long setae, palmar margin short with a deeply concaved, spine of propodus corner strong, reached to the terminal margin; posterodorsal margin of uropods 1 and 2 without teeth. The amphipods found in this work also lived in similar habitats on algal beds.

***Gammaropsis* sp.**
(Figure 2R)

Diagnosis: Body not tubiform. Coxa 1 large and visible. Coxa 2 not covered coxa 1, Carpus of gnathopods 1 and 2 shorter than propodus. Gnathopod 2 larger than 1. Pereopod 6 does not elongate Uropod 3 with two rami.

Remarks: The *Gammaropsis* sp. differs from *Gammaropsis* (*Gammaropsis*) *longiseta* by having: 1) gnathopod 1-2 smaller, and without dense long setae. We have only one incomplete specimen which lacks the diagnostic characteristics of species.

Family Podoceridae

***Podocerus andamanensis* (Giles, 1890)**
(Figure 2S)

Cyrtophium andamanense Giles, 1890: 72-73, fig. 7.
Podocerus andamanensis Stebbing, 1906: 702; Wongkamhaeng, 2010 p 19–22, figs 16–17.

Diagnosis: Head anterodorsally elongated. Antenna very strong, antenna 1 shorter than antenna 2; accessory flagellum presents with one article. Pereonite 2 with gills. The mandibular appendage is large and claw-like. Gnathopod 1 smaller than gnathopod 2. Propodus of male gnathopod 2 with spines. Urosomite 1 shorter than length of pleosomites 2 and3 combined. Uropod 2 present, biramous; uropod 3 without rami. Maxilla 1 outer plate with nine apical spines.

Distribution: Africa, South Africa, Gulf of Thailand

Remarks: Our specimen is similar to those of Wongkamhaeng (2010) *Paragrubia vorax* Chevreux, 1901, and has been widely reported throughout the Indo-Pacific, but this species is recorded for the first time in Thai waters.

Discussion

The highest diversity of ampithoid amphipods in the algal bed was previously observed in the *Sargassum filipendula* bed of North Carolina, USA (Duffy, 1990). In this study, the family Ampithoidae was comprised of five species, being the most diverse family. This might be a result of the rich of the food (*i.e*., alga) that supports the survival of the ampithoid amphipod, because the ampithoid amphipods are herbivores, consuming both macro-algae and epiphytes associated with the macro-algae (Duffy, 1990). Furthermore, amphipods consider algae to be a refuge from predators and turbulent waves (Ref.) and sometimes as a food source for both macro-algae and epiphytes, attaching to their hosts.

The algal group might relate to amphipod diversity and density (Gabr *et al*., 2020). In the present work, the amphipod diversity in different sites was similar, with the highest diversity being in Samaesan Villa (14 species), followed by Nangrog Beach (13 species) and Phra Island (ten species). The observation showed that Samaesan Villa was the only place containing all algal groups, *i.e*., red, brown, and green, while other sites contained only two out of three groups of macro-algae. The diversity of amphipods is likely related to the diversity of the group of macro-algae. Previous research suggests that amphipod diversity was highest in red algae during winter, spring, and summer, while the highest diversity was found in brown algae during autumn (Gabr *et al*., 2020).

Table 2. Macro-algae composition of macro-algal assemblage in the Samaesan Islands.

Species	Algal groups	Sites				
		Samaesan Villa	Nangrong Beach	Phra Island	Chorake Island	Samaesan Island
Amphiroa sp.	red	-	-	+	-	-
Gracilaria sp.	red	+	-	-	-	-
Caulerpa racemosa	green	+	+	-	+	-
Caulerpa lentillifera	green	-	-	-	-	+
Dictyota sp.	brown	+	-	-	+	-
Lobophora challengeriae	brown	-	+	-	+	-
Lobophora obscura	brown	-	-	-	+	-
Lobophora sp.	brown	-	-	+	-	-
Padina sp.	brown	+	-	-	-	-
Sargassum binderi	brown	-	+	-	-	+
Turbinaria conoidae	brown	-	-	-	+	-
Total number of species/ taxa		4	3	2	5	1

The sampling of amphipods in Samaesan Island was limited in the *Caluarpa* cultural pond because no algal bed was recorded in Samaesan, and only one amphipod species, *Grandidirella halophila,* was found. Wongkamhaeng *et al*. (2012) reported *G. halophila* inhabited saltpans at a salinity of 80 ppt, while Shahin *et al*. (2023) reported *G. halophila* from the estuarine lagoons in Kelantan at a salinity of seven ppt. It is clearly shown that the species can tolerate a wide range of salinity. The species also shows high fecundity, early maturation, and rapid growth. This might be the key factor in the succession of *G. halophila* in the cultural pond. Because of the mentioned finding, the monitoring of *G. halophila* is needed because the amphipod can potentially be invasive (Shahin *et al*., 2023).

Summary

This study revealed that the shallow-water species are mostly those associated with algae. The Family Amphithoidae (5 species), followed by Maeridae and Photidae (3 species), contained the highest species richness. Samaesan Villa had the highest species diversity (14 species), followed by Nang Rong Beach (13 species), and Phra Island (10 species). On Samaesan Island, only one species of gammarid amphipod, Grandidirella halophilla, was found.

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