

Short communication: The crustaceans fauna from Natuna Islands (Indonesia) using three different sampling methods

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Abstract. Pratiwi R, Elfidasari D. 2020. Short communication: The crustaceans fauna from Natuna Islands (Indonesia) using three different sampling methods. *Biodiversitas* 21: 1215-1226. Research on crustacean fauna has been carried out in Natuna waters. Natuna is the outer islands of Indonesia which is still very abundant in fisheries resources including crustaceans. Unfortunately, research on crustaceans is rarely carried out there, especially on the islands around Natuna. Therefore research and information about fisheries, especially crustaceans are needed. The study was conducted on 12-29 April 2011 and sampling locations around the Bunguran Islands, Sedanu, Kognang, Batang, and Sebangmawang. The sampling collection was focused on three different sampling methods, namely: bottom trawling, transects, and free collection. The purpose of this study is to find out which method is best used in crustacean fauna research and it is expected that the crustacean data obtained can add information about crustacean fauna found in the Natuna Islands. Crustacean fauna, which were collected, showed that species from basic trawlers numbered 66 species, 41 species were from transects and 101 species was from free collections. The total number of individuals from the bottom trawl were 746, from the transect were 65 and from the free collection were 704. From the results of the study using three different methods have advantages and disadvantages of each method. The best method used is the free collection method and bottom trawling, because it can collect many crustacean species.

Keywords: Batang Island, bottom trawl, Bunguran Islands, free collection, Kognang Island, Sedanu Island, Sebangmawang Island, transect

INTRODUCTION

Natuna Regency is an archipelago consisting of 272 islands and is located in the southern part of Natuna Island, South China. Administratively, this island is included in the Riau Islands Province. Natuna is the northernmost island in the Karimata strait and stretches at 4°0'0" LU and 108°15'0" East, about 1,140 km north of Jakarta. The islands are bordered by Vietnam and Cambodia (North), South Sumatra and Jambi (South), Singapore, Malaysia, Riau (West) and East Malaysia and West Kalimantan (East). The largest island in the Natuna archipelago is Bunguran Island (Mirmanto 2014). The Natuna Islands are part of the Sunda shoal, which has oceanic characteristics with a depth of no more than 200 meters and overgrown with corals that form coral reefs (Widyastuti 2016).

Crustaceans are a group of important macrobenthic fauna in coastal ecosystems, ranging from mangrove ecosystems, coral reefs, and seagrass ecosystems. These animals play a very important role in ecosystems with life activities such as foraging, digging, spawning, in the cycle of nutrition, and energy flow (Kathiresan and Bingham 2001; Hamidy 2010; Widyastuti 2016). In addition, crustaceans are also one of the most important members of the benthic fauna community living in tropical and subtropical regions. Crustacean faunas play an important role in the maintenance of marine ecosystems where larger

species of groups control the populations of other species and provide important food for human consumption. Smaller crustacean species increase habitat diversity and provide a prey base for larger species (Trivedi et al. 2015).

The Natuna Islands coastal area supports a variety of marine habitats such as mangrove forests, coral reefs, seagrasses, rocky beaches, mud, sandy beaches, and estuaries, which on the other hand support rich marine biodiversity. Many researchers have conducted different studies related to marine biodiversity in Natuna waters. Crustacean studies conducted in Natuna waters are not many, of them were conducted by Li (2004), Yeo et al. (2004), Ahyong and Moosa (2004), Widyastuti (2007). Among the various marine fauna that occurs in the Natuna waters, the crustacean fauna is the least studied group. Therefore, data and information regarding the existence of crustacean fauna are still not widely found.

In this study of the fauna crustaceans, three different methods were used for sampling. The data obtained were analyzed, with three different methods, it is expected to know which method is very well used and suitable for ecological research in Crustacea and can preserve the environment. However, this research is a preliminary study (preliminary research) in order to obtain deeper information so that it can support further research on crustaceans in the future.

MATERIALS AND METHODS

The species of crustacean presented in this paper were collected during the 2011 in the Widya Nusantara Expedition carried out on Natuna Island. This expedition used the research vessel Baruna Jaya VIII owned by the Indonesian Institute of Sciences. The sampling locations were the Bunguran Islands, Sedanau, Kognang, Batang, and Sebangmawang, Natuna Islands, the southern South China Sea (Figure 1). Collections were carried out from various habitat types using different collection methods, e.g.: hands, free collection, transects, and trawls (bottom trawls). However, this paper only used data from trawlers, transects, and free collections while other data were not discussed. In addition to knowing the fauna of crustaceans, this study was also used to find out what species were captured during the study using three different methods. The aim of this is to know what is the best method appropriate for this research.

The obtained samples were then sorted at the Oceanographic Research Center-LIPI. The samples put into a bottle and preserved with 70% ethanol. Individual counters and identified using reference books for crabs and shrimp by Holthuis (1955), Hall (1962), Banner and Banner 1966; Sakai 1976; Burukovskii 1982; Banner and Banner 1982; Banner and Banner 1985; Kim and Abelle 1988; Rahayu and Davie 2002; Pratiwi 2002; Wicksten and Maclure 2007; Ng et al. 2008; Prodam and Ng 2009;

Rahayu and Setyadi 2009; Schubart et al. 2009; Wong et al. 2011). Crustaceans obtained are grouped and sorted into their respective families and identified by reading the identification keys. After the species is known, the next step is to photographs. The photographs and drawing were taken on these species and carried out a description of the parts of the body that are character identification species. The Specimen depiction were using Camera Lucida

Bottom trawling (a sweep method)

Crustacean sample collections were carried out using demersal trawl (bottom trawl) with the width of 22 m mouth opening, 2/3 mouth opening arches, and 130 m long rope. Sampling by trawling is carried out three times, at trawl 1/station 14 (Sedanau Island), trawl 2/ station 16 (Batang Isand) and trawl 3/station 20 (South Station Bunguran Island). Station 14 with a depth of 46 meters, station 16 with a depth of 37 meters, and station 20 with a depth of 30 meters. Start towing to start hauling is 1 hour with an area that varies depending on the depth and existing substrate. After hauling is pulled back, all the biota is laid out on the back deck for sorting. The catches are then sorted by group, (family) which is then stored in a container for identification in the laboratory. After that all species obtained by the trawl method we put together into one place (big freezer).

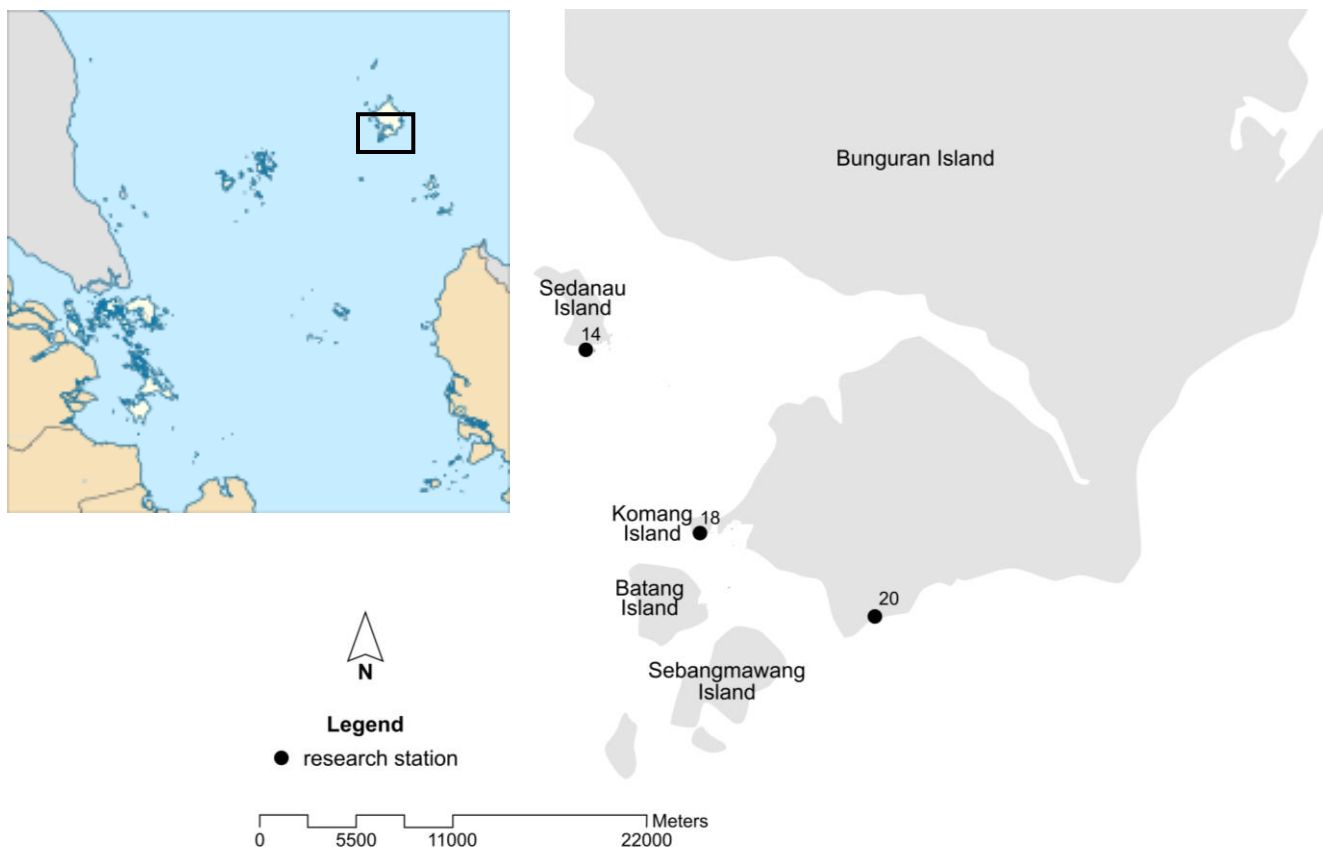


Figure 1. Location of sampling fauna of crustacean at Natuna Island, Indonesian

Transect method

Transects conducted perpendicular coastline, which starts from the shore towards the edge, depending on tidal conditions. A transect line can be made using a nylon rope or roll meter marked and numbered at 10 m intervals, all the way along its length. At each distance of 10 m, put the quadrats measuring 1 x 1 m², which was randomly placed. Transects were carried out three times in Bunguran, Sedanu, Kognang, Batang, and Sebangmawang Islands. The existing crustaceans on the surface of the substrate were taken by hand (hand picking), and those contained in the hole were taken by digging the hole using a shovel. Excavation to a depth of ± 10 cm was also carried out to collect the living crustaceans, which immerse themselves in the substrate. The number of individuals and species of each crustaceans in the square were recorded. This sampling method was adapted from the method used by Sasekumar (1974), Frith et al. (1976), and Kathiresan et al. (2016).

Free collections

The free collection method is done by breaking stones, digging holes, using fishing gear such as hand net, hammer, and hand. When found a living coral or dead corals, breaking down corals using a hammer to carried out the crustaceans that living in side the corals. After crustaceans are found, recorded, and marked, their location position were recorded by using GPS Garmin 76sx. Free collections were carried out in Bunguran, Sedanu, Kognang, Batang and Sebangmawang Islands. Sampling is done freely as many as three people and for 2 hours. Samples were taken randomly, where rocks were found. Once a coral reef is found, the coral will be broken, crustaceans were taken inside and recorded its location. The collected specimens were stored in samples bags, labeled, and stored in the freezer until the photography session and to be further identified. Afterward, they were fixed in 96% ethanol overnight to ensure the whole specimen bodies were completely preserved. The overnight samples were exposed to 70% ethanol for longer preservation. All preservation methods were carried out the same way for samples from trawlers transects and free collections. The crab collections were conducted during the low tide to make the collection easier (Katili et al. 2017).

RESULTS AND DISCUSSION

Based on the results of the study, the total number of 66 species of crustaceans were obtained from bottom trawls, 41 species were obtained from transects and 101 species were obtained from free collections. While the total number of crustacean individuals was 746 individuals from bottom trawls, 65 individuals from transects and 704 individuals from free collections (Table 1 and Table S1). There are only three species of crustaceans obtained from

the three methods used, namely: *Alpheus facetus*, *A. rapax*, and *Thalamita crenata* (Table 2).

Composition of number species and number of individuals crustaceans using trawl, transects, and free collections

In terms of the number of crustaceans obtained by trawling, transect, and free collection methods, there are different numbers of species and individuals (Table 1). This is because the retrieval of sampling using different methods and tools. The trawl retrieval is adjusted to the conditions when the trawl towing. The trawl depth of about 20 to 30 m. When seen from the results obtained (Table 1) the number of crustacean species is only 66 species, but the number of individuals is 746 individuals, this happens because when trawling is done at night these species usually come out and gather to look for food. In addition, the species of crustaceans that are obtained that indeed living in the depths.

Meanwhile, the transect method is carried out at low tide, using a 1 x 1 m² transect frame that is carried perpendicular to the beach using a length of rope that depends on the length of the beach. In this case the length of the beach ranges from 150 meters to 300 meters. With this transect method not many species of crustaceans are found because not all crustaceans are in the transect frame. This is also because crustaceans are very mobile and getting into the hole quickly so it is very difficult to find. Thus a very small number of species and the number of individuals obtained by this method.

Whereas free collection, carried out in the coastal area at low tide by breaking the coral found and the location chosen randomly. With this method more species and numbers of individuals are obtained from the species of crustaceans, because it is not limited to the transect frame and the location is determined randomly.

Species of crustacean discovered by using three sampling methods

Three species discovered in all of sampling methods consisted of two families. *Alpheus facetus* and *A. rapax* are shrimp belonged to the family Alpheidae. Whereas, the species of crab, *T. crenata*, belongs to the Family Portunidaea. Based on the results of research using these three methods, three species of crustaceans were found. Two species come from the Alpheidae family, which are species of pistol shrimps that live in symbiotic in corals, seagrass beds and mangrove. It has a very small size, only a few mm and cannot be eaten, therefore it has no important economic value (Pratiwi 2006). This species of *Alpheus* shrimp inhabits various habitats on coral reefs in both the tropics and sub-tropics. Most of these species are found living in the coral colonies and/ or hide under dead rock corals. These species like clear waters (Pratiwi 2002; Bezerra and Almeida 2008). Several species of Alpheidae can also be found in the intertidal depth range up to 130 meters (Chace 1988).

Table 1. The composition of number species and number of individuals from crustaceans using three different methods

Methods	Trawl	Transect	Free collections
Total number of species	66	41	101
Total number of individu	746	65	704

Table 2. Species of crustacean discovered using three methods

Family	Genus/species	Sampling methods			Total
		Trawl	Transect	Free collections	
Alpheidae	<i>Alpheus facetus</i> de Man, 1908	1	4	9	14
	<i>Alpheus rapax</i> Fabricius, 1798	3	1	1	5
Portunidae	<i>Thalamita crenata</i> Rüppell, 1830	3	2	19	24

Another species is *T. crenata* which is a species of crab belonging to the family Portunidae. The habitat of the *T. crenata* is broken coral sand and the bottom of the sandy sand waters, with depths between 25 and 30 m (Dai and Yang 1991), but this species is found only slightly in shallow non-reef habitats with soft substrates. Although it is a commercial species, not all Indonesian people eat it and sell it. Fishermans usually eat for the needs of their family.

Synopsis and identification of three species crustaceans

Phylum: Arthropoda
 Subphylum: Crustacea
 Class: Malacostraca
 Order: Decapoda
 Family: Alpheidae
 Genus: *Alpheus*

Alpheus facetus de Man, 1908

Alpheus facetus (Fig. 3) belongs to the Macrochirus group. The local names of this species is "*Udang pistol*". This shrimp has a small body size that is 18.0-23 mm body length and 7.0-11 mm carapace length. The rostrum is pointed (acute), with the tip of the rostrum reaching to the front of the end of the first antenna segment. The carina spine is blunt and rounded slightly wider posteriorly and extends almost to the center of the carapace. Orbital hoods (parts of the eye) have sharp (acute) teeth at each end (anterior margin) and have a shorter size than rostrum.

The antennules having an antennular peduncle length (antenna stalk) is almost the same and with all three-ratio ratios compared to: 0.3: 0.5: 0.3. The Stylocerite section (the inside of the antenna) is slim, with a sharp (acute) lateral part reaching the middle of the second antenna segment. The Scapocerite part (part of the antenna) has an edge (lateral margin) in a straight shape with lateral teeth that exceeds the length of the third segment of the antenna, and lamellae. The Carapocerite (part of the antenna) is hard and exceeds the size of the antennules. While Basicerite armed has acute tooth The segment of the third maxilliped has a ratio: 10: 5: 15, with a narrow shape and at the edges there are hairs attached along the edge of the tip.

The major chela (Large claws) of shrimp *A. facetus*, large, flat and elongated. The superior margin supports two longitudinal ridges. Inferior margins are round without curves or grooves. Dactylus (part of a claw) is blunt, has movable fingers, and is slightly longer in size than immovable fingers. Merus (part of a claw) has 4-6 small spines and small pointed teeth (acute).

The minor chela (Small claws) have a slim shape with a sharp (acute) Dactylus. Carpus (small claw part) slim. Merus is unarmed and Ischium is bearing acute movable spine. This shrimp has a sharp (acute). Telson (tail part) in the posterior margin has acute shape. While in the middle of the telson (posterolateral) there are four spines (a pair of spines) that are slim and elongated. The uropodal endopod (the inside of the tail) and the uropodal exopod (the outside of the tail) are elongated with a large and sturdy spine in the external part.

This species has been collected from intertidal to depths of 30 m, but most specimens have come from dead coral heads collected in 2 m or less depths. This species is new records from the Natuna Islands.

General distribution:

Alpheus facetus has distribution in the Western Indian Ocean, Vietnam, Thailand, Philippines, Indonesia, Japan Australia and Caroline Islands (Banner and Banner 1982; Chace 1988). Specifically, distribution in Australia was found in Western Australia near northern Perth to Yampi Sound and North Australia from Darwin, Gulf of Carpentaria and Islands on Thursday; in eastern Australia from south Port Douglas to near Sydney and New South Wales (Banners and Banners 1982. While the distribution of this shrimp in Indonesia, according to de Man 1911; Tiwari 1963 starts from Jedan Island, East Coast of Aru Islands and Paging Island.

Indonesian distribution

We have 14 specimens from Pulau Burung, Kepulauan Seribu; collected from intertidal and muddy substrate; 11 from Lancang Island, Thousand Islands from muddy substrate; 20 specimens from Bokor Island, Jepara, collected from muddy substrate and 7 specimens from

Situbondo (Pasir Putih), collected from muddy substrate (Pratiwi 1999; 2002); One specimen from Hative Besar Island, Ambon, collected overground coral by Banner and Banner, 1975 (Banner and Banner 1985). In addition we got 14 specimens in the form of new records obtained from Natuna waters, i.e Sedanu Island, Bunguran Island and Batang Islands, from sand, coral, coll. Pratiwi 4/23/2011. All specimens are stored well in the Reference Collection room of the Oceanography Research Center (P2O)-Indonesian Institute of Sciences, Jakarta.

Alpheus rapax Fabricius, 1798

Alpheus rapax (Fig. 3) is the member of Brevirostris Group. The local names of this species is “Udang pistol”. These specimens are medium size, measuring 19.0-26.0 mm in carapace length and 32.8-55.9 mm in body length. The rostrum is acute not reaching end of first antennular segment. The dorsal carina spines are acute and sharp in anteriorly and rounded in the posteriorly. Orbital hoods (part of the eyes) are unarmed, inflated, and rounded anteriorly. Orbitorostral groove deep and broader. The antennular segment of peduncle (antenna stalk) has ratio 0.4-0.9: 1.4-2.3: 0.5-0.9. The Stylocerite section (the inside of the antenna) has an acute tooth reaching almost near end of first antennular segment. The scaphocerite part (part of the antenna) has an acute lateral tooth reaching past end of third antennular segment. The lamella is broader and lateral margin are slightly concave. The scaphocerite is longer than carapocerite. The Carapocerite is strong and slender reaches the end of antennular peduncle. While Basiscerite armed has acute tooth. The segment of the third maxilliped has ratio: 10: 4-5: 12-15.

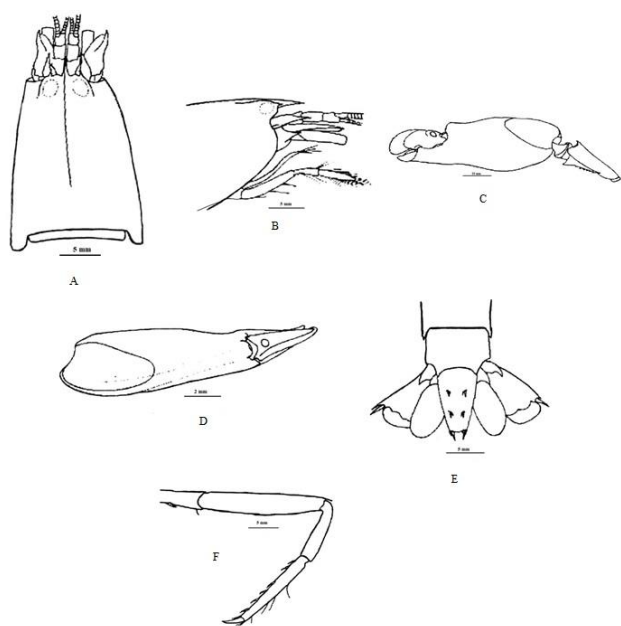


Figure 2. *Alpheus rapax* from Natuna Islands. A, B. anterior region, dorsal and lateral view; C, D. large chela and merus,

lateral and dorsal view; E. telson and uropods, dorsal view; F. third leg (in 5 mm scale), lateral view.

The major chela (Large claws) of shrimp *A. rapax* is compressed with rounded transverse groove proximal to dactylus on superior margin, which is moderately flattened and bearing long forward hairs. Inferior margin is also flattened on palmar and bearing row of long forward hairs extends to distal of finger. Dactylus compressed bearing long forward hairs similar to propodal finger. Merus with superior distal is truncated inferior distal with acute tooth and bears 6-7 spines and are scattered long setae.

The minor chela (Small claws) is compressed shows sexual dimorphism, but without balaeniceps shape on both sexes. Dactylus is moderately curved at tip and with dense row of bristles on opposing faces fringed and cutting edges on both margin of fringer. Superior and inferior margin bearings forward hairs. Merus is similar with large chela. The ischium of this chela is armed with a small and acute tooth sub-distally.

Telson (tail part) in the posterior margin has rounded shape. While in the middle of the telson (posterolateral) there are four spines (a pair of spines) that are slim and elongated. The uropodal endopod (the inside of the tail) and the uropodal exopod (the outside of the tail) are elongated with a large and sturdy spine in the external part.

General distribution:

Alpheus rapax distributes in South and East Africa, Zanzibar, Djibouti, Madagascar, Red Sea, Maldives Archipelago, Ceylon (Sri Lanka), Mergui Archipelago (Andaman Sea), Indian Ocean, Netherlands, Indies, Singapore, Indonesia, Thailand, Australia, Japan, Mariana and Marshall Islands and Hawaii (de Man 1911; Barnard 1950; Banner and Banner 1982).

Indonesian distribution

We have 8 specimens from Burung Island, Thousand Islands collected from intertidal and muddy substrate; 3 specimen from Lancang Island, Thousand Islands, collected from muddy substrate; 2 specimen from Bojonegoro, Banten Bay, collected from muddy substrate; one specimen from Lima Island, Buntan Bay, collected from muddy substrate. 4 specimen from Bokor Island, Jepara, collected from muddy substrate. 9 specimens from Pasir Putih, Situbondo, collected from muddy substrate (Pratiwi 1999; 2002). 5 specimens from Sedanu Island, Bunguran Island and Batang Islands, Natuna (as New records), collected from sand, coral, coll. Pratiwi 4/23/2011. All specimens are stored well in the Reference Collection room of the Oceanography Research Center (P2O)-Indonesian Institute of Sciences, Jakarta.

Phylum: Arthropoda
Subphylum: Crustacea
Class: Malacostraca
Order: Decapoda
Family: Portunidae
Genus: *Thalamita*

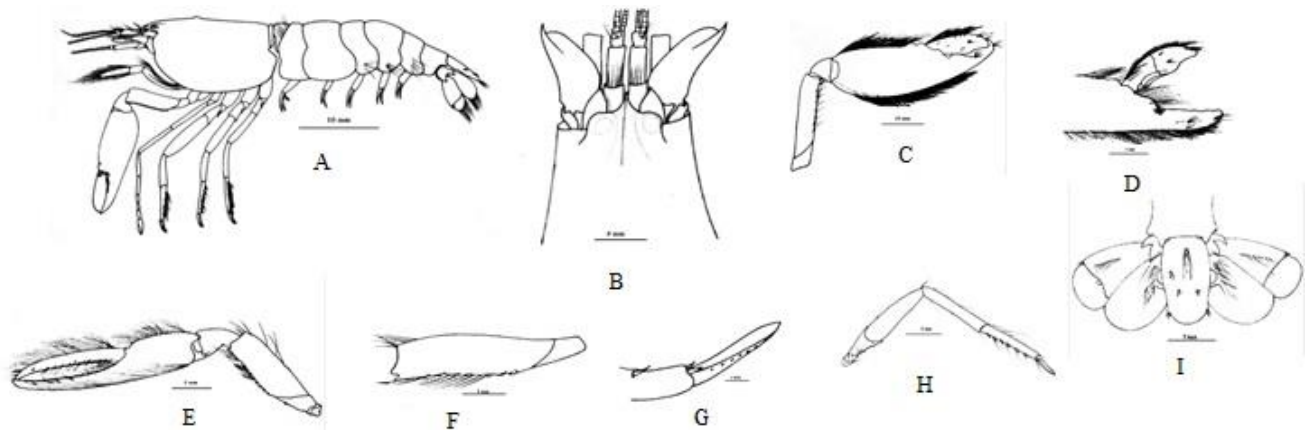


Figure 3. *Alpheus rapax* from Natuna Islands. A. Hole body of male, B. Anterior region, dorsal view, C. Large chela and merus lateral view, D. Enlarged large chela, medial view, E. Small chela and merus, lateral view. F. Merus of large chella, medial view, G. Enlarged dactylus, lateral view H. Third leg, lateral view, I. Telson and uropods, dorsal view.

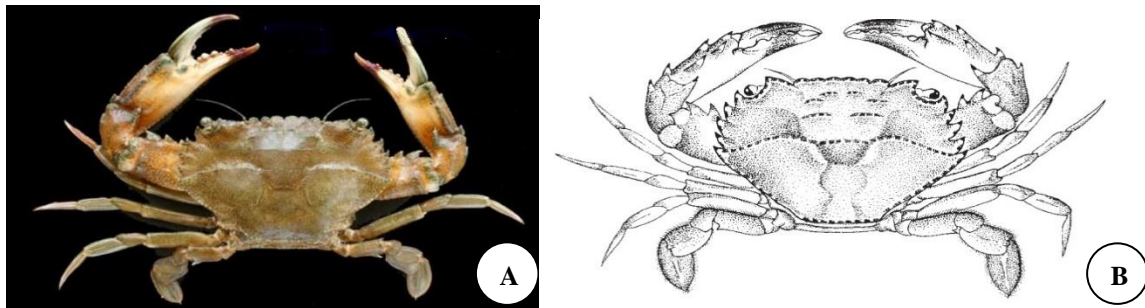


Figure 4. Photo (A) and sketch (B) of *Thalamita crenata* from Natuna Islands

Thalamita crenata Rüppell, 1830

The local name of this species is “Kepiting Batu”. This crab has a size of more than 8 cm in carapace area. This species is also known as swimming crab, with a pair of fourth legs flattened into a paddle-like structure for swimming. The carapace is smooth in structure, with some low ridges present across the middle section. The claws are thicker and shorter than those of the blue swimming or long-eyed crab. There are five teeth along the front margin of the carapace, with the front teeth slightly larger than the last teeth. The species is identified by the six rounded lobes, nearly equal in size, along the anterior margin of the carapace between the eyes, and by five fine sharp spines on the antero lateral margin. The chelipeds or pincers are large and strong.

The habitat of *T. crenata* is the mud flat, muddy beach, river mouth, mangrove area, broken coral sand and the bottom of the sandy sand waters etc. with depths between 25-30 m (Dai and Yang 1991). It seems to prefer brackish water but is seldom found in clear seawater like coral reef. This middle-sized crab is mostly caught with baby trawlers, skimming netters or crab traps in the inner portion of a bay or mangrove creek. This species is very popular both for sale and consumption. They are caught by crab traps, often sold in fish market in southern of Sulawesi and Ambon Island, but in Jakarta this species is only consumed for local fishermen's families. *T. crenata* is one of the most

distinctive species of the genus, and one of the few found in shallow non-reef habitats with soft substrates. General distribution:

Thalamita crenata is distributed in the entire tropical Indo-Pacific area from Hawaii southward and westward across the tropical western Pacific Ocean, through East Indies and across the Indian Ocean finally reaching the coast of Africa and the Red Sea. China, Indonesia, Malaysia, Singapore, Australia, Tuamotu, Tonga, French Polynesia, and Hawaii.

Indonesian distribution

Mysore Island, Cendrawasih Gulf, Papua (de Man 1902); near Padang, Sumatera; Ujung Pandang, south of Sulawesi (de Man 1892); Ternate (de Man 1902); Ambon and Banda islands (Stephenson 1972); Haruku Island; Hoga Island, Kaledupa, Tukang Besi Island (Stephenson 1975) Southeast Sulawesi; Kepulauan Seribu (Pari Island, Ayer island, Nusalenga island, Kongsii island, Lancang Kecil island, Macan island, Pamagaran island, Pancalirang island dan Sebaru Besar island); Kamojan island, Karimunjawa island; Saubi island, Larat island, Kangean island; Sesi island; Tomea island, Nusa Tenggara Barat island; Saumlaki island; Jinatu island; Komodo island; Tajandu island, Aru islands; Kate-kate island, Ambon bay and Panarikan bay, Belitung; Mawi bay; Arafura Ocean; Maratua, Northeast, Kalimantan; near Manumbai, Hainsisi,

Semau, near Timor island; Sapuka Besar; Postiljon islands; Bima island, Sumbawa island; Pankaja, Spermonde islands; Taliabu, Sula island, east of Sulawesi (Moosa and Juwana 1996). Sedanu Island, Bunguran Island and Batang Islands, Natuna (a new record), sand, coral, coll. Pratiwi 4/23/2011.

The species of crustacean discovered in deep habitats (trawling)

The results from trawling that conducted three times at Sedanu Island, Batang Island, and South Station Bunguran Island obtained 66 number of species and 746 number of individuals (Table 3 and Table S2). From these results, it appears that there are some species that usually found in habitats with a depth of 20 to 46 meters. Penaeidae has the highest individual compared to other families. *Metapenaeopsis palmensis* (Haswell, 1879) with 246 individuals are found to be abundant in all stations (trawling) with adult and juvenile stages. Majidae (crab) is the second highest individuals after Penaeidae, with *Phalangipus hystrix* (Miers, 1886) (83 individuals). While *Metapenaeopsis andamanensis* (Wood-Mason in Wood-Mason & Alcock, 1891) with 63 individuals and *Charybdis callianassa* (Herbst, 1789) (Portunidae) with 52 individuals (Table S2). Shrimps and crabs are one of the demersal fisheries, which means demersal fisheries related to both types are fishery products ranging from the coast to a depth of approximately 40 meters. The species of shrimp Penaeidae and Portunidae crabs found at the research station are also demersal fisheries (Nirmala and Pratiwi 2011).

The abundance of shrimp Penaeidae, *Metapenaeopsis palmensis* (Haswell, 1879), *Metapenaeopsis andamanensis* (Wood-Mason in Wood-Mason & Alcock, 1891) in all stations because the environmental conditions are very supported for life. The temperature ranges are 29°C-31°C with an average of 30°C, 19 ‰-32 ‰ salinity with an average of 30‰, pH 7.9 to 8, 9 and the average at the station is 8.8. Oxygen at the study site was 1,605-4,442 ml/L with an average of 3,957 ml/L and was found at a depth of 40 to 45 meters. This is strongly supported by crustacean research in other Indonesian waters, where the optimal temperature range for crustaceans is around 28°C-30°C, optimum salinity ranges are from 23 ‰-32 ‰, and optimum pH is 7.4-8.5 (Romimohtarto and Yuwana 2001; Alfitriatussulus 2003; Pratiwi 2010; Nirmala and Pratiwi 2011). According to those researches, the temperature, salinity, pH, oxygen and depth at each research station can still be tolerated by the crustaceans for survival. Supply of freshwater and sediment from the mainland or river flow are also very influential on the lives of shrimp (Penaeidae),

especially the study site near the mainland of the island of Natuna, which is heavily influenced by the rivers around the Natuna Islands. Toro and Soegiarto (1979) state that shrimp live as benthic on the seabed. The most preferred habitat by shrimp is the seabed, which has a soft substrate (a mixture of mud and sand) because it can fulfill fertility in the area.

According to Pramonowibowo et al. (2007), based on its life cycle, all shrimp larvae and juvenile phases live in shallow waters and along with the development of the body. The shrimps will migrate to deeper waters and they choose an area with base substrate where corresponds to their life. Such is the case with the Portunidae, *Charybdis callianassa* (Herbst, 1789) and Majidae, *Phalangipus hystrix* (Miers, 1886) crab with the appropriate environmental conditions, will be supportive of their lives so that, their presence at each station will vary depending on the environmental conditions in which they are located.

Crustaceans obtained in Natuna waters have different numbers of individual crustaceans at each station this is influenced by differences in water environmental conditions. Station 14 has the highest number of individuals (410 ind./ha) and station 16 has the lowest number of individuals (125 ind./ha) when compared to station 20 which has the number of 211 ind/ha (Table 3).

The species of crustacean discovered in shallow habitats (estuarine)

The results of research conducted in shallow areas (estuarine) using transect and free collections methods in Bunguran, Sedanu, Kognang, Batang and Sebangmawang Islands, found that the species of crustaceans commonly found in areas with substrate sand, mud and muddy sand. Both methods are carried out at low tide, so that sample collection can be done easily.

The results of free collections have more species of crabs (101 number of species and 704 numbers of individuals) and there are 6 dominant species obtained from mangrove (mud substrate), seagrass (sand and mud sand substrate) and also in sandy beach areas (Table S4, Figure 3 and Figure 4). These species are *Parasesarma plicatum* (Latreille, 1803), *Parasesarma pictum* (De Haan, 1835), *Ocypode ceratophthalmus* (Pallas, 1772), *Pagurus* sp. *Coenobita rugosus* H. Milne Edwards, 1837 and *Thalamita crenata* Rüppell, 1830. Whereas from the transect only obtained 41 numbers of species and 65 numbers of individual and around 3 dominant species namely *Metopograpsus messor* (Forskål, 1775), *Tabuca coarctata* (H. Milne Edwards, 1852) and *Pilumnus tomentosus* Latreille, 1825 (Table S3).

Table 3. Number of species and number of individual from tree location trawlings of crustaceans in the waters of the Natuna Islands

Parameter	Trawl 1/sta 14 (Sedanau Island)	Trawl 2/sta 16 (Batang Island)	Trawl 3/sta 20 (Bunguran Island)	Total
Total of Species	31	15	20	66
Total of Individuals	410	125	211	746

Based on the results of the free collection in the mangrove area, crustacean species were found which are dominated by the Sesamidae, Ocypodidae, and Coenobitidae families. This is in accordance with research conducted by Ravichandran et al. 2011, their research showed that *Uca* spp. found mostly in mangrove forests and is a dominant species compared to other crustacean species. In general, *Uca* spp. often found with very large number of species in open areas and has an important role in the mangrove forest ecosystem. While other crab species, such as the Paguridae and Xanthidae families, were also found at the study site, but they were not numerous. Their presence is thought to be just to find food and shelter for while. In this study the crab of *Scylla* spp. rarely found in the study site. Possibility this shows that the destruction of mangrove vegetation at the study site has caused disruption of the mangrove ecosystem and caused an ecological stability to have an impact on the decline in crab species in the area. In addition, crabs in the mangrove area can adapt well if there is an environmental change in their habitat, they will migrate quickly when their habitat is disturbed. The dominant crab species at the study site was *Parasesarma plicatum* species (Latreille, 1803), and *Parasesarma pictum* (De Haan, 1835) are most commonly found in mangrove forests in intertidal areas with a total of 42 and 48 individuals. However, this species cannot be consumed. Both species have the ability to adapt to the surrounding environment both in damaged or extreme conditions. Besides that according to (Salgado and Keith 2010), this species has a habit of eating litter and even mangrove seeds.

The conclusion that can be drawn from this study is that, there needs to be thought about the tools and methods that will be used in the research. The location, habitat and environment around the research site must also be pre-surveyed before the research is conducted. The results from research in a location will work well, if done in accordance with the right tools and methods.

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Table S1. The total species of crustacean fauna obtained from Natuna islands using three different methods

Family	Genus/species	Sampling methods		
		Trawl	Transect	Free collections
Alpheidae	<i>Alpheus facetus</i>	1	4	9
	<i>Alpheus rapax</i>	4	1	1
	<i>Alpheus lottini</i>	3	0	4
Callapidae	<i>Ashtoret lunaris</i>	0	2	3
	<i>Calappa</i> sp.	0	0	2
Coenobitidae	<i>Coenobita rugosus</i>	0	4	33
Grapsidae	<i>Grapsus albolineatus</i>	0	1	23
	<i>Grapsus longitarsis</i>	0	0	2
	<i>Grapsus</i> sp.	0	0	10
	<i>Grapsus tenuicrustatus</i>	0	0	16
	<i>Metopograpsus messor</i>	0	5	22
Hapalocarcinidae	<i>Hapalocarcinus marsupialis</i>	0	0	2
Larvae	White shrimps larvae (?)	0	0	60
Leucosiidae	<i>Arcania gracilis</i>	3	0	0
	<i>Arcania heptacantha</i>	1	0	0
	<i>Arcania undecimspinosa</i>	1	0	0
	<i>Ixa</i> sp.	2	0	0
	<i>Ixoides</i> sp.	1	0	0
	<i>Leucosia</i> sp.	1	0	0
	<i>Liagore</i> sp.	3	0	0
	<i>Liomera cinctimanus</i>	0	1	1
	<i>Pariphiculus coronatus</i>	1	0	0
	<i>Randallia eburnea</i>	1	0	0
Majidae	<i>Myra fugax</i>	1	0	0
	<i>Myra</i> sp.	1	0	0
	<i>Phalangipus hystrix</i>	83	0	0
Ocypodidae	<i>Ocypode cordimana</i>	0	2	21
	<i>Ocypode ceratophthalmus</i>	0	4	36
	<i>Uca (Tubuca) coarctata</i>	0	10	20
	<i>Uca (Austruca) annulipes</i>	0	3	2
Parthenopidae	<i>Parthenope contrarius</i>	0	0	1
Paguridae	<i>Clibanarius</i> sp.	0	0	12
	<i>Pagurus</i> sp.	0	0	41
Penaeidae	<i>Metapenaeus ensis</i>	27	0	0
	<i>Metapenaeopsis palmensis</i>	246	0	0
	<i>Metapenaeopsis andamanensis</i>	73	0	0
	<i>Megokris pescadoreensis</i>	19	0	0
	<i>Penaeus merguensis</i>	20	0	0
	<i>Penaeus monodon</i>	25	0	0
	<i>Penaeus semisulcatus</i>	3	0	0
	<i>Trachysalambria curvirostris</i>	23	0	0
Portunidae	<i>Charybdis (Charybdis) acuta</i>	0	0	21
	<i>Charybdis callianassa</i>	52	0	0
	<i>Charybdis (Goniohellenus) truncata</i>	0	0	24
	<i>Charybdis</i> sp. 1	1	0	0
	<i>Portunus (Monomia) gladiator</i>	4	0	0
	<i>Portunus (Cycloachelous) granulatus</i>	3	0	0
	<i>Portunus (Portunus) pelagicus</i>	0	0	13
	<i>Portunus sanguinolentus</i>	0	0	6
	<i>Portunus (Xiphonectes) tenuipes</i>	0	0	4
	<i>Thalamita crenata</i>	3	2	19
	<i>Thalamita prymna</i>	0	0	35
Sesarmidae	<i>Parasesarma plicatum</i>	0	0	42
	<i>Parasesarma pictum</i>	0	1	48
Scyllaridae	<i>Eduarctus martensii</i>	2	0	0
	<i>Thenus orientalis</i>	5	0	0
Scyroidae	<i>Sicyonia ocellata</i>	3	0	0
Squillidae	<i>Oratosquillina inornata</i>	1	0	0
	<i>Oratosquilla nepa</i>	14	0	0
	<i>Oratosquilla</i> sp. 1	2	0	0
	<i>Oratosquilla</i> sp. 2	5	0	0
	<i>Oratosquilla</i> sp. 3	1	0	0
	<i>Oratosquilla</i> sp. 4	3	0	0
	<i>Oratosquilla</i> sp. 5	2	0	0
	<i>Quollastria ornata</i>	6	0	0
Xanthidae	<i>Actae</i> sp.	0	1	2
	<i>Atergatis floridus</i>	0	2	1
	<i>Baptozius vinosus</i>	0	0	5
	<i>Chlorodiella nigra</i>	0	2	2
	<i>Etisus</i> sp.	0	0	11
	<i>Euxanthus exsculptus</i>	0	2	4
	<i>Pilumnus longicornis</i>	0	0	4
	<i>Pilumnus tomentosus</i>	0	4	16
	Total of species	66	41	101
	Total of individu	746	65	704

Table S2. Fauna of crustacean obtained tree times from trawling

Family	Genus/Species	Sampling methods			Total	
		Trawl 1	Trawl 2	Trawl 3		
Alpheidae	<i>Alpheus facetus</i>	0	0	1	1	
	<i>Alpheus lottini</i>	0	0	4	4	
	<i>Alpheus rapax</i>	3	0	0	3	
Leucosiidae	<i>Arcania gracilis</i>	0	3	0	3	
	<i>Arcania heptacantha</i>	0	0	1	1	
	<i>Arcania undecimspinosa</i>	0	1	0	1	
	<i>Ixa</i> sp.	2	0	0	2	
	<i>Ixoides</i> sp.	0	1	0	1	
	<i>Leucosia</i> sp.	1	0	0	1	
	<i>Liagore</i> sp.	0	3	0	3	
	<i>Pariphiculus coronatus</i>	1	0	0	1	
	<i>Psoptheticus hughis</i>	0	1	0	1	
	<i>Randallia eburnea</i>	1	0	0	1	
	Majidae	<i>Myra fugax</i>	1	0	0	1
		<i>Myra</i> sp.	0	0	1	1
Penaeidae	<i>Phalangipus hystrix</i>	83	0	0	83	
	<i>Metapenaeus ensis</i>	27	0	0	27	
	<i>Metapenaeopsis palmensis</i>	145	73	28	246	
	<i>Metapenaeopsis andamanensis</i>	20	25	18	63	
	<i>Megokris pescadoreensis</i>	7	0	12	19	
	<i>Penaeus merguensis</i>	20	0	0	20	
	<i>Penaeus monodon</i>	25	0	0	25	
	<i>Penaeus semisulcatus</i>	3	0	0	3	
	<i>Trachysalambria curvirostris</i>	23	0	0	23	
	Portunidae	<i>Charybdis (Charybdis) acuta</i>	0	0	21	21
		<i>Charybdis callianassa</i>	3	4	45	52
<i>Charybdis</i> sp. 1		2	0	0	2	
<i>Portunus (Monomia) gladiator</i>		1	0	0	1	
<i>Portunus (Cycloachelous) granulatus</i>		14	0	0	14	
<i>Portunus (Portunus) pelagicus</i>		0	0	1	1	
<i>Portunus sanguinolentus</i>		0	0	6	6	
<i>Portunus (Xiphonectes) tenuipes</i>		4	0	0	4	
<i>Thalamita crenata</i>		3	2	19	24	
<i>Thalamita mitsienseis</i>		0	0	2	2	
<i>Thalamita prymna</i>		0	0	35	35	
Scyllaridae		<i>Eduarctus martensii</i>	2	0	0	2
		<i>Scyllarides latus</i>	3	0	0	3
		<i>Thenus orientalis</i>	1	1	3	5
Scyoiidae		<i>Sicyonia ocellata</i>	1	4	3	8
Squillidae		<i>Oratosquilla inornata</i>	1	0	0	1
		<i>Oratosquilla nepa</i>	7	4	3	14
	<i>Oratosquilla</i> sp. 1	1	1	0	2	
	<i>Oratosquilla</i> sp. 2	1	0	4	5	
	<i>Oratosquilla</i> sp. 3	1	0	0	1	
	<i>Oratosquilla</i> sp. 4	0	1	2	3	
	<i>Quollastria ornata</i>	3	1	2	6	
Total of species	31	15	20	66		
Total of individu	410	125	211	746		

Table S3. Crustacean fauna obtained from transects

Family	Genus/species	Station			Total	
		TR SCT 1	TR SCT 2	TR SCT 3		
Alpheidae	<i>Alpheus facetus</i>	1	2	1	4	
	<i>Alpheus rapax</i>	1	0	0	1	
	<i>Apheus lottini</i>	0	0	0	0	
Callapidae	<i>Ashtoret lunaris</i>	0	2	0	2	
	<i>Calappa</i> sp.	0	0	0	0	
Coenobitidae	<i>Coenobita rugosus</i>	0	2	2	4	
Dromiidae	<i>Frodromia atypica</i>	1	0	0	1	
Grapsidae	<i>Grapsus albolineatus</i>	0	0	1	1	
	<i>Grapsus</i> sp.	2	2	1	5	
	<i>Metopograpsus messor</i>	4	3	3	10	
	<i>Grapsus tenuicrustatu</i>	0	0	0	0	
	<i>Grapsus longitarsis</i>	0	1	1	2	
Leucosiidae	<i>Liomera cinctimanus</i>	0	0	1	1	
	<i>Parasesarma plicatum</i>	0	0	0	0	
Sesarmidae	<i>Parasesarma pictum</i>	1	0	0	1	
	Ocypodidae	<i>Ocypode cordimana</i>	1	0	1	2
<i>Ocypode ceratophthalmu</i>		1	2	1	4	
<i>Uca (Tubuca) coarctata</i>		1	5	4	10	
<i>Uca (Austruca) annulipes</i>		0	1	2	3	
Paguridae	<i>Clibanarius</i> sp.	0	0	0	0	
	<i>Pagurus</i> sp.	0	0	0	0	
Parthenopidae	<i>Parthenope</i> sp.	0	0	0	0	
Portunidae	<i>Scylla serrata</i>	0	0	0	0	
	<i>Thalamita admete</i>	0	0	0	0	
	<i>Thalamita crenata</i>	0	1	1	2	
	<i>Thalamita prymna</i>	0	0	0	0	
	<i>Thalamita mitsienseis</i>	0	0	0	0	
	<i>Charybdis (Charybdis) acuta</i>	0	0	0	0	
	<i>Charybdis (Goniohellenus) truncata</i>	0	0	0	0	
	<i>Portunus (Portunus) pelagicus</i>	0	0	0	0	
	<i>Portunus sanguinolentus</i>	0	0	0	0	
	Xanthidae	<i>Atergatis floridus</i>	1	1	0	2
		<i>Actae</i> sp.	0	0	1	1
		<i>Liomera</i> sp.	0	0	1	1
		<i>Chlorodiella nigra</i>	1	0	1	2
		<i>Etisus</i> sp.	0	0	0	0
		<i>Euxanthus exsculptus</i>	0	2	0	2
<i>Pilumnus tomentosus</i>		2	1	1	4	
<i>Pilumnus longicornis</i>		0	0	0	0	
<i>Baptozius vinosus</i>		0	0	0	0	
<i>Cardisoma</i> sp.		0	0	0	0	
Hapalocarcinidae	<i>Hapalocarcinus marsupialis</i>	0	0	0	0	
	White shrimps larvae (?)	0	0	0	0	
Total number of species	12	13	16	41		
Total number of individuals	17	25	23	65		

Table S4. Crustacean fauna obtained from free collections

Family	Genus/Species	Station			Total	
		FC 1	FC 2	FC 3		
Alpheidae	<i>Alpheus facetus</i>	3	3	4	9	
	<i>Alpheus rapax</i>	1	0	0	1	
	<i>Alpheus lottini</i>	3	2	2	7	
Callapidae	<i>Ashtoret lunaris</i>	2	1	2	5	
	<i>Callapa</i> sp.	0	1	1	2	
Coenobitidae	<i>Coenobita rugosus</i>	6	10	25	41	
	<i>Pagurus</i> sp.	5	15	13	33	
Grapsidae	<i>Grapsus albolineatus</i>	8	12	3	23	
	<i>Metopograpsus messor</i>	14	7	6	27	
	<i>Grapsus</i> sp.	6	1	3	10	
	<i>Grapsus tenuicrustatus</i>	2	6	8	16	
	<i>Grapsus longitarsis</i>	2	0	0	2	
Leucosiidae	<i>Liomera cincimanas</i>	1	0	0	1	
Ocypodidae	<i>Ocypode cordimana</i>	6	13	2	21	
	<i>Ocypode ceratophthalmus</i>	12	9	15	36	
	<i>Uca coarctata</i>	2	8	10	20	
	<i>Uca annulipes</i>	0	2	0	2	
Paguridae	<i>Clibanarius</i> sp.	1	4	7	12	
Parthenopidae	<i>Parthenope</i> sp.	0	1	0	1	
Portunidae	<i>Thalamita crenata</i>	20	13	12	45	
	<i>Thalamita admete</i>	1	6	4	11	
	<i>Thalamita prymna</i>	2	5	10	35	
	<i>Thalamita mitisensis</i>	2	0	0	2	
	<i>Charybdis (Charybdis) acuta</i>	3	0	18	21	
	<i>Charybdis (Goniohellenus) truncata</i>	11	5	8	24	
	<i>Portunus (Portunus) pelagicus</i>	3	5	5	13	
	<i>Portunus sanguinolentus</i>	0	1	5	6	
	Sesarmidae	<i>Parasesarma plicatum</i>	9	14	20	42
		<i>Parasesarma pictum</i>	8	19	21	48
	Xanthidae	<i>Atergatis floridus</i>	1	0	0	1
<i>Actae</i> sp.		2	0	0	2	
<i>Liomera</i> sp.		1	0	0	1	
<i>Chlorodiella nigra</i>		0	2	0	2	
<i>Etisus</i> sp.		10	0	1	11	
<i>Euxanthus exsculptus</i>		1	3	2	6	
<i>Pilumnus tomentosus</i>		5	3	8	16	
<i>Pilumnus longicornis</i>		3	1	0	4	
<i>Pilumnus</i> sp.		0	1	0	1	
<i>Baptozius vinosus</i>		2	3	0	5	
<i>Cardisoma</i> sp.		1	2	0	3	
Hapalocarcinidae	<i>Hapalocarcinus marsupialis</i>	0	1	1	2	
	Larva White shrimps larvae (?)	0	60	0	60	
Total number of species		36	35	30	101	
Total number of individuals		171	269	264	704	

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