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Diversity of Penaeidae at the Teluk Mengkudu Waters, North Sumatra, Indonesia

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Abstract. *Azwar E, Sularno, Waruwu FP, Tarigan MRM, Ulfa SW, Djaingsastro AJ. 2023. Diversity of Penaeidae at the Teluk Mengkudu Waters, North Sumatra, Indonesia. Biodiversitas 24: 1376-1384*. Microscopic animals play an important role in the growth of marine biota. Crustaceans are a marine biota group often found in waters and have high economic value. Crustaceans also have a significant role in coral reef ecosystems, contributing around 20% of all invertebrate species. Crustaceans are an important group of microbenthic fauna in coastal ecosystems, ranging from mangroves, coral reefs, and seagrass ecosystems. This present study was conducted from April to June 2022 to identify Penaeidae diversity in Teluk Mengkudu waters, Serdang Bedagai District, North Sumatra Province, Indonesia. Furthermore, it used a purposive sampling method to harvest crustacean species near the waters. An exploratory method was applied with quantitative data collection to select Penaeidae crustaceans from the catches retrieved by fishermen. The tools used in this study were boat, net, fiber, knife, compass, flags, camera, notebook, ice cubes, a thermometer, pH meter, and DO meter. The material used in this study was shrimp caught by fishers. Data collection techniques used interviews and documentation with fishing communities about catching crustaceans at the study site. Data analysis uses the formula diversity, evenness, knowledge richness, and dominance index. Based on the results, *Penaeus indicus* H.Milne Edwards, 1837 and *Metapenaeus ensis* (De Haan, 1844) were the two species obtained from the Penaeidae family. The evenness index for *P. indicus* and *M. ensis* was respectively highest in June (0.237 and 0.519) but lowest in May (0.203 and 0.510) with a total value of 2.212. Also, the prominent richness index for both species was respectively highest in June (5.762 and 29.371) but lowest in May (4.568 and 27.053). The highest dominance index (D) was measured in May, where the highest D value of *P. indicus* was 0.003, and the lowest was 0.002. The highest D of *M. ensis* was discovered in June, namely 0.086, while the lowest, at 0.073, was recorded in May, and in general, both species had a total D of 0.245. Parameters of salinity, pH, temperature, substrate, and oxygen strongly influence crustacean diversity. The parameters measured in the study area included temperature (28°C), salinity (20-35 ppt), DO (6.8 mg/L), and pH (6.7).

Keywords: Abundance, crustacea, diversity, dominance, Penaeidae, similarity

INTRODUCTION

Crustaceans, such as crabs, shrimp, and lobsters, are important members of the Indonesian marine ecosystem. They play a vital role in maintaining the ecosystem balance by serving as a food source for other animals and helping to control the population of other organisms. Without crustaceans, the ecosystem would become unbalanced, and the water would become toxic, leading to a decline in the population and diversity of other aquatic life (Mégevand et al. 2022). According to studies by Everett et al. (2015) and Vogt (2019), up to 89% of crustaceans live in marine waters, 10% in freshwaters, and 1% in terrestrial environments. Therefore, preserving the diversity of crustaceans is very important, and this is intended so that the ecosystem balance can be maintained and utilized sustainably. In addition, various types of crustaceans exist in waters to show the quality of the environmental conditions (Kramer et al. 2014).

Crustaceans are a marine biota group often discovered in waters and have high economic value (Kouba et al. 2022). Crustaceans also play a significant role in coral reef ecosystems, comprising about 20% of all invertebrate species (Bondad-Reantaso et al. 2012; Kramer et al. 2014; Behringer and Duermit-Moreau 2021). Crustaceans consist of the macrobenthic faunas that inhabit coastal ecosystems, such as mangroves, coral reefs, and seagrass meadows in tropical and subtropical regions (Gerami et al. 2016; Starko et al. 2016; Al-Asif et al. 2020; Pratiwi and Elfidasari 2020; Arfianti and Costello 2021; Wong et al. 2021). Decapoda is almost entirely made up of crustaceans, easily recognized by their relatively large size and bright colors (Hamid and Wardiatno 2018). The main characteristic of crustaceans is the presence of two pairs of antennae. Additionally, the head and thorax are fused to form a unit of body parts called the cephalothorax (Timms 2015; Wahyudin et al. 2017; Muhtadi et al. 2022). Crustacea is a subphylum of arthropods consisting of organisms that live in the sea, breathe with gills, and have five joined segments. Members in this group are crustaceans, known to have one pair of jaws plus two maxillas (Krapp-Schickel and Vader 2015) and live in

association with seagrass meadows and rhizomes. Crustaceans feed on detritus, seagrass leaves, mollusks, polychaete, and some algae (Lapolo et al. 2018; Ginantra et al. 2021; Setyadi et al. 2021) while being considered significant contributors to coral reefs productivity (Kramer et al. 2014; González-Gómez et al. 2018).

Understanding the diversity and population of crustaceans is important for properly managing and conserving coral reef ecosystems. Therefore, regular and continuous data collection is necessary to identify the species in a specific water body and monitor changes over time. For example, Annisaqois et al. (2020) recorded seven groups of isopods on Bangka Island, North Sulawesi: Anthuridea, Asellota, Bopyridae, Cirolanidae, Gnathiidae, Limnoriidea, and Sphaeromatidea. Furthermore, Josia et al. (2019) reported the density of shrimp and crabs in the mangrove waters of the Meras Village, Bunaken District, Manado. The shrimp species were divided into four genera, including *Portunus monodon*, *Portunus semisulcatus*, *Portunus merguiensis*, and *Portunus trituberculatus*. While the crabs were divided into ten genera, including *Uca chlorophthalmus*, *Uca tetragonon*, *Uca capricornis*, *Penaeus latisulcatus*, *Portunus pelagicus*, *Portunus trituberculatus*, *Scylla olivacea*, *Scylla serrata*, *Scylla paramamosain*, and *Scylla tranquebarica*. Sousa et al. (2013) documented 24 species of water fleas in the Brasilia National Park and 30 in Campo de Instrução de Formosa. The 30 species included *Latonopsis australis, Ceriodaphnia cornuta, Ceriodaphnia* sp1, *Ceriodaphnia* sp2, *Ilyocryptus spinifer, Macrothrix elegans, Macrothrix paulensis, Streblocerus pygmaeus, Acroperus tupinamba, Alonadentifera, Alona glabra, Alona setigera, Alona iheringula, Alona intermedia, Alona ossiani, Alona ellaclathratula, Alona elladadayi, Anthalona verrucosa, Celsinotum candango, Chydorus dentifer, Chydorus eurynotus, Chydorus pubescens, Disparalona leptorhyncha, Ephemeroporus tridentatus, Epheme roporus, Graptoleberis occidentalis, Leydigiopsis curvirostris,* and *Notoalona sculpta*.

Teluk Mengkudu has a large variety of crustaceans. Marine crustaceans' great diversity and abundance are inextricably linked to the role played by microscopic organisms such as plankton. These microscopic animals play a significant role in the growth of marine biota, allowing crustacean species to live in the waters of this location. So far, however, no data has been collected on crustaceans in the waters of Teluk Mengkudu. Therefore, it is crucial to disseminate the results of this study as a source of knowledge and insight for other researchers in developing further research. The difference between this study and other studies is that this research used purposive sampling by determining station points and collecting crustacean samples using hand nets carried out directly by fishermen. In contrast, other studies were limited to collecting data on the crustaceans' environment. Therefore, the urgency of this research is to add new data on crustaceans living in the waters of Teluk Mengkudu Briefly: this study aimed to determine the diversity of crustaceans of the Penaeidae family in the waters of Teluk Mengkudu in North Sumatra. It is also expected that this research will contribute to developing similar research.

MATERIALS AND METHODS

Study area

Teluk Mengkudu Sub-district covering an area of 66.96 km^2, is located in northern Serdang Bedagai District, North Sumatra Province, Indonesia with geographic coordinates ($03^0$34'38.62" NL, $99^0$12'06.75" EL) as shown in Figure 1. The villages in Teluk Mengkudu include Sialang Buah, Sentang, Pematang Kuala, and Kuala Aceh or Kuala Simpang, each containing water bodies or beaches. These areas have mixed tidal conditions, namely two high and two low tides daily with different amplitudes and periods. The water brightness and temperature are 2.8 m and 27-30°C, respectively. One way to measure the brightness of water is using a Secchi disk, a round disc with a diameter of 20 cm made of zinc and painted white or black and white with a weight (the chip). First, the chip is lowered into the water until it is not visible; its depth is measured and lowered even deeper. Furthermore, the chip is lifted slowly, and if the chip is almost visible, then the depth is measured (Bowers et al. 2020). While water measurement is done by inserting the lower end of the thermometer into the water without touching the bottom of the liquid container (Bonacci et al. 2022). Also, the current water speed ranges between one and three knots with directions from southwest, northeast, and southeast (Tondang et al. 2020).

This study was conducted from April to June 2022 (Figure 2). It used purposive sampling to harvest crustacean species near the waters. Furthermore, an exploratory method was applied with quantitative data collection to select Penaeidae crustaceans from the fisheries catches. The purposive sampling method determination is based on the condition of the waters that contain crustacean habitat, where crustacean habitat is found.

Study procedures

The tools employed in this study included boats, nets, fiber, knives, compasses, flags, cameras, notebook, ice cubes, thermometers, pH meters, DO meter, and Secchi-disk, while the materials used were shrimps. Interviews were conducted with fishing communities while catching crustaceans from the Penaeidae family in Teluk Mengkudu. First, make direct observations at the research location by preparing interview questions orally to respondents to obtain the right information. After that, the author seeks information on fisherman groups' profiles in coastal communities with middle to lower socio-economic status. The author selected respondents who work as fishermen because only fishermen use the surrounding natural resources as necessities of daily life. At the research location, there were three groups of fishermen, namely Bintang Satu, Sepakat, and Sinar Jaya Fishermans. All three have bases in Pematang Kuala Village. The number of respondents interviewed consisted of 12 fishermen. The author chooses two respondents from each group of fishermen to be interviewed regarding their daily results while sailing. The interview type used in this study was unstructured, meaning the researcher conducted interviews

based on existing research topics. The interview included the topic of diversity and identification of crustaceans found in Teluk Mengkudu and was asked openly so that the interviewer could ask questions in a flowing manner, and could ask questions spontaneously. While the number of respondents who were interviewed amounted to 3 different groups of fishermen, namely Bintang Satu, Sepakat, and Sinar Jaya fishermens.

Moreover, the main study procedure involved preparing tools and materials for sampling. During the trip, the compass was used to locate the sampling point, and boats were anchored within a ±2 km range. The fishing net was stretched and marked with a buoy flag at the specified point for 10 minutes. Afterward, the nets were lifted, the catches were put into the fiber-containing ice cubes, and the fishermen pulled the nets by moving over a ±30 m distance to dock again. Sampling was carried out from the starting point to the fishing line, about ±4 kilometers away. The crustacean samples were preserved in 10% formalin solution and labeled with other necessary information. Furthermore, their morphology was identified at the Laboratory of Integrated Resource Management, Faculty of Agriculture, University of North Sumatra, Medan, Indonesia. These samples were identified based on Ghafor (2020) and Saxena (2005).

Water quality was evaluated while collecting shrimp samples. The parameters measured included water and air temperature, pH, dissolved oxygen (DO), and salinity. Water temperature was determined by immersing a thermometer halfway into the water. The scale on the thermometer was read while still inside the water. The temperature was recorded after the number on the scale became constant. Air temperature measurement was carried out using a temperature thermometer. The pH was calculated by dipping the tip of universal pH paper into the water and left to stand for some time. The resulting color was matched with a universal pH indicator. A digital DO meter calibrated in distilled water for 15 minutes was used to evaluate DO levels and water salinity. After removal, this tool was dried with a tissue and dipped in the sample water. The DO levels and water salinity waited until the values displayed on the screen were constant and recorded.

Figure 2. The study location in Teluk Mengkudu, Serdang Bedagai District, Indonesia

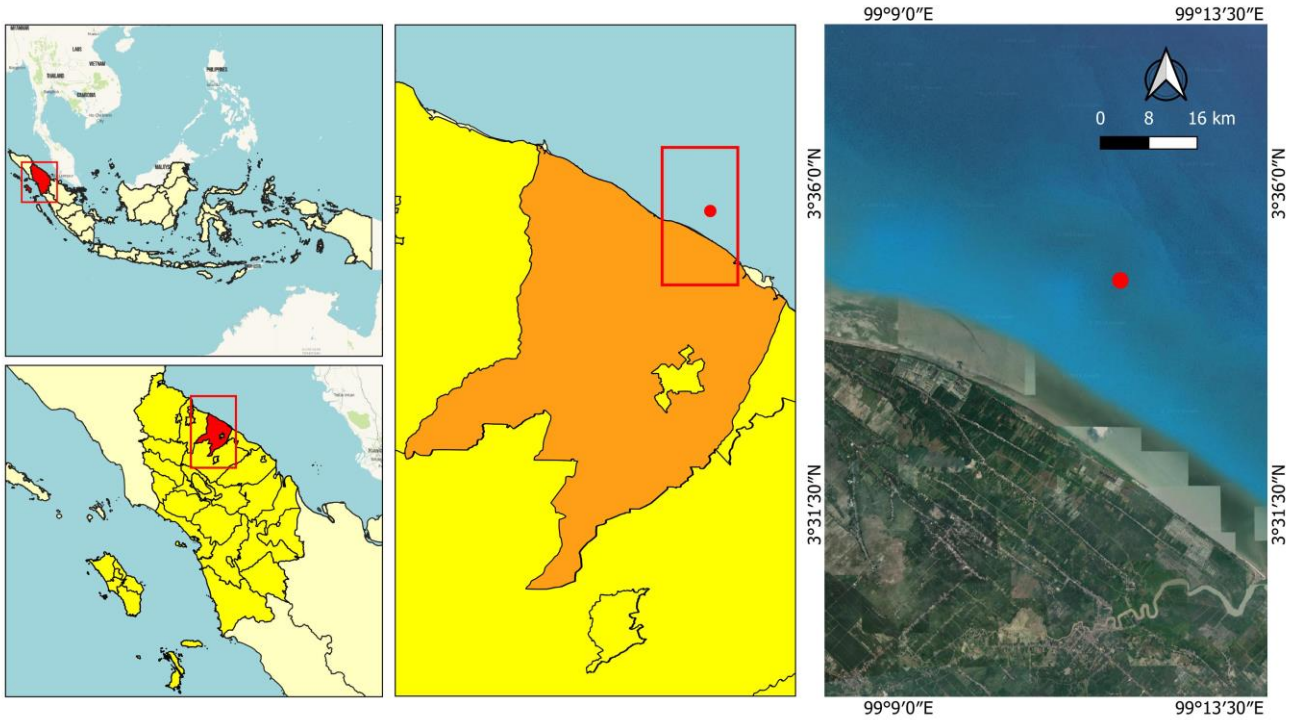

Figure 1. Sampling location of crustaceans from the family Penaeidae in Teluk Mengkudu, Serdang Bedagai District, North Sumatra Province, Indonesia

Data analysis

The fishermen's catches were classified, weighed, and analyzed for diversity determination. The data obtained were estimated using the following formula.

The diversity index (H')

The diversity index (Shannon-Weiner index) of crustaceans found in the Penaeidae family was calculated using the following formula.

$$H' = - (\sum pi \ In \ pi)$$

Where: H' is the diversity index; Pi is the number of individuals of the i-th species (ni) to the total individuals (N): (ni/N); ni is the number of individuals of each species; N is the total number of individuals. According to Odum (1993), the Shannon-Wiener (H') diversity index divides fauna diversity into four categories, namely very high (H'>3.0), high (H' = 1.6-3.0), moderate (H'= 1.0-1.5), and low (H'<1).

The evenness index (E)

The evenness index was known by comparing the diversity index with the maximum value, expressed as follows:

$$E = \frac{H'}{In \ S}$$

Where: E is the evenness index, H' is the diversity index, and S is the number of individuals in a species. The Evenness index ranges from 0-1; hence, E=0 indicates low inter-species uniformity, meaning the individual richness of each species is very much different. Conversely, e=1 signifies uniformity between species, which is relatively even, meaning the number of individuals in each species is relatively the same.

Knowledge Richness Index (KRi)

The crustaceans' abundance or knowledge richness index (KRi) was calculated using the following formula:

$$KRi = \left(\frac{ni}{N}\right) x \ 100\%$$

Where: KRi describes the knowledge richness index of the crustaceans, ni is the number of individuals from each species, and N is the total number of individuals from all species. KRi<0.1 = rare, 0.1-2.0 = uncommon, 2.1-10.0 = often, 0.1-40.0 = common, and >40.0 = abundant.

Dominance index (D)

The Simpson's dominance index (D) method was used to determine whether certain species are dominant. The D was calculated using the following formula:

$$D = \sum(pi)^2 = \sum\left(\frac{ni}{N}\right)^2$$

Where: D is the Simpson dominance index, Pi is the i-th proportion of species in the community, ni is the number of individuals of the i-th species, and N is the total number of individuals. D ranges from 0-1; in this case, it is categorized as D=0, meaning no species dominate another or the community structure is stable. Meanwhile, D=1 signifies that some species dominate others or the community structure is unstable due to ecological pressure.

RESULTS AND DISCUSSION

Physical and chemical parameters of the environment

This study measured the physical and chemical parameters of Teluk Mengkudu waters, including temperature, salinity, DO (Dissolved Oxygen), and degree of acidity (pH). Table 1 shows the measurement results.

Crustaceans from the family Penaeidae found in Teluk Mengkudu, North Sumatra, Indonesia

This study was conducted from April to June 2022 in Teluk Mengkudu waters and showed that crustaceans from the species *Penaeus indicus* and *M. ensis* dominated the total catches retrieved.

Penaeus indicus is yellowish-white in color with patterns, and the length measures 13-15 cm from the head tip to the caudal fin. This species' body has 13 segments consisting of 5 on the head and eight on the chest with a segmental diameter ranging from 0.5-1.1 cm. *P. indicus* possesses a pair of round eyeballs with a diameter of 0.3-0.4 cm (Figure 3). Furthermore, its distinctive feature is having a much longer rostrum than crabs, with 7 or 8 spines on the top and 4-6 spines on the bottom, with no triangular protrusion at the top. The antennal ridges extend beyond the epigastric teeth, while the postrostral protuberance ends at 1/4 or 1/6 of the length of the carapace base. *P. indicus* has 6-7 cm long bluish antennae, and the leg is 0.7-1.2 cm long.

Figure 3. A. *Penaeus indicus*; B. *Metapenaeus ensis.* Bar = 2 cm

Table 1. The physical-chemical parameters of the waters in Teluk Mengkudu, Serdang Bedagai District, North Sumatra, Indonesia

Location	Sampling	Parameters			
		Temp. (°C)	Salinity (ppt)	DO (mg/L)	pH
Teluk	I	28°C	34	6.8	6.7
Mengkudu	II	26°C	35	7.1	7.5
waters	III	29°C	33	6.5	7.2

Meanwhile, *M. ensis* has a medium size with a total length of 9-14 cm (excluding rostrum), irregular corrugated carapace surface, smooth protruding parts, and a lateral lycaeum plate with prominent lateral sides. This species has a straight rostrum, with 7-8 teeth on the top, but the bottom is toothless. Thorns are situated on the stomach, and antennae. The tail has no spines on the sides, but there are spines on the bases of the first to third legs and the ischium of the first legs. In males, there are protrusions on the coxa and merus of the fifth. Table 2 shows the results for crustacean species found in Teluk Mengkudu.

Table 2 shows that *M. ensis* dominated the catches in June, namely 115,847 individuals, while *P. indicus* had the lowest value in May with 18,017 individuals. The total catch of both shrimp groups in three months, i.e., April-June, was 394,432 heads. Data from the field were analyzed using formulas for H', E, KRi, and D.

Diversity index

Crustaceans caught by fishermen from the waters of Teluk Mengkudu, Serdang Bedagai District, North Sumatra Province, can be seen in Table 3.

Evenness index

Table 4 presents the evenness index of each crustacean species found at Teluk Mengkudu between April, May, and June. Based on Table 4, the E value of *P. indicus* was highest (0.237) in June but lowest (0.203) in May. The highest E (0.519) of *M. ensis* was obtained in June, while the lowest (0.510) was recorded in May. Therefore, the total evenness index of the crustaceans at Teluk Mengkudu was 2.212. Based on the data, the species uniformity is relatively even, or the number of individuals in each species is approximately the same.

Knowledge Richness Index

Table 5 presents the KRi of each crustacean species discovered at Teluk Mengkudu between April, May, and June. Table 5 shows that *P. indicus* and *M. ensis*, respectively, had the highest KRi (5.762 and 29.371) in June, while the lowest value (4.568 and 27.053) was recorded in May. The results indicated both species to be abundant at Teluk Mengkudu because their total KRi was 100.

Dominance Index (D)

Table 6 shows the D of each crustacean species obtained from Teluk Mengkudu between April, May, and June. Table 6 shows the highest D of crustaceans from the Penaeidae family was found in May. The highest D value of *P. indicus* was 0.003, and the lowest was 0.002. The highest D of *M. ensis* was recorded in June, namely 0.086, and the lowest was in May, namely 0.073. In general, the total D of both species caught by fishermen in Teluk Mengkudu was 0.245. These numbers fall into the stable community structure category, meaning no species dominate another.

Based on the results of interview data with fishermen in Pematang Kuala Village, Teluk Mengkudu, there are three groups of fishermen, including Bintang Satu, Sepakat, and Sinar Jaya Fishermans. Each fishing group consists of 12 members. The fishermen started sailing at 06.00 WIB by preparing tools and materials. To get to the location point, fishermen travel 2.5 miles or 4 km from the mainland using explorative fishing methods such as nets. Most of the catches of fishermen are *P. indicus* and *M. ensis*. The lack of fishermen's catch due to changing climatic conditions is a factor in the decreased abundance of marine biota, which causes large water currents so that the existence of crustaceans is at the bottom of the waters. In addition, the influence of climate can affect the spawning season for the abundance of shrimp every year, so the highest peak abundance of shrimp occurs in November, and the lowest peak abundance occurs in May. This indicates that the peak season of abundance in the waters tends to occur during the rainy season. The low catch of fishermen is also affected by damage to the seagrass meadow ecosystem and the activities of residents. The activities that pollute water by ship engines result in spilled oil in the sea intentionally or unintentionally, which can physically, chemically, and biologically reduce water quality. As a result, it affected the presence of marine biota in these waters, including crustaceans.

The catch analysis showed that the *M. ensis* species had the highest KRi in June. Several factors, including water temperature, caused these catchments. Krykhtina et al. (2021) revealed temperature as a crucial environmental factor for the survival of aquatic organisms, particularly crustaceans, because this parameter affects their metabolism and reproduction processes. Additionally, climate can contribute to the survival of crustaceans due to their most abundant in waters during the rainy season (Wahyudin et al. 2017; Hamid and Wardiatno 2018; Shields 2019; Gondal et al. 2021; Muhtadi et al. 2022). One of the diversity of crustaceans in the waters of Teluk Mengkudu is fishermen who sail at night using trawls which can damage coral reefs. That led to the loss of crustacean habitat. In addition, chemical waste from fishermen's transport vehicles, such as oil from large ships, decomposes into the waters. Those conditions could decrease crustaceans' diversity level (Suebpala et al. 2021). In addition, damage to the seagrass bed ecosystem is that marine biota habitat can experience extinction by the crustaceans. Various residents' activities are also a source of pollution for their surroundings, such as water transportation activities using ship engines that use oil, ship engine oil that spills at sea either intentionally or unintentionally can reduce the quality of water physically, chemically and biologically. The accumulation of various negative effects caused by community activities can directly affect the presence of marine life in these waters, including crustaceans (Thomsen et al. 2020).

Table 2. Crustaceans from the family Penaeidae in Teluk Mengkudu, Serdang Bedagai District, North Sumatra, Indonesia

Group item	April		May		June	
	P. indicus	***M. ensis***	***P. indicus***	***M. ensis***	***P. indicus***	***M. ensis***
Bintang Satu Fishermen	7,079	33,830	5,860	33,918	7,670	37180
Sepakat Fishermen	6,740	39,589	5,618	36,938	7,496	43379
Sinar Jaya Fishermen	7,609	36,291	6,539	35,848	7,560	35288
Total	21,428	109,710	18,017	106,704	22,726	115.847
Grand total						394.432

Table 3. Diversity of crustaceans from the family Penaeidae in Teluk Mengkudu, Serdang Bedagai District, North Sumatra, Indonesia

Month	Species	Number of trips	Ni	N	ni/N=Pi	In *pi*	H'
April	*P. indicus*	2 trips	21,428	394,432	0.054326	-2.912748	0.158239
	M. ensis		109,710	394,432	0.278147	-1.279606	0.355918
May	*P. indicus*	2 trips	18,017	394,432	0.045678	-3.086131	0.140969
	M. ensis		106,704	394,432	0.270526	-1.307388	0.353682
June	*P. indicus*	2 trips	22,726	394,432	0.057617	-2.853937	0.164435
	M. ensis		115,847	394,432	0.293706	-1.225176	0.359842
Total			394,432				1.533085

Table 4. The evenness index of crustaceans from the family Penaeidae in Teluk Mengkudu, Serdang Bedagai District, North Sumatra, Indonesia

Month	Species	H'	LnS	E
April	*P. indicus*	0.158239	0.693147	0.228290
	M. ensis	0.355918	0.693147	0.513482
May	*P. indicus*	0.140969	0.693147	0.203376
	M. ensis	0.353682	0.693147	0.510256
June	*P. indicus*	0.164435	0.693147	0.237230
	M. ensis	0.359842	0.693147	0.519142
Total				2.211775

Table 5. The knowledge richness index (KRi) of crustaceans from the family Penaeidae in Teluk Mengkudu, Serdang Bedagai District, North Sumatra, Indonesia

Month	Species	ni	N	ni/N=Pi	%	KRi
April	*P. indicus*	21428	394432	0.054326	100	5.43262
	M. ensis	109710	394432	0.278147	100	27.8146
May	*P. indicus*	18017	394432	0.045678	100	4.56783
	M. ensis	106704	394432	0.270526	100	27.0525
June	*P. indicus*	22726	394432	0.057617	100	5.76170
	M. ensis	115847	394432	0.293706	100	29.3705
Total						100

Table 6. Dominance index of crustaceans from the family Penaeidae in Teluk Mengkudu, Serdang Bedagai District, North Sumatra, Indonesia

Month	Species	Ni	N	ni/N=Pi	D
April	*P. indicus*	21428	394432	0.054326	0.002951
	M. ensis	109710	394432	0.278147	0.077366
May	*P. indicus*	18017	394432	0.045678	0.002087
	M. ensis	106704	394432	0.270526	0.073184
June	*P. indicus*	22726	394432	0.057617	0.003320
	M. ensis	115847	394432	0.293706	0.086263
Total				0.245171	

The measurement showed slight temperature difference where the value recorded in the Teluk Mengkudu is one degree lower, namely 28ºC. Factors that can affect water temperature include weather, wind, and currents, where a sudden change in current patterns in a body of water will lower its temperature (Samphan et al. 2015). The salinity measurement at 20-35 ppt also follows the quality standard. Salinity is a limiting factor for crustaceans' life because the variability greatly affects their body osmoregulation ability. The optimum salinity for crustaceans is around 23-35 ppt, and the optimum value of tolerance to traffic in seawater is 35 ppt. Decreasing salinity will reduce the photosynthetic ability of seagrass ecosystem species. There is an interaction between salinity, temperature, and tropical seagrass beds where species live. Species with a lower tolerance for salinity and low temperatures cannot survive at this same salt level but in higher temperature conditions. The pH in this study meets the quality standards at 6-7, following Karpowicz and Ejsmont-Karabin (2021), which is good for supporting crustaceans' life. The DO content of 6.8 mg/L measured in Teluk Mengkudu is important for organisms' respiration and a good water quality determination.

The Teluk Mengkudu waters had temperatures ranging from 27-30ºC, an average brightness of 2.8 m, and an average current speed of 1.5 knots that flows from the Southwest, Northeast, and Southeast. One way to measure water's brightness is using a Secchi disk, water's brightness is using a Secchi disk, a round disc with a diameter of 20 cm made of zinc and painted white or black and white with a weight (the chip). The chip is lowered into the water until it is not visible; its depth is measured, then it is lowered even deeper. Furthermore, the chip is lifted, and if the chip is almost visible the depth is measured again (Bowers et al. 2020). In addition, water measurement is done by inserting the lower end of the thermometer into the water without touching the bottom of the liquid container (Bonacci et al. 2022). The environmental conditions at this location were well maintained and free from wastes that could negatively affect the crustacean ecosystem's sustainability. These results align with the study conducted in June-September by Samphan et al. (2015), which showed Meteapenaeus sp. from the Penaeidae family in Thailand waters with an average temperature of 28ºC. Crustaceans from the Penaeidae family live in warm waters temperature and spread across tropical to sub-tropical seas (Samphan et al. 2015; Kusbiyanto et al. 2020; Muhtadi et al. 2022). Their life is also affected by the abundance of food supply within the food chain (Havens et al. 2015; Hariyadi et al. 2020; Karpowicz and Ejsmont-Karabin 2021; Li et al. 2022). However, the number of species identified in this study is limited. This is because fishermen go to sea at night using trawlers, which can damage coral reefs, thus losing crustacean habitat. In addition, chemical waste from fishermen's transportation, such as oil from large ships decomposes into the waters. So conditions like this can cause a decrease in the level of diversity of crustaceans and result in a limited number of species obtained and identified (Suebpala et al. 2021).

Crustaceans from the Penaeidae family tend to thrive in habitats with salinity levels ranging from 15-50 ppt (Samphan et al. 2015; Samphan et al. 2016). The results showed a 20-35 ppt salinity level in the waters explored. This value significantly supports the survival of species from the Penaeidae family. Thabet et al. (2017) stated that crustaceans have different tolerance levels for water salinity. However, this recent study discovered some species with the tendency to experience a decreased development due to increased salinity (Torres et al. 2011). Penaeidae organisms avoid waters containing a salinity level exceeding 65 ppt, which can inhibit their development and habitat (Samphan et al. 2015). In addition, even though crustaceans' diversity is affected by the acidity level (pH) in waters, they still can survive at pH 6-7 (Sastranegara et al. 2020). Teluk Mengkudu has an average pH of 6-7 and a DO of 6.8 mg/L. This condition positively influences the abundance of *M. ensis* and *P. indicus* species.

This research carried out over three months, shows the diversity of the crustacean family of Penaeidae in the waters of Teluk Mengkudu. The highest fish catches are in June, while the lowest is in May. The author suggests further research regarding crustacean diversity. In addition, it is hoped that there will be crustacean cultivation so that the total population does not experience extinction. Therefore, the germplasm of the Teluk Mengkudu waters is maintained. Based on the results, *P. indicus* and *M. ensis* were most obtained from the Penaeidae family. The lack of fishermen's catch due to changing climatic conditions is a factor in the decreased abundance of marine biota. The climatic change causes large water currents so that the existence of crustaceans at the bottom of the waters decreases. The influence of climate can affect the spawning season for the abundance of shrimp every year, while the highest peak abundance of shrimp occurs in June and the lowest peak abundance occurs in May. This indicates that the peak season of abundance in the waters tends to occur during the rainy season. The low catchment is also affected by damage to the seagrass meadow ecosystem and residents' activities, which are a source of water pollution. Intentionally or unintentionally, ship engines that result in spilled oil could reduce the decline in water quality physically, chemically, and biologically. As a result, it can affect the presence of marine biota in these waters, including crustaceans.

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