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DIVERSITY AND DISTRIBUTION OF MANGROVE SHRIMPS (DECAPODA) IN BABO, BINTUNI-PAPUA AND ITS CONSERVATION ASPECTS

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Abstract

The study aims to identify the distribution and diversity of shrimp species (Decapoda) in the Babo, Bintun Mangrove Forest Area and its conservation aspects. This research has been carried out in the period from March 2024 to May 2024 in three villages in the waters of bintun Bay, Babo District, namely Nusei Village, Modan Village, and Amutu Village. The results of the analysis show that the number and abundance of shrimp at the three research stations in Babo are moderate. Only one species was found in the family Palaemonidae. The distribution of shrimp was influenced by the distribution of food. The average temperature of the shrimp was 25.06 °C, and the good temperature for the growth of white leg shrimp ranged from 22.0 - 29.6ºC. The good temperature of shrimp ranges from 0 to 30ºC. Among the six species, Penaeus indicus, jerbung, vannamei, and alpheus were the most abundant.

Keywords: Decapoda, shrimp, Babo Mangrove Forest, conservation

INTRODUCTION

Mangrove ecosystems in general play a crucial role in carrying out ecological processes and maintaining the life of the various biotic components that inhabit the region. Mangrove forests, found along the coast and river estuaries, are unique ecosystems and are influenced by the tides of sea water (Atekwana et al., 2022; Bathmann et al., 2021; Ellison, 2021; Hilaluddin et al., 2020; Komiyama et al., 2020). In addition to storing carbon, it also plays a role in providing habitat for various animal species such as fish, shrimp, and other marine life. Coastal mangrove forests are often used for port construction, transportation, the construction of connecting bridges and other household activities, and are used as basic building materials for house construction and even used as firewood in households (Lekito & Tambing, 2018).

Estuarine shrimp usually live in mixed waters of freshwater and sea, such as estuaries, lagoons, and coastal areas where salinity is between freshwater and seawater. The general characteristics and conditions of brackish shrimp are as follows: living in waters where the salinity of the water is higher than that of fresh water but lower than seawater, the size of brackish shrimp varies according to species and environmental conditions, the color is different, but usually has a color that matches the substrate. For the environment, such as brown, gray, to blend in muddy or sandy environments, brackish shrimp are natural animals, acting as carnivores, usually found in lagoons, mangroves, and estuaries, which can help clean the environment by eating decaying organic materials and other animals around them (Rahayu & Annawaty, 2021).

Bintuni Bay Regency is rich in biological resources, including the second largest mangrove forest after Brazil. The area of mangrove forests is 289,000 hectares or 75% of the total area of mangrove forests in West Papua Province. There are many potential natural resources in the sea or waters such as fish, shrimp, and crabs that live in mangrove ecosystems. Various types of mangroves grow and develop well in the mangrove ecosystem around Bintuni Bay (Lekito & Tambing, 2018).

Ecological processes are very important and are expected to support forest growth at all stages of growth, from nursery to tree. Currently, the coastal area of Bintuni Bay in West Papua has mangroves that are still high as a large coastal hydrological patch. Although in good condition, the relationship between existing fragments and ecological processes must be maintained in order to maintain and preserve the survival of organisms. The condition of the mangrove forest that dominates the coastal area of Babo is very suitable for the growth and development of brackish shrimp or mangrove shrimp (Lekito & Tambing, 2018).

Environmental stress greatly affects the growth and development of lobster (Jane et al., 2024; Leiva et al., 2022; Spencer et al., 2023; Wang et al., 2024; Zeng et al., 2021). Some of the environmental impacts that affect mangrove shrimp include the loss of mangrove forests, environmental pollution, changes in salinity, as well as overfishing and unsustainable shrimp fishing. Therefore, conservation measures such as habitat protection, sustainable fisheries management, mangrove protection, education and public awareness-raising, as well as research and monitoring are urgently needed (Tjahjo et al., 2019).

Referring to the description above, the researcher conducted the current research to identify the distribution and diversity of shrimp species (Decapoda) in the Babo, Bintun Mangrove Forest Area and its conservation aspects. With this information, the public will know the distribution of shrimp species of the order Decapoda and the suitable habitat for shrimp development and know the conservation aspects.

RESEARCH METHOD

This research has been carried out in the period from March 2024 to May 2024. This research has been carried out in three villages in the waters of Bintun Bay, Babo District, namely Nusei Village, Modan Village, and Amutu Village.

The tools involved in this research include hand nets, jars, storage boxes, pH meters, DO meters, Salino meters, thermometers, Canon cameras, paper stickers, and plastic clips. Meanwhile, in the implementation of the research, the materials used included shrimp samples, 70% alcohol, raffia rope and aquades.

The sample collection area uses the transect line method with a length of 1000 m for each transect at each research station. Each research station is made as many as 3 transects, with each transect having 4 plots with a size of 20 x 20 m. Shrimp sample collection used tools, namely nets, hand nets (shovels) and nets.

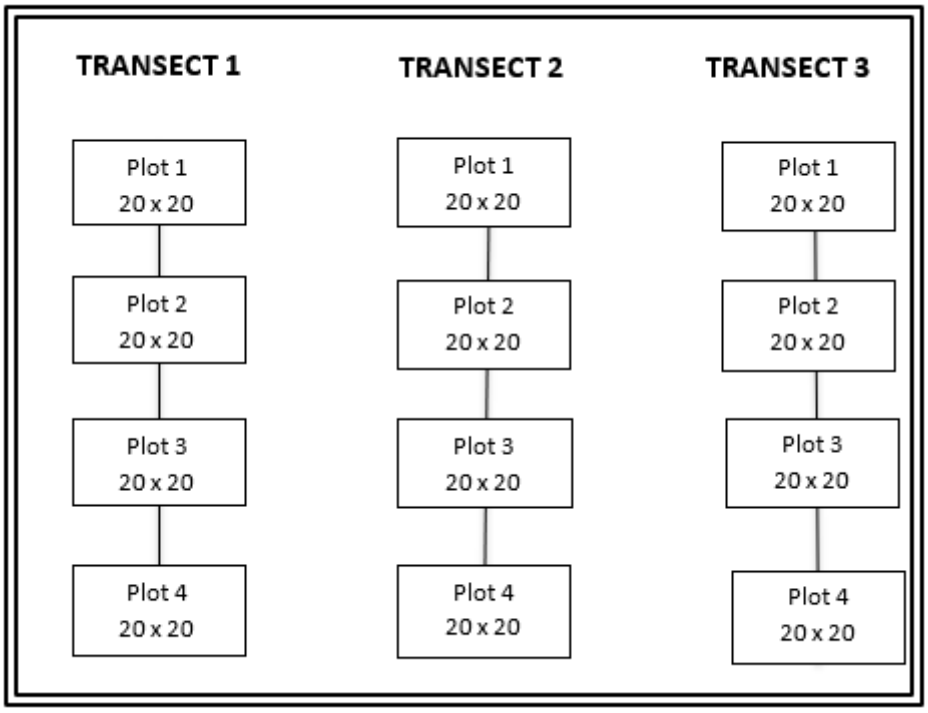

Figure 1. Transek of the research location

The shrimp caught in each study plot were morphologically analyzed and the number of individuals was calculated. Shrimp identification was carried out based on morphometric shapes and characteristics using guidebooks from Cai et al. (2004), FAO (1983), and Wowor & Choy (2001). Morphometric measurements are performed with a digital caliper, and ice cubes are used to keep the sample from drying out during measurement. The morphometric characteristics measured included total length, abdominal length, telson length, carapace length, first and second claw length, and leg length. Meanwhile, the measured meristic characteristics include the number of upper and lower rostrum serrations.

The determination of the number and diversity of shrimp species is done by visually counting all individuals of each transect, and the diversity is calculated based on the diversity index. The distribution pattern of shrimp populations was analyzed using a method that referred to the equation in data analysis, with the distribution influenced by the distribution of food. Environmental factor measurements were carried out on each transect and plot to determine its influence on the distribution and diversity of shrimp. The abiotic factors measured include water temperature, pH, water flow rate, and substrate type, with measuring tools such as pH meters, DO meters, refractometers, and thermometers.

RESULT AND DISCUSSION

Aquatic Environmental Factors

Weather factors play a very important role in the growth and distribution pattern of decapoda shrimp in habitats in ecosystems. Rainfall**:** High rainfall can result in changes in salinity in shrimp habitats, especially in estuary areas. These changes can affect the availability of food, oxygen, and overall water quality.

The rainfall in the Bintuni Bay area from January to May is quite high, so it is somewhat hampered by the observation process at the research site, where the plan is to make observations at the research site (three stations with three transeks and three repeats) should only take about 27 days, but due to the influence of rain so that the observation at the research site is longer (approximately three months).

Water Temperature

The temperature at the 3 stations is as follows: the first station (Nusei) has an average surface temperature of 30.22oC, the middle part is 28.30oC and the base part is 26.22oC. the second station (Modan) has an average surface temperature of 30.09 ^{o}C, the middle part is 28.66^{o}C and the base part is 25.61^{o}C while in the third station the average temperature on the surface is 30.57oC, the middle part is 28.61oC and the base part is 25.72oC

Environmental parameters show that the water temperature at the three stations ranges from 25 °C to 32 °C. This happens because observations are made in the morning until noon starting from 08.00-10.00 WIT or 15.00-17.00 WIT and normally the temperature in the Babo mangrove area is normal for Crustacean life. The temperature difference between stations is not noticeable. The water temperature in the Babo mangrove area is relatively good to support shrimp life. The good temperature for the growth of white leg shrimp ranges from 22.0 - 29.6 °C with an average temperature of 25.06 °C. White leg shrimp can live at temperatures ranging from 12-37 °C, grow well at temperatures ranging from 24-34 °C, and the optimal temperature for growth ranges from 28-31 °C (Yunarty, 2022).

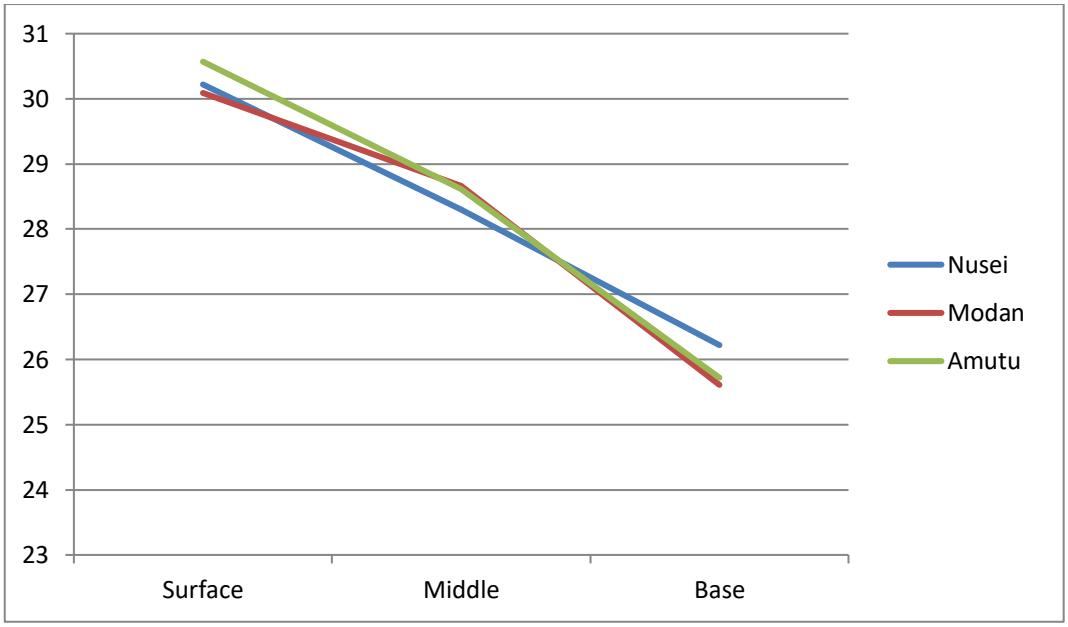

Figure 2. Water temperature measured at the 3 research stations for 3 months of observation

The water temperature value obtained at each observation location ranged from 27-32 oC, while according to the Ministry of Agriculture. LH No. 51 (2004) mangrove and seagrass forest areas have a temperature limit of around 28-30^{o}C. Generally, aquatic organisms require an optimum temperature ranging from 20-30^{o}C, while the optimum temperature for some types of biota is 30^{o}C (Pratiwi & Widyastuti, 2013).

pH

Environmental pH is an important factor that affects the growth and health of decapoda shrimp, including Penaeus indicus shrimp. Here are some of the main effects of pH on the growth of decapoda shrimp in general.

The optimal pH range for decapoda shrimp growth typically ranges from 7.5 to 8.5. Outside of this range, the growth and survival of shrimp can be impaired. The degree of acidity or pH describes the potential activity of hydrogen ions in a solution expressed as the concentration of hydrogen ions (mol/l) at a given temperature, or pH = - log (H+). Pure water has a pH value = 7, and is stated to be neutral, while in normal brackish water it ranges from

7-9. The pH concentration affects the fertility level of the waters because it affects the life of the microscopic body. Acidic waters tend to cause death in fish as well as pH which has an over-alkaline value. At a water pH that is too low or too high can cause stress on shrimp and soft shrimp skin and low shrimp survival. The optimal aquatic pH for shrimp farming is 6.5 to 9 (Supriatna, 2020).

The pH value of water is affected by the concentration of CO2 during the day because photosynthesis occurs, so the CO2 concentration decreases so that the pH of the water increases. On the other hand, at night, all organisms in the water release CO2 from respiration so that the pH of the water decreases. However, brackish water is well buffered so that the pH of the water rarely drops to a value below 6.5 or increases to a value of 9, so that adverse effects on cultivation rarely occur (Supriatna, 2020).

Salinity

Water salinity refers to the amount of salt content in seawater, river water, and lake water calculated in ‰ (thousandths/ppt). Salinity is a limiting factor for the survival of macrozoobentos including crustaceans and gastropods, both those living in freshwater, brackish water and seawater (Pratiwi & Widyastuti, 2013)

Maximum growth of aquatic organisms requires optimal water quality. Among the water quality variables that play a very important role in the growth and survival of white leg shrimp is salinity (Yunarty, 2022). Temperature and salinity are considered to be the most important physical factors that affect marine organisms and the biological effects of these factors are very complex and extensive (Yunarty, 2022).

Number and abundance of species

The number and richness of species on Earth are very diverse and difficult to determine precisely due to the many factors that influence, such as habitat, time, and different calculation methods. However, it can be estimated that there are millions of species living on Earth, including plants, animals, and microorganisms. Many species are still undiscovered and studied.

Species richness refers to the biodiversity or biodiversity in a particular region or environment. An environment rich in species has a wide variety of living organisms. The richness of these species is very important because each species has an important role in maintaining the balance of the ecosystem.

Shrimp species found in each research location at each station can be presented in the following table.

Table 1. The number and abundance of shrimp species obtained at the three research stations in Babo, Bintuni Bay

No	Family	Species Name	Nusei Station	Modan Station	Amutu Station	Total
1	Penaeidae	*Litopenaeus vannamei*	589	866	320	1775
2	Penaeidae	*Penaeus margiensis*	571	789	306	1666
3	Penaeidae	*Penaeus indicus*	322	775	317	1414
4	Palaemonidae	*Macrobrachium lar*	102	290	502	894
5	Penaeidae	*Penaeus monodon*	112	267	185	569
6	Alpheidae	*Alpheus sp*	126	481	0	607
Total Species			6	6	5	
Total Individual			1827	3468	1630	6925

At the first station (Nusei) three families were found, namely the family penaeidae, palaemonidae and alpheidae. In the penaeidae family, as many empat speies are found, namely *Litopenaeus vannamei, Penaeus margiensis, Penaeus indicus* and *Penaeus monodon.* Family Palaemonidae is found only one species, *Macrobrachium lar*, while family Alpheidae is also found to be one species, namely *Alpheus sp.*

The second station (Modan) was found in 3 families, namely family penaeidae, palaemonidae and alpheidae. In the penaeidae family, as many empat speies are found, namely *Litopenaeus vannamei, Penaeus margiensis, Penaeus indicus* and *Penaeus monodon.* Family Palaemonidae is found only one species, *Macrobrachium lar*, while family Alpheidae is also found to be one species, namely *Alpheus sp.*

The third station (Amutu) was found in two families, namely the family penaeidae and the palaemonidae. In the penaeidae family, four speies are found, namely *Litopenaeus vannamei, Penaeus margiensis, Penaeus indicus* and *Penaeus monodon.* Only one species was found in the family Palaemonidae, namely *Macrobrachium lar* (Figures 1, 2 and 3).

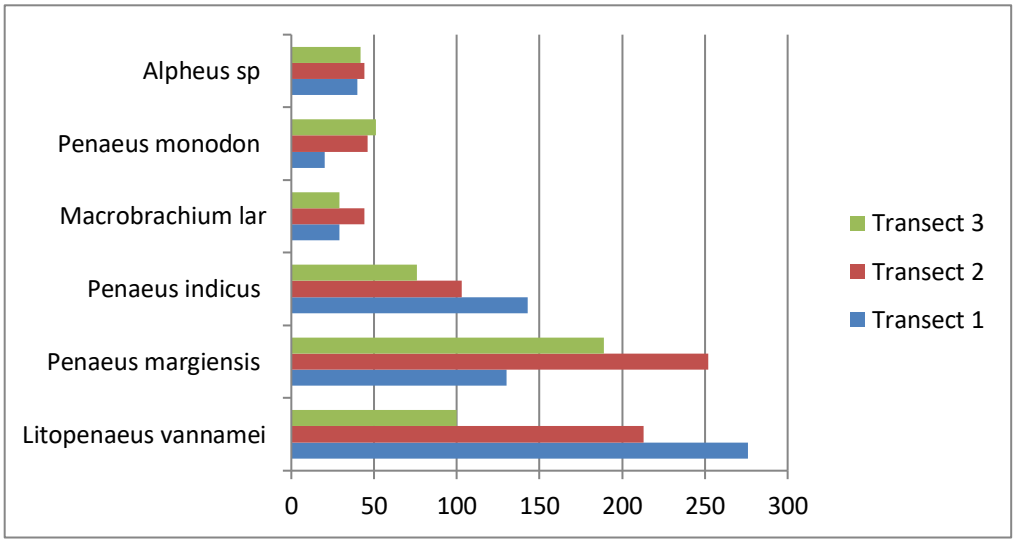

Figure 1. Abundance of shrimp species at Nusei station

The relative abundance of shrimp found in the three transects at Nusei station. In the first transect the highest relative abundance is *Litopenaeus vannamei,* in the second transect the relative abundance is the species *Penaeus marginensis,* while in the third transect the highest relative abundance of the species is *Penaeus marginensis.*

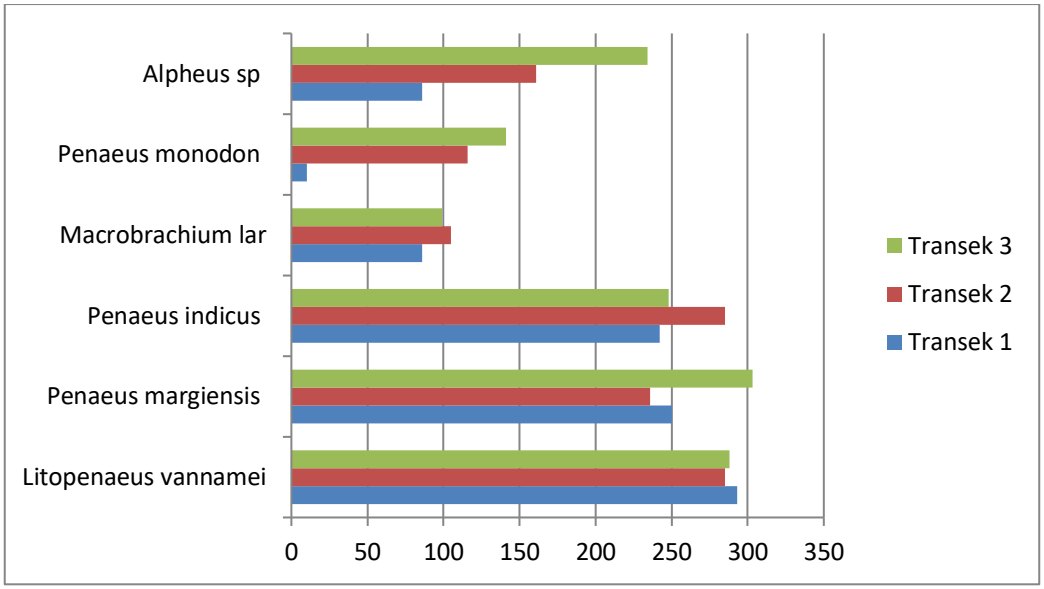

Figure 2. Abundance of shrimp species at Modan station

The relative abundance of shrimp found in the three transects at the Modan station. In the first transect, the highest relative abundance is *Litopenaeus vannamei*, then in the second transect, the highest relative abundance is *Litopenaeus vannamei* and *Penaeus indicus.* Meanwhile, in the third transect, the highest relative abundance is *Penaeus marginensis*.

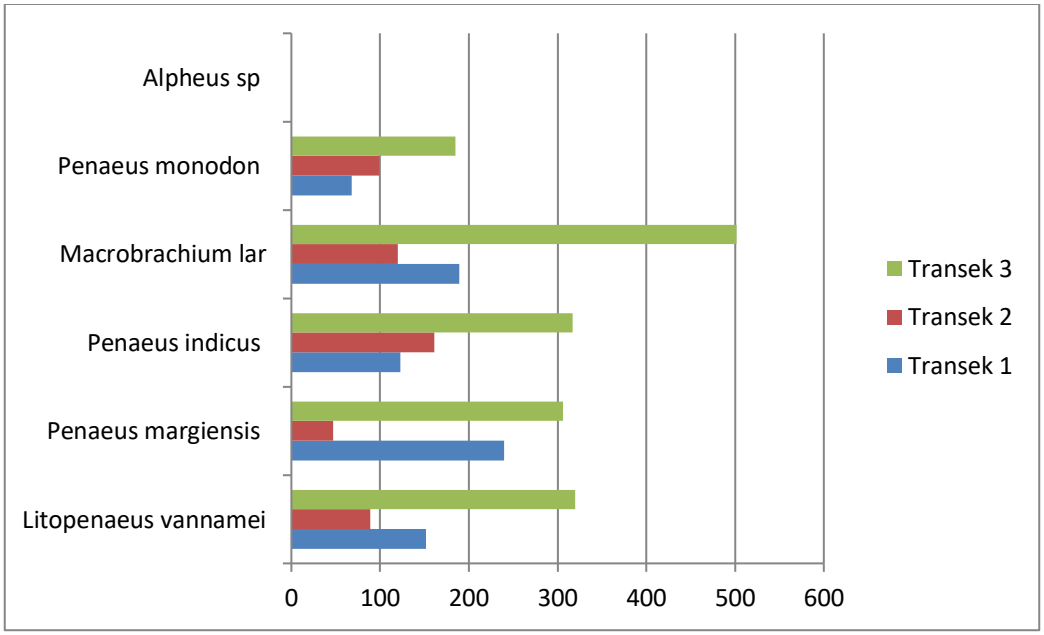

Figure 3. Abundance of shrimp species at Amutu station

The relative abundance of shrimp found in the three transects at the Amut station. In the first transect, the highest relative abundance is *Penaeus marginenssis* and the second transect is *Penaeus indicus* and the third transect relative abundance is the *Macrobrachium lar* species.

Species Diversity

The diversity of shrimp species found at the research site in the Babo Bay mangrove ecosystem of Bintuni Bay based on the biological index is shown in Table 2.

Table 2. Shrimp Biological Index in Babo Teluk Bintuni

No.	Station	H’	Category	E	Category	C	Category
1	Nusei	1,53	Medium	0,25	Low	0,25	Low
2	Modern	2,01	Medium	0,33	Low	0,76	High
3	Amutu	1,56	Medium	0,23	Low	0,22	Low

Description: H' = species diversity, E = Species uniformity, C = Dominance

From the analysis of the uniformity index in table 2, it can be explained that the species diversity in the 3 research stations is 1.53, 2.01 and 1.6, meaning that the species diversity is moderate. As for the evenness, it can be seen that from all stations is a small category (there are only 6 species), while for the dominance index, it can be seen that there is a difference between stations 1 and 2, stations 1 and 3 are classified as low or no one dominates, while at the 2nd station it is classified as high, meaning that at the 2nd station there is a dominating species, namely the *Litopenaeus vanname* species.

Species Richness

The diversity index (H') obtained after analyzing the research data was as follows, the first station was 1.53, the second station was 2.01 and the third station was 1.56. From the results of the analysis, it can be seen that the diversity of decapoda shrimp at the three research stations in Babo is classified as moderate.

The Shannon-Wiener diversity index (or Shannon diversity index) is used to measure the diversity of species in an area or habitat. This index depends on the number of different species and the number of individuals within each species.

If the Shannon-Wiener diversity index is in the low category, this can be interpreted as the species diversity in the area is relatively low. This means that the area may have few different species or it may be that the dominant species has a much larger population than other species. This can be caused by a variety of factors, such as habitat disturbance, habitat fragmentation, or other environmental stressors.

Species Dominance

The index values in all habitats, namely Nusei Station, Modan Station and Amutu Station, have a low dominance index, meaning that the abundance of each species is evenly distributed or none dominate (Figure 4).

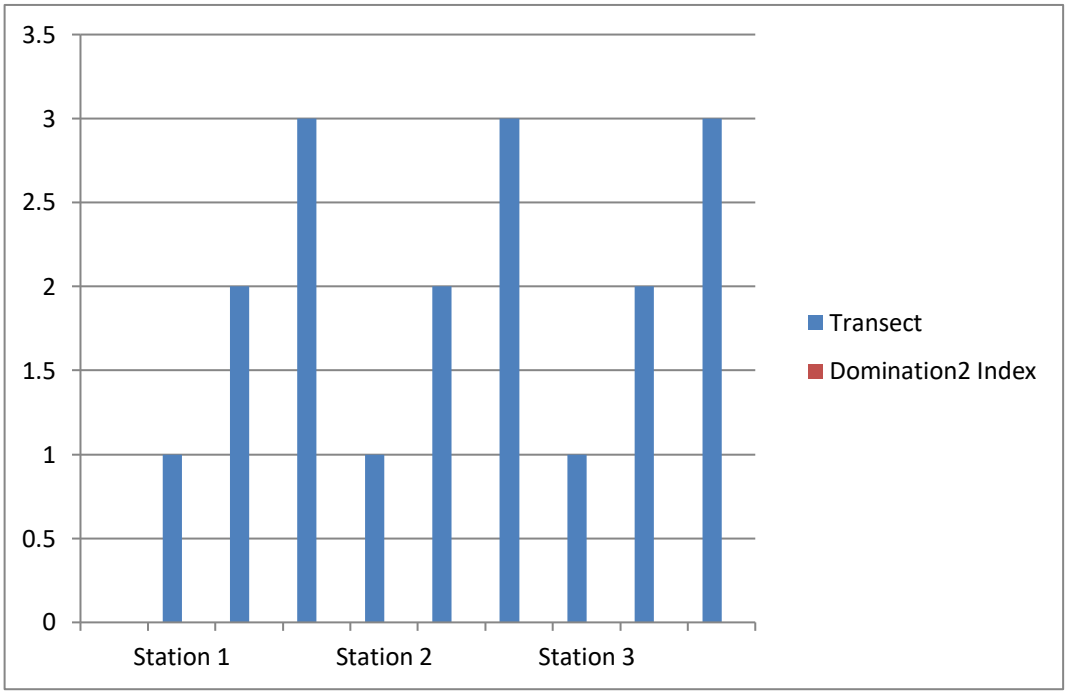

Figure 4. Species Dominance Index

Species Distribution Patterns

Table 3. Distribution index of decapoda shrimp in Babo, Bintuni Bay

Station	Plot				Number of individuals	Morisita Index (Id)	Distribution Pattern
	1	*2*	*3*	*4*			
Nusei	459	451	466	377	1753	1,00	Random
Modan	908	881	895	792	3476	1,00	Random
Amutu	460	381	378	423	1642	1,00	Random

From the value of the morisita index, it can be seen that all plots at the three stations have a random distribution pattern. Random distribution patterns occur because almost every plot is found with different individuals.

The random distribution pattern of decapoda shrimp refers to a pattern in which individual shrimp are randomly scattered within their habitat. In this random distribution pattern, it means that the position or location of shrimp individuals is not affected by certain environmental factors or by interactions with other individuals.

Species Description

Penaeus monodon (Taiger shrimp / tiger)

Native training : *Penaeus monodon*
Common name : Taiger
Local name : Taiger

The characteristics and morphology of the tiger shrimp's body are long body (slender), bluish-black in color, the head and chest are fused (cephalotorax), the head and chest are wrapped in a shell called carapace, cepalotorax consists of 5 segments (segments), on the head there are 5 pairs of appendages (2 pairs of antennae, 1 pair of mandibulla, 1 pair of maxilulla and 1 pair of maxilla) the chest there are 8 segments and the most at the end there is a rostrum (hard and iridescent shell), The chest has 3 pairs of maxilped, and the body has 5 pairs of swimming legs (pleopoda), the abdomen has 6 segments and 1 telson,

long legs, wide fins, large eyes, large head, wide mouth, sharp teeth. The general morphology is: the head and chest are fused (cephalotorax), the head and chest are wrapped in a shell called carapace, the cepalotorax consists of 5 segments (segments), the chest has 8 segments and the most extremity is a rostrum (hard and ribbed shell), the abdomen has 6 segments and 1 telson, 5 pairs of pedestrians (periopods), 1 pair of uropda (Figure 5).

Figure 5. *Penaeus monodon* shrimp (Taiger shrimp or tiger shrimp)

Penaeus indicus (Udang sima)

Native training : *Penaeus indicus*
Common name : Sima Shrimp
Local name : Sima shrimp

The body color is transparent or yellowish, on the dorsal part (back) dark stripes are visible, the abdomen is lighter. Body Size**:** The body length can range from 18-20 cm in adults, the small ones are 8-17 cm in size. Shell and Body Structure**:** The shell is hard and somewhat transparent, we can see internal organs such as the intestines along the body, the body consists of the head, chest (thorax), and abdomen (abdomen). The chest has several pairs of legs used to move and forage, and the tail (abdomen) is long and slender (Figure 6).

Figure 6. *Penaeus indicus* (Sima Shrimp)

Macrobrachium lar (Lobster)

Native training : *Macrobrachium lar*
Common name : Lar Shrimp
Local name : Lobster

Macrobrachium lar has a body length of 9cm, mossy green with black stripes all over its body, On the head *M. lar* has a pair of compound eyes and a pair of head fins, has a fairly large horn in the shape of a straight forward curved downwards, the number of teeth on the top of the rostum is 7 teeth while at the bottom it only has 3 teeth. *M. lar* has a pair of antennae and a pair of antennae that are very small in size. On the lower part of the head has 6 pairs of walking legs and adjacent to it can be seen a pair of accomplices who have fine hairs. The body has 6 abdominal segments, the lower part of the body has 5 pairs of swimming legs and the tail has a pointed telson, the tail has 2 pairs of tail fins (Figure 7).

Figure 7. *Macrobrachium lar* (Lobster)

Penaeus margiensis (Jerbung shrimp)

Native training : *Penaeus margiensis*
Common name : Jerbung Shrimp
Local name : Ende shrimp

size 16-20 cm, tpis, slippery skin, yellowish-white color, green/brown spots, dense body, rostrum teeth 5-8, lower part 2-5, red antenna, claws 3 pairs, walking legs 5 pairs, abdomen, swimming legs there are 6 pairs on each body segment, the last segment fuses into a fan tail (Figure 8).

Figure 8. *Penaeus margiensis* (Jerbung shrimp)

Litopenaeus vannamei (Banana shrimp)

Native training : Litopenaeus vannamei
Common name : Banana shrimp
Local name : Banana shrimp

It has a body length of 9 cm, clear white color, the head is fused with the chest consisting of a pair of compound eyes, a pair of antennae and a pair of antennae, 4 pairs of maxiliped, 5 pairs of walking legs, 1-3 parts of the walking leg have claws, have 7 segments of the rostum, and a pair of head fins, antenna length 13 cm, have 6 segments of the body, 5 pairs of swimming legs, one telson pointed between 2 pairs of fan tails, and has thin, see-through skin, booked, with black spots on its body (Figure 9).

Figure 9. *Litopenaeus vannamei* (Banana Shrimp)

Alpheus sp (Lobster or crazy shrimp)

Native training : *Alpheus sp*
Common name : Alpheus shrimp
Local name : Lobster or Crazy shrimp

Alpheus shrimp, or better known as pistol shrimp, has distinctive features: body length that can range from 10 mm to 4 cm, blackish-brown in color, body protected by hard shell, has strong claws to aid in digging holes, has a long pair of antennae, Larger shells serve as protectors and homes, while smaller shells are used to protect the front of the body and its claws. and the legs twitch to swim and move at the bottom, a pair of asymmetrical shells, where one shell is larger than the other. One claw is usually larger than the other, used to shoot air bubbles quickly to create a distinctive explosive sound, Alpheus is nocturnal, foraging for food and performing activities, which aids in navigation, foraging for food, and interacting with its surroundings (Figure 10).

Figure 10. *Alpheus sp* (Lobster or crazy shrimp)

Decapoda shrimp conservation efforts

Efforts to conserve decapoda shrimp in mangrove ecosystems can be carried out in various ways, including: by regulating fishing patterns, where limiting the number and type of fishing equipment used can reduce overfishing and habitat damage. Law Enforcement means implementing strict regulations and laws against illegal fishing, illegal sales, and habitat destruction practices. Habitat Management Conservation of important habitats for shrimp, such as mangrove forests and coastal areas, includes efforts to maintain and restore mangrove ecosystems that are key habitats for decapod shrimp.

The most important function of mangroves for coastal areas is to be a connector between land and sea, as well as a buffer for natural phenomena caused by waters, such as abrasion, waves, storms and also a buffer for other biota life which is a source of livelihood for the community around the mangrove forest. The important ecological function of mangrove forests is as a nursery ground, feeding ground and spawning ground for various aquatic biota such as fish, shrimp and good shellfish that live in coastal waters (Latupapua et al., 2023).

CONCLUSION

The diversity of decapoda shrimp in the Babo area, Bintuni Bay is medium, with a small uniformity and low dominance in Nusei and Modan stations. The distribution pattern is

random with an index of 1.00. Six species of Decapoda shrimp are found at the research site: Litopenaeus vannamei average, Penaeus margiensis, Penaeus indicus, jerbung, vannamei, and alpheus. Conservation efforts include biodiversity conservation, reducing overexploitation, maintaining mangrove habitats, and limiting international trade. To maintain ecosystem stability, community counseling, sustainable fisheries management, cultural development, and habitat management are essential. Further research is needed on the types of decapoda shrimp and the influence of substrate on their abundance in the Babo area.

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