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Potential Development of Sea Cucumber Farming in Tablolong Beach, Kupang, East Nusa Tenggara

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A B S T R A C T

Tablolong Beach, Kupang, West Nusa Tenggara, has significant potential for sea cucumber aquaculture development. This study examines the environmental conditions, climatic factors, and local natural resources that support sea cucumber farming in this area. The results showed that Tablolong Beach has very suitable environmental characteristics for sea cucumber growth, including suitable water temperature and sufficient natural food availability. In addition, the local community has strong traditional knowledge on sea cucumber collection and cultivation. the purpose of this study was to determine the potential and types of sea cucumbers found around Tablolong beach. This research method is an experimental method where samples are taken by diving in the waters of Tablolong beach. Sea cucumber species found consisted of H. atra, H. leucospilota, H. fuscocinerea, and S. monoturbeculatus. This research provides an important basis for designing a sustainable sea cucumber aquaculture development plan in Tablolong Beach, integrating ecological, economic, and social aspects. By utilizing the natural potential and local knowledge, the development of sea cucumber aquaculture in this area can become a model for sustainable utilization of marine resources and support the livelihoods of coastal communities.

INTRODUCTION

Indonesia is one of the countries that has high potential for marine resources because most of its territory is water. Indonesian seas have a major contribution in providing food for the people of Indonesia. One of the marine products that have an important economic value is sea cucumber and generally entered into the trade called "teripang" (Darsono, 2005)

Tablolong kupang district, East Nusa Tenggara is one of the waters with an intertidal zone because it has a beach with a white sand substrate, extensive seagrass beds so that it becomes a place to live sea cucumbers. Many sea cucumbers found are Holothurians sea cucumbers which are included in the Holothuroidea class (Filum Echinodermata). The Holothuroidea class (sea cucumber) has six orders, one of which is Aspidochirotida which consists of three families, namely Stichopodidae, Holothuriidae, and Synallactidae (Janies, 2001)(KERR & KIM, 2001). The Stichopodidae family includes nine genera, two of which are found in Indonesian and Australian waters, namely Stichopus and Thelenota (Pearse, 1988). Stichopodidae is one of two families that are commercial sea cucumbers in tropical shallow waters. To date, Stichopodidae in Indonesia is known to have 11 species (Massin, 1999). The applicable characteristics to distinguish these species are external morphology, internal organs, and spicules (Purcell, Samyn, et al., 2012).

Sea cucumbers are found in coral reefs, rocky shores or mudflats. They can be found from shallow waters to certain depths, and can still be found in deep troughs. In some areas of the water, sea cucumbers can be found at depths of 1 m to 40 m. One of the waters that is often found in Echinodermata groups including sea cucumbers is Kupang Bay (Neno et al., 2020).

Sea cucumbers have many economic and ecological benefits. This animal is a source of protein, has various healing properties, and has a high selling price locally and internationally. This is due to the content of medicinal substances and nutrients contained in sea cucumber meat. The proximate results of sea cucumber meat are 21% minerals, 7% ash content, 2% fat, 43% protein, 17% water content (Lewerissa, 2014).

Aquaculture is a step that needs to be taken to meet sea cucumber production needs, and to maintain the sustainability of seed stocks and populations in nature, sea cucumber cultivation must be ecosystem-based in order to be sustainable. Sea cucumber aquaculture is considered a low investment, as the investment required is not as large as that used to cultivate other fishery commodities such as shrimp and pearls. Sea cucumber cultivation methods can be in the form of ponds in the sea or the method of cage or fence cage or pen culture. For the pen culture method, it can be distinguished based on the cage material used, namely bamboo fence cages and net fence cages (Sugama et al., 2019). The shape and size of both bamboo and net fence cages vary greatly and there is no definite size. The shape and size of the cage basically depends on the available capital, available cultivation sites and management capabilities. The purpose of this study is to identify the types of sea cucumbers found on Tablolong beach and the potential for sea cucumber cultivation on Tablolong beach

LITERATURE REVIEW

Sea cucumber is one of the animals with spines (Echinodermata). The spines on sea cucumbers are actually a skeleton or skeleton composed of lime and contained in the skin. The skeleton of the lime substance cannot be seen using a microscope. However, not all types of sea cucumbers have spines, some types of sea cucumbers do not have spines. (Yusron & Susetiono, 2006)

There are about 1,250 species of sea cucumbers that have been described by taxonomists. The sea cucumbers are in six nations (orders) namely Dendrochirotida, Dactylochirotida, Apodida, Molpadida, and Elapisoda (Bakus, 1973).

Taxonomically, the classification of sea cucumbers (Bakus, 1973) is,

Filum : Echinodermata
Subfilum : Echinozoa
Kelas : Holothuridae
Subkelas : Aspidochirotacea
Ordo : Aspidochirotida
Famili : Holothuriidae
Genus : Holothuria, Muelleria, Stichopus

All types of commercial sea cucumbers, especially from the tropics, belong to the nation (Order) Aspidochirotida from the tribe (Family) Holothuriidae and Stichopodidae. Includes the genus Holothuria, Actinopyga, Bohadschia, Thelenota and Stichopus. There are 25 species of potentially commercial sea cucumbers identified from coral waters in Indonesia (Ladd, 1977). Ten of them have good commercial value.

Sea cucumber bodies are generally elliptical or cylindrical about 10-30 cm in length, with a mouth at one end. The sea cucumber's mouth is surrounded by tentacles or feeling arms that are sometimes branched. The body is beroto, while the skin can be smooth or spotted (Pearse, 1988).

Sea cucumber habitats are widespread in aquatic environments around the world, ranging from tidal zones to the deep sea, especially in the Indian and Western Pacific Oceans. Some of them prefer waters with a rocky bottom, others like seaweed or in sand and mud burrows (Purcell, Samyn, et al., 2012). Types of sea cucumbers included in Holothuria. Stichopus and Muelleria have a habitat on a fine sandy bottom, located between coral reefs, and influenced by tides.

Around the waters of Pari Island, the distribution of sea cucumbers can be divided based on the habitat of sea cucumbers which include, sand flat areas (adjacent to algae growth areas) in this area found Holothuria sea cucumbers in small numbers; sea weeds and algae growth areas that have a high diversity of sea cucumbers because the types of Holothuria scabra, H. arcenicola, H. edulis, H. nobilis, H. atra and Stichopus variegatus are found, and shallow water areas that have Holothuria atra, H. coluber, Stichopus atra and Stichopus variegatus. arcenicola, H. edulis, H. nobilis, H. atra and Stichopus variegatus, and shallow water areas that have Holothuria atra, H. coluber, Stichopus variegatus, S. choloronatus and Thelenota anana (Sugama et al., 2019).

Sea cucumbers have an important role in the waters, because they are a major component in the coral reef food chain and its associated ecosystem at various trophic levels. Sea cucumbers play an important role as deposit feeders and suspension feeders .

In the marine aquatic food chain, sea cucumbers act as food contributors in the form of eggs, larvae and juwana sea cucumbers, for other marine organisms such as various crustaceans, molluscs and fish. Sea cucumbers digest large amounts of sediment, which allows for the oxygenation of the upper layers of sediment (Sukmiwati et al., 2012).

The sea cucumber's behavior of "churning" the bottom in search of food helps to fertilize the surrounding substrate. This is similar to what earthworms do on land. The process prevents the buildup of decaying organic matter and is likely to help control populations of pests and pathogenic organisms including certain bacteria (Trivedi et al., 2016).

The life cycle of most sea cucumbers is carried out on the shallow seabed and is usually found lying on one particular side only, namely on the body which is usually paler in color. There are also types of sea cucumbers that bury themselves in the sand. Sea cucumbers move very slowly with tube feet. In each leg tube terdpat 2 rows of leg vessels that alternately (contraction fan relaxation) will produce forward motion in sea cucumber (Yusron & Susetiono, 2006).

Most sea cucumbers are nocturnal, actively foraging at night and hiding during the day. Feeding involves random movements in search of food and simultaneous feeding according to the abundance and presence of detritus. As a slow-moving organism, this sea cucumber is highly dependent on the availability of food on the substrate. Most of the food supply is benthic and is below the body of the sea cucumber rather than in the water column. This can be seen on the body where the mouth is located ventrally (Neno et al., 2020).

Research conducted in (Alirman et al., 2019) on feeding activities in sea cucumbers in the Pacific living on various islands, including those living on the coral reef flat of Palao Island, divides the feeding activities of sea cucumbers in two groups, namely sea cucumbers that always stay on the surface of the sand and eat at any time, day and night and sea cucumbers that eat 2 to 3 days and the rest of the time is used to take refuge in coral reefs or dig holes under the surface of sand or green algae.

METHODOLOGY

Sampling

This research was conducted on July 9, 2023 in the coastal waters of Tablolong Kupang Regency, East Nusa Tenggara. The samples used in the study were sea cucumbers taken from Tablolong Kupang district, East Nusa Tenggara. The sampling technique was done by diving. Sampling was done during the day. Each type of sea cucumber sample taken represents one species each.

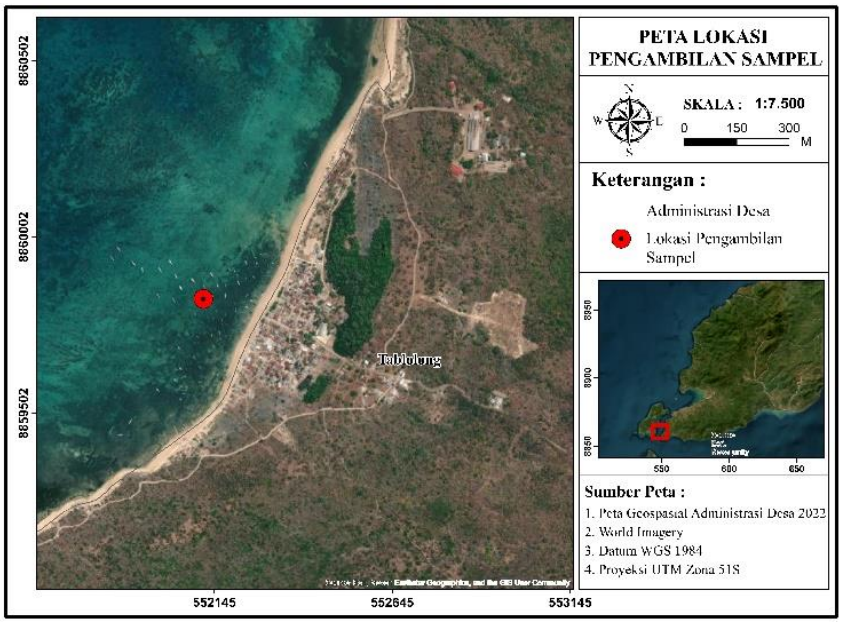

Figure 1: Sampling location

Water quality

Water quality observations were made at the time of sea cucumber sampling. Water quality observations include temperature using a mercury thermometer, salinity using a refractometer, pH using a pH meter, dissolved oxygen using a DO meter and current speed using a current meter.

RESEARCH RESULT AND DISCUSSION

Based on the results of the research, the family composition of sea cucumbers found in the waters of Tablolonng Kupang Regency is the Holothuridae family by 75% (3 species) and the Stichopodidae family by 25% (1 species). Family Holothuridae consists of H. leucospilota, H. atra, H. fuscocinerea, while family Stichopodidae consists of S. monotuberculatus. Family Holothuridae is a family that dominates in the waters of NTT, in this case the coastal waters of Tablolong Kupang Regency, this is in accordance with the opinion of (Azis, 1997) in Indonesian waters there are 2 families that are most commonly found, namely family Holothuridae and Stichopodidae. (Bakus, 1973) adds that the Holothuridae and Stichopodidae family sea cucumber groups are typical sea cucumber groups that represent the tropics (including in NTT waters) The diverse number of species is thought to be due to the grouping nature of sea cucumber species and each species has different preferences for its habitat type

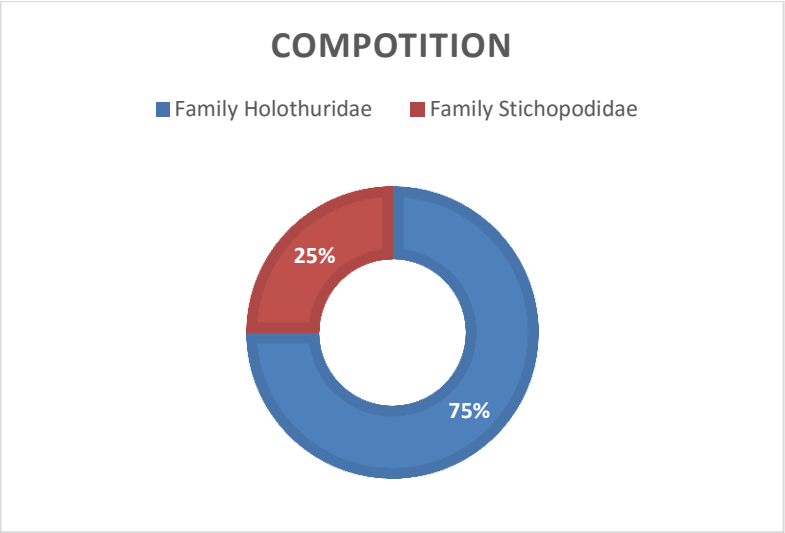

Figure 2. Composition of sea cucumbers in Tablolong beach waters

Based on observations in the field, the dominant substrate is sandy substrate. Based on the results of the study, it shows that the types of sea cucumbers found are found on these substrates. According to (Purcell, Hair, et al., 2012) , some types of sea cucumbers have a tendency to be in harder habitats such as corals or coral flats, but there are several other types of sea cucumbers that have a tendency to be in softer substrates such as muddy sand. In addition, some species are found associated with seagrass beds or both (seagrass beds and corals). Sea cucumber species from the Holothuridae family tend to occur in both habitat types. The species of H. leucospilota, H. atra, H. fuscocinerea and S. monotuberculatus are generally always found during the day and tend to be scattered on harder or coarser substrates.

Table 1: Sea cucumber species found in the coastal waters of Tablolong, Kupang Regency.

No	Figure	Latin Name	Local Name
1		*S. monotuberculatus*	Teripang gamat
2		*H. leucospilota*	Teripang cera merah
3		*H. atra*	Teripang cera hitam
4		*H. fuscocinerea*	Teripang kapok

The substrate is a living medium for sea cucumbers as benthic organisms. Various activities carried out in coastal areas can have positive and negative effects on the existence of coastal resources, in this case sea cucumbers. Over-utilization of sea cucumbers for consumption or sale can reduce sea cucumber populations in the waters. Substrate changes due to the activities of the surrounding community can result in changes in sea cucumber habitat which can later affect the existence of sea cucumbers. Substrate is closely related to living habits such as foraging at night and immersing during the day. This immersion activity is more closely related to the temperature of the water.
If the temperature increases, small sea cucumbers will spend the whole day immersed in the substrate. For sea cucumbers that inhabit habitats with coarse substrate types, they will hide behind corals. If the water temperature increases more than 30 degrees c, the sea cucumber remains on the surface, but if the water temperature drops below 28-29^{o}C, the sea cucumber will immerse itself by not following the pattern of immersion (Pearse, 1988).

Good water quality conditions reflect the state of good carrying capacity for sea cucumber life, with good water quality conditions, sea cucumber populations can grow and reproduce well. The distribution of sea cucumber species can be controlled by aquatic environmental factors. Temperature is one of the important environmental factors in the life of aquatic organisms. Aquatic environmental parameters measured as follows temperature, salinity, pH, DO, current speed. According to Madduppa et al., 2017 that generally sea cucumbers can adapt to a temperature range of 24-30℃.

The results of salinity measurements in Tablolong beach waters amounted to 32 ppt. The optimum salinity for sea cucumber life as stated by Alirman et al., 2019 that sea cucumbers can adjust to salinities ranging from 30-37%, the salinity that can be tolerated by sea cucumbers is in the sea of 33-37%, and in coastal waters of 32-35%. Furthermore, Azis, 1997 also suggested that the ideal salinity for sea cucumber growth is 32-34% and if an increase of 3% will cause skin peeling, and in extreme circumstances can cause the death of sand cucumbers.

Table 2. Measurement Results of Water Quality Parameters

No	Parameter	Measurement Results
1	Temperature	28 ^{o}C
2	Salinity	32 ppt
3	pH	7,5
4	DO	4 mg/l
5	Current Cpeed	0,3 m/detik

The results of pH measurements in Tablolong beach waters amounted to 7.5. The degree of acidity (pH) is an environmental parameter that also affects the growth of sand sea cucumbers as Rumahlatu et al., 2008 suggested that the growth of sand sea cucumbers is also influenced by the pH of the waters where the pH is suitable for the growth of sea cucumbers is 6.50-7.50 for productive waters and 7.50-8.50 for very productive waters.

The results of DO observations in the field showed results of 4 mg / l. Dissolved oxygen in the waters comes from air diffusion and photosynthesis of aquatic plants both micro (phytoplankton) and macro (seagrass, macro algae, mangroves). Dissolved oxygen is needed for the respiration of organisms in the waters including sand sea cucumbers. The optimum range for sea cucumber growth, as stated by Rumahlatu et al., 2008 that the optimum dissolved oxygen content for sea cucumber growth is 3 mg/L, while Neno et al., 2020 suggested 4-8 mg/L. While the current speed at the research location showed results of 0.3 m/sec. Sea cucumbers can develop well in calm waters. The current speed that can still be tolerated by sea cucumbers is 0.3-0.5 m/sec (Sukmiwati et al., 2012).

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of research in the field showed that the types of sea cucumbers found were the Holothuridae family by 75% and the Stichopodidae family by 25%. Water quality parameters show results that are suitable for sea cucumber cultivation. So the potential for sea cucumber cultivation is still very wide open to be developed.

Suggestions for the next research are to experiment with innovations that are suitable for the development of sea cucumber cultivation.

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REFERENCES

Alirman, O., Jurusan, M., Kelautan, I., Perikanan, F., Oleo, U. H., Darsono, T., Komunitas, S., & Darmisa, T. (2019). *4*(November), 187–195.

Azis, A. (1997). Status Penelitian Teripang Komersial di Indonesia. *Oseana*, *22*(1), 9–19.

Bakus, G. J. (1973). *10. – THE BIOLOGY AND ECOLOGY OF TROPICAL HOLOTHURIANS*. https://api.semanticscholar.org/CorpusID:89310219

Darsono, P. (2005). Komunikasi Pendek. In *Jurnal Biologi Indonesia* (Vol. 3, Issue 9, pp. 405–410).

Janies, D. (2001). Phylogenetic relationships of extant echinoderm classes. *Canadian Journal of Zoology*, *79*(7), 1232–1250. https://doi.org/10.1139/z00-215

KERR, A. M., & KIM, J. (2001). Phylogeny of Holothuroidea (Echinodermata) inferred from morphology. *Zoological Journal of the Linnean Society*, *133*(1), 63–81. https://doi.org/https://doi.org/10.1006/zjls.2000.0280

Ladd, H. S. (1977). *1 - TYPES OF CORAL REEFS AND THEIR DISTRIBUTION* (O. A. JONES & R. B. T.-B. and G. of C. R. ENDEAN (eds.); pp. 1–19). Academic Press. https://doi.org/https://doi.org/10.1016/B978-0-12-395528-9.50009-9

Lewerissa, Y. (2014). STUDI EKOLOGI SUMBERDAYA TERIPANG DI NEGERI PORTO PULAU SAPARUA MALUKU TENGAH. *BIOPENDIX: Jurnal Biologi, Pendidikan Dan Terapan*, *1*(1 SE-Articles). https://doi.org/10.30598/biopendixvol1issue1page32-42

Madduppa, H., Taurusman, A. A., Subhan, B., Anggraini, N. P., Fadillah, R., & Tarman, K. (2017). Short communication: Dna barcoding reveals vulnerable and not evaluated species of sea cucumbers (Holothuroidea and Stichopodidae) from Kepulauan Seribu reefs, Indonesia. *Biodiversitas*, *18*(3), 893–898. https://doi.org/10.13057/biodiv/d180305

Massin, C. (1999). Reef-dwelling Holothuroidea (Echinodermata) of the Spermonde Archipelago (South-West Sulawesi, Indonesia). *Zoologische Verhandelingen*, *329*, 1–144.

Neno, I., Risamasu, F., & Sine, K. (2020). Studi potensi echinodermata di perairan intertidal pasir panjang dan peluang pengembangan budidayanya. *Jurnal Aquatik*, *2*(2 SE-Articles). https://ejurnal.undana.ac.id/index.php/jaqu/article/view/2569

Pearse, J. S. (1988). Marine Strategists: A Functional Biology of Echinoderms. John Lawrence. Johns Hopkins University Press, Baltimore, MD, 1987. xii, 340 pp., illus. $56.50. *Science*, *239*(4836), 200. https://doi.org/10.1126/science.239.4836.200.a

Purcell, S. W., Hair, C. A., & Mills, D. J. (2012). Sea cucumber culture, farming and sea ranching in the tropics: Progress, problems and opportunities. *Aquaculture*, *368–369*, 68–81. https://doi.org/https://doi.org/10.1016/j.aquaculture.2012.08.053

Purcell, Samyn, Y., & Conand, Y. (2012). *Purcell, S.W., Samyn, Y. & Conand, C. Commercially important sea cucumbers of the world. FAO Species Catalogue for*

Fishery Purposes. No. 6. Rome, FAO. 2012. 150 pp. 30 colour plates.

Rumahlatu, D., Gofhur, A., & Sutomo, H. (2008). Hubungan Faktor Fisik-kimia Lingkungan dengan Keanekaragaman Echinodermata pada Daerah Pasang Surut Pantai Kairatu. *MIPA Dan Pembelajarannya*, *37*(1).

Sugama, K., Giri, N., zairin, muhammad, Hartati, R., Widianingsih, W., Sembiring, S., Haryanti, H., Indriana, L., Hutabarat, J., Wibawa, G., Firdaus, M., Roza, D., Zafran, & Nursid, M. (2019). *ASPEK BIOLOGI DAN BUDIDAYA TERIPANG PASIR, Holothuria scabra*.

Sukmiwati, M., Salmah, S., Ibrahim, S., Handayani, D., Biologi, J., Matematika, F., Alam, P., Kimia, J., Matematika, F., & Alam, P. (2012). *Keanekaragaman Teripang (Holothuroidea) di Perairan Bagian Timur Pantai Natuna Kepulauan Riau*. *14*(2), 131–137.

Trivedi, S., Aloufi, A. A., Ansari, A. A., & Ghosh, S. K. (2016). Role of DNA barcoding in marine biodiversity assessment and conservation: an update. In *Saudi journal of biological …*. Elsevier. https://www.sciencedirect.com/science/article/pii/S1319562X15000029

Yusron, E., & Susetiono. (2006). Holothurian (Holothuroidea) community structure in some coastal waters of Tanjung Merah Island, Lembeh Strait, North Sulawesi. In *Jurnal Perikanan* (Vol. 8, Issue 1, pp. 134–138).