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## ABSTRACT

**FRANS TONY, INDIRA FITRILIYANI, M. RIZA SEPTIADY, AKHMAD SAHRIL**; Monitoring Marine Biota (*Identification of Coral Reefs and Coral Fish*) in 17 Island Marine Nature Park, Riung District, Ngada Regency, East Nusa Tenggara. East Nusa Tenggara.

The work area of the NTT KSDA Center covers 22 regencies/cities throughout NTT province. There are several districts that do not have conservation areas, but are still the work area of the Center. In districts that do not have conservation areas, the main task is aimed at the circulation of wild plants and animals in the area. Conservation Areas managed by the NTT KSDA Center are 28 conservation areas with a total area of 234,517.24 ha, where the area is still dynamic considering the progress of area confirmation which is still not complete. The conservation areas are located in 12 regencies/cities out of 22 regencies/cities in NTT Province. List of conservation areas within the scope of the NTT KSDA Center. One of the conservation areas is the Seventeen Island Marine Nature Park (TWAL) which is administratively included in the Riung sub-district of Ngada Regency, which still lacks information about its marine biota, so it is deemed necessary to explore more deeply related to its underwater potential by monitoring marine biota (*Identification of Coral Reefs and Reef Fish*) in the 17 Island Marine Nature Park, Riung sub-district, Ngada Regency, East Nusa Tenggara Prov. East Nusa Tenggara.

This monitoring aims to: 1). To identify and provide data on the types of coral reefs and reef fish found in TWAL 17 Island. 2). Identify and provide data on the condition of coral cover in the marine waters of TWAL 17 Islands. 3). The index of diversity, uniformity, and dominance of coral reefs and reef fish in TWAL 17 Island is known. 4). Knowing the physical and chemical conditions of water in the marine waters of TWAL 17 Island.

The research method used is the method of data collection by observation, interviews with the community and local government. Coral reef data collection using *Line Intercept Transects* (LIT) method, reef fish data collection using *Underwater Visual Census* (UVC) method. To determine the extent of coral cover in TWAL 17 Island using Image data processing is done with several software, namely Arcgis 10.8, ENVI 5.6, ER Mapper 7.1, while the image used is Lansat-8 image, Envi software is used to perform radiometric processing, Er Mapper 7.1 software is used to process map data using Lyzenga transformation and for Arcgis 10.8 software is used for map classification and layouting.

The results of monitoring marine biota show that; 1). The types of coral reefs found in the TWAL 17 Island Area of Riung District, Ngada Regency, East Nusa Tengara Province.

is composed of 4 *Acropora* coral *lifeforms* at the study site namely: *AcroporaI Coral Digitate* (ACD), *AcroporaI Coral branching* (ACB) and *Acropora Coral Tabulate* (ACT), *Acropora Coral Encrusting* (ACE) and 6 *Non-Acropora* forms namely *Coral branching* (CB), *Coral massive* (CM), *Coral encrusting* (CE), *Coral foliose* (CF), *Coral Mushroom* (CMR), *Coral Heliopora* (CHL), 1 form of Dead Scleractinia namely DC with algae (DCA), 3 forms of Algae namely *Macro Algae* (MA) and *Corralline Algae* (CA), *Halimidae Algae (*HA), 4 forms of Other Fauna namely; *Soft Coral* (SC), *Spoonge* (SP), *Zoanthids* (ZO) and Others (OT) while for Abioic there are 2 forms namely: Sand (S), *Rubble* (R). For reef fish, the number of species recorded was 96 species consisting of 18 families spread across 8 observation stations. The largest fish composition was from the Pomacentridae (14 species) and Labridae (14 species) families, while Lutjanidae (13 species), Chaetodonthidae (12 species), Scaridae (6 species), Haemulidae (6 species), Serranidae (6 species),

Caesionidae (5 species), Pomacanthidae (4 species), Achanturidae (4 species), Nemipteridae (4 species), Holocentridae (2 species) and Pseudochromidae (1 species), Platacidae (1 species), Antennaridae (1 species), Mullidae (1 species), Muraenidae (1 species) and Plotosidae (1 species). The most species of reef fish are from the family Pomacentridae and for the most tribe is Pomacentridae and Labridae also ranks top in terms of the number of species (biodiversity). 2). The condition of coral reef cover around the 17 Islands TWAL Area in Riung Subdistrict, Ngada Regency, East Nusa Tengara Province is Moderate to Good. 3). The diversity index of coral reefs around the 17 Islands TWAL Area, Riung Sub-district, Ngada Regency, East Nusa Tenggara Province is medium diversity with moderate environmental pressure, high uniformity index with a stable community, the dominance index also has no tendency for one individual to dominate. Meanwhile, the diversity index of reef fish at all observation stations shows that the diversity index of reef fish is in the high category and there is a balance of ecosystems, a high diversity index and a stable community, with a dominance index there is no one fish species that dominates other individuals. 4). Overall, the physical and chemical conditions of water in the marine waters of TWAL 17 Pulau Riung Sub-district, Ngada Regency, East Nusa Tengara Province showed good conditions for coral reef and reef fish life, with some variations in temperature, brightness, and salinity. Higher salinity may reflect seawater characteristics, while DO and pH values were within appropriate ranges to maintain a balanced aquatic ecosystem.

# INTRODUCTION

Assalamualaikum Warahmatullahi Wabarakatuh

Alhamdulillah, praise be to God Almighty for the implementation of the technical guidance activity on Marine Biota Monitoring (Identification of Coral Reefs and Reef Fish) in the 17 Islands Marine Nature Tourism Park (TWAL) in Riung District, Ngada Regency, East Nusa Tenggara Province**.** This activity is the result of a solid collaboration between the East Nusa Tenggara Natural Resources Conservation Center (BBKSDA NTT) and the Faculty of Fisheries and Marine Science of Lambung Mangkurat University (FPIK ULM), which has the same commitment in efforts to preserve and monitor marine ecosystems.

The main objective of this activity is to increase the capacity of the participants in diving skills while strengthening their understanding of the importance of conservation and monitoring of marine biota in the 17 Island TWAL area. With this technical guidance, it is hoped that competent human resources can be formed in monitoring marine ecosystems, which is very important for the sustainability of coastal and marine ecosystems in East Nusa Tenggara.

This collaboration is a form of synergy between the government and academics in supporting the sustainable conservation of marine resources. We hope that this activity will not only benefit the participants of the technical guidance on monitoring marine biota, but also make a real contribution to efforts to preserve the marine environment, especially in the 17 Island TWAL Area.

Finally, we would like to express our deepest appreciation to all parties who have supported the implementation of this activity. May this collaboration continue in the future for the sustainability of our natural resources so that they remain sustainable.

Kind regards,

**Dr. Frans Tony**
Head of Research Team

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# CHAPTER I
# INTRODUCTION

## 1.1 Background

The work area of the NTT KSDA Center covers 22 regencies/cities throughout NTT province. There are several districts that do not have conservation areas, but are still the work area of the Center. In districts that do not have conservation areas, the main task is aimed at the circulation of wild plants and animals in the area. Conservation Areas managed by the NTT KSDA Center are 28 conservation areas with a total area of 234,517.24 ha, where the area is still dynamic considering the progress of area confirmation which is still not complete. The conservation areas are located in 12 regencies/cities out of 22 regencies/cities in NTT Province. List of conservation areas within the scope of the NTT KSDA Center. One of the conservation areas is the Tujuh Belas Pulau Marine Nature Park (TWAL), which is administratively included in the Riung sub-district of Ngada Regency, which includes 6 coastal villages, namely: Lengkosambi, Tadho, Latung, Sambinasi, East Lengkosambi and West Lengkosambi villages and 2 villages, namely Benteng Tengah and Nangamese. Administratively, the management is located in the Riung resort, Region III Conservation Section, Region II Ruteng Division of the KSU Center.
II Ruteng at the NTT KSDA Center. Astronomically located at 08° - 09° N and 121° 45' - 121° 50'E, with the following administrative boundaries:

a. The northern part is bordered by the Flores Sea.
b. The south is bordered by So'a sub-district.
c. The west is bordered by Manggarai Regency.
d. The eastern part is bordered by Nagekeo Regency.

The Marine Area in Riung Sub-district was initially designated as a Nature Reserve by Minister of Forestry Decree No. 427/KptsII/1987 Dated December 28, 1987 with an area of 11,900 hectares. This area was subsequently re-designated into 2 areas by Minister of Forestry Decree No: 589/Kpts-II/1996 Dated September 16, 1996 into the Tujuh Belas Pulau Nature Park covering 9,900 hectares and the Riung Nature Reserve covering 2,000 hectares. Then based on the Minister of Forestry's Collective Designation Decree No.3911 / MENHUTVII / KUH / 2014 dated May 14, 2014, it was changed to the 17 Island Marine Nature Park with an area of 7,303.16 hectares. This area is nomenclaturally called TWAL Tujuh Belas Pulau to describe the beauty of this area is very beautiful and beautiful like a 17-year-old girl even though it actually has 24 islands consisting of Batang Kolong Island, Bakau Island, Rutong Island, Table Island, Tangil Island, Lainjawa Island, Tiga Island (East Bampa), Sui Island, Ontoloe Island, Wire Island, Wongkoroe Island, Pata Island, Besar Island, Halima Island (Nani Island), Copper Island, Barrier Reef, Dua Island (2 islands so one name) and several taka (atolls). (BBKSDA NTT, 2011).

The ecosystem of TWAL 17 Island consists of dry tropical forest, savanna, mangrove, seagrass, and coral reef. A total of 17 species from 10 families and 3 types of associations (coastal vegetation) make up the mangrove forest ecosystem on the coast of the islands. There is a relatively low diversity of flora species in TWAL 17 Island, this is more due to the rocky soil conditions so that there is less space available as a medium for growing various types of trees. In addition, most of the area is karst, causing low flora diversity. Some dominant tree species in the 17 Islands TWAL area include: tamarind (Tamarindus indica), kesambi (Schleichera oleosa), lontar (Borrassus flabeilifer) and several other species with rare abundance such as ure (Cagenaria sicecaria), redwood (Pterocarpus indicus). In the TWAL 17 Pulau area there is also a mangrove forest ecosystem with intact vegetation conditions. Mangrove forests are a transitional area between marine and terrestrial ecosystems or an ecotone area. This area is rich in biodiversity that comes from or is influenced by terrestrial and marine ecosystems. This ecosystem can be found in almost all coastal areas in Kecamatan Riung. There are about 17 types of mangrove constituent trees from 10 families and about 3 types of mangrove associations (coastal vegetation). The dominant species include Rhizopora apiculata, Sonneratia alba, Ceriops roxburghii, Brugueira parfifolia and Avicenia officinalis. The existence of mangrove ecosystems provides very important functions and benefits, in addition to functioning as a wave barrier protection system and seawater infiltration, the types of magroves are Rhizophora apiculata, R. stylosa, R. mocronata, Bruguiera gymnorhiza, B. parviflora, Ceriops. parviflora, Ceriopstagal, Sonneratia alba, S. Casoelaris, Aegiceras corniculatum, A. Floridium, Heritiera littoralis, Exoecaria agallocha, Pemphisacidula, Xylocarpus muluccensis, Lumnitzerare comosa, Avicennia alba, Derris heterophylla. As for fauna, TWAL 17 Island has a variety of protected species, one of the most familiar is the Komodo dragon (Varanus komodoensis). This animal can be found on Ontoloe Island, the largest island in the western region. Although smaller in size and brighter in color than the Komodo monitor lizards in Komodo National Park, they are scientifically the same, with genetic variation leading to a more yellowish coloration (Ciofi, 1999). The 17 Islands TWAL area is also home to a variety of bird species including the white-bellied sea eagle (Haliaetus leucogaster), coral egret (Egretta sacra), red-footed egret (Megapodius reinwardt), reed grub (Centropus bengalensis), dugong (dugon), Long-tailed monkey (Macaca fasicularis) dolphin, whale, hawksbill turtle (Erectmohelys imbricata), green turtle (Chelonia mydas), giant clam (Tridacna gigas), hollow nautilus (Nautilus popillius), round milkfish (Trochus niloticus), goathead (Cassis cornuta), trumpeter triton (Charonia tritonis). Mangrove vegetation can be found almost throughout the coastline, which is a habitat for bats (Pteropus sp), especially on Ontoloe Island. This population of bats is also a potential prey for komodo lizards. Another potential in the 17 Islands TWAL is one of the natural habitats of the komodo dragon lizard (Varanus komodoensis) or as the local people call it "mbou". TWAL 17 Island in Riung sub-district, Ngada Regency, which is located on the north coast of Flores Island, also offers marine tourism that can spoil the eyes with a cluster of small islands and white sandy beaches. As part of the world's coral triangle, the turquoise water combined with the white sandy beaches and mangroves are interconnected to support life, especially the underwater world. Unfortunately, data on the structure of coral reef communities and reef fishes are lacking.

On the basis of these considerations, and referring to the conservation area that has been determined based on the division of blocks in the area consisting of marine protection blocks, utilization blocks and traditional blocks as well as the potential for tourism, especially marine tourism, it is deemed necessary to explore more deeply the existing underwater potential by monitoring marine biota (*Identification of Coral Reefs and Coral Fish*) at the 17 Island Marine Nature Park, Riung District, Ngada Regency, East Nusa Tenggara. NTT.

## 1.2 Problem Formulation :

Based on the background above, the lack of available data on coral reefs and reef fish found in the 17 Island Marine Nature Park, Riung District, Ngada Regency, NTT. NTT.

## 1.3 Objectives

The purpose of conducting marine biota monitoring (*Identification of Coral Reefs and Reef Fish*) at the 17 Islands Marine Nature Park, Riung District, Ngada Regency, East Nusa Tenggara Prov. NTT are:

1. Identify the types of coral reefs and reef fish found in the 17 Islands TWAL.
2. Knowing the condition of coral cover in the marine waters of TWAL 17 Island.
3. Knowing the index of diversity, uniformity, dominance of coral reefs and reef fish in TWAL 17 Island.
4. Knowing the physical and chemical conditions of water in the marine waters of TWAL 17 Island.

## 1.4 Benefits

The purpose of conducting marine biota monitoring (*Identification of Coral Reefs and Reef Fish*) at the 17 Island Marine Nature Park, Riung District, Ngada Regency, East Nusa Tenggara Province. NTT are:

1. Identification and availability of data on the types of coral reefs and reef fish found in TWAL 17 Island.
2. Known and available data on the condition of coral cover in the marine waters of TWAL 17 Island.
3. The index of diversity, uniformity, and dominance of coral reefs and reef fish in TWAL 17 Island is known.

4. To know the physical and chemical conditions of water in the marine waters of TWAL 17 Island.

## 1.5 Space Scope

### 1.5.1 Regional Scope Research

The scope of the research area is in TWAL 17 Islands in the Marine Protection Block (2 observation stations), Utilization Block (4 observation stations) and in the Traditional Block (2 observation stations).

### 1.5.2 Scope of Activities :

Instruments in monitoring the condition of coral reefs and reef fish in TWAL 17 Island are implemented in the following description:

a. Identifying coral reef and reef fish species
b. Knowing the condition of coral cover
c. Knowing the index values of diversity, uniformity and dominance of coral reefs and reef fish.
d. Knowing the physical and chemical conditions of water in the observation station area.

# CHAPTER II
# FRAMEWORK THEORY

## 2.1. Foundation Theory

### 2.1.1. **Definition of Coral Reef**

Coral reef is an ecosystem on the seabed that is built mainly by lime-producing marine biota, especially types of stone corals and calcareous algae, together with other bottom-living biota such as species of Molluscs, Crustaceans, Enchinodermata, Polychaeta, Porifera and Tunicata and other biota that live freely in the surrounding waters including types of fish, (Sukarno, 1993). Basically, coral reefs are formed from massive deposits of calcium carbonate (CaCO3) produced by reef-building coral organisms (hermartipic corals) from the phylum Cnidaria, order Scleractinia that live symbiotically with zooxantellae, and a little extra from calcareous algae and other organisms that secret calcium carbonate (Bengen, 2002). The coral polyp wall consists of three layers: ectoderma, endoderma, mesoglea. Ectoderma is the outermost tissue that consists of various types of cells including mucous cells and nematoxic cells. The endoderma tissue is in the inner layer which most of its cells contain algae cells which are coral symbionts, while the mesoglea is a tissue that is in the middle between the two in the form of a jelly-like layer. The entire coral tissue is also equipped with well-developed cilia and flagella in the outer layer of the tentacles. The structure of the polyps and lime skeleton of coral animals consists of the base plate, epithelium, corallite, corallum, callus, costa and columella. The base plate is located at the bottom as the foundation of the septa which emerge to form an upright structure and are attached to the wall called epithelia.

The corallite, which is the entire skeleton formed from one polyp in an individual or colony, is called the corallum. Kalik is the exposed surface of the corallite, and the one that grows up to the outer wall of the corallite is called costa. The structures at the base and center of the corallite that are a continuation of the septa are called columella. Each individual living *polyp* grows in a hard bowl shape (*calyx*) while forming a framework of lime (CaCO3) that is stacked underneath. Over time this layer of lime gets thicker while the living *polyp* remains attached to the top. There are various characteristics of the shape there are solid, branched, flat round, finger shape, thick and so on. This type of coral animal is called hard coral. Adult coral animals can usually extend and move their tentacles but cannot move out of the bowl (*calyx*) where they are attached. Coral *polyps* are symbiotic with other biota. In the life of the coral association acts as a producer as well as as consumers. This is caused because coral is symbiotic with *zooxanthellae* that produce organic matter (Yusri, 2011).

### 2.1.2. Coral Type

Coral types are divided into two, namely corals that form limestone buildings *(hermatypic corals)* and those that cannot form coral buildings *(ahermatypic* corals). *Hermatypic corals* are coral colonies that can form buildings or *reefs* of calcium carbonate ($CaCO_3$) , so they are often called *reef building corals*. While *ahermatypic corals* are coral colonies that can not form reefs (Veron, 1986). It is also said by Supriharyono, 2000 that there are two types of corals: corals that form limestone buildings or *hermatypic* corals, and corals that can not form limestone buildings or *ahermatypic corals.*

According to Supriharyono (2000), in general the number of coral species (*reef-building corals*) in the Indo-Pacific tends to be more than in the Atlantic. The greatest diversity of coral species in the Indo-Pacific is found in Melanesia and Southeast Asia, and the highest is recorded in Indonesia.

### 2.1.3. Growth

Coral growth is influenced by abiotic and biotic factors. Abiotic factors can include light intensity, length of irradiation, temperature, nutrients, and sedimentation. Corals have the ability to live in nutrient-poor waters and can adapt to periodic increases in nutrients, such as *runoff*. Corals cannot adapt to sudden large increases in nutrients. Biotic factors include predation, competition, aggression of other corals, and others (Timothy, 2003).

*Coral reefs* are a collection of coral communities (animals) (*reef coral*), which live on the bottom of the water, in the form of limestone ($CaCO_3$) , and have a strong enough ability to withstand the force of ocean waves. These coral animals generally have a limestone skeleton, as well as algae associated in this ecosystem, many of which also contain limestone (Supriharyono, 2007).

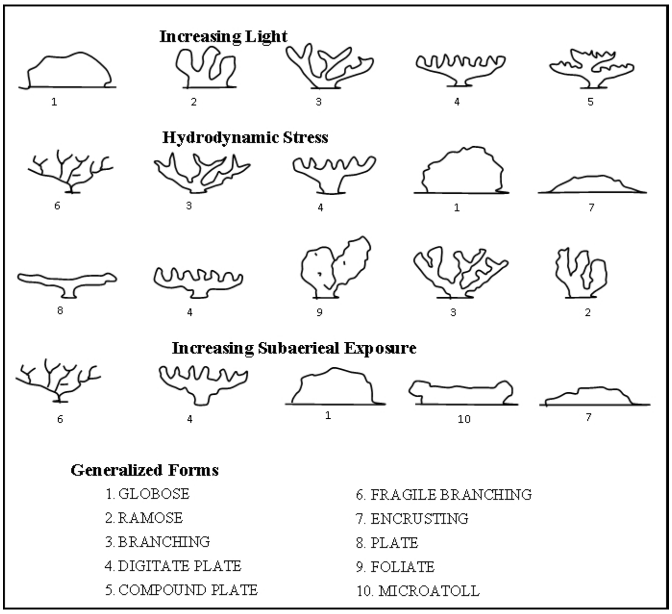
### 2.1.4. Growth Forms

Corals have a variety of coral growth forms (*lifeform*) which can be divided into:

1. *Branching* form. Corals like this have branches with a longer branch size compared to the thickness or diameter it has.
2. *Massive*. These corals have hard colonies generally rounded in shape, smooth and solid surface. The size varies from the size of an egg to the size of a house.
3. *Encrusting*. This coral grows creeping and covers the surface of the reef floor, has a rough surface and hard small holes.

4. Table shape (*tabulate*). This coral grows to resemble a table with a wide and flat surface and is cut by a kind of support pole which is part of the colony.
5. Leaf shape (*foliose*). These corals form sheets that stand out on the reef floor, are small and form circular folds.
6. *Mushroom* shape. This coral consists of one *polyp* that is oval in shape and looks like a mushroom, has many protrusions like ridges that are grooved from the edge to the center (Yusri, 2011).

Some types of growth forms can be seen in Figure 1.




Forms of coral growth (Supriharyono, 2000).

Based on the growth form of rock corals are divided into *Acropora* and *non- Acropora* corals (English *et*. *al*., 1994). The difference between Acropora and non-Acropora lies in the skeleton structure. Acropora has a part called axial coralite and radial coralite. While non- Acropora only has radial corallite whose growth form consists of :

1. *Non-Acropora* Growth Form

a. The *branching* form has a branching section that is longer than its diameter. Many are found around reef edges and at the top of slopes, especially protected and semi-exposed ones. Many provide shelter for fish and certain invertebrates.

b. *Massive*, with varying sizes and some boulder-like shapes, the surface of this coral is smooth and dense. Usually found along the reef edge and top of the reef.

c. *Encrusting*, growing to resemble the reef floor with a rough and hard surface and small holes. Many are found in open and rocky locations, providing shelter for small animals whose bodies are partially covered by shells.

d. *Foliose*, which are prominent sheets on the reef floor, are small and form folds or circles, especially on reef slopes and sheltered areas. Provides shelter for fish and other animals.

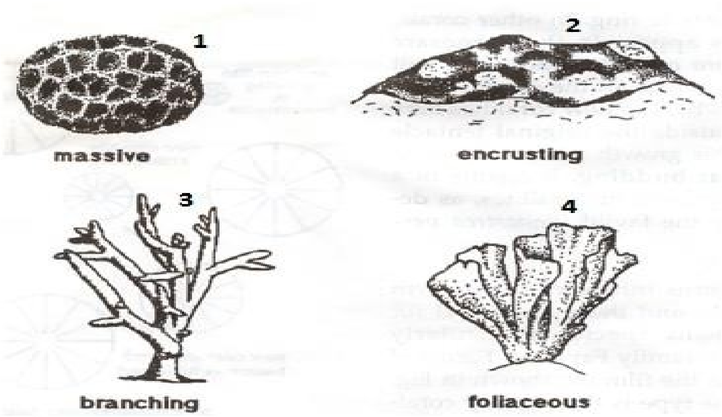
e. *Mushroom* shape, oval and mushroom-like in appearance, has many ridgelike ridges running from the edge to the center of the mouth.

f. *Submassive* (*submassive*), a solid shape with protrusions or small columns.

g. Fire corals (*millephora*), all types of fire corals that can be recognized by the presence of yellow color at the tip of the colony, and a burning sensation when touched.

h. Blue coral (*heliophora*), recognizable by the blue coloration of the skeleton.

Examples of growth forms in the non-Acropora category can be seen in Figure 2.3.




*Non-acropora* growth form (Timothy, 2006).

2. *The Acropora* growth form consists of:

a. *Branching acropora*, shaped like a tree branch.

b. Table *acropora* (*tabulate acropora*), a branching shape with a horizontal direction and flat like a table. This coral is supported by a stem that is centered or rests on one side to form an angle or flat.

c. Creeping *acropora* (*encrusting acropora*), creeping forms usually occur in rudimentary *acropora*.

d. *Submassive acropora*, branching double shape like a slab and sturdy.

e. Fingered *acropora* (*digitate acropora*), branching form tightly with branches like fingers (Yusri, 2011).

Coral reefs have associated biota, one of which is reef fish. The reef fish utilize the coral reef area as a refuge, spawning ground, and a place to find food. Therefore, coral reef ecosystems cannot be separated from reef fish.

2.1.5. Live coral cover

Reefs are massive deposits of limestone, mainly calcium carbonate (CaCO3). The calcium carbonate is produced by coral animals and other lime-secreting biota such as calcareous algae and mollusks. In the world of marine navigation, reefs are sea mountains formed by coral or sand near the surface of the water (Suharsono, 1996). The coral polyp wall consists of three layers: ectoderma, endoderma, mesoglea. Ectoderma is the outermost tissue consisting of various types of cells including mucous cells and nematoxic cells. The endoderma tissue is in the inner layer which most of its cells contain algae cells which are coral symbionts, while the mesoglea is a tissue that is in the middle between the two in the form of a jelly-like layer. The entire coral tissue is also equipped with well-developed cilia and flagella in the outer layer of the tentacles. The structure of the polyps and lime skeleton of coral animals consists of the base plate, epithelium, corallite, corallum, callus, costa and columella. The base plate is located at the bottom as the foundation of the septa that emerge to form an upright structure and are attached to the wall called epithelia.

Each individual living polyp grows in a hard bowl shape (calyx) while forming a framework of lime (CaCO3) that is stacked underneath. Over time this layer of lime gets thicker while the living polyps remain attached to the top. There are various characteristics of the shape there are solid, branched, flat round, finger shape, thick and so on. This type of coral animal is called hard coral. Adult coral animals can usually extend and move their tentacles but cannot move out of the bowl (calyx) where they are attached. Coral polyps are symbiotic with other biota. In the life of coral associates act as producers as well as consumers. This is because corals are symbiotic with zooxanthellae that produce organic matter (Yusri, 2011).

Ecosystem assessment criteria for coral cover based on the Minister of Environment Decree No. 4 of 2001 can be seen in the following table:

Table 1. Coral Reef Damage Standard Criteria of the Minister of the Environment

| PARAMETERS | CRITERIA OF ACCIDENTAL DAMAGE OF MARKBUILDING (in %) | | |
|---|---|---|---|
| Percentage of Living Coral Reef Cover Area | Poor | Damaged | 0 - 24,9 |
| | | Medium | 25 - 49,9 |
| | Good | Good | 50 - 74,9 |
| | | Very good | 75 - 100 |

Kepmen LH No. 4 of 2001

According to Suharsono (1998) coral damage can naturally be caused by predation and competition, disease, bio erosion, tidal temperature, salinity, tsunamis, volcanoes, earthquakes and storms. The source of threat of coral damage due to human factors directly such as coral mining, bombs, cyanide, traps, anchors, and tourism, indirectly is due to sedimentation, municipal waste, and petroleum. Coral reefs are fertile and food-rich ecosystems. Their complex physical structure, branching, caves, and passageways make the ecosystem an attractive habitat for marine life species. Therefore, the inhabitants of coral reefs are very diverse, both plants and animals. (Romimohtarto, 2005).

**2.2. Coral Reef Function.**

2.2.1. Ecological.

Ecological benefits of coral reefs can be defined as the benefits of coral reefs in terms of the reciprocal relationship between living things and their environment. Ecological benefits of coral reefs include:

1. As a habitat and food source for various types of living things in the sea. Here many different types of living things live, find food, shelter, and breed.
2. A source of high biodiversity. With the high biodiversity that exists in it, this coral reef becomes a source of genetic diversity and the species found have a higher survival rate.
3. Beneficial as a protector for the surrounding ecosystem, for example in the function of mangrove forest ecosystems, and also protect beaches and coastal areas from large waves. Coral reefs can minimize the energy of waves heading inland that can cause coastal abrasion and surrounding damage.
4. Can reduce the cause of global warming that occurs with the chemical process carried out by coral reefs and zooxanthellae. The chemical process is the process of changing $CO_2$ gas into lime substances which are reef building materials.

2.2.2. Socially.

Socially, coral reefs can be utilized to support education and research activities so that the ecosystem within and around them, as well as marine plants and animals in the coral reef ecosystem can be better known so that it is easy to learn. This will be very useful as knowledge so that management and conservation actions carried out by coral reefs are more appropriate so that damage to coral reefs can be overcome easily.

In addition, the ecosystem of the coral reef area can also be utilized as a means of community recreation, both local communities and foreign communities who want to see the beauty produced by this coral reef ecosystem.

2.2.3. Economically.

The economic benefits of coral reefs include coral reefs as a source of high fisheries. Because in it live various types of fish that can be caught for human food needs. In addition, coral reefs are also a source of medicine. Because in coral reefs there are chemicals that have been researched by many experts can produce drugs for humans.

1. Besides being a source of fisheries and a source of medicine
2. because of the beauty produced by the coral reef ecosystem, this ecosystem can be used as an attractive tourist attraction so that it can increase the income of the people who live around it.
3. The surrounding community can also utilize the biota that live in coral reefs, such as seaweed, shrimp, and fish to be a source of food that can later be sold so that it becomes a source of income for the community.
4. Various types of fish, sea cucumbers, and seaweed that live on coral reefs can also be used as seeds for cultivation.

## 2.3. Structure Community

According to Veron (1995) based on research to assess the ecological structure of coral and reef fish communities showed a stretch of coral reef habitat with the type of edge reef clusters in the form of *flats* and *slopes* and the characteristics of sloping sea waters with white sand and widely used for tourism activities. The condition of coral reefs with emphasis on the percentage of *hard* coral cover shows the condition of coral reefs included in the category of moderate to good. While the analysis of fish diversity shows that the families *Acanthuridae*, *Chaetodontidae*, and *Pomacentridae* are the most commonly found groups in this area with a relatively large number of individuals. Community structure can be aimed at the biological structure of a community, which includes species composition, abundance, temporal changes and relationships between species in a community.

## 2.4. Sustainable Utilization of Coral Reefs (Decorative Coral Trade).

Many efforts have been made by humans to overcome or repair coral reef ecosystems that have been damaged. In general, the efforts made are management, for example the establishment of marine protected areas or with rehabilitation technologies such as artificial reefs and coral transplantation. Coral transplantation is a long-term activity so it cannot be project-based. The program system is one solution to increase the success of coral transplantation in the context of coral reef rehabilitation.

Coral transplantation research in Indonesia includes the Thousand Islands (Subhan et al., 2008), Tanjung Lesung Banten (Zamani et al, 2009), Spermonde Islands (Haris, 2011), and several other areas. Coral species that are widely transplanted include Acropora (Haris 2012: Zamani et al, 2009; Madduppa et al., 2007), *Euphyllia* sp, *Plerogyra sinuosa*, *Cynarina lacrymalis (*Subhan et al., 2008), *Hynopora* sp, *Pocillopora* and *Sylopora* (Johan, 2012). Transplantation methods in Indonesia currently vary. Some methods that have been used are the net rack and substrate method (Subhan et al., 2008), concrete (Johan, 2012), nets and fragments (Fadli, 2008), natural substrates (Haris 2012) and modified using coral biorock (Zamani et al., 2009; Madduppa et al., 2007). Each method has advantages and disadvantages and not all are good for rehabilitation activities.

Transplantation methods continue to evolve in accordance with technological advances and user understanding. Easy and practical methods are the most widely used methods. However, not all practical and simple methods can produce the expected results. This paper aims to provide insight on how to implement methods and considerations in transplantation activities that can provide optimal results.

Coral transplantation can be done for various purposes, namely:

1. To restore damaged coral reefs

Coral transplantation with the aim of restoring damaged coral reefs is done by moving pieces of live coral from coral reefs that are still in good condition to the location of coral reefs that have been damaged. Techniques and procedures are as follows:

a. The location of the seedling collection is around the damaged coral reef (not far from the planting location) with good coral reef conditions.
b. The location where the seedlings are taken and the location of the damaged coral reef have similar environmental conditions (depth and current).
c. Collecting seedlings is done by cutting branches of parent corals on the spot, and not cutting parent coral colonies that are located close to each other to avoid damaging the ecosystem.

d. Transportation of seedlings from the collection site to the transplantation site should take no more than one hour.

2. Transplantation for ornamental coral trade purposes.

Transplanting of ornamental coral species for trade is done by moving pieces of traded ornamental coral species to artificial substrates placed around natural coral reef habitats, which will later become broodstock for traded ornamental corals. Techniques and procedures are as follows:

a. Performed by ornamental coral entrepreneurs who have a license as an exporter of ornamental corals.
b. The types of ornamental corals that are bred are the types of ornamental corals that are traded for aquarium making and are not traded as dead corals.
c. The number of ornamental coral seedlings to be planted as ornamental coral parents is in accordance with the quota that has been approved by the MA.
d. Entrepreneurs report to the MA about the time when planting starts, the location of breeding, the number, and types of ornamental corals to be planted.

### 2.5. Coral Reef Expansion.

Coral reef transplantation for the purpose of coral reef expansion is an effort to create new coral reef habitats or convert other habitats outside of coral reef habitats into coral reef habitats. Technical requirements and procedures for collecting seedlings and seedling collection sites are the same as those for coral reef transplantation for the purpose of restoring damaged coral reefs.

### 2.6. Tourism Purposes.

Coral transplantation for tourism purposes is distinguished from coral transplantation for reef expansion purposes. The goal is to create a coral reef habitat with high biodiversity. Or create a beautiful panorama on the seabed as well as in the coral reef ecosystem. For this reason, coral seedlings to be transferred must consist of coral species that are diverse in shape and color.

The artificial bottom substrate should depict an attractive bottom shape and be resistant to currents and seawater. In addition, a map of the coral transplantation site should be made according to the group or type of coral and its depth. This map is very useful for tourists and coral reef conservation groups.

### 2.7. Building Community Awareness

Coral transplantation is one way of conducting restoration activities with the aim of building community awareness carried out by coastal communities who are already aware of the negative impacts of coral reef damage. Training activities on coral transplantation techniques, how to determining the location of the nursery, how to take seedlings from their parents, how to transport the seedlings, how to attach the seedlings to the substrate, and then how to maintain it consistently implemented to coastal communities. By maintaining the integrity of coral reef transplantation results, fishing communities will be able to feel the results. Another way that can be done besides coral transplantation is with Bioreef_blok. Bioreef_blok is a combination of bioreeftek with artificial reef, namely realizing coral reefs naturally and making homes for fish in the form of community-based environmentally friendly conservation efforts.

Based on previous activities in realizing natural coral reefs and making houses for fish in the form of Biofeef_Block as a friendly conservation effort, efforts will be made to propagate the existence of Bioreef_block stations, involving the community so that efforts to enrich fish resources that can be utilized by the surrounding community as a fishing ground area, so that the fishing distance is close and efficient in catching time. Community-based, in this case it will make activities carried out by the community and the results are also utilized for the community. (Tony. F, et al., 2021)

## 2.8. Fish Ecology Coral

In a coral reef ecosystem there is an abundance, diversity of reef fishes that compose an activity of predation, competition and interaction. Wootton (1992) also stated that the limited resources of food, shelter, and shelter resulted in evolutionary mechanisms. Evolutionary mechanisms reduce competition between species, species with the same food needs will not compete because they have different places this is called habitat selection, then resource selection, for example carnivorous fish that show food division, and also time division, namely feeding activities at night or during the day. According to Syakur (2000), some carnivores are diurnal, their feeding activities take place during the day and rest at night, the other group is nocturnal, their feeding activities take place at night.

Almost all reef fishes go through a pelagic phase early in their life cycle. After a month or so the juveniles reach a certain size, they settle in the reef area. If space on the reef is limited, mortality and migration of reef fishes will provide opportunities for juveniles. When and where this space will become available cannot be predicted. The consequence of this mechanism is changes in species composition and relative abundance at any given time due to *recruitment* (Wotton, 1992).

### 2.8.1 Coral Fish Relationship with Coral Reefs

Reef fishes are one of the groups of animals associated with coral reefs, their presence is conspicuous and found in various micro-habitats on coral reefs. Reef fish

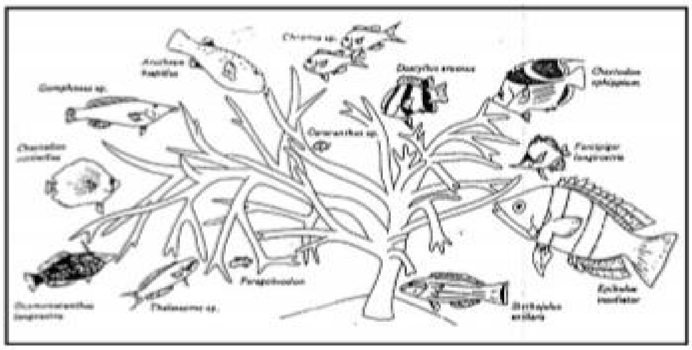
Reef fish live and feed in coral reef areas, so if coral reefs are damaged or destroyed, reef fish will also lose their habitat (Rani *et al*., 2010).

The spatial distribution of reef fishes is related to habitat characteristics and interactions among the fishes themselves, both in the nature of relationships between species and relationships between individuals and certain species (Nybakken, 1992). Reef fish interactions with coral reef ecosystems are:

a. Predation Two groups of fish that actively feed on coral colonies, namely coral species that feed on coral polyps such as pufferfish *(Tetraodontidae*), sand lance (*Monachantidae*), pakol fish (*Balistidae*), and kepe-kepe fish (*Chaetodontidae*) and a group of multivorous (*omnivorous*) fish that move coral polyps to obtain algae inside coral skeletons or as invertebrates living in skeletal holes (families *Acanthuridae* and *Scaridae*).
b. Grazing activities by herbivorous fishes from the *Siganiidae, Pomacentridae, Acanthuridae* and *Scaridae families* can increase the ability of corals to recover by reducing the amount of algae.

The most common type of predation is carnivorous, which is approximately 50% to 70%. Herbivorous and coral-eating fishes make up the second major group, accounting for approximately 15% of the species and the most important of these are the families *Scaridae* and *Acanthuridae*. The rest are classified as omnivores, namely fishes of the families *Pomacentridae, Chaetodontidae, Pomachantidae, Monachantidae, Ostaciantidae*, and *Tetraodontidae*. *Zooplankton-eating* fishes have small body sizes, namely fishes of the families *Clupidae* and *Antherenidae* (Nybakken, 1992). Reef fish interactions with coral reefs can be divided into three forms (Choat and Bellwood 1991), namely:

a. Direct interaction, as a refuge from predators or predators, especially for young fish.
b. Interactions in foraging, including relationships between reef fish and biota that live on corals including algae.
c. Indirect interactions as a result of coral structure and hydrological and sediment conditions. Interactions of several reef fish species with coral colonies are presented in Figures 1 and 2.



Interaction of Reef Fish with Branching Type Coral Colonies (Nybakken, 1992)

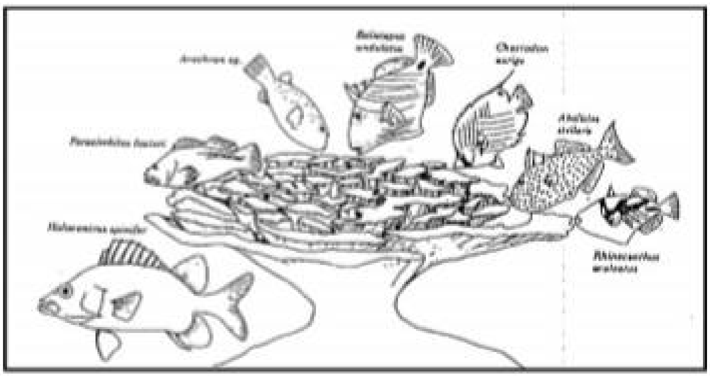


Figure 4. Coral Fish Interaction with Flat-type Coral Colonies (Nybakken, 1992)

### 2.8.2 Coral Fish Grouping

In coral reef ecosystems, reef fish communities can be divided into two groups, namely groups of fish that are sometimes found on coral reefs and fish that depend on coral reefs as a place to find food, a place to live or both (Sopandi, 2000).

*English et all.* (1997) categorized reef fish species into three main groups, namely:

a) Target fishes, which are economically important and commonly caught for consumption. Usually, target fishes use coral reefs as spawning and nesting grounds. Target fishes are represented by the *families Serranidae* (grouper), *Lutjanidae* (snapper), *Lethrinidae* (lencam), *Nemipteridae* (curryfish), *Caesionidae* (yellowtail), *Siganidae* (baronang), *Haemulidae* (thick-lipped fish), *Scaridae* (old brother fish) and Acanthuridae (pakol fish);
b) Indicator fishes, which are reef fish species that typically inhabit coral reef areas and become indicators of the fertility of the ecosystem of the area. Indicator fishes are represented by the *family Chaetodontidae* (kepe-kepe fish);
c) Major fishes are small fishes, generally 5 to 25 cm in size, with diverse coloring characteristics that are known as ornamental fishes. Major fishes are generally found in abundance, both in number of individuals and species, and tend to be territorial. The major fish groups live their entire lives on coral reefs, represented by the *families Pomacentridae* (betok laut fish), *Apogonidae* (serinding fish), *Labridae* (broom fish), and *Blenniidae* (imitating fish).

Some descriptions of reef fish families according to Randall *et al.* (1990) are:

1. *Acanthuridae*: known as surgeonfishes, feed on bottom algae and have long digestive tracts; their main food is zooplankton or detritus. Surgeonfishes are able to cut other fishes with sharp spines located on their caudal fins.

2. *Balistidae*: A class of triggerfishes, solitary carnivores that live during the day, feeding on a variety of invertebrates including hard-shelled molluscs and echinoderms; some species also feed on algae or zooplankton.

3. *Blennidae*: usually living in small holes on the reef, mostly bottom-digging species that feed on a mixture of algae and invertebrates; some are plankton eaters, and some specialize in feeding on the skin or fins of larger fishes, mimicking a cleaner.

4. *Caesonidae*: known as yellowtails, during the day are often found in schools feeding on zooplankton in mid-water above reefs, along shoal beds and pinnacles in shoals. Although they are active swimmers, they often stay put to catch zooplankton and

usually take refuge on the reef at night.

5. *Centriscidae*: swims in an upright position with snout down; feeds on small zooplankton.

6. *Chaetodontidae*: also known as *butterfly* fish, generally brilliantly colored, feeding on coral tentacles or polyps, small invertebrates, other fish eggs, and filamentous algae, some species are also plankton eaters.

7. *Ephippidae*: flattened body shape, flat, small mouth, generally omnivorous, feeds on algae and small invertebrates.

8. *Gobiidae:* commonly found in shallow waters and around coral reefs. Mostly bottom-digging carnivores that feed on small bottom invertebrates, some are also plankton feeders. Some species have symbiotic relationships with other invertebrates (e.g. shrimp) and some are known to remove *ectoparasites* from other fishes.

9. *Labridae*: known as wrasses, are economically important fishes, having very different shapes, sizes and colors. Most species are sand diggers, carnivorous of bottom *invertebrates*; some are also plankton eaters and some small species transfer *ectoparasites* from larger fishes.

10. *Mullidae*: known as *goatfish*, have a pair of scutes on their chin, which contain chemical sensory organs and are used to check for the presence of bottom invertebrates or small fish in sand or holes in the reef, many have brilliant colors.

11. *Nemipteridae*: known as *threadfin breams or whiptail breams*, carnivorous fishes that feed mainly on small bottom fishes, cuttlefishes, shrimps or worms; some species are plankton feeders.

12. *Pomacentridae*: known as *damselfishes*, have a variety of colors that differ individually and locally within the same species. Some species are herbivorous, omnivorous or plankton-eating fish. *Damselfish* lay their eggs on the bottom which are guarded by male fish. This group includes anemone fishes (*Amphiprioninae*) that live in association with sea anemones.

13. *Scaridae:* known as *parrotfish*, herbivores, usually obtain algae from dead coral substrates. Chewing coral along with algae and forming coral sand, this makes *parrotfish* one of the important sand producers in coral reef ecosystems. *Scaridae* are economically important fish.
14. *Serranidae:* known as sea bass, grouper, bottom-digging predator, commercial fish, feeds on crustaceans and fish. *Subfamilies* are *Anthiinae, Epinephelinae* and *Serranidae*.
15. *Sygnathidae*: known as seahorses or *pipefish*. Some have beautiful colors. Generally restricted to shallow waters. Feeds on invertebrates by sucking on its snout. Males have an erectile sac where eggs are deposited and incubated.
16. *Zanclidae*: shaped like *Acanthuridae* with a tabular mouth without caudal spines. Feeds on sponges as well as bottom invertebrates.

## 2.9. Physico-Chemical Parameters of Waters

Coral reef survival is limited by several physico-chemical parameters according to Nybakken (2000) divided into five factors, namely temperature, depth, light, salinity and deposition factors. according to Giyanto et al (2017) grouped the limiting factors into 7, namely:

### 2.9.1 Water Temperature

Coral growth is strongly influenced by the condition of the aquatic environment. Environmental conditions in reality are not always fixed, but often change due to disturbances, either from nature or human activities (Oktarina *et al*., 2014). Temperature is a limiting factor that has a major influence on coral life so that it will also have an impact on the lives of other animals that are associated with coral reef ecosystems. The temperature at the research station ranged from 30 - 31 $^{(0)\,C}$. Coral Watch (2011) states that water temperature fluctuates according to the solar and tidal cycles. Temperature patterns in waters are influenced by various factors such as sunlight intensity, heat exchange between water and surrounding air, geographical altitude and also by the factor of closure by vegetation from trees that grow around it. Supriharyono (2007) explains that in the life of coral reefs have a temperature range to live between 25-32 $^{(0)\,C}$. Temperatures that exceed the tolerance limits of coral reefs can cause coral *bleaching*.

### 2.9.2 Brightness

Sunlight plays a role in the process of coral reef formation, because it determines the photosynthesis process for algae. Corals live symbiotically with *zooxanthellae* algae. Therefore, corals are difficult to grow and develop at depths where light penetration is very poor, usually at depths greater than 50-70 m.

### 2.9.3 Current Velocity

Nontji (1993) states that the presence of currents and waves in the water is very important for the survival of coral reefs. Currents are needed to bring food in the form of plankton, in addition to cleaning themselves from sediments and to supply oxygen from the free sea, therefore coral growth in places where the water is always stirred by currents and waves, should be better than calm and protected waters.

### 2.9.4 Salinity

The ideal salinity for growth is between 27-35‰. According to Haruddin (2011) the optimal salinity levels for coral reefs are 25-30‰, the salinity of sea water in the tropics is 35‰, and coral biota live well at salinity levels of 34-36‰.

Salinity according to Sadarun et.al., (2006), the optimum salinity for coral life ranges from 30-35 ppt, therefore corals are rarely found living in large river estuaries, high rainfall, and waters with high salt content. Coral watch (2011) adds that salinity changes due to the increase and decrease of water molecules through the process of evaporation and rainwater. Salinity increases when the rate of evaporation in an area is greater than rainfall. Conversely, in areas where rainfall is greater than evaporation salinity decreases. These conditions depend on latitude and season

### 2.9.5 Degree of Acidity (pH)

Referring to Kepmen LH No 51 of 2004, the best pH of seawater for marine biota including coral reefs is between 7-8.5. In general, the pH of seawater does not vary much because the carbon dioxide system in seawater has a strong *buffering capacity*. This means that the pH of seawater is not easily changed (Mismail 2010).

### 2.9.6 Dissolved Oxygen (DO)

The high value of dissolved oxygen in each ecosystem can be caused by the diffusion of oxygen from the free air. Based on the decision of the Minister of Environment No. 51 of 2004 concerning quality standards for marine biota, namely, optimal dissolved oxygen (DO) levels for the growth of aquatic biota with oxygen levels of more than 5 mg/l. Waters that have low oxygen levels will inhibit growth, and can even cause death in biota.

According to Faturohman et al, (2016), if a body of water has a dissolved oxygen (DO) value of less than 3 mg/l, this will cause death to aquatic organisms.

### 2.9.7 Nitrate

Nitrate is an important element as a nutrient for the growth of biota in the coral reef ecosystem. Based on the Kepmen LH (2004) on water quality standards for aquatic biota stipulates that the optimal nitrate nutrient levels for aquatic biota do not exceed 0.008 mg/l. The results obtained in the reef ecosystem.

2.9.8 Phosphate

Phosphate is an important nutrient for coral reef growth and development. Phosphate nutrients can also be a limiting factor for the growth of coral reefs and other marine life, if the content in the water is in a less than optimal condition. Nybakken (2000) states that phosphate is an important organic substance as a limiting factor and is used by zooxanthellae to grow.

Analysis of physico-chemical parameters of water with the quality standards of Kepmen LH No. 51 of 2004 concerning Seawater Quality Standards for Marine Biota, which is presented in the following table:

Table 2. Seawater Quality Standards for Marine Biota

| **Parameter** | **Quality Standard** |
|---|---|
| Temperature | 28 - 30 $^{0}$C |
| brightness | >5 m |
| Salinity | 30 - 36 ‰ |
| pH | 7,0 - 8,5 |
| DO | >5 mg/l |
| Nitrate | 0.008 mg/l |
| Phosphate | 0.015 mg/l |

Based on the theoretical basis above, coral reef and reef fish identification is not only important for understanding biodiversity in marine ecosystems, but also as a first step in coral reef management and conservation. By understanding coral reef ecosystems, identification methods, and the challenges and opportunities that exist, we can develop effective strategies to preserve these marine resources for future generations.

**CHAPTE**
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The research method used was observation data collection and interviews with the local community and government. Coral reef data collection using the *Line Intercept Transect* (LIT) method based on English et al, (1997) and for reef fish data collection using the Underwater Visual Census (UVC) method (English et al., 1994).

## 3.1 Time and Place

### 3.1.1. Time

The period of implementation of the Marine Biota Monitoring Work (*Identification of Coral Reefs and Reef Fish*) at the 17 Island Marine Nature Park, Riung District, Ngada Regency, Prov. NTT is 6 (six) months or until December 2024.

The marine biota monitoring activity itself is estimated to require implementation time for 2 (two) calendar months, with the implementation schedule in the following table:

Table 3. Activity Schedule

| **Activity Stages** | **Implementation Time (Week-)** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| 1) Preparation | | | | | | | | |
| 2) Data collection & processing | | | | | | | | |
| 3) Analysis | | | | | | | | |
| 4) Reporting Preparation | | | | | | | | |
| 5) Exposure of research results | | | | | | | | |

### 3.1.2. Place

The monitoring of marine biota was carried out in the 17 Island Marine Nature Park, Riung District, Ngada Regency, East Nusa Tengara Province.

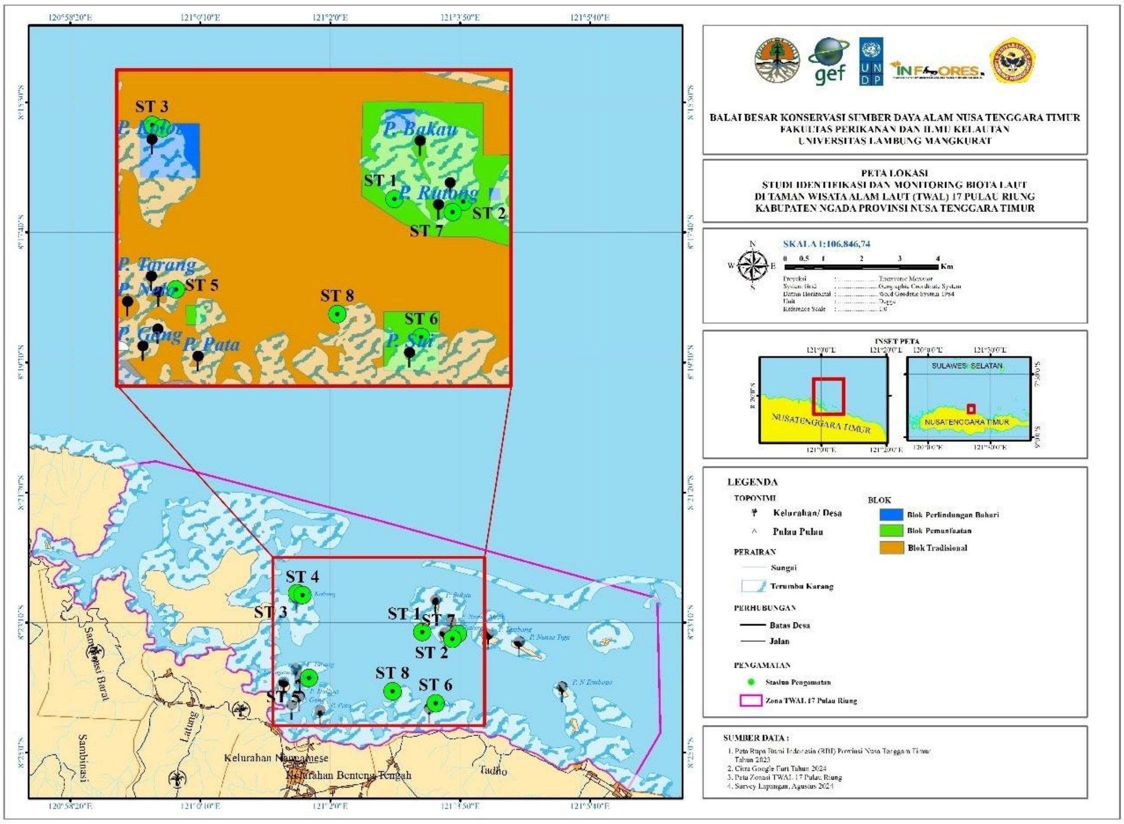



Figure 5. Location of Marine Biota Monitoring (*Identification of Coral Reefs and Reef Fish*) at 17 Island Marine Nature Park, Riung District, Ngada Regency, East Nusa Tenggara Province. East Nusa Tenggara.

### 3.2 Station Determination and Research Parameters

Determination of the research station point was carried out using *purposive sampling* technique. The technique is based on the consideration that the selected location can represent the waters of the marine waters of the TWAL 17 Island area which refers to the block arrangement. Data collection of coral and reef fish communities consisted of 8 stations determined purposively at each of which refers to the block arrangement map made by the NTT KSDA Center made in September 2015, namely 4 observation stations in the utilization block named ST 1, ST 2, ST 6 and ST 7, 2 stations in the marine protection block named ST 3 and ST 4 while the other 2 stations in the traditional block named ST 5 and ST 8. By marked using the help of GPS (*Global Position System*). Each station consists of 2 (two) transects, each transect measuring 50 meters or 1 transect with a length of 100 meters straight while for water quality parameters taken at these stations, Table. 4. Coordinates of research stations.

| Station Name | Coordinates | Description | Description of Block Arrangement |
|---|---|---|---|
| ST 1 | 08°23'18.90" S<br>121°03'18.14" E | Rutong Island | Utilization Block |
| ST 2 | 08°23'19.39" S<br>121°03'48.22 "E | Rutong Island | Utilization Block |
| ST 3 | 08° 22' 45,267" S<br>121°1' 32.123" E | Batang Kolong Island | Maritime Protection Block |
| ST 4 | 08° 22' 46,723" S<br>121° 1' 36.663" E | Batang Kolong Island | Marine Protection Block |
| ST 5 | 08° 23' 56,911" S<br>121° 1' 42.211" E | Lainjawa Island | Traditional Block |
| ST 6 | 08° 24' 18,306" S<br>121° 3' 29.516" E | Sui Island | Utilization Block |
| ST 7 | 08° 23' 23,839" S<br>121° 3' 43.590" E | Rutong Island | Utilization Block |
| ST 8 | 08° 24' 8,050" S<br>121° 2' 52.871" E | Sui Island | Traditional Block |

Research Parameters

In monitoring marine biota carried out in the TWAL 17 Island Area, Riung District, Ngada Regency, East Nusa Tengara Province, there are several parameters observed, namely bioecological aspects, physical aspects and chemical aspects which can be seen in the following table.

Table 5. Parameters that will be studied in the 17 Island TWAL Area, Riung District, Ngada Regency, East Nusa Tengara Province.

| **No.** | **Parameter** | **Description** |
|---|---|---|
| **Marine Life** | | Coral Reefs and Reef Fishes |
| Bioecological Aspects | | |
| 1 | Live coral cover | Coral Reef Assessment Criteria according to KEPMEN LH No. 4 Th. 2011 |
| 2 | Coral *lifeforms* | Coral reef data collection using the *Line Intercept Transect* (LIT) method based on English *et. al*., (1997) |
| *3* | Coral Fish | Fish data collection using the *Underwater Visual Census* (UVC) method (English *et al.*, 1994). |

| Water Quality Parameters | | Analysis of physico-chemical parameters of water according to the quality standards of Kepmen LH No. 51 of 2004 concerning Quality Standards for Seawater for Marine Biota |
|---|---|---|
| Physics aspect | | |
| 1 | Temperature | The optimum sea temperature for coral reef life is between 26-28$^{(0)}$ C, an increase or decrease in temperature for a relatively long time can result in death of coral animals |
| 2 | Water brightness | Brightness, measured in situ using a sechi disk >5 m. |
| 3 | Current velocity | Measured in situ using the Lagrange method. |
| Chemical Aspect | | |
| 1 | Salinity | Is the amount of natural salt (grams) contained in one liter of seawater, usually expressed as per mile (‰) or thousandth which indicates how many grams of mineral content are in every 1,000 grams of seawater. |
| 2 | pH | Referring to Kepmen LH No 51 of 2004, the best pH of seawater for marine biota is for marine biota including coral reefs is between 7-8.5. |
| 3 | DO | *Dissolve Oxygen* is the oxygen level in the water >5 mg/l. |

### 3.3 Tools and Materials

3.3.1. Tools

Table 6. Monitoring tools

| No. | Tool Name | Number | Usage |
|---|---|---|---|
| 1 | SCUBA | 6 sets | *Diving* aids |
| 2 | 50m meter | 2 bh | Used as a line transect |
| 3 | Underwater stationery | 2 pcs | Underwater writing media to record data |
| 4 | *Underwater* camera | 1 set | Recording media for activity documentation |
| 5 | *Secchi disk* | 1 bh | Tool to measure water brightness |
| 6 | Current kite | 1 piece | Tool for measuring current speed |
| 7 | *Portable* GPS | 1 piece | Tool used to mark the location |
| 8 | Boat | 1 bh | Transportation media in the field |
| 9 | Buoy | 1 bh | Tool for marking transect locations |
| 11 | Stopwatch | 1 piece | Time measurement tools |
| 12 | *Refractometer* | 1 bh | Tool to measure salinity |
| 13 | *DO Meter* | 1 piece | Tool to measure oxygen dissolved in water |
| 14 | Professional Digital Water Quality Testing Pen | 1 bh | Tool for measuring water temperature and pH |

3.2.1. Materials

Table 7. Materials for monitoring

| No. | Material Name | Quantity | Usage |
|---|---|---|---|
| 1 | Tissue | 1 roll | To erase writing on note paper |
| 2 | Toothpaste | 1 pack | To erase writing on note paper |
| 3 | Raffia rope | 1 roll | Media for fastening the buoy |

## 3.4 Retrieval Method Data

3.4.1. Coral Community Data

Coral reef data were collected using the *Line Intercept Transect* (LIT) method based on English *et. al*., (1997). The LIT method is a method used to estimate coral cover and cover of benthic communities that live with corals. This method is quite practical, fast and very suitable for coral reef areas in the tropics. Information that can be obtained using this method is the percentage cover of benthic communities such as hard corals, soft corals, algae, rocks, dead corals and sponges. Medium to detailed information can be obtained from *lifeforms* to the level of family, genus and species depending on the purpose and expertise of the observer (Yusri, 2011).

The advantages of this LIT method are:

1. *Lifeform* categories allow useful information to be obtained by observers with limited knowledge in coral reef benthic community identification.
2. Quantitative data so it is more accurate
3. An easy and efficient data sampling method to obtain quantitative percent cover.
4. Can provide detailed information on spatial patterns.
5. If repeatable at desired times, provides information on temporal changes.
6. Can obtain coral colony size, which is an indicator of community stability.
7. Requires minimal equipment and is relatively simple.
8. Can measure relative density
9. Can be combined with similar techniques, such as belt and video transects and fish censuses.
10. Information on colony size can be obtained.

Table 8. *Lifeform* categories and codes for the LIT method (English *et. al.,* 1998)

| ***Lifeform*** | | **Code** |
|---|---|---|
| Hard Coral (Acropora) | Digitate | ACD |
| | Branching | ACB |
| | Tabulate | ACT |
| | Encrusting | ACE |
| | Sub Massive | ACS |
| Hard Coral (Non Acropora) | Branching | CB |
| | Massive | CM |
| | Encrusting | CE |
| | Sub Massive | CS |
| | Foliose | CF |
| | Mushroom | CMR |
| | Meliopora | CME |
| | Heliopora | CHL |
| Dead Scleractinia | Dead coral | DC |
| | DC with algae | DCA |
| Algae | Macro | MA |
| | Turf | TA |
| | Corralline | CA |
| | Halimidae | HA |
| | Algae Assemblage | AA |
| Other Fauna | Soft Coral | SC |
| | Spoonge | SP |
| | Zoanthids | ZO |
| | Others | OT |
| Abiotic | Sand | S |
| | Rubble | R |
| | Silt | SI |
| | Water | WA |
| | Rock | RCK |

Working Procedure

The working procedure for using the LIT method is as follows:

1. Select a location that is representative of the coral community on a reef, which can be determined by observing from a boat or using *snorkeling* or *diving* techniques.
2. Set a marker (buoy) at the starting point of the transect installation, then stretch the transect line as close as possible to the substrate for 50 meters.
3. Place a marker (buoy) at the end of the transect.
4. Return to the starting point of the line transect, then move slowly along the transect while recording the growth forms found directly below the transect line (Figure 4).

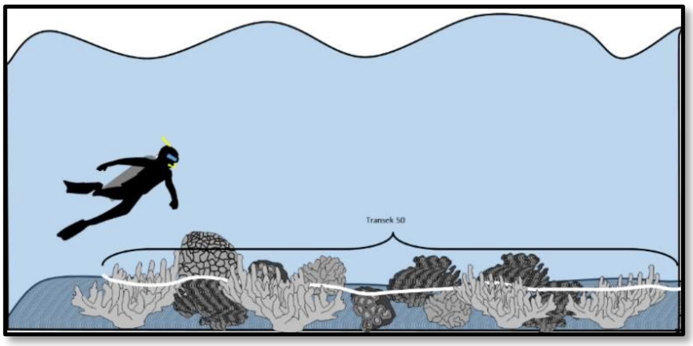



Figure 6. Process of observing coral reefs in the water (referring to English *et. al*., 1997).

5. Record transition sites (changes) in centimeters where there are different growth forms, organisms and substrate changes.

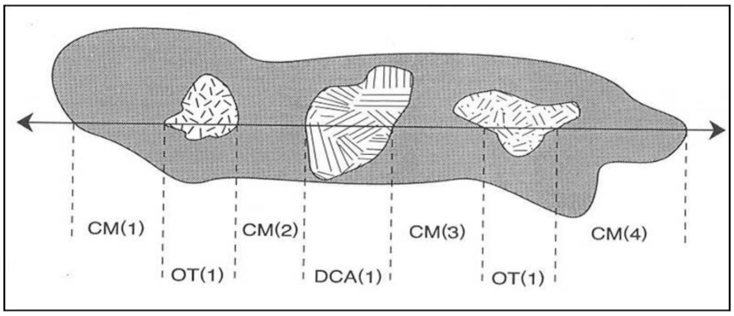



Diagram showing a transect passing a single colony more than once (English *et al.,* 1997).

6. For greater accuracy, observers should record all changes when a line transect *intercepts* a single *lifeform* or colony more than once.

### 3.4.2. Reef Fish Data

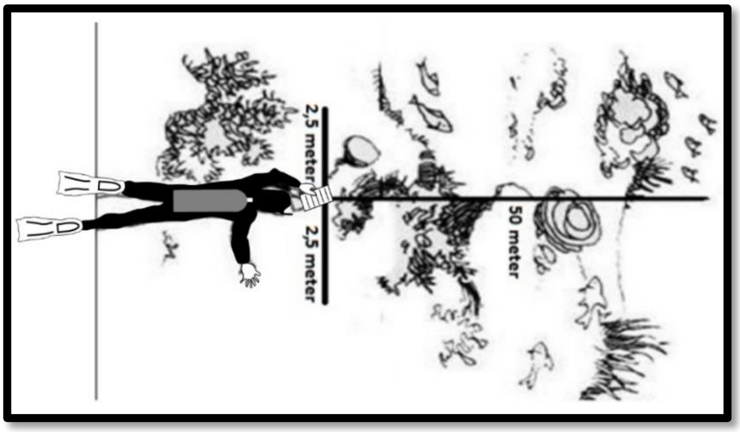
Reef fish data were collected using the *Underwater Visual Census* (UVC) method (English *et al.*, 1994). Fish observations were made by swimming slowly using SCUBA equipment around the research object, namely artificial reefs while identifying the presence of fish in the vicinity. After reaching the object of research, researchers stopped *diving* for 10-15 minutes to attract fish attention or to restore reef fish that were disturbed by their own movement activities. This observation used a visual census method along 50 m which was carried out simultaneously with coral measurements. The limit of fish data observation is 2.5 meters to the left and right so that the observation area obtained at each station is 250 $m^2$. Reef fish data were identified to species level based on Kuiter (1992), Allen (2000), Allen *et al*. (2003) and Allen & Erdmann (2012). Furthermore, the identified species were grouped into major species, target species and indicator species according to English *et al*. (1994).

Working Procedure

Reef fish data collection was conducted simultaneously with coral data collection using the same line transect. Reef fish observers moved in front of coral observers. This is done because reef fish are always moving while corals are sessile animals. Work procedures in the visual census method according to Sumadhiharga (2006):

1. Observers move from the starting point of the line transect installed.
2. Wait approximately 5 minutes at the starting point after the transect line is installed 100 meters. This is intended to get an overview of reef fish in the observation location.
3. Fish species that are visible with a visibility of 2.5 m. from the limit of this distance can be recorded on the board, reef fish species that cannot be identified directly by the researcher are written on the board or by photographing and recording observations using an underwater camera that has been set on video mode, and then the results are identified using the identification key book from Kuiter (1992), Allen (2000), and Allen & Erdmann (2012).
4. For target fish and indicator fish, counts were quantitative, while for other fish (major groups) in schools, counts were semi-quantitative.
5. Do not count fish that enter the census area that has been passed (looking backwards).

Reef Fish Data Collection Technique




3.4.3. Temperature and pH Data

Temperature and pH are measured with the same tool so that the data is obtained at once, namely using a water quality cheker tool, how to collect data before using the tool has been calibrated first. Temperature and pH are measured above the surface of the waters of each predetermined station. Insert the tool into the surface of the water and record the data of each parameter read on the screen.

### 3.4.4. Water Brightness Data

Data collection of water brightness is done on the surface. The following are the stages of measuring water brightness:

1. Dip the *secchi disk* into the water slowly until the black and white plates are not visible then record how deep the *secchi disk* slab enters the water (H1).
2. Try not to shake too much so that the *secchi disk* remains flat.
3. Lift the *secchi disk* slowly until the black and white slab is visible then record how deep the *secchi disk* slab enters the water (H2).

### 3.4.5. Current Velocity Data

Current speed is measured using a current kite. The following are the stages in measuring current velocity:

1. Dip the current kite into the water.
2. Turn on the timer shortly after the current kite into the water.
3. Observe the current kite until it reaches the maximum rope length limit (5 meters).
4. After reaching the maximum limit, stop the timer and record the time.

### 3.4.6. Salinity Data

Salinity, is the amount of natural salt (grams) contained in one liter of seawater, usually expressed as per mile (‰) or thousandth which indicates how many grams of mineral content in every 1,000 grams of seawater. Salinity is measured using a refractometer. The sample water is dripped onto the refractometer, then the tool is directed towards the direct sun, the blue and white fields will appear, the boundary line between the two fields is what shows the salinity level. Record the salinity value.

### 3.4.7. *Dissolve Oxygen* (DO) Data

*Dissolve Oxygen* is the level of oxygen in the water. The dissolved oxygen comes from the atmosphere directly which can then be utilized by aquatic biota. DO is also a benchmark for determining whether or not a water body is good. The greater the DO value contained, the better the water quality.
How to Use DO Meter:

How to use the DO Meter is very easy, namely dip the pen on the DO meter into the water, then automatically the dissolved oxygen value will be seen on the DO meter monitor.

## 3.5 Data Analysis

3.5.1. Coral Reef Data Analysis

The percentage cover of live corals, dead corals and other types of *lifeforms* is calculated using the formula (English *et. al.,* 1997):

$$C = \frac{\alpha}{A} \times 100\%$$

Description:

- C = Percentage cover of *lifeform i*
- α = Transect length of *lifeform i*
- A = Total transect length

Coral reef ecosystem assessment criteria.

| PARAMETERS | STANDARD CRITERIA FOR CORAL REEF DAMAGE (in %) | | |
|---|---|---|---|
| Percentage of Coral Reef Cover Area Living | Poor | Damaged | 0 - 24,9 |
| | | Medium | 25 - 49,9 |
| | Good | Good | 50 - 74,9 |
| | | Very good | 75 - 100 |

Kepmen LH No. 4 of 2001

3.5.2. Reef Fish Community Analysis

Diversity Index (H')

$$H' = \sum_{i=1}^{s} pi \ln pi$$

Where : H'= diversity index.
s= number of reef fish species.
p= proportion of the number of individuals in reef fish species.

The diversity index was calculated with criteria according to Brower & Zar (1977):

**a. H'**$\leq$ 2.30 : little diversity, very strong environmental pressure.
**b.** 2.30< H'$\leq$ 3.30 : moderate diversity, moderate environmental pressure
**c. H'**> 3,30 : high diversity, ecosystem balance occurs Diversity Index

(E)

$$E = \frac{H'}{Hmax}$$

Where:
E = uniformity index
Hmax = species balance in maximum equilibrium= ln s

The index value ranges from 0 - 1 with criteria (Brower & Zar, 1977):

- $E \leq 0.4$ : small uniformity, stressed community
- $0.4 < E \leq 0.6$ : moderate uniformity, labile community
- $E > 0.6$ : high uniformity, stable community

Dominance Index C'

$$C = \sum_{i=1}^{s} pi^2$$

Description:

C = dominance index
Pi = proportion of individuals in reef fish species s =
number of reef fish species

According to Odum (1993) the dominance index value ranges from 0-1 with the criteria if the dominance index is close to zero, it means that no species **dominates** the station or is in a stable state, if the **dominance index** is close to 1 then there are species that dominate the station or unstable state.

Coral Fish Abundance

Coral fish abundance was calculated using the equation below (English *et al.*, 1994), 1994):

$$N = \frac{ni}{A}$$

Where:
*N* is the abundance of fish (ind/m) *ni*
is the number of the Ith individual;
and *A* is the area ($m^2$)

3.5.3. Data Analysis of Water Brightness

Brightness measurements obtained using a secchi disk (in units of meters) are processed to obtain the percentage value (%) of water brightness with the equation;

$$I = \frac{\left(\frac{(H_1+H_2)}{2}\right)}{H_{tot}} \times 100\%$$

Description:

- I = water brightness (%)
- $H_1$ = *secchi disk* depth to invisibility (m)
- $H_2$ = *secchi disk* depth when visible (m) $H_{tot}$ = total depth of water (m)

3.5.4. Analysis of Current Velocity Data

To determine the value of the current velocity at each station used the following equation following:

$$V = \frac{L}{p}$$

Description:

- V = current velocity (m/s)
- L = length of rope stretched (m)
  p= time taken for the rope to unfold (m) Table 10.

Tabulation of water quality parameters.

| Station | Time | Parameter | | | | | |
|---|---|---|---|---|---|---|---|
| | | Physical Factors | | | Chemical Factor | | |
| | | Temperature | Brightness | Current | Salinity | pH | DO |
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| Kepmen LH No 51 Thn 2004 | | 28 -30 °C | > 5 m | | 33 - 34 ‰ | 7 - 8,5 | > 5 mg/l |

## 3.6 Analysis Method Imagery

3.6.1 Lansat-8 Image Data Processing

Image data processing is done with several software, namely Arcgis 10.8, ENVI 5.6, ER Mapper 7.1, while the image used is Lansat-8 image, Envi software is used to perform radiometric processing, Er Mapper 7.1 software is used to process map data using the Lyzenga transformation and for Arcgis 10.8 software is used for map classification and layouting.

3.6.2 Radiometric - Atmospheric Correction

The first data *pre-processing* on Lansat-8 imagery for coral reef information extraction includes radiometric correction. Radiometric correction is an important step in satellite image processing to remove the effects of atmosphere, sensor, and lighting conditions that affect the pixel values in the image. The method used in this correction is empirical. Empirical correction is a radiometric correction method used to remove or reduce the influence of the atmosphere in satellite images based on information or assumptions taken directly from the image itself, without using complex physics models.

using complex physical models. This method is often used because of its simplicity and can be applied to various types of imagery, especially when atmospheric data or information is not available.

### 3.6.3 Band Compositing and Image *Cropping*

Band compositing is the process of combining multiple spectral bands into a single color image. Satellite images usually have multiple bands that capture data at different wavelengths (such as red, green, blue, infrared, etc.), and combining these bands can aid in the visualization and analysis of certain features on the Earth's surface. The Band Composite of Lansat-8 uses a *tru color composite* of RGB 4-3-2 (Red, green and blue).

### 3.6.4 Lyzenga Transformation

Image analysis using the *Lyzenga* logarithm classification method using the *Dept Invariant Index* (DII), in its processing is intended to obtain better underwater object information. There are several kinds of factors that affect the quality of the reflected value of underwater objects such as current, turbidity and water level movement. The bands used are blue, green and red.

The *Lyzenga* logarithm used is the formula in the following equation:

$$Y = In\ (Li) - \left(\left(\frac{ki}{kj}\right)\right) In(Lj)$$

$$\frac{ki}{kj} = a + \sqrt{a^2 + 1}$$

$$a = \frac{aii}{2\sigma ij}$$

Where:

| | |
|---|---|
| Li & Lj | = Digital value at jth banf & jth band |
| Ki/Kj | = Ratio of attenuation coefficients in the pair of band i and j |
| $\sigma ii$ | = Band i variant |
| $\sigma jj$ | = Band J Variance |
| $\sigma ij$ | = Band ij covariance |

Lyznga transformation is used to separate the area between the sea and the aquatic ecosystem with the aim of clarifying other objects around shallow water for easy classification. The Lyznga formula begins with region separation to obtain the ki/kj value where the region separation (*training area*) is used to separate the water pool and *the region* separation represents one type of color (object).

### 3.6.5 Image Classification

After the lyznga transformation process, Unsupervised ISOCLASS is carried out which is carried out with ErMapper 7.1 software with the object classification method. The results of Unsupervised ISOCLASS are colored and the next process is *reclass* and *editing*. Image classification to minimize the class of objects / ecosystems found in the waters in order to easily determine the object to be observed by the color differences of objects or ecosystems that are managed such as coral reefs, seagrass / algae, coral fragments, sea and sand.

# CHAPTER IV

# DISCUSSION

The Seventeen Islands Marine Nature Park (TWAL) is administratively included in the Riung sub-district of Ngada Regency which includes 6 coastal villages, namely: Lengkosambi, Tadho, Latung, Sambinasi, East Lengkosambi and West Lengkosambi villages and 2 villages, namely Benteng Tengah and Nangamese. Administratively, the management is in the Riung resort, Region III Conservation Section, Region II Ruteng Division at the NTT KSDA Center. TWAL 17 Islands in Riung Sub-district, Ngada Regency, which is located on the north coast of Flores Island, also offers marine tourism that can spoil the eyes with a cluster of small islands and white sandy beaches. Not only marine tourism, TWAL 17 Island is also part of the world's coral triangle, turquoise sea water combined with white sand beaches, and mangrove beds are interrelated so as to support life, especially the underwater world.

## 4.1 Water Condition in TWAL 17 Island

In the monitoring of marine biota carried out in the TWAL 17 Island Area, Riung District, Ngada Regency, East Nusa Tengara Province, there were several parameters observed in addition to the bioecological aspects, namely the physical aspects and chemical aspects of the waters.

### 4.1.1 Bioecological Aspects

Bioecological aspects of coral reef ecosystems include complex interactions between biodiversity, symbiosis, food chains, nutrient cycling, organism adaptation, and population dynamics. A balance in all these aspects is essential to maintain the viability of species-rich coral reef ecosystems. However, pressures from human activities and global environmental change threaten these ecosystems, so proper conservation and environmental management efforts are urgently needed to protect coral reefs.

### 4.1.2 Coral Reef Community Structure.

Based on the analysis of Lansat-8 images extracted from Lyzenga and Unsupervised logarithm analysis using ArcGIS 10 software, TWAL 17 Island has a *reef* cover of 396,794 Ha or 49.52%, Algae / Seagrass of 140,337 Ha or 17.51%, Rubble 116,938 Ha or 14.59%, while *Sand* is 147,215 Ha or 18.37% with a total area of 801,284 Ha.

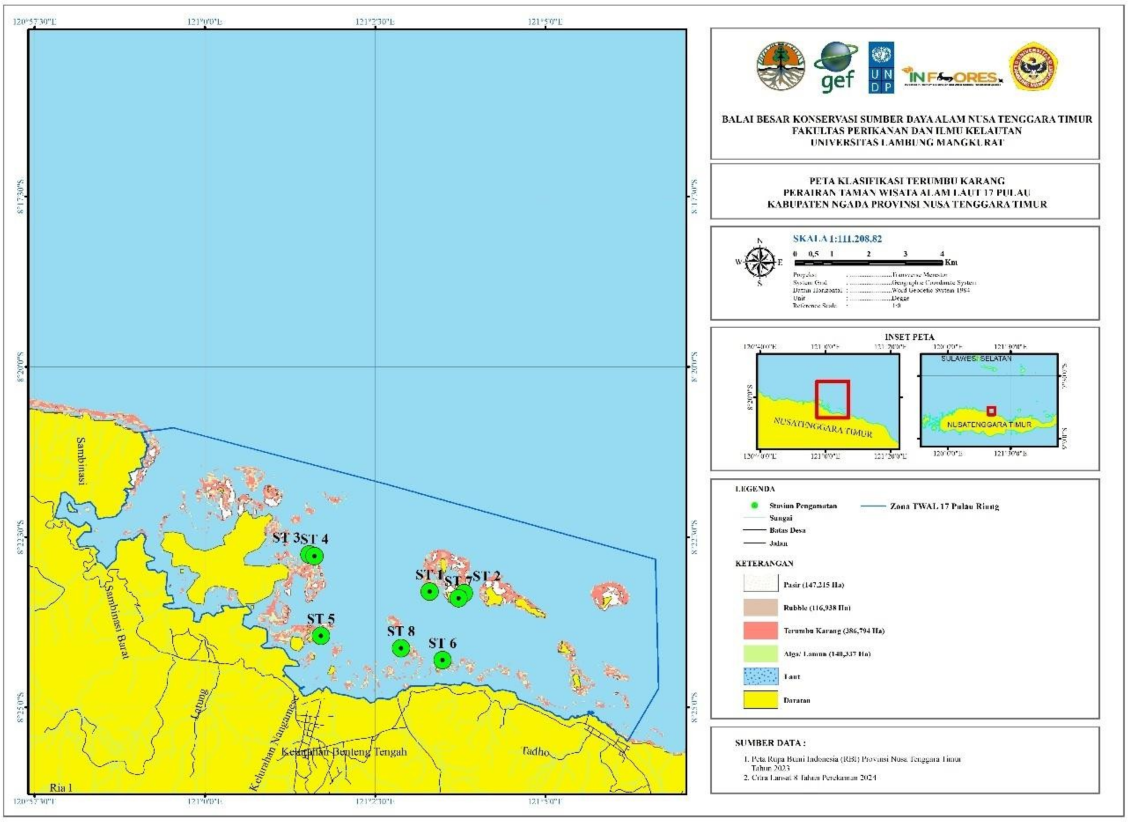



Figure 9: Coral Reef Classification Map from Lansat-8 Image analysis extracted from Lyzenga logarithm and Unsupervised analysis using ArcGIS 10 Software.

From the results of the research that has been done shows that there are 20 forms of *life form* which consists of 4 forms of *Acropora* coral *lifeform* at the research site, namely: *AcroporaI Coral Digitate* (ACD), *AcroporaI Coral branching* (ACB) and *Acropora Coral Tabulate* (ACT), *Acropora Coral Encrusting* (ACE) and 6 *Non-Acropora* forms namely *Coral branching* (CB), *Coral massive* (CM), Coral *encrusting (*CE), *Coral foliose* (CF), *Coral Mushroom* (CMR), *Coral Heliopora* (CHL), 1 form of Dead Scleractinia namely DC *with algae* (DCA), 3 forms of Algae namely *Macro Algae* (MA) and *Corralline Algae* (CA), *Halimidae Algae* (HA), 4 forms of Other Fauna namely; *Soft Coral* (SC), *Spoonge* (SP), *Zoanthids* (ZO) and Others (OT) while for Abioic there are 2 forms namely: *Sand* (S), *Rubble* (R).

*Lifeform AcroporaI Coral Digitate* (ACD) is only found at observation station 4 and observation station 8 (ST 4 and ST 8), while *AcroporaI Coral Branching* (ACB) almost all observation stations have this *Lifeform* except at Observation Station 8 (ST 8) while *Acropora Tabulate* (ACT) is found at all stations except at observation station 5 and observation station 7 (ST 5 and ST 7), this is because this form of *AcroporaI Coral Branching* (ACB) grows faster than the others. According to the results of growth rate measurements in Khasanah's research (2020), Acropora formosa has the highest growth rate of 1,958 cm / month. Acropora intermedia 1.730 cm / month, Acropora pulchra 0.958 cm / month, and 0.756 cm / month. / month, and 0.756 cm / month for Acropora gomezi. Meanwhile, according to Suharsono 2017, the growth of branching corals such as Acropora has a growth rate of between 10-15 cm per year.

year. While massive corals generally grow very slowly, which is about 0.8-1.0 cm per year.

The overall condition of coral reefs based on *lifeforms* in the waters of TWAL 17 Islands in Riung District, Ngada Regency, East Nusa Tenggara Province is presented in Table 15 below:

Table 11: Coral Reef Condition of Each Research Station.

| **Category** | | **ST 1** | **ST 2** | **ST 3** | **ST 4** | **ST 5** | **ST 6** | **ST 7** | **ST 8** |
|---|---|---|---|---|---|---|---|---|---|
| **Hard Coral (Acropora)** | Digitate | - | X | - | - | - | - | - | X |
| | Branching | X | X | X | X | X | X | X | - |
| | Tabulate | X | X | X | X | - | X | - | X |
| | Encrusting | - | - | X | - | - | - | - | - |
| | Sub Massive | - | - | - | - | - | - | - | - |
| **Hard Coral (Non Acropora)** | Branching | X | X | X | X | X | X | X | X |
| | Massive | X | X | X | X | X | X | X | X |
| | Encrusting | X | X | X | X | X | X | X | - |
| | Sub Massive | - | - | - | - | - | - | - | - |
| | Foliose | X | X | - | - | X | X | X | X |
| | Mushroom | X | X | X | X | X | X | X | X |
| | Meliopora | - | - | - | - | - | - | - | - |
| | Heliopora | X | X | X | X | - | - | X | - |
| **Dead Scleractinia** | Dead coral | - | - | - | - | - | - | - | - |
| | DC with algae | X | X | X | X | X | X | X | X |
| **Algae** | Macros | X | - | - | - | - | - | - | X |
| | Turf | - | - | - | - | - | - | - | - |
| | Corralline | - | X | X | X | - | - | - | - |
| | Halimidae | X | - | - | X | - | - | - | - |
| | Algal Assemblage | - | - | - | - | - | - | - | - |
| **Other Fauna** | Soft Coral | X | X | X | X | X | X | X | X |
| | Spoonge | - | - | - | - | X | X | X | - |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Zoanthids | - | X | - | - | X | X | X | - |
| | Others | X | X | X | X | X | X | X | X |
| **Abiotic** | Sand | X | X | X | X | X | X | X | - |
| | Rubble | X | X | X | X | X | X | X | X |
| | Silt | - | - | - | - | - | - | - | - |
| | Water | - | - | - | - | - | - | - | - |
| | Rock | - | - | - | - | - | - | - | - |

The percentage of coral cover in the research location based on *lifeforms* at each station on each transect is presented in Figure 10 below:

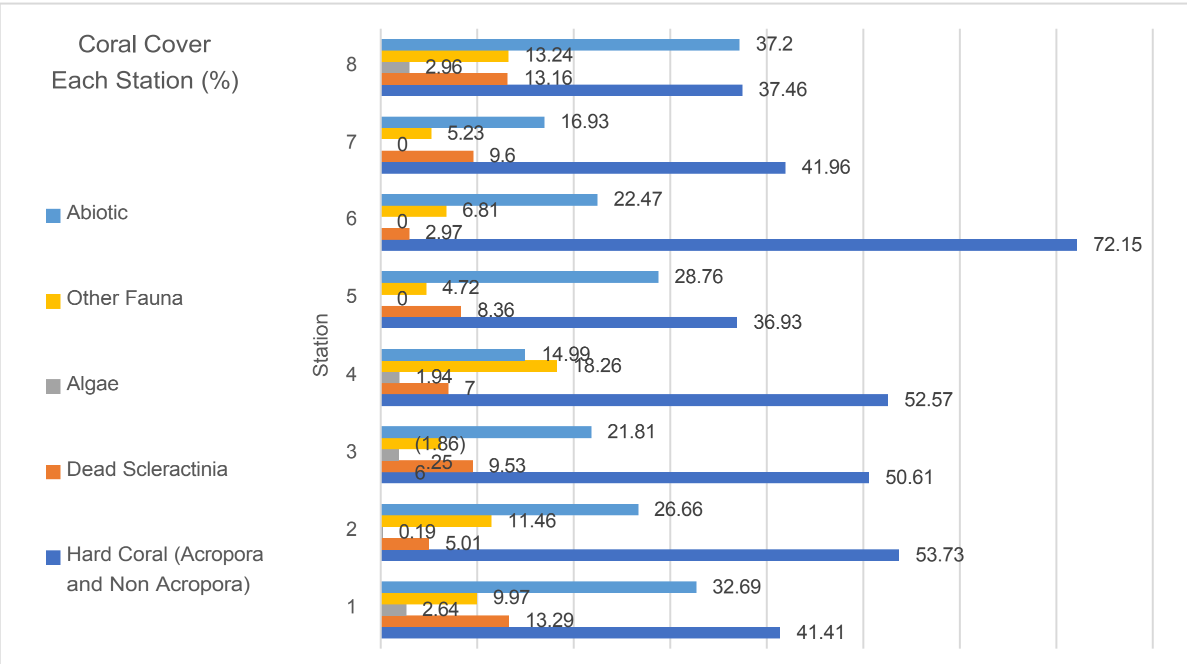



Figure 10: Percentage of Coral Cover by *Lifeform* in the Waters of TWAL 17 Island Riung Sub-district, Ngada Regency, East Nusa Tenggara Province.

Meanwhile, the distribution of coral cover by *lifeform* can be seen in Figure 11 below:

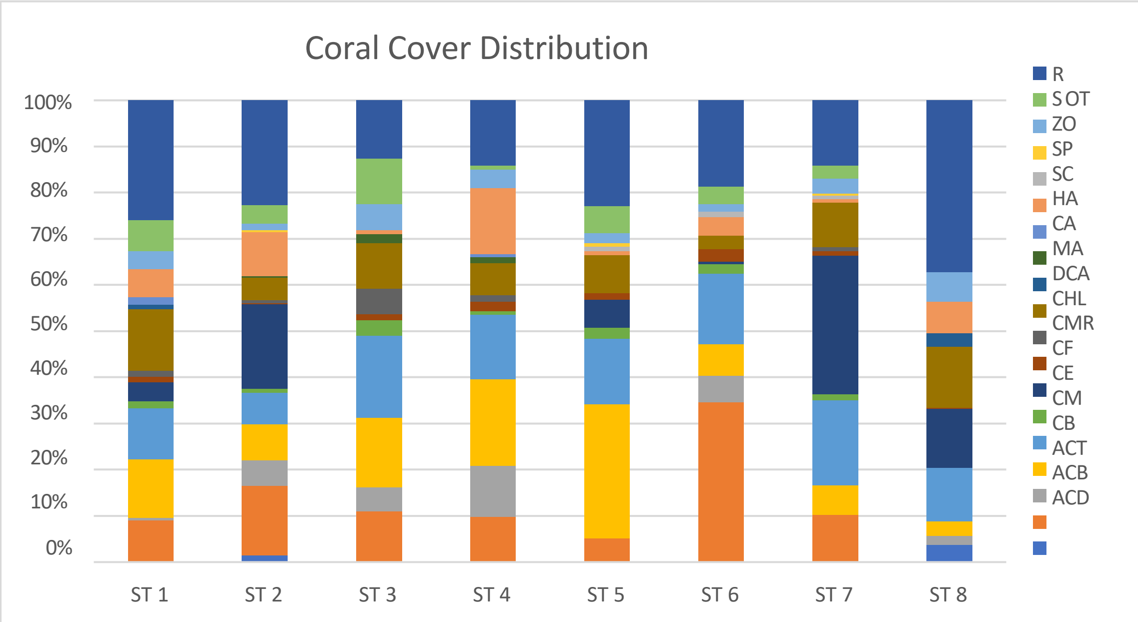



Figure 11. Distribution of Coral Cover in the Waters of TWAL 17 Island Riung District, Ngada Regency, East Nusa Tenggara Province.

Based on the results of the coral cover category in the research location based on the Decree of the Minister of Environment No. 4 of 2001 that the condition of coral reefs around the waters of Halang Malingkau Island ranges from damaged to good which is presented in Table 16 below.

Coral Cover (%) based on Kepmen LH No. 4 of 2001.

| **Observations** | **ST 1** | **ST 2** | **ST 3** | **ST 4** | **ST 5** | **ST 6** | **ST 7** | **ST 8** |
|---|---|---|---|---|---|---|---|---|
| Tupan<br>Live Corals (%) | 41.41 | 56.68 | 60.55 | 57.81 | 58.16 | 67.75 | 68.24 | 33.44 |
| Category based on Kepmen LH No 4 Year 2001 | Medium | Good | Good | Good | Good | Good | Good | Medium |

The lowest percentage of live coral cover is found at station 8, which is only 33.44% with a moderate category, while the highest at station 7 is 68.24% with a good category. For a complete percentage of live coral cover is presented in Figure 12 below.

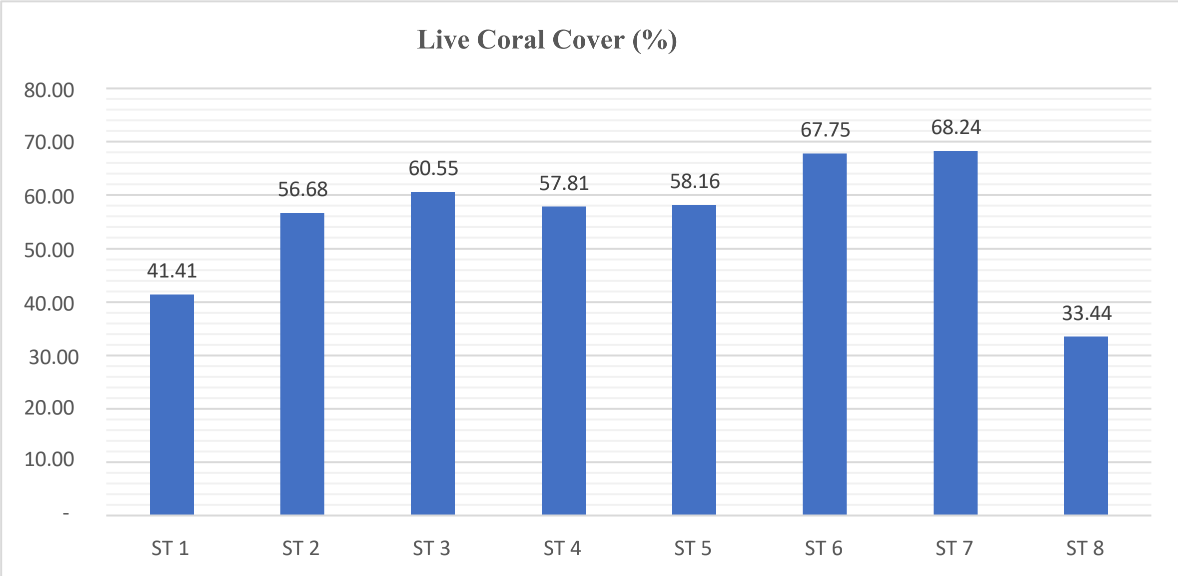
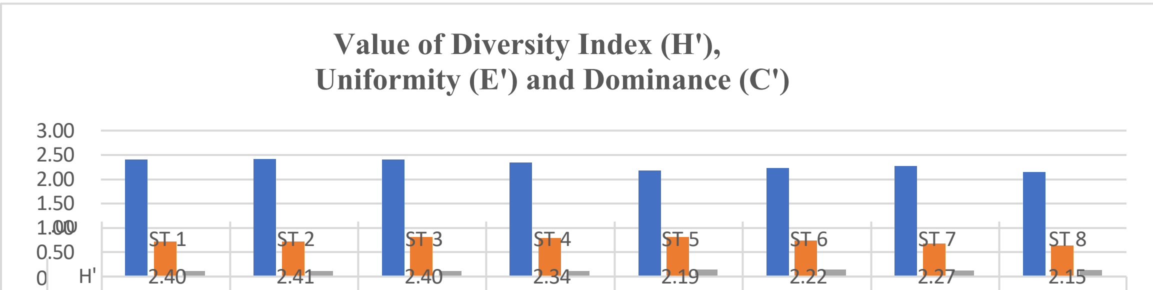



Figure 12: Live Coral Cover (%) at Each Station in the Waters of TWAL 17 Island Riung Sub-district, Ngada Regency, East Nusa Tenggara Province.

Based on the results of the analysis of the value of the diversity index at all stations shows that the highest diversity is found at station 2 with a value of 2.41, so what if 2.30 < H'≤ 3.30 then the research site has moderate diversity, moderate environmental pressure. The value of the uniformity index (E') shows that there is no value smaller than 0.6 or all locations have a uniformity value (E') > 0.6 so that the research location shows that the uniformity is high uniformity, stable community, while the dominance index (C') value ranges from 0.11 to 0.14, because there is no value close to 1, it means that there is no tendency for one individual to dominate the others.

The results of the calculation of the Diversity index (H') and Uniformity index (E), and Dominance (C') of coral reefs in each transect at each station in the research location are presented in Figure 17 below.




| | ST 1 | ST 2 | ST 3 | ST 4 | ST 5 | ST 6 | ST 7 | ST 8 |
|---|---|---|---|---|---|---|---|---|
| H' | 2.40 | 2.41 | 2.40 | 2.34 | 2.19 | 2.22 | 2.27 | 2.15 |
| E | 0.71 | 0.72 | 0.81 | 0.79 | 0.81 | 0.73 | 0.67 | 0.64 |
| C | 0.11 | 0.11 | 0.11 | 0.11 | 0.14 | 0.14 | 0.12 | 0.14 |

Diversity (H'), Uniformity (E') and Dominance (C') Index Values of Coral Reefs in the Waters of TWAL 17 Island Riung District, Ngada Regency, East Nusa Tenggara Province.

4.1.3 Coral Fish Community Structure.

Reef fish are one of the groups of animals associated with coral reefs, their presence is striking and found in various micro-habitats on coral reefs. Reef fish live and feed in the coral reef area (*sedentary*), so that if the coral reef is damaged or destroyed, reef fish will also lose their habitat (Rani *et al*., 2010). According to Munasik *et al*. (2011) coral communities in South Kalimantan are unstable and depressed because they are influenced by land *run off* from the Barito River.

Based on the results of the study in general, the number of reef fish species recorded was 96 species from 18 families spread across 8 observation stations. The largest fish composition was from the Pomacentridae (14 species) and Labridae (14 species) families, while Lutjanidae (13 species), Chaetodonthidae (12 species), Scaridae (6 species), Haemulidae (6 species), Serranidae (6 Species), Caesionidae (5 Species), Pomacanthidae (4 Species), Achanturidae (4 Species), Nemipteridae (4 Species), Holocentridae ( 2 Species) and Pseudochromidae (1 Species), Platacidae ( 1 S p e c i e s ), Antennaridae (1 Species), Mullidae (1 Species), Muraenidae (1 Species) and Plotosidae (1 Species).

The results of this study indicate that the tribes Pomacentridae and Labridae ranks top in terms of the number of species (biodiversity) of 14 species, while the lowest is Pseudochromidae, Platacidae, Antennaridae, Mullidae, Muraenidae and Plotosidae each 1 species. While the highest individual abundance is also in the fish tribe Pomacentridae as much as 10930 while Labridae is 2570 and the lowest is the fish tribe Muraenidae with the species Gimnothorax meleagris as much as 6 individuals found in ST 3, ST4 and ST 7. The type and number of species and the number of reef fish individuals can be seen in Table 17 below.

Table 13. Families, species and number of reef fish.

| Family Name and Fish Species | Number of Species | Abundance |
|---|---|---|
| **MAYOR** | | |
| Pomacentridae | 14 | 10930 |
| Labridae | 14 | 2570 |
| Pomacanthidae | 4 | 647 |
| Pseudochromidae | 1 | 296 |
| Platacidae | 1 | 80 |
| Scaridae | 6 | 912 |
| **TARGET** | | |
| Achanturidae | 4 | 114 |
| Antennaridae | 1 | 42 |
| Caesionidae | 5 | 1650 |
| Haemulidae | 6 | 1100 |

| | | |
|---|---|---|
| Holocentridae | 2 | 524 |
| Lutjanidae | 13 | 2760 |
| Mullidae | 1 | 110 |
| Muraenidae | 1 | 6 |
| Nemipteridae | 4 | 652 |
| Plotosidae | 1 | 318 |
| Serranidae | 6 | 824 |
| **INDICATOR** | | |
| Chaetodonthidae | 12 | 1370 |
| Total | 96 | 24905 |

Based on abundance data per station, it is known that ST 7 has the highest abundance compared to other stations, namely 10.04 Ind/$m^2$while the lowest is found at ST 8, namely
3.82 Ind/$m^2$. While at stations 1, 2, 3, 4, 5 and 6 respectively 7.47 ind/$m^{2,}$, 6.03 ind/$m^{(2)}$, 5.94 ind/$m^2$, 5.85 ind/$m^{(2)}$ ,5.52 ind/$m^2$, and 5.14 ind/$m^{(2)}$. The abundance of reef fish at each station during the observation in the TWAL 17 Island Watershed of Riung Subdistrict, Ngada Regency, East Nusa Tenggara Province can be seen in Figure 18 below;

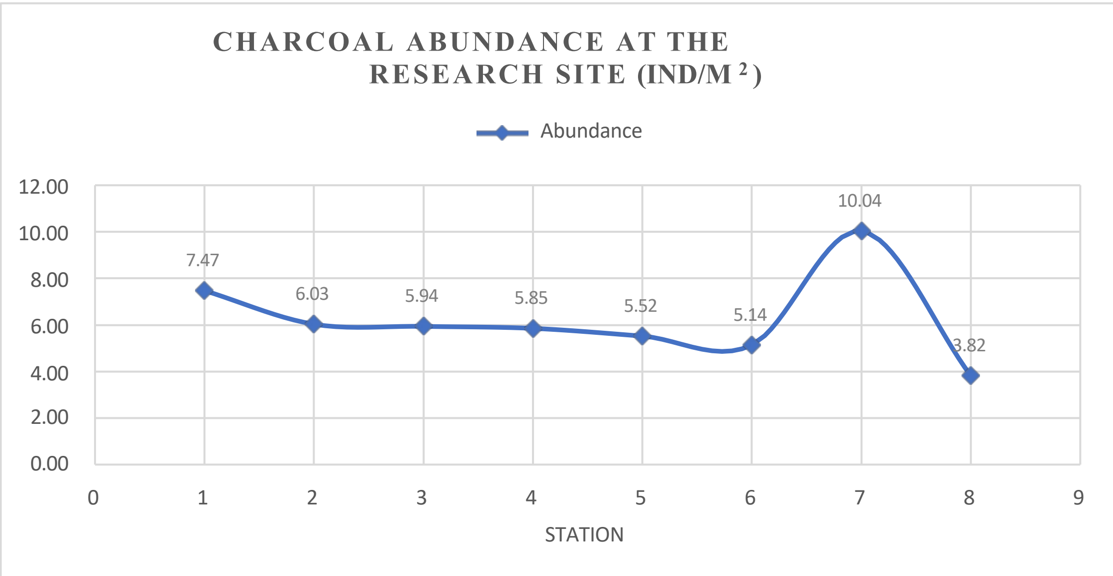



Figure 14. Reef fish abundance at each station (Ind/$m^2$) in the TWAL 17 Island Watershed, Riung Subdistrict, Ngada Regency, East Nusa Tenggara Province.

Observations showed that there were different numbers of fish at all stations in the categories of major fish, target fish, and indicator fish. The major fish category had the highest number at station 7, which amounted to 3055 individuals followed by station 1 with 2417 individuals and the lowest number was at station 8 with 1175 individuals. The same results are shown in the target fish category with the highest number found at station 7 amounting to 1684 individuals and followed by station 1 amounting to 1127 individuals, while the lowest number is found at station 8 with the number of fish amounting to 1175 individuals.

640 individuals. The indicator fish category showed the highest number at station 7 with 280 individuals and followed by station 1 with 193 individuals, while the lowest number was at station 8 with 96 individuals. Station 7 which shows the highest results both the total number and the number of each category of fish is thought to be due to the environment, especially coral cover that is more supportive than other stations, one of which is coral cover which is a habitat for fish (Syms and Jones, 2000). This is in line with the presence at ST 7 on coral cover which is 68.24% with a good category.

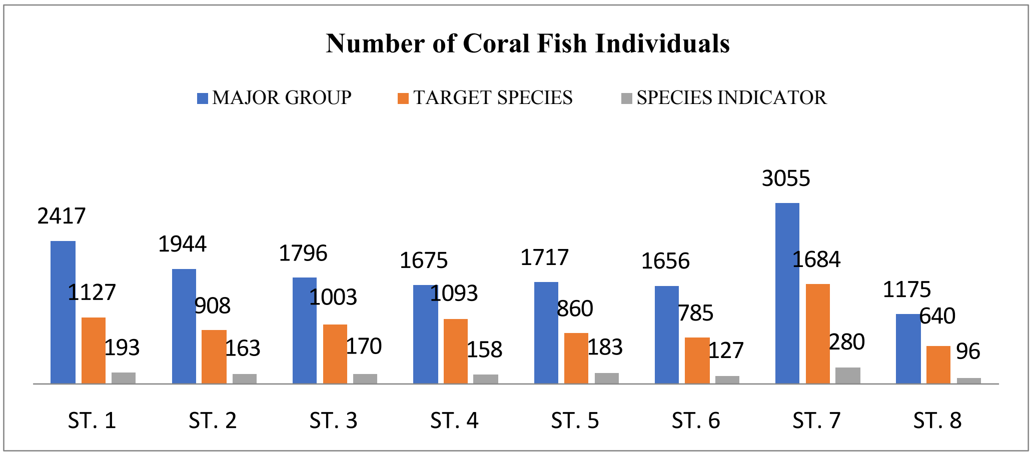



Figure 15. Number of Coral Fish Individuals at Each Station in the TWAL 17 Island Waters Area, Riung District, Ngada Regency, East Nusa Tenggara Province.

Variation in the number of reef fish species in each station with the highest number of species found at station 7 both in the category of major fish (40 species), target fish (43 species), or indicator fish (12 species). This is directly proportional to the number of individuals found at station 7. While station 8 has the lowest number of species compared to other stations. In the category of major fish (35 species), target fish (35 species) and indicator fish (12 species) which all stations have the same number but the abundance of individuals is different.

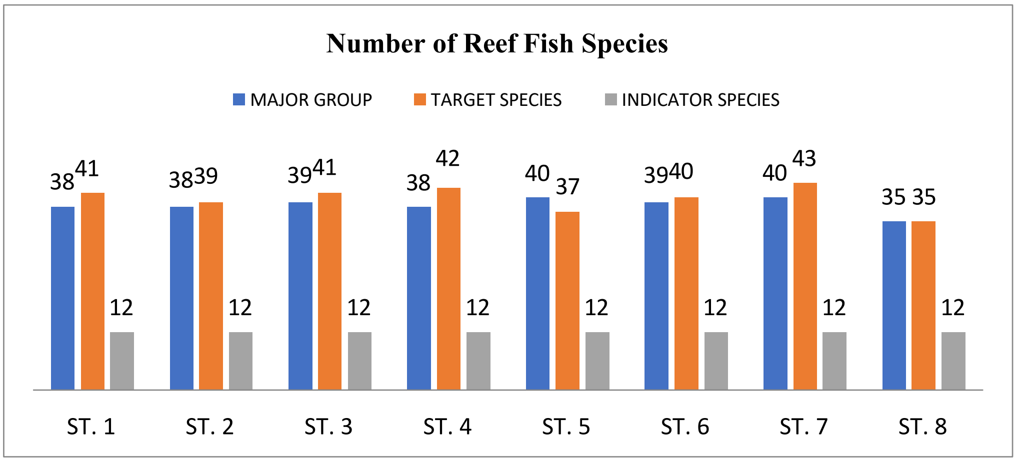



Figure 16. Number of Coral Fish Species at Each Station in the Waters of TWAL 17 Island Riung District, Ngada Regency, East Nusa Tenggara Province.

From the data obtained, it can be concluded that the abundance of individuals and species is presented in Figure 17 below:

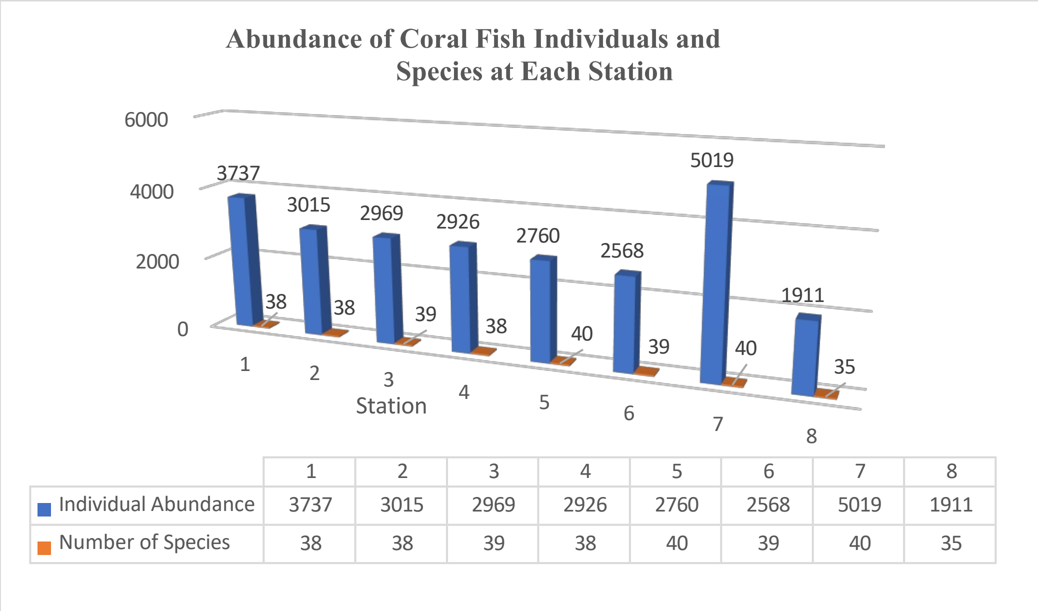



Figure 17: Abundance of reef fish individuals and species at each station in the waters of TWAL 17 Pulau Riung Sub-district, Ngada Regency, East Nusa Tenggara Province.

Reef fish communities can also be measured through several indices, including diversity index (H'), uniformity (E) and dominance (C) of reef fish (Hill & Wilkinson, 2004). The values and criteria of the dominance index (C), uniformity index (E') and diversity index (H') of reef fish can be seen in Table 18 below.

Values and criteria of the diversity index (H'), uniformity index (E'), dominance index (C) and abundance value of reef fish (Ind/m$^{2)}$ .

| Station | Diversity | | Diversity | | Dominance | |
|---|---|---|---|---|---|---|
| | H' value | value Criteria | E' Value | Values Criteria | C' value | Value Criteria |
| 1 | 4.02 | High | 0.89 | High, Stable | 0.03 | None |
| 2 | 4.09 | High | 0.91 | High, Stable | 0.03 | None |
| 3 | 4.17 | High | 0.92 | High, Stable | 0.02 | None |
| 4 | 4.17 | High | 0.92 | High, Stable | 0.02 | None |
| 5 | 4.15 | High | 0.92 | High, Stable | 0.02 | None |
| 6 | 4.12 | High | 0.91 | High, Stable | 0.02 | None |
| 7 | 4.18 | High | 0.92 | High, Stable | 0.02 | None |
| 8 | 4.04 | High | 0.92 | High, Stable | 0.02 | None |

The abundance (N), dominance index (C), uniformity index (E) and diversity index (H) of reef fish at each station can be seen in Figure 18 below;

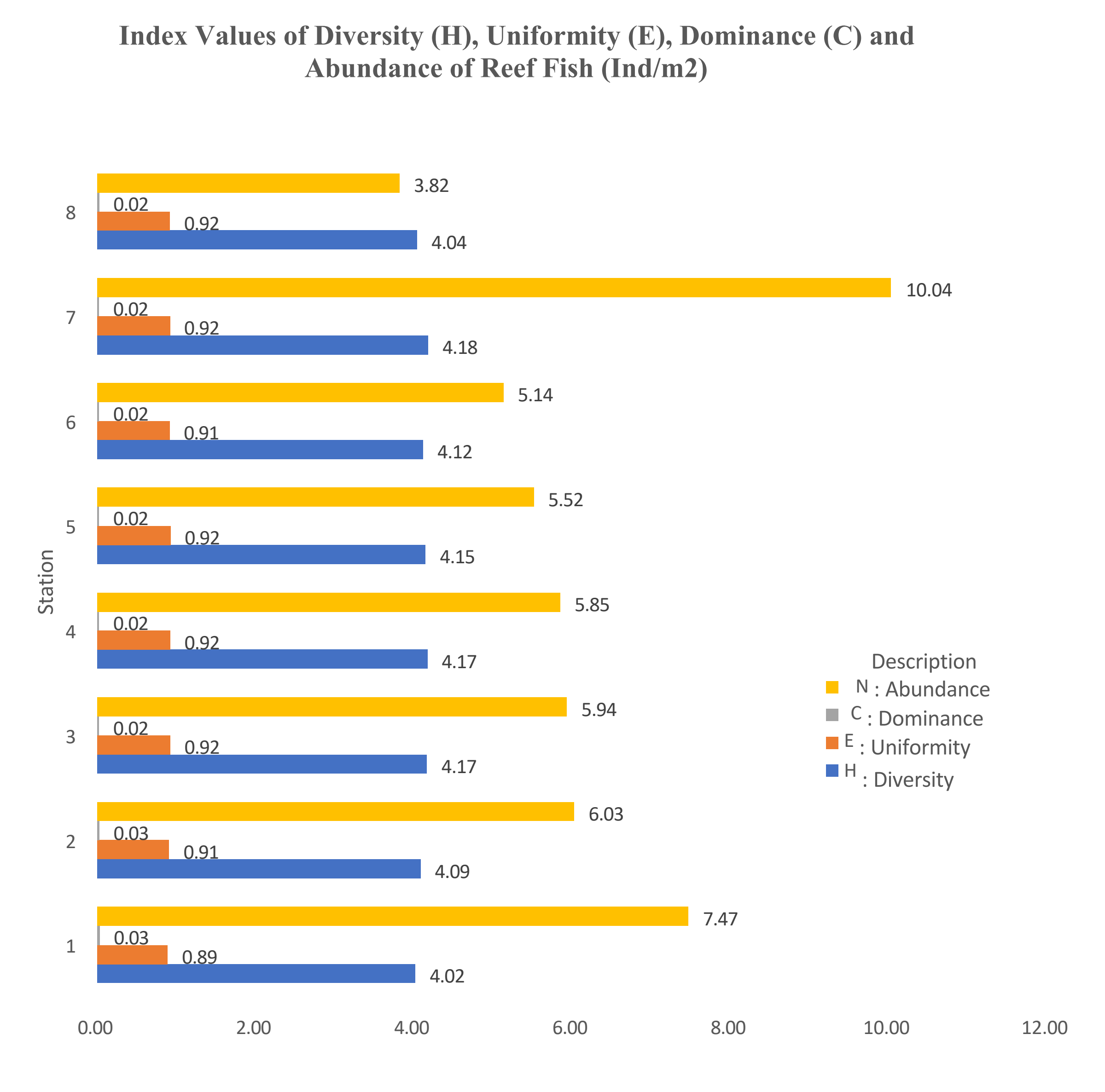



Figure 18: Diversity index (H), uniformity index (E), dominance index (C) and abundance (N) of reef fish at each station in the TWAL 17 Island Riung District, Ngada Regency, East Nusa Tenggara Province.
(C) and abundance (N) of reef fish at each station in the waters of TWAL 17 Island Riung District, Ngada Regency, East Nusa Tenggara Province.

Figure 18 shows the variation of several ecological indices of reef fish, namely diversity index (H'), uniformity (E), and dominance (C). All observation stations found that the reef fish diversity index was in the high category and there was an ecosystem balance, with high uniformity and stable communities and no one fish species dominated other individuals. The high and low value of reef fish diversity is influenced by several factors, including the physico-chemical conditions of the waters and the condition of the coral reef ecosystem, which is the habitat of reef fish.

which is the habitat of reef fish. The level of diversity of a biota is categorized as high if the number of species with the number of individuals of each species is relatively evenly distributed (Syms & Jones, 2000).

The results of the calculation of the uniformity index show varied values ranging from 0.89 - 0.92. The uniformity index value shown at all stations is included in the high category and the community is stable with a value above 0.6 (Brower & Zar, 1977). If the value of the community uniformity index is lower, the lower the uniformity of the community in an ecosystem. This can also be caused by the presence of biota that dominate in an ecosystem. The greater the uniformity value of a biota indicates that the community is stable, ie the waters have the same type of biota or not much different (Pratchett *et al*. 2011).

The dominance index value ranges from 0 - 1, which means that if the value is close to the value of 1, there is a tendency for one individual to dominate the others, while the average Dominance Index (D) value at 8 observation stations is in the category ranging from 0.02 to 0.003. the smaller the dominance index value, it shows that there are no species that dominate, on the contrary, the greater the dominance, it shows that there are certain species (Odum, 1993).

The results of the calculation of the dominance index also have a value almost not much different between 0.02 - 0.03 but the index value at all stations is included in the same category, namely the low category with a value below 0.5 (Howard *et al*., 2009). A low dominance value leads to a high uniformity value in an ecosystem, as is the case when monitoring marine biota in the waters of TWAL 17 Island Riung District, Ngada Regency, East Nusa Tenggara Province.

4.1.4 Physical and Chemical Parameters of Water

The physical parameters of the waters observed in the 17 Island TWAL are Temperature, Brightness and Current. The average temperature in the water area is ranging from 26.7 $^0$C to 32.3 $^0$C and for brightness parameters ranging from 2 meters to 7 meters or 100% at the observation station point and for current parameters ranging from 0.0075 m/s to 0.0083 m/s. While in the chemical parameters that salinity is in the range of 36 ‰ to 40 ‰, in the acidity parameter (pH) ranges from 7.3 to 8.4 and for oxygen dissolved in water (DO) is in the range of 6.5 (mg/l) to 8.3 (mg/l). (*can be seen in table 11*)

The following is a map of temperature distribution in the waters of TWAL 17 Island where it can be seen that the temperature is high at ST 6, ST 7 and ST 8 and compared to other stations.

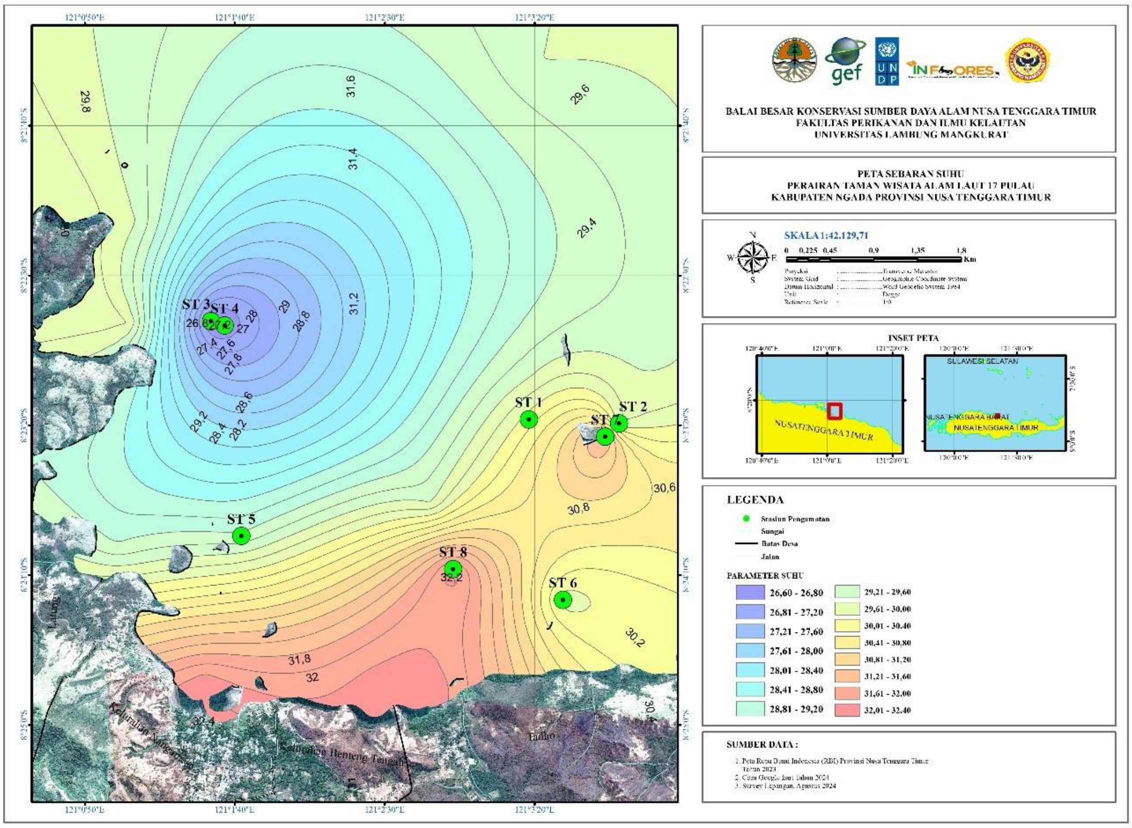



Figure 19: Temperature distribution map in the waters of TWAL 17 Island, Riung District, Ngada Regency, East Nusa Tenggara Province.

Seawater temperature has a significant influence on coral reef health and survival. Some of the main effects of seawater temperature on coral reefs include:

1. Increase in Seawater Temperature: When seawater temperatures increase, coral reefs can experience thermal stress. This often leads to a phenomenon called *coral bleaching*, where symbiotic algae living in coral tissue (zooxanthellae) lose pigment or exit the coral. Without these algae, the coral loses its food source and becomes pale or white in color.
2. Coral Bleaching: Bleaching occurs because corals depend on these algae for most of their energy. When temperatures rise too high, the symbiotic relationship between corals and algae is disrupted. If these conditions continue for a long time, corals can die from lack of nutrients.
3. Decreased Reproduction and Growth: Non-ideal water temperatures can also hinder coral reproduction and growth. Coral larvae that develop in excessively high temperatures may not survive or settle well on the substrate, reducing coral reef regeneration.
4. Changes in Species Composition: Increases in seawater temperature can also alter species composition in coral reef ecosystems. Coral species that are more resistant to high temperatures may dominate, while more sensitive species may decline or become extinct.

5. Increased Disease: Warmer water temperatures can increase the prevalence of disease in corals. Some pathogens or diseases are more active in warm conditions, which can lead to disease outbreaks that damage coral reefs.

Overall, changes in seawater temperature, especially global warming, are one of the biggest threats to the health of coral reefs around the world, while based on the results of this data collection that ST 6, ST 7 and ST 8 are above the threshold set based on Decree No. 51 of 2004 concerning seawater quality standards for marine biota. There are differences in temperature at ST 6, ST 7 and ST 8 with other stations. The occurrence of temperature differences at each observation station is thought to be due to differences in time of data collection, it is clear that data collection in the morning is lower than during the day or above 12:00 Wita. Sampling at this station was carried out at 12:33 Wita,
14.15 WITA and 16.10 WITA with values of 30.1 ° C, 31.7 ° C and 32.3 ° C respectively. Meanwhile, ST 1 and ST 2 were also taken at almost the same time the previous day, namely at 12:48 WITA and 14:25 WITA with temperature values of 29.8 °C and 30 °C, but this is still below the seawater quality standard threshold for marine biota and this shows that there is no significant temperature change during the observation/monitoring of marine biota in the 17 Island TWAL Area. In contrast to ST 3, ST 4 and ST 5, where the time of data collection at this observation station was carried out in the morning, namely at 09.27 WITA, 10.40 WITA and 11.25 WITA with values of 26.7 ° C, 27.2 ° C and 29.4 ° C respectively. For more details can be seen in table 15.

Other physical factors such as brightness or light intensity are also very important in coral reef ecosystems because most coral reefs have a symbiotic relationship with photosynthetic algae called zooxanthellae. These algae live inside coral tissue and provide energy through the process of photosynthesis. The results of the measurement of brightness parameters at the research location in the form of brightness reached 100% at each observation station. Figure 20 below is a map of the distribution of brightness in the waters of TWAL 17 Island Riung District, Ngada Regency, East Nusa Tenggara Province.

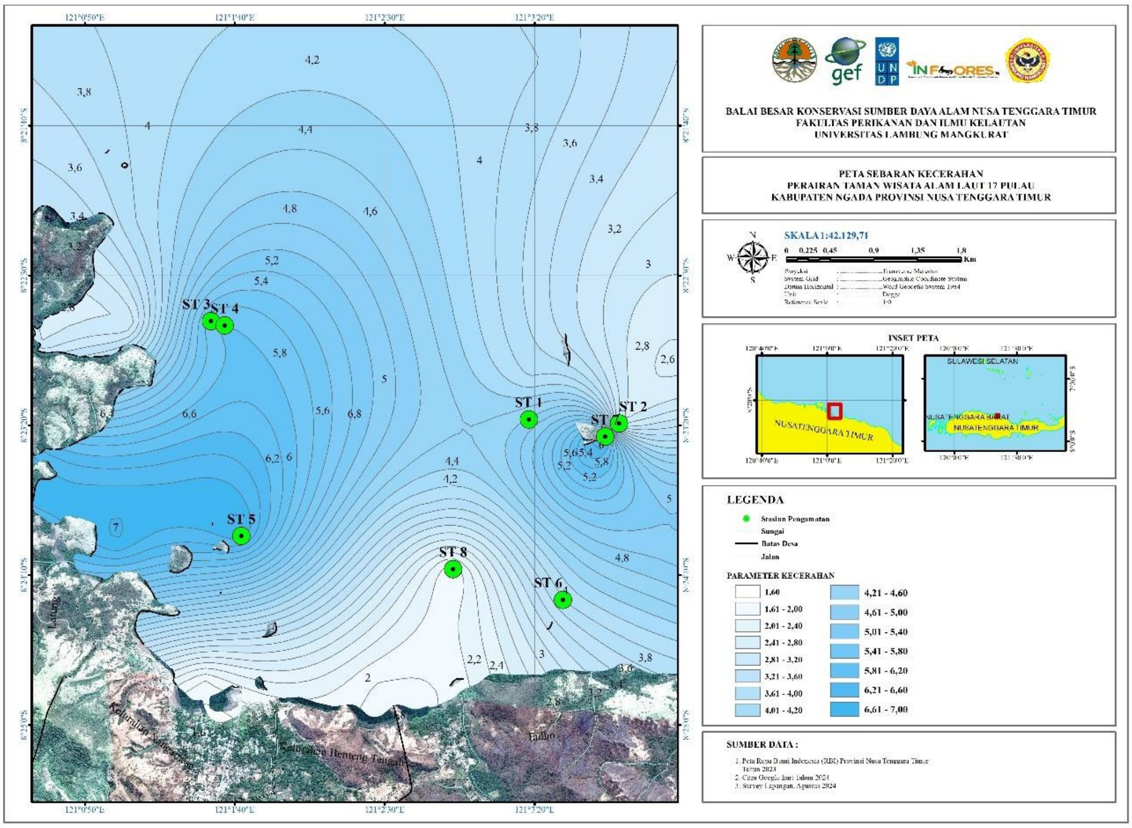



Figure 20: Brightness distribution map in the waters of TWAL 17 Island Riung District, Ngada Regency, East Nusa Tenggara Province.

Sunlight plays a role in the process of coral reef formation, as it determines the photosynthesis process for algae. Corals live symbiotically with *zooxanthellae* algae. Brightness affects coral reef growth because Zooxanthellae need sunlight for photosynthesis, which produces oxygen and essential nutrients for corals. If the brightness is too low, the photosynthesis process will be reduced, thus reducing the food supply for corals. Sufficient light allows zooxanthellae to produce more energy, which is then used by corals to grow and build the limestone (calcium carbonate) structures that make up reefs but too high or low brightness can also cause stress to zooxanthellae and corals. Excessive brightness can cause photoinhibition, where photosynthesis slows or stops due to too much light. This can lead to coral bleaching, where the coral repels the zooxanthellae, causing the coral to lose its color and food source. If the zooxanthellae are driven away by light stress (or other factors such as increased temperature), the coral will turn white and risk dying if this condition persists, commonly referred to as *coral bleaching.* If light intensity is too low, zooxanthellae are also unable to photosynthesize effectively, resulting in decreased nutrient production for corals. In the long run, this can cause corals to weaken or die. Therefore, optimal brightness is essential for coral reef health and growth. Without enough light, coral reefs cannot get the necessary nutrients, and too much light can also damage this ecosystem. At the location of the observation station in the waters of TWAL 17 Island Riung District, Ngada Regency, East Nusa Tenggara Province, the brightness is in accordance with the Ministerial Decree No. 4 of 2021 concerning the quality standards for marine biota, which is greater than 5 meters. (*Data can be seen in table 15*)

In addition to providing energy in the photosynthesis process, brightness can also affect comfort in tourism activities in the form of *snorkeling* and *diving* at TWAL 17 Island. The following is data on the physical parameters of the TWAL 17 Island water area, Riung District, Ngada Regency, East Nusa Tenggara Province.

Table 15. Physical and Chemical Parameters of Water Quality at the Research Site.

| Station | Coordinates | Time (WITA) | Parameter | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Physical Factors | | | Fak tor Chemical | | |
| | | | Temperature °C | Brightness | Current (m/s) | Salinity (‰) | pH | DO (mg/l) |
| 1 | 08°23'18,901" S<br>121°03'18.14" E | 12.48 | 29.8 | 4m / 100% | 0.0083 | 40 | 7.8 | 6.5 |
| 2 | 08°23'19,392" S<br>121°03'18.22" E | 14.25 | 30 | 3m / 100% | 0.0083 | 37 | 8.2 | 6.9 |
| 3 | 08°22' 35,267" S<br>121°2' 41,123" E | 9.27 | 26.7 | 6m / 100% | 0.0082 | 36 | 7.7 | 7.2 |
| 4 | 08°22' 36,623" S<br>121°2' 46,7" E | 10.4 | 27.2 | 6m / 100% | 0.0083 | 36 | 7.7 | 7.2 |
| 5 | (08°23'52,911" S)<br>121°3' 46,21" E | 11.25 | 29.4 | 7m / 100% | 0.0075 | 37 | 7.3 | 6.8 |
| 6 | 08° 24' 18,306" S<br>121° 3' 29,516" E | 12.33 | 30.1 | 4m / 100% | 0.0076 | 36 | 8.1 | 7.6 |
| 7 | 08° 23' 23,839" S<br>121° 3' 43,590" E | 14.15 | 31.7 | 7m / 100% | 0.0078 | 38 | 8.2 | 8.3 |
| 8 | 08° 24' 8,050" S<br>121° 2' 52,871" E | 16.1 | 32.3 | 2m / 100% | 0.0081 | 39 | 8.4 | 7.8 |
| Ministerial Decree No. 51 of 2004 | | | 28 -30 | > 5 m | | 30 - 36 | 7 - 8,5 | > 5 |

Based on field data for ocean current parameters in TWAL 17 Island ranges from 0.0075 m/s to 0.0083 m/s. According to Dahuri (2003) ocean currents affect shipping and tourism activities. Current speed greatly affects the level of safety and comfort for marine nature tourism activities in the form of *snorkeling* and *diving* and also affects the coral reef ecosystem. The ideal ocean current speed is sufficient to support the circulation of nutrients and oxygen without causing stress or physical damage to coral reefs. Good management of the marine environment should consider all of these factors to preserve the coral reef ecosystem. The following is an image of the current velocity map in the waters of TWAL 17 Pulau Riung Sub-district, Ngada Regency, East Nusa Tenggara Province.

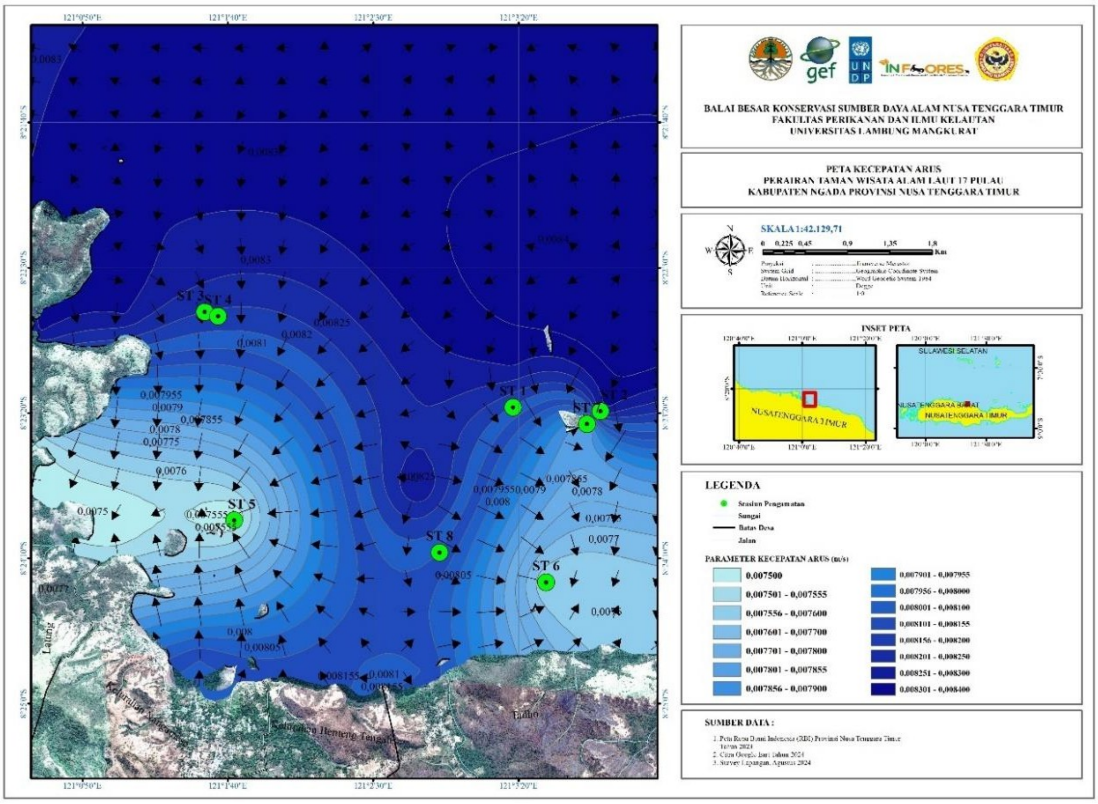



Figure 21: Map of Current Velocity in the Waters of TWAL 17 Island Riung Sub-district, Ngada Regency, East Nusa Tenggara Province.

In addition to the physical parameters of the waters, monitoring of marine biota in the 17 Island TWAL Area also observed chemical parameters in the form of salinity, acidity (pH) and also *Dissolve Oxygen* or oxygen levels in the water. For the salinity parameter, the water area of TWAL 17 Island, Riung District, Ngada Regency, East Nusa Tenggara Province ranged from 36‰ to 40‰. From all observation stations conducted, the salinity value is above the quality standard threshold based on the Ministerial Decree No. 4 of 2021 concerning the quality standards of marine biota which is only 30‰ to 34‰, (*can be seen in table 15*). According to Haruddin (2011) the optimal salinity level for coral reefs is 25-30‰, the salinity of sea water in the tropics is 35‰, and coral biota lives well at salinity levels of 34-36‰.

Coral Animals, like other marine organisms, are adapted to a certain salinity in their environment. When salinity increases drastically, corals will experience osmotic stress, which is an imbalance in the water pressure within their cells. When salinity is too high, water inside the cells of corals and other organisms will be pushed out of the cells through osmosis, causing dehydration and cell damage. In addition, metabolic disorders will also occur, namely disruption of biochemical processes in corals due to osmotic stress, which ultimately affects the growth and reproduction of these corals. The following is a map of salinity distribution in the waters of TWAL 17 Pulau Riung District, Ngada Regency, East Nusa Tenggara Province.

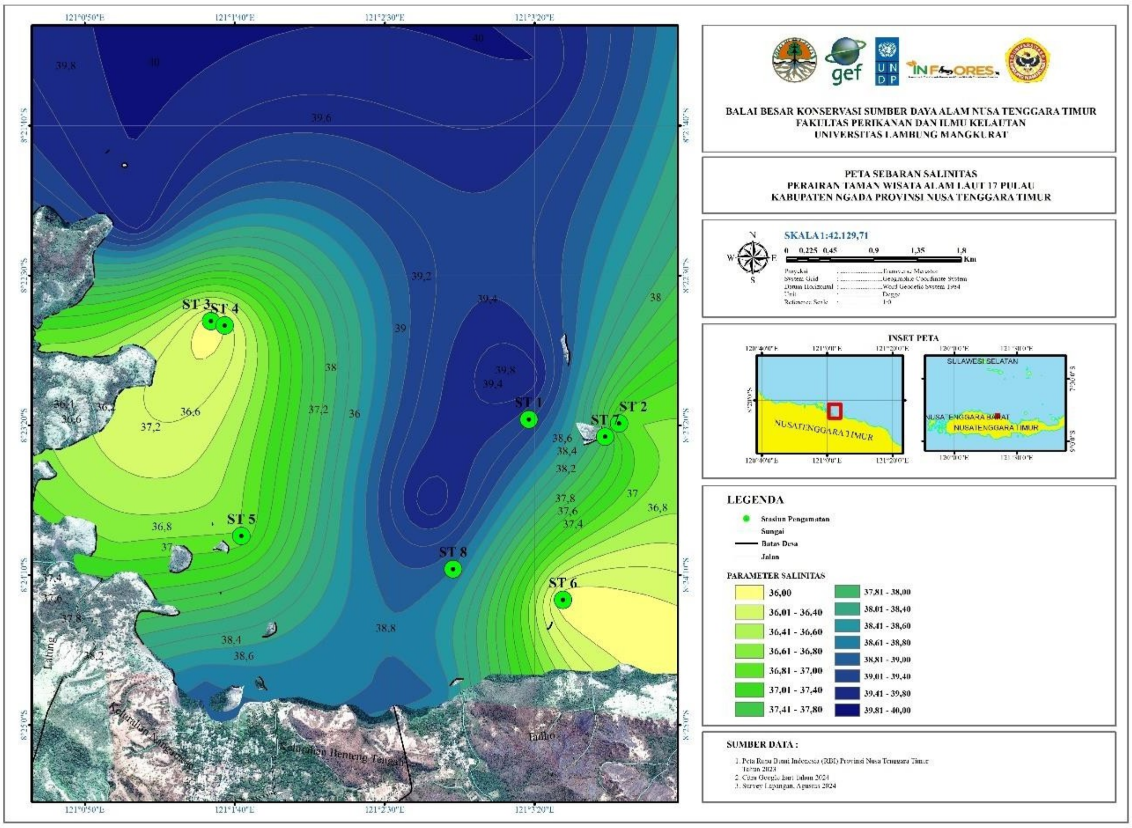



Figure 22: Salinity Distribution Map of the Twal 17 Island Watershed, Riung District, Ngada Regency, East Nusa Tenggara Province.

A stable degree of acidity (pH) is key to maintaining a balanced coral reef ecosystem. Changes in pH not only impact the corals themselves, but also other organisms that depend on the reef, such as fish, mollusks, and algae. High acidity (pH) can interfere with the ability of calcareous organisms (such as clams and snails) to build their shells, thus disrupting the food chain and ecosystem balance. At the research location, data were obtained that all observation stations had very stable acidity (pH) levels and showed a range between 7.3 to 8.4. This shows that the balance of the coral reef ecosystem in TWAL 17 Island is in accordance with the Ministerial Decree No. 4 of 2021 concerning the quality standards of marine biota in the range of 7 - 8.5. The following is a map of the distribution of acidity (pH) in the Twal 17 Island Watershed, Riung District, Ngada Regency, East Nusa Tenggara Province.

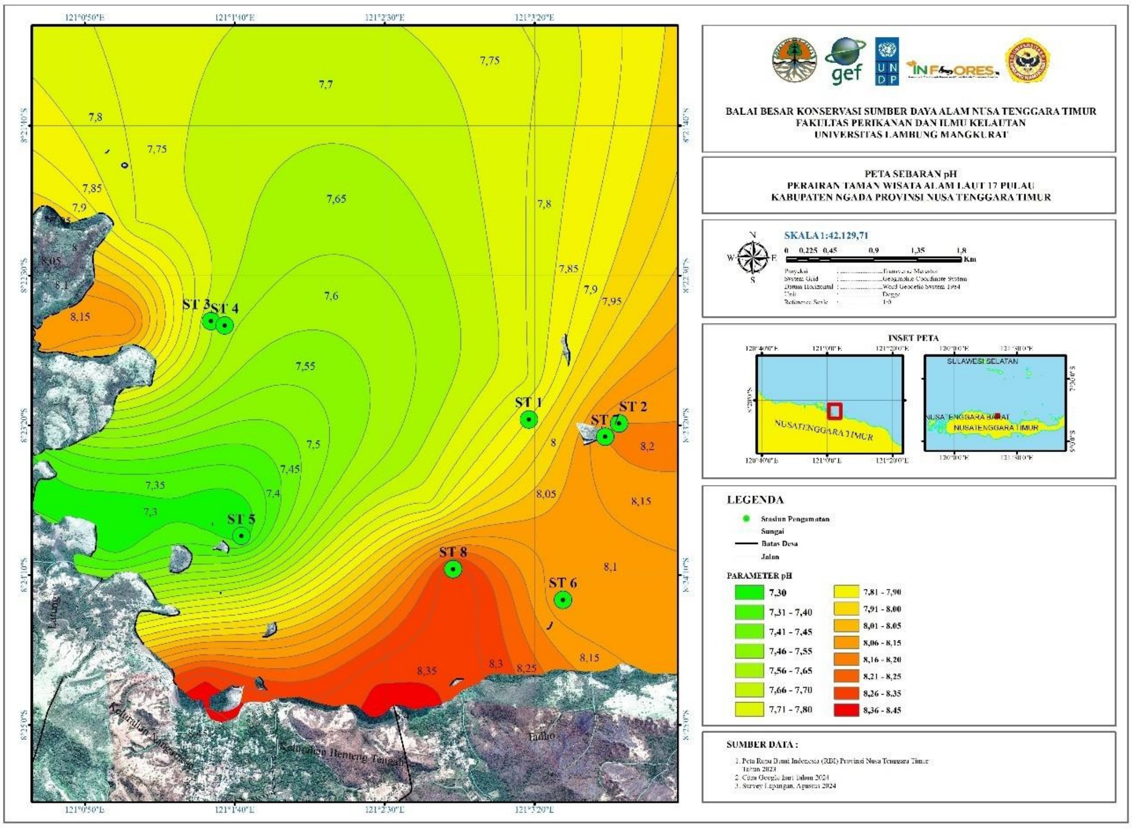



Figure 23: Map of the distribution of the degree of acidity (pH) in the TWAL 17 Island Waters Area, Riung District, Ngada Regency, East Nusa Tenggara Province.

A decrease in the *acidity* (pH) of seawater or *ocean acidification* occurs due to increased concentrations of Carbon Dioxide ($CO_2$) in the atmosphere, which dissolves in seawater and forms carbonic acid. When pH drops, this can also cause stress to corals, increasing the risk of coral bleaching especially if it occurs in conjunction with other stressors such as increased water temperatures. Global efforts to reduce carbon emissions are essential to maintain pH stability, temperature and the future viability of coral reefs.

*Dissolved oxygen* (DO) is critical to the health of coral reef ecosystems, as many organisms within these ecosystems, including corals, fish, and invertebrates, require oxygen to breathe and carry out their biological functions. Based on the ideal dissolved oxygen value according to Kepmen LH No. 4 of 2021 concerning the quality standards of marine biota is more than 5 mg/l (> 5m/l), while at all research locations, all observation stations showed values > 5m/l or ranged from 6.3 m/l to 8.5 m/l. This shows that the waters of TWAL 17 Pulau Riung Sub-district, Ngada Regency, East Nusa Tenggara Province are ideal for coral growth, or other organisms living in the sea to carry out biological processes used by living organisms to produce energy through the breakdown of organic molecules, such as glucose, using oxygen or aerobic respiration. Zooxanthellae (symbiotic algae in corals) also require oxygen to support their growth.

photosynthesis process, which then provides energy for the coral. Therefore, adequate DO levels are essential for coral respiration to obtain the energy needed to grow and repair itself. In the balance of the ecosystem many species such as fish, mollusks, crustaceans, and other organisms in the coral reef ecosystem also depend on dissolved oxygen for their survival. The following is a map of *Dissolved Oxygen* (DO) distribution in the waters of Twal 17 Island, Riung District, Ngada Regency, East Nusa Tenggara Province.

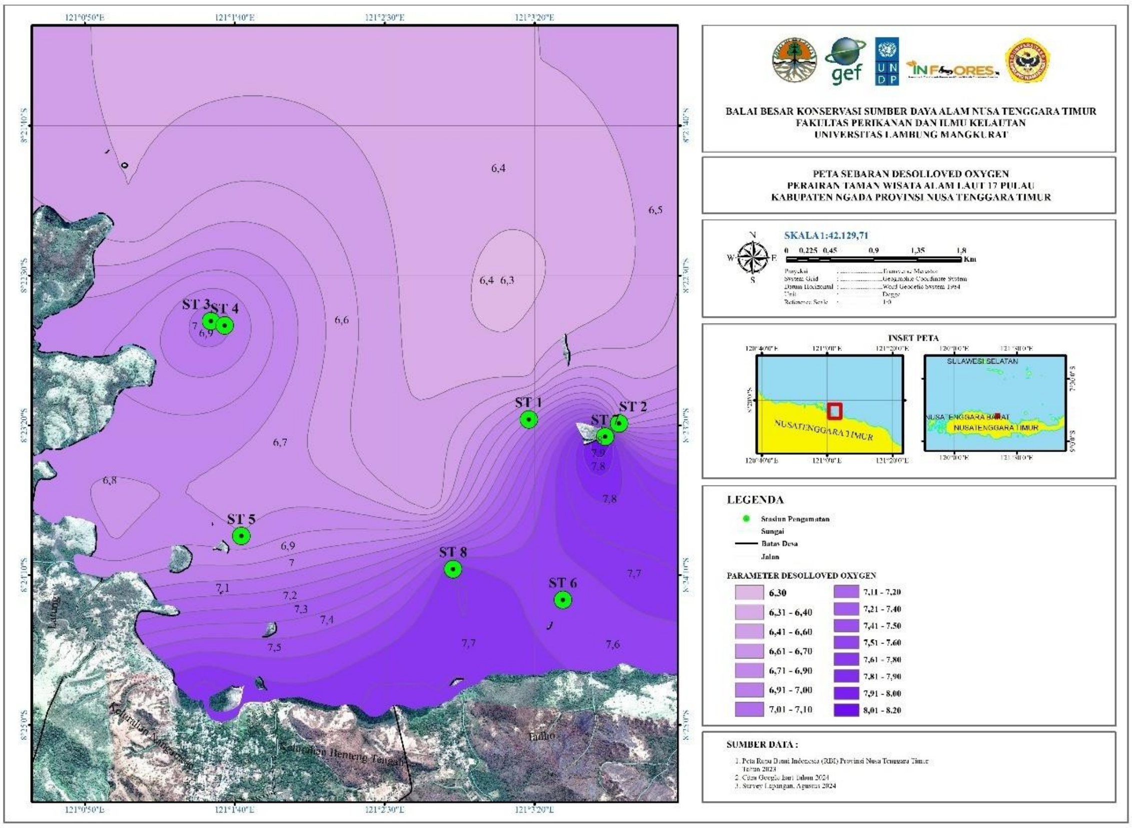



Figure 24: Dissolved Oxygen (DO) Distribution Map of the Twal 17 Island Watershed, Riung District, Ngada Regency, East Nusa Tenggara Province.

Ideal physical and chemical parameters are essential for the survival of coral reef ecosystems. A balance of temperature, light intensity, ocean currents, salinity, pH and dissolved oxygen (DO), allows corals to grow optimally, form strong skeletons, and support biodiversity. Imbalances in these parameters can lead to stress, impaired growth, and even coral mortality, so maintaining a stable environment is key to protecting coral reef ecosystems from the threats of climate change and human activities.

**Physical Factors:**

Temperature**:** Temperatures ranged from 26.7°C to 32.3°C. Average temperature values correspond to the ideal 28-30°C range for a given aquatic environment, although there are slight variations that can be influenced by weather conditions or time of measurement.

Brightness: The water brightness varied from 2 meters to 7 meters, with most showing good water transparency (100%). However, at some points (4 meters and 2 meters), transparency appeared lower due to the depth of the water.
Current: The current speed varied slightly, between 0.0075 m/s to 0.0083 m/s. These speeds are relatively slow, which may indicate calm or stagnant water conditions.

**Chemical Factors:**
Salinity: Salinity varied between 36‰ to 40‰, with an average value close to 37‰, slightly higher than the recommended range (33-34‰). This indicates a fairly high level of salt, which may reflect marine water conditions.
Acidity Level (pH): The pH values varied from 7.3 to 8.4, with the expected range being 7-8.5. This indicates that the water is in a fairly neutral to slightly alkaline condition, which is still generally good for aquatic life.
Dissolved Oxygen (DO): DO values range from 6.5 to 8.3 mg/L, with a minimum expected value of more than 5 mg/L. All DO values above this limit indicate that dissolved oxygen levels are good enough to support the life of organisms in the water.

Overall, the physical and chemical factors of the water indicated good conditions for coral reef and reef fish life, with some variation in temperature, brightness, and salinity. Higher salinity may reflect seawater characteristics, while DO and pH values were within appropriate ranges to maintain a balanced aquatic ecosystem.

## 4.2 Implications of Marine Biota Monitoring Results

The implications of the results of monitoring marine biota in the TWAL 17 Island Watershed of Riung Subdistrict, Ngada Regency, East Nusa Tenggara Province have implications in various aspects, especially ecology, economics, and natural resource management. Here are some of the implications:

### 4.2.1 Ecology

The conservation of biodiversity, especially coral reefs, is important because they are the main habitat for many species of fish and other marine organisms. The results of this monitoring can help detect threatened or endangered species, so that conservation measures can be implemented to protect the ecosystem in the 17 Islands TWAL Conservation Area, Riung District, Ngada Regency, East Nusa Tenggara. The balance of the marine ecosystem reflects the condition of coral reefs and reef fish populations, which are indicators of the overall stability of the marine environment. A decline in coral cover has the potential to disrupt food chains and undermine the balance of these ecosystems.

### 4.2.2 Economy

Healthy coral reefs support diverse fish populations, which contribute to local fisheries. The results of monitoring marine biota can be used to guide the sustainable management of fisheries resources, which is important for fishermen's livelihoods as a source of income for them. The coral reef ecosystem is also attractive to tourists, especially for activities such as snorkeling and diving. The results of this marine biota monitoring can also show damage to coral reefs that can impact the local tourism industry and demand ecosystem restoration policies.

### 4.2.3 Management and Policy.

Information on the condition of coral reefs and reef fish communities found in each block in the waters of TWAL 17 Pulau Riung Sub-district, Ngada Regency, East Nusa Tenggara Province can be used to establish coastal zone management policies, including the setting of *marine protected areas* and restrictions on destructive activities. Coral reef ecosystems are vulnerable to climate change, particularly global warming and ocean acidification. The results of this marine biota monitoring can strengthen the urgency of climate change mitigation measures and adaptation efforts in the waters of TWAL 17 Island Riung District, Ngada Regency, East Nusa Tenggara Province.

### 4.2.4 Public Education and Awareness

The results of this marine biota monitoring can be used to educate the public about the importance of coral reefs and reef fish communities for marine ecosystems and human life. This can encourage environmentally friendly practices and support conservation. Overall, this marine biota monitoring of coral reef and reef fish ecosystems in particular can provide important insights that help in maintaining the sustainability of these ecosystems, which affects ecological balance, economic prosperity, and data-driven policy development.

## 4.3 Theoretical Implications

The theoretical implications of monitoring the marine biota of coral reef and reef fish ecosystems relate to how the findings contribute to the development and testing of existing theories in ecology, marine biology, and environmental conservation. Here are some possible theoretical implications.

### 4.3.1. Strengthening Ecological Theory on Biodiversity

The results of this marine biota monitoring based on the Theory of Ecosystem Diversity and Equilibrium that shows the relationship between reef fish species diversity and reef ecosystem stability can strengthen the theory that links biodiversity with ecosystem resilience. These findings support the idea that high-diversity ecosystems are more stable and better able to withstand external disturbances. In the theory of ecological ratios in marine biota monitoring this could strengthen or expand understanding of how reef fish species share resources in reef ecosystems, as well as how ecological niches (the role of species in ecosystems) are formed and maintained in complex ecosystems. Where according to Charles Birkeland (1982), a marine ecologist emphasizes the importance of mutual interactions between coral reefs and reef fishes in maintaining a healthy ecosystem. According to him**,** herbivorous reef fish play an important role in controlling the growth of algae that can dominate and damage coral reefs. A healthy ecological ratio is when the number of herbivorous fish is sufficient to balance the growth of algae, so that coral reefs can develop properly without being disturbed by excess algae.

### 4.3.2. Theories on Ecosystem Functions, Ecosystem Services and Ecological Succession

Ecosystem Function Theory in marine biota monitoring can provide new empirical evidence on the role played by certain species in maintaining ecosystem functions, such as the maintenance of coral reef structure. This could have implications for understanding the importance of keystone species in maintaining vital ecosystem services, such as fisheries, tourism and coastal protection. While ecosystem services theory on these findings relating to the contribution of coral reef ecosystems to human well-being may reinforce theories on the relationship between biodiversity and ecosystem services, it clarifies how if the loss of certain species can disrupt the flow of ecosystem benefits. This can be seen in the theory of ecological succession, the lower the coral cover, the lower the abundance of individual reef fish, such as the low abundance of reef fish communities and coral reefs with moderate cover as in station 8.

## 4.4 Practical Implications

The practical implications of the results of monitoring marine biota in the form of coral reef ecosystems and reef fish relate to the application of scientific findings in conservation activities, resource management, and environmental policies aimed at preserving marine ecosystems and human welfare. Here are some of the practical implications:

### 4.4.1 Ecosystem Conservation and Recovery

Based on the results of monitoring marine biota can be a reference in improving conservation efforts. These results can show the condition of live coral cover and reef fish populations, which can lead to improved conservation measures. If ecosystem damage or degradation is found, recovery measures can be taken such as coral reef restoration, restrictions on destructive activities (such as fishing with environmentally unfriendly fishing gear, explosives or poisons). The development of artificial reefs is one way to support the diversity of reef fishes can encourage the expansion of artificial reef development to improve fish habitat and protect the coast from erosion as well as coral reef ecosystem restoration using the *Bioreef_block* method, a new technique for natural artificial reef engineering, because it uses natural materials such as coconut shells for planula attachment, combined with hollow cube-shaped concrete blocks that also function as homes for fish. (Tony F, Iskandar R, Rifa'i., 2021).

### 4.4.2 Local Community Empowerment

The results of marine biota monitoring can be used to involve local communities in conservation efforts, for example through training programs on marine biota monitoring, the importance of coral reefs and how to protect them. Local community involvement can include participation in coral reef restoration activities, sustainable fishing, and monitoring of illegal activities as a form of community participation in conservation. Development of coral reef monitoring systems. Monitoring data is essential to detect changes in the ecosystem and respond quickly. Technologies such as satellite imagery, drones, or underwater sensors can be used to track the health of coral reefs in real-time or schedule monitoring over a period of time. In order to develop a more systematic and regular coral reef ecosystem monitoring program, inter-agency collaboration between the government, universities, and other conservation agencies can be carried out in research efforts and the protection of coral reef ecosystems. It is hoped that this collaboration can produce a more effective and scientifically-based management program.

## 4.5 Policy Implications

The policy implications of coral reef and reef fish ecosystem research relate to how scientific findings can influence and shape the formulation, implementation, and evaluation of public policies at the local, national, and international levels. Below are some possible policy implications:

### 4.5.1 Oversight of Marine Protected Areas

Monitoring *Marine Protected Areas* (*MPAs*): The results of this marine biota monitoring can serve as a reference for the importance of coral reef ecosystems for the sustainability of reef fish species and ecosystem balance, encouraging the government to increase monitoring of marine protected areas. This could include banning fishing activities in marine protected block areas, setting marine use zoning, or stricter monitoring of human activities within MPAs.

### 4.5.2 Improved Sustainable Tourism Management

Regulation of Tourism in Coral Reef Areas: Findings that moderate coral cover is suspected to be a result of poorly managed tourism, such as snorkeling, or boat activities. The government can set environmental contribution fees to support rehabilitation and conservation programs, for example setting entry fees for environmental maintenance, training tour operators in conservation, installing boat mooring buoys so there is no need to throw anchors. The government can also encourage policies that require tour operators in coral reef areas to provide tourist education on how not to damage the environment, such as not touching corals, littering and other activities that are dangerous and can damage the coral reef ecosystem.

### 4.5.3 Ecotourism-Based Local Economic Development

The results of monitoring marine biota from coral reef ecosystems with live coral cover (%) based on Kepmen LH No. 4 of 2001 that there are 6 observation stations in the good category and 2 other stations in the medium category. This can be the basis for policies to promote ecotourism as an alternative source of income for the community. This policy can include training support for local communities to manage community and environment-based tourism destinations, so that they have an economic incentive to preserve the ecosystem. The development of partnerships with the private sector also needs to be carried out by the government, for example in the development of environmentally friendly ecotourism infrastructure, such as the construction of resorts or tourist attractions that support coral reef conservation.

### 4.5.4 Coral Reef Restoration and Rehabilitation Policy Development

Coral Reef Restoration Program: The results of monitoring marine biota also show that in some stations there is damage to coral reefs due to human activities and other climate changes. This may encourage the government to develop coral reef restoration policies. These policies could include coral transplantation, artificial reef development, or rehabilitation of damaged marine ecosystems. Governments can allocate budgets and technical support for creative coral reef restoration initiatives, in collaboration with universities, research institutions, environmental NGOs, and the private sector concerned with the sustainability of marine ecosystems.

### 4.5.5 Participation in International Agreements and Policies

The results of marine biota monitoring can strengthen government commitments to comply with international agreements and conventions that protect marine ecosystems, such as the Convention on Biological Diversity (CBD), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and initiatives under the UN Framework for Climate Change. In addition, Regional Cooperation for Marine Protection between countries that share the same marine ecosystems, such as in the Coral Triangle region, can use these marine biota monitoring findings to strengthen cooperation in the management and protection of coral reefs in the region.

## 4.6 Business Implications

The business implications of monitoring marine biota, especially coral reef and reef fish ecosystems, include opportunities for the private sector to engage in businesses that support environmental sustainability, while encouraging innovation in fisheries, tourism, technology and more. Scientific discoveries that demonstrate the condition of coral reef ecosystems and reef fish populations can provide economic benefits, while spurring sustainable business development. Coral Reef Restoration as a Business Sector With the growing need for coral reef ecosystem restoration, environmental companies can invest in coral reef restoration projects. The development of technological innovations for coral ecosystem restoration, or the construction of artificial structures that support marine life, such as the use of *Bioreef_block* which is an environmentally friendly artificial reef engineering technique. This technique allows the creation of new habitats for fish and other marine organisms, which in turn can be utilized by fishing communities to increase fish catches more efficiently and sustainably.

## CHAPTER

## V

## CLOSING

### 5.1 Conclusion

Monitoring results can be concluded that:

1. The types of coral reefs found in the TWAL 17 Island Area of Riung District, Ngada Regency, East Nusa Tengara Province are composed of 4 forms of *Acropora* coral *lifeforms* at the research site, namely: *AcroporaI Coral Digitate* (ACD)*, AcroporaI Coral branching* (ACB) and *Acropora Coral Tabulate* (ACT), *Acropora Coral Encrusting* (ACE) and 6 forms of *Non-Acropora* namely *Coral branching* (CB), *Coral massive* (CM), *Coral encrusting* (CE), *Coral foliose* (CF), *Coral Mushroom* (CMR), *Coral Heliopora* (CHL), 1 form of Dead Scleractinia namely DC with algae (DCA), 3 forms of Algae namely *Macro Algae* (MA) and *Corralline Algae* (CA), *Halimidae Algae (*HA), 4 forms of Other Fauna namely; *Soft Coral* (SC), *Spoonge* (SP), *Zoanthids* (ZO) and Others (OT) while for Abioic there are 2 forms namely: Sand (S), *Rubble* (R). For reef fish, the number of species recorded was 96 species consisting of 18 families spread across 8 observation stations. The largest fish composition was from the Pomacentridae (14 species) and Labridae (14 species) families, while Lutjanidae (13 species), Chaetodonthidae (12 species), Scaridae (6 species), Haemulidae (6 species), Serranidae (6 species), Caesionidae (5 species), Pomacanthidae (4 species), Achanturidae (4 species), Nemipteridae (4 species), Holocentridae (2 species) and Pseudochromidae (1 species), Platacidae (1 species), Antennaridae (1 species), Mullidae (1 species), Muraenidae (1 species) and Plotosidae (1 species). The most reef fish species are from the family Pomacentridae and for the most tribes, Pomacentridae and Labridae also rank top in terms of the number of species (biodiversity).
2. The condition of coral reef cover around TWAL 17 Islands Riung District Ngada Regency East Nusa Tenggara Province is Moderate to Good.
3. The diversity index of coral reefs around the 17 Islands TWAL Area, Riung Subdistrict, Ngada Regency, East Nusa Tenggara Province is medium diversity with moderate environmental pressure, high uniformity index with a stable community, the dominance index also has no tendency for one individual to dominate. Meanwhile, the diversity index of reef fish at all observation stations shows that the diversity index of reef fish is in the high category and there is a balance of ecosystems, a high diversity index and a stable community, with a dominance index there is no one fish species that dominates other individuals.
4. Overall, the physical and chemical conditions of water in the marine waters of TWAL 17 Island Riung Sub-district, Ngada Regency, East Nusa Tengara Province, showed good conditions for reef life.

showed good conditions for coral reef and reef fish life, with some variation in temperature, brightness, and salinity. Higher salinity may reflect seawater characteristics, while DO and pH values were within appropriate ranges to maintain the balance of the aquatic ecosystem.

## 5.2 Suggestions

In order to maintain and preserve the diversity of coral reefs and reef fish, intensive monitoring and management of marine tourism based on education and conservation should be carried out, the application of technology in coral reef rehabilitation can be utilized. In order for this activity to run well and can be one of the pillars of the community's economy in a sustainable manner (*an economically sustainable area / ecosytem*), it must be built with a planned strategy and long-term vision, therefore to achieve the objectives of the activity, it is deemed necessary to synergize in the implementation of its implementation between the Community, Government, Higher Education Institutions, Non-Governmental Organizations and Companies that are oriented towards the welfare of the community and preservation of the environment.

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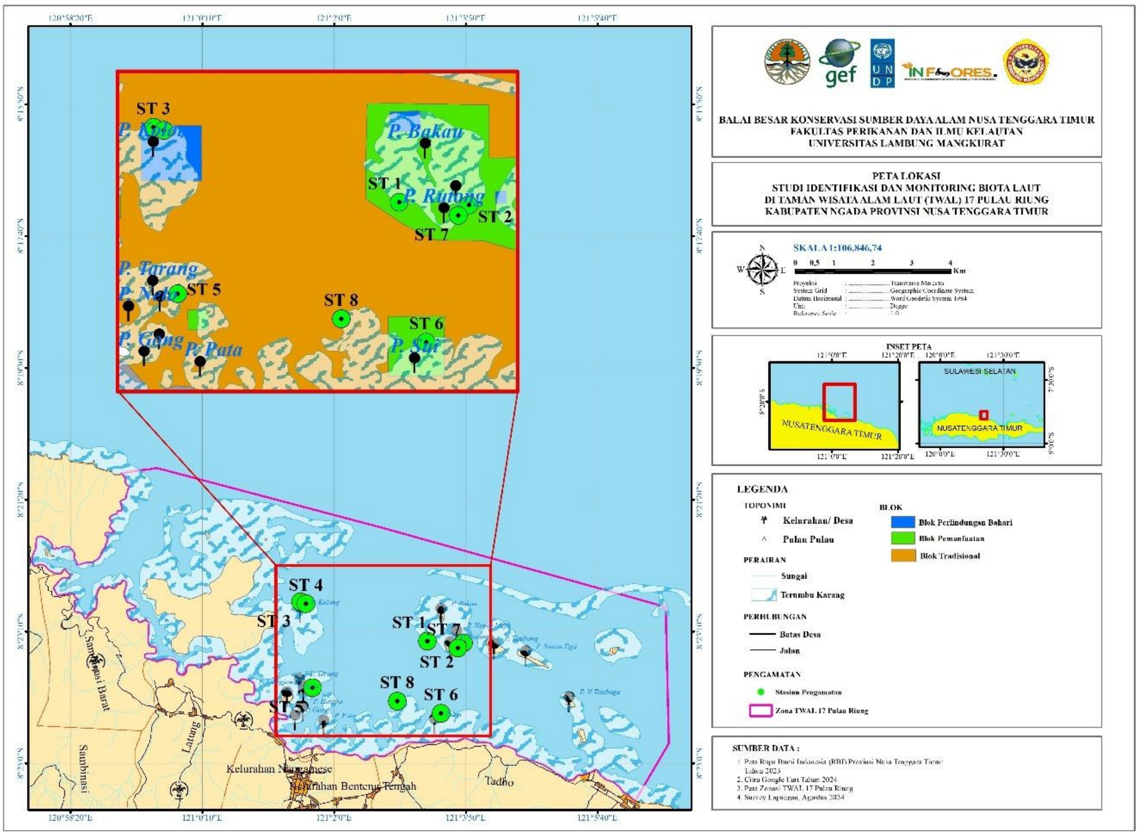
Appendix 1

Coordinates of Monitoring Stations

| Station Name | Coordinates | Description | Block Arrangement Description |
|---|---|---|---|
| ST 1 | 08°23'18.90" S<br>121°03'18.14" E | Rutong Island | Utilization Block |
| ST 2 | 08°23'19.39" S<br>121°03'48.22" E | Rutong Island | Utilization Block |
| ST 3 | 08° 22' 45,267" S<br>121° 1' 32,123" E | Batang Kolong Island | Maritime Protection Block |
| ST 4 | 08° 22' 46,723" S<br>121° 1' 36,663" E | Batang Kolong Island | Maritime Protection Block |
| ST 5 | 08° 23' 56,911" S<br>121° 1' 42,211" E | Other Islands | Traditional Block |
| ST 6 | 08° 24' 18,306" S<br>121° 3' 29,516" E | Sui Island | Utilization Block |
| ST 7 | 08° 23' 23,839" S<br>121° 3' 43,590" E | Rutong Island | Utilization Block |
| ST 8 | 08° 24' 8,050" S<br>121° 2' 52,871" E | Sui Island | Traditional Block |

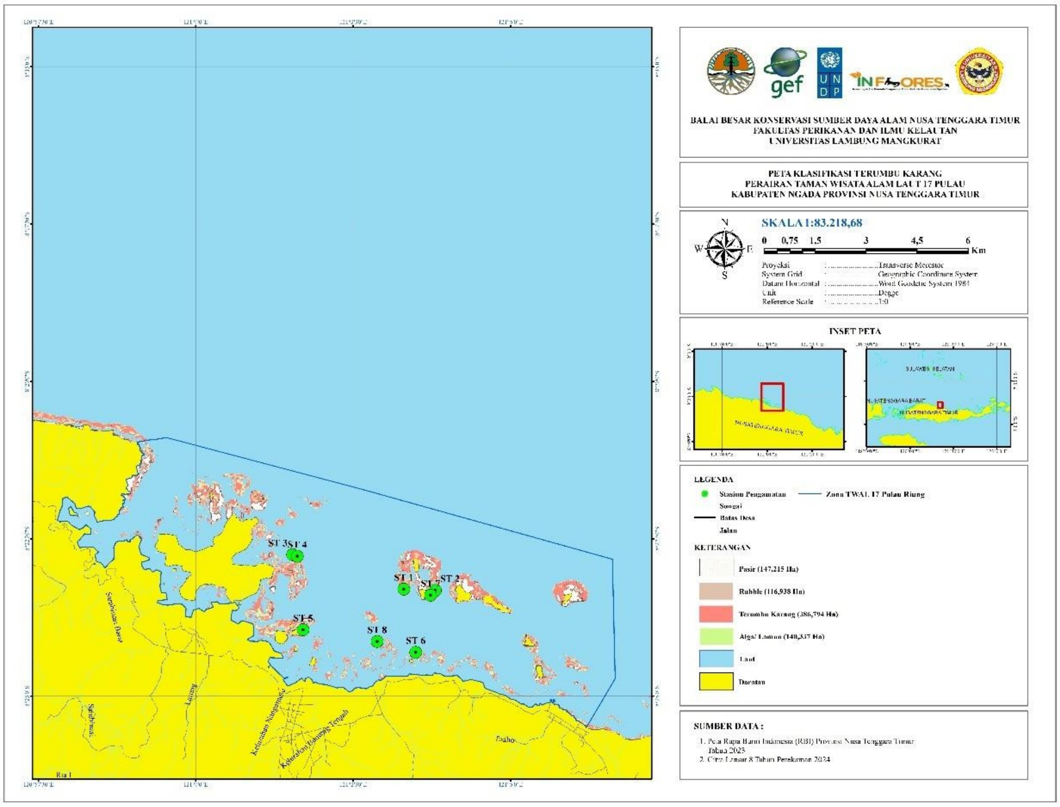
Appendix 2

Location Map of Marine Biota Monitoring (*Identification of Coral Reefs and Reef Fish*) at 17 Island Marine Nature Park, Riung District, Ngada Regency, East Nusa Tenggara. East Nusa Tenggara.



Appendix 3

Coral reef classification map from Lansat-8 image analysis.



Appendix 4

Coral Reef Condition of Each Research Station

| Category | | Code | ST 1 | ST 2 | ST 3 | ST 4 | ST 5 | ST 6 | ST 7 | ST 8 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Hard Coral (Acropora)** | Digitate | ACD | 0 | 141 | 0 | 0 | 0 | 0 | 0 | 372 |
| | Branching | ACB | 904 | 1519 | 1070 | 975 | 517 | 3465 | 1020 | 0 |
| | Tabulate | ACT | 61 | 537 | 505 | 1106 | 0 | 574 | 0 | 198 |
| | Encrusting | ACE | 0 | 0 | 310 | 0 | 0 | 0 | 0 | 0 |
| **Hard Coral (Non Acropora)** | Branching | CB | 1262 | 794 | 1459 | 1877 | 2900 | 683 | 637 | 318 |
| | Massive | CM | 1103 | 683 | 1717 | 1395 | 1424 | 1526 | 1850 | 1154 |
| | Encrusting | CE | 157 | 81 | 333 | 91 | 235 | 206 | 134 | 0 |
| | Foliose | CF | 407 | 1829 | 0 | 0 | 603 | 50 | 3003 | 1280 |
| | Mushroom | CMR | 128 | 26 | 124 | 197 | 137 | 271 | 87 | 22 |
| | Heliopora | CHL | 119 | 58 | 537 | 140 | 0 | 0 | 93 | 0 |
| **Dead Scleractinia** | DC with algae | DCA | 1329 | 501 | 953 | 700 | 836 | 297 | 960 | 1316 |
| | Macro | MA | 102 | 0 | 0 | 0 | 0 | 0 | 0 | 296 |
| **Algae** | Corralline | CA | 0 | 19 | 186 | 129 | 0 | 0 | 0 | 0 |
| | Halimidae | HA | 162 | 0 | 0 | 65 | 0 | 0 | 0 | 0 |
| | Soft Coral | SC | 619 | 966 | 89 | 1425 | 78 | 407 | 83 | 679 |
| **Other Fauna** | Spoonge | SP | 0 | 0 | 0 | 0 | 103 | 114 | 74 | 0 |
| | Zoanthids | ZO | 0 | 31 | 0 | 0 | 70 | 0 | 43 | 0 |
| | Others | OT | 378 | 149 | 536 | 401 | 221 | 160 | 323 | 645 |
| **Abiotic** | Sand | S | 672 | 395 | 955 | 83 | 578 | 384 | 275 | 0 |
| | Rubble | R | 2597 | 2271 | 1226 | 1416 | 2298 | 1863 | 1418 | 3720 |
| **Total** | | | **10000** | **10000** | **10000** | **10000** | **10000** | **10000** | **10000** | **10000** |

Appendix 5

Values of diversity index (H), uniformity index (E), dominance index (C) and abundance (N) of reef fish at each station in the waters of TWAL 17 Pulau Riung District, Ngada Regency, East Nusa Tenggara Province.

| **Index** | **ST 1** | **ST 2** | **ST 3** | **ST 4** | **ST 5** | **ST 6** | **ST 7** | **ST 8** |
|---|---|---|---|---|---|---|---|---|
| Diversity (H) | 4.02 | 4.09 | 4.17 | 4.17 | 4.15 | 4.12 | 4.18 | 4.04 |
| uniformity (E) | 0.89 | 0.91 | 0.92 | 0.92 | 0.92 | 0.91 | 0.92 | 0.92 |
| dominance (C) | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| Abundance (N) | 7.47 | 6.03 | 5.94 | 5.85 | 5.52 | 5.14 | 10.04 | 3.82 |

Appendix 6

Families, species and numbers of reef fish

| Family Name and Fish Species | Number of Species | Abundance |
|---|---|---|
| **MAYOR** | | |
| Pomacentridae | 14 | 10930 |
| Labridae | 14 | 2570 |
| Pomacanthidae | 4 | 647 |
| Pseudochromidae | 1 | 296 |
| Platacidae | 1 | 80 |
| Scaridae | 6 | 912 |
| **TARGET** | | |
| Achanturidae | 4 | 114 |
| Antennaridae | 1 | 42 |
| Caesionidae | 5 | 1650 |
| Haemulidae | 6 | 1100 |
| Holocentridae | 2 | 524 |
| Lutjanidae | 13 | 2760 |
| Mullidae | 1 | 110 |
| Muraenidae | 1 | 6 |
| Nemipteridae | 4 | 652 |
| Plotosidae | 1 | 318 |
| Serranidae | 6 | 824 |
| **INDICATOR** | | |
| Chaetodonthidae | 12 | 1370 |
| Total | 96 | 24905 |

Appendix 7

Abundance of reef fish individuals and species at each station in the waters of TWAL 17 Pulau Riung Sub-district, Ngada Regency, East Nusa Tenggara Province.

| N0 | N A M A S U K U A N J E C T I O N A L L Y | STATION | | | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ST 1 | ST 2 | ST 3 | ST 4 | ST 5 | ST 6 | ST 7 | ST 8 | |
| | **MAJOR GROUP** | | | | | | | | | |
| I | POMACENTRIDAE | | | | | | | | | |
| 1 | *Abudefduf sexfasciatus* | 128 | 216 | 132 | 146 | 112 | 121 | 288 | 110 | 1253 |
| 2 | *Abudefduf septemfasciatus* | 362 | 189 | 203 | 102 | 132 | 118 | 152 | 97 | 1355 |
| 3 | *Amblyglyphidodon aureus* | 68 | 54 | 87 | 53 | 102 | 79 | 125 | 102 | 670 |
| 4 | *Amblyglyphidodon batunai* | 185 | 95 | 72 | 61 | 73 | 98 | 194 | 84 | 862 |
| 5 | *Amblyglyphidodon leucogaster* | 246 | 162 | 183 | 176 | 159 | 96 | 293 | 72 | 1387 |
| 6 | *Amblypomacentrus breviceps* | - | 16 | 12 | - | 16 | 11 | 21 | - | 76 |
| 7 | *Amphiprion clarkii* | 36 | 48 | 62 | 81 | 72 | 102 | 157 | 86 | 644 |
| 8 | *Amphiprion ocellaris* | 29 | 46 | 51 | 65 | 72 | 84 | 102 | 41 | 490 |
| 9 | *Chromis cinerascens* | 183 | 127 | 102 | 135 | 97 | 82 | 192 | 53 | 971 |
| 10 | *Neopomacentrus bankieri* | 126 | 82 | 62 | 51 | 43 | 85 | 128 | 21 | 598 |
| 11 | *Pomacentrus alexanderae* | 183 | 162 | 102 | 106 | 124 | 114 | 194 | 72 | 1057 |
| 12 | *Pomacentrus brachialis* | 96 | 82 | 53 | 49 | 106 | 102 | 121 | 52 | 661 |
| 13 | *Pomacentrus coelestis* | 83 | 62 | 52 | 61 | 73 | 101 | 118 | 47 | 597 |
| 14 | *Premnas biaculeatus* | 27 | 17 | 31 | 52 | 61 | 26 | 73 | 22 | 309 |
| II | LABRIDAE | | | | | | | | | |
| 1 | *Cheilinus celebicus* | 36 | 31 | 27 | 21 | 31 | 22 | 41 | 19 | 228 |
| 2 | *Cheilinus digramma* | - | 4 | - | - | 6 | 2 | 11 | - | 23 |
| 3 | *Cheilinus fasciatus* | 31 | 28 | 14 | 29 | 32 | 12 | 36 | 10 | 192 |
| 4 | *Cheilinus unifasciatus* | 12 | 24 | 21 | 11 | 9 | 16 | 22 | 6 | 121 |
| 5 | *Cirhilabrus solorensis* | 28 | - | 22 | 17 | 8 | 12 | 26 | - | 113 |
| 6 | *Epibulus insidator* | 41 | 37 | 31 | 26 | 24 | 28 | 47 | 25 | 259 |
| 7 | *Halichoeres hortulanus* | 13 | 14 | 18 | 16 | 22 | 19 | 24 | 12 | 138 |
| 8 | *Hemigymnus melapterus* | 17 | 12 | 26 | 21 | 15 | 7 | 31 | 9 | 138 |
| 9 | *Labrichthys unilineatus* | 18 | 25 | 31 | 26 | 13 | 11 | 38 | 16 | 178 |
| 10 | *Labroides dimidiatus* | 31 | 26 | 42 | 31 | 23 | 37 | 39 | 21 | 250 |
| 11 | *Labricthys unilineatus* | 42 | 31 | 28 | 23 | 19 | 21 | 51 | 16 | 231 |
| 12 | *Pseudocheilinops ataenia* | 41 | 38 | 32 | 29 | 27 | 29 | 57 | 22 | 275 |
| 13 | *Pteragogus enneacanthus* | 26 | 23 | 19 | 17 | 21 | 12 | 47 | 19 | 184 |
| 14 | *Wetmorella nigropinnata* | 32 | 26 | 32 | 33 | 27 | 29 | 46 | 15 | 240 |
| III | POMACANTHIDAE | | | | | | | | | |
| 1 | *Centropyge flavicauda* | 43 | 42 | 23 | 21 | 24 | 18 | 42 | 12 | 225 |
| 2 | *Pomacanthus annularis* | 16 | 19 | 24 | 17 | 13 | 18 | 27 | 8 | 142 |
| 3 | *Pomacanthus imperator* | 13 | 11 | 16 | 12 | 11 | 21 | 23 | - | 107 |
| 4 | *Pomacanthus semicirculatus* | 32 | 26 | 23 | 22 | 15 | 12 | 31 | 12 | 173 |
| IV | PSEUDOCHROMIDAE | | | | | | | | | |
| 1 | *Pseudochromis paccagnellae* | 41 | 37 | 36 | 42 | 27 | 33 | 51 | 29 | 296 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| V | PLATACIDAE | | | | | | | | | |
| 1 | *Platax boersii* | 6 | 7 | 11 | 8 | 13 | 11 | 19 | 5 | 80 |
| VI | SCARIDAE | | | | | | | | | |
| 1 | *Cetoscarus bicolor* | 26 | 22 | 12 | 18 | 14 | 9 | 28 | 6 | 135 |
| 2 | *Chlorurus bleekeri* | 32 | 24 | 26 | 28 | 17 | 19 | 42 | 18 | 206 |
| 3 | *Leptoscarus vaigiensis* | 31 | 42 | 31 | 21 | 26 | 18 | 47 | 21 | 237 |
| 4 | *Scarus dimidiatus* | 22 | 19 | 25 | 21 | 17 | 12 | 31 | 6 | 153 |
| 5 | *Scarus forsteni* | 22 | 18 | 15 | 22 | 17 | 9 | 24 | 9 | 136 |
| 6 | *Scarus schlegeli* | 13 | - | 7 | 5 | 4 | - | 16 | - | 45 |
| | **<u>TARGET SPECIES</u>** | | | | | | | | | |
| VII | ACHANTURIDAE | | | | | | | | | |
| 1 | *Acanthurus lineatus* | - | 3 | 12 | 13 | - | - | 17 | - | 45 |
| 2 | *Acanthurus xanthopterus* | 3 | 1 | 6 | 4 | - | 1 | 3 | 1 | 19 |
| 3 | *Naso lituratus* | 2 | - | - | - | 1 | 8 | 7 | - | 18 |
| 4 | *Zebrasoma scopas* | - | - | 7 | 4 | 7 | 3 | 11 | - | 32 |
| VIII | ANTENNARIDAE | | | | | | | | | |
| 1 | *Antennarius biocellatus* | 8 | 14 | - | - | 3 | 12 | - | 5 | 42 |
| IX | CAESIONIDAE | | | | | | | | | |
| 1 | *Caesio cuning* | 23 | 28 | 20 | 18 | 32 | 36 | 48 | 15 | 220 |
| 2 | *Caesio xanthonota* | 35 | 50 | 46 | 32 | 48 | 22 | 85 | 35 | 353 |
| 3 | *Caesio Teres* | 29 | 31 | 26 | 42 | 39 | 21 | 47 | 23 | 258 |
| 4 | *Caesio Lunaris* | 37 | 23 | 14 | 24 | 31 | 36 | 54 | 39 | 258 |
| 5 | *Pterocaesio digramma* | 65 | - | 123 | 162 | - | - | 211 | - | 561 |
| X | HAEMULIDAE | | | | | | | | | |
| 1 | *Diagramma melanacrum* | 28 | 23 | 18 | 21 | 11 | 15 | 32 | 9 | 157 |
| 2 | *Diagramma pictum* | 15 | 23 | 27 | 31 | 22 | 18 | 34 | 11 | 181 |
| 3 | *Plectorhinchus chrysotaenia* | 24 | 33 | 19 | 16 | 26 | 11 | 31 | 18 | 178 |
| 4 | *Plectorhinchus lessonii* | 32 | 28 | 22 | 21 | 26 | 25 | 35 | 21 | 210 |
| 5 | *Plectorhinchus picus* | 26 | 23 | 17 | 19 | 21 | 22 | 29 | 20 | 177 |
| 6 | *Plectorhincus polytaenia* | 27 | 22 | 28 | 24 | 32 | 15 | 31 | 18 | 197 |
| XI | HOLOCENTRIDAE | | | | | | | | | |
| 1 | *Sargocentron praslin* | 32 | 36 | 22 | 27 | 31 | 25 | 41 | 17 | 231 |
| 2 | *Sargocentron rubrum* | 46 | 26 | 37 | 41 | 27 | 31 | 56 | 29 | 293 |
| XII | LUTJANIDAE | | | | | | | | | |
| 1 | *Lutjanus boutton* | 32 | 28 | 33 | 34 | 21 | 20 | 41 | 38 | 247 |
| 2 | *Lutjanus biguttatus* | 35 | 31 | 22 | 27 | 18 | 15 | 39 | 29 | 216 |
| 3 | *Lutjanus ehrengeergii* | 32 | 27 | 22 | 26 | 24 | 31 | 38 | 21 | 221 |
| 4 | *Lutjanus decussatus* | 26 | 38 | 21 | 37 | 12 | 24 | 37 | 21 | 216 |
| 5 | *Lutjanus fulviflama* | 93 | 37 | 12 | 27 | 31 | 21 | 31 | 12 | 264 |
| 6 | *Lutjanus fulvus* | 46 | 28 | 26 | 34 | 24 | 20 | 41 | 18 | 237 |
| 7 | *Lutjanus gibbus* | 16 | 17 | 26 | 21 | 19 | 11 | 29 | 14 | 153 |
| 8 | *Lutjanus lemnicatus* | 24 | 22 | 32 | 22 | 21 | 21 | 40 | 19 | 201 |
| 9 | *Lutjanus lutjanus* | 28 | 25 | 31 | 33 | 27 | 34 | 43 | 21 | 242 |
| 10 | *Lutjanus rusellii* | 42 | 34 | 31 | 26 | 31 | 27 | 48 | 22 | 261 |
| 11 | *Lutjanus sebae* | 34 | 29 | 33 | 36 | 21 | 25 | 52 | 21 | 251 |
| 12 | *Macolor niger* | 16 | - | 8 | 13 | - | - | 27 | - | 64 |
| 13 | *Pinjalo pinjalo* | 32 | 22 | 18 | 24 | 16 | 21 | 41 | 13 | 187 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| XIII | MULLIDAE | | | | | | | | | |
| 1 | *Parupeneus barberinus* | 17 | 19 | 11 | 12 | 21 | 6 | 24 | - | 110 |
| XIV | MURAENIDAE | | | | | | | | | |
| 1 | *Gimnothorax meleagris* | - | - | 2 | 1 | - | - | 3 | - | 6 |
| XV | NEMIPTERIDAE | | | | | | | | | |
| 1 | *Scolopsis vosmeri* | 13 | 16 | 22 | 18 | 22 | 11 | 28 | 11 | 141 |
| 2 | *Scolopsis bilineata* | 31 | 24 | 33 | 27 | 41 | 23 | 47 | 13 | 239 |
| 3 | *Scolopsis ciliata* | 22 | 12 | 16 | 13 | 28 | 25 | 38 | 6 | 160 |
| 4 | *Scolopsis taenioptera* | 18 | 15 | 6 | 9 | 11 | 17 | 29 | 7 | 112 |
| XVI | PLOTOSIDAE | | | | | | | | | |
| 1 | *Plotosus lineatus* | 52 | 48 | 37 | 32 | 41 | 22 | 62 | 24 | 318 |
| XVII | SERRANIDAE | | | | | | | | | |
| 1 | *Chelidoperca tosaensis* | 18 | 13 | 22 | 21 | 16 | 11 | 27 | 21 | 149 |
| 2 | *Cephalopholis miniata* | 7 | 3 | 18 | 21 | 13 | 24 | 32 | 28 | 146 |
| 3 | *Plectropomus leopardus* | 18 | 13 | 25 | 27 | 22 | 21 | 39 | 8 | 173 |
| 4 | *Plectropomus maculatus* | 12 | 17 | 21 | 22 | 23 | 31 | 30 | 12 | 168 |
| 5 | *Plectropomus oligacanthus* | 28 | 21 | 31 | 29 | - | 17 | 37 | - | 163 |
| 6 | *Seranus inexpextatus* | 3 | 5 | - | 2 | - | 6 | 9 | - | 25 |
| | **SPECIES INDICATOR** | | | | | | | | | |
| XVIII | CHAETODONTHIDAE | | | | | | | | | |
| 1 | *Chaetodon baronessa* | 11 | 17 | 12 | 7 | 16 | 13 | 23 | 14 | 113 |
| 2 | *Chaetodon citrinellus* | 13 | 9 | 21 | 19 | 8 | 4 | 27 | 3 | 104 |
| 3 | *Chaetodon decussatus* | 10 | 9 | 13 | 11 | 14 | 17 | 22 | 9 | 105 |
| 4 | *Chaetodon ephippium* | 12 | 5 | 14 | 12 | 15 | 6 | 21 | 6 | 91 |
| 5 | *Chaetodon octofasciatus* | 21 | 18 | 15 | 13 | 17 | 10 | 23 | 11 | 128 |
| 6 | *Chaetodon oxycephalus* | 17 | 12 | 6 | 14 | 23 | 21 | 31 | 14 | 138 |
| 7 | *Chaetodon vagabundus* | 21 | 19 | 12 | 17 | 21 | 12 | 24 | 9 | 135 |
| 8 | *Chelmon rostratus* | 15 | 12 | 9 | 7 | 11 | 6 | 18 | 2 | 80 |
| 9 | *Coradion altivelis* | 17 | 13 | 23 | 19 | 12 | 9 | 17 | 6 | 116 |
| 10 | *Coradion chrysozonus* | 19 | 11 | 7 | 8 | 13 | 9 | 18 | 4 | 89 |
| 11 | *Coradion melanopus* | 14 | 11 | 21 | 18 | 12 | 9 | 24 | 9 | 118 |
| 12 | *Heniochus diphreutes* | 23 | 27 | 17 | 13 | 21 | 11 | 32 | 9 | 153 |

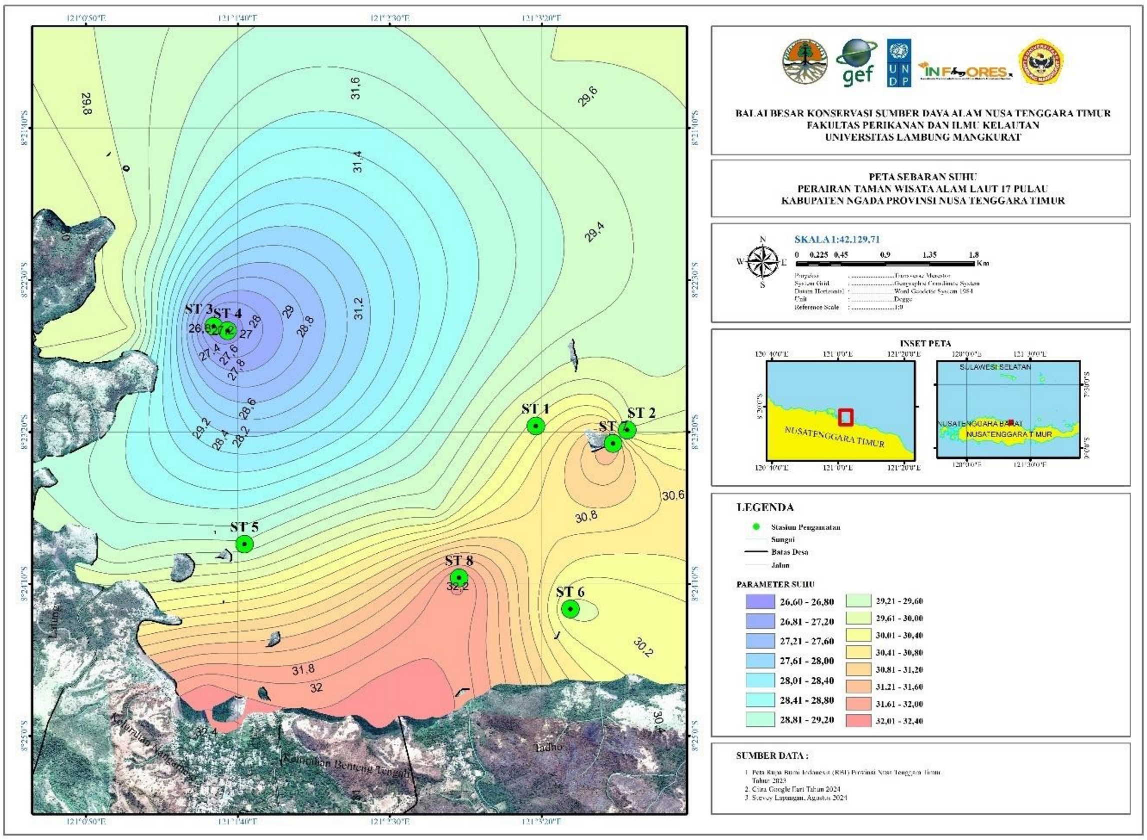
Appendix 8

Physical and Chemical Parameters of Water Quality at the Study Site

| Station | Coordinates | Time (WITA) | Parameter | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Physical Factor | | | Chemical Fact | | |
| | | | Temperature °C | Brightness | Current (m/s) | Salinity (‰) | pH | DO (mg/l) |
| 1 | 08°23'18.90" S<br>121°03'18.14" E | 12.48 | 29.8 | 4m / 100% | 0.0083 | 40 | 7.8 | 6.5 |
| 2 | 08°23'19.39" S<br>121°03'48.22" E | 14.25 | 30 | 3m / 100% | 0.0083 | 37 | 8.2 | 6.9 |
| 3 | 08° 22' 45,267" S<br>121° 1' 32,123" E | 9.27 | 26.7 | 6m / 100% | 0.0082 | 36 | 7.7 | 7.2 |
| 4 | 08° 22' 46,723" S<br>121° 1' 36,663" E | 10.4 | 27.2 | 6m / 100% | 0.0083 | 36 | 7.7 | 7.2 |
| 5 | 08° 23' 56,911" S<br>121° 1' 42,211" E | 11.25 | 29.4 | 7m / 100% | 0.0075 | 37 | 7.3 | 6.8 |
| 6 | 08° 24' 18,306" S<br>121° 3' 29,516" E | 12.33 | 30.1 | 4m / 100% | 0.0076 | 36 | 8.1 | 7.6 |
| 7 | 08° 23' 23,839" S<br>121° 3' 43,590" E | 14.15 | 31.7 | 7m / 100% | 0.0078 | 38 | 8.2 | 8.3 |
| 8 | 08° 24' 8,050" S<br>121° 2' 52,871" E | 16.1 | 32.3 | 2m / 100% | 0.0081 | 39 | 8.4 | 7.8 |
| Kepmen LH No 51 Thn 2004 | | | 28 -30 | > 5 m | | 33 - 34 | 7 - 8,5 | > 5 |

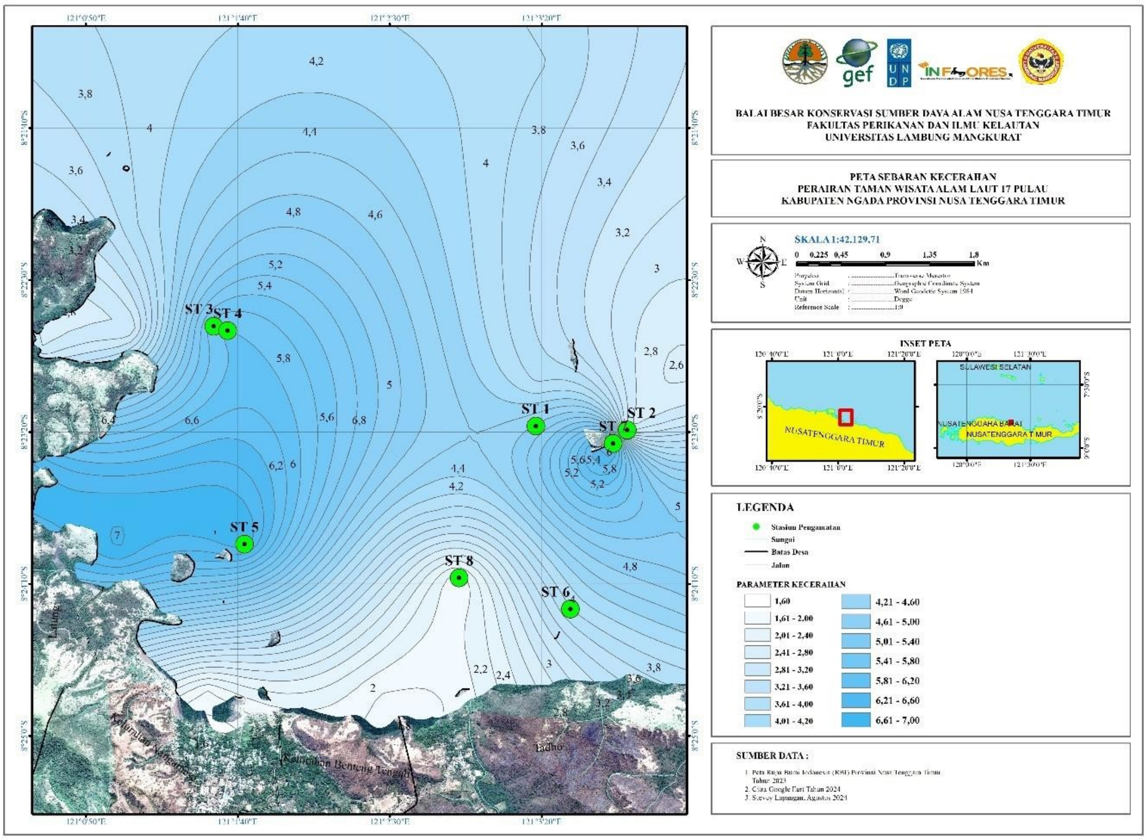
Appendix 9

Map of temperature distribution in the waters of TWAL 17 Island Riung Sub-district, Ngada Regency, East Nusa Tenggara Province



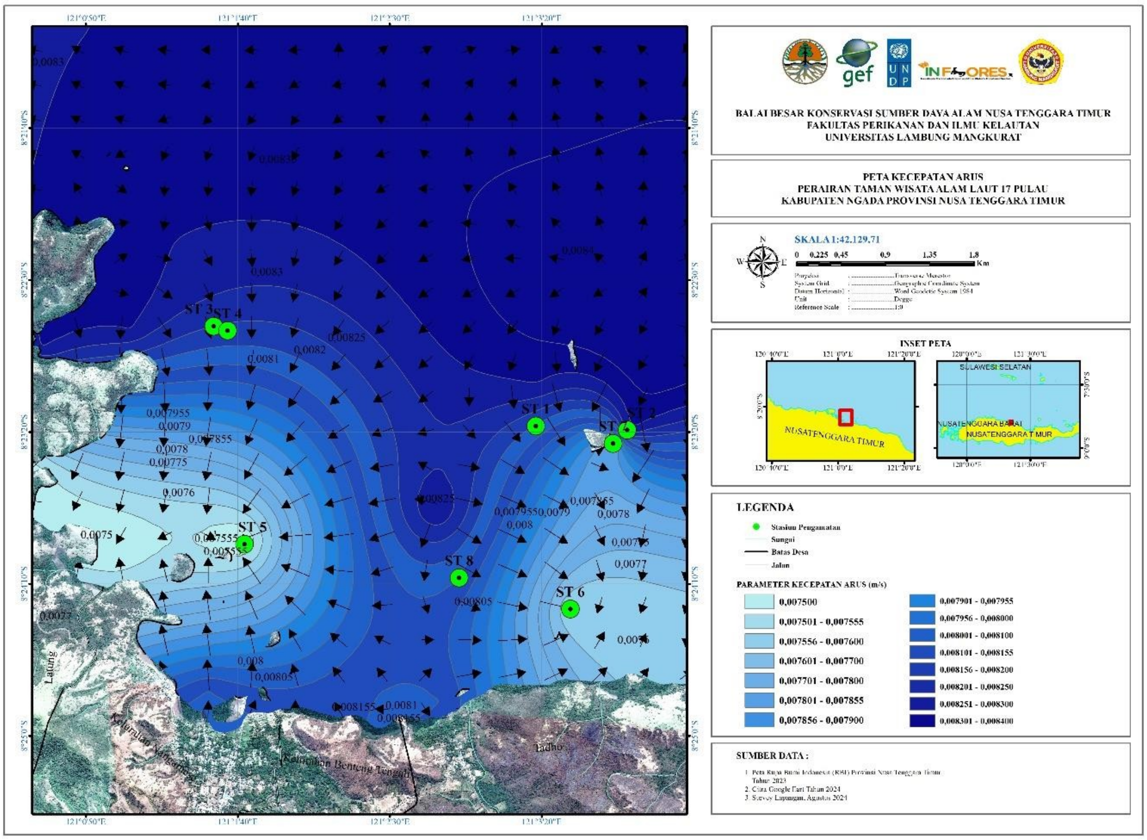
Appendix 10

Brightness distribution map in the waters of TWAL 17 Island Riung Subdistrict, Ngada Regency, East Nusa Tenggara Province.



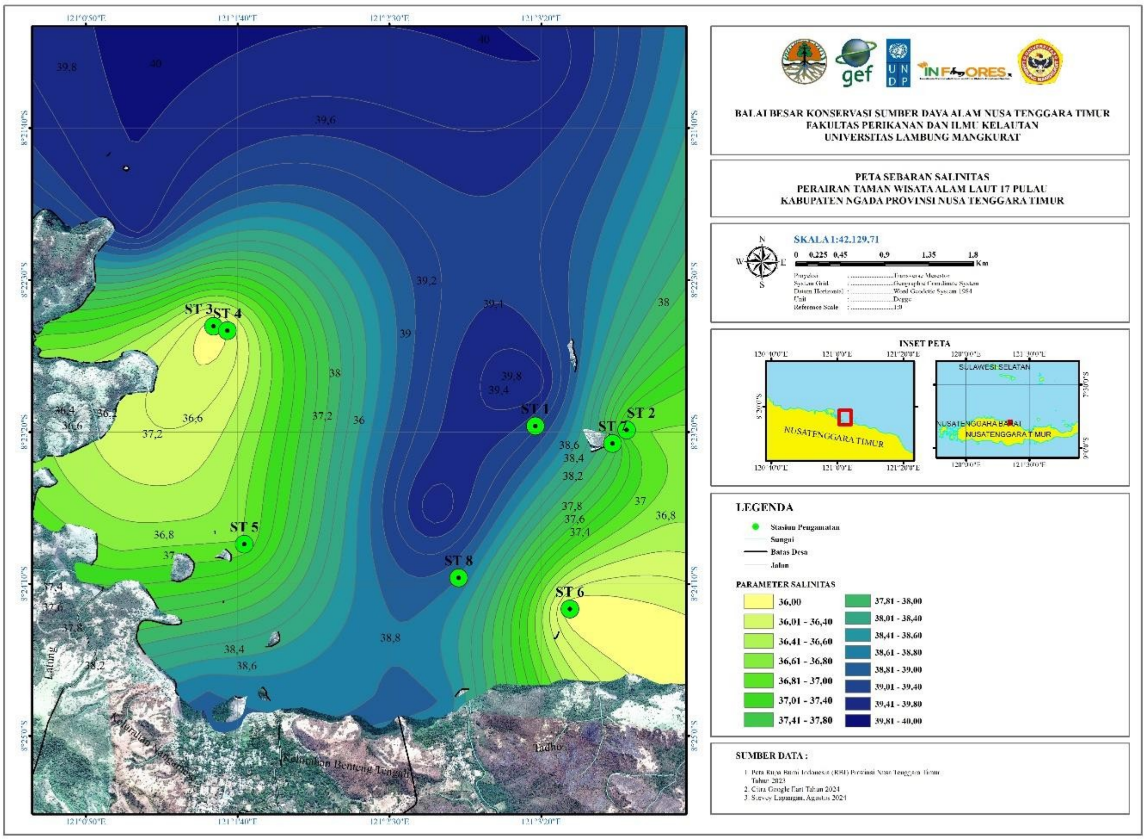
Appendix 11

Map of current speed in the waters of TWAL 17 Island Riung Sub-district, Ngada Regency, East Nusa Tenggara Province



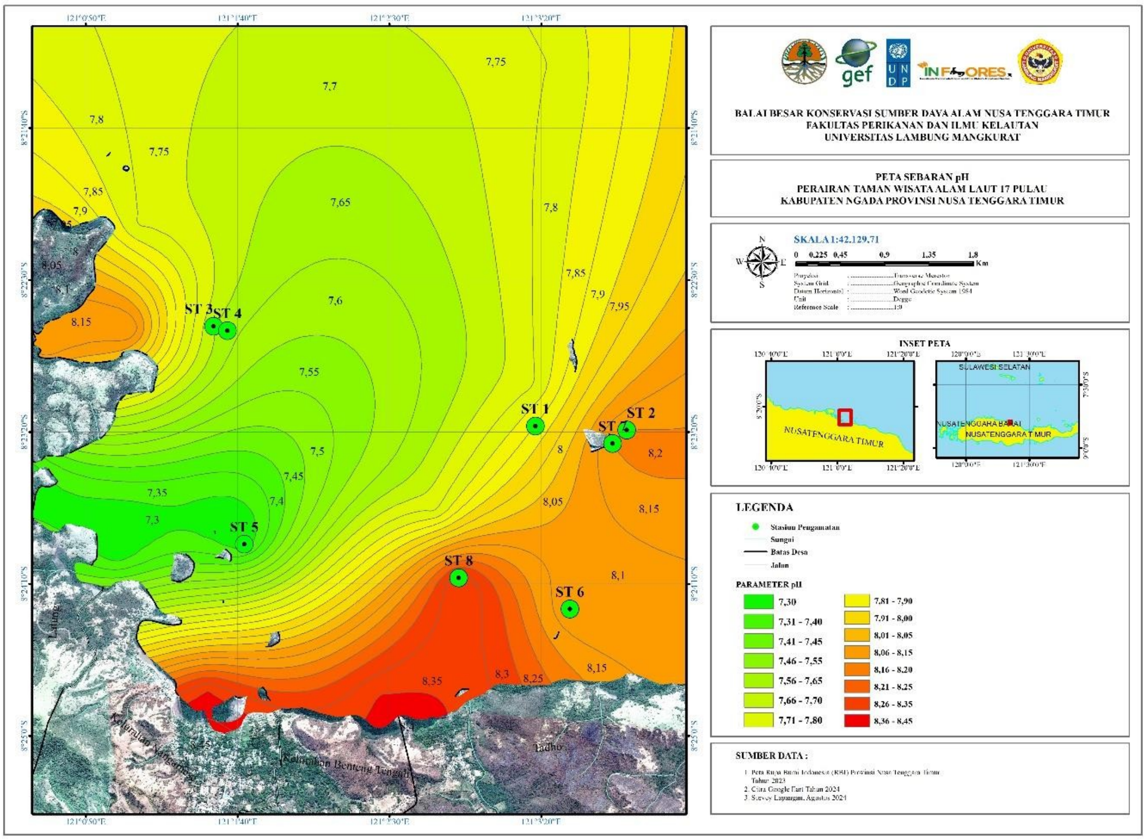
Appendix 12

Salinity Distribution Map of the Twal 17 Island Waters, Riung District, Ngada Regency, East Nusa Tenggara Province.



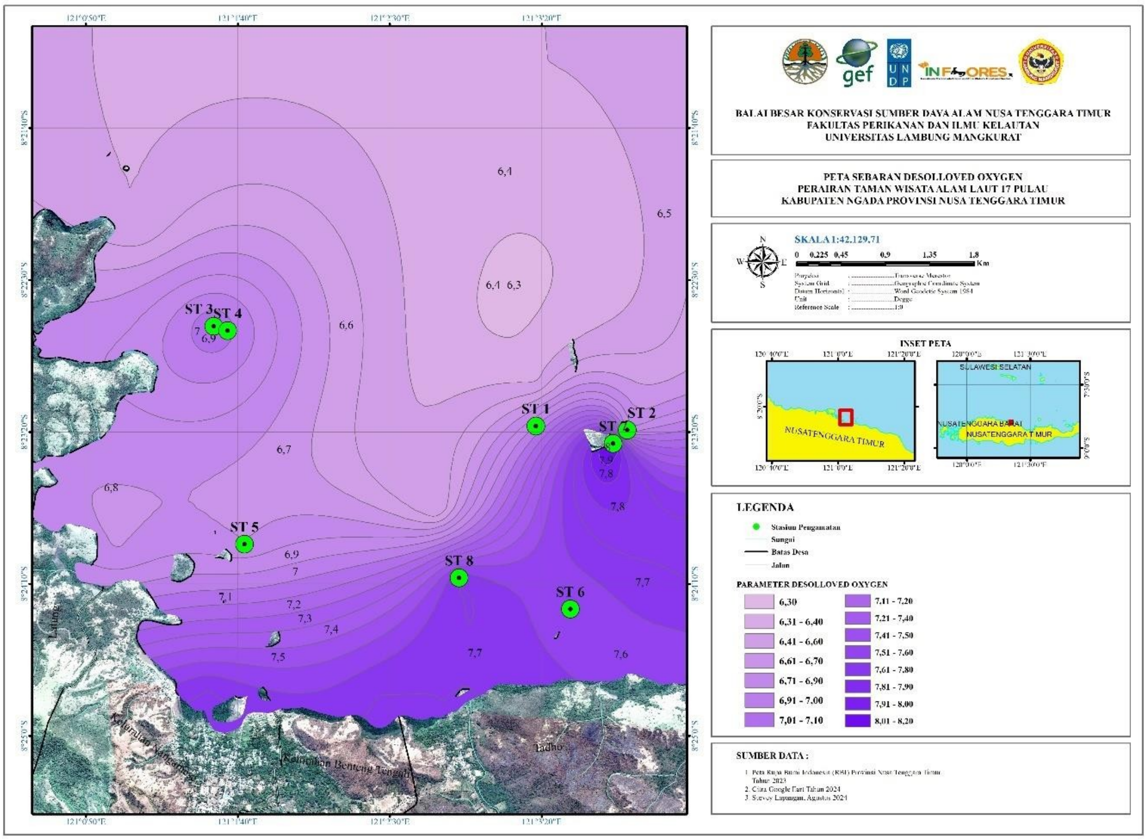
Appendix 13

Distribution Map of Acidity Level (Ph) in the Waters of TWAL 17 Island Riung Subdistrict, Ngada Regency, East Nusa Tenggara Province.

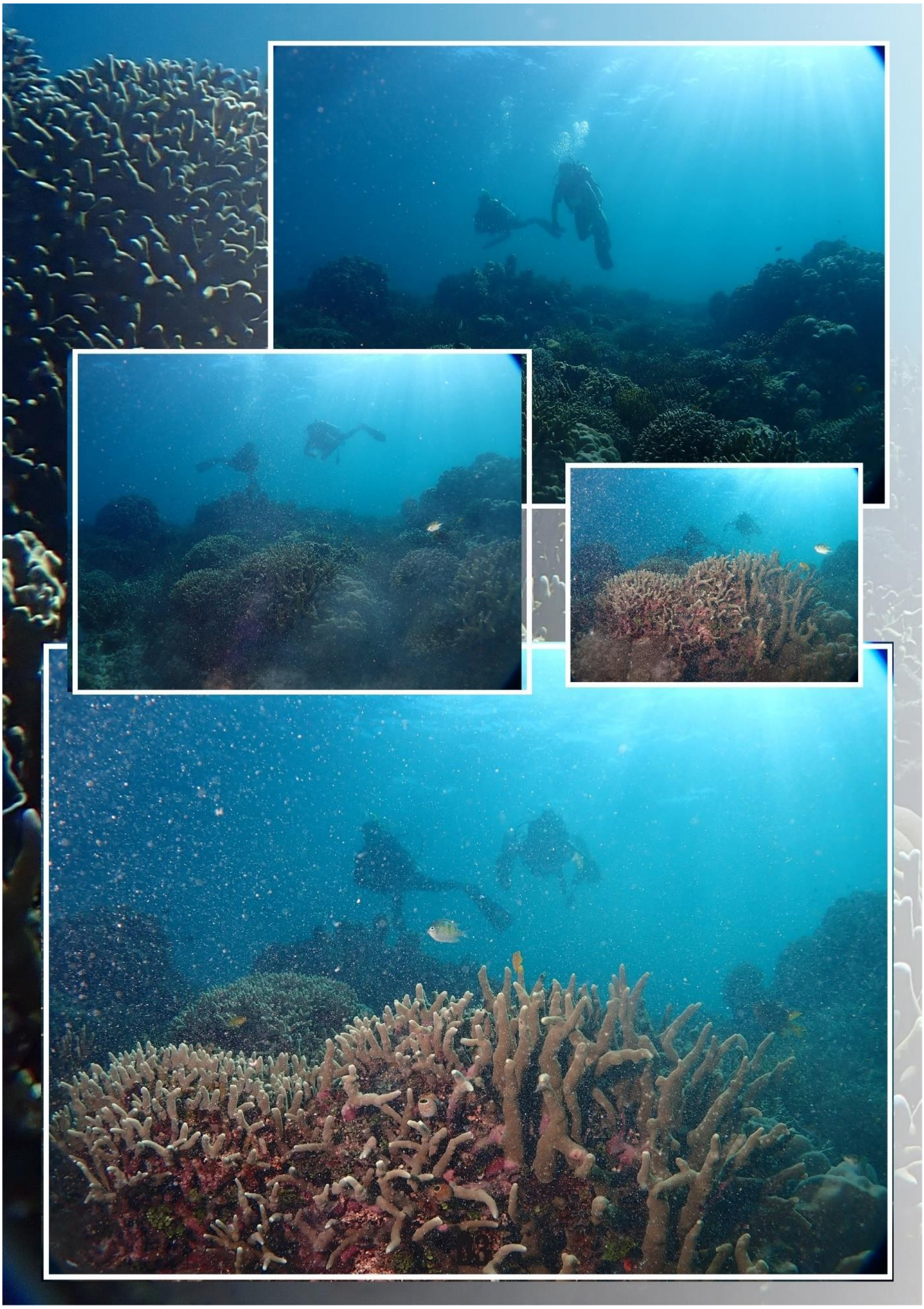


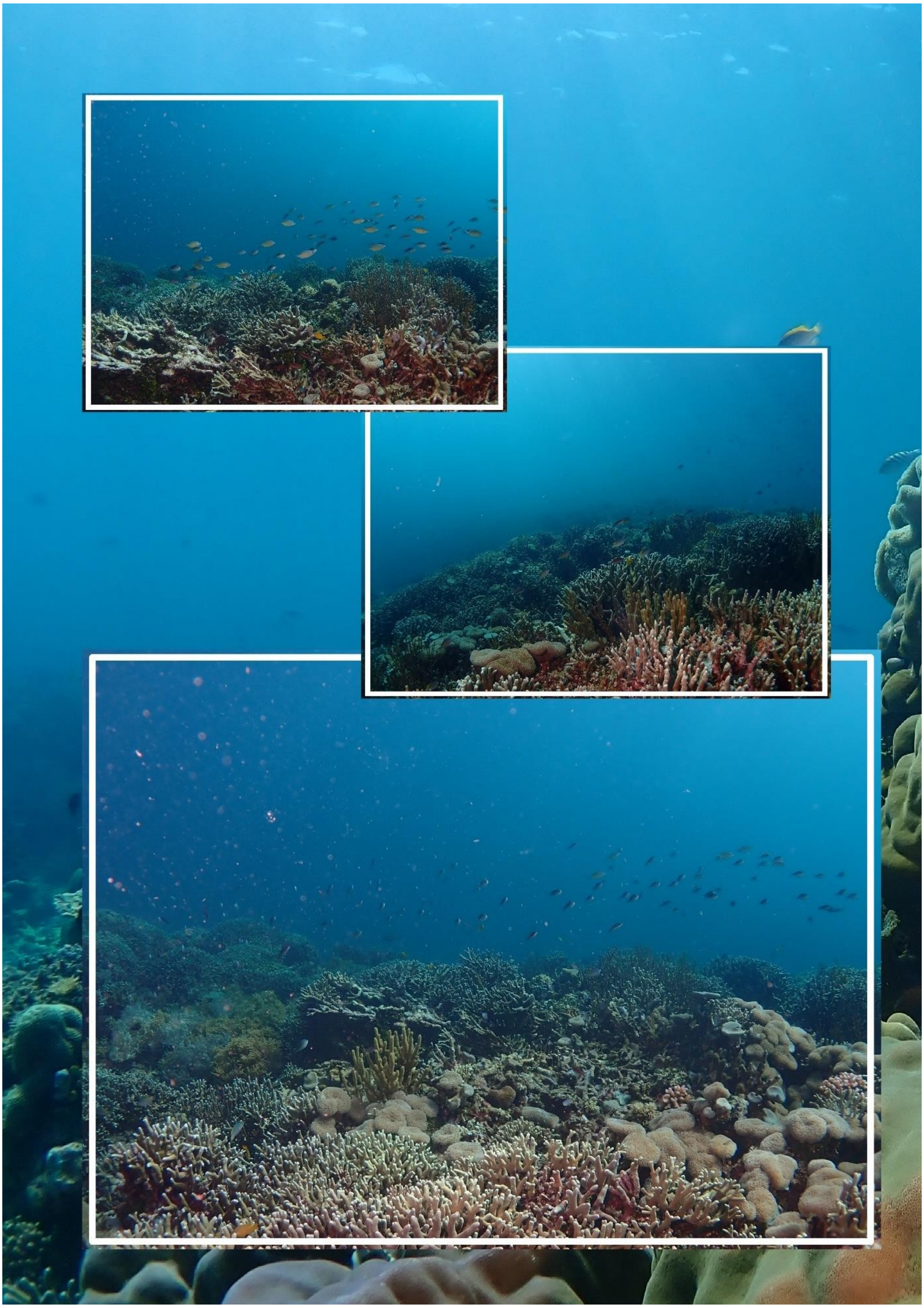
Appendix 14

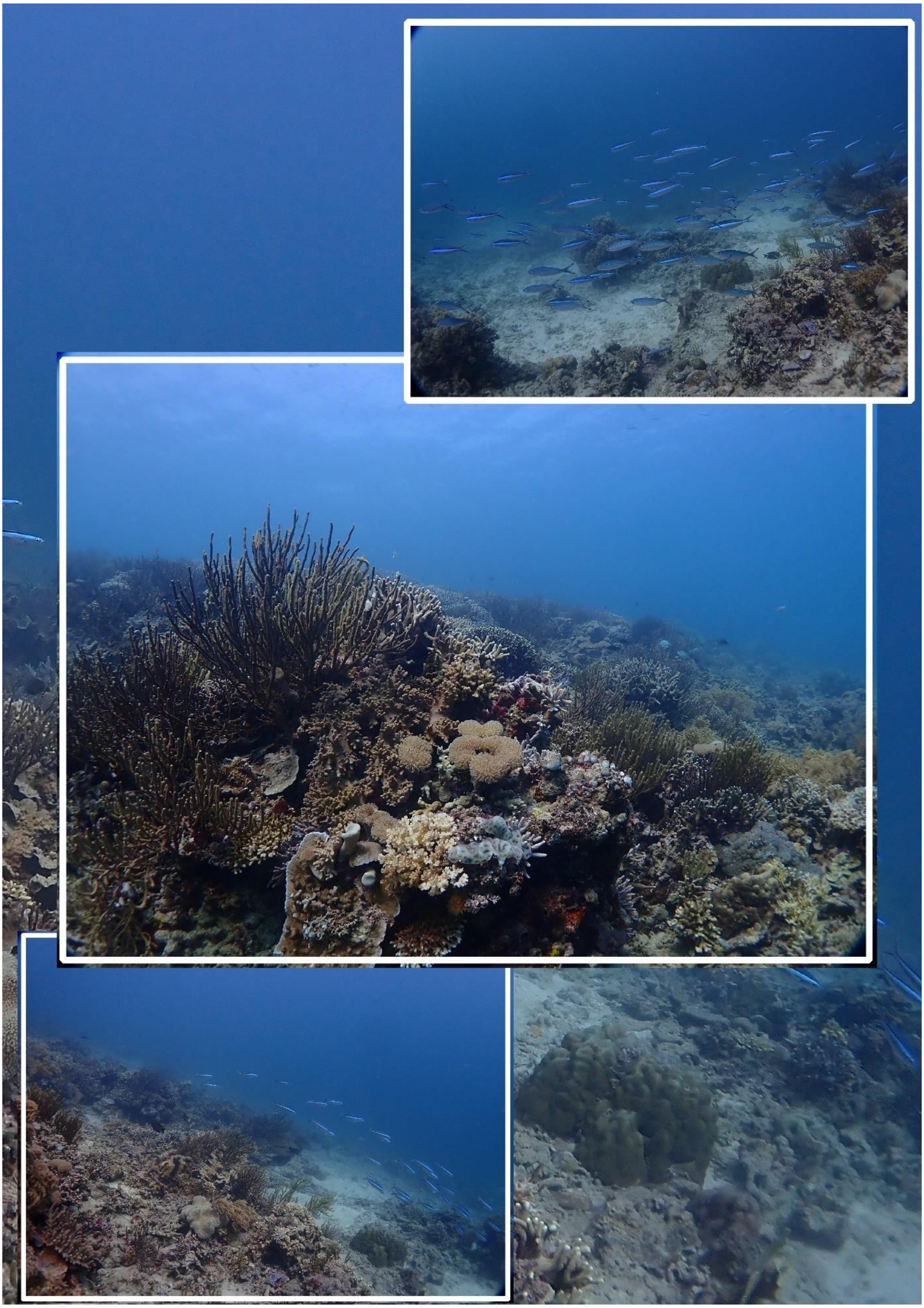
Dissolved Oxygen (DO) Distribution Map in the Waters of TWAL 17 Island Riung Sub-district, Ngada Regency, East Nusa Tenggara Province.

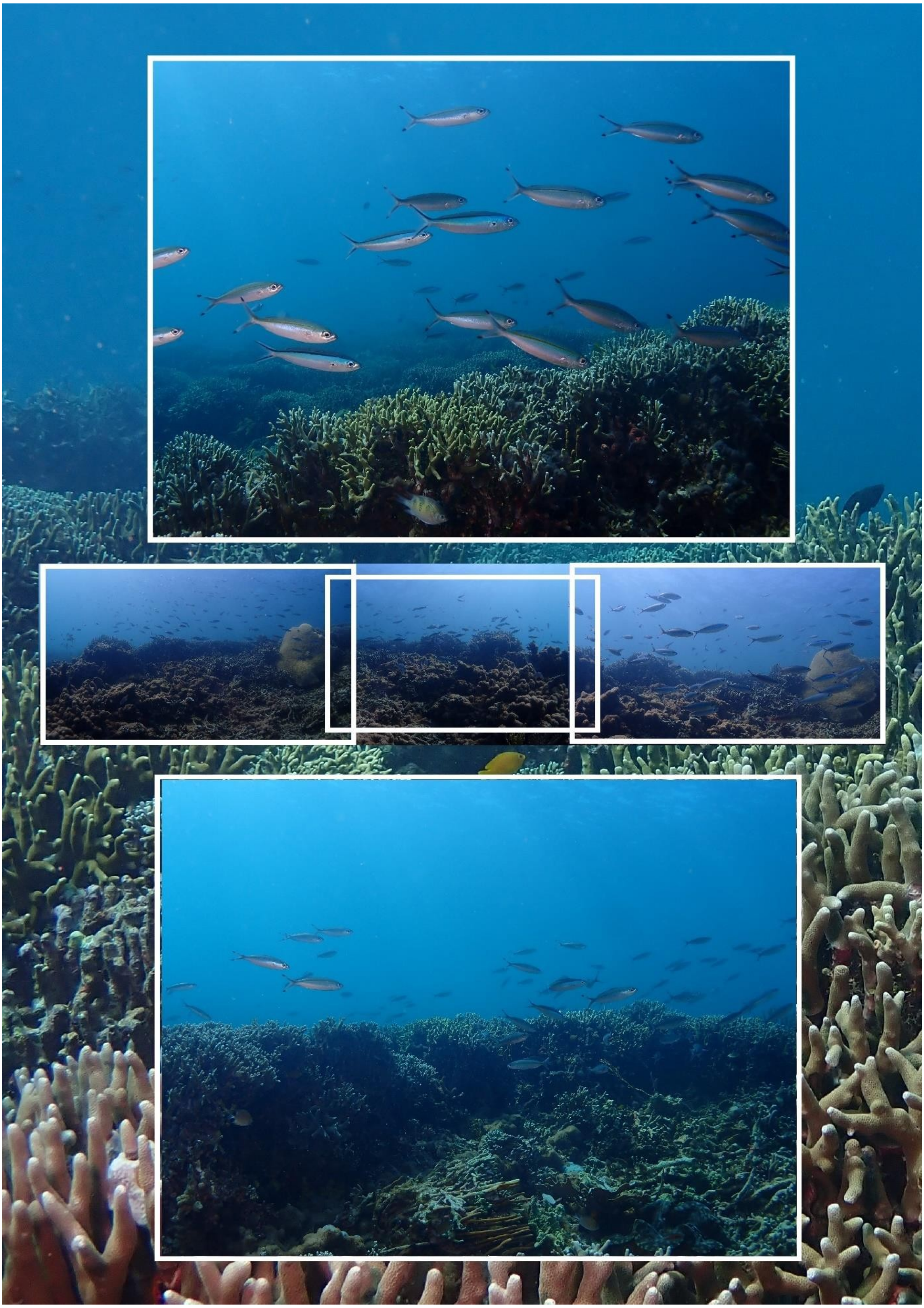


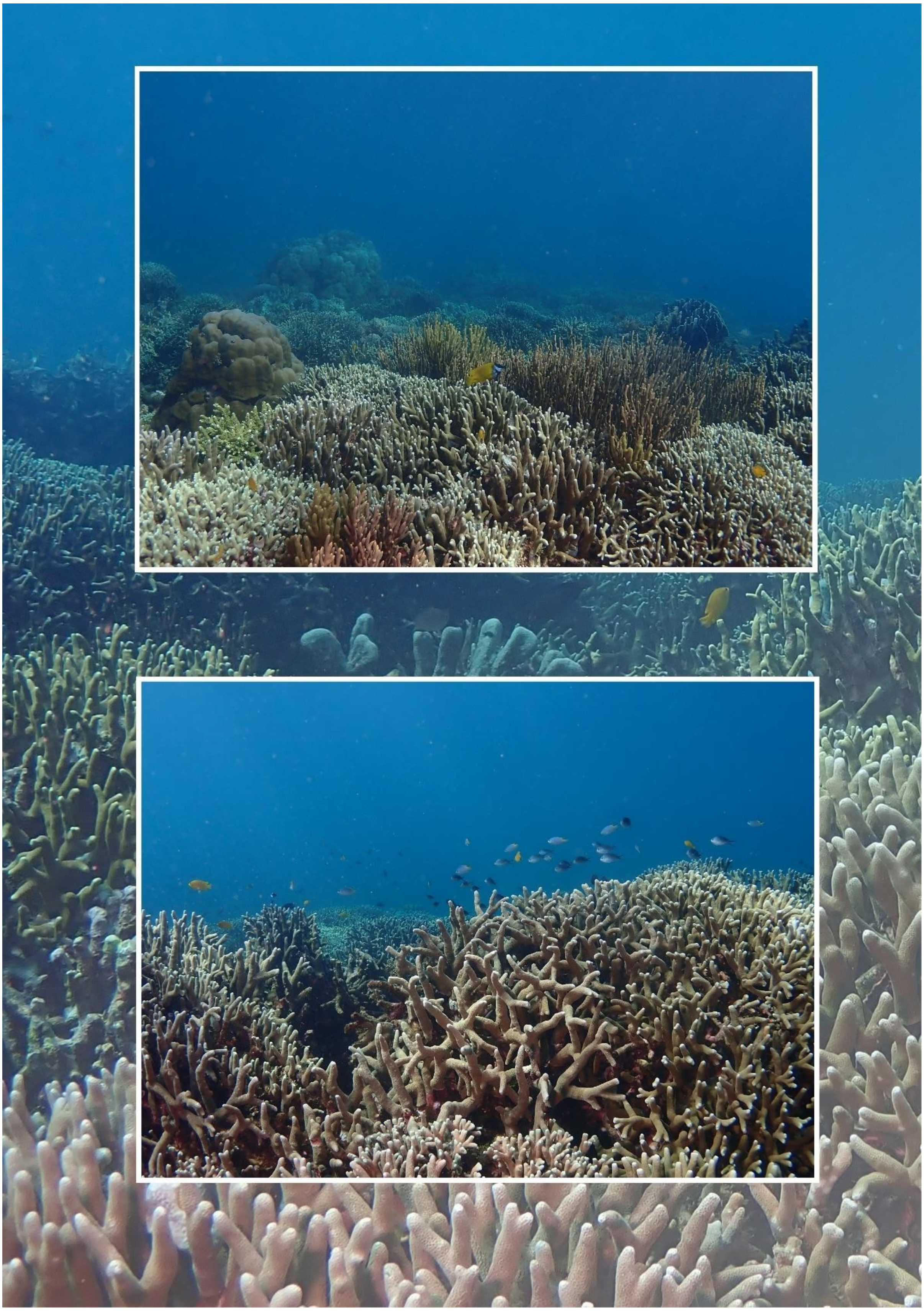
# DOKUMENTASI KEGIATAN












BBKSDA NTT
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Appendix.

Memorandum of Cooperation Agreement.

NO¥A **PERJ** **W KKBJagA5Lg**

**ANTAAA**

**NUSA TENGGARA TIMUR**

**DENGAN**

**FAKULTAS PERIKANAN DAN ILMU KELAUTAN**

**UNIVERSITAS LAMBUNG MANGKURAT**

**TENTANG**

**PROGRAM KEGIATAN KONSERVASI PERAIRAN PADA BALAI BESAR KSDA NUSA TENGGARA TIMUR**

Xoux'r: 0I/X.J/BX6'II/TtJ.1/7'2024

Mannar: 7tXrt. fi.ll° 4

Pxnpag y "ang Imtm'ta ungen difa

LBa I Besar Karl tl b "r Oaya Alam Nsa Ty T\sur

wJahu K "pda Uubzzg KflIJA \ iJa;ah ll BBKSUA N "I "F scleku Pcjabs Pmzztnias Ktuoitzism in-Florcs Tatms 2024. bczttat t uoaA da' atas raom Babti Bemr Koizmwasi St-nbsr Dayn Alaa Nåns Tcnggara 1luttu. yyng fmke'hdu€an di yaag hcrk<luLao di 7I. SK Lerik No.1 Kelapa Lima Kota Kupang Nusa Tenggara Faaw. srlanjatuys aixtxa PtBaK KTSATL! .

I.**Fakultas Perikanan dan Ilmu Kelautan Universitas Lambung Mangkurat**

diuxLili öI¢h Dz'. m. B. Llataeg 8gP.

Uał+'ersizas Laez¥-ng MaagłzmsŁ yaog dian$a hczdmazŁan Kcptflxaao Rckas L'aivczsizaa tebtutg hdangktus Nr. . ł 7&ż4J?48/K '^Aż3 tm$$d 01 Noveaibes 20?J dsngus so sah sah nscwakil' W bczt act txuuk Ma Hza nuoa Fxkukaa Ptnidaa lłfau Kelo ml Uzń¥wrdias M urai vazi berkedudukan di A.Yani Km 32 Loktabat selanjutnya disebut **PIHAK KEDUA** ;

I. **PIHAK KESATU** Memiliki Rencana Kerja Tahunan pada tahun anggaran 2024, yaig akm dikk- na au usMia za¢€an?uac s lata dmgan PgNAX K6DL!A.

1 PgHAK KEBUA agdab ta&aini poztcrietdt others who ztxm has kompotixa4 dJuts Pa¢¥ii'tiäea du PeneJJtJaa PezzLanaa daa lbnu Keiautoz. o n "m "rtiv

tenaga kelautan yang professional bersertifikat instruktur, memiliki/pemegang hak

| PIHAK KESATU |
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z. z-ıHzE ı 'Lsaz'\ aka tıHat¢ ı'P.hua my
**PIHAK KEDUA** sebagai pelaksana kegiatan 1) pelatihan dan sertifikasi selam,

seeaa sx¥aEeLzb ztpe M }sag diMxaag}'aa zeba$ai biuJkuL

Jimilibi raBsîng-4o aüıg pbzzk dâluo ruzgLa – i un Protuatzı Kzgûzzafs Kxa mv mi
î*szaîruı psrla Italai T oar KgI7I buza Tcqggara Ttrour yaag didıîkıxıg olch Irrllorcs - L ıNlJr "î "ntıals 2f04 yim î) jxÎatiî+nrı dnn ifiku zc1wn, 3j îdmtifîkssi dm rrxxütnring biota laut di taman wisata alam (TWA) 17 Pulau Riung Kabupaten Ngada.

RLi 1LNGKtJF

Ruang lingkup pekerjaan yang disepakati dalam kesepakatan kerjasama ini adalah sebagai berikut : pelatihan dan sertifikasi selam, identifikasi dan monitoring biota laut di Taman Wisata Alam (TWA) 17 Pulau Riung Kabupaten Ngada.

**PELAKSANAAN**

Untuk melaksanakan satuan pekerjaan pada pasal 2 di atas, **PARA PIHAK**

P*) f-- zU-4 .l'"-* --Br- - *!^^* ^ ' -*t-sB-br î- -b
şxgaksa/ta PfHAE EEDL*A. yazgç suttxuaz lik Jaa Ee-umjibaa, kedtaJsd:w ty and
pccaî and füngşi dvi PPK PIHAIg K¥BAT£I scbag8î pcnazggpxtg jan+ab 8ztggarzut and Tim lekaena iri ¥'tNAX KfiDU1.

**PEMBIAYAAN**

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b. McodapaćLao ps\atîbezi œbaoŞak 15 œang porsmit yang bxscnîõŁØ intrs "xaeiw-i

(2) **PIHAK KEDUA** BERHAK:

a. Mendapatkan informasi dan data kawasan yang diperlukan dalam rangka

b. kłcodapsîŁæ pmdæapingBo of Bd8î Bcsæ XSDA LEFT atxzæ 8>=....^ --

c. Mendapatkan Dukungan anggaran pelaksanaan kegiatan sesuai RAB kegiatan.

kc4c-rsrnpiłan Î s Ł i l [j idcniiŁlkesî dao aumibxśng" biafa ł a b i , Lesersa łağonut cLm

kepada **PIHAK KEDUA** setelah perjanjian kontrak kerjasama ditandatangani, dan sż0eaş- sxbnnyak ?fRt akzn atan rildi PgŒAlg KB TU r¢tclsłi I'ïH1K KF.GÎ!A msİzdad'ør "<zah tsrl-n łoşxtłaø b'zxsrtn iuera 5"#rig has Jierşøhui '4di koAza Lcl8h pîhaL

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tidak segera ditindaklanjuti sebagaimana pelaksanaan ketentuan Pasal 3 dalam kesepakatan kerjsama ini, maka dengan sendirinya kesepakatan kerjasmaa saling

| PIHAK KESATU | PIHAK KEDUA |
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| PIHAK KESATU, | PIH  EDUA, |
| --- | --- |
| Dibuat di : Ruteng | FAKULTAS PERIKANAN DAN ILMU KELAUTAN |
| Pada Tanggal : 9 Agustus 2024 | UNIVERSITAS LAMBUNG MANGKURAT |
| PIHAK KESATU | |
| METERAI TEMPEL | |
| Daniwari Widiyanto, S.Hut, M.Si | **Dr. Ir. H. Untung Bijaksana, MP.** |
| NIP. 19810119200  11006 | Dekan |

Attachment.

Decree of the Dean of FPIK Regarding the Appointment of the Implementation Team

KE tE TER1AI't P£NDîDIKAN AND KEBUDAYA AN
RISFT. OAt-i TECHNOLOGY
UNJYERGJTAS LAMBUNG MANGKURAT
FACTORY OF FISHING AND FISHING SCIENCE
J1. A. Yani Kfvt. 36 Bacjxbaru 70714
Telepon : (0511) 4772124 Laman : http//fpik.ulm.ac.id

**KEPUTUSAN DEKAN FAKULTAS PERIKANAN DAN ILMU KELAUTAN**
**UNIVERSITAS LAMBUNG MANGKURAT**
Nomor : 2913/UN8.1.27/KP/2024
TENTANG :
**PENGANGKATAN TIM PELAKSANA**
**PROGRAM KEGIATAN KONSERVASI PERAIRAN PADA BALAI BESAR KSDA**

**DEKAN FAKULTAS PERIKANAN DAN ILMU KELAUTAN UNIVERSITAS LAMBUNG MANGKURAT**

Nusa Tenggara Timur dengan Fakultas Perikanan dan Ilmu Kelautan Universitas Lambung Mangkurat Nomor 01/K.5/BKWII/TU.1/7/2024 dan 1gmr7Bf1lTWES.0Z 4Tmümg9mgxnK WnnenniFtm#nn At Balai %m Kedi Ne Topları Tiıxaır

b. Oehea "mzk terma£sud ıersebuı yada pcia (ay di au perk dixta

Mengingat : 1. Undang-Undang RI Nomor 20 Tahun 2003 tentang Sistem Pendidikan Bgask;eatl I L¢gfzteı-aa |-gqggm &0publik ladonçgla I aJ-ıun *8(lî Ncxncır +g, Tandahan Leizgaraa I/egxra Aepubiik lodonesîz New 4301J:

2. Mıxtaog-Uadaog tU Ne 12 "Jatıuıı 20I 2 g Pmdîdikxn 1 "Inggı P Iaı-aı N "şva R "puî'lîk Iıxkm "xîs Talx n 30IZ H n1t'v 158. Tazbal'aı t<rntarau wcgara Itcpublik ln i- N 5J36y

î. PursMan Pumotnısh N'm'r' ı Taisurı I460 fmuaxg PmJirian tJnûsr" Lambong û4ang un ( I Âoıbdon Lcnıbaan Meg-a k-I-ıhI* h'd ncs-a

4. Peraturan Pemerintah Nomor 4 Tahun 2014 tentang Penyelenggaraan Pendidikan Tinggi dan Pengelolaan Perguruan Tinggi (Tambahan Lembaran Negara Republik Indonesia Nomor 5500);

5. Peraturan Menteri Riset, Teknologi dan Pendidikan Tinggi RI Nomor 42 Tahun

dirubah dan ditambah dengan Peraturan Menteri Riset, Teknologi dan Pendidikan Tinggi RI Nomor 11 Tahun 2018 (Berita Negara Republik Indoensia Tahun 2018 Nomor 474);

S. Pee uran idurx¢rl Rk<g, 1e1 "oïngi doo Pendïdikazs "IiaggJ 6I Nc-rnnr J4 Tohun 2015 t "nsrqt St dar Nuiraul PmdidiLan Ting2i f8eritn esmu Rcpa IiL &cbxasie 7aAuzi OIS Non 952),

6. Pcratarxn jdcnerï Rij 1'okrolu$j and 'cnd6dikan Tinggi RI Nc-rflnr J1 Takuo 2Olü a y Susnxa \Jnitetsizaa Lwntxssg Mxigkwat f8crila Ect -a piiz a i' - - *na N- 1*a':

7. f'ge@urqn I¥j . RisaS, Tokr "dwgi and Pend lid Tinggi RI Nomnr W Tal u 20.6 r x..=- z--iia-i ' aids g'toxaawez dat 'I aa cera Pclaäxasaao 9mi Penelili¥n dong-n Mc'yguragan Szandar BÏa¿a i¢elua-o (0-ira Nagaz- RJ zahrtn ZO ï6 4'-" x I6ti1 yaxg tel¥k diuïatt and üüunfah Pczsturan fdeuKri kiscL i c t .n-k'xi duo' Pendidikan Tinggi RI Nomor 27 tahun 2019 (Berita Negara Republik Indonesia Tahun 2019 Nomor 396);

8. Keputusan Menteri Pendidikan, Kebudayaan, Riset, dan Teknologi RI Nomor 58843/MPK.A/KP/KP.06.02/2022, tanggal 9 September 2022 tentang Pengangkatan Rektor Universitas Lambung Mangkurat Periode Tahun 2022-

9. K¥jaxusazt Ra¥sïB- LILM Zo, l7gZ/L.' g/kf'r2f}2$ TaoggaJ Ol Nos<mlas- Z0*3. bcrheniJxe Dekxn f aLuIi-s l'zztkarms dao läzsu New Universitas Lambung Mangkurat Periode 2019-2023 dan Pengangkatan Dekan FakultBs l-crik-san dau lknu kclaaiao Uni+srsias Laabuog fvlartgkvzat Pc'raxfs Six.'1-2bZ7.

**M E M U TU S K A N**

$¢"pi¥usen D-ksa F "ahuIM Padutrian M Ilmit Kek "isn Uni-or-ass Lamf-in8 ?flangburai Tentazig I-cngaegkxian Tim PclaLsaoa Prograïs ¥ayürlwi Koascrvasi Pe aJ "us PaJa IÏxIaJ èlasar kSUA huss I'atggera timur

Pf-R TAMA fdmigjn "kut ilaato-iuota mrcarnazzi pade Ï a z s p !r-+ -zrat k-pu Wt'acai r'm M k wa uitenzzocaAhi i'zc1AeAr' sun "r.Rx' rr'.izAIRA "i yApA aM-AI Br:i'AN zcsDA rrtiM Yzxf fi4RA Tlvt'R

KEDUA Keputusan ini mulai berlaku sejak tanggal ditetapkan, dengan ketentuan apabila di kemudian hari terdapat kekeliruan akan diadakan pembetulan sebagaimana

Ditetapkan di : Banjarbaru
Pada tanggal : 9 Agustus 2024
Dekan,

UNTUNG BIJAKSANA
NIP. 196405171993031001

LAMPIRAN
KEPUTUSAN DEKAN FAKULTAS
PERIKANAN DAN ILMU KELAUTAN
UNIVERSITAS LAMBUNG MANGKURAT
NOMOR : 2 9 1 3 /UN8.2/KP/2024
TANGGAL 9 AGUSTUS 2024
TENTANG
PENGANGKATAN TIM PELAKSANA PROGRAM
KEGIATAN KONSERVASI PERAIRAN PADA
BALAI BESAR KSDA NUSA TENGGARA TIMUR

**TIM PELAKSANA PROGRAM KEGIATAN KONSERVASI
PERAIRAN PADA BALAI BESAR KSDA NUSA TENGGARA TIMUR**

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| 5. | Akhmad Sahril, S. Si | | Anggota |

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Pada tanggal : 9 Agustus 2024
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