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The Status of Diversity of Coral Reefs and Reef Fish Supporting Marine Tourism on Kodingareng Keke Island, Makassar City.

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Abstract

This study aimed to determine the potential diversity of the coral reef and coral reef fish ecosystems of Kodingareng Keke Island and the development strategies and priorities of Kodingareng Keke Island as a marine tourism destination. This research used purposive sampling with 50 respondents. The coral data collection method was Line Intercept Transect (LIT), with a transect line length of 50 meters and depth of 5 meters. The process used to obtain coral reef fish data was the Underwater Visual Census (UVC). The analysis showed that the average coral ranged from 63,6% to 77,8%. The average abundance of fish at 3 observation stations, namely Station I (17,65%), station II (14,78%) and Station III (18,67%), thus it can be concluded that this location is feasible for snorkelling and diving tourism. The priority programs for the development of the marine tourism area of Kodingareng Keke Island include increasing supervision, creating periodical Object Development Master Plans (RIPO), implementing local regulations on the use of coastal resources, involving local communities, the general public and the government in nature conservation activities, setting labour standards and improving the quality of local human resources through training.

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Introduction

Tourism is one of the essential mainstay sectors that can provide economic improvements for coastal communities, the Nation and the State. Currently, beach tourism is one of the areas that can develop very quickly in many coastal countries (Bergmann et al., 2017). Marine and coastal tourism is an inseparable component of the growth of the global tourism industry (Leposa, 2020).

The provision of community welfare can be obtained from the provision of environmental goods and services originating from marine and coastal ecosystems. Community social development, especially in coastal areas, can be encouraged by marine

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and coastal ecosystems (Hatam et al., 2015; Fachry & Alpiani, 2021). The International Coastal Maritime Tourism Society defines coastal and marine tourism as an entertainment activity travelling from home to tourist attractions. Tourism activities focus on marine areas and small islands (Orams & Lück, 2014). The concept of coastal and marine tourism includes various activities with maritime nuances, such as recreational diving, snorkelling, fishing, swimming and boating.

Indonesia is known as one of the most maritime countries in the world, with an area of 2/3 consisting of water. This condition is undoubtedly one of the supporting factors and directly benefits Indonesia in developing coastal tourism potential and small islands. One of the areas in eastern Indonesia with a variety of coastal and small island tourism potentials is Makassar City. The potential for coastal and small island tourism in this region is very large to be encouraged and developed into coastal, marine and beach tourism. Most people who live in coastal areas have a livelihood as fishermen who depend on the sea for their livelihood by fishing to fulfil their daily needs (Fisher et al., 2014; Roswiyanti et al., 2022). Therefore, the community generally inhabits and uses the allotment of marine biological resource wealth, which is relatively high up to the limit of over-exploitation. This has a significant impact, such as a decrease in ecosystems in coastal areas which will ultimately affect the decrease in the income of the fisherman concerned.

Currently, the environmental conditions of coastal areas can be threatened very quickly because of their dynamic nature as a result of various human activities. This has a significant real impact on the coastal environment in the future. Therefore, serious attention is needed to overcome the impacts arising from tourism activities on the sustainability of coastal and marine tourism. Sustainable management in tourism development needs support from stakeholders, especially the local government and the community, so that a balance of the three (3) aspects can be achieved, namely economic, social and environmental aspects (Wang et al., 2016; Putri et al., 2020).

Marine area development plans must be linked to fundamental interests, namely empowering coastal communities. Coastal communities are people who have much knowledge about the objective conditions of their area, therefore in the development of marine tourism areas, an approach to the local community should always be initiated as a model of a participatory planning approach that places coastal communities in the possibility of sharing, increasing and analyzing their knowledge about marine and coastal life, plan and act (Muhtazib et al, 2022). Community-centred development emphasizes empowerment, which views community potential as the leading resource in development and views togetherness as a goal to be achieved in the development process.

Makassar City has enormous potential to be developed as a marine tourism area. This can be seen from the location and typology of the area, which is quite supportive. The coastal area has sandy beaches with beautiful natural views that can be enjoyed both during the day and at night. In addition, there are various tourism options for visitors in the form of outbound tours, theme parks, historical sites, and a variety of people's livelihoods with exceptional food that can be developed as a tourist attraction. Whereas in small island areas, there are beaches with typical island vegetation, various types of coral reefs and types of reef fish which can be developed as diving and snorkelling tourist attractions.

The coastal areas and small islands of Makassar City from the supply side are beautiful tourist destinations. In contrast, from the demand side, the potential for tourists to come is

quite promising because some tourists can spend quite a lot of money to enjoy the natural panorama of the beach, diving and snorkelling on the coast. And the small islands of Makassar City. Currently, tourism development is focused only on coastal areas, while on small islands, it has yet to be optimal. This is due to the low attention and seriousness of the Makassar City government in utilizing the resources of small islands for tourism utilization. This can be seen from the lack of facilities and infrastructure to support tourism on small islands, the low level of knowledge and welfare of the people in the field of tourism, and the tendency for degradation and functional areas to occur as a result of the low level of public awareness and respect for nature and the dominance of the economic aspect over the biological aspect. And social culture in area management.

Kodingareng Keke Island is one of the islands in Makassar City which has good potential for marine tourism to be developed. Its strategic location, quite close to Makassar, can be reached approximately 25 minutes from the Kayu Bangkoa Crossing Port, making Kodingareng Keke Island quite attractive to tourists to enjoy snorkelling and diving tours. Apart from the superior tourism potential of Kodingareng Keke Island, until now, the management of marine tourism on the island has not been carried out optimally, so the income of the community and Makassar City's income from the marine tourism sector has not been optimal.

This research was conducted to determine the potential of coastal natural resources and underwater objects and formulate strategies and priorities for developing Kodingareng Keke Island as the leading destination for marine tourism in Makassar City.

Materials and Methods

The research was conducted from January to March 2022 on Kodingareng Keke Island, Makassar City, South Sulawesi Province (Figure 1).

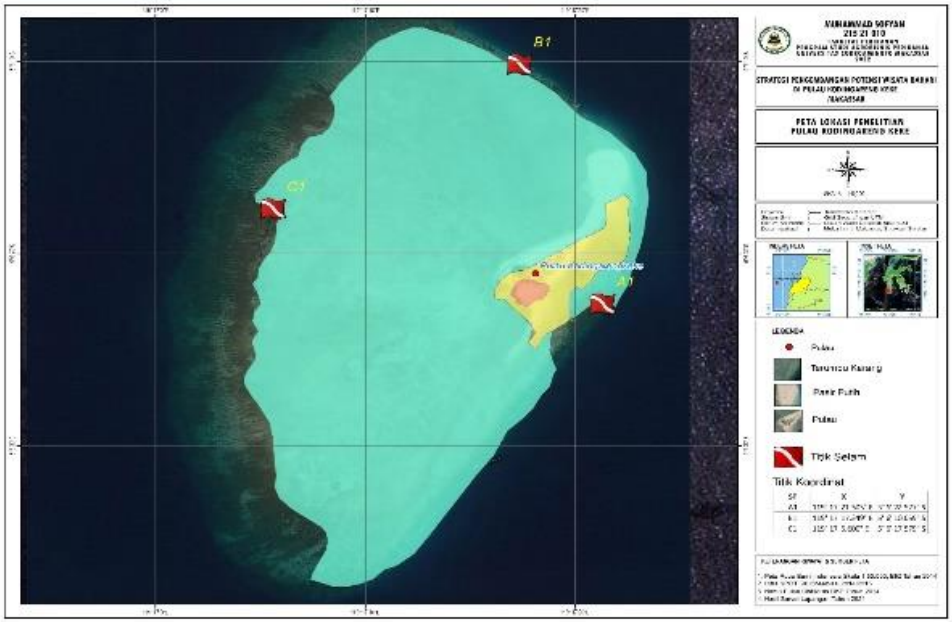

Figure 1. Map of sampling points for research locations

Materials and Tools

The tools used in this research activity are presented in Table 1 below:

Table 1. Research Tools

No	Tool's Name	Useful
1.	*Global Position System* (GPS)	Taking coordinates and tracking coral reef areas
2	Underwater digital camera	Documentation of coral reefs
3	Computer	Processing data
4	Roll meter	Measuring coral reef transects
5	Scuba diving equipment	Doing dives and collecting data on coral reefs
6	Steel frame (58x44 cm)	Observation of coral reefs
7	Waterproof paper	To write underwater
8	Boat	Field data collection sea transport

Work Procedures

Research Preparation

Before conducting research activities, tools and materials, as well as supporting references/literature, are prepared in advance to assist in collecting field data, namely collecting data on potential marine resources on Kodingareng Keke Island, collecting data using questionnaires and preparing cameras for documentation.

Dive Survey Preparation

Before diving on Kodingareng Keke Island, prepare a three-seat scuba gear with six tubes, an underwater camera for underwater documentation, a lone para pipe for coral reef transects, and a 50-meter tape measure. Before the dive, the station points will be observed for the condition of the waters. When diving, use a boat to the location of the diving point.

Retrieval of Data on Coral Reefs and Reef Fish

Data collection in the field using the Line Intercept Transect (LIT) method with a transect line length of 50 meters and a depth of 5 meters (Loya, 1978; Sarbini, 2016), reef fish data using the Underwater Visual Census (UVC) method is carried out by underwater shooting using a digital camera. A 50-meter-long transect was laid, and framed photos were taken at each meter. Shooting was carried out from the 1st meter on the left side of the transect line, followed by taking photos at the 2nd meter on the right. Continuous shooting is carried out until the end of the transect. So for odd meters (1st meter, 3rd, 5th,..) is taken on the left, while for even meters (2nd meter, 4th, 6th,..) on the right. Shooting starts from the transect of 90 cm in each meter (Manuputty, 2006).

Shooting should be done about 60 cm from the bottom of the substrate and done perpendicularly. Taking pictures of coral reefs and fish, assisted by two (2) people with two different roles, namely as a photographer and holding the frames (Kuiter & Tonozuka, 2001).

Coral Reef Photo Processing

The photos obtained are then analyzed with computer software such as CPCe. This analysis aims to obtain quantitative data such as the percentage of coral cover or other

substrates. The basic operations of CPCe consist of defining a digital image, defining frame boundaries, overlaying random points, identifying the coral species and substrate type under each random point, and saving the data to a file. After the images have been processed, the data can be automatically assembled into an Excel spreadsheet for statistical analysis. CPCe is specifically designed to flow logically from one operation to the next and to simplify and speed up processing efforts (Kohler et al., 2005)

The results of the analysis of all photos (50 photos) on one transect are then calculated automatically by the software used. Then quantitative data can be obtained.

Data Analysis

a) SWOT Analysis

The method to find strategies in the development of coastal and marine problems uses SWOT analysis in which there are internal factors (inside) and external factors (Strengths, Weaknesses, Opportunities and Threats) (Freddy, 2014) presented in Table 2.

Table 2. SWOT Analysis Table

Internal Factors / External Factors	Strengths	Weaknesses
Opportunities	SO Strategy	WO Strategy
Threats	ST Strategy	WT Strategy

Based on Table 2, 4 (four) bases are obtained in determining the Strategy, namely:

1) SO Strategy, used to take advantage of strengths to seize opportunities available in the external environment;
2) WO Strategy aims to improve internal weaknesses to seize opportunities from the outside environment;
3) ST strategy, used to utilize strength to minimize threats that come from outside;
4) WT strategy, used to reduce weaknesses and overcome external threats.

b) Priority Strategy for Marine Tourism Development on Kodingareng Keke Island

Prioritizing the Strategy for developing marine diving tourism on Kodingareng Keke Island by giving weights based on the degree of importance to each element of strengths, weaknesses, opportunities and threats based on respondents' perceptions in developing marine tourism diving Kodingareng Keke Island with the following details:

1) Very Important : 3
2) Important : 2
3) Less Important : 1

c) Analysis of Marine Tourism Development Programs

The analysis of the dive marine tourism development program on Kodingareng Keke Island was carried out after prioritization was determined based on the weighting, which was then formulated based on the elements forming the Strategy and then used as a policy direction in preparing priority strategies based on the ranking of each Strategy produced. From the resulting priority strategy, various development programs for Kodingareng Keke Island as a marine tourism and diving area were born.

Results and Discussion

General Condition of Kodingareng Keke Island

Kodingareng Keke Island is one of the 12 islands which are island and water tourism objects owned by the City of Makassar. This island is uninhabited, where at the lowest tide, there is a relatively wide plain composed of coral rubble material, especially in the waters to the west, which was formed due to the sedimentation process. On the island's south side, the beach is composed of coral fragments of various sizes, while on the island's north side lies white sand with fine–medium sizes. Meanwhile, the east and south waters are shipping lanes in and out of the Port of Makassar. With clear water conditions without contamination from city waste, Kodingareng Keke Island is an ideal location for marine tourism, especially diving, witnessing the beauty of coral reefs and the diversity of biota on the seabed. While on the beach, white sand stretches and is overgrown with several pine trees and other trees around it.

Kodingareng Keke Island is classified as a tourist attraction which is quite crowded with local and foreign tourists. There is no regular transportation to the island of Kodingareng Keke, so to reach the location of the island is done by renting a 40 PK motorboat (local boat) which is available at the jetty in front of Rotterdam at a rate of IDR 800,000/day. The trip to the island takes about 30 minutes.

Figure 2. Kodingareng Keke Island

Marine Tourism is a tourism activity that utilizes the potential of marine biodiversity as the main attraction. Marine tourism activities, in general, aim to obtain economic benefits primarily for the local community, tourism stakeholders and the local government.

Kodingareng Keke Island has the biophysical carrying capacity of the tourism environment. The availability of natural factors in the form of a white sand environment, coral reef ecosystem, artificial reef Atlantis garden and Japanese shipwreck is a unique attraction for marine lovers, especially diving. Another thing is supported by the availability of local boat facilities every day from Makassar to this island, which only takes 40 minutes.
Tourist visits to Kodingareng Keke Island, both local and foreign tourists, have started to get busy in the last five years reaching 1,135 tourists, consisting of 535 local tourists and 600 foreign tourists. Data on tourist visits to Kodingareng Keke island for the last five years are presented in Table 2 below:

Table 2. Data on Visits by Kodingareng Keke Island Tourists for 2017-2021

	Year	Total of Local Visit	Foreign Tourist	Tourist Destination
1	2017	165	74	snorkelling, swimming
2	2018	177	88	diving, sunbathe
3	2019	198	96	fishing, jetski
4	2020	233	115	diving, snorkelling
5	2021	256	125	diving, snorkelling

Source: Makassar City Tourism Office, 2022

The number of tourists visiting Kodingareng Keke Island, both local and foreign, especially from 2017 and 2018, has increased. However, there has been a decrease in visitors from 2019 and 2020 due to Covid 19, where there was a travel ban for foreign communities. In addition, due to the limited data on the latest underwater objects owned by the city government and the lack of resources that understand the development of diving tourism, the island of Kodingareng Keke needs to be faster to develop into a leading diving tourism object. Public facilities and infrastructure to support tourism activities on Kodingareng Keke Island, including the availability of lodging, restaurants, clean water facilities, docks and mooring ports for tourism ships, still need to be improved in quality and quantity.

Diversity of Coral Reef Ecosystems for Marine Tourism

A distinctive feature of marine tourism areas is the presence of natural resources of the coast, waters and biota in the area, which are still natural and attractive for tourists. Natural beaches can be in the form of white sand beaches that look stunning for visitors. The attractiveness of the waters for tourists can be the depth and clarity of the waters, which make it easier for visitors to swim and snorkel. While the biota in the area can be coral fish and coral reefs, as well as various other types of aquatic biota.

a) The marine natural resource potential of Kodingareng Keke island is shown from several parameters that support the development of the island as a marine tourism object, especially diving, including: a) oceanographic parameters, b) parameters of coastal and island typology, and c) biological parameters. These parameters were obtained by the author from secondary data from related agencies and recent survey data on the condition of the underwater coral reefs and coral fish of Kodingareng Keke Island, as follows:

b) In terms of physical oceanographic parameters, namely waves, surface currents, water brightness and sea water temperature on Kodingareng Keke Island, it shows that the wave height ranges from 10 cm to 15 cm but sometimes reaches 50 cm in the west monsoon. In addition, the speed of surface currents ranges from 1.13 cm/sec to 1.28 cm/sec, and the water brightness reaches 100% at a depth of 15 meters. Various marine tourism activities have great potential in this physical oceanographic condition. The marine tourism objects that can be developed according to the physical oceanographic conditions are snorkelling, diving, water skiing, windsurfing and fishing which can be done all year round.

c) In terms of coastal typology parameters, it shows that Kodingareng Keke Island has a very supportive potential for marine tourism with a sloping sandy beach profile and a slope at sea depth, which are standard criteria for various coastal and marine tourism activities. The types of marine tourism activities that can be developed based on the parameters and typology of the beach are sunbathing, beach volleyball, panoramic photography, swimming and diving.

d) In terms of biological parameters, which include the condition of coral reefs, coral fish and also several factors of underwater heritage which are very specific for the sale value of diving tourism, are described as follows:

The condition of the coral reef ecosystem and observations of reef fish on Kodingareng Keke Island was carried out by direct observation using the LIT (Line Intercept Transect) method with three observation stations at a depth of 5 meters. The results of observations at three different stations on three sides of the island showed that the average live coral cover ranged from 63.6% to 77.8%, so it can be concluded that it is very suitable for snorkelling and diving tourism. Data in the following figure:

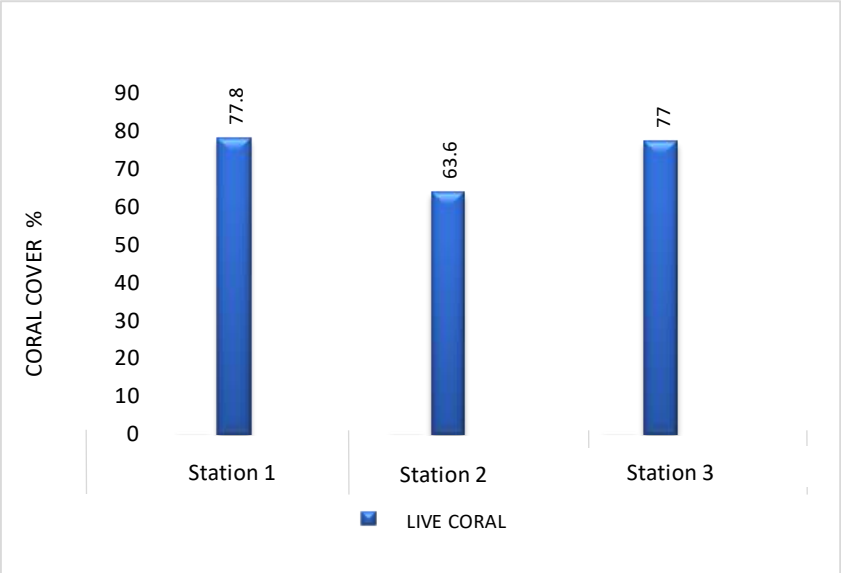

Figure 3. Percentage of live coral cover

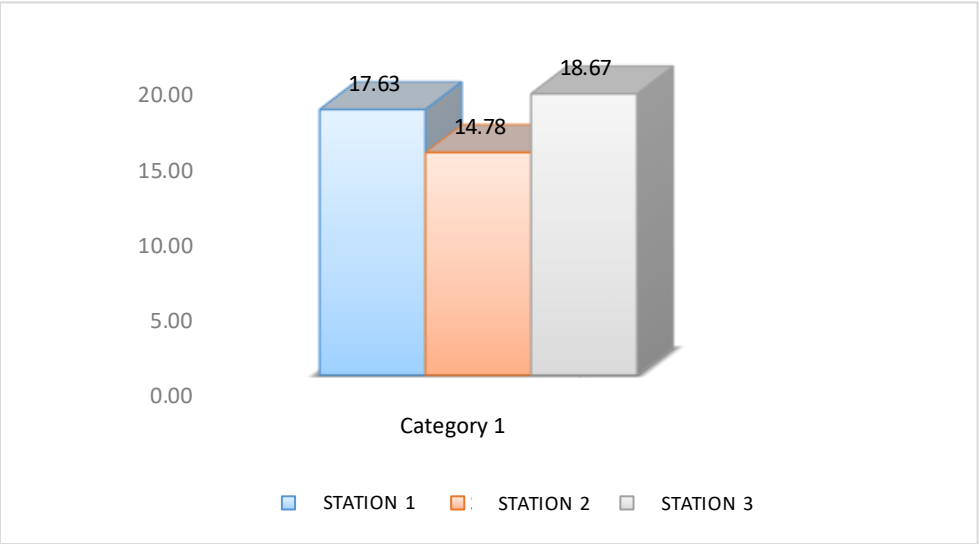

Figure 4. Percentage of Live Coral Cover

Diversity of Reef Fish for Marine Tourism

The abundance of reef fish species found in the three survey locations of Kodingareng Keke Island is also suitable for snorkelling and diving tourism objects. The existence of reef fish in the waters depends on the coral reefs' health, which is shown in the percentage of live coral cover. This is possible because live reef fish are associated with the shape and type of coral reefs as a place to live, protect and find food. Reef fish are relatively sedentary for most of their lives. The average number of fish abundance at three observation stations, station 1 (17.63%), station 2 (14.78%) and station 3 (18.67%). They are presented in Figure 4 above. The suitability of diving tourism on Kodingareng Keke Island is in the very suitable category, with an area (of 5.742 ha) and a very high area of live coral cover (42.88%) (Anwar, 2011). The islands in the very suitable category have a relatively wide average of coral reefs on the west, south and north sides.

Analysis of The Development Strategy for The Marine Tourism Area of Kodingareng Keke Island

The preparation of development strategy through studying the potential of the Kodingareng Keke Island marine tourism area was prepared by examining the potential and characteristics in the field in exploring the elements of strengths, weaknesses, opportunities and threats. In addition, it is also necessary to analyze in more depth the SWOT elements that may or are expected to have the potential to emerge in the future. Thus, the formulated Strategy for the development of the Kodingareng Keke Island marine tourism area can be anticipatory towards changes that occur in the future, which are presented in Table 3.

The factors that become the strengths and weaknesses in preparing the Strategy for the development of the Kodingareng Keke island marine tourism area in an integrated and sustainable manner. Based on the results of the identification, there are four factors which are strengths and also four factors which are weaknesses, in preparing the development strategy for the marine tourism area of Kodingareng Keke Island. In terms of opportunity and

threat factors, there are also four factors that become opportunities and threats in preparing the development strategy for the marine tourism area of Kodingareng Keke Island. Strengths and weaknesses are internal factors, and opportunities and threats are external factors. The strengths and opportunities factors have a positive impact. In contrast, the weaknesses and threats factors hurt the development strategy for the marine tourism area of Kodingareng Keke Island (Table 3).

Table 3. Identification of Strengths, Opportunities, Weaknesses and Threats

Aspect	Strengths	Weakness	Opportunity	Threats
Ecology	Diversity of coral reefs, various types of reef fish, Underwater Heritage Japanese WW II), natural white sand beaches	Environmental sustainability threatened by tourism activities	Environmental sustainability issues related to damage to coral reefs	Excessive exploitation of marine resources from within and outside the area by using tourists who are not environmentally friendly
Economy	There are supporting tourist objects and attractions	Public understanding of the objectives and economic benefits of the tourism industry sector is still weak	The tourism sector is now considered the prima donna for national development	Many depend on foreign aid and investment
Socio-Cultural	The diversity of ethnic, cultural and community groups is relatively high	The potential for managing human resources is still minimal	The government's political will which makes tourism a mainstay in PAD revenue	Socio-cultural changes and cultural influences from foreign tourists
Law and Institutions	There are clear rules regarding the development of tourist areas contained in Regional Regulations.	There is no integrated and sustainable tourism planning yet	Makassar City Spatial Planning policy which develops Kodingareng Keke Island as a marine tourism area	Increased crime and drug trafficking

Source: Primary data after processing, 2022

There are seven strategies produced in this study, namely:

1) Strict maintenance of environmental sustainability and development of tourist areas.
2) Dissemination and promotion of marine tourism development ideas.
3) Integrated and comprehensive planning across sectors.
4) Dissemination of benefits and economic objectives from the existence of marine tourism accompanied by an increase in human resources in the field of marine tourism.
5) Law enforcement and regular preparation of tourism development plans.
6) Determination of marine tourism area development zones.
7) Local culture needs to be developed and preserved.

Conclusion

Based on the results of research that has been conducted on Tana Keke Island, Makassar City, it can be concluded that:

1. The average number of corals on Tana Keke Island ranges from 63.6% to 77.8%, and the average number of fish abundance at three observation stations, station I (17.65%), station II (14.78%) and station III (18.67%) making it suitable for snorkelling and diving tours.
2. Priority programs for the development of the marine tourism area of Kodingareng Keke Island are increased supervision, regular preparation of Object Development Master Plans (RIPO), implementation of local regulations for the use of coastal resources, involvement of local communities, the general public and government in nature conservation activities, setting labour standards, and improving the quality of local human resources through training.

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