Study Bioecological of Banggai Cardinalfish in the Sea Waters of BanggaiLaut Regency, Indonesia

ABSTRACT

Indonesia is a country with a high level of biodiversity. This is proven by the large number of fish and coral species. The large amount of biodiversity also makes it possible for Indonesia to have endemic species, one of which is the Banggai Cardinalfish. Banggai Cardinalfish (pterapogon kauderni) is an endemic species found in the Banggai Islands, Central Sulawesi, Indonesia. This research aims to look at the bio-ecological conditions of the Banggai Cardinalfish. This research was carried out in January-March 2014 indistrictBanggai Utara, BanggaiLaut Regency, Central Sulawesi Province. The research was carried out using the method of observing and monitoring the number of *Pterpogon kauderni populations* at predetermined stations and measuring the quality of sea waters at each station. Population monitoring is carried out using the *Belt transect method.* The data obtained was then analyzed using population density analysis. The water quality data obtained is then compared with sea water quality standards according to PP No. 22 of 2021 . Based on the research results, it is known that the highest population of Banggai Cardinalfish was found at station III with a total population of 15.92 individuals/m ^{2} . The population is dominated by juveniles 12.60 individuals/m ^{2} , recruits 1.14 individuals/m ^{2} and adults 2.18 individuals/m ^{2} . The highest population of associated biota was found at station III with a population of sea urchins of 0.91 individuals/m ^{2} and sea anemones of 0.08 individuals/m ^{2} . Water quality conditions at each station are temperature 29.3-31.8 ^{o} C (optimum) , pH 8.01-8.19 (optimum), DO 7.9-11.04 ppm (optimum) , Salinity 34-41 ppt (Less optimal).

Keywords: Bioecology; Banggai cardinalfish; BanggaiLaut

1. INTRODUCTION

Indonesia is part of *The Coral Triangle region* , which is a region that has a very high level of biodiversity and is the center of marine biota diversity [1]–[3] . This high level of biodiversity allows for native/endemic marine biota species that are only found in Indonesian waters. Banggai Cardinalfish (*Pterapogon kauderni*) is a species native/endemic to the Banggai Islands-Central Sulawasi, and one of Indonesia's Endemic Coral Fish Species [4], [5] . This species has a distribution area of 5,000 km ^{2} with a potential habitat area of 20-24 km ^{2}, its main habitat is coastal areas containing coral reefs and seagrass beds with a depth of 0-5 m [6] .

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current existence of *Pterapogon kauderni has experienced a decline in population numbers due to human activities, both due to fishing, land use and so on. Pterapogon kauderni* has been categorized as an endangered species in the 17th CITES CoP in 2016, Appendix I. This decision requires Indonesia to ensure the preservation of this species by carrying out conservation and sustainable management [7]–[9] .

The Indonesian governmentthrough the Decree of the Minister of Maritime Affairs and Fisheries of the Republic of Indonesiahas issued decision Number: 49/KEPMEN-KP/2018 concerning Determination of the Limited Protection Status of the BanggaiCapungan Fish (*Pterapogon kauderni*). Along with the Decree of the Minister of Maritime Affairs and Fisheries Number: 53/KEPMEN-KP/2019 concerning coastal conservation and the Banggai Small Islands, Banggai Sea, Banggai Islands and the surrounding waters of Central Sulawesi Province. To maintain the preservation of *Pterapogon kauderni* in its natural habit.

Based on monitoring in 2019, the population status of *Pterapogon kauderni* at 8 monitoring locations in the Bokan Islands showed a decline in the population of *Pterapogon kauderni* and its associated biota (sea urchins and sea anemones) [10] . Judging from the results of previous population monitoring, it is necessary to re-monitor the *Pterapogon kauderni population* in other locations in the Banggai Islands. The waters of North Banggai District, BanggaiLaut Regencyare one of the areas where *Pterapogon kauderni lives,* and have been designated by the KKP as part of the coastal and small island conservation area in Central Sulawesi Province. This area is also a beach tourist attraction in BanggaiLaut Regency.

The existence of aquatic biota populations cannot be separated from the quality conditions of the waters. Water quality can be broadly interpreted as physical and chemical factors that influence the life of fish and other aquatic organisms, either directly or indirectly [11] . Monitoring water quality aims to maintain ecosystems and aquatic habitats, because these two components are very easily affected by a decrease in water quality [12] . Therefore, this research aims to determine the population density of *Pterapogon kauderni* and water quality in BanggaiUtara District, BanggaiLaut Regency.

2. MATERIALS AND METHODS

2.1 TIME AND PLACE

The research was carried out in January-March 2024 located inBanggai Utara District, BanggaiLaut Regency, Central Sulawesi Province. This area is an area that is included in the conservation area that has been designated by the KKP in PERMEN KP Number: 53/KEPMEN-KP/2019. The data collection location can be seen in Figure 1.

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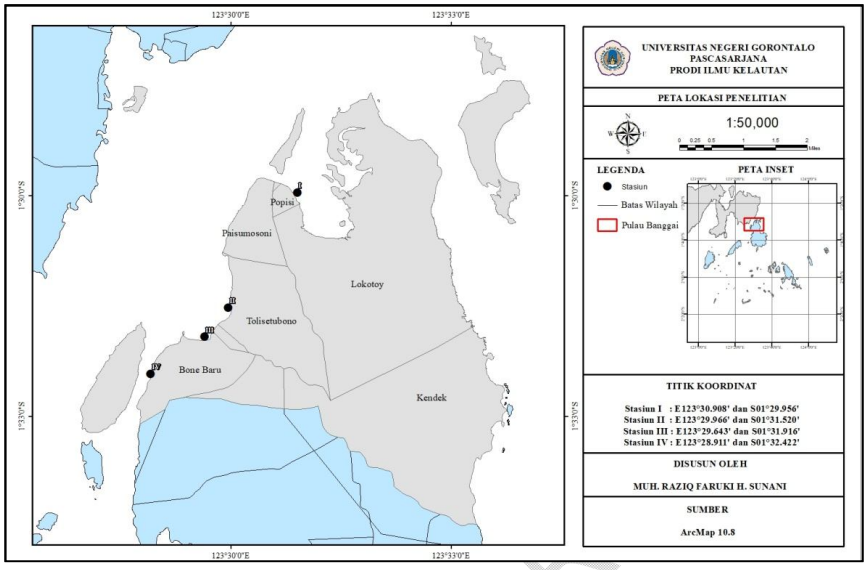

Figure 1. Research Location

Data collection on population and water quality was carried out at four location points, namely:

1. Station I Popisi Village: E123 ^{o} 30,908' and S01 ^{o} 29,956'
2. Station II Tolisetubono Village: E123 ^{o} 29,966' and S01 ^{o} 31,520'
3. Station III Bonebaru Village: E123 ^{o} 29,643' and S01 ^{o} 31,916'
4. Station IV Bonebaru/Bongo Village: E123 ^{o} 28,911' and S1 ^{o} 32,422'

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2.2 TOOLS AND MATERIALS

The tools and materials used in this research can be seen in table 1.

Table 1. Tools and materials in research

No	Tools/Materials	Works
1	ATK	Data Logging
2	Water Quality Check	Measuring Temperature, pH and DO
3	*Refracto meter*	Measuring salinity
4	*Drifter Buoy*	Measuring current speed
5	Meter Roll	Measure
6	Camera	Documentation

2.3 RESEARCH METHODS

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The research was carried out using survey methods and direct observation at predetermined research locations. Data collection in this research was by monitoring the population number of *Pterpogon kauderni* at predetermined stations and measuring the quality of sea waters at each station. The technique for collecting data on population numbers and water quality can be seen as follows.

a. Number of Populations of *Pterpogon kauderni* refers to [13]
   1) Observations were carried out placing transects parallel to the coastline at a depth of 1.5-3 m where Banggai Cardinalfish are generally found. However, it will have to be adjusted to tidal conditions;
   2) Observations were made using the *belt transect method.* The size of the transect is 20 m long and 5 m wide (transect area 10 m^2), namely 2.5 m wide on the right and 2.5 m on the left (figure 2);

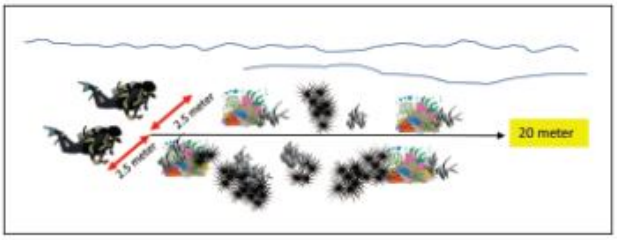

Figure 2. Population survey *of Pterapogon kauderni* using the *belt transect method* [13]

   3) Data collection was carried out by two divers with each diver dividing the task of collecting fish data. each on the left and right of the transect;
   4) SumuaBanggai Cardinalfish found were recorded based on fish size categories.

b. Water quality
   1) Water quality measurements carried out *in-situ* in the field include temperature parameters (^oC), pH, DO (ppm), salinity (ppt), current speed (m/s), waste and odor.
   2) The water sampling technique is carried out in a composite manner between the bottom of the water and 30 cm from the water surface;

2.4 DATA ANALYSIS

The data analysis used is descriptive qualitative, namely describing existing conditions analytically and synthesizing them integrally. Data from *the Pterapogon kauderni population survey* and associated Biota were analyzed to determine the density of fish at each location and size category using a density formula based on the following monitoring guidelines from the Ministry of Marine Affairs and Fisheries:

$$Kepadatan\ (individu/m^2) = \frac{Jumlah\ total\ individu\ ikan}{100}$$ ---------- [13]

Water quality measurement data is analyzed by comparing with quality standards based on PP No. 22 of 2021 concerning Sea Water Quality Standards.

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3 . RESULTS AND DISCUSSION

3.1Population Conditions of *Pterapogon kauderni*

Pterapogon kauderni population survey are presented in Figure 3. Based on Figure 3, the most numerous *Pterpogon kauderni* population is at station III which is dominated by the very high presence of Juveniles reaching 12.60 Individuals/m ^{2} , then Adults 2.18 Individuals/m ^{2} and Recruitment 1.14 Individuals/m^2 .

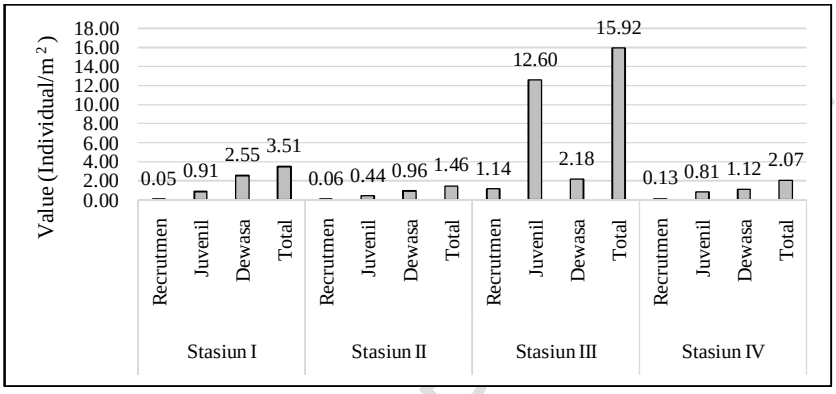

Figure 3. Population Density of *Pterpogon kauderni*

The high population at station III is thought to be due to the large number of associated biota and coral reefs at this station. It is known that *Pterapogon kauderni* can be found in seagrass and coral reef ecosystems in the form of *fringing reefs* and *reef flats[7].* Coral reefs are ecosystems that provide a place for fish to shelter, spawn and provide food.

The lowest population density was found at station II with the number of recruits being 0.06 individuals/m^2 , juveniles 0.44 individuals/m ^{2} and adults 0.96 individuals/m ^{2} . The low population of *Pterapogon kauderdi* at station II is thought to be due to the lack of associated biota at that location. The absence of an ecosystem that supports the existence of this species and its associated biota can affect its population density. *Pterapogon kauderni* does not have a self-defense mechanism so it needs associated biota to avoid predators. It is known that for most of its life it coexists with biota, its main associations are sea urchins, soft corals and sea anemones[7], [10], [14] .

3.2 Condition of Association Biota

Comment [MF38]: Figure 3 presents the Pterapogon kauderni population survey results. The most numerous Pterpogon kauderni population is at station III, which is dominated by the very high presence of Juveniles, reaching 12.60 Individuals/m 2, then Adults, 2.18 Individuals/m 2, and Recruitment, 1.14 Individuals/m2.

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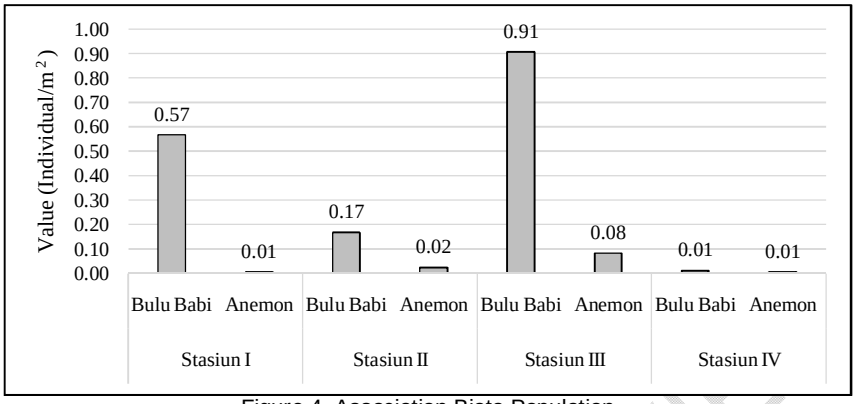

Figure 4. Association Biota Population

Based on Figure 4. The population of associated biota (sea urchins and anemones) is most abundant at station IIIwith a density of sea urchins of 0.91 individuals/m ^{2} and anemones of 0.08 individuals/m ^{2} . Meanwhile, the lowest was at station IV with a density of both associated biota, namely 0.01 individuals/m ^{2} .

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It is strongly suspected that the existence of associated biota at Station IV is because it is captured for consumption by the local community. Tourist activities can also be the cause of the reduction in sea urchins in the area. As is known, this area is a tourist spot for local people on Banggai Island. The loss of associated biota is caused by habitat degradation caused by human activities and climate change [7], [10] .

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3.4 Water Quality

Water quality conditions at each research location can be seen in table 2.

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Table 2. Water quality at the research location

Parameter	Location				Quality Standards (PP No. 22 of 2021)	Note.
	Station I	Station II	Station III	Station IV		
Temperature (^{o}C)	29.8	29.9	29.3	31.8	28-32 ^{o}C	Optimal
pH	8.06	8.08	8.01	8.19	7-8.5	Optimal
DO (ppm)	7.9	11.04	8.1	11.04	> 5 ppm	Optimal
Salinity (ppt)	35	34	41	36	33-34 ppm	Bad

Based on the research results, it is known that the water quality conditions for temperature, pHand DO at each station are still at optimal conditions for seawater biota. The water temperature at the research location ranges from 29.3-31.8 ^{o} C. Optimal water conditions will have a good impact on marine biota,these conditions will support the metabolic processes of fish so that they can support growth, survival and reproduction.

The pH of the waters ranges between 8.01-8.19, which is still in optimal conditions. Water pH can affect the physiology of marine biota, including inhibiting growth,biota will be very sensitive to bacteria and parasitesand the water will be toxic to fish. Changes in pH that are very acidic or alkaline will disrupt the survival of aquatic organisms because they disrupt the respiration process [15] .

The DO condition of the research location waters ranges from 7.9-11.04 ppm, which is very good. The DO of waters greatly determines the survival of marine biota. Water conditions that contain dissolved oxygen. Oxygen levels can affect the decomposition, reproduction and growth processes. The need for dissolved oxygen in fish is influenced by age, activity and water conditions. The oxygen content influences the oxidation and reduction processes of organic and inorganic materials [16] .

Salinity at the research location ranges from 34-41 ppt, this value is quite high and can be dangerous for the existence of marine biota. Seawater salinity influences the distribution, abundance and growth of aquatic biota as well as their density in a body of water [17] . Suboptimal salinity can cause osmoregulation disorders for biota. The high salinity in the waters is thought to be due to the very high level of evaporation that occurs. The cause of the high salinity is also thought to be due to the data collection being carried out in sunny and cloudless conditions. One of the factors that influences salinity is evaporation. The greater the level of seawater evaporation in an area, the higher the salinity and vice versa in areas with low levels of seawater evaporation [18] .

4. CONCLUSION

[Based on research results, it is known that the highest population of Banggai Cardinalfish was found at station III with a total population of 15.92 individuals/m ^{2} . The population is dominated by juveniles 12.60 individuals/m ^{2} , recruits 1.14 individuals/m ^{2} and adults 2.18 individuals/m ^{2} . The highest population of associated biota was found at station III with a population of sea urchins of 0.91 individuals/m ^{2} and sea anemones of 0.08 individuals/m ^{2} . Water quality conditions at each station are temperature 29.3-31.8 ^{o} C (optimum) , pH 8.01-8.19 (optimum), DO 7.9-11.04 ppm (optimum) , Salinity 34-41 ppt (not optimal)]

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