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DENSITY OF BANGGAI CARDINALFISH (BCF) BY SIZE CLASS IN THE KILOMETER LIMA WATERS LUWUK, BANGGAI REGENCY

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Abstract

Banggai Cardinalfish (*Pterapogon kauderni*) which is abbreviated as BCF is a marine fish native to Indonesia. Observations were made on 6 (six) different transects from November to December 2021 in Kilometer Lima Luwuk Waters, Banggai Regency, Central Sulawesi Province. Each transect was observed for BCF in each colony. Each colony was censused by individual BCF based on size class, namely recruit class <1.8 cm, juvenile 1.8-3.5 cm and adults >3.5 cm. The method used is the belt transect method. The total individual Banggai Cardinalfish observed on 6 (six) transects in the waters of Kilometer Lima amounted to 1,232 individuals. Based on size class, 252 recruits were observed, 480 juveniles, and 500 adults or could be represented by 20% in the infant/recruit category (<1.8cm), 39% in the juvenile category (1.8cm-3.5cm) and 41% in the juvenile category. adults (>3.5 cm).

Keywords: Banggai Cardinalfish, Five Luwuk Kilometers, BCF Size Class.

INTRODUCTION

Banggai Cardinalfish (*Pterapogon kauderni*), abbreviated as BCF, is a marine fish native to Indonesia (Ndobe et al., 2019). Naturally, BCF is known to be endemic to the areas predominantly located in the southern and eastern parts of the Banggai Islands, Central Sulawesi, as well as several small islands at the western tip of Taliabu Island, North Maluku (Lunn & Moreau, 2004). The Banggai Cardinalfish (*P. kauderni*) is one of the fish species in the family Apogonidae. The distribution of BCF is limited to shallow coral reefs, with depths not exceeding 3.5 meters, making this fish species highly vulnerable to natural disturbances and exploitation (Ndobe et al., 2019). The population of *P. kauderni* has significantly declined due to increasing market demand and overfishing in the wild. Banggai Island in Banggai Laut serves as a center for harvesting the ornamental fish species *P. kauderni* and has fairly good accessibility for surrounding islands (Ndobe et al., 2023). The number of this fish has decreased by more than 25% since the beginning of trade around the 1990s, with an estimated trade volume of 700,000-900,000 individuals per year from 2001 to 2004 (Vagelli, 2008). It has even been reported that Banggai Cardinalfish has become extinct on Limbo Island since 2004 (Conant, 2015).

To preserve and ensure the existence and availability of BCF populations in the waters of the Banggai Islands, the Ministry of Marine Affairs and Fisheries (KKP) has issued Ministerial

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Decree No. 49/KEPMEN-KP/2018 regarding the designation of the restricted protection status for Banggai cardinalfish (Negara et al., 2023). Subsequently, the KKP designated BCF habitat as a marine conservation area through Ministerial Decree No. 53/KEPMEN-KP/2019 concerning the Coastal Conservation Areas and Small Islands of Banggai, Banggai Laut, Banggai Islands, and Surrounding Waters in Central Sulawesi Province, with an area covering 856,649.13 hectares. Conservation efforts are aimed at maintaining or increasing BCF populations in the wild. Periodic population monitoring is necessary to assess the effectiveness and success of interventions to preserve BCF populations in their habitat. Ndobe et al. (2020) conducted research on the monitoring of the endemic ornamental fish *P. kauderni* in the Bokan Islands, Banggai marine protected area, Indonesia, using standard methods (KKP guidelines) as well as additional methodologies. The research results indicate the population status of *P. kauderni* at 8 monitoring locations in the Bokan Islands. Overall monitoring data show a decrease in the abundance of *P. kauderni* and its microhabitat (sea urchin of the genus Diadema and nine out of ten host species of sea anemones). The study on Banggai Cardinalfish (BCF) Density by Size Class in Kilometer Lima Luwuk Waters, Banggai District aims to determine the total number of individuals based on size classes of Banggai Cardinalfish (BCF) present in the waters of Kilometer Lima Luwuk, Banggai District. The benefits of the research are to provide information and knowledge to the local community, relevant agencies, and academia regarding the size classes and percentages of BCF present in the waters of Kilometer Lima Luwuk, as well as to serve as a database for further research.

MATERIAL AND METHODS

The research was conducted from November to December 2021 and was located in the waters of Kilometer Lima, Luwuk, Banggai District, Central Sulawesi Province. Observations were made in 6 (six) different transects. Each transect involved observations of BCF at each colony. A census of individual BCF based on size classes was conducted for each colony, namely recruit class <1.8 cm, juvenile 1.8-3.5 cm, and adult >3.5 cm. The method used was the belt transect method. This method records the target organisms found in a specific area in the form of a rectangle with certain lengths and widths, where the length of the area is 20 meters and the width is 5 meters (with an area of 100 square meters).

RESULT AND DISCUSSION

Observation data collected in the field has been tabulated using the Microsoft Excel program to determine the total individual and BCF density according to the size class of each transect with the following calculations:

$$D = \frac{x}{100}$$

Where: D is the density of fish (fish/m^2) and X is the total number of individual fish

BCF density per observation point (transect) is calculated by calculating the average fish density from the fish density value (D) from each transect.

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General Description of Research Locations

Banggai District is one of the districts in Central Sulawesi Province, Indonesia. The capital of this district is located in Luwuk. Banggai District is a lowland area with an average elevation of ±84 meters above sea level, situated at positions 0° 30' - 2° 20' South Latitude and 122° 23' - 124° 20' East Longitude. The northern part of Banggai District is bordered by Tomini Bay, the eastern part is adjacent to North Maluku Province, the southern part is adjacent to Banggai Islands Regency, and the western part is bordered by Tojo Una-Una and Morowali Regencies (Wahyuni, 2014). The fisheries potential in Banggai District is quite significant, especially in the marine fisheries sector. Banggai District has abundant natural resources from the sea such as fish, shrimp, pearls, seaweed, and so on. However, this potential has not been optimally managed, as evidenced by the relatively small yields obtained due to the widespread use of simple and traditional fishing gear in the marine fisheries sector. In addition to fisheries potential, Banggai District also has tourism potential, including Salodik Nature Reserve, Ondorneming Tobelombang, Pulau Dua, and Kilometer Lima Beach Tourism (BPS Banggai, 2014). Kilometer Lima Waters is one of the main tourist destinations located in Luwuk City, Banggai District. Administratively, Kilometer Lima is in the Maahas Subdistrict, South Luwuk District. Its main potential lies in the beauty of the underwater world with various fish species and coral reefs, the clarity of its water, and the sunset view in the evening. The name Kilometer Lima (Kilometer Five) is derived from its location, which is exactly 5 km away from the city center (Joyce, 1994). Its strategic location makes this tourist spot a perfect choice to visit. With good accessibility and being located not far from the main road, it gives tourists an impression of ease in visiting. Visitors are mostly families looking to spend their weekends, student groups, or community groups.

Banggai Cardinalfish Density Percentage According to Size

Observation transect (TR) I was conducted at coordinates 0° 58'54.725" S and 122° 47'16.572" E, with sampling location at a depth of 3 meters. Banggai Cardinal Fish (BCF) were observed in 7 colonies dominated by juveniles (1.8-3.5cm), totaling 42 individuals, while recruits (<1.8 cm) and adults (>3.5 cm) numbered 34 each. The observations for each colony are presented in Table 1. The total individuals observed in transect I were 110, with density percentages shown in Figure 1. All observed Banggai Cardinal Fish individuals in this transect were symbiotic with sea urchins as their microhabitat.

Table 1: Observed BCF in TR 1

Colony	Recruit (<1.8 cm)	Juvenile (1.8-3.5 cm)	Adult (>3.5 cm)
1	3	-	2
2	-	-	2
3	4	20	-
4	-	8	1
5	10	5	22
6	15	-	7
7	2	9	-
Total	**34**	**42**	**34**

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Transect II was conducted at coordinates 0° 58'55.475" S and 122° 47'16.852" E, where a very high total of 555 BCF individuals per 100 m² were observed. BCF were observed in 8 colonies with 51 recruits, 256 juveniles, and 248 adults. The observation site had a depth of 3 meters. A large number of sea urchins, totaling 794 individuals, were found in this transect. The observed BCF presented in Table 2 respectively.

Table 2: The observed BCF in TR 2

Colony	Recruit (<1.8 cm)	Juvenile (1.8-3.5 cm)	Adult (>3.5 cm)
1	11	48	12
2	8	70	31
3	-	15	10
4	-	64	79
5	-	22	8
6	-	20	31
7	25	-	2
8	7	17	75
Total	**51**	**256**	**248**

In transect III, located at coordinates 0° 58' 56.104" S and 122° 47' 17.050" E, Banggai Cardinal Fish (BCF) were predominantly observed in the juvenile class (1.8cm-3.5 cm) and adults (>3.5 cm), with a total of 164 individuals observed.

The observation site for this transect was at a depth of 2 meters. BCF were observed in 6 colonies in this transect, and they were solely symbiotic with sea urchins as their microhabitat. The observation results are presented in Table 3 below.

Table 3: Observed BCF in TR 3

Colony	Recruit (<1.8 cm)	Juvenile (1.8-3.5 cm)	Adult (>3.5 cm)
1	10	4	7
2	-	47	11
3	13	10	21
4	-	-	7
5	-	-	10
6	-	9	15
Total	**23**	**70**	**71**

In transect IV, located at coordinates 0° 58' 56.73" S and 122° 47' 18.366" E, the observation results were dominated by recruits (< 1.8cm), numbering 44 individuals, juveniles with 22 individuals, and adults with 41 individuals.

The total observed individuals of Banggai Cardinal Fish (BCF) were 107, with a density of 1.07 individuals/meter. The observation site was at a depth of 3 meters, with 5 colonies observed, and Banggai Cardinal Fish were solely symbiotic with sea urchins. The observed BCF are presented in Table 4.

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Table 4: The observed BCF in TR 4

Colony	Recruit (<1.8 cm)	Juvenile (1.8-3.5 cm)	Adult (>3.5 cm)
1	14	10	24
2	20	-	12
3	4	2	-
4	6	10	1
5	-	-	4
Total	**44**	**22**	**41**

In transect V, located at coordinates 0° 58' 57.194" S and 122° 47' 17.828" E, the total number of Banggai Cardinal Fish (BCF) observed was only 49 individuals per 100 m², and in some colonies, no BCF of baby and juvenile sizes were found.

The BCF density in this transect is 0.49 individuals/meter. Meanwhile, sea urchins, serving as the microhabitat at this station, numbered 228 individuals per 100 m², with a density of 2.28 individuals/meter, which is the lowest density among the 6 transects. Observations were conducted at a depth of 3 meters.

Table 5: The observed BCF in TR 5

Colony	Recruit (<1.8 cm)	Juvenile (1.8-3.5 cm)	Adult (>3.5 cm)
1	-	-	3
2	10	28	2
3	-	-	2
4	-	-	2
5	-	-	2
Total	**10**	**28**	**11**

In transect VI, located at coordinates 0° 58' 57.216" S and 122° 47' 18.075" E, the presence of Banggai Cardinal Fish (BCF) was observed with a total of 247 individuals. Observations were conducted at a depth of 4 meters.

The microhabitat found in transect 6 was sea urchins, with a total of 284 individuals observed, along with 1 individual anemone. The observation results for each colony are presented in Table 6.

Table 6: The observed BCF in TR 6

Colony	Recruit (<1.8 cm)	Juvenile (1.8-3.5 cm)	Adult (>3.5 cm)
1	8	22	10
2	3	-	2
3	-	2	5
4	53	26	59
5	15	10	17
6	11	2	2
Total	**90**	**62**	**95**

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Total observed individuals of Banggai Cardinal Fish (BCF) by Size

The observation results of Banggai Cardinal Fish (BCF) density by size in the 6 observed transects in the waters of Kilometer Lima Luwuk, Banggai Regency, can be seen in Table 7, while the percentage of BCF by size in each transect at the research site can be seen in Figure 1. Out of the total of 1,232 individuals of Banggai Cardinalfish observed in all transects at the research site, 252 were recruits, 480 were juveniles, and 500 were adults.

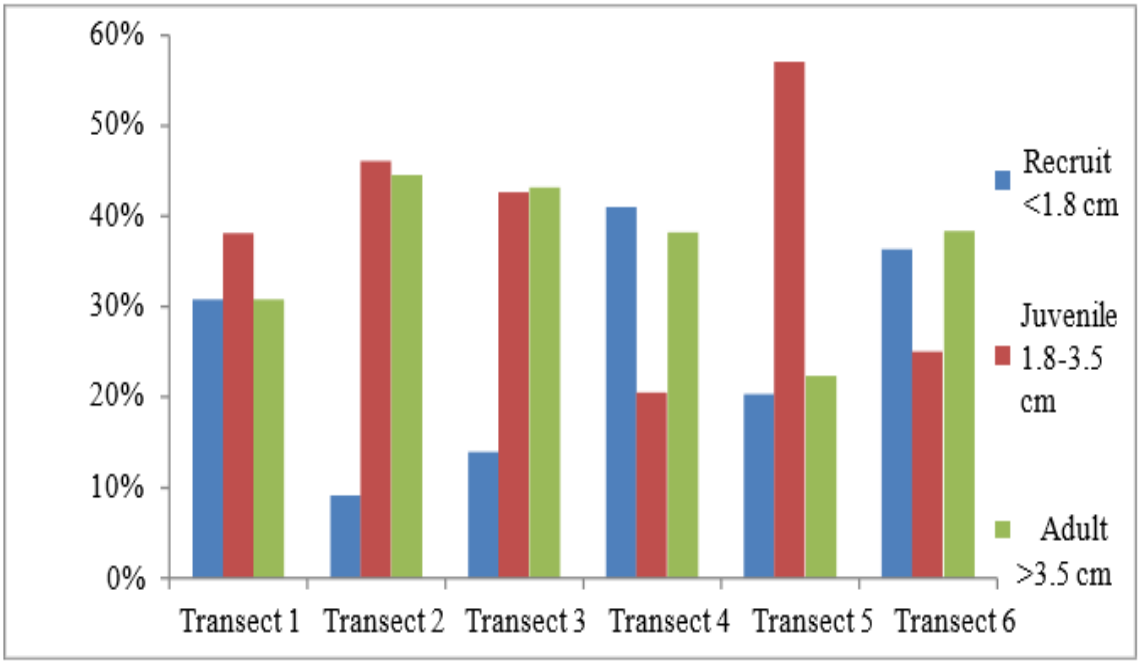

Figure 1: Banggai Cardinalfish were observed on all transects at the research location

Table 7: Total Banggai Cardinal Fish Observed According to Size

Colony	Recruit (<1.8 cm)	Juvenile (1.8-3.5 cm)	Adult (>3.5 cm)
I	34	42	34
II	51	256	248
III	23	70	71
IV	44	22	41
V	10	28	11
VI	90	62	95
Total	**252**	**480**	**500**

Based on this distribution, 20% can be represented in the baby/recruit category (<1.8cm), 39% in the juvenile category (1.8cm-3.5cm) and 41% in the adult category (>3.5 cm). The total percentage of BCF individuals according to size is presented in Figure 2 below.

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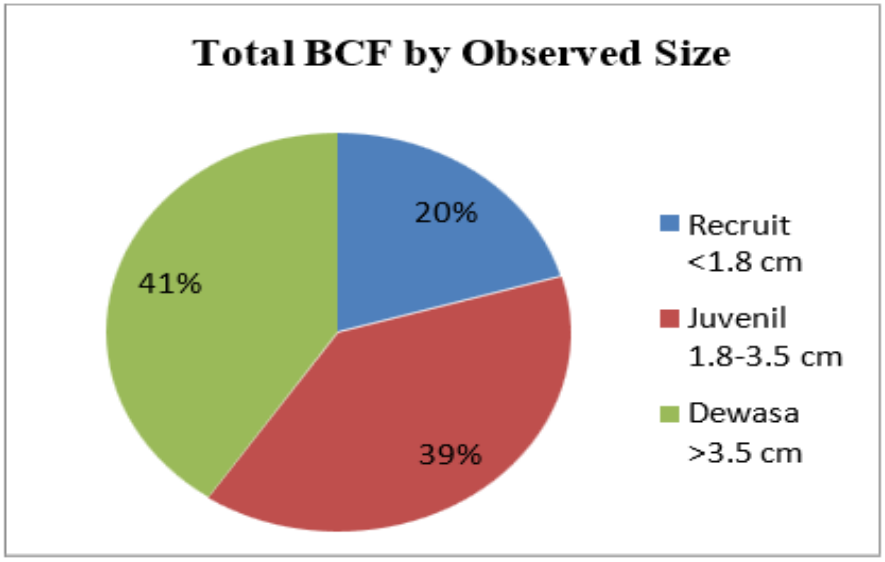

Figure 2: Total BCF by Size during observation

CONCLUSION

The total observed individuals of Banggai Cardinalfish in the 6 transects in the waters of Kilometer Lima amounted to 1,232 individuals. Based on the observed size classes, there were 252 recruits, 480 juveniles, and 500 adults, which can be represented as 20% for the baby/recruit category (<1.8cm), 39% for the juvenile category (1.8cm-3.5cm), and 41% for the adult category (>3.5 cm). Research on BCF density by size in other locations is necessary because regular monitoring is crucial to understand the presence of BCF in both endemic and introduced populations.

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