Jurnal Ilmu Kelautan
SPERMONDE (2023) 9(2): 1-8

P-ISSN: 2460-0156
E-ISSN: 2614-5049

THE IMPACT OF SPIDER MODEL OF CORAL TRANSPLANTATION ON FISH ABUNDANCE IN THE WATERS OF BOTUTONUO, GORONTALO PROVINCE

Andeas A. Hulu[1], Femy M. Sahami[2], Sri N. Hamzah[2]

Submitted: 12 Juni 2023 Accepted: August 10, 2023

[1]Student of Department of Water Resources Management, Faculty of Fisheries and Marine Sciences, State University of Gorontalo.
[2]Department of Aquatic Resources Management, Faculty of Fisheries and Marine Sciences, State University of Gorontalo
Corresponding Author:
*Femy M.Sahami
E-mail: femysahami@ung.ac.id

ABSTRACT

This study aims to determine the abundance of fish in the recovery location of the coral reef ecosystem in Botutonuo waters, Gorontalo Province. The research was conducted in February - May 2023. The research location consisted of 2 sites, namely site A which had coral transplants with spider coral skeletons and site B which had no transplants (natural coral reefs). Observations were made 3 times with an interval of 2 weeks. Reef fish data was collected using the Underwater Visual Census (UVC) method, with a 50 m x 5 m line transect. Calculation of data using fish abundance rum. The results showed that the number of fish species found in the Botutonuo waters of Gorontalo Province at site A was 89 species with a total individual abundance of 2,429 ind/m2, while at site B there were 69 species with a total individual abundance of 2,054 ind/m2.

Keywords: Abundance, coral reef fishes, UVC, coral transplantation.

INTRODUCTION

Ecologically, coral reef ecosystems are one of the potential food supply ecosystems for humans, because of the diversity of existing marine biota, such as fish, algae, crustaceans and molluscs that can be found in this ecosystem. The existence of various types of biota invites large-scale resource exploitation activities such as excessive and irresponsible fishing (Titaheluw et al., 2015). The increasing needs of people who depend on the resources available on coral reefs can result in very concerning ecological damage. This increased pressure will certainly threaten the existence and sustainability of coral reefs and the biota within them (Syahrul, 2022).

Various types of coral reef fish have a great dependence on the coral reefs that become their habitat. According to Sasauw et al. (2022) coral reef fish utilize the coral reef ecosystem as a shelter, feeding ground, spawning ground, and nursery ground.

It is necessary to know the existence of reef fish communities in a reef, considering their role and use naturally and for human life. There is a need for sustainable management and utilization actions, for the presence of reef fish in an area or area ofcoral reefs. Rondonuwu, (2014) reported that the abundance of fish on coral reefs will increase depending on the habitat of the coral reefs and vice versa.

Quoted from Suryono et al., (2022) the degradation of coral reefs is caused by natural factors and anthropogenic factors (human activities). Natural factors consist of storms, an increase in the population of coral reef predators, an increase in sea water temperature and global warming. Then the anthropogenic factors consist of pollution, sedimentation, coral mining and destructive fishing practices. The effort that can be done to reduce the pressure from an activity that can damage the coral reef ecosystem is by carrying out coral transplantation activities. Coral transplantation activities have been carried out by both the private sector and the government, such as related agencies. Coral transplantation is an alternative that is widely used in coral reef conservation, because this transplant is relatively easy and inexpensive. Coral transplantation activities have been carried out in several waters in Indonesia. One example is in the waters of Botutonuo Village, Bone Bolango Regency, Gorontalo Province, which was initiated by the Ministry of Environment and Forestry of the Republic of Indonesia (KLHK-RI) in collaboration with the Center for Maritime Studies and the Potential of the Tomini Bay Area, State University of Gorontalo. This activity was first carried out in 2018 then continued in 2022. Umar (2020) observed fish at the transplant site in 2018 and stated that the coral transplantation activity had had a major impact on the abundance of coral reef fish in that location. Meanwhile, the assessment of the

P-ISSN: 2460-0156
E-ISSN: 2614-5049

abundance of coral reef fish at transplant sites in 2022 has not been reported or published. Based on the description above, it is deemed necessary to look at the impact of the spider-style coral transplant on fish abundance in Botutonuo waters.

MATERIALS AND METHODS

Time and Location of Research

This research was conducted in February-May 2023 at coral transplant sites (Site A) and natural coral reef areas (Site B) in Botutonuo waters, Bone Bolango Regency. The research location can be seen in Figure 1 below:

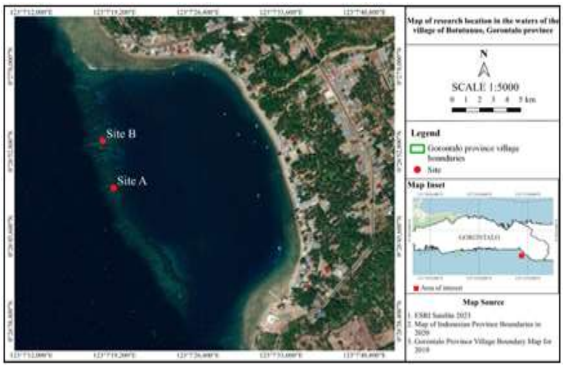

Figure 1. Map of the study Location.

Data Collection Techniques

Reef fish data was collected using the Underwater Visual Census visual enumeration method (English et al., 1994). Data collection was carried out in coral transplantation areas and natural coral reefs as much as 3 (three) observations at intervals of 2 (two) weeks.

Data collection was carried out using a 50 meter long transect with an estimated width of 2.5 meters to the left and 2.5 meters to the right. After the transect is attached, the researcher waits for several minutes with an estimate of ±10 minutes before making the observation process. Data on the type and number of individuals was carried out by photographing the types of fish present at each location using an underwater camera. Then an identification process was carried out referring to several literatures, namely the book Identification of Coral Fish and Marine Invertebrates by (Setiawan, 2010); fish base and Florent's Tropical Reef Life. Identification is carried out by matching the data in the form of photographs or pictures of the fish found, taking into account external morphological characters such as body shape and color pattern, following the identification guide.

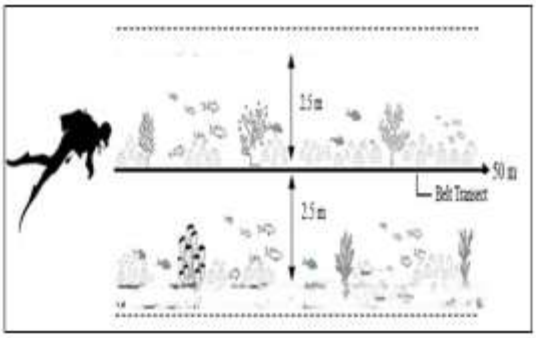

Figure 2. Sketch of coral reef fish data collection using the underwater visual census method

Abundance of Coral Reef Fish

Fish abundance can be calculated by comparing the number of individual fish per unit area of observation. Fish abundance obtained through visual census data collection English et al., (1994) is calculated by the following formula:

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

Where:

N = Fish abundance (individual/m²)
ni = Number of individual of fish species-i
A =Fish census area (m²)

The results of calculating species abundance values are tabulated in the form of tables and graphs. then analyzed descriptively to obtain an overview between sites.

RESULTS AND DISCUSSION

Based on the results of this study indicate that the reef fish found at the study site consisted of 24 families and 89 species. Table 1 shows that at site A there were 20 families with 73 species and at site B there were 20 families with 69 species. Both of these sites have the same number of families, but have different family composition. At site A there were 4 families which were not found at site B, namely the families Apogonidae, Centriscidae, Scorpaenidae and Tetraodontidae. Whereas at site B there were also 4 families that were not found at site A, namely the families Blenniidae, Holocentridae, Oscraciidae and Synodonthidae.

The results of the identification of reef fish found during the research are presented in the following Table 1. Paembonan et al., (2022) conducted a study in a coral transplantation area using a spider model located in the coastal waters of Kastela Village which showed relatively lower results compared to the number of fish found in the study location.

Table 1. Species of Fish Found in Research Locations.

No	Family	Genus	Species	Site A				Site B			
				P.1	P.2	P.3	∑	P.1	P.2	P.3	∑
1	Acanthuridae	*Acanthurus*	*Acanthurus pyroferus*	✓	✓	✓	✓	✓	✓	✓	✓
2		*Acanthurus*	*Acanthurus nigrofuscus*	-	-	-	-	-	-	✓	✓
3		*Acanthurus*	*Acanthurus nigricans*	-	-	-	-	-	✓	-	✓
4		*Ctenochaetus*	*Ctenochaetus cyanocheilus*	✓	✓	✓	✓	✓	✓	✓	✓
5		*Ctenochaetus*	*Ctenochaetus striatus*	✓	✓	✓	✓	✓	✓	✓	✓
6		*Ctenochaetus*	*Ctenochaetus binotatus*	✓	✓	✓	✓	✓	✓	✓	✓
7		*Ctenochaetus*	*Ctenochaetus hawaiiensis*	✓	-	✓	-	✓	-	✓	✓
8		*Naso*	*Naso lituratus*	-	-	✓	✓	-	-	-	-
9		*Zebrasoma*	*Zebrasoma scopas*	✓	✓	✓	✓	✓	✓	✓	✓
10	Apogonidae	*Pristiapogon (Klunzinger, 1870)*	*Pristiapogon kallopterus*	-	✓	-	✓	-	-	-	-
11	Balistidae	*Balistapus (Tilesius, 1820)*	*Balistapus undulatus*	✓	✓	✓	✓	✓	-	✓	✓
12	Blenniidae	*Ecsenius*	*Ecsenius bandanus*	-	-	-	-	-	✓	-	✓
13		*Ecsenius*	*Ecsenius stictus*	-	-	-	-	✓	-	-	✓
14	Centriscidae	*Centriscus*	*Centriscus scutatus*	-	-	✓	✓	-	-	-	-
15	Cirrhitidae	*Cirrhitichthys*	*Cirrhitichthys falco*	✓	✓	✓	✓	✓	✓	✓	✓
16		*Paracirrhites*	*Paracirrhites arcatus*	✓	✓	✓	✓	-	-	✓	✓
17		*Paracirrhites*	*Paracirrhites forsteri*	-	-	✓	✓	-	-	-	-
18	Chaetodontidae	*Chaetodon*	*Chaetodon baronessa*	-	-	✓	✓	-	-	-	-
19		*Chaetodon*	*Chaetodon punctatofasciatus*	✓	✓	✓	✓	✓	✓	✓	✓
20		*Chaetodon*	*Chaetodon vagabundus*	✓	-	✓	✓	-	✓	-	✓
21		*Chaetodon*	*Chaetodon trifascialis*	-	-	-	-	-	✓	-	✓
22		*Chaetodon*	*Chaetodon lunulatus*	✓	-	✓	✓	✓	✓	-	✓
23		*Chaetodon*	*Chaetodon ornatissimus*	-	-	-	-	-	✓	-	✓
24		*Forcipiger*	*Forcipiger longirostris*	✓	-	✓	✓	✓	-	✓	✓
25		*Heniochus*	*Heniochus varius*	-	-	✓	✓	-	-	✓	✓
26		*Chaetodon*	*Chaetodon rafflesii*	-	✓	✓	✓	✓	-	-	✓
27	Gobiidae	*Nemateleotris*	*Nemateleotris magnifica*	✓	✓	✓	✓	✓	-	-	✓
28	Holocentridae	*Sargocentron*	*Sargocentron caudimaculatum*	-	-	-	-	-	-	✓	✓
29	Labridae	*Cirrhilabrus (Temminck & Schlegel, 1845)*	*Cirrhilabrus tonozukai*	✓	-	-	✓	-	-	-	✓
30		*Cirrhilabrus*	*Cirrhilabrus aurantidorsalis*	✓	-	-	✓	-	-	-	-
31		*Cheilinus*	*Cheilinus fasciatus*	✓	-	-	✓	-	-	✓	✓
32		*Cheilinus*	*Cheilinus undulatus*	-	-	✓	✓	-	-	-	-
33		*Cheilio*	*Cheilio inermis*	-	-	✓	✓	-	-	-	-
34		*Halichoeres*	*Halichoeres hortulanus*	✓	✓	✓	✓	✓	✓	✓	✓
35		*Halichoeres (Rüppell, 1835)*	*Halichoeres marginatus*	-	✓	-	✓	-	-	-	-
36		*Halichoeres*	*Halichoeres chrysotaenia*	✓	-	-	✓	-	-	-	-
37		*Hemigymnus*	*Hemigymnus melapterus*	-	-	-	-	-	-	✓	✓
38		*Hemigymnus*	*Hemigymnus fasciatus*	-	-	-	-	-	-	✓	✓
39		*Labroides*	*Labroides dimidiatus*	✓	✓	✓	✓	✓	✓	✓	✓
40		*Labroides*	*Labroides pectoralis*	✓	✓	✓	✓	✓	✓	✓	✓
41		*Macropharyngodon*	*Macropharyngodon ornatus*	-	✓	-	✓	-	-	✓	✓
42		*Thalassoma*	*Thalassoma hardwicke*	✓	✓	✓	✓	✓	✓	✓	✓
43		*Thalassoma*	*Thalassoma lunare*	✓	✓	✓	✓	-	✓	✓	✓
44	Mullidae	*Parupeneus*	*Parupeneus multifasciatus*	✓	✓	✓	✓	✓	✓	✓	✓
45		*Parupeneus*	*Parupeneus bifasciatus*	✓	✓	✓	✓	✓	✓	✓	✓
46	Muraenidae	*Rhinomuraena (Garman, 1888)*	*Rhinomuraena quaesita*	-	-	✓	✓	-	✓	✓	✓
47	Nemipteridae	*Scolopsis*	*Scolopsis bilineata*	✓	-	✓	✓	✓	✓	✓	✓
48		*Pentapodus (Quoy & Gaimard, 1824)*	*Pentapodus paradiseus*	✓	-	-	✓	-	✓	✓	✓
49	Oscraciidae	*Ostracion*	*Ostracion meleagris*	-	-	-	-	-	-	✓	✓

50	Pomancanthidae	*Centropyge*	*Centropyge vrolikii*	✓	✓	✓	✓	✓	✓	✓	✓
51		*Pomacanthus*	*Pomacanthus navarchus*	-	✓	-	✓	-	-	✓	✓
52		*Pomacanthus*	*Pomacanthus imperator*	-	-	-	-	-	✓	-	✓
53		*Pygoplites (Fraser-Brunner, 1933)*	*Pygoplites diacanthus*	✓	-	✓	✓	✓	✓	✓	✓
54	Pomacentridae	*Abudefduf*	*Abudefduf saxatilis*	-	-	-	✓	-	-	✓	✓
55		*Amphiprion*	*Amphiprion clarkii*	-	✓	-	✓	✓	✓	✓	✓
56		*Amphiprion*	*Amphiprion ocellaris*	-	-	-	✓	-	-	✓	✓
57		*Amphiprion*	*Amphiprion sandaracinos*	-	-	✓	✓	-	✓	-	✓
58		*Amblyglyphidodon*	*Amblyglyphidodon curacao*	-	-	-	-	✓	-	✓	✓
59		*Chrysiptera*	*Chrypsiptera rex*	✓	✓	✓	✓	✓	✓	✓	✓
60		*Pycnochromis*	*Chromis atripes*	✓	-	✓	✓	✓	-	✓	✓
61		*Chromis (G. Cuvier, 1814)*	*Chromis ternatensis*	✓	-	✓	✓	✓	-	✓	✓
62		*Chrysiptera*	*Chrysiptera talboti*	✓	-	✓	✓	-	-	-	-
63		*Pycnochromis*	*Chromis margaritifer*	✓	✓	✓	✓	✓	✓	✓	✓
64		*Dascyllus*	*Dascyllus trimaculatus*	✓	✓	✓	✓	✓	✓	✓	✓
65		*Neoglyphidodon*	*Neoglyphidodon melas*	✓	✓	✓	✓	✓	✓	✓	✓
66		*Neoglyphidodon*	*Neoglyphidodon nigroris*	✓	✓	✓	✓	✓	✓	✓	✓
67		*Pomacentrus*	*Pomacentrus moluccensis*	✓	✓	✓	✓	✓	✓	✓	✓
68		*Pomacentrus (Lacépède, 1802)*	*Pomacentrus lepidogenys*	✓	✓	✓	✓	✓	✓	✓	✓
69		*Pomacentrus (Lacépède, 1802)*	*Pomacentrus coelestis*	✓	✓	✓	✓	✓	✓	✓	✓
70		*Pomacentrus*	*Pomacentrus philippinus*	✓	✓	✓	✓	✓	✓	✓	✓
71		*Pomacentrus*	*Pomacentrus bankanensis*	✓	✓	✓	✓	✓	✓	✓	✓
72		*Pycnochromis*	*Pycnochromis lineatus*	✓	✓	✓	✓	✓	✓	✓	✓
73		*Premnas (Cuvier, 1816)*	*Premnas biaculeatus*	✓	-	-	✓	-	-	✓	✓
74		*Pseudocheilinus*	*Pseudocheilinus hexataenia*	-	-	-	✓	-	-	✓	✓
75	Pinguipedidae	*Parapercis*	*Parapercis millepunctata*	✓	-	✓	✓	-	-	✓	✓
76	Siganidae	*Siganus*	*Siganus vulpinus*	✓	-	-	✓	-	-	-	-
77		*Siganus*	*Siganus spinus*	✓	-	✓	✓	✓	-	✓	✓
78	Serranidae	*Cephalopholis*	*Cephalopholis urodeta*	✓	✓	-	✓	-	-	-	-
79		*Epinephelus*	*Ephinephelus merra*	-	✓	-	✓	-	✓	-	✓
80		*Pseudanthias (Bleeker, 1871)*	*Pseudanthias tuka*	✓	-	✓	-	-	-	-	-
81	Scaridae	*Chlorurus*	*Chlorurus sordidus*	✓	✓	✓	✓	-	✓	✓	✓
82		*Chlorurus*	*Chlorurus bleekeri*	✓	✓	✓	✓	-	-	✓	✓
83		*Scarus*	*Scarus quoyi*	-	-	✓	✓	-	-	-	-
84		*Scarus*	*Scarus rubroviolaceus*	✓	-	✓	✓	-	-	-	-
85	Scorpaenidae	*Scorpaenodes (Bleeker, 1857)*	*Scorpaenodes caribbaeus*	-	-	✓	✓	-	-	-	-
86		*Pterois*	*Pterois antennata*	-	✓	✓	✓	-	-	-	-
87	Synodonthidae	*Synodus*	*Synodus variegatus*	-	-	-	-	✓	-	✓	✓
88	Tetraodontidae	*Canthigaster*	*Canthigaster papua*	-	-	✓	✓	-	-	-	-
89	Zanclidae	*Zanclus (Cuvier in Cuvier and Valenciennes, 1831)*	*Zanclus cornutus*	✓	✓	✓	✓	-	✓	✓	✓
Number of Family				15	14	19	20	13	11	17	20
Number of Spesies				53	41	57	73	41	39	57	69

The data collection technique was carried out using the uvc (underwater visual census) method. During the three months of observation, the study found 8 families, 17 genera and 25 species of associated reef fish in the coral transplant area. The most common reef fish species were species from the families Pomacentridae and chaetodontidae, each of which had 6 species. The low number of reef fish species found was due to the damaged condition of the coral reefs which could affect the availability of coral reef food resources around the coral transplantation area. The high or low abundance of fish at the research location can be caused by chemical factors or physical factors in the waters which depend on the conditions of the research location (Paembonan et al., 2022).

Individual Abundance

Observations on the number of individual reef fish were carried out for three observations in two different locations, namely at site A (coral transplants) 2,429 fish were found consisting of 2,054 individuals at site B (natural coral reefs). The results of calculating the number of individual reef fish in each observation can be seen in Figure 2. Figure 2 shows the results of the abundance of individual coral reef fish found during three observations that are known to have different numbers of fish abundance.

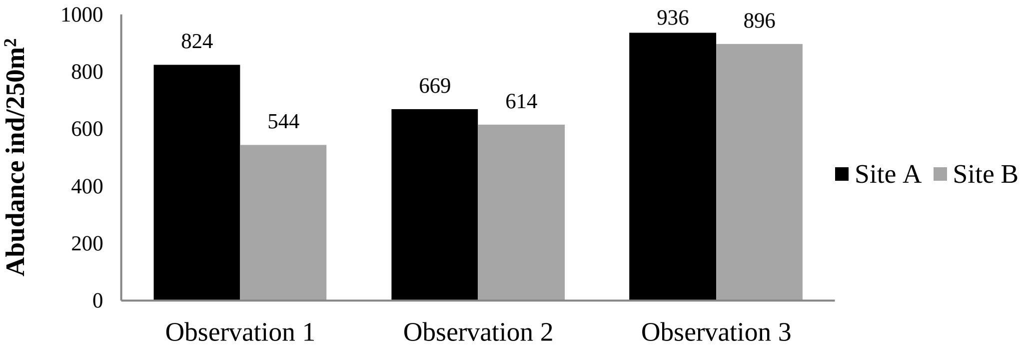

Figure 2. The abundance of individual reef fish found at the study site.

Observation 1 shows that the abundance of fish is 1368 ind/m2. Then in observation 2 the number of fish abundance was 1313 ind/m2. Furthermore, in observation 3 it was known that the abundance of fish was 1,832 ind/m2. The difference between high and low fish abundance is thought to be influenced by water conditions at the time of the study. In the first observation, it was found that the water conditions were much calmer or not wavy compared to the water conditions during the second observation, where the ocean currents at that time were strong enough to make it difficult for divers to document fish. Then in the third observation the condition of the waters was very calm compared to observation 1 so that the fish documentation process could be carried out easily.

The difference in the number of fish abundance during three observations was also reported by Arqam et al., (2019) in the waters of Tanjung Tiram Village, South Konawe Regency, the results of this study showed that the abundance of coral reef fish in that location fluctuated, which at the time of in observation 1 the abundance value was 0.04, then in the second observation it decreased by 3.4 and increased during the third observation which was 4.96. This is caused by very strong water currents that affect the brightness of the waters with high levels of water turbidity, resulting in a decrease in the abundance of fish at the observation site. According to Puspasari et al. (2015) that climate influence will be one of the factors whether or not fish come out of their hiding places and are also often caused by several other factors, such as the condition of the coral reef ecosystem itself, the aquatic environment and uncertain climate change.

Individual Abundance of Each Coral Reef Fish Family Site A

The existence of a diverse community of reef fish on artificial coral reefs (coral transplants) in Botutonuo waters still depends on natural coral reefs where fish usually find food. The following is the abundance of reef fish families at the site based on (ind/ha) in Figure 3. Figure 3 shows that there are three families that have the highest abundance at the site, namely the Pomacentridae family with an abundance of 53,960 ind/ha, the Acanthuridae family with 17,240 ind/ha and the Labridae family with 12,200 ind/ha.

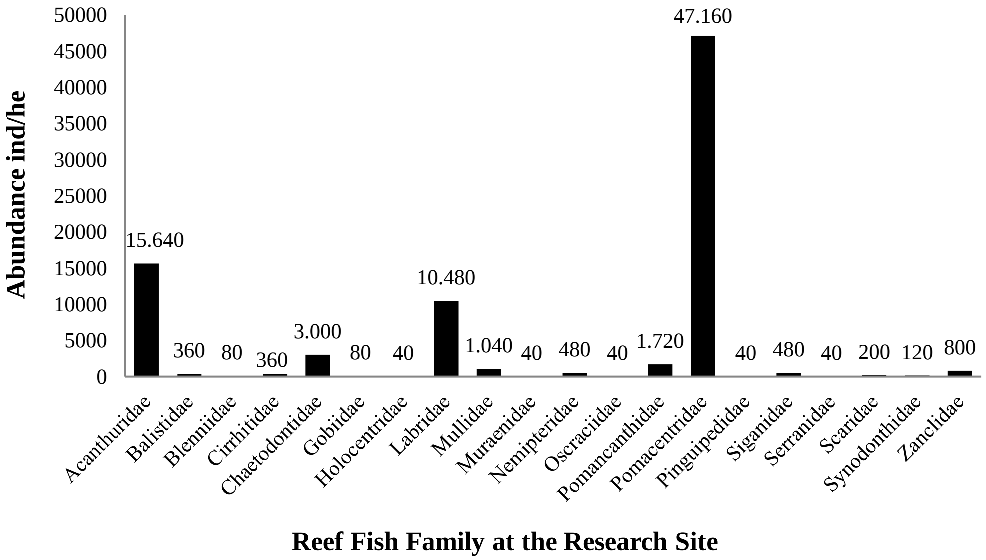

Figure 3. Individual Abundance of Each Coral Reef Fish Family Site A Coral Transplants (ind/ha)

This is because the Pomacentridae family includes fish that live in coral reefs. Nurhasinta et al. (2019) the pomacentridae family is a group of large fish that often coexist with coral reef ecosystems and live in association with coral reefs to find food, spawn and shelter. The family group that has the next highest abundance value is Acanthuridae which is then from the Labridae family group. Both of these fish families belong to the target fish group.

The Acanthuridae family is commonly found in waters because these fish are algae eaters and like new places, such as coral transplant areas. According to Amrulah & Putranada (2018) the coral transplantation area is a suitable place for algae to attach, so the Acanthuridae family uses the area as a place to find food.

The Labridae family is also one of the target fish groups on coral reefs, therefore the presence of these fish depends on the condition of their habitat. The better the condition of the coral reefs, the more fish of the labridae family and vice versa (Mujiyanto & Satria, 2013)

Figure 3 also shows that the chaetodontidae family has an abundance of 2,400 ind/ha while the others have relatively low values. The existence of the chaetodontidae family greatly determines the speed of coral reef recovery because members of this fish family are indicator fish whose presence can indicate the health of the coral reef itself. According to Nurjirana & Andi (2017) chaetodontidae fish are a species of reef fish that consume polyps found in coral (coralivore), so any changes that occur in the coral reef ecosystem will also have an impact on the condition and behavior of chaetodontidae fish. Fish of the chaetodontidae family are also indicator fish in coral reef ecosystems which have a close relationship with coral reef ecosystems.

Individual Abundance of Each Coral Reef Fish Family Site B

The results of the analysis of the abundance of reef fish families at station II (natural coral reefs) in Botutonuo waters, Bone Bolango Regency are presented in Figure 4. The results of the study at station II (natural coral reefs) found 20 families of 69 species of fish. The Pomacentridae family obtained the highest abundance value, which was 47,160 ind/ha, followed by the Acanthuridae family 16,640 ind/ha, the Labridae family 10,480 ind/ha, the Chaetodontidae family 3,000 ind/ha, the Pomacantidae family 1,720 ind/ha, and other fish families can be seen in Figure 4. The results of observations of coral reef fish at site A and site B are known to have differences, in that at site A the level of fish abundance is higher than at site B. It is suspected that the coral transplantation activity in Botutonuo waters has had a positive impact, namely being a contributor to the high abundance value reef fish at site A compared to site B. According to Yanuar & Aunurohim (2015) coral transplantation can increase fish abundance because the location is a fish shelter and the food sources in coral reefs are important for the fish that occupy them. In addition, according to Fazillah et al. (2020) changes in the abundance and community of reef fish depend on the magnitude of the influence of seasonal changes and available food sources, thus affecting the presence or absence of fish that inhabit these waters. This was proven in the third observation of the emergence of 11 new species which did not appear in the first observation or in the second observation.Several new fish species that appeared in the third observation were the species Naso lituratus, Chaetodon baronessa, Chaetodon rafflesii, Heniochus varius, Cheilinus undulatus, Cheilio inermis, Rhinomuraena quaesita, Amphiprion sandaracino, Scarus quoyi, Scorpaenodes caribbaeus, and Canthigaster papua. In addition, at the time of observation, the appearance of napoleon fish (Cheilinus undulatus) was found which indicated that the health of coral reefs in a conservation area waters was getting better (KKP-RI, 2020). Maulana (2022) artificial coral reefs can be the basis for knowing the level of success of coral transplantation which can be indicated by the presence of coral reef fish as associated biota, in addition to invertebrate biota.

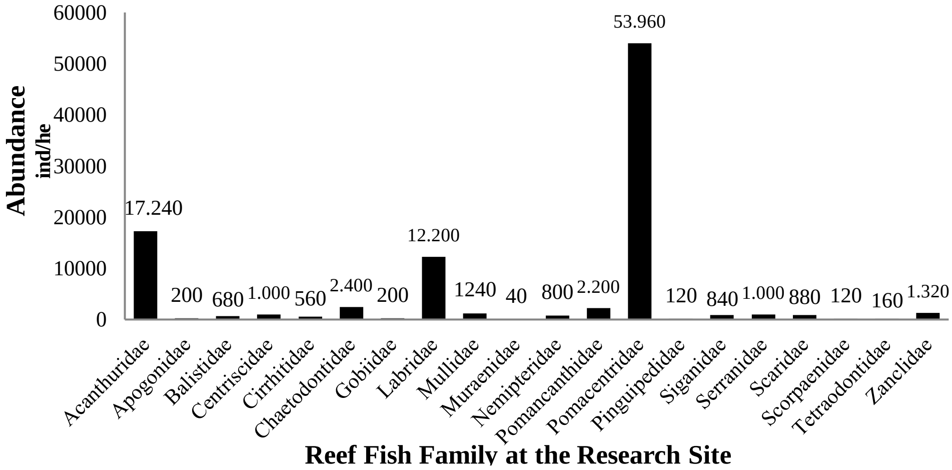

Figure 4. Individual Abundance of Each Coral Reef Fish Family Site B Natural Coral (ind/ha)

CONCLUSION

Based on the research results, it was known that the number of fish species found in Botutonuo waters, Gorontalo Province, at site A was 89 species with a total individual abundance of 2,429 ind/m2, while at site B, there were 69 species with a total individual abundance of 2,054 ind/m2.

ACKNOWLEDGMENT

The author thanks to God Almighty for His mercy and grace so that the writer can finish writing this journal. The author also expresses many thanks to my supervising lecturers, Prof. Dr. Femy Mahmud Sahami, S.Pi., M.Si and Dr. Sri Nuryatin Hamzah, S. Kel., M.Sc. who have taken the time, guided, provided direction, advice and motivation to the author during the preparation of this journal. As well as to those who have assisted in data collection, the Team from the UNG maritime study center who have assisted during the research, to the Team Diver, Mr. Hidayat Bachtiar S.Kel, Mr. Alinton Pisuna, Ms. Ronal Lahmutu S.Pi, my friend Akbar Hidayat Hiola and Fitriana M. Hadju who helped during the research. And friends of the 2019 Ludfin, Musdalifah and other friends who have helped, motivated, supported so that the writer can finish writing this journal.

REFERENCES

Arqam, M., L. Anadi dan Nadia, Loar. (2019). Struktur Komunitas Ikan Karang pada Lokasi Rehabilitasi Karang Modul Bioreeftek di Perairan Desa Tanjung Tiram, Kabupaten Konawe Selatan. *Jurnal* Manajemen Sumber daya Perairan. *4* (3), 214-221.

English, et.al. 1994. Survey Manual for Tropical Marine Resources. Australian Institute of Marine Science, Townsville.

Fazillah, M. R., Afrian, T., Razi, N. M., Ulfah, M. U., & Bahri, S. (2020). Kelimpahan, Keanekaragaman dan Biomasa Ikan Karang Pada Perairan Ujong Pancu, Kabupaten Aceh Besar. *Jurnal Perikanan Tropis*, *7*(2), 134-144.

Https://reefguide.org/search.html

Maulana, R. (2022). Struktur Komunitas Ikan Karang Berdasarkan Peranannya Pada Area Transplantasi Terumbu Karang di Kawasan Taman Wisata Perairan Kapoposang, Kabupaten Pangkajene Kepulauan Sulawesi Selatan= *Community Structure of Reef Fish in The Coral Reef Transplant Area In Aquatic Park Area of Kapoposang Island, Pangkajene and Island Regency, South*

Sulawesi (*Doctoral Dissertation*, Universitas Hasanuddin).

Mujiyanto., & Satria, F. (2013) Sebaran Jenis-Jenis Ikan Famili Labridae (*Wrasess*) Di Taman Nasional Karimunjawa, Jawa Tengah. *Jurnal*. Balai Penelitian Pemulihan dan Konservasi Sumberdaya Ikan.

Nurhasinta, N., Umroh, U., & Syari, I. A. (2019). Kelimpahan ikan *Chaetodontidae* dan *Pomacentridae* di ekosistem terumbu karang Pulau Ketawai dan Pulau Gusung Asam Kabupaten Bangka Tengah. Maspari *Journal: Marine Science Research*, *11*(2), 97-114.

Nurjirana, N., & Burhanuddin, A. I. (2017). Kelimpahan dan keragaman jenis ikan Famili Chaetodontidae berdasarkan kondisi tutupan karang hidup di Kepulauan Spermonde Sulawesi Selatan, *Jurnal Ilmu Kelautan Spermonde*, *3*(2).

Paembonan, R. E., Naipon, Y. D., Baddu, S., Baksir, A., Marus, I., Ramili, Y.,& Akbar, N. (2022). Penilaian Ikan Karang Pada Daerah Transplantasi Karang di Perairan Laut Kastela Ternate. *Jurnal* Ilmu Kelautan Kepulauan, *5*(1).

Puspasari, R., Rahmadi, P., Rahmawati, P. F., & Samu-Samu, A. S. (2015). Interaksi Variabilitas Iklim Dengan Ekosistem Terumbu Karang Dan Sumber Daya Ikan Karang. Jurnal Penelitian Perikanan Indonesia, *21(*4), 211-220.

Rondonuwu, A. B. (2014). Ikan karang di wilayah terumbu karang kecamatan maba kabupaten halmahera timur provinsi maluku utara. *Jurnal Ilmiah Platax*, *2*(1).Sasauw, H., Bataragoa, N. E., Manu, G. D., Rondonuwu, A. B., Lalita, J. D., & Kusen, J. D. (2022). *Acanthuridae in Bitunuris Waters Talaud Islands*. *Jurnal* Ilmiah PLATAX, *10*(2), 261-268.

Sasauw, H., Bataragoa, N. E., Manu, G. D., Rondonuwu, A. B., Lalita, J. D., & Kusen, J. D. (2022). *Acanthuridae in Bitunuris Waters Talaud Islands*. *Jurnal* Ilmiah PLATAX, *10*(2), 261-268.

Setiawan, F. (2010). Panduan lapangan identifikasi ikan karang dan 8nvertebrate laut. *Wildlife Conservation Society, Manado.*

Suryono, S., Ambariyanto, A., Munasik, M., Ario, R., Pratikto, I., Taufiq-SPJ, N., & Supryhatun, E. (2022). Perubahan Luas Terumbu Karang di Pulau Panjang, Jepara. Jurnal Kelautan Tropis, *25*(3), 337-344.

Syahrul, M. (2022). Keterkaitan Kondisi Terumbu Karang Dengan Sebaran dan Keanekaragaman Fauna Megabentos di Perairan Pulau Barranglompo Kota Makassar (*Doctoral dissertation*, Universitas Hasanuddin).

Titaheluw, S. S., Kamal, M. M., & Ernawati, Y. (2015). Hubungan antara ikan Chaetodontidae dengan bentuk pertumbuhan karang. Agrikan: *Jurnal* Agribisnis Perikanan,*8*(1), 77-86.

Umar, J. (2020). Komunitas Ikan Karang di Daerah Transplantasi Karang dan Di Daerah Terumbu Karang Alami (Studi Kasus Di Perairan Desa Botutonuo Kabupaten Bone Bolango Provinsi Gorontalo). *Skripsi*,*1*(633414067).

Www.fishbase.org

Yanuar, A., & Aunurohim, A. (2015). Komunitas Ikan Karang Pada Tiga Model Terumbu Buatan (Artificial Reef) di Perairan Pasir Putih Situbondo, Jawa Timur. *Jurnal Sains dan Seni ITS*, *4*(1), E19-E24.