SPECIES DIVERSITY AND ABUNDANCE OF CORALS AND FISHES IN A MARINE PROTECTED AREA

GENE PEARL ABAYON LUNA[1], PRINCES LUISE DELA TINA-PICAZA[2]
REY ALMER L. GINDAP[3]
https://orcid.org/0000-0002-5696-7881[1], https://orcid.org/0000-0002-1915-809X[2], https://orcid.org/0000-0002-1477-6278[3]
lunagenepearl@gmail.com[1], pldt.picaza@ddosc.edu.ph[2], sirgindapreyalmer@gmail.com
Davao Oriental Regional Science High School , Mati, Davao Oriental Philippines[1],
Davao de Oro State College, Maragusan, Davao de Oro Philippines[2]
Mapua Malayan Colleges Mindanao, Gen Douglas McArthur Matina Davao City 8000[3]

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ABSTRACT

This quantitative-descriptive study's purpose was to gather information about the current state of fish and coral distribution in the Barangay Tamisan Marine Protected Area. Specifically, it aimed to determine the level of physicochemical parameters, reef health status, coral composition and abundance, reef fish abundance, and biomass in the study site. The study used line transect and fish visual methods. Results of the study revealed that the physicochemical parameters in the said area fall within the normal range, which is favorable for the survival of fishes and corals in the study site. The Tamisan Marine Protected Area's average cover of hard coral is 38.5%, which falls under the " fair " category. Corals with the greatest abundance are from the massive porites genera which comprise 70% of the hard coral cover. Nineteen species from different families of fishes were in the study area, and 1 class was identified, Actinopterygii. Among the species, it is Pomacentridae that has the greatest number of counts, that is, 34. Other species identified were Labridae, Siganidae, Ephinephilenae, Acanthurida, Balistidae. Apogonida, Scarida, Chaetodontidae, Caesionidae. Monacantidae, Tetraodontidae, Fistularidae, Synodontidae, Synanciinae and, Pomacantidae. The fishes in the study area have a diversity index of 0,820, representing a high index of diversity, but have very low fish biomass. The results implied that although the coral cover is fair and fishes are diverse, further studies on human activities still need to find the reason behind very low fish biomass.

*Keywords**:** fishes, reef health status, quantitative-descriptive study, Marine Protected Area, Mati City*

INTRODUCTION

The Philippines is an archipelagic country with its proud diversity of marine species. In many parts of the Philippines, marine biodiversity has been a source of Filipino livelihood, consumption, and indication of ecological status. Knowing the diversity indices of these marine species gives us a glimpse of the ecological health of the marine environment of our localities.

Coral reefs are among the most diverse ecosystems on the planet (National Oceanic and Atmospheric Administration, 2017). They support reef-associated species by providing essential habitat systems and resources in coral reef systems. Many fish species rely on corals for food and habitat. The fishing stocks and tourist industry opportunities provided by reefs provide a living for an estimated five hundred million people. Despite their importance, coral reefs are dying all over the world due to warming waters, pollution, acidification of the oceans, overharvesting, and physical destruction (Gibbens, 2020). According to a recent study, human activities are endangering the health of the world's oceans. More than 80% of marine pollution is caused by land-based activities. From coastal erosion to sea level rise, entire aquatic ecosystems are changing at a rapid pace.

The findings extend previous global studies' findings (Cinner et al., 2016) by proving that specific MPA strategic planning attributes are essential for protecting various components of corals. A study in Sabah, Borneo, examined the coral reef and benthic reef assemblage, revealing high species richness in the area (Waheed et al., 2015). In Indonesia, a study revealed that the MPA in the coral reefs of the study site was severely damaged (Baigo et al., 2019). Another study in Australia assessed reefs in MPA and found a great hard loss in the study area (Millen et al., 2016). These studies reveal the importance of having regular assessments of the coral reefs and fishes in Marine Protected Areas

In the assessment of Asid Gulf, Southern Luzon Philippines found that critical coastal habitats such as coral reefs face destruction mainly from anthropogenic activities (Mendoza & Soliman, 2017). The low coral cover and abundance of corals is a confirmation of the effect of the activities, but that the presence of MPAs can serve as a platform for development and research activities in the gulf.

The current status of coral reefs in Calangahan, Lugait, Misamis Oriental, Philippines, demonstrated the effectiveness of MPA as a tool in reef assessment and monitoring (Tabugo et al., 2016). Results showed that the most prevalent genera, Porites and Acropora, have been dominant, of Porites lobata being the most plentiful coral species in the area. Furthermore, the findings revealed that various diseases were present, causing coral mortality to increase.

Tamisan is a coastal barangay located in the eastern portion of Mati City; surveying corals and fish abundance and diversity showed that the establishment of an MPA was a viable option in the area way back in 2004 (Lahagit,2018). Several studies have been conducted on the species diversity and abundance of corals and fishes in other parts of the Philippines. However, there are no studies yet on the overall species of corals and fishes concerning on the population and diversity and their status in the study area. It is a must to undertake sustained, regular monitoring of corals and fishes (Licuanan, 2020). It is important to link this monitoring to management actions at the local level. Assessments will reveal what the MPA has lost over the years, and it will be able to help generate management-actionable information.

OBJECTIVES OF THE STUDY

The researchers conducted this study to gather information about the current fish and coral distribution in Barangay Tamisan Marine Protected Area (MPA). The study specifically sought:

1. To measure the level of physiochemical parameters in terms of pH, salinity, temperature, and turbidity.
2. To evaluate the status of the reef health in the MPA.
3. To identify the coral composition of the corals found in the coral reef ecosystem.
4. To measure the relative abundance of the corals found in the coral reef ecosystem.
5. To identify the different fish species found in the coral reef ecosystem of the MPA.
6. To evaluate the status of reef fish abundance in the MPA.
7. To evaluate the status of fish biomass in the MPA.

METHODOLOGY

This study utilized quantitative research following a descriptive design. Quantitative – descriptive research aimed to collect quantifiable information for statistical analysis of the population sample. This study used the quantitative research design to gather information about the reef health status, coral cover percentage, and reef fish abundance and biomass.

A descriptive research design helped the researchers to obtain complete and correct information about the status of the corals and fishes in the area. This also provided data on the different physico parameters in the study area. It was utilized for the investigation of the community structure of the corals and fishes in the Marine Protected Area in Tamisan, Mati City.

The research subjects of this study were the different species of fishes and corals found inside the quadrants in the Marine Protected Area in Tamisan, sitting on the stretch of Mati City, Davao Oriental, positions 6.8457º N, 126.2951 º E. The coral habitat may consist of eight (8) possible components. Fishes that the researchers observed include the indicator fish species and other different species such as damselfish/clownfish, wrasse, butterflyfish, pipefish, and triggerfish.

The fish biomass and density were determined, as well as the abundance of the corals in the area. The temperature was recorded using the digital thermometer, the pH level was identified using a pH meter, and a refractometer was used for the salinity level. The data was collected with the help of expert divers from the Provincial Environmental and Natural Resources Office and Davao Oriental State College of Science and Technology – Regional Integrated Coastal Resource Management.

Data gathered were treated using Quartile Index for Reef Health Established by Gomez and Alcala (1979), fish abundance, and fish biomass by using the categories described by Hilomen et al. (2000), and Nanola et al. (2006) for fish biomass.

RESULTS AND DISCUSSION

1. Physico-Chemical Parameters

Table 1 represents the physico – chemical parameters measured during the sampling period in the Tamisan, Mati City study site.

As shown in Table 1 above, station 1 had a pH value of 8.23; Station 2 had 8.24, while Station 3 also had a value of 8.24. The pH of the MPA falls under the Standard Seawater pH value as slightly alkaline, usually from a pH of 7.5 to 8.4.

Table 1
Level of Physico-Chemical Parameters

Physico – Chemical Parameters	Sampling stations					
	1	Description	2	Description	3	Description
pH	8.23	Basic	8.24	Basic	8.24	Basic
Salinity (PSU)	30.19	Average	30.12	Average	30.1	Average
Temperature ^{0}C	28.4	Average	28.51	Average	28.53	Average
Turbidity NTU	22.2	Fair	22.0	Fair	22.3	Fair

The pH of marine waters is influenced by the concentration of carbon dioxide and organic substances dissolved in water (Walag & Canencia, 2016).

The salinity ranged from 30.1 to 30.19 psu in the three sampling stations of the study area. This range of values is normal for tropical areas. Normal salinity ranges from 30 to 37 grams of salt per kilogram of seawater or psu (McKenzie, Howard &Duxbury, 2020). Water temperature reading within the period of study ranged from 28.40^{0}C to 28.53^{0}C. Water temperature reading in the study area were in the range for the survival of aquatic organisms (Bos et al., 2018). The Turbidty of water, as shown in Table 1, had values of 22.2, 22.0, and 22.3. These water turbidity levels in the study site reading were categorized as fair (Waterwatch, 2021). Turbidity levels are shown to have adverse effects on benthic communities when they exceed 39.0 NTU (Pentony, 2020). In the marine ecosystem, the physico-chemical parameters are the most imperative parameters in the physical surroundings of an organism to regulate the survival, growth, reproduction, and distribution of organisms (Murugan, et al., 2018).

2. Status of Reef Health in the MPA

The table below shows the reef health status of the study site as indicated by the percentage of coral cover. The coral cover percentage is determined by adding the total per habit class divided by the total per transect multiplied by 100%.

Table 2
Reef Health Status

Benthic Attributes	Percent Coral Cover
Hard Corals	38.5%
Dead Corals with Algae	16.40%
Algae	0
Others	21.0%
Abiotic	42.9%

The Tamisan Marine Protected Area mean hard coral cover of 38.5% falls under the "fair" category as shown in Table 1. The status of the reef health was determined by noting the percentage of live scleractinian (hard) corals and comparing them against the quartile index established by Gomez and Alcala (1979) to classify the status of the reefs inside the MPA. The four categories and corresponding ranges of live coral cover (LCC) are as follows: "poor" (0%–25% LCC), "fair" (25%–50% LCC), "good" (50%–75% LCC), and "excellent" (75%–100% LCC). Live coral cover was measured by adding hard and soft coral covers per site. In a study by Licuanan et al. (2021), in their coral cover assessment done in 2017, Mati City's coral cover is 18, under the "poor" category. This would mean that there has been an improvement in the coral cover present in the Marine Protected Area.

3. Coral Composition in the MPA

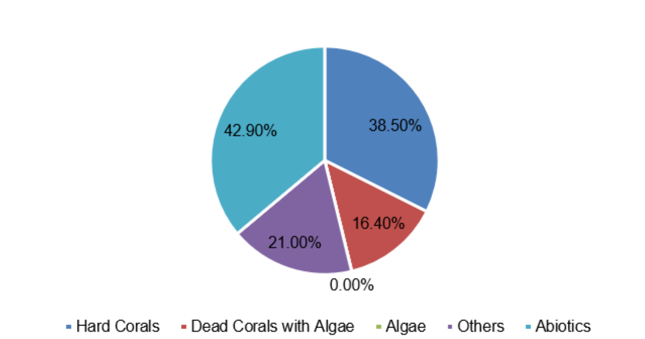

Figure 1. Coral composition found in the coral reef ecosystem of the MPA

The figure above shows the coral composition found in the coral reef ecosystem of the MPA. The in situ recording gathered by the expert divers generated data on the percent cover of the various attributes that comprise the benthos (e.g., live hard coral, soft coral, dead corals, abiotics, algae, other organisms). Computations were done on Microsoft Excel.

Figure shown above reveals that there is 38.5% of hard corals. Hard corals are live corals. Dead corals algae comprised 16.40% of the coral cover. These corals have long been dead and are now covered with microalgae. Soft corals, sponges, sea stars, seagrasses, and other live organisms form 21.0% of the coral cover. The rest of the coral cover, which comprises 42.9% is abiotic, the sand, rubble and other non-living components of the benthic environment.

4. Live hard corals (LHCs) observed in the MPA

Table 3
Relative Abundance

Genera of Hard Corals	Abundance
Portites (massive)	70%
Pocillopora (branching)	17%
Porites (branching)	5%
Acropora	5%
Anacropora	3%

The table below shows the relative abundance of the hard corals in the study site. In this method, a diver diving along a transect 25 m long and 5 m wide visually records a visual in situ estimate of % coral cover by species. The method necessitates the use of an experienced observer. During this study, Arnel G. Gayta from Provincial Environment and Natural Resources Office made the measurements using this method.

Table 3 shows the different corals present in the areas as identified by the marine biologist at the genera level. It also describes their abundance on the site. Observed on site were porites (massive) which comprises 70% of the corals, pocillopora 17%, porites (branching) 5%, acropora 5%, and anacropora 3%.

Porites' abundance (massive) could be attributed to their tolerance to a wide range of conditions in the environment, including temperature, salinity, and alkalinity fluctuations (De Vantier & Turak, 2017). Furthermore, a 2018 study on the status and trends of Pacific coral reef communities found evidence of stasis or decrease in mean coral cover over the last 40 years; only one coral taxon to deviate from in this regional pattern has been massive Porites, which showed evidence of net rise in overall cover during this period (Sandin et al., 2020).

5. Fish Species Found in the Coral Reef System of the MPA

Table 4
Fish Species in the MPA

Family	Record number of fishes per size class	
	1-10 cm	11-20 cm
Ephinephilenae Groupers; lapu-lapu	3	2
Lethrinidae Emperors; katambak	3	
Caesionidae Coral breams, silay	2	
Mullidae Goatfishes; bimbungan	2	1
Balistidae Triggerfishes, pakol	4	
Chaetodontidae Butterfly fishes; alibangbang	1	
Pomacanthidae Angelfishes; adlo	1	
Labridae Wrasses; labayan	8	
Scaridae Parrotfishes; molmol	3	
Acanthuridae Surgeonfish; bakaday	4	
Siganidae Rabbitfishes; kitong;	6	
Pomacentridae Damselfishes; palata	34	
Pomacentridae *Clownfish*	2	
Synancinae Stonefish; bantol		1
Synodontidae Lizardfish; tikitki	1	
Apogonidae Cardinalfish; moong	3	
Fistularidae Flutemouthfish; tubotubo		1
Tetraodontidae Butiti	1	
Monacantidae Filefish	1	

Pomacentridae coral reef damselfishes are the most abundant species because they have whether facultative or obligate prerequisites for coral reefs as habitat (Emslie, et al., 2019). These fish are mostly small, and many use coral structures as a shelter, emerging to feed and quickly retreating when a predator threatens them.

6. Reef fish Abundance in the MPA

Table 5 presents the reef fish species richness and abundance found in the MPA. Summaries of species richness and abundance for the transect were generated and expressed in units of 1000 m^2. This table displays the record number of fishes per size class, species richness or the number of species/1000 m^2, and the abundance or the number of individuals/1000 m^2. There are five categories for species richness and abundance, as described by Hilomen et al., (2000). The range of this based on the 1000 m^2, includes very rich and very high for greater than 7592, rich and high in 2268–7582, moderate for 667–2267, poor for 202–676, and very poor for less than 202.

Table 5
Fish Species Richness and Abundance in the MPA

Family	Number of Species (n)	Species Richness (No. of Species/ 1000 m^2)	Interpre™tation	Abundance (No. of Individual/ 1000 m^2)	Interpretation
Ephinephilenae	5				
Lethrinidae	3				
Caesionidae	2				
Mullidae	3				
Balistidae	4				
Chaetodontidae	2				
Pomocanthidae	1				
Labridae	8				
Scaridae	3				
Acanthuridae	4				
Siganidae	6	0.019	Very Poor	0.085	Very Low
Pomacentridae Damselfishes	34				
Pomacentridae *Clownfish*	2				
Synancinae	1				
Synodontidae	1				
Apogonidae	3				
Fistularidae	1				
Tetraodontidae	1				
Monacantidae	1				
Total	85				

Furthermore, it can be observed on the table that based on the recorded number of fishes per class size, the species with the highest number was Pomocanthidae with 35, followed by *Labridae* with 8, then *Siganidae* with 6. The least number of species were *Chaetodontidae, Synancinae, Synodontidae, Fistularidae, Tetraodontidae,* and *Monacantidae,* having 1 for each. Also, the richness of the species was described as very poor since the computed value was 0.019, which was less than 202. Lastly, on the abundance of species, since this computed value was just 0.085, and it was less than 202, then the abundance was described as very low.

Low fish species richness and abundance may still happen even in MPAs. In evaluating different MPAs in the Philippines, MPAs should not be viewed as a panacea for all fisheries management issues (Muallil et al., 2019). They do not address critical issues for the overall management of the area beyond an MPA's boundaries. They also do not address previous ineffective fisheries management, which has frequently resulted in overcapacity, overfishing, and economic loss.

7. Fish biomass in the MPA

Table 6 presents the fish biomass in the study site; weight in tons is computed for their overall weight in grams divided by the area of the study site as their fish biomass.

Table 6
Fish Biomass

Family	Record number of fishes per size class	Weight (in grams)	Weight (in ton)	Categories of sites according to fish biomass of a certain species
Ephinephilenae	3	24.4035918	0.0000244	Very low
Lethrinidae	3	27.263208	0.0000272	Very low
Caesionidae	2	10.495154	0.0000105	Very low
Mullidae	2	20.6723575	0.0000006	Very low
Balistidae	4	10.4952	0.0000105	Very low
Chaetodontidae	1	25.2189985	0.0000252	Very low
Pomocanthidae	1	23.8380812	0.0000239	Very low
Labridae	8	23.7231766	0.0000237	Very low
Scaridae	3	31.5261682	0.0000315	Very low
Acanthuridae	4	43.8437498	0.0000438	Very low
Siganidae	6	35.1261189	0.0000351	Very low
Pomacentridae	34	13.5376704	0.0000135	Very low
Synancinae	1	68.3252121	0.0000682	Very low
Synodontidae	1	50.8	0.0000508	Very low
Apogonidae	3	15.1512659	0.0000315	Very low
Fistularidae	1	4.48	0.0000005	Very low
Tetraodontidae	1	4.69	0.00000056	Very low
Monacantidae	1	0.52572	0.00000052572	Very low

This table shows that fish biomass in the MPA is very low. Fish are the most diverse vertebrates; they play critical functional roles in aquatic ecosystems and provide protein to billions of people, particularly in developing countries. Increasing pressures on marine biodiversity and ecosystems are jeopardizing these functions. Fish biomass is threatened due to its economic and food value (Duffy et al, 2016). Marine-protected areas do not reduce fishing pressure; they simply shift it to a different location (Dagupta, 2018).

Table 7
Other Observations

Biotic Observations	Abiotic Observations
Tridacna-quamosa (taklobo)	Sinkers
Crown of Thorns (Dap-ag)	Rubbers
Starfish	Anchor

It was also evident that sinkers, rubber ropes, and anchors were found during the fish visual census, as shown in Table 7. This indicates that although the area is marine protected, there was evidence of human activities that could affect the fish. This finding is consistent with a study conducted by Arizona State University (2020) on anthropogenic factors on resource wild fish on the island of Hawaii. Over a decade of surveys, the researchers discovered a startling 45% decrease in fish biomass.

CONCLUSIONS

Through the findings of the study, the following conclusions were drawn:

1. The level of physico – chemical parameters is within the normal range, which is favorable for the survival of fishes and corals in the study site.
2. Coral reef health is fair as not many hard corals are found in the study area.
3. Coral composition of the study site is composed of hard corals, dead corals, algae, other organisms, and abiotic components that make up the benthic environment.
4. It was the genera portites who were most abundant in the coral cover competition.
5. Among the 18 families of fishes, the most abundant was the *Pomacatidae*. These fish are mostly small, and many use coral constructions as a shelter, emerging to feed and quickly retreating when a predator threatens them.
6. Fish diversity was high, with an index near 1.0.

7. Fish biomass was very low as, although diverse, they are not abundant.

RECOMMENDATIONS

Based on the findings, analysis, and conclusion drawn in the study, the researchers recommend the following:

1. To conduct another research using a larger area of transect involving the similarities of fish diversity and coral reefs and seaweeds as their home.
2. Further studies on the human activities in the Marine Protected Area to determine the cause of very low fish biomass and fair coral cover.
3. Further studies on the fish catch pattern outside the perimeters of the Marine Protected Area.
4. Regular monitoring and assessment of fish and corals should be done in the area.
5. Conservation and protection measures must be maintained in the area.
6. Science teachers can use the learning materials, the book of fish, and video clips on the locality's marine ecosystem to indigenize their biodiversity lesson.

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AUTHORS' PROFILE

Gene Pearl A. Luna, LPT, MAED is a science research teacher in Davao Oriental Regional Science High Scool, Mati City. She earned her bachelor's degree in Secondary Education major in Physics at Ateneo De Davao University and earned her Master's degree at St. Mary's College of Tagum inc. She is currently taking up Doctorate degree at Bukidnon State University

Dr. Princes Luise C. Dela Tina graduated with a Bachelor of Science in Secondary Education major in Biological Science at St. Mary's College of Tagum, Inc. in 2015 and earned her master's degree in Teaching Science at the same Institution. She finished her PhD for Science Education with a concentration in Biology in Bukidnon State University's graduate program (BukSU). Her dissertation is entitled "Distribution of the Lichen Flora in Mt. Candalaga, Davao de Oro: Basis for Development of Instructional Module for Biology Teaching." Dr. Dela Tina's field of interest is quantitative research, experimental research, and lichen species' biodiversity. She presented her researches in international research conferences. Dr. Dela Tina has also served as a research adviser and data analyst

Rey Almer L. Gindap, LFA, LPT, MAEd, is a graduate of Bachelor of Science in Secondary Education and Master of Arts in Education Major at St. Mary's College of Tagum, Inc. He was also one of the topnotchers in the September 2018 LET. He taught research and sciences subjects in Senior High School and College Department of St. Mary's College of Tagum, Inc. He is currently a full-time faculty of the High School Department of Mapua Malayan Colleges Mindanao. He is passionate in teaching research subjects: Qualitative, Quantitative, and CAPSTONE Project. He is also actively volunteering and advising two non-government organizations - CoExister Philippines and Youth Service Philippines.

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