Republic of the Philippines
Department of Environment and Natural Resources
PROVINCIAL ENVIRONMENT AND NATURAL RESOURCES OFFICE
MIMAROPA Region

MIMAROPA RECORDS SECTION
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MEMORANDUM

FOR	:	The Regional Executive Director 1515 L&S Bldg., Roxas Blvd., Ermita, Manila
THRU	:	The ARD for Technical Services
FROM	:	The PENR Officer
SUBJECT	:	SUBMISSION OF THE CORAL REEF MONITORING REPORT OF APO REEF NATURAL PARK FOR CY 2022

Respectfully forwarded is the memorandum dated August 24, 2022 from CENRO Sablayan re Submission of the Coral Reef Monitoring Report of Apo Reef Natural Park (ARNP) for CY 2022.

Please be informed that the report includes the result of conducted field surveys last March 2022. For this year, the result in hard coral cover (HCC) is 10.41% which is under HCC Category D. This HCC is much lower than the estimates in the WPS Bioregion and entire Philippines. This is fairly the same with estimates in 2020 and 2021 but far lower than the value reported in 2017.

In addition, coral recovery in most monitoring stations were found to be slow if not inevident because of these findings, the recommendations are to strengthen the linkage with marine scientist for the possible solutions in the active rehabilitation of the reef and capacitation of ARNP-PAMO staff. On the other hand, the communities of reef-associated fishes and macroinvertebrates have been stable since 2017, scaling up of existing initiatives preventing anthropogenic disturbance and law enforcements should be intensified to minimize, if not eradicate, illegal fishing activities – which they can do more effectively with additional watercrafts and manpower which affects macroinvertebrates and reef-fishes communities, are also advised.

Attached is the narrative report with its annexes.

For your information and record.

ERNESTO E. TAÑADA

Republic of the Philippines
Department of Environment and Natural Resources
MIMAROPA Region
COMMUNITY ENVIRONMENT AND NATURAL RESOURCES OFFICE
National Road, Brgy.Sto. Niño, Sablayan, Occidental Mindoro
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August 24, 2022

MEMORANDUM

FOR : The Regional Executive Director
DENR MIMAROPA Region
Ermita, Manila

THRU : The PENR Officer
Mamburao, Occidental Mindoro

FROM : The CENR Officer

SUBJECT : SUBMISSION OF THE CORAL REEF MONITORING REPORT OF APO REEF NATURAL PARK FOR CY 2022

Respectfully forwarded is the Coral Reef Monitoring Report of Apo Reef Natural Park – Protected Area Management Office (ARNP-PAMO) for CY 2022. The report includes the results of the field surveys conducted last March 2022. For this year, the overall average hard coral cover in ARNP is 10.41% (HCC Category D). This is fairly the same with the estimates in 2020 and 2021 but far lower than the value reported in 2017. On the other hand, the communities of reef-associated fishes and macroinvertebrates have been stable from 2017 to 2022.

Attached herewith is the narrative report with its corresponding appendices.

For information and record.

FOR. ANASTACIO A. SANTOS, MPA

Department of Environment and Natural Resources
MIMAROPA Region
APO REEF NATURAL PARK
Protected Area Management Office

August 24, 2022

MEMORANDUM

FOR : The Regional Executive Director
DENR-Region 4B – MIMAROPA
1515 L&S Bldg., Roxas Blvd., Ermita, Manila

THRU : The OIC, PENR Officer
Mamburao, Occidental Mindoro

The CENR Officer

FROM : The Protected Area Superintendent

SUBJECT : SUBMISSION OF THE CORAL REEF MONITORING REPORT OF APO REEF NATURAL PARK FOR CY 2022

Respectfully submitted is the Coral Reef Monitoring Report of Apo Reef Natural Park for the CY 2022. The estimate for hard coral cover (HCC) in Apo Reef Natural Park this year is 10.41% which is under HCC Category D. This HCC is much lower than the estimates in the WPS Bioregion and entire Philippines. To add, coral recovery in most monitoring stations were found to be slow if not inevident. With these findings, among our recommendations is to strengthen the linkage with marine scientist for the possible solutions in the active rehabilitation of the reef and capacitation of PAMO Staff. While communities of reef-associated fishes and macroinvertebrates have been fairly the same since 2017, scaling up of law enforcement – which we can do more effectively with additional watercrafts and manpower – to reduce the anthropogenic disturbances which affects macroinvertebrates and reef fish communities, is also advised.

Attached herewith are the narrative report and its corresponding appendices.

For your information and record.

KRYSTAL DAYNE T. VILLANADA

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Coral Reef Monitoring Report

CY 2022

I. INTRODUCTION

Apo Reef Natural Park (ARNP) is an offshore Marine Protected Area (MPA) that lies approximately 30 kilometers off the western coast of Mindoro. It spans a total of 15,799.23 hectares, covering two oceanic atolls, each with a rocky islet, and an emergent limestone island that is surrounded by a fringing reef. Coral reefs within the MPA extend to mesophotic depths of up to 70 meters (Ross & Hodgson, 1981; Cabaitan et al., 2018). At present, ARNP is known to host at least 63 genera of hard corals and 482 species of fish. The larvae of which are possibly transported to Cagayancillo during the northeast monsoon (Deocadez et al., 2008).

Half of the world's global living coral cover has been lost since 1950 (Eddy et al. 2021). In the Philippines, there has been a marked decline in hard coral cover (HCC) in the past decade bringing the most recent national estimate to only 22% (Licuanan et al., 2019). Similarly, ARNP has been under the threat of coral cover loss due to a number of stressors including Crown-of Thorns Starfish (CoTS) outbreaks, ship grounding incidents, coral bleaching, and storms. Monitoring of coral reefs, thus, has been relevant to management staff by providing up-to-date information on the status of the coral reefs in ARNP.

To our knowledge, the earliest known coral reef assessment in ARNP is that of Ross and Hodgson (1981). This was conducted along the fringing reef surrounding Apo Island, extending to mesophotic depths of up to 30 meters. Surveys in the last two decades have been mostly conducted different monitoring stations. These particularly are the 15 monitoring stations established by WWF-Philippines and distributed across the shallow water reefs of the Marine Protected Area.

Monitoring of Coral Reefs, Mangrove Forests, and Seagrass Beds is an activity under the Coastal and Marine Ecosystems Management Program (CMEMP) which ARNP-PAMO has been fulfilling since last year. However, it is only this year that PAMO conducted the assessment on the previously mentioned 15 monitoring stations. This was done under the leadership of Dr. Victor S. Ticzon, project head of the DOST-PCAARRD-funded project SMaRT-Corals. The objectives of the coral reef monitoring were to a.) determine the hard coral cover and community structure in shallow water reefs and b.) assess the status of reef-associated fish and macroinvertebrate communities.

II. METHODOLOGY

15 monitoring stations were monitored within the first quarter of 2022 (Figure 1). These previously established stations are distributed across areas in ARNP that are exposed to the two monsoon winds.

Five 50-m transect lines were laid in each station parallel to the contours of the reef or along the reef slope. These were done within an approximately 75 m x 25 m area. Following the photo-quadrat method of van Woesik et al. (2009), an image of the benthos was taken every meter, starting at the 0-m mark of each transect. All images were taken from a fixed distance with the use of a digital camera with underwater housing mounted on a monopod. The images were then post-processed in image editing software to improve their quality and analyzed for benthic cover using Coral Point Count with Excel extensions (CPCe) version 4.1 (Kohler & Gill, 2009). 10 points were randomly placed in each photo and the benthos intercepted by the points were identified. The frequency of each benthic category was averaged across transects to acquire the percentage cover. The new scales by Licuanan et al. (2020) were used to describe hard coral cover and coral diversity as TAUs (Tables 1 & 2).

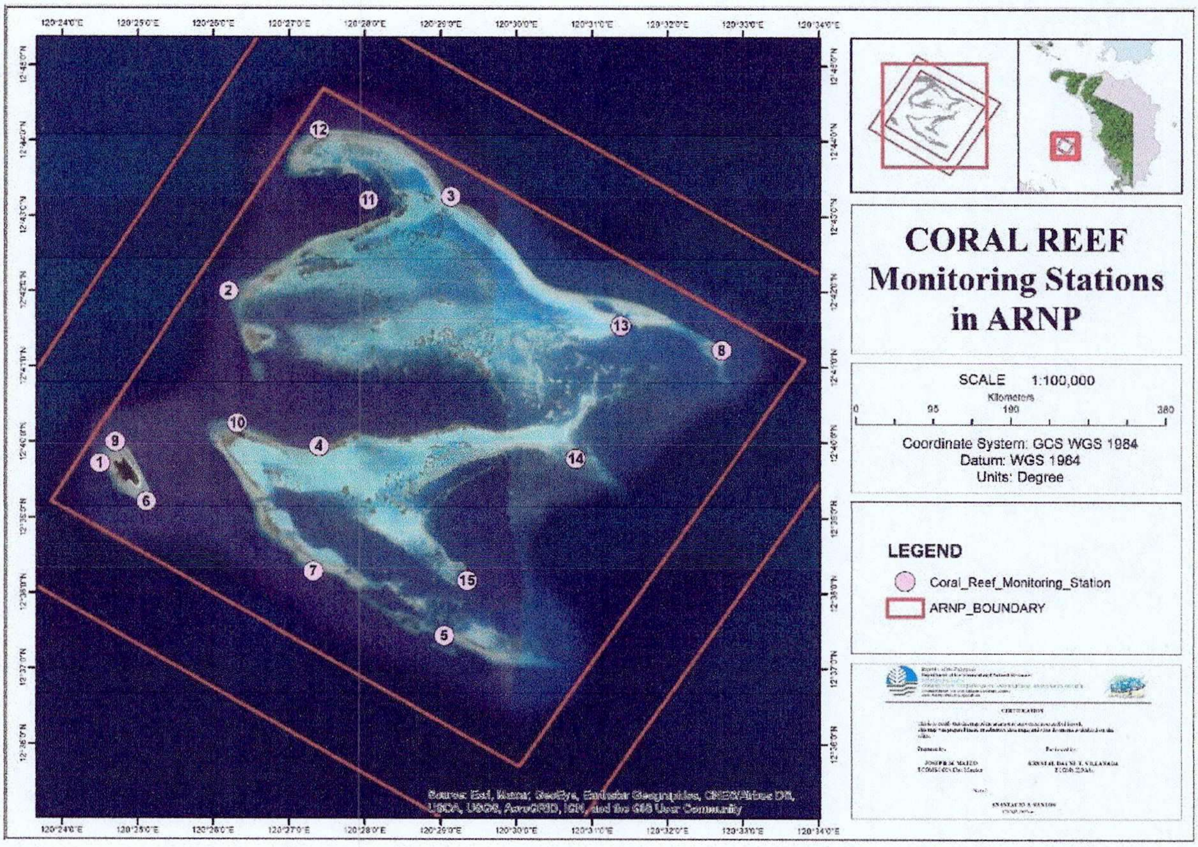

Figure 1. Fifteen established coral monitoring stations in ARNP.

Table 1. Assessment scale for the interpretation of hard coral cover by Licuanan et al. (2020).

Category	Hard Coral Cover
HCC Category A	>44%
HCC Category B	>33%-44%
HCC Category C	>22%-33%
HCC Category D	0-22%

Table 2. Assessment scale for the interpretation of hard coral diversity as taxonomic amalgamation units by Licuanan et al. (2020).

Category	No. of TAUs
Diversity Category A	>26 TAUs
Diversity Category B	>22-26 TAUs
Diversity Category C	>18-22 TAUs
Diversity Category D	0-18 TAUs

To assess reef fish communities, three of the five 50-meter transect lines were surveyed following the method for fish visual census described in English et al. (1997). A 5-meter belt was established in each transect. All fishes observed within the belt transects were identified to species level whenever possible and counted. Field guides including Randall (2005), Kuiter and Debelius (2007), and Allen et al. (2015) were used in the identification of species. The total lengths (TL) of fishes were also estimated and the biomass for each species was computed using the following formula:

$$W = (aL^b)n$$

where W is body weight (g), L is TL (cm), a and b are species-specific growth constants derived from length-weight relationships, and n is the number of individuals. The a and b parameters of length-weight relationships were based on available publicly available information from FishBase (Froese & Pauly, 2022).

A dedicated survey for reef-associated macroinvertebrates was also conducted in three of the five transects. In contrast with fish visual census, only a 1-meter belt was surveyed for each transect line. Macroinvertebrates observed within the belt transect were identified with the aid of Colin & Arneson (1997) and counted. Ascidians and sponges were excluded from this specific survey because their percentage covers were already quantified using the photoquadrat method.

III. RESULTS AND DISCUSSION

Corals

The overall average HCC for the 15 stations surveyed this year is 10.41% (Figure 2). This estimate is under the HCC Category D (0 - 22%) based on the metrics by Licuanan et al. (2020). It is well below the reported HCC for the West Philippine Sea (WPS) Bioregion (26%) and for the entire country (22.8%). All stations fell within HCC Category D except for S02 and S06 which yielded 29.07% (HCC Category C) and 33.60% HCC (HCC Category B), respectively. Coral diversity (as TAUs) of ARNP is under Diversity Category C (>18 – 22 TAUs) with an overall average of 22 TAUs (Figure 3). It is slightly higher than average TAUs for the WPS Bioregion (19.2 TAUs) and the entire country (14.5 TAUs). Similar to percent HCC, the highest coral diversity was also observed in Station 6 (36 TAUs) followed by Station 2 (32 TAUs) which are both under Diversity Category A (>26 TAUs).

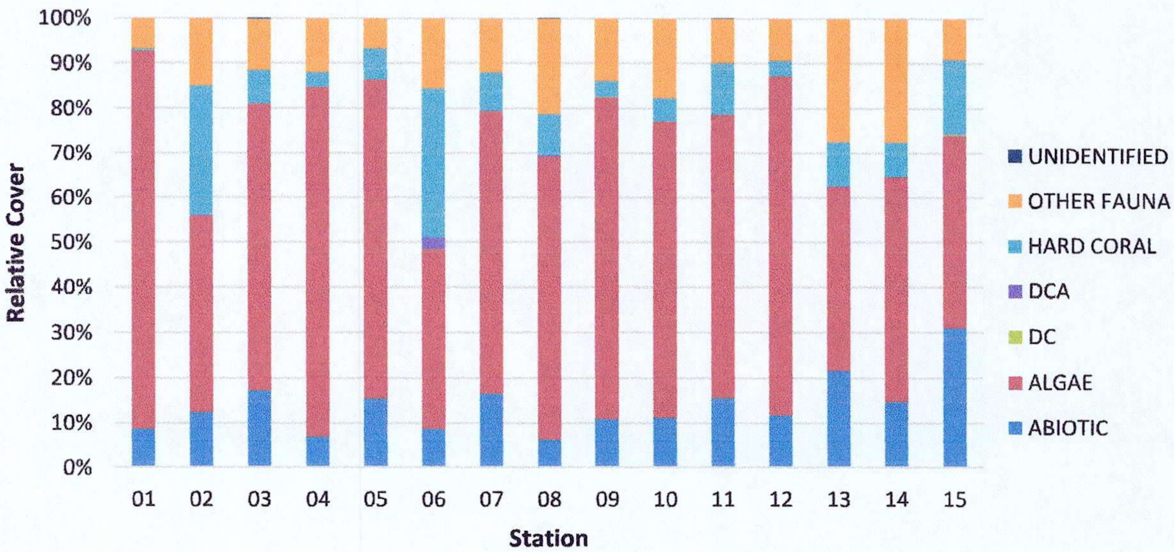

Figure 2. Relative cover of major life form categories at the 15 monitoring stations in Apo Reef Natural Park.

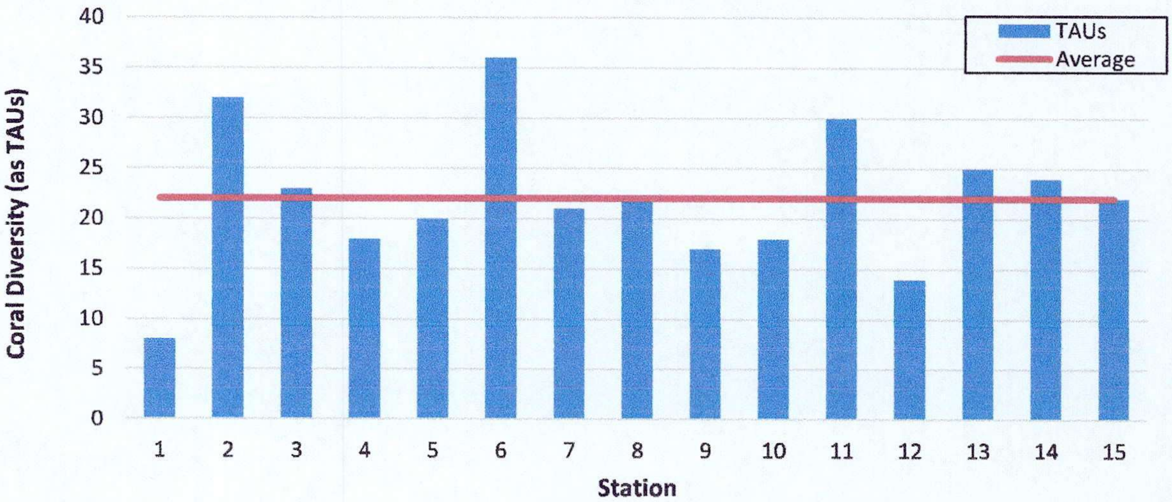

Figure 3. Average coral diversity (as TAUs) in the 15 monitoring stations in Apo Reef Natural Park.

Algae was the most dominant benthic life form in Apo Reef Natural Park with an overall average cover of 61%. It also yielded the highest average percent cover in all sites with values ranging from 39.76% in S06 to 84.00% in S01. It is important to note that crustose coralline algae (CCA), a type of algae that induces coral larval settlement (Harrington, 2004, Whitman et al., 2020), only had an overall average cover of 1%. Algae was followed by Other Fauna and Abiotics with an overall average percent cover of 14.38% and 13.89%, respectively. The other life forms (Dead Corals, Dead Corals with Algae or DCA, and Unidentified Benthos) only had a cumulative overall average cover of less than 0.32%.

The overall average HCC in ARNP remained fairly constant during the field surveys from 2020 to 2022 (Figure 4). However, a marked decline of more than 10% HCC may be observed from 2017 to 2020. Tabulate and branching corals, which are generally less resistant to environmental disturbances than other coral growth forms (Loya et al., 2001; Marshall & Schuttenberg, 2006 ; Madin et al., 2014) showed 88% and 75% decrease in cover from 2017 to 2020 (Figure 5). The likely drivers of the observed HCC loss are the outbreaks of CoTS in 2018, 2019, and early-2020 (Table 3) and increased wave action due to storms (Severe Tropical Storm *Ramil*, Typhoon *Tisoy,* and Typhoon *Ursula*).

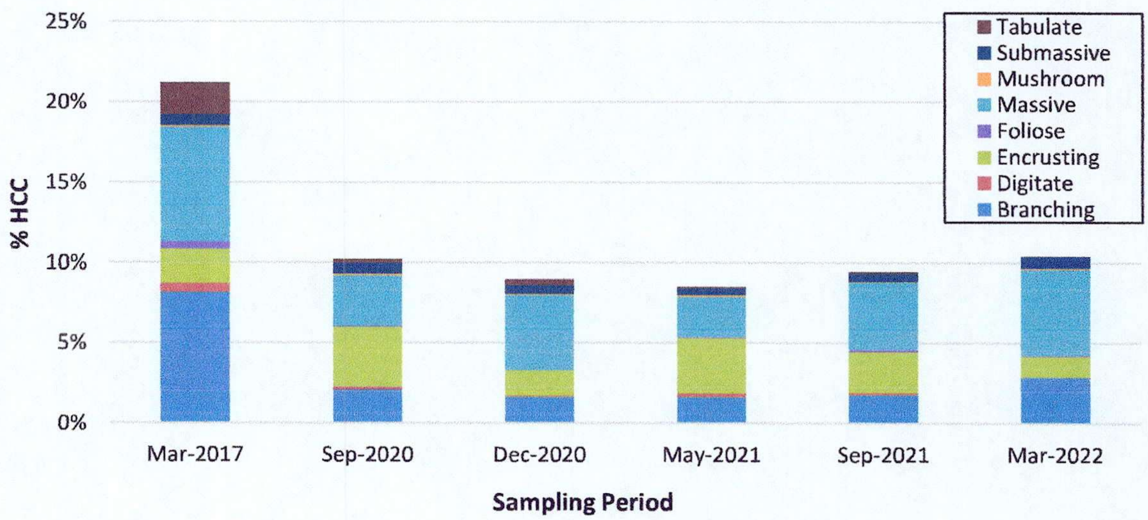

Figure 4. Changes in the overall average cover of coral growth forms from 2017 to 2022.

Table 3. Crown-of-Thorns Starfish control activities in Apo Reef Natural Park in the last five years.

Year	Period of Culling Activities	No. of individuals culled
2018	May	2,099
2019	January-June	10,680
2020	April	400*
2021	March	179

**The number of CoTS culled in 2020 were only estimated by the Park Rangers*

The current HCC estimates for most stations remain lower than those in 2017 (Figure 6). Among the monitoring stations, only S02 and S06 yielded higher HCC in 2022 than 2017 (Figure 6a & 6c). Clear signs of recovery from major disturbances were observed in these sites such as the increase in the percentage cover of encrusting, submassive, and massive corals which are more resistant to disturbances. Even the percentage cover of fast-growing branching corals increased in S06. Although less apparent, S03, S11, and S15 are also showing signs of recovery as evidenced by higher HCC estimates in 2022 as compared to 2020 and 2021. Meanwhile, lack of recovery was observed in the remaining stations. Smaller outbreaks of CoTS, both detected and undetected, and storms (Typhoon *Quinta* and *Rolly*) may be impeding with coral reef recovery in these monitoring stations. The high cover of algae may be exacerbating these disturbances by inhibiting the settlement of coral larvae, increasing the mortality of coral juveniles, and overgrowing adult corals (Box & Mumby, 2007; Webster et al., 2015). Illegal fishing activities may also contribute to these although it is unlikely because even stations proximal to the Ranger's Station (Figure 6a) were not showing clear signs of recovery (S01 and S09).

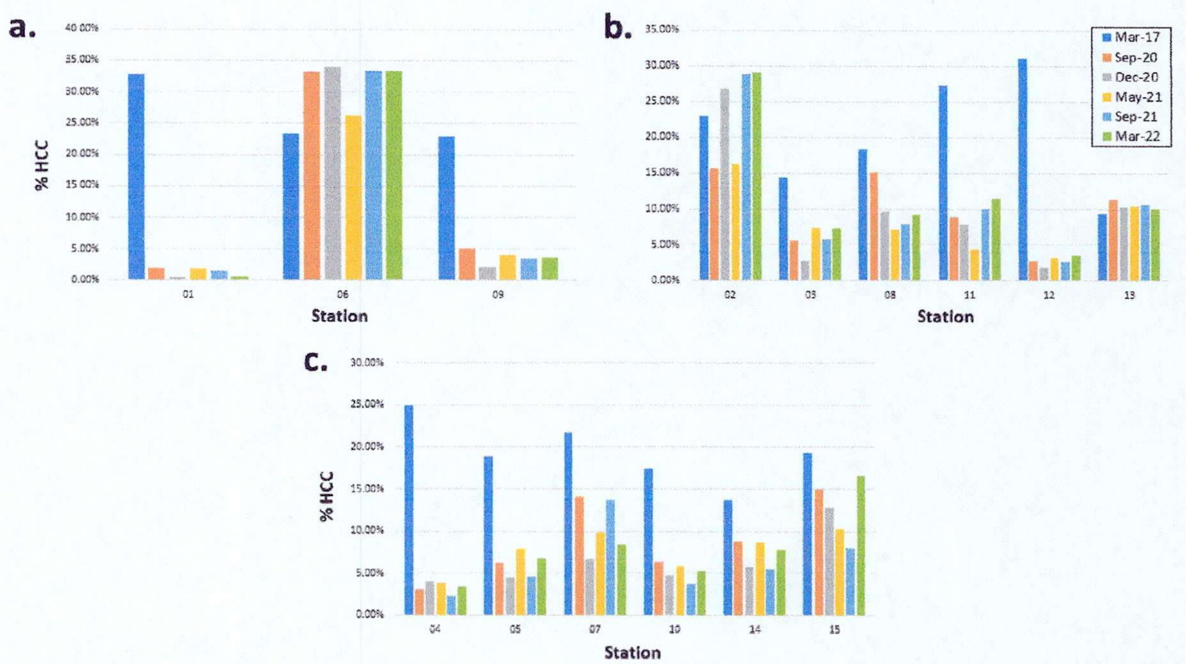

Figure 5. Average HCC in the 15 monitoring stations in Apo Reef Natural Park in 2017, 2020, 2021, and 2022. A) Apo Island stations, B) northern stations, and C) southern stations.

Reef Fish

A total of 252 species from 30 families were recorded during the survey. Of which, 222 were major species, 19 were indicator species, and 11 were target species. The overall average species richness at Apo Reef Natural Park is 37.02 species/250 m^2. Among the 15 monitoring stations, the highest average species richness was recorded in S08 (55.67 species/250 m^2) while the lowest was in S15 (24.33 species/250 m^2) (Figure 6). Following major disturbances, majority stations did not show a remarkable and continuous decrease in terms of species richness (Figure 7).

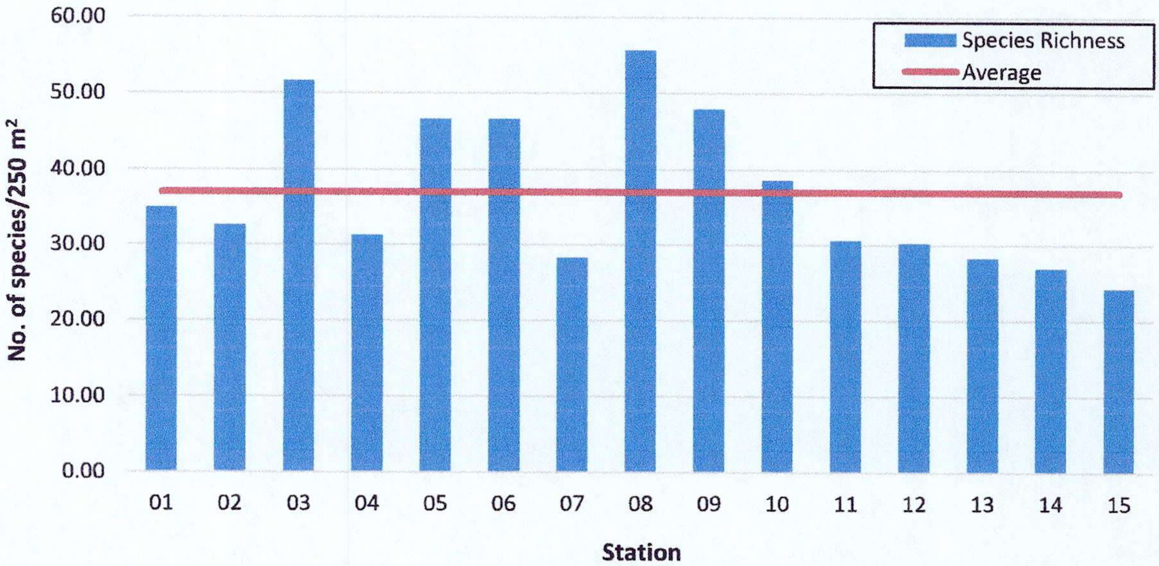

Figure 6. Average species richness in the 15 monitoring stations in Apo Reef Natural Park.

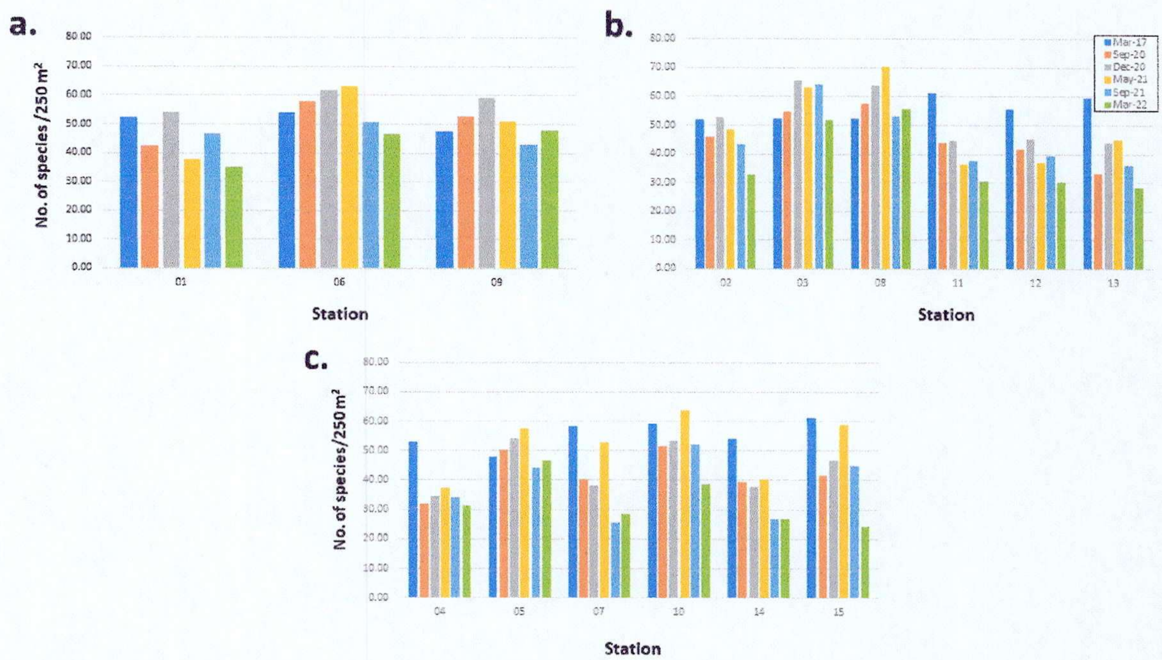

Figure 7. Average fish species richness in the 15 monitoring stations in Apo Reef Natural Park in 2017, 2020, 2021, and 2022. A) Apo Island stations, B) northern stations, and C) southern stations.

The overall average abundance of reef fish in Apo Reef Natural Park is 340.69 individuals/250 m². The average abundance in the monitoring stations ranged from 173.33 individuals/250m² to 708.33 individuals/250m² (Figure 8). The lowest average abundance was recorded in S14, while the highest was in S08. Despite the more than 50% decline in coral cover after major perturbations, reef fish abundance did not reflect a similar decrease in all stations (Figure 9).

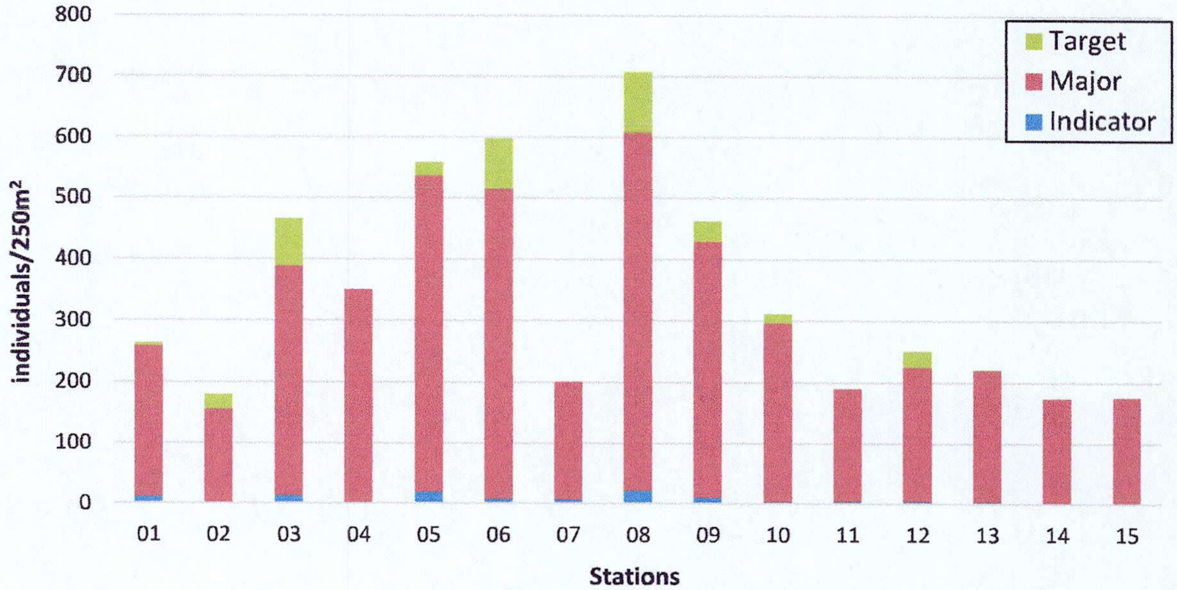

Figure 8. Average abundance of target, major, indicator fishes in the 15 monitoring stations in 2022.

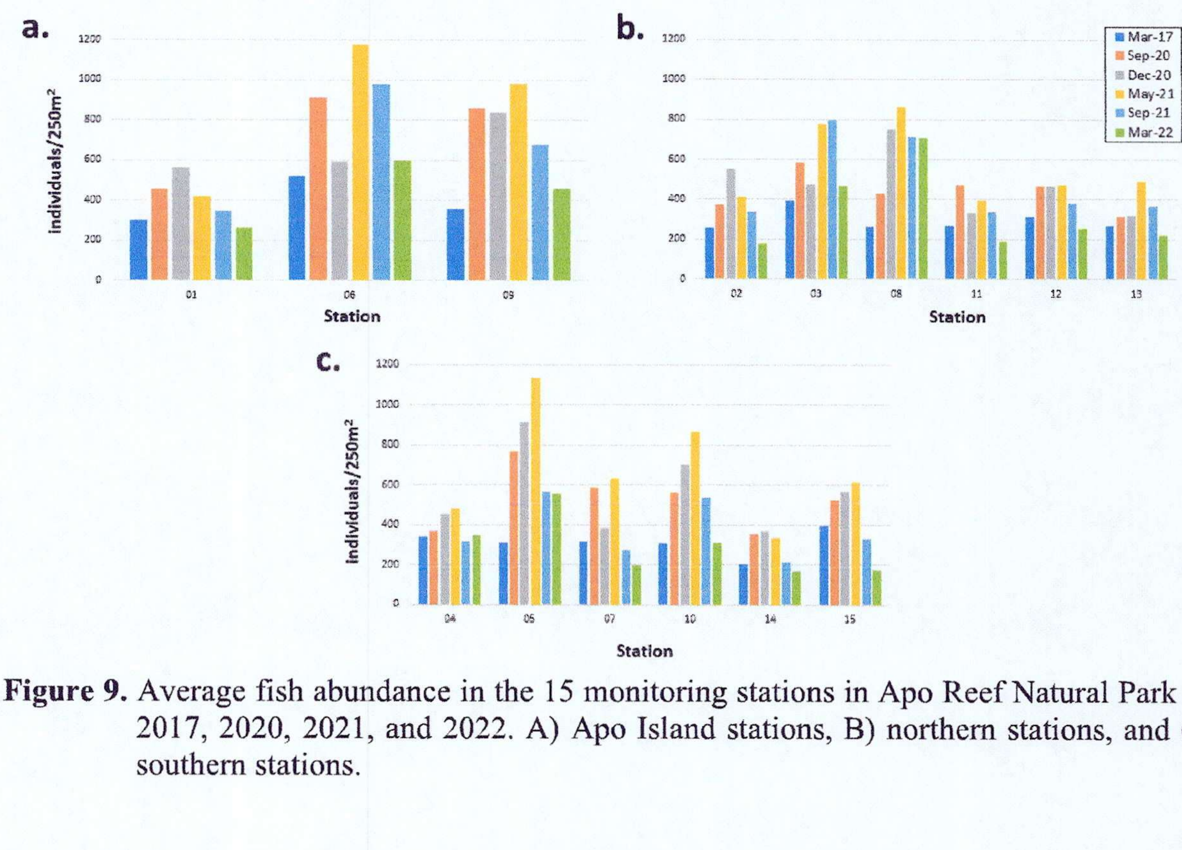

Figure 9. Average fish abundance in the 15 monitoring stations in Apo Reef Natural Park in 2017, 2020, 2021, and 2022. A) Apo Island stations, B) northern stations, and C) southern stations.

Reef fish community structure, in terms of species richness and abundance, was hardly affected by the marked decline in coral cover from 2017 and 2020. A similar response of reef fish to coral cover loss has been reported by Holbrook et al. (2008). Therefore, the results of this survey also suggest that reef fish communities in Apo Reef Natural Park may be resistant to changes in coral cover. They may also indicate that other pressures on reef fishes, such as fishing pressure, are effectively prevented. Nonetheless, it shall be noted that further decline in coral cover may result to a sharp fall in species richness and abundance (Holbrook et al., 2008).

The overall average biomass for Apo Reef Natural Park this year is 19.93 kg/250 m^2 (Figure 10). The highest average biomass was recorded in S06 (53.35 kg/250 m^2), followed by S08 (33.18 kg/250 m^2) and S03 (32.15 kg/250 m^2). Meanwhile, the lowest was recorded in S14 (4.03 kg/250 m^2). Based on the scale by Hilomen et al. (2000), the overall average biomass of Apo Reef Natural Park is high (35.1-75 MT/km^2) (Figure 11). Majority of the stations fell within high category, while one station (S06) was under very high (>75.0 MT/km^2). Although the overall average biomass this year is the lowest estimate since 2017, it is important to note that some estimates from 2020 to 2021 were higher than 2017 despite the disturbances (Figure 12). This is despite the low counts of Bumphead Parrotfish (*Bolbometopon muricatum*), the species which significantly increased the overall average biomass in 2017.

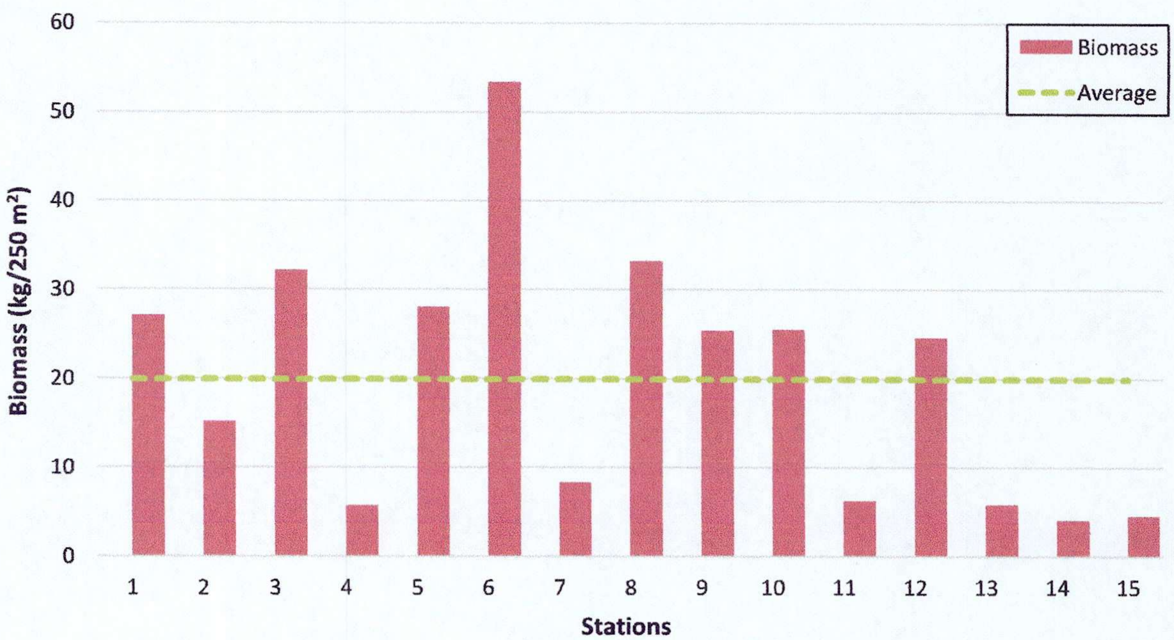

Figure 10. Average fish biomass (in kg/250 m^2) in the 15 monitoring stations in Apo Reef Natural Park.

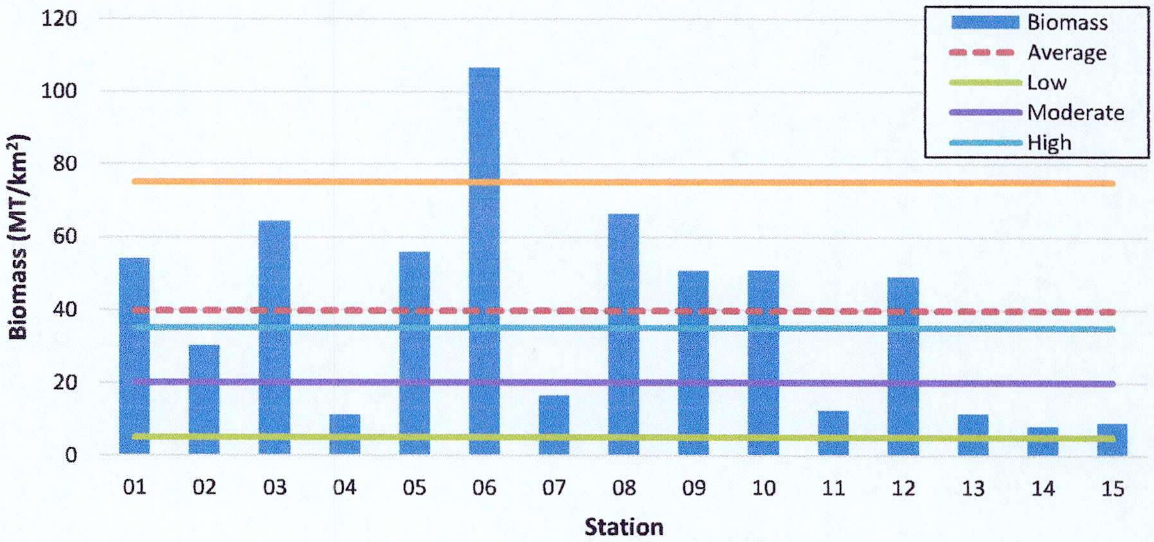

Figure 11. Fish biomass (in metric tons/km^2) in the 15 monitoring stations in Apo Reef Natural Park compared against the scale provided by Hilomen et al. (2000).

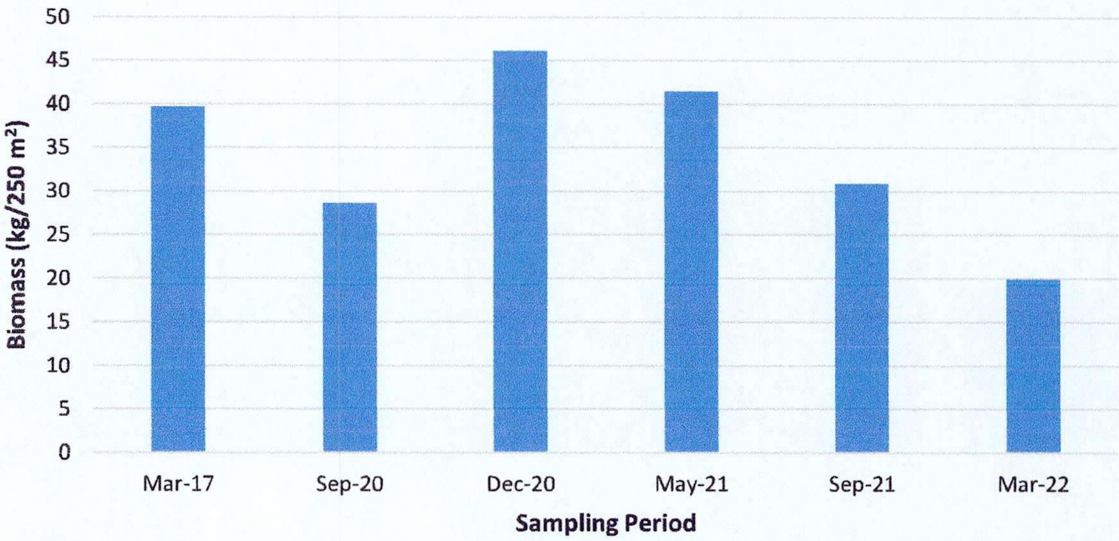

Figure 12. Overall average fish biomass (in kg/250 m^2) in Apo Reef Natural Park from 2017 to 2022.

Reef-associated Macroinvertebrates

On the dedicated survey for invertebrates, a total of 42 genera from 10 classes were recorded. The overall average abundance was 73.31 individuals/100 m^2 (Figure 13). The most abundant classes of invertebrates were bivalves (Class Bivalvia) and ophiuroids (Class Ophiuroidea) with 11.36 individuals/100 m^2 and 10.84 individuals/100 m^2, respectively. Majority of the bivalves were under the genus *Tridacna,* while all of the ophiuroids were from the genus *Ophiotrix*. The Prickly Redfish (*Thelenota ananas*) which is listed as *Endangered* under the IUCN Red List of Threatened Species was recorded along one of the transects in S05.

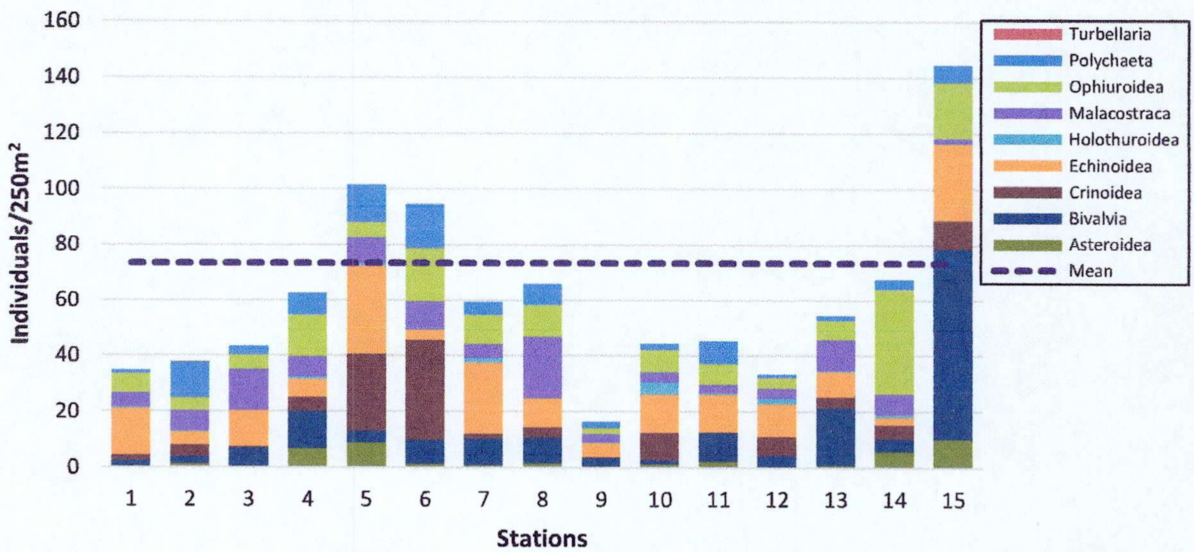

Figure 13. Average macroinvertebrate abundance in the 15 monitoring stations in Apo Reef Natural Park.

Macroinvertebrate community structure remained fairly the same pre- and post-disturbance (Figure 14). The only notable differences were the 40% decrease in the abundance of crinoids from 2017 (10.31 individuals/100m^2) to 2020 (6.39 individuals/100m^2). This may be attributed to the loss of structural complexity of the reef due to storms and CoTS outbreaks which negatively affected the branching and tabulate growth forms which are structurally complex coral growth forms. Fabricius et al. (2015) similarly reported a decrease in crinoid density in structurally less complex coral reef areas in Papua New Guinea. The loss of structural complexity exposes crinoids to its predators which includes fishes and regular echinoids (Stevenson et al., 2017). It is also important to note that the density of echinoids increased from post-disturbance which may be contributing to predatory pressure on crinoid species.

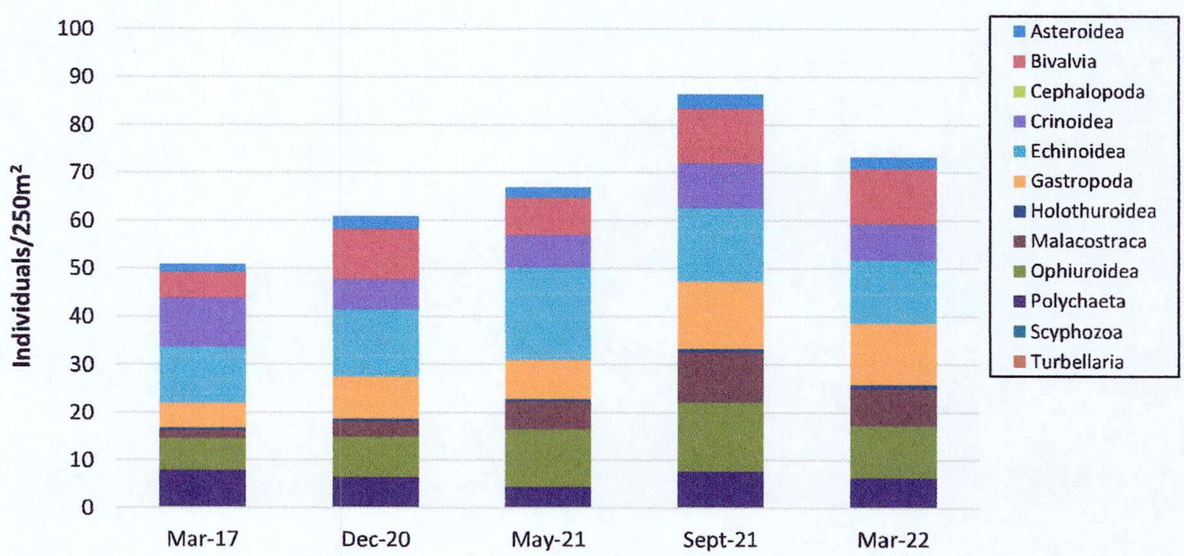

Figure 14. Overall average macroinvertebrate abundance in the 15 monitoring stations in Apo Reef Natural Park since 2017.

IV. CONCLUSIONS AND RECOMMENDATIONS

The fifteen pre-established coral reef monitoring stations were sampled this year. The HCC estimate in ARNP is 10.41% which is at the lower threshold of HCC Category D (0-22%) and less than half of the reported HCC in 2017 (21.2%). This is also much lower than the regional (WPS Bioregion) and nationwide estimates which are 21.2% and 22.8%, respectively. Contrastingly, coral diversity (as TAUs) in ARNP (22 TAUs) remained within the same category as that of the WPS Bioregion (Diversity Category C).

Acute stressors, particularly storms and CoTS outbreaks, may be attributed for the more than 10% decrease in HCC from 2017 to 2020. Evidence of recovery following the major disturbances was only observed in few monitoring stations. The slow recovery of coral reef areas in ARNP may be the outcome of combined impact of smaller outbreaks of CoTS and storms (Typhoon *Quinta* and Typhoon *Rolly*) which followed the major disturbances. The increase in algal cover, excluding CCA cover, may also be exacerbating the effects of these stressors specifically by inhibiting the settlement of coral larvae, increasing the mortality of coral juveniles, and overgrowing adult corals.

Despite the more than observed decrease in HCC, communities of reef-associated macroinvertebrates and reef fish did not reflect a similar magnitude of change. For reef-associated macroinvertebrates, only crinoids showed a decrease in abundance and this may be attributed to the loss of structurally complex coral growth forms. Similarly, species richness and abundance as well as biomass of reef fish remained fairly similar pre-disturbance estimates. These findings may indicate that reef-associated macroinvertebrate and fish communities are more resilient and are able to recover at a faster rate than hermatypic corals. Although reef-associated macroinvertebrate and fish communities have remained stable in the recent years, further coral cover loss may cause these communities to decline sharply.

To assist the recovery of the coral reef, it is recommended that existing initiatives preventing anthropogenic disturbance be scaled up. Law enforcement should be intensified to minimize, if not eradicate, illegal fishing activities within the MPA as they directly affect reef-associated macroinvertebrates and reef fish communities. Procurement of additional watercrafts and increasing manpower on the ground are among the steps that may be taken to scale up law enforcement within ARNP. The frequency and coverage of CoTS surveillance in ARNP should also be increased to ensure the early detection and control of outbreaks. Further, the existing management zoning implemented within the MPA may be reviewed with marine scientists involved in *SMaRT-Corals* and revised as necessary to ensure that tourism activities do not exacerbate natural disturbances. Aside from these, support should be given to studies exploring the application of active rehabilitation of coral reefs as well as the capacity building of management staff.

Prepared by:	Reviewed and submitted by:
HUGO IGNACIO G. SALVADOR	**KRYSTAL DAYNE T. VILLANADA**
CMEMP Extension Officer	Protected Area Superintendent

V. REFERENCES

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VI. APPENDIX

Appendix A. Percentage cover of general life forms (Abiotic, Algae, Dead Coral, Dead Coral with Algae, Hard Coral, and Other Fauna) in the 15 monitoring stations in Apo Reef Natural Park for 2022.

Station	Percentage Cover					
	Abiotic	Algae	Dead Coral	Dead Coral with Algae	Hard Coral	Other Fauna
01	8.80%	27.12%	0.32%	8.40%	32.88%	19.52%
02	13.52%	30.00%	0.00%	9.12%	22.88%	22.00%
03	3.44%	52.08%	0.00%	7.12%	14.32%	16.88%
04	6.24%	34.80%	3.28%	12.72%	24.88%	14.40%
05	13.84%	43.28%	0.24%	10.24%	18.88%	10.80%
06	9.76%	34.16%	0.56%	11.04%	23.36%	19.36%
07	8.48%	33.44%	1.92%	14.00%	21.68%	16.56%
08	13.52%	38.96%	0.40%	13.28%	18.32%	12.56%
09	5.92%	42.32%	0.32%	11.84%	22.88%	12.64%
10	11.92%	39.60%	0.08%	9.68%	17.36%	18.88%
11	1.92%	49.44%	0.00%	8.32%	27.20%	10.80%
12	4.96%	36.16%	0.48%	11.04%	31.12%	13.36%
13	21.60%	33.44%	0.16%	3.52%	9.36%	28.80%
14	9.76%	44.80%	0.40%	9.92%	13.76%	18.40%
15	4.72%	50.08%	0.00%	15.52%	19.36%	7.28%
Average	9.23%	39.31%	0.54%	10.38%	21.22%	16.15%

Appendix B. Percentage cover of coral growth forms (branching, digitate, encrusting, foliose, massive, mushroom, submassive, and tabulate) in the 15 monitoring stations in Apo Reef Natural Park for 2022.

Station	Percentage Cover					
	Branching	Encrusting	Foliose	Massive	Mushroom	Submassive
01	0.12%	0.04%	0.00%	0.36%	0.00%	0.00%
02	0.44%	2.08%	0.08%	25.92%	0.32%	0.24%
03	3.00%	0.92%	0.00%	3.36%	0.00%	0.00%
04	0.40%	0.40%	0.00%	2.56%	0.00%	0.00%
05	0.60%	0.08%	0.08%	3.68%	0.08%	2.20%
06	12.60%	10.20%	0.12%	5.80%	0.16%	4.48%
07	0.88%	0.72%	0.00%	6.88%	0.00%	0.00%
08	1.92%	0.08%	0.00%	5.72%	0.00%	1.44%
09	0.40%	0.80%	0.00%	2.36%	0.00%	0.00%
10	0.52%	0.20%	0.00%	4.52%	0.04%	0.00%
11	1.40%	2.32%	0.04%	7.16%	0.16%	0.32%
12	0.24%	0.12%	0.00%	1.84%	0.00%	1.28%
13	3.20%	0.20%	0.04%	6.36%	0.20%	0.00%
14	3.04%	1.12%	0.00%	3.04%	0.12%	0.44%
15	14.00%	0.44%	0.12%	1.40%	0.04%	0.68%
Average	2.85%	1.31%	0.03%	5.40%	0.07%	0.74%

Appendix C. Percentage cover of algae (algal assemblage, crustose coralline algae, *Halimeda*, macroalgae, and turf algae) in the 15 monitoring stations in Apo Reef Natural Park for 2022.

Station	**Percentage Cover**			
	Algal Assemblage	Coralline Algae	Halimeda	Macroalgae
01	77.12%	0.40%	0.04%	6.44%
02	39.00%	2.08%	0.00%	2.40%
03	60.60%	1.12%	0.00%	1.92%
04	72.16%	0.52%	0.00%	5.08%
05	63.68%	1.44%	0.00%	5.76%
06	35.08%	2.28%	0.08%	2.32%
07	50.76%	0.76%	0.00%	11.20%
08	56.56%	1.28%	0.00%	5.16%
09	65.28%	1.48%	0.00%	4.80%
10	60.60%	0.28%	0.08%	5.00%
11	60.00%	1.40%	0.00%	1.72%
12	73.76%	0.28%	0.00%	1.36%
13	39.08%	0.12%	0.00%	1.68%
14	46.92%	1.52%	0.08%	1.40%
15	41.12%	0.00%	0.08%	1.76%
Average	56.11%	1.00%	0.02%	3.87%

Appendix D. Percentage cover of abiotics (rock, rubble, and sand) in the 15 monitoring stations in Apo Reef Natural Park for 2022.

Station	**Percentage Cover**		
	Other Fauna	Soft coral	Sponge
01	0.76%	0.16%	5.96%
02	0.96%	0.84%	13.12%
03	0.48%	0.12%	10.72%
04	0.32%	0.16%	11.48%
05	0.24%	0.92%	5.64%
06	1.04%	4.36%	10.20%
07	0.16%	0.68%	11.12%
08	1.40%	4.04%	15.84%
09	1.04%	0.32%	12.52%
10	0.56%	1.48%	15.64%
11	0.04%	1.00%	8.88%
12	0.36%	0.12%	8.84%
13	0.28%	0.04%	27.12%
14	0.12%	1.16%	26.28%
15	0.04%	7.60%	1.48%
Average	0.52%	1.53%	12.32%

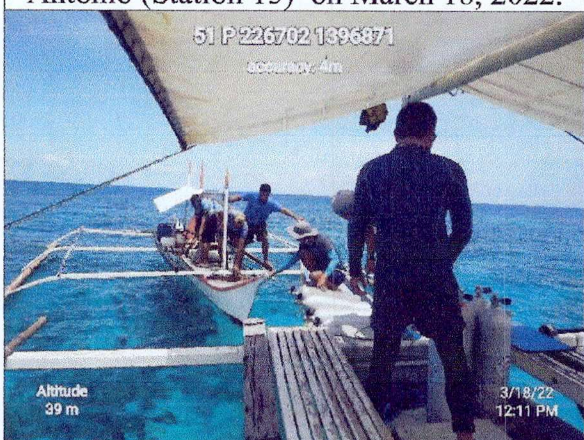
Appendix E. Photodocumentation of the coral monitoring activity in Apo Reef Natural Park last March 2022.

Park Ranger Kelvin U. Zubiri preparing the equipment of the participating divers on March 14, 2022.

Boat Captain Romel M. Pacaul inspecting the speedboat prior to the field survey in Binanggaan on March 17, 2022.

Boat Captain Romel M. Pacaul operating the outrigger boat while in transit to San Antonio (Station 15) on March 18, 2022.

Forest Ranger Efraim Z. Pagador reeling the transect laid on Station 15.

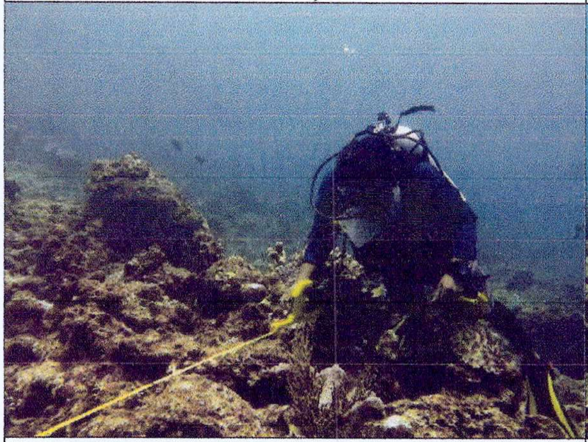


Park Rangers transferring used diving tanks to the spotter boat for refilling.

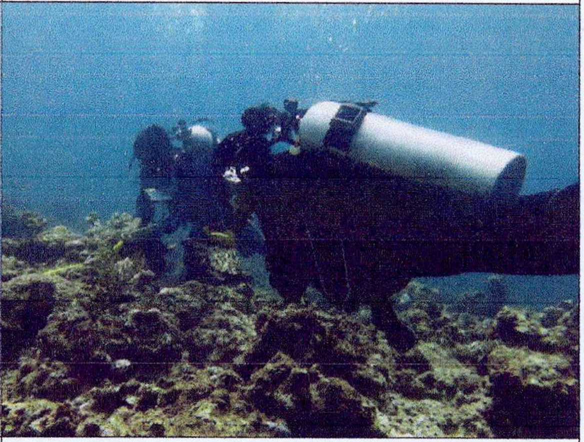
Humphead Wrasse (*Cheilinus undulatus*) recorded off-transect at Station on March 18, 2022.

Park Maintenance Foreman Roberto P. Beringuela searching for the coral restoration blocks in Bahura Cinco on March 18, 2022.

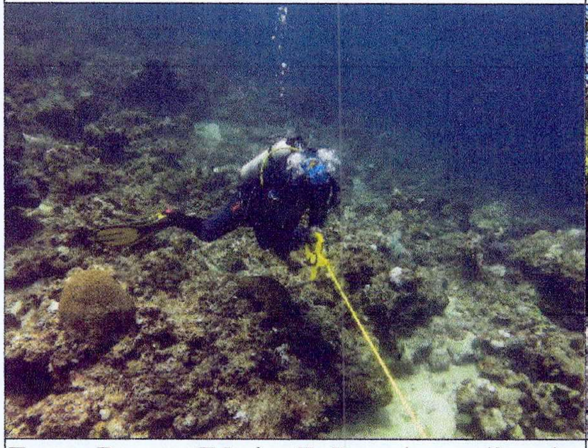
Park Ranger Sherwin R. Benoza filling up the diving tanks for the scheduled field survey on March 19, 2022.



PMF Roberto P. Beringuela preparing to reel Transect 3 at Station 11 on March 19, 2022.



CMEMP Extension Officer Hugo Ignacio G. Salvador surveying invertebrates at Station 11.



Forest Ranger Efraim Z. Pagador reeling the transect surveyed for fish communities at Station 11.

Participants of the coral reef assessment in Apo Reef Natural Park for CY 2022.

Appendix F. Map of coral reef monitoring stations in Apo Reef Natural Park.