



Republic of the Philippines  
Department of Environment and Natural Resources  
MIMAROPA Region  
**PROVINCIAL ENVIRONMENT AND NATURAL RESOURCES OFFICE**  
Mamburao, Occidental Mindoro

JUL 11 2022

**MEMORANDUM**

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

**THRU** : The ARD for Technical Services

**FROM** : The OIC, PENR Officer

**SUBJECT** : **SUBMISSION OF THE MANGROVE FOREST  
ASSESSMENT REPORT OF APO REEF NATURAL  
PARK-PROTECTED AREA MANAGEMENT OFFICE  
FOR CY 2022**



Forwarded is the memorandum dated June 29, 2022 of CENRO Sablayan regarding submission of the Mangrove Forest Assessment Report of Apo Reef Natural Park-Protected Area Management Office for CY 2022. This year, twelve 100 m<sup>2</sup> plots within Apo Island, Apo Reef Natural Park were surveyed on March 16 to 17, 2022. As per report the mangrove remains to be in excellent condition based on the criteria set in BMB Technical Bulletin No. 2017-18.

Attached herewith is the detailed narrative report with its annexes pertaining to the conduct of the said activity.

For information and record.

  
**ERNESTO E. TAÑADA**

TSD-CDS6/8/2022

So. Pag-asa, Brgy. Payompon, Mamburao, Occidental Mindoro  
Email: tsdoccmin04@gmail.com



Department of Environment and Natural Resources  
PENRO Occidental Mindoro

## PENRO DOCUMENT ACTION TRACKING SLIP

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Originating Office	CENRO SABLAYAN	Date Received	2022-07-07
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Subject	SUBMISSION OF THE MANGROVE FOREST ASSESSMENT REPORT OF APO REEF NATURAL PARK-PROTECTED AREA MANAGEMENT OFFICE FOR CY 2022		
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Department of Environment and Natural Resources  
MIMAROPA Region  
COMMUNITY ENVIRONMENT AND NATURAL RESOURCES OFFICE

June 29, 2022

**MEMORANDUM**

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

**THRU** : The OIC, PENR Officer  
Mamburao, Occidental Mindoro

**FROM** : The CENR Officer

**SUBJECT** : **SUBMISSION OF THE MANGROVE FOREST ASSESSMENT  
REPORT OF APO REEF NATURAL PARK – PROTECTED  
AREA MANAGEMENT OFFICE FOR CY 2022**

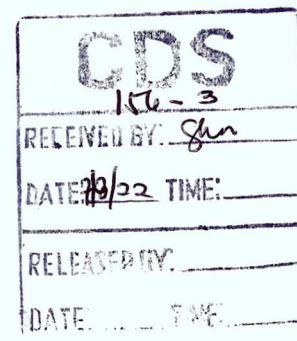
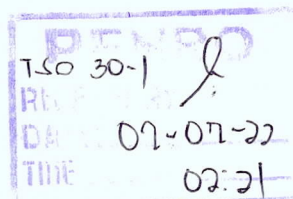
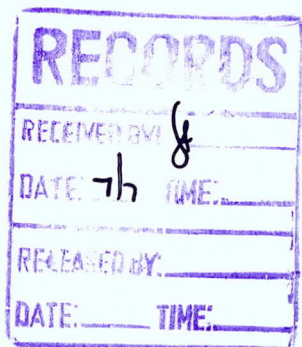
Respectfully forwarded is the Mangrove Forest Assessment Report of Apo Reef Natural Park – Protected Area Management Office (ARNP-PAMO) for CY 2022. The ARNP-PAMO conducted their field survey on March 16 to 17 and June 10, 2022. Based on the criteria set in BMB Technical Bulletin 2017-05, the mangrove forest remains in excellent condition.

Attached herewith is the narrative report with its appendices.

For information and record.

FOR

**FOR. ANASTACIO A. SANTOS, MPA**







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

June 27, 2022

**MEMORANDUM**

**FOR** : The OIC, 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 MANGROVE FOREST  
ASSESSMENT REPORT OF APO REEF NATURAL  
PARK – PROTECTED AREA MANAGEMENT OFFICE  
FOR CY 2022**

Respectfully submitted is the Mangrove Forest Assessment Report of Apo Reef Natural Park – Protected Area Management Office for CY 2022. This year, twelve 100 m<sup>2</sup> plots within Apo Island, Apo Reef Natural Park were surveyed on March 16 to 17 and June 10, 2022. The mangrove forest remains to be in excellent condition based on the criteria set in BMB Technical Bulletin 2017-05.

Attached herewith is the narrative report with its annexes.

For information and record.

  
**KRYSTAL DAYNE T. VILLANADA**





# **Mangrove Forest Monitoring Report**

**CY 2022**

## I. Introduction

Apo Reef Natural Park (ARNP), which is situated approximately 33 kilometers off the western coast of Occidental Mindoro, spans 15,799.23 hectares and covers a 34 square kilometer sub-triangular, atoll-like coral reef divided by a deep channel (Figure 1). The Natural Park hosts a number of ecosystems including a 9.538-hectare mangrove forest. To date, the Marine Protected Area (MPA) is known to host at least 11 species of true mangroves (Tabaranza et al., 2014; REECS, 2017).

Mangrove forests play a number of ecological and socio-cultural roles. They prevent coastal erosion and reduce damages from waves, storm surges, and tsunamis (Sandilyan & Kathiresan 2015; Spalding et al. 2014). Mangroves are also known to serve as nursery grounds for species of reef fish (Abu El-Regal & Ibrahim 2014; Mumby et al. 2003) and habitat for a diverse range of terrestrial fauna (Nagelkerken et al. 2008). Moreover, mangrove forests are valued for their cultural services like ecotourism and recreation (Friess 2016; Mukherjee et al. 2014). Thus, monitoring the health of this ecosystem is important.

The mangrove forest in ARNP was monitored in fulfillment of an activity under MPA Management, Strengthening, and Networking, a subcomponent of the Coastal and Marine Ecosystems Management Program. Specifically, the objectives of the mangrove forest monitoring conducted are the following:

1. Assess the diversity and structure of the mangrove community in Apo Reef Natural Park; and,
2. Identify management interventions to further the conservation of the mangrove forest, if necessary.

## II. Methodology

The monitoring of the mangrove forest in ARNP was conducted following the methods described in BMB Technical Bulletin Nos. 2017-05 and 2019-04 with slight modifications. Twelve monitoring plots were established within the 9.538-hectare mangrove forest in Apo Island Apo Reef Natural Park which surrounds a saline lagoon. It was ensured that the plots were evenly distributed across the different zones in the island based on tidal level (landward, middle, and seaward zone).

Within each 100 m<sup>2</sup> plot, mangrove trees with a diameter-at-breast height (dbh) greater than 5 cm were identified and counted. The total height and dbh of each mangrove were measured using a laser rangefinder (TruPulse Laser Rangefinder 200, USA) and diameter tape (Yamayo Million Diameter Tape, Japan), respectively. The crown diameter of each mangrove was also measured. Two measurements of crown diameter were acquired per tree: the widest length of the tree canopy through its center ( $W_1$ ) and a second measurement perpendicular to the widest length ( $W_2$ ). The crown area and percent crown cover were then computed using the following formula:

$$\text{Crown Area} = 0.7854 \left( \frac{W_1 + W_2}{2} \right)^2$$

$$\text{Percent Crown Cover} = \frac{\text{Total Crown Area}}{\text{Total Area Sampled}} \times 100$$





**Figure 1.** Twelve monitoring plots within the mangrove forest in Apo Island, Apo Reef Natural Park.

The species diversity was computed using Shannon-Wiener Index of Diversity ( $H'$ ) (Shannon & Wiener 1940). The computation was performed using Paleontological Statistics (PAST) version 3.16 (Hammer et al. 2016). The values acquired were interpreted using the classification scheme in Fernando et al. (1998) (Table 1). Furthermore, the relative density, relative frequency, relative dominance, and importance value index (IVI) of the mangroves species were computed using the following formulas:

$$\text{Relative Frequency (RF)} = \frac{\text{Plot frequency}}{\text{Total plot frequency}} \times 100$$

$$\text{Relative Density (RD)} = \frac{\text{Density}}{\text{Total density}} \times 100$$

$$\text{Relative Dominance (RDo)} = \frac{\text{Basal area}}{\text{Total basal area}} \times 100$$

$$\text{Importance value index} = \text{RF} + \text{RD} + \text{RDo}$$



**Table 1.** Classification scheme for Shannon diversity indices ( $H'$ ) developed by Fernando et al. (1998).

Relative Values	Shannon Diversity Index ( $H'$ )
Very High	3.5 and above
High	3.0-3.49
Moderate	2.5-2.99
Low	2.0-2.49
Very Low	1.9 and below

Each 100 m<sup>2</sup> plot was further divided into a smaller 4 m<sup>2</sup> plot. This was done to quantify the regenerants (<4 cm dbh). Saplings and seedlings were identified and counted in the 4 m<sup>2</sup> plots. The condition of the entire mangrove forest was then assessed using the criteria in Deguit et al. (2004) (Table 2).

**Table 2.** Criteria for determining the condition of mangrove forest based on Deguit et al. (2004).

Condition	Criteria
Excellent	76% and above in % Crown Cover 1 Regeneration per m <sup>2</sup> Above 5m in average tree height Undisturbed to negligible disturbance
Good	51% - 75% Crown Cover 0.76 - <1 Regeneration per m <sup>2</sup> 3m - <5m in average tree height Slight disturbance and few cuttings
Fair	26% - 50% Crown Cover 0.50 – 0.75 Regenerants per m <sup>2</sup> 2m - <3m in average tree height Moderate disturbance to noticeable cuttings
Poor	0% - 25% Crown Cover <0.50 Regenerants per m <sup>2</sup> <2m in average tree height Heavy disturbance

### III. Results and Discussion

Seven species of true mangroves were present in the 12 monitoring plots in Apo Island, Apo Reef Natural Park (Table 3). These species were from three families namely, Rhizophoraceae (4 species), Meliaceae (1 species), and Lythraceae (1 species). The most notable species recorded was *Pemphis acidula* which is classified as Endangered under the DENR Administrative Order No. 2017-11 (Updated National List of Threatened Philippine Plants and their Categories). Only saplings of this species were recorded during this survey but mature individuals were observed outside the sampling plots, particularly within the landward portion of the mangrove forest. It is important to note that *P. acidula* was listed in this report under true mangroves instead of mangrove associates following the classification of Wang et al. (2011).

**Table 3.** Species of true mangroves sampled across six plots in Apo Island, Apo Reef Natural Park.

Species	Common Name	Family	Conservation Status	
			IUCN Red List	PH Red List
<i>Bruguiera cylindrica</i>	Pototan/Busain	Rhizophoraceae	LC	
<i>Rhizophora apiculata</i>	Bakauan-lalaki	Rhizophoraceae	LC	
<i>Rhizophora mucronata</i>	Bakauan-babae	Rhizophoraceae	LC	
<i>Rhizophora stylosa</i>	Bakauan-bato	Rhizophoraceae	LC	
<i>Pemphis acidula</i>	Bantigi	Lythraceae	LC	EN
<i>Sonneratia alba</i>	Pagatpat	Lythraceae	LC	
<i>Xylocarpus rumphii</i>	Malapiagau	Meliaceae	NE	

LC – Least Concern, EN – Endangered, NE – Not Evaluated

A total of 148 mangrove trees were recorded. The most abundant species across the 12 monitoring plots is *Rhizophora mucronata* (78 individuals), followed by *R. apiculata* (33 individuals) (Table 4). These two abundant species were also widely distributed in the mangrove forest but they specifically dominated the middle and seaward zone. Plots within the middle and seaward zones are muddy to which *Rhizophora* sp. are highly adapted to (Duke, 2006). The third most abundant species was *Bruguiera cylindrica* (31 individuals). Unlike the *Rhizophora* spp., its distribution was only restricted to plots at the landward margin of the mangrove forest wherein the substrate was sandy. Less abundant species, *Sonneratia alba* (2 individuals) and *Xylocarpus rumphii* (2 individuals) had a similar distribution with *B. cylindrica*. Contrastingly, *S. alba* usually occurs in areas exposed to tidal waves (Waycott et al., 2011). The occurrence of mature *S. alba* individuals within the landward zone may be due to outcompetition by *Rhizophora* spp. in the low-intertidal zone.

**Table 4.** Distribution and abundance of mangrove species in Apo Island, Apo Reef Natural Park.

Species	Abundance	Frequency
<i>Bruguiera cylindrica</i>	31	0.25
<i>Rhizophora apiculata</i>	33	0.58
<i>Rhizophora mucronata</i>	79	1.00
<i>Rhizophora stylosa</i>	1	0.08
<i>Sonneratia alba</i>	2	0.17
<i>Xylocarpus rumphii</i>	2	0.08

Abundance – total count of individuals in the 12 monitoring plots

The Shannon diversity index ( $H'$ ) computed for the mangrove forest in Apo Island ranged from 0.00 to 1.5412 (Table 5). The highest diversity index ( $H'$ ) value was recorded in Plot 4 ( $H' = 1.178$ ) while the lowest was recorded in Plot 5 ( $H' = 0.3501$ ). These values are within the very low diversity category ( $<1.9999$ ) (Fernando et al., 1998). The low diversity values are attributed to the low number of species and the uneven distribution of abundance among the different species across monitoring plots. Similar values have been reported in other mangrove forests in the Philippines including Puerto Princesa, Palawan (Dangan-Galon et al., 2016) and Tacloban, Leyte (Patindol & Casas, 2019).



**Table 5.** Shannon diversity indices ( $H'$ ) at mangrove monitoring plots in Apo Island, Apo Reef Natural Park.

Plot No.	Zone	$H'$
1	Landward	1.54
2	Middle	0.56
3	Seaward	0.62
4	Landward	0.69
5	Middle	0.00
6	Seaward	0.50
7	Landward	0.50
8	Middle	0.00
9	Seaward	0.00
10	Landward	0.26
11	Middle	0.56
12	Seaward	0.35

The overall mean dbh and tree height for the mangrove forest in Apo Island, Apo Reef Natural Park are 19.07 cm and 6.62 m, respectively (Table 6). These estimates are higher than the values acquired in previous assessments conducted in 2017 and 2021. Moreover, the aggregated crown area and percent crown cover of mangroves in Apo Island, Apo Reef Natural Park is 1192.79 m<sup>2</sup> and 99.40%, respectively (Table 7). It is important to note, however, that overestimation was induced in the measurement of percent crown cover because all tree crowns were assumed to have a circular shape and crown overlap was disregarded. There were no distinct patterns in tree height, dbh, basal area, and crown cover observed across zones or tidal levels.

**Table 6.** Mean dbh and total height across plots in Apo Island, Apo Reef Natural Park.

Plot No.	Zone	Mean dbh (cm)	Mean total height (m)	Stand Basal Area (m <sup>2</sup> /ha)
1	Landward	18.67	7.16	413.83
2	Middle	20.20	6.60	241.99
3	Seaward	20.35	7.16	390.99
4	Landward	9.60	5.39	132.79
5	Middle	21.12	8.56	541.87
6	Seaward	18.02	4.92	344.32
7	Landward	40.22	6.32	1218.94
8	Middle	22.02	7.62	307.59
9	Seaward	14.88	5.14	233.07
10	Landward	19.65	7.09	439.54
11	Middle	20.98	6.70	240.23
12	Seaward	25.16	7.52	387.71
Overall mean		19.07	6.62	407.40



**Table 7.** Total crown area and percent cover across plots in Apo Island, Apo Reef Natural Park.

Plot No.	Zone	Total Crown Area (m <sup>2</sup> )	Percent Cover (%)
1	Landward	194.08	194.08
2	Middle	154.43	154.43
3	Seaward	80.72	80.72
4	Landward	68.46	68.46
5	Middle	103.72	103.72
6	Seaward	81.10	81.10
7	Landward	64.44	64.44
8	Middle	98.19	98.19
9	Seaward	55.12	55.12
10	Landward	87.40	87.40
11	Middle	111.65	111.65
12	Seaward	93.48	93.48
<b>Overall</b>		1192.79	99.40%

*R. mucronata* (144.70) is the most ecologically important species in Apo Island, Apo Reef Natural Park on the basis of IVIs (Table 8). It had the highest relative dominance (46.15), relative frequency (53.38), and relative density (45.16). *R. mucronata* is followed by *R. apiculata* (IVI = 65.64) and *B. cylindrica* (IVI = 45.39).

**Table 8.** Relative density, frequency, and dominance, and importance value of mangroves in Apo Island, Apo Reef Natural Park.

Species	Relative Density	Relative Frequency	Relative Dominance	Importance Value
<i>Bruguiera cylindrica</i>	11.54	20.95	12.90	45.39
<i>Rhizophora apiculata</i>	26.92	22.30	16.42	65.64
<i>Rhizophora mucronata</i>	46.15	53.38	45.16	144.70
<i>Rhizophora stylosa</i>	3.85	0.68	0.10	4.63
<i>Sonneratia alba</i>	7.69	1.35	23.98	33.02
<i>Xylocarpus rumphii</i>	3.85	1.35	1.43	6.63

A very low density of mangrove saplings and seedlings was recorded in Apo Island, Apo Reef Natural Park (0.02 individuals/m<sup>2</sup>). Regenerants were only observed in five of the twelve plots. *R. mucronata* had the highest abundance of regenerants (15 individuals) spread in four of the five plots. Low regenerant density is a characteristic that is likely to be associated with old-growth mangrove forests (Lugo, 1996). Based on the acquired sapling density, it is possible that old-growth stands are present in the mangrove forest in Apo Island.

**Table 9.** Distribution and abundance of saplings and seedlings in Apo Island, Apo Reef Natural Park.

Species	Abundance	Frequency
<i>Bruguiera cylindrica</i>	5	0.08
<i>Pemphis acidula</i>	4	0.08
<i>Rhizophora apiculata</i>	1	0.08
<i>Rhizophora mucronata</i>	15	0.33

The mangrove forest of Apo Reef Natural Park is generally in excellent condition following the criteria of Deguit et al. (2004). It qualifies in three of the four criteria namely, crown cover, mean height, disturbance level. The density of regenerants (1 individual/m<sup>2</sup> or greater) is the sole criterion that was not reached. Nonetheless, this does not indicate that the mangrove forest in Apo Reef Natural Park is degraded.

#### IV. Summary and Conclusion

Seven of the 11 known species of true mangroves in the island were identified during the survey. These were namely, *B. cylindrica*, *R. apiculata*, *R. mucronata*, *R. stylosa*, *P. acidula*, *S. alba*, and *X. rumphii*. All of these species are listed under *Least Concern* in the IUCN Red List of Threatened Species however, *P. acidula* is also classified as *Endangered* under DENR Administrative Order 2017-11. *R. mucronata* is the most ecologically important species based on IVI (152.91), followed by *R. apiculata* (65.64). These two occurred in all zones, but specifically dominated the middle and seaward zone. *B. cylindrica*, *S. alba*, and *X. rumphii* were restricted in the landward margin of the mangrove forest. In terms of crown cover, total height, and level of disturbance, the mangrove forest still falls under *Excellent Condition* based on Deguit et al. (2017). Ultimately, this assessment suggests that the mangrove forest in Apo Island, Apo Island Natural Park is a well-conserved ecosystem.

It is recommended that monitoring plots be established at Binanggaan in the future. Tabaranza et al. (2014) reported small stands of *Rhizophora* spp. and *Sonneratia* spp. on this island. Furthermore, the management staff shall be capacitated in conducting more advanced methodologies such as, but not limited to carbon stock assessment.

Prepared by:

  
**HUGO IGNACIO G. SALVADOR**  
CMEMP Extension Officer

Reviewed and submitted by:

  
**KRYSTAL DAYNE T. VILLANADA**  
Protected Area Superintendent



## V. References







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## VI. Appendices

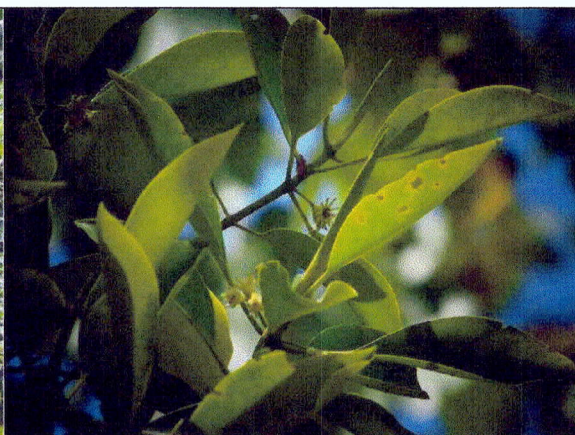
### Appendix A. Photo-documentation of the field surveys conducted on March 16 to 17 and June 10, 2022.

	
<p><i>Xylocarpus rumphii</i> recorded in Plot 1 on March 16, 2022.</p>	<p>Fruit of <i>Xylocarpus rumphii</i> photographed in Plot 1.</p>
	
<p>Park Rangers Sherwin R. Benoz and Ludygario D. Matira demarcating Plot 1 using a nylon wire.</p>	<p>Leaves of <i>Sonneratia alba</i> recorded in Plot 1.</p>
	
<p>Representative photograph of Plot 2 which was surveyed on March 16, 2022.</p>	<p>Flowers of <i>Rhizophora mucronata</i>, the most numerous species in Plot 2.</p>





Representative photo of Plot 3 which was surveyed on March 16, 2022.



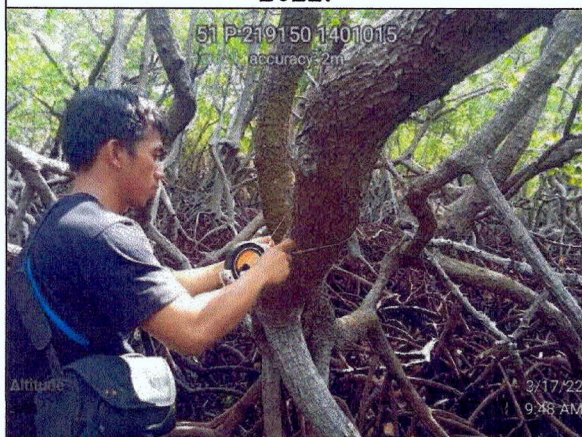
Flowers of *Bruguiera cylindrica*, the species that was most numerous in Plot 4. This plot was surveyed on March 17, 2022.



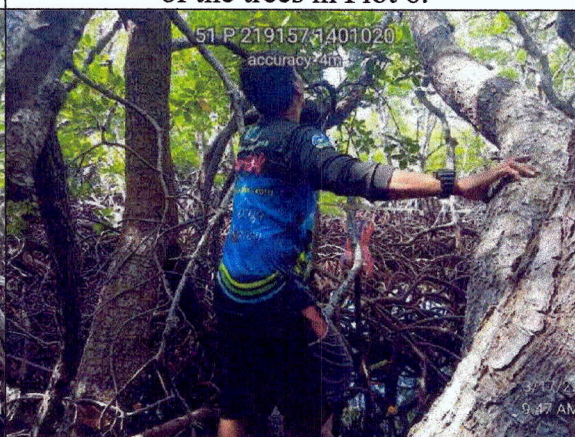
Park Ranger Ludygario D. Matira marking a *R. mucronata* tree in Plot 5 on March 17, 2022.



CMEMP Extension Officer Hugo G. Salvador recording the dbh and total height of the trees in Plot 6.



Park Ranger Sherwin R. Benozza measuring the dbh of a *Rhizophora apiculata* tree in Plot 6.



Park Ranger Ludygario D. Matira acquiring measurements for the computation of elliptical crown cover.

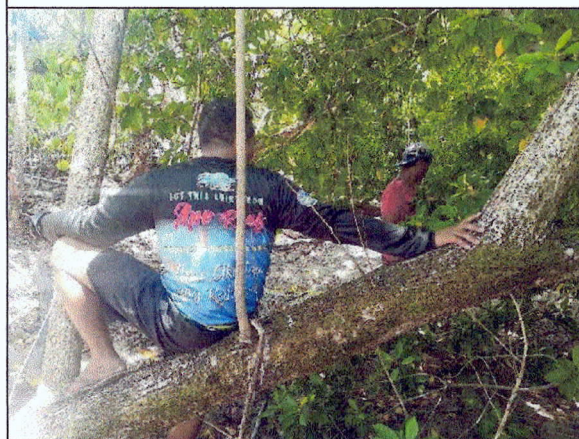




Park Ranger Sherwin R. Benozza preparing to demarcate Plot 10 on June 10, 2022.



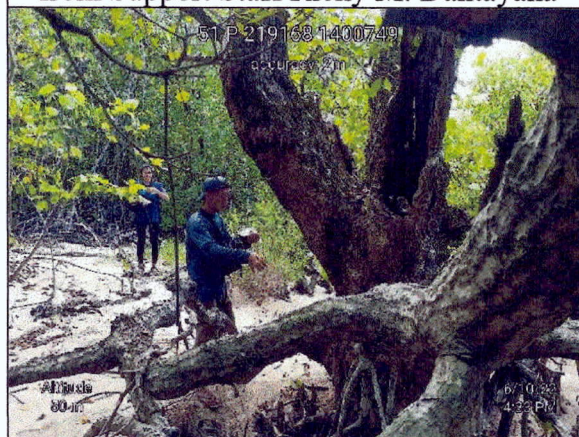
CMEMP-EO Hugo Salvador identifying the species of mangroves within Plot 10.



Park Ranger Ludygario M. Matira measuring crown diameter with assistance from Support Staff Ricky M. Dantayana



Park Rangers in transit to Plot 11.



Park Ranger Sherwin R. Benozza demarcating Plot 8.



Members of the Mangrove Assessment Team for CY 2022.



**Appendix B.** Map of mangrove monitoring stations in Apo Island, Apo Reef Natural Park.

