



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

JUN 26 2023

**MEMORANDUM**

**FOR** : The Regional Executive Director  
DENR MIMAROPA Region  
1515 DENR By the Bay Building, Roxas Boulevard,  
Barangay 668, Ermita, Manila

**THRU** : The ARD for Technical Services

**FROM** : The OIC, PENR Officer

**SUBJECT** : **SUBMISSION OF FINAL REPORT FOR MANGROVE  
FOREST ASSESSMENT IN APO REEF NATURAL PARK  
FOR CY 2023**

Forwarded is the memorandum dated June 21, 2023 of CENRO Sablayan regarding submission of final report for Mangrove Forest Assessment in Apo Reef Natural Park for CY 2023.

A total of twelve (12) 100 m<sup>2</sup> plots distributed across in Apo Island, were surveyed from February 21 to 23, 2023. These sampling plots are representative to the 9.64 hectares mangrove forest within the Marine Protected Area. Eleven species of true mangrove species were identified during the survey. The overall mean dbh and tree height for the mangrove forest in Apo Island, Apo Reef Natural Park are 18.52 cm and 7.34 m respectively. These estimate is similar to the values acquired last year. Contrastingly, the percent crown cover acquired this year (90.03%) is much less than the previous year (99.40%-Table 7). These decrease is due to the change in the method used to measure percent crown cover. In terms of crown cover, total and level of disturbance the mangrove forest still falls under Excellent Condition based on Deguit et.al (2017) and the assessment suggest that the mangrove forest in Apo Island, Apo Island Natural Park is a well-conserved ecosystem and that no significant change has been recorded in the recent years based on the monitoring of the PAMO.

Attached is the final report with geotagged photos undertaken during the conduct of Mangrove Forest Assessment.

For information and record.

  
**ERNESTO E. TAÑADA**

TSD-CDS6/23/2023  
Copy furnished:  
1. Planning Section  
2. File

So. Pag-asa, Brgy. Payompon, Mamburao, Occidental Mindoro  
Email: penroccemin@denr.gov.ph



**Department of Environment and Natural Resources**  
**MIMAROPA Region**  
**COMMUNITY ENVIRONMENT AND NATURAL RESOURCES OFFICE**

June 21, 2023

**MEMORANDUM**

**FOR** : The Regional Executive Director  
DENR MIMAROPA Region  
1515 DENR By the Bay Building, Roxas Boulevard,  
Barangay 688, Ermita, Manila

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

**FROM** : The CENR Officer

**SUBJECT** : **SUBMISSION OF FINAL REPORT FOR THE MANGROVE  
FOREST ASSESSMENT IN APO REEF NATURAL PARK FOR  
CY 2023**

Respectfully forwarded is the final report for the mangrove forest assessment in Apo Reef Natural Park (ARNP) for CY 2023. The ARNP-PAMO has already monitored twelve 100 m<sup>2</sup> monitoring plots distributed across Apo Island, ARNP.

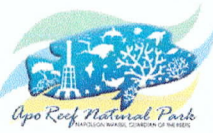
For information and record.

  
FOR. ANASTACIO A. SANTOS, MPA

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

June 21, 2023

**MEMORANDUM**

**FOR** : Regional Executive Director  
DENR MIMAROPA Region  
1515 DENR By the Bay, Roxas Blvd.  
Brgy. 668, Ermita, Manila

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

The CENR Officer  
Sablayan, Occidental Mindoro

**FROM** : The Protected Area Superintendent

**SUBJECT** : **SUBMISSION OF FINAL REPORT FOR MANGROVE FOREST  
ASSESSMENT IN APO REEF NATURAL PARK FOR CY 2023**

Respectfully submitted is the final report for the mangrove forest assessment in Apo Reef Natural Park (ARNP) for CY 2023. Twelve 100 m<sup>2</sup> plots in Apo Island, ARNP were surveyed from 21-23 February 2023. These sampling plots are representative of the 9.64-hectare mangrove forest within the MPA. During the three-day survey, 11 species of true mangroves. The diameter-at-breast height and tree height of large trees and the canopy cover within the monitoring plots were also acquired during the survey. 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 and that no significant change has been recorded in the recent years. Attached herewith is the final report.

For your information and record.

  
**KRYSTAL DAYNE T. VILLANADA**



# **Mangrove Forest Assessment**

## *Narrative Report*

*CY 2023*

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## I. Introduction

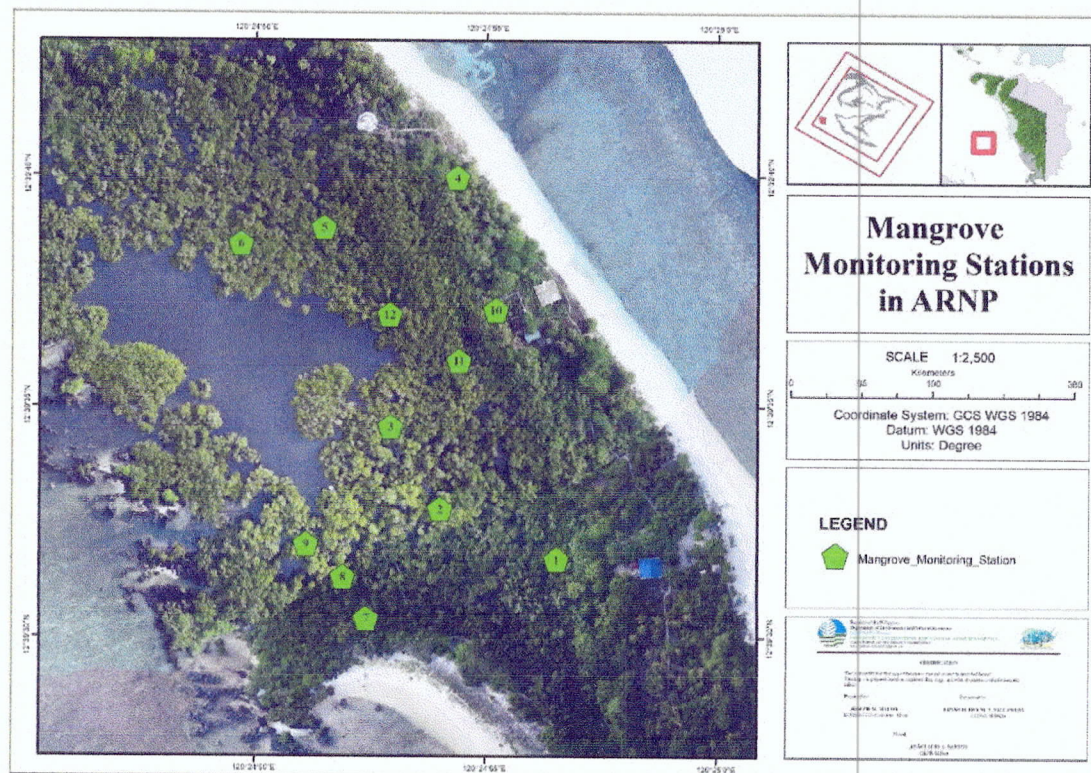
Apo Reef Natural Park (ARNP) is a 15,799.23-hectare Marine Protected Area (MPA) that covers an irregularly shaped atoll, a fringing reef, and three islets. The Natural Park hosts a number of ecosystems and among which are mangrove forests. The mangrove forests in ARNP, particularly in Apo Island and Binanggaan, are estimated to span 9.64 hectares. To date, at least 11 species of mangroves have been recorded within the MPA (Tabaranza et al., 2014; REECS, 2017).

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

The monitoring of mangrove forests in ARNP is an activity under *MPA Management, Strengthening, and Networking*, a subcomponent of the Coastal and Marine Ecosystems Management Program or CMEMP. Since 2021, surveys have been conducted annually by the Protected Area Management Office of ARNP (ARNP-PAMO) with the aim of a) assessing mangrove species diversity and abundance and trends in the condition of the mangrove forests and b) developing necessary management interventions to further their protection.

## II. Methodology

Twelve monitoring stations in Apo Island, ARNP were surveyed from February 21 to 23, 2023 (Figure 1). These stations were similar with those monitored last year. The monitoring team included personnel from the ARNP-PAMO and the Municipal Environment and Natural Resources Office (MENRO) of Sablayan (Table 1).



**Figure 1.** Twelve monitoring plots within the mangrove forest in Apo Island, ARNP.



**Table 1.** Members of the mangrove forest monitoring team for CY 2023.

Name	Office	Task
Krystal Dayne T. Villanada	ARNP-PAMO	Species identification
Hugo G. Salvador	ARNP-PAMO	Species identification, Tree height measurement
Roberto P. Beringuela	ARNP-PAMO	Densiometer measurements
Kelvin John U. Zubiri	ARNP-PAMO	Recorder
Ludygario M. Matira	ARNP-PAMO	Dbh measurement
Federico A. de Jesus	ARNP-PAMO	Dbh measurement
Jaysrael D. Urieta	ARNP-PAMO	Plot demarcation
Mark Dennis M. Barretto	ARNP-PAMO	Plot demarcation
Melvin Cariño	MENRO Sablayan	Dbh measurement

100 m<sup>2</sup> plots were demarcated in each monitoring station using a nylon wire. The four corners of these plots were permanently marked with green waterproof paint. Large trees (>5 cm diameter-at-breast height [dbh]) were counted and identified up to species level using Primavera et al. (2004) and Primavera (2009). The tree height and dbh of the large trees were measured using a laser rangefinder (TruPulse Laser Rangefinder 200, USA) and diameter tape (Yamayo Million Diameter Tape, Japan). Canopy cover was measured using a convex spherical densiometer (Forestry Suppliers Inc., USA) (Figure 2). Densiometer measurements were taken four times at different directions (north, south, east, and west) within each plot, and these were averaged to minimize observer errors (Lemmon, 1956; Baudry et al., 2014). One 4 m<sup>2</sup> subplot was established in each 100 m<sup>2</sup> plot and surveyed for regenerants. Saplings and seedlings were also counted and identified.



**Figure 2.** Convex spherical densiometer used in measuring canopy cover in the mangrove forest monitoring plots.



The relative density, relative frequency, relative dominance, and importance value index (IVI) of the mangrove species were computed using the following formulas:

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

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

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

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

Furthermore, the condition of the mangrove forests of ARNP were assessed using the criteria in DENR BMB Technical Bulletin No. 2017-05 (Table 3).

**Table 3.** Criteria for determining the condition of mangrove forest based on DENR BMB Technical Bulletin No. 2017-05.

Condition	Criteria
Excellent	76% and above in % Crown Cover 0.1 Regenerants per m <sup>2</sup> Above 5m in average tree height Undisturbed to negligible disturbance
Good	51% - 75% Crown Cover 0.76 - <1 Regenerants 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

Opportunistic surveys were also conducted outside of the monitoring plots to collect more information on species presence. The species encountered during the opportunistic surveys are included in this report.

### III. Results and Discussion

During the field surveys, eleven species from four families were recorded. Most of which are recorded in Apo Island (Table 4, Figure 3). The lone threatened species of true mangrove recorded was *Pemphis acidula* (locally known as Bantigi). This species is listed as Endangered under DENR Administrative Order 2017-11 or the *Updated National List of Threatened Philippine Plants and their Categories*. Notably, the survey team also recorded the presence of *Rhizophora lamarckii* and *Avicennia marina* (Figure 3b and 3h). These species

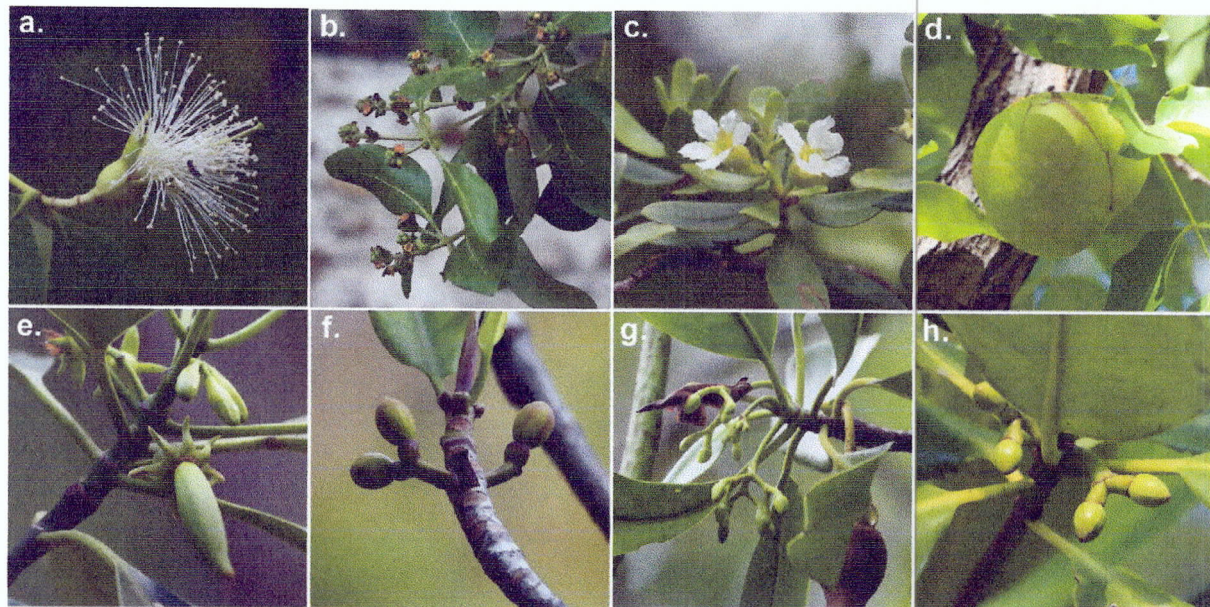


have not been reported in previous mangrove assessments including MBCFI (2014) and REECS (2017).

**Table 4.** Species of true mangroves sampled across twelve monitoring stations in Apo Island, ARNP.

Species	Common Name	Family	Presence (+/-)	
			Apo Island	Binanggaan
<i>Avicennia marina</i>	Api-api	Acanthaceae	+	-
<i>Bruguiera cylindrica</i>	Pototan	Rhizophoraceae	+	-
<i>Ceriops tagal</i>	Tangal	Rhipzophoraceae	+	-
<i>Rhizophora apiculata</i>	Bakauan-lalaki	Rhizophoraceae	+	+
<i>Rhizophora mucronata</i>	Bakauan-babae	Rhizophoraceae	+	-
<i>Rhizophora stylosa</i>	Bakauan-bato	Rhizophoraceae	+	+
<i>Rhizophora lamarckii</i>	-	Rhizophoraceae	+	-
<i>Pemphis acidula</i>	Bantigi	Lythraceae	+	-
<i>Sonneratia alba</i>	Pagatpat	Lythraceae	+	-
<i>Xylocarpus rumphii</i>	Malapiagau	Meliaceae	+	-
<i>Xylocarpus moluccensis</i>	Piag-ao	Meliaceae	+	-

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



**Figure 3.** Flowers and fruits of selected mangrove species in Apo Island and Binanggaan. A) *Sonneratia alba*, B) *Avicennia marina*, C) *Pemphis acidula*, D) *Xylocarpus rumphii*, E) *Bruguiera cylindrica*, F) *Rhizophora apiculata*, G) *Rhizophora mucronata*, and H) *Rhizophora lamarckii*.

Only six of the eleven species were recorded within the 12 monitoring plots. The most abundant species was *Rhizophora mucronata* (71 individuals), followed by *R. apiculata* (50 individuals) (Table 5). 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 have a muddy substrate to which *Rhizophora* spp. are highly adapted to (Duke, 2006). The third most abundant species was *Bruguiera cylindrica* (30 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* (1 individual) had a similar distribution with *B. cylindrica*. The *A. marina* observed outside of the monitoring plots were also in the landward zone. *S. alba* and *A. marina* usually occurs in areas exposed to tidal waves (Waycott et al., 2011). The occurrence of mature *S. alba* and *A. marina* individuals within the landward zone may be due to competition by *Rhizophora* spp. in the muddy low-intertidal zone or shoreline evolution.

**Table 5.** Distribution and abundance of mangrove species in Apo Island, Apo Reef Natural Park.

Species	Abundance	Frequency
<i>Bruguiera cylindrica</i>	30	0.25
<i>Rhizophora apiculata</i>	50	0.67
<i>Rhizophora lamarckii</i>	4	0.25
<i>Rhizophora mucronata</i>	71	0.83
<i>Rhizophora stylosa</i>	2	0.17
<i>Sonneratia alba</i>	2	0.17
<i>Xylocarpus rumphii</i>	1	0.83

Abundance – total count of individuals in the 12 monitoring plots

The overall mean dbh and tree height for the mangrove forest in Apo Island, Apo Reef Natural Park are 18.52 cm and 7.34 m, respectively (Table 6). These estimates are similar to the values acquired last year. Contrastingly, the percent crown cover acquired this year (90.03%) is much less than the previous year (99.40%) (Table 7). This decrease is due to the change in the method used to measure percent crown cover. The method used in the previous year assumed a perfectly spherical crown area and disregarded crown overlap thus, overestimating the crown cover. In terms of tree height, dbh, stand basal area, and crown cover, no distinct patterns were observed among 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)	Percent Crown Cover
1	Landward	18.55	7.55	98.44
2	Middle	23.17	7.22	90.90
3	Seaward	16.24	7.38	90.90
4	Landward	9.50	6.38	89.60
5	Middle	22.23	10.68	95.58
6	Seaward	17.09	6.57	88.30
7	Landward	24.52	6.62	76.60
8	Middle	21.68	8.19	92.46
9	Seaward	15.04	7.37	81.54
10	Landward	15.77	5.57	92.98
11	Middle	19.55	7.27	92.46
12	Seaward	32.99	8.16	90.64
<b>Overall mean</b>		18.52	7.34	90.03

*R. mucronata* is the most ecologically important species in Apo Island, Apo Reef Natural Park on the basis of IVIs (127.88) (Table 7). It had the highest relative density (44.375), relative frequency (34.48), and relative dominance (49.02). *R. mucronata* is followed by *R. apiculata* (IVI = 81.49) and *B. cylindrica* (IVI = 38.28). In the previous year, *R. mucronata* also had the highest IVI, followed by *R. apiculata* and *B. cylindrica*.

**Table 7.** Relative density, frequency and dominance, and the Important value of the common mangrove species of Apo Reef Natural Park.

Species	Relative Density	Relative Frequency	Relative Dominance	Importance Value
<i>Bruguiera cylindrica</i>	18.75	10.34	9.19	38.28
<i>Rhizophora apiculata</i>	31.25	27.59	22.65	81.49
<i>Rhizophora lamarckii</i>	2.5	10.34	0.94	13.78
<i>Rhizophora mucronata</i>	44.375	34.48	49.02	127.88
<i>Rhizophora stylosa</i>	1.25	6.90	0.54	8.69
<i>Sonneratia alba</i>	1.25	6.90	16.06	24.21
<i>Xylocarpus rumphii</i>	0.625	3.45	1.60	5.67

A very low density of mangrove saplings and seedlings was recorded in Apo Island, Apo Reef Natural Park (0.01 individuals/m<sup>2</sup>). Regenerants were only observed in three of the twelve plots. *B. cylindrica* had the highest abundance of regenerants (7 individuals) (Table 8). 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 8.** Distribution and abundance of saplings and seedlings in Apo Island, Apo Reef Natural Park.

Species	Abundance	Frequency
<i>Bruguiera cylindrica</i>	7	0.17
<i>Rhizophora mucronata</i>	6	0.08

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

11 species of true mangroves were identified during the survey. These were namely, *A. marina*, *B. cylindrica*, *C. tagal*, *R. apiculata*, *R. mucronata*, *R. lamarckii*, *R. stylosa*, *P. acidula*, *S. alba*, *X. moluccensis*, 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 and that no significant change has been recorded in the recent years.

It is recommended that the monitoring of mangrove forests be decreased from annually to once every three years. Instead of conducting a similar activity, funding should be redirected to the capacitation of PAMO staff in conducting more advanced methodologies such as, but not limited to carbon stock assessment.

Prepared by:

  
**JANE FRANCES T. SENOSA**  
CMEMP Extension Officer

Reviewed and submitted by:

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

## V. References

- Abu El-Regal M., & Ibrahim, N. (2014). Role of mangroves as a nursery ground for juvenile reef fishes in the southern Egyptian Red Sea. *The Egyptian Journal of Aquatic Research*, 40(1): 71-78. <https://doi.org/10.1016/j.ejar.2014.01.001>
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## VI. Photo documentation



Former CMEMP Extension Officer Hugo Salvador measuring the dbh of the *X. rumphii* tree within Plot 1



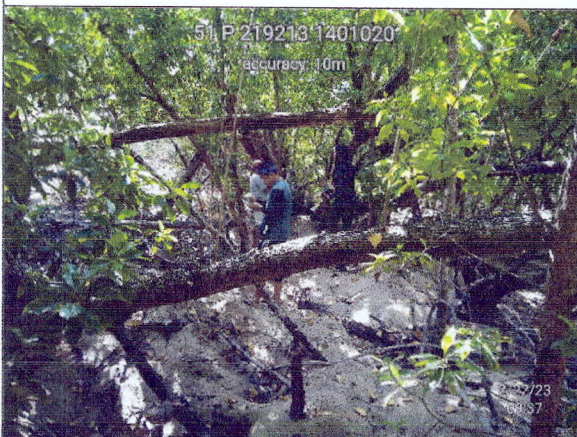
Park Ranger Kelvin John Zubiri writing down the dbh of an adult tree within Plot 1



MENRO personnel Melvin Cariño assisting in the measurement of dbh in Plot 1



Boat Crew Jaysrael Urieta marking one of the four corners of Plot 4



Park Ranger Kelvin Zubiri (middle) recording the data gathered onto a waterproof slate



Members of the survey team en route to Plots 5 & 6





Park Ranger Ludygario Matira (left) measuring the dbh of an *R. mucronata* tree within Plot 5.



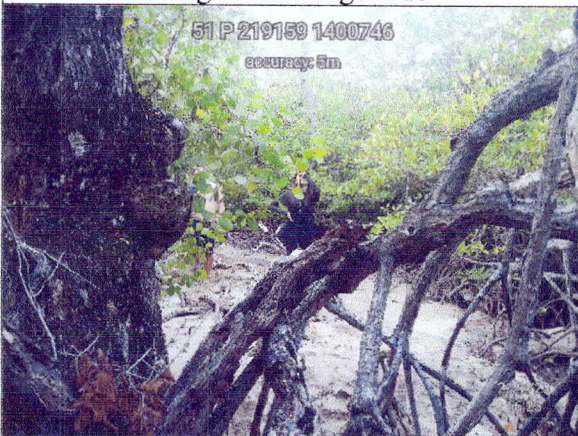
Park Ranger Ludygario Matira measuring the dbh of an *R. mucronata* tree within Plot 6.



CMEMP Extension Officer Hugo Salvador measuring tree height of large trees within Plot 6 using a laser rangefinder



Park Ranger Ludygario Matira measuring the dbh of the largest *S. alba* tree in ARNP

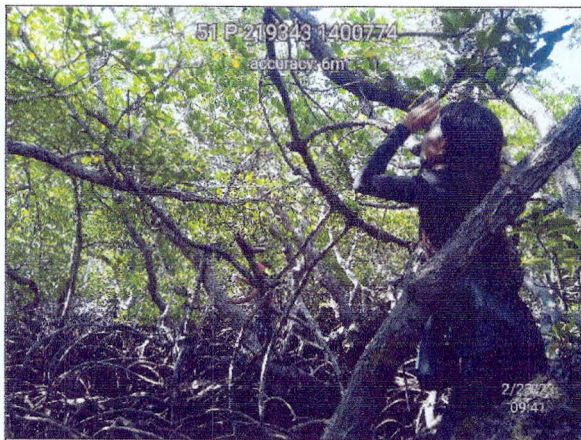


CMEMP Extension Officer Hugo Salvador measuring tree height of the *S. alba* tree in Plot 7



Boat Crew Jaysrael Urieta (middle) marking the four corners of Plot 2 after it has been demarcated with a nylon wire





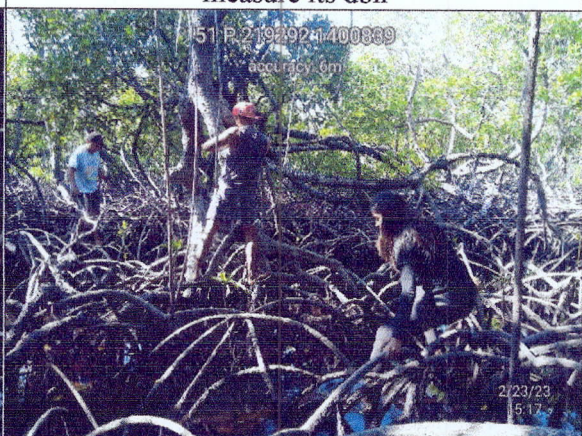
Former CMEMP Extension Officer Hugo Salvador (right) measuring tree height of large trees within Plot 2



Park Ranger Ludygario Matira (middle) climbing a mangrove tree within Plot 3 to measure its dbh



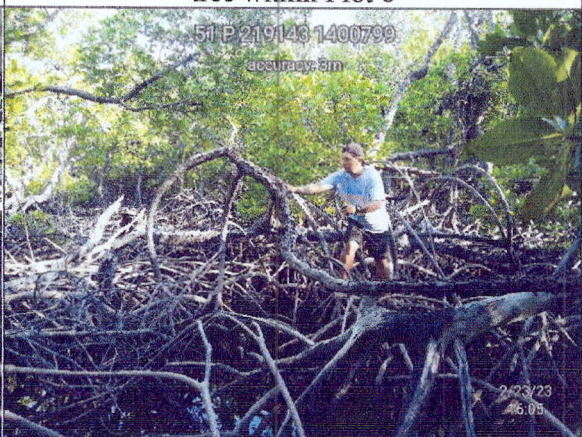
Photograph of the convex spherical densiometer that was used by Park Maintenance Foreman Roberto Beringuela in measuring canopy cover



Park Ranger Ludygario Matira (middle) tying the nylon wire on a stilt root of a *Rhizophora* tree within Plot 8



Boat Crew Jaysrael Urieta marking the corners of Plot 8



Boat Crew Jaysrael Urieta marking the corners of Plot 9