Research article

Mangrove Rehabilitation Using *Rhizophora* sp. in Northeastern Bohol, Philippines

SAMUEL J. GULAYAN*
Bohol Island State University, Candijay Campus, Bohol, Phillipines
Email: samgulayan@yahoo.com

JESRELLJANE AARON-AMPER
Bohol Island State University, Candijay Campus, Bohol, Phillipines

EDLIN RENE B. HANDUGAN
Bohol Island State University, Candijay Campus, Bohol, Phillipines

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Abstract National government issued an Executive Order 26, series of 2011 – declaring interdepartmental convergence initiative for national greening program. Bureau of Fisheries and Aquatic Resources commissioned the Bohol Island State University (BISU) Candijay Campus to facilitate the rehabilitation of degraded mangrove areas in coordination with local government units and in partnership of mangrove planters in Northeastern Bohol. Hence, the main objective of the study was to to document the progress and accomplishment of mangrove rehabilitation project in Northeastern Bohol, Philippines. Survived mangroves were counted manually. Principal branch of mangrove was measured to determine the growth performance in 12 months. Identified the sea shells for baseline information and interviewed the mangrove planters for determining the problems. In this study, a 48.36% survival rate was found out after one year of planting. The average growth (in height) was 6.097 cm per month. The Municipality of Candijay had the highest growth rate. *Terebralia* sp. (Dao-dao) and *Narita* sp. (Sihi) are the common sea shells found in the reforested areas. Proper selection of site is important before planting *Rhizophora* sp.

Keywords mangrove, reforestation, survival, sea shell, rehabilitation, propagule

INTRODUCTION

Mangrove is a type of forest growing along tidal mudflats and along shallow water coastal areas. Its ecosystem is primarily dominated by mangrove trees which is the primary producer. These trees interacts with associated aquatic fauna, and social and physical factors of the coastal environment (Melana et al., 2000a). Mangrove trees produces leaf litter and detrital matter, which are valuable sources of food for animals in estuaries and coastal waters. It is also use as firewood in coastal communities and most bakeries because of its heating value, but a greater volume is exported to Japan as a source of rayon (Melana et al., 2000b).

Philippines is endowed with lush coastal ecosystems including mangrove. Unfortunately, the huge area of mangrove forest in the country decreases into 120, 000 ha in the year 1981 from an estimated coverage of 450,000 ha in 1918. This has happened due to the rapid degradation during 1960's and 1970's when the government set a national policy that encourages expansion of the aquaculture. This reduces the forest into 117,700 hectares (DENR, 1995) that disturbed the whole coastal ecosystems.

In 2011, the national government with the leadership of President Benigno Simeon Aquino III issued the Executive Order No. 26, s. 2011 – declaring and interdepartmental convergence initiative for a national greening program. This order strengthened after the issuance of Executive Order No. 23, s. 2011 – mandated the DA-DAR-DENR convergence initiative to develop a national greening program in cooperation with the Department of Education, Commission on

Higher Education, Department of Social Welfare and Development and Department of Budget and Management, private sector and other concerned agencies and institutions.

The Bohol Island State University Candijay Campus was commissioned by the Bureau of Fisheries and Aquatic Resources to rehabilitate the degraded mangrove areas in Northeastern Bohol. Fifty three (53) hectares of intertidal zones were planted with *Rhizophora* sp. in year 2013 in collaboration with local communities and local government units in Northeastern Bohol.

OBJECTIVES

The general objective of this study was to document the progress and accomplishment of mangrove rehabilitation project in Northeastern Bohol, Philippines. Specifically, the study aims to:

1. determine the survival rate of *Rhizophora* planted after one year,
2. determine the growth rate after year of planting,
3. identify the sea shells for baseline information in the rehabilitated areas, and
4. identify the problems encountered in planting and management of *Rhizophora*.

METHODOLOGY

Location

Project sites are located in the four coastal municipalities of Northeastern Bohol, Philippines namely; Candijay, Mabini, Bien Unido and Talibon (Fig. 1). Coordinates for Talibon are 10˚09'55.55"N; 124˚20'57.25"E, then 10˚10'56.2"N; 124˚23'13.5"E for Bien Unido; 9˚55'20.04"N; 124˚32'32.23"E for Mabini and 9˚49'05.78"N; 124˚34'17.13"E for Candijay. These municipalities were chosen intentionally because these are the areas where the Bohol Island State University- Candijay Campus is working for mangrove rehabilitation using *Rhizophora* sp. with the coordination of the local government units and in partnership with mangrove planters.

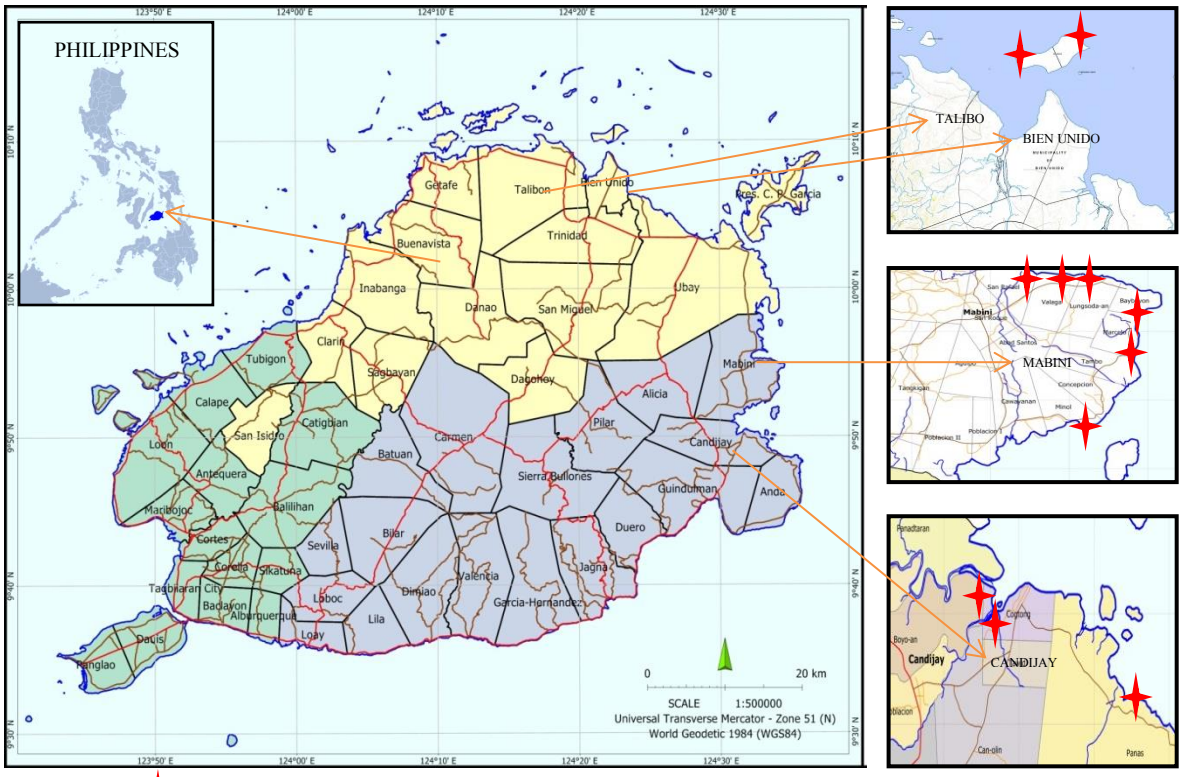
Procedures

General purpose of the study was presented to the local government officials of the four coastal municipalities in Northeastern Bohol for their information and guidance about the activity. Support from them was obtained. Data on the numbers of *Rhizophora* sp. planted in the four coastal municipalities in Northeastern Bohol were then gathered from the Extension Office of Bohol Island State University-Candijay Campus. The data were validated by the mangrove planters.

Census was applied in the counting of planted *Rhizophora* with participation of mangrove planters. Tally counters, slateboards and pencils were used for recording and counting of live *Rhizophora* sp. in four coastal municipalities in Northeastern Bohol. Sea shells were identified to establish baseline information in the reforested area. Assistance from mangrove planters were utilized especially on the naming locally of sea shells then after it was referred to the field guide published by FAO (1998) for right identification and naming scientifically.

Growth rate was measured inside the 6 ha mangrove plantation. This area is equivalent to 10% of 53 ha of planted *Rhizophora* sp. Eighteen plots were ramdomly established in 6 ha with 1 plot per hectare, and in every plot has 10 samples of mangrove trees. Samples were measured with tip measure with the aid of slateboard and pencil. The aimed was to determine the growth in height of planted mangroves.

Problems encountered in planting and management of *Rhizophora* sp. were gathered through an informal discussion with the 30 mangrove planters in four coastal municipalities in Northeastern Bohol. Problems were listed and collated and then it was presented to the other members of the communities for verification and validation of the data.



Legend: ✦ Study sites

Fig. 1 Map of Bohol

RESULTS AND DISCUSSION

Table 1 shows the four coastal municipalities of Northeastern Bohol that involved in mangrove planting using *Rhizophora* sp. The largest area planted with *Rhizophora* sp. is in the municipality of Mabini. It was planted in the lower intertidal zones near the river banks. The Municipality of Candijay has the second largest area where the species was planted in the middle and upper intertidal zones, followed by the municipality of Bien Unido and Talibon where the mangroves planted mostly in the lower intertidal zones of the island. All the mangroves were planted in 2013.

Table 1 Rehabilitated mangrove areas in Northeastern Bohol using *Rhizophora* sp.

Municipalities	Total area per municipality (Ha)
Candijay	19
Mabini	27
Bien Unido	4
Talibon	3
Total	**53**

Table 2 *Rhizophora* sp. that survived in the rehabilitated mangrove areas (53 ha)

Municipalities	Number of *Rhizophora* sp. planted	Numbers of survived *Rhizophora* sp.	Survival rate (%)
Candijay	63,327	46,463	73.37
Mabini	89,991	23,774	26.42
Bien Unido	13,332	8,901	66.76
Talibon	9,999	2,687	26.87
TOTAL	**176,649**	**81,825**	**48.36**

Table 2 presents the number of *Rhizophora* sp. that survived in four coastal municipalities in Northeastern Bohol after one year of planting. It was found out that Candijay has 73.37% survival rate followed by Bien Unido with 66.76% survival rate, Talibon with 26.8%, and Mabini with 26.42%. Overall, the average survival rate of *Rhizophora* sp. planted in Northeastern Bohol is 48.36%. It was observed that the mangroves planted in the midle and upper intertidal zones have good survival rate compared to those planted in the lower intertidal zones near the river banks.

Table 3 shows the identified sea shells in the rehabilitated mangrove areas in four coastal municipalities in Northeastern Bohol. Reason of identifying the sea shells in the rehabilitated areas was to establish baseline information. It was found out that there are eleven species of sea shells in the municipality of Mabini and Talibon, eight in Bien Unido and seven in Candijay, Bohol. The most dominant and common species in the four municipalities are *Terebralia* sp. (Dao-dao) and *Narita* sp. (Sihi). These species occurs widely in the mangrove system (Crowe, 1997).

Table 3 Sea shells identified in the rehabilitated area in northeastern Bohol

Municipality(s)	Sea shell species	
	Scientific name	**Local name**
Mabini, Bohol	*Terebralia* sp.	Dao-dao
	Apolymetis sp.	Toway
	Narita sp.	Sihi
	Bursidae sp.	Lubot-anay
	Telescopium sp.	Bagongon
	Crassostrea sp.	Tagnipis
	Donas sp.	Punaw
	Anadara sp.	Litob
	Solen sp.	Tudlo dato
	Protothaca sp.	Balisaha
	Perna sp.	Amahong
Bien Unido, Bohol	*Terebralia* sp.	Dao-dao
	Narita sp.	Sihi
	Bursidae sp.	Lubot-anay
	Anadara sp.	Litob
	Protothaca sp.	Balisaha
	Conidae sp.	Liswe
	Pinna sp.	Tab
	Morola sp.	Tandok-tandok
Talibon, Bohol	*Terebralia* sp.	Dao-dao
	Narita sp.	Sihi
	Anadara sp.	Litob
	Protothaca sp.	Balisaha
	Perna sp.	Amahong
	Conidae sp.	Liswe
	Pinna sp.	Tab
	Motorola sp.	Tandok-tandok
	Cuarium sp.	Aninikad
	Turbo sp.	Taktakon
	Unidentified sp.	Wasay-wasay
Candijay, Bohol	*Terebralia* sp.	Dao-dao
	Apolymetis sp.	Toway
	Bursidae sp.	Lubot-anay
	Telescopium sp.	Bagongon
	Crassostrea sp.	Tagnipis
	Morola sp.	Tandok-tandok
	Saccostrea sp.	Sihi

Fig. 2 presents the growth (in height) performance of mangrove planted. Kruskal Wallis Test was used in determining significant difference on the growth of the mangrove planted between sites. Tukey's post hoc test was then used afterwards. It was found out that the average mean of growth in height is 6.097 cm per month and that the growth of the mangrove planted in Mabini differs from Candijay, Bien Unido and Talibon. *Rhizophora* is best suited in the intertidal zone (Feller and Sitnik, 1996).

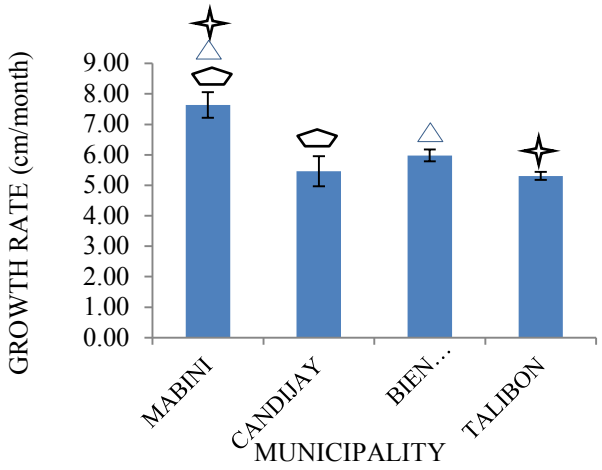


Fig. 2 Growth performance of *Rhizophora* sp. in terms of heights (in cm.)

Fig. 3 presents the problems encountered in planting and management of *Rhizophora* sp. From the data we could see that the barnacles gave greatest problem of the project and to the mangrove planters, followed the fishing inside the rehabilitated areas. Same problem met by the mangrove planters in Thailand who used *Rhizophora mucronata* (Erftemeijer and Lewis, 2000). This problem highly contributed to the low survival rate.

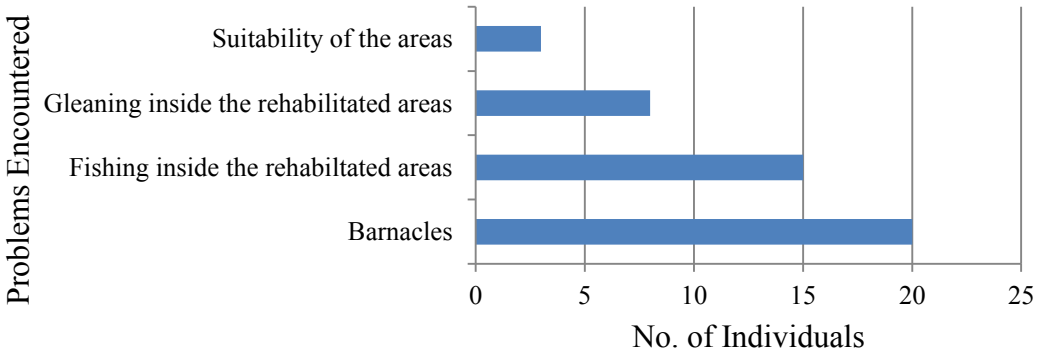


Fig. 3 Problems encountered in planting and management of *Rhizophora* sp. (n=30)

CONCLUSION

It is concluded that *Rhizophora* sp. planted in the middle and upper interterdal zones has higher survival rate compared to the mangrove planted in the lower intertidal zones near the river banks. The occurence was due to the infestation of barnacles in the mangroves planted. In terms of growth rate, the Municipality of Candijay had the highest since the mangrove was planted in the lower intertidal which suites them best. With regards to the sea shells, it was observed that *Terebralia* sp. and *Bursidae* sp. are common in all the rehabilitated areas.

REFERENCES

Crowe, T.P., 1997. The distribution of Terebralia palustris (Linne) with respect to microhabitat in mangrove forests of Darwin Harbour I: Description of patterns. In: Hanley, J.R., Caswell, G., Megirian, D. and Larson, H.K. (Eds.), Proceedings of the Sixth International Marine Biological Workshop. The Marine Flora and Fauna of Darwin Harbour, Northern Territory, Australia. Museums and Art Galleries of the Northern Territory and the Australian Marine Sciences Association, 435-443.

DENR Statistics. 1995. Environmental and natural resources atlas of the Philippines. Environment Center of the Philippines Foundation. 1998. Manila, Philippines.

Erftemeijer, P.L.A. and Lewis, R.R. 2000. Planting mangroves on intertidal mudflats: Habitat restoration or habitat conversion?. Proceedings of the ECOTONE VIII Seminar Enhancing Coastal Ecosystems Restoration for the 21st Century, Bangkok: Royal Forest Department of Thailand. 156-165.

Feller, I.C. and Sitnik, M. 1996. Mangrove ecology: A manual for a field course. A Field Manual focused on the Biocomplexity on Mangrove Ecosystems. Smithsonian Institution, Washington.

FAO. 1998. Species identification guide for fishery purposes. The Living Marine Resources of the Western Central Pacific. Volume 1 Seaweeds, Corals, Bivalves and Gastropods. Edited by Carpenter, K.E. and Niem, V.H.

Melana D.M., Melana, E.E. and Mapalo, A.M. 2000a. Mangrove management and development in the Philippines. A paper presented during the meeting on "Mangrove and Aquaculture Management" held at Kasetsart University Campus, Bangkok, Thailand on February 14-16, 2000.

Melana D.M., Joseph Atchue III, Yao, C.E., Edwards, R., Melana, E.E. and Gonzales, H.I. 2000b. Mangrove management handbook. Department of Environment and Natural Resources, Manila, Philippines through the Coastal Resource Management Project, Cebu City, Philippines. 96 p.