

## MANGROVE REHABILITATION EFFORTS IN BAIS BAY

Hilconida P. Calumpong and Pablina L. Cadiz  
Silliman University Marine Laboratory  
6200 Dumaguete City

### INTRODUCTION

The mangrove forest in Bais Bay used to be contiguous (LANDSAT map of Negros Island, DENR Forest Inventory 1187-01361). However, due to logging for various purposes (construction, firewood, forage) and conversion into fishponds, what remained in 1979 were small patches covering about 811.6 ha. (Biña, 1979), including the highly denuded 200-hectare Talabong Mangrove Forest in South Bais Bay which was declared as a game refuge, wildlife sanctuary and tourist spot by the Department of Environment and Natural Resources in 1985. Now, the mangrove forest in Bais Bay covers only about 250 hectares (Calumpong and Serate, 1994).

Since this mangrove ecosystem has been the source of edible fish and shellfish to fisherfolk (Alcala, 1979; Alcala and Alcazar, 1984; Dolar *et al.*, 1991) — not mentioning the traditional uses of the mangrove trees themselves (Jara, 1987) as well as their role as a major contributor of organic matter (“fertilizer”) to the Bay (de Leon *et al.*, 1992) — its management is critical to the overall productivity and stability of Bais Bay.

The issue on mangrove deforestation in Bais Bay is a major concern of the Environment and Resource Management Project. Attempts have been made to mitigate this issue, such as the establishment of mangrove nurseries and multispecies mangrove reforestation, in spite of some constraints. However, with the persistent efforts of the Environment and Resource Management Project-Marine Component Team and the local “ambassadors,” as well as the cooperation of the city government and the Central Visayas Polytechnic College (CVPC), some of these constraints were eventually eased out.

This study was conducted with the following objectives:

1. to gain full community support for the on-going efforts in mangrove reforestation and in developing a multispecies mangrove nursery;
2. to disseminate the technology of planting mangroves;
3. to rehabilitate the Talabong Mangrove Park;
4. to conduct experiments on multispecies reforestation; and
5. to establish a multispecies mangrove nursery.

## MATERIALS AND METHODS

### Establishment of the Nursery Site

An ocular survey of Talabong Mangrove forest and Capiñahan in Bais Bay was conducted to determine possible sites for nursery and reforestation. Initially, a small piece of land at the back of the old Human Settlements Building at Capiñahan was selected because of its strategic location (Figure 1). However, a major problem arose, i.e., the area had been converted into fishponds and the "leasee" wanted to be reimbursed for his expenses amounting to about 30,000 pesos. Because of this constraint, other sites were surveyed. One was the area leased to Central Visayas Polytechnic College (CVPC) adjacent to Barangay Okiot's recreation center. Negotiations with the President of CVPC resulted favorably. Not only was an area set aside for mangrove nursery but also other fields of cooperation with the project was agreed upon in a memorandum of agreement between CVPC and the Project.

The nursery site, adjacent to a newly constructed fishpond of CVPC and behind a cluster of houses, measured 100m x 100m. The substrate is generally mud-silt with a water depth ranging from 0-4m. Natural vegetation consists of *Avicennia marina* in the intertidal and *Sonneratia alba* in the seaward side. A few *Rhizophora* were planted previously.

The area was planted with as many species of mangroves as possible. The site was arbitrarily divided into rows, each row starting 1.8m from the fishpond dike and 1m apart (Figure 2). Propagules or seedlings were planted at 0.5m interval: the first two rows from the land were planted with *Ceriops*, followed by two rows of *Bruguiera*, and the middle to five rows each with three *Rhizophora* species. Sources of these propagules were the Talabong Mangrove Forest, Bindoy and Palawan.

### Reforestation Sites

In choosing the sites to be reforested, the Talabong Mangrove Forest was the obvious choice; first, because it urgently needed rehabilitation, and second, because there were no tenurial problems associated with it. However, to mobilize a large number of people to undertake such a task was both costly and nightmarish. The long-term problem was the maintenance and monitoring of the plantings.

The strategy of organizing the community and starting reforestation efforts with associations was discarded because of the long history of community organizing that the fisherfolk of Bais had encountered. One problem with this strategy as has been experienced by the Central Visayas Regional Project is the problem of tenure.

To avoid this, the strategy of starting reforestation efforts with Certificate of Stewardship Contract (CSC) holders was explored. A list of CSC holders and the location and the hectarage of their holdings was secured from Community Environment and Natural Resources Office II (Ayungon Office). It was found that a substantial part of Bais Basin, especially in the Barangays of Looc (8.2699 ha), Okiot (5.7467 ha), and Capiñahan (3.9072 ha) have been designated under a CSC agreement (Figure 1). A total of 183 CSC holders were identified in these three barangays.

A cursory check of these areas under the CSC showed an almost zero reforestation effort being undertaken. Under the law, 20% of an area acquired through CSC should be reforested on pain of cancellation. The Provincial Environment and Natural Resources Office was consulted regarding this and a workshop to remind the CSC holders of their responsibilities and to enlighten them on the real meaning of CSC was recommended. This was also considered a good venue to introduce the ERMP-Development Action Program and mangrove management as a whole. To ensure good attendance, individual letters of invitation signed by the PENRO head himself was distributed to the CSC holders. Barangay and city officials as well as heads of line agencies (e.g., DA) were invited.

Venues for the workshop were explored. CVPC-Bais campus was chosen because of its strategic location and its involvement with the project. Meetings with the CVPC-Bais campus dean and administrators were held. When CVPC gave its okay, preparations were done.

The workshop was conducted in CVPC on 11 July 1992 with the specific objective of initiating community involvement in mangrove reforestation using CSC holders as the point of entry. It was successfully attended by about 80% of the CSC holders, DENR representatives, the mayor of Bais City and his staff, DA representatives, barangay officials and even non-CSC holders. More than 200 people were present.

A follow up house-to-house monitoring was conducted by the DENR representative assigned in Bais. Of the 30 CSC holders monitored, only six had planted part of their area with *Rhizophora* and only three requested for seedlings. Two factors were cited as reasons for not wanting to plant more *Rhizophora*: unsuitability of substrate and disease.

### Germination Trials and Growth Monitoring of Refo Species

Different species of mangrove propagules were allowed to germinate at Silliman University Marine Laboratory and at the back of the Human Settlements Building at Capiñahan. The propagules were collected from Bindoy, Talabong (Figure 3) and Ulugan, Palawan. These were allowed to germinate in plastic bags filled with soil for about two months or more, depending on the species germinated (Figure 4).

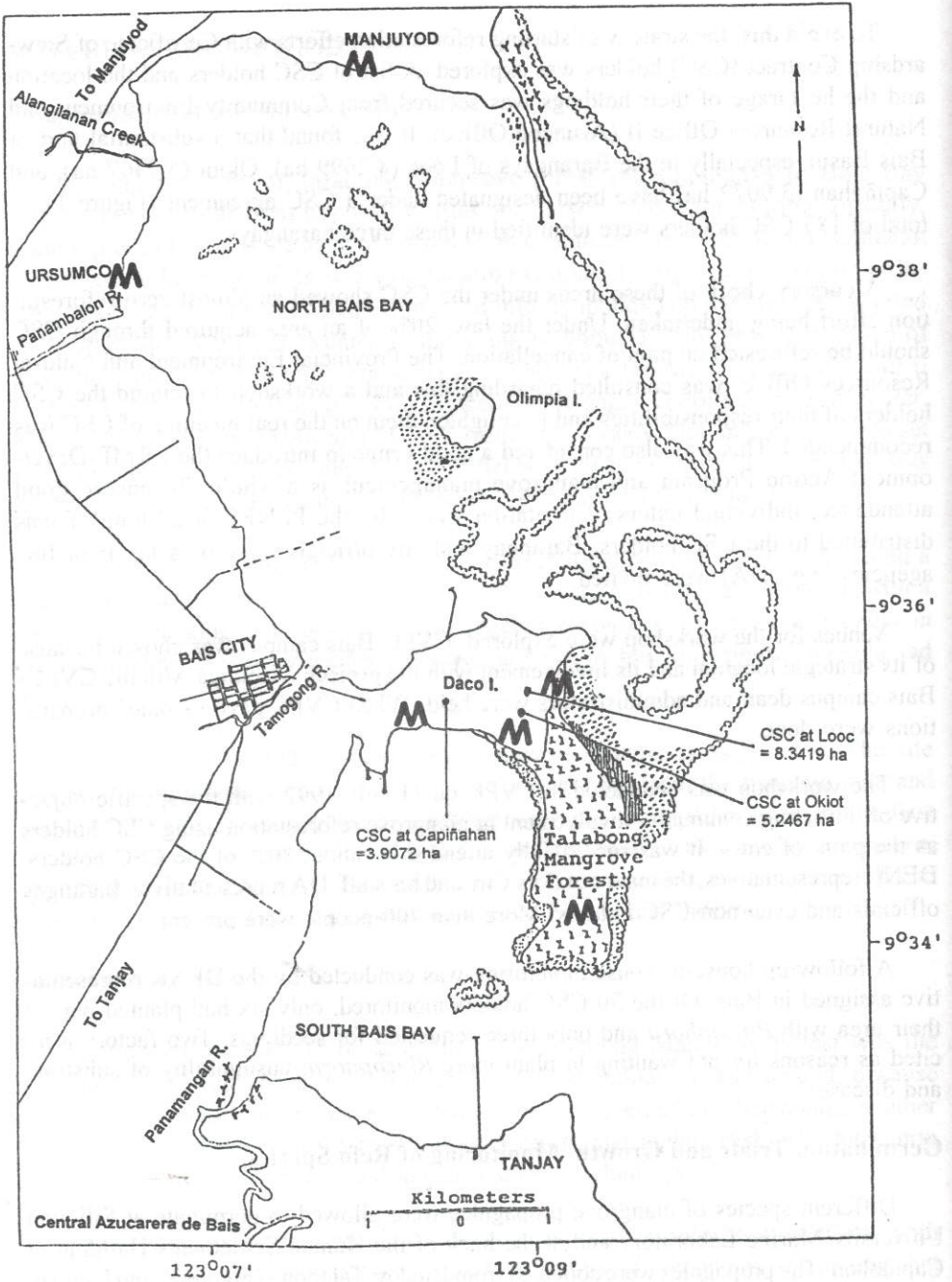


Figure 1. Map of Bais Bay indicating mangrove reforestation sites (M).

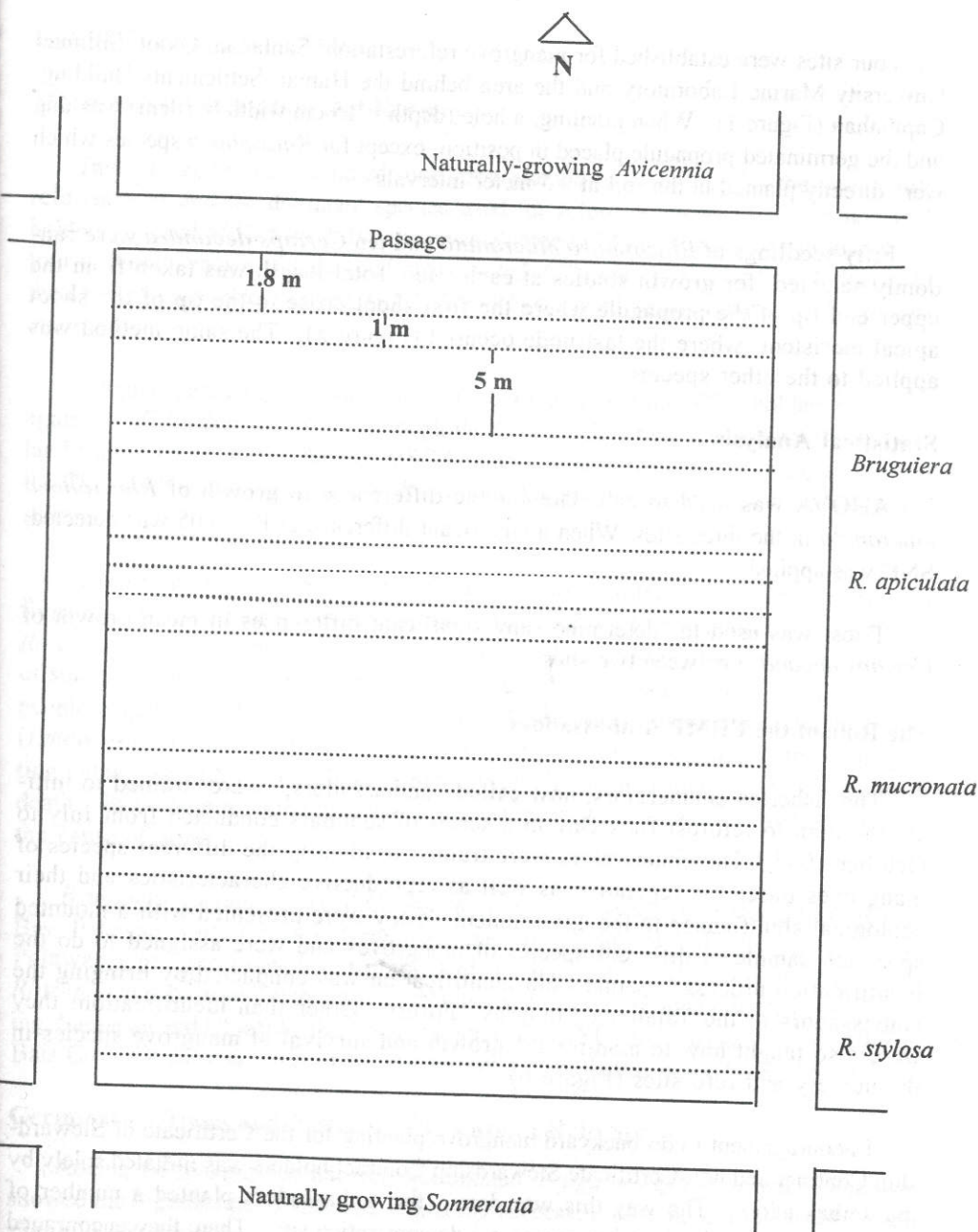


Figure 2. Schematic diagram of the nursery site in CVPC/SU-ERMP (Bais).

Four sites were established for mangrove reforestation: Sanlagan, Okiot, Silliman University Marine Laboratory and the area behind the Human Settlements Building, Capiñahan (Figure 1). When planting, a hole (depth = 15 cm, width = 10 cm) was dug and the germinated propagule placed in position, except for *Rhizophora* species which were directly planted in the soil at 0.5 meter intervals.

Fifty seedlings of *Rhizophora mucronata* and ten *Ceriops decandra* were randomly selected for growth studies at each site. Total length was taken from the upper end tip of the propagule where the first shoot arose to the tip of the shoot apical meristem where the last node occurred (Figure 5). The same method was applied to the other species.

### Statistical Analysis

ANOVA was used to calculate for the differences in growth of *Rhizophora mucronata* in the three sites. When a significant difference at  $P = 0.05$  was detected, SNK was applied.

T-test was used to determine any significant differences in mean growth of *Ceriops decandra* between two sites.

### The Role of the ERMP Ambassadors

The fisheries enumerators, now called "ambassadors," were trained to initiate the plan to reforest Bais Bay in a series of seminars conducted from July to October 1993. The enumerators were trained to identify the different species of mangroves based on vegetative as well as reproductive characteristics and their ecological significance to the environment. They were presented with a mounted specimen sample of different species of mangroves and were assigned to do the identification process. Actual field identification was conducted by bringing the ambassadors to the Talabong Mangrove Forest. Other than identification, they were also taught how to monitor the growth and survival of mangrove species in the nursery and refo sites (Figure 6).

Encouragement to do backyard mangrove planting for the Certificate of Stewardship Contract and non-Certificate Stewardship Contract holders was initiated solely by the ambassadors. The way this was done, the ambassadors planted a number of propagules at their backyard to serve as a demonstration site. Then, they encouraged at least five community members to do the same. Using a questionnaire, they were also given the task of surveying the present status of mangrove reforestation done by CSC and non-CSC holders.

## RESULTS AND DISCUSSION

### Mangrove Reforestation and Nursery

Table 1 shows the estimated total area planted to mangrove by the community, refo survival and the dominant species used for reforestation by CSC and non-CSC holders. A total of 18.5 ha in 10 sitios was planted to 253,074 mangrove propagules of four different species. Of the total area planted, 65% was owned by CSC holders. Of the 253,074 propagules planted, 101,128 or 40% survived. Most of these are *Rhizophora mucronata*.

A higher percentage of survival was recorded among non-CSC holders (68%) as against CSC holders (19.6%); although the CSC holders own a significant amount of land (about twice that of the non-CSC holders). These results do not augur well for the CSC holders, calling for a re-evaluation of this strategy as a mangrove management scheme.

According to a survey conducted by a representative of the Department of Environment and Natural Resources, only six members had planted their area with *Rhizophora* spp. and only three requested for seedlings. Many cited the unsuitability of substrates and diseases as reasons for not planting. In some areas like Dungguan, people complained that the area was quite exposed and that sometimes algal bloom (*Enteromorpha intestinalis* and *Rhizoclonium* sp.) occurred, resulting in the algae getting entangled with the seedlings, which eventually stunted their growth leading to death. Still others reported predator attacks (*Crassostrea* sp. and *Cardissoma* sp.) as the cause of death.

*Bruguiera gymnorrhiza* and *Ceriops tagal* were two species collected from Honda Bay, Palawan while *Ceriops decandra* came from Talabong. The two species from Palawan were germinated and planted at the back of SUML while *Ceriops* and *Rhizophora* spp. from Talabong were planted at Bais Bay (Human Settlements Building, Sanlagan and Okiot) by the Rotary Youth Club (RYC) and the students of CVPC in Bais City. *Ceriops decandra* from Bindoy were also planted at the back of SUML.

### Germination Trials and Patterns of Growth in Refo Species

Among the five species that were germinated, *Bruguiera gymnorrhiza* of Palawan showed the highest rate of survival, indicating successful adaptation to its location and suitability of substrates (Table 3). *Ceriops decandra* and *Ceriops tagal* showed very low survival rates, which was probably due to heat exposure at the time of planting and the lack of water, as the area they were planted to could not be reached by seawater even at high tide. In addition, the seedlings in the Panambalon area were eaten by



**Figure 3.** Talabong Mangrove Forest as one of the major sources of propagules.



**Figure 4.** Germinating of propagules in plastic bags.



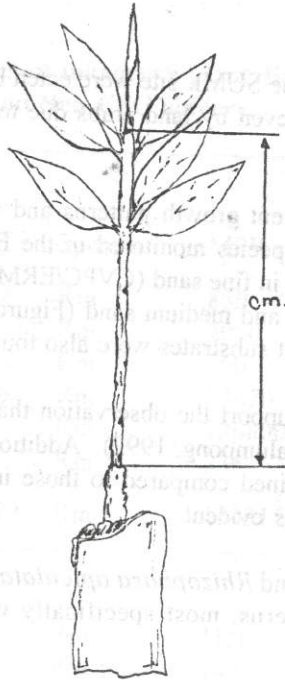


Figure 5. Growth measurement of mangrove.



Figure 6. Monitoring of growth and survival rates by the ambassadors.

goats and sheep while those at the SUML site were eaten by land crabs. *Cerriops* spp. are very susceptible to grazing even by land crabs due to their small and soft young leaves.

Each species showed different growth patterns and survival rates (Table 4 and Figures 7-9). Among the four species monitored in the Bay, *Rhizophora mucronata* showed the highest growth rates in fine sand (CVPC/ERMP site) compared to those in substrates dominated by coarse and medium sand (Figure 7). Differences of growth in *Cerriops decandra* in different substrates were also found (Figure 8).

The results of this study, support the observation that different species have different affinities to substrates (Calumpong, 1992). Additionally, from February to July, slower growth rates were obtained compared to those in August to October, which makes the effect of water stress evident.

*Bruguiera gymnorhiza* and *Rhizophora apiculata* (Figure 9) demonstrate different growth habits and patterns, most specifically with regard to substrate affinities (Table 5).

### Talabong Mangrove Park

Plans to convert the Talabong Mangrove Forest into a Mangrove Park materialized in the later part of 1992. The Department of Tourism approved and funded a 12- room hotel in Okiot and the City government constructed a ferry terminal in Hindungawan. Board walks were being constructed in Talabong. The next step is to put up labels and do enrichment plantings.

### SUMMARY AND RECOMMENDATIONS

A core group of Bais Bay residents (10 ambassadors) were trained in community organizing, information dissemination, mangrove refo technology and techniques in encouraging community participation. Also, teachers and students at the Central Visayas Polytechnic College (CVPC), Bais campus, were included in these trainings. This group represents a big potential that can be tapped to facilitate community-based mangrove management in Bais Bay.

Silliman University workers, together with the ambassadors, have identified the species suitable for reforestation in specific substrates as well as the available sources of propagules. They have looked at the germination performance, the growth rates of some of these species, and some problems associated with reforestation. With these information, reforestation efforts can now proceed at a more systematic pace.

**Table 1. Estimated area of mangrove plantation in North and South Bais Bay of CSC and Non-CSC holders.**

| CSC Holder     |                       |          |        |        |            |
|----------------|-----------------------|----------|--------|--------|------------|
| Location       | Area(m <sup>2</sup> ) | Species  | MPP    | MTS    | % Survival |
| A              | 3309.102              | Rm       | 850    | 203    | 23.9       |
| C              | 226                   | Rm       | 2060   | 120    | 5.8        |
| D              | 3030                  | Rm       | 600    | 20     | 33.3       |
| E              | 7920.486              | Rm       | 13670  | 6465   | 47.3       |
| H              | 102750                | Rm       | 126800 | 21400  | 16.9       |
| J              | 1097                  | Rm       | 335    | 91     | 27.2       |
| Subtotal       | 118332.59             | Rm       | 144315 | 28299  |            |
| Non-CSC Holder |                       |          |        |        |            |
| A              | 125                   | Rm       | 1150   | 15     | 1.3        |
| B              | 124                   | Rm       | 140    | 7      | 5.0        |
| C              | 102                   | Rm       | 130    | 67     | 51.5       |
| E              | 41                    | Rm       | 520    | 310    | 59.6       |
| F              | 7256                  | Rm;Bg;Cd | 22119  | 19480  | 88.1       |
| G              | 4900                  | Rm;Ra    | 24300  | 20320  | 83.6       |
| H              | 39225                 | Rm       | 48000  | 20450  | 42.6       |
| I              | 15675                 | Rm       | 12200  | 12050  | 98.7       |
| J              | 20                    | Rm;Ra    | 200    | 130    | 65         |
| Subtotal       | 67468                 |          | 108759 | 72829  |            |
| Overall total  | 185800.59             |          | 253074 | 101128 |            |

LEGEND: A=Okiot F=Batugan  
 B=Lag-it G=Opao  
 C=Cabiloy H=Dungguan  
 D=Canibol J=Campuyo  
 E=Sanlagaan I=Capiñahan

MPP=Mangrove propagules planted  
 MTS=Mangrove tree surviving  
 CSC=Certificate of Stewardship Contract

Species: Rm=*Rhizophora mucronata* Bg=*Bruguiera gymnorrhiza*  
 Ra=*Rhizophora apiculata* Cd=*Ceriops decandra*

Table 2. Percent germination rates in different substrates.

| Species               | Source  | Substrate   | Number | Date Germinated | %Survival |
|-----------------------|---------|-------------|--------|-----------------|-----------|
| <i>B. gymnorrhiza</i> | Bais    | sandy       | 515    | September 1992  | 40.30     |
| <i>C. decandra</i>    | Bais    | sandy/muddy | 250    | September 1992  | 44.00     |
| <i>C. decandra</i>    | Bais    | sandy/muddy | 100    | March 1992      | 0         |
| <i>B. gymnorrhiza</i> | Palawan | sandy       | 125    | June 1992       | 71.30     |
| <i>C. tagal</i>       | Palawan | sandy       | 100    | June 1992       | 0         |
| <i>B. gymnorrhiza</i> | Palawan | sandy       | -      | July 1993       | 83        |
| <i>C. tagal</i>       | Palawan | sandy       | -      | July 1993       | 70        |
| <i>A. marina</i>      | Bais    | muddy/sandy | 15     | September 1993  | * 0       |
| <i>C. decandra</i>    | Bais    | sandy/muddy | 475    | September 1993  | * 0       |
| <i>X. granatum</i>    | Bais    | sandy       | 10     | September 1993  | * 0       |

\*eaten by goats

Table 3. Summary of substrate analysis in different refo sites.

| Classification   | SITES         |              |              |
|------------------|---------------|--------------|--------------|
|                  | CVPC/ERMP     | CAPINAHAN    | SANLAGAN     |
|                  | % Composition | %Composition | %Composition |
| Very coarse sand | 12.71         | 16.94        | 24.21        |
| Coarse sand      | 20.40         | 21.34        | 23.03        |
| Medium sand      | 17.48         | 18.12        | 16.24        |
| Fine sand        | 28.78         | 21.64        | 19.45        |
| Very Fine sand   | 12.35         | 10.30        | 9.08         |
| Silt             | 8.27          | 11.68        | 8.03         |

Table 4. Summary of growth and percent survival of the refo species. (N=50)

| Site      | Species | Initial Growth(I <sub>0</sub> ) | Final Growth (I <sub>p</sub> ) | Growth (cm/mo) Rate | Survival |
|-----------|---------|---------------------------------|--------------------------------|---------------------|----------|
| CVPC/ERMP | Rm      | 28.57                           | 40.91                          | 50.82 ±1.21         | 76       |
| Capiñahan | Rm      | 3.72                            | 47.04                          | 29.62 ±5.62         | 73       |
|           | Cd      | 1.37                            | 8.41                           | 4.85 ±1.21          | 48       |
| Sanlagan  | Rm      | 3.72                            | 62.3                           | 31.19 ±3.37         | 52       |
|           | Ra      | 6.82                            | 29.53                          | 25.20 ±1.47         | 48       |
|           | Cd      | 0.38                            | 14.68                          | 7.08 ±1.09          | 52.5     |
| SUML      | Bg      | 5.71                            | 23.56                          | 29.58 ±2.38         | 76.92    |

Rm=*Rhizophora mucronata*Cd=*Ceriops decandra*Ra=*Rhizophora apiculata*Bg=*Bruguiera gymnorrhiza*

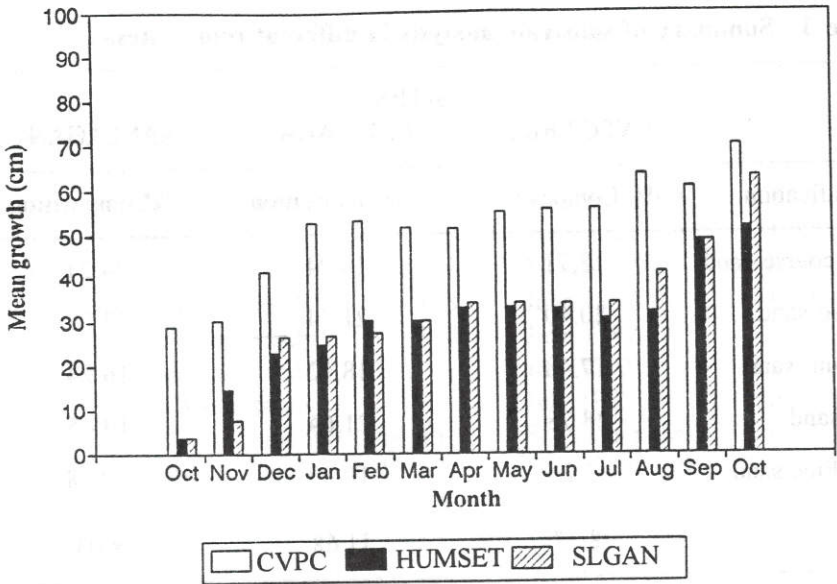


Figure 7. Monthly growth of *Rhizophora mucronata* in nursery and refo sites. Oklot (CVPC); Capiñahan (HumSet); Sanlagan (SLGAN) (N=50).

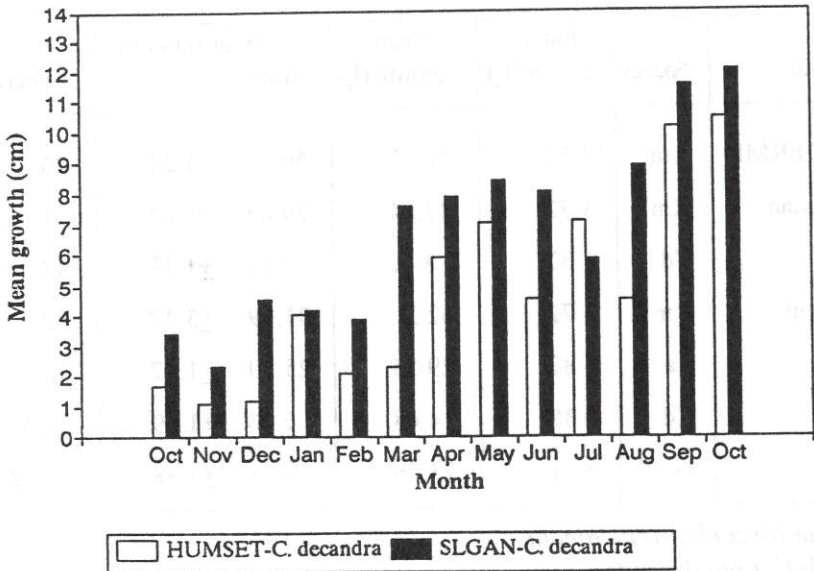


Figure 8. Monthly growth of *Ceriops decandra* in Capiñahan (HumSet) and Sanlagan (SLGAN). (N=10).

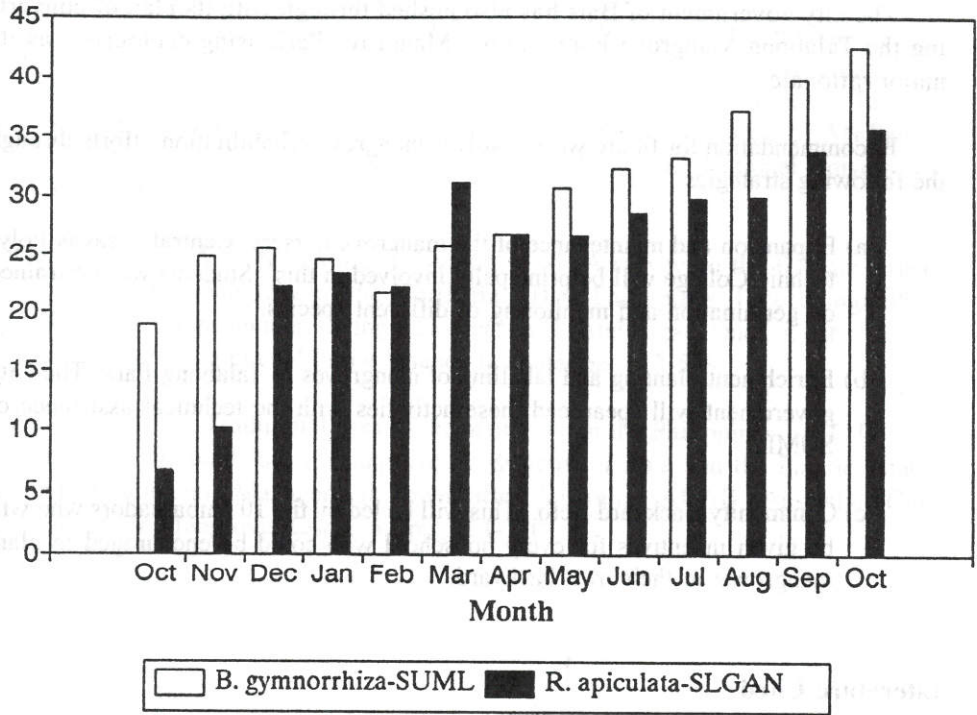


Figure 9. Monthly growth of *Rhizophora apiculata* and *Bruguiera gymnorrhiza* in Sanlagan (SLGAN) and SU-Marine Laboratory (SUML). (N=10).

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The city government of Bais has also pushed through with its plan of converting the Talabong Mangrove Forest into a Mangrove Park using ecotourism as its major rationale.

Recommendation for future work involves mangrove rehabilitation efforts through the following strategies:

- a) Expansion and maintenance of the mangrove nursery. Central Visayas Polytechnic College will be principally involved in this. Students will be trained on germination and monitoring of different species.
- b) Enrichment planting and labelling of mangroves in Talabong Park. The City government will spearhead these activities with the technical assistance of SUML.
- c) Community Backyard Refo. This will be led by the 10 ambassadors who will be given incentives for every household who could be encouraged to plant mangroves in their own backyard.

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