STOCK ASSESSMENT OF THE RABBITFISH, *SIGANUS CANALICULATUS* PARK

Julieta A. Luchavez and Bruna T. Abrenica
Silliman University Marine Laboratory
6200 Dumaguete City

INTRODUCTION

After the fish stock assessment training was conducted in the SU Marine Laboratory from October 11 to 16, 1993, an assessment to estimate growth and mortality parameters of "danggit" (*S. canaliculatus*) was made from the available length-frequency data (Figure 1) of sampled fish caught by fish corral from January to October 1992. The assessment was made only on "danggit," since this was the most exploited among the abundant species in Bais Bay (Figures 2A & B), being harvested by six fishing gears (Figure 3-A) and five fishing techniques (Figure 3-B) and as shown by the small sizes of fish caught and low catch per unit effort. Furthermore, the length frequency measurements of other fish species were monitored from fish samples harvested by different fishing gears and an analysis of this would not generate a good estimate of growth and mortality. Also because of the limited length-frequency data that have been monitored for only 10 months, other parameters like stock biomass and maximum sustainable yield (MSY) for *S. canaliculatus* cannot be estimated.

METHODS

The analysis of fish data was performed using FAO/ICLARM Stock Assessment Tools (FiSAT) program to generate growth parameters and mortalities (both natural and fishing) for *Siganus canaliculatus*.

RESULTS AND DISCUSSION

Growth

Figure 1 presents the length-frequency (L/F; cm, total length) data of *Siganus canaliculatus* collected from Bais Bay. The minimum recorded length (TL) is 5 cm and the maximum is 25 cm. Since the samples did not show modal progression and the linking of sample means was not possible, the Powell Wetherall Plot Method (1986) was used to get estimates of $L\infty$ (asymptotic length) and Z/K which yielded $L\infty$=26.661 cm and Z/K=3.481 (Figure 4). Further testing using ELEFAN 1 program generated a K value (growth constant) of K=0.29 for year 1. The K value of 0.29 for *Siganus* *canaliculatus* (Figure 5) is quite low--which may suggest that "danggit" is a slow-growing species. Studies by Carumbana and Luchavez (1979) revealed that the rate of 5-15 cm (SL) for *Siganus canaliculatus* reared in fish pen at Bais Bay was slow, about 0.5 mm (SL) per month for 3 months.

Mortality

Catch curve analysis (Figure 6) reveals the overall mortality of *Siganus canaliculatus*, Z = 1.53; natural mortality, M = 0.85 which maybe caused by natural death, predation and/or immigration and fishing mortality, F = 0.68 (for fish corral only). The overall exploitation rate is E = 0.44. This value of E = 0.44 which is almost 50 % rate for fish corral alone, is quite high, considering that there are six more fishing gears and five fishing techniques also used to exploit *S. canaliculatus* in Bais Bay (Figure 3-A & B). Figure 7 shows the probability of capture of *S. canaliculatus* in Bais Bay using fish corral, revealing that this species is usually caught at relatively small sizes, from 6 cm to 9 cm total length, with highest number caught for the latter. Samples at 17-20 cm (TL) length sizes are seldom caught. Virtual Population Analysis (VPA), the length-based approach, (Figure 8) shows the trend of catch, natural losses, survivors and fishing mortality of *S. canaliculatus*. It is evident in the graph that the highest fishing mortality occurs at 19 cm-- the approximate size for the gear analyzed (fish corral). Such heavy mortality may be explained by the small population size of the species at this particular length size. Some fishermen revealed that during spawning seasons these fish are heavily exploited because of their schooling behavior and their spawning grounds which are known by the fishermen. Earlier results showed that danggit reach spawning size at length sizes of 10 cm and above. Further estimates of catchable lengths show that at 25%, 50 %, 75 % probability of capture, the most vulnerable sizes are at 6.8, 7.5, 8.0 cm total length, respectively.

SUMMARY AND RECOMMENDATIONS

Using the Fish Stock Assessment Tools (FiSAT) program developed from ICLARM, an assessment of the growth and mortality parameters of *S. canaliculatus* was made. Results show that *S. canaliculatus* in Bais Bay grows to a maximum length of 26.661 cm; ($L\infty$ = 26.661 cm), however it grows very slowly (K = 0.29). Also, the total mortality Z = 1.53, natural mortality M = 0.85, and fishing mortality F = 0.68 with an overall exploitation E = 0.44 are quite high, considering that there are six more fishing gears and five fishing techniques used in harvesting this fish from Bais Bay. Sizes usually caught by fish corral range from 6-9 cm (TL) with heavy exploitation towards 9 cm (TL) size. Highest fishing was estimated to fall at 19 cm length size (TL) which may mean that there are very few fish left of this size, or there are only a small number of samples.

Based on the results, it is recommended that:

1. Growth overfishing (i.e. harvesting before fish reaches sexual maturity) of *S. canaliculatus* (danggit) be minimized by banning the use of less than 3-cm mesh-sized nets (measured between two separate knots of a full mesh when stretched) by sahid (beach seine), pukot (gill net), hulbot (modified Danish seine), tapsay (fish net), and screen of bunsod (fish corral). Presidential Decree 704 Sec. 34 & F.A.O. 155, Series of 1988, bans the use of nets with mesh sizes of less than 3 cm. Through their students, the Bais School of Fisheries could help to persuade the fishing community to stop the use of small mesh-sized nets. Two of this study's enumerators who are students of this school of fisheries can be potential instruments in persuading the fishermen. Otherwise, the city government is responsible for the execution of the ban through the "Bantay Dagat".

2. Recruit overfishing (i.e., harvesting before fish could spawn) of *S. canaliculatus* should be minimized by declaring a close fishing season for *Siganus canaliculatus* during its spawning season. Studies show that *S. canaliculatus* spawn from four to seven days after the new moon, around midnight (Bryan et al, 1975). Alcala and Alcazar (1979) reported that the spawning season of *S. canaliculatus* in Dumaguete as inferred from gonad indices occur during the months of February through September with peaks in March-April and July- August. Results of this study show that *S. canaliculatus* are reproductive during the months of January to July (Figure 9). The enumerators may be given the responsibility to discourage fishermen from harvesting gravid fish.

3. Since seagrasses are an important habitat not only of *Siganus canaliculatus* but also of other important species, this ecosystem should be protected. Alcala (1979) reported that both young and adult *S. canaliculatus* are found in seagrasses. (Figure 10) shows the seagrass areas of Bais Bay: around Diutay Island and Talabong Mangrove Forest, which are the fishing grounds for *S. canaliculatus*. Making the fishing community understand the importance of seagrass in Bais Bay is a joint responsibility of the CO worker of the Coastal Living Resources Project and the Central Visayas Polytechnic College (CVPC) School of Fisheries.

4. A continuous monitoring of the catch harvest of *Siganus canaliculatus* for at least three years to determine effectivity of these restrictions and most of all to determine the maximum sustainability yield of this species in the Bay, should be carried out by the ERMP enumerators under the supervision of the SUML.

Literature Cited

Alcala, A.C. 1979. Ecological notes on rabbitfishes (Family Siganidae) and certain economically important marine animals in Southeastern Negros and environs, Philippines. Silliman Journal 26: 117-133.

Alcala, A.C. and S.N. Alcazar. 1979. A study on gonad index, and fecundity in the rabbitfish, *Siganus canaliculatus* (Park), Silliman Journal 26: 135-147.

Bryan, P.G., B.B. Madraisan, and J.P. Mc-Vey, 1975. Hormone induced and natural spawning of captive *Siganus canaliculatus* (Pisces: Siganidae) year round. Micronesia 11: 199-204.

Carumbana, E.E. and J.A. Luchavez. 1979. A comparative study of the growth rates of *Siganus canaliculatus*, *S. spinus*, and *S. guttatus* reared under laboratory and seminatural conditions in Southern Negros Oriental, Philippines. Silliman Journal 26: 187-209.

De Leon, R.O.D., A.C. Alcala and R.J. Raymundo. 1991. Potential levels of primary production and community structure of the Talabong Mangrove Forest, Negros Oriental, Philippines. Proceedings of the Regional Symposium on Living Resources in Coastal Areas, Manila, Philippines: University of the Philippines. pp. 441-453.

Gayanilo, F.C. Jr., P. Sparre and D. Pauly, 1993. The FiSAT User's Guide. FAO Comput. Info. Series. ICLARM, DIFMAR. Rome, FAO-UN.

Proceedings of the ERMP-DAP Bais Bay Basin Workshop. 1991. Bais City, 1 August 1991.

Bais Bay Environment and Resource Management Project Marine Component: Terminal Report (Year I): 1992. Silliman University, Dumaguete City.

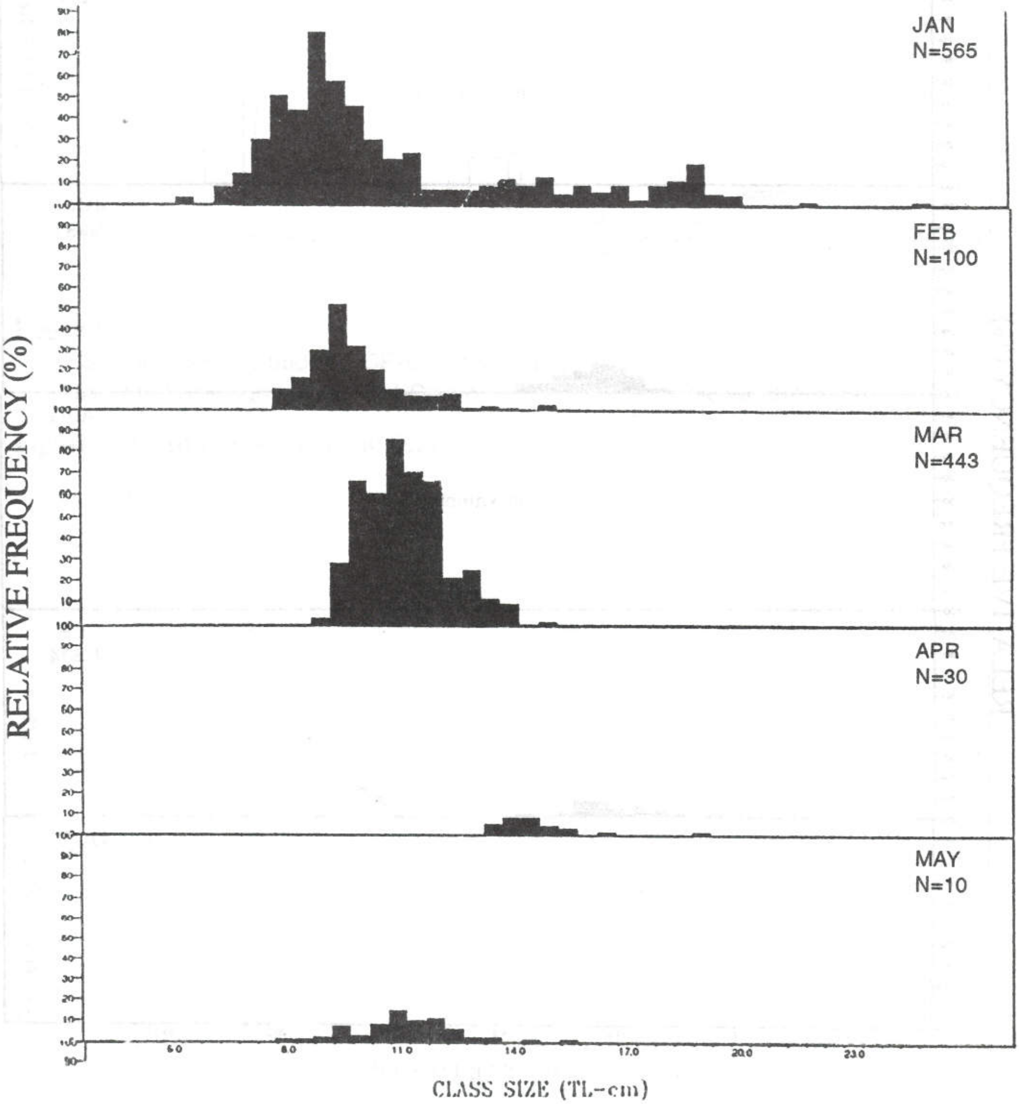


Figure 1. Length frequency of *Siganus canaliculatus* (danggit) collected using fish corral in Bais Bay from January to October 1992.

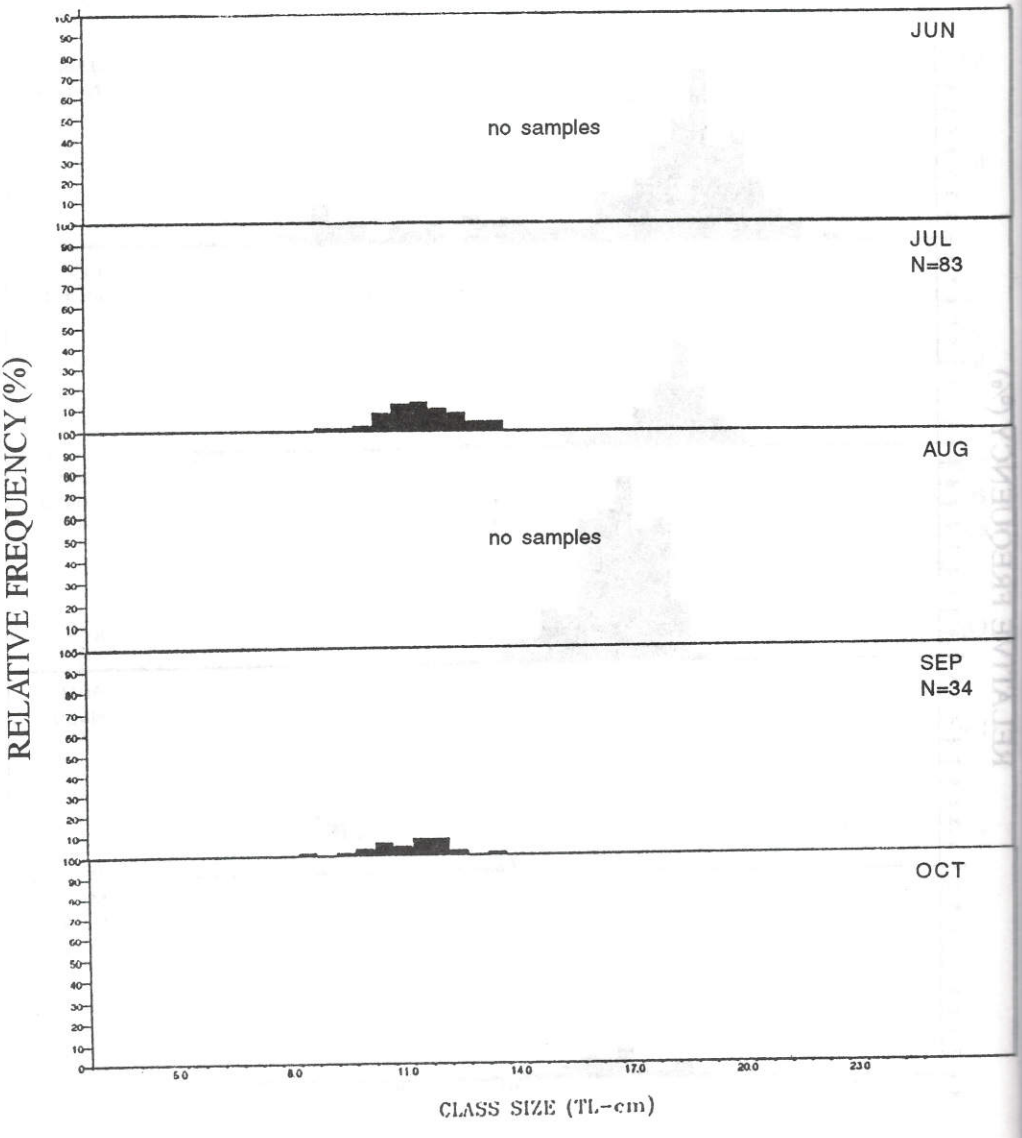
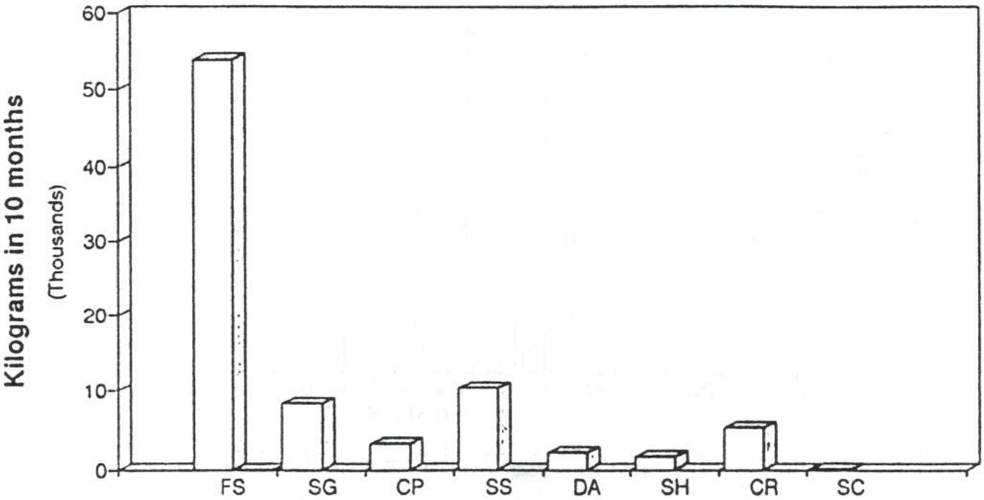


Figure 1. (Continued)



Legend:

FS-Fish; SG-Siganidae; CP-Cephalopods; SS-Seashells
DA-*Dolabella auricularia*; SH-Shrimps; CR-Crabs; SC-Sea cucumber

Figure 2-A. Important marine fisheries of Bais Bay.

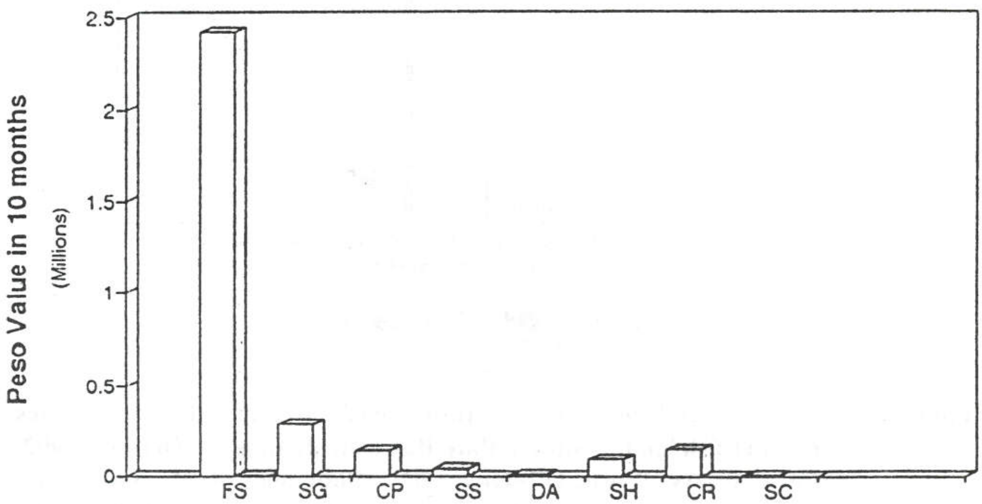


Figure 2-B. Peso values of important fisheries in Bais Bay.

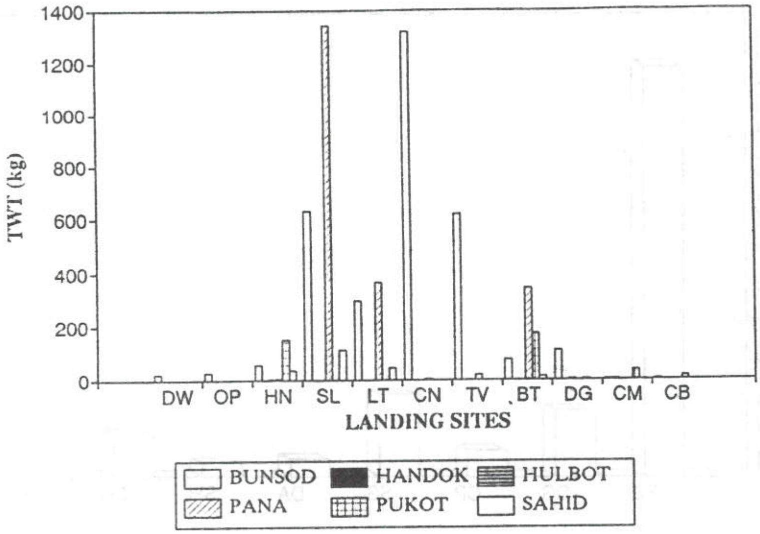


Figure 3-A. ***Siganus canaliculatus*** **harvest (kg) using 6 different types of fishing gears from 11 fish landing sites in Bais Bay from January to October 1992.**

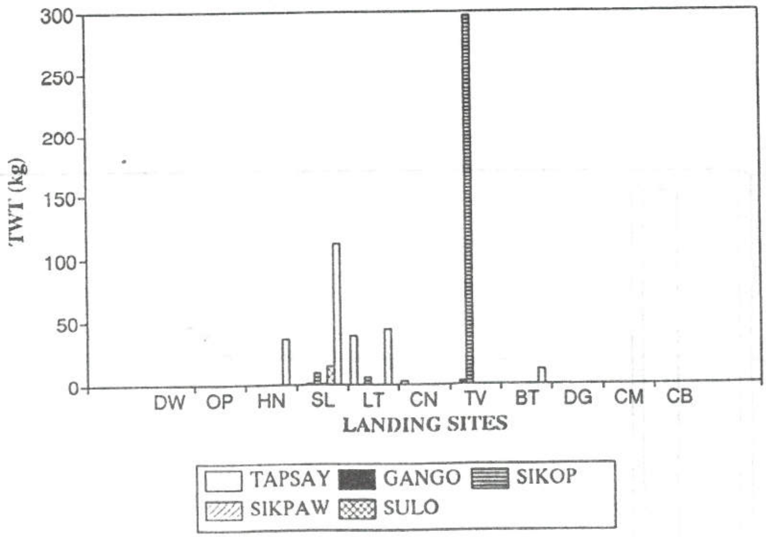
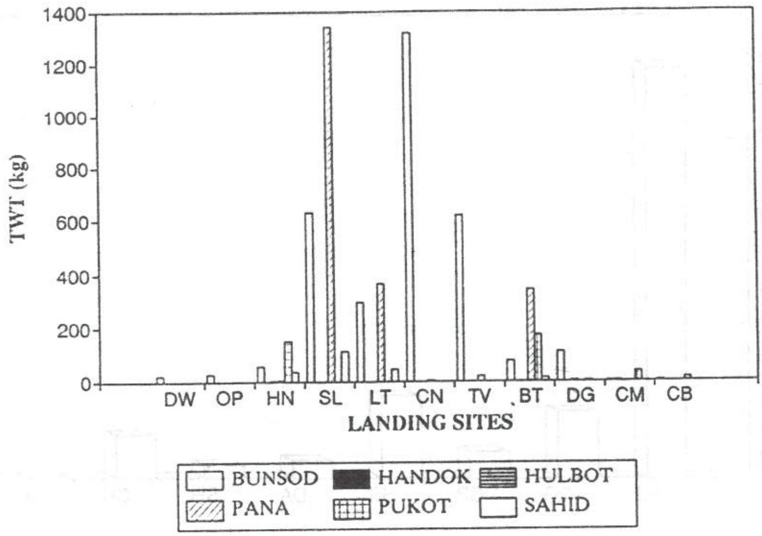


Figure 3-B. ***Siganus canaliculatus*** **harvest (kg) using 5 different fishing techniques from 11 fish landing sites in Bais Bay from January to October 1992. Legend: DW=Dawis, OP=Opao, HN=Hindungawan, SL=Sanlagan, LT=Lag-it, CN=Canibol, TV=Tavera, BT=Batugan, DG=Dunggu-an, CM=Campuyo, CB=Cabiloy.**



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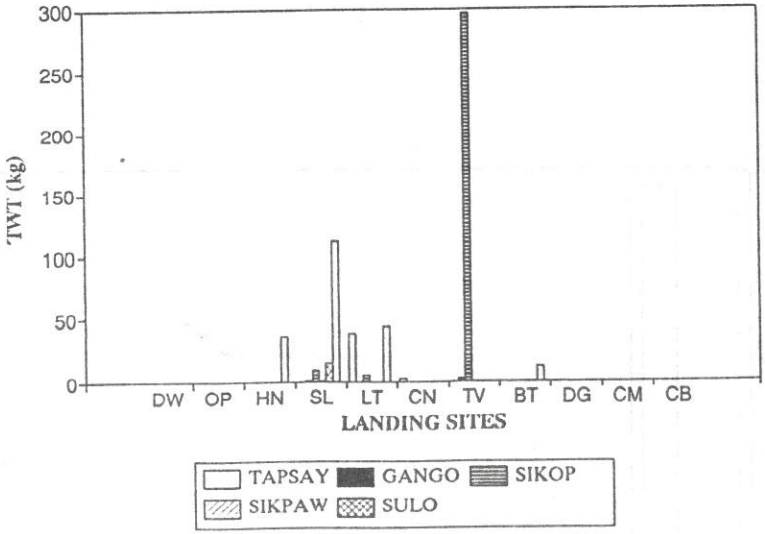

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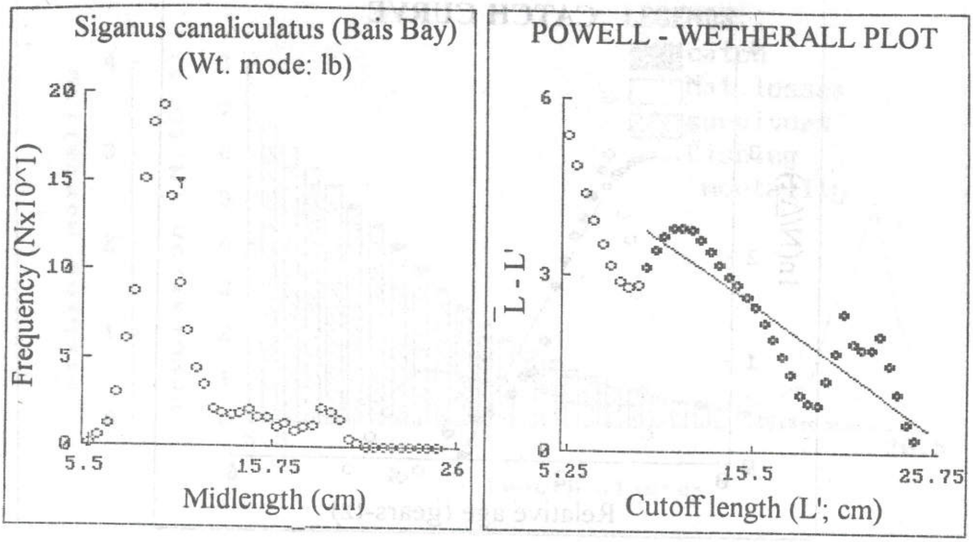

Figure 4. Wetherall method for estimating L ∞ and Z/K from length frequency data of *Siganus canaliculatus* harvested from Bais Bay, January to October 1992; the regression equation is Y=5.95 -0.223 x, (or = -0.800);i.e, L ∞ = 26.661 cm and Z/K = 3.481.

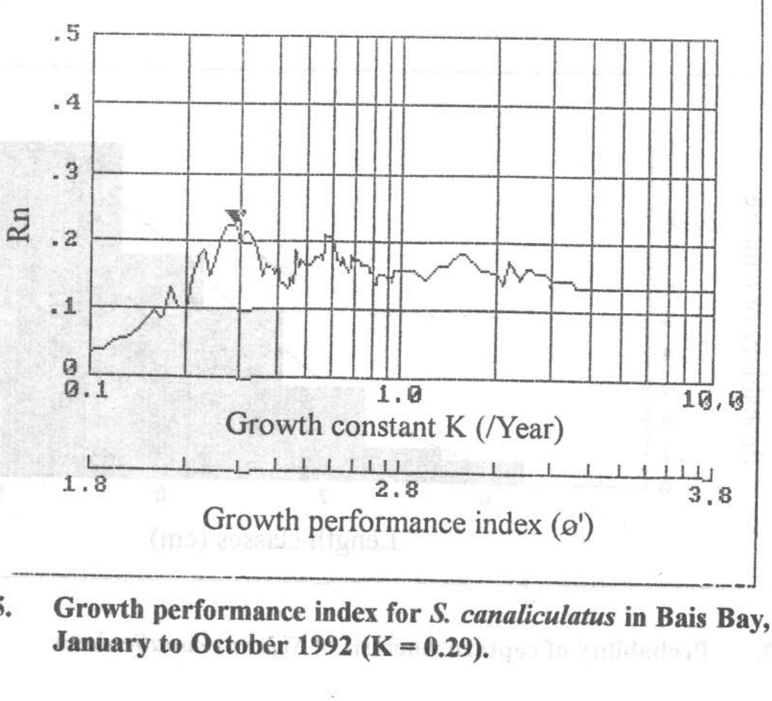

Figure 5. Growth performance index for *S. canaliculatus* in Bais Bay, January to October 1992 (K = 0.29).

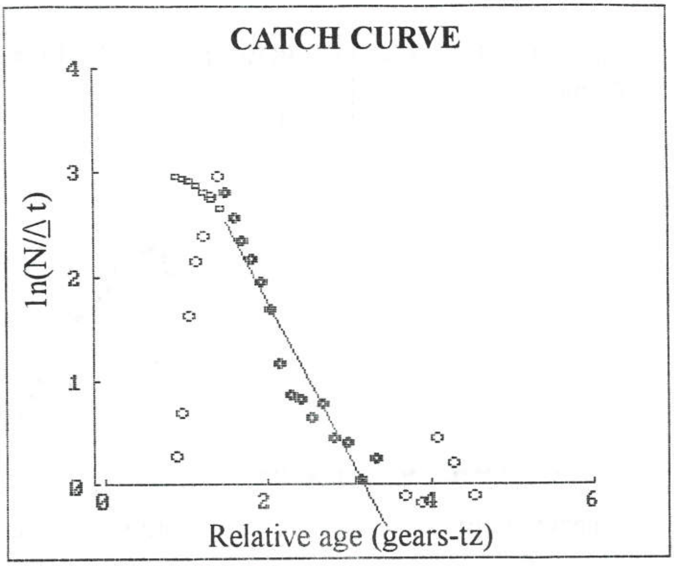

Figure 6. **Length-converted catch curve of *S. canaliculatus* in Bais Bay, January to October 1992 (Z = 1.53 year [1], M = 0.85, F. = 0.68, E = 0.44).**

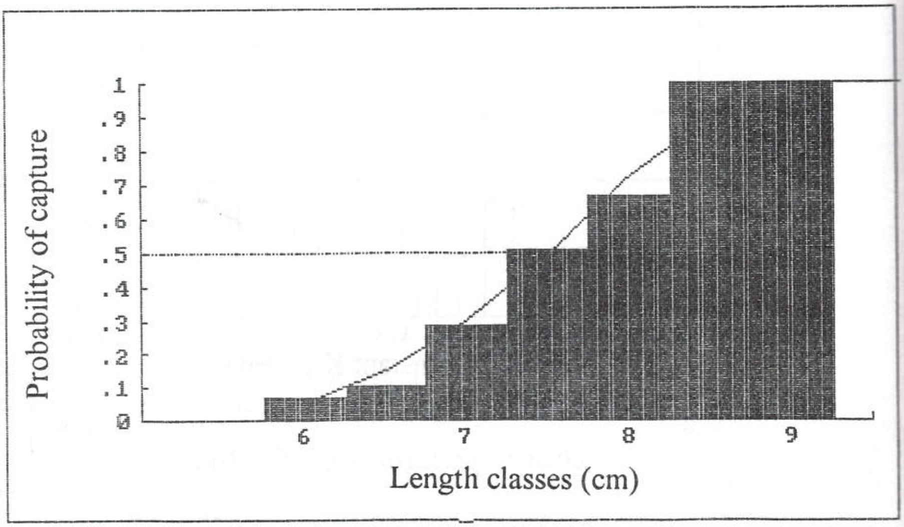

Figure 7. **Probability of capture Analysis of *Siganus canaliculatus***

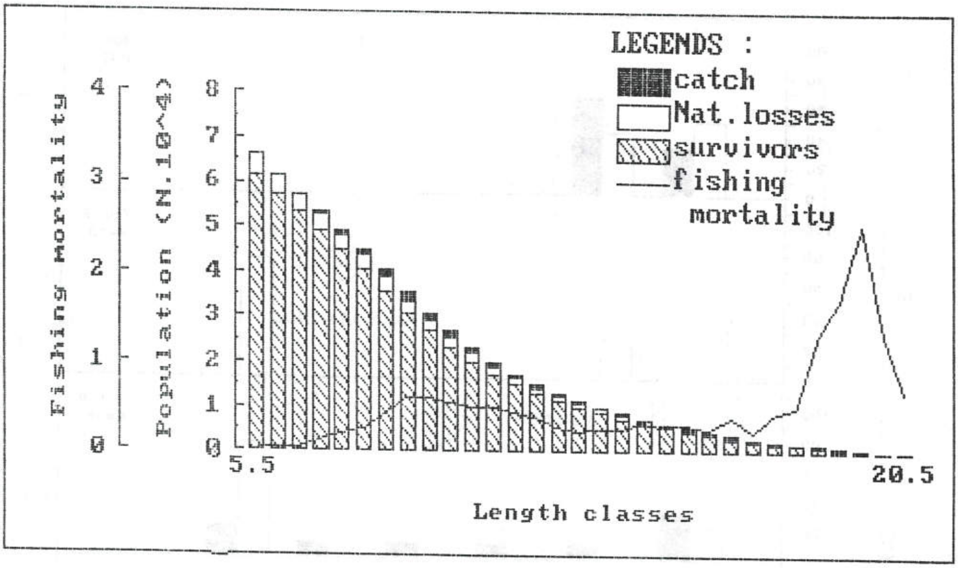

Figure 8. Length-structured Virtual Population Analysis of *S. canaliculatus* in Bais Bay, January - October 1992, showing trend of catch: L50 = 7.533.

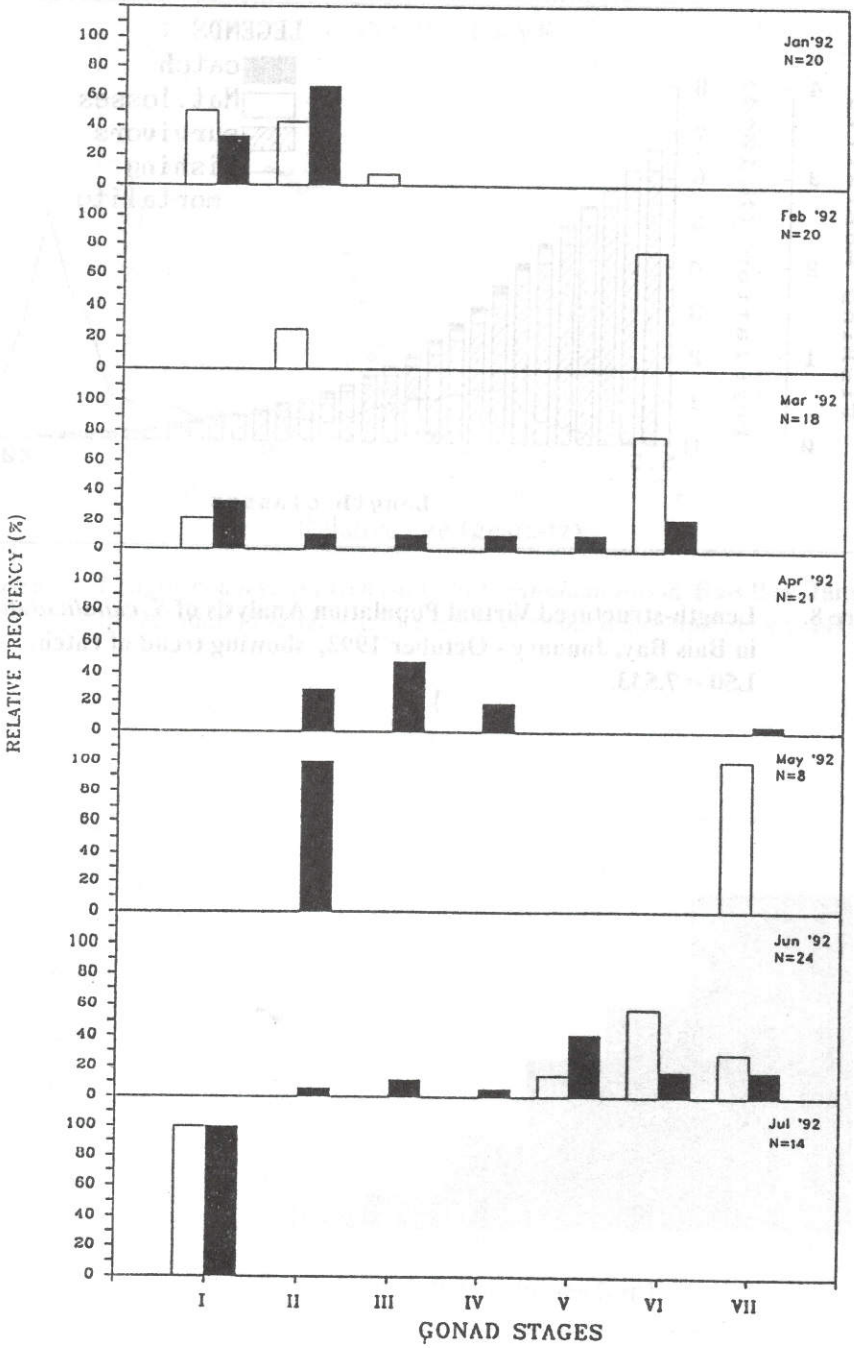

Figure 9. **Gonad stages of *Siganus canaliculatus.***

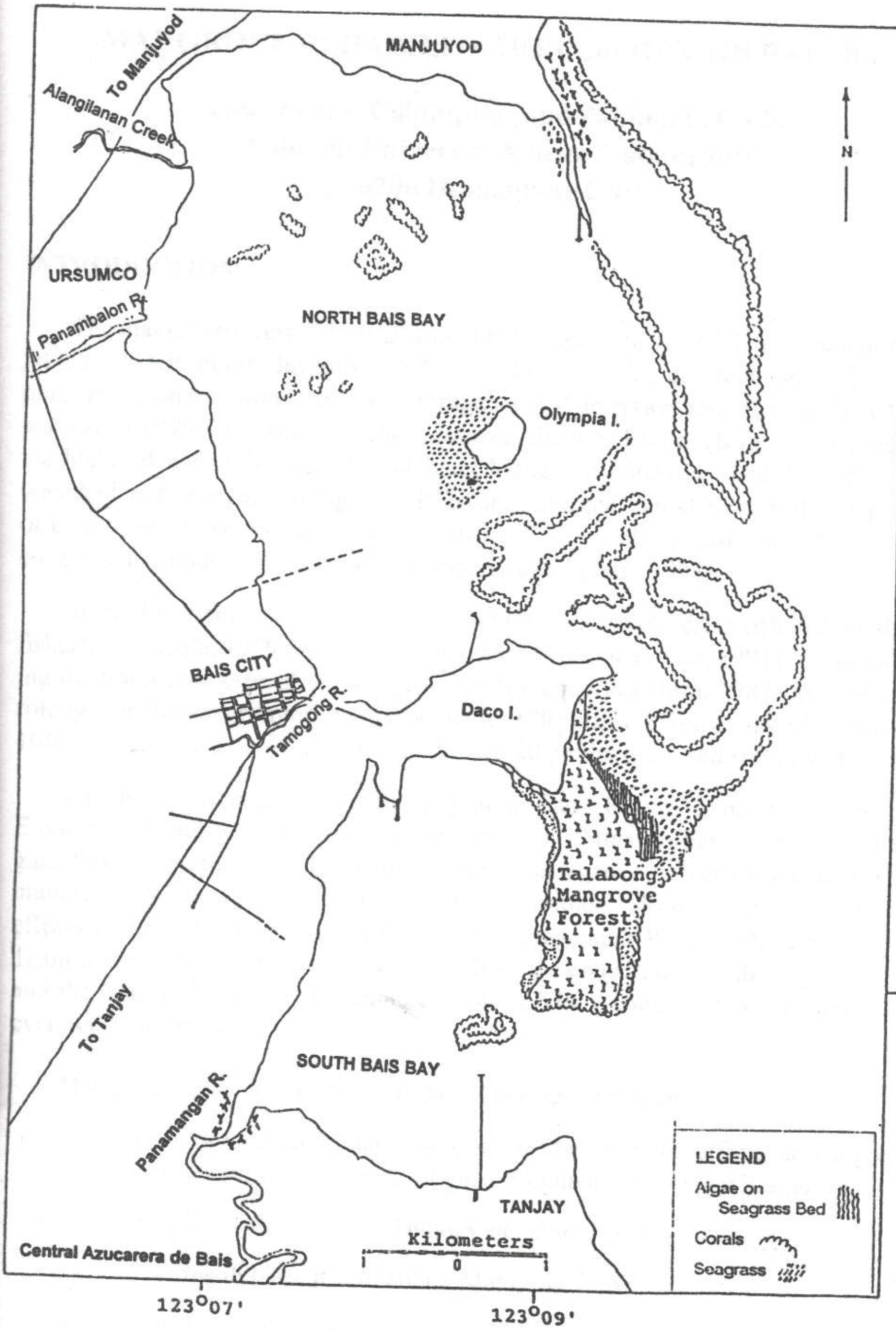

Figure 10. Map of Bais Bay showing the seagrass areas.

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.