A SURVEY OF THE MARINE FLORA AND FAUNA IN THE NORTHWESTERN COASTAL AREAS OF DINAGAT ISLAND, SURIGAO DEL NORTE

Arturo L. Abal, Jr. and Eva G. Abal**

INTRODUCTION

The seas and oceans have *always* been ideal sources of food and livelihood for man and perhaps may provide the resources for his ultimate survival. Organisms that are denizens of the seas include representatives of virtually all phyla and are remarkably varied.

Among the different zones of our seas, the intertidal areas are one of the most productive, yet most threatened portions. Although they are by far the smallest areas of all the world's oceans, existing as an extremely narrow fringe a few meters from the shore, they are the ones most utilized and exploited by coastal residents.

Majority of the commercial marine organisms are harvested from these natural grounds. Supply, therefore, is to some extent, dependent on the wild-stock. Thus, population of marine organisms normally fluctuates from year to year. However, the indiscriminate utilization and, sometimes, destruction of some marine organisms are generally ignored by the public and private sectors. The unregulated exploitation may deplete our marine resources and cause the extinction of some species. Regulatory measures, thence must necessarily be formulated.

Incidentally, in the Philippines, the Blue Revolution Program is an attempt to maximize resource utilization of Philippine waters through effective management, utilization and conservation . However, such measures require basic data on the relative conditions, biology and ecology of our marine resources. Information especially on the commercial species, the areas where these resources are found, and the methods of gathering them are also imperative.

The seas surrounding Dinagat Island, in Surigao del Norte, are considered to be among the more productive and rich sources of food and livelihood for many people. However, such areas are no exception to the increasing human exploitation and intervention such as pollution. Parallel to the utilization and exploitation of these resources is the increase of human population along the coastal areas. The state of marine resources or any change in its resources exploitation system usually affects the lives of these creatures. Hence, to determine the future impacts of such interventions, knowledge on the present status of the marine flora and fauna in an area is deemed necessary.

This study therefore aimed to determine quantitatively and qualitatively the existing flora and fauna in the intertidal areas of Dinagat Island, Surigao del Norte. Such survey will serve as a baseline study on which future studies to determine the degree of over-exploitation of this area may be based. Further-

*Department of Biological Sciences, MSU-IIT

more, surveys of the marine flora and fauna are necessary from time to time not only for the purpose of description and baseline information, but also for the future monitoring of the effects of traumatic influences such as pollution, storms, etc. on such organisms. So far, no extensive survey on the marine resources around the island has been reported.

All samplings were conducted on the intertidal areas of seven stations set up on the Northwestern coastline of Dinagat Island. Due to the prevalence of strong waves in the eastern side, which faces the Pacific Ocean, no sampling was conducted here. Sampling was carried out for a period of 17 days only (May 16-June 1, 1987), thus no temporal or seasonal distribution of marine organisms was investigated.

MATERIALS AND METHODS

General Description of the Study Area and Sampling Stations

Dinagat Island is situated north of Surigao City (125.6^0 N and 10^0 E). It is accessible by an approximately 5-hour ride on a ferry boat from the city. It has several municipalities, including San Jose, Libjô and Loreto. Its eastern coastal area extends approximately 200 km while the western coastal areas extend about 150 km. To the west of Dinagat Island is Bohol Sea and to the east is the Pacific Ocean. Due to the prevalence of strong waves and winds on the eastern side, most of the residents are concentrated on the western coastal areas.

A total of seven sampling stations were set-up along the western coastal area (Fig. 1). The choice of such sampling areas was based on the accessibility, safety and the availability of shelter for the researchers and their equipment.. The stations were as follows:

Station 1 - located in the intertidal area of Santiago, Loreto, about 1 km from the town proper.
Station 2 - a coral reef flat in front of the town proper, but separated from the intertidal area of Santiago by a deep channel.
Station 3 - located in the intertidal area of Esperanza, a town north of Loreto proper.
Station 4 - located in the intertidal area north pf Libjô proper which lies in proximity to a mangrove area and with only very few residents in the coastal area.
Station 5 - located in the proximity of the Libjô pier.
Station 6 - located in the intertidal area south of Libjô proper which is most often used by ferry boats and pumpboats as a shelter area from strong winds and rough waves.
Station 7 - located in a narrow intertidal area fronting a big white cave with no residents in the area.

This study was conducted for a period of 20 days (May 16-June 1, 1987) inclusive of travel and preparation.

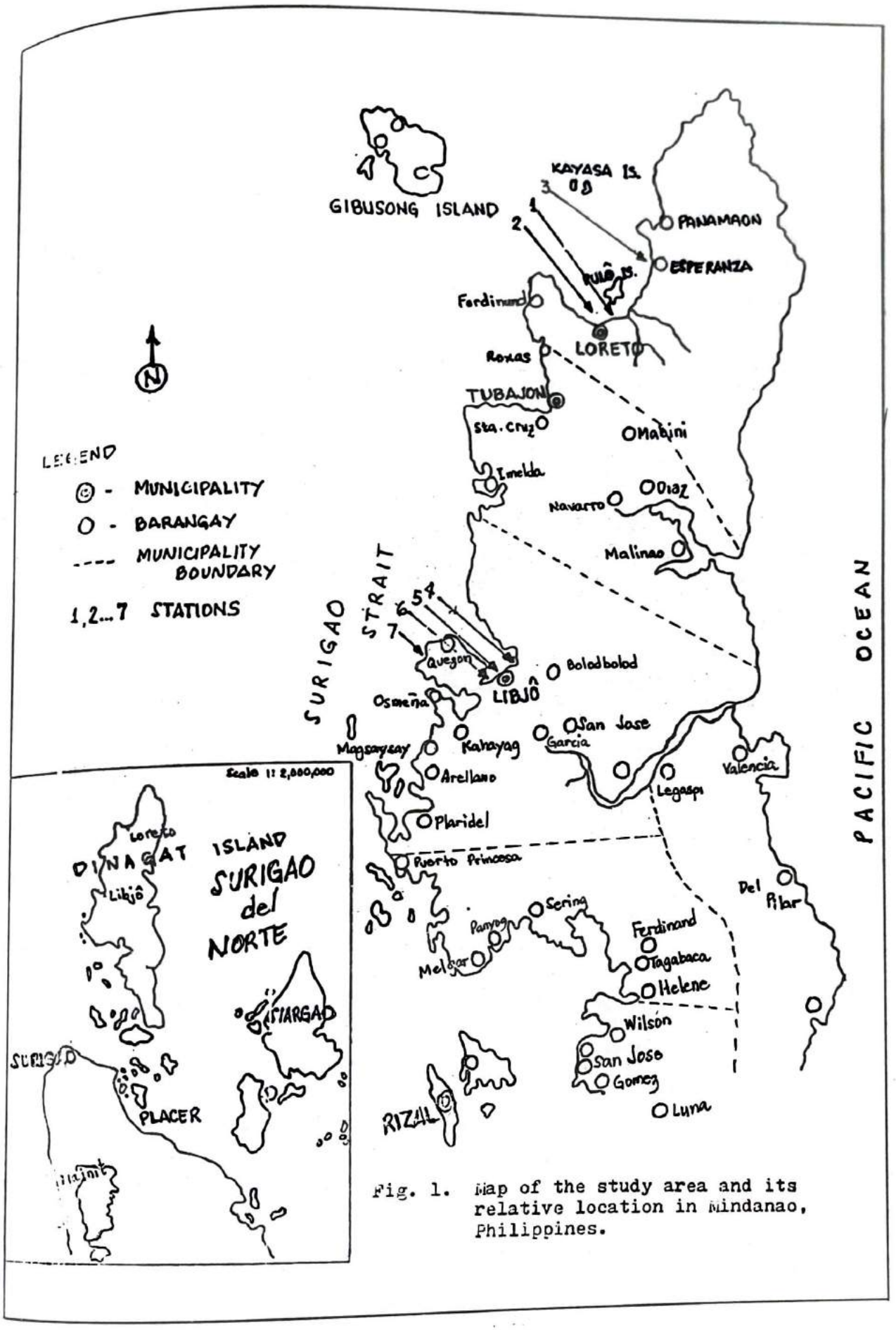

Fig. 1. Map of the study area and its relative location in Mindanao, Philippines.

Actual Survey

Transect-quadrat and random sampling methods were employed in the study. Utilized species were identified. The nature and extent of their utilization as well as their relative importance as resources to the people in the area were investigated through casual interviews and observations.

Marine benthic faura flora. In each station, a transect line was laid perpendicular to the shoreline. Sampling was done using a 0.5 m x 0.5 m quadrat laid at intervals of 10 m along the transect line. The frequency and coverage of each species was measured in each quadrat using the system of Saito and Atobe (1976).

The occurrence of each species was noted in each of the grids (sample areas) of the quadrat. This, when expressed in percentage, is also otherwise referred to as the frequency of each species.

In recording the algal coverage, the following numbers to indicate the degree of cover were used:

5 - covering 1/2 - 1 of the substratum surface
4 - covering 1/4 - 1/2 of the substratum surface
3 - covering 1/8 - 1/4 of the sustratum surface
2 - covering 1/16 - 1/8 of the substratum surface
1 - covering less than 1/16 of the substratum surface
+ - cover negligible

In the laboratory, the indices (5,4,3,2,1,+) of algal coverage were sustituted with the median value of percentage as follows:

5 = 75%
4 = 37.5%
3 = 18.75%
2 = 9.375%
1 = 4.6875%
+ = not considered

The Shannon-Weiner index of diversity was computed for each station based on the results of the coverage using the formula:

$$H = -\sum_{i=1} (pi)\ (\log_2 pi)$$

where: H = Shannon-Weiner index of diversity (bits)
pi = proportion of total sample belonging to the ith species to the total number of species

Species dominance was computed using the formula:

$$S.D. = \frac{Am}{\sum Am}$$

where: Am = average coverage value of each species
$\sum Am$ = total coverage value of all species in each station

Samples of the different species were collected with the aid of digging tools and placed in plastic bags. They were brought to the field laboratory where the delicate forms were immediately pressed on herbarium sheets and the hardy ones were air-dried.

Corals. For each station, a transect line perpendicular to the shoreline was set up. The different zones along each line was determined. In the coral reef area, relative coral condition was determined using the scale of Aliño et al. (1981) as follows:

0 - 24% = poor relative coral condition
25 - 49% = fair relative coral condition
50 - 74% = good relative coral condition
75 - 100% = excellent relative coral condition
where: Relative Coral Condition = % Hard Corals + % Soft Corals

Samples were obtained randomly by cutting parts of a coral colony with a pick hammer for identification purposes. Samples were boiled to kill and soften the living organisms inside the exoskeletons. After boiling, the samples were washed with a strong jet of water to remove the dead organisms. These were then sun-dried for one week to eliminate any disagreeable odor.

Identification was based on the morphology of the total external skeleton, employing the taxonomic keys of Montecillo (1976) and Nemenzo (1986).

Other invertebrates. Random collection of shells, crustaceans and echinoderms was undertaken. All samples were placed in large pails/containers holding 10% buffered formalin and brought to the MSU-IIT museum Laboratory room. Some mollusks were not preserved, however, to insure the rapid decay of the living organisms, thereby facilitating the cleaning of the shells without any alteration of their colors. These shells were then soaked in ordinary tap water which was changed weekly for at least 2 months. They were then cleaned of sticking particles and dead seaweeds, after which they were coated with oil to preserve their natural colors. All other invertebrates were placed in properly-labelled jars with 95% alcohol.

Fishes. The underwater visual census techniques (Russel et al., 1978) was employed in the survey of fish species. Results were also obtained from the fish catch of local residents and from a fish broker who bought fish from the different fishermen in the area for transport to Surigao City. Fish species were identified as to their families by only using the keys of Rau and Rau (1981) and Wheeler (1975).

RESULTS AND DISCUSSIONS

The seas surrounding Dinagat Island, Surigao del Norte, continue to be one of those which support fsirly-rich marine ecosystems. Distribution of marine flora and fauna are more often affected by natural factors (substratum available, fluctuations in physico-chemical factors and incidence of storms which might alter bottom topography, etc.) and the direct utilization by the residents. This utilization by the residents plays a specially important role in affecting the fish population in the area.

The following results present an inventory and baseline information on the marine flora and fauna in the seven stations set up along the coastline of Dinagat

Island. Due to time constraint, these stations may not insure representativeness. However, they may be used as basis and sampling points for future monitoring of the effects of utilization on the marine resources.

Macrobenthic Plants

A total of 24 algal species belonging to three major divisions (Division Chlorophyta, Division Phaeophyta and Division Rhodophyta) and four species of seagrasses (Division Anthophyta)were recorded in the study area from May 16 to 30, 1987. This number of species is much lower than those obtained by Domantay (1961), Menez (1961), Reyes (1970), Liao and Sotto (1980), Menez and Calumpong (1981), Tiin et al, (1981) and Apao and Camarao (1983) from other areas in the country. This is because sampling was less extensive. Sampling period of the different marine plants, together with the marine animals, was only for 15 days for the whole study area. No temporal and seasonal distribution of the macrobenthic plants were obtained.

Tables 1 and 2 show the relative frequency of the different species in the different stations set up. A total of 20 species were recorded for the different stations set up in Loreto, while 21 species were observed from the different stations set up in Libjô, Dinagat Island.

Tables 3 and 4 further show the percentage coverage of the different macrophytes in the study area. These data were used for the computation of species dominance and species diversity.

The average frequencies of the different species in the various stations are shown in Table 5. *Amphiroa fragilissima*, *Amansia glomerata* and *Hypnea musciformis* (all members of Division Rhodophyta), were the most frequently recorded species in Station 1. The seagrass, *Halodule uninervis*, was the most frequent species in Stations 2 and 4. This may be explained by the generally muddy substrates of the two stations. *Sargassum* spp., a brown algae, was the most frequently recorded species in Station 3. Station 3 had sandy to sandy-rocky types of substrates thereby favoring the occurrence of this algae.

Table 1. Frequency of the macrobenthic flora in the sampling stations setup in Loreto, Surigao del Norte.

TAXA	FREQUENCY (%)																	
	Station 1					Station 2							Station 3					
	T1	T2	T3	T4	Ave	T1	T2	T3	T4	T5	T6	Ave.	T1	T2	T3	T4	T5	Ave
DIVISION CHLOROPHYTA																		
Bornitella nitida									4			.67						
Caulerpa racemosa											16	2.67						
Dictyosphaeria cavernosa										12		2.00						
Enteromorpha intestinales													20	20				8.00
Halimeda opuntia									16			2.67						
Ulva reticulata	20				5.00	40	25			52		19.50		30				4.00
DIVISION PHAEOPHYTA																		
Dictyota dichotoma									32			5.33				4		0.80
Padina sp.							8					1.33			12			2.40
Sargassum spp.		4			1.00				4	56		10.00				4	48	10.40
Turbinaria ornata			24	16	10.00						8	1.33						
DIVISION RHODOPHYTA																		
Amphiroa fragilissima	16	92	16	36	32.00					32		22.00				32	12	8.80
amansia glomerata			68	60	32.00											12		2.40
Chondrococcus sp.			12		3.00													
Galaxaura oblongata		4			1.00					4		0.67						
Gracilaria coronopifolia											48	8.00				32	12	8.80
Hyphea musciformis			68	60	32.00													
Laurencia papillosa	16				4.00													
DIVISION ANTHOPHYTA																		
Halodule pinifolia								12	40			8.67						
Halodula uninervis							96	92	100			48.00		32				6.40
Thalassia hemprichii														32				6.40

Table 2. Frequency of the macrobenthic flora in the sampling stations set up in Libjô (Albur), Surigao del Norte.

TAXA	FREQUENCY (%)																	
	Station 4						Station 5					Station 6			Station 7			
	T1	T2	T3	T4	T5	Ave	T1	T2	T3	T4	Ave	T1	T2	Ave	T1	T2	T3	T4	Ave
DIVISION CHLOROPHYTA																			
Bornitella nitida	20	4				4.8	9	4			2.0				8	40	40	100	47.0
Bornitella sphaerica	20					4.0													
Caulerpa serrulata								4			1.0								
Halicoryne wrightii							4				1.0	36		18.0					
Halimeda opuntia		4	4	4		2.4				20	5.0	4		2.0		4	4	4	3.0
Neomeris van-bossae		4				0.8													
Ulva reticulata							40				10.0				4				1.0
DIVISION PHAEOPHYTA																			
Dictyota dichotoma		44	12	8		12.8				100	25.0		20	10.0					
Hydroclathrus clathratus		4				0.8													

Lobophora sp.														4	4	4	3.0	
Padina sp.					44	24		17.00	48		24.0							
Sargassum spp.	8	24	20	10.4		16	4	5.00				56	28	28	28	35.0		
Turbinaria ornata		8		1.6			20	5.00										
DIVISION RHODOPHYTA																		
Amphiroa fragilissima						80	80	40.0	36	20	28.0	16	12	12	12	13.0		
Galaxaura oblongata													8	8	8	6.0		
Gelidiella acerosa	4			0.8								28	4	4	4	10.0		
Gracilaria coronopifolia		12		2.4		40	96	34.0										
DIVISION ANTHOPHYTA																		
Enhalus acoroides	20	44		12.8		8		2.0										
Halodule pinifolia	92	80		34.4														
Halodulle uninervis	100	80		36.0														
Thalassia hemprichii		80		16.0		16	96	28.0										

Table 3. Coverage of the macrobenthic flora in the sampling stations set up in Loreto, Surigao del Norte.

	Cover (%)																	
	Station 1					Station 2							Station 3					
	T1	T2	T3	T4	Ave	T1	T2	T3	T4	T5	T6	Ave	T1	T2	T3	T4	T5	Ave
DIVISION CHLOROPHYTA																		
Bernitella nitida									4.7			0.78						
Gaulerpa racemosa											9.4	1.57						
Dictyosphaeria cavernosa										9.4		1.57						
Enteromorpha intestinales													37.5	37.5				15.0
Halimeda opuntia									4.7			0.78						
Ulva reticulata	9.4				2.35	4.7				18.8		4.70		37.5				7.5
DIVISION PHAEOPHYTA																		
Dictyota dichotoma									9.4			1.57				4.7		0.94
Padini sp.						4.7								9.4				
Sargassum spp.		4.7			1.18				4.7	18.8		3.92				4.7	37.5	8.44
Turbinaria ornata			9.4	9.4	4.7					9.4		1.7						

DIVISION RHODOPHYTA																		
Amphiroa fragilissima	4.7	37.5	9.4	18.8	17.6				4.7	75.0	13.28			37.5	9.4	9.38		
Amansia glomerata		75.0	37.5	28.13														
Chondrococcus sp.		4.7		1.18														
Galaxaura oblongata	4.7			1.18					4.7		0.78							
Hyphea musciformis		75.0	37.5	28.13						4.7	0.78			37.5	9.4	9.38		
Laurencia papillosa	9.4			2.35														
DIVISION ANTHOPHYTA																		
Halodule pinifolia						4.7	4.7				1.57							
Halodule uninervis						37.5	37.5	75.0			21.88	37.5				7.5		
Thalassia hemprichii												37.5				7.5		

Table 4. Coverage of the macrobenthic flora in the sampling stations set up in Libjo (Albur), Surigao del Norte.

	COVER (%)																
	Station 4						Station 5					Station 6			Station 7				
	T1	T2	T3	T4	T5	Ave.	T1	T2	T3	T4	Ave.	T1	T2	Ave	T1	T2	T3	T4	Ave.
DIVISION CHLOROPHYTA																			
Bornitella nitida	4.7	4.7				1.88	4.7	4.7			2.35				4.7	9.4	9.4	10.8	10.58
Bornitella sphaerica	4.7					0.94													
Caulerpa serrulata								4.7			1.18								
Halicoryne wrightii							4.7				1.18	9.4		4.7					
Halimeda opuntia		4.7	4.7	4.7		2.35				4.7	1.18	4.7		2.35		4.7	4.7	4.7	3.53
Neomeris van-bossae		4.7				0.94													
Ulva reticulata							18.8				4.70				4.7				1.18
DIVISION PHAETOPHYTA																			
Dictyota dichotoma		9.4	4.7	4.7		3.76				75.0	18.75		9.4	4.7					
Hydroclathrus clathratus		4.7				0.94													

Lobophora sp.				18.8	9.4		7.05	18.8		9.4		4.7	4.7	4.7	3.53
Padina sp.						4.7	3.53								
Sargassum spp.	4.7	9.4	9.4	4.7	9.4	9.4	2.35				37.5	18.8	18.8	18.8	23.48
Turbinaria ornata		4.7					11.72	9.4	9.4	9.4	9.4				
DIVISION RHODOPHYTA															
Amphiroa fragilissima						9.4	37.5	11.73	9.4	9.4	9.4	9.4	4.7	4.7	4.7	5.88
Galaxaura oblongata												9.4	9.4	9.4	7.05
Gelidiella acerosa	4.7		0.94												
Gracilaria coronopifolia		9.4	1.88	18.8	37.5		14.08				18.8	4.7	4.7	4.7	8.23
DIVISION ANTHPHYTA															
Enhalus acoroides	9.4	37.5	9.38	4.7			1.18								
Halodule pinifolia	37.5	4.7	8.44												
Halodule uninervis	37.5	4.7	9.38												
Thalassia hemprichii	37.5		7.5	9.4		37.5	11.73								

Table 5. Average frequency values of the macrobenthic flora recorded in the different sampling stations.

TAXA	Average Frequency (%)						
	St. 1	St. 2	St. 3	St. 4	St. 5	St. 6	St. 7
DIVISION CHLOROPHYTA							
Bornitella nitida		0.67		4.8	2.0		47.0
Bornitella sphaerica		2.67		4.0	1.0		
Caulerpa racemosa					1.18		
Caulerpa serrulata		2.0					
Dictyosphaeria cavernosa			8.0				
Enteromorpha intestinales					1.0	18.0	
Halicoryne wrightii		2.67	8.0	2.4	5.0	2.0	3.0
Halimeda opuntia				0.8			
Neomeris van-bossae	5.0	19.5	4.0		10.0		1.0
Ulva reticulata							
DIVISION PHAETOPHYTA							
Dictyota dichotoma		5.3	0.8	12.8	25.0	10.0	
Hydroclathrus clathratus				0.8			3.0
Lobophora sp.		1.3	2.4		17.0	24.0	
Padina sp.	1.0	1.0	10.4	10.4	5.0		35.0
Sargassum spp.	10.0	1.3		1.6	5.0		
Turbinaria ornata							
DIVISION RHODOPHYTA							
Amphiroa fragilissima	32.0	28.0	8.8		40.0	28.0	13.0
Amansia glomerata	32.0						
Chondrococcus sp.	3.0						
Galaxaura oblongata	1.0	0.67					6.0
Gelidiella acerasa				1.8			
Gracilaria coronopifolia		8.0	8.8	2.4	34.0		3.0
Hypnea musciformis	32.0						
Laurencia papillosa	4.0						
DIVISION ANTHOPHYTA							
Enhalus acoroides				12.8	2.0		
Halodule pinifolia		8.67		34.4			
Halodule uninervis		48.0	6.4	36.0			
Thalassia hemprichii			6.4	16.0	25.0		

Amphiroa fragilissima was most frequent in Stations 5 and 6, most often attached to rocks and big boulders, especially in the case of Station 5, which was situated in the proximity of the pier area of Libjô,

The green alga, **Bornitella nitida** had the greatest frequency in Station 6, most often attached to dead corals.

Table 6 shows the percent coverage of the macrobenthic algae in the different stations. Among the macrophytes with the greatest percentage coverage were *Amansia glomerata* and *Hypnea musciformis* for Station 1, *Halodule uninervis* for Station 2, *Halicoryne wrightii* for Station 3, *Enhalus acoroides* and *halodule uninervis* for Station 4, *Dictyota dichotoma* for Station 5, *Padina sp.* and *Amphiroa fragilissima* for Station 6 and *Sargassum spp.* for Station 7.

It is worth noting that these results showed that a frequently found species need not necessarily have the greatest coverage in a certain station. Thus, a species may occur often and yet may have a small coverage or vice-versa.

Abundance and frequency of certain species of macrophytes may thus be affected by several factors. According to Nybakken (1982) such factors may be divided into physical factors, which include bottom topography or substrate types, physico-chemical quality of the water, availability of light, tide exposure (desiccation) and biological factors such as competition for space availability and consumer grazing. Seasonality of some species may also affect the distribution and existence of the different species at a certain time. Charters et al. (1969) further stated that strong waves and currents may also result in the uprooting of some erectly growing thalli and some loosely attached forms. In the study area, algae were more limited or affected by the substratum type.

Factors which affected the distribution of algae may also have affected the distribution of seagrasses. Seagrasses usually thrive well in unconsolidated muddy-sandy substrates (Philipps, 1978). This once more explains the dominance of *Halodule uninervis* in Stations 2 and 4, both in terms of frequency and abundance. In Station 4, another seagrass, *Enhalus acoroides*, had a great coverage. The structural make-up of seagrasses usually restricts them to the relatively shallow portions of the intertidal belt. The lacunae of seagrasses could accumulate certain concentrations of gases (e.g. CO_2 and O_2), and thus could prevent them from growing at greater depths and at higher pressures. In contrast, macroscopic algae lack internal gas spaces and are therefore unaffected by pressure and depth.

Table 7 shows the species diversities of the different stations in terms of macrophyte coverage. Species diversity indices range from 2.28 - 3.13 bits. These values, in spite of the not so extensive sampling, were comparatively higher than those obtained in other areas, e.g. Yap et al. (1986).

Table 6. Average percentage coverage of the macrobenthic flora recorded in the different stations

TAXA	Coverage (%)						
	St. 1	St. 2	St. 3	St. 4	St. 5	St. 6	St. 7
DIVISION CHLOROPHYTA							
Bornitella nitida		2.35		1.88	2.35		10.58
Bornitella sphaerica				0.94			
Caulerpa racemosa		0.78			1.18		
Caulerpa serrulata		1.57					
Dictyosphaeria cavernosa			15.00				
Enteromorpha intestinales					1.18	4.70	
Halicoryne wrigtii		0.78		2.35	1.18	2.35	3.53
Halimeda opuntia				0.94			
Neomeris van-bossae	2.35	4.70	4.70		4.70		1.18
Ulva reticulata							
DIVISION PHAEOPHYTA							
Dictyota dichotoma		1.57	0.94	3.76	18.75	4.70	
Hydroclathrus clathrus				0.94			
Lobophora sp.							3.53
Padina sp.		0.78	1.88		7.05	9.40	
Sargassum Spp.	1.18	3.92	8.14	4.70	3.53		23.48
Turbinaria ornata	4.70	1.57	8.44	0.94	2.35		
DIVISION RHODOPHYTA							
Amphiroa fragilissima	17.60	13.28	9.38		11.33	9.40	5.38
Amansia glomerata	28.13						
Chondrococcus sp.	1.18						
Galaxaura oblongata	1.18	0.78					7.05
Gelidiella acerosa				0.94			
Gracilaria coronopifolia		0.78	9.38	1.88	14.08		8.23
Hypnea musciformis	28.13						
Laurencia papillosa	2.35						
DIVISION ANTHOPHYTA							
Enhalus acoroides				9.38	1.18		
Halodule pinifolia		1.57		8.44			
Halodule uninervis		21.88	7.50	9.38			
Thalassia hemprichii			7.50	7.50	11.73		

Table 7. Species diversity and dominance of the macrobenthic flora in the different sampling stations set up in Dinagat Island, Surigao del Norte.

STATION NUMBER	DIVERSITY (BITS)	DOMINANT SPECIES	MOST FREQUENT SPECIES
1	2.28	*Amansia glomerata* *Hypnea musciformis*	*Amphiroa fragilissima*
2	2.78	*Halodule uninervis*	*Halodule uninervis*
3	2.59	*Enteromorpha intestinales*	*Sargassum spp.*
4	3.10	*Enhalus acoroides* *Halodule uninervis*	*Halodule uninervis*
5	3.13	*Dictyota dichotoma*	*Amphiroa fragilissima*
6	2.16	*Padina sp.* *Amphiroa fragilissima*	*Amphiroa fragilissima*
7	2.59	*Sargassum spp.*	*Bornitella nitida*

Of these stations, Station 5 (in Libjô) had the highest species diversity.

Relative Coral Conditions

Coral conditions in the study area were generally fair. Except for two stations (Stations 5 and 6), coral conditions ranged from fair to good (Table 8). The poor coral conditions in Station 5 may be attributed to the proximity of the stations to the pier area. Although no actual measurements on the water circulation patterns were made, the structure of the pier may have affected the general circulation pattern in this station. The municiplaity of Libjô is located within a bay, thus general circulation in this area would be relatively lesser than in the other areas.. The pier structure may have aggravated such conditions. It is interesting to note, however, that in the stations set up in Libjô, there is an abundance of macrophytes. In fact, Station 5 exhibited the highest diversity of macrophytes.

Station 6 also had poor coral conditions. A large portion of the bottom of this station was covered with coral rubbles. The littoral zone is very narrow, thus making the area an ideal shelter for ferry boats and pumpboats that can easily approach the shore during strong winds and typhoons. The station also lies within the bay.

Station 1, which is a coral reef divided from the main coastline by a deep channel, had the best coral condition. Because of the inaccessibility of this station

Table 8. Relative conditions of the coral communities in the different sampling stations.

	STATIONS						
	1	2	3	4	5	6	7
Hard Coral (%)	37.78	20.00	41.00	18.75	5.00	5.00	23.33
Soft Coral (%)	15.56	6.67	11.00	6.25	1.05	1.67	5.83
Dead Coral (%)	8.33	13.33	2.00	15.00	10.00	11.67	7.50
Coral Rubble (%)	16.11	28.33	12.00	10.00	7.00	36.67	18.33
Rocks (%)	12.22	10.00	12.00	2.50	6.00	10.00	16.67
Mud (%)	0	0	0	0	2.00	3.33	3.33
Sand and Mud (%)	7.77	16.67	10.00	31.25	56.00	20.00	10.00
RELATIVE CONDITION (%)	53.34 good	26.67 fair	52.00 good	25.00 fair	6.05 poor	6.67 poor	29.16 fair

to residents who do not own a boat, the reef is to some extent protected from the pressures to which the other stations are most often exposed. It houses a considerably diverse marine ecosystem. Furthermore, based on personal experience, water current in this area is relatively strong and light penetrates to the bottom, with minimal effects of siltation, if any.

Station 3, located in Esperanza, also had good coral conditions. Current in the area was also relatively strong and substratum here favored the growth of corals.

Dayton (1977) has demonstrated that for a benthic marine rocky intertidal zone, substrate space is potentially the most important limiting resource. Its utilization is controlled by a combination of physical and biological disturbances. Other factors which control the distribution of coral species are sedimentation, salinity, freshwater run-off, depth, wave action and desiccation effects due to tidal fluctuations.

A total of 39 genera of hard corals were recorded in the study area. This value is slightly higher than that recorded by Abal (1987) in Lanao del Norte, Philippines, Bouchon (1981) on the reef flat of a fringing reef situated in Reunion Island in the Indian Ocean and Loya (1976) on the reef flat of Bilat, Red Sea. The list below summarizes the different coral genera recorded. Most of these genera were similar to those recorded by Montecillo (1976) in the Visayas area. It must be noted that the western coastline of Dinagat Island, where the different stations were set up, faces the Visayas area.

List of coral genera recorded in the different sampling stations setup in Dinagat Island:

Acropora	*Galaxea*	*Parahalomitra*
Anacropora	*Goniastrea*	*Pavona*
Astraeopora	*Goniopora*	*Pectinia*
Coeloseris	*Halomitra*	*Pocillopora*
Cyphastrea	*Heliopora*	*Podabacia*
Dendrophyllia	*Hydnophora*	*Polyphyllia*
Diploatrea	*Leptoria*	*Porites*
Echinopora	*Lobophyllia*	*Psammocora*
Euphyllia	*Merulina*	*Seriatopora*
Favia	*Montipora*	*Stylophora*
Favites	*Mycedium*	*Symphyllia*
Fungia	*Pachyseris*	*Tubipora*
		Turbinaria

Crustaceans, Echinoderms and Mollusks

The lists of the different crustaceans, echinoderms and mollusks recorded in the study area reveal a total of 16 genera of crustaceans, 30 species of echinoderms and 206 species of mollusks. Most of the crustaceans and mollusks were harvested by the local residents for food. These organisms were randomly collected along the different stations set up since their distribution was very patchy. No single method could suffice to determine quantitatively their distribution since methods vary from one species to another. However, comparing Loreto and Libjô municipalities, the former housed more diverse invertebrate fauna than the latter. Most of the shell species were collected from Loreto.

The five classes of echinoderms were represented. Only four classes of mollusks though, had representatives, while the crustaceans obtained during the study belonged to two sub-classes: Subclass Cirrepedia and Subclass Malacostraca.

Of these different invertebrate groups, the mollusks were the most abundant, most diverse and most common group.

List of crustaceans and their respective common names recorded in the different sampling stations in Dinagat Island:

Balanus (rock barnacle)
Coenobita (hermit crab)
Metapeneus (shrimp)
Pagurus (hermit crab)
Peneus (tiger prawn)
Portunus (blue crab)
Sesarma (mangrove crab)
Ibacus (squat crab)
Lepas (goose barnacle)
Ocypode (ghost crab)
Squilla (mantis shrimp)
Uca (fiddler crab)
Calappa (box crab)
Scylla ("alimango")

List of echinoderms recorded in the different sampling stations set up in Dinagat Island:

CLASS ASTEROIDEA

Acanthaster planci
Archaster typicus
Astropecten sp.
Crossaster sp.
Culcita sp.
Goniaster sp.
Linckia laevigata
Oreaster duoderlini
Oreaster nodosis
Protoreaster sp.

CLASS CRINOIDEA

Cenometra sp.
Gorgonocephalus sp.
Humerometra sp.

CLASS OPHIUROIDEA

Ophiuracna sp.
Ophiucoma sp.

CLASS ECHINOIDEA

Clypraster sp.
Diadema setossum
Echinocardium cardatum
Echinodiscus sp.
Echinometra oblongata
Echinithrix calamares
Heterocentrotus mammillatus
Laganum laganum
Prionocidares sp.
Salmacis sp.
Tripneustes grattila
Toxopneustes sp.

CLASS HOLOTHUROIDEA

Holothuria astra
Holothuria sp.
Synapta sp.

List of mollusks recorded in the different sampling stations set up in Dinagat Island:

CLASS GASTROPODA

Family Trochidae

Trochus niloticus
Trochus incrassatus
Trochus fenestratus
Trochus tubiferus

Family Turbinadae

Turbo petholatus
Turbo petholatus
Turbo argyrostoma
Astrae calcar

Family Angariidae

Angaria delphina

Family Cerithidae

Rhinoclavis asper
Cerithius aluco
Rhinoclavis sinensis

Family Architectonidae

Architectonica maxima

Family Strombidae

Strombus aurisdianae
S. luhuanus
S. canarium
S. sinuatus
S. ureaus
S. sp.
Lambis lambis
L. scorpius
L.millepeda
L.chiragra

Family Cymatiidae

Distorsio anus
Cymatium nicobaricum
C. pyrum
C. hepaticum
C. rubecula
Charonia tritonis

Family Bursidae

Bursa rosa
Bursa granularis
Bursa rubeta
Bursa crumena

Family Cassidae

Cassis cornuta
Casmaria erinaceus

Family Cypraeidae

Cypraea vitilus
C. eglantina
C. argus
C. lynx
C. carneola
C. caputserpentis
C. erosa
C. chinensis
C. quadrimaculata
C. pallidula
C. hirundo
C. kieneri
C. teres
C. stolida
C. catholicorum
C. cribraria
C. arabica
C. mauritiana
C. scurra
C. talpa
C. mappa
C. tigris
C. isabella
C. moneta
C. annulus
C. felina
C. caurica
C. errones
C. asellus
C. cicercula

Family Ficidae

Ficus ficus

Family Ovulidae

Ovula ovum

Family Muricidae

Murex sp.
Purpura persica
Haustellium haustellium
Chicoreus palma-rosea
C brunneus
C. terrefactus
C microphyllus
Chicoreus sp. 1
Chicoreus sp. 2
Murexsul balteatus

Family Turridae

Turris sp.
Turris crispa
Turris undosa
Lophiotoma acuta
Clavus canicularis

Family Costelariidae

Vexillum vulpeculum
V. rugosom
V. plicarium
V. acuminatium
V. semifasciatus
V. deshayesi

Family Coralliophilidae

Nassa serta
Thais armigara
T. aculeata
Mancinella alouina
Drupella cornus
Drupina grossularis
Drupa rubusidaea
Drupa recina

CLASS BIVALVIA

Family Arcidae

Arca ventricosa
A. subnavicularis
Anadara antiquata
Anadara sp.
Tasarca vellicata
Barbatia decussata
Imparilarca craticulata

Family Pinnidae

Pinna sp. 1
Pinna sp. 2

Family Isognominidae

Isognomon isognomon
Isognomon sp.

Family Pteridae

Pteria sp. 1
Pteria sp. 2

Family Glycymeridae

Glycymeris sp.

Family Pectinidae

Pecten sp. 1
Pecten sp. 2
Astropecten sp.
Chlamys sp.

Family Limidae

Lima sp.

Family Mytilidae

Lithophaga teres
Perna viridis
Mytilus perna

Family Spondylidae

Spondylus sp. 1
Spondylus sp. 2
Spondylus barbatus

Family Tridacnidae

Tridacna gigas
T. squamosa

Tridacna sp.
Hippopus hippopus

Family Lucinidae

Codakia orbicularis

Family Solenidae

Solen sp.

CLASS POLYPLACOPHORA

Acanthozostera sp.

CLASS CEPHALOPODA

Sepia sp.
Loligo sp.
Octopus sp. 1
Octopus sp. 2

Family Mitridae

Mitra eremitarium
M. mitra
M. ferruginea
M. ambigua
Strigatella litterata
S. retusa
S. scutulata
S. auriculoidea
Mitra stictica
Pterygia crenulata
Nebularia contracta
N. fraga

Family Buccinidae

Cantharus fumosus
C. undosus

Family Fasciolariidae

Latirulus turritus
Latirus gibbulus
L. turritus
Latirolagena smaragdula
Peristernia nassatula
Pleuroploca sp.
Fusinus colus

Family Vasidae

Vasum ceramicum
V. amouretta

Family Harpidae

Harpa amouretta

Family Tonnidae

Tonna chinensis
T. sulcosa

Family Olividae

Oliva textilina
O. episcopalis
O. annulata

Family Volutidae

Melo broderipi

Family Conidae

Conus marmoreus
C. nicobaricus
C. stercusmuscarum
C. arenatus
C. radiatus
C. carinatus
C. parius
C. aburneus
C. flavidus
C. distans
C. clarus
C. litteratus
C. leopardus
C. emciatus
C. coronatus
C. miliaris
C. ebraeus
C. chaldeus
C. musicus
C. sponsalis
C. vitulinus
C. planorbis
C. textile
C. aulicus
C. generallis
C. terebra
C. glans
C. cylindraceus
C. striatus
C. vexillum
C. capitaneus
C. miles
Conus sp. 1
Conus sp. 2
Conus sp. 3
Conus sp. 4
Conus sp. 5

Family Terebridae

Terebra areolata
T. subulata
T. folina
T. anilis
Terebra sp.

Fishes

Based on the daily observations of the fish catch of the fishermen in the area and visual census survey techniques, a total of 63 families of bony fishes were represented in the study area as shown in the list below. Thus, one can say that Dinagat Island supports a vast array of fish species which is most often utilized by the nearby residents. Bohol Sea which borders Dinagat Island to the west, is among the ten richest fishing grounds in the country (MNR, 1081).

List of families of bony fishes and their respective common names represented in the waters of Dinagat Island.

Acanthuridae (surgeonfishes)
Antennaridae (frogfishes)
Adrianichthyidae (shrimpfishes)
Apogonidae (cardinalfishes)
Aulostomidae (trumpetfishes)
Balistidae (filefishes, triggerfishes)
Bleniidae (blennies)
Bothidae (left-eye flounders)
Carangidae (jacks, scads, trevallies)
Centropomidae (seaperches)
Chaetodontidae (coralfishes, butterflyfishes)
Chanidae (milkfishes)
Clupeidae (herrings, sardines, shads)
Cynoglossidae (tongue soles)
Dasyatidae (rays)
Echeneidae (remoras)
Drepanidae (sicklefishes)
Dormionidae (black pomfrets)
Engraulidae (anchovies)
Exocoetidae (flyingfishes)
Fistularidae (cornetfishes)
Gerreidae (mojarras, silver biddies)
Gobiidae (gobies)
Haemulidae (grunts, sweetlips)
Hemiramphidae (halfbreaks)
Holocentridae (squirrelfishes, soldierfishes)
Kyphosidae (chubs)
Labridae (wrasses)
Leiognathidae (slipmouths)
Lethrinidae (emperors)
Lutjanidae (snappers)
Macroramphosidae (snipefishes)
Megalopodae (tarpons)
Mugilidae (tarpons)
Mullidae (goatfishes)
Muraenesocidae (pike congers)
Nemipteridae (threadfin breams)
Ostracidae (boxfishes)
Platacidae (batfishes)
Plotosidae (sea catfishes)
Polynemidae (threadfishes)
Pomacanthidae (angelfishes)
Pomantridae (damselfishes)
Priacanthidae (big eyes)
Pseudochromidae (colourful reef fishes)
Rachycentridae (sergeantfishes)
Scaridae (parrotfishes)
Scombridae (mackerels, tunas)

Scorpaenidae (scorpionfishes)
Serranidae (groupers)
Siganidae (rabbitfishes)
Soleidae (soles)
Sparidae (sea breams)
Sphyraenidae (barracudas)
Stromateidae (pomfrets)
Synceidae (stonefishes)
Syngnathidae (pipefishes, seahorses)
Synodontidae (lizardfishes)
Tetraodontidae (pufferfishes)
Thereponidae (therapons)
Triacanthidae (tripodfishes)

A Brief Account on the Utilization Of Marine Resources in the Area

There are several economically-important marine organisms in Dinagat Island. Most of these are mollusks, crustaceans and fishes. Residents usually utilize the invertebrates with the exception of squids, cuttlefish and lobster, only for home consumption. Fishes, squids, cuttlefish and lobsters are most often sold to a local businessman who ships these resources to Surigao City where they are once more bought by another person to be sent to different areas in the Philippines. Most often, specific sizes of these marine organisms are required and a standard price per kilo is set for certain species. The middleman takes care of the expenses entailed in freezing and shipping the products.

The question on the overexploration or underexploitation of the marine resources of Dinagat Island cannot yet be answered based on the obtained results. However, this study will serve as a reference point or baseline study for a long-range investigation and extensive monitoring specifically concentrated on the commercially important species. The degree of over-or under-exploitation will be determined after such a study. The population-carrying capacity of the marine resources must also be determined in order to answer this question.

This study thus recommends the continuance of a long-range and extensive survey of the marine flora and fauna in the area, one that will take into consideration temporal and seasonal factors. Only then will one know if the marine resources in a certain area are enough to support the population in an area.

ACKNOWLEDGMENT

This study was part of an expedition funded by the Coordination Center for Research and Development of MSU-IIT. The authors would also like to extend their heartfelt gratitude to the members of the team: Prof. Samuel V. Ochotorena, Emma Pineda, Alrey Eya and Manuel Actub for their companionship, to the authors' relatives and friends in Dinagat Island for the warm accommodation and to all those who in one way or another made this study possible.

LITERATURE CITED

Abal, A.L. 1987. Coral community structure of the reef flat fronting the western coastal area of Kauswagan, Lanao del Norte. Unpublished Masteral Thesis. University of San Carlos. 88 pp.

Aliño, P. M., V. Rosaroso and C. A. Orosco. 1981. A report on the subtidal marine environment around the Philippine Mining Service Corporation at Alcoy, Cebu. Phil. Scient. (18) 129-140.

Apao, P.A. and G. C. Camarao. 1983. Hydrobioecology of Iligan Bay, II. Productivity of intertidal benthic macrophytes in Iligan Bay. MSU-IIT CCRD Technical Paper. 66 pp.

Bouchon, C. 1981. Quantitative study of the scleractinian coral communities of a fringing reef of Reunion Island (Indian Ocean). Mar. Ecol. Prog. Ser. 4.273-288.

Charters, A. C., M. Neusuhl and C. Barliotti. 1969. The functional morphology of *Eisenia arborea*. Int. Seaweed Symp. 6.89-105.

Dayton, P.K. 1971. Competition, distribution and community organization; in the provision and subsequent utilization of space in a rocky intertidal community. Ecol. Monog. 41. 351-389.

Domantay, J.S. 1961. An ecological survey of the marine vegetation of the Hundred Islands and vicinity. Philipp. J. Sci. 90:271-295.

Liao, L.M. and F.B. Sotto. 1980. A preliminary list of marine algae of Mactan Island and the neighboring islands (Cebu, Philippines). Phil. Scient. 17(1980): 94-100.

Loya, Y. 1976. Effects of water turbidity and sedimentation in the community structure of Puerto Rican corals. Bull. Mar. Sci. 26(4):450-466.

Ministry of Natural Resources. 1981. The blue machine; a primer on our fishery resources. Quezon City. MNR. 48 pp.

Meñez, E.G. 1961. The marine algae of the Hundred Islands, Philippines. The Phil. J. Sci. 90(1) 37-86.

Meñez, E. G. and H.D. Calumpong. 1981. The genus *Caulerpa* from Central Visayas Philippines. Smith. Cont. Mar. Sci. 17. 21 pp.

Montecillo, E.A. 1976. Taxonomy of reef-building corals of Eastern Cebu. Phil. Scient. 8.1-47.

Nemenzo, F. 1986. Guide to Philippine flora and fauna. Vol. V. Corals. Manila. Nat. Res. Management Center and U.P. 273pp.

Nybakken, R. 1962. Marine biology. an ecological approach. New York. Harper and Row. 307 pp.

Phillips, R.C. 1978. Seagrasses and the coastal marine environment. Oceanus 21(3) 30-40.

Rau, N. and A. Rau. 1980. Commercial Marine fishes of the Central Philippines (Bony Fishes). Deutche Gessellshaft fur Technische Zusammenarkeit (GTZ).

Reyes, A. Y. 1970. A survey of the littoral benthic algae of the coastal areas of Dumaguete City. Phil. J. Sci. 99(3-4):131-163.

Saito, Y. and S. Atobe. 1976. Photosociological study of intertidal marine algae. Bull. Fac. Fish., Hokkaido Univ. XXI(2).

Tiin, Y., G.P. Israel, D.B. Magpulong and H. Simbol. 1981. Occurrence and seasonal variation of the dominant macrobenthic algae in some littoral zones of IliganBay. Proc. FIMDS 14th Ann. Conf. IFRD, Naawan, Mis. Oriental.

Yap, T. N., P. B. Bacolod, E.P. Gualberto, C. A. Orosco, D.T. Dy, A.L. Abal, D. Largo, and F. Sotto. 1986. Environmental impact assessment of Cebu Thermal Complex. Vol. 6. Marine Ecology Module. NPC-EMD 235 pp.