Spot assessment of the coral resources of Baybay waters

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ABSTRACT

The coral resources of Baybay were assessed using the transect-quadrat method. Two samplings in 14 stations over an area of 1400 m^2 yielded a mean coral cover of 59.1%. Fifty-four species belonging to 21 genera in 13 families of scleractinian and nonscleractinian corals were identified.

Based on relative cover, the three most dominant species are *Acropora hebes, Porites tenuis* and *A. granulosa*. The most ubiquitous of the dominant species are *P. lutea*, followed by *Pocillopora damicornis, A. squarrosa* and *Seriatopora angulata*. Coral cover was highest in Palhi (Tomakin reef) followed by Plaridel, and lowest in Maybog, ViSCA and Maslog. Species diversity was highest in Plaridel and Palhi, and zero in ViSCA and Maslog. In general, southern stations have better coral cover and diversity than northern stations. The major factors limiting the distribution of corals in the area are apparently depth and substratum.

To improve the cover and diversity of corals in Baybay, coral transplantation is recommended in the available continental shelves of the northern stations, with Plaridel and Palhi serving as the source of materials. Criteria for site selection are discussed. Introduction of rocks and boulders and planting of mangrove or beach trees and seagrasses in coral transplantation sites are also recommended to improve larval survival and coral colonization. Vigilance against dynamite fishing and slash-and-burn agriculture should also be maintained.

Keywords: *Corals, Baybay waters, coral cover, species diversity, depth, substratum, coral transplantation.*

INTRODUCTION

Coral reefs are among the most productive tropical marine ecosystems with primary productivity estimates of 1500-5000 g C/m^2/yr (Lalli and Parsons 1993). They support a diverse assemblage of fauna and flora including some endangered species of giant clams and holothurians. They are also very important as wave breakers, protecting islands from strong waves.

Along the coast of Baybay, coral reefs are not very extensive probably because the continental shelf is generally narrow especially in the northern stations. Moreover, several rivers and streams that may bring freshwater and silt unfavorable to corals are present. Damage to corals has also been inflicted by strong typhoons in the past (pers. comm. with local fishermen) and dynamite fishing (actual observation). An initial survey along the Baybay coast showed predominantly dead coral and some new growth. In the southern area, some have good coral coverage. This study was thus undertaken to assess the condition of corals in the entire Baybay waters. It also aims to provide the needed baseline information for the conservation and management of corals and coral reefs in the area in order to improve productivity and biodiversity. With the constantly growing coastal population and the multiplicity of demands on coral reef resources, the improvement of coral reef productivity and biodiversity is deemed imperative.

MATERIALS AND METHODS

Twenty-three stations that were established for macroinvertebrate survey in Baybay were also surveyed for corals. However, only 14 out of the 23 stations had coral growth. Thus only 14 stations were sampled for corals. Each station was sampled twice from May 1991 to June 1992.

A combination of the transect line and quadrat method was used for sampling. The quadrat method is the most effective method for surveying relative cover and density compared with six other sampling methods (Weinberg 1981 in Gamble 1984). A calibrated 100 m transect line was laid perpendicular to the shoreline and a 1 x 1 m quadrat was placed every 10 m distance along the transect. In the southern stations where coral reefs are somewhat extensive, the transect line started at the forereef. In the other stations where corals have not formed reefs, corals were sampled along with the other invertebrates. The deepest range of the transects was around 10 m. All corals enclosed in the quadrat were individually identified and their percent cover noted. Determination of percent cover was facilitated by having 0.01 m^2 grids on the 1 x 1 m quadrat. Since most of the species could not be identified on the spot, samples were collected and labelled using numerical codes for later identification. In the identification of coral species, the works of Nemenzo (1986 and earlier works) in the Philippines and other works covering the Indo-Pacific basin were consulted. Verification and identification of unidentified specimens were done by specialists from the University of San Carlos and the Philippine National Museum.

The percent cover of each species in each station is based on the mean of the two samplings in each station. Dominance of the different species was determined using relative cover which was computed as follows:

$$\text{Relative Cover (\%)} = \frac{\text{cover per species}}{\text{total cover per station}} \times 100$$

The relative cover of each species in the entire Baybay waters was also determined.

Coral species diversity of each station was computed using the Shannon-Wiener diversity index (Pielou 1976) as follows:

$$H' = -\sum_{i=1}^{s} p_i \, ln \, p_i$$

where H' is the Shannon-Wiener diversity index, s is the total number of species in each station, and p_i is the cover of a species divided by the total cover per station

Frequency of occurrence of each species was computed using the formula (Pichon 1978):

$$\text{Frequency (\%)} = \frac{\text{\# of stations species is present}}{\text{total \# of stations}} \times 100$$

The physico-chemical data used in this study for correlation (using microstat program) with percent cover and species diversity were obtained from a separate simultaneous study done by colleagues. These include temperature, salinity, dissolved oxygen, water transparency and sedimentation rate. The substrate in each station and the presence of tributaries were also noted.

Any seasonality in coral community structure is not studied nor reflected in this paper.

RESULTS

A mean (two samplings) total area of 1400 m^2 in Baybay was sampled for live corals. Of this, mean total coral cover obtained was 828 m^2. This corresponds to a mean (per station) coral cover of 59.1%. Fifty-four species of scleractinian and soft corals out of 21 genera in 13 families were identified (Table 1). The genus *Acropora* had the highest number (17) of species.

Based on relative cover, the three most dominant species are *Acropora hebes, Porites tenuis* and *Acropora granulosa.* The 13 most dominant species in the entire Baybay waters are shown in Table 2 and their distribution is presented in Fig. 1. They constitute a total relative cover of 75.7%. Among the most dominant species, *P. lutea* is the most ubiquitous (Table 3) being found in six out of 14 stations. This is followed by *Pocillopora damicornis, Acropora squarrosa* and *Seriatopora angulata.* Many of the coral species are not widely distributed in the study area.

Among the 14 stations in Baybay where corals are present, Palhi (Tomakin reef) had the highest

Table 1. Scleractinian and nonscleractinian corals in Baybay.

ALCYONACEA	Fungiidae
Alcyoniidae	*Fungia donai*
Lobophyton sp.	*Fungia echinata*
Sarcophyton sp.	*Fungia gravis*
COENOTHECALIA	*Fungia paumotentis*
Helioporidae	*Fungia repanda*
Heliopora caerulea	*Fungia* sp.
SCLERACTINIA	*Halomitra philippensis*
Acroporidae	*Herpolitha limax*
Acropora aculeus	*Polyphyllia talpina*
Acropora affinis	Mussidae
Acropora alliomorpha	*Lobophyllia hemprechii*
Acropora ambuscula	*Lobophyllia* sp.
Acropora corymbosa	Oculinidae
Acropora dispar	*Galaxea fascicularis*
Acropora formosa	Pectiniidae
Acropora granulosa	*Pectinia plicata*
Acropora hebes	*Pectina* sp.
Acropora multi-acuta	Pocilloporidae
Acropora palitera	*Pocillopora damicornis*
Acropora plana	*Pocillopora verrucosa*
Acropora specifera	*Seriatopora angulata*
Acropora sp.	Poritidae
Acropora squarrosa	*Porites attenuata*
Acropora subclabra	*Porites lutea*
Acropora subglabra var. *rugosa*	*Porites nigrescens*
Montipora ramosa	*Porites stephensoni*
Coeloseris mayeri	*Porites tenuis*
Pavona cactus	Tubiporidae
Pavona frondifera	*Tubipora musica*
Pavona praetorta	MILLEPORINA
Faviidae	Milleoporidae
Favia speciosa	*Millepora dichotoma*
Platygyra exigua	*Millepora exesa*
	Millepora tenella

Table 2. Thirteen most dominant coral species in Baybay.

SPECIES	RELATIVE COVER (%)	FAMILY
Acropora hebes	12.2	Acroporidae
Porites tenuis	10.4	Poritidae
Acropora granulosa	10.3	Acroporidae
Millepora dichotoma	6.9	Milleporidae
Porites lutea	5.9	Poritidae
Pocillopora damicornis	5.7	Pocilloporidae
Pavona frondifera	3.7	Acroporidae
Acropora specifera	3.7	Acroporidae
Acropora corymbosa	3.7	Acroporidae
Acropora squarrosa	3.7	Acroporidae
Seriatopora angulata	3.4	Pocilloporidae
Acropora affinis	3.0	Acroporidae
Acropora formosa	2.9	Acroporidae
TOTAL	75.7	

Table 3. The most ubiquitous coral species in Baybay.

SPECIES	FREQUENCY (%)
Porites lutea	42.9
Pocillopora damicornis	28.6
Acropora squarrosa	28.6
Pavona praetorta	28.6
Seriatopora angulata	28.6

cover followed by Plaridel (Fig. 1). Lowest coral cover was observed in Maybog, ViSCA and Maslog. The total coral cover of each of the 14 stations are shown in Fig. 2. In general, the southern stations (stations 8-14) have higher total coral cover. The trend in species diversity also followed a similar pattern (Fig. 3). Highest species diversity was observed in Plaridel followed by Palhi. ViSCA and Maslog showed zero species diversity.

The physico-chemical characteristics of the different stations in the study area as obtained in a separate study are shown in Figs. 4 and 5. Temperature and dissolved oxygen were fairly uniform but salinity varied somewhat. Water transparency was generally lower in the middle stations (from ViSCA to Maitum) while sedimentation rate was higher from Palhi southward to Plaridel. The southern stations starting from Punta also have more tributaries emptying into them.

No significant correlations of coral cover and species diversity with any of the physico-chemical parameters were obtained (Table 4) except for the negative correlation between water transparency and coral cover.

Legend:

1. *Acropora hebes*
2. *Porites tenuis*
3. *Acropora granulosa*
4. *Millepora dichotoma*
5. *Porites lutea*
6. *Pocillopora damicornis*
7. a. *Pavona frondifera*
   b. *Acropora specifera*
   c. *Acropora squarrosa*
   d. *Acropora corymbosa*
8. *Seriatopora angulata*
9. *Acropora affinis*
10. *Acropora formosa*

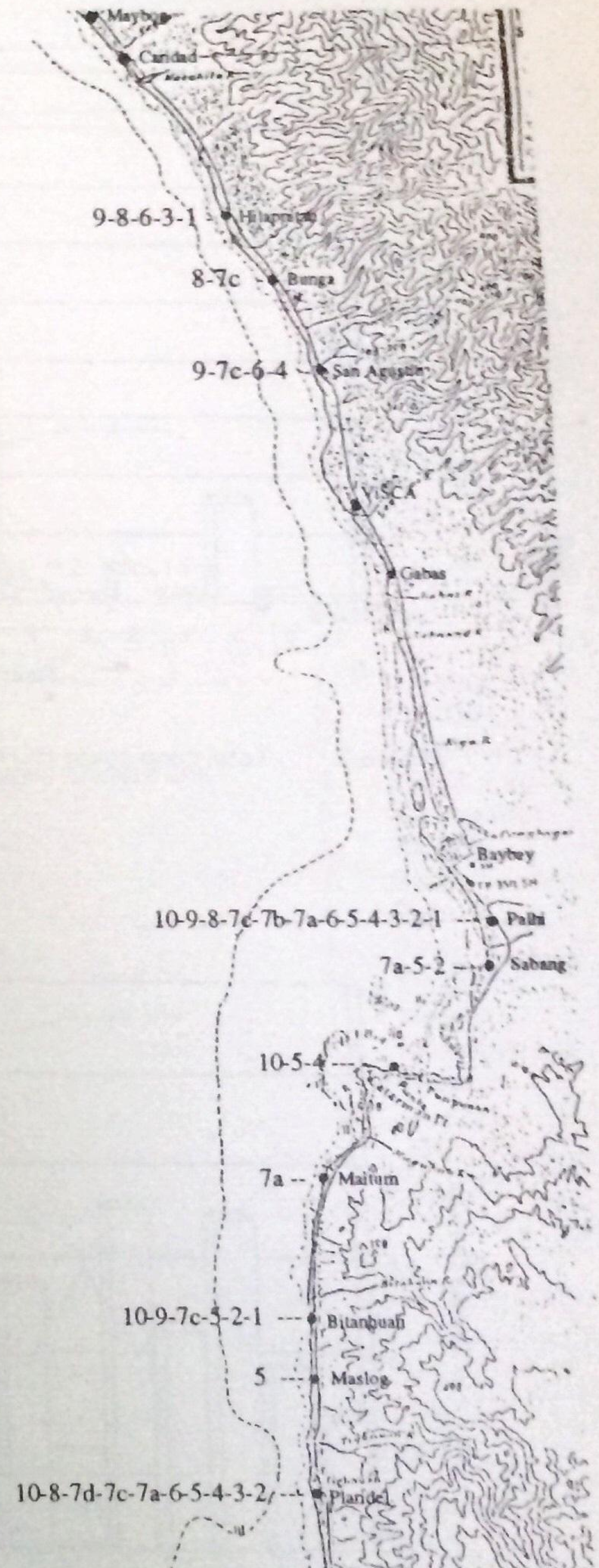

Figure 1. Map of the study area showing the 14 stations with corals (•) and the distribution of the 13 most dominant coral species.

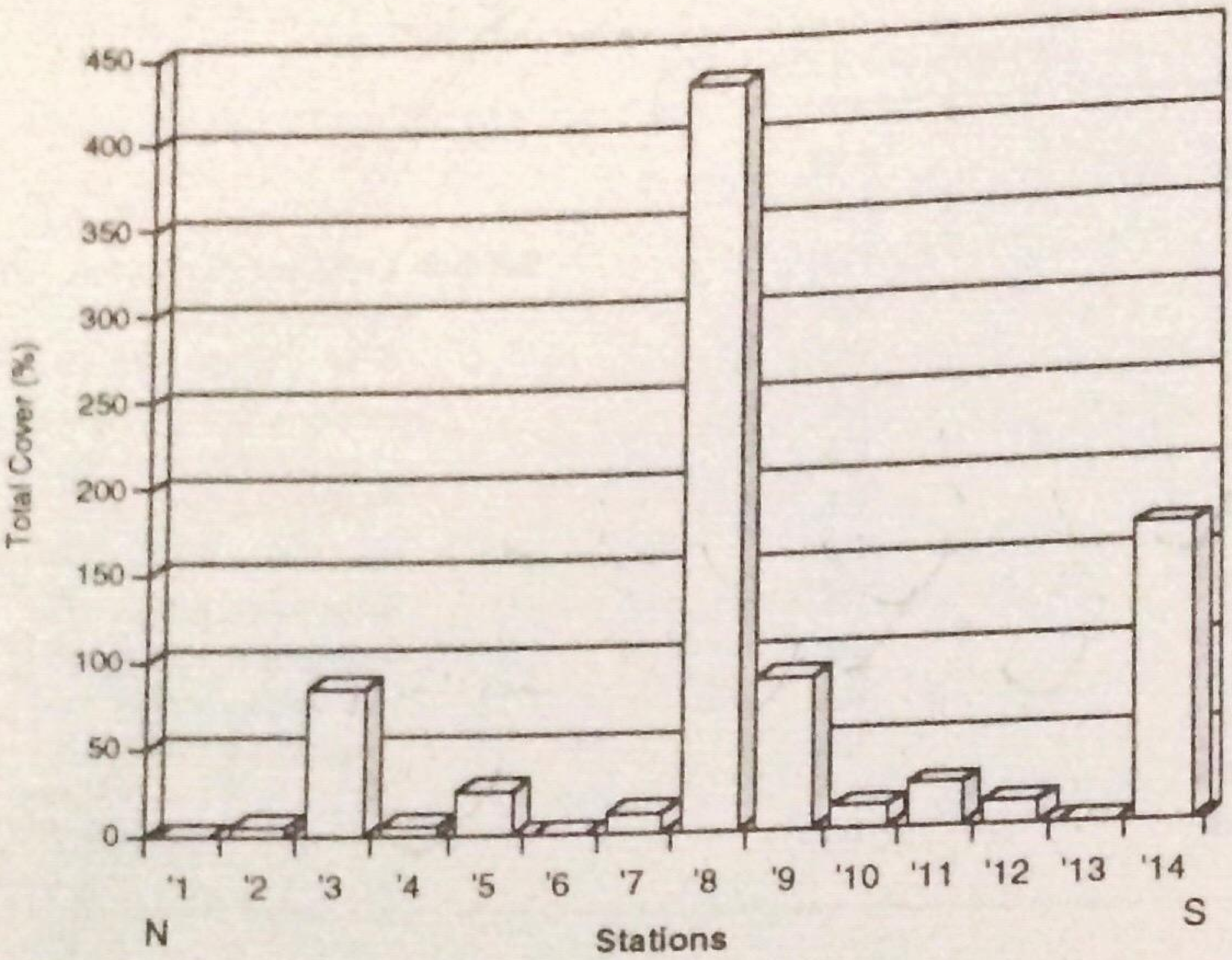

Figure 2. Total coral cover (%) of different stations in Baybay.

Stations:

1. Maybog
2. Caridad
3. Hilapnitan
4. Bunga
5. San Augstin
6. ViSCA
7. Gabas
8. Palhi
9. Sabang
10. Punta
11. Maitum
12. Bitanhuan
13. Maslog
14. Plaridel

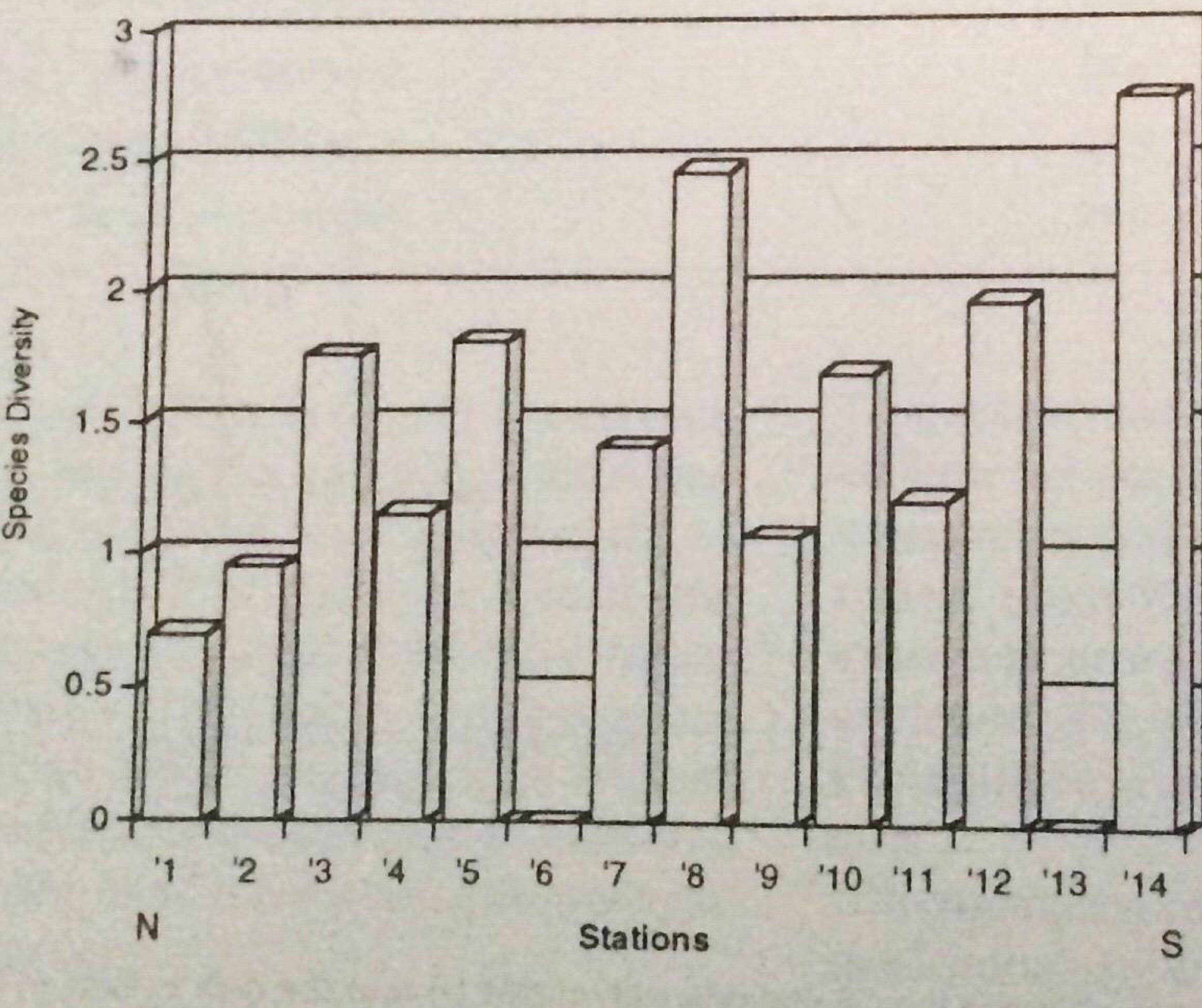

Figure 3. Coral species diversity of different stations in Baybay.

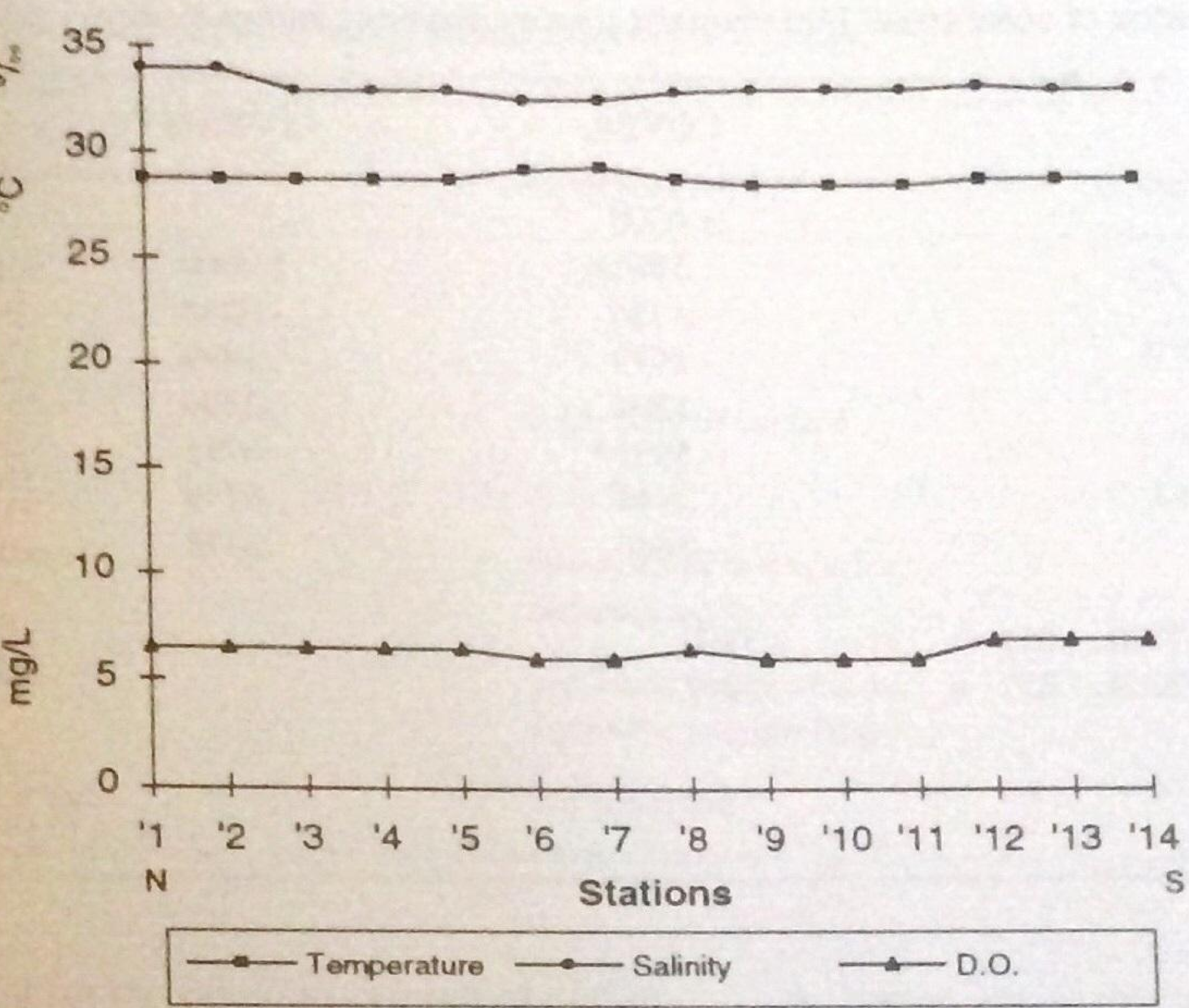

Figure 4. Mean temperature, dissolved oxygen content and salinity in different stations in Baybay.

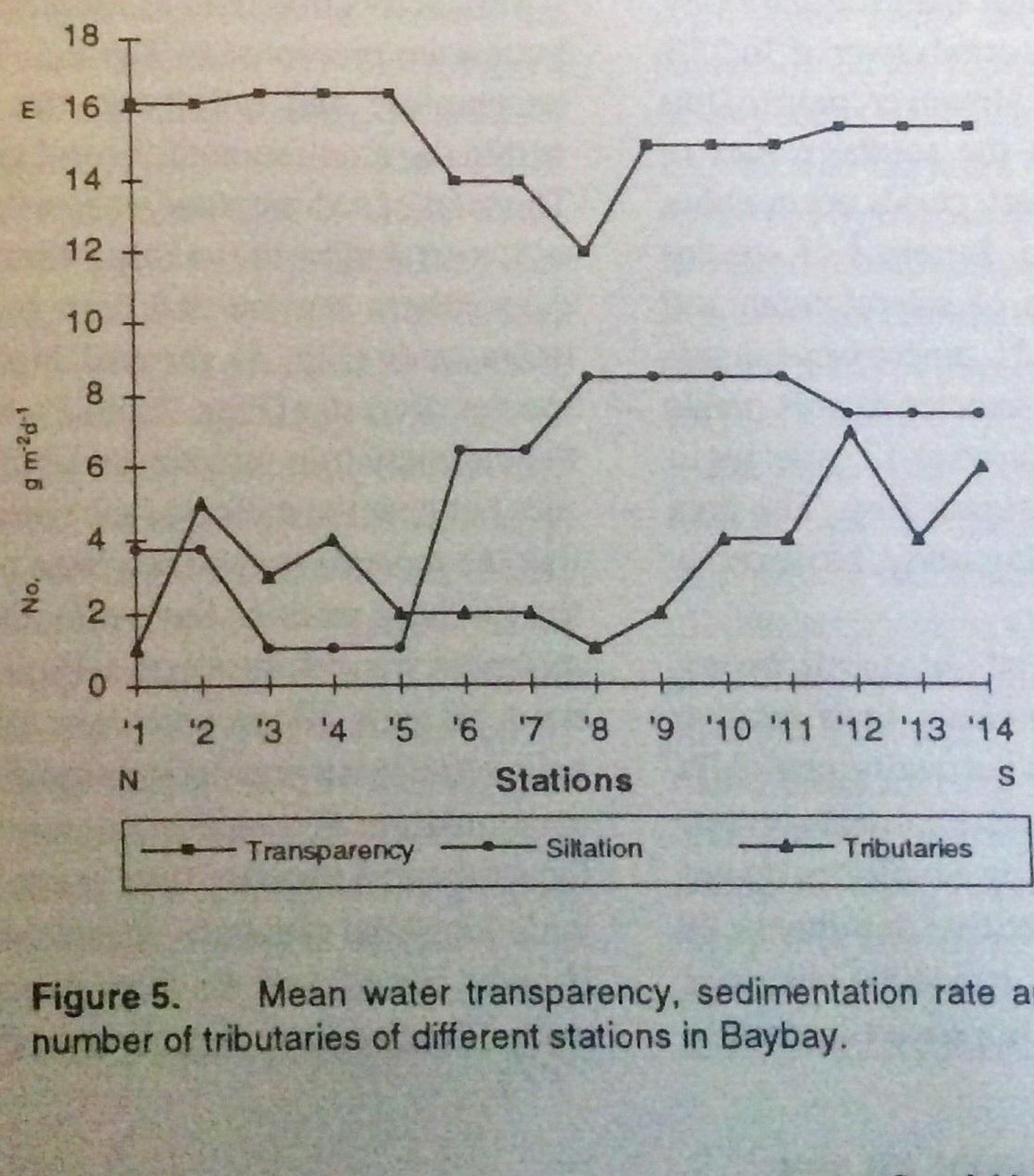

Figure 5. Mean water transparency, sedimentation rate and number of tributaries of different stations in Baybay.

Stations:

1. Maybog
2. Caridad
3. Hilapnitan
4. Bunga
5. San Augstin
6. ViSCA
7. Gabas
8. Palhi
9. Sabang
10. Punta
11. Maitum
12. Bitanhuan
13. Maslog
14. Plaridel

Table 4. Correlation matrix of coral cover and diversity versus physico chemical data.

	COVER	DIVERSITY
Cover	1.0000	
Diversity	.5881*	1.0000
Temperature	-.1116	-.0265
Salinity	-.2573	-.1499
D.O.	.1390	.2496
Transparency	-.5951*	-.0991
Sedimentation	.2944	.0778
Tributaries	-.2660	.2498

CRITICAL VALUE (1-TAIL, .05) = +/- .45900
CRITICAL VALUE (2-TAIL, .05) = +/- .53067

N = 14
* = significant

DISCUSSION

With a mean coral cover per station of 59.1%, the corals in the area can be considered to be in good condition (Gomez and Yap 1982). Baybay has higher mean coral cover than Carigara Bay, also in Leyte, with highest coral cover of 36.25% (Alcala and Alcala 1992). However, more of this cover is concentrated in the southern part of Baybay. In the northern part, corals occur either in patches or are isolated. In terms of species richness, only 54 species of scleractinian and nonscleractinian corals in 21 genera were identified in Baybay (at least 8 species of soft corals await identification) compared to 127 species in 48 genera recorded in Carigara Bay. The area coverage of the Carigara Bay study, however, is much bigger.

Despite the dominance of *Acropora hebes, Porites tenuis* and *A. granulosa,* their relative cover values (Table 2) are not really markedly different from those of the less dominant species. This indicates that the existing conditions do not necessarily favor the competitive dominance of only 1 or 2 fugitive species; hence the observed diversity level can still be improved in certain stations. The limited distribution of most of the coral species may partly be due to the limited availability of recruits especially in the northern stations. The corals in the northern stations are mostly new growths.

The factors that tend to limit coral reef distribution are presented in Table 5. The prevailing temperature and salinity in the area are well within the requirement for coral growth (Fig. 4). The rates of sedimentation observed appear to be well tolerated by the existing coral species since the southern stations that have higher sedimentation rates (Fig. 5) showed higher cover and species diversity (Figs. 2 and 3). However since the sediment trap was not set up right in the reef area but near the mouth of the river, it is possible that the mangroves and seagrass beds present in the southern stations have effectively served as sediment traps minimized sediment influx into the coral reefs. Moreover, wave action may have been efficient in preventing significant sediment accumulation. Exposure to air is not a problem in the study area because tidal range is narrow and wide intertidal areas are absent except in Punta, Brandy Island and Baybay town proper. The insignificant correlation of coral cover and spe-

Table 5. Reef distribution limiting factors (Nybakken 1982).

FACTOR	REQUIREMENT	OPTIMAL RANGE
Temperature	> 18°C	23 - 25°C
Depth	< 50-70 m	< 25 m
Light	> 15-20% of surface	
Salinity	> 32 ‰	32-35 ‰
Sedimentation	few species tolerate high sedimentation	
Wave action	preferred to prevent sediment accumulation	
Exposure to air	not tolerated	

cies diversity with the physico-chemical parameters suggests that the observed parameters do not limit the cover and diversity of corals in the area. Although sedimentation rates in the southern stations are high, their adverse effects on corals are attenuated by the presence of mangroves and seagrass/algal beds. Moreover, the presence of several tributaries in the southern stations does not markedly reduce the salinity below the tolerance level of corals. The significant negative correlation between water transparency and coral cover may just be artificial. This might have resulted from the limited area available for coral colonization in the northern stations where water transparency is high. Apparently, the major factors limiting distribution of corals in Baybay are depth and substratum. As shown in Fig. 1, the continental shelf especially in the northern stations is generally narrow, hence the drop-off is very near the coastline. This limits the area which can possibly be colonized by corals. Also, the predominance of the sandy to sandy silt substrate in the northern stations have probably prevented the settlement of planula larvae. In the southern stations especially in Plaridel, Bitanhuan, Punta and Palhi, the substratum is coralline rocky. Settling of planula larvae is better on rocky than on sandy substratum because the more stable rocks are more resistant to wave action, hence coral colonies get established easily on them.

Of the 14 stations in Baybay with coral growths, Palhi (Tomakin reef) and Plaridel have the best coral reefs. These sites appear to be the main source of larval recruits for recolonization of nearby areas. Nybakken (1982) suggests that it may take 25-30 years before a reef that has been destroyed by hurricanes can completely recover. If indeed recolonization takes that long, colonization and/or recolonization of the available continental shelves in coral-poor stations can probably be hastened by transplantation activities.

The good coral cover in the southern stations with mangrove stands and seagrass beds further emphasizes the interdependence of these three marine ecosystems (Fortes 1988). While mangroves and seagrass beds protect coral reefs from siltation by trapping silt and resuspended sediment, coral reefs in return protect the seagrass beds and mangrove areas from strong waves by acting as wave breakers and dampening wave energy. Aside from physical interdependence, the three ecosystems also share biological and nutrient interconnections which are presently being studied in detail by some marine scientists. These interconnections further emphasize the need to properly conserve and manage all three ecosystems to sustain marine productivity.

RECOMMENDATIONS

To improve the cover and diversity of corals in Baybay, coral transplantation activities must be undertaken especially in the available continental shelves of the northern stations. These northern areas especially from San Agustin to Maybog should be transplanted with corals to utilize the prevailing high water transparency. Higher water transparency suggests higher light intensity and thus also higher potential primary productivity (Parsons et al. 1977). Tomakin reef in Palhi and Plaridel could serve as the source of materials for transplantation. To satisfy the requirements for coral survival, the sites for transplantation should be in clear water away from the mouth of rivers, the substratum should be rocky sandy, and the depth should allow sufficient amount of sunlight to penetrate. Mangroves or other beach trees and seagrasses should also be planted in coral transplantation sites to improve the survival of transplanted corals. These could serve as sediment traps, to keep eroded sediment (from land sources) from limiting the photosynthesis of symbiotic zooxanthellae and smothering the transplanted corals. Structural diversity in transplantation sites should also be increased by introducing rocks and even boulders which can possibly be colonized by corals in the sublittoral zone. These activities will not only increase coral diversity but also marine biodiversity and productivity of Baybay as a whole.

Even if the present coral cover appears to be good, local officials should be vigilant. The practice of dynamite fishing, the use of poisonous substances in fishing, and slash-and-burn agriculture should be checked so as to protect and conserve the corals and coral reef resources of Baybay.

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