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Occurrence of Soft and Hard Corals at Igang Bay and Villa Corazon, Nueva Valencia, Guimaras, Philippines

MELCHOR MAGRAMO
MARY MAR ESMAÑA
JUNE RAYMOND PETER FLORES
MARLON TERUNEZ
JBLFMU-Arevalo, Ilo-ilo City, Philippines

Abstract - The distribution of soft and hard corals is due to prevailing environmental conditions, coral anatomical features and structural composition and presence or absence of predators and competitors. The study determined the occurrence of soft and hard corals in Igang Bay, Nueva Valencia, Guimaras, Philippines. Ocular survey was conducted at front beach of Villa Igang and transect – quadrat sampling was carried out. . The results showed that soft corals found in Igang Bay include the genera *Lobophytum, Radianthus, Sarcophyton, Sinularia* and *Xenia* and hard corals include those that belong to *Acropora, Coeloseris, Coscinaraea, Favia, Favites, Fungia, Lonophyllia, Millepora, Montipora and Porites* genera. Hard corals had a greater cover with a total of 38.94% while soft corals had 3.33%. In each transect, hard corals occupied more space than soft corals. There were 6 colonies for hard corals and none for soft corals. Physico – chemical conditions, particularly the salinity did not vary between three sampling points with a value of 29 ppt. and the temperature between surface and bottom had an average of 31°C and 31.7°C.The water depth ranged from 0.9 to 1.1 meters. Generally, the substrate type was rocky and sandy with presence of some coral rubbles in some portions along the transect lines.

Keywords – hard corals, soft corals, salinity, temperature, Igang Bay

INTRODUCTION

The distribution of soft and hard corals vary from place to place due to several factors including the prevailing environmental conditions, coral anatomical features and structural composition and presence or absence of predators and competitors. Because they both require about the same environmental conditions to survive, soft and hard corals are competitors for space on the reef.

Environmental factors like temperature, water velocity, water depth, water transparency and the shape of the shoreline or coast were observed to have an effect on coral cover and number of colonies of both hard and soft corals (White, 1987; Veron, 1986).

Hard corals usually thrive in an area where there is good illumination and water clarity. Good illumination is necessary because hard corals harbor photosynthetic algae that incidentally also gives color to the coral tissues. These algae, called zooxanthellae, provides up to 98% of coral nutrition and would allow faster deposition of calcium carbonate (CaCO3) in hard coral skeletons (Chalker et. al.,1986).

Soft corals are usually found in deeper waters, in low intertidal rocks, under ledger or in crevices (White, 1987; Thurman and Weber, 1984). Hard corals have calcium carbonate exoskeleton which effectively protects the polyps. When retracted, the polyps project little above the skeletal platform and are thus difficult for most fishes and other predators to remove (Barnes, 1980).

Soft corals which are also called leather corals because of the leathery texture of their colonies, may resemble hard corals with the fleshy coenechyme mass acting as substrate for the colony instead of calcium carbonate that hard corals have (Barnes, 1980).

Although both possess certain defense mechanisms in competing for space, they can not always protect themselves against their predators. Predators of hard and soft corals have adapted themselves to the harmful or toxic effects of those coelenterates. Common predators of hard corals are parrotfish, crowns of thorns starfish, mollusks and crabs. Soft coral predators include the egg cowrie (Ovula ovum) and the aoelid nudibranch *Phyllodesma longiciera* (on Sarcophytom).

Soft corals kill hard corals by simple overgrowth (Nishihira, 1981) or through chemical substances which are believed to be toxic (Coll and Sammarco, 1986). On the other hand, hard corals are observed to cause tissue lesions on soft corals (Coll and Sammarco, 1986).

Despite the similar environmental requirement of hard corals, there may be certain environmental conditions that favor the proliferation of one over the other. This is coupled with their defense mechanisms, particularly against one another; may bring about the dominance of one against the other in a site.

FRAMEWORK

Although soft and hard corals require relatively the same physic-chemical parameters (White, 19870, it has been found that each (soft or hard corals) has certain mechanisms for survival and defense over the other. These mechanisms may directly and/or indirectly determine the soft and hard coral cover and number of colonies in an area.

Competition for Space. Studies have shown that soft corals and hard corals inhibit the growth of one another through certain mechanisms.

The studies of Nishishira (1981) revealed that soft corals kill many species of hard corals by simple overgrowth. Conducted after the devastation of a coral community by the crown of thorns starfish *Acanthaster planci,* the study intended to observe interspecific interactions between soft and hard corals in recolonizing the community. The presence of hard corals overgrown by soft corals like Sinularia, Lobophytum and Sarcophyton was observed.

Soft corals are also known to kill, retard growth and cause tissue necrosis in hard corals through secretion of terpenoid toxins (Coll and Sammarco, 1986). Most of the soft corals affected were Pavona, Porites and Acropora. Studies showed that pure terpenoid compounds from soft corals killed both *Porites andrewsi* and *Acropora formosa* at very low concentrations of less than or equal to 10ppm (Co an Sammarco, 1986). Another study conducted by Coll and Sammarco (1986) showed that terpenoid toxins secreted by soft corals affect the recruitment rate of hard corals. They observed that hard corals have different recruitment responses with respect to the location of soft corals and wave current. Hard corals growing down current from soft corals have lower recruitment or survival rates than if the water direction is vice versa.

Hard corals, on the other hand, have elaborate mechanisms against their competitors like soft corals (Coll and Sammarco, 1986) an even other hard corals (Lang and Chornesky in Dubinsky, 1990). Some hard corals, e.g. Pectinia have long filaments that are capable of extracoelenteric digestion, while some possess sweeper tentacles e.g. Goniopora that can extend up to 15 cm. (Lang and Chornesky in Dubinsky, 1990). These mechanisms kill neighboring sessile organisms such as soft corals and even other species of hard corals.

Although soft corals have none of these hard coral apparatus, other mechanisms protect them from hard coral tentacles, a soft coral may secrete a polysaccharide layer which can overgrow living hard coral tissue. When a soft coral is in contact with another coral whether hard or soft, it bends away from this potential space competitor (Coll and Sammarco, 1986).

Reproduction, Dispersal and Survival

Soft and hard corals have a diverse set of reproductive options, both sexual and asexual. According to Sammarco (1986), their propagules-body parts capable of growing into a new organism have different dispersal capabilities. The settlement and growth of Acropora propagules are affected by physical (e.g. strong water current and illumination) and predation and competition factors.

Soft corals reproduce sexually in two ways: (1) as externally fertilized on the surface of the coral, and (2) as externally fertilized eggs developed planktonically in the water column. Asexual reproduction is via colony growth, fragmentation, or formation of stolons or runners. A stud has showed that soft corals ensure the survival of their propagules by first secreting toxic metabolites prior to ovation (Coll and Sammarco, 1986). These toxic metabolites were found in high concentrations in the eggs of soft corals Sinularia sp. and *Lobophytum crassum*. Brooding, reproduction of sticky eggs, toxic young and rapid growth all help to restrict predation on the settling and recently settled young of sessile soft forms (Lang and Chornesky in Dubinsky, 1990).

Hard corals reproduce sexually by external fertilization followed by brooding of larvae within polyps. Both external and internal fertilization of propagules pose a major problem for organisms attached to reefs. Where currents are strong, gametes disperse quickly and this inhibits fertilization of gametes.

According to Sammarco (1986), patterns of coral distribution is genus-specific and based on reproductive modes but the actual dispersal distances of larvae is still unknown. He has also observed that the mortality rate of hard corals were higher inshore due to high sedimentation rates and salinity variation and also in shallow water on the outer shelf where wave action inhibits planulae or planktonic larvae settlement. According to Veron (1986), the fates of planules depend on the prevailing currents and their ability to find unoccupied substratum. Planulae of hard corals may drift for days, weeks or months and cover great distances searching for unoccupied space before they detect (probably by chemical means) the proximity of substrate.

Predation

Soft corals have defense mechanisms against predators which are absent in hard corals. Chemical analysis showed that soft corals are nutritionally rich enough in proteins, fats and carbohydrates to serve as food for other organisms but studies have shown that incidence of predation is lower in soft corals than in hard corals. This is traced to the ability of Alcyonarians to secrete terpenes which are volatile toxic substances. Less toxic soft corals bear physical defenses against predators: Sarcophyton can retract its polyps completely inside the surface layer of the colony. Others like *Sinularia dura* bear spicules aside from being retractile (Coll and Sammarco, 1986).

These physical and chemical defenses as some specialized predators feed on highly toxic species of soft corals. The egg cowrie Ovula ovum feeds exclusively on Sarcophyton. This gastropod is capable of transforming highly toxic Sarcophyton into less toxic compounds without ill effects. The aeolid nudibranch phyllodesma longicirra stores toxins from Sarcophyton trocheliophorum in long, tubular projections on its back, called cerata. This coluntarily autotomized appendage is used to ward off predatory fish by being used as toxic projectile (Coll and Sammarco, 1986).

Hard coral polyps which seem invincible due to their ability to retract into their calcareous skeletons are not free from predators. Parrot fishes have teeth adapted to biting off and then crushing pieces of hard corals or scraping off polyps. The *Acanthaster planci* and the gastropod destructive outbreaks on some reefs as record in several such incidents in the Great Barrier Reef of Australia (Endean in Endean and Jones, 1976).

There is a stiff competition for survival between soft and hard corals as both organisms have relatively the same environmental recruitments. Soft and hard corals have other as well as unique mechanisms to adapt themselves to the prevailing environmental conditions and protect themselves against predation. Reports have shown that soft corals seem superior over hard corals in competing for space, reproduction and in deterring predation, yet soft corals do not dominate the whole area due to their specialized predators (Coll and Sammarco, 1986) and shorter lifespan (Nishihira, 1981). Like any other sessile organisms, corals are subject to environmental and other conditions and according to whether these are favorable or not, may either proliferate to dominance, compete in order to survive, or by larval or other types of propagation, wait to be resettled in another site.

OBJECTIVES OF THE STUDY

The main objective of this research was to compare the cover of soft and hard corals at Igang Bay and Villa Corazon, Nueva Valencia, Guimaras. The specific objectives are: (1)To determine if there is a difference between the cover and number of colonies of soft and hard corals in the study sites; (2) To compare the difference between coral cover and colony between the two sites; and, (3) To determine the physico-chemical condition of the sampled areas.

The results of this study may serve as baseline information for future coral researches, by pinpointing a site at Igang Bay, where hard or soft corals predominate. This may also give useful data for future studies regarding hard and soft coral interaction.

MATERIALS AND METHODS

The Study Sites

The study sites were located at the Igang Bay and Villa Corazon, Villa Igang, Nueva Valencia, Guimaras. Igang Bay, with a total area of approximately 200 and 250 square meters, respectively (Figures 1A-C). Igang Bay is located at the front beach of Villa Igang Beach Resort bounded by land on northern, eastern and western sides and open on southern (Figure 1A) while Villa Corazon is located at the southeastern part of Villa Igang and bounded by land on northern side and open sea on eastern, southern and western sides (Figures 1B and C).

Figure 1. Igang Bay (A); Villa Corazon (B & C) sampling areas

Sampling Procedure

Ocular surveys were conducted at Igang Bay and Villa Corazon where Transect – quadrat sampling was carried out on July 24, 2009 and October 24, 2009, respectively. Physico – chemical factors such as temperature, salinity and water depth were obtained. Coral cover and colony were determined through the line transect – quadrat method. A 1m x 1m quadrat divided into 25 squares with each square covering 4% of the total quadrat surface was placed in such a way that one side of the quadrat aligned with the transect line (Figure 2C).

Three 50-meter transect line were laid in each sampling site (Figures 2A-F). The 0-point of each transect line was the point nearest the shore where corals are present. Five quadrats placed at 10-meter intervals were taken n each line, thus a total of 15 quadrats were taken in each site.

Distinguishing between soft and hard corals

Field identification of soft and hard corals was based mainly on touch and feel method. The absence of a hard skeleton and the presence of a fleshy base distinguish a soft coral from a hard coral. The polyps of hard corals have tentacles in factors of 6 while soft corals have tentacles in factors of 8 (Thurman and Webber, 1984). Other characteristics of soft and hard corals (e.g. size, shape and color) described by Thomson (1931) and Vernon (1986) were also used.

Computation of percent (%) cover
Descriptive statistical methods was used to get % cover.

$$Cs = (qns \times 0.04) / 15 \times 100$$

$$Ch = (qnh \times 0.04) / 15 \times 100$$

Where : qns = number of grids occupied by soft corals
qnh = number of girds occupied by hard corals

0.04 = given value for each grid
15.0 = given value in 15 quadrats

25	grids / quadrat
x15	quadrats / area
375	grids in 15 quadrats

375 grids x 0.04 given value = 15 given value in 15 quadrats

The physico – chemical parameter

With a laboratory thermometer, surface and bottom temperatures were taken at the 25meter mark of each transect line, during the sampling period (Figure 4).

Other physico – chemical conditions like salinity, water depth and type of substratum were determined with the use of a hand refractometer and visual feel.

Sampling Procedures

Three transect lines were used in each site, perpendicular to the shore and a 25-meter distance from each other. The 0 meter mark of the 50 meter transect line was placed at the distance of approximately 150 meters at Igang Bay and about 5 meters at Villa Corazon from the shore where corals were first observed. At every 10 meter interval, a 1m x 1m quadrat divided into 25 squares covering 4% was positioned in such a way that the spaces occupied by hard and soft corals found inside the laid quadrat was recorded. One-half colony to one whole found within the quadrat was counted as 1 colony and less than half of the colony included in the quadrat was not counted as a colony (Odum, 1971).

Temperature was determined using the thermometer. Surface temperature was taken submerging the thermometer at horizontal position for 2 minutes. Bottom temperature was taken directly and read under water.

Salinity was measured with a hand refractometer calibrated to 0 ppt. by rinsing with distilled water, before and after use.

Substratum type was determined by touch and feel method.

Water depth was noted using a meter stick. Depth at 25 meter point of the transect line was taken. Depth was determined during low tide while sampling was conducted.

RESULTS AND DISCUSSIONS

Soft corals found at Igang Bay and Villa Corazon include the genera Lobophytum, Radianthus, Sarcophyton, Sinularia and Xenia. Hard corals that belong to Acropora, Coeloseris, Coscinaraea, Favia, Favites, Fungia, Lonophyllia, Millepora, Montipora and Porites genera. Almost all genera were observed in Villa Corazon except the genus Fungia. On the other hand, the genus Goniopora and Pocillopora were observed in Villa Corazon which was not found at Igang Bay (Table 1).

Table 1. List of hard and soft corals found at Igang Bay and Villa Corazon, Nueva Valencia Guimaras

soft corals	site		Hard corals	site	
genera	Igang Bay	Villa Corazon	Genera	Igang Bay	Villa Corazon
Lobophytum			Acropora		
Radianthus			Coeloseris		
Sarcophyton			Coscinaraea		
Sinularia			Favia		
Xenia			Favites		
			Fungia		
			Lobophyllia		
			Millepora		
			Montipora		
			Porites		
			Goniopora		
			Pocillopora		

Hard corals had a greater cover in two sampling sites with an average of 12.98% at Igang Bay and 46.13% in Villa Corazon. However, comparing between sites, Villa Corazon has a higher percentage of coral cover in both categories with 3.47% soft coral and 46.13% hard corals as opposed to 1.11% soft corals and 12.98% hard corals at Igang Bay (Table 2 and Figure 5). The number of colonies gives the same picture with an average of 0.4 colonies for hard corals in both sites. No colony has been found to be exhibited by the soft corals at Igang Bay and Villa Corazon (Table 2 and Figure 6).

Table 2. Hard and soft corals percent cover and colony sampled at Igang Bay and Villa Corazon, Nueva Valencia, Guimaras.

Site	Soft corals		Hard corals	
	% cover	colony	% cover	Colony
Igang Bay	1.11	0	12.98	0.4
Villa Corazon	3.47	0	46.13	0.4

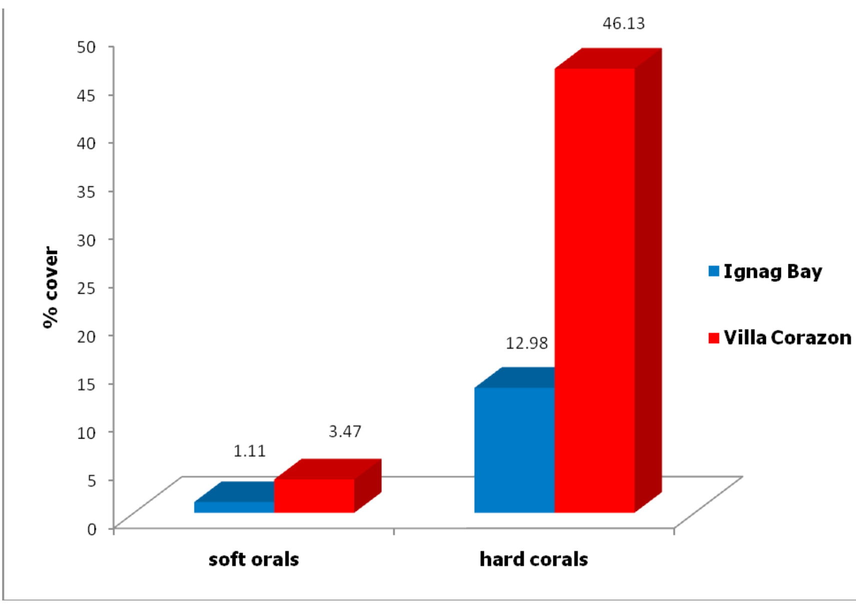

Figure 3. Percent cover of soft and hard corals at Igang bay and Villa Corazon, Nueva Valencia, guimaras

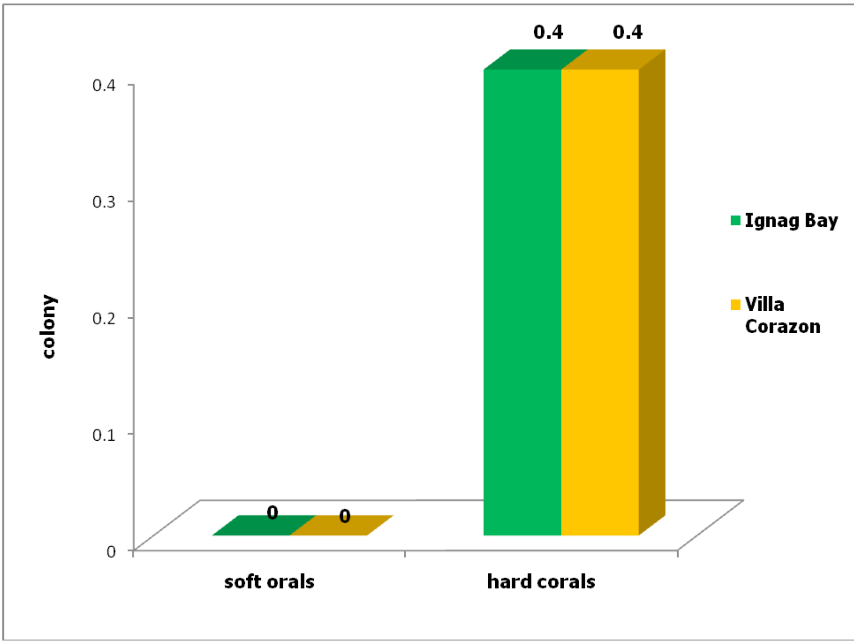

Figure 4. Colony of soft and hard corals at Igang Bay and Villa Corazon, Nueva Valencia, Guimaras.

Physico–chemical conditions, particularly the temperatures varied between two sampling sites exhibiting higher values at Igang Bay with 31oC surface and 31.7 °C bottom over 29 °C surface and 29.3 °C bottom in Villa Corazon. The salinity was not relatively varied with higher value in Villa Corazon with 29.7ppt. (Table 3). The water depths recorded were 1 meter at Igang Bay and 0.59 meters in Villa Corazon. Generally, the substrate type was rocky and sandy with presence of some coral rubbles in some portions along the transect lines at Igang Bay (Figure 7A-D) while presence of coral rubbles was relatively higher in Villa Corazon (Figure 8A-D).

Table 3. Physico – chemical parameters and general observation of the substratum in Igang Bay, Nueva Valencia Guimaras

	Igang Bay	Villa Corazon
Temperature (^{0}C)		
a) Surface	31	29
b) Bottom	31.7	29.3
Salinity (ppt)	29	29.7
Average depth (m)	1	0.59
Type of substratum	rocky and sandy	rocky, sandy, rocky, presence of a lot coral rubbles

In comparing the sampling sites, Villa Corazon exhibited a higher percentage of both hard and soft corals. Hard corals were found to have a greater percentage cover of 46.19% than the soft corals with an average of 12.98%. In terms of number of colonies of hard and soft corals, there was no difference between the two sites but in terms of coral category, the hard corals were found to have higher number of colonies with an average of 0.4 in both sites than the soft corals. This explains the dominance of hard corals in terms of colonies since there was no soft coral colony being observed during the sampling and also the higher composition of hard corals with 9 genera found at Igang Bay and 11 genera in Villa Corazon than 5 genera of soft corals in both sites.

The distribution of the soft and hard corals in an area may be due to the physical environment (Veron, 1986) or determined to an appreciable extent by chemical compounds secreted by soft corals (Coll and Sammarco, 1986). Higher number of genera was observed in Villa Corazon perhaps due to the less anthropogenic disturbance as Igang Bay is directly located in front of the Villa Igang Beach Resort which makes them more vulnerable and accessible to human destruction. It was also observed that higher sedimentation rate seem relatively lower in Villa Corazon. This promotes the growth and survival of the soft and more especially the hard corals which tend to survive in shallow waters. Villa Corazon also exhibited a relatively wider coral reef area since the site is facing more towards open sea promoting higher rate of dispersal of the juveniles. The physico-chemical parameters recorded in the two sites did not greatly vary with each other.

The positions of islands, islets and coast in the Philippines may slow down the water current approaching the shore. Land masses may shade the area or part of an area (White, 1987), thus affecting the location, size and composition of coastal communities which include the intertidal coral reef community. The distinctive characteristic of an area is due to particular combinations of environmental factors such as wind, waves, current and coastal shape. It has also been observed that the current coming into the Igang Bay was moderate upon high tide which may affect the occurrence of hard corals more than the soft corals. On the other hand, because of varying effects of shading, wind and current direction and intensity, the abundance or diversity, composition and dominance of soft and hard corals vary (White, 1987).

Shallow water (Table 3) allows good illumination for zooxanthellae metabolism that in turn enhances the hard coral growth (Chalker and Dunlap, 1986). In the presence of light, hermatypic corals grow faster than they are eroded by physical and biological agents like the action of waves and predation or effects of interaction with soft corals (Chalker and Dunlap, 1986).

Also, the sites have rocky and sandy substratum, which is very conducive for hard coral growth than for soft corals. In addition, it was observed that the hard coral genus Acropora seemed prevalent in the site. The said genus is known to thrive in areas with low sedimentation that is more apparent in a sandy-rocky type of substrate, good illumination, shallow water and moderate wave action (Veron, 1986; Endean, 1976).

Low soft coral cover and colony counts in the said sites (Table 2 and Figures 5 and 6) may be attributed to the shallowness of water and frequent exposure of the sites. High illumination is not favorable for soft corals that can only withstand short and infrequent exposures to light and atmosphere, and commonly thrive in areas that are shaded by cliff overhangs (White, 1987). Yet some soft corals like Lobophytum and Sarcophyton were observed to be present more individually than hard corals but were not included along the transect line during the sampling period.

Coral rubbles were also observed in portions along the transect lines with greater degree observed in Villa Corazon (Figure 7 and 8).

Endean (1976) observed that corals growing in a wave-stressed area especially near islets are prone to breakage, and the resulting coral rubble may abrade and bury other corals. Also, there were more rubbles observed in Villa Corazon because the area is more open seaward where wave action is greater compared to Igang Bay.

The rocky sandy type of substratum is devoid of organic components thus this site has relatively clear water. The absence of seagrass may be basically due to wave stress that inhibits seagrass growth and maybe also due to the poor organic content of the substratum since wave action does not allow detritus to stay. Although few patches of seagrass were observed occasionally along transect 1 nearest the 0 meter point since the northern side of the sampling site is said to be the site of the seagrass assessment project.

The exposure of this site to the open sea at the southern and wave shock, limited the distribution of many species (White, 1987) and the dominance of hard corals over soft corals in both percentage cover and number of colonies. The shading effect of the surrounding area may consequently affect the water temperature both at the surface and bottom. Table 3 shows that the temperatures did not vary much. Hard corals seem to prefer higher temperatures. Although more hard corals were observed in Villa Corazon despite the lower temperatures recorded mainly because it was raining during the sampling time.

Aside from physico-chemical factors, hard corals can also be influenced by interaction with soft corals as characterized by the presence of unoccupied substratum and dead portions of hard corals near soft coral colonies (Nishihira, 1981; Coll and Sammarco, 1986). Soft corals can also inhibit the growth or recruitment of hard corals and they also secrete compounds which belong to the chemical class terpenes which serve as defense against predators or weapons for space competition and in reproduction (Sammarco, 1986).

CONCLUSIONS

Survival and competition for space between soft and hard corals seems to be a natural part of coral life but the dominance of one over the other can be enhanced or hampered by the topography and such environmental factors such as amount of illumination, water depth, wave action and temperature. These factors were found to contribute to the dominance of hard corals at Igang Bay and Villa Corazon, Guimaras, Philippines.

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