An Assessment of the Coastal Resources of Ibajay and Tangalan, Aklan: Implications for Management

Edited by
Luis Maria B. Garcia

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A Report Prepared

by the

Southeast Asian Fisheries Development Center
Aquaculture Department
Tigbauan, Iloilo

for the

Municipalities of Ibajay and Tangalan, Aklan

Luis Maria B. Garcia *(Editor)*

On the Cover:

A collage of the resources of coastal communities in Aklan - fishers, seagrass, seaweeds, corals and reefs fishes, and mangroves - that impact on local food fish production.

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Foreword

The last decade before the new millennium are the years of realization that natural resources on this planet are finite and fragile, requiring an immediate shift in paradigms that have long governed their utilization. Such realization has never been more critical than in the country's fishing communities whose teeming inhabitants depend on the bounty of the sea for their daily sustenance. Over the years, the present utilization of coastal resources for food production has manifested the inadequacy of existing information and the weakness of social support structures that are critical in designing policies to govern resource use. Indeed, the present state in many coastal communities is a scene showing the various conflicts in resource use among stakeholders. Examples are the incursion of commercial fishers in municipal waters, the conversion of a common resource such as mangroves into a single-use private property, and the ineffectiveness of local governments to settle equitably such disputes. These states of affair have left the majority of already impoverished coastal inhabitants marginalized.

While advancing aquaculture through its research and training mandates, the SEAFDEC Aquaculture Department has now come to realize its role in promoting the sustainable use of coastal resources. The Mararison Island project from 1991 to 1998 was a testing ground to examine an inter-disciplinary approach to coastal resource management. The establishment and continuing enforcement of territorial use rights over fishing grounds and the island fishing community's attempts through mariculture to mitigate pressure on the fishery were examples worth replicating elsewhere.

The insights and experience gained from Mararison Island were useful indeed when the Department in 1998 involved itself in research on mangrove-friendly aquaculture in Ibajay and Tangalan, Aklan. Since the last remaining stands of mangrove forests in Western Visayas are located in these neighboring municipalities, this novel aquaculture technology became a tool to promote the wise utilization and management not only of mangroves but the other coastal ecosystems (seagrass-seaweeds, coral reefs) as well. An inter-disciplinary team of rural sociologists, resource economists, and biologists gathered baseline information of the resource to support options for management. The result of that survey is the content of this report. Open-access fishery, failure of law enforcement, customary property rights over mangrove and reef resource use, indifference of local government, and a persistent discord over municipal boundaries were the prevailing difficulties and conflicts documented. With this report, the local government and the coastal communities in these municipalities will certainly have many points for discussion to reconcile and integrate their development plans. The SEAFDEC Aquaculture Department will continue to catalyze these discussions if only to learn from the experience and the authors hope that readers of this report will do as well.

Rolando R. Platon, Ph.D
Chief, SEAFDEC Aquaculture Department

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Summary

This report describes the present state of marine resources in several coastal barangays of Ibajay and Tangalan, Aklan. Field data were obtained from rapid surveys conducted from July to September 1998. Recommendations based on analyses of the data will guide fisherfolk and other stakeholders, particularly the local government units, in their development plans for these neighboring municipalities.

Along their contiguous coastline, Ibajay and Tangalan share a fairly extensive fringing reef bounded by Sigat Point to the west and Apga Point to the east. Together with the fringing reef, several patch reefs (Pangayawan, Pungtod, Tigpuyo) located 3 to 8 km from their coastline are shared resources that support their reef fishery. Estimated by a manta tow and a line-intercept method, hard coral cover (less than 50%) was generally poor in all sites surveyed. Soft corals (37% cover) dominated the bottom community of fringing reefs, but hard corals were more numerous (14-45 species) at two patch reefs (Pangayawan and Pungtod) surveyed. Evidence of blast fishing (wide craters, coral rubble) was noted, especially in offshore patch reefs. Extensive areas of both fringing and patch reefs revealed signs of bleaching that affected both soft and hard coral species. Reef fishes recorded by underwater visual census were mostly low-value, small sub-adults, which are not preferably targeted by fishers. Fusiliers (Caesionidae, *sulig*) and surgeonfishes (Acanthuridae, *barangon, badok*) comprised the major catch from the reef fishery, but very low fish yields of 1 to 6 t per km^2 were estimated.

Eight species of seagrasses and 27 species of macrobenthic seaweeds were recorded from shallow parts (less than 3 m depth) of the intertidal zone from Apga Point to Bgy. Bugtong Bato. The distribution of marine flora was mainly due to the substratum type in the area, which varied from sandy-coralline, muddy to rocky. Seaweed species with gelatinous (phycolloidal) and medicinal value were few in number. Nonetheless, the culture of the red algae *Kappaphycus alvarezii* ("tambalang") has been attempted recently in Bgy. Bugtong Bato and Jawili.

Ibajay has an estimated 75 ha of mangrove, of which only 5% has already been converted into aquaculture ponds. However, about 30% of the area consisted of open cultivated nipa stands; thus, only 65% remain as original growth, precluding further expansion and development of open, aquaculture ponds in the area. The remaining original mangrove community in Bgy. Bugtong Bato and Naisud consisted of 19 species, indicating a high level of biodiversity. Characterized by greater basal area and species diversity, mature communities were encountered in inland mangrove sites. *Ceriops decandra* ("barasbaras"), *Avicennia* ("bungalon", "apiapi") and *Nypa fruticans* ("nipa") were the most common species encountered.

Both land and marine products in the area are mainly harvested for the local market. All coastal barangays are dependent on fishing for their livelihood. The medium-scale municipal fishery of Tangalan employs several passive (encircling gill net, bag net, fish corral) and active gears (baby purse seine) compared with the traditional fishing methods employed by Ibajay fishers. Pond aquaculture in mangrove areas is well-developed in Ibajay West (Bgy. Aquino and Ondoy) and in Tangalan. However, ownership of these ponds is limited to a few individuals and families, unlike in Bgy. Bugtong Bato where informal ownership distributed among families has been the traditional rule. Nonetheless, the introduction of so-called environment-friendly methods of utilizing mangroves (e.g., aquasilviculture) and other shared coastal resources may seriously undermine the informal rights-based social structures in the barangays. Without proper rules and enforcement, the application of these methods may be misused, aggravating the already poor overall state of their coastal resources.

Major problems affecting their fishing livelihood include siltation of nearshore waters due to illegal deforestation upland, encroachment of municipal fishing grounds by commercial and other

fishers elsewhere, and the lack of capital to finance the fishery. Weak inter-organizational links among government and non-government organizations have hampered the implementation of solutions to these common problems in coastal barangays. For instance, a conflict between fishers from these neighboring municipalities over territorial boundaries of common fishing grounds in Pangayawan and Pungtod reefs has not been resolved over the years. Likewise, the introduction of aquasilviculture in mangrove areas may become a potent source of conflict among resource-users who maintain informal rights over the mangrove resource.

The overall state of coastal resources in these municipalities is in immediate need of a unified plan to promote both their preservation and conservation. To achieve this end, a joint resource management council representing all resource-users from both municipalities must be organized and convened. To address the presently weak inter-organizational links among existing organizations, this joint council may provide a legitimate forum to identify, resolve, integrate, implement, and enforce guidelines on the common use of resources, both marine and inland. Low estimated yields from the reef fishery, conversion of mangroves for aquaculture beyond the allowable limit, a persistent conflict over fishing rights in several reefs offshore, the limited resources for seaweed and fish mariculture, and threats on existing traditional social structures by progressive resource-users are several issues that require thorough discussions to formulate popularly approved and acceptable management strategies. These strategies include community-based approaches of co-managing resources such as "no-take zones" (sanctuaries), ecotourism development, and livelihood schemes to mitigate, in part, the pressure of over-exploitation of fishery resources. Likewise, the innovative strategy of mangrove-friendly aquaculture in existing ponds or in mangrove forests may be pursued as long as the value and function of the mangrove ecosystem are not compromised. If well-planned, this strategy may provide lasting opportunities to stakeholders in terms of derivable goods and benefits with minimal negative effects on the mangrove resource-base.

1

Introduction

The coastal barangays of Ibajay and Tangalan share a common resource: their municipal waters with fringing and offshore coral reefs, mangroves, and seagrasses and seaweeds. As in other coastal communities, household families in these coastal barangays depend mainly on fishing for their livelihood. Tangalan and Ibajay fishers are faced with similar problems among coastal communities nationwide: dwindling fish catch, encroachment of fishers from neighboring islands or barangays, destruction of coral reefs and other coastal resources as a result of destructive and illegal fishing methods, no other livelihood opportunities, lack of favorable credit plans, and other problems. Local government officials, national agencies, and non-government organizations (NGOs) in Ibajay and Tangalan have initiated some activities aimed at developing plans to improve the municipal fishery and other resources as well as providing additional livelihood opportunities for the coastal inhabitants. Through the efforts of the local government, the Fisheries and Aquatic Resource Management Council (FARMC) and with assistance from national agencies, a fisheries management plan has been drawn for Tangalan. Similar plans may also be made for the coastal barangays of Ibajay.

An important part of the fisheries management plan for Tangalan is the declaration of Pungtod reef as a marine sanctuary through a municipal ordinance passed in 1993. However, the ordinance has not been implemented. Local officials of Bgy. Bugtong Bato, Ibajay have similarly voiced out plans to declare part of Pangayawan reef as a marine sanctuary.

Having gained valuable experience and insight from a community-based, development-oriented research project on fishery co-management in Mararison Island in Antique, the Department was requested by the local governments of Tangalan and Ibajay in Aklan to strengthen and accomplish the objectives of their fisheries management programs. Local government officials acknowledge the lack of information on the status of their coastal and socioeconomic resources, which is a necessary prerequisite for future assessment of the long-term outcome of their management programs. Aquaculture is a component of such program. The Department offered to develop and test on a pilot-scale a system of utilizing existing ponds and wetlands in Bgy. Bugtong Bato and environs by introducing mangrove-friendly aquaculture methods developed elsewhere. The biological and social impacts of these innovative methods remain unknown in the country, much less in these municipalities in Aklan where most of the remaining growth of mangroves in Region VI are located.

As an initial activity therefore, surveys of the mangrove, coral reef, seaweed and seagrass resources of Tangalan and Ibajay were undertaken in July to September 1998 by the coastal resource assessment team of the SEAFDEC Aquaculture Department. A quick socioeconomic resource survey was likewise conducted over this period. This report provides baseline information on the nearshore and socioeconomic resources of Tangalan and Ibajay, which will be necessary for the implementation of integrated fisheries management programs and sustainable marine resource-based livelihood activities in these municipalities.

2

Methodology

Coral Reefs

To obtain a general qualitative assessment of reef condition, manta tow surveys were conducted on the fringing reef along the coastline of Ibajay and Tangalan and three patch reefs (Pangayawan, Pungtod, and Tigpuyo reefs) located 3-8 km offshore (Fig. 1). Briefly, with the aid of a topographic map (1:50,000 scale), a local guide accompanied the survey team to these reefs whose precise location was obtained with a hand-held global positioning system (GPS). Three to four skin divers were slowly towed behind a motorized banca for two-minute periods following the contour of the fringing reef and across the length of the patch reefs during which coral cover was visually estimated (refer to Appendix 1). Percent cover of hard (scleractinian) and soft coral, sand, rock and rubble was calculated from the ratings of the divers. Data from the manta tow surveys guided the identification of sites on the reefs where more detailed coral and reef fish censuses were made (English et al., 1994).

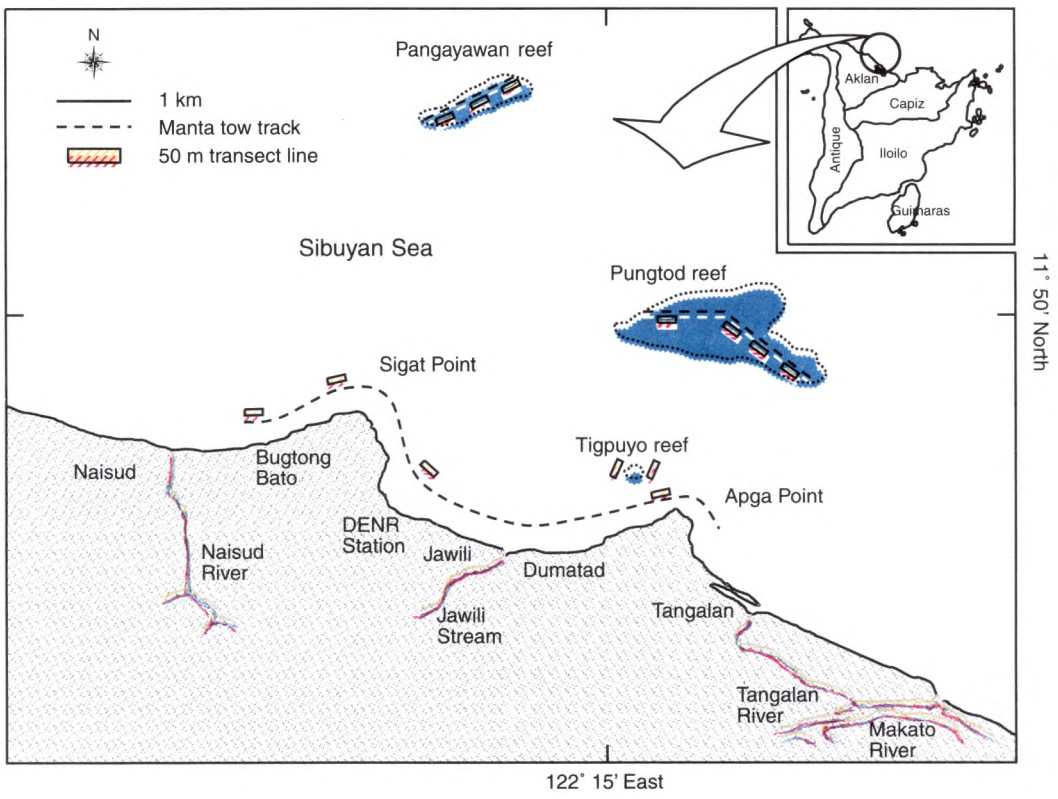

Figure 1. Location of transect lines laid during a survey of reefs in Tangalan and Ibajay, Aklan

Quantitative estimates of coral cover and fish populations were made on four sites of the fringing reef, three sites at Pangayawan, four sites at Pungtod, and two sites at Tigpuyo reefs by a line-intercept transect method (English et al., 1994). Two 50-m transects were laid approximately 10 m apart on each of the selected sites. One transect was used to estimate percent coral cover and frequencies of life forms while the other was used for visual census of reef fishes (Veron, 1986; Randall et al., 1990; English et al., 1994). The abundance and standard length of fish encountered within a 500 m^2 area were estimated underwater by a scuba diver swimming slowly a meter above the transect tape. A "first estimate" of fish biomass was estimated from established length-weight relationships of reef fishes (Samoilys, 1997). In addition, video footage was taken to record the condition of the reefs.

Seagrass and seaweeds

The seaweed-seagrass resource in the intertidal zone from west of Apga Point through Bgy. Jawili and Sigat Point to the fish landing area in Bgy. Bugtong Bato was assessed (Figs. 2 and 3). Identification and mapping of this resource was made along two to three 50 m transect lines, separated from each other by about 100 m, and laid perpendicular to the shore (Hurtado-Ponce, 1992; Hurtado-Ponce et al., 1998). Sampling stations were established at 5 m intervals along each transect line and a quadrat laid at each station. A ring sampler (0.159 m^2) served as a standard sampling quadrat. The dominant type of substrate and the standing biomass (as wet weight in gm per m^2) of seagrasses were obtained from each station (Saito and Atobe, 1970; English et al., 1994).

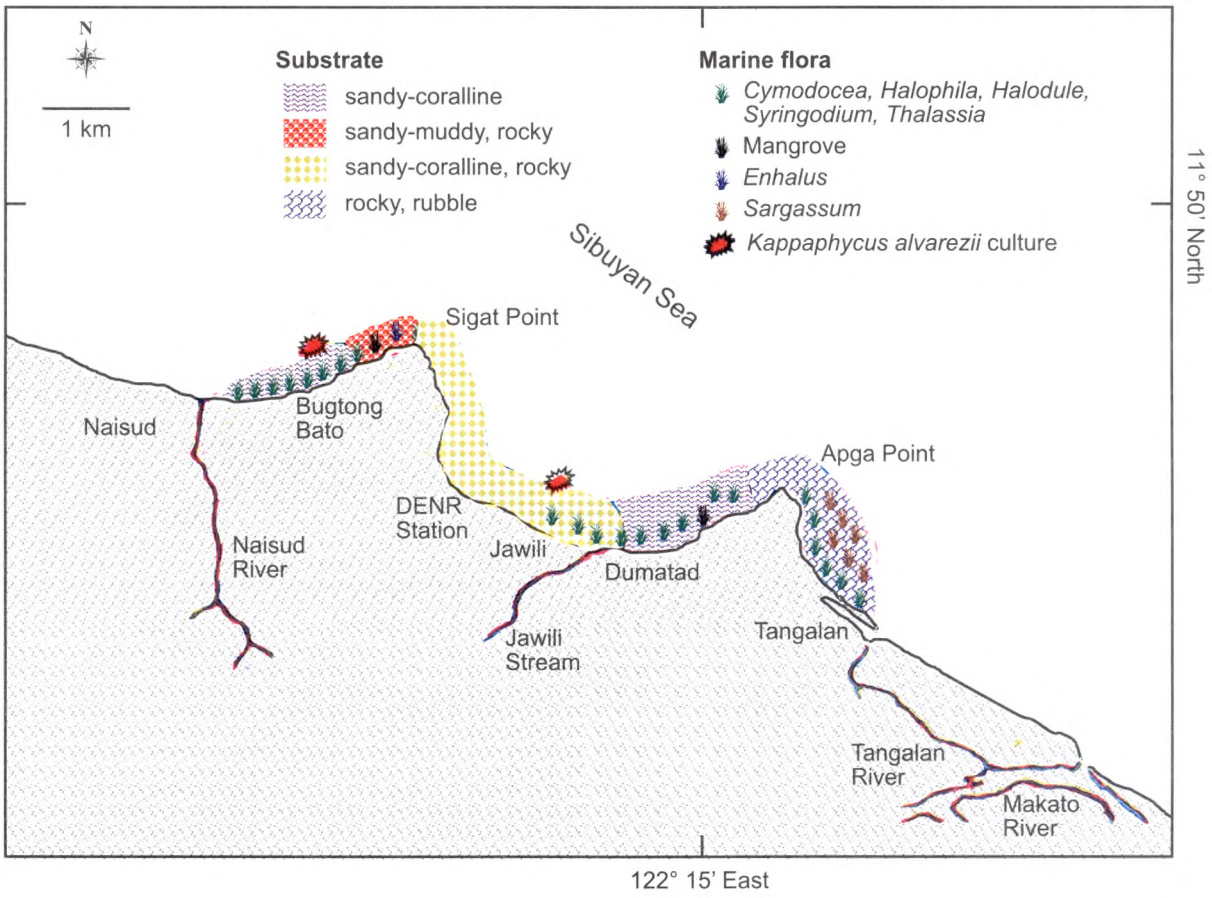

Figure 2. Substrate type and the distribution of dominant marine flora in nearshore waters of Tangalan and Ibajay, Aklan. Sampling sites are also shown in Fig. 3

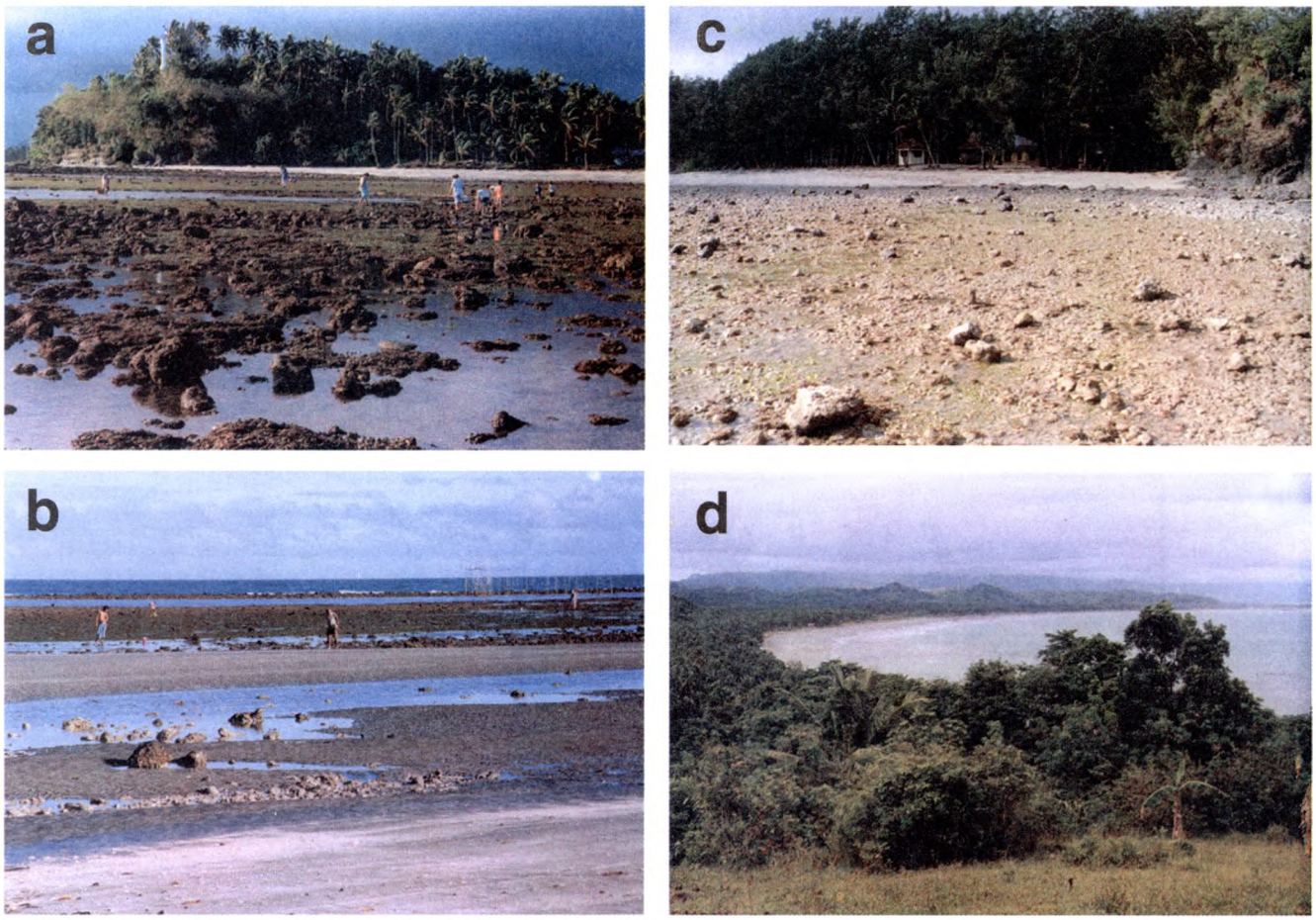

Figure 3. Sampling sites of seagrass and seaweed in the intertidal zone at a) Apga Point, b) Bgy. Dumatad, west of Apga Point, c) Bgy. Jawili, in front of the DENR station, and d) Sigat Point (foreground) in Bgy. Bugtong Bato

Mangroves

The extent of mangrove growth and development in Bgy. Bugtong Bato and Naisud in Ibajay was assessed through field interviews with local people and through a guided walking tour. Visual inspection of landmarks such as streams, rivers, beach, roads and bridges dissecting the mangrove forest was conducted. The latitudinal and longitudinal coordinates of these landmarks, including the peripheral edge of the forest, were located by a hand-held GPS and plotted on a grid scale. A digitized image of the plotted map was then obtained by an image analysis software to calculate with precision the perimeter and areal extent of mangrove cover.

The remaining mangroves of Ibajay total around 75 ha: 24 ha in Bgy. Naisud and 51 ha in Bgy. Bugtong Bato (Fig. 4). Only 5% of the total mangrove area of Ibajay has been converted into aquaculture ponds, although much of the forest consisted of open, cultivated stands of nipa. Due to limited time, only three sampling stations were established: one in Bgy. Naisud and two in Bgy. Bugtong Bato (refer to Appendix 2). These stations were selected according to distance from the sea: 300 m for Station I, 600 m for Station II, and 400 m for Station III. At each station, quadrats were laid out for mangrove seedlings (1x1 m), saplings (5x5 m), and trees (10x10 m). Species of mangroves were identified following Tomlinson (1986). The number of seedlings, saplings, and trees were counted and diameter breast height (DBH) of trees measured following English et al. (1994). From these data, calculations were made for basal area, relative frequency, relative dominance, relative density, importance value by species, and species diversity index by station.

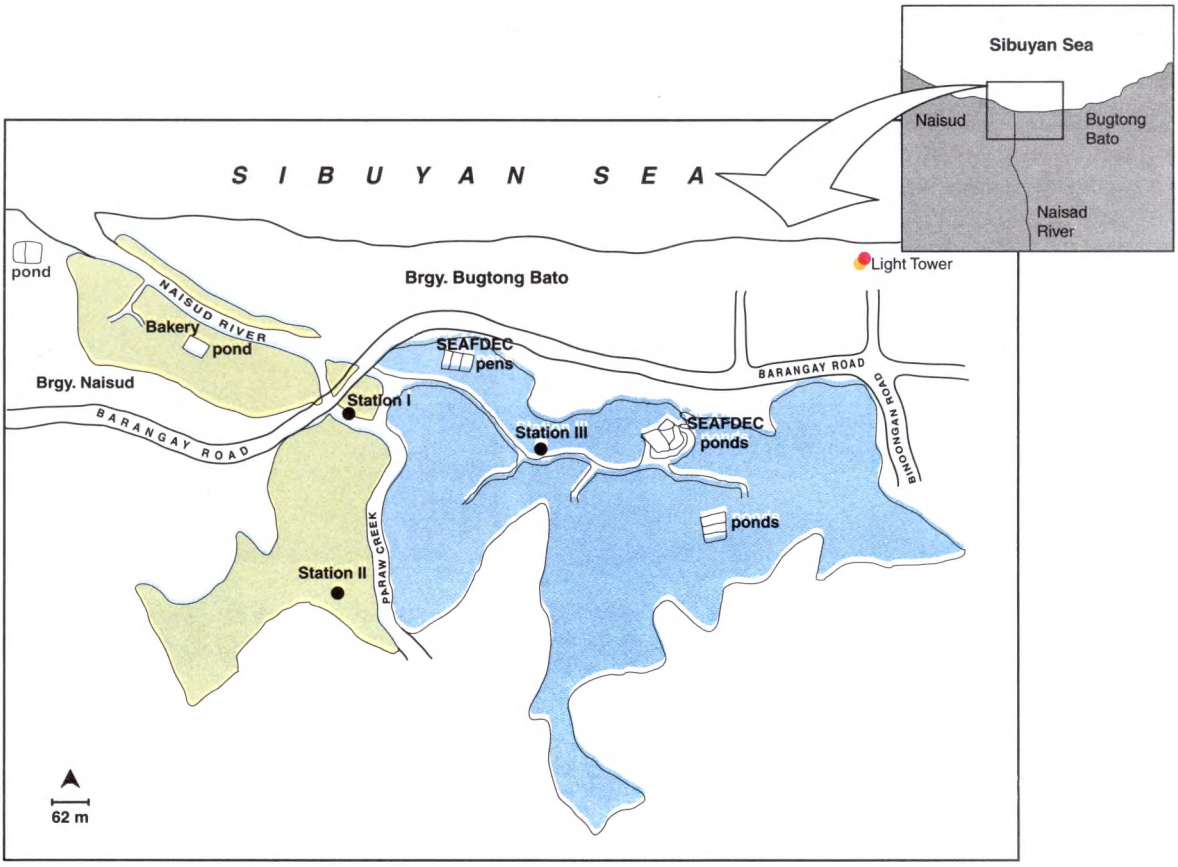

Figure 4. Location of sampling stations (I, II, III) in a mangrove community at Brgy. Bugtong Bato (blue shade) and Naisud (green shade) in Ibajay, Aklan

Socioeconomics

An assessment of the socioeconomic resources of Ibajay and Tangalan was obtained through a seminar-workshop conducted in August 1998 participated by representatives of the local government, people's organizations, NGOs, and researchers with interests in the development of these municipalities. Local participants were divided into four groups according to village affiliation: Bgy. Bugtong Bato, Ibajay West (Bgy. Aquino and Ondoy), Bgy. Naisud, and Tangalan. Each group was tasked to produce a village transect that extends from nearshore waters to upland areas (Appendix 3; Walters et al., 1998). Each transect enumerated and mapped all major agricultural and marine resources, products, technology, problems and threats, opportunities, and existing livelihood activities in the area. In a separate activity, the village transect of Bgy. Bugtong Bato was verified through a rapid rural appraisal (RRA) method (Pido et al., 1997). Likewise, a seasonal calendar of activities in Bgy. Bugtong Bato was undertaken through interviews of key informants.

3

State of Coastal Resources

Coral Reefs

Physiography

The coastline of Tangalan and Ibajay in Aklan from Apga Point to Bgy. Bugtong Bato is bordered by narrow fringing reefs interspersed with sandy-muddy areas in Bgy. Jawili (11°47.8' N, 122°13.4' E) and Bugtong Bato (11°48.5' N, 122°12.6' E). Water visibility however is limited due to silt from discharges of nearby Ibajay, Tangalan, and Naisud Rivers. Depth at the reef crest varies from 5 m near Apga Point to 12 m at Sigat Point.

With an approximate area of 85 ha, Pangayawan reef (11° 52.4' N, 122°14.1' E) is a small patch reef located about 8 km offshore from Bgy. Bugtong Bato. Average depth at the reef crest is 11 m becoming deeper at the southwest and northeast ends of the reef. The reef slopes to depths of more than 100 m on the southwest end and about 30-40 m on the eastern side of the reef. Water visibility is relatively high.

Pungtod reef (11° 52.4' N, 122° 14.1' E) is a patch reef located 6 km north of Bgy. Jawili in Tangalan. It has an approximate area of 134 ha, and an average depth over the reef crest of about 8 m. The reef slopes gradually to a depth of about 30-45 m. Located west, southwest and northeast of Pungtod Reef are smaller patch reefs separated from the former by shallow channels.

Tigpuyo reef (11° 48.3' N, 122° 15.2' E) is a small patch reef with an approximate area of 7 ha located about 3 km northeast of Bgy. Jawili. Depth at the reef crest is about 9 m. The waters at Pungtod and Tigpuyo reefs were relatively silty during the survey. Possible sources of silt are the discharges from river outlets nearby.

Manta tow survey

Fringing reef

Fifty two tows were made on 9 July 1998 to survey reefs fringing the coastline from Apga Point through Bgy. Dumatad and Jawili and passing Sigat Point going westward to Bgy. Bugtong Bato (Fig. 1). Living hard coral (*buhi nga pagang*) was estimated at 31-50%, dead coral (*patay nga pagang*) at 11-30% and soft coral (*karne karne*) at 51-75% (Table 1).

Patch reefs

Seven manta tows were conducted on 30 July 1998 over Pangayawan reef from the west end of the reef going eastward passing through the reef crest. Living hard coral cover was estimated at 31-50%, dead coral at 0-10%, soft coral and rock cover both at 11-30% (Table 1).

Twenty-two tows were made on 8 September 1998 over Pungtod reef from approximately 11° 50.1' N, 122° 15.6' E going southeastward to 11° 49.3' N, 122° 16.3' E. Living hard coral and soft coral, sand, rock and rubble covers were estimated at 31-50% (Table 1).

No manta tows were conducted over Tigpuyo reef.

Table 1. Summary of manta tow survey of the fringing and patch reefs of Tangalan and Ibajay, Aklan in July and September 1998

Reef	Number		Score[a]			
	Tows	Divers	LC	DC	SC	RCK
Fringing reef						
Apga Point to Bgy. Bugtong Bato	52	3	3	2	4	-
Patch reef						
Pangayawan	7	3	3	1	2	2
Pungtod	22	4	3	2	3	1

[a] Mean of median scores. Scores refer to categories estimating the extent of live (LC), dead (DC), soft coral (SC), and rock (RCK) cover. Score 1 = 0-10%; 2 = 11-30%; 3 = 31-50%; 4 = 51-75%; 5 = 76-100%.

Coral Transects

Percent coral cover at the various sites of the fringing and patch reefs are presented in Tables 2 to 5. Checklists of hard and soft coral species found along the transect lines in each of the reefs surveyed are shown in Tables 6 and 7.

Fringing reef

Average live hard coral cover of the four sites from Apga Point to Bgy. Bugtong Bato was 13% and average live soft coral cover was 37% (Table 2, Fig. 5 and 6). Highest live hard coral cover of 21% was found in Bgy. Jawili in front of the site of the National Museum Station. The four sites were characterized by a high percentage of soft coral cover (27-48%) and sand and silt (23-47%). The number of hard coral species found along the transect lines varied from 9 species at Apga Point to 23 species at Bgy. Bugtong Bato. More than 12 genera of soft corals, whip corals, sea fans, and zooanthids were found on the reef.

Table 2. Summary of coral census of 31 July 1998 by a line-intercept transect method of the fringing reef from Apga Point to Bgy. Bugtong Bato, Aklan. For the life form, numbers represent the area covered (in percent) by each trait along a 50 m transect line. Refer also to Figs. 5 and 6

Trait	Location of Transect			
	Apga Point	Bgy. Jawili	Sigat Point	Bgy.Bugtong Bato
Depth (m)	4.6	5.5	10.7-12.2	6.1-7.6
Lifeform				
Total live coral cover	35.0	55.0	58.8	55.2
Live hard coral	7.7	20.6	10.9	15.1
Live soft coral	27.3	34.3	47.9	40.1
Dead coral	0.5	1.0	0.4	3.6
Algae	0.5	0.4	0	2.7
Coral rubble	0	0	0	2.0
Rock	16.1	14.2	12.5	10.8
Sand and silt	46.5	29.4	27.1	22.5
Others	1.4	0.1	1.2	3.2
Number of species of live hard coral	**9**	**22**	**22**	**23**

Table 3. Summary of coral census of 30 July and 12 August 1998 by a line-intercept transect method of Pangayawan reef, Aklan. Refer also to Table 2 for other details and to Figs. 7 and 8

Trait	Transect Number		
	PYW1	PYW2	PYW3
Depth (m)	7.6-9.1	13.7-15.2	9.1-12.2
Lifeform			
Total live coral cover	21.1	50.7	38.1
Live hard coral	6.1	23.8	30.2
Live soft coral	15.0	26.9	7.9
Dead coral	0.8	0.8	9.4
Algae	0.1	1.7	4.4
Coral rubble	75.3	41.5	35.5
Rock	2.0	2.0	5.6
Sand and silt	0.8	1.5	4.0
Others	0	1.8	3.0
Number of species of live hard coral	**14**	**39**	**45**

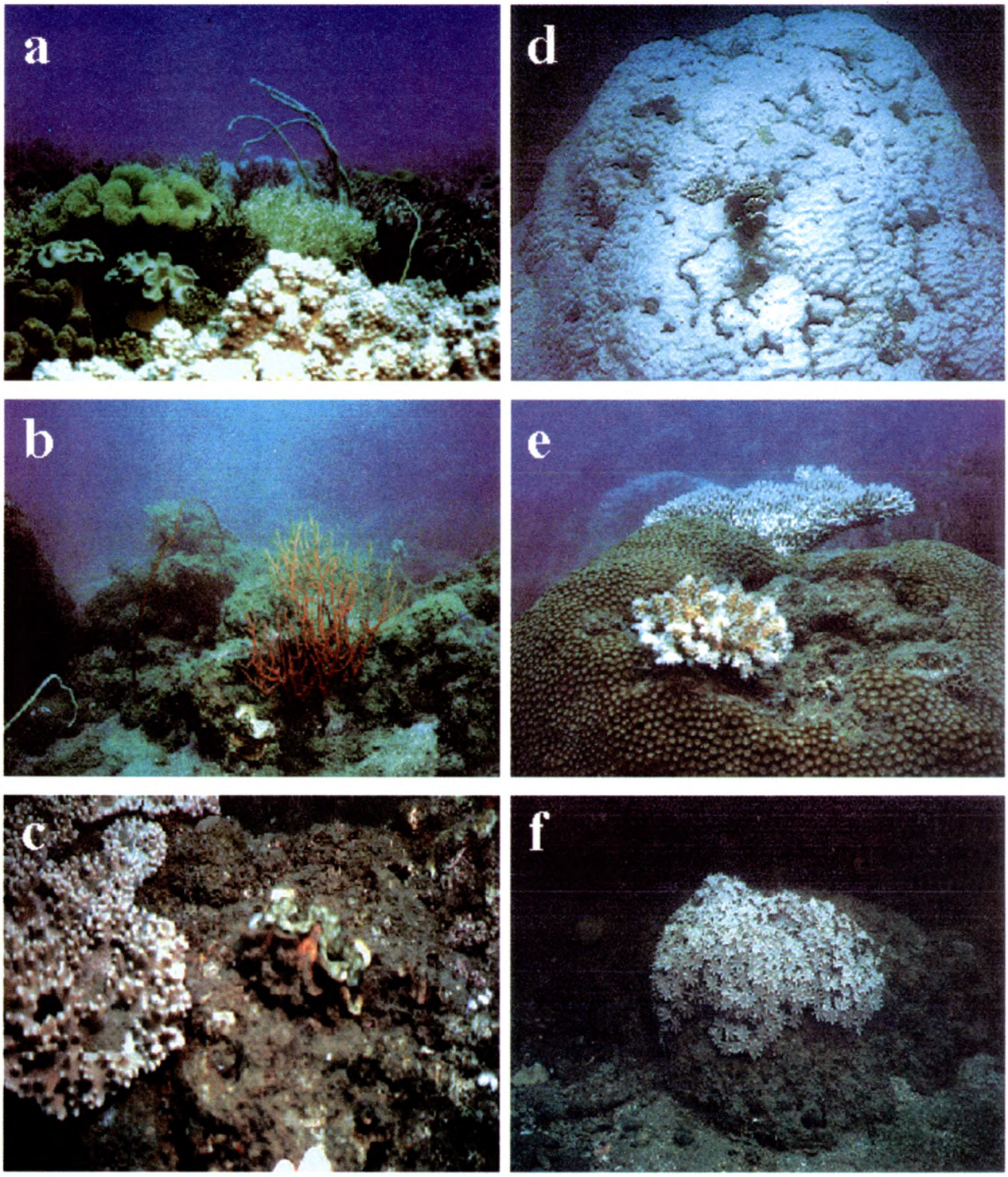

Figure 5. The fringing reef (4.6-5.5 m depth) from Apga Point (a-c) to Bgy. Jawili (d-f) in Tangalan and Ibajay, Aklan. Note bleached hard corals (a,d,e) and silted substrate (c,f). Refer also to Table 2 and Fig. 6

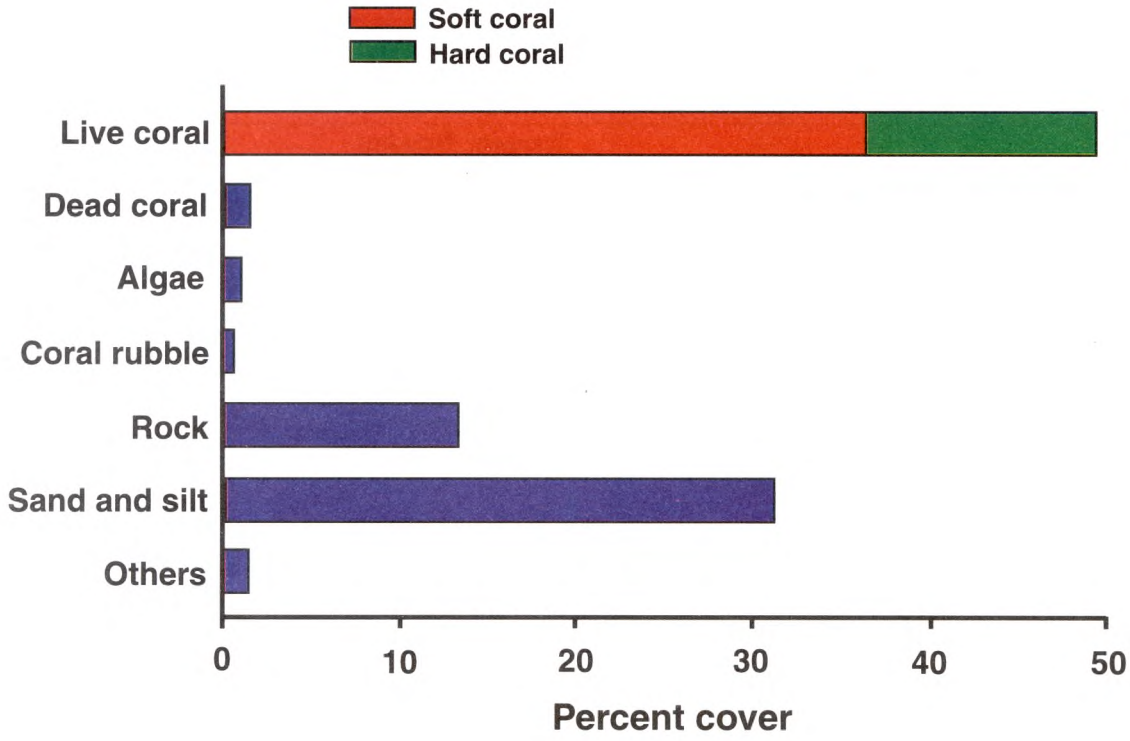

Figure 6. Average percent cover of bottom traits of the fringing reef extending from Apga Point to Brgy. Bugtong Bato, Aklan. Refer also to Table 2 and Fig. 4

Table 4. Summary of coral census of 8-9 September 1998 by a line-intercept transect method of Pungtod reef in Tangalan, Aklan. Refer also to Table 2 for other details and Figs. 9, 10, and 11

Trait	Transect Number			
	PNTD1	PNTD2	PNTD3	PNTD4
Depth (m)	4.6-6.1	7.6-9.1	10.7	6.1-9.1
Lifeform				
Total live coral cover	21.4	30.0	34.2	58.4
Live hard coral	17.8	16.4	25.7	12.2
Bleached hard coral	6.3	5.9	4.3	2.5
Live soft coral	3.6	13.6	8.5	46.1
Bleached soft coral	2.1	0.3	0.5	1.1
Dead coral	9.2	12.3	15.6	12.8
Algae	0.5	2.2	9.8	2.7
Coral rubble	42.5	16.1	17.0	1.5
Rock	9.8	17.4	7.5	14.9
Sand and silt	5.7	11.9	7.9	4.8
Others	2.5	3.8	2.2	1.2
Number of species of live hard coral	**14**	**29**	**45**	**28**

Table 5. Summary of coral census on 10 September 1998 by a line-intercept transect method of Tigpuyo reef in Tangalan, Aklan. Refer also to Table 2 for other details and Figs. 11 and 12

Trait	Transect Number	
	TGP1	TGP2
Depth (m)	6.1-9.1	6.1-9.1
Lifeform		
Total live coral cover	17.6	18.3
Live hard coral	4.0	8.5
Bleached hard coral	1.4	0.6
'Live soft coral	13.6	9.8
Bleached soft coral	12.3	8.4
Dead coral	0.7	0.4
Algae	0.9	0
Coral rubble	29.0	63.0
Rock	4.2	2.0
Sand and silt	28.5	5.2
Others	5.4	2.1
Number of species of live hard coral	**15**	**10**

Patch reefs

Although percent live hard coral cover at Pangayawan reef was slightly higher (6-30%; average of 20%) than at the fringing reef, a high percentage of coral rubble (average of 51%) indicates that the reef has been considerably damaged (Table 3, Fig. 7 and 8). Percent live soft coral cover is relatively low compared to the fringing reef. Percent hard coral cover is highest at the east end of the reef (PYW3, 30%) and lowest at the reef center (PYW1, 6%). Hard coral species diversity is highest also at PYW3 where 45 species were recorded along the transect line and lowest at the reef center (PYW1) where only 14 hard coral species were encountered.

At Pungtod reef, percent cover of live corals was lowest at the southwest end of the reef (PNTD4, 12%) and highest at the eastern end (PNTD3, 26%) where stands of branching and table corals are still present (Table 4, Fig. 9 and 10). Percent live hard coral cover at the mid-section (PNTD1) of the reef was 16-18%. Live soft corals were abundant (46%) on the southwest end. Fourteen to 45 hard coral species were seen along the transect lines at Pungtod. The midsection is the shallowest area and had the highest percentage of coral rubble, again indicating that this portion of the reef has undergone considerable damage.

Tigpuyo reef had a very low percentage of live hard coral (4-9%) and live soft coral cover (10-14%; Table 5, Fig. 11 and 12). Only 10-15 hard coral species were seen at Tigpuyo. Like the other patch reefs Tigpuyo had a high percent cover of coral rubble (average of 46%). Together with the very low percentage of total coral cover (average of 18%), this reef appears to be the most damaged among the patch reefs surveyed in Ibajay and Tangalan, possibly because of its closer proximity to shore and therefore easily accessible even to non-motorized boats. A distinctive feature of Tigpuyo reef was the presence of numerous whip corals and sea fans.

Table 6 . Checklist of hard (scleractinian, "buhi nga pagang") corals censused at fringing and patch reefs in Ibajay and Tangalan, Aklan

	Species	Fringing reef				Patch reef		
		Apga Point	Bgy. Jawili	Sigat Point	Bgy. Bugtong Bato	Panga-yawan	Tigpuyo	Pungtod
A. Family Pocilloporidae								
1	*Pocillopora damicornis*		x			x	x	x
2	*Pocillopora meandrina*							x
3	*Pocillopora verrucosa*		x			x		x
4	*Seriatopora hystrix*		x		x	x	x	x
5	*Seriatopora caliendrum*	x				x		
6	*Stylophora pistillata*		x		x	x		x
B. Family Acroporidae								
7	*Acropora aculeus*					x		
8	*Acropora brueggemanni*					x		
9	*Acropora caroliniana*					x		
10	*Acropora cerealis*					x		x
11	*Acropora clathrata*					x	x	
12	*Acropora cytherea*					x		x
13	*Acropora digitifera*					x		
14	*Acropora echinata*					x		
15	*Acropora florida*					x	x	x
16	*Acropora formosa*					x		
17	*Acropora gemmifera*							x
18	*Acropora granulosa*			x		x		
19	*Acropora humilis*							x
20	*Acropora latistella*							x
21	*Acropora longicyathus*		x			x		
22	*Acropora loripes*					x		
23	*Acropora multiacuta*			x				
24	*Acropora nana*					x		x
25	*Acropora nasuta*			x		x	x	x
26	*Acropora nobilis*		x					x
27	*Acropora palifera*							x
28	*Acropora tenuis*					x		x
29	*Acropora valenciennesi*		x					
30	*Anacropora matthai*					x		x
31	*Montipora aequituberculata*	x	x			x		x
32	*Montipora danae*			x		x		x
33	*Montipora foliosa*					x		
34	*Montipora monasteriata*		x		x	x	x	x
35	*Montipora spumosa*			x		x		
36	*Montipora stellata*					x		x
37	*Montipora undata*					x		x
38	*Montipora tuberculosa*							x
39	*Astreopora myriophthalma*	x	x		x	x	x	x
C. Family Poritidae								
40	*Porites annae*		x		x		x	
41	*Porites cylindrica*							x
42	*Porites lobata*	x					x	
43	*Porites lutea*	x	x	x	x	x	x	x
44	*Porites rus*					x		x
45	*Goniopora* sp.			x	x	x		
D. Family Siderastreidae								
46	*Psammocora profundacella*		x		x	x		x
E. Family Agariciidae								
47	*Pavona cactus*				x	x	x	
48	*Pavona explanulata*	x						x
49	*Pavona varians*					x	x	
50	*Pavona venosa*					x		x
51	*Coeloseris mayeri*				x	x		x
52	*Leptoseris papyracea*					x		
53	*Pachyseris speciosa*	x		x	x	x		x

Table 6 (cont'd)

	Species	Fringing reef				Patch reef		
		Apga Point	Bgy. Jawili	Sigat Point	Bgy. Bugtong Bato	Panga-yawan	Tigpuyo	Pungtod
F. Family Fungiidae								
54	*Fungia concinna*					x		x
55	*Fungia echinata*					x		
56	*Fungia repanda*				x	x		x
57	*Fungia scutaria*							x
58	*Fungia valida*							x
59	*Herpolitha limax*					x		
60	*Podabacia crustacea*			x	x			x
G. Family Oculinidae								
61	*Galaxea astreata*			x	x	x		x
H. Family Pectiniidae								
62	*Echinophyllia aspera*			x			x	x
63	*Pectinia paeoniae*						x	
I. Family Mussiidae								
64	*Acanthastrea echinata*							x
65	*Lobophyllia hemprichii*		x	x		x	x	x
66	*Symphyllia radians*						x	
J. Family Merulinidae								
67	*Hydnophora exesa*						x	
68	*Hydnophora microconos*				x	x		x
69	*Hydnophora rigida*				x			x
70	*Merulina ampliata*		x		x	x		x
K. Family Faviidae								
71	*Caulastrea furcata*							x
72	*Echinopora gemmacea*							x
73	*Echinopora lamellosa*			x		x		x
74	*Leptoria phrygia*					x		
75	*Platygyra pini*					x		
76	*Platygyra sinensis*		x		x	x		x
77	*Goniastrea aspera*			x		x		x
78	*Goniastrea pentagona*							x
79	*Goniastrea retiformis*			x		x		x
80	*Favites abdita*					x		
81	*Favites flexuosa*				x	x		
82	*Favites halicora*		x		x	x	x	x
83	*Favites russelli*			x		x		x
84	*Favites pentagona*						x	x
85	*Favia favus*		x			x	x	
86	*Favia laxa*							x
87	*Favia pallida*					x		x
88	*Leptastrea transversa*				x			x
89	*Cyphastrea japonica*						x	
90	*Cyphastrea microphthalma*		x				x	x
91	*Diploastrea heliopora*		x	x			x	x
92	*Montastrea curta*	x	x	x		x		x
93	*Montastrea valenciennesi*		x	x		x	x	x
94	*Barabattoia amicorum*					x		x
95	*Oulastrea crispata*							x
L. Family Caryophyllidae								
96	*Euphyllia glabrescens*						x	
M. Family Dendrophylliidae								
97	*Turbinaria reniformis*	x	x	x	x			
Total number of families		**6**	**8**	**9**	**10**	**12**	**8**	**10**
Total number of species		**9**	**22**	**21**	**22**	**68**	**20**	**60**

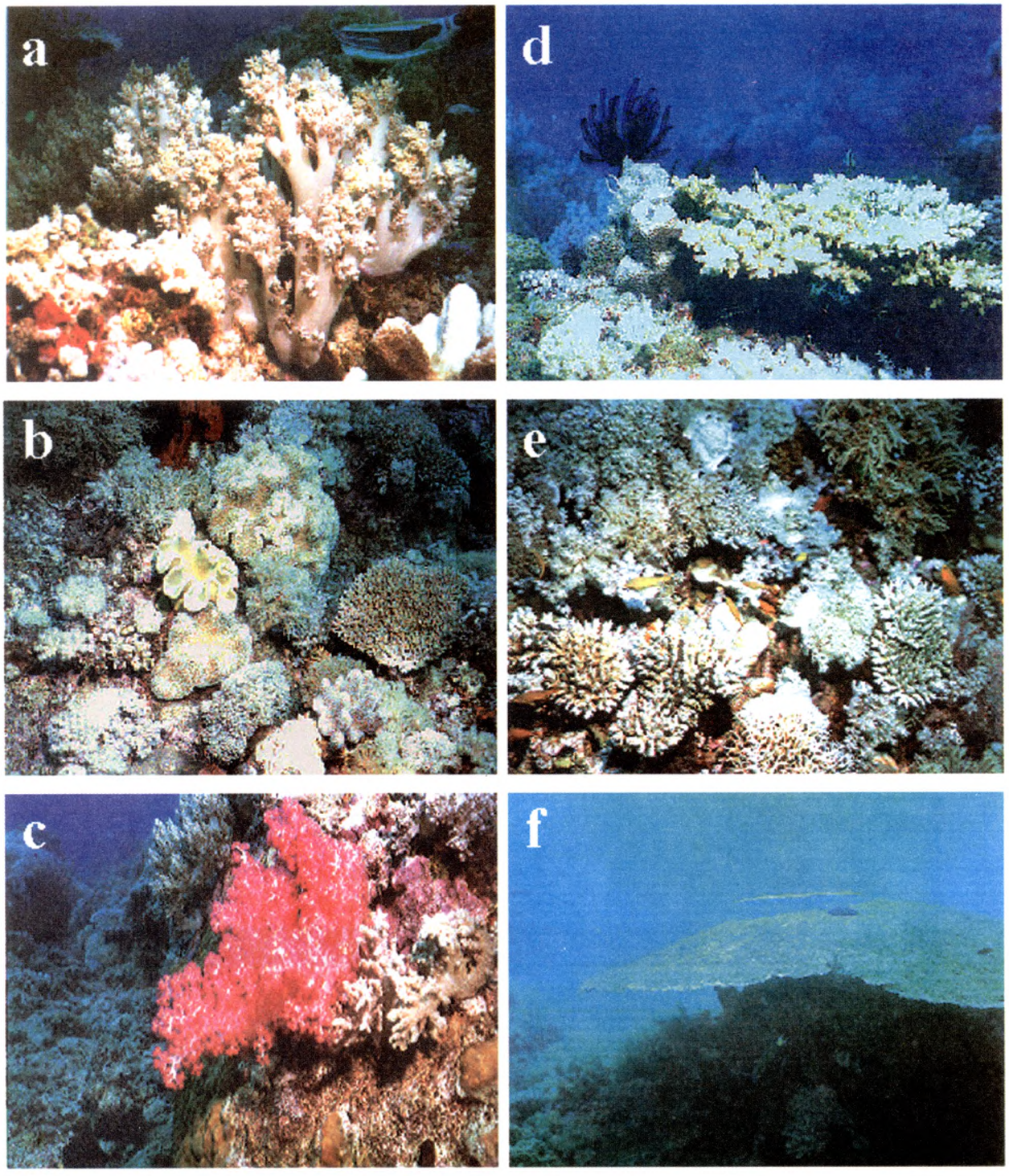

Figure 7. Pangayawan reef in Tangalan and Ibajay, Aklan at 7.6-13.7 m depth. Panels a to c show soft corals; d to f are hard corals in various stages of bleaching. Refer also to Tables 3 and 8 and, Fig. 3

Table 7. Checklist of soft corals censused at patch reefs in Tangalan Aklan. No listing of these corals at Pangayawan reef was conducted

Species	Pungtod	Tigpuyo
A. Family Alcyoniidae		
1 *Lobophyton* sp.	x	x
2 *Sarcophyton* sp.	x	x
3 *Sinularia* sp.	x	
B. Family Xeniidae		
4 *Anthelia* sp.	x	x
5 *Xenia* sp.	x	x
C. Family Nephtheidae		
6 *Nepthea sp.*	x	
7 *Dendronepthea* sp.	x	
Total number of families	**3**	**2**
Total number of species	**7**	**4**

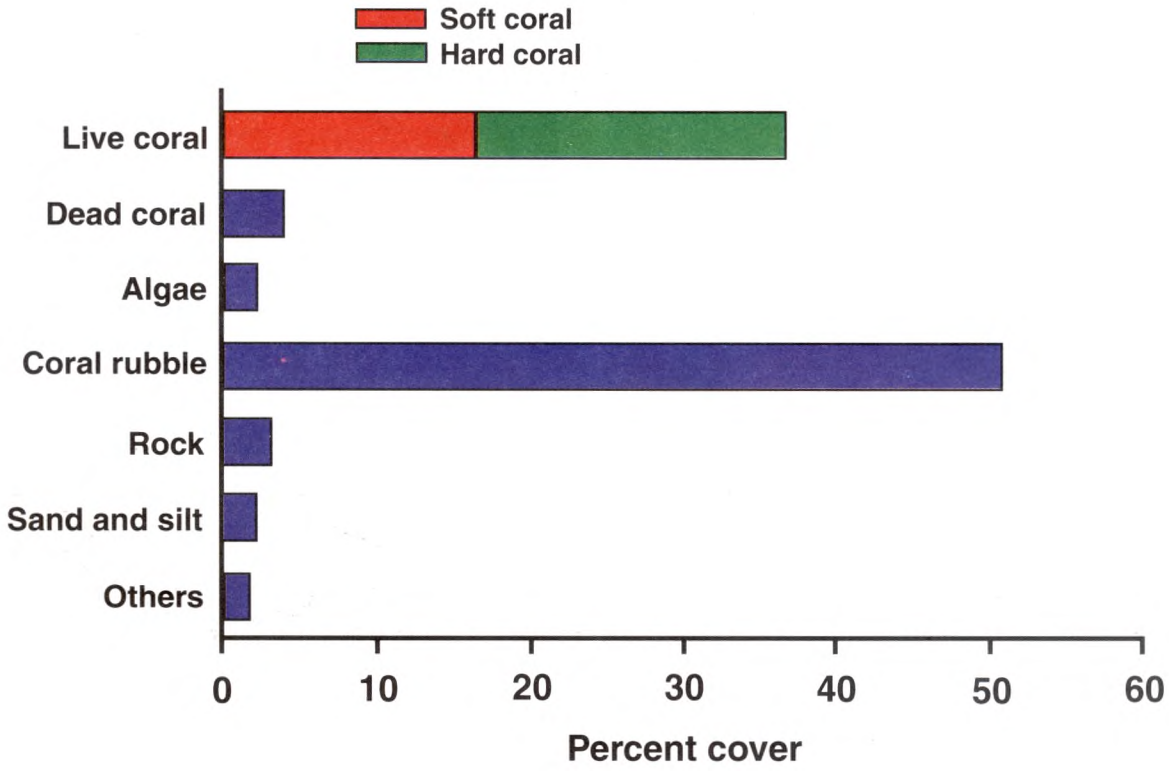

Figure 8. Average percent cover of bottom traits of Pangayawan reef, Aklan. Refer also to Table 3 and Fig. 7

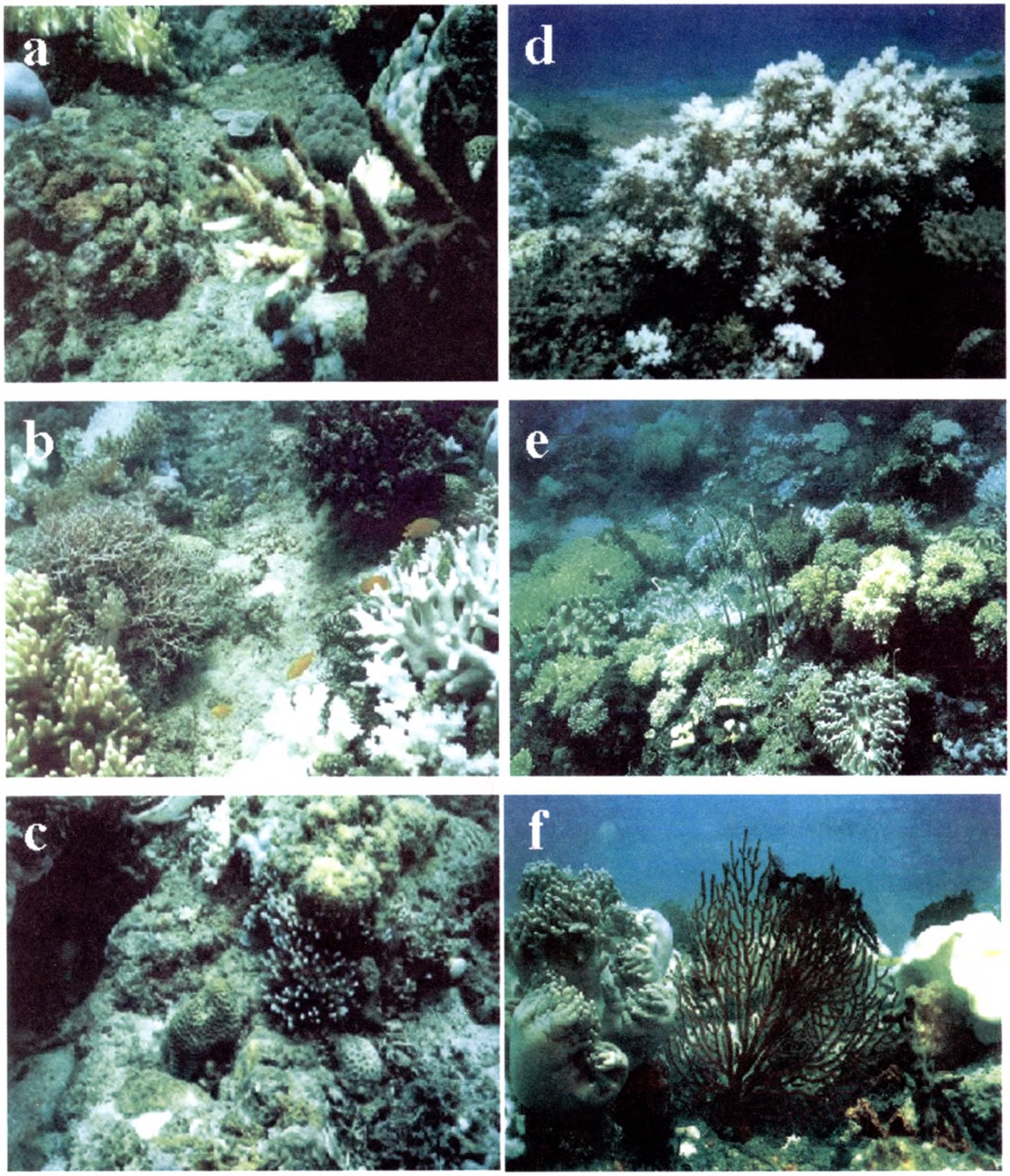

Figure 9. The coral community of Pungtod reef in Tangalan, Aklan at 4.6-10.7 m depth. Note the silty substrate with many bleached and dead corals (a-d). Whip and fan corals among soft coral are shown in panels e and f

Coral Bleaching

At Pungtod and Tigpuyo reefs in Tangalan, an unusual number of bleached hard and soft corals were observed during the survey (Table 8, Fig. 8 and 10). This unusual occurrence may have been the result of a combination of human-induced (siltation, freshwater run-off, etc.) and natural events, particularly the warming of surface sea temperatures over a wide area due to the El Niño phenomenon in 1998 (Gleason, 1993; Meehan and Ostrander, 1997; Fabricius, 1999; Wesseling et al., 1999). From 3% to 6% (average of 5%) of total live and dead hard corals and from 0.3% to 2% (average of 1%) of total live and dead soft corals were bleached at Pungtod reef while at Tigpuyo reef 0.6-1% (average of 1%) of total live and hard hard corals and an average of 10% of total live and dead soft corals were bleached (Table 9). Hard and soft corals were in various stages of bleaching, indicating that this event occurred probably a few weeks prior to the survey. Soft corals were also in various stages of disintegration. Bleached corals were not observed during a survey in July and August 1998 at Pangayawan reef about 5 km northwest of Pungtod reef, although a few colonies of the massive coral *Porites* were found bleached at the fringing reef fronting Bgy. Jawili during the survey of July 1998. Fifty five to 64 bleached corals were counted over a 500 m^2 area on two of the sites at Pungtod reef. Most of the bleached hard corals were branching corals belonging to the genus *Acropora* and *Pocillopora* although other species in various degrees of bleaching were also noted (Table 8). Dead and bleached soft corals belong to the genera *Sarcophyton*, *Lobophyton*, and *Sinularia*.

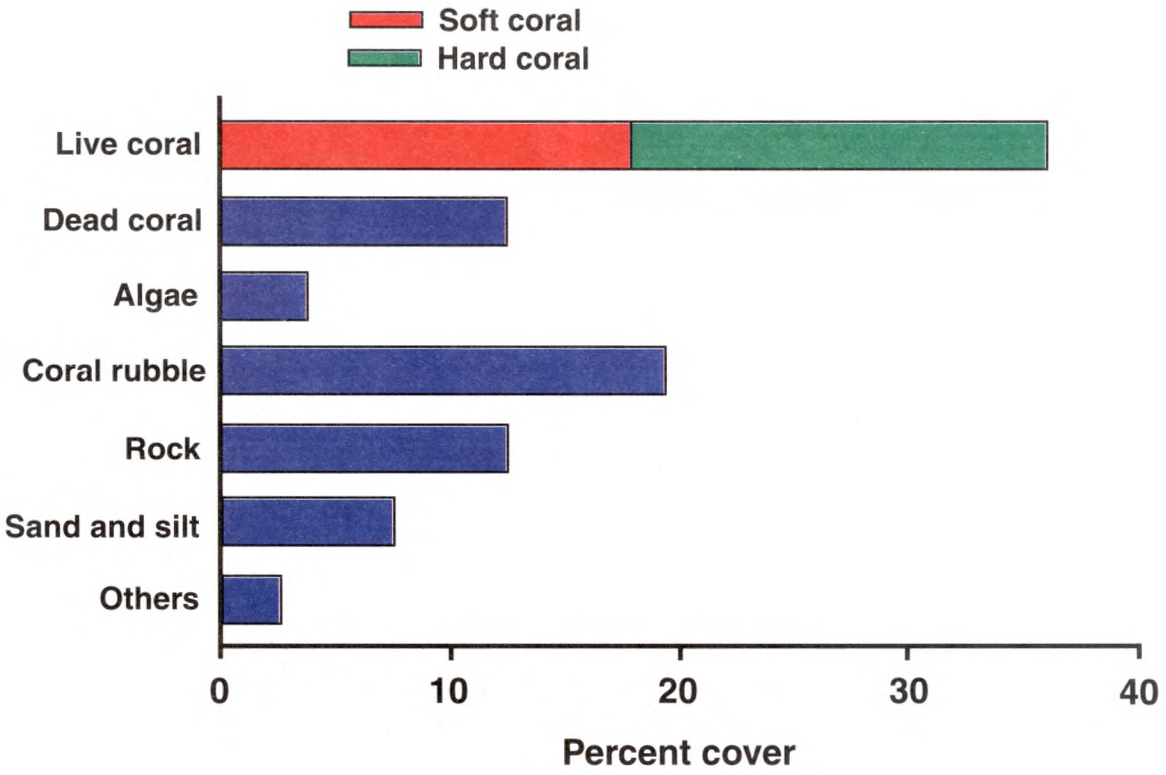

Figure 10. Average percent cover of bottom traits of Pungtod reef in Tangalan, Aklan. Refers also to Table 4 and Fig. 9

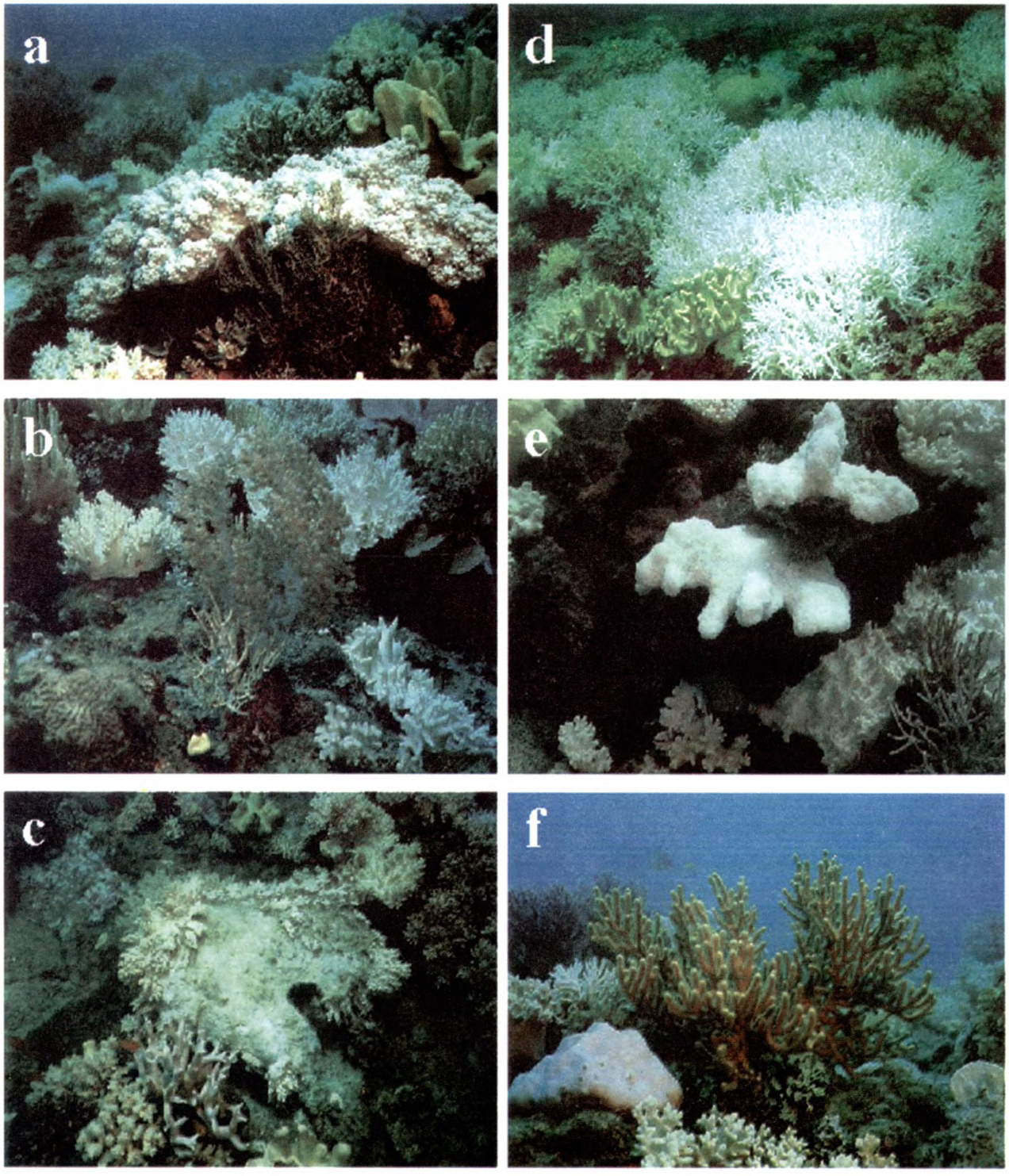

Figure 11. Bleached hard and soft corals at Pungtod and Tigpuyo reefs in Tangalan, Aklan. Soft corals in various stages of bleaching and decay are shown in panels a-c. Bleached hard coral affect both branching (d), digitate (e), and massive (f) growth forms

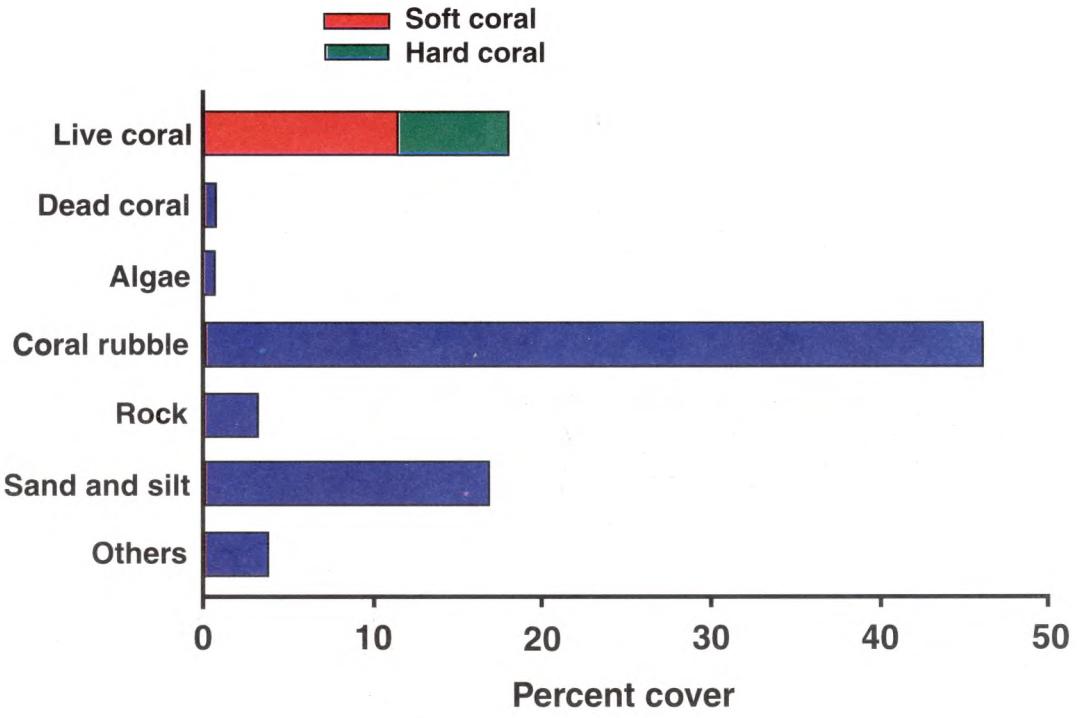

Figure 12. Average percent cover of bottom traits of Tigpuyo reef in Tangalan, Aklan. Refer also to Table 5 and Fig.10

Table 8. Checklist of bleached and dead hard and soft coral species censused at two patch reefs in Tangalan, Aklan

Species	Pungtod	Tigpuyo
Family Pocilloporide		
1 Pocillopora damicornis	x	x
2 Seriatopora hystrix	x	x
3 Stylophora pistillata	x	x
Family Acroporidae		
4 Acropora sp.	x	
5 Acropora palifera	x	
6 Acropora grandis	x	
7 Acropora echinata	x	
8 Acropora nobilis	x	
9 Acropora valenciennesi	x	
10 Anacropora matthai	x	
11 Montipora danae	x	
12 Montipora sp.	x	x
13 Montipora stellata	x	
Family Poritidae		
14 Porites lutea	x	
15 Porites sp.	x	
Family Agariciidae		
16 Pavona explanulata	x	
17 Pavona venosa		x
18 Pachyseris speciosa		x
Family Fungiidae		
19 Fungia sp.	x	
Family Faviidae		
20 Goniastrea retiformis	x	
21 Montastrea sp.		x
Family Alcyoniidae		
22 Lobophyton sp.	x	x
Total number of families	**6**	**4**
Total number of species	**18**	**8**

Table 9. Incidence of bleached hard and soft corals at Pungtod and Tigpuyo reefs in Tangalan, Aklan on September 1998

Reef Transect Number	Hard Corals		Soft Corals	
	Total[a]	Bleached[a]	Total[a]	Bleached[a]
Pungtod (PNTD)				
PNTD1	24.1	6.3	5.7	2.1
PNTD2	22.4	5.9	13.9	0.3
PNTD3	30.0	4.3	9.0	0.5
PNTD4	14.8	2.5	47.2	1.1
Average cover	**22.8**	**4.8**	**19.0**	**1.0**
Tigpuyo (TGP)				
TGP1	5.4	1.4	25.9	12.3
TGP2	9.1	0.6	18.2	8.4
Average cover	**7.3**	**1.0**	**22.1**	**10.4**

[a] Percent of total cover of both live and dead corals estimated by a line-intercept transect method.

Reef Fish

A checklist of fishes censused at the fringing and patch reefs of Ibajay and Tangalan is presented in Table 10. A total of 128 species from 27 families was recorded during the brief survey.

Fringing Reef

The community of reef fish in the fringing reef along the coastline of Bgy. Bugtong Bato, Jawili, Dumatad, and Apga Point consisted of 61 species from 19 familes (Table 10). Comprising about 65% of total fish censused, damselfishes (*palata*) were most abundant followed by wrasses (*pilog, banog, mameng*) at about 8% and fusiliers (*sulig*) about 7%.

Although commercially important species (i.e., target species or those favored by fishers) represented about 60% of total reef fish biomass and 15% of abundance, their estimated yield was low (1.6 t per km^2; Table 11). Parrotfishes (*molmol*) comprised about 42% of total biomass of target species followed by barracuda (23%) and fusiliers (14%).

Patch Reefs

Composed of 109 species from 18 families, the reef fish community in Pangayawan reef had one of the most diverse assemblages of fish among the reefs surveyed in Tangalan and Ibajay (Table 10). Anthiids (*butlogan*) were most numerous, comprising about 45% of total fish censused followed by damselfishes (26%) and wrasses (16%). Fusiliers contributed only 7% in number but comprised the largest part of total biomass at about 34%. Surgeonfishes (*surahan, komay, badok, indangan*) followed in biomass with about 19% and parrotfishes 11%.

Commercially important fishes comprised 71% of total biomass and 11% in number, but estimated yield was at 5.9 t per km^2. (Table 12). Fusiliers (59%) and surgeonfishes (20%) were most abundant among target species from Pangayawan reef, although parrotfishes (15%) comprised the bulk of biomass of target fishes.

Composed of 77 species from 18 families, the reef fish community in Pungtod reef was the most diverse among the reefs surveyed (Table 10). Damselfishes were the most abundant comprising about 78% of the total fish censused. Surgeonfishes and parrotfishes represented the largest biomass contributing about 20% each. Fusiliers and butterfly fishes (*alibang-bang*) comprised 11% each of the total estimated biomass while damselfishes followed comprising about 9%.

Table 10 . Checklist of reef fish censused at the fringing and patch reefs of Ibajay and Tangalan, Aklan. Species under families in bold print are economically important fishes. Common name(s) in Hiligaynon are italicized in parenthesis

Species	Fringing reef				Patch reef		
	Apga Point	Bgy. Jawili	Sigat Point	Bgy. Bugtong Bato	Panga-yawan	Tigpuyo	Pungtod
1. **Family Acanthuridae (*barangon, badok, komay, surahan*)**							
1 *Acanthurus pyroferus*				x	x	x	
2 *Acanthurus thompsoni*							x
3 *Ctenochaetus binotatus*					x		
4 *Ctenochaetus striatus*	x				x	x	
5 *Naso hexacanthus*					x	x	
6 *Naso lituratus*							x
7 *Zebrasoma scopas*		x			x	x	
2. **Family Apogonidae (*parangan*)**							
8 *Apogon* sp.		x	x				
3. **Family Balistidae (*pakol*)**							
9 *Balistapus undulatus*			x	x	x	x	
10 *Sufflamen bursa*					x	x	x
11 *Sufflamen chrysopterus*							x
4. **Family Caesionidae (*sulig*)**							
12 *Caesio caerulaurea*				z	x	x	
13 *Caesio cuning*						x	
14 *Caesio digramma*						x	
5. **Family Carangidae (*mamsa*)**							
15 *Caranx* sp.							x
6. **FamilyCentriscidae (*sipul-sipul*)**							
16 *Aeoliscus strigatus*	x						
7. **Family Chaetodontidae (*alibang-bang*)**							
17 *Chaetodon baronessa*		x			x		x
18 *Chaetodon kleinii*				x	x	x	
19 *Chaetodon lineolatus*							x
20 *Chaetodon melannotus*			x	x	x	x	x
21 *Chaetodon mertensii*						x	
22 *Chaetodon mesoleucus*						x	
23 *Chaetodon octofasciatus*	x	x					
24 *Chaetodon punctatofasciatus*	x				x	x	
25 *Chaetodon speculum*					x		
26 *Chaetodon trifasciatus*					x	x	
27 *Coradion chrysozonus*			x			x	x
28 *Heniochus acuminatus*						x	
29 *Heniochus varius*				x	x	x	
8. **Family Cirrhitidae**							
30 *Paracirrhites arcatus*					x		x
9. **Family Fistulariidae (*torotot*)**							
31 *Fistularia commersonii*					x		
10. **Family Gobiidae**							
32 *Amblygobius hectori*			x				
11. **Family Haemulidae (*bakoko*)**							
33 *Plectorhinchus diagramma*		x					
12. **Family Kyphosidae**							
34 *Kyphosus gibbus*					x		
13. **Family Labridae (*pilok banog, mameng*)**							
35 *Anampses meleagrides*					x	x	
36 *Bodianus diana*					x		
37 *Bodianus mesothorax*						x	x
38 *Cheilinus chlorourus*						x	
39 *Cheilinus diagrammus*			x	x	x	x	
40 *Cheilinus unifasciatus*					x		
41 *Choerodon anchorago*							x
42 *Cirrhilabrus cyanopleura*			x		x	x	x
43 *Coris gaimard*					x		
44 *Coris schroederi*						x	
45 *Coris variegata*						x	x
46 *Diproctacanthus xanthurus*		x			x	x	
47 *Epibulus insidiator*			x				x
48 *Halichoeres biocellatus*	x	x					x
49 *Halichoeres chrysus*					x		
50 *Halichoeres hortulanus*	x				x	x	
51 *Halichoeres prosopeion*	x						
52 *Halichoeres* sp.						x	
53 *Hologymnosus doliatus*						x	
54 *Labroides dimidiatus*	x	x				x	
55 *Labropsis australis*							x
56 *Pseudocheilinus evanidus*		x					
57 *Thalassoma hardwicki*					x	x	
58 *Thalassoma lunare*	x	x	x	x	x	x	x
14. **Family Lutjanidae (*maya-maya*)**							
59 *Lutjanus bohar*					x		
60 *Lutjanus decussatus*		x			x	x	x
61 *Lutjanus fulvus*					x		
62 *Lutjanus* sp.				x			
63 *Macolor macularis*						x	

Species	Fringing reef				Patch reef		
	Apga Point	Bgy. Jawili	Sigat Point	Bgy. Bugtong Bato	Panga-yawan	Tigpuyo	Pungtod
15. Family Monacanthidae							
64 *Amanses scopas*						x	
16. Family Mullidae (*bayabao*)							
65 *Parupeneus barberinus*			x				
66 *Parupeneus barberinoides*					x	x	
67 *Parupeneus multifasciatus*					x	x	
68 *Parupeneus indicus*	x						
17. Family Nemipteridae							
69 *Pentapodus paradiseus*						x	
70 *Pentapodus sp.*					x		
71 *Scolopsis bilineatus*	x				x	x	x
72 *Scolopsis ciliatus*							x
73 *Scolopsis* sp.				x			
18. Family Ostraciidae (*kaban-kaban*)							
74 *Ostracion solorensis*				x		x	
19. Family Pinguipedidae							
75 *Parapercis hexophthalma*	x				x	x	x
76 *Parapercis millepunctata*						x	x
20. Family Pomacanthidae (*alibang-bang*)							
77 *Centropyge bicolor*					x		
78 *Centropyge bispinosus*					x		
79 *Centropyge vroliki*					x	x	x
80 *Genicanthus lamarck*					x	x	
81 *Pygoplites diacanthus*					x	x	
21. Family Pomacentridae (*palata*)							
82 *Amblyglyphidodon aureus*					x		
83 *Amblyglyphidodon curacao*		x	x	x	x	x	x
84 *Amblyglyphidodon leucogaster*		x		x	x	x	
85 *Amphiprion clarkii*				x	x		
86 *Amphiprion perideraion*		x					
87 *Chromis amboinensis*						x	
88 *Chromis atripectoralis*			x			x	
89 *Chromis retrofasciatus*					x	x	
90 *Chromis viridis*						x	
91 *Chromis weberi*					x	x	x
92 *Chromis xanthura*						x	x
93 *Dascyllus aruanus*		x	x	x		x	
94 *Dascyllus reticulatus*		x		x	x	x	x
95 *Dascyllus trimaculatus*					x	x	x
96 *Neoglyphidodon melas*			x		x	x	
97 *Neoglyphidodon thoracotaeniatus*		x		x		x	
98 *Plectroglyphidodon lacrymatus*						x	x
99 *Pomacentrus alexanderae*		x	x	x			
100 *Pomacentrus amboinensis*		x	x		x	x	x
101 *Pomacentrus brachialis*	x		x		x	x	x
102 *Pomacentrus coelestis*	x				x	x	x
103 *Pomacentrus lepidogenys*		x			x	x	x
104 *Pomacentrus moluccensis*		x		x	x	x	x
105 *Pomacentrus nigromarginatus*				x	x		
106 *Pomacentrus philippinus*		x	x	x			
107 *Pomacentrus stigma*			x			x	
108 *Pomacentrus taeniometopon*							x
109 *Pomacentrus vaiuli*	x	x				x	
110 *Stegastes nigricans*		x		x			
22. Family Scaridae (*molmol*)							
111 *Scarus bleekeri*			x				
112 *Scarus dimidiatus*			x	x	x	x	x
113 *Scarus flavipectoralis*							x
114 *Scarus oviceps*					x		x
115 *Scarus sordidus*			x	x	x	x	x
116 *Scarus sp.*			x		x		
23. Family Serranidae, Subfamily Epinephelinae (*inid, bayat*)							
118 *Aethaloperca rogaa*						x	
119 *Cephalopholis microprion*						x	
120 *Cephalopholis miniata*					x		
121 *Gracila albomarginata*					x		
122 *Variola louti*					x		
23. Family Serranidae, Subfamily Anthiinae (*botlogan*)							
123 *Pseudanthias huchtii*	x				x	x	x
24. Family Siganidae (*samaral, danggit*)							
124 *Siganus corallinus*						x	
125 *Siganus doliatus*					x	x	
25. Family Sphyraenidae (*barakuda*)							
126 *Sphyraena barracuda*			x				
26. Family Synodontidae (*tiki-tiki*)							
127 *Synodus* sp.							
27. Family Zanclidae (*alibang-bang*)					x	x	
128 *Zanclus cornutus*							
Number of Species	16	24	25	24	68	77	41
Number of Families	9	7	10	10	18	19	13

Commercially important fish groups comprised about 66% of total biomass but only about 14% of total number of fish censused (Table 13). Surgeonfishes and fusiliers dominated both abundance and biomass of commercially important species censused. The estimated yield of target fishes from Pungtod reef was 3.8 t per km^2.

Forty one species from 13 families were censused in Tigpuyo reef. Damselfishes were also numerically dominant comprising about 58% of total fish censused (Table 10). Anthiids and wrasses followed in abundance at about 19% and 8%, respectively. Parrotfishes represented the largest biomass at about 31% followed by butterflyfishes (27%), fusiliers (8%), triggerfishes (*pakol, payagot,* 7%), threadfin breams (6%) and damsels (6%).

Commercially important fish groups comprised about 48% of the total biomass but only about 10% of the total fish censused (Table 14). Fusiliers (51%) dominated abundance but 65% of biomass was composed of parrotfishes. The estimated yield of target fishes in Tigpuyo reef was 1.0 t per km^2 , the lowest among the reefs surveyed.

Table 11. Abundance and biomass of the top five families of economically important reef fishes censused at the fringing reef from Apga Point to Bgy. Bugtong Bato in Aklan

Family	Common Name		Abundance		Biomass (kg)	
	English	Hiligaynon	Per km^2	%[a]	Per km^2	%[a]
Scaridae	parrotfish	*molmol*	11,000	23.9	0.7	41.8
Sphyraenidae	barracuda	*barakuda*	5,000	10.9	0.4	23.2
Caesionidae	fusilier	*sulig*	20,000	43.5	0.2	14.4
Acanthuridae	surgeonfish	*barangon, badok*	3,500	7.6	0.2	11.4
Mullidae	goatfish	*timbungan*	4,000	8.7	0.1	
Estimated yield	**1.6 t per km^2**					

[a] Percentage of total abundance and biomass of economically important reef fishes censused.

Table 12. Abundance and biomass of the top five families of economically important reef fishes censused at Pangayawan reef in Aklan

Family	**Common Name**		**Abundance**		**Biomass (kg)**	
	English	**Hiligaynon**	**Per km^2**	**%[a]**	**Per km^2**	**%[a]**
Caesionidae	fusilier	*sulig*	110,000	58.9	2.8	48.0
Acanthuridae	surgeonfish	*barangon, badok*	37,333	20.0	1.6	29.0
Scaridae	parrotfish	*molmol*	20,667	11.1	0.9	15.4
Serranidae (Epinephelinae)	grouper	*inid, bayat*	2,000	1 .1	0.2	3.2
Siganidae	rabbitfish	*samaral, danggit*	2,000	1.1	0.1	1.7
Estimated yield	**5.9 t per km^2**					

[a] Percentage of total abundance and biomass of economically important reef fishes censused.

Table 13. Abundance and biomass of the top five families of economically important reef fishes censused at Pungtod reef in Tangalan, Aklan

Family	Common Name		Abundance		Biomass(kg)	
	English	Hiligaynon	Per km²	%[a]	Per km²	%[a]
Acanthuridae	surgeonfish	*barangon, badok*	20,500	21.5	1.2	30.8
Scaridae	parrotfish	*molmol*	20,000	20.0	1.2	30.1
Caesionidae	fusilier	*sulig*	37,500	3.9	0.6	16.3
Lutjanidae	snapper	*maya-maya, gingaw, bulian, dapak*	2,000	2.1	0.4	10.5
Serranidae (Epinephelinae)	grouper	*inid, bayat*	1,000	1.0	0.2	4.2
Estimated yield		**3.8 t per km²**				

[a] Percentage of total abundance and biomass of economically important reef fishes censused.

Table 14. Abundance and biomass of the top five families of economically important reef fishes censused at Tigpuyo reef in Tangalan, Aklan

Family	Common Name		Abundance		Biomass(kg)	
	English	Hiligaynon	Per km²	%[a]	Per km²	%[a]
Scaridae	parrotfish	*molmol*	9,000	23.1	0.7	30.1
Caesionidae	fusilier	*sulig*	20,000	51.3	0.2	15.7
Nemipteridae	threadfin bream	*tulong*	8,000	20.5	0.1	13.2
Carangidae	jackfish	*mamsa*	1,000	2.6	0.05	4.6
Lutjanidae	snapper	*maya-maya, gingaw, bulian, dapak*	1,000	2.6	0.01	1.1
Estimated yield		**1.0 t per km²**				

[a] Percentage of total abundance and biomass of economically important reef fishes censused.

Overall, the reef fish communities in Tangalan and Ibajay are composed largely of low-value, small sub-adult fish, which are not preferably targeted by fishers. The fish community in the fringing reef shows marked evidences of this condition. If transient reef fishes (*sulig*) are excluded from the analyses, the community of reef fishes in the patch reefs of Pungtod, Pangayawan, and Tigpuyo also show much of a similar trait. Despite the high estimates of abundance of surgeonfishes (*barangon, badok*) and fusiliers (*sulig*) ranging over 20,000 per km^2, their very low estimated biomass of at most 3 kg per km^2 strongly suggests that the magnitude of fishing effort in the area has resulted in fish being caught before they have time to grow, hence reducing substantially the proportion of large-size individuals in the fish stock (Russ, 1991). Indeed, the very low estimated yields of 1 to 6 t per km^2 of all targeted reef fishes from all sites surveyed are indications of an apparent state of overfishing.

Seagrass and seaweeds

The dominant substrate types observed in the intertidal zone from Apga Point to Bgy. Bugtong Bato are shown in Figs. 2 and 3. Having a rocky and rubble substrate, the area slightly west of Apga Point was dominated by *Sargassum*, but only during the wet season. *Sargassum* was present in Bgy. Bugtong Bato during the dry season. The substrate of the rest of the intertidal area surveyed varied from sandy-coralline to sandy-muddy and rocky. Among the eight seagrass species recorded in the area, *Thalassia hemprichii* (3 kg per m^2) had the highest standing biomass followed by *Cymodocea rotundata* (0.9 kg per m^2), *Halodule uninervis* (0.7 kg per m^2), *Syringodium isoetifolium* (0.6 kg per m^2), and *Halophila ovalis* (0.3 kg per m^2).

Generally, the seagrass community in the shallow parts of the intertidal areas surveyed was dominated by a mixture of *Cymodocea, Halophila, Halodule, Syringodium*, and *Thalassia* (Table 15 and Fig. 13). However, all eight species of seagrass recorded in the area surveyed were present in Bgy. Bugtong Bato, and notably, *Halodule pinifolia* was found in this place only. Stands of *Enhalus* sp. were observed in a sandy-muddy area in front of a few mangrove trees between Sigat Point and Bgy. Bugtong Bato. A few mangrove trees were also seen near Bgy. Dumatad west of Apga Point.

Three classes of macrobenthic seaweeds were collected: 10 green, 5 brown, and 12 red seaweed species (Table 15). Apga Point had the most number of macrobenthic seaweed species (25) recorded in the area surveyed; Bgy. Jawili the least (10). Although the density of seaweeds was not determined in each sampling area, seaweeds with phycolloidal importance (e.g., *Hormophysa, Sargassum, Turbinaria, Eucheuma, Gelidiella, Gracilaria, Hypnea*) and medicinal properties (e.g., *Claudea, Halymenia, Portieria*) were few in number.

The culture of *Kappaphycus alvarezii* by hanging long line was observed during the survey period in Bgy. Jawili and Bugtong Bato (Fig. 2). Poor growth was observed in both localities because of excessive grazing by herbivorous reef fishes and disease ("ice-ice").

Table 15. Distribution of seagrass and seaweed species censused September 1998 in Tangalan and Ibajay, Aklan

Species	Apga Point	Bgy. Dumatad	Bgy. Jawili	Sigat Point	Bgy. Bugtong Bato	Economic Importance
Seagrass						
Cymodocea rotundata	x	x	x	x	x	
Enhalus acoroides	x	x	x	x	x	
Halodule pinifolia					x	
Halodule uninervis		x	x	x	x	
Halophila decipiens				x	x	
Halophila ovalis			x	x	x	
Syringodium isoetifolium	x	x	x	x	x	
Thalassia hemprichii	x	x	x	x	x	
Total	4	5	6	7	8	
Seaweeds						
Chlorophyta (green)						
Bornetella nitida		x			x	
Caulerpa racemosa	x		x		x	food
Caulerpa sertularioides	x		x	x		
Caulerpa serrulata	x		x	x		
Codium sp.		x		x	x	
Halimeda macroloba	x	x	x	x	x	
Halimeda discoidea	x	x	x	x	x	
Neomeris annulata	x	x			x	
Udotea occidentalis	x	x	x			
Valonia aegagropila	x	x			x	
Phaeophyta (brown)						
Hormophysa triquetra	x	x				alginate
Padina australis	x	x	x	x	x	
Padina japonica	x	x	x	x	x	
Sargassum sp.	x					alginate
Turbinaria ornata	x					alginate
Rhodophyta (red)						
Actinotrichia fragilis	x			x	x	
Amphiroa fragilissima	x	x		x	x	
Claudea batanensis	x				x	medicine
Eucheuma cottonii	x	x			x	carrageenan
Gelidiella acerosa	x	x		x	x	food, agar
Gracilaria coronopifolia	x	x	x		x	food, agar
Gracilia echeumoides	x	x		x	x	food, agar
Halymenia durvillaei	x	x			x	food, carrageenan
Halymenia dilatata	x	x				food, carrageenan
Hypnea valentia	x	x	x		x	food, carrageenan
Mastophora rosea	x	x				
Portieria hornemanii	x				x	medicine
Total	**25**	**18**	**10**	**11**	**19**	

Mangroves

The mangrove community in Ibajay had a high level of biodiversity. A total of 21 species of mangroves, or half of the total number of Philippine species (Primavera, in press), have been identified in Ibajay (Table 16). The community parameters are presented in Table 17 (all species and all sizes), Figs. 14 and 15 (by station and species) and Figs. 16 to 19 (by species).

As a newly colonized area in the river delta, Station I had trees of low basal area (767 cm^2) and low species diversity (0.38) but a high number of stems (84,700 stems per ha), which are mainly composed of *Ceriops decandra* ("barasbaras", Figs. 14, 15 and 20). Therefore, being a young community, Station I had very few trees (i.e., small basal area) but numerous saplings. In contrast, Stations II and III were more mature communities having trees with greater basal area (2,549-4,209 cm^2) and higher species diversity (0.50-0.71). Because these latter stations have more trees, the mangrove density of 52,900-75,400 stems per ha was less compared with Station I. *Avicennia officinalis* ("apiapi") with a maximum DBH of 53 cm was encountered in these stations, suggesting a century-old growth, which was corroborated by local people (Fig. 21).

C. decandra has the highest relative density and relative frequency in all stations. In addition, high relative frequency was observed for *Nypa fruticans* ("nipa") in Station I and for *Avicennia* officinalis and A. rumphiana ("apiapi" or "miapi") in Stations II and III. Because of their size (i.e., high basal area), "apiapi"**or** "miapi" are dominant in the inner mangroves in Stations II and III, whereas "barasbaras" is dominant in Station I due to the absence of *Avicennia* species. *C. decandra* has high importance value in all stations, but *Avicennia* species were important in Stations II and III only.

Table 16. Species of mangroves censused in Bgy. Bugtong Bato, Ibajay, Aklan. Abbreviations of each species in parentheses correspond to those used in Figs. 14 to 19

Species	Common Name (Aklanon or Hiligaynon)
1. *Acanthus ebracteatus* (AE)	-
2. *Acanthus ilicifolius* (AI)	-
3. *Aegiceras floridum* (AF)	*saging saging*
4. *Avicennia marina* (AM)	*bungalon*
5. *Avicennia officinalis* (AO)	*apiapi*
6. *Avicennia rumphiana*	*apiapi*
7. *Bruguiera cylindrica* (BS)	*pototan*
8. *Camptostemon philippinensis* (CP)	*gapas gapas*
9. *Ceriops decandra* (CD)	*baras baras*
10. *Ceriops tagal* (CT)	*tangal, tongog*
11. *Excoecaria agallocha* (EA)	*alipata*
12. *Heritiera littoralis* (HL)	*dungon*
13. *Lumnitzera racemosa* (LR)	-
14. *Nypa fruticans* (NF)	*nipa*
15. *Rhizophora apiculata* (RA)	*bakauan lalaki*
16. *Rhizophora mucronata* (RM)	*bakauan babae*
17. *Rhizophora stylosa* (RS)	*bakauan*
18. *Sonneratia alba* (SA)	*pagatpat*
19. *Sonneratia caseolaris* (SC)	*pagatpat*
20. *Xylocarpus granatum* (XG)	*tabigi*
21. *Xylocarpus moluccensis* (XM)	*tabigi*

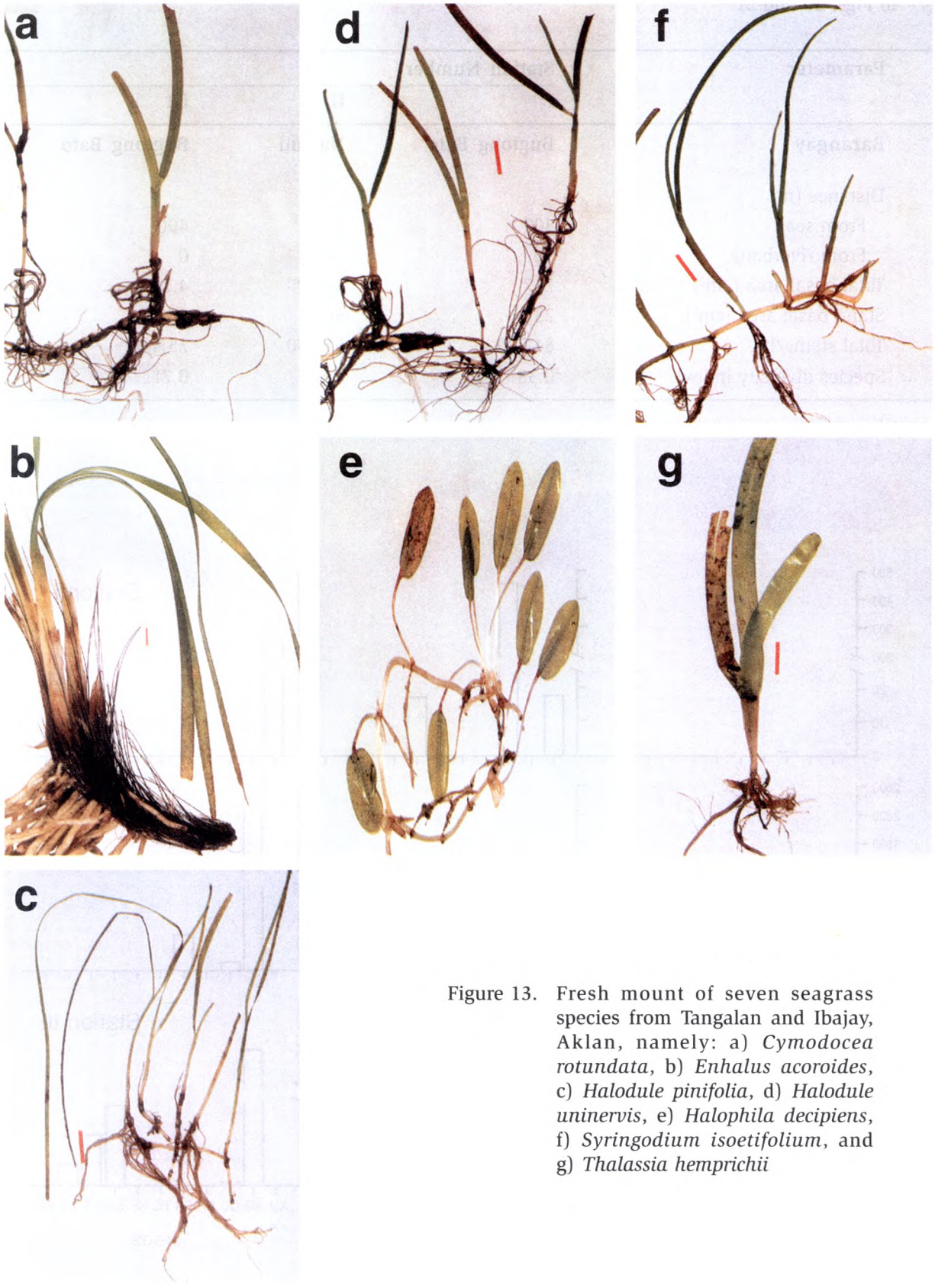

Figure 13. Fresh mount of seven seagrass species from Tangalan and Ibajay, Aklan, namely: a) *Cymodocea rotundata*, b) *Enhalus acoroides*, c) *Halodule pinifolia*, d) *Halodule uninervis*, e) *Halophila decipiens*, f) *Syringodium isoetifolium*, and g) *Thalassia hemprichii*

Table 17. Location and characteristics of sampling stations in a mangrove community in Ibajay, Aklan. Refer also to Figs. 20 and 21

Parameter	Station Number		
	I	II	III
Barangay	**Bugtong Bato**	**Naisud**	**Bugtong Bato**
Distance (m)			
From sea	300	600	400
From riverbank	30	200	0
Total basal area (cm^2)	767	2,549	4,209
Stand basal area (cm^2)	23.2	31.2	45.0
Total stems/ha	84,700	52,900	75,400
Species diversity index[a]	0.38	0.50	0.71

[a] Shannon-Wiener diversity index.

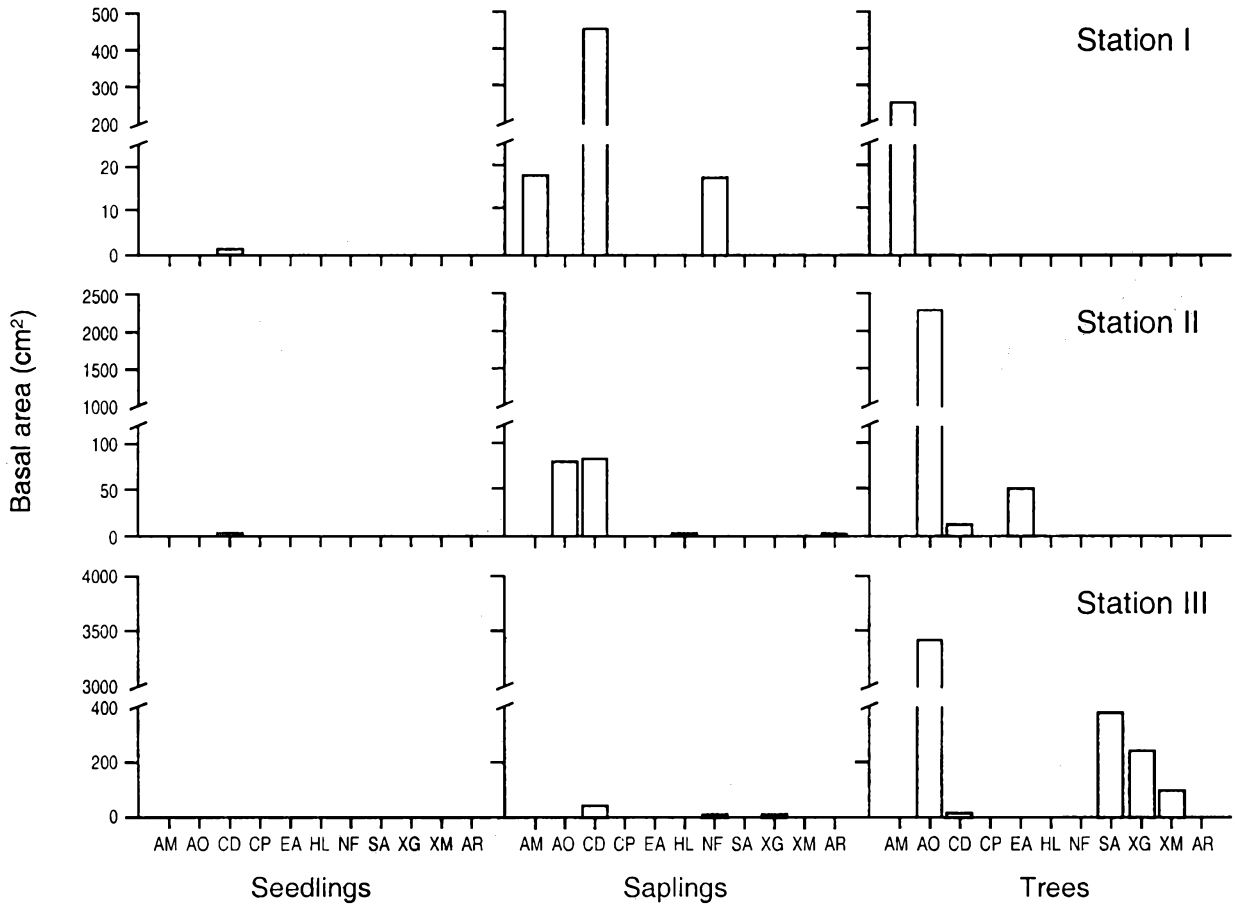

Figure 14. Basal area by stations and mangrove species. Refer to Table 16 for abbreviations.

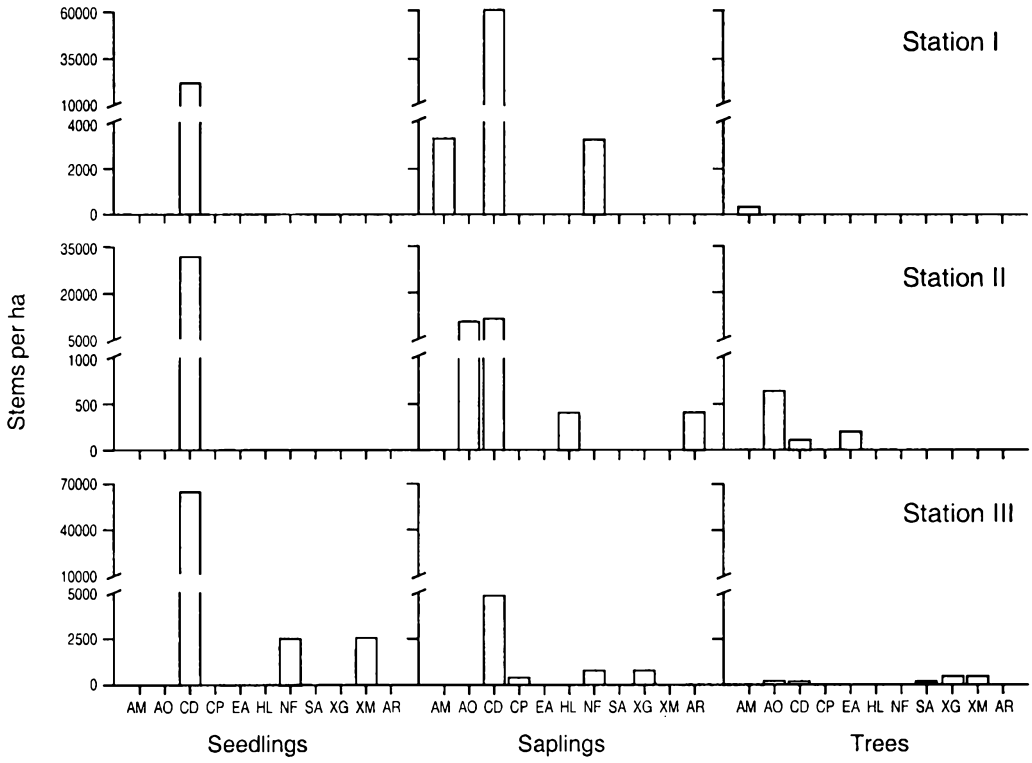

Figure 15. Stems per ha by stations and magrove species. Refer to Table 16 for abbreviations.

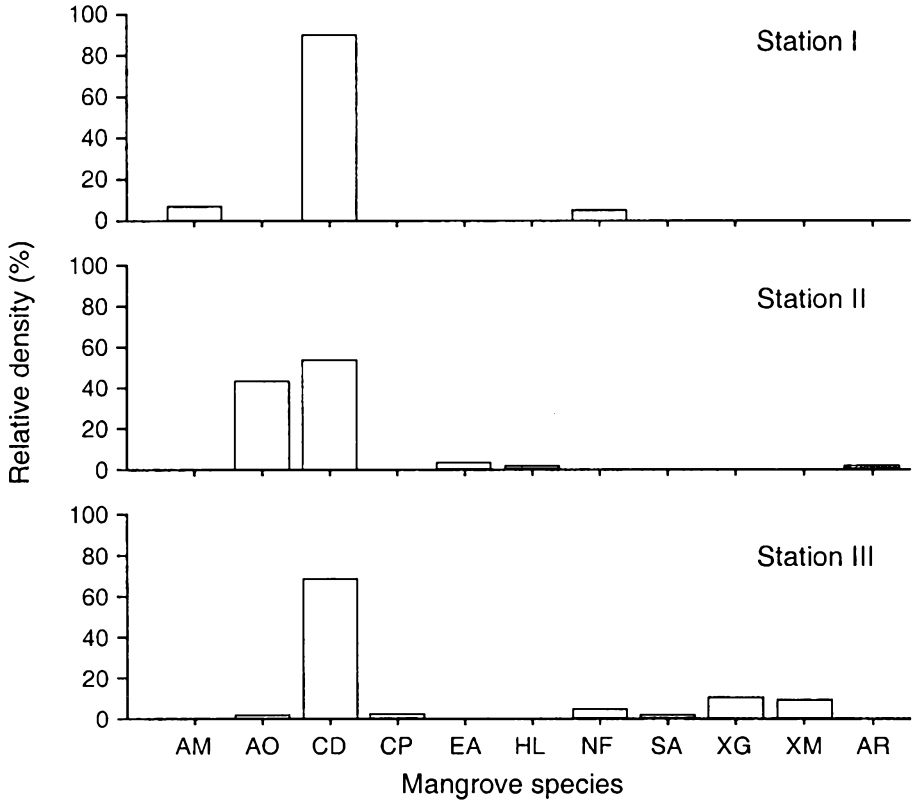

Figure 16. Relative density of mangrove species. Refer to Table 16 for abbreviations.

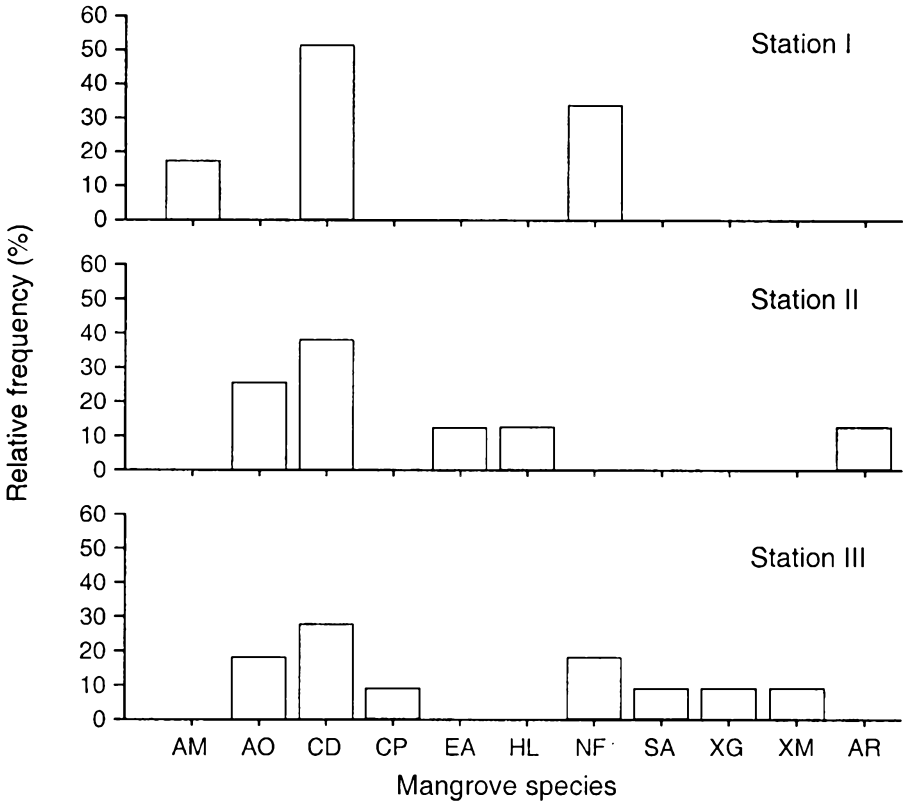

Figure 17. Relative frequency by magrove species. Refer to Table 16 for abbreviations.

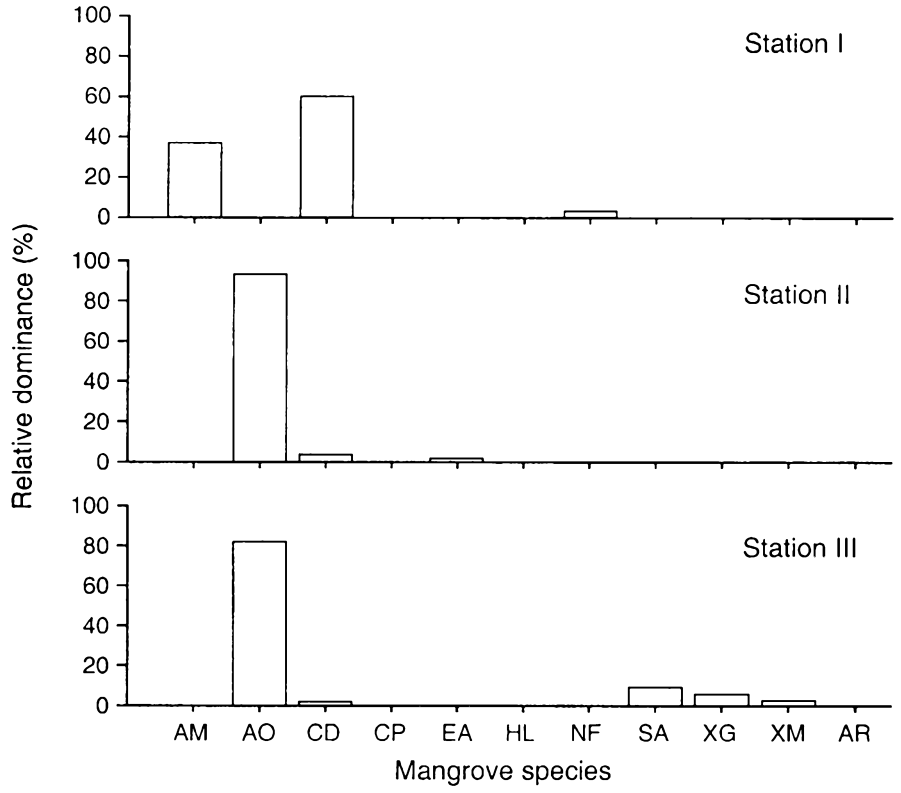

Figure 18. Relative dominance by mangrove species. Refer to Table 16 for abbreviations.

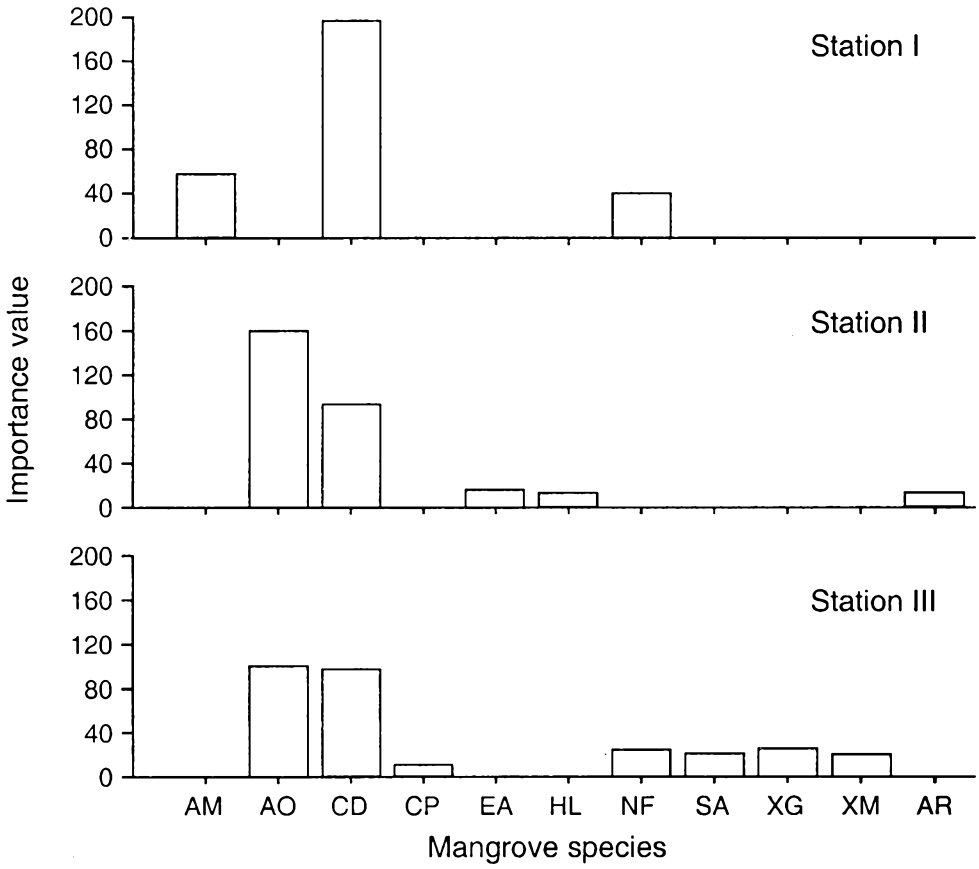

Figure 19. Importance value by mangrove species. Refer to Table 16 for abbreviations.

Figure 20. The mangrove community in Station I, Bgy. Bugtong Bato (a) and Station II, Naisud (b) in Ibajay, Aklan. Station I is a newly colonized area by the river bank dominated by seedlings and saplings of "baras baras" *Ceriops decandra*. Station II is a mature forest of "apiapi" *Avicennia officinalis* and *A. rumphiana* whose open canopy (due to cutting) allows undergrowth of "baras baras" saplings.

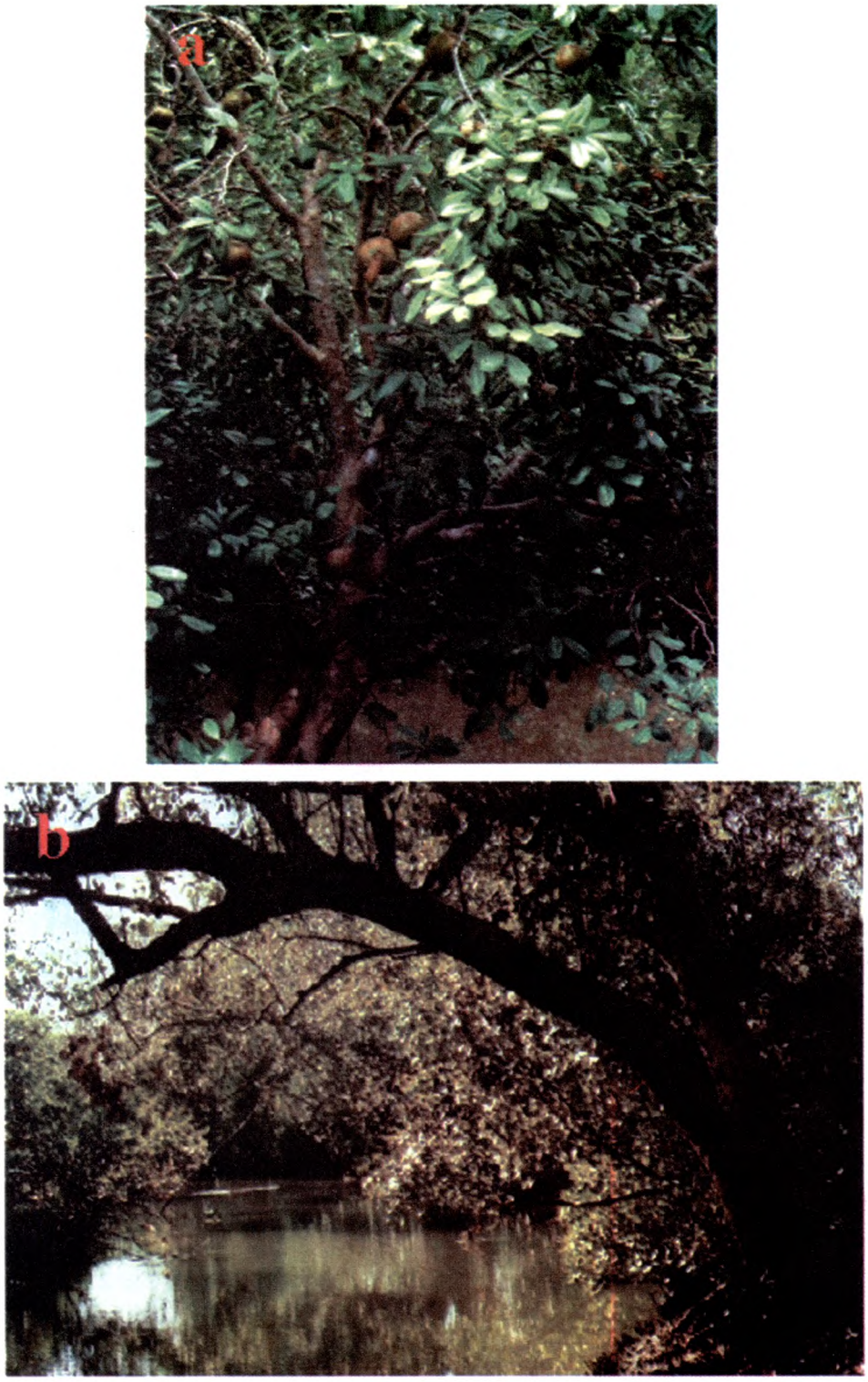

Figure 21. A mangrove community in Bgy. Bugtong Bato (Station III). Station III has the highest biomass and biodiversity among the three stations. Fruit-bearing "tabigi" *Xylocarpus granatum* (a) is one of the dominant species. "Apiapi" or *Avicennia officinalis* (b, foreground) in Station I is the dominant species in a mature mangrove community.

Socioeconomics

Village transects covering the three groups of coastal barangays in Ibajay and the municipality of Tangalan are presented in Figs. 22 to 25. The resource systems in each transect were uniform and included the mountain, farm, mangrove, upland, lowland and settlement area, nearshore, coral reefs, and the open sea. The land and marine resources of these neighboring villages were varied yet basically similar and, in fact, ideal for the maintenance of a subsistence economy allowing market-valued products to be either harvested or cultured. Nonetheless, the scale of operation in terms of capital, technology, and marketing of these resources and products are different.

Illegal deforestation activities and soil erosion upland were identified as major problems in all the coastal barangays surveyed. Although the forested mountains between Ibajay and Tangalan have been declared a reserve, villagers in Ibajay West still engage in *kaingin*. Aquaculture activities in most of the mangrove areas of Ibajay West are well-developed compared with Bgy. Bugtong Bato and Naisud, with these barangays having 83% of the remaining mangroves in Ibajay. De facto "ownership" of mangroves in Bgy. Naisud is limited to a few unlike in Bgy. Bugtong Bato where ownership is equitably distributed among families. Fishponds for milkfish, shrimps, and tilapia are present in Tangalan.

All the coastal barangays surveyed in these municipalities are highly dependent on fishing for livelihood. Major constraints to nearshore fishing in all barangays include the seasonal occurrence of the northeast monsoon (September-December), the intrusion of fishers from nearby islands who engage in illegal fishing activities (*muro-ami*, cyanide, dynamite), and the entry of commercial fishing vessels particularly in Tangalan, Bgy. Naisud and Bugtong Bato. Perhaps as a result of the northeast monsoon, Ibajay West villagers complained of low productivity of their fishponds due to the piling up of sand and silt at the river mouth. In addition, strong northeast monsoon winds wash away garbage from allegedly the tourist island of Boracay nearby, thus compounding the already poor state of garbage disposal in these coastal barangays. In terms of capital investment, Tangalan reported to have the most developed medium-scale municipal fisheries since bag nets and encircling gill nets are commonly operated. Income from fishing in Tangalan is supplemented by a number of men working as overseas seamen.

During the seminar-workshop in August 1998, participants proposed solutions to livelihood problems commonly encountered in their coastal barangays, which included the provision of soft loans from development banks and other institutions (e.g., loans from the Department of Social Welfare and Development or DSWD to fish traders and store owners), availment of livelihood training activities particularly on production and distribution. Only participants from Tangalan saw prospects in ecotourism, but all participants noted the weak support systems in technology and infrastructure. Nonetheless, the presence of NGOs such as the Participatory Research Organization of Communities and Education towards Struggle for Self-Reliance (PROCESS) and the Uswag Development Foundation in forming sectoral cooperatives, and the formation of FARMC were recognized to have eased difficulties in fisheries.

Bgy. Bugtong Bato, Ibajay

Only the social structure of Bgy. Bugtong Bato, one of 11 coastal barangays of Ibajay, was surveyed in July 1998. Among 187 households (out of a possible 224) surveyed, 60 have 1-3 members, 82 have 4-6 members, and 38 have 7-9 members. The population of this coastal barangay is young. Among 995 residents interviewed, 44% were from 0 to 16 years of age (Fig. 26). About 15% were of marriageable age with the option to pursue a college education, marry or take employment outside the barangays. Only 7% were of retirement age (i.e., 65 years and above).

Due to limited agricultural land, dependence on fishing and other supplemental jobs is high. Among the 277 barangay residents engaged in some form of livelihood, 171 were fishers, 20 farmers, 10 carpenters, 7 tricycle drivers, 28 fish traders, and 7 store owners (Table 18). Among those surveyed, 86% (or 239 residents) were males engaged in livelihood activities. Aside from traditional activities such as dressmaking and tending the home store, women were engaged in fish vending. Twenty seven households depend on external remittances from the father or sons doing contract work elsewhere (e.g., driver, construction worker in Manila).

Traditional fishing gears are the dominant forms of fishing in Bgy. Bugtong Bato. Most fishers use hook-and-line with canoe (14 fishers) or a motorized boat (55 fishers). In group fishing, sharing of operation cost is common since fishing grounds are relatively far. Traditional fishing methods are complemented by other forms of gears employed seasonally, contributing further to high fishing efforts. These other fishing gears include: spear (4 fishers), net (5 fishers), and fish corral (9 fishers). Fishers employ 3-4 gears in a year.

Acting as a "culture broker" (or one who introduces and facilitates a system that will result in local organizational changes), the barangay captain of Bgy. Bugtong Bato recently introduced to the village the use of a gill net and compressor (*bahala na* method) by directly employing fishers from Mararison Island, Antique. Other culture brokers include fishers from Tablas Island who introduced hook-and-line fishing and *karakatan* (a type of sailboat), and from Cebu who introduced *balsa* (raft), a fish-aggregating device.

Fishers sell their catch directly to middlemen (fish traders) who also reside in Bgy. Bugtong Bato. Each fishing group usually has a middleman as *suki* who transports by tricycle and sells the fish at Ibajay market. Fish drying is not a common activity because of the scarcity of salt in the barangay. With financial assistance through the Self-employment Assistance-Kaunlaran (SEA-K) from the DSWD's national program on Comprehensive and Integrated Delivery of Social Services (CIDDS), the number of middlemen has increased recently. Fish traders who are mostly women have availed of loans from this project, which ranged from P1,000 to P3,000.

The two cooperatives in Bgy. Bugtong Bato are strong advocates of livelihood activities, although membership among community members is low. *Pagtilibyog it Maintok nga Mananagat it Ibajay* (PAMMI) was organized by PROCESS in 1987 and has recently created a women's group. About 36% of household members of Bgy. Bugtong Bato are members of PAMMI. *Samahang Kabuhayan ng Maliliit na Mangingisda sa Ibajay* (SKMI) has been in existence since the 1970's as part of the Marcos government program's *Kilusang Kabuhayan at Kaunlaran.* SKMI has 46 members or 25% of the barangay's household members. Both organizations have been engaged in *otoshi ami.* SKMI has been a self-sustaining organization, even providing social security insurance coverage for its members. In addition to these organizations, the barangay council is legally responsible for the entire village's welfare, particularly health and sanitation, fisheries, peace and order, and livelihood programs. The recently organized FARMC is responsible for the management of the fishery and related aquatic resources. Unfortunately, inter-organizational links among these four organizations in Bgy. Bugtong Bato are weak, despite their common concern for the establishment of livelihood projects to benefit the barangay. Such development has impeded a more harmonious implementation of common objectives.

A seasonal calendar of activities of Bgy. Bugtong Bato is presented in Table 19. At a time when fishers from the barangay were still using sailboats and paddle canoes, traditional fishing has been restricted mainly by the northeast monsoon (September-December), but this constraint was overcome by the introduction of motorized boats. Motorboats proliferated in the barangay in the 1980s and informants correlated this development with increased income derived from *balsa,* a fish aggregating device used with hook and line and *sapaw* net or baby purse seine net. A good catch with these gears may gain 200 kg of fish, mostly *marot* (*Carangoides* sp. ?) and *aloy* (*Auxis* sp.). The recent introduction of motorized boats and new fishing net gears such as *sapaw, panambilawan, pangsulig, otoshi ami* in the 1980s has likewise opened new fishing grounds in the Sibuyan Sea (e.g., Uk-ok, Nabas) and generally intensified fishing effort in the area. As a result, most families or 89% of the barangay household members are presently engaged in fishing for cash income while the rest depend on farming. Nonetheless, most farmers also engage in hook-and-line fishing with paddle canoes or spearfishing octopus and reef fish. Better income from hook and line fishing is derived by motorboat owners (32 men) or crew members of a fishing group (38 men). Beach seining is engaged in if weather conditions do not allow fishing by motorized boats elsewhere. Reef gleaning is not popular among residents of the barangay; hence, most gleaners come from upland areas (*ilaya*).

Out-migration, common among adult men before the 1980s, has virtually stopped. Before this period, men from this village supplied, in part, the labor force (*sacada*) of sugar plantations in Negros Island during the harvest period (August-March). This development may be correlated with the intensification of motorized fishing in recent years. Presently, farming in general have declined in importance to the household economy because of increased income derived from fishing. In fact, the number of rice harvesters (*manuggarab*) in the barangay has decreased.

Resource System	Mountain	Farm	Mangrove	Upland	Lowland Settlement	Nearshore/ Seashore	Coral Reef	Open Sea
Resources	coconut, fruit trees, bamboo	rice, corn, vegetable, livestock,	*nipa, piyapi, piyapi, tungog, bakhaw, sugpo alimango,*	coconut, trees, bamboo, banana, wild animals	coconut, houses vegetable, fruit trees	boats, *talaba* seaweeds, shells, nets, sea urchin, sand, sea cucumber	fish, corals, seagrass	fish
Products	lumber, firewood, fruits, bamboo	rice, corn, vegetable,	*pawod,* firewood, lumber, fry, *sugpo,* shrimp	root crops	vegetables, fruit trees	*saang, sikad-sikad (shell),* seaweed, fish	corals, fish shell	fish
Technology	chainsaw	direct planting				fish corrals	nets, hook & line, spear	
Problem	illegal cutting of trees	no irrigation	illegal cutting of mangrove trees for domestic use	illegal cutting of trees, *kaingin*	potable water over population lack of toilet facilities, lack of employment	improper garbage disposal, destruction of seagrasses	destruction of corals	illegal fishing (entry of commercial fishers & dynamite)
Opportunities	furniture making, copra	shallow tube well	aquaculture projects, mangrove	poultry raising, livestock, tree planting	information, education campaign	tourism, fish port	proper management	marine sanctuary
Existing livelihood projects			PROCESS/ BFARMC mangrove reforestation project		CIDSS livelihood projects (*sari-sari* store, buy & sell, abaca weaving) PROCESS livelihood project (rice trading)			Otoshi-ami operations (KKK/ cooperatives)

Figure 22. A village transect of Bgy. Bugtong Bato in Ibajay, Aklan

Resource System	Upland forest	Lowland/ Riceland	Lowland Village	Midland	Lowland/ Fishpond	Lowland/ Village	Shoreline	Seashore	Coral Reef	Open Sea
Soil	rocky, clay, sandy	clay loam	sandy loam	sandy loam	sandy, clay loam	sandy	sandy, rocky			
Water	spring	ground water, spring	deep well	spring, deep well	seawater	deep well				
Crops	cassava, camote, rice	cassava, rice, pineapple, eggplant, okra, squash, raddish, ampalaya	cassava, rice, pineapple, eggplant, okra, squash, raddish, ampalaya	peanuts, corn	cassava	cassava, peanuts				
Trees	mahogany, *ipil-ipil*, *Gmelina* sp. (jimilina)jackfruit, coconut, *kasoy*, banana, papaya, *kakawate*, narra, *lawaan*, *apitong*	mahogany ipil-ipil, coconut, papaya	mahogany, *ipil-ipil*, mango, papaya, jack fruit, *Gmelina* sp. (jimilina), star apple, *mabulo*, coconut, *makopa*	mahogany, *ipil-ipil*, mango, papaya, jack fruit, *Gmelina* sp. (jimilina), star apple, *mabulo*, coconut, *makopa*	mangroves *piyapi*, nipa, coconut, *pagatpat*	coconut, mangroves				
Animals	birds	chicken, cow, carabao, turkey, ducks, goat, pig	chicken, cow, carabao, ducks, goat, pig	chicken, cow, carabao, turkey, ducks, goat, pig	goat, cow, chicken, pig turkey,	goat, cow, chicken, pig	oyster, clam, fish	fish, crabs	fish, crabs	tuna, barracuda, *moy*-moy, *mamsa*, *shark*, dugong, dolphin
Other activities	*kaingin*, *baliw*, firewood gathering	vegetable gardening, rice planting	carpentry, social services, mechanic	carpentry, mechanic social services,	carpentry, mechanic, social services	driftwood collection, net weaving, shell gathering	shell gathering	shell gathering		
Problems/ threats	illegal cutting, soil erosion, *kaingin*	flood, typhoon, drought	flood, typhoon, unemployment	flood, typhoon, unemployment	closure of river mouth, flood, siltation, drought		flood, typhoon, unemployment			illegal fishing (dynamite, cyanide, *muro-ami*)
Opportunities	timber	integrated farming	furniture, dress making, animal husbandry	furniture, dress making, animal husbandry	*bangus*, seaweeds and shrimp culture	salt making, boat making	oyster culture, seaweeds	seaweeds, oyster culture	fishing	fishing

Figure 23. A village transect of Ibajay West (Bgy. Aquino and Ondoy), Aklan

Resource System	Upland forest	Upland Crops	Lowland/ Riceland	Lowland Village	Mangrove/ Fishpond	Shoreline	Seashore	Open Sea
Soil	clay loam, rocky	clay loam	clay loam, sandy loam	clay loam, sandy loam	sandy, silt	sand	sand	
Water	spring	spring, rain	creek, river, spring	ground water, spring	river, seawater	seawater	seawater	seawater
Trees	timber, natural forest	mango, guava, banana, bamboo	coconut, banana	mango, coconut, jackfruit, mahogany, banana, star apple, guava, bamboo	nipa, mangrove			
Crops		vegetable, *camote*, banana, pineapple	rice, corn, vegetable	vegetable, banana, coconut, other fruit trees	*bangus*, tilapia, shrimps, *tangal*			
Animals	birds, monkeys	carabao, pig, cattle, chicken farming	carabao, cattle	pig, chicken, carabao, cattle, dog	frogs		fish, crabs, shrimps	fish, sea mammals
Other activities			farming	buy & sell fish, nipa making, bamboo furniture, bagoong making, fish drying, vegetable gardening, livestock raising, *sari-sari* store	nipa leaves gathering	repair and maintenance of fishing nets	fishing	fishing
Problem	illegal cutting, charcoal making	typhoon & extreme weather conditions	overflooding, inadequate water supply, pest, typhoon, diseases	no telephone line and unemployment	overflooding, scarcity of fish fry, private ownership of mangrove ponds	erosion	poor catch of fish	poor catch of fish, destructive fishing, superlights
Strength			presence of farmer's association and coops	community organization, furniture making, livestock raising				
Opportunities	strict implementation of forest laws, tree planting		low credit interest to farmers loan	training course on livelihood and food processing	training course on mangrove-friendly aquaculture	strong community support for the implementation of fishery laws	strong community support for the implementation of fishery laws	strong community support for the implementation of fishery laws

Figure 24. A village transect of Bgy. Naisud in Ibajay, Aklan

Resource System	Upland forest	Midland	Lowland Riceland	Lowland Village	Lowland/ Fishpond	Shoreline	Seashore	Coral Reef	Open Sea
Soil	brown, red, rocky, clay	brown/black clay	brown/ black clay	soil	clay loam	sand, pebbles	seagrass, seaweeds		
Water	spring	spring water	impounding	ground water	ground water				
Crops	*kamote*, fruits, cassava, copra, pineapple	coconut, mango, guava, papaya, cashew		coconut trees, mango	mangrove	pine tree, coconut, *talisay*			
Forage, etc. ornamental,	grass, vines, ornamental, rattan	bamboo, guava	weeds, shrubs		weeds				
Animals	carabao, cow, wild pigs, chickens	carabao, pigs, cow, goats, chicken	carabao, cow, chicken	chicken, dogs, pigs, turkey, cats	dogs, goat, chicken				
Fishery products	eels, freshwater shrimps	freshwater shrimps, eels, mudfish, catfish	tilapia, catfish, mudfish		*bangus*, shrimps, tilapia, crab, snails	shells	shells, fry, seaweeds, seagrass	seaweeds, fish, shell, sea cucumber	fish
Other activities	planting, upland farming	planting, farming	nipa hut making, farming	*sinamay-piña* weaving, concrete hollow block, making, fish drying, gardening		driftwood collection	shell gathering, ecotourism	spear fishing, fishing	fishing
Problems/ threats	soil erosion, deforestation	soil erosion, deforestation	lack of water supply, siltation	potable water supply, pollution, finances, unemployment	flooding, ownership, dikes	land erosion, quarrying	fine-meshed net, fish poisoning, siltation	cyanide fishing, blast fishing, boat anchorage	intrusion of big fishing boats, dynamite fishing
Opportunities	charcoal making, boulders quarrying	copra production, ecotourism, plantation	integrated farming	animal husbandry, tree nursery, livestock, handicraft, post-harvest factory	tilapia, *bangus*, shrimp and prawn culture	ecotourism, ornamental fish, salt making	seaweed farming, sea ranching, fishing	fish sanctuary, sea cucumber gathering, fishing	fishing

Figure 25. A village transect of Tangalan, Aklan

Table 18. Distribution of occupations among residents of Bgy. Bugtong Bato, Ibajay in Aklan. Most males censused were of ages 26 years and above but a few belonged to the age bracket 17-25 years. Most females under ages 26 years and above were housewives. Refer also to Fig. 26

Occupation	Male	Female
Farmer	20	-
Carpenter	10	-
Fisher	171	-
Tricycle driver	7	-
Fish vendor/peddler	-	28
Blacksmith	1	-
Dressmaker	-	3
Storeowner	-	7
Laborer (in Manila)	10	-
Retired fisher	20	-
Total	**239**	**38**

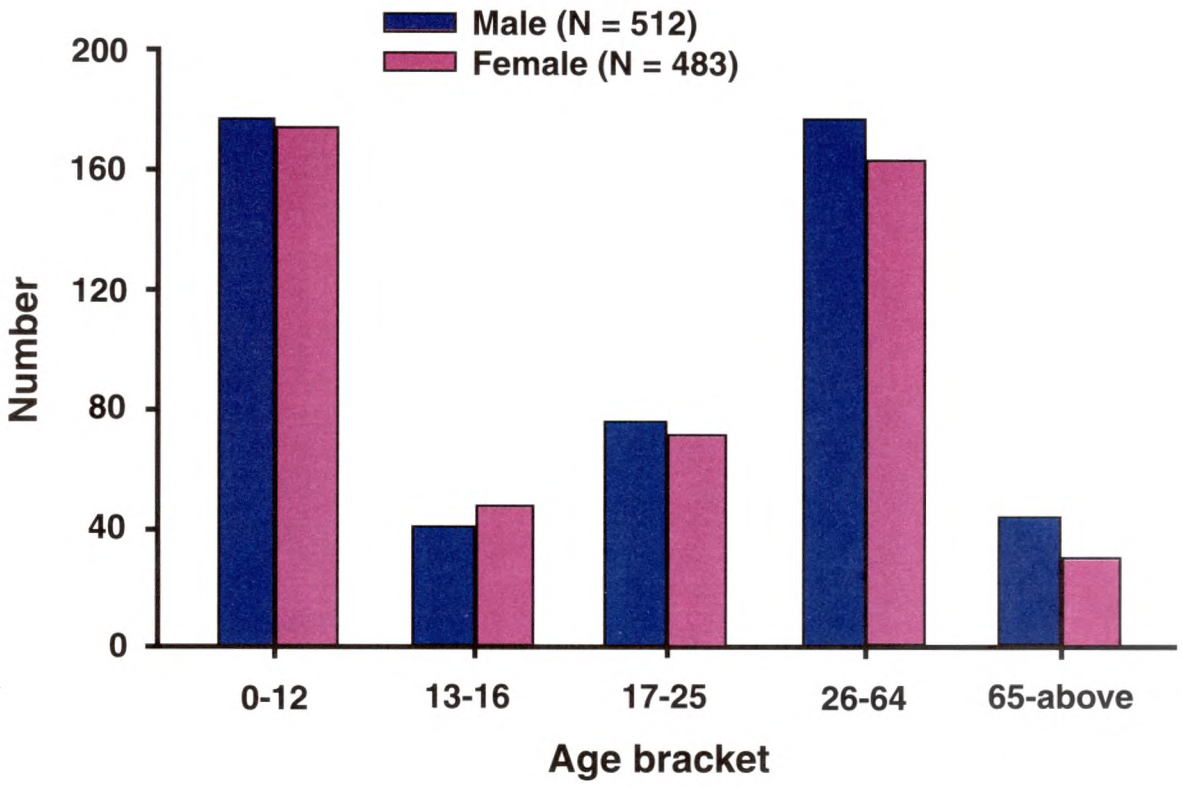

Figure 26. Age structure of the population of Bgy. Bugtong Bato, Ibajay, Aklan. Age brackets show the traditional stages in the lives of residents: 0-12, attendance in elementary school; 13-16, secondary education; 17-25, college education, marriage, work in factories or as domestic helper; 26-64, married life; 65-above, retirement

Table 19. Seasonal calendar of fishing and other activities at Bgy. Bugtong Bato in Ibajay, Aklan. ------ peak months; - - - - lean months

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Remarks
Net fishing													
Sapaw	------	------	------	------	------			------	------	------	------	------	
Panambilawan	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	*For sulog*
Pangsulig				Recently adopted for a year only									
Taksay	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	For *luta*
Spearfishing													
Pamana				- - - -	- - - -	- - - -	- - - -	- - - -	- - - -				
Hook-and-line fishing													
Pamunton	------	------	------	------	------	------	------	- - - -	------	------	------	------	For *sulog*
Lambo	------	------	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	------	------	------	For *luta*
Sintog	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	For *luta*
Pang-gab-i				- - - -	- - - -	- - - -	- - - -	- - - -					Clear weather only
Taba (corral)		------	------	------	------	------	------	------	------	------	------		
Reef gleaning *by ilaya*	x												
Religious festival	x												
Harvest	x		x						x				
Out-migration to Manila or Kalibo									x	x	x	x	

4

Discussion and Recommendations

The municipalities of Ibajay and Tangalan, Aklan have a contiguous coastline that stretches approximately 20 km facing the Sibuyan Sea. Numerous streams and two major river systems (Ibajay and Tangalan Rivers) drain part of the mountain range of northern Panay, emptying effluvia that enhance the productivity of nearshore waters. Two major promontories (Apga Point and Sigat Point) provide protection to coastal barangays against the northeastern monsoon. These neighboring municipalities share common fishing grounds in their extensive coral reefs. But because of the open access nature of the reef fishery in municipal waters, overfishing and conflicts in the use of reef resources have been common over the years. Generally, the coastal barangays are not aware of the importance of seagrass and seaweeds as vital trophic links in coastal ecosystems; in fact, these commodities are neglected as a possible source of food and income for these resource-dependent communities. Governed by informal use-rights, some areas of primary and secondary growth of mangroves, which are located mostly in Ibajay, have been exploited over the years. Consequently, the present state of the coastal resources in these municipalities is reflected in dwindling catch from municipal waters and in the continuing impoverishment of coastal barangays. Indeed, benchmark information obtained from this study revealed nearshore resources in distress that require concerted attention by resource-users from both municipalities. Major attention must be therefore focused on the implementation of the following management strategies, namely:

1. **There is a need to organize a joint resource management council among all resource-users from these neighboring municipalities**. This council must be empowered to decide and enforce measures to assure the productivity of their shared coastal resources, which include upland resources as well. The joint council can address common critical issues such as the persisting boundary conflict, which is reflected in disputes over fishing rights at Pangayawan reef. The enactment through legislation by the Tangalan municipal council of a 16 km^2 marine sanctuary at Pungtod reef and the establishment of fishing zones in adjacent patch reefs are timely and appropriate. However, this unilateral action may only further intensify the animosity between Tangalan and Ibajay fishers sharing this common reef resource. The joint council can provide a legitimate forum to settle this dispute. Allowing the dispute to persist may further contribute to unregulated use of resources by local fishers and poachers that will contribute to the already degraded condition of coral reefs, seagrass and seaweeds. Present and potential estimates of reef fish catch from their municipal waters indicate a state of overfishing that must be arrested in order to allow its recovery.

2. **An overall coastal fishery resource strategy must be integrated with upland resource management plans of Tangalan, Ibajay, and other neighboring municipalities**. Extensive damage by siltation from upland activities is clearly reflected by very low hard coral cover and the dominance of soft corals in marine benthic communities. The overall poor state of reef health has made the reef ecosystem vulnerable to perturbations from which it may not be able to recover. The extensive bleaching of hard and soft corals is a recent perturbation, perhaps caused by elevated sea surface temperatures (El Niño) over prolonged periods. Low estimated fish yields particularly from fringing reefs in the area are indications of poor reef health.

3. **Delineation of coastal resource use must be managed through zonation schemes after thorough consultations with users represented in the joint council**. Pungtod reef is an appropriate choice for the establishment of a marine sanctuary where all fishing regardless of gear should be totally banned. In addition to its proximity to both municipalities, the Pungtod reef sanctuary is sufficiently large to fulfill the functions of a marine protected area. The choice of Pangayawan reef for a jointly managed marine sanctuary is not recommended. Being located halfway near the legal,

seaward boundary of municipal waters (i.e., 7.5 km), a ban on any form of fishing in Pangayawan reef will be difficult and expensive to enforce. Poachers from other islands and elsewhere will easily violate any fishing ban. Moreover, the deployment of artificial concrete habitats may be suitable but only in some sections of the marine sanctuary at Pungtod reef.

Although limited in area, seagrass communities are generally depauperate because of extensive gleaning by coastal inhabitants. Therefore, by banning gleaning in some areas, sections of seagrass beds near or adjacent to mangroves and coral reefs may also be declared sanctuaries to provide nursery habitats for juvenile fish and crustaceans that reside in this and in other nearshore ecosystems. In the same manner, many sections of the Ibajay mangroves may be declared reserves to complement greenbelt, ponds, and aquasilviculture activities and to conserve the high biodiversity in the area.

4. The Pungtod reef marine sanctuary and mangrove parks in Ibajay may be suitable for ecotourism development. Together with the cold springs in Nabas, Jawili Falls and the DENR station in Tangalan (as viewing point), these sites form an ecotourism belt between Kalibo and Boracay Island that must be integrated with the tourism development plans of the Aklan provincial government. These sites in Ibajay and Tangalan may be developed as alternative and novel destinations and then promoted as part of a typical package tour of Boracay Island where tourism infrastructure support is already relatively well-developed.

Pangayawan reef may be added for ecotourism development, but only if some degree of protection of its natural reef habitats can be enforced. This move may support conservation and rehabilitation of these ecosystems, and, at the same time, allow the diversification of income in the coastal barangays of Ibajay and Tangalan. For instance, tourism activities in these ecosystems may be planned by establishing open and closed seasons timed according to the prevailing monsoon season. However, tourism activities in these areas must be closely monitored and managed by a joint resource management council to preclude further deterioration of reef, mangrove, and seagrass-seaweed habitats by "innocent" visitors. Safeguards to be established in designated sections of the marine sanctuary open to tourists must include proper boat anchorage facilities and underwater guide markers.

5. Development plans of several organizations in each barangay must be consistent, unified, and integrated with the overall plans of Tangalan and Ibajay. For instance, in Bgy. Bugtong Bato, the organizational link among four organizations (two cooperatives, FARMC, and the barangay council) is presently weak, although each entity supports the establishment of a single livelihood project benefiting all. The construction of two separately managed fish corrals (*otoshi ami*) is evidence of this weak link. Tight organizational links will be important in the administration and implementation of livelihood projects, market and credit linkages, and as channels of technological information.

Ideally, common objectives can be better served by the establishment of a single cooperative whose membership must be comprised of the majority of fishers in the barangay. Otherwise, efforts should be made to strengthen links between and among existing organizations in coastal barangays so that problems of management, particularly the enforcement of fishery regulations and the establishment of livelihood programs, will be minimized.

6. Pond development in mangroves, particularly in Bgy. Bugtong Bato and Naisud in Ibajay, must not exceed 20-25% of the total mangrove area of 75 ha in these barangays. Aquaculture ponds cover only about 5% of the mangrove area in Ibajay, but much of the mangrove forest now consist of cultivated nipa stands, which cover at least 30%, thus leaving only 65% undeveloped. Following the precautionary principle in ecology, 70-80% of a mangrove area must be retained, leaving only 20-25% to be converted to other uses such as aquaculture ponds (Saenger et al., 1983). Aquaculture development must be based on the institutional context that defines the rules for the use and conservation of mangroves and other coastal ecosystems.

Therefore, any development plans of the remaining mangroves must consider the overall integrity of the mangrove ecosystem, especially its nursery, coastal buffer, and other essential functions (Primavera, 1995; 2000). If any aquaculture activity is to be introduced, it must be pond and pen system integrated with mangroves (Primavera and Agbayani, 1997), preferably in nipa areas with enrichment planting of non-nipa species. Mangrove ponds and pens that integrate mangrove trees (with mono- or polyculture of crabs, shrimps, and fish, i.e., aquasilviculture) are a better alternative

to open pond systems that destroy mangrove trees. Planting of mangrove seedlings (*bakhaw* or *apiapi*) can then be done in the platform section of the pond or pen to enhance mangrove species diversity. Around 8 ha of nipa in Bgy. Bugtong Bato and 4 ha in Naisud may be converted for aquasilviculture for a total of 15 ha (including 3 ha of existing ponds) or 20% of the total mangrove area in Ibajay. Also essential and following existing government regulations (e.g., Department of Environment and Natural Resources Administrative Order No. 76 released in 1987), sites adjoining waterways shall maintain a greenbelt or buffer zone of at least 20 m adjoining rivers and creeks and also 50 m at the least for those facing the open sea.

Furthermore, because of its high species biodiversity, the mangrove ecosystem in Ibajay is ideal for the development of ecotourism (refer to Recommendation No. 4). Together with aquasilviculture development in the area, the site may be turned into a public showcase window on the integration of utilization and conservation of a valuable and common resource such as mangroves. Toward this end, two structures need to be built: 1) a tree house built on tall mangrove trees adjoining the existing aquaculture ponds in Bgy. Bugtong Bato and, 2) an elevated footwalk to serve as a nature trail along the 500-m distance between the existing aquasilviculture ponds and pens. The tree house may be utilized as a mini-museum to show and emphasize the deriveable goods and services from all coastal ecosystems. From the elevated footwalk, tourists, excursionists, and even local students will be able to view and appreciate up-close without getting wet and muddy the unprecedented variety of mangrove trees and their associated faunal and floral species so now rarely encountered elsewhere in the country. The planning, construction, and long-term maintenance and management of these structures may be a joint undertaking of the proposed joint resource management council.

7. Management of coastal resources must integrate plans for alternative and supplementary livelihood for coastal communities. The integrated mariculture of seaweeds and fish in cages may be suitable in some areas of Bgy. Bugtong Bato and Jawili, although recent attempts have resulted in poor growth due to excessive grazing by herbivores, disease outbreak, and relatively poor water quality. Nonetheless, a system of culturing seaweeds and fish may be designed and appended to existing bamboo structures supporting lift and bag nets in these areas. The culture of other native stocks such as various marine and estuarine bivalves (e.g., *Anadara* or blood cockle, oysters, mussels) may also be possible candidates for culture or management.

8. The present existing rights over resource use need to be re-evaluated through a joint resource management council. Informal (*de facto*) ownership and use of coastal resources, particularly of reef and mangroves, are governed by customary use rights that have been effectively enforced in the community over generations. Customary rights are not supported by legal documentation recognized by the government. While such form of ownership has been binding to the local community, it may however become a point of serious conflict, especially when the profitability of new technologies of resource utilization is demonstrated by a few progressive sectors of the community. Two examples may be cited. If the present move to develop aquasilviculture in certain mangrove areas in Bgy. Bugtong Bato may over time prove to increase revenue over those derived from the traditional use of mangrove resources (e.g., source of firewood, etc.), an influx of other so-called "owners" from within or outside of the local community may also claim such areas, displacing traditional users. Historically, the mangroves in Ibajay were once threatened by a big developer in the 1980s who wanted to develop the common resource into aquaculture ponds. The developer was however prevailed upon to do otherwise, particularly by residents of Bgy. Naisud who were aware of the benefits of mangroves in protecting their coastal village from perennial floods. If such an attempt may again occur and become successful; institutional arrangements in the community that have long been proven effective to avert conflicts in resource use will therefore be seriously threatened.

A similar scenario may occur with the introduction of innovative and efficient fishing gears in the open access reef fishery of Tangalan, Ibajay, and neighboring municipalities. The increased catch of fusiliers (*sulig*) from Pangayawan reef with the use of the *bahala na* method of gill net and compressor has reinforced the existing boundary conflict between Ibajay and Tangalan. As a result, Ibajay fishers from Bgy. Bugtong Bato have reinforced their claim over Pangayawan reef for their exclusive use because of the increased revenues derived from fishing. Since Tangalan has declared unilaterally a marine sanctuary in Pungtod reef, which is a shared fishing ground, Ibajay fishers

have also contemplated "acquiring" Pangayawan reef for their own, a move that indeed appears consistent with the new Local Government Code. Should these conflicts fail to be resolved, management plans for common and shared resources will be paralyzed. Clearly, an open flow of communication and commitment through a joint resource management council between these neighboring municipalities becomes imperative.

Therefore, co-management of the mangrove and other coastal resources addresses the issues of ownership of resources and of mechanisms to allocate use rights through rules and regulations. There is a need to document the customary use rights particularly on the adaptive and evolutionary significance of systems of appropriations. There is a need to look into the social dynamics of the different players in the community to anticipate and reduce resource use conflicts (Cordell, 1989) and inequitable distribution of benefits (Ruddle, 1994).

5

References

Cordell J (editor). 1989. A sea of small boats: customary law and territoriality in the world of inshore fishing. Cultural Survival, Cambridge, Massachusetts, Report No. 26. 418pp.

English S, Wilkinson C, and Baker V (editors). 1994. Survey manual for tropical marine resources. ASEAN-Australian Institute of Marine Science. 368 pp.

Fabricius K. 1999. Tissue loss and mortality in soft corals following mass-bleaching. **Coral Reefs**, 18: 54.

Gleason MG. 1993. Effects of disturbance on coral communities: bleaching in Moorea, French Polynesia. **Coral Reefs**, 12: 193-201.

Hurtado-Ponce AQ, Luhan MRJ, and Guanzon NGJr. 1992. Seaweeds of Panay. Southeast Asian Fisheries Development Center/Aquaculture Department, Iloilo. 114 pp.

Hurtado-Ponce AQ, Chavoso EAJ, and Parami NP. 1998. Assessment of the seaweed-seagrass resource of Mararison Island, Culasi, Antique, Philippines. **Phycological Research**, 46: 175-182.

Meehan WJ and Ostrander GK. 1997. Coral bleaching: a potential biomarker of environmental stress. **Journal of Toxicology and Environmental Health**, 50: 529-552.

Pido MD, Pomeroy RS, Garces L, and Carlos M. 1997. A rapid rural appraisal approach to evaluation of community-level fisheries management systems: framework and field applications at selected coastal fishing villages in the Philippines and Indonesia. **Coastal Management**, 25: 183-204.

Primavera JH. 1995. Mangroves and brackishwater ponds in the Philippines. **Hydrobiologia,** 295: 303-309.

Primavera JH and Agbayani RF. 1997. Comparative strategies in community-based mangrove rehabilitation programmes in the Philippines. *In* Proceedings of Ecotone V, Community Participation in Conservation, Sustainable Use and Rehabilitation of Mangroves in Southeast Asia (Hong PN, Ishwaran N, San HT, Tri NH, and Tuan MS, editors). Pp. 229-243. UNESCO, Japanese Man and the Biosphere National Committee and Mangrove Ecosystem Research Centre, Vietnam.

Primavera JH. 2000. Development and conservation of Philippine mangroves: institutional issues. **Ecological Economics**, 35:91-106

Randall JE, Allen GR, Steeve RC. 1990. Fishes of the Great Barrier Reef and Coral Sea. University of Hawaii Press, USA. 507 pp.

Ruddle K. 1994. A guide to the literature on traditional community-based fishery management in the Asia-Pacific tropics. FAO Fisheries Circular No. 869. Rome, Food and Agriculture Organization of the United Nations. 114 pp.

Russ GR. 1991. Coral reef fisheries: effects and yields. *In* The ecology of fishes on coral reefs (Sale PF, editor). pp. 601-635. Academic Press, USA.

Saenger P, Hegerl EJ, and Davie JDS. 1983. Global status of mangrove ecosystems. IUCN Commission on Ecology Papers No. 3. Gland, Switzerland.

Saito Y and Atobe S. 1970. Phytosociological study of intertidal marine algae. I. Usujiri Benten-Jima, Hokkaido. **Bulletin of the Faculty of Fisheries, Hokkaido University**, 21: 37-69.

Samoilys M. 1997. Manual for assessing fish stocks on Pacific coral reefs. Department of Primary Industries, Queensland, Australia. 78 pp.

Tomlinson PB. 1986. The botany of mangroves. Cambridge University Press, United Kingdom. 413 pp.

Veron JEN. 1986. Corals of Australia and the Indo-Pacific. The Australia Institute of Marine Science, Australia. 644 pp.

Walters JS, Maragos J, Siar S, and White AT. 1998. Participatory coastal resource assessment: a handbook for community workers and coastal resource managers. Coastal Resource Management Project and Silliman University, Cebu City. 113 pp.

Wesseling I, Uychiaoco AJ, Aliño PM, Aurin T, and Vermaat JE. 1999. Damage and recovery of four Philippine corals from short-term sediment burial. **Marine Ecology Progress Series**, 176: 11-15.

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APPENDIX 1

Methods for Characterizing Reef Benthic Traits

I. Manta Tow Reconnaissance Technique

Materials

skin diving gear (mask, fins, snorkel)
100 m nylon rope
three manta boards
outrigger pumpboat with a 10 or a 16 hp engine and 2-man crew
waterproof data sheets
pencils
scoring guide pasted onto manta boards (see Figure 2.7 in English et al., 1994)
topographic map (1:50,000 scale)
waterproof watch
waterproof compass

General Procedure (modified from English et al., 1994)

1. Obtain a topographic map (1:50,000 scale is best) of the reef to be surveyed. Interview local fishers in the area to determine the extent and depth contour of the reef. Hire a local fisher who is knowledgeable of the reef.

2. Attach 20 m of nylon rope to each manta board and securely tie the free end to the back of a pumpboat and to each outrigger. A typical pumpboat can tow three skin divers each hanging on to a manta board.

3. While one boat crew tends the engine, the other crew with a waterproof watch sits at the back of the pumpboat to receive instructions from the lead skin diver and to guide the direction of the manta tow. Hand signals are standardized between skin divers and the other crew.

4. At the start and end of a series of tows, the lead skin diver picks a prominent landmark along the shore and, if possible, records the compass bearings to determine his position on the reef relative to this landmark. The lead skin diver shouts for the tow to start or end.

5. The skin divers are slowly towed (not more than 1 knot) parallel to the reef slope or reef crest for 2 minutes, after which, the other boat crew signals the boat to stop while each skin diver writes his individual score of cover of live and dead coral, soft coral, sand, rubble, and other distinct observations (e.g., fish species and abundance, etc.). Several 2-minute tows over a certain reef will be able to detect gross changes in the features of the reef.

6. At the end of the survey, the median score of each reef bottom trait is determined and the mean of median scores of all skin divers calculated. The scores are juxtaposed with locations on the reef where the data were obtained in order to detect gross variations in reef benthic traits, a prerequisite for selecting sites on the reef for a more detailed assessment by a line-intercept transect method.

7. Underwater visibility and cloud cover are estimated. If possible, surface and bottom temperature and salinity readings are obtained and recorded.

II. Line-Intercept Transect Technique

Materials

scuba diving gear for two dive buddies
50-100 m measuring tape with 1 cm graduation
waterproof writing slates
a pencil tied to each writing slate
dive boat

General Procedure (modified from English et al., 1994)

1. Divers must be knowledgeable of the common coral lifeform categories encountered in tropical reefs (see Fig 2.19 and Table 2.5 in English et al., 1994). Trial dives may be necessary to familiarize oneself of these categories.

2. Specific sites on the reef are identified with a topographic map and data obtained from the manta tow reconnaissance technique. Sites are marked by buoys. For each site, at least three transects of 50 m length are laid by divers parallel to the 3 and 10 m depth contour of the reef. The transect tape must be securely attached and remain very close to the substratum (about 10 cm) at all times and not suspended more than 50 cm above the substrate (i.e., water category). For safety, dives are first conducted in the deeper transects before ascending to the shallower transect sites.

3. Starting at one end, a diver moves slowly along the tape and records the coral lifeform category encountered or intercepted by the tape. At each point where the coral lifeform category changes, the diver records the transition point in centimeters and the code of the coral lifeform category. If possible, the taxonomic identity (species level) of the coral lifeform is recorded.

4. The intercept of each lifeform and coral species is calculated as the difference between the transition points recorded for each lifeform or coral species. The percent cover of each lifeform and each species encountered is expressed as a percentage of the total length of the transect tape. This calculation is done for each transect for all depths censused and a working mean estimated.

III. Underwater Visual Census of Reef Fishes

Materials

Refer to Line-intercept transect technique

General Procedure

1. The underwater visual census of reef fishes utilizes the same 50 m transect tape employed in the line-intercept transect technique for corals. Visual census is done during the day (8am-4pm) in reef waters with clear underwater visibility (not less than 5 m). Several trial dives are required to familiarize divers with species identification and length estimation of fishes underwater.

2. About 10-20 minutes after the end of the coral census, one of two divers slowly swims a meter above the tape and records all fishes (if possible, to species level), including their individual or average length (standard or total) to the nearest centimeter. Fishes censused must all be within a specified area (e.g., 5 m on both side of the tape and 5 m above it) and in some cases, restricted to pre-agreed categories of fishes (e.g., all caesionids, groupers, rabbitfishes, snappers, etc.). The other dive buddy swims behind the diver-observer.

3. Census data are transferred to a logbook or a computer. Abundance and biomass of each species are calculated. "First estimate" of biomass is calculated from known and published length-weight relationships of reef fish species (Samoilys, 1997). The estimated yield of the reef may then be calculated from the "first estimate" of biomass since the area of census along the transect tape is known.

APPENDIX 2

A Method for Determining the Structure of Mangrove Communities

Materials

42 m nylon rope marked every 1 m (for 10 m x 10 m plot)
12 m nylon rope marked every 1 m (for 5 m x 5 m plot)
4 m nylon rope marked every 1 m (for 1 m x 1 m plot)
tape measure
big plastic bags (for plant specimens)
masking tape
pentel pen
data sheets
pens

General Procedure (adapted from English et al., 1994)

1. For each site, establish transect lines from the seaward margin of the forest at right angles to the edges of mangrove forest.

2. Divide the transect into zones corresponding to some environmental parameters, e.g., low, mid and high intertidal zones; main forest types according to tree species present; etc.

3. Establish 3 randomly located replicate plots of equal size in each forest type encountered along the transect.

4. The size of the plot is determined by the density of the trees, but should be no less than 10 m x 10 m.

5. Saplings (diameter < 4 cm and height > 1 m) are identified and the actual number of individuals by species is counted. If the density of saplings is very high and uniform, smaller subplots may be used (5 m x 5 m would be the minimum size). Use the reference corner (origin) of the main plot as the reference corner of the subplot.

6. Seedlings (height < 1 m) are identified and the actual number of individuals by species is counted. Subplots (1 m x 1 m) can be used when densities are high.

7. Record all data on prepared data sheets.

8. Analyze data using formulae described by English et al. (1994) and calculate basal area, number of stems per hectare, importance value (relative density + relative frequency + relative dominance) and species diversity.

APPENDIX 3

Methods in Participatory Coastal Resource Assessment

1. Resource Mapping

A map shows not only the position but also the relationship among objects depicted on a map. Mapping is a powerful tool for identifying and locating resources, users, and practices. It is an activity that highlights the knowledge and perceptions of local users and the importance they attach to certain resources. What can be mapped?

1. Physical features: river mouths (*baba ka suba*), islands, deep channels, passages (*kanal, alagyan sang barko*), etc.

2. Natural resource habitats: coral reefs (*puntod*), mangroves (*bakhawan*), seagrass beds (*kalusayan*), spawning grounds (*bulutwan sang isda*), etc.

3. Infrastructure: roads, pier, ice plants, water wells, etc.

4. Other human features: boundaries of sanctuaries, use zones, political and administrative boundaries, fishponds, etc.

Steps during resource mapping are as follows:

Stage 1

1. For reference, a map with a scale of 1:20,000 showing the coastline is needed. Such map is available from the National Mapping and Resource Information Authority (NAMRIA). An outline of the place to be mapped should be drawn on a cartolina or manila paper. It is important to include in the outline geographical markers such as rivers, mountain, and other natural features of the place.

2. Key informants such as divers who are knowledgeable about the resources should be asked. Each resource system like mangroves, settlement area, seagrass beds should each have a corresponding color. For example, a mangrove area is best signified by colored green, red for corals, orange for seagrass beds, etc. Physical infrastructure like roads, school, ice plants should also have a code. It is important to capture the local terms, especially for coral reefs.

Stage 2

1. Draw up a list of fishery resources that are found in the area such as fish, shellfish, seaweeds, and other aquatic plants and animals.

2. List resources on a manila paper so that participants will have a guide.

3. If the number of resources identified does not fit in, ask informants to choose the top ten most important species.

4. Code each resource with Arabic numerals or pictorial symbols.

5. Starting with the first resource on the list, ask participants to mark with Arabic numerals or symbols where the resource is found.

6. Finish mapping one resource first before proceeding to the next.

Stage 3

1. Obtain the community's fishing practices, fishing gear, methods, and uses. Examples of uses are fuelwood and thatching materials from mangrove trees. Include also destructive fishing gears such as dynamite, cyanide, etc.

2. Revise the map to ensure its reliability and clarity.

2. Gendered mapping

Men and women differ in their access to and control of resources. A gendered mapping exercise may be done with a mixed group of men and women or separate groups of men and women. Gendered mapping may be done as an extension or a variation of resource mapping. Some of its uses are the following:

- raising and discussing concerns that address needs of men and women,
- identifying potential impacts of activities or interventions such as the conversion of mangroves into fishponds,
- identifying livelihood opportunities for men and women, and
- discussing issues on and control of resources.

The steps during gendered mapping are as follows:

1. Follow the steps for preparing a resource map.
2. Identify symbols to denote "man" and "woman."
3. Ask informants whether the resources and features identified are predominantly associated with men, women, or both and apply the appropriate symbols.

3. Transect diagram

A transect diagram is usually formulated by a group of key informants and inter-disciplinary group of researchers while walking or after walking along a cross-section of the village, e.g., from the mountain towards the shore or vice versa. The walking tour that accompanies or precedes the preparation of a transect diagram is a good way of getting acquainted with conditions in the village. Because it covers both land-based and coastal resources and the problems and opportunities associated with such resources, the transect diagram is a good complement to the resource map.

4. Seasonal calendar

A seasonal calendar is a graphical or pictorial representation of the various events and activities in a village during a one-year period. Calendar diagrams show the seasonality of occurrence of certain fishes, monsoon, spawning, wind, rainfall, wave patterns, peak and lean seasons for different livelihood activities, periods of low and big catch, and seasonality of labor requirements.

A seasonal calendar is very useful in analyzing relationships among different activities and events, e.g., periods of intense encroachment of commercial fishing vessels that may coincide with periods of low catch for small-scale fishers, or the period of high catch may coincide with spawning aggregations of certain fishes. The seasonal calendar may also provide information regarding periods when fishers would need supplementary sources of income.

5. Trend Lines

A trend line is a graphical representation of the changes in the abundance or availability of a resource over a period. Trend lines may also be used to depict the occurrence of events like the upsurge of dynamite fishers from other places, drought, fish kills, and red tides. Here, it would be best to interview old folks in the village.

In analyzing trend lines, it is possible to draw explanations for the increase or decrease in catch and attempt to establish relationships between events, e.g., the introduction of a new fishing gear or accredit program for buying new gear and vessel in a particular year led to a dramatic increase in fish catch the following year.

6. Problem Ranking

Problem ranking is a process by which community members decide on the seriousness or importance of a list of problems that have been identified through group interviews or during preparation of a transect diagram, resource and gendered maps.

Ranking of the problems may be done using a set of criteria, e.g., how widespread among the population a certain problem is, seriousness of the problem, or importance of the problem to a certain sector or group within the community like the fishing households. Scores may be assigned (e.g., 10 for the most important and 1 the least important) and these scores are then ranked. If the number of participants in this activity are not too many, each participant may be asked to give his or her score for each problem and after which the scores are tabulated and ranked.

7. Group interview

A group interview is similar to a semi-structured interview that is conducted among a group of key informants. It is an effective way of gathering quantitative information on a situation where random sampling is difficult to achieve and in cases where individual face-to-face interviews may be difficult to conduct due to the presence of neighbors and other listeners. It works well at the village level where practically everybody knows each other. During a group interview, the information presented by one participant is validated right there by other participants who may challenge the accuracy or reliability of the information given.

Group interviews are excellent for gathering information with depth, e.g., critical issues and concerns of the village. A good facilitator is needed in conducting a group interview. A checklist of information that must be generated should be prepared before conducting a group interview.

The Southeast Asian Fisheries Development Center (SEAFDEC) is a regional treaty organization established in December 1967 for the purpose of promoting fisheries development in the region. Its member countries are Japan, Malaysia, the Philippines, Singapore, Thailand, Brunei Darussalam, the Socialist Republic of Vietnam, Union of Myanmar, and Indonesia.

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Created to develop fishery potentials in the region in response to the global food crises, SEAFDEC undertakes research on appropriate fishery technologies, trains fisheries and aquaculture technicians, and disseminates fisheries and aquaculture information. Four departments were established to pursue the objectives of SEAFDEC.

- The Training Department (TD) in Samut Prakan, Thailand, established in 1967 for marine capture fisheries training
- The Marine Fisheries Research Department (MFRD) in Singapore, established in 1967 for fishery post-harvest technology
- The Aquaculture Department (AQD) in Tigbauan, Iloilo, Philippines, established in July 1973 for aquaculture research and development
- The Marine Fishery Resources Development and Management Department (MFRDMD) in Kuala Terengganu, Malaysia, established in 1992 for the development and management of the marine fishery resources in the exclusive economic zones (EEZs) of SEAFDEC Member Countries.

SEAFDEC/AQD is mandated to:

- promote and undertake aquaculture research that is relevant and appropriate for the region
- develop human resources for the region
- disseminate and exchange information on aquaculture

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