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Coastal Environment Profile of Lopez Jaena, Misamis Occidental

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ABSTRACT

A rapid coastal habitat and resource assessment was conducted between April and September, 2006 in nine coastal barangays of Lopez Jaena, Misamis Occidental in Northeastern Mindanao to obtain an updated ecological and socio-economic profile. A digitized coastal resource map estimated the coral reef area at 324.2 ha, a seagrass meadow of 526.2 ha, and mangrove forests covering 143.0 ha. Hard coral cover was highest inside the Capayas Is. marine sanctuary (44%) than in the non-sanctuary reef of Looc (40%) while the lowest coral cover was recorded in the Mansabay Bajo marine sanctuary (24%). High percentages (13-47%) of dead coral was evident of past damage from blastfishing or severe storms. A total of 146 species of fish belonging to 23 families occur on the reefs where 102 species are found inside the Capayas Island marine sanctuary. Fish communities on the deeper reef areas were fairly diverse in Capayas Is. (65 species) and Looc Reef, Mansabay Bajo (73 species), while Mansabay Bajo marine sanctuary has only 45 species. The most abundant species of reef fish in Lopez Jaena are small damselfishes (Family Pomacentridae), contributing little to available biomass. Mean population densities are higher in Capayas Is. (2.12 ind.m^{-2}) and Looc reef (1.41 ind.m^{-2}) than Mansabay Bajo sanctuary (0.64 ind.m^{-2}). Estimates of fish biomass range between 29.7-63.0 t.km^{-2} which are considered high. Eight species of seagrasses occur on the sites surveyed with an overall cover of 48.23%. The most common seagrasses are the dugong grass *Thalassia hemprichii* and the tropical eelgrass *Enhalus acoroides*, while seaweed resources are not very diverse (44 species). Edible invertebrates are commonly gleaned from seagrass beds. At least 26 species of true mangroves and mangrove associates are found in Lopez Jaena. The mangrove ecosystems in many barangays are primarily natural forest with a small mix of reforested stands particularly of *Rizophora mucronata* and *R. apiculata*. The coastal fishery is characterized as a multi-gear, multi-species economic activity involving about 712 fishers, 362 fishing boats and 25 types of fishing gears. Estimated monthly catch of major gears amounts to 90.43 tons, or an annual production of 915.60 tons. Income from fishing is generally small, ranging from P54.00 $fisher^{-1}.d^{-1}$ to P113.00 $fisher^{-1}.d^{-1}$, often not enough to support basic daily needs. Management interventions are needed to improve habitat quality, increase diversity and abundance of coastal resources, and to provide alternative sources of income for coastal communities in Lopez Jaena.

Keywords: Participatory coastal resource assessment, coral reefs, seagrasses, mangroves, coastal fisheries and socio-economic profile.

INTRODUCTION

The coastal municipality of Lopez Jaena (Fig. 1) is endowed with rich marine life that has sustained the livelihood and subsistence of its populace for decades. Among the municipalities in Misamis Occidental, Lopez Jaena has been credited for its excellent track record in coastal protection, fisheries law enforcement and rehabilitation during the 1990s. Lopez Jaena has also taken the lead in livelihood enhancement projects and is a recipient of several capacity building assistance programs. Between 1996-1998, the University of the Philippines' Center for Integrative and Development Studies (UP-CIDS) implemented a community-based biodiversity research and conservation program in Lopez Jaena, Misamis Occidental as part of the UP-CIDS-NAST Biodiversity Conservation Program (BCP). More recently, Lopez Jaena has also been in the forefront of community assistance projects supported by the Philippines-Australian Livelihood Support (PALS) program.

The earliest comprehensive assessment conducted by the UP-CIDS has drawn a picture of a rich biodiversity system that needs to be conserved and sustained for future generations (Rollon, *et al.*, 1999). Information generated by this early assessments had considerably helped in formulating coastal resource management interventions for the municipality. Another resource and ecological assessment was made by the DENR-10 in April-May 2001 in only three barangays, namely, Sibula, Biasong, and Katipa. In 2004, the Save Our Nature Society, Inc. (SNSI, 2004) made a comprehensive ecological and socio-economic profiling of the province of Misamis Occidental, but limited information on the ecological status of important coastal habitats and resources of Lopez Jaena was provided.

The Save our Nature Society, Inc. report (SNSI, 2004) showed that the fringing coral reefs of Lopez Jaena are generally in fair (32.62% live coral cover) condition with diverse and abundant fish communities with an estimated biomass of 15.04 $t.km^{-2}$. An earlier assessment (Rollon, *et al.,* 1999) reported 107 species of reef-associated fish, with an estimated average biomass of 18.87 $t.km^{-2}$, which falls within the medium category according to "benchmark" estimates for Philippine reefs (Dantis *et al.,* 1999). While fish diversity in Lopez Jaena reefs is comparable with many areas in the Philippines, most of these fish (75%) are small, non-commercial reef fishes that would be valued higher as marine aquarium or ornamental fishes than as food.

Rollon, *et al.* (1999) reported that the mangrove resources of Lopez Jaena are relatively diverse (16 species), dominated by *Rhizophora* and *Sonneratia* species. In 1999 the total remaining cover of mangroves was 29 ha from the reported 156 ha in 1993 – the decline attributed to fishpond development in the area. In 2004, a great deal of improvement in mangrove cover due to reforestation efforts was evident in the abundance of trees, saplings and seedlings (SNSI, 2004). The regenerative capacity (*i.e.* ratio of seedlings to trees and saplings) of mangroves in Lopez Jaena (68%) was quite high. The seaweed (64 spp.) and seagrass (6 spp.) resources are similarly diverse and productive, serving as important habitat for shells and fish, particularly in Capayas Is. High potential of Capayas Is. as larval source of fish and invertebrates (Rollon, *et al.*, 1999) and for

ecotourism formed the basis of declaring it a marine sanctuary in 2002, together with Sibula and Mansabay Bajo (M.O. 02, s. 2002). The aggregate area of the three marine sanctuaries is about 70 has.

The present report provides an updated profile of the coastal environment and resources of Lopez Jaena, that may help in improving the draft CRM plan for the municipality. Comprehensive ecological data on the coral communities of the Capayas Island and Mansabay Bajo marine sanctuaries, and on the seagrass, seaweed, and invertebrate resources, and mangrove forests along nine coastal barangays are presented. An updated profile on fishing effort, fish production, and average fisher income is also presented. The information that this report has generated will help define the direction of the integrated coastal management planning that the local government will undertake.

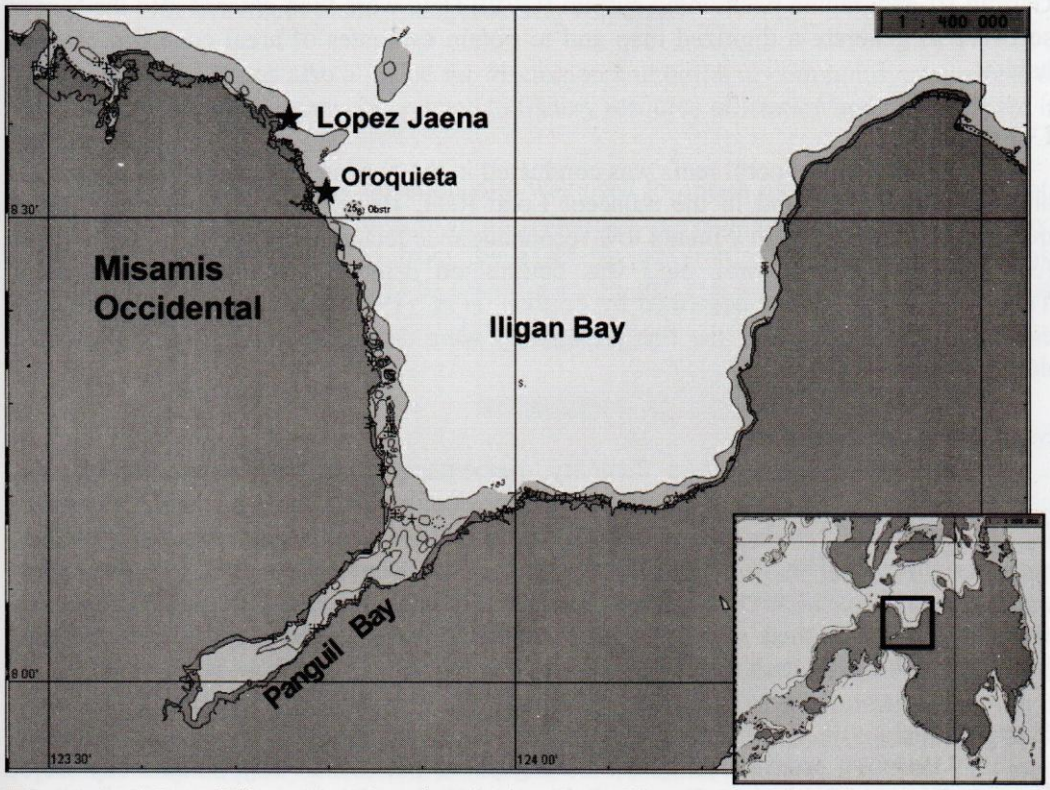

Figure 1. Map of Iligan Bay showing the location of Lopez Jaena in Misamis Occidental. Inset is the island of Mindanao, Southern Philippines.

METHODS

A rapid coastal habitat and resource assessment was conducted between April and June, 2006 in nine coastal barangays of Lopez Jaena, specifically on the following: a) coral reefs inside marine sanctuaries and other areas; b) seagrass beds and seaweed resources; c) mangrove forests; and d) coastal fisheries and socio-economic condition of the fishing community.

An integral component of the coastal profiling was a PCRA training to capacitate the community and LGU staff in various areas of coastal habitat assessment. The training was attended by 19 participants representing nine coastal barangays of Lopez Jaena. Assessment of the habitats, fishery resources and socio-economic condition of the fishing community was conducted with these participants. Coordinates of boundaries and areal extent of each habitat in nine coastal barangays were taken using a Garmin III geographic positioning system (GPS). Data were then entered into the Surfer software to generate a digitized map and to obtain estimates of areal coverage of each habitat.

Coral Reefs

Assessment of coral reefs was conducted in the marine sanctuaries of Capayas Is. and Mansabay Bajo and in the adjacent Looc Reef. Broad-scale examination of reef quality was made through a manta tow reconnaissance technique. Benthic lifeform cover (e.g. live coral, dead coral, etc.) was determined using the standard Line-intercept Transect (LIT) technique described by English, *et al.* (1997). Diversity, abundance, size estimates, and biomass of the fish community were determined along the shallow and deep portions of the reef.

Seagrasses and Seaweeds

Assessment of seagrass diversity, percentage cover, and shoot density was conducted in the barangays of Danlugan, Western Poblacion, Capayas Island, Mansabay Bajo, Puntod, and Sibula. The survey involved the use of the transect-quadrat method modified after English, *et al.* (1997). Seagrasses and seaweed cover inside the $0.25m^2$ quadrat were scored based on percentage cover for each species. Fish and invertebrates associated with seagrass meadows were identified and counted along a belt transect. Substrate type within each sample quadrat was also noted.

Mangroves

Mangrove ecosystems in the barangays of Molatuhan Bajo, Mansabay Bajo, Puntod, Western Poblacion, Eastern Poblacion, Katipa, Biasong, Sibugon and Sibula were assessed adopting the standard transect-plot method. Two to three transects were laid out from the seaward to the landward edge of the forest where a 10x10m plot was established as sampling units at 10-20 meter intervals. The different species of mangroves, and the number of trees, saplings and seedlings were recorded in each plot, and measures of girth-at-breast height (GBH) of trees (i.e. with diameter of 40mm or more) were obtained. An estimate of the regeneration potential, expressed as percentage, was made based on the proportion of seedlings and saplings to the overall plant density in

each site (SNSI, 2004). The occurrence of flowering or fruiting trees, as well as evidences of tree cutting, garbage and other threats was noted.

Participatory Coastal Fisheries and Socio-Economics Assessment

A combination of focus group discussion (FGD) and fisheries and socio-economic survey was used to gather data on municipal fisheries and socio-economics. The FGD was attended by fishermen, barangay officials, BFARMC Chairs, and representatives of womenfolk in each of nine barangays. The FGD obtained information on coastal fisheries and socio-economics covering the following parameters:

- Fishing effort (number of fishers and gear types) in each barangay
- Fish catch of major gear types
- Data on fishing seasons and fishing areas
- Fishery and non-fishery livelihood, income and household expenses
- Prices of commonly caught fishery resources

The FGD was also a venue for discussion and building community awareness of the multiple issues and concerns related to fishery resource utilization and management in Lopez Jaena.

A three-page survey questionnaire was used to obtain more comprehensive data on fisheries and socio-economics from 88 fishermen representing nine coastal barangays and to validate data obtained from the FGD. In addition, a one-page fisheries data monitoring form was distributed to obtain data on fish catch and effort using different fishing gears.

RESULTS

Coastal Resource Map

Coastal resource mapping (Fig. 2) estimated the entire coral reef area of Lopez Jaena to be about 324.2 ha measured from the rocky coralline reef flat to the reef slope between Barangay Molatuhan Bajo and Barangay Sibula. Dense seagrass meadows comprise 321.4 ha while another 204.8 ha of seagrass area have patchy distribution. Mangrove forests and patchy stands in nine barangays together cover 143.0 ha. This value is significantly higher than the 1999 estimate of 29.0 ha of remaining mangroves in the nine barangays of Lopez Jaena (Rollon, *et al.,* 1999). Such discrepancy in areal estimates may be partly attributed to massive reforestation efforts since 1999, however, much of the difference in area estimates could be due to the more rigorous method of mapping of mangrove forests in each barangay.

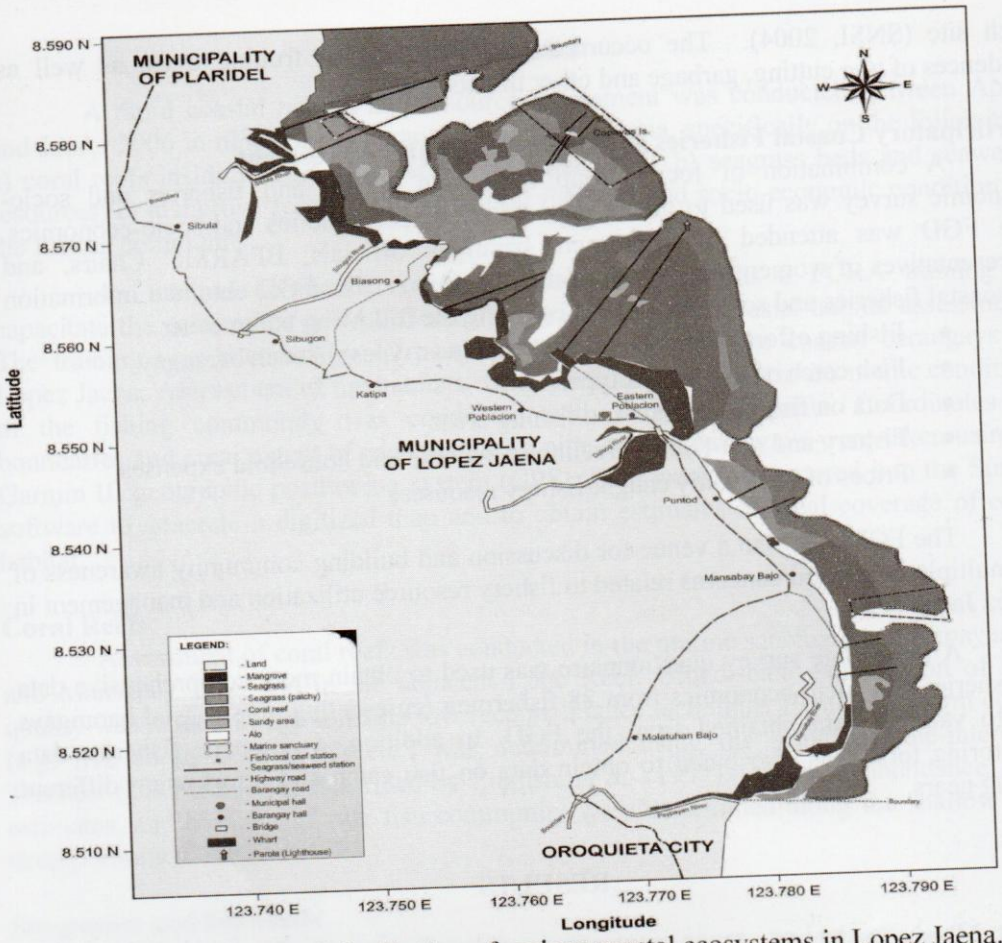

Figure 2. The extent and distribution of various coastal ecosystems in Lopez Jaena.

Coral and Fish Communities

A comparison of hard coral cover in three coral reef sites shows that the Capayas Is. marine sanctuary has the highest percentage of live coral (44%), however, dead coral cover reaches 36% (Fig. 3). Interestingly, live coral cover in the non-sanctuary reef of Looc, Mansabay Bajo (40%) is higher than inside the Mansabay Bajo marine sanctuary (24%). Dead coral cover in Looc is also low (<13%), but the reef has a large proportion of sand and other abiotic components (47%). The reef slopes of Capayas Is. marine sanctuary, on the other hand, has negligible amount of abiotics, instead, a relatively large cover of soft coral (7%) occurs, possibly attributed to moderately strong currents in the area that favor growth of soft, plankton-feeding coral (Fenner, 2007). Coral cover in the shallow portions of the reef in the two sanctuary sites is considerably lower (18-33%) than in deeper reef slopes (30-55%). Large percentage of dead coral in the Mansabay Bajo sanctuary suggests the extent of past damage from either destructive human activities or strong wave action. The shallow reefs in Mansabay Bajo are more accessible to fishers than Capayas Island and, thus, are more vulnerable to destructive fishing

activities. Fishers who participated in the validation workshop observed that blastfishing was rampant in the area before fishing regulations were actively enforced.

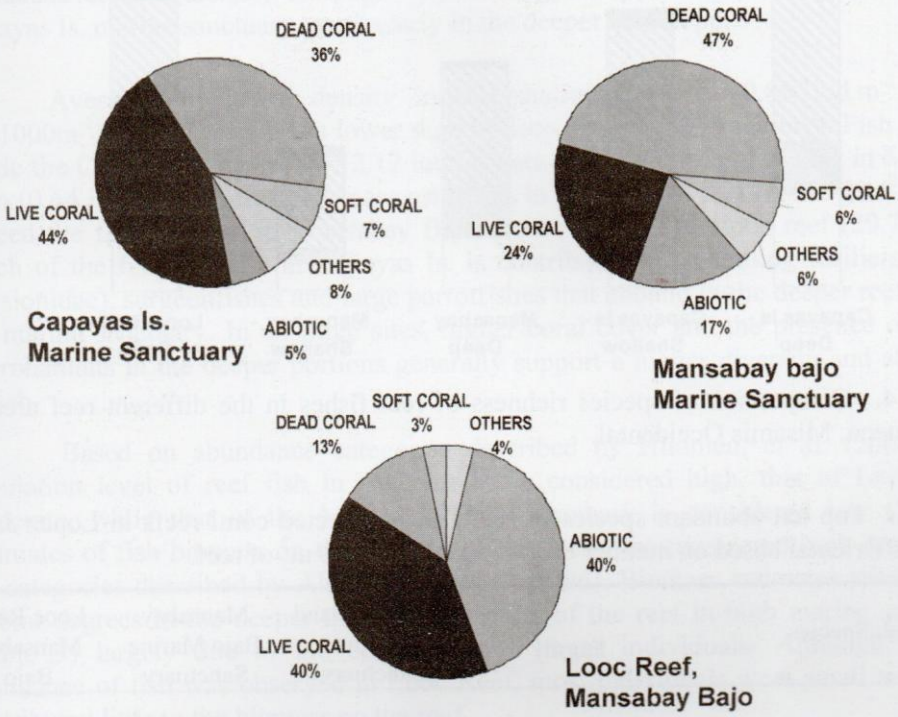

Figure 3. Proportions of coral and other benthic lifeforms among three reef sites in Lopez Jaena.

The coral reefs of Lopez Jaena are home to a rich variety of fish fauna, with a total of 146 species belonging to 23 families. Target food fish groups show a high diversity with 40 species, but the bulk of fish diversity on the reefs is made up of 78 species of small demersal fish that are commonly abundant on Philippine reefs. Some 16 species of colorful, coral-eating fish (Chaetodontidae, Pomacanthidae, and Zanclidae) found in Lopez Jaena are known indicators of healthy reefs. The coral reef inside the Capayas Island Marine Sanctuary has the highest combined species variety of 102 species for both shallow and deep stations, while the Mansabay Bajo Marine Sanctuary has only 58 species of reef fish. The submerged Looc Reef has a moderately high species variety of 73 species, even exceeding the diversity in the deeper reef slopes of Capayas Island (Fig. 4).

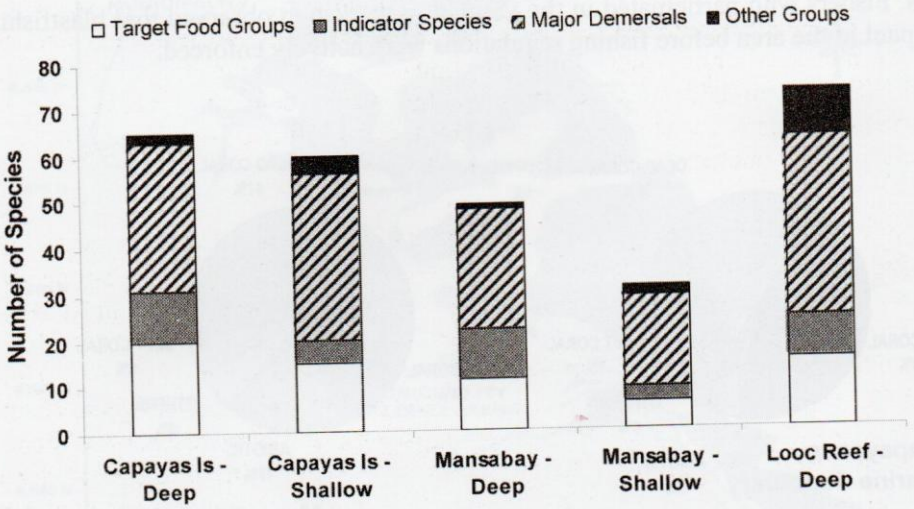

Figure 4. Comparison of species richness of reef fishes in the different reef areas of Lopez Jaena, Misamis Occidental.

Table 1. Top ten abundant species of reef fish in selected coral reefs in Lopez Jaena, Misamis Oriental based on number of individuals per 500 m^2 of reef.

Reef Fish Species	Family	Capayas Island Marine Sanctuary	Mansabay Bajo Marine Sanctuary	Looc Reef, Mansabay Bajo
Pomacentrus coelestis	Pomacentridae	116	41	2
Dascyllus reticulatus	Pomacentridae	29	53	50
Pomacentrus moluccensis	Pomacentridae	1	19	73
Chromis retrofasciata	Pomacentridae	0	12	78
Abudefduf vaigiensis	Pomacentridae	11	3	60
Neoglyphidodon nigroris	Pomacentridae	0	0	48
Thalassoma lunare	Labridae	36	8	1.5
Scarus sordidus	Scaridae	10	19	1
Scarus microrhinos	Scaridae	0	22	6
Ctenochaetus striatus	Acanthuridae	2	24	0

The most abundant species of fish on the reefs of Lopez Jaena (Table 1) are six species of damselfishes (Family Pomacentridae), the common wrasse *Thalassoma lunare* (Family Labridae), two parrotfishes (Family Scaridae) and the surgeonfish *Ctenochaetus striatus* (Family Acanthuridae). Damselfishes are common inhabitants of coral reefs and their bright colors make them popular specimens for the aquarium trade. Most of these

fish, however, are small and contribute little to available biomass. Large target food species such as snappers (Family Lutjanidae), parrotfishes and surgeonfishes are more common in the deeper reef areas, but their numbers are often small. In all three sites surveyed, fish communities are dominated by major demersal species such as pomacentrids and labrids, although several target food fishes are found inside the Capayas Is. marine sanctuary, particularly in the deeper reef slope.

Average population density in the shallow stations (0.86 ind.m^{-2} or 860 ind.1000m^{-2}) in all three sites is lower than in deep stations (1.74 ind.m^{-2}). Fish densities inside the Capayas Is. sanctuary (2.12 ind.m^{-2}) are significantly higher than in Mansabay Bajo (0.64 ind.m^{-2}). Average biomass estimates in Capayas Is. reef (63.02 g.m^{-2}) also far exceed the fish biomass in Mansabay Bajo (36.66 g.m^{-2}) and Looc reef (29.72 g.m^{-2}). Much of the fish biomass in Capayas Is. is contributed by schooling fusiliers (Family Caesionidae), surgeonfishes and large parrotfishes that abound in the deeper reef slope of the marine sanctuary. In all three sites, higher coral cover and the presence of diverse microhabitats in the deeper portions generally support a higher diversity and abundance of fish.

Based on abundance categories described by Hilomen, et al. (2000), mean population level of reef fish in Capayas Is. is considered high, that of Looc reef is moderate, while that of the Mansabay Bajo sanctuary is considered low (Table 2). Estimates of fish biomass on the reefs of Lopez Jaena are considered high according to the categories described by Aliño and Dantis (1996). Biomass estimates are higher by several degrees in the deeper than shallow parts of the reef in both marine sanctuaries (Table 3) largely due to the occurrence of larger individuals. Although moderate abundance of fish was observed in Looc Reef, most individuals were small and, hence, contributed little to the biomass on the reef.

Table 2. Comparison of abundance (ind.1000m^{-2}) of reef fish in three sites.

Station	Shallow	Deep	Mean	Abundance Category*
Capayas Is. MS	1,222	3,025	2,120	High
Mansabay Bajo MS	491	782	637	Poor
Looc, Mansabay Bajo	No Station	1,408	1,408	Moderate

** Abundance categories based on Hilomen, et al. (2000).*

Table 3. Comparison of biomass (t.km^{-2}) of reef fish in three sites.

Station	Shallow	Deep	Mean	Biomass Category*
Capayas Is. MS	24.2	101.84	63.02	Very High
Mansabay Bajo MS	9.8	63.52	36.66	High
Looc, Mansabay Bajo	No Station	29.72	29.72	High

**Biomass categories based on Aliño and Dantis (1996).*

Seagrass Resources

A total of eight species of seagrasses occurred on the sites surveyed, half the 16 species recorded from the Philippines. The same number of seagrass species was also recorded in nearby coastal municipalities of Baliangao and Oroquieta City (Save our Nature Society, Inc. 2004) and in Panguil Bay (MSUNFSTDI, 2006). Seagrass cover for all species had an average of 48.23% which was highest in Katipa (72.61%) and lowest in Puntod (21.27%). The dominant seagrasses were the dugong grass *Thalassia hemprichii* and the tropical eelgrass *Enhalus acoroides* with average cover of 29.09% and 9.08%, respectively (Table 4 and Fig. 5). Other species occurred in variably low cover, particularly *Cymodocea serrulata* and *Syringodium isoetifolium.* With the exception of *S. isoetifolium*, all the other seagrass species were recorded in a similar study conducted by Rollon, *et al.* (1999) in Lopez Jaena, Misamis Occidental.

Seagrasses in Lopez Jaena thrive in three habitat types: in shallow reef flats where they form thick meadows, in sandy areas of coral reefs, and in deep lagoons where monospecific fronds occur. Seagrasses showed no apparent zonation pattern in the surveyed sites. *Thalassia hemprichii* covered a wide range of areas from the reef edge to the very exposed shore where sediment movement occurs, while *Cymodocea serrulata* was observed only in the deeper portion of Sibula at an extremely low cover of 0.002%.

Table 4. Estimates of percent cover of different species of seagrasses in Lopez Jaena, Misamis Occidental.

Species	Common Name	Mean Percent Cover (%)	Relative Abundance (%)
Family Hydrocharitaceae			
Thalassia hemprichii	Dugong Grass	29.09	60.32
Enhalus acoroides	Tropical Eelgrass	9.08	18.83
Halophila ovalis	Spoon Grass	1.81	3.13
Family Potamogetonaceae			
Halodule uninervis	Fiber-strand Grass	2.51	4.34
Cymodocea rotundata	Round-tipped SG	4.71	9.77
Cymodocea serrulata	Toothed Seagrass	<0.01	<0.01
Halodule pinifolia	Fiber-strand Grass	1.71	2.94
Syringodium isoetifolium	Syringe Grass	0.64	0.66
Total Estimated Cover		**48.23**	**100.00**

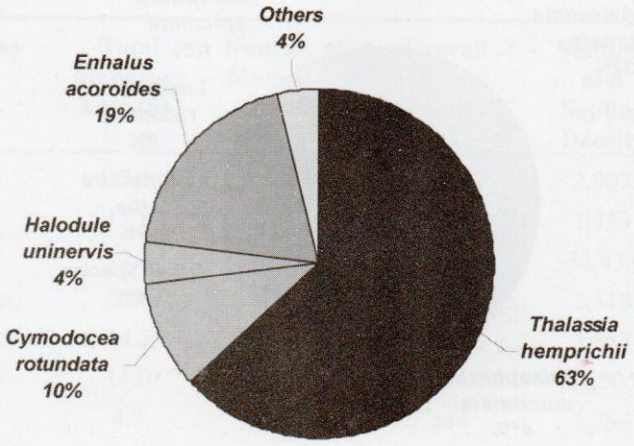

Figure 5. Relative abundance of seagrass species in Lopez Jaena, Misamis Occidental.

A total of 43 species of seaweeds with a cover of 66.97% were found associated with seagrasses in the surveyed sites. Among the algal groups, the brown algae had the highest relative abundance at 45.69%, dominated by *Sargassum crassifolium* (15.33%) and *Dictyota cervicornes* (10.12%). The most number of seaweed species (28) were found in Capayas Island followed by Puntod (23), while only seven and two seaweed species were found in Sibula and Katipa, respectively. The seagrass beds of Lopez Jaena harbor only a few species of invertebrates, such as bivalves (e. g. mussels and clams), gastropod shells, and sea urchins, that often comprised the bulk of the gleaners' collection and form part of the staple food in the coastal communities. Abundance of these fauna is, however, low (<0.5 ind.m^{-2}) as a result of unregulated gleaning on reef flats. Four individuals of sea horse (*Hippocampus sp.*) were found on the seagrass beds of Mansabay Bajo. This economically important species has virtually disappeared from many seagrass beds in Mindanao due to overfishing.

Mangrove Resources

At least 23 species of true mangroves and three species of known mangrove associates were identified across the nine coastal barangays of Lopez Jaena. Species composition varied in each barangay, where the most number of mangrove species were found in Puntod (12), Sibula (12) and Katipa (10). Although the species composition and relative abundance varied in each site, the two most dominant species of mangroves in all sites are *R. mucronata* (*bakhaw bae*) and *Avicennia lanata* (*piapi*, Fig. 6). Other ubiquitous species of mangroves in all sites are *Rhizophora apiculata* (*bakhaw laki*), *Sonneratia alba* (*pagatpat*), and *Nypa fruticans* (*nipa*).

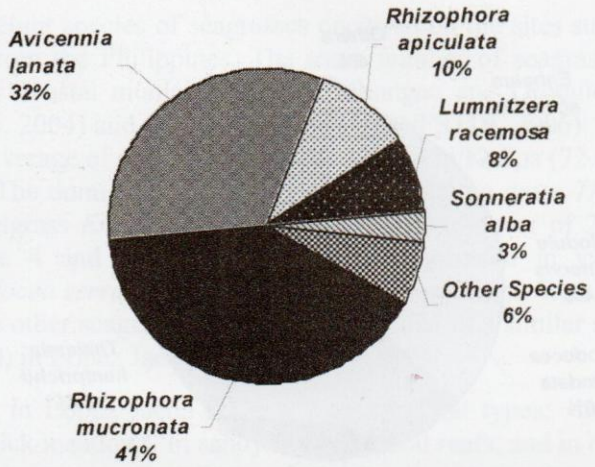

Figure 6. Relative abundance (%) of top five species of mangroves in Lopez Jaena.

The mangrove ecosystems in Molatuhan Bajo, Puntod, Sibugon and Sibula are primarily old growth or natural forests with a small mix of reforested stands mostly of *R. apiculata* and *R. mucronata.* Mangrove forests in Mansabay Bajo, Eastern Poblacion and Biasong are mostly reforestation areas. Natural stands of *pagatpat* and *piapi* found in the mangrove forests of Lopez Jaena consist of old trees as evidenced by large girth-at-breast height (GBH) measurements of more than 100 cm. A number of old *piapi* and *pagatpat* trees with GBH of 344-450 cm were found in old growth patches in Puntod, Eastern Poblacion and Biasong. Large reforested areas planted to *Rhizophora* species mostly occur along exposed seaward portions of Biasong, Molatuhan Bajo, Katipa, Sibula, and Sibugon, but small patches are also found on shoreline portions of some sites, such as Mansabay Bajo, Katipa, and Biasong.

At least 143 hectares of mangroves still exist in Lopez Jaena (Table 5). The largest mangrove areas are found in Barangay Eastern Poblacion (28.8 ha) and Sibugon (25.0 ha), while the smallest mangrove community is found in Biasong (4.7 ha). Regeneration potential, or the capacity of the mangrove forest for natural recruitment, was high in most barangays as indicated by the large proportion of seedlings and saplings (Table 5 and Fig. 7).

Table 5. Comparative profile of mangrove communities in the nine coastal barangays of Lopez Jaena, Misamis Occidental.

Coastal Barangay	Total Mangrove Area (ha)	Number of Mangrove Species	Overall Plant Density (ind.ha^{-1})	Seedling and Sapling Density	Regeneration Potential (%)
Molatuhan Bajo	17.1	5	4,121	2,907	70.53
Mansabay Bajo	13.8	5	2,689	1,789	66.53
Puntod	17.3	12	43,850	36,438	83.10
Eastern Poblacion	28.8	5	3,884	2,518	64.84
Western Poblacion	14.5	4	4,133	3,567	86.29
Katipa	14.0	10	49,691	47,505	95.60
Biasong	4.7	4	7,244	1,756	24.23
Sibugon	25.0	8	3,382	2,018	59.68
Sibula	17.3	12	6,550	4,400	67.18
Total	**143.0**	**23**	**125,545**	**102,898**	

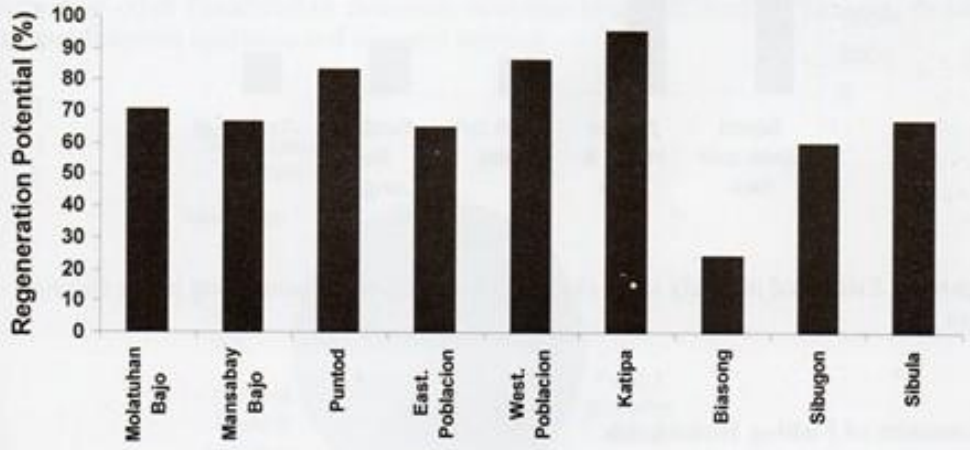

Figure 7 . Comparison of regeneration potential of mangroves in the nine coastal barangays of Lopez Jaena.

Municipal Fishery Production

The coastal fishery of the municipality is largely confined within the waters of Iligan Bay, an important fishing ground in northwestern Mindanao. Marine fisheries in Lopez Jaena is a multi-gear and multi-species economic activity that is primarily small-

scale, involving some 712 fishers and 362 fishing boats and 25 various fishing gears designed for sustenance fishing within municipal waters. Data on catch per trip and effort based on Focus Group Discussion are available only on the top five gears, namely, squid hook and line (*angkala*), single hook and line (*pasol*), trammel net (3-ply), bottom set longline (*palangre*) and drift gill net (*pukot-palutaw*). Estimates of total monthly production, which are aggregate catches by a large number of fishers, are relatively high reaching 151.87 tons from five major gears alone, or tantamount to 1,076.65 tons annually. Among the major gear types, squid hook and line (*angkala*) gave the highest monthly estimate of catch (42.38 tons), followed by single hook and line (*pasol*) of 24.10 tons (Fig. 8).

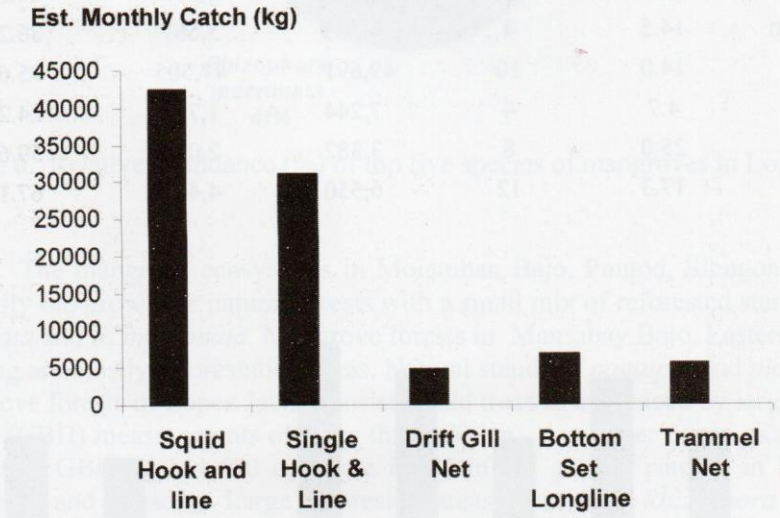

Figure 8. Estimated monthly catch (kg) of fishers in Lopez Jaena using major fishing gears.

Economics of Fishing Households

Estimates of fisher income were derived from FGD data based on daily catches of five major gears, less what fishers retain for household consumption (range of 10-20% of fish catch). Fish catch from municipal fishery is generally low except for the occasional rare peaks or "jackpot" that can generate an average income for each fisher per day from Php270 (squid hook and line) to Php330 (drift gillnets). After having deducted the fishing cost, the net daily income of fishers from various gears ranged from Php54 (drift gillnet) to Php181 (single hook and line). Daily costs of fishing differ among fishers where it can be as low as Php50 using non-motorized bancas, to as high as Php300/day for motorized boats. A large portion of the total fishing costs is spent on fuel

as many fishers venture to neighboring municipalities within Iligan Bay to fish. For many fishers in Lopez Jaena, daily net incomes are considerably low or nil.

The Focus Group Discussion provided some information on the economic status of fishers in Lopez Jaena. A greater fraction of their daily income (60%) is spent on food and immediate grocery needs, and on daily expenses for their children's education (15%) (Fig. 9). Thus, on a monthly basis, food, grocery, and children's school expenses comprise the largest share (75%) of household expenditures. On the average, each family would need Php5,670 each month to cover basic necessities and miscellaneous expenses. Estimates of monthly income from fishing, however, showed that fishers earn an average of Php4,500 – less than what a household needs to keep afloat. Fishers generally spend very minimal amount on clothing and medicines, but spend considerable amount on cigarettes, cellular phone load, and alcoholic beverage which have become part of the rustic lifestyle in coastal communities. , which would indicate whether or not the income derived from fishing activity could sustain the household expenditures of the fisher's family.

Fishers are generally poorly educated where a majority (61%) have only an elementary education, and thus, have little access to better livelihood opportunities. Many of them (47%) had been fishing for more than 20 years, and yet remain poor, earning marginal incomes. In order to compensate for meager incomes from fishing, many fishers engage in other livelihood or economic activities (Fig. 10), such as farming, livestock raising, fishpond operation and seaweed farming.

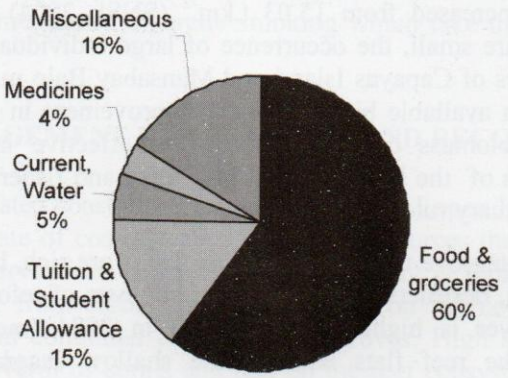

Figure 9. Distribution of daily household expenses in an average fishing family in Lopez Jaena

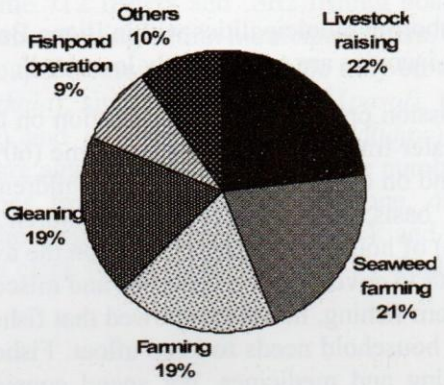

Figure 10. Profile of fishers engaged in various non-fishing livelihoods in Lopez Jaena.

DISCUSSION

Lopez Jaena has been endowed with a rich coastal biodiversity and productive fishery resources. As in many areas in Mindanao, however, it is vulnerable to multiple resource use conflicts and other environmental and social barriers to economic growth. Except in the deeper portions of the Capayas Island marine sanctuary, hard coral cover is only fair (<50%) in many parts of the reef, although coral cover has considerably improved from the 32.62% average HCC reported by SNSI in the 2004 assessment. Fish diversity on the reefs is higher than the 111 species earlier reported, while average biomass has significantly increased from 15.03 $t.km^{-2}$ (SNSI, 2004) to 41.92 $t.km^{-2}$. Although most reef fishes are small, the occurrence of large individuals of target food fish in the deeper reef slopes of Capayas Island and Mansabay Bajo marine sanctuaries contribute to the increase in available biomass. Such improvement in coral cover, fish diversity, abundance and biomass can be attributed to effective law enforcement, primarily through the efforts of the Bantay Dagat task force and fisherfolk associations that enforce the marine sanctuary rules in Lopez Jaena.

The seagrass and mangrove resources of Lopez Jaena are rich, but these are also being threatened by siltation, destructive gears, and cutting even of reforested mangrove trees. While seagrass cover is higher than reported in 2004 (mean of 32.86%), unregulated gleaning on the reef flats has left the shallow seagrass beds almost depauperate of edible invertebrates that could have provided food and supplemental income for fishers. The SNSI (2004) report listed more diverse invertebrate communities on Lopez Jaena's seagrass beds than the present study, indicating progressive exploitation of these nearshore resources. Higher species number of mangroves is reported in the present paper (23) than in 2004 (16) but the last assessment was made in only three sites: Eastern Poblacion, Sibula, and Molatuhan Bajo, and presumably incomplete. The dominance of saplings and seedlings in many areas indicates the large potential of the mangrove community to regenerate and replace what may be lost due to natural causes or

human impacts. Regeneration potential of mangroves in Lopez Jaena is highest in Katipa (95.6%), Western Poblacion (86.3%) and Puntod (83.1%) where large numbers of *Avicennia* and *Sonneratia* saplings and seedlings occur. This observation, however, should be taken with caution since reforestation efforts mainly using *Rhizophora* seedlings are still on-going in many mangrove forests in Lopez Jaena. Moreover, tree cutting violations observed in Puntod, Eastern Poblacion, Katipa and other barangays can easily diminish the regeneration potential of many mangrove ecosystems of the municipality. Abundance of young mangrove recruits has considerably increased since 2004 when mean seedling and sapling densities of 954 ind.ha^{-1} and 216 ind.ha^{-1}, respectively, were reported from three sites in Lopez Jaena.

Survey of daily catches of major gear types reveal low catch rates of 2-5 kg on each fishing trip, except in rare occasions when large catches of squid or pelagic fish are landed. These estimates are not much different from those reported by SNSI (2004), which may either be an indication that the amount of fishery resources in Lopez Jaena has dwindled over the years, or fishing effort is much higher than should be maintained for sustainable fisheries. A large number of fishers employ non-motorized bancas to reduce fishing costs, yet income from fishing does not increase since catches in nearshore areas are quite poor. While higher catch rates are most likely obtained from fishing in deeper waters where most of the bigger fish are found, this operation, however, would require more effort and larger costs for fishers.

Despite meager incomes, fishing households in Lopez Jaena endeavor to send their children to school. The high regard for education manifested by fisher households typifies the average Filipino's hope for a better future for their children. On the other hand, many fishers are reckless in spending their hard-earned income, indulging in petty gambling and unregulated cigarette smoking which take up quite a proportion of their daily profit.

MANAGEMENT IMPLICATIONS AND RECOMMENDATIONS

The updated coastal environment profile of Lopez Jaena has shown encouraging results on the state of coastal habitats and the resources therein resulting from years of management interventions. On the other hand, there is some anxiety over the negative impacts ensuing from certain human activities on the coastal habitats, such as high fishing effort and continued cutting of mangroves. High silt loading from rivers also threatens the survival of corals and fish on the reef ecosystems. For example, the coral reef inside the Sibula marine sanctuary practically receives the bulk of silt load from the Sibula-Sibugon river so that an underwater assessment is virtually impossible.

The establishment of marine sanctuaries in Capayas Island and Mansabay Bajo indicate how habitat quality and abundance of resources can improve under strict protection. Positive impacts of management are indicated by improving live coral cover, presence of relatively undisturbed coral beds and numerous growing colonies of young corals, and a high diversity and abundance of reef-associated fish. There is a need,

however, for more vigilant protection of these sanctuaries in order to maximize their social and economic benefits.

Abundant seagrass resources of Lopez Jaena provide habitat and food for diverse groups of fish and invertebrates so that these ecosystems should be adequately protected. Mangrove resources in Lopez Jaena have a high potential for recovery, but must be protected against illegal cutting and other forms of degradation. Protecting natural habitats would require a combination of regulatory measures and improved IEC programs.

This updated profile provides a sound basis for the municipal Integrated Coastal Management (ICM) Plan that the local government of Lopez Jaena has formulated for the sustainable utilization of coastal resources. The following are specific recommendations for the improvement of the municipal ICM program:

1. Protection of coral reefs and marine sanctuaries should be enhanced through capacity building of the *Bantay Dagat* task force and provision of incentives (e.g. insurance) for *Bantay Dagat* volunteers on top of what they currently receive.
2. Create and equip a research and monitoring team to regularly monitor and evaluate the status of marine protected areas (MPAs) and other coastal ecosystems.
3. Protection of seagrass meadows through prevention of use of destructive fishing gears (trawl, push net, drags seine), establishment of designated routes for boats in shallow seagrass areas, and regulation of gleaning or gathering of shells, invertebrates and seaweeds.
4. Implement a sustainable mangrove restoration and management program to include the establishment of mangrove greenbelts and mangrove protected areas, adopt multispecies rehabilitation and planting of appropriate mangrove species in appropriate areas, creation of a mangrove monitoring team and implementation of an effective IEC campaign.
5. Effective regulation of fishing effort by strictly implementing the fisher/gear registration, boat color coding, and finalize the delineation of municipal waters.
6. Revive the enthusiasm and community participation toward stronger implementation of CRM programs through IEC, capacity building and establishment of an award system for community support.

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