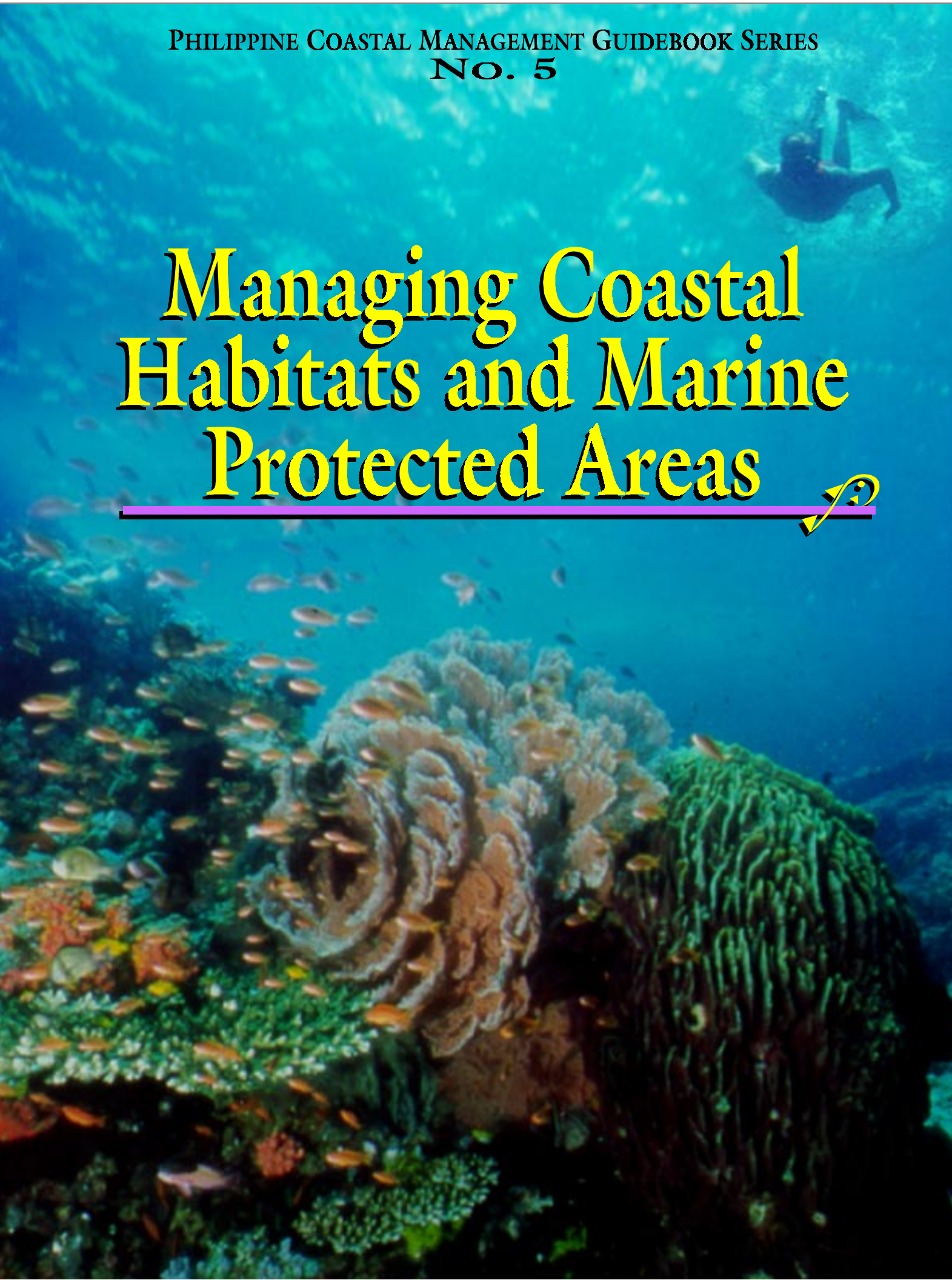
PHILIPPINE COASTAL MANAGEMENT GUIDEBOOK SERIES
NO. 5

Managing Coastal Habitats and Marine Protected Areas



PHILIPPINE COASTAL MANAGEMENT GUIDEBOOK SERIES

NO. 5:

MANAGING COASTAL HABITATS AND MARINE PROTECTED AREAS

By:

Department of Environment and Natural Resources

Bureau of Fisheries and Aquatic Resources
of the
Department of Agriculture

Department of the Interior and Local Government

and

Coastal Resource Management Project
of the
Department of Environment and Natural Resources
supported by the
United States Agency for International Development

Philippines

PHILIPPINE COASTAL MANAGEMENT GUIDEBOOK SERIES
NO. 5

Managing Coastal Habitats and Marine Protected Areas

by

Department of Environment and Natural Resources (DENR)
Bureau of Fisheries and Aquatic Resources of the Department of Agriculture (DA-BFAR)
Department of the Interior and Local Government (DILG)
and
Coastal Resource Management Project (CRMP)

2001

Printed in Cebu City, Philippines

Citation:
Department of Environment and Natural Resources, Bureau of Fisheries and Aquatic Resources of the Department of Agriculture, and Department of the Interior and Local Government. 2001. *Philippine Coastal Management Guidebook No. 5: Managing Coastal Habitats and Marine Protected Areas*. Coastal Resource Management Project of the Department of Environment and Natural Resources, Cebu City, Philippines, 106 p.

This publication was made possible through support provided by the United States Agency for International Development (USAID) under the terms and conditions of Contract No. AID-492-C-00-96-00028-00. The opinions expressed herein are those of the authors and do not necessarily reflect the views of the USAID. This publication may be reproduced or quoted in other publications as long as proper reference is made to the source.

Photo credits: *Front cover:* Lynn Funkhouser and Mike Ross. *Back cover:* Alan White.

CRMP Document No. 05-CRM/2001

ISBN 971-92289-4-6

Contents

List of tables

List of figures

List of acronyms and abbreviations

AO	-	Administrative Order
APLS	-	Apo Island Protected Landscape and Seascape
BFAR	-	Bureau of Fisheries and Aquatic Resources
CBFM	-	Community-based Forest Management
CBFMA	-	Community-based Forest Management Agreement
CBMFM	-	Community-based Mangrove Forest Management
CEP	-	Coastal Environment Program
CO	-	community organizer
CRM	-	coastal resource management
CRMP	-	Coastal Resource Management Project
DA	-	Department of Agriculture
DA-BFAR	-	Department of Agriculture-Bureau of Fisheries and Aquatic Resources
DENR	-	Department of Environment and Natural Resources
EIA	-	environmental impact assessment
FLA	-	Fishpond Lease Agreement
GMPS	-	general management planning strategy
ha	-	hectare
ICM	-	integrated coastal management
IUCN	-	IUCN-The World Conservation Union
km	-	kilometer
km^2	-	square kilometer
LGC	-	Local Government Code
LGU	-	local government unit
M&E	-	monitoring and evaluation
M/CFARMC	-	Municipal/City Fisheries and Aquatic Resources Management Council
MFDP	-	Municipal Fishery Development Plan
MPA	-	Marine Protected Area
NGO	-	nongovernment organization
NIPAS	-	National Integrated Protected Areas System
OIWS	-	Olango Island Wildlife Sanctuary
PAMB	-	Protected Area Management Board
PASU	-	Protected Area Superintendent
PCRA	-	Participatory Coastal Resource Assessment
PO	-	people's organization
RA	-	Republic Act
SMC	-	Sanctuary Management Committee
t	-	ton
USAID	-	United States Agency for International Development
WWF	-	World Wide Fund for Nature

Acknowledgments

This book represents the composite work of many individuals and organizations. The authors are:

Alan T. White, Ph.D., Deputy Chief of Party, Coastal Resource Management Project
R. Steven Nakashima, M.P.A., M.S.P.H., Environment Specialist, New Rochelle, New York
Mary Gleason, Ph.D., Tetra Tech EM Inc.

The following Departments have endorsed, reviewed, and made contributions to this book:
Department of Environment and Natural Resources
Department of Agriculture
Department of the Interior and Local Government

The special technical editors include:
Porfirio Aliño, Ph.D., University of the Philippines, Marine Science Institute
Hilconida Calumpong, Ph.D., Director, Marine Laboratory, Silliman University
Catherine A. Courtney, Ph.D., Chief of Party, Coastal Resource Management Project
Benjamin Francisco, Palawan Provincial Coordinator, Coastal Resource Management Project
Emma Melana, M.S., Division Chief, Ecosystems Resources, Research Division, Department of Environment and Natural Resources

The reviewers from the workshops include:
Dir. Flor Barangan, Department of Environment and Natural Resources, Manila
Tom Bayer, M.S., Training Coordinator, Coastal Resource Management Project
Renato Cruz, Department of Environment and Natural Resources, Protected Areas and Wildlife Bureau
Rudolf Hermes, Philippine Council for Aquatic and Marine Research and Development
Jesus Juario, Ph.D., Professor, University of the Philippines, Cebu
Amuerfino Mapalo, Department of Environment and Natural Resources Region 7
Roy Olsen de Leon, Silliman University - Center of Excellence, Coastal Resource Management
Ma. Lourdes Palomares, Ph.D., International Center for Living Aquatic Resources Management
Protacia Sayson, Bureau of Fisheries and Aquatic Resources, Region 7
Filipina B. Sotto, Ph.D., University of San Carlos
Dir. Eustaquito Tandug, Ph.D., Coastal Environment Program, Department of Environment and Natural Resources, Manila

Romeo Trono, Executive Director, World Wide Fund for Nature, Philippines
Sammy Umandap, International Marinelife Alliance
William Villaver, Provincial Planning and Development Office, Cebu
Alexis Yambao, M.A., Coastal Management Specialist, Coastal Resource Management Project

This book has been supported by the Coastal Resource Management Project of the Department of Environment and Natural Resources with support from the United States Agency for International Development. Copy editing was done by Leticia Dizon and final production was assisted by Ysolde Collantes, Leslie Tinapay, and Dexter Allen Besa.

Foreword

Department technical personnel have reviewed and fully endorse the *Philippine Coastal Management Guidebook Series* as an essential information guide to assist in improving the status of Philippine coastal resources and their management. This series of guidebooks strengthens our capacity to enhance coastal management efforts in the country. It clearly identifies roles and responsibilities for all concerned departments, agencies, and organizations in this collaborative coastal environmental management effort.

Let us enjoin all users of these guidebooks to collectively work for sustainable management of our coastal resources for the economic and environmental well-being of our country!

Department of Environment and Natural Resources

Department of Agriculture - Bureau of Fisheries and Aquatic Resources

Department of the Interior and Local Government

Preface and orientation to this guidebook series

This book is the fifth in a series of eight guidebooks to coastal management in the Philippines. The titles and basic content of these eight books are shown next page. The series covers major topics concerning all aspects of coastal management in the Philippines and follows a theme of local government perspective, while highlighting the role of the various stakeholders and other factors that affect coastal environments.

This fifth book, *Managing Coastal Habitats and Marine Protected Areas*, presents the rationale and the means to protect, manage, and rehabilitate valuable coastal and marine habitats. This book provides an overview and analysis of each important coastal habitat in the country. Basic ecology, resource uses and values, management issues and interventions, and the legal and institutional framework are all explained in relation to habitat management. Estuaries, lagoons, and bays; mangrove forests; beaches and foreshore areas; seagrass beds; and coral reefs with their related fisheries are all described. The interconnections among the habitats within the larger coastal ecosystem are explained and guidelines for integrated management are presented.

Within this volume, guidelines for the creation and management of marine protected areas are also addressed. The guidelines represent an important tool for protecting and enhancing the condition and productivity of all coastal habitats in the Philippines and are explained through a sequence of activities that can lead to the successful implementation of a marine protected area. Case studies are presented to highlight viability in the creation and sustainability of marine protected areas. Benefits in terms of fish catch and other economic revenues for well-managed areas are described.

Coastal management is the theme of these books because of the urgent need to manage and protect the coastal resources of the Philippines. These resources are known to be incredibly valuable and important to the country's security. If the management problems are not addressed soon using integrated approaches, the environmental and food security of the country will be further threatened. These guidebooks lay out a process to address deteriorating coastal environments, loss of resources, increasing poverty, and to reverse current trends. They are holistic in approach while offering many specific solutions that are easy to implement. Read, comprehend, and make use of these guidebooks!

Philippine Coastal Management Guidebook Series—Titles and contents

1. Coastal Management Orientation and Overview	◆ Definitions and trends in coastal management ◆ Issues, resources, and impacts of concern in the Philippines ◆ Introduction to the coastal management process in the Philippines ◆ Guidebook series and how to use it
2. Legal and Jurisdictional Framework for Coastal Management	◆ All laws pertaining to coastal management ◆ All jurisdictions affecting coastal areas and resources ◆ The roles and mandates of government agencies
3. Coastal Resource Management Planning	◆ Coastal management planning process from local government perspective ◆ Key steps and procedures in the process ◆ How to develop the coastal management plan
4. Involving Communities in Coastal Management	◆ Importance of involving coastal communities ◆ Community organization process and participatory approaches ◆ Information, education, and communication techniques ◆ Sustainability of community-based coastal management
5. Managing Coastal Habitats and Marine Protected Areas	◆ The coastal marine ecosystem and how it functions ◆ Management considerations of critical coastal habitats ◆ Creating and managing marine protected areas
6. Managing Municipal Fisheries	◆ Municipal waters and legal jurisdiction for fisheries management ◆ Planning for fisheries management ◆ Management interventions and how to apply them
7. Managing Impacts of Development in the Coastal Zone	◆ Roles of planning and environmental impact assessment ◆ Environmental guidelines for coastal development ◆ Government role and mandate to prevent development impacts ◆ Managing coastal and marine pollution
8. Coastal Law Enforcement	◆ Major issues in effective law enforcement in coastal management ◆ Roles and responsibilities of major law enforcement groups ◆ Initiatives to improve fishery law enforcement

Glossary of terms

Abiotic	Not involving or produced by organisms; no biological activity
Accretion	The process of accumulation of sediment by natural forces, such as the accretion of sand on a beach
Biotic	Relating to life; caused or produced by organisms
Brackish	A mixture of saltwater diluted by freshwater containing between 5 and 30 parts per thousand (ppt) of dissolved solids
Coral	The animal that uses calcium from seawater to construct its skeleton and in aggregate forms a coral reef
Detritus	Excrement and other waste products of all types of organisms including their remains after death
Ecosystem	A basic subunit of the biosphere comprised of both living and nonliving components
Erosion	The process of breaking down or moving away under an outside force as waves causing the erosion of a sandy beach
Estuary	A partially enclosed coastal embayment where freshwater and seawater meet and mix
Eutrophication	The process by which a body of water becomes enriched with dissolved nutrients (as phosphates) that stimulate the growth of aquatic plant life usually resulting in the depletion of dissolved oxygen
Habitat	The place or environment where a plant or an animal naturally or normally lives and grows
Lagoon	Subtidal water enclosed by barrier reefs or an atoll reef flat
Littoral	Of or pertaining to the shore or coast of the sea
Photosynthesis	Process by which plants capture light energy from the sun to convert carbon dioxide and water into carbohydrates
Polyp	A sessile or sedentary cnidarian (animal belonging to Phylum *Cnidaria*; the corals and anemones, for example) individual with a cylindrical body and usually tentacles surrounding a mouth at the free end

Primary productivity	Rate of production especially of food by the utilization of solar energy by producer organisms
Symbiotic	An intimate association between two (or more) organisms in which both obtain benefit from the relationship
Watershed	All the land area within which water will flow over the surface of the land to a common outlet
Zooxanthellae	Symbiotic dinoflagellates (unicellular marine planktons) in the tissues of various marine invertebrates; symbionts that are brown in color

chapter 1
The Philippine marine coastal ecosystem

Coastal resources, such as finfish and shellfish, and the habitats that nurture them—coral reefs, seagrass beds, and mangrove forests—are among the most fundamental elements of the Philippine environment. The marine waters of the Philippines are one of the richest in the world. They provide great benefits to more than half of the population that lives in the 832 coastal municipalities. Fish captured in nearshore waters along the 18,000 km of coastal Philippine shoreline provide more than 50 percent of the animal protein consumed by the average Filipino. Tourists drawn to the islands by the lure of sandy beaches and colorful coral reefs provide millions of dollars in tourism revenues annually (White and Cruz-Trinidad 1998). Unfortunately, the ecosystems that provide these gifts are under severe stress. Open access to coastal resources and use of destructive fishing practices such as use of explosives and poisons among others are causing overfishing and habitat destruction. Compounded with pollution, rapid population growth, poorly managed shoreline development and slow economic development, the unsustainable use and the degradation of the bountiful coastal resources of the Philippines is readily apparent. The condition of coral reefs and mangrove forests has declined markedly in recent years as examples.

Fortunately, there is a growing awareness about the degraded state of the Philippines' coastal resources and the urgent need for solutions. The link between Filipinos and their marine and coastal ecosystems and the need for stewardship is well illustrated by the following quote:

> "…Filipinos are blessed in a million different ways by the oceans that embrace our 7,100 islands. We are true children of the sea, shaped and nurtured by the sea, which separates us and makes us distinct and diverse as a people, and yet also connects us in the most natural way to each other and the rest of the world… As we approach the 21st Century and as individual nations become more and more integrated into one big global community, we will all the more appreciate the value of the ocean as our greatest heritage and a fragile resource base upon which we will all continue to depend. Let us not forget that we are all, individually as well as collectively, stewards of this heritage."
>
> Former Philippine President Fidel Ramos
> Proclaiming 1998 as the Year of the Ocean

The purpose of this book is to assist stewards as they marshal support for management and protection of critical coastal habitats. Key concepts are introduced about the Philippine coastal marine ecosystem. Five important habitats are described: lagoons and estuaries, mangrove forests, beaches and foreshore lands, seagrass beds, and coral reefs (Figure 1). Background

information is provided on each habitat including its ecology and status, uses, major threats, suggested management interventions and legal protection. Finally, a chapter is dedicated to establishing and implementing marine protected areas. Marine protected areas are the management mechanism that can effectively protect critical coastal habitats. They are being implemented around the Philippines but still need guidance and improvement to make them truly effective and sustainable.

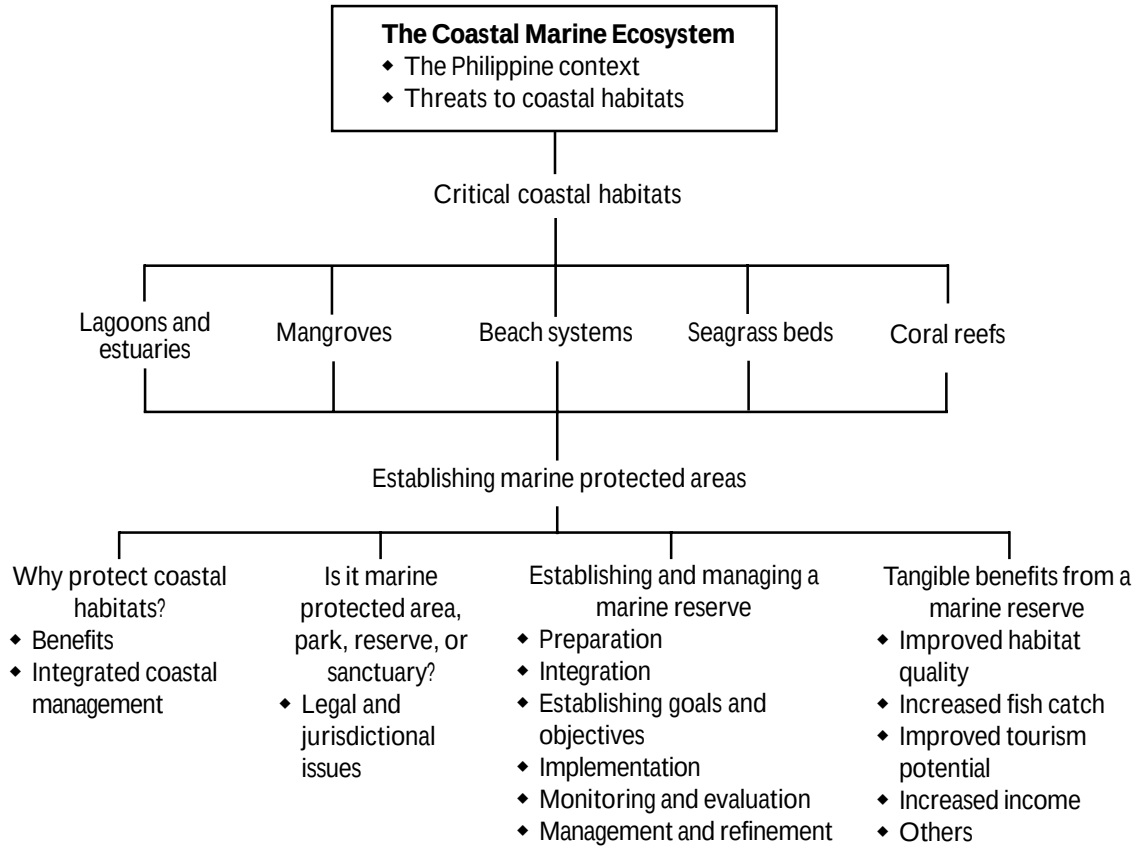


Figure 1. Key themes for managing coastal marine habitats and marine protected areas.

THE PHILIPPINE SETTING

The Philippines lies in the western Pacific Ocean where its 7,100 islands geographically are a part of the Malay Archipelago. They are bounded on the east by the Philippine Sea, on the south by the Celebes Sea, and on the west by the South China Sea. The islands of the archipelago are volcanic in origin. Rising from the adjacent Philippine Trench more than 10 km, they reach a maximum height of 2.94 km above sea level at Mindanao's Mount Apo. Land is at a premium in a country where only about 460 of the islands have land areas larger than 1 square mile. The vast majority of the country's estimated 80 million (year 2000) inhabitants live on the eleven largest islands, most within the narrow coastal zone lining 18,000 km of coastline (Figure 2). Population density in coastal areas now surpasses 500 people per km^2 in some rural areas.

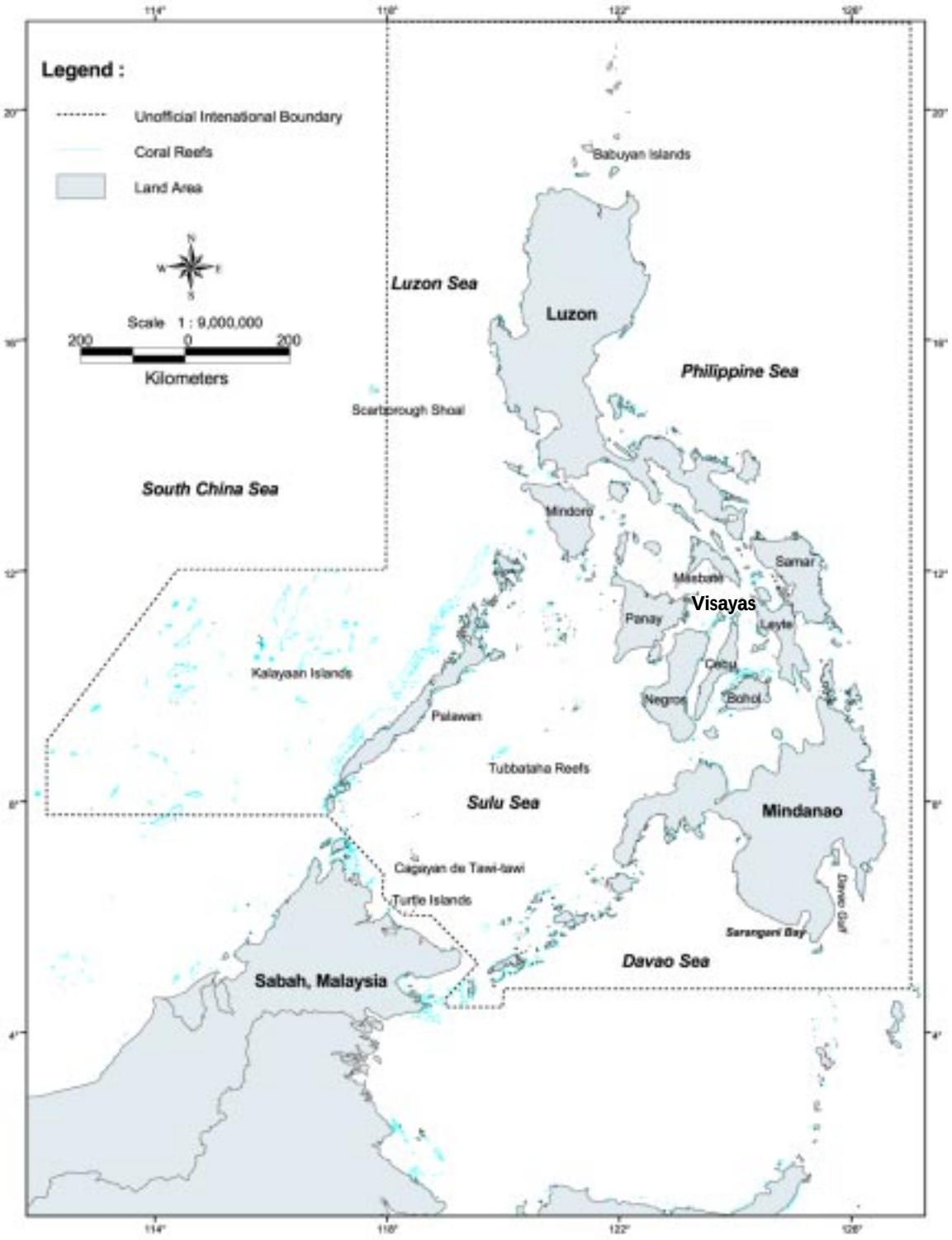


Figure 2. The Philippine Islands and important coral reef areas *(WRI 2000)*.

BIOGEOGRAPHY

Philippine waters contain some of the world's richest ecosystems, characterized by extensive coral reefs, seagrass beds, and dense mangrove forests. Blessed with a sunny tropical climate, waters enriched with nutrients from the land and driven by the wind, the Philippines supports an exceptionally high diversity of marine life. The Philippines lies within the global center of marine biodiversity (Sale 1991). For example, the 430 species of hard or stony corals (scleractinians) found in Philippine coral reefs far exceed the 70 species of the Caribbean. Figure 3 shows that the Philippines lies in the heart of the region with the greatest number of coral genera. Fourteen species of seagrasses are also found in the Philippines, the highest number in the Indo-Pacific region and second worldwide only to Western Australia with 17 species (Fortes 1989).

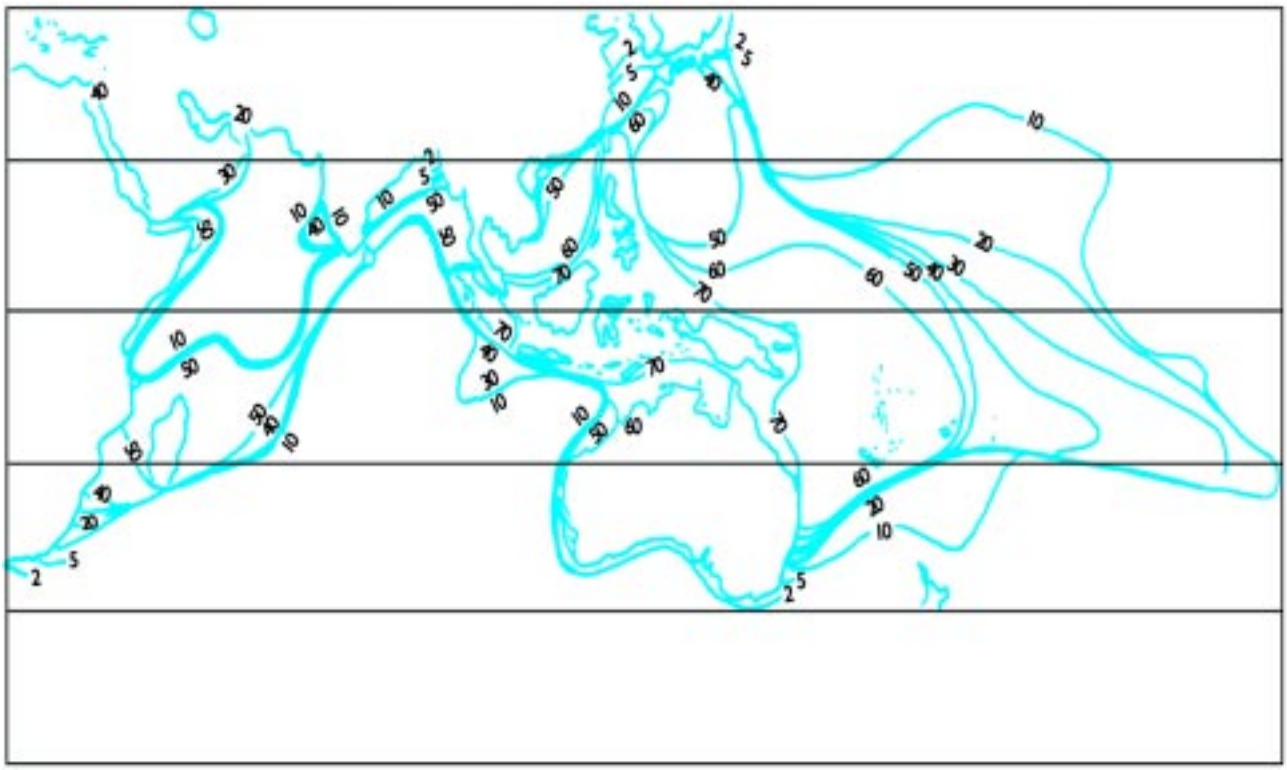


Figure 3. Geographical variation in the number of coral genera across the Indo-Pacific region *(Ormond and Douglas 1996)*.

Factors that contribute to this exceptional range of biodiversity include:

- A warm climate and stable water temperatures that rarely dip below 18°C;
- The sun's abundant light that fuels the energy-capturing photosynthesis process that supports the growth of algae, coral, and other organisms;
- Relatively low sediment loads that allow passage of the light deep into the water;
- Generally low freshwater inputs that maintain a salinity level between 30 and 36 ppt; and
- Currents, clean water, and hard substrates that provide optimal conditions for the corals and other aquatic life to thrive (White 1987a).

High levels of primary productivity also fuel the exceptional biodiversity of the coastal marine systems. Primary productivity is a measure of an area's ability to capture the energy of sunlight and convert the basic building blocks of water, carbon dioxide, and nutrients into plant cell matter. This plant matter is then consumed by animals that transfer energy up through a food chain (described below) (Brewer 1979). Figure 4 presents the ranges of primary productivity of major marine communities. It can be noted that these tropical coastal marine habitats produce the highest levels of primary productivity of any ecosystem worldwide.

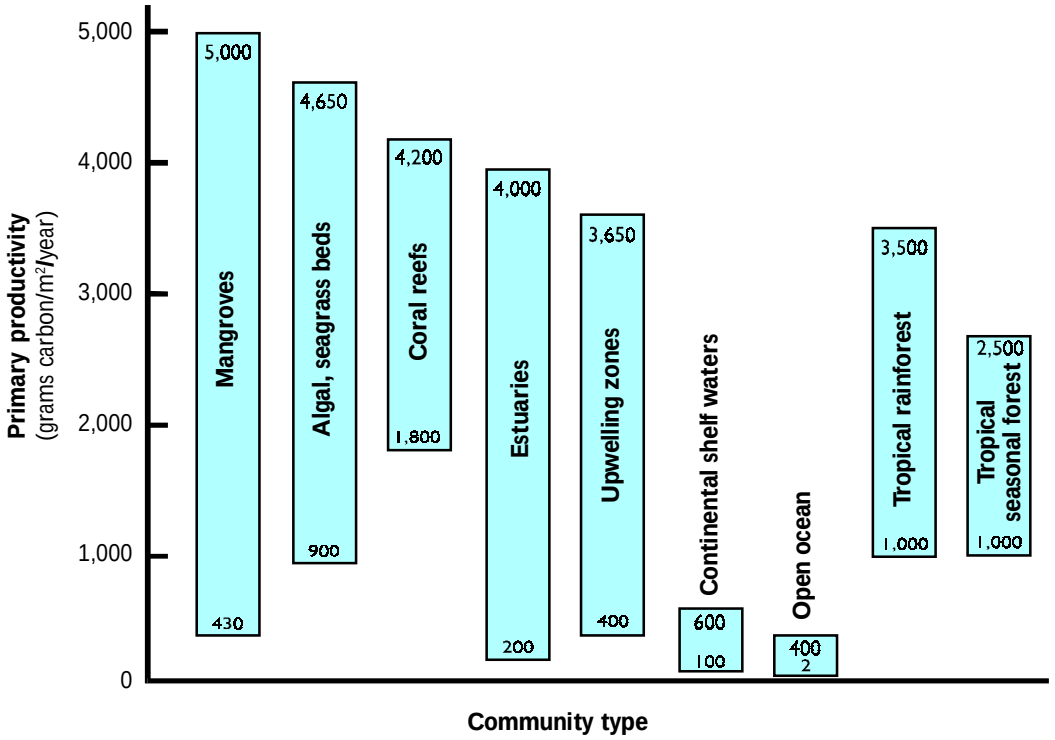


Figure 4. Ranges of primary productivity of some major marine communities *(Whittaker 1975)***.**

HABITATS OF THE COASTAL ZONE

The coastal zone is the interface where the land meets the ocean. It includes the shoreline environment and the adjacent coastal waters. The Philippines' diverse coastal zone consists of a variety of tropical ecosystems. These include sandy beaches, rocky headlands, sand dunes, coral reefs, mangroves, seagrasses, wetlands, estuaries, and lagoons. The various ecosystems are interconnected, making it virtually impossible to alter one feature of the coastal zone without affecting another, either directly or indirectly. Each plays a critical role in maintaining the viability and health of the entire coastal zone as well as the other ecosystems. Figure 5 illustrates some of these important coastal ecosystems and habitats. A brief description of these habitats is included in Table 1.

Table 1. Brief descriptions of key coastal habitats and terms *(Castro and Huber 1997)**.***

Beaches	A dynamic zone or strip of unstable unconsolidated material (e.g., sand, gravel) deposited along the shoreline. Beaches are subject to erosion (removal of material) and accretion (deposition of material) produced by waves, wind, and tidal currents.
Coral	A variety of small organisms, most easily recognized as the hard or stony coral that comprise the single most significant feature of any coral reef. These small organisms generally live in colonies attached to hard substrates where only the surface portions exposed to sufficient light are alive. The underlying coral structure is a dead calcium carbonate skeleton deposited by the living surface polyps.
Coral reef	Wave and current resistant calcareous structures formed *in situ* from the skeletons of corals and other organisms. They constitute the largest biogenic structures on the planet and support assemblages of living corals and many other organisms, including fish, mollusks, marine worms, crustaceans, algae, and sponges (Ormond and Douglas 1996).
Estuaries	A semi-enclosed coastal basin in which fresh river water entering at its head mixes with saline water entering from the ocean; usually associated with a river's intersection of the coast.
Foreshore	The intertidal part of a beach or the part of the shorefront lying between the beach head (or upper limit of wave wash at high tide) and the mean low water mark that is ordinarily traversed by the uprush and backrush of the waves as the tides rise and fall. Legally defined as 40 m inland from mean high tide.
Lagoons	A semi-enclosed coastal basin with limited fresh water input, high salinity, and restricted circulation; lagoons often lie behind sand dunes, barrier islands, or other protective features, such as the coral reef of an atoll lagoon.
Mangroves	Any of the many genera of woody plants that are capable of living and growing in salt water or salty soils. The mangrove forest harbors a rich biological community that is supported by the mangrove and associated species of trees and other plants.
Seagrass beds	Areas of salt tolerant plants that occur in shallow nearshore waters, estuaries, lagoons and adjacent to coral reefs. They hold sediment in place, support a rich detrital community, and provide food and habitat for many important nearshore species.

MECHANISMS FOR EXCHANGE OF BENEFITS AMONG ECOSYSTEMS

An important key to the biodiversity of the Philippine ecosystems is the exchange of benefits between various ecosystems. For example, coral reefs can efficiently use the nutrients in water to support a diverse and dazzling ecosystem. However, the water surrounding the reefs is nearly devoid of critical nutrients such as nitrate and phosphate. Nutrients required to support the rich coral communities come from adjacent ecosystems. Algae and bacteria growing in the very productive mangrove forests and seagrass beds contribute nutrients to coral reef animals. Reef fish move between habitats, feed on plants, and then deposit the nutrients as feces on the reefs. The water's currents also carry detritus (decomposing organic materials) and nutrients released by the mangroves and seagrass beds to coral reefs (Nybakken 1982; Castro and Huber 1997). In

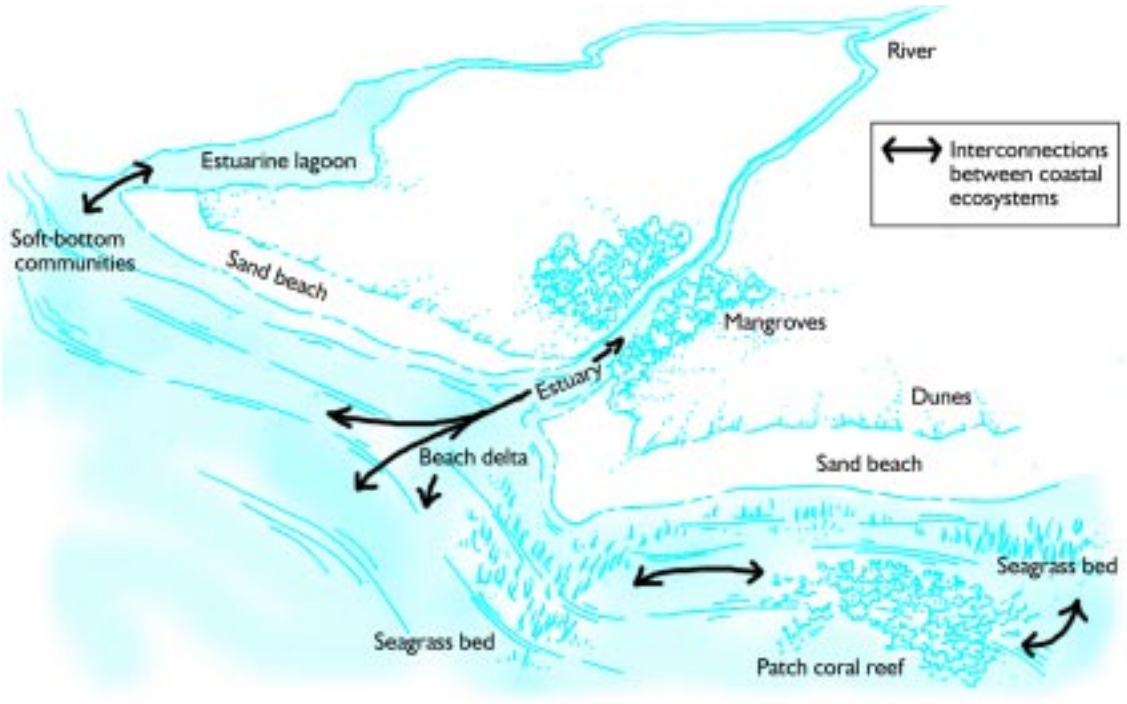


Figure 5. Important coastal ecosystems and habitats *(Maragos* et al. *1983)*.

addition, mangrove and seagrass habitats provide nursery grounds and feeding areas for coral reef and small pelagic fish. An example, yellowfin tuna, are known to feed on coral reefs.

The habitats of the coastal marine environment are linked by a variety of mechanisms, which aid in the transfer of nutrients, wastes, seeds, spores and other reproductive cells (gametes), and sediments between the different ecosystems. These mechanisms include the hydrologic cycle, currents, tides, wind, waves, and self-propelled movement. Habitats are also connected by energy cycles such as food webs.

The **hydrologic or water cycle** is the passage of water through earth's natural systems (Figure 6). Water falls to the earth as precipitation. It percolates into the earth and recharges groundwater aquifers, providing water for wells and base flows for streams and rivers. Alternatively, water may run off over the ground into waterways connecting via streams, rivers, ponds, and lakes with the ocean. As it passes over the ground, water collects sediment, nutrients, toxic compounds, trash, and heat. Water returns to the atmosphere either by evaporation from surface water bodies or during transpiration when plants release water vapor as a byproduct of the energy-capturing photosynthesis process.

Development activities disrupt the cycle by altering the ability of the ground surface to absorb water. This decreases groundwater recharge and increases surface runoff causing more flooding with higher water volumes and velocities. The result may be loss of life and property. Increased sediment from erosion can block light transmission in coastal waters or physically smother reefs and seagrass beds (Fortes 1989). Inhibiting groundwater recharge can lower groundwater aquifers leading to dry wells and streambeds.

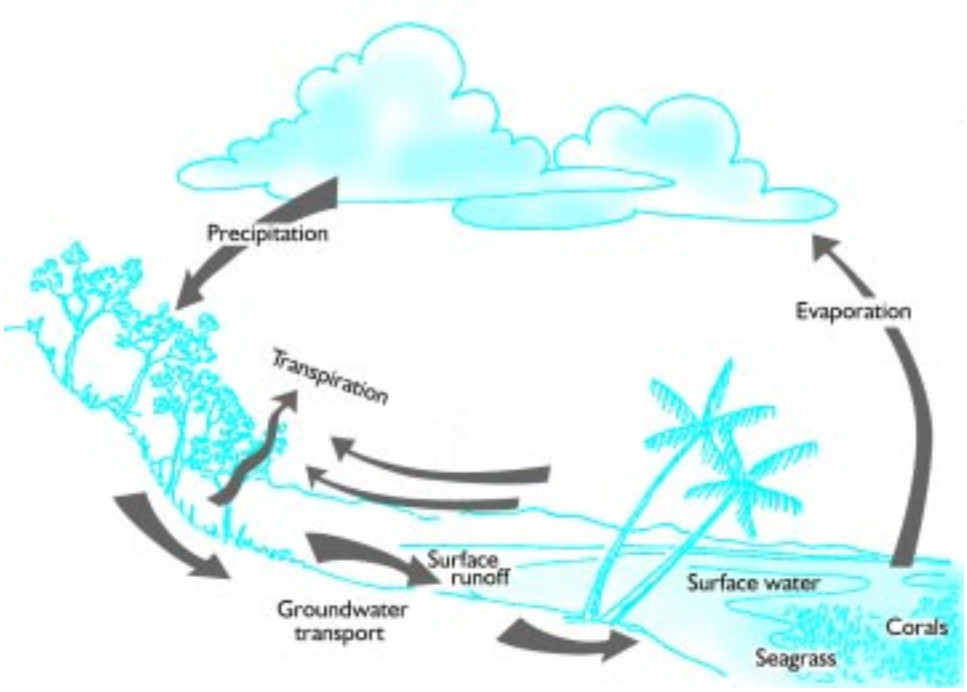


Figure 6. The hydrologic cycle *(Rees 1990)*.

The hydrologic cycle distributes water among natural systems, and when it meets the ocean, currents, tides, and waves also distribute it further. Currents occur when water moves in mass in a continuous direction. Currents create circulation patterns that act to transport water and its contents. The movement of currents is dictated by three major influences: gravity, tides, and the wind. The mixing of fresh and saltwater is enhanced by gravity and currents as shown in Figure 7. Tides are a constant force in coastal waters, changing once or twice daily. The normal range between low and high tide in the Philippines is approximately 2 m. Winds push water horizontally ahead along the surface of the ocean. An onshore wind (blowing towards the shore) piles water up against the shore. Storms can increase the normal tide range by pushing water onshore and thus increase the height of a normal lunar tide. Severe damage can occur if these extremes in tides are not considered during the design of coastal facilities and setbacks (Clark 1995, 1998).

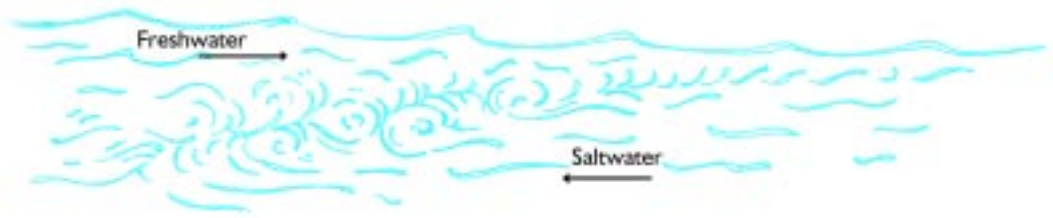


Figure 7. Freshwater entrains saltwater to enhance mixing as in an estuary.

Waves are an important form of water movement, particularly close to the shore. They are the primary force in rearranging the sand and sediments of the beaches and foreshore. Waves are normally created by the wind and storms. The angle of wave approach in relation to the shore generally determines the long-shore movement of sand and sediments. Beaches often undergo periods of erosion and accretion depending upon the wave patterns of the season.

Food chains and food webs

Food chains and webs represent dynamic processes for transferring energy between the different organisms in the coastal marine ecosystem. A food chain refers to the transfer of food energy from plants (primary producers) through a series of organisms eating one another. In most cases, organisms serve as links in more than one food chain, thus they are interconnected in a complex food web (Figure 8). Having several alternative food sources can provide more stability for an organism (Nybakken 1982). Organisms can be grouped into three major food groups:

Producers: Organisms that convert the energy of sunlight into carbon, water, and nutrients through the photosynthesis process. Phytoplankton are the most numerous group in the marine ecosystem.

Consumers: Organisms that eat producers (primary consumers) are planktivores or herbivores while carnivores eat the planktivores and herbivores or even other carnivores (secondary consumers).

Decomposers: Micro-organisms (bacteria and fungi) that break down organic debris to their basic inorganic nutrients that can then be recycled through the food web.

These food chains provide the links between different habitats as organisms pursue their food. In many instances, fish and other organisms residing in one habitat often forage for food in another. For example, rabbitfish shelter in the reef's nooks and crannies and then graze amongst the seagrass beds (Fortes 1989). After spawning, shrimp and milkfish use the mangroves for nurseries and feeding ground before leaving for deeper waters when mature.

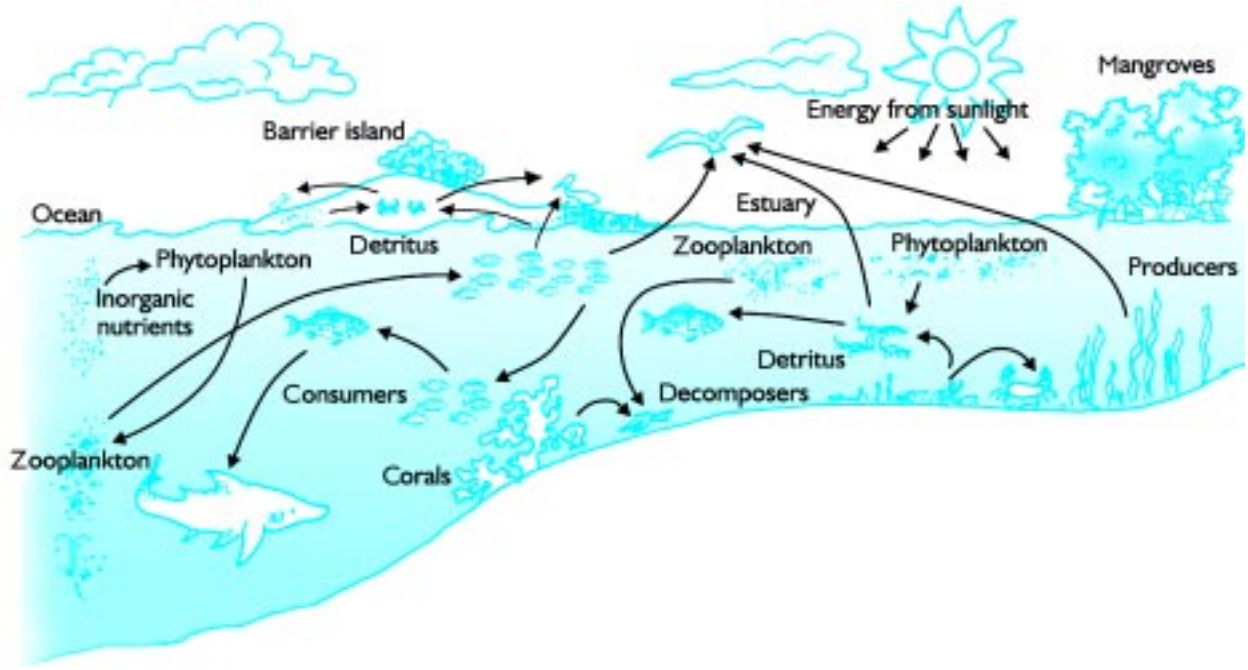


Figure 8. The food chain or food web of the coastal ecosystem *(Clark 1995)*.

Taken together these mechanisms interconnect the various critical habitats of the coastal marine systems. This interdependence makes the coastal zone an extremely sensitive geographic area and leaves it particularly vulnerable to the adverse impacts of human activities and natural events. Poor upland forestry practices release sediments that reduce light transmission in the water and physically smother seagrasses and corals (Fortes 1989). Corals die, erode, and allow greater wave action onshore, causing beach and property loss. Figure 9 illustrates the benefits exchanged between important coastal marine habitats. To avoid unnecessary adverse impacts and environmental damage, a sound understanding of coastal systems is essential. Improved watershed management will also play an important role in minimizing negative impacts.

THREATS TO CRITICAL HABITATS OF THE COASTAL ZONE

The various economic activities that can adversely affect the coastal zone represent a challenge to integrated coastal managers (Figure 10). The task of controlling these threats can be daunting when one considers the broad range of activities that occur in coastal areas.

> "…Geographically, the outermost boundary {of the coastal zone} is defined as the extent to which land-based activities have measurable influence on the chemistry of the water or on the ecology or biota. The innermost boundary is one kilometer from the shoreline except at places where recognizable indicators for marine influences exist like mangroves, nipa swamp, beach vegetation, sand dunes, salt beds, marshlands, bayous, recent marine deposits, beach and sand deposits and delta deposits, in which case the one kilometer distance shall be reckoned from the edges of such features" (NEPC 1980).

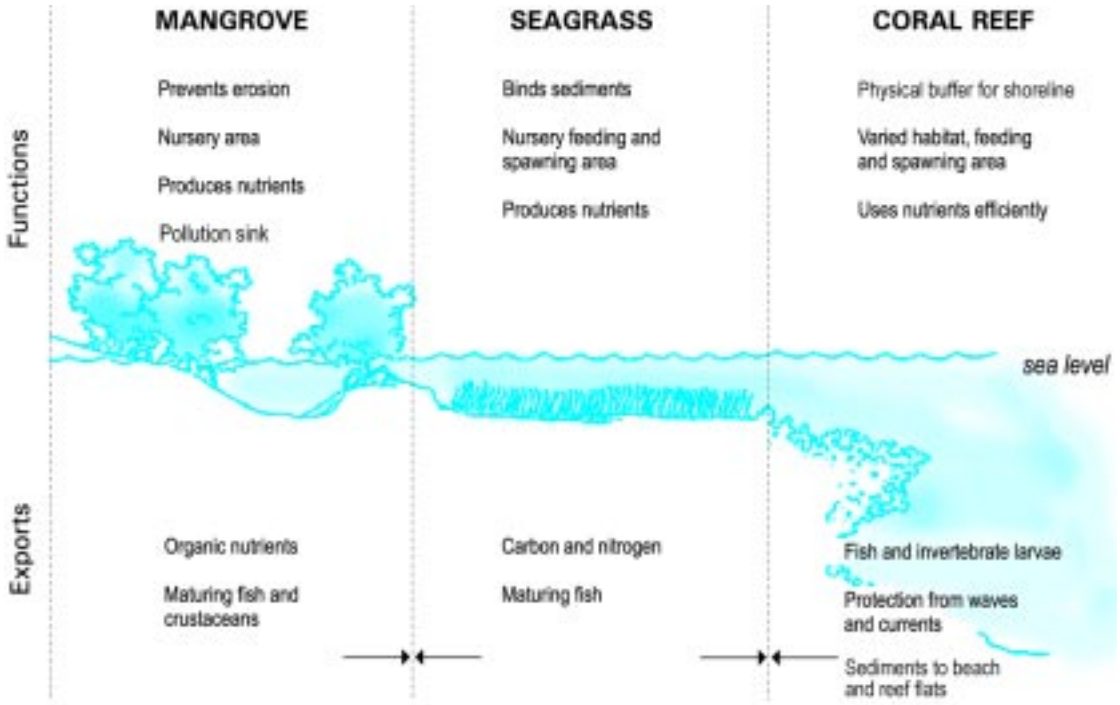


Figure 9. Exchange of mutual benefits among mangrove, seagrass, and coral reef ecosystems *(White 2001)*.

This definition of the coastal zone is complicated by resource use activities occurring outside the coastal zone that directly impact coastal habitats. For instance, agriculture (agrochemical runoff), forestry (siltation), or mining practices (discharge of toxic materials) can occur many kilometers from the coastal zone and yet still be within a watershed that discharges to a coastal lagoon or habitat. Management is difficult because the responsibility for controlling these activities is often under a different government unit or sector. Single issue or sector interventions usually overlook or ignore important causes contributing to coastal management issues. Effective solutions instead require a multisectoral approach involving inter-agency cooperation. The integrated coastal management (ICM) process outlined in *Guidebook 1: Coastal Management Orientation and Overview* and *Guidebook 3: Coastal Resource Management Planning* of this series provides details on this comprehensive management process.

Activities affecting the coastal zone can result in many different impacts. Environmental impact assessment (EIA) is the process of determining the potential impacts of a proposed activity and its alternatives, and documenting the decision-making process. The proposed activity that is ultimately selected should have the fewest negative impacts and the most positive benefits. An in-depth discussion of EIA is in *Guidebook 7: Managing Impacts of Development in the Coastal Zone*.

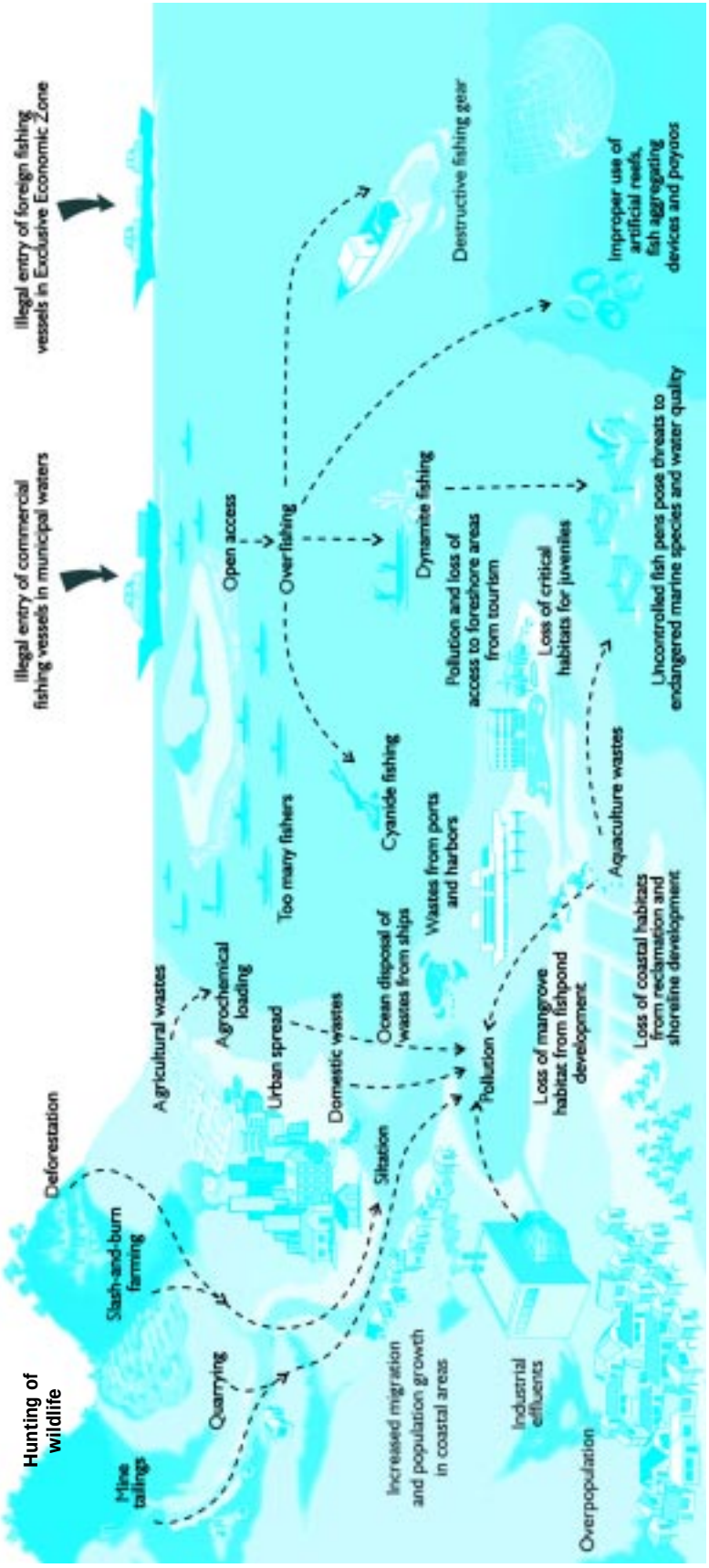


Figure 10. Varied economic activities and their associated impacts that occur in the coastal zone.

Major development activities important to integrated coastal management include the following (Maragos *et al.* 1983; Carpenter and Maragos 1989; and *Guidebook 7: Managing Impacts of Development in the Coastal Zone*):

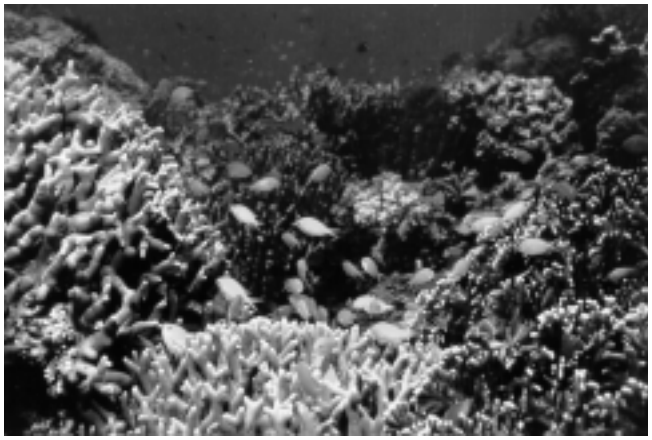
- Agriculture and forestry
- Aquaculture and mariculture
- Coastal and seabed mining
- Coastal construction
- Human settlements and urbanization
- Industry
- Military facilities
- Offshore oil and natural gas development
- Tourism
- Upland mining

The major impacts to the coastal environment and the activities that generally cause them are shown in Table 2.

Table 2. Major physical impacts from human activities in the Philippine coastal zone.

IMPACTS	SOURCE ACTIVITIES
Siltation and smothering	◆ Soil erosion by improper forestry, agriculture, mining, or construction practices; land reclamation
Loss of shoreline features	◆ Filling and dredging; land reclamation ◆ Erosion or accretion due to placement of shoreline structures ◆ Coral mining and mangrove harvest
Loss of physical habitat	◆ Destructive harvest practices: walking on reefs and breaking corals blast fishing drive-in nets use of poisons ◆ Coral or sand mining ◆ Mangrove conversion
Overharvesting	◆ Excessive fishing effort ◆ Lack of control to access ◆ Excessive gleaning of shore areas ◆ Hunting of wildlife ◆ Illegal and destructive fishing methods poisons dynamite fishing fine mesh nets drift nets trawling "superlights"
Eutrophication	◆ Excess agrichemicals and domestic fertilizer use ◆ Waste from animal and fish farming ◆ Discharges of industrial waste and domestic sewage
Pollution by: toxics pathogens solid waste	◆ Runoff from urban, agriculture, or mining areas ◆ Industrial discharges, municipal sewage, and solid waste ◆ Oil exploration and transport
Change of water conditions: turbidity salinity temperature dissolved oxygen (DO) acidity (pH)	◆ Poorly managed site drainage and irrigation development ◆ Excessive groundwater extraction, erosion ◆ Salt mining ◆ Power plant coolant system

This introduction to the Philippine coastal ecosystem highlights the interconnectivity of the various ecosystems and habitats. The coastal ecosystem or more commonly, the coastal zone, must be analyzed as a whole system including all human elements and impacts so that management can balance and maintain the connectedness of the environment. Since the system can also be broken down into its parts for a more detailed understanding, critical coastal habitats are reviewed in Chapter 2.



ALAN WHITE

Coral reefs, such as this one in Bohol, are the most naturally productive marine ecosystem known to humans.

ALAN WHITE

Bays and estuaries are extremely productive nutrient rich ecosystems that require careful management.

chapter 2

Critical coastal habitats

ESTUARIES, LAGOONS, AND BAYS

Littoral basin ecology

Estuaries, lagoons, and bays are coastal geographic features described as shallow, semi-enclosed, and sheltered littoral (pertaining to the seashore or coast) water bodies. A few true estuaries and lagoons exist in the Philippines such as Malampaya Sound in Taytay, Palawan. These water bodies have high ecological value but often are modified in ways that substantially degrade their environmental quality and thus their capacity to provide benefits to people. Bays or embayments are more open littoral basins, with less restriction of the inflow and outflow of salt water and salinity levels near or equal to the open ocean. Estuaries, lagoons, and bays often support a specialized fishery habitat as well as soft-bottom mudflats and communities.

Although more abundant along coasts with broad flat continental margins, estuaries are found in the Philippines. A distinguishing feature of estuaries is that their water is diluted by fresh water drainage. River mouths are a good example where tidal influx causes salinity fluctuations that can range from normal seawater to fresh water.

Lagoons are basins with limited fresh water supply and high salinity. They may be cut off from the sea for part of the year by seasonal formation of sandbars which causes them to become hypersaline. Figure 11 illustrates the range of classic inlet types from lagoons to estuaries and deltas. It does not include lagoons associated with coral reefs because they are not true lagoons as described above since they are not enclosed by dry land nor are they cut off from the sea.

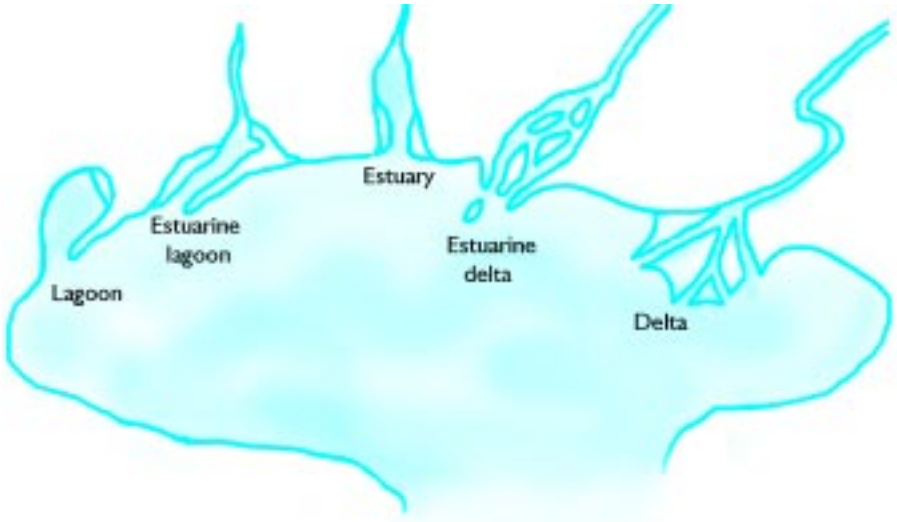


Figure 11. Examples of inlet types from lagoons to deltas *(adapted from Day* et al.*1989).*

Resource uses

The littoral basins (estuaries, lagoons, and embayments) play essential roles in the life cycles of economically and recreationally important crustaceans, fish, and shellfish. They maintain very high levels of biological activity and provide environmental benefits including:

- Export nutrients and organic materials through tidal circulation;
- Provide habitats for many commercially and recreationally valuable species; and
- Serve migratory species with shallow, protected areas for feeding, breeding, and nursery habitat through associated habitats like seagrass beds and mangroves.

Factors that help to explain the high productivity of littoral basins include:

- Favorable range of salinity which decreases as one ascends upstream through the tidal rivers;
- Large quantity of organic nutrients and oxygen provided by estuarine flora and marine inputs;
- Use of solar radiation which is enhanced by the shallow depths;
- High rates of vertical mixing that assists oxygen and nutrient exchange; and
- Close proximity of bordering wetlands, mangroves, and seagrass beds that provide critical habitats for many estuarine species.

Management issues

Estuaries, lagoons, and bays are special habitats for the biological functions mentioned above, but they are also the focus for substantial economic activity. Fisheries, shipping, commerce, tourism, and housing are among the land uses that crowd the coastline. These and other uses are listed in Table 3. The pressure on these coastal resources increases as the population and economy of the Philippines expand.

Table 3. Typical uses of estuaries, lagoons, and bays.

Non-extractive	Harbors
	Disposal sites (sewage and industrial effluents)
	Recreation
	Science and education
	Aquaculture
	Transport
Extractive	Fishing
	Sand mining
	Seed fish and shrimp collection
	Ornamental fish collection
	Gleaning
Transformation	Desalinization
	Landfill
	Aquaculture

The total area of intact littoral habitats is being reduced by land filling in many places. The result is loss of the biologically rich habitats of wetlands, mangroves, seagrass beds, and soft or muddy communities. Land filling for disposal of solid waste and reclamation projects for agriculture or aquaculture sites or for developing waterfront property destined for residential, commercial, or industrial uses are the usual reasons. There is little justification for altering these valuable natural areas especially since their existence is finite and they are highly productive ecologically.

The uncontrolled extraction of fishery and sand resources is disrupting the cycles that make these water bodies so productive. For example, sand mining in rivers or along littoral basins removes sand from the system that replenishes area beaches and offshore bars. The disruption can lead to long-term erosion of beachfront property. Excessive harvesting of juvenile fish while they are concentrated in an estuary serving as a nursery area may permanently reduce the population of fish for that site and for nearby areas.

Pollution of all kinds is carried by water and affects all living coastal resources and their ability to grow and reproduce naturally. Numerous pollution types occur in the Philippines but a few sources are pervasive and are causing harm to coastal ecosystems (Table 4).

Significant diversion of water upstream in the watersheds for irrigation reduces water flows, which can alter salinity gradients and the flushing or dilution capability of a water body. The change in salinity can affect the life cycles of organisms that depend upon the availability of different salinity ranges during portions of their life cycle. Plant populations, like mangroves and seagrasses, also are susceptible to changes in salinity. Water volume and velocity also affect sand and sediment transport. Reduction in flow can increase the deposition of sediment and sandbar formation at the mouth of rivers thus impeding transport. Placement of large aquaculture operations can blanket a watercourse, disrupting transport by boats and altering sediment deposition patterns.

Table 4. Common pollution types in the Philippines.

- Domestic sewage waste from coastal cities, municipalities, and ships
- Domestic solid waste dumped along shoreline areas or rivers
- Sediments from upland and coastal erosion, construction sites, and poor agriculture practices
- Mine tailings and sediments from quarrying and mining in coastal and upland areas
- Industrial organic and toxic wastes
- Chemicals from agriculture and aquaculture
- Oil and fuel leaks and spills on land and from ships

Management interventions

Environmental impact assessments (EIAs) to evaluate the potential effects of development on the habitat should be utilized as much as possible. This can be done in the context of integrated coastal management (ICM) to ensure that development plans for coastal areas are integrated and consider all the benefits generated by coastal resources (see *Guidebook 7: Managing Impacts of Development in the Coastal Zone*). Both EIA and ICM can be employed to minimize pollution from shoreline sources and other impacts of development such as land reclamation and aquaculture. Sources of pollution may be divided into point and nonpoint sources and include: direct and indirect discharges of sewage, bath water, and garbage to shoreline waters; polluted runoff that occurs during rainstorms and from polluted groundwater; fertilizers, pesticides, trash, road oils, and sediment.

Efforts to improve infiltration of rainwater into the soil will reduce surface runoff. This reduces the entry of pollutants to the coastal ecosystem and also helps to recharge the groundwater aquifers that supply wells and maintain flows in streams. Proper agriculture and forestry methods will promote infiltration in rural areas as rain strikes the ground surface. Increasing pervious vegetative cover in urban areas by limiting the amount of impervious surfaces (compacted soil, asphalt roads, parking lots, buildings, and sidewalks) is important to help reduce runoff.

Nonpoint source pollution also occurs as groundwater, contaminated with sewage, fuel or other materials, enters the ocean through the soils at the land-sea interface. Care must be taken to ensure that sewage disposal systems and underground storage tanks are constructed so that they will not contaminate the groundwater. Both types of facilities should be constructed so that they are above the maximum groundwater levels in the soil. Sewage septic tanks should be emptied regularly to remove solids and greases that accumulate inside before they exit and foul the leaching fields or disposal pits. Below-ground fuel tanks should be monitored to assess leakage. Ideally, fuel storage tanks should be placed above ground for ease of inspection and containment in the event of leaks.

Legal and institutional framework

Pollution acts relating to discharge of solid waste, sewage, or other impacts from sources inside the LGU normally are under the responsibility of the LGU as devolved by the DENR. The DENR is mandated to investigate complaints arising against all pollution sources. Sedimentation or discharge of waste related to mining activities is pursued by LGU in coordination with the Mines and Geosciences Bureau. *Guidebook 2: Legal and Jurisdictional Framework for Coastal Management* of this series covers the legal and regulatory aspects of coastal management and makes reference to all the relevant laws.

MANGROVE FORESTS AND HABITATS

Mangrove ecology

Mangroves are woody, seed-bearing plants adapted for life in brackish and waterlogged soils that are acidic and often anoxic (without oxygen). They vary in size from shrubs to tall trees and are found along sheltered tropical mudflats in association with estuaries and lagoons and extend inland along rivers, streams, and their tributaries where the water is brackish. The mangrove ecosystem is extremely productive and supplies resources such as wood, fish, and crustaceans as well as many other ecological and economic benefits for the Philippines. Despite the value of this resource, formerly they were considered as unused wastelands and converted to other less productive uses.

Mangroves have characteristic features that allow them to live in coastal marine environments. In the Philippines, there are 77 mangrove and associated species. Major genera are *Rhizophora, Avicennia, Bruguiera, Sonneratia,* and *Nypa*. Some species such as *Avicennia* spread shallow root systems widely across the mud. Their pneumatophores or breathing roots project up through the mud to absorb oxygen. Others like *Rhizophora* spp. have prop or stilt roots from trunks and branches that buttress or support the plants, providing better anchorage during high winds and waves. The prop roots also provide attachment substrates for a multitude of marine organisms. Mangroves have succulent leaves to retain fresh water and salt-excreting capabilities to maintain internal osmotic (salt/water) balance (Calumpong and Meñez 1997). Some have evolved strategies that improve the survival of seed for dispersal. The seed of *Bruguiera* spp. produces a rudimentary stem (hypocotyl) before it drops off and plants itself.

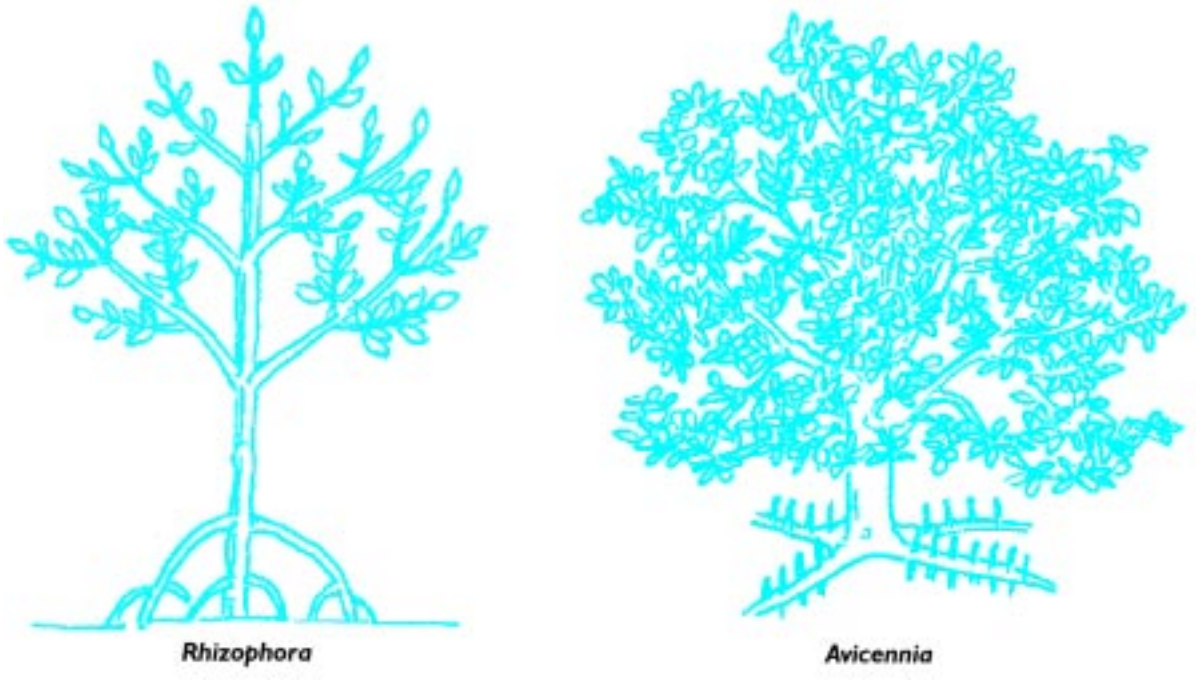


Figure 12. Examples of two major mangrove genera (*Rhizophora *and* Avicennia*) *(Clark 1995).*

Distribution is determined largely by the limits of salinity, substrate, and tidal inundation. Generally *Avicennia marina* and *Sonneratia alba* dominate the most seaward area with its breathing roots protruding from the mud. Moving inland is *Rhizophora stylosa* followed by *R. apiculata* whose extensive prop roots reduce tidal currents, causing sediment and silt to deposit. Progressing further inland, *Bruguiera* inhabits the landward areas reached by the highest tides. The most landward zone is occupied by the *Ceriops* or *Lumnitzera*. Another important species is the creeping palm (*Nypa*), found along brackish rivers and lagoons.

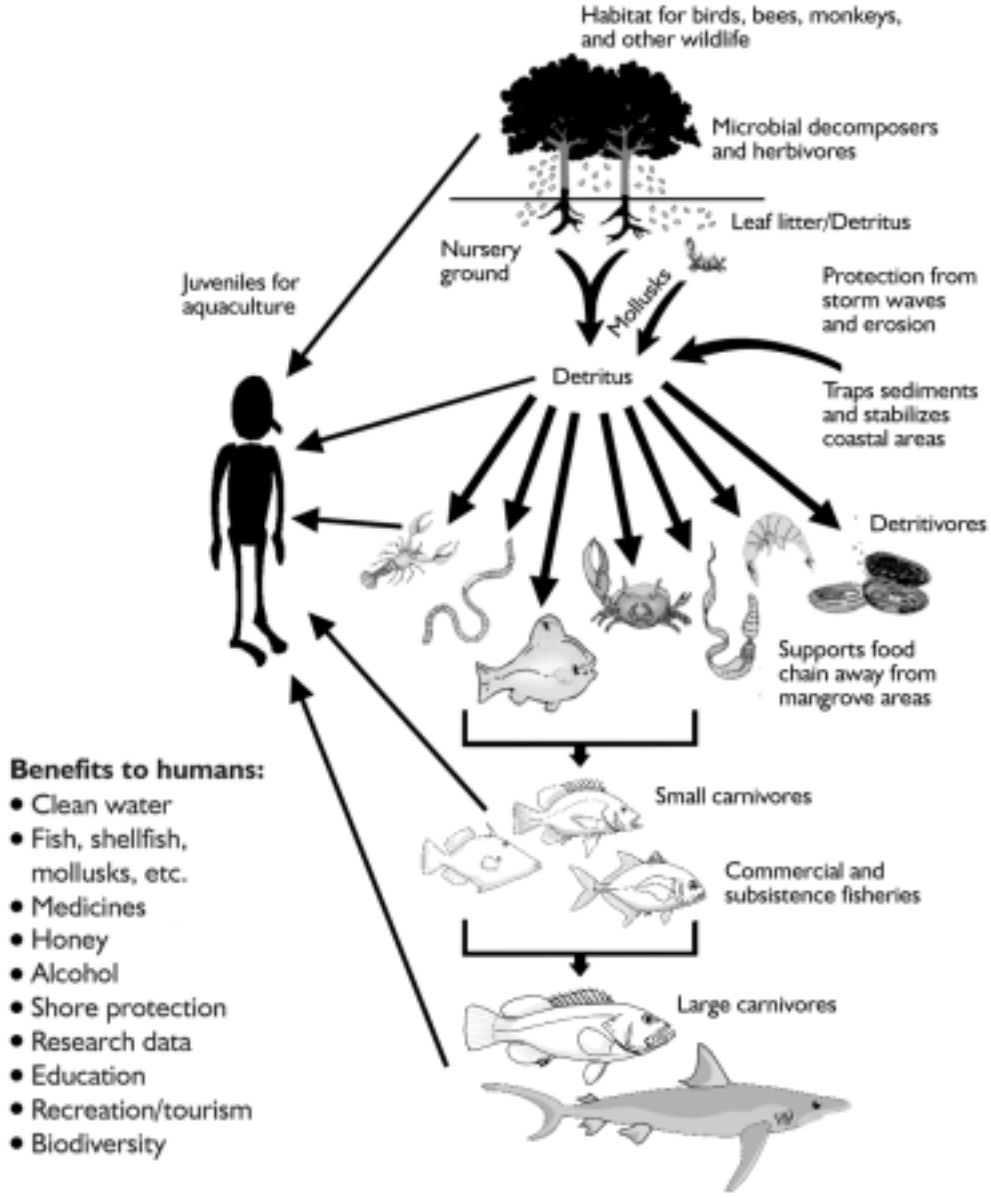


Figure 13. Mangroves and their ecological and economic products *(modified from Berjak* et al. *1977)*.

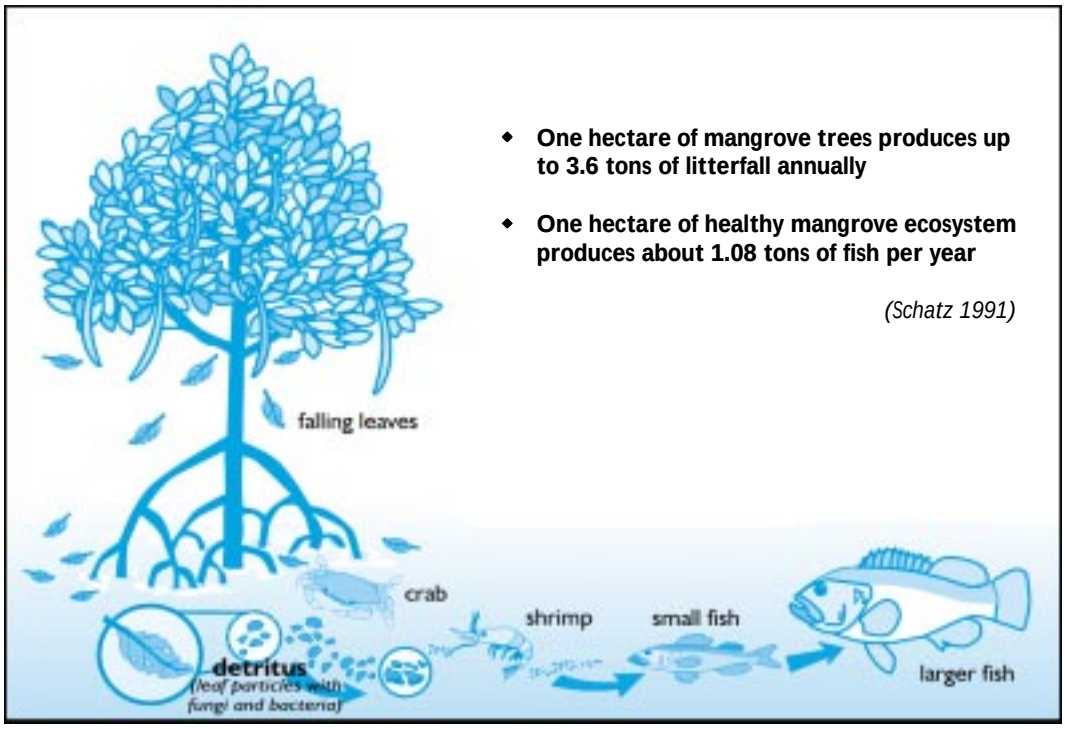


Figure 14. Mangrove detrital food chain.

Resource uses

Although mangroves provide humans with numerous products, one great benefit is the nutrients produced from decomposing leaf litter. This partially decomposed detritus is exported to and used by the many aquatic organisms of lagoons and the nearshore ecosystems such as seagrass beds and coral reefs. Commercial species of shellfish, shrimps, and fish rely heavily upon this nutritious food source (Figures 13 and 14).

Mangroves comprise one of the most diverse communities in the coastal zone, providing habitat that serves as reservoirs, refuges, feeding grounds, and nursery grounds for many useful and unusual organisms. Migratory bird species roost in some mangrove wetlands such as in the Olango Island Wildlife Sanctuary. Smaller organisms such as crabs, shrimps, and juvenile stages of commercial fishes are particularly important. During high tides, many move into the mangroves to feed on invertebrates and other organic matter. Major cage culture industries in shrimp and grouper depend on capture of the larvae and juveniles feeding and sheltering in mangroves. The best shrimp grounds often occur in sites offshore from sizable mangrove forest stands (Martosubroto and Naamin 1977).

In addition to their biotic functions, mangroves have extensive rooting structures that slow water movement to trap sediments, forming new land. Pollutants washed from the land, particularly those that are adhered to sediment particles, also are filtered and absorbed by the mangroves. Mangroves anchor the soil and also absorb and dissipate the energy of the waves, slowing their passage inland. This is particularly important as high waves or storm tides can quickly erode coastlines and damage structures.

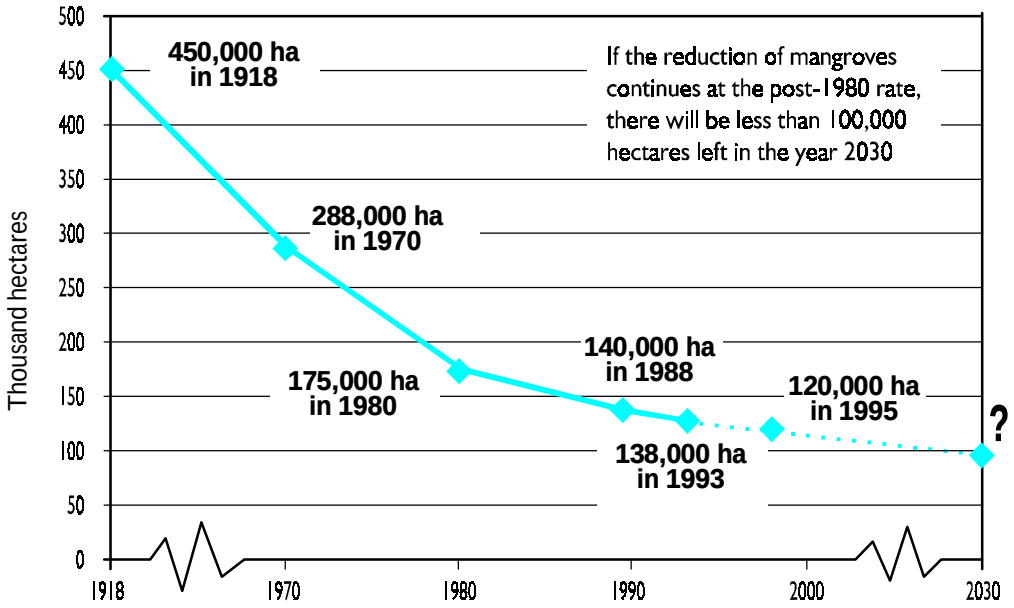


Figure 15. Mangrove resource decline in the Philippines *(Brown and Fischer 1918; DENR 1988, 1998; White and de Leon 1996)**.***

Human uses include food resources produced by many species of fish, prawns, crabs, and mollusks living in the mangroves. Aquaculture and commercial fisheries depend on mangroves for juvenile and mature fish species. The timber, strong and resistant to insects and rot, is prized for beams and poles in structures, fish traps, boats, tool handles, and furniture. It is sought as firewood and particularly for charcoal making. Some species have medicinal value; others provide tannin for leather preservation and dyes for cloth. Their sap is used for many foods including fermented drinks.

Management issues

Forested mangrove area has decreased greatly in the Philippines from an estimated coverage of 450,000 ha in 1918 to less than 120,000 ha in the late 1990s (DENR 1988, 1998). The most rapid decrease in mangrove coverage occurred during the 1960s and 1970s when national policies encouraged the expansion of aquaculture. Today, fishponds cover about 289,000 ha, most of which were formerly mangroves. For the period 1967-88, the average rate of decline was about 8,000 ha annually (Figure 15).

Mangrove stands remaining in the country are mostly found on the southern islands of Mindanao and the eastern islands of Palawan. Less than 5 percent of existing trees are in old or primary growth forest and found in Palawan (mature forests with less than 25 percent of the mature trees cut). Most mangrove forests in the Luzon and Visayas islands are secondary growth or in plantations. Mangroves are now of much lower quality and cover less than one-third of their original range.

Despite a 1982 government ban on further mangrove conversion to fishponds, mangrove area continued to decline by about 3,700 ha annually, roughly matching the increase in fishpond areas. Production of firewood, charcoal, and building materials often was the initial incentive to cut trees, followed later by conversion to fishponds. Many former mangrove sites now are not being used for aquaculture despite the loss of natural fisheries and wood resources. The low annual rent for Fishpond Lease Agreements (FLAs) (US$2/ha/year) has encouraged fishpond conversion since they carry no penalties for low production. They also pay very little back to the government or local community for lost benefits. The estimated value of lost mangrove benefits ranges from US$550 to 1,550/ha/year (Dixon 1989). The rental is too low to ensure economically efficient use of land for fishponds and does nothing to discourage the conversion of mangrove for aquaculture.

Management interventions

Despite a national ban (Presidential Proclamation 2146, 1982; Republic Act 7161, 1991) on cutting mangroves, questions have been raised about whether this is an effective management approach. Many people have no other alternatives for obtaining the materials and benefits that mangroves supply. Based on the successful Banacon Island Communal Tree Program, subsequent policies have encouraged community stewardship. In 1994, the DENR adopted the NGO-assisted Community-based Mangrove Forest Management model as a more sustainable approach to reforestation and maintenance of existing mangrove resources. It allows limited harvesting of the forest by the community stewards, and direct involvement of the community in mangrove forest management. Mangrove reforestation through community-led initiatives is a thrust of all successful mangrove rehabilitation efforts. The mangrove sanctuary, where no direct uses are allowed, is an important management intervention in some areas.

Table 5. Community-based Forest Management Agreements and their implementation.

CBFM visions:

- Manage, develop, and conserve mangrove resources for sustainability;
- Organize coastal community as forest resource managers; and
- Socioeconomic uplift of coastal community organization members.

CBFM participants:

- Mangrove dependents or users (e.g., firewood gatherers, charcoal makers, *nipa* shingle makers);
- Fishermen's associations or cooperatives;
- Traditional claimants; and
- Local government units (LGUs).

Areas covered by CBFM:

- Areas covered by reforestation contracts;
- Mangroves in protected areas that are zoned for "multi-use"; and
- Unused mangrove areas released to BFAR which are not used or which have been abandoned for 5 years since the issuance of the Fishpond Lease Agreement (FLA).

(continued)

Table 5. (continued)

Obligations of a Community-based Forest Management Agreement (CBFMA) holder:

- Form either a special interest group or fishermen's association/cooperative;
- Submit quarterly stewardship reports during the first year and annual reports thereafter;
- Participate in Bay Management Councils;
- Perform all duties and responsibilities laid out in the CBFMA;
- Submit a 25-year management plan and a 6-month rehabilitation plan with assistance from DENR and the facilitating NGO;
- Abide by the ban on cutting of mangroves under RA 7161 of 1991 unless the new Forestry Bill No. applies which allows limited cutting in recognized plantation areas; and
- Ensure forest protection and rehabilitation.

Community-based Forest Management Agreements (CBFMAs) allow communities to plant and harvest plantation per DAO 10, 1998 in areas that have been depleted by overharvesting or fishpond conversion. Rather than cutting entire trees, residents learn to "thin" and "prune" trees more efficiently, to promote faster growth and better quality wood products (Table 5). Communities collaborate with the DENR and an NGO or people's organization (PO) to accomplish the following activities under CBFM:

- Community organizing and training;
- Identifying habitat areas and learning planting procedures;
- Forestation;
- Forest stand improvement;
- Forest resource utilization;
- Livelihood and marketing activities;
- Forest protection and conservation; and
- Cutting, but only in plantations per DAO 10, 1998.

A complete review of mangrove management is available in the *Mangrove Management Handbook* (Melana *et al*. 2000).

Alternative livelihood opportunities in mangrove forests include crab fattening, bee and honey culture, limited aquaculture, and sustainable use of selected wood products. An essential aspect of any extraction from the mangrove forest ecosystem is to determine what is a sustainable amount that does not lower the ecosystem integrity.

Legal and institutional framework

The DENR is responsible for determining which lands can be released to the Department of Agriculture-Bureau of Fisheries and Aquatic Resoures (DA-BFAR) for fishpond use. Once designated, the DA-BFAR has administrative jurisdiction for management of FLAs on sites designated as suitable for fishponds.

Under the Local Government Code (LGC), the responsibility for conservation of mangroves and management of fishery resources is shared with the LGU. In an attempt to integrate management of fisheries resources and mangrove habitat more closely, the Fisheries Code of 1998 encourages establishment of marine/coastal sanctuaries. These sanctuaries must include large areas "to be set aside for the cultivation of mangroves to strengthen the habitat and the spawning grounds of fish" (Section 81, RA 8550).

Under the Code, the DENR together with DA-BFAR and the LGU are mandated to direct participatory processes in determining which abandoned, undeveloped, or underutilized fishponds covered by FLAs can be reverted to timberland for rehabilitation to their original mangrove state (Section 49).

For those mangrove areas to be managed as forest resources, the DENR's CBFMA provides a more sustainable approach to reforestation and maintenance of existing resources. In 1996, Administrative Order 29 applied CBFM to all mangroves and forest resources within certain limitations as noted in the *Mangrove Management Handbook* (Melana *et al.* 2000).

BEACHES AND FORESHORE LAND USE

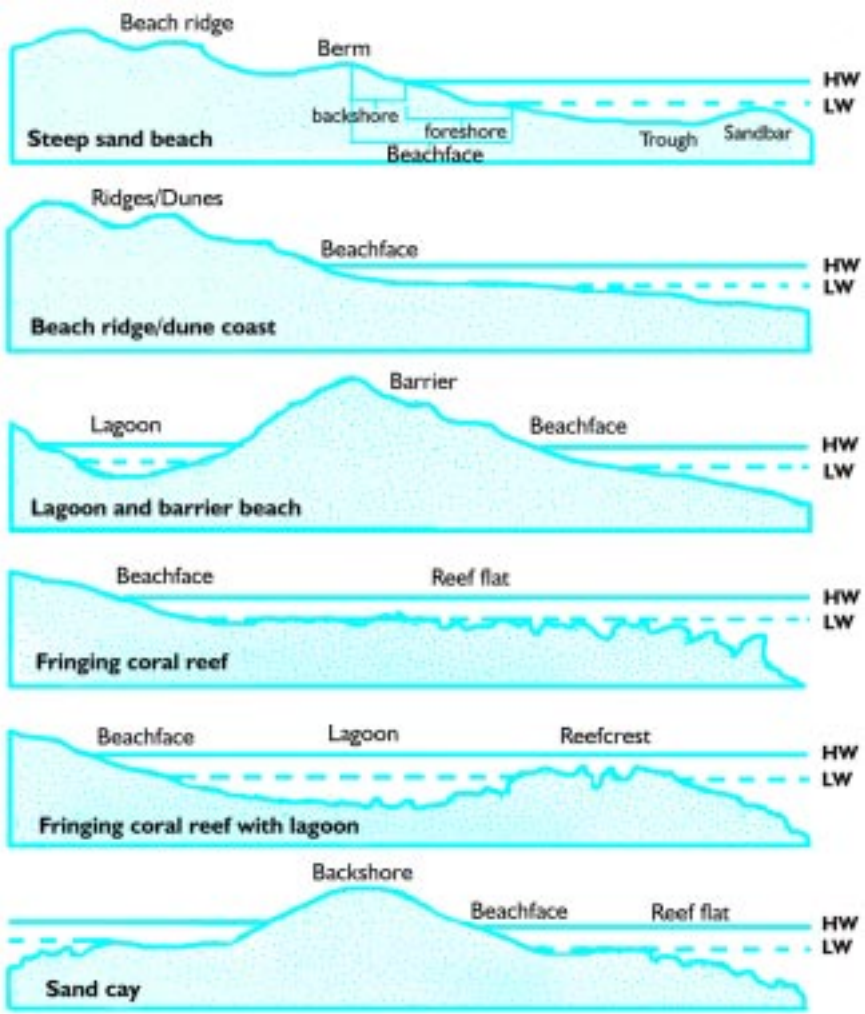
Beaches are the most widely recognized habitat in the coastal zone. They are a limited access area governed by foreshore land use setback requirements of the DENR and other laws described in *Guidebook 2: Legal and Jurisdictional Framework for Coastal Management*. Recreation and tourism draw millions of people to beaches for rest and relaxation. They are used extensively for fishing activities, boat landings, and construction materials. The land behind beaches is prized as sites for hotels, restaurants, resorts, and other water dependent activities around the world. Many other species also compete with humans for use of beaches. Sea turtles lay their eggs in the sand above the high tide lines. Terns, plovers, and other seabirds lay their eggs in the upper beach or dunes. Beaches also provide habitat for burrowing species, such as clams, crabs, and many other small crustaceans. Such organisms are part of the complex intertidal community that attracts fish and shore birds.

Beaches are extremely important as buffers between the land and sea where they provide protection against waves and erosion. They remove silt and sediments carried by water as it passes over the ground surface. This is particularly important in areas where impervious surfaces (asphalt pavement, cement sidewalks, compacted soils, and buildings) drain to the seashore. Water passing through the beach sand is diffused so that the point of discharge is spread over a larger area rather than one small point.

Beaches are defined as the non-vegetated part of the shoreline formed of loose materials, usually sand, that extend from the upper berm to the low-water mark. They are dynamic landforms whose features are constantly being shaped through the forces of wind and water. The typical profiles of beaches in tropical reef zones are shown in Figure 16 and described in Table 6.

Table 6. Description of beach zones and features — general definitions *(Clark 1995)*.

- **Bar:** An offshore ridge that is submerged permanently or at higher tides.
- **Trough:** A natural channel that runs between an offshore bar and the beach or between offshore bars.
- **Beachface:** The beach zone that encompasses both the foreshore and backshore.
- **Foreshore:** That part of the shore that lies between the crest of the most seaward berm and the ordinary low -water mark. It is usually traversed by the wash of waves as the tides rise and fall. Often is the steepest part of the beach profile. The slope depends on the wave energy and size of the sand grain. Larger grain size generally is associated with steeper beaches.
- **Backshore:** The portion of the beach that is usually dry, lying between the foreshore and the dune line. It is normally impacted by waves only during storms and exceptional high water.
- **Berm:** A ridge or ridges on the backshore of the beach, formed by the deposit of material by wave actions that marks the upper limit of ordinary high tides and wave rush.
- **Beach ridge:** A more or less continuous mound of beach material behind the berm that has been heaped up by wave actions during extreme high water levels. If largely wind made, it is usually called a dune and may be vegetated.
- **Dunes:** These are more or less continuous mounds of loose, wind-blown material, usually sand behind the berm (often vegetated). They can be very mobile, visibly gaining or losing sand. Dunes are rarely found in the Philippines.



HW = high water; LW = low water

Figure 16. Typical profiles of sandy and coral coasts *(Wong1991)*.

Beach formation and erosion process

Beaches are dynamic landforms. Problems associated with beaches occur when people fail to recognize this basic concept. Their size and shape reflect the local balance between the deposition or accretion (gain) and erosion (loss) processes occurring at that particular time and location. Worldwide, beaches are subjected to erosion that results in net beach loss. The Philippines is no exception to this process. Fortunately, coral reefs provide the material base for replenishing the beaches on small islands and also shelter them from erosion. Most major beaches in the Philippines are created from inland sediment deposits with some contributions from the debris of coral reefs, algae, and mollusk shells. The health of Philippine beaches on small islands, though, depends almost totally upon maintaining healthy reefs.

The key dynamic mechanism for beaches is littoral transport or the movement of sand and sediments in the nearshore area by waves and currents. Movement paralleling the shoreline is long-shore movement. Movement of sand perpendicular to the beach is offshore transport. A beach's long-term condition depends upon the sand movement between the beach and offshore sand storage areas. The shoreline erodes when the rate of loss is more than the rate of accretion or incoming supply.

Each part of the beach can receive, store, or lose sand depending upon the forces of wind, waves, and currents. Balancing the sand reserves held in the different locations is very important to maintaining a beach. During periods of high waves, sand from beaches and dunes are eroded into the sea as the waves wash deep inland. Eventually it settles to form sandbars offshore. These bars hold the sand in reserve while also acting as a natural defense to break waves and thus reduce the amount of erosion. During long periods of low waves, sand is gradually moved back towards the shore where onshore winds can then carry it further back to replenish the backshore and dunes. Beaches often have an annual cycle where the storm season quickly erodes beaches and the calm season rebuilds them slowly. Beaches generally accrete much more slowly than they erode, thus they may undergo multiple year cycles where they may erode for several years and then accrete for several years (Figure 17).

In addition to the offshore transport of sand, beaches are greatly affected by the long-shore movement of materials paralleling the shoreline. Currents will carry the sand along the shoreline in a predominant direction until an obstruction, such as a stone or concrete pier, harbor, groin, or revetment interrupts this flow. Sand accumulates on the up-current side of the obstruction and cannot replace material eroded from the down-current side; eventually the beach may disappear. A series of parallel groins placed close together may actually push the littoral sand transport offshore so that it works only from tip to tip of the groins. All the beaches then suffer as the sand stays offshore and never gets to the beach (Figure 18).

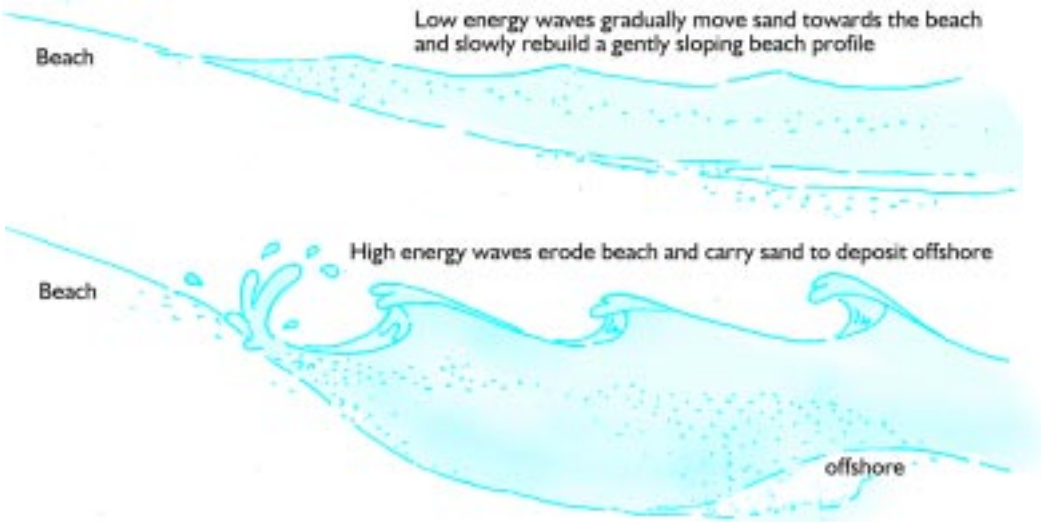


Figure 17. Seasonal variations in beach erosion and accretion.

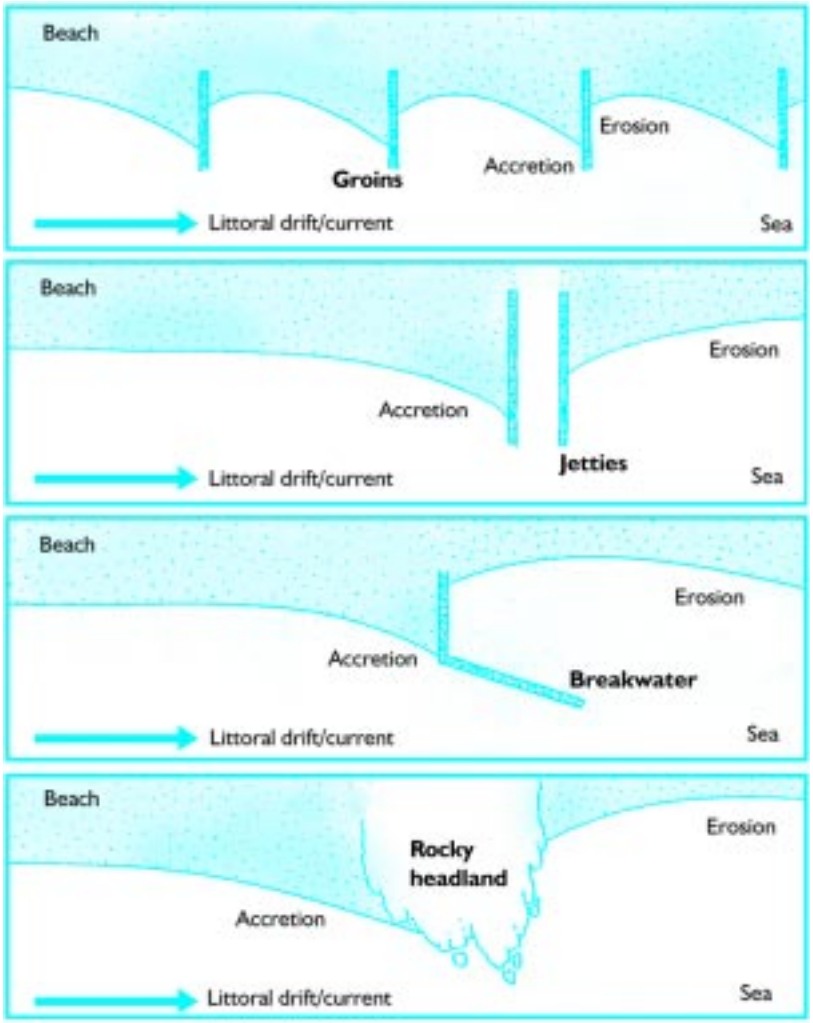


Figure 18. Examples of down-drift erosion resulting from hard engineering solutions and headlands as seen from aerial view *(Clark 1985)*.

An example of erosion due to a perpendicular structure built offshore is the Dumaguete City airport runway extension on area beaches, Negros Oriental. In 1985, the runway for the airstrip serving Dumaguete City was extended about 350 m. At the time, it was considered easier to fill the reef flat north of Silliman University instead of vacating land and extending the runway inland. No comprehensive environmental assessment was conducted prior to filling the beach and reef flat. A simple analysis would have quickly revealed the likelihood for severe impacts on littoral sand transport. The runway extension presently interrupts the long-shore movement of sand that was feeding the beaches fronting the university as well as several tourist resorts. Without the replenishing sand flow, the beaches of the area quickly eroded and were not replaced. One resort and various residences that once faced a wide sandy beach are now confronted with coastal erosion that threatens to undermine their dwellings and structures. The beaches that once dissipated wave energy are no longer present.

To postpone the erosion process, concrete seawalls were erected at significant cost by the government and resort to hold the ocean away. One must now climb over walls and rocks in order to reach the ocean rather than easily walk to the water's edge. In some locations, unsanitary conditions have occurred as garbage and washwater accumulate next to the wall. Surface runoff also is impeded during periods of heavy rain. Over the long-term, these walls will fail as the ocean slowly erodes the land supporting the structures (Figure 19).

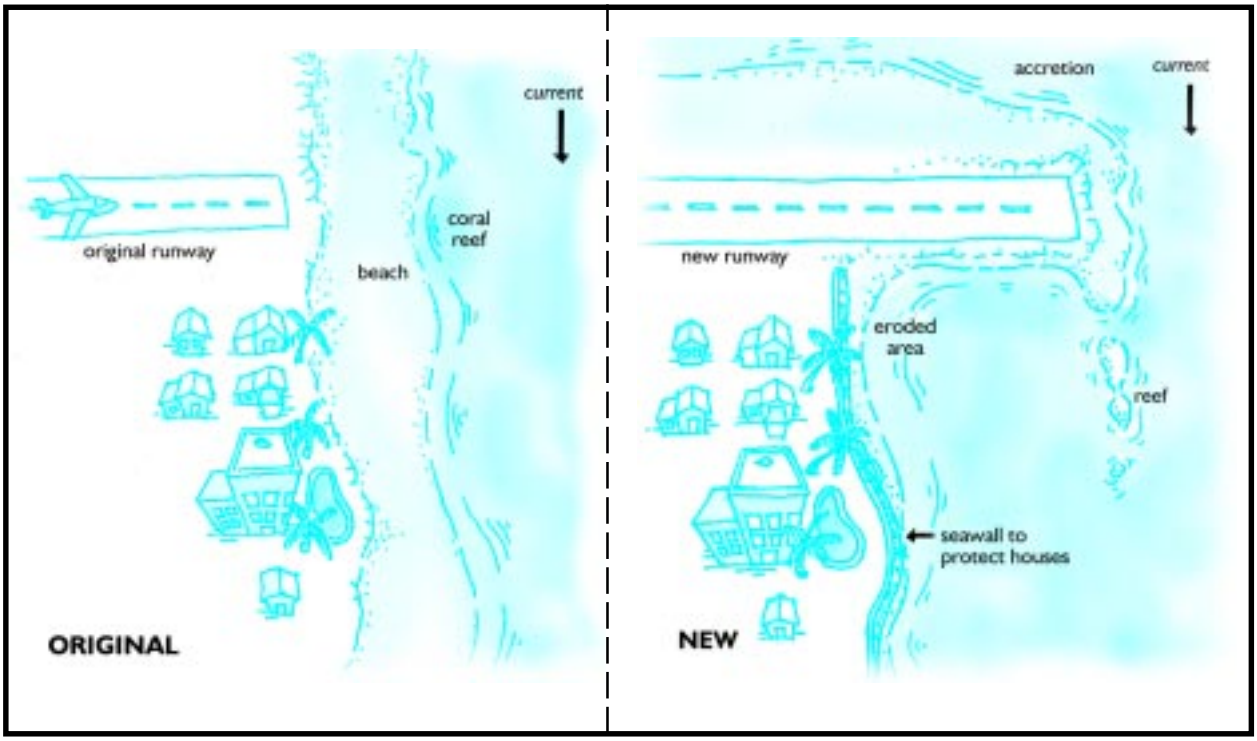


Figure 19. Extension of airport runway interferes with sand movement, Dumaguete City.

Resource issues

1. Multiple conflicting uses

   As with any valuable resource, there is conflict between competing beach uses. People use the beaches for landing boats and nets, repairing equipment, offloading catch, and drying fish. Tourists enjoy swimming, sunning, boating, surfing, walking, and other leisure pastimes. Livestock may graze on the beach vegetation and use it as an animal thoroughfare. Squatters perch on a parcel of land as they eke out an existence gleaning the reef flat and seagrass beds for food and sellable items. Hoping to capitalize on the needs of these persons, landowners build stores, souvenir shops, bars, restaurants, hotels, laundries, discos, markets, and government buildings on the beaches. Seeking the beauty of the ocean, homes are built there also. With the high demand, there are many illegal activities and conflicting issues surrounding beach space and foreshore areas in the Philippines. Illegal structures causing negative environmental impacts are a leading infraction in these areas.

2. Erosion

   Erosion is often associated with improper shoreline development. Left undisturbed, the beaches will undergo a cyclical erosion and accretion process. Human activities frequently disturb this cycle. In some instances, persons wishing an unobstructed view of the water have removed protective sand dunes or built too close to the water. They suffer extensive storm damage as the waves sweep high up the beachface. In other cases, structures built to prevent erosion actually serve to intensify and exacerbate the situation. Seeing that their beach is eroding during the normal cycle, persons have hastily erected retaining walls and groins. A sloping beach will allow the energy of the wave to diffuse as it rushes up the beachface. A hard retaining wall will reflect back the wave's energy. This creates a scouring action that may eventually undercut the base of the wall and topple it as shown in Figure 20. The retaining walls described earlier to protect the Dumaguete beach will suffer the same fate.

3. Pollution by sewage and solid waste

   Beaches often serve as receptacles for solid waste and sewage. Where trash pickup is irregular or non-existent, people will dump garbage on any land that is not clearly controlled, including beaches. Often, the garbage and sewage is dumped into a river, stream, or drain. Currents carry the refuse along and deposit it upon the beach. Boats and many beach visitors also discard waste.

   In-ground disposal of sewage and wastewater from kitchens, baths, laundries, and toilets can cause waste disposal and water supply problems for beach areas that are overdeveloped. The highly pervious beach sand readily accepts sewage water but it provides very poor filtering before it reaches the watertable. The shallow groundwater in areas close to the beach, consequently, is easily contaminated. In some instances, tides and seasonal changes (dry versus wet season) actually raise the groundwater level and flood improperly placed systems as shown in Figure 21.

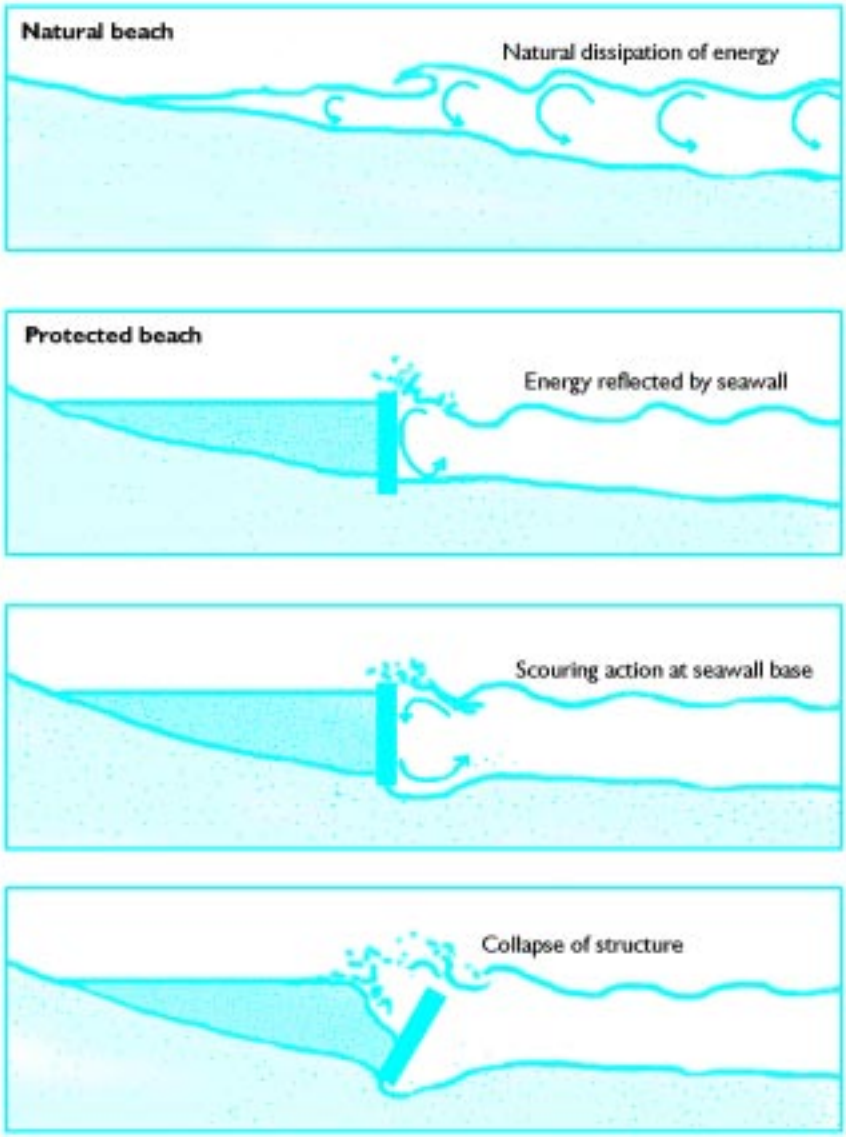


Figure 20. Undermining of a seawall built on a high wave energy coastline *(CCD 1990)*.

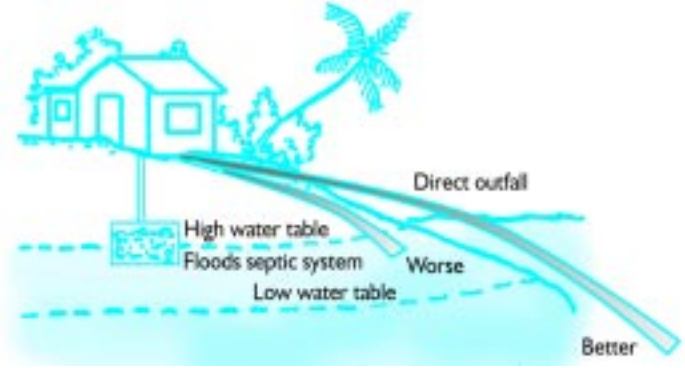


Figure 21. Changes in groundwater elevation will affect sewage disposal tanks and outfalls *(Rees 1990)*.

High density development often occurs with little planning for sewage systems or water supply. Many aquifers are shrinking as excessive demand depletes groundwater aquifers and promotes saltwater intrusion into the aquifer. As land development increases within the watershed, there are fewer pervious surfaces available to allow rainwater to infiltrate into the ground and recharge aquifers. Communities may find that sewage has contaminated the aquifer from which they draw their drinking water supply yet there is little suitable area for a new water supply (Figure 22).

4. Public access
   Retaining adequate public access to beaches requires planning. Local landowners frequently control access to the beach. Although the foreshore is considered public property, gaining access from the land may be difficult. In some instances, private interests have extended their claims to include offshore resources such as nearby reefs. Communities need to designate and retain public rights of way and maintain public beaches and public landings to ensure access to the shoreline and beaches. Consideration should be given to private landowners who wish to maintain clean and peaceful surroundings for their visitors and personal pleasure.

5. Sand mining
   Beaches are often used as sources of sand for filling excavations or for construction materials even though beach sand is a poor construction material because of its silica and salt content (Carpenter and Maragos 1989). Together with offshore sandbars, they are important storage components of the sand transport system. Any mining can seriously affect the normal accretion/erosion process by removing material that replenishes the system. Sandbar and beach removal allows greater wave shock, leading to erosion and recession of the beach. It also destroys nesting and breeding habitat for birds and animals residing in the sand. The mining may strip vegetation cover that is holding the sand in place. In areas with strong winds and dunes, drifting sand can easily move and cover vegetation, structures, and roads.

Figure 22. Contamination of well by improper location of sewage disposal system *(Rees 1990)*.

6. Reclamation/dredging
   These activities are inconsistent with beach and foreshore maintenance since they totally change or destroy the area and cause pollution and impacts along the shoreline, downstream from the dredging or reclamation area.

7. Light pollution
   Sandy beaches are often used by sea turtles to lay their eggs. This process is disturbed or aborted when bright lights shine on sandy beaches at night when sea turtles emerge.

Management interventions

The basic principles for beach management focus on preventing damage due to erosion, storm effects, and controlling activities that degrade the coastal environment (Clark 1995). Preventive planning is the most cost-effective measure. There are also non-structural or soft engineering techniques that work with nature's forces rather than against them. Coastal zone setbacks and beach nourishment are examples of "soft" non-structural solutions. "Hard solutions" often involve constructing permanent features such as revetments, walls, groins, and jetties to harden the coastline. Expensive to build and maintain, they also are difficult to adapt to changing conditions. They can accelerate beach loss if improperly placed. A well-balanced coastal program incorporates good planning with a mixture of soft and hard solutions that emphasize non-structural interventions. Guidelines and examples follow:

1. Set back all permanent development inland of the active part of the shoreline: Evaluate the erosion hazard of a site before construction and build outside the hazard zone, based on a 50-100 years estimate of the erosion rate. Communities can establish a standard setback or retreat line that provides a buffer zone. New construction or expansion of existing facilities and reconstruction of damaged structures may be prohibited within the retreat zone. Restricting construction within the buffer zone also reduces pollution since sources are set back from the sea.

2. Do not block sand movement or remove sand from any part of the sand transport system: A beach cannot replenish itself if sand is removed or its movement blocked. Mining sand from beaches, bars, and dunes should be considered only after careful study, particularly for sites important for tourism, recreation, or wildlife habitat. Anticipating the effects of a project is difficult because the current flows for a particular site vary depending on the two monsoon seasons. A system of environmental studies and permits should control sand removal from beaches, bars, and dunes.

3. Let the normal beach cycle replace the sand: Wait several years before erecting protective structures or engaging in beach nourishment. The observed erosion may be part of a multi-year cycle of erosion and accretion. A groin extension to trap sand for a beach will starve beaches down current and result in erosion. Careful study is necessary to understand why sand loss is occurring before starting expensive restoration or protection projects.

4. Beach nourishment: Sand can be brought in to replace lost sand but needs careful evaluation of negative impacts. It must be considered as an on-going control process since the imported sand will be transported later and lost. The financial costs and environmental cost posed for the source of the sand must be considered. Try to improve the production capability of the natural source of sand rather than replacing with new sand. Remember that the beach profile depends upon the sand grain size. Match the imported sand to the original material, otherwise the waves will sort the materials and wash it away.

5. Sand by-pass systems: Where a large obstruction to long-shore transport is built, provisions must be taken to allow for an adequate sand by-pass system. The system has to work regularly and be responsive to changes in current direction. It cannot be a one-time intervention. Dredging can be used but may cause excessive sedimentation. A sand pump can continuously move sand and water from one side of an obstruction through a pipe to the other side.

6. Conserve natural protective features like coral reefs, mangroves, and dunes: Coral reefs provide much of the beach materials in the Philippines. Ensure that reef uses do not damage the reef and degrade its functions as a breakwater and sand source. Coral mining and blast fishing must be eliminated. Vigilance by the community and a law enforcement partnership with officials promotes good surveillance and an effective judicial process. Protect and encourage reproduction of aquatic creatures like parrotfish that produce sand particles. Control polluting land-based activities. Protect mangroves for they provide habitat and nutrients, filter and trap sediments, and prevent erosion.

7. Pollution prevention: Maintain healthy and aesthetically attractive conditions on the beaches. Adjacent businesses and residences must have suitable systems for sewage and solid waste disposal. Removing trash from the beaches requires daily attention with proper means for collection and conveyance. Existing high-density conditions may require the development of a central sewage treatment facility and a sanitary landfill for solid waste. User fees should support the infrastructure costs and operation of these facilities rather than a higher general tax.

8. Maintain public access: Assess the status of municipal public beaches and public rights of way to the coastal zone. Approve new developments with conditions attached to provide public access. Take care to ensure that the public use is controlled so as not to degrade the surrounding environment. This may mean placement of public facilities for sewage and solid waste disposal. A fee for use can be instituted in order to pay for maintenance of these facilities. The protection and patronage of private individuals and organizations sustain many of the best-protected environments. True public access would likely lead to overexploitation and degradation of the habitat. The two sides of private and public access must be debated in open forums that produce collaborative site-specific use policies that are attainable and sustainable.

9. Zoning: To reduce competition and harmonize beach use, zoning can effectively guide development and curtail conflicts. Minimize uses at the beach that are not water dependent. General considerations when developing a zoning plan can include the following (Clark 1995):
   - Keep the zoning plan simple and understandable;
   - Minimize interference with customary uses and rights through active participation by users when developing the zoning plan;
   - When prohibiting existing uses in a zone, try to make provisions for these uses in other parts of the area;
   - Zoning of beach uses should be consistent with the zoning in the uplands and offshore waters;
   - Avoid sudden transitions in zones, such as having strict sanctuaries adjacent to marinas;
   - Use natural landmarks to delineate zones as much as possible;
   - Consider the ecological source and path between various habitats when establishing zones;
   - Be consistent with existing navigational zones, fishery closure areas, and other complementary management regimes in the area; and
   - Be aware of natural habitat uses of the beach such as sea turtle which requires minimum development and no artificial light at night.

Legal and institutional framework

The legal authority for management of beaches and adjacent properties lies primarily with the LGU. The LGC tasks LGUs to develop and adopt comprehensive land use plans supported by ordinances. It is responsible for providing solid waste disposal and for environmental services related to general hygiene and sanitation, enforcing laws and regulations related to pollution control and protection of the environment, preserving natural ecosystems, and issuing environmental clearance certificates in coordination with the DENR. It also has responsibility for regulating tourism facilities and other tourist attractions, including regulation and supervision of business concessions and security services for such facilities through the issuance of business permits.

Mining and quarrying are governed by the DENR, the provincial governor, and the *Sangguniang Panlalawigan* or the Municipality depending on the situation. Extraction of sand and gravel along beaches is prohibited by national law up to 200 m inland (*Batas Pambansa Bilang* 265).

The DENR also has set procedures (DENR AO 97-05) to retain vegetated cover and trees within certain distances along the banks of rivers, streams, and shores of seas, lakes, and oceans for environmental protection and for public use in the interest of recreation, navigation, floatage, fishing, and salvage. No permanent infrastructure is allowed on these areas, unless intended for erosion control or to enhance the aesthetic qualities of the area. Setback distances are 3 m in urban areas, 20 m in agricultural areas, and 40 m in forest areas. Foreshore leases and environmental clearance certificates must be obtained directly from the DENR before any development is permitted within the setback areas of up to 40 m in forest areas.

SEAGRASS AND ALGAL BEDS AND SOFT-BOTTOM COMMUNITIES

The Philippines enjoys extensive seagrass and algal beds and soft-bottom communities that often occur in close proximity to mangroves and coral reefs. Soft-bottom communities comprised of sand or muddy substrates occur in many shallow subtidal areas. Some are dominated by seagrass and algal beds while others are not vegetated. Organisms that inhabit soft-bottom areas are influenced by particle size and stability of the sediment, light, and temperature. Although not obvious the unvegetated soft-bottom areas have a variety of organisms that are infauna, benthic animals that burrow or dig in the sediment. Some animals live on the surface such as clumps of seaweeds, mollusks, flat fishes, and rays. Typical infauna include various worms, bivalves, heart urchins, sand dollars, some sea cucumber, and shrimps. All depend to some degree on detritus for food and are easily disturbed if the sediment is moved or churned up.

Seagrasses that usually inhabit sandy and soft-bottom areas are the only submerged flowering plants in the marine environment. Thriving in the shallow waters lining the shore, they have adapted to life in saline waters with a root system that can withstand wave action and a reproductive system that distributes pollen by water. They possess erect leafy shoots and creeping stems or rhizomes that aid in propagation. Unlike other marine plants like seaweeds or algae, they flower, develop fruit, and produce seeds. They are normally found in areas where light can easily penetrate (shallow, clear, calm waters) enabling photosynthesis to occur. Vast seagrass meadows are often found between coral reefs and the coastal mangroves, colonizing the soft, shallow, sandy-muddy bottom. They can be several hundred meters wide and cover large expanses of the reef flat. They can also include algal beds of *Sargassum* or other seaweeds interspersed in the shallow reef flats.

Seagrass ecosystems have very high primary productivity. It is this capacity which helps to support and provide nutrients and physical habitat to a variety of organisms. Seagrasses can grow quickly without fertilizers or modern cultivation techniques. Some species can grow as much as 8 cm/day (Fortes 1995). They also produce multiple crops (2-4 times annually). Their high productivity includes not only their own high growth rates but also the many small plants and other organisms that attach to their surfaces and live amongst the seagrass.

Relatively few animals actually eat seagrasses. The main role of seagrasses as a nutrient source occurs when the dead seagrass decomposes and releases its nutrients to the water. The seagrass food web is illustrated in Figure 23. Important fish species, such as some rabbitfishes *(siganids)* rely completely upon the seagrasses. Shrimps, sea cucumbers, sea urchins, seahorses, crabs, scallops, mussels, and snails are economically important and abundant in seagrasses. Many resident and transient species use the seagrasses for refuge, spawning, and nursery activities. Large animals like *dugong* and green sea turtles also graze extensively in seagrass beds. Seahorses, a tourist attraction and of medicinal value, reside in seagrass beds (see Figure 23).

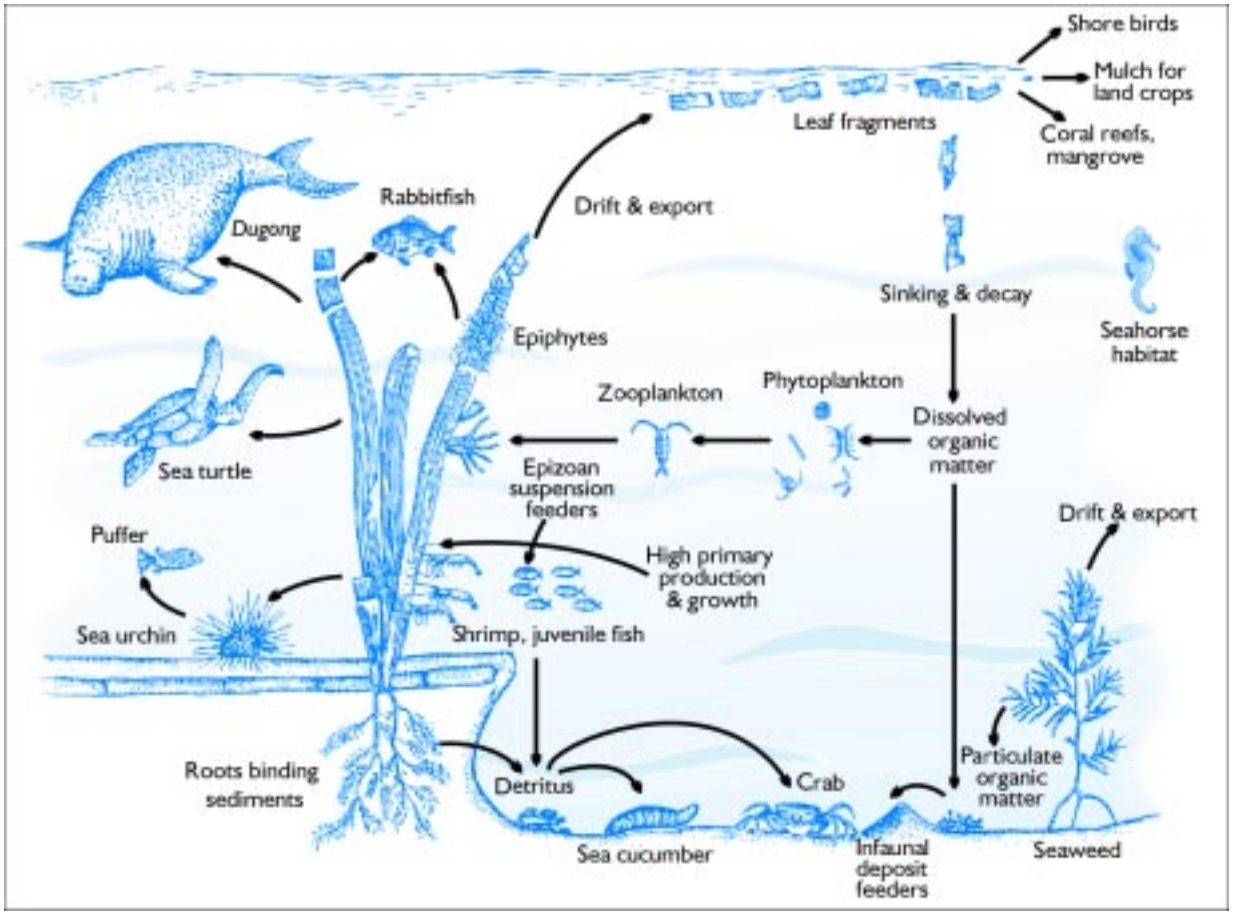


Figure 23. Food chain in Philippine seagrass ecosystems *(Fortes 1989)***.**

Seagrass beds slow down water velocity so that sediments settle out of suspension before they can be washed onto the reef. Without the seagrass roots anchoring the bottom sediments, they become loose, erode, and smother benthic populations. Scallops, clams, crabs, and many fish species suffer from the loss of protective seagrass habitat and from the sedimentation and erosion of the bottom (Fortes 1989).

Major distributions of seagrass beds occur in Bolinao Bay in Luzon, Palawan, Cuyo Islands, the Cebu-Bohol-Siquijor area, Zamboanga, and Davao. Other beds are scattered throughout the coastal expanse of the other islands (Fortes 1989).

Resource uses

Seagrasses have a long history of use in the Philippines. Traditional uses for seagrasses as well as a list of potential contemporary uses are given in Table 7. A primary ecological function of seagrass beds is to provide nursery areas for a variety of fish and crustaceans that migrate to other habitats as adults. This contributes significantly to fisheries. Soft-bottom areas, being primary habitat for many mollusks, worms, and some fish have corresponding resource values.

Table 7. Traditional and contemporary uses for seagrasses.

Traditional Uses:	Potential Contemporary Uses:
Woven into baskets	Bio- filters for sewage
Burned for salt-making and heat	Coastal stabilizers
Stuffing for mattresses	Paper manufacturing
Roof thatch	Source of useful chemical fertilizer and fodder
Upholstery and packing material	
Compost for fertilizer	Food and medicine for people
Insulation for sound and temperature	
Fiber substitute for making nitrocellulose	
Piles to build dikes	
Cigars	
Children's toys	

Source: (Fortes 1989)

Management issues

Seagrass beds and soft-bottom communities are often forgotten during preparation of various management plans because their values and functions are not as well recognized. The many coastal activities having major impacts on littoral basins discussed earlier also cause loss of seagrass habitat or damage to soft-bottom communities.

1. Encroachment and seagrass modification
   Encroachment by "land reclamation" for development of shore facilities has reduced the habitat for seagrasses. Both dredging and filling greatly disturb the bottom and largely remove that area as a potential seagrass area and area for soft-bottom organisms. Shrimp and fish farming have displaced many hectares of seagrass beds and mangroves.

2. Sedimentation
   Excessive sedimentation can physically smother the seagrasses or it can cause such turbidity in the water that photosynthesis is impaired and filter feeders die. Major sediment sources include improper mining, agriculture, or forestry practices. Large areas of seagrasses have been smothered by mining runoff in Marinduque Island and other areas (Fortes 1989).

3. Introduction of waterborne pollutants
   Pollution of nearshore waters occurs from domestic waste, oil and gas from boats and ships, and the accumulation of solid waste in shallow areas. In highly polluted waters, concentrations of herbicides, heavy metals, and detergents may be elevated enough to cause tissue damage to seagrasses (Fortes 1989). However, the major long-term threat to seagrasses in the world is from coastal eutrophication. Surface water runoff and groundwater

containing excessive nutrients from fertilizers or sewage create conditions that promote algal blooms. Excessive algal growth shades the seagrasses on the bottom, interfering with light passage and the photosynthesis process. In addition, excessive amounts of dying algae will strip the oxygen from the water causing anoxic (no or low oxygen content) conditions in waters and sediments. The two actions combined may severely limit seagrass survival, either killing everything or leaving only those species that are hardy enough to survive.

4. Destruction of submerged and fringing vegetation
   Destruction of fringing vegetation, such as mangroves, allows additional sediment and pollutants to enter the water. It also removes significant sources of nutrients that help to sustain the seagrasses and coral reefs. Blast fishing gouges large holes in the bottom, not only killing the plants but also creating erosion sites that may remove more plants. Dragging boats, nets, anchors, and other gear can dislodge seagrass as can the churning of shallow waters from small boats and jet skis. In addition, planting of mangroves in seagrass beds is destructive to seagrasses and not appropriate.

Management interventions

Management interventions for addressing the loss of seagrass and soft-bottom habitats include:

- Mapping and identification of beds to catalogue the extent and location of the resource;
- Zoning to prioritize use of space between pristine seagrass meadows versus those that are disturbed, altered, or newly emergent;
- Controlling of fishing methods to ban bottom trawling, blast fishing, and other methods of harvesting which tear up the bottom and cause turbidity;
- Reducing pollution by enforcing prohibitions against discharge of urban and industrial effluent and sea dumping of solid waste or dredge spoils and by reducing the amount of impervious surface area in the upland areas abutting the shoreline. Maintaining vegetated buffers along the shoreline and around disturbed sites to filter the runoff and promote infiltration of water into the ground; improve logging, mining, and agriculture practices to prevent erosion;
- Control coastal construction and beach nourishment;
- Transplanting shows signs of success from experimental transplanting; however, careful selection of the transplant site in regard to light, nutrients, and sediment type and stability is important while considering relative cost and benefits; and
- Recreation and tourism opportunities can provide opportunities for alternative sources of income to replace income generated by activities that degrade seagrass beds.

An example of a successful intervention to protect seagrass beds is at Barangay Handumon on Handayan Island in Getafe, Bohol where a municipal seahorse sanctuary was established with assistance from the Visayan Seahorse Project of Haribon Foundation. Ordinarily, a fisherman would receive PhP10 per seahorse from a broker feeding a lucrative market supplying Chinese folk medicines. Through the Visayan Seahorse Project, fishermen learned to let the animals

mature to reproductive size and to allow pregnant males to deliver their young. Tourists can arrange to go with a fisherman on a seahorse catch and release night expedition. The PhP300 fee compensates the fisherman (PhP250) for his catch and the project receives PhP50. Visitors stay in basic accommodations built by the project that are priced high enough (PhP750 including meals) to increase benefits to the community. Additional bungalows are added as profits from the venture permit. Local residents also are learning to create alternative products for sale, including woven bags and pillows stuffed with old fish nets, rattan products, wooden boat models, and assorted fish and squid "snack foods" for local consumption.

Legal and institutional framework

Except for inclusion in a sanctuary or other management scheme there are few specific regulations for seagrasses. Nevertheless, many of the potential development impacts on seagrass beds and soft-bottom areas are controlled under the environmental impact requirements of the DENR.

CORAL REEFS

Reef ecology

Coral reefs are known as the "oasis of the ocean" because they are small points of very high productivity occurring within vast oceans, which are essentially very low in nutrients and energy. They are extremely efficient in capturing nutrients and sunlight and then cycling them for use by many different organisms. They often occur in association with other ecosystems, particularly seagrass beds and mangrove forests which provide nursery and feeding areas for many reef creatures. Detritus from decomposing plant and animals in these areas of high primary productivity provides nutrients for the coral reef organisms. Coral reefs also generate much of the beach sand in the Philippines. The Philippines is near the center of coral diversity in the world, with at least 430 different species of corals (Gomez *et al.* 1994).

Although corals often appear rock-like, they are actually colonies of living organisms. Reefs are unique in that they are built up entirely by biological activity. Each coral animal or polyp builds a cup-shaped calcium carbonate (limestone) skeleton around it by extracting calcium from the seawater (Figure 24). This hard fixed skeleton gives coral its rock-like appearance. Requiring light and nutrients, only the thin surface layer of polyps is actually alive in a colony. The underlying coral mass is made of the many skeletons of dead polyps. As the colony grows, it provides structure and niches that serve as homes for many different organisms including fish, sea snakes, mollusks, marine worms, crustaceans, algae, and sponges. It is this ability to provide diverse structure which supports the vast biodiversity associated with Philippine reefs.

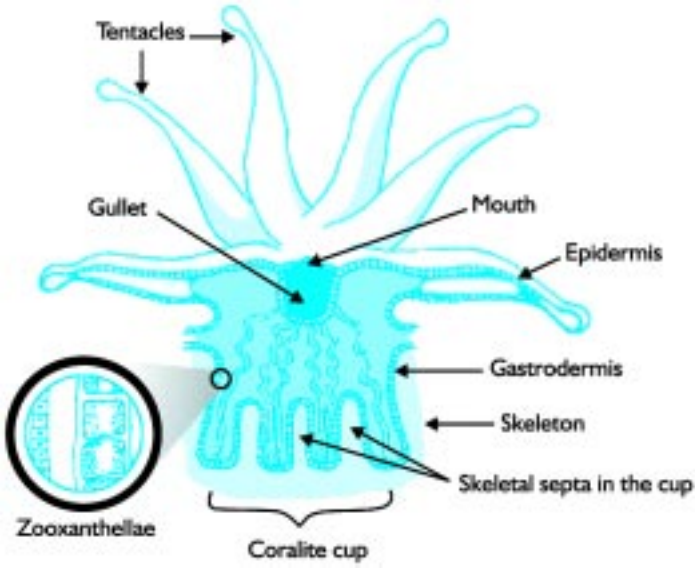


Figure 24. Parts of a coral polyp *(White 1987a)***.**

Coral colonies occur in many different colors and shapes depending upon the prevailing water quality, circulation and wave patterns. The coral grows slowly as polyps bud off to create another polyp or when coral larvae settle close by on hard clean substrates. It takes years for a colony to increase in size. The fastest growing branching corals add only 5 to 10 cm/year. Slower encrusting and mound corals may increase in diameter by a few mm/year. Damage to a reef may take many decades to recover, if at all.

Corals extend small tentacles into the water and filter out tiny floating organisms. The polyps have tentacles with stinging cells that grab and stun the passing prey before guiding them to its mouth. Corals also obtain energy through a symbiotic (mutually beneficial) relationship with small photosynthetic algae (zooxanthellae) that live in the soft tissue of the polyp. The algae absorb waste from the polyps and, via photosynthesis, incorporate the nutrients into the polyp tissues. These algae are essential for coral life; thus, sufficient light for photosynthesis is a requirement for the survival of corals.

Coral growth is restricted to shallow and clear water without turbidity due to excessive sediment or algae. Prolonged exposure to freshwater, too much direct sun, or too little light will kill the corals and restrict growth. Consequently, coral growth is directed laterally towards open water where oxygen and nutrients are available. Sedimentation is a major factor in the destruction of corals. Excessive sediments from upland erosion can physically smother the corals. In lesser amounts, they interfere with the feeding processes, inhibit the release of larvae, and can interfere with the photosynthesis process (Figures 25 and 26).

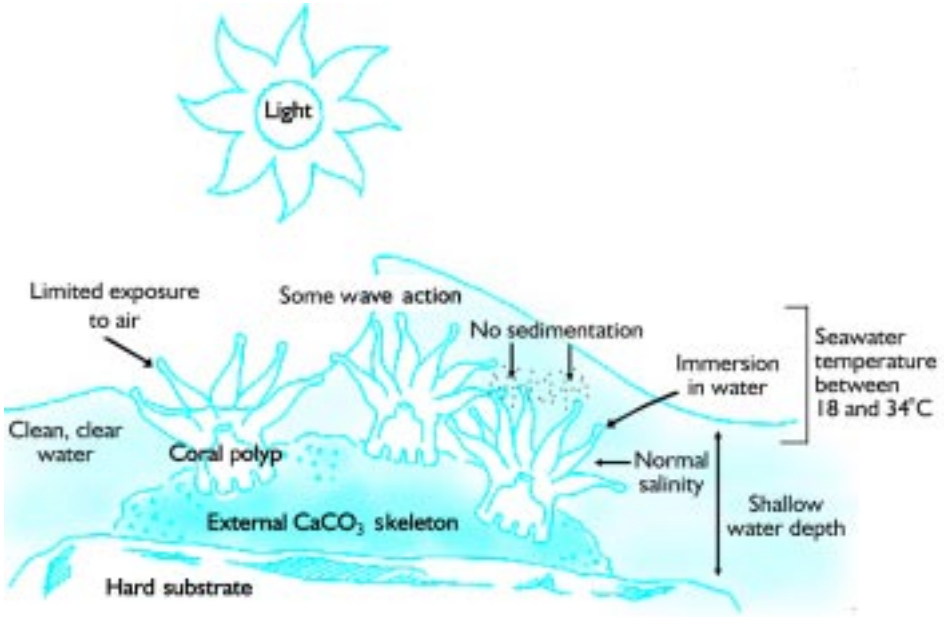


Figure 25. Requirements for healthy coral reef growth *(White 1987a)*.

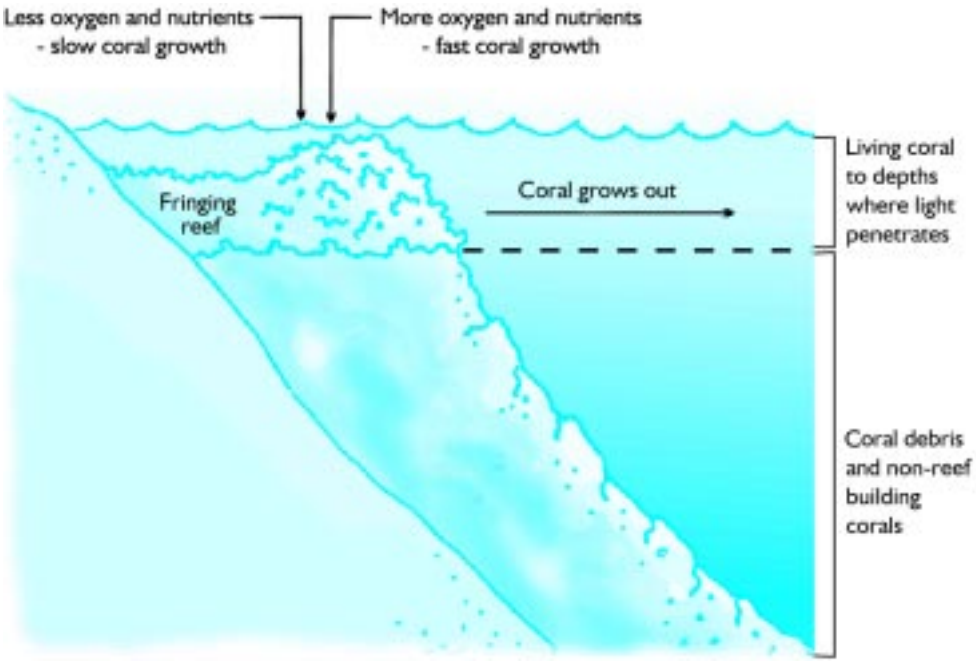


Figure 26. Formation of a typical fringing coral reef *(White 1987a)*.

Reef types and zones

Coral reefs are generally grouped into three types: barrier reefs, fringing reefs, and atolls. Figure 27 shows the evolution of a reef system, starting as a fringing reef and progressing to a barrier and then atoll system. The model assumes that subsidence of land and/or elevation of the sea level is occurring. Present day reefs are the result of growth over the past 5,000 years where sea levels have remained fairly stable.

Fringing reefs that border the island shores are the most common type in the Philippines. Most of these reefs have a similar structure and support similar living communities. Due to their physical constraints, corals and reef organisms can live only at shallow depths and in certain habitats or niches. Figure 28 illustrates the typical zonation for a fringing reef.

Most shores abutting coral reefs are sandy beaches, mangrove forests, and rocky cliffs or other intertidal areas. Sloping gently away from this shore is a shelf-like reef flat of varying width and depth. It usually consists of a combination of sand, mud, rocks, seagrass, algae, and scattered corals. The mean water depth of the reef flat is often no more than one meter thus extreme low tides can leave large areas exposed. At the outer edge of the reef flat is the reef crest and often exhibits the most diverse and productive zone due to its exposure to the waves, currents and clear, shallow water. Below the reef crest is the more tranquil reef slope.

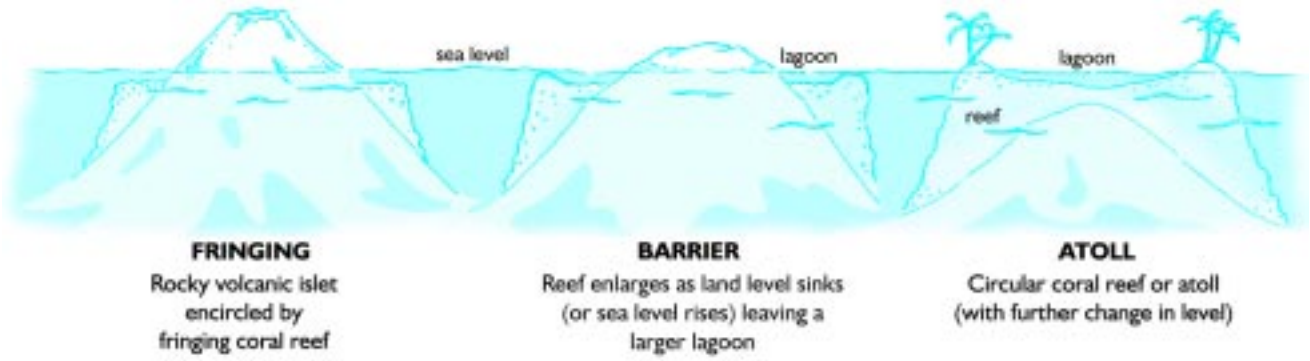


Figure 27. Coral reef types and their geological evolution *(White 1987a)*.

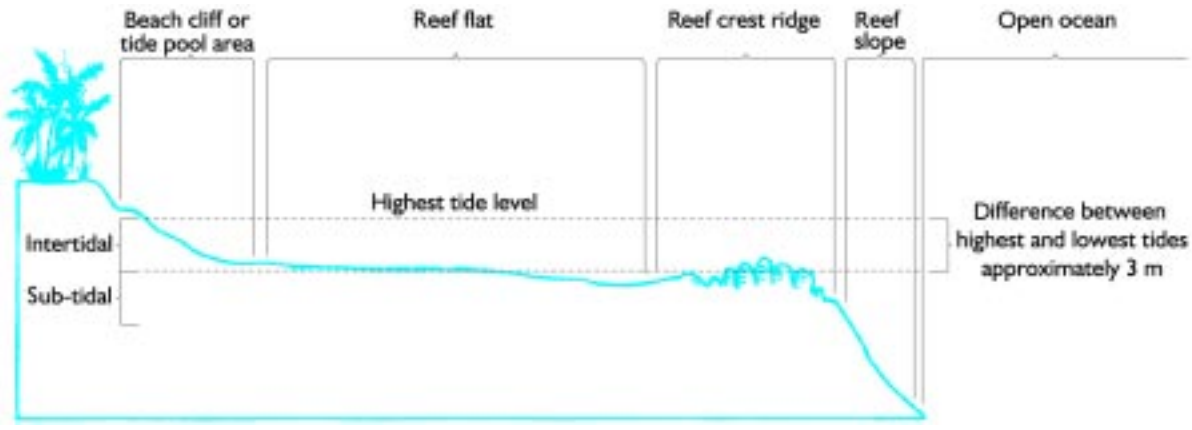


Figure 28. Zonation of a fringing reef *(White 2001)*.

Resource uses

Coral reefs constitute an area of about 27,000 km^2, which is equal to about 10 percent of the total land area of the Philippines or an area more or less equal to Bohol, Siquijor, Cebu, and Negros islands. Coral reefs provide about 15 percent of the total Philippine fish catch or about 170,000 t/year (Murdy and Ferraris 1980). Most of the reefs are located on the shelf surrounding the western island of Palawan or around the numerous small islands of the archipelago. Most reefs are in a degraded state with more than 70 percent listed as either poor or fair in quality and quantity of coral cover. Less than 5 percent can be categorized as in excellent condition (Gomez *et al.* 1994). Reef degradation is caused by a variety of factors related to the increasing dependence of a growing Philippine population (annual growth rate ca. 2.3 percent) on the finite fishery resources provided by reefs (Pauly 1990).

Table 8. Coral reef resource products and uses.

A. Major reef export products of economic importance

Resource	Role in reef	Product use
*Stony coral[a]	Primary reef frame builder	Building material, fish tank decoration
*Precious coral[b]	Enhances habitat	Jewelry, decoration
Fish[b]	Link in metabolism	Food, aquarium fish
Mollusks[b]	Calcification, food chain	Shell collection
**Tridacna* clams[b]	Calcification	Decoration, novelty
Top shells, *Trochus*	Calcification, food chain	Mother-of-pearl
Oysters[b]	Calcification, food chain	Pearls
Lobsters[b]	Scavenger	Gourmet food
Sea cucumbers	Detritus feeder, sand	"Trepang," food
Sponges[b]	Borer	Toiletry
*Sea turtles[b]	Food chain	Shell, oil, meat, eggs
*Sea snakes[b]	Food chain	Skin, crafts
Misc. invertebrates	Varied	Antibiotics, drugs
*Coral sand	Substrate, beaches	Concrete, building
*Ecosystem	Conservation, genetic diversity	Tourism, aesthetic appeal, natural laboratory

B. Subsistence food products commonly used

Organism group	Kind
Fish[c]	Large variety
Bivalves	Clams, mussels, oysters
Gastropods	Most large ones
Cephalopods	Squid, cuttlefish and octopus
Crustaceans	Crab and shrimp
Echinoderms	Sea cucumbers and sea urchins
Coelenterates	Jellyfish and anemones
*Sea turtles	All species (shell, meat, and eggs)
Algae	Many edible varieties

[a]*1,830,089 m^3 were exported from the port of Zamboanga in 1976.*
[b]*Seriously depleted on many reefs throughout the Philippines and Southeast Asia.*
[c]*The most significant contribution of reefs to subsistence food consumption in the Philippines and throughout Southeast Asia.*
**Organism regulated by law in some form so that traditional use is no longer allowed or is controlled.*

Source: White and Cruz-Trinidad (1998)

Resource use on coral reefs is intensive. Most uses are extractive, for example, fishing and reef gleaning, collection of ornamental fish or other reef products, and coral mining. Fishing and reef gleaning account for 10-15 percent of the total fish catch of the country (White 1987a). A growing industry is the export of organisms to support new biotechnology industries for medicines and industrial chemicals. Table 8 lists many of the products that are obtained from different coral reef organisms.

Management issues

The effects of fishing on coral reef fish stocks analyzed by fishing method are shown in Table 9. Modern boats and fishing methods have greatly increased the efficiency of fishermen. At the same time, most fishing gear are not very selective. As stocks become overexploited and decline, fishing effort increases and even juvenile fish and the adults of very small species are targeted. This causes the size of individual fish to decline and reproductive rates to decrease since egg numbers are directly related to body size (Bohnsack 1990). Too many people with too many gear are now chasing too few fish (Pauly 1990).

Table 9. Impacts and selectivity of various fishing methods used on coral reefs.

Fishing gear	Species caught	Negative impacts on habitat/species	Selectivity of gear	Efficiency of extraction
Traditional methods				
hook-and-line	large fish	+	+ +	+
	squid	+	+ + +	+
nets:				
gill, barrier, trammel, cast	variety of fish	+	+ +	+
beach seine	shallow, schooling fish	+ +	+ +	+ +
small drive-in	variety of fish	+ +	+ +	+ +
hand nets	live fish or aquaria	+	+ + +	+
hand spears	large demersal fish	+	+ + +	+
traps	demersal fish, lobsters	+ +	+ +	+
fish corrals/fences	shallow schooling fish			
	tidally migrating fish	+ + +	+ + +	+
gleaning or gathering:				
walking at low tide	seaweed, invertebrates	+ + +	+ + +	+ + +
free-diving	invertebrates incl. octopus	+	+ + +	+ +
Non-traditional (modified) methods				
trawls	various fish, invertebrates	+ + +	+	+ + +
drive-in nets *(muro-ami) (hulbot-hulbot)*	wide variety of fish	+ + +	+	+ + +
explosives	all fish	+ + +	+	+ + +
poisons*	live food fish and aquarium fish	+ + +	+ +	+ + +
spear-gun using scuba	large bottom fish	+	+ + +	+ + +

Legend: degree
+: low + +: moderate + + +: high)
*Poisons kill many organisms on the affected area of reef, but only the fish are collected.
Source: modified from Ormond and Douglas (1996)

Destructive methods such as trawling, blast fishing, drive-in nets, and cyanide fishing are methods that grossly affect reef ecology by destroying either its physical or its biological structure. The first three techniques force fish from their refuges while physically destroying the nooks and crannies that provide the diverse structure of a reef. Fouled nets continue to kill fish long after they have been abandoned as they blanket the reef. Cyanide poison, used for collecting aquarium and live food fish, is a systemic poison that paralyzes and kills fish. Some non-target species, particularly invertebrates and the coral polyps, are particularly sensitive and die quickly. Thus the most basic element for reef building is destroyed. Fine mesh nets and traps kill fish that are too small to have much commercial importance.

Spear fishing causes less damage to reef structure but is more selective. The larger and more valuable fish are removed quickly from the reef system. Unfortunately the largest individuals of a species also tend to be the best sources for new offspring (Figures 29 and 30). Extensive harvest of selected species also deprives the reef of the services provided by these species. For example, parrotfish, popular spear targets, create sand by ingesting coral and excreting the residual limestone fragments; their loss from the system affects beach development.

Collecting aquarium fish, coral, and shells for decorative purposes often targets those species which can command high prices, thus wiping out local populations. Reef-destroying outbreaks of crown-of-thorns seastars may be linked to the taking of its main predator, the *Triton* trumpet gastropod. The effects of destructive collection practices, like the use of cyanide, were described above.

Coral mining removes pieces of the reef or reef flat by hand or dredging. The coral is used either as a building material, similar to stone, or to produce lime for cement and plaster. The long-term cost of placing man-made coastal protection structures is much more expensive than the short-term benefit gained from mining the coral. Dredging for the coral also stirs up great amounts of sediment that kills neighboring corals.

Reefs are attractive as natural boat harbors. Damage can occur from the physical bumping of boat hulls, anchors, and mooring lines on the nearby coral. A boat swinging in response to changes in wind or tide can destroy corals in a wide circle around the anchor. Sediments suspended by the turbulence of passing boats settle on top of corals. Pollutants, such as oily discharges, trash, and blood or entrails from fish cleaning also can affect surrounding water quality.

Reefs can provide valuable services as excellent sites for science and environmental education. The living laboratories provide good sites for the study of basic biological processes for students of all ages. Reefs also serve as major tourist attractions in some locales. Snorkeling, scuba diving, and coral viewing by glass-bottom boat can provide substantial revenues for local entrepreneurs providing guide services, dive equipment, transport, lodging, restaurants and

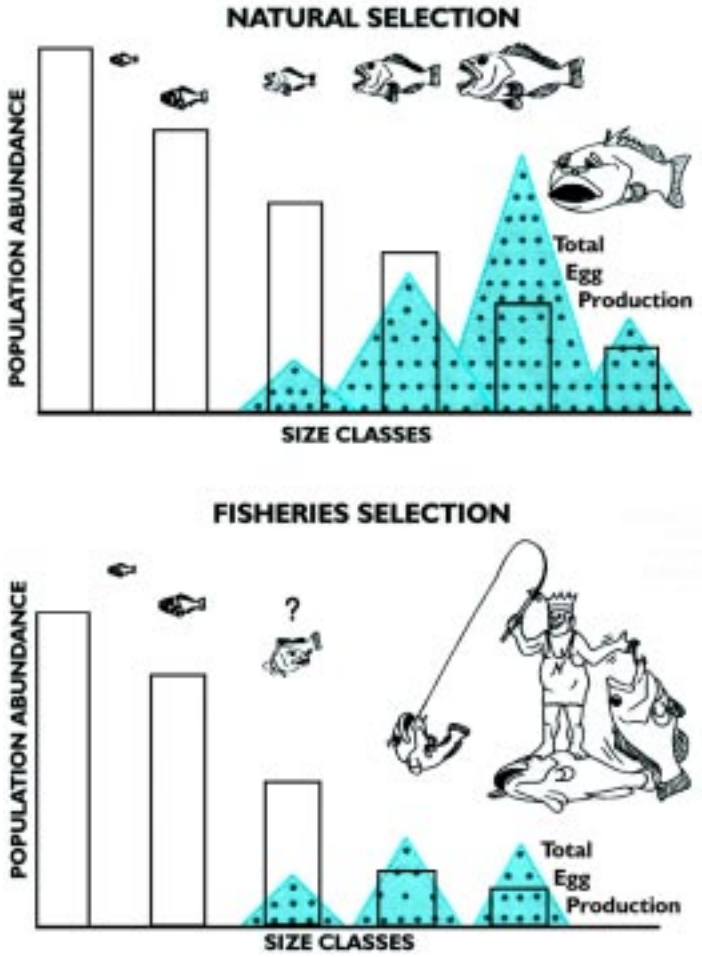


Figure 29. Effects of natural versus fishing mortality on population size structure and total egg production from coral reef fishes *(Bohnsack 1990)***.**

Figure 30. Equivalent red snapper fecundity. One 61 cm (12.5 kg) female has the same number of eggs (9,300,000) as 212 females at 42 cm (1.1 kg each) *(Bohnsack 1990)***.**

souvenirs. Care must be taken to ensure that participants move carefully to avoid breaking corals by walking and standing on it, hitting it with watercraft or anchors, taking souvenirs or harassing wildlife. Development of tourist and educational facilities must be done carefully to avoid adverse impacts due to poor site planning.

Management interventions

Strategies and management interventions to protect coral reefs can be divided into two broad categories: site-specific protective measures versus strategies with a broader geographic focus, for example, sanctuary zoning versus coastal cleanup campaigns. The more site-specific strategies will be discussed later in the following chapter on establishing marine sanctuaries. This section looks at the broader interventions listed in Table 10. There are many instances of overlap where actions in the broader category also can be applied as more site-specific strategies and vice versa. Many of these measures are applicable for management of other critical habitats also.

Table 10. Interventions for coral reef conservation in general.

	Activity/Need	Result/Benefit
Emphasize tourism use of reefs	• Promote alternative livelihoods for fishermen and reef users • Raise community awareness about non-extractive use of reef • Encourage setup of marine protected area	• Recreation users are non-extractive and maintain a high quality of reefs • Healthy recreation use can support many different types of related business
Establish rules for capture of live fish	• Stop degradation of coral reef habitat by cyanide poisoning	• Stimulate sustainable live fish incomes
Training for divers, dive shop and boat operators	• Decrease damage to reefs by accidental or intentional touching of corals by recreational visitors • Provide mooring buoys to limit anchor damage • Jet skis	• Raises awareness of reef users • Diver operators can participate in efforts to maintain reef quality • Decreases accidental damage to reef organisms
Conduct reef cleanups	• Improve aesthetics of reefs frequented by visitors • Remove hazards for aquatic life	• Cleaner reef areas are more aesthetic for tourists • Fewer plastic bags and trash to be eaten by turtles and fish • Decreases entanglement of fish and animals on old nets
Restoration of reef by artificial reef placement and transplanting*	• Restore or improve quality of life in a limited area of a sanctuary or reserve where water quality and reef damage mechanisms will allow survival	• Results are easy to see although survival rate is variable • Increased settlement of coral larvae • Allows reintroduction in areas where natural recruitment is limited • Improved aesthetic quality of areas frequented by tourists

**Transplantation requires a permit because it entails collection of living corals.*

1. Emphasize tourism use of reefs and other coastal habitats
   Conservation of coastal resources usually means decreasing fishing pressures and other extractive uses. Tourism is often promoted as a means for developing alternative livelihoods for persons affected by conservation measures. Recreation uses can be low impact and non-extractive if managed properly. Tourists are usually willing to pay in order to maintain a high quality of resources, particularly if they know that the money will be spent on resource protection measures. Tourism can also help to diversify a local economy as different services are needed, for example, lodging and eating establishments, taxis, guides and boat services, boat and dive equipment rental, boat maintenance, souvenirs, laundries, and communication centers with fax, email, and postal services. Raising the awareness about non-extractive uses and values of the reefs can encourage people to adopt alternative livelihoods and to gather the political and financial support for conservation management.

2. Establish guidelines for gathering reef fish for aquarium and live food fish trade (McAllister and Ansula 1993)
   Fish destined for the aquarium or live fish restaurant trade are worth much more per unit weight than as iced whole fish. Demand for live reef fish has prompted destructive fishing techniques like cyanide fishing. Cyanide stuns fish for easy capture, yet the same dose also kills the surrounding corals and other invertebrate reef inhabitants. Organisms collected for aquarium trade include most fish species as well as various sea anemones, corals, shrimps, seastars, and "live rock" or coral with attached fauna. The live food fish trade tends to concentrate on several popular fish including humphead wrasse, many groupers, stonefish, and rock lobsters (Johannes and Riepen 1995).

   Preferred methods of collection and management interventions (modified from Barber and Pratt 1997):
   - Reduce demand for scarce species by encouraging people to eat fish that are more hardy and easier to cultivate;
   - Capture live food fish using hook and line or traps;
   - Set up cyanide detection stations to aid in the analysis of confiscated fish and to assist in preparing cases for judicial trial;
   - Use small filament nylon fence nets to entangle aquarium fish or pick them off with a dip or scoop net;
   - Improve post-capture handling to reduce mortality, gas bladder release techniques, and improved filtration and aeration systems;
   - Leave enough parent fish or shellfish to insure adequate spawning sources for the next generation;
   - Set regulations prohibiting capture during critical spawning periods or during unusual schooling periods (spawning);

- Avoid using tangle nets or dredges to collect shells as they destroy corals and bottom habitat;
- Regulate or ban the use of compressed air or scuba in taking fish; and
- Use dip nets for capture of grouper fingerlings attracted to fingerling aggregation devices (*gango*) for grow out by fish farmers to replace wild capture on the reef.

3. Education of scuba divers and snorklers

Damage by divers in popular areas can eventually lead to degradation of dive sites. Briefings by diver operators about the need for careful diving to avoid damage can help reduce accidental damage by fins and the taking of souvenirs. Instruction would include what can be touched and what should be avoided to prevent damage to the corals (and harm to the diver).

4. Conduct reef and coastal cleanup campaigns

Garbage, trash, and abandoned nets create hazards for aquatic organisms and resource users. Abandoned nets continue to trap and kill fish when they cover the reef. Numerous animals and fish die after mistaking plastic bags or fishing line for food. The presence of refuse also detracts from the recreational and aesthetic values of the resources. A community cleanup campaign can help to remove undesirable materials and at the same time raise awareness for participants and observers. Tourists often will volunteer to help in such a campaign when visiting an area. Hotels and dive shops have sponsored such events in the past, providing refreshments, boats, and dive gear as contributions.

5. Artificial reefs and coral transplantation

Artificial reefs are presently discouraged in the Philippines because they act as fish aggregating devices (FADs) that lend themselves to uncontrolled overfishing and ownership conflicts. Their use is guided by a Joint DENR-DA-DILG-DND Memorandum Order No. 2000 on the establishment, management, and utilization of artificial reefs in municipal waters. They have more value when incorporated into sanctuaries as part of a management plan. In such a case, their placement must be planned carefully so that they are placed close together to provide suitable substrate for coral growth and yet do not displace other naturally occurring coral nor impede water or nutrient flows (White *et al*. 1990). Where artificial reefs are placed to act as a substrate that promotes coral growth, characteristics like water quality or excessive wave energy must be considered to allow coral growth. In areas where reefs have deteriorated, it is most important to halt the activities that have led to deterioration of the natural reef structure. Otherwise they will have the same impacts on the new artificial reef.

Coral transplanting sounds good but it is an expensive way to reproduce something that nature can produce more efficiently. It may be applicable to promote regrowth, for example, a hotel wants to rebuild its coral garden. If attempted, one should note that studies by Clark and Edwards (1995) found that mortality of transplanted coral is very high (50 percent) and that the rate of survival varies among species. The more fragile branching corals had much

higher mortality. In contrast, Heeger *et al.* (1999) have shown survival rates of over 80 percent in an experiment together with community assistance on Olango Island, Cebu. The larger massive corals seem to survive transplantation well, even though their growth is slower. Larger pieces of any species transplant better than small fragments. In the Philippines, coral transplantation requires a permit because it is illegal to remove living corals for any purpose (PD 1219).

Natural recruitment can be stimulated if a stable substrate is provided for attachment. Corals prefer settling on vertical surfaces rather than on horizontal surfaces. Sedimentation decreases natural recruitment because the sand, silt, and coral rubble quickly fill available void areas. Fragile and quicker growing branching corals tend to recruit more quickly and often than do the slower growing massive corals. Transplantation and monitoring its effectiveness are time consuming, thus labor costs may be high. Since transplanting does not appear to enhance natural recruitment of an area and transplanted colonies have a reduced life expectancy, its use may be limited to increasing diversity by placing some of the larger massive corals that tend to survive transplanting.

Legal and institutional framework

The protection and management of coral reefs is primarily the responsibility of LGUs through the authority of the LGC and that shared by national agencies like the DENR and DA-BFAR. Although the national government agencies have banned such destructive practices as coral mining, blast fishing, cyanide use, and trawling within most municipal waters, corals usually are located nearshore within the statutory limits of municipalities (less than 15 km from their coastline).

LGUs can control activities occurring within their municipal waters and as such are able to regulate resource use by local ordinance. Such measures must complement and strengthen the conditions set by national laws. LGUs are able to limit access to marine resources, prescribe zones for different uses and collect taxes or fees associated with the use of these municipal natural resources. They also can establish municipal sanctuaries without the approval of the national government agencies. Municipal marine reserves or sanctuaries are one of the most important coastal resource management tools available for protecting and improving local marine resources. A more complete discussion on marine sanctuaries can be found in Chapter 3.

WILDLIFE HABITAT REQUIREMENTS

The habitats discussed in this chapter all support a large variety of marine organisms. The condition and quality of the habitat determines to what extent these marine organisms can thrive in a particular habitat. Generally a healthy coral reef or mangrove habitat contains a very large diversity of species. This diversity serves as a buffer against disrupting forces in the environment, both natural and human related. In addition to the general ecosystems associated with the various

habitats and all the species that make up the ecosystems, there are some well-known large species that have special habitat requirements. These animals, because of their size and specialized reproduction cycles, are becoming rare and require special attention to ensure their long-term existence. Sea turtles, sea snakes, sea cows (*dugong*), whales, dolphins, and seabirds are all becoming increasingly scarce and depend to a large degree on coastal habitats for their survival. Legally protected species and their habitat requirements are listed in Table 11.

Table 11. Threatened and legally protected marine species and their habitat requirements*.

Marine animal	Habitat requirements	Legal issuance
Reptiles		
Sea turtles (all species)	Coral reefs, seagrass beds, beaches, and nearshore waters	FAO 29; FAO 76 FAO 88; FAO 185-1
Sea snakes (all species)	Fringing coral reefs, mid-water reefs	FAO 208
Mammals		
Sea cow (*dugong*)	Seagrass beds, bays with reefs	DAO 55, s1991
Dolphins (all species)	Open water areas and mid-water reefs	FAO 185, FAO 208
Whales and porpoises (all species)	Open water areas	FAO 185-1, FAO 208
Seabirds	Small islands, rocks, and cliffs	None
Fishes		
Whale sharks (1 specie)	Open water and mid-water reefs	FAO 193
Manta rays (all species)	Open water and coral reefs	FAO 193
Milkfish (1 specie)	Estuaries, coral reefs, and open water areas	FAO 129 and FAO 173
Crabs		
Coconut crabs (*Birgus latro*)	Beach areas	FAO 208
Mollusks		
Mollusks in general (all species)	Coral reefs, seagrass beds, and sandy areas	FAO 11, FAO 168, and FAO 208
Giant clams (7 species)	Coral reefs	CITES; FAO
Giant triton shell (*Charonia tritonis*)	Coral reefs	FAO 158
Helmet shell (*Cassis* spp.)	Coral reefs, sandy areas	FAO 158
Kapis shell (*Placuna placenta*)	Estuaries, reefs, and mudflats	FAO 157
Corals		
Stony and precious corals (all species)	Coral reefs	PD 1219; FAO 184 RA 8550

**Not all "threatened species" are legally protected: see Guidebook No. 2 for detailed list of species protected by law.*

Sea turtles

Sea turtles are known to have been extremely common in the Philippine waters in years past. Now they are scarce because they are harvested for their meat and shell and their eggs are collected for food and medicine. The animals and their eggs are legally protected. A primary habitat requirement of sea turtles is a sandy beach where they can lay their eggs without disturbance. Key requirements are:

- Sandy beach above mean high tide for egg laying;
- No light on beach at night since turtles will not approach a beach with bright lights shining on the sandy area;
- 60 days of undisturbed incubation period for the eggs without predators or flooding;
- Lack of beach predators so that hatchlings can go to the water unmolested; and
- Protected feeding grounds, primarily seagrass beds and coral reefs, where adults can feed and reproduce.

Sea snakes

Sea snakes, in years past, inhabited most coral reefs and shallow water habitats in the Philippines. Now, they are scarce because they are collected for food and for their skin. In many localized areas they are extinct because their reproduction is slow and specialized. A primary habitat requirement of sea snakes is a coral reef that ranges from 0 to 20 m deep. Several species of sea snakes require shoreline cliffs to crawl on for reproduction. Thus, although sea snakes are not legally protected, all fishing for these reptiles should be stopped to ensure their survival. Known breeding and feeding areas should be set aside as marine sanctuaries such as Gato Island, Cebu; Hunters Rock, Palawan; and other areas where they still thrive in reduced numbers from the past.

Sea cows (*dugong*)

Sea cows are almost extinct in the Philippines and most of the world although several small populations still exist in Mindanao and Palawan. They have been heavily collected for food since they are docile animals and very easy to catch living in shallow, nearshore environments. A primary habitat requirement of sea cows is a seagrass bed for feeding that is protected from heavy wave action and currents. Sea cows are legally protected in the Philippines and all countries of the world but their population is so critically low that reproduction is probably not taking place at sufficient rates to support survival in most areas. A critical need in the Philippines is that shallow bays with extensive seagrass beds where sea cows are known to reside be set aside as strict wildlife refuges for these animals. Several key requirements for sea cow habitat are:

- Healthy seagrass beds in areas protected from wave action and strong currents;
- Areas of limited boat and human disturbance in general; and
- Clean, pollution free water.

Whales and dolphins

The Philippines is endowed with 24 species of whales and dolphins, a few of which are commonly seen in many coastal areas (Tan 1995). Although they are all legally protected, in some areas, fishermen still harvest these animals. The primary habitat requirements for whales and dolphins are clean marine waters where they are not molested by people, boats, or pollution. These marine mammals also require sizeable amounts of fish food to survive and will tend to congregate where feeding is good. Although this need may be in conflict with local fisheries for humans, a large fish sanctuary is an important need of healthy whale and dolphin populations. An example of a marine mammal protected area of sufficient size to benefit the animals of concern is the Tañon Strait Marine Protected Area between Cebu and Negros Islands.

Seabirds

Seabirds are rare in the Philippines because most of their natural habitat has been converted to human habitation. Seabirds are not legally protected but require special attention if they are to survive in the wild. Their primary habitat requirement is open space near the sea with, or without vegetation, depending on the species. Some species such as boobies nest on the open ground and cannot live near trees or bushes. Other species, such as terns and frigate birds, nest in bushes and small trees. All seabirds feed on marine organisms in nearshore waters and that is why they are called “seabirds”. An urgent need in remote areas of the country is to set aside small islands from human habitation where seabirds are known to abound. The only large marine protected area in the Philippines with seabirds nesting inside is the Tubbataha Reef National Marine Park in the Sulu Sea (Arquiza and White 1999).

CONCLUSION

The coastal habitats and ecosystems of prime importance to the Philippines include coral reefs, seagrass and algal beds, soft-bottom communities, mangrove forests, estuaries, and beaches. All are under increasing threats from human development and resource extraction activities so that their natural productive functions are becoming impaired. The basic management strategy for all these systems should be that of precaution. As these systems are destroyed and lost, they will not easily come back. The losses to people dependent on them for fishing and food, recreation, other forms of income and aesthetic purposes cannot be measured.

ALAN WHITE

Productive mangrove habitat with view of mangrove prop roots and pneumatophores.

TONI PARRAS

Mangroves at Handayan Island, Getafe, Bohol provide habitat for fish and crustaceans.

ALAN WHITE

Thalassia *and seagrasses often provide habitat for rabbitfishes.*

ALAN WHITE

Seagrass habitat exposed at low tide near Silliman University Marine Laboratory, Dumaguete.

ALAN WHITE

An integrated management approach is needed for bay habitats such as Malalag Bay.

LYNN FUNKHOUSER

Manta rays are protected species in the Philippines, yet still subject to illegal hunting.

Marine mammals, such as these melon-headed whales, are protected species and a source of income from eco-tourism ventures.

LYNN FUNKHHOUSER

One square kilometer of healthy coral reef can produce 20 tons of fish per year, provided the environmental quality is maintained and the reef is not subject to overfishing.

LYNN FUNKHOUSER

Healthy coral reefs in the Philippines have high biodiversity and support many species that benefit humans.

ALAN WHITE

Reefs, such as this one at Tara Island, that are destroyed or damaged can take 50 years or more to recover.

ALAN WHITE

Damaged reef, with broken and dead corals, does not support fishery production or other sources of food and livelihood.

ALAN WHITE

Anchor damage to branching corals is a problem that can be managed by the installation of mooring buoys.

MIKE ROSS

Continued enforcement is needed to prevent the harvest of protected species such as sea turtles.

ALAN WHITE

Seagrass habitat in shallow waters near Mactan Island, Cebu provides nursery grounds for many fish.

CALIXTO YAO

Dead standing mangroves after being enclosed with a dike around an illegal fishpond, in contrast with the healthy dense stand in the backgound.

chapter 3
Creating and managing marine protected areas

WHY MARINE PROTECTED AREAS FOR MANAGING COASTAL AND MARINE HABITATS?

Coastal marine habitats are being exploited beyond their capacity to recover as overfishing and destruction of coral reef, mangrove, seagrass, and estuarine habitats continue. In the Philippines, reducing fishing pressure and habitat destruction often means providing alternative sources of income. As tourism increasingly supplements or substitutes as an income source for coastal communities, there is a growing realization that maintaining high biodiversity levels and pristine coastal areas is vital to attract and sustain tourism and to maintain healthy populations of fish for food security. Yet, even the advent of tourism gives rise to additional conflicts in coastal resource use.

Marine protected areas (MPAs) such as reserves, sanctuaries, and parks can achieve protection of particular, well-defined areas and critical habitats (Agardy 1997). When properly designed and well managed, a marine reserve can meet various marine and coastal conservation needs by preserving habitat and important species and protecting specific areas. Coral reef fisheries, in particular, can be effectively managed through implementation of "no-take" areas on reefs (Roberts and Polunin 1993). The approach has been adopted by two of the world's leading conservation organizations, the World Wide Fund for Nature (WWF) and the IUCN-The World Conservation Union, as the number one objective in a global strategy for conserving areas of high biological importance and productivity.

A site is usually chosen for having high productivity and biodiversity or because it serves a special ecological function like a spawning and/or feeding ground for one or more marine species. An ideal sanctuary is large enough to include sections from all the critical habitats discussed in Chapter 2 as they are interconnected and provide benefits to each other. Such a sanctuary can be particularly effective at promoting long-term productivity of shallow-water fisheries in places like the Philippines where about 10-15 percent of the marine fish production is supplied by coral reefs. For some small islands, reefs support more than 70 percent of the total fish catch and provide most of the protein consumed by residents (Savina and White 1986). Mangroves and seagrass beds provide the nursery habitat for many species of fish and should be included in management strategies. Basic criteria for selection of marine protected area sites may include (White 1988a; Agardy 1997; Hermes 1998):

- Relative naturalness: Areas still in good condition;
- Representativeness: Areas that are unique, include important ecological functions and/or species;

- Biodiversity: Areas with high diversity of species/ecosystems;
- Vulnerability: Areas with rich resources/biodiversity that are relatively vulnerable to disturbance or destruction;
- Fisheries value: Areas that are strategic to enhance fisheries;
- Tourism value: Areas that could, if protected, enhance appropriate recreational uses and tourism revenues;
- Social acceptance: Acceptability of all stakeholders; and
- Practicality of management: Relative ease of management.

Reserves help to sustain and increase biotic and genetic diversity by protecting rare, threatened, and endangered species, subpopulations and their habitats. By restricting fish harvest, sanctuaries give different species the chance to freely reproduce. As fish inside a sanctuary grow larger and multiply more easily, this leads to a faster turnover of fish from the reserve to the non-reserve area, which increases yields for fishermen (White 1988b; Russ and Alcala 1996a, 1996b). Some species like grouper, parrotfish, and snapper do not breed until they are 4-6 years old. Lacking protection, juveniles are taken before they reach breeding age increasing the risk for local depletion or extinction. Selective removal of species disrupts the ecosystem and can lead to unforeseen consequences. For example, removal of grazers like sea urchins, parrotfish, and others may allow too much algae to grow, smothering the reef.

The first so-called municipal marine park or fish sanctuary in the Philippines was established in 1974 on Sumilon Island, Cebu under the guidance of Silliman University and its marine laboratory. Sumilon Island fish sanctuary is often cited in the Philippines and even internationally as the best example of why coral reef fish sanctuaries contribute to improved reef fisheries management (White 1987b, 1989; Russ and Alcala 1996b). This initial experiment in reef management, that in fact stopped all fishing on a portion of the Sumilon Island reef for about 10 years, allowed researchers to collect substantial data on the effects of such management on the coral reef and its related fisheries (Alcala 1988) (Figure 31). First, the coral reef substrate condition improved remarkably because all destructive fishing practices were halted. Living coral cover more than doubled to about 50 percent. Second, the fish abundance on the reef, as measured in terms of fish individuals per 500 m^2, more than doubled with the most significant increase among those fish targeted by fishermen. Finally, and most importantly, the yearly fish catch to fishers fishing on the Sumilon Island reef, but not in the sanctuary, increased from about 14 t/km^2 to almost 36 t/km^2 (Russ and Alcala 1996a, 1996b) (Figure 32). This unprecedented fish catch and large measurable increase convinced scientists, reef managers, and fishers alike that fish sanctuaries did indeed improve reef fisheries, and most importantly benefit the fishers dependent on the area through export of fish and their larvae (White and Savina 1987; Alcala and Russ 1990) (Figure 33). Unfortunately in 1984, the fish sanctuary on Sumilon was violated and that marked the beginning of a fish yield decline in years thereafter for that particular reef as noted in Figure 32. Apo Island Marine Reserve was another protected area in Negros Oriental established at that time and is a successful example of a community-based MPA with an increasing fish yield (Figure 32).

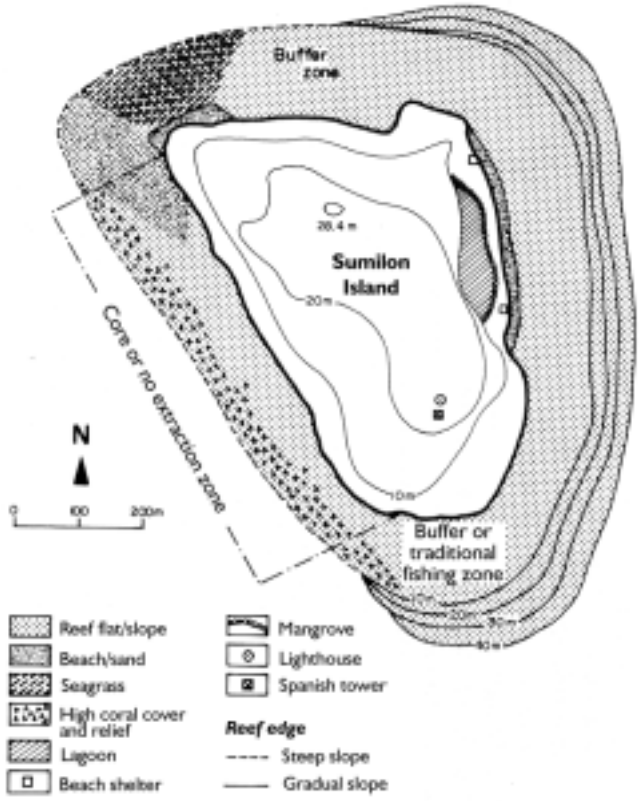


Figure 31. Sumilon Island, Cebu: coral reef and reserve *(circa 1984)***.**

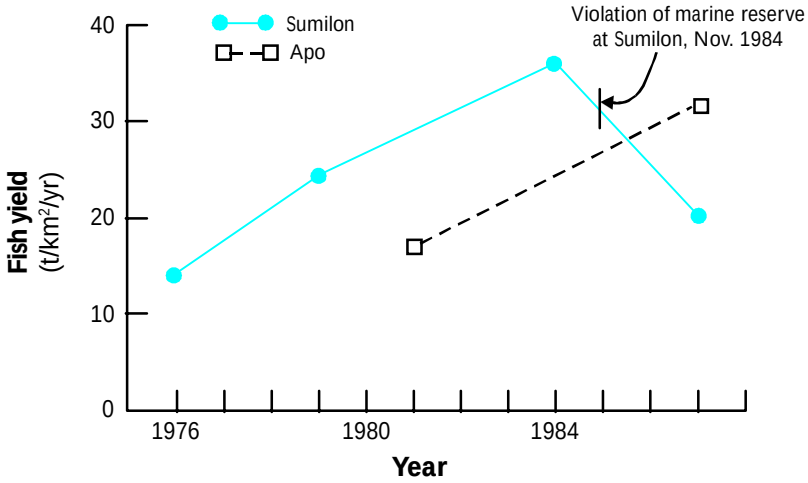


Figure 32. Change in fish yield reported for Sumilon and Apo Islands from 1976 through 1986, reflecting the effects of different management regimes *(White 1989)***.**

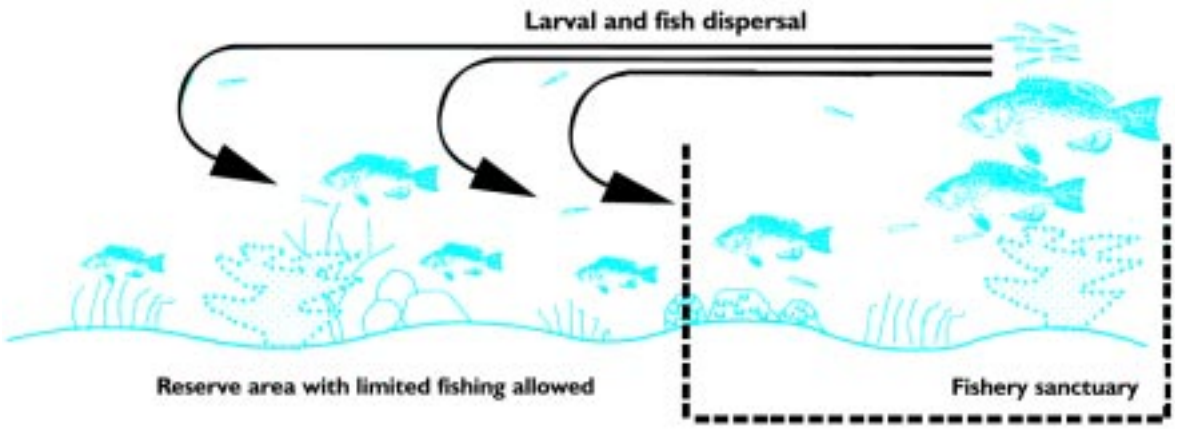


Figure 33. Dispersal of fish and larvae from the sanctuary of a marine reserve *(Bohnsack 1990).*

Controls on fishing, boating, and other resource uses promote the recovery of degraded coral reefs by reducing the incidence of physical damage. Incompatible uses can be separated by zoning, which then simplifies awareness building for compliance and enforcement measures. Sanctuaries serve educational and research functions by allowing us to compare protected areas to open areas. They also provide cultural and recreational amenities that can generate revenue for management and livelihoods.

INTEGRATED COASTAL MANAGEMENT AND MARINE HABITAT PROTECTION

Safeguarding critical habitat for increasing fish production, preserving genetic resources, protecting scenic and coastal areas, and enjoying the natural environment are all important reasons for implementing strict protection through MPAs to retain some areas in their natural productive state. Yet these goals also can create conflicts among different interests, user groups, levels of government and national government agencies. Where competition for coastal resources exists, careful design and implementation of integrated coastal management (ICM) or more narrowly focused coastal resource management (CRM) schemes can ensure continued benefits from some natural areas.

ICM is a process aimed at guiding coastal area development in an ecologically sustainable fashion. ICM embraces all of the coastal and upland areas, the uses of which can affect coastal waters and the resources therein. The ICM process tries to break down the barriers erected by traditional sectoral management of natural resources as well as the divide that can exist between local government, national agencies, community groups and nongovernment organizations (NGOs). ICM strives to improve and integrate the administrative, policy, and regulatory processes that affect coastal management (Figure 34). A thorough discussion of ICM can be found in *Guidebook 1: Coastal Management Orientation and Overview* and *Guidebook 3: Coastal Resource Management Planning*.

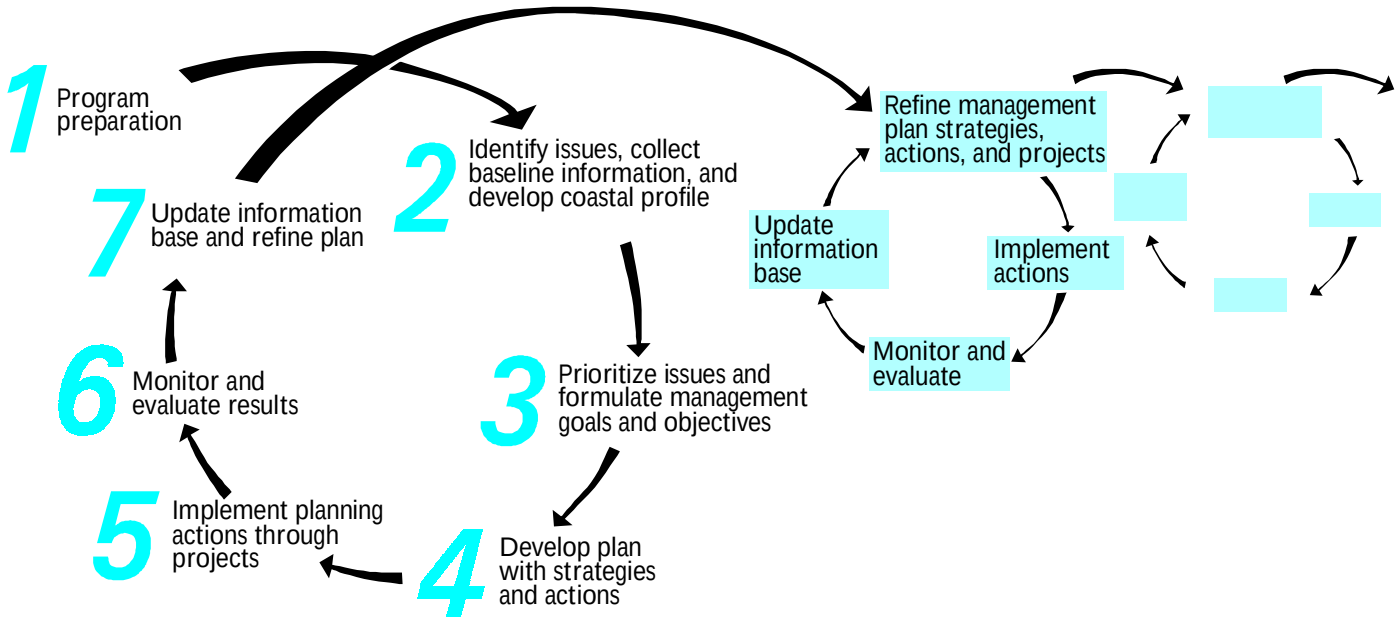


Figure 34. Cyclical integrated coastal management data collection, planning, implementation, and monitoring process *(White 1997; Olsen* et al. *1998).*

MPAs can be one important management strategy within a larger area-wide coastal management framework whose broader goals may include: maintaining essential ecological processes and life support systems, maintaining genetic diversity, and ensuring sustainable utilization of species and ecosystems. MPAs are closely linked to issues of ownership and control over specific pieces of coastal marine space. Their management outcomes greatly affect activities that degrade local coastal conditions.

Depending upon community needs and management concerns within the context of a larger ICM or CRM plan, MPAs can be designed and managed to accommodate various activities. Pursuing one benefit (sustaining biodiversity) therefore does not necessarily exclude pursuit of others and thus allows various management options. Still, the underlying premise is to conserve and protect natural resources. Establishment and management of an MPA should follow the basic planning steps outlined in *Guidebook 3: Coastal Resource Management Planning* (Figure 33).

In addition to bringing ICM planning to a more local level, an MPA can serve as a learning area for the process. As one establishes and manages an MPA, the day-to-day conflicts of community development and natural resource protection provide opportunities to learn. The lessons learned are transferred to the policy debates associated with the larger ICM process. Thus the experiences gained at the local level provide feedback and reinforce the national or regional policy and planning processes.

A key lesson being learned in the Philippine context for MPAs is that community involvement and ownership of the planning and implementation process are essential to succeed (White *et al.* 1994). The real stewards of carefully managed small areas of coral reef and shorelines are the local resource stakeholders (White 1988a; Bolido and White 1997; Hermes 1998). The process of involving communities in MPAs is described below and in *Guidebook 4: Involving Communities in Coastal Management*.

The lessons of Philippine coastal management projects with the implementation of MPAs are summarized in the remainder of this chapter. In addition, useful books on MPAs and coral reef management are listed in Table 12.

Table 12. Additional publications on marine protected area management in the Philippines.

Arquiza, Y.D. and A.T. White. 1999. **Tales from Tubbataha: Natural history, resource use and conservation of the Tubbataha Reefs, Palawan, Philippines, 2nd ed.** Sulu Fund for Marine Conservation Foundation, Inc. and Bookmark, Inc., Philippines, 190 p.

De la Cruz, M. and M.C. Militante. 1996. **Marine reserve monitoring manual for communities.** Guian Development Foundation, Inc., Tacloban, 28 p.

Hermes, R. 1998. **Establishment, maintenance and monitoring of marine protected areas, A guidebook.** Philippine Business for Social Progress, Manila, 63 p.

McAllister, D.E. and A. Ansula. 1993. **Save our coral reefs-Pagyamanin ang mga bahura: A coral reef care manual.** Ocean Voice International, Ottawa, Canada, 126 p.

White, A.T. 1988. **Marine parks and reserves: Management for coastal environments in Southeast Asia.** ICLARM Education Series 2, 36 p., Manila.

White, A.T. and H.P. Vogt. 2000. **Philippine coral reefs under threat: Lessons learned after 25 years of community-based conservation.** Marine Pollution Bulletin 40(6):537-550.

IS IT A MARINE PROTECTED AREA, PARK, RESERVE, OR SANCTUARY?

Marine protected area (MPA) is a broad term for sites whose boundaries have been established in order to provide some level of management with the primary intent of protecting the site's natural resources. There are different classifications for MPAs with some used inconsistently and interchangeably, such as parks, reserves, refuges, and sanctuaries. Confusion can arise further because MPAs also can be established at different levels of government, such as national and local. In the Philippines, MPAs can be established through the NIPAS Act (national) or through local (municipality or city) government planning and ordinance. The process for establishing MPAs under the NIPAS Act is distinct from a local government and community-based establishment. The latter is described herein while the process for the NIPAS Act is described in a publication by the DENR.

Among the various enabling regulations that provide the legal basis for establishing a protected site there is inconsistency in terminology. Referring to the examples from national legislation in Table 13 we can see that the term used to refer to a protected area varies depending upon the designating authority as well as the type and quality of the resources and the intent.

Table 13. Examples of national and local categories for protected areas.

National Fisheries Act of 1998 (RA 8550) provides the following:

Fishery refuge and sanctuary: A designated area where fishing or other forms of activities which may damage the ecosystem of the area is prohibited and human access may be restricted.

Fishery reserve: A designated area where activities are regulated and set aside for educational and research purposes.

National Integrated Protected Areas System Act of 1992 (NIPAS – RA 7586) contains definitions for the following:

Protected area: …identified portions of land and water set aside by reason of their unique physical and biological significance, managed to enhance biological diversity, and protected against destructive human exploitation;

National park: A forest/marine reservation essentially of natural wilderness character which has been withdrawn from settlement, occupancy or any form of exploitation except in conformity with approved management plan and set aside as such exclusively to conserve the area or preserve the scenery, the natural and historic objects, wild animals and plants therein and to provide enjoyment of these features in such areas;

Resource reserve: An extensive and relatively isolated and uninhabited area normally with difficult access designated as such to protect natural resources of the area for future use and prevent or contain development activities that could affect the resource pending the establishment of objectives which are based upon appropriate knowledge and planning;

Wildlife sanctuary: …an area which assures the natural conditions necessary to protect nationally significant species, groups of species, biotic communities, or physical features of the environment where these may require specific human manipulation for their perpetuation.

Buffer zones: …identified areas outside the boundaries of and immediately adjacent to designated protected areas …that need special development control in order to avoid or minimize harm to the protected area.

Barangay Council, Gilutungan Island, Cordova, Cebu (Barangay Resolution No. 0023, Series of 1991):

Fish sanctuary: A protected water area where fish are able to spawn, feed, and grow undisturbed and where fishing and other activities are absolutely prohibited.

Municipal Council, Dauin, Negros Oriental for Apo Island (Ordinance approved November 3, 1986):

Marine reserve and fish sanctuary: The entire coral reef and waters surrounding Apo Island to 500 m offshore are protected from destructive fishing activities and a smaller area is a fish sanctuary where no extraction is allowed.

For the purposes of this series of guidebooks and this chapter on MPAs, we will apply the following terms:

- **Marine Protected Area (MPA):** Any specific marine area which has been reserved by law or other effective means and is governed by specific rules or guidelines to manage activities and protect part or the entire enclosed coastal and marine environment.
- **Sanctuary:** An MPA where all extractive practices, such as fishing, shell collection, seaweed gleaning, and collecting of anything else is prohibited. It also allows for control of other human activities, including access, in order to protect the ecosystem within the specific site.

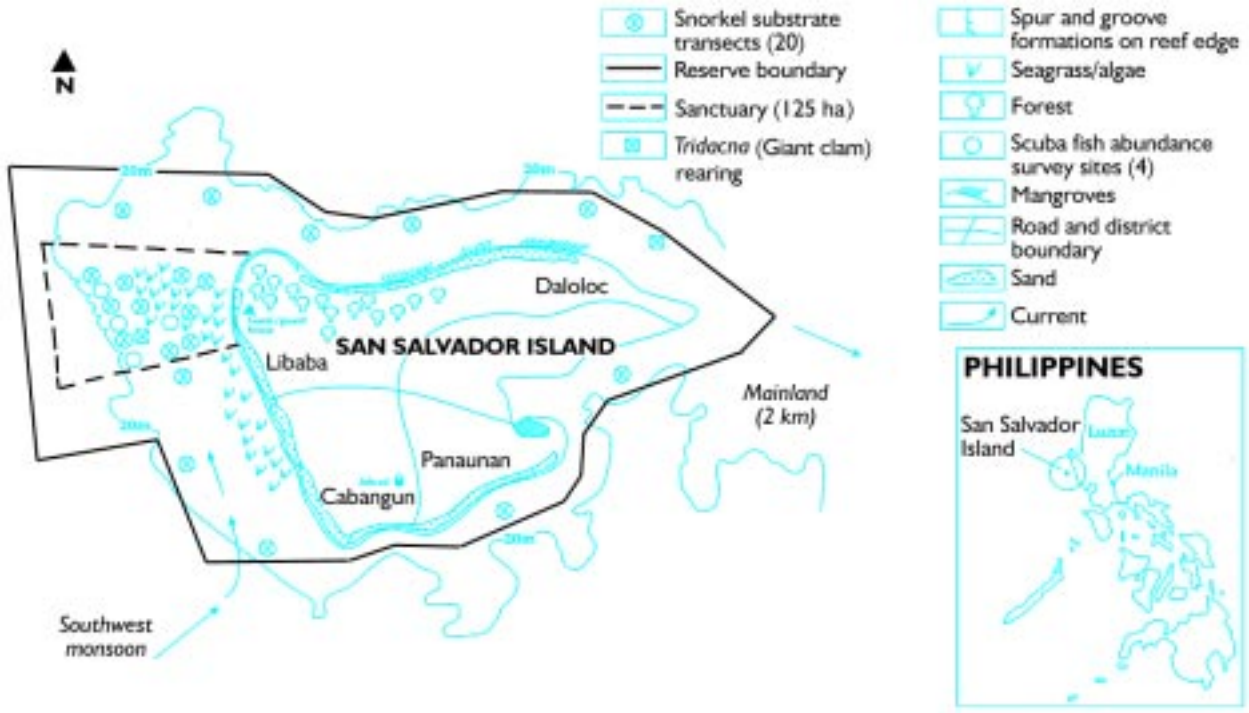


Figure 35. Coral reef features, reserve boundaries, survey locations, and political subdivisions on San Salvador Island, Masinloc, Zambales *(White* et al. *1994).*

- **Reserve:** An MPA where strict sanctuary conditions are not mandated for the entire area yet there is still a desire to control access and activities, such as boating, mooring, and various fishing techniques. It allows for zones that include a sanctuary area.
- **Marine Park:** An MPA where multiple uses are encouraged that emphasize education, recreation, and preservation; usually implemented by zonation schemes that can include a sanctuary area (White 1988a).

A common Philippine MPA model is a municipal reserve established by LGUs that includes a core sanctuary or "no-take" zone (Figure 35). In another model, an MPA can be specified for specific species. For example, a local ordinance was passed in Donsol, Sorsogon, which declares the entire municipal waters as a whale shark sanctuary.

LEGAL/JURISDICTIONAL ISSUES FOR MARINE PROTECTED AREAS

The authority to establish and manage MPAs is held by three jurisdictions—the local government unit (LGU), Department of Environment and Natural Resources (DENR), and the Department of Agriculture-Bureau of Fisheries and Aquatic Resources (DA-BFAR). Both national government agencies have responsibilities for protecting marine environments, although their mandates may sometimes overlap. For example, DA-BFAR is mandated in the Fisheries Code of

Table 14. The National Integrated Protected Areas System (NIPAS).

The NIPAS applies only to those areas or islands established by a national law, decree, proclamation, or order. Most of the MPAs established by LGUs do not fall within this category of national management.

The NIPAS was instituted through Republic Act 7586 in 1992. Designation of a new site for inclusion in the NIPAS presently requires a presidential proclamation followed by the appropriate enabling law passed in Congress. The DENR is mandated through NIPAS to classify and administer "all designated protected areas in order to maintain essential ecological processes and life support systems, to preserve genetic diversity, to ensure sustainable use of resources found therein, and to maintain their natural conditions to the greatest extent possible." It requires the preparation of a site-specific "general management planning strategy" (GMPS) as part of a larger national strategy for management of protected areas (Protected Areas and Wildlife Bureau). Preparing each GMPS requires input from NGOs and local communities while a Protected Area Management Board (PAMB) oversees management of each site.

LGUs exercise great local authority for resource protection even in NIPAS sites through the local PAMB. The PAMB is usually dominated by local community representatives from the municipality or city, *barangay*, tribal community, NGO, or other local organization. Therefore, PAMB decisions often carry the majority vote of LGU representatives. Even when the initiative for establishing a sanctuary comes from a national agency, LGU approval still must be obtained.

1998 (RA 8550) to "achieve food security as the overriding consideration in the utilization, management, development, conservation, and protection of fishery resources in order to provide the food needs of the population" and to "manage fishery and aquatic resources, in a manner consistent with the concept of an integrated coastal area management in specific natural fishery management areas..." Meanwhile, the DENR has been given authority to regulate the "development, exploration and utilization of marine, freshwater, brackish water and overall aquatic resources.." (Section 1 of Title XIV). In addition, the DENR has the authority over all nationally declared protected areas by virtue of the National Integrated Protected Areas System Act of 1992. This law encompasses the process by checking and managing national protected areas through a Protected Area Management Board with local government and stakeholder representatives (Table 14). This law and its contents are explained in detail in *Guidebook 2: Legal and Jurisdictional Framework for Coastal Management*.

Despite the mandate of the DENR to establish and manage MPAs under the NIPAS Act, LGUs are the most active participants. The DA-BFAR is mandated to assist LGUs with MPAs or to establish and manage MPAs outside of municipal waters. The LGC of 1991 confers several important measures which enhance the administrative abilities of the LGU: political autonomy (decentralization) and the ability to generate and mobilize economic resources through taxes and fees. Together with powers devolved through the Fisheries Code of 1998 (see Table 15), LGUs possess broad powers to control fishing activities occurring within their municipal waters. Consequently, LGUs are able to set conditions for marine resource use by local ordinance. Such

Table 15. Fisheries Code of 1998.

The Fisheries Code of 1998 consolidated numerous existing laws, decrees, rules, and orders. One principal outcome was to implement the constitutional and statutory mandates in favor of LGUs and the subsistence fisherfolk by limiting open access to fishery resources, giving priority to municipal fisherfolk and including people empowerment in the management process through formation of local councils. The code also declared its intent to manage fishery and aquatic resources in specific areas using integrated coastal management. The code also provides controls for commercial fishing and aquaculture in an effort to promote sustainable development in Philippine waters.

LGUs (municipalities/cities) were given the primary responsibility for "management, conservation, development, protection, utilization and disposition of all fish and fishery/aquatic resources within their respective municipal waters." They may establish fishery refuges and sanctuaries by ordinance after consultation with the advisory body known as the Municipal/City Fisheries Area Resources Management Council (M/CFARMC). The M/CFARMC, comprised mostly of representatives from local fisherfolk, assists in the preparation of a Municipal Fishery Development Plan, recommends appropriate municipal ordinances, assists in law enforcement, and advises the *Sangguniang Bayan/Panlungsod* on fishery matters. FARMCs may also be formed at the level of the *barangay* as well as at a higher level for shared resources like lakes, bays, gulfs, and rivers which are bounded by two or more municipalities/cities.

The Fisheries Code of 1998 mandates that where applicable, at least 15 percent of the total municipal waters in each municipality shall be identified, based on the best available scientific data, and automatically designated as fish sanctuaries by the LGUs in consultation with the FARMCs. Although statutorily there is not a mandate that an MPA be incorporated into an approved ICM process or CRM plan, there are benefits to doing so. Ideally, such large sanctuary areas would be established as part of each Municipal Fishery Development Plan (MFDP). Effective planning to integrate sanctuary locations would be enhanced if the MFDP is prepared in harmony within a larger Integrated Fishery Development Plan or a Provincial Plan.

measures must be at least as strong or stronger than the conditions set by the national government agencies. They can never be weaker. The strong local power can be a benefit if used properly to manage and protect marine resources.

Municipal marine reserves or sanctuaries are one of the most important coastal resource management tools available for protecting and improving local marine resources. MPAs usually occur in the waters within the regulatory boundaries of LGUs. LGUs are able to establish sanctuaries, limit access to marine resources, prescribe zones for different uses, as well as collect taxes or fees associated with the use of these municipal resources. LGUs do not require the approval of the national government agencies to establish municipal reserves or sanctuaries.

PLANNING AND ESTABLISHING A MARINE PROTECTED AREA

Planning and establishing an MPA occurs through a process that covers several stages. The stages in the community-based approach described below occur somewhat sequentially yet several will also run concurrently. The process for developing and implementing an MPA adapts the coastal planning process described in detail in *Guidebook 3: Coastal Resource Management Planning*. Though each site and its management measures are unique, the techniques for encouraging

Table 16. Phases and activities for marine protected area establishment and management within local government jurisdictions.

Phases of coastal management*	Stages and activities for MPA establishment and management**
1. Issue identification and baseline assessment	Recognition of a need and program preparation Integration with the community and assessment of issues 1. Community organization and mobilization 2. Conduct of baseline studies 3. Information, education, and communication
2. Plan preparation and adoption	Definition of goals and objectives: Formation of the core group and development of the management plan 1. Formation of the core group 2. Definition of goals and objectives 3. Preparation of management strategy and action plan 4. Determination of reserve boundaries and zones
3. Action plan and project implementation	Implementation: Formalization of the reserve, implementing management strategies, enforcement, and community strengthening 1. Formalization of the reserve through local ordinance 2. Implementation of strategies for managing the reserve 3. Enforcement 4. Permits and user fees 5. Strengthening of community involvement
4. Monitoring and evaluation	Monitoring and evaluation Refinement of the management plan
5. Information management, education, and outreach	Review of status of MPA and its benefits Refinement of education program from experience Development of outreach program as appropriate

**Described in detail in Guidebooks 1 and 3 of this series as the overall phases for coastal resource management planning and implementation*

***These stages and activities are different from those prescribed under the NIPAS Act because of the focus on MPA within local government jurisdiction.*

community support and establishing a marine reserve are widely applicable. Participatory approaches to improve community support for MPAs are described in *Guidebook 4: Involving Communities in Coastal Management*. The importance of community organization, community participation, and public education in the successful examples of MPAs is well-documented. This chapter adapts the principles applied in the Philippines and as described by Wells and White (1995). The general process and activities essential for successful MPA establishment are outlined in Table 16.

Phase 1. Issue identification and baseline assessment

Recognition of a need and program preparation

The recognition of the need for an MPA often comes from outside the immediate community, such as from a local conservation organization or scientists aware of the biological significance of

the area or may come from within the LGU in response to concerns about fishery resources or other issues. On the Philippine island of San Salvador, a Peace Corps Volunteer identified the potential site for a community-based reserve and documented the basic status of the reefs. He introduced the concept of marine sanctuary to the local people and made contacts with agencies involved in natural resource management. A project proposal was written and approved to support a community-based resource management project. Examples from San Salvador (Buhat 1994; White *et al.* 1994) are used throughout this discussion to illustrate the principles.

In some cases, the staff of an existing coastal project or natural resource management agency may be able to provide some of the preparatory steps that help communities to recognize the need. In other instances, a mayor, a few concerned citizens, private interests, or a community group may initiate the first discussions and investigations. Once the success of a few initial sites became known, other communities then began approaching local conservation groups, universities, development projects, and government agencies for assistance in establishing their own reserves. Recognition of need increases as people became more aware of the benefits of MPAs and the status of their own resources.

Integration with the community and assessment of issues

The effectiveness of a marine reserve is closely linked to the traditional resource use patterns of the people who live within or close by the site. Thus, the process to establish a reserve must include a complete understanding of the people in their local environment as well as the ecology of the target species and their critical habitat. Knowing how people use their resources is crucial when establishing a range of management strategies within the context of a marine reserve. This stage is very important and thus requires sufficient time to develop thorough consultation and negotiations with different user groups and community interests. See *Guidebook 4: Involving Communities in Coastal Management* for more information.

1. Community organization and mobilization

   The Philippine model uses trained community workers or community organizers (COs) to enter an area for a period of 6 months or longer. While living in the community, they introduce the idea of marine sanctuary, meet local leaders, attend local meetings, and generally become familiar with the local culture and management issues. Rather than being strictly biologists, the COs require skills in sociology, negotiation, and diplomacy to quickly develop knowledge of the local natural resource management issues as well as their "authorizing environment" (the social, economic, and political context which determines the decision-making process). The ideal candidate also possesses basic skills in marine resource monitoring and fishery assessment (White and Vogt 2000).

   The key information being sought during this stage tries to answer the classic question, "Who wins and who loses if an MPA is established?" Typical information will include:

A. Basic information and inputs required for planning:

- Basic resource management issues to be addressed;
- Causes of overfishing; what species are affected most;
- Existing and traditional socioeconomic and resource use patterns for the area;
- Groups or institutions that control resource use patterns;
- Goals people expect as outcomes from resource management intervention;
- Participants in the planning process for establishing a reserve and in the day-to-day operation; and
- Area required to adequately meet the management goals.

B. Information needs for refining the plan and management:

- Boat mooring issues and locations;
- Public access and encroachment or squatting;
- Research;
- Too much or too little tourism;
- Sanitation;
- Activities to be allowed or curtailed in the protected areas; and
- Management methods acceptable or unacceptable to the local population.

This information helps to determine the scope of the physical environment baseline studies that are a part of Phase 1. This review of the "authorizing environment" along with the baseline studies is compiled to form a coastal environmental profile about the proposed management site.

2. Conduct of baseline studies

Compiling the available information as a coastal environmental profile facilitates discussions about establishing the goals and objectives of MPA management plan in Phase 2. A sample outline for a coastal environmental profile is shown in Table 17 (Walters *et al.* 1998) and is discussed in detail in *Guidebook 3: Coastal Resource Management Planning.*

To establish an MPA, one must be familiar with the resources and people that will be managed. Data collection and scientific studies of the area should start early in the process of establishing an MPA. The baseline information is used for development of a management plan

Table 17. Key chapters in a coastal environmental profile.

- Introduction of the location, description of area, history, and summary of issues;
- Physical features: land area, topography, hydrology, soil, land uses, and climate;
- Natural resources: mineral, forest, coastal (resource maps);
- Sociopolitical setting: political/administrative boundaries, demographics, public health and sanitation, settlements, infrastructure;
- Economic sector: fisheries, aquaculture, tourism, industry, agriculture, forestry;
- Institutional and legal framework: relevant laws, local/national government, NGOs, community organizations; and
- Management issues and opportunities: environmental, economic, political/institutional.

and later for evaluating the impact of the marine reserve. By assembling the best data available for the site, people can be confident that everyone is using the same information and that their decisions are based on sound information. It can also point to gaps in the data that can be acquired later as part of the MPA management plan.

Local community members should be encouraged to gather baseline data with the assistance of project or other technical staff. Local residents can often provide great detail on seasonal variations of species, distribution of various marine ecosystems, resource use, and weather patterns. Techniques such as the Participatory Coastal Resource Assessment (PCRA) can be used. More information about PCRA is available in both *Guidebook 3: Coastal Resource Management Planning* and *Guidebook 4: Involving Communities in Coastal Management* of this series, as well as the PCRA Handbook by Walters *et al*. (1998). Participation at this early stage improves the likelihood that the local community will feel ownership of the MPA. A key strategy is the development of coastal resource maps that can be used to identify the appropriate location of an MPA (Figure 36). Maps and boundaries should ultimately be certified by a geodetic surveyor for accuracy.

Members of the local academic community are valuable participants as they can provide local technical knowledge and perhaps bring their own institutions into the process. Schools and universities often can provide eager receptive audiences, lab facilities, venues for meetings, and student volunteers for gathering data and community outreach. They may eventually align their research interests with those of the proposed reserve (White and Vogt 2000).

Although monitoring and evaluation appear later in our planning framework, it is useful to discuss them now. Monitoring and evaluation are an extension of the process that begins with the baseline studies. Therefore, the scope and criteria of the baseline studies should include indicator criteria suitable for monitoring progress, tracking changes, and evaluating the effectiveness of the MPA interventions. Monitoring is a continuous process and should not be considered a single event.

Monitoring and evaluation provide the foundation for learning lessons and defining future program development. Changes in policies should be guided by monitoring results of improvements in coral reef conditions (substrate, fish density, and fish yields) rather than by popular opinion. Simple monitoring methods can include reef surveys using standard techniques of snorkeling, line intercept transects, and general observation as recommended by Uychiaoco *et al.* (2001). These methods can be done by community members after training by a capable government, NGO, or academic institution. Public opinion itself also may change as monitoring results become available. Publicizing the results of the scientific work helps to increase interest in and acceptance of the marine reserve by local people.

Figure 36. Participatory Coastal Resource Assessment exercise to refine maps *(Walters* et al. *1998)*.

3. Information, education, and communication
   The education process occurs throughout all stages of development and implementation for a marine reserve. Initially, the focus is on explaining to local people the basic principles of marine ecology and resource management. The connection between a healthy marine system, the present conditions and the proposed MPA must be clear. This can occur through small group meetings and also in more formal presentations using slides, posters, and other visual aids. As the process for establishing an MPA matures, then the topics may shift to learning about the political process, funding options, management strategies, enforcement and monitoring, and then discerning lessons learned from experience. Several suggestions include:
   - Use non-formal methods that encourage participation, interaction, and personal contact;
   - Prepare a good map to help people relate to their areas of specific interest;
   - Encourage local enthusiasm for the project by recruiting academics, divers, fishermen, resort owners, and others who have personally noted changes in the quality of the habitat to share their observations and positive opinions about results;
   - Organize cross-visits to successful sites for local leaders. Discussion with local leaders who have established successful reserves is very convincing;
   - Use monitoring information as it becomes available to prepare education programs that describe the observed changes in ecology, biodiversity, and quality and quantity of fish stocks. Trends are very important to track over time; and
   - Refining knowledge of threats and management options is an important outcome of information and education activities.

Phase 2. Plan preparation and adoption

Defining goals and objectives: Formation of the core group and development of the management plan.

1. Formation of the core group
   A key step in establishing most marine reserves is the formation of a local committee that is directly interested and committed to planning, implementation, and management of the proposed MPA. In the Philippines, the CO helps to initiate a Sanctuary Management Committee (SMC), a *barangay* level FARMC or a committee or group with a different title. For our purposes, the term SMC will suffice. In other cases, the SMC may form in response to some common concern, such as a fish kill or the decline in tourism bookings. Establishing these committees is quite important as it begins the transfer of real responsibility and power to the community for the management of the proposed protected area. It surpasses the level of participation that holding a public meeting can provide. As the process continues, more in-depth training can be arranged on specific aspects of resource management and leadership training. At the same time, community training on the basic concepts of marine resources protection continues to broaden awareness and the base of support for the process.

Formation of small subgroups usually occurs as people respond to different interests and issues. This strengthens the group by increasing the diversity of interests and broadening the base of support in the community. It also allows people to concentrate their investigation of various management strategies for inclusion in a management plan.

Several pluses and minuses of committees are:

- Making decisions by consensus allows people to relax and feel confident that their interests will be represented.
- The coordination capabilities of small committees may be overwhelmed easily. Plan activities carefully to avoid overloading.

2. Definition of goal and objectives
   A simple management plan for the MPA should include the basic ingredients of a plan as described in *Guidebook 3: Coastal Resource Management Planning*. This plan can be incorporated into a municipal or city ordinance to formalize the management of the area. The goal and several objectives for setting up the MPA should clearly state the overall purpose for establishing the MPA. Objectives should be measurable and stated explicitly. Some example objectives include but are not limited to the following:
   - To define management long-term goals and initial objectives;
   - To protect the coral reef or other types of critical habitat from any physical damage caused by humans;
   - To increase fish abundance and diversity on the coral reef;
   - To stabilize and improve the living coral cover on the reef;
   - To increase the fish catch to fishers operating outside of the marine sanctuary; and
   - To attract diving tourists to generate income for sanctuary enforcement and operation costs as well as for extension activities for the local community.

3. Preparation of management strategies and action plan
   An SMC can become involved in a broad range of activities such as identifying management strategies, many of which are later included in a management plan. Some examples of actions supporting management strategies include:
   - Define membership and responsibilities of a management committee;
   - Reach consensus agreement on permissible activities and the limits of use;
   - Set boundary and mooring buoys locations and points of embarkation;
   - Define community enforcement and links to municipal or national enforcement agencies;
   - Draft a local resolution or ordinance to establish the reserve;
   - Develop resource restoration schemes like mangrove or coral planting or raising *Tridacna* giant clams;
   - Establish procedures for reviewing proposed projects for impacts on the reserve;
   - Decide whether to establish and fund an office or interpretive center;

Table 18. Factors to consider when establishing reserve boundaries.

Management objectives for the MPA: Objectives for establishing an MPA may include:

- Protecting biodiversity;
- Restoring or rehabilitating damaged habitat;
- Increasing fish yield for harvest;
- Increasing (or decreasing) tourism visitation;
- Improving public safety; and
- Increasing or controlling public access

Size and shape:

- Reserves should have clearly defined boundaries and be large enough to offer true protection for target species. If they are too small or have highly contoured boundaries, fish may migrate out too often and be susceptible to fishing.
- Clear boundaries help prevent inadvertent fishing in the sanctuary and simplify enforcement.
- For reef fish, at least 20 percent of an ecosystem type should be in a reserve to protect the future of the species. A reserve should include all types of habitat important to marine life, including seagrass beds, mangrove fringes, and reef areas. Many species migrate between these habitat types during various life stages.
- Smaller reserves still provide important benefits but are less effective overall.

Species: The species present will influence the boundaries and size of a sanctuary.

- Sanctuaries can be effective for territorial reef species, like snappers and groupers, and many other reef fishes and invertebrates.
- Far ranging species like tuna may not be effectively protected in a small reserve and sanctuary.

Prevailing currents: Locate reserves upstream of important fishing areas and habitat to maximize the replenishment to areas outside the reserves. Larvae and excess individuals will travel on the current to repopulate areas outside the reserve.

Enforcement: To be effective, reserves must be enforced through statutory ordinance, by voluntary or peer pressure motives and by organized and legally mandated enforcement.

- How close are they to the homes of the SMC or the *Bantay Dagat*? Is someone from the SMC or *Bantay Dagat* appointed to monitor use of the area violations?
- Will close proximity to another political jurisdiction or other user groups create resource conflict? Are they outside this management process? Can they be included?

- Plan and implement education, fund raising, or cleanup events; and
- Conduct monitoring to refine baseline data and research to fill data gaps.

4. Determination of reserve boundaries and zones

Try to delay drawing boundary lines on a map for as long as possible. Lines tend to polarize stakeholders and draw attention away from the issues. Instead focus discussion and negotiation on the objectives you hope to meet with your MPA. Once there is agreement on the objectives then lines can be drawn (Table 18).

The reserve is an area management technique that limits use within a defined space. The uses permitted, to what extent they are limited, and by what means may be defined by different

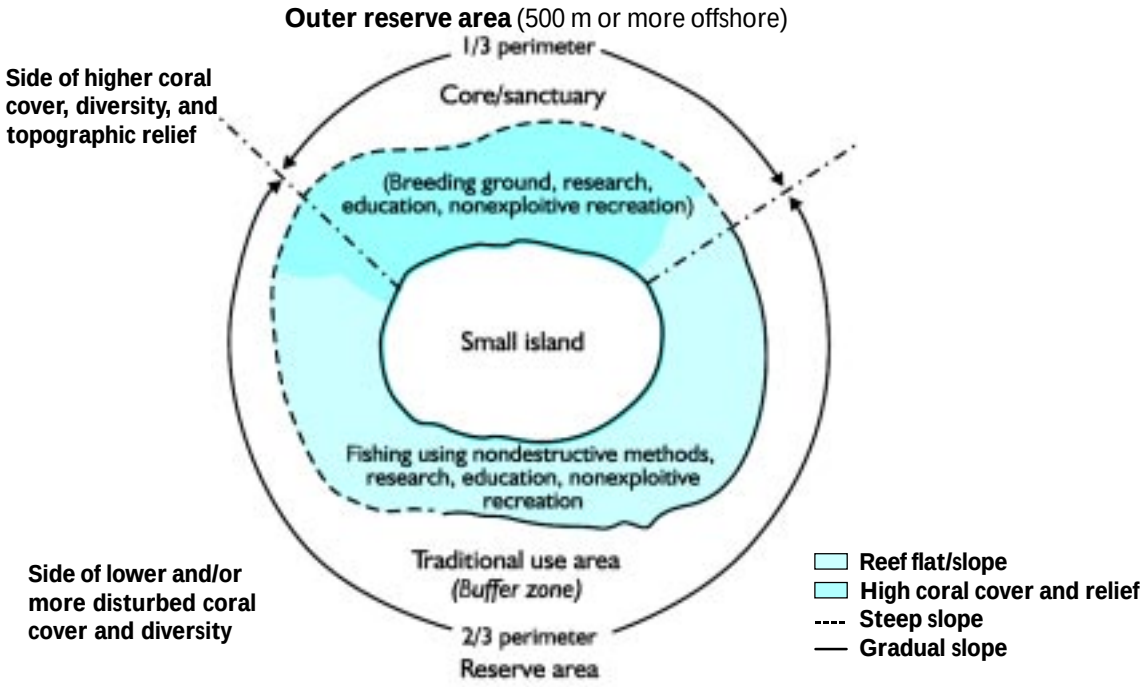


Figure 37. Example of reserve system with core sanctuary and "traditional use" buffer areas applied to islands *(White 1988a)***.**

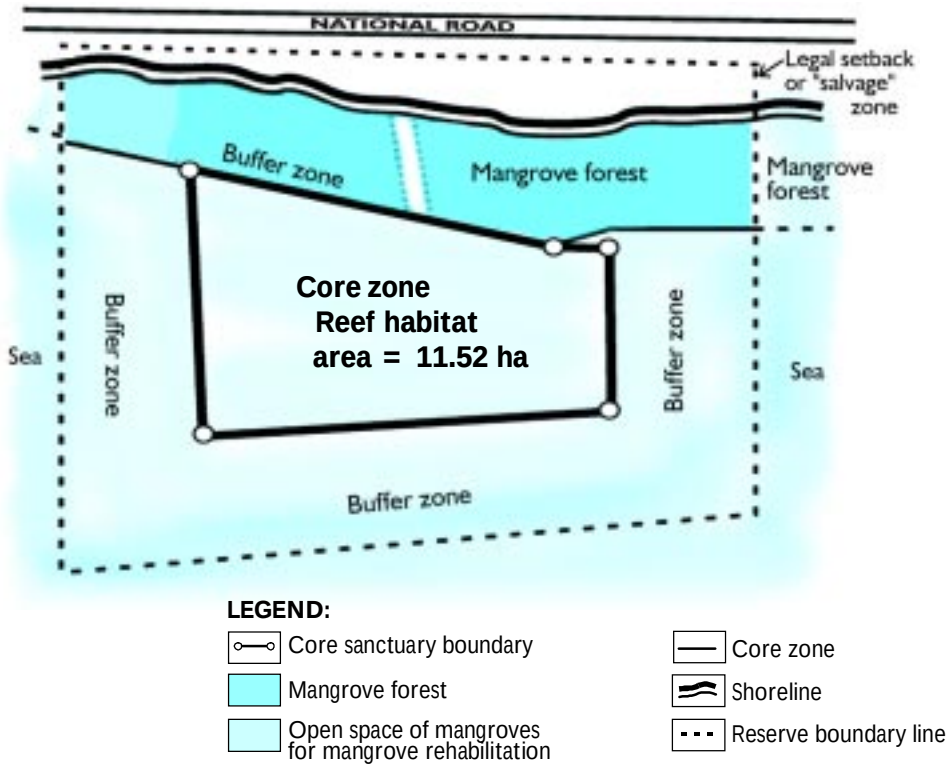


Figure 38. The "box and border" model where a sanctuary is established along the coastline and a buffer zone of a certain width is created around its perimeter to form the "reserve area".

zones within a reserve or park. A zoning plan provides the basis for management of an area sufficiently large for zones to justify different forms of management and use. By providing for a gradation of restriction, a zoned management scheme can be easier to establish and police since it can satisfy the requirements of a range of resource uses. There is no definitive list of zones and what they may or may not achieve. The mix depends upon the site, its unique characteristics and the decisions of the stakeholders. Multiple zones may not be suitable for very small reserves because they are difficult to establish and enforce.

A common reserve model includes both the core "no-take" sanctuary and a "traditional use" buffer zone that controls various activities (Figures 37 and 38). The core sanctuary preserves ecosystems, habitats, species, processes, and genetic diversity within a more strictly protected "no-take" area where all destructive and/or collecting activities, such as fishing, may be prohibited. The general guideline is that large protected areas tend to be more effective in maintaining ecological processes and species diversity than smaller areas. A minimum size of 300 ha has been suggested to successfully maintain coral species diversity (Salm and Clark 1984). In contrast to this, reports from sanctuaries as small as 2.5 ha indicate that the incidence of large individuals of prized fish species increases within the safety of the sanctuary (Roberts and Hawkins 1997). Ideally, the minimum size encompasses the general vicinity in which all species are certain to be found and reproduce. Thus, the sanctuary or core zone should contain not only the coral reef but portions of its neighboring habitats such as reef flats, seagrass communities, mangroves, algae beds, beaches, and sand flats. The Fisheries Code of 1998 mandates that a minimum of 15 percent of the total coastal area in a municipality be identified and designated as fish sanctuary. In the Philippine context, most municipal MPAs range in size from 5 to 50 ha. For a sanctuary to be effective, 10 ha should be an absolute minimum size (White and Vogt 2000).

The buffer zone (multiple use or traditional use zone) provides a transition space between the inner core sanctuary and the outer non-sanctuary or less managed areas. They may include neighboring habitats (seagrass beds, mangrove swamps, beaches, and estuaries) whose functions are crucial for the continued health of the core ecosystems. Less strict regulations are applied to the buffer zone. A combination of different uses may be included in the buffer zone but it should be kept as simple as possible. Different uses may include the following:

- Visitor use areas for appropriate recreation and general education activities;
- Traditional use grounds where exploitation using ecologically sound methods (gleaning or hand line) is allowed and monitored;
- Research and education zone where ecologically sound and non-disturbing research and education activities are permitted; and
- Sustained yield/fishery management zone where sites of breeding and spawning activities or concentrations of fish stocks or target species are closely regulated for use and access.

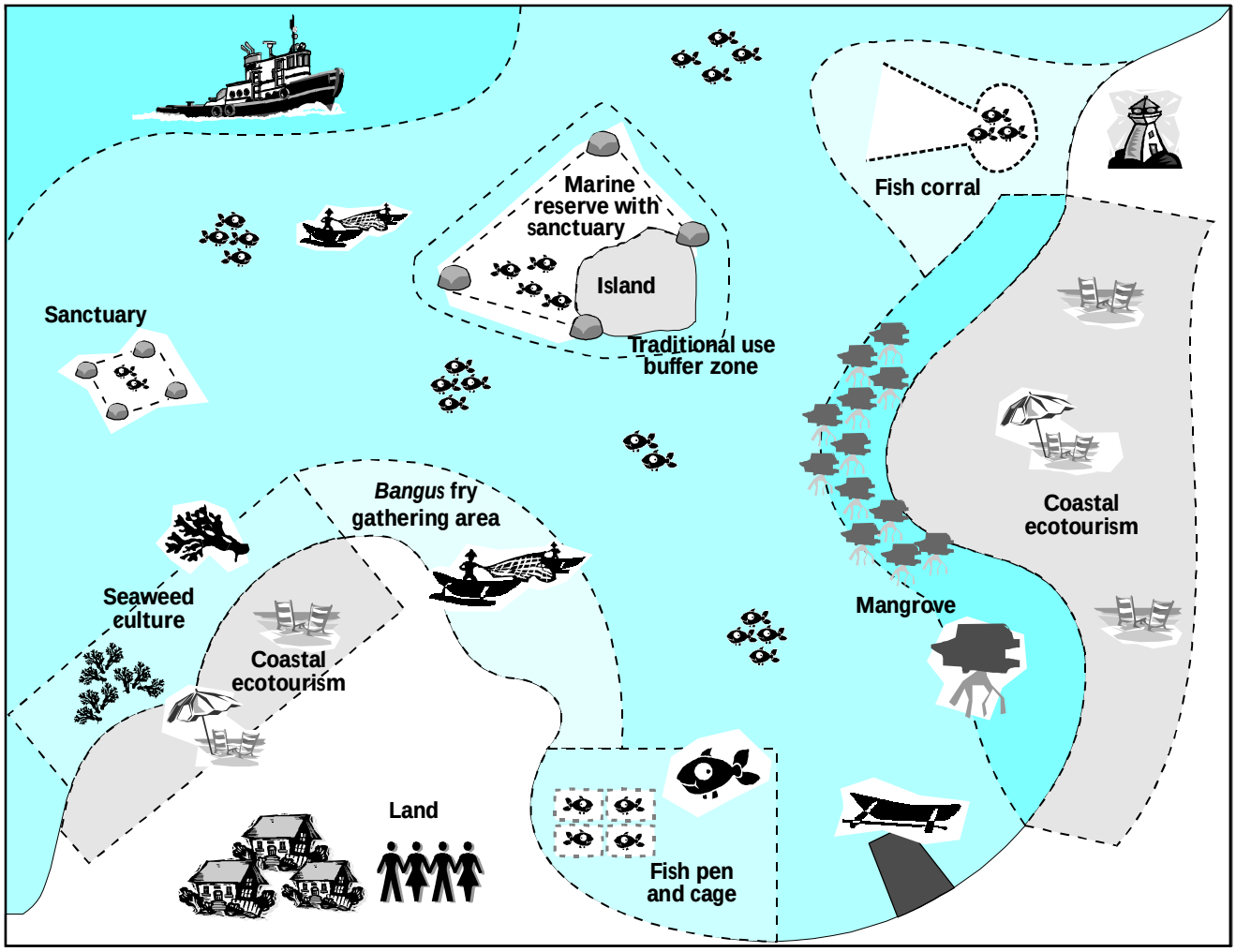


Figure 39. The "multiple use Marine Reserve model" where a section of the marine area is a sanctuary and the remaining areas form a reserve with various zones for different activities.

Zoning schemes can take on many different forms depending on the needs of an area to be managed. A multiple-use zoning plan is shown in Figure 39 for an idealized coastal area in the Philippines where different uses are accommodated within one municipal area. Such a zoning plan can be planned and formalized through municipal ordinance. Of course, for effective management to occur, the community and important stakeholders must be fully involved in the planning and implementation activities.

In addition to subtidal areas, the MPA zoning land use plan and supporting ordinances may also consider proper management of the adjacent shoreline. For example, under Presidential Decree No. 1067 as supplemented by DENR Administrative Order No. 97-05, the following shoreline distances are "subject to the easement of public use in the interest of recreation, navigation, floatages, fishing, and salvage" namely 3 m in urban areas, 20 m in agricultural areas, and 40 m in forest areas.

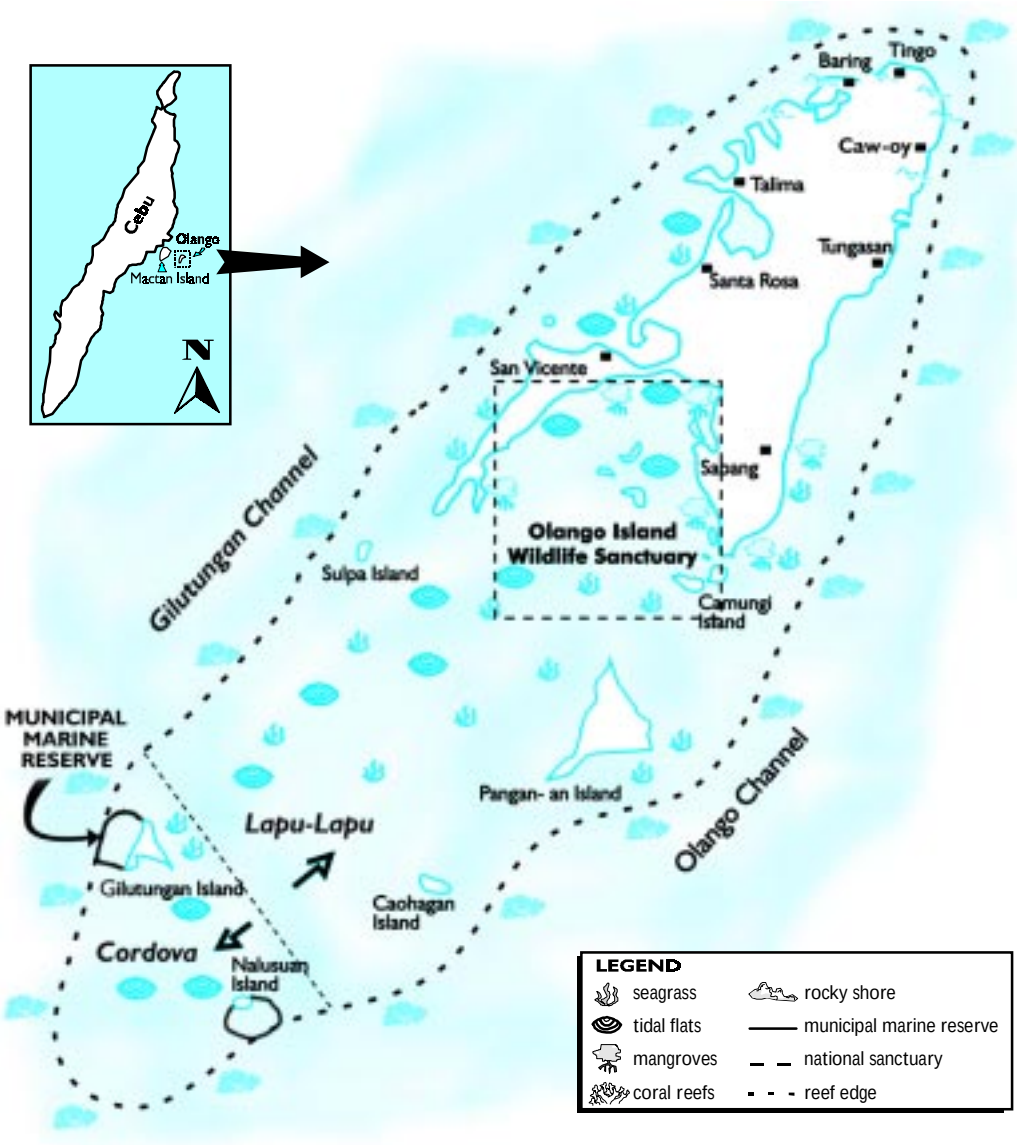


Figure 40. Olango Island, Lapu-Lapu City, Cebu: An example for zoning *(Parras* et al. *1998)*.

A good example of an area in the Philippines where a multiple-use zoning plan is coming into effect is that of Olango Island, Cebu. Olango Island and its accompanying islets are located just 5 km from Mactan Island, Cebu, Philippines. This low-lying group of limestone islands shown in Figure 40 is known for its extensive intertidal mudflats, wide fringing coral reefs and seagrass beds, and mangroves. The Olango Island Wildlife Sanctuary, a national park under NIPAS, is located on the southwestern portion of Olango Island for birds traveling the East Asian Migratory Flyway. Gilutungan Island in the municipality of Cordova has been designated as a municipal marine sanctuary and is a popular scuba diving destination.

Olango Island provides few resources for the more than 20,000 inhabitants except those derived from coastal habitats (Parras *et al.* 1998). Thin soils and meager freshwater supplies limit agriculture. Livelihoods are primarily aimed at exploiting coastal resources with most

residents engaged in some type of fishing or collecting activity. As effort increases to maximize resource use, the incidence of destructive harvesting also rises. Blast fishing, cyanide poisoning, coral extraction, and trawling provide no long-term benefits for the inhabitants of Olango.

Now, tourism from scuba diving is beginning to provide local benefits since dive and snorkeling tours within the recently established marine sanctuary at Gilutungan Island, Cordova, Lapu-Lapu are paying entrance fees. Benefits of the Olango Island Wildlife Sanctuary are also starting to materialize to the islanders who are now part of tours to the area.

Following community awareness-building efforts and formation of the Olango Synergy Group in April 1997, a field trip sent LGU representatives, Lapu-Lapu City council members, Olango *barangay* officials, and CRMP facilitators to two other municipal sanctuaries at Apo Island and Bais Bay in Negros Oriental. The local policy makers observed and appreciated the value and importance of marine sanctuaries. Support has grown for managing Olango in an integrated manner that will protect the OIWS and the Gilutungan Marine Sanctuary and also provide opportunities for alternative livelihoods. These alternative enterprises are site-specific and commodity or product-specific as follows:

Location	**Enterprise**	**Target user groups**
Sabang	Ecotourism in Olango Island Wildlife Sanctuary	Fishers, youth, and women
Pangan-an Island	Seaweed farming	Blast fishers and coral miners
Gilutungan	Seaweed farming, ecotourism	Fishers
San Vicente	Alternative crafts, marketing	Marine collectors, shellcraft makers

As interest grows to manage the area, it is becoming apparent that zoning of uses will be necessary to avoid conflicts. For example, San Vicente residents complain that seaweed farms in Gilutungan are already encroaching into San Vicente waters, thus preventing fishing there. These conflicts illustrate the importance of clearly designating specific uses for different zones. Ongoing efforts to promote long-term sustainable development and resource use will require effective coastal resource management and planning. This will have to be done through an open participatory process that involves all affected stakeholders as scarce resources are distributed. Planning also has to consider water circulation patterns to avoid pollution and excessive warm water among other factors.

A final lesson regarding the development and use of zones for a coastal and marine area is that zoning should be established before the community has agreed on the final sanctuary boundaries and before the sanctuary is legislated through a municipal ordinance. Once consensus on zones and boundaries is reached, a final plan and ordinance can be drafted and passed.

Phase 3. Action plan and project implementation

Implementation: Formalizing the reserve, implementing management strategies, enforcement, and community strengthening

Implementation refers to several key steps: formalizing the reserve, implementing management strategies, enforcement of regulations, and strengthening the community by implementing the key recommendations of the management plan.

1. Formalizing the reserve
   - Ensure that designating the proposed site as an MPA will not create legal or jurisdictional conflicts with management measures as established by previous proclamation, order, or other uses or designations such as a foreshore lease agreement;
   - Consult with municipal and/or *barangay* FARMCs and other key stakeholders, including owners of any private coastal lands bordered by two MPAs;
   - Ensure agreement by the LGU to support the management plan;
   - Pass supporting legislation such as a *barangay* resolution and municipal ordinance to legally create the reserve (see sample ordinance);
   - Allocate 6-12 months for completing municipal ordinance; and
   - Locate and mark boundaries for the reserve and any applicable zones.

2. Managing the reserve

   The following are examples of strategies that can be used for managing the reserve.

   Limits on fishing methods

   The method of harvest is the main determinant as to the effects of fishing upon the coral reef or other habitat. Separating competing fishing gear categories is a way to reduce the intense competition between fishermen. Fishing in reserves should be limited in the type of equipment and the amount of effort. It must also be nondestructive. Fishing methods normally permitted in designated MPA traditional use areas are:
   - Hook and line using traditional equipment;
   - Throw nets with mesh size large enough to allow the escape of small fish species and juveniles of larger fish;
   - Traps that are placed and maintained without disturbance to coral;
   - Mesh sizes similar to the throw nets described above; and
   - Reef gleaning in ways that do not overturn or break corals, stir up sediments, nor crush corals while walking.

   Fishing methods normally not permitted in designated MPA traditional use areas are:
   - Use of scuba or hookah diving for underwater gathering and spear fishing;
   - Any active gear where sweeping the water to drive fish or motorized pursuit is involved including all types of *muro-ami*, *kayakas*, and variations thereof; and
   - Any illegal method such as use of poison, explosives, bottom trawls, and others.

Reminders for installing and maintaining an anchor buoy system:

- Selection of mooring buoy sites should be based on the agreed MPA management and zoning plan;
- Inspect regularly to monitor condition and to repair shackles, links, and lines;
- Remove during periods of routine extended heavy weather (monsoon season) when mooring is not possible during this season;
- Use nylon or other strong synthetic line for the downline and pickup lines because it floats;
- Buoy line should be two-part polydacron for durability. Alternative, lower cost buoy line materials (such as rubber strips made from used tries) may be locally available;
- Loop at the end of the buoy line should be large so that it can easily be connected;
- The eye-splice connecting the bottom of the downline should be encased in plastic, nylon reinforced hose; and
- The shackle should have a removable pin that can be replaced easily.

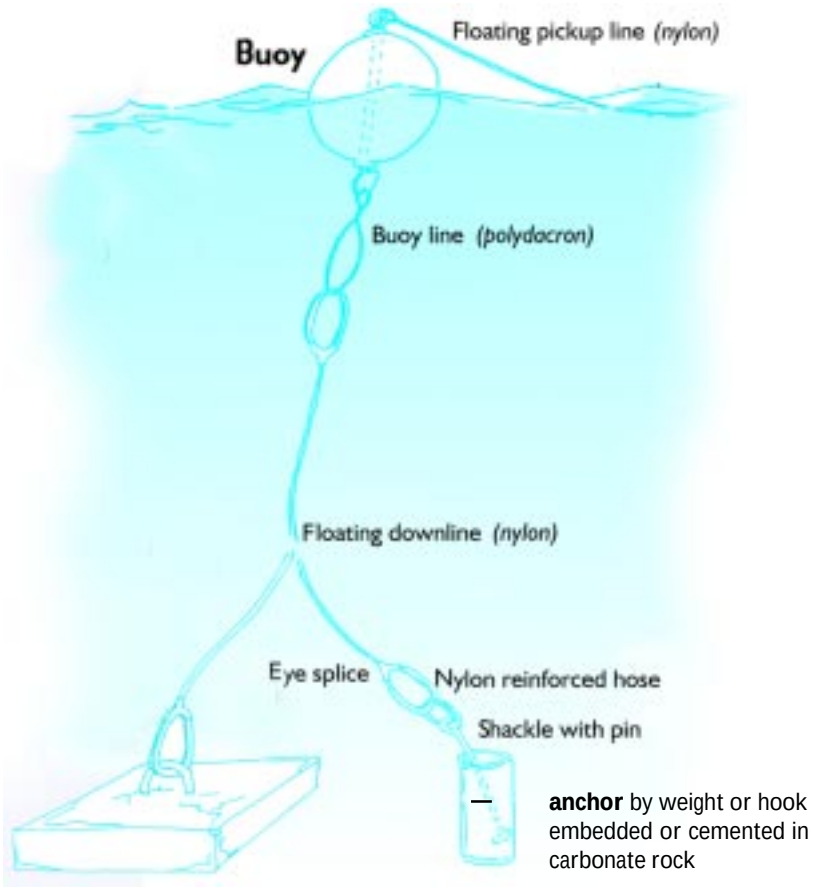


Figure 41. Components of a permanent mooring buoy.

Note: Anchors can use several systems. Conventional cement or heavy objects can be used if placed carefully. Another system uses eyebolts that are sunk into the bottom sediment and cemented into place using hydraulic portland cement (contains 10 percent plaster of paris by weight). The systems vary depending upon the bottom type (hard and compacted versus loose sand or coral rubble) and the anticipated load, as larger boats require more substantial anchors. The length of the downline should include consideration of depth at highest tides and adequate "scope" or angle of the line to avoid direct, upward pull on the mooring anchor.

Permanent mooring buoys

Permanent mooring buoys can be located in strategic areas to minimize the coral damage due to dropping anchors and chains, a substantial source of reef damage. High quality reefs popular for scuba diving and snorkeling need well-placed mooring buoys. One misplaced anchor can totally destroy a large coral head. The anchor chain and line also extend the radius of the damage by sweeping across the live coral as it rises to the surface. Permanent mooring buoys incorporate a permanent anchor connected to a floating line leading to a surface buoy (Figure 41). In addition to preventing anchor damage, permanent buoys also help to centralize diver activity so that coral damage due to divers themselves is less dispersed.

Designate boat trails or travel ways in heavily visited areas

Heavily visited sites may need a trail to help skippers avoid damage by accidental grounding and to avoid swimming areas. This is effective when there are only limited routes through barrier reefs to sites with high visitor preference. One can also set visiting hours for sensitive sites based on the tide cycles to avoid accidental grounding during low tides (e.g., no glass-bottom boat visits for one hour before to one hour after maximum low tide).

Establish regular embarkation points to control access to sanctuaries

This facilitates collection of entrance fees and helps if one desires to set up boat queues for passenger pickup. It also provides a central point for boat inspections if safety and seaworthiness are conditions for receiving permits or licenses for travel within the sanctuary. Centralized embarcation points also allow an opportunity for educational activities and communication of reserve regulations. Damage due to boat docking also can be centralized rather than dispersed all along the coastline abutting the sanctuary.

Establish a visitors' trail for underwater viewing of corals and other marine life in heavily visited areas

Interpretive markers can be linked to a trail guide that is printed on waterproof cards to enhance a visitor's experience. The cards, sold either as a trail guide or as a souvenir, can have illustrations of common reef inhabitants. The trail helps inexperienced divers enjoy their visit and also keeps their activities more within a controlled area. Damage to coral by novice divers kicking the bottom and failing to maintain neutral buoyancy can be centralized. This is an ideal situation for public-private partnerships. For example, a tourist resort fronting a nice coral garden may want to subsidize such an endeavor along with a municipal government.

3. Enforcement

The success of most small reserves lies in the amount of support within the community. The SMC and *Bantay Dagat* ("sea watch") organized and deputized for coastal law enforcement activities are the key to successful enforcement. Enforcement by the community through peer group pressure and local disincentives is often more effective and less costly than government enforcement and legal prosecution. However, government assistance may be necessary in

instances when the reserve area is very large, where there are strong conflicting uses and where violations are from fisherfolk from other communities or in some cases, powerful individuals involved in disruptive activities. While education and monitoring can gradually reduce the need for enforcement and police action, there must be adequate enforcement powers and effective penalties for offenders.

Few government units have the budget or manpower necessary to keep a constant and close watch on a sanctuary. The SMC and the police must be able to work together with locally organized and deputized village watch groups. Community watch groups can enhance the municipality's ability to monitor sanctuary activity. Groups can range from a simple network of observers to actually deputizing people with the authority to assist in enforcing the regulations. The group can help to bring peer pressure upon known violators and to safeguard the resource from outside intruders. Ideally, the group should be able to derive some direct benefits from their vigilance. This can be through improved fish catch in buffer zones or perhaps sharing benefits funded by entrance fees, licenses, or permits for regulated activities occurring in the protected areas. A sanctuary manager may deserve a small stipend as an incentive to maintain close watch on the area.

4. Permits and user fees

Open access to a free resource prompts people to take all that they can now for fear that the next person who comes will take everything. There is no incentive to conserve in such situations and overfishing is the inevitable result. Yet few LGUs currently restrict access by applying licenses, fees, taxes, or other controls to the use of municipal waters. Most LGUs have neither an established CRM plan that zones municipal water use nor an appropriate tax or fee structure that collects economic rent.

Permits for reef use are a way to limit access to what otherwise would be a free resource. Permits allow the LGU to control access and protect the resource. It allows one to set conditions for the use of the resource, such as harvest limits, harvest methods, and harvest seasons. The number of permits should be low enough to ensure that the resource can be used in a sustainable manner. They should also be tradeable so that people can exchange permits in return for some financial benefit. This ensures that the permits are held by persons who really value the use of the resource as shown by their willingness to pay.

Paying a fee to receive a permit establishes a basic value to that resource. It sets the minimum that people are willing to pay in order to have the privilege of a permit. The fee should be high enough to reflect the actual value of having access to that resource. Setting a token nominal level for a fee is meaningless. It should be high enough to warrant its collection and to act as a barrier to entry for casual users. In some cases a multiple tier fee schedule can be used. For example, a foreign tourist can be expected to pay more for snorkeling in a coral reef sanctuary than a visiting student from the local university. The tourist values the resource very

highly as shown by his willingness to travel long distances and pay hundreds of dollars in order to get to that sanctuary. They can probably afford and are probably willing to pay a little extra, particularly if it is clear that the fee supports sanctuary management activities. In setting fees, LGUs also must consider the costs for research and monitoring the impacts of management. The basic assumption to be made is that eventually without management, net revenues from coastal activities will fall to zero as the resource is destroyed.

The generation of revenues serves the following purposes:

- To set tangible and easily measurable values on municipal water use zones and the resources of the coastal zone;
- To provide the community with an obvious economic incentive to protect and manage their coastal waters and resources;
- To regulate and limit the extraction of resources; and
- To generate funds for the continued implementation of coastal resource management.

Taxes, fees, and other charges that LGUs may apply for use of municipal waters include:

- Fees for management, utilization, and exploitation of coastal resources, including marine sanctuary entrance fees and diving/snorkeling fees;
- Fines imposed on violators of fisheries and related laws;
- License to operate tourist boats;
- License for municipal fishing gear or for registration of fishers;
- Fishery charges such as rentals for mariculture; and
- Licenses and taxes on income derived from sustainable use of resources in the multiple use zones such as concession fees from appropriate businesses.

Fees are often based on the cost of administering the procedure and the cost of conducting surveillance to ensure compliance. Rarely does it include the true value of natural resources, which includes, not only the marketable goods they produce, but also the services and benefits they provide—many of which are difficult to measure. An example of a municipal ordinance that outlines all rules of fee structure is shown in Table 19. Apo Island has progressed from a basic municipal ordinance with use regulation in 1985 to a more comprehensive system approved in 1999 by the Protected Area Management Board.

5. Strengthening community involvement

The initial activities to define a reserve and to develop the management plan often create a lot of action and energy among the SMC and the community. As the process matures and initial implementation actions are completed, the interest may begin to subside. Often that coincides with the end of project assistance that was facilitating development of the marine protected area. Technical assistance and community organizers may reduce their involvement in the community and begin moving on to new sites. The challenge for this later

Table 19. Summary of ordinances that have served the Apo Island Marine Reserve, 1986 and 1999.

EXCERPTS FROM THE MINUTES OF THE *SANGGUNIANG BAYAN*'S REGULAR SESSION HELD AT THE OFFICE OF THE MUNICIPAL MAYOR ON MONDAY, NOVEMBER 3, 1986.

WHEREAS, The rationale for the marine reserve and fish sanctuary is as follows:

a) The coral reef serves as habitat for fish and once physically disturbed supports fewer and fewer fish;
b) A fish sanctuary is necessary to allow coral reef fish to breed and grow to maturity without fishing so that reproduction rates may increase potential fish catch to local fishermen;
c) A fish sanctuary where increased numbers of tame fish reside will attract scuba diving and snorkeling tourists and non-tourists to Apo who will give a small amount in the form of donation that will go to the community development project, e.g. toilet facility, beach cottages, etc.
d) The entire marine habitat surrounding Apo be declared a marine reserve to help prevent illegal and destructive fishing activities done by outsiders to Apo;
e) The area extending at least 500 meters on the southeast corner to be chosen as a fish sanctuary because this topographically diverse drop-off area with strong currents provides good breeding habitat for fishes which will circulate around the island, and the minimum 500 meters area is necessary to insure breeding and protection for sufficient number of species.

NOW THEREFORE, to fully protect the reserve area, particularly Apo Island fish sanctuary, Dauin, Negros Oriental, the body RESOLVE, as it is HEREBY RESOLVED, to adopt an ORDINANCE protecting the reserve area from all fishing methods or other ways destructive to the coral reef habitat, viz:

ORDINANCE NO. I_

"AN ORDINANCE PROTECTING THE MARINE RESERVE AND FISH SANCTUARY OF APO ISLAND, DAUIN, NEGROS ORIENTAL

Be it ordained by the *Sangguniang Bayan* that:

Section I. The entire marine habitat around Apo Island, from the high tide mark to a distance of 500 meters offshore be protected from all fishing methods or other ways destructive to the coral reef habitat including:

a) dynamite fishing
b) *muro-ami* type of fishing or related methods using weighted scare lines or poles
c) spear fishing using SCUBA
d) cyanide or other strong poisons and
e) every small mesh gill net.

Section II. A coral reef fish sanctuary and breeding area be located on the southeast corner of the island where the following rules apply:

a) no fishing or collecting is permitted
b) anchoring of boats is allowed but destruction of corals be avoided

Section III. The marine habitat outside of the fish sanctuary but within the marine reserve be called a traditional fishing area where all destructive fishing methods are prohibited and where the following traditional fishing methods are permitted:

a) hook and line
b) bamboo traps
c) gill nets
d) spear fishing without scuba
e) other types of netting and
f) traditional gleaning

Section IV. The Apo Marine Reserve area be protected by municipal resolution and managed by the Apo barangay Marine Management Committee in conjunction with the Dauin Municipal Council with logistic and legal support from the BFAR and PC-INP in Negros Oriental and management advice from the Marine Conservation and Development Program of Silliman University.

Section V. This Ordinance shall take effect immediately upon approval.

PROTECTED AREA MANAGEMENT BOARD (PAMB)
APO ISLAND PROTECTED LANDSCAPE/SEASCAPE
Municipality of Dauin
Province of Negros Oriental

BOARD RESOLUTION NO. 1
Series of 1999

A RESOLUTION PROHIBITING, REGULATING AND PRESCRIBING FEES FOR ACCESS TO AND SUSTAINABLE USE OF RESOURCES IN APO ISLAND PROTECTED LANDSCAPE/SEASCAPE.

Pursuant to Republic Act No. 7586 known as National Integrated Protected Areas System (NIPAS) Act and Presidential Proclamation No. 438, dated August 9, 1994 that declared the Apo Island and its surrounding waters as Protected Landscape/ Seascape situated within the Municipality of Dauin, Province of Negros Oriental, containing an area of 681.45 hectares is established and reserved for the purpose of protecting and conserving the ecological, scientific, educational, economic and recreational values of the area. Sustainable development of the area shall be pursued to address the social and economic needs of the local communities without causing adverse impact on the environment.

Section 1. Basic Policy – The Protected Area Management Board (PAMB) hereby adopts the following policies on the sustainable use of resources within Apo Island Protected Landscape and Seascape:

1.1 The use of resources and facilities in the protected area shall be regulated.
1.2 Fees and charges shall be collected for every access to and sustainable use of resources and facilities located in the protected area for recreational, commercial, educational, subsistence, and all other purposes.

Section 2. Registration Requirement – All tourists/visitors including their carrier or boat are required to register at the Apo Protected Landscape and Seascape (APLS) Visitor Assistance Center, to give the following information: name, age, status, sex, address, occupation, purpose of visit, the proposed duration of stay and activities, number of logged dives/certification level for scuba divers and such other information of a similar nature.

Section 3. Anchoring/Mooring Area – Anchoring/Mooring shall be allowed at the following designated areas only as shown in the map below which are marked buoys.

For purposes of this resolution, anchoring is distinguished from mooring. Anchoring is understood as the throwing of the anchors overboard while mooring shall mean the act of tying the boat in to a mooring buoy.

3.1 For boats weighing less than 1.5 tons
   a. From Baluarte Point to Point Pook at Sitio Baybay on the west side of the island, provided that the anchor is within 40 meters from the beach at the mean lowest tide level.
   b. In front of the beach at Sitio Cogon on the east side of the island in the vicinity of the canal, provided that the anchor is within 40 meters from the beach at the mean lowest tide level.
   c. On the eastern boundary of the marine sanctuary at Sitio Ubos on the south side of the island in the vicinity of the canal, provided that the anchor is within 40 meters from the beach
3.2 For boats weighing 1.5 tons or more but not to reach 5.0 tons:
   a. From Baluarte Point 200 meters southward at Sitio Baybay on the west side of the island, provided that the anchor is within 40 meters from the beach.
3.3 Boats weighing 5.0 tons or more are prohibited to anchor in the whole-protected seascape. However, these boats are allowed to moor at designated mooring buoys.

Section 4. Diving Regulation – The number of divers and snorkelers inside the marine sanctuary shall be regulated.

4.1 Only fifteen (15) scuba divers including 3 dive guides shall be allowed to dive in the marine sanctuary area (Strict Protected Zone) per day, provided that they have registered in accordance with Section 2 thereof. A guide or watcher shall be required for every four (4) scuba divers in order to monitor the activities of the divers.
4.2 Only eight (8) snorkelers shall be allowed to swim in the marine sanctuary at any one time. Swimming and bathing in the marine sanctuary are strictly prohibited. The term “snorkelers” does not include swimmers and bathers.
4.3 **Entry and Exit Area** – Scuba divers and snorkelers shall use the designated entry and exit points in the marine sanctuary area (Strict Protected Zone).

4.3.1 Diving Gear – Scuba diving with spear guns is strictly prohibited in the Apo Island Protected Landscape and Seascape (APLS). Spear guns carried around the APLS except those carried by Apo Island residents is disallowed, hence it shall be deposited in the APLS Center.

4.3.2 Scuba divers and snorkelers shall not wear gloves, except for research purposes and with prior approval by PAMB thru PASU

4.3.3 Divers are not allowed to dive or approach within 100 meters from fishers conducting fishing activities in the APLS.

Section 5. Fees and Charges – It shall be collected from every tourist/visitor at the APLS Visitor Assistance Center or at other designated areas.

5.1 **Visitor Entrance Fee:**

a. Adults (local)	PhP	10.00
b. Students (local)		5.00
c. Foreign Nationals		20.00

5.2 **Additional Charges/Fees:**

5.2.1 Scuba diving per day/per diver or fraction thereof:

a. Within marine sanctuary	PhP	150.00
b. Outside marine sanctuary		75.00
c. With camera (still picture)		50.00

5.2.2 Snorkeling per day or fraction thereof:

a. Within marine sanctuary	PhP	25.00
b. Outside		10.00

5.2.3 Camping per day or fraction thereof:

a. Adults	PhP	20.00
b. Students		10.00

5.2.4 Filming for movie production, TV, and commercials per day or fraction thereof:

a. Landscape area	PhP	500.00
b. Seascape (within marine sanctuary)		1,000.00
b. Seascape (outside marine sanctuary)		750.00

Acknowledgement of the area shall be included in the film production for promotion.

5.2.5. Lodging at cottages

Per person/day or fraction thereof:	PhP	50.00

5.2.6 Per picnic shed per unit/day or fraction thereof: PhP 50.00

5.2.7 Mooring per boat/day or fraction thereof: (1 day = 24 hrs.)

a. Less than 1.5 tons	PhP	50.00
b. 1.5 tons or more but not to reach 5.0 tons		100.00
c. 5.0 tons or more		500.00

5.2.8 Anchoring per boat/day or fraction thereof at designated areas: (1 day = 24 hrs.)

a. Less than 1.5 tons	PhP	50.00
b. 1.5 tons or more but not to reach 5.0 tons		100.00

Section 6. Mode of Collection. The following procedure shall be observed in the collection of fees and charges:

6.1 Entrance fee shall be collected from tourists/visitors at the APLS's Visitor Assistance Center after filling-up the registration form. Corresponding tickets or official receipts shall be issued for such fees.

6.2 Charges for resource/facility use and services shall be collected upon reservation and corresponding official receipts shall be issued for such payments.

6.3 Payment of fees and charges shall be made on cash basis only. Personal checks or credit cards shall not be honored.

Section 7. Collection Responsibilities: The following shall be responsible for the collection and account of pertinent fees, charges, and donations.

a. The Protected Area Superintendent (PASU)

b. PASU duly appointed representative concurred by PAMB. All collecting officers shall be bonded.

(The remainder of the Resolution describes penalties and is not included here.)

**These samples are indicative only. They should not be copied but rather adapted for any given area and its requirements.*

implementation stage is sustaining the interest of the community and strengthening its capability to manage process. Feedback, community extension, and partnerships are good strategies for strengthening community involvement.

Positive feedback

One of the most effective ways to strengthen the community is by providing positive feedback and publicity about the success of the MPA. Favorable comments from visitors, government counterparts, and tourists will help to confirm the value of the MPA in the eyes of the community. Incorporating an MPA management plan as the keystone for a Municipal Development Plan or for the Municipal Fisheries Development Plan demonstrates the importance placed by municipal officials.

For a community-based MPA, steady contact with relevant government agencies, marine research facilities and NGOs is essential. These organizations must be willing to provide support when problems arise (such as those involving politics, legal issues, and planning decisions) that the community may lack the necessary skills or authority to handle. This assistance must be provided through the channels set up by the community and in a way that is acceptable. Community support often is eroded if an agency or organization abruptly takes over an activity that normally was handled by the local community.

Community outreach

Exchange programs with other communities involved with MPAs can generate further interest and pride as people learn from each other's experiences. Use the sanctuary as a training site and incorporate key local individuals as a part of the training team. Involved groups may develop a case study that can be used as an example for training, cross-visits, and extension activities.

Partnerships

Building partnerships for coastal resource management mobilizes the resources and energies of various players and stakeholders towards achieving a common goal, such as marine reserve management or empowering communities to manage and develop their resources. Cutting across different sectors, partnerships can bring together various groups with diverse roles. Partnerships offer the following benefits:

- Foster dialogue and understanding among various sectors of the community and bring them to a consensus on certain principles, issues, and resolutions relating to a particular resource or the coastal environment in general;
- Build on the unique strengths of different groups toward the achievement of a common goal;
- Mobilize resources and funding for implementing programs and activities; and
- Provide venue to pilot test and scale-up programs and to push for local policy reform.

Involving a broad range of community groups fosters support for an MPA. Schools, NGOs, and local media can be involved in the provision of printed materials, newsletters, T-shirts and special event as a way to reach the broader community. The private sector, particularly resort and dive operators, as well as concerned individuals can help to fund, construct, and maintain visitor facilities and exhibits, signs and trails. A popular strategy is to establish an adoption campaign ("Adopt a Bay", "Adopt a Trail", "Adopt a Reef ", "Adopt a Species", etc…) that enables people and concerned businesses to support some aspect of an MPA either financially or in kind.

Phase 4. Monitoring and evaluation

Monitoring the marine reserve should be repeated at regular intervals throughout the management process (De la Cruz and Militante 1996). Assessing key biological indicators begins with baseline studies. Increases in fisheries stocks and diversity both inside and outside the reserve confirm the value of conserving the stock within the sanctuary. The results should be conveyed to the communities; positive results can be celebrated and negative results evaluated to identify management problems.

Evaluation should occur and is used to determine the effectiveness of the management process and to determine future directions. It answers the questions, "Were the objectives of the project met? Why or why not?" or "What were the reasons for the success/failure of the project?"

To answer these questions, it is necessary to identify indicators that show whether one is meeting the project goals and objectives as described in detail in *Guidebook 3: Coastal Resource Management Planning*. For example, the parameters that might show improvements in coral reef habitat could be environmental (i.e., changes in fish and coral diversity, size of individual fish, or percent live coral cover). It is important that these parameters are monitored using standardized methods as described in Coral Reef Monitoring for Management (Uychiaoco *et al.* 2001). Indicators for improved enforcement may be administrative processes (changes in number of blast fishing incidents; number of fishing permits and violations issued). The effectiveness of education programs can be measured by the number of workshop participants and their level of awareness. Improved quality of environment is also indicated by the number of tourist visits and their duration.

Important considerations for baseline assessment and monitoring include:

- What information about habitat conditions, activities, and program achievements is needed?;
- When should information be collected as baseline for later comparison?;
- Who needs the information and will use it?;
- How will the information be used?;
- Who will generate the various types of information?;
- What are the procedures for collecting, storing, retrieving, and analyzing the data?; and

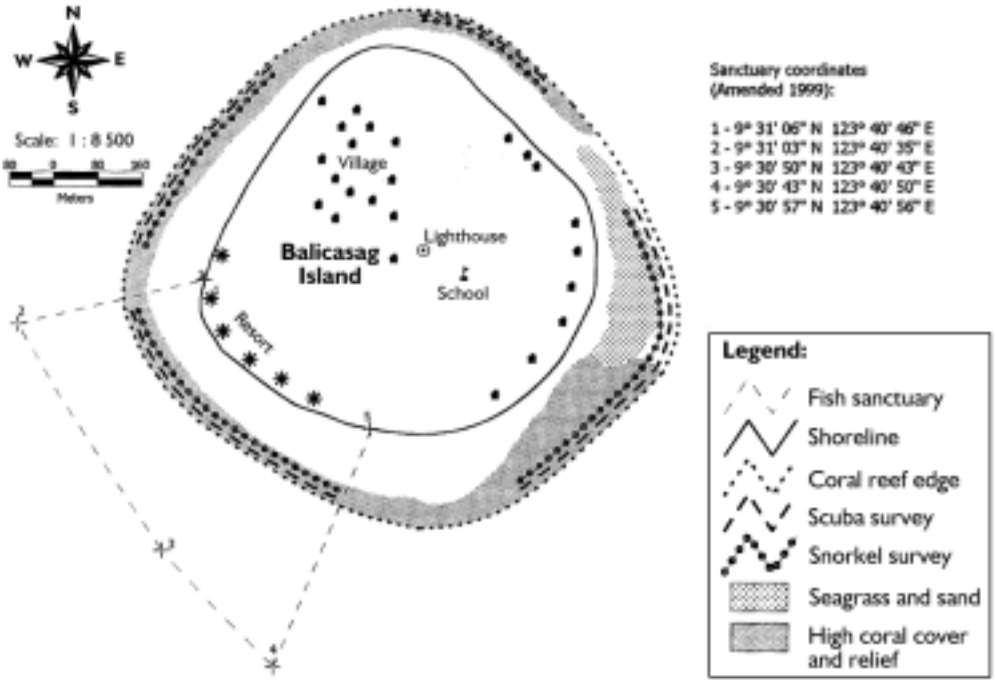


Figure 42. Balicasag Island, Panglao Island, Bohol Sanctuary, and coral reef *(White* et al. *1999)***.**

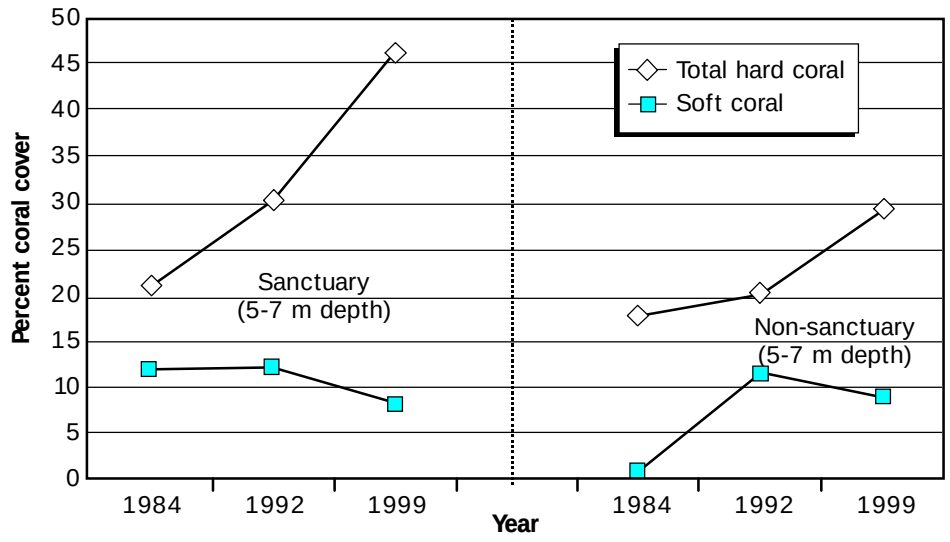
- What kind of qualitative and quantitative information can indicate improvements in the environment, the people's awareness about their environment, and the socioeconomic condition of people?

Monitoring and evaluation are activities that must include all the stakeholders. Planners, local communities, user groups, NGOs, academics, and the private sector should be involved in the participatory monitoring and evaluation of a project since all will share in the responsibility for implementing the plan and in reaping its benefits (Uychaioco *et al.* 2001).

The results of monitoring for Balicasag Island over the years are shown in Figures 42 and 43. Here the beneficial impacts of the marine reserve shown in Figure 42 are clearly indicated by improvement in living coral cover (Figure 43).

Refinement of management plan

The MPA management plan is not a static document. Modification and refinement of a plan is a normal occurrence that is based on new knowledge and experience. Goals and strategies often need to be modified to reflect changes in the reserve conditions, the surrounding community, the knowledge base and the regulatory/administrative authorizing environment. The monitoring and evaluation processes should alert one to these changes in conditions. Based upon these new conditions, the next iteration of the plan can be modified. It should indicate whether or not the community can or wants to manage the MPA on its own.



	Scuba						Snorkel	
	Sanctuary			Non-sanctuary			Sanctuary	Non-sanctuary
	1984	1992	1999	1984	1992	1999	1999	1999
SUBSTRATE COVER								
Sand and silt		10.5	1.6		8.2	20	6.3	20
Coral rubble		9.9	13.1		40.6	15.8	13.7	16.9
Rock and block		32.5	12.9		12.8	13.4	32.7	23.5
White dead standing coral		4.3	3.8		6.4	1.3	3.5	2.5
Dead coral with algae			14			11	15.1	10.9
Subtotal dead substrate	**67**	**57.2**	**45.5**	**81**	**68**	**61.5**	**71.4**	**73.8**
Branching			20.4			17		
Massive			2.5			4.3		
Flat/encrusting			5.5			2.6		
Foliose/cup			17.9			5.5		
Total hard coral	**21**	**30.5**	**46.3**	**18**	**20.4**	**29.5**	**24.1**	**20.3**
Soft coral	**12**	**12.3**	**8.2**	**1**	**11.6**	**9**	**4.4**	**6**
Subtotal coral	**33**	**42.8**	**54.5**	**19**	**32**	**38.5**	**28.6**	**26.2**
Seagrasses						3.8	2.5	8.3
OTHER								
Slope (degrees)			44.6			34.7	5.7	3
Topography (m)		2.9	4.7		0.6	2.6	1.4	1.4
Depth (m)		8	6.4		5.5	6.8	2.8	2.7
Horizontal visibility (m)		24	23.9			22.7	21.6	20.8
Sample size (No./50 m transects/stations)		15	11		7	25	539	520

Figure 43. Comparison of mean percent living and dead substrate cover for Balicasag Island (sanctuary and non-sanctuary), 1984, 1992, and 1999 *(White* et al. *1999)***.**

Phase 5. Information management, education, and outreach

Review status of MPA and its benefits

The monitoring and evaluation activities will highlight how well the MPA is being managed and what benefits are being derived from its management. Data should be stored and managed effectively to support long-term efforts. It is important that this information be collected and used to refine information on the MPA for use by the community and the local government. A successful MPA, if monitored carefully, will reinforce its own implementation success of increased benefits for local resource users as shown for Balicasag Island (Figures 42 and 43).

Refine education program from experience

The education materials used to help the community to plan and implement their MPA should be updated after implementation is in place. Results from the monitoring activities can be incorporated into the information and education materials. An example of this would be that fish yields have been recorded for two years showing some level of improvement resulting from the marine sanctuary enforcement. The data reflecting this improvement should be shared with the community and all stakeholders as evidence of their success. This can also be used to convince the local government officials about the importance of supporting an MPA within their jurisdiction and providing needed assistance to maintain the area.

Develop appropriate outreach program

Outreach programs based on a successful MPA can help other communities to establish their own. Successful project sites can also be used for study tours from other interested communities in the vicinity or even from other countries. The Apo Island Marine Reserve, for example, has hosted many such study tours from around the Philippines and as far away as Indonesia and Sri Lanka where people want to learn about establishing similar management approaches.

CONCLUSION

We have emphasized the unique and valuable habitats and their interactions that are found in the Philippines. These coastal marine habitats provide irreplaceable benefits to the millions of people living along the coast and to the rest of the populace. Unfortunately, the quantity and condition of these habitats are steadily declining as an expanding population increases the pressure on these critical areas. Unclear ownership of coastal resources and conflicting mandates for their protection make management difficult.

Effective coastal resource management requires an integrated perspective that identifies and assigns value to coastal and marine habitats and responsibility for their management. MPAs can help to accomplish this task on both local and national levels.

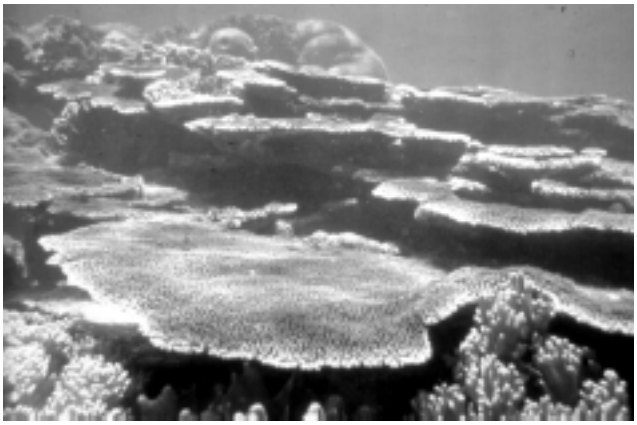
Establishing an MPA requires an integrated and participatory management process that involves the various stakeholders in the planning and implementation process. Consensus must be the driving force behind the process. The perceived and real issues need to be prioritized and solutions sought that are consistent with environment, social, and political realities of the local area of concern (White and Vogt 2000).

Key aspects of successful MPAs, in all their forms in the Philippines are noted below. All of these points were discussed in this chapter and are essential for achieving long-term implementation and benefits from MPAs. Although conditions vary from site to site, there are prerequisites that we cannot do without. These are:

- **Community preparation**: Does the community and the local government understand the need for and process of implementing an MPA?
- **Resource assessment and mapping**: Has the area been assessed and mapped so that everyone concerned knows the location and condition of resources and the potential boundaries for an MPA?
- **Core group formation**: Has a functional core group been formed or identified and empowered that can manage the MPA at the local level?
- **Clear goals and objectives**: Are the objectives for management clear to all the stakeholders and generally agreeable to the majority of the community members?
- **MPA boundaries and zones**: Are the boundaries in accordance with the habitat assessment and are the boundaries and zones sufficient for management and generally agreeable to the stakeholders?
- **Management strategies for implementation**: Are the strategies simple and easy to implement within the local context of the MPA and reflected in the ordinance legally supporting the MPA?
- **Law enforcement and monitoring**: Is a group assigned to watch the MPA and to monitor all activities and to collect fees and to assess changes in the marine environment on a regular basis?
- **Ongoing education**: Does the education program address the needs of the community and stakeholders so that benefits are highlighted and that questions regarding the need for the MPA are addressed?
- **Co-management in place**: Is the local government supporting the MPA together with the community in a mutually beneficial manner?
- **Monitoring and evaluation occurring**: Have baseline data on the condition of the habitat been updated and changes noted? Has this information been incorporated into an education program for the community and local government?

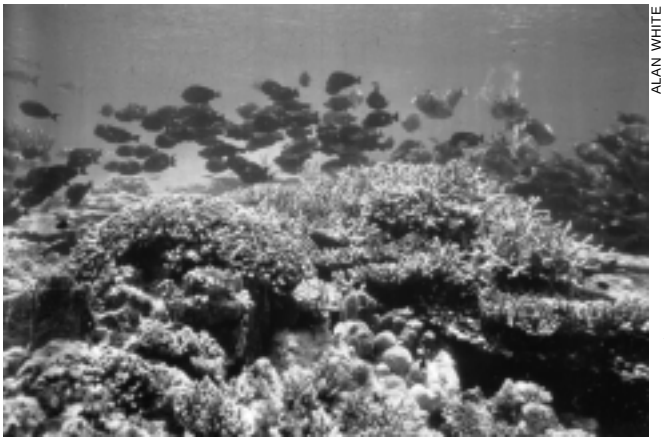
In the final assessment, MPAs are becoming a primary tool to protect and manage coastal and marine habitats in the Philippines. The reason they are popular and successful is because people residing in the immediate area are the stewards together with the local government and directly benefit from the MPAs. MPAs can spread throughout the coastal areas of the Philippines because they depend mostly on support from the local people that benefit from them and partly on the collaboration between communities and their LGUs or other partners. Along these lines, Former President Fidel Ramos made an appropriate statement in 1997:

"Let us not forget that we are all, individually as well as collectively, stewards of this heritage".



ALAN WHITE

Healthy coral protected from dynamite and cyanide fishing inside a marine sanctuary.



ALAN WHITE

Fish abundance inside the no-take zone of the Apo Island Marine Reserve has increased, providing direct benefit to the community from diving tourism and higher fish catch outside the sanctuary.

ALAN WHITE

Welcome sign at Apo Island Marine Reserve shows the map of resources and lists management rules.

ALAN WHITE

Coral reef monitoring using a line-intercept transect method provides baseline information to monitor changes in live coral cover over time.

TONI PARRAS

Community participation in gathering information for a coastal profile is an essential first step in planning for marine protected areas.

References

Agardy, T.S. 1997. Marine protected areas and ocean conservation. Academic Press, San Diego, California, USA.

Alcala, A.C. 1988. Effects of protective management of marine reserves on fish abundances and fish yields in the Philippines. Ambio 17: 194-199.

Alcala, A.C. and G.R. Russ. 1990. A direct test of the effects of protective management on abundance and yield of tropical marine resources. Journal du Conseil International pour l'Exploration de la Mer 46: 40-47.

Arquiza, Y.D. and A.T. White. 1999. Tales from Tubbataha: Natural history, resource use and conservation of the Tubbataha Reefs, Palawan, Philippines. 2nd ed. Sulu Fund for Marine Conservation Foundation, Inc. and Bookmark, Inc., Philippines. 190 p.

Barber, C.V. and V.R. Pratt. 1997. Sullied Seas: Strategies for combating cyanide fishing in Southeast Asia and beyond. World Resources Institute, International Marinelife Alliance.

Berjak, P., G.K. Campbell, B.I. Huckett and N.W. Pammenter. 1977. *In* The mangroves of Southern Africa. Natal Branch of Wildlife Society of Southern Africa, Durban.

Bohnsack, J.A. 1990. The potential of marine fishery reserves for reef fish management in the U.S. Southern Atlantic. NOAA Technical Memorandum NMFS-SEFC-261, Miami, USA. 40 p.

Bolido, L. and A.T. White. 1997. Reclaiming the island reefs. Tambuli 3:20.

Brewer, R. 1979. Principles of ecology. W.B. Saunders Company, Philadelphia, Pennsylvania, USA. 134 p.

Brown, W.H. and A.F. Fischer. 1918. Philippine mangrove swamps, Bureau of Forestry Bull. No. 17. Department of Agriculture and Natural Resources, Bureau of Printing, Manila, Philippines. 132 p.

Buhat, D.Y. 1994. Community-based coral reef and fisheries management, San Salvador Island, Philippines, p. 33-50. *In* A.T. White, L.Z. Hale, Y. Renard and L. Cortesi (eds.) Collaborative and community-based management of coral reefs: Lessons from experience. Kumarian Press, Inc., Connecticut, USA.

Calumpong, H.P. and E.G. Meñez. 1997. Field guide to the common mangroves, seagrasses and algae of the Philippines. Bookmark, Inc., Makati, Philippines. 19 p.

Carpenter, R.A. and J.E. Maragos. 1989. How to assess environmental impacts on tropical islands and coastal areas, A training manual prepared for the South Pacific Regional Environment Programme. Environment and Policy Institute, East-West Center, Hawaii, USA. 345 p.

Castro, P. and M.E. Huber. 1997. Marine biology, 2nd ed. W.M.C. Brown Publishers. 450 p.

Clark, J.R. (ed.) 1985. Coasatl resources management: Development case studies. Research Planning Institute, Inc., Columbia, S.C.

Clark, J.R. 1995. Coastal zone management handbook. CRC Press, Boca Raton, Florida, USA. 270 p.

Clark, J.R. 1998. Coastal seas: The conservation challenge. MPG Books Ltd. Bodmin Cornwall, Great Britain. 134 p.

Clark, S. and E.J. Edwards. 1995. Coral transplantation as an aid to reef rehabilitation, Evaluation of a case study in the Maldive Islands. Coral Reefs 14(20): 201-213.

CCD (Coast Conservation Department). 1990. Coastal zone management plan. Coastal Resources Management Project of the University of Rhode Island and Coast Conservation Departmnet, Colombo. 81 p.

Day, J. W., C.A.S. Hall, W. M. Kemp and A. Yañez-Arancibia. 1989. Estuarine ecology. John Wiley and Sons, New York, USA. 49 p.

DENR (Department of Environment and Natural Resources). 1988. Mapping of the natural conditions of the Philippines, Final Report. Swedish Space Corporation, Solna, Sweden.

DENR (Department of Environment and Natural Resources). 1998. Philippine forestry statistics of 1995. Forest Management Bureau, DENR (Table 1.03).

De la Cruz, M. and M.C. Militante. 1996. Marine reserve monitoring manual for communities. Guian Development Foundation, Inc., Tacloban, Philippines. 28 p.

Dixon, J.A. 1989. Valuation of mangroves. Tropical Coastal Area Management Newsletter 4(3): 1-6, ICLARM, Manila.

Fortes, M.D. 1989. Seagrasses: A resource unknown in the ASEAN region. ICLARM Education Series 5, International Center for Living Aquatic Resources Management, Manila, Philippines. 46 p.

Fortes, M.D. 1995. Seagrasses of East Asia: Environmental and management perspectives. Regional Coordination Unit, East Asian Seas Action Plan Technical Report Series No. 6. United Nations Environment Programme. 79 p.

Gomez, E.D., P.M. Aliño, H.T. Yap and W.Y. Licuanan. 1994. A review of the status of Philippine reefs. Marine Pollution Bulletin 29(1-3): 62-68.

Heeger, T., M. Cashman and F. Sotto. 1999. Coral farming as alternative livelihood for sustainable national resource management and coral reef rehabilitation, p. 171-185. *In* Proceedings of Oceanology International, Pacific Rim Exhibition and Conference, 27-29 April 1999, Singapore.

Hermes, R. 1998. Establishment, maintenance and monitoring of marine protected areas, A guidebook. Philippine Business for Social Progress, Manila, Philippines. 63 p.

Johannes, R.E. and M. Riepen. 1995. Environmental, economic, and social implications of the live reef fish trade in Asia and the Western Pacific. The Nature Conservancy, Honolulu, USA. 82 p. (Unpublished report).

Maragos, J.E., A. Soegiarto, E.D. Gomez and M.A. Dow. 1983. Development planning for tropical coastal ecosystems. *In* R.A. Carpenter (ed.) Natural systems for development, what planners need to know. East-West Center and MacMillan Publishing Co., New York, USA.

Martosubroto, P. and N. Naamin. 1977. Relationship between tidal forests (mangroves) and commercial shrimp reproduction in Indonesia. Marine Resources of Indonesia 18:81-86.

Melana, D., J. Atchue III, C. Yao, R. Edwards and E. Melana. 2000. Mangrove management handbook. Coastal Resource Management Project, Cebu City, Philippines. 98 p.

McAllister, D.E. and A. Ansula. 1993. Save our coral reefs-Pagyamanin ang mga bahura: A coral reef care manual. Ocean Voice International, Ottawa, Canada. 126 p.

Murdy, E. and C. Ferraris. 1980. The contribution of coral reef fisheries to Philippine fisheries production. ICLARM Newsletter 6(1):3-4.

NEPC (National Environmental Protection Council). 1980. The Philippine coastal zone, Vol. 1 Coastal zone resources. Ministry of Human Settlements, Quezon City, Philippines.

Nybakken, J.W. 1982. Marine biology: An ecological approach. Harper & Row, Publishers, Inc., New York, USA.

Olsen, S.B., J. Tobey and L.Z. Hale. 1998. A learning-based approach to coastal management. Ambio 27(8): 611-619.

Ormond, R. and A. Douglas, Editors. 1996. The exploitation of coral reefs. British Ecological Society, London, England. 47 p.

Parras, T., M.F. Portigo and A.T. White. 1998. Olango Island: A profile of coastal management issues and opportunities. Tambuli 4:1-9.

Pauly, D. 1990. On Malthusian overfishing. Naga, the ICLARM Quarterly 13(1): 3-4.

PCARRD (Philippine Council for Agriculture, Forestry and Natural Resources and Development). 1991. The Philippines recommends for mangrove production and harvesting. PCARRD Philippines Recommends Series No. 74. 96 p.

Ramos, F. V. 1997. Message to the nation. Tambuli 3:3.

Rees, C. 1990. A guide to development in urban and coastal areas. Asian Wetland Bureau, Malaysia. 78 p.

Roberts, C.M. and J.P. Hawkins. 1997. How small can a marine reserve be and still be effective. Coral Reefs 16(3):150.

Roberts, C. and N.C. Polunin. 1993. Marine reserves: Simple solutions to managing complex fisheries. Ambio 22(6): 363-368.

Russ, G.R. and A.C. Alcala. 1996a. Marine reserves: Rates and patterns of recovery and decline of large predatory fish. Ecological Applications 6(3):947-961.

Russ, G.R. and A.C. Alcala. 1996b. Do marine reserves export adult fish biomass? Evidence from Apo Island, Central Philippines. Marine Ecology Progressive Series 132:1-9.

Sale, P.F., Editor. 1991. The ecology of fishes on coral reefs. Academic Press, San Diego, California, USA.

Salm, R.V. and J.R. Clark. 1984. Marine and coastal protected areas: A guide for planners and managers. International Union for the Conservation of Nature and Natural Resources, Gland, Switzerland. 302 p.

Savina, G.C. and A.T. White. 1986. A tale of two islands: Some lessons for marine resource management. Environmental Conservation 13 (2): 107-113.

Schatz, R.E. 1991. Economic rent study for the Philippines Fisheries Sector Program. Asian Development Bank Technical Assistance 1208-PHI, Manila, Philippines. 42 p.

Sullivan, K., L. De Silva, A.T. White and M. Wijeratne, Editors. 1995. Environmental guidelines for coastal tourism development in Sri Lanka. Coastal Resource Management Project and Coast Conservation Department, Colombo, Sri Lanka. 9 p.

Tan, J.M.L. 1995. A field guide to whales and dolphins of the Philippines. Bookmark, Inc., Manila, Philippines. 127 p.

Uychiaoco, A.J., S.J. Green, M.T. dela Cruz, P.A. Gaite, H.O Arceo, P.M. Aliño and A.T. White. 2001. Coral reef monitoring for management. University of the Philippines Marine Science Institute, United Nations Development Programme Global Environment Facility-Small Grants Program, Guiuan Development Foundation, Inc., Voluntary Service Overseas, University of the Philippines Center for Integrative and Development Studies, Coastal Resoruce Management Project, and Fisheries Resource Management Project, Cebu, Philippines. 110 p.

Walters, J.S., J. Maragos, S. Siar and A.T. White. 1998. Participatory Coastal Resource Assessment: A handbook for community workers and coastal resource managers. Coastal Resource Management Project, Silliman University and Center of Excellence in Coastal Resource Management, Cebu City, Philippines. 113 p.

Wells, S. and A.T. White. 1995. Involving the community, p. 61-84. *In* S. Gubbay (ed.) Marine protected areas: Principles and techniques for management. Chapman and Hall, London.

White, A.T. 1987a. Coral reefs: Valuable resources of Southeast Asia. ICLARM Education Series 1, 36 p.

White, A.T. 1987b. Philippine marine park pilot site: Benefits and management conflicts. Environmental Conservation 14(1):355-359.

White, A.T. 1988a. Marine parks and reserves: Management for coastal environments in Southeast Asia. ICLARM Education Series 2, 36 p., International Center for Living Aquatic Resources Management, Manila, Philippines.

White, A.T. 1988b. The effect of community-managed marine reserves in the Philippines on their associated coral reef fish populations. Asian Fisheries Science 1(2): 27-42.

White, A.T., L.M. Chou, M.W.R.N. De Silva and F.Y. Guarin. 1990. Artificial reefs for marine habitat enhancement in Southeast Asia. ICLARM Education Series 11, 45 p. International Center for Living Aquatic Resources Management, Manila, Philippines.

White, A.T. 1989. Two community-based marine reserves: Lessons for coastal management, p. 85-96. *In* T.-E. Chua and D. Pauly (eds.) Coastal area management in Southeast Asia: Policies, management strategies and case studies. ICLARM Conference Proceedings 19, 254 p. Ministry of Science, Technology and the Environment, Kuala Lumpur; Johor State Economic Planning Unit, Johore Bahru, Malaysia; and International Center for Living Aquatic Resources Management, Manila, Philippines.

White, A.T. 1995. Philippines: Community management of coral reef resources, p. 561-567. *In* J. Clark (ed.) Coastal zone management handbook. CRC Lewis Publishers, Baton Rouge, Louisiana, USA.

White, A.T. 1997. Planning for integrated coastal management: What are the steps? Tambuli 3:15-19.

White, A.T. 2001. Philippine coral reefs: A natural history guide. 2nd ed. Bookmark Inc. and Sulu Fund for Marine Conservation Foundation, Inc., Manila, Philippines.

White, A.T. and R.O. De Leon. 1996. Mangrove resource decline in the Philippines: Government and community look for new solutions. Tambuli 1:6-11.

White, A.T., L.Z. Hale, Y. Renard and L. Cortesi, Editors. 1994. Collaborative and community-based management of coral reefs—Lessons from experience. Kumarian Press, West Hartford, Connecticut, USA. 130 p.

White, A.T. and G.C. Savina. 1987. Reef fish yield and nonreef catch of Apo Island, Negros, Philippines. Asian Marine Biology 4:67-76.

White, A.T. and A. Cruz-Trinidad. 1998. The values of Philippine coastal resources: Why protection and management are critical. Coastal Resource Management Project, Cebu City, Philippines. 96 p.

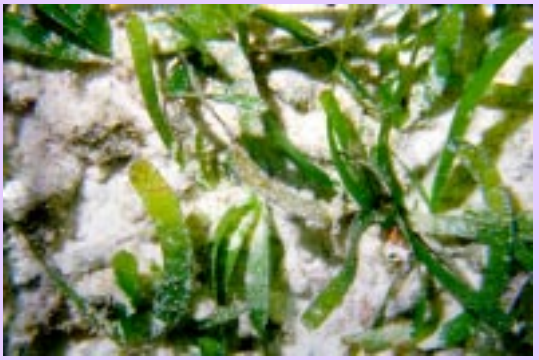
White, A.T., P. Christie, M.F. Divinagracia, J. Apurado, J. Alvarado and E. White. 1999. Summary Field Report: Coral reef surveys for conservation in Southwest Bohol, Earthwatch expedition to the Philippines, 1-22 May 1999. Coastal Resource Management Project, Sulu Fund and Earthwatch Institute, Cebu City, Philippines. 79 p.

White, A.T. and H.P. Vogt. 2000. Philippine coral reefs under threat: Lessons learned after 25 years of community-based conservation. Marine Pollution Bulletin 40(6):537-550.

Whittaker, R.H. 1975. Communities and ecosystems. 2nd ed. MacMillan, New York, USA.

Wong, P.P. (ed) 1991. Tourism vs environment: The case for coastal areas. Kluwer Academic Publishers, Dordrecht, the Netherlands. 225 p.

WRI (World Resources Institute). 2000. Reefs at Risk Project maps. World Resources Institute and the World Conservation Monitoring Centre.



Blessed with a sunny tropical climate, waters enriched with nutrients from the land and driven by the wind, the Philippines supports an exceptionally high diversity of marine life.

This guidebook was produced by:

Department of Environment and Natural Resources

Department of the Interior and Local Government

Department of Agriculture - Bureau of Fisheries and Aquatic Resources

Local Government Units, Nongovernment Organizations, and other Assisting Organizations

through the Coastal Resource Management Project, a technical assistance project supported by the United States Agency for International Development.

Technical support and management is provided by:

Tetra Tech EM Inc.

The Coastal Resource Management Project, 5/F Cebu International Finance Corporation Towers
J. Luna Ave. cor. J.L. Briones St., North Reclamation Area 6000 Cebu City, Philippines
Tels.: (63-32) 232-1821 to 22, 412-0487 to 89 Fax: (63-32) 232-1825 Hotline: 1-800-1888-1823
E-mail: crmp@oneocean.org or crmhot@mozcom.com Website: www.oneocean.org