Managing Municipal Marine Capture Fisheries in the Philippines

Context, Framework, Concepts & Principles

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Managing Municipal Marine Capture Fisheries in the Philippines:
Context, Framework, Concepts & Principles

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Managing Municipal Marine Capture Fisheries in the Philippines:

Context, Framework, Concepts & Principles

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Fisheries Improved for Sustainable Harvest (FISH) Project
Cebu City, Philippines
2010

Preface

Do you work with or in local government and communities to manage municipal fisheries?

Are you concerned that in the not-so-distant future we may not have any fish left to eat?

Would you like to help make fisheries sustainable?

If you answered 'yes' to any of the above questions, this *Sourcebook* was written especially for you. It was produced as an offshoot of the implementation of the Fisheries Improved for Sustainable Harvest (FISH) Project of the United States Agency for International Development (USAID) and the Philippines' Department of Agriculture-Bureau of Fisheries and Aquatic Resources (DA-BFAR). In the course of carrying out the FISH Project, we have worked with countless individuals in local government, non-governmental organizations (NGOs) and the fishing communities toward establishing an ecosystem-based fisheries management system in each of the four areas where we operate — Calamianes Group of Islands, Palawan; Danajon Bank, Bohol; Lanuza Bay, Surigao del Sur; and Tawi-Tawi Bay, Tawi-Tawi. Deeply concerned about poor fish catches and high fish prices, these government and non-governmental organization (NGO) workers and community members have been keen students of fisheries management, eagerly absorbing the knowledge and skills that we have to share, and asking endless questions about the practical aspects of managing their fishery resources.

Given Project limitations, it was not been possible for us to be present in all sites at all times to address all their concerns and questions. So we did the next best thing: We produced this *Sourcebook* to provide a readily available source of information to municipal fisheries managers and stakeholders everywhere, including those outside the FISH Project sites that we were unable to directly assist.

This *Sourcebook* contains information drawn from past experience in coastal and fisheries resource management in the Philippines, particularly experiences and lessons from the FISH Project and another USAID-supported project, the Coastal Resource Management Project (CRMP) of the Department of Environment and Natural Resources (DENR). Additional sources include documents from the UN Food and Agriculture Organization (UN-FAO), San Miguel Bay Project (ICLARM [WorldFish Center]), Visayan Sea Project (Deutsche Gesselschaft für Technische Zussamenarbeit [GTZ]), Fishery Sector Program 1 and 2 (Asian Development Bank [ADB]), and Fisheries Resources Management Project (ADB).

Fisheries trainers, law enforcers, policymakers, researchers and students can also benefit from this *Sourcebook*. Indeed, if you are involved or have any interest at all in supporting sustainable fisheries in the Philippines and want to know how it can be done, the *Sourcebook* is for you. Through the *Sourcebook*, we hope to provide you with the knowledge that will help you in your work as a manager or steward of your community's coastal and fishery resources, or as an advocate of sustainable fisheries.

Only a small number of print copies of this *Sourcebook* have been produced, mostly for our national and local government partners. But anyone interested can get a copy, as we will make *Sourcebook* available in electronic (pdf) format, freely downloadable from our web site at *http://oneocean.org/download/.*

Department of Agriculture-Bureau of Fisheries and Aquatic Resources

Foreword

Since the enactment of the 1998 Philippine Fisheries Code, our local governments have taken on more and more of the responsibility of caring for our coastal and fishery resources mandated on them by law. Having embraced the goal of sustainable development, many of our coastal cities and municipalities have slowly built their capacity to manage local resources, some to a point where direct stakeholders are beginning to reap the rewards of resource protection and management.

But even as they continue to grow their capacity, confidence and commitment for coastal and fisheries management, our local governments have only really skimmed the surface of the complex problems facing our municipal fisheries. The capacity-building and institutionalization effort must continue to fully equip our cities and municipalities to manage these problems in the most effective, most strategic way.

As an institution that shares the responsibility for sustainable fisheries, we in the Bureau of Fisheries and Aquatic Resources have so much at stake in such capacity-building and institutionalization effort. We know that there are many of you, committed individuals in the local government who have made sustainable fisheries their life's goal. We must – and intend to — equip you with the knowledge, expertise and resources necessary to effectively manage our municipal fisheries and, in particular, address the crucial problem of overfishing.

This *Handbook Series on Managing Municipal Marine Capture Fisheries in the Philippines* contains valuable information, knowledge, strategies and tools that will help you in your job as municipal fisheries manager. We hope that you will use it well as you help map out the future of our vital municipal fisheries, on which so much of our national well-being depends. We in the Bureau will continue to work with you to pave the way to sustainable fisheries.

MALCOLM I. SARMIENTO, JR.
Director, DA-BFAR
2009

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Chapter 1
Introduction

In This Chapter

- Know what this *Sourcebook* is about
- Get a sneak peek of the chapters ahead
- Find out how you can get the most out of this *Sourcebook*

AY MAY LANGAW NGA. SIGE PO, AKO NA ANG BAHALA.

If the only tool you have is a hammer,
you tend to see every problem as a nail.
— Abraham Maslow, Father of Humanistic Psychology

As a fisheries manager, your first order of business is to understand what it is that you are tasked to manage and know what your action choices are. This *Sourcebook* gives you the basic thinking tools to better study what is going on in your fisheries and what your options may be, and guide you to the best practical course of action.

WHAT THIS SOURCEBOOK IS ABOUT

This *Sourcebook* contains what its title says it does: the context, framework, concepts and principles of municipal fisheries in the Philippines. We look into the current state of our fisheries, and look back to the past for understanding on how we got here. We lightly

explore fisheries science for clues on why fisheries are the way they are and how they would be in an ideal world. We examine Philippine policy and make the case for a change in the country's current exploitation policies and patterns toward more sustainable practices. And we survey our social and political landscape and encourage the strengthening of fisheries management capacities at all levels of government and society.

WHAT YOU CAN (AND CANNOT) FIND IN THIS SOURCEBOOK

Fisheries science is so cram full of information that it can overwhelm. While this *Sourcebook* includes more theory than you will find in the rest of the *Handbook Series*, don't expect it to be a definitive reference on fisheries management theory — we figured we would do you a favor by leaving out those theoretical details that make for interesting academic study but are not particularly relevant or immediately useful to practical action. Expect, instead, to find much information with direct application to your work, including answers to such questions as:

1. Why must fisheries be managed?
2. What assumptions, concepts, values and practices go into managing fisheries?
3. What is the local government's role in fisheries?
4. What strategy or approach is recommended?
5. What else can we do to do things better?

Because our main focus is on municipal *marine capture* fisheries, any reference to the other sectors (commercial and aquaculture) will only be in relation to municipal marine capture fisheries.

HOW TO USE THIS SOURCEBOOK

This *Sourcebook* is an important resource not only for fisheries managers, but also for those involved in advocacy, training and public education. It comes with a CD supplement that contains important resources for municipal fisheries management trainers.

The next chapters are organized in such a way that each part builds on the information that comes before it. But while best read sequentially, the various parts are self-contained enough to allow you to jump to any topic that meets your current interests or work requirements. **Bolded** words or phrases in the body text are also explained in the Glossary.

Chapter 2 — Background & Rationale

Here you will find the many important social, economic and natural reasons for managing fisheries, as well as an overview of your management options and an analytical look at overfishing and sustainable fishing.

Chapter 3 — Legal & Policy Framework

This chapter focuses on the laws and policies governing municipal fisheries, in particular those provisions of the 1998 Philippine Fisheries Code (Republic Act [RA] No. 8550) that are relevant to municipal fisheries. It also includes a discussion on other

pertinent laws and policies, including international agreements to which the Philippines is a party, and points out the national policy to use integrated coastal management (ICM) as the preferred strategy.

Chapter 4 — The Ecosystem Approach

In this chapter, we will introduce a management strategy that, according to emerging expert consensus, must be integrated into current coastal management systems: the ecosystem approach to fisheries (EAF). Here you will see what we mean when we say "ecosystem approach," and what ecosystem considerations must be addressed by municipal fisheries management.

Chapter 5 — Planning & Implementation Framework

This is where you will get your first good view (if only just an overview) of the planning and management process that has been shown to work well for municipal fisheries in the Philippines. This process is anchored on a participatory local government-driven CRM planning process now used widely in the Philippines, and incorporates current best practices and many of the principles of EAF.

Chapter 6 — Making It Happen

Here we look into what fisheries managers can do to jumpstart the fisheries management planning process, and what other actions must be taken in the near and medium-term by responsible authorities to properly integrate EAF in the CRM planning process that has been adopted by many local government units (LGUs).

Additional information, meanings of acronyms and abbreviations, and definitions of hard-to-avoid technical terms are provided in the last sections of this book. Some of these information and terms are used in the specific context of Philippine fisheries, so make liberal use of these sections:

Appendices
Acronyms & Abbreviations
Glossary

JUST LEARNING, ESSENTIALLY

Fisheries science and policy, no matter how basic, are not light subject matters to read, so you will need to give them some serious focus and attention. Still, this *Sourcebook* is designed and organized in a way that should make for, if not entirely easy reading, at least an interesting learning experience. So make the most out of it — put on your thinking cap, enjoy a good read, and *learn*!

FOLLOW THESE ROAD SIGNS

We will make extensive use of icons to help you find important stuff easily in each handbook and throughout the *Sourcebook*, like road signs do. Each of the following icons will call your attention to some essential information:

Tip Icon – handy information to take on the road to help you in your work as a fisheries manager

Remember Icon – important stuff to keep in mind, for example, (when choosing a site for a marine protected area) "Talk to the old folks!"

Five-Step or Five-Phase Icon – reminds readers of the five key steps (or phases) of the coastal resource management process: Early Planning and Commitment (Issue Identification and Baseline Assessment), Plan Preparation and Adoption, Action Planning and Plan Implementation, Monitoring and Evaluation, and Policy Development and Information, Education and Communication

Time Icon – indicates recommended frequency, prescribed timeframe, or "best time of year/ week/ day" to initiate/complete an action

IEC/Policy Icon – tells readers to consider IEC or policy support for a management action

Information Icon – tells readers to refer to another section for more information on a bolded item in the body text

Checklist Icon – reminds readers to go through a to-do or to-have list.

Caution Icon – warns readers of a pitfall they must avoid

Chapter 2
Background & Rationale

In This Chapter

- Take a hard look at our fisheries and how we got to the current critical level of resource degradation.
- Examine both human history and natural history for guidance on how we can do things better
- Look into the effects of fishing on fish populations
- See the difference between exploitative and sustainable fishing

History is a vast early warning system
— Norman Cousins, Political Journalist

For the longest time, we regarded the sea as so vast and bottomless as to be inexhaustible, impenetrable and totally resistant to any but the most catastrophic event. Now, increasingly, we are learning that it is in fact a very delicate system, vulnerable to minute changes in the environment, even those that happen thousands of kilometers, perhaps even light years, away. Having progressively exploited and degraded our marine resources decade after decade, we are waking up to the harsh reality that virtually all of our major fishing grounds have become depleted, no longer the reliable source of food and income that we used to know.

The good news is, the sea is reasonably resilient. Within limits, it can and has been shown to recover from various stresses, both natural and man-made. We don't know all there is to know about the processes and interactions that occur in and impact the sea, but we know enough to know that we can manage some of the stresses to mitigate their impacts, specifically (at least for our purpose), on the sustainability and viability of our municipal fisheries. Indeed, this is what fisheries managers are expected to do.

Our goal in fisheries management is not to stop fishing, but to stop fishing from being destructive, excessive and wasteful. Our goal is sustainable fishing. As a fisheries manager, you will be confronted with many management dilemmas, some of them not even directly related to, but still impacting, fisheries. To be effective, you must understand how the sea works, what we're doing to it, and what we can do to protect, manage and improve it.

This chapter offers you perhaps the most important tool with which to tackle your work challenges: an understanding of the dynamics of fisheries, particularly how the forces and processes that occur naturally in the sea are changed by fishing and other human activities, and how this ultimately impacts the various fisheries and their viability. Armed with such understanding, you should be able to anticipate, adapt to, respond in a timely and appropriate manner, and hopefully avoid most potential problems in the fisheries you are tasked to manage.

ARE WE THE GENERATION TO FISH THE LAST FISH?

Consider this:

- Most of the world's stocks of the top 10 commercially valuable fish species, which account for about 30% of the world's fish catch, are fully exploited. (FAO, 2009)
- More than 75% of world fish stocks are reported to have been fully exploited, overexploited or depleted. (FAO, 2007)
- Extensive loss of **biodiversity** along coasts has been recorded since 1800, with the collapse of about 40% of species; about one-third of once viable coastal fisheries are now useless. (Worm et al, 2006. *In*: Stanford Report, 2006)
- From 1950, catch records from the open ocean show widespread decline of fisheries, with the rate of decline increasing; in 2004, 29% of fisheries were collapsed. (Worm et al, 2006. *In:* Stanford Report, 2006)
- By some estimates, if current trends continue, there will be nothing left to fish from the sea by the middle of this century. (Worm et al, 2006. *In*: Stanford Report, 2006)

☞Glossary

And here's what we know of the Philippine fisheries situation:

- Our various types of fishery resources are all biologically overfished, often severely in traditional fishing grounds and nearshore areas (Luna et al, 2004).
- In the 1980s, fishing effort in **pelagic** fisheries reached twice the magnitude necessary to harvest **maximum sustainable yield (MSY)**, while the average catch rate during this same period was only one-sixth of the rate recorded in the 1950s. (Armada, 2004)

☞Glossary

- Overall, fish in highly exploited areas in the Philippines are being harvested at a level 30% more than their capacity to reproduce. (ICLARM [WorldFish Center], 2002)
- Substantial declines have been noted in the abundance of large, commercially valuable species like snappers, sea catfish and Spanish mackerels. (Armada, 2004)

MORE HARD FACTS

Even now, we are feeling the impacts of a severely diminished resource. The excess fishing happening in our country is resulting in economic losses conservatively estimated at about Php6.25 billion per year in lost fish catch. The Philippines, one of the world's largest fish-producing nations, is ironically among the top 10 low-income, food-deficit countries of the world. Fish still accounts for more than half of the total animal protein consumed in the country, but per capita national consumption of fish dropped from 40 kg in 1987 to 24 kg in 1996. By some estimates, if no appropriate action is taken to reverse declining per capita fish production trends, only about 10 kg of fish will be available annually for each Filipino by 2010 (Kurien, 2002; Bernascek, 1996).

The declining trend in the small fisher's catch is not usually clearly evident in official reports, which mostly highlight the positive *overall* growth of the fishery sector. Indeed, production data show that municipal fish landings are at about the same level as they were in the mid-1970s through the mid-1980s, and appear to be approaching their peak in the late 1980s to the early 1990s (Figure 2.1.).

The data, however, do not reflect the rapid growth of our fishing population. According to the Philippine Census on Fisheries, there were 584,000 municipal fishing operators on record in 1980, and 1.8 million in 2002, more than 98% of them individual operators. (NSO, 2005) That's a more than 200% jump in the number of small-scale fishing operators in just over two decades! And with an average of 5 persons for every fisher household (NSO, 2005), we're talking about nearly 10 million Filipinos that rely *directly* on small-scale fishing for food, nearly 10 million Filipinos that will be displaced by a collapse of our fisheries.

On the ground, nearly everywhere you go in the Philippines every other fisher will confirm the decline in his average daily catch, from two-figure levels just over a decade ago to under 3kg today — and he will also say the *quality* of his catch used to be better. At a fisheries summit organized in 2008 by the Department of Agriculture (DA), it was reported that marginal fishers in the Philippines were earning an average income of only Php39 (less than USD1) a day! Any further decline in **municipal fisheries** production will be sure to devastate this large segment of our fishing population.

☞Glossary

WISDOM IN HINDSIGHT

This, in a nutshell, is the problem: The world's technological capacity to exploit (and unfortunately degrade) the sea has equaled the great human propensity to pursue

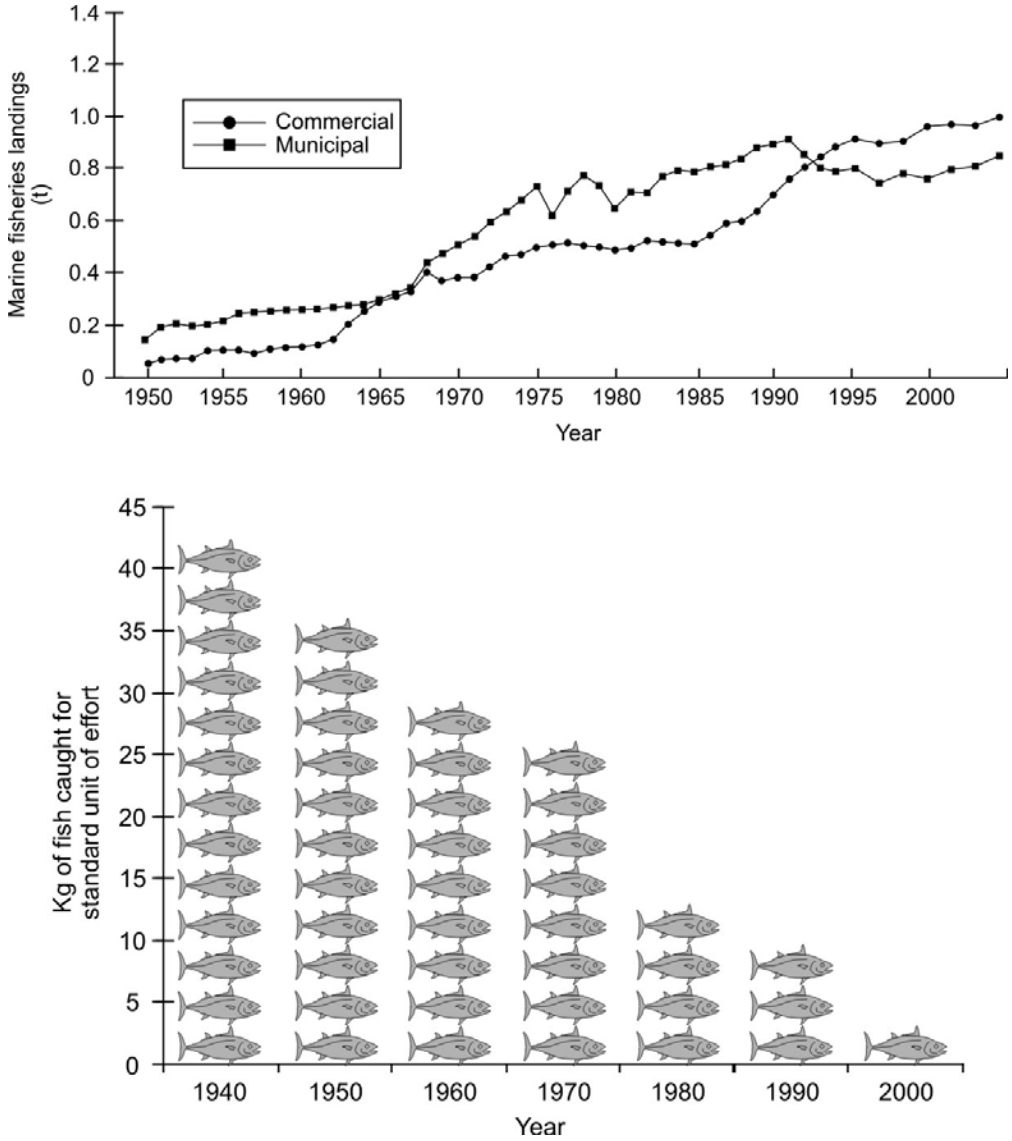

Figure 2.1. Declining fish catches. Records (BAS, 2001) of total marine fishery landings by both municipal and commercial operations (top diagram) do not quite reflect what scientists say is a severely degraded resource. But research conducted by the WorldFish Center in 1998-2001 found that, overall, "the level of fishing in the grossly modified stock (in the Philippines) is 30% higher than it should be." (ICLARM [WorldFish Center], 2002) Analyses of catch per unit effort (CPUE) in six coastal provinces in the Philippines for the common hook-and-line type of fishing reveal even more alarming results: that fish catch is in some cases less than 5% of the original levels of only a few decades ago (bottom diagram). CPUE shows the catch of fish or fishery for a given fishing gear and level of effort over time that such fishing gear is applied. (Green et al, 2003)

maximum short-term economic gains, which far exceeds the sea's capacity to repair and replenish itself.

In his eloquent *Unnatural History of the Sea* (2007), marine biologist Callum Roberts traces the beginnings of the intensification of marine capture fisheries to the 11th century. Until then, most fishing happened inland, but as fishing techniques improved and freshwater quality deteriorated because of pollution, fishers turned to the sea for food and income.

Initially, fishing was concentrated in coastal waters, partly because nearshore stocks were sufficient to meet (mostly local) demand, and partly because available technology at the time did not allow fishers to travel long distances and still bring their perishable goods to market. In time, within the limited confines of the coastal waters, more efficient fishing technologies were developed, fishing intensified, resource use conflicts grew, and regulations became necessary. (Roberts, 2007)

It appears the destructive nature of trawls was recognized early on. Roberts (2007) says the beam trawl was met with hostility when it was introduced in the 14th century. A few centuries later, France made the practice of trawling a capital offense, and two fishermen were executed in England "for using metal chains on their beam trawls (standard issue on the beam trawl today) to help scare fish off the bottom and into the nets." Still, says Roberts, trawling was too lucrative to be totally abandoned and thus never completely disappeared.

A drastic shift in policy came during the Industrial Revolution in the 1800s. Major advances in sea and land transport and refrigeration during this period provided the missing link between fisher and market. The new technologies allowed fishers to travel farther out to sea in search of new fishing grounds. More crucially, these technologies gave them access to a much bigger market. Demand for fish exploded and a new worldview dominated. Now that all of the sea was potentially within human reach, fishers – as well as policymakers and even some scientists – were convinced that the productivity of the sea was inexhaustible. Despite early evidence of fish stock depletion in many areas, many fishing regulations were lifted, trawling and other efficient gear became the methods of choice, and fisheries expanded with a vengeance. (Roberts, 2007)

And so it was until recently in the Philippines. For much of the last century, we pursued coastal and marine development as if the sea could be exploited without limit, through the use of more efficient gear, in an open access regime. Even as we began to see signs of distress in many of our fishing grounds and despite warnings from a growing number of scientists, we were stuck with the delusion that the problem with our fisheries was not one of resource decline, but a problem of access to the resource, which could be solved by technology.

Thankfully, in recent years, beliefs have changed, no doubt because resource degradation and declining trends in fish catch have become too hard to ignore. Clearly, fishing cannot be sustainable without regulation and management. Fishers tend to catch their prey way too much like any typical human hunter does. Hunters are opportunistic – they actively seek their prey, adjust to its environment, and adapt their activity to maximize the opportunities. In the view of paleontologist Niles Eldrige, "no natural instinct urges the human hunter to practice sustainability; hunters are by nature opportunists with a tendency to kill whatever they can get." (Radkau, 2008)

It is our responsibility as fisheries managers to help ensure the sustainability of what is essentially the last commercially hunted species in the world. If we do not do our job

well, fish would surely go down the path of all commercially hunted species before it – toward depletion of disastrous proportions, if not extinction. (Myers and Worm, 2003; Weber, 1993)

Roberts told the *Washington Post* (2007) in an interview, "Many of the problems we see in the oceans today were recognized 100 years ago, as were many of the solutions. The difference is that there was so much more in the sea then, and people felt they didn't need to act, but could just fish somewhere else or for something else. We no longer have that choice. Today, we must act to bring depleted species back, because we have nearly run out of alternatives (unless you like jellyfish)."

The job of a fisheries manager is perhaps a bigger challenge now than it has ever been because of the severity of our fisheries problem. But as a fisheries manager who must necessarily advocate conservation and timely management intervention, you will no longer feel like a lone voice in the wilderness, because you have all of history to back you up, at least on these several key points:

- The sea is neither inexhaustible nor indestructible.
- Unless properly managed and regulated, fishing easily escalates into overfishing.
- Our fisheries problem is real and growing; as it grows, our options shrink.
- Solutions are available, but time is running short.

FACTS OF (FISH) LIFE

We've seen how fishing has been allowed to expand so much as to deplete our fish stocks; now we will take a closer look at the world of sea fishes, how it works, and how it may react to various stresses, including fishing. As much as we must learn from what Roberts (2007) calls the "unnatural history of the sea," we also need to understand the natural history of fish and its environment.

Learning especially the ecological interactions and relationships that characterize ocean life will help us understand better the concepts and principles of fisheries management, which in turn will enable us to think both critically and creatively as we deal with our fishery problems and determine our actions.

But first, here are some unavoidable fish facts that should be our mantra in fisheries management (based mostly on Cunningham and Saigo, 1997):

- Fish are a biological resource with biological limits.
- Fish have limits to the environmental conditions they can endure.
- Like any biological population, a fish population cannot survive below a minimum size.
- No population exists in complete isolation; all of nature is interconnected.
- Every species plays a role in its community, called its ecological niche.

These are the givens of fish life; as fisheries managers, there is really not much we can do to *directly* manage them. But with some basic understanding of fish life in particular

and ocean life in general, we can do a better job of identifying and managing those things that we can actually control – above all, fishing and the other human activities that impact the sustainability of our fishery resources.

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The following sections contain more detailed discussions of fish ecology and other important concepts to help guide us as we begin to tackle the many practical challenges of fisheries management. But first, let's get some definitions straight:

- **Population** – a group of individuals of the same species inhabiting a certain area.
- **Species** – a group of similar organisms that can reproduce sexually among themselves.
- **Community –** consists of populations of various living organisms living and interacting in a certain area at a given time.
- **Fish stock** – the total mass of a fishery resource, which is usually identified by its location and may consist of one or several species.

WATER MATTERS

Fish can live in almost any place where there is water. It is known to exist at an altitude of 4,572 meters above the sea level, in a lake in the Andes Mountain Range in South America called Titicaca. It is also known to survive in the deepest part of the Marianas Trench, at 11,033 meters. We can with certainty therefore conclude that the total vertical range of fish occurrence is 15,605 meters. That's a distance of over 15 kilometers, an extensive range that, along with the fact that water covers nearly three-quarters of the earth's surface, gives an indication of the ability of fish to adapt to various aquatic environments.

Water on earth is distributed among interacting compartments where it resides for short or long periods of time (in the deepest oceans, up to tens of thousands of years). Nearly 98% of all liquid water in the world is in the oceans, circulated and exchanged through evaporation, rainfall, river discharge, groundwater flow and runoff among the different compartments in a process called **hydrologic (water) cycle**. (Figure 2.2)

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The hydrologic cycle performs three vital functions: 1) It supplies fresh water to the land masses; 2) It regulates world temperatures; and 3) It makes our climate fit to be lived in. The water in our oceans is too salty for most human uses, but by its sheer volume, it is our planet's main temperature moderator and climate regulator. (Cunningham and Saigo, 1997)

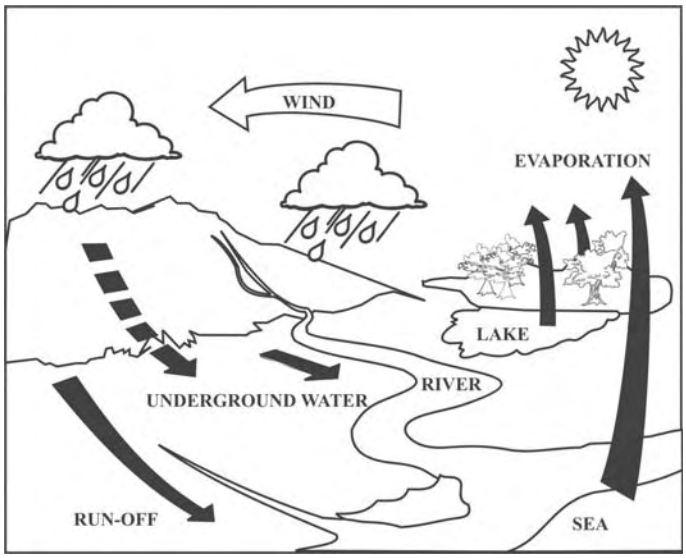

Figure 2.2. The water cycle. Driven by solar energy and gravity, the hydrologic cycle moves water between the earth's aquatic, atmospheric and terrestrial compartments. (image adapted from Met Office)

THE OCEANS IN DEPTH

The oceans actually form a single unbroken reservoir, but they do not have the same properties. The presence of shallow and narrow parts between them reduces water exchange, which results in variations in composition, climatic effects and surface elevations. Different water densities, different salinities and different temperatures further inhibit the mixing of water, forming sharp boundaries or ocean layers. Such physical and chemical variations influence the kinds of plant and animal life that occur in the different oceans and ocean layers.

For purposes of research and study, scientists have devised several ways to classify the oceans into different regions based on the physical and biological conditions of these areas. One classification uses the edge of the continental shelf – that is, the underwater extension of the margins of the landmass – as the point of delineation between two regions (Figure 2.3):

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1. the **neritic province**, which includes the water column overlying the continental shelf, more or less most or all the coastal zone, and
2. the **oceanic province**, which encompasses the rest of the open waters up to the deepest portion of the ocean.

One major difference between these two provinces lies in the fact that the neritic province is contiguous to the landmass and therefore directly influenced by it. There are bodies of water whose entire extent lies over the continental shelves and entirely within the neritic province.

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Another classification divides the ocean into two broad categories called realms (Figure 2.3):

1. The **benthic realm**, which extends from the high tide line on the shore to the deepest parts of the seafloor, and
2. The **pelagic realm**, which consists of ocean waters, the "water column".

The two realms are further divided into separate zones or layers (Figure 2.3).

IN THE WATER

The subdivision of the two realms is based primarily on the living conditions in the different zones. One common classification divides the pelagic realm into two layers according to sunlight penetration (Figure 2.3):

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1. The **light zone** is the layer of water that can be reached by sunlight, limited to the depth of light penetration, which varies depending upon the intensity of sunlight and the transparency of the water. Generally, the depth of light penetration ranges between 100 and 200 meters.
2. The **dark zone** is the water column below the light zone, where there is a permanent absence of light.

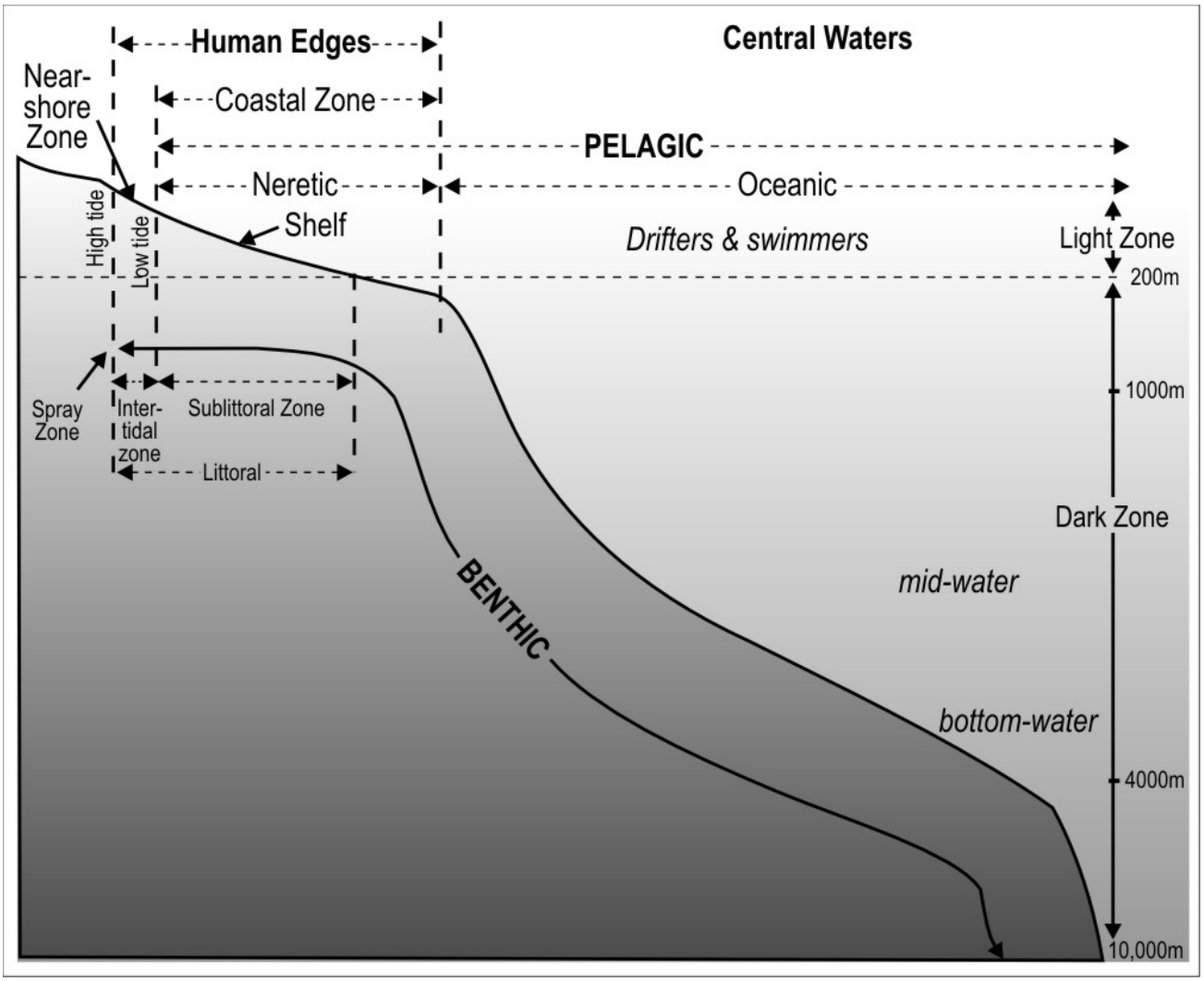

Figure 2.3. Ocean zones. Scientists have classified the sea into realms, zones and divisions, such as those shown above, because of differences in the living conditions in different parts of the water and the seabed. (Image adapted from FAO, 2005; Wikipedia.org, Ocean).

The light zone serves as the interface between the atmosphere and the water mass, allowing exchange of energy between them. As such, it is influenced by the natural cycle of light (the so-called light-dark cycle), as well as climatic and seasonal changes in the atmosphere.

Obviously, the main difference between the light and dark zones is the presence or absence of light. The deep dark ocean layers are also characterized by extremely high pressure (due to the weight of the water above) and relatively low temperature with small fluctuations.

ON THE SEAFLOOR

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In the benthic realm, our primary interest would be that part of the seafloor called the **littoral zone**. This zone is reckoned at 0 to 200 meters from the highest tide level, well within the influence of sunlight. It is where we find many of the marine habitats we are most

familiar with – the rocky shorelines, sandy beaches, mangroves, seagrass beds and coral reefs.

The littoral zone is subdivided into three zones based on exposure to seawater (Figure 2.3):

1. Spray or splash zone (also called supralittoral zone);
2. Intertidal zone (also, mesolittoral zone); and
3. Sublittoral zone.

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The **spray zone** is the meeting point between land and ocean life, above the mean highest water line, so named because it gets seawater mostly in the form of ocean spray, splash or mist. It is covered by water only during extremely high tides or in the presence of strong waves, usually during storms or high winds. The long intervals between such marine influences allow atmospheric and terrestrial influences to dominate. Sunlight affects this zone directly, resulting in rapid changes in temperature, as well as extreme variations in salinity. Tidal pools may form after a storm that can have freshwater conditions after a heavy rain, becoming concentrated saltwater after several sunny days, eventually drying up after a prolonged drought period, and then forming again under suitable conditions.

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The **intertidal zone**, regarded as the "real" littoral zone, extends from the mean highest water level to the mean lowest water level. Organisms in this zone are subject to alternating floods and droughts twice each day, following the six-and-a-half-hour tidal rhythm. It is considered a very hostile and complicated habitat because of the ever-changing tide timing and height, in addition to the fact that this is where climate changes and human activities make their greatest impact.

The environment in the intertidal zone is one of harsh extremes. The tide brings in water like clockwork, but salinity is highly variable, ranging from nearly fresh with rain, to highly saline and dry salt between tidal inundations. The mechanical forces of wave action can knock intertidal residents loose. And temperatures can vary greatly from very high under the full sun to very low in cold weather.

The intertidal zone is generally divided into three layers based on the length of time it is submerged in water. The *uppermost layer* is covered by water only during the highest tide so it experiences dry periods daily, the *middle layer* is submerged at high tide and exposed at low tide, and the *lowest layer* is exposed only during the lowest tide.

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Below the intertidal zone is the **sublittoral zone**, which extends from the mean lowest water level to the deepest point where benthic plants are still found, at the farthest depth of sunlight penetration. This zone is permanently covered with water.

A QUESTION OF PRODUCTIVITY

The vastness of our oceans — they cover more than 70% of our planet's surface and extend to an average depth of 3,800 km — gives the illusion of infinitude. Indeed, because of their huge expanse, the oceans contain over 90% of the world's living matter. However, their *total* productivity is *less* than that of land. *On average*, marine ecosystems are much less productive than terrestrial ecosystems. Coral reefs, estuaries and other rich shallow water ecosystems are known to be as productive as tropical rainforests, but they are relatively rare compared to the enormous expanse of the open ocean, where the less than ideal conditions tend to reduce productivity. (Cunningham and Saigo, 1997)

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Productivity is measured as the rate of production of biomass, that is, the amount of living matter produced in a given population or area within a certain period of time. It indicates the rate by which organisms "manufacture" food using energy from the sun through the process of **photosynthesis**. Nearly all life either depends on photosynthesis directly as a source of energy or indirectly as the ultimate source of the energy in their food. How much energy is converted is determined by temperature, light levels, moisture and availability of nutrients. In the oceans, the distribution of temperature and nutrients is affected by factors that act to move water masses, such as currents, upwelling and diffusion.

Benthic Life

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The different ocean zones contain distinctive and varying abundance of plant and animal life depending on the living conditions that prevail there. In the benthic realm, the distribution, composition and abundance of life depends not only on light and other hydrological influences, but also on the sea bottom itself. Like land, the sea bottom consists of various types of landscape – mountain ranges, volcanic mounds, cliffs, desert plains and trenches. If made up of boulders, rocks, stones and pebbles, it is classified as **hard bottom**; if it consists of fine sediments, it is called **soft bottom.**

Organisms that thrive in the spray and intertidal zones include specialists capable of surviving under extreme changes in temperature, moisture and salinity.

The spray zone is occupied by relatively few species of algae, grazing mollusks, and suspension-feeding barnacles. These organisms have various adaptations to prevent dehydration – the Philippines' coconut crab, for example, has hairs all over its body that prevent excessive loss of moisture and enable it to stay for long periods outside the water.

The intertidal zone hosts many species of algae, sponges, sea anemone, barnacles, mussels, and other invertebrates. Compared to the spray zone, diversity is greater here due to the longer time spans this area is submerged, but organisms still face dramatic salinity and temperature changes.

Of all the benthic zones, the sublittoral zone has the most favorable conditions for marine life. This zone is a permanently submerged marine environment that gets adequate

sunlight for photosynthesis, and is thus known to have the largest number of species among the benthic zones.

The Dark Zone

The deepest parts of the ocean used to be regarded as largely barren because they lack sunlight for photosynthesis. But surveys have now revealed "more life than expected" actually exists there. (COML, 2008)

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While most organisms living in the ocean's vast dark zone are dependent on the primary production of the light zone, many others have evolved to cope with the absence of light. Hot springs on the seafloor called "hydrothermal vents" are known to have dense biologic communities that depend on food from **chemosynthesis**, a process by which certain specialized bacteria convert inorganic carbon to sugars (i.e., food) using energy from chemical oxidation instead of sunlight. And, more recently, researchers reported that photosynthesis does in fact take place even in the absence of sunlight. They found photosynthetic organisms nearly 2,400 meters below the ocean; instead of sunlight, these organisms utilize light from hydrothermal vents to manufacture food. (Derra, 2005)

The Light Zone

Still, marine life is found mostly in the light zone. In fact, the bulk of the marine resources we exploit are caught in the light zone, mainly in the neritic province. This is primarily because the shallow waters of the light zone, especially in the neritic province, are the most accessible, and also because many of our most productive fishing grounds are found there.

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In tropical seas like ours, the neritic province is where you will find some of the world's most productive and highly diverse coastal communities. This region is rich in nutrients washed off from land, which supports a large population of microscopic plants called **phytoplankton**. An abundance of phytoplankton is the foundation of rich fishing grounds – it attracts a host of primary predators and subsequent predators (yes, including humans) thus ultimately forming a food web (Figure 2.4).

Almost all primary production in the oceans is performed by phytoplankton, and only a small fraction is contributed by seaweeds and other groups. Because these organisms make up the bottom of the marine food web and thus provide the rest of the other organisms the energy necessary to perform their activities and to build their own biomass, potential fishery yields from aquatic ecosystems can be estimated from measurements of primary productivity.

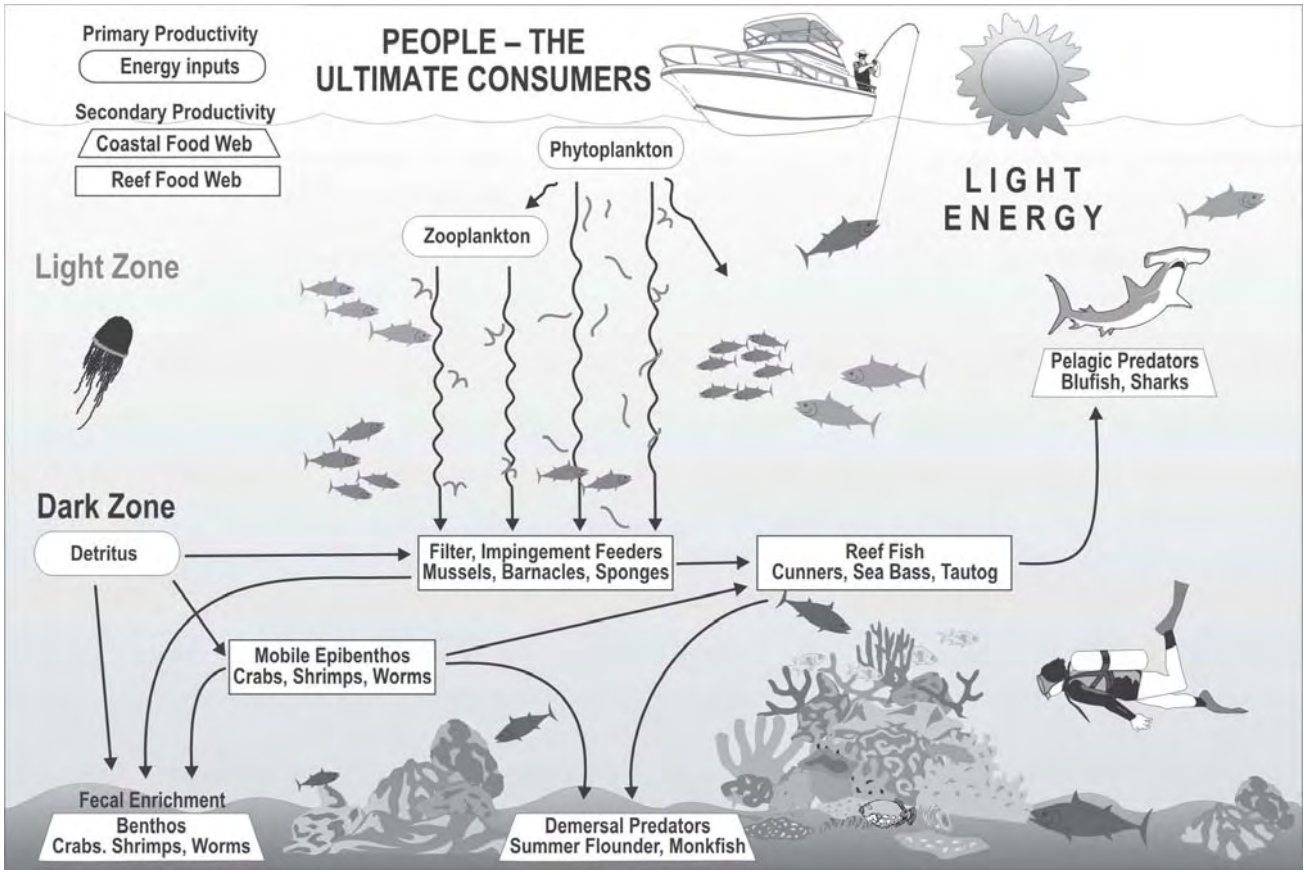

Figure 2.4. Marine food web. A marine fisheries food web illustrates the feeding relationships between sea organisms, from microscopic primary producers called phytoplankton, to the topmost predators, including humans.

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Where The Fish Are

One rule of fishing is pretty on point: Find the food, find the fish. Indeed, the most productive waters in the world are in the so-called **upwelling zones**, where dense, cooler and usually nutrient-rich water is driven by wind toward the ocean surface, replacing the warmer, usually nutrient-depleted surface water. (Figure 2.5)

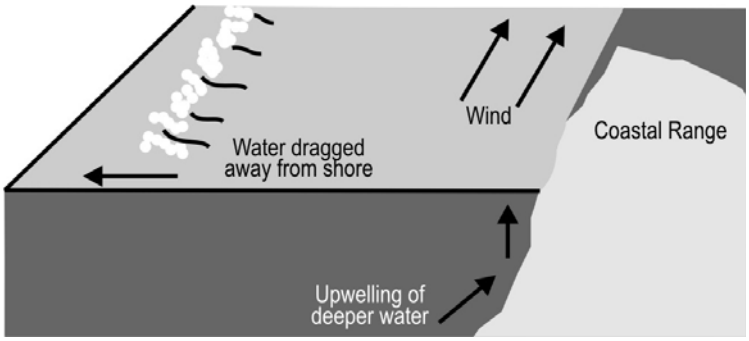

Figure 2.5. Dynamics of upwelling (illustration adapted from UIUC, 1999). An upwelling involves wind-driven motion of dense, cooler, and usually nutrient-rich water toward the ocean surface, replacing the warmer, usually nutrient-depleted surface water. Coastal upwelling, the best known type of upwelling, supports some of the most productive fisheries in the world, like small pelagics (sardines, anchovies, etc.). (Wikipedia.org, Upwelling)

Deep waters are rich in nutrients from the decomposition of sinking organic matter (called "detritus") from surface waters. When brought to the surface, these nutrients are used by phytoplankton to produce food through photosynthesis. Upwelling zones therefore show very high levels of primary production compared to other areas of the ocean.

Coastal upwelling in particular supports some of the most productive fisheries in the world. The presence of sunlight and moisture, as well as the proximity of coastal upwelling zones to land and other nutrient-rich habitats, translates to a regular supply of the basic ingredients for primary production, kicks off the flow of energy from one organism to another in the marine food web, and ultimately builds a rich fishing ground. Little wonder then that the world's major upwelling zones along the western coasts of North America, South America and Africa, and the west side of the Indian Ocean are also where the world's greatest fish catches occur.

The constant flow of water through various channels transports nutrients from the upland into the estuaries. Nutrients are directly consumed by small aquatic animals or used by phytoplankton in photosynthesis. Leaves from mangroves fall into the water and disintegrate into detritus, which is consumed directly by shrimps, fishes and clams. Some organic materials and nutrients may be transported to other areas and serve the same purpose as food for small animals or raw materials for plants.

In seagrass beds, some aquatic animals directly consume the seagrass while others feed on detrital seagrass. And coral reefs provide a substrate for algae and microscopic plants, which in turn attract a variety of fishes and invertebrates feeding specifically on such kind of food.

The Philippines has about 25,000 sq km of coral reefs, seagrass and algae beds, and about 138,000 ha of standing mangrove forests and wetlands hosting a multitude of biological communities that produce food not only for their own consumption, but also for other organisms that live in the more distant and deeper parts of the ocean. By some estimates, the Philippines has 430 coral species, 2,300 fish species, 16 seagrass species, hundreds of seaweed species and thousands of marine invertebrate species.

FOOD CHAINS & FOOD WEBS

It is clear from studying land-water interactions and the food web that all living things, on land and in water and the air, are interconnected. The food web lies at the core of such interactions, and represents the complex interdependence between marine organisms, and between marine and other life forms. (Figure 2.4) It is made up of a network of food chains, each chain depicting a linear "eat and be eaten" relationship between major players in a biological community.

As we have already indicated, the ocean's food chain starts with the production by phytoplankton of food from the basic materials available in the environment. As the initiators of the food chain, phytoplankton belong to a group of organisms called the

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primary producers or **autotrophs** (meaning "supplying one's own food"), which also include large aquatic plants. They are eaten by **primary consumers**, mostly plant-eating aquatic animals commonly called **herbivores**. In turn, herbivores are eaten by the **secondary consumers** called **carnivores**.

Consumers in general (including humans) are called **heterotrophs** (meaning relying on other sources to get their food).

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The predator-prey interactions of the different groups of aquatic organisms make up the **trophodynamics** through which energy and biomass flow from one group to another (*trophe* is Greek for "food" or "nourishment"). The transfer of energy and biomass that occurs in these feeding interactions follows a hierarchical structure called **trophic structure** made up of several consumer or **trophic levels**. As energy passes from one trophic level to another, a substantial amount of it is lost through heat and metabolic consumptions by the organisms themselves.

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As a general rule, only about 10% of available energy is passed on from one level to the next, until the energy left is too little to sustain another level. Because of this low transfer efficiency, predators occupying the higher trophic levels must consume large amounts of prey biomass to meet their energy requirements. This diminishing energy availability in a trophic system is depicted in an **energy pyramid** or **trophic pyramid** (Figure 2.6).

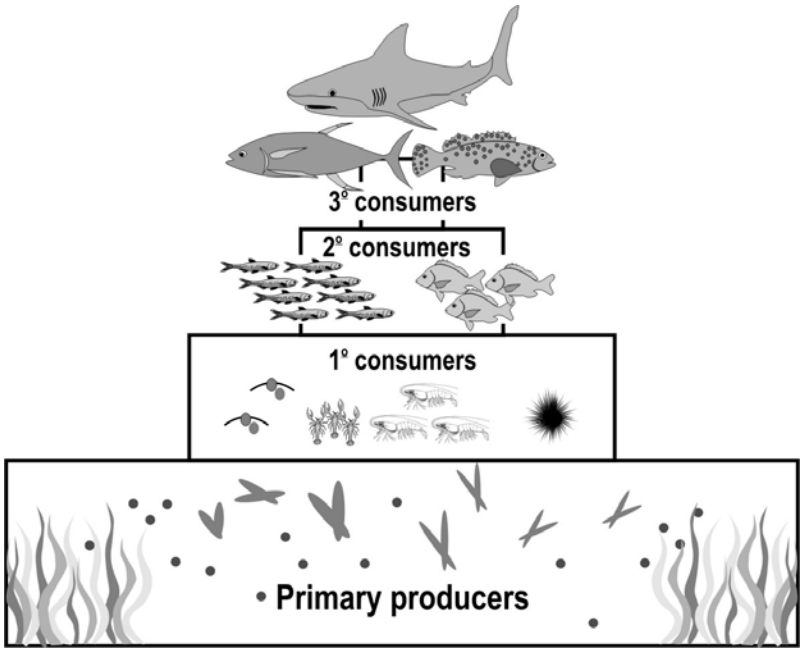

Figure 2.6. A trophic pyramid. Trophic pyramids graphically represent the distribution of biomass or energy among the different trophic levels of an ecosystem. While food chains and food webs show the particular trophic relationships between species in an ecosystem, the individual species are not at all considered in the trophic pyramid, which focuses on overall trophic levels. Note in the illustration above that the biggest level is the producer level, and this is always the case in a stable ecosystem. On average, only about 10% of energy is transferred from prey to predator, and even less when the organism consumed is a plant. This explains why herbivore populations far outnumber the carnivores. There are more plants than all other organisms combined, and there should well be, because directly or indirectly, plant populations feed all other populations in the ecosystem.

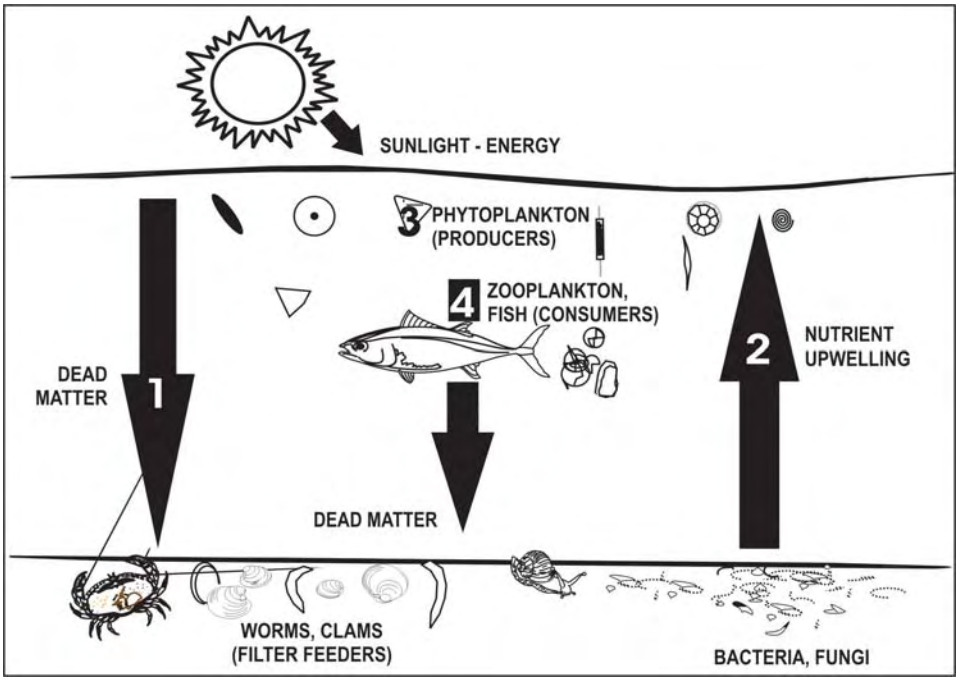

Figure 2.7. Marine nutrient cycling. In any ecosystem, nutrients are continuously transferred from one organism to another in a process called nutrient cycling. Elements are extracted from their mineral, aquatic or atmospheric sources or recycled from their organic forms, consumed and absorbed by living organisms, and ultimately returned to the atmosphere, water or soil. A typical marine nutrient cycling process involves four steps: (1) Remains of dead organisms sink to the bottom, where they are broken down into nutrients. (2) Wind, tidal currents and other physical processes that cause turbulence cause upwelling, which pushes up nutrients from the bottom to the top of the water. (3) Phytoplankton use available nutrients to grow and reproduce. (4) Various organisms feed on the phytoplankton, grow, reproduce and eventually die. (5) The cycle starts again. (based on DFO, 2007)

As living things, all organisms produce waste materials; when they die, they go through the process of decay. Both events give back materials to the aquatic environment, and the food cycle starts over as nutrients are 'recycled' and once again become available to microscopic and large aquatic plants for primary production (Figure 2.7).

THINK ECOSYSTEM

Let's digress a little and define precisely a word that we have been using rather loosely up to this point: "Ecosystem." It means a community of organisms and its physical environment, viewed as a system of *interacting* and *interdependent* relationships and including such processes as the flow of energy through trophic levels and the cycling of chemical elements and compounds through living and nonliving components of the system — relationships and processes that we have been discussing in the last sections.

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For purposes of management, we define ecosystems at given geographical and functional scales. We will discuss this more fully in Chapter 4. For now, in order to explain the different interactions within an ecosystem and between various ecosystems, let's take a closer look at the three major tropical coastal ecosystems, namely, mangrove, seagrass and coral reef. These ecosystems, along with estuaries and other wetlands, are reported to directly support between 75% and 89% of all marine fishes.

The Mangrove Ecosystem

Mangroves are seed-bearing plants capable of surviving and propagating in saltwater or salty soil at the edges of water environments — in intertidal zones along sheltered tropical mudflats where there is not much wave action. Usually associated with estuaries and lagoons and often extending inland along banks of rivers and streams, these plants are adapted to life in water, having developed strategies to ensure their propagation and survival. (Figure 2.8)

The primary role of mangroves in the marine ecosystem is to produce litter consisting of partially decomposed falling leaves and fruits. The litter is broken down by decomposing microorganisms into digestible nutrients, which are then consumed by small organisms, including young shrimp and fish. The nutrients are partly consumed locally, and some are exported to nearby bodies of water and utilized by the residents of estuaries, lagoons, bays, seagrass beds and coral reefs. Litter from mangrove is a major source of food for many shallow shrimp and finfish species, and a significant contributor to shrimp and finfish fisheries in the Philippines and the rest of Southeast Asia. (Figure 2.9)

Besides being a major food source, mangroves act as a nursery for young fish. They also take up excess organic compounds, soil particles and heavy metals discharged from land, thus helping prevent siltation and pollution of the marine environment.

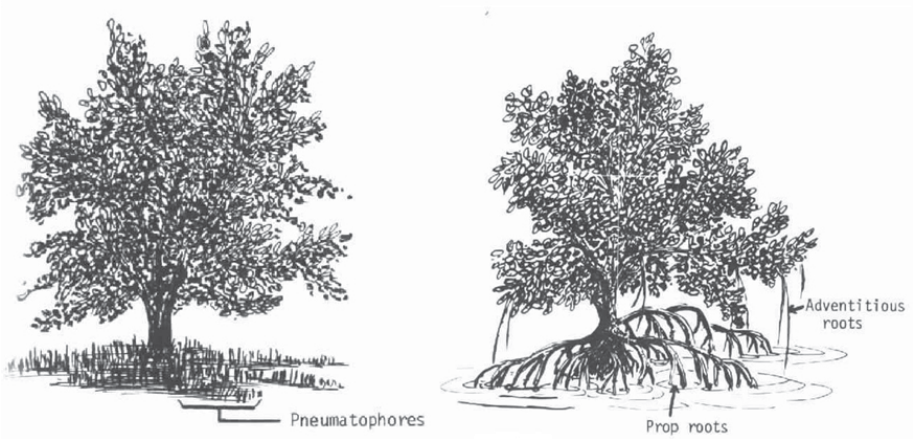


Figure 2.8. Mangrove adaptations. Different mangrove species have developed special adaptations to their environment. With their thick, tough leaves they can retain water in their tissues, and some species have salt glands that excrete excess salt. Species belonging to the genus *Avicennia* (left) are equipped with shallow but extensive root systems called pneumatophores that project up to the mud and are used by the plants for breathing. *Rhizophora* species (right) have prop roots extending from the trunk that serve a dual purpose: 1) to provide better anchorage and prevent the trees from being toppled or uprooted during strong waves and high winds; and 2) to act as substrate for many marine organisms. The seeds of some *Bruguiera* and *Rhizophora* species germinate and start to grow while still attached to the parent plant, elongating and becoming heavier at the bottom end. Such weight distribution makes the seeds float upright in the water when they detach and fall from the parent plant. The seeds stay upright as they are dispersed by water current, anchor themselves when they touch the bottom and grow into mature plants. (DENR, et al, 2001)

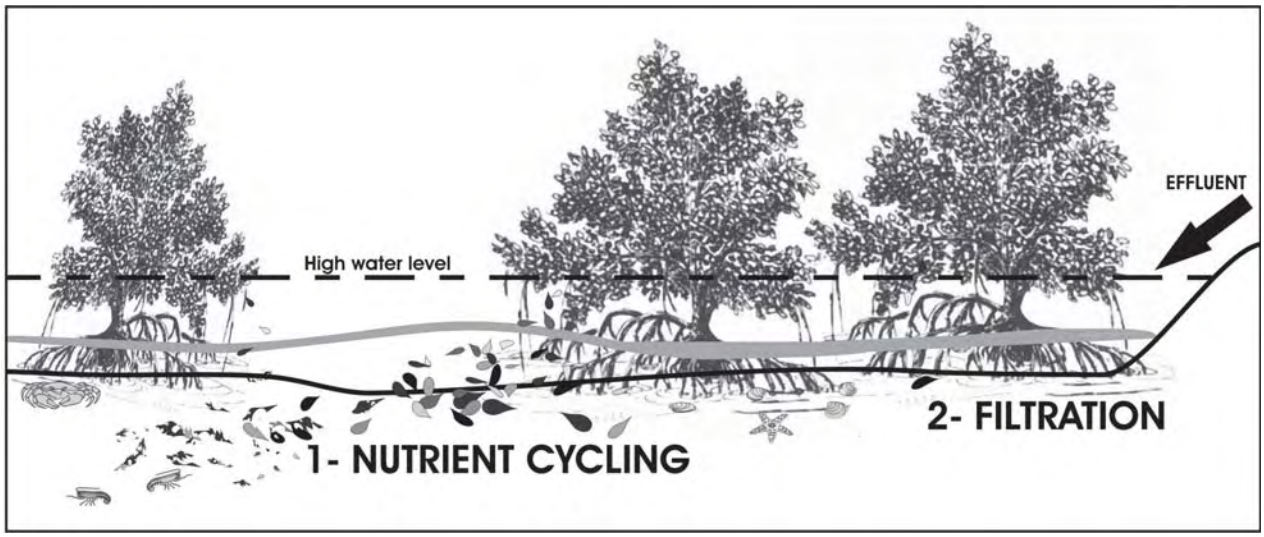


Figure 2.9. Role of mangroves in the coastal ecosystem. The Philippines has 77 mangrove and associated species that grow in the inter-tidal zone, coastal lagoons and islands and play a critical role as part of the coastal ecosystem, as shown in this diagram: (1) Mangroves provide a continuous supply of food for sea life, constantly shedding leaves that are quickly broken down by bacteria and fungi and released into the water. (2) They trap silt and pollutants and filter run-off from land, which reduces the risk of polluting the sea with chemicals that can harm corals and fishes and keeps adjacent waters clean and clear, thus allowing light to penetrate the water column and living things that need light to thrive under the sea. Mangroves also act as breeding area for many fish species and other commercially valuable sea life, nesting ground for many water birds, and habitat for countless other animals and plants. And they act as a firm, flexible barrier against natural forces like typhoons and waves, thus helping protect and stabilize the shoreline.

The Seagrass Ecosystem

Seagrasses are flowering plants adapted to grow in loose sand and mud substrate and withstand wave action. These plants are equipped with runners called rhizomes, which creep through the loose sand and mud substrate and provide them some anchorage. They can tolerate a wide range of salinity, occurring in the middle of shallow seas as well as near river systems.

Because they require enormous amounts of sunlight and nutrients, seagrasses are often abundant only where there is ample sunlight, in the shallow waters of coastal areas. A typical seagrass habitat is a shallow, clear, calm and protected body of water situated near estuaries and lagoons. Vast seagrass beds and meadows are often found between coral reefs and mangroves, indicating the natural link between them, and may be interspersed with seaweeds and algal communities.

The high productivity of seagrass beds is due to both the seagrasses themselves and the small plants and animals that attach to their surfaces. Like mangrove forests, seagrass beds are major contributors to the production of nutrients, also through the decomposition of seagrass material (Figure 2.10). Some species, such as the rabbitfishes, rely completely on seagrasses for nourishment, habitat and nursery, while other species rely on seagrass beds for just one or two of these functions.

And like mangroves, seagrass meadows are known to have filter function — they trap sediments suspended in water that may otherwise be harmful to other organisms such as corals, mussels and other filter feeders.

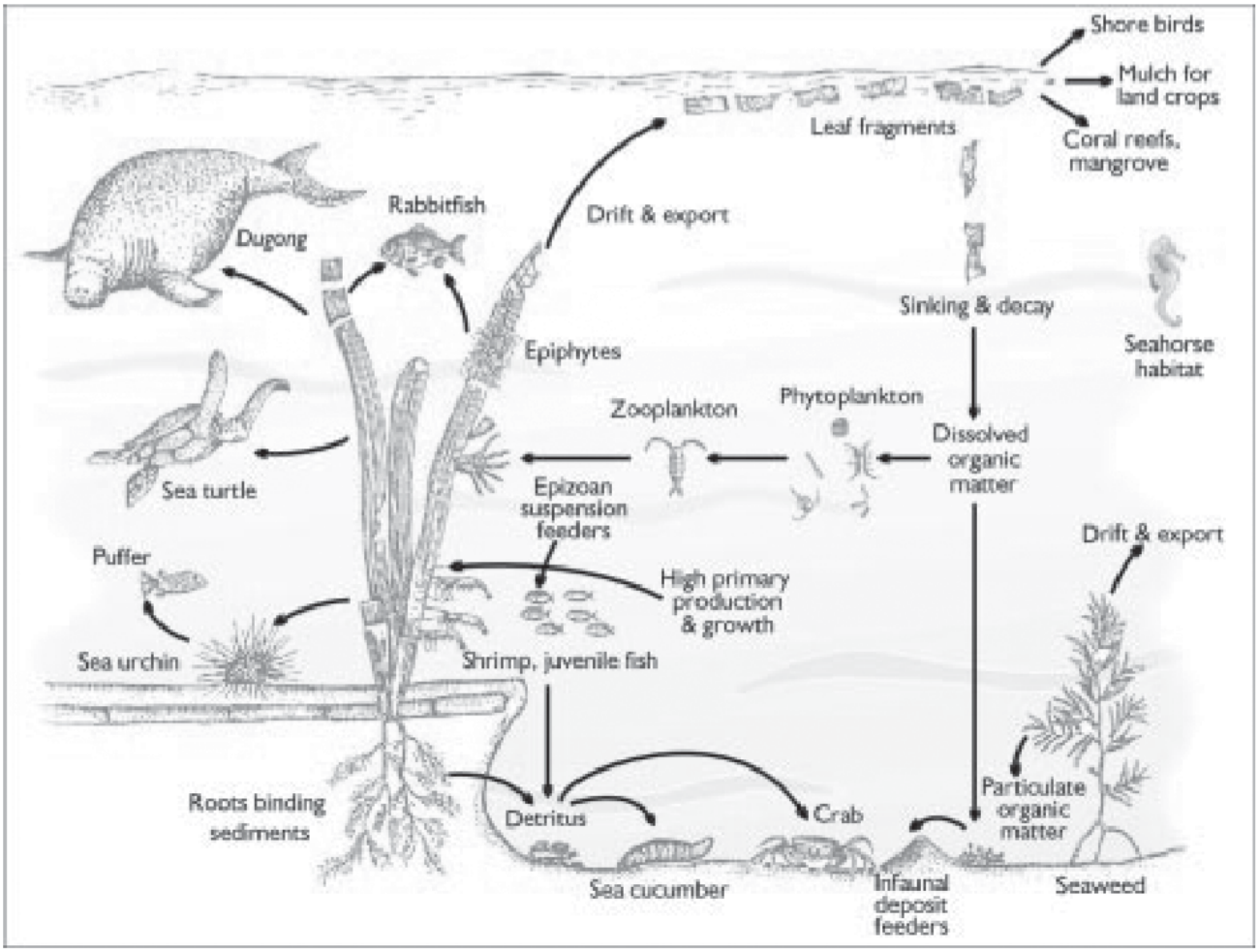


Figure 2.10. Role of seagrass in the coastal ecosystem. Seagrasses, the only group of submerged flowering plants in tropical and temperate marine environments, are a vital part of the coastal ecosystem. They harbor a diverse community of marine organisms and serve as an essential link between mangroves and coral reefs; most of the nutrients produced in the mangroves are utilized in the seagrass beds. Seagrasses also slow and retard water currents and waves, and regulate water turbidity by trapping sediment through leaf action. They serve as nursery grounds and shelter for many fish species — in the Philippines, they support at least 172 species of fish, 46 species of invertebrates, 51 species of seaweeds, 45 species of algal epiphytes, They trap debris and small particles and produce dissolved organic matter, thus contributing to the nutrient cycle within the reef ecosystem. They stabilize and hold bottom sediment even under the force of typhoons and storms. Seagrasses are sometimes called ecosystem engineers because they partly create their own habitat: the leaves increase sedimentation by slowing down water currents, and the roots and rhizomes stabilize the seabed.The removal of seagrass beds from the marine ecosystem results in lower productivity and decreases water quality. Typically, when a seagrass community is eliminated, animal associates also disappear from the area. (Fortes, 1989)

The Coral Reef Ecosystem

Coral reefs take up different forms, namely, fringing reefs, barrier reefs and atolls. (Figure 2.11)

☞Glossary

Fringing reefs are the most common type and are widespread in the Indo-Pacific region. They form around islets or as patches along coastlines of big islands, remaining submerged most of the time since they do not usually extend beyond the low tide level.

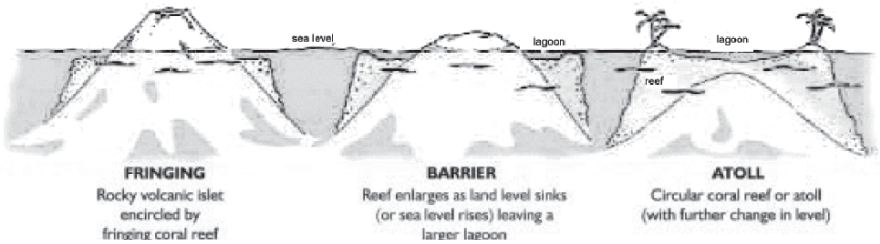


Figure 2.11. Coral reef forms. The three forms of coral reefs shown above may be stages of their evolution: Assuming that subsidence of land or elevation of the sea is occurring, a typical reef may start as a fringing reef, progressing to a barrier and then atoll system. Present day reefs are the result of growth over the past 5,000 years where sea levels have remained fairly stable. (White, 1987a)

☞Glossary

Barrier reefs run linear and parallel to the coastline, creating a barrier between the deep sea and the shallow water or "lagoon" near the land. In the Philippines, there is a unique occurrence of a double barrier reef system in Danajon Bank, northern Bohol called the Philippine Double Barrier Reef (Figure 2.12).

☞Glossary

Barrier reefs that develop around a subsiding islet are called **atolls.**

Coral reefs are the most diverse and productive communities on earth. Compared to the vast but relatively low-nutrient ocean surrounding them, reefs are like oases in the ocean with extremely high production concentrated in a very small area. Most reefs are found in warm clean and clear waters along the coastline. Although clear and clean waters are relatively low in nutrients, corals are extremely efficient in utilizing them.

Some reef organisms convert atmospheric nitrogen, which is otherwise biologically unavailable, into a form that corals and plants can use for nourishment. Nutrients are also captured by reefs from the sea and from groundwater, stored in the diverse organisms living in the reef ecosystem, and tightly recycled within and between these organisms. Such numerous ways in which coral reefs capture and recycle nutrients from the environment provide sufficient nutrients to biological partnerships (or "symbiosis") between coral polyps

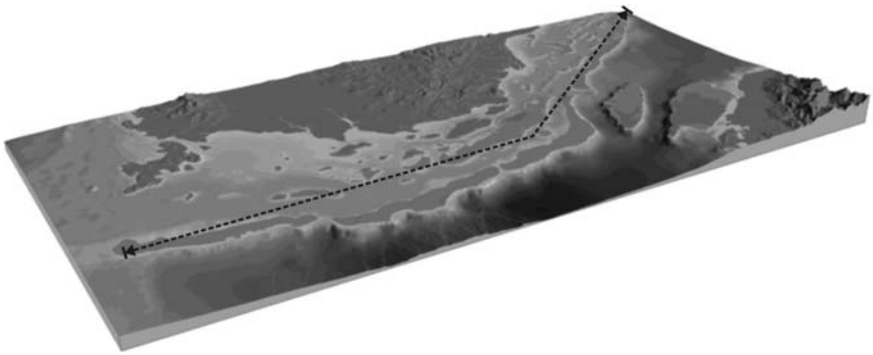


Figure 2.12. The Philippine Double Barrier Reef. Found in Danajon Bank in central Visayas, the PDBR is a rare geologic structure developed through 6,000 years of coral growth. Larger and better-defined than other known double barrier reefs in the world, the PDBR is spread almost 80 nautical miles (148 km – see dotted line in computer-generated image above). It is the only one of its kind in the Philippines, and one of only six double barrier reefs documented in the world.

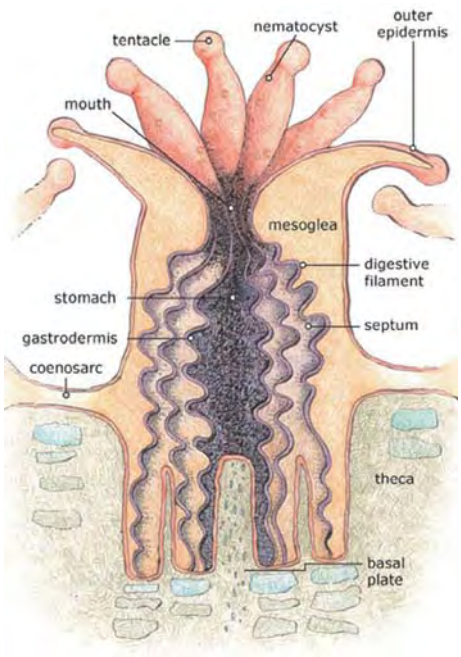


Figure 2.13. The coral polyp. Corals are colonies made up of many small animals called **polyps**. A typical polyp has a tubular and sac-like shape with a central mouth surrounded by a ring of tentacles. The end opposite the tentacles is called the base and is attached to the substrate. Feeding is done by extending the tentacles into the water to filter out tiny floating organisms. The tentacles are equipped with stinging cells to stun and capture the passing prey. This way the prey is made immobile before it is finally guided to the mouth.

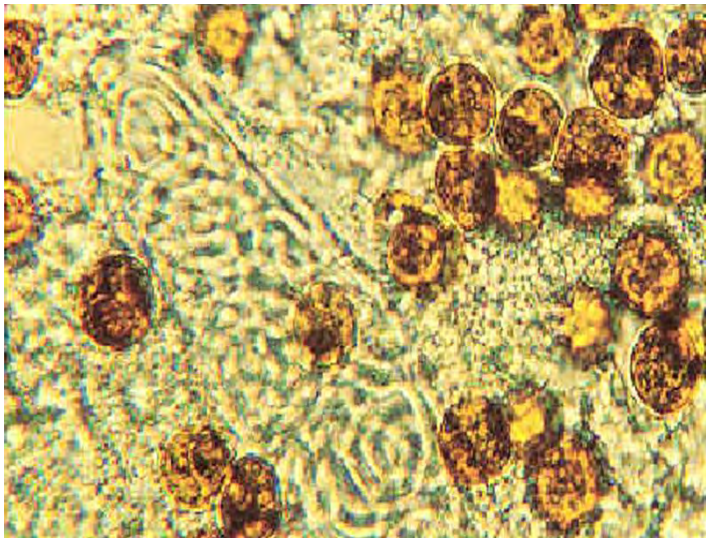


Figure 2.14. What make reefs productive. The reef's efficiency in obtaining energy is enhanced through "symbiosis" with **zooxanthellae** (Figure 2.13), the vegetative stages of microscopic plants known as **dinoflagellates**. Zooxanthellae live in the soft tissue of the polyps and are able to take up some of the corals' waste products, such as carbon dioxide, for their own use. By removing such waste products, they enhance the corals' metabolism. Zooxanthellae are also believed to have a direct role in the calcification or production of the coral's hard outer structure (called "exoskeleton"). (Image: Coles, 1996)

and certain organisms (Figure 2.14) and allow them to grow at a fast rate, which in turn help the reefs to rapidly transform carbon and nutrients into food through photosynthesis.

Interactive Systems

There are various ways by which these major marine ecosystems interact with each other, among the most important of which is the constant exchange of energy and materials (e.g., nutrients and carbon) between them. (Figure 2.15) Mangrove forests transform nutrients into organic matter, which nourish diverse and productive life forms. Seagrass meadows provide food for many of the fishes and invertebrates, which then transport energy and materials between coral reefs and the seagrass beds.

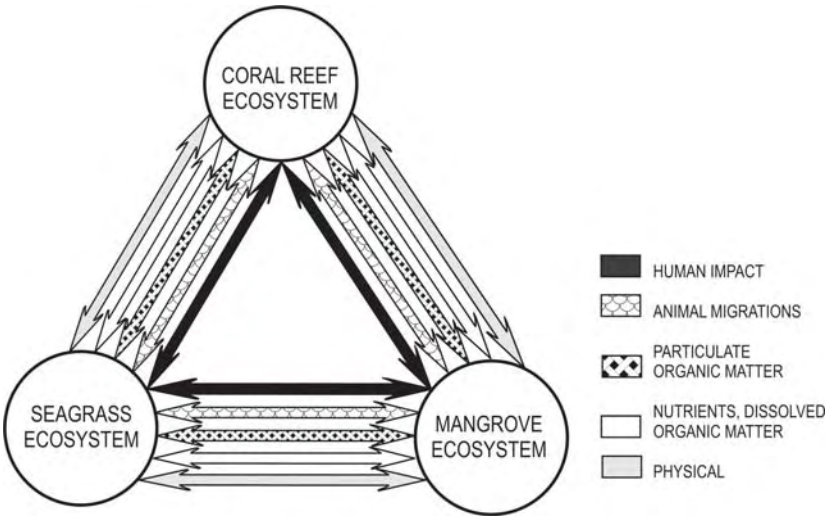


Figure 2.15. Interactions between major coastal ecosystems. A marine ecosystem is an "open system," with structures and processes that are dependent on its interactions with other ecosystems. The transfer of resources by water currents and the active movement of organisms among adjacent ecosystems (e.g. mangrove, seagrass, coral reef) influence the flow and availability of nutrients, trophic transfer, fishery production and species diversity. As might be expected in such a closely interlinked system, all processes – including human impacts – in one habitat can affect all habitats. (Image adapted from Ogden and Gladfelter, 1983. *In* Clark, 1994)

Seagrasses and mangroves also export nutrients and provide shelter and nursery grounds for a wide variety of organisms that move between the three marine ecosystems, enriching coral reef productivity. In addition, by trapping sediments, they prevent silt from suffocating the corals. In turn, coral reefs produce calcareous sediment that provides substrate for seagrasses and mangroves to grow. By dispersing wave energy, reefs also protect mangroves and seagrass beds from being dislodged by wave action, and thus allow them to flourish.

WHEN A LINK BREAKS

In the closely interlinked biological system of the ocean, conditions change when certain processes are disrupted. Changes are not always clearly or immediately evident or even predictable, but they are nearly always inevitable.

Because of the many land-sea-air interactions, various processes that happen on land and in the atmosphere – both natural and human-induced – can impact the natural processes that sustain life in the sea. During storms and other short-term weather changes, there may be minor changes in fish distribution, as fish try to avoid rough conditions. Climatic variations may affect the length of migration of some species. The quality of surface waters, groundwater and air even from hundreds of kilometers away affects the health of marine ecosystems. Solid matter from land is constantly being transported downstream with the flowing water as suspended load. Extremely high suspended load can cause siltation

that may be favorable to mangrove growth (by enriching its substrate) but can suffocate seagrasses and corals (by hampering respiration). Very high suspended load also significantly reduces light penetration and thus diminishes photosynthesis.

☞Glossary

As yet we don't know enough to fully understand many of the ocean processes, and we can only speculate at how the so-called **global warming** (and how much) could affect our fisheries. This much we know: Temperature changes alter the ocean's circulation patterns, which in turn may affect the variety and abundance of plankton, the main food source of fish. Dramatic changes in ocean temperatures can be extremely disruptive, sometimes completely obliterating some life forms. To illustrate, let us examine a natural phenomenon that we have already heard much about: the **El Niño**, defined by abnormally high temperatures that occur periodically in the Pacific Ocean off the western coast of South America. (Figure 2.16)

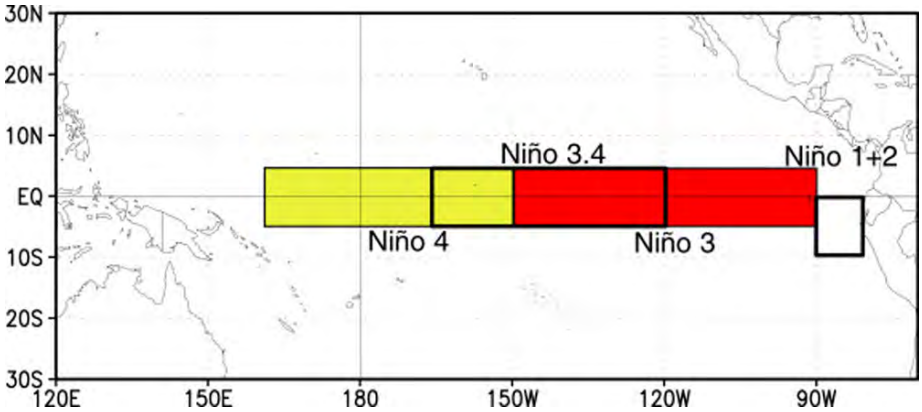


Figure 2.16. The El Niño region. The El Niño is officially defined as a phenomenon in a critical region of the equatorial Pacific Ocean referred to as Niño 3.4 region "characterized by a positive sea surface temperature departure from normal (for the 1971-2000 base period)… greater than or equal in magnitude to 0.5ºC (0.9ºF), averaged over three consecutive months." This region contains what scientists call the "equatorial cold tongue," a band of cool water that extends along the equator from the coast of South America to the central Pacific Ocean. (NOAA, 2005b). (Image: NOAA, 2005a)

☞Glossary p17

The waters off the South American west coast from the southern tip of Chile to the northern tip of Peru are one of the major **upwelling** systems of the world. This system supports a remarkable abundance of marine life and the world's largest fisheries, its high productivity fueled by the cold, nutrient-rich water brought to the surface by upwelling. Off the coast of Peru, upwelling normally occurs year-round, while off Chile, it happens only during the spring and summer months. The warmer-than-normal ocean temperatures during an El Niño disrupt this upwelling, significantly affecting fish abundance and distribution.

El Niño is Spanish for "little boy," which refers to the fact that the warming ocean conditions usually happen around the Christmas season. Often, the phenomenon lasts for only a few weeks to a few months, after which conditions return to normal. But El Niño episodes lasting five months or more have historically happened at intervals of between two

and seven years, each usually lasting one or two years. Long-lasting El Niño episodes (persisting for many months) have caused some fish stocks to collapse, as what happened to the Peruvian anchovy fishery during the 1982-83 El Niño (the El Niño was also suspected in the massive bleaching observed in various coral reefs in the Philippines in 1998).

But don't blame it all on the El Niño: Many experts believe that the Peruvian fishery collapse would not have come about had the fishery not already been weakened by overfishing (and in the Philippines, the 1998 bleaching incident might well have been caused by both human-induced and natural factors).

The Human Factor

Obviously, the El Niño is not something we can prevent, but we can mitigate its impacts. While we cannot stop an El Niño episode, there is much we can do to keep our fisheries healthy. We can regulate fishing effort to prevent overfishing, as indeed we can manage other human threats to the ecosystems that support our fisheries. Of the many variables that affect the health of a fishery, there is only one over which we truly have significant control: the human factor. And it is one factor that truly needs to be regulated.

☞Appendix 1

Everywhere we look where ecosystems are threatened and a fishery is in decline, we find heavy human hand. A major reason for the decline of fisheries in the Philippines is the degradation of fish habitats. Our mangrove area shrank from 450,000 hectares in 1918 to less than 120,000 hectares in the 1900s, largely due apparently to massive conversion to aquaculture (total fishpond area in the country now stands at about 289,000 hectares, most of which used to be mangroves). Some 30-50% of our once extensive seagrass beds have been lost to or severely degraded by dredging, sand mining and other direct and indirect human impacts (Fortes and Santos, 2002). And only about 5% of our reefs are in excellent condition, while more than 70% are in poor or fair condition, damaged by trawling, use of cyanide and dynamite and other destructive human activities.

Between 1990 and 1995, the number of people living within 100 km of the coast worldwide rose from about 2 billion to 2.2 billion, an increase of roughly 50 million every year (WRI, 2000). Not everyone is directly dependent on the sea for livelihood, but 2.2 billion people translate to tremendous amounts of agricultural, industrial and domestic wastes, most left untreated and ending up in the sea.

Pollution has persistent effects on the aquatic environment that usually cannot be contained in any one area. In highly polluted bays, heavy metals and herbicides are known to cause damage to seagrass tissues, and excessive nutrient load from fertilizers, mariculture feeds and household liquid wastes promote algal blooms, which consume oxygen and thus reduce its availability to other organisms. We have numerous fish kills on record, most of them traceable to the high nutrient load emanating from households and industries, and often, also from water-based activities such as **aquaculture and mariculture**. In some areas, the gradual disappearance of some species of fish, shellfish and crustaceans have been noted.

☞Appendix 1

Even land conversion that happens far inland can ultimately affect the marine environment. The denudation of our forests results in increased flow of water with high sediment load, which ultimately ends up in the sea. Extremely high sedimentation rates affect seagrasses and corals by increasing water turbidity, which limits sunlight penetration and therefore impairs photosynthesis. Trapped in the seagrass beds, high amounts of sediment can build up and eventually suffocate the plants. High sediment loads can also kill organisms that filter water through their gills to collect food.

Furthermore, the increased flow of freshwater into estuaries upsets the sea's salinity balance, as does the diversion of water upstream for irrigation purposes. Drastic changes in salinity affect the life cycle of many organisms, including mangroves, seagrasses, fishes and algae.

Clearly, we must identify and regulate those human activities, both land- and water-based, that result in habitat loss and damage the ecosystems that support our fisheries. These include fishing itself, the quantity of fish we take from the sea and the manner in which we take it.

☞ p7

In the early parts of this chapter, we looked back in history and saw a fishing industry that had the tendency to expand well beyond the capacity of the resource base that supported it, with disastrous results: **fish catch declines, and the collapse of once lucrative fisheries**. To achieve our goal of sustainability, we must understand how fishing impacts any fish population, and how much and what kind of fishing we can safely allow to keep that fish population healthy.

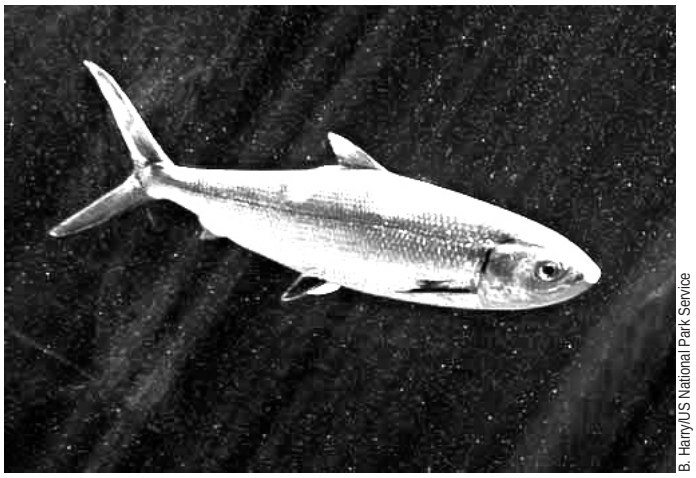
SO LET'S TALK ABOUT FISH

Let us now acquaint ourselves with what we call "marine fishery resources." If we go by the legal definition, the term refers to "any aquatic flora and fauna including but not restricted to fish, algae (including seaweeds), coelenterates (e.g. jellyfishes, corals, sea anemones, etc.), mollusks (e.g. shellfishes, squids, octopuses, cuttlefishes, slugs, etc.), crustaceans (e.g. shrimps, crabs, etc.), echinoderms (e.g. sea urchins, sea cucumbers, starfishes, brittle stars, etc.), and cetaceans (e.g. marine mammals)" (RA 8550, 1998) – meaning practically all living things we take from the sea for numerous uses, primarily food and income.

There are two main groups, namely, 1) demersal and 2) pelagic.

☞ Glossary

Demersal fishery resources are those found on the seafloor in benthic habitats such as coral reefs, seagrass beds, soft-bottom or muddy substrates, and mangrove areas. Some of the more commonly exploited demersal fishery resources include reef-dwelling fishes such as groupers and snappers, soft-bottom fishes such as the mullets and ponyfishes, and invertebrates such as lobsters, crabs, shells, and octopuses.



B. Harry/US National Park Service

Figure 2.17. Fish know no borders. When we say that pelagics are found in the water column and demersals on the seafloor, we generally mean they are *mostly* found there. Sea creatures have no boundaries, readily moving across so-called ocean realms and zones within their range at various stages in their life cycles. Indeed, some exhibit such clear and regular migration patterns between realms or zones that they are put in a class of their own.

Take our own bangus (*Chanos chanos*, also milkfish; in photo). A fast and powerful swimmer, bangus is **benthopelagic**, meaning, it lives near the bottom as well as in midwaters or near the surface, feeding on benthic as well as free swimming organisms.

Bangus is also **diadromous**, that is, it migrates between salt and fresh water. The adult fish spawns in the ***open sea***, so its eggs float, hatching into pelagic larvae. As the larvae develop, they move (or are perhaps carried by the tide) shoreward. Juveniles seek out protected, shallow waters where there is plenty of food, often finding their way to nutrient-rich ***brackishwater*** coastal habitats. Later they leave their nursery grounds to spend the remainder of their growing period until adulthood in ***freshwater*** lakes with extensions to the sea. They leave the lake before they are fully mature, reaching sexual maturity at sea where they spawn. (Garcia, 1990)

☞Glossary

Pelagic fishery resources are found in the water column or open sea, that is, the pelagic realm, and many move in large schools over great distances and even across oceans throughout their life cycle. This group includes the tunas, mackerels, roundscads, anchovies, and herrings (sardines).

A Living Resource

For purposes of fisheries management, the key thing to understand about fish is that they are biological resources. They need energy, food, water, oxygen and space. They can detect and respond to changes in their external environment, and within certain limits regulate their internal environment so as to maintain a stable, constant condition. They interact with their environment and with each other, even exhibiting social behaviors such as grooming and courting. They grow and develop. They reproduce. They may get sick. They die.

As biological resources, fish are renewable, meaning they have the ability to replenish their populations over time after being subjected to natural stresses such as predation, or human-induced stresses such as fishing. Such ability is however affected by both biological considerations and human exploitation. If, for example, the level of fishing effort is much higher than the natural ability of a fish stock to replenish its population, eventual collapse of the stock and even species extinctions may ensue. It is thus useful for fisheries managers to have at least some basic knowledge of the life-history traits of fish, and how these may be affected by fishing.

Two scientific principles behind the renewability of biological resources provide the basis for fisheries and wildlife management: 1) survival and 2) surplus production.

Every species must maintain a minimum population size required for its long-term viability – a population with a small number of individuals can suffer severe declines due to environmental, genetic and other factors (Cunningham and Saigo, 1997). The principle of **survival** refers to the capacity of all animals to produce more offspring than survive to adulthood, providing some insurance against the natural calamities that they face (Wallace and Fletcher, 2001).

☞Glossary

The principle of **surplus production**, on the other hand, is based on how a fish population reacts to the removal of older fish and other fish: the population grows as more of the smaller, younger fish (otherwise dominated by older, larger fish) are able to survive, which may result in an increase in the number of individuals beyond what is needed to maintain that population, that is, "surplus production" (Wallace and Fletcher, 2001).We will tackle these subjects in greater detail as we discuss the biology of fish below.

☞Glossary

Unless there is a particular need to be more specific, we will for the most part in this *Sourcebook* use "fish" as a general term for all fishery resources, including bony fishes and **invertebrates** (organisms that lack a backbone or spinal column, including crabs, lobsters, and shellfishes).

LIFE IN THE SEA (AS WE KNOW IT)

As we now know, ocean life is so very diverse it would be surprising if we would not find a huge variety of life-history patterns among the various species. Even so, because the life-history traits of various species are influenced by their living conditions, it is quite possible to describe some generalized life patterns for species that live under similar situations. Only a tiny fraction of the hundreds of thousands of marine organisms have so far been thoroughly studied by experts, but they show clearly that life in the sea is pretty much about what American author Joseph Campbell calls the "second law of life": Survival. (The first law, according to Campbell, is interconnectedness – "we are one.")

It's All About Survival

Most fishery species go through three phases in their life cycle: larval, juvenile and adult (Tissot and Hallacher, 2003; Figure 2.18). For the most part, life for the young individuals (larvae and juvenile) is about surviving to adulthood, and nature has equipped them with various mechanisms for survival. For the adults, it's mostly about reproduction, the whole purpose of which is to ensure species survival.

The duration of the larval phase varies among species, and is influenced by environmental conditions such as temperature, primary production, and availability of food, among others. For most reef fish species, the duration is about 20-30 days, but it can vary widely from a few days to a few months depending on the species, geographic region or season (Victor, 1991). Similarly wide variations have been observed in pelagic fishes – in the tropical and sub-tropical yellowfin, skipjack and bigeye tunas in the eastern central

Atlantic, the larval stage lasts only about 15 days (Cayre et al, 1993); in Atlantic herring it can last up to 11 months (GMA, 2009).

Individuals start out as eggs before hatching into larvae. Especially in the tropics where there is an abundance of food, larvae are mostly pelagic. Most tropical fish larvae appear to feed on plankton, particularly zooplankton (Hallacher, 2003 and sources therein), thus high concentrations of larvae can be expected to occur in areas of high photosynthetic production that yield an abundant source of zooplankton and phytoplankton. Light being a vital component of the energy transfer process, feeding happens mostly during the daytime (Leis, 1991).

Pelagic larvae float in the open water as a component of marine plankton, which allow them to efficiently disperse and locate suitable habitats for their adult life (Johannes, 1978). This, however, makes them highly vulnerable to being eaten by predators. Mortality among pelagic larvae is very high, with close to 100% of larvae lost to predation by other planktonic organisms and adult fishes (Hunter, 1984; Leis, 1991). But, following the principle of survival, most species are genetically wired to survive high mortality by producing huge numbers of eggs, so there normally are enough surviving larvae that eventually develop into adults. A female fish, for example, can lay up to well over one million eggs (Sale, 1980).

Species that do not lay as many eggs exhibit other reproductive strategies to ensure species survival. Pelagic sharks, for example, produce only a few eggs or embryos but these are retained in the female fish for a much longer time so that at birth or hatching, the young are large enough to fend for themselves and be immune to most potential predators. The whale shark (*Rhincodon typus*) embryos develop inside egg capsules within the female adult, feeding on the egg yolk. At size 59-64 cm the embryos then shed their egg case and are born as live young individuals into the water (Joung et al. 1996; Dulvy and Reynolds 1997).

In deep-sea habitats and areas where productivity is limited to very short warm seasons, some benthic invertebrates produce fewer but bigger eggs with large yolks**.** Having large yolks means the larvae do not need to rely too much on plankton for food and thus spend less time among plankton than pelagic larvae do. This makes them less vulnerable to being eaten by predators, although it also means they have less ability to disperse. Other marine invertebrates in cold and deep-sea water invest in very few eggs with very large yolks. Their larvae are ***non-pelagic***, develop in the eggs and hatch as juveniles. This means zero plankton mortality, but also very little or no dispersal (Nybakken 1982).

☞Glossary

In demersal species, the ***juvenile phase*** begins when the young fish settle onto a benthic habitat in a process called **recruitment**. The size at settlement for most reef fishes is between 7 mm and 12 mm length, but varies widely among different fishes from 8mm to 200 mm length (Leis, 1991). Currents, tides, waves, and winds assist the transport of pelagic larvae back to reef environments for their juvenile phase, but not all reef fishes immediately settle in reefs. Some fishes are initially recruited to estuaries (Keener et al, 1989), seagrasses (Bell et al, 1987), and mangroves (Lindeman, 1989), and then later migrate to reef areas.

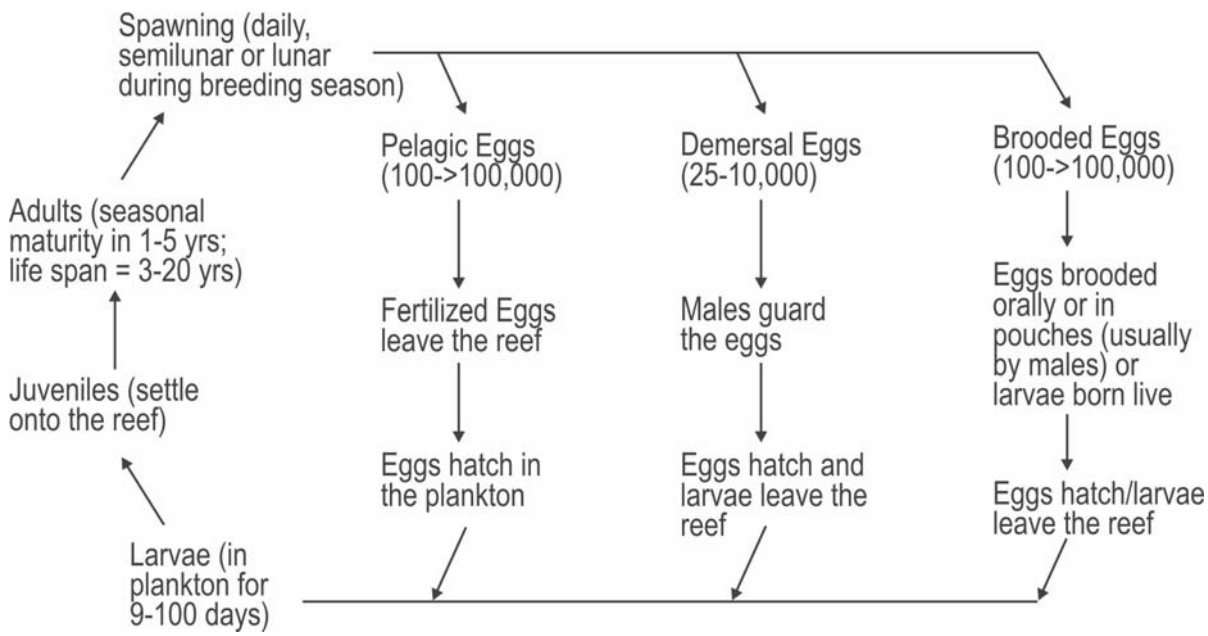


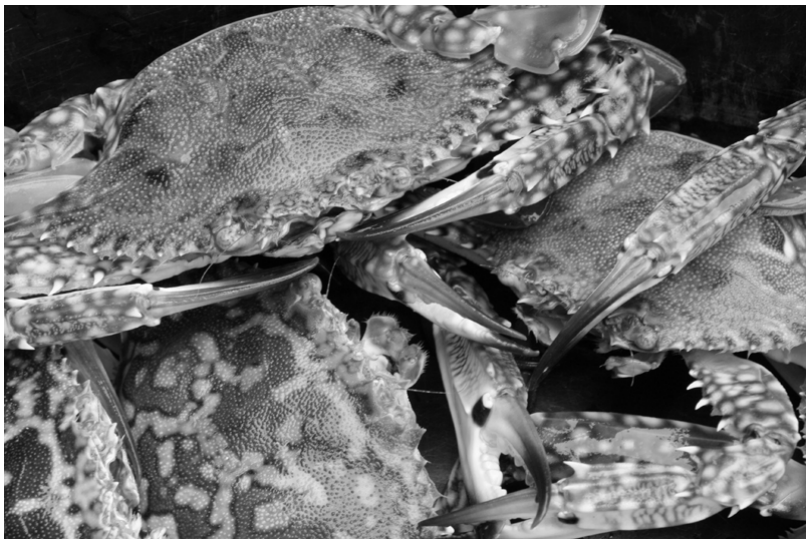
Figure 2.18. Life cycle of coral reef fishes. Fish species generally have a three-phase life cycle, going through larval, juvenile and adult stages over the their lifespan. This diagram shows the life cycle of reef fishes. (Image modified from Hourigan and Reese 1987)

☞Glossary

These settlement areas are called **"sinks"** or, more often, "nursery areas" (as opposed to **sources**, also referred to "spawning areas").

As in the larval phase, survival dictates where and how recruitment happens. Like all living organisms, fishery species are genetically wired to respond to their environments in a way that will improve their survival rates. For example, taking advantage of the darkness to minimize predation, most settlement of reef fish larvae probably takes place at night (Robertson et al, 1988). For some fishes, settlement appears to occur during certain phases of the lunar cycle, say, around the time of the new moon, when the night is darkest, and tidal cycles assist migration toward the shore.

Settlement areas basically provide the young individuals with some essentials for survival: shelter and hiding places from predators, such as in intricate coral branches and mangrove root systems (Parrish, 1989; Robertson and Blaber, 1992); reduced predation risk, such as in turbid or shallow waters where there are fewer large fish-eating predators (Blaber, 1997; Robertson and Blaber, 1992; Odum and Heald, 1972; Ogden and Ziemann, 1977); or an abundant food supply, such as in mangroves and seagrass beds with high vegetation cover (Odum and Heald, 1972; Ogden and Ziemann, 1977).



J Unson / FISH Project (2006)

Figure 2.19. Crab's life. Benthic crustaceans such as marine crabs and lobsters start out as a mass of dark colored eggs attached to their mother's abdomen, where they are fertilized and develop over several days (crabs) or months (lobsters), changing color to yellow, then orange and brownish. In time, they are released into the water column as pelagic larvae, sometimes in batches to improve survival rate. As with other organisms that undergo a pelagic larval stage, mortality is highest at this point in their life cycle. Relying primarily on water currents for movement and dispersal, the larvae form part of the marine plankton, and are highly vulnerable to predation.

How long the larval phase lasts varies by organism and is highly influenced by the water temperature. The larvae go through a number of changes in form and structure (metamorphosis), developing a hard outer structure (exoskeleton) and then shedding it (molting) several times before they become juveniles.

In the juvenile stage, the young individuals have fully acquired the basic physical form of the adults. They begin to settle onto bottom substrates inshore, their growth still accompanied by molting, which becomes less frequent as the individuals grow older but continues through sexual maturity.

Adults move from the coast to offshore islands and reef areas in deeper waters to mate and reproduce. Shortly after molting when the female's shell is still soft, the male deposits packets of sperm into the female. The female stores the sperm until she extrudes her eggs out to be fertilized. The fertilized eggs remains attached to her abdomen where they develop and eventually hatch into larvae to start the cycle anew.

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A well-known strategy among both pelagic and demersal fishes is **schooling**, a prevalent behavior exhibited by almost 80% of the more than 20,000 known fish species during some phase of their life cycle (Stout, 2005). Young pelagic fishes might migrate shoreward, collecting in dense schools near the water surface, perhaps hiding under docks or piers to avoid predators. Many spend part or all of their juvenile lives in inshore waters, before moving offshore to join schools of adult fishes.

Schooling provides some safety against predation, allowing individuals to hide behind each other, or confusing a predator by a school's sheer size or the changes in shapes and colors presented as the school swims along. Predatory fish also gain from schooling because it gives them the ability to travel in large numbers in search of food (Stout, 2005). Sadly, the world's fishing industries have taken advantage of this behavior pattern to catch prized species such as tuna in huge volumes, often beyond sustainable levels.

The ***adult phase*** is marked by the onset of sexual maturity, representing the period during which individuals enter the reproductive population. This is indicated by the first development of the gonads or sex organs – ovaries for the females and testes for the males.

The onset of maturity is usually related to the attainment of a particular size. Fishery species in the tropics attain sexual maturity earlier than those found in the temperate and polar regions. Generally, the slower a fish grows, the later would be its onset of maturity, and vice versa. Fishes that attain larger sizes tend to mature later also.

Spawning patterns

Different species spawn at different times and frequencies, and spawning seasons vary from one geographical area to the next, even within the same species. Spawning seasons tend to be more distinct in colder climates, where seasonal trends are highly pronounced. In the tropics, lunar and diurnal patterns (tidal and light-dark cycles) appear to be the more dominant factors influencing spawning in reef fishes, while in pelagic fishes, it is the onset of and shifts in the monsoon seasons.

As a rule, fishes take advantage of the best local conditions to ensure maximum spawning success. For most reef fishes, spawning follows the rhythm of tides related to the lunar cycle, which transport the larvae offshore and away from predators or act as a dispersal mechanism for the larvae to find suitable habitats on which to settle. Many spawners might also respond to favorable food and light conditions associated with certain lunar phases, and others minimize risk from visual predators by spawning at dusk (Polunin and Roberts, eds. 1996).

Pelagic fishes travel long distances to find food or to spawn in places that are suitable as nursery areas for small fish. The periodicity, location, and intensity of their spawning are therefore likely influenced by sea conditions in a particular region that result from the onset of, or shifts in monsoon seasons.

In the Philippines, the recruitment and spawning of small pelagics coincide with changes in the monsoon winds (Pauly and Navaluna, 1983). Possible spawning months for roundscads (*Decapterus* spp.) caught in Palawan waters are November through March based on the abundance of mature individuals during this time of the year (Tiews et al, 1975a); spawning in Manila Bay also appears to start in November, perhaps lasting until May. These months mark the shifts in the Philippine monsoon seasons. In other parts of the world, spawning events for roundscads coincide with the end of the wet and dry seasons, transitions during which food becomes abundantly available after nutrients from land sources are washed into the sea by rain runoff.

Three species of anchovies (*Stolephorus* spp.) are known to spawn throughout the year in the Indo-Pacific region, but peak spawning activity is associated with the onset of the northeast monsoon season (Tiews et al, 1975b; Dalzell and Wankowski, 1980). Similarly, tropical sardines show considerable variability in spawning seasonality and locations throughout the year, with spawning intensity peaking with wind and rain (Weber, 1974). Just as rain-bearing monsoons bring high nutrient loads to coastal waters, winds may cause seasonal **upwelling** that increases the productivity in the sea.

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It is clear from everything we have discussed so far that fishery species are sensitive to changes in their environment. We now know that fish size, age at maturity and egg production are affected by environmental factors – lack of food or poor food quality, too low or too high temperatures, or toxic elements in the habitat – that weaken the health of fish populations. In the Philippines, it has been shown that reef fisheries, for example, lose much

of their productivity in areas where siltation is prevalent. In 1995, the coral reef fishery of the Lingayen Gulf was reported to have lost an estimated Php6.17 million in revenues due to damage caused by siltation on coral reefs in the area (Padilla et al, 1997).

Furthermore, scientists are finding increasing evidence that fishing itself has caused – and continues to cause – perhaps the most significant changes in fish populations, with long-term repercussions that may not be easily discernible now, but could irreversibly undermine still apparently productive fisheries.

Surplus Production

☞Glossary

Note that every habitat has a **carrying capacity**, that is, a maximum number of individuals that can be supported over the long term by the food, water and other resources available there. Below carrying capacity, populations would typically increase, while above, they would decrease.

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Note also that every biological population in the wild has a **minimum viable population (MVP)**, that is, the smallest possible size at which it can exist without facing extinction from natural disasters or demographic, environmental or genetic factors (Wikipedia.org, Minimum Viable Population). Below MVP, the risk of extinction of a population drastically increases.

Now picture if you will an un-fished population. Maximizing the use of available resources in its habitat, such population would be at or close to carrying capacity. As a rule, it would have a lot of older, larger fish and fewer young, immature individuals, as the older fish would dominate the habitat and prevent all but a small percentage of young fish from surviving to become old fish (Wallace and Fletcher, 2001). Assuming adequate food and other resources in a healthy habitat, it would also have more than the number of individuals it would normally need to persist over time, which in turn suggests that you can remove the "excess population" – or **surplus production** – and still have enough fish left to keep the population viable in the long term. (Figure 2.20)

☞Glossary

WHAT ABOUT FISHING

So let's put fishing in the picture. When fish are removed, the population falls below carrying capacity. Food and other resources necessary for growth become more available, allowing a bigger number of young fish to survive, reach reproductive age, spawn and produce their own offspring, thus replacing the spawners and offspring that were "lost" to fishing.

In an ideal world, we would harvest only the surplus production, and allow the rest to survive and reproduce to ensure a viable population. Or, if by some miscalculation we harvest more than the surplus production, we would stop fishing long enough so that the population is able to recover. But of course we know in the real world this is not always the

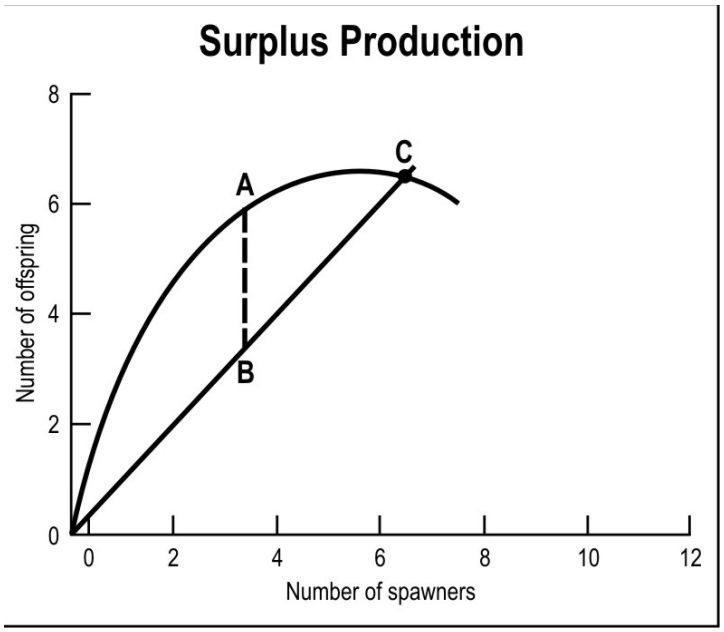

Figure 2.20. Surplus production. This graph illustrates the concept of surplus production. Point C is the habitat's carrying capacity, beyond which the population cannot grow any bigger. The straight line 0 to C represents a scenario where one offspring is produced for every new adult that is added to the spawning population. The curved line represents the typical situation: Initially, as more young individuals join the adult population, the number of offspring increases more rapidly than the number of spawners.

When the spawning biomass approaches the habitat's carrying capacity, that is Point C, competition for resource becomes tighter, and the addition of new spawners will contribute few offspring. At Point C, the carrying capacity is reached, with spawners and offspring in balance. Moving to the right of Point C, the population will overshoot carrying capacity and further increases in spawners do not necessarily result in more offspring. Fewer offspring will survive, and the population moves back toward carrying capacity.

When fishing begins on an unfished population, biomass is close to carrying capacity. As fish are removed, the population responds by increasing the number of offspring, as represented in the graph by the distance between the straight line and the curved line – this is your surplus production. Surplus production is greatest at Point A, the maximum distance (line A-B) between the curve and the straight line – this would be the MSY available from this theoretical population. If more fish are removed, the population moves to the left of A, which means less production as more spawners and offspring are being taken out than can be replenished by the population. Unless fishing stops and the population is given enough time to rebound, the stock becomes overfished and may eventually collapse. (Adapted from Wallace and Fletcher, 2001)

case. In the real world, fishing often removes both spawners and offspring faster than they can replace themselves (Wallace and Fletcher, 2001).

☞Glossary

Scientists have long used the surplus production model to estimate the maximum catch that can be taken from a fish stock over an indefinite period, called **maximum sustainable yield** (MSY). The classic model assumes that MSY will be exactly at half the carrying capacity of a species, as this is the stage when population growth is highest (Figure 2.21). But, in most modern fisheries models, MSY usually occurs at around 30% of the unexploited population size, and differs among populations depending on the life history of the species and age-specific selectivity of the fishing method. At MSY, there is the same

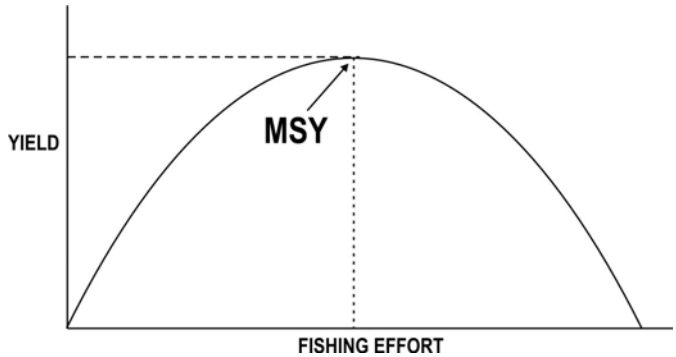

Figure 2.21. Maximum sustainable yield. The MSY model assumes that a fish population has surplus production that can be removed continuously from the stock without depleting the stock. Based on this model, enough parent stock (spawners) would be left in the stock after the maximum amount of surplus production, or maximum sustainable yield, is removed, allowing to stock to reproduce the required number of offspring and compensate for losses due to fishing. If removal is not controlled, however, the stock will decrease to a point where there are not enough individuals left to produce the needed number of offspring to replace those lost to fishing.

amount of new fish added to the stock as that removed from it, and the balance between addition and removal is maintained. Beyond MSY, the balance is disrupted: There is more removal than addition to the stock. The yield will then start to decrease even if we continue to increase fishing effort.

The problem with MSY is that it is difficult to estimate with precision how much surplus production a fish population really has, if at all. Management strategies based on the wrong estimates have caused a number of fisheries to become depleted. The New Zealand orange roughy fishery, for example, set early quotas based on the assumption that the orange roughy had a fairly short lifespan and bred relatively quickly. Later, managers found out that the species in fact live long and breed slowly (about 30 years). But it was too late: At that stage, stocks had already been largely depleted. (Wikipedia.org, Maximum Sustainable Yield)

The US West Coast groundfish fishery, once touted as one of the world's best managed fisheries, also failed, apparently because MSY estimates were based less on science than on political demands, because "science [was] subservient to politics" (Johnson, 2007). Still, despite its deficiencies, MSY continues to find some use in fisheries management, providing a scientific basis (or at least an argument) for setting limits on fishing effort.

Russell's Axiom

A quick summary:

1. As a biological resource, a fish population is regulated by carrying capacity and tends to establish balance: below carrying capacity, the population increases; above carrying capacity, it decreases.

2. When we harvest fish, we lower the size of the population below the carrying capacity of its habitat; the population responds by increasing the number of offspring so that it moves toward carrying capacity.
3. We can continue to harvest fish for as long as we want, *provided* we can maintain the ability of the population to replenish itself and move toward maximum carrying capacity.

Russell (1931) used these concepts to devise a graphic illustration that depicts the fish stock as a management unit, and explains the factors that cause that unit to increase or decrease. ***Russell's Axiom***, as it is popularly known, focuses less on geographical boundaries than on the processes that influence the stock. This allows us to zero in on the major processes minus the distraction of dealing with the complexities of the minor processes involved.

The stock, represented by a rectangle in Figure 2.22, may refer to a group of different species or organisms that constitute an ecosystem or it may refer to a particular population of a species. "Stock" therefore may mean a school of herring in Manila Bay, or all the organisms that inhabit Tubbataha Reef in Palawan.

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In an ***unexploited, closed*** system isolated from other bodies of water (Figure 2.22-A), the stock will increase through the ***growth*** of each individual member and the production of new individuals (**recruitment**). And it will decrease when individuals die from natural causes (**natural death** by old age, ailment or predation). These factors are a function of carrying capacity (availability of food and other resources) and normally offset each other to maintain balance in the system.

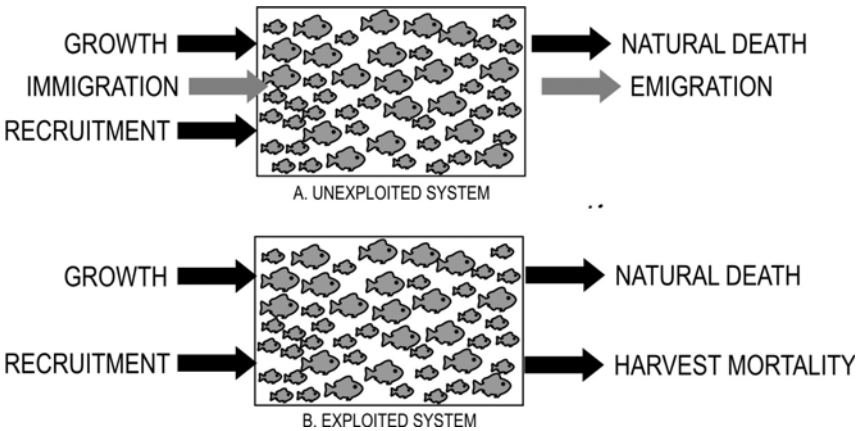

Figure 2.22. Russell's Axiom. This diagram depicts Russell's Axiom (Russell, 1931), which defines the fish stock as a management unit. A fish stock may be confined to a specific body of water, say a lake, a bay, or an ocean. Its size or biomass is regulated by carrying capacity and influenced by a number of factors. In an unexploited system, growth and recruitment increase the stock; natural death decreases it. If the system is open (i.e., it is connected to other bodies of water), the stock may also increase with immigration, and decrease with emigration. When the system is exploited, in particular through fishing, harvest mortality comes into the picture, and it contributes to the reduction of the stock. Normally, the stock will seek a state of balance or equilibrium, and will invariably move toward its habitat's maximum carrying capacity. Below carrying capacity, the stock increases; above, it decreases.

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Typically, a water body is an **open system**, that is, it is physically connected to other systems and thus allows organisms to move in and out, or **migrate**, between systems. Thus in an open system, two other factors are at play besides recruitment and natural death: **Immigration** (moving in) increases biomass in the system, while **emigration** (moving out) decreases it. When the system is in a **steady state**, immigration and emigration are equal, cancel each other out, and thus can be conveniently eliminated from the equation. Normally, an unexploited system is in a steady or balanced state.

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The ***exploited system***, however, is of greater interest to us. The modified diagram of Russell's Axiom shown in Figure 2.22-B depicts how fishing in particular might impact a fish stock – by removing individuals from the stock, it reduces biomass. The stock will seek a steady or balanced state by producing new recruits, some of which then become available for removal by fishing, starting the process of recruitment all over. Indeed, for as long as the rate of removal (**harvest mortality**) does not exceed the stock's capacity to replenish itself, fishing will be sustainable and can go on indefinitely.

Age-Size Effects

If the harvest mortality does exceed the rate of natural replenishment of a fish stock by growth and entry of new individuals, overfishing sets in and the stock naturally goes into decline. The decline may not be immediately visible – as has been stated, the population typically compensates for the removal of bigger spawning individuals by increasing the number of recruits or offspring. But if the high mortality rate is not reversed, the decline becomes more persistent with permanent repercussions, and the stock eventually collapses.

Observations from heavily exploited and collapsed fisheries have led scientists to conclude that some stocks are now maturing earlier than what was considered "normal" 50 years ago, and they believe overfishing is the main culprit. When the bigger fish are removed, smaller, younger fish dominate the seeding of the next generation. They become sexually mature earlier, producing some offspring that are also small and early maturing (Daley, 2001).

"It's like (eliminating) all the people who are 7 feet tall, they will become rarer and rarer and you'll have only small people left… if you look at cod populations and other fisheries, they are maturing earlier. And the only common factor is overfishing" (Daley, 2001).

Older and larger female fish have larger body cavities with larger ovaries, and thus produce exponentially more eggs than do the smaller fish (Palumbi, 2004). For example, a single 61cm long red snapper (*Lutjanus campechanus*) has been estimated to produce as many eggs as 212 smaller 43cm long snappers (NMFS, 1990). Yellowfin releases a greater number of eggs than skipjack, as its size at reproduction and the size of its ovaries are greater than those of skipjack (Cayre et al, 1993).

Furthermore, older and larger females of a fish species appear to make better eggs than the younger, smaller individuals because they produce larger oil droplets, a source of food for fish larvae after they are hatched that increases their chance of survival.

Scientists have yet to determine if the early onset of maturity is a true genetic or evolutionary change, or a short-term adaptation that will end when the fishing pressure eases. They also have not discounted that other factors – the availability of food and pollution, for example – may have contributed to the change in fish size or maturity.

Whatever the case, it is the fisheries manager's job to ensure that a fish stock has enough fish of different ages to ensure the species' survival. Scientists warn that, if genetic change is indeed happening, fish that spawn earlier could produce offspring that are smaller in size and less viable, producing fewer and fewer fertile offspring so that the fishery could eventually collapse (Daley, 2001).

Keeping the different ages available in a fish population is especially critical in reef fisheries because many of the commercially important reef fish species undergo sex change or sex reversal (Charnov, 1982). Some species start out as juvenile females then later change into males; these include certain species of angelfish (Chaetodontidae), emperorfish (Lethrinidae), parrotfish (Scaridae), wrasses (Labridae), and grouper (Serranidae). Others change from males to females within their lifetime, such as porgies (Sparidae), snooks (Centropomidae) and flatheads (Platycephalidae).

When specific size ranges of any of these species are targeted and fished heavily, the balance of the sexes is upset, impairing the population's ability to replenish itself. Excessive size-selective harvesting is especially problematic for slow-growing species that cannot compensate quickly for the loss of individuals of one sex group, thus decreasing spawning success (Figure 2.23).

It is advantageous to optimize the size of fish caught by ensuring that young individuals reach their optimum size and reproductive potential and that sufficient

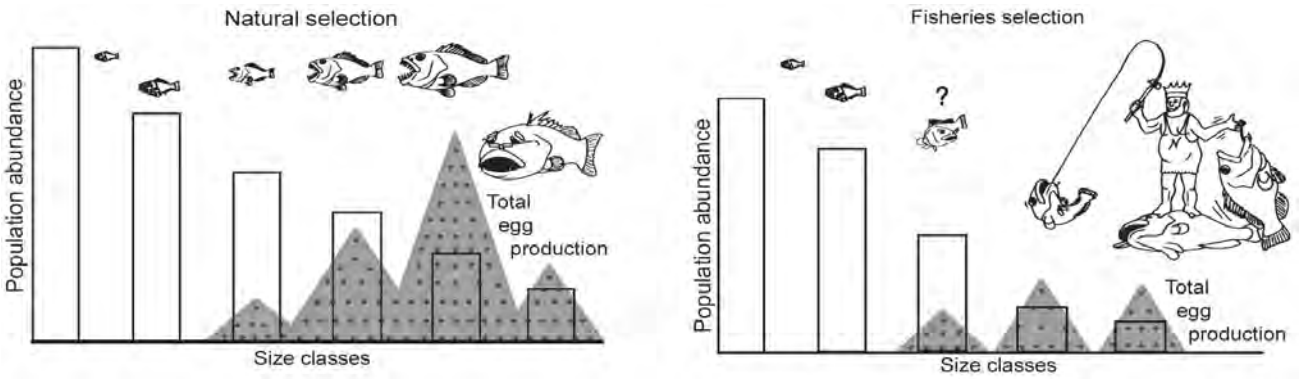

Figure 2.23. Age-size effects of fishing. The diagrams above show what might happen when specific size ranges (usually the larger sizes) in a fish population are heavily harvested. When large, more productive individuals are taken from a fish population, egg production is greatly reduced. This is especially true for many commercially important coral reef species that undergo sex reversal. In particular, slow-growing species often cannot compensate for the loss of individuals of one sex group. Fewer eggs are produced, and the population begins to decline. (Green et al, 2003)

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populations of large adults are maintained. But, as we know only too well, non-target sizes of the desired catch – and indeed non-target species – often end up as **bycatch** in fishing operations, or get injured and die from contact with the fishing gear underwater (**incidental mortality**). Knowledge of the size and age at first maturity of exploited fish stocks will help fishery managers design management measures that will ensure sufficient numbers of juveniles will reach maturity and be able to reproduce.

Ecosystem Effects

Now remember that fish are interactive organisms: They interact with each other and their environment through, for instance, food chains and webs. To function properly, the marine ecosystem requires a mix of fish of various species, sizes and age. This means that we cannot expect the impacts of removing fish stocks from the system to end with that particular resource alone. The loss of one group of organisms from a food web may disrupt predator-prey or trophic interactions, and even affect the carrying capacity of a habitat for certain species.

So, yes, carrying capacity – and therefore surplus production and MSY – is not constant. It changes with environmental conditions, sometimes temporarily, such as when water salinity decreases after a heavy rainfall, and sometimes irretrievably, such as when a habitat is permanently altered. And it can change drastically with the removal of even a single species, especially when that species plays a critical role in maintaining the structure of its ecological community.

In some cases, the decline in populations of organisms that act either as predator or competitor to other organisms has resulted in population explosions of "pest" organisms. A classic example is the sea star, a major predator of mussels and sea urchins. In his frequently cited paper "*Food web complexity and species diversity*," Paine (1966) noted that, when the sea star was removed from Mukkaw Bay in Washington State, USA, the mussel population exploded uncontrollably, driving out most other species, while the urchin population annihilated coral reefs.

Also, when fishing directly impacts the habitat – for instance, when trawling destroys the sea bed, or when dynamite fishing turns productive reefs to rubble – the habitat becomes less livable overall, and the fish stock is dealt a double whammy. Besides losing a large percentage of individuals, the stock must learn to survive in a degraded habitat. The alteration of habitats may cause a series of direct impacts to fish populations such as disrupted life cycles, diminished food availability, loss of shelter, and increased susceptibility to stresses such as natural predators and fishing.

Poor living conditions translate to lower carrying capacity for at least some populations, which allows other populations or trophic levels to dominate, changes overall species composition or decreases species richness, and alters the general ecosystem structure and function. Populations directly affected soon decline, and this may trigger a series of other unintended ecosystem effects such as loss of closely interdependent groups,

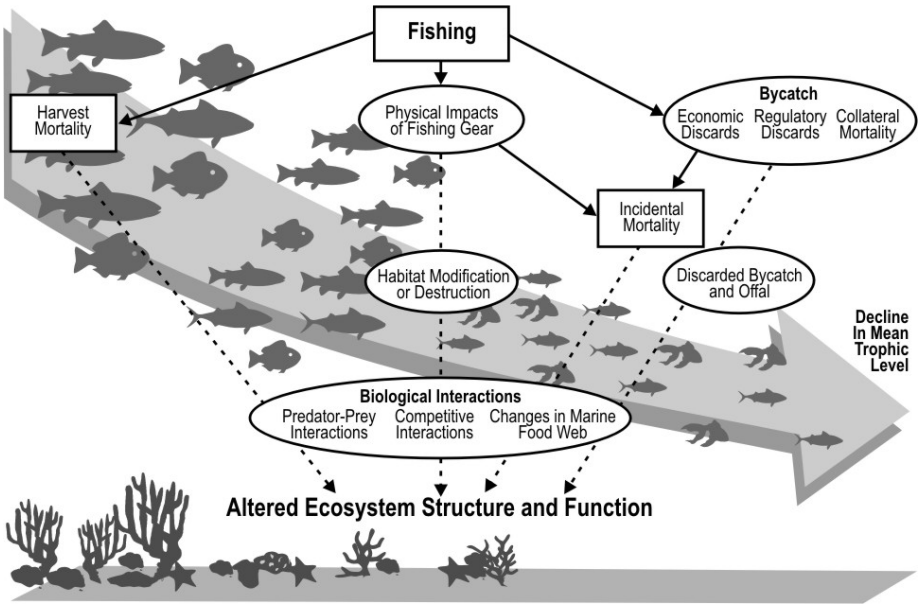

Figure 2.24. Ecosystem effects of fishing. Excessive fishing, combined with the destructive effects of some gear on fish habitats, results in changes in the ecosystem structure and function that have caused many fisheries to decline, and in some cases, ultimately collapse. (Image adapted from Dayton et al. 2002)

decrease in biodiversity, and reduced total system productivity (Figure 2.24). In short, the system will not be able to support sustained fish yields in the long run.

There have been many cases of various fisheries collapsing around the world. We made brief mention of the orange roughy (New Zealand) and groundfish (US West Coast) fisheries, but perhaps the most well-known is Canada's cod fishery.

In 1992, after years of overfishing, the once highly productive "northern cod" fishery off the province of Newfoundland and Labrador fell so dramatically that the Canadian government declared a moratorium on cod fishing to allow stocks to recover. The moratorium, which cost more than 40,000 people their jobs, was thought to be a short-term measure. To this day, it remains largely in place – despite over a decade of drastic conservation measures and severely limited fishing, the stocks have not recovered as expected. Some experts are now saying that the crash may be irreversible: even if left alone, the northern cod may never recover because the population appears to have undergone genetic changes that may have permanently altered its reproductive capacity (MCBI, 2001; Carpenter, 2009). Meanwhile, fishers have turned to alternatives further down the food chain, harvesting once "under-utilized" species such as herring, eel and skates so intensively that even these have become scarce (MCBI, 2001).

Fishing Down The Food Web

Fishing down the food web – or "serial depletion," as some would call it – refers to the situation where, as prized species become less abundant, fishing shifts from the prized species to related, but perhaps less valuable, species, and then, as each species is depleted,

moves further and further down the food web (Dayton et al, 2002). This is what has happened (and continues to happen) in many of the world's fisheries. After large carnivores – the top predators – were targeted and depleted, effort shifted to smaller fish and so on in a downward spiral through the food web, resulting in large-scale changes in fish stocks and creating dramatic fluctuations as certain species are removed and as predators, prey and other species modified their behavior to fill gaps in the food web. Indeed, fish catch records show that only a few decades ago, fisheries looked very different from what we have today (Myers and Worm, 2003).

For example, in Tañon Strait in Central Visayas, the main fish caught in the 1960s, the high-value rainbow runner, is now almost totally replaced by the lower-trophic and lower value scad. Small tunas (frigate/bullet tunas), the dominant fishes in the 1980s, have given way to round scads, which occupy a trophic level at least several layers down the food web. What's more, the volume of invertebrates like squids has increased significantly, indicating that, besides the top predators, middle-level predators have already become depleted (Green et al, 2004).

It could be worse: The scientific community has obviously just scratched the surface of the world's overfishing problem. Reports are still coming out about how the effects of overfishing may be more severe, more persistent and more widespread than previously thought, and they all add new dimensions to the ever more complex picture of overfishing, revealing increasingly bigger gaps in our current knowledge of the problem.

DISSECTING OVERFISHING

Fortunately, there is at least enough world experience in fisheries management to help us resolve many overfishing issues using only the best available information. To help toward understanding and finding solutions to the problem, scientists have clarified overfishing by breaking it up into components that are more or less consequences of each other, namely, growth overfishing, recruitment overfishing, ecosystem overfishing, and economic overfishing.

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Growth overfishing happens when fish are caught below the size or age required for reproduction (Figure 2.25). It is usually the effect of low egg and larval survival resulting from habitat destruction and using small mesh nets and inappropriate fishing gear which catch fishes when they are young, thus preventing them from growing and increasing population biomass.

Sometimes growth overfishing happens as a consequence of bycatch. This is true for fisheries that target species such as *Acetes sp.* ("alamang") that do not grow bigger than a few centimeters. Fishing is done using fine mesh nets, which are allowed under the law for specific small-sized species but unfortunately also catch larvae and juveniles of other species. Bycatch can be reduced by limiting the use of fine mesh nets to the season in which the target species appear.

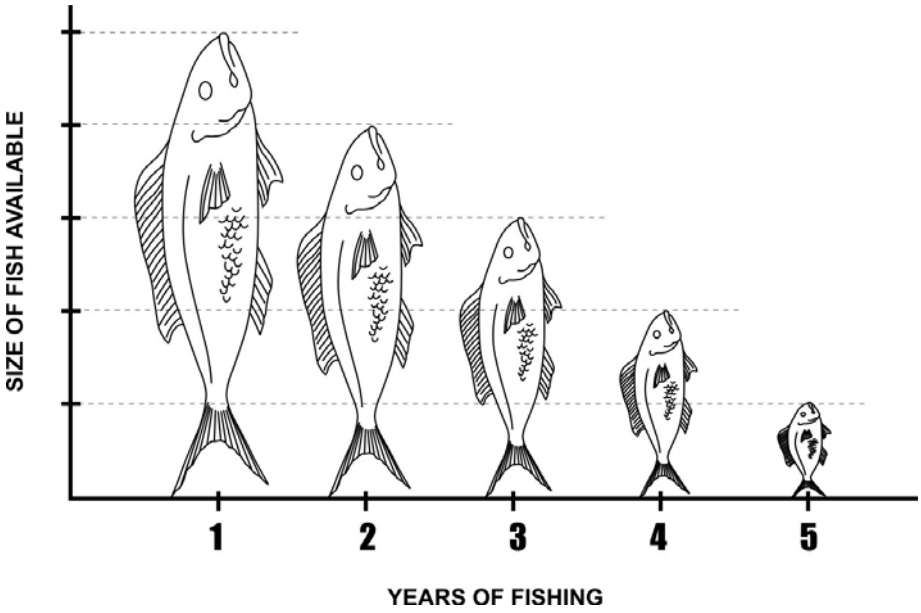

Figure 2.25. Growth overfishing. When there's growth overfishing, the size and volume (and perhaps price) of fish reaching the market are smaller because fish are caught when they are very young, before they reach optimal growth. (Green et al, 2003)

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If growth overfishing is left unchecked, it can lead to **recruitment overfishing**, a situation where the population is left with too few adults that the production of eggs and larvae is severely reduced, and recruitment is impaired (Figure 2.26). Mainly it is caused by extremely high fishing intensity that tends to reduce the parent stock (either both or one of the sexes). In a fishery showing recruitment overfishing, the majority of certain species caught are juvenile, as most of the adult fish have already been caught.

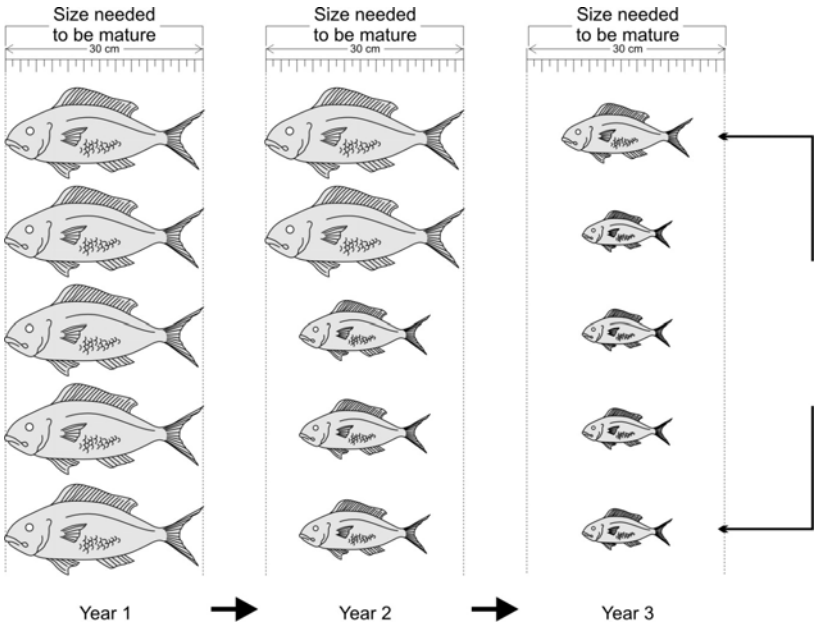

Figure 2.26. Recruitment overfishing. In recruitment overfishing, adult fishes are heavily fished. With the remaining fish mostly young, immature and unable to produce the next generation, the fishery becomes much less productive. (Green et al, 2003)

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If a population becomes so severely depleted as a result of recruitment overfishing, **ecosystem overfishing** may ensue. We have established that because of the close interdependence of various species in the marine ecosystem, fishing out a species can alter ecosystem structure and balance and ultimately lead to profound changes in the fishery. In a multi-species stock, the end effect is a change in the composition of the species mix. In most cases, the species composition changes from a mix of large species to a mix of relatively smaller species, which cause fishers to catch more individuals to maintain production. Ecosystem overfishing is deemed to have occurred when the mix of smaller individuals cannot compensate for the loss of larger species, making the fishery no longer fully functional and less productive. (Figure 2.27)

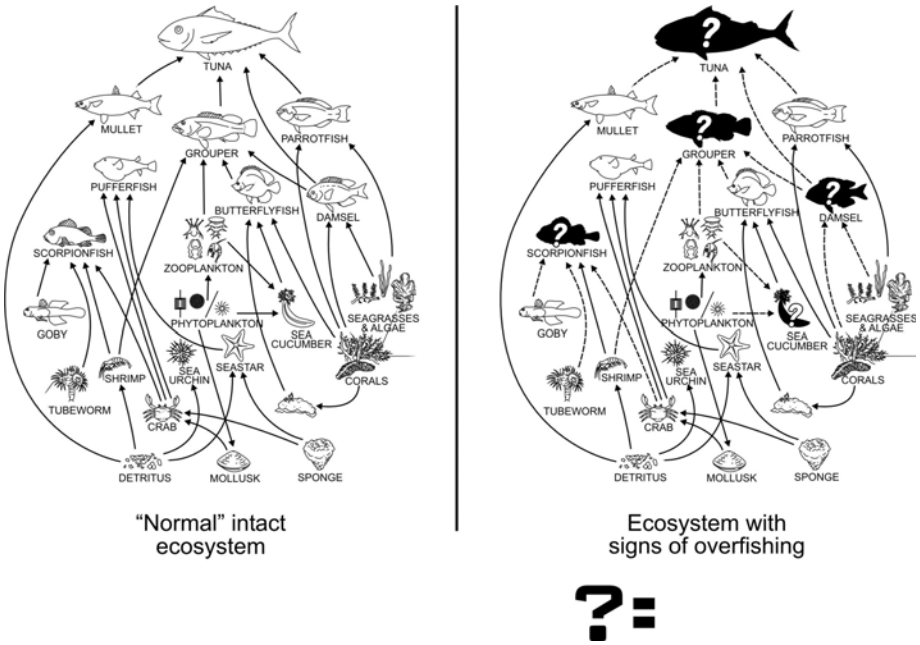

Figure 2.27. Ecosystem overfishing. The depletion of one or more species can alter the structure and function of the ecosystem, which then results in changes in fish composition that significant reduce the productivity of the fishery. This situation is called ecosystem overfishing, depicted in the above right diagram. (Green et al, 2003; King, 1995; White, 2001)

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The fishery can deteriorate to the point where it no longer produces any economic yield. This is called **economic overfishing.** In general, economic overfishing refers to a situation where the fisheries are overinvested, have limited returns, and are unprofitable overall. The situation is not always as clear-cut, however. The fishing business as a whole may run at a loss, but because the returns are not evenly distributed, some sectors are affected more than others. A sure sign that economic overfishing is happening is when the total economic value of all the fishing paraphernalia and equipment exceeds the maximum fish catch that the fishery can sustain (Figure 2.28). (Green et al. 2003)

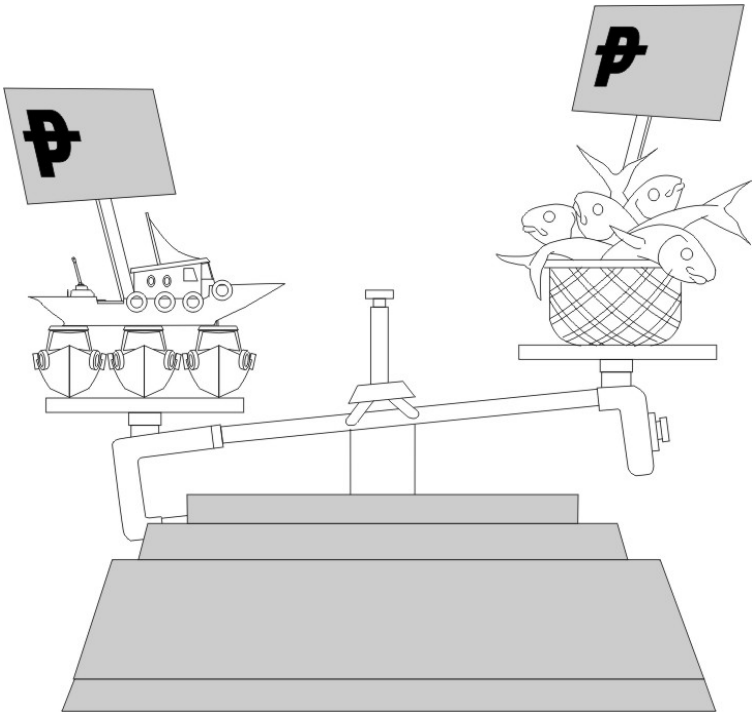

Figure 2.28. Economic overfishing. When fisheries are no longer profitable, and the value of fish caught (right side of scale) is less than the cost of producing it (left side), the situation is called "economic overfishing." Economic overfishing is believed to be happening in many of the world's fisheries, which remain viable only because they get various forms of government subsidies – access to cheap credit, inflated prices for their products, capital and infrastructure programs, tax breaks, trade agreements and price support programs. At the turn of the millennium, developed countries were spending US$124 billion in subsidies for commercial fleets to catch US$70 billion worth of fish. (Green et al, 2003; Wilson, 2000)

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Overfishing has a fifth component that may be a cause as well as a consequence of the other components. It is called **Malthusian overfishing**, and it is based on a theory made by English economist Thomas Malthus, who argued that the number of people would increase faster than the food supply, and that population would eventually reach a resource limit, at which point any further increase would result in a population crash, caused by famine, disease, or war (Wikipedia.org, Malthusian Catastrophe).

Malthusian overfishing manifests itself when the fishery cannot provide enough fish for all the people who depend on it (Pauly, 1990), probably because the fishery in such poor state that it has become unproductive, or perhaps because there are too many people chasing after the same resource, or most likely for both reasons. Fishers, getting little or no catch and believing they have little choice, use illegal and destructive fishing gear to improve their catch, which provides income in the short term but affects ecological processes by destroying habitats and thus makes the situation worse over the long term.

CAN FISHING BE SUSTAINABLE?

Clearly sustainable fisheries cannot happen unless we address the various facets of overfishing, which means realizing certain objectives, as follows (Cochrane, 2002):

1. To maintain the target species at or above the levels necessary to ensure their continued productivity (***biological***);
2. To minimize the impacts of fishing on the physical environment and on non-target associated and dependent species (***ecological***);
3. To maximize the net incomes of the participating fishers (***economic***); and
4. To maximize employment opportunities for those dependent on the fishery for their livelihoods (***social***).

There are obvious conflicts among these objectives. The pursuit of maximum economic returns has brought us to where we are now, struggling with the problem of overfishing. Maximizing employment opportunities from the fisheries can mean reducing each fisher's individual income, a situation we see in many sustenance fisheries around the world.

It is not easy, and indeed sometimes it may be impossible, to strike a perfect balance between these objectives. Often, it is more realistic to establish priorities based on the specific needs of the resource system. A community managing a marine habitat dedicated to tourism, for example, would probably benefit most by prioritizing biological and ecological objectives. A group of fishers exploiting a predominantly pelagic fishery might feel they are best served by emphasizing the economic objective. And for a community managing a marine protected area primarily for livelihood, the social objective may be the main consideration. All four objectives may be pursued, but situational needs in most cases weigh more heavily for one or two objectives than the others.

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In practice, each objective is articulated as one or more ***operational objectives*** that are specific and measurable, say, to raise hook-and-line fish catch by *X* amount in two years, or to reduce the incidence of illegal fishing by *Y%* in one year. An operational objective has both a measurement and a reference point, and serves as a simple foundation for developing fisheries management strategies. We will discuss this more thoroughly in Chapter 5.

Regulate, Regulate, Regulate

There is one requisite of sustainability that cannot be compromised: Whatever the management priorities may be, there must be adequate controls to ensure that the biological limits of the resource are never breached. To all purposes, fisheries management is primarily about the regulation of fishing effort. Given the state of our fisheries, our immediate goal in most cases would be to reverse – and then prevent – overfishing, which begs the question: how many fish can we sustainably catch?

We do not have an official definition of overfishing in the 1998 Philippine Fisheries Code, so let's borrow from the U.S. Sustainable Fisheries Act of 1996, which defines overfishing as "a rate or level of fishing mortality that jeopardizes a fishery's capacity to produce MSY on a continuing basis" (Wallace and Fletcher, 2001).

Two points jump out of this definition:

1. To stop overfishing, we must keep fishing intensity at or below MSY; and therefore
2. We must have at least an estimate of MSY.

MSY is estimated using a number of methods. One of the most commonly used is the so-called surplus production or Schaefer model, which can be applied where data are available on the yield (catch in weight by species) and effort (e.g., number of fishing vessels) expended over a certain number of years. The problem with using MSY is that in many fisheries, reliable information is hard to come by.

To be useful, information must be at least reasonably accurate *and* timely. Remember that MSY is a function of the habitat's ever-changing carrying capacity – data collected 50 years or even 10 years ago may not give us a true estimate of the current MSY of a fishery. Many of our fish habitats continue to be reduced or degraded, so it is highly unlikely that our fisheries can sustain MSY based on conditions from 10 or 50 years ago. All things considered, we cannot insist on harvesting the same amount of fish that we did in the past. The sea has without question lost much of its productivity, even if by today's common perception, it appears healthy enough (Figure 2.29).

Ideally, for every species, we should have reasonably current information on aspects of its biology, its behavior, its interactions with other species or groups, and its role in the ecosystem. Details on the rates and patterns of exploitation of the particular resource and the social and economic characteristics of the resource users are equally critical. Sadly, few fisheries have such information. Where the information is available, it is often incomplete or distorted due to the complexity and unpredictability of aquatic ecosystems, as well as technological constraints, errors and biases in data collection.

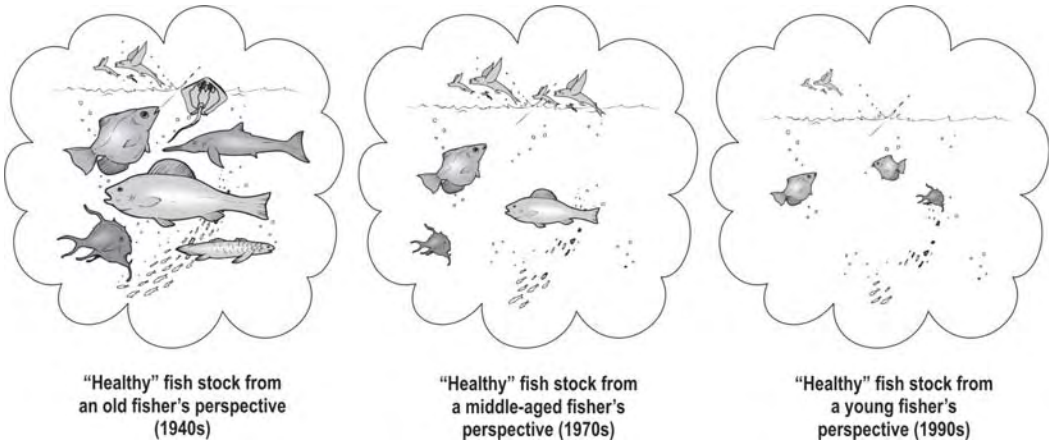

Figure 2.29. Shifting baselines. Human activities have altered the sea dramatically over the last few centuries that it is now very difficult to imagine how full of life our oceans once were. Our assessment of the productivity of the sea is only relative to our time reference, and will likely look very different if we used baselines from another period. For example, a fishery may be regarded as "healthy" today only because we are using information from the 1950s; compared to baselines from an earlier time (if such were available), it would probably be described as severely degraded. This phenomenon is called "shifting baselines." We cannot allow our baselines to keep shifting, otherwise we will begin to disregard our standards and accept the degraded condition as being the natural or healthy state. (Pauly et al, 2002). (Image: Adapted from Jacquet, 2007)

No reason for inaction

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So what are we supposed to do when faced with a lack of information? Take the experts' advice: Err on the side of caution. We call this the **precautionary approach**:

> *"In order to protect the environment, the precautionary approach shall be widely applied… Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."* (UNCED, 1992)

The precautionary approach admonishes us to "exercise prudent foresight to avoid unacceptable or undesirable situations, taking into account that changes in fisheries systems are only slowly reversible, difficult to control, not well understood, and subject to change in the environment and human values."

Such admonition acknowledges that all fishery activities impact the resource, either directly or indirectly, with both perceptible and imperceptible changes on resource condition. It also emphasizes that the impacts are potentially dangerous to human well-being in the long term, and therefore must be addressed in a timely manner, even when information is lacking.

In the absence of good hard statistics, long-term fish stock assessments and CPUE data, managers and resource users must learn to rapidly assess their fisheries (Johannes, 1998). The following are common indicators that managers can use to detect overfishing (DENR et al, 2001):

- Changes in species composition
- Marked increase in the catch and sale of trash fish (lower-value fish)
- Rapid growth in the population and catch of squids
- Bigger volumes of smaller-sized fish being caught and sold
- Decreasing catch of targeted species such as groupers, snappers (*Lutjanidae)*, breams, and flatfish (*Psettodidae*)
- Fewer sightings of specialty species such as stingrays (*Dasyaritidae*), manta rays, sharks and others
- Decrease in fish age and size at maturity
- Increased catch of small-size individuals (less than 20cm) of typically large-backed fish such as jacks or groupers
- Significantly lower total fish catch compared to five years ago
- Fishers going out farther to fish
- Fishers needing more time to catch the same amount of fish that they did five years ago
- Decrease in catch determined using informal or formal data sets of catch records over at least 10 years
- Change in CPUE
- Decline in average income of fishers

- Fewer boats going out to sea or less frequent use of boats for fishing
- Increase in the number of fishers in the area due to migration or lack of employment
- Absence of seabirds hunting for schools of fish
- Marked increase in the establishment of "payaos" or fish aggregating devices
- Increased use of fine-mesh nets to catch fish (e.g., triplenet, double-net and even mosquito net!);
- Marked increase in illegal fishing and use of destructive fishing methods;
- Increasing conflicts between municipal and commercial fishers;
- Increased encroachment of commercial fishing boats on municipal waters;
- Large increases in the price of first and second-class fish; and
- Increasing number of fishers traveling to distant fishing grounds (even to other countries) to catch fish they used to be able to catch locally; and fish traps proliferating along mangroves and rivers.

Using the best available information, we should take immediate actions that focus on practical efforts to detect the causes of overfishing. When we know the causes, we can work toward eliminating them, by applying remedies to alleviate the situation while simultaneously formulating and then implementing a more comprehensive solution.

Control mechanisms

The precautionary approach is applied through ***control mechanisms*** that limit the exploitation of fishery resources. In a well-managed fishery, the aim is to protect fish stocks from being harvested beyond their capacity to replenish themselves. But few fisheries are currently even managed. In most cases, control mechanisms are applied only to promote the recovery of already heavily exploited stocks, more as curative measures than as instruments to promote sustainable exploitation.

There are two main categories of control mechanisms: 1) output controls, and 2) input controls. These controls are either qualitative or quantitative.

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Output controls put direct limits on the catch by prescribing *what* fishers can harvest from a fish stock (Morison 2004, Figure 2.30). An output control may be quantitative, that is, it limits the *amount* of fish to be harvested through catch quotas or total allowable catches (TACs). It may also be qualitative, imposing restrictions on the various characteristics of the catch other than the amount, such as size and age. For example, minimum and maximum size limits may be prescribed on individual fish caught to allow smaller individuals to grow and to protect mega-spawners. Or there may be prohibitions on the harvesting of individuals at a specific critical stage, such as juveniles and spawners. Prohibitions on the harvest of endangered and rare species are also forms of qualitative output controls.

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Input controls regulate the various aspects of fishing effort, including *who* can fish, *when* they can fish, *where* they can fish, and *how* they can fish (Morison, 2004). Input controls are quantitative when they prescribe a limit on the number or quantity of fishing effort, for

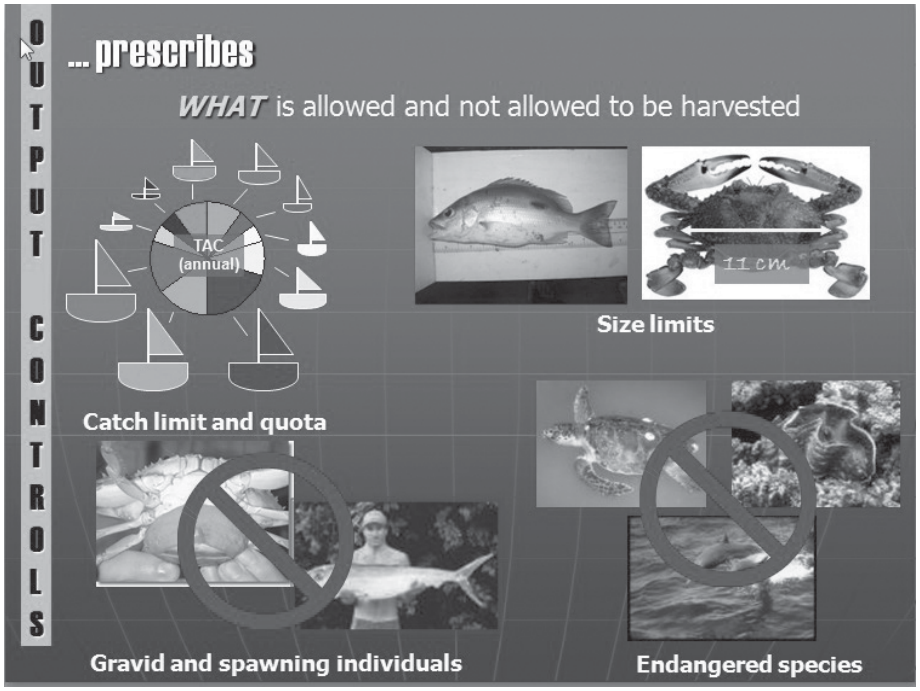

Figure 2.30. Output controls. Control mechanisms that set a limit on what and how much can be harvested from a fish stock are called "output controls."

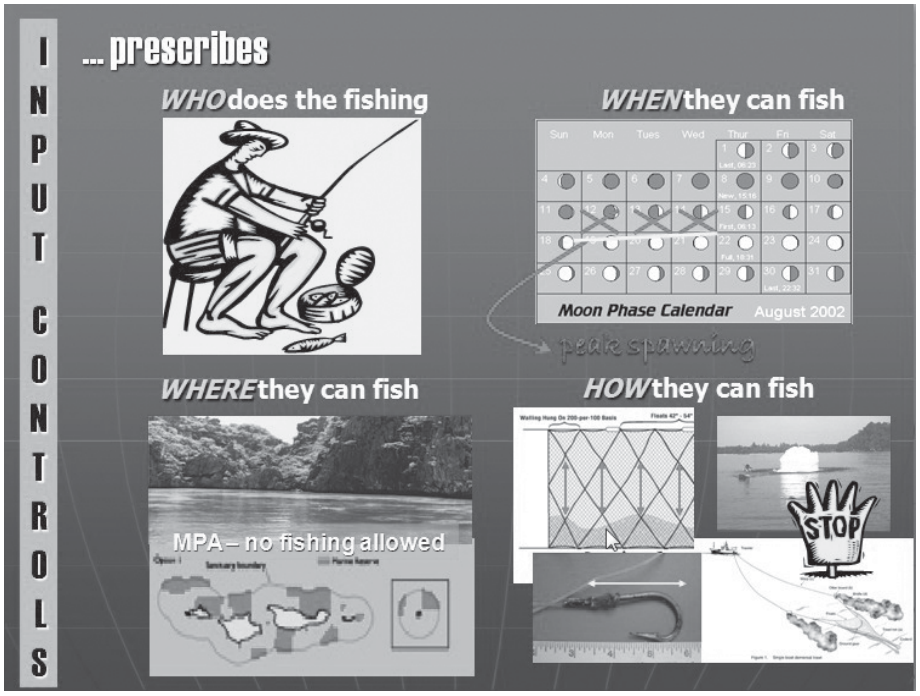

Figure 2.31. Input controls. Control mechanisms that regulate the fishing effort are called "input controls."

example, by setting a limit on the number of fishing licenses or permits issued; regulating the total number of gillnet panels per unit, or allowing only a fixed number of fish corrals to be operated in an area. The closure of a fishery can be classified as a quantitative control when it prescribes a specific number of days when fishing is not allowed.

When an input control puts a limit on a characteristic of the fishing effort, then it is classified as a qualitative control. Examples include closed seasons that prescribe the type of day or season, such as during the week of the new moon; mesh size regulations; limits on vessel tonnage; and controls on the gear through specific requirements in gear specifications and characteristics. Gear controls regulate not only the harvesting of fish stocks; often, they are also imposed to prevent the destruction of fish habitats.

Habitat protection

The protection of habitat is par for the course in fisheries management – the survival of a fish population primarily hinges on its accessibility to healthy, functional habitats that can support its growth and reproductive needs. To enhance fisheries, we must protect habitats *from fishing* as well as other threats, and ensure that connections between interdependent habitats, accessibility of fishery resources to critical habitats, and overall productivity are maintained. Critical habitats therefore need to be identified and assessed, habitat management strategies have to be formulated, gear improved to reduce impact, and bans enforced on destructive fishing methods such as dynamiting, poisoning, and trawling. (Garcia et al, 2003)

An increasingly popular habitat management strategy is the protection of selected marine areas, often called marine sanctuaries or MPAs. MPAs generally limit access to designated critical habitats, most commonly coral reefs, in which certain activities are regulated, restricted or prohibited, depending on their degree of harm. They have proven most useful and are often regarded as central to biodiversity conservation. In the Philippines, community-managed MPAs have been demonstrated to help increase fishery productivity and small fishers' incomes, gaining wide acceptance for their well-documented contribution not only to improving habitat conditions, but also to promoting stewardship among fishers and other stakeholders.

The current call is for the establishment of "MPA networks" on the assumption that a group of several MPAs working together can enhance fisheries management and biodiversity conservation beyond what an individual MPA can achieve alone (Palumbi, 2004). The call has resounded in recent years amid growing concern about the rising concentrations of greenhouse gases in the atmosphere that experts believe is the main cause of one of the most potentially disastrous environmental problems of our time: climate change.

The levels of several greenhouse gases – in particular carbon dioxide – have increased by about 25% since large-scale industrialization began some 150 years ago. This has caused the so-called greenhouse effect to intensify, raising the average surface temperature of our planet over time, which in turn produces changes in rainfall patterns, storm severity and sea level, that is, **climate change**. (EIA, 2008)

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The **greenhouse effect** describes the increase in temperature that our planet experiences because heat from the sun is trapped by certain gases in the atmosphere (called

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greenhouse gases, which include water vapor, nitrous oxide, methane, and most of all, carbon dioxide). Without the greenhouse effect, we would be living in a planet that's about 15°C colder on average. Conversely, if the greenhouse effect intensifies, our planet would be warmer than usual. Either way would cause problems for plants, animals and humans.

We have had a taste of the serious damage that high ocean surface temperatures can cause on coral reefs – the 1997-98 El Niño caused the bleaching of reefs in more than 50 tropical countries worldwide (Figure 2.32). It seemed then that unless the warming of the ocean could be reversed, there was not much anyone could do about it. The effects, scientists warned, would be devastating on reefs and reef-associated fisheries.

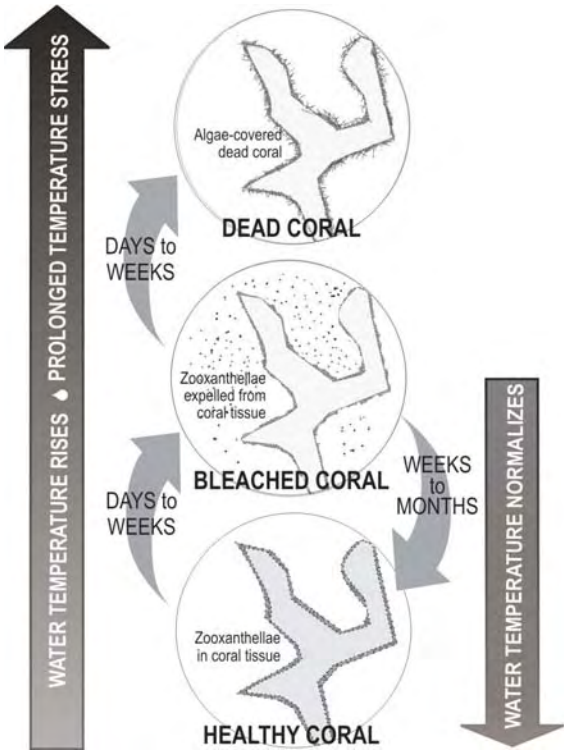


Figure 2.32. Impacts of temperature changes on marine life. Coral bleaching starts when high water temperatures expel zooxanthellae that nourish the coral polyps, resulting in algal overgrowth and coral suffocation. Temperature increases of only 1.5-2°C lasting for 6-8 weeks is enough to set off bleaching. If such temperatures persist for more than eight weeks, the corals begin to die. Other stressors (disease, sedimentation, pollutants and changes in salinity, among others) can also cause bleaching, but only at local scales. Elevated water temperatures, on the other hand, can affect reefs at regional and even global scales, resulting in disastrous fish catch declines worldwide and potential loss of revenues from fisheries and tourism.

Besides significantly damaging coral reefs, changes in water temperature may disrupt the migration patterns of pelagic fishes and the distribution of fish populations. In addition, an increase in water temperature can also reduce the abundance of plankton and change their distribution. A decrease in plankton abundance will result in lower fish yields. (Image adapted from Marshall and Schuttenberg, 2006)

Now evidence is emerging that potential damage from global warming on reefs can be *mitigated*, if reefs that are resilient to bleaching are protected to begin with. A 2003 study identified the factors that help make reefs more resilient to bleaching, including "diverse populations of corals that produce lots of larvae, surface currents that spread the larvae, herbivorous fish that graze the algae that otherwise grow on top of damaged reefs and prevent the establishment of new corals, and management that decreases stresses such as pollution and fishing methods that destroy reefs." (SCB, 2003)

Knowing these factors, reef managers can identify and protect patches of coral reef that are most likely to persist during continuing climate change. A network of MPAs can be established to protect these patches and help ensure that at least some corals will survive a major bleaching event and be able replenish those that do not. (SCB, 2003)

MORE THAN FISHING

While our main concern is fishing, we cannot put aside the other human activities that contribute to the depletion of fish stocks by changing or degrading their habitats. Fishery productivity is easily compromised when habitats are altered or reduced, such as when coral reefs are damaged by siltation, or when wetlands are reclaimed for housing, or when the sea becomes polluted with household and industrial wastes, or when seagrasses are lost to dredging, or spawning areas destroyed by coral reef mining.

Unfortunately, fishers – and indeed even fishery managers – usually do not have much influence over many non-fishery activities that contribute to habitat loss. But they can in most cases do something to mitigate their negative impacts. And they can exercise their responsibility as advocates of sustainable fisheries by promoting stakeholders' and policymakers' awareness and appreciation of the intrinsic value of affected habitats, how much will be lost by their destruction, and how much can be gained from investments in habitat protection and management.

It is actually possible to assign economic values to resources by measuring the benefits that accrue to society from the use of such resources. Besides food and income from fish, the coastal environment provides us with many goods and services, such as recreation, education, medicines, and shoreline protection. It even serves as a waste treatment facility, absorbing and treating tremendous amounts of waste from land.

Put together, the total value of all these benefits and countless others that we have yet to discover is tremendous, and whatever value we ultimately assign to our coastal and marine resources is likely always going to be an underestimation. In Ubay, Bohol, the total economic value of fishery-related goods and services alone has been estimated at more than Php98 million, certainly well worth the Php2.4 million that the local government is investing yearly in coastal resource and fisheries management (Appendix 3).

REVIEW

1. Most of the world's stocks of the top 10 commercially valuable species are currently in decline. In the Philippines, our various types of fishery resources are all biologically overfished, with fish in highly exploited areas being harvested at a level 30% more than their capacity to reproduce. Meanwhile, fishery-dependent populations keep growing, thus putting ever-escalating pressure on fishery resources. The number of municipal fishing operators in the Philippines jumped more than 200% from 584,000 in 1980 to 1.8 million in 2002; among them are hundreds of thousands of marginal fishers who earn less than Php40 a day.
2. History teaches us many lessons, not the least of which is the urgent need to effectively regulate fishing. Fueled by rapid technological advances and ever-growing market demand, the expansion of fishing industries worldwide has been fast and furious. For much of the last century, despite warnings from scientists, governments tacitly encouraged the pursuit of higher and higher production targets

using increasingly efficient (and often destructive) gear. Policies did change eventually, when fishery decline became too serious and too widespread to ignore. Today, on paper at least, the overriding goal is sustainable fisheries.

3. Current fisheries management strategies are based on several principles, including:
   a. The marine ecosystem is an open system — materials and processes easily move between its various 'compartments,' so what happens in one compartment eventually affects the rest of the system. By the same token, marine organisms are interconnected through food webs and other processes; one broken link can disrupt the function and structure of the whole system.
   b. Find the fish, find the food. Fishery productivity is highest where there is an abundance of materials necessary for life, e.g. sunlight, water, moisture and nutrients.
   c. Fish are biological resources. This means they are renewable: They have the natural ability to replenish their populations over time and can be harvested continuously – within limits – without being depleted. It also means they are interactive, and will react or adjust to changes and stressors in their environment.
   d. Following the principle of survival, fish produce more offspring than the actual number that will reach adulthood. Like all living things, every fish population is equipped with some form of survival mechanism. This ensures that the population is not easily eliminated by the natural calamities that all animals face.
   e. Every fish population is regulated by its habitat's carrying capacity: Above carrying capacity, it decreases; below, it increases. When fishing occurs, the population falls below carrying capacity, and will then produce more offspring to return to carrying capacity. As long as both spawners and offspring are not removed faster than they can replace themselves, continued fishing will not deplete the population.

f. Carrying capacity is not constant: It changes when environmental conditions change. A degraded habitat has a much reduced carrying capacity and will not be able to support the same population size as a healthy habitat.

g. Overfishing occurs when individuals are harvested faster than they can replace themselves. It has four components, each more or less the consequence of the other. Biological overfishing occurs when young fish are harvested before they can reproduce. When there are too few adults left so that the production of eggs and larvae is severely reduced, recruitment is impaired and recruitment overfishing results. The depletion of a population of species can lead to ecosystem overfishing, where in most cases the species composition changes from a mix of large species to a mix of relatively smaller species. Eventually, the fishery can become so depleted that it no longer yields profit, a situation known as "economic overfishing."

4. As fisheries managers, our goal is to make fishing sustainable. To be sustainable, fishing must be regulated through restrictions on fishing effort or harvest, or both. This requires knowledge of fish biology and catch-and-effort trends over a period of time. The lack of information, however, should not be a reason to delay measures to remedy or prevent resource degradation. In the absence of hard data, managers and resource users must know how to detect common signs of overfishing (or potential overfishing) and take appropriate and timely action, before the problem escalates (or even before it happens).
5. Habitat protection is central to biodiversity conservation and an important component of fisheries management. Healthy habitats support productive fisheries, and they also provide many other goods and services that benefit humans. Estimations of the total economic value of such goods and services underscore how much we can potentially lose if we do not take proper care of what remains of our vital coastal and fishery resources.

ADDITIONAL REFERENCES

Look up these resources in this *Sourcebook*'s companion CD, or follow the links provided:

1. Philippine Fisheries in Crisis: A Framework for Management – *http://oneocean.org/download/db_files/philippine_fisheries_in_crisis.pdf*
2. Philippine Coastal Management Guidebook Series
   a. Coastal Management Orientation and Overview – *http://oneocean.org/download/db_files/crmguidebook1.pdf*
   b. Legal and Jurisdictional Framework for Coastal Management – *http://oneocean.org/download/db_files/crmguidebook2.pdf*
   c. Coastal Resource Management Planning – *http://oneocean.org/download/db_files/crmguidebook3.pdf*
   d. Involving Communities in Coastal Management – *http://oneocean.org/download/db_files/crmguidebook4.pdf*
   e. Managing Coastal Habitats and Marine Protected Areas – *http://oneocean.org/download/db_files/crmguidebook5.pdf*

f. Managing Municipal Fisheries – *http://oneocean.org/download/db_files/crmguidebook6.pdf*
g. Managing Impacts of Development in the Coastal Zone – *http://oneocean.org/download/db_files/crmguidebook7.pdf*
h. Law Enforcement — *http://oneocean.org/download/db_files/crmguidebook8.pdf*

3. In Turbulent Seas: The Status of Philippine Marine Fisheries – *http://oneocean.org/download/db_files/fshprofl.pdf*

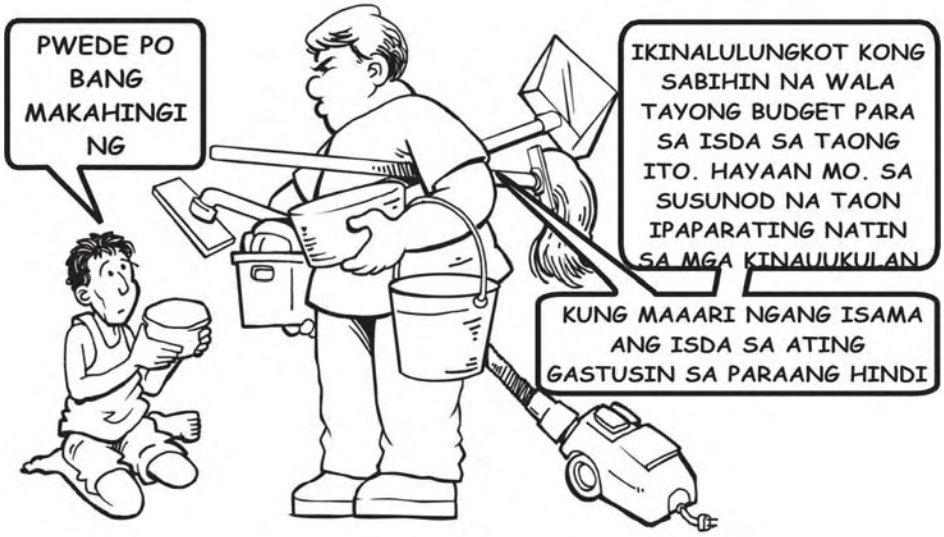
From Web sources only:

1. Ecological Effects of Fishing in Marine Ecosystems of the United States – *http://www.pewtrusts.org/uploadedFiles/wwwpewtrustsorg/Reports/Protecting_ocean_life/environment_pew_oceans_effects_fishing.pdf*
2. Understanding Fisheries Management: A manual for understanding the Federal Fisheries Management Process, including analysis of the 1996 Sustainable Fisheries Act – *http://nsgl.gso.uri.edu/masgc/masgch00001.pdf*
3. Impacts of biodiversity loss on ocean ecosystem services —*http://www.stanford.edu/group/Palumbi/PeoplePages/Worm2006.pdf*

Chapter 3
Legal & Policy Framework

In This Chapter

- Understand the local government unit's mandate on fisheries management
- Examine the specific provisions of the 1998 Fisheries Code of the Philippines and other policies and issuances that relate to municipal fisheries
- See where national policy may be headed as it responds to current issues and emerging trends in fisheries in the country and around the world



If the misery of the poor be caused not by the laws of nature but by our institutions, great is our sin.
— Charles Darwin, English naturalist

Fisheries management is now a mandate laid down for government by law, but it was not always so. Only in 1932 did we have a Fisheries Act, and even then very little attention was given to what was generally regarded as an unlimited resource for which there was limited demand. At the time, most fisheries were small-scale, done mostly in fishing grounds not too far from the shore. Up until the 1960s, in fact, fisheries were not considered a significant sector, so the government did not fully promote their growth and development (DENR et al, 2001).

The pendulum swung sharply in the opposite direction from the 1960s to the mid-1970s, when the government began promoting the optimal exploitation and use of fisheries. This period was marked by rapid growth and development in fisheries and aquaculture. Commercial-scale fishing expanded and soon equaled small-scale fisheries in terms of catch, while fish pens and fishponds proliferated, unfortunately at the expense of vital fish habitats. (DENR et al, 2001)

The degradation of the environment was severe and progressive, prompting the government to pass in 1975 Presidential Decree (PD) 705 (the Forestry Code), which identified mangroves as being needed for shoreline protection, and PD 704 (the 1975 Fisheries Decree), which, while encouraging "maximum economic utilization of fishery resources," also set down rules that put some limits to fishing.

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PD 704 introduced the concept of **municipal waters**, defined as marine waters extending to 3 nautical miles (about 5.6 km) from the general coastline over which the municipal (or city) LGU had some jurisdiction (limited to the granting of fishing privileges and licenses subject to the agriculture secretary's approval). The law also included prohibitions on commercial fishing in waters up to 7 kms from the shoreline, and trawling in waters up to 7 fathoms deep.

More regulations were put in place over the years as concern grew over the continued degradation of marine habitats. In 1979, a Coastal Zone Management Task Force was created to regulate the use of coastal areas for tourism, mining, human and industrial development, reclamation and fisheries. In the 1980s, destructive gear (e.g., **muro-ami** and **kayakas**) were banned and habitat protection measures were instituted. (DENR et al, 2001)

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Through all those years, laws, policies and interventions largely emanated from the national government and were often hampered by jurisdictional issues. In 1991, with the passage of the Local Government Code (LGC or RA 7160), the Philippines changed over to a decentralized form of government. This devolved the fisheries management mandate, along with other environmental management mandates, to LGUs. The fisheries mandate was subsequently reinforced by the 1998 Fisheries Code of the Philippines (RA 8550).

So this is where we're at today: More than a decade after the passage of the Fisheries Code, LGUs are only just beginning to settle into their legally mandated role as the most important player in the management of our municipal fishery and coastal resources. In this chapter, we will discuss what this role is, the laws and policies that define it, and how it is and should be supported both locally and nationally by our legal and political institutions.

A FUNDAMENTAL MANDATE

The government's mandate to protect our fishery resources is enshrined in the 1987 Philippine Constitution, which states, "The State shall ***protect the nation's marine wealth… and exclusive economic zone, and reserve its use and enjoyment exclusively*** to Filipino citizens" (Art. XII, Sec. 2). The Constitution also specifically declares that the "the State shall

2006	The Philippine government officially adopts ICM as the national strategy to ensure the sustainable development of the country's coastal and marine environment; ASEAN members adopt Sustainable Guidelines for co-management using group user rights, fishery statistics, indicators and fisheries refugia
2004	Fisheries scientists, managers and field practitioners issue urgent call to rebuild Philippine fishery resources; 3,500kms of shoreline meet criteria for improved CRM; Code of Practice for Aquaculture adopted (FAO 214 s2004); DA issues guidelines on municipal water delineation for municipalities/cities with no offshore islands (DAO 01 s2004); ASEAN members adopt Code of Practice for Sustainable Use of Mangrove Ecosystems for aquacutulture; and the Regional Guidelines for Post-Harvest Practices and Trade
2003	ASEAN members adopt regional guidelines for fisheries management
2002	National CRM Policy reviewed at the national level
2001	More than 100 municipalities allocated budget for CRM; municipal water delineation begins in several municipalities and cities; CEP of DENR institutionalized as Coastal and Marine Management Office; ASEAN members adopt Regional Guidelines for Responsible Aquaculture
2000	POPULATION: 76 million; DA and DENR sign memorandum on implementation of Fisheries Code
1999	May proclaimed Month of the Ocean in the Philippines; historic Conference of Coastal Municipalities of the Philippines convened; ASEAN members adopt Regional Guidelines for responsible fishing operations
1998	Fisheries Code passed, reinforces role of LGU in CRM; Philippines celebrates International Year of the Ocean; Ocean Charter signed
1997	COMMERCIAL FISHING EFFORT: 45% > optimum level
1996	NATIONAL FISH CONSUMPTION PER CAPITA: 24kg
1995	POPULATION: 73 million; CORAL REEFS: < 5% in excellent condition; Fisheries and Aquatic Resource Management Councils authorized
1993	MANGROVES: 138,000 has; Coastal Environment Project (CEP) of DENR starts
1992	PCSD created; Philippines signs Agenda 21; NIPAS Act passed
1991	Local Government Code devolves responsibilities for CRM to local government
1990	POPULATION: 65 million
1988	MANGROVES: 140,000 has; First National Marine Park established at Tubbataha Reefs, Sulu Sea
1987	NATIONAL FISH CONSUMPTION PER CAPITA: 40kg
1986	*Kayakas* and *muro-ami* banned
1984	BFAR moved from Ministry of Natural Resources to DA
1981	Philippines signs CITES
1980	POPULATION: 51 million; MANGROVES: 175,000 has
1979	Lingayen Gulf fisheries reach maximum sustainable yield; Coastal Zone Management Committee with 22 agencies formed
1978	Marine Parks Task Force created to recommend sites for marine parks; Philippine Extended Economic Zone established; Environment Impact Assessment System established;
1977	Coral gathering limited to scientific research
1976	National Mangrove Committee created
1975	Fisheries decree promotes optimal exploitation and use of fisheries; Forestry Code cites need to protect mangroves
1974	First municipal marine reserve established around Sumilon Island, Cebu
1970	POPULATION: 37 million; MANGROVES: 288,000 has
1968	Fishery scientists warn of overfishing in Manila Bay
1960	POPULATION: 27 million
1932	Fisheries Act gives most fisheries management responsibility to central government
1918	POPULATION: 10 million; MANGROVES: 450,000 has

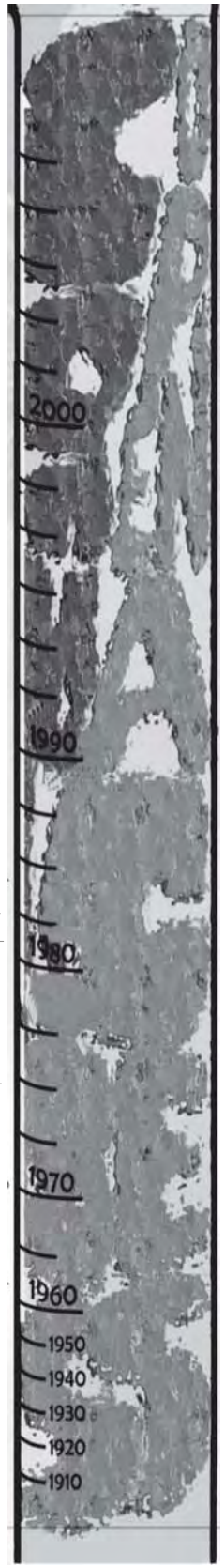

Figure 3.1. Evolution of integrated coastal management and fisheries management in the Philippines. Fisheries management in the Philippines evolved over the last century in response to both opportunities and threats to the fisheries sector. For the most part, the policy thrust was to accelerate the development of the industry. At first, there was little regard for the need for conservation and regulation. But beginning in the late 1970s, as the degradation of fishery resources became more evident, the government set about implementing progressively regulation- and conservation-oriented policy reforms.

protect the ***rights of subsistence fishermen***, especially of local communities, to the preferential use of the communal marine and fishing resources, both inland and offshore… [and] provide support to such fishermen through appropriate technology and research… and other services" (Art. XIII, Sec. 7).

The prescribed manner by which this is to be accomplished is also stated, through a declaration of the people's right "to effective and reasonable participation at all levels of social, political and economic decision-making" (Art. XIII, Sec. 16).

The Constitution was drafted in 1986 by a Constitutional Commission, which apparently recognized the urgent need to address festering inequities between small and big fishers – the haves and the have-nots – in the distribution of fishery resources. The above provisions deal directly with this social issue, first by underscoring the State's duty to protect our marine resources, and then declaring a preferential regard for subsistence fishers and the people's right to participate in the government's decision-making process. And just in time, too: The inequity problem in our coastal communities was threatening to grow into crisis proportion, as overfishing, habitat destruction, rapid population growth and an ever-expanding demand for fish intensified the competition over a diminishing resource, pushing small fishers farther and farther away from the economic mainstream to the edges of society.

These laws would define the eminent role of LGUs in fisheries management, giving substance in particular to the Constitution's expressed concern to protect the nation's marine wealth and the rights of subsistence fishers. In them we find unequivocal declaration that the protection and management of our municipal fishery resources and other coastal resources is a basic legal mandate that those of you in local government are obligated to fulfill, and not some "special project" that you can opt to do or not to do.

THE RISE OF LOCAL AUTONOMY

The LGC embodies the operative principles and mechanics of decentralization in the Philippines. It is a wide-ranging law, covering the whole gamut of services for which LGUs are responsible. Here we will take a broad look at what the decentralization process has entailed and what it means to fisheries governance.

The following keystone principles have guided governance reform in the Philippines since the LGC came into effect (LGC, Sec. 2):

1. Genuine and meaningful local autonomy, which requires LGUs to be self-reliant communities, with powers, authority, responsibilities and resources;
2. Accountability, which holds government officials responsible to the people for their decisions and actions; and
3. Participatory governance, which strives to create opportunities for citizens to make meaningful contribution to decision-making, and provide access to such opportunities to as many sectors of society as possible.

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The principle of **local autonomy** is based on the assumption that the well-being of a community is best cared for by the members of that community. Local autonomy presupposes decentralization of services, and in this case, the LGC has "decentralized" to the LGU many government services related to fisheries and environmental management and protection, among other basic services (LGC, Sec. 17; Sec 444; and Sec. 446).

☞Glossary

The principle of **accountability** requires that the LGU is given specific responsibilities and authority as well as guidance and support, and that it is held to account for and should be monitored and assessed in the exercise of its responsibilities and authority. Accountability in government is the cornerstone of good governance. It demands transparency, which means that as a general rule, the public has the right to scrutinize the decisions and actions of those in government and can hold them responsible for such decisions and actions. It therefore requires clear and enforceable sanctions for low performance, negligence of duty, or outright breach of public trust.

In its strictest sense, the term "accountable person" means the individual that has the power to change a process or its outcome. In a complex process such as fisheries management, accountability is usually delegated to many individuals. The mayor holds the ultimate accountability and is answerable to the public for the delivery of fisheries management services. But every LGU member who is tasked in some way to make those services happen is answerable – to his immediate superior at least – for the way he exercises the specific authority and responsibilities delegated to him.

☞Glossary

Much is expected of the LGU because of its increased autonomy. Having more power, authority and resources means having greater responsibility and accountability. Using the principle of **participatory governance**, the LGC requires the various government units to consult periodically with each other, NGOs, people's organizations (POs), and other concerned sectors of the community before any project or program is implemented in their respective jurisdictions. This allows the public not only to get involved in decision-making by government but also gives them a venue in which to express their views on how government programs are and should be run, and to actively hold government officials to their sworn duties as public servants.

Coincidentally, the LGC was drafted at a time when community-based approaches had become widely recognized as effective strategies for environmental conservation and management. Also during that time, the international community was gearing up for the 1992 Earth Summit that would specifically recommend the adoption and implementation of ICM by all nations with coastlines (DENR et al, 2001). Unlike fisheries programs that were then mostly run by national government, ICM in the Philippines developed largely from NGO-led community-based initiatives to manage critical coastal habitats, particularly coral reefs. By encouraging people's participation in governance, the LGC effectively adopts this ICM approach as a key strategy for fisheries management, with the LGU as the lead actor.

DEFINING THE JOB

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The LGU's responsibilities for fisheries management under the current decentralized system of government were first laid down in the LGC. With the passage of the LGC in 1991, the municipal (or city) LGU became the main entity responsible for **municipal waters**, redefined to encompass marine waters up to 15 kms from the coastline.

☞Glossary

In a nutshell, according to the LGC, the LGUs have the legal obligation to carry out **basic services** that promote environmental protection and management, in general, and fisheries management, in particular. These basic services include, but are not limited to the following (Sec. 17):

1. ***Extension and on-site research*** services and facilities related to agriculture and fishery activities which include …***enforcement of fishery laws in municipal waters*** including the conservation of mangroves;
2. Pursuant to national policies and subject to the supervision, control and review of the DENR, ***implementation of community-based forestry projects***… management and control of communal forests with an area not exceeding 50 sq km; establishment of tree parks, greenbelts, and similar forest development projects;
3. Solid waste disposal system or environmental management system and services or facilities related to ***general hygiene and sanitation***; and
4. ***Infrastructure facilities*** intended primarily to service the needs of the residents of the municipality and which are funded out of municipal funds including, but not limited to… fish ports… and similar facilities.

To effectively deliver these services, the LGU must perform a host of functions specific to fisheries and environmental governance, as well as general executive and legislative support functions that one might expect of a local bureaucracy. It may have to pass ordinances, set local policies, get necessary training for its staff, draw up project plans in consultation with stakeholders, allocate budget, raise revenues through taxes and user fees, enforce fishery laws and regulations, impose administrative sanctions, inform and educate the public, monitor and evaluate performance, and so on.

The LGC grants the LGU the authority to do all of the above — subject, of course, to certain limitations specified by law. For example, the LGU is not authorized to implement projects funded by the national government, and those wholly or partially funded from foreign sources, except in those cases where it is duly designated as the implementing agency for such projects. It must also adhere to national policies, standards and guidelines, and it cannot adopt ordinances that would violate or contradict national laws. To be valid, ordinances promulgated by the LGU (1) must not contravene the Constitution or any national law; (2) must be fair and not oppressive; (3) must not be partial or discriminatory; (4) must be general and consistent with public policy; and (5) must not be unreasonable (DENR et al, 2001).

Having identified "extension and on-site research services and facilities" related to fisheries, fishery law enforcement in municipal waters, and "the conservation of mangroves" as ***basic services***, Sec. 17 of the LGC compels the LGU, ***at the minimum***, to

Table 3.1. Provisions in the 1991 Local Government Code that define the LGU's duties and functions in fisheries and environmental management

1. Sec. 17 – Basic Services and Facilities
2. Sec. 26 – Duty of the National Government Agencies in the Maintenance of Ecological Balance
3. Sec. 131 – Definition of Terms
4. Sec. 138 – Tax on Sand, Gravel, and Other Quarry Resources
5. Sec. 149 – Fishery Rental, Fees and Charges
6. Sec. 185 – Personal Property Exempt from **Distraint** or **Levy**
7. Sec. 234 – Exemptions from Property Tax (for machinery and equipment used for pollution control and environmental protection)
8. Sec. 290 – Amount of Share of Local Government Units (in the National Wealth)
9. Sec. 388 – Persons in Authority (Barangay Level)
10. Sec. 389 – Chief Executive: Powers, Duties and Functions (of the Punong Barangay)
11. Sec. 443 – Officials of the Municipal Government
12. Sec. 447 – Powers, Duties, Functions and Compensation (of the Sangguniang Bayan)
13. Sec. 454 – Officials of the City Government
14. Sec. 458 – Powers, Duties, Functions and Compensation (of the Sangguniang Panglungsod)
15. Sec. 463 – Officials of the Provincial Government
16. Sec. 468 – Powers, Duties, Functions and Compensation (of the Sangguniang Panlalawigan)
17. Sec. 482 – Qualifications, Powers and Duties (of the Municipal Agriculturist)
18. Sec. 484 – Qualifications, Powers and Duties (of the Environment and Natural Resources Officer)

These provisions describe the LGU's fisheries and environmental management functions, including who is responsible for what. The list does not include other provisions in the Code that support but are not specifically about fisheries or environmental management, such as provisions for information and education, law enforcement, tourism, social welfare, health, population management, and many others that are not included in the above list. The full text of the LGC may be downloaded from the following web site: *http://oneocean.org/download/20020326/LGC1991.pdf*.

effectively carry out these functions, among other basic services listed there. This requires ensuring the availability of resources – funds, trained staff, and others – to appropriate LGU offices.

The LGC has several provisions to address the LGU's need for resources. The main source of funds is the LGU's internal revenue allotment (IRA) and local revenues. The LGC (Sec. 149) gives the LGU the exclusive authority to grant fishery privileges in municipal waters and impose rental, charges and fees for such privileges. Just remember that although such authority provides the LGU the opportunity to raise funds locally, it is primarily a regulatory function, designed to limit and rationalize access to municipal coastal and fishery resources. It must be used judiciously in the interest of promoting small fishers' rights, fisheries management and stewardship otherwise it could defeat the purpose of fisheries management.

Locally sourced revenues may be augmented by funding support from the national government, government-owned corporations and other legitimate external sources. If the LGU is unable to sufficiently meet the requirements of its communities for basic services or facilities, the national government or the next higher level of government may provide or augment such services or facilities. Even so, the LGU has the responsibility to organize itself properly. It must establish an efficient system of governance that will allow it to effectively deliver basic services and facilities, while simultaneously pursuing other program objectives and priorities that support its development goals.

LAYING THE GROUNDWORK FOR FISHERIES MANAGEMENT

Several laws provide the legal framework and systems for the implementation of fisheries management in the Philippines. These include three major national laws: the 1992 National Integrated and Protected Areas System (NIPAS) Act (RA 7586), the 1997 Agriculture and Fisheries Modernization Act (AFMA, or RA 8435), and primarily, the 1998 Fisheries Code, which defines in greater detail the LGU's fisheries management functions and responsibilities.

The NIPAS Act, which provides for the establishment and management of protected areas (by the national government), defines mechanisms for coordination between the LGU and other government units, primarily the DENR, in the management of so-called NIPAS areas.

The 1997 AFMA — designed to modernize the agriculture and fisheries sectors, enhance profits and incomes particularly of small farmers and fishers, and ensure the accessibility, availability and stable supply of food – gave the LGU the primary mandate to identify "Strategic Agriculture and Fisheries Development Zones" (SAFDZs), as well as responsibilities for providing extension and basic services to the agriculture and fishery sectors.

Given that these laws relate to municipal fisheries management mostly only in general terms, we will not tackle them in great detail and instead focus more extensively on the more relevant and specific provisions of the 1998 Fisheries Code.

We must make brief mention of a fourth law, RA 8371 (Indigenous Peoples Rights Act of 1997). While not applicable to all LGUs, RA 8371 is relevant to fisheries management in so-called "ancestral domains," defined as "lands, inland waters, coastal waters and natural resources under a claim of ownership, occupied or possessed by ICCs/IPs." The law guarantees the rights of indigenous cultural communities and peoples (ICC's/IPs) to these areas and defines the mechanisms to enforce and protect these rights, which include, among others, right of ownership, right to develop natural resources, right to regulate entry of migrants into the domains, right to safe and clean air and water, right to claim parts of reservations, and right to resolve conflict.

The NIPAS Act

The NIPAS Act instituted the NIPAS, which is defined by law as "the classification and administration of all designated protected areas 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."

NIPAS areas are designated through presidential proclamation followed by the appropriate enabling law in Congress. While the DENR is mandated to classify and

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Figure 3.2. NIPAS and the LGU. Although NIPAS marine areas cannot be designated as "municipal waters," as a member of the PAMB, the LGU does have some say in their management. Moreover, LGU approval is required for any initiative to establish a NIPAS area to prosper. The Apo Island Marine Sanctuary and Protected Seascape in Dauin, Apo Island is a NIPAS area that is co-managed by DENR, the community and LGU through the PAMB. Besides sharing the responsibility of protecting the sanctuary, both the community and LGU also get a share of proceeds from the sanctuary's users' fee system.

administer NIPAS areas, LGU approval is required even when the initiative for establishing a sanctuary comes from a national agency. The LGU also participates in the preparation of a site-specific "general management planning strategy" (GMPS) as part of a larger national strategy for the management of protected areas, which requires input from NGOs and local communities.

In addition, the LGU exercises local authority for resource protection through the local Protected Area Management Board (PAMB), which oversees the management of each NIPAS site. The PAMB is usually dominated by local community representatives from the municipality or city, *barangay*, tribal community, NGO, or other local organizations. Because of this, PAMB decisions often carry the majority vote of LGU representatives. (DENR et al, 2001)

The AFMA

Signed into law in December 1997 and in effect since January 1998, the AFMA provides the overall framework for the "modernization" of agriculture and fisheries in the Philippines. A key AFMA concept is the SAFDZs, special areas set aside for agricultural and agro-industrial development. Within these zones, government resources and development projects are to be concentrated with the hope that benefits will spill over to the adjacent areas and eventually spur economic growth.

Although a SAFDZ's boundaries are based on production (e.g., crop, livestock, or fish) and may not necessarily coincide with existing political or administrative boundaries, concerned LGUs are required to cooperate with the DA and other stakeholders, including zone committees, NGOs and POs, in the preparation of the zone's integrated development plan. The LGU's input is essential as such plan needs to be consistent with and incorporated in local land use and zoning ordinances. The AFMA prohibits the conversion of agricultural and fisheries areas within a SAFDZ for a period of 5 years from the date of its effectivity. If at all necessary, only 5% of the total area determined to be eligible for conversion may be allowed provided that the conversion is consistent with the natural expansion of the locality.

The AFMA also penalizes the non-utilization of land classified for agriculture, including inactive or abandoned fishponds, through an idle land tax of PhP3,000/ha/year or the reversion of property to government under normal court proceedings. The LGU through the Municipal Agriculture Officer (MAO), or any concerned fishers' group, may initiate such proceedings.

To support the AFMA's main objective to turn the agriculture and fisheries sectors from resource-based to technology-based industries, the LGU is tasked to develop local Agriculture and Fisheries Modernization Plans (AFMPs) that have as their goals food security, poverty alleviation and social equity, income enhancement and profitability, global competitiveness, and sustainability. For multi-area projects, the Provincial Agriculturist and Governor have the responsibility to review and aggregate all AFMPs. (DENR et al, 2001)

The Fisheries Code

RA 8550 or the Philippine Fisheries Code of 1998 codified all fishery laws existing at the time it was being drafted. Several provisions contain policies which are quite new and innovative, while others reiterate or improve old ones. Notable among the "new" concepts espoused by the Fisheries Code are: (a) limitation of access using scientifically determined procedures; (b) integrated management consistent with inter-LGU cooperation as articulated in the LGC; and (c) enhanced and institutionalized participation by the community through the various levels of the Fisheries and Aquatic Resource Management Council (FARMC).

The Code has largely clarified issues pertaining to the extent of jurisdiction of LGUs and the operation of commercial fishing vessels in municipal waters, consolidates and updates all prior penal laws related to fisheries, and adds new prohibitions. It includes prohibitions against electrofishing, blast and cyanide fishing, use of fine mesh nets, gathering of corals, and use of superlights. The codification of these laws facilitates enforcement, local legislation, and project implementation. (DENR et al, 2001)

NATIONAL POLICY DICTATES SUSTAINABLE FISHERIES

In general terms, the Fisheries Code prescribes "a flexible policy toward the attainment of food security … in response to changes in demographic trends for fish, emerging trends in

the trade of fish and other aquatic products in domestic and international markets, and the law of supply and demand." (Sec. 2)

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At first reading, some might take this to mean that the Fisheries Code encourages demand-driven production above all else. In fact, however, **food security** is the overriding concern, and fish being a vital food source for our country, the Code deems the conservation and protection of our fishery resources imperative "in order to provide the food needs of the population." By "population," of course, it means Filipinos, following the Constitutional provision to "limit access to the fishery and aquatic resources of the Philippines for the exclusive use and enjoyment of Filipino citizens," except for strictly regulated research and survey activities "that would also benefit Filipino citizens." (Sec. 5)

Food security requires not only that food is available, but also that people have the ability to acquire it without resorting to illegal or socially unacceptable means, like stealing, scavenging, or even emergency food supplies. Food security exists when people enjoy freedom from hunger or fear of starvation, or as the UN-FAO puts it, "when *all people, at all times*, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life." (Italics provided.)

This requires the sustainability of our fishery resources, an objective that the Code addresses by sounding the call "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, appropriately supported by research, technical services and guidance provided by the State." (Sec. 2f)

Area Of Jurisdiction

For municipal and city LGUs, the call for ICM means, primarily, that they must manage municipal waters in a sustained and integrated manner, giving preferential use rights to municipal fishers and protecting them against foreign and commercial fishing intrusion (Sec. 2). Following the LGC, the Fisheries Code defines **municipal waters** as:

> *"… not only streams, lakes, inland bodies of water and tidal waters within the municipality which are not included within the protected areas as defined under Republic Act No. 7586 (The NIPAS Law), public forest, timber lands, forest reserves or fishery reserves, but also marine waters included between two (2) lines drawn perpendicular to the general coastline from points where the boundary lines of the municipality touch the sea at low tide and a third line parallel with the general coastline including offshore islands and fifteen (15) kilometers from such coastline. Where two (2) municipalities are so situated on opposite shores that there is less than thirty (30) kilometers of marine waters between them, the third line shall be equally distant from the opposite shore of the respective municipalities."* (Sec. 4)

The Code directs the DA to "authorize the National Mapping and Resource Information Authority (NAMRIA) for the… delineation of municipal waters." (Sec. 123) This

provision would later be translated in the Code's Implementing Rules and Regulations (IRR) as a coordinative effort between the DA (through BFAR), NAMRIA and concerned LGUs, using the Code and LGC rules to resolve overlapping municipal water boundaries. Consequently, guidelines for the delineation of municipal waters were issued, first through an administrative order from the DENR in 2001 (DAO 17, Series of 2001), and then through another administrative order from the DA in 2004 (DAO 1 Series of 2004). DAO 1 has superseded DAO 17, but it covers only municipalities and cities without offshore islands, so DAO 17 is still applied by default to municipalities and cities with offshore islands. Fig. 3.3 shows the delineation of the municipal waters of Cebu based on the prescribed guidelines.

The Code also adopts a classification system that defines fishing as either "commercial" or "municipal." **Commercial fishing** refers to "the taking of fishery species by passive or active gear for trade, business or profit beyond subsistence or sports fishing," using fishing vessels of more than 3 gross tons (GT).

Municipal fishing refers to "fishing within municipal waters using fishing vessels of 3GT or less, or fishing not requiring the use of fishing vessels."

The LGC has conferred two important mandates to the LGU that are particularly useful to enhancing its ability to administer fishing in municipal waters: political autonomy (decentralization) and the ability to generate and mobilize economic resources through taxes and fees. These mandates, along with those devolved through the Fisheries Code of 1998, give the LGU broad powers to control fishing activities occurring within its municipal waters and set conditions for marine resource use by local ordinance. Such measures must be at least as strong and could never be weaker than the conditions set by the national government agencies. (DENR et al, 2001)

A municipal or city LGU can enact appropriate ordinances to protect and manage its municipal waters following the legislative and review process prescribed in the LGC. The LGU is then mandated to enforce, within its jurisdiction, valid fishery ordinances enacted by its legislative council, as well as national fishery laws, rules and regulations. (Sec. 16)

Note that the LGU's jurisdiction does not cover, as indicated in the definition of municipal waters above, NIPAS areas and fishery reserves established by national law, as well as "areas where there are special agencies or offices vested with jurisdiction over municipal waters by virtue of special laws creating these agencies" (Sec. 17). These agencies include, for example, the Palawan Council for Sustainable Development (PCSD), which has the authority to grant fishery rights in Palawan's municipal waters.

Furthermore, because the Code prescribes ICM in "specific *natural* fishery management areas" (italics provided), there is a provision for "the management of contiguous fishery resources such as bays which straddle several municipalities, cities, and provinces… in an integrated manner and not based on political subdivisions of municipal waters." LGUs that share or border such resources are urged "to group themselves and coordinate with each other to achieve the objectives of integrated fishery resource management" (Sec. 16). This provision

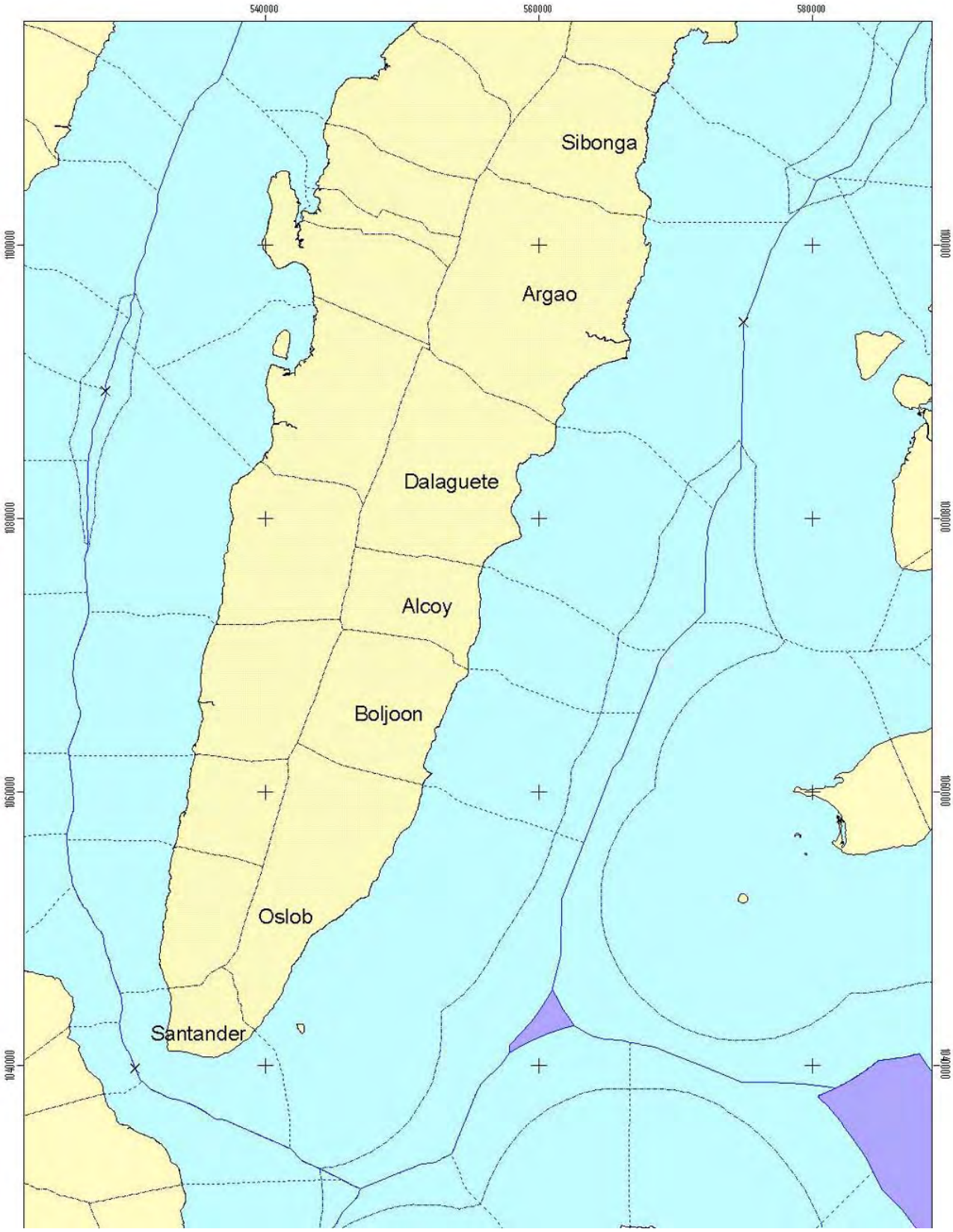


Figure 3.3. Municipal waters of Cebu. This map was prepared in a consultative process involving representatives of the LGUs of Cebu Province based on guidelines prescribed under DAO 17 Series of 2001, which has been superseded by DAO 1, Series of 2004. It shows the 15km zone encompassing the marine waters defined by law as "municipal waters."

underscores an important point that we highlighted in Chapter 2: Fish is a living resource that is easily affected by many factors, including those that originate outside its immediate environs. Like it or not, fisheries management will require LGUs to work together to address issues that do not fall within the direct or full control or jurisdiction of one LGU acting alone.

The Fisheries Code's IRR contain more specific provisions on the LGU's jurisdiction and legal mandates, including:

1) Rule 16.1 mandates the municipal or city LGU to enact a basic ***Municipal Fisheries Ordinance (MFO)*** delineating the boundaries of the municipal waters… and providing the rules and regulations on licensing and permits and other fisheries activities. It also directs cities or municipalities whose waters are adjacent or contiguous to international borders to consult with the Department of Foreign Affairs (DFA) and other concerned agencies on the delineation of municipal waters before enacting their MFOs.
2) Rule 16.2 states that the LGU has the authority to determine, in consultation with or upon recommendation by the FARMC, appropriate ***license fees*** for fisheries activities in municipal waters.
3) Sec. 15 authorizes the LGU to charge a fee and issue auxiliary invoices to cover administrative costs on fish and fishery products to be transported from a local source to destinations in the Philippines or overseas.
4) Rule 16.3 defines the LGU's authority to enact ***"special MFOs***." Such ordinances, to be enacted in consultation with BFAR, may set "special **demarcated fisheries areas**, **closed seasons** and environmentally critical areas and sanctuaries," among other management measures.
5) Rule 16.6 states that municipal and city LGUs may ask the DA to help resolve ***overlapping municipal water boundaries***;
6) Rule 16.7 provides for LGUs that share jurisdiction over bays, lakes and gulfs to formulate and adopt a ***unified fisheries ordinance*** for the integrated management of their resources.
7) Rule 16.8 directs the LGU to adopt a ***color coding system*** to facilitate identification of municipal fishing boats (for purposes of enforcing fishery laws and preferential rights).
8) Rule 16.9 underscores the LGU's mandate and authority to ***enforce fishery laws***, rules and regulations, both national laws and local ordinances, in municipal waters. As part of a monitoring, control and surveillance (MCS) system established by the BFAR, the LGU is expected cooperate fully with other agencies and help ensure judicious utilization, sustainable management and conservation of our fishery and aquatic resources for the exclusive benefit and enjoyment of Filipino citizens (Sec. 14).

☞Glossary

Promoting Participatory Management

The call for integrated management entails broad stakeholder participation, and to encourage this, the Code provides for the creation of Municipal or City FARMCs (M/CFARMCs) composed of representatives from the LGU, the municipal or city development

A. Sia / FISH Project (2008)

Figure 3.4. Participatory management through the FARMC. The Philippine Fisheries Code of 1998 mandates the creation of a municipal or city FARMC, through which stakeholders can participate directly in fisheries management.

council, NGOs, private sector, DA, and at least 11 fisherfolk representatives, including those from the youth and women sectors (Sec. 75).

The M/CFARMC is primarily an advisory body, tasked to provide stakeholder input in the preparation of the municipal (or city) fishery development plan and the formulation of local ordinances for fisheries. In addition, it is mandated to participate directly in fisheries management, by assisting in the enforcement of fishery laws, rules and regulations in municipal waters (through deputation by authorized government units, usually the DA through BFAR), and by performing other functions that may be assigned to it by the Sangguniang Bayan or Sangguniang Panlungsod. (Sec. 74)

To address the need for ICM across political boundaries, the Code also provides for the creation of Integrated FARMCs (IFARMCs) in "bays, gulfs, lakes and rivers and dams bounded by two or more municipalities/cities" (Sec. 76). Each IFARMC is composed of representatives from the LGUs, private sector, and fisherfolk organization in the cities or municipalities involved, with much the same functions as an M/CFARMC, but at the inter-LGU level. The Code intends the IFARMC to serve as "venues for close collaboration among LGUs in the management of contiguous resources." (Sec. 16)

The DA is tasked to administer a separate fund established specifically for use by the FARMCs.

FISHING BY THE CODE

As a matter of policy, the regulation of fishing effort is provided in the Fisheries Code in Sec. 2, which states that government has the duty *"to protect the rights of fisherfolk, especially of the local communities with priority to municipal fisherfolk, in the preferential use of the municipal waters. Such preferential use, shall be based on, but not limited to…* MSY… *or …* TAC *on the basis of resources and ecological conditions, and shall be consistent with our commitments under international treaties and agreements."*

Sec. 7 reiterates this policy, mandating the DA to "issue such number of licenses and permits for the conduct of fishery activities subject to the limits of the MSY of the resource as determined by scientific studies or best available evidence." This section also reiterates the preferential treatment that must be accorded "resource users in local communities adjacent or nearest to the municipal waters."

To support the implementation of this policy and recognizing the ever-changing carrying capacities of fish habitats, the IRR of the Fisheries Code directs the DA to "determine every three years… through continuous stock assessment studies an estimate of the MSY and TAC of major fisheries, including but not limited to large pelagic, small pelagic, reef and demersal fisheries, for the entire Philippines and for each major fishing area." (Rule 7.1)

Table 3.2. Fisheries Code provisions prescribing output controls

Sec. 2(d).	Preferential use of municipal waters based on MSY and TAC
Sec. 7	Access to fishery resources (subject to the limits of the MSY of the resource)
Rule 7.1.	Determination of MSY and TAC
Sec. 8.	Catch ceiling limitations
Sec. 11.	Protection of rare, threatened and endangered species
Rule 89.2.	Determination of juvenile fishes
Sec. 96.	Catching of sabalo and other breeders/spawners
Sec. 101.	Violation of catch ceilings
Sec. 103(c).	Gathering and marketing of shell fishes

☞Glossary

Based on such estimates, the DA Secretary may then prescribe limitations or quotas on the total quantity of fish that may be captured (**catch ceilings**) for a specified period of time in a specified area. In municipal waters, the concerned LGU may concur with, approve or recommend such limitations after consulting with the local FARMC (Sec. 8). In addition, the Code provides that "maximum quantities" be prescribed by the DA for "particular species" of shell fish (Sec. 103).

To guide decision-making, the IRR tasks the DA to "establish a comprehensive information network system at the national, regional and local levels, in cooperation with other concerned agencies, for collection, storage and retrieval of fisheries data" (Rule 7.2). This requires coordination with LGUs and other agencies to ensure that catch and effort data that are collected meet the information requirements of the BFAR (Rule 7.3).

☞p51

But the law cannot rely solely on catch ceilings to manage fishing effort. Several provisions in the Code prescribe other ways to regulate the manner and extent that fishing can be done. As municipal fisheries managers, we will be concerned in particular with the provisions that relate to municipal fisheries management, specifically those that guide the LGU's application of the various **control mechanisms** discussed in Chapter 2. There are several such provisions, but if at any point in the next sections the details begin to overwhelm, just remember that fishery regulations are for the most part based on only six main considerations, the same considerations that you will likely take when you formulate ordinances to fit the specific circumstances of your local fisheries:

1) *How many and how much* fish are caught
2) *What kinds* of fish are caught
3) *Who* does the fishing
4) *How* fishing is done
5) *Where* fishing happens
6) *When* fishing happens

☞Glossary p51

Recall our discussion in Chapter 2 about how fishing effort may be reduced: The first two items listed above are what we described as **output controls** because they set limits on the product of fishing, that is, what may be harvested from the fish stock (Table 3.2). The remaining four items, on the other hand, are called **input controls** because they regulate the fishing effort itself – who are fishing, where and when they are fishing, and the gear or method employed.

What's The Catch?

Early in the above section we cited the legal provisions for ***quantitative output controls***, primarily catch ceilings that put a lid on the quantity of fish that may be harvested. Here we will look at those provisions in the Code that regulate the harvesting of certain types and species of fish, the so-called "***qualitative output controls***."

Qualitative output controls are often applied to:

1) Rare, threatened and endangered species;
2) Juveniles and breeders or spawners; and
3) Fish of certain sizes or at critical stages of their life cycle.

☞Glossary p203

There is a blanket ban on the taking of **rare, threatened and endangered species** (Sec. 11) that the LGU is mandated to enforce in its area of jurisdiction. **BFAR maintains a list of species protected under Philippine laws and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)**. The list is shown in Appendix 4 as it appeared on 31 March 2009 on the BFAR web site at http://bfar.da.gov.ph/infocorner/endangered.htm. But always check for updates — this list is periodically reviewed by authorized country and international bodies, and may have likely changed by the time you read this (some species may have been reclassified or removed, while others may have been added).

Table 3.3. Fisheries Code provisions prescribing input controls

Sec. 9.	Establishment of closed season
Rule 16.3.	Special municipal fisheries ordinances (declaring, among others, special demarcated fisheries areas, closed season and environmentally critical areas and sanctuaries)
Sec. 17.	Grant of fishing privileges in municipal waters
Sec. 18.	Users of municipal waters
Sec. 19.	Registry of municipal fisherfolk
Sec. 20.	Fisherfolk organizations and/or cooperatives
Sec. 21.	Priority of resident municipal fisherfolk
Sec. 22.	Demarcated fishery right
Sec. 23.	Limited entry into overfished areas
Sec. 45.	Disposition of public lands for fishery purposes
Sec. 46.	Lease of fishponds
Sec. 47.	Code of practice for aquaculture
Sec. 51.	License to operate fish pens, fish cages, fish traps and other structures
Sec. 53.	Grant of privileges for operations of fish pens, cages, corrals/traps and similar structures
Sec. 80.	Fishing areas reserves for exclusive use of government
Sec. 81.	Fish refuge and sanctuaries
Sec. 86.	Unauthorized fishing or engaging in other unauthorized fisheries activites
Sec. 87.	Poaching in Philippine waters
Sec. 88.	Fishing through explosives, noxious or poisonous substance and/or electricity
Sec. 89.	Use of fine mesh nets
Rule 89.1.	Regulation of mesh sizes
Sec. 90.	Use of active gear in municipal waters, bays and fishery management areas
Sec. 92.	Ban on muro-ami, other methods and gear destructive to coral reefs and other marine habitat
Sec. 93.	Illegal use of superlights
Sec. 95.	Fishing in overfished area and during closed season
Sec. 96.	Fishing in fishery reserves, refuge and sanctuaries
Sec. 103e.	Construction and operation of fish corrals/traps, fish pens and fish cages

The Code also specifically prohibits the capture of mature milkfish or *sabalo*, "except for local breeding purposes or scientific or research purposes" subject to guidelines from the DA. Other ***breeders or spawners*** may be included in the ban, if the DA determines that it is necessary to do so.

While the Code itself has no specific provision for output controls on ***juvenile fish***, Rule 89.2 of its IRR states that the DA, through BFAR, "shall issue the appropriate FAO [Fisheries Administrative Order] on fishes considered in juvenile stage and penalizing possession thereof."

In addition, the Code contains specific provisions on the gathering and marketing of shellfish, setting limits on both size and quantity of shellfish that may be harvested. Sec. 103 states, "It shall be unlawful for any person to take, sell, transfer or have in possession for any purpose any shell fish which is sexually mature or below the minimum size… prescribed for the particular species." BFAR has issued a number of FAOs setting size limits on certain shell species that can be collected from Philippine waters, and even an outright ban on the gathering of shell species that are considered rare or endangered. The LGU is mandated to enforce these regulations, at least one of which (Fish and Game Administrative Order No. 11, Series of 1935) has been devolved to the LGU.

Note that the decisions on what fish species or fish stocks would be placed under protection – and what size and how many fish could be taken – are usually made at the national and even international levels, based on experts' findings on the status, biology and ecology of such species or stocks. When that happens, the BFAR issues an order detailing the prescribed controls or limits, which the agency, LGU and other authorities would then have to enforce. Such decisions are generally based on research that often takes years, however. This is why, more than a decade after the Fisheries Code first took effect, we are unable to enforce many of the output controls prescribed by the Code, and why we continue to rely mostly on input controls to regulate fishing effort in municipal waters.

Gear Checks & Other Input Controls

☞Glossary

The Fisheries Code authorizes the LGU to use various mechanisms to limit fishing effort within its jurisdiction, prescribing in particular the following input controls:

1. Controls on gear and methods
2. **Closed seasons**; and
3. Fishing licenses and permits.

☞Glossary

Fishing gear and methods are usually regulated or banned when they are shown to destroy fish habitats or cause overfishing. The use of the following gear and methods in municipal waters is expressly prohibited:

1) Electricity, explosives, noxious or poisonous substance such as sodium cyanide (Sec. 88);
2) Fine mesh nets except in "the gathering of fry, glass eels, elvers, *tabios* and *alamang* and such species which by their nature are small but (as determined by BFAR) already mature" (Sec. 89);
3) Active gear (Sec. 90);
4) Muro-ami and other methods and gear destructive to coral reefs and other marine habitats (Sec. 92); and
5) Superlights (Sec. 93).

Being part of the national law, these prohibitions are immediately enforceable at the local level. And so are related laws such as FAOs from the DA which contain more specific provisions defining the method, scale of fishing, gear or gear size that is considered destructive or too efficient and therefore prohibited, or declare certain areas as fishery reserves or in an environmentally critical condition and therefore off-limits to all or some types of fishing, whether permanently or for a specified time such as during a closed season.

☞Glossary

Given its national scope, the Code cannot always directly address very site-specific issues. Instead, it gives the LGU fairly wide elbow room to tackle local fishery concerns. The LGU can, for example, take action to protect certain species or stocks even before they are officially declared by BFAR as depleted or overfished. Sec. 9 of the Code mandates the LGU in consultation with the FARMC to establish **closed seasons** "for conservation and ecological purposes," while Rule 16.3 directs the LGU, in consultation with BFAR, to enact Special MFOs declaring closed seasons, among other measures. Fishing of affected species

or stocks is of course not allowed during the closed season, which can last from a few days to several months.

Besides closed seasons that set the ***time*** when fishing can be done, the Code also has provisions that authorize the LGU to use various mechanisms to delimit the ***area*** where fishing can occur and the ***number*** and ***type of fishers (or gear)*** that may be allowed entry to such area. These mechanisms include:

1) ***Registry of municipal fisherfolk*** (Sec. 18; Sec. 19; Sec. 20; Sec. 21; Sec. 22) – The law requires the LGU to maintain this registry, and use it to monitor fishing activities, limit entry into its municipal waters, and determine which fishers should be given priority to fish within its waters. Registration requires residency in the municipality or city of at least six month (Rule 19.2). The registry must be updated annually, using ***inclusion and exclusion mechanisms*** that the LGU must formulate in consultation with or upon the recommendation of the FARMC. As a general rule, only municipal fishers – that is, fishers engaged in municipal fishing – and their cooperatives or organizations who are listed in such registry can engage in fishery-related activities in municipal waters, but registration is *not* equivalent to a permit to fish (Rule. 19.3). The LGU may authorize small and medium commercial fishing vessels (3.1-150GT) to operate within its municipal waters at a distance of more than 10km from the shoreline, but only under the following conditions:
   a. The waters are at least 7 fathoms deep;
   b. The gear and methods used are those allowed by law;
   c. The FARMC has been consulted through public hearing;
   d. The commercial fishing concern has been certified by the appropriate agency as "not having violated this Code, environmental laws and related laws."

   The gross tonnage of the fishing vessel being a major basis for determining whether a fishing operation is municipal or commercial, the ***registration of municipal fishing vessels*** has also been devolved to the municipal and city LGUs through Executive Order (EO) No. 305 issued in 2004. The Code limits the capacity or size of municipal fishing vessels to not more than 3GT.
2) ***Licenses, leases and permits*** (Sec. 17; Sec. 86; Sec. 87) – The LGU has the authority to grant (or deny) fishing privileges in municipal waters, except in areas where other agencies have been vested with jurisdiction over municipal waters, such as the PCSD in Palawan. The law prohibits fishing in Philippine waters without a license, lease or permit, except by persons engaged in "fishing for daily food sustenance or for leisure which is not for commercial, occupation or livelihood purposes." Moreover, licenses, leases and permits can only be granted to Filipino citizens, making it unlawful for foreign entities to fish or operate any fishing vessels in Philippines waters, whether within or outside municipal waters.
3) ***Declaration of overfished areas, special demarcated fishery areas, environmentally critical areas, and fish refuge and sanctuaries by the LGU*** (Sec. 16; Sec. 23; Sec. 81; Sec. 95; Sec. 96) – The LGU, after consulting with the BFAR and FARMCs concerned, can declare all or parts of its municipal waters as overfished or in danger of being overfished, or as special demarcated fishery areas, environmentally critical areas, or sanctuaries. The LGU in consultation with or upon recommendation with

concerned FARMCs may also establish fishery refuge and sanctuaries. In fact, Sec. 81 provides that "at least 15% where applicable of the total coastal areas in each municipality shall be identified, based on the best available scientific data and in consultation with the DA, and automatically designated as fish sanctuaries by the LGUs in consultation with the concerned FARMCs." When such a declaration is adopted, the LGU can limit, if not totally prohibit, fishery activities in affected areas.

4) ***Declaration of fish reserves for the exclusive use of government*** (Sec. 80; Sec. 96) – The LGU in consultation with the FARMC, or the FARMC acting alone, may recommend to the DA that portions of its municipal waters be declared as fishery reserve "for special or limited use, for educational, research, and/or special management purposes." Regulations in this case are issued in an appropriate FAO by the DA (through the BFAR).

Fish caught using illegal gear, or during closed seasons, or in areas where fishing is regulated or prohibited, or by unauthorized persons, or by any unlawful means are considered illegal goods, the mere possession of which may be punishable by law. Penalties come in various forms, including market denial, fines, revocation of license or permit to fish, confiscation of catch and gear, and even jail time. The Code prescribes the amounts of penalty and terms of prison that may be applied to specific violations. As provided in the LGC, the LGU also has the authority to impose fines for the violation of local ordinances, subject to a limit of Php2,500 for every violation of a municipal ordinance and Php5,000 per violation of a city ordinance.

Limits On Fish Culture

☞ p177, p180

A number of mechanisms that might be classified as input control pertain to fish farming practices, and the Code has plenty of these, no doubt acknowledging the harmful impacts of uncontrolled **aquaculture** and **mariculture** development (Appendices 1 and 2), and the potential of conflict among different resource users. The LGU holds most of the authority over aquaculture and mariculture activities in municipal waters, except for fishponds, which remain the BFAR's responsibility. While it may not be so expressly articulated in the Code, the key thing to remember about such authority is that it is intended primarily to establish regulations for and set limits to fish farming activities so that they do not cause harm to either the environment or human health. Such restrictions include the following:

1) ***Fishponds in public lands*** — The Code sets fairly strict limits on the conversion to other uses of public lands such as "tidal swamps, mangroves, marshes, foreshore lands and ponds," all of which cannot be disposed or alienated. The DA, working with the DENR, is mandated to declare portions of such lands as reserved areas or fish sanctuaries "for conservation and ecological purposes" (Sec. 45, Rule 45.1). Lands declared available for fishpond development may be converted to fishponds only under the following conditions:
   a. The area must be covered by a ***fishpond lease agreement (FLA)*** issued by the DA through BFAR**.** BFAR must give preference to "qualified fisherfolk cooperatives or associations." (Rule 45.2, Rule 45.3)

Figure 3.5. Land conversion to fishponds. BFAR, working with DENR, holds the primary responsibility for ensuring that the strict limits set by law on fishpond development are properly and adequately followed. Illegal fishponds such as the one shown here are required by law to be reverted to its natural use, in this case to mangroves.

b. Maximum area that can be leased is 50 ha for individuals and 250 ha for corporations or fisherfolk organizations. (Sec. 46a)
c. The lease has a term of 25 years and is renewable for another 25 years. Payment of fees and annual rent is required, the rates to be determined by the DA. (Sec. 46b, c)
d. Fishponds and related structures must not obstruct "any defined migration path of migratory fish species, such as river mouths and estuaries within a distance determined by the concerned LGUs in consultation with and upon recommendation of the FARMC." (Sec. 56)
e. Development of the area must start within three years from the approval of the lease contract, and the area must be "fully producing" within five years from the approval of the contract, otherwise it will automatically revert to the public domain for reforestation. (Sec. 46d; Sec. 49)
f. Subleasing is not allowed and will mean the cancellation of the FLA, but the rights to the FLA may be transferred or assigned to another person if prior approval is obtained from the DA. (Sec. 46e, f)
g. The lessee is obligated to reforest river banks, bays, streams and seashore fronting the dikes of his fishpond according to prescribed rules and regulations. In addition, the lessee must provide anti-pollution facilities, such as settling ponds or reservoirs, or risk the cancellation of his FLA. In addition, there may be fines and fees – for example, effluent charges, user fees and negotiable permits, fines and penalties for pollutants traceable to the fishpond – for non-compliance, as well as awards and incentives for compliance with environmental regulations. (Sec. 46g, h; Sec. 48)
h. Because of the Constitutional prohibition on the access of foreigners to our fishery resources, the approval of any application for an FLA requires proof of citizenship. Any FLA holder who acquires citizenship in another country automatically loses his lease. Improvements on the lease area are forfeited in favor of the government. (Sec. 50)

J Unson / FISH Project (2006)

Figure 3.6. Limits on fish cages and other structures. The LGU has full authority to regulate fish culture activities within its municipal waters, and the responsibility to ensure that such activities do not cause harm to the marine environment. The uncontrolled installation of fishing structures such as this fish cage called "bintol" in the waters of Talibon, Bohol, may lead to overfishing, resource use conflicts and other issues. (Photo: J Unson, 2006)

i. Operators are required to submit an annual report providing details of the species they culture and their volume of production (Sec. 57).

2) ***Fish hatcheries, fish breeding facilities and private fishponds*** – Registration with the LGU is required to operate these facilities, and operators must comply with the following requirements:
   a. Facilities must meet the minimum standards prescribed by the DA. (Sec. 57)
   b. They must not obstruct "any defined migration path of migratory fish species, such as river mouths and estuaries within a distance determined by the concerned LGUs in consultation with and upon recommendation of the FARMC." (Sec. 56)
   c. Operators must submit an annual report to the DA providing details of the species they produce and their volume of production. (Sec. 57)

3) ***Fish pens, fish cages, fish traps and other fish culture structures*** – This type of operations requires a license issued by the LGU (Sec. 51) and is subject to the following limitations:
   a. Only municipal fishers and their organizations may be granted a license and therefore qualify to operate such structures. (Sec. 53) The LGU concerned may also grant demarcated fishery rights to fishers organizations or cooperatives for mariculture operation in specific areas identified by the DA. (Sec. 22)
   b. Structures can only be installed "within established zones duly designated by LGUs in consultation with the FARMCs concerned, consistent with national fisheries policies, after the corresponding licenses… have been secured." (Sec. 51)
   c. Structures must not obstruct free navigation "in any stream, river, lakes or bays flowing through or adjoining" the structures, or impede the flow of the tide to and from the area. The DA, working with other government agencies, is mandated to order and effect the removal of such structures. (Sec. 55)
   d. Structures must also not obstruct "any defined migration path of migratory fish species, such as river mouths and estuaries within a distance determined by the

concerned LGUs in consultation with and upon recommendation of the FARMC." (Sec. 56)

e. In a lake or river, the area that can be allotted for aquaculture should not exceed 10% of the suitable water surface area, "and the stocking density and feeding requirement shall be controlled and determined by its carrying capacity." (Sec. 51)

f. The LGU may grant ***pearl farm leases*** to qualified persons with the necessary capital and technology. Pearl farms that were already in operation at the time the Code took effect (under old leases issued by BFAR) are allowed to continue under the terms of their original leases. (Sec. 52)

All those involved in fish culture of whatever form are expected to abide by a Code of Practice for Aquaculture that the DA is mandated to develop "through a consultative process with DENR, the fish workers, FLA holders, fishpond owners, fisherfolk cooperatives, small-scale operators, research institutions and the academe, and other stakeholders" (Sec. 47). The Code of Practice is contained in FAO No. 214 issued by the DA in 2001, and so it has the force of law. It outlines principles and guidelines for environmentally sound and best practices in "fishery operations involving the breeding and farming of fish and other fishery species in fresh, marine and brackishwater areas" (aquaculture) and "sea farming of aquatic plants and animals" (mariculture). The full text of FAO No. 214 Series of 2001 is provided in this *Sourcebook's* companion CD, or at the website listed under *Additional References* at the end of this chapter.

☞p101

Also in 2001, as a member of the Association of Southeast Asian Nations (ASEAN), the Philippines adopted the *Regional Guidelines for Responsible Aquaculture in Southeast Asia.* This was followed in 2004 by the *Code of Practice for Sustainable Use of Mangrove Ecosystems for Aquaculture in Southeast Asia*. **These documents are available on the Internet** (see Additional References at the end of this chapter).

In 2008, the DA, DENR and DILG issued a joint administrative order (*JAO No. 1 s. of 2008*) identifying and defining areas of cooperation and collaboration between the three agencies in the planning, management and control of aquaculture development, with focus in particular on mitigating its impacts on the environment. This JAO includes the following key provisions, among others:

1) Conduct of environmental impact assessment (EIA) of development activities with potential direct impacts on coastal and fisheries management and monitoring of compliance with EIS, to be conducted by a team composed of DENR, BFAR, concerned LGUs, FARMC, and other stakeholders.
2) Creation of an inter-agency technical working group to be chaired by DENR, with members from BFAR, concerned LGUs and FARMCs to identify FLA areas which have been abandoned for at least five years from the date of approval of the lease contract. These areas, upon proper notice to their leaseholders, will automatically revert to public domain and should be reforested under the DENR's administration.
3) Reconstitution and strengthening of the Joint Quick Response Team composed of BFAR and DENR to also include DILG, the League of Municipalities of the Philippines, League of Cities of the Philippines or the LGU concerned and FARMC

representatives. Closely coordinating with the PCG and PNP-Maritime Group, this team is tasked to address aquatic pollution cases.

4) Management of lakes and other bodies of water within protected areas under NIPAS. The JAO mandates the DILG, PNP-Maritime Group, PCG and FARMC to assist the PAMB to dismantle any fish culture structures that obstruct navigation, impede the natural tidal flow or cause pollution in the area. The creation of an integrated FARMC, composed of all concerned FARMCs, is made compulsory.

A copy of JAO No. 1 s. 2008 is included in this *Sourcebook*'s companion CD.

Habitat Protection

Many control mechanisms provided in the Fisheries Code, while designed primarily to regulate fishing effort, also help protect or prevent the destruction of fish habitats. This is true for prohibitions on destructive fishing gear and methods, as well as the declaration of fishery reserves or sanctuaries where there are limits, if not a total ban, on some or all fishery activities. The following provisions in the Code, however, focus mainly on habitat protection and maintaining ecosystem integrity:

1) ***Introduction of foreign aquatic species*** – As a precaution against our waters being overrun by foreign species, or being infested by foreign pests or diseases, the Code prohibits the introduction of exotic aquatic species, both plants and animals, except where there is "a sound ecological, biological and environmental justification based on scientific studies" and the bio-safety standards provided by law. The DA may however approve the introduction of such species for scientific or research purposes. (Sec. 10)
2) ***Environmental Impact Statement (EIS) and Environmental Compliance Certificate (ECC)*** – These documents are required and must be secured (from the DENR) before the start of any activity that could affect the quality of the environment, such as infrastructure development, mining, oil exploration, and even fishponds, fish hatcheries and fish breeding facilities.
3) ***Cultivation of mangroves*** – At least 25% but not more than 40% of bays, foreshore lands, continental shelf, or any fishing ground must be set aside for the cultivation of mangroves to strengthen the habitat and spawning grounds of fish. (Sec. 81)
4) ***Ban on coral exploitation and exportation*** – This prohibition applies to the collection, possession, selling and export of all types of corals – "ordinary, precious and semi-precious, whether in raw or in processed form" – except for scientific or research purposes. (Sec. 91)
5) ***Ban on the gathering, selling or export of white sand, silica, pebbles and other materials that make up any marine habitat*** (Sec. 92) – The LGU, in consultation with the Bureau of Mines and Geosciences, is mandated to enact and enforce the appropriate MFO establishing such prohibition. (Rule 92.3)
6) ***Conversion of mangroves*** – The conversion of mangroves to fishponds or for any other purposes is not allowed under any circumstances. Violators not only face fines and jail time but must restore or compensate for the restoration of the damaged mangroves. (Sec. 94)

FISH Project

Figure 3.7. MPAs: Microcosm of the benefits of participatory management. MPAs have become a popular tool for protecting habitats in the Philippines. For LGUs, they have demonstrated not only the benefits of protection and management, but also the value of stakeholder participation in management. This MPA in Carrascal, Surigao del Sur, managed by the LGU and a people's organization, boasts a concrete guardhouse built by the community members themselves.

7) ***Aquatic pollution*** – It is unlawful to introduce to the aquatic environment, whether directly or indirectly, substances or energy that causes damage to the environment or hazard to human health, or results in any other harmful effects (Sec. 102). The legal definition of aquatic pollution is quite broad, encompassing deforestation, unsound agriculture practices such as the use of banned chemicals or excessive use of chemicals, intensive use of artificial fish feeds, and wetland conversion, which cause similar hazards and harmful effects. (Sec. 4)

We did not include MPAs in this list because we have already cited the pertinent provisions on fish sanctuaries and reserves in our previous discussions on input controls. But let's talk some more about MPAs, perhaps the most widely accepted mechanism for fisheries conservation and management in the Philippines. For many LGUs, MPAs have turned out to be more than just a strategy to regulate fishing effort or protect habitats. They have also proven to be a venue for demonstrating the benefits of resource management, and thus a powerful tool of persuasion that has turned public opinion in favor of LGU efforts to regulate fisheries. And fortunately for the LGUs, MPAs are one management measure over which they have significant authority. (DENR et al, 2001)

Despite the mandate of the DENR to establish and manage MPAs under the NIPAS Act, LGUs have become the most active participants in MPA management in the Philippines. 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 (NGAs) to

establish municipal reserves or sanctuaries, and even within NIPAS areas they are key participants in management through the PAMB. (DENR et al, 2001)

… & A Few More

As the main authority in municipal waters, the LGU has a few other mandates relating to promoting the general welfare of municipal fishers, fair labor practices and some aspects of fisheries as a business activity. These include the following:

1) ***Support to municipal fisherfolk***. In particular, the LGU is mandated to help municipal fishers through appropriate technology and research, credit, production and marketing assistance, training for additional or supplementary livelihood, and others. (Sec. 24)
2) ***Rights and privileges of fishworker***s. It is the LGU's duty to ensure that fishworkers are given the privileges accorded to them by law. The Code entitles fishworkers to the same privileges as those accorded to other workers under the Philippine Labor Code, Social Security System and other laws or social legislation for workers (Sec. 25). Note that workers on board any fishing vessel engaged in fishing operations are classified as "field personnel" who, under the Labor Code, are not subject to the same regulations on normal working hours and overtime (Rule 25.1).
3) ***Establishment of post-harvest facilities for fishing communities***. Following guidelines promulgated by the BFAR through a Comprehensive Post-Harvest and Ancillary Industries Plan, the LGU is mandated to coordinate efforts to set up post-harvest facilities with the private sector, the FARMCs and concerned government agencies. Such facilities – municipal fish landing sites, fish ports, fish processing plants, ice plants and cold storage, among others – should serve primarily the municipal fishers. (Sec. 59)
4) ***Registration and licensing of all post-harvest facilities.*** The LGU is also tasked to register and license all post-harvest municipalities operating within its area of jurisdiction, based on minimum standards prescribed by the BFAR and the Philippine Fisheries Development Authority (PFDA). (Sec. 60)
5) ***Sanctions against fraudulent and illegal possession or use of weighing and other measuring instruments***. The LGU has the authority to penalize those who commit fraud or in any manner possess or use illegally weighing and other measuring instruments for fishery transactions. (Sec. 62)

There are also general LGU functions – health, sanitation and hygiene, food safety, and waste management, for example – that must be applied as necessary throughout the fisheries production and distribution chain. Here the LGU can seek advice and assistance from concerned NGAs. The BFAR, for one, is specifically mandated to "advise and coordinate with the LGU on the maintenance, proper sanitation and hygienic practices in fish markets and fish landing areas" (Sec. 65j).

The BFAR is also mandated to work with LGUs and other agencies "for the establishment of productivity-enhancing and market development programs in fishing communities to enable women to engage in other fishery/economic activities and contribute significantly to development efforts." (Sec. 65m)

COUNTING ON BFAR

Indeed, although jurisdiction and authority over municipal fisheries have been devolved to the municipal and city LGUs, the BFAR continues to hold certain mandates and responsibilities that LGUs should be cognizant of, because they could contribute directly to better fisheries management. If you want to quickly figure out what kind of assistance you can expect from the BFAR, take a close look at Sec. 65 of the Fisheries Code. One particularly important mandate contained in this section requires the BFAR to "assist the LGUs in developing their technical capability in the development, management, regulation, conservation and protection of fishery resources" (Rule 3.1; Sec. 65[q]). Such assistance may also cover the following critical areas, among other aspects of fisheries management:

1) Formulation of local regulations on fees and other fishery charges (Rule 6.5)
2) Establishment of catch ceilings in municipal waters (Rule 8.2)
3) Establishment of closed season and fishery management areas (Sec. 9)
4) Establishment of a MCS system (Sec. 14)
5) Formulation of Special MFOs (Rule 16.3)
6) Resolution of overlapping boundaries of municipal waters (Rule 16.6)
7) Development of a standard registration form for municipal fishing vessels, gear and fisherfolk (Rule 19.1)
8) Identification of mariculture areas (Rule 22.1)
9) Studies to determine if municipal waters are overfished or in danger of overfished and need to be protected (Rule 23.1)
10) Impact assessment of the state of fisheries in declared overexploited areas (Rule 23.3)
11) Support to municipal fisherfolk through appropriate technology and research, credit, production and marketing assistance and other services, such as training for supplemental livelihood (Sec. 24)
12) Establishment of fisheries management system in municipal waters (Rule 24.5)
13) Organization and strengthening of fishers organizations and cooperatives (Rule 24.6)
14) Reversion of abandoned, undeveloped or underutilized fishponds to their original state (Rule 49)
15) Determination of the carrying capacity of lakes and inland waters (Rule 51.1)
16) Preparation of a model municipal fisheries ordinance governing the issuance by the LGU of permits for pearl farms. (Rule 52.2)
17) Removal of structures that obstruct navigation (Sec. 55)
18) Definition of migration paths of migratory fish species to guide the LGU in the issuance of permits for fish culture (Sec. 56)
19) Establishment of minimum standards for fish breeding facilities, hatcheries and private fishponds (Sec. 57)
20) Conduct of inventory of fish culture facilities (Sec. 57)
21) Establishment of post-harvest facilities for fishing communities (Sec. 59)
22) Establishment and implementation of minimum operating standards for post-harvest facilities (Sec. 60)

23) Development support services in all aspects of fisheries production, processing and marketing (Sec. 65g)
24) Advisory services and technical assistance on the improvement of quality of fish from the time it is caught (i.e. on board fishing vessel, at landing areas, fish markets, to the processing plants, and to the distribution and marketing chain). (65h)
25) Coordination of efforts related to fishery production undertaken by the primary fishery producers, LGUs, FARMCs, fishery organizations/cooperatives (65i)
26) Help in resolving conflicts of resource use and allocation (in consultation with the LGUs and FARMCs). (65n)
27) Development of value-added fishery products for domestic consumption and export. (65o)
28) Formulation of rules and regulations for conservation and management of straddling fish stocks and highly migratory species. (Sec. 65r)

Other services that are expected of BFAR include:

1. ***Quarantine and quality inspection services*** of all fish and aquatic products to prevent the introduction of "exotic" fish pests and diseases into the country on the one hand, and on the other, prevent endemic fishery and aquatic resources from being taken out of the country. (Sec. 67)
2. ***Laboratory services*** for surveillance, inspection and fish disease diagnosis during handling, transport, manufacturing and storage (Rule 67.2). Although not specifically stated in the Code, the BFAR also assists in law enforcement in municipal waters by providing fish examination services that help detect some illegal fishing methods, such as the use of dynamite and cyanide.
3. ***Training services*** for LGU personnel to improve their job skills, and for municipal fishers to increase their economic productivity as well as develop their capacity to participate in fisheries governance. Training is usually provided through the Regional Fisheries Training Centers (Rule 66.7). The BFAR is also mandated to provide training to the deputy fish wardens in fishery laws, apprehension techniques and gathering of evidence. (Rule 124.1)
4. ***Research services*** to raise the income of fishers, determine their condition and needs, and promote maximum utilization of available fisheries technology. Research activities are done primarily by the National Fisheries Research and Development Institute (NFRDI).

To bring its services closer to the LGUs, the BFAR is directed to establish an office in every region, and provincial and municipal offices "as may be appropriate or necessary." (Rule 66.4)

IT'S ALL ABOUT RESPONSIBLE, SUSTAINABLE USE

We must point out that the law can be – and has been – revised many times as the global community of fisheries experts, managers, users and other stakeholders try to respond to new challenges in fisheries management. Indeed, the Fisheries Code itself

recognizes the need for adaptive management and calls for a mandatory review by Congress "at least every five years or as often as [Congress] deems necessary, to ensure that fisheries policies and guidelines remain responsive to changing circumstances." What remains constant is this: Fisheries governance must ensure that adequate measures are in place to address existing and potential fishery issues, and that all resource users practice sustainable and responsible fishing and are made accountable for their actions.

Six core principles have been proposed to guide the governance of oceans and fishery resources that also apply in general to environmental governance (Costanza et al, 1998):

Principle 1: Responsibility. Access to environmental resources carries attendant responsibilities to use them in an ecologically sustainable, economically efficient, and socially fair manner. Individual and corporate responsibilities and incentives should be aligned with each other and with broad social and ecological goals.

Principle 2: Scale-matching. Ecological problems are rarely confined to a single scale. Decision-making on environmental resources should (i) be assigned to institutional levels that maximize ecological input, (ii) ensure the flow of ecological information between institutional levels, (iii) take ownership and actors into account, and (iv) internalize costs and benefits. Appropriate scales of governance will be those that have the most relevant information, can respond quickly and efficiently, and are able to integrate across scale boundaries.

Principle 3: Precaution. In the face of uncertainty about potentially irreversible environmental impacts, decisions concerning their use should err on the side of caution. The burden of proof should shift to those whose activities potentially damage the environment.

Principle 4: Adaptive management. Given that some level of uncertainty always exists in environmental resource management, decision-makers should continuously gather and integrate appropriate ecological, social, and economic information with the goal of adaptive improvement.

Principle 5: Full cost allocation. All of the internal and external costs and benefits, including social and ecological, of alternative decisions concerning the use of environmental resources should be identified and allocated. When appropriate, markets should be adjusted to reflect full costs.

Principle 6: Participation. All stakeholders should be engaged in the formulation and implementation of decisions concerning environmental resources. Full stakeholder awareness and participation contributes to credible, accepted rules that identify and assign the corresponding responsibilities appropriately.

These principles have been adopted by national or international law, or at least considered in policy-making processes in many parts of the world. You can see from our earlier discussions in this chapter that, at national policy level in the fisheries sector, the Philippines has complied to some degree with all principles, but their application remains patchy at all levels. At any rate, as a signatory to many international treaties, agreements and global programs of action on various aspects of the environment, the Philippines falls

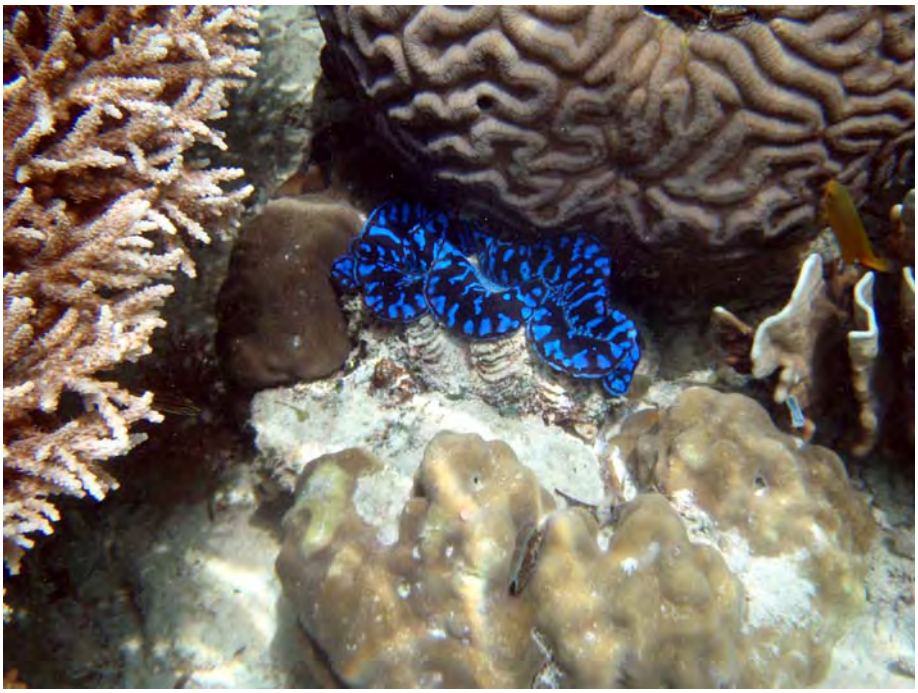


Figure 3.8. Management of Red-listed species and the LGU's role. Giant clams (left) and other marine species protected under the CITES are the LGU's responsibility because the major sources of many of these species are within the jurisdiction of the LGU. The LGU is therefore mandated to prevent their collection, trafficking and trade, as well as to institute measures to protect them.

within the international legal regime recognized by the community of nations on the proper management of the oceans.

Above we have cited the CITES because it involves the cooperation of LGU authorities. The CITES is a treaty between 151 states which have agreed to control or prohibit the international trade of over 40,000 species of animals and plants, including any products made from them, depending on the extent of the threat to their survival as a species. As a party to the treaty, we use a system of permits and certificates, which are issued when certain conditions are met and have to be presented when consignments of specimens of any species listed under the agreement leave or enter a country. Since the sources of these flora and fauna are directly within their jurisdictions, local governments are required to prevent the collection, trafficking of, and trade in the species listed under CITES (DENR et al, 2001). The IRR (draft as of 28 September 2009) of RA 9147 (Wildlife Resources Conservation and Protection Act) further define the LGU's role in aquatic wildlife conservation and protection (Table 3.4).

The BFAR has issued several FAOs on CITES-protected marine species, including marine mollusks (*FAO No. 158 s. 1986*, and *FAO No. 168 s. 1990*), corals (*FAO No. 202 s. 2000)*, dolphins (*FAO No. 185, s. 1992*), and whale sharks and manta rays (*FAO No. 193, s1998*). (DENR et al, 2001)

Table 3.4. LGU role in aquatic wildlife conservation and protection under RA 9147's draft IRR as of 28 September 2009

a.	Perform the following functions as a Member of the Regional Wildlife Management Committee: ▪ Assist the NWMC (National Water Management Council) in the performance of its functions; ▪ Provide technical assistance and scientific advice to the Regional Director for the management and conservation of aquatic wildlife of the region; ▪ Evaluate applications for the collection or use of aquatic wildlife for thesis purposes, conservation, breeding or propagation of threatened species; and, ▪ Perform tasks requested by the Secretary, Director or Regional Director for the proper implementation of RA 9147 and its implementing rules within the region.
b.	Be consulted/ provide clearance for the following activities using aquatic wildlife: ▪ Scientific Researches on Wildlife (Section 12) ▪ Other government initiated or implemented research or scientific projects (Section 12.5) ▪ Thesis and dissertation of students affiliated with local academic institutions (Section 12.6) ▪ Small-scale (with capital of Php1,500, 000.00 and below / medium (with capital of more than Php1.5M) farming of wildlife (Section 13.2) ▪ Issuance of wildlife collectors permit and wildlife special use permit ▪ Utilization of aquatic wildlife for educational purposes and documentation for commercial purposes
c.	Enforce RA 9147 for aquatic wildlife ▪ Function as deputized Wildlife Enforcement Officer (Section 27) ▪ Operate/ establish Wildlife Rescue Centers (Section 36) to take temporary custody and care of all confiscated, abandoned, donated and rescued aquatic wildlife to ensure their welfare and well-being.

Given the inherent difficulties in international treaty-making, countries have recently begun resorting to less formal instruments with varying degrees of binding force. Among these instruments are so-called programs of action and codes of conduct. One that pertains specifically to fisheries is the Code of Conduct for Responsible Fisheries adopted by the UN-FAO in 1995. (DENR et al, 2001)

The Code of Conduct provides a general framework for national and international efforts to ensure sustainable exploitation of aquatic living resources, "with a view to ensuring the effective conservation, management and development of living aquatic resources, with due respect for the ecosystem and biodiversity." It also contains guidelines for the use and management of six areas of aquatic resource management, namely fisheries management; fisheries operation; aquaculture development; integration of fisheries into coastal area management; post-harvest practices and trade; and fisheries research. (DENR et al, 2001)

A quick look at the highlights of the UN-FAO Code of Conduct (Appendix 5) shows that the Philippine government has adapted the UN-FAO Code to more specifically address the country's fisheries situation, primarily through the Fisheries Code. The Fisheries Code provision declaring "the concept of an integrated coastal area management" as the preferred approach to fisheries management responds to the UN-FAO Code's provisions that call on member-states to promote the integration of fisheries into coastal area management. Such provisions include:

1. States should ensure that an appropriate policy, legal and institutional framework is adopted to achieve the sustainable and integrated use of the resources, taking into account the fragility of coastal ecosystems and the finite nature of their natural resources and the needs of coastal communities. (Art. 10.1.1)
2. In view of the multiple uses of the coastal area, States should ensure that representatives of the fisheries sector and fishing communities are consulted in the decision-making processes and involved in other activities related to coastal area management planning and development. (Art. 10.1.2)
3. States should promote multidisciplinary research in support of coastal area management, in particular on its environmental, biological, economic, social, legal and institutional aspects. (Art. 10.2.5)

As a member of the ASEAN, the country has contributed and agreed to several sets of regional guidelines for responsible fisheries in Southeast Asia. We have mentioned earlier two sets of regional guidelines for aquaculture. In addition to these, the ASEAN has adopted regional guidelines for responsible fishing operations (1999), fisheries management (2003), post-harvest practices and trade (2004), and co-management using group user rights, fishery statistics, indicators and fisheries refugia (2006).

Through *Executive Order (EO) No. 533 s. 2006*, the country has also officially adopted ICM "as a national strategy to ensure the sustainable development of the country's coastal and marine environment."

WHO ELSE ARE ON OUR TEAM?

Besides the BFAR, several other institutions lend assistance and support to LGU efforts in municipal fisheries management. This has especially been so in recent years as ICM involving multi-sectoral participation gained acceptance nationally and among local governments and fishing communities as the preferred approach to resolve many fishery issues. The official adoption of ICM as a national sustainable development strategy, in particular, also installed the following mechanisms and programs that support coastal management:

1. ***ICM Education*** involving primarily the ***Department of Education***, which is tasked to integrate ICM into the primary and secondary education curricula or subjects (i.e., Science, Biology, Sibika, History, among others), textbooks, primers and other educational materials, the basic principles and concepts of conservation, protection and management of the country's marine resources;
2. ***ICM Training Programme for LGUs*** to be provided by the ***DENR and Department of the Interior and Local Government (DILG)***, which will develop, through the ***Local Government Academy (LGA)***, ICM training programs for LGUs based on existing ICM expertise and experiences;
3. ***Environmental and Natural Resource Accounting and Valuation for ICM Planning*** involving primarily the ***National Economic and Development Authority (NEDA)*** and the ***National Statistics Coordination Board***, which are mandated to incorporate coastal and marine resource accounting in the national and regional accounts; and

4. ***Coastal and Marine Environmental Information Management System and Network*** to be established and maintained by the ***DENR***, in collaboration with other concerned national government agencies, institutions and the LGUs.

The *Philippine Coastal Resource Management Guidebook Series Vol. 2* (DENR et al, 2001) includes a detailed description of the roles of the major ICM players that assist or work with LGUs in the Philippines. Parts of this description are reproduced below, with emphasis on those that relate particularly to resource management at the local level.

Department of Environment & Natural Resources

Where ICM is concerned, the DENR is recognized as the lead agency at the national level. To pursue its mandates, the DENR has been involved in policy issuances and programs that focus on the management of mangroves and associated terrestrial and aquatic flora and fauna within the marine zone. It has not directly involved itself, however, in fishery regulatory, licensing, research, and enforcement functions, which are primarily the BFAR's mandate. (DENR et al, 2001)

In 1993, the Department began addressing its marine concerns by including seascapes in the category of protected areas under the NIPAS Act, which it was tasked to implement. It also launched its Coastal Environment Program (CEP) through DENR AO No. 19, s1993, which aimed to uplift the socioeconomic conditions of the country's coastal population through the protection of the environment and the implementation of strategic interventions on resource assessment, community organizing, information and education campaigns, and the identification and establishment of impact sites and seascapes. (DENR et al, 2001)

Despite the enactment of the LGC, the DENR retained many environmental management functions relating to forest management in forestlands not devolved to the LGUs; mines and geosciences management which do not fall under the purview of the Small-scale Mining Act; environmental management, specifically the implementation of the EIA System for certain businesses and projects; management of all protected areas, including those under the NIPAS; land management; and ecosystems research.

The following functions related to ICM have been devolved by the DENR to the LGUs. However, the DENR remains an important source of technical assistance to LGUs in the exercise of these functions.

1. Implementation of community-based forestry projects (including mangroves): integrated social forestry projects, new regular reforestation projects, forestland management agreements, and other community forestry projects;
2. Management and control of communal forests (including mangroves) with an area not exceeding 50 sq km;
3. Management, protection, rehabilitation, and maintenance of small watershed areas as identified by the DENR;

CRMP (2002)

Figure 3.9. DENR's technical assistance role. The specific mandate of DENR to assist LGUS in the management and conservation of the coastal environment is lodged under its Coastal and Marine Management Office (CMMO), which was created in February 2002 to monitor and coordinate local implementation of CRM.

4. Enforcement of forestry laws in community-based forestry projects and communal forests;
5. Establishment, protection, and maintenance of tree parks, greenbelt areas, and other tourist attractions in areas identified by the DENR;
6. Implementation of the Rehabilitation in Conservation Hotspots Project;
7. Conservation of Rare and Endangered Species Project in areas identified by the DENR;
8. Enforcement of pollution control laws, including the apprehension of smoke belching vehicles;
9. Solid waste disposal and other environmental management systems related to hygiene and sanitation; and
10. Implementation of cease-and-desist orders issued by the Pollution Adjudication Board.

Department of the Interior & Local Government

The DILG was reorganized by virtue of RA 6975 that created two basic sectors within the department -- the Local Government Sector and the Interior or Public Safety Sector.

The ***Local Government Sector***, which is responsible for planning, implementing, monitoring, and evaluating plans, programs, and policies pertaining to local autonomy, decentralization, and local governance consists of the Bureau of Local Government Development (BLGD), Bureau of Local Government Supervision (BLGS), National *Barangay* Operations Office (NBOO), LGA, and staff bureaus. The BLGD is in charge of establishing and prescribing policies, guidelines, systems, and approaches to local governments, and in evaluating local development policies to enhance the participation of local governments in planning and implementation. It also provides support services to the Oversight Committee of the LGC in its sustained implementation. The BLGS, on the other hand, is the principal

Figure 3.10. Joining forces against illegal fishing. Coastal and fishery law enforcement in the Philippines is a mandate of several agencies, including the PNP, PCG, and the local government. This photo shows a composite sea-borne patrol team from PNP and PCG during operations in Davao Gulf.

staff bureau that formulates policies pertaining to general supervision over LGUs and provides assistance in the preparation of national legislation affecting local governments.

The ***Interior or Public Safety Sector***, which is composed of the National Police Commission, the Philippine National Police (PNP), the Bureau of Fire Protection, and the Bureau of Jail Management and Penology is responsible for planning and implementing the Department's programs on peace and order and public safety.

In 2003, the PNP issued LOI No. 8 Series of 2003 creating the Police Environment Desk Officer (PEDO) in all police stations nationwide.

RA 6975, as amended by RA 8551, also created the PNP-MARIG (Maritime Group), a maritime police unit within the PNP, which has been vested with the authority to perform all police functions "over Philippine territorial waters and rivers, coastal areas from the shoreline to one mile inland to include ports and harbors and small islands of two miles in length or diameter with less than 1,000 population." Sec. 24 of RA 6975 also clarified that after an 18-month transition period, the PNP-MARIG will absorb all police functions of the PCG. This transition period ended in June 1992.

Although the extent of the PNP-MARIG's jurisdiction over the entire Philippine territorial waters remains unqualified, there is general acceptance of the delineation of its jurisdiction with that of the PCG inasmuch as the former is under the DILG while the latter is now under the Department of Transportation and Communication (DOTC).

Department of Transportation & Communication

The DOTC's involvement in CRM is through the Maritime Industry Authority (MARINA), the Philippine Ports Authority (PPA), and the Philippine Coast Guard (PCG). Under EO 125, the DOTC "is the primary policy-making, planning, programming, coordinating, implementing, regulating, and administrative entity of the executive branch of

government in the promotion, development, and regulation of dependable and coordinated networks of transportation and communications systems."

In practice, the DOTC undertakes policy formulation, infrastructure development, and regulatory functions. The MARINA is responsible for the promotion and development of the maritime industry, regulation of shipping, and maritime safety regulatory functions in collaboration with the PCG.

Under RA 9295 otherwise known as the Domestic Shipping Development Act, the MARINA has the power and authority to register all vessels except municipal fishing boats (3GT and below), issue certificate of public convenience, set safety standards for vessels, inspect all vessels, investigate complaints, and adjudicate and hear complaints against any domestic shipping such as commercial fishing vessels.

The PPA is responsible for the development of ports and the provision and supervision, control, operation, and maintenance of port facilities and services. The PPA also regulates the establishment of private ports.

The PCG is responsible for preparing and responding to oil spill contingencies and implementation of the anti-marine pollution decree. Both the PPA and the MARINA rely on the PCG to enforce regulations and ensure compliance with maritime safety requirements.

Department of Science & Technology

The DOST exercises its ICM functions primarily through the Philippine Council for Aquatic and Marine Research and Development (PCAMRD). The PCAMRD began as a unit under the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), which was attached to the DA. During the 1987 reorganization, the PCAMRD was placed under the DOST as one of its sectoral planning councils through EO 128 and was given the following broad mandates:

1. Monitor aquatic and marine research and development projects;
2. Formulate strategies, policies, plans, programs, and projects for aquatic and marine science technology; and
3. Generate external funds.

In carrying out its mandate, the PCAMRD provides research and development directions for fisheries and aquatic resources through its 5-year NARRDS (National Aquatic Resources Research Development Systems). NARRDS consists of a network of research and development institutions, state colleges and universities, and regional research stations of the DA and DENR; it directly overlaps with the Fisheries Sector Program's (DA-FSP) research and extension component, which is being implemented by the Bureau of Agricultural Research.

Other Assisting Organizations

The government recognizes the roles of NGOs, POs and civic groups in catalyzing development in the rural areas, particularly in securing people participation in the decision-making process and amplifying the community's role in environmental protection. Most of the more than 17,000 NGOs listed with the Securities and Exchange Commission have evolved in the pursuit of institutional strengthening of local governments, provision of social services, and policy advocacy. Their operations are normally characterized by special goals on:

1. social reforms,
2. participatory management,
3. community development for alternative livelihood and empowerment, and
4. basic services delivery

The NEDA encourages NGAs to involve NGOs in development projects, in recognition of the fact that NGOs can better deliver to communities front-line services which a government agency is normally constrained to accomplish. The LGC also encourages LGUs to involve NGOs (Sec. 34 to 36).

Emerging Institutional Arrangements For ICM

Institutional arrangements for coastal management are emerging as four basic categories, described in the *Coastal Resource Management Guidebook Series Vol. 2* (DENR et al, 2001) as follows (Fig. 3.11):

1. ***Intra-LGU arrangements*** that focus on the relationship between municipal and *barangay* levels of government, POs, and other coastal stakeholders.
2. ***Inter-LGU arrangements*** established between municipal and provincial LGUs and between upland or adjacent LGUs to preserve critical ecosystem functions.
3. ***Institutional arrangements between LGUs and NGAs*** that provide for resource sharing and technical assistance.
4. ***Public-private sector partnerships*** that serve as viable joint ventures for a wide range of environmental infrastructure and services.

The need for such institutional arrangements arises out of the complex nature of management required in the coastal zone, where there is a host of often conflicting resource uses, and multiple authorities involved in the various aspects of management, some with overlapping functions and areas of jurisdiction. Figure 3.12 shows the various agencies' areas of jurisdiction and operation within the coastal zone.

Figure 3.11. Emerging public-private sector coastal management functions in the Philippines. Community-based approaches that directly involve coastal stakeholders and assisting organizations are of paramount importance in the devolved functions, as are other co-management mechanisms with neighboring local governments, national governments, and other sectors. (DENR et al, 2001)

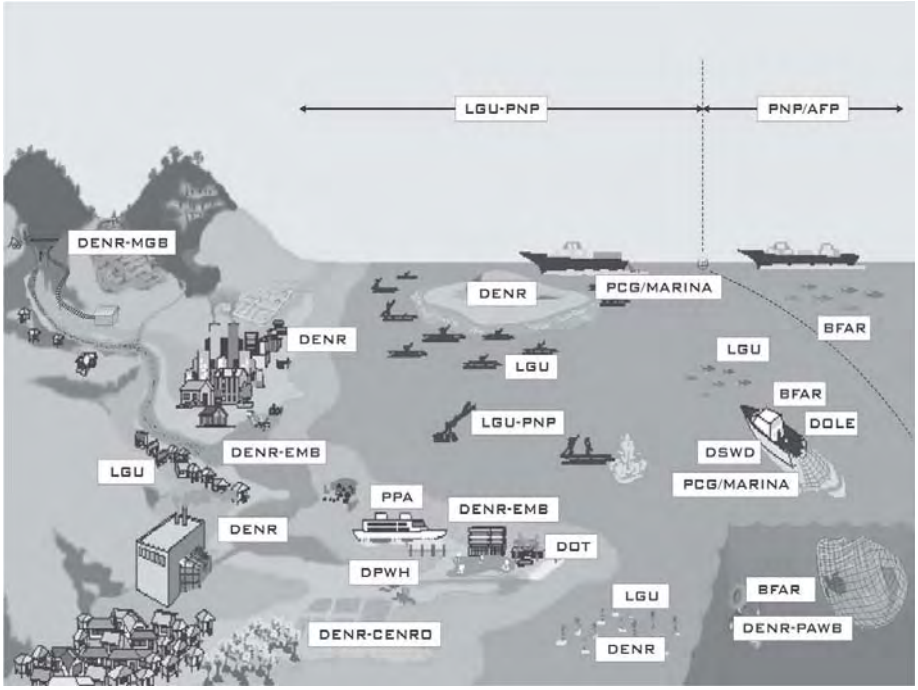


Figure 3.12. Government agencies with authority and jurisdiction over the coastal zone. The multi-faceted and complex demands of coastal management require the cooperation and coordination of the various agencies with authority and jurisdiction in the coastal zone.

REVIEW

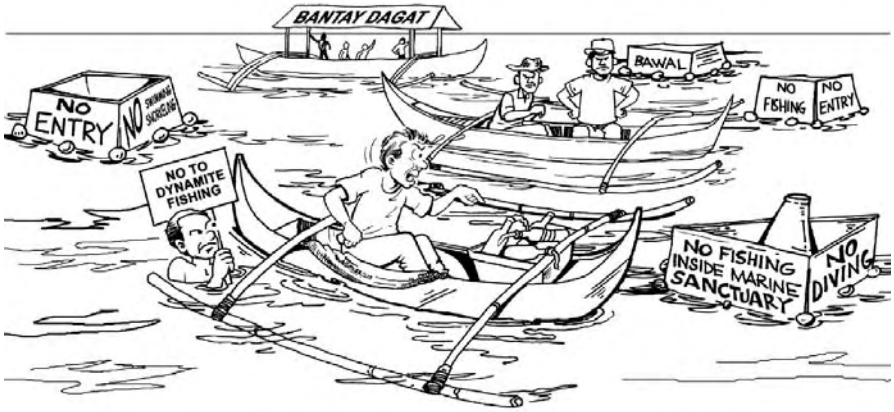
1. From paying too little or virtually no attention to fisheries, to putting way too much focus on fishery industrialization, our political system began to acknowledge about 40 years ago that our fishery resources were rapidly being degraded and depleted. A legal and policy framework for fisheries management was developed initially as a reactive response to threats or problems that had then already occurred. But it has since evolved into the current more proactive approach that attempts to make

changes to the fisheries system and its practices to address current threats and opportunities as well as avoid potential future threats or capitalize on future opportunities.

2. Up until the 1990s, laws, policies and interventions largely emanated from the national government and were often hampered by jurisdictional issues. With the enactment of the LGC in 1991, the Philippines changed over to a decentralized form of government. This devolved the fisheries management mandate, along with other environmental management mandates, to the LGU. But it was only after the Fisheries Code took effect in 1998 that many LGUs began to gradually assume such mandate.
3. The government's mandate to protect our fishery resources is enshrined in the 1987 Philippine Constitution, which emphasizes the exclusive right of Filipinos to use such resources; the rights of subsistence fishermen, especially of local communities, to the preferential use of the communal marine and fishing resources; and the people's right "to effective and reasonable participation at all levels of social, political and economic decision-making."
4. The LGC embodies the operative principles and mechanics of decentralization in the Philippines. Under the LGC, the municipal (or city) LGU assumes primary responsibility for municipal waters, defined to encompass marine waters up to 15 kms from the coastline. Among the environment-related functions devolved to the LGU are extension and on-site research services and facilities related to fisheries, enforcement of fishery laws in municipal waters including the conservation of mangroves, management and control of communal forests, solid waste management and environmental management services or facilities related to general hygiene and sanitation, and infrastructure facilities that service the needs of local residents and are funded out of municipal funds, including fish ports and similar facilities.
5. Several other laws provide the legal framework and systems for the implementation of fisheries management in the Philippines. These include three major national laws:
    a. The NIPAS Act, which provides for the establishment and management of protected areas (by the national government), defines mechanisms for coordination between the LGU and other government units, primarily the DENR, in the management of so-called NIPAS areas.
    b. The 1997 AFMA — designed to modernize the agriculture and fisheries sectors, enhance profits and incomes particularly of small farmers and fishers, and ensure the accessibility, availability and stable supply of food – gave the LGU the primary mandate to identify SAFDZs, as well as responsibilities for providing extension and basic services to the agriculture and fishery sectors.
    c. The 1998 Fisheries Code, which defines in greater detail the LGU's fisheries management functions and responsibilities, codified all fishery laws existing at the time it was being drafted. The Code includes the following "new" fisheries management concepts: (a) limitation of access using scientifically determined procedures; (b) integrated management consistent with inter-LGU cooperation as articulated in the LGC; and (c) enhanced and institutionalized participation by the community through the various levels of FARMCs. It calls on all

concerned authorities and stakeholders "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, appropriately supported by research, technical services and guidance provided by the State."

6. For municipal and city LGUs, the call to ICM means, primarily, that they must manage municipal waters in a sustained and integrated manner, giving preferential use rights to municipal fishers and protecting them against foreign and commercial fishing intrusion.
7. The Code adopts a classification system that defines fishing as either "commercial" or "municipal". Commercial fishing refers to "the taking of fishery species by passive or active gear for trade, business or profit beyond subsistence or sports fishing," using fishing vessels of more than 3GT. Municipal fishing refers to "fishing within municipal waters using fishing vessels of 3GT or less, or fishing not requiring the use of fishing vessels."



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8. The LGC has conferred two important mandates to the LGU that are particularly useful to enhancing ability to administer fishing in municipal waters: political autonomy (decentralization) and the ability to generate and mobilize economic resources through taxes and fees. These mandates, along with those devolved through the Fisheries Code of 1998, give the LGU broad powers to control fishing activities occurring within its municipal waters and set conditions for marine resource use by local ordinance.
9. The LGU's jurisdiction does not cover NIPAS areas and fishery reserves established by national law, as well as "areas where there are special agencies or offices vested with jurisdiction over municipal waters by virtue of special laws creating these agencies." Nevertheless LGUs have become the most active participants in MPA management. 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, and even within NIPAS areas they are key participants in management through the PAMB.

10. Because the Code prescribes ICM in "specific *natural* fishery management areas," there is a provision for "the management of contiguous fishery resources such as bays which straddle several municipalities, cities, and provinces… in an integrated manner and not based on political subdivisions of municipal waters." LGUs that share or border such resources are urged "to group themselves and coordinate with each other to achieve the objectives of integrated fishery resource management."
11. The call to integrated management also entails broad stakeholder participation, and to encourage this, the Fisheries Code provides for the creation of M/CFARMCs composed of representatives from the LGU, the municipal or city development council, NGOs, private sector, DA, and at least 11 fisherfolk representatives, including those from the youth and women sectors. The M/CFARMC is primarily an advisory body, tasked to provide stakeholder input in the preparation of the municipal (or city) fishery development plan and the formulation of local ordinances for fisheries. In addition, it is mandated to participate directly in fisheries management, by assisting in the enforcement of fisheries laws, rules and regulations in municipal waters. To address the need for ICM across political boundaries, the Code provides for the creation of IFARMCs in "bays, gulfs, lakes and rivers and dams bounded by two or more municipalities/cities." The IFARMC serve as "venues for close collaboration among LGUs in the management of contiguous resources."
12. The Code supports regulation of fishing effort based on, but not limited to, MSY and TAC consistent with national commitments under international treaties and agreements. The DA Secretary may prescribe catch ceilings for a specified period of time in a specified area. In municipal waters, the concerned LGU may concur with, approve or recommend such limitations after consulting with the local FARMC.
13. Fishery regulations are for the most part based on six main considerations: (a) *How many and how much* fish are caught, (b) *What kinds* of fish are caught, (c) *Who* does the fishing, (d) *How* fishing is done, (e) *Where* fishing happens, and (f) *When* fishing happens.
14. Decisions on what fish species or fish stocks would be placed under protection – and what size and how many fish could be taken – are usually made at the national and even international levels, based on experts' findings on the status, biology and ecology of such species or stocks. When that happens, the BFAR issues a FAO detailing the prescribed controls or limits, which the agency, LGU and other authorities would then have to enforce.
15. The Fisheries Code authorizes the LGU to use various mechanisms to limit fishing effort within its jurisdiction, prescribing in particular the following input controls:
    a. Controls on fishing gear and methods used primarily when such gear or methods destroy fish habitats or cause overfishing;
    b. Closed seasons during which fishing of affected species or stocks is prohibited; and
    c. Fishing licenses and permits to regulate the number and type of fishers and gear that may be allowed entry into designated fishing areas.
16. The LGU holds most of the authority over aquaculture and mariculture activities in municipal waters, except for fishponds, which remain the BFAR's responsibility. Such

authority is intended primarily to establish regulations for and set limits to fish farming activities so that they do not cause harm to either the environment or human health. All those involved in fish culture of whatever form are expected to abide by the Code of Practice for Aquaculture contained in FAO No. 214 issued by the DA in 2001 (see *Additional References* at the end of this chapter).

17. Although jurisdiction and authority over municipal fisheries have been devolved to the municipal and city LGUs, the BFAR continues to hold certain mandates and responsibilities that LGUs should be cognizant of, because they could contribute directly to better fisheries management. One particularly important mandate requires the BFAR to "assist the LGUs in developing their technical capability in the development, management, regulation, conservation and protection of fishery resources."
18. Besides the BFAR, several other institutions lend assistance and support to LGU efforts in municipal fisheries management, including the DENR, DILG, DOTC, DOST and other NGAs, as well as NGOs, POs and civic groups involved in catalyzing development in rural areas. The LGU can avail of such support through various forms of institutional partnership arrangements, such as intra-LGU, inter-LGU, LGU-NGA, and public-private sector partnerships.
19. The Code recognizes the need for adaptive management, and calls for mandatory review "at least once every five years or as often as [Congress] may deem necessary to ensure that fisheries policies and guidelines remain responsive to changing circumstances." Fisheries governance must ensure that adequate measures are in place to address existing and potential fisheries issues, and that all resource users, both fishers and non-fishers, practice sustainable and responsible fishing, and are made accountable for their actions.

ADDITIONAL REFERENCES

Look up these resources in this *Sourcebook*'s companion CD, or follow the links provided:

1. Code of Conduct for Responsible Fisheries — *ftp://ftp.fao.org/docrep/fao/005/v9878e/v9878e00.pdf*
2. Code of Practice for Aquaculture (FAO No. 214 s. 2001 and FAO No. 214-1 s. 2004) – *http://bfar.da.gov.ph/legislation/fao/fao214.htm; http://bfar.da.gov.ph/legislation/fao/fao214-1.htm*
3. Code of Practice for Sustainable Use of Mangrove Ecosystems for Aquaculture in Southeast Asia – *http://www.seafdec.org.ph/pdf/Code_of_Practice_Mangrove.pdf*
4. Full text of EO No. 533 s 2006 (adopting ICM as a national development strategy – *http://oneocean.org/download/db_files/eo533.pdf*
5. Full text of JAO No. 1 s 2008 (defining/identifying the areas of cooperation and collaboration among DA, DENR and DILG in the planning, management and control of aquaculture development to mitigate impacts on the environment) – *http://philminaq.eu/pdf/Downloads/Joint%20Administrative%20Order.pdf*
6. *Managing Aquaculture and Its Impacts – http://bfar.da.gov.ph/news/BFAR-PHILMINAQ [final].pdf*

7. Mending Nets: A Handbook on the prosecution of fishery and coastal law violations 2nd edition – *http://oneocean.org/download/db_files/mending_nets2nd_ed.pdf*
8. Philippine Coastal Resource Management Guidebook Series Vol. 2 – *http://oneocean.org/download/db_files/crmguidebook2.pdf*
9. Philippine Coastal Management Guidebook Series
    a. Coastal Management Orientation and Overview – *http://oneocean.org/download/db_files/crmguidebook1.pdf*
    b. Legal and Jurisdictional Framework for Coastal Management – *http://oneocean.org/download/db_files/crmguidebook2.pdf*
    c. Coastal Resource Management Planning – *http://oneocean.org/download/db_files/crmguidebook3.pdf*
    d. Involving Communities in Coastal Management – *http://oneocean.org/download/db_files/crmguidebook4.pdf*
    e. Managing Coastal Habitats and Marine Protected Areas – *http://oneocean.org/download/db_files/crmguidebook5.pdf*
    f. Managing Municipal Fisheries – *http://oneocean.org/download/db_files/crmguidebook6.pdf*
    g. Managing Impacts of Development in the Coastal Zone – *http://oneocean.org/download/db_files/crmguidebook7.pdf*
    h. Law Enforcement — *http://oneocean.org/download/db_files/crmguidebook8.pdf*
10. Philippine Fisheries Code of 1991 (RA 8550) and Implementing Rules and Regulations -- *http://oneocean.org/download/990330/fishery_code_irr.pdf*
11. Regional Guidelines for Responsible Aquaculture in Southeast Asia — *http://www.seafdec.net/rccrf/GL2.pdf*
12. Regional Guidelines for Responsible Fisheries Management in Southeast Asia – *http://www.seafdec.net/rccrf/GL3.pdf*
13. Regional Guidelines for Responsible Fishing Operations in Southeast Asia – *http://www.seafdec.net/rccrf/GL1.pdf*
14. Regional Guidelines for Responsible Post-harvest Practices and Trade in Southeast Asia – *http://www.seafdec.net/rccrf/GL4.pdf*
15. Supplementary Guidelines on Co-management using Group User Rights, Fishery Statistics, Indicators and Fisheries Refugia – *http://www.seafdec.net/rccrf/GL5.pdf*

Web sources only:

1. Full text of FAOs — *http://bfar.da.gov.ph/legislation/list.htm*

Chapter 4
The Ecosystem Approach

In This Chapter

- Learn about EAF, its principles and concepts
- Understand why experts say EAF must be made an integral part of the government's coastal management systems
- Know the major considerations of EAF
- Explore the management options that can be applied to municipal fisheries under EAF

ANO BA YAN?! KAGAGAWA LANG NG KALSADA AH!

We need to start looking at having a way of managing the whole ecosystem, because you can't pick away at it piece by piece, you have to truly start being coordinated and managing our resources as a system. We haven't gotten to that point yet.

— Ted Danson, American actor and environmental advocate

☞ p70

We noted in Chapter 3 that the Philippine Fisheries Code provision "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" (italics provided) responds the UN-FAO Code of Conduct's call for member-states to integrate fisheries into ICM, taking into account "the fragility of coastal ecosystems and the finite nature of their natural resources and the needs of coastal communities." This call arose out of frustration with conventional approaches that have failed to adequately address the decline of fish populations worldwide.

While there is no explicit mention of "ecosystem approach" in either Code, it is clear that the framers of both the Philippine policy and the UN-FAO Code recognized emerging expert consensus that our fishery problems could not be solved in isolation from each other, and that fisheries could not continue to be managed one fishery or fishing area at a time, without regard to the dynamics (and limits) of the ecosystem. The strategy must be "integrated" and must include ecosystem considerations.

☞p30
p42

We have discussed in Chapter 2 the **scientific concept** on which such approach is based: Fish is a biological resource that interacts and depends on its environment and other living organisms in order to survive. What this means to fisheries management in practical terms is still being fleshed out, but there is now widespread agreement on at least some of the elements and principles of what is officially referred to as the "ecosystem approach to fisheries," or EAF.

Direct official reference to the ecosystem approach was made at the 2002 World Summit on Sustainable Development, which encouraged "the application by 2010 of the ecosystem approach, noting the Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem" (Garcia et al, 2003). The Reykjavik Declaration, which came out in 2001, recognized the need to "take into account the impacts of fisheries on the marine ecosystem and the impacts of the marine ecosystem on fisheries," and called on governments to take the necessary steps to begin to incorporate ecosystem considerations in management, including the development of guidelines for the implementation of EAF (Garcia et al, 2003).

EAF SPELLED OUT

There has been much desk work done on these directives since the Reykjavik Declaration, and many variations of the definition of ecosystem approach have been put forward through the years. We'll keep it simple and stick with the one adopted by the 2002 UN-FAO Expert Consultation, which agreed that "*an ecosystem approach to fisheries strives to balance diverse societal objectives, by taking account of the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries*." (Garcia et al, 2003)

Let's break it down:

1) EAF management seeks to balance "diverse societal objectives."
2) All components of the ecosystem, whether biotic (living), abiotic (non-living) or human, must be considered.
3) The approach to fisheries must be integrated
4) The geographical boundaries of each fishery must be based on ecological and other pertinent criteria.

The experts further agreed that the "*purpose of an ecosystem approach to fisheries is to plan, develop, and manage fisheries in a manner that addresses the multiplicity of societal needs and desires, without jeopardizing the options for future generations to benefit from a full range of goods and services provided by marine ecosystems*." (Garcia et al, 2003)

Balancing Diverse Objectives

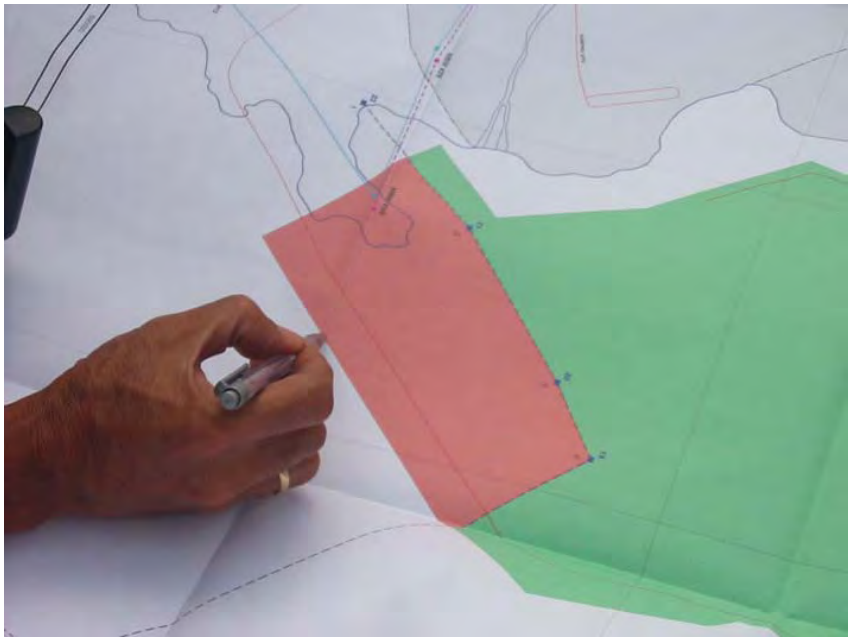
☞ p47

Societal objectives cover both human use and ecosystem objectives, including biological, ecological, economic and social objectives. They are multi-faceted, varied, and as we pointed out in Chapter 2, usually mutually conflicting.

Human use objectives are largely concerned with income generation, employment, food security, social equity and other economic, social and political issues associated with fisheries. They are the primary focus of traditional fisheries management (referred to in some literature as "target-oriented resource management" or TORM), which has been generally concerned with achieving optimum utilization of resources to support national economic development and maintaining the resource base by "managing" the size and operations of the fishing activity (e.g. species, gear and jurisdiction), with little regard for the ecosystem structure or boundaries in which it is operating (FAO, 2003).

☞ Glossary

Given the many different uses of marine resources and the sheer number of users, conflicts do arise and in most cases are inevitable. Fisheries management attempts to resolve these conflicts, backed by policies that control fishing activities and give preferential rights to certain groups of users, often the disadvantaged. The designation of **municipal waters**, for example, is a mechanism to prevent the complete economic dislocation of small-scale fishers, who lose out in the competition for resources when put alongside large-scale fishing operators.



CRMP

Figure 4.1. Municipal waters for municipal fishers. Local governments are mandated to delineate their municipal waters according to prescribed guidelines. This is part of their duty to protect the constitutional and legal rights of small-scale fishers, especially of local communities, to the access to and preferential use of "communal marine and fishing resources, both inland and offshore."

Ecosystem objectives, on the other hand, refer to biological and conservation (ecological) objectives, including maximization of biological yield, conservation of fishery resources, and maintenance of biological and genetic diversity. These objectives are increasingly being integrated in fishery policies and management plans, as concern about the continued degradation of marine resources escalates. Fishery closures and the protection of endangered and threatened species are common examples of current measures being taken to support fishery conservation.

In many cases, even when a fishery is in obvious decline, ecological considerations often take a backseat to creating jobs and expanding the fishery industry. But increasingly, fisheries managers are being advised to deal with the issues in a holistic way, address "both human and ecological well-being," and more effectively take into account "the interactions that occur between fisheries and ecosystems, and the fact that both are affected by natural long-term variability as well as by other non-fishery uses" (FAO, 2003).

The goal is sustainable fisheries, something that can be achieved only when we are able to ensure that our fishery resources will remain healthy tomorrow, even as we continue to take care of human needs today. This requires understanding of the complex relationships between fisheries and the ecosystem, of how fisheries impact the ecosystem and are in turn impacted by changes in the ecosystem.

Covering All Grounds

☞Glossary

We have described the ecosystem as having two main components, a **biotic** component which includes humans, and an **abiotic** component which includes land, water, seabed, etc. To better explain fishery interactions within the ecosystem, experts have devised a simplified diagram that depicts the ecosystem as having four compartments that interact with each other (Figure 4.2). The four main ecosystem compartments are as follows (Garcia et al, 2003):

1) A biotic compartment, including target fish resources, associated and dependent species and the living habitat (seagrass, algal beds, corals);
2) An abiotic compartment, characterized by its topography, bottom types, water quality and local weather/climate;
3) A fishery compartment, where harvesting and processing activities take place and which is often characterized by the use of technology; and
4) An institutional compartment, comprising laws, regulations and organizations needed for fisheries governance.

There are other – mostly external – factors involved, categorized as follows: (1) non-fishing activities; (2) the global climate; (3) other ecosystems, usually adjacent, with which fishery ecosystems exchange matter and information; and (4) the socio-economic environment as reflected in the market, relevant policies and societal values. (Garcia et al, 2003)

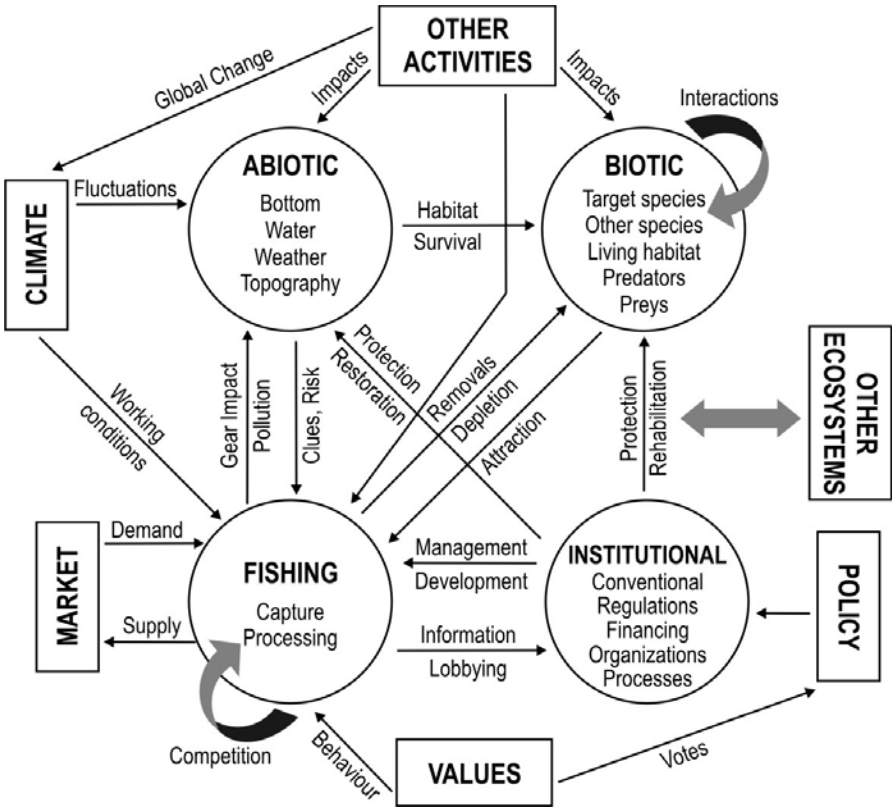


Figure 4.2. Fishery interactions involved in an exploited ecosystem. Typically, fishery interactions are depicted as having four main compartments represented by circles. Humans are a part of the biotic compartment, which is their source of resources, food, services and livelihood. They are also part of – and drives – the fishery compartment. The four compartments interact with each other and are affected as well by other factors (represented by rectangles), including non-fishery activities. (Garcia et al, 2003)

☞ p26

If the interactions look intricate and difficult to sort out, it's simply because they are. The sea, as we learned in Chapter 2, is an **open system** where the parts freely interact and exchange material, energy and information with each other and their external environment (including the socio-economic environment), so that what happens to one part ultimately affects the whole. Therefore, no fishery can exist in isolation. In this open system, every fishery is sooner or later affected and altered by everything that happens around it; by the same token, each fishery drives a chain of reactions and interactions that changes the way the whole system behaves.

It is never easy to identify each and every event and predict all its potential impacts, and it is not always easy to pinpoint exactly what has caused particular changes in the ecosystem. Nevertheless, the ecosystem approach tells us that we cannot achieve sustainable fisheries if we do not bear in mind and address the ecosystem changes associated with fisheries. Given the complexity of our marine ecosystem and how little we truly understand about it, EAF tries to cover a wide ground, encompassing not only fishing itself but also other processes, both natural and human, that affect and are affected by fisheries. As fisheries managers, we are not always in control of such processes, but we must be aware of how they can potentially affect our fishery resources, so that we can apply appropriate measures to minimize any negative impacts (Cochrane, 2002).

An Integrated Approach

EAF *is* holistic – it cannot be anything else, given the multitude of diverse and often conflicting objectives it seeks to achieve. The approach must necessarily be integrated, as it attempts to bring together disparate interests into a single management system with sustainable development as the primary goal. This coincides with our national development philosophy, which prescribes "harmonious integration of sound and viable economy, responsible governance, social cohesion/harmony and ecological integrity to ensure that development is a life-enhancing process." (Philippine Agenda 21, 2007)

You might ask, understandably, how EAF differs from ICM, the "integrated" approach to resource management that many Philippine LGUs have begun to institutionalize and are therefore more familiar with. To answer, we quote Garcia (2002):

> *"All ecosystem-based approaches to management of economic activities 'rely on similar precepts: the need for sound science, adaptation to changing conditions, partnerships with diverse stakeholders, and organizations, and a long-term commitment to the welfare of both ecosystem and human societies' (Kimball, 2001)."*
>
> *"The ecosystem-related concepts [on which EAF is based] have a lot in common and relate very closely to the already widely used concept of integrated management. The latter involves comprehensive planning and regulation of human activities towards a complex set of interacting objectives and aims at minimizing user conflicts while ensuring long-term sustainability. It implies the use of a collaborative/participative approach involving the main stakeholders in a flexible, responsible and transparent planning process, respectful of existing rights and duties. It recognizes the need to protect the ecosystem and the implications of multiple uses and aims at sustainable development. Taking account of uncertainty, it complies with the precautionary approach. It takes account of natural and economic areas and not only administrative or political ones. It specifically identifies ecosystem-oriented objectives and indicators. It acknowledges the fragmentation of the sectoral approaches and the linkages between inland, coastal and ocean uses. It integrates data collection, information and research (assessment) and recognizes traditional knowledge. It develops processes for stakeholders' interaction, particularly in objective setting, planning and implementation, including conflict resolution. It explicitly considers the cumulative effects of human activities, and its implementation is based on integrated management plans.* ***This reading indicates clearly that EAF… [is a subset or alias] of integrated management, possibly with greater emphasis on the ecosystem implications.***"

Simply put, there really is not much difference between EAF and ICM, at least conceptually. In terms of application, ICM should perhaps be broader in scope, although our current ICM practices at the municipal level are primarily concerned with addressing fishery issues. In this sense we can rightly claim that in the Philippines, we now have in our governance system the foundation for EAF. There is, of course, much more in the theory of EAF that has yet to be translated to a management process that we can actually implement at the LGU level. This includes many traditional fisheries management tools that, while they

may be available elsewhere, have yet to be integrated into the local governance system and thus remain out of the reach of most municipal fisheries managers.

Setting Boundaries

Where we operate at the municipal level, the area that we can directly manage would be limited to the municipality's jurisdictional boundaries, that is, our municipal waters. But what EAF specifically requires is for each fishery to be managed not only according to political jurisdictions and socio-economic considerations but also "within ***meaningful ecological boundaries***." And here lies one of the bigger challenges of EAF.

For practical purposes, ecosystems are defined in terms of geographical scales, "from a drop of morning dew to an ocean, from a mountain meadow to a continent, from a pebble to a planet," and their scale is often determined "by the management problem at hand" (Lackey, 1999).

In fisheries, we have an adage: "Fish do not recognize political boundaries." From the ecological standpoint, most fishery resources are actually shared by two or more municipalities, posing a dilemma to municipal fisheries managers whose jurisdictions are typically limited by political boundaries, i.e. within their respective municipal waters. Our law does provide some remedy: Integrated management of "contiguous fishery resources such as bays which straddle several municipalities, cities or provinces" (1998 Fisheries Code) through alliances involving the LGUs with jurisdiction over the ecosystem, local communities dependent on the ecosystem, and other stakeholders. What is still missing is a clear definition of the boundaries and scales of the fishery ecosystems where the integration of management initiatives is supposed to happen.

There is ongoing effort at the national level (BFAR) to divide Philippine waters into distinct management areas called "fisheries management units" or FMUs, based on a set of ecological, geophysical and other pertinent criteria (Figure 4.3). But even while the details of the FMU system are still being worked out, we must not be constrained by the limits of our current jurisdictions. In reality, we need to deal with every fishery issue locally anyway, even when it requires involving many authorities that have jurisdiction over it.

EAF is not necessarily intended to expand our immediate working environment or jurisdiction; rather, it seeks to improve the way we do things by widening our viewpoint and influence to include the larger ecosystem. It gives us a more integrated and holistic interpretation of what it will take for us to take care of not only the fishers' interests, but also the well-being of the ecosystem and other sectors of society, based on our concept of sustainable development.

The governance system that will inform and guide the EAF management process at the local level is still being developed. We can expect that this system will use the FMU boundaries as the basis for integration at the ecosystem level, and that it will be heavily influenced by internationally accepted concepts and guidelines for responsible fisheries,

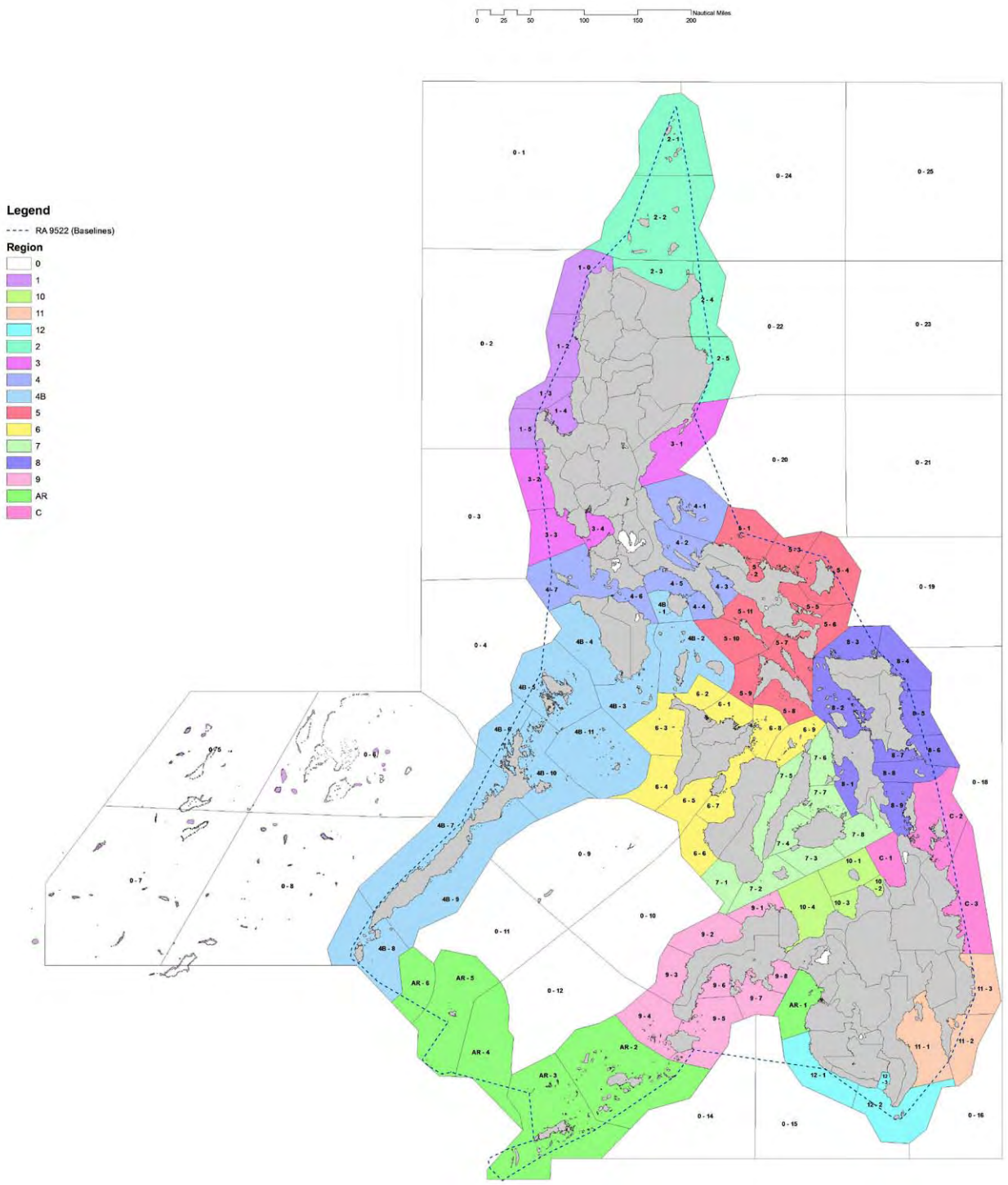


Figure 4.3. Proposed fishery management unit map with 25 nautical mile offset from shore. The different color areas represent distinct management areas called "fisheries management units" or FMUs, defined based on a set of ecological, geophysical and other pertinent criteria. The dotted line represents the country's baselines as defined under the Republic Act 9522 signed into law last March 10, 2009 in compliance with United Nations Convention on the Law of the Sea (UNCLOS).

particularly those relating to EAF. Some of these concepts and guidelines are discussed below, specifically as they relate to the management of municipal fisheries.

GUIDING EAF

At the conceptual level, there is expert consensus on the principles that fisheries management under EAF must subscribe to. These principles are discussed in several contexts throughout this volume. Briefly, they include (FAO, 2003):

1) Fisheries should be managed to limit their ***impact on the ecosystem*** to the extent possible;
2) ***Ecological relationships*** between harvested, dependent and associated species should be maintained;
3) Management measures should be compatible across the ***entire distribution of the resource*** (across jurisdictions and management plans);
4) The ***precautionary approach*** should be applied because the knowledge on ecosystems is incomplete; and
5) Governance should ensure both ***human and ecosystem well-being and equity***.

☞ p60

For the most part, these principles have been translated to **national policy goals**, but they have not all been translated to action. The UN-FAO has published technical guidelines for the implementation of EAF, which categorizes the many elements of EAF as follows (FAO, 2003):

1) The fisheries management process;
2) The biological and environmental concepts and constraints;
3) Technological considerations;
4) The social and economic dimensions;
5) Institutional concepts and functions;
6) Time scales in the fisheries management process;
7) The precautionary approach; and
8) Special requirements of developing countries

We are providing you the full text of the guidelines in the CD that accompanies this *Sourcebook*, so we will only briefly explain here what these EAF elements might constitute in the context of our experience in the Philippines in managing our municipal fisheries.

The Fisheries Management Process

☞ p126

The ICM-based but mostly municipal waters-centric **CRM process of participatory planning**, setting objectives, and implementing strategies and measures to meet the objectives that is now being followed by many Philippine LGUs needs to incorporate more meaningful mechanisms for managing fishing effort and monitoring and assessing performance, as well as a broader consideration of ecological values and constraints than is currently the case. There must be integration at the ecosystem level, incorporating both the fishing and non-fishing elements of the ecosystem. We will discuss how EAF can enhance the Philippine ICM experience in greater detail in Chapter 5.

Biological &Environmental Concepts & Constraints

☞ p26

Recognizing that our ability to predict ecosystem behavior is inadequate, EAF emphasizes that **all ecosystems have limits that, when exceeded, can result in major ecosystem change – possibly irreversibly**. Maintaining biological diversity is regarded as being of major importance to ecosystem functioning and productive fisheries, as well as providing flexibility for future uses.

Technological Considerations

EAF seeks to regulate fishing mortality through the use of input controls, output controls and technical measures (including spatial measures) as well as other measures. Habitat restoration and MPAs will continue to play an important role in facilitating fishing activity or enhancing the populations of target species as well as protecting biodiversity and providing broader benefits to the system as a whole.

FISH Project

Figure 4.4. Restoring mangroves. In the past, the government, guided by fisheries experts, encouraged the conversion of mangroves to fishponds. The policy has since changed in favor of restoration, protection and management, in the face of the mounting evidence of the vital ecological role of mangroves, in particular, their role in maintaining fishery productivity as breeding and nursery grounds of many commercially important species.

Gear modifications, such as those used to selectively harvest the target species and minimize unwanted by-catch (for example turtle exclusion devices (TEDs) and by-catch reduction devices [BRDs]), will take on increasing importance as ecological objectives are broadened within the context of EAF. Fishing gear and operations known to produce serious impacts will be restricted, and where possible new technologies will be developed to mitigate any negative impact, such as destruction of bottom habitats, continued fishing by lost gear ("ghost fishing"), emission of exhaust gas with dangerous substances to the atmosphere and pollution from oily waste, litter and fish waste. In addition, negative

impacts from other users, including upstream land-based activities, will have to be addressed by responsible agencies. Fisheries managers will need to take a proactive approach so the appropriate authorities recognize fisheries as an important stakeholder in these ecosystems.

Social & Economic Dimensions

The overarching goal of EAF is sustainable development, and this will entail the recognition of the wider economic, social and cultural benefits that can be derived from fisheries resources and the ecosystems in which they occur. The identification of the various direct and indirect uses and users of these resources and ecosystems is a necessary first step to attain a good understanding of the full range of potential benefits.

In addition, EAF provides a framework within which to use traditional ecological knowledge about fish and their habitats to address overcapacity, overfishing and destructive practices in many small-scale fisheries, as well as habitat degradation and pollution. EAF must, however, take into account the dependence of artisanal and small-scale fishing communities on fishing for their life, livelihoods and food security.

Institutional Concepts & Functions

One of the implications of implementing EAF is an expansion of stakeholder groups and sectoral linkages. An effective ecosystem approach will depend on better institutional coordination (e.g. between NGAs and LGUs at all levels). This will require clarification of roles and responsibilities, improved coordination and integration across government and other users, and more accountability across all stakeholder groups.

CRMP

Figure 4.5. Stakeholder participation. Integral to EAF is the participation of a wide range of stakeholders, and certainly the local communities. Well-tested consultative, participatory approaches involving direct stakeholders, for instance in resource assessments (in photo), will continue to be relevant, and new approaches must be explored to enhance the capacity of all other concerned stakeholders to participate in the resource management process.

A greater emphasis on planning at a range of geographical levels that involves all relevant stakeholders will be required and will involve a much more collaborative approach and sharing of information. Management units may need to be redefined geographically or, at the very least, coordinated within a larger-scale planning process (as proposed under the FMU scheme), particularly where natural and operational boundaries straddle jurisdictions and management plans, and where the indirect effects of fisheries are manifested elsewhere.

For municipal fisheries managers, this means that our current consultative, participatory approaches should include stakeholders in areas outside our jurisdiction with which we share our fishery resource. Capacity-building will be par for the course – we must improve our understanding of the ecosystem structures and functions within which we are working; learn to deal with a broader range of options and trade-offs, conflicts, rights and regulations; and enhance the capacity of all concerned stakeholders to participate. This may be achieved, at least in part, by mobilizing and linking with existing institutions.

Time Scales

For the most part, we are expected to keep up with the time scales recognized by the UN-FAO to have immediate relevance to the fisheries management process – a policy cycle of about 5 years, a fishery management planning and strategy cycle of 3-5 years and a shorter cycle of management implementation and review at an operational level, usually occurring annually. The coordination necessary to achieve EAF may however mean that progress will be slower in some more complicated areas, such as climate change or the well-being of future fisheries generations.

Precautionary Approach

As we stated in Chapter 2, our limited knowledge of ecosystem dynamics should not be used as an excuse to delay or avoid taking action. EAF dictates that we take conservative management action until more is known about ecosystem structures and functions. Under EAF, in fact, the principle is much broader than just environmental degradation, and applies to any undesirable outcome (ecological, social or economic) in all stages of the management process.

Special Requirements For Developing Countries

Those of us working at the local level in small-scale fisheries know firsthand how formidable the challenge of EAF is, particularly in poor communities where fishing is the only source of livelihood and alternatives to fishing are scarce or non-existent. In such situations, the short-term economic necessities, at both national and local levels, may be too overwhelming for serious consideration of change even when the long-term benefits are apparent. The international community recognizes the problem, and there are special provisions in our law and various international instruments to which the Philippines is a party to help LGUs meet the requirements of EAF, even as they try to cope with pressing

fundamental socio-economic issues such as food security, health, and access to basic necessities.

As fisheries managers, we can assist this process by highlighting the many benefits for both fishery and non-fishery sectors and the existence of potentially high returns that can be derived from EAF. We can also take advantage of current participatory practices to begin to integrate fisheries management into ICM where it could benefit from economies of scale and the existing networks for participation.

NO DEARTH OF OPTIONS

You will have noticed by now that there really is not much about the concept of EAF that's new. The principles on which it is based are well known, and the issues it proposes to address have existed for a long time and are fairly well documented. What is new is the attempt to actually define these principles in practical terms, and make EAF operational.

Given the too little experience we have in EAF, we must fall back on currently available options to manage fishing, including the various input and output controls and technical measures that are now being used to regulate fishing mortality. Until new tools are developed and become available, the UN-FAO encourages the use of these measures "in a broader context… [to] not only address a series of target species concerns, but… also enhance ecosystem health and integrity." (FAO, 2003)

☞ P124

The management options described below are provided in the **UN-FAO technical guidelines for the implementation of EAF** (FAO, 2003). Again, we will only summarize them here, as they are explained in greater detail in the UN-FAO guidelines (see Additional References).

Technical Measures

Technical measures used in fisheries management include gear regulation and area and time restrictions. These measures are outlined below (FAO, 2003):

☞ p20

1. ***Gear modifications that improve selectivity.*** Under EAF, the impacts of gear on non-target organisms and ecosystem structure and functions (Chapter 2) must be considered. Measures include *mesh size restrictions* which however have limitations in multi-species fisheries where organisms of different shapes and sizes occur on the same fishing ground, and immature individuals of a co-occurring larger species might still be captured; and the use of square mesh and tools or BRDs which enable the unwanted portion of the catch to escape. Examples of BRDs are TEDs; sorting grids that assist in allowing unwanted by-catch to escape; circle hooks and blue dye baits that reduce incidental capture of turtles in longline fishing; scaring lines positioned above a longline gear during setting, thawed bait, night setting with minimum ship light, weighting the line, underwater setting, prohibition of dumping

offal during setting to reduce catching seabirds; and acoustic pingers to distract marine mammals from becoming entangled in gillnets.

2. ***Measures to limit ghost fishing.*** Gillnets and traps/pots that get lost during fishing operations may continue to capture fish for weeks, months or years depending on prevailing environmental conditions. This can be avoided by using biodegradable materials or some means to disable the gear, through increased effort to avoid losing them, or by facilitating the quick recovery of lost nets. In some areas, active campaigns are undertaken to "sweep" periodically for lost nets in known gillnet fishing grounds.

J Unson / FISH Project (2006)

Figure 4.6. Making gear ecosystem-friendly. The objective of fisheries management is not to stop fishing, but to make fishing sustainable by keeping wastage and other adverse effects to the minimum, and being mindful of potential impacts of any fishing activity. Even passive gear like crab pots (in photo) become wasteful when they are lost during fishing operations and continue to capture fish by "ghost fishing." The use of biodegradable materials is encouraged, and if necessary, effort must be taken to occasionally clean the sea of lost pots, nets and other gear.

3. ***Spatial and temporal controls on fishing.*** Closures – including closed seasons and MPAs – can be used to reduce the mortality rate of individuals of either target or non-target species in vulnerable life stages. They may also be used to protect critical habitats where the fishing activity would otherwise cause damage to the physical structures supporting the ecosystem. Commonly, spatial and temporal closures have been established in the context of specific target stocks or fisheries. While such an approach may have its benefits, there may be advantages in a more systematic scheme where consideration is given to a coordinated attempt to protect a range of habitats and species on a scale which is relevant to the ecosystem concerned. The success of spatial and temporal closures can be limited if their effect is merely to displace fishing activity and increase mortality of other species or life stages elsewhere. Species that are mobile and move between the protected and non-protected areas may, in fact, gain little protection. Where stocks are shared by more

than one authority (e.g. more than one LGU), the closures – like other management measures – must be coordinated.

4. ***Control of the impact from fishing gear on habitats.*** Fishing gear that touches or scrapes the bottom during fishing operations is likely to produce negative impact on the biotic and abiotic habitats. Use of towed gear with reduced bottom contact is a technical option in such areas. Prohibition of certain gear in some habitats is another, e.g. trawling in coral reef and seagrass areas. A third option is to replace a high-impact fishing method with one with less impact on the bottom, e.g. trapping, longlining or gillnetting.
5. ***Energy efficiency and pollution.*** Many modern fishing vessels use fossil fuel, resulting in exhaust gas emission of dangerous substances. Such emissions can be reduced through improved efficiency of fishing gear or improved management that leads to less fishing effort.

Input & Output Controls

☞Glossary p51

We noted in Chapter 2 that **control mechanisms** should ideally be used to protect fish stocks from being harvested beyond their capacity to replenish themselves, and not merely to promote the recovery of already heavily exploited stocks. Their application under EAF is further explained below (FAO, 2003):

1. ***Input controls.*** These mechanisms apply to *capacity* (which is closely related to the fishing mortality a fishing fleet could generate if the entire fleet were to fish full time) and *effort* (the actual amount of fishing activity). From an EAF viewpoint, these input controls have the benefit of restricting the overall pressure on the ecosystem, and thus offer the potential of limiting negative impacts. Care must be taken however to also monitor and control efficiency, in order to avoid increased fishing mortality.
   a. *Capacity limitation* seeks to restrict the total size of the fleet in order to reduce both fishing mortality and the pressures on decision-makers to allow higher fishing mortality. Capacity controls have the potential to reduce fishing mortality in the same way that effort or spatial/temporal access limitations do.
   b. *Effort limitation* seeks to restrict the fishing activity of fleets and hence reduce fishing mortality. Although there is a considerable difference in the likely social and economic effects of different effort limitation regimes, the net effect of reducing the amount of fishing will produce benefits for the ecosystem, provided the continual improvement in efficiency ("effort creep") does not cancel out the effect over time.
2. ***Output controls.*** If complemented with bycatch controls (such as quotas), output controls can help protect associated species. For the purpose of EAF, however, in a mixed-species fishery, the different vulnerabilities and productivity of the various species must be considered. It will be necessary to implement a set of consistent catch limits across the range of target and bycatch species to reflect these differences and address desired ecosystem related objectives (such as maintaining food webs).

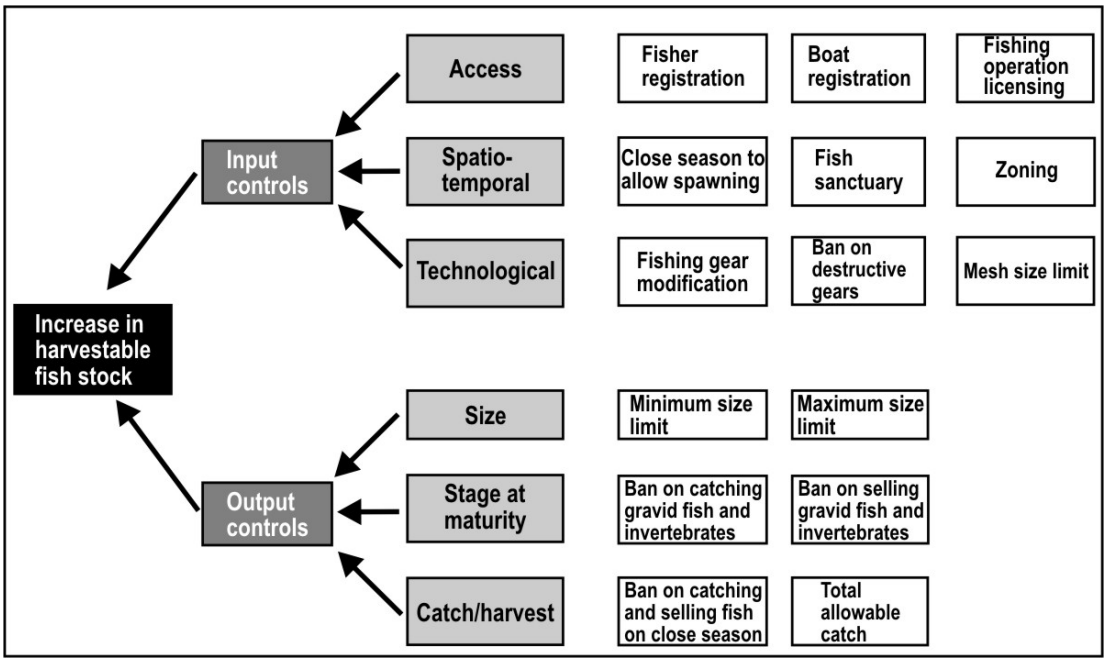


Figure 4.7. Control mechanisms. There are several input and output control mechanisms that have been used or may apply to common fisheries management situations in the Philippines. Input controls – especially bans on gear destructive to marine habitats and the establishment of fish sanctuaries — are more widely used in the Philippines, because they usually do not require as much hard-to-obtain information about fish biology as output controls.

Some control mechanisms that are already used or may apply to various management situations in the Philippines are shown in Figure 4.7.

Ecosystem Manipulation

In some situations, technology and understanding of marine ecosystems have advanced to the point where ecosystems may be manipulated (for example, through stock enhancement, culling or habitat restoration) to achieve societal objectives that include conservation and restoration. However, mitigation is rarely totally effective, carries with it some risk of unexpected consequences, and may also be costly. Avoiding the causes of the problem in the first place is a much more desirable approach. (FAO, 2003)

Habitat preservation in marine fisheries is the key to EAF, because it underpins the health of exploited ecosystems. Managers need measures to prevent damage to habitats, restore damage where it has occurred and increase habitat where required. Such measures must be in harmony with other ecosystem functions. The different measures needed to reduce such impacts include the following (FAO, 2003):

1. ***Prohibition of destructive fishing methods*** in ecologically sensitive habitats (such as seagrass beds);
2. ***Prohibition of intentional cleaning of the seafloor*** to facilitate fishing; and
3. ***Reduction of the intensity of fishing*** in some fishing grounds to ensure that non-target, habitat-forming species are not reduced below acceptable levels.

Rights-Based Management Approaches

The dangers and consequences of allowing open access to fisheries are now well understood, and different options for limiting access and their properties have been developed. A well-defined and appropriate system of access rights in a fishery produces many essential benefits, most importantly ensuring that fishing effort is commensurate with the productivity of the resource and providing the fishers and fishing communities with longer-term security that enables and encourages them to view the fishery resources as an asset to be conserved and treated responsibly. (FAO, 2003)

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Figure 4.8. Access rights. Key to solving and preventing overfishing is to limit access to the resource. Already, the law has declared municipal waters off-limits to commercial fishing. Within municipal waters, other options for limiting access have also been developed and must be considered by local authorities, including different forms of territorial use rights and limited entry systems.

FAO (2003) cites several different types of use rights, including territorial use rights assigned to individuals or groups in certain localities; limited entry systems that allow only a certain number of individuals or vessels to take part in a fishery; and access rights assigned through a system of input or output controls where the TAC is split into quotas and the quotas allocated to authorized users (this last option has yet to be tested in the Philippines).

No single system of use rights will work under all circumstances, so it is necessary to devise a system that best suits the general objectives and context for each case. EAF requires that all the uses and users of a fishery resource be considered and reconciled, and that interactions between different fisheries within the designated geographic area be taken into account. This will mean that the systems of access rights across different fisheries or different fishery sectors within the management area should be mutually compatible and, overall, that the total effort applied should never be allowed to exceed the productivity of the ecosystem and its component parts. (FAO, 2003)

EAF CONCERNS BEYOND FISHING

Many of the problems facing fisheries management in an EAF context fall outside the direct control of fisheries managers. Fisheries managers need to ensure that they are recognized as important stakeholders in the ICM process so that they can safeguard the function of the habitats that support fisheries ecosystems from adverse effects stemming from activities in other sectors. The UN-FAO guidelines identify the following non-fishing issues that should be considered in EAF (see also Chapter 2):

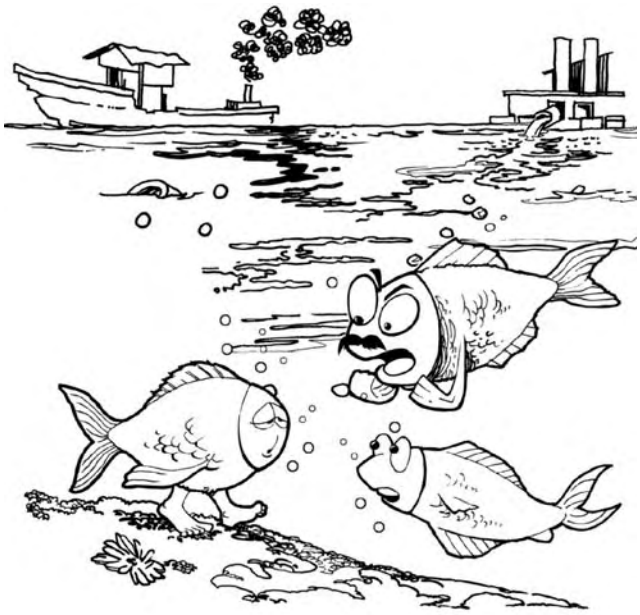
1. ***Eutrophication*** of coastal waters resulting from excess nutrients from agriculture and sewage, which cause toxic algal blooms and affect the health of seagrass and coral reef habitats (by encouraging growth of epiphytes, for example);
2. ***Sediment loads*** from agriculture, forestry and construction of infrastructure in catchment that degrade coastal ecosystems, particularly the critical coral reefs and seagrass habitats;
3. ***Destruction of fish habitats*** through foreshore development;
4. ***Introduction of exotic species*** through ballast water and on the hulls of ships;
5. Contamination of fish products through ***chemical pollution*** from agriculture and industry;
6. ***Competing use of waterways*** from other sectors, including aquaculture; and
7. Effects of ***climate change*** on distribution of stocks and sea level rise on nursery habitats.

REVIEW

1. At policy level, there is recognition that our fishery problems could not be solved in isolation from each other, and that fisheries could not continue to be managed one fishery or fishing area at a time, without regard to the dynamics (and limits) of the ecosystem. The strategy must be "integrated" and must include ecosystem considerations.
2. An ecosystem approach to fisheries strives to balance diverse societal objectives, by taking account of the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries. Its purpose is to plan, develop, and manage fisheries in a manner that addresses the multiplicity of societal needs and desires, without jeopardizing the options for future generations to benefit from a full range of goods and services provided by marine ecosystems.
3. Societal objectives are diverse and often conflicting, covering both human use and ecosystem objectives, including biological, ecological, economic and social objectives.
4. In the past, even when a fishery was in obvious decline, ecological considerations often took a backseat to creating jobs and expanding the fishery industry. Today, the call is for fishery managers to deal with the issues in a holistic way, address "both human and ecological well-being," and more effectively take into account

"the interactions that occur between fisheries and ecosystems, and the fact that both are affected by natural long-term variability as well as by other, non-fishery uses."

5. Four main ecosystem compartments describe fishery interactions within the ecosystem: biotic, abiotic, fishery, and institutional compartments. These components interact with each other as well as other, mostly external, factors, such as non-fishing activities, global climate, other ecosystems, and the socio-economic environment.
6. Given the complexity of our marine ecosystem and how little we truly understand about it, EAF tries to cover a wide ground, encompassing not only fishing itself but also other processes, both natural and human, that impact and are impacted by fisheries. As fisheries managers, we are not always in control of such processes, but we must be aware of how they can potentially affect our fishery resources, so that we can apply appropriate measures to minimize any negative impacts.



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7. EAF *is* holistic. In practice, it may be considered as "a subset or alias" of ICM. Given that ICM has been adopted as a sustainable development framework in the Philippines and that many LGUs have some institutional mechanisms to implement it, we can rightly claim that we now have in our governance system the foundation for EAF. But there is much more in the theory of EAF that has yet to be translated to a management process that we can actually implement at the LGU level.
8. EAF requires that fisheries are managed not only according to political jurisdictions and socio-economic considerations but also "within meaningful ecological boundaries." Following this principle, our law calls for integrated management of "contiguous fishery resources such as bays which straddle several municipalities, cities or provinces" through alliances involving the LGUs with jurisdiction over the ecosystem, local communities dependent on the ecosystem, and other stakeholders.

9. At the conceptual level, there is expert consensus on the principles that fisheries management under EAF must subscribe to. These include:
   a. Fisheries should be managed to limit their impact on the ecosystem to the extent possible;
   b. Ecological relationships between harvested, dependent and associated species should be maintained;
   c. Management measures should be compatible across the entire distribution of the resource;
   d. The precautionary approach should be applied because the knowledge on ecosystems is incomplete; and
   e. Governance should ensure both human and ecosystem well-being and equity.
10. The ICM-based but mostly municipal waters-centric CRM process of participatory planning, setting objectives, and implementing strategies and measures to meet the objectives that is now being followed by many Philippine LGUs needs to incorporate more meaningful mechanisms for managing fishing effort and monitoring and assessing performance, as well as a broader consideration of ecological values and constraints than is currently the case.
11. Maintaining biological diversity is regarded as being of major importance to ecosystem functioning and productive fisheries, as well as providing flexibility for future uses.
12. The overarching goal of EAF is sustainable development, and this will entail recognition of the wider economic, social and cultural benefits that can be derived from fisheries resources and the ecosystems in which they occur. The identification of the various direct and indirect uses and users of these resources and ecosystems is a necessary first step to attain a good understanding of the full range of potential benefits.
13. An effective ecosystem approach will depend on better institutional coordination (e.g. between NGAs and LGUs at all levels). Management units may need to be redefined geographically or, at the very least, coordinated within a larger-scale planning process, particularly where natural and operational boundaries straddle jurisdictions and management plans, and where the indirect effects of fisheries are manifested elsewhere.
14. There is ongoing effort at the national level (BFAR) to divide Philippine waters into distinct ecosystem areas called FMUs, based on a set of ecological, geophysical and other pertinent criteria. But even while the details of the FMU system are still being worked out, we must not be constrained by the limits of our current jurisdictions and deal with our fishery issues in a holistic way, using participatory approaches.
15. The governance system that will inform and guide the EAF management process at the local level is still being developed. We can expect that this system will use the FMU boundaries as the basis for integration at the ecosystem level, and that it will be heavily influenced by internationally accepted concepts and guidelines for responsible fisheries, particularly those relating to EAF.
16. There are several management options that are now available and can be applied under EAF. These include the use of input controls, output controls and technical measures (including spatial measures). Until new tools are developed and become

available, the UN-FAO encourages the use of these measures "in a broader context… [to] not only address a series of target species concerns, but… also enhance ecosystem health and integrity."

12. In some situations, technology and understanding of marine ecosystems have advanced to the point where ecosystems may be manipulated (for example, through stock enhancement, culling or habitat restoration) to achieve societal objectives that include conservation and restoration. However, mitigation is rarely completely effective, carries with it some risk of unexpected consequences; it may also be costly. Avoiding the causes of the problem in the first place is a much more desirable approach.
13. A well-defined and appropriate system of access rights in a fishery produces many essential benefits, most importantly ensuring that fishing effort never exceeds the productivity of the resource and provides the fishers and fishing communities with longer-term security that enables and encourages them to view the fishery resources as an asset to be conserved and treated responsibly.
14. Habitat preservation in marine fisheries is the key to EAF, because it underpins the health of exploited ecosystems. Managers need measures to prevent damage to habitats, restore damage where it has occurred and increase habitat where required. MPAs will continue to play an important role in facilitating fishing activity or enhancing the populations of target species as well as protecting biodiversity and providing broader benefits to the system as a whole.
15. Capacity-building will be par for the course – we must improve our understanding of the ecosystem structures and functions within which we are working; learn to deal with a broader range of options and trade-offs, conflicts, rights and regulations; and enhance the capacity of all concerned stakeholders to participate. This may be achieved, at least in part, by mobilizing and linking with existing institutions.
16. Many of the problems affecting fisheries under EAF fall outside the direct control of fisheries managers. Fisheries managers must be proactive and ensure that they are recognized as important stakeholders in the ICM process so that they can safeguard the function of the habitats that support fisheries ecosystems from adverse effects stemming from activities in other sectors.

ADDITIONAL REFERENCES

Look up these resources in this *Sourcebook*'s companion CD, or follow the links provided:

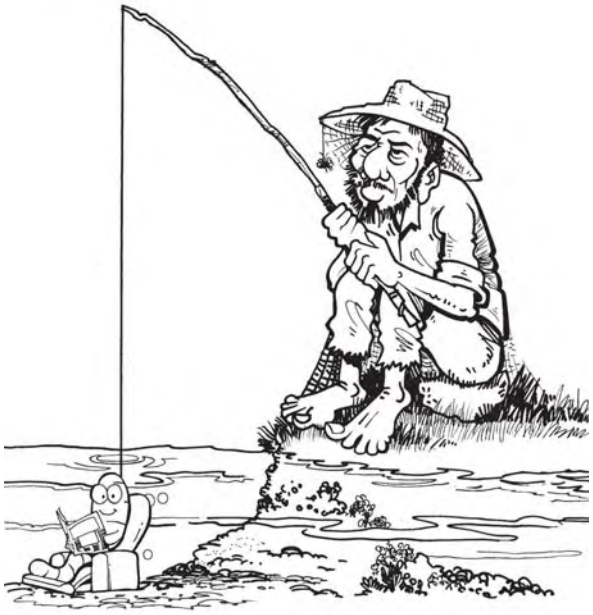
1. A Fishery Manager's Guidebook. Management measures and their applications. FAO Fisheries Technical Paper 424 — *ftp://ftp.fao.org/docrep/fao/004/y3427e/y3427e00.pdf*
2. Code of Conduct for Responsible Fisheries — *ftp://ftp.fao.org/docrep/fao/005/v9878e/v9878e00.pdf*

3. FAO Technical Guidelines for Responsible Fisheries 4 Suppl. 2: The ecosystem approach to fisheries – *ftp://ftp.fao.org/docrep/fao/005/y4470e/y4470e00.pdf*
4. FAO Fisheries Technical Paper 443. The ecosystem approach to fisheries: Issues, terminology, principles, institutional foundations, implementation and outlook – *ftp://ftp.fao.org/docrep/fao/006/y4773e/y4773e00.pdf*
5. Philippine Fisheries Code of 1991 (RA 8550) and Implementing Rules and Regulations -- *http://oneocean.org/download/990330/fishery_code_irr.pdf*
6. Philippine Coastal Management Guidebook Series
    a. Coastal Management Orientation and Overview – *http://oneocean.org/download/db_files/crmguidebook1.pdf*
    b. Legal and Jurisdictional Framework for Coastal Management – *http://oneocean.org/download/db_files/crmguidebook2.pdf*
    c. Coastal Resource Management Planning – *http://oneocean.org/download/db_files/crmguidebook3.pdf*
    d. Involving Communities in Coastal Management – *http://oneocean.org/download/db_files/crmguidebook4.pdf*
    e. Managing Coastal Habitats and Marine Protected Areas – *http://oneocean.org/download/db_files/crmguidebook5.pdf*
    f. Managing Municipal Fisheries – *http://oneocean.org/download/db_files/crmguidebook6.pdf*
    g. Managing Impacts of Development in the Coastal Zone – *http://oneocean.org/download/db_files/crmguidebook7.pdf*
    h. Law Enforcement — *http://oneocean.org/download/db_files/crmguidebook8.pdf*

Chapter 5
Planning & Implementation Framework

In This Chapter

- Review the ICM framework adopted by the Philippines for sustainable development
- Understand how EAF fits in the ICM framework
- See how the CRM planning process now employed by many LGUs can be applied to municipal fisheries planning under EAF
- Look at the elements that may be included in a municipal fisheries management plan under EAF



One thing is sure. We have to do something. We have to do the best we know how at the moment . . . If it doesn't turn out right, we can modify it as we go along.

— Franklin D. Roosevelt, US President

The last decade has seen remarkable acceptance and institutionalization of coastal management by LGUs. Funding and other resources have become more easily available for the implementation of crucial management measures, particularly in areas such as participatory resource assessment, habitat protection, and coastal law enforcement, as well as IEC activities that promote community awareness and acceptance of the need for protection and management of our coastal resources.

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Moreover, the adoption by the national government of ICM as a development framework (Chapter 3) should help facilitate our job as municipal fisheries managers. As we noted in Chapter 4, ICM is closely related to and highly compatible with the **ecosystem approach** that we are being encouraged to adopt in fisheries management. In doing our duty to promote sustainable and responsible fishing, we will certainly benefit from the ICM perspective that is already incorporated in our sustainable development agenda.

We now have in many LGUs regular budget allocations for key ICM activities, especially MPAs, which have been a particularly well-received strategy not only to protect marine habitats (mainly coral reefs and mangroves) but also to revitalize fish stocks and promote a better understanding among fishers of the value of a healthy ecosystem.

The following sections describing the ICM framework and CRM planning process are taken mainly from the *Philippine Coastal Management Guidebook Series* (DENR et al, 2001).

ABOUT ICM

ICM comprises those activities that achieve sustainable use and management of economically and ecologically valuable resources in coastal areas that consider interaction among and within resource systems as well as interaction between humans and their environment (White and Lopez, 1991). It emphasizes the integration of management across both environmental and human realms to solve complex problems that span sectoral concerns, ecosystems, institutions, and political boundaries – from the top of the mountain, where deforestation and subsequent siltation degrade coastal water quality and coral reef growth, to the sea, where overfishing and uncontrolled shoreline development are resulting in a decline of municipal fisheries and habitats (Figure 5.1).

The operative word is "integration," and it means:

1. Integration across academic disciplines and sectors is needed to identify issues and research and development management measures;
2. Spatial and temporal integration is needed to address the interconnectedness of ecosystems and long-time scales often required to meet management objectives;
3. Legal and institutional integration is necessary where sometimes as many as 50 government agencies at several levels of government have legal authority over some respect of coastal space, resources, and human activities; and
4. Integration of policies is essential to address conflicting and overlapping legal and institutional mandates, laws, plans and programs.

We have not achieved the level of integration required for a truly functional ICM system, but we have made some headway in institutionalizing a management process at the municipal level that emphasizes the integration of government and community toward promoting sustainable coastal resource use.

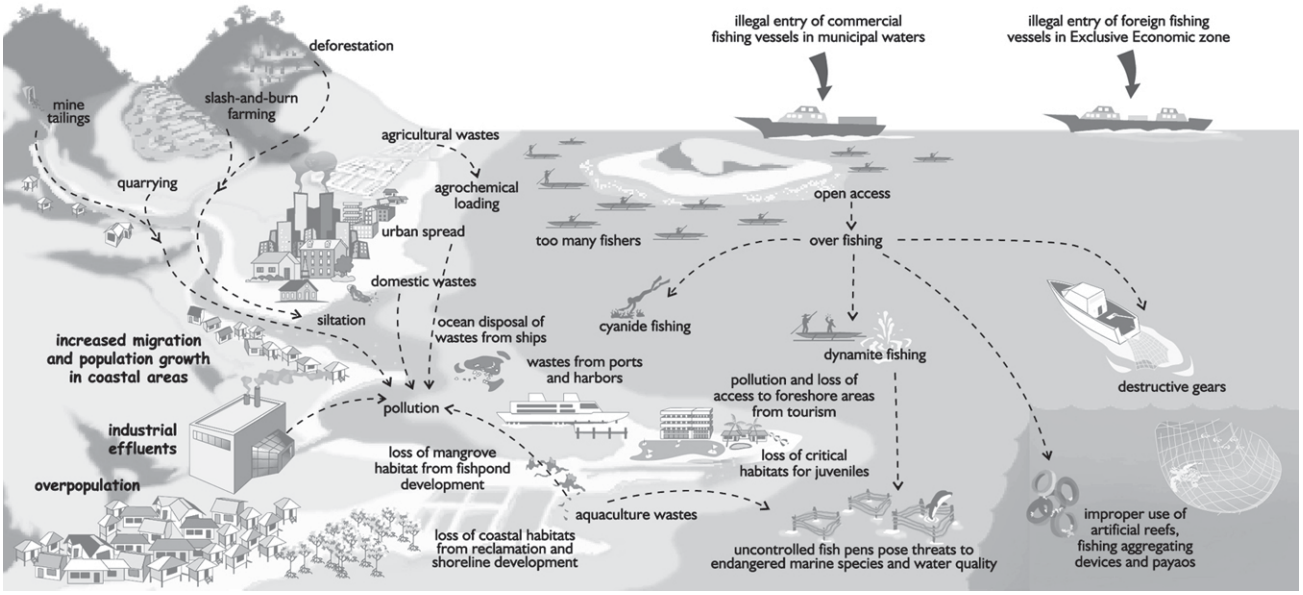

Figure 5.1. Impacts of human activities on the coastal zone. The coastal environment is impacted by both natural and human factors, including those that occur far from the coastal zone. Single issue or sector interventions cannot solve complex coastal management issues and their contributing causes (White et al, 1997). Emphasizing the interconnectedness of ecosystems, ICM attempts to address the issues by integrating management across both environmental and human realms, and incorporating the tenets of multi-sectoral collaboration (co-management) and community participation. (DENR et al, 2001)

Planning Coastal Management

"The essential elements of this management process are simultaneous integration and coordination on multiple levels, which can incorporate national and local government working together with community groups in an iterative assessment, planning, and implementation process." (Christie and White, 1997)

This process is commonly referred to in the Philippines as "coastal resource management" (CRM). It generally involves participatory planning, implementation and monitoring of sustainable uses of coastal resources through collective action and sound decision-making.

The CRM planning process practiced in the Philippines falls under the ICM framework and follows its core guidelines (Table 5.1) and planning logic. Like ICM, it emphasizes the iterative nature of the planning cycle (Figure 5.2). It stresses the need for a strong foundation of good information on which the plan and field activities will be based. And it is highly collaborative, encouraging both government and non-government partners – all major stakeholders – to participate in formulating the plan, implementing it, and periodically refining and revising it as new information is obtained or conditions change.

ICM – being a broader set of activities that underscore integration within government, non-government and environmental realms – encompasses CRM. CRM, in turn, encompasses any number of best practices that address and rationalize land use, water use, and socioeconomic development in the **coastal zone** (extending 1km inland from the high tide) and municipal waters (Figure 5.3). Obviously, for most Philippine coastal LGUs,

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Table 5.1. Core ICM guidelines (DENR et al, 2001)

Purpose of ICM — The aim of ICM is to guide coastal area development in an ecologically sustainable fashion.
Principles — ICM is guided by sustainable development principles with special emphasis on the principle of intergenerational equity, the precautionary principle, and the polluter pays principle. It is holistic and interdisciplinary in nature, especially with regard to science and policy.
Functions — ICM strengthens and harmonizes sector management in the coastal zone. It preserves and protects the productivity and biological diversity of coastal ecosystems and maintains amenity values. It promotes the rational economic development and sustainable utilization of coastal and ocean resources and facilitates conflict resolution in the coastal zone.
Spatial Integration — An ICM program embraces all of the coastal and upland areas, the uses of which can affect coastal waters and the resources therein, and extends seaward to include that part of the coastal ocean that affects the land of the coastal zone. The ICM program may also include the entire ocean area under national jurisdiction, over which national governments have stewardship responsibilities.
Horizontal and Vertical Integration — Overcoming the sectoral and intergovernmental fragmentation that exists in today's coastal management efforts is a prime goal of ICM. Institutional mechanisms for effective coordination among various sectors active in the coastal zone and between the various levels of government from national to regional and local operating in the coastal zone are fundamental to the strengthening and rationalization of the coastal management process. From the variety of available options, the coordination and harmonization mechanism must be tailored to fit the unique aspect of each government setting and concerned resource stakeholders.
The Use of Science — Given the complexities and uncertainties that exist in the coastal zone, ICM must be built on the best science (natural and social) available. Techniques such as risk assessment, economic valuation, vulnerability assessments, resource accounting, benefit-cost analysis, and outcome-based monitoring should all be built into the ICM process as appropriate. (Source: Cicin-Sain et al, 1995)

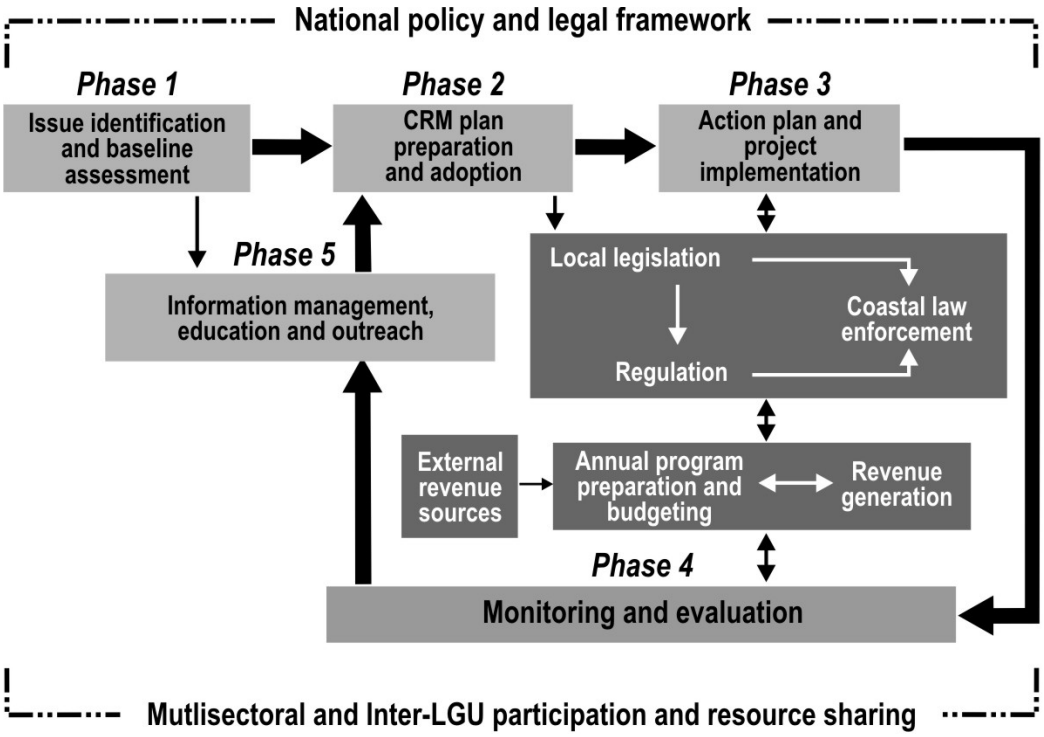


Figure 5.2. CRM planning cycle adapted for Philippine LGUs. The CRM planning cycle is an iterative process whereby the plan is periodically reviewed, refined and revised as new information is obtained or conditions change. Goals and strategies often have to be refined or adapted to meet changing circumstances or when better information or a new understanding of the coastal issues becomes available. Insights into the viability or utility of management strategies or better knowledge about the agencies or individuals responsible for implementation can also lead to program changes. The plan may require refinements and adjustments to incorporate community feedback and improve stakeholder participation and support. (DENR et al, 2001)

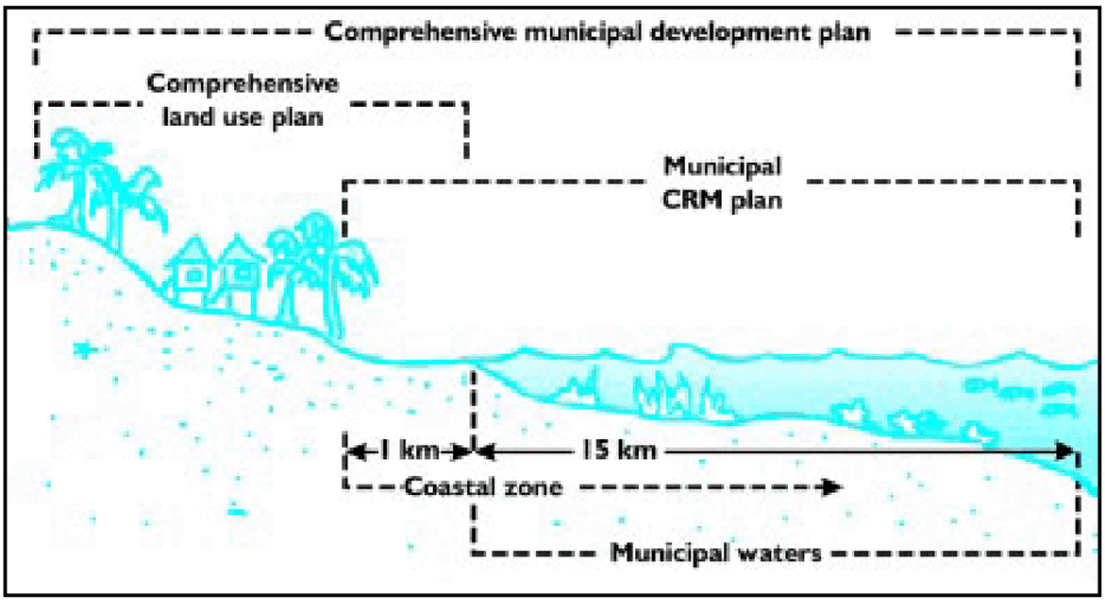


Figure 5.3. CRM scope and context. The scope and context of CRM planning may vary depending on the spatial scales of priority issues. Barangay plans developed through community participatory processes are incorporated in municipal plans. Municipal plans may need to address issues upland from the coastal zone or outside the municipality (thus requiring the participation of other concerned LGUs). Bay-wide plans are encouraged where several municipalities share a common physical feature such as a bay. ICM plans may be required when addressing upland or watershed issues that affect the coastal zone (Cicin-Sain and Knecht, 1995. *In*: DENR et al, 2001). And when dealing with ecosystem issues, ecosystem-level planning may be called for requiring the participation of all concerned stakeholders from different sectors across many political and institutional jurisdictions.

fisheries management will be a priority concern, among other planning areas such as shoreline foreshore management and pollution control, municipal water delineation and coastal zoning, habitat protection and management, coastal law enforcement, waste management, and development of coastal environment-friendly enterprises.

If you've had any experience implementing CRM, you would be familiar with at least a few of these planning areas, mainly habitat protection and management (through MPAs, mangrove rehabilitation and management), coastal law enforcement, solid waste management, and perhaps municipal water delineation. But perhaps you would not have had as much exposure to the specific aspects of planning fisheries management, especially under EAF.

To help you get your bearings, before we describe the fisheries management planning process under EAF, we will first review the CRM planning process that is now used widely by Philippine LGUs.

The Planning Process

The CRM planning process adapted for Philippine local governments consists of five phases (Table 5.2). It is the same process we will follow whether we're laying out our fisheries management program or addressing some other concerns.

Table 5.2. The five phases in the CRM planning process adapted for Philippine LGUs (DENR et al, 2001)

Phase 1:	Issue identification and baseline assessment
Phase 2:	Plan preparation and adoption
Phase 3:	Action plan and program implementation
Phase 4:	Monitoring and evaluation
Phase 5:	Information management, education and outreach

Phase 1 of this process, issue identification and baseline assessment, requires community involvement to ensure that critical issues are identified and prioritized and that coastal resource conditions and uses are described. The identification of key issues is needed to guide plan preparation and adoption in Phase 2.

Phase 2 involves designing specific management strategies such as zoning municipal water use, regulation (e.g. licenses and permits) of human uses and activities, enforcing existing laws, designing alternative enterprise development programs, establishing MPAs, and educating resource user groups. Once completed, the plan is formally adopted through the normal legislative process.

In Phase 3, the strategies articulated in the plan are implemented through specific municipal programs and actions.

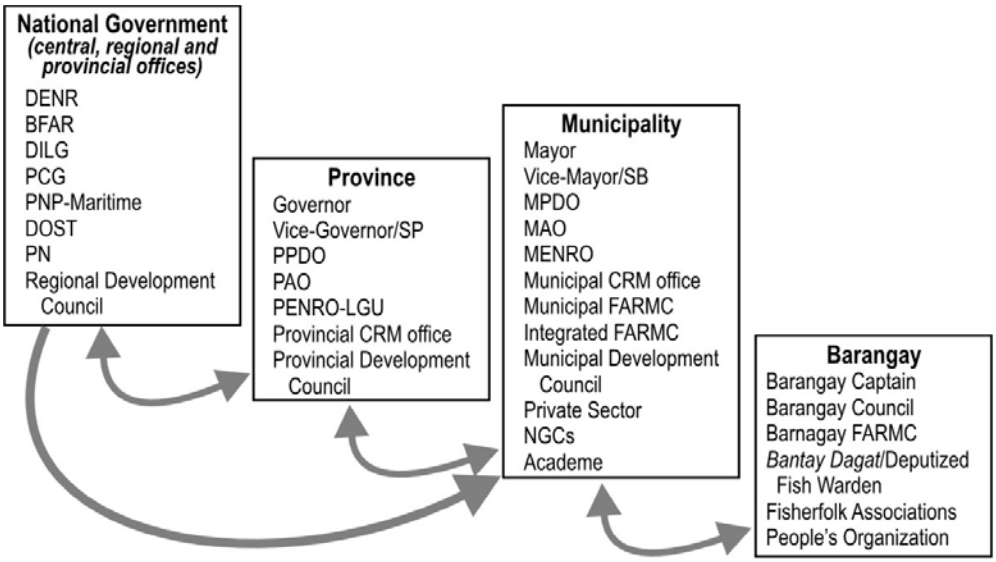
Phase 4 consists of monitoring and evaluation (M&E), two very critical actions that need to be regularly taken in order to review and assess – using benchmarks of performance and best practices – the effectiveness of the plan and programs we are implementing.

In Phase 5, the results of M&E are organized and stored in a database for easy retrieval and use in management. As well as being fed back into the planning process, the information will serve as an input to education and outreach programs.

A Non-Linear Process

There may be a logical sequence of events in the planning process described above, but in practice, these five phases do not happen sequentially. Often two or more phases occur simultaneously, or a phase may begin before the one before it. In fact, we would do well to undertake Phase 5 (*information management, education and outreach*) before or simultaneously with Phase 1 (*issue identification and baseline assessment*) so that at the outset we would have a database system in which to store our baseline data. Also, education and outreach (including stakeholder consultation) are critical activities that, if started early and continued throughout the process, will help build community support and facilitate plan implementation.

During Phase 3, we can initiate specific strategies or "early management actions", such as the establishment of MPAs, even before plan preparation is completed. Early management actions are usually undertaken to address issues that need immediate



BFAR - Bureau of Fisheries and Aquatic Resources
CRM - coastal resource management
DENR - Department of Environment and Natural Resources
DILG - Department of Interior and Local Government
DOST - Department of Science and Technology
FARMC - Fisheries and Aquatic Resources Management Council
LGU - Local government unit
MAO - Municipal Agriculture Office
MENRO - Municipal Environment and Natural Resources Office
MPDO - Municipal Planning and Development Office
NGO - nongovernment organization
PAO - Provincial Agriculture Office
PCG - Philippine Coast Guard
PENRO - Provincial Environment and Natural Resources Office
PN - Philippine Navy
PNP - Philippine National Police
PPDO - Provincial Planning and Development Office
SB - *Sangguniang Bayan*
SP - *Sangguniang Panlalawigan*

Figure 5.4. Major players in coastal management in the Philippines. While municipal and city governments have the primary mandate to manage municipal waters, they are just one among many key players in coastal management in the Philippines. National agencies, DA-BFAR and DENR primarily, have important supporting and monitoring roles in the coastal management process. Regional and municipal development councils can also contribute significantly as multi-sectoral planning bodies that include representatives from the private sector, NGOs and academe. NGOs are involved in community-level implementation. Academic and research institutions have important roles in baseline assessments, information management and analysis for planning and monitoring. And private sector stakeholders, including municipal fishers, commercial fishing operators, tourism operators, and industries, form part of the coastal community and must participate in CRM planning. (DENR et al, 2001).

attention, and to generate "small wins" that encourage public support and stakeholder participation in the process, or neutralize resistance from affected stakeholder groups.

Indeed, ultimately, it will not matter very much what phase of the process we start implementing first. What is more important is that we are able to gain the broadest acceptance possible by maintaining a high level of **stakeholder participation** throughout the process (**Appendix 6**), that we are able to activate all phases in a timely manner, and that we will at some point have a plan that ties together in a rational manner our goals, objectives and strategies toward sustainable coastal resource use.

☞Appendix 6

In general, we want our plan to have the following characteristics (White, 1997):

1) It involves the active participation of key stakeholders (Figure 5.4);
2) It contains relevant baseline information about human activities that impact the coastal environment;
3) It is understood and supported by government officials, resource user groups, and other stakeholders;

4) It is flexible enough to allow for adaption to changing socio-political conditions;
5) It resolves conflicts and provides mechanisms to resolve potential conflicts among key stakeholders;
6) It is organized to ensure a continuing management effort; and
7) It is designed to promote measurable results over long-term (10-25 years), medium-term (5 years) and short-term time horizons (1 year).

We will not discuss here the CRM planning process in any more detail as it is discussed quite extensively in other literature that we have provided in the CD that accompanies this *Sourcebook* (see Additional References at the end of this chapter). Instead, let us now focus on how we can build on the CRM planning process to improve our management of fisheries, and what we need to have and do to bring about fisheries management under an EAF.

The sections that follow are adapted mainly from UN-FAO guidelines (FAO, 2003) and describe the best scenario based on current knowledge and practices. Some parts dealing specifically with the integration of fisheries management into the CRM planning process are taken primarily from the *Philippine Coastal Management Guidebook Series* (DENR et al, 2001).

PLANNING FOR SUSTAINABLE MUNICIPAL FISHERIES

With ICM as our framework and the CRM planning process as a platform for the integration of our management efforts, we have the basic ingredients to begin improving the management of our municipal fisheries. For many reasons, CRM has become the preferred process to solve fishery-related problems in the Philippines (DENR et al, 2001).

> *First, fisheries management does not imply managing every fishery by itself, but also involves managing institutions and people that affect the fishery. Collaboration between formal and non-formal institutions that affect fisheries is therefore an essential aspect of management.*
>
> *Second, given the increasing complexity of fishery-related issues, it has become necessary for fisheries managers to look beyond fish stocks as a management unit and consider the broader considerations of ecosystem approaches. Thus, the protection of essential fish habitats and the interrelationships within and between the different coastal and terrestrial ecosystems have become an integral part of fisheries management.*
>
> *Third, traditional fisheries management strategies involve mostly reactive and stop-gap measures, instant and often sectoral solutions conceived only to address a specific problem without regard to the broader physical and social environment that created the situation. CRM provides a more deliberate planning perspective that attempts to solve the underlying issues causing fishery decline.*

Let's run through the CRM planning process again, this time focusing on fisheries management and incorporating EAF principles (Figure 5.5). Again, we must emphasize that this process is not necessarily sequential. Also, we must reiterate the need for stakeholder

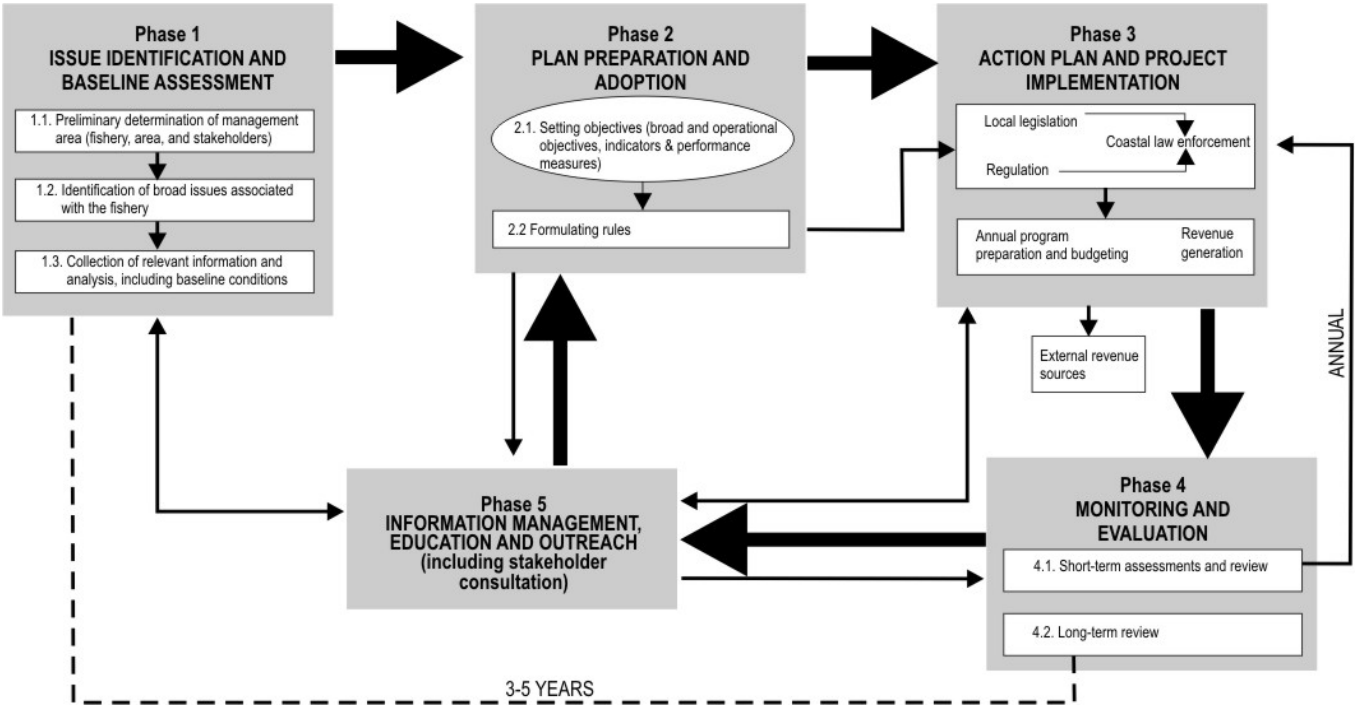


Figure 5.5. Fisheries management under EAF based on the Philippine CRM planning process. This diagram shows how fisheries management under EAF can be integrated into the ICM-based CRM planning process that has been adapted for Philippine LGUs. The diagram assumes the existence of a functional management body at the LGU level, very likely the same management body in charge of CRM functions. It introduces several fisheries-focused, EAF-based elements, including an emphasis on the need for fisheries managers to pay as much attention to ecological considerations as we do to socio-economic concerns. And it underscores the importance of long-term M&E of the fishery-related impacts and the effects of management measures.

participation at all stages in the process. At the outset we must involve stakeholders, not only to promote their sense of ownership in the plan and its implementation, but also because they can provide valuable information and insights about the state of the fishery or fisheries under consideration and the management issues that need to be addressed.

The *UN-FAO Technical Guidelines on Fisheries Management* (FAO, 1997) describe a management plan as "a formal or informal arrangement between a fisheries management authority [e.g., the municipal or city LGU] and interested parties [e.g., the fishers] which identifies the partners in the fishery and their respective roles, details the agreed objectives for the fishery and specifies the management rules and regulations which apply to it, and provides other details about the fishery which are relevant to the task of the management authority."

Every fishery must have a well-formulated management plan (Cochrane, 2002). Ensuring that plans are developed and implemented for all fisheries helps to avoid planned management measures on one fishery creating unforeseen problems and externalities in a neighboring fishery for which no plan is available (FAO, 1997).

Consultation processes must ensure that stakeholder involvement sufficiently represents the breadth of views of affected sectors, without the group becoming unmanageably large. By engaging the stakeholders in the process, we can address issues

related to their capacity and commitment to participate in management. We must keep the process transparent and provide formal and accountable arrangements to allow all parties to work collaboratively. Maintaining transparency, credibility and ownership in the outcomes is particularly important because logistic constraints often prevent us from including all stakeholders and interested parties. (FAO, 2003)

Informing Fisheries Management Under EAF

To be effective managers and allow for continuous improvement, we must have access to timely and reliable information at all stages in the management process, from policy and plan formulation through implementation to evaluating our progress and updating our policies and plans. Understandably, given the broad concerns of an EAF, our information needs for management would be wide-ranging (Table 5.3).

Information management (Phase 5) is an important part of our planning process (Figure 5.5), which requires that we regularly monitor and evaluate our progress. Over time, with effective monitoring and information management, we should have easy access to the information and data we need when we need them. But right now, considering that we've

Table 5.3. Information requirements of fisheries management under EAF (FAO, 2003)

Information about the fishery

1. The area of operation of the fishery and its jurisdiction;
2. The various stakeholders;
3. The gear and vessel types to be employed in the fishery;
4. The history, management and socio-economic importance of the fishery;
5. If possible, the distribution area of the most important commercial species in the catch (preferably as a map);
6. Relevant information about the life histories of these species;
7. The effects of the fishery on the recruitment, abundance, spatial distribution and age or size structure of the target species, as far as possible;
8. Any available monitoring data; and
9. Any management procedures already in place, with descriptions and a performance evaluation.

Information about the ecosystem (or at least a comment on each of the following ecosystem attributes)

1. The critical habitats that may be affected and the potential direct and indirect impacts of the fishery on these habitats;
2. The species composition of both the retained and non-retained by-catch and the potential effects of additional fisheries-generated mortality on affected populations;
3. The likely amounts of discards produced by the fishery and the importance of these discards for potential scavengers;
4. The potential amounts of litter produced by the fishery and the possible effects of lost or abandoned gear on fish and other biota;
5. The ecosystem within which the fishery takes place including the impact of other anthropogenic activities such as releases of nutrients and contaminants;
6. The major biological interactions in which the harvested species participate and the potential effects of fisheries on these interactions. Particular efforts should be made to identify possible interactions with critical species, with forage species important for transfer of energy in the food chain, and with habitat structuring species such as coral;
7. The impact of fishing on life history traits, such as age and size of first maturity and possible effects of the fishery on the genetic diversity of affected populations;
8. The legal framework and extent to which the effects generated by the fishery would comply with regulations related to nature conservation with consideration for endangered species (Chapter 4); and the possible management measures to reduce adverse environmental impacts.

barely begun institutionalizing various fisheries and CRM functions at the LGU level, the sheer amount of data required can no doubt seem overwhelming.

It is important to stress that immediate action should be based, as much as possible, on data and information that already exist. There may be reports and statistics on well-studied fisheries from various research organizations and government agencies. More frequently, however, reports and statistics specifically about the particular fishery or fisheries we have to manage would be hard to come by. In this case we will have to rely more heavily on traditional knowledge about the ecosystem and the fishery that we can get and validate from interviews with local fishermen and other stakeholders.

In all cases – to ensure that all issues relevant to a particular fishery are covered and that all alternative objectives, indicators and reference points can be assessed – knowledge about the local situation should be complemented by "the best available scientific advice," using information from ecologically similar situations in other places, if there is no such information about the fishery with which we are specifically concerned (FAO, 2003). And always, in dealing with data-poor management situations, we should be guided by the precautionary principle (Chapter 2).

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Phase 1: Issue Identification & Baseline Assessment

The main purpose of Phase 1 is to gather and analyze information that we will need for decision-making (DENR et al, 2001). We can break this stage down into three steps (Figure 5.6): (FAO, 2003)

1) Preliminary determination of management area (fishery, area, and stakeholders)
2) Identification of broad issues associated with the fishery; and
3) Collection of relevant information (from secondary information and field/ participatory resource assessment), analysis of information and development of profile, including baseline conditions in the management area, ideally both ecological/biological and socio-economic conditions.

All these will entail expense, so at this stage we should already have some ***initial funding*** for our first few activities and a budget allocation — or at least the commitment of relevant authorities to provide adequate funding — for the preparation of the plan and its implementation.

Preliminary determination of management area

Ideally, we should start the planning process with the identification of the fishery (or fisheries) and geographic area that we should address, so that from the very outset, we would have an idea of the scope of our management effort.

We can begin by defining all the fishery activities that happen within our area of immediate concern and jurisdiction (our municipal water, or a portion of it). A fishery can be as simple as a **fleet** using the same type of gear (say gillnet) targeting the same species (for

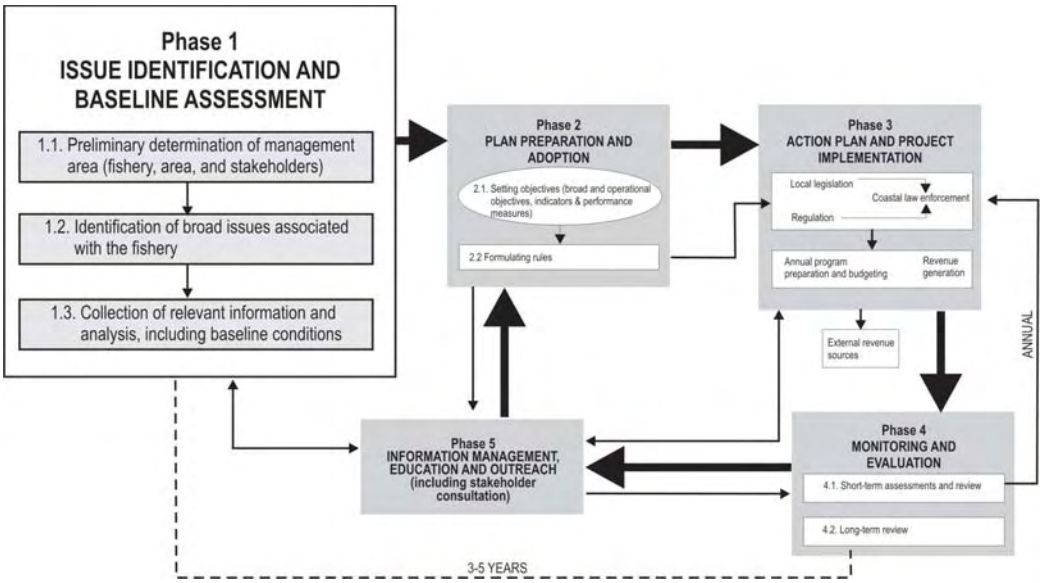

Figure 5.6. Fisheries management under EAF based on the Philippine CRM planning process, Phase 1. Phase 1, Issue Identification and Baseline Assessment (enlarged box above), consists of three major steps, namely (1) Preliminary determination of management area (fishery, area, and stakeholders); (2) Identification of broad issues associated with the fishery; and (3) Collection of relevant information (from secondary information and field/participatory resource assessment), analysis of information and development of profile, including baseline conditions in the management area, ideally both ecological/biological and socio-economic conditions.

example, blue crab) in the same geographic area (for example, at Guindacpan Island in Talibon, Bohol). Or it can be a geographic area where a number of fleets using different types of gear are targeting a number of different species. We might find in the same geographical area a fleet that uses a particular gear to target a particular species that is not caught by the other vessels operating there – in this case it may be worthwhile to identify that fleet as a separate fishery. (FAO, 2008)

By "fleet" we generally mean "the aggregation of units of any discrete type of fishing activity utilizing a specific resource. For example, a fleet may be all the purse seine vessels in a specific sardine fishery, or all the fishers setting nets from the shore in a tropical multispecies fishery." (FAO, 1997)

As a rule, we would define a fishery in terms of the "people involved, species or type of fish, area of water or seabed, method of fishing, class of boats, purpose of the activities, or a combination of the foregoing features" (Fletcher et al, 2002). Depending on the level of interaction within a geographic area, we may be able to identify several fisheries operating there, based on the species caught (e.g. siganid fishery, blue crab fishery, anchovy fishery), the type of gear or method used (e.g. gillnet fishery, trap fishery), the area of water where it operates (demersal fishery, reef fishery), or a mix of many attributes (e.g. nearshore finfish trap fishery, live food fish reef fishery, siganid fry push net fishery).

We may have to conduct an ***inventory of all fishers and gear, including those operating illegally,*** in our area of jurisdiction. If it is at all possible, we should at this early stage begin to establish a ***fishery registration and licensing system***. In order to encourage

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Figure 5.7. Fishers' registration. A team from the local government sets up a makeshift registration center in a coastal community in Talibon, Bohol to encourage fishers to register. The development of a fishery registry containing information on the municipal fishers and the gear and vessels they use is a crucial first step in fisheries management planning.

fishers to participate, the registration and system should be initially inclusive, ***excluding only those gear and vessels that are not legally allowed under existing laws*** (FAO, 2008).

Once we know the fishery or fisheries that we need to address, we must determine the geographic extent of their influence. Remember, under EAF, we are concerned not only with optimizing the production of our fish stocks but also with how a fishery impacts or is impacted by other sectors – both fishing and non-fishing – and the ecosystem. From the EAF viewpoint, the geographic area of a fishery in many cases extends way beyond its immediate area of operation.

In small pelagic fisheries such as anchovy fishery, for example, we will usually find the same species being targeted by different groups of fishers in different areas, for instance, by artisanal boats operating close to shore and those operating offshore or in other inshore areas outside our jurisdiction. In this case, the two groups would likely be competing with each other as well as producing cumulative impacts on the stocks and ecosystem.

Furthermore, the two fleets may be catching species other than their target species, and therefore producing other ecosystem impacts through **bycatch** and **byproducts**. We would then have to estimate the geographic range of such impacts and expand our area of concern accordingly.

EAF dictates that the spatial coverage of our management plan should coincide with the ecosystem associated with the fishery under consideration. Much has been said about the difficulty of determining often uncertain ecosystem boundaries, especially in the data-poor municipal fishery areas where we work. In practice, the final choice of fishery or

fisheries and geographic area would have to be determined in the next step (see below) when we know the issues that we are dealing with. Even so, it is necessary at this early stage to delineate our geographic area, if only to allow the identification of stakeholders (FAO, 2003) and identify issues related to managing those fisheries that extend beyond our jurisdiction. We should, to the extent that we can, include not only stakeholders that impact and are impacted by a given fishery, but also those that may be affected by our actions to manage that fishery.

We don't have to be very rigid about our definitions, but must have at least some basic understanding of the major fishery interactions in our area of concern. The operative word at this stage is "preliminary." The preliminary steps are interactive and our initial choices can be adapted as subsequent steps reveal new information or concerns (FAO 2003). By identifying our prospective management area at the start of the planning process, we would have gained a better appreciation of what it will take to make a good fisheries management plan and effectively implement it under EAF.

J Unson / FISH Project (2006)

Figure 5.8. Addressing the need for an ecosystem viewpoint. EAF attempts to fill gaps in management approaches that focus on species or political jurisdictions. It acknowledges the nature of the sea as an open system and addresses fishery issues from a wider ecosystem perspective. It therefore calls for the participation of a wider range of stakeholders than would normally be involved in a typical municipal program, including those that operate outside municipal waters.

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More importantly, should the geographic extent of our management plan turn out to be indeed wider than our area of jurisdiction (**municipal waters**), we would have already identified and anticipated those issues related to the need for coordination of management measures across fisheries and political boundaries. We would then be able, early in the planning process, to involve key stakeholders and develop appropriate coordination mechanisms within and outside our LGU.

Identification of broad fishery issues

Stakeholder participation is important when we begin to evaluate the issues associated with our fishery or fisheries of concern. Ideally, we should include at this stage all major stakeholders, even those that operate outside our municipal water, if they are in

anyway affecting or are affected by the identified fishery/ies. Formal consultation arrangements – the IFARMC, for example – are the best way to go, but if these are not available, informal meetings with stakeholders may be arranged through concerned LGUs.

The lack of participation from some stakeholders should, however, not prevent us from starting our planning process. From a practical perspective, EAF recognizes existing fisheries management entities and jurisdictions and build incrementally on these (FAO, 2003). We can begin with what we have and know, within our area of jurisdiction, while still working out collaboration arrangements with other LGUs or management authorities with whom we share the same fishery ecosystems.

Initially, our objective is to define, as far as possible, all potential consequences of the identified fishery/ies and the management tools and options that might be available. Our evaluation should cover economic, social and ecological components of sustainable development and be guided by the high-level policy goals set at the national or regional level. Ecological considerations would need to include (FAO, 2003):

- Sustainable harvesting of the retained species (target and by-product species, i.e., those that comprise catch that is "landed" or brought to shore);
- Managing the direct effects of fishing (especially on habitat and non-retained bycatch – including discarded catch and fish which die as a result of interaction with the fishing gear even if they do not leave the water, such as fish caught by lost or abandoned fishing gear); and
- Managing the indirect effects of the fishery on ecosystem structure and processes.

There are several frameworks for guiding this process, including those described in the UN-FAO's guidelines on indicators for sustainable development in marine capture fisheries (FAO, 1999). The use of such frameworks helps ensure that all relevant issues are included and meaningful indicators are developed to track the impacts of our management effort at both the local fishery and ecosystem level. This is important because the root cause of a problem in one fishery is not always directly linked to that fishery. The decline in catch of a fishery targeting a particular species, for example, may not necessarily be due to overfishing within the fishery, but may be due to bycatch by other fisheries or other factors, perhaps including those operating in other areas. Furthermore, the decline could have implications on other fisheries and the overall ecosystem structure that we also have to consider.

In practice, it is not critical which framework we adopt as long as it will generate the information we need to make decisions on the scope of our management plan. Based on the information we gather, we must make decisions on the following (FAO, 1999):

1) Our overall purpose or ***goal***: Is it to promote the contribution of a fishery to broader objectives of sustainable development or to the sustainable development of the fishery itself?
2) ***Human activities*** to be covered (e.g. just fishing, other uses of the fishery resource, other uses of the particular area, upstream activities);

3) ***Issues*** to be addressed (e.g. overcapacity, land-based pollution, endangered species); and
4) What constitute the ***geographical boundaries*** of the system under consideration, based on:
   a. Identification of all the fisheries and their harvesting subsectors;
   b. Characteristics of the subsectors including gear, species, commercial or subsistence, etc.;
   c. Nature of biological resources used or affected, e.g. straddling or highly migratory;
   d. Critical habitats for the primary resource; and
   e. Interaction between fisheries.

We should aim for an approach that covers the main concerns of sustainable development, namely human and ecological well-being, and at the same time cover management capacity or our "ability to achieve" our management objectives, including governance and environmental impacts on the fishery. One such framework, called the "hierarchical tree," is illustrated in Figure 5.9.

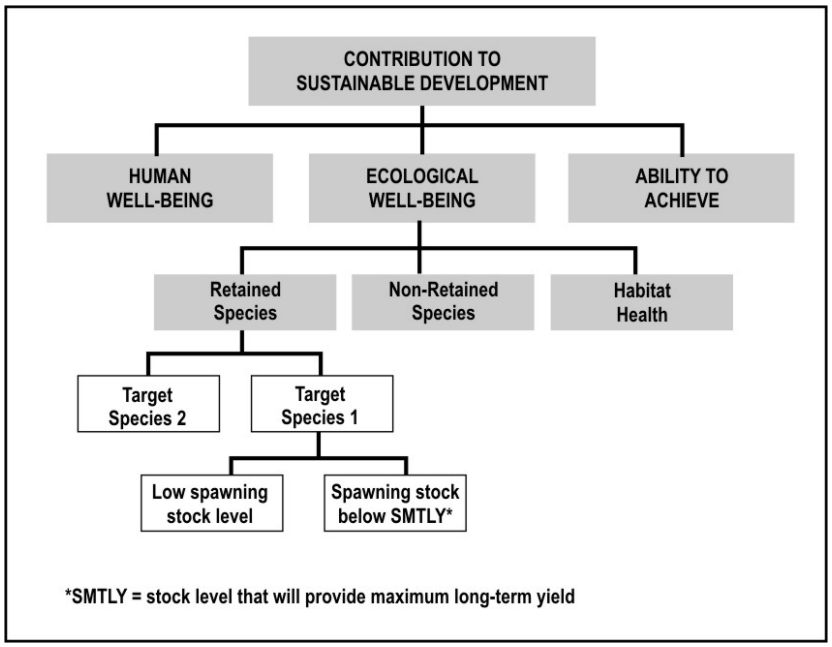

Figure 5.9. Hierarchical tree framework for identification of fishery issues. Many structural frameworks allow their constituent parts to be subdivided hierarchically. In this example, the sustainable development reference system is broken down into the effects of fishing on humans and the environment, and a third component that covers governance and environmental impacts on the fishery. Each component is then subdivided further to represent more specific concerns, such as species. For example, ecological well-being will track issues related to retained catch, non-retained catch, and other aspects of the fishery, such as habitat health, which are then broken down further to more and more specific issues as we go down the hierarchical tree. (adapted from FAO, 2003)

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Identifying the possible consequences of interactions between gear, fishing effort, fish, and habitat requires an understanding of not only the **dynamics of the marine ecosystem** (Chapter 2), but also the biology of target species, the fishery operation (e.g. seasonality, locality of fishing in relation to the distribution of the stock, etc.) and the mechanics of each gear (at least its selectivity and impacts on habitats).

What is important to remember is that, during the identification of issues, we should make a deliberate effort to bring out not only the fishers' top-of-mind concerns, which quite understandably would focus more on the effects of the fishery on human well-being (food, employment, income and lifestyle) and perhaps even the ability of government to support and manage the fishery. For our plan to be holistic, integrated and EAF-oriented, we must ensure that the process also generates enough information on the impacts of the fishery on ecological well-being (retained catch, non-retained catch and habitat). Then we can work toward securing the participating stakeholders' agreement on the potentially important – and often contentious – ecological and socio-economic (including governance) issues that we should address in the management plan.

Background information compilation, analysis & baseline assessment

When we reach an agreement on the issues that must be covered in the plan, we will compile and analyze relevant information to allow us to identify more specific issues and formulate more detailed objectives. As well as looking into impacts on the identified target resource base, our analysis of the environmental impacts of the fishery should focus on effect on habitat and direct and indirect impact on biota other than the target species (FAO, 2003). For fisheries that have been adequately studied and documented, this will normally be a desk study of available information, but in data-poor environments where we usually operate, it will often also require some rapid resource assessments.

If we have access to more sophisticated science-based stock assessment – whether from within the LGU or from outside sources such as BFAR or academic institutions involved in fishery research – it would be ideal to bring them in at this point to provide the process with objective scientific information. If not, we can generate the basic information we need for management from fisher interviews or focus group discussions (FGDs) with key informants and some rapid participatory resource assessments, such as those shown in Table 5.4.

The data and information, along with the issues earlier identified, will be analyzed to determine the interactions, geographical extent of impact, and baseline resource conditions of our target fishery or fisheries.

Based on this analysis, we should now define more firmly the geographic boundaries of our fishery ecosystem and plot these on a map, which should also indicate the boundaries of our area of jurisdiction (i.e., our municipal water).

Table 5.4. Some basic data requirements for informing fisheries management (FAO, 2008)

Biological	*Total landings* by major species per fleet per year *Total effort* by fleet per year *Length and/or age composition of landings* for major species *Discards* of major species per fleet per year *Length and/or age composition of discards* per species per fleet per year *Areas fished* by each fleet
Ecological	*Total catches of by-catch species (including discarded species), or selected indicator* species, per fleet per year *Length and/or age composition of catches of by-catch species or selected indicator species* *Impact of fishing gear and activities* on the physical habitat *Changes in critical habitats* brought about by non-fishing activities
Economic	*Average income* per fishing unit per year for all fleets *Costs per fishing unit* per year *Profitability* of each fleet *Destination of landings* from each fleet, and a measure of the dependence on the fishery of other sectors of the community (e.g. processors, wholesalers, etc.)
Social	Total number of fishers employed within each fleet Total number of people employed in fishing or shore-based activities per fleet, by gender and age groups where appropriate *Dependence of fishers and shore-based workers* for their livelihoods for each fleet

Table 5.5. Information generated by a full assessment of a fish stock (Wallace and Fletcher, 2001)

Information about fishing effort, capacity and catch

1. The kind of gear, vessels, and fishers in the fishery and where they operate (longliners, rod and reel, netters, marginal/subsistence, small-scale, motorized, non-motorized, etc.)
2. Weight (kg or tons) of fish caught by each kind of fisher over many years
3. Fishing effort expended by each kind of fisher over many years
4. The age structure of the fish caught by each group of fishers
5. How the fish are marketed (preferred size, etc.)
6. The value of fish to the different groups of fishers
7. The time and geographic area of best catches

Biological information

1. The age structure of the stock
2. The age at first spawning
3. Fecundity (average number of eggs each age fish can produce)
4. Ratio of males to females in the stock
5. Natural mortality (the rate at which fish die of natural causes)
6. Fishing mortality (the rate at which fish die of being harvested)
7. Growth rate of the fish
8. Spawning behavior (time and place)
9. Habitats of recently hatched fish (larvae), of juveniles and adults
10. Migratory habits
11. Food habits for all ages of fish in the stock
12. Estimate of the total number or weight of fish in the stock

The data, maps, analysis and all pertinent information (including priority issues) should be compiled into a fishery profile (or a set of profiles of all target fisheries) as well as entered into our fisheries database system so we can easily access them during the course of the planning process.

Interviews and FGDs with fishers will likely highlight current issues and problems in a fishery, and perhaps provide enough information to reveal at least some of their root causes and allow us to address current problems and prevent their recurrence. But at some point, we must strive for capacity to identify issues and problems ***before*** they occur, so that we can prevent them and not merely to react to them when they happen. To do this, we will need a more comprehensive stock assessment to provide us with sufficient information about each of the fisheries we are tasked to manage (Table 5.5).

Typically, a full stock assessment involves regular catch-and-effort monitoring and other scientific assessments designed to generate biological information. If necessary, we can bring in technical expertise from outside, perhaps from BFAR or academic institutions involved in fishery research. Always, however, all information must be validated by interviews and FGDs with major stakeholders.

Various technologies of participation, including participatory resource assessment, are well-accepted by many LGUs for their effectiveness in promoting stakeholder involvement in the planning process. Certain standard practices and formats are now being followed to some extent in the collection of, for example, gear, vessel and landing data, and these will no doubt be refined when the requirements of the **proposed FMUs** (Chapter 4) have been fleshed out. In the meantime, we can be advised by existing **guidelines from the UN-FAO**. (Appendix 7)

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Appendix 7

☞ Appendix 7

Table 5.6. Example contents of a simple fishery profile

1. **The Fishery Ecosystem**
   a. Geography (including boundaries)
   b. Attributes
      i. Major habitats
         1. Coral reefs
            a. Live coral cover (%)
            b. Coral diversity
            c. Fish diversity
            d. Fish population density
            e. Fish biomass
         2. Mangroves
            a. Mangrove species richness
            b. Area (hectares)
         3. Seagrass
            a. Seagrass species richness
            b. Area (hectares)
            c. Fish diversity
            d. Fish population density
            e. Fish biomass
      ii. Fish stock
         1. Abundance
         2. Biomass
         3. Patterns of fish movement (if applicable)
         4. Existing management

2. **The Fishery**
   a. Profile of the fishing effort
      i. Number of fishers
      ii. Inventory of gear and methods used
   b. Economics of the fishery
      i. Fish catch (total annual production and CPUE)
      ii. Catch rates and catch composition of fishing gear
      iii. Fishing costs, revenues and income
         1. Average fisher's incomes (per type of gear or species caught, if appropriate)
         2. Fishery resource rent

3. **Issues**
   a. Biological
   b. Economic
   c. Social
   d. Institutional

4. **Institutions and their roles in fisheries management**

Note: *The profile may contain more or fewer details, depending on the availability of information, and must be religiously updated as new information becomes available (see Tables 5.4 and 5.5 and Appendix 7 for more detailed lists of the data requirements of fisheries management)*

As a rule at the local level, under our decentralized management set-up, the LGU should be responsible for setting up and overseeing the structures and mechanisms for routine collection and analysis of the necessary data (FAO, 1997). At this stage, we would like to start the development of our fisheries database and profile (Table 5.6), which will include maps and all the relevant data we have collected at this point. We would also want to set up a data management system to facilitate the storage, organization and retrieval of data throughout the planning and implementation process.

In collaborative management involving more than one LGU under an EAF, our task can be made much easier if the different partners all collect data according to common definitions, classifications and methodologies and in a pre-agreed, standardized format, enabling all data to be combined and compared as required.

Phase 2: Plan Preparation & Adoption

The profile will guide us during planning. In Phase 2, we will identify our goals and objectives in managing the target fishery, identify appropriate management measures, and develop strategies and an action plan (DENR et al, 2001). Phase 2 consists of the following steps (Figure 5.10):

1) Identification of broad and operational objectives, and selection of indicators and reference points for each operational objective; and
2) Formulation of rules.

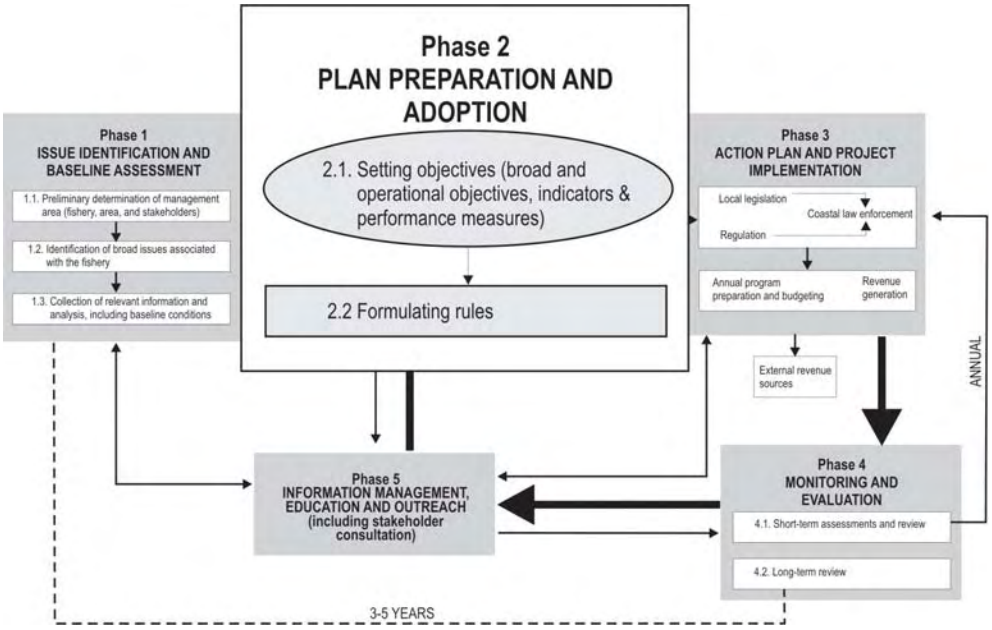

Figure 5.10. Fisheries management under EAF based on the Philippine CRM planning process, Phase 2. Phase 2, Plan Preparation and Adoption (enlarged box above), involves two main, namely (1) Objective-setting; and (2) Formulation of rules. This is the planning proper, and it covers both the broad objectives of management and its operational objectives.

The procedure above assumes the existence, at least locally, of a functional management body, perhaps the MAO working with the FARMC, or the same management body in charge of CRM. If you do not already have such an organization in your LGU, please refer for more details to Chapter 4 of *Vol. 3 of the Philippine Coastal Management Guidebook Series* (DENR et al, 2001), which is provided in the CD that accompanies this *Sourcebook*.

Setting objectives and indicators

Before we can determine the management measures we need to take, we must formulate our objectives based on the broad issues we identified earlier. There are two levels in the development of our objectives, and a third step to develop our performance measures:

1) Setting the broad objectives for our fishery;
2) Formulating operational objectives; and
3) Selecting indicators and reference points for each operational objectives

Broad Objectives

The broad objectives for the fishery provide statements of the intended outcomes of the fishery management plan in addressing the set of issues identified in Phase 1. These broad objectives provide a link between the principles, policy goals, major issues and what a particular fishery is trying to achieve. For example, the broad management objectives for a given fishery might be to (FAO, 2003):

- Keep harvested species within ecologically viable stock levels by avoiding overfishing and maintaining and optimizing long-term yields;
- Maintain habitats and populations of non-retained (bycatch) species within ecologically viable levels;
- Keep impact on the structure, processes and functions of the ecosystem at an acceptable level;
- Maximize net revenues; and
- Support employment.

Note that the first three objectives are ecological concerns that should ideally be addressed by EAF. They will require the participation of stakeholders from across the different sectors, different levels of government, and very likely, different LGUs that impact or are impacted by the target fishery, or may be affected by the plan.

At the outset, it would be best if we have all stakeholders, including those from outside our area of jurisdiction, already working with us in the preparation of the plan. But, as we noted earlier, this may not be immediately possible, as it entails a coordination mechanism that may not yet be available. In addition, where coordination mechanisms do exist, we may need time to strengthen our management organizations, perhaps even restructure them, so that they can better adapt to the requirements of EAF.

Institutional and jurisdictional constraints should not prevent us from taking action however, even if it means we can only directly address those issues that happen in our municipal water. At the same time, we must not lose sight of our broader ecosystem objectives. As we implement our plan to address local concerns, we must simultaneously build on our local management efforts by actively pursuing collaboration with other LGUs and groups and thus incrementally expand the sphere of our influence. Indeed, we would do well to include inter-LGU collaboration or other modes of ecosystem-wide cooperation as a major operational objective of our fisheries management plan.

A. Sia / FISH Project (2006)

Figure 5.11. Keeping stakeholders informed. Stakeholder consultations are a vital requirement in EAF, which requires a transparent and participatory process that enables all interested parties to understand and contribute to the development and selection of the operational objectives, establishes broad ownership and thus encourages compliance.

Operational Objectives

To implement EAF, we must translate our broad objectives into operational objectives that have direct and practical meaning in the context of the fishery, and could serve as a yardstick against which we can evaluate the performance of the fishery and its management. The process of developing operational objectives from the broad objectives should be transparent and participatory. This will enable interested parties to understand and contribute to the development and selection of the operational objectives, establish broad ownership and encourage compliance. (FAO, 2003)

The potential issues involved in fisheries and their ecosystems are varied and numerous, but there is a practical limit to how many operational objectives (and linked indicators) we can effectively use to make management decisions. Thus, as we identify our operational objectives, we must also be able to screen a large number of possibilities and choose only the most important and feasible ones. (FAO, 2003)

Every fishery will have a different set of management needs and will therefore follow a different detailed consultation and decision process for translating broad management objectives into operational objectives. In general, however, we will be following a three-step process that includes (FAO, 2003):

1) Identification of the issues at a practical level, relevant to the fishery under each broad objective;
2) Prioritization of issues based on the risk they pose; and
3) Development of operational objectives for priority issues, and as necessary, a process for monitoring of some lower priority issues.

At some point, and particularly in setting the operational objective, we may find that the information available is inadequate to address some important concerns satisfactorily, and therefore some data will have to be collected before we can move forward in developing our management plan. Ideally, as noted above, the process should include participation of appropriate technical experts who will conduct the assessment based on the procedure described in Phase 5 below. The process will both inform and be informed by the analysis and evaluation conducted by the assessment team. (FAO, 2003)

But what if, as is often the case, such technical expertise or opportunity does not exist? We should, of course, carry out the process in whatever way possible — using qualitative judgments based on traditional knowledge (including fishers' knowledge) and other available information can be informative and constructive, and certainly much better than not addressing the issues at all. (FAO, 2003)

Throughout the process, we must continually keep in mind the following simple questions (FAO, 2008):

1. Are current catches in the fishery sustainable and making good use of the resources?
2. Are current fishing practices avoiding any damaging and irreversible impact on non-target species in the ecosystem?
3. Are the current fishing activities having minimum practical impact on the physical habitat?
4. Are other non-fishing activities in the fishing grounds and in the supporting ecosystem being adequately managed to avoid damage and irreversible impact on the ecosystem, including the critical habitats?
5. Is the fishery being conducted in an economically responsible and efficient manner consistent with the economic goals and priorities of the country or local area?
6. Are those dependent on the fishery for income and livelihoods receiving appropriate, beneficial returns from their fishery-related activities?

Identify the issues under each of the broad objectives. The hierarchical tree diagram (Figure 5.9) is a good tool for identifying specific issues under each of our broad objectives. The process involves moving from the high-level issue to an operational level, with as much branching as is necessary to specify the issue at a level that can be managed with one or more of the **control measures** we described in Chapters 2 and 4. To illustrate, let's examine more closely the hierarchical tree example given earlier (Figure 5.9):

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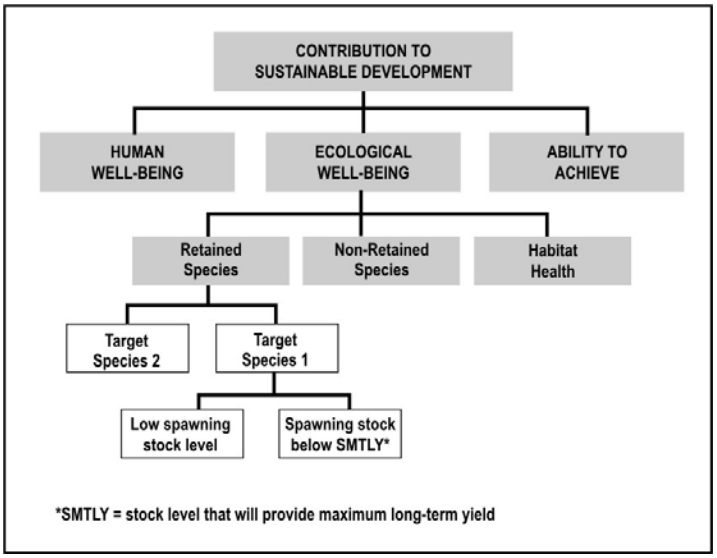
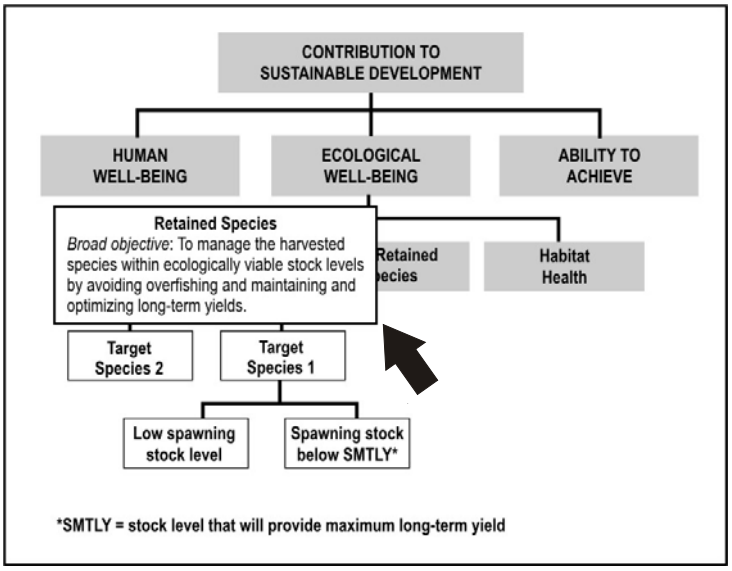
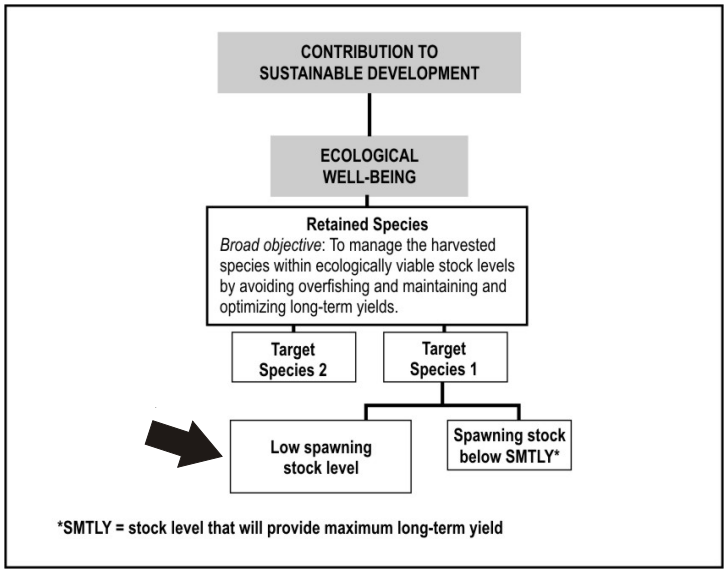


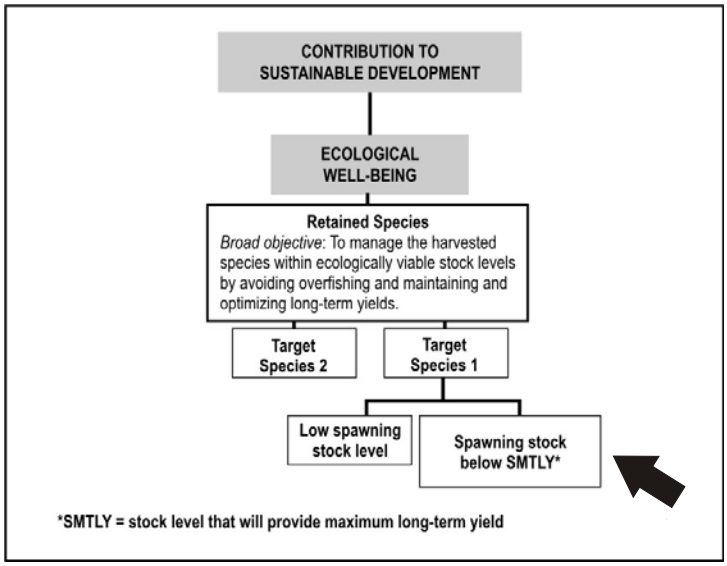
Under ecological well-being, let's state fully our ***broad objective*** for retained species, for example, "To manage the harvested species within ecologically viable stock levels by avoiding overfishing and maintaining and optimizing long-term yields." (FAO, 2003):



Two ***specific issues*** under this objective area are identified in the diagram. The first issue relates to the spawning stock declining to a level that impairs recruitment:



And the second issue is about the spawning stock declining to a level that does not maximize long-term yield.



Again, if there is not enough information to define the issue in specific quantitative terms, we can define it qualitatively. Following on our example above, it is not often that we would have the data we need to make an accurate estimate of the decline of a spawning stock biomass. But we can infer that such a decline may have occurred if we see certain trends like declining fish catch, greater effort to catch the same or smaller amounts of fish, or declines in the average size of fish caught.

What is important is that we are able to identify the issues relevant to each broad objective as specifically as possible. At more specific levels, the issues will vary from fishery to fishery. Turtles, for example, may be of concern in one fishery and require specific objectives, while seabirds may be of concern in another fishery with a completely different set of objectives. (FAO, 2003)

As we successively elaborate the issue in increasingly operational terms, we will have to make judgments on currently not well-defined or understood concepts such as biodiversity, ecosystem integrity and ecosystem functions (FAO, 2003). This process will help explain – and provide the argument for – the operational objectives that we will develop at a later stage in this Phase 2 of the planning process (see below).

☞p37

We may, for example, conclude at the end of the process that ecosystem function can be achieved or protected by an operational objective which states that we should maintain all target and bycatch species at population levels that would ensure their long-term **MSY** (assuming, of course, that we know their MSY). Or we may conclude that our broad objective can be achieved by an operational objective which states that we should place within MPAs 40% of the area occupied by the ecological community containing our target species (FAO, 2003), or that we should close the fishery permanently or periodically at critical stages to allow stocks to recover.

☞Glossary

Rank the issues. When completed, our tree diagram will have identified many issues at different scales of relevance. In this second stage of the process, we will prioritize the issues that occur at the bottom of the tree structure in order to identify those for which detailed operational objectives, **indicators** and **reference points** will be developed. One practical way to do this is through a risk assessment. (FAO, 2003)

Risk assessments can be qualitative and opinion-based, or highly quantitative and data-based. The appropriate level will depend on the circumstances, but should always include, given the information available, the best possible practices to conduct and document at least a qualitative risk assessment and capacity evaluation. There are many ways to do a risk assessment. One simple qualitative assessment method involves scoring – on a scale of, say, 1 to 5 – both the probability of occurrence and degree of impact of an issue. High-priority issues are those with high likelihood of occurrence and high impact (Figure 5.12). (FAO, 2003)

Don't forget, and we must emphasize this again – ***the process of issue identification must involve extensive stakeholder participation***. It is important that the stakeholders themselves identify both broad issues and specific issues related to their fishery, or at least recognize the problems when these are pointed out to them. This will facilitate objective-setting, and help ensure stakeholder cooperation during implementation.

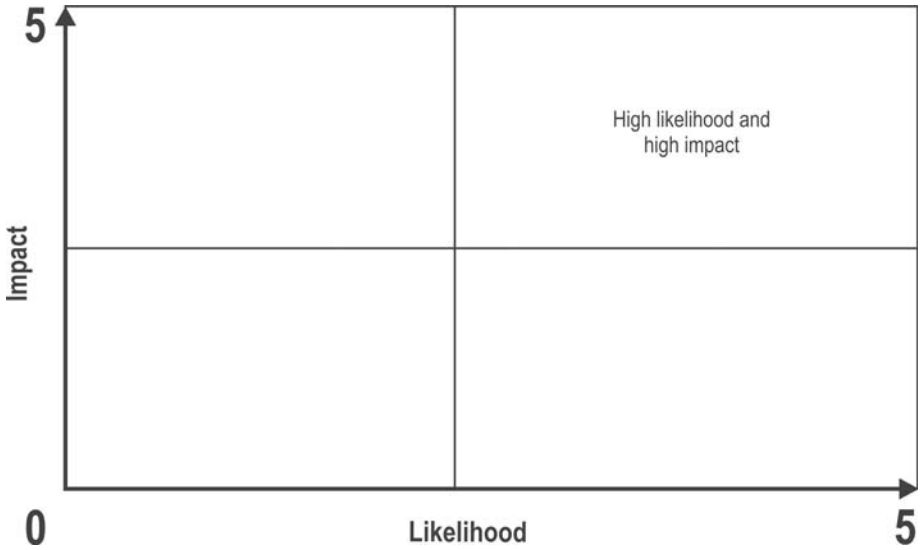


Figure 5.12. Qualitative risk assessment. One way to prioritize our fishery issues is to do a simple qualitative risk assessment using this template. We will assign to each box certain issues, depending on how we score each issue in terms of its likelihood of occurring and degree of impact. Issues that go into the lower left box would be those that, based on our judgment, would entail the lowest likelihood of occurring and the lowest impact (lowest risk), while issues that go into the upper right box would have the highest likelihood of occurring and the highest impact (highest risk). Issues in the upper left box and lower right box may be classified as "medium risk." (FAO, 2003)

Develop operational objectives for priority issues. We will tackle each issue according to the related risk, as follows (FAO, 2003):

- ***High-risk issues*** – Elaborate into detailed operational objectives.
- ***Medium-risk issues*** – Identify a mechanism in the plan for ongoing review and some form of contingency plan.
- ***Low-risk issues*** – Note in the plan, explaining why they are considered low-risk.

Following on from the target species example used above, an operational objective for the two specific issues relating to a target species might be to maintain the spawning stock above 40% of the estimated un-fished level – that is, if we have the data to support such very specific objective (FAO, 2003). Alternatively, if we do not have enough information about the abundance of the stock, our operational objective could be to set certain gear restrictions (e.g. mesh size limits for gillnets), or to declare a closed season during the period when the stock is spawning, or to prohibit the use of certain gear, or at the extreme, to close the fishery or declare a fishing moratorium until the stock recovers.

Working with stakeholders, we must develop an objective that is achievable, taking into account the level of understanding and uncertainty about the issue under consideration. Do our operational objectives reliably reflect the intent of our broad objective? How will these objectives promote the fishery's contribution to sustainable development, for example? Following the precautionary principle, the higher the uncertainty, the more rigorous we should be in setting our operational objectives. This will help ensure that when we achieve our operational objectives, we would also achieve the corresponding broad objective at minimum risk, despite the uncertainty. (FAO, 2003)

We should avoid unnecessary contradictions between our operational objectives. Normally we should be able to do this by avoiding contradictions in our policy goals and broad fishery objectives (or our interpretations of them). Sometimes, however, contradictions represent real competing demands that the fishery management process and plan should seek to balance. We should reconcile such competing demands in consultation with concerned stakeholders between the time we set our operational objectives and during the process of setting indicators and reference points (see below), using new information and insights generated by the monitoring and assessment process described in Phase 4. (FAO, 2003)

Also, it is important that stakeholders do not come out of the objective-setting process feeling as if they were manipulated to provide information that would ultimately be used against them (in which case they may, in the future, choose to withhold information). The viewpoint that should prevail is that all data shared between fishers and managers during issue identification and objective-setting are being used and will continue to be used to ensure that the fishery can continue over the longer term.

Selecting indicators and reference points

☞Glossary

In order to adequately describe the state of our resources and assess our progress toward our objectives, we will need appropriate **indicators**.

The UN-FAO guidelines on indicators of sustainable marine capture fisheries (FAO, 1999) define an indicator as a "variable, pointer or index [whose] fluctuation reveals the variations in key elements of a system… [like] the instruments on the deck of a fishing vessel, showing the captain the orientation and speed of the vessel, the remaining fuel, and the state of the operating systems necessary to ensure that the vessel can safely continue its operations. Indicators will signal potential hazards in the vessel's pathway, but the responsibility for judging risks and changing direction rests with the captain. Just as the deck instruments do, indicators summarize large quantities of information into the few relevant signals the captain needs to take action."

At the fishery level, indicators provide an operational tool in fisheries management, as a bridge between objectives and management action. For example, we can use an indicator such as an estimate of current biomass from a stock assessment model (or an appropriate proxy such as CPUE) to calculate next year's catch limit (FAO, 1999), or determine if current gear restrictions are working.

At the ecosystem level, indicators can provide us with information about not only the status of the fishery resources (i.e. are they overfished?) but also of the non-target components of the ecosystem (associated and dependent species), as well as the overall "health" of the ecosystem (FAO, 1999). Some indicators can provide data that can help determine our next action toward our broader ICM objectives.

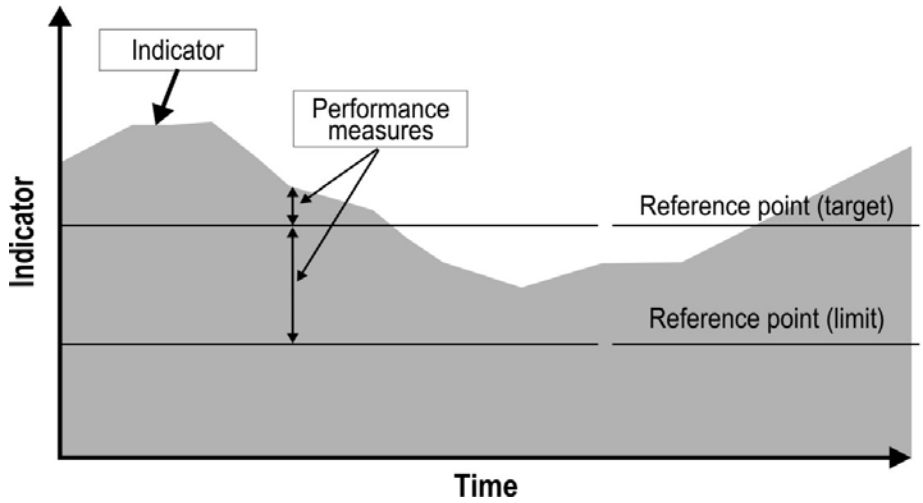


Figure 5.13. Indicators, reference points and performance measures. The overall aim in setting indicators, reference points and performance measures is to provide a framework to evaluate the management rules, and to assess the performance of the fishery in achieving its objectives. An indicator tracks the key outcome identified in the operational objective and, when compared with agreed target and limit reference points, provides a measure on how well management is performing (performance measure). The indicator and reference points define simple quantitative performance measures – the difference between the indicator value and its target or limit reference point in any year. The target should be the desired state of the indicator, and the limit should be a boundary beyond which it is undesirable to be (including the possibility of both upper and/or lower limits). The target and limit can be quantitative (e.g. a target value where the value of the indicator should be or a specified limit where the value of the indicator should not exceed), or can reflect a trend (e.g. the indicator should increase over the period of the plan). *Source: FAO, 2003*

☞Appendix 8

Our choice of indicators will depend on our operational objectives. Examples are shown in Appendix 8. To interpret indicator changes, it is necessary to specify reference values (or reference points) that are either targets (indicating desirable states of the system and good performance) or thresholds to be avoided (Figure 5.13). We can derive such reference points from past performance of the system (for example, fisheries are likely to "crash" when less than 30% of the spawning biomass is left). Or we can derive them from mathematical models (if these are available) that indicate how the system should be expected to perform. (FAO, 2003)

If there is no experience or information that we can use to derive our reference points, we should be guided by the precautionary principle and initially set conservative targets or thresholds (which means stricter regulations or more stringent restrictions). The key is to promote stakeholder support by achieving demonstrable benefits within a fairly short time (ideally, in order to promote program sustainability, within the term of a sitting mayor). We can then test our reference points by gradually easing restrictions and tracking the system's response in order to determine what the system's real thresholds are (and what our targets should be). Over time, as we gain knowledge about the system, we should be able to reduce uncertainties and refine our indicators and reference points.

The final selection of indicators and reference points should take the technical, management and operational issues of a given fishery into account (FAO, 2003). In other words, we should have the capability of actually tracking and measuring our indicators, and we as well as other stakeholders should feel confident that the indicators are both meaningful and practicable.

Where the LGU has strong enforcement capabilities, it may be possible to "impose" conservative indicators and reference points that require stringent management measures and regulations aimed at generating the greatest benefits at acceptable levels of risk in the shortest time possible, in the hope that any initial stakeholder resistance will be overcome when the benefits become evident. In most cases, however, the selection of indicators and reference points necessarily involves an iterative process of negotiation between all technical participants and stakeholders involved with the development of the plan. During the process, possibilities are suggested and tested, conflicting sets of targets and limits are identified and reconciled, indicators and reference points are agreed, management measures are identified, targets and limits adjusted, stakeholder expectations altered, and so on – the process can continue on throughout the implementation of the plan.

Certain adjustments would mean that some or all of the stakeholders would have to alter their expectations about the results to be obtained from the ecosystems and/or the fisheries, and any negotiation would have to be carried out by the stakeholders themselves for the plan to remain credible. As with the selection of operational objectives, there should be a clearly explained basis for selection of any indicator and reference point. The scientific support for the chosen basis may differ in different circumstances, and can be expected to improve over time as information becomes available. **However, again, lack of scientific certainty should not prevent the selection of indicators and reference points that are considered important.** (FAO, 2003)

Formulating rules

Now that we have information about our fishery and have set our operational objectives, we can begin identifying the management measure or measures we need to take to achieve each objective. The different management measures are explained in Chapters 2 and 4 of this *Sourcebook* (and in even greater detail in *Part 2* of this *Handbook Series*) so we will not discuss them here. Instead we will talk about decision rules that specify what management measure we should take under different conditions according to our indicators, targets and reference points, and how we should apply it.

Decision rules include how the measure is to be determined, what data must be collected and how data will be used to determine the measure. They can be quantitative (e.g. set catch limits for the species under consideration) or qualitative (e.g. review management when a certain value of an indicator is observed). Ideally, we should develop measures and decision rules based on rigorous data analyses. However, as we have emphasized again and again, a lack of this capacity should not prevent us from taking action. Even in data-poor situations, the best available information should be objectively analyzed and considered. In such cases, an extrapolation based on better studied areas can be used to provide guidance on operational objectives and associated decision rules. (FAO, 2003)

There are several approaches to developing decision rules. One such approach, called ***management strategy evaluation,*** attempts to model and simulate the whole management process. It involves making projections about the state of the fishery resources

and other ecosystem parameters for a number of years into the future under a variety of decision rule options, and then selecting and applying the management measure and rules that achieve the best results in terms of specified objectives. (FAO, 2003)

Management strategy evaluation, which can be qualitative or quantitative (or both), is often recommended for data-poor situations, because it is said to help greatly in identifying strategies that are resilient to uncertainties in scientific understanding. Using this approach, we can identify precautionary management measures and decision rules by testing the performance of each measure against a range of circumstances (or combinations of circumstances) that may be happening in the fishery, using appropriate reference points that include acceptable levels of risks. The output from such an evaluation is generally similar to that of a conventional risk assessment – the greater the uncertainty, the more conservative the management response will need to be to maintain risks at acceptable levels. (FAO, 2003)

But even such simulation or modeling approach may not be immediately applicable to the management situations in which we have to operate. In most cases, applying the principles of adaptive management, we simply have to start with what we have and know, and adjust our indicators and reference points as we acquire more resources, gain more skills and learn more about the circumstances surrounding the fishery that we are managing (Figure 5.14). To better adapt to uncertainties, a decision rule should evolve and improve through time, based on feedback on the outcome of past years. To help reduce the level of uncertainty, we can also adjust management measures to take new data into account as they become available (FAO, 2003). Through all this, we must try to keep the process as participatory as possible.

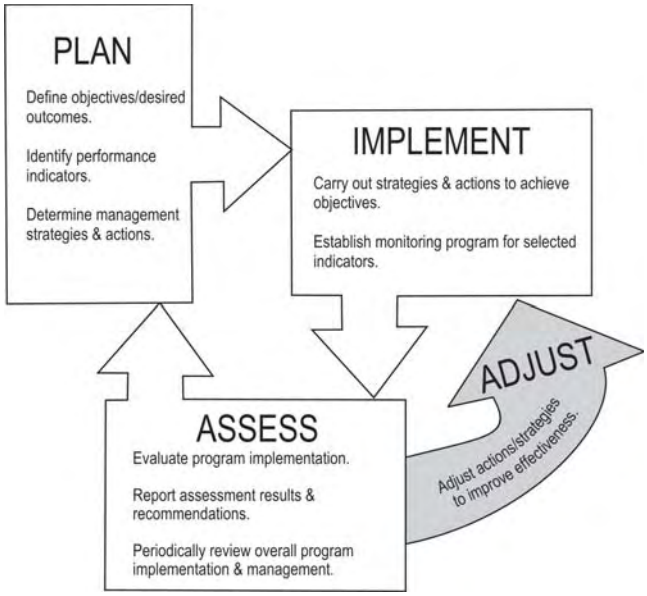


Figure 5.14. Adaptive management planning cycle. In data-poor management situations, we can use adaptive management approaches and "learn by doing." One way to do this is to choose a strategy or management measure that, based on present knowledge, appears to have the highest probability of succeeding or producing the best outcome. In most cases, at least initially, we would have to be very conservative (that is, apply more strict measures) in order to minimize the risk. As we gain more knowledge about the system, we can adapt our strategies, and adjust our performance indicators accordingly in an iterative process of planning, doing, evaluating and learning, and adjusting as new circumstances emerge and conditions change. If appropriate, without unnecessarily increasing the level of risk, we can even test alternative strategies to see if they work better. In all cases, we must religiously and rigorously monitor the system to ensure that changes are tracked in a timely manner and new knowledge is considered in decision-making.

The Plan

When completed, our plan will include our broad objectives, operational objectives, strategies, management measures, indicators, reference points, performance measures and decision rules, along with some background information about the fishery. It will also indicate the following (DENR et al, 2001):

1. Output (what will be produced or changed?);
2. Timeframe (over what period will each strategy be implemented?);
3. Who is responsible for implementation;
4. Who are the participants (whose cooperation is needed to effectively carry out this action?);
5. What are the funding sources (who will pay for the strategy?);
6. How progress and performance will be tracked and assessed; and
7. How the plan and related issues will be communicated to concerned stakeholders.

In addition to fishery-specific strategies, the plan may also contain general strategies that seek to remedy problems common to most municipal fisheries. Some of these strategies and the issues they address are shown in Table 5.7. They are usually included in the broader municipal CRM plan but may be reiterated in the fisheries management plan.

Suggested elements for a fisheries management plan under EAF are shown in Table 5.8.

Table 5.7. General strategies to address common problems in Philippine municipal fisheries (Adapted from DENR et al, 2001)

Problem	Applicable type of intervention	Suggested indicator
Use of destructive and illegal fishing methods and habitat destruction	Strengthen law enforcement Regulate distribution of materials used for destructive fishing methods Educate fishers about effects of destructive fishing Establish MPAs	Enforcement operations Incidence rate of destructive and illegal fishing Reef fish biomass inside and adjacent to MPAs; reef fish species richness inside and adjacent to MPAs; benthic condition inside MPAs
Weak law enforcement	Community participation and educationTraining	Community-based law enforcement teams formed and active
Development activities in coastal areas	Zone municipal waters	Zones established and enforced
Poverty	Provide alternative/supplemental livelihood	Fishing household income from alternative/supplemental livelihood
Conflict among fishers	Strengthen law enforcementDelineate municipal waters	Enforcement operationsOrdinance delineating municipal waters
High human population growth rate among fishing communities	Disseminate information on reproductive health and family planning Provide alternative/supplemental livelihood	Reproductive health plan adopted and integrated into municipal CRM and development planHouseholds availing of opportunities for alternative/ supplemental livelihood

Table 5.8. Suggested elements for a fisheries management plan under EAF (FAO, 2003)

TITLE

BACKGROUND
Social and institutional aspects
Area of operation of the fishery, jurisdiction and ecosystem "boundaries"
History of fishing and management
Social and economic benefits, both now and in the future
Description of stakeholders and their interests
Description of other uses/users of the ecosystem, especially activities that could have major impacts and arrangements for coordination and consultation processes
Consultation process leading to the plan
Ongoing consultative arrangements
Details of decision-making process, including recognized participants

Descriptions of fishing activity, resources and the ecosystem
Description of resource (target species and by-product)
Description of the aquatic ecosystem in which the fishery occurs
Description of fleet types or fishing categories

Ecological issues and challenges
Details of critical environments, particularly sensitive areas
Details of bycatch concerns including threatened/protected species
Details of other environmental concerns, including biodiversity and trophic changes

OBJECTIVES
Objectives, reference points and performance measures for the fishery

- Resource
- Environment (including bycatch, habitats, prey protection, biodiversity, etc.)
- Social
- Economic

MANAGEMENT MEASURES
Agreed measures for the regulation of fishing to meet all objectives within agreed time frame, including by-catch, habitat protection, prey protection, etc.

DECISION RULES
Pre-agreed rules for applying management measures

ACCESS RIGHTS
Nature of rights granted in the fishery and details of those holding the rights

EVALUATION OF MANAGEMENT
Most recent status of stocks including, critical by-catch species, based on risk and stock assessments using agreed indicators and performance measures
Status of the aquatic ecosystem, using agreed indicators relevant to essential and performance measures
Social and economic analyses using agreed indicators and performance measures

MONITORING, CONTROL AND SURVEILLANCE
Arrangements for ongoing monitoring, control, surveillance and enforcement

COMMUNICATION
Communication strategy
Details of any planned education and training of stakeholders

REVIEW
Date and nature of next review and audit of performance of management

Phase 3: Action Plan & Project Implementation

The test of our planning process is, of course, in the implementation of the plan. If we did our job well in Phases 1 and 2, Phase 3 has a good chance to succeed.

The management strategies and decision rules we identified in Phase 2 will feed into a regulatory process that consists of three components (Figure 5.15): 1) conceptualization of regulation; 2) formalization of regulation through legislation; and 3) enforcement. Relevant elements of the plan also feed into the municipal programming and budgeting cycle to ensure that the plan is integrated into the LGU's annual investment plan and that resources are made available to support enforcement and overall plan implementation.

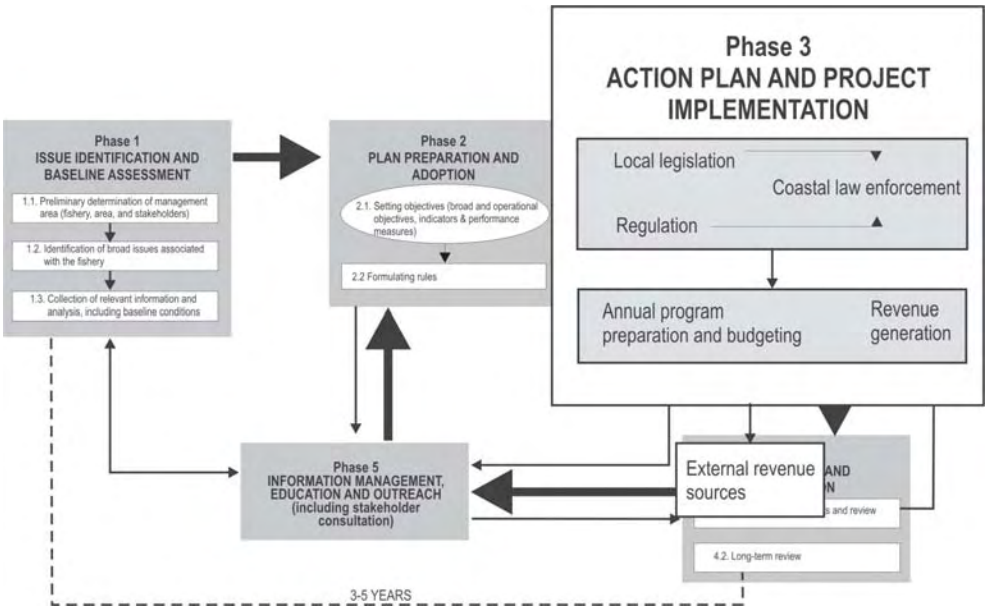


Figure 5.15. Fisheries management under EAF based on the Philippine CRM planning process, Phase 3. The management strategies and decision rules identified and adopted in Phase 2 will feed into Phase 3, Action Plan and Project Implementation (enlarged box above), which consists of (1) A regulatory process involving legislation, regulation and enforcement; and (2) Annual programming and budgeting.

As with most aspects of the planning process, Phase 3 should ideally involve stakeholder participation. Legislation (or rules) enacted through a genuine participatory process helps ensure the sustainability of an initiative beyond political terms (DENR et al, 2001). In addition, community participation and education have been proven to improve the enforcement of and compliance with fishery laws, rules and regulations.

LGUs would do well to invest in strengthening its enforcement capabilities by providing patrol and enforcement staff, or training local communities that benefit from management. Local communities tasked with enforcing the rules will also require some logistic support.

Phase 4: Monitoring & Evaluation

Phase 4 is the link that binds the different aspects of our planning process together. It is informed by and informs the other planning phases, telling us where we're at and how well our strategies are working relative to our operational and broad objectives (Figure 5.16).

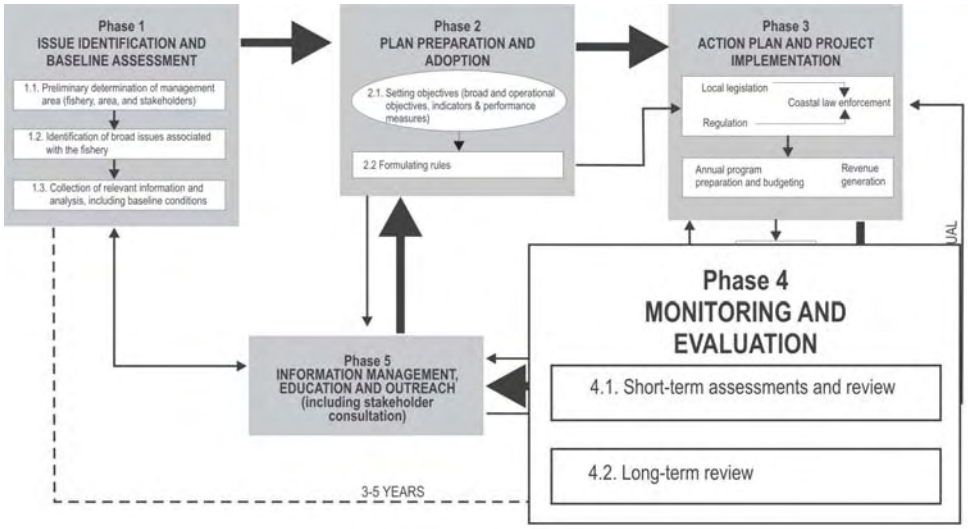


Figure 5.16. Fisheries management under EAF based on the Philippine CRM planning process, Phase 4. Phase 4, Monitoring and Evaluation, is informed by and informs the management process. It includes both short-term (annual) assessments and long-term reviews (3-5 years).

In order to track our progress toward our broader sustainable development goals, we must conduct both short-term and long-term reviews. These reviews will benefit from data that has been collected by an effective and well-directed monitoring program and analyzed by appropriate technical experts. They must be carried out in consultation with and should make regular reports to concerned stakeholder groups (FAO, 2003).

Short-term reviews would usually be part of our annual planning and programming cycle. When doing short-term reviews, we should assess species abundance and productivity of targeted resources, as well as the impacts of the fishery for other broader ecological, social and economic assessments.

The review process should be guided by our selected indicators and reference points, which are closely linked to our operational objectives, and use the same data collection methods employed during baseline assessment. To minimize variables, field assessments especially biological assessments should be conducted under conditions that are the same as or as similar as possible to those for the baselines. The indicator values, when compared against our reference points, will tell us whether or not we are on track toward achieving our operational objectives (Figure 5.13).

The review process should also include an evaluation of whether the longer-term broader objectives are being achieved. If the review shows we are not progressing as well as planned, we should be able to take appropriate action to keep the indicators on track, using the rules identified in our plan. If it produces unexpected results, there should be mechanisms to bring forward the longer-term review detailed below. In addition, the review should also consider whether monitoring is achieving the quantity and quality of data collection required for the regular updating of management measures. (FAO, 2003)

Longer-term reviews should be conducted on a regular basis, at an interval of between three and five years, depending on the dynamics of the species concerned and the utilization and management systems. Slower rates of change may permit longer intervals between reviews (FAO, 2003).

The whole point of M&E is to keep us informed about what is happening to, within and around the system that we are tasked to manage so that we are able to respond as necessary, in a timely and appropriate manner. Reviews should therefore take account of the full management arrangements, including data collection/resource monitoring, comprehensive re-assessment, reappraisal of decision rules and progress towards meeting longer-term objectives.

If we should find out during the review that an objective set earlier (for example, recovery to a certain target abundance level by a particular date) is no longer appropriate, or our societal objectives have changed, or there are flaws in the management system, then we should be able to adjust appropriately. Again, stakeholder participation should be encouraged. The system should allow for stakeholder groups to provide revised and agreed operational objectives and associated indicators and reference points when required (FAO, 2003).

Phase 5: Information Management, Education & Outreach

We have said time and again that the lack of information should not prevent us from taking precautionary action to address fisheries management concerns. But we also can never overestimate the value of information and data to fisheries management. It is therefore extremely important that, even if we start out having little information about our fisheries, we should take every effort and opportunity to build our knowledge base of each fishery under our care.

As fisheries managers, it is our responsibility to ensure that all information and data collected and related studies and analyses are kept and organized for easy retrieval and further analysis. Primary and secondary information and data are gathered throughout the planning process, from baseline data collection and participatory resource assessments through implementation to monitoring. These information and data – along with occasional research studies that may be done by the LGU or outside groups – should feed into an information management system that facilitates information and data storage, retrieval and analysis (Figure 5.17). Ideally, there should be provisions for our fisheries database to be

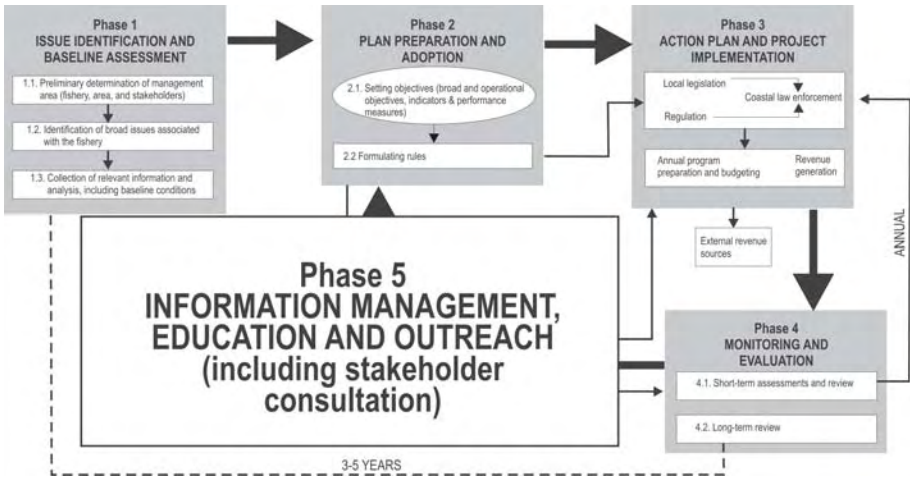


Figure 5.17. Fisheries management under EAF based on the Philippine CRM planning process, Phase 5. Phase 5, Information Management, Education and Outreach, is implemented throughout the management process to ensure that all information and data collected and related studies and analyses are kept and organized for easy retrieval and further analysis. It also helps ensure that stakeholders are kept informed of the program's progress and objectives and any adjustments that must be made to promote program success.

integrated into a bigger municipal coastal database that informs and is informed by our broader CRM system.

A fisheries (and CRM) information management system should (adapted from DENR, 2001):

1) Provide a common framework for LGU planning and M&E that can be used by the LGU to monitor and evaluate the implementation of fishery-related interventions;
2) Determine the current status of each fishery management system and related activities, including any information gaps;
3) Facilitate the collection of information for use in fisheries management planning; and
4) Provide a venue for LGU leaders and community groups to report to each other their accomplishments in managing their fishery/ies and identify concerns that they could commit to address together.

As fisheries managers, we recognize that fishers hold a large amount of information and knowledge about their fisheries and the ecosystem, and that not having their cooperation would make our job so much more difficult. The need for stakeholder cooperation and participation requires taking a truly inclusive approach to fisheries management, which in turn requires a strong education and outreach program that aims to promote stakeholders' understanding and acceptance of the importance of managing their fishery activities. Such program must consciously promote equitable participation by empowering stakeholders and building their capacity to get involved in fisheries governance and management.

In addition, there must be strong provisions for continuously building the LGU's capacity in fisheries management (and CRM), including regular trainings for fisheries staff, to ensure that we have the technical expertise available to address the ever-changing needs of fisheries management, especially under EAF.

Human resource development for fisheries management (and CRM) should cover the following areas of training, among other subjects (adapted from DENR et al, 2001):

1) Management and administration
2) Planning, problem solving, and decision-making
3) Participatory methods, facilitation and conflict resolution
4) Social mobilization and marketing
5) Proposal preparation and feasibility studies
6) Environmental impact assessment
7) Fisheries management and biology, including study of fishing gear and their ecosystem impacts
8) Coral reef ecology and management techniques
9) Mangrove forest ecology and management techniques
10) Legal and policy review and development
11) Coastal and fishery law enforcement
12) Information management, including computer skills and database management

REVIEW

1. The Philippine government has adopted ICM as a development framework. This should help facilitate our job as municipal fisheries managers because ICM is closely related to and highly compatible with the ecosystem approach that we are being encouraged to adopt in fisheries management.
2. Although we have not achieved the level of integration required for a truly functional ICM system, we have made some headway in institutionalizing a management process at the municipal level that emphasizes the integration of government and community (stakeholder participation) toward promoting sustainable coastal resource use. This process is commonly referred to in the Philippines as "coastal resource management" (CRM). It generally involves participatory planning, implementation and monitoring of sustainable uses of coastal resources through collective action and sound decision-making.
3. ICM – being a broader set of activities that underscore integration within government, non-government and environmental realms – encompasses CRM. CRM, in turn, encompasses any number of best practices that address and rationalize land use, water use, and socioeconomic development in the coastal zone and municipal waters. For most Philippine coastal LGUs, fisheries management is a priority concern of CRM.
4. The CRM planning process adapted for Philippine local governments consists of five phases:
   a. Phase 1: Issue identification and baseline assessment;
   b. Phase 2: Plan preparation and adoption;

   c. Phase 3: Action plan and program implementation
   d. Phase 4: Monitoring and evaluation; and
   e. Phase 5: Information management, education and outreach
5. In general, the planning process should have the following characteristics:
   a. It involves the active participation of key stakeholders;
   b. It contains relevant baseline information about human activities that impact the coastal environment;
   c. It is understood and supported by government officials, resource user groups, and other stakeholders;
   d. It is flexible enough to allow for adaption to changing socio-political conditions;
   e. It resolves conflicts and provides mechanisms to resolve potential conflicts among key stakeholders;
   f. It is organized to ensure a continuing management effort; and
   g. It is designed to promote measurable results over long-term (10-25 years), medium-term (5 years) and short-term time horizons (1 year).
6. With ICM as our framework and the CRM planning process as a platform for the integration of our management efforts, we have the basic ingredients to begin improving the management of our municipal fisheries. For many reasons, CRM has become the preferred process to solve fishery-related problems in the Philippines:
   a. Fisheries management does not imply managing every fishery by itself, but also involves managing institutions and people that affect the fishery. Collaboration between formal and non-formal institutions that affect fisheries is therefore an essential aspect of management;
   b. Given the increasing complexity of fishery-related issues, it has become necessary for fisheries managers to look beyond fish stocks as a management unit and consider the broader considerations of ecosystem approaches; and
   c. Traditional fisheries management strategies involve mostly reactive and stopgap measures, instant and often sectoral solutions conceived only to address a specific problem without regard to the broader physical and social environment that created the situation. CRM provides a more deliberate planning perspective that attempts to solve the underlying issues causing fishery decline.
7. *Every* fishery must have a well-formulated management plan. Ensuring that plans are developed and implemented for all fisheries helps to avoid planned management measures on one fishery creating unforeseen problems and externalities in a neighboring fishery for which no plan is available.
8. A fishery management plan is "a formal or informal arrangement between a fisheries management authority [e.g., the municipal or city LGU] and interested parties [e.g., the fishers] which identifies the partners in the fishery and their respective roles, details the agreed objectives for the fishery and specifies the management rules and regulations which apply to it, and provides other details about the fishery which are relevant to the task of the management authority."
9. By engaging the stakeholders in the process, we can address issues related to their capacity and commitment to participate in management. We must keep the process

transparent and provide formal and accountable arrangements to allow all parties to work collaboratively.

10. To be effective managers and allow for continuous improvement, we must have access to timely and reliable information at all stages in the management process, from policy and plan formulation through implementation to evaluating our progress and updating our policies and plans. Information management (Phase 5) is an important part of our planning process, which requires that we regularly monitor and evaluate our progress.
11. It is important to stress that immediate action should be based, as much as possible, on data and information that already exist. In many cases, we will have to rely more heavily on traditional knowledge about the ecosystem and the fishery that we can get and validate from interviews with local fishermen and other stakeholders. Knowledge about the local situation should be complemented by "the best available scientific advice", using information from ecologically similar situations in other places, if there is no such information about the fishery with which we are specifically concerned.

12. In dealing with data-poor management situations, we should be guided by the precautionary principle.
13. Fisheries management entails expense, so at the outset we should have some *initial funding* for our first few activities and a budget allocation — or at least the commitment of relevant authorities to provide adequate funding — for the preparation of the plan and its implementation.
14. The main purpose of Phase 1 is to gather and analyze information that we will need for decision-making. We can break this stage down into three steps:
    a. Preliminary determination of management area (fishery, area, and stakeholders)
    b. Identification of broad issues associated with the fishery; and

   c. Collection of relevant information, analysis of information and development of profile, including baseline conditions in the management area, ideally both ecological/biological and socio-economic conditions.

15. As a rule, we would define a fishery in terms of the "people involved, species or type of fish, area of water or seabed, method of fishing, class of boats, purpose of the activities, or a combination of the foregoing features."
16. EAF dictates that the spatial coverage of our management plan should coincide with the ecosystem associated with the fishery under consideration. In practice, the final choice of fishery or fisheries and geographic area would have to be determined when we know the issues that we are dealing with.
17. Stakeholder participation is important when we begin to evaluate the issues associated with our fishery or fisheries of concern. The lack of participation from some stakeholders should, however, not prevent us from starting our planning process. From a practical perspective, EAF recognizes existing fisheries management entities and jurisdictions and build incrementally on these.
18. When we reach an agreement on the issues that must be covered in the plan, we will compile and analyze relevant information to allow us to identify more specific issues and formulate more detailed objectives. The data and information, along with the issues earlier identified, will be analyzed to determine the interactions, geographical extent of impact, and baseline resource conditions of our target fishery or fisheries.
19. The information, data and analysis will be compiled in a fishery profile that will guide us during planning. In Phase 2, we will identify our goals and objectives in managing the target fishery, identify appropriate management measures, and develop strategies and an action plan. Phase 2 consists of the following steps:
    a. Identification of broad and operational objectives, and selection of indicators and reference points for each operational objective; and
    b. Formulation of rules.
20. The broad objectives for the fishery provide statements of the intended outcomes of the fishery management plan in addressing the set of issues identified in Phase 1. These broad objectives provide a link between the principles, policy goals, major issues and what a particular fishery is trying to achieve.
21. To implement EAF, we must translate our broad objectives into operational objectives that have direct and practical meaning in the context of the fishery, and could serve as a yardstick against which we can evaluate the performance of the fishery and its management. The process of developing operational objectives from the broad objectives should be transparent and participatory.
22. Throughout the process, we must continually keep in mind the following simple questions:
    a. Are current catches in the fishery sustainable and making good use of the resources?
    b. Are current fishing practices avoiding any damaging and irreversible impact on non-target species in the ecosystem?
    c. Are the current fishing activities having minimum practical impact on the physical habitat?

d. Are other non-fishing activities in the fishing grounds and in the supporting ecosystem being adequately managed to avoid damage and irreversible impact on the ecosystem, including the critical habitats?
e. Is the fishery being conducted in an economically responsible and efficient manner consistent with the economic goals and priorities of the country or local area?
f. Are those dependent on the fishery for income and livelihoods receiving appropriate, beneficial returns from their fishery-related activities?

23. In order to adequately describe the state of our resources and assess our progress toward our objectives, we will need appropriate indicators. At the fishery level, indicators provide an operational tool in fisheries management, as a bridge between objectives and management action. At the ecosystem level, indicators can provide us with information about not only the status of the fishery resources but also the non-target components of the ecosystem, as well as the overall "health" of the ecosystem.
24. Our choice of indicators will depend on our operational objectives. To interpret indicator changes, it is necessary to specify reference values that are either targets to be achieved or thresholds to be avoided.
25. If there is no experience or information that we can use to derive our reference points, we should be guided by the precautionary principle and initially set conservative targets or thresholds (which means stricter regulations or more stringent restrictions). They key is to promote stakeholder support by achieving demonstrable benefits within a fairly short time. Over time, as we gain knowledge about the system, we should be able to reduce uncertainties and refine our indicators and reference points accordingly.
26. We should have the capability of actually tracking and measuring our indicators, and we as well as other stakeholders should feel confident that the indicators are both meaningful and practicable.
27. Decision rules specify what management measure we should take under different conditions according to our indicators, targets and reference points, and how we should apply it. Even in data-poor situations, the best available information should be objectively analyzed and considered.
28. To better adapt to uncertainties, a decision rule should evolve and improve through time, based on feedback on the outcome of past years. To help reduce the level of uncertainty, we can also adjust management measures to take new data into account as they become available.
29. When done, our plan will include our broad objectives, operational objectives, strategies, management measures, indicators, reference points, performance measures and decision rules, along with some background information about the fishery. It will also indicate the following:
    a. What will be produced or changed;
    b. Over what period each strategy will be implemented;
    c. Who is responsible for implementation;
    d. Whose cooperation is needed to effectively carry out this action;
    e. What are the funding sources;
    f. How progress and performance will be tracked and assessed; and

g. How the plan and related issues will be communicated to concerned stakeholders.

30. Suggested elements for a fisheries management plan under EAF are shown in Table 5.10.
31. In Phase 3, the management strategies and decision rules we identified in Phase 2 will feed into a regulatory process that consists of three components:
    a. Conceptualization of regulation;
    b. Formalization of regulation through legislation; and
    c. Enforcement.
32. Relevant elements of the plan also feed into the municipal programming and budgeting cycle to ensure that the plan is integrated into the LGU's annual investment plan and that resources are made available to support enforcement and overall plan implementation.
33. Phase 4 (monitoring and evaluation) is the link that binds the different aspects of our planning process together. It is informed by and informs the other planning phases, telling us where we're at and how well our strategies are working relative to our operational and broad objectives.
34. In order to track our progress toward our broader sustainable development goals, we must conduct both short-term and long-term reviews. These reviews will benefit from data collected by an effective and well-directed monitoring program and analyzed by appropriate technical experts. They must be carried out in consultation with and should make regular reports to concerned stakeholder groups.
35. Primary and secondary information and data are gathered throughout the planning process, from baseline data collection and participatory resource assessments through implementation to monitoring. These information and data – along with occasional research studies that may be done by the LGU or outside groups – should feed into an information management system (Phase 5) that facilitates information and data storage, retrieval and analysis.

ADDITIONAL REFERENCES

Look up these resources in this *Sourcebook*'s companion CD, or follow the links provided:

1. FAO Technical Guidelines for Responsible Fisheries 4, Suppl. 2. Fisheries Management: The ecosystem approach to fisheries – *ftp://ftp.fao.org/docrep/fao/005/y4470e/y4470e00.pdf*
2. FAO Technical Guidelines for Responsible Fisheries: Indicators for sustainable development of marine capture fisheries – *http://www.fao.org/DOCREP/004/X3307E/X3307E00.HTM*
3. FAO Technical Guidelines for Responsible Fisheries: Fisheries management. 3. Managing fishing capacity – *ftp://ftp.fao.org/docrep/fao/011/i0318e/i0318e.pdf*
4. A Fishery Manager's Guidebook. Management measures and their applications. FAO Fisheries Technical Paper 424 — *ftp://ftp.fao.org/docrep/fao/004/y3427e/y3427e00.pdf*

5. Philippine Coastal Management Guidebook Series
    a. Coastal Management Orientation and Overview – *http://oneocean.org/download/db_files/crmguidebook1.pdf*
    b. Legal and Jurisdictional Framework for Coastal Management – *http://oneocean.org/download/db_files/crmguidebook2.pdf*
    c. Coastal Resource Management Planning – *http://oneocean.org/download/db_files/crmguidebook3.pdf*
    d. Involving Communities in Coastal Management – *http://oneocean.org/download/db_files/crmguidebook4.pdf*
    e. Managing Coastal Habitats and Marine Protected Areas – *http://oneocean.org/download/db_files/crmguidebook5.pdf*
    f. Managing Municipal Fisheries – *http://oneocean.org/download/db_files/crmguidebook6.pdf*
    g. Managing Impacts of Development in the Coastal Zone – *http://oneocean.org/download/db_files/crmguidebook7.pdf*
    h. Law Enforcement — *http://oneocean.org/download/db_files/crmguidebook8.pdf*

Chapter 6
Making It Happen

In This Chapter

- Identify actions that must be taken in the near and medium-term by responsible authorities to integrate fisheries management under EAF in the CRM planning process that has been adopted by many LGUs
- Look into what fisheries managers can do to jumpstart the fisheries management planning process

"All problems become smaller if you don't dodge them, but confront them."
— William F. Halsey, US Naval officer

Researchers have noted that "people have the most faith in a process that capitalizes on past institutional and monetary investments in fisheries management and marine conservation, rather than starting anew with radically new management models and field interventions (Christie et al, 2007)." We now have many management practices that are well-accepted among LGUs and fishing communities, including ***MPAs***, ***participatory coastal resource assessment (PCRA)***, ***IEC***, and ***coastal law enforcement***. We can use these as platform for managing fishing capacity, to hammer home the point that management and protection are good and, as difficult as they may seem at first, eventually result in more sustainable benefits for fishing communities.

But even as we reach out to and encourage fishers and other resource users to get involved, we must also make a conscious effort to build our capacity from within the LGU. Institutionally, the LGU has a number of things to do. First, it must adapt its legislative and regulatory systems to more effectively address the dynamic nature of fisheries management under EAF. Fishery conditions change constantly, so fisheries managers and institutions must have the flexibility and capacity to respond appropriately and timely to the changes when they occur.

Second, again, we must stress the importance of building into the LGU's governance system the information management functions necessary to inform and guide the management process. It is highly likely that, in the initial stages of managing its fisheries, the LGU would have little information to work with. But this does not mean that data and information would always be deficient. As data and information become available during the course of the management planning and implementation process, the LGU must be able to feed these into an efficient information management system that collects, stores, organizes and properly distributes and disseminates information where and when needed for sound management decisions to be made.

Third, limiting access and implementing appropriate systems of access rights are essential for successful and responsible fisheries (FAO, 2003). They must be supported by a sustained campaign to enforce fishery and related laws, rules and regulations, and educate stakeholders and the general public on the objectives of fisheries management in order to encourage compliance and self-regulation. These functions must be fully integrated into the LGU system, to ensure that they are permanently staffed, regularly funded, and thus exercised by responsible, accountable and properly (and continuously) trained personnel. Also, the LGU must be equipped to determine the most equitable and sustainable use of fishery and associated resources so that they can be appropriately allocated (through access rights) to qualified user groups. If necessary, it must consider provisions for alternative and supplemental livelihood for those who may be displaced by the enforcement of access limits.

Fourth, the LGU must institute a strong MCS system to ensure that fishery policy in general, and the conservation and management arrangements for specific fisheries in particular, are implemented fully and expeditiously (FAO, 2003). A good MCS should be able to address the wide range of concerns of our fisheries management system, including its non-fishery components. It will require provision and continuous training of enforcement staff, the participation of local communities, the use of technology, and therefore additional funding from the LGU or other sources.

Finally, a system must be instituted to allow the LGU to manage its fisheries from an ecosystem perspective. This can be accomplished to a limited extent by determining and addressing the possible ecosystem interactions of the various fisheries within an LGU's area of jurisdiction (i.e., the municipal water). To more effectively address ecosystem concerns, however, a mechanism for consultation and coordination must be provided between LGUs sharing the same resources. The ongoing effort to divide the country's marine waters into distinct ecosystem areas or FMUs (Chapter 4) could result in the establishment of ecosystem-

level management bodies composed of concerned LGUs, BFAR and other agencies and stakeholders. In the meantime, every LGU is a participant in various inter-LGU assemblies – it is in its interest to bring its fisheries management concerns to the attention of these bodies.

Individually, as municipal fisheries managers, we can begin by rigorously applying the tools that we now have, and by being proactive in acquiring the knowledge and skills that we do not yet have. As we pointed out in the previous chapters, even in data-poor and capacity-poor situations, there is always some place where we can start. Here are some basic first steps that we can take at the outset:

1. ***Identify the various direct and indirect uses and users of our fishery resources*** – This will help us understand better the issues we are dealing with. As well, it will give us an idea of the extent of our management area, and the range of stakeholders that we must engage in the management process. An inventory of all fishers and gear (including the illegal ones) would be useful. The LGU is required by law to maintain a registry of municipal fishers, vessels and gear – such registry, if already available, is a good source of information about the breadth of fishery uses and users that we must consider.
2. ***Classify the various fisheries for which we are responsible and determine preliminary ecological boundaries*** – This means categorizing into individual fisheries the various fishing activities happening within our area of jurisdiction, based mainly on their relative importance as an economic activity and their interactions with each other and rest of the ecosystem. Seek expert guidance if it's available. If it's not, begin with a tentative classification. We can adjust this as we gain more knowledge about our fisheries system.
3. ***Identify priority issues, ecological boundaries and possible management actions*** – High priority issues are usually the more obvious problem areas and top-of-mind concerns of the fishing community, so they should be easy to detect. Tackle them first, following the planning process prescribed for fisheries management under EAF, which emphasizes that, as well as the target species, ***ecosystem considerations*** (bycatch, discards, and habitats) be taken into account (Chapter 5). Again, we should not use lack of information as an excuse for delaying or not taking action. There are always remedies that will work if applied firmly and promptly. The precautionary principle should guide us in data-poor situations.

☞ p139

4. ***Establish a communication channel with our partners and stakeholders*** – Take every opportunity to consult with stakeholders, even if only informally at first. They know their fisheries, sometimes better than the experts. They can point us to problem areas and possible solutions. Talk to them — ask them about fishing, life, family. How's work? Do they think fishers are catching enough fish? Are their children going to school, eating well? How have things changed compared to the past? There are infinite gems of wisdom we can unearth from the locals' knowledge and insights on fish, fishing and life in general that we can apply in our work. Our interviews with fishers have provided a qualitative assessment of the state of fishery resources in our sites that proved to be quite accurate when validated against the more scientifically rigorous data-based assessment conducted by our fisheries experts. In another instance, a fish dealer provided the FISH Project detailed records of his

CRMP

Figure 6.1. Why keep records. Integral to good planning is the ability to access timely and accurate information to guide decision-making and track progress toward set goals. Good recordkeeping practices, supported by information management technology if available, are essential ingredients for a successful fisheries management program.

☞Appendix 3

transactions with fishers that proved valuable in our **study of the costs and benefits of CRM interventions in Ubay, Bohol** (Appendix 3).

5. ***Begin to set a common vision for fisheries management based on a relationship built on trust and cooperation with partners and stakeholders*** – Stakeholder cooperation is a key ingredient for success in fisheries management. It is therefore important that we reach an agreement with fishers and other stakeholders on the objectives of fisheries management, and what it may entail to achieve such objectives. Restrictions and regulations are part and parcel of fisheries management – to win stakeholder cooperation and promote compliance they must be presented by fisheries managers and accepted especially by fishers as vital measures to ensure that we are all able to enjoy the benefits we are currently getting from our fishery resources more fully and for far longer than we otherwise would without management.
6. ***Take prompt action*** – When the solutions are agreed upon, we are duty-bound to act with dispatch to enforce them, fairly and consistently. The solution may require simply the stronger enforcement of existing laws. Or it may require new rules, which ideally must be agreed upon by concerned stakeholders. But even where there is prior agreement from stakeholders on the rules and the manner by which they will be enforced, resistance in the initial stages of enforcement can be expected. Stakeholder consultations must continue to identify emerging issues, as well as to point out the benefits of management. Especially in data-poor situations that call for a precautionary approach, rules and regulations must be sufficiently rigorous and stringent to generate any benefits. It is therefore essential that stakeholders feel that they "own" the decision-making process and their cooperation or any information they provide is not being used against them.

7. ***Document, document, document*** – Take detailed notes, and keep meticulous records. Write down your observations of any changes in your management system, no matter how insignificant they may appear to be. We may start out data-poor, but with deliberate documentation and record-keeping, we can have a reliable and up-to-date information management system, perhaps within three years. A computer database application developed by the FISH Project can help LGUs manage their coastal and fisheries data, including their fishery registry. But don't let the lack of modern technology deter you from documenting your management efforts and establishing an information management system. Combined with a good filing system, the old pen-to-paper technology is still a reliable and trusty way of keeping our all-important fishery records.

Fully retrofitting the LGU for fisheries management under EAF will take time, commitment to serious capacity building, and considerable resources. But, as daunting as they may seem, we cannot allow institutional, informational and economic barriers to stop us from addressing the increasingly urgent issues threatening the sustainability of our municipal fisheries and the well-being of our coastal communities. For sure, there are many questions we cannot answer now, but we know enough to know we have to – and *can* – do something.

Now.

"Do it, fix it, try it."

— Thomas J. Peters & Robert H. Waterman, Jr.,
American authors

Appendices

Appendix 1. Impacts of Human Activities On the Coastal Zone

Source: DENR et al, 2001

Illegal activities

The destruction of coastal habitats and decline of fisheries are due to a large extent to the proliferation of illegal activities. While national policies and laws exist prohibiting a wide range of activities in coastal areas, without swift, painful, and public enforcement of these laws, illegal activities abound.

Examples of illegal and damaging activities that can be addressed by coastal management include:

- Use of destructive and illegal fishing methods such as blast fishing, poisons, superlights, *muro-ami*, and others;
- Intrusion of commercial fishing into municipal waters;
- Lack of observance of shoreline setback regulations resulting in damaging construction activities and development in the coastal zone;
- Conversion of mangrove and seagrass habitats to land or other uses resulting in decline of nearshore catch;
- Harvesting of banned species including corals, whale sharks, manta rays, giant clams, and endangered marine species; and
- Habitat destruction from other causes.

Illegal fishing methods, such as cyanide and blast fishing that are known to destroy or shatter the physical structure of the coral reef, create considerable losses to society (Figure 8). Here, the net private benefits from blast fishing are only about US$15,000 (net present value over 25 years for 1 sq km of reef). In contrast, the net present value of losses to society in terms of foregone coastal protection (US$193,000), fisheries (US$86,300), and tourism (US$482,000) is many times higher than the gain to the blast fisher(s) (Cesar 1996).

The impacts of illegal and destructive fishing practices on the environment are long-term and irreversible, with continuing reductions in net returns for all types of fishing methods. The loss in potential fish catch alone from a destroyed coral reef is shown in Figure A1.1. Enforcing prohibitions against dynamite and cyanide fishing and other illegal activities is an important part of the overall management challenge. While improved enforcement is critical, coastal management tools and processes must also be applied to reduce conflicts among fishers and other coastal stakeholders, restrict unsustainable fishing practices, and provide greater protection to habitats.

Respect for and obedience to the law needs to be promoted and become accepted as an important means to improve the status and productivity of coastal ecosystems. Fisheries will improve significantly if illegal fishing is stopped! Public education and better enforcement are two strategies that have proven to be effective.

Although it is not common knowledge, the foreshore areas from mean high tide to 40m inland are protected by law and are reserved as open access space where no building or private ownership is allowed. This law is not being enforced, but it should be in the near future to prevent overcrowding and environmental degradation in foreshore areas. In fact, private control over beach and foreshore areas has increased to the point that oceanfront and beach access is limited within or near most urban centers.

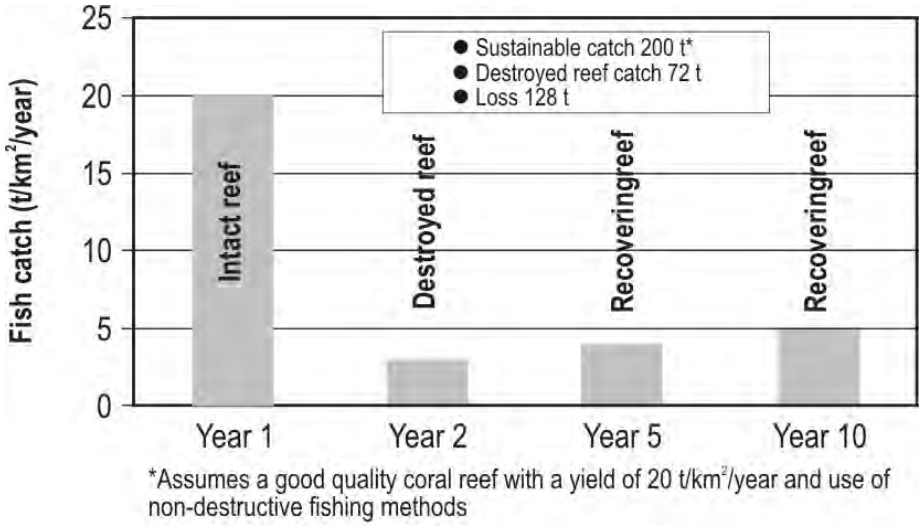


Figure A1.1. Fish yield decline and loss on a destroyed and recovering coral reef over 10 years (Alcala and Gomez 1979; White 1987; White and Cruz-Trinidad 1998)

Fishing

The impacts of removing fish stocks from the marine ecosystem do not end with that particular resource alone. Given the interconnectedness of resource systems by way of the food web or trophic level, the reduction or loss of a resource may have direct and non-direct impacts on the ecosystem as a whole. For instance, non-target species or non-target sizes of the desired catch may still end up as ***by-catch*** in fishing operations, or get injured and die from contact with the fishing gear underwater (***incidental mortality***).

Alterations in predator-prey relationships could lead to shifts not only in relative dominance of certain populations or trophic levels, but also changes in overall species composition or decrease in species richness. The decline in populations of fish groups that act either as predator or competitor to other organisms can result in population explosions of "pest" organisms. Examples are: algal overgrowth usually in areas where herbivorous fishes are intensely fished; the explosion of sea urchin populations where reef fishes are overharvested (no predator and competition); and outbreaks of crown of thorns, *Acanthaster* in reefs where natural predators of these pests have been overfished. In turn these "pests" hinder the settlement, survival and growth of corals (Potts, 1977);

Equally significant are the effects of overfishing on marine ecosystems that may serve as habitats, feeding grounds, and spawning or nursery areas for the different fishery resources. Alterations or modifications to these features may cause a series of direct impacts to fish populations such as disrupted life cycles, diminished food availability, loss of shelter, and increased susceptibility to stresses such as natural predators and fishing. Consequently, populations of groups directly affected soon decline, which in turn may trigger a progression of other unintended ecosystem effects such as loss of closely interdependent groups, decrease in biodiversity, and reduced total system productivity. In short, the system will not be able to support sustained fisheries yields in the long run (Armada, 2004).

Aquaculture development

The primary impacts of concern in the Philippines related to aquaculture development are the conversion of coastal ecosystems, primarily mangrove, to fish or shrimp ponds. This activity alone has replaced more than 60 percent of the original mangrove forest in the country. Another significant impact results from various kinds of pollution generated by aquaculture because it is essentially a farming system that uses fertilizer, feeds, and chemicals. In concentrated form, they are detrimental to nearshore water quality, natural fisheries, and human health (Pullin *et al.* 1993).

Foreshore land use and development

Coastal areas all over the Philippines are being developed rapidly since people like to live and do business near the sea. The consequence is that beaches and foreshore land areas are in demand and are being utilized for industry, construction, dumping, boat landings, recreation, habitation, and many other uses.

- Inadequately regulated foreshore development has resulted in several issues:
- Inadequate development setbacks from the water line. Adequate setbacks are essential to create an open space for access, to minimize negative impacts on the nearshore marine systems such as reefs and seagrass beds, to minimize erosion caused by structures on the beach, to better control what is dumped into the sea, and to create a visually attractive area, uncluttered with haphazard development, as a transition area to the sea (Sullivan *et al*. 1995);
- Increased pollution in nearshore waters that often emanates from shoreline areas where there is a lack of control on activities. Domestic waste generated in shoreline communities all goes to the sea. Septic systems constructed too close to the beach drain to the sea and pollute the nearshore areas, especially in densely populated areas**.** Dumping of solid waste in nearshore areas is a related problem. Construction activities near the beach and sea often cause silt to wash into marine waters and smother reefs and seagrasses or affect nearshore fisheries;
- Erosion of beach sand, usually resulting from the construction of structures on or near the beach. Although sandy beaches will normally replenish themselves after a storm, once a beach wall or perpendicular jetty is in place, the natural movement and return of the sand is prevented (Maragos *et al.* 1983). Thus there is a need to control all construction in the foreshore areas. Examples of this problem can easily be seen along developed shorelines such as on Mactan Island or in Lingayen Gulf, where natural beaches have disappeared; and
- Squatting and illegal structures in the foreshore areas. Such settlements are difficult to eradicate because the squatters are usually aware that their presence is illegal so they try to minimize opportunities for arrest and are adept at making excuses about why they are there. Squatters in particular have the excuse that they are poor, landless people with few alternatives. Unfortunately, the continued prevalence of squatting only encourages more people to do the same, mostly to the detriment of foreshore and beach areas and any hope of environmental integrity.

Coastal habitat conversion and land filling

The competition for space in coastal areas is encouraging more projects designed to create new, usable land by converting coastal habitats such as estuaries, shallow reef flats, beaches, and mangroves to other uses through land filling. Several large and well-known reclamation areas in the Philippines are located in the urban centers of Manila and Cebu. The economic justification for these is strong given the tremendous need for quality land for urban expansion and renewal. However, these land reclamation efforts should be viewed as exceptions. There is often little justification to fill a coastal habitat because reefs, mangroves, and seagrasses are naturally valuable and their existence is finite. For every square meter of seagrass bed destroyed, we lose a lifetime of natural production of invertebrates and fish that feed many people and support their livelihood (Fortes 1989). Whenever an area is lost to human encroachment, it will never return and can never be recreated somewhere else. In short, the implications of habitat conversion and land filling are:

- Total and permanent loss of the natural habitats and their ecological and economic functions;
- Permanent decreases in localized fish catch and traditional livelihood opportunities for society's most economically vulnerable;
- Significant pollution in the form of sediments that can spread for many square kilometers and last for years after the construction is completed
- The potential for increased risk of sinking and flooding; and
- The potential for disrupted drainage patterns that will change the natural mixing of fresh water and sea water and thus affect marine organisms not tolerant of fresh water.

Mining and quarrying

Mining and quarrying in coastal areas of the Philippines are subject to environmental impact assessment in all cases. Nevertheless, these activities continue illegally, without proper assessments, in many areas as small-scale and sometimes large operations. Upland mining is regulated but can have well-known impacts in coastal areas such as the mine tailing spill in Marinduque Island that smothered several square kilometers of seagrass beds and polluted the waters along kilometers of coastline. Coastal mining, which is the primary concern here, has impacts that are not always obvious but can significantly change shoreline dynamics and beaches if not properly regulated. The mining activities and their most important impacts are:

- Sand mining from beaches causes beach erosion and eventual disappearance of the beach. All white-sand beaches in the Philippines are generated from the natural erosion of reef corals and shells which, when deposited on a beach, are ground into sand. The rate of beach formation is slow; mining of beach sand removes a finite resource that takes hundreds to thousands of years to rebuild through natural processes;
- Sand mining from submerged reef or sandy areas stirs up silt in the water column and changes water-flow patterns. Also, the sand removed from a submerged area can easily be part of a yearly wave and current cycle that places the sand on the beach for part of the year and under the water for another part of the year. The obvious result of sand mining is that the beach will not return during the next cycle; and
- Mining for any material in a foreshore area always causes some polluting silt and runoff material that smother nearshore habitats.

Tourism development

Tourism-related activities in the coastal zone are increasingly common in the Philippines. The coastal areas and all their resources are one of the primary attractions for tourists. Most people come for a beach, swimming or scuba-diving holiday or some variation of this theme. Consequently, the amount of economic development supported by tourism, including resorts, shorefront developments, roads, boating, and diving, has escalated in recent years. The lack of planning in much of the tourism sector is a major issue and is causing many problems. Although it is in the interest of tourism developers to maintain the environmental quality most tourists come to enjoy, the opposite is occurring in many instances. Good intentions in the tourism sector are not an adequate replacement for good planning and the anticipation of irreversible environmental impacts.

The most common impacts are not much different from those discussed above in sections on pollution, foreshore development, mining, and others that involve construction in beach and shoreline areas. The unique impact of tourism is more related to certain forms of recreation that cause both biophysical damage to the environment and social disruption within the communities where tourism flourishes. The recent introduction of motorized recreation vehicles, such as jet skis and speedboats, has added new dimensions to the need for regulation in shore areas. The age-old problems of social corruption and prostitution associated with tourism can only change with better education and planning, and most of all, marketing tourism for the country in a manner that attracts “eco-friendly” tourists.

Appendix 2. Various Aquaculture Systems, Their Impacts & Benefits

System	Potential impacts and problems	Benefits
Extensive		
Seaweed culture	May occupy formerly pristine reefs; rough weather losses; market competition; conflicts/failures, social disruption	Income; employment; foreign exchange
Coastal bivalve culture (mussels, oysters, clams, cockles)	Public health risks and consumer resistance (microbial diseases, red tides, industrial pollution); rough water losses; seed shortages; market competition especially for export produce; failures, social disruption	Income; employment; foreign exchange; directly improved nutrition
Coastal fishponds (mullets, milkfish, shrimps, tilapias)	Destruction of ecosystems, especially mangroves, increasingly non-competitive with more intensive systems; non-sustainable with high population growth; conflicts/failures, social disruption	Income; employment; foreign exchange (shrimps); directly improved nutrition
Pen and cage culture in eutrophic waters and/or on rich benthos (carps, catfish, milkfish, tilapias)	Exclusion of traditional fishers; navigational hazards; conflicts, social disruption; management difficulties; wood consumption	Income; employment; directly improved nutrition
Semi-intensive		
Fresh- and brackishwater ponds (shrimps and prawns; carps, catfish, milkfish, mullets, tilapias)	Freshwater: health risks to farm workers from water-borne diseases. Brackishwater: salinization/ acidification of soils/ aquifer. Both: market competition, especially for export produce; feed and fertilizer availability/prices; conflicts/ failures, social disruption	Income; employment; foreign exchange (shrimps and prawns); directly improved nutrition
Integrated agriculture-aquaculture (rice-fish; vegetables-fish, and all combinations of these)	As freshwater above, plus possible consumer resistance to excreta-fed produce; competition from other users of inputs such as livestock excreta and cereal brans; toxic substances in livestock fees (e.g., heavy metals) may accumulate in pond sediments and fish; pesticides may accumulate in fish	Income; employment; directly improved nutrition; synergistic interactions between crop, livestock, vegetable and fish components; recycles on-farm residues and other cheap resources
Sewage-fish culture (waste treatment ponds; latrine wastes and septage used as pond inputs; fish cages in wastewater channel)	Possible health risks to farm workers and consumers; consumer resistance to produce	Income; employment; directly improved nutrition; turns waste disposal liabilities into productive assets
Cage and pen culture, especially in eutrophic waters or on rich benthos (carps, catfish, milkfish, tilapias)	As extensive cage and pen systems above	Income; employment; directly improved nutrition
Intensive		
Freshwater, brackishwater and marine ponds (shrimps and prawns; fish, especially carnivores -- catfish, snake-heads, groupers, seabass, etc.)	Effluents/drainage high in BOD and suspended solids; market competition, especially for export produce; conflicts/ failures, social disruption; consumption of wood and other materials	Income; employment; foreign exchange
Freshwater, brackishwater and marine cage and pen culture (finfish, especially carnivores -- groupers, seabass, etc. -- but also some omnivores, such as common carp)	Accumulation of anoxic sediments below cages due to fecal and waste feed buildup; market competition, especially for export produce; conflicts/failures, social disruption; consumption of wood and other materials	Income; foreign exchange (high priced carnivores); a little employment
Other — raceways, silos, tanks, etc.	Effluents/drainage high in BOD and suspended solids; many location-specific problems	Income; foreign exchange; a little employment

Appendix 3. Developing A Framework For Economic Analysis Of CRM Investments: The Case Of Ubay, Bohol

By Rina Maria P. Rosales, September 2008

INTRODUCTION

The archipelagic state of the Philippines calls for the management of coastal and marine resources to form a major part of economic planning and environmental management. To date, more than half of the country's population is living in coastal areas, and a great number of these coastal municipalities and cities contain the poorer sections of Philippine society. In recent island-wide workshops for the formulation of the Philippine Plan of Action for the Coral Triangle Initiative, numerous issues and concerns have been raised in the realm of CRM: overfishing, destructive methods of fishing, overpopulation, poor ecosystem management, weak enforcement, and low institutional capacities to name a few. With the recent event of climate change, the need to speed up and invest in CRM activities, both for mitigation and adaption purposes has become more pronounced than ever.

Coral reefs have always been subject to stresses borne from human activities. Increasing demand for marine-based products due to increasing population and economic development has led to environmental degradation that usually takes the form of loss of live coral, mangrove areas and seagrass beds as well as continuing decline in fish stocks. On the positive side, coral reefs are said to have a "*remarkable long-term resilience to such stresses, and can and do recover from even the most devastating impacts*" (Ruitenbeek, 1999). The issue though is not so much whether the ecosystems will recover, rather what is the time scale involved for them to recover, and what opportunity costs do they impose on populations dependent on the coral reefs. For instance, MPAs which are enforced to enable coral reefs to recover will have short-term opportunity costs on subsistence and commercial fisheries, and can quickly undermine economic stability (Ruitenbeek, 1999). On the other hand, long-term benefits from MPAs have been recorded and acknowledged in the scientific literature, and should therefore be taken into account when making decisions on whether to pursue CRM or not.

Ubay, Bohol is one of the few municipalities in the Philippines where CRM has reached a relatively advanced stage. The municipal government has made significant strides in enforcing its very own Fishery Ordinance, which in turn draws heavily from RA 8550 otherwise. Aside from the creation of a coastal law enforcement team and having a separate building and office purely for CRM operations, the LGU has ensured annual budgets are dedicated to running its CRM office and pursuing its CRM Plan. Bantay Dagat operations are all internalized in LGU expenditures. The provincial government of Bohol is equally serious in investing in environmental management, and has funded some of the CRM expenditures of Ubay. The USAID-funded FISH Project has provided the municipal government workers with numerous training opportunities, all of which have been put to good use with improved enforcement operations. MPAs have been established, some by the foreign-funded FISH Project and Project Seahorse, some by the LGUs themselves. Against this backdrop, the LGU now wants to take a step back and see whether there have been any tangible and measurable benefits that have redounded back to the municipality attributable to the expenses they have incurred in pursuit of CRM.

This report has seven parts. The next part outlines the objectives of the study, followed by a brief description of the situation in Ubay, Bohol. The fourth part discusses the proposed framework for assessing CRM investments of the LGU. It proposes two types of analyses: economic and financial, and provides caveats to the use of the framework. The fifth part provides results of using the framework with the available data collected from the municipal LGU and from the FISH database. The sixth part enumerates the data gaps that may be addressed to allow for a full-blown economic analysis to be conducted later on. Finally, the study concludes with recommendations on how to take the study forward.

OBJECTIVES

The study aims to develop a framework for economic analysis that will show the costs and benefits of CRM interventions in the municipality of Ubay, Bohol. Where data is available, actual costs and benefits will be estimated. If there are components of the framework that do not have data existing at the municipality, these will be taken note of. How to address the gaps will form part of the recommendations of the study.

UBAY CRM PLAN & IMPLEMENTATION

Ubay is a first class municipality located in the province of Bohol. It lies on the north-eastern part of the mainland and has a total land area of almost 30,000 ha and 59.47 km coastline. Municipal waters cover 20,296 ha. Population in 2000 reached almost 60,000, with an annual average growth rate of 3.35%. Twenty of its 36 barangays have coastlines and are occupied by 51% of the population (Ubay CRM Plan, 2006). Results of a rapid survey conducted earlier reveal that majority of the population had very few years spent for education. As a consequence, only a small percentage had limited income opportunities outside fishing. 68% relied solely on fishing for livelihood, while 14% engaged in both fishing and farming. Income was expectedly low, with 85% of the survey respondents earning below Php 5,000 a month (Ubay CRM Plan, 2006). Addressing short- and long-term considerations of municipal fishing becomes a great challenge for the LGU of Ubay.

Ubay is considered as one of the more progressive municipalities in the country in the realm of CRM. It has established a separate office that addresses CRM issues, complete with a separate building and staff fully funded by the municipal Mayor's Office. A CRM Plan was formulated and completed in 2006, with assistance from the FISH Project. It incorporates the elements of ICM, wherein land-based strategies are interlinked with sea-based strategies, falling under the following general management programs:

1. Fisheries Management
2. Coastal Law Enforcement Program
3. Habitat Management
4. Shoreline Management
5. Coastal Tourism Management
6. Watershed Management
7. Solid Waste Management
8. Legal Arrangements and Institutional Development
9. Reproductive Health Program
10. Livelihood Development

Habitat management forms a major part of the CRM Plan of the municipality. Mangrove rehabilitation is recognized as an important activity, with only a total of 1,824.53 ha of forest cover left. Mangrove conversion for fishponds has been recorded at 1,141 ha (Ubay CRM Plan, 2006). According to expert opinion, there should be a 4:1 ratio between mangrove forest cover and fishponds (Primavera, J. 2008). A rehabilitation project in Barangay Tipolo was undertaken through a Community-Based Forest Management Agreement. Project Seahorse, a foreign-funded project, has likewise extended their assistance in mangrove reforestation in other barangays. Expansion of larger rehabilitation areas is a target of the CRM Plan by 2010. A MOA was recently signed by the LGU with DENR on co-management of mangrove areas, which hopefully translates to sharing of expenditures as well.

Shoreline and seagrass bed management are mentioned as major strategies in the CRM Plan, although there are no concrete programs lined up for meeting the targets. Seagrass beds were assessed to contain 64% cover, and the substrates where these are found were generally in muddy, sandy or rocky surfaces (Ubay CRM Plan, 2006). Similarly, strategies for coastal tourism, watershed and solid waste management have yet to be translated into concrete projects and action plans.

As far as coral reefs are concerned, the LGU has focused its CRM expenditures for their rehabilitation and management. Live hard and soft coral covers registered low averages at 23.2% and 11.2%, respectively due to destructive fishing methods practiced over the years. Fish catch is said to have declined by 80% to 90% starting in the early 1990s to early 2004 (Bernales, 2008). During the decade of the 90s, efforts to control illegal fishing were initiated, but national enforcement agencies were allegedly not cooperating then. There was a strong clamor for government to intervene as the local population started feeling the negative impacts of marine environmental degradation. CRM was then initiated in the late 1990s under the auspices of both the municipal and provincial LGUs, strengthening their efforts in 2004 by institutionalizing CRM through a separate office and the creation of a municipal law enforcement team.

Save for the coastal clean-up and mangrove rehabilitation project in Barangay Tipolo, all LGU expenses have been geared towards coral reef and fisheries management. Enforcement of fishing rules and regulations takes the largest share of the budget. Most of the equipment required for patrolling and

surveillance have been purchased and provided by the LGU. Boats, communication equipment, safety devices, direct operational needs (e.g. gasoline and boat maintenance) and food for patrolling are regularly supplied to Bantay Dagat volunteers. Trainings for enforcement teams have been provided mostly by the USAID-funded FISH Project. On the other hand, MPAs have been established through joint efforts of FISH, Project Seahorse and the local governments of Bohol. As far as manpower is concerned, there is an adequate number of fishers who volunteer their time and effort together with permanent PNP personnel detailed in the area. Although not explicitly stated, the allowances provided do not appear adequate to fully compensate for the opportunity costs of the fishers who dedicate their time to patrolling. But then again, they may be valuing the benefits on a more non-monetary and longer-term period than a direct compensation in the form of a larger allowance or salary.

The LGU has provided livelihood assistance to a number of its constituents through the establishment of fish cages and fish corrals. To date, there are three fish cages that have been set up for three POs (with an estimated average of 25 members each) in separate barangays in Ubay. DA-BFAR, through its Ubay Brackishwater Fish Farm Station has provided the technology and fingerlings for establishing the cages. Capital outlay amounting to Php100,000 for each cage came from the provincial LGU, the municipal LGU and from BFAR. What is interesting about the financial assistance provided is that the PO is expected to repay the capital cost after two cropping periods, which in turn will be used to lend assistance to another PO.

Institutional development has been clearly demonstrated through the creation of the CRM office and the inclusion of enforcement operations in the regular budget of the LGU. Sustainable financing sources are being pursued through the creation of the CRM Office Trust Fund through Ubay E.O. 06-08. The E.O. mandates that 30% of all revenues sourced from the use of municipal waters and its resources, including fines and penalties, be dedicated to the use of the CRM Office. Ideally, this should have been larger, since it would be justifiable to allocate most, if not all revenues of that nature for the implementation of the CRM Plan. Nevertheless, it is a progressive step in principle, and should be replicated in other coastal municipalities throughout the country.

Finally, reproductive health is actively being implemented in Ubay. The population-environment link is acknowledged in the Plan, and there are clear strategies on how to pursue objectives of reducing population growth rates, safe sex and responsible parenthood. PATH Philippines has been active in assisting the LGU in this domain, and there is anecdotal evidence that their efforts are being replicated in neighboring barangays which PATH did not initially target as pilot sites. Local residents allegedly blame overpopulation for the unsustainable increase in demand for fish, which consequently led to overfishing and the use of destructive fishing methods. There is thus an incentive to reduce population growth rates to reduce the pressure on coastal resources in their municipality. The same linkage is being propagated by the CRM Office as part of their IEC campaign.

FRAMEWORK FOR ANALYSIS

Two types of analysis will be used to assess the impacts of CRM investments in Ubay, Bohol. Although they are related, they show two distinct sets of benefits. The framework for economic analysis can be used for measuring benefits that accrue to society as a whole. It goes beyond financial revenues and takes account of non-market goods or non-monetary benefits that accrue to humans, many of which contribute to improving human well-being. However, it abstracts from government revenues. In classical economic analysis, government revenues are treated as transfers, thus are not considered as adding economic value for goods and services in principle.

On the other hand, the framework for financial analysis is useful if one wishes to focus on financial revenues and costs that accrue to the local government alone. It provides a rough balance sheet for local government finances in the context of CRM on a short-term basis. In the long run though, the essence of government spending should be seen in terms of economic benefits that accrue towards society. Their mandate is to manage public goods and ensure the equitable distribution of benefits that ensue from their use. CRM expenditures should not be viewed as a source of LGU revenue that progresses or is sustainable through time. The investments should be viewed as providing benefits that may or may not be monetary, and should be spread as equitably as possible to the LGU's constituents over the long run.

Economic Analysis

Benefits from Marine Resources

There are many ways in which humans utilize coastal resources. Some people primarily rely on the marine environment for their main source of livelihood. Among these people, some use traditional methods of extraction, while others have ventured into the use of more aggressive methods and gear. Coral reefs, mangroves and seagrass beds provide nurseries and habitats for many of these aquatic resources we extract. Still, there are some people who utilize coastal resources for recreational purposes, while some are interested in conducting research for scientific and information purposes. Local residents who live in coastal areas and lowlands are dependent on the capacity of marine ecosystems to protect their houses from potential floods that storms bring, as well as on the capacity of watersheds to regulate the amount of soil eroding from the uplands due to natural occurrences and man-made activities. Our coastal waters have long been the recipient of human waste, and we constantly rely on its capacity to absorb and treat waste without sacrificing water quality in the long-term. Some industries use coastal resources and its waters as direct inputs to production, thus contributing significantly to the total value of the final product. With the advent of climate change, scientists are trying to estimate how much carbon is actually being sequestered by coral reefs and other marine organisms, in order to determine how much these resources are contributing to climate regulation. Finally, there are still potentially yet undiscovered medicinal uses of marine resources which may be used later on for drug development against diseases that afflict humans. Recently, certain discoveries have been made with a particular marine organism that are said to be able to combat diabetes and cancer. The impacts of these discoveries on disease control can thus be tremendous.

There are benefits associated with each type of use. The most obvious of these would be production of fish and related resources which are directly used for consumption and livelihoods. Measurement of such benefits is pretty straightforward due to the presence of market prices for each of these goods. The value of such benefits is equal to the price of the goods multiplied by the quantity consumed. Complications arise when some benefits and costs cannot be expressed in the same straightforward manner. These occur when the goods (and services) in question are what are termed as non-market goods, i.e. there are no market prices existing to reflect their economic value to society. Because they do not have market prices, they are treated as free goods with no accompanying costs in using them. Yet the very presence of conflicts and scarcity produces a positive value for such goods and services. On the other hand, there are costs involved when the use of one group precludes the use of others. In the latter case, opportunity costs are said to be incurred. And because many of these resources are located in the public domain, the costs are borne by the public in general.

Costs of Protection

The growing number of MPAs has attested to the increasing scarcity of natural resources in the marine sector due to the increasing number and intensity of resource use conflicts. The management of these MPAs itself is a direct cost which society bears. Government resources are allocated for MPA management which in turn decreases the amount of resources that could be used for other government priorities. Despite that, government recognizes the need to establish and manage MPAs because of the welfare gains that society gets from doing so. In other words, there are benefits that are perceived to outweigh the maintenance and operating costs of environmental protection.

The establishment of MPAs also imposes opportunity costs to groups of users who have traditionally used the resources without any restrictions in the past. Many of these affected groups are those that reside within or near MPAs and most of the benefits they have enjoyed make up a significant proportion of their livelihoods. The imposition of regulations and limitations in resource use most probably would have caused negative impacts on their well-being thus offsetting a proportion of society's welfare gains. In assessing the total impact of MPAs, it will be vital to identify what the benefits and costs are, and to whom will each of them accrue.

Total Economic Value

In conducting an economic analysis of CRM investments in Ubay, the total economic valuation (TEV) framework is proposed as the main tool of analysis. TEV is defined as the sum of all direct, indirect and non-use values of the study site, including all natural goods and environmental services that benefit humans.

Direct uses are made up of environmental goods and services that directly benefit humans, such as:

- harvesting of seafood for food, decor, curios, aquariums, and other goods for direct consumption
- mariculture
- sand mining and quarrying
- tourism or recreational services, such as snorkeling and scuba diving
- education and scientific research

Indirect uses are made up of ecological functions of marine ecosystems which are essential for human survival, such as:

- Provision of nurseries and habitat for breeding, spawning and foraging of marine organisms
- Gas and climate regulation, e.g. carbon sequestration functions of corals and phytoplanktons
- Disturbance prevention and alleviation, e.g. coral reefs and breakwaters that provide coastal protection
- Bioremediation of waste, e.g. using marine waters as receptacles of human waste
- Nutrient cycling for primary production
- Resilience and resistance, e.g. sandy beaches and dunes that support complex ecosystems

Non-use values are made up of option values, existence values and bequest values. Even if there is no immediate or planned use of such resources, positive values are still attached to them. Option values are derived from the potential to provide direct and indirect uses for humans later on. For instance, marine resources have become vast sources of information for medical, agricultural and industrial uses. Keeping them intact provides humans the option to make such discoveries in the future. Existence values emanate from the desire of humans to keep the resource in existence for humanity as a whole, and bequest values refer to the desire to protect resources for future generations.

In all valuation techniques that have been used, the concept of "willingness to pay" (WTP) is present. WTP represents the costs to the user of the natural goods or service, in order to derive the benefits from such use. It is measured either by actual monetary payments, or sometimes by implicit payments through other costs incurred in the use of the natural resource in question. They can be payments that do not involve money directly, nevertheless are costs on the part of the user, such as time or own labor. In measuring WTP, complications arise when what is being valued is a non-market good or service, i.e. no market price exists. This is particularly true for indirect and non-use values in the equation. Various techniques in environmental economics have been used to come up with estimates of WTP for such non-market goods and services.

The TEV framework will be applied mostly to the coral reef ecosystem. To date, most expenditures of the LGU have been geared towards management of coral reefs and fishing practices. It will be difficult to attribute indirect and non-use benefits from mangroves and seagrass beds emanating from such investments. Estimation of most benefits will in effect be focused on coral reefs only.

Benefit-Cost Analysis

Ideally, to estimate the marginal effects of CRM investments, a "with and without" or "before and after" analysis should be conducted. In other words, the value of resources with and without CRM investments, or before and after investments were poured in, should be estimated. Following is a description of the marginal benefits to be valued and a general description of the data sources.

A. Increased Fish Catch from Legal Methods

Increases in fish catch would constitute direct use values or direct benefits that accrue to the fishing population of Ubay in general. For increases in fish catch, the current data available at the Ubay CRM office are not very clear cut to determine exactly when there was an increase in benefits due to CRM investments. There is no baseline data existing for periods when CRM expenditures were not yet part of local government budgets. In the absence of a clear baseline scenario, 2004 data from the fish catch monitoring survey will be used as the base figures. It is assumed that investments may have been made prior to 2004, but actual impacts were only realized after a year or two of fully enforcing fishing rules starting in 2004.

To validate the data from fish landings, annual purchases of a fish broker in Bgy. Humay-humay for three years will be collated. The hypothesis is that there would be an increase in the volume of fish catch being sold to brokers, and there will be a shift from lower valued fish species to higher valued species being caught in some parts of Ubay. These values will then be compared to the estimates from fish landing data. They should however not be added up to avoid double-counting errors.

Note that the figures used are gross values hence do not represent resource rent estimates. If a survey can be undertaken later on to determine excess profit, the figures can be adjusted to better reflect rent estimates. Nevertheless, the gross values can initially be used to demonstrate the increase in benefits brought about by enforcement investments.

B. Damages Avoided From Destructive Fishing Methods

The previous section on TEV described the various ecological services and non-use values that humans derive from marine ecosystems. Although it would have been ideal to estimate values for each TEV component, there are no data existing to perform such a task. In lieu of this, other indicators will be used to measure the increase in ecological services brought about by a decrease in damages arising from destructive methods of fishing and the increase in coral cover due to the establishment of MPAs.

A "with and without" scenario will be inferred for estimating damages from illegal and destructive fishing methods, but a lot of assumptions will be made to capture the baseline and current scenarios. Without enforcement, blast fishing would have continued unabated, causing damages to coral reefs and losses of environmental services that they provide. With blast fishers being caught and discouraged to continue with their destructive operations due to effective enforcement, there will be environmental damages that will be avoided. Those avoided environmental damages will be estimated and will form part of the benefits from enforcement.

C. Decreased Fish Catch from Illegal Methods

Aside from increase in coral cover due to less blast fishing, there is also the case of decreased fish catch from all other illegal methods, assuming there are less of them because of increased enforcement. The decrease in their catch can represent an increase in total fish biomass in the area, using the assumption that illegal gear are responsible for overfishing and catching of juveniles. Although there is the danger that the decrease from these methods may intersect with the increase in fish catch from legal methods, the current data set does not allow for separating these variables from each other. In any case, this indicator will be used to represent a decrease in overfishing and catching of juveniles.

D. Increased Healthy Coral Cover in MPAs

The establishment of MPAs in Ubay is done primarily to increase healthy coral cover to serve as breeding and nursery grounds for fish. Such an increase will necessarily result in increases in the provision of environmental and ecological services that humans benefit from, such as climate regulation, coastal protection, waste bioremediation, nutrient cycling and resilience of marine ecosystems. Valuing coral reefs will be undertaken through the use of the replacement cost method, wherein the costs of replacing coral reefs through technological applications are computed to value the resource itself.

E. Decreased Encroachment of Commercial Fishers

Observations have been made on the success of enforcement activities in minimizing commercial fishers from encroaching in municipal waters in Ubay. The CPUE of commercial fishers has not been monitored and is not included in the fish catch monitoring database of Ubay. Assumptions will be thus be made that commercial fishers who used to fish in Ubay waters are similar in operations and fish catch volumes with fishers in other parts of the country, for which data on CPUE exists. If there is an estimated number of encroachers who used to fish in the area, the total damages avoided from encroachment can represent additional benefits from enforcement and implementation of the CRM Plan.

Total Benefits

The resulting sum of all these benefits will thus represent the total value-added with investments in place. It can then be compared to the amount of LGU expenditures being poured into CRM to determine whether there is a net benefit that occurs, which in turn can represent a crude measure of efficiency of local government investments in CRM.

Financial Analysis

Financial analysis of CRM investments in the study site consists of looking at actual management costs versus the revenues generated from enforcing CRM rules and regulations in the area. It will attempt to segregate local government accounts in the field of CRM, thus showing if local government investments are also providing a source of revenue for the municipal LGU, aside from the benefits that may be accruing to the municipal population as a whole.

Weaknesses of the Framework

Admittedly, the framework proposed for analyzing CRM investments in Ubay has a number of inherent weaknesses and flaws. The values used to estimate direct benefits from fish catch are **gross values**, i.e. they do not consider the costs of harvesting. Ideally, rent estimates (which are derived from net values) should be used to demonstrate this benefit. Unfortunately, there is no available data existing on fish harvesting costs, and the study does not allow for a survey to be conducted in filling out this gap. The danger this poses is that the values for these benefits may be overestimated. Be that as it may, there will be some benefits that will be undervalued, particularly the ecological services that coral reefs, mangroves and seagrass beds provide. There are hardly any studies that exist on this subject, and even those that have been published have been questioned and criticized for possible measurement errors. It might therefore be more prudent to just qualitatively acknowledge the presence of some of these benefits, without necessarily providing any estimates for numerical values.

Second, in economic valuation, marginal values are what are more relevant in estimation, rather than **average values**. Unfortunately, the data available does not allow for marginal values to be estimated. The use of average values necessarily implies that the value of one unit of coral reef, e.g. one ha, is the same as the next unit. This is, however, far from the truth given the complexity of ecological relationships of marine resources and ecosystems. There are hardly any existing economic research studies that have attempted to measure prices or economic values of these relationships.

PILOT-TESTING RESULTS FOR UBAY

The framework was tested using data from the municipality of Ubay, Bohol. As shown earlier, the LGU has spent a considerable amount of funds and effort in protecting its coastal habitats throughout the past few years. As interventions were focused mainly on protecting and rehabilitating coral reefs, benefits measured pertain to the improvement of resources found within the coral reef ecosystem, i.e. increase in fish catch and stock and improvement of coral cover. Following are the results of the pilot-testing exercise for the economic analysis portion of the framework.

Economic Analysis

Estimation of Benefits

A. Increased fish catch for municipal fishers

In measuring the increase in municipal fish catch, two sets of data were used for comparison and validation. The first set utilized the estimated annual fish landings from the monitoring data of the FISH Project housed in Cebu. Data in Table A3.1 shows that annual landings from legal gear more than doubled between 2004 and 2006, but decreased from 2006 to 2008. Nevertheless, fish catch for the whole four-year period still doubled. The decrease in catch from illegal gear was significant from 2004 to 2006, registering a drop by more than 90%. Illegal catch increased in 2008, though, but again, total fish catch for the four-year period significantly decreased. Legal gear pertain to almost all types of gear, while illegal gear were composed of all seines and dragnets, and dynamite fishing. Compressor fishing/diving is still considered legal in Ubay, although there are plans of regulating this activity in the future.

In estimating the value of the increase in fish catch from legal means, 2008 farmgate prices from Ubay were used. On the average, fish was sold by fishers at Php60/kg, based on 56 species bought by fish brokers in 2007 and 2008 (Galvez, 2008). Table A3.2 contains the estimated annual value of the increase in municipal fish catch from the period 2004 to 2008, totaling more than Php10 million/year.

The other set of data used to estimate increase in fish catch was based on the amount of fish bought by Mr. Romeo Galvez, a medium-sized fish broker in Barangay Humayhumay in Ubay. A detailed daily record of amount and type of fish bought was obtained for the whole year of 2007 and for the months of January to July of 2008. Mr. Galvez is one of three brokers who operate in the village of Humayhumay. Brokers his size are the main buyers of fish that deal directly with municipal fishers. In turn, most of them sell their fish to six big brokers in the whole of Ubay who in turn distribute the fish either to the local Ubay market or export the fish out of the municipality. Brokers like Mr. Galvez are thus the direct buyers from the fishermen and their buying prices are reflective of the farmgate prices of fish.

One problem with this data set is that fish caught using legal and illegal methods are not distinguished from each other. If we use this data set to measure benefits from increased fish catch, there is the implicit assumption that most, if not all, of fish bought by brokers are from legal means. While this assumption may not hold true in all cases, the main purpose of this exercise is just to validate the results drawn from the fish catch monitoring survey.

Table A3.3 shows the increase in fish bought by fish brokers during the period January to July of 2007 and 2008. For one broker, there was almost a 3,500 kg. Increase for the first seven months. Using the same average price of fish at Php60/kg reflects an increase in fishing income by almost Php210,000. Translating the figures into annual values shows an increase of almost Php360,000, or an average of Php30,000/month. Unfortunately, the total number of brokers for Ubay was not established. A very conservative estimate would be to assume one broker per fishing Barangay, or a total of 19 brokers, which sums up to an average annual value of increase in fish catch close to Php 6.9 million/year. According to Ubay CRM personnel, this assumption can be considered a minimum. If one were to assume two brokers per fishing Barangay, the figure would double to almost Php14 million/year.

Table A3.1. Estimated annual landings of fish catch in Ubay, 2004-08

GEAR MAJOR CATEGORY	GEAR VARIATION	CPUE			Inventory			No. Days/ Year	Est. Annual Landings (kg)		
		2004	*2006*	*2008*	*2004*	*2006*	*2008*		*2004*	*2006*	*2008*
GILLNETS	Bottom-set gillnet	6.93	6.89	5.78	5	82	90	227	7,880.4	128,480.2	118,345.3
	Crab gillnet	2.59	2.26	1.56	117	100	317	262	79,332.7	59,258.8	129,522.9
	Drift gillnet	17.00	14.89	15.71	64	67	79	170	184,839.1	169,492.1	210,819.1
	Drive-in gillnet	5.47	12.08	5.52	3	5	6	218	3,572.1	13,140.2	7,204.8
	Encircling gillnet	8.90	—	—	2	—	2	226	4,022.8		
	Set gillnet w/ plunger	10.72	14.33	11.25	24	60	50	260	66,883.7	223,539.7	146,242.4
	Squid gillnet	—	3.72	—		1	2	80		297.7	
	Trammel net	5.16	3.66	3.69	6	10	13	220	6,815.3	8,061.4	10,544.3
IMPOUNDING NETS	Barrier net	4.70	10.26	11.71		5	3	96	0.0	4,922.7	3,373.7
	Fish corral	4.59	3.32	8.54	17	16	47	165	12,861.3	8,763.9	66,198.3
	Stationary liftnet	10.31	17.38	62.10	4	16	21	186	7,672.5	51,732.8	242,573.8
JIGS	Squid jig (troll)	1.53	1.73	—	5	340	10	125	959.7	73,840.9	
LINES	Bottom-set longline	*4.59*	5.98	3.20	55	117	87	229	57,826.4	160,123.4	63,753.6
	Hook and Line (Simple)	2.04	1.86	2.12	266	567	308	217	117,790.8	228,463.0	141,973.7
	Multiple handline	2.33	6.58	3.56	26	170	203	214	13,010.8	239,717.5	154,938.8
OTHERS	Handspear, spear gun, harpoon	0.90	4.43	—	37	53		195	6,503.5	45,802.7	
	Dynamite	187.26	32.48	—	15	8		84	235,952.5	21,824.3	
	Compressor fishing/diving	29.05	23.22	—	2	32	26	181	10,503.0	134,304.5	
POTS & TRAPS	Crab liftnet	2.98	2.67	3.28	84	66	115	218	54,498.6	38,284.3	82,004.4
	Crab pot	6.86	4.21	3.83	57	23	49	213	83,440.9	20,669.2	40,053.7
	Fish pot	14.50	21.57	—	3	33	13	117	5,088.2	83,274.8	
	Shrimp pot	—		—	13	11	25	300		0.0	
	Squid pot	3.74	3.40	—	16	22	5	167	9,970.4	12,482.7	
SEINES & DRAGNETS	Beach seine	7.25	4.50	7.89	21	4	3	158	23,971.1	2,835.0	3,727.5
	Danish seine	17.73	16.50	20.59	27		2	***15***	7,178.6	0.0	617.7
	Mid-water trawl	—	—	—	5						
	Otter trawl	13.45	6.38	13.01	12	3	4	***10***	1,614.3	191.3	520.5
	Seine net	—	—	26.12			4	286			29,881.3
TOTAL ANNUAL LANDINGS									**1,002,188**	**1,729,503**	**1,452,296**
ANNUAL LANDINGS, LEGAL GEAR									**733,472**	**1,704,653**	**1,417,549**
ANNUAL LANDINGS, ILLEGAL GEAR									**268,717**	**24,851**	**34,747**

Source: Fish Catch Monitoring Data, FISH Project, Cebu, August 2008

Table A3.2. Increase in municipal fish catch from legal gear, based on annual landings, Ubay, Bohol, 2004-08

	2004	2006	2008
Fish catch, in kg	733,472	1,704,653	1,417,549
Increase from previous reporting period, in kg		971,181	(287,104)
Value of increase, in Php		58,270,843	(17,226,217)
Annual value of increase in fish catch, in Php		**10,261,156**	

Source of basic data:
1. Fish Catch Monitoring Data, FISH Project, Cebu, August 2008
2. Mr. Romeo Galvez, Fish Broker, Humayhumay, Ubay, Bohol, August 2008

Table A3.3. Fish bought by fish broker in Humayhumay, Ubay, Bohol, 2007-08

	2006	2008
Total fish bought, Jan to Jul, in kg	8,546	12,045
Total fish bought, Aug to Dec, in kg	7,997	
Increase in fish bought, Jan to Jul, in kg		3,499
Value of increase, in Php		209,942
Annual value of increase in fish bought/broker, in Php		359,900
Annual value of increase in fish bought, 19 brokers, in Php		**6,838,104**

Source: Mr. Romeo Galvez, Fish Broker, Humayhumay, Ubay, Bohol, August 2008

Looking at both results in Tables A3.2 and A3.3, it can be safely concluded that during the four-year period since enforcement was vigorously pursued in Ubay, there has been a noticeable increase in fish catch by municipal fishers in the area.

B. Damages avoided from destructive fishing methods

Among the destructive methods of fishing, dynamite or blast fishing was identified as a common practice in Ubay. In fact, it was one of the types of gear/methods included in the monitoring survey of the FISH Project. With the increase in enforcement activities of the LGU, there was a noted decrease in the number of dynamite fishers observed in the area. The baseline survey indicated 15 blast fishers operating in Ubay in 2004, each one operating at 84 days in a year (Table A3.1). The number decreased to 8 in 2006 and the latest survey in 2008 shows that there were no blast fishers observed during the survey period. Some marine scientists estimate that the damage brought about by 1 blast averages at 10 sq m of coral reef, although this figure is highly variable depending on the dynamite used and the depth where the blast fisher operates. For lack of any other basis for coming up with estimates of damages from blast fishing, it is assumed that the damage caused by one blast is equivalent to 5 sq m, which hopefully veers towards the conservative side of estimation.

Previous environmental economics studies estimate the range of values of one square meter of coral reef, depending on the site where the reefs are located. The valuation technique used is what is called the replacement cost method, or the coral reef restoration method. An increasingly popular way of dealing with damaged coral reefs is coral reef restoration. Numerous attempts at restoring coral reefs are currently being undertaken with a wide range of objectives and techniques (NCRI, 1999). Such mechanisms involve a number of cost components such as capital, operational and labor costs. Capital costs include both pre-construction and construction costs. Operational costs include materials, equipment, staff wages, expenses and general administration costs.

Finally, labor costs involve all costs for supervision, training and labor in actual restoration activities. Estimating the cost of restoration is a valuation technique used to value coral reefs. If blast fishing occurs, the damage can be said to be equivalent to the cost of having the coral reef restored (Rosales, 2006). Values in the Philippines have ranged from Php13,148/sq m/year in Apo Reef National Marine Park (Bautista, 2004), to

Table A3.4. Blast fishing damages avoided, Ubay, 2004-08

Indicator	Value
Decrease in no. of dynamite fishers, 04-08	15
Total blasts/fisher/year	84
Damage/blast, in sq m	5
Economic value of 1 sq m of corals, in Php	13,000
Total damages avoided from blast fishing, in Php	81,900,000
Annual damages avoided from blast fishing, in Php	**20,475,000**

Php14,964 for Tubbataha Reef National Marine Park (Rosales, 2006). Using the lower end to approximate the value of coral reefs in Ubay results in an estimate of total damages avoided from blast fishing to be equal to Php20.5 million a year (Table A3.4 below). The assumptions are conservative such that the restoration costs were not adjusted to reflect inflation and additional transportation costs to get to Ubay. The figure can thus represent a minimum value of damages avoided through increased enforcement.

C. Damages avoided from illegal fishing methods

Aside from the increase in fish catch from legal methods, there is also the observed decrease in fish catch from illegal methods. As pointed out earlier, the value for this indicator might overlap with the value of increased fish catch through legal means. Still, it is included here to represent the benefits derived from avoiding damages brought about by illegal gear, such as overfishing and catching of juveniles.

Table A3.5 contains the estimated annual landings from illegal gear, represented by all types of seine nets, dragnets and dynamite fishing. Using the same farmgate price for one kg of fish, and adding the value of confiscated gear during 2008, the annual value of the decrease in damages from illegal gear is estimated to be Php4 million. (Estimates were provided only for January to July 2008. They include the value of confiscated gear and boats. Earlier confiscations were not recorded and valued.)

Table A3.5. Illegal fishing damages avoided, Ubay, Bohol, 2004-08

	2004	2006	2008
Total catch from illegal methods, in kg	268,717	24,851	34,747
Decrease in catch, in kg		243,866	(9,896)
Value of decrease in catch, in Php		14,631,957	(593,785)
Value of confiscated gear, in Php			499,100
Annual damages avoided from illegal fishing methods, in Php			**4,008,643**

D. Increased coral cover from MPAs

Establishment of MPAs is a major program in the CRM Plan of Ubay. To date, there have been three sanctuaries that have been set up: Humayhumay MPA (71 ha), Sinandigan MPA (51 ha) and Tipolo MPA (31.4 ha). One of the objectives of these MPAs is to increase healthy coral cover, which in turn will lead to an increase in fish stock. MPA benefits can thus be measured by the increase in healthy coral cover.

The FISH Project's database established monitoring sites in MPAs found within the vicinity of Danajon Bank, although Ubay MPAs were not part of the sample. According to natural scientists working with the FISH Project, it is safe to assume that the coral reefs found in the municipalities covering Danajon Bank are similar in type and composition. An assumption is thus made that the results of the monitoring sites within Danajon Bank can be applied to Ubay MPAs.

Monitoring data from 2004 to 2006 reveal that there was a total increase in live hard coral by 4.8 ha, or an average increase of 6% across all monitoring sites (Table A3.6). This roughly translates to a 3% increase in live hard coral every year. To be conservative in estimation, this increase is applied only to the total dead coral area in Ubay MPAs. To get dead coral area in Ubay MPAs, the coral reef status in the whole of Ubay was used, which registered at 10% (Ubay CRM Plan, 2006). Applying the value of coral reefs using the replacement cost method translates into MPA benefits with an annual value of Php 56.7 million (Table A3.7).

Table A3.6. Increased coral cover, Danajon Bank, 2004-06

	Bilangbilangan, East	Hingutanan East	Bantigue	All sites
Live hard coral (LHC), 2004, in ha	18.7	22.7	33.9	
LHC, 2006, in ha	25.86	23.37	41.35	
Increase in LHC, 04-06	3.21	0.15	1.41	4.76
Total MPA area, in ha	44.8	21.7	18.9	85.4
% Increase in LHC, 04-06	7%	1%	7%	6%
Annual increase in LHC				3%

Source of basic data: MPA Monitoring Report 2004-2006, FISH Project

Table A3.7. Value of MPA benefits, Ubay, Bohol, 2004-08

	Total area, in ha	Annual increase in LHC, in ha	Value of annual increase in LHC, in Php
Sinandigan MPA	51	0.15	18,851,024.66
Tipolo MPA	31.4	0.09	11,606,317.14
Humayhumay MPA	71	0.20	26,243,583.34
All MPAs	153.4	0.44	**56,700,925**

E. Damages Avoided from Decreased Encroachment of Commercial Fishers

Commercial fishing encroachment is said to have been completely eliminated in Ubay ever since enforcement efforts were beefed up. Informal talks with former commercial fishers reveal that there were roughly 15 or so of them operating in the 1990s up until the middle of this decade. In the meantime, previous surveys of commercial and municipal fishing operations estimate commercial fish catch to be four or five times higher than municipal fish catch, on the average.

Applying the lower estimate (i.e. 4) to the average CPUE of Danish Seine fishers in Ubay (Table A3.1) produces a total volume of 222,000 kg of fish that could have been caught by commercial fishers, with a value of Php13.3 million (Table A3.8). If the elimination of commercial fishing encroachment is assumed to have taken place over the four-year period of this study, the annual value of damages avoided from commercial fishing encroachment is Php6.7 million. The figure is an underestimation of this benefit, since estimated annual catches were averaged over a four-year period of enforcement. There was no basis to assume a number representing the actual decrease in commercial fishing encroachment on a yearly basis.

Table A3.8. Damages avoided by reducing commercial fishing encroachment on municipal waters, Ubay, Bohol, 2004-08

Indicator	Value
Total commercial fishers, Ubay	15
Average annual fish catch/commercial fisher, in kg	14,824
Total annual fish catch, all commercial fishers, in kg	222,360
Value of total fish catch, all commercial fishers, in Php	13,341,600
Annual value of damages avoided from decreased commercial fishing encroachment	**6,670,800**

Total Economic Benefits

Summing up the estimated values reveals that the municipality of Ubay is enjoying annual benefits in the amount of Php98 million/year. Table A3.9 below provides a summary of the estimated values of benefits brought about by enforcement efforts of the LGU. Using the estimated increase in fish catch from data of fish brokers will lower the total by a few million pesos (Php95 million), but will not affect the conclusions significantly. In fact, if the number of brokers proves to be more than 19 for the whole of Ubay, the figures could be higher. Note that the process of estimating benefits tried to be as conservative as possible, although admittedly there could be some overlaps in the values attributed to some of the categories. Be that as it may, the exercise still proves useful in demonstrating that the total value of benefits can be substantial if all types of economic benefits are valued and accounted for.

Table A3.9. Summary of annual economic benefits from enforcement, Ubay, Bohol, 2004-08

Economic Benefit	Value
Increased municipal fish catch, legal methods	10,261,156
Damages avoided from blast fishing	20,475,000
Damages avoided from illegal fishing methods	4,008,643
Increased coral cover from MPAs	56,700,925
Damages avoided from commercial fishing encroachment	6,670,800
TOTAL	**98,116,524**

Costs of Enforcement

Over the past four years, costs incurred for enforcement activities may be classified according to whether they were incurred by the LGU or by some other entity. Furthermore, some cost items could be termed as one-time investments, while others recur every year. One-time costs include MPA establishment, assessment and training workshops, procurement of boats, and livelihood projects. Recurring costs pertain to direct expenses for patrol operations, periodic meetings, regular coastal clean-up activities and IEC. In general, all types of costs should be reflected and compared with benefits accruing from enforcement for a full-blown economic analysis. It is however useful to disaggregate cost items to assess how much exactly the LGU is investing.

During the period 2002 to 2007, the LGU has been incurring a total cost of Php820,000 in recurring costs, and it has invested Php1.2 million in one-time costs (Table A3.10). Unpaid costs are borne by varying entities. Outside interventions, such as the FISH Project and Project Seahorse have contributed funds (costs highlighted in gray are direct contributions of the FISH Project). Other government agencies such as BFAR, DENR and the Provincial LGU of Bohol have likewise given funds for CRM activities in Ubay. Finally, a substantial amount of unpaid labor and voluntary contributions from community members have been included as unpaid costs. For one-time costs, the LGU has spent for a little over half of total costs, while it has spent 60% for recurring costs. This shows that a big portion of total enforcement costs is being borne by other stakeholders. In sum, a total of more than Php2.2 million has been invested, and more than Php2 million is being spent annually for enforcing CRM rules in Ubay. The figure represents 3.2% of the total annual budget of the LGU in 2007.

In computing for annual costs from 2008 onwards, the same activities were accounted for. This time, one-time costs were depreciated so they could be reflected in total annual costs. Some activities were likewise added, particularly training workshops that will need to be held periodically. In sum, total CRM costs should amount to almost Php 2.4 million every year to continue enforcement activities in Ubay (Table A3.11).

Net Benefits

Combining benefits and costs reveal a huge net benefit for the municipality of Ubay, in the amount of Php95.7 million (Table A3.12). Large economic benefits are realized from improved coral cover because of its large unit value. Some critics warn against the use of the replacement cost method because engineering

Table A3.10. Costs of enforcing CRM rules and regulations in Ubay, Bohol, 2002-07

ACTIVITY	ONE-TIME COSTS			ANNUAL COSTS, 2002 to 2007		
	ACTUAL	UNPAID	TOTAL	ACTUAL	UNPAID	TOTAL
Sea-borne patrol				1,152,476	749,261	1,901,737
Coastal clean-up				2,700	12,500	15,200
PCRA				3,000	5,580	8,580
CLEC meetings				39,584	38,400	77,984
MFARMC meetings					11,480	11,480
IEC				13,600	2,680	16,280
CLEC-wide assessment		319,200	319,200			
CLE assessment workshop		12,600	12,600			
Fish examiners' training	6,300	12,000	18,300			
Paralegal training	3,200	55,000	58,200			
CLE training	41,600	300,000	341,600			
Deputation of fish wardens	12,000		12,000			
Fish cage establishment	50,000	54,600	104,600			
Mud crab culture	50,000	254,600	304,600			
MPA establishment:						
a. Tipolo	150,000	15,400	165,400			
b. Sinandigan	150,000	15,400	165,400			
c. Humay Humay	50,000	15,400	65,400			
CBFMA mangrove rehabilitation	10,140	15,400	25,540			
Procurement of boats						
a. 1st	150,000		150,000			
b. 2nd	250,000		250,000			
c. 3rd	250,000		250,000			
TOTAL	**1,173,240**	**1,069,600**	**2,242,840**	**1,211,360**	**819,901**	**2,031,261**
% to Total	***52%***	***48%***		***60%***	***40%***	

Source: FISH Project, July 2008

solutions (such as coral transplantation, in this case) do not always reflect WTP (which is the crux of economic valuation), and they usually tend to be large. On the other hand, there are not enough basic data to allow estimation of the various indirect and non-use values derived from coral reefs. Admittedly, this study does not intend to produce an absolute or exact estimate of benefits and costs. Rather it attempts to show their relative values or magnitude, which in this case demonstrates the soundness of investing in CRM. Costs approximately represent a mere 2% of annual benefits derived from CRM investments.

Financial Analysis

Current Revenues

The main source of income of any LGU in the Philippines would be from taxes. In Ubay, certain business taxes have been charged against marine-related businesses such as crab processing plants and fish vendors. At the start of 2008, the LGU has decided to expand its revenue-generating schemes that draw from natural resources in the marine sector. Fish corrals are now being promoted, and there have been a number of them who have registered and paid taxes to the Municipal Treasurer. Special fishing permits are now sold to non-Ubay fishers who fish in their municipal waters. A registration and licensing scheme has been set up for fishing gear and boats.

Finally, the LGU has started issuing auxiliary invoices with concomitant fees for marine products that are brought out of Ubay. Fines and charges against violators of CRM rules have been collected since 2004. However, as pointed out earlier, these should not be seen as revenue-generating schemes, rather should be

Table A3.11. Costs of enforcing CRM rules and regulations in Ubay, Bohol, 2008

ACTIVITY	ANNUAL COSTS, 2008 onwards		
	ACTUAL	UNPAID	TOTAL
Sea-borne patrol	1,152,476	749,261	1,901,737
Coastal clean-up	2,700	12,500	15,200
PCRA	3,000	5,580	8,580
CLEC meetings	39,584	38,400	77,984
MFARMC meetings	-	11,480	11,480
IEC	13,600	2,680	16,280
CLEC-wide assessment	12,768		12,768
CLE assessment workshop	12,600		12,600
Fish examiners' training	9,150		9,150
Paralegal training	29,100		29,100
CLE training	113,867		113,867
Deputation of fish wardens	6,000		6,000
Fish cage establishment	52,300		52,300
Mud crab culture	52,300		52,300
MPA establishment:			
a. Tipolo	6,616		6,616
b. Sinandigan	6,616		6,616
c. Humay Humay	2,616		2,616
CBFMA mangrove rehabilitation	1,022		1,022
Procurement of boats			
a. 1st	6,000		6,000
b. 2nd	10,000		10,000
c. 3rd	10,000		10,000
TOTAL	**1,542,314**	**819,901**	**2,362,215**
% to Total	*65%*	*35%*	

Table A3.12. Net annual benefits from CRM Investments, Ubay, Bohol, in Php, 2004-08

Total annual economic benefits	**98,116,524**
Total annual costs	**2,362,215**
Net annual benefits	**95,754,309**

viewed as regulating mechanisms and disincentives. In the long run, the main objective should have these fines and charges decrease, which would translate to a lower rate of violations among community members. Ubay's experience has proven this, with fines and charges drastically being reduced in four years. The trend is consistent with the decreasing number of violators recorded by the monitoring survey of the FISH Project.

Table A3.13 contains a summary of current revenues that have been collected by the LGU. Revenues have been increasing throughout 2004 to 2008. To date, collections have totaled almost Php548,000 for 2008.

When compared with costs incurred in enforcement, the LGU is still experiencing negative net income, as shown in Table A3.14.

Potential Revenues

There are several potential sources of revenues that the LGU can tap into which will allow for a positive net income from CRM.

First, the current registration and licensing scheme has only been able to tap around 10% of the total number of fishers and gear operating in Ubay waters. If all fishers and gear are registered, there can be a

Table A3.13. Current revenues from CRM-related activities, Ubay, Bohol, in Php, 2004-08

Source	2004	2005	2006	2007	2008
1. Registration and licensing					158,512
2. CRM-related business permits and taxes					
a. Crab processing plant 1			17,635	16,635	17,030
b. Crab processing plant 2				2,495	6,980
c. Fish vendors			178,468	130,592	203,205
d. Fish corrals					23,010
e. Special fishing permits					11,000
3. Fines and charges	99,550	62,280	53,100	33,000	5,000
4. Auxiliary invoices				113,286	123,068
TOTAL REVENUES	**99,550**	**62,280**	**249,203**	**296,007**	**547,804**

Table A3.14. Current net income from CRM-related activities, Ubay, Bohol, in Php, 2008

Annual revenues	**547,804**
Annual costs	**2,362,215**
Annual net income from CRM	**(1,814,411)**

substantial increase in LGU revenues. Using the fees prescribed in Ubay's Fishery Ordinance, the estimated number of gear from the fishcatch monitoring survey, and the total number of fishers operating in Ubay, total revenues from gear registration can amount to Php426,900, while revenues from boat registration can reach Php420,400. The assumption used is that out of the total 2,068 fishers (Ubay CRM Office), 1000 vessels are classified as less than 9HP, and 1,068 are within the range of 9 to 16HP. Potential revenues from gear registration is a conservative estimate considering that the survey recorded only 1,480 gear in operation, some of which were classified as illegal hence could not be registered.

Second, income from issuing auxiliary invoices can increase substantially once the system is fully set up. There are two possible sources of income from auxiliary invoices: capture fisheries and aquaculture. According to Ubay CRM officials, total exports of capture fisheries can safely be placed at 30% of total production. Using the estimated annual landings from Table A3.1, potential income from this source can reach Php212,632.

With respect to aquaculture, there is still no available data on current production from fish farms in Ubay. What is known is the total area that has been allowed for aquaculture production, i.e. 1,141 ha. To get production data, BFAR's provincial average yields are applied. Five aquaculture species are being grown in Bohol: tiger prawns, milkfish, tilapia, and mudcrabs, including large-size mud crabs locally known as "king crabs". Among these, milkfish produces the lowest value of yield per ha. If the total area is assumed to be dedicated to just milkfish, total production value can reach Php65.7 million. To get a minimum value of potential revenues, we assume only 10% of this total production is exported out of Ubay. The Fishery Ordinance states that 2% tax is applied to the value of aquaculture production brought out of the municipality. This translates to potential revenues of Php131,405 from milkfish production. Using the same assumptions for "king crabs" generates a maximum amount of potential revenues at over Php1 million.

A third source of potential revenues is from fees from the use of land for aquaculture purposes. The Ordinance allows the LGU to charge Php 2,000/ha/year dedicated to aquaculture. Assuming only 90% of total area is subjected to fees, the LGU can earn an additional Php 2 million/year.

Finally, the Ordinance mandates the charge of production fees from aquaculture, at Php1/kg/cropping for tiger prawn and crabs, and Php0.50/kg per cropping for milkfish and tilapia. This time, crabs have the lowest volume in terms of yield/ha. To get the minimum value of production fees, we assume total area is dedicated to mud crabs, which translates to a total production of 353,710 kg/cropping. Assuming two croppings/year can yield Php707,420 in annual revenues for the LGU, if "king crabs" were produced in all fish farms in Ubay, the maximum revenues can reach as high as Php5.9 million/year. If we abstract from the

aquaculture species and assume an average figure of 800 kg/cropping, a 50-centavo production fee can yield an average of Php912,800 in annual revenues.

In sum, additional LGU revenues from CRM-related activities can reach Php3.7 million using minimum values for assumptions, and Php9.8 million using maximum figures for assumptions in aquaculture production (Table A3.15).

Table A3.15. Potential additional LGU revenues from CRM activities, Ubay, Bohol, in Php

SOURCE	AMOUNT
1. Registration and licensing	
a. Gear	426,900
b. Boats/ fishers	420,400
2. Auxiliary invoices	
a. Capture fisheries	212,632
b. Aquaculture	
b.1 Minimum	131,405
b.2 Maximum	1,017,253
3. Permits, aquaculture	
a. Land use	2,000,000
b. Production	
b.1 Minimum	707,420
b.2 Maximum	5,887,560
b.3 Average	912,800
TOTAL MINIMUM	**3,740,245**
TOTAL MAXIMUM	**9,806,233**

Net Revenues

Combining revenues and costs shows that at the current level of revenues, the LGU is still experiencing negative investments. But if they are able to realize all types of fees prescribed in their Fishery Ordinance, they can increase revenues by almost 700% and come out with positive net income levels every year (Table A3.16). Similar with the caveats on doing economic analysis, these figures are only meant to demonstrate the relative magnitude of benefits that can be obtained from CRM investments. They are not meant to be exact estimates of what the LGU can earn from taxes, especially since there are a lot of assumptions used in most of the revenue scenarios. Instead, they attempt to show that the LGU can actually earn positive revenues if CRM activities are pursued effectively. If more CRM-friendly businesses can be set up, such as seaweed and "king crab" production, the LGU increases its potential to earn more revenues.

Table A3.16. Current and potential net income from CRM activities, Ubay, Bohol, in Php

Current annual revenues	**547,804**
Annual costs	**2,362,215**
Annual net income from CRM	**(1,814,411)**
Potential annual revenues (minimum)	**4,288,050**
Annual costs	**2,362,215**
Potential annual net income from CRM	**1,925,835**

Data Requirements & Gaps

The monitoring survey introduced and maintained by the FISH Project has proven highly useful in providing a number of important indicators in estimating economic benefits from CRM investments, such as:

1. Types of legal and illegal gear used in Ubay
2. Total number of gear operating in Ubay, by gear type
3. Total no. of operating days in a year, by gear type
4. Annual fish catch by type of gear, in kg.
5. Live hard coral cover in MPAs

Other types of data gathered that should be monitored periodically include the following:

1. No. of commercial fishers operating in the area
2. No. of dynamite fishers operating in the area
3. Total fish catch bought by fish brokers from municipal fishers
4. Farmgate prices of fish commercially traded
5. Actual costs incurred in CRM activities, by type of activity

These indicators should continuously be monitored to keep track of the economic benefits that the LGU provides through the implementation of its CRM program for coral reefs. Meanwhile, the following indicators could further enrich and refine the benefit estimates for Ubay:

1. Actual size of area damaged by dynamite fishing
2. Actual increase in hard coral cover in MPAs of Ubay
3. Actual number of fish brokers in Ubay
4. Actual aquaculture production in Ubay
5. Actual volume of fish exported out of Ubay, both for capture and aquaculture fisheries
6. Actual number of fish corrals operating in Ubay waters

Admittedly, there are other potential social benefits that were not accounted for due to lack of existing data. In theory, the increase in fish catch could mean that there are more sources of protein for community members, thereby improving their daily diets and health status. Increases in income from fishing could also mean higher savings for local households, which could in turn translate to better opportunities for children's education or higher quality of living for them in general. If socio-economic surveys can be conducted later on, estimates for income and social impacts could be established and added to the benefits from CRM interventions.

Potential revenues for the LGU are large provided that there is an adequate monitoring and collection mechanism in place. The actual area and production from aquaculture should be monitored, along and all municipal fishing boats and gear operating in Ubay waters. Ideally, registration and licensing should not only be treated as revenue generating measures, but should be used primarily as management tools to regulate fisheries. If overfishing is already a problem, then limits to fishing should be implemented. Otherwise, if the regenerating capacity of the resource itself cannot cope with the demand, no amount of enforcement will be able to save it from extinction or collapse.

In this connection, the program on reproductive health care should be continued and monitored as well. Controls should be instituted for all aspects affecting fisheries (i.e. fisheries management along with human population management). Further studies can focus on the impacts of a controlled population on both the state of the natural resource and on the well-being of the community members themselves. The integration of health care and fishery programs in the overall CRM program of Ubay is an ideal set-up that should be replicated in other parts of the country. Not only does it bode well for fisheries, but it also allows for a better quality of life of the local population, which should be the ultimate goal of public service.

Note that only the coral reef ecosystem was covered by this study due to the lack of data for mangroves, seagrass beds and foreshore areas. A full blown implementation of the CRM plan even includes programs that cover watersheds in the area in recognition of the impact of upland activities on the marine sector. Before the other components of the plan are implemented, it would be ideal if baseline data can be established with the same level of detail done for coral reefs.

Conclusion & Further Steps

The journey towards effective CRM should be viewed from the point of view of providing adequate opportunities of sustainable exploitation for the current and future generations. It is thus important for the LGU to know whether its investments are still providing net economic benefits to its constituents now and in the future. Aside from filling in the data gaps identified above, the analysis can be extended further to go into the details of whether fish catch size is growing, and if there are positive trends in harvesting species that go up the food chain. Offhand, the database can allow for this analysis if monitoring is ensured. Even the data collected from fish brokers can serve as a powerful source of such types of analyses if it extends beyond the current time frame.

Socio-economic monitoring can also benefit the LGU in this arena. If benefits from CRM investments can be linked with household income increases, thereby promoting positive social and economic impacts including poverty alleviation, it would be worthwhile for the LGU to invest in such surveys. Lower income municipalities in particular whose main goal is to alleviate poverty would probably be interested in such conclusions.

The increase in financial revenues can lead to further investments in the other components of the CRM Plan. It was rightfully recognized that upland activities directly impact the marine sector. Investing in programs that deal with proper watershed management and waste/water pollution management would increase benefits in improving the status of the various marine ecosystems as well as to quality of living of the population. What the LGU should look out for are the potential impacts of increased mariculture and aquaculture activities. Such programs may bring about income increases but they come with their own set of environmental and pollution problems when left unabated. To address these at the onset, the LGU may choose to dedicate its funds earned from mariculture and aquaculture towards mangrove and foreshore habitat management. Increasing revenues therefrom may be tempered by the need to conduct more management activities and regulatory measures if economic activities increase.

Finally, the LGU may opt to consider the use of economic instruments in furthering its enforcement activities. If the fishing population reaches a point whereby they are able to police themselves and patrolling is conducted efficiently on a bay-wide basis, individual transferable quotas or similar instruments may be implemented later on. Not only can they become regular sources of revenue for the LGU, they have likewise been proven to be one of the more effective tools in other countries that have had longer and richer experiences in managing their fishing sector.

Appendix 4. DA-BFAR List Of Rare, Threatened & Endangered Species

Source: DA-BFAR

A. Rare species:

1. Gastropods

Bolma girgyllus (Girgyllus star shell)
Clypeomorus aduncus (bent cerith)
Recluzea lutea (recluzia snail)
Separatista blainvillana (true separatista)
Malluvium lissus (deep sea cap)
Strombus thersites (thersite stromb)
Varicospira crispate (network beak shell)
Tibia martini (Martini's tibia)
Cyprea childreni (children's cowrie)
Cyprea beckii (Beck's cowrie)
Cyprea guttata (great spotted cowrie)
Cyprea porteri (porter's cowrie)
Cyprea teramachii (Teramachi's cowrie)
Cyprea saulae (Saul's cowrie)
Cyprea katusae (Katsue's cowrie)
Cyprea leucodon (white-toothed cowrie)
Cyprea aurantium (golden cowrie)
Cyprea valentia (prince cowrie)
Phenacovolva dancei (dance volva)
Cypraeacassis rufa (bullmouth helmet)
Phalium coronadoi wyvillei (Wyville's bonnet)
P. glabratum glabratum (smooth bonnet)
Morum kurzi (Kurzi's morum)
Morum grande (giant morum)
Morum watsoni (Watson's morum)

2. Bivalves

Amusium obliteratum (smudged moon scallop)
Eufistulana mumia (club-shaped boring clam)

B. Threatened species

1. Gastropods

Turbo marmoratus (green snail) - laong; bulatok
Trochus niloticus (smooth top shell) - samong; simong; tuwad
Barnea manilensis (angel wing shell) – diwal

2. Crabs

Birgus latro (coconut crab) - tatus, umang; alimangong lupa

C. Endangered Species

1. Whales and dolphins

Stenella longirostris (spinner dolphinl) - lumba-lumba
Stenella attenuata (pantropical spotted dolphin) - lumba-lumba; balakiki
Lagenodelphis hosesi (Fraser's dolphin) – mahayon
Tursiops truncates (long-snouted bottle-nose dolphin) - lumba-lumba; lumod-lumod
Grampus griseus (Risso's dolphin) - lumba-lumba; kabang
Peponocephala electra (melon-headed whale) – lumod
Feresa attneuata (pygmy killer whale) – lumod
Globicephala macrorhyncus (short-finned pilot whale) - pakatang amguhatan
Pseudorca crassidens(false killer whale) – balyena
Orcinus orca (killer whale) – balyena
Steno bredamensis (rough-toothed dolphin) - lumba-lumba
Kogia breviceps (pygmy sperm whale) - balyena
Kogia simus (dwarf sperm whale) – balyena
Mesoplodon densirostris (Blainville's beaked whale) – balyena
Ziphius cavirostris(Cuvier's beaked whale) – balyena
Physeter macrocephalus (sperm whale) – balyena
Megaptera novaeangliae(golden cowrie)
Balaenoptera edeni Bryde's whale (prince cowrie) - balyena, bongkaras
Balaennoptera physalus (fin whale) - balyena

2. Clams

Tridcacna gigas (true giant clam) – taklobo
Tridacna derasa (smooth giant clam) – taklobo
Tridacna squamosa (fluted scaly giant clam) - hagdan-hagdan
Tridacna maxima (elongated giant clam) - manlet; manlot
Tridacna crocea (boring / crocus clam) - let-let
Hippopus hippopus (strawberry / horse hoof clam- kukong kabayo
Hippopus porcellanus (china / porcelain clam) - kukong kabayo

3. Sea snakes

Cerberus rhynchops (dogfaced water snake) - kalabukab

Corals (not rare, threatened or endangered but still prohibited for trade)

Red, pink and white corals
Black corals
All kinds of coral other than precious and semi-precious corals

Examples of prohibited corals

Heliofungia sp. (mushroom coral)
Herpolitha sp. (slipper coral)
Sandalolitha sp. (bowl coral)
Acropora sp. (branch coral)
Pocillopora sp. (lace coral)
Seriatopora sp. (bird's nest coral)
Pachyseris sp. (vase coral)
Turbinaria sp. (pagoda coral)
Montipora sp. (crust or branch coral)
Favia sp. (moon coral)
Corallium sp. (precious coral)9
Antipathes sp. (black coral)
Tubipora musica (organ pipe coral)
Heliopora sp. (denim coral)
Melithaea sp. (sea fan coral)
Xenia sp. (anemone coral)
Lemnalia sp. (asparagus coral)
beach / aquarium / white sand

Appendix 5. Highlights Of The FAO Code Of Conduct For Responsible Fisheries

Source: FAO, 1995. In: DENR, et al, 2001

Fisheries management

- States should adopt measures based on best scientific evidence available for the long-term conservation and sustainable use of fisheries resources – through appropriate policy, legal, and institutional framework.
- States should apply the precautionary approach to conservation, management, and exploitation of living aquatic resources. Such approach considers: uncertainties relating to size and productivity of stocks, stock condition in relation to such reference points, levels and distribution of fishing mortality, and the impact of fishing activities.
- States should cooperate with each other through bilateral/subregional/regional fisheries organizations.
- Mechanisms for fisheries monitoring, surveillance, control, and enforcement should also be drawn to ensure that compliance and transparency in the mechanisms for fisheries management should be practiced.

Fisheries operation

- Only fishing operations allowed by the States are conducted within waters under their jurisdiction and these operations are carried out in a responsible manner.
- Fishing which is safe to human life, nondestructive to the resources, documented, selective, efficient in the use of energy, adoptive of appropriate technology, decreases discards, minimizes loss of fishing gear, and well-assessed as to its effect to the habitat, should be promoted.

Aquaculture development

- States should promote responsible development and management of aquaculture, including an advance evaluation of the effects of aquaculture development on genetic diversity and ecosystem integrity, based on the available scientific information.
- States should produce and regularly update aquaculture development strategies and plans to ensure that aquaculture development is ecologically sustainable and to allow the rational use of resources shared by aquaculture and other activities.
- States should not only ensure that the livelihoods of local communities, and their access to fishing grounds, are not negatively affected by aquaculture developments, but should also undertake appropriate environmental assessment and monitoring specific to aquaculture to minimize adverse ecological changes and related economic and social consequences resulting from water extraction, land use, discharge of effluents, use of drugs and chemicals, and other aquaculture activities.

Integration of fisheries into coastal area management

- States should ensure that an appropriate policy, legal, and institutional framework is adopted to achieve the sustainable and integrated use of the resources, taking into account the fragility of coastal ecosystems and the finite nature of their natural resources and the needs of coastal communities.

- Representatives of the fisheries sector and fishing communities should be consulted in the decision-making processes.
- Constant need for public awareness for the protection and management of coastal resources is stressed.
- The value of coastal resources should account for economic, social, and cultural factors.
- Coastal environment monitoring should use all physical, chemical, biological, economic, and social parameters.
- States should establish mechanisms for cooperation and coordination among national authorities involved in planning, development, conservation, and management of coastal areas.

Post-harvest practices and trade

- States should adopt appropriate measures to ensure the right of consumers to safe, wholesome, and unadulterated fish and fishery products by establishing national safety and quality assurance systems to protect consumer health and prevent commercial fraud.
- International trade should not compromise the sustainable development of fisheries and responsible utilization of living aquatic resources.

Fisheries research

- States should recognize that responsible fisheries require sound scientific basis to assist fisheries managers and other interested parties in making decisions.
- States should ensure that appropriate research is conducted in all aspects of fisheries including biology, ecology, technology, environmental science, economics, social science, aquaculture, and nutritional science, that research facilities and training are made available, and that human resources as well as responsive institutions are developed to conduct the research, taking into account the special needs of developing countries.
- States should ensure that research results are used as basis for the setting of management objectives, reference points, and performance criteria, as well as for ensuring adequate linkages between applied research and fisheries management should be promoted.
- Relevant technical and financial international organizations should, upon request, support States in their research efforts, devoting special attention to developing countries.

Appendix 6. Coastal Management Phases & Steps As A Basic LGU Service & The Roles Of Various Sectors

Source: Modified from White, 1997. In: DENR et al, 2001

Phases and steps	Activities and outputs	Roles of local municipal or city government, community and stakeholders	Technical assistance roles of national and provincial government, NGOs, academe, and donors
PHASE 1 — Issue identification and baseline assessment			
a. Program preparation	• Allocate budget • Determine boundaries and scope • Make workplans/budgets • Assign personnel • Secure consensus on overall approach	• Source funding for CRM planning activities • Prepare annual investment plan • Enter into memoranda of agreement • Participate in discussion • Communicate needs and potential roles • Agree on design	• Prepare work plans • Formulate working agreements • Contract and train staff • Facilitate consensus on design
b. Secondary information gathering	• Compile existing maps, reports, data • Interview information sources • Compile existing laws, plans • Review other sources of information	• Provide information • Assist to compile information • Begin to develop information storage and retrieval system	• Locate sources of information • Compile information in useful form • Coordinate activities
c. Field assessment/ participatory coastal resource assessment (PCRA) and other research	• Train practitioners • Conduct PCRA mapping and data collection • Contract special research studies on fish stock assessment, habitat condition, water quality, enterprise, and others	• Conduct PCRA with technical assistance • Participate in special research and data collection • Assist to analyze data • Provide inputs to mapping	• Train practitioners • Facilitate PCRA • Conduct specialized research • Analyze research data
d. Database and profile development	• Complete maps • Set up data storage and retrieval system • Compile coastal environmental profile • Use profile as planning base • Refine boundaries and further research needs	• Provide information • Assist with profile analysis • Validate data • Use profile for planning • Decide on boundary demarcation • Present profile to legislative bodies	• Make results available • Determine data storage site, personnel • Write profile • Distribute profile • Facilitate discussions on boundaries and research needs
e. Prioritization of issues and analysis of causes	• Conduct community and municipal-based planning sessions • Develop issue tree • Prioritize issues for management	• Participate in process and provide major input • Participate in conflict Resolution • Set priorities in real terms	• Facilitate process • Interject outside perspectives, research findings, policies, etc. • Help translate issues into causes

Phases and steps	Activities and outputs	Roles of local municipal or city government, community and stakeholders	Technical assistance roles of national and provincial government, NGOs, academe, and donors
PHASE 2 — CRM plan preparation and adoption			
a. Establish management bodies	• Establish and activate barangay and municipal FARMCs established • Establish multisectoral technical working group	• Provide advice to LGU • Provide basic policies • Provide major inputs to plan • Build consensus among community	• Facilitate planning process • Conduct planning workshops • Provide technical guidance • Assist to set up management bodies
b. Define goals and objectives	• Conduct CRM planning workshop • Identify and evaluate management options • Identify management strategies and actions	• Support planning process (LGU)	
c. Develop CRM arrangements and action plan	• Delineate and map proposed water use zones• Draft multi-year management plan• Conduct community consultations on draft management plan• Present proposed CRM plan in multi-sectoral forum• Finalize and adopt multi-year CRM plan	• Participate in planning process (LGU and community) • Present plan to concerned legislative bodies for adoption and support	• Facilitate inter-agency coordination
PHASE 3 — Action plan a d project implementation			
a. CRM plan implementation	• Establish and staff municipal CRM office • Develop action plan for CRM plan implementation • Secure support as required • Increase implementation effort • Establish and operationalize marine sanctuaries • Establish environment-friendly enterprises • Rehabilitate and manage mangrove areas under community-based forest management agreement • Establish registry of municipal fishers	• Take full responsibility • Participate in implementation • Provide local personnel • Organize community groups to assist with implementation • Enter stakeholder agreements • Source funding • Participate in decision process • Endorse and implement	• Facilitate initial implementation • Provide seed funding • Provide technical guidance • Conduct training course as required • Assist to draft • Provide information with examples
b. Legislation and regulation	• Enact ordinances for CRM plan and implementation	• Participate in decision process • Endorse and implement	

Phases and steps	Activities and outputs	Roles of local municipal or city government, community and stakeholders	Technical assistance roles of national and provincial government, NGOs, academe, and donors
cont. PHASE 3 — Action plan and project implementation			
c. Legislation and regulation	• Issue permits and licenses for municipal water uses that are consistent with CRM plan		
d. Law enforcement	• Train and make operational coastal law enforcement units • Enforce ordinances	• Participate and support law enforcement • Deputize and organize fish wardens	• Technical training • Assist in coordination
e. Revenue generation	• Collect taxes, fines and fees from enterprise development, coastal law enforcement and municipal water use	• Establish regular collection system • Use revenue for CRM	• Provide examples and technical assistance
f. Annual program preparation and budgeting	• Review implementationProgress of CRM plan • Prepare annual investment plan and allocate budget for CRM • Identify staffing requirements • Identify capital outlay requirements • Identify special projects • Identify training, technical assistance and outreach needs	• Conduct public review • Develop annual investment plan for CRM • Allocate budget • Commit staff	• Provide technical assistance as appropriate • Provide policy guidance • Source funds
PHASE 4 – Monitoring and Evaluation			
a. Monitoring and evaluation	• Train monitoring and evaluation team • Monitor environment and CRM process and feedback to database and plan • Conduct performance evaluations • Conduct management capacity assessments • Conduct outcome evaluations • Prepare annual monitoring and evaluation report	• Collect data • Participate in process • Take responsibility	• Assist to train LGU personnel • Assist to analyze data • Assist to set up sustainable system
b. Refine management plan	• Review and revise annual CRM plan	• Use data to refine plan and update database	• Provide input on plan refinement

Phases and steps	Activities and outputs	Roles of local municipal or city government, community and stakeholders	Technical assistance roles of national and provincial government, NGOs, academe, and donors
PHASE 5 – Information management, education and outreach			
a. Information management	• Establish and update municipal coastal database • Produce and update municipal water use and coastal habitat maps • Produce annual status reports and maps • Institutionalize information management system functions	• Process data into useful information	• Design information system • Maintain provincial and national coastal databases • Provide training
b. Information, education and communication	• Disseminate information for education and planning • Establish technical assistance and outreach program • Conduct education campaigns for municipal CRM programs • Hold public hearings for proposed CRM plans and ordinances	• Disseminate and use information • Feedback to plan • Disseminate municipal report on status of coastal resource management	• Assist with information and education materials development • Prepare and disseminate provincial and national reports on the status of coastal resource management

Appendix 7. Data Requirements & Use Relevant To Fisheries Management Planning At The LGU Level

Source: Adapted from FAO, 1997

General Considerations in the Collection & Provision of Data & Information for Fisheries Management

Verification or validation of data

1) Approaches to collecting data for fisheries management vary substantially, depending on, for example, the nature of the fishery, the staff and facilities available, and the social and economic importance of the fishery. Whatever methods are used, the quantity and quality of the data collected will have a direct influence on the quality of the management which can be exercised, and so the most effective use must be made of personnel and facilities available for data collection.
2) The verification or validation of data is essential to ensure that it is accurate, complete and gives a true indication of the state or value of the factors under consideration. The problems associated with the collection of fisheries data mean that the risks of collecting erroneous or inappropriate data are very high without careful and statistically valid design and monitoring of sampling approaches;
3) Different types of data will need to be verified in different ways. Some examples of methods to validate data that may be currently doable for Philippine LGUs include:
   a. Checking logbooks against landings data (e.g. sales notes);
   b. Sampling catches for species composition;
   c. Comparing landings statistics with certificates of origin, trade and commodity production statistics (e.g. processed fish) and similar sources of information;
   d. Inspecting data collection methods by statistical staff;
   e. Interviews with fishers;
   f. Observer schemes;
   g. Reporting from sea on retained catch on entering and leaving the fishing zones;
   h. Instituting shipboard surveillance, associated with the boarding of vessels.
4) Adequate training and supervision of staff involved in monitoring are essential if the data collected are to be valid. Staff members involved in data collection are frequently relatively junior in organizational hierarchies. However, they are also frequently expected to work in remote areas or as the sole observers aboard ships, often with no contact with their supervisors or colleagues for lengthy periods. It is important that they are prepared for this with adequate training and that every effort is made to maintain morale and an awareness of the role of their task within the broader fisheries agency. Regular site visits incorporating quality control should be made by supervisory staff to data collection points, and regular in-service training sessions provided.

Standardization of data collection

1) Many stocks, and possibly most marine stocks, are not found exclusively within the areas of jurisdiction of a single municipality or city but are distributed across political boundaries. Stocks must be managed as units or the management actions will almost certainly fail to achieve the desired objectives. Where this requires cooperation between management authorities of different LGUs, provinces, regions and even countries, the task of cooperative management is made much easier and more effective if the different partners in the cooperative management all collect data according to common definitions, classifications and methodologies and in a pre-agreed, standardized format, enabling all data to be combined and compared as required.
2) Collection of data in a standardized manner will require that the cooperating partners meet periodically to agree on the data requirements, the methods to collect the data, the amount of data to be collected and to review the sample design within each independent jurisdiction. In addition, joint training of staff involved in data collection will almost certainly be advantageous.

Timely distribution

1) The prompt provision of data in time for appropriate decisions and action to be taken is essential for effective fisheries management. Regular and frequent, typically annual, assessments of fisheries and

resources, and a review of appropriate management options in response to changes are essential, and these can only be effective if they incorporate reliable and up-to-date data and information. With due regard for confidentiality requirements, management authorities should participate in and encourage sharing of information and data among different agencies and interest groups with genuine needs for these.

2) Collection of appropriate and high quality data can be complex and costly but, for reasons pointed out above, fisheries management authorities must ensure, by providing adequate support, that the necessary data collection and analysis systems exist and function effectively.
3) Particularly where distances between sampling points are great as, for example, with highly migratory or straddling stocks, the potential role of data transmission by radio, fax, email and satellites or transponders installed on commercial fishing vessels should be considered.

Confidentiality of data

1) It is usually important to the fishing industry and to individual fishers to know that aspects of the information which they supply to fisheries management authorities are kept confidential, in particular that information or those data which could be used by their competitors to gain an advantage. In view of this, fisheries management authorities must implement policies and strategies which ensure confidentiality of data falling into this category. While aggregated catch data are generally not regarded as being confidential, data relating to the fishing activity of individual vessels or company specific catch rates, fishing localities and fishing strategies are frequently seen as being of potential interest to competitors and therefore need to be kept confidential.
2) Fisheries management authorities need to liaise with all providers of data to establish which data should be kept confidential. Failure to do this could result in future problems in obtaining data, falsification of data or similar problems related to or stemming from a lack of trust in the management authority.
3) Related to confidentiality, it is usually desirable to ensure that the data collection tasks and structures of a management authority are kept totally separate from the enforcement tasks and structures. Failure to do this will generate a fear among fishers that the data they supply to the management authority to facilitate monitoring and assessment of the stocks and fishery will be used against them by the enforcement arm. Again, this could lead to difficulties obtaining data or to falsified or incomplete data.

Costs of collection and collation of data

1) The collection, collation and dissemination of data should be carried out in the most cost-effective manner possible so as to minimize costs while acquiring the required information. Collection and analysis systems should be based on appropriate statistical designs to ensure that sufficient but only necessary data are collected.
2) Duplication in data collection and analysis should be avoided unless deliberately intended for validation purposes or for other reasons related to maintaining quality. Unnecessary duplication is most likely to occur where there are straddling or shared stocks with multiple authorities having common responsibilities.

Data Requirements & Use Relevant to the Formulation of a Fisheries Management Plan

General considerations

1) A fisheries management plan is an explicit arrangement between a fishery management authority (e.g. the LGU, BFAR) and the recognized interested parties. It should identify these parties and clarify their respective roles, rights and responsibilities. It should list the objectives agreed on for the fishery and the harvesting strategy, rules and regulations applied to realize those objectives. It should also describe the mechanisms for on-going consultations, the arrangements to ensure compliance and any other information relevant to the management of the fishery.
2) The formulation of a management plan should include iterative consultation between the management authority or authorities and the user groups and other stakeholders. Stock assessment and modeling approaches, where feasible and appropriate, should be used to investigate the biological, social and economic implications of different harvesting strategies and management options, and the results used to assist in the selection of the most appropriate plan. A summary of data and information essential or desirable in the formulation of management plans is provided in Table A7.1.

Table A7.1. Desirable data & information requirements for fisheries for the formulation & implementation of management plans, according to nature and use of the data

** = Desirable but lower priority*

Data type			
Related to the resource	**Fishery characteristics**	**Social and economic information**	**Monitoring, control and surveillance**
Historical and current catch data (in weight or numbers), including directed and by-catch and discards, for fishery and fleets Size and/or length composition of catch per fleet Sex and maturity composition of catch per fleet(*) Age composition of catch per fleet(*) Time, date and locality of all catches(*) Fishery independent biomass estimates	Gear used by different fleets and knowledge of its selectivity Number of fishing units (e.g. vessels and fishers) in each fleet Numbers and localities of landing sites and fishing units operating from or landing at each site Total effort for each fleet Relative fishing power of different fishing units Area fished by each fishing unit	Description of the types of production units in the fishery and the number of each type of production unit per fleet Details of user or access rights systems related to the fishery Total number of fishers employed in all fisheries-related activities, with details on gender and age-group characteristics	Existing monitoring and control systems for the fishery and fleets within it Known strengths and weaknesses of existing systemsImplications (personnel, costs, benefits, etc.) of range of approaches for monitoring and control Potential for greater user participation
Results of stock assessments indicating potential yields and resource status under different harvesting strategies Annual estimates of number of recruits entering fishery(*) Stomach contents data for knowledge of trophic relations Data on mass of species consumed per predator type and feeding preferences of predators(*)	Detailed characteristics on equipment per vessel which could influence efficiency (e.g. GPS, echo-sounder, etc.)(*) Mass of catch (*) Implications for each fleet for range of management approaches Comprehensive data, per catch, on effort used, exact position, depth fished and other data relevant to characteristics of the catch for each fleet(*)	Existence of, and possible solutions to, any conflicts between fisheries or fleets Total landed value of the catch for each fleet and any other benefits Details on processing of catch and on markets, as well as benefits derived from these activities Existing or potential systems (institutions) and their potential roles in shared responsibility or co-management	Existing legislation and regulations Additional legislation and regulations, or modifications, required for range of management approaches
Time series of indices of environmental characteristics (e.g. sea surface temperature)(*)		Details on full costs of fishing by fleet and processing, marketing and distribution costs Specific international trade or cooperation agreements relevant to fisheries Details on socio-economic characteristics of national or local non-fishing activities which do or may impinge on the fisheries Procedures for consultation and joint decision-making	

Data type			
Related to the resource	**Fishery characteristics**	**Social and economic information**	**Monitoring, control and surveillance**
Most recent data on indices (or indicators) used in management procedure (e.g.CPUE, estimated biomass, etc.) Information on biological or environmental features which could affect interpretation of indices Information on any unexpected event related to the stock (e.g. unusual recruitment, natural mortality, environmental conditions) which could warrant departure from management procedures	Total catch and effort data for the fishery or, if heterogenous, per fleet Unusual features of fishery or fleet behavior which could influence interpretation of stock indices used in the management procedure Changes in fishery or fleet composition which could impact on management procedures	Unexpected social changes which could require departure from management procedure, e.g. movements, changes in patterns of access Unexpected economic changes, e.g. in markets, returns or costs which could seriously impact the management plan Social and economic performance of fisheries and fleets in relation to objectives of management plan	Name of each fisher or licensed fishing unit (e.g. vessel) Address or port of registry of each vessel or fishing unit Name and address of owner of each fishing vessel or unitInformation from each fishing unit necessary for enforcing management measures (e.g. catch, effort deployed, catch position, etc.)
Status of the stock in relation to trends anticipated in the management plan		Details on the nature and causes of any serious conflicts within the fishery	In the case of vessels: (1) date and place built (2) type of vessel (3) length of vessel (4) vessel markings (5) type of gear (6) international radio call signIncidence and causes of any serious and ongoing violations of the management plan

The target stock, or stocks, and its environment

1) The potential yield from a stock or community is dependent not only on the biological characteristics of the stock and on the environment, but also on the harvesting strategy used, in particular the age structure and species and sex composition of catches, and the timing of fishing in relation to maturity and spawning. These characteristics of the catch can also affect the social and economic benefits derived from the fishery. For example, smaller animals may command a higher price per unit mass than larger animals in some markets while in others, the opposite situation may apply.
2) In the formulation of management plans, the management authority, with the participation of the interest groups, should investigate and provide information on the biological, social and economic implications of different harvesting strategies and management options. For biological assessments, data will be required on historical catch and effort in the fishery, the size composition of the catch (translated into age composition, if possible) and the sex and sexual maturity characteristics of the catches.
3) While it is sometimes possible to undertake reliable stock assessments using fisheries information alone, independent estimates, or indices, of stock biomass with time generally provide very useful supplementary data on stocks. Where the value of the fisheries being managed justifies it, management authorities should attempt to collect, annually or biennially, fishery-independent estimates of stock biomass or abundance.
4) Stocks and ecological communities are influenced by other stocks and ecological communities with which they interact, and changes in their population structure induced by fishing can, in turn,

influence these interacting stocks or communities. Where possible, information should be collected, even if only qualitative, on the nature and strength of such relationships to allow the implications of different management plans on non-target species or communities to be evaluated.

5) Basic data for this would normally include information on trophic interactions through studies on diets of interacting species and on the relative abundances of interacting species.
6) Information on environments critical in the life history of the stocks or communities should be considered in the development of management plans, particularly for inland waters species or for marine species where one or more life stages occur inshore. This will enable consideration, and inclusion, of the possible impacts of other uses of these environments or habitats in the management plan.

Fishery characteristics

1) Generally, management plans are developed on fisheries which already exist and may have existed for many decades. The fishery on any given stock may be simple, consisting of a single, relatively homogenous fleet, or may be complex, consisting of several different fleet types, each fleet using distinct gear with distinct selectivity patterns or fishing different fishing grounds. A management plan needs to consider each of these fleets in terms of their impact on the resources and, in turn, the impact of a management plan on them.
2) This requires that data and information be collected and analyzed on each fleet such as: the number of vessels or units; their gear characteristics and the selectivity of the gear; any seasonality in fishing; the locality of fishing in relation to the distribution of the stock and other fleets; any navigational or technological aids which assist in fishing; and related factors.
3) Systems for sampling landings need to be designed to ensure that the weight of landings and the biological characteristics of the catch, as well as effort, are accurately determined for each fleet. Where there is reason to suspect that discarding of unwanted portions of the catch occurs before landings are recorded, the quantity, species composition and biological characteristics of the discarded portion should be estimated. Observers during fishing operations and simulated fishing (test fishing) are generally the most reliable means of obtaining these estimates.

Social and economic information

The details provided in these sections should not be taken to be encouraging major involvement of the management authority in the operations of the various interest groups. In most cases, these interest groups will be in possession of the best information on the economic details and trends necessary for the successful operation of their fishery interests. Under such circumstances, the role of the fishery management authority will be more to provide advice where necessary and to consider, or facilitate consideration of, issues of common interest between different fisheries interest groups, and between fisheries interest groups and others whose activities interact with the fisheries. This may frequently require capabilities in multi-criteria decision-making and conflict resolution.

1) Humans are an integral part of fisheries systems, and fisheries systems cannot be understood unless the social and cultural features and the economic characteristics of the people and communities within the system are understood. Any fisheries management decision is likely to have an impact on peoples' livelihoods and way of life. The purpose of collecting and analyzing social and economic information is to be able to anticipate the nature and extent of these impacts and to make decisions so as to optimize them. Collection and analysis of data on relevant social, economic and institutional factors is therefore essential for responsible fisheries management.
2) Fishery managers should have information on the following:
   a. The interest groups, their features and their interests in the fishery;
   b. The economic factors related to the fishery, particularly the economic and social dependence of the different interest groups on the fishery;
   c. Details on costs and benefits to the region, State or local area from the fishery;
   d. The role of the fishery in providing employment to different interest groups;
   e. The alternative sources of employment and income for the different interest groups or communities;
   f. The current status of access to or ownership of the resources;
   g. the institutions currently involved in decision-making within the fishery;
   h. An outline of the history of the fishery and the historical roles of the different interest groups within that fishery.

3) The economic role and performance of fisheries is influenced by the whole regional, national or local economy, and information on these influences is required for wise and responsible policy development. These include the main factors contributing to the broader economy, the main factors driving or hindering development within this broader economy and the influences or potential influences of any development on the fisheries sector.
4) Social, economic and even institutional characteristics are as dynamic as biological features and tend to change with time. It is therefore important to monitor and provide information on trends in these factors, including on issues such as demographic changes, movements of people, trends in the markets and issues related to costs in order to assist in the development of policies which will not rapidly become obsolete.
5) Fisheries are frequently marked by conflicts between different sectors or within sectors. Often, an important role of fisheries management is to determine a fisheries environment in which conflict or the potential for conflict is minimized. Information is therefore required on historical and existing conflicts and their causes, as well as on possible solutions to such conflicts.
6) Fisheries may also be aggregated into production units, which may not coincide with the interest groups. For example, a production unit may consist of a boat with its associated crew, a single net and those required to operate it, or a factory and its management and labor. The impacts of management decisions must be considered in terms of production units as well as in terms of the interest groups. It is therefore essential to identify the types and number of production units in a fishery and to consider the impacts of production units on the fishery and the impacts of management decisions on production units in formulating a management plan. Fishing effort is normally a function of production units and management actions may involve direct action on these units, either altering the number or influencing their mode of operation.
7) Interest groups will generally be heterogeneous in structure, and management action may have a different impact on one sub-group within an interest group than on another. For example, the role of women in an artisanal fishery will frequently be different from that of the men. Children may also have a distinct function. Decision-makers, particularly at community level, may be dominated by older men. Information on these differences needs to be collected and analyzed to enable evaluation of the impacts of a management plan on all the distinct sub-groups within an interest group. Failure to do this may result in the failure of a management plan because of unexpected social or economic consequences.
8) The information necessary to forecast the economic impact of fisheries management actions needs to be collected and analyzed for use in the formulation of a management plan. Any action is likely to have different economic implications for the different interest groups, sub-groups and on the fishery as a whole, and these implications need to be estimated and considered. The economic importance of fisheries involves not only people and transactions related to the capture and processing of the fish but also, more generally, the dynamics of investments and markets, and this broader importance must also be considered. For example, in remote coastal areas whole towns or villages may be ultimately dependent on fisheries and hence affected by fisheries management decisions and plans.
9) Economic factors which need to be taken into account for each interest group, and their sub-groups, include:
    a. Benefits, which can include rent earned from sale of the fish at different stages in its capture and processing;
    b. Benefits other than financial, such as opportunities for bartering and factors related to social status;
    c. Costs, including costs such as those associated with harvesting (fuel, repairs, crew remuneration, depreciation of capital, insurance etc.), costs associated with processing (capital depreciation, fuel, electrical power and water, packaging, wages etc.), and opportunity costs (the "loss" incurred by not using the money invested in the fishery in some other way, such as simply investing it in an interest-bearing account).
    d. Taxes paid as a result of the fishery and, conversely, subsidies paid into the fishery.
10) The contribution of the fishery to employment should be quantified. Fisheries management decisions frequently have an impact on formal or informal employment, and the impact of a specific decision, or plan, on this should be considered. Labor in fisheries is frequently seasonal in nature and this should also be explicitly considered. For example, management decisions that ignore the seasonality of fish or labor availability are likely to fail.

11) It is important in the formulation of a management plan to have information on the existing institutional structures pertinent to that fishery. This requires that information is available on: the formal and informal institutions involved in the fisheries and their composition and functions; the leadership of different interest groups; the decision-making process within the different interest groups; and the management mechanisms relating to the fishery at all levels. Again, this information should be used to assist in ensuring that the opinions and interests of all groups and sub-groups are genuinely considered in the management plan and that the probable impacts on and responses of these groups and sub-groups have been considered and appropriately covered within the plan. Failure to do this will increase the risks of failure of the management plan to achieve its objectives, or result in inappropriate objectives being selected.
12) Where there are appropriate institutions in existence, such as traditional structures, these should be used as a part of the fisheries management system. For example, if a community has an accepted and functional system for determining access to a fishery or regulating fishing seasons, this should be incorporated into the fisheries management plan to facilitate both acceptability and implementation. However, care needs to be taken that the institution is appropriate for the function or functions being delegated to it. Institutions which have a customary role may not be appropriate for other non-customary functions and their decisions and actions may not be accepted by the community if they are beyond the normal jurisdiction of the institution. Information is therefore required on the customary roles of existing institutions and on roles which can successfully be transferred to them.
13) Finally, social, economic and institutional factors are dynamic and are subject to change. Cultural and political factors may also lead to changes in access distribution or changes in pressures for access. Changes in the market, whether local or international, may result in substantial shifts in fishing behavior or strategies. All of these may mean that the objectives initially identified for a management plan become rapidly obsolete. Therefore, trends in such important factors need to be described and the information on their implications for a management approach or plan collected and evaluated. Failure to do this may result in a management plan becoming unworkable in a short space of time.

Monitoring, control and surveillance

1) Monitoring, control and surveillance of fisheries is critical to their successful management, and the widespread failure of fisheries management on a global scale has, in large part, been a result of the inability of authorities to enforce successfully or otherwise ensure compliance with their management regulations and to monitor accurately the behavior and performance of the fishers. Responsible fishing requires effective monitoring, control and surveillance, which is dependent on the collection, collation and analysis of accurate and relevant data and information.
2) Because of the importance of monitoring and control, the implications for it of alternative management plans must be seriously considered by management authorities in selecting the most appropriate plan. Management plans should not be adopted where their implementation cannot be adequately monitored and controlled. For example, the use of TAC as a control mechanism requires that all landings must be monitored and catch by species recorded in close to real time, and adequate steps must be taken to prevent discarding of less valuable or unwanted catch or the unregistered transfer of this at sea. This approach requires substantial monitoring and information processing capacity. The use of effort control, on the other hand, is generally less expensive, but it requires accurate fleet registration and close monitoring of fleet performance and of technical or operational developments which could increase fishing efficiency and thus effectively increase effort. Use of closed areas or closed seasons requires the capacity to patrol during off seasons or in closed areas to ensure infringements do not occur. The most appropriate combination of control measures will depend on the nature of the resource, the fishery and the capacity of the management authority.

Data Requirements and Use in the Determination of Management Actions and Monitoring Performance

1) An integral part of a management plan should be a management procedure. A management procedure specifies how management actions should be determined and implemented, by describing which data should be collected, how they should be analyzed and exactly what management action should be taken according to the results of the analyses. Management actions and the means by which they may be adjusted for changing circumstances, such as biomass fluctuations, should be determined by pre-

negotiated management procedures. The specific actions can then be implemented by the management authority without the need for additional consultation and negotiation. A management procedure may also include contingency plans, also reviewed in advance with interested parties, enabling the management authority to undertake speedy and effective action in cases where the stock falls to levels requiring emergency action. If circumstances change before a review of the management plan is due, to the point where the management plan and procedure need to be revised, the requirements become those of plan formulation.

2) Except under exceptional circumstances of either very high catch or very low biomass, valid and scientifically defensible estimates of the risk to a stock induced by a particular fishing strategy can only be obtained by looking at projections over the medium to long term, typically ten years or more. Such studies should underlie the development of management plans and their associated management procedures. It is not possible to estimate reliably the impact on a stock or community in the medium to long-term of a single *ad hoc* decision on allowable catch or effort. Therefore, management decisions should be made on the basis of a pre-negotiated management plan and procedure, the impact of which has been tested over a suitably long projection period.

The target stock, or stocks, and its environment

1) Invariably, an estimate or index of stock size will be required for the adjustment, typically annually, of those control measures included within a management plan. If the management procedure includes a requirement that there should be an annual or seasonal adjustment to, for example, the TAC, total effort, length of a closed season or other measure to regulate fishing mortality, this adjustment will almost certainly need to be made on the basis of the best estimate of the status of the stock. The management authority must ensure that it collects, collates and analyzes the data necessary to determine as precisely and accurately as possible this index or estimate, in time for the decision to be made. Probably the most commonly used index of abundance is a mean commercial CPUE figure for the period under review for the fishery or for a representative sub-section of the fleet. The precision of such an index should be commensurate with the risk involved and the possibility of an over-estimation of stock size should be covered under the precautionary approach.
2) The spatial distribution of living aquatic resources is dynamic, changing seasonally and sometimes markedly from year to year. Changes in distribution can cause changes in "catchability" (of the resource) by the fishery or by survey gear. These could be interpreted as changes in abundance, leading to incorrect decisions on management action being taken. Therefore, CPUE data should not be used alone without some additional information on geographic distribution and trends in stock distribution. The best approaches to this are not well defined, but a relatively simple approach that can be taken to incorporating geographic trends is to stratify the area or areas in which a stock is fished into sub-areas, and to analyze each sub-area separately. This will enable evaluation of the CPUE, or survey index, in a variety of localities and thus increase the probability of picking up changes in CPUE in parts of the range brought about by changes in distribution.
3) As with data for the development of a management plan, if the value of the fishery can justify it, a valid fisheries-independent estimate of stock abundance provides extremely useful supplementary information. For fisheries which are highly dependent on recruiting age-classes (such as most short-lived species), a survey directed on pre-recruits may be most useful. Surveys should use standard fishing techniques which must remain constant, or be calibrated to each other, for valid estimates of trends or changes in stock abundance to be made from one survey to the next. Experience has shown that it is frequently difficult to avoid changes in fishing technique, and care must be taken in interpreting data where this is suspected to have occurred.
4) The [UN-FAO Code of Conduct for Responsible Fisheries] calls for emergency action in the event of natural phenomena having substantial actual or potential negative impact on living aquatic resources. Therefore, at least rudimentary information on the status of the key environmental parameters, such as sea surface temperature, climatic conditions (such as wind strength and direction, rainfall, river outflows, etc.) should be routinely collected and analyzed to assist in the detection of abnormal phenomena and their influence on the stock which may require particular management measures. Other factors which could be considered include, for example, the water level or seasonal flow patterns in inland waters, changing chlorophyll abundance and distribution, unusual seasonality, oxygen concentrations in low oxygen areas, and the status of key predators and prey on the stocks. Remote sensing has a potentially important role to play in this area.

Fishery characteristics

1) The nature of the fishery, and the fleets comprising it, here considered to be not only discrete groups of vessels but also of land-based fishers, should have been considered in the development of the management plan. In the implementation of the management plan, as with the resources, the role of information on fishery characteristics would be limited to those types of data required by the management procedure to support control decisions.
2) The most common use of fishery-related data in the implementation of a management procedure is the application of effort statistics to facilitate estimates of CPUE. Again, the method of collection and analysis of catch and effort data should be carefully specified in the management plan. This would normally involve obtaining estimates of the total catch per fleet comprising the fishery and of the total fishing effort, in appropriate units, exerted by each fleet. These would then be interpreted collectively to provide an index of stock abundance, taking note of the considerations discussed under ***The target stock, or stocks, and its environment*** above. It may also be possible to use representative sub-sets of a specified fleet component for these calculations where data for the whole fleet are not available. Care must also be taken in this connection in deciding on vessel categories by size, gear type and fishing behavior. In special cases, for example where one or more fleets are fishing on the same age component of the stock in the same area and with gears of equivalent selectivity, it may be possible to use the data from only one of the fleets for assessment of an abundance index.
3) The characteristics and behavior of the fleet should be monitored to facilitate correct interpretation of CPUE trends. Any changes in fishing grounds, seasonal distribution of effort, gear type or other factors which could influence efficiency of the fishery need to be considered in interpretation of the catch and effort data.

Social and economic information

1) In general, the social and economic features of the fishery should have been considered early in the development of the management plan, and the agreed needs and preferences of the various interest groups should have been incorporated into it. The implementation of the pre-negotiated management plan should be in the best interests of the different interest groups, including important sub-groups within the groups. Therefore, social and economic considerations would not normally be a major input into the management procedure used to determine annual or seasonal control measures.
2) Social and economic forces and dynamics can influence the fishery, among others giving rise to changes in the behavior of the fishers. For example, changes in market preference for size could result in changes in the fishing strategy of the fishery, which in turn result in changes in CPUE which are independent of stock abundance. On-going liaison with the different interest groups, and monitoring of appropriate social and economic indicators to detect such changes, should be carried out. Where necessary such changes will need to be reflected in the calculations or implementation of the management procedure.
3) The management plan should include explicit statement of objectives and these will normally include social and economic objectives. The degree to which the plan is succeeding in attaining such objectives should be monitored continually and the reasons for and implications of any marked failures in achieving objectives evaluated. Serious failures in performance of a management plan could lead to a decrease in compliance with its provisions or strong pressure to revise the plan without waiting for the scheduled routine review. However, it must be accepted that the natural variability in fish abundance and productivity means that social and economic benefits are likely to be similarly variable from year to year. Therefore, a management plan must be evaluated over a number of years and not abandoned whenever returns fall below the expected average return.
4) Notwithstanding the existence of a pre-negotiated and agreed management plan, experience has shown that the interest groups will tend to try and depart from the management plan when it results in decisions that they perceive are not in their immediate best interests, for example if it leads to substantial controls on fishing effort. In such cases, social and economic arguments are normally used to support a requested departure from the management plan. The management authority should be in possession of the data and information necessary to evaluate these claims of social or economic hardship and, therefore, to be able to weigh them up objectively against negative impacts such as an increased risk to the stock. In general, departures from a management plan should only be considered in exceptional circumstances.

Monitoring, control and surveillance

1) ***Monitoring*** involves the collection, measurement and analysis of data and information on fishing activities and is therefore largely covered in the preceding sections. In addition to collecting the data necessary for implementation of a management plan fisheries management authorities must ensure that they are collecting on a regular and continuous basis the data necessary for the next revision of that plan. ***Control*** refers to specifying the terms and conditions under which resources can be harvested and ***surveillance*** involves checking and supervising fishing activities to ensure all applicable laws and regulations are being observed by the participants in the fishery.
2) Monitoring, control and surveillance needs and approaches will vary substantially from fishery to fishery and even fleet to fleet. For example, the approaches are likely to be very different for small-scale artisanal fisheries fishing in diverse, tropical ecosystems and large-scale industrial fisheries utilizing essentially single stocks.
3) Monitoring, control and surveillance require knowledge of the details of the fishers, the gear they are using, and the port or ports of registry and landing. Such information could, for example, be obtained from a comprehensive frame survey undertaken every two to three years.
4) Thereafter, at the simplest level, acquiring the data required for monitoring, control and surveillance may involve simply collecting catch and effort information at landing points and encouraging fishers to report any infringements in regulations they observe. However, at the other end of the spectrum, monitoring, control and surveillance may involve the use of dedicated patrol craft and aircraft supported by effective administrative and legal structures. In this case, operations of surface craft and aircraft used for this purpose should be closely coordinated, and patrols should be based on a historical understanding of the fishery or fleet operations.

Appendix 8. Linkages Between Some Basic Data Requirements, Indicators (Suggested Examples) & Operational Objectives For A Hypothetical Fishery

Source: Adapted from FAO, 2003

Note: Not all objectives will apply to all fisheries; many fisheries will be concerned by other issues, objectives and, hence, data requirements.

OBJECTIVE	EXAMPLE INDICATOR	DATA REQUIREMENTS	POSSIBLE SOURCES / METHOD OF COLLECTION OF DATA
Fishery resources (Target species)			
Reduce fishing effort	Fishing effort of different fleets	Vessels, time fished and gear type per fleet	Secondary information; catch and effort monitoring; fishery registry; interviews/surveys
Reduce fleet capacity	Fleet capacity	Vessels registered and gear type per fleet	Secondary information; fishery registry; interviews/surveys
Increase/maintain fish landings of commercially valuable species by area	Fish landings by major species by area	Total landings by major species per fleet per year	Catch and effort monitoring; secondary information; interviews/surveys
Increase/maintain spawning stock biomass of key retained species above a pre-defined limit	Spawning stock biomass of key retained species (or suitable proxy such as standardized CPUE)	Length and/or age composition of major retained species (or data required to estimate CPUE, e.g. total catches of retained species, time fished, number of gear, number of vessels, etc.)	Catch and effort monitoring; stock assessment; secondary information; interviews/surveys
Decrease/maintain the level of fishing mortality for key retained species below a predefined limit	Level of fishing mortality for key retained species	Length and/or age of the target species catch	Catch and effort monitoring; secondary information; interviews/surveys
Other ecological concerns			
Reduce discards to the extent practical	Total amount of discards	Total catches of by-catch species (or species groups/indicator species),per fleet per year	On-board observations of fishing operations?; interviews; secondary information
Reduce discards of high-risk species (or species groups) to predefined level	Amount of discards of high-risk species (or species groups)	Length and/or age of high-risk by-catch species	On-board observations of fishing operations?; interviews; secondary information
Reduce number of deaths of vulnerable and/or protected species to predefined level	Number of deaths of vulnerable and/or protected species	Catch of vulnerable and/ or protected speciesCatch of non-fishery material (critical habitat)	Catch and effort monitoring; police/ enforcement records; secondary information
Decrease/maintain same area of the fishery impacted by gear	Area of the fishery impacted by gear	Area fished by each fleet	Interviews, focus group discussions, surveys, secondary information

OBJECTIVE	EXAMPLE INDICATOR	DATA REQUIREMENTS	POSSIBLE SOURCES / METHOD OF COLLECTION OF DATA
cont. ... Other ecological concerns			
Increase amount of habitat protected by MPAs to predefined level	Amount of habitat protected by MPAs – this will be supported by additional indicators of habitat health: Reef fish biomass inside and adjacent to MPAs Reef fish species richness inside and adjacent to MPAs Benthic condition inside MPAs	Area under MPAs by habitats Population density (based on fish visual census), average body size of each species Number of fish species (based on fish visual census) Live coral cover in MPA	LGU ordinances PCRA, technical surveys, secondary information
Increase ratio of large fish in the community	Size spectrum of fish community	Length of fish in a representative sample of community	Catch and effort monitoring; stock assessment; interviews/FGDs, surveys; secondary information
Minimize the impact of other activities on fish resources and habitats	Area of fish nursery habitat degraded	Area of habitat, e.g. seagrass beds, mangroves and coral reefs	PCRA, technical surveys, secondary information
Maintain ecological balance	Mean trophic level of catch	Species composition from sample catches	Catch and effort monitoring; stock assessment; interviews/FGDs/ surveys, secondary information
Economic			
Increase the contribution of fishing to the local economy	Net economic return for fishery Profit to harvesting sector	Revenue from fishing per fleet per year Costs per fishing unit per year	Interviews/FGDs/surveys; auxiliary receipts; tax records; secondary information
Increase/maintain profit of the harvesting sector to that of similar industries	Household income from fishing	Revenue from harvesting Cost of harvesting	Interviews/FGDs/surveys; secondary information
Maintain or increase economic contribution to community		Fishers' income from fishing	Interviews/FGDs/surveys; tax records, if applicable; secondary information
Social			
Health benefits/Increase fish consumption per capita	Fish consumption per capita	Fish consumption from representative sample	Interviews/FGDs/surveys; secondary information
Ensure seafood quality meets food safety requirements	Number of food compliance reports	Food safety compliance reports	DOH records; Compliance reports
Increase/maintain employment in the harvesting and processing sector by fleet	Employment in the harvesting sector by fleet	Total number of fishers employed in each fleet Total number of people employed in fishery-associated activities (e.g. processing)	Fishery registry; secondary information (NSO, MDP)

OBJECTIVE	EXAMPLE INDICATOR	DATA REQUIREMENTS	POSSIBLE SOURCES / METHOD OF COLLECTION OF DATA
cont. ... Social			
Maintain or improve lifestyle value	Life-style value	Social surveys	Interviews/FGDs/surveys; secondary information
Maintain or improve cultural values	Cultural value	Cultural sites and values	Interviews/FGDs/surveys; secondary information
Maintain/increase level of activity of indigenous community	Number of indigenous fishers	Dependence of local community on fishing as a source of income or food	Fishery registry; National Commission on Indigenous Peoples; surveys/FGDs/ interviews; secondary information
Reduce the dependence of community on fishing	Dependence of community on fishing	Other income or livelihoods of the fisher	
Management activity / Institutions			
Have well-developed management plans, including indicators and reference points and evaluation procedure in place for all fisheries	Number of fisheries with well-developed management plans, including indicators and reference points	Number of fisheries with a well developed management plan, including operational objectives, indicators and reference points	MAO or other relevant office
Allocate regular budget for plan implementation	Budget allocated	Amount allocated by LGU; funding from other sources; percentage of total LGU budget allocated to fisheries management	Municipal annual investment plan; budget office
Establish restrictive licensing system	Number of fishers, gear and vessels registered and licensed; fleet capacity	Number of registered and licensed fishers, gear and vessels	Fishery registry
Reduce fishing effort	Effort restrictions introduced	Ordinances, administrative orders and other government issuances that restrict fishing effort	SB Secretary, Mayor's office, MAO
Enforce rules and regulations	Budget allocation for enforcement Enforcement operations	Amount allocated by LGUNumber of operations by enforcement units	Municipal annual investment plan; budget office
Establish collaborative inter-LGU and inter-agency arrangements to manage shared resources	Inter-LGU and inter-agency partnership agreements, collaborative activities	MOAs, MOUs, joint plans, joint activities	Mayor's office; Chief of Police; MAO
Encourage multi-sectoral support for fisheries management	Public-private sector partnerships supporting fisheries management, social infrastructure, population programs, and socioeconomic development in fishing communities	Agreements; amount of private sector investments in social infrastructure and socioeconomic development in fishing communities; activities to support fisheries management undertaken by NGOs, POs and other groups	Mayor's office; MAO MAO; Mayor's Office; Interviews with fishing and NGO communities; secondary information

OBJECTIVE	EXAMPLE INDICATOR	DATA REQUIREMENTS	POSSIBLE SOURCES / METHOD OF COLLECTION OF DATA
cont. ... Management activity / Institutions			
	Dissemination and utilization of fisheries management information materials	Activities undertaken by various groups (including LGU) to increase public awareness and encourage community action in support of fisheries management	

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Consolidated List of Additional References Provided with this *Sourcebook* or available from Web sources

Look up these resources in this *Sourcebook*'s companion CD, or follow the links provided:

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2. Code of Practice for Aquaculture (FAO No. 214 s. 2001 and FAO No. 214-1 s. 2004) – *http://bfar.da.gov.ph/legislation/fao/fao214.htm; http://bfar.da.gov.ph/legislation/fao/fao214-1.htm*
3. Code of Conduct for Responsible Fisheries — *ftp://ftp.fao.org/docrep/fao/005/v9878e/v9878e00.pdf*
4. Code of Practice for Sustainable Use of Mangrove Ecosystems for Aquaculture in Southeast Asia – *http://www.seafdec.org.ph/pdf/Code_of_Practice_Mangrove.pdf*
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7. FAO Technical Guidelines for Responsible Fisheries 4: Fisheries management. 3. Managing fishing capacity – *ftp://ftp.fao.org/docrep/fao/011/i0318e/i0318e.pdf*
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10. Full text of JAO No. 1 s 2008 (defining/identifying the areas of cooperation and collaboration among DA, DENR and DILG in the planning, management and control of aquaculture development to mitigate impacts on the environment) – *http://philminaq.eu/pdf/Downloads/Joint%20Administrative%20Order.pdf*
11. In Turbulent Seas: The Status of Philippine Marine Fisheries – *http://oneocean.org/download/db_files/fshprofl.pdf*
12. Local Government Code of 1991 (RA 7160) -- *http://oneocean.org/download/20020326/LGC1991.pdf*
13. Managing Aquaculture and Its Impacts – *http://bfar.da.gov.ph/news/BFAR-PHILMINAQ [final].pdf*
14. Mending Nets: A Handbook on the Prosecution of Fishery and Coastal Violations – *http://oneocean.org/download/db_files/mending_nets2nd_ed.pdf*

15. Philippine Coastal Management Guidebook Series

a. Coastal Management Orientation and Overview — *http://oneocean.org/download/db_files/crmguidebook1.pdf*

b. Legal and Jurisdictional Framework for Coastal Management – *http://oneocean.org/download/db_files/crmguidebook2.pdf*

c. Coastal Resource Management Planning – *http://oneocean.org/download/db_files/crmguidebook3.pdf*

d. Involving Communities in Coastal Management – *http://oneocean.org/download/db_files/crmguidebook4.pdf*

e. Managing Coastal Habitats and Marine Protected Areas – *http://oneocean.org/download/db_files/crmguidebook5.pdf*

f. Managing Municipal Fisheries – *http://oneocean.org/download/db_files/crmguidebook6.pdf*

g. Managing Impacts of Development in the Coastal Zone – *http://oneocean.org/download/db_files/crmguidebook7.pdf*

h. Law Enforcement — *http://oneocean.org/download/db_files/crmguidebook8.pdf*

16. Philippine Fisheries in Crisis: A Framework for Management – *http://oneocean.org/download/db_files/philippine_fisheries_in_crisis.pdf*

17. Philippine Fisheries Code of 1991 (RA 8550) and Implementing Rules and Regulations -- *http://oneocean.org/download/990330/fishery_code_irr.pdf*

18. Regional Guidelines for Responsible Aquaculture in Southeast Asia — *http://www.seafdec.net/rccrf/GL2.pdf*

19. Regional Guidelines for Responsible Fisheries Management in Southeast Asia – *http://www.seafdec.net/rccrf/GL3.pdf*

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2. Full text of FAOs — *http://bfar.da.gov.ph/legislation/list.htm*

3. Impacts of biodiversity loss on ocean ecosystem services —*http://www.stanford.edu/group/Palumbi/PeoplePages/Worm2006.pdf*

4. Understanding Fisheries Management: A manual for understanding the Federal Fisheries Management Process, including analysis of the 1996 Sustainable Fisheries Act – *http://nsgl.gso.uri.edu/masgc/masgch00001.pdf*

Acronyms & Abbreviations

ADB	Asian Development Bank
AFMA	Agriculture and Fisheries Modernization Act
AFMA	Agriculture and Fisheries Modernization Act
AFMP	Agriculture and Fisheries Modernization Plan
Art.	Article
ASEAN	Association of Southeast Asian Nations
BFAR	Bureau of Fisheries and Aquatic Resources
BLGD	Bureau of Local Government Development
BLGS	Bureau of Local Government Supervision
BRD	by-catch reduction device
CBFMA	community-based forest management agreement
CEP	Coastal Environment Program
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CLE	coastal law enforcement
CLEC	Coastal Law Enforcement Council
cm	centimeter
CPUE	catch per unit effort
CRM	coastal resource management
CRMP	Coastal Resource Management Project
DA	Department of Agriculture
DA-BFAR	Department of Agriculture-Bureau of Fisheries and Aquatic Resources
DA-FSP	Department of Agriculture-Fisheries Sector Program
DAO	department administrative order
DENR	Department of Environment and Natural Resources
DFA	Department of Foreign Affairs
DILG	Department of the Interior and Local Government
DOST	Department of Science and Technology
DOTC	Department of Transportation and Communication
EAF	ecosystem approach to fisheries
ECC	environmental compliance certificate
EIS	environmental impact statement
EO	executive order
FAO	fisheries administrative order
FARMC	Fisheries and Aquatic Resource Management Council
FGD	focus group discussion
FISH Project	Fisheries Improved for Sustainable Harvest Project
FLA	fishpond lease agreement; foreshore lease agreement
FMU	fisheries management unit
FSP	Fisheries Sector Program
GMPS	general management planning strategy
GT	gross ton; gross tonnage

GTZ	Deutsche Gesselschaft für Technische Zussamenarbeit (German Agency for Development Cooperation)
ha	hectare
ICLARM	International Center for Living Aquatic Resources Management (now WorldFish Center)
ICM	integrated coastal management
IEC	information, education and communication
IFARMC	Integrated Fisheries and Aquatic Resource Management Council
IRA	internal revenue allotment
IRR	implementing rules and regulations
kg	kilogram
km	kilometer
LGA	Local Government Academy
LGC	Local Government Code
LGU	local government unit
LHC	live hard coral
M&E	monitoring and evaluation
M/CFARMC	Municipal/City Fisheries and Aquatic Resource Management Council
MAO	municipal agriculture officer
MARINA	Maritime Industry Authority
MCS	monitoring, control and surveillance
MFO	municipal fisheries ordinance
mm	millimeter
MPA	marine protected area
MSY	maximum sustainable yield
MVP	minimum viable population
NAMRIA	National Mapping Resource and Information Authority
NARRDS	National Aquatic Resources Research Development Systems
NBOO	National Barangay Operations Office
NEDA	National Economic Development Authority
NFRDI	National Fisheries Research and Development Institute
NGA	national government agency
NGO	non-governmental organization
NIPAS	National Integrated Protected Areas System
NWMC	National Water Management Council
PAMB	Protected Area Management Board
PCAMRD	Philippine Council for Aquatic and Marine Research and Development
PCARRD	Philippine Council for Agriculture, Forestry and Natural Resources Research and Development
PCG	Philippine Coast Guard
PCRA	participatory coastal resource assessment
PCSD	Palawan Council for Sustainable Development
PD	presidential decree
PDBR	Philippine Double Barrier Reef
PEDO	Police Environment Desk Officer
PFDA	Philippine Fisheries Development Authority

PNP	Philippine National Police
PNP-MARIG	Philippine National Police Maritime Group
PO	people's organization
PPA	Philippine Ports Authority
RA	Republic Act
SAFDZ	Strategic Agriculture and Fisheries Development Zones
Sec.	section
sq m	square kilometer
TAC	total allowable catch
TED	turtle exclusion device
TORM	target-oriented resource management
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UN-FAO	Food and Agriculture Organization
USAID	United States Agency for International Development
USD	US dollar
WTP	willingness to pay

Glossary

abiotic – non-living

accountability – as used in this text, requires that the LGU is given specific responsibilities and authority as well as guidance and support, and that it is held to account for and should be monitored and assessed in the exercise of its responsibilities and authority. Accountability in government is the cornerstone of good governance. The following are some of its core elements (AWID, 2008):

a) *norms and standards*: the action that is required or prohibited should be clearly defined and should be the outcomes of processes that are themselves consistent with human rights principles;
b) *information, education and communication*: norms and standards should be communicated to all actors who are expected to comply, to those responsible for oversight, to the direct beneficiaries and to society at large as the ultimate beneficiary of human rights guarantees; this element, together with the requirements that the rules (norms and standards) be clearly defined, amounts to *predictability*, which allows individuals and groups to conform their action to the rules; education is the enabling factor for communicating the rules;
c) *responsibility for oversight:* legal, institutional and operational responsibility for ensuring conformity to norms and standards should be clearly designated;
d) *defined scope of responsibility for failing to meet, or violating, obligations*: both individual and collective forms of responsibility for violations should be expressly recognized and the scope (or extent) of responsibility for violations and failure to fulfill obligation should be defined;
e) *transparency*: information about the act or failure to act should be subject to scrutiny by an independent entity and, ultimately, to consideration by civil society;
f) *inquiry*: effective procedures should be established for eliciting or establishing the facts and assessing the facts against the applicable standards or directives;
g) *fairness*: decisions to seek accountability and the processes by which it is established should be bias-free and consistent with the core human rights protections; to be fair, accountability processes should, to the maximum extent possible, minimize power differentials within the process itself, including power disparities based on gender, race, economic status or other status, and between the state and individuals subject to the process; fairness includes recognition of the interests of those most directly affected by the action or inaction. It also restrains the use of accountability processes for the political or other gain of those holding power;
f) *corrective responses:* the outcome of procedures aimed at censuring accountability should provide for redress of past harm and prevention of violations or inactions in the future; and *follow up*: the capacity to encourage or induce the implementation of corrective responses, whether through ongoing scrutiny and assessment or more coercive measures, is necessary to sustain accountability. Accountability processes require the capacity to move forward into the future in order to support remedial and/or transformative action.

active adaptive management – involves changing management strategies altogether in order to test completely new hypotheses. So while the goal of passive adaptive management is to improve existing management approaches, the goal of active adaptive management is to learn by experimentation in order to determine the best management strategy. (*related:* **passive adaptive management***; see also* **adaptive management**). (Wikipedia.org, Adaptive management)

active fishing gear — a fishing device characterized by gear movements, and/or the pursuit of the target species by towing, lifting, and pushing the gears, surrounding, covering, dredging, pumping and seating the target species to impoundments; such as, but not limited to, trawl, purse seines, Danish seines, bagnets, paaling, drift gill net and tuna longline. (RA 8550, 1998) (*Related:* **passive fishing gear**)

adaptive management – is a structured, iterative process of optimal decision making in the face of uncertainty, with an aim to reducing uncertainty over time via system monitoring. In this way, decision making simultaneously maximizes one or more resource objectives and, either **passively** or **actively**, accrues

information needed to improve future management. Adaptive management is often characterized as "learning by doing." (Wikipedia.org, Adaptive management)

anadromous species -- marine fishes which migrate to freshwater areas to spawn. (RA 8550, 1998) (*related:* **catadromous species**)

ancestral domain – subject to Section 56 of RA 8371, refer to all areas generally belonging to indigenous cultural communities/indigenous peoples (ICCs/IPs) comprising lands, inland waters, coastal areas, and natural resources therein, held under a claim of ownership, occupied or possessed by ICCs/IPs, by themselves or through their ancestors, communally or individually since time immemorial, continuously to the present except when interrupted by war, force majeure or displacement by force, deceit, stealth or as a consequence of government projects or any other voluntary dealings entered into by government and private individuals/ corporations, and which are necessary to ensure their economic, social and cultural welfare. It shall include ancestral lands, forests, pasture, residential, agricultural, and other lands individually owned whether alienable and disposable or otherwise, hunting grounds, burial grounds, worship areas, bodies of water, mineral and other natural resources, and lands which may no longer be exclusively occupied by ICCs/IPs but from which they traditionally had access to for their subsistence and traditional activities, particularly the home ranges of ICCs/IPs who are still nomadic and/or shifting cultivators (RA 8371, 1997)

ancillary industries - firms or companies related to the supply, construction and maintenance of fishing vessels, gears, nets and other fishing paraphernalia; fishery machine shops; and other facilities such as hatcheries, nurseries, feed plants, cold storage and refrigeration, processing plants and other pre-harvest and post-harvest facilities. (RA 8550, 1998)

appropriate fishing technology - adaptable technology, both in fishing and ancillary industries, that is ecologically sound, locally source-based and labor intensive. (RA 8550, 1998)

aquaculture - fishery operations involving all forms of raising and culturing fish and other fishery species in fresh, brackish and marine water areas. (RA 8550, 1998); the farming of aquatic organisms including fish, mollusks, crustaceans and aquatic plants with some sort of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated. For statistical purposes, aquatic organisms which are harvested by an individual or corporate body which has owned them throughout their rearing period contribute to aquaculture (FAO Glossary). (*related:* **demarcated areas**, **mariculture, sea ranching**, **sea farming**)

aquatic pollution - the introduction by human or machine, directly or indirectly, of substances or energy to the aquatic environment which result or is likely to result in such deleterious effects as to harm living and non-living aquatic resources, pose potential and/or real hazard to human health, hindrance to aquatic activities such as fishing and navigation, including dumping/disposal of waste and other marine litters, discharge of petroleum or residual products of petroleum Of carbonaceous materials/substances, and other, radioactive, noxious or harmful liquid, gaseous or solid substances, from any water, land or air transport or other human-made structure. Deforestation, unsound agricultural practices such as the use of banned chemicals and excessive use of chemicals, intensive use of artificial fish feed and wetland conversion that cause similar hazards and deleterious effects shall also constitute aquatic pollution. (RA 8550, 1998)

aquatic resources - includes fish, all other aquatic flora and fauna and other living resources of the aquatic environment including, but not limited to, salt and corals. (RA 8550, 1998)

artificial reef - any structure of natural or man-made materials placed on a body of water to serve as shelter and habitat, source of food, breeding areas for fishery species and shoreline protection. (RA 8550, 1998)

atoll – a type of barrier reef that develop around a subsiding islet

autotroph — (from the Greek *autos* = self and *trophe* = nutrition), an organism that produces complex organic compounds from simple inorganic molecules using energy from light (by **photosynthesis**) or inorganic chemical reactions (**chemosynthesis**). Autotrophs are the **producers** in a **food chain**, such as plants on land or algae in water. (Wikipedia.org, Autotroph) (*related:* **heterotroph**)

bacterioplankton – bacterial component of the plankton, which play are important role in transforming organic material to inorganic form (remineralization) down the water column. They are the **recycler** group of the plankton community. **Prokaryotic phytoplankton** are also bacterioplankton. (Wikipedia.org, Bacterioplankton) (*related:* **phytoplankton, zooplankton**)

baklad (*see* **fish corral**)

barrier reef – a type of reef that runs linear and parallel to the coastline, creating a barrier between the deep sea and the shallow water or "lagoon" near the land.

basic social services – services to which access should be universal, while targeting the poorest and most vulnerable. The United Nations (UN) defines basic social services as comprising basic education and primary health care, including reproductive health and population programs, nutrition programs and safe drinking water and sanitation, shelter, and the institutional capacity for delivering those services.

benthic realm – the seafloor, that part of the ocean which extends from the high tide line on the shore to the deepest parts of the seafloor.

biodiversity — the variation of organisms within a given area (an **ecosystem**, a **biome**, or the entire Earth). It is often used as a measured of the health of biological systems.

biological system – a system consisting essentially of biological processes (IPMRC Glossary).

biomass — is the mass of living biological organisms in a given area or ecosystem at a given time. Biomass can refer to *species biomass*, which is the mass of one or more species, or to *community biomass*, which is the mass of all species in the community. The mass can be expressed as the average mass per unit area, or as the total mass in the community. It might be measured in grams per square metre or tonnes per square kilometre, or it might be measured as the total mass present in a system such as a lake. How biomass is measured depends on why it is being measure. In fisheries, the biomass is regarded as a the natural mass of organisms *in situ*, just where they are, for example the total wet weight tuna would have if they were taken out of the water. (Wikipedia.org, Biomass)

biome – a major community of organisms that occupy a distinct region. Aquatic biomes are divided into two main categories: freshwater biome and marine biome. Marine biomes may coincide with the ocean zones, i.e. benthic, pelagic, inter-tidal, etc.

biotic – related to life or living organisms; produced or caused by living organisms

bycatch – part of a catch of a fishing unit taken incidentally in addition to the target species towards which fishing effort is directed. Some or all of it may be returned to the sea as discards, usually dead or dying (FAO Glossary).

by-product – part of a catch of a fishing unit taken incidentally in addition to the target species towards which fishing effort is directed. By-products, while not the main target of the fishery, are mostly retained. (*related:* **bycatch**)

carnivore (*see* **secondary consumers**)

carrying capacity – a maximum number of individuals that can be supported over the long term by the food, water and other resources available there. Below carrying capacity, populations would typically increase, while above, they would decrease.

catadromous species - freshwater fishes which migrate to marine areas to spawn. (RA 8550, 1998) (*related:* **anadromous species**)

catch ceilings - the annual catch limits allowed to be taken, gathered or harvested from any fishing area in consideration of the need to prevent overfishing and harmful depletion of breeding stocks of aquatic organisms. (RA 8550, 1998)

catch per unit effort — The amount of catch that is taken per unit of fishing effort (e.g., number of fish per longline hook-months). Nominal CPUE is often used as a measure of the economic efficiency of a type of gear. Standardized CPUE is normally used as an abundance index for "tuning" assessment models. (Restrepo, 1999)

chemosynthesis – the biological conversion of one or more carbon molecules (usually carbon dioxide or methane) and nutrients into organic matter using the oxidation of inorganic molecules (e.g. hydrogen gas, hydrogen sulfide) or methane as a source of energy, rather than sunlight, as in **photosynthesis**. Many microorganisms in dark regions of the oceans use chemosynthesis to produce biomass from one-carbon molecules. (Wikipedia.org, Chemosynthesis)

climate change – any long-term significant change in the expected patterns of average weather of a specific region (or, more relevantly to contemporary socio-political concerns, of the Earth as a whole) over an appropriately significant period of time. Climate change reflects abnormal variations to the expected climate within the Earth's atmosphere and subsequent effects on other parts of the Earth, such as in the ice caps over durations ranging from decades to millions of years. In recent usage, especially in the context of environmental policy, climate change usually refers to changes in modern climate. (Wikipedia.org, Climate change)

closed season — seasonal closure. The banning of fishing activity (in an area or of an entire fishery) for a few weeks or months, usually to protect juveniles or spawners. (FAO Glossary)

closed season - the period during which the taking of specified fishery species by a specified fishing gear is prohibited in a specified area or areas in Philippines waters. (RA 8550, 1998)

coastal area (*see* **coastal zone**)

coastal resource management – a participatory process of planning, implementing and monitoring sustainable uses of coastal resources through collective action and sound decision-making. (DENR et al, 2001)

coastal zone – also called "coastal area," a band of dry land and adjacent ocean space (water and submerged land) in which terrestrial processes and uses directly affect oceanic processes and uses, and vice versa; its geographic extent may include areas within a landmark limit of one (1) kilometer from the shoreline at high tide to include mangrove swamps, brackish water ponds, nipa swamps, estuarine rivers, sandy beaches and other areas within a seaward limit of 200 meters isobath to include coral reefs, algal flats, seagrass beds and other soft-bottom areas. (RA 8550, 1998)

commercial fishing - the taking of fishery species by passive or active gear for trade, business or profit beyond subsistence or sports fishing. Commercial fishing are classified as **small-scale**, **medium-scale**, or **large-scale**. (RA 8550, 1998)

commercial scale - a scheme of producing a minimum harvest per hectare per year of milkfish or other species including those raised in pens, cages, and tanks (RA 8550, 1998).

community – consists of populations of various organisms living and interacting in a certain area at a given time

consumer (see **heterotroph**)

control - the regulatory conditions (legal framework) under which the exploitation, utilization and disposition of the resources may be conducted. (RA 8550, 1998) (*Related:* **monitoring**, **surveillance**)

coral - the hard calcareous substance made up of the skeleton of marine coelenterate polyps which include reefs, shelves and atolls or any of the marine coelenterate animals living in colonies where their skeletons form a stony mass. 'They include: (a) skeletons of anthozoan coelenterates characterized as having a rigid axis of compact calcareous or horny spicules, belonging to the genus corallium as represented by the red, pink, and white corals which are considered precious corals; (b) skeletons of anthozoan coelenterates characterized by thorny, horny axis such as the antipatharians represented by the black corals which are considered semi-

precious corals; and (c) ordinary corals which are any kind of corals that are not precious nor semi-precious. (RA 8550, 1998)

coral reef - a natural aggregation of coral skeleton, with or without living coral polyps, occurring in intertidal and subtidal marine waters. (RA 8550, 1998)

CPUE (see **catch per unit effort**)

critically endangered species – a species deemed to be facing *extremely* high risk of extinction in the wild based on criteria set by a governing authority. The IUCN, for example, categorizes species using criteria based on population size, geographic range, population decline, and probability of extinction. A species would be considered critically endangered if, among other criteria, its population size is estimated to number fewer than 250 mature individuals and shows an estimated continuing decline of at least 25% within three years or one generations (IUCN, 2001). (*related* **endangered species**, **near threatened species**, **threatened species**, **vulnerable species**)

dark zone – the layer of ocean below the **light zone**, where there is a permanent absence of light.

decomposers – also called **recyclers**, organisms such as fungi and bacteria that break down decaying organic matter into a form (nutrients) that can be used for food production in a process called nutrient cycling

demarcated areas - boundaries defined by markers and assigned exclusively to specific individuals or organizations for certain specified and limited uses such as (RA 8550, 1998): a) **aquaculture**, **sea ranching** and **sea farming**; b) **fish aggregating devices**; c) fixed and **passive fishing gears**; and d) **fish fry** and **fingerlings** gathering.

demersal fisheries – fishing activities that target **demersal species**. (*related* **pelagic fisheries**)

demersal fishery resources – fishery resources found on the seafloor in benthic habitats such as coral reefs, seagrass beds, soft-bottom or muddy substrates and mangrove areas.

demersal species – species that live on or near the bottom of the sea and feed on bottom-dwelling organisms, including other fish. (*related:* **pelagic species**)

deposit-feeders (aquatic) – organisms that collect particulate matter from the sediment. (Palaeos.org, Trophic groups)

detritivores – organisms that feed on decaying organic matter in the soil. (Palaeos.org, trophic groups)

detritus – matter produced by the decay of an organic substance

distraint — the seizure and holding of property as security for payment of a debt or satisfaction of a claim

diurnal pattern – light-dark cycle occurring within a 24-hour period

ecological niche — all of the physical, chemical and biological conditions required by a species for survival, growth and reproduction (PhysicalGeography.net, Glossary of Terms)

economic overfishing – occurs when a fishery generating no economic rent, primarily because an excessive level of fishing effort is applied in the fishery and does not always imply biological overfishing, (FAO Glossary) (*related:* **ecosystem overfishing**, **growth overfishing**, **Malthusian overfishing, recruitment overfishing**)

ecosystem – a system formed by the interactions of organisms with each other and their physical environment, including processes such as the transfer of energy through **trophic levels** and the cycling of nutrients or chemicals through living and non-living components of the system.

ecosystem approach to fisheries – a development strategy that strives to balance diverse societal objectives, by taking account of the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries. (Garcia, et al, 2003)

ecosystem overfishing – occurs when the historical species balance (composition and dominance) of a fish stock is significantly modified by fishing (e.g. with reductions of large, long-lived, demersal predators and increases of small, short-lived species at lower trophic levels). (FAO Glossary) (*related:* **economic overfishing**, **growth overfishing**, **Malthusian overfishing**, **recruitment overfishing**)

El Niño – a natural phenomenon defined by abnormally high temperatures that occur periodically in the Pacific Ocean off the western coast of South America. The official definition is "a phenomenon in a critical region of the equatorial Pacific Ocean referred to as Niño 3.4 region "characterized by a positive sea surface temperature departure from normal (for the 1971-2000 base period)… greater than or equal in magnitude to 0.5°C (0.9°F), averaged over three consecutive months. (Wikipedia.org. El Niño-Southern Oscillation)

electrofishing - the use of electricity generated by batteries, electric generator and other source of electric power to kill, stupefy, disable or render unconscious fishery species, whether or not the same are subsequently recovered (RA 8550, 1998).

emigration – movement of individuals out of a **biological system**, resulting in a decrease in biomass in the system (*related:* **immigration**)

endangered species – a species that is facing a very high risk of extinction in the wild based on criteria set by a governing authority. The IUCN, for example, categorizes species using criteria based on population size, geographic range, population decline, and probability of extinction. A species would be considered endangered if, among other criteria, its population size is estimated to number fewer than 2,500 mature individuals and shows an estimated continuing decline of at least 20% within five years or two generations (IUCN, 2001). (*related:* **critically endangered species, near threatened species**, **threatened species**, **vulnerable species**)

endangered, rare and/or threatened species -- aquatic plants, animals, including some varieties of corals and sea shells in danger of extinction as provided for in existing fishery laws, rules and regulations or in the Protected Areas and Wildlife Bureau of the Department of Environment and Natural Resources (DENR) and in the Convention of the International Trade of Endangered Species of Flora and Fauna (CITES). (RA 8550, 1998)

energy pyramid (see **trophic pyramid**)

eutrophication – physical, chemical and biological changes in a water body as a result of the input nitrogen and phosphorus. (PhysicalGeography.net, Glossary of Terms)

exclusive economic zone (EEZ) - an area beyond and adjacent to the territorial sea which shall not extend beyond 200 nautical miles from the baselines as defined under existing laws (RA 8550, 1998).

exoskeleton – a hard outer structure, such as the shell of a crab, that protects or supports an organism. (*related:* **metamorphosis**, **molting**)

farm-to-market roads - shall include roads linking the fisheries production sites, coastal landing points and other post-harvest facilities to major market and arterial roads and highways. (RA 8550, 1998)

fine mesh net - net with mesh size of less than three centimeters (3 cm) measured between two (2) opposite knots of a full mesh when stretched or as otherwise determined by the appropriate government agency. (RA 8550, 1998)

fish aggregating device – artificial or natural floating objects placed on the ocean surface, often anchored to the bottom, to attract several schooling fish species underneath, thus increasing their catchability. (FAO Glossary). (*related:* **demarcated areas**)

fish and fishery/aquatic products - include not only finfish but also mollusks, crustaceans, echinoderms, marine mammals, and all other species of aquatic flora and fauna and all other products of aquatic living resources in any form. (RA 8550, 1998)

fish cage - refers to an enclosure which is stationary or floating made up of nets or screens sewn or fastened together and installed in the water with opening at the surface or covered and held in a place by wooden/ bamboo posts or various types of anchors and floats. (RA 8550, 1998)

fish corral – commonly known as **baklad**, a stationary weir or trap devised to intercept and capture fish consisting of rows of bamboo stakes, plastic nets and other materials fenced with split bamboo mattings or wire mattings with one or more enclosures, usually with easy entrance but difficult exit, and with or without leaders to direct the fish to the catching chambers, purse or bags. (RA 8550, 1998)

fish fingerlings - a stage in the life cycle of the fish measuring to about 6-13 cm. depending on the species. (RA 8550, 1998)

fish fry - a stage at which a fish has just been hatched usually with sizes from 1-2.5 cm. (RA 8550, 1998)

fish pen - an artificial enclosure constructed within a body of water for culturing fish and fishery/aquatic resources made up of poles closely arranged in an enclosure with wooden materials, screen or nylon netting to prevent escape of fish. (RA 8550, 1998)

fish stock – the total mass of fishery resource, which is usually identified by its location and may consist of one or several species

fisherfolk - people directly or personally and physically engaged in taking and/or culturing and processing fishery and/or aquatic resources. (RA 8550, 1998)

fisherfolk cooperative - a duly registered association of fisherfolk with a common bond of interest who have voluntarily joined together to achieve a lawful common social or economic end, making equitable contribution to the capital requirement and accepting a fair share of the risks and benefits of the undertakings in accordance with universally accepted cooperative principles. (RA 8550, 1998)

fisherfolk organization - an organized group association, federation, alliance or an institutions of fisherfolk which has at least 15 members, a set of officers, a constitution and by-laws, an organizational structure and a program of action. (RA 8550, 1998)

fisheries - refers to all activities relating to the act or business of fishing, culturing preserving processing marketing, developing, conserving and managing aquatic resources and the fishery areas, including the privilege to fish or take aquatic resource thereof. (RA 8550, 1998)

fisheries manager – the fisheries management authority as a whole, including technical experts, MCS units, administrative units, the executive body of the formal authority, the consultative mechanisms, the advisory body where one exists, and the responsible political head, in the Philippine LGU's case, the mayor. Each member of these functional bodies, is to some extent, a fishery manager. (adapted from Cochrane, 2002)

fishery management area - a bay, gulf, lake or any other fishery area which may be delineated for fishery resource management purposes. (RA 8550, 1998)

fishery operator - one who owns and provides the means including land, labor, capital, fishing gears and vessels, but does not personally engage in fishery. (RA 8550, 1998)

fishery refuge and sanctuaries - 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. (RA 8550, 1998)

fishery reserve - a designated area where activities are regulated and set aside for educational and research purposes. (RA 8550, 1998)

fishery species - all aquatic flora and fauna including but not restricted to, fish, algae, coelenterates, mollusks, crustaceans, echinoderms and cetaceans. (RA 8550, 1998)

fishing - the taking of fishery species from their wild state or habitat, with or without the use of fishing vessels. (RA 8550, 1998)

fishing boat/gear license - a permit to operate specific types of fishing boat/gear for specific durations in areas beyond municipal waters for demersal or pelagic fishery resources. (RA 8550, 1998)

fishing gear - any instrument or device and its accessories utilized in taking fish and other fishery species. A fishing gear may be **active** or **passive**. (RA 8550, 1998)

fishing vessel - any boat, ship or other watercraft equipped to be used for taking of fishery species or aiding or assisting one (1) or move vessels in the performance of any activity relating to fishing, including, but not limited to, preservation, supply, storage, refrigeration, transportation and/or processing. (RA 8550, 1998)

fishing with explosives - the use of the dynamite, other explosives or other chemical compounds that contains combustible elements or ingredients which upon ignition by friction, concussion, percussion or detonation of all or parts of the compound will kill, stupefy, disable or render unconscious any fishery species. It also refers to the use of any other substance and/or device which causes an explosion that is capable of producing the said harmful effects on any fishery species and aquatic resources and capable of damaging and altering the natural habitat. (RA 8550, 1998)

fishing with noxious or poisonous substances - the use of any substance, plant extracts or juice thereof, sodium cyanide and/or cyanide compounds or other chemicals either in a raw or processed form, harmful or harmless to human beings, which will kill, stupefy, disable or render unconscious any fishery species and aquatic resources and capable of damaging and altering the natural habitat. (RA 8550, 1998)

fishpond - a land-based facility enclosed with earthen or stone material to impound water for growing fish. (RA 8550, 1998)

fishworker - a person regularly or not regularly employed in commercial fishing and related industries, whose income is either in wage, profit-sharing or stratified sharing basis, including those working in fishpens, fish cages, fish corrals/traps, fishponds prawn farms sea farms, salt beds, fish ports, fishing boat or trawlers, or fish processing and/or packing plants Excluded than this category are administrators, security guards and overseers. (RA 8550, 1998)

fleet — The aggregation of units of any discrete type of fishing activity utilising a specific resource. Hence, for example, a fleet may be all the purse seine vessels in a specific sardine fishery, or all the fishers setting nets from the shore in a tropical multispecies fishery.

food chain – a typically graphical description of the eating relationships between species within an **ecosystem**. Organisms are connected to the organisms they consume by lines representing the direction of organism or energy transfer. The graph also shows how the energy from the producer is given to the consumer. Sometimes, on a food chain, each animal is separated with an arrow. If it is pointing right, it means "is eaten by" or "is consumed by." (Wikipedia.org, Food chain)

food network (*see* **food web**)

food security - refers to any plan policy or strategy aimed at ensuring adequate supplies of appropriate food at affordable prices. Food security may be achieved through self-sufficiency (i. e. ensuring adequate food supplies from domestic production) through self-reliance (i. e. ensuring adequate food supplies through a combination of domestic production and importation) or through pure importation. (RA 8550, 1998)

food web – also called **food network**, extends the **food chain** concept from a simple linear pathway to a complex network of interactions. The direct steps as shown in the food chain example above seldom reflect

reality. This "web" makes it possible to show much bigger animals (like a whale) eating very small organisms (like plankton). Food sources of most species in an ecosystem are much more diverse, resulting in a complex *web* of relationships. (Palaeos.org, Food web)

foreshore land - a string of land margining a body of water: the part of a seashore between the low-water line usually at the seaward margin of a low tide terraces and the upper limit of wave wash at high tide usually marked by a beach scarp or berm. (RA 8550, 1998)

fringing reef – the most common type of reef, forming around islets or as patches along coastlines of big islands, remaining submerged most of the time since they do not usually extend beyond the low tide level.

global warming – the increase in the average temperature of the Earth's near-surface air and oceans since the mid-20th century and its projected continuation. Global surface temperature increased 0.74 ± 0.18 °C (1.33 ± 0.32 °F) during the last century. (IPCC, 2007. *In:* Wikipedia.org, Global warming)

greenhouse effect – refers to the change in the steady state of temperature of a planet or moon by the presence of an atmosphere containing gas that absorbs and emits infrared radiation. **Greenhouse gases** warm the atmosphere by efficiently absorbing thermal infrared radiation emitted by the Earth's surface, by the atmosphere itself, and by clouds. As a result of its warmth, the atmosphere also radiates thermal infrared in all directions, including downward to the Earth's surface, thus trapping heat within the system. This mechanism is fundamentally different from the mechanism of an actual greenhouse, which instead isolates air inside the structure so that the heat is not lost. (Le Treut et al, 2007. *In:* Wikipedia.org, Greenhouse effect)

greenhouse gases — gases in an atmosphere that absorb and emit radiation within the thermal infrared range. This process is the fundamental cause of the **greenhouse effect**. Common greenhouse gases in the Earth's atmosphere include water vapor, carbon dioxide, methane, nitrous oxide and chlorofluorocarbons. (Wikipedia.org, Greenhouse gas)

gross tonnage - includes the underdeck tonnage permanently enclosed spaces above the tonnage deck except for certain exemptions In broad terms all the vessel's 'closed-in' spaces expressed in volume terms on the bases of one hundred cubic feet (that equals one gross ton). (RA 8550, 1998)

growth overfishing – occurs when too many small fish are being harvested too early, through excessive fishing effort and poor selectivity (e.g. too small mesh sizes) and the fish are not given enough time to grow to the size at which maximum-yield-per-recruit from the stock would be obtained. A reduction of fishing mortality on juveniles, or their outright protection, would yield to an increase in yield from the fishery. (FAO Glossary) (*related:* **economic overfishing**, **ecosystem overfishing**, **Malthusian overfishing**, **recruitment overfishing**)

hard bottom – part of the sea floor that consists mostly of boulder, rocks, stones and pebbles

harvest mortality – rate of removal of individuals from a fish stock by fishing (*related:* **natural mortality**)

herbivore (*see* **primary consumers**)

heterotroph — from Greek *heteros* = another and *trophe* = nutrition, an organism that uses organic substrates to get its chemical energy for its life cycle. Heterotrophs are known as consumers in food chains and obtain organic carbon by eating other organisms. Heterotrophs are classified based on their **trophic level** as **primary consumers** (herbivores) and **secondary consumers** (carnivores). (Wikipedia.org, Heterotroph) (*related:* **autotroph**)

holoplankton — those organisms that spend their entire life cycle as part of the **plankton** (e.g. most algae, copepods, salps, and some jellyfish). (Wikipedia.org, Plankton) (*related:* **meroplankton**)

hydrologic cycle – a natural process in which water is circulated and exchanged through evaporation, rainfall, river discharge, groundwater flow and runoff among Earth's different interacting compartments.

hydrothermal vent — a fissure in a planet's surface from which geothermally heated water issues, commonly found near volcanically active places, areas where tectonic plates are moving apart, ocean basins, and hotspots. (Wikipedia.org, Hydrothermal vent)

immigration – movement of individuals into a **biological system**, resulting in an increase in biomass in the system (*related:* **emigration**)

incidental catch – catch of non-fish, non-target species in the course of fishing (*related:* **incidental mortality**)

incidental mortality – removal of non-target species in the course of fishing (*related:* **incidental catch**).

index – aggregated measures that combine indicators most important to describe the performance or condition of a system (adapted from IISD in Baldi, 2001)

indicator — a variable or pointer that reveals the variations in key elements of a system. The position and trend of the indicator in relation to reference points or values indicate the present state and dynamics of the system. Indicators provide a bridge between objectives and action. At the fishery level, indicators provide an operational tool in fisheries management, as a bridge between objectives and management action. For example, we can use an indicator such as an estimate of current biomass from a stock assessment model (or an appropriate proxy such as CPUE) to calculate next year's catch limit, or determine if current gear restrictions are working. At the ecosystem level, indicators can provide us with information about not only the status of the fishery resources (i.e. are they overfished?) but also of the non-target components of the ecosystem (associated and dependent species), as well as the overall "health" of the ecosystem. Some indicators can provide data that can help determine our next action toward our broader ICM objectives. Our choice of indicators will depend on our operational objectives (FAO, 1999). Indicators may be aggregates of raw and processed data but they can be further aggregated to form complex indices." (Adapted from IISD in Baldi, 2001)

inland fishery - the freshwater fishery and brackish water fishponds. (RA 8550, 1998)

input control – a management instrument used to control the time and place as well as type and/or amount of fishing with the view to limit yields and fishing mortality, for example, restrictions on type and quantity of gear, effort and capacity, closed seasons. (FAO Glossary) (*related:* **input control**)

integrated coastal management – comprises those activities that achieve sustainable use and management of economically and ecologically valuable resources in coastal areas that consider interactions among and within resource systems as well as interactions between humans and their environment (White and Lopez, 1991).

intertidal zone – that part of the **littoral zone** extending from the mean highest water level to the mean lowest water level, subject to alternating floods and droughts twice each day, following the six-and-a-half-hour tidal rhythm.

invertebrate – organisms that lack a backbone or spinal column, including crabs, lobsters and shellfishes

lake - an inland body of water an expanded part of a river a reservoir formed by a dam or a lake basin intermittently or formerly covered by water. (RA 8550, 1998)

large-scale commercial fishing - fishing utilizing active gears and vessels of more than 150 GT(RA 8550, 1998). (*related:* **medium-scale commercial fishing, small-scale commercial fishing**)

levy — the imposition and collection of taxes, tariffs, or fines

life cycle — a period involving one generation of an organism through means of reproduction, whether through asexual reproduction or sexual reproduction. (Wikipedia.org, Life cycle)

light-dark cycle (see **diurnal pattern**)

light zone – the layer of the ocean that can be reached by sunlight, limited to the depth of light penetration, which varies depending on the intensity of sunlight and the transparency of the water. Generally the depth of light penetration ranges from 100 to 200 meters

limited access - a fishery policy by which a system of equitable resource use and allocation is established by law through fishery rights granting and licensing procedure. (RA 8550, 1998)

littoral zone – that part of the **benthic realm** from 0 to about 200 meters from the highest tide level well within the influence of sunlight

lunar pattern – regular behavior or event related to the lunar cycle (e.g. tidal cycle)

local autonomy – refers generally to the local government's own self-governance based on the assumption that the well-being of the community is best cared for by the members of that community. Local autonomy can, and, to some extent, is usually waived to another, higher authority, such as the national government, based on certain governing laws.

Malthusian overfishing – occurs when socio-economic conditions drive small-scale fishers to overexploit and destroy their fishery resources, resulting in declining yields and deepening poverty. It manifests itself when the fishery cannot provide enough fish for all the people who depend on it (Pauly, 1990), probably because the fishery in such poor state that it has become unproductive, or perhaps because there are too many people chasing after the same resource, or most likely for both reasons. Fishers, getting little or no catch and believing they have little choice, use illegal and destructive fishing gear to improve their catch, which provides income in the short term but affects ecological processes by destroying habitats and thus makes the situation worse over the long term. (*related:* **economic overfishing**, **ecosystem overfishing**, **growth overfishing**, **recruitment overfishing**)

mangroves - a community of intertidal plants including all species of trees shrubs, vines and herbs found on coasts swamps or border of swamps. (RA 8550, 1998)

marginal farmer or fisherman – an individual engaged in subsistence farming or fishing which shall be limited to the sale, barter or exchange of agricultural or marine products produced by himself and his immediate family (RA 8550, 1998)

mariculture — cultivation, management and harvesting of marine organisms in the sea, in specially constructed rearing facilities e.g. cages, pens and long-lines. For the purpose of FAO statistics, mariculture refers to cultivation of the end product in seawater even though earlier stages in the life cycle of the concerned aquatic organisms may be cultured in brackish water or freshwater or captured from the wild (FAO Glossary). (*related:* **aquaculture, mariculture, sea farming, sea ranching)**

marine protected area – a protected marine intertidal or subtidal area, within territorial waters, EEZs or in the high seas, set aside by law or other effective means, together with its overlying water and associate flora, fauna, historial and cultural features. It provides degrees of preservation and protection for important marine biodiversity and resources; a particular habitat (e.g. a mangrove or a reef) or species, or sub-population (e.g spawners or juveniles) depending on the degree of use permitted. In MPAs, activities (e.g. of scientific, educational, recreational, extractive nature, including fishing) are strictly regulated and could be prohibited (FAO Glossary). Any area of intertidal or subtidal terrain, together with its overlaying waters, and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment (IUCN, 1994). (*related:* **fishery reserve**, **fishery management area**)

maximum sustainable yield — is the largest average quantity of' fish that can be harvested from a fish stocks/ resource within a period of time (e. g. one year) on a sustainable basis under existing environmental conditions (RA 8550, 1998); the highest theoretical equilibrium yield that can be continuously taken (on average) from a stock under existing (average) environmental conditions without affecting significantly the reproduction process. Also referred to sometimes as **potential yield**. (FAO Glossary)

medium-scale commercial fishing - fishing utilizing active gears and vessels of 20.1 gross tons up to150 GT (RA 8550, 1998). (*related:* **large-scale commercial fishing, small-scale commercial fishing**)

meroplankton — those organisms that are only planktonic for part of their lives (usually the **larval stage**), and then graduate to either the **nekton** or a **benthic** existence. Examples of meroplankton include the larvae of sea urchins, starfish, crustaceans, marine worms, and most fish. (Wikipedia.org, Plankton) (*related:* **holoplankton**)

mesolittoral zone – intertidal zone, which extends from the mean highest water level to the mean lowest water level of the shoreline

metamorphosis – a change in the form or structure, and often habits of certain animal species as part of their normal development after the embryonic stage. For example, a crab larva would go through a number of changes in form and structure, developing an **exoskeleton** and **molting** several times before it becomes a juvenile.

migratory species - any fishery species which in the course of their life could travel from freshwater to marine water or vice versa, or any marine species which travel over great distances in waters of the ocean as part of their behavioral adaptation for survival and speciation. A migratory species may be **anadromous** or **catadromous**. (RA 8550, 1998)

minimum viable population – the smallest possible size at which a biological population at which it can exist without facing extinction from natural disasters or demographic, environmental or genetic factors (Wikipedia, Minimum viable population).

molting – periodic shedding of part or all of an organism's skin or other outer covering (such as a crab's shell), which is then replaced by new growth.

monitoring - the requirement of continuously observing: (1) fishing effort which can be expressed by the number of days or hours of fishing, number of fishing gears and number of fisherfolk; (2) characteristics of fishery resources; and (3) resource yields (catch). (RA 8550, 1998) (*Related:* **control**, **surveillance**)

MSY (*see* **maximum sustainable yield**; *related:* **total allowable catch**)

municipal fisherfolk - persons who are directly or indirectly engaged in municipal fishing and other related fishing activities. (RA 8550, 1998)

municipal fishing - refers to fishing within municipal waters using fishing vessels of three (3) gross tons or less, or fishing not requiring the use of fishing vessels. (RA 8550, 1998)

municipal waters - include not only streams, lakes, inland bodies of water and tidal waters within the municipality which are not included within the protected areas as defined under Republic Act No. 7586 (The NIPAS Law), public forest, timber lands, forest reserves or fishery reserves, but also marine waters included between two (2) lines drawn perpendicular to the general coastline from points where the boundary lines of the municipality touch the sea at low tide and a third line parallel with the general coastline including offshore islands and fifteen (15) kilometers from such coastline. Where two (2) municipalities are so situated on opposite shores that there is less than thirty (30) kilometers of marine waters between them, the third line shall be equally distant from the opposite shore of the respective municipalities. (RA 8550, 1998)

municipal waters – includes not only streams, lakes, and tidal waters within the municipality, not being the subject of private ownership and not comprised within the national parks, public forest, timber lands, forest reserves or fishery reserves, but also marine waters included between two lines drawn perpendicularly to the general coastline from points where the boundary lines of the municipality or city touch the sea at low tide and a third line parallel with the general coastline and fifteen (15) kilometers from it. Where two (2) municipalities are so situated on the opposite shores that there is less than fifteen (15) kilometers of marine waters between them, the third line shall be equally distant from opposite shores of the respective municipalities (RA 8550, 1998)

muro-ami or **kayakas** — a fishing technique (now prohibited) that uses an encircling net together with pounding devices, usually large stones fitted on ropes that are pounded onto the coral reefs or large heavy blocks of cement that are suspended above the sea by a crane fitted to the vessel. The pounding devices are repeatedly and violently lowered into the area encircled by the net, literally smashing the coral in that area into small fragments in order to scare the fish out of their coral refuges. (RA 8550, 1998)

National Integrated Protected Areas System – the classification and administration of all designated protected areas 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. (RA 7586, 1992)

natural death (*see* **natural mortality**)

natural mortality – death by natural causes, such as old age, ailment or predation; rate of removal of individuals from a fish stock by natural causes (*related:* **harvest mortality**)

near threatened species – a species that is close to qualifying or is likely to qualify for a threatened category in the near future (IUCN, 2001). (*related:* **critically endangered species**, **endangered species**, **threatened species**, **vulnerable species**)

nekton – the aggregate of actively swimming aquatic organisms in a body of water (usually oceans or lakes) able to move independently of water currents. (Wikipedia.org, Plankton) (*related:* **plankton**)

neritic province – that part of the ocean which includes the water column overlying the continental shelf, more or less most or all of the coastal zone

non-governmental organizations – commonly referred to by the acronym NGO, an agency, institution, a foundation or a group of persons whose purpose is to assist peoples organizations/associations in various ways including, but not limited to, organizing education, training,, research and/or resource accessing. (RA 8550, 1998)

oceanic province – that part of the ocean which encompasses the open waters beyond the continental shelf up to the deepest portion of the ocean

omnivores – organisms that feed on animals or plants, generally anything they can find. (Palaeos.org, Trophic groups)

open system – a system, such as a water body, that is physically connected to other systems and thus allows organisms to move in and out between systems.

output control – a management instrument aimed at controlling the characteristics of the catch and landings. This is achieved by one or any combination of the following: a) limiting catch or landings through **total allowable catch** (TAC) and **quotas**; b) prohibiting the landing of: protected species, certain sizes, a given sex, or animals in a particular stage of the breeding cycle; c) regulating discards; (d) establishing limits for the daily bag and possession. (FAO Glossary) (*related:* **output control**)

parasites – organisms that feed on another (usually larger) organism (whether plant or animal) without (usually) killing it. There are two kinds: ectoparasites, which live externally to the host, and endoparasites, which live internally. Parasitoids differ from true parasites by eventually killing the host. (Palaeos.org, Trophic groups)

participatory governance – refers to democratic and inclusive governance, generally aimed at fighting poverty and achieving sustainable development and social justice, and involving ample opportunities for citizens and their organizations to engage with governance (CIVICUS). For the purposes of its discussion during its 6th session in April 2007, the United Nations Committee of Experts on Public Administration (CEPA) defined participatory governance as one of many public institutional strategies that contribute to shared visions in planning, budgeting, monitoring and accountability of development policies and programs. The Committee noted that participation in public affairs is a right of citizens. The challenge for every government, therefore, is to design governance and public administration systems and processes that are inclusive, with the capacity to engage citizens in formulating, implementing and accounting for national development strategies. Informing, consulting, involving, collaborating with and empowering citizens in public policy formulation, program design, budgeting, service delivery, evaluation and audit can link them more directly to decision-making processes and result in more responsive public services. Moreover, participation can serve at least three useful functions: building mutual trust ("integrative"); information exchange ("educative"); and mainstreaming public reasoning and consensus building ("deliberative").

Participatory governance can be structured in different ways, including:

1) government-driven formal deliberative processes (as in National Economic and Social Councils, local government councils);

2) devolution of policy management and oversight to committees of local users (as in community-based public programs);
3) partnerships between government and community service organizations (as in participatory budgeting); and
4) application of information, communication and technologies (ICTs).

For the most part, the introduction and operationalization of participatory governance require:

1) a clear expression of political commitment and legal provisions;
2) learning lessons from a community of practice and benchmarking of best practices;
3) advocacy;
4) introduction of appropriate tools/methodologies to link participation at all levels: national, sectoral, sub-national and local;
5) development of indicators to measure the processes of participation and their outcomes;
6) skills in managing participation and transforming participation inputs into coherent policies;
7) behavioral changes in public institutions;
8) active involvement of universitities, research institutes, media, etc.; and
9) support of the international community, including the UN, in promoting active citizen demands and capacity-building in participation. (CEPA, 2008)

Passive adaptive management — begins by using predictive modeling based on present knowledge to inform management decisions. As new knowledge is gained, the models are updated and management decisions adapted accordingly. (*related:* **active adaptive management***; see also* **adaptive management**). (Wikipedia.org, Adaptive management)

passive fishing gear - characterized by the absence of gear movements and/or the pursuit of the target species; such as, but not limited to, hook and line, fishpots, traps and gill nets across the path of the fish. (RA 8550, 1998) (*Related:* **active fishing gear**)

payao - a fish aggregating device consisting of it floating raft anchored by a weighted line with suspended materials such as palm fronds to attract pelagic and schooling species common in deep waters. (RA 8550, 1998)

pearl farm lease -- public waters leased for the purpose of producing cultured (RA 8550, 1998)

pelagic fishery resources – fishery resources found in the water column or open sea (the pelagic realm). Many of these resources move in large schools over great distances and even across oceans throughout their life cycle.

pelagic realm – the ocean waters, that part of the ocean consisting of the "water column." (*related:* **benthic realm**)

pelagic species – species that live in mid-water or close to the surface of the sea. (*related:* **demersal species**)

people's organization – or PO, a *bona fide* association of citizens with demonstrated capacity to promote the public interest and with identifiable leadership, membership and structure. Its members belong to a sector/s who voluntarily band themselves together to work for and by themselves for their own upliftment, development and greater good. (RA 8550, 1998)

person - natural or juridical entities such as individuals, associations, partnership, cooperatives or corporations (RA 8550, 1998)

Philippine waters - include all bodies of water within the Philippine territory such as lakes, rivers, streams, creeks, brooks, ponds, swamps,, lagoons, gulfs, bays and seas and other bodies of water now existing or which may hereafter exist in the provinces, cities, municipalities, and barangays and the waters around, between and connecting the islands of the archipelago regardless of their breadth and dimensions, the territorial sea, the sea beds, the insular shelves and all other waters over which the Philippine bits sovereignty and jurisdiction, including the 200-nautical miles exclusive economic zone and the continental shelf. (RA 8550, 1998)

photosynthesis – a process that converts carbon dioxide into organic compounds, especially sugars, using the energy from sunlight. Photosynthesis occurs in plants, algae, and many species of bacteria. (Wikipedia.org, Photosynthesis)

phytoplankton — (from Greek *phyton*, or plant), algae (small, simple plants) that live near the water surface where there is sufficient light to support **photosynthesis**. Phytoplankton are the broad **producer (autotrophic)** group within the plankton community. The name comes from the Greek words *phyton*, or "plant", and *planktos*, meaning "wanderer" or "drifter." Most phytoplankton are too small to be individually seen with the unaided eye. However, when present in high enough numbers, they may appear as a green discoloration of the water due to the presence of chlorophyll within their cells (although the actual color may vary with the species of phytoplankton present due to varying levels of chlorophyll or the presence of accessory pigments). (Wikipedia.org, Phytoplankton) (*related:* **bacteroplankton, zooplankton**)

plankton – floating organisms whose movements are more or less dependent on currents (Odum, 1959). There are two plankton types **— holoplankton** and **meroplankton –** and three broad functional (**trophic level**) groups **– phytoplankton**, **zooplankton** and **bacteroplankton**. (Wikipedia.org, Plankton) (*related:* **nekton**)

population – a group of individuals of the same species inhabiting a certain area

post-harvest facilities - these facilities include, but are not limited to, fishport, fishlanding, ice plants and cold storages, fish processing plants. (RA 8550, 1998)

potential yield, long-term – LTPY, the largest average harvest that can be taken from a fish stock on a sustainable basis, allowing for variable environmental conditions. This may be estimated in various ways, from taking an average of a time series of historical catches to use of sophisticated mathematical models (FAO Glossary). (*related:* **maximum sustainable yield**)

precautionary approach – set of measures involving the application of prudent foresight, taking account of the uncertainties in fisheries systems and the need to take action with incomplete knowledge. It requires, among others:

a) consideration of the needs of future generations and avoidance of changes that are not potentially reversible;
b) prior identification of undesirable outcomes and of measures that will avoid them or correct them promptly;
c) that any necessary corrective measures are initiated without delay, and that they should achieve their purpose promptly, on a timescale not exceeding two or three decades;
d) that where the likely impact of resource use is uncertain, priority should be given to conserving the productive capacity of the resource;
e) that harvesting and processing capacity should be commensurate with estimated sustainable levels of resource, and that increases in capacity should be further contained when resource productivity is highly uncertain;
f) all fishing activities must have prior management authorization and be subject to periodic review;
g) an established legal and institutional framework for fishery management, within which management plans that implement the above points are instituted for each fishery, and
h) appropriate placement of the burden of proof by adhering to the requirements above. (FAO, 1996)

primary consumers – organisms that feed on **autotrophs**; they are also called "herbivores" (meaning they feed on plants). (*related:* **secondary consumers**)

primary producer (see **autotroph**)

producer (*see* **autotroph**)

productivity – the amount and rate of production of biomass which occur in a given ecosystem over a given time period. It may apply to a single organism, a population, or entire communities and ecosystems.

purse seine - a form of encircling net having a line at the bottom passing through rings attached to the net, which can be drawn or pursed. In general, the net is set from a boat or pair of boats around the school of fish.

The bottom of the net is pulled closed with the purse line. The net is then pulled aboard the fishing boat or boats until JTC fish are concentrated in the bunt or fish bag. (RA 8550, 1998)

RA 8550 – The Philippine Fisheries Code of 1998; an Act providing for the development, management and conservation of the fisheries and aquatic resources, integrating all laws pertinent thereto, and for other purposes.

rare species – an organism which is very uncommon or scarce. This designation, made by an official body such as the national government, may be distinct from the term endangered or threatened species. (Wikipedia.org, Rare species)

recruitment – the number of fish added to the exploitable stock, in the fishing area, each year, through a process of growth (i.e. the fish grows to a size where it becomes catchable) or migration (i.e. the fish moves into the fishing area); the process by which fish enter the exploitable stock and become susceptible to fishing, a process that may be short or take more than one year. (FAO Glossary)

recruitment overfishing – a situation in which the rate of fishing is (or has been) such that **annual recruitment** to the exploitable stock has become significantly reduced. The situation is characterized by a greatly reduced spawning stock, a decreasing proportion of older fish in the catch, and generally very low recruitment year after year. If prolonged, recruitment overfishing can lead to stock collapse, particularly under unfavorable environmental conditions. (Restrepo, 1999) (*related:* **economic overfishing**, **ecosystem overfishing**, **growth overfishing**, **Malthusian overfishing**)

recyclers (*see* **decomposers**)

reference point — an estimated value derived from an agreed scientific procedure and/or model, which corresponds to a specific state of the resource and of the fishery, and that can be used as a guide for fisheries management. A reference point may correspond to a situation considered as desirable (target reference point, TRP) or undesirable and requiring immediate action (limit reference point, LRP, and threshold reference point, ThRP) . Reference points may be general (applicable to many stocks) or stock-specific (Garcia, 1997)

resource rent - the difference between the value of the products produced from harvesting a publicly owned resource less the cost of producing it, where cost includes the normal return to capital and normal return to labor. (RA 8550, 1998)

scavengers – organisms that consume dead and/or partially decayed organisms. (Palaeos.org, Trophic groups)

schooling – a prevalent behavior and survival strategy of almost 80% of the more than 20,000 known fish species during some phase in their life cycle where they collect and swim together in dense groups (Stout, 2005).

seagrass – flowering plant that grows underwater in tropical and temperate marine environments.

sea farming - the stocking of natural or hatchery- produced marine plants or animals, under controlled conditions, for purposes of rearing and harvesting, but not limited to commercially-important fishes, mollusks (such as pearl and giant clam culture), including seaweeds and seagrasses. (RA 8550, 1998) (*related:* **aquaculture, mariculture, sea ranching)**

sea ranching – commercial raising of animals, mainly for human consumption, under extensive production systems in the ocean, where they grow using natural food supplies (FAO Glossary); the release of the young of fishery species reared in hatcheries and nurseries into natural bodies of water for subsequent harvest at maturity or the manipulation of fishery habitat, to encourage the growth of the wild stocks (RA 8550, 1998). (*related:* **aquaculture**, **mariculture, sea farming**)

secondary consumers – organisms that feed or prefer to feed on **heterotrophs**; they are also referred to as "carnivores" and capture, kill, dismember (usually), and feed on live prey (Palaeos.org, Trophic structure). (*related:* **primary consumers**)

sink – the nursery area of fishes

small-scale commercial fishing - fishing with passive or active gear utilizing fishing vessels of 3.1 gross tons up to 20 gross tons (RA 8550, 1998). (*related:* **large-scale commercial fishing, medium-scale commercial fishing**)

soft bottom – part of the seafloor consisting of mostly sediments

source – the spawning area of fishes

species – a group of similar organisms that can reproduce sexually among themselves

spatial access limitations – refers to controls on fishing access to certain areas

spray zone — the meeting point between land and ocean life, above the mean highest water line, so named because it gets seawater mostly in the form of spray, splash or mist. It is covered by water only during extremely high tides or in the presence of strong waves, usually during storms or high winds.

steady state – a condition where the **biological system** is in a balanced state, **immigration** and **emigration** are equal, cancel each other out and thus can be conveniently eliminated from the equation. Normally, an unexploited biological system is in a steady or balanced state.

sublittoral zone – that part of the **littoral zone** which extends from the mean lowest water level to the deepest part where benthic plants are still found, at the furthest depth of sunlight penetration. This zone is permanently covered with water.

superlight - also called magic light, is a type of light using halogen or metal halide bulb which may be located above the sea surface or submerged in the water. It consists of a ballast, regulator, electric cable and socket. The source of energy comes from a generator, battery or dynamo coupled with the main engine. (RA 8550, 1998)

supralittoral zone (see **spray zone**)

surplus production – an increase in the number of individuals in a fish population beyond what is needed to maintain that population

surveillance - the degree and types of observations required to maintain compliance with regulations. (RA 8550, 1998) (*Related:* **control**, **monitoring**)

suspension feeders — also called filter feeders, these organisms collect particulate matter or microorganisms from suspension in the water without need to subdue or dismember the particles. The biggest fish, the whale shark, is a filter feeder. (Palaeos.org, Trophic group)

TAC (*see* **total allowable catch**; *related:* **maximum sustainable yield**)

target-oriented resource management –a fisheries management strategy that is generally concerned with achieving optimum utilization of resources to support national economic development and maintaining the resource base by "managing" the size and operations of the fishing activity (e.g. species, gear and jurisdiction), with little regard for the ecosystem structure or boundaries in which it is operating (FAO, 2003)

temporal access limitations – refers to time-based controls on fishing, such as closed seasons, or fishing bans during critical life stages of certain species.

threatened species – a species that is facing a high to extremely high risk of extinction; based on the level of risk, a threatened species may be further classified as **vulnerable**, **endangered** or **critically endangered**.

total allowable catch – called TAC, the maximum harvest allowed to be taken during a given period of time from any fishery area, or from any fishery species or group of fishery species, or a combination of area and species and normally would not exceed the **maximum sustainable yield** (MSY). (RA 8550, 1998)

trawl - an active fishing gear consisting of a bag shaped net with or without otter boards to open its opening which is dragged or towed along the bottom or through the water column to take fishery species by straining them from the water, including all variations and modifications of trawls (bottom, mid-water, and baby trawls) and tow nets. (RA 8550, 1998)

trophic dynamics (*see* **trophodynamics**)

trophic group — a category of organisms within a **trophic structure**, defined according to their mode of feeding. They include **primary producers**, **herbivores**, **carnivores** or **predators**, **omnivores**, **scavengers**, **parasites**, **suspension** or **filter feeders**, **detrivores**, **deposit feeders**, and **decomposers**. (Palaeos.org, Trophic group)

trophic level — classification of natural communities or organisms according to their place in the food chain. Green plants (producers) can be roughly distinguished from herbivores (primary consumers) and carnivores (secondary consumers). (UN, 1997)

trophic pyramid – a graphical representation of the distribution of biomass or energy among the different trophic levels of an ecosystem

trophic structure — the way in which organisms utilize food resources and hence where energy transfer occurs within an ecosystem. There are a number of different feeding habits and feeding interactions between the various organisms as well as organisms and their environment, resulting in specific **trophic groups**. Trophic structures are represented graphically as **food pyramids**, **food chains**, and **food webs**. (Palaeos.org, Trophic structure)

trophic transfer – the flow or transfer of energy between two **trophic levels**

trophodynamics — the system of **trophic levels**, which describe the position that an organism occupies in a **food chain** — what an organism eats, and what eats the organism. Also referred to as "trophic dynamics"

upwelling — an oceanographic phenomenon that involves wind-driven motion of dense, cooler, and usually nutrient-rich water towards the ocean surface, replacing the warmer, usually nutrient-depleted surface water. There are several types of upwelling. The most common is coastal upwelling, which is the most closely related to human activities as it supports some of the most productive fisheries in the world, targeting for example, small **pelagic species** like sardines and anchovies. (Wikipedia.org, Upwelling)

vulnerable species – a species that is facing a high risk of extinction in the wild based on criteria set by a governing authority. The IUCN, for example, categorizes species using criteria based on population size, geographic range, population decline, and probability of extinction. A species would be considered vulnerable if, among other criteria, its population size is estimated to number fewer than 10,000 mature individuals and shows an estimated continuing decline of at least 10% within 10 years or three generations (IUCN, 2001) (*related:* **critically endangered species**, **endangered species**, **near threatened species**, **threatened species**)

water cycle (see hydrologic cycle)

zooplankton — (from Greek *zoon*, or animal), small animals (e.g. crustaceans) that feed on other plankton. Some of the eggs and larvae of larger animals, such as fish, crustaceans, and annelids, are included here. Zooplankton make up the **consumer** group of the plankton community. (Wikipedia.org, Plankton) (*related:* **bacteroplankton, phytoplankton**)

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