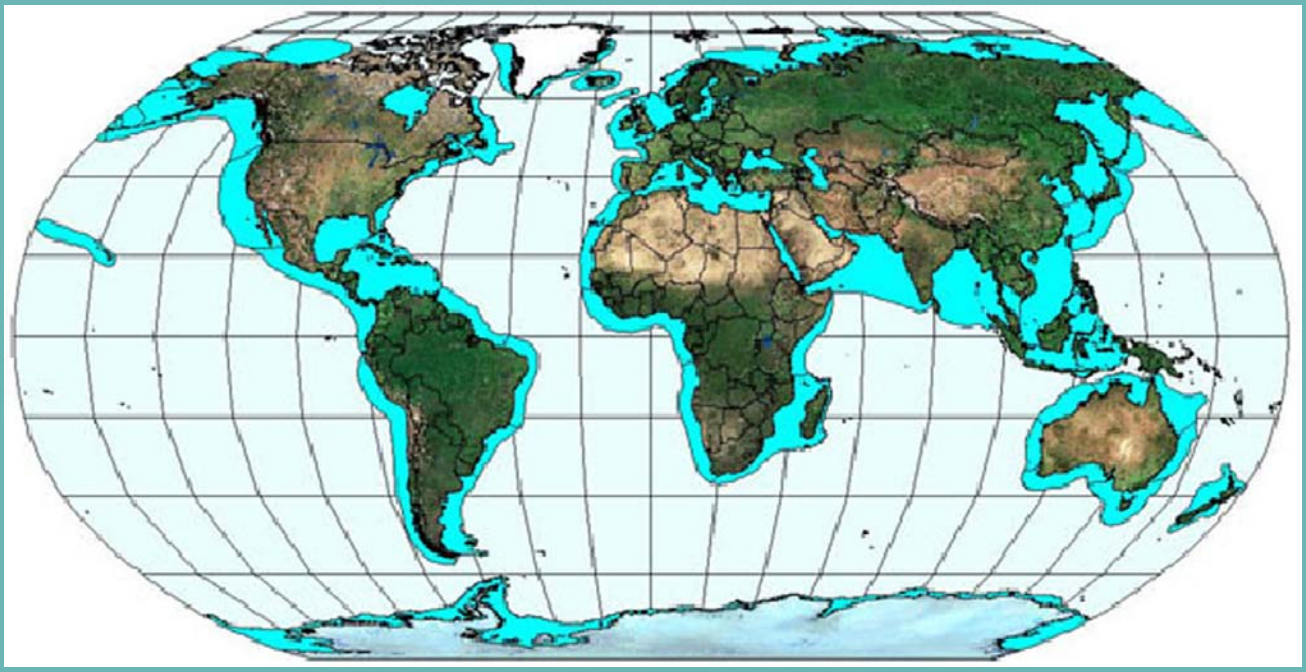
A Handbook
on
Governance and Socioeconomics
of
Large Marine Ecosystems



Stephen B. Olsen

Jon G. Sutinen

Lawrence Juda

Timothy M. Hennessey

Thomas A. Grigalunas

University of Rhode Island

2006

GEF IW LEARN UNDP UNEP NOAA

A Handbook on Governance and Socioeconomics of Large Marine Ecosystems

By

Stephen B. Olsen
Jon G. Sutinen
Lawrence Juda
Timothy M. Hennessey
Thomas A. Grigalunas

Coastal Resources Center
University of Rhode Island

University of Rhode Island

2006

TABLE OF CONTENTS

PREFACE

The primary purpose of this Handbook is to serve as a practical guide to innovators of governance and socioeconomics in Large Marine Ecosystem (LME) projects. Based on a Global Environmental Facility IW:LEARN-sponsored workshop for 11 LME programs,[1] the Handbook is designed to be used in short courses and workshops on governance and socioeconomics science to support the ecosystem approach to marine resources management.

The Handbook explains why governance and socioeconomics are important to the success of resource management in the LME context. Good governance and socioeconomics can lead to good outcomes; bad governance and socioeconomics nearly always doom management efforts to failure. To improve the chances of successful management, the Handbook explains the basic principles and ingredients that make for good governance and socioeconomics – at all phases of LME project development, from the Transboundary Diagnostic Analysis to the Strategic Action Program, and implementation of adaptive management and sustainable financing.

[1]Information on the workshop can be found at http://www.iwlearn.net/abt_iwlearn/pns/learning/b2-2lme

ACKNOWLEDGMENTS

This Handbook builds upon a series of meetings and publications on the human dimensions of large marine ecosystems extending back over the past several years. With funding from the Global Environmental Facility (GEF) IW:LEARN program this Handbook and a training course were produced. The training course was held in Newport, Rhode Island in March 2006. It was attended by 21 participants associated with nine large marine ecosystems. An early draft of the Handbook was the basis for the training and this final version is much improved thanks to the excellent discussions and many suggestions of the participants.

We are particularly grateful for the strong support of Ken Sherman, director of the National Oceanic and Atmospheric Administration/National Marine Fisheries Service Narragansett Laboratory and Office of Ecosystem Studies who instigated this effort and worked closely with the team on the design and content of the training workshop and this Handbook. Dann Sklarew (GEF IW:LEARN) served as our project manager. His many efforts in support of all aspects of the project are gratefully acknowledged. The final draft of the Handbook benefited from the comments and suggestions of many reviewers including Alfred Duda (GEF Secretariat), Marea Hatziolos (World Bank), Andrew Hudson (United Nations Development Program), and Veerle Vandeweerd, Ulrik Weuder and Annie Muchai of the United Nations Environmental Progamme.

Glenn Ricci ably served as project manager at the University of Rhode Island Coastal Resources Center (CRC) and dealt with the many substantive and logistical issues with effectiveness and good humor. Kimberly Kaine and Sharon Clements, also of CRC, with the assistance of Omar Fahmy and Ryan McLane smoothed the path for the participants' travel and all the details that made the training a success.

FOREWORD

Dr. Veerle Vandeweerd
United Nations Environment Programme
Coordinator GPA/Head, Regional Seas Programme

The health, and in some cases the very survival, of coastal populations depends upon the health and well being of the marine and coastal ecosystems. The effective governance of marine and coastal ecosystems is therefore essential to progress towards sustainable forms of development. Good governance, in turn, requires a thorough understanding of the socioeconomic implications of coastal and marine ecosystem change. Together, the governance and socioeconomic aspects of large marine ecosystems (LME) address the human dimensions of important regions of our planet.

This Handbook sets forth the defining features and the dynamic interplay between the governance and socioeconomic modules and the three natural science modules (productivity, fish and fisheries, and pollution and ecosystem health) that together describe the condition and functioning of LMEs. As such it is a major contribution to LME planning and decision-making. The Handbook begins with a discussion of ecosystem-based management as a paradigm shift from traditional sector-by-sector management. It proceeds to analyze the planning and decision-making process as it unfolds into a plan of action for ecosystem-based management. A primer on the driving forces and challenges that must be understood and addressed in LME management explores markets and the factors that determine whether stakeholders comply with or resist the implementation of rules governing how natural resources are allocated and utilised. The final chapter is devoted to the critical issue of sustained financing for long-term ecosystem-based management initiatives.

The production of the Handbook contributes to the partnership that links the coastal and marine activities of the global Regional Seas Programme coordinated by the United Nations Environmental Programme (UNEP) with the LME approach. This joint initiative also contributes to one of the global Regional Seas Strategic Directions to "(d)evelop and promote a common vision and integrated management, based on ecosystem approaches, of priorities and concerns related to the coastal and marine environment and its resources in Regional Seas Conventions and Action Plans, introducing amongst others proactive, creative and innovative partnerships and networks and effective communication strategies."

The Regional Seas Programmes provide a policy framework for the regional implementation of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA). The GPA is the only global Programme of Action that addresses the linkages between freshwater and the marine and coastal environment. It is now recognised that some 80 percent of the pollution load in the oceans originates from land-based activities. The Regional Seas/ LME partnership and the Global Environmental Facility/LME approach to ecosystem-based management are crucial to the implementation of the GPA.

This Handbook will complement the publication of "Ecosystem-based Management: Markers For Assessing Progress," among other publications, for the 2nd Intergovernmental Review Meeting of the GPA. This document, jointly produced by the GPA, the Coastal Resources Center of the University of Rhode Island, and UNEP Collaborating Centre on Water and the Environment offers sets of markers that can be used to assess progress in the integrated management of river basins, coasts or large marine ecosystems. Like the Handbook, it provides guidance on the design and conduct of ecosystem-based management that addresses both the impacts of human activities and the need to sustain or restore the goods and services generated by healthy ecosystems.

This "Handbook on the Governance and Socioeconomics of Large Marine Ecosystems" will be an important reference that provides managers with important insights into good governance practices and the socioeconomic dimensions of marine and coastal ecosystems.

PART I

FROM SECTORAL TO ECOSYSTEM-BASED MANAGEMENT

A Paradigm Shift

The ecosystem paradigm has emerged as the dominant approach to managing natural resources and the environment. Traditionally, management efforts have been organized around particular uses such as fisheries or mineral exploitation, resulting in separate governance regimes for each use. Over time it has become ever more apparent that such a sectoral approach results in conflicts among users and is inadequate in meeting the need for sustaining the goods and services that flow from healthy ecosystems (Commission on Marine Science Engineering and Resources, 1969; Independent World Commission on the Oceans, 1998; Pew Oceans Commission, 2003; United States Commission on Ocean Policy, 2004).

The shift away from the management of individual resources to a systems approach is evidenced in the broader perspective of ecosystem-based management that has taken hold in a number of fields such as forestry and fisheries and has been endorsed by a number of studies and expert commissions (U.S. Commission on Ocean Policy, 2004; Pew Commission on the Oceans, 2003; the Independent Commission on World Oceans, 1998). It is also reflected in the actions of a variety of U.S. states (Juda, 2003; Laffoley, 2004) and in the work of international organizations ranging from the International Oceanographic Commission, to the Food and Agriculture Organization, to the United Nations Environment Program, to the Global Environment Facility.

Why the need for change from traditional ways of governing natural resources and the natural environment? What is ecosystem-based management and what advantages does it offer? And, what has to be done in the name of this new approach?

Economic activity and human well-being depend on the functioning of natural systems that provide goods such as clean air, clean water, food, and services, such as the filtering of pollutants and provision of living resource habitat. The economic value of the goods and services generated by the operation of natural systems has been assessed at extremely high levels and the loss of these goods and services would have devastating socioeconomic effects at local, regional, and global levels (Costanza, 1997; GEF, 1998; Daily, 2000; U.S. Commission on Ocean Policy, 2004). Yet over time, the natural systems that provide these benefits have come under growing pressure as a consequence of a combination of factors including:

- Growing world population and the global scale of markets that generate increasing demands for natural resources
- Modern technology that enhances human capabilities to exploit natural resources, often with attendant damage to the environment

- Human impacts on the environment, including living resource habitat destruction and the introduction into the environment of vast quantities of waste, including effluents which may not be biodegradable, may be highly toxic, or, in the ocean environment, may significantly reduce oxygen availability; overexploitation of renewable resources (fisheries, freshwater, etc.); and introduction/transfer of invasive species.

In a number of areas such as fisheries, coastal water quality, climate change and sea level rise, it is clear that existing management efforts are falling short (Millennium Ecosystem Assessment Synthesis Report, 2005). When the usual ways of doing things no longer result in desired outcomes, it is natural that new approaches will be considered (Kuhn, 1970).

In the years preceding the 1992 United Nations Conference on the Human Environment and Development (UNCED), attention progressively turned to ecosystem-based management (World Commission on Environment and Development, 1987). The Rio Declaration adopted at UNCED called upon States "to conserve, protect and restore the health and integrity of the Earth's ecosystem" (Rio Declaration, principle 7, 1992). And, Agenda 21 adopted at that meeting observed that oceans and adjacent coastal areas form "an integrated whole that is an essential component of the global life-support system." This realization, it was noted, requires new approaches to marine and coastal area management and development at the national, subregional, regional and global levels – approaches that are "integrated in content and are precautionary and anticipatory in ambit…" (Agenda 21, 17.1, 1992). Indeed, by 1997, the UN Commission on Sustainable Development found that:

The concept of integrated management of watersheds, river basins, estuaries and marine and coastal areas is now largely accepted in the United Nations system and in most countries as providing a comprehensive, ecosystem-based approach to sustainable development (E/CN.17/1997/2/Add.16 (24 January 1997).

In simple terms, ecosystem-based management recognizes that human communities, like plant and animal communities, are interdependent and interact with their physical environment to form distinct ecological units called ecosystems. These units that provide the basis of life for fish, birds, marine mammals, and humanity itself are transboundary in character, typically cutting across existing political and jurisdictional boundaries and, thus, subject to multiple management systems. Likewise, many human actions and their consequences, including pollution, extend across jurisdictional boundaries and impact the functioning of important ecosystems shared by multiple jurisdictions.

The emergence of the ecosystem paradigm seeks to address management failure associated with the lack of congruence of (a) ecologically defined space, that is, the geographic areas encompassed by the extent of natural ecosystems and (b) politically defined space, the geographical area coming under the legal jurisdiction of particular political authorities (Juda, 1999; Juda and Hennessey, 2003). It also seeks to overcome the significant limitations posed by the traditional, single sector/ single species approach to management of natural resources and the natural environment. This traditional type of management generates unintended detrimental effects, that is, negative externalities. For example, the widespread and heavy use of fertilizers employed by modern agriculture has resulted in water bodies, as in the U.S. Gulf of Mexico, the Baltic and the Black Seas, that are oxygen depleted and, consequently, devoid of fisheries. By definition, cosystem-based approaches to management take a systems view and seek to incorporate such potential externalities into decisionmaking (Christensen, et al., 1996; Franklin, 1997).

Table 1. Ecosystem-Based Management as a Paradigm Shift

From	To
• Individual species	• Ecosystems
• Small spatial scale	• Multiple scales
• Short-term perspective	• Long-term perspective
• Humans independent of ecosystems	• Humans as integral parts of ecosystems
• Management divorced from research	• Adaptive management
• Managing commodities	• Sustained production potential for ecosystem goods and services

From: Lubchenco (1994) in Sherman and Duda (1999)

Ecosystem-based management has been defined by the Ecological Society of America as management:

> …driven by explicit goals, executed by policies, protocols, and practices, and made adaptable by monitoring and research based on our best understanding of the ecological interactions and processes necessary to sustain ecosystem structure and function (Christensen, et al., 1996).

As discussed below, such management requires substantial change in a number of areas of human activity and strongly underscores the need for intersectoral, stakeholder, and intergovernmental coordination and cooperation.

The approach in this Handbook has been inspired by our own experiences in the design and implementation of coastal management efforts in the U.S. and several low-income nations, and by the large marine ecosystem (LME) management efforts underway in several regions. The management and assessment of LMEs – comprised of estuaries, inshore shallow waters and linked watersheds – is an expression of a movement that substituted managing individual sectors with an integrated approach directed at sustaining the productive potential for ecosystem goods and services (See Table 1). In ecosystem-based management, the associated human population and economic/social systems are seen as integral parts of the ecosystem. Most importantly, ecosystem-based management is concerned with the processes of change within living systems. Ecosystem-based management is therefore designed and executed as an adaptive, learning-based process that applies the principles of the scientific method to the processes of management.

Ecosystem-based Management in LMEs

Developed by Kenneth Sherman and Lewis Alexander, the concept of LMEs provides a science-based approach for dividing the world's oceans into meaningful, ecosystem-based units that have management utility (Sherman and Alexander, 1986; Alexander, 1993). LMEs include geographic areas of oceans that have distinct bathymetry, hydrography, productivity, and trophically dependent populations. The geographic limits of most LMEs are defined by the extent of continental margins and the seaward extent of coastal currents. Over 90 percent of all fish and other living marine

resources produced are taken from the world's 64 LMEs. Many LMEs are currently stressed from overexploitation of marine resources, habitat degradation, and pollution.

It is useful to emphasize the significance of the individual words in the name Large Marine Ecosystems. The significance of *large* is that many of the natural resources of the areas are transboundary. In other words, the resources, such as fish stocks, mineral deposits, etc., cross the jurisdictional boundaries of two or more sovereign states. The word *marine* is significant to the extent that the focus of the approach is on marine resources. However, the marine resources and the overall status of the marine environment is inextricably linked to the coastal watersheds that border the ocean portion of the LME. As such, the LME model links the management of drainage basins and coastal areas with continental shelves and dominant coastal currents. The approach:

- Addresses the many-faceted problem of sustainable development of marine resources
- Provides a framework for research, monitoring, assessment and modeling to allow prediction and better management decisions
- Aids in focusing marine assessments and management on sustaining productivity and conserving the integrity of ecosystems (Sutinen, et al., 2000)

The Global Environment Facility (GEF) and its Implementing Agencies (World Bank, United Nations Development Program [UNDP] and United Nations Environmental Program [UNEP]) have adopted the LME approach for use in marine ecosystem management and assessment, seeing it as providing a framework for integrated management efforts (World Bank, 1996: Annex A).

As will be considered below, the LME-based approach requires social science as well as natural science investigations, since many of the root causes of the problems of the marine environment are the consequences of human activities (Pernetta and Mee, 2001; Belausteguigoitia, 2004; Newell, et al., 2005). The GEF LME initiative has five modules:

- **Productivity**: focuses on oceanic variability and its effect on the production of phytoplankton and zooplankton that are at the base of the ocean food chain; it is concerned with the carrying capacity of ecosystems and their ability to sustain fishery and other living resources.
- **Fish resources and fisheries**: considers the sustainability of individual species and the maintenance of biodiversity of living resources.
- **Pollution and ecosystem health**: examines ecosystem status and threats to the productivity and sustainability of ecosystems as a consequence of eutrophication, biotoxins, pathology, and emerging diseases.
- **Socioeconomics**: considers human actions and the long-term sustainability and associated socioeconomic benefits and costs of human activities.
- **Governance**: concentrates on adaptive management, stakeholder participation, and efforts to influence human behavior in support of ecosystem sustainability.

The first three modules are natural resource science-based and have been well-developed. Extensive scientific work has resulted in methods for monitoring and assessing the productivity, fish resources and fisheries, pollution and ecosystem health of LMEs (Sherman and Alexander, 1981,

1986; Sherman, et al., 1991, 1993, 1996, 1998; Sherman and Tang, 1999; Sherman and Skjoldal, 2002; Duda and Sherman 2002; Hempel and Sherman 2003). Sustained, accurate and efficient assessments of changing ecosystem states are now feasible because of the advent of advanced technologies applied to coastal ocean observation and prediction systems. Such systems can now measure ocean productivity, changes in fish stocks, and changes in water and sediment quality and general health of the coastal ocean.

Consideration of the socioeconomic and governance modules has been more limited, despite the fact that work on these modules is essential to achieving effective ecosystem-based management. But as attempts are made to go from theorizing and conceptualization of natural system dynamics to operationalization and implementation of management strategies, greater consideration must be given to the human dimension of LMEs, represented by the latter two modules (Juda, 1999; Juda and Hennessey, 2001).

Managing Humans in LMEs

Efforts to manage resources and the environment in the context of ecosystems are really about managing human behavior and encouraging and inducing behavioral patterns that take into account the operation of the natural world. People, of course, are part of that world and, given their increasing numbers and their intensifying use of resources and the environment, together with the implications of their employment of ever more sophisticated technologies, their activities have increasing or perhaps even dominant significance in the continued evolution of natural systems. Thus, ecosystem-based management is not simply about science; successfully effectuating such management requires a very significant shift in human mindsets and behavior (Grumbine, 1993; Newell et al., 2005). Accordingly, careful attention must be given to human institutions, organization, activities, values, and their implications for the ecosystems and resources for which protection is sought (McGlade and McGarvey, 1991; Hanna, 1998; Juda, 1999).

Management of LMEs requires not only knowledge of the changing pattern of human use of ecosystems and their ecological impacts but also the effects of change on the availability of socioeconomic benefits to be derived from LMEs. Both human and ecological systems are composed of complex webs of interrelated components and processes. Interactions occur within each respective system and also between systems. It is necessary to view the natural environment and related human dimensions as a set of interrelated components and processes rather than isolated elements that act independently.

The Dimensions of Governance

The term "governance" has become prominent in many settings where a fundamental rethinking of societal goals, structures and mores is seen as necessary. As defined by Olsen (2003), governance addresses the values, policies, laws and institutions by which a set of issues are addressed. Governance probes the fundamental goals and the institutional processes and structures that are the basis for planning and decision-making. Management, in contrast, is the process by which human and material resources are harnessed to achieve a known goal within a known institutional structure. We therefore speak of business management, park management, personnel management or disaster management. In these instances, the goals and the mechanisms of administration are well known and

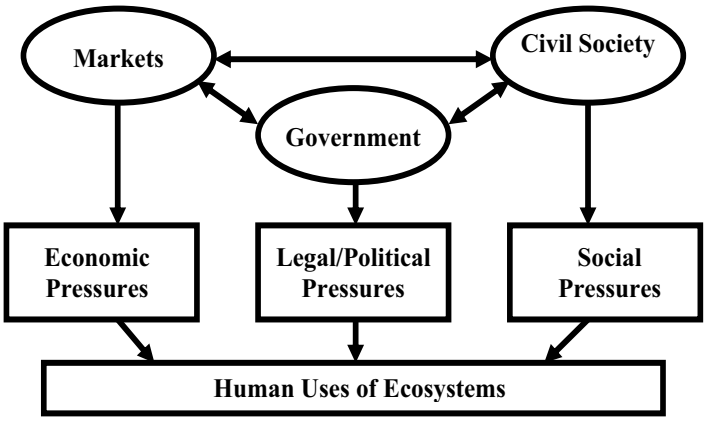


Figure 1. Three key governance mechanisms

widely accepted. Governance sets the stage within which management occurs.

The paradigm shift requires such a profound reassessment of how change within ecosystems is analyzed, how goals are set and how human activities within ecosystems are regulated that the fifth LME module is termed governance and not management. However, once the paradigm shift has been made successfully, the day-to-day operations within an LME will assume the characteristics of management. It would be more accurate to refer to ecosystem-based *governance* and not ecosystem-based *management*. The reality, however, is that the term ecosystem-based management has been formally adopted by many institutions even though its practice is widely recognized as requiring the fundamental shifts in thinking and behavior that are associated with governance.

Governance encompasses the formal and informal arrangements, institutions, and mores that structure and influence:

- How resources or an environment are utilized
- How problems and opportunities are evaluated and analyzed
- What behavior is deemed acceptable or forbidden
- What rules and sanctions are applied to affect the pattern of use

We emphasize that governance is *not* synonymous with management. It includes all other mechanisms and institutions that serve to alter and influence human behavior (Juda, 1999; Juda and Hennessey, 2001).

As suggested in Figure 1, there are three mechanisms by which the processes of governance are expressed: the marketplace, the government, and the institutions and arrangements of civil society.[1] These mechanisms interact with one another through complex and dynamic interrelationships. Individually and collectively these three mechanisms of governance affect how humans use and otherwise interact with a LME. Failure to heed the signals from these institutions may lead to sanctions that range from economic loss, to incarceration or monetary penalties, or to expulsion or alienation from the community.

Each of the three governance mechanisms can alter patterns of behavior through tools such as those identified in Table 2. Which tools to utilize in particular LMEs, and in what combination, are matters

[1] We use the term civil society to refer to the arena of uncoerced collective action around shared interests, purposes and values, where its institutional forms are distinct from those of the state (government) and market. See the Centre for Civil Society (http://www.lse.ac.uk/collections/CCS/introduction.htm).

requiring careful consideration by governments and stakeholders.

Table 2. Major Governance Mechanisms and Tools

Government
- Laws and regulations
- Taxation and spending policies
- Education and outreach

Marketplace
- Profit-seeking
- Ecosystem service evaluation
- Eco-labeling & green products

Institutions and organizations of civil society
- Socialization processes
- Constituency roles and "issue framing"
- Co-management

The marketplace, in which goods and services are exchanged by profit-seeking producers, traders, and consumers, affects how the environment is utilized, what resources are extracted, and the manner in which these resources are exploited. For their part, consumers may come to consider not only the product itself but also the manner in which it is produced, providing some significance to eco-labeling that may be supportive of natural ecosystem protection. Very importantly, contemporary efforts to attach monetary value to ecosystem services (Costanza, 1997; Independent Commission on the World Oceans, 1998), which have been regarded in the past as free, give a more concrete sense of value to those services, demanding more careful consideration of the natural environment. It could also encourage the internalization of the costs of maintaining such services. In a variety of ways, the marketplace could make significant contributions to ecosystem protection. These topics are discussed in greater detail in Part III.

Government policy and regulation, whether at a local, regional, or national level, is well recognized as a mechanism that can affect human behavior. Tax policies can provide incentives for particular types of conduct and, through government spending patterns, a substantial portion of society's resources may be directed so as to promote specific objectives. Regulatory efforts, such as zoning and permitting, can channel efforts along desired paths and, with their potential for unpleasant consequences in the form of fines or even imprisonment, can discourage undesired behavior. But in the long run, and perhaps most importantly, education may encourage environmental and ecosystem awareness that can encourage behavioral patterns supportive of ecosystem sustainability.

Social norms and networks – sometimes referred to as 'social capital' – shape individual and collective behavior, and also facilitate cooperation among individuals and between groups of individuals. By encouraging trust, civic engagement, and social networks, social capital can enhance effective governance while reducing management costs (Grafton, 2005). Social capital appears to have great potential for advancing ecosystem-based management in informal governance systems. As a manifestation of social capital, nongovernmental organizations (NGOs) are becoming more evident in political activity at local, national, and international levels; there is a proliferation of NGOs that actively and purposefully seek to influence public policy on a wide range of issues. NGOs are a recognized force and play multiple roles in affecting behavior and public policy. They may serve as advocates of particular courses of action for government (e.g., limit the construction of shrimp ponds) or of societal behavioral patterns (e.g., rejection of corrupt practices) or seek to encourage or discourage enactment of particular pieces of legislation. In democratic and pluralistic societies, nongovernmental groups play important constituency roles, affecting both governmental and marketing decisions with attendant ramifications for the natural environment.

In traditional political usage, NGOs are exemplified by environmental organizations such as the International Union for the Conservation of Nature and the World Wildlife Fund or trade associations such as the Chamber of Commerce or the National Association of Manufacturers that have purposeful political agendas which, through explicit strategies, seek to influence public attitudes, governmental policy, and the marketplace so as to achieve particular goals. But for the purposes of the present analysis, NGOs should be thought of more broadly and include bodies that may be less overtly political in nature, ranging from community associations to fraternal organizations to families and religious groups. All of these may serve as agents of socialization and thus shape human perceptions, preferences, and attitudes in positive ways.

While such groups may not issue edicts that are legally binding (in the way that law is in civil society) or explicitly seek to change governmental or economic policy, they do influence ideas and patterns of thought and often generate meaningful social pressures that encourage adherence to particular norms of behavior. Nongovernmental institutions and arrangements can beneficially affect ecosystem use patterns.

The Potential Benefits of Managing LMEs as Ecosystems

Society reaps tremendous benefits from the world's oceans and coasts. In the United States, for example, the economies of coastal watersheds account for half of the gross domestic product and 60 million jobs. The human activities that generate this income and employment include marine transportation and trade, fisheries, tourism and recreation. These activities draw people to settle in and visit coastal areas. As a result, the coasts are becoming increasingly crowded. In 2003, 53 percent of the U.S. population lived in coastal counties, a zone that comprises only 17 percent of the total U.S. land area. Twenty-three of the 25 most densely populated counties are on the coast, and average 300 persons per square mile. In addition, there is growing demand to use living marine resources and to produce energy and minerals from offshore deposits.

The growth and settlement of populations in the coastal zone, in conjunction with the associated

Table 3. Linkages Between 5 LME Modules and TDA/SAP Processes

LME Module	*TDA*	*SAP*
1. Productivity	Transboundary issue, identify threats and root causes	Regional and national reforms to maintain productivity
2. Fish resources and fisheries	Transboundary issue, identify threats and root causes	Regional and national reforms to sustain fisheries
3. Pollution & Ecosystem Health	Transboundary issue, identify threats and root causes	Regional and national reforms to reduce pollution and sustain ecosystem
4. Socioeconomics	Socioeconomic impact analysis, including prioritization of issues	Economic instruments, investments, etc. as tools for SAP implementation
5. Governance	Governance analysis; stakeholder analysis	Legal, policy and institutional reforms; ministerial level adoption; stakeholder involvement (private sector & civil society)

economic activities, constitute a set of major stressors on coastal and ocean ecosystems. Humans' activities often lead to the degradation and loss of natural habitats; added waste disposal and pollution discharges to water bodies; overexploitation of living marine resources; invasive species, pathogens, toxic contaminants, and harmful algae blooms; and increased vulnerability to coastal hazards. In recent years in the U.S., for example, nearly a fourth of the estuarine areas were unsuitable for swimming or fishing; and there were 18,000 days of beach closings and advisories issued in 2003 due to high bacterial counts. Nonpoint source pollution has increased as human activities have grown in coastal areas, causing nutrient enrichment, hypoxia, harmful algal blooms, toxic contamination, and other problems that plague coastal waters. Problematic point sources of pollution include sewer system overflows, septic systems, wastewater treatment plants, animal feeding operations and industrial facilities – all of which are the products of major economic activities. In addition, the overexploitation of fisheries and other living marine resources continues for the majority of the world's stocks.

It is clear from this evidence that the failure to properly manage the human activities that affect oceans and coasts is compromising their ecological integrity, diminishing our ability to fully realize their potential, costing jobs and revenue, threatening human health, and putting our future at risk.

Management of human activities that affect an LME will, by necessity, depend on the information produced by a comprehensive monitoring network to assess the status and trends of the LME. A monitoring network is 'essential' to an ecosystem approach to management, since policy must be based on a scientific 'understanding of the natural, *social, and economic* processes that affect oceans and coastal environments' (United States Commission on Ocean Policy 2004, emphasis added).

In other words, it is essential to understand the social and economic processes that affect oceans and coastal environments. Policy makers and stakeholders need to understand and have the ability to explain variations in those human activities that impact habitat, pollute and over exploit the natural resources in an LME.

The Global Environment Facility and Its Investments in LME Management

The Global Environment Facility (GEF, 1996a) defines its role in international waters as that of a catalyst for the implementation of ecosystem-based approaches to managing international waters and their drainage areas. The GEF's investments follow a two-step process. The first calls for the preparation of a Transboundary Diagnostic Analysis (TDA) that identifies threats, issues and their root causes. The TDA is followed by the negotiation of a Strategic Action Program (SAP) that creates the enabling conditions and identifies the necessary actions and commitments (including policy, legal and institutional reforms and investments) that will be required to make the management of an LME an operational reality. "Inter-ministry committees," i.e., committees of representatives from pertinent national ministries, oversee TDA/SAP development and national-level implementation. Thus, both TDA and SAP are designed and implemented through country-driven processes that involve the governments of the countries, civil society and private sector stakeholders with interests in the marine resources and management. The relationship between the TDA/SAP and the five LME modules is presented below as Table 3.

The GEF funds for the TDA/SAP process are provided through grants administered by GEF implementing agencies – i.e., either the World Bank, UNDP or UNEP. The countries within each LME provide matching funds and in-kind contributions.

During the World Summit on Sustainable Development held in Johannesburg in 2002, participating world leaders agreed to adopt four marine goals: (1) to achieve substantial reductions in land-based sources of pollution in 2006; (2) to introduce an ecosystems approach to marine resource assessment and management by 2010; (3) to designate a network of marine protected areas by 2021; and (4) to maintain and restore fish stocks to sustainable yield levels by 2015. These goals reaffirmed the need for GEF investments in LME management.

Since 1993, GEF has provided over US$260 million and mobilized US$450 million in additional funding to improve the assessment and management of LMEs across 121 countries participating in GEF projects (Duda and Sherman 2002; Alfred Duda, pers. comm.) following a country-driven process described in Part II of this Handbook. Of 18 GEF-funded LME projects, the Benguela Current project and the Guinea Current project are in the process of preparing SAPs, and three have reached agreements among the several ministries in each country bordering the LMEs to establish joint commissions to serve as decision-making bodies to apply ecosystem-based management practices.

The Centrality of Governance Challenges in LMEs

While the three natural science modules have so far received the greatest attention it is clear that the priority issues that must be addressed to restore and/or sustain the qualities of any LME all are rooted in the design and implementation of a reformed governance structure and a new planning and decisionmaking process. This is well illustrated by the Benguela Current LME. Here, the TDA identified the following seven *priority issues* in the region:

- Decline in commercial fish stocks
- Uncertain ecosystem status
- Inadequate capacity to assess the ecosystem
- Deterioration in water quality
- Habitat destruction and alteration
- Loss of biotic integrity
- Harmful algal blooms

Six of the seven *generic root causes* (2-7) for these issues are challenges that require socioeconomic analysis and governance reforms.

1. A complex and variable ecosystem.
   a. Changing state of the Benguela Current
   b. Inadequate information
   c. Difficulty in monitoring and assessment

2. Inadequate capacity development (human and infrastructure) and training.
    a. The legacy of the colonial past
    b. Institutional downsizing and brain drain
    c. Limited inter-country exchange
3. Poor legal framework at the regional and national levels.
    a. Regionally incompatible laws and regulations
    b. Ineffective environmental laws and regulations
4. Inadequate implementation of available regulatory instruments.
    a. Inadequate compliance and enforcement (overfishing, pollution)
    b. Indifferent and poor communication
    c. Posts not filled.
5. Inadequate planning at all levels.
    a. Inadequate intersectoral planning
    b. Poorly planned coastal developments
    c. Limited time horizon of the planners
    d. Rapid urbanization
6. Insufficient public involvement.
    a. Lack of awareness and public apathy
    b. Conflicts about rights to access
7. Inadequate financial mechanisms and support
    a. Low country Gross Domestic Products
    b. Ineffective economic instruments
    c. Insufficient funding for infrastructure and management; poor salaries.

The importance of socioeconomic and governance issues are again borne out in the SAP which calls for the reforms and actions that also stem from the governance and socioeconomic dimensions of LME analysis.

In summary, capacity building, regional collaboration, policy development and harmonization are overarching actions that require knowledge of governance capacity analysis, institutional design, transdisciplinary collaboration and socioeconomics. These are the topics addressed by this Handbook.

PART II

FROM PLANNING TO IMPLEMENTATION: THE STEPS IN THE GOVERNANCE PROCESS

A Strategic Approach to the Transition to Ecosystem-based Management in LMEs

We now turn to the processes by which the governance and socioeconomic dimensions of LMEs are analyzed and a program of action is negotiated and then implemented. This is a complex undertaking that requires integrating across the five modules by which GEF investments in LME management are organized. The GEF recommends completing a series of actions that are organized as a Transboundary Diagnostic Analysis (TDA) followed by the negotiation of a Strategic Action Program (SAP). Similar processes have been followed by all other efforts to manage large ecosystems containing a diversity of competing human activities.

GEF financing in support of LME management can be obtained through the following grants:

- PDF Block A grants (up to $50,000) finance the very early stages of project or program identification
- PDF Block B grants (up to $350,000 for single country and up to $700,000 for multi -country projects) finance information gathering activities and the stakeholder consultations necessary to prepare full-sized project proposals
- PDF Block C grants (up to $1 million) provide additional financing, where required, for large, complex projects to complete technical design and feasibility analysis
- Medium-Sized Projects (MSPs; up to $1 million)
- Full-Sized Projects (>$1 million) for TDA/SAP development and/or implementation

How Long Does It Take?

The transition from traditional sector-by-sector management to ecosystem-based management requires important shifts in the thinking and the behavior of both individual specialists and institutions. It is a process that evolves over considerable periods of time. Duda (2002) points out that experience in the management of such large ecosystems as the North American Great Lakes, the Baltic Sea, the Rhine basin and the Mediterranean Sea shows that 15-20 years were required before meaningful commitments to joint management improvements could be secured from the several countries involved. More time is needed before the transboundary water bodies respond to the reductions in the stress from pollution, overfishing, eutrophication and habitat alteration that are brought by the implementation of a program of action. Attaining environmental and societal goals for desired ecosystem goals at this large scale may, therefore, require 20 to 30 years. As a consequence, GEF investments in LME management "will often have ceased before actual water body improvements can be detected" (Duda, 2002). A major strength of the TDA/SAP process is

that it has adopted a country-driven, learning-by-doing approach by which such concrete actions as monitoring the condition of the fisheries, conflict resolution and piloting of management actions all contribute to building capacity in local institutions and demonstrating the benefits of ecosystem management. In the case of the Benguela Current LME, the most advanced of the GEF-supported LME management programs, seven years were required to complete the TDA/SAP process and make the transition into an initial phase of implementation in 2002.

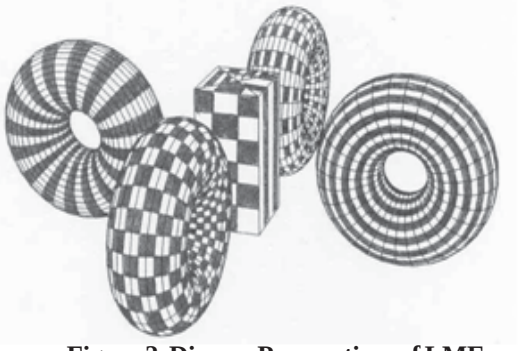


Figure 2. Diverse Perspectives of LME specialists

Forming and Managing an Interdisciplinary Team

The holistic nature of ecosystem management and the need to understand the dynamics of the functioning, condition, uses and governance of a complex system requires a team with capabilities in diverse fields. Figure 2 below illustrates the typical situation in which specialists representing such diverse fields in the natural sciences, economics, political science, law and journalism come together to analyze, and act upon, the issues posed by the governance of an ecosystem. Each of these specialists has been shaped by their specialized education and has a distinct vocabulary, draws upon different conceptual frameworks and often has a worldview shaped by a distinct values and beliefs. Each of these is illustrated in the diagram as an independent "ring." The central pillar represents the ecosystem governance issues that these specialists are working to understand and address.

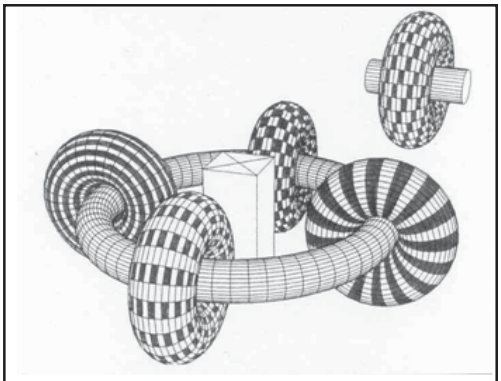


Figure 3. An epistemic community of specialists with shared perspectives

In Figure 3, a cable links the rings together. The cable represents a shared appreciation of the many dimensions of the issues and the specialized knowledge of each specialist. When the cable is present, an "epistemic community" has been formed (Haas 1992). Its members share the same ultimate goals and have learned to respect and sufficiently understand the fundamental features of each other's disciplines, so that the team as a whole can analyze issues from the perspectives of the five modules by which LME analysis and planning is organized.

In LMEs supported by the GEF, an interdisciplinary team is usually formed in the initial stages of the preparation of the TDA as a Technical Task Team (TTT) led by a project coordinator. Specialists in fisheries, various branches of oceanography, socioeconomics and governance must together identify and understand the issues that the TDA and SAP will address. The importance of the socioeconomic and governance dimensions of LME management makes it imperative that these social scientists are members of the team from the outset. The broad interdisciplinary representation required at this stage does not imply retaining the best scientific and academic experts, but rather those familiar with the condition and management issues of the LME being addressed (Mee, 2003).

Table 4. Assembling The Enabling Conditions For Sustained LME Governance Through the TDA/SAP Process

TDA/SAP Essential Actions	*TDA/SAP Process Indicators*
Project Development	
Design project concept	Facilitator hired Technical task team (TTT) formed Project approved by GEF
STEP 1: Issue Identification & Constituency Building	
Characterize management issues	Project manager appointed
Identify stakeholders and their interests	Inter-ministerial committees and steering committee formed
[Prepare a governance baseline to assess existing management system]	Draft TDA prepared
Identify & locate trans-boundary issues	Stakeholders meeting to review TDA
Conduct causal chain analysis	TDA adopted by steering committee
Prepare stakeholder and public involvement plan	
STEP 2: Issue-Driven Analysis and Planning	
Evaluate potential goals with stakeholders Gather & interpret additional information on environment & socioeconomic consequences of each issue Complete a gap analysis of institutions, laws, policies and projected investments [Build scenarios] [Compare costs and benefits of alternative strategies] [Identify sustained funding options] [Experiment and monitor] Formulate the SAP	
STEP 3: Negotiation of Goals, Policies & a Plan of Action	
Select the implementing Framework	TTT proposes 'vision statement' of long-term goals (EcoQOs)
Conduct feasibility study of options and their social soundness	Brainstorming long-term EcoQOs and options for achieving them
Prepare monitoring andevaluation indicators	Appoint national and regional SAP formulation teams
Win formal endorsement of policies	Set operational objectives/targets
Establish the implementing structure	Agree on national/regional institutional framework
Secure sustainable financing	Produce draft SAP Partnership conference and national endorsement Develop GEF intervention(s) Ministerial conference to adopt SAP
Step 4: SAP Implementation	
[Promote compliance with policies/procedures] [Implement inter-agency coordination agreements] [Construct and maintain necessary infrastructure] [Strengthen staff technical and administrative capabilities] [Implement conflict resolution procedures] [Adjust program strategies as necessary] [Monitor program performance and societal/environmental trends]	Conduct a donors conference Develop GEF and other donor interventions

STEP 5: Program Evaluation
Routine self-assessments
Periodic external evaluations of governance processes and outcomes
Program adaptations negotiated and adopted

The TDA/SAP actions and indicators are those listed by Mee and Bloxham (2005). Items in [ ] in the essential actions column are additional recommendations that draws from Olsen (1999).

UNDERSTANDING THE GOVERNANCE CYCLE

Table 4 outlines the sequence of actions that should be completed as an LME management initiative funded by the GEF progresses through the TDA/SAP process. In order to emphasize the dynamics of a strategic and issue-driven governance process, we have elected in this Handbook to group the actions required by the TDA/SAP process into the five steps of the policy cycle. Rather than emphasizing the mechanics of the analysis associated with each TDA/SAP action, this manner of visualizing the governance process helps understand the dynamics of a process characterized by bargaining and negotiation among the many governmental agencies and the private sector stakeholders that must be fully involved in the LME planning and decision-making process. We refer the reader to the training materials contained in the TRAINSEACOAST preliminary manual on the TDA/SAP process (Mee and Bloxham, 2005, with updates to be posted at www.iwlearn.net)) for detailed descriptions and associated exercises on each step and action, as these are required by those receiving GEF Block B grants. In this Handbook our purpose is to place the TDA/SAP process in the context of other large-scale initiatives in ecosystem-based management and to suggest additional forms of governance and socioeconomic analysis and capacity building that may be helpful in the development of a robust LME management system.

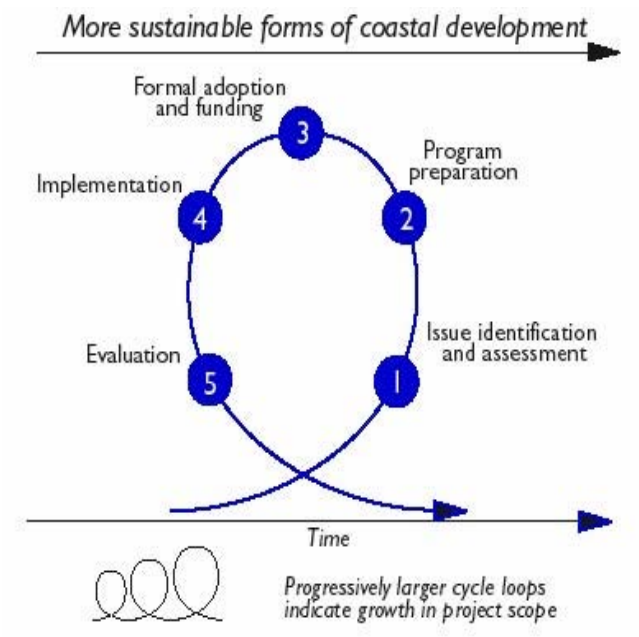


Figure 4. The Policy Cycle (GESAMP 1996)

The policy cycle is shown in Figure 4. It begins with an analysis of threats, issues and their root causes called for by the TDA. It then proceeds to the formulation of a course of action (Step 2) through the actions and processes associated with the preparation of a SAP. Experience in a wide diversity of settings suggests that the final phases of a SAP – where the goals, the authorities, the

implementing structures and the financing arrangements are formally committed to by the governments involved – have a distinct dynamic that is best understood and managed as a separate step (Step 3). This is when stakeholders, managers, and political leaders commit to new behaviors and formally allocate the authorities and resources by which the SAP will be implemented. Implementation of the program of action is Step 4. Evaluation of successes and failures, learning and a re-examination of how the issues themselves have changed, rounds out a "generation" of the management cycle as Step 5.

Given the lengths of time that are required to achieve the fundamental goals of sustainable levels of human activity in an LME, it is important to understand that in adaptive management the processes of issue analysis, planning and implementation and evaluation proceed as a sequence of linked *generations* of management: the TDA/SAP process. When successfully completed, it constitutes a single cycle, or generation, of LME governance. In some instances, portions or even the entire LME may have progressed through an earlier cycle, or fragment of a management cycle before a GEF Block B grant was negotiated. For example, the North Sea had been the subject of several management initiatives before the unifying concept of ecosystem-based management was adopted. Similarly, as a GEF-supported LME program matures it should anticipate completing several generations of governance. Each generation is marked by the actions associated with each of the five steps illustrated in Figure 4. As the capacity of the institutions responsible for the governance of an LME matures and grows, it should be expected that each subsequent generation will address additional issues and/or expand the reach of its activities over a larger geographic area. This can be achieved through an iterative, adaptive management approach of revising and updating the TDA and SAP in agreed time frames (say every five years). In the case of LMEs, it may be anticipated that as the program gains strength it will address issues and associated root causes that either were not present in the first generation or were not viewed as priorities at the time. The TDA/SAP process, as further described below, is designed to proceed through a logical process that is designed to create the enabling conditions for the changes in human behaviors that will mark the implementation of a program of action. This is Step 4 of the policy cycle.

Step 1: Issue Identification through the TDA

It is essential to recognize that any process that attempts to unify the management of LME resources will require governmental endorsement and must win support among the people of the place if it is to be implemented successfully. The future governance of the LME must therefore be rooted in developing with the people of the place and with responsible governmental agencies, a full appreciation for the past and current conditions and the social and biophysical processes that have shaped them. The Technical Task Team (TTT) should begin by assuming that considerable information exists on the LME resources being addressed, including anecdotal information held by the users of the ecosystem.

Ecosystem-based management of LME resources is particularly difficult because jurisdiction over the resources lies with multiple sovereign coastal states. In addition, the major user groups that comprise the stakeholders that will be most directly affected by changes in how LME resource uses are allocated may live and work in places at a great distance from one another. They may be unaware of the linkages between, for example, water pollution in a faraway estuary and the abundance of fish offshore that depend upon those estuaries as a nursery. Similarly, the

governmental agencies responsible for managing conflicts and allocating use of fishery resources in the LME may have had no relationship with the agency responsible for the management of another LME resource, such as petroleum resources or pollution control in an adjoining watershed. Forging new relationships requires identifying common interests and building trust.

The issue analysis process that begins at Step 1 is the heart of any ecosystem management effort and must be sustained through all the steps in a generation of management and then form the unifying thread that links subsequent generations of ecosystem management to each other. We suggest several forms of issue identification and analysis that are best accomplished in parallel with frequent discussions and integrations of ideas and findings that involve the full project team.

Identify Stakeholders and Their Interests

All parties involved or affected by the condition and use of an LME should be considered stakeholders in the management process. In order to be objective in its analysis and effective in solutions, the LME management process must develop a shared vision that enables the stakeholders to be independently identified and fully involved in all steps of the policy process.[1] During the initial TDA fact finding process, stakeholders should agree to freely share the necessary information and the project team should make sure that full recognition is given to the sources of the information that is assembled (Mee, 2003). The resulting TDA is a document that is freely available to all participants in the process as well as to the public. As the LME management process matures, new issues will emerge and the relative importance of individual stakeholder groups will change.

Prepare a Governance Baseline

No LME management effort begins with a blank slate. It is, therefore, essential to comprehend the already existing governance framework and to understand who does what and with what motivation and with what effect. Such analysis may begin with a governance "baseline" that answers the following questions:

- What are the impacts of past planning and management in and affecting the LME?
- What are the existing rights to use the natural resources in the LME?
- Does the existing legal, institutional, and policy framework sustain the ecosystem processes and resources that produce the goods and services that can be generated by the LME?
- Are there governmental organizations with a sufficiently broad mandate to adopt and implement a program of action to address perceived problems with marine resource use? Do they possess the necessary institutional capacity to implement such a program successfully?

Rather than compiling a static "snapshot" of the existing governance system, a governance baseline traces how the current system has evolved. To do this, the team should focus on the outcomes of past action – or inaction – on management issues. This form of analysis provides a basis for making informed judgments on how best to influence the existing system. A sound SAP should build on the strengths of the existing governance system and address its weaknesses. An important element of a governance baseline is a "governance map" that indicates who does what, who is responsible for what, how responsibilities are perceived, and what role is played by non-governmental actors in the existing system. The baseline is the basis for a gap analysis that examines during the preparation of

[1] A handbook for incorporating stakeholders into goal-setting and the entire adaptive management process is being developed by the GEF IW:LEARN project. For details , see www.iwlearn.net.

the SAP how the existing system needs to be reformed to meet the requirements for effective LME-based management. A gap analysis identifies the inadequacies, voids, and gaps in essential elements of LME-based management system and options for how such gaps could be filled.

In some developing nations, the "rule of law" is weak and, at times, has only a marginal influence on how decisions affecting the allocation and use of freshwater are made. In other situations, institutions – both formally constituted governmental institutions and the less formal business associations, unions or political parties – play important roles. A governance baseline should work to understand these relationships and to analyze the distribution of power as this relates to the issues posed by the management of a LME.

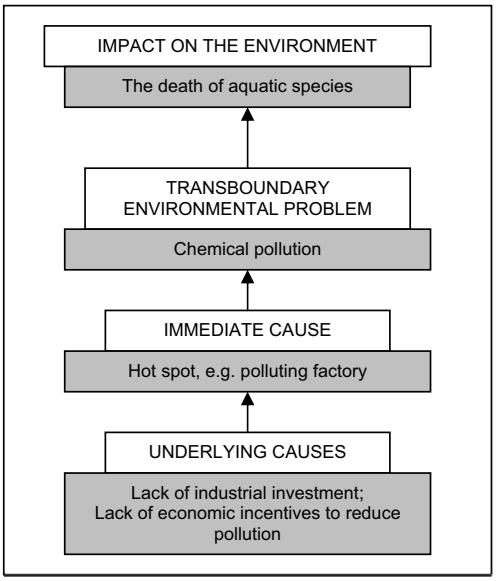


Figure 5. An example of causal chain analysis

Causal Chain Analysis

Working closely with those engaged in the integration of information on the productivity, fisheries and pollution modules, the project team should compile existing information on historical trends in the condition and activities of the LME. This will lead to the identification of the management issues that the SAP will be designed to resolve. As illustrated in Figure 5, "causal chain analysis" organizes data on ecosystem change within an LME so as to illuminate the interplay between human activities, natural resources and ecosystem processes. According to Pernetta and Mee (2001), a "causal chain is a series of statements that demonstrates and summarizes, in a stepwise manner, the linkages between problems and their underlying or "root' causes." It can also be useful to assemble matrices that array terrestrial and marine uses and ecosystem components in a manner that helps identify cause/effect relationships and interdependencies. The use of such matrices encourages the systematic and more holistic, as opposed to purely sectoral, consideration of actions.[2]

To foster exchange and cross disciplinary analysis, first within the project team and subsequently with the stakeholders in government and the private sector, it is important to organize information on ecosystem processes and trends in the condition and use of the LME in text, figures and tables that convey the essence of the knowledge that emerges from this analysis.

[2] See Sutinen, et al. (2000) for more details on the use of matrices for diagnosing the causes and effects of problems in LMEs.

Step 2: Negotiation of a Strategic Action Program

Gap Analysis

All ecosystem management programs contain common generic actions that must be performed successfully if they are to be effective. Given the variance in the nature of the problems in different LMEs and in the governance structure of the adjacent states, the needs and options for policy and institutional reform must be shaped through a country-driven process that is rooted in a thorough understanding of the existing governance system, traditions and cultures of the place. The governance baseline should therefore probe the presence or absence, strengths and weaknesses in the existing governance system to identify the gaps that must be filled to develop a working LME governance system. As suggested by Olsen (2002), the pre-conditions for the sustained implementation of an ecosystem management program can be grouped into four categories:

1. Unambiguous *goals* that define in specific terms the environmental conditions and the intensities and types of human activities that will lead to the fulfillment of the outcomes that the SAP is designed to achieve
2. Informed and supportive *constituencies* among stakeholders in both the private sector and government that understand and support what the LME program is working to achieve
3. Institutional *capacity* to practice adaptive ecosystem management including the ability to collect and interpret data on ecosystem change, skills in conflict resolution, sufficient capabilities in surveillance and enforcement of SAP policies and procedures and a culture that encourages self evaluation and learning.
4. *Commitment*, from both government and powerful private interests, that is expressed as the allocation of the authorities, funding and other resources necessary to implement the program. The TDA/SAP process is designed to gain such governmental commitment through a series of steps that begins with the negotiation of a Block B GEF grant and proceeds through the appointment of national-level Inter-ministry Committees (composed of representatives from pertinent ministries) and a Steering Committee, the adoption of the TDA by the Steering Committee and culminates in the adoption of the SAP at a ministerial conference.

Gap analysis examines the difference between what is already present in terms of each of these four preconditions and what needs to be done to advance effective governance of the LME. This is the heart of the SAP and involves analysis and debate on the policies and strategies that will be adopted to address the issues identified in the TDA. Throughout this process, consultation with the relevant stakeholders for each issue continues to be essential. Among the questions that will need to be addressed are:

1. What needs to be done that is not currently being done or not being done well?
2. What needs to be done first, i.e. what is the priority order of change?
3. Who should be responsible for needed change?
   a) Government?,
   b) Marketplace?
   c) Non-governmental bodies?
   d) Some combination thereof?

4. Should change be top down? Bottom up? A mix of the two?
5. How should stakeholders and the public be consulted and involved?
6. What principles should be used to guide the development of new governance approaches?
7. What are the future conditions of the LME and what future forms of human use constitute the outcomes that LME management is striving to achieve?
8. What realistic intermediate objectives should be set and what time lines should be adopted?
9. What instruments should be employed to advance these objectives?
10. What indicators should be used to assess progress toward achievement of objectives and in what time frame?
11. How can adaptability, transparency and accountability of governance efforts be ensured?

Answers to these questions can be used to guide the adoption and implementation of appropriate principles, tools, regulations and management measures that will close identified gaps and contribute to effective LME management systems.

Evaluate Potential Goals with the Stakeholders

Goals must be selected that define the qualities of the environment and the societal conditions that the program is working to achieve. Program goals need to appeal to the values of the society as well as reflect a solid understanding of the ecosystem and institutional process that must be orchestrated to achieve them. It is difficult to manage what one cannot measure. Without clear goals it is difficult or impossible to assess the long-term impacts of a program. Such goals should define both the environmental and social conditions (outcomes) that, when achieved, would constitute success. It is most useful to set goals that define specifically how much by when. Goal setting is a complex process and reaching agreement requires building consensus on the nature and significance of the issues being addressed, visualizing an attractive but achievable future and debating how power and wealth will be distributed in the future. It is, therefore, very important to begin discussing goals early on in the SAP process and not leave it to a short-term decision in the formalized negotiation process of Step 3. For example, in the seriously eutrophied Danube/Black Sea basin system, the countries agreed on a long-term goal of returning the Black Sea ecosystem to its ecological conditions in the 1960s, prior to the onset of serious eutrophication. In the nearer-term, the countries agreed to work collectively to reduce nutrient loads to the Black Sea to 1997 levels.

Goals should address issues and outcomes that the people of the place care about deeply. They are the basis for accountability. Specific goals encourage the project team and stakeholders to focus upon a few, carefully selected priorities and to think through what is feasible within a given time period. While goals associated with timeframes a decade or more out into the future make the fundamental purposes of the program tangible, near-term goals mark the stepping stones to those ends. The capacity to manage an ecosystem must be assembled gradually over time and the goals should balance the complexity and scope of the issues to be addressed with the management capacity that is present in the society and responsible institutions.

Conduct Additional Targeted Data Collection and Research

The analyses conducted in the TDA pertaining to consequences of the interactions among the natural and human components of the LME should be the basis for setting priorities for additional data

collection and targeted research on those topics most relevant to framing management policies and a suitable institutional design for program implementation. This additional data gathering and analysis may be focused on collecting new or additional data on environmental, economic and social conditions relevant to priority LME management issues. Some data collection and research will invariably need to be sustained during the implementation of the management plan. During the preparation of the SAP, additional analysis and discussions with stakeholders should probe knowledge and perceptions on the future implications of environmental, economic and social trends within and affecting LME resources, and weigh the implications of important uncertainties on how the ecosystem functions and how it is likely to change.

Build Scenarios

Plausible scenarios of contrasting future conditions can help visualize the likely implications of different courses of action. Scenarios can be very helpful in prompting informed debate and in building constituencies for an emerging program of action. Scenarios are developed by applying what has been learned from the TDA and the emerging SAP and engage the private sector stakeholders and the institutions involved in grappling with the potential impacts of changes to the condition and uses of the LME. Scenarios should crystallize the implications of alternative actions and identify the key elements of a program of action. Well-prepared scenarios can play a central role in public education programs and in focusing the analysis and debate over what actions should be taken to address current or anticipated changes to the ecosystem and the human activities it supports. The economic dimensions of alternative scenarios may play a central role in mustering political support for an Ecosystem-Based Management initiative in Step 3 (discussed below).

Scenarios are only one means for helping institutions, stakeholders and the public at large to absorb, discuss and consider the issues raised by an analysis of changes to freshwater flows and the long-term implications of such changes. While public awareness of the issues is important, the priority is to build a well-informed constituency for the emerging LME program. Events that foster interactions among groups that otherwise do not know each other, and provide a forum where differing perspectives and needs can be aired and discussed are particularly valuable.

Compare the Costs and Benefits of Alternative Courses of Action

A given problem may have several alternative solutions which appear both technically feasible and more-or-less effective. Still, the investment and recurring costs of the alternatives will usually vary substantially. Selecting among them is not straightforward and requires information not only on costs over time, but also on their relative efficiency — that is, cost effectiveness. For example, when selecting among treatment strategies for a source of water pollution, effectiveness involves selecting the alternative(s) with lowest cost per unit treated. At one level this can be viewed as a technical, engineering-economic problem. However, effective policy requires implementation, and it is therefore critical that the necessary management mechanisms and institutional structures be in place. If they are not, this will change the cost-effectiveness calculation.

Benefit-cost analysis can be a valuable decision tool, for several reasons. First, it puts public investments on the same footing as private investments in that they must meet the same standard: the costs of a policy, program, or activity should be justified by the resulting benefits. A well-done benefit-cost analysis makes all calculations and assumptions explicit and thereby transparent to all stakeholders. Even so, even qualitative comparisons of costs and benefits can help to inform decisionmaking.

Benefit-cost analysis raises several issues. One is whether the value of important benefits and costs can be quantified. Many advances have been made in natural resource valuation, and the opportunities and limitations of resource valuation are becoming increasingly well understood. But many difficulties remain, and data problems are always an issue, especially in developing countries. Another important issue, equity – the distribution of the benefits and costs of a proposed policy action – should always be examined in such an analysis.

Sustained Financing for Implementation

A major challenge for all LMEs will be to secure the funding required to sustain the management system after GEF funding is no longer available. No GEF-assisted LME has, as yet, made this transition. However, when legitimate government commitment to reform is evident, the GEF may support one or more SAP implementation projects over an extended period – as long as 10 years – towards achieving a financially and institutionally sustainable LME governance system.

Securing such sustained funding is considered a national responsibility and must typically be funded through the national budgetary allocations to the institutions involved. In many countries the funds to implement a program through a permit program, to monitor and enforce, and continue research on critical uncertainties are scarce. Such budgetary constraints may be a central limitation to institutional capacity. Market-based management systems can address this issue by raising revenues from LME resource users licensed to harvest specified amounts of resources. More details on methods of sustainable financing are provided in Part III of this Handbook.

Experiment and Monitor

The implementation of a management program designed to address current or impending issues will require changes in the behavior of several groups and institutions. The challenges of instigating, and maintaining such changes in behavior lie at the heart of successful implementation (Step 4) and invariably raise unforeseen problems and benefits. Experience has repeatedly demonstrated, particularly in low-income settings and where top-down enforcement by governmental agencies has a record of yielding poor results, that experimenting with new policies and their associated behaviors at a pilot scale can be very useful. Seeing is believing. If a new practice – for example a new approach to addressing habitat degradation or overfishing or modifying how petroleum extraction or mining takes place – is implemented at a pilot scale during the SAP, the experience, if positive, can do much to build support and credibility for the ideas put forward by the project team. Similarly if what appeared at first to be a good idea proves in practice to be impractical, it is best if these problems are identified early on and do not require modifying a new rule or practice that has gained formal endorsement and is, therefore, hard to change. Many GEF LME SAP projects pilot such approaches through demonstration projects designed during the Block B stage.

Step 3: Formal Endorsement of the SAP

Step 3 is the culmination of a process that has worked to integrate results of technical analysis with a process of mutual education and consensus building among the various stakeholders. The implementation of actions that will have emerged as most critical to sustaining the LME resources will require formal endorsement by government. In the case of LMEs, which span the waters of more than one nation (85 percent of the world's 64 LMEs span two or more nations), negotiations with several governments and governmental agencies will be required. Formal adoption of new ecosystem-based management policies and procedures may take many forms, but typically requires

executive decrees, cabinet resolutions, and – at a minimum – high level administrative decisions. New government agencies may need to be created to implement an LME program. Existing agencies may need to formally commit to collaborating on the implementation of discrete elements of the program, and important roles may be given to NGOs.

Win Formal Endorsement of the Policies That Will Shape LME Governance

Formal adoption of a new ecosystem-based management set of policies and procedures usually affects the distribution of authority and influence among institutions, interest groups and politicians. This may trigger defensive behavior and bureaucratic maneuvering. Bargaining and accommodation will dominate the process by which new policies and institutional arrangements find their place in the existing structures and institutional territories of government. Critical to success is the meaningful involvement of the pertinent private sector stakeholders and the pertinent institutions in both the TDA and SAP. If these institutions and decision makers have not been involved in the processes of analysis and in weighing the options suggested by the scenarios it will be difficult to win their support at this late stage.

By Step 3, the project team and its supporters should have clearly defined the changes that are needed to the resource allocation and management process to address the ecosystem management issues that have been identified. The gap analysis should have identified any needed adjustments to how LME resource uses are allocated and whether some resources are to be protected. The solutions being proposed must be politically, as well as technically, viable. Convincing arguments must be made that demonstrate that the whole ecosystem-based management approach, which is the heart of the LME program, will, over the long term, generate greater benefits for both society and the LME than would traditional state-by-state and sector-by-sector planning and decisionmaking. The fundamental points are that (1) the values of sustained, or restored flows of benefits generated by a healthy ecosystem are large, and they benefit a diversity of groups and

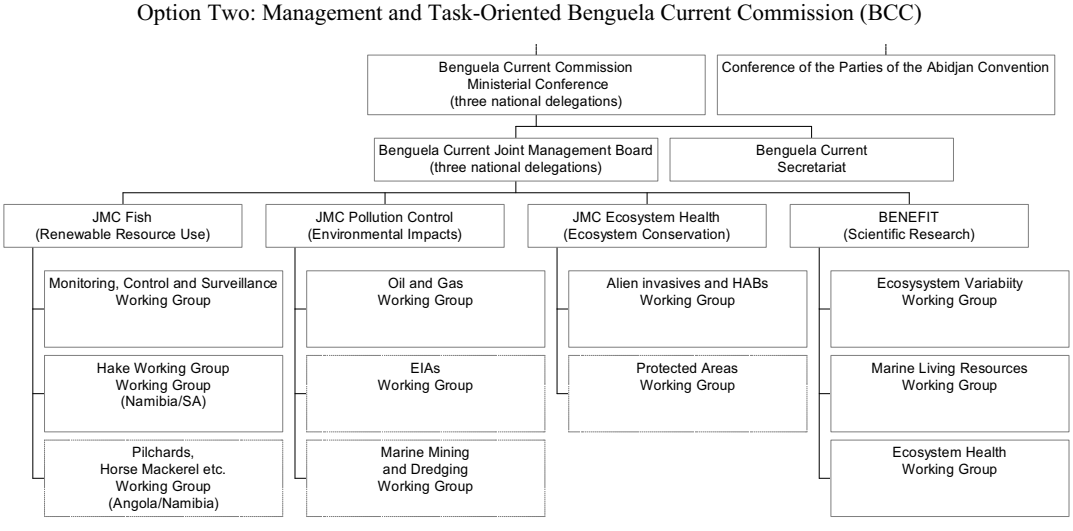


Figure 6. Organizational Structure of the BCLME

economically important activities in the LME, and (2) that a transparent and accountable system for allocating resource uses produces a secure environment for all concerned, including those who wish to make economic investments in the region. Simple graphics and cost-benefit tables can crystallize the basic points and focus debate on the substance of the issues.

Select the Institutional Structure for Ecosystem-based Management Policy Implementation

Fully as important as winning the legal basis for LME management is the design of the institutional structure by which it will be implemented. The allocation of responsibilities for the management of LME resources, and the capabilities of institutions involved, vary so widely from region to region and nation to nation that there is no single model for the structure of a transboundary management program. Nevertheless, there are three important considerations that should guide this important element of ecosystem-based management design.

The first is to match the scope and complexity of the agenda with the capacity of the institutions that will be responsible for implementation. Institutional capacity to successfully practice ecosystem-based management is in short supply everywhere. Ecosystem management will succeed if it is applied incrementally and such capacity is "grown" within the responsible institutions and its supporting constituencies.

The second consideration reflected in what is known as the "subsidiarity principle" is that institutional arrangements should be designed as a decentralized system in which authority and responsibility is delegated to the lower levels of an internally coherent "nested" system.

A third consideration that guides ecosystem-based management efforts is the "precautionary approach."[3] Here the central idea is that a cautious approach must be taken in situations that pose serious or irreversible threats to human societies, or the environment. The probable benefits of action must be weighed carefully against the likely costs of inaction. Important elements of this approach are: establishing the minimum level of proof needed to justify action to reduce hazards, the early detection of hazards, promotion of environmentally sound practices and reducing risks before full proof of harm is available.

The Benguela Current LME (BCLME) offers one model for the institutional structure for the implementation of an LME management program. Here, the strategy has been to establish during the SAP process an Interim Benguela Current Commission (IBCC) which is to become the Benguela Current Commission during the five years of initial SAP implementation. Working with the member states, the IBCC will promote cooperation with regional bodies, institutional linkages with the South African Development Commission, and commitment with both the Law of the Sea and the FAO Code of Conduct for Responsible Fisheries.[4] The Commission is a forum for dispute resolution. A Program Coordinating Unit (PCU) that will act as its secretariat will support it. The Commission will also be supported by three activity centers in each state and whose focus will be on marine living

---

[3] The UN Fish Stocks Agreement in article 6(2) describes the precautionary approach in the following manner: "States shall be more cautious when information is uncertain, unreliable or inadequate. The absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures."

[4] The BC Commission is linked to the Abidjan Convention, a UNEP Regional Seas Programme (http://www.unep.org/regionalseas/Programmes/UNEP_Administered_Programmes/West_and_Central_Africa_Region/default.asp).

resources, environmental variability and predictability and ecosystem health and pollution. There will also be five advisory groups: fisheries and living resources, marine environmental variability and ecosystem health, marine pollution, legal affairs and maritime law, and information and data exchange. The advisory groups will work with experts and institutions, industry and the NGOs. Activity centers will provide technical support to the advisory groups. Figure 6 illustrates the organizational structure of the BCLME.

Step 4: Adaptive Implementation of the SAP

The entire TDA/SAP effort culminates in Step 4, with the sustained implementation of an integrated ecosystem-based management process that protects the health, fishery resources, and productivity of the LME and the human activities it supports. Because all living systems evolve and change over time, the implementation of an action program cannot be a static or rote process. The implementation phase will have to adapt to new issues, new knowledge and changes in the context within which the system and its management operate. Adaptive ecosystem-based management is complex and requires long-term commitment to processes in which conflict mitigation is a dominant theme.

The key to understanding the challenges of implementing a new policy and thereby working to influence the trajectory of societal and environmental change in an LME is to recognize that such change requires alterations in the behavior of key groups and institutions. Success includes evidence of new forms of collaborative action among institutions, the actions of state-civil society partnerships, and the behavioral changes of resource users as well as changes in patterns of investment.

Implementing the ecosystem-based management policies and procedures formally endorsed in the SAP typically will be expressed in rules governing:

- The extraction and other uses of LME resources
- The discharge of wastewater and other substances that impact ecosystem health
- Land use practices (e.g., agriculture) in the coastal watersheds that are linked to the condition of the LME

All three of these variables must be managed, since the interconnections between them will determine the impacts on the ecosystem. This, in itself, is a challenge since in many instances responsibility for each feature has been allocated to a different institution, each of which has its constituencies and a distinct "way of doing things." It is essential to understand that the formal written rules that resulted from a formalized process may, in practice, be less important than the informal rules that have evolved over time and are followed by the common consent of those affected. Such informal rules may be the source of corrupt dealings and this may add additional layers of complexity when working to implement ecosystem-based management procedures that should be founded upon transparency and consultation with all those affected – including the poor.

Central to the implementation and practice of adaptive management is sustained and carefully targeted monitoring of natural and human conditions in the LME. Such monitoring falls into three broad categories. The first is to monitor environmental, economic and social conditions at targeted locations in the LME. Continuous monitoring is best, since important pulses may be of short duration and easily missed. A second focus for monitoring should be directed at the abundance and

distribution of the LME resources that the management rules have been designed to conserve or restore. Third, there should be some monitoring of selected measures of program performance in terms of the behaviors that most directly express the implementation of ecosystem management rules and procedures. These may include data on permit processing, enforcement actions and – very important – voluntary compliance with the program's policies.

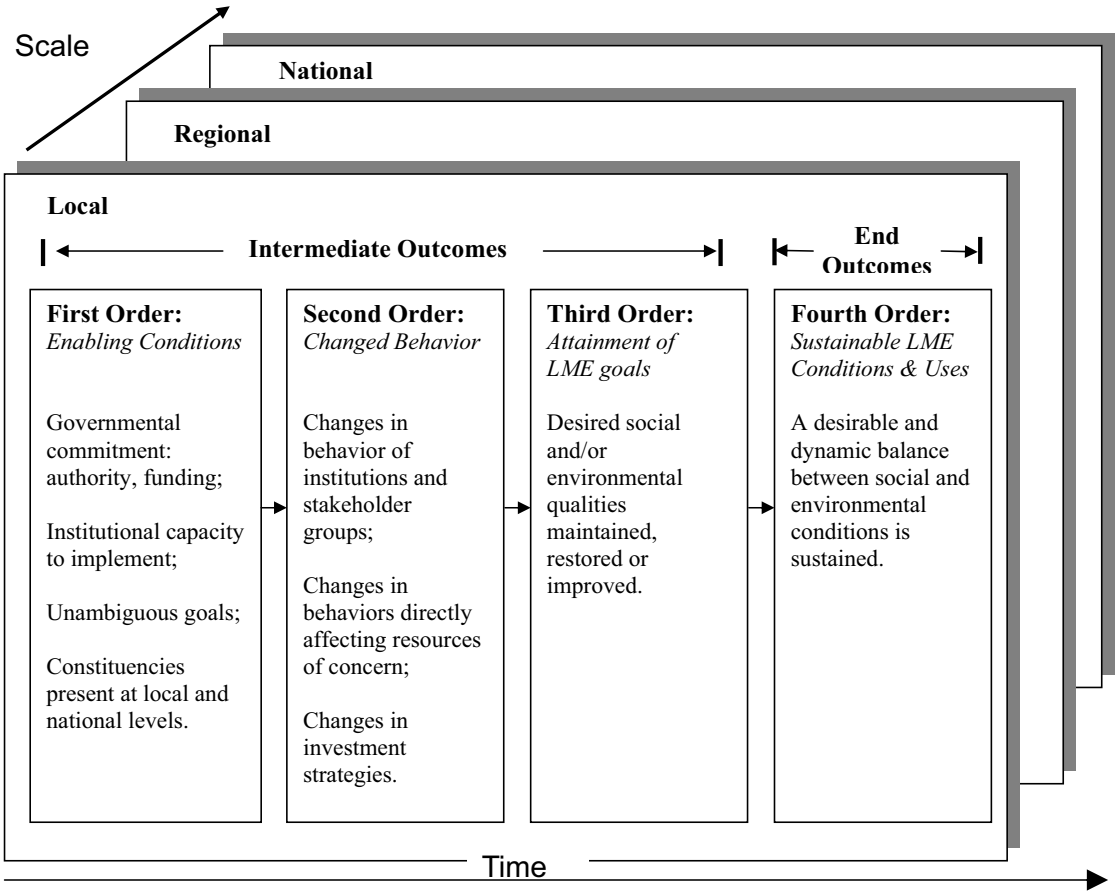
Since ecosystems at the LME scale are living systems that are in a constant process of change, monitoring activities should be linked to further research that can help interpret the data that is gathered and suggest the adjustments that should be considered to increase or sustain the efficiency and impact of the program. The implementation of new rules governing the allocation of water, and the monitoring of the accompanying changes in the system will invariably produce surprises and suggest new insights and ideas. In an adaptive management process, these are welcomed and can form the basis of a culture that encourages learning. As in Step 2, new management techniques are often best tested initially at a pilot scale and applied to the whole LME management system only when they have been shown to be workable and effective.

Step 5: Evaluation and Sustained Learning

Adaptive ecosystem-based management can only fulfill its promise if its principles and processes are applied in an LME over several decades. The entire management system, its impacts, and the condition of the LME, should be periodically re-evaluated to determine whether the goals of the program are being achieved. Such evaluations may close the loop of distinct "generations of management" and mark the sustained practice of adaptive ecosystem management. In programs that practice adaptive management, much of the learning occurs through internal processes of analysis, reflection and adjustment. These should be complemented by more formalized external evaluations typically conducted by individuals with no former involvement in the program. There are dozens of approaches and methodologies for self-assessment and evaluation. These approaches vary greatly in their purposes, substantive rigor and the validity and persuasiveness of the conclusions they offer. Within the ecosystem management context, these tools and approaches may be grouped into two broad categories:

Performance evaluations are designed to assess the quality of the execution of a program and the degree to which they meet the mandate and responsibilities awarded to them and the commitments made to a funding institution. Here, the focus is upon accountability and quality control. Management capacity assessments are conducted to determine the adequacy of project or program design including management structures and governance processes as these relate to generally accepted international standards and experience. The purposes are generally to find ways to improve program design and implementation and to make adjustments to the internal workings of a project or program and to the coastal management strategies and practices that the project or program is promoting. This evaluative emphasis typically promotes "instrumental" learning expressed as adjustments to the program's strategies.

Outcome evaluation assesses progress towards the program's goals. The focus, therefore, is on the impacts of a program on the LME's natural and human dimensions of concern to the program. An outcome evaluation examines the trends and indicators of direct relevance to the program and works to objectively estimate the relative contributions of ecosystem-based management policies and processes to observe social, economic, and environmental change. The relevant outcomes may



Source: Olsen, 2003

Figure 7. The Four Orders of Outcomes in Ecosystem-Based Management

include such expressions as a decrease in the destruction of important habitats, reduced pollution in the LME, and increases in fish stock abundance.

Measuring Progress in Ecosystem-based Management through Four Orders of Outcomes
As applications of ecosystem-based management mature, the needs to complement methods of organizing the *processes* of management with methods for assessing the *outcomes* of management has become apparent. The unifying framework developed by Olsen (2003) – shown in Figure 7 – is useful for this purpose since it desegregates the ultimate goal of sustainable development into a sequence of more tangible thresholds of achievement. This framework suggests the sets of indicators that can be used to trace the evolution of an LME management system as it progresses from the baseline conditions documented by the TDA to progressively more sustainable conditions and patterns of use.

The framework defines the First Order as the most critical outcomes generated by the TDA and SAP. Building on methods developed by Canada's International Development Research Center (IDRC), the implementation of a program is defined in the Second Order as changes in behavior in the institutions and human population within and/or affecting the ecosystem in question (Earl et al.,

2001). Only after the requisite changes in behavior have been practiced for a sufficient period can improvements be expected in the environment and in the social benefits that constitute the Third Order achievement of the environmental and societal goals selected in the earlier phase of program design. In an operational sense, the ultimate goal of sustainable forms of coastal development is a "north arrow" that points in the direction of desired change.

It is important to recognize that some expressions of First, Second and Third Order outcomes will accumulate concurrently within a given time period. While there are causal relationships between the three Orders, they are not, and should not, be achieved in a strictly sequential order. For example, once some progress has been made in assembling First Order outcomes, programs should work to achieve some evidence of Second and Third Order outcomes in a learning-by-doing mode. This can be accomplished, for example, by management activities at a pilot scale. Experience has repeatedly reconfirmed that the most successful initiatives focus their efforts on one or two issues and then expand the scope of the program as experience, capacity, and constituencies are built. Particularly in developing country contexts, it is usually a mistake to launch a fully integrated program directed at multiple issues and goals.

The First Order: Assembling the Enabling Conditions for Ecosystem-based Management
The goal of GEF investments in LMEs is to catalyze a country-driven process that creates the enabling conditions for sustained ecosystem-based management. These conditions (GEF "Process Outcomes"; Duda, 2002) are created by a successful TDA/SAP process and can be grouped in outcome terms under the four headings of (1) unambiguous goals that define the conditions that the SAP is striving to achieve, (2) constituencies that actively support the SAP, (3) institutional capacity to practice ecosystem management and implement the SAP (4) governmental commitment as expressed by the allocation of authority and resources required to successfully implement the SAP. Table 4 summarized the actions and indicators that serve as markers for the attainment of these preconditions for the effective and sustained implementation of an LME Program of Action.

The Second Order: Program Implementation as Behavioral Change
Second Order outcomes are evidence of successful implementation of an ecosystem-based management program. This includes evidence of new forms of collaborative action among institutions, the actions of state-civil society partnerships, and the behavioral changes of resource users and changes in patterns of investment.

Changes in the behavior of institutions. Since governments are invariably organized along sectoral lines, a major challenge is to achieve more integrated forms of planning and decision-making. The preparation of the SAP may require the reorganization of institutions, the redistribution of power and resources, the creation of commissions and task forces. These are First Order achievements (GEF 'Stress Reduction Outcomes') that, when they produce the changes in behavior, mark a critical expression of program implementation that marks the Second Order. While attention must focus on behavior change in the organs of government, equally important evidence of collaborative behavior may be seen in businesses, fishers associations, trade groups and the like. In recent years, much attention has been given to fostering public-private partnerships to achieve conservation and development goals. All of these are expressions of changes in institutional behavior.

Changes in the behavior of individuals, groups and businesses that make direct use of the goods and services that coastal ecosystems generate is often the focal point of program implementation. An obvious example is the cessation of such destructive practices as dynamite fishing or the release of untreated wastes into the environment. The successful implementation of by-catch reduction practices signals a behavior change that may be important to a reformulation of how fisheries are regulated in an LME.

Changes in investments that signal the provision of sustained financing for LME management and strengthening the capacity of institutions to practice ecosystem-based management, and the construction of necessary physical infrastructure supportive of a program's policies and programs is the third category of behavioral change. These may include decisions to invest in better enforcement of existing rules, decisions to invest in long-term monitoring of the condition of the ecosystem, or the financing of appropriate fish-harvesting and processing infrastructure. Investments in habitat protection and restoration, including patrolling of protected areas and restoration of wetlands, may be important expressions of program implementation.

From a GEF perspective (Duda, 2002), Second Order outcomes may be gauged through "stress reduction indicators" that document specific on-the-ground measures implemented by the countries collaborating in the management of an LME. For example:

- Enforcement actions on industrial pollution discharges
- Reduced incursion of industrial fishing vessels into nearshore waters reserved for artisanal fishers
- Successful elimination of activities in designated protected or "no-take" areas
- Reductions in fishing pressure, achieved through fleet reductions or other means consistent with the Law of the Sea and FAO Code of Conduct for Responsible Fisheries
- Successful revenue gathering from those benefiting from the exploitation of LME resources

The Third Order Outcomes: The Achievement of Specific Ecosystem Goals

Third Order outcomes mark the achievement of the program's goals as were defined during the issue selection and planning phase (the First Order) and may have been modified during implementation (the Second Order). These are the rewards for sustained achievements in institutional and behavioral change. Water quality improves, there are more fish, income levels rise, and target communities' engagement in supplemental livelihoods stabilizes or improves. Third Order outcomes can be allocated to the two categories of ecosystem-based management goals.

- Targets for sustained or restored qualities of the bio-physical environment
- Targets in human quality of life may be expressed as greater equity and diversified livelihoods

Within the GEF (Duda, 2002), the indicators of the Third Order have been termed "environmental status indicators." They should be defined during the SAP process and be the basis for measuring the actual performance or success in restoring and protecting the LME. Examples of Third Order outcomes are:

- Measurable improvements chemical, physical and biological parameters
- Improved recruitment of priority fish species

- Demonstrable reduction of persistent organic pollutants in the food chain
- Changes in local community income and social conditions as a result of improved environmental conditions in the LME
- Reductions in the loading of nutrients and the associated evidence of eutrophic conditions

For an example of a GEF International Waters project reporting substantial progress in both Stress Reduction and Environmental Status Outcomes, see the mid-term report of the Danube/Black Sea Basin Strategic Partnership for Nutrient Reduction at: http://thegef.org/Documents/Council_Documents/GEF_C27/documents/C.27.Inf.6Danube.pdf.

The Fourth Order: Sustainable LME Conditions and Uses

The difference between Third and Fourth Order outcomes is that sustainable development requires achieving a dynamic equilibrium among *both* social and environmental qualities. Sustainable development has not been achieved if, for example, the condition of the coral reefs of a place is sustained or improved, but the people associated with them continue to live in unacceptable poverty. Similarly, sustainable development has not been achieved if some measures of quality of life are high, but such achievements are eroding the resource base or require the exploitation of other social groups. The challenge is vastly complicated by the imperative of defining an acceptable balance in terms of both intergenerational equity and a planetary perspective on both societal and environmental conditions and trends. Recognizing that all living systems are in a constant process of change, sustainable forms of development will be dynamic, not static, and must be capable of responding to the surprises that Mother Nature delivers.

PART III

A PRIMER ON THE CHALLENGES AND DIMENSIONS OF LME GOVERNANCE

As set forth in Part I of this Handbook, there are three primary mechanisms that influence how humans utilize an LME: the marketplace (i.e., the economy), the institutions and arrangements of civil society; and the government. This part of the Handbook explains how socioeconomic and governance analyses can be applied to understand and explain how these mechanisms function, and how they interact with one another. We emphasize again that failure to understand these institutions and to heed their signals may doom efforts to manage LME resources to achieve societal goals and objectives. Let us now examine each of these three mechanisms in more detail.

MARKETS

Markets are powerful institutions. Markets are where goods and services are exchanged and profits are sought; and markets play a major role in governing how LME resources are used. Markets, too, are linked to the organizations and institutions of government and civil society – the other two forces shaping humans' interactions with natural ecosystems. This section explains in brief some of the fundamental forces that emanate from markets, and how those forces affect the status of LMEs in general.

Markets and Ecosystems

Markets are the mechanism upon which economies are built. They have a solid record of producing great improvements in the lives of people in all corners of the globe. Markets, too, can do great harm – especially to the earth's natural ecosystems.

Markets, which offer the prospects of substantial economic gains, are principal drivers of excessive extraction of natural resources and disposal of damaging pollutants. The evidence of the ecological costs that market-driven economic activity has caused is frequently reported by news media: overexploited and collapsed fish stocks, harmful algae blooms, dying coral reefs, coastal dead zones, deforestation, endangered species, global warming and the rise in sea level, and many other cases of environmental degradation. Market-driven economic activities are one of the direct causes of overexploited fishery resources, of large marine ecosystems' degraded primary productivity and overall health.

The degraded marine ecosystems are, in turn, threatening the long-term well-being of the human communities that the economic activities support. This Tragedy of the Commons is playing out on a large scale in our LMEs; and markets are at the center of the tragedy. The markets upon which these communities depend are tragically stressing the very natural systems upon which the markets themselves depend.

Why is this? Why are markets causing so much harm to our natural ecosystems?

Markets harm our ecosystems because market prices do not tell the 'ecological truth' (Brown 2001). In other words, market prices do not reflect the full cost of producing products from ecosystem resources. Market prices cover the cost of capital and labor, but market prices to do not cover the costs of reducing a fish stock, of damaging habitat, of waste disposal and pollution, and other ecological costs. Low prices and costs drive consumers to demand more and suppliers to produce more ecosystem-based products. The consequence is excessive levels of economic activities that ultimately threaten the sustainability of the ecosystems upon which they depend.

This tragedy is particularly acute in coastal and marine ecosystems. As explained in Part I, the economic activities that contribute most to a country's gross domestic product commonly lie along the coasts. Those economic activities include marine transportation and trade, fisheries, tourism and recreation; and these industries draw people to work and settle in, and visit those coastal areas.[1] These economic and other human activities often lead to the degradation and loss of natural habitats, added waste disposal and pollution discharges to water bodies, overexploitation of living marine resources, invasive species, pathogens, toxic contaminants, harmful algae blooms, and increased vulnerability to coastal hazards. In addition, the overexploitation of fisheries and other living marine resources continues for many of the fish stocks that have been assessed.

Pollution is a threat to both marine and fresh waters.

Pollution

Both groundwater and surface water stocks are susceptible to contamination in coastal regions. Approximately one-third of the world's population depends on groundwater supplies for drinking and other household uses, for irrigation and other commercial purposes. The principal sources of contamination include human, urban, industrial, and agricultural activities that discharge waste products that leach into water-saturated soil. Once the toxic substances enter groundwater very little cleansing occurs; and, since the rate of groundwater replenishment is often very low, little mixing and dilution take place.

Surface waters – the streams, lakes, estuaries, and oceans – are contaminated by many of the same human activities. According to UNEP (2002), sewage is the principal source of marine and coastal pollution.[2] Sewage discharges dominate in urban areas. Globally, agriculture run-off and atmospheric deposition are major sources of fixed nitrogen. According to Larsen (2004), annual fertilizer use has risen tenfold during the past 50 years. The growth in nitrogen inputs has caused eutrophication in marine and coastal waters – including severe cases in several enclosed and semi-enclosed seas. In addition, the greater growth and decay of phytoplankton has increased the number and extent of dead zones (oxygen-depleted waters), which now number nearly 150, having doubled each decade since the 1960s (Larsen, 2004). Red tides of harmful algal blooms have had major economic impacts on fisheries, aquaculture and tourism in many coastal regions.

[1] As of the mid-1990s, nearly 40 percent of the worlds inhabitants lived within 60 km of the coast (UNEP 2003).
[2] UNEP. 2003. *Global Environmental Outlook 3*. United Nations Environmental Program, Nairobi.

Other important types of marine pollution are marine debris, oil spills, and ocean dumping. Marine debris consists of materials such as plastic, polystyrene, metals and glass that slowly degrade and persist in the marine environment for long periods of time. Lost or discarded fishing gear, shipping materials and other forms of solid waste material kill and injure large numbers of marine mammals, sea turtles and sea birds by ingestion or entanglement.

Oil is discharged from shipping, offshore extraction operations, and pipelines. The incidence of accidental oil spills can be controlled but never eliminated altogether, since nearly 60 percent of the world's oil is shipped by sea before being consumed.[3] Many of the oil spill hot spots are in heavily trafficked large marine ecosystems.[4] In addition to accidental oil spills, there are oil discharges from sunken, grounded or abandoned ships, from offshore drilling platforms, and from pipelines.

Ocean dumping – the deliberate disposal at sea of material or substances of any kind – accounts for about 10 percent of marine pollution.[5] The materials commonly dumped at sea include dredged materials, industrial waste, sewage sludge, radioactive waste, mine tailings, decommissioned vessels, residues from chemical industries, ash from power stations and other unrecycled wastes, ballast water contaminated with invasive microbes, and fish waste.

Why are humans contaminating their marine ecosystems with such large and diverse quantities of pollutants?

Although some of this pollution is accidental and unintentional, a substantial portion of the waste discharges are deliberate.[6] Industries, households, and even municipalities find water bodies serve as convenient places to dump sewage and industrial wastes. In addition, there are indirect, diffuse sources in the form of run-off from agricultural fields, silviculture, urban storm drains, and individual disposal systems.

Those who are deliberately discharging these wastes into the marine environment often are unaware of the indirect ecological costs that their discharges have on the ecosystem. They view the discharge of waste as free or allowed for a nominal charge. Such charges do not reflect the full ecological cost of the harm to the natural ecosystems. As a result, businesses and households produce more waste than they otherwise would if their costs of disposal were higher.

Loss of mangroves can lead to a variety of problems in coastal and marine ecosystems

[3] http://oils.gpa.unep.org/facts/oilspills.htm.

[4] These include the Gulf of Mexico, Northeastern U.S., Mediterranean Sea, Persian Gulf, North Sea, Baltic Sea, among others. Source: http://oils.gpa.unep.org/facts/oilspills.htm, accessed February 13, 2006.

[5] Source: http://www.oceansatlas.com/unatlas/U.S.es/oceandumpingwastes/dumping/dumping_at_sea.htm#Marine%20Pollution%20and%20Dumping; accessed February 13, 2006. Also see UNEP (2002, 192-198).

[6] http://oils.gpa.unep.org/facts/oilspills.htm.

Destruction of Coastal Wetlands, Mangroves, Coral Reefs

Destruction of habitats and other forms of direct physical alteration are one of the greatest threats to coastal and marine ecosystems (UNEP 2002: 184). Nearly 60 percent of the world's coral reefs are dying or under threat from human pressures; and almost half of the world's wetlands and more than half of the world's mangrove forests were destroyed during the 20th century. Loss of coastal wetlands, mangroves and coral reefs reduces the buffer zone between land-based sources of pollution and the open sea and between storm surges and tidal waves and vulnerable inhabited coastlines. These losses of coastal wetlands, mangrove forests, and coral reefs have further aggravated the levels of nitrogen in coastal and marine ecosystems (UNEP 2002: 181).

The development of coastal areas for human use directly causes much of this physical alteration. Principal types of physical alterations that harm habitats include dredging for ports and shipping lanes, creation of solid waste dumps and landfills, coastal construction of buildings and roads, cutting and destruction of mangrove and other coastal forests, and mining of marine sand, gravel, and reefs.

The markets that drive the development and alteration of coastal areas place little or no value on coral reefs, mangroves, wetlands, and other ecological assets. As a result, the costs of destroying these assets are not reflected in the market, which in turn causes excessive and harmful dredging, dumping, construction, and extraction of marine ecosystem resources.

Overfishing

The FAO (2004) estimates that in 2003, one quarter of marine fish stocks were overexploited, depleted or recovering from depletion; about half were fully exploited; and one-forth could tolerate more catch. The trends are not comforting. From the mid-1970s to the present, the proportion of overexploited and depleted stocks has increased 2.5 times, and the proportion of stocks offering potential for higher catches has declined (from 40 percent to about 25 percent). There are many causes of the deteriorating status of these fish stocks. But overfishing remains the number one threat. There simply are too many highly productive fishing vessels harvesting from fish stocks that are dwindling in size and in number.

The markets that are driving commercial fishing operations are not telling the ecological truth. The market prices of the inputs (fuel, bait, labor, gear and other capital) and the prices of fish products do not include the ecological costs of stock depletion. Fishing operators typically pay no price to remove fish from the sea; yet there are costs in the form of lower stocks and future yields, and in the form of reduced biodiversity. There are associated ecological costs from damage to habitat, and from mortality of marine mammals and sea birds. There are no markets for these valuable assets.

Overfishing is a problem worldwide.

In general, no individual producer (fisherman) has the right to exclude other producers from harvesting (or otherwise using) any part of the resource. From an individual producer's perspective, leaving fish to grow and reproduce is done at the risk of losing the fish to other producers. Thus, there is no incentive to

conserve the resource for future use, since no producer has exclusive use. The free use of marine fisheries is the fundamental cause of overexploitation in modern fisheries.

Since producers do not have the ability to protect and conserve the resource for their own use, there is competition among producers to catch fish before others do, driving the stock down below the optimum. The draw of perceived lower costs and greater net benefits brings more producers to the fishery, and induces each to apply more effort than is optimal for maximum economic performance of the fishery. The resulting economic performance in the fishery is inferior. The net benefits (for all producers and consumers summed across all future periods) could be greater with lower levels of fishing effort. By lowering effort levels, future net benefits to producers could increase, and more than offset the reduction in current net benefits.

Under a regime of non-exclusive use and free access, competition to catch fish before other producers causes a "race-to-fish," resulting in fishing seasons that are shorter than optimal for maximum economic performance, landings that are too small and of inferior quality, excessive investments in vessels and gear, and in intermittent and inconsistent income generation for fishers themselves.

Free access and non-exclusive use also leads to conflicts among user groups. Where no producer has the right to exclude another from access to the resource, two or more producers can interact at the same time and place in a fishery, imposing external costs on each other in the form of gear or other losses. Mobile gear (such as trawls) may fish in the same area as fixed bottom gear (such as traps), causing damage to one or both of the gears. Large, efficient international vessels can operate in a fishery on which small-scale local producers are heavily dependent, draining the stock available for capture by the smaller domestic producers. Failure to consider these external costs when deciding where and how to fish causes inferior economic performance in the fishery.

Processors, distributors, wholesalers, retailers and consumers are also affected by the non-exclusive nature of the fishery. The race-to-fish can result in large quantities of fish being landed during short periods, requiring the buildup of excessively large processing, storage and distribution facilities to handle the periodic peak loads. Wholesalers, retailers and consumers find supplies of specific fish are abundant for short periods and scarce for long periods; or, the product is processed for long shelf life, generally reducing the quality of the products and price on the market.

General economic trends of rising prices for fish as markets expand, and of improved harvesting technology, combine to put intense pressure on fisheries under free access. Rising fish prices and/or falling costs induce more investments and more participants in the fishery. The structure of the entire fishing sector becomes too large and is placed at risk as resource stocks are drawn further down, widening the gap between what the resource stocks are able to supply and what the fishing sector needs to survive and prosper. In other words, capital's capacity to produce exceeds the resource's capacity to produce.

The degraded state of LMEs did not occur suddenly. Rather, the condition of LMEs has been deteriorating over the course of several decades. Starting at the midpoint of the 20th century, we can construct a stylized picture of the trends in economic activities and ecosystem conditions for a hypothetical LME. At about 1950, marine transportation and trade, fisheries, marine mining, tourism and recreation produced relatively low economic activity; and the condition of the natural ecosystem was good (little pollution, little physical alteration of habitats, and no overfishing). Figure 8 illustrates

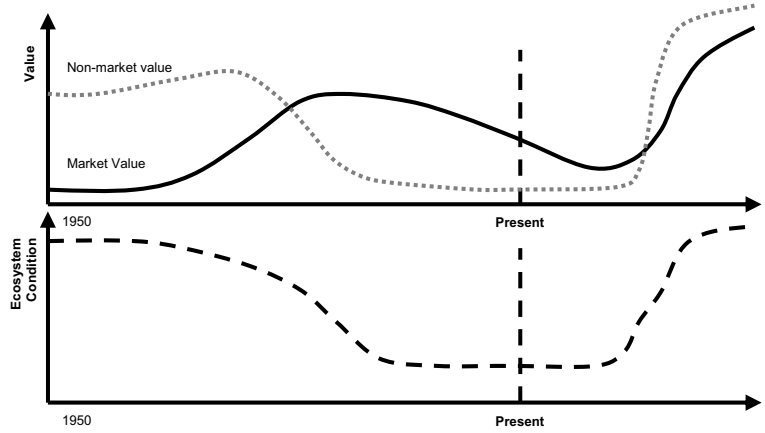


Figure 8. Stylized trends of LME values and biophysical conditions

this imagined scenario with the solid black line showing low economic market values being produced during the 1950s, the dashed black line showing a high level of some measure of the condition of the natural ecosystem, and the dashed grey line representing the non-market values of ecosystem services (such as biodiversity, water quality, natural hazard mitigation).

As the coastal economy grew during the 1960-1980 period, the market value of LME-related economic activity rose and the condition of the natural ecosystem began to decline with increased pollution, habitat destruction and overfishing. The non-market value of ecosystem services initially grew and then declined as the condition of the natural ecosystem began to decline. During the 1980-2000 period, the condition of the natural ecosystem continued to decline, which in turn weakened economic activity dependent on LME resources. At present, the LME finds itself with relatively low economic activity, and low non-market value of ecosystem services, which are the result of the degraded condition of the natural components of the LME. The projected future upturns in Figure 8 would be based on effective LME management.

All of these undesirable outcomes can be traced back to markets that do not tell the ecological truth. Markets favor those who can produce and sell at the lowest cost. The market mechanism, in effect, drives participants to ignore the ecological costs of pollution, of habitat destruction, and of overexploitation.

Markets are imperfect in other ways as well. As explained in the next section, imperfections in markets obstruct sustainable development and present a major challenge to the governance of LMEs.

Markets and Economic Justice

Markets are not intrinsically just institutions. Markets do not provide the greatest benefit to the least advantaged in society; and markets do not always offer fair and equal opportunities to all members of society (Rawls, 1971).[7]

[7] John B. Rawls, *A Theory of Justice*. Cambridge, Massachusetts: Belknap Press of Harvard University Press, 1971. Rawls second principle of justice (p. 303) requires that "Social and economic inequalities are to be arranged so that they are to the greatest benefit of the least advantaged, and attached to offices and positions open to all under conditions of fair equality of opportunity."

The World Bank, in its recent *World Development Report 2006, Equity and Development*, concludes that unequal opportunities are 'truly staggering on a global scale.' There are huge disparities within and across countries in individuals' opportunities for life itself, for education, for health, and for quality of life. These disparities are correlated with nationality, race, gender, and social-economic status – characteristics that are predetermined and beyond an individual's control.

These inequities are not only morally offensive; they also limit individuals' opportunities to realize their full potential and, in turn, limit their collective ability to achieve sustainable development. In other words, there is a complementary relationship between equity and sustainable growth and development.[8] The *Report* explains that poorer segments of society in developing countries often do not have access to the markets for credit, insurance, human capital, land and other natural resources. As a result, these imperfect and missing markets limit the ability of individuals to use their labor, capital and natural resources in the most productive ways. In addition, unequal opportunities tend to result in institutions and arrangements that protect and favor those groups with more economic and political influence. These inequities can severely limit the ability of the poorer, disadvantaged groups to exploit their talents and contribute to sustainable development.

The *Report* says that "to prosper, a society must create incentives for the vast majority of the population to invest and innovate." Perfect capital markets, for example, allow anyone – regardless of their wealth or status – with a profitable investment opportunity to either borrow money or use collateral of an asset to finance the investment. These markets are not perfect, however. Access to credit is not equally distributed, and differences in interest rates among borrowers and lenders are arbitrary. Title and security of tenure to land and other valuable property are often reserved for privileged individuals; and discrimination and stereotyping limit the opportunities for education and employment in human capital markets.

Markets for LME resources also are imperfect in similar ways. For example, in the U.S. and some other developed countries, exclusive rights to harvest fish were awarded free only to the owners of fishing vessels. Crewmen and others who had material stakes in the fisheries did not have the opportunity to secure these harvest rights. South Africa currently is in the process of reallocating fishing rights to historically disadvantaged individuals who did not have access to resources under apartheid on racial grounds.[9]

Economic and political institutions establish the incentives and constraints faced by individuals when they engage in market transactions. These institutions, which result from complex historical processes, too often protect the opportunities and interests of privileged groups. The imperfections in markets tend to favor those privileged interests. These imperfections then lead to social conflict and impede progress towards sustainable development of environmental and natural resources.

What Does the Issue of Equity Have to do with LME Governance?

Governance arrangements and policies that promote equal opportunities – where all people face similar conditions for becoming economically productive, politically influential, and socially active – promote sustainable growth and development. Correcting the equity imperfections in markets and other governance institutions is an essential task of good governance.

[8] Equity is where individuals have equal *opportunities* to pursue their interests and also not be subjected to extreme deprivation (World Bank, 2006).

[9] In contrast, the rights to extract oil and gas in U.S. federal waters are allocated in markets that are open to all who have enough financial resources to participate in an open, competitive bidding process.

As coastal nations attempt to overcome the problems of overexploitation, pollution and habitat destruction in LMEs, new governance regimes and arrangements will be created. The message of the World Bank *Report* for LME governance is that equity matters. Creating governance institutions that offer equal opportunities to all individuals in society will improve the prospects for the sustainable development of LME resources and improve the prospects for mitigating the ravages of poverty that persist in many of these coastal areas.

The new LME governance arrangements that are developed and implemented should attempt to level economic playing fields. This can be achieved by designing LME governance policies that strengthen the opportunities for participation by poorer and disadvantaged groups in gaining access to and use of LME resources. This will not be easy or accomplished swiftly, for even new LME governance institutions and arrangements will be linked to other economic and political institutions. The extent to which there is equity in credit, insurance, human capital, and land markets, will affect the extent to which equity can be incorporated in LME governance institutions and arrangements.

Correcting and Mitigating Market Failures

What can be done about markets that do not tell the ecological truth? What can be done to correct or mitigate markets' tendencies to harm ecosystems?

As explained above, the market does not properly value ecosystem goods and services and natural assets. Key to creating a market that supports sustainable development of LME resources is to get it to tell the ecological truth. If we can design or reform markets so that they tell the ecological truth, we can correct or mitigate their tendency to harm LMEs.

The first set of tasks is to calculate the ecological costs of those activities that are extracting LME resources, polluting and altering the environment. Economists can work with natural resource scientists to calculate these costs. This work will require integrating the socioeconomics module with the three natural science modules of fish and fisheries, pollution and ecosystem health, and productivity.[10]

Once the ecological costs of resource extraction, pollution, and reduced productivity are calculated, the costs can be incorporated into the market prices. The various ways in which these ecological costs can be incorporated into market prices are reviewed below in the section on Sustainable Financing. One way to incorporate ecological costs into market prices is to apply taxes to those activities that harm the ecosystem. Another way is to place a cap on the amount of the damaging activity and allow producers to trade their allowances – known as "cap and trade" and "tradable permits."

Subsidies of some economic activities (such as fishing) also lead to overexploitation and damage to marine ecosystems. Conservative estimates of government subsidies to the fishing sector amount to more than a quarter of the annual value of trade in fish (Milazzo, 1998). Many of these subsidies, in effect, lower the cost of fishing, further distorting the market's ability to tell the ecological truth. Economists can assess the nature and extent of subsidies – identify which subsidies cause overfishing and overcapacity – which can then be phased out or replaced with environmentally neutral subsidies.

[10] Examples of such integrated analyses can be found in Chapters 9 – 12 of Hennessey and Sutinen 2005.

The approach that some countries are using is not to simply add more taxes and eliminate subsidies, but rather to shift taxes and subsidies to work in ecologically benign ways. For example, some countries are reducing income and property taxes in exchange for adding taxes on environmentally damaging activities, with an over all neutral effect on the total amount of taxes collected (Brown, 2001). Subsidies can also be shifted such that their overall level is essentially unchanged while they no longer promote ecological harm.

If these and other ways are found to tame markets so they support conservation, we can look forward to improving the ecological condition of LMEs (Le Quesney and McNally, 2005). Referring again to Figure 8 and a hypothetical LME, with effective management and market mechanisms, we can imagine that the condition and non-market value of ecosystem services will begin to rebound in the near future and, after a lag in time, the market value of LME-related economic activities will grow to heights not heretofore realized – the result of markets that work in harmony with the LME.

What can be done to prevent markets from creating and/or aggravating economic inequities?

The first task should be to level the economic playing field by creating an economy where all people have equal opportunity of access to markets. In other words, equalize access to credit, labor, land and other markets that exist. In addition, when new markets are created – as, for example, for rights to use LME resources – ensure that they are designed to allow participation by small producers who may otherwise not have access to these markets. Insuring access may require government-guaranteed loans to small producers for the purpose of purchasing fishing quota and other resource use rights. Another avenue for leveling the economic playing field is to design or reform market-access arrangements to encourage community-based organizations to participate in LME resource-related markets. If communities or small producers lack the will or ability to participate in such markets, arrangements to share revenues generated by the use LME resources can be implemented. Such revenue sharing arrangements have proven effective in giving local communities a stake in the ecological health of animal populations and their habitat (an example is Zimbabwe's Campfire program[11]).

GOVERNMENT

The conventional view of government is that it sets the rules and enforces them, it recognizes and protects property rights, and the government produces goods and services. The rules regulate the use of natural resources, business practices, etc. In its protective role, government maintains security and order by enforcing a set of rules within which people can interact peacefully with one another. These include rules against theft, fraud, physical harm to person and property. Without protection, property rights are not secure and the economy and social order suffer. A distinguishing characteristic of government is its monopoly on the legitimate use of coercive force to control the behavior of individuals and groups.

The government also undertakes productive activities that cannot be efficiently organized by the market. As explained above, markets do not "tell the ecological truth." Markets generate too much of those activities that generate negative spill-over effects (where one party's actions impose costs

[11] See http://www.unsystem.org/ngls/documents/publications.en/voices.africa/number6/vfa6.08.htm for a brief description of the program.

on other parties).[12] In addition, the market fails to provide sufficient quantities of public goods, as explained below in the section on Sustainable Financing.[13]

Providing public goods such as national security is a classic case of government production. Other public goods include a monetary system, a system of jurisprudence, flood-control and insect-abatement programs. Near or quasi-public goods are also produced or subsidized by government. Examples of near-quasi public goods include education, streets and highways. In line with its productive function, a government will also promote competitive markets because competition generally enhances productivity and value for the common good.

The presence of public goods and spill-over effects, which are common for LME resources, typically mandates government intervention. For example, the above analysis of the fishery shows that open access to the resource leads to too many fishers chasing too few fish (a case of "reciprocal spill-overs"), and typically prescribes government intervention, in the form of fishery management policies, to correct the market failure.

Government policies aimed at correcting market failure generally assign specific functions to governmental agencies to produce specific outputs expected to correct the market's shortcomings. These activities and outputs include:

- Regulatory services (e.g., fishery and environmental management regulations)
- Public goods (e.g., general law and order, fisheries research)
- Administering transfer payments (e.g., subsidies, social welfare)

It is important, if not essential, to analyze how those policies are produced, how management services are produced; and ask what conditions lead to government successes and failures. The behavior of individuals and agencies in the public sector can be analyzed by applying the common tools of governance and socioeconomic analysis. These tools help to understand and explain whether the underlying conditions promote government failure or success. The basic idea is that incentives matter – they shape the behavior of resource users and consumers, and they shape the behavior of public officials and government organizations as well.

With such analysis and understanding, we are then prepared to prescribe ways to correct the obstacles in the public sector that lead to failures of government processes and policies. Otherwise, by promoting government intervention without prescribing proper arrangements, we might be encouraging greater inefficiencies that result from what Wolf (1988) calls "nonmarket failure."

All forms of government intervention, such as fishery management regulations, require a regular flow of government services – services that are costly. Management costs are sometimes acknowledged, but not systematically accounted for in the analysis of policy. These costs, of course, must be covered. Below, we address this issue in a section on sustainable financing.

---

[12] These effects are known as 'external effects' or 'externalities' in economics.

[13] Public goods are those which, when provided for one, are available to all at a zero price – for free.

Challenges for Successful Government Programs

As explained above, the institutions and organizations that comprise LME governance do not always perform optimally. Markets, if not designed or regulated properly, can harm ecosystems and disadvantaged members of society. Government institutions and organizations also can fail to achieve societal objectives. If not properly designed and managed, they can thwart efforts to implement the ecosystem approach to management of LME resources.

In this section we identify some of the factors that challenge efforts to design and implement successful government programs. We offer a brief analysis of how resource management *policies* are produced, how management *services* are provided; and identify *conditions* that tend to lead to government successes and failures. With such analysis and understanding, we are then better prepared to prescribe ways to correct the obstacles in the public sector that lead to failures of government processes and policies.

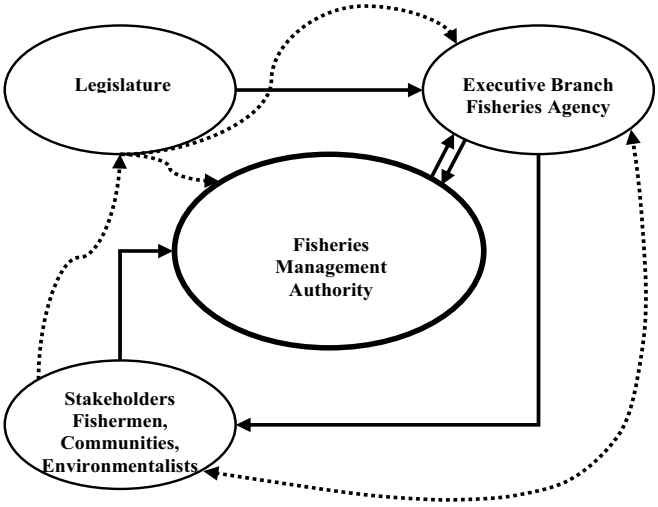


Figure 9. Fisheries Governance System

Let us use fisheries to illustrate this analysis.[14] Above, we reported on the dismal state of global fisheries, many of which are overexploited by fleets with overcapacity. This record demonstrates that our fishery management institutions have failed to conserve fishery resources and improve the economic health of fishing communities. Why have our management institutions not done better? The FAO (2000) and other observers attribute this poor record to (i) tendencies to give priority to short-term social and economic needs at the expense of the longer-term sustainability of fish stocks; (ii) poorly defined objectives; and (iii) institutional weaknesses, particularly in relation to the absence of long-term rights amongst the different key stakeholders and decisionmaking structures and processes. These three problem areas are really just manifestations of the incentive structure found in most fisheries (and many other natural resource) governance regimes.

We based the analysis on the following simplified system of fisheries governance. In democratic countries, the fisheries governance system consists of both formal and informal linkages among four components of the system.[15] The legislature passes fisheries laws that authorize the implementation of fisheries policies and programs by a fisheries agency. In turn, the fisheries agency commonly establishes a fisheries management authority to develop fishery management plans that specify the

[14] This section draws heavily upon, and uses excerpts from, Sutinen and Soboil (2003).

[15] This analysis does not apply to non-democratic countries such as Burma, China, Cuba, Egypt, Iran, Pakistan, Saudi Arabia, and Vietnam, where more than one-sixth of the world's people live. The analysis of government performance by non-democratic states requires further research.

set of management measures that are applied to the fisheries under its jurisdiction. Stakeholders (such as fishing producers, communities and environmental advocates) usually have a formal role – from advising to decision-making – in the management plan development process. The resultant plans, if approved, are then implemented by the fisheries agency. The solid arrows in Figure 9 represent these formal linkages.

In addition to the formal linkages, there are informal linkages – represented by the dashed arrows in Figure 9. As voters who help elect members of the legislature, fisheries stakeholders frequently take their problems and concerns to their elected representatives. If a stakeholder group feels that the fishery management process has not treated it properly, they will ask their elected representative to assist them. The assistance often is in the form of influencing the fisheries agency and/or fisheries management authority. Sissenwine and Mace (2001) refer to this as the "end run" phenomenon. We now examine the political dynamics of the fisheries governance system in more detail. [16]

The political process controls government and, in democratic countries, political decisions are produced by a legislative process. Voters elect representatives to guide government policies and actions; agencies are formed; and bureaucrats hired to implement government policies. These three domestic groups are major players in the political process, and government policies and actions result from complex interactions among these players. Voters – especially groups of voters with special interests – express their demand for government policy and action. Elected representatives supply legislation (policy) to address this demand; while government bureaucrats implement the programs and rules specified in the legislation. In the fisheries context, the principle products of this political marketplace are fisheries laws and regulations related to conservation and management, safety, environmental protection, etc.

Voters are the consumers of the political process, demanding political products. Voters - including groups of voters that form to pursue their special interests – demand public-sector action to reduce inefficiencies and to redistribute income, usually through self-serving benefits. Votes, campaign contributions and lobbying are the currency by which these demands are expressed. In addition, foreign groups also participate in the political process by lobbying for their special interests.[17]

Politicians are the elected administrators and legislators in federal, state/provincial and local government, including members of executive and legislative branches. Politicians are motivated, in part, by the need to be elected or remain in power by supplying the political goods that are demanded by voters. Therefore, politicians tend to select positions that maximize the probability of re-election.

Bureaucrats work at national, state/provincial and local levels as hired officials. Agency employees implement laws, implement regulations and develop programs. Bureaucrats are motivated in part by self-interest too. They naturally resist downsizing their budget and number of employees, and commonly attempt to increase the size of their budget and number of employees. To achieve this objective, they often appeal to politicians with programs that would be favored by voters.[18]

[16] The arguments in this section are based on extensive public choice literature, e.g. Buchanan and Tullock, 1962; Buchanan, 1980; Niskanen, 1971; Olson, 1964; and Wolf, 1988. Applications of public choice to fisheries can be found in Andersen *et al*., 1998, and Upton and Sutinen, 2000.

[17] For example, EU industrial fishing fleets and U.S.-based international NGOs are forms of foreign interests that have significant influence on developing countries and their LME management.

[18] For a study of this phenomenon outside of fisheries, see Johnson and Libecap (1994).

Political equilibrium is reached as voters, politicians and bureaucrats make choices to achieve their own objectives. Both socially desirable and undesirable outcomes are possible, depending on the underlying incentives of these groups.

Government failure (i.e., socially undesirable outcomes) is due to a number of interrelated causes, including:

- Special interest effects (both domestic and foreign)
- Rational voter ignorance
- Bundling of issues
- Shortsightedness effects
- De-coupling of costs and benefits
- Lack of public accountability among legislators and/or bureaucrats
- Bureaucratic inefficiencies.

Special-interest effects occur when a relatively small number of citizen or foreign parties make large individual gains at the expense of a large number of citizens who bear small individual losses. Rent seeking occurs when individuals and groups attempt to use the political process to redistribute income from others to themselves. Special interests gain disproportionate power relative to their numbers because they can provide campaign funds, publicity and delivery of voters who are passionate about a particular issue. Meanwhile, rational voter ignorance occurs because it is seldom worth the cost for the typical voter to acquire the information needed to make a fully informed voting decision. In addition, the choice of a single voter is seldom decisive when the overall number of voters is large. This further decreases the voter's motivation to acquire more information.

The packaging or bundling of the candidate's positions further accentuates special interest effects and rational voter ignorance. Members of the general public who are relatively disinterested in a specific issue are unlikely to vote on the basis of that issue alone. It is likely that many other issues are of greater importance to her or him, especially when the impact on their welfare is small. Yet, members of an interest group are likely to vote strictly according to the issue, especially when it has a significant effect on their welfare. A given political candidacy tends to be accepted or rejected on the basis of the entire package of positions and not on the basis of a single, special-interest issue. Since voters can only express their will through a legislator who represents a bundle of political goods, the political process becomes imprecise with regard to voter preferences. For example, it has been estimated that the typical citizen makes only one public choice decision for each thousand made in the private sector. In addition, politicians often package issues in a complex manner so that most voters will be unaware of the true costs that programs will impose upon them. However, special interests are more likely to be well-informed regarding the underlying costs and benefits of a policy that is specific to their interests.

Politicians tend to be shortsighted because they face short re-election cycles that range from two to six years.[19] They are concerned about the consequences of policies and programs before the next election. The long-term consequences tend to carry little weight in the calculations of the politician.

[19]We use the term shortsightedness to describe the tendency by people to ignore, or give little weight to, future consequences, especially consequences in the medium-to-distant future.

Politicians often exhibit shortsightedness. They regularly enact special legislation and appropriations for fisheries, and periodically attempt to directly influence the contents of fishery management plans.

Shortsightedness also is present on the demand side. Fishing interests in most managed fisheries tend to be shortsighted about fishery management policy. In open-access fisheries, fishermen have no secure claim on future outcomes in their fishery. That is, they have no assurance that they will reap the benefits that might accrue from their short-term sacrifices. Fishermen in rights-based fisheries, on the other hand, are expected to be less shortsighted. Fishermen also tend to be shortsighted because of the great uncertainty they face regarding future fishery policies, fish stocks and markets. Fishermen are simply being rational in their shortsightedness.

The shortsightedness on both the demand and the supply sides of the political marketplace combines to favor legislation that provides easily identified current benefits at the expense of future costs that are complex and difficult to identify. Conservation, which requires short-term sacrifice in exchange for long-term gains, tends to be disfavored in this environment.

Another characteristic that strongly influences fishery policies and outcomes is de-coupled benefits and costs. Political products have benefits and they have costs. For many fishery products, those who benefit are not those who pay the cost of a product. For other products, benefits accrue at a different point in time from the costs. An example of de-coupled benefits and costs are government-financed vessel buyback programs, such as the US$25 million vessel/permit buyout program in the U.S. Northeast fisheries. The beneficiaries are the fishermen whose vessels are purchased by the program and those remaining in the fishery. The costs, on the other hand, are borne by the general taxpayer. The beneficiaries do not pay in proportion to the benefits they receive; and the payers do not benefit in proportion to what they pay. In short, the principal conclusion from this analysis is that who pays and how they pay for management services influences policies and the economic performance of a fishery (Andersen and Sutinen, 2003).

The two characteristics of 1) shortsightedness of the principal actors and 2) de-coupled benefits and costs of fishery products have a powerful influence on the choice of fishery management policies. The presence of shortsightedness and de-coupled costs and benefits works against adoption of effective conservation policies. The structure of the fishery management system tends to disfavor effective conservation policies because they concentrate short-term costs upon resource users in exchange for benefits in the future that would not necessarily accrue to those users who make the sacrifice.

There are many examples in which the political marketplace favors fishery policies and programs where benefits are distributed to a few and the costs are borne by taxpayers. Fishery policies and programs with short-term benefits, and costs to be borne in the future are also favored. The political marketplace disfavors policies and programs for which costs are concentrated on a few and benefits accrue to many; and policies and programs with short-term costs in exchange for future benefits. The fishery political marketplace can be expected to produce effective conservation policies only when those who sacrifice in the present can expect to receive benefits in the future.

Government agencies do not face incentives to produce goods and services efficiently. By cultivating the political influence of powerful politicians and groups of constituents, bureaucrats create opportunities for themselves to lead larger government agencies. While bureaucrats compete for tax revenues, promotions, higher incomes and greater power (just as employees do in the private

sector), they do not face incentives to increase the value and decrease the costs of their outputs. Public employees cannot increase their income by improving the efficiency of the agency, and their job performance is usually difficult to measure (at least in terms of the contribution to the agency's output). As a result, they tend to be less conscious of costs, especially since they are spending other people's money. There is no need to compare revenues with costs; there is no measure of inefficiency and no pressure to reduce it. The incentives inherent in government agencies lead to inefficient production of government goods and services (Niskanen, 1971; Wolf, 1988).

In addition, government is often the sole provider of the good or service. The exclusive right of production is often mandated by law. Education and postal services in the U.S. are exceptions. In general, the lack of constant competition for customers leads to inefficiency in government production.

Unlike the private sector, there is no systematic mechanism to weed out governmental inefficiencies. In the private sector, inefficient firms do not survive – they go bankrupt. In the public sector, agencies with high costs or that cannot meet their targets are often rewarded with increased funding. Agencies that reduce costs and do not spend their budget allocation are penalized with the threat of a smaller budget the following year.

Correcting and Mitigating Government Failures

The fishery political marketplace can be expected to produce effective conservation policies only when those who sacrifice can expect benefits in proportion to their sacrifice. To implement this principle, governance arrangements should include the following:

First, devolve to users and others with strong interests in a fishery, the rights and responsibilities of setting management policies and bearing the full consequences of those policies. Such action would attempt to harmonize interests of managers and users to act in the nation's interest. This can be achieved by efforts to encourage and facilitate implementation of individual or community fishing quota and other rights-based programs. Examples of rights-based methods include the lobster management zones in Maine, quota holder associations in New Zealand, and the community-based management regime in Japan. Government still has a legitimate role in management, but it should be the role of oversight rather than operational decision-making. Appropriately done, such reform would greatly weaken the shortsightedness among resource users, giving them the incentive to be willing to make the short-term sacrifices needed to rebuild depleted stocks and avoid overfishing.

Second, remove or minimize opportunities for the political marketplace to produce fishery products with de-coupled costs and benefits. In current governance systems, too many policies and programs provide benefits for a select few and impose widespread costs. The full costs of fishery management need to be recovered from the beneficiaries of that management. That is, we need to implement the principle of beneficiaries paying in proportion to the benefits they receive. In some cases, this would mean imposing user fees on resource users and, for other policies and programs, paid for by the general taxpayer.[20] Properly designed and implemented, cost-recovery can have sizeable beneficial effects on the performance of fishery management. Experiences with cost-recovery in Australia and New Zealand bear this out.

[20] For more on cost-recovery and ways to finance fishery management, see Andersen and Sutinen (2003).

Third, fishery managers need to be protected from the shortsighted tendencies of elected representatives. Political interference is common in fishery management throughout the world. Australia has attempted to remove fishery management from the political arena by establishing the Australian Fisheries Management Authority (AFMA) in 1991. By statute, AFMA has the day-to-day responsibility for developing and implementing fishery management plans. Political involvement in fishery management is allowed only at the strategic level. Unlike in the U.S., Commonwealth government agencies have no authority for developing or implementing fishery management plans. Another way to minimize political interference may be to request our elected representatives to pledge not to interfere in the development and implementation of fishery management plans. This may be all that they need in order to effectively resist the pleas of constituents who are pursuing short-term interests.

Civil Society

The institutions and arrangements of civil society play a central role in influencing behavior. As explained above, social norms and networks – "social capital" – shape individual and collective behavior, and also facilitate co-operation among individuals and between groups of individuals. The social norms and networks can encourage trust, civic engagement, and enhance effective governance while reducing management costs. These have considerable potential for advancing ecosystem-based management in informal governance systems.

The institutions and arrangements establish "working rules" that are commonly known, monitored and enforced (Ostrom, 1990). Though different than the legal requirements established through governmental processes, they are powerful tools that influence individual and group actions. The violation of patterns of behavior adopted by the formal and informal institutions of civil society can produce powerful peer pressures and, ultimately, can lead to isolation or expulsion from the community or even physical retribution.

Basic to effective management of common property resources is trust among users that they will all adhere to applicable rules (Hall-Arber and Finlayson, 1997). Social institutions contribute expertise and local knowledge and play a crucial role in the diffusion and adoption of reforms, for example, in how fisheries are conducted and wastes are disposed. Social institutions and NGOs can provide "eyes and ears" to ensure that the policies and actions adopted by the SAP are put into place with their participation and involvement, and are implemented.

All is not always well with existing institutions and arrangements of civil society, however. Social norms in some societies are not consistent with conserving LME resources, protecting habitat and the quality of the aquatic environment. Many of the institutions and arrangements of traditional societies have been weakened or destroyed by various influences of globalization. For example, traditional marine tenure arrangements that once protected local fishery resources do not apply to encroachment by fishers from outside the local community. In such cases, there is a need to build new, or expand and strengthen the traditional, institutions and arrangements for the issues of LME resource management and governance.

To address this challenge, many inter-governmental and non-governmental organizations are currently engaged in efforts to educate, change values, attitudes and behavior through the use of social marketing and participatory management approaches. These are discussed in more detail

below. It is increasingly recognized that civil society should directly and officially share actual management responsibilities with governmental authorities through what is termed "co-management" (Felt, Neis, and McKay, 1997; Wilson, et al., 2003).

Strengthening Adaptive Governance For Complex Ecosystems

Effective governance institutions are crucial to sustaining the goods and services that flow from LMEs. The work of Elinor Ostrom and others (Lee, 1993; Hennessey, 1994; Hennessey and Healey, 1994; Juda and Hennessey, 2001) have demonstrated the need for governance institutions at a variety of levels to cope with the uncertainty and dynamics of ecosystems, and the impacts of human uses. Elinor Ostrom (2003), one of the leading authorities on institutional analysis and design has observed: "The most important contemporary environmental challenges involve systems that are intrinsically global or are tightly linked to global pressures and that require governance at levels from the global down to the local." This observation clearly applies to LME governance needs which require integration at all levels and sectors from the national to the local and from program to program. Ostrom suggests the following general principles to guide the design of robust ecosystem governance systems:

- Devise rules that match prevailing ecological conditions
- Clearly define the boundaries of natural resources and users
- Devise accountability mechanisms for monitors
- Apply graduated sanctions for violations
- Establish low cost mechanisms for conflict resolutions
- Involve interested parties in informed discussion of rules
- Allocate authority to allow for adaptive governance at multiple levels from the global to the local (also referred to as nested governance systems)
- Employ a variety of institutional types that are tailored to their position and roles in a layered governance system

Perhaps, most important for our purposes is the notion of "nested institutions." Ostrom suggests that institutional arrangements must be complex, redundant, and nested in many layers. She warns that strategies that rely on one level and centralized command and control have been repeatedly designed and applied to complex ecosystems and they have failed. Governance should employ a mix of institutional types using a variety of decision rules to change incentives, increase information, monitor use and induce compliance.

Another key feature of adaptive governance is the role of adaptive management. Adaptive governance sees ecosystems as laboratories for the design and adaptation of the institutions that contribute to a governance system. The management of ecosystems consists of far more than passing data from scientists to decisionmakers. Management occurs within an institutional setting that attempts to reconcile the differing values of user groups and the general public and then provides the means for implementing chosen objectives. After making a detailed analysis of the

governance of large and complex coastal ecosystem – the watershed of the Columbia River in the U.S. – Lee (1993), concluded that "adaptive management is an approach to natural resource management that embodies a simple imperative: policies are experiments; learn from them." He proposes a set of institutional conditions that enable adaptive management and the challenges facing those who are working to practice adaptive ecosystem governance (see Lee 1993 for details).

Compliance, Enforcement and LME Governance

One of the principal challenges of ecosystem-based management is to secure acceptable levels of compliance with the regulations and management measures implemented in an LME. Governments regulate the extraction and use of LME resources to mitigate the overexploitation of those resources, pollution and destruction of habitat. Government relies on monitoring, surveillance, and enforcement of the regulated economic agents to control these activities (such as fishing, mining, tourism services, waste disposal, land use).

Enforcement programs are based on the deterrence framework, which assumes that the threat of sanctions is the only policy mechanism available to secure compliance with regulations. The theory of deterrence, has at least two important shortcomings, however first, the model does not explain the available evidence very well and, second, the policy prescriptions of the model are not very practical. Low expected penalties do not always result in high levels of non-compliance; and prescriptions of more enforcement inputs and higher penalties are usually unfeasible or not cost-effective.

In addition, acquiring more and better enforcement services is expensive. In living marine resource management programs, for example, enforcement is frequently the most costly element, accounting for a quarter to over a half of all public expenditures (Wallis and Flaaten, 2000: Table 1). This raises questions of whether there are ways to improve the cost-effectiveness of traditional enforcement, and whether there are ways to secure compliance without heavy reliance on costly enforcement. There are such ways, as this section illustrates, for the case of fisheries.[21]

Compliance Behavior in Fisheries[22]

The purpose of a fisheries compliance program is to have fishers comply with conservation and management regulations. Therefore, we need to understand why people comply, and why they do not. We begin by reviewing the basic theory of compliance behavior, first for the individual and then for fishers as a group. Research studies indicate that four factors tend to influence individuals' decisions whether to comply with a law or regulation: (1) the amount of illegal gain or benefit, (2) the expected penalty, (3) moral obligation, and (4) social influence.[23] This is illustrated by the cartoon in Figure 10.

[21] Much of what follows applies to compliance behavior in general, not just fisheries. Similar patterns of compliance behavior are found in sectors that are subject to environmental regulations, for example. Also, note that this section does not address the problem of fish piracy on the high seas, which has been a prominent concern in recent years (see http://www.high-seas.org/ for more information).

[22] This section uses excerpts from Sutinen, J. G. 1996. *Fisheries Compliance and Management: Assessing Performance*. Australian Fisheries Management Authority, Canberra, ACT (August).

[23] See Kuperan and Sutinen (1998) and Sutinen and Kuperan (1999) for a detailed derivation of these factors; also see Gezelius (2002) and Hatcher and Gordon (2006) for reviews of the fisheries compliance research literature. The literature includes studies of fisheries in developed and developing countries, such as Indonesia, Philippines, Malaysia, and South Africa (Kuperan, et al. 1997; Hauck and Kroese, 2006).

Next, we discuss each of the four factors in more detail, for each is influenced by fishery policy and each, in turn, influences the extent to which fishery policy is effective.

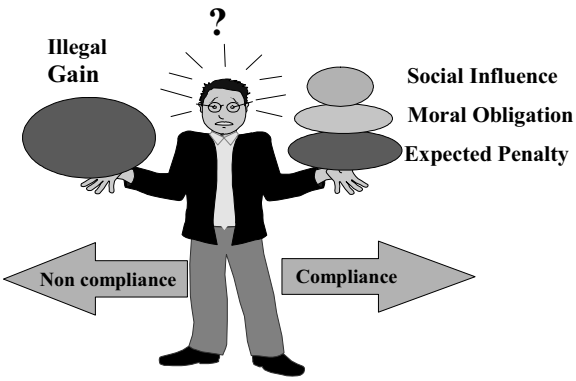


Figure 10. The compliance decision

Illegal Gains

The illegal gain or benefit in a commercial fishery is the amount of added income that can be earned from violating a regulation.[24] It is this added illegal gain that usually temps people to violate a fishery regulation, though, in some cases, violations are inadvertent or due to ignorance.

The amount of potential illegal gains in fisheries often is quite large. For example, in the New England groundfish fishery referred to above, Sutinen, et al. (1990) found a large percentage of fishers were earning illegal gains of about a quarter of million dollars per year. In some cases, illegal fishing trips earned three times the revenue of legal trips. Not all fisheries offer such large potential illegal gains, of course. The important point, however, is that often the incentive to violate can be very powerful and difficult for fishers to resist.[25]

Potential and actual illegal gains are dynamic, frequently changing, and are influenced by several conditions in the fishery. The regulations influence the extent of illegal gain. In general, the more restrictive the regulation, the greater the potential gain from violation. Biological conditions are a major factor determining illegal earnings relative to legal earnings. The size, location and composition of the fishery resource, which are constantly in flux, strongly influence where and how fishers can earn the most income. Prices and market conditions also affect the prospects for illegal gains and thereby influence the amount of compliance in a fishery.[26] A compliance program must account for the nature and determinants of illegal gains and be prepared to adapt and adjust to these conditions as they change over time.

Expected Penalty

The expected penalty works to deter individuals from committing a violation. If large enough, the expected penalty can offset the illegal gain and remove the incentive to violate. Unfortunately, this is rarely the case. As explained below, the expected penalty usually is small relative to the illegal gain.

The expected penalty is equal to the size of the penalty times the probability of being caught and convicted of the violation. The magnitude and nature of the penalty or sanction is often constrained by law and determined by the judicial system. The average size of the penalty for any given violation usually is less than the maximum allowed by law.

---

[24] In the case of a subsistence fishery, the illegal benefit is the added value of fish taken illegally for personal consumption.

[25] Poverty and other forms of dire financial circumstances are well-known to drive noncompliance among fishers.

[26] For more discussion of these conditions and how they influenced compliance in the New England groundfish fishery, see Sutinen, et al. (1990).

Penalties generally are not large relative to illegal gains. For example, in the groundfish fishery of the Northeast United States, Sutinen, et al. (1990) estimate flagrant violators grossed about $15,000 *per trip* from violating closed area and mesh size regulations, resulting in illegal earnings of $225,000 during 1987. Typical penalties, when caught and sanctioned for these violations, ranged from $3,000 to $15,000 in monetary fines.

The probability of being caught and convicted is usually small, very small. The typical odds of being caught violating a fishery regulation are below one percent, and often at or near zero (Sutinen and Gauvin, 1989; Bean, 1990; Furlong, 1992; Kuperan, 1992).

When the small probability is multiplied by the modest penalty usually imposed, the expected penalty most fishers face is small. It is regarded by many fishers as a "cost of doing business." This pattern of low certainty and severity of sanctions relative to potential illegal gains tends to appear in most fisheries. Raising penalties to the point where the expected penalty offsets illegal gain generally is not feasible. The courts are not willing to mete out sanctions perceived as excessively severe. Rather, courts tend to impose sanctions that fit the crime, as measured by the illegal gains realized or the social harm caused by the *detected and proven* violation.

The implications of this evidence are clear. Compliance policy cannot depend exclusively on deterrence to ensure a high degree of compliance among most fishers.

Moral Obligation

Despite the strong incentive to violate (high potential illegal gain relative to the expected penalty), a high proportion (50 to 90 percent) of fishers normally comply with regulations (Sutinen, et al., 1990; Sutinen and Gauvin, 1988; Bean, 1990). This pattern is typical of regulated fisheries.

Asked why they persist complying when illegal gains are much larger than the expected penalties, many fishers refer to the need to "do the right thing" (Gauvin, 1988; Gezelius, 2002). That is, they express an obligation to obey a set of rules (either their own or an authority's). The sense of moral obligation is common throughout society and may be a significant motivation explaining much of the evidence on compliance behavior.

An individual's moral obligation to comply is the result of two forces: the individual's moral development and standards of personal morality, and the individual's perceptions of how just and moral are the rules and regulations. That is, the moral obligation to comply is based on individuals' perceptions of the fairness and appropriateness of the law and its institutions.

An individual who believes that complying with the regulation is the "right thing to do" will feel a moral obligation to comply. An individual disagreeing with the regulation, or management policy and procedures, may feel the opposite, and be obliged to violate the regulation. The basis of moral obligation is discussed in more depth below, as it is an important consideration when setting and implementing policy.

Social Influence

Most individuals also are influenced by their peers, or people who matter to them, when deciding whether to comply. Social influence is known to play a significant role in everyday social exchange, often taking subtle forms of ostracism or withholding of favors. A group of fishers can reward and punish its members, either by withholding or conferring signs of group status and respect, or more directly by threatening them with sanctions.

Social influence in fisheries is often manifested in forms of verbal and physical abuse (e.g., fist fights, destruction of gear and vessels). In the Massachusetts lobster fishery strong forms of social influence, commonly called "self-enforcement," are estimated to account for the bulk of enforcement in the fishery (Sutinen and Gauvin, 1988). Fisheries, where social influence to comply with management regulations is prevalent and appears highly forceful, include American lobster (Massachusetts and Maine), clam (Rhode Island), herring roe (Alaska, British Columbia, Oregon, San Francisco Bay), saithe (Norway), and sakuri ebi (Japan). There probably are many other fisheries where this phenomenon is operative.

Social influence and moral obligation are closely linked. The standards an individual uses to judge his/her own behavior are used to judge others' behavior. Therefore, the moral principles on which individuals base their own behavior are also the basis for the social influence they exercise. The more widespread a common moral obligation is in the fishing population, the stronger the social influence is expected to be. An important implication is that policies that strengthen the moral obligation to comply also strengthen social influence.

These four factors do not always influence individuals as portrayed in Figure 10. In some fisheries there is no moral obligation to comply and social influence is on the other side – encouraging individuals to violate (Figure 11). This was the case in the New England groundfish fishery during the late 1980s where the pressures from crews and competition with others drove captains of vessels to fish in closed areas and use illegal nets on most trips (Sutinen, et al., 1990). In such cases, compliance programs must not only strive to increase deterrence (i.e., the expected penalty), they also must strive to build a strong sense of moral obligation to comply among fishers and to shift social influence to the side of supporting compliance with the regulations. How this can be accomplished is discussed at some length below.

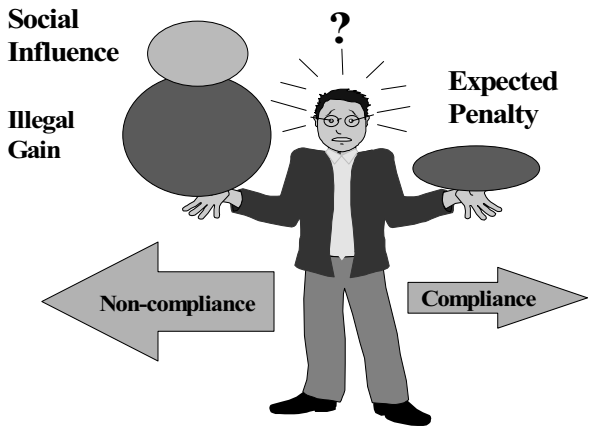


Figure 11. Undesirable Compliance Context

Aggregate Compliance Behavior

All fishers are not alike in their compliance behavior. Some are more compliant than others, reflecting variations in the size and nature of the four forces of compliance. For example, some fishers invest in methods to avoid detection and face lower probabilities of detection than other fishers (Anderson and Lee, 1986; Bean, 1990). Others have a stronger moral obligation and face more social pressure to comply (Gauvin, 1988).

The available evidence suggests that within the typical population of fishers there is a small core subgroup, of about 5 to 15 percent of fishers, which tends to violate chronically and flagrantly. They are motivated largely by the tangible (usually financial) gains from illegal fishing. Moral obligation and social influence have little or no effect on their behavior. Only by changing the economic incentives,

by reducing the potential illegal gains or by increasing the expected penalty, can their illegal fishing be controlled. In the absence of incentive programs, the only control mechanism for this subgroup is enforcement.

The remainder of the population consists of a small fraction (5-15 percent) that is strongly influenced by moral obligation and comply most, if not all, of the time, and a large portion that normally complies, depending largely on the degree of social influence they face. This latter group typically consists of about 70 to 90 percent of the fishing population.

The result is that a small number of fishers tend to account for – directly and indirectly – most of the non-compliance, and most of the risk to conservation and management of a fishery. Chronic violators can only be controlled by enforcement and other tangible incentives. Smart compliance policy (discussed below) recognizes and exploits this critical feature of compliance behavior.

Voluntary Compliance

It is becoming increasingly evident that a critical and necessary condition for successful fishery management is fishers' support for the program. The evidence is extensive and persuasive, originating from several countries for a variety of fishery settings. The evidence is provided by front-line fishery managers, enforcement authorities, industry spokesman and field researchers.[27] We know that without widespread industry support, a fishery management program is doomed.

As noted above, the vast majority of compliant behavior is "voluntary," more the result of moral and social considerations rather than coercive enforcement.[28] Studies of fisheries compliance indicate that a large proportion of fishers are strongly affected by the twin forces of moral obligation and social influence. This group of fishers, which often comprises about 90 percent of the fishing population, normally complies with fishery regulations.

Individuals' voluntary compliance is closely linked to regulatory policy and practices. The compliance literature recognizes two types of intrinsic motivation or obligation to comply (Tyler, 1990). One is related to the individual's desire to behave according to her/his sense of personal morality, i.e., an internal obligation to follow one's own sense of what is right or wrong. The other type is related to the intrinsic obligation to follow the dictates of a "legitimate" authority (such as the police, one's boss, or other authority figure). These relationships are illustrated in Figure 12. Legitimacy effectively functions as a stock of loyalty on which leaders can draw. Those who accept an authority's legitimacy tend to comply with its dictates even when the dictates are contrary to an individual's self-interest.[29]

[27] 'The point is that fishery management cannot rely on the surveillance and control system to ensure total compliance. There are two important aspects of this conclusion. One, there will always be some degree of non-compliance with the regulations. No amount of enforcement effort will completely eradicate violations of the regulations, and management policy should allow for this fact. Two, the degree of compliance is closely linked to the extent to which fishers support management policy. A high level of support by the fishing community translates directly into compliance with management regulations' (Sutinen, 1995).

[28] This pattern of high compliance rates in the face of low expected penalties is commonly found in other regulated industries as well.

[29] Tyler (1990) argues that it is better for a rule-making body to base compliance on legitimacy rather than on personal or group morality because the scope of legitimate authority is more flexible (in that leaders usually have a wide range of discretionary authority). Personal morality, on the other hand, is double-edged, for it may or may not accord with the dictates of the authority, leading to resistance to the law and legal authority, instead of compliance with its dictates.

Fishers tend to comply more with laws and regulations that are "legitimate." Coercion, the threat of sanction, usually is not the principal factor influencing their compliance decisions (Sutinen and Kuperan, 1999; Kuperan and Sutinen, 1998; Hanna, 1995; Gezelius, 2002).

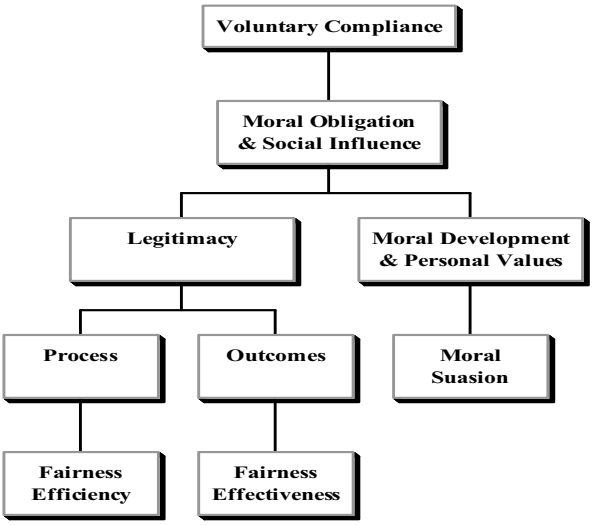


Figure 12. Determinants of voluntary compliance

What is the basis for legitimacy and voluntary compliance?

- First, there must be a reasonably *common understanding* of the basic nature and extent of the *problem*, such as overexploitation.
- Second, the *procedures* for developing and implementing management measures must be perceived to be *fair*.
- Third, the resulting measures must be perceived to be *effective*, i.e. to make a significant contribution to resolving the problem.

When these conditions are reasonably well satisfied, fishers are willing to sacrifice personal gain for the good of the fishery, and to sacrifice immediate gain to realize improved harvests in the future. When these conditions are not reasonably well satisfied, fishers balk. Their resistance is expressed in a variety of ways. They speak out at public hearings (either personally or via lobbyists). They seek support from their legislative representatives. And/or, they violate the regulations. Non-compliance for most is a last resort, but is also one of the most effective means of protest, and it effectively sabotages a management program.[30]

How can legitimacy and, therefore, voluntary compliance be strengthened? One approach is through greater user participation in the design and implementation of policy. Moral suasion is another approach.

User Participation

User participation in the design and implementation of policy can help create the conditions of legitimacy noted above. A large body of research on user (stakeholder) participation in fishery management indicates that compliance is greater and far less costly when users are meaningfully involved in the development and implementation of fishery management programs. Involving fishers and other stakeholders in the development and implementation of a compliance program improves the fairness and appropriateness of the program, and in turn improves its cost-effectiveness. Keeping regulations simple and with a clear connection to conservation goals, and the equitable application of regulations and enforcement are also believed to be important for securing industry support (Sutinen, 1995).

[30] See Hauck and Kroese (2006) for an example of "protest fishing" in the South African abalone fishery.

Hanna (1995) argues that the extent of user participation in the process significantly affects the costs and the effectiveness of management. She identifies four stages of the management process: (1) description of the resource context, (2) program design, (3) program implementation, and (4) monitoring and enforcement. Describing the resource context is an assessment process with users as its focus, and includes information on describing users, processors, markets and analysis of users' interests. This is related to the TDA process presented in previous sections. Design of the management program is dependent on the descriptive information, and the quality of the description determines whether the management program design reflects well its social and economic environment. This effort is comparable to the SAP development process described in previous sections. As with SAP implementation, implementation of the management program is the legal and administrative process required to put the program into effect. Monitoring the state of the fishery and enforcing compliance with regulations are ongoing processes over the life of the program. Each of the four stages of management involves costs. The major costs of fishery management are the costs of gathering information, designing regulations, coordinating participants, monitoring conditions, enforcing regulations. This group of costs is called *transactions costs*.

Hanna asserts that the transactions costs of management will vary by the extent of user participation in the management process. In particular, she argues that the least-cost structure for the *description and design* stages is a top-down management structure, relying on small numbers of experts and involving very little participation by resource users. This is because a user participatory structure requires greater amounts of time and resources spent in coordination, information dissemination, and conflict resolution. In the *implementation stage*, however, the balance of transactions costs shifts. The benefits of user participation are realized in lower transactions costs of monitoring and enforcement because users are more likely to comply with the regulations and the regulations are more likely to be enforceable. Costs also are affected by the different incentives faced by users under top-down and bottom-up management structures. The top-down structure creates an incentive to sabotage the program because uncertainty about the goals of the process tends to shorten time horizons of users, encouraging short-term actions at the expense of long-term sustainability. The bottom-up structure, involving extensive user participation, creates a stake in the outcome and reduces uncertainty about process goals. Also, user participation can promote stewardship through creating an assurance of control over outcomes. Hanna concludes that the "benefits of top-down management are front loaded, whereas the benefits of user participation are end loaded," having the potential for long lasting returns.

The extent and nature of user participation in fishery management can vary widely. In general, it is "a dynamic partnership using the capacities and interests of user-groups complemented by the ability of the fisheries administration to provide enabling legislation and administrative assistance. The fisheries administration and the user-groups share responsibilities and competence for fisheries management" (Nielsen and Vedsmand, 1995). The partnership can encompass a range of possible ratios of government and user-group rights and responsibilities in the management process. The rights and responsibilities concern the tasks of management. There are at least seven key tasks that can be shared between government and resource users in the development and implementation of a fishery management program. These include (1) assessment of the state of the fishery, (2) setting management objectives, (3) selecting management measures, (4) allocation of catches (or other benefits) among resource users, (5) allocation of catches over time, (6) enforcing regulations, and (7) learning about changing conditions in the fishery.

It is important to recognize that as the degree of participation increases, the program's control over both the process and the outcomes diminishes. More participation is not necessarily better. The degree of participation that a program selects can be visualized as a ladder with four rungs.

Level One: Providing Information. Providing information can be the sole objective of a project's participation efforts. Public information materials typically include publications, slide shows, videos, books and brochures. Information can increase the public's awareness and understanding of the resource area, its management issues, and the causes and solutions to coastal problems. Information can encourage stakeholders to voluntarily comply with regulations and to participate more fully in the program.

Level Two: Consultation. Consultation is a two-way process. It calls for both giving and receiving opinions and information. It provides stakeholders a role in shaping both the analysis of issues and what should be done about them. It is a process that allows the project manager to retain control over the project's process while seeking local knowledge and welcoming ideas on what actions to take. Committees, working groups and public workshops are common consultation techniques.

Level Three: Collaboration. In collaborative management, those responsible for a coastal management program share power with others external to their team. Collaborative participation works well when project managers are willing to limit program actions to those that the collaborators can formally agree to. This can reduce a program to following easy courses of action, rather that the more difficult, proactive courses that may ultimately have a greater impact. Strong leadership may be required to make a collaborative approach viable. Collaboration is built on partnerships that usually require considerable time and energy to develop. Collaborative approaches, however, are often the most effective path to solving complex issues including many interests.

Level Four: Support to Independent Initiatives. When supporting independent initiatives, a program works to help government agencies or local communities develop and carry out their own plans. Such programs must put clear limits on what they will support. Formal institutional structures will be needed to define the goals and the procedures that allow stakeholders to organize, engage in contracts, and own and manage assets.

All effective ecosystem governance programs rely upon a mixture of methods to implement their plan of action. Regulations – applied by rules, zoning ordinances and permit processes – are invariably important. Non-regulatory methods include investments in infrastructure, the purchase of lands, education and investments in monitoring and research. A participatory approach to ecosystem governance enables stakeholders and the public to see these efforts as a coherent whole and works to win their support for the program. Voluntary compliance by a supportive population lies at the heart of the successful implementations of an ecosystem governance program.

Most major fishing nations currently rely on the consultative mode of user participation, but there is a growing trend toward greater sharing of power between government and user groups. The available evidence from these experiences supports Hanna's (1995) argument that the performance of fishery management institutions is strengthened by meaningful user participation.

Moral Suasion

Another common approach to strengthening voluntary compliance is moral suasion. Formal social marketing techniques,[31] as well as straight forward education, provide people with information which, if successful, shapes their attitudes and values, and induces socially desirable behavior. The general operating hypothesis is that information influences personal values, and personal values influence behavior (Fishbein and Azjen 1975).

An illustration of this is Michael Crichton's (1988) story of his search for egg-laying leatherback turtles along the east coast of Peninsular Malaysia. After several nights waiting, he discovers one of the giant turtles laying her eggs near his hotel. While Crichton watches the turtle's slow and clumsy effort to dig a pit for her eggs, a vacationing family arrives. The parents take flash photographs of the children each taking a turn sitting atop the back of the turtle. After several minutes of the family's taunting the creature, a local Malay boy arrives and explains to the family what the turtle is doing, how she had laboriously struggled up the beach, turned around to face the ocean, how long it had taken her to dig her pit, the effort it would take to lay her eggs, and the many hours she would lie there, exhausted, trying to find the strength to struggle down the beach and return to the surf by daybreak. The family listened in silence, their young son got off the turtle's back. The children were encouraged to touch the turtle's shell and make peace with the great creature. With growing respect, the family stepped back from the pit. Once they understood what was happening, they became sympathetic and understanding, stopped harassing the turtle and quietly drifted away.

In this example, the Malay boy's explanation persuaded the family to stop their environmentally undesirable behavior. Simple education functioned as moral suasion, i.e., inducing socially desirable behavior by shaping and/or appealing to people's personal values.

Properly executed, moral suasion can be a cost-effective means of strengthening compliance with fishery regulations. The effort will have to do more than just educate in most instances; it will have to persuade. The effort will have to develop a common understanding of the nature and extent of fishery management and compliance problems, and to convince users of the fairness and effectiveness of procedures and measures used to manage fisheries. The moral suasion effort will have to be ongoing. Short-term moral suasion efforts have no long-lasting effects and the payoff from the effort may take a generation to fully realize.

Smart Compliance Policy

What do these considerations imply about policy?

The stylized facts about compliance behavior have two meaningful implications for compliance and enforcement policy, and for overall policy: (1) promote voluntary compliance, and (2) target chronic and frequent violators. In addition, there are three other policy prescriptions implied by the research on compliance: (3) maximize the deterrent effect of sanctions; (4) account for non-compliance in setting regulations; and (5) adopt enforceable regulations. We now discuss each of these in turn.

A compliance program needs to recognize that compliance behavior varies among fishers. The compliance problems presented by those fishers not affected by moral obligation and social

[31] Social marketing is a communication approach that makes use of commercial marketing principles to "sell" ideas, attitudes and behaviors to campaign for behavioral change. Mahanty and Stacey (2004) illustrate how social marketing techniques can be applied to promote participatory management of natural resources in the Pacific region.

influence need to be addressed differently than the compliance problems presented by the rest of the fishing population. This will involve developing strategies that seek to strengthen voluntary compliance, and to target scarce and costly enforcement resources.

Promote Voluntary Compliance

As explained previously, the willingness to comply stemming from moral obligation and social influence is based, *inter alia*, on the perceived legitimacy of the authorities charged with implementing the regulations. Research evidence suggests that a key determinant of perceived legitimacy is the fairness built into the procedures used to develop and implement policy. Therefore, regulatory authorities should determine what policies and practices are judged fair by those segments of the population subject to regulations. This may mean, for example, that civil penalties and other sanctions should be comparable in value to the larger of the harm done or gains realized. This may mean that individuals subject to surveillance and monitoring be treated with dignity and respect. This may mean that regulations must appear reasonable and 'make sense'.

There are a number of conclusions for policy that flow from the model developed here. Perhaps the most important implication is that top-down, command and control-style policies likely will not be perceived as legitimate. The result will be policy that is ineffective in achieving its goals, and a program that is costly and rife with popular dissatisfaction.

Another implication of the theory is that policy makers should pay more attention to the fundamental issues of institutional design. Like other political and legal institutions in society, regulatory bodies should devote great effort to developing legitimacy. The mere fact that an institution is formed under a piece of legislation does not necessarily confer on it legitimacy. How legitimacy can be earned is beyond the scope of this contribution, but is an important issue worthy of future investigation.

More equitable procedures for imposing restrictions on the economic community should strengthen legitimacy and voluntary compliance. Co-management regimes, in which participants are empowered to play a prominent role in decisionmaking, may be a means of achieving this end (Hanna, 1995). This would address, in part, the need to incorporate procedural justice in the institution. Similarly, enforcement policies and practices need to be seen by participants as being fair. This means that enforcement authorities should target chronic and flagrant violators of the regulations, punishing them accordingly, while tolerating to some degree minor violations by individuals who normally comply with the regulations.

To the extent that a regulatory authority has legitimacy, it will possess a precious stock of loyalty upon which it can draw in times of crisis. A collapse of a fishery resource, or environmental calamity, can be swiftly and severely dealt with by a legitimate authority, imposing on participants significant short-term sacrifices. Participants who view the authority as legitimate feel a strong obligation to comply even when the dictates of the authority are contrary to their self interest.

Target Frequent Violators

We turn now to the subgroup of fishers who tend to flagrantly and chronically violate fishery management regulations. Even if the subgroup of chronic, flagrant violators is small and the amount of their illegal fishing is minor, they need to be controlled. Weak enforcement would allow chronic, flagrant violators to flaunt violation of the law. Being seemingly immune to the regulations sends two signals to normally law-abiding fishermen. One is that regulatory procedures are unfair, having no effect on flagrant illegal fishing. The other is that the regulatory program is not effectively managing

the fishery (protecting the resource). Each of these signals weakens the moral obligation to comply and the moral basis on which social influence is exercised. As moral obligation and social influence are weakened, compliance begins to erode among those who would normally comply with the regulations. Their subsequent noncompliant behavior influences others not to comply with the regulations, and ultimately compliance breaks down.[32] Only effective enforcement can prevent this deterioration.

The cost-effective use of scarce and costly enforcement resources requires targeting the chronic, flagrant violators, devoting more enforcement resources to detecting and sanctioning these pernicious individuals. The reductions in illegal fishing mortality will be greatest when these violators are brought under control. Also, a positive multiplier effect on deterrence is expected when the chronic, flagrant violator is caught and penalized. The reverse is also true – i.e., while severe enforcement actions taken against the marginal, inadvertent or infrequent violator is counterproductive, possibly having a negative multiplier effect on deterrence.

Another reason for targeting chronic, flagrant violators is that it places them at greater risk. A chronic violator – by virtue of the fact that s/he is violating more frequently – stands a greater chance of being detected during the course of a season than a fisher who infrequently violates. By increasing the surveillance and monitoring of chronic, flagrant violators, the odds of detection can be substantially improved. It is easy to demonstrate for a not unrealistic setting that increasing the inspection frequency from once to fours times a year can increase the odds of detection from about 20 percent to over 60 percent. Therefore, targeting is an effective way of increasing the expected penalty to the point where it can be a potent deterrent.

Penalties for this group should be high, especially for repeat offenders. Offenders with serious violations should face more comprehensive and regular reporting, monitoring and surveillance requirements (the reason for this is discussed below in the subsection on maximizing deterrence). Repeat violators should face the prospect of being banished from all fisheries.

The need to target chronic, flagrant violators does not imply no enforcement resources are directed towards fishers who normally comply with management regulations. Indeed, a balanced allocation of costly enforcement resources is optimal. While enforcement resources should be used to target chronic, flagrant violators, there also is the need for routine monitoring and surveillance of normally compliant fishers. These fishers must have occasional contact with and other reliable information about the presence and performance of enforcement personnel so that the legitimacy of the enforcement program is maintained.

Coercive enforcement measures remain an essential ingredient in any compliance regime, even where a high degree of compliance is realized via the twin forces of moral obligation and social influence. As noted above, in almost any group of individuals subject to regulation there is a core subgroup (usually small) of chronic, flagrant violators motivated largely by the direct tangible consequences of their actions. Moral obligation and social influence have little or no effect on their behavior. Only by changing the economic incentives, by reducing the potential illegal gains or by increasing the expected penalty, can their illegal activity be controlled. In the absence of incentive programs, the only control mechanism for this subgroup is enforcement.

[32] This process of deteriorating compliance is believed to have occurred in Northeast fisheries in the late 1980s (Sutinen, et al., 1990).

Some of the findings in the large body of research literature on enforcement and compliance also have implications for policy that are useful for LME governance. We briefly present three of these policy prescriptions next.

Maximize Deterrent of Sanctions

The first is to maximize the deterrent effect of sanctions. As indicated above, the courts commonly restrict the severity of sanctions to not exceed the illegal gains realized or the social harm caused by the violation. This, combined with the usual small probability of detection and conviction, results in a relatively small expected penalty and, thus, weak deterrence. To maximize the deterrent effect of the given sanction, compliance authorities can apply what is popularly referred to as the heaven, hell and purgatory approach to compliance. Developed by Russell (1990),[33] the method involves categorizing regulated entities (e.g., fishermen) by their compliance status, and imposing monitoring requirements and sanctions that induce high levels of compliance.

The first step in developing the heaven, hell and purgatory approach to compliance is to categorize regulated entities by their compliance status. There would be a "green list" of entities that have a superior record of compliance – for example, no more than one significant violation during the past three (or five) years; a "red list" of frequent and/or flagrant violators who have a poor record of compliance; and a "yellow list" of entities that have a slightly blemished record of compliance during the past three (or five) years.

The second step is to define the set of privileges and obligations that entities face in each list category. Green list entities would have the most privileges and fewest obligations; the red list entities the fewest privileges and most obligations; and the yellow list categories privileges and responsibilities somewhere in between. Indeed, red entities may be banned altogether from fishing. For example, green entities may able to fish whenever and wherever they wish within the confines of the fishing regulations; and yellow entities may be restricted to fishing only during some hours of each day and only in some areas. Green entities would be monitored (inspected) infrequently and have minimal, if any, reporting requirements; whereas yellow entities would be regularly monitored and have frequent and onerous reporting requirements. In other words, yellow entities are entitled to some, but not all, of the privileges accorded to green entities, and are subject to greater scrutiny and self-reporting than green entities.

A key component of this approach is that yellow entities may earn elevation to the green status by demonstrating an acceptable level of compliance for a specified period of time. The status of red entities, on the other hand, is irreversible. Therefore, the third step is to determine the terms under which a yellow entity may 'earn' elevation to the green list – such as having a perfectly clean record of compliance and reporting over the course of, say, three years.

This method of graduated sanctions (in terms of privileges and obligations) produces a stronger incentive to comply for a given probability of detection and penalty. This occurs because a violation has an expected cost in terms of future foregone opportunities (lost privileges) and future costs (increased scrutiny) in addition to the expected penalty of the violation itself.

[33] Also see Russell (2003) for a comprehensive discussion of environmental monitoring and enforcement.

Account for Non-Compliance in Setting Regulations

One of the most important implications is to systematically account for the level of non-compliance when setting management policy.[34] This principle can be easily seen in the context of a regulation on total catch. Suppose there is a reliable estimate of the amount of illegal fish being taken in a fishery managed with a quota on the total catch by individual producers (i.e., individual quotas). Non-compliance is properly accounted for in such a fishery when the amount of illegal catch is systematically factored into the setting of the total allowable catch (TAC) for the fishery. That is, if the biological sustainable yield for the fishery is 100 units and the amount of illegal catch in the fishery is estimated to be 20 units, then the amount of total allowable catch allocated to quota holders in the fishery should equal the difference, 80 units. The sustainability of the fishery can only be ensured if the amount of illegal catch is systematically factored in to the amount of the TAC.

The same principle applies to other management measures. For example, in the case of a closed area, if the closed area is being breached and fish illegally taken in the area, that fishing mortality has to be taken into account when assessing the performance of the management program. Boundaries of the closed area may have to be adjusted to ensure that the amount of total fishing mortality is at sustainable levels. The principle also applies to other input controls.

Adopt Enforceable Regulations

Enforcement authorities regularly report that too many fishery management regulations are simply not enforceable. It is too easy to evade detection. A common refrain of field agents is that "we only catch the stupid." To minimize, if not avoid, the implementation of unenforceable regulations, enforcement authorities need to be included the process that develops regulations. They should be tasked with assessing the enforceability of each and every management measure under consideration.

Summary and Conclusions

This part of the Handbook has briefly explained some of the implications of socioeconomic and governance analyses for LMEs. The analyses indicate that while the three mechanisms of governance (markets, government, civil society) are potent determinants of LME outcomes for productivity, fish resources and fisheries, pollution and ecosystem health, there are several key challenges inherent in each mechanism that have to be addressed. Some approaches for addressing these challenges have been discussed in this and other previous parts of the Handbook. Sustainable financing also has the potential for addressing many of the challenges presented by imperfect markets and government, which is the subject of the following Part IV.

[34] Examples of methods for measuring noncompliance in fisheries can be found in Gauvin (1988), Bean (1990), and Kuperan (1992). Also see the Appendix in Sutinen (1996).

PART IV

SUSTAINABLE FINANCING

During the past 30-plus years, coastal nations have enacted numerous environmental and natural resource laws and programs to mitigate or halt the degradation of marine ecosystems. There now exist myriad national and international programs to regulate pollution, to reduce the destruction of coastal wetlands, mangroves, and coral reefs, and to manage fishery resources at scales that range from inshore small-scale fisheries to large marine ecosystems. In some regions, the implementation of the laws and programs have resulted in substantial expenditures for pollution control, fisheries management, and land use regulation in the coastal regions. In other settings, there is a large "implementation gap" and little has been done to implement formally adopted policies and management schemes. Although there is no global accounting of the total amounts that coastal nations have spent and are spending on programs to improve the condition of LMEs, there are a few examples that indicate the order of magnitudes of expenditures on some programs.

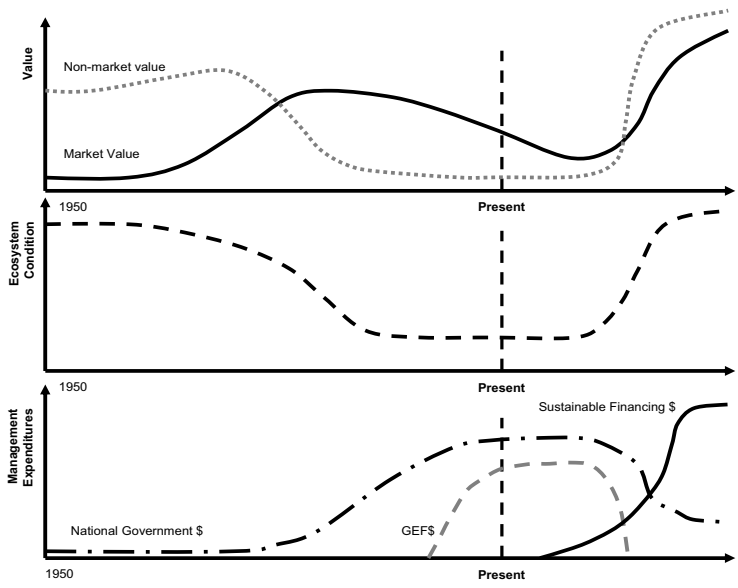


Figure 13. Stylized trends of LME values, ecosystem condition, and management expenditures

For example, Olsen and Nickerson (2003) report that the U.S. Chesapeake Bay Program, an outstanding example of adaptive ecosystem management at the scale of a large estuary and its watershed, spends approximately US$70 million per year on efforts that are linked directly to program goals.[1] The program operates with an annual budget of US$6 million in core funding that covers the costs of maintaining the program's offices, the salaries of the staff, the production and publication of reports and elements of the public education programs. The Great Barrier Reef and the Wadden Sea programs each spend

[1] The area of the Chesapeake Bay is 6,475 square kilometers, and its watershed extends over some 172,000 square kilometers. Management of the Bay primarily involves efforts to control and reduce nutrients and pollutants that flow into the Bay and its tributaries, as well as restore riparian and aquatic habitat to sustain estuarine fisheries.

approximately US$20 million per year on management efforts (Olsen and Nickerson 2003).[2] Regarding fisheries, Wallis and Flaaten (2000) report that OECD countries governments spent a total of US$2.24 billion in 1997 on fisheries management, an amount equivalent to 6 percent of the value of OECD fisheries landings. The expenditures on fisheries management – for research, enforcement and management administration – account for about one third of all government financial transfers to marine capture fisheries (OECD 2000: 133). Emerton, et al. (2006) summarize the latest available data on the amounts and sources of funding globally for all protected area management, which totals US$6.5 billion annually. For comparison, Spergel and Moye (2004) claim that the operation of a global network of marine protected areas "might cost between US$7 billion and US$19 billion annually."

Although we do not know the magnitudes with much certainty, we can comfortably conjecture that the amount of expenditures on conservation and management of marine resources has grown steadily since the mid-1970s. We illustrate this stylized trend in expenditures for a hypothetical LME in Figure 13. As noted above, the GEF has provided over US$260 million and mobilized US$450 in additional funding to support the planning and implementation of LME assessment and management projects in 121 countries since 1993. The grey dashed line in Figure 13 represents the GEF expenditures for our hypothetical LME, which extends beyond the present and ending at some time in the future.

The Financing Challenge

Programs for managing LME resources will likely grow significantly in scale and scope, which will increase the demand for additional revenues to cover the costs of these programs. GEF funding, although large by some standards, is limited and will not continue indefinitely into the future. It is essential that LME program managers and their partners begin early on in the TDA/SAP process to plan for the long-term financing of these critical programs. Financial planning for resource management is not common. Traditionally, policy makers and managers have focused primarily on the scientific and administrative requirements of environmental and natural resource management plans, and ignored or given little attention to the long-term financing required to implement programs and practice adaptive management over the decades.

There are at least two major challenges for financing LME programs. LMEs, by definition, involve transboundary resources, which require expensive monitoring and assessment efforts to support cooperative management programs among two or more coastal states. This challenge is complicated by the fact that not only do two or more countries have to agree upon how to manage use of a resource, they also have to agree upon how to finance the monitoring, assessment, enforcement, and administration of the management program. And, while some financing approaches may be appropriate in one of the countries, the same approaches may not be appropriate or feasible in another of the countries participating in the project. How costs and benefits will be allocated among participating states will likely be another major issue.

A second major challenge for financing LME programs after GEF support ends is competing for national funds with other sectors, such as education, health, housing, transportation, which often have priority over environmental programs for government revenue. According to WCPA (2000),

[2] Australia's Great Barrier Reef covers an area of 347,800 square kilometers; and the Wadden Sea, an estuary bordered by the Netherlands, Germany, and Denmark, covers an area of 13,500 square kilometers.

'following the economic crisis in South East Asia, budget cuts resulted in significant reductions in funding for the environment.' Well-designed financing arrangements that are linked to revenues generated by users of LMEs resources can mitigate, if not avoid, this erosion and fluctuation in funding for an LME program.

Fortunately, there is a growing awareness of the need for and application of financial planning in environmental and resource management programs. There are several excellent guides for planning and implementing sustainable financing mechanisms (described in brief below). The guides explain the principles and methods of developing financial plans, and explain and provide examples of specific financing mechanisms or tools that are being used throughout the world.

As good as they are, the guides on sustainable financing tend to focus on a relatively narrow set of issues and approaches to environmental and natural resource management. The excellent guides by the World Wildlife Fund (2004) and the World Conservation Union (IUCN 2000) concentrate on financing protected areas, both marine and terrestrial. There clearly is a need for a set of guidelines on sustainable financing for LME projects that involve multiple approaches to management and, perhaps most challenging, that involve multiple countries attempting to manage transboundary resources.

This Handbook will not attempt to provide comprehensive guidelines on LME sustainable financing. Instead, this part of the Handbook will summarize some of the essential aspects of sustainable financing, and provide some directions on how LME program participants can move forward on developing sustainable financing for their programs.

Planning for Sustainable Financing

LME programs and projects should view the development of long term financial plans for SAP implementation as a top priority. Paraphrasing the World Commission on Protected Areas (WCPA) (2000), a financial plan helps to determine the funding requirements (including the amounts and timing of the funding) and to identify income sources for each of the needs. In other words, the planning involves identifying both how much money is needed for all the activities and "locates the most appropriate funding sources for short, medium, and long-term needs." WCPA notes that some sources of funding "are more reliable than others, some sources are easier to raise than others, and some can be used freely according to management priorities while others come with strings attached." In addition, funding sources vary by the time horizons for which they are available (e.g., bank overdrafts vs. mortgages), and by the effort required to acquire the funding. Some funding arrangements require considerable amounts of time and effort to establish, and while they provide little revenue in the short term, they offer the prospect of providing steady and reliable revenues over the long term.

The guidelines in WCPA (2000) provide an excellent set of principles and procedures for developing plans for sustainable financing. Although the WCPA focuses on financing planning for protected area management, the guidelines can be readily adapted to LME programs. The guidelines prescribe three operational principles:

- Develop financial plans within the full context of LME management plans and its legal framework

- Adopt a business approach to financing LME programs, including identifying specific consumers (beneficiaries) of LME resources and management programs, and determining methods for capturing appropriate remuneration from those consumers
- Link public revenue streams to public goods, and link private revenue streams to club, local public, and private goods[3]

The guidelines encourage program managers to investigate a wide range of financing options and to diversify their portfolios of revenue sources. Chapter 2 in the WCPA guidelines explains how to identify and classify benefits from the environmental and natural resources, and how to link the consumers/beneficiaries with each form of the benefits. Chapter 3 explains the basics of implementing the financial plan in the context of an overall business plan for the management program. The second part of the guidelines catalogs various sources of funding, and the third part presents a few case studies of sustainable financing programs.

In a recent update of the WCPA guidelines, Emerton, et al. (2006) provide a more sophisticated and complete exposition of sustainable financing for protected areas. Numerous examples and case studies are presented that demonstrate the full set of challenges and promising prospects of sustainable financing approaches. Those who are interested in developing long-term financial plans for LME programs will find this report immensely valuable. There is, however, a need to adapt and expand the guidelines to account for the multinational, transboundary resource aspects of LME projects.

Taming Markets

Sustainable financing can potentially yield a double dividend. In addition to covering the costs of LME projects, financing arrangements and mechanisms also can be used to tame markets and mitigate the harm that markets do to ecosystems.

As explained in Part III of this Handbook, markets do not naturally tell the ecological truth – i.e., do not reflect the full costs of using ecosystem resources – which drives economic activities that lead to degradation of ecosystems. Market-driven economic activities are one of the direct causes of overexploited fishery resources, of degraded primary productivity and overall health of large marine ecosystems. Although market prices cover the cost of capital and labor, the prices to do not cover the costs of reducing a fish stock, of damaging habitat, of waste disposal and pollution, and other ecological costs. Sustainable financing offers a suite of mechanisms for creating markets that tell the ecological truth, and mitigate their tendency to harm LMEs.

[3] Public goods are those which, when once provided, are available to all at a zero price — for free. More specifically, public goods are those for which one party's use of the good does not subtract from another party's use (examples include marine research and education, navigational aids, clean waters and beaches, habitat and species preservation and restoration, early warning systems for tsunami and typhoons, and attractive vistas). In the case of private goods, one party's use subtracts from, and perhaps precludes, the use by another party (examples include exclusive individual mining and fishing rights). In addition, there is a wide variety of government goods and services that are impure public goods, that are neither perfectly non-rival nor perfectly non-excludable. Goods (or services) that are excludable and non-rival are club or local public goods; and goods that are non-excludable and rival are common-pool goods.

The judicious application of taxes, user charges, fees, and other financing mechanisms can make markets more ecologically truthful. By calibrating taxes, charges, and fees, to reflect ecological costs, and adding them to costs of capital and labor, market-driven activities will reduce their exploitation of fisheries, damage to habitat, and pollution. For example, pollution charges resulting from damage assessments for marine oil spills could provide the funds for cleanup and restoration of injured resources. Thus, compensation for damages provides sustainable financing for protection of LME resources. In addition, charging polluters for damages also internalizes environmental costs so that the ecological costs of a harmful activity are better reflected in the market price of outputs. By raising the cost of market goods to include their harmful effects, charging polluters for damages serves to help "get the price right," a cornerstone in sustainable resource use.

To calibrate these and other charges, the ecological costs of activities that are extracting LME resources, and polluting and altering the environment must be estimated. Economists, working with natural resource scientists, apply valuation techniques to calculate these costs. This involves the integration of the socioeconomics module with the three natural science modules of fish and fisheries, pollution and ecosystem health, and productivity. For examples of such integrated assessments, see Hennessey and Sutinen (2005: Chapters 9 – 12).

Valuation of Ecosystem Services and Assets

The coastal and marine natural resources of an LME are capital assets – in effect, representing wealth embodied in its marine natural resources. Capital assets – natural or otherwise – can provide valuable services ("interest") over time if maintained, much like savings in a bank provides a flow of interest income. Resource valuation involves the use of concepts and methods to estimate the economic value the public holds for ecosystem services and assets.[4] These services may be direct or indirect; and they may or may not be bought and sold in the marketplace.

Direct services include on-site use of marine parks, beaches, exploitation of marine minerals, or harvesting of fish, shellfish, or wood from mangroves. Indirect services occur off site, for example, when fish "produced" by a mangrove stand are harvested many miles away. Some natural resources services are exchanged in organized markets, such as commercial fisheries, oil and other minerals, coastal land and other property, or tourism. However, a central feature of many, if not most, marine resource issues is that the ecosystem services provided are not traded in markets. The services provided, as for example, by mangroves, corals, and sea grasses, water quality, recreation, scenic amenities and biodiversity are not bought and sold in markets – and, as a result, often are given inadequate attention in public policy.

Four types of value are associated with resource services: (1) use value is the benefit received from on site or physical use, such as harvesting of fish, exploitation of oil or beach us; (2) passive use value is the enjoyment one gets from a resource above and beyond any direct use. Passive use losses may arise if individuals feel worse off when they learn of the loss of an endangered species, closure of beaches, or other adverse impacts on other natural resources – even if they do not use these resources themselves. People might be willing to pay to prevent such losses, much as they might pay to reduce the malnutrition of children or respond to a natural disaster in a place that they will never actually visit; and (3) total value is the sum of use and passive use value. Individuals also

[4] A succinct explanation of these methods is provided by the National Research Council (1997: 21-24).

may have an (4) *option value* when supply (e.g., threat of extinction; the outcome of a policy) or demand is uncertain. Option value may be thought of as what you would pay to keep open the opportunity to later use a site or a resource.

Resource valuation, which estimates the value of particular resource services, can be used to inform policy for improving resource management. Many advances have been made in natural resource valuation, and the opportunities and limitations of resource valuation are becoming increasingly well understood. The World Bank's manual, *Estimating the Costs of Environmental Degradation*, explains, in practical terms, the methods of resource valuation.[5] Excellent examples of resource valuation studies can be found at several websites, including the IUCN's Biodiversity Economics (www.biodiversityeconomics.org/library/index.html), the Conservation Finance Alliance (www.conservationfinance.org/Relevant_links/CF-Papers.htm), and the WWF (www.worldwildlife.org/conservationfinance/pubs.cfm), among others.[6] The multitude of studies and applications documented to date is evidence that data problems and other difficulties are being overcome, and that resource valuation is a critical tool for managing ecosystem resources.

In addition, estimates of the value of lost or degraded ecosystem services and assets can be used to calculate the ecological costs of market-driven activities. Once resource valuations have estimated the ecological costs of resource extraction, pollution, and reduced productivity are calculated, the costs can be incorporated into the market prices. The ecological costs can be incorporated into market prices by applying taxes and user charges to those activities that harm the ecosystem. In other words, the ecological cost estimates can be used to design financing mechanisms that correct market prices that would otherwise ignore ecological costs.

In addition to helping to correct failures of markets, sustainable financing mechanisms also have the potential to improve government performance. If properly designed and implemented, user charges and other mechanisms can mitigate shortsightedness, link benefits with costs, and reduce government inefficiencies in the provision of policies and programs. Ensuring that beneficiaries of government management efforts pay in proportion to the benefits they derive from the use of ecosystem resources and services – through the use of taxes, user charges and fees, for example – encourages cost-effective provision of government program products (see Anderson and Sutinen 2003 for a detailed discussion of this issue).

Finance Mechanisms: An Overview

There are literally hundreds of mechanisms for sustainable financing of LME programs.[7] However, there are four basic types of methods for financing government programs: taxes, user charges and borrowing (bonds and loans), and grants. Broad-based general taxes comprise the main source of government revenue. Designating general tax revenues for LME programs raises at least two

---

[5] Available online at http://siteresources.worldbank.org/INTEEI/214574-1110798478534/20781069/EnvironmentalDegradationManual.pdf. Another excellent reference is NRC (2004).

[6] Other references related specifically to economic valuation of *marine* resources are included on the IW:LEARN Web page for the Workshop on the Sustainability of Large Marine Ecosystems, a companion resource to this Handbook (http://www.iwlearn.net/abt_iwlearn/pns/learning/b2-2lme/riworkshop).

[7] The *Guidebook of Financial Tools* produced by the U.S. Environmental Protection Agency (EPA 1999) covers some 340 mechanisms that can be used to pay for sustainable environmental programs. (http://www.epa.gov/efinpage/guidebook/guidebooktp.htm)

significant concerns. First, general tax revenues are the primary source of funding for defense, transportation, education, and social services programs. Earmarking general taxation funds for LME programs places the financial security of those programs in competition with the other programs upon which the governments commonly place higher priority. In addition, earmarking these funds constrains policy makers' ability to redirect these funds where they may be most needed at certain points in time.

The second concern with using general tax revenue is that there is no relationship between the amount of taxes paid by individual taxpayers and the amount of goods and services they have used or benefits received. Broad-based taxes (such as income, property, sales taxation) are appropriate means of financing public goods. Public goods, such as national security or elementary and secondary education, are financed with broad-based taxation because the benefits are widespread and excluding nonpayers from access to its benefits would be nearly impossible.

Since many government-provided goods and services are not pure public goods, and perhaps because of a widespread sentiment to reduce the taxpayers' burden, there is movement away from broad-based taxation towards user charges (also known as fees and selective taxes). A salient advantage of user charges is that this form of generating revenue is capable of balancing what people pay with the benefits they receive. From an economic perspective, user charges allocate scarce resources and distribute costs. When the correlation between benefit and charge is strong, user charges become prices, which helps to mitigate the harm that markets do to ecosystems.

User charges are fees individuals pay to government that are based on the benefits received or the amount used of the good or service provided by the government. At least four types of user charges can be distinguished:

- User fees
- Regulatory fees
- Beneficiary-based taxes
- Liability-based taxes

User fees include royalties on the use of natural resources, bridge and highway tolls, lease and rental payments, and charges for recurring sales of resources (e.g., timber, minerals, water). Regulatory fees include charges for inspecting and testing services, patent and copyright fees, permit and license fees associated with regulatory programs, judicial services, passport and customs services. Other examples include fees that households and businesses pay for the costs of providing water and waste water services, electricity, etc. Some specific examples include fees for access and connection to public utilities (e.g., sewage lines), construction of environmental facilities (e.g., underground storage tanks), operating franchises/businesses on public property, monitoring and inspection services, recreational uses (e.g., moorings), permitting services, product registration, solid waste disposal, and water withdrawal.

Examples of special charges include effluent and emission charges, impact fees, severance tax (a charge for the extraction of a natural resource on public lands, such as timber, water, fish, coal, oil and gas, minerals), and for hazardous waste disposal.

Table 5. Financing Mechanisms (Spergel and Moye 2004)

1. Tourism revenues
- a) Protected area entry fees
- b) Recreation fees, e.g., diving, angling, & yacht/mooring fees
- c) Airport passenger & cruise ship fees, taxes & fines
- d) Hotel taxes
- e) Tourism-related operations of conservation agencies
- f) Voluntary contributions by tourism industry groups

2. Energy & Mining revenues
- a) Oil spill fines & funds
- b) Taxes, royalties & fees from offshore mining & oil & gas
- c) Right-of-way fees for pipelines & telecommunications infrastructure
- d) Hydroelectric power revenues
- e) Voluntary contributions by energy companies

3. Fishing industry revenues
- a) Tradable quotas
- b) Catch & service levies
- c) Eco-labeling & product certification
- d) Fishing access payments
- e) Recreational fishing license fees & excise taxes
- f) Fines for illegal fishing

4. Real estate & development rights
- a) Purchases & donations of land &/or underwater property
- b) Conservation easements
- c) Real estate tax surcharges for conservation
- d) Tradable Development rights & wetland banking
- e) Conservation concessions

5. For-profit investments
- a) Private sector investments promoting conservation
- b) Biodiversity prospecting

6. Grants and donations
- a) Donors
- b) Foundations
- c) Nongovernmental organizations
- d) Private sector
- e) Conservation trust funds

7. Government revenue allocations
- a) Direct allocations from government budgets
- b) Earmarked government bonds & taxes
- c) Lottery revenues
- d) Wildlife stamps & tags
- e) Economic instruments to stimulate environmental investment
- f) Debt relief

Beneficiary-based taxes (sometimes referred to as earmarked taxes) are correlated with, but not tied to, the use of a government-provided good or service. For example, taxes on gasoline in the U.S. are dedicated to a highway trust fund for financing highway construction and other transportation projects. Liability-based taxes are charges for the purpose of abating hazards (e.g., oil spills) or compensating for environmental and other damages imposed on third parties (CBO, 1993). Other examples include selective taxes on sales of energy, petroleum products, agricultural chemicals (fertilizer, pesticides), motor fuels, vehicles, rental cars, marine fuels, watercraft, hotels, real estate transfers, hard-to-dispose items.

Examples of Sustainable Financing for Marine Governance Initiatives

An excellent discussion of some of the more common financing mechanisms can be found in Spergel and Moye (2004).[8] Table 5 lists many of the funding methods that they present. We present here a few examples how these mechanisms are and could be used for the implementation of an LME SAP.

Tourism

As Spergel and Moye observe, marine-based tourism activities – cruises, scuba diving, sailing, whale-watching, and beach-side resorts – generate billions of dollars of revenue each year. The national economies of some countries, such as those in the Caribbean and the Maldives, depend heavily on marine tourism; and this tourism activity depends heavily on the health of reefs and marine life, and on the quality of the water and beaches of marine ecosystems. In most cases, the industry is freely benefiting from the use of those marine ecosystem goods and services, but this situation is beginning to change as shown by the following examples.

***User Fees: Scuba Diving in Mabini, Batangas, Philippines*:** [9] The Center for Conservation Finance and WWF-Philippines helped to establish a dive fee system in Mabini, Batangas, the Philippines, a popular site for scuba diving. The fee revenue collected is directly allocated to coastal resource management activities. Management focuses on combating the pollution and unregulated exploitation that threaten the municipal waters. There are three types of fees: a Diver's Daily Pass (P50), an Annual Diver's Pass (P1,000), and an Annual Dive Professional Pass (P700). Divers may either pay for the pass on their hotel bill, or when they register at the municipal tourism office. Divers with no pass are subject to fines and confiscation of gear, redeemable only after paying the fine. Boatmen who ferry divers without passes also may be fined. A Coastal Resource Management Board ensures that fees collected are applied to funding conservation, protection, and management of Mabini municipal waters. The Board comprises representatives from the local government, NGOs, and recreational diving associations, thus engaging the various stakeholders of the region. Activities supported through the Board include implementation of marine sanctuary policies, waste management programs, and enforcement patrol.

***Trust Fund: Mesoamerican Reef*:** [10] Conservation trust funds in Belize, Guatemala, Honduras, and Mexico are being used to protect the Mesoamerican Reef. The World Bank, the Global Environment Facility, the WWF, the IUCN, worked with the governments of Mexico, Belize, Guatemala, and Honduras to establish conservation priorities at both a regional and national level. One outcome has been that the four countries bordering the Mesoamerican Reef now realize that the tourism and fisheries –two major sectors of their national economies – depend directly on the health of the reef's ecosystem. As one of the first conservation trust funds to be implemented on an ecoregional, trans-national scale, it provides a model for similar transboundary and ecoregional projects elsewhere.

---

[8] Several other good sources of sustainable financing methods are listed and described at the end of this part of the Handbook.

[9] Source: http://worldwildlife.org/conservationfinance/projects/scuba.cfm

[10] Source: http://worldwildlife.org/conservationfinance/projects/mesoamerican.cfm

Energy and Mining

The marine mining and energy sectors also produce significant revenues each year. Offshore and coastal production of oil and gas is found in many of the world's LMEs, including the Gulf of Guinea, Benguela Current, South China Sea, Timor Sea, Gulf of Mexico, Caribbean, and the North Sea. According to Snyder (2005), oil industry experts predict that offshore oil and gas production will grow from providing around 34 percent of global oil production and 28 percent of global gas production in 2004, to 39 percent and 34 percent, respectively, by 2015. The oil industry currently is spending in excess of US$100 billion/year to explore, develop and operate offshore oil and gas fields. The industry pays royalties on their offshore production, and in most areas producers are subject to regulations to control their impacts on the marine ecosystem. The following examples describe a few cases of how finance mechanisms are being applied in this sector.

Gamba Complex Biodiversity Project, Gabon: In 2000, the Shell Foundation, in partnership with the Smithsonian Institution, WWF, and the Wildlife Conservation Society, funded efforts to monitor and mitigate impacts on biodiversity of petroleum exploration and production in the Gamba Complex (Spergel and Moye 2004).

Oil Spill Revolving Fund in the Straits of Malacca: A group of Japanese marine insurance companies established a revolving fund for emergency response and cleanup of oil spills in the Straits of Malacca. The fund pays for emergency actions to control and remove spilled oil; and companies responsible for the spills reimburse the fund for the expenses incurred (Spergel and Moye, 2004).

Emergency Response Fund in the Galápagos: The fund, established by the Government of Belgium and managed by a local committee, covers the cost of responding to oil spills and other environmental emergencies (Spergel and Moye, 2004).

Polluter Liability for Damages Oil Spills: Liability is a clear application of the Polluter Pays Principle and holds responsible parties financially accountable for the damages they cause. Generally, liability for damages provides an incentive to reduce pollution, compensate losers and also provides the means to restore injured ecosystems. Several states in the United States, including Alaska, Florida, and Washington State, make claims against oil polluters using general damage or penalty-based compensation formulae for oil spills (e.g., Plante, et al., 1993; Grigalunas and Johnston, 1999; Grigalunas, et al., 1999; Brans, 2001). Generally, the size of damages using these approaches depends upon the amount spilled, the quantity recovered, the characteristics of the oil, and the sensitivity of the environment contaminated by the spilled oil. Hence, the formula tries to approximate a damage function.

At the federal level in the U.S., a simplified damage assessment procedure has been developed and put into regulations to assess polluters ("responsible parties") for damages. Economic damages are assessed based on lost use value from reduced recreational and commercial catch, losses to public beach users when oil comes ashore and reduces beach uses, and viewing value losses to bird watchers. These losses are assessed over time until the injured resources are estimated to recover to their without-spill level. Discounting is used to convert all annual future dollar flows of losses into a lump-sum equivalent loss today. Responsible parties are required to restore natural resources harmed by the spill. They must also pay for response and cleanup, assessment costs, lost profits, and costs incurred by governments in assisting the public in the assessment process.

Fishery Management

General taxation pays for most fishery management programs, but this approach began to change in the 1980s and 1990s when a few countries introduced major changes in the way fishery management services are financed and provided (Anderson and Sutinen, 2003). Australia, Canada and New Zealand implemented user charges to recover the costs and devolved or arranged for alternative suppliers to bid on providing some fishery management services.

Australia: Beginning in the mid-1980s, Australia applied the principles of cost-recovery to a wide range of administrative and program delivery areas. The cost-recovery policy is based on the "user pays" principle, in which users of Commonwealth services pay for services in proportion to the benefits they receive. As required by statute, the fishing industry pays 100 percent of recoverable costs of running the Australian Fisheries Management Authority (AFMA), including the costs of Management Advisory Committees and Consultative Committees, licensing, AFMA's day-to-day fisheries management activities, the cost of maintenance of management plans, logbooks and surveillance.

Canada: In the mid-1990s, Canada began collecting user fees from holders of licenses in the Atlantic and Pacific commercial fisheries. Canada also applies the "user pays" principle where those who benefit from a public resource pay an amount that reflects the value of fishing. The fees recover a portion of the costs of monitoring, at-sea observers, basic fisheries science, enforcement and other fisheries management services. The user charges are paid to the service provider – either the government or private contractors.

New Zealand: In 1995, New Zealand changed from collecting fishery resource rentals to cost-recovery. The government first recovered the costs of fishery management on the basis of the "avoidable cost" principle, which involves recovering the government's costs that otherwise would have been avoided if the fisheries were not used for commercial purposes. After discovering first hand that the avoidable cost approach led to numerous problems, New Zealand changed, in 1999, the basis for recovering costs from an avoidable cost approach to an efficiency-based approach. Under the efficiency-based approach, those who benefit from a service pay for the cost of such service.

Namibia: The government of Namibia levies a tax on commercial landings, and the revenue collected is placed into a Fisheries Management and Research Fund, which is used to support stock assessments and enforcement of no-take marine protected areas (Spergel and Moye, 2004).

United States: The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act authorizes collecting user fees on fisheries that are managed under individual fishing quotas and community development quotas. Currently, some costs of management are being recovered from the Alaska halibut and sablefish fishery.

Real Estate Tax Surcharges

The value of coastal property generally tends to be high, especially along coastlines that are favored for residential, tourist, and industrial uses. In recognition of this and the fact that property owners benefit from a healthy marine ecosystem, governments have applied surcharges to real estate taxes as a way of generating funds for marine conservation and management.

San Juan County Land Bank Tax: All buyers of real estate in San Juan County in the state of Washington (U.S.) pay an additional 1 percent real estate transfer tax. The County uses the revenue collected with the tax to purchase conservation easements and land, such as beaches and shoreline, to protect it from being developed and to preserve wildlife habitat (Spergel and Moye, 2004).

Earmarked Bonds and Taxes

Green Fund Levy: In Trinidad and Tobago, where tourism and fisheries are key components of the economy, a Green Fund Levy provides funds for the governmental Environmental Management Agency, NGOs and communities to carry out environmental projects. The levy imposes a tax on gross sales of businesses, which generates about US$10 million per year, specifically to mitigate environmental impacts of pollution and inappropriate development (Spergel and Moye, 2004).

Seaweed farming has become an attractive investment opportunity in many countries

For-profit Investments

***Asian Conservation Company*:**[11] The Asian Conservation Company (ACC), which links private sector investment and biodiversity conservation, was developed through an NGO-private sector partnership. This innovative private sector model involves a private equity holding company to leverage long-term financial support for biodiversity conservation from portfolio companies. The ACC is assembling a portfolio of private investments for the purpose of conserving biodiversity and being profitable. ACC invests in companies that operate in high priority biodiversity areas and work to reduce adverse environmental impacts. Incorporated in January 2001 with an initial capitalization of $12.5 million, the ACC has invested in a environmentally-responsible nature tourism operation and a sustainably managed blue crab production facility. By proving that private investment in ecologically sound companies is both beneficial to the environment and profitable in the marketplace, ACC is an example of novel conservation finance that can be replicated in other priority conservation areas of the world. ACC's Web site (http://www.asianconserve.com/) provides further information about the company's activities and investments.

Potential Applications

Environmental Charges for Marine Mining: Environmental charges also might be important for sustainable financing for marine environmental protection and restoration from injury to ecosystems because of marine mining. Ocean mining for hard minerals – sand, gems, and metals – occurs throughout much of the world. For example, a significant (about 28 percent) and growing share of the sand used in construction in Korea comes from ocean mining (Ministry of Construction and

[11] Source: http://worldwildlife.org/conservationfinance/projects/acc.cfm.

Transportation, 2002). Placer minerals (garnet and ilmenite) in the Gulf of Mannar, India (Sambandam, 2003), and Namibia's coastal waters are mined for diamonds.

Mining, often using hydraulic dredges, is by its nature environmentally obtrusive. Borrow pits created by marine mining can take many months to recover, during which time the pre-mining bottom productivity is lost. Further, sediment plumes can cause mortality for sensitive eggs and larvae. A tax or fee on extraction might be levied to reflect damage to fisheries. (Indeed, such a fee is levied on *onshore* sand mining in Korea to restore the environment). The proceeds then could be used to restore or maintain fishery resources harmed by marine mining and/or to compensate for studies of the effects of mining on the environment or policies which might be implemented to reduce losses.

A tax per unit mined would internalize costs for mining operators which, in turn, may influence operator behavior by creating incentives for mining in less vulnerable areas, limiting mining temporally to avoid sensitive period (similar to the use of environmental windows), or adoption of new practices. A successful system might also collect sufficient funds to help maintain or restore injured fishery stocks and support needed research.

A main issue is quantifying the economic losses to commercial fisheries from mining. To fill this gap, Grigalunas et al, (2004) used a bioeconomic model to provide preliminary estimates of short-term, long-term and indirect (ecosystem) damages to vulnerable benthic and demersal commercial fisheries from marine sand mining in the Ongjin area. This area is off the west coast of Korea, near Incheon. Damages are assessed over time until the harmed species recover to their pre-mining equilibrium. Depending upon the maximum life, for some species the time to recovery can be many years. In the case of crab, which has a short life span, recovery occurs over a brief period, once the bottom habitat is restored to its pre-mining productivity. Other assumptions are given in Grigalunas, et al. (2004). Damages were estimated to amount to US$18,618 (preliminary) for one year of hypothetical mining on a single site. If a charge was to be imposed on mining operators, the methods outlined above might be used to set the charge on miners. Ongoing research will refine (and likely increase) these estimates by including excess mortality to larvae from sediment plume and employing a more realistic, longer period for bottom habitat recovery.

Cost Sharing for Navigational Safety Aids in Malacca Straits: This example concerns how one might allocate among user states the cost of navigational aids to improve vessel safety in the Malacca Straits.[12] By way of background, the Malacca Straits are the second-busiest international straits in the world and are intensively used for transporting oil, bulk commodities, and containerized goods. Dangerous operating conditions exist in much of the Straits because of narrow waters at some points, sedimentation of channels, shipwrecks, and heavy traffic through and across the straits.

The littoral states of Malaysia, Indonesia, and Singapore have funded most of the navigational aids, but efforts have been made over the years to have the users of the Straits (Japan, China, Korea, Taiwan China, the U.S., etc.) contribute to the cost of providing navigational measures (e.g. Hamza, 1997). However, international law prevents littoral states from restricting passage or charging a user fee, except during time of war. Hence, funding from international sources for navigational aids would have to be voluntary or come through international bodies.

[12] For a brief description of the WB-GEF Malacca Straits Marine Electronic Highway (MEH) Project; see http://gefonline.org/projectDetails.cfm?projID=1270.

Grigalunas (2000) estimated how the costs of navigation aids would be allocated under alternative "rules of the game" for ships using the Malacca Straits. These rules of the game are meant to reflect (albeit imprecisely) the beneficiaries. All of the alternatives would rely on asking (moral suasion) user countries to pay a "fair share" based on their use, i.e., the "beneficiary pays" principle is employed.

Five rules-of-the-game were considered:

1. *Share of costs based on transits.* Using this rule, cost share would be concentrated on Panama (20.8 percent), Singapore (10.3 percent), Liberia (9.0 percent) and Malaysia (8.0 percent). Thus, the top five users pay 52.7 percent of costs.
2. *Share of costs based on shipowner nationality*. Under this rule, the top five users would pay 57.5 percent of costs. The top five under this rule consist of: Japan (16.9 percent) , Singapore (18.5 percent), Greece (8.5 percent), Malaysia (7.1 percent), and China (6.5 percent).
3. *Share of cost based on tanker transits.* For this rule, costs would be distributed: Japan (63.7 percent), Korea (18.5 percent), Singapore (11.1 percent), China (3.1 percent), and Australia (2.4 percent).
4. *Share based on gas transits.* Japan (74.2 percent), Korea (19.6 percent), China (4.8 percent), Spain (0.8 percent), and Australia (0.4 percent).
5. *Share of costs based on combination of tanker and gas transits*. One can argue that tankers and gas tankers pose the greatest threat to the environment. Tankers use the Malacca Straits more than twice as frequently as gas tankers. A cost sharing mechanism based on tankers and gas transits would be paid largely by Japan (63.7 percent), followed by Korea (18.5 percent) and then Singapore (11.1 percent).

The examples described here are but a small sample of the growing list of sustainable financing arrangements currently in use. These cases demonstrate that sustainable financing is feasible and that there is almost no limit to ways in which marine conservation and management projects can be funded sustainably.

Criteria for Selecting Among Financing Options

Financing provides the means to carry out governance activities, and also has the potential to tame markets and improve governments' delivery of policies and programs. We have also seen that there are numerous examples of sustainable financing mechanisms that are operational in the field. Taming markets, improving government performance, and practicability are important considerations when designing sustainable financing plans for LME projects. In addition, there are other criteria that are relevant for weighing the potential success of financing approaches. For instance, excessive transaction costs to study, implement, and enforce compliance with a resource governance program will cause the program to fail. Hence, designing financing methods requires anticipation of transaction costs and tailoring methods to the seriousness of the issues faced.

In sum, criteria that can be important in assessing financing options include:

- Efficient resource use
- Cost effectiveness

- Transaction costs
- Political feasibility
- Fairness

Financing will be easier to justify if the benefits (broadly construed) of proposed governance activities clearly exceed their costs ('economic efficiency'). The public would be ill served – and few programs are sustainable – if costs systematically outweigh benefits. Nor would the public interest be served by blatantly excessive costs imposed on operators, driving them out of business. Similarly, failure to use a cost-effectiveness standard, for example, for restoration of coastal wetlands or to treat water pollution, would mean costs that are higher than necessary. This reduces what could be accomplished with a given budget. Perceptions of wasteful use of resources will also erode public support for governance.

High transactions costs undermine the potential for success, and thus curtail or eliminate potential gains from governance. For example, simplified approaches for assessing damages from oil spills or other marine pollution provides a quick and inexpensive way to assess damages for small incidents. Generally, making programs too costly or too inconvenient is a formula for failure.

Fees and charges provide environmentally friendly incentives and can be used to raise funds for governance programs. At the same time, imposing fees and penalties is rarely popular, those individuals/users subject to regulations may not comply, and proposed actions for financing which lack broad public support will not be implemented or successful. Hence, political feasibility also is a major concern when weighing financing options.

Fairness encourages support for financing and compliance with programs. As explained in Part III of this Handbook, compliance is encouraged when affected parties feel they have a say in new programs, and the costs of programs are distributed in a way considered to be equitable by those most affected by the policy.

The above criteria are not independent. An onerous user fee system, or a program which is too complicated, likely will not be politically feasible to implement or maintain. Similarly, a system of transferable quotas for fisheries management or for nutrient pollution control could capture considerable economic rents for public LME uses through the auctioning of quotas or permits. However, a transferable quota or permit system might not be politically feasible, unless at least some of the permits are given to those currently in the industry ('grandfathering'), with the balance of permits auctioned and awarded to the highest bidders. We make note of these criteria below, when discussing financing options.

The Way Forward for Sustainable Financing of LMEs

There is an urgent need to plan for the sustainable financing of LME projects. The current practice of financing projects – with GEF funds and appropriations of general tax revenues by coastal governments – cannot be relied upon to support the growing demand of applying the ecosystem approach to managing transboundary resources in LMEs. Implementing sustainable financing arrangements faces several challenges, not the least of which is to secure agreement among coastal states on how to finance the costly monitoring, assessment, enforcement, and administration of the transboundary LME management programs. Development of long-term financial plans needs to

begin as soon as possible. Fortunately, there is a growing body of experience with sustainable financing arrangements to draw from for this planning exercise. Unfortunately, there are few reports of experiences on financing arrangement for transboundary resource management programs.

To set the stage for this planning, there is a need to document the amounts and types of expenditures on LME-related management programs. In conjunction with expenditures data, there also is a need to document (1) the amount of public revenues (taxes, fees, etc.) currently provided by the economic activities in LMEs – the beneficiaries of management programs; (2) how these revenues are collected, and how they are used; and (3) the extent to which the fiscal policies of taxes and subsidies are supporting the sustainable development of marine ecosystem resources.

With this evidence in hand, the LME community can begin to examine and consider – perhaps in the context of an international forum – the most appropriate sustainable financing methods and approaches for transboundary resource management programs (current and prospective) that are the peculiar feature of LMEs. Clearly, there is much work to be done if we are to secure the potential that the sustainable development of LMEs offers to future generations.

Readings and Sources of Information on Sustainable Financing

The following set of documents and websites provide excellent information on financial planning, the details of financing mechanisms, and examples and case studies of sustainable financing arrangements.

Conservation Finance Alliance (CFA). 2006. *Conservation Finance Guide*. An online version of the Guide can be found at guide.conservationfinance.org/.

The Guide presents a host of potential financing opportunities for nature conservation in general, with a special focus on protected area management. Chapters are written to help users (i) understand; (ii) select; (iii) assess; and (iv) implement the most appropriate finance mechanisms for their particular situation. The Guide is designed to allow non-experts to get started and make tangible progress on conservation finance initiatives, as well as provide resources and ideas for those with more experience. Potential audience members include: government officials; protected area managers; conservation NGOs; technical consultants; and donor agencies.

Emerton, L., Bishop, J. and Thomas, L. (2006). *Sustainable Financing of Protected Areas: A global review of challenges and options*. IUCN, Gland, Switzerland and Cambridge, UK. x + 97pp. Available at www.biodiversityeconomics.org/applications/library_documents/lib_document.rm?document_id=781.

IUCN's World Commission on Protected Areas (WCPA) prepared Guidelines on Financing Protected Areas in 2000. At that time there was an expectation that by the time of IUCN's World Parks Congress, or shortly thereafter, a new edition might be available. This document is a greatly expanded and quite different study that reflects the increasing sophistication with which financial and funding issues for protected areas are now considered. The changing global and financial environments faced by protected area agencies and managers include the unpalatable reality that competition for government funds has led to greater funding shortfalls for protected area management. This Guideline sets out the background to financing protected areas and identifies a series of approaches towards PA financial sustainability. The Guideline includes many examples

and case studies that give protected area managers some familiar stories of funding challenges as well as some excellent indications of the way forward.

Environmental Protection Agency (EPA). 1999. *A Guidebook of Financial Tools: Paying for Sustainable Environmental Systems*. Environmental Finance Program. Available at www.epa.gov/efinpage/guidebook/guidebooktp.htm.

The Guidebook provides an overview of approximately 340 financial tools that are useful in paying for sustainable environmental systems. The financing tools include traditional means of raising revenue, borrowing capital, enhancing credit, creating public-private partnerships, and ways of providing technical assistance; and financing tools that are, will, or might soon be, available to address significant environmental priorities, including ways of lowering the costs of compliance, encouraging pollution prevention, paying for community-based environmental protection, financing brownfields redevelopment, and improving access to capital for small businesses and the environmental goods and services industry. Each tool is described along with its actual and potential uses, advantages and limitations, and references for further information.

Le Quesne, T. and R. McNally. 2005. *The Green Buck: using economic tools to deliver conservation goals, a WWF Field Guide*. WWF-UK. 66 pp. Available at www.biodiversityeconomics.org.

This field guide aims to introduce economic approaches to conservation to non-specialists. using case studies from the WWF network, it illustrates how economic mechanisms have been &/or are being used to (1) finance conservation, (2) create markets that support conservation, and (3) influence government policies and plans. Ways in which economics can be used to influence policies and plans include (a) cost-benefit analysis, (b) environmental assessment, (c) valuation for advocacy, and (d) reforming taxation, charges & subsidies. The guide contains a few marine-related programs, e.g., scuba divers fund in the Philippines, communal area conservancies in Namibia, turtle egg protection in the Philippines, tourism development in Fiji, marine resource valuation in Samoa, coral reef degradation globally, and ecological criteria for sharing tax revenues in Brazil.

Spergel, B. and M. Moye. 2004. *Financing Marine Conservation: A Menu of Options*. Center for Conservation Finance, WWF. Available at www.worldwildlife.org/conservationfinance.

This guide describes over 30 mechanisms for financing marine conservation, both through raising revenues and providing economic incentives. Included with the descriptions are real examples of how these mechanisms have been implemented around the world. It is intended as a practical guide to familiarize conservation professionals with a menu of options to creatively and sustainably finance marine and coastal conservation.

WCPA. 2000. *Financing Protected Areas: Guidelines for Protected Area Managers*. Financing Protected Areas Task Force of the World Commission on Protected Areas of IUCN, in collaboration with the Economics Unit of IUCN, Gland, Switzerland and Cambridge, UK. viii + 58 pp. Available at www.iucn.org/themes/economics/.

This document reviews and assesses the status of various protected area (PA) finance mechanisms, the major obstacles and opportunities for their implementation, and the potential for improvement. Part I of the report presents the background and a conceptual framework for discussing PA financing. Part II defines and describes different mechanisms for financing PAs, and

reviews their strengths and weaknesses in light of real-world experiences. Part III identifies key conclusions and makes several recommendations for improving the sustainability, efficiency and effectiveness of PA financing.

Internet sources of information on sustainable financing:

- conservationfinance.org/
- ecosystemmarketplace.com/
- worldwildlife.org/conservationfinance/pubs.cfm
- www.biodiversityeconomics.org/index.html
- www.ifc.org/ifcext/enviro.nsf/Content/SFMF-What
- www.iucn.org/themes/economics/

PART V

FUTURE DIRECTIONS

LMEs are being analyzed in the context of five modules: productivity, fish resources and fisheries, pollution and ecosystem health, socioeconomics, and governance. The first three modules, which have received extensive attention, provide a description and assessment of the operation of natural systems that yield many needed and desired goods and services. The socioeconomic and governance modules, which are the subject of this Handbook, are now receiving increasing consideration. They encompass the human dimension of LMEs, examining the societal consequences of observed changes in the natural environment and contemplating the mechanisms and measures that can serve to protect the sustainability of natural systems on which we all depend. As LME management efforts have matured, the socioeconomic and governance modules have come to be recognized as central to the ecosystem-based approach to marine resource and environmental management.

Addressing the governance and socioeconomic requirements for effective management of large marine ecosystems is not an easy task. However, it is absolutely essential to sustaining marine ecosystem benefits to humanity. Insights and information derived from analyses of these modules are at the core of success in encouraging behavioral modifications at both the individual and collective scale that are required to achieve natural system sustainability. This Handbook has considered the potential roles of the three key governance mechanisms: the marketplace, government, and civil society, which together can contribute to better environmental outcomes and close the gap between what is currently being done and what needs to be done. The challenging path ahead is to instigate processes of societal change that are informed by scientific expertise, inspire public involvement and support, are sensitive to the unique societal context of each LME and are flexible and adaptive to emerging circumstances in their execution. Context is critical too. The goal of environmental sustainability remains constant, but the means of achieving that goal will vary from place to place.

There are many obstacles to achieving the necessary changes in existing governance systems. Moving toward ecosystem-based management requires substantial will, inspired leadership, sustained effort, technical capacity, and cooperation among people and states sharing large marine ecosystems. It also requires sustained financial support. This Handbook has sought to explain why ecosystem-based management must succeed, why the analysis of governance issues is of central importance, and to suggest how governance efforts may be designed to contribute to desired outcomes. The precise nature of governance systems and the actions taken must always be created and shaped by those who benefit from, and those with responsibility for maintaining or restoring, the qualities of each LME.

REFERENCES

Acheson, J. M. (ed.) 1994. *Anthropology and institutional economics*. Lanham, Maryland: University Press of America.

Akers, R. L. 1985. *Deviant Behavior: A Social Learning Approach*, Third Edition. Wadsworth, Belmont, Calif.

Alchian, A.A. 1977. *Economic forces at work*. Liberty Press, Indianapolis, Indiana.

Alexander, L. (1993). "Large Marine Ecosystems: A new focus for marine resources management." Marine Policy 17: 186-198.

Andersen, P, and J. G. Sutinen. 2003. Financing Fishery Management: Principles and Economic Implications, in W. Shrank, R. Arnason, R. Hannesson (eds.), *The Cost of Fisheries Management*: pp 45-63. Hants, England: Ashgate Publishing.

Andersen, P., J. Sutinen and K. Cochran. 1998. Paying for Fishery Management: Economic Implications of Alternative Methods for Financing Management. Pp. 439-454, In *Proceeding of the IXth Conference of the International Institute of Fishery Economics and Trade*. Tromso, Norway.

Anderson, L.G. and Lee, D.R. 1986. "Optimal Governing Instruments, Operation Level, and Enforcement in Natural Resource Regulation: The Case of the Fishery". *Amer. J. Agricultural Econ*. 68(3):678-690.

Arnason, R. 2000. Economic Instruments to Achieve Ecosystem Objectives in Fisheries Management, *ICES Journal of Marine Science* 57(3): 742-51.

Aronfreed, J. 1968. *Conduct and Conscience*. Academic Press, New York.

Ayres, R.U. and A.V. Kneese. 1969. Production, consumption and externalities. *American Economic Review*, Vol. 59: 282-297.

Baden, J. And R. Stroup. 1981. Saving the wilderness: a radical proposal. *Reason* 13:29-36.

Bavinck, M. et al. *Interactive Fisheries Governance: A Guide to Better Practice*. (Amsterdam: Centre for Maritime Research, 2005)

Bean, C. 1990. An Economic Analysis of Compliance and Enforcement in the Quahaug Fishery of Narragansett Bay. Unpublished Masters Thesis, University of Rhode Island.

Becker, Gary. 1968. 'Crime and Punishment: An Economic Approach,' *J. Political Economy* 76(2): 169-217.

Benguela Current Large Marine Ecosystem Programme: Transboundary Diagnostic Analysis 2002. Windhoek, Namibia.

Braden, John and Charles Kolstat. 1991. *Measuring the Demand for Outdoor Recreation*. New York: North Holland publishing Co.

Bradley, Paul. 1974. 'Marine Oil Spills: A Problem in Environmental Management'. *Natural Resource Journal* 14(July): 337-359.

Brainerd, T., P. Clay, D. Hakserver, M. Hall-Arber, C. Kellogg, A. Kitts, and D. McCarron. 1996. Report to the ASMFC committee on economics and social sciences; Commercial sector reference document on identification and prioritization of economic and sociocultural data elements. ASMFC, Washington DC, 41 pages.

Brans, Edward H.P. 1994. 'Liability for Ecological Damage Under the 1992 Protocols to the Civil Liability Convention and the Fund convention, and the oil pollution Act of 1990, Part II', TMA '94-3, pp. 85-91.

Brans, Edward H.P. 1995. 'The *Braer* and the Admissibility of Claims for pollution Damage Under the 1992 protocols to the civil Liability Convention and the Fund Convention. *Environmental Liability* (3)4: 61-69.

Brans, Edward H.P.. 1994. 'Liability for Ecological Damage Under the 1992 Protocols to the Civil Liability Convention and the Fund convention, and the oil pollution Act of 1990, Part I', TMA '94-3, pp. 61-84.

Brown, L. 2001. *Eco-Economy: Building an Economy for the Earth*. Earth Policy Institute (http://www.earth-policy.org/Books/Eco/index.htm).

Buchanan, J. and G. Tullock. 1962. *The Calculus of Consent*. Ann Arbor: University of Michigan Press, 1972.

Buchanan, J.M. 1980. Rent-seeking under external diseconomies. In *Toward a Theory of the Rent-Seeking Society*, J.M. Buchanan, R.D. Tollinson, and G. Tullock (eds.). College Station: Texas A&M Press.

Caddy, J.F. and G.D. Sharp. 1986. An ecological framework for marine fishery investigations. *FAO Fish. Tech. Pap.*, (283):152 p.

Calow, P. and V. Forbes, *Initial Risk Assessment* Manila, The Philippines: UNDP IMO Regional Programme for the Prevention and Management of Marine Pollution in East Asian Seas.

Caton, A and McLoughlin, K (eds.). 2000. Fishery Status Reports 1999: Resource Assessments of Australian Commonwealth Fisheries. Bureau of Rural Sciences, Canberra, Australia.

Cheung, S.N.S. 1970. The structure of a contract and the theory of a non-exclusive resource. *Journal of Law and Economics* 13: 49-70.

Christensen, N., A. M. Bartuska, et al. (1996). "The Report of the Ecological Society of America Committee on the Scientific Basis for Ecosystem Management." *Ecological Applications* 6: 665-691

Christensen, Norman et al. 1996. 'The Report of the Ecological Society of America Committee on the Scientific Basis for Ecosystem Management,' *Ecological Applications*, 6: 665-691.

Clark, John R. 1996. *Coastal Zone Management Handbook*. Boca Raton: Lewis Publishers.

Coase, R. 1960. The problem of social cost. *Journal of Law and Economics* 3:1-44.

Coastal Zone Management Act, Public Law 92-583.

Commission on Marine Science Engineering and Resources (Stratton Commission) (1969). *Our Nation and the Sea: A Plan for National Action*. Washington, D.C., Government Printing Office.

Committee on the Scientific Basis for Ecosystem Management. 1996. *Ecological Applications* 6: 665-691.

Cordell, John. 1984. Defending Customary Inshore Sea Rights. *Senri Ethnological Studies* 17: 301-326.

Costanza, R. and 12 others. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387:253-260.

Costanza, R. And C. Folke. 1996. The structure and function of ecological systems in relation to property rights regimes. Pages 13-34 in S. Hanna, C. Folke and K-G. Maler (eds.), *Rights to nature: ecological, economic, cultural, and political principles of institutions for the environment.* Island Press, Washington, D.C..

Costanza, Robert, et al., (eds.). 1992. *Ecosystem Health: New Goals for Environmental Management* (Washington, D.C.: Island Press.

Couper, Alistair. 1983. *The Times Atlas of the Oceans*. New York: Van Nostrand Reinhold Company.

Crawford, Jeffrey S. 1984. *An Economic Input-Output Analysis of the Marine-Oriented Industries of New London County, Connecticut*. Masters Thesis. Storrs: Univ. Of Connecticut.

Creed, Carolyn F. & Bonnie J. McCay. 1996. 'Property Rights, Conservation and Institutional Authority: Policy Implications of the Magnuson Act reauthorization for the Mid-Atlantic Region.' *Tulane Environmental Law Journal* 9(2): 245-256.

Crichton, M. 1988. *Travels*. Ballantine, New York.

Cumberland, J.H. 1966. A regional inter-industry model for analysis of development objectives. *Regional Science Association Papers*, Vol. 17: 65-95.

Daily, G. C., T. Soderqvist, et al. (2000). "The Value of Nature and the Nature of Value." *Science* 289: 395-396.

Daly, H.E. 1968. On economics as a life science. *Journal of Political Economy*, Vol.76: 392-406.

Demsetz, H. 1964. The exchange and enforcement of property rights. *Journal of Law and Economics* 7:11-26.

Demsetz, H. 1967. Toward a theory of property rights. *American Economic Review* 57:347-359.

Department of Fisheries and Oceans (DFO). 2000. DFO Science Stock Status Reports 2000. Canadian Stock Assessment Secretariat. Ottawa, Ontario.

Department of Fisheries and Oceans (DFO). 2001. *Marine Protected Areas*, Oceans Canada. Ottawa, Ontario

Dietz, T., E.Ostrom, and C. Stern. 2003. The struggle to govern the commons. *Science*: 12:1907-1911.

Dinneford, E.; K. Iverson; B. Muse and K. Schelle. 1999a. Changes under Alaska's Halibut IFQ program, 1995 to 1998. Alaska Department of Fish and Game; Juneau, Alaska.

Dinneford, E.; K. Iverson; B. Muse and K. Schelle. 1999b. Changes under Alaska's Sablefish IFQ program, 1995 to 1998. Alaska Department of Fish and Game; Juneau, Alaska.

Doeringer, Peter, Philip Moss, and David Terkla. 1986. *The New England Fishing Economy: jobs, income and kinship.* Amherst: University of Massachusetts Press.

Downs, Anthony. 1967. *Inside Bureaucracy.* Boston: Little, Brown and Company.

Duda, A.M. and K. Sherman. 2002. A new imperative for improving management of large marine ecosystems. *Ocean & Coastal Management* 45:797-833.

Dyer, C., and J. Poggie. 1998. 'Application of the Natural Resource Region as a Unifying Human Ecosystem Theory,' unpublished draft. University of Rhode Island.

Dyer, Christopher L. and David Griffith. 1996. *An Appraisal of the Social and Cultural Aspects of the Multispecies Groundfish Fishery in New England and the Mid-Atlantic Regions.* Aguirre International/ NOAA. Bethesda, MD.

Dyer, Christopher L. and James R. McGoodwin. 1994. *Folk Management in the World's Fisheries: Lessons for Modern Fisheries Management*. Boulder: University Press of Colorado.

Dyer, Christopher L., and John J. Poggie, Jr. 1998. 'Integrating Socio-cultural Variables into Large Marine Ecosystems: The Natural Resource Region Model.' NOAA Workshop on Large Marine Ecosystems. University of Rhode Island. Kingston.

Dyer, Christopher L., Duane A. Gill and J. Steven Picou. 1992. 'Social Disruption and the Valdez Oil Spill: Alaskan Natives in a Natural Resource Community.' *Sociological Spectrum* 12(2): 105-126.

Edwards, Stephen F. and Glenn A. Anderson. 1984. Land use Conflicts in the Coastal Zone: An Approach for the Analysis of the Opportunity Costs of Protection of Coastal Zone Resources': *J. of the Northeast Agric. Econ. Council* (13): 1: 73-82.

Eggertsson, T. 1990. *Economic behavior and institutions*. Cambridge University Press, New York.

European Union, 'Overview of the Programme [Integrated Coastal Zone Management Demonstration Programme],' (http://europa.eu.int/en/comm/dg11/iczm/overview.html)

FAO. 1999. *The State of World Fisheries and Aquaculture 1998*. United nations, Rome.

FAO. 2004. *The State of World Fisheries and Aquaculture 2004*. UN Food & Agriculture Organization, Rome.

FAO. In Prep. Guidelines for the Routine Collection of Capture Fishery Data. Fisheries Technical Paper. Rome: Food and Agriculture Organization of the United Nations.

Felt L., B. Neis, and B. McKay, "Comanagement," in J. Boreman, et al., (eds.), *Northwest Atlantic Groundfish: Perspectives on a Fishery Collapse* **(**Bethesda, MD: American Fisheries Society, 1997) pp. 185-194

Franklin, J. F. (1997). *Ecosystem Management: An Overview*. New Haven, Yale University Press.

Freeman, A. Myrick III. 1993. *The Measurement of Environmental and Resource Values: Theory and Methods. Washington, D.C.*: Resources for the Future.

Furlong, W.J. 1991. "The Deterrent Effect of Regulatory Enforcement in the Fishery", *Land Economics*, 67(1):116-129.

Gauvin, J. 1988. An Econometric Estimation of Compliance Behaviour in the Massachusetts Inshore Lobster Fishery. Unpublished Masters Thesis, University of Rhode Island.

Gezelius, S. 2002. Do Norms Count? State Regulation and Compliance in a Norwegian Fishing Community, *Acta Sociologica* 45:305-314.

Global Environment Facility (1998). *Valuing the Global Environment: Actions and Investments for a 21st Century*. Washington, D.C., Global Environment Facility

Gordon, H.S. 1954. The economic theory of a common-property resource: the fishery. *Journal of Political Economy* 62:124-142.

Goulder, Lawrence H. and Donald Kennedy. 1997. 'Valuing Ecosystem Services: Philosophical Bases and Empirical Methods.' pp. 23-47. *In* Daily, Gretchen (ed.), *Nature's Services: Societal Dependence on Natural Ecosystems.* Washington, D.C.: Island Press.

Grafton, R. Q. (2005). "Social Capital and Fisheries Governance." *Ocean & Coastal Management* 48: 753-766.

Grigalunas, T., J. J. Opaluch, J. Diamantides. 1998. 'Estimating the Economic Cost of Oil Spills: Issues, Challenges and Examples', *Coastal Management* (June).

Grigalunas, T., J. Opaluch, D. French, and M. Reed. 1988. Measuring damages to marine natural resources from pollution incidents under CERCLA: application of an integrated, ocean systems/ economics model', *Marine Resource Econ.*, 5:

Grigalunas, Thomas A. 1998. Practical uses of Environmental Economics in Large Scale Marine Ecosystems. Paper presented to the meeting on the Benguela Current LME, Cape Town, South Africa (July).

Grigalunas, Thomas A. and Craig A. Ascari. 1982. 'Estimation of Income and Employment Multipliers for Marine-Related Activity in the Southern New England Marine Region', *J. of the Northeast Agric. Econ. Council* (XI) 1:25-34 (Spring).

Grigalunas, Thomas A. and James J. Opaluch. 1988. 'Liability for Oil Spills: A New Approach for Providing Incentives for Pollution Control' *Natural Resources Journal* Vol. 28 (Summer).

Grigalunas, Thomas A. and James J. Opaluch. 1989. 'Managing Contaminated Marine Sediments: Economic Considerations', *Mar. Policy*.

Grigalunas, Thomas A. and James J. Opaluch. 1990.'Social Costs', in Scott Farrow (ed.), *Managing Our Outer Continental Shelf Resources: Oceans of Controversy*. New York: Taylor and Francis Publ. Co.

Grigalunas, Thomas A. and James J. Opaluch. 1998a. *Natural Resource Damage Assessment and the Straits of Malacca*. Manila: UNDP/IMO/GEF Regional Programme for Marine Pollution and Management in East Asian Seas.

Grigalunas, Thomas A. and James J. Opaluch. 1998b. *Sustainable Financing for Ship-Based Pollution Prevention and Management in the Malacca Straits*. Manila: UNDP/IMO/GEF Regional Programme for Marine Pollution and Management in East Asian Seas.

Grigalunas, Thomas A.. 1997. *Benefit-Cost Framework for Marine Pollution Prevention and Management in the Malacca Straits*. Manila: UNDP/IMO/GEF Regional Programme for Marine Pollution and Management in East Asian Seas.

Grumbine, R. E. (1993). "What is Ecosystem Management?" *Conservation Biology* 8(1): 27-38.

Haas, P. 1992. Epistemic communities and international policy coordination. *International Organization* 46: 1.

Hall-Arber, M. and A.C. Finlayson, "Role of Local Institutions in Groundfish Policy," in J. Boreman, et al., (eds.), *Northwest Atlantic Groundfish: Perspectives on a Fishery Collapse* **(**Bethesda, MD: American Fisheries Society, 1997) pp. 111-138

Hanna, S. 1995. 'Efficiencies of user Participation in Natural Resource Management'. in *Property Rights and the Environment - Social and Ecological Issues*. Beijer International Institute of Ecological Economics and The World Bank. Washington, DC.

Hanna, S. S. (1998). "Institutions for marine ecosystems: economic incentives and fishery management." *Ecological Applications* 8 (Supplement): S170-174

Hanna, S., C. Folke and K-G. Maler. 1966. *Rights to nature: ecological, economic, cultural, and political principles of institutions for the environment*. Island Press, Washington, D.C.

Hanna, S.S. 1998. Institutions for marine ecosystems: economic incentives and fishery management. *Ecological Applications* 8(Supplement):S170-S174.

Hatcher, A. and D. Gordon. 2005. Further Investigations in the Factors Affecting Compliance with UK Fishing Quotas, *Land Economics* 81(1): 71-86.

Hatcher, A. and Robinson, K. (eds.). 1999. The Definition and Allocation of use rights in European Fisheries. Center for the Economics and Management of Aquatic Resources (CEMARE). University of Portsmouth, UK.

Hatcher, A., S. Jaffry, O. Thébaud, and e. Bennett. 2000. Normative and Social Influences Affecting Compliance with Fishery Regulations, *Land Economics* 76 (August): 448-61.

Hauck, M. and M. Kroese. 2006. Fisheries Compliance in South Africa: A Decade of Challenges and Reform 1994-2004, *Marine Policy* 30: 74-83.

Hauck, M. and N. Sweijd. 1999. A Case Study of Abalone Poaching in South Africa and its Impact on Fisheries Management, *ICES J. Marine Science* 56: 1024-32.

Healey, M. and T. Hennessey. 1994. The utilization of scientific information in the management of estuarine ecosystems. *Ocean and Coastal Management* 23:167-191.

Hempel, G. and K. Sherman, eds. 2003. *Large Marine Ecosystems of the World: Trends in Exploitation, Protection, and Research*. Elsevier. the Netherlands.

Hennessey, T. 1994. Governance and adaptive management for estuarine ecosystems: The case of Chesapeake Bay. *Coastal Management* 22:119-145.

Hennessey, T. and D. Soden. 1999. Ecosystem management: The governance dimension. In Soden, D. and B. Steele, eds. *Handbook of Global Environmental Policy and Administration.* New York, Marcel Decker.

Hennessey, T. and J. Sutinen, Eds. 2005. *Sustaining Large Marine Ecosystems: The Human Dimension*. Large Marine Ecosystems Series. Amsterdam, Elsevier.

Hennessey, T. M. 1997. Ecosystem Management. In: Soden, D., B. Lam and J. Tennert (eds.), *Ecosystems management: a social science perspective*. Dubuque, Iowa: Kendal/Hunt.

Hennessey, Timothy. 1994, 'Governance and Adaptive Management for Estuarine Ecosystems: The Case of Chesapeake Bay,' 22 *Coastal Management* 119-145.

Hiatt, Terry and Terry, Joe. 2000. Stock assessment and fishery evaluation report for the Groundfish fisheries of the Gulf of Alaska and the Bering Sea/Aleutian Island area: Economic Status of the Groundfish fisheries off Alaska, 1999. National Marine Fisheries Service (NMFS). Seattle, WA

Hønneland, G. 1998. Compliance in the Fishery Protection Zone around Svalbard. *Ocean Development and International Law* 29, 330-360.

Hønneland, G. 1999. *Compliance in the Barents Sea Fisheries.* Oslo: Institute of Political Science, University of Oslo.

Horwood, J.W., J.H. Nichols, and S. Milligan. 1998. Evaluations of closed areas for fish stock conservation. *Journal of Applied Ecology*. 35:893-903

Hunt, Robert, ed. 1997. Property Rights. *Monographs in Economic Anthropology*, Vol. 14. University Press of America. Lanham, MD.

IDA. 1999. *Fisheries Law Enforcement: Assessment of Deterrence*. IDA Document D-2381. Institute for Defense Analysis, Alexandria, VA.

Imperial, Mark T. and Timothy Hennessey. 1993. 'The Evolution of Adaptive Management for Estuarine Ecosystems: the National Estuary Program and its Precursors,' 20 *Ocean and Coastal Management* 147-180'

Imperial, Mark T. and Timothy Hennessey. 1996. 'An Ecosystem-Based Approach to Managing Estuaries: An Assessment of the National Estuary Program,' 24 *Coastal Management* 115-139.

Independent World Commission on the Oceans. 1998. *The Ocean Our Future*. Cambridge, Cambridge University Press.

International Union for the Conservation of Nature and Natural Resources (IUCN). 1994. *Guide lines for Protected Area Management Categories*. IUCN, Gland, Switzerland, and Cambridge, U.K.

Interorganizational Committee on Guidelines and Principles. 1993. Guidelines and Principles for Social Impact Assessment. IAIA, Box 70, Belhaven, NC 27810 (40 pages).

Isard, W. 1972. *Ecologic-Economic Analysis for Regional Development*. The Free Press, New York.

Jentoff, S. and B. McCay. 1995. user participation in fisheries management. *Marine Policy*. 19(3). pp. 227-246.

Johnson, R. & Libecap, G. 1994. *The Federal Service System and the Problem of Bureaucracy: The Economics and Politics of Institutional Change,* Chicago: University of Chicago Press.

Juda, L. 1993. 'Ocean Policy, Multi-use Management, and the Cumulative Impact of Piecemeal Change: The Case of the United States Outer Continental Shelf,' 24 Ocean Development and International Law 355-376.

Juda, L. 1999. Considerations in Developing a Functional Approach to the Governance of Large Marine Ecosystems. *Ocean Development and International Law* 30: 89-125.

Juda, L. 2003. Changing National Approaches to Ocean Governance: The United States, Canada, and Australia. *Ocean Development and International Law* 34: 161-187.

Juda, L. and T. Hennessey. 2001. Governance profiles and the management and use of large marine ecosystems. *Ocean Development and International Law* 32:43-69.

King, Dennis M. and David A. Story. 1974. *Use of An Economic-Environmental Input-Output Analysis for Coastal Planning With Illustration for the Cape Cod Region*. Amherst: University of Massachusetts, Center for Water Resources Research.

Kirkley, J.E. and I.E. Strand. 1988. The technology and management of multi-species fisheries. *Applied Economics* 20:1279-1292.

Kitts, Andrew W., and Scott R. Steinback. No date. Data Needs for Economic Analysis of Fishery Management Regulations. Unpublished manuscript, Northeast Fisheries Science Center, Woods Hole, MA.

Kohlberg, L. 1969. 'Stage and Sequence: the Cognitive-Development Approach to Socialization,' in D. A. Goslin (ed.) *Handbook of Socialization Theory and Research*. Rand McNally, New York.

Kohlberg, L. 1981. *Essays on Moral Development. Vol. 1.The Philosophy of Moral Development: Moral Stages and the Idea of Justice*. San Francisco: Harper and Row.

Kohlberg, L. 1984. *Essays on Moral Development: Vol. II*. Harper and Row, San Francisco.

Kopp, Raymond and V. Kerry Smith. 1993. *Valuing Natural Assets: The Economics of Natural Resource Damage Assessment*. Washington, D.C.: Resources for the Future, 358 pp.

Kuhn, T. S. (1970). *The Structure of Scientific Revolutions*. Chicago, University of Chicago Press.

Kuperan Viswanathan, K. 1992. *Deterrence and voluntary compliance with the zoning regulation in the Malaysian Fishery.* Ph.D dissertation, University of Rhode Island, Kingston. 294p.

Kuperan, K. and J. G. Sutinen. 1995. Compliance with Zoning Regulations in Malaysian Fisheries. In D. Liao (ed.), *International Cooperation for Fisheries and Aquaculture Development: Proceedings of the 7th Conference of the International Institute of Fisheries Economics and Trade*, Vol. 1, Keelung, Taiwan: National Taiwan Ocean University.

Kuperan, K., and J. G. Sutinen. 1998. 'Blue Water Crime: Legitimacy, Deterrence and Compliance in Fisheries,' *Law and Society Review* 32(2):309-338.

Kuperan, K., N. Abdullah, I. Susilowati, I. Siason, and C. Ticao. 1997. *Enforcement and Compliance with Fisheries Regulations in Malaysia, Indonesia and the Philippines.* Universiti Pertanian Malaysia. Diponegoro University, University of the Philippines in the Visayas.

Laffoley, L., E. Maltby, et al. (2004). The Ecosystem Approach: Coherent Actions for Marine and Coastal Environments, English Nature. Millennium Ecosystem Assessment (2005). Ecosystems and Human Well–being: Biodiversity Synthesis.

Larkin, P.A. 1996. Concepts and issues in marine ecosystem management. *Reviews in Fish Biology and Fisheries* 6:139-164.

Larsen, J. 2004. Dead Zones Increasing in World's Coastal Waters, *Eco-Economy Updates*, Earth Policy Institute (http://www.earth-policy.org/Updates/Update41.htm).

Laurens, et al.. 1997 Indicators for Environmental Issues in the European Coastal Zone, *Intercoast Network*, Fall 1997, pp. 3-4, 31.

Lee, David (ed.). 1999. *United Kingdom Sea Fisheries Statistics 1998*. Ministry of Agriculture, Fisheries and Food (MAFF). The Stationery Office, London.

Lee, K. 1993. *Compass and Gyroscope*. Washington, D.C. Island Press.

Levy, M., R. Keohane and P. Haas. 1993. Improving the effectiveness of international environmental institutions. In Haas, P. ed. *Institutions for the Earth*. Cambridge, MIT Press.

Lewis M. Alexander. 1993. Large Marine Ecosystems: A New Focus for Marine Resources Management, 17 *Marine Policy* 186-198.

Libecap, G.D. 1989. *Contracting for property rights*. Cambridge University Press, New York.

Mahanty, S. and N. Stacey. 2004. *Collaborating for Sustainability: A Resource Kit for Facilitators of Participatory Natural Resource Management in the Pacific*. South Pacific Regional Environment Programme. Available at http://www.sprep.org.ws/iwp/documents/IWP_Complete_version_001.pdf.

Marine Protection, Research, and Sanctuaries Act, Public Law 92-532.

MARPOL, International Convention for the Prevention of Pollution from Ships. 1973, as modified by the Protocol of 1978 (MARPOL73/78)

McCay, Bonnie & James Acheson (eds.). 1987. *The Question of the Commons*. Tucson: University of Arizona Press.

McClanahan, T.R., and B. Kaunda-Arara. 1996. Fishery recovery in a coral-reef marine park and its effect on the adjacent fishery. *Conservation Biology* 10(4): 1187-1199

McGlade, J.M. 1989. Integrated fisheries management models: understanding the limits to marine resource exploitation. *American Fisheries Society Symposium* 6:139-165.

McGlade, Jacqueline. 1995 . 'Intelligent Knowledge Based Systems for the Analysis of Coastal Zones: Design Logic of SIMCOAST,' in ASEAN-EU Workshop Report, Interdisciplinary Scientific Methodologies for the Sustainable use and Management of Coastal Resource Systems (University of Warwick).

McGoodwin, James R. 1990. *Crisis in the World's Fisheries: People, Problems, and Policies*. Stanford: Stanford University Press.

Mee and Bloxham, 2005

Milazzo, M. 1998. *Subsidies in World Fisheries: A Reexamination*. World Bank Technical Paper No. 406: Washington, DC.

Miles, E. *et al.* 2002. *Environmental Regime Effectiveness: Confronting Theory and Evidence.* Cambridge, MIT Press.

Milliman, Scot. R. 1986. 'Optimal Fishery Management in the Presence of Illegal Activity'. *J. Environ. Econ. and Manage*. 13(4):363-381.

Musgrave, Richard. 1969. Cost-Benefit Analysis and the Theory of Public Finance, *Journal of Economic Literature (7)3*.

National Academy of Sciences. 1997. *Striking a Balance: Improving Stewardship of Marine Areas*. Washington, D.C.: National Academy Press.

National Oceanic and Atmospheric Administrations (NOAA). 1999. *Our Living Oceans: Report on the Status of U.S. Living Marine Resources, 1999*. NOAA Technical Memorandum NMFS-F/SPO-41. National Oceanic and Atmospheric Administrations, Silver Spring, MD.

National Research Council (NRC). 2004. *Valuing Ecosystem Services: Toward Better Environmental Decision-Making*. National Academy Press. Washington, D.C.

National Research Council (NRC). 1999. *The Community Development Quota Program in Alaska*. National Academy Press. Washington, D.C.

National Research Council (NRC). 2001. *Marine Protected Areas: Tools for Sustaining Ocean Ecosystems*. National Academy Press. Washington, D.C.

NEPA, National Environmental Policy Act, Public Law 91-190.

Nielsen, J.R. and T. Vedsmand. 1995. Fisheries co-management: An alternative strategy in fisheries - cases from Denmark. Issue paper for the OECD study on the efficient management of living marine resources.

Nielsen, J.R. and C. Mathiesen. 2003. Important Factors Influencing Rule Compliance in Fisheries: Lessons from Denmark, *Marine Policy* 27(5): 409-16.

Niskanen, W. 1971. *Bureaucracy and Representative Government*. Chicago, IL: Aldine Press.

North Pacific Fishery Management Council (NPFMC). 2001. *Joint Report of the Pollock Conservation Cooperative and High Seas Catchers Cooperative, 2000*. Anchorage, Alaska.

North, D.C. 1992. *Transaction costs, institutions, and economic performance*. ICS Press, San Francisco, California.

OECD. 1994. *Fisheries Enforcement Issues*, Paris: Organization for Economic Co-operation and Development.

Olsen, S. B. 2003. Frameworks and indicators for assessing progress in integrated coastal management initiatives. *Ocean and Coastal Management* 46: 347-361.

Olsen, S. B. and D. Nickerson. 2003. *The Governance of Coastal Ecosystems at the Regional Scale*. Narragansett, R.I., Coastal Resources Center, University of Rhode Island: 32pp.

Olson, M. 1964. *The logic of Collective Action*. Harvard University Press, Cambridge MA.

Organization for Economic Co-operation and Development (OECD). 1997. *Towards Sustainable Fisheries: Economic Aspects of the Management of Living Marine Resources*. Paris, France.

Organization for Economic Co-operation and Development (OECD). 2000. *Review of Fisheries in OECD Countries. Volume I: Policies and Summary Statistics*. Paris, France.

Organization for Economic Co-operation and Development (OECD). 2000. *Review of Fisheries in OECD Countries. Volume II: Country Statistics*. Organization for Economic Co-operation and Development (OECD), Paris, France.

Ostrom, Elinor. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. New York: Cambridge University Press.

Osuga, Hideo. 1997. 'International Conventions on Liability and Compensation for Oil Pollution Damages', in Ross, Tejales, and Rosales (eds.) *Sustainable Financing Mechanisms: Public Sector-Private Sector Partnerships*.

Pauly, D. V. Christensen, J. Dalsgaard, R. Froese and F. Torres, Jr. 1998. Fishing down marine food webs. Science 279: 860-863.

Pew Oceans Commission (2003). *America's Living Oceans: Charting a Course for Sea Change*,

Pollnac, Richard B. 1984. Investigating Territorial Use Rights Among Fishermen. Senri Ethnological Studies 17: 285-300.

Pollnac, Richard B. 1992. Multi-use Conflicts in Aquaculture – Sociocultural Aspects. World Aquaculture 23 (2): 16-19.

Ross, S. A., C. Tejales, and R.M Rosales (eds.). 1997. *Sustainable Financing Mechanisms: Public Sector-Private Sector Partnerships*. Proceedings of the Regional Conference on Sustainable Financing Mechanisms for the Prevention of Marine Pollution. Manila, The Philippines: UNDP IMO Regional Programme for the Prevention and Management of Marine Pollution in East Asian Seas.

Rowley, C.K., R.D. Tollison, and G. Tullock (eds.). 1988. The political economy of rent-seeking. Kluwer Academic Publishers, Boston.

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

Russell, C. S. 1990. Game Models for Structuring Monitoring and Enforcement Systems, *Natural Resource Modeling* 4(2): 143-73.

Russell, C. S. 2003. *The Economics of Environmental Monitoring and Enforcement*, Ashgate Publishing Ltd.

Russell, Susan. 1994. Institutionalizing Opportunism: Cheating on Baby Purse Seiners in Batangas Bay, Philippines. in *Anthropology and Institutional Economics*. Edited by James M. Acheson. pp. 87-108.

Sherman, K. and H.R. Skjoldal, eds. 2002. Large Marine Ecosystems of the North Atlantic: Changing States and Sustainability. Elsevier. the Netherlands.

Sherman, K. and L. M. Alexander, Eds. (1986). *Variability and Management of Large Marine Ecosystems*. Boulder, Westview Press.

Sherman, K., L.M. Alexander, B.D. Gold, eds. 1993. Large Marine Ecosystems: Stress, Mitigation, and Sustainability. AAAS Press,Washington, DC.

Sherman, K., M. Grosslein, D. Mountain, D. Busch, J. O'Reilly and R. Theroux. 1996. The northeast shelf ecosystem: An initial perspective. in *The Northeast Shelf Ecosystem, Assessment, Sustainability and Management.* edited by K. Sherman, N.A. Jaworski and T.J. Smayda. pp. 103-126.

Sherman, Kenneth, et al. (eds.). 1986. Variability and Management of Large Marine Ecosystems. Boulder: Westview.

Sherman, Kenneth, et al. (eds.). 1989. Biomass Yields and Geography of Large Marine Ecosystems. Boulder: Westview Press.

Sherman, Kenneth, et al. (eds.). 1990. Large Marine Ecosystems: Patterns, Processes, and Yields. Washington, D.C.: American Association for the Advancement of Science.

Sherman, Kenneth, et al. (eds.). 1992. Food Chains, Yields, Models, and the Management of Large Marine Ecosystems. Boulder: Westview Press.

Sherman, Kenneth, et al. (eds.). 1993. Large Marine Ecosystems: Stress, Mitigation and Sustainability Washington, D.C.: American Association for the Advancement of Science.

Sherman, Kenneth, et al. (eds.). 1998. Large Marine Ecosystems of the Indian Ocean: Assessment, Sustainability, and Management. Malden, MA: Blackwell Science.

Sherman, Kenneth, N.A. Jaworski and T.J. Smayda (eds.). 1996. The Northeast Shelf Ecosystem: Assessment, Sustainability, and Management. Cambridge, MA: Blackwell Science.

Sherman, Kenneth. 1994. 'Sustainability, Biomass Yields, and Health of Coastal Ecosystems: an Ecological Perspective,' 112 Marine Ecology Progress Series 277-301.

Sherman, Kenneth. 1997. 'Large Marine Ecosystems: Assessment and Management from Drainage Basin to Ocean,' Paper to the Joint Stockholm Water Symposium/EMECS Conference.

Shrank, W., R. Arnason, and R. Hannesson (eds.). 2003. *The Cost of Fisheries Management*: pp 45-63. Hants, England: Ashgate Publishing.

Sigurjonsson, Johann (eds.). 2000. State of Marine Stocks in Icelandic Waters 1999/2000. Prospects for the Quota year 2000/20001. Marine research Institute Report No. 75, Reykjavik, Iceland.

Sissenwine, M. & Mace, P. 2001. Governance for Responsible Fisheries: An Ecosystem Approach. In M. Sinclair and G. Valdimarsson (ed.), *Responsible Fisheries in the Marine Ecosystem*. Rome: The Food and Agriculture Organization of the United Nations.

Slocombe, D. Scott. 1993. 'Implementing Ecosystem-based Management,' 43 BioScience 612-622 (1993).

Snyder, Robert E. 2005. What's New in Production, *World Oil Magazine* 226 (1) (January) (http://www.worldoil.com/magazine/MAGAZINE_DETAIL.asp?ART_ID=2479&MONTH_YEAR=Jan-2005 accessed May 2, 2006).

Solow, R.M. 1991. 'Sustainability: an economist's perspective.' Paper presented as the Eighteenth J. Seward Johnson Lecture to the Marine Policy Center, Woods Hole Oceanographic Institution, Woods Hole, MA., June 14, 1991.

Stratton Commission. 1969. (Commission on Marine Science, Engineering and Resources), Our Nation and the Sea: A Plan for National Action. Washington, D.C.: Government Printing Office.

Sutinen, J. G. 1987. 'Enforcement of the MFMCA: An Economist's Perspective,' *Marine Fisheries Review*, 49(3):36-43.

Sutinen, J. G. 1993. "Morality and Fairness, and Their Role in Fishery Regulation," in *Proceedings of the IV Annual Conference of The European Association of Fisheries Economists*, M. Spagnolo (ed.), Salerno, Italy; pp 7-15.

Sutinen, J. G. 1995. 'Summary and Conclusion of the Workshop on Enforcement Measures,' *Fisheries Enforcement Issues*. OECD.

Sutinen, J. G. 1996. *Fisheries Compliance and Management: Assessing Performance*. Australian Fisheries Management Authority, Canberra, ACT (August).

Sutinen, J. G. and J. R. Gauvin. 1988. A Study of Law Enforcement and Compliance in the Commercial Inshore Lobster Fishery of Massachusetts. Volumes I and II. An unpublished Report to the Environmental Enforcement Division, State of Massachusetts.

Sutinen, J. G. and K. Kuperan. 1994. A Socioeconomic Theory of Regulatory Compliance in Fisheries. Paper presented to the 7th Conference of the International Institute of Fisheries Economics and Trade, 18-21 July, 1994, Taipei, Taiwan.

Sutinen, J. G. and K. Kuperan. 1999. 'A Socioeconomic Theory of Regulatory Compliance in Fisheries,' *International Journal of Social Economics* 26(1/2/3):174-193.

Sutinen, J. G. and P. Andersen. 1985. 'The Economics of Fisheries Law Enforcement.' *Land Economics*, 6l(4):387-397.

Sutinen, J. G. and T. M. Hennessey (eds.), 1987. *Fisheries Law Enforcement: Programs, Problems and Evaluation*, Marine Technical Report 93, University of Rhode Island, Kingston, RI.

Sutinen, J. G. and T. M. Hennessey. 1986. 'Enforcement: The Neglected Element in Fisheries Management.' E. Miles, R. Pealy and R. Stokes (eds.), *Natural Resource Policy and Management: Essays in Honor of James A. Crutchfield*. Seattle: University of Washington Press.

Sutinen, J. G., A. Rieser, and J. R. Gauvin. 1990. 'Measuring and Explaining Noncompliance in Federally Managed Fisheries,' *Ocean Development and International Law*, 21:335-372.

Sutinen, J. G., and J. R. Gauvin. 1989. "An Econometric Study of Regulatory Enforcement and Compliance in the Commercial Inshore Lobster Fishery of Massachusetts," in P. A. Neher, R. Arnason, and N. Mollet (eds.), *Rights-Based Fishing*. Kluwer Academic Publishers, Dordrecht, Boston, London.

Sutinen, J. G., et al. 2000. *A Framework for Monitoring and Assessing Socioeconomics and Governance of Large Marine Ecosystems*. NOAA Technical Memorandum NMFS-NE-158. Northeast Fisheries Science Center, Woods Hole, MA.

Sutinen, J.G. 1993 'Recreational and Commercial Fisheries Allocation with Costly Enforcement.' *Amer. J. Agricultural Econ*. 75(5): 1183-1187.

Sutinen, J.G., and M. Soboil. 2003. 'The Performance of Fisheries Management Systems and the Ecosystem Challenge.' In M. Sinclair and G. Valdimarsson (ed.), *Responsible Fisheries in the Marine Ecosystem*. Rome: The Food and Agriculture Organization of the United Nations.

Sutinen, Jon G. and Harold F. Upton. 2000. 'Economic Perspectives on New England Fisheries Management,' Northeast Naturalist 7(4): 361-72.

Sutinen, J. G., J. Yahaya, and V. Hirunruk. 1992. "Fisheries Law Enforcement Programs, Practices and Problems in Malaysia, Philippines, and Thailand," in James B. Marsh (ed.), *Resources and Environment in Asia's Marine Sectors*, Taylor and Francis Publishers.

Tyler, T. 1990. *Why People Obey the Law*. New Haven & London: Yale University Press, 273p.

U.S. Commission on Ocean Policy. 2004. *An Ocean Blueprint for the 21st Century*.

Underdal, A. 1980. 'Integrated Marine Policy: What? Why? How?,' 4 *Marine Policy* 159-169.

Underdal, A. 2002. One question, two answers. In Miles et al., eds. *Environmental Regime Effectiveness: Confronting Theory and Evidence*. Cambridge, MIT Press.

UNEP. 2002. *Global Environmental Outlook 3: Past, present, and future perspectives*. United Nations Environmental Programme, Nairobi, Kenya. http://www.unep.org/GEO/geo3/english/pdf.htm

United States Congress. 1990. *Oil Pollution Act of 1990*. Pub.Law 101-380, 104 Stat. 484, Aug. 18.

Vallega, A. 1991. The human geography of semi-enclosed seas: the Mediterranean case — a first approach. in *The Development of Integrated Sea-use Management*. Edited by H.D. Smith and A. Vallega. Routledge, New York, pp.238-259.

Vallega, Adalberto. 1992. *Sea Management: A Theoretical Approach* (London: Elsevier Applied Science)

van den Bergh, J.C.J.M. 1996. *Ecological Economics and Sustainable Development, Theory, Methods, and Applications.* Edward Elgar, Brookfield, U.S..

Victor, P.A. 1972. *Pollution Economy and the Environment*. George Allen and Unwin Ltd. London.

Vogt, W. 1948. *Road to Survival.* New York: William Sloan.

Von Moltke, Konrad. 1997. 'Institutional Interactions: The Structure of Regimes for Trade and Environment,' in Oran Young, *Global Governance*. Cambridge: MIT Press, pp. 247-272.

Wallis, Paul, and Ola Flaaten. 2000. Fisheries Management Costs: Concepts and Studies. Paris: Organization for Economic Cooperation and Development.

Walters, C. 1986. *Adaptive Management and Renewable Resources*. New York: Macmillan.

Wilson, D. C., et al., (eds.), *The Fisheries Co-management Experience: Accomplishments, Challenges and Prospects*. Dordrecht, Kluwer Academic Publishers, 2003)

Wolf, C. Jr. 1988. *Markets or Governments: Choosing between Imperfect Alternatives*. The MIT Press, Cambridge, MA.

World Commission on Environment and Development (1987). *Our Common Future*. Oxford, Oxford University Press.

Young, O. 1989. *International Cooperation: Building Regimes for Natural Resource and the Environment.* Cornell University Press.

Young, O. 1999. *Governance in World Affairs*. Cornell University Press.

Young, O. and G. Osherenko, eds. 1993. *Polar Politics: Creating International Environmental Regimes*. Ithaca, Cornell University Press.

Young, O. ed. 1999. *The Effectiveness of International Environmental Regimes.* Cambridge: MIT Press.

COASTAL RESOURCES CENTER
University of Rhode Island

Narragansett Bay Campus, Narragansett, Rhode Island 02882, USA
Tel: (401) 874-6224 FAX: (401) 874-6920 WWW: http://www.crc.uri.edu/