

A RESOURCE MANAGEMENT STRATEGY FOR
THE BELIZE BARRIER REEF SYSTEM

by

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Thesis submitted to the faculty of the
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of
MASTER OF SCIENCE

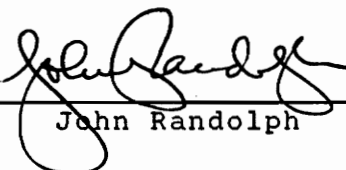
in

Geography

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April 1992

Blacksburg, Virginia

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(ABSTRACT)

The need for a broader geographical and functional perspective in managing natural resources of the Belize barrier reef system was examined. The small country of Belize in Central America is struggling to increase its economic development and growth. It has an excellent natural resource base, the most dramatic component being the extensive barrier reef system just offshore.

The research identified key economic and environmental issues relative to Belize's reef complex, and analyzed resource management policies and actions taken to date. Development and conservation needs suggest a multiple use strategy aimed at economic and environmental sustainability. Due to areal extent and ecological complexity, the present reactive, small-scale and piecemeal approach is not adequate to realize sustainable utilization of the area's resources. This research shows the need for a broad spatial and

interdisciplinary "coastal zone" perspective, leading to a comprehensive and integrated strategy upon which to base resource planning and management.

A strategy for the reef system must be accomplished within the broader context of a national resource management strategy, integrating concerns of economic development and environmental protection. As a component of this national policy, the proposed strategy for the barrier reef system is based on principles of multiple use of resources, coastal zone scope, and sustainability. The research supports a reef system-wide protected area, using a biosphere reserve framework and a customized model planning process to implement the strategy.

ACKNOWLEDGMENTS

I wish to express my appreciation to Dr. James B. Campbell, my advisor and committee chair, for his superb support and assistance throughout this research. Thanks also go to Dr. Bonham C. Richardson and Dr. John Randolph, committee members, for their insights and assistance.

In Washington D.C., officials of the World Resources Institute, World Wildlife Fund, Programme for Belize, The Nature Conservancy, and U.S. Agency for International Development were very helpful and informative. In Belize, special thanks are extended to the staffs of the Belize Center for Environmental Studies and the Hol Chan Marine Reserve for their research support and expert, cheerful assistance. I also greatly appreciate the time and information provided to me through interviews and discussions with those individuals who are described more completely in the Appendix.

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CHAPTER 1
INTRODUCTION

Need for a Resource Management Strategy

Belize, a small and newly independent nation in Central America, has struggled to find its place in the international community. While economic growth and development is important to Belize, so is maintaining the natural resource base upon which the country depends. The nation's premier resource is its barrier reef and associated environs, the most extensive and pristine reef system in the Western Hemisphere.

The barrier reef itself (Figure 1) is a nearly continuous coral formation extending the length of the country. The larger reef system includes an extensive number of cayes, inner lagoons, the coastal edge, and three outer atolls. This diverse and well-developed reef ecosystem represents the last extensive and flourishing reef environment in the Caribbean (Perkins and Carr 1985). The reef protects the continental shelf and coastline, supporting a complex interaction of marine and terrestrial environments along most of the coast. Features such as shelf atolls, patch reefs, sea grass meadows and mangrove swamps support a broad array of flora and fauna.

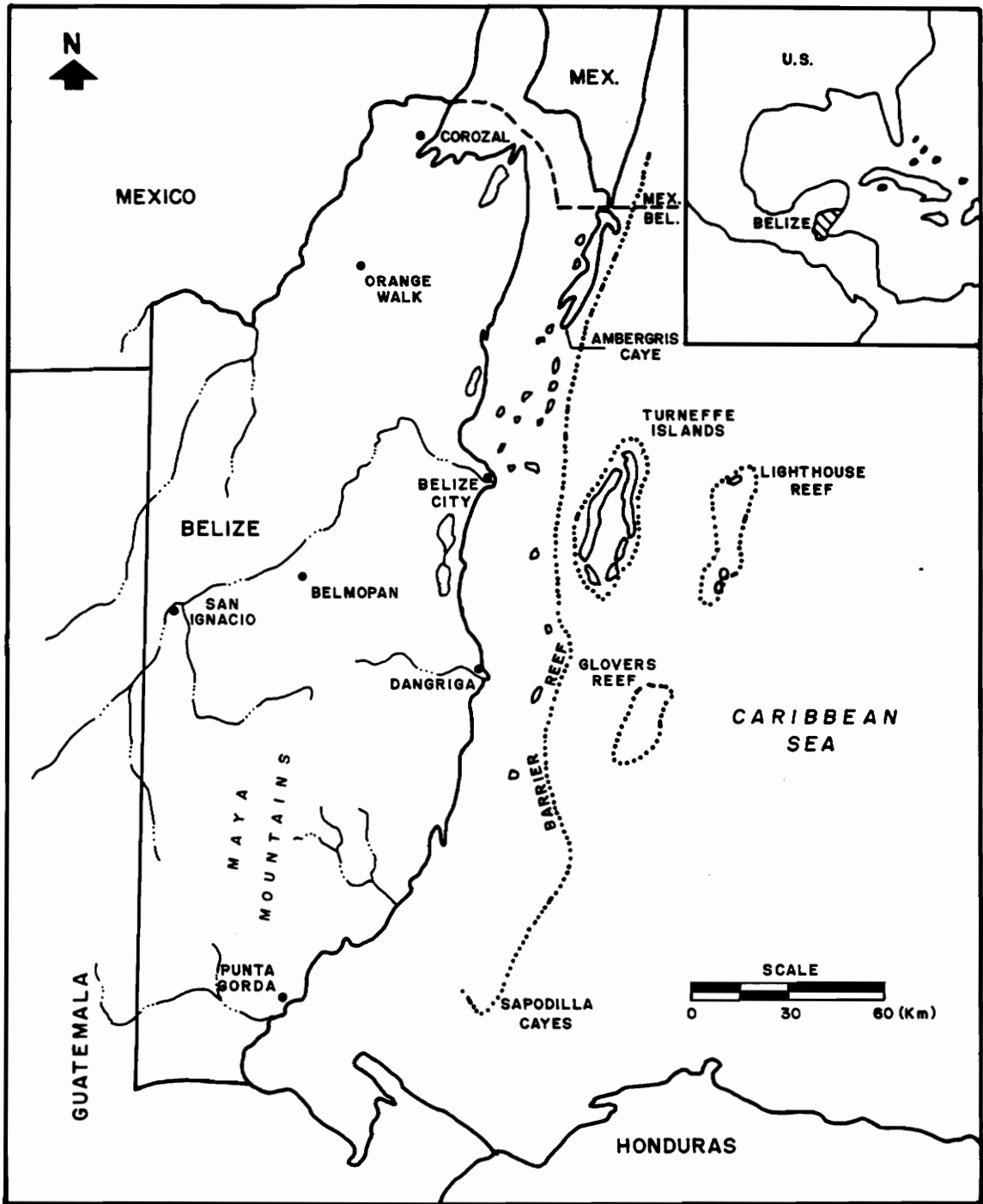


Figure 1. Map of Belize

The ecological integrity of the reef system has been maintained primarily because Belize has a small population and is relatively underdeveloped. However, significant population growth has occurred over the past several years and the country is actively pursuing economic expansion. Belize's economic development policies have focused upon its natural resource base. While agricultural development forms the top priority, expansion of the tourist and fishing industries is also receiving significant attention (Hartshorn et al 1984). These activities, along with shipping and oil exploration, pose particular dangers for the fragile habitats of the barrier reef complex. Some water contamination, especially around the towns along the coast, is already evident and will worsen with further growth in population and development (Katz 1989).

Effective management of the Belize barrier reef system is important for several reasons. The reef protects Belize's entire coastline, serving as a buffer from the ocean's adverse effects. It provides the habitat for a tremendous diversity of marine and coastal life, which depends upon the reef for survival. It also provides the basis for much of the nation's economy, particularly fishing and tourism. Damage to the reef system, indeed the whole coastal zone, will occur without adequate protection measures and will result in significant ecological and economic harm. This situation requires a resource

management approach that recognizes and addresses both economic and environmental issues. As is the case in similar situations elsewhere, economic concerns typically prevail; the argument here is that these legitimate concerns can and must be reconciled with environmental protection.

An environmental ethic of sorts is seen in the extent of legislation enacted, an environmental network of concerned private and international organizations, and the scope of conservation units established throughout the nation. However, there is a lack of regulatory laws and procedures, as well as deficiencies in the government's organization, financial resources and trained personnel (Hartshorn et al 1984). These factors cause serious problems in managing and enforcing natural resources and environmental programs. The most serious shortcoming, from a broad perspective, is the lack of a national resource management strategy. Even though Belize's government has an awareness of environmental issues and its conservation record is relatively progressive, such concerns have not yet been incorporated into the resource planning/management decision-making process. These problems are manifested in the coastal zone through the few small-scale and piecemeal actions that have been taken to date. Half Moon Caye National Monument and the Hol Chan Marine Reserve are the only marine conservation units that have been officially established. Several other small reserves, using the Hol

Chan zoning model, are in various stages of planning.

The coastal zone and barrier reef constitute an extensive and complex ecological system that is subject to an equally complex mix of economic factors. The measures that have been taken to date, while certainly preferable to inaction, have been reactive, small-scale, and piecemeal. Policies and actions have been largely in response to individual, articulated pressures, and simply do not go far in recognizing and addressing system-wide economic and environmental issues. This was not a critical shortcoming as long as the resources were unthreatened. In the future, however, it will be difficult, if not impossible, for Belize to come to terms with these issues and effectively manage its resources with a narrow, piecemeal and incremental focus.

Research Approach and Methodology

In view of these issues and concerns, this research on resource management of Belize's barrier reef system focuses upon the need for a broader geographical and functional perspective. Legitimate development and conservation requirements suggest a multiple use resource management strategy aimed at economic and environmental sustainability. Actions to conserve and use the reef's resources should be complementary, and above all serve to sustain the natural resource base. This research will demonstrate that the

reef's extensive area and ecological complexity require a strategy that is comprehensive in scope and purpose, but sufficiently flexible to provide for smaller-scope and timely actions/changes brought about through the political process and other exigencies. Concepts such as coastal zone management, world heritage sites, biosphere reserves, and the Hol Chan model will be useful in examination of this problem. The intent here is to propose a strategy rather than a specific plan, because a conceptual framework is necessary before planning principles can be effectively applied. Specific objectives of the study are to:

- . identify key economic and environmental issues in regard to the Belize barrier reef system
- . ascertain and analyze the approach, policies and actions taken to date
- . demonstrate the need for and value of a more comprehensive resource management strategy

The methodology employed for this study includes both library and field research. A search of the literature bearing on the subject reveals a variety of both subject matter and form of publication, reflecting a wide range of interrelated disciplines. Secondly, seven weeks of on-site field study in Belize during the summer of 1991 gave the author first-hand contact with characteristics of the reef system, local development and environmental issues, existing and planned government policies and actions, and other aspects of the problem. Additionally, interviews with

individuals representing both public and private organizations provided direct knowledge of local issues as well as governmental policies and their impact. A list of these interviews and discussions is provided in the Appendix.

A description of Belize, including an historical overview, follows in Chapter 2. Subsequent chapters address characteristics and importance of the reef system, resource management concepts and how they have been applied within the Belizean context, evaluation of the current approach in terms of objectives/criteria and alternative models, and a proposed strategy for system-wide resource management. The thesis concludes by commenting on implementation of the strategy and potential areas for further research.

CHAPTER 2

BELIZE

Historical Perspective

The area that is now Belize was once inhabited by the Maya, whose civilization reached its height during the Classic Period from the third to the tenth centuries A.D. It is estimated that at least 400,000 people inhabited the area of Belize in the late Classic Period (Bolland 1986). The civilization declined suddenly and mysteriously in the 10th century, probably as the result of environmental degradation; a peasant revolt against the priest rulers may have been an immediate cause of its demise (Setzekorn 1981). Many Mayas left Belize in favor of the Yucatan; leaving those who remained in relative isolation. The Spanish conquests of the 16th century resulted in further population decline through killing, disease, and slavery. The Spanish never really settled the area, however, feeling it was unsuitable for habitation and devoid of riches (Setzekorn 1981).

The British presence began in the mid-17th century. First used as a base for privateering and piracy against Spain, the area soon became important commercially because of the presence of logwood, a tree valued for dye, and later

mahogany, a wood prized for its beauty and durability. Over the course of many years, Britain and Spain were rivals for control of Belize. Britain eventually legitimized its colonization of the territory as British Honduras in 1862 after years of questionable and anomalous sovereignty (Dobson 1973). British interest focused on the logwood and mahogany industries. The British presence, over a period of almost 300 years, has formed an important influence on the culture and development of Belize. British dominion gave the colony its Caribbean flavor, despite its Central American setting. Thus, economic and cultural relations developed primarily with Britain and its Caribbean colonies, rather than with Spain and Central America. As a result, cultural, political, and economic institutions developed differently here than in the rest of Central America. Examples include a parliamentary political framework, an Anglican rather than Catholic church, and greater separation of church and state. Importation of slaves from the Caribbean islands in support of the logging industry reinforced this orientation and provided the nucleus for a substantial proportion of the population. Another influence was the de-emphasis, even discouragement, of agriculture as almost all attention and investment were devoted to logging. Agricultural development was consequently retarded until the decline of the forest industry within the past 30-40 years. Modern reliance on food imports arises from this

influence and continues to the present day.

British freeholders owned large tracts of land in the colony. For the most part, this land was either devoted to the logging industry or lay unused. Other land was occupied by Mayas and Mestizo immigrants from other Central American countries. These people, particularly the Mayas, practiced traditional milpa farming methods, and raised elementary cash crops as well. Garifuna (black Carib) immigrants in the middle to late 1800s also engaged in subsistence farming and fishing, mostly in the southeastern region.

Belize became self-governing in 1964; independence from Great Britain was contingent only upon an accommodation with neighboring Guatemala regarding their long-standing claims to Belizean territory. With a satisfactory assurance of sovereignty, backed up by a token British military presence, Belize officially gained its independence in September 1981. The Guatemalan government decided in 1991 finally to recognize Belize and begin diplomatic relations, a move that should reduce tension, lead to resolution of border disputes, and facilitate greater bilateral cooperation (Cody 1991a).

The Belize of Today

Belize is now a member of the British Commonwealth, governed by a Prime Minister, a bicameral National Assembly (elected House of Representatives and appointed Senate), and

Ministers of Government appointed from the Assembly. The government has been democratic and stable ever since the country gained independence, an important point since political traditions and institutions are key factors in how resource management policies are formulated.

Belize is bordered by Mexico, Guatemala and the Caribbean Sea. Its character shows more Caribbean than Central American influences in many respects and, although small in size and population, it has substantial diversity of land and culture. The country's territory (approximately 23,000 square kilometers) still has an abundance of good land due to the low population density, traditional land use practices, and discouragement of agriculture during the colonial era. Substantial tracts of land remain undeveloped and unused, particularly in the south and northeast. Also, primarily in the south, in and around the Maya Mountains, is one of the largest remaining tropical rainforests left in Central America. The northern part of the country is the most densely settled; its terrain is formed on a low-lying plain, swampy near the coast but rising to a fairly fertile limestone plateau inland and toward the west. Drainage patterns contrast as well between the northern and southern regions. In the north, streams tend to be fewer in number, with lower gradients, whereas in the mountainous south they are more numerous but shorter and steeper.

The climate of Belize is sub-tropical, with average

temperatures ranging from 24°C in January to 27°C in July. There are clearly marked dry and wet seasons throughout the country, although the spring dry season lasts longer in the northern portions. Rainfall varies greatly from an annual average of 102 centimeters in Corozal to 406 centimeters in Punta Gorda. Although hurricanes do not visit Belize as regularly as some other parts of the Caribbean, they are still a serious threat during the fall months. In 1970, the capital was moved from Belize City to Belmopan, eighty kilometers inland, to escape the potential destruction of periodic hurricanes. The disastrous Hurricane Hattie in 1961 provided the immediate impetus for the decision (Dobson 1973).

The population of 190,000 is mainly Creole and Mestizo, with smaller portions of Mayans, East Indians and Garifuna. Although it remained stable for many years, Belize's population has recently experienced significant growth. A noteworthy amount of immigration from neighboring Central American countries has contributed to this growth, and has more than balanced losses from traditionally high emigration of Belizeans to Great Britain and the United States in search of employment opportunities. Almost one third of the people live in Belize City, the commercial center and by far the country's largest city. Belize is relatively free of endemic diseases and a comprehensive health network exists with hospitals, regional health

centers and an increasing number of doctors. Education has received substantial emphasis, as indicated by the literacy rate of over 90%, compulsory education for children between ages six and fourteen, availability of specialized training and advanced education, and a well-equipped library service (Government of Belize 1989).

With the gradual decline of the logging industry and forestry products, Belize has turned increasingly to fishing and agricultural development. Fishing has become an important industry, both for domestic consumption and for export. Grass beds and reefed areas inside the barrier reef and the outer atolls provide a seemingly endless supply of spiny lobster, conch, shrimp and fish. Commercial sugar, the top agricultural crop, is produced chiefly on small farms in the north. Banana and citrus production has expanded rapidly since World War II, primarily in the east and southeast, partly on large plantations and partly on individual or leased farms. Several other agricultural products have become established in recent years including corn, rice, red kidney beans, cacao, and honey. Beef and poultry have also become important parts of the economy, as Belize attempts to increase its agricultural diversification and become more self-sufficient (Bolland 1986). Marijuana production, which had become a leading cash crop in Belize, has recently declined with an apparently successful spraying campaign financed by the United States. Of greater concern

now is the country's role as a stop-off point for cocaine trafficking; its utility as a refueling and distribution center for smuggling cocaine has grown, and efforts to reduce the traffic have been largely ineffective (Cody 1991b).

Some light industry such as clothing manufacturing has developed recently, but does not figure significantly in the country's economy, now or in the foreseeable future. International tourism has grown substantially and will expand even more as the national economy exploits its tremendous potential. Power and transportation infrastructures need to be modernized to support the current economy and opportunities for expansion. Belize is largely dependent on imported oil for its energy requirements; production of electricity, while increasing, is still unreliable and expensive (World Bank 1984). More and better roads are needed throughout the country and rail service does not exist; however, air and marine transportation systems have undergone recent improvements, and the country's bus service is adequate. Lodging facilities are expanding but still are insufficient to support a substantial tourism program. The telecommunications system is also adequate; telephone service has been modernized and improved significantly in recent years, and radio and television service is changing as well (World Bank 1984).

All of the factors and characteristics described above

affect the reef system in one way or another. The most significant features will be discussed contextually and in greater detail in subsequent chapters. These include political and cultural contexts and how they affect legislation, government organization, national policy, and implementation of programs. Also important are land use patterns such as settlement and agriculture along the coast and rivers, causing siltation and other harmful effects. Multiple economic uses of the coastal zone such as fishing and tourism, their interaction with conservation interests, and other ramifications of population and economic growth to the sustainability of the reef system will be examined in depth. It is first necessary to describe and examine the Belize barrier reef system itself.

CHAPTER 3
THE BARRIER REEF SYSTEM

The Reef System

Coral reefs have been called nature's richest realm, the most abundant and diverse natural communities on earth (Steene 1990). A basic understanding of the development and characteristics of coral reefs in general, and the Belize barrier reef system in particular, is necessary to appreciate the economic and ecological issues involved.

Coral reefs of the world. Corals are marine organisms, closely related to sea anemones, which usually exist in colonies in many parts of the world. Corals are carnivores and use their tentacles to capture zooplankton from the ocean. Colonies grow by asexual proliferation, the rate varying by their type, age and habitat (Boaden and Seed 1985). Coral polyps secrete calcium carbonate which forms a foundation of dead skeletal limestone over years of accretion. This process forms the structure of a coral reef; living coral tissue forms only a thin veneer of interconnecting polyps over the surface of the extensive network. The limestone foundation or reef provides support and protection for the corals.

The main geomorphological categories of reef, first

proposed by Charles Darwin, are fringing reefs, barrier reefs and atolls. Fringing reefs are formed close inshore usually on rocky coastlines by the growth of coral and associated non-coral organisms. Barrier reefs are separated from the coastline by a lagoon, usually formed by coastal subsidence, and continue their upward growth to form a wall separating the lagoon from the ocean beyond. Atolls are ring reefs, enclosing a central lagoon which may contain islands and other reefs; they develop around subsiding volcanic islands or on tectonic fault features. The three types of reefs have the same basic biological structure and processes of accretion (Barnes and Hughes 1982).

Coral reefs occur primarily in shallow tropical seas. Reef development requires a water temperature of at least 18°C, attaining maximum growth at 23°-25°C. Adequate light is also essential, since reef coral growth depends upon a symbiotic, photosynthetic relationship between the polyps and zooxanthellae plant cells which permeate the coral tissue. Consequently, reef growth usually occurs at depths shallower than 30 meters, near margins of continents and islands. Strong water movement or wave action is another requirement for extensive reef development. This keeps the water well-oxygenated and prevents sedimentation, which can diminish light and feeding ability. A relatively high level of salinity is also necessary for optimal growth conditions. When these conditions are favorable, they combine with a

highly efficient system for recycling nutrients to make coral reefs one of the most productive ecological communities on earth (Boaden and Seed 1985).

These conditions also determine the worldwide distribution of reefs, which is generally within a broad band around the tropical midriff of the earth. Coral reefs are extensive in the Pacific and Indian Oceans, being most prolific around off-shore islands, oceanic islands, and the eastern coasts of Africa and Australia. The reef area of the Atlantic Ocean is smaller, limited primarily to the Caribbean and the coast of Brazil; cool water temperatures from ocean currents and silt deposition from rivers have prevented reef formation elsewhere (Barnes and Hughes 1982).

The Belize reef system. The coastline of Belize is dominated by the barrier reef, which, referring again to Figure 1, extends in a nearly continuous formation from the Mexican border to the Sapodilla Cayes, a distance of approximately 220 kilometers. The reef is part of an even longer, more broken, structure reaching 450 kilometers into the upper Yucatan Peninsula. It ranges in distance from the mainland from nearly off-shore at Ambergris Caye to more than 40 kilometers in the south (DuBois 1983). Figure 2 schematically illustrates the general structure and characteristics of the reef system.

The barrier reef itself comprises a fore-reef seaward

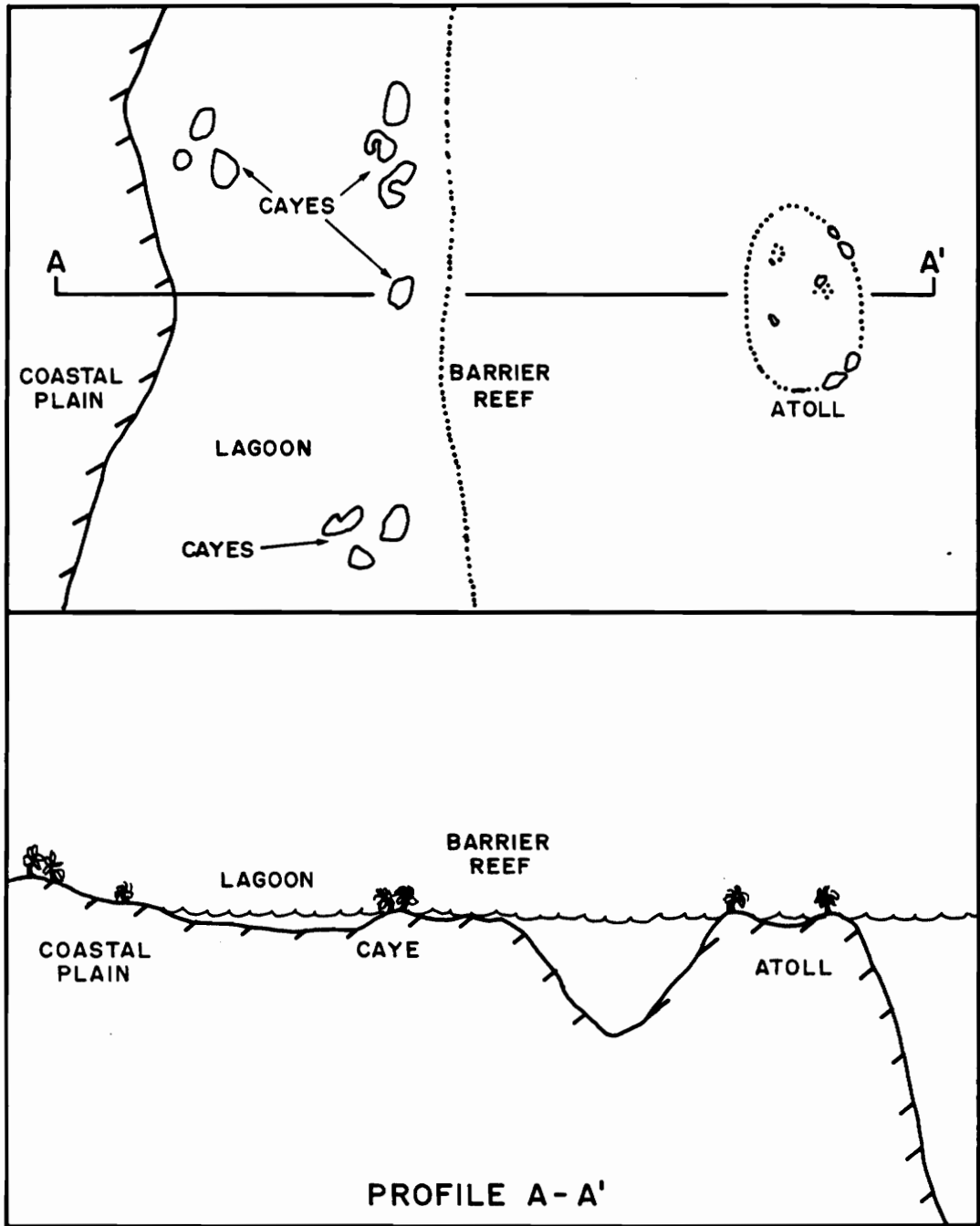


Figure 2. Schematic Diagram of Barrier Reef System

of the reef crest which extends at a slope to the ocean floor. Outside of this, three large atolls have formed-- Turneffe Islands, Lighthouse Reef and Glover's Reef-- which are among the best developed atolls in the region. Glover's Reef, in particular, has been described as the prototypical atoll (Perkins 1983). The barrier reef crest is a wide and shallow rampart built primarily of coral rubble. Inside the crest, the back-reef encompasses several different environments. A shallow northern shelf lagoon (north of Belize City) and deeper southern shelf lagoon contain a maze of patch reefs, faroes (shelf atolls) and fringing reefs. Over 400 cayes exist, mostly on the continental shelf inside the barrier reef, but some at the three outer atolls as well (Perkins 1983). Extensive sea grass beds, dominated by turtle grass, constitute the main ground cover, particularly of the barrier platform and the northern shelf and coastal lagoons. Additionally, mangroves fringe most of Belize's coastline and many of the off-shore cayes. The sheltered cayes consist entirely or mostly of mangroves, as sand cayes are confined to the exposed eastern sides of the atolls, faroes and barrier platform.

The coastal strip forms the interface between land and sea. The northern coastal plain is characterized by numerous coastal lagoons, embayments and wetland areas. The plain narrows midway down the coast, then broadens somewhat again to the south between the coastline and the Maya

Mountains. Fewer lagoons/wetlands, but more and faster-flowing rivers, exist in the southern part of the country. Much of Belize's coast is swampy, consisting of mangrove or littoral forest; however, sandspits and narrow beaches are also common coastal features. Water movement is generally dynamic, except in the northernmost bay and lagoons, as the active north-south current flows between the coast and the barrier reef.

The reef and its environs support a wide variety of plant and animal life. Few countries possess the extent and diversity of highly productive tropical coastal ecosystems characteristic of Belize (DuBois 1983). The mangroves, sea grass beds, and coastal/shelf lagoons form significant sources of nutrients, providing habitat for nursery and feeding purposes to many species of wildlife. They also provide a stable substrate in trapping and binding sediment, as well as a buffer zone between marine-generated storms and coastal areas. The reef structures themselves provide a critical habitat for marine wildlife and important protection to the coast. The fauna abounding in this coastal zone include a large number of bird species which live on or visit the coastal area and cayes; conch, shrimp and the commercially-vital spiny lobster; a wide variety of scale fish species, many of which are commercially important; and such endangered animals as crocodiles, turtles, manatees and dolphins.

Importance of the Reef System

It serves little purpose to consider economic and ecological/environmental values separately in examining the importance of the reef to Belize. They are inextricably linked and will be considered accordingly. Economically, the reef system is of key importance to the country, especially in terms of fishing and tourism. Fishing has always been important to Belize, serving as a staple food source to the local population and ranking among the top export earners. In 1989, seafood accounted for approximately \$6 million (US) in export earnings (U.S. Department of Commerce 1990). The industry provides a livelihood to several thousand fishermen and their families (Figure 3). Substantially all of the fishing is done within the greater reef area. The tourism industry is not large in absolute terms, but has grown substantially in recent years and is expected to continue growing. Tourism statistics for 1990 reflect more than a threefold increase in the seven years since 1981, doubling just since 1987 to an estimated 207,000 visitors (Government of Belize 1991). The government's statistical capability does not yet provide more detailed information; however, it is acknowledged that the large majority of visitors spend at least some of their time in the coastal zone. Most of the hotels/guesthouses are on the coast and cayes (Figure 4); additionally, studies such as that by Elizabeth Boo on ecotourism indicate that



Figure 3. Lobster Fishing, Caye Caulker



Figure 4. Hotel, Caye Caulker

most tourists go to Belize because of the natural features of the environment (Boo 1990).

If the reef system is economically important to Belize, it is critical from an environmental perspective. The ecological health of the reef is crucial to the well-being of the country. As a buffer between the coast and the ocean, the reef provides protection from oceanic storms and resulting waves and tidal action. Without the reef, the coastal areas would be subject to continual damage and erosion. As discussed above, the reef system and greater coastal zone provide the habitats for the nursing and feeding of fish that support the valuable seafood industry. The ecological integrity and quality of these habitats is the key factor in maintaining the diversity and quantity of wildlife, whether important economically or not. It is also the foundation for the tourist industry. Activities such as scuba diving, snorkeling, sailing and sport fishing-- activities for which many if not most tourists visit Belize--depend upon a healthy reef ecosystem. This close relationship between economic and ecological values forms the underlying theme throughout this research.

State of the Reef

Present condition. The Belize barrier reef ecosystem has remained relatively pristine primarily because of the small population and economic status. Fishing and a modest

tourist industry have been the principal users, along with small-scale shipping and limited oil exploration. Demands upon the resources of the reef complex have therefore been fairly modest (Perkins and Carr 1985).

Population growth and economic development, however, place increasing demands upon the reef system. The entire coastal zone is being subjected to greater stress than ever before. The fishing industry is being called upon to make a greater contribution to export earnings, and it already overharvests lobster and conch stocks. Closed seasons on these marine resources have been instituted with some success, as well as greater control over the local industry as a whole by the strong fishing cooperatives. The Hol Chan Marine Reserve was established partly to restore and maintain fish populations; this will be discussed later in greater detail. The rapidly growing tourism industry is also causing increasing pressures to the reef system. Boat anchors, divers and snorkelers are damaging coral structures, especially in the more popular tourist areas. Infrastructure such as hotels, roads and airstrips are being constructed to support tourism, usually without concern for environmental impact (Edington and Edington 1986). Mangrove and turtle grass often hinder development and are destroyed to provide hotels and beaches for tourists. These short-sighted actions are now resulting in increased land erosion and decreased habitat for marine wildlife (Beveridge

1990). These developmental actions also lead to such other consequences as trash and sewage discharges, and are very difficult to regulate or prevent.

Increasing agricultural and industrial development, especially along the coast, provide additional pressures to the ecological health of the reef system/coastal zone. The coastal waters serve as the de facto sink for human and industrial wastes, with high potential for contamination of coastal waters and degradation of mangrove areas (Katz 1989). Sewage treatment systems are being installed in Belize City, but this is only the first and a long-delayed step to prevent water pollution. Economic and population growth are also creating demands for more shipping and thus more port facilities and dredging operations. Additionally, the need for more and more energy keeps oil exploration in business. While no significant deposits have yet been found, some drilling continues along Belize's continental shelf. Such activities as oil drilling and shipping pose obvious and dramatic potential impacts to the reef system.

Human impact, of course, is not the only cause of danger and damage to coral reefs. They also suffer damage from predators such as the thorn-of-crowns starfish, coral diseases, tidal emersion and storms. The latter cause is the most dramatic; in fact, The Belize barrier reef was extensively damaged by Hurricane Hattie in 1961 and Hurricane Gerta in 1978 (Barnes and Hughes 1982). Reefs

recover from natural disturbances in time; in some cases, these actions actually regenerate and maintain reef productivity at a high state. Human-induced disturbances, however, such as direct breakage, asphyxiation by excessive sedimentation, chemical contamination of polyps, and unnaturally elevated water temperatures not only damage or destroy reefs but also alter the ecological conditions to which corals have adapted (Perkins 1983). Consequently, these actions are harmful in a direct sense and, perhaps more importantly, in making corals more susceptible to impact and less able to recover. They also often originate far from the reef itself, posing additional considerations relative to ecological scope and geographic extent of protective measures.

Global perspective. Human actions, particularly land use practices, have had severe impacts on coral reefs in other parts of the world. Suffocation and poisoning of corals have resulted from excessive sedimentation from dredging and filling operations during construction, soil erosion related to deforestation, chemical contamination from agricultural fertilizers and insecticides, and wastes/effluents from industrial sources (Mosher 1986; Perkins and Carr 1985; World Resources Institute 1990). Population growth and poverty are decimating the once extensive and diverse coral communities in the Philippines and Madagascar; five of the

seven Tanzanian reefs recently recommended for world heritage status are now dead due primarily to dynamite fishing; and yacht anchors and resort hotel construction have helped wipe out coral reefs in the Caribbean (Brower 1989). These are just a few examples; other incidences of reef degradation and destruction reflect a bleak global picture. It is vitally important that Belize learn from what has happened elsewhere. Too many countries, and the whole world in a collective sense, have lost a valuable ecological and economic resource.

CHAPTER 4

RESOURCE MANAGEMENT

The natural resources of the barrier reef system and its associated environs are clearly of key economic and ecological importance. Accordingly, it is critical that they be managed and utilized in a manner that meets the legitimate needs of both development and conservation. This chapter identifies concepts and approaches to resource management that must be considered in this context, then proposes a statement of purpose and specific objectives upon which to base actions and measure progress.

Development and Conservation

Two dominant, and often conflicting, elements of resource management are development and conservation. The International Union for Conservation of Nature and Natural Resources (IUCN) has provided definitions for these terms. Development can be defined as the modification of the biosphere and the application of human, financial, living and nonliving resources to satisfy human needs and improve quality of human life. Conservation is the management of human use of the biosphere in order to yield the greatest sustainable benefit to present generations while maintaining its potential to meet needs and aspirations of future

generations. Thus, while development seeks to achieve human goals primarily through use of the biosphere, conservation attempts to achieve them by ensuring that such utilization can continue (IUCN 1980). Development can be viewed as "production" and conservation as "maintenance" (Balzer 1984). The mutual dependence of development and conservation is highlighted when examined from this perspective. Development cannot take place, at least not for long, without maintaining the natural resource base. Sustainable development clearly requires conservation of resources. The other side of the mutual dependence coin is not as apparent; however, it is maintained that conservation cannot effectively stand on its own. Conservation by itself cannot meet the very real economic needs of a nation's population, especially in a third world context. In this light, it should be noted that conservation is distinguished from preservation, the latter term connoting non-use or withdrawal of resources from use, saving them for their own sake in perpetuity.

Principles of Resource Management

Several important concepts or principles follow from application of these definitions to the Belize barrier reef system. As discussed in the following paragraphs, these are sustainable utilization, multiple use of natural resources, protected area designation, coastal zone management scope,

ecodevelopment/ecotourism, and carrying capacity of designated areas.

Sustainable use. The first and most important of these is the concept of sustainable use/development. This issue forms the foundation upon which to base analysis of the appropriate balance between development and conservation. Resources should be maintained so that their capability for renewal is not jeopardized; sustainable use maintains biological potential and enhances the long-term economic potential of renewable marine resources (Salm 1984). Sustainable utilization is a strategy of resource use that strives to meet present economic and social needs without compromising the ability of future generations to meet their own needs. This concept can perhaps be considered analogous to "spending the interest while keeping the capital" (IUCN 1980). Sustainability of ecological processes and life-support systems depend on maintaining sufficient genetic diversity to support production of food and materials, as protection against harmful environmental changes, and as the source for much scientific and industrial innovation. The concept of sustainable use has proven to be an effective means of interjecting an environmental perspective into the developmental planning and decision-making process where it otherwise might not occur. It also facilitates acceptance of conservation

measures by legitimizing them in socio-economic terms.

Multiple use. Another important concept that should be kept in mind is that resources of the reef system and greater coastal zone serve a number of uses. Coastal protection, a source of food, recreation, export earnings, private utilization, and other uses illustrate both the value of the ecosystem and the need to maintain it. Education and scientific research are also vital uses--to increase public awareness and determine future conditions, requirements and options. These also add to the complexity of the already complicated situation, since multiple uses entail multiple and competing interests. However, multiple use is a reality that must be addressed in the formulation of strategies and management plans. It has formed a key factor in determining existing policies in Belize, and will be equally important in development of future resource management options.

Protected areas. The principle of area protection represents another issue in resource management planning and implementation. It is difficult to envision achievement of sustainable utilization goals that satisfy the needs of both development and conservation without some form of protected status for the coastal area. Protected areas promote sustainability, so that resources may be used but not used up, providing for a variety of uses and controls in an integrated resource management scheme (Salm 1984).

Protected area status is therefore essential for areas with unique or special resource management requirements.

Conservationists recognize several different forms of protected areas, or conservation categories. The IUCN has defined ten conservation categories which support a spectrum of conservation issues and objectives. These categories, ranging from Scientific/Nature Reserves to World Heritage Sites, are keyed to each area's resources and requirements and provide the basis for sustainable resource management (IUCN's Commission on National Parks and Protected Areas 1984). Chapter 6 will examine these conservation categories in greater detail.

Coastal zone management. Marine areas, including the Belize barrier reef system, are part of more extensive coastal zones, thereby complicating management even further through the complexity of ecological and geological processes on one hand and political/administrative considerations on the other (Salm 1984). The concept of coastal management for marine areas involves not only water but also coasts and shorelines where activities that may affect the entire ecosystem must be controlled. Such related concepts as island biogeography (Eagles 1984; IUCN 1986) and other scientific considerations present ecologically-based arguments regarding the need for and characteristics of management areas. These propositions must be balanced,

however, with other considerations in defining management areas or conservation units that are ecologically sound, politically acceptable and manageable. No distinction is made in this research between coastal zone and barrier reef systems since the terms essentially describe the same ecosystem; nevertheless, the concept and ideas of coastal zone management are useful in understanding and dealing with the issues involved.

Ecotourism. Various types of "ecodevelopment", especially ecotourism, illustrate tenets of sustainable use.

Ecotourism is a partnership between nature and tourism, focusing on enhancement or maintenance of natural systems through tourism (Farrell and Runyan 1991). Cooperative strategies benefit an increasingly popular form of tourism from the viewpoint of travelers interested in enjoying nature and environmentalists interested in protecting it. Ecotourism has been embraced by governments seeking to expand their economies at relatively little cost and/or provide an economic justification for conservation of areas that might not otherwise receive protection (Boo 1990).

Carrying capacity. Finally, the principle of carrying capacity defines relationships between intensity of use and the management objectives for a resource area (Farrell and Runyan 1991). It emphasizes level of impact; i.e., the amount of use that can be sustained without adversely

affecting the area beyond an acceptable level. The need to determine capacity and appropriate controls for tourists and various types of tourism development is particularly important in view of the seriousness of threats to the natural environment (Inskeep 1987). Current growth rates and high potential for further growth of tourism in Belize highlight the requirement to deal with this issue.

Planning and Management Approaches.

Traditional approaches. The scope and characteristics of the particular environmental situation, including cultural and institutional contexts, appear to determine selection of the approach to resource management. Many resource management decisions are characterized by small-scale, piecemeal, and uncoordinated actions. This incremental approach has a narrow and reactive perspective. Being political and time-sensitive, incrementalism provides for quick action and smaller, sequential steps; even when not used deliberately, this approach often prevails because it is practical and expedient. It does not require long-term planning or acceptance of a broader philosophy of management. Its antithesis is the rational comprehensive approach, which uses scientific methodologies and an interdisciplinary focus to establish broad objectives, formulate a wide range of alternative solutions to the problem studied, assess the impacts of these alternatives,

and select the one that best meets the objective criteria (Briassoulis 1989). This is the favored natural resource planning approach of many environmental policy-makers because of its broad and scientific perspective; however, this same perspective makes it difficult to implement and change if necessary.

A hybrid approach called "special area management planning" (SAMP) emphasizes anticipatory planning for areas where competing uses and values are concentrated (Healy and Zinn 1985). SAMP involves all important players in the planning process to generate a plan that reflects trade-offs between development and environmental protection. Other hybrid approaches fall between the extremes of the incremental and rational comprehensive models or combine elements of the two. These include the adaptive approach, stressing flexibility and adaptive learning; the advocacy approach, typified by competition and confrontation; the contingency approach, focusing on accidents or disasters; and the consensual approach, based on voluntary participation and nonadversarial dispute resolution (Briassoulis 1989).

Cultural and institutional context. The best approach for a specific situation is determined in part by the cultural and institutional context. In developing countries, and specifically in Belize, culture and institutions have

developed as the product of many factors and form the context in which plans and decisions are made relative to resources. Within such a context, where the greatest weight is still placed on economic development, it is especially important that ecological and environmental considerations play positive roles in long-term sustainability (Hufschmidt et al 1983). This context is also important in influencing the degree of public participation and involvement in resource management planning and decision-making. In a democratic society such as Belize, an open process is especially important in both defining the "public interest" and accomodating special interests relative to development and conservation (Victor Gonzalez, personal interview, 20 June 1991). The country's political tradition and openness of the political process enhance its ability to determine the need for resource management policies and implement them effectively. The workings of the political process and the participation of affected publics, agencies and special interests temper technical expertise in determining priorities and courses of action. Other important institutional factors in developing and implementing management programs are technical expertise, data and information, and financial resources. These factors are particularly important where they are lacking. This is the case in Belize, which helps explain its actions and dependence on outside assistance.

Model planning process. An appropriate strategy is therefore seen to arise from a number of factors constituting the particular resource management situation. While there is no guarantee that what works in one situation or location will be effective in another, a "model" process has evolved over a number of years as an overall framework for natural resource planning. This model has been developed primarily in the United States, but forms a useful framework for application elsewhere as well. The model planning process contains several features. First of all, it is characterized by a rational comprehensive basis to give it a broad, scientific and integrated perspective. It also contains, however, an incremental component to allow for political exigencies and time-sensitive actions; this is particularly evident in those features of management plans providing for monitoring, evaluating, and implementing corrective action. Public participation forms another key element of the model approach, providing for early and continuous involvement of all affected parties throughout the process. Participation is essential in determining what the public wants, increasing awareness and debate of the issues, and building support for the policy and programs.

The final key feature of the model process is environmental impact assessment (EIA), which has become the primary means of integrating consideration of environmental

factors into resource planning and development decisions. EIA is still largely a reaction to specific development project proposals; however, advocates of an earlier and broader use of EIA make a persuasive case, such as the strategic or area-wide approach to impact assessment (Kelly et al 1987). Even in some developing countries, EIA has progressed beyond the focus of specific projects to a formalized policy instrument within the political context, serving as a catalyst for increasing the influence of environmental considerations in the decision-making process (Wandesforde-Smith, Carpenter and Horberry 1985).

Purpose and Objectives

It is appropriate here to state an overall purpose and specific objectives for managing the resources of the Belize barrier reef system. These follow directly from the concept and approaches of resource management examined above, applied to the specific ecological situation and Belizean context. They also will form the basis for analysis of the policies and actions to date and development of a resource management strategy for the reef system.

An appropriate statement of purpose can be made from the earlier discussion of development and conservation:

The resources of the barrier reef system and associated environs will be utilized so as to provide a desired variety and level of benefits to present generations while maintaining the potential of the resource base to meet the needs of the future.

This overall purpose should be incorporated into a national resource management strategy, similar to the national conservation strategy envisioned by the IUCN for all countries to document a broad national environmental management plan (IUCN 1986). Many countries have developed such a national conservation strategy, optimistically hailed as a highly effective mechanism for managing the use of resources on a sustainable basis (McNeely 1990). Nevertheless, even though defined from the perspective of sustainable use, conservation is considered to be a deficient term. Resource management is more balanced and acceptable, and a strategy based on this perspective is more likely to succeed.

The World Conservation Strategy provides a good starting point for the formulation of specific resource management objectives (IUCN 1980). Modification and adaptation of world conservation objectives to the Belize coastal zone is based on the resource management perspective discussed above and the realities of the local context. The objectives of resource management of the Belize barrier reef system are to:

- . Preserve the integrity of the barrier reef and associated environs to maintain essential ecological processes, genetic diversity and life support systems
- . Provide for the planned and rational utilization of the area and its resources for a variety of desired uses
- . Ensure the sustainability of the ecosystems and species of the system for future, continued existence and use

- . Provide an area of vital interest for education and scientific research into reef and coastal processes.

This statement of purpose and objectives constitutes, in effect, the initial portion of a resource management strategy for the Belize barrier reef system. Subsequent portions of the strategy depend on a description and evaluation of what Belize has and has not done relative to managing its reef system/coastal zone resources.

CHAPTER 5
MANAGING RESOURCES IN BELIZE

Legal authorities, governmental and nongovernmental agencies, and international organizations all form key elements of the decision-making process for resource management in Belize. Policies and actions have generally been incremental (small-scale, piecemeal, reactive) and economically oriented; however, they also reflect an environmental ethic with regard to the country's resources. In this chapter, the institutional context for making resource decisions is examined, as well as policies and actions that have resulted from this process.

Legal Framework

Legislative authorities and requirements pertaining to utilization, development and conservation of natural resources are presently in place in Belize. Most of the statutes were enacted soon after independence (Brightman and Leonard 1983). Some laws, mostly incorporated from colonial ordinances, authorize and regulate use of such natural resources as lands in the public domain, forests, minerals, petroleum and fish. For example, the 1981 Land Utilization Ordinance governs the use and development of lands and watersheds. It empowers the Minister of Natural Resources

to make regulations to designate and protect watersheds, prevent soil erosion, and control the type of development allowed in designated areas. The 1983 Public Health Ordinance provides the authority for regulations to prevent contamination of the soil and water. This broad catch-all for control over effluents provides sufficient authority; however, like much of the legislation, it lacks procedural standards for implementation.

In regard to conservation, two measures passed soon after independence form the foundation of environmental legislation. The Wildlife Protection Act (Government of Belize 1981a) provides for protection and conservation of wildlife, including regulation of licensing and other hunting requirements. The National Parks System Act (Government of Belize 1981b) is designed to preserve and protect important natural and cultural features and regulate their use. It also provides authority for creation of national parks, nature reserves, wildlife sanctuaries, and natural monuments. Soon after, the Fisheries Act was amended to provide authority for establishing marine reserves (Government of Belize 1983). Additionally, in recognition of the important economic and ecological roles of mangroves, legislation has recently been passed to control mangrove clearing (Price et al 1990). These statutory actions, particularly the initial 1981 acts, have made conservation a more conscious and central concern than

it was before independence (Zisman 1989).

Institutional context

Most, if not all, of the eleven current ministries of government are involved in some way in coastal zone management. The same is true of nationwide resource management authorities and responsibilities. For example, the Fisheries Department of the Ministry of Agriculture and Fisheries manages all fishing activities; it is also responsible for establishing and managing marine reserves. The Ministry of Tourism and the Environment includes major divisions with responsibility for tourism and environmental protection/pollution control. The Ministry of Industry and Natural Resources has authority over the country's forests, lands and surveys, minerals and petroleum, water and sewage; it also creates and manages national parks, reserves and forests. The Port Authority, concerned with shipping and related activities, is located within the Ministry of Energy and Communications. The Ministry of Works is responsible for land reclamation and drainage. Other ministries are also involved directly or indirectly in the management of coastal zone resources (Price et al 1990). There is no single government agency responsible for managing resources of the barrier reef system, or even for managing either development or conservation alone. According to the Permanent Secretary of the Ministry of Tourism and the

Environment, the organizational conflicts of interest and jurisdictional diffusion of authority have contributed to the lack of integrated resource management programs in Belize (Victor Gonzalez, personal interview, 20 June 1991). Yet, decision-making is concentrated in the hands of relatively few government officials, a cultural and political characteristic Belize shares with many other developing countries. Individuals such as Prime Minister George Price and top political associates have been as important as institutions in the development and administration of public policy. But in Belize, the democratic tradition and political stability have kept cultural differences to a minimum and prevented oligarchic tendencies from developing into autocratic rule.

Two other types of institutions have played key roles in resource management--nongovernmental organizations (NGOs) in Belize and international organizations. NGOs that represent commercial interests include the Belize Fishermen's Cooperative Association and the recently formed Belize Tourist Industry Association. The co-ops that constitute the Fishermen's Cooperative Association have been important factors in the industry, wielding substantial control over the activities of fishermen and influence with the government over regulation of fishing in Belizean waters. Environmental and conservation interests are represented by several NGOs, notably the Belize Center for

Environmental Studies, Belize Zoo and Tropical Education Centre, Programme for Belize, and Belize Audubon Society. The latter group has been especially influential in the decision and policy-making process. It has been a major force in the passage of conservation legislation, calling international attention to environmental issues in the country, and managing several conservation units with its own resources (Brightman and Leonard 1983).

International organizations have also had a broad role in furthering and financially supporting both development and conservation causes in Belize. The IUCN, World Wildlife Fund, The Nature Conservancy, Wildlife Conservation International, and Tropical Agronomy Teaching and Research Center have been among the groups actively involved in environmental issues. Technical assistance organizations such as CARE and the U.S. Peace Corps, and development assistance agencies such as the World Bank, the U.N.'s Development Program and Food and Agriculture Organization, and U.S. Agency for International Development (USAID) have made important contributions to economic development. These organizations have become increasingly environmentally conscious, and have incorporated environmental concerns in their development projects and contributed to conservation causes as well (Hartshorn et al 1984). For example, USAID is currently providing funding for studies on tourism development and coastal zone management. Others have

supported projects to stabilize and diversify the fishing industry and develop a sewage system. Belize's visibility is also increasing as the result of various world and regional affiliations. These include the Caribbean Community, Gulf and Caribbean Fisheries Institute, Convention Concerning the Protection of World Culture and Natural Heritage, Law of the Sea Convention, and others (Price et al 1990). The importance of these affiliations is highlighted by the recent creation of a specific government office, the National UNESCO Commission, to coordinate activities with that influential organization (Hipolito Bautista, personal interview, 19 June 1991).

Resource Management Policies and Actions

Developmental bias. It is not surprising that Belize, as a developing country, places top priority on economic development. Governmental economic policy has been particularly geared toward agricultural growth and diversification, expansion of the tourist industry, and encouragement of foreign investment to attract capital for these and other economic ventures (U.S. Department of State 1990). Economic growth has been achieved; however, it is constrained by such factors as vulnerability to world commodity price fluctuations, dependence on trade preferences by the United States and Great Britain, and limitations on domestic industry due to the high cost of

labor and energy, lack of infrastructure, and a small domestic market. A number of areas are being pursued by the government, often with the financial assistance of foreign public and private agencies. For example, several privately financed shrimp farming projects are in the early stages of development, and other aquaculture ventures have high potential in both the public and private spheres (Katz 1989). Additionally, foreign development agencies are currently assisting in projects such as upgrading road systems, rural electrification, water and sewage systems, and hotel construction (U.S. Department of State 1990). Land use has perhaps the most potential for both economic development and environmental impact. Governmental policies in regard to agricultural development are economically oriented to diversify the country's agricultural base and achieve greater self-sufficiency.

Environmental ethic. Belize's development bias is neither zealous nor single-minded, and an environmental ethic of sorts is apparent. The country is relatively aware of environmental issues and an active network exists of concerned nongovernmental and international organizations. The government, while not exhibiting a comprehensive and proactive perspective, has at least been receptive to enacting environmental legislation and establishing conservation units. More than 30% of Belize's land area is

now covered by forest reserves and other conservation units. These include the privately operated Community Baboon Sanctuary, the first wildlife preserve in the tropics run by local people on private lands, and the Cockscomb Basin Wildlife Sanctuary and Forest Reserve, established in part as the world's only reserve for jaguars. The Rio Bravo Conservation Area in northwest Belize is another significant and interesting protected area, particularly in its prospects for becoming the third piece of a tri-national peace park, along with the Calakmul Biosphere Reserve in Mexico and the Maya Biosphere Reserve in Guatemala. Existing and planned reserves in the coastal zone will be examined in the next section.

Other recent policies and actions reflect an increasing concern for environmental issues, some steps toward a more comprehensive perspective for the Belize barrier reef system, and adoption of such concepts as sustainable use, coastal zone management, and ecotourism. In 1989, Belize hosted a Coastal Zone Management Workshop which has been helpful in promoting a broader perspective toward managing resources in the coastal zone. It also led to the formulation of guidelines for developing a coastal zone management plan for Belize (Price et al 1990). The guidelines highlight benefits of an integrated approach to coastal zone management in order to meet the objectives of sustainable development and use of coastal resources. It is

the first significant effort to take a coastal zone, system-wide approach to planning and managing resources of the barrier reef ecosystem. While only an initial effort to formulate "guidelines" for a plan, it represents an important step in developing a resource management strategy.

The government's legislation to control mangrove clearing reflects increasing awareness of environmental concerns in the coastal zone. Similarly, in 1990 the government placed a moratorium on development on publically-owned land in the cayes, pending completion of a coastal zone management plan. This action may prevent development in the most sensitive areas, and set up a regulatory and monitoring system to minimize impacts of any new tourism projects (Ryan 1991).

Ecotourism is quickly becoming an important component of the tourist industry in Belize. It is being promoted as the missing link between economic development and environmental protection by the government, private commercial interests, and the general public. Belize hosted an Ecotourism Conference in July 1991 to further promote the concept. The study by Boo (1990) shows that almost half the visitors to Belize indicate that protected areas are the primary or an important reason for their visit; natural history was, overall, the most frequently cited reason and highest ranked factor. Potential for expansion of nature tourism is great, especially in the barrier reef system, and

pressures to develop this potential are mounting rapidly.

Marine Conservation Units.

Half Moon Caye National Monument. One of the early actions of the Belizean government was to make Half Moon Caye and its surrounding reef and lagoon area a National Monument, the first marine park in Central America. Part of Lighthouse Reef, the outermost atoll (Figure 5), the cayes abounds with boobies, frigate birds, turtles, a host of other creatures, and a rich and diverse reef ecosystem (Weyer 1982). The national monument is especially important to the red-footed booby bird, a protected species since 1950. The Belize Audubon Society has site management responsibility, although the Forestry Department is responsible for national monuments and the Fisheries Department is responsible for enforcing most of the regulations applicable to the cayes.

Hol Chan Marine Reserve. The acclaimed Hol Chan Marine Reserve was established in May 1987 at the southern tip of Ambergris Caye (Figure 5). Protection of this area had been under consideration for a number of years due to the need to protect fishing grounds from overfishing of conch and lobster, and coral reef environs from effects of tourists and development. Its proximity to San Pedro on Ambergris Caye, a tourist and fishing center, made it vulnerable to excessive utilization. Increase in tourism particularly led

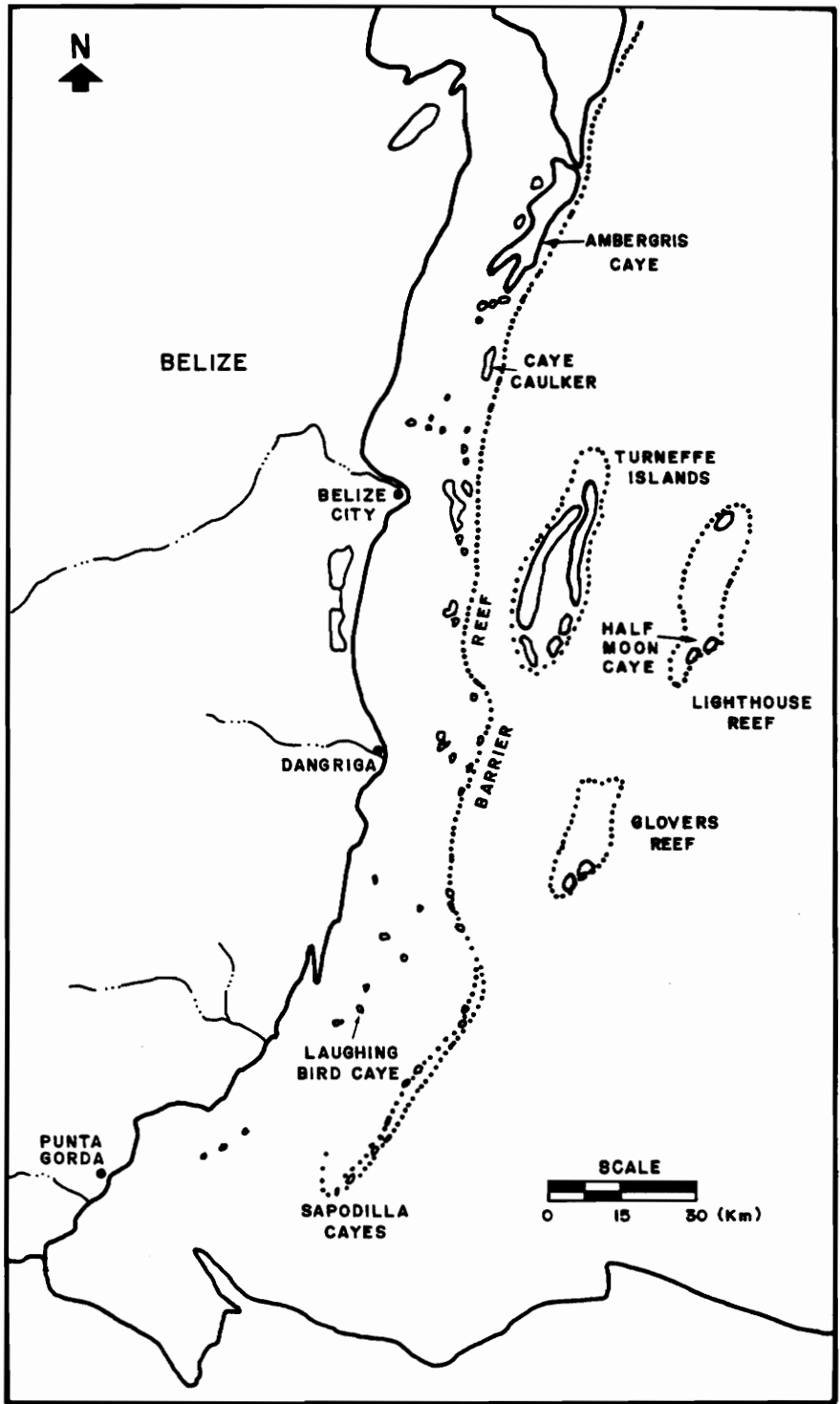


Figure 5. Belize Barrier Reef Complex

to sewage output and sedimentation from development of infrastructure and damage from anchoring, scuba diving, snorkeling, shell collecting, and other recreational activities (Gibson 1986).

The term Hol Chan means "little cut" in Mayan, and describes the natural break or cut in the barrier reef. The 13 square kilometer reserve includes this portion of the reef, along with portions of the lagoon and mangrove cayes at the southern end of Ambergris Caye. Figure 6 illustrates the boundaries of the reserve and the manner in which it is zoned for specific uses, thereby utilizing a biosphere reserve concept on a small scale. The goals of the reserve are to (1) maintain a coral reef ecosystem in its natural condition, (2) provide recreation and tourism services and preserve the value of the area for fisheries, (3) provide an area for education and research, and (4) conserve genetic resources (Gibson 1986).

The uses and rules applying to the three zones are specified in the reserve regulations (Government of Belize 1988). In Zone A, use of buoy moorings is required and no fishing or collecting is allowed. This zone receives most of the business from tour boats, snorkelers and scuba divers because of the reef and cut. Zones B and C permit fishing under special license only. Zone C further prohibits collecting or disturbing plants and wildlife on the mangrove cayes. A small staff, under the Fisheries Department,

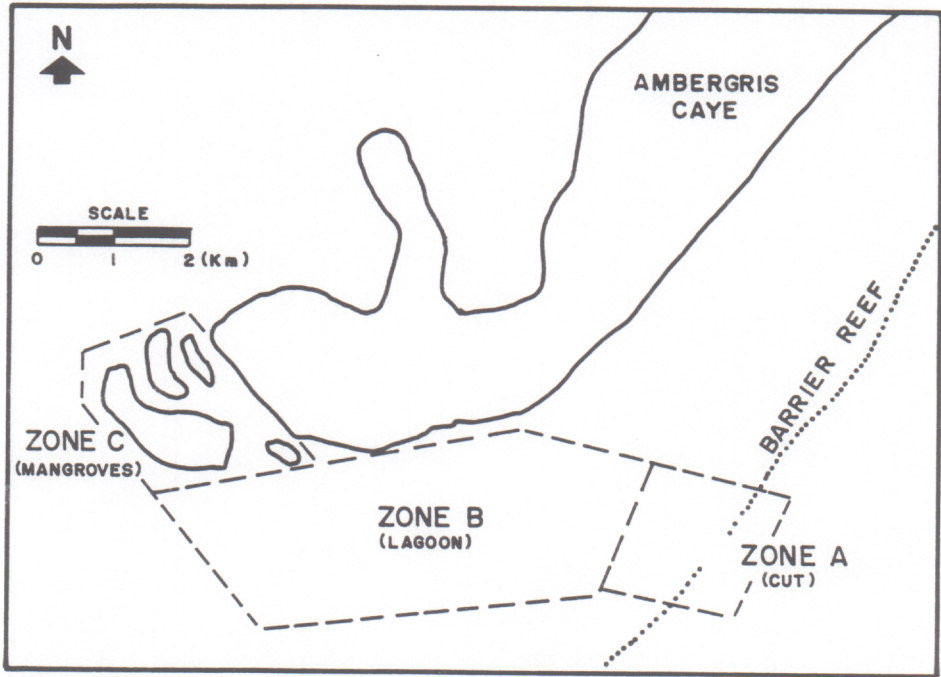


Figure 6. Hol Chan Marine Reserve



Figure 7. Ranger, Hol Chan Marine Reserve

manages the activities of the marine reserve, including patrolling and collecting fees (Figure 7). In addition to the Director, the staff consists of two marine biologists and two warden/rangers. The World Wildlife Fund has been financing management expenses; however, this outside funding is being phased out as the government assumes financial responsibility. It is hoped that the reserve will become largely self-supporting as revenues go up with the increase in visitations. Marine reserve records documented almost 30,000 visitors in 1990 (Azueta 1991).

Proposed protected areas. Half Moon Caye National Monument and Hol Chan Marine Reserve are the only protected areas established to date in the barrier reef system. Two other areas have been proposed for conservation status and are awaiting government approval. The first of these, the Siwa-ban Nature Preserve, has been proposed at Caye Caulker, about 15 kilometers south of Ambergris Caye (Figure 5). Siwa-ban is named after a rare black catbird species found there. The objectives and structure of the proposed conservation unit are patterned after Hol Chan. The area of barrier reef to be protected includes two cuts or channels around which a significant amount of snorkeling and scuba diving takes place. Other zones would include a section of the lagoon with thick seagrass and sand patches, and the southern portion of Caye Caulker containing fringing

mangrove, littoral forest, and seasonally flooded interior mangrove swamps (McRae 1990).

The other proposed protected area is Glover's Reef, the best developed and most diverse coral reef atoll in the Caribbean Sea. The draft management plan by Janet Gibson (1988) follows the same pattern as her earlier plan for Hol Chan in terms of goals and structure; however, the proposal for Glover's Reef is more extensive and complex. The entire atoll down to a depth of 100 fathoms is recommended for protected coverage. This also includes six cayes situated on the southeast side of the atoll and numerous interior patch reefs. Four zones are proposed to reflect multiple uses and appropriate management techniques; additionally, a scientific research center is an important part of the plan (Gibson 1988).

Several other areas of the barrier reef system have been mentioned as possible protected sites, such as Laughing Bird Caye (Figure 5). These range in size from small individual cayes to larger areas encompassing several cayes and/or sections of the reef. All of these, however, are individually and incrementally conceptualized and fall far short of a system-wide or coastal zone perspective. A critical analysis of the approach that has been used and arguments for a broader perspective are the focus of the next chapter.

CHAPTER 6

NEED FOR A BROADER PERSPECTIVE

Analysis of Current Approach

The purpose and objectives outlined at the end of Chapter 4 provide the basis for evaluating the effectiveness of policies and actions taken in Belize to manage coastal resources. The piecemeal and incremental approach used so far has had some beneficial results. Governmental policy has been reasonably balanced between economic development and resource conservation, displaying an environmental awareness and concern absent in many other developing countries. A legislative framework is in place, and organizational authorities and responsibilities have been allocated. Economic growth has occurred with increasing utilization of the coastal resources for a variety of uses, particularly the expanding tourist and fishing industries and development along the coast in response to population growth and other pressures. This has been moderated, however, by corresponding actions to slow or mitigate impacts of economic growth, conserve threatened natural resources, and promote education and scientific research. The Hol Chan Marine Reserve is perhaps the primary illustration; it has been described as an important success

and model for other marine protected areas (Azqueta 1991). In regard to conservation actions, it is significant to note that the establishment of small-scale units has been conscious and deliberate due to political, financial and logistical exigencies (Carter 1990).

While the approach used to date has had some success, the case against it is compelling. Legislation and public policy is spotty and reactive. Ministerial jurisdiction does not provide for coordinated or consistent resource planning, management and enforcement. The current approach has a limited spatial perspective; accordingly, policies and actions fail to take important factors into consideration and suffer in effectiveness. For example, the effects on the reef ecosystem of expanding agriculture and industry on the mainland, especially along the coast and rivers which carry runoff to the sea, have been pointed out by Carter (1990), Gibson (1990), and others. Aerial reconnaissance has revealed the disdain of plantation owners and farmers for leaving buffer strips along riverbanks-- these buffers diminish runoff but they also diminish profits (Skow 1991).

The issue of carrying capacity offers another illustration of the insufficiency of the present approach. The popularity of the Hol Chan Marine Reserve has prompted concern about its carrying capacity, as tourist overuse has already damaged some areas. Staging of development, better distribution of use, and limitations on use during peak

periods are some means of dealing with the problem (Inskeep 1987). The president of the Belize Audubon Society feels these measures may become necessary, and both she and Gonzalez further suggest that creation of more reserves will help remove the pressure from Hol Chan (Janet Gibson, personal interview, 8 July 1991; Victor Gonzalez, personal interview, 20 June 1991). This issue would be best served by an integrated system-wide approach to planning and management.

Current policies and actions suffer from a narrow functional perspective as well. The lack of involvement by all concerned parties limits input and support. Limiting participation is expedient but is not conducive to long-term effectiveness and success. The objective of providing for planned utilization of coastal resources for varied uses is not presently being met, due primarily to nonparticipation of the general public and many special interest groups. Policies and actions have too often been taken in response to pressure from particular groups or interests without considering views of other parties. Hol Chan appears to be an exception; the objectives clearly reflect the principle of multiple use and the degree of public participation has been notable. However, evaluation has so far emphasized mainly its recreational success. A formal, comprehensive "five-year" evaluation would be valuable.

On balance, the incremental approach of limited scope

has not been effective in meeting resource management needs and objectives. It favors short-term economic growth but is deficient in meeting systemic ecological needs, providing for rational use of resources, and ensuring sustainability. The scope and complexity of the resource management issues account for the inadequacy of actions taken to date, and a broadening of perspective is necessary to deal effectively with these comprehensive and complex issues.

System-wide Management Strategy

Spatial perspective. The Belize barrier reef is only a part, albeit a central and important part, of a larger system. The coastal and marine habitats and wildlife occupy essentially the entire coastal zone of the country, even extending into neighboring nations, and comprise ecosystems of great ecological and economic value. The dynamic system is influenced by complex interactions between natural processes and human activities. It is also characterized by an intricate web of interdependence; consequently, a change in one part of the system can have unforeseen and often deleterious effects on other parts (Price et al 1990). A coastal zone perspective is considered necessary to adequately address and resolve such broad, complex and interrelated problems. It is doubtful that resource management objectives can be met otherwise.

Added to the generic characteristics of an ecological

system are factors of location and scale in regard to the area of concern. The coastal zone includes both terrestrial and marine ecological communities. The dynamics of marine ecosystems are more open and complex; boundaries and linkages are widespread in a geographical sense and highly variable in time and space. Kenchington and Agardy (1990) argue for managing such areas as "open cells" with a large-scale approach to their conservation. Characteristics of the system such as water current movements and river discharges illustrate this point. These features cover wide areas, extending beyond the defined boundaries of management units and highlighting the importance of a broad approach. They also introduce an international perspective to the situation, not only in terms of the scope of the issue but also with respect to the technical and financial resources that are needed to deal with it.

Review of the literature on design of protected areas is useful in examining optimal size or extent of resource management areas in general. There is no consensus on the subject, but the arguments favor a large-scale approach, especially for marine areas. The primary point is that an area be ecologically or biogeographically defined, having as wide a contiguous range of ecological communities as possible (IUCN 1986). Arguments for "disaggregation" (many small protected areas) are best applied to terrestrial areas for which they were formulated, whereas "aggregation" (fewer

and larger areas) seems to be a better approach for the marine environment (Salm 1984). Ecological openness, dynamics and complexity combine to indicate the advisability of a coastal, ecosystem-based protected area for the Belize barrier reef system. The question of size will be further addressed in discussing implementation of the strategy.

Functional perspective. The scope and interrelatedness of resource issues require a broad interdisciplinary view. An effective strategy mandates the input, expertise and support of all concerned parties, including participation of local interests who will be affected by whatever action is taken. It is important that they have an opportunity to influence the direction and character of resource policies and programs. A high degree of local involvement has helped Hol Chan succeed (James Azueta, personal interview, 17 June 1991); conversely, a more narrow range of local involvement and support has stymied efforts to establish the proposed Siwa-ban preserve.

The variety of uses for resources in the coastal zone increases the number of interests which must be represented and accommodated. An effective resource management strategy must provide for a breadth of view commensurate with the issues and problems involved. Further, each component in the process must broaden its viewpoint to recognize and accommodate legitimate needs of other components. A Caye

Caulker businesswoman (and Siwa-ban proponent) expresses the need for sustainable use of natural resources relative to tourism planning (Maria Vega, personal interview, 10 June 1991). This illustrates the breadth and balance of perspective needed to plan and implement effective programs. As another example, one of the objectives of fisheries management should be to conserve marine populations for present and future generations (Revelle 1985). Additional data and research are also needed to attain a broader base of information and greater depth of knowledge. Gillett (1990) and Dickinson (1989) specifically point this out in regard to fisheries, and it is required in other components of resource management as well. A key contribution of the "guidelines" for coastal zone management (Price et al 1990) is the emphasis placed on data collection and analysis.

Resource management policy. As important as it is to apply broad spatial and interdisciplinary views in managing the resources of the reef system, it is also important to keep the issue in context. The need for a national resource strategy is reiterated here. Reef or coastal zone management should be incorporated within a comprehensive and coordinated program for managing the nation's resources. This approach can form the basis for a national policy of sustainable use--balanced development programs that rely on conservation of natural resources (IUCN 1986; McNeely 1990).

The process for formulating such a policy should be as open and participatory as possible.

There are some institutional changes that would assist in making an effective national policy. The primary issues are administrative, technical and financial. Policy and strategy should be promulgated in a national resource management statute; other legislation is needed to provide a broad, coordinated national program. The problems of organization and jurisdictional diffusion will have to be resolved so that policies and programs can be formulated, implemented and managed (Hartshorn et al 1984). It may be necessary to establish a central agency with broad resource management authority, at least for policy development and oversight. Lack of money and trained personnel are longer-range problems and Belize may have to rely on outside assistance for some time. Nevertheless, actions such as education and training programs to improve technical capability should be initiated as soon as possible to address these problems. The issue of participation may involve institutional change as well. Enlightened political leadership will be required to create the climate and framework necessary to ensure broad-based public participation. Belizean culture and traditional practices suggest that more local, in addition to national, mechanisms are needed to foster such involvement.

The national and barrier reef system strategies should

provide policy guidance relative to principles examined throughout the research. These include broad spatial and functional perspectives, sustainability and multiple use. Ecotourism, as a facet of both multiple and sustainable use, is particularly in need of policy guidance. Its popularity and potential notwithstanding, further research and assessment of ecotourism should precede its wholesale, unqualified adoption as official policy.

Planning. Guidelines and principles for resource management strategy should also carry over to the planning process. While a specific plan is beyond the intent of this research, some general comments are appropriate. The model process described in Chapter 4 is a useful framework for natural resource management planning in Belize. The need for and value of a strategic rational comprehensive approach has been discussed at length; it is appropriate from a tactical planning perspective as well. However, an incremental component that provides for timely and smaller-scale action when needed is imperative, as long as such action operates within a comprehensive and integrated frame of reference (Janet Gibson, personal interview, 8 July 1991). The other two common features of the model process--active public participation and environmental impact assessment--are also important in Belize. The model must be "customized" in several respects. The barrier reef system's international

character, private ownership of substantial portions of land, and institutional problems are factors that add even greater scope and complexity to the planning process. Also, natural and man-made hazards pose constant, dramatic threats to the Belize barrier reef system and need to be dealt with in a contingency planning component. The model process is flexible enough to accommodate these changes, and its use as a planning framework is encouraged.

Alternative Conservation Models

The Belize barrier reef system or coastal zone requires protected area status if its resource management objectives are to be achieved. These objectives and strategic principles are the primary factors in determining the most appropriate type(s) of protection. The IUCN's conservation unit categories (Table 1) constitute a useful framework for examining this final component of the resource management strategy (IUCN's Commission on National Parks and Protected Areas 1984).

National unit categories. The first eight categories shown in the table are protected areas which can be approved and established on a national basis, as is the case for all of Belize's present units. They constitute a variety of categories based on the characteristics and requirements of the area to be protected. There are several problems, however, in relying on national categories of conservation

Table 1. Categories for Conservation Units (Adapted from IUCN's Commission on National Parks and Protected Areas 1984)

- I. Scientific Reserve/Strict Nature Reserve
Area free of human intervention and available exclusively for scientific research and environmental monitoring; established to protect nature and maintain natural processes in an undisturbed state
 - II. National Park
Relatively large natural and scenic area of national or international significance for scientific, educational and recreational use
 - III. Natural Monument/Natural Landmark
Relatively small area focused on protection of specific features of particular scientific and educational interest
 - IV. Nature Conservation Reserve/Managed Nature Reserve/Wildlife Sanctuary
Area where manipulative management techniques are used to protect nationally significant or endangered species, communities and habitats
 - V. Protected Landscape/Seascape
Mixed natural/cultural landscape of high scenic value where traditional land uses are maintained; degree of protection while providing opportunities for recreation and tourism
 - VI. Resource Reserve
Protection category for an area and restrictions on use of its natural resources until a permanent classification can be determined
 - VII. Anthropological Reserve/Natural Biotic Area
Natural area protected to allow the way of life of traditional societies living in harmony with the environment to continue undisturbed by modern technology
 - VIII. Multiple Use Management Area/Managed Resource Area
Provides for sustained production, with the conservation of nature oriented to support of the economic activities
 - IX. Biosphere Reserve
Internationally designated site managed for research, education and training; conserves diversity and integrity of ecosystems for present and future use; typically fairly large area zoned for multiple uses
 - X. World Heritage Site
Area of outstanding universal value; protects natural features and provides for research, worldwide education and environmental monitoring
-

units. While some of them are suitable for limited purposes, all have shortcomings when viewed in the context of the entire barrier reef system. They do not provide means for dealing with the scope and complexity of the situation. An attempt is being made to develop standard coastal zone guidelines; however, even if successful, this will not guarantee the comprehensive and integrated approach that is required. It may actually do more to perpetuate piecemeal and small-scale actions. Additionally, national conservation categories do not adequately deal with the international perspective mentioned previously. The geographic and disciplinary scope of the issues and dependence on foreign financial and technical capabilities suggest the need for broader management status. These problems also suggest that national categories of protected areas would be unlikely to achieve the country's resource management objectives.

World heritage site. The last two categories shown in the table--Biosphere Reserve and World Heritage Site--are international units. Both are subject to approval and designation by UNESCO, and are managed locally (nationally) with some international funding and technical assistance. The World Heritage Convention came into force in 1975 to provide international sponsorship and assistance for the protection of cultural and natural areas of universal value

(UNESCO 1981). Since then, over 300 sites, mostly cultural, have been inscribed on the World Heritage List. A number of World Heritage Sites are also designated as National Parks, Reserves or other categories, usually because they were so classified prior to world heritage selection. International recognition and moral support are supplemented by modest financial and technical assistance, including contributions from non-governmental bodies and private individuals (UNESCO 1988). The aim of the Convention is to complement national conservation initiatives; accordingly, the primary benefits would appear to be the prestige of international recognition and at least some degree of financial and technical support. The Belize barrier reef would easily qualify for World Heritage Site selection, and benefits seem worth pursuing.

Biosphere reserve. This category of conservation unit will be examined in some detail. The biosphere reserve concept is an outgrowth of UNESCO's Man and the Biosphere program launched in 1971. The first reserves were designated in 1976 and now number approximately 300 throughout the world. Their primary functions are to protect genetic resources, species and ecosystems; promote rational and sustainable use of ecosystem resources and cooperation with concerned human populations; and develop an international network of protected areas for research and monitoring. These roles highlight the emphasis on multiple and sustainable use of

natural resources and the synergistic combination of development and conservation (Batisse 1990; Vernhes 1987). They provide actual examples of application of the World Conservation Strategy--sustainable development in action (UNESCO 1984).

The different interests of a biosphere reserve are combined by a system of zonation (Figure 8). Critical habitat areas (core zones) are designated for strict protection with no economic use. Buffer zones are used to adjoin or surround the core areas, with a variety of nondestructive activities permitted but regulated. Transition zones have flexible boundaries containing less controlled economic activities, an area of cooperation with local human communities where sustainable resource uses can be practiced. The zoning pattern has evolved from a simple design to more dynamic and flexible models such as that depicted in the illustration. Zoning has been an important element of the integrative, man-environment approach of this conservation category (Vernhes 1987). It is significant that the Hol Chan Marine Reserve and proposed Siwa-ban and Glovers Reef areas use a zoning system, although on a small scale. Their schemes do not use the classic pattern for core, buffer and transitional zones; rather, they are geared toward their own features and requirements. The key point is that zoning is useful for multiple use resource management.

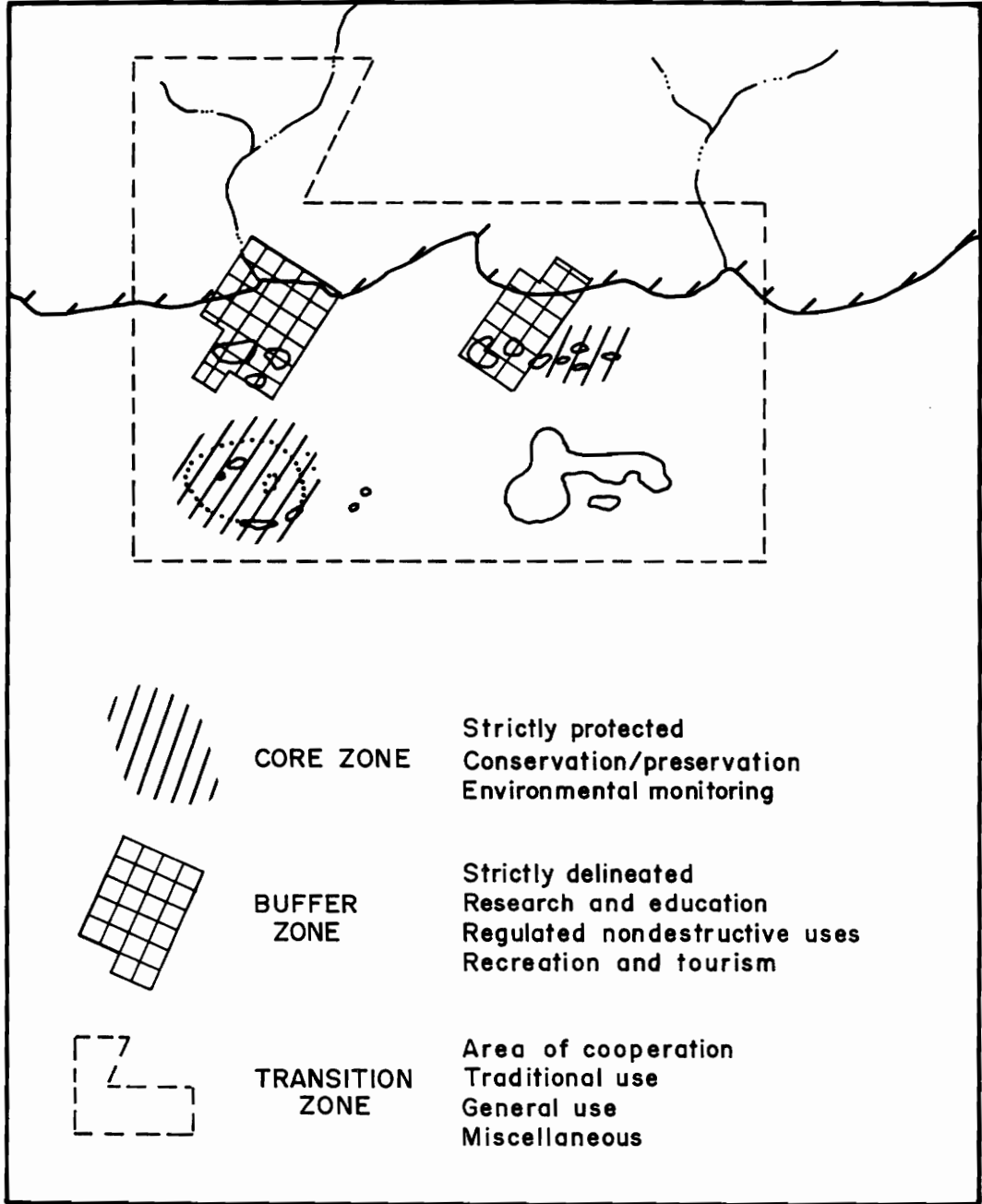


Figure 8. Zoning for Multiple Use

Biosphere reserve appears to be the most appropriate category for meeting the resource management objectives of the Belize barrier reef system. It is based on the same principles and has substantial flexibility of design for size, structure and content. The zoning system, in particular, provides the means to effectively manage a variety of uses while protecting reef and coastal ecology. Additionally, some funding and research/technical assistance are given to the host country in managing the reserve (UNESCO 1984). Application of the biosphere reserve concept to coastal environments has been the subject of recent works by Batisse (1990), Kenchington and Agardy (1990), and Ray and Gregg (1991). Geographic boundaries of coastal zones, special coastal development and conservation concerns, and zonation patterns are some of the key issues being examined in an expanding body of knowledge.

Analysis of established protected areas is useful but somewhat deceiving. For example, Sian Ka'an Biosphere Reserve just north of Belize is a coastal unit. However, Sian Ka'an is almost completely unpopulated and undeveloped, and is not managed like a biosphere reserve. Consequently, it has limited applicability to the Belize barrier reef situation. The best example may be Australia's Great Barrier Reef Marine Park, established as a national protected area but also designated as a World Heritage Site in 1981. It is analogous to Belize's situation, although on

a larger scale. The resource management principles and objectives match, especially in regard to multiple and sustainable use. The marine park is managed like a biosphere reserve, including zoning to accommodate the dual goals of preservation and multiple use (Kelleher 1985). Government officials and other concerned parties from Belize have studied the issues and management of the Great Barrier Reef for potential application at home. This example and that of Hol Chan will be most useful in designing an appropriate model for the Belize barrier reef system.

CHAPTER 7

PROPOSED RESOURCE MANAGEMENT STRATEGY

The preceding chapters have described the Belize barrier reef system and examined issues associated with utilizing and managing its natural resources. The research has analyzed policies and actions taken to date, documenting inadequacies of the present approach and proposing a more comprehensive and integrated resource management strategy. This chapter provides a synthesis of that proposed strategy and its implementation, both from a national perspective and the barrier reef system in particular.

National Resource Management

National policy and process. It has been demonstrated that Belize needs to formulate an overall national resource management strategy. At this level, such a strategy should contain a broad national policy on how the country views its natural resources and how it wants to make use of them. Table 2 illustrates, in a general sense, what this resource management strategy should contain.

A national policy should formulate and articulate a broad-based vision of the development, use and conservation of the country's natural resources. This vision should be conceptually based upon the principle of sustainable

Table 2. Components of a National Resource Management Policy

- . Vision/conceptual basis
 - . Overall goals and priorities
 - . National standards and requirements
 - . Cultural and political context
 - . Strategic components
 - .. Public education
 - .. Ecotourism policy
 - .. Other major strategic concerns
 - . Major management areas
 - .. Barrier reef system
 - .. National forests
 - .. Other management areas
 - . Institutional arrangements
-

utilization. It is especially important that the needs and concerns of economic development and conservation of natural resources be recognized, integrated and balanced. The policy will include national goals and priorities, as well as standards, criteria and requirements applicable to all programs and projects. Further, all of this must be accomplished within the Belizean context. Factors such as ethnic variation and traditional fishing and farming practices must be recognized and accommodated. The democratic but oligarchic political situation arises from these cultural and historic factors and largely directs public action. Nevertheless, policies and programs are developed and approved through the political process; their success, particularly in a democratic society, depends significantly upon a broad range of public input and

support. The national policy should also contain components for major resource management areas and other concerns of a strategic nature (e.g., network of national forests, public education, policy on ecotourism, etc.). The barrier reef system, or coastal zone, is certainly a key component and the strategy for its management will form a critical part of the overall national approach.

Institutional context. Institutional structures and arrangements play very important roles in the development and implementation of national policy (Eagles 1984). This starts with a legislative foundation and framework. While incorporating the country's commitment to conserving its living resources into its constitution (IUCN 1980) is not considered practical, such a commitment should be made legislatively as part of a national policy of sustainable use. Clear, unequivocal legislation is necessary to formalize a balanced and integrated national policy on use and management of the country's natural resources. Beyond that central "umbrella" statute, a legislative agenda should be pursued in a planned and proactive manner in accordance with the national strategy. The result will be a statutory framework for comprehensive, coordinated resource management. All legislation should clearly assign authorities and responsibilities, prescribe funding requirements and implementing directives, ensure enforcement

capabilities, and provide for public participation at the beginning of and throughout the process.

Whether or not they are brought about through legislation, administrative and organizational changes are needed. A high priority should be given to resolving the jurisdictional problems that exist and determining an effective structure for managing the country's resources. It would be impractical, even undesirable, to vest all national resource management authority in a single agency. Nevertheless, a central organization with one or more of the basic authorities of policy development, planning, program management, and oversight may be necessary. The issue of a central agency for resource management versus the operating ministries is a key institutional consideration for Belize (Figure 9). The type and extent of authority constitutes one of the primary determining factors in this issue. An important point is that authorities vested in a central agency will either be new ones not previously exercised by anyone or existing ones being exercised by the ministries.

The other primary factor is that of organization. How the government organizes for managing its natural resources, particularly in regard to conservation and economic development, will influence whether and to what degree these components are integrated. This, in turn, will play an important role in the success or failure of sustainable use as the underlying principle of resource management. Two

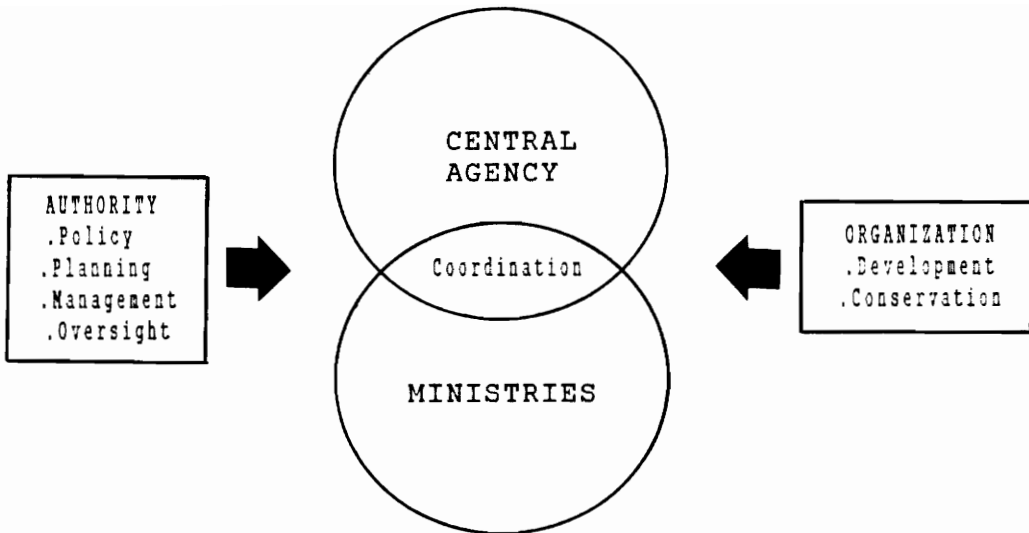


Figure 9. Institutional Arrangements

clear organizational options are separate agencies for economic development and conservation or an integrated organization combining both resource management components; other organizational arrangements can also be designed.

A high degree of coordination will be necessary between all responsible administrative bodies as well. This becomes increasingly important with a broadening in national resource management policy and corresponding modifications in the authorities, responsibilities, and organizational structures required to implement that policy. Lack of or poor coordination and communication among governmental agencies can render even the best policies and programs ineffective.

Strategy for Barrier Reef System.

Basic tenets. The purpose, objectives and principles of managing barrier reef resources are interconnected and interdependent (Table 3). The primary purpose or reason for management is to ensure that the resources of the area serve present needs without being depleted for future generations. The overriding principle of sustainable use is at the very heart of this purpose; without this conceptual basis, neither the objectives will be achieved nor the purpose realized. Multiple use has been considered in this paper as a desirable principle, but it is already well-established. Resources of the area are utilized for food, commerce, coastal protection, recreation, scientific research, and other purposes. The other principle, that of coastal zone scope, reflects those broad spatial and functional perspectives needed to deal with the scope and complexity of issues involved and achieve resource management objectives of the Belize barrier reef system. Interaction among components of the model is also reflected in the thrust and scope of objectives; they both derive from and reinforce the principles and purpose as well.

Protected area status. The need for resource protection, or protected area status, follows from the above discussion. Conservation cannot be one-dimensional; that is, at the expense and exclusion of necessary economic development.

Table 3. Resource Management Strategy for the Belize Barrier Reef System

STATEMENT OF PURPOSE. The resources of the barrier reef system and associated environs will be utilized so as to provide a desired level and variety of benefits to present generations while maintaining the potential of the resource base to meet the needs of the future

OBJECTIVES

- .Preserve the integrity of the barrier reef and associated environs to maintain essential ecological processes, genetic diversity and life support systems
- .Provide for the planned and rational utilization of the area and its resources for a variety of desired uses
- .Ensure the sustainability of the ecosystems and species of the system for future, continued existence and use
- .Provide an area of vital interest for education and scientific research into reef and coastal processes

PRINCIPLES

- .Coastal zone scope
- .Multiple use
- .Sustainable use

PROTECTED AREA STATUS. Designate coastal zone/barrier reef area as Biosphere Reserve and World Heritage Site

PLANNING STRATEGY. Use model planning process, customized for (1) cultural and institutional context and (2) components for public and private land ownership, international perspective, and contingencies for natural and manmade disasters

Nevertheless, conservation is required for resource sustainability, and it must be institutionalized to be effective (IUCN's Commission on National Parks and Protected Areas 1984; Lucas 1984). Different conservation categories were examined in the previous chapter and a preference expressed for international categorization in this case. Biosphere reserve designation, in particular, meets the conditions and needs of the Belize barrier reef system. Accordingly, the recommendation is made here that Belize expeditiously and aggressively pursue this designation from UNESCO for the entire coastal zone/barrier reef system. The country's own Hol Chan Marine Reserve on a smaller scale and the Great Barrier Reef Marine Park (the World Heritage Site that is really a Biosphere Reserve) on a larger scale provide excellent examples. It is further recommended that inscription of the reef system on the World Heritage List be pursued. It is deserving of world heritage designation and would benefit from the additional international stature and assistance from this recognition. This would be of particular benefit to education and scientific research. Responsibility for managing the protected area should be vested in a management body similar to that of the Great Barrier Reef in Australia. It is essential that authorities granted this agency be commensurate with its broad responsibilities, and that it be adequately funded and staffed with qualified personnel.

Planning approach. As previously discussed, a model planning process can be effectively applied to the barrier reef system with some necessary modifications to fit the Belizean context. This process is a useful framework because it provides an overall rational comprehensive approach while retaining the flexibility to take incremental actions, public participation throughout the planning process, and timely and thorough environmental impact assessment of proposed actions. This last element should include assessment of social as well as environmental impacts, especially important in a different cultural setting such as Belize.

Planning involves a wide range of functions. In this case, typical planning actions will include determination of resource management objectives for specific areas and sites of the coastal zone and reef complex; resource inventory, data collection and analysis; formulation of management alternatives and their potential allocation to specific areas/sites; assessment of the impacts of these measures; and evaluation and selection of the particular management alternatives. Additionally, it will be necessary to provide planning components for some other key factors particular to this area. A substantial degree of private land ownership along the coast and on the cayes is a complicating factor in public planning, due to the need to protect private rights of land use while attempting to provide for the public good.

An international perspective is also required, not only in terms of conservation unit categorization but also potential areal contact with Mexico to the north and Guatemala and Honduras to the south. Finally, a component for contingency planning would provide a needed means to deal with natural and manmade hazards--to prevent their occurrence if possible and ameliorate their effects if they do happen.

Management alternatives. A number of options are available in managing Belize's coastal zone resources, ranging from complete nonintervention in the area to total resource protection (Figure 10). Nonintervention would correspond with current general, unregulated use. Cooperative agreements are useful management tools where certain objectives or outcomes are desired, but regulation or greater controls are not called for. An agreement with residents maintaining traditional land use or fishing rights might be appropriate; one with owners/developers to encourage a desired ecotourism activity could also be effective. In areas where more intensive management is needed, regulatory controls such as licensing or permits can be applied. In other areas, development and certain uses such as fishing or snorkeling can be restricted. Such prohibited practices can apply altogether or only at certain times (e.g., ban on lobster fishing during spawning season). Acquisition of privately owned land may also be pursued to

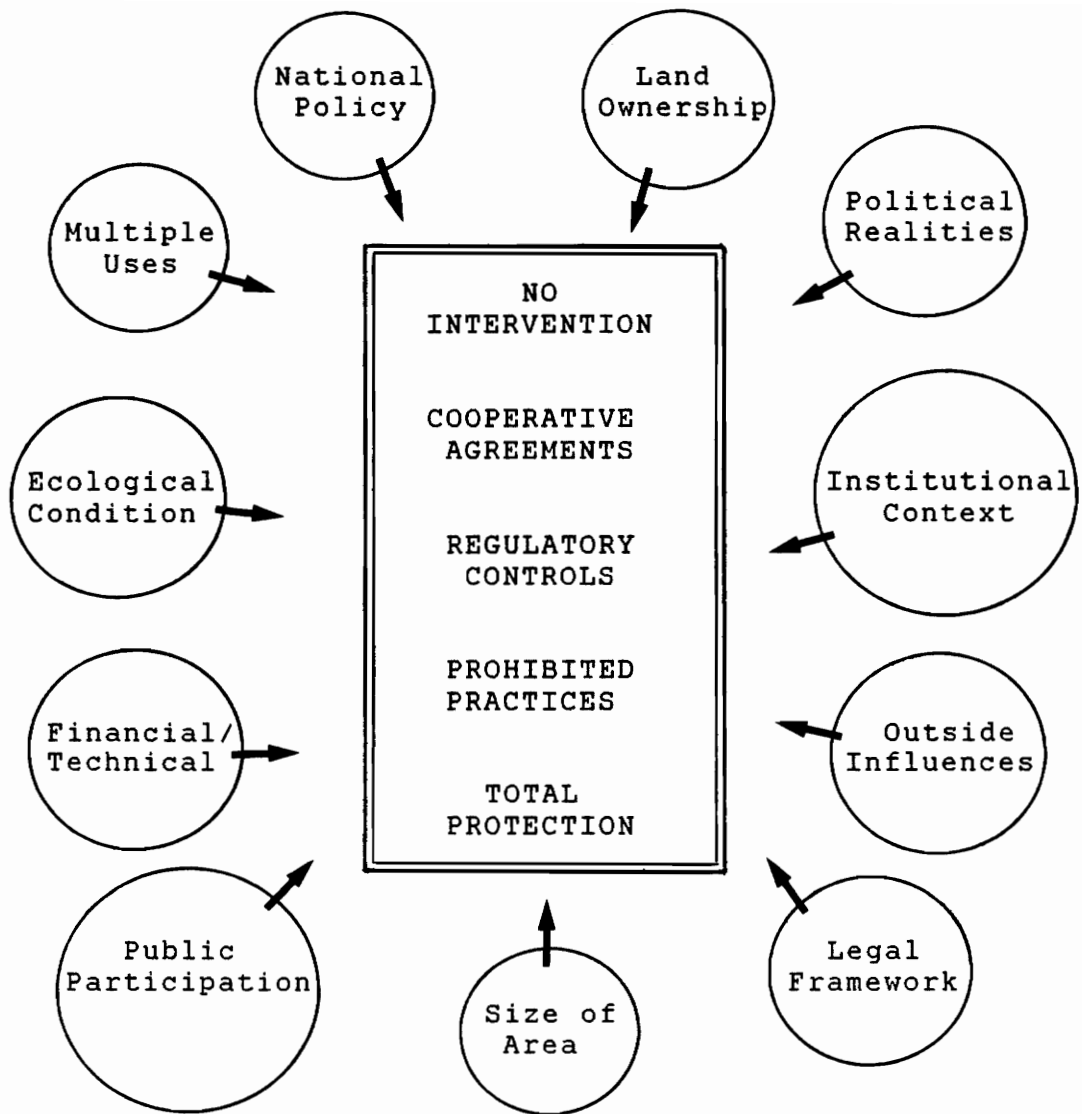


Figure 10. Management Alternatives

achieve a greater degree of public control and management. Finally, some sites/areas may be so ecologically sensitive or damaged that they must be totally protected. In these cases, intensive management ensures preservation or such limited use as scientific research and monitoring.

A wide variety of factors, as reflected in the illustration, determine appropriate and practicable management decisions. These influencing factors not only interact to choose a particular type of management but interact differently by locale to produce a mosaic of alternatives to fit diverse features and needs. For example, otherwise similar sites may be publically and privately owned, and the difference in land ownership may necessitate differences in managing the areas. Whereas a cooperative agreement relative to subsistence fishing might be appropriate in privately owned areas, fishing might only be allowed by special permit or prohibited altogether in other areas. Similarly, political realities and public desire for recreation may outweigh the fragile ecological condition of a particular locale in determining less restrictive resource management options. International assistance might overcome problems of extensive area and financial/technical limitations, resulting in more intensive management than would otherwise be possible.

Examination of these resource management options further highlights advantages and flexibilities of the

biosphere reserve category, especially the value of zoning in effectively meeting the needs of different areas and their multiplicity of uses. It will provide the planners, decision-makers and managers more latitude in selecting and implementing appropriate management designs.

Putting Strategy Into Action

In speaking of a strategy for planning and management of environmentally sensitive areas, it has been pointed out that a plan is only as good as its implementation and is implemented only when it is feasible and acceptable (Eagles 1984). Successful implementation of the strategy formulated in this research depends upon maximizing favorable factors and minimizing or overcoming unfavorable ones. Several factors will present particular difficulties, and these should be accorded special attention. The first is that of public participation, common to all such endeavors and often a "make or break" factor. The process must deliberately provide for the involvement of general and special interest publics throughout planning and implementation phases. As previously discussed, Belize would benefit from more open and broad-based public participation in the decision-making process, and developing an effective process for this is a key challenge for the country's leaders. It must further be realized that participation will not necessarily result in consensus. Human activities are not always compatible with

conservation, especially for local populations and traditional uses (Halffter and Ezcurra 1987). It may be necessary to change the traditional practices of local people or else change the plan. The important point is that creating opportunities for public participation is vital. Education can enhance public input and support, and a great deal of this is occurring in Belize. The zoo, public schools, Belize Audubon Society, and government agencies (especially the Fisheries Department) are engaged in extensive educational activities for resource management. It is critical that public education programs be continued and expanded in order to build a well-informed, supportive constituency. This should be an integral part of all strategy development, program planning and resource management activities.

Another troublesome factor is the need for institutional changes. Legal and administrative changes that have been mentioned are necessary now if strategy and policy formulation is to be accomplished. Other institutional factors will also play important roles in resource planning and management. However, changes to existing bureaucratic structures and authorities are not easy to institute. Foresight, determination and leadership will be needed to bring about such change. As an initial step, a central policy/planning body should be created as soon as possible to develop requisite strategy, policy and

implementing actions.

The third key factor of concern is that of size of the total managed area. As discussed earlier, the basic unit of management should be the ecosystem (IUCN 1980; IUCN 1986). However, the scale of ecosystems in coastal and marine environments like the Belize barrier reef system is large, perhaps too large to manage as a single conservation unit. The flexibilities of biosphere reserve zoning can play an important role here. For example, areas that need to be preserved can form a network of reference sites, with buffer zones, even several different types, addressing the needs of multiple use and sustainable development (Kenchington and Agardy 1990). The protected area can also extend inland, in accordance with a coastal zone perspective, to the point where other ecosystems (and other management areas) predominate. The primary point here is that the biosphere reserve concept and its zoning system can accommodate the spatially extensive character and requirements of the barrier reef system.

This completes development of an overall resource management strategy for the Belize barrier reef system, including a national policy for managing the country's natural resources. The research has endeavored to provide the necessary strategic framework for planning and implementing specific resource management policies, programs and actions.

CHAPTER 8

CONCLUSION

The small nation of Belize has one of the most extensive and pristine barrier and coral reef environments in the world. The system is of great economic and ecological significance to the country. Belize needs economic growth, and development is a high national priority. However, an environmental ethic has emerged as protection of the natural resource base becomes an increasingly important concern. Actions taken to date, while laudable, have been small-scale, piecemeal, and reactive. They are not adequate to deal effectively with the broad, interrelated characteristics and requirements of the area.

This research has examined resource management issues in the Belize barrier reef system. Objectives and principles have been identified and used in assessing policies and actions in Belize. The need for a broader geographical and functional perspective has been demonstrated in proposing a comprehensive, integrated resource management strategy. The research focuses on a broad approach, based on the underlying principle of sustainable use, to reconcile interests of development and

conservation of natural resources. Legitimate, long-term economic and environmental requirements suggest a strategy aimed at resource sustainability. The proposed strategy includes a recommendation for a zoned biosphere reserve management scheme in the coastal zone, utilizing its flexibilities to achieve the objectives of multiple and sustained use. National resource management policy and institutions constitute the context within which any such strategy must exist.

This approach provides a conceptual framework upon which to plan and implement specific policies and programs of resource management. Its emphasis upon a coastal zone spatial scope and interdisciplinary functional perspective forces a broad, integrated view of policy development, planning and management. The conclusions and proposals made here are intended to provide a frame of reference for future deliberations of Belize barrier reef system resource management. Some other studies have utilized a broad spatial and functional perspective relative to managing natural resources in general, and a few have dealt with barrier reef conservation/development or coastal zone management in Belize from a more narrow view. This research has attempted to furnish a comprehensive synthesis of a broad strategic management approach to resources of the Belize barrier reef system.

Problems and complicating factors have been identified

and discussed throughout the study, particularly in regard to implementing the proposed strategy. These difficulties are serious but can be overcome. Belize has a government and public which is relatively knowledgeable of and concerned about managing its resources in a responsible manner. The need for sustainable use of the country's natural resource base is becoming increasingly apparent. Dedicated NGOs and individuals, as well as willing international agencies, are providing expertise and financing to support developmental and environmental actions. Some of them are providing the beginnings of a comprehensive and integrated perspective of coastal zone resource management. It is hoped that the impetus in this direction will continue.

This research has been purposely broad in examining development and conservation issues of the Belize barrier reef system and proposing an overall resource management strategy. Additional research in this area would be extremely beneficial. In particular, research on the spatial extent and boundaries of coastal zone management units would be useful to Belize in establishing their protected area(s). This will be an issue of considerable difficulty and concern. Resource data and inventory is another area in which some important work has been done but more is needed. Detailed, comprehensive baseline information is of key importance to identify present

inventory and status of resources, develop appropriate programs of action, and evaluate effects of these and other programs. A third subject for additional research is the Hol Chan Marine Reserve. Research is needed to thoroughly analyze impacts and evaluate effectiveness of this reserve in terms of the objectives for which it was established. This is particularly important if Hol Chan is to be used as a model for other reserves in the barrier reef complex or for a system-wide biosphere reserve. Additionally, research on ecotourism would be very useful, particularly its positive and negative effects in contexts such as Belize. Research in these and other topics relative to the Belize barrier reef system or coastal zone/reef resource management will have important applications here and elsewhere.

APPENDIX

INTERVIEWS IN BELIZE

Jeffrey Allen
Natural Resources Officer
U.S. Agency for International Development
30 May 1991

Lou Nicolait
Executive Director
Belize Center for Environmental Studies
31 May 1991

Vincent Gillett
Administrator
Department of Fisheries
4 June 1991

Evan Cayetano
Director, Marine Division
Programme for Belize
5 June 1991

Ellen McRae
Director
Siwa-ban Foundation
10 June 1991

Maria Vega
Vice-President
Belize Tourism Industry Association
10 June 1991

Melanie Dotherow
Marine Biologist
Hol Chan Marine Reserve
13 June 1991

James Azueta
Director
Hol Chan Marine Reserve
17 June 1991

Hipolito Bautista
Secretary-General
National UNESCO Commission
19 June 1991

Walter Craig
Chairman, Science and Technology Sub-committee
National UNESCO Commission
19 June 1991

Victor Gonzalez
Permanent Secretary
Ministry of Tourism and Environment
20 June 1991

Janet Gibson
President
Belize Audubon Society
8 July 1991

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BIOGRAPHICAL SKETCH

Fred T. Wildes was born in 1943 in Brooklyn, New York. He graduated from the University of Maine in 1965 with a Bachelor of Arts degree in International Affairs, and received a Master of Arts degree in Public Administration from the University of Oklahoma in 1974.

Mr. Wildes worked for the United States government (civil service) for twenty five years, primarily in the Department of Air Force personnel business. Key positions included Personnel Officer at Bitburg Air Base, Director of Civilian Personnel for the Tactical Air Command, and Special Assistant for Systems Innovation and Simplification for Headquarters Air Force (assigned to the U.S. Office of Personnel Management). He held assignments in Guam, Germany, and a number of locations in the United States.

Mr. Wildes left government employment in 1990 and returned to the academic world. He received a Master of Science degree in Geography in 1992 from Virginia Polytechnic Institute and State University, and is pursuing further study in that field.

