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COASTAL AND MARINE RESOURCES MANAGEMENT FOR THE GALAPAGOS ISLANDS

By

J. Broadus, I. Pires, A. Gaines, C. Bailey, R. Knecht, and B. Cicin-Sain

Marine Policy and Ocean Management Center
Woods Hole Oceanographic Institution

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Technical Report

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David A. Ross
Director, MPOM

ABSTRACT

The report briefly describes coastal and marine resource uses and problems in Ecuador's Galápagos Islands, discusses general principles of coastal zone management (CZM) and marine resources management (MRM), examines the current status of CZM and MRM in the Galápagos Islands, and offers observations on possible avenues for improvement. The archipelago has long been the object of worldwide scientific interest. Increased demands on its coastal and marine resources, to serve a growing resident population and to accommodate potentially lucrative tourism, signal a need for greater attention to the management of these resources. Coastal and marine affairs and problems in the Galápagos which can be addressed by a CZM/MRM process include: conservation of the Islands' unique biota and habitats; tourism; port development; waste disposal; resource extraction; and fisheries. The basic elements of a CZM and MRM system are already in place in the Galápagos, but they are uncoordinated and largely ad hoc in nature. Existing and potential jurisdictional ambiguities or conflicts between the Navy/Port Captaincies, the municipalities, the National Park, the development agency for the Galápagos (INGALA) and other organizations are described. A two-zone management scheme for coastal and marine resources is outlined. It avoids the establishment of complicated new systems of boundaries and institutions, instead adapting itself to the existing situation. Four possible mechanisms for improved coordination are identified: cooperative management; a coastal zone and marine resources council; a series of agreements ("convenios") between relevant agencies; and application of incentives. The possible creation of a marine protected area is discussed, including rationale for the area's establishment, its designation and organization, jurisdictions, boundaries and zoning, and the protection of traditional uses.

PREFACE

This Technical Report is presented to the Government of Ecuador in the sincere hope that it may be of use to the Ecuadorian people. This is a revision of an earlier draft prepared by the Marine Policy and Ocean Management Center (MPOM) of the Woods Hole Oceanographic Institution (WHOI) as a working document for Ecuador's High Level Commission for the Formulation of a Galápagos Master Plan.

MPOM comprises a multidisciplinary group of social and natural scientists who conduct research into topics concerning use of the world's oceans and coastal areas. In February 1983, the High Level Commission invited MPOM to participate in research to support the Commission's planning effort. MPOM was requested to examine coastal and marine resources management in the Galápagos and to suggest concepts for an improved management approach.

During 1983 MPOM Senior Fellows Robert Knecht, formerly head of the U.S. Office of Coastal Zone Management, and Dr. Bilitiana Cicin-Sain, a political scientist with expertise in Latin American marine affairs, visited the Galápagos and outlined a possible WHOI approach to the project for the High Level Commission. Later, in July 1983, a second MPOM group visited Ecuador for three weeks to examine conditions in the Galápagos. This team consisted of Dr. James Broadus, an economist, Mr. Ivon Pires, LL.M., an international lawyer, Dr. Arthur Gaines, an oceanographer with coastal zone experience, and Dr. Conner Bailey, a rural sociologist with expertise in artisanal fisheries. The team interviewed officials and other residents on all four of the populated islands and visited a number of Galápagos National Park sites and uninhabited islands.

The WHOI research focused on: the nature of coastal and marine resources in the Galápagos and how they are used, including the management of fisheries; legal and administrative arrangements for coastal and marine resource management and the conflicts that exist; and the possibilities for establishment of a marine park or reserve. This report is the result of that study. As it is intended primarily for use by Ecuadorian planners and decision makers, the report provides background on Ecuadorian institutions and agencies only as needed to highlight their roles in the management of coastal and marine resources in Galápagos.

The authors gratefully acknowledge all those who gave their time and support to provide information for our study, particularly Dr. Raúl Moscoso and Dr. Rodrigo de la Puente from the High Level Commission, Senator Rodrigo Cisneros, then Galápagos representative to the Ecuadorian Congress, mayors from the Galápagos municipalities, and the many officials from the Galápagos National Park, Galápagos National Institute, the Ecuadorian Navy, the Charles Darwin Research Station, and from other Ecuadorian agencies and institutions, several of whom are cited in this report. Special appreciation is due Ab. Efraín Pérez, who accompanied us on our visit, provided us with many knowledgeable observations, and consulted with us on the legal accuracy of this report, and to MPOM Research Assistant Ingrid Desilvestre for her many diligent efforts.

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EXECUTIVE SUMMARY

COASTAL AND MARINE RESOURCES MANAGEMENT FOR THE GALAPAGOS ISLANDS

The report briefly describes coastal and marine resource uses and problems in Ecuador's Galápagos Islands, discusses general principles of coastal zone management (CZM) and marine resources management (MRM), examines the current status of CZM and MRM in the Galápagos Islands, and offers observations on possible avenues for improvement.

The Galápagos Islands Setting

The Galápagos Islands have long been the object of worldwide scientific interest because of their unique and instructive ecosystem. With over 90 per cent of the islands' land area assigned to the Galápagos National Park (PNG) in 1979, less than 10 per cent is occupied by a small but growing resident population (now estimated to be slightly over 6,000). Local affairs on the four populated islands are managed through three municipal governments. The Galápagos National Institute (INGALA) was created in 1980 to plan and coordinate development activities within the archipelago in place of a provincial council.

Increased demands on the coastal and marine resources of the Galápagos, to serve a growing resident population and to accommodate potentially lucrative tourism, signal a need for greater attention to the management of coastal and marine resources. An integrated approach to coastal zone and marine resources management would attempt to address these demands in a comprehensive and coordinated way, but the formulation of such an approach suitable to the Galápagos is a major challenge.

Coastal and Marine Resources of the Galápagos and their Uses

Uses of the coastal and marine resources of the Galápagos fall into two general classes: a) environmental conservation and preservation for science,

education and tourism activities; and b) economic and development activities to serve the resident and transient population in the inhabited areas. Continued development of the coastal urban areas raises issues of appropriate shoreline development and allocation of access to limited available shoreline. Conflicts already have arisen over siting of coastal buildings and sewage outfalls. Selection of suitable building sites is complicated by such natural hazards as periodic flooding, seawater intrusion, and shifting beach sands. Water management and waste disposal are complicated by the complex hydrology of the islands' volcanic rock, raising the risk of water contamination by sewage and agricultural runoff. Removal of beach sand for building purposes has raised concerns about accelerated coastal erosion and destruction of recreational beaches and turtle nesting sites. Questions will also be faced in the near term about improvement and expansion of primitive port and harbor facilities and their relationship to expanded airport capacity.

Special problems of the Galápagos include the archipelago's remote location, the isolation of its scattered human population, and its unique global importance as an environmental and scientific asset. The entire land area of the islands is strongly interactive with oceanic processes and thus comprises a coastal zone. A number of endemic and indigenous terrestrial organisms are dependent on the surrounding marine environment. There is also a high degree of endemism in the archipelago's marine species.

The introduction of alien species is a problem of peculiar importance in the Galápagos. The inability of large ships to come alongside existing harbor facilities may be an important protection from introduction of alien species to the Galápagos. Ships are well-known vectors of exotic species and the lightering step employed in all municipal harbors may confer a measure of safety in this regard.

The Galápagos marine area, a distinct biogeographic province, is not currently included in the PNG. However, it is believed to be critically important to the preservation of the islands' ecosystem and provides an important economic resource for the islands' inhabitants. Although artificial pressures on this complex marine environment now appear relatively minor, human activities could grow to the point or be of a kind that would result in unacceptable or irreversible effects from marine pollution, tourism uses,

commercial collecting, and industrial fisheries. Artisanal fishing is a long-established economic activity in the Galápagos Islands which provides an important source of employment and income for the islands' residents. Existing artisanal fisheries do not appear to threaten the main finfish resources (bacalao and mullet). The status of the lobster and black coral resources and the role of commercial lobster fisheries in exploiting these resources is less clear. The Galápagos marine environment has shown increasing appeal as a tourist attraction, but no clear mechanism has been established to coordinate control of tourist activities in the marine area.

Coastal Zone and Marine Resources Management: Concepts and Principles Applied to Small Islands

Small islands are dominated by the surrounding ocean and its influences. Experience indicates that coastal zone and marine resources management systems on oceanic islands should take into account the following common features: isolation and spatial confinement; shortages of natural resources including fresh water; natural hazards; limited organic diversity; high incidence of endemic or unique species; tourism; vulnerability to rapid and destructive environmental and economic change from outside influences.

Coastal management experience in small island situations also suggests that a strong public awareness and education effort is often crucial to success. With insularity comes suspicion of new ideas, especially those that may appear to be brought by outsiders. Parallel with the adoption of coastal policies and procedures, the public must be encouraged to understand and accept their value.

Developments in coastal and marine resources management within other countries may hold some relevance for the Galápagos. Until recently, the management of coastal and marine resources in most countries was conducted on a resource-by-resource basis. The interrelated nature of many coastal processes (both natural and manmade) has created a need for more integrated approaches to management as intensity of resource use increases. Three basic components are common to every coastal management system: 1) a set of public goals or policies; 2) a framework of procedures for carrying out these policies; and 3) a set of organizations or agencies which implement these procedures.

Coastal and Marine Resources Management in the Galápagos Islands

The basic elements of a CZM and MRM system are in place in the Galápagos, but they are often uncoordinated and largely ad hoc in nature. Jurisdiction over the coastal and maritime areas for the purpose of managing specific uses or resources is somewhat fragmented among several institutions: Navy, Port Captaincies, PNG, INGALA, the municipalities, Subsecretariat of Fisheries Resources and the National Fisheries Authority within the Ministry of Natural Resources and Energy, and the National Tourism Authority (DITURIS). The most important apparent ambiguities, conflicts, or gaps in the system as it now stands are:

- * The degree of municipal jurisdiction over marine areas is unclear, vital though these areas are to inter-island transportation, fisheries, and other uses.
- * The degree of navy/port captaincy control over the land zone contiguous to the beach and bay area is unclear.
- * There is a lack of centralized planning and monitoring of touristic activities on the islands.
- * Existing technical expertise is not effectively incorporated into the planning process.
- * INGALA's mandate is not explicit on how interaction should occur with the PNG.

Concepts for Improved Coastal and Marine Resources

Management in the Galápagos

It should be possible to achieve coordination and improved coherence in coastal and marine resources management through improved and focused communication and the application of existing powers within already recognized boundaries. The greatest opportunities for improvement seem to lie in refinement of the existing procedural framework and the structure of interagency responsibilities and relationships.

A general statement of purpose for the design of more coherent coastal zone and marine resources management in the Galápagos might be:

To fashion a process by which both public and private actions in coastal and marine areas of the archipelago can be managed to improve the social condition of the islands' inhabitants, given that the protection of the islands' unique ecosystems will continue to be an overriding consideration.

To meet this objective, the following features of a coastal zone and marine resources management process seem appropriate to the Galápagos.

- * Emphasize protection of environmental values.
- * Reflect and accommodate needs and concerns of the resident population, including traditional fishing activities.
- * Address the issue of formal protection of the Galápagos marine area.
- * Incorporate the best feasible scientific and technical information.
- * Be simple, inexpensive, and politically realistic.
- * Minimize the creation of new boundaries, laws or institutions.

Under a two-zone management system, two overlapping management areas would be established: 1) a marine resources management zone extending seaward some distance and perhaps containing a narrow onshore margin; and 2) an onshore coastal zone management area, overlapping the landward margin of the marine resources zone and extending some relevant distance seaward as well. Existing boundaries and agency assignments might be readily adapted to a revised system of coastal zone and marine resources management similar to the two-zone working model. As a frame of reference for further discussion, management areas in this model are broadly defined, with all islands treated as coastal zone and all internal waters included in a special marine management area. In addition, the marine zone includes a buffer of some width surrounding the archipelago's internal waters. A special marine management area could be readily organized to permit multiple-use activities.

New administrative instruments or mechanisms may be required to initiate and achieve improved coordination. Several possible alternative or complementary mechanisms can be identified: 1) adoption of a cooperative management approach; 2) establishment of a permanent or temporary coastal zone and marine resources council, perhaps operating through a series of task forces; 3) execution of a series of coastal and marine area management convenios between the relevant agencies to clarify roles, responsibilities, and understandings of purpose; and 4) application, either within the existing situation or as a supplement to other instruments, of tangible incentives for involvement and cooperation in the joint effort.

Provisions for public access to and involvement in the process are important for the management system to succeed. Attention might also be directed to the creation of a workable process by which relevant technical and scientific information can be generated and fed into the management process on a timely basis. Public education is also important to cultivate a sense of stewardship among the resident population that could greatly reduce frictions and cross-purposes in coastal and marine area management efforts.

Marine Resources Management: The Special Problem of A Galápagos Marine Park or Reserve

The long-pending issue of a marine park or reserve for the Galápagos is one of the major questions facing coastal area and marine resources management there. While national policy for the onshore area of the Galápagos Islands stresses conservation of the natural environment, no clear policy seems to have been defined for the Galápagos marine area. Because the Galápagos marine environment is virtually pristine, an obvious opportunity exists for the orderly establishment of special management provisions that preserve the habitats and traditional uses of this important marine area.

A basic rationale for creation of a marine reserve would be:

To protect and conserve for all time a place which is a significant example of Ecuador's and the World's marine heritage and also to encourage public understanding, appreciation and enjoyment of this heritage in ways which leave the area unimpaired for future generations.

Several proposals have been made previously for the creation of a marine park or reserve in Galápagos waters, but little has come of these. Resistance by local residents to possible new controls on their traditional use of the marine environment, such as for artisanal fishing, may have hindered the formulation of a clear national policy.

Protection of traditional use is a major consideration in establishment of a special marine management area, as are questions about: designation and administrative assignment; boundary delimitation; and zonation. Protection of traditional uses can be a prime objective in creating such a marine reserve and is a common feature of a number of the world's marine parks. Although some restrictions on artisanal or commercial activities are maintained in Ecuador's national parks under the 1971 National Parks and Reserves Law, several other natural area designations are available under the 1981 Forestry

and Conservation Law that explicitly permit or foster traditional uses.

"Fauna production areas," for example, not only allow activities of scientific research and recreation but also the rational development and use of wildlife for the benefit of local communities. As these activities must not damage existing species and resources, this designation might represent one way of implementing a "marine park" in the Galápagos.

Because of the importance of the marine area to the integrity of terrestrial Galápagos habitats, it would seem important that PNG play an influential role in the formulation of policies, regulations, and management rules of procedure. The Navy might be called upon and granted the resources to play a primary enforcement role. Effective administration of a marine reserve will in any case require a high degree of interagency coordination and cooperation. Inclusion of all the archipelago's internal waters would provide a broad buffer for sensitive coastal habitats and could greatly simplify administrative coordination and reduce enforcement costs.

There seems little point in moving to a detailed planning stage until the intention to create such a park or reserve has been established as national policy. Among several options available for consideration by the Government of Ecuador on this issue, two stand out as most promising:

- * Establish policy that future creation of marine park or reserve in Galápagos waters is envisaged and initiate discussions and further study toward most appropriate definition and timely implementation of such a park or reserve.
- * Establish a marine park or reserve in the Galápagos immediately by decree, which could leave open the details of the organization and implementation of the park or reserve.

Opportunities for Action

More general opportunities for constructive action by the Government of Ecuador in CZM and MRM for the Galápagos Islands might include the following possibilities:

- * Establish as a matter of national policy that an integrated process of coastal zone and marine resources management is appropriate for the Galápagos Islands and initiate the actions necessary to implement that policy.
- * Establish a general policy for conservation and preservation in the Galápagos marine environment that accommodates the continued economic use of the marine area and begin discussions toward implementation, with particular attention to the issue of a marine park or reserve.

- * Design and initiate a program to educate the resident population more fully about the special global importance of the Galápagos environment.
- * Devise and incorporate mechanisms to assure effective public access to and involvement in the CZM and MRM process.
- * Design and establish a workable system by which relevant technical and scientific information can be generated and employed on a timely basis in the Galápagos Islands CZM and MRM process.
- * Review the management of tourism traffic in the Galápagos in order to identify alternative approaches that might increase tourism revenues, expand benefits to the resident population, and at the same time reduce environmental pressures from tourism.

With the cooperation of involved agencies and institutions, and with public participation and support, marine policies and a process of coastal and marine resources management can be achieved that will benefit the archipelago's inhabitants directly while protecting its unique ecosystems for generations to come.

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LIST OF ACRONYMS

CANEITG--Comisión de Alto Nivel para el Estudio del Impacto del Turismo en Galapagos (High Level Commission for the Study of the Impact of Tourism on the Galápagos)

CZM--Coastal Zone Management

DITURIS--Dirección Nacional de Turismo (National Tourism Authority)

DIMERC--Dirección de la Marina Mercante y del Litoral (Merchant Marine and Coastal Authority)

DIGEIM--Dirección General de Intereses Marítimos (General Directorate of Maritime Affairs)

IATTC--Inter-American Tropical Tuna Commission

INGALA--Instituto Nacional Galápagos (National Galápagos Institute)

INP--Instituto Nacional de Pesca (National Fisheries Institute)

INOCAR--Instituto Oceanográfico de la Armada (Naval Oceanographic Institute)

MPOM--Marine Policy and Ocean Management Center

MRM--Marine Resources Management

PNG--Parque Nacional Galápagos (Galápagos National Park)

UNESCO--United Nations Education, Science and Cultural Organization

WHOI--Woods Hole Oceanographic Institution

1. THE GALAPAGOS ISLANDS SETTING

The Galápagos is a watery domain. Situated some 1,000 km west of the Ecuadorian mainland, the remote archipelago sits virtually alone in a huge expanse of Pacific Ocean. The Galápagos coastline is longer than that of continental Ecuador, and the ratio of coastline to land area in the Galápagos is nearly 40 times that of continental Ecuador. As on all oceanic islands, marine and coastal processes are of central importance in the Galápagos Islands.

Uses, Goals and Trends

Distinguished as a unique and instructive ecosystem, the archipelago has long been the object of worldwide scientific interest. The heterogeneity of biological adaptive responses is nowhere more apparent than on oceanic islands (Dobzhansky, 1965), and the Galápagos have provided an important and relatively isolated laboratory for studies in comparative evolution ever since Darwin's historic visit in 1835. They are also a major site for the study of earth sciences: among oceanic islands of the Pacific, the only other place where active surface eruption is still in progress is the island of Hawaii (Thomas, 1965).

A major goal of the Government of Ecuador has therefore been to preserve the natural environment of the archipelago and to maintain the value of the islands for science and education. To that end, the Galápagos have been declared the "Natural Patrimony of Mankind" and are to be nominated for inclusion in the United Nations' system of "Biosphere Reserves." A Galápagos National Park (PNG) was established in 1959 (Decreto-Ley no. 17), with over 90 percent of the islands' land area assigned to the PNG in 1979 (Acuerdo no. 297).

The remainder of the islands' area, less than 10 percent, is occupied by a small but growing resident population. From a total of only a few hundred in the 1940s, population of the islands has now expanded to over 6,000 people. Limited to only four islands, most of the population is divided between Santa Cruz and San Cristóbal. A few hundred people live on Isabela and about 65 on Floreana. Principal occupations are administration, tourism, agriculture and livestock, and fishing. Tourism has grown rapidly in importance over the past

decade and is seen by some as having potential for greatly expanded revenue creation.

Colonization and some degree of development were considered to be the avenues to the maintenance of sovereign control over the remote archipelago. Although there is now no apparent challenge to Ecuadorian sovereignty in the Galápagos (Pérez, 1983), in Ecuador this still seems to be a sensitive political issue relating to the archipelago, even superseding that of conservation (Cisneros, 1983).

Political Organization

Ecuador exercises its sovereignty over the ocean space to the extent of a two-hundred mile territorial sea (Código Civil, Art. 628) which, in the Galápagos, is to be measured from an archipelagic baseline formed by straight lines connecting its outermost islands (see Figure 1): Darwin, Genovesa, San Cristóbal, Española, Floreana, Isabela and Fernandina (Decreto Supremo 959-A). The water mass between this archipelagic baseline and the lowest tide marks within the archipelago is considered to be internal waters. Both the territorial sea and the internal waters are components of an area Ecuadorian law refers to as "adjacent sea."

The creation of the Galápagos Province in 1973 (Decreto Supremo no. 164; Decreto Supremo no. 274) established the division of 16 major islands and neighboring islets under the jurisdiction of three cantons: San Cristóbal, Santa Cruz and Isabela (see Figure 2). Puerto Baquerizo Moreno, an urban area on the island of San Cristóbal, was designated the head of the canton and the capital of the province. El Progreso, a rural area also on the island of San Cristóbal, and the island of Floreana, with the urban area of Puerto Velasco Ibarra and an agricultural sector, are additional populated segments of this canton. In Santa Cruz, Puerto Ayora is the head of the canton, with rural settlements inland at Bellavista and Santa Rosa. The canton of Isabela is headed by Puerto Villamil and has only one rural community, Santo Tomás de Berlanga.

Each Galápagos canton thus corresponds to a municipality created by law to perform specific functions, such as the planning and development of urban and rural areas of the cantons, and to contribute to the welfare and protection of local interests (Ley de Régimen Municipal as amended by Decreto Legislativo no. 104). This is to be accomplished with a view toward the

Figure 1. Illustration of the Galápagos adjacent sea.

Figure 2. Cantonal division of the Galápagos Province: San Cristóbal, Santa María Floreana, Española, Santa Fe and Genovesa; 2) Santa Cruz, Pinzón, Rábida, Santiago, Pinta, Marchena and Baltra; 3) Isabela, Fernandina, Charles Darwin and Teodoro Wolf.

preservation of the unique natural flora and fauna of the islands (Decreto Supremo no. 164). Because most of the Galápagos area is under the administration of the Ministry of Agriculture (Ley de Parques, and Ley Forestal y de Conservación), only the colonized areas according to the 1979 demarcation (Acuerdo no. 297) are under the effective control of the municipalities. Municipal authority also may extend into the adjacent sea (Ley de Régimen Municipal).

According to the Constitution of 1979, the administration of the Province resides with a governor appointed by the President. In the absence of a provincial council, the Galápagos National Institute (INGALA) was created in 1980 to plan and coordinate developmental activities within the archipelago at the provincial level. Besides the work that would normally correspond to a provincial council, INGALA was mandated to provide technical and financial assistance to other institutions and to regulate most activities within the archipelago (Ley de INGALA). The President of Ecuador may nominate and remove INGALA's manager at will (Ley de INGALA).

Coastal and Marine Management Challenges

Increased demands on the coastal and marine resources of the Galápagos, to serve a growing resident population and to accommodate potentially lucrative tourism, signal a need for greater attention to the management of coastal and marine resources. Continued development of the coastal urban areas raises issues of appropriate shoreline development and allocation of access to limited available shoreline. Conflicts have already arisen over siting of coastal buildings and sewage outfalls. Selection of suitable building sites is complicated by the presence of such natural hazards as periodic flooding, seawater intrusion, and shifting beach sands. Water management and waste disposal are complicated by the complex hydrology of the islands' volcanic rock, raising the risk of water contamination by sewage, agricultural runoff, and seawater. Removal of beach sand for building purposes has raised concerns about accelerated coastal erosion and destruction of recreational beaches and turtle nesting sites. Questions will also be faced in the near term about improvement and expansion of primitive port and harbor facilities and their relationship to expanded airport capacity.

An integrated approach to coastal zone and marine resources management would attempt to address such issues in a comprehensive and coordinated way, but the formulation of such an approach suitable to the Galápagos is a major challenge. Management of the archipelago's coastal area and marine resources currently is ad hoc and often uncoordinated. Ecuador is a leader in conservation activities and has begun efforts to plan integrated regulation and development of its coastal zone (DIGEIM-UN, 1983). This preliminary coastal zone work, however, has not addressed the special problems of the Galápagos. These include the archipelago's remote location, the isolation of its scattered human population, and its unique global importance as an environmental and scientific asset. The entire land area of the islands is strongly interactive with oceanic processes and thus comprises a coastal zone. A number of endemic and indigenous terrestrial organisms are dependent on the surrounding marine environment. There is also a high degree of endemism in the archipelago's marine species. The introduction of alien species is a problem of peculiar importance in the Galápagos.

The Galápagos marine environment has shown increasing appeal as a tourist attraction, but no clear mechanism has been established to coordinate control of tourist activities in the marine area. While national policy for the onshore area unambiguously stresses conservation of the natural environment, no clear policy seems to have been defined for the Galápagos marine area. Several proposals have been made previously for the creation of a marine park or reserve in Galápagos waters, but little has come of these. Resistance by local residents to possible new controls on their traditional use of the marine environment, such as for artisanal fishing, may have hindered the formulation of a clear national policy. Because the Galápagos marine environment is virtually pristine, however, an obvious opportunity exists for the orderly establishment of special management provisions that preserve traditional uses for this important marine area.

These challenges for coastal zone management (CZM) and marine resources management (MRM) in Galápagos are addressed in greater detail below. The remainder of the report briefly describes coastal and marine resource uses and problems in the Galápagos, discusses general principles of coastal zone and marine resources management, examines the current status of CZM and MRM in the Galápagos, and offers observations on possible avenues for improvement.

2. COASTAL AND MARINE RESOURCES OF THE GALAPAGOS AND THEIR USES

The complex Galápagos marine environment is still little-known. Wellington's 1974 work is the only comprehensive reference on marine life and habitats of Galápagos (Wellington, 1975 and 1984). He stresses that much remains to be learned. Biogeographers regard these waters as a distinct biotic province. The Galápagos marine environment is characterized by:

- * High diversity--a rich and varied flora and fauna compared to other marine insular environments in the Eastern Pacific.
- * High degree of endemism in the marine biota--around 25 percent of most groups occur nowhere else on earth (Wellington, 1976a).
- * Complex and unusual system of oceanic currents--cool currents, upwelling areas, and water masses of different origins transporting bioelements from tropical and subtropical regions of the American continent as well as from the Indo-Pacific biotic province (Robinson, 1983b; Villa, 1981).
- * Unusual mixed biogeographic affinities--strong phyto- and zoogeographical affinities with the Tropical and Subtropical American continent, with many elements representing the Peruvian/Chilean and West Pacific Provinces.
- * Large habitat-type diversity and highly complex marine communities relative to other insular marine areas in the Eastern Tropical Pacific. The variety of geomorphologic characteristics offer a high density of marine habitats isolated from the continent (Villa, 1981). Comprises rocky, vertical cliff face, mangrove, sandy beach, lagoon, embayment, and hypersaline panne habitats.
- * Critical importance to a large number of terrestrial organisms which are dependent on the marine environment for survival. "Many of the fantastic animals such as the penguin, fur seal, sea lions, flightless cormorant, waved albatross, and marine iguana--not to mention the large array of sea bird species--are directly dependent on the marine environment for their existence" (Wellington, 1976a). Of 57 resident bird species in Galápagos, 27 depend on the surrounding ocean (Robinson, 1983b; Harris, 1982).
- * Pristine quality--little altered by man compared to most marine areas in the world (Wellington, 1976a).
- * Scientific Importance--the available evidence indicates that the Galápagos marine environments may offer opportunities for basic biological studies comparable to those of the terrestrial environment.

"The underwater life and habitats of the Islands certainly offer opportunities equal to those of the terrestrial areas to observe and understand the structure and function of insular ecosystems and to learn about the processes of evolution" (Wellington, 1976a).

Because of the common volcanic origin and oceanic setting of the islands, the topography, and the distribution of vegetation, soils and precipitation are similar in gross aspects from island to island. The intersection of the sea with the typical shield volcanic cone (or chains of shield volcanic cones in the case of Isabela) characteristic of the islands results in a low, arid coastal margin around a high, moist interior, with precipitation averages of about 250 mm at the coast to more than 1200 mm in the interior (Putney, 1982). The shoreline is characterized by low cliffs which often make landing difficult. Narrow pocket beaches fill some indentations of the coast.

Many similarities also exist from island to island in the problems associated with human use and habitation as well as in the resolution of those problems. A basic distinction can be made, however, between uninhabited and inhabited islands. Figure 3, panel A, schematically illustrates the generalized nature of the uninhabited islands, all of which are included entirely in the PNG; and Figure 3, panel B, similarly illustrates the generalized distribution of land use and infrastructure on the four inhabited islands.

Two classes of use overlap most noticeably in the archipelago's coastal and marine area: 1) environmental conservation and preservation for science, education and tourism activities in the Galápagos National Park (PNG); and 2) economic and development activities to serve the resident and transient population in the inhabited areas. The Galápagos marine area is not currently included in the PNG, but it is critically important to the preservation of the islands' ecosystem and provides an important economic resource for the islands' inhabitants.

Conservation, Science and Tourism in the Coastal Areas

The PNG is the principal use of all islands and the only use of the uninhabited islands. A major goal of the PNG is to govern use of park areas to preserve indigenous and endemic species as well as the natural environment that supports them. Loss of endemic species is a problem of the highest

Figure 3. General characteristics of (A) uninhabited islands and (B) inhabited islands.

priority in the Galápagos, and the introduction of alien species poses a long-term threat that has already caused significant damage in the Galápagos. Introduction of species can be either purposeful or accidental. Many of the most conspicuous and troublesome alien species were introduced for agricultural or domestic purposes. It has been estimated that between 77 (Tuoc, 1983) and 250 (Putney, 1982) alien plant species have been introduced, some of which have become abundant. The introduction of dogs, cats, pigs, goats, donkeys, cattle, mice and rats, together with insect pests such as fire ants and pathogens brought in with domesticated animals and plants, has strongly affected native tortoises, iguanas, rats, snakes, lizards and certain birds on some islands, and many shrubs, cacti and small plants have been partially or totally eliminated (Putney, 1982).

The PNG is constantly the site of major scientific studies. The degree to which scientific work in the islands has been facilitated by the PNG since its establishment in 1959 is reflected in Figure 4, which shows a more than threefold increase since then in the annual number of scientific publications on Galápagos research, as compiled by the Smithsonian Institution.

Perhaps the most extensive use of the PNG area, however, comes from tourism. To help accommodate this tourism, while confining its physical effects, the PNG has designated over forty visitor sites. These sites are shown in Figure 5, along with the approximate number of visitors to each in 1980 (CANEITG, 1981). All visitors are accompanied by private naturalist-guides trained and registered by the PNG in collaboration with the Charles Darwin Station or by experienced auxiliary guides, also registered by the PNG. All companies conducting tourism must receive PNG permits.

Tourist visits to the Galápagos have grown spontaneously, with annual visits increasing from 4,500 in 1970 to nearly 20,000 in recent years. About one fifth of these visits are by Ecuadorians and the rest by foreigners (Putney, 1982). Most arrive by air at Baltra. Nearly two-thirds of the visitors travel through the archipelago on the four (50-90 passenger) ships operated by continental tour companies, while the other third are served by some 35 small (under 15 passengers) local boats in Puerto Ayora (Garcés and Ortiz, 1983). Because certain sites are favored by the large tour ships (see typical cruise track as dotted line in Figure 5), and because of the small boats' more limited range, tourist visits are concentrated at relatively few

Figure 4. Frequency of Galapagos Scientific References in the Smithsonian Institution Bibliography.

Source: Simkin, 1984.

1. Punta Suárez	16. Estación Charles Darwin	30. Punta Espinoza
2. Bahía Gardner	17. Caleta Tortuga Negra	31. Volcán Alcedo
3. Isla Lobos	18. Isla Mosquera	32. Punta García
4. Cerro de las Fraguas	19. Isla Daphne	33. Punta Albemarle
5. El Junco	20. Isla Seymour Norte	34. Punta Tortuga
6. Puerto Grande	21. Bahía Darwin	35. Caleta Tagus
7. Santa Fe	22. El Barranco	36. Bahía Urbina
8. Plaza Sur	23. Isla Bartolomé	37. Bahía Elizabeth
9. Zona Alta	24. Bahía Sullivan	38. Punta Moreno
10. Zona de Reserva	25. Caleta Bucanero	39. Lagunas de Villamil
11. Los Gemelos	26. Playa Espumilla	40. Volcán Sierra Negra
12. Bahía Ballena	27. Puerto Egas	41. Punta Cormorant
13. Bahía Tortuga	28. Isla Sombrero Chino	42. Bahía Post Office
14. Bahía Conway	29. Isla Rábida	43. Corona del Diablo
15. Playa las Bachas		

Figure 5. PNG visitor sites and a typical tourist ship cruise track.

Source: CANEITG, 1981.

sites. Only one-sixth receive over half the tourist visits (CANEITG, 1981). Plaza Sur is the most popular site, with a total of over 14,000 visits in 1980.

There are indications that an increasing proportion of tourists are entering the water for snorkeling, diving or swimming (Wellington, 1978). Some of the large commercial tour operators have developed dive programs, and scuba equipment and dive tours have become increasingly accessible in Puerto Ayora. Although these activities are still in their incipency in the Galápagos, the spectacular worldwide boom in marine recreation suggests that increasing demands for access to Galápagos waters will be expressed by tourists. However, there is currently no mechanism for the regulation and control of such activities, nor is there an existing capability to ensure the safety of diving visitors or to respond to accidents should they occur. Increasing tourist use of Galápagos waters also raises questions about the growth and control of more traditional water sports, such as spear and sport fishing, sunbathing, recreational boating and waterskiing.

In recent years there has been, throughout the world, an explosion of tourism concerned with wildlife, wildlife areas, and scenic beauty based on natural resources. It is clear that visitors to the Galápagos come almost exclusively to observe the biota and the natural features of the islands (CANEITG, 1981). In a sense, visitors to the Galápagos Islands are more pilgrims than tourists. However, if a 'saturation point' is reached, or when a critical threshold is passed, rapid degradation seems inevitable in the natural asset which attracts them (Budowski, 1976). There is concern, too, about becoming overly dependent on tourism, since islands that depend for economic well-being mostly on a single industry will suffer severely if that industry is hurt (Beller, 1973).

Tourism and conservation can benefit from each other. The conservation use of the islands supports tourism, and it is thus related to coastal development activities in the populated areas as well as affecting the benefits received in continental Ecuador in the form of proceeds to the national airlines for travel to the islands, mainland-based travel agencies, etc. Tourism, in turn, can provide support to conservation programs which enhance educational, scientific, and recreational resources, with the objective that they in turn will attract more tourists. The Galápagos Islands

have, in fact, been cited as a good example of such mutual support (Budowski, 1976).

Coastal Uses in the Inhabited Areas

The largest portion of the typical populated island falls within the jurisdiction of the PNG, but most of the conflicts, problems and human needs arise in the nonpark areas. For each inhabited island, the main population is centered in an urban area on the coast. The great majority of the Galápagos population lives in or adjacent to these urban areas. These are small towns, in two cases rather densely settled, with municipal buildings, schools, medical facilities, stores, small hotels, etc. The Navy also maintains a "Port Captaincy" in each of the four coastal towns (refer to p. 52 for details).

Coastal Urban Development

Most of the archipelago's population growth in recent years has been concentrated in Puerto Ayora, the center of local tourism activities. Twelve of the islands' seventeen hotels are located there, nine of which have been added since 1971 (CANEITG, 1981). Virtually all onshore tourism facilities, including restaurants and shops, are near the urban waterfront. In the three largest urban areas, waterfront projects seem to be a significant part of urban development efforts. Formal waterfronts with sea walls and some degree of landscaping range from the promenade and urban parks at Puerto Baquerizo (see Figure 6) to the Puerto Ayora Garden Sea Wall (Figure 7), the Puerto Villamil Park (Figure 8) and the retaining wall and paved dock and landing area at Puerto Velasco Ibarra (Figure 9). Recreational facilities are available in docks and natural features such as beaches and sheltered bays.

Locational Problems and Natural Hazards

Since much development activity in the Galápagos occurs near the shore, the siting of buildings and other projects must be planned to account for natural coastal processes. Some of the houses and hotels in Puerto Ayora are located very close to the water, but according to Nelson (1983) there have been no severe storms in many years. Generally speaking, coastal erosion does not appear to be a problem in the Galápagos. Shoreline recession in Puerto Villamil might be an exception, but in fact probably results from landward beach migration, rather than erosion.

Figure 6. Map of Puerto Baquerizo Moreno urban area, San Cristóbal, Galápagos Islands (a - sea wall; b - Martha Bucaram de Roldos Recreation Park; c - "La Poza" Park Jaime Roldos Aguilera.

Source: Comisión Alto Nivel Plan Maestro Galápagos, 1982.

Figure 7. Map of Puerto Ayora urban area, Santa Cruz, Galápagos Islands (a - Garden Sea Wall).

Source: Comisión Alto Nivel Plan Maestro Galápagos, 1982.

Figure 8. Map of Puerto Villamil urban area, Isabela, Galápagos Islands (a - Puerto Villamil Park).

Source: Comisión Alto Nivel Plan Maestro Galápagos, 1982.

Figure 9. Map of Puerto Velasco Ibarra urban area, Floreana, Galápagos Islands (dock and adjacent sea wall are shown).

Source: Comisión Alto Nivel Plan Maestro Galápagos, 1982.

A unique set of problems is faced by Puerto Villamil as a result of its location on a barrier beach (the only urban area so located). The two principal problems are: 1) landward migration of the beach and its attrition owing to use of the sand for construction and 2) flooding of parts of the village from changes in level of the lagoon behind the beach. There is evidence that part of the lagoon is hypersaline during normal years, suggesting its level usually is depressed. During the past year's heavy rains, portions of the adjacent village were flooded when this lagoon's level rose. The flood also inundated the town's newly constructed sewer system, filling parts of it with sand.

During El Niño years, which occur at irregular 4 to 10 year intervals, rainfall can exceed average values by many times and lead to extensive flood damage throughout the islands. The problem in Puerto Villamil is only one example. Possibly the problem there was made worse when a natural breachway that opened in the barrier beach was artificially closed, preventing the lagoon from draining (Jaramillo, 1983). At San Cristóbal, a newly completed urban park project was destroyed because a natural water course had been obstructed by the new sea wall. This led to flooding of buildings on the landward side and, eventually, to destruction of the new sea wall to restore drainage. It is clear that coastal planning in the Galápagos must take into account variability and extremes in climate, as well as average conditions.

Water Management

A major urban area problem with coastal and marine aspects concerns water management. Seawater intrusion into the aquifer at coastal sites in the Galápagos, for example, has produced brackish coastal groundwater. Imported bottled water or rainwater stored in cisterns often is used for drinking. Plans have been proposed to enlarge the freshwater supply through construction of inland dams, weirs and reservoirs with pipelines to urban areas. It also is possible that existing desalination technology could efficiently and reliably supply drinking water for the entire Galápagos population with less environmental impact.

Waste Disposal

A related urban use with coastal and marine aspects is waste disposal. Because of the volcanic nature of rock beneath most urban areas, leachate from on-site sewage disposal tends to channel into the same fissures that conduct

groundwater. Municipal sewage systems in varying stages of completion are therefore under way in all municipalities. The ultimate disposal of sewage from these systems is the source of considerable controversy in the Galápagos and poses potential contamination problems in ports and harbors there. In Puerto Villamil, we learned that completion and operation of a nearly-finished system was being held up by failure to obtain the necessary permit through the "Port Captain" to operate an ocean outfall. A sewer system designed for Puerto Baquerizo has been held up by the Municipal Council because of uncertainty about contamination of harbor waters by leachate from six proposed communal leaching wells sited near the shore. The mayor in Puerto Baquerizo also expressed concern regarding public health impacts of a sewage outfall operated in the harbor there by the 2nd Naval Command, in apparent violation of national law (Cruz, 1983). The "Port Captaincy" at Floreana also is reported to have a small ocean outfall sewer (Garcés, 1983).

Solid waste dumps such as those at Puerto Ayora are another potential source of contamination, aside from their unfavorable aesthetic impact. Although the arid coastal climate probably minimizes leaching from dumped materials, the potential for groundwater contamination needs to be recognized. On San Cristóbal, we visited a construction dump at the airport site containing hundreds of 55 gallon drums. The ultimate decision on the disposal of these drums might benefit from a consideration of deep ocean disposal options. As the archipelago's waters are well flushed by ocean currents, carefully controlled ocean disposal of both solid and liquid wastes generated by the resident and tourist populations may prove to be an efficient and environmentally sound option. The possible advantages and shortcomings of this option do not appear to have been assessed, and no mechanism seems to exist currently for the coordinated planning of such ocean waste disposal.

Resource Extraction

Resource extraction activities on the islands include removal of beach sand, quarrying of volcanic aggregate, and mining of evaporite salts for the fishing industry. White sand from beaches has been widely used for construction in the last ten to fifteen years with the shift from wooden building styles to brick/cement construction. Since the beaches of the Galápagos Islands are pocket beaches with a paucity of sand, it is possible to affect a beach strongly by mining sand.

In some cases this practice may have a detrimental effect on such species as marine iguanas, which often nest in sandy backshore areas, and sea turtles, which need to bury their eggs on sandy beaches. Three species of sea turtle, Chelonia mydas agassizi, Eretmochelys imbricata, and Dermochelys coriacea, are reported in Galápagos waters (Green and Ortiz-Crespo, 1982). It appears that part of the Galápagos turtle population is resident and part migratory. C. mydas agassizi is the only species that nests in the Galápagos, and the islands are believed to be the most important nesting area for this species in Pacific South America. Figure 10 shows major nesting beaches and indicates sightings of the other two species. Although local residents are allowed by law to fish for turtles on a subsistence basis, there is virtually no exploitation of turtles in Galápagos (Green and Ortiz-Crespo, 1982). The primary commercial species in Ecuador (Lepidochelys olivacea) has been harvested in great numbers off the continental coast (Hurtado, 1981) but is not known to occur in the Galápagos.

Sand removal also may have damaged recreational beach areas (Angermeyer, Devine, Jaramillo, 1983) and contributed to coastal erosion in Puerto Villamil and Santa Cruz. The Council President in Puerto Villamil estimated 10,000 cubic meters of sand had been removed there for fill and construction between 1975 and 1981 (Jaramillo, 1983). According to Putney (1982), sand quarrying at Canal de Itabaca has eliminated the beach there, and continued quarrying activity was occurring at beaches in special use zones of the Park on Santa Cruz. The removal of sand for construction purposes falls under the authority of the "Port Captaincies", who have permitted this activity subject to the payment of a nominal fee.

An alternate source of aggregate on the Galápagos is found in volcanic ash. We visited a quarry located several miles inland from Puerto Villamil, from which road fill had been extracted, producing a depression several acres in extent, partially filled with water at the time of our visit and occupied by pink flamingos. A second aggregate quarry was observed in San Cristóbal in the military zone near the urban area. The principal purpose of this quarry was to provide fill for the new airport there, which is currently operational only for certain military aircraft. INGALA operates a crushing machine in this quarry to make sand for road construction and building purposes, but its output does not fill existing demand. This quarry is conspicuous from a distance because it is situated on the side of a small cinder cone.

Figure 10. Turtle nesting areas in the Galápagos Islands.

Source: Green and Ortiz-Crespo, 1982.

Salt used for preserving fish and for sale on the continent has in the past been taken from natural evaporite deposits on certain islands. Between 1963 and 1974 salt was extracted at a site on San Salvador, where "great deposits of saline crystals of the utmost purity" can be found (Ramsal, 1980). At the present time the Park has abolished mining of salt, but interest exists among the fishermen to exploit this resource once again.

Agricultural Effects

Agricultural activities in the populated islands are restricted by precipitation patterns to interior areas (Figure 3-B). Each populated island has such an agricultural center in this part of the colonized zone. Travel and exchange of commodities and utilities between the agricultural and urban parishes necessitates a connecting corridor, containing a road or path and extant or planned service lines to carry electricity to the agricultural area and water to the urban area. Because lands surrounding the corridors are used intensively for non-Park purposes, they have been designated as "special use" zones in the PNG (Putney, 1982).

Although agricultural lands comprise only a small proportion of the islands' surface, the use of agricultural chemicals, such as fertilizers, herbicides and pesticides, represent a potential source of contamination not only at the site of their application but also in their transportation and handling. In the longer term they can contaminate groundwater ultimately discharged at the coast, with potential impact on coastal biota. At present it appears that the use of agricultural chemicals is relatively rare. However, stores of chemicals and spraying equipment were seen in a government warehouse in the agricultural zone of Isabela, suggesting official encouragement of the use of chemical inputs.

A practice that has resulted in unfavorable publicity for Galápagos cattle farmers is the method of loading live cattle for shipment to the continent. Small motorboats called "pangas" tow the cattle by the horns out to waiting cargo ships. There the cattle are lifted by the horns and dropped roughly into the ship's hold, commonly with broken bones or other injury (Robinson, 1983c). According to the "Port Captain" at Isabela, the practice is officially illegal and harnesses are prescribed for lifting the animals. That the method is shocking to tourists and must be ended is recognized by cattle farmers themselves, who point to a need for better harborside loading facilities (Cheise, 1983).

Ports and Harbors

The location of urban areas is related in part to the suitability of the coast for harbor facilities (see Figure 11). The harbors at all the urban areas, however, are too shallow for large ships to come alongside (Figures 12-15); existing docks, moreover, are too small to accomodate them. The harbor at Puerto Villamil is frequently too unsheltered to permit landing at the main dock in the village, and a much smaller one about one kilometer from town must be employed. Natural structures offshore provide shelter to a large embayment at Puerto Villamil, but extensive dredging would be needed to render it serviceable even for fishing boats. This has been proposed but the costs are evidently prohibitive (Jaramillo, 1983). At Puerto Baquerizo, the Navy dock and the municipal "new dock" are limited to vessels of about 3 meters draft (Figure 13). One of the best sites for docking appears to be an abandoned dock in Puerto Baquerizo, formerly part of a fish processing plant. At Floreana, the anchorage is essentially an open road, but it is located on the lee side of the island where seas often are calm. We observed ramps for hauling boats at all urban areas except Puerto Villamil, where one is proposed for construction. At this urban area, however, natural sand beaches provide a means for hauling boats from the water during calm weather.

Freight is lightered back and forth on outboard motor-powered barges at all the urban area harbors, except for fresh water, which can be run by hose out to anchored vessels at Puerto Baquerizo. The inability of large ships to come alongside may be an important protection from introduction of new species of biota to the Galápagos. Ships are well-known vectors of exotic species and the lightering step may confer a measure of safety in this regard.

The islands' principal harbor is operated by the Navy at Baltra (Figure 16). This is the only dock facility with deep enough water, about 5 meters, for a moderate-sized vessel to come alongside. Water from the mainland, gasoline and diesel fuel also are for sale at this location. The proximity of this harbor to the airport on Baltra also makes it the most effective base for transfer of passengers and freight to and from flights to the mainland. Generally the islands' harbors provide an important basis for transit and commerce among islands and with the outside world, despite the growing importance of airports.

Figure 11. Dock, port and airport facilities in the Galápagos Islands.

Figure 12. Chart of the coast off Puerto Villamil, Isabela, Galapagos Islands (depth in fathoms). Note the numerous obstructions to navigation, shallow inshore waters, and exposure to south. Water bodies west of Puerto Villamil are lagoons, separated from the sea by barrier beaches.

Source: Defense Mapping Agency, 1973.

Figure 13. Chart of the harbor at Puerto Baquerizo Moreno, San Cristóbal, Galápagos Islands (depths in meters). Note shallow inshore waters; note also the 5 meter depth indicated for the abandoned dock north of the urban area. Dotted squares indicate anchorages.

Source: INOCAR, 1978.

Figure 14. Chart of the harbor at Puerto Ayora, Academy Bay, Santa Cruz, Galápagos Islands (depth in meters). Note shallow inshore waters and southern and eastern exposure.

Source: INOCAR, 1983b.

Figure 15. The open road at Puerto Velasco Ibarra (Black Beach), Floreana, Galapagos Islands (depths in fathoms).

Source: Defense Mapping Agency, 1975.

Figure 16. Chart of the harbor on Isla Baltra, Galápagos, with dock facilities operated by the Navy. This is the deepest, best sheltered harbor facility presently functioning on the Galápagos. The dashed feature shown bottom, center, is a discontinued airstrip adjacent to the active one, not shown.

Source: INOCAR, 1983a.

All airports are located near the coast and harbor facilities in the Galápagos (see Figures 3 and 11). Both active airports, at Baltra and at Puerto Baquerizo, are in zones falling under military jurisdiction. At Puerto Villamil a new airport has been proposed a few miles from the urban area, and the potential of refurbishing a former World War II airstrip, also a few miles from the urban area, exists. It should be noted that improved air travel is sometimes promoted by advocates of increased tourism, and its overall advantages, disadvantages and possible operational constraints might be topics for consideration in coastal planning.

Pressures on the Galápagos Marine Environment

Artificial pressures on the marine environment of the Galápagos now appear relatively minor. In the near term, at least, it is hard to imagine human activities imposing stresses on the marine system nearly as severe and disruptive as the natural background perturbation of such periodic events as El Niño (Jordán, 1983; Halpern et al., 1983). However, it is evident that Galápagos organisms have long coped with these natural variations, while human influences are more likely to be of an entirely new kind. Over the longer term, it is possible that human activities could become responsible for unacceptable or irreversible effects.

Marine Pollution

Some danger to the marine environment is posed already by inadvertent spills of chemicals, such as cargo loss from shipwrecks and transportation accidents on the islands themselves. Small oil spills associated with petroleum products handling are a common occurrence in the Galápagos and are viewed as a problem by some observers. Increasing quantities of petroleum products are consumed on the islands by motor vehicles, boats and electrical generation. During our visit, we observed the sheen of diesel fuel on the harbor surface at Puerto Ayora, and we smelled the fumes while drums of diesel were being lightered ashore. The drums, many dented and dripping diesel, are evidently brought out empty to a waiting ship and filled by hose, a process that commonly results in overflow and spillage into the water. This method is also used at other ports except, possibly, at Baltra where tankers may be able to come alongside large storage tanks near the dock, and at Floreana where filled drums are thrown into the sea and towed ashore.

Such spills can hardly be considered major ones, but they appear to be unnecessary and could have serious effects. The major 1981 study of tourism impacts in the Galápagos, for example, found that endemic flightless cormorants in the channel between Isabela and Fernandina could be pushed "dangerously close to extinction" by oil pollution from tourist boats (CANEITG, 1981). Disposal of waste oil and its potential impact will also need attention, especially if the number of boats and motor vehicles continues to grow. Overall, an important coastal management need is to define policies and regulations surrounding the transportation, handling, storage and disposal of petroleum hydrocarbons.

A related issue, but of potentially greater scale, is the possible danger to these islands of large scale spills or discharges associated with shipping near the Galápagos. We have not identified any tanker routes that appear to threaten the islands immediately, but the topic deserves further attention.

More remote marine pollution concerns arise from the possibility that marine minerals deposits, such as the polymetallic sulfides discovered on the Galápagos Rift, may someday be mined and processed in the islands' vicinity (Amann, 1983; Malahoff, 1982). However, independent analysis of the economic prospects for marine polymetallic sulfides undertaken at WHOI indicates that they have essentially no commercial significance and show little long-run promise (Broadus, 1984; Broadus and Bowen, 1983).

Commercial Collecting

Growing access to the Galápagos marine environment raises concerns about the protection of species valued by collectors. Thirty-five percent of the islands' marine gastropods, for example, are found nowhere else on earth. A number of these seashells are quite rare and are considered prize collectors items (Abbott and Dance, 1983; Keen, 1971). Although existing national legislation can be interpreted to protect such species, no formal administrative mechanism is functioning in the Galápagos to police the collection of endemic marine species or to impede the development of a commercial-scale market for their removal.

Black coral (Antipathes panamensis and A. galapagensis, the latter an endemic species) are found in the vertical rock walls habitat, and it is reported that commercial lobster fishermen collect this coral for jewelry-

making in continental Ecuador (Subsecretaría de Pesca, Grupo Técnico Plan Maestro, 1982). Wellington (1984) notes that local entrepreneurs also take this very slow-growing and long-lived coral, the abundance of which has been reduced in recent years. Growth of tourist demand for black coral handicrafts, together with improvements in diving and recovery techniques, could impose increasingly severe pressures on Galápagos black corals in the future.

Industrial Fisheries

International tuna fleets operate in Galápagos waters and are reported to move within a few miles of shore. It has been suggested further that some of these operations are by unauthorized foreign vessels (Jaramillo, 1983). While the Gulf of Guayaquil is the major area in Ecuadorian waters for tuna catch, the western waters of the Galápagos with their rich seasonal upwelling have also been major producers during part of the year (see Figure 17). In January, 1981, fifteen vessels landed 470 metric tons, and in March of that year catches of "barrilete" were greater in Galápagos than Guayaquil (Jiménez, 1982). As seen in Figure 17, much of the Galápagos catch was in internal archipelagic waters. In 1982, over 1,200 metric tons of yellowfin tuna were harvested from the Galápagos area (circled in Figure 18) by purse seiners from several nations. In earlier years, the Galápagos waters are reported to have sustained seasonal activity by as many as 250 boats and the full-time operation of a canning facility in the United States (Ramsal, 1980).

The impact of industrial fishing in the archipelago's waters could impinge adversely on species other than target fish and might warrant further assessment. The scale of the problem is indicated by the estimate that during 1979-1981 over 100,000 marine mammals were killed accidentally by the tuna fishery in the Eastern Pacific (IATTC, 1983).

Traditional Marine Fisheries of the Galápagos

Fishing in the Galápagos Islands is a long-established economic activity traditionally geared to continental markets. An artisanal fishery for "bacalao" (cod) has existed at least fifty years (Reck and Rodriguez, 1978) and supplies continental Ecuador with a salted sun-dried product widely consumed as traditional Lenten fare. Other artisanal fisheries include those for mullet and lobster, which are sold primarily to local consumers but are of

Figure 17. Distribution of tuna in Ecuadorian waters.

Source: Jiménez, 1982.

Figure 18. Catches of yellowfin in the eastern Pacific Ocean in 1982 by 1 degree areas for all purse-seine trips for which usable logbook data were obtained.

Source: IATTC, 1983.

limited economic importance compared to the bacalao fishery. In addition to these local artisanal fisheries, a commercial lobster fishery based in Guayaquil operates in the Galápagos.

In 1981 a total of 171 men were employed in the local artisanal fisheries of the Galápagos (Dirección General de Pesca, 1981), approximately 8 percent of the total work force (INGALA, 1981a; Subsecretaría de Pesca, Grupo Técnico Plan Maestro, 1982). Over three-quarters of these fishermen operate out of Puerto Baquerizo Moreno (Dirección General de Pesca, 1981). Barragán (1975) reports that only 31 percent are full-time fishermen having no other occupation, while 20 percent are engaged in fishing only as an incidental occupation.

Virtually all fishermen from the Galápagos operate in waters fringing (i.e., within 2 km of) islands or rocky outcrops and at a depth of 200 meters or less. Wellington (1984) notes that these areas contain 90 percent of the marine biota of the archipelago and are therefore of considerable importance in managing and conserving the unique flora and fauna of the Galápagos Islands for future generations.

The Bacalao Fisheries

The most important and well known artisanal fishery of the archipelago is that for bacalao (Reck and Rodriguez, 1978; Rodriguez, in press). The bacalao fishery is limited to a six-month fishing season beginning in October and ending just before Easter (March or April). After the Lenten holidays, demand and hence fishing effort for bacalao is virtually nil.

The wooden boats used in the bacalao fishery are small (displacing between seven and eleven gross tonnes) and are powered by small inboard diesel engines. During the 1982/83 season there were fifteen boats engaged in this fishery, twelve from San Cristóbal and three from Isabela. Each boat carries a crew of five or six men, including owner-operator, and is equipped with sleeping quarters and fish holds to support extended fishing trips of up to three weeks. The fish are caught by simple baited hand lines (two hooks per line) in waters from 15 to 150 meters or more in depth.

Little is known of the life history of Mycteroperca olfax or related species of Serranidae which make up the bacalao fishery. There exist no adequate stock assessment data to establish the status of the bacalao resource. However, data are available on total landings and levels of fishing effort as measured by number of fishing trips and average landings per trip

between the 1973/74 and the 1980/81 fishing seasons. During this eight-year period, the size of the bacalao fleet declined (INGALA, 1981a) as did, in general, the number of fishing trips per season (Figure 19). This reduction in fleet size and level of fishing effort was due largely to the use of fishing boats in the economically more attractive tourist industry.

Reck and Rodriguez (1978) report that bacalao stocks in fishing grounds near San Cristóbal have been exploited to the point that local fishermen have begun operating in more distant waters in order to fill their fish holds more quickly. It is unclear whether this expansion into new fishing grounds reflects localized over-exploitation of the resource, or, more simply, represents a decline in local populations of bacalao, which must be expected as a result of fishing mortality. A more serious concern regarding the bacalao fishery is reported by Rodriguez (in press), who states that artisanal fishermen are landing a high proportion of sexually immature M. olfax. Not enough is known about the life history of this species to predict the impact of this practice on recruitment patterns.

It is notable that during the 1976/77 season, total fishing trips reached their lowest level during the eight year period shown in Figure 19, but that average landings per trip increased dramatically. Perhaps during this season fishermen first began to exploit fishing grounds on the south and west coasts of Isabela Island (Rodriguez, in press). The high average landings per trip during that season probably encouraged increased fishing effort in the following year, though at a level below that of the 1973/74 and 1974/75 seasons. Average landings per trip declined over the next two years, probably because previously virgin stocks around Isabela began to be reduced. During the 1979/80 and 1980/81 seasons, however, average landings per trip again increased. Improved catch rates during these seasons probably occurred because fishermen began operating off the small distant islands of Darwin and Wolf, where virgin stocks of large bacalao are abundant. Such opportunistic behavior by the small number of local fishermen catching bacalao within the Galápagos Islands suggests that, as fishing pressure increases in certain fishing grounds, fishermen will move to other areas where stocks are more abundant.

Figure 19. Total bacalao landings, total number of fishing trips, and average landings of bacalao per trip (in metric tons, dried weight), 1973/74 to 1980/81.

The following factors suggest little cause for concern regarding the status of the bacalao stocks:

- * The small and declining (due to alternative opportunities) size of the fishing fleet;
- * the overall decline in fishing effort over the past eight years, which is attributable to declining fleet size and not to declining landings per trip;
- * the application of fishing effort over an increasingly wide geographical area and range of bacalao species;
- * the small number of fishermen, more than half of whom are employed on a part-time basis;
- * the use of simple hand lines, a selective gear of limited fishing power;
- * marketing constraints which limit the bacalao fisheries to only six months per year.

The long term prospects of the bacalao fisheries are, however, dependent upon developments in the broader economy, particularly in the tourist industry. For example, a rapid increase in fishing pressure could develop were the tourist industry no longer an economically attractive alternative to fishing. Policy decisions which discourage or limit use of small boats in the tourist trade also might lead to a major increase in fishing effort. The introduction of a COMGAL carrier boat with freezing capacity might have the same result.

Other Artisanal Fisheries

Mulletts (Mugil spp.) are caught by local artisanal fishermen using small simple seines from either small powered boats or unpowered open skiffs. Fishing for mullets takes place in shallow waters rarely more than a few hundred meters from shore or more than a few kilometers from human settlements. There may be as many as twenty of these small fishing boats within the archipelago, though only eleven are registered in the provincial fisheries office. Mulletts are landed throughout the year and are sold to local consumers, particularly restaurants in Puerto Ayora. Fishing for mullet appears to be a part-time activity that provides supplemental income to those involved. There have been no studies of the mullet fisheries of the Galápagos. It appears, however, that available mullet stocks are lightly exploited due primarily to the limited local demand for fisheries products.

Some of the small boats used in the mullet fishery also are used by local fishermen who dive for lobster. Two spiny lobsters (Panulirus gracilis Streets and P. penicillatus Oliver) and one slipper lobster (Scyllarides astori Holthuis) are found in the Galápagos Islands. The latter species is caught incidentally by fishermen primarily interested in the two spiny lobsters (Holthuis and Loesch, 1967).

A commercial fishery exists also for the islands' three lobster species. In the 1960s and 70s large boats came from Guayaquil, supporting smaller boats with hooka-divers (Barragán, 1975). We were told, however, that only one commercial lobster boat now visits from Guayaquil, perhaps as a result of decline in profitability associated with a moratorium on lobster exports from Ecuador (Wellington, 1976b). Still, concerns about depletion of the islands' lobster stock often are heard. The National Fisheries Institute (INP) plans to publish a study by Karl-Gunther Reck on the lobsters of the Galápagos Islands, which will shed further light on this fishery.

On Santa Cruz a large proportion of the lobster catch is consumed by tourists, though elsewhere lobster are usually caught for consumption by the local population. Local tourist boat operators rely heavily on catching fresh fish, lobster, and occasionally crabs and chitons, to feed their passengers. If pelagic fish are not caught while traveling between Park visitor sites, the deck hand will fish for serranids, grunts, labrids, etc., while passengers are visiting ashore. Crews of the larger tourist ships also often engage in fishing activity while tourists are ashore. Therefore, heavily visited tourist sites may receive concentrated fishing effort. While this activity may have negligible effect on the archipelago's overall fish stock, there may well be localized overexploitation. It has been reported, for example, that Tagus cove formerly had abundant populations of slipper lobster, Scyllarides, which are now uncommon there. (Robinson, 1984).

Existing artisanal fisheries do not appear to threaten the main finfish resources (bacalao and mullet), and they are a source of employment and income for the islands' residents. There is even some evidence of reduced pressure on the stock, perhaps as a result of boats being diverted to the tourist trade. Also, the National Fisheries Institute has reportedly proposed a production limit of 200 metric tons per annum for salted dry fish (Robinson, 1983b). Efforts made to diversify the artisanal technology, however, through

the introduction of traps and bottom nets, may inadvertently threaten such endemic species as penguins and flightless cormorants (Robinson, 1983c; Wellington, 1976a).

3. COASTAL ZONE AND MARINE RESOURCES MANAGEMENT: CONCEPTS AND PRINCIPLES APPLIED TO SMALL ISLANDS

Developments in coastal and marine resources management within other countries may hold some relevance for the Galápagos. Until recently, the management of coastal and marine resources in most countries was conducted on a resource-by-resource basis. Specialized programs dealt individually with coastal erosion, planning and operation of beaches and other recreation sites, regulation of coastal marshes and wetlands, water pollution, fisheries management, and control of coastal development. Each resource or problem area was likely to be the responsibility of a different agency of government, in effect creating barriers to more integrated approaches to the management of these resources. The problem of coordination often was compounded further by the involvement of different levels of government.

Given the interrelated nature of many coastal processes (both natural and manmade), it is not surprising that more integrated approaches to management have been found necessary as the intensity of resource use increases. Recognition that a more comprehensive approach was needed began in a handful of economically developed nations in the early to mid-1960s when the problems facing their highly stressed coastal areas became increasingly visible.

In a general sense, the types of coastal problems that gave rise to the more integrated resource management approach represented by CZM are:

- * Degradation and irreversible losses of biologically productive coastal ecosystems (wetlands, mangroves, estuaries, etc.).
- * Destruction of beaches and dunes and, hence, loss of the many protective, recreational, and aesthetic functions these natural systems serve.
- * Losses of shoreline property (and lives) due to failure to guide coastal development into safe locations away from coastal hazards.
- * Unavailability of shoreline space for water-dependent facilities and developments due to lack of adequate plans for the use of the limited area of the coastal zone.

Experience has shown that in most situations these problems tend to arise because of the following gaps or inadequacies:

- * Lack of adequate inventories of the natural resources existing in the coastal region and inadequate information on the value of these resources.
- * Use of a fragmented, single resource approach to resources management.
- * Frequent use of ad hoc, crisis oriented decision-making in dealing with coastal issues.
- * Lack of adequate enforcement of existing regulations.
- * Lack of adequate coordination among agencies and individuals responsible for coastal resource development and protection.
- * Lack of effective conflict identification and resolution mechanisms.
- * Lack of a set of agreed (and binding) coastal policies which could be used in the day-to-day decision making of agencies having coastal jurisdiction of some type.
- * Lack of an overall coastal plan to guide the long-term development of an area.
- * Lack of effective mechanisms to bring the wide range of interests directly affected by coastal issues, including the general public, into the coastal planning and management process.

In retrospect, we can see that two movements, having quite different origins and motivations--the move to explore and exploit the resources of the coast and ocean for man's benefit, and the move to restore and conserve the natural environment--were important factors shaping a more comprehensive coastal and marine resources management approach to alleviate such inadequacies. Encouraged by federal legislation passed in 1972, three quarters of the U.S. coastal states and territories had adopted some form of comprehensive CZM by 1983. Other developed countries such as the United Kingdom, France and the Netherlands, also now have coastal programs in place.

Basic Components of CZM

Although there are great variations among them, three basic components (Mitchell, 1982) are common to every coastal management system: I) a set of public goals or policies; II) a framework of procedures for carrying out these

policies; and III) a set of organizations or agencies which implement these procedures. Each is briefly elaborated below.

I. A Set of Public Coastal Policies - The starting point for the CZM concept is the recognition that the land-water interface (the "shoreline" or "coastal line") requires a special kind of planning and management. Within a zone of land and water straddling the shoreline, forces associated with both the ocean and land environment operate, so uses within this zone can directly affect both ocean and land resources. The heart of the CZM process is the development of a set of public coastal policies for use in guiding land and water use decisions within this zone. While tailored to fit the particular problems and opportunities of the jurisdiction in question, CZM programs in general contain the following types of policies:

A. Resource protection and conservation policies aimed at--

- * Protection of lagoons and mangrove areas to maintain biological productivity and aesthetic properties.
- * Protection of beaches and dunes to maintain flood hazard protection aspects and recreational potential.
- * Protection of coastal water quality and special habitats to maintain fisheries and recreation potential.

B. Shoreland development policies aimed at--

- * Giving priority to water-dependent uses (fisheries facilities, port facilities).
- * Preventing development in hazardous areas.
- * Maintaining public access to recreational amenities.
- * Preserving historical and cultural locations.

II. A Framework of Procedures for Carrying out the Coastal Policies - Obviously, a statement of goals by itself will not improve coastal resource management. Ways must be found to require that the policies be applied regularly in the day-to-day coastal decision-making of the many agencies that deal with the coastal area. Many options have been used. The chief executive can, by decree or executive order, mandate that agencies use the policies in the execution of their regular authorities and programs. The national legislature can take a similar action by amending the statutes through which

various national, regional and local agencies operate, to require use of the prescribed set of coastal policies. Other procedures and techniques also can be implemented to achieve the desired policy goals. For example, environmental impact assessments can be required of all coastal developments and permitting agencies can be mandated to take account of these statements. Municipalities may be required to zone coastal areas, setting aside specific areas for protection, designating other areas as suitable for development, according to broad national policy guidelines. The basic need is that ways and means be developed to make the coastal policies "enforceable." These can include use of existing authorities and regulations, enactment of new authorities, use of zoning and land acquisition authority, and the like.

III. A Set of Institutions and Agencies - Every CZM jurisdiction will include a number of existing agencies and institutions with existing programs that affect the coastal zone. They generally include government agencies with specialized missions such as the Navy, the fishery agency, port and harbor authorities, park and recreation agencies, and the like. A second group of agencies that will be involved have specialized functions such as planning, legal matters, and economic development. Finally, different levels of government with broad general purpose functions, such as municipal governments, and provincial or state governments, also will be involved. All will have activities and responsibilities that affect the coastal zone and all will tend to protect their prerogatives. Often the single greatest challenge in the formation of a CZM program is to develop an effective working coalition among all of these interests to cooperate in the collective effort. Developing these incentives and designing and balancing the coordinative mechanisms are central to the eventual success of the overall effort.

Application of the CZM Approach to Island Situations

Of all of the possible coastal environments, small islands are the most affected by the adjacent marine environment. Small islands are dominated by the surrounding ocean and its influences. These include such obvious aspects as the formation of beaches, dunes, coral reefs, lagoons, mangrove forests, salt marshes and such less obvious effects as the maritime climate, shoreland impacts of ocean-spawned storms, and the impact of elements of the island economy dependent on the use of marine resources such as fisheries, coastal tourism, and marine transportation.

Further, comparative experience suggests the land area immediately adjacent to the shoreline is generally the most critical area in an ocean island (Beller, 1973). The relevant coastal zone for oceanic islands, the area where the influences of the land meeting the sea are strongly felt, is not confined to the immediate shore area, however, but more typically will include the entire island (Beller, 1973).

Experience elsewhere (Beller, 1973; UNESCO, 1973; Fosberg, 1965) suggests that coastal zone and marine resources management systems on oceanic islands should take account of the following common features:

- * Oceanic islands are relatively isolated and spatially confined.
- * Oceanic islands almost invariably are short of needed natural resources (hydrocarbons, minerals, agricultural products, etc.).
- * Small oceanic islands generally are short of fresh water supplies.
- * Small islands are frequently subject to natural hazards such as hurricanes, typhoons, volcanic eruptions, earthquakes, etc.
- * The ecology of oceanic islands often is distinguished by limited organic diversity, reduced interspecies competition, and a high incidence of endemic or unique species.
- * Small islands, especially those in the tropics, frequently are attractive tourist destinations or have high tourism potential.
- * Small islands, especially those with low populations, are subject to rapid and destructive environmental and economic change from outside influences.

Other indications of common experience with coastal zone and marine management issues may be found in a 1981 UNESCO study of coastal zone management problems in Oceania. The main problems identified there involve the degradation of the marine environment as a result of man's activities on land and his use of the sea for transport and dispersal of effluents (UNESCO, 1981). The development of coastal tourism, both domestic and foreign, was also seen as a major problem since fragile island ecosystems are fundamentally incompatible with large-scale developments. Further, the UNESCO study found that while the basic mechanisms of degradation of the marine habitats are understood by the scientific communities, activities which enable this understanding to be applied to economic and environmental management have not kept pace with scientific progress.

About 15 years ago, several of the more rapidly developing islands undertook coastal area planning efforts (Beller, 1969, 1970, 1974). The formal initiation of the U.S. CZM effort in 1972, and federal financial assistance beginning in 1974 in the form of grants-in-aid, encouraged additional islands to undertake coastal area development and conservation studies. Thus, CZM efforts were started in Samoa, Guam, and the Northern Marianas, and the programs in Hawaii, Puerto Rico, and the Virgin Islands were given added impetus.

Two major problems developed as the CZM programs were fashioned in these island situations. Similar problems have arisen or seem likely to arise in the case of the Galápagos Islands.

First, the public agencies concerned with coastal issues showed great reluctance to relinquish any of their prerogatives to any other authority or to be bound by any policies other than those directly connected with their primary functions. While this has been a problem in many CZM programs, it seemed to manifest itself more seriously in insular situations.

The second problem relates to groupings of islands under a common jurisdiction (the Hawaiian Islands and the Virgin Islands are good examples). Typically, individual islands have, over time, developed many unique characteristics and traits. The individual island strongly resists the notion of a set of common coastal policies within the entire jurisdiction. Only through the strong encouragement and leadership of the chief executive (the governor in these cases), a very delicately balanced system of representation from each island on a coordinating council, and the availability of a set of incentives (access to which was dependent on participation in the program), was it possible to construct a management program for the set of islands.

Agreement on the particular tools or procedures to use in accomplishing the goals of the CZM program (component II above), was also a major difficulty in some island cases. Possible management procedures include the following:

- * Island-wide land use planning and zoning (used in Hawaii with specialized additional coastal zones).
- * Designation of special area plans and regulations.
- * Use of shoreland and exclusionary regulations (setback lines, construction free zones, etc.).

- * Use of critical area protection programs (special regulations affecting mangrove forests or limiting construction in flood hazard zones, etc.).
- * Use of environmental impact assessment programs (for all coastal construction and preservation projects).
- * Provision of development guidelines (technical guidance and regulations for various kinds of shoreline development projects).
- * Use of shoreland acquisition programs (provided the means to acquire the necessary shorelands are available).

A final point needs to be made concerning the application of the CZM concept to small island situations. Experience suggests that a strong public awareness and education effort often is crucial to success. With insularity comes suspicion of new ideas, especially those that may appear to be brought by outsiders. In tandem with the adoption of coastal policies and procedures, the public must be encouraged to understand and accept their value. Without relatively strong public support, the CZM-related changes could be short-lived and superficial at best. In some circumstances, support by influential citizens and groups (that is, those that tend to shape public opinion) realistically may be all that can be obtained in the shorter term, but this should not deter putting longer term educational programs in place.

4. COASTAL AND MARINE RESOURCES MANAGEMENT IN THE GALAPAGOS ISLANDS

A loose system now functions to manage the coastal zone and marine resources in the Galápagos. The existing system is largely ad hoc in nature and is not consciously coordinated as a coastal zone management (CZM) or marine resources management (MRM) process. As a result, conflicts and misunderstandings may be more common than is necessary. Still, it is important to recognize that the basic framework for coastal zone and marine resources management already is present in the Galápagos. In this section, the CZM and MRM system operating in the Galápagos is analyzed. Particular attention is devoted to existing ambiguities, conflicts or misunderstandings.

Existing Jurisdictions

Jurisdiction over the coastal and maritime areas of the Galápagos is somewhat fragmented among several institutions for the purpose of managing specific uses or resources. Thus, while the Navy is charged with military defense, the "Port Captaincies" control maritime traffic and coastal use permits, and provide some degree of marine environmental protection. Both are under the Ministry of Defense.

Conservation of the unique "land" habitat is the responsibility of PNG, an agency of the Ministry of Agriculture. Tourism regulation is assigned to the National Tourism Authority (DITURIS) of the Ministry of Industry and Commerce. Fisheries fall under the authority of the Subsecretariat of Fisheries Resources and the National Fisheries Authority within the Ministry of Natural Resources and Energy. Overall development policies and infrastructure work are entrusted to INGALA, an agency directly linked to the Ecuadorian Presidency. The statutory authority of this agency affects in varying degrees most of the zones and jurisdictions under primary responsibility of other agencies. Finally, the activities of these different institutions take place within the political and administrative framework of the Galápagos province and municipalities. In order to avoid conflicts with other public institutions that may also have jurisdiction over municipal areas, the Law of Municipal Organization (Ley de Régimen Municipal) provides that the municipalities should coordinate with these entities the joint

execution or management of their overlapping activities. The judicial system plays no role in conflict management. Jurisdictional disputes are routinely dealt with in an ad hoc manner and resolved through the political process.

In the following discussion, the roles and responsibilities of the various agencies and institutions involved in coastal zone and marine resources management in the Galápagos are examined in greater detail. The discussion is organized according to five areas of central interest for coastal and marine resources management in the Galápagos: sovereignty and maritime control, conservation, tourism, development activities, and fisheries. Comprehension may be aided by reference to Figure 20, which schematically indicates major lines of jurisdiction in the coastal and marine areas.

Sovereignty and Maritime Control

By controlling maritime traffic, "port captains" have an enforcement role in almost all legislation applicable to the Galápagos, be it conservation, tourism, fisheries, or any other. The Maritime Police Code (Código de Policía Marítima) prohibits the hunting of seals and marine birds, along with the capture of any Galápagos terrestrial species. "Port captains" must in addition protect Ecuadorian fishing grounds against unauthorized fisheries, cooperate for the development of national fisheries, and protect these resources from environmental damage that certain activities could cause, such as deballasting or the discharge of residues and toxic substances.

"Port captains" also control use of the "beach-and-bay area," comprised by the coastal strip between the lowest and the highest tide marks. To a more limited degree, they also control the "contiguous land zone," an eight meter wide belt above and adjoining the highest tide mark (Código de Policía Marítima, art. 31). Together, the beach-and-bay area and the contiguous zone form the "shoreline zone." No construction may occur in the beach-and-bay area without special permission for its occupation from the Ministry of Defense requested through the "port captaincies" (Código Civil, art. 634; Código Policía Marítima, art. 80; Decreto no. 918). Even the municipalities must request use permits for their own constructions in the beach-and-bay area (Código Policía Marítima, art. 88). The concession for land use on the beach-and-bay area does not bestow any form of ownership rights on the user;

Figure 20. Coastal and marine area agency jurisdictions in the PNG and urban areas.

and upon expiration of the concession, both the land and related buildings return to exclusive state control (Código Civil, art. 637). The Military Geographic Institute was mandated (Decreto no. 918) to establish the demarcation of this coastal strip, but so far these limits have not been set (Pita, 1983). Until comprehensive mapping is performed by the Military Geographic Institute, "port captains" have been authorized by law to effect individual demarcations on a case by case basis as requested by potential users, primarily relating to private sales of neighboring property.

Fishermen, however, may utilize the beach-and-bay area as necessary to their activity. This includes the building of cottages, placement of boats and gear onshore, and the drying of nets (Código Civil, Art. 647). Land use in the contiguous zone, which functions as a transition zone to the land territory (Código Civil, Art. 648), must not hinder the normal conduct of fishermen. Building, planting and fencing are permitted as long as provisions are made for intermittent open spaces that will assure the continuation of those protected activities (Código Civil, Art. 649).

There are altogether five "Port Captaincies" located on the populated islands and on the island of Baltra. Their jurisdiction covers all but the land area and includes the responsibility for maintaining Ecuadorian sovereignty over the archipelago. "Port captains" will follow orders from the Second Naval Command concerning military operations, but with regard to civil matters, they are subordinate to the provincial governor and the Merchant Marine and Coastal Authority (DIMERC) which controls maritime traffic, discharge permits, beach use permits, etc. throughout Ecuador (Código Policía Marítima, arts. 8 and 27).

Naval operations in Ecuador thus are divided into military and administrative functions. Military objectives are fulfilled by naval commands according to a 1981 zoning division of the Ecuadorian territory (Decreto Ejecutivo no. 1,091). The Galápagos archipelago, for instance, corresponds to the jurisdiction of the Second Naval Zone. Administrative functions, which include regulatory and police powers, are exercised by several maritime agencies, such as DIMERC. Port Captaincies are usually a branch of DIMERC, but no port captaincy strictu sensu has been legally created in the Galápagos (Código Policía Marítima). Due to this, the Second Naval Command has apparently kept five naval posts to fulfill such functions de facto. These

often separate naval entities (Navy and Port Captaincies) are hereinafter referred to as "Navy/Port Captaincies" in our discussion.

Conservation

Environmental conservation and education and the control of visitors are the primary functions of the PNG (Acuerdo no. 944). With these objectives in mind, the head of PNG is required to coordinate PNG activities with those of tourism and those of other institutions that operate on the archipelago, particularly the Charles Darwin Research Station, which was established in 1964 by agreement between the Charles Darwin Foundation and the Government of Ecuador (Acuerdo no. 181).

As an international organization subject to Ecuadorian laws and sovereignty, the Darwin Station was not established to exercise control over specific activities or areas, but to fulfill the need of scientific research and environmental awareness in the Galápagos (Acuerdo no. 181). The Station has played a vital role in supplying scientific understanding and advice for the implementation of environmentally sound government programs on the islands. Shortly after its creation, the Darwin Station was authorized by the government of Ecuador to (1) designate reserve zones; (2) determine which endemic species of flora and fauna were in danger of extinction and should have conservation priority; and (3) make decisions as to the control and extermination of animals that were endangering the Galápagos habitat (Decreto Supremo no. 523).

Later, the Forestry Service of the Ministry of Agriculture was called in to cooperate with the Darwin Station for the definite delimitation of the Galápagos National Park, and to maintain a park service on the islands (Acuerdo no. 690-A). Although the PNG was set up in 1959 (Decreto-Ley no. 17), it was not until 1973 that regulations were passed for its administration (Acuerdo no. 944). The area under the jurisdiction of the PNG was demarcated in 1979 (Acuerdo no. 297).

Operators of tour boats must provide PNG officials with a list of passengers and the trip itinerary in order to obtain permission to sail. PNG personnel will see to it that all visitors have entry cards and that boats adhere to fixed itineraries. They may board and inspect any vessel operating within the Galápagos. Visits may be restricted in some areas of the park, and

the manufacture and sale of souvenirs made with materials originating from the Galápagos flora and fauna are forbidden. Violators of PNG rules may be prosecuted by port captains, police judges, or the PNG director (Acuerdo no. 944), depending upon where the violation took place. This implies that violations occurring at sea or on beach-and-bay areas will fall under the jurisdiction of port captains; at populated areas, police judges; and within the PNG, the PNG director (Pérez, 1983).

Vessels entering the Ecuadorian/Galápagos waters are required to respect the environmental protection rules of the PNG and are liable for compensation of any damage that they might cause to the natural species declared to be national patrimony (Decreto Ejecutivo no. 812). Furthermore, industrial development is not encouraged by law on the islands as it is on the continent (Pérez, 1983).

INGALA also may develop programs to promote the conservation of natural resources of scientific interest, and may provide technical and financial assistance regarding the protection of the environment. It is still unclear what role INGALA will have in the PNG. INGALA may regulate tourism and other activities of ecological impact. Its board of directors may designate tourist areas and the rules pertaining to visitation. The INGALA law could even be interpreted to give INGALA the role of the absent National Tourism Authority (DITURIS) (Pérez, 1983), which would give it a higher authority on tourism matters than that of the PNG (Ley de Parques). There already appear to have been problems between the PNG and INGALA serious enough for the PNG to note the existence of "legal or bureaucratic difficulties which were not experienced with other entities" (PNG, 1982), and for INGALA to criticize "restrictive conservation measures" by the PNG (INGALA, 1981b).

It seems unlikely that any major conflict will arise between the PNG and the municipalities in the near future. This stems partially from the fact that PNG areas have been clearly demarcated and the municipalities do not interfere with the way the PNG is run. A potential problem could, nonetheless, result from population growth in colonized areas and the subsequent pressure this would exert for expansion beyond present fringes. PNG "special use zones" might be particularly vulnerable to such pressure.

The relationship between the Navy/Port Captaincies and the PNG is one of informal cooperation. Tourist vessels are required to seek park approval in

order to obtain sail permits from the Navy/Port Captaincies. Prior consultation with park authorities also is common procedure for any beach sand quarrying within park areas. This has created a situation of mutual understanding which has strengthened the role of both institutions on the islands. Perhaps an explicit agreement formalizing these procedures would further reduce the possibility of future misunderstandings.

Tourism

Tourism seems to be developing in an ad hoc manner in the Galápagos; as travel agencies bring tourists to the islands, the PNG attempts to control their itineraries, and the municipalities attempt to provide services to mushrooming urban parishes.

Tourism promotion is the responsibility of DITURIS, based in Quito, which operates within the Ministry of Industry and Commerce (Ley de Fomento Turístico). The PNG is statutorily under the jurisdiction of DITURIS regarding tourism (Ley de Parques). DITURIS' interministerial council is formed by representatives from the Ministries of Commerce, Finances, Foreign Relations, and Defense, the Planning and Economic Coordination Board, the Hotel Association of Ecuador and the Ecuadorian Association of Travel Agents. This council was mandated to establish the policy of Ecuador in regard to tourism and may declare areas of touristic interest. It should be noted that while the private sector and several ministries are represented in the council, no representation has been provided for the protection of environmental concerns. Investment from the private sector, on the other hand, is encouraged in the form of exemption from certain business taxes and import duties, and income tax deductions (Ley de Fomento Turístico, as amended by Decreto Supremo no. 1,979).

Subsequent to the establishment of DITURIS, the Minister of Industry and Commerce created a Galápagos Tourism Commission to be based at Puerto Baquerizo Moreno, the Provincial Capital (Acuerdo no. 224). The provincial governor, the municipalities, the provincial director of public works, the provincial director of education, the National Park director, the provincial police commander, the Ecuadorian Air Force, the Port Captaincy, the Charles Darwin Station, DITURIS and the private sector would all be represented in this commission. Its primary function would be the coordination of touristic

activities in the archipelago among the involved parties: DITURIS, the provincial government, the municipalities and the private sector. In practice, however, neither the commission nor a regional office of DITURIS are functioning in the Galápagos (Pérez, 1983).

Development

Most coastal conflicts that presently occur in the inhabited areas seem to be over development activities involving the municipalities and the Navy/Port Captaincies. The main subjects of these conflicts appear to have been: 1) beach sand removal, 2) construction permits, and 3) sewage outfalls.

Beaches are public property subject to the authority of the Navy/Port Captaincies, who have authorized the removal of sand for construction purposes to private entrepreneurs, municipalities and governmental agencies, subject to the payment of a nominal fee. The Maritime Police Code (Código de Policía Marítima, Art. 80) has explicitly prohibited any beach concession that could prevent beach use by owners or tenants of neighboring property, and the Galápagos naval command has recently prohibited the removal of beach sand from urban areas (García Alvarez, 1983). Beach sand, however, may still be taken from PNG areas, but this has been alleged to have become more difficult and expensive for the municipalities. The municipality of Puerto Baquerizo Moreno, for example, has complained of being charged a fee for the extraction of beach sand and that new bureaucratic measures have caused unnecessary delays (Cruz, 1983).

Construction permits for the shoreline zone also have been a source of recurring conflict. The shoreline zone is defined for purposes of our report to include both the beach-and-bay area between the lowest and the highest tide mark and the eight-meter belt of contiguous land above the highest tide mark (see Figure 3). Although the use of both zones is controlled by the Navy/Port Captaincies according to Ecuadorian maritime law, this control is not absolute by any means. The Navy/Port Captaincies exercise police power over beach-and-bay areas and thus are authorized to grant permission for the occupation of the land to individuals. While the Navy/Port Captaincies may authorize individuals to use land in the shoreline zone, this does not include a permission to build there. The latter must conform to urban regulations and needs a municipal permit, as unequivocally established by the Procedural

Regulations for DIMERC and Port Captaincies (Reglamento de Trámites en la Dirección de la Marina Mercante y del Litoral y Capitanías de Puerto de la Republica, Art. 219). The reverse also is true: to be implemented, a municipal permit to build in the shoreline zone depends on the use permit from the Navy/Port Captaincies.

Municipalities have built sewage systems without the necessary discharge permit from the Navy/Port Captaincies, and in one case, a municipality complained that discharge from a naval compound was affecting the health of the adjacent urban area in violation of municipal regulations (Jaramillo, 1983; Cruz, 1983). The Maritime Police Code (Código Policía Marítima, Art. 106) and the 1974 Fisheries Law (Ley de Pesca) specifically prohibit the discharge of nontreated sewage into the coastal zone. Unless municipal sewage is treated, the Navy/Port Captaincies do not seem to have any other option but to deny the discharge. Sewage treatment is, evidently, also mandatory for naval compounds, which must additionally take into consideration other applicable municipal ordinances.

INGALA's legal mandate encourages extensive interaction with the municipalities in development activities. INGALA's activities, such as the building of roads and the provision of potable water, electricity, schools, etc., primarily affect populated areas. During our visit we heard some expressions of disappointment in INGALA from officials who felt large sums of money had been misspent to modernize airport terminals or build new air strips which they considered to be neither social priorities nor of direct benefit to the community. Finkelstein and Polk (1982) have observed that the presence of INGALA on the islands is manifest primarily through the introduction and sudden proliferation of heavy-duty vehicles (trucks and tractors). Whatever the merit of these criticisms, it is apparent that INGALA's role in the Galápagos has been a subject of controversy and some degree of tension.

The motivation behind the establishment of INGALA seems to have been to plan and coordinate developmental activities within the archipelago at the provincial level, since the Galápagos does not have a provincial council. The legislative decree that created INGALA noted in its consideranda that the Galápagos lacked the appropriate administrative framework to provide for adequate environmental protection, social assistance, organization of tourism and the utilization of natural resources on the islands. Tourism was

specifically singled out as important in the acquisition of foreign revenues and as a generator of jobs, primarily in air transport, maritime and hotel activities. But it further emphasized that decisions from this new organization should take into account the need to preserve both the terrestrial and marine environment.

INGALA's jurisdiction seems to extend over the whole archipelago (inhabited and uninhabited, onshore and marine areas) and is in fact broader than that of a provincial council. Besides the work that would normally be done by a provincial council, INGALA was mandated to provide technical and financial assistance to other institutions in the areas of conservation, public works, community welfare, development of tourism, natural resources development and training of human resources (Ley de INGALA). It may further regulate most activities that take place within the archipelago, including the settlement of newcomers, the number and traffic of tourists, agricultural and fisheries activities, and the destination of sewage waters.

Although INGALA appears to have some jurisdiction over coastal and maritime areas, the only direct conflict that we are aware of between that agency and the Navy/Port Captaincies concerns the levy of a fee on INGALA for use of the lava quarry in the San Cristóbal military zone (Ortiz-Crespo, 1983).

Fisheries

All laws concerning fisheries have been compiled and incorporated into the 1974 Fisheries Law (Ley de Pesca, Decreto no. 178), which centralizes control over fisheries activities and regulates the catching, processing and commercialization of fish products in Ecuador. Policy guidelines are established in Quito by the National Council for Fisheries Development, a public entity attached to the Ministry of Natural Resources and Energy. Actual planning and implementation of this policy, however, are done by the Subsecretariat of Fisheries Resources and the National Fisheries Authority in Guayaquil (Ley de Pesca). Plans and programs for fisheries development are formulated by the Subsecretariat and must meet the approval of the National Council. The Subsecretariat also coordinates the activities of the public and private sectors. Control over fish catch, industrialization and sale falls under the jurisdiction of the more specialized National Fisheries Authority.

Fisheries research is the responsibility of the National Fisheries Institute in Guayaquil, in coordination with the Oceanographic Institute of the Navy (Ley de Pesca).

The Ministry of Natural Resources and Energy, following guidelines from the Fisheries Council, may limit or prohibit fishing activities whenever national interests demand (Ley de Pesca). Some provisions in the Fisheries Law (Ley de Pesca) attempt to protect available resources either by prohibiting specific catches or by banning unacceptable fishing techniques. Foreign vessels, for example, are not allowed to catch lobster or shrimp; and utilization of toxic or explosive materials are not permitted in Ecuadorian waters. Special reserve areas may also be established by the President.

Artisanal fisheries in Ecuador are a prerogative of Ecuadorians only. The 1974 Ley de Pesca provides incentives in the form of technical and financial assistance to those fishermen that are organized in cooperatives or associations. These organizations may import duty-free the machinery, fishing gear and accessories that are necessary for the implementation of their programs.

Areas of Apparent Ambiguity or Conflict in Existing CZM and MRM

As seen from the preceding analysis, the basic elements of a CZM and MRM system are in place and functioning in the Galápagos. Although the existing system is somewhat ad hoc and uncoordinated, most of the major areas of concern to coastal and marine resource managers seem to be covered through the existing structure of agency and institutional responsibilities. However, some apparent conflicts, ambiguities, or gaps do seem to be present in the system as it now stands. Greater coherence and coordination in coastal and marine resources management will be achieved if these areas of apparent ambiguity or conflict can be removed.

- * The degree of municipal jurisdiction over marine areas is unclear, vital though the marine areas are to interisland transportation, fisheries, and other uses. The municipalities may regulate activities on national properties such as beaches and the adjacent marine area (Ley de Régimen Municipal, arts. 267 and 274). The Ministry of Defense through the Navy and Port Captaincies also exercises control of these zones.

- * The Second Naval Base in San Cristóbal was not included within the urban limits of Puerto Baquerizo Moreno (Ordenanza Municipal and Acuerdo no 297). It is unclear whether this naval zone would be completely out of any municipal jurisdiction.

- * The degree of Navy/Port Captaincy control over the land zone contiguous to the beach-and-bay area is unclear since it is not necessarily in the public domain. It appears that the scope of control there is restricted to limiting construction or activities that may hinder fisheries operations that take place in the adjacent beach-and-bay area. Other controls also are applicable to the shoreline zone, primarily concerning construction guidelines, zoning, and any other matter regulated by municipal ordinances. The Procedural Regulations for DIMERC and the Port Captaincies have established an appropriate procedure for obtaining use/construction permits for the shoreline zone. This procedure could provide the basis for an agreement between the Navy/Port Captaincies and the municipalities that would remove existing misunderstandings.
- * Misunderstanding about permit requirements for planned sewage outfalls could have been avoided if procedures had been understood beforehand. More specific agreement between Navy/Port Captaincies and municipalities on appropriate procedures would facilitate future planning and administration.
- * In the 1979 demarcation of PNG boundaries, no reference was made to the outer boundaries of the PNG (Acuerdo no. 297). PNG officials and the Navy/Port Captaincies have interpreted PNG jurisdiction to extend seaward to the limit of the water mark, varying according to low or high tide, thus overlapping with Naval jurisdiction over the contiguous land belt and, alternatively, the beach-and-bay area coastal strip.
- * Despite the preponderant role tourism plays in the Galápagos today and the provisions of the National Parks and Reserves Law (Ley de Parques), Law of Tourism Incentives (Ley de Fomento Turístico) and the creation of a Tourism Commission for the Galápagos (Acuerdo no. 224), there is a lack of centralized planning and monitoring of touristic activities on the islands.
- * The jurisdiction of INGALA seems to extend over the whole archipelago and is even broader than that of a provincial council, raising constitutional questions as to the performance of functions that usually pertain to a provincial council (Pérez, 1983).
- * INGALA's mandate is not explicit on how interaction should occur with the PNG. It does not provide an administrative formula for decision-making in which ultimate decisions concerning PNG areas must be either approved or vetoed by the PNG to ensure adequate environmental protection.
- * Although research and planning must precede actual implementation of INGALA projects, the law is not clear on how these studies should be conducted in order to protect the Galápagos environment.
- * INGALA does not have any enforcement or military/police role in coastal and maritime areas, but it may regulate fisheries, the discharge of sewage waters, and other activities that may cause environmental impact there. All of these functional responsibilities will undoubtedly require close consultation with the Navy/Port Captaincies. This would

be facilitated by prior specific agreements on division of responsibilities and rules of procedure.

- * In general, it appears that interagency conflicts in the Galápagos, particularly those between the municipalities and the Navy/Port Captaincies, may be solved without much difficulty if general enforcement guidelines are made clearer and less dependent on the arbitrary interpretations of individuals who hold power at any particular time. The roots of the misunderstandings seem to be historic and lie in the fact that the military also held civilian authority throughout much of the islands' history (Pérez, 1983). Although the military has not held civilian authority since 1979, there still seems to be some confusion regarding leadership and the extent of each agency's jurisdiction.

5. CONCEPTS FOR IMPROVED COASTAL AND MARINE RESOURCES

MANAGEMENT IN THE GALAPAGOS

Referring to the characteristic features of a coastal zone management system--1) a set of public policies for coastal and marine areas, 2) a framework of procedures to carry out the policies, and 3) a set of institutions and agencies to implement the procedures--it can be seen that in fact such a system already exists to manage the coastal zone and marine resources of the Galápagos. Although uncoordinated and largely ad hoc in nature, the basic elements of a CZM and MRM system are in place and functioning. Therefore, coherent management planning and refined policy formulation should be possible with relatively minor adjustments to existing practice, thus minimizing the need to draw new boundaries, create new institutions, and write new laws. It should be possible to achieve coordination and greater coherence through improved and focused communication and the application of existing powers within already recognized boundaries.

A clear set of public coastal policies already has been established to guide land and water use decisions within the coastal and marine areas of the Galápagos. Thus protection of wildlife and the natural environment appear to be well established as a primary objective of national policy in the Galápagos, at least in the onshore areas. Shoreland development and maritime use policies also seem to be relatively well established to serve the purposes of national sovereignty and the economic needs of the islands' residents. The major area where policy does not appear to be well-developed concerns conservation and preservation in the marine environment and accommodation of those goals with the continued economic use of the marine area.

The existing framework of procedures for achieving national policy objectives, together with the organizations and agencies that implement those procedures, has been described and analyzed in some detail above. There appears to be ample institutional coverage for all the major topics of coastal and marine resources concern, with the possible exception of environmental protection in the marine area. Indeed, in several areas functional redundancies are apparent between the responsible agencies. While such redundancy can sometimes serve as a useful check on agency excesses, it can,

when not properly organized and controlled, also lead to conflicts and confusion of purpose. Thus, the greatest opportunities for improvement seem to lie in refinement of the existing procedural framework and the structure of interagency responsibilities and relationships.

Tailoring CZM and MRM to the Galápagos Situation

This task will require that some aspects of agency behavior be defined more carefully to assure that they serve national policy. The major areas of apparent ambiguity or conflict have been enumerated in the previous section. We have mentioned several possible instruments through which clarification can be attempted, including executive decrees and legislative initiatives. To the extent possible, it may be best to use existing authorities and institutions and to employ the executive or legislative powers only so far as necessary to better define interagency rules of procedure. As the greatest challenge in the formation of a CZM or MRM program often is to develop an effective working coalition among the various involved interests, planning emphasis for executive or legislative action might well be placed on devising incentives and designing and balancing coordinative mechanisms. This will be true especially where there is reluctance to modify existing agency prerogatives or to submit individual island interests to a more inclusive process concerned with the entire archipelago.

Initial steps in this direction could be to identify clearly the area to be managed and to describe desirable features of the refined management system. A general statement of purpose for the design of more coherent coastal zone and marine resources management in the Galápagos might be:

To fashion a process by which both public and private actions in coastal and marine areas of the archipelago can be managed to improve the social condition of the islands' inhabitants, given that the protection of the islands' unique ecosystems will continue to be an overriding consideration.

To meet this objective, the following features of a coastal zone and marine resources management process seem appropriate and necessary to the Galápagos.

- * Emphasize protection of environmental values.
- * Reflect and accommodate needs and concerns of the resident population, including traditional fishing activities.

- * Address the issue of formal protection of the Galápagos marine area.
- * Incorporate the best feasible scientific and technical information.
- * Be simple, inexpensive, and politically realistic.
- * Minimize the creation of new boundaries, laws or institutions.

The Two-Zone Concept

As a frame of reference in the formulation of management concepts specifically appropriate to coastal and marine areas of the Galápagos, the WHOI group initially described a hypothetical two-zone management scheme as a working model. Under this system (see Figure 21), two overlapping management areas would be established: 1) a marine resources management zone extending from the shoreline seaward some distance and encompassing most of the important marine resources and uses; and 2) a shoreland and nearshore coastal zone management area, overlapping the nearshore margin of the marine resources zone.

The applicability and feasibility of this two-zone approach in the Galápagos was a major issue addressed in our investigation. To avoid imposing additional confusion and unnecessary expense, we feel that simplicity and economy dictate against creation of complicated new systems of boundaries or institutions. However, existing boundaries and agency assignments might be adapted with limited modification to a revised system of coastal zone and marine resources management similar to the two-zone working model. Even if the eventual system does not follow these lines, overlapping zones such as those in the model still may prove to be a useful and practical informal device to help structure planning and management decisions.

A Hypothetical Application for the Galápagos

As a frame of reference for further discussion, Figure 22 provides an illustration of a two-zone concept applied to the Galápagos that is defined largely by existing boundaries. Management areas in this model are broadly defined, with all island area treated as coastal zone and all internal waters included in a special marine management area. In addition, the marine zone includes a buffer of some width, here shown as 15 miles, surrounding the archipelago's internal waters. Notice that nothing is specified yet in this scheme about uses, use restrictions, or agency assignments. Rather, the

Figure 21. Hypothetical two-zone coastal and marine area management scheme.

Figure 22. Two-zone management concept hypothetically applied to the Galápagos Islands.

figure merely portrays one possible form of the two-zone approach for definition of geographic areas that might accommodate a management system meeting our design criteria. For example, the only new boundary creation required in the illustrated model is the outer limit of the buffer zone in the territorial sea.

With regard to its landward extent, the "coastal zone" should include all of the area in which human and other activities are substantially influenced by the nearby ocean and the processes associated with it. For small islands such as the Galápagos, or for peninsulas, the coastal zone usually will include the entire land body (an example of this in the United States is Cape Cod, Massachusetts, where Woods Hole is located). Thus, all the islands of the archipelago are included in the coastal zone as illustrated.

In the seaward direction a similar principle applies. Comprehensive management of the coastal zone requires that attention be given to those nearshore and offshore areas and activities most directly affected by onshore uses or of greatest influence on the onshore environment. In the Galápagos, many valued species depend on both terrestrial and marine environments. Management of a marine area therefore is enhanced by attention to the onshore area and activities most immediately affecting the marine environment. To establish the desired interrelationship between the coastal zone and special marine management area within existing boundaries, the beach-and-bay area or the beach-and-bay area plus the contiguous eight-meter land area which together we call the "shoreline zone," are convenient possibilities that already have recognized standing in Ecuadorian law and administrative practice in the Galápagos.

Any new coastal and marine management system should anticipate the eventual creation of a marine national park or marine reserve in the Galápagos (see Ch. 6). One rationale for inclusion of the entire body of internal waters in the marine management area is that this avoids the definition and enforcement of a complicated system of more narrow boundary bands around each island. Since the special marine management area readily could be organized to permit multiple-use activities, specifically including traditional fishing uses, this advantage can be gained with no loss of political palatability. Indeed, as most of the favored fishing areas appear to fall within even the

narrowest marine area boundaries that have been proposed, this simpler and more inclusive zone should not arouse any new fears or resistance from Galápagos fishermen.

Operational Distinctions

Because many areas of the larger zones are less subject to jurisdictional uncertainty or use conflicts, certain basic operational distinctions may be useful in the implementation and enforcement of a more refined management process. This is illustrated schematically in Figure 23 and is reflected in Figure 22. The first distinction is whether a use decision or administrative problem involves the onshore area or the marine area, as different agencies and interests will predominate in each. Specifically, whatever administrative designation is selected for the special marine management area, naval and fisheries interests are likely to be more important there than in much of the coastal zone.

Similarly, for decisions involving onshore areas, four institutions now have primary regulatory and enforcement authority: the municipalities, the Navy/Port Captaincies, the PNG and INGALA. Their authorities overlap for various uses and activities occurring immediately on the coast, i.e., in shoreland or nearshore areas, including land occupation, conservation, tourism and fisheries. Permit authority for these uses would, in some cases, be shared among these institutions, such as between the municipalities and the Navy/Port Captaincies relating to construction on coastal municipal areas, or between the Navy/Port Captaincies and the PNG regarding boating to park areas.

It probably makes good sense to treat uninhabited islands differently than inhabited ones. This is because PNG purposes will have clear precedence on uninhabited islands, and management activities by the PNG and Navy/Port Captaincies on the uninhabited islands seem to function relatively smoothly and effectively already. Explicit formalization of this division of responsibility might nonetheless be useful, particularly to remove any remaining ambiguities about the operational authority of INGALA and the municipalities on the uninhabited islands.

The greatest problems of use conflict and jurisdictional ambiguity or conflict naturally are found on the inhabited islands, so these might well receive special status within the coastal zone. Even on inhabited islands, however, a distinction can be made between PNG areas, where national goals and

Figure 23. Basic operational distinctions in the implementation of the coastal and marine area management process.

administrative responsibilities seem to be clear, and the colonized areas, particularly the coastal urban areas, where a multitude of competing objectives are more common. Therefore, it is on the inhabited islands and in their urban areas that the need to clarify and coordinate coastal zone goals and procedures seems most pressing.

Of course, even if all of an island's area is regarded as coastal zone, all of its problems are not properly considered coastal problems to be managed through CZM. Table 1 provides a general guide to the kinds of substantive problems that relate directly to the nearby land-water interface (both negative aspects and opportunities) and are therefore appropriately addressed by a CZM system.

Possible Administrative Mechanisms

New administrative instruments or mechanisms should be considered to initiate and achieve improved coordination. Several possible alternative or complementary mechanisms can be identified: 1) adoption of a cooperative management approach; 2) establishment of a permanent or temporary coastal zone and marine resources council, perhaps operating through a series of task forces; 3) execution of a series of coastal and marine area management agreements or "convenios" between the relevant agencies to clarify roles, responsibilities, and understandings of purpose; and 4) application of tangible incentives, either within the existing situation or as a supplement to other instruments, for involvement and cooperation in the joint effort.

Key features of the first approach, cooperative management, might include: a) clear identification of areas to be managed, b) a conscious effort to improve intergovernmental cooperation, c) increased public involvement, d) agreement by consensus, e) use of technical expertise and scientific information, and f) agreement on an implementation approach and on conflict resolution mechanisms. Such cooperative management is difficult to achieve, but it has been successfully employed in several cases of coastal zone and special management areas in the United States (Matuszeski, 1981). The major problems with this approach lie in maintaining a motivation for ongoing cooperative management and in overcoming the well-known difficulties of rule by consensus (where each participant has an effective veto of any decision). Presumably the first problem could be addressed through strong executive

Table 1

Potential and Substantive Management Issues for a Galápagos CZM Program

- Introduction of exotic species
 - Intentional introduction of agricultural and domestic species
 - Unintentional introductions
 - Agriculture associated
 - Shipping
 - Airplanes
- Chemical Contamination
 - Natural contamination
 - Seawater contamination of coastal groundwater
 - Man-induced
 - Intentional Activities
 - Sewage disposal
 - Contaminating groundwater
 - Contaminating harbors and coastal waters
 - Dumps and rubbish disposal
 - Agricultural chemicals
 - Fertilizers
 - Pesticides
 - Herbicides
 - Accidental
 - Oil spills
 - Cargo loss in ship wrecks
- Resource Extraction
 - Beach sand quarrying
 - Volcanic aggregate quarrying
 - Salt mining
- Natural hazards
 - Vulcanism
 - Flooding
 - Fire
 - Beach erosion
- Aesthetic sensitivities
 - Urban design and development
 - Agricultural infrastructure and practices
- Facilitation of water-dependent development
 - Port and harbor-related
 - Fisheries related
 - Tourism/visitor related
 - Recreation related
 - Siting of industrial facilities (i.e., power generation)

interest and action, perhaps combined with the use of supplementary incentives. The latter problem is more difficult, particularly in large groups with diverse interests, but might be ameliorated through sensitive and skillful leadership. Public involvement in the process is clearly advantageous, as it provides direct input of public interests and reduces the chance of later political opposition or uncooperative response to management decisions. Employment of technical expertise and the best feasible scientific information is of obvious value. The cooperative management approach can be employed in full or only in part. It also has the advantage of leaving most of the detailed design of the implementation and conflict resolution mechanism to those who will be using it.

While cooperative management is a process-oriented approach, distinguished by consensus decisions and public involvement, establishment of a coastal and marine area management council, either permanent or temporary, is an institutional approach. This approach would have the obvious disadvantage of adding yet another organization to the existing group, along with raising the question of financing the cost of its operation. However, such a council, composed of representatives from all the major interests involved in coastal and marine area problems in the Galápagos, could avoid some of this problem if it were seen as a temporary body. It might, indeed, provide a useful vehicle for the initiation of a less institutionalized, ongoing process of future management coordination between existing authorities. Such a council, given a more permanent status, might operate as a focus for coherent, coordinated management and could further serve to resolve conflicts as they arise. The council itself could attempt to operate on the principles of cooperative management, seeking a high degree of public involvement, using technical expertise when needed, and arriving at decisions through consensus.

To manage the agenda faced by the full council, a series of task forces might prove effective in addressing specific areas of long-term concern. These task forces would be composed of people from existing groups, using existing facilities and largely existing legal authority, and their objective would be to bring to the problem-solving process all available expertise and perspectives for a given issue. Areas which would warrant most immediate attention through this mechanism might include: petroleum management,

waterfront and harbor development, coastal and marine tourism development issues, and, though it is not strictly a coastal issue, exotic species introduction. It must be recalled, however, that a similar approach has been attempted for tourism, through the Galápagos Tourism Commission, without success.

As an inexpensive and expeditious alternative or complement to the above, a simple series of interagency convenios might be considered. This incrementalist approach in effect would accept the existing structure of coastal zone and marine resources management as the best base on which to build and would seek improvement through clarification of responsibilities and relatively minor adjustments in the status quo. With the possible exception of the creation of a new special marine management area, these adjustments would take the form of formal, clearly stated descriptions of relevant agency roles and purposes. The most obvious and immediate areas requiring such clarification have been listed earlier. The temporary council described above, or a general assembly of involved parties, might be an effective device for the initiation of the process leading to the series of convenios. The question of motivation applies to this approach as well as the others, so strong executive leadership might be required to insure the success and implementation of such a series of agreements. Again, the use of tangible incentives could be an effective inducement to participation and continued cooperation.

Incentives and Inducements

One potentially effective incentive in the approaches suggested above is that they would probably leave most existing agency prerogatives in place. The possibility of a change in prerogatives or jurisdictional domain, however, is also likely to motivate agency participation, especially if the process has strong executive sponsorship. Another tangible incentive might be the establishment of a special supplementary coastal zone management fund, with access and share contingent on participation in the coordination process. The locus of control over such incentives would be critical to its effectiveness and, again, might require strong executive involvement.

Public Involvement

No matter what mechanism ultimately is employed in the Galápagos to achieve more coherent coastal area and marine resources management, provisions

for public access to and involvement in the process appear important to its chances for success. Public involvement, indeed, is one of the hallmarks of CZM in many countries and can be a principal means of avoiding future conflicts and costly resistance. Public participation also can be a valuable source of critical information for decision-making, sometimes bringing to light pivotal facts or relationships that otherwise would be overlooked (Fox, 1983; McAllister, 1980).

Access to Relevant Scientific and Technical Information

Another source of information that will be of value to any coastal zone and marine resources management process in the Galápagos is technical and scientific expertise. With the presence of the Darwin Station, and the flow of scientific expertise which it attracts, the Galápagos situation is favored in a way that is unusual for many oceanic islands. The Darwin Station has played an important role in providing pertinent and accurate scientific and technical information for management decisions in the past. However, as the Darwin Station's ultimate value is in serving basic scientific research and not in acting as an extension service or adjunct to area management, it cannot be counted upon to provide the kind of applied research and services needed in day-to-day management. Therefore, attention might be directed to the creation of a simple and inexpensive process by which relevant technical and scientific information needed for the management process can be obtained on a timely basis. Financial support from international sources might be available for such a process because of the intense international scientific interest in and concern for the wellbeing of the Galápagos.

Public Education

This same international concern also might be marshalled, together with the deep Ecuadorian pride and interest in the Galápagos, to support public education programs in the Galápagos. These could be an indispensable aid to the management process by heightening public understanding of the complex environmental relationships at work in the archipelago and of the sources of international interest in their islands. A significant beginning in environmental education along these lines already has been made in some Galápagos schools (Gordillo, 1983). The cultivation of a sense of stewardship among the resident population could greatly reduce frictions and

cross-purposes in coastal and marine area management efforts. This sense of stewardship might be enriched by a deeper understanding of the quality of the natural asset which attracts tourist revenues and its susceptibility to degradations that could forfeit those revenues.

The long-standing issue of a marine park for the Galapagos is one of the major questions facing coastal area and marine resource management in the Galapagos. Establishment of marine parks and reserves has become a well-accepted and widely-used means of achieving a number of national and international goals (McLachlan and Ketchen, 1981; Bjorndal, 1974). In 1962, the 15th Recommendation of the First World Conference on National Parks invited "governments of all those countries having marine frontiers, and other appropriate agencies, to examine as a matter of urgency the possibility of creating marine parks or reserves to defend underwater areas." The typical functions of marine parks or reserves have been listed by IUCN (1978): habitat preservation; species preservation or conservation of genetic resources; research; protection, education, and scientific; special or cultural purposes; and multiple use.

A marine component for the Galapagos National Park has been envisaged since at least 1972 (Robinson, 1983b). Over the past decade, however, little progress has been made toward the establishment of such a marine park, and opposition has been expressed on several points. As currently written, the National Parks and Reserves Law (Ley de Parques, 1972) clearly prohibits the removal of any organisms from a national park. Yet, as Robinson (1983a) points out, "any proposal to restrict or eliminate recreational and economically important activities such as the banana fishery is certainly doomed to failure." Some have questioned, too, whether any appreciable ecological damage would occur without the protection of a marine park (Gianeros, 1983). Further, there is serious question about the feasibility of effective control and administration of an extensive marine area. The officials have stated unequivocally that effective management of a marine extension would be impossible with current capabilities and levels of support (Gianeros, 1983).

6. MARINE RESOURCES MANAGEMENT: THE SPECIAL PROBLEM OF
A GALAPAGOS MARINE PARK OR RESERVE

The long-pending issue of a marine park for the Galápagos is one of the major questions facing coastal area and marine resources management in the Galápagos. Establishment of marine parks and reserves has become a well-accepted and widely-used means of achieving a number of national and international goals (Kelleher and Kenchington, 1982; Bjorklund, 1974). In 1962, the 15th Recommendation of the First World Conference on National Parks invited "governments of all those countries having marine frontiers, and other appropriate agencies, to examine as a matter of urgency the possibility of creating marine parks or reserves to defend underwater areas." The typical functions of marine parks or reserves have been listed by Ray (1976): habitat preservation; species preservation or conservation of genetic resources; research; recreation, education, and aesthetics; special or cultural purposes; and multiple use.

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Rationale

The basic rationale for creation of a marine park or reserve in the Galápagos Islands can be paraphrased from the Marine Parks Policy (Parks Canada, 1983) formulated in Canada: To protect and conserve for all time a place which is a significant example of Ecuador's and the world's marine heritage, and also to encourage public understanding, appreciation and enjoyment of this heritage in ways which leave the area unimpaired for future generations. More specific rationales which we have identified are:

1. To provide a management focus for uses compatible with the program and purposes of PNG without denying traditional use by local residents.
2. To assure the protection of species and habitats critical to the survival of important Galápagos terrestrial organisms.
3. To assure the protection of species and habitats unique to the Galápagos marine environment.
4. To support worldwide efforts in the Man and Biosphere program with integrated protection of a unique biome in its entirety for genetic diversity and as a baseline case for study of changes in other systems.
5. To provide a coherent administrative mechanism for the management of educational, scientific and economic uses of the Galápagos marine area and for the resolution of conflicts arising among various uses.
6. To reserve economically vital living marine resources for the exclusive or preferred use by the resident population, who have traditionally relied on them.

The relatively undisturbed quality of the marine area, in fact, is one justification for its inclusion in a special management area or reserve. This represents an opportunity to achieve perpetuation of an unspoiled marine area without waiting until it has been subjected to heavy stress and alteration. Too little is known of the interaction between physical processes of environmental degradation and the workings of political bureaucracy to feel confident that timely protective measures would be established once immediate threats become obvious.

On pragmatic grounds, there is some uncertainty that a marine reserve would generate large economic benefits beyond those already accruing from the existing park. Severe financial constraints are common for developing countries planning marine reserves, but these can be successfully overcome

(Genolagani, 1982; Movcan, 1982; Bjorklund, 1974). Development of dive visits to natural marine attractions could provide access for the Galápagos to an important and growing segment of the Nature Tourism market. It could thus bring visitors who might otherwise choose not to visit Galápagos but who, like the current flow of nature tourists, would appreciate and respect its environmental fragility. Development of natural marine attractions also could help spread tourist visits over a larger number of sites and so reduce pressure on existing visitor sites. At least nineteen prospective marine sites have been identified already (Garcés and Ortiz, 1983).

Previous Recommendations

The 1982 Consultant's Report on Reformulation of the Management Plan for PNG does not address marine area management concepts. The report does state, however, that "the importance of including a marine area in the national park as soon as possible should be underlined" (Putney, 1982). The Plan states that the PNG as presently composed could not maintain the insular ecosystems of Galápagos until the marine component is included. A strong recommendation was included urging such an addition at the earliest possible opportunity (Putney, 1982). The 1981 High Level Commission to Study the Impact of Tourism in the Galápagos (Comision de Alto Nivel para el Estudio del Impacto del Turismo en Galápagos) also recommended inclusion of marine areas within the PNG as a matter "of the greatest urgency" which "cannot be postponed" (CANEITG, 1981).

Designation and Administrative Assignment

The question of title or designation of the special marine management area --whether as national park, ecological reserve, biological reserve, etc.--may not prove to be crucial. Table 2, adapted from Miller (1975), shows a number of potential designations along with the primary objectives usually associated with each. As can be seen in the table, "National Park" and "Scientific or Biological Reserve" both seem to capture the kinds of major objectives that might be anticipated for a special marine management area in Galápagos, as long as they can be modified to permit the traditional production of protein from artisanal fishing activities. Alternatively, if the area is established as an "Artisanal Fisheries Reserve" (as in the Game Reserves, Farms and

Table 2

Alternative Systems for the Management of Renewable Natural Resources to Accomplish Primary Conservation Objectives

Alternative Management Systems

Primary Conservation Objectives	National Parks*	Natural Monument	Scientific or Biological Reserve*	Wildlife Sanctuary*	Resource Reserve*	National Forest	Game Reserves, Farms, and Ranches	Protection Zones	Recreation Area
Maintain sample eco-systems in natural state	(1)	(1)	2	(1)	-	2	4	4	4
Maintain ecological & environmental regulation	(1)	(1)	(3)	(1)	(1)	(1)	(3)	(3)	(4)
Conserve genetic resources	(1)	(1)	3	(1)	-	3	3	3	2
Provide education, research & environmental monitoring	(2)	(2)	(1)	(2)	-	2	4	4	3
Produce protein from wildlife; sport hunting & fishing	-	-	-	-	-	(2)	(1)	-	-
Provide for recr. & tourism	(2)	4	-	4	-	(2)	2	-	(1)
Protect sites & objects of cultural, historical & archaeological heritage	(1)	4	-	-	-	4	-	-	4
Protect scenic beauty & green areas	(1)	(1)	3	3	-	3	3	3	(1)
Maintain open options, multi-purpose management	-	-	-	-	(1)	(1)	-	3	3
Stimulate nat'l use of marginal lands & rural development	(3)	(3)	(3)	(3)	(4)	(1)	(1)	(1)	(3)

() Major purposes for employing management systems

- 1 Objective dominates management of entire area
- 2 Objective dominates management of portions of area through "zoning"
- 3 Objective is accomplished throughout portions or all of area in association with other management objectives
- 4 Objective may or may not be applicable depending upon treatment of other management objectives, and upon characteristics of the resources
- Not applicable
- * Designation appears to capture most important proposed purposes for Galápagos marine area

Source: Miller, 1975.

Ranches column of the table), virtually all the objectives of national parks or reserves might be accomplished throughout portions or all of the marine area in association with the fisheries reserve objectives.

The major issues still pending concern: administrative assignments; boundary delimitation; zonation; and protection of traditional use. Once a decision to create a marine park or reserve has been made, these issues may not prove too complex. It would seem desirable, and even necessary, to provide assurances of traditional use and of resident input on zonation decisions before the park or reserve is created or is established as a goal of national policy. We see no reason, therefore, why all management decisions must be specified in every detail before the establishment of a marine park or reserve can be embodied as national policy.

On the question of administrative assignment, the 1981 Forestry and Conservation Law (Ley Forestal) and its 1983 regulations (Decreto Ejecutivo no. 1,529) provides that all natural areas are to be administered by the Ministry of Agriculture through its National Forestry Program (PRONAF). The designation of new natural areas is determined by this Ministry following technical recommendations and management guidelines of PRONAF.

In addition to providing for the establishment of national parks and ecological or biological reserves, which maintain restrictions on artisanal or commercial activities as determined in the 1971 National Parks and Reserves Law (Ley de Parques), the new system permits the creation of recreation areas, hunting and fisheries areas, as well as fauna production areas. The latter not only allows activities of scientific research and recreation, but also the rational development and utilization of the wildlife for the benefit of local communities or commercialization. These activities, like those in any of the other natural areas, must not damage existing species and resources. This designation might thus represent one way of implementing a "marine park" in the Galápagos.

Because of the importance of the marine area to the integrity of terrestrial Galápagos habitats, it would seem important that PNG play an influential role in the formulation of policies, regulations, and management rules of procedure, no matter what options are pursued. Even in the face of severe resource constraints, the management of PNG has been exceptionally successful and has received worldwide recognition as a model to be emulated (Ponce and Villa, 1982; Budowski, 1976).

Boundaries and Zonation

On the questions of park boundaries and zonation, several existing proposals are summarized in Table 3. Although there appears to be a large variety of different proposed boundaries--for example, 2 miles, 2 nautical miles, 1-5 kilometers, 15 miles, all interior waters, etc.--more careful examination of the table and of Figure 24 reveals striking uniformity in basic features of the plans. Most treat the area as a marine extension of PNG, and all surround all islands, with the possible exception of urban areas, with a band of marine park. The 2-nautical-mile extent proposed by Wellington is little different from the 1974 Master Plan's 2-mile extent, and it encompasses much of the archipelago's 200-meter isobath with over 90 percent of the marine fauna and flora characteristic of the islands (Wellington, 1976a). The 5-kilometer extent would also achieve this end, as would the 15-mile and all internal waters boundaries.

The major difficulty that arises with specific boundary widths concerns ease of recognition for control and enforcement. This is one major advantage that can be identified for including all the archipelago's internal waters, particularly if rights of traditional use are protected.

Also apparent from Table 3 is the basic similarity between the zonation schemes proposed by Wellington (1975) and Robinson (1983a). Both correspond roughly to the zoning categories of the existing PNG, and both essentially would allow the status quo in 90-96 percent of the islands' coastal waters. A key distinction is that Wellington's proposed "Primitive" zone, with special protection and no taking of marine life, would have included many of the small islands and islets favored as productive artisanal fishing areas. This potential defect is remedied in the Robinson zonation scheme, which was developed jointly by G. Robinson, marine biologist at the Darwin Station; P. Villa, Darwin Station; M. Hurtado, Instituto Nacional de Pesca; O. Aquirre, INGALA; F. Cepeda, PNG; and A. Putney, consultant (Robinson, 1984). This zonation scheme also differs by including coastal waters adjacent to ports.

A more important innovation proposed by Robinson, however, is the inclusion of all internal waters in the park or reserve (Robinson, 1983b). Doing this could greatly simplify administrative coordination and reduce enforcement costs. In addition, Robinson (1983b) states: "The 2-nautical-mile zone would provide protection for nearly all the Galápagos marine life

Table 3

Comparison of Major Proposals for a Galápagos Marine Reserve or Park

Proposal Source	Designation	Administration	Extent	Zonation	Comments
Master Plan for the Galápagos National Park (1974)	Extension of Galápagos National Park (PNG)	PNG	1 km seaward of uninhabited coast of all islands.	<u>Class I</u> : Visitor zone; <u>Class II</u> : Primitive zone, with limited development, to protect and present park values; <u>Class III</u> : Restricted zone, highest order of protection--no human use intruding upon or damaging natural scene; <u>Class IV</u> : Special use zone to permit activities supporting existing neighboring land use.	Class I is a relatively small zone; Class II is the most extensive; Class III is buffered by Class II zones; specific zoning of marine areas to be determined on acquisition of further basic information.
Wellington Report (1975)	Marine zone of existing PNG	PNG	2 nautical miles seaward from all islands.	<u>Intertidal</u> : shoreline except urban; visitor use with complete protection except for traditional subsistence exploitation. <u>Special Use</u> : from coast out 2 nm; existing commercial and non-commercial uses permitted with present methods and levels. <u>Intensive Use</u> : 1/2 nm from designated park coastline; complete protection and large concentrations of visitors. <u>Primitive</u> : 1/2 nm from designated park coastline; special protection, permit to visit, no taking of marine life; almost all small islands. <u>Primitive-Scientific</u> : 2 nm from designated coastline; complete protection; for scientific research only.	Encompasses nearly all of the 200 m. depth contour, with over 90% of distinctive flora and fauna; 96% of coastline in Special Use zone, which maintains status quo.
IUCN Bulletin re. statement by Government of Ecuador (May, 1978)	Extension of PNG	n.s.	15 miles seaward of all islands, and all internal waters of archipelago.	n.s.	Reported by Robinson (1983a).
High Level Commission for Study of Impact of Tourism in Galápagos (CANEITG, 1981)	Extension of PNG	<u>Agriculture Min.</u> (PNG): visitor control & park administration; <u>Defense Min.</u> : marine laws and nat'l sovereignty; <u>Natural Resources Min.</u> : fisheries.	Band of 1 to 5 km. around all islands.	n.s.	Draft presidential decree proposed but not adopted; boundaries to be established by Ministries, with immediate creation of temporary 1 km. band around all islands.
Presidential Speech at San Cristóbal (1982)	n.s.	n.s.	n.s.	n.s.	Not so much to protect ecosystems as to protect resources of islands from outside commercial interests; privileged use for Galápagueños; reported in Robinson (1983a).
Robinson (1983a)	Extension of PNG	n.s.	2 nm, or, preferably, all internal waters.	<u>Zone 1</u> : traditional fishing permitted (like special use zone); includes 90% of coastal area. <u>Zone 2</u> : science, tourism and education; often adjacent to onshore visitor sites (similar to intensive use zone). <u>Zone 3</u> : all coastal areas and bays adjacent to PORTS; park control, except traffic, controlled by port captain; innocent passage. <u>Zone 4</u> : representative habitat areas; complete protection. <u>Zone 5</u> : refuge and recuperation areas set by Nat'l Fisheries Institute (INP); limited term status; exploitation of specified marine species prohibited.	Advantages of having all internal waters; 1. provision of buffer areas for sensitive marine habitats; 2. establishment of nat'l policy re. development & management; 3. protection of migratory mammals.

n.s.: not specified

Figure 24. Boundaries in major proposals for a Galápagos marine park or reserve.

associated with coastal habitats, but not necessarily for migratory marine mammals, such as whales and dolphins, nor for sea lions and seabirds that often feed far out at sea." Inclusion of all internal waters also would provide a broad buffer for sensitive coastal habitats requiring complete protection.

As an alternative to creating a marine park or reserve contiguous with the entire existing national park, consideration could be given to establishing a series of clearly delineated smaller marine reserves exclusively designated for scientific and touristic use. This would be similar to including only certain of the proposed protected zones from existing proposals. These smaller marine reserves could be selected in such a way as to also provide breeding sanctuaries for bacalao, lobster, and other species of current or potential interest to local fishermen. They might thus serve to moderate fluctuations in population size for the various species being exploited. This could be emphasized to local fishermen, who could be expected to oppose restrictions on their traditional fishing grounds that offered no countervailing benefit.

Protecting Traditional Uses

The desirability of incorporating meaningful local input in the planning of a marine park or reserve, along with the advantages of assuring traditional artisanal uses in the area, cannot be stressed too strongly. Indeed, protection of traditional uses can be a prime objective in creating such reserves and is a common feature of a number of the world's marine parks.

Existing artisanal fisheries do not represent a serious threat to the marine environment of the Galápagos Islands. These long-established fisheries provide significant employment opportunities to local residents. The banning of all fishing within the Galápagos Islands would create considerable hardship, particularly in Puerto Baquerizo Moreno, and is not justified by the existence of foreseeable threats to the marine resources of the archipelago. Because of the potential dangers to important endemic species, however, the introduction of new technology and gear types must be approached with great caution. The status of the lobster and black coral resources, and the role of commercial lobster fisheries in exploiting these resources, is less clear and may require further scrutiny and possibly controls.

Of course fishing is not the only traditional use of Galápagos waters that must be reconciled with a marine park or reserve. Because of the importance of waterways and boat transport for interisland communication, some assurance of unrestricted rights of navigation, consistent with the purposes of the park and public safety, might be considered. Further, as the Navy has long experience and unexcelled competence in regulating maritime traffic, jurisdiction in this domain will be left with the Navy no matter how else a marine park or reserve is designated administratively. Indeed, as the enforcement of national rules and regulations may be viewed as a basic expression of national sovereignty, the Navy might be called upon and granted the resources to play the primary role in enforcing rules and regulations for the marine park or reserve. The effective administration of a marine park or reserve will in any case require a high degree of interagency coordination and cooperation.

Policy Options

There seems little point in moving to a Master Plan stage of development until the intention to create such a park or reserve has been established as national policy. It is important, furthermore, to make it clear that even a Master Plan for a marine park or reserve need not specify every detail of the area's future management.

Six options for next steps by the Government of Ecuador are suggested here for further consideration.

1. Establish policy that marine park or reserve will not be created in Galápagos waters, that traditional uses and status quo will be maintained.
2. Do nothing. De facto acceptance of status quo without foreclosing possibility of future establishment of a park or reserve in Galápagos waters.
3. Initiate immediate discussion and further study into issue of whether, how, and where a marine park or reserve should be established in Galápagos waters.
4. Establish policy that future creation of a marine park or reserve in Galápagos waters is envisaged and initiate discussions and further study toward most appropriate definition and timely implementation of such a park or reserve.

5. Establish a marine park or reserve in the Galápagos immediately by decree, which could leave open the details of the organization and implementation of the park or reserve.
6. Immediate establishment by decree of a marine park or reserve for Galápagos waters, fully specified in operational detail.

It is difficult to see what constructive purpose would be served by the choice of option 1 that could not also be achieved through option 2. Option 2 might have some advantage over the first option in preserving greater scope for future flexibility. Option 2 certainly is as inexpensive as any other option, but it bears the risk of missing a timely opportunity to achieve the purposes of the marine park or reserve that may not be available again in the near future. Option 3 would seem to add little to what has already been underway over the past ten years, and Option 6 seems unrealistic. Too much lead time would be required, too many new resources would have to be provided, and too many mistakes could result from attempting to specify every operational detail of the new reserve immediately.

Options 4 and 5 need not be costly, and both would permit the planning process to proceed cautiously and sequentially. The course to be followed, however, would have been clearly set.

7. SUMMARY OF FINDINGS AND OPPORTUNITIES FOR ACTION

Increased demands are being imposed on the coastal and marine resources of the Galápagos Islands both to serve a growing resident population and to accommodate potentially lucrative tourism. Coupled with the goals of environmental protection and scientific study, these demands signal a need for greater attention to the management of the archipelago's coastal and marine resources. Substantive problems in the Galápagos involve: conservation of the Islands' unique biota and habitats; tourism; port development; waste disposal; resource extraction; and fisheries.

An ad hoc system of coastal zone and marine resources management does function in the Galápagos, but it is incomplete and largely uncoordinated. The most important apparent ambiguities, conflicts, or gaps in the CZM system as it now stands concern interagency relationships and responsibilities. Further, existing technical expertise often is not effectively incorporated into the planning process.

An integrated approach to coastal zone and marine resources management would attempt to address problems in a comprehensive and coordinated way, but the formulation of such an approach suitable to the Galápagos is a major challenge. A general statement of purpose for the design of more coherent coastal zone and marine resources management in the Galápagos might be:

To fashion a process by which both public and private actions in coastal and marine areas of the archipelago can be managed to improve the social condition of the islands' inhabitants, given that the protection of the islands' unique ecosystems will continue to be an overriding consideration.

To meet this objective, the following features of a coastal zone and marine resources management process seem appropriate to the Galápagos: emphasis on protection of environmental values; reflect and accommodate needs and concerns of the resident population; address the issue of formal protection of the Galápagos marine area; incorporate the best feasible scientific and technical information; be simple, inexpensive, and politically realistic; minimize the creation of new boundaries, laws or institutions.

It should be possible to achieve coordination and improved coherence through improved and focused communication and the application of existing

powers within already recognized boundaries. The greatest opportunities for improvement seem to lie in refinement of the existing procedural framework and the structure of interagency responsibilities and relationships.

New administrative instruments or mechanisms may be required to initiate and achieve improved coordination. Several possible alternative or complementary mechanisms can be identified: 1) a cooperative management approach; 2) a permanent or temporary coastal zone and marine resources council; 3) a series of coastal and marine area management agreements or "convenios" between the relevant agencies to clarify roles, responsibilities, and understandings of purpose; and 4) application of tangible incentives for involvement and cooperation in the joint effort.

Under a two-zone management system, two overlapping management areas would be established: 1) a marine resources management zone extending seaward some distance and perhaps containing a narrow onshore margin; and 2) an onshore coastal zone management area, overlapping the landward margin of the marine resources zone and extending some relevant distance seaward as well. Existing boundaries and agency assignments might be readily adapted to a revised system of coastal zone and marine resources management similar to the two-zone working model.

Provisions for public access to and involvement in the process appear important to its chances for success. Attention might also be directed to the creation of a workable process by which relevant technical and scientific information can be generated and fed into the management process on a timely basis. Public education is also important to cultivate a sense of stewardship in the resident population that could greatly reduce frictions and cross-purposes in coastal and marine area management efforts.

While national policy for the onshore area of the Galápagos Islands unambiguously stresses conservation of the natural environment, no clear policy seems to have been defined for the Galápagos marine area. The long-pending issue of a marine park or reserve for the Galápagos is one of the major questions facing coastal area and marine resources management there. Because the Galápagos marine environment is virtually pristine, an obvious opportunity exists for the orderly establishment of special management provisions that preserve the habitats and traditional uses of this important marine area.

Protection of traditional uses can be a prime objective in creating such a marine reserve and is a common feature of a number of the world's marine parks. Although some restrictions on artisanal or commercial activities are maintained in Ecuador's national parks under the 1971 National Parks and Reserves Law, several other natural area designations are available under existing law that explicitly permit or foster traditional uses. There seems little point in moving to a detailed planning stage, however, until the intention to create such a park or reserve has been established as national policy.

More general opportunities for constructive action by the Government of Ecuador in CZM and MRM for the Galápagos Islands might include the following possibilities:

- * Establish as a matter of national policy that an integrated process of coastal zone and marine resources management is appropriate for the Galápagos Islands and initiate the actions necessary to implement that policy.
- * Establish a general policy for conservation and preservation in the Galápagos marine environment that accommodates the continued economic use of the marine area and begin discussions toward implementation, with particular attention to the issue of a marine park or reserve.
- * Design and initiate a program to educate the resident population more fully about the special global importance of the Galápagos environment.
- * Devise and incorporate mechanisms to assure effective public access to and involvement in the CZM and MRM process.
- * Design and establish a more effective system by which relevant technical and scientific information can be generated and employed on a timely basis in the Galápagos Islands CZM and MRM process.
- * Review the management of tourism traffic in the Galápagos in order to identify alternative approaches that might increase tourism revenues, expand benefits to the resident population, and at the same time reduce environmental pressures from tourism.

The problems of coastal and marine resources management in the Galápagos Islands are relatively self-contained and distinct. With the cooperation of involved agencies and institutions, and with public participation and support, marine policies and a process of coastal and marine resources management can be achieved that will benefit the archipelago's inhabitants directly while protecting its unique ecosystems for generations to come.

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16. Abstract (Limit: 200 words) The report describes coastal and marine resource uses and problems in Ecuador's Galápagos Islands, briefly discusses general principles of coastal zone and marine resources management, examines the current status of CZM and MRM in the Galápagos Islands, and offers observations on possible avenues for improvement. The archipelago has long been the object of worldwide scientific interest. Increased demand on its coastal and marine resources, to serve a growing resident population and to accomodate potentially lucrative tourism, signal a need for greater attention to the management of these resources. Coastal and marine affairs and problems in the Galápagos which can be addressed by a CZM/MRM process include: conservation of the Islands' unique biota and habitats; tourism; port development; waste disposal; resource extraction; and fisheries. The basic elements of a CZM and MRM system are already in place in the Galápagos, but they are uncoordinated and largely <u>ad hoc</u> in nature. Existing and potential jurisdictional ambiguities or conflicts between the Navy/Port Captaincies, the municipalities, the National Park, the development agency for the Galápagos (INGALA) and other organizations are described. A two-zone management scheme for coastal and marine resources is proposed. It avoids the establishment of complicated new systems of boundaries and institutions, instead adapting itself to the existing situation. Four possible mechanisms for improved coordination are identified: cooperative management; a coastals zone and marine resources council; a series of agreements ("convenios") between relevant agencies; and application of incentives. The possible creation of a marine protected area is discussed at length, including rationales for the area's establishment, its designation and organization, jurisdictions, boundaries and zoning, and the			
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