Guidelines for Developing a Coastal Zone Management Plan for Belize

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in collaboration with

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Coral reefs and other renewable resources along the coastal zone of Belize collectively represent one of the country's greatest assets. "Eco-tourism" is already a major source of national revenue. The uniqueness of the reef system, in particular, is recognized internationally. Although much of the coastal environment is still relatively pristine, human demands on the coast are increasing annually. The need for wise management of the coastal zone is evident.

The document begins by highlighting the benefits of adopting an integrated approach to coastal zone management. The major components, or phases, of the coastal zone management planning process are also briefly described. These include, firstly, data collection and compilation (Phase 1), to summarize ecological, socio-economic and related information about the coastal zone. In the next step (Phase 2), the information obtained in the previous phase is analyzed. This helps identify resource use opportunities and problems that exist, or might arise, within the coastal zone. The final section (Phase 3) involves developing a series of goals and tasks, to respond to the identified opportunities and problems. The tasks, in particular, provide the main thrust of the coastal zone management action plan.

The sections of the document that follow provide a series of provisional guidelines that may be useful for the development of a coastal zone management plan for Belize. However, it needs to be recognized that what superficially may appear to be a logical sequence of planning steps may not in reality be straightforward to implement. The present guidelines should therefore be viewed primarily as a contextual setting and analytical framework into which the array of coastal zone management activities may be placed. Developing a workable coastal zone management plan, and incorporating it into the overall planning process for Belize, is both an opportunity and a challenge. It will take time, and in reality it is an evolving process. It will also require the commitment, involvement and cooperation of many different sectors of Belizean society.

Finally, if the coastal zone management plan for Belize succeeds in meeting its objectives (sustainable development and use of coastal resources), it is hoped that it might serve as a useful model for other parts of the Caribbean.

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1. Introduction

1.1. Background

The Barrier Reef complex of Belize is one of the country's greatest natural assets (Fig. 1). The reef's massive structure provides a physical defence to coastal areas against storms and erosion. It functions as a self-repairing breakwater. The living reef, associated ecosystems and their vast array of interdependencies (e.g. fishery resources, turtles and birds) collectively represent a resource of immense social and economic importance. "Eco-tourism", in particular, is already a thriving business, and provides a major input to the national economy. For instance, an estimated 25,000 tourists visited the Hol Chan Marine Reserve in 1989. The uniqueness of the reefs is also recognized internationally. Like Australia's Great Barrier Reef, the reef complex of Belize represents one of the greatest manifestations of life on earth. Compared to many other parts of the Caribbean, coastal and marine environments of Belize are still relatively pristine.

Unless human uses and economic activities derived from the coastal zone are wisely managed, however, Belize may soon change. The increasing attraction of the country, especially its magnificent coral reefs, to scuba divers and other tourists could place heavy demands on Belize's coastal environment. Already, coastal dredging and clearance of shoreline swamps has begun in certain places, to help meet the needs of expanding tourism and development. Deforestation and, more recently, intensifying agriculture could also generate conditions detrimental to the nearby reefs and fisheries such as soil erosion, pesticide and fertilizer runoff and coastal sedimentation. Moreover, Belize's close proximity to the extensive Mexican and Guatemalan oil deposits is understandably encouraging further exploration. If prospecting in Belize proves successful, the resulting oil wealth will undoubtedly accelerate the pace of national development and economic growth. To meet these increasing human demands, and also economic opportunities, institutional and legal mechanisms will need to be further developed. Management objectives and policies for the coastal zone have yet to be comprehensively defined or fully agreed upon. An integrated coastal zone management plan for Belize provides a means and an opportunity to help maintain the various values provided by its coastal zone.

In response to recognition that careful management is needed to ensure sustainable use and development of Belize's coastal system, a Coastal Resources Management Workshop was convened in San Pedro (Belize) from 21-23 August 1989. The workshop involved participants from nine countries, including some of the world's foremost experts on coastal zone management. As a result of the deliberations, the participants developed a series of draft recommendations for consideration and action by the Government of Belize, NGOs and other sectors of society. These recommendations (Appendix 1) were given strong support and endorsement by the international participants at the Workshop, but have yet to be given formal approval.

1.2. Purpose of this Document

One of the recommendations (VIII) arising from the above workshop is as follows: 'The planning process should begin with a rapid compilation of available information on coastal zone resources, including their utilization and socio-economic importance, the existing legal and institutional framework and human and financial resources available for their management, and major threats to their sustainable utilization.'

The document begins by highlighting the benefits of adopting an integrated approach to coastal zone management (Section 2). The major components, or phases, of the coastal zone management planning process are also briefly described. These include, firstly, data collection and compilation (Phase 1), to summarize ecological, socio-economic and related information about the coastal zone. In the next step (Phase 2), the information obtained in the previous phase is analyzed. This helps identify resource use opportunities and problems that exist, or might arise, within the coastal zone. The final section (Phase 3) involves developing a series of goals and tasks, in ressponse to the identified opportunities and problems. The tasks, in particular, provide the main thrust of the coastal zone management action plan.

Section 3 of the document provides a series of tentative guidelines that may be helpful during the development of a coastal zone management plan for Belize. However, it must be recognized that what superficially may appear to be a logical sequence of planning steps, may not in reality be straightforward to implement. The present guidelines should therefore be viewed primarily as a contextual setting and analytical framework, into which the array of coastal zone management activities may be placed. Developing a workable coastal zone management plan, and incorporating it into the overall planning process for Belize, is both an opportunity and a challenge. It will take time, and in reality it is an evolving process. It will also require the commitment, involvement and cooperation of many different sectors of society.

Finally, if the coastal zone management plan for Belize succeeds in meeting its objectives (e.g. sustainable development and use of coastal resources), it is hoped that it might serve as a useful model for other parts of the Caribbean.

2. Integrated Coastal Zone Management

2.1. The Need for an Integrated Approach

Coral reefs and other ecosystems of Belize are a key renewable resource, characterized by complex exploitation patterns. Like other ecosystems, Belize's barrier reef may be regarded as a complex dynamical system, influenced not only by natural processes (e.g. hurricanes), but also by human activities such as fishing and diving. This concept can be extended to larger areas, even to the entire zone and its vast array of interdependencies. Yet despite concern over the state of the world's coastal environments, knowledge of the connections between the non-living, biological and human domains is still far from complete. Even the workings of just the principal biological elements (e.g. mangrove forests and associated fisheries) are ecologically intricate and poorly understood. But when interactions of the various coastal users and beneficiaries (i.e. the human domain) are superimposed, the system becomes truly complex. Almost any management initiative entails altering (usually limiting) resource access, by manipulating individual parts of the system. However, it has been shown time and time again that altering one part of a system can have unforeseen effects on another part. For instance, in Belize it is understood that mangrove clearance on certain cays has resulted in acute coastal erosion. In some cases, the effects may be felt in more distant areas. Failure to perceive and analyse a system such as the coastal zone holistically, then manage it accordingly, is undoubtedly contributing to the widespread degradation of natural resources. The problem may be further compounded by increasing demands on resources for local trade or distant international markets.

Management clearly cannot proceed effectively through science, socio-economics, politics, or simple intuition alone. Solutions to problems and issues are seldom straightforward and require an integrative approach. A fundamental objective of resource planners and managers, and indeed of most human societies, is sustainable development. This implies forms of development aimed at enhancing nature's contribution to human welfare, not just anticipating and preventing undesirable side effects. It involves participation not just from government agencies and NGOs, but from all sectors of society. Strategies need to be developed, whereby the needs of conservation and the needs of development begin to converge.

But how should management proceed, recognising the complexities inherent in natural systems? Clearly, a more interdisciplinary and integrative approach is needed. Recent advances have been made in disciplines such as socio-economics, anthropology, law, marine sciences and non-linear mathematics: these are of much relevance to resource management. One promising avenue is to integrate scientific and socio-political considerations by means of dynamical models. Possible short-term and long-term future states of the system arising from a range of management strategies can thereby be explored. Experience elsewhere has shown that assessment and management of coastal resources often takes place most effectively within the framework of a coastal zone management programme or plan.

2.2. Major Components of a Coastal Zone Management Plan

Despite the genuine complexities associated with coastal resource exploitation, some sort of coherent framework into which management activities may be placed is clearly desirable. Such a framework, or coastal zone management plan, can also help provide boundaries for an array of activities and issues, which otherwise might seem limitless. Table 1 is a suggested framework into which the array of coastal zone management planning activities for Belize could be situated. The suggested framework consists of three principal activities, or phases. A pre-requisite to effective coastal zone management, however, is strong government and public commitment. This is discussed further in section 3.1.

Phase 1: Data Collection and Compilation. This needs to include both socio-economic and scientific considerations. Information can be gathered during field surveys and also from other sources. Discussions with experts and local people, and the wealth of existing documents on Belize, can make a valuable contribution. The information collected needs to be systematically compiled, for instance on maps and computer databases. Information can also be transferred to a Geographical Information System (GIS), allowing spatial and temporal updating and periodic reanalysis of information.

Phase 2: Data Analysis. This is undertaken primarily to determine resource use conflicts and resource use opportunities. Analysis of both resources and socio-economic issues, using integrative approaches, is a valuable tool for coastal zone management. At least three main types of analysis can be undertaken. First, map analysis, using information on the geographic dimensions of resources, uses and environmental pressures. Second, numerical analysis of socio-economic and ecological information, using appropriate models (e.g. non-linear dynamical models) and appropriate statistical methods. Third, issue analysis, to help understand the issues and concerns that presently are not open to insightful interpretation from map or computer analysis, but which may nevertheless may have significant implications to management.

Phase 3: Data Synthesis: Development of Action Plan. This generally includes development of a series of major goals, which need to be developed and agreed upon. This is followed by development of tasks, to respond to the opportunities and problems identified in Phase 2. The tasks, in particular, provide the main thrust of the coastal zone management action plan.

3. Key Elements of a National Coastal Zone Plan for Belize

3.1. The Need for Strong Government and Public Commitment

A pre-requisite for effective coastal zone management is a firm commitment to sustainable use of its resources, by both government and users of the coastal zone, including the general public. It is understood that the conservation ethic in Belize is already quite strong. However, a mechanism, or facility, with which to bring about the various coastal zone management activities (e.g. data collection, data analysis and data synthesis) is seen as a major requirement (see also section 3.4.2).

3.2. Data Collection and Compilation (Phase 1)

3.2.1. Key Coastal and Marine Resources

Much information exists on the coastal and marine resources of Belize. The following sections attempt to summarize, principally by means of maps, important details on the distribution and magnitude of renewable coastal and marine resources. More detailed accounts are available elsewhere (see e.g. Perkins and Carr, 1985; Hartshorn *et al.*, 1984; UNEP/IUCN, 1988).

Fisheries: The fisheries clearly represent the coastal resource of Belize that is of most apparent economic and social value. For instance, the total value of Belize fisheries production in 1989 amounted to US$ 8.8 million (Fisheries Dept. Statistics, 1990). Details of exports by product are given in Table 2.

Coastal and marine areas of Belize containing concentrated fishery resources are shown in Figure 2. These occur mostly inshore, but also in association with the barrier reef lagoon, and within lagoons of the three large outer atolls. Principal fishery resources include conch, lobster, shrimps, deep sea fish and other fin fish. A detailed map showing the location of different fisheries is also available (see Appendix 2). Mariculture is considered in section 3.2.2.

Other Important Species Groups: Other species groups of known economic, conservational or local value are also of significance. Information has been compiled and mapped for turtles (3 species), manatees, the American and Morelet's crocodile and seabird nesting sites (Fig. 3). Concentrations are found scattered along the coast and offshore cays, but in greatest abundance in the vicinity of Belize City. A detailed map showing the distribution of each species group is also available (see Appendix 2).

Habitats and Ecosystems: Coastal and marine habitats occupy virtually the entire coastal zone

of Belize. Together with their associated plant and animal species, they form units (ecosystems) which represent a resource base of great value. Certain habitats, or ecosystems (e.g. coral reefs, seagrass beds and mangroves), are considered to be critical, and may be more important than others in sustaining the productivity of renewable natural resources. They also have numerous human and economic values (e.g. coral reef fisheries). Less information is available on ecosystems which appear to be less critical (e.g. sand and rock beaches, subtidal sand/mud). However, such ecosystems undoubtedly contribute in some way to the overall ecological integrity of the coastal zone. Consequently, they should not be totally disregarded or misutilized.

The distribution of concentrated areas of mangroves, seagrasses and coral reefs is shown in Figure 4. A map showing detailed distribution of each ecosystem is also available (see Appendix 2). These areas are extensive. However, the distribution of seagrasses shown is at present only provisional. It is evident that most of the shoreline and extensive tracts of the offshore region are occupied by one or more of these ecosystems. It is of significance that the coastal zone, in particular, is highly productive. At the same time it is the part of Belize associated with the greatest human population densities. Natural processes (e.g. hurricanes, water movement and sediment transport) have a significant influence on the occurrence and control of coastal ecosystems. Consideration should therefore also be given to the influence of natural processes in coastal ecosystem assessments. Detailed maps showing basic details of hydrographic and oceanographic conditions are also available (see Appendix 2).

Concentrated Key Resources: Of particular value to coastal zone planners and managers is an overall picture of the location of concentrated key resource areas. These have been identified and mapped in Figure 5. This was prepared by combining the maps on fisheries (Fig 2), other important species groups (Fig. 3) and critical marine habitats (Fig. 4). Areas occupied by key resources are clearly extensive.

3.2.2. Coastal and Marine Uses and Their Environmental Effects

Human Population Trends

Human population size is of much relevance in resource management, since there is often a positive association between human numbers and resource/environmental pressures. From a population of around only 2,000 in 1790, Belize's population level grew slowly to around 4,000 by 1830, but had increased exponentially to about 180,000 by 1989 (Hartshorn *et al.*, 1984; Ministry of Economic Development, 1989). The population increase would have been even greater without emigration of Belizeans over recent decades (see also Hartshorn *et al.*, 1984). Probably of greater significance, however, is the increase in numbers of immigrants (e.g. refugees and farmers) and tourists entering Belize over recent years. The estimated number of tourists visiting Belize in 1980 was 63,735, rising to 88,430 in 1984 and reaching 179,814 by 1989 (Ministry of Economic Development, 1989). The number of tourists visiting Belize in 1989 was therefore equivalent to the total number of residents. Furthermore, of the 188 hotels present in Belize in 1988, more than 75% were sited on the coastal zone. Increasing human pressures potentially could have a dramatic impact on coastal resources (see below). While 'eco-tourism' and other coastal activities contribute enormously to the national economy, it is important that they are managed wisely.

Uses and Environmental Pressures

A summary map showing areas of coastal use is shown in Figure 6. This includes areas of: fishing; tourism; construction and development; aquaculture; desalination plants; ports and harbours; military facilities and activities; hunting; sand mining; coastal communities; navigational channels; dredging and coastal infilling. Areas of heavy human use appear to be widespread, both on the coast and offshore. In some cases, the environmental effects of the various uses are known (see also UNEP/IUCN, 1988). For instance, the environmental effects from dredging and infilling are usually overt and often immediate. A detailed map showing the distribution of each major use is also available (see Appendix 2), and these uses are discussed briefly below.

Tourism: Hotels within Belize are located principally at San Pedro and Belize City. As indicated above, about 75% of hotels in Belize occur along the coast. Dive sites and sports fishing areas are also a feature of coastal tourism.

Construction and Land Development: Coastal areas under construction and land development are located mostly around Belize City and San Pedro. A detailed map showing land developments is also available (see Appendix 2). At the present time only a relatively small proportion of the coast is developed. However, with a rapidly expanding population, and increasing tourism, there will undoubtedly increasing demands on use of the coastal zone of Belize. Sewage and solid waste disposal are a problem in certain areas.

Fishing: Fishing takes place in widespread areas of the coastal zone, the barrier reef and atolls. Fishing areas correspond closely with the location of major fishery resources, as would be expected. Fishing and the fisheries therefore constitute both a use and a resource.

Aquaculture: Like the fisheries, aquaculture may be regarded as both a resource and a human use of the coastal zone. Aquaculture products include penaeid shrimp (*Penaeus vanami*) and aquarium fish. A detailed map showing principal aquaculture areas is also available (see Appendix 2). These are situated behind the mangrove belt, mainly in a type of soil known as lowland pine ridge.

Desalination Plants: The conversion of seawater to freshwater, using desalination plants, represents both a human use and an actual resource. At present there are only four plants in Belize, and a further one is proposed. In the event of a major oil spill, or seawater contamination from other sources, it is possible that outgoing freshwater could become tainted. Severe oiling could also impair the functioning of the plant machinery.

Ports and Harbours: Although there are several small harbours, the only major ports in Belize are Belize City, Commerce Bight and Big Creek. According to the information available, there are no future plans for large ports.

Military Facilities: Military facilities and activities are confined to a few coastal areas, particularly in the vicinity of Belize City, Placencia and Hunting Cay. Military use of the coastal zone at present probably causes little environmental impact. However, a large military presence

could perhaps pose a potential environmental problem (e.g. disturbance to nesting turtles), as could other unmanaged human activities.

Sand Mining: This is carried out principally near the mouth of the Sibun River. Sand is collected from coastal and brackish areas for use in construction. At present sand mining is conducted only on an artisanal level. However, if operations were to involve mechanical suction pumps, dredgers, and motorised transport, environmental problems could well follow. For instance, this could lead to shoreline erosion and increase the vulnerability of the coast to hurricanes.

Coastal Communities and Fishing Settlements: Numerous small coastal communities and fishing settlements are found along the coast and cays of Belize .

Navigational Channels and Oil Transportation: The main navigational channels for shipping are the English Cay Channel and the Inner Channel. A detailed map showing these channels is available (see Appendix 2). Apart from merchant and passenger ships, two oil tankers visit Belize city every month. One of these (1,931 gross tonnage) ships only diesel, generally 15,000 barrels, or 630,000 gallons each month. The other (17,000 gross tonnage) ships on average 40,740 barrels, or 1.7 million gallons, each month. A major spill from tankers and other sources of oil would constitute a serious hazard. In 1990, a minor spillage occurred from an oil barge near San Pedro. Although oil is distributed within Belize primarily via overland routes, smaller quantities are often transported to coastal areas by barge. In 1988, an oil barge carrying Bunker C fuel sank *en route* to Belize from Honduras. An oil spill contingency plan is therefore seen as a major priority, and is discussed further in section 3.4.2.

Dredging and Landfill: The main areas associated with dredging and coastal infilling are located around Belize City and certain cays. Both activities can have serious immediate and indirect effects on nearby ecosystems, such as mangroves, coral reefs and seagrass beds. In many tropical countries these activities have been responsible for widespread degradation of coastal resources and decline in fisheries and other revenue.

Agriculture: Certain agricultural practices (e.g. deforestation, use of fertilizers and pesticides), if excessive, can affect the coastal environment, sometimes beneficially, but usually adversely. Seven shipments of fertilizer, each of 750 gross tonnes, are received each year. Further details of the agricultural activities and patterns are available elsewhere (Hartshorn *et al.*, 1984). An understanding of terrestrial-coastal interactions is of major significance in coastal zone planning and management.

3.2.3. Existing Coastal Reserves, Shipwrecks and Archaeological Sites

Existing coastal reserves, including terrestrial reserves having a coastal component, are shown in Figure 7 and a detailed map of their distribution has also been prepared (see Appendix 2). These consist of marine reserves, sanctuaries, national monuments, forest reserves and private reserves. Of particular importance is the highly successful Hol Chan Marine Reserve, established in 1987 on the south of Ambergris Cay. Wrecks and archaeological sites are also included in Figure 7, since these are considered to be an important cultural resource.

3.2.4. Existing National and International Legislation

Summarized below are the main national and international laws, conventions and commitments which have relevance to the control of environmental problems and to coastal zone management in general. Legislation acting directly includes, for instance, controls on the clearance of mangrove vegetation. Legislation acting indirectly includes regulation of activities inland (e.g. forestry and agricultural practices). Uncontrolled, these can have adverse effects on coastal zone resources (e.g. coral reefs) through sedimentation caused by soil erosion. It may be mentioned here that the upholding of existing legislation and agreements represents an important activity in any coastal zone management plan.

National Legislation

Fisheries Ordinances and Regulations (1977, Chapter 133): Regulations relating specifically to fishing activities include the following:

a) Closed seasons;
b) Size limits (e.g. for conch and lobster);
c) Mesh limits on fishing gear;
d) Fishing licenses (for both local and foreign vessels);
e) Prohibition on fishing using SCUBA gear;
f) Licensing for harvesting of coral which, with few instances (e.g. black coral),is not permitted.

Full details of these and related regulations are given in the Fisheries Ordinances and Regulations.

Of particular significance, both to fisheries and coastal management in general, is the highly successful Hol Chan Marine Reserve on the south of Ambergris Cay (see also section 3.2.3). This was established and is managed under the aegis of the Fisheries Department. A framework therefore already exists in Belize for the creation and management of marine protected areas. The same or similar framework presumably could be used in future initiatives.

Forestry Acts and Ordinances: There are several acts and ordinances which, although within the mandate of the Forestry Department, directly or indirectly have relevance to the management of the coastal zone. The most important include:

a) National Parks System Park Act (1981): The National Monument at Half Moon Cay was established under this act.
b) Wildlife Protection Act (1981): Protection of species of economic, social or conservational importance such as green and hawksbill turtles, crocodiles, and manatees, is promoted under this act.
c) Mangrove Legislation (1989): In recognition of the important economic and ecological role of mangroves within Belize, legislation has been recently passed to control mangrove clearing. However, it is understood that mangroves are still being lost to development in certain areas. The effectiveness of this and certain other environmental legislation may therefore need to be reviewed.
d) Forests Ordinance (Chapter 115): Forest Reserves were established and are managed under this Ordinance. This affords some protection to waterbasins, which are an important link between terrestrial and marine environments.
e) Minerals Ordinance (Chapter 125): This ordinance provides guidelines and regulations for mining within Belize, which should help limit potentially harmful substances such as heavy

metals from polluting water courses and reaching the marine environment.
f) Petroleum Ordinance (Chapter 126): Regulations and leases for the prospecting and extraction of oil are governed by this ordinance. However, it is understood that few provisions are made for controlling pollution arising from drilling or oil production. This may become a major issue if oil is discovered and extracted in commercial quantities.
g) Public Health Ordinance (Chapter 81): This aims to regulate pollution, particularly in situations where human health may be at risk.
h) Control of Dive Boats and Cruise Ships: The Ministry of Tourism and Environment aims to produce legislation to control and regulate dive boats and cruise ship, to reduce degradation of the coastal and marine environment.
i) Pesticides Control Act (1985): This provides guidance and regulations on the use of pesticides. As mentioned above, pesticides may reach the coastal environment, and in high concentrations can be harmful to marine life.
j) Other National Legislation: The following legislation is also of actual or potential significance in coastal zone planning and management, and merits further consideration: Ancient Monuments and Antiquity Act (1971); Aliens Landholding Act; Land Utilisation Ordinance (amended, 1990); Crown Lands Ordinance (Chapter 110); Development Incentives Ordinance (repealed and/or modified, 1990); Ports and Harbours Acts; and Salvage of Wrecks Law.

International Legislation
Law of the Sea: This has been signed by Belize and also ratified.
Convention on International Trade In Endangered Species (CITES): Belize is signatory to this Convention.
International Convention on the Regulation of Whaling: Belize is a member of the International Whaling Commission (IWC) within the Convention.
Cartagena Convention: Belize is not yet a member, although it is understood that it may become a signatory.

Regional Affiliations
Gulf and Caribbean Fisheries Institute (GCFI): Belize is a member.
Caribbean Conservation Association (CCA): Belize is a member.
UNEP Regional Seas Programme: Belize is a member of UNEP's Caribbean Environment programme, but not an active participant.

3.2.5. Existing Institutional Arrangements

The major government agencies and NGOs currently involved in some way in national coastal zone management in Belize are listed below. Details of their responsibilities and mandates fall outside the scope of this document. This great array of institutions represents a valuable foundation for present and future coastal zone management efforts. This capability will be enhanced by good coordination with the activities of outside agencies and collaborators.

Government Agencies
Ministry of Agriculture and Fisheries: The Fisheries Department is involved in several coastal zone management initiatives, in particular the management of all commercial and artisanal fishing activities. The Hol Chan Marine Reserve is also managed by the Fisheries Department.

Ministry of Tourism and The Environment: The divisions of this ministry include: Legal Division and Drafting; Tourism Bureau; Environmental Protection and Pollution Control; and Archaeology. Since tourism assumes such importance in Belize, this ministry will clearly have a significant role in coastal zone management initiatives.
Ministry of Industry and Natural Resources: The divisions of this ministry include: Forestry Department; Lands and Survey Department; Petroleum Office; and Water and Sewage Authority.
Ministry of Energy and Communications: Included within this ministry is the Port Authority, which is concerned with shipping and related activities.
Ministry of Foreign Affairs, Economic Development and Education: This ministry's portfolio includes: University College of Belize (UCB); Development Incentives; and Population.
Ministry of Health: The main division of significance to coastal zone management is the Public Health Department.
Ministry of Finance, Home Affairs and Defence: The Belize Defence Force (Maritime Wing) is the main division of this ministry actively involved in management of coastal uses and activities.
Ministry of Housing and Cooperatives: The Cooperative Department encompasses fishing cooperatives, and is therefore involved directly in coastal affairs.
Ministry of Works: Land Reclamation and Drainage is the division concerned with use of land and coastal areas. This has implications for future use of mangroves and other coastal resources.
Ministry of Labour, Public Service and Local Government: Town Boards, a division within this ministry, has some involvement in coastal affairs and activities.

Non Governmental Organizations (NGOs)
The main NGOs in Belize include:
Belize Fishermen's Cooperative Association: There are nine registered and operating Fishermens' Cooperatives:
Southern Fishermen Co-op Society Ltd; Northern Fishermen Co-op Society Ltd;
National Fishermen Producers Co-op Society Ltd;
Placencia Producers Co-op Society Ltd;
Caribena Producers Co-op Society Ltd;
Central Fishermen Co-op Society Ltd;
Independence Fishermen Co-op Society Ltd;
Toledo North Fishermen Co-op Society Ltd;
Mullins River Co-operative;
Belize Audoubon Society;
Belize Centre for Environmental Studies;
The Belize Zoo and Tropical Education Centre;
Belize Tourist Industry Association.

3.2.6. Technical and Development Assistance

A number of outside agencies and organizations are currently involved in the assessment or management of the coastal zone and its resources, in collaboration with local government organizations and NGOs. This assistance should be recognized as a valuable input to any national coastal zone management plan. However, activities must be carefully coordinated to ensure maximum benefit. The principal organizations involved are summarized below.

US Agency for International Development (USAID): USAID's CAC Amendment Project includes funding for coastal zone planning in Belize, and there may be provision for a an advisor and training. A component of this project will include a coral reef assessment and monitoring programme (see also section 3.4.2 and Appendix 3).

The World Conservation Union (IUCN): IUCN contributed to the recent workshop in San Pedro on Coastal Resource Management (Appendix 1). It is also engaged in following up on recommendations from the workshop.

Programme for Belize (PFB): Under this programme funds have been provided for an assistant/ trainee to work in collaboration with the IUCN team for a first year.

Overseas Development Administration (ODA): ODA have expressed interest in providing assistance to the Ministry of Fisheries for the development of a coastal zone management plan. A division of ODA (ODNRI) is collaborating with to the Department of Lands and Survey in the form of a GIS. Detailed maps of coastal vegetation, including mangroves, and human uses are being developed and the information compiled as a GIS/database. Access to this and other available coastal zone information is of paramount importance. This will help to avoid unnecessary duplication of effort by the various agencies involved in development and implementation of the coastal zone management plan.

World Wide Fund For Nature (WWF): WWF is assisting Belize in the development of coastal zone management plan by funding the environmental education component of the project through the Belize Audobon Society. Funds have been provided to hire a full time environmental educator, and for a vehicle and a photocopier. A critical habitat survey funded by WWF and coordinated by the Belize Centre for Environmental Studies was completed in 1991.

Wildlife Conservation International (WCI): WCI has supported several coastal zone management initiatives. WCI is currently collaborating with the Fisheries Department to develop a possible framework for a coastal zone management plan.

The Great Barrier Reef Marine Park Authority (GBRMPA): GBRMPA, in conjunction with IUCN, provided 3 months of training in their planning office in Australia for the Fisheries Administrator. GBRMPA will also assist with the development of the coastal zone management plan.

Caribbean Environmental Health Institute (CEHI): This institute is interested in helping establish a long-term monitoring system for the coastal zone. Under this arrangement, CEHI has provided assistance and training in coral reef monitoring techniques, and has donated some equipment. A CEHI consultant recently visited Belize and helped set up the first permanent monitoring stations on the reef.

Food and Agriculture Organization of the UN (FAO): Some assistance to the Fisheries Department is being provided by FAO's WECAF Project, and FAO has provided some training to staff in remote sensing techniques.

3.3. Data Analysis: Identification of Problems and Opportunities (Phase 2)

As discussed earlier (section 2.2), analysis of socioeconomic and scientific information can be undertaken to identify both problems and opportunities occurring along the coastal zone. Results of analysis undertaken during the present mission are described briefly below. Clearly, more extensive and intensive analysis will be required once the coastal zone planning process is in full operation. Some of these analyses could be incorporated into the interdisciplinary research and monitoring programmes (section 3.4.2 and Appendix 3).

3.3.1. Resource Mapping and Analysis

By comparing the areas of concentrated key coastal resources (Fig. 5) with areas of major coastal uses and environmental pressures (Fig. 6), it is possible to identify the main areas of resource use conflict (Fig. 8). In this figure, areas of overlap (shaded) denote actual or potential resource use conflict areas. This preliminary analysis points to areas that might be in most need of management. The main resource use conflict areas (actual or potential) occur along southern regions of the coast, along parts of the Barrier Reef system, and also in several offshore areas including Ambergris Cay, Turneffe islands, Lighthouse Reef and Glovers Reef. Such analysis can be a helpful means of determining which areas might be suitable candidate sites for protected areas (see also section 3.4.2). Those areas whioh are not shaded in Figure 8 represent areas without use conflict which may provide opportunities for further use of the coastal zone. Some provisional guidelines for zoning the coast for different uses (and non-use) are suggested in section 3.4.2.

3.3.2. Statistical and Related Analysis

Statistical and related analysis of the coastal zone data is clearly outside the scope of the present study. Building on earlier studies, it will be of value to undertake both socio-economic and ecological analysis, using appropriate techniques (e.g. non-linear models). For instance, these could be used to explore present and future socio-environmental states of mangroves under a variety of management regimes. It is of significance that mangrove vegetation often provides the productivity base for shrimp and other types of aquaculture. In some countries, large areas of mangroves have been cleared for aquaculture. This is believed to have resulted in an overall decline in coastal productivity, leading to a decline in abundance of juvenile shrimp, which are used to stock the ponds. This has impaired the viability of aquaculture production. While mangrove clearance is not yet of major concern in Belize, increasing demands on the coast may change this situation. The above and related considerations therefore need to be included in coastal assessments and valuations.

The economic implications of violating existing regulations could also be investigated. For instance, if hazardous or toxic wastes are dumped on mangroves, do current penalties provide an adequate disincentive to continue such practices? Also, what would be the ecological damage caused by hazardous substances?

Other bioeconomic studies could assess the immediate value (e.g. to tourism and fisheries) and less obvious benefits (e.g. protective function) of coral reefs. Cost benefit analysis can also be

a useful tool in this context, if all major factors are incorporated in the evaluation.

3.3.3. Identification of Issues

This is taken to include analysis of issue and factors that at present are difficult to understand through more formal types of analysis (e.g. mapping and computer analysis). Nevertheless, issues of this sort may have significant implications to management. An example might be assessment of the perceptions and implications of private land ownership of the cays, and the implication of private land ownership to coastal zone management (see also section 3.4.2 and Appendix 3). It should also be added that analysis of some such issues is now possible using computer aids, and such advances are likely to become of great value in coastal zone management.

3.4. Data Synthesis : Development of Coastal Zone Management Action Plan (Phase 3)

3.4.1. Goals

A series of goals is a major requirement in any coastal zone management plan. A number preliminary goals were suggested at the recent coastal resource management workshop in San Pedro (Appendix 1). An appropriate overall, primary objective might therefore be as follows, although the exact wording clearly will need to be agreed by all concerned institutions.

'To ensure the protection, enjoyment, development and sustainable use of the coastal zone of Belize'.

However, adoption of primary and secondary goals in practice will need to involve considerable inter-sectoral collaboration. The perceptions and expectations of private individuals, fishermen, and of tourist and other industries also need to be heard. These are seen as a vital considerations in the development of a coastal zone management plan.

3.4.2. Tasks

The following tasks are among those that need to be considered in development of a national coastal zone plan. Clearly, it will not be feasible to consider and implement all of these at once.

To Develop Institutional Arrangements for a Coordinated Approach

Coastal zone management is an interdisciplinary activity involving many sectors of society (including different government agencies, NGOs and local people). A need therefore exists for inter-sectoral collaboration, and a coordinated approach. This is seen as vital to the success of any management programme. The importance of this was also clearly identified at the recent coastal zone management workshop in San Pedro (Appendix 1). The workshop recommended establishment of the following: i) an interministerial board; ii) a coastal zone advisory board; iii) a coastal zone planning unit. The recommendations for establishing these were intended to help forge stronger links between all concerned agencies and users of the coastal zone. The exact mechanism needed for implementing these recommendations will need to be carefully worked out.

Interministerial Board: This should be a high level body, to improve co-ordination of Government policy and programmes relating to Belize's coastal zone resources. The responsibility for coordination of this Board could be given to an existing government body or a new body could be created for this purpose. The Board would conduct its work through periodic meetings, perhaps involving workshops and audiovisual presentations. It is important that the Interministerial Board has the necessary terms of reference and authority to respond in accordance with the overall coastal zone management objectives (see sections 3.1 and 3.4.1).

Coastal Zone Advisory Board: This should include representatives from Government agencies, NGOs, educational institutions, and in particular, resource user groups involved in coastal zone management, to provide ongoing recommendations to the interministerial board (above). It has been suggested that the existing National Conservation Advisory Council might play a central role in this.

Coastal Zone Planning Unit: A comprehensive multiple-use management process for the entire coastal zone will need to be supported by a coastal zone planning unit. The existing planning team of the Fisheries Department and Wildlife Conservation International (WCI) might be considered for undertaking this role, as they have already been involved in the creation of and planning for the Hol Chan Marine Reserve, and have initiated activities to follow up the recommendations of the Coastal Resource Workshop held in San Pedro in 1989.

At present (1992) coastal zone management is being spearheaded by the Department of Fisheries. A key role of this group will be to improve liaison and coordination of the different environment sectors.

To Continue Development of Protected Area System

A number of coastal protected areas, including the successful Hol Chan Multiple-Use Marine Park at San Pedro have already been established (see section 3.2.3). Additional sites have also been identified (see Fig. 4; UNEP/IUCN, 1988). The development of a protected area systems should be seen as an ongoing initiative, like other components of a coastal zone management plan. Of particular interest are the current plans for creating a protected area to include Glovers Reef.

There have also been attempts to establish the entire barrier reef system of Belize as a World Heritage Site. Efforts to bring this about should continue, with proposal documents endorsed by the interministerial board (see section 3.4.2). A World Heritage Site within Belize would undoubtedly create great national pride and international prestige. Moreover, it would contribute in a positive way to ensuring long-term sustainable development and use of a unique national asset.

Areas in need of special management can also be identified using the analyses discussed previously. For instance, areas in which concentrated key resources coincide with heavy human uses denote resource-use conflict areas (Fig. 8). Identification of these areas offer one means of helping to select candidate sites. However, it may also be desirable to create marine reserves in areas which at present are relatively free of major environmental threats. Other scientific and socio-economic criteria also need to be taken into account (see Salm and Clark, 1984). For

instance, which category of protected area is appropriate (e.g. multiple use, strict preservation) depends on the management objectives decided upon for the particular area. Preparation and adoption of a detailed management plan is normally seen as a requirement if a protected area is to be most effective. There is clearly already much enthusiasm for specially managed areas within Belize, and it is hoped that initiatives can be expanded further.

Special Development Areas may be seen as a special category of protected area and are receiving high level backing and support. The first to be designated was Monkey River in 1991. This is a coastal village whose community is involved in management of the area through zoning and other measures. The reserve is proving to be very successful and may serve as a case study and model to be applied to other coastal settings in Belize. The eastern side of the Corozal in the Northern District and South Lagoon in Belize District are also being designated as Special Development Areas. Designation of these and subsequent areas may be a particularly effective means of helping reconcile the often conflicting needs of conservation and development.

To Create a Zoning System for the Coast of Belize

It is understood that the most acceptable overall management regime will be one involving multiple use of the coastal zone. Within this framework, few activities are likely be totally prohibited throughout the region, and restrictions are best kept to a reasonable minimum wherever possible. Nevertheless, experience elsewhere indicates that limited access within at least certain areas is necessary. For instance, limitations on certain activities are essential, if a long-term sustainable use of Belize's coastal zone is to be a reality (see Kelleher, 1990). A need is seen for firm procedures to be established whereby applications for developments and coastal uses should follow a clear sequence of planning guidelines prior to approval.

Through the establishment of additional protected areas (e.g. multiple use marine reserves), and implementation of coastal and marine policies, it should eventually be possible for the entire coastal zone of Belize to become zoned. The whole region would then essentially comprise a vast multiple-use reserve. This would include coastal areas in which human uses are permitted (e.g. fishing, tourism, residential and commercial construction), and other areas set aside for research and conservation, and perhaps also other activities. The recreational and other needs of Belizean citizens should be included in any zoning scheme. Creation of a zoning system will probably take two or more years, and will require development of detailed management plans. In coastal areas in which coastal uses are permitted, the use of Environmental Impact Assessment (EIA) is strongly recommended for any large developments. However, incorporating EIAs into the planning and management process is seldom straightforward. Various approaches have been adopted, but many do not match the needs or skills of developing countries. In general, however, EIAs involve five main activities (see McGlade, 1988): i) identification of potential impacts; ii) prediction and measurement of impacts; iii) interpretation and evaluation of impacts; iv) identification of monitoring requirements; v) communication of impact assessment results.

To Develop Options for New Environmental Policies and Laws

The success of Belize's ability to safeguard economic, environmental, health, recreational and cultural values associated with its coastal zone will depend on the management emphasis that

is placed on future use of its coastal resources. Following a more detailed review and analysis of the status of the coastal zone, it may be found that existing policies and laws cannot always deal effectively with all types of environmental problems (e.g. dredging and infilling) and exploitation patterns. Consequently, new policies may need to be formulated. However, with minor modifications, development activities can often continue, as long as any adverse environmental effects are minimized, or eliminated. Where possible, coastal uses that are not strictly coastal-dependent should be sited inland rather than on the coast. The use of Environmental Impact Assessment (EIA) is seen as an important tool and is discussed above.

To Develop Interdisciplinary Research and Monitoring Programmes

Although considerable information has been collected on the coastal zone of Belize, there are clearly gaps in knowledge. Clearly, a vast array of projects and studies would be desirable. However, given logistical and financial constraints, only those of greatest relevance to coastal management may be possible initially. Some guidelines for interdisciplinary research and monitoring programmes are given in Appendix 3. These are listed below.

Critical Habitat Study; Population Studies on Crocodiles; Use of Satellite Imagery For Assessment of Coastal Ecosystems; Monitoring of Water Quality; Greenhouse Gases and Global Warming; Land Ownership; Central Data Bank;

These include projects recently initiated, as well as those expected to begin shortly. At some later date, for instance after 2-3 years, it may be necessary to review these and other projects, to determine if coastal zone management priorities have changed. If so, a change in project emphasis may be desirable.

To Develop an Oil Spill Contingency Plan

In view of the close proximity of Belize to heavy shipping, consideration may need to be given to an appropriate emergency response, in the event of a serious oil spill. Belize's extensive barrier reef system could be at particular risk. Acquisition of emergency equipment (e.g. booms to contain oil) and training of local personnel in different methods of oil spill combat is an important requirement of an oil spill contingency plan. Knowledge of the pros and cons of the different methods of dealing with oil spills (e.g. booms, detergents, 'do nothing approach') is also important and would enable the equipment most appropriate for the situation to be deployed. Coastguards and other personnel comprising the Disaster Preparedness Consul (e.g. for hurricanes) could possibly form the basis of the oil spill combat team.

It would also be useful to compile an ecosystem vulnerability index, to determine which ecosystems and resources are most sensitive to oil pollution. From other studies, it is known that mangroves and coral reefs are particularly vulnerable to oil pollution, and both ecosystems are particularly prevalent in Belize. This information, in conjunction with socio-economic considerations, can then be used to assign a priority for clean-up to different areas of the coastal zone in the event of a spill.

Some or all of the components of an oil spill contingency plan might be an identifiable project, and perhaps considered for funding by outside agencies.

To Periodically Reappraise Status of the Coastal Zone and Management Needs to Meet New Demands

As better information on the coastal zone of Belize becomes available, the existing information base should be upgraded periodically. This task would be facilitated by a Geographic Information System (GIS). The coastal zone management planning unit will then be better equipped to deal with new or changing demands placed on the coastal zone.

To Continue Development of Public Awareness Programmes

This is seen as a key element of a coastal zone management plan, or indeed of any conservation initiative. Through TV programmes, brochures, magazines, audiovisual and slide presentations, the benefits of wise use and management of the coastal zone can be positively portrayed. These should build on existing environmental public awareness initiatives, for instance slide shows of the Audubon Society, and displays at the Hol Chan Marine Reserve. The educational value of these and other exhibits (e.g. Belize Zoo and Tropical Education Centre, Howler monkey reserve at Bermudian Landing) is already clearly apparent. Creation of a public aquarium, or sea zoo, and marine museum in Belize city or Belmopan would also help increase understanding of the coastal zone. Public Awareness Programmes ideally should be targeted at a broad spectrum of society, including for instance fishermen, schools, colleges, tourists, developers and other sectors.

It would also be of value to develop marine and environmental curricula at schools and colleges, to expand and supplement existing courses. These will help provide students, including future natural resource managers in Belize, with a firm grounding in the principles of resource assessment and ecology, conservation, environmental science, management and planning.

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Table 1

Possible Framework For a Coastal Zone Management Plan for Belize

PHASE 1	PHASE 2	PHASE 3
Data Collection and Compilation (Assessment)	Data Analysis (Problems and Opportunities)	Data Synthesis (Coastal Zone Management Action Plan)
Data Collection (Field Surveys, Interviews and Existing Info.) * Coastal Ecosystems * Natural Processes * Coastal uses and Pressures * National and International Legislation * Institutional Arrangements * Socio-economic Conditions	* Resource Mapping and Analysis * Statistical and Related Analysis * Identification of Issues	Goals Tasks * Develop Institutional Arrangements * Create Additional Protected Areas * Create zoning system for the coast * Develop options for coastal policies and law * Develop Inter-disciplinary Research Studies * Develop Oil Spill Contingency Plan * Periodically Reassess Status of Coast * Continue Development of Public Awareness Programmes
Data Compilation * Maps * Databases * Documents		

Table 2
Details of Fishery Exports in 1989

COMMODITY		National	Northern	Placencia	Caribeña Fisherman	Independent Fisherman	Mullins River Shrimp	General Shrimp	Caribbean Shrimp	Laguna Madre Shrimp	TOTAL
Lobster	lb	251,077	305,960	13,400	31,000	-	-	-	-	-	601,437
	BZ$	4,670,032.20	6,119,200.00	227,800.00	580,940.00	-	-	-	-	-	11,597,972.20
Conch	lb	128,400	29,500	18,700	12,800	-	-	-	-	-	189,400
	BZ$	963,000.00	221,250.00	112,200.00	76,800.00	-	-	-	-	-	1,373,250.00
Fish Fillet	lb	5,300	1,590	-	-	-	-	-	-	-	6,890
	BZ$	21,200.00	6,360.00	-	-	-	-	-	-	-	27,560.00
Frozen Whole Fish	lb	95,350	79,889	162,090	78,300	-	2,000	-	-	-	417,629
	BZ$	181,165.00	179,750.25	283,657.50	137,025.00	-	3,500.00	-	-	-	785,097.75
Fresh Whole Fish	lb	18,700	17,073	-	-	-	-	-	-	-	35,773
	BZ$	56,100.00	59,755.50	-	-	-	-	-	-	-	115,855.50
Dry Salted Fish	lb	-	-	-	-	22,000	-	-	-	-	22,000
	BZ$	-	-	-	-	38,500.00	-	-	-	-	38,500.00
Salt Water Aquarium Fish	lb	-	-	-	-	30,936	-	-	-	-	30,936
	BZ$	-	-	-	-	82,422.28	-	-	-	-	82,422.28
Stone Crab Claws	lb	-	4,993	-	-	-	-	-	-	-	4,993
	BZ$	-	54,923.00	-	-	-	-	-	-	-	54,923.00
Shrimp	lb	123,650	74,500	72,450	35,200	-	-	62,997.4	2,300	19,850	390,947.4
	BZ$	1,174,675.00	707,750.00	688,275.00	334,400.00	-	-	419,541.90	21,850.00	188,575.00	3,535,066.90
Lobster Head Meat	lb	792	200	-	-	-	-	-	-	-	992
	BZ$	4,752.00	1,000.00	-	-	-	-	-	-	-	5,752.00
Salted Shark Skin (Pieces)	lb	-	-	-	-	10,470	-	-	-	-	10,470
	BZ$	-	-	-	-	2,274.00	-	-	-	-	2,274.00
Dry Sharks Fin	lb	-	-	-	-	58	-	-	-	-	58
	BZ$	-	-	-	-	1,839.76	-	-	-	-	1,839.76
Sea Crab "Ratti"	lb	-	-	-	-	50	-	-	-	-	50
	BZ$	-	-	-	-	201.75	-	-	-	-	201.75
TOTAL	lb	623,269	513,705	266,640	157,300	32,578	2,000	62,997.4	2,300	19,850	1,680,639.4
	BZ$	7,070,924.20	7,349,988.75	1,311,932.50	1,129,165.00	125,237.79	3,500.00	419,541.90	21,850.00	188,575.00	17,620,715.14

Figure 1

Base Map of Belize Coastal Area

Note: Limit of territorial waters is currently 3 miles, but may be extended to 12 miles. There may also be options in the future for Belize to exercise certain rights within the 200 miles EEZ. Such changes would have implications for future coastal zone management initiatives.

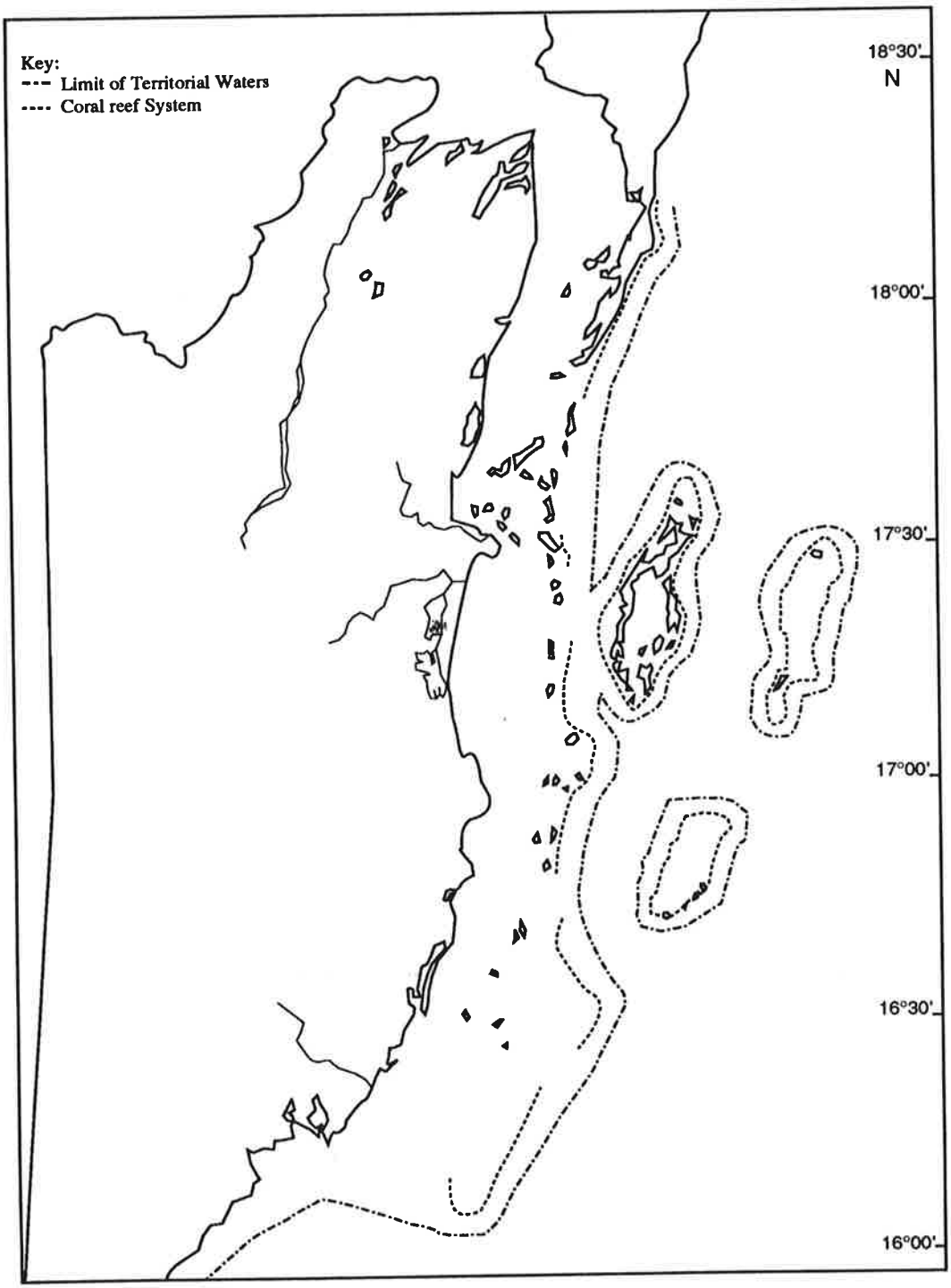


Figure 2

Summary Map of Fishery Resources (shaded)

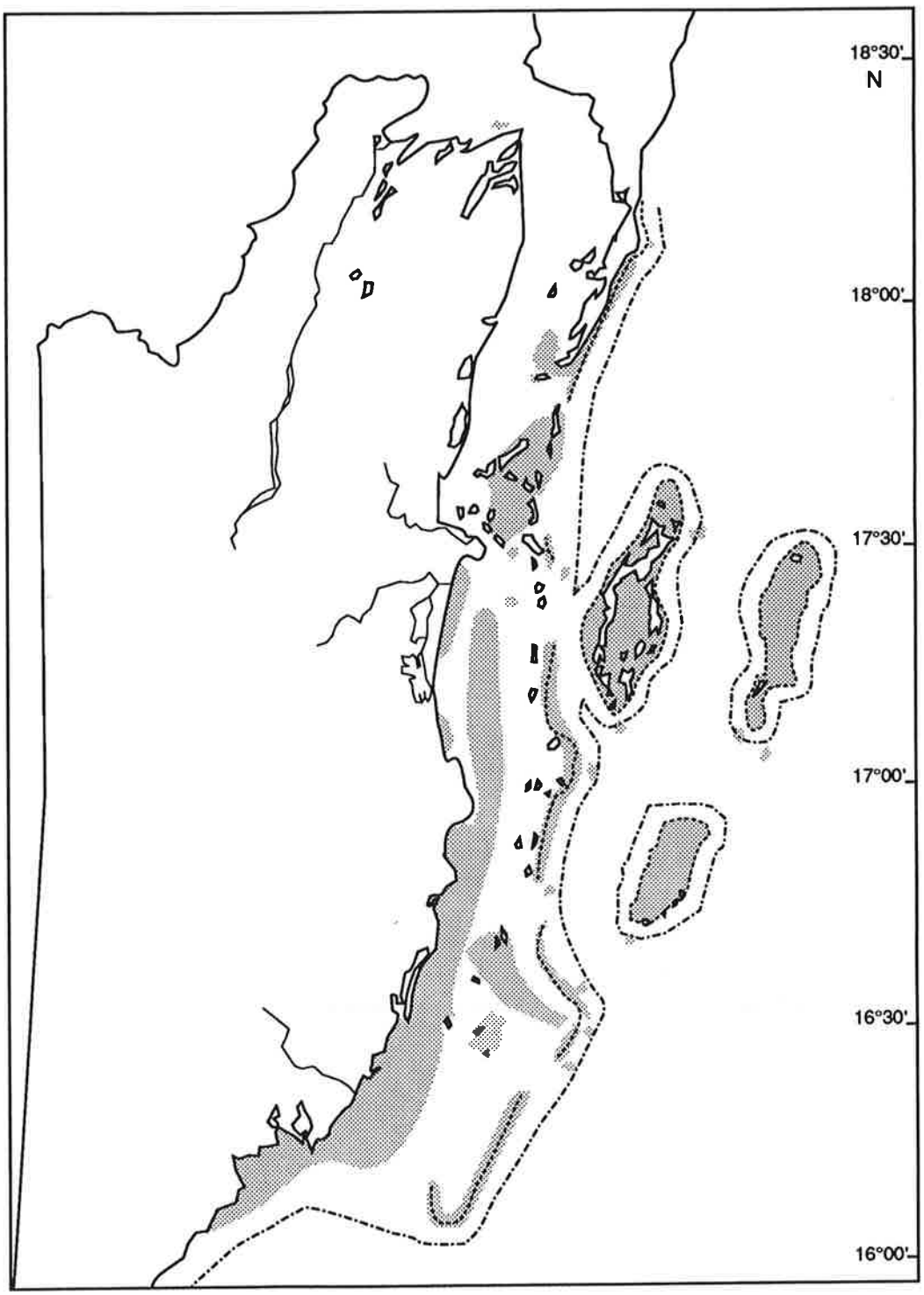


Figure 3

Summary Map of Key Coastal Species (shaded)

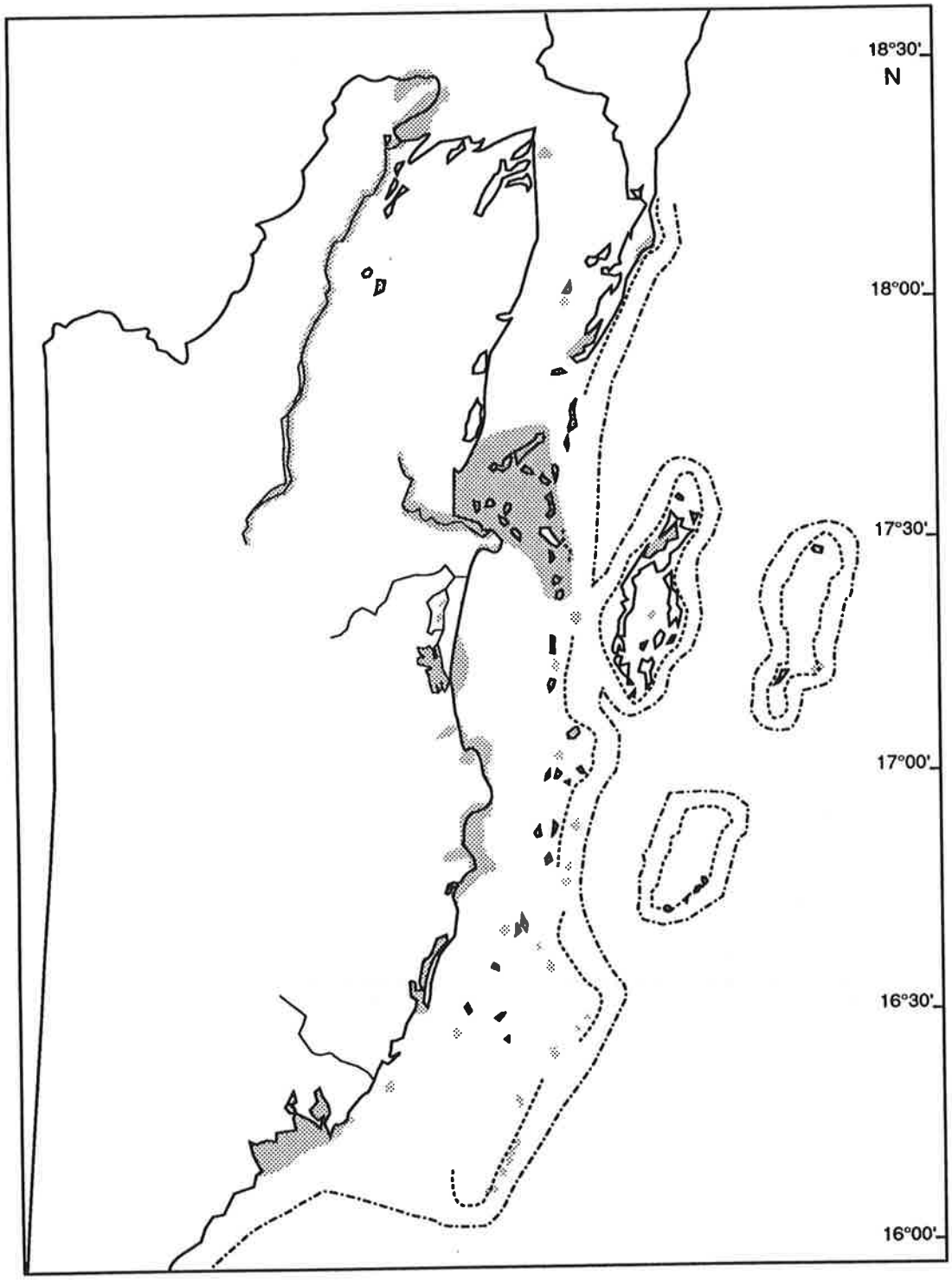


Figure 4

Summary Map of Key Coastal Ecosystems of Belize (shaded)

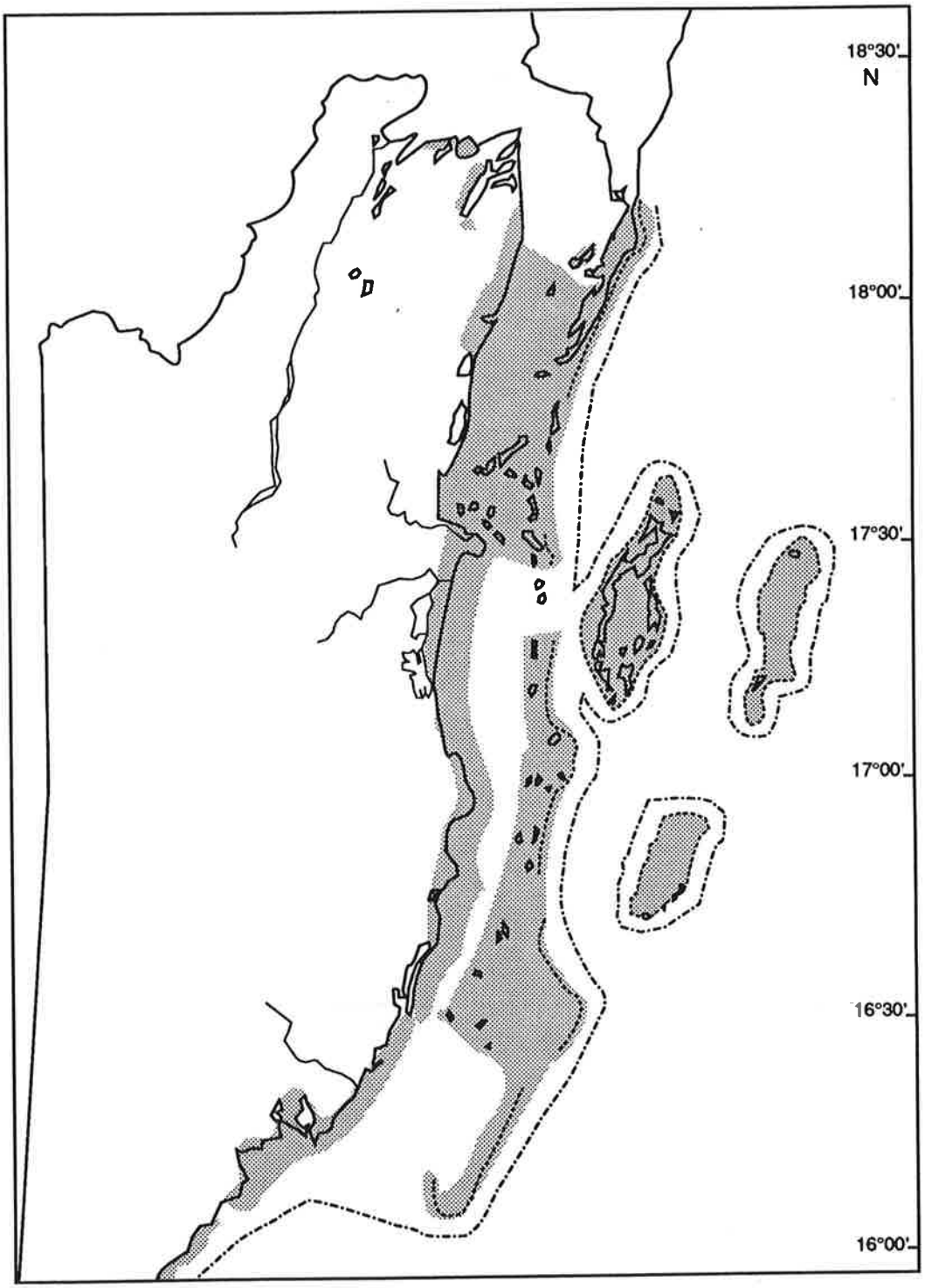


Figure 5

Summary Map of Concentrated Coastal Resources (shaded)

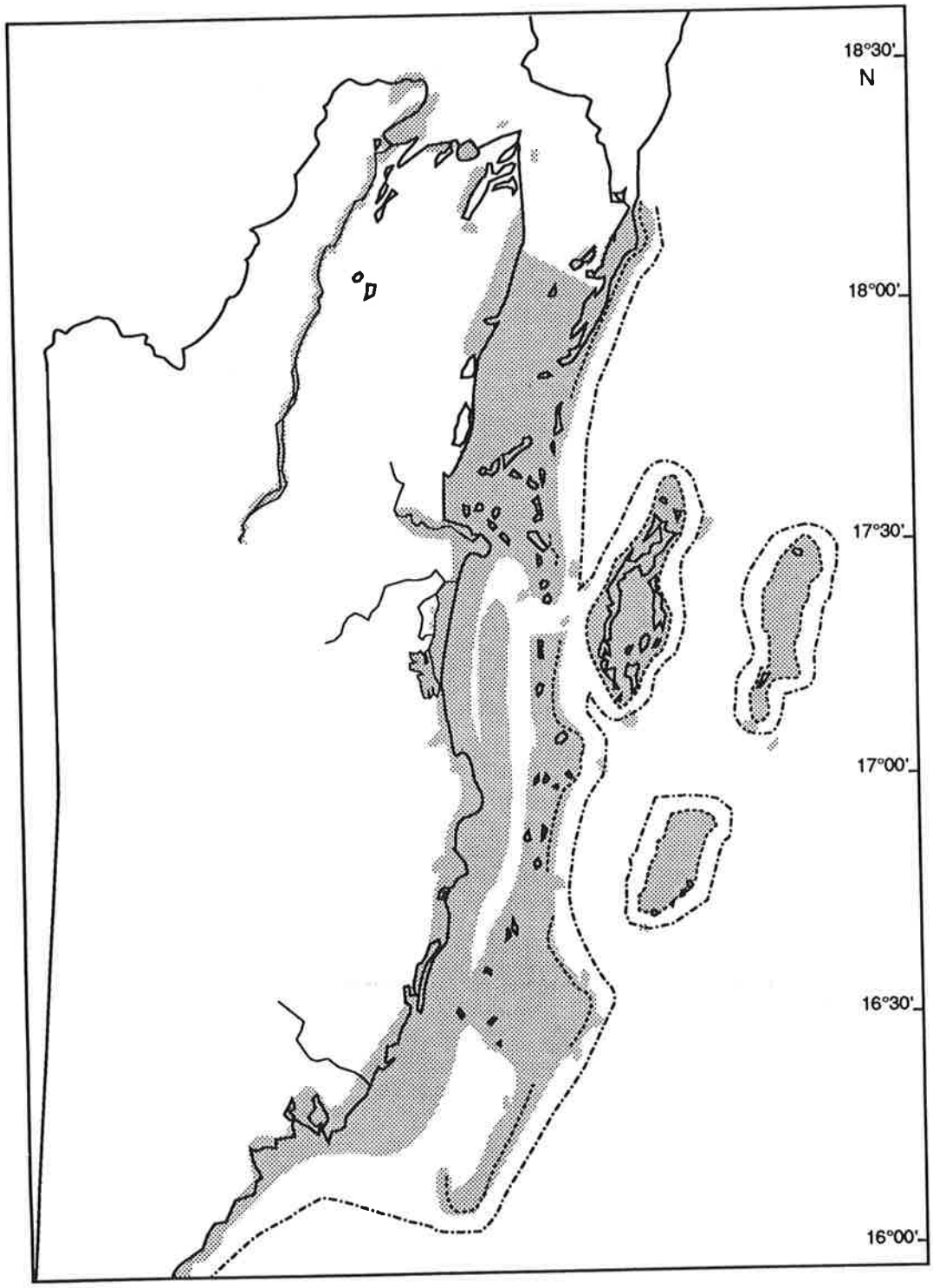


Figure 6

Summary Map of Major Coastal Uses and Environmental Pressures (shaded)

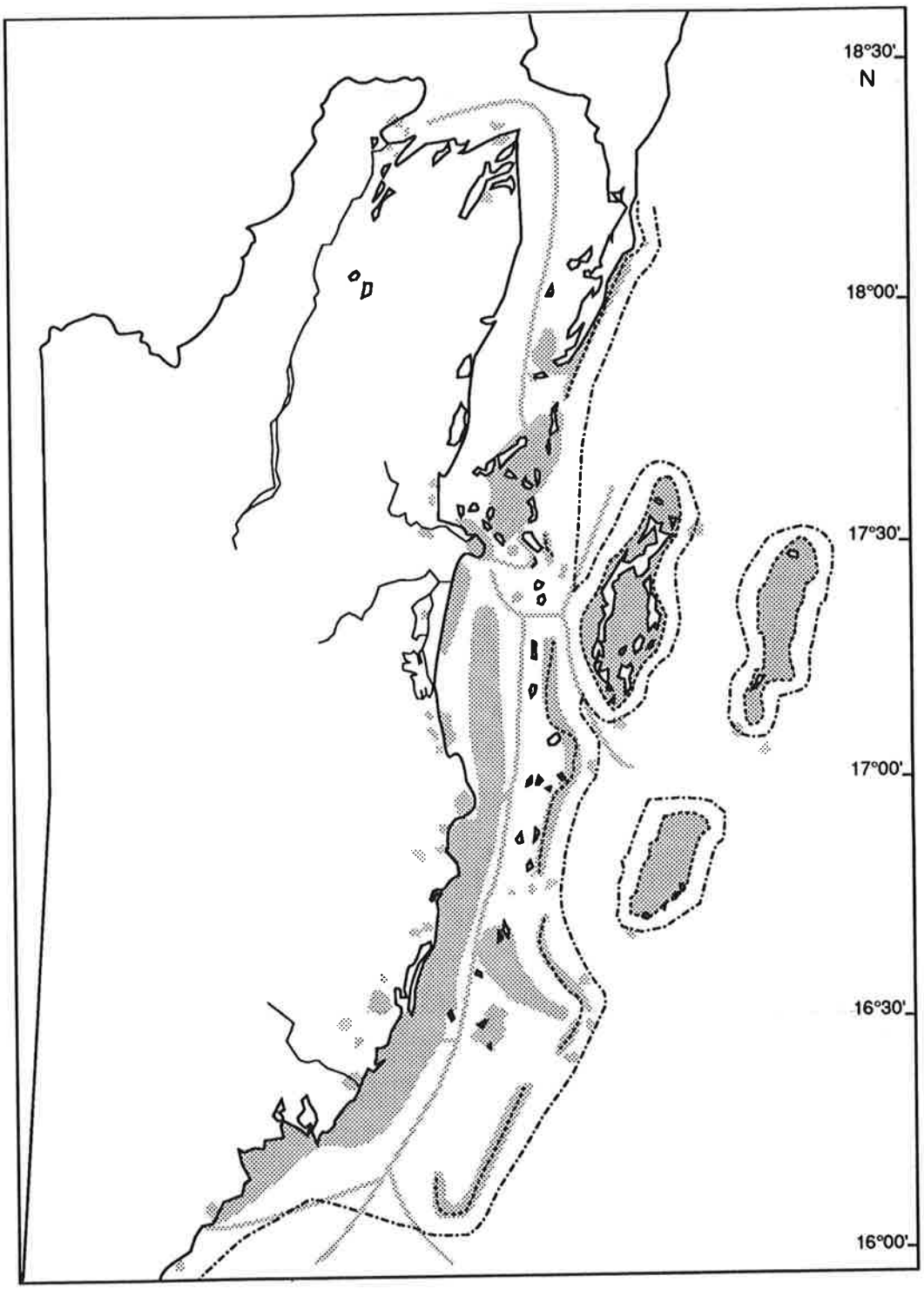


Figure 7

Summary Map of Coastal Reserves, Archaeological Sites and Wrecks (shaded)

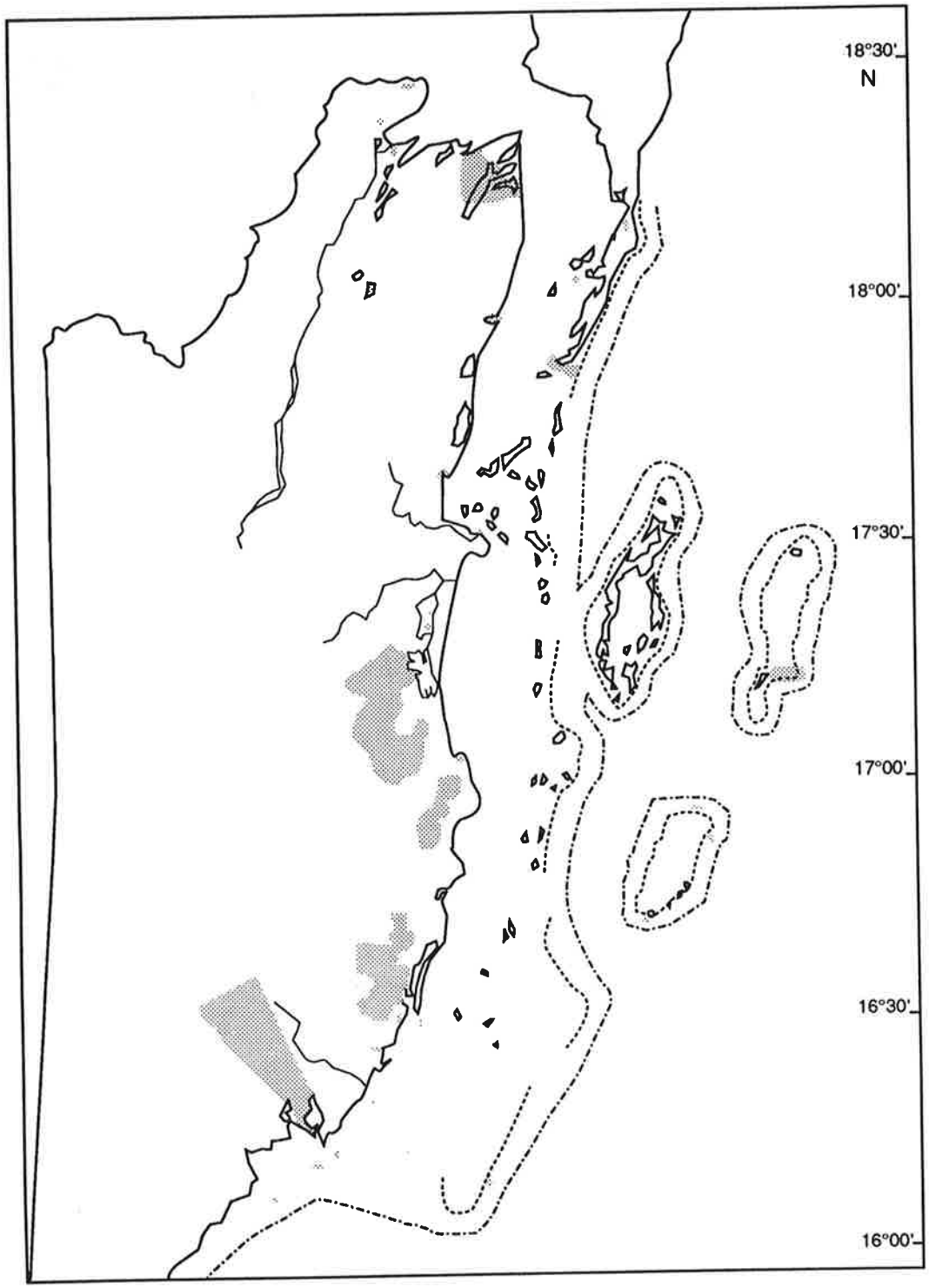
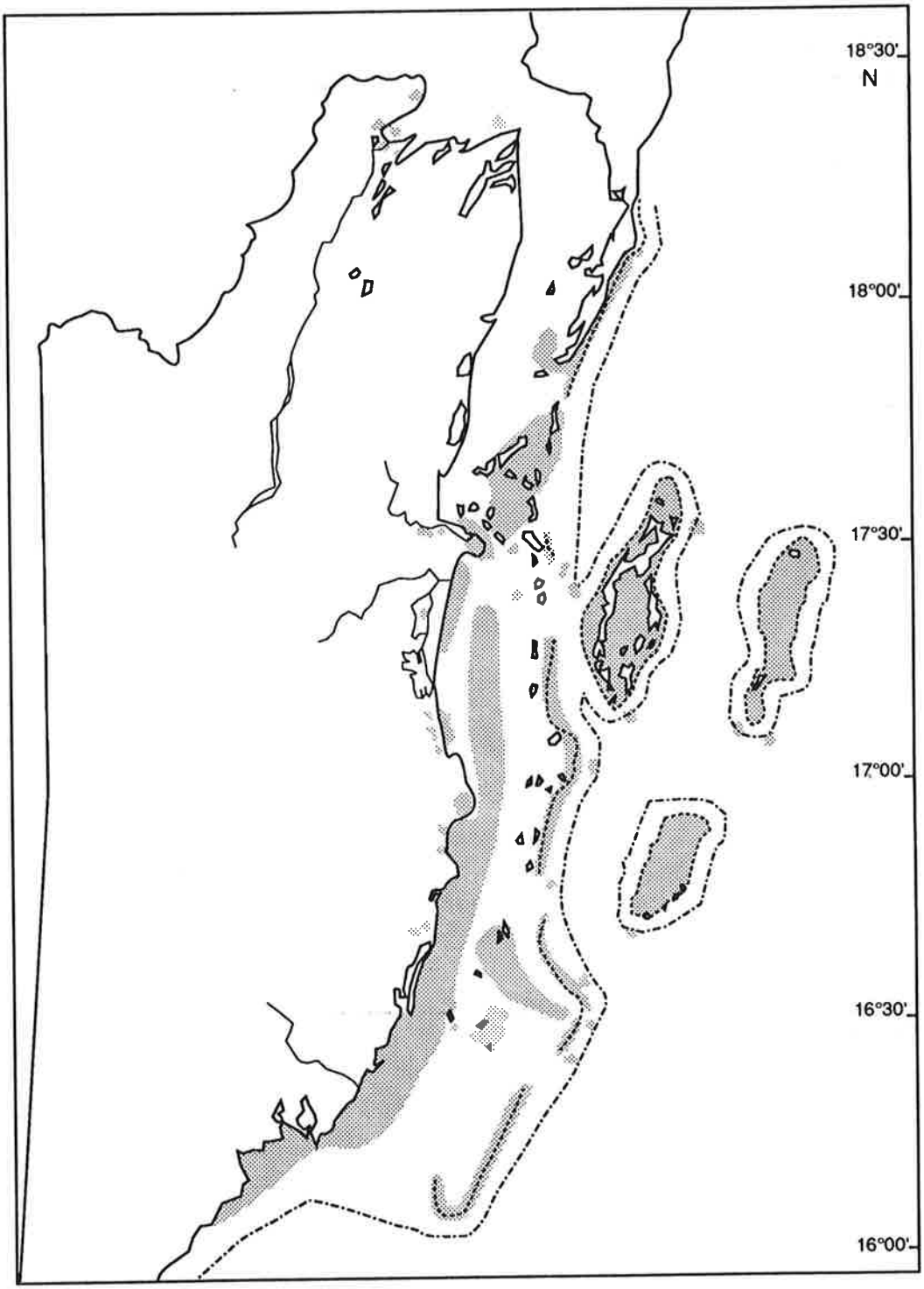


Figure 8

Main Coastal Resource-Use Conflict Areas (Actual or Potential) (shaded)



Appendix 1

Belize Coastal Zone Manangment Workshop, 21st - 23rd August 1989
Final Recommendations

During this unique and important workshop, fifty-five participants from nine countries, including some of the world's foremost experts on Coastal Zone Management, met in San Pedro, Belize, on Ambergris Cay, close to the morthern end of the Belize Barrier Reef - a site which Charles Darwin called "The Most Remarkable Reef in the West Indies", and which UNESCO has acknowledged as one of the world's greatest natural areas. The impetus for this workshop was the recognition that careful management is vital to assure the sustainable development of Belize's coastal system mainly because of its traditional importance to commercial and subsistence fisheries and because of its rapidly growing significance in supporting a nature-based tourism industry.
During these three days the group analyzed existing information on the coastal zone resources of Belize, and current management efforts of Government, local NGOs and the international community. It also compared and contrasted experiences of a number of other countries in coastal zone management to take advantage of their expertise in the design of a programme to manage Belizean coastal zone resources for optimum utilization.
As a result of the deliberations, the participants developed a series of draft recommendations for action by the Government of Belize, NGOs and educational institutes which are submitted for review and approval. These recommendations were given strong support and endorsement by the international participants of the workshop.

Main Recommendations

I The Belizean Government should establish a high level interministerial committee on coastal zone management, in which the Ministry of Fisheries should play a lead role, to improve co-ordination of Goverment policy and programmes relating to Belize's coastal zone resources.

II The Government should create a Coastal Zone Advisory Board including representatives from Government agencies, NGOs, educational institutions, and resource user groups involved in Coastal Zone Management (CZM) to provide ongoing recommendations to the interministerial committee.

III Endorsement of the initiation of a comprehensive multiple-use management planning process for the entire coastal zone of Belize. To support this, a coastal zone planning unit should be established to undertake this process, expanding on the existing planning team of the Fisheries Department and Wildlife Conservation International (WCI) which has spearheaded the planning effort leading to the creation and successful management of the Hol Chan Marine Reserve and which has already begun development of an overall coastal zone management plan.

IV Development of a coastal zone management plan as submitted by the Fisheries Department and Wildlife Conservation International (WCI). (See paper entitled "Proposal for the

Development of a Belize Coastal Zone Management Plan").

V Completion of the planning process by mid-1992 with a management programme that includes the following objectives:

a. Ensure that development and use of the coastal zone is sustainable.
b. Involve the public and users meaningfully in the development and implementation of the plan.
c. Use existing agencies and expertise and information in Belize to the maximum extent practicable.
d. Effect the planning process with minimal interference in, and regulation of, the coastal zone consistent with meeting the goals and aims of the plan.
e. Minimize costs consistent with meeting the goals and aims.
f. Encourage sustainable economic development consistent with meeting the goals and aims.
g. Ensure that the Government has the legal, institutional, financial and human resources necessary to develop, implement, monitor and update the plan.

VI The planning process should be an interdisciplinary, multisectorial effort with strong public participation, and should utilize to the maximum extent possible existing human and institutional resources available in Belize.

VII The planning process should begin with a rapid compilation of available information on coastal zone resources, including their utilization and socio-economic importance, the existing legal and institutional framework and human and financial resources available for their management, and major threats to their sustainable utilization.

VIII The plan should:

a. Follow internationally accepted and proven guidelines for coastal zone planning. It should contain a definition of major policy guidelines for coastal zone management, a zoning scheme, and a definition of an appropriate legal and institutional framework for sustainable management of the coastal zone.
b. Provide a detailed outline of specific objectives and activities relating to the components of the integrated coastal zone management ititiative. These would cover research and monitoring programmes, public education, resource utilization, both consumptive and non-consumptive, and administrative operations.
c. Clearly define the personnel, infrastructure, and should conclude with strategies for identifying human resource development and financial self-sufficiency, drawing on the economic, technical and other types of support from a broad range of local and international sources.
d. Be dynamic and be seen as a tool for sustainable management of the reef and not an end in itself.
e. Be periodically updated based on new information obtained through research programmes and in response to changing socio-economic situations and threats to resources.

Educational Recommendation

Participants agreed that increased public and decision-maker support for coastal zone management is of vital importance to ensure successful implementation of the proposed plan. In this regard, Belizean education institutions should strengthen their training and extension activities related to coastal zone management.

Specific recommendations on these are as follows:

I Promote public awareness of, and an appropriate attitute towards, the marine environment.

II Provide occupational training.

General recommendations are as follows:

1. Expand to two years the present one year marine programme being offered at the Belize Technical College (BTC) with a view towards developing a degree programme in applied sciences at the University College of Belize (UCB).

2. Include marine science in the primary and secondary education curricula at the Belize Teachers College in order to introduce it at the primary and secondary school levels. This should be supported by an educational package that would include resource persons from agencies which are involved in marine work.

3. Include courses/majors in marine education in the secondary education degree programme at UCB.

4. Extend the Belize Audubon Society speaker programme to schools and Colleges.

5. Involve the Belize Audubon Society in guest lecture series at UCB.

6. Develop a programme similar to that of the agricultural extension officers/demonstration officers to work with the fishing co-operatives and independent fishermen.

7. Involve Belizeans as much as possible in research conducted in Belize. This could be done in co-ordination with UCB and other local institutions.

8. Establish a repository of published research that would be co-ordinated by UCB which would maintain links with all agencies and institutions involved with research projects.

9. Develop educational programmes that would include field trips, publications and visual aids.

10. Emphasise the importance of local training. USAID and other agencies now offer some scholarships abroad. However, local training would lessen the probability of trained personnel staying abroad once they received their education. It would also assure that their education be relevant to our developing needs.

Resolution
It was resolved that the Coastal Zone Advisory Board (once formed) convene a meeting to plan and establish a research centre that would be used by tertiary level institutions in Belize. This centre could be established at the UCB.

Research Recomendations
The main research priorities identified by participants were as follows :

1. Monitoring fundamental parameters of reef health including pesticide and nutrient pollutants and turbidity studies, at select sites within the coastal system.

2. Small scale marine habitats mapping and status assessment that will aid proposed CZM programmes and be compatible with other large scale country resource mapping programmes currently under consideration by Government.

3. Biology, ecology, life history and resuscitation studies for threatened and endangered species.

4. Culture and re-seeding programmes for severely depleted, commercially important fish and invertebrate stocks.

5. Establishment of a marine science and research and educational facility, capable of conducting research and education programmes appropriate for this hemisphere's largest barrier reef.

6. Programmes that would give priority to the following types of research relating to:
   a. Beach erosion, coastal run-off, and habitat destruction/degradation related to land-use activities.
   b. Viable physical planning for land use, urban and touristic development, including mandatory environmental impact assessments of all major development proposals in the coastal zone, to be carried out by impartial teams.

General Conclusions
Participants praised recent initiatives by the Belizean Government to improve management of coastal zone resources, including the establishment of the Hol Chan Marine Reserve. They urged the government to move ahead with adoption and implementation of other plans pending approval, including the plan for management of Glover's Reef, and the land-use plan for Ambergris Cay. They felt strongly that Government should continue to strengthen existing initiatives and implement pending plans, even before completion of the overall coastal zone plan. They also urged the Belizean government to ratify the World Heritage Convention and move towards nomination of all or a part of the reef complex as a World Heritage Site.

Finally, participants expressed their sincere appreciation to the organizers and sponsors of this workshop, and made an urgent appeal to the international community to redouble their technical and financial support of the commendable efforts of the Belizean Government and people to manage a national resource of global significance in a sustainable manner.

Appendix 2

Outline of Belize Coastal information available on detailed maps produced using a GIS

Map 1: Fishery Resources: Conch, Lobster, Shrimps, Stonecrab, Deep Sea Fish and Other Fin Fish

Map 2: Critical Habitats for Species: Crocodiles, Manatees, Turtles and Hicatees; Bird and Turtle Nesting Sites

Map 3: Key Coastal Ecosystems of Belize: Mangroves, Coral Reefs and Seagrasses (map to be completed)

Map 4: Marine and Coastal Protected Areas: Forest Reserves, Sanctuaries, Proposed Sanctuaries, No-hunting Areas, and National Land

Map 5: Major Coastal Uses i: Tourism, Dive Sites, Recreational Fishing and Desalination Plants

Map 6: Major Coastal Uses ii: Fishing Settlements and Coops, Large and Small Communities, Research Stations, Ports, Military Bases, Farming (Mango, Shrimp and Fish), Archaeological Sites, and Shipwrecks

Map 7: Human Impacts: Hunting and Poaching, Sand Mining, Dredging and Landfilling, Oilspills, Land Development, Development Concessions (Agriculture, Industry, Tourism, Food, and Aquaculture)

Map 8: Transport and Concession Blocks: Oil Exploration Concession Blocks and Drilling Sites, Salvage Wreck Concession Blocks, Vacant and Reserved Areas, Roads and Tracks, Navigational Channels, Airstrips

Map 9: Physical Features: Bathymetry and Salinity Limits

These colour maps are available for examination at IUCN in Gland, and may be released as a separate report at a later date. They were prepared on a GIS at the World Conservatiuon Monitoring System (WCMC) in the UK during a visit by Janet Gibson.

Appendix 3

Suggested Interdisciplinary Research and Monitoring Programmes

Critical Habitat Study

This project, funded by WWF US, was initiated by the Environmental Centre, and provided key information on the distribution and status of critical habitats. This should help to improve understanding of the connections between terrestrial and coastal environments. Any information obtained on critical marine habitats is of course also of value for coastal zone management. For instance, this and related information can be used to improve the picture portrayed in this document.

Population Studies on Crocodiles

It is understood that the moratorium on hunting will terminated in 1991. Estimates are therefore needed of crocodiles populations to be compared to pre-moratorium figures. The American crocodile is considered to be particularly at risk, since only two major breeding sites are known in Belize. One of these sites (Northern Two Cay, Lighthouse Reef) is already being developed.

Use of Satellite Imagery for Assessment of Coastal ecosystems

A need is seen for obtaining satellite imagery for helping delineate and quantify coastal and marine ecosystems, in particular coral reefs and seagrass beds, and perhaps also other marine ecosystems (e.g. sand). The use of satellite imagery for broadscale resource assessments is becoming increasingly recognized. In Belize, much use has already been made of satellite imagery by the Lands Department for delineating land uses, mangroves and other vegetation (Gray *et al.*, 1990). It is understood that this information will be made available for coastal zone management.

Compared with conventional resource mapping techniques, the net saving in cost can be tremendous: A$21 million in the case of the Great Barrier Reef (Kelleher, 1990). The use of satellite imagery could be supplemented by site specific studies to provide more detailed information, for instance on species and community composition, biogeography and environmental impacts. These project activities might form a 'package' appropriate for funding by one or more outside agencies. Training of Belizeans in the enhancement and interpretation of satellite imagery would represent an important element of the project.

Monitoring of Water Quality

The population of Belize is undergoing rapid expansion, particularly as a result of increasing tourism (see section 3.2.2). Increasing population pressures are believed to have caused, directly or indirectly, some localized deterioration of the marine environment. This includes elevated concentrations of nutrients arising from sewage pollution, which can lead to algal blooms and reef deterioration. There is also concern that pesticides and herbicides used for agriculture, often far inland, may be carried down rivers to the sea. These compounds can then become incorporated in marine food webs including fish, which constitute a major food source in Belize. On the other hand, it needs to be recognized that human activities can sometimes have a beneficial impact on the environment (e.g.'artificial reefs').

The need to obtain baseline information on water quality, to provide a general picture of the status of Belize's coastal waters is evident. The programme could later be expanded, to establish permanent monitoring stations. These could be used to obtain baseline information, against which future coastal environmental changes can be determined, and to identify the principal point sources of pollution.

Ideally, the following parameters should be considered in any preliminary monitoring programme:

a) basic hydrographic parameters, such as temperature, salinity and oxygen,
b) inorganic nutrients,
c) faecal coliform bacteria,
d) heavy metals,
e) the effects of agriculture e.g. pesticides,
f) hydrocarbon levels.

Possible effects from industrial activities, for instance sedimentation arising from coastal dredging and reclamation, could also be assessed.

It is understood that a detailed proposal for an outside agency to carry out such a programme is currently under consideration in Belize. Detailed monitoring of ecosystems (e.g. community structure) would be included in the study. These activities could perhaps be undertaken in parallel with the critical habitats study (above).

Within the long-term monitoring programme two different approaches should be included:

a) extensive monitoring, using simple methods, to investigate basic environmental phenomena over large spatial or temporal scales (e.g. 1 year, or even indefinite time periods, but measured iteratively);
b) more research-oriented intensive monitoring (many different variables and measurements within time scales of the dynamic processes, which may be months, days, or only hours). In practice, intensive monitoring can normally be undertaken at some of the sites sampled within the extensive programme. A combination of approaches is needed to provide inputs for theoretical models.

Greenhouse Gases and Global Warming

Over the past century global temperatures have risen 0.6 °C (Gable, 1987/88). This increase is consistent with the observed rise in concentration of greenhouse gases (e.g. CO_2). One major consequence of global warming is sea level rise. There are predictions that over the next 40 years relative sea level rise in the Caribbean may be in the region of 30 cm. It is also believed that 1 cm rise in sea level will generally result in a 1 m retreat of shoreline (Gable, 1987/88). Consequently, low-lying countries, such as the Maldives, may become completely flooded. The effects on countries such as Belize could also be acute. Much of the coastline of Belize (e.g. Belize City) is low-lying and could face major flooding. Since most of the population resides in or near the coastal zone, the problem could be particularly acute.

It is suggested that a study is undertaken, in collaboration with outside agencies, to assess possible effects of global warming on the coastal environment and socio-economic structure of Belize. The results should be analysed and the major findings incorporated into the coastal zone management planning process.

Using large scale maps, the loss of coastal and land area could be calculated and mapped for incremental rises (e.g. 20 cm) in sea level. Such estimates could be made quite easily, if detailed maps were available. This should some indication of the likely overall magnitude of the problem. More detailed studies could follow, for instance: assessment of the effects of increasing CO_2 levels on the productivity and water relations in mangroves and their interdependencies; the ecological effects of sea level rise on coral reefs, seagrasses, mangroves and other marine ecosystems; assessment of the overall socio-economic disruption caused by sea level rise, and reappraisal of coastal zone management requirements.

Land Ownership

The issue of land ownership is of much relevance to any coastal zone management plan, since much land within the coastal zone of Belize (e.g. mangrove and other cays) is owned by private individuals. An assessment of socio-economic and environmental issues relating to land ownership is clearly important. A review and evaluation of existing legislation is also seen as a requirement. It is understood that plans are underway for a project, with assistance from USAID, to assess issues relating to land ownership and to strengthen the capabilities of NGOs with respect to coastal management.

Central Data Bank

Considerable information already exists relating to the coastal zone of Belize. However, it appears that this often resides among a variety of ministries, NGOs and individuals within Belize. A need is therefore seen for existing and future information to be made available to planners and managers of the coastal zone. This will require a central data bank. It may be appropriate for such a data bank to reside within a government department, but with NGOs and other concerned groups having easy access to the information, for instance via computor networks. Creating and running such a databank and network would require outside funding and assistance.