Coral reef management in Belize: an approach through Integrated Coastal Zone Management

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Abstract

Belize has one of the most extensive reef ecosystems in the Western Hemisphere, comprising one of the largest barrier reefs in the world, three atolls and a complex network of inshore reefs. Until recently, the main impacts were probably from natural events such as hurricanes. However, anthropogenic threats such as sedimentation, agrochemical run-off, coastal development, tourism and overfishing are now of concern. To limit these impacts, Belize is taking the approach of integrated coastal zone management. The programme is building on the existing legislative framework and involves the development of an appropriate institutional structure to co-ordinate management activities in the coastal zone. A Coastal Zone Management Plan is being prepared, which will include many measures that will directly benefit the reefs: a zoning scheme for the coastal zone, incorporating protected areas; legislation and policy guidelines; research and monitoring programmes; education and public awareness campaigns; measures for community participation; and a financial sustainability mechanism. © 1998 Elsevier Science Ltd. All rights reserved.

1. Introduction

The Belize Barrier Reef is renowned as the largest barrier reef in the Western Hemisphere. Nearly 260 km long, it runs from the northern border of the country, where it is only about 1 km offshore, south to the Sapodilla Cayes which lie some 40 km offshore. Belize also has one of the most diverse reef ecosystems in the world, with all the main types of reef represented: fringing reefs along the mainland coast; the
Barrier Reef itself; three offshore atolls (Lighthouse Reef, Turneffe Atoll and Glovers Reef); and a variety of inshore lagoonal reefs including faroes and patch reefs.

Since early this century, the economic role of the reef has increased steadily. Initially, its importance lay in the fishing industry, with a wide range of species being harvested ranging from turtles, sharks and finfish, to sponges and seaweeds. Today, lobster and conch are the principal fisheries products, and contribute most of the total value of exported wild-caught seafood, estimated at over US$10 million in 1995. There is also a domestic fishery for shallow reef fish and a commercial fishery for deep slope grouper and snapper. However, the main use of the Belize Barrier Reef is now tourism, which is the country’s largest source of foreign exchange. Tourism generated an estimated US$75 million in 1994, when tourist arrivals at the international airport totalled 87,399, having increased by 45% since 1991. The cayes and the reef are major attractions: 78% of hotel rooms are in the coastal zone and 77% of tourists go snorkelling and diving [1].

2. Threats to the Belize reef ecosystem

Although Belize may be one of the last countries in the Caribbean to have extensive areas of almost pristine reef, the impacts of human activities are increasingly posing threats. The main concerns are as follows:

2.1. Global climate change and natural impacts

Until recently, the main impacts on the reefs of Belize were from natural events such as hurricanes [2, 3], and these may still pose the greatest threat in terms of their magnitude and rate of destruction. However, the impact of coral diseases and bleaching is of growing concern. Black band disease has been recorded on corals on all three atolls and the barrier reef and has been a major problem in the heavily used Hol Chan cut area. White line disease has devastated branching corals (Acropora spp.) in some locations, although the damage appears to be less widespread than in some other parts of Caribbean [1]. Coral bleaching, at low levels, has been reported on several occasions over the last decade. In 1995, the intense and widespread bleaching event that affected much of the Caribbean had a major impact in Belize. Over 50% of hard coral colonies were affected at many of the sites surveyed (McField, preliminary data), and the event appeared to be correlated with a period of high temperatures and calm seas.

Management of coral reefs in the context of such unpredictable and global phenomena, particularly where their causes are ill-defined and their relationship to human activities poorly understood, is clearly very difficult. It has been suggested that coral diseases are more prevalent in polluted waters, and there is now a strong indication that the growing frequency of coral bleaching events is linked with rising sea temperatures associated with global warming, and with increased UV radiation. Monitoring of reef condition and the environmental parameters that affect this is crucially important for a better understanding of these phenomena. Beyond that, the
priority must be to reduce and remove other deleterious impacts on the reef ecosystem, as there is evidence that healthy corals and their associated communities will withstand or recover from such perturbations more readily than damaged systems.

2.2. Pollution

Nutrient enrichment can be one of the most serious forms of pollution for coral reefs, particularly for those close to shore. In Belize, there have been anecdotal reports of algal overgrowth on the barrier reef although this has not been quantified and a correlation with nutrient enrichment has not been proven. However, there are several sources of nutrient input to coastal waters. Studies have confirmed that potentially damaging quantities of fertilizers enter coastal waters from the Stann Creek watershed, where citrus fruit is intensively cultivated [4].

Despite the small population of Belize (ca. 200,000), domestic sewage pollution from treatment facilities, septic tanks and direct outfall is a potential threat, particularly around the mouth of the Belize River, Belize City, Dangriga and developed cayes. Belize City is the only coastal town with a centralized sewerage system and one is shortly to be opened in San Pedro, but both provide secondary treatment only by concentrating effluents into settlement ponds and releasing them through mangroves which act as nutrient filters. The concentrated effluent could potentially cause localized eutrophication and broader nutrient enrichment, and it is not certain that the mangroves at each location have the capacity to deal with the predicted quantities of effluent. Industrial effluents with high BOD are entering coastal waters, but are not yet likely to affect corals given current levels (there is no industrial development on the cayes) [1].

Most other known pollution sources are far from coral reefs and no direct correlations have been made between pollutants and reef degradation. However, the following pollution sources could potentially have an impact on reefs: heavy use of pesticides, including herbicides and fungicides, many of which may be toxic to corals; waste oil, caustic acids and chemicals, primarily entering the Belize and New Rivers; and marine debris including fishing line, nets, and ship-generated debris, which is found in low to moderate levels throughout the reef system including the atolls [1].

The Department of Environment (DOE) takes the lead role in pollution regulation, through its responsibility for implementation of the Environmental Protection Act (EPA), with the Water and Sewerage Authority (WASA) responsible for sewage. The EPA provides for the control of pollution and specifically allows for the making of regulations for ‘preserving and protecting the barrier reef and prohibiting the dumping of wastes in the marine environment’. Several sets of regulations have been passed or are in preparation, including those for Effluent Limitations, Hazardous Wastes and Air, Soil and Water Pollution. A registry of wastes and emissions, and a National Waste Oil Management Plan are being prepared. The Solid Waste Management Act allows for the establishment of a Solid Waste Management Authority and efforts are underway to establish this. Currently solid waste disposal is the responsibility of town
boards and Public Health Department, and little attention is paid to its environmental impacts. The Pesticide Control Board (PCB) regulates the use of pesticides by licensing farmers and providing education on safety and the proper use of agrochemicals and other chemicals, but enforcement is poor.

The potential for an oil spill near coral reefs is an ever-present threat, as international fuel tankers enter Belizean waters approximately once a month and local fuel barges make weekly trips to the cayes and atolls. There have been no major spills yet, but the small spills that have occurred have shown that cleaning, dispersal, monitoring and mitigation mechanisms are as yet insufficient and should be installed before a major spill occurs. An Oil Spill Contingency Plan is being developed by the DOE and will cover spills from vessels and offshore oil wells. Belize ratified MARPOL in 1995, which means that certain obligations will now have to be met in relation to marine pollution. The Petroleum Regulations are being revised to strengthen their environmental provisions, and will make both environmental impact assessments (EIAs) and oil spill/fire contingency plans mandatory.

2.3. Siltation

Sedimentation of corals has been reported at localized sites along the barrier reef and on fringing reefs around Placencia. In the few sites that regularly have high visitor numbers, divers and snorkelers may cause localized areas of coral siltation, but the main sources of sediment are from land, as a result of agricultural practices (which increase soil erosion particularly in the Stann Creek and Toledo Districts), and deforestation (especially along riverbanks). Destruction of mangroves and seagrass beds, as well as marine dredging and sand mining operations also increase sedimentation on reefs. The Geology and Petroleum Office (GPO), which issues licences for dredging and mining, may specify types of equipment, methods or other means of environmental protection (such as requiring the use of silt curtains or screens), and generally refers to the Coastal Zone Management Unit (CZMU) of the Fisheries Department on a case-by-case basis. However, monitoring capabilities are extremely limited and there are many cases where illegal dredging occurs. A Minerals Policy is being prepared by the GPO, and will include as an annex the Marine Dredging Guidelines that have been prepared with input from the CZM Technical Committee [1].

2.4. Direct destruction of or damage to corals

This is reported in all areas with intensive diving and boating activity. Boat groundings, collisions and propeller impacts may have a cumulative effect. Commercial fishing activities are thought to result in small scale damage, primarily due to anchors and discarded nets and other gear. Diver inflicted breaks and scrapes to coral can be serious at popular dive sites, but is not a major problem on a wider scale. Anchor damage can be severe, especially from larger dive boats and yachts. In San Pedro, Caye Caulker and Placencia, dive operators have assisted in the installation and maintenance of buoys in a community-based programme, with assistance from
the Fisheries Department. The live-aboard dive boats also install and maintain mooring buoys. Workshops on installation and maintenance of buoys have been held by the CZMU. These activities are to be co-ordinated through a national mooring buoy program being developed by the Fisheries Department with assistance from the CZMP.

2.5. Overfishing

Compared to other Caribbean countries, stocks of reef fish may be relatively healthy, as evidenced by the continued availability of prime commercial species such as groupers and snapper [5, 6]. However, fishing pressure is increasing and there is a general consensus that overfishing is occurring, with widespread fishing in closed seasons and of undersized conch and lobster. There is evidence that certain species have declined and there are many incursions by illegal alien fishermen particularly in the south of the country [1, 7]. Over-exploitation has the potential to disrupt the ecological balance of the reef, although few herbivorous species, important in controlling algal growth, are fished commercially in Belize.

The fisheries sector is managed largely by traditional methods and is the responsibility of the Fisheries Department. All vessels and fishermen must be licensed but at present the fee is so low (US$1.00 p.a.) that it plays no role in regulation of fishing effort. There are a number of gear restrictions, including the prohibition of SCUBA gear, poisons and explosives. The conch and lobster fisheries are regulated through minimum size limits, closed seasons and, in the case of lobsters, protection of soft-shelled and berried individuals. Guidelines have been prepared for the aquarium fish industry, and the Fisheries Department has an in-house policy by which they regulate this. The fisheries legislation has been fully revised with the assistance of FAO, and is currently being reviewed by the Solicitor General’s Department.

Fishery regulations are enforced by the Conservation Compliance Unit (CCU) of the Fisheries Department. When first established (with USAID funding), this was well equipped and provided an enforcement capability considerably greater than that found in most other Caribbean countries. However, government resources have proved insufficient to maintain this at its original level and additional mechanisms for regulation are required. For example, as much of the grouper and snapper fishery is seasonal and site specific, seasonal closure of certain areas, may be more appropriate than size limits or quotas, particularly where such areas can be incorporated within an MPA and thus have regular surveillance, as for example at Glover’s Reef and Rocky Point in Bacalar Chico. It will be essential however that closed seasons coincide with at least part of the spawning season of the exploited species, which is not at present always the case [8].

3. Integration of management efforts

Initially the Great Barrier Reef Marine Park in Australia was viewed as a model for management of the Belize Barrier Reef and its associated ecosystems. Early reef management efforts therefore focused primarily on the establishment of marine
reserves. However, in recognition of the fact that management must extend to land-based activities outside marine reserves if reefs are to be protected from siltation and land-based sources of pollution, the approach of integrated coastal zone management was chosen to ensure the long-term viability of both the protected areas and the reef system in general. The Coastal Zone Management Unit (CZMU) was therefore established in March 1990 within the Fisheries Department. It has been assisted since March 1993 by the UNDP/GEF Coastal Zone Management Project (CZMP), through an agreement between the Global Environmental Facility (GEF), as the funding agency, and the United Nations Development Programme (UNDP), as the implementing agency. It was recognized that the CZMU’s limited management capacity and its location within a sectoral Ministry were obstacles to an integrated approach and with the assistance of the CZMP, institutional arrangements for a permanent CZM programme are being developed.

At present, two committees are largely responsible for integrating coastal zone management efforts. The CZM Technical Committee was established in 1990 to facilitate working relationships between all the agencies involved, and comprises representatives of all government departments, community and private organizations, education and research institutions and NGOs involved in coastal zone management issues. It encourages the sharing of information, contributes to the creation of feasible government policies, plans and programmes, identifies technical problems, and provides advice to the Government, NGOs and private sector on a variety of issues including screening and scoping of projects that may require EIAs. The CZMP Steering Committee, established at the initiation of the UNDP/GEF project, oversees implementation of the CZM programme and ensures inter-ministerial co-ordination. It comprises representatives at senior level of the Ministries of Agriculture and Fisheries, Natural Resources, Tourism and Environment and Economic Development, and of UNDP and the CZMP.

Plans for a more permanent institutional arrangement have been drawn up and approved by Cabinet. The Steering Committee is to be established as a CZM Authority, which will have a co-ordinating and advisory role, statutory responsibilities remaining with the relevant Ministries. In addition a CZM Institute is to be established, affiliated with University College of Belize (UCB), which will play an important role in monitoring, research, education and training and provide a supporting role to relevant government departments [1]. A Coastal Zone Management Act is currently being drafted to establish the Authority and Institute, to define the composition and functions of these bodies and to provide for the formalization of the Technical Committee as an Advisory Committee. The Act will also address the need for financial support by empowering the Minister to introduce resource user fees. This institutional arrangement is expected to lead to more effective coastal zone management, and thus to improved reef management in a number of ways:

3.1. Policy development and legislation

The CZM Technical Committee already plays a major role in developing policies to address management issues in the coastal zone, ensuring that the views of all relevant
government departments, NGOs and other bodies are represented. For example, a Cayes Development Policy has been drafted which gives guidelines for sustainable development by both the public and private sectors, while recognizing the economic value of this fragile ecosystem to investors, developers, tourists, fishing communities and residents. When approved by Cabinet and implemented, it will encourage management practices that are compatible with the protection of Belize’s reefs.

Given the relatively pristine nature of Belize’s reefs, the prevention of damage from new coastal developments and pollution sources is of critical importance. The CZMU and CZM Technical Committee are therefore vigorously pursuing the establishment of an effective EIA mechanism, as this could prevent much damage and expensive mitigation measures to vulnerable ecosystems such as reefs. There is already a strong legislative framework for this through the Environmental Impact Assessment Regulations of the EPA which require EIAs for certain types of projects, particularly those located on the coast and cayes and involving activities which could negatively affect coral reefs. The National Environmental Appraisal Committee (NEAC) which has statutory membership from several government departments, including the Fisheries Department and NGO community, advises the DOE on environmental screening and the approval of EIAs. Improved implementation of the existing regulations is required, as well as the training of a cadre of qualified scientists and technicians capable of carrying out EIAs. Harmonization of legislation is also needed as EIAs are required under three different pieces of legislation: the Mines and Minerals Act, the National Lands Act, and the proposed new Petroleum Regulations.

The CZM Technical Committee is working closely with the Fisheries Department, the Belize Tourist Board (BTB), the Belize Port Authority (BPA), DOE and the CZMP to develop policies and legislation for tourism and recreation that will help to minimize damage to reefs. The Environmental Compliance Plan for Cruise Ships requires that cruise ships are issued operating licences stipulating a number of conditions, such as the restriction of anchoring to designated areas, prohibition of the release of waste water into Belize’s territorial waters, and requirements for visitor education and scheduling of group’s recreational activities, with a maximum group size of 50 persons at any one site. Monitoring of such activities is to be coordinated by the BTB with the assistance of the Fisheries Department and DOE, but the necessary manpower is currently lacking. Guidelines for recreational vessels are being developed by the CZM Technical Committee and will address environmental issues. The Tourist Guide Regulations require that all tour guides are registered and meet standard levels of professional training and certification. Licences can be revoked for unacceptable behavior or for not adhering to the requirements. These regulations are not yet fully implemented but training materials for tour guide courses are being developed by the Belize Institute for Management for the BTB.

Belize has an extensive body of legislation that, if fully enforced, will help in the protection of its reefs and coastal zone [9]. However, there are many instances of overlap. Recommendations have been made for harmonization, and this will be an important component of later stages of the CZM programme. For example, much of the legislation relating to marine pollution through the Harbours and Merchant Shipping Act and the Belize Port Authority Act needs review, and better enforcement
and monitoring mechanisms are required. Other vessel and shipping legislation is the responsibility of a variety of agencies including the BPA and the BTB, and there is a clear need to review and improve the environmental aspects of the regulations to prevent reef damage from inappropriate vessel handling, anchoring and waste disposal. A major problem in Belize, a country with a small population and limited government resources, is the lack of enforcement capabilities. The CZM programme will address this issue, looking at alternative approaches to enforcement including public participation and improved public education.

3.2. Land and marine use planning

The CZM programme puts considerable emphasis on the planning process. Existing legislative and planning powers are being used where possible. Planning for the terrestrial component of the coastal zone is carried out through two pieces of legislation: the Land Utilisation Act, administered by the Land Utilisation Authority (LUA) and the Housing and Town Planning Act, administered by the Central Housing and Planning Authority (CHPA). Development plans provide a means to ensure that industry, agriculture and residential areas are located away from watercourses that have an impact on coastal waters, and that there are appropriate waste control and treatment facilities.

The LUA is responsible for Special Development Areas (SDAs) which are a form of strategic planning, providing for the zoning of land both for use (rural, urban, residential, reserve etc) and for sub-division or lease density [10]. Much of the mainland coast is covered by seven declared SDAs, four of which have approved Development Plans, although implementation of these has not progressed very far. The CHPA is responsible for detailed land use planning, with an emphasis on building control, and several coastal areas have been considered for planning. Ambergris Caye is furthest advanced with a draft Ambergris Caye Master Plan which is being used as a guideline for development until it is approved by Cabinet. Development plans have also been prepared or are in preparation for several caye areas through the CZM programme, including Turneffe Atoll, Caye Caulker and the cayes and waters adjacent to Belize City.

A zoning plan for Belize’s marine waters will ultimately be developed. At present, such planning has been on a sectoral basis, with the designation of certain areas as, for example, shipping channels, ‘no-wake’ (i.e. slow speed) zones, and no-anchoring areas (with public mooring buoys in some areas). The other form of planning for marine waters is the marine protected areas (MPAs) system. MPAs can be designated under two pieces of legislation. Marine Reserves (MRs) are established under the Fisheries Act, and are administered by the Fisheries Department. National Parks (NPs), Wildlife Sanctuaries, Natural Monuments (NMs) and Nature Reserves (NRs) are designated under the National Parks Systems Act and are administered by the Forest Department.

Belize’s MPA programme will result in a network of protected sites along the length of the Barrier Reef and on each of the atolls. Four sites on the barrier reef (Hol Chan MR, South Water Caye MR, Sapodilla Cayes MR and Bacalar Chico NP and MR),
three on the atolls (Glovers Reef MR, Blue Hole NM and Half Moon Caye NM), and one on inshore reefs (Laughing Bird Caye NP) are protected (Fig. 1). A combined NP and MR (similar to that at Bacalar Chico) is to be established covering the northern part of Caye Caulker and adjacent segment of Barrier Reef. Planning is underway for
the protection of the Port Honduras area in the south of the country (through a project being led by the Belize Center for Environmental Studies), and of as yet undetermined sites on Turneffe Atoll.

An integrated approach to MPA management is already being taken, with sites such as Bacalar Chico designated under joint initiatives of the Fisheries and Forest Departments. These recognise the importance of managing adjacent terrestrial areas as part of the protected area. An increasing emphasis is also being placed on collaborative management of MPAs between government agencies, NGOs and local communities. Thus the Belize Audubon Society is mandated by the government to manage Half Moon Caye and Blue Hole NMs, and Laughing Bird Caye NP is being managed in a collaborative arrangement with the local community. Like development plans, MPAs are a useful tool for addressing a number of threats to coral reefs, particularly those related to tourism and exploitation. Most of the designated MPAs have, or will have, zoning schemes providing for recreational activities and small-scale fishing by traditional users, and full protection of key habitats and species in ‘no-take’ zones. Management of the MPA system still needs much attention, particularly in relation to its role in tourism management. For example, the designation of Hol Chan as an MR has led to a major increase in visitor numbers, which now total over 30 000 visitors a year.

MPAs can play a key role in protecting reefs with breeding stocks of commercially valuable or endangered species, and this is recognised in Belize’s fisheries legislation, with its provisions for the designation of marine reserves. Research at Hol Chan and Half Moon Caye has illustrated that MPAs may enhance fish stocks [8, 11].

### Table 1
Existing and proposed marine protected areas in Belize

<table>
<thead>
<tr>
<th>Existing protected areas</th>
<th>Total area (ha)</th>
<th>Marine area (ha)</th>
<th>No-take zone (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hol Chan MR</td>
<td>1116</td>
<td>1024</td>
<td>273</td>
</tr>
<tr>
<td>Glovers Reef MR</td>
<td>30 784</td>
<td>30 735</td>
<td>201</td>
</tr>
<tr>
<td>Half Moon Caye NM</td>
<td>3925</td>
<td>3907</td>
<td>3907</td>
</tr>
<tr>
<td>Bacalar Chico NP and MR</td>
<td>11 303</td>
<td>6118</td>
<td>89</td>
</tr>
<tr>
<td>Laughing Bird Caye NP</td>
<td>4286</td>
<td>4261</td>
<td>199</td>
</tr>
<tr>
<td>South Water Caye MR</td>
<td>29 789</td>
<td>29 153</td>
<td>u</td>
</tr>
<tr>
<td>Sapodilla Cayes MR</td>
<td>12 742</td>
<td>12 722</td>
<td>u</td>
</tr>
<tr>
<td>Blue Hole NM</td>
<td>410</td>
<td>410</td>
<td>410</td>
</tr>
<tr>
<td>Total</td>
<td>94 355</td>
<td>88 330</td>
<td>5079</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Proposed protected areas</th>
<th></th>
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<th>u</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caye Caulker NP and MR</td>
<td>4362</td>
<td>4299</td>
<td>u</td>
</tr>
<tr>
<td>Port Honduras MR</td>
<td>40 521</td>
<td>39 848</td>
<td>u</td>
</tr>
<tr>
<td>Southern Lagoon</td>
<td>u</td>
<td>u</td>
<td>u</td>
</tr>
<tr>
<td>Belize R. mouth and cayes</td>
<td>u</td>
<td>u</td>
<td>u</td>
</tr>
<tr>
<td>Turneffe Atoll site(s)</td>
<td>u</td>
<td>u</td>
<td>u</td>
</tr>
</tbody>
</table>

Note: MR = Marine Reserve, NM = Natural Monument, NP = National Park, NR = Nature Reserve, u = not yet known.
yields in adjacent areas have not yet been demonstrated, and the extent to which populations migrate out of protected areas is not known, but a research programme underway at Glovers Reef Marine Reserve is investigating this [8]. The total area of marine habitat with statutory protection in Belize at present is 88 330 ha, but of this only a small proportion is ‘no-fishing’ (Table 1). The feasibility of increasing this area will be addressed during the preparation of the marine component of the CZM Plan. It has been recommended that 30% of the coastal zone of Belize should be closed to fishing, the remainder to be managed by traditional methods [11]. This recommendation is based on work in southern US coastal waters, which concluded that by closing 20–30% of fishing grounds, a level of spawning stock biomass above the critically overfished level could be retained, even if other traditional management strategies fail [12].

3.3. Regulation of land-based sources of pollution and siltation

These are invariably the most difficult threats to address because of the frequent separation of cause and effect, with the main sources of pollution often lying far inland and away from reefs. The Cayes Development Policy provides guidelines on appropriate sewage disposal systems to be installed on the cayes under different circumstances (large resorts and subdivisions, individual houses, etc), but it is recognised that these require further review and consideration. The conditions under which septic tanks, centralised sewage systems, packaging plants or stabilisation ponds, and composting toilets are most appropriate in terms of installation cost, maintenance and effectiveness in reducing or eliminating nutrient enrichment, need to be determined.

The CZM programme also needs to work increasingly closely with the Department of Agriculture (DOA) and the Pesticide Control Board to ensure that fertilizer run-off does not become a major cause of nutrient enrichment, as has occurred in Great Barrier Reef waters in Australia, and that pesticides and soil run-off are reduced. The DOA’s Sustainable Agriculture Production program, is aiming to promote the introduction of mucuna cover crops to reduce erosion and bubble-house technology for vegetable production which eliminates pesticide use and increases quantity and quality of production. Permanent hillside agriculture will also be promoted, using model farms, aimed at replacing shifting cultivation and the slash-and-burn milpa system. A high priority is to regulate intensive cash crop agriculture (citrus and bananas) on the savannahs and pine ridge vegetation where run-off is a problem. DOA policy is to encourage farmers, community-based organizations and grower’s associations to provide self regulation, given the lack of government resources. The approach of integrated pest management, which is now being introduced through training courses, will be one mechanism for preventing pollution from pesticides.

Closer collaboration with the Forest Department is also required to reduce the impact of soil run-off from forestry activities and to protect key watersheds. A proportion of nationally-owned forest is categorized as ‘protection forest’, which means that it should be protected as watersheds, catchment areas, drainage basins, steep hill slopes and for the prevention of erosion, control of run-off, regulation of stream-flow and stabilization of climate. There is also legislation to provide for a vegetated buffer
along watercourses to minimize erosion, although this is often ignored and needs better enforcement through land use legislation and development plans. These policies and legislative framework should be closely integrated into CZM policies and monitoring activities.

3.4. Public participation and constituency building

Many components of the CZM programme have substantial public involvement, including the preparation and implementation of development plans, the EIA process where public participation is specifically required under the EA Regulations, and the establishment and management of protected areas. It is intended that this approach will be continued and expanded as the CZM programme develops and that individuals and organizations such as the Belize Tourism Industry Association, NGOs, fishing co-operatives, farmers associations and the Chamber of Commerce will participate during all stages of development of the CZM Plan.

In many cases, participation and involvement is achieved through the establishment of committees. For example, in each of the CHPA planning areas, a local planning committee, with representation from all sectors of the community, is established to receive development applications from the general public and to implement and manage the plan. SDAs are also developed by committees established specifically for this purpose, with representation of all user groups with an interest in an area. Similar committees are likely to be established for marine regional planning areas. Hol Chan MR was established primarily as a result of community concern [13] and the process of consultation through public forums at key stages in the development phase of an MPA is now used for other sites. In addition, Advisory Committees have been or are being established for each of the MPAs, comprising representatives of all the main stakeholder groups in the area and of the agencies and NGOs responsible for management.

Public participation is also taking place in more direct ways. Fishermen are taking part in monitoring and assessment programmes of the main commercial fisheries stocks. Dive operators play a major role in the installation and maintenance of mooring buoys, as described above. The tourist industry is being involved in numerous ways, and the regulations and structure of local tour guide associations, which can act in a self-policing capacity, provide a good basis for improved management of tourists on reefs. For example, a voluntary ‘no-take’ zone was enforced around Laughing Bird Caye, initiated by the local Placencia tour guides and agreed to by fishermen.

3.5. Monitoring and research

Ideally, a CZM programme starts with an assessment of existing information, research is then carried out to fill in the gaps, and a monitoring programme initiated to evaluate changes and the impact of management activities. Belize’s CZM programme was designed as such a staged process, but the nature of its institutional development and history, the political process involved, and the need for immediate
management efforts for several issues, has meant that research, planning and implementation have taken place in parallel. With the assistance of IUCN and the UNDP/GEF CZMP, a GIS was installed as a primary step in the establishment of the data gathering and analysis capability [14]. Aerial photography and satellite imagery are used and ground truthing and data gathering have been carried out for many of the existing and proposed marine protected areas [15].

Initially a largely sectoral approach was taken to monitoring, with the Fisheries Department responsible for monitoring marine waters and habitats, and the DOE responsible for monitoring inland waters. Monitoring programmes undertaken by the CZM programme are at present limited to water quality and coral reef health, as these are considered of key importance, with the Fisheries Department strengthening its monitoring activities relating to commercial fish stocks. These programmes have experienced difficulties in maintaining long-term data collection, typical of countries where equipment and trained personnel are not readily available [1, 16]. As the CZM programme develops it is hoped that a more integrated approach will be developed, involving government agencies, education and research institutions, marine protected areas, and local communities, taking account of the many biological, physical and socio-economic parameters that need to be monitored for adequate feedback into the management process.

The need for a more integrated approach to research and monitoring is also recognized in, and can be fulfilled through, the proposed CZM Institute which will be affiliated with UCB. UCB is already closely involved with coastal zone management issues and is represented on the CZM Technical Committee. The link between science and management will be strengthened through the applied nature of the UCB marine and coastal courses that are being developed, and the fact that the existing marine research centres (UCB's Marine Research Centre, Glovers Reef Research Station, and the Smithsonian Institution's Carrie Bow Caye facility) are all within existing or proposed marine protected areas or sites of particular management interest [16].

3.6. Sustainable financing

For the long-term viability of the CZM programme and sustainable reef management, a financing mechanism will be essential. Like many countries, the government of Belize is facing increasing economic constraints, and a variety of revenue generation strategies will be necessary. Belize has recently introduced a Protected Area Conservation Trust (PACT) fund which raises money through a conservation fee levied from tourists as part of the departure tax, as well as from other sources including a percentage of entrance fees from each protected area and grants from external funding bodies. This will fund a range of conservation activities, such as providing basic infrastructure for protected areas.

For financing the CZM programme, the introduction of a diver's permit fee has been recommended, revenue from which could support the running of a CZM Authority and Institute and certain specific CZM activities. Other potential funding mechanisms include a marine dredging royalty (to support coastal management activities carried out by the Geology and Petroleum Office), a pesticide charge (to
support management activities undertaken by the DOA and PCB that will benefit the coastal zone), and a product-charge on non-biodegradable goods (to go to general revenue) [17]. The establishment of Trust Funds for individual protected areas, such as Hol Chan MR, is also important and will be encouraged.

4. Conclusion

Management of Belize’s coastal zone and marine waters has evolved through a number of stages: from a species-specific sectoral fisheries approach, to a broader habitat approach and the establishment of marine reserves, to the current ecosystem-wide approach of integrated coastal management. The latter approach is likely to prove critical to successful long-term protection of the reef ecosystem. Through the CZM programme, Belize is now moving towards a fully multi-sectoral strategy which will involve the establishment of the CZM Authority. Much depends on the success of this programme, including the long-term economic stability of Belize and the future survival of one of the world’s most pristine reef ecosystems, recently declared a World Heritage Site under the UNESCO World Heritage Convention.

Successful management of Belize’s coral reef will also depend to a large extent on initiatives in adjacent countries. The reefs of the Gulf of Honduras, Belize and Mexico are all part of one system, commonly referred to as the Meso-American Caribbean Reef. The individual reefs are closely linked by currents which have both physical (e.g. pollutants) and biological (e.g. larvae) impacts. The interdependence of conservation efforts in these countries has been recognised for some time in the development of several joint initiatives. Currently, the five year PROARCA-Costas programme, supported by US-AID, WWF-US, URI and The Nature Conservancy, is addressing this in the Gulf of Honduras, which is one of several Central American Project sites where local NGOs are being helped to build up capacity in coastal management. This project collaborates closely with the Belize CZM Programme. Similarly, there is close collaboration with projects on the Yucatan coast of Mexico. For example, exchange visits have been arranged between the Belize CZM programme and Amigos de Sian Ka’an, a Mexican NGO working on a community-based marine resource management project at Xcalak, a fishing community just north of the Belize border. Ultimately it is hoped that a trans-boundary reserve might be established, linking the Bacalar Chico Marine Reserve in Belize with proposed conservation areas on the southern Yucatan coast.

More recently, the importance of a regional approach has been recognised at the highest governmental level through the Declaration of Tulum. This was signed in June 1997 by the presidents of Mexico, Guatemala and Honduras and the Prime Minister of Belize. It calls for the development of a regional action plan and of an overall mechanism for institutional co-ordination. Although important coastal management efforts are underway in Mexico, Guatemala and Honduras, these countries do not yet have integrated programmes at the advanced stage that Belize has achieved.

Belize’s CZM programme could provide a good model for sustainable coral reef management, bearing in mind that a holistic national approach like this is probably
only possible in a small country, where impacts on the coastal zone are relatively small and management measures relatively easy to implement; in large countries such an approach probably has to be taken initially at the regional level. At present, there is no mechanism within the CZM programme for evaluating its impact or measuring its success. However, some of the factors that may be important are the following:

- Widespread consensus among both the general public and government agencies that conservation of the reef ecosystem and sustainable management of marine resources are high priorities; the role of these in protecting the coast from storms and erosion, in providing food and thus national security, in providing export revenue through fishery products and in forming the basis of the tourism industry is widely understood. National pride in the reef and an economic impetus for its sustainable utilisation provide a good foundation for conservation and co-operative management.

- The CZM programme has involved a wide range of players at all stages of its evolution, including government agencies, NGOs, local communities and the private sector. This has contributed to the acceptance of integrated coastal management as the most appropriate approach.

- A flexible approach to integrated coastal management has been taken, to allow for the particular socio-cultural and political characteristics of Belize. It is now of course recognised that no single model of ICZM will be appropriate to all countries.

- A recognition that commitment and good planning are as important as financing, and that dependence on external funding is not a long-term solution; the CZM programme has sought mechanisms for sustainable financing from its inception.

- An on-going commitment to developing national capacity for coastal management, that has ensured training at a number of levels and close collaboration with education and training institutions both within the country and overseas.

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References


