The Coral Reefs of Tobago: Status and Management

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ABSTRACT

The marine ecosystems of Tobago are extremely important to the island for both ecological and socio-economic reasons. Not only are they needed for coastal defense/breakwater/ protection of shoreline, nursery grounds, habitat for marine organisms, production of sand, reduction of pollution (mangroves); but also as a source of recreation, livelihood, and food. It is no great surprise, therefore, that Tobago's two premier industries (Tourism and Fisheries) depend on a very healthy marine environment for their own survival. The existence and continued formation of good quality reefs in Tobago is contingent on the growth of hermatypic corals.

Additionally, it must be noted that these tiny unicellular organisms are very sensitive to any changes in the delicate balance of their physical and chemical environment. Work conducted by both the CARICOMP project in Buccoo Reef Marine Park (BRMP), and by Lapointe et al. (2002) in both the dry and rainy seasons of 2001 has shown the susceptibility of the complex ecosystem to environmental changes in temperature and nutrients. This review showed some of the various environmental and anthropogenic impacts affecting the coral reefs. It also looked at the present status through the ongoing CARICOMP project and the work of Lapointe et al, where information on the status of the benthos of most of Tobago's reefs was revealed (cover of hard corals, octacorals, macro algae, turf algae, coralline algae and sponges). Information was also obtained on dissolved inorganic nitrogen, soluble reactive phosphorus and N^{15} to N^{14} ratios. Based on the above it was deduced that land-based discharges of nutrients from deforestation, sewage, construction and agricultural activities contribute a threat to Tobago's coral reefs.

The Department of Marine Resources and Fisheries (DMRF) through its management plans, its annual work programmes and very enthusiastic but small staff work conscientiously each year to manage the marine resources and fisheries of the island. The DMRF, however, is unable to realize the desired successes due to the many constraints it encounters. It is therefore necessary for the state to start financing the DMRF and its programmes; so that it can carry a more holistic ecosystems-based management programme, as is advised in the two marine areas management plans and the legal instruments at its disposal.

KEY WORDS: Coral reefs, Tobago, management

Los Arrecifes de Tobago: Condiciones y Manejo

Trinidad y Tobago es una isla del Caribe pequeña (300 km2) situó el noreste de aproximadamente 29 kilómetros de Trinidad entre las latitudes 111 8 = y 111 22 = y las longitudes 601 30 = y 601 51 =. el aproximadamente 70 % de las aguas costeras de Tobago's (a lo largo de sus líneas de la costa del este y del Caribe) son caracterizados por las formaciones del arrecife de las cuales el arrecife de Buccoo es el más grande y es el único parque marina protegido en la República de Trinidad y Tobago. Un plan de la gerencia ahora se está terminando para el segundo sitio más grande en Speyside, que se puede pronto considerar para el estado protegido similar del área como Buccoo bajo acto del realce y de la preservación de 1970. Los otros sitios principales del arrecife coralino alrededor de Trinidad y Tobago incluyen los arrecifes en la isla de la cabra, poca Trinidad y Tobago y la bahía de la Hombre-de-Guerra en el noreste; Bahía de Culloden y Arnos Vale en la costa del norte; y el arrecife del vuelo, el filón de la salsa de tomate, la tierra del grouper, el filón de Kariwak, el filón del Mt. Irvine y el asilo de la piedra ladran en la costa al sudoeste (Laydoo, 1991). Estos arrecife son importantes para las industrias de la pesca y del turismo de Tobago's. Se cree que sirven en parte como argumentos del cuarto de niños para algunas de Trinidad y Tobago de especies comerciales importantes de s. La industria de pesca local es pequeña pero es en segundo lugar solamente al turismo como Tobago's la mayoría del adquirente importante del rédito. La industria de pesca abarca unos 694 recipientes, la mayoría de los cuales es pirogues más unos 10 recipientes multipropósito. La blanco del fisherfolk de los island's un ciertas 19 especies de pescados y de crustáceos por once diversos métodos de la pesca. Seis impianto de los pescados procesan la porción principal del retén y el producto se empaqueta y se vende localmente, nacionalmente e internacionalmente. Los affinis de Hirundicthys (los pescados que vuelan cuatro-cons alas) y su pelagics grande asociado son las especies principales cogidas. Además, el turismo está vivo y bien con los barcos inferiores de cristal que funcionan su excedente de los viajes algunos de los arrecifes, anunciando snorkeling y la visión del filón. Tiene también sido un aumento sensible en el número de los zambullidores de la ESCAFANDRA AUTÓNOMA que visitan los arrecifes y el número de las tiendas de la zambullida (21) en la isla también ha aumentado. Se cree que algún 40 % del turismo de los island=s es turismo de la zambullida. Conch, la langosta y los pescados se creen para ser tomados regularmente de las aguas cerca de los arrecifes a los restaurantes locales de la ayuda y para la pesca de la subsistencia. El pote y una cierta pesca de la lanza se divulgan como campo común en algunas áreas. La joyería y los recuerdos también se hacen de corales y de otros organismos del arrecife para sostener negociar turístico. El anclar dentro de las bahías y por lo tanto sobre el filón es común. El departamento recientemente establecido de recursos y de industrias pesqueras marinas de la casa de Trinidad y Tobago de la asamblea ha asumido la responsabilidad de la gerencia de los recursos marinas y de las industrias pesqueras

de la isla. Ha emprendido un plan ambicioso de la gerencia de recurso natural participante, que incluyen las entradas de un número de tenedores de apuestas locales, nacionales y regionales, determinado para utilizar las mejores prácticas de gerencia de asegurar sustainability.

PALABRAS CLAVES: Arrecifes coralinos, Trinidad y Tobago, gerencia

INTRODUCTION

Tobago is a small island (300 km^2) situated approximately 29 km northeast of Trinidad between latitudes 11° 8' and 11° 22' and longitudes 60° 30' and 60° 51'. Approximately 70 % of Tobago's coastal waters (along its eastern and Caribbean coastlines) are characterized by reef formations, of which Buccoo Reef is the largest and is the only protected marine park in the Republic of Trinidad and Tobago. The other major coral reef sites around Tobago include reefs at Speyside, Goat Island, Little Tobago and Man-of-War Bay on the northeast; Culloden Bay and Arnos Vale on the north coast; and Flying Reef, Ketchup Reef, Grouper Ground, Kariwak Reef, Mt. Irvine Reef and Stone Haven Bay Reef on the Southwestern coast (Laydoo, 1991) (Figure 1).

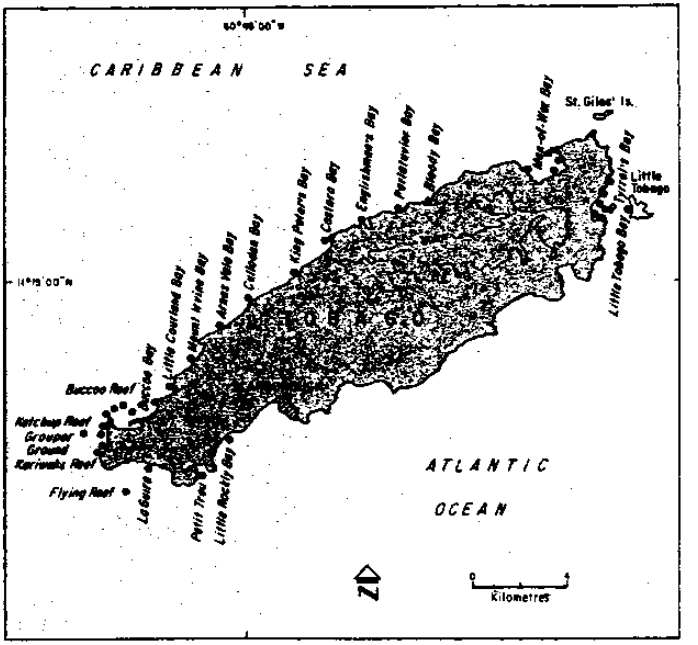

Figure 1. Map showing the Major Reefs around Tobago

These reefs are important to Tobago's Tourism Industry. Glass bottom boats operate their tours over some of the reefs advertising snorkeling and reef viewing. There has been a noticeable increase in the number of SCUBA divers visiting the reefs. The number of dive shops on the island has increased significantly (22) within resent years. Conch, lobster, and fish are believed to be regularly taken from waters near the reefs to support local restaurants and for subsistence fishing. Pot and spear fishing are common activities. Jewelry and souvenirs are also made from corals and other reef organisms to sustain tourist trading. Anchoring within the bays and therefore over the reef is common.

The reefs of Tobago are directly and indirectly impacted on by human, construction development and agriculture activities, which occur in the adjacent villages, towns and estates. Southwest Tobago, with reefs at Mt. Irvine, Buccoo and the general Crown Point area has seen massive building growth and development in the tourism and related services sector (hotels and guest houses), as well as, in residential village expansion. The unprecedented buildup has resulted in increased nutrient enrichment on the complex marine ecosystems (corals, sea-grass beds and mangroves) through pollution from hotel and household effluent and sewage. This nutrient loading has lead to over growth of marine macro-algae on the once sandy bottoms and in the coral areas.

Tropical coastal ecosystems, and coral reefs in particular, are suffering worldwide from the impacts of land-based nutrient pollution and eutrophication of coastal waters (NRC 2000). Pollution from land-based sources is considered the single most important threat to the marine environment of the Caribbean and an impediment to sustainable use of its resources (UNEP 1994). Sources of nutrient pollution known to impact Caribbean reefs include poorly treated sewage and gray-water, domestic and commercial (tourism) outfalls, fertilizers, deforestation, and topsoil loss (Lapointe et al. 1990, Lapointe and Thacker 2001, Likens, 2001). Throughout the Caribbean SIDS (Small Island Developing States) inappropriate or non-existent wastewater treatment represents a major source of land-based nutrient pollution to not only coral reefs, but also to adjacent sea grass and mangrove ecosystems as well (NRC 2000).

The island of Tobago offers an ideal site to study the effects of nutrient pollution on coral reefs. Approximately 70 % of Tobago's coastal waters (along its eastern and Caribbean coastlines) are characterized by reef formations, of which the Buccoo Reef Complex (BRC) is the largest and the premier Marine Protected Area (MPA) in the Republic of Trinidad and Tobago.

SOCIO - ECONOMIC IMPACT

The importance of the fishing industry to Tobago's economy and social development cannot be overemphasized. Indeed, in providing opportunities for employment, food security, and stability for rural communities it has a pivotal role to play in Tobago's development and is by far the main economic support for our

coastal communities. The fishing industry is second only to tourism as an income earner for this island. According to 1998 statistics, the fisheries sector contributed approximately 80 % to Tobago's agricultural gross domestic product (GDP). There are some 35 main landing beaches around the island, including 10 with fish landing centers. There are over 2,000 registered fishermen operating 1603 registered fishing vessels (including bumboats, pirogues, and ten multipurpose vessels). It has been calculated that these vessels represent a current capital investment of approximately 41 million TT dollars. Enormous investment has also been made by the private sector in establishing and developing Tobago's ten processing plants that process and market high quality fish locally, regionally and internationally and where more than three hundred persons are employed during the year. Over 180,000 kg of fish are caught annually and, in 1998 around five million dollars worth of fish was purchased by fish processors from Tobago fishermen. In addition, the diving industry is also a significant contributor to the economy of Tobago, contributing an estimated gross of 54 million TT dollars in 1998, from 22 dive shops.

INTERNATIONAL CONVENTIONS, GOVERNMENT POLICIES, LAWS, AND REGULATIONS

The management of reefs in Tobago are directly influenced by three (3) United Nations Conventions, twelve (12) pieces of national legislation and two (2) policy documents (details in APPENDIX) and indirectly by numerous other conventions, legislation and policies. The Tobago House of Assembly through its Department of Marine Resources and Fisheries has the direct responsibility for the management of Tobago's reefs. This network of conventions, legislation, and policy provide an intricate atmosphere for the management of coral reefs around the island. For example, the THA undertakes the day to day responsibilities for management while the Ministry of Agriculture, Land, and Marine Resources has the legal responsibility for the implementation of the Marine Areas (Preservation and Enhancement) Act of 1970 and the Environmental Management Authority will legislate activities within selected reefs through the Environmentally Sensitive Areas Rules 2001. Efforts are being made to harmonize these documents and effect much needed management initiatives through the signing of memoranda of understanding among the various entities but progress to date is dismal.

BIOLOGICAL/ PHYSICAL (IMPACTS/ EFFECTS)

Tobago is located along the runoff path of several major South American river systems that have a direct effect on the reefs that fringe the island. The runoff brings with it large quantities of sediments, minerals, and nutrients such as nitrogen and phosphates that encourage algal growth. This coupled with global problems such as sea level rise and global warming has exacerbated an already burgeoning problem on the reefs of Tobago. In 1998, there was a bleaching event that affected 100 % of

the observed reefs of Tobago (Guppy 2000). This was part of the worldwide trend in 1998, widely attributed to the rise in global sea temperatures in that year. Since then there have been unconfirmed bleaching events in 2000 (Guppy 2000), 2001 and 2002 (Lum Kong and Juman 2002). It is feared that with the change in the climate these bleaching events will become regular occurrences with the added threat of rising sea levels.

Man's activities negatively impact on the reefs, both directly and indirectly. Anchorage, breaking corals for the tourism trade, over-fishing of reef species and boat operators dumping garbage directly onto the reefs are problems common to all the reefs of Tobago. For over 20 years reef tour operators in Buccoo Reef encourage visitors to walk upon the corals in an attempt to snorkel. Yachts anchor around the reef at Man-of-War Bay in Charlotteville and have been known to empty their tanks directly onto the reef. Yacht owners are asked to dispose of their waste some five kilometres out at sea, but there is no enforcement of marine policies and regulations outside the boundaries of the Buccoo Reef Marine Park.

Construction development on the island is at an all time high, with numerous other developments being proposed for the future. In the Marine Park area alone, a resort has been earmarked for the adjoining lands in addition to the three major housing developments, which are already significantly impacting the reef. This is in addition to the numerous registered hotels and guesthouses, as well as the other unregistered bed and breakfast homes already existing in the area. This trend is being duplicated throughout the island, thus posing a severe threat to our reefs, especially in terms of nutrient loading from sewage and other sources such as agricultural run-off, industrial and domestic wastewater.

The Institute of Marine Affairs has the responsibility to monitor the Buccoo Reef Complex as part of the Caribbean Coastal Marine Productivity (CARICOMP) project. Data collected over the past few years showed that there was no significant decrease in the hard and soft coral cover and no increase in the algae from 1996 to 2000 (Lum Kong and Juman 2002). There was, however, a decrease in rugosity during that period. There are diseases such as dark spot disease, black band disease and white pox affecting the corals around the island but there is no proven correlation between the occurrence of diseases in corals and human activities.

MANAGEMENT

Of the 34 reefs identified, management plans were commissioned for the two most popular reef systems at Buccoo and Speyside. Recommendations of the Buccoo Reef Management Plan, formulated in 1995, are yet to be implemented. The approach seemed to rely heavily on beaurocracy to effect changes. The management plan for the Speyside Marine Park, completed in 2001, however, has sought to place an emphasis on collaborative (participatory) management. Present trends seem to indicate that the recommended approach to the management of reef systems around the island may be best addressed by the formulation and

implementation of a coastal zone management plan, which would incorporate concerns involved in the 'ridge to reef' management concept.

Environmental Education and Public Awareness

There have been several collaborative, public awareness and education programs initiated by government, government agencies and NGOs over the past few years. The Institute of Marine Affairs and The Tobago House of Assembly began a program in Speyside in September 2002 to meet the needs of the Speyside Reef area. Local NGO Buccoo Reef Trust, in conjunction with the Department of Marine Resources and Fisheries produced a video, which highlighted the problems facing Buccoo Reef Complex Ecosystem. There is yet to be a comprehensive education program implemented for other coastal communities around Tobago.

Research, and Monitoring

To date, some 36 research papers have been written about the Buccoo Reef Marine Park. In compariso,n there has been just a few papers written on Speyside and even less on other the reefs around the island. Traditionally, monitoring has been carried out by the Institute of Marine Affairs, but the Department of Marine Resources and Fisheries has recently began regular monitoring the coral cover and reef species as part of the Reef Check Program. There are plans to monitor the five main reefs around the island.

Conflict Management

With the growth of the tourism industry there has been increased competition for use of the marine resources. Tourism in Tobago, as in many other Caribbean islands, is concentrated along the coast. Traditional beach access is constantly threatened, and fishermen and other local users of the beaches are often at odds with hoteliers and developers. One prominent example was the recent conflict between the owners of Club Pigeon Point Beach Resort and the fishermen that traditionally use the area. This culminated with a fatal shooting in March 2000. The Department of Marine Resources and Fisheries played a most pivotal role in the resolution of this conflict through mediation between the two sides on many occasions.

Enforcement

Currently, the Department of Marine Resources and Fisheries is staffed with four (4) Reef Patrolmen that have responsibility for enforcing the regulation governing the use of the marine park at Buccoo. ,The reef patrol system lacks effectiveness as it is in dire need of appropriate tools and equipment, as well as, an adequate number of properly trained, motivated staff to implement a 24-hour workday, for seven days every week. In an effort to improve the system, the DMRF hosted Phase 1 of a Marine Ranger Training Workshop in July 2001 from which persons will be recruited to work with the Department. Plans are also underway to set up a volunteer marine ranger system, which will allow for the involvement of

community members in patrolling and monitoring of their local marine resources. The local Police and Coast Guard personnel have been trained in the legislation governing the marine areas earlier in 2002.

Work Programs

Each year, as part of the annual budget, the Department of Marine Resources and Fisheries requests funding for marine areas (e.g. reefs, sea-grasses and mangroves) management, protection, conservation, research and development. Some of these projects include reef regeneration, placing signs on the boundaries of the reefs, public awareness and education programs, placing permanent moorings for anchorage on the reefs, training reef tour operators in coral reef biology, and tour guide methodology.

Government officials have consistently denied requests for funding of reef related projects, as with many other environmental projects. Over the last six years, funding for reef management was allocated in 1997, 1998 and 2001, with total allocation representing less than 1 % of the total Tobago House of Assembly budget. This has allowed for ineffective management as there are insufficient funds to hire staff, purchase equipment, or establish a feasible infrastructure.

CONCLUSION AND RECOMMENDATION

Tobago's coral reefs along with its sea grass beds and mangroves are extremely important for both ecological and socio-economic reasons. They have been constantly impacted over recent decades by not only natural phenomena but also more so by the sea-based and land-based actions of man. Land-based and coastal engineering and developmental activities have had numerous devastating effects on coral reef health. It is therefore recommended that adequate funding be made available by the State and any donor agency to ensure the annual conduct of the Department's programmes, thus ensuring the much needed wise-use management of these important reefs and associated ecosystems.

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Appendix 1. The legal document governing the management of Reefs in Tobago

Document	Brief Description
The Three Chains Act (1865)-	This Act refers to land surrounding the coast that is three chains breadth from the high water mark that was reserved for the execution of forts and batteries. The Act grants the State the authority over those areas and the public access through the three chains. It essentially gives the control of the land beyond the high water mark around the coast to the landowners (not the State). This affects the governing of the land bordering the Bon Accord Lagoon where this land was mangrove in 1865.
State Lands Act (1918)	Section 3 of this Act states that "the domination of the nearshore between the high water and low water marks belong to the and is vested in the State." Coast begins where the shore ends at the high water mark.
Marine Areas (Preservation and Enhancement) Act (1970)	The Act which defines the Marine Areas, and allows 'the Minister' to designate any area in Trinidad or Tobago a restricted area. It also gives general directions on how to manage protected areas.
Marine Areas (Restricted Area) Order (1973)	Designated Buccoo Reef Complex as an area for preservation and protection. It determines that no person may go into the Buccoo Reef area except as provided for by the Regulations. This Order demarcates the boundaries of the proposed Buccoo Reef National Marine Park inaccurately.
Marine Areas ("Preservation and Enhancement) Regulations (1974)-	Under Section 6, 'the Minister' has the discretion to make regulations generally for purposes of giving effect to the Act.
CARTAGENA Convention	This is the Convention for the Protection of Development of the Marine Environment of the

	Wider Caribbean Region. It was entered into force in Trinidad and Tobago on October 11th 1986.
SPAW Protocol	This is the Convention concerning Specially Protected Areas and Wildlife to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region which was entered into force in Trinidad and Tobago on January 18th 1990
The United Nations Convention on Biological Diversity	Entered into force on August 01st 1996. Instrumented by the development of the National Biodiversity Strategy and Action Plan, which provides a contextual framework for development and management of the natural living resources of the country.
Environmental Management Act (1995)	Provides for management of the environment within Trinidad and Tobago through the establishment and operation of an Environmental Management Authority (EMA), an Environmental Trust Fund, and an Environmental Commission, to define the powers and duties thereof, and for related matters. The THA signed a Memorandum of Understanding (MOU) with the EMA in 2001.
Tobago House of Assembly Act (1980)	Section 21 gave the THA the responsibility for implementing, in Tobago, Government policy relating to the 'conservation and improvement of the environment'.
Amendment to the Constitution Act # 39 (1996)	Made necessary changes in the constitution to effect THA Act 40 of 1996.
Tobago House of Assembly Act # 40 (1996)	Replaces the Tobago House of Assembly Act (1980).
National Environmental Policy	Approved by Cabinet and laid in Parliament on September 2nd 1998. This provides a "national, practical and comprehensive framework for environmental management.
Environmental Management Act # 3 (2000)	Replaces Environmental Management Act 1995.
*Environmental Sensitive Area Rules (2001)_*	One of the criteria for designation is the "conservation of natural resources and protection of the environment and the targeting of areas for effective management.
*Environmental Sensitive Species Rules (2001)_*	Seeks to protect species for the conservation of biological diversity and protection of the environment.
Technical Agenda for Agriculture, Marine Affairs and the Environment (2001)	3.4.4 states an objective "to conserve and restore coral reefs of Tobago and their associated fauna".