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# Marine Modeling in the Caribbean Sea: A Tool for Integrated Adaptive Resource Management

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**ABSTRACT**

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This paper presents a regional perspective on the barriers and importance of managing the resources in the Caribbean Sea using an integrated approach and how the use of a marine model can help to determine quantitatively, the impacts of present and future development trends on the resources. The Caribbean Sea is a semi-enclosed sea surrounded by a twenty- five island archipelago and other mainland territories. The resources are managed country specific within each territorial jurisdiction, hence resource degradation and concomitant environmental problems continue. This Geographic Information System model proposes to quantify the resource consumption and waste assimilation of a given population in terms of productive marine areas using three Caribbean Small Island States as case studies. It will produce sustainability indicators and risk assessments, which will be used to inform policy decisions and the formulation of a management strategy.

**ADDITIONAL INDEX WORDS:** *Ecosystem, geographic information system, small Island states.*

## INTRODUCTION

The Caribbean Sea is the second largest sea in the world covering approximately 1063 000 sq. miles (2 515 900 sq. Km). The sea is important because of the role it plays in the economies of many countries lending heavily to activities such as tourism, trade, fisheries and dumping ground for various forms of waste. Most notable economic activity is tourism in which the beaches and rich diversity of marine life found within the coral reefs and sea grass areas (Fig. 1) form the tourist package of these destinations. Judging from the activities, it is therefore imperative for single and small economies like those that exist in the Caribbean area, to make an effort to sustain the resources they invariably depend on. At present, most of the marine resource management occurs within respective country's legal marine borders. This does not bode well for example, migratory biological stock since any attempt at management in one jurisdiction may be inconsequential if other territories do not implement similar measures. Comparatively, the effects of the resource use and other activities in the sea do not remain within these man-made borders but rather diffuse into the wider ecosystem, ultimately affecting the same resources these islands so depend upon. This cycle of use and be used can have serious ecological consequences and direct economic disasters hence it is imperative to rethink our strategy of resource management in this sea.

Notwithstanding, efforts are being made to tackle depletion and damaging of ecological stocks which are seen though the manifestation of legislation, environmental institutions, increase project EIA,s etc, but so far exhibited, is the inability of these mechanisms to deal with the issues effectively. The exploitation continues partly because of the little emphasis of integrated management, insufficient information on stock biology, ecology and active impacts but more so the lack of an effective tool to quantify resource consumption, waste assimilation and risks.

Therefore, this paper will present part of an overall study aimed at building and applying a GIS based model in resource quantification with emphasis on the Caribbean Small Island States.

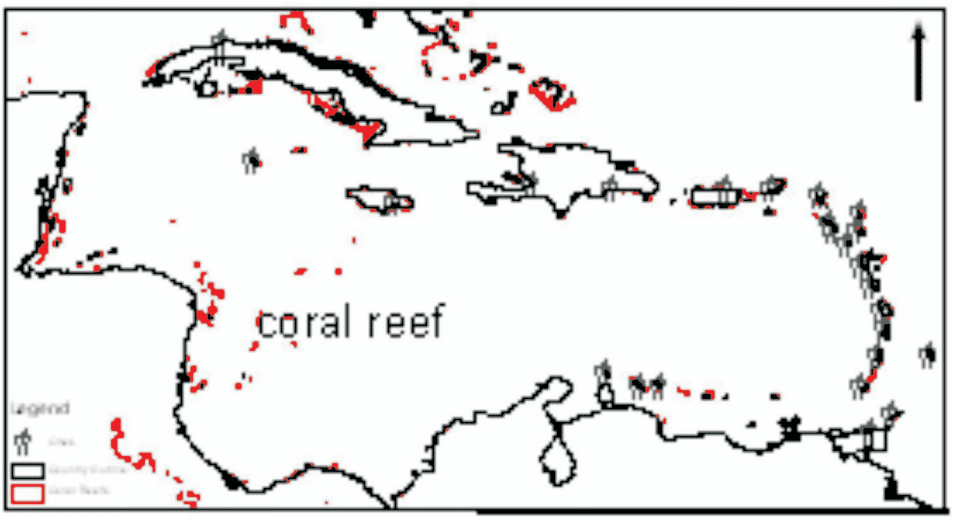


Figure 1. Showing atributes of the study area.

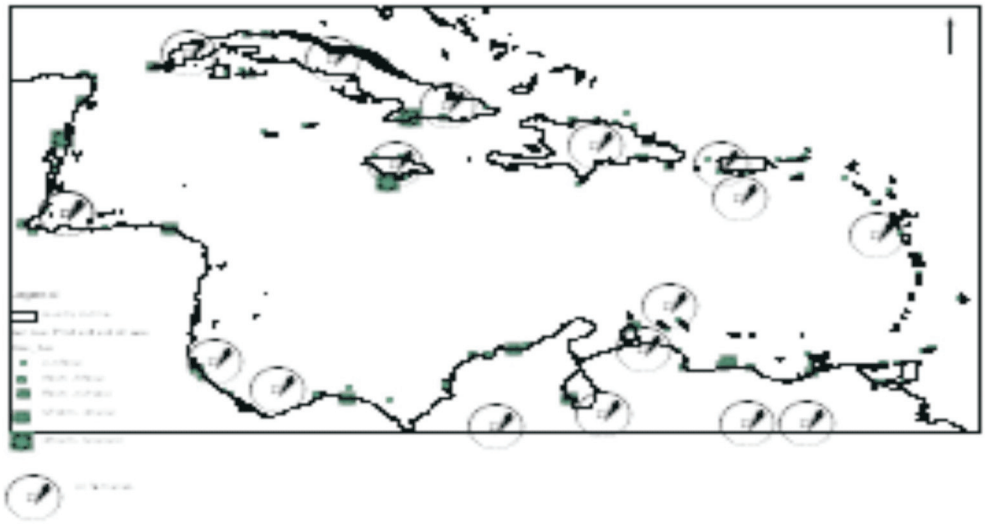

Figure 2. Showing the legally protected areas and oil renfreries locations.

## METHODOLOGY

Using GIS as an assessment tool, information on transport, energy, fishing, refineries, bathymetry, and legally protected areas found in the Caribbean Sea will be collected, analysed and input to produce spatial relation of features, resource use and activities in the sea. Further analysis will be conducted to show the risk areas using the techniques of buffering followed by the application of 1sq.km grids to show possible risk areas and contributing source (s).

This aspect of the study will provide crucial information and forms part of the development of the model. For the model, five sectors (tourism, fisheries, energy, urban-industrial development and agriculture) which reflect the activities on the islands in general will be investigated using a DPISR (driver-pressure-state-impact-response) concept (OECD , 1991). This model will then be applied to pre-selected countries to estimate the resource consumption and waste assimilation requirements of the population in terms of corresponding productive marine area.

Having an operational model, further efforts will be made to explore likely alternative development scenarios, which are likely given the current or predicted development trends and policy

## CURRENT RESULTS

At the time of compilation of this paper, information on transport, energy, refineries, and legally protected areas were compiled and spatially represented as shown in Figure 2 and 3. Using a twelve year period of data (1990-2002), it is found that the study area receive on average 6, 813 cruise calls annually and movement of commercial vessels is high though individual port statistics are still to be compiled. The Eastern Caribbean region has the highest cruise calls when compared to the Western and Southern, as shown in Figure 4. It is also found that most of fishing done by local population is within the continental areas and overall total catch has steadily increased in all the islands. There is a total of one hundred and five legally marine Protected Areas in the Caribbean Sea. There are seventeen oil refineries including those found in mainland South America.

## DISCUSSIONS

The relationship between the Caribbean in relation to the Islands is unique. Most of the islands have their greatest abundance of coral reefs in the Caribbean Sea as oppose to the Atlantic Ocean, therefore it is expected most of the biodiversity

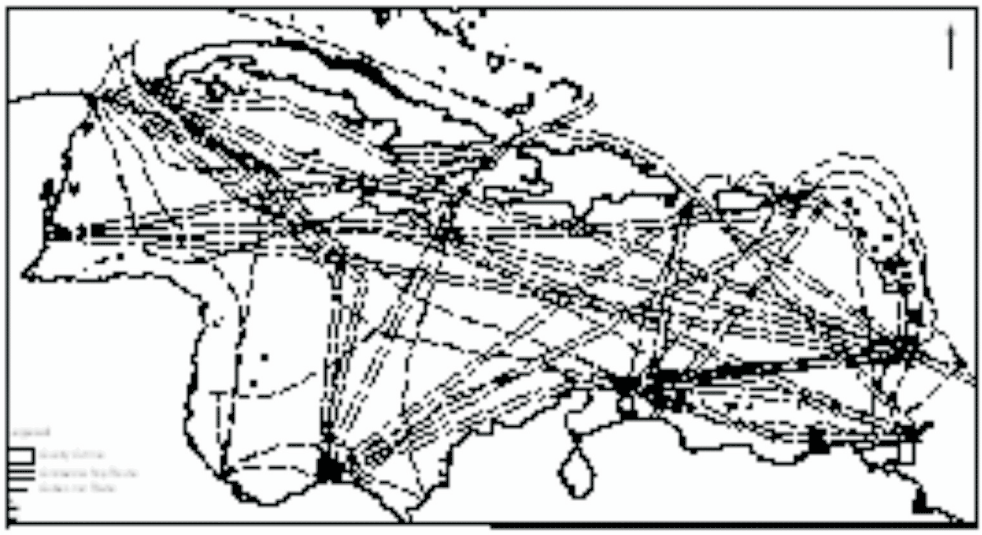

Figure 3. Showing the transportation network in the Caribbean Sea.

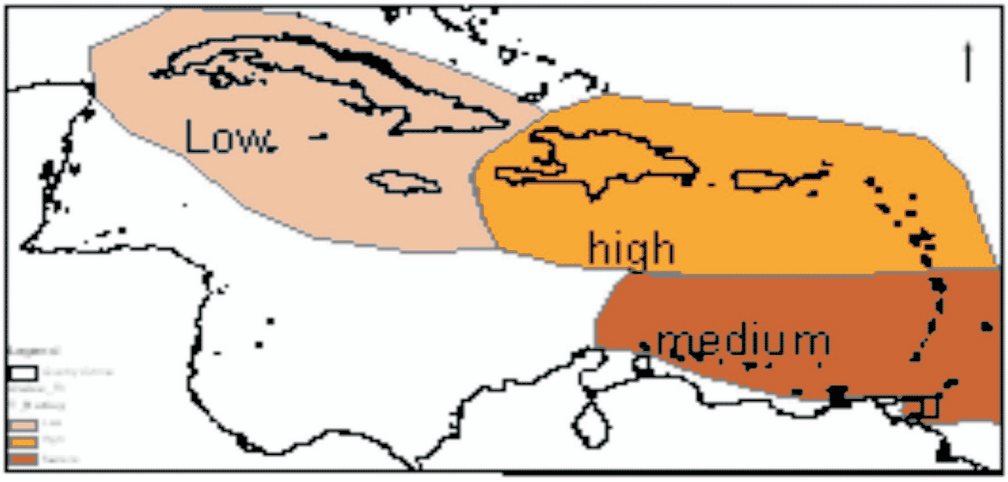


Figure 4. Showing the Cruise Titanic.

richness lie therein (HUGHES, 1994). In addition, the islands with the exception of Puerto Rico and Cuba have their major (Capital city) urban area (s) in close proximity to the Sea, hence in most of the islands, settlements and population will be on concentrated on this side. Therefore, the known trend of inadequate infrastructure will ultimately have more effects on this water body. In addition, most of the tourist infrastructures such as accommodation are situated in close access to the sea and by extension wastewater and other effluents are dumped here. As if not enough lack of port reception facilities and no restriction on bilge and ballast water adds to the pollution problem. With a large amount of cruise, pleasure and commercial traffic, the risk of pollution from dumping and spills is great. Agriculture which in most cases is the second most important economic activity on these islands also add it share of pollution, as eutrophication in coastal water is reported in all islands in the study area. Evident from the result provided is the imminent risk of pollution from ships both cruise and commercial vessels with the likely hood of increasing with the predicted increase in cruise tourism to the Caribbean island (CTO, 2003). This potential risk will be further investigated with the addition of current pattern later in the study. As for fishing, the data shows a steady increase over the years, this is alarming, considering the limited demersal resources available from the small area of island shelf and high dependence on this sector for employment. Therefore inevitably, effective management is required with a high level of commitment and co-operation among islands especially for migratory species. To date, this co-operation is never much of practice because of the cultural and political differences, development issues, economic factors and linguistic problems.

## CONCLUSION

Though the modelling is yet to provide conclusive results, it is evident from the information provided in this paper that such application can provide quantitative data, and will be particularly useful in areas where real time data is absent or severely lacking. No better example can be displayed as that of the Caribbean Sea.

## LITERATURE CITED

CARIBBEAN TOURISM ORGANISATION, 2003. *Cruise Passenger Arrival: Statistical Report*, (no pagination).

COLOMENARES, N.A. and ESCOBAR, J.J, 2002. Ocean and Coastal issues and policy responses in the Caribbean. *Journal of Ocean and Coastal Management*, 45 905-924.

HUGH, T.P,1994. Castastrophes, Phase Shift and Large Scale Degradation of a Caribbean Coral Reef. *Science* 265, 1547-1550.

MONTERO, 2002. Ocean and Coastal issues and policy responses in the Caribbean. *Journal of Ocean and Coastal Management*, 45 677-693.