

## **Executive Summary**

### **Introduction – the Argument in Brief.**

The peoples of the Caribbean are defined by the Sea whose shores they inhabit. In the rich diversity of cultures and nations making up the region, the one uniting factor is the marine ecosystem on which each ultimately depends.

If that ecosystem is under threat, so are the livelihoods of millions of people. The economic activity of the Caribbean is based to a very great extent on the bounty of the Sea and the natural beauty which attracts visitors from around the world – which in turn require the healthy functioning of complex physical and biological processes. The coral reefs and the seagrass beds, the white-sand beaches and the fish shoals of the open ocean: these are natural capital assets whose loss or degradation has huge implications for the development of the region.

Apart from the economic importance of the ecosystem, it shapes the lives of all the inhabitants of the Caribbean in ways which defy statistical analysis. The Sea and its coasts form the stage on which the cultural, spiritual and recreational life of the region is played out.

It may be united by its sea, but the Caribbean region is divided by its history. Five hundred years of settlement by Europeans, Africans, Asians and people from other parts of the Americas has bequeathed to the region a patchwork of independent states and numerous colonies administered by governments in a different hemisphere. This presents unique challenges to the establishment of the cooperative policies needed to manage this ecosystem for the common good, and to achieve the most secure long-term future for the Caribbean peoples.

The situation is made even more complex by the influence on the Caribbean Sea ecosystem of decisions in parts of the world with no direct territorial link to the region: from the use of the waters for fishing by Asian fleets and by international shipping, including the transport of nuclear waste en route to the Panama Canal and oil shipments from the Middle East to refineries in the Gulf of Mexico; to the pollution and sediments carried by rivers from deep inside the South American continent; and even the energy choices of societies throughout the world which have major implications for the Caribbean Sea through the pace of global warming.

All of these factors combine to create an urgent need for a new overview of the state of the Caribbean Sea; an analysis of the forces driving change and the implications for the well-being of the Caribbean peoples; and a review of the options available to policymakers in the region and beyond. This Caribbean Sea Ecosystem Assessment (CARSEA) attempts to fulfil that need.

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In common with the practice of the Millennium Ecosystem Assessment (MA) of which it is a part, CARSEA first sets out a detailed picture of the condition and trends of the ecosystem; it then develops a number of scenarios aiming to simulate the likely outcome of different plausible future paths for the region; and finally reviews the responses available to decision-makers.

The main points of the assessment will be summarised in the following pages. More detailed analysis and references to the sources on which it is based **are available in the full CARSEA report.**

**Three key messages can be highlighted at the outset.** First, some of the vital services which human communities derive from the Caribbean Sea ecosystem are being placed in jeopardy, often by the very activities and industries whose long-term future depends on the continuing provision of those services.

Second, a reduction in the stresses being placed on the natural functions of the Caribbean Sea will require new ways of working together amongst the disparate political authorities making up the region.

Finally, the combination of dependence on the integrity of its marine ecosystem and vulnerability to global forces beyond its control puts the Caribbean in a special position which merits recognition and concrete action by the international community.

### **The Sea and its People.**

The semi-enclosed Caribbean Sea is a distinct ecological region, bounded to the North by the Bahamas and the Florida Keys, to the East by the Windward Islands, to the South by the South American continent, and to the West by the isthmus of Central America. Covering an area of more than 3.2 million square kilometres, it is the second largest sea in the world, after the Mediterranean. For the purposes of this assessment, the Caribbean is taken as these waters, the islands within the Sea and bordering it, and the river basins of continental territories draining into the Sea, **as shown in Figure 1.1, taken from the main CARSEA report.**

**Figure 1.1: Map of the Caribbean Sea Large Marine Ecosystem with Hypothetical Exclusive Economic Zone (EEZ) Boundaries<sup>1</sup>**



Source: The Nature Conservancy (TNC) 2005.

The Caribbean, home to more than 116 million people<sup>2</sup>, is divided among 22 independent states, of which nine are continental countries of South and Central America, and the remainder islands and archipelagos. In addition, four colonial powers – the United States, the United Kingdom, France and the Netherlands – still exercise political control over eleven island territories in the region.

The complex political structure, produced by the historic struggles for control of the resources of the Caribbean, and reflecting a wide cultural diversity arising from that history, has left the region with a series of overlapping regional authorities exercising varying degrees of policy co-ordination over parts of the Sea. This creates a significant problem in the exercise of a holistic approach to the management of the Caribbean Sea ecosystem.

**What unites the people inhabiting this region is a common dependence on two particular products of the marine ecosystem, known in the terminology of the MA as ecosystem services.** Because of the dominant role of fishing and tourism in the Caribbean economy, this assessment concentrates mainly on the implications for these two services of current trends and future options.

<sup>1</sup> It should be emphasised that the lines on this map are indicative only, as some boundaries are disputed.

<sup>2</sup> Defined as those living within 100km of the Caribbean coast

### **3. Why fishing and tourism?**

A few facts and figures help to justify the choice of these two services.

New data provided for this assessment confirm that relative to its size, the island population of the Caribbean is more dependent on income from tourism than that of any other part of the world. In 2004, more than 2.4 million people were employed either directly or indirectly in travel and tourism, accounting for 15.5% of total employment, a proportion nearly twice as high as the global average. The sector contributed US\$28.4bn to the Gross Domestic Product, 13% of the total, and US\$19bn or 16% of exported services and merchandise. Over one-fifth (21.7%) of all capital investment was linked to tourism, well over twice the global average.

Twenty-five million tourists choose to holiday in the Caribbean each year, in large part in pursuit of a dream of sensuous relaxation shaped by its natural features – palm-fringed beaches, blue-green lagoons with crystal-clear water, opportunities to see multi-coloured fish swimming amongst coral reefs. Dependence on tourism, therefore, also implies dependence on the capacity of nature to continue providing the conditions which make the Caribbean such a popular destination. In cases such as the diving industry, this connection is so close that degradation of ecosystem quality can be measured directly in lost income.

Fishing is also a significant provider of jobs and income in the Caribbean. It is estimated that more than 200,000 people in the region are directly employed, either full-time or part-time, as fishers. In addition, some 100,000 work in processing and marketing of fish, with additional job opportunities in net-making, boatbuilding and other supporting industries. Assuming each person employed has five dependents, more than 1.5 million people in the Caribbean rely for their livelihood on commercial fishing. The activity also brings in approximately US\$1.2bn annually in export earnings, with the United States the principal destination.

However, the true importance of fishing is not fully reflected in these figures. In a region where most of the population has access to the Sea, fish provide a vital resource for poor communities in ways which do not always appear on the national accounts. It is estimated, for example, that fish products account for seven per cent of the protein consumed by people in the Caribbean region. Anything which damages the productivity of the marine food chain is therefore a significant threat both to the health and to the wealth of these societies.

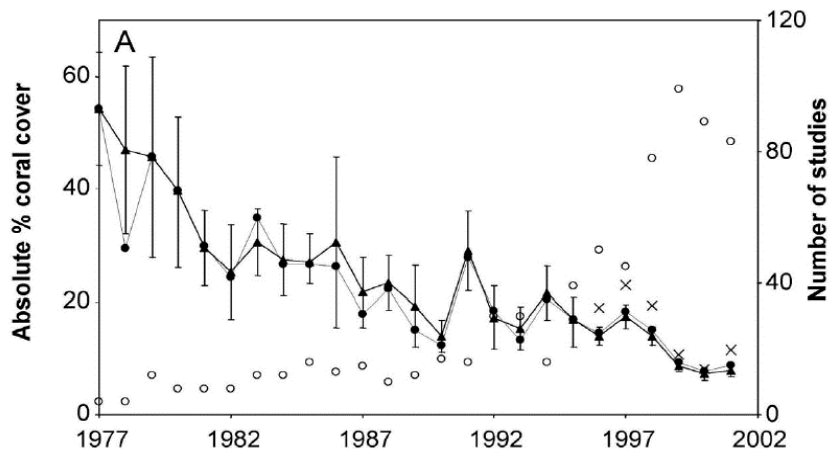
#### **State of the ecosystem – signs of trouble**

##### *Damaged infrastructure*

The functioning of the Caribbean Sea ecosystem and the delivery of its services are heavily reliant on the condition of four interdependent coastal formations: beaches, coral reefs, mangroves and seagrass beds. The white-sand beaches beloved of tourists are formed partly from the fragments of coral skeleton; the coral reefs themselves are both a rich source of food and a magnet for visitors; seagrass beds act as nurseries for many species of fish and shellfish; and mangroves help to provide nutrients for a range of marine life, shield coastal communities from the full force of wind and waves, purify wastes from land-based sources that enter the coastal zone, and attract eco-tourists to their vibrant wildlife.

Each of these formations is showing signs of significant damage as a result of human activities, with serious implications for the future capacity of the ecosystem to provide income from tourism and fishing. The best-documented example is for corals: recent studies suggest that some 80% of living coral in the reefs of the Caribbean has been lost in the past 20 years, as seen in Figure 2.3, taken from the main CARSEA report. Absolute percent coral cover of the reefs investigated is the average difference between the estimated percent live coral at the start and end of each year of the study period. This unprecedented rate of degradation has seen some reefs change from 50% cover with live coral organisms, to just 10%. It has been estimated that the continued decline of coral reefs could cost the region between US\$350m and US\$870m per year by 2050.

**Figure 2.3: Absolute Percent Coral Cover From 1977 to 2001 Across the Caribbean Basin<sup>3</sup>**



Source: Gardner et al., 2003

<sup>3</sup> Relevant trends are represented by solid triangles which indicate weighted means with 95% bootstrap confidence intervals; open circles indicate the number of studies.

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A number of factors, each interacting with the other, are causing the degradation of coral reefs. They include: increased sedimentation from rivers discharging into the Caribbean; excess nutrients due to pollution from farmland run-off and sewage, including from cruise ships; overfishing; diseases affecting creatures such as sea fans and sea urchins critical to the ecological balance of the reef; physical damage through dynamiting and dredging; and “bleaching” of corals, in which rising sea temperatures upset the symbiotic balance between coral polyps and the algae on which they feed

The decline of coral reefs has reduced their ability to act as a protective barrier, and this may be one reason for increased levels of beach erosion. It has recently been estimated that 70% of Caribbean beaches are eroding at rates of between 0.25 and nine metres per year. The cost of artificially replacing this sand, in a process known as beach nourishment, can run into millions of dollars.

Seagrass beds and mangrove forests have each seen widespread declines through direct removal to make way for various types of coastal development: seagrass is often cleared to “improve” bathing beaches, while mangroves have made way for commercial and housing construction, and for shrimp-farming ponds.

### *Fish stocks under pressure*

In common with ocean regions across the world, the Caribbean has seen dramatic change over the past thirty years in the efficiency and intensity with which fish stocks have been targeted. Greatly increased demand, combined with the use of new types of catching gear, have helped to exert unprecedented pressure on this key resource of the ecosystem.

A number of factors set the Caribbean apart and present particular problems in protecting fish stocks for future generations. One is the sheer variety of fish and invertebrates involved in commercial fishing. It has been estimated that 680 species of bony fish, including 49 types of shark, are targeted in the region. This makes it extremely difficult to monitor the state of particular stocks, and to manage them sustainably. For example, of the 197 fish stocks falling under the jurisdiction of the Caribbean Fisheries Management Council, the status of 175 (88%) was unknown or undefined.

Another problem arises from the lack of a unified political authority with responsibility for the resources of the Caribbean. Fish are no respecters of national boundaries, and the failure to regulate adequately those stocks shared by different states has led to damaging disputes between Caribbean countries in competition for shared resources. In addition, existing arrangements enable fishing fleets from throughout the world to engage in a “free for all”, placing added pressure on the marine life of the Sea. It is the tragedy of the commons.

Lack of reliable data makes it difficult to give a complete picture of the condition of this particular service of the Caribbean Sea ecosystem. Some trends, however, give cause for

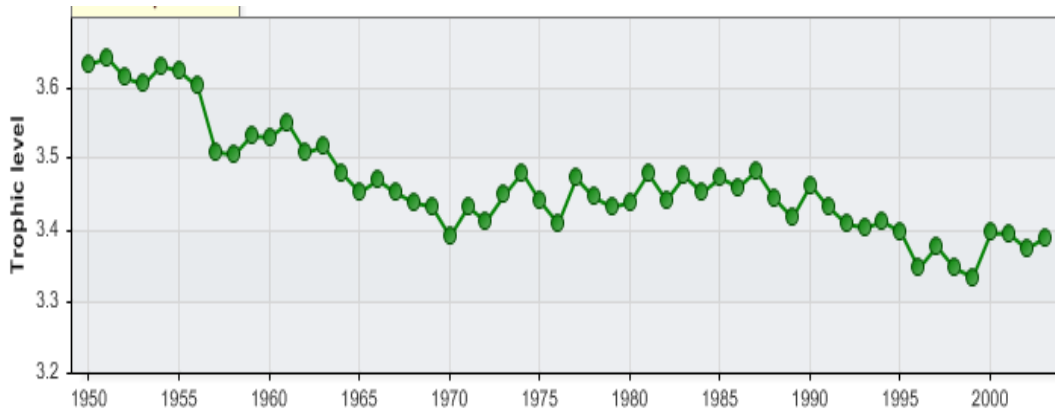
concern. All the major commercially-important species and groups of species in the region are reported to be fully-developed or over-exploited. In the case of one valuable stock, the conch, the pressure has been serious enough to put it on the list of threatened species held by the Convention on International Trade in Endangered Species (CITES).

New analysis of historical trends carried out for this assessment suggests that fish landings in the Caribbean rose to unprecedented levels during the 1990s, reaching a peak of nearly 500,000 tonnes in 1998, but subsequently went into sharp decline.

The reasons for variations in the size of catches are complex, involving both human and environmental factors, but some indicators do point to the impacts of overfishing. A recent study of fishing data for four of the Windward Islands, for example, found that while overall catches increased in the period from 1980-99, the increase in the effort used to catch those fish was very much greater. The ratio of fish caught for each “unit of effort” is estimated to have declined by up to 70% over these two decades, an indication that fish are becoming harder to find.

There are also signs that Caribbean fish stocks are suffering from the phenomenon known as “fishing down the food web”, in which longer-lived, predatory fish become more scarce, and stocks become dominated by shorter-lived, plankton-eating species, as seen in Figure 4.2, taken from the main CARSEA report. This reduction in the average trophic level, as it is termed, may not affect catches in the short-term, but signals long-term trouble for the ecosystem.

**Fig. 4.2 MEAN TROPHIC LEVEL FOR THE CARIBBEAN SEA**



Source: Sea Around Us Project

### Drivers of change

It is a central part of the assessment of any ecosystem to identify the key factors leading to changes which can affect the services provided by the natural systems of a region or locality. Known as drivers, these can either be direct (such as pollution) or indirect (such

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as population increase leading to pollution); they can be local drivers (such as habitat destruction) or external ones (such as global climate change).

By analysing these drivers, it becomes possible to understand better the full consequences of particular policies or activities on the well-being of our societies, and to suggest the type and scale of changes which may be required to reduce the stress on ecosystems.

It is important to note that ecosystem change is often the result of two or more of these factors working together – for example a healthy coral reef may be able to withstand the introduction of a disease organism, but that same disease could have a devastating impact on another reef already weakened by the effects of nutrient pollution or overfishing.

Here are some of the key examples in each category of driver:

### **Local, direct**

*Changes in coastal land and sea use* in the Caribbean have been the single greatest cause of ecosystem damage. Flat land along the coastline and reclaimed from the Sea has been used for industry and commerce, and in a wide range of tourism developments such as hotels, apartments and golf courses. The consequence has been severe depletion of habitats such as seagrass beds and mangroves, damage to coral reefs and the destabilisation of beaches.

*Sewage pollution* from land sources and from cruise ships has been the most pervasive form of contamination of the coastal environment. Apart from affecting bathing beaches and thereby the tourism potential for particular areas, the elevated nutrient levels from such pollution can over-stimulate the growth of algae, causing fish kills and coral damage.

*Overfishing* through the increasingly widespread use of certain types of gear is putting unprecedented strain on the fish stocks of the Caribbean.

### **Local, indirect**

*Urbanisation of coastal communities* has been the major factor underlying the direct pressures on the Caribbean Sea ecosystem.

*High tourism dependency* has led to a massive amount of capital investment in coastal infrastructure, which has in turn damaged the capacity of the ecosystem to provide services to the region.

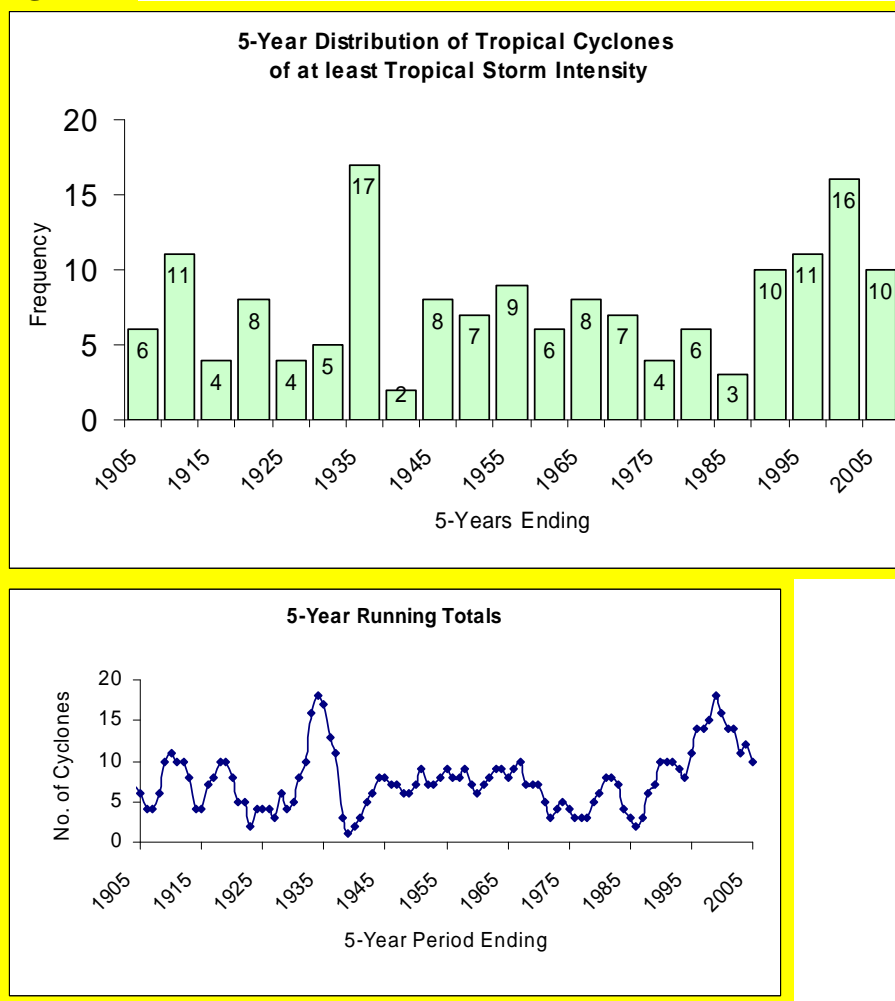
*Lack of co-ordinated governance* in the region has led to a competitive rather than co-operative approach to issues such as fish stocks and tourism management, to the detriment of the ecosystem.

### **External, direct**



Global climate change can potentially have a profound impact on the Caribbean Sea ecosystem. Increased intensity and frequency of tropical storms, as shown in Figure 4.5, taken from the main CARSEA report has devastated the tourism industry of some islands, and the overall scale of destruction has been exacerbated due to the increased population along the coasts. Rising sea temperatures, meanwhile, have increased the incidence of coral “bleaching”.

**Figure 4.5**



Source: Caribbean Meteorological Institute/CARSEA

River discharge from the Magdalena, Orinoco and Amazon basins can cause significant damage to the marine environment of the Caribbean, through an excess of sediments or contamination resulting from deforestation or pollution in distant regions.

Alien species introductions are thought to have caused ecological damage when marine creatures were carried in the ballast tanks of ships, and even dust particles from the Sahara Desert are implicated in spreading disease organisms to Caribbean reef species.

### **External, Indirect**

*International shipping rules* under the UN Convention on the Law of the Sea (UNCLOS) grant foreign vessels the right of “innocent passage” through Caribbean waters, exposing the ecosystem to extra pressures of pollution, overfishing and even the risk of radioactive contamination from shipments of nuclear material.

The combined impact of these drivers is that the poorest economies and communities of the Caribbean are prone to suffer the consequences of changes to the marine ecosystem, while enjoying few of the benefits that accrue from exploitation of its resources. For example: the least-developed countries and territories are especially vulnerable to the damage caused by more destructive storms; small-scale fishing communities are unable to compete fairly with better-equipped fleets for scarce stocks; local people are sometimes prevented from enjoying coastal resources as space is taken up by “enclave tourism” and other uses benefiting more prosperous sections of society; and lack of coordinated governance prevents more of the profits from tourism from being returned to local economies.

### **Scenarios**

As part of the development of this assessment, four scenarios illustrating possible futures for the Caribbean region up to 2050 were drawn up and analysed. These are not intended as predictions of what will happen, but rather as tools to assess the consequences of certain plausible alternative pathways. Using our knowledge about the drivers of ecosystem change, scenarios can help to map out potential prospects for services such as tourism and fishing, depending on the values and priorities exercised by people inside and outside the Caribbean region in the coming decades.

The “storylines” and outcomes of the scenarios are available in Chapter 5 of the full CARSEA report.

A challenging general message emerges from these scenarios. They suggest that in the short and medium term, there may be little difference in terms of tangible costs and benefits to the population, between approaches which favour greater environmental care and regional co-operation, and those which prioritise unrestricted development and the dominance of international market forces in the Caribbean.

The outcomes only begin to diverge towards the middle part of this century, when continued neglect of ecosystems could start to create such degraded environments that the Caribbean would lose its appeal for many tourists, and fish stocks might start to collapse. It is at this point that alternative scenarios start to reap benefits, for example where a more controlled approach to “niche” tourism (in the scenario *Quality over Quantity*) has produced a sustainable, higher-value industry less susceptible to sudden shocks or surprises.

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The challenge for policymakers is that in order to avoid serious negative consequences for the future, decisions will need to be taken now whose benefits may only be realised well beyond the normal time-cycles of politics.

In other words, the changes required to secure a better long-term future for the Caribbean will require courage and vision. The good news is that these changes will incur no significant costs, and even in the short term will enhance the quality of life of many in the region.

### **The Policy Response -- Options for Change**

In 2002, the United Nations General Assembly passed the latest of three resolutions recognising the importance, uniqueness and vulnerability of the Caribbean Sea, and stressing the need to take an integrated approach to its management. Several states in the region are currently advocating an additional resolution which would declare the Sea a “special zone” in the context of sustainable development.

It is not part of the remit of this assessment to take a position on whether such a resolution is justified or necessary, although the information contained within CARSEA should help to inform the debate on this issue. It is important that the campaign over many years to achieve this status for the Caribbean should be seen as a means to an end, not an end in itself. This assessment has found very little evidence of action to implement the integrated management of the sea mentioned in the existing resolutions.

There has been no shortage of programmes and ad hoc initiatives aimed at addressing particular problems afflicting the marine environment of the Caribbean. Some have had impressive results and can serve as models for future action.

However, these initiatives have been set up and operated by different governments, inter-governmental groups and non-governmental organisations, with little or no coordination between them. They are also frequently directed at a specific sector or activity, and lack an overview of the ways in which programmes may conflict with one another, or produce better results with greater collaboration. As this assessment has shown, the interconnected nature of the ecosystem services of the Caribbean Sea, and of the threats they face, require a much broader outlook.

Among the priorities for improvement of policy must be a better system of managing fisheries in the region, recognising the value of the Sea as a complete ecosystem rather than a series of interlocking national territories; and capturing more of the value of tourism in the region, to be re-invested in measures to protect the natural beauty and diverse cultures without which there would be no tourists.

To address the shortcomings of current management of the Caribbean Sea ecosystem, strong arguments have emerged during the CARSEA process for a new technical

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commission or council, with responsibility for the entire region (ie the Wider Caribbean) to be set up. Its precise title, status and remit are matters for open debate, but some of its essential functions would be:

To monitor and assess the condition of the Caribbean Sea as an ecosystem, and to use that information to inform policy in the region.

To assess the effectiveness of existing programmes at all levels, and to offer advice as to how they may be improved and better coordinated.

To initiate studies on specific policy options available to decision-makers in the region, for example economic policy instruments to enhance the protection of ecosystem functions.

To act as a catalyst to achieve better co-ordination between the disparate institutions whose decisions affect the Caribbean Sea, and to promote greater co-operation with states outside the region, whose activities have an impact on its ecosystem.

To provide continuing analysis of the impacts of policies and programmes, so that the correct lessons can be fed back into better design of future measures.

To avoid adding to the complexity of the existing governance of the Caribbean, it is not suggested that this body should be a new institution, but rather that it should reside within one or other of the existing inter-governmental groups. It is pleasing to note that the Association of Caribbean States (ACS) **has already set up a Commission of the Caribbean Sea** which shares many of the features of the proposal outlined in this assessment.

It is vitally important that any new body which emerges should not become a toothless “talking shop”. By its nature it is likely to be advisory rather than executive, and for the commission or council to address the problems facing the Caribbean Sea and its peoples, decision-makers must be prepared to value and act on its advice – or if they ignore it, to be accountable to the citizens whom they represent.

Better information and more coordinated institutions are an essential first step to a brighter future for the region. Ultimately, however, it will be up to those in positions of responsibility in the Caribbean and beyond to use that information and those institutions, to ensure that the natural wealth of this unique Sea is passed on to future generations.

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## **Brochure Back outside cover**

### **List of credits, ways to get further information, etc.**

The Caribbean Sea Assessment (CARSEA) was led by The University of the West Indies (UWI) and The Cropper Foundation, in collaboration with The Institute of Marine Affairs (IMA), the United Nations Environment Programme Regional Office for Latin America and the Caribbean (UNEP ROLAC), the Caribbean Conservation Association (CCA), and the Caribbean Agricultural Development Research Institute (CARDI).

Over sixty individuals, drawn from about thirty institutions and organizations from the Wider Caribbean Region, contributed voluntarily to the Assessment. The engagement between contributors during the course of the Assessment was the first step towards establishing better collaboration and coordination for joint management of the Caribbean Sea.

A follow-up project to CARSEA, made possible through funding from The International Development Research Center of Canada (IDRC), was jointly initiated by The Cropper Foundation and The University of the West Indies in 2005, to continue work towards better management of the Caribbean Sea with Regional Intergovernmental Bodies - including CARICOM, The Association of Caribbean States (ACS), and the UN Economic Commission for Latin America and the Caribbean (UNECLAC).

CARSEA was undertaken as part of a 5-year global project known as the Millennium Ecosystem Assessment (MA – [www.millenniumassessment.org](http://www.millenniumassessment.org)).

- for explanation of the ways in which the Caribbean Sea and its resources are being affected...
- for analysis of how the well-being of the peoples of the wider-Caribbean will be affected..
- for proposals about how the situation can be improved...

see Report of the Caribbean Sea Assessment, published as a 2006 Special Issue of the Caribbean Marine Studies Journal of the Institute of Marine Affairs.

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