Global Climate Change and Coral Reefs: Implications for People and Reefs

Report of the UN EP-IOC-ASPEI-UCN Global Task Team on the Implications of Climate Change on Coral Reefs

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with contributions from the members of the UNEP-IOC-ASPEI-IUCN Global Task Team on Coral Reefs

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Preface

This publication represents the deliberations of a Global Task Team of experts with experience in coral reef science and management throughout the world. The work of the Task Team was initially supported and funded by the United Nations Environment Programme (UNEP); the Intergovernmental Oceanographic Commission (IOC) of UNESCO and the Association of South Pacific Environmental Institutions (ASPEI) who convened the first meeting of the Task Team in Guam, 27-28 June, 1992. At their subsequent meeting in Miami, 2-4 June, 1993 the expert members and representatives of the co-sponsoring agencies invited IUCN - The World Conservation Union to co-sponsor and support the work of the Task Team.

The initial stimulus for convening of a Global Task Team of experts to examine the potential impacts of climatic changes and sea level rise on the world's coral reefs came from the experiences of various UNEP and IOC sponsored Regional Task Teams established to examine the implications of climate change and sea level rise on the countries participating in the Regional Seas Programme. Several of these Task Teams had experienced difficulties in making appropriate impact assessments, in the absence of good evaluations of the potential response of reef systems to the anticipated changes.

The members of the Task Team and Secretariat are listed in Annex 1. At its first meeting in Guam the Task Team, under the chairmanship of Dr Clive Wilkinson of the Australian Institute of Marine Science (AIMS) was charged with preparing an authoratative assessment of the potential impacts of climatic change and sea level rise on coral reefs. The meeting agreed a workplan and timetable and Drs Buddemeier and Wilkinson agreed to undertake collation and editing of inputs from the Task Team members. A draft report was subsequently prepared by the co-authors and circulated to all members prior to the second meeting in Miami. At this meeting the contents of the draft were reviewed and amended and agreements on the final form and the process of finalizing the report were reached.

This meeting agreed that the conclusions of the report should be presented as an executive summary for policy makers to the World Coast Conference held in the Hague in November 1993. This summary, produced as the booklet "Reefs at Risk", was prepared and published by IUCN on behalf of the co-sponsoring agencies, and represents the non-technical summary of this report.

Preparation of this report would not have been possible without the support of the Kansas Geological Survey and the Australian Institute of Marine Science which provided invaluable infrastructural support and services to the co-authors of this report. In addition the University of Guam and the Rosentiel School of Marine and Atmospheric Sciences provided valuable facilities and logistical support fo rmeetings of the Team. Preparation of the text was completed at the Australian Institute of Marine Science with formatting by Liz Hewlett and Christine Cansfield-Smith, and figure preparation by Steven Clarke of AIMS, and Mark Shoneweis of the Kansas Geological Service, University of Kansas. Daphne Fautin (University of Kansas), and Joanna Ellision and Janice Lough (AIMS) provided valuable technical and editorial revision. This support is gratefully acknowledged as is the support of the co-sponsoring agencies to the work of the Global Task Team.

Executive Summary

The Task

The major theme of this Report is an assessment of the potential and expected effects of global climate change on coral reef ecosystems and the peoples associated with them. This was the task of the UNEP-IOC-ASPEI-IUCN Global Task Team on the Implications of Climate Change on Coral Reefs, which was formed and supported by a cooperative effort of the participating agencies.

The Task Team approached this task with two fundamental objectives:

a. to prepare a global overview on the potential impacts of climate change and sea level rise on coral reefs and the implications of such impacts for ecologically sustainable use of coral reefs. The overview will be based on the best available knowledge and insight into the problems relevant to its subject;

b. to identify selected case study sites using the best available knowledge on coral reefs for specific sites.

The ultimate objective of the Task Team is to assist governments in the identification and implementation of suitable policy options to mitigate the negative consequences of the impacts on coral reefs and the associated socio-economic structures.

The Process

The Task Team met on two occasions to prepare this Report. In Guam (June 1992), the Task Team determined the major themes and structure of the report, and then in Miami (June 1993), they reviewed a substantial draft prepared by the compiling authors and suggested additional sections and material. The Report was completed as a collaborative effort by the authors, with additional editorial help, and then published by the IUCN in Switzerland.

The Report

After a general Introduction (Chapter 1), the Report covers how coral reef ecosystems interact with their environment, emphasizing potential impacts of global climate change (Chapter 2). Then follows discussions of how humans currently use coral reefs and the consequences of that use (Chapter 3), and what is climate and climate change (Chapter 4).

The predicted effects of climate change on human use of reefs and consequences of inaction (Chapter 5) are followed by the management and policy requirements to implement sustainable use and preservation of reefs (Chapter 6). A final section (Chapter 7) presents the Report's conclusions, and these are summarized below.

The Findings

Coral reefs are being seriously and increasingly stressed by exploitation and anthropogenic environmental changes, such as sedimentation, nutrient loading and pollution, physical destruction, and overfishing. These effects are distinct from, and unrelated to, climate change.

The coral reef ecosystem has evolved through massive climate changes in the past and could be expected to survive further climate change (although some of the changes will disadvantage those humans dependent on reefs as they are now). The current scenarios for climate change by the IPCC (Intergovernmental Panel on Climate Change) are less extreme than past changes experienced by reefs during geological time. But, the combination of the current changing climate and the additional, and steadily increasing stresses from growing populations, and economic and coastal development, may prove to be a lethal synergy.

Some reef communities have proved to be resilient to chronic or acute stress, but the persistence of some acute human stresses has resulted in system collapses. For example, corals have been replaced by more competitive, and less desirable, communities such as algal-dominated ecosystems, when damaged by a combination of acute and chronic stress. Climate change threatens to augment the acute stress (typically as more and greater storms or more high-temperature episodes) and some chronic stresses (such as changing oceanic acidity due to atmospheric $C0_2$ uptake) and add these to the chronic stresses already imposed by nutrient loading, over-exploitation etc.

Human dependence on reefs for food, materials, and income (tourism or exports) is high and growing. The threat posed by rising sea levels is a special case for the inhabitants of low coral reef islands and coastal plains, since human use and habitation of reef islands and structures may become impossible, even though the surrounding reefs are unaffected and remain healthy. If some reefs are also damaged through climate change, then destruction of islands and shorelines will be more rapid and devastating. The world's coral reefs constitute a great economic resource, but they are also of great biological, cultural, and aesthetic value and all of these values are increasingly at risk.

Our major finding is that human pressures pose afar greater immediate threat to coral reefs than climate change, which may only threaten reefs in the distant future. The essential first step to preserve reef ecosystems and protect the human communities that depend on them, is to eliminate or mitigate the present anthropogenic threats to reefs so that they may retain their natural ability to accommodate to global environmental change. At a fundamental level, this involves confronting the underlying problems of ever-expanding human populations, unsustainable exploitation and the increasing discharge of contaminants (including the green-house gases that drive climate change) into the environment. More immediate attention, however, should be focussed on obtaining an increased understanding of reef ecosystems and improving their protection and management.