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UNIVERSITÉ DE GENÈVE

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sciences naturelles de
l'environnement

International Conference

**The impact of
global
environmental
problems on
continental and
coastal marine
waters**

Abstracts and presentations
Geneva, 16-18 July 2003

CORAL REEFS: AN ECOSYSTEM UNDER GLOBAL STRESS

Arthur Lyon DAHL

International Environment Forum, Switzerland

Recent reviews of the state of coral reefs have documented widespread degradation, linked not only to local pressures but also to high water temperatures probably related to global warming. Corals are also directly sensitive to rising carbon dioxide levels. Sea level rise and increasing storm damage will also affect reefs. Biological disturbances of reef ecosystems have a global component including invasive species and epidemic diseases. Global trade in corals and live fish are further pressures. While coral reefs have inherent resilience, the balance between degradation and recovery under global pressures is uncertain. Management responses include a strategy for improved coral reef monitoring and the International Coral Reef Action Network.

Presented at the Int. Conf. "The impact of global environmental problems on continental and coastal marine waters", Geneva 16-18 July 2003

Coral Reefs: an ecosystem under global stress

Arthur Lyon Dahl
International Environment Forum
and Senior Adviser, UNEP
17 July 2003

Coral reefs



- Ancient highly-evolved ecosystem of global significance
- More than 20 million years old
- High biodiversity and productivity
- Many developing countries dependent on reef resources



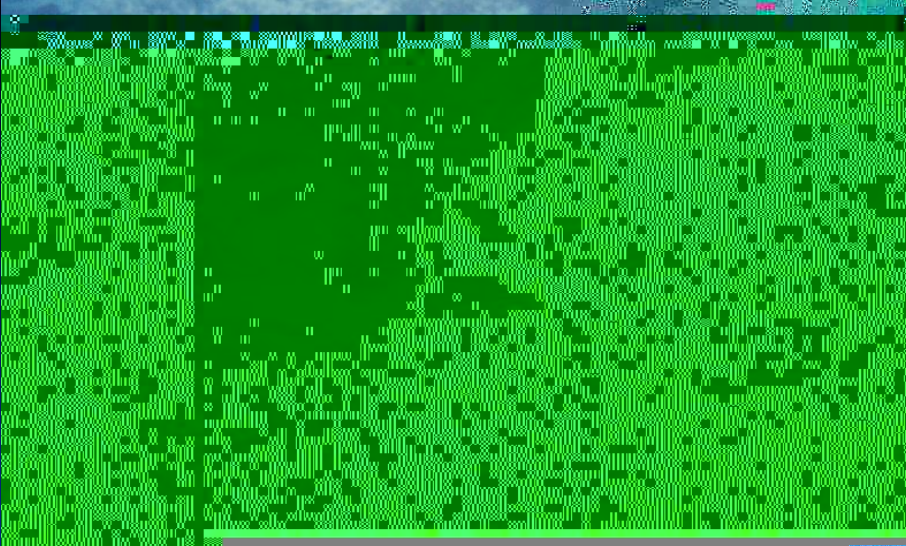
Coral reefs line many tropical coasts

- The world's largest structures built by biological activity
- Visible from space
- Thickness: + 1 km of biological skeletons
- 500 million people live within 100 km of reefs



High reef biodiversity

400 corals, 4000 molluscs, 1500 fish just on the Great Barrier Reef



Millions depend on coral reefs

Reefs provide food and livelihood for many poor coastal inhabitants of tropical developing countries

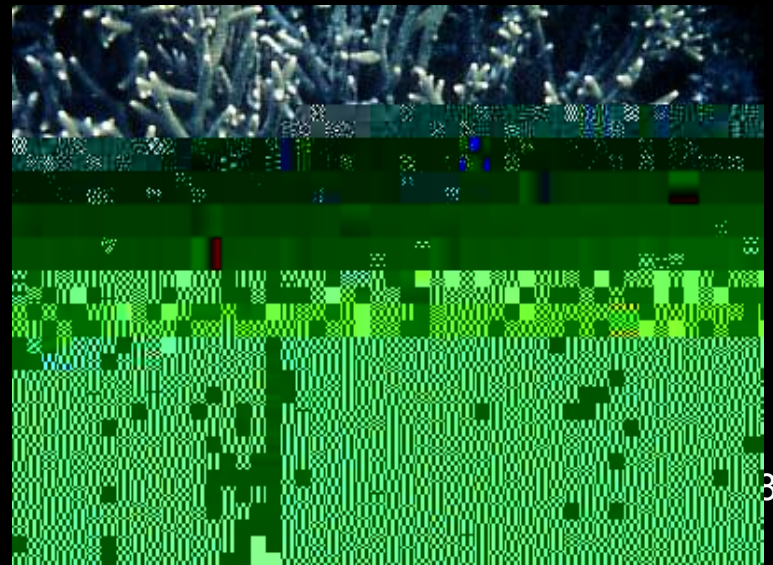


Reef construction: a delicately-balanced process

- Corals



- Algae



Coral reef vulnerability

- Dynamic and resilient within limits
- Carefully balanced ecosystems
- Now subject to local and global stresses
- Accumulating interactions between stresses are particularly damaging
- Increasing frequency of stresses does not give reef time to recover
- Reef ecosystems are integrated and linked over local and regional scales through exchanges and larval transport

LOCAL IMPACTS: Over fishing



Removing top predators or major herbivores upsets the reef balance
Fishing with dynamite, cyanide or iron bars destroys the reef

Impacts from terrestrial runoff

- ❑ Land-based sources of sediment smother reefs
- ❑ Polluted runoff from cities and agriculture causes eutrophication

Tourism impacts



Tourists can directly damage corals, remove important species, and cause pollution

Other local impacts on coral reefs put them under additional stress

- Transport, fuel spills, anti-fouling compounds
- Construction, land reclamation
- Materials extraction, coral mining, sand dredging
- Recreation, reef walking
- Anchor damage, ship groundings

Coral reefs are the first major ecosystem type to show global impacts

Reefs around the world are in rapid decline



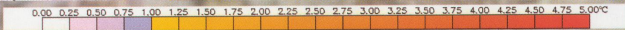
In the Caribbean, a new study shows an average decline in coral cover of 80% (from 50% to 10%) over the last 3 decades
(Toby Gardner, *Science*, in press)



Satellite Annual Coral Bleaching HotSpot Charts (1985 - 2000)

Satellite retrospective annual composite monthly mean coral bleaching "HotSpot" charts document the spatial distribution, pattern and magnitude of the thermal stresses that may have contributed to coral bleaching in the past. A coral bleaching HotSpot is defined as the sea surface temperature (SST) anomaly, above a "static" coral bleaching threshold SST climatology. These HotSpot charts were derived from the NOAA/NASA 9-km satellite AVHRR (Advanced Very High Resolution Radiometer) Oceans Pathfinder SST dataset, the most refined available. HotSpot charts are proving to be highly successful in detecting coral bleaching over large spatial scales.

Incidences of coral bleaching were influenced by unprecedented SST anomalies during 1998, due to a severe El Niño event as shown by the HotSpot chart (see below). This bleaching event was the most extensive in the modern record.



http://orbit-net.nesdis.noaa.gov/orad/coral_bleaching_index.html

Effects of global warming

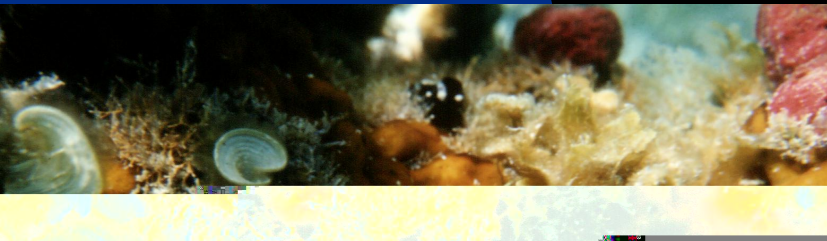
- Hot spots of warm water build in coral reef areas
- If they last too long, the corals bleach and may die



If the corals die, algae take over

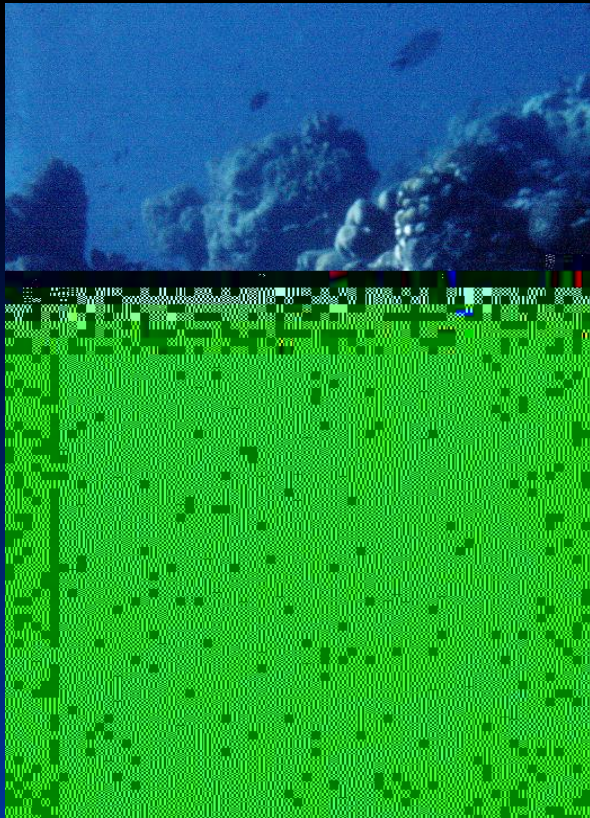


Many reefs have shifted from coral to algal dominance, and it seems difficult to get them to shift back again



Corals are directly vulnerable to rising CO₂

Dissolved carbon dioxide changes water chemistry and makes calcification more difficult



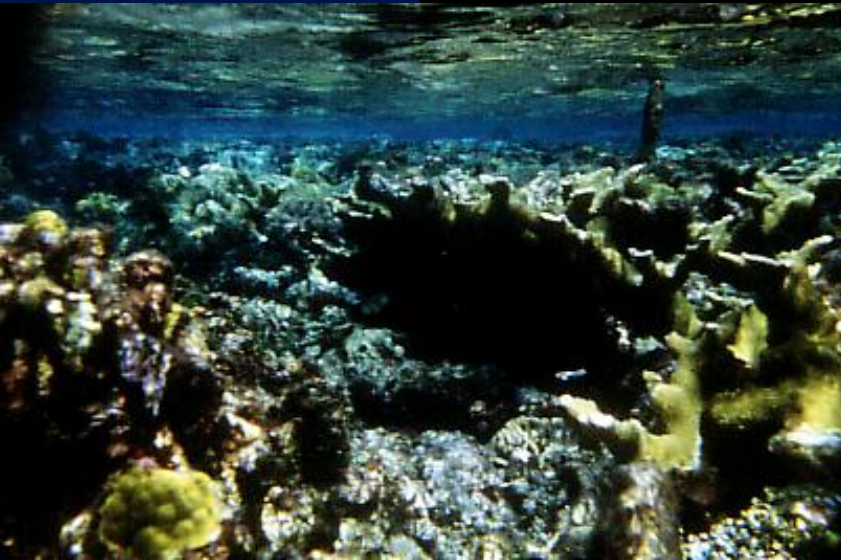
Reefs are impacted by increasing storms

Corals are smashed, sediment shifted, and the rubble piled up as islands



Rising sea levels threaten reefs

They will keep up, catch up or drown,
depending on the rate of rise



Other global impacts

- Epidemic diseases
- Invasive species
- Global trade in corals, live fish



Response strategy

Reduction of local stresses with human causes that can be managed in order to maintain reef resilience in the face of global pressures



Carrie Bow Cay, Belize, Research Station of the Smithsonian Institution

Global coral reef action



- International Coral Reef Action Network (ICRAN): demonstration and target sites
- Coral Reef Fund
- UNEP Coral Reef Unit to coordinate international action
- ReefBase coral reef information system at WorldFish Center
- Major NGO programmes
- Marine protected areas
- World Heritage and Ramsar sites

Assessment of coral reefs

- Global Coral Reef Monitoring Network (*Status of Coral Reefs of the World*)
- Reef Check volunteer assessment
- WRI *Reefs at Risk* series
- UNEP WCMC *World Atlas of Coral Reefs*



Monitoring

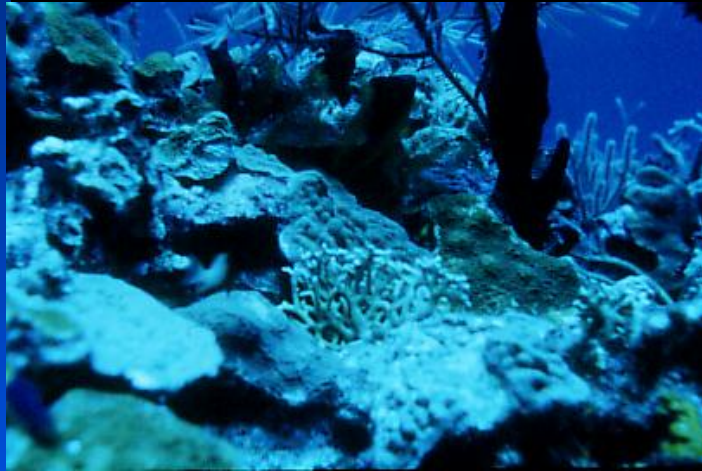
The Integrated Global Observing Strategy (IGOS) Partnership has recently adopted a Coral Reef Sub-theme report with a strategy to improve Coral Reef observations and monitoring from satellites and *in situ*

Remediation

Projects for reef restoration are underway in Florida, Fiji, etc.

Research

World Bank targetted research programme



The Future for coral reefs?

- Dawn of reef sustainability?
- Sunset on a wasted heritage?

