# THE ROLE OF SCIENCE IN MARINE ENVIRONMENT PROTECTION

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1. *Why science?*
2. *Why is marine environment protection challenging?*
3. *What are the main degradation issues?*
4. *How effective is regional cooperation?*

# 1. WHY SCIENCE?

# COASTAL DEVELOPMENT

Coastal road (Cha-am, Thailand)

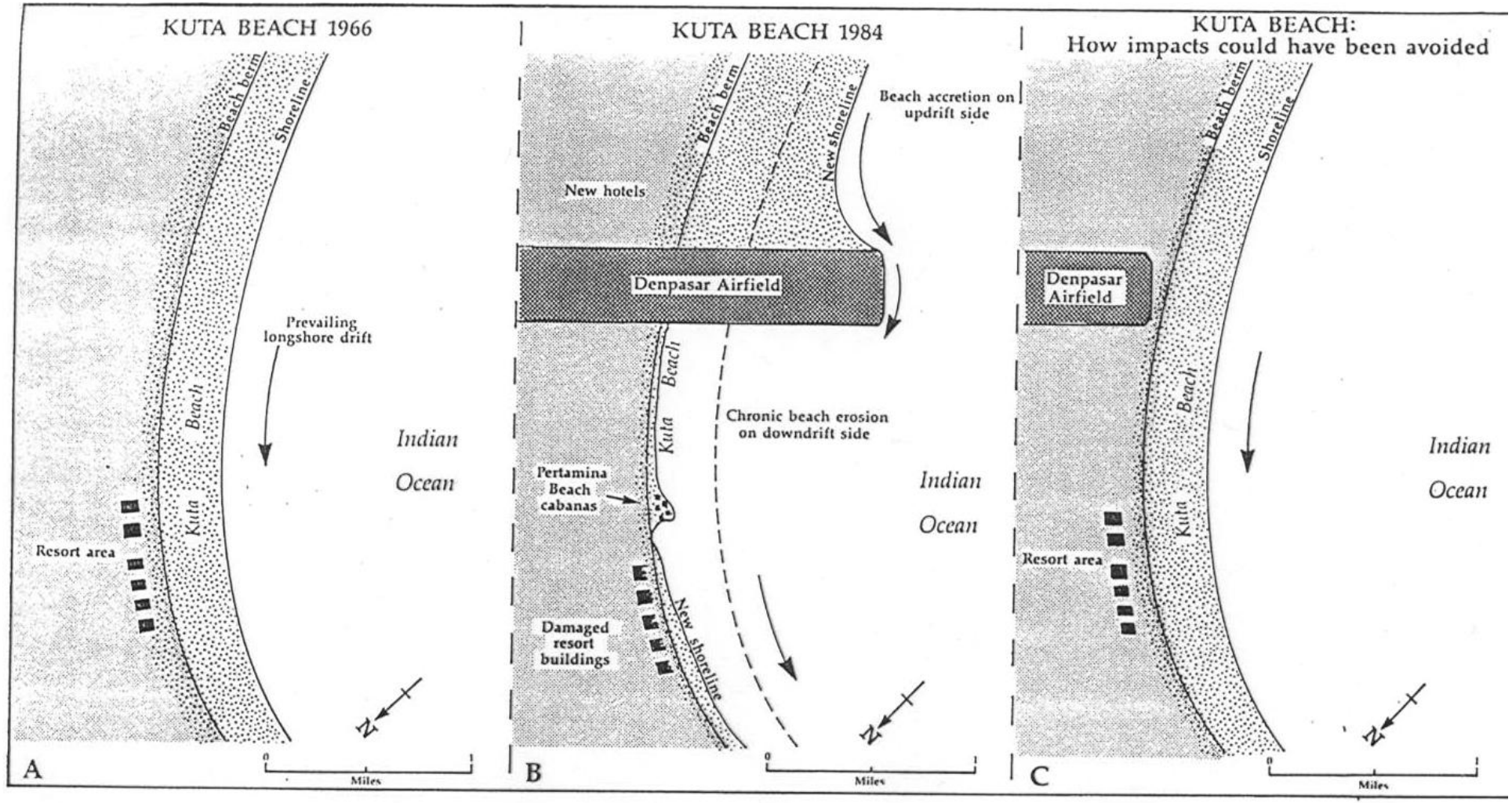
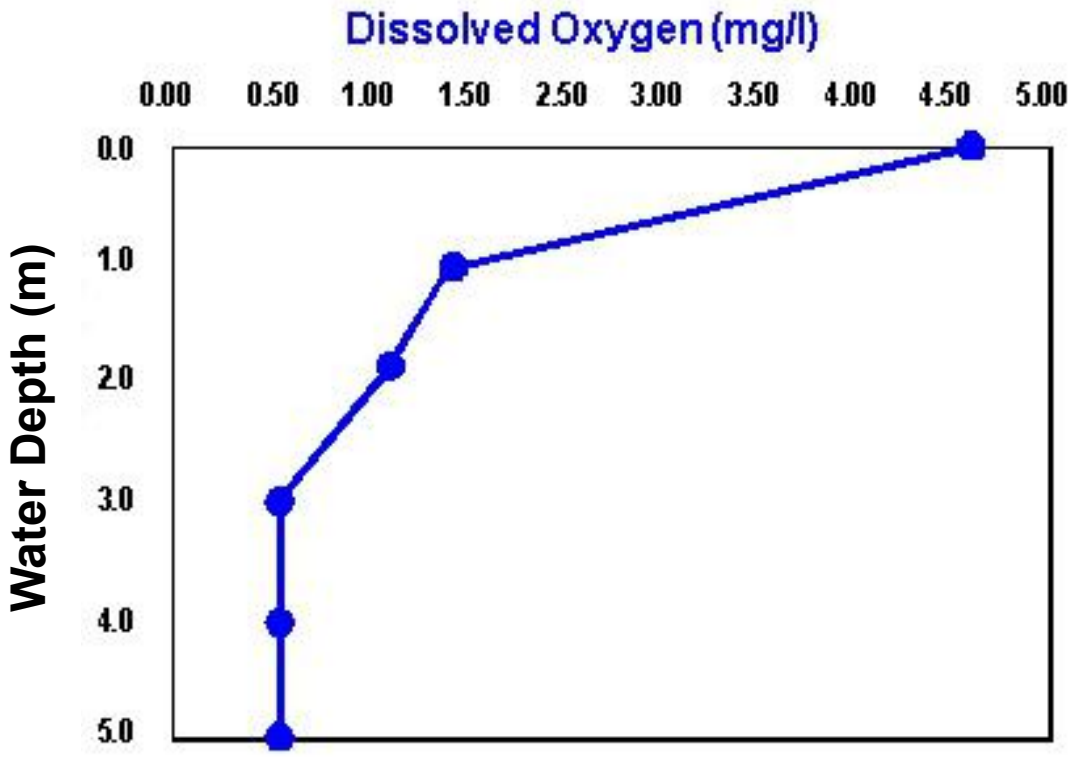



Figure IV.21. Adverse effects of coastal airfield construction near Kuta Beach, Bali Island, Indonesia. Before 1967, Kuta was Bali's largest resort and beach area. In 1967, the new Denpasar airfield was constructed, projecting 3,000 ft offshore beyond the beach. Since that time the beach has eroded more than 1,000 ft on the downstream-side of the airfield. Uninformed officials blamed the erosion on traditional coral mining activities but, in fact, the airfield acted as a huge groin blocking beach replenishment and causing the erosion. While restaurants and hotels fall into the water on the eroding side of the airfield, entrepreneurs construct new resorts on the accreting side. The airfield should have been moved landward of the beach dunes and berm to avoid beach erosion caused by the airfield projecting offshore. In turn, damage to the beach and structures and the need for shore protection could have been avoided (After Burbridge and Maragos 1985).

## Fish kill - 1000 tonnes

### Dissolved Oxygen in the South Harbour of Maluanwan Bay, Xiamen, China




Note: As shown in the figure, the DO level in the South Harbour where significant fish kills occurred ranged from approximately 0.5 to 1.5 mg/l, at water depths from 1 and 5 m. Caged fish cannot survive at these oxygen levels. The national DO standard is set at >5 mg/l.

Science - useful in helping to define management issues. Identifies causes with greater certainty.

Objectivity removes misconceptions and prejudices, exposing real causes.

# SCIENCE → ENVIRONMENTAL PROTECTION

## *ENVIRONMENTAL CONCERNS*

- oil/chemical spills
- TBT contamination
- harmful algal blooms
- nutrient loading
- fecal coliform
- heavy metal contamination
- sedimentation
- erosion
- overexploitation
- critical habitat destruction
- viral diseases
- endocrine disruptors
- microplastics
- climate change impacts

## *IMPACTS*

- ecosystem
- individual
- society

oil-contaminated mangroves

AGENDA 21 CHAPTER 35

SCIENCE FOR SUSTAINABLE DEVELOPMENT

A. *Strengthening the scientific basis for sustainable management*

B. *Enhancing scientific understanding*

C. *Improving long-term scientific assessment*

D. *Building up scientific capacity and capability*

# 2. WHY IS MARINE ENVIRONMENT PROTECTION SO CHALLENGING?

Seas and oceans perceived to -

- support **inexhaustible supply of food and materials**.
- be a **massive absorber of pollutants/impacts**.

Impacts exacerbated by:

- “out of sight, out of mind” mentality

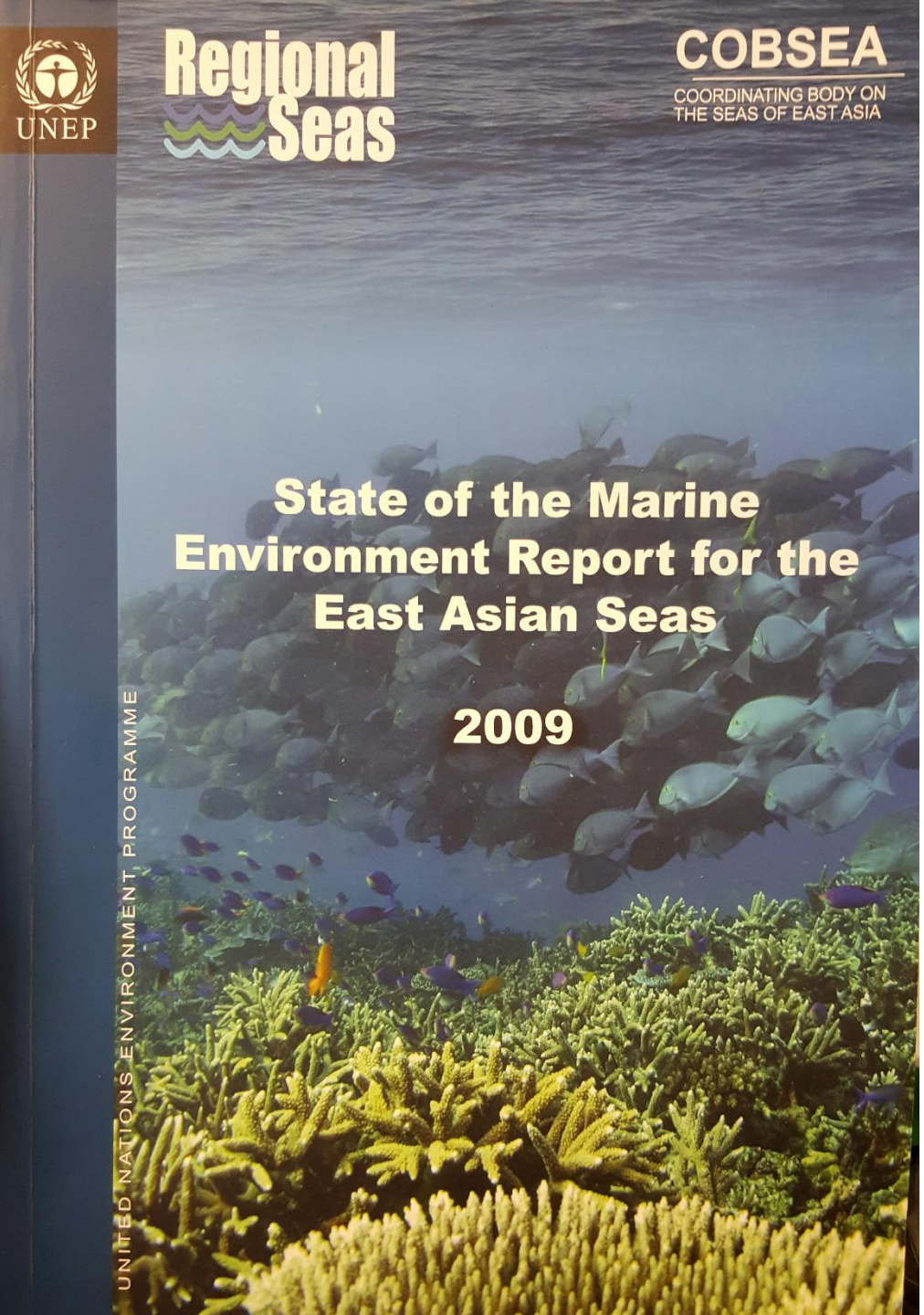
- open access, common property - “tragedy of the commons”
  (Hardin G.1968. The tragedy of the commons. Science 162: 1243-1248).

Oceans are a downstream environment.

Materials including pollutants generated on land or released into atmosphere eventually enter the sea.

| PROPERTY | MANAGEMENT IMPLICATION |
| --- | --- |
| Open and inter-connected | Species cross national boundaries easily. Long larval dispersal distance, goes beyond management boundaries. Need trans-boundary management, international agreements/instruments. |
| Extensive. | Costly. Measures for open oceans largely ineffective. |
| Three dimensional. | Processes involve depth; present management confined to top layer with little understanding of impact on entire system (*2D management of 3D environment*). Expensive to study deep ocean. |
| Primary producers patchier spatially and temporally. | Affects distribution of consumers. |
| Downstream environment. | Receives anything from land and air. |
| Nutrient/pollutant trap. | Nutrients/pollutants accumulate throughout water column – surface to deep sea bottom. |

# 3. WHAT ARE THE MAIN DEGRADATION ISSUES?




- presents current status and projected trends for the coastal/marine environment.
- identifies emerging coastal and marine environmental issues.
- analyses ongoing management initiatives at national and regional levels.
- synthesises case studies (e.g. economic valuation), best practices, and effective management measures to address current and emerging coastal and marine environmental concerns.

Trends based on information over 25-year period between 1981 and 2006 with new information up to 2009 included.

Incorporates findings/recommendations of other recent regional reports:
Sustainable Development Strategy for the Seas of East Asia (PEMSEA, 2003)
Third ASEAN State of the Environment Report 2006 (ASEAN, 2006)
Strategic Action Programme for the South China Sea (UNEP, 2008)
Regional Plan of Actions of the Coral Triangle - Coral Triangle Declaration (May 2009).

**TRENDS**

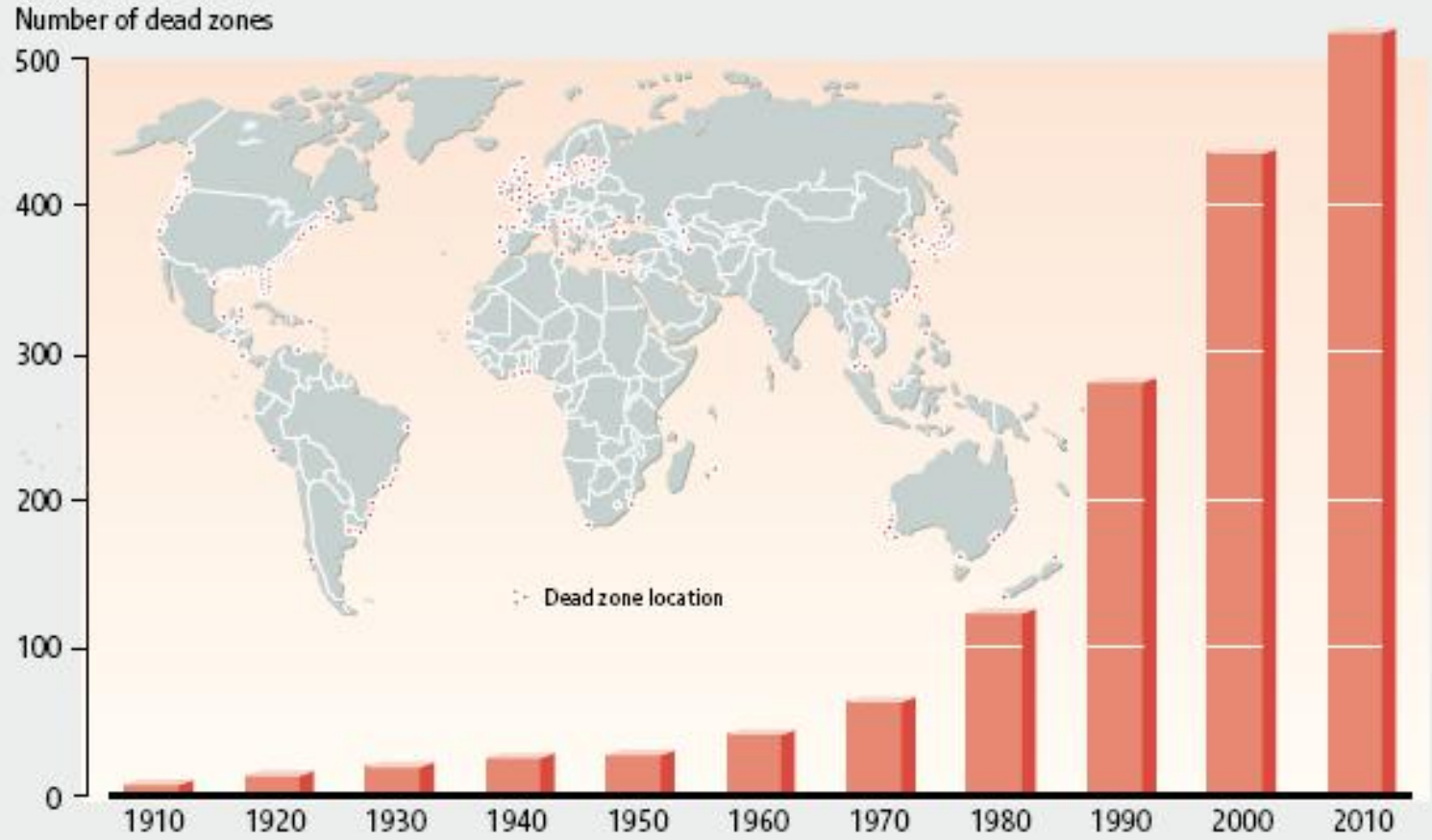
Climate-related hazards impose substantial socio-economic burden. Cost of direct damage by tropical cyclones and flood-related damages increased sharply in recent decades.

Steady decline in quality of region's marine and coastal waters (from oil spills and contaminants from shipping, sewage, other domestic wastes, industrial effluents, and urban and agricultural runoff). Most serious is rising levels of nutrients from land-based sources leading to increased risk of harmful algal blooms (HABs).

Suspended solids in Asia's rivers quadrupled since late 1970s.

Two-thirds of the world's total sediment transport to oceans occur in Southeast Asia.

**FIGURE 15 Marine "dead zones"**




The number of observed "dead zones", coastal sea areas where water oxygen levels have dropped too low to support most marine life, has roughly doubled each decade since the 1960s. Many are concentrated near the estuaries of major rivers, and result from the buildup of nutrients, largely carried from inland agricultural areas where fertilizers are washed into watercourses. The nutrients promote the growth of algae that die and decompose on the seabed, depleting the water of oxygen and threatening fisheries, livelihoods and tourism.

Source: Updated from Diaz and Rosenberg (2008). Science

Source – Global Environment Outlook 3.

Healthy ecosystems generate exploitable levels of ecosystem services.

# ECOLOGICAL CARRYING CAPACITY

*COLLAPSE OF ECOLOGICAL INTEGRITY*

| | |
|---|---|
| BORACAY | 2018 |
| MAYA BAY, PHI PHI | 2018 |
| PATTAYA | 1980 |

## OUTLOOK

- Capacity to deal with issues differs widely across region because of varying socio-economic situations.
- Capacity building urgent for countries facing enormous pressures.
- State of the marine environment differs among countries because of varying pressures.
- Capacity development and transfer needed to strengthen region's capability to address common goal of improved sustainability of coastal and marine environment.

# 4. HOW EFFECTIVE IS REGIONAL COOPERATION?

# REGIONAL COLLABORATION

Some examples:

ASEAN-Australia Living Coastal Resources Project

ASEAN-USAID Coastal Resources Management

UNEP – COBSEA

PEMSEA

- Scientific capacity strengthened.
- Increased understanding of ecosystem services.
- Greater acknowledgement of science-based policy formulation.

Example of regional cooperation on long-term monitoring (reef monitoring network).

**ASEAN-Australia Living Coastal Resources Project** (1987-1994) – Indonesia, Malaysia, Philippines, Singapore, Thailand.

Common survey methodology adopted to support:

- temporal and spatial comparison
- identification of trends locally and across region.

## GLOBAL CORAL REEF MONITORING NETWORK (GCRMN) - 1996

Objectives:

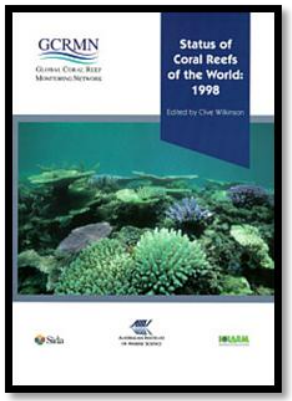
1. to collect information on state of coral reefs
2. to raise awareness about reef conservation

Two regional nodes (Northeast Asia and Southeast Asia) represented in East Asia.

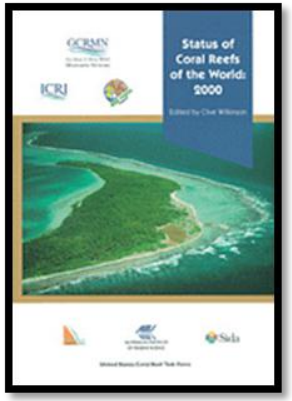
Supported by Japan's Ministry of the Environment and Japan Wildlife Research Center.

GCRMN East Asia node remained an informal network contributing to reef status reports since 1998.

Status of Coral Reefs of the World

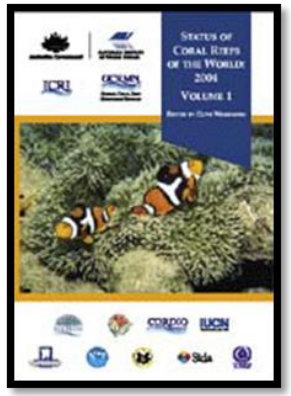


1998



2000

2002



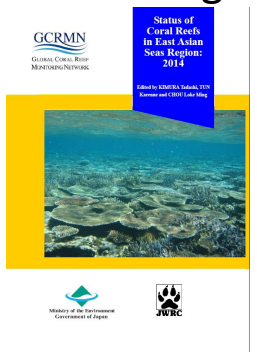
2004

2008

Status of Coral Reefs in East Asian Seas Region

2004

2010



2014

Reports provide summary of coral reef condition in each country.

Showed how reefs responded to anthropogenic and natural impacts.

Indication of slowdown of degradation in response to management.

But emerging impacts –

- tsunami (Status of Coral Reefs in the East Asian Region:2004)
- mass bleaching (Status of Coral Reefs in the East Asian Region: 2010)
- migration to higher latitude (Status of Coral Reefs in the East Asian Region: 2010, 2014)

# CONCLUSIONS

1. Science has an important role in marine environment protection (long-term monitoring, integrated data management system, predictive capability).
2. Properties of marine environment make protection challenging.
3. Numerous impacts including emerging ones.
4. Regional collaboration indispensable.