

# M1.4 EAF approach and MPAs

**Assessing the status of fish stock for  
management: the collection and use of basic  
fisheries data and statistics**

27 November -8 December 2006,

**University of the South Pacific,  
Suva, Fiji Islands**

# Ecosystem Approach to Fisheries



# World Summit on Sustainable Development 2002

- Oceans, seas, islands and coastal areas form an **integrated** and essential component of the Earth's **ecosystem** and are critical for global food security and for sustaining economic prosperity and the well-being of many national economies, particularly in developing countries. Ensuring the **sustainable development** of the oceans requires effective coordination and cooperation, including at the global and regional levels, between relevant bodies, and actions at all levels to:
- Encourage the application by **2010** of the **ecosystem approach**, noting the Reykjavik Declaration on **Responsible Fisheries** in the Marine Ecosystem and decision 5/6 of the Conference of Parties to the **Convention on Biological Diversity**

# The Ecosystem Approach to Fisheries

## The ecosystem approach to fisheries

Issues, terminology, principles, institutional foundations, implementation and outlook



FAO  
FISHERIES  
TECHNICAL  
PAPER

443



*“an ecosystem approach to fisheries strives to balance diverse **societal objectives**, by taking account of the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an **integrated approach** to fisheries within ecologically meaningful boundaries”* ?

FAO 2003

# Ecosystem Approach - CBD



- The Ecosystem Approach is a strategy for the **integrated management** of land, water and living resources that promotes **conservation and sustainable use in an equitable way**. Thus the application of the ecosystem approach will help reach a balance of the three objectives of the Convention of Biological Diversity

# What is an ecosystem?

CBD, article 2:



- “**Ecosystem**’ means a **dynamic complex** of plant, animal and micro-organism communities and their non-living environment interacting as a **functional unit**” ?
- CBD recognizes that **humans**, with their cultural diversity, are an **integral component** of most ecosystems.

# History of EAF



## UNCLOS

UN Convention on the Law of the Sea

UN Fish Stock Agreement

UNICPOLOS

## UNCED

UN Conference on the Human Environment

Jakarta Mandate

UN Conference on Environment and Development

Malawi Principles

WSSD

- Rio Declaration
- CBD
- Agenda 21 (Chapter 17)

## FAO

Cancùn Declaration

Code of Conduct for Responsible Fisheries

Reykjavik Declaration

*Ecosystem Approach to Fisheries*

# Principles

- **None** of the principles behind the EAF are **new**. They can all be traced in earlier instruments, agreements, declarations.
- But **implementation** of these principles **lags behind** in relation to their formulation in agreed international instruments.
- The EAF highlights and reorganizes the principles of **sustainable development** but operational guidelines are fuzzy.

# CBD Operational guidelines



- Focus on **functional relationships** and processes within ecosystems
- Enhance **benefit sharing**
- Use **adaptive management** practices
- Carry out management actions at the appropriate scale, **decentralized** to lowest appropriate level
- Ensure inter-sectoral **cooperation**

Ecosystem interactions are complex

Social interactions are complex

Climate and environmental drivers

Scientists

Public

Other stakeholders

Other ecosystems

Nutrient inputs or pollution

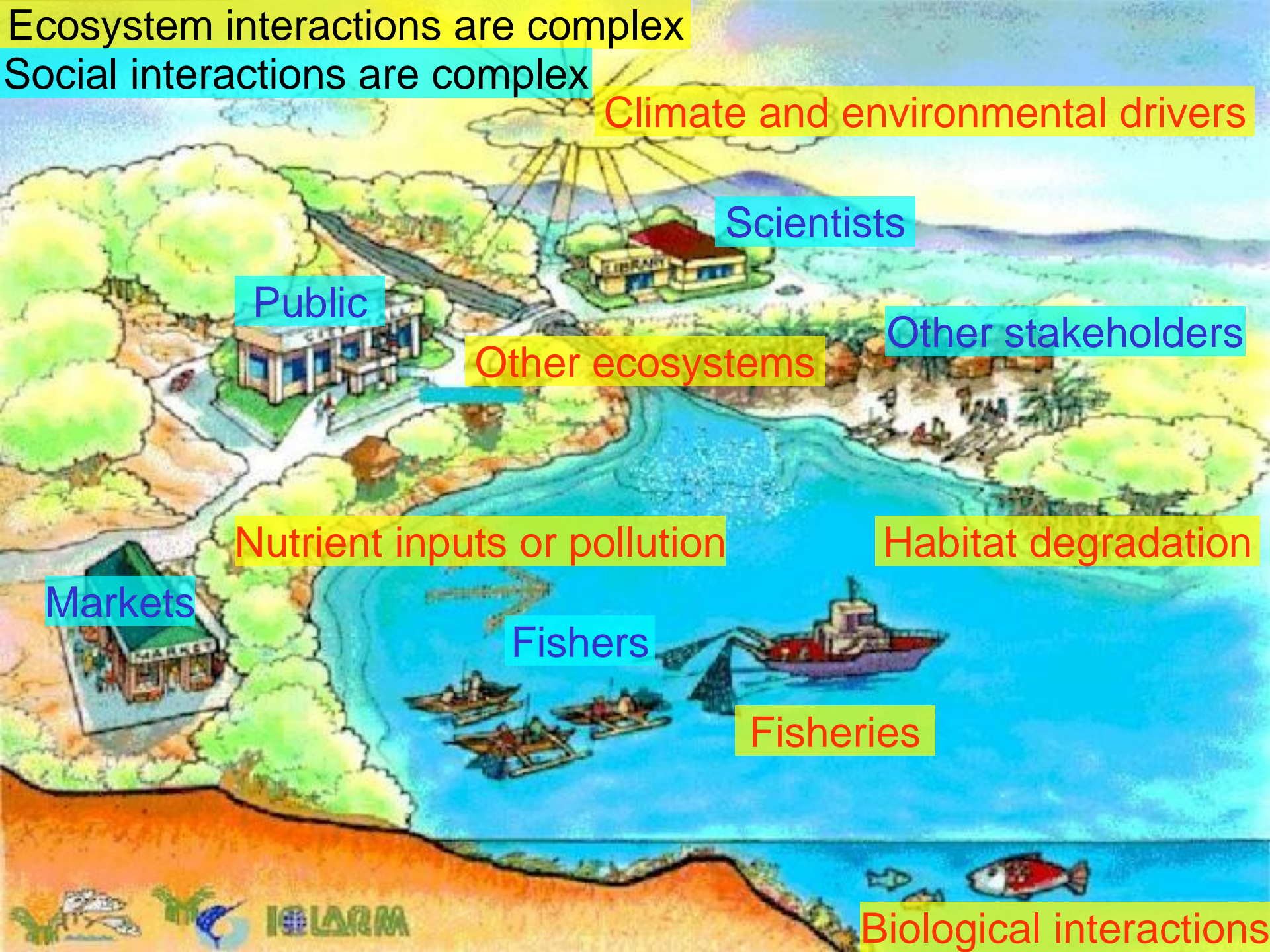
Habitat degradation

Markets

Fishers

Fisheries

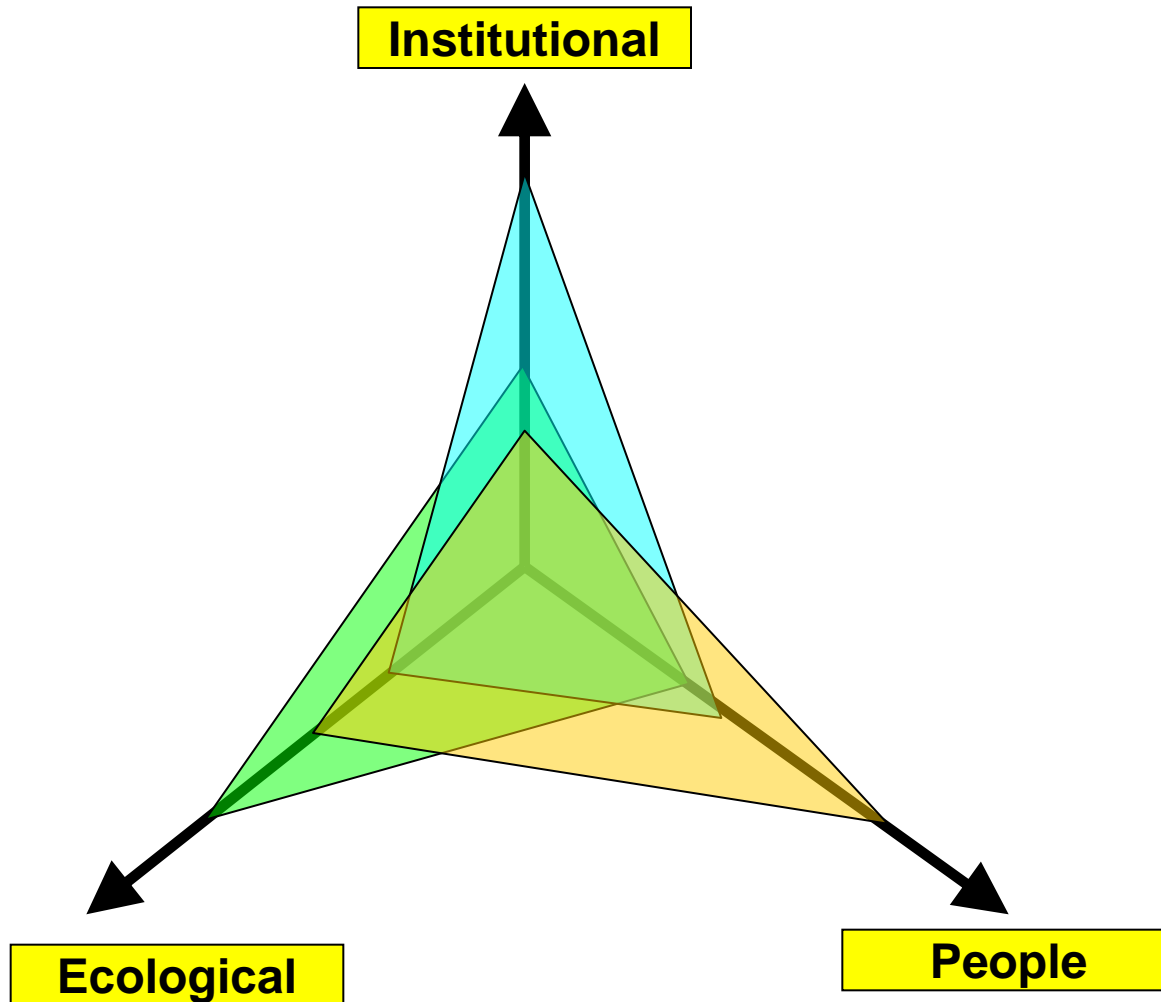
Biological interactions



# Many approaches are proposed in the context of sustainable development for aquatic ecosystems

- Ecosystem-based fisheries management (EBFM)
- Ecosystem-based management (EBM)
- Ecosystem approach (EA)
- Ecosystem approach to fisheries (EAF)
- Integrated coastal zone (or area) management (ICZM, ICAM)
- Integrated ocean management (IOM)
- Community-based fisheries management (co-management)
- Large Marine Ecosystems (LME)
- Territorial user rights for fisheries (TURFS)
- Marine protected areas (MPAs)
- Sustainable Livelihood Approach (SLA)

# With different angles...



**Integrated approach:**

Different approaches have different emphasis.

**Societal objectives:**

The relevance of different approaches depends on the objectives

# FAO and EAF

## Technical guidelines

- 1995: Precautionary approach
- 1996: Integration of fisheries in ICAM
- 1996: Fishing operations
- 1997: Fisheries management
- 1997: Aquaculture development
- 1997: Inland fisheries
- 1999: Indicators of sustainability
- 2000: Sharks management
- 2003: Ecosystem approach to fisheries
- 2005: Ecolabelling
- 2006: Marine Protected Areas (in prep.)
- 2007: Ecosystem Approach to Aquaculture (in Prep.)
- 2007: Aquaculture risk assessment (in Prep.)



# 12 CBD principles

## Principle 1

- The objectives of management of land, water and living resources are a matter of **societal choice**

## Principle 2

- Management should be decentralized to the lowest appropriated level

## Principle 3

- Ecosystem managers should consider the effects (actual and potential) of their activities on adjacent and other ecosystems



# 12 CBD principles..

## Principle 4

- There is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should:
  - a) Reduce those market distortions that adversely affect biological diversity;
  - b) Align incentives to promote biodiversity conservation and sustainable use;
  - c) Internalize costs and benefits in the given ecosystem to the extent feasible

## Principle 5

- Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach

## Principle 6

- Ecosystems must be managed within the limits of their functioning



# 12 CBD principles..

## Principle 7

- The ecosystem approach should be undertaken at the appropriate spatial and temporal scales

## Principle 8

- Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term

## Principle 9

- Management must recognize that **change is inevitable**



# 12 CBD principles..

## Principle 10

- The ecosystem approach should seek the appropriate balance between, and integration of, **conservation** and **use** of biological diversity

## Principle 11

- The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices

## Principle 12

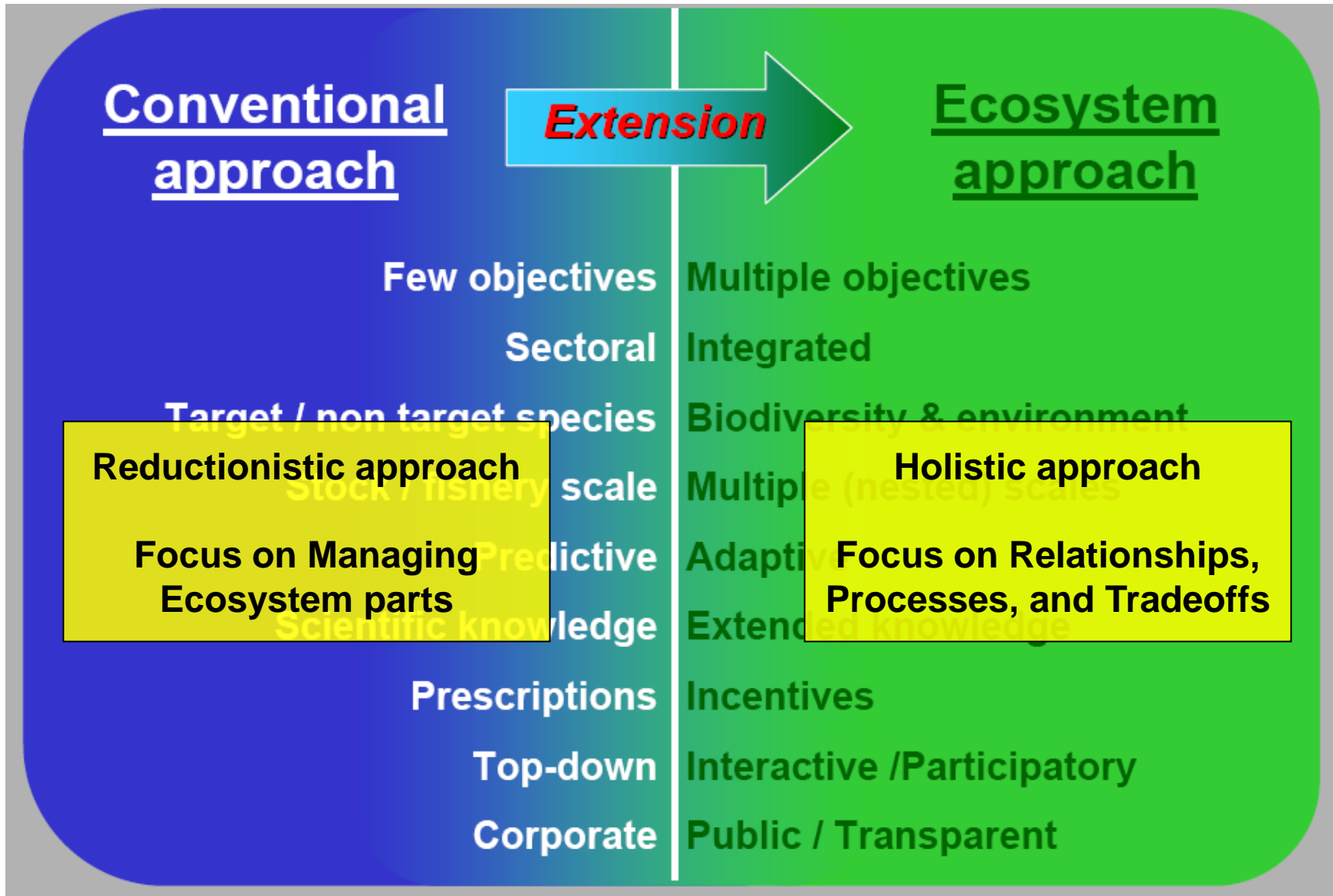
- The ecosystem approach should involve all relevant sectors of society and scientific disciplines

# Integrated approach..

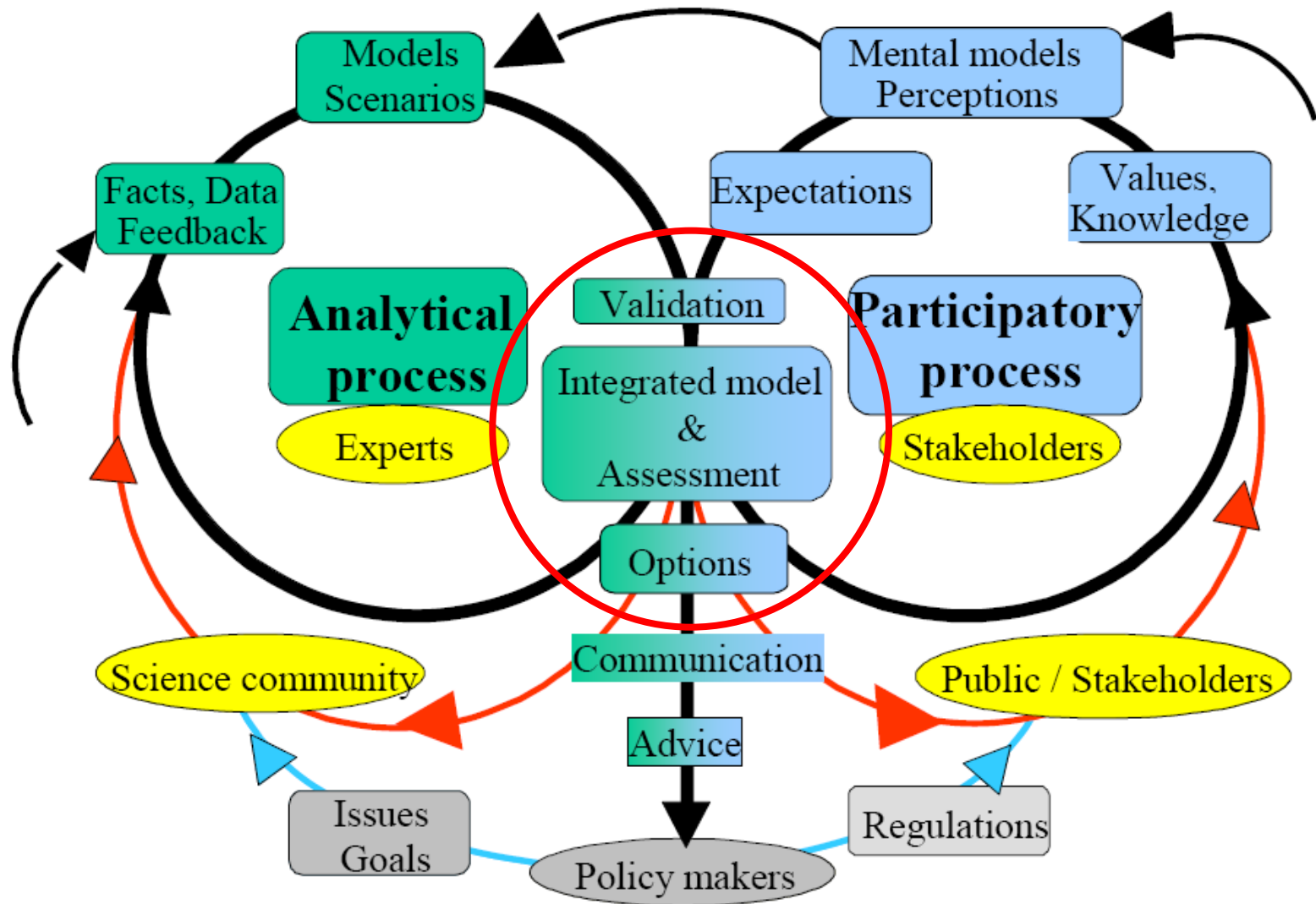
## **Integration is needed between:**

- Science and policy
- Policy and society
- Disciplines
- Forms of knowledge
- Quantitative and qualitative analyses
- Facts, values and perceptions

# The extension paradigm



# Integrated advisory process

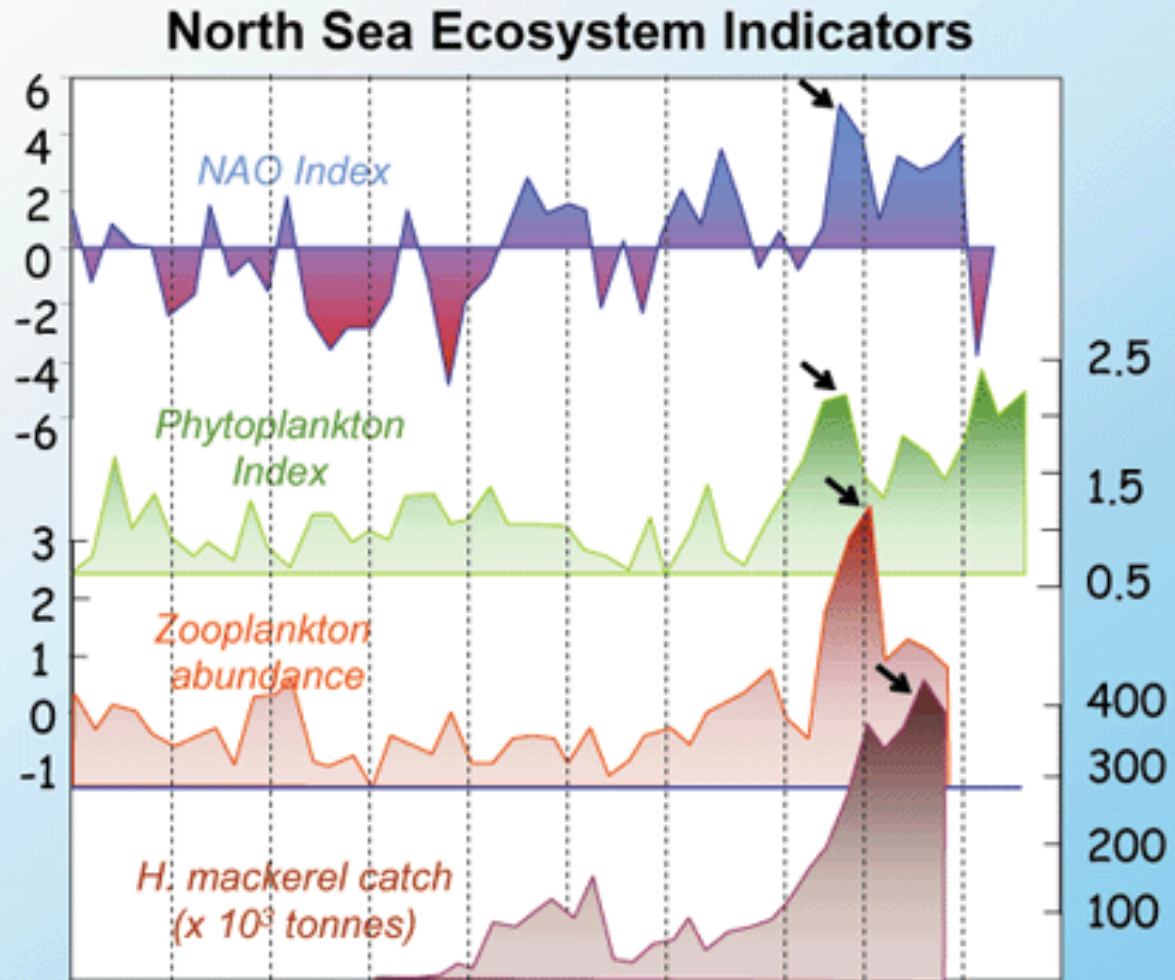


# What is an “Integrated Ecosystem Assessment”?

- **Compile and archive** all relevant data sets for a defined ecosystem
- Report on current conditions and trends in relevant **time series** of physical, biological and human use information
- **Synthesize time series** information to link important ecological responses to changes in climate and human use drivers,
- Evaluate data time series to provide suites of **key indicators** of ecosystem state (status), and propose **reference levels** for the desired state of marine ecosystems
- Forecast the **relationship between state indicators and pressure indicators** (e.g., pollution, climate change, fishing-related removals, coastal development, etc.)
- Provide **periodic ecosystem assessment** updates to inform the managers, stakeholders and the public on the state of marine ecosystems

# Integrated Ecosystem Assessment

Physical, Biological and Social Components combined



Holliday and Reid 2001 ICES J. Mar.Sci 58, 270-274, Reid et al 2000 Fish. Res. 50, 163-171

# Status

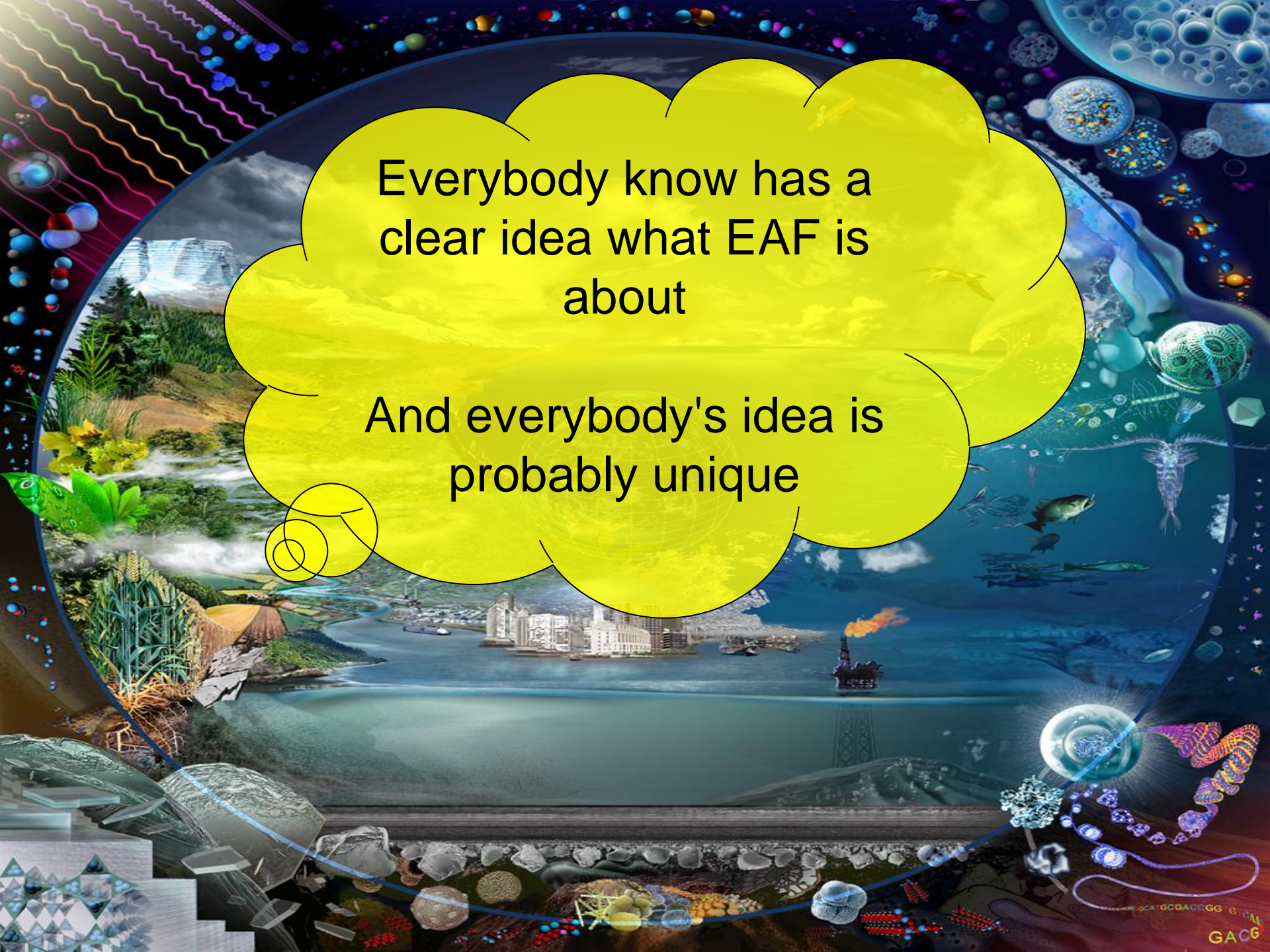
- The process of evolution from conventional management has started and is gaining momentum. Valuable experience is already available and valuable action can be readily taken.
- The implementation can only be incremental and adaptive. However, broadening the scope of fisheries management will also require a process of reprioritization.
- Guidance is provided, by FAO and other institutions, but the actual application of EAF can only take place with the main actors on the ground taking responsibility for the needed changes and in a way relevant to a given context
- Implementing EAF means realizing the principles of Sustainable Development. Reconciling short term economic and social gains with long-term sustainability may still prove a major challenge.

# Way forward

- Ecosystem approach is ...working together!
- Ecosystem approach is:
  - Sector integration
  - Adaptive management
- Ecosystems are dynamic
  - Need to take dynamics and variability into account
- How? Scientific knowledge
  - Time series, time series, time series, time series, time series .....
  - Assessment, correlations!
  - Biological understanding!

# Conclusions

- EAF concepts are *didactic* rather than *normative*. More a tool for teaching and learning than a plan of action. Their role is to raise questions and to point out difficulties that need to be addressed, rather than to advocate particular solutions.
- An EAF is a general approach, not a specific outcome.
- Holistic approaches risk loss of focus.



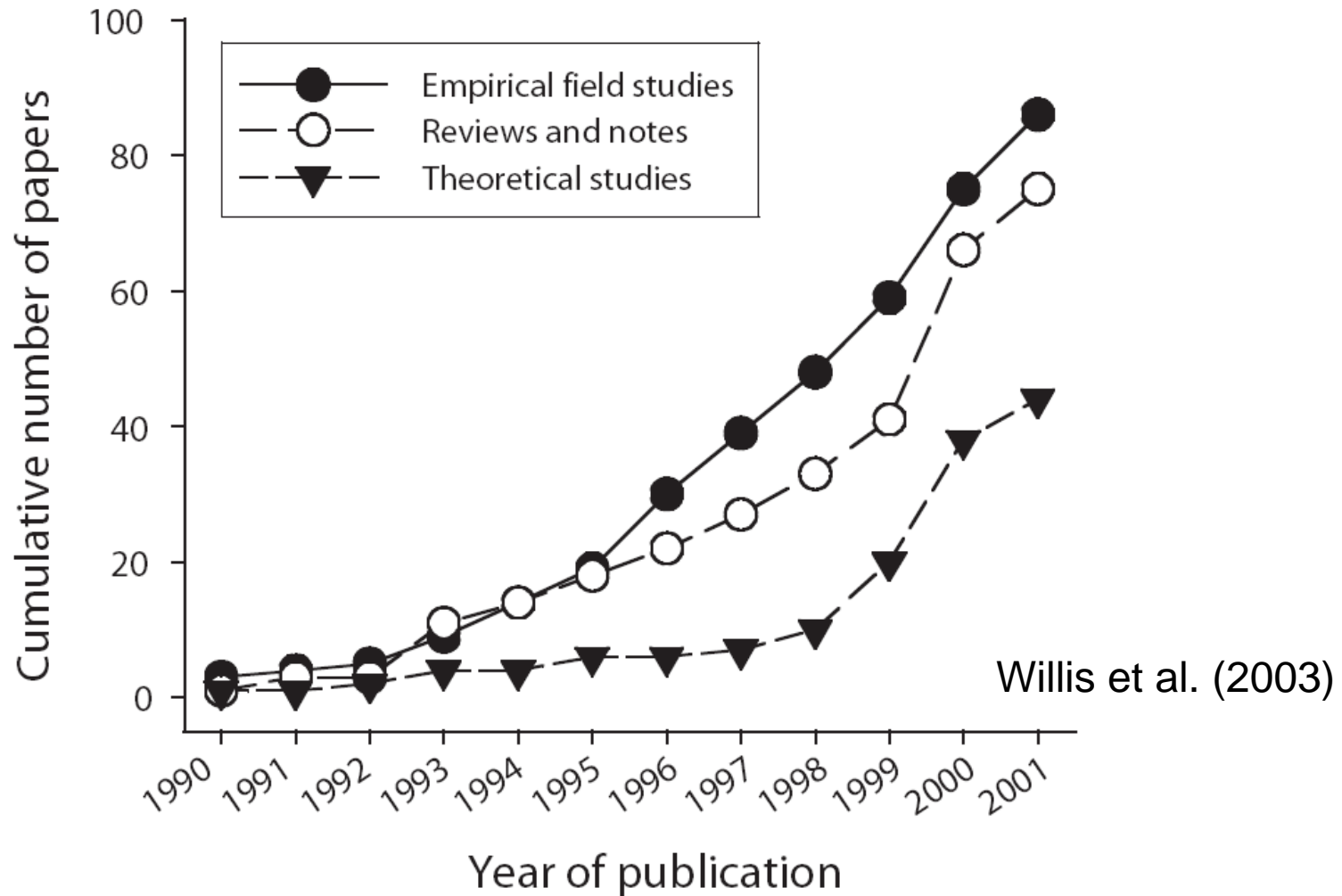
Everybody know has a  
clear idea what EAF is  
about

And everybody's idea is  
probably unique

# MPAs in relation to fisheries – What are the biological and fish stock implications?

- EAF and MPAs are **NOT** the same thing
- EAF is an approach for an integrated view to fisheries –and ecosystem - management
- MPAs are a management tool (one of many)

# The MPA pandemic



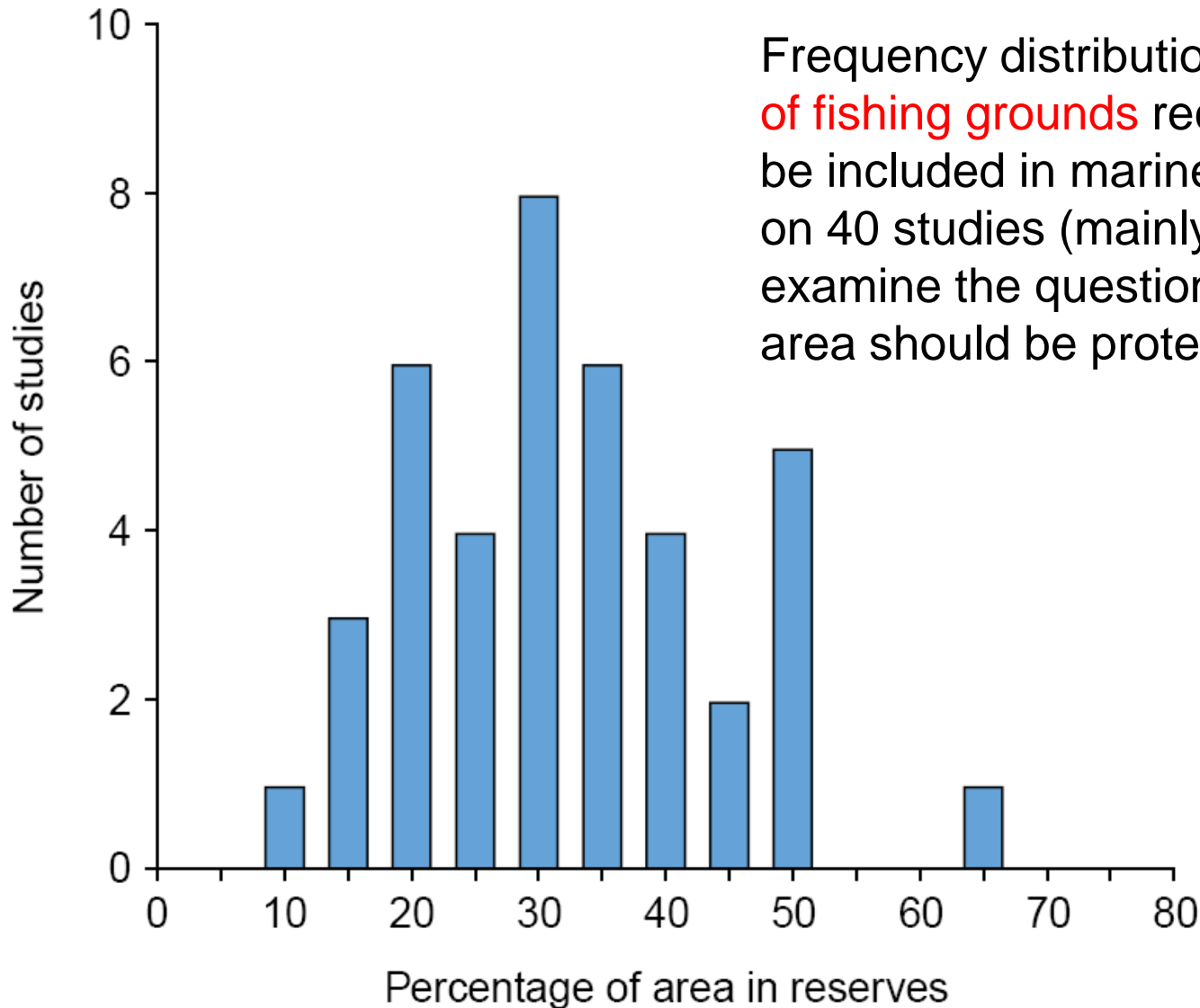
Publications concerned with the effects of marine reserves in the primary literature, 1990–2001: comparison of the number of field and desktop studies.

# MPAs – the solution to our crisis?

- Over the past decade+ there has been a global wave of environmental groups, politicians and ecologists pushing for the large-scale implementation of Marine Protected Areas (MPAs), with many calls for **protecting 20–30% of the oceans**
- Most MPA literature begins with a litany of the **failures of fisheries management** and the omnipresent threat of **stock collapses**

(Russ and Zeller 2003, Hilborn et al. 2004)

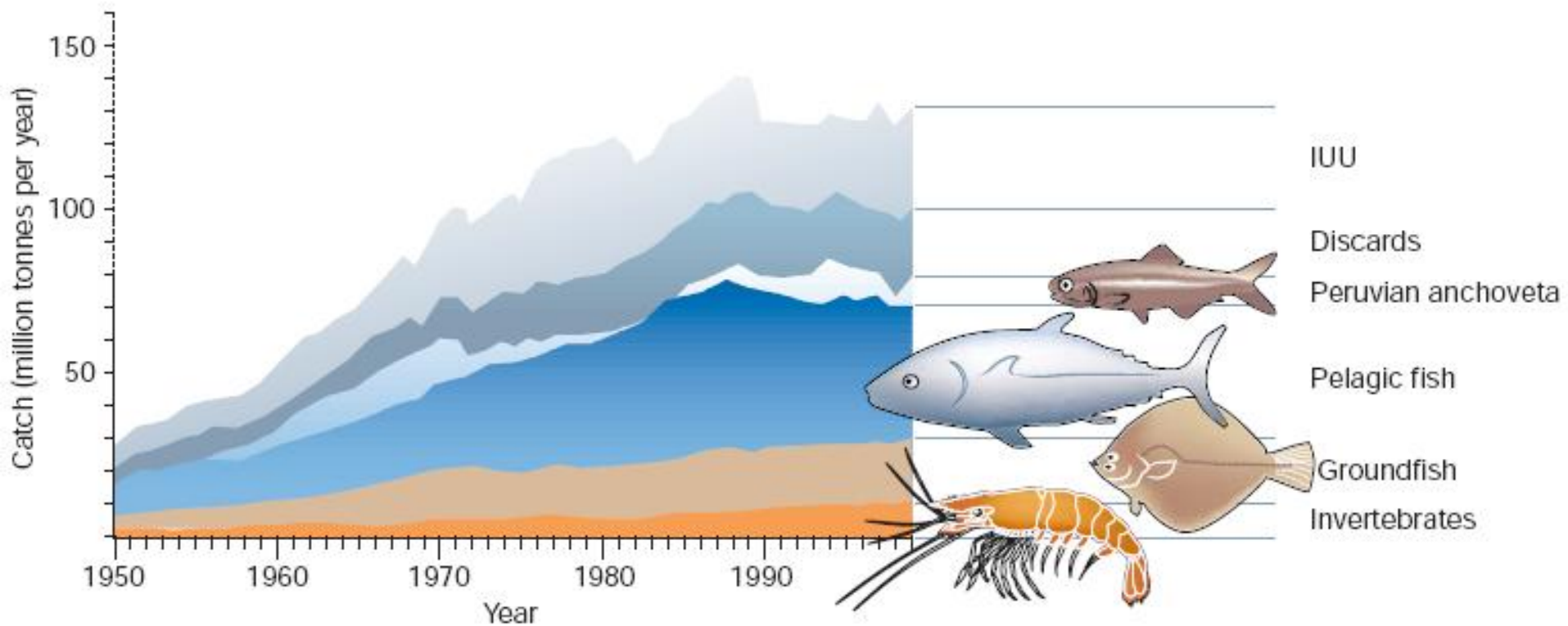
# How much should be conserved?



Frequency distribution of the **fraction of fishing grounds** recommended to be included in marine reserves, based on 40 studies (mainly theoretical) that examine the question of how much area should be protected from fishing.

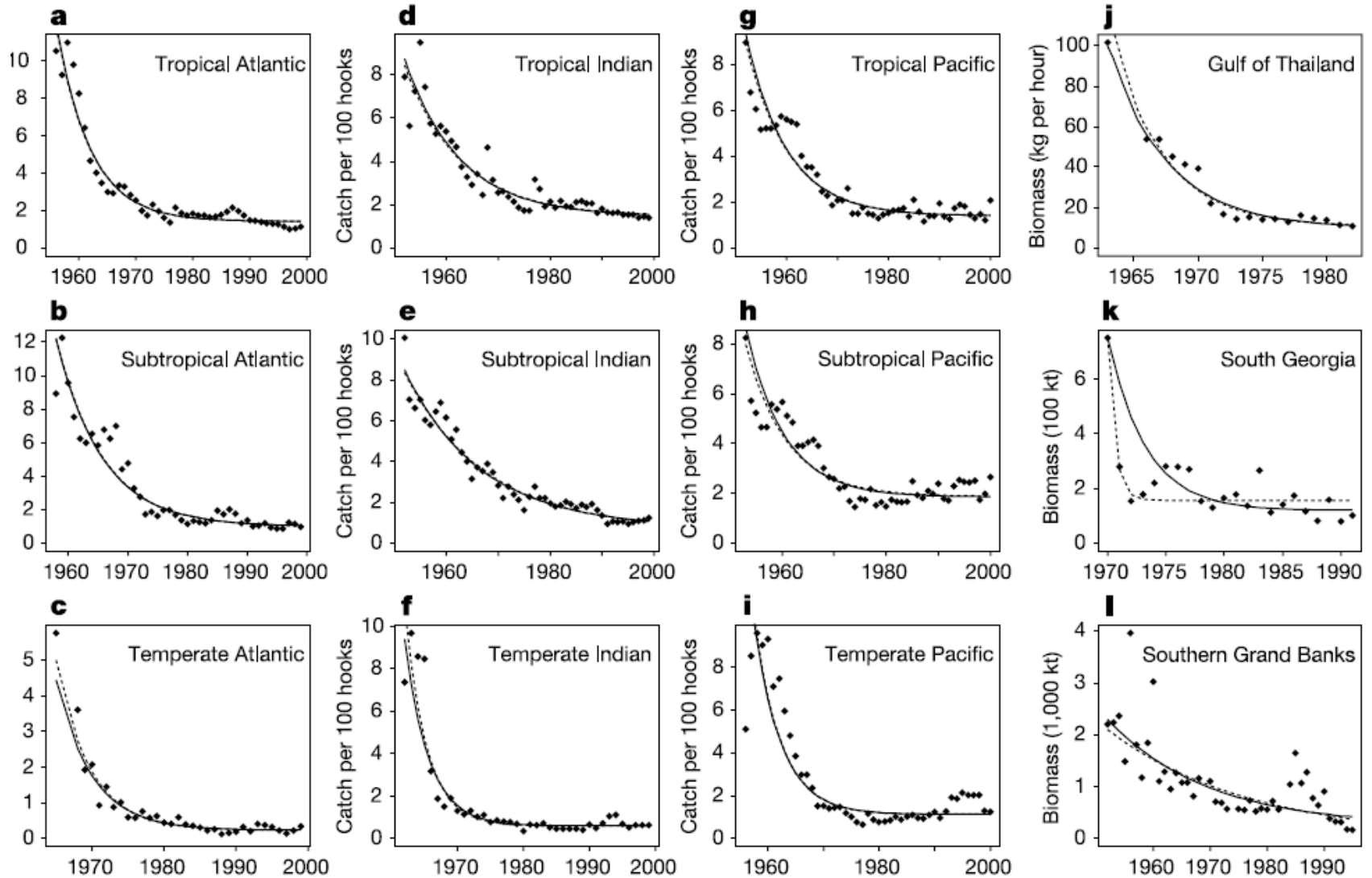
# Is there a fisheries crisis?

Estimated global fish landings

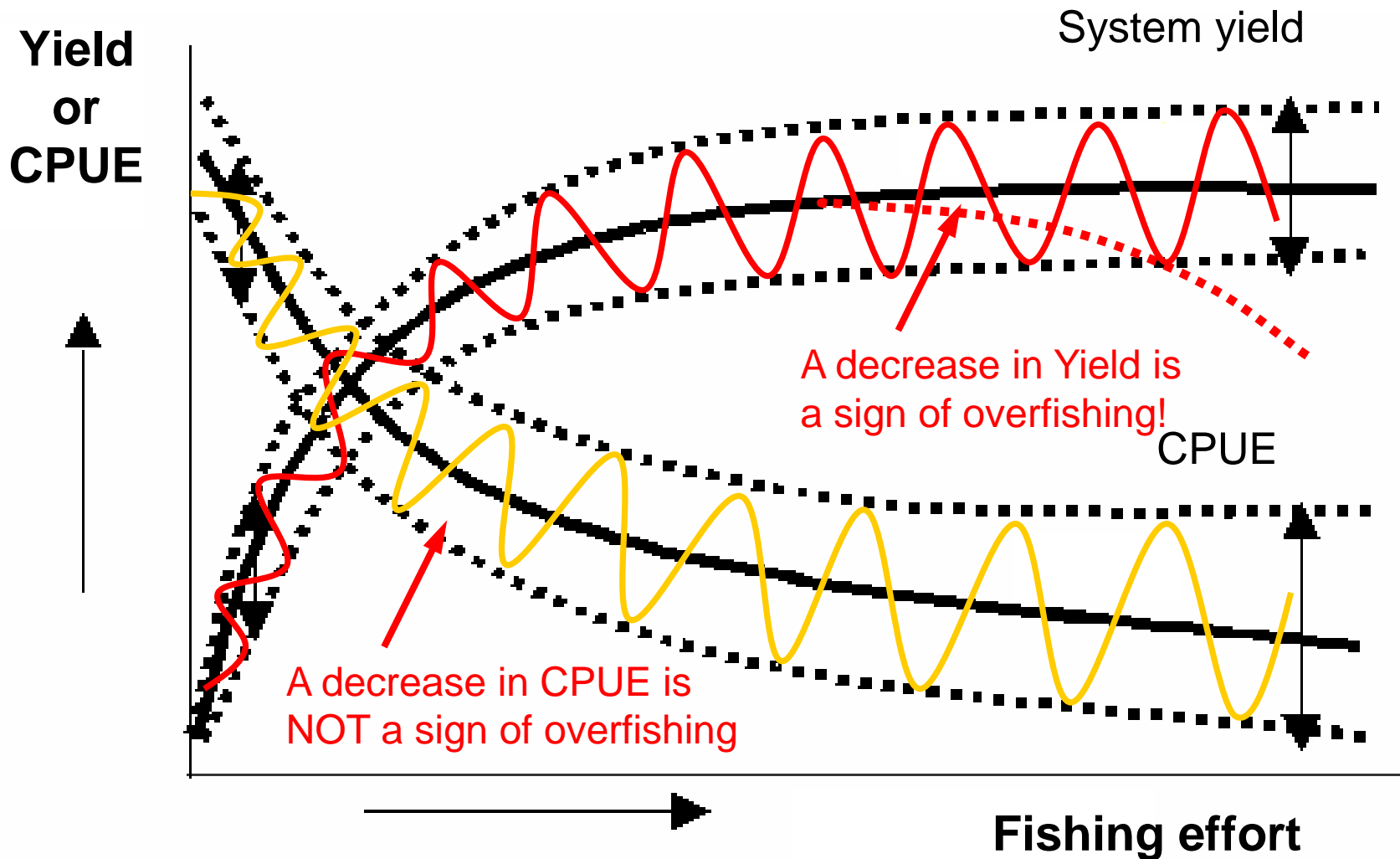


Pauly et al. (2002)

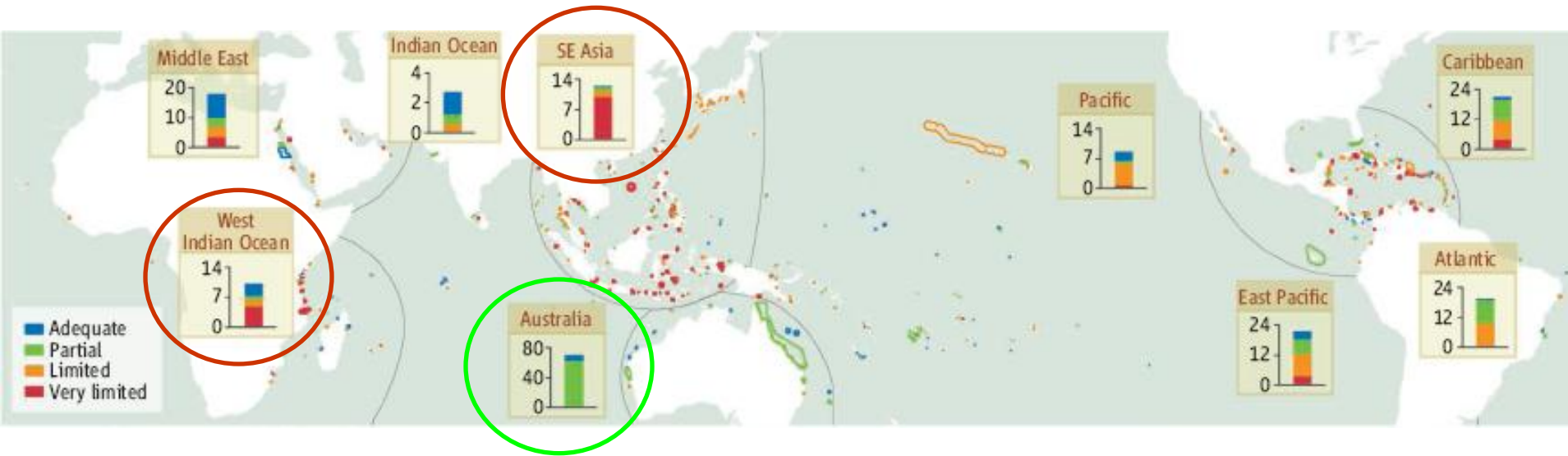
# The 'collapse' of marine communities



# Is this pattern a crisis?



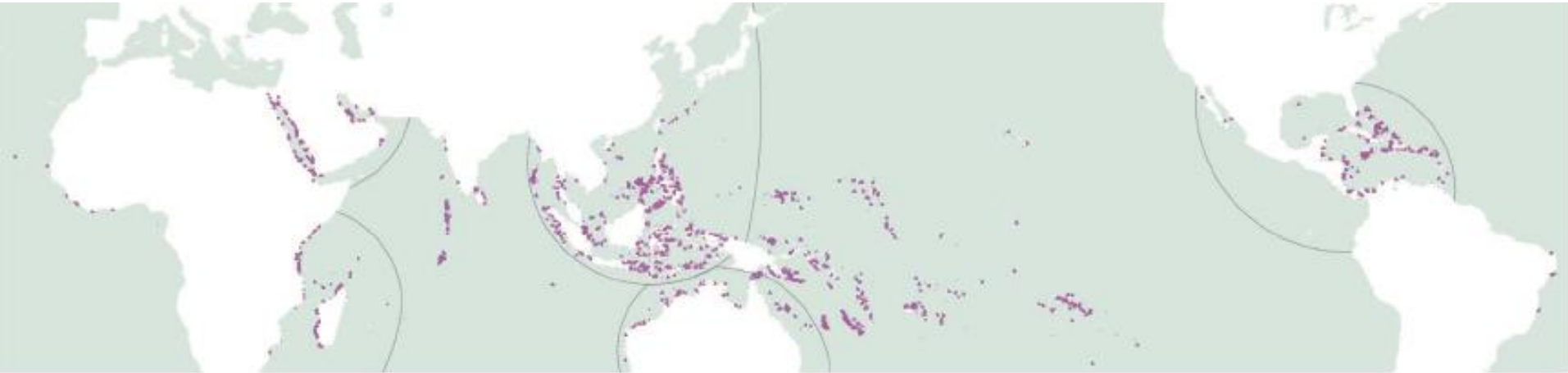
# Present status of MPA's on coral reefs



Location and status of 980 MPAs surveyed. Categorized according to their 'success' as No-Take zones. The percent of coral reefs per region covered by MPAs in those categories is shown on the bar charts.

From Mora et al. 2006 (*Nature*)

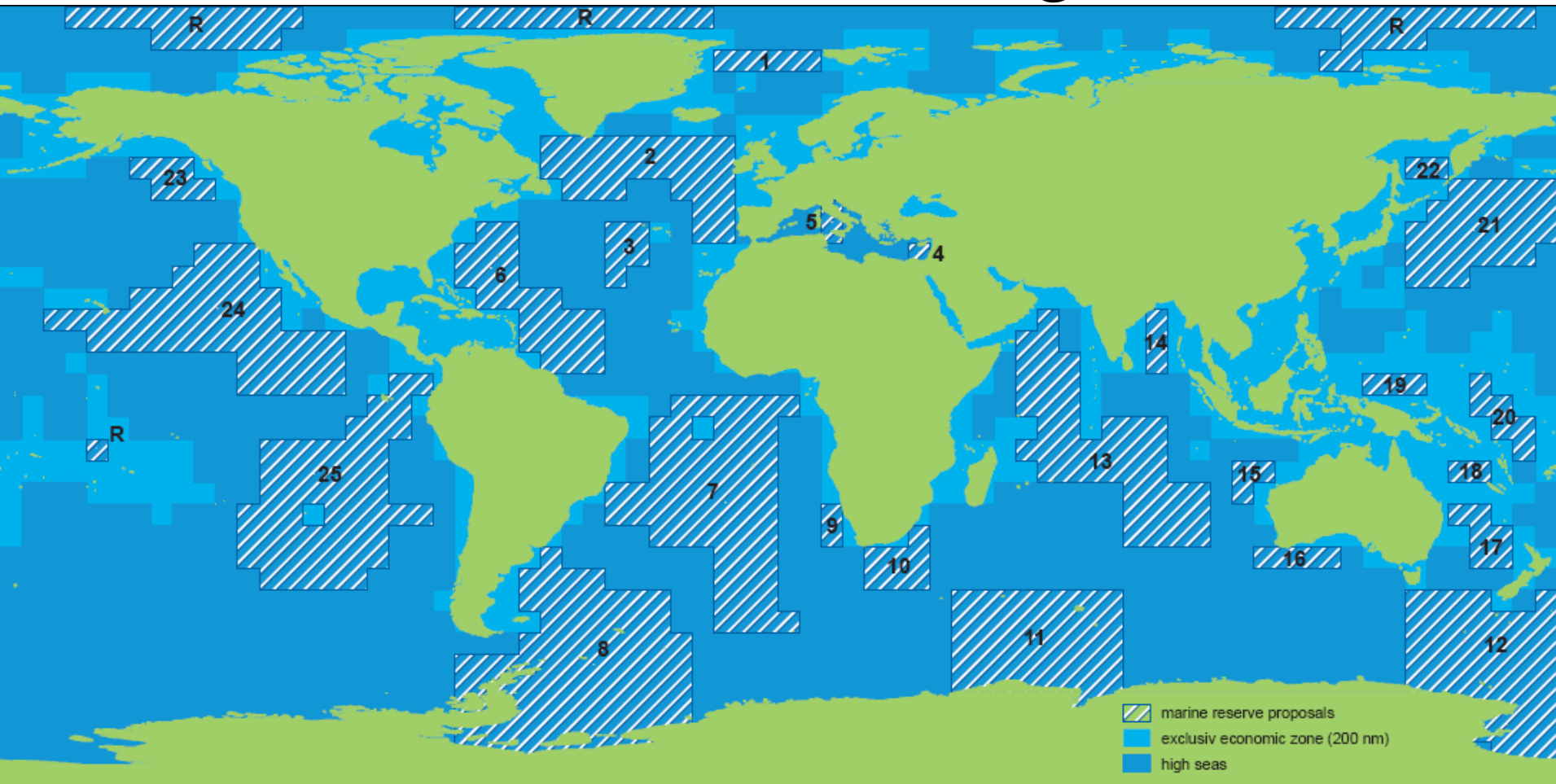
# Desired number MPA's on coral reefs



MPAs **needed for an optimum coverage** of the world's coral reefs. Dots represent MPAs of 10 km<sup>2</sup> and spaced at 15 km from each other. From Mora et al. 2006 (*Nature*)

Optimum according to what? The fishermen?

# Desired MPA's on High seas

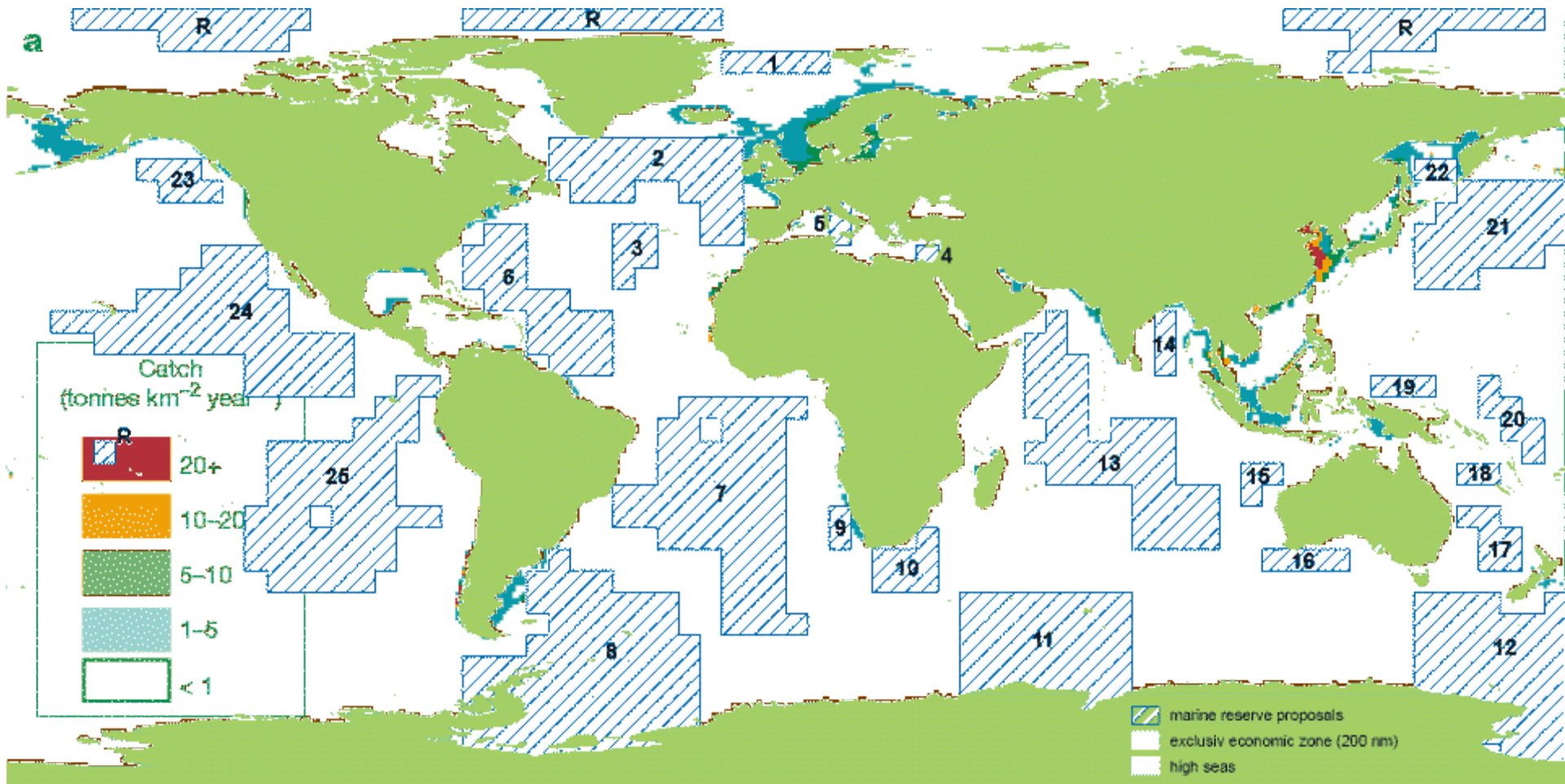


## Roadmap to recovery: a proposal for a global network of marine reserves on the high seas

- |                                   |   |                                       |                           |
|-----------------------------------|---|---------------------------------------|---------------------------|
| (1) Greenland Sea                 | (8) Antarctic-Patagonia                   | (15) Northwestern Australia           | (22) Sea of Okhotsk       |
| (2) North Atlantic                | (9) Vema Seamount-Benguela                | (16) South Australia                  | (23) Gulf of Alaska       |
| (3) Azores/Mid-Atlantic Ridge     | (10) South Africa-Agulhas Current         | (17) Lord Howe Rise and Norfolk Ridge | (24) Northeastern Pacific |
| (4) Eastern Mediterranean         | (11) Southern Ocean                       | (18) Coral Sea                        | (25) Southeastern Pacific |
| (5) Central Mediterranean         | (12) Southern Ocean-Australia/New Zealand | (19) Northern New Guinea              | (R) Representative areas  |
| (6) Sargasso Sea/Western Atlantic | (13) Central Indian Ocean-Arabian Sea     | (20) Western Pacific                  |                           |
| (7) South-Central Atlantic        | (14) Bay of Bengal                        | (21) Kuroshi-Oyashio Confluence       |                           |

**GREENPEACE**

# World's fishing grounds



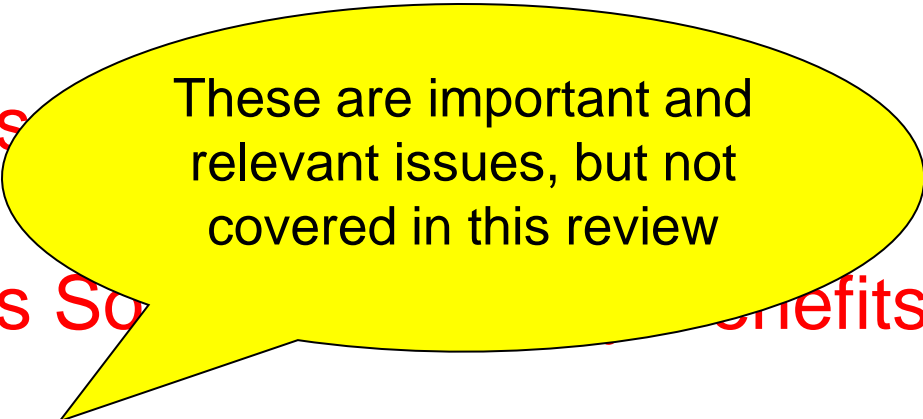
Road to recovery? No overlap between proposed High Sea MPAs and fishing grounds

Watson & Pauly (2001), based on FAO statistics

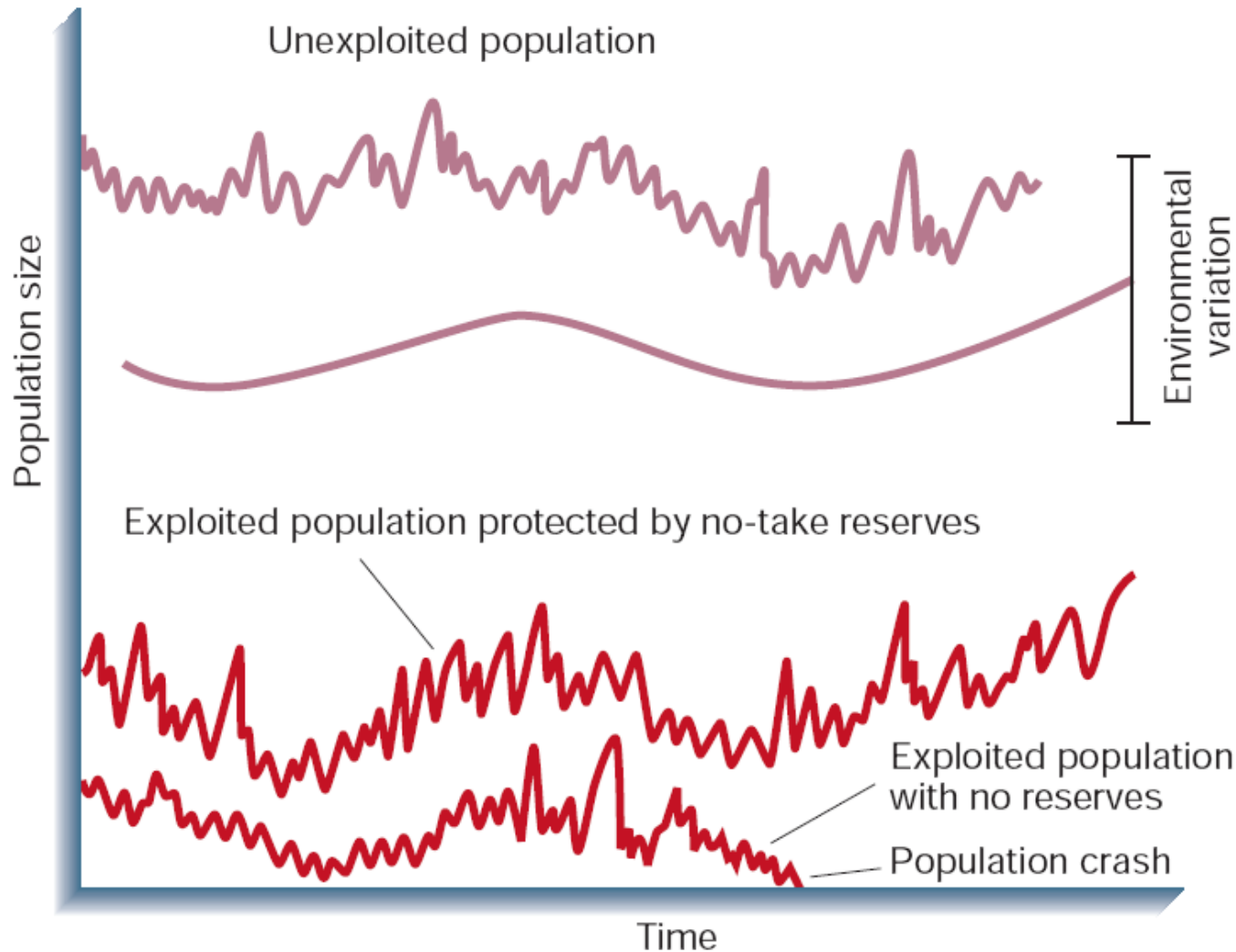
# What does this mean?

- That MPAs predominantly are focused on **tropical small scale fisheries** (most on coral reefs – so far)
- That the proposed **high sea** MPAs are all **outside** the main industrial fishing grounds.
  - So who will be affected? Are small scale tropical fisheries **overfished**?
  - If MPAs, will the people benefit? If not do they have **alternative incomes**?

# Objectives of MPAs

- A. Reserves as  These are important and relevant issues, but not covered in this review
- B. Reserves as Source of Ecosystem Benefits
- C. Reserves as Source of Ecosystem Benefits
- D. Reserves as Means of Achieving Social Objectives
- E. Reserves to Advance Scientific Knowledge

# Reserves as Insurance Policy



Pauly et al. (2002)

*“MPAs are our insurance policy against future fisheries management failures — a healthy dose of the precautionary principle”. (Russ 2002)*

# Reserves as Source of Fishery Benefits

- The topic has an almost **seductive** quality about it.
- It offers conservation **and** sustainable exploitation.
- It offers, simultaneously, what in the past was conflicting objectives: **maintaining the aesthetic qualities** of ecosystems for e.g. tourism while also **providing sustainable fisheries**.

Russ (2002)

# So how can this be offered?

## Effects inside reserves

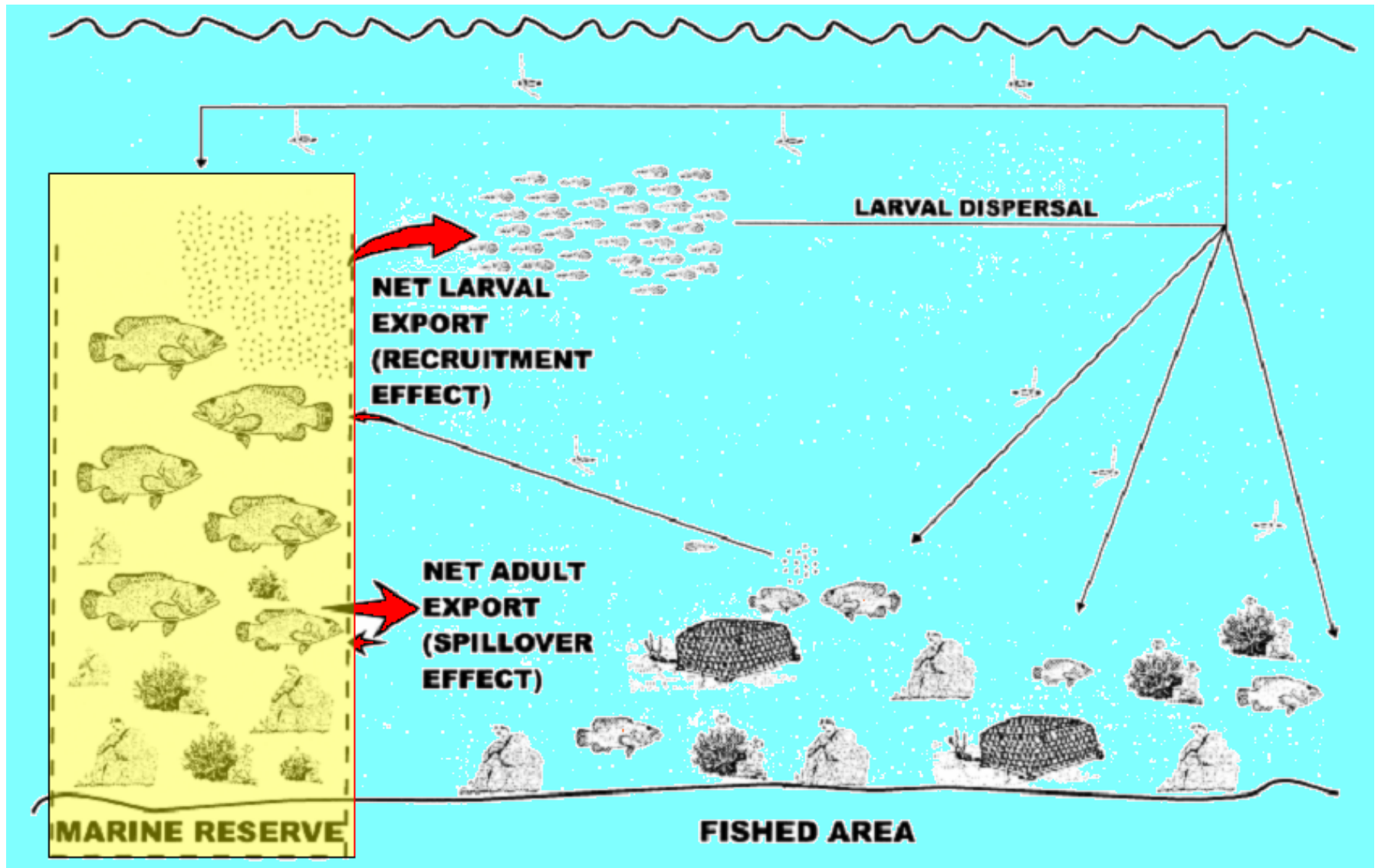
- 1. Significantly lower **fishing mortality** ( $F$ ) than in fished areas, or even  $F = 0$ .
- 2. Significantly higher **density** of target species.
- 3. Significantly higher mean **size/age** of target species.
- 4. Significantly higher **biomass** of target species.
- 5. Significantly higher production of **propagules** (eggs/larvae) per unit area.

## Effects outside reserves = fisheries enhancement

- 6. Effects 1–4 above **result** in net **export of adult** (post settlement) fishes (the “**spillover effect**”).
- 7. Effects 1–5 above **result** in net **export of eggs/ larvae** (the “**recruitment effect**”).

The result is an **enhanced supply** of recruits to fished areas.

# Reserves as Source of Fishery Benefits



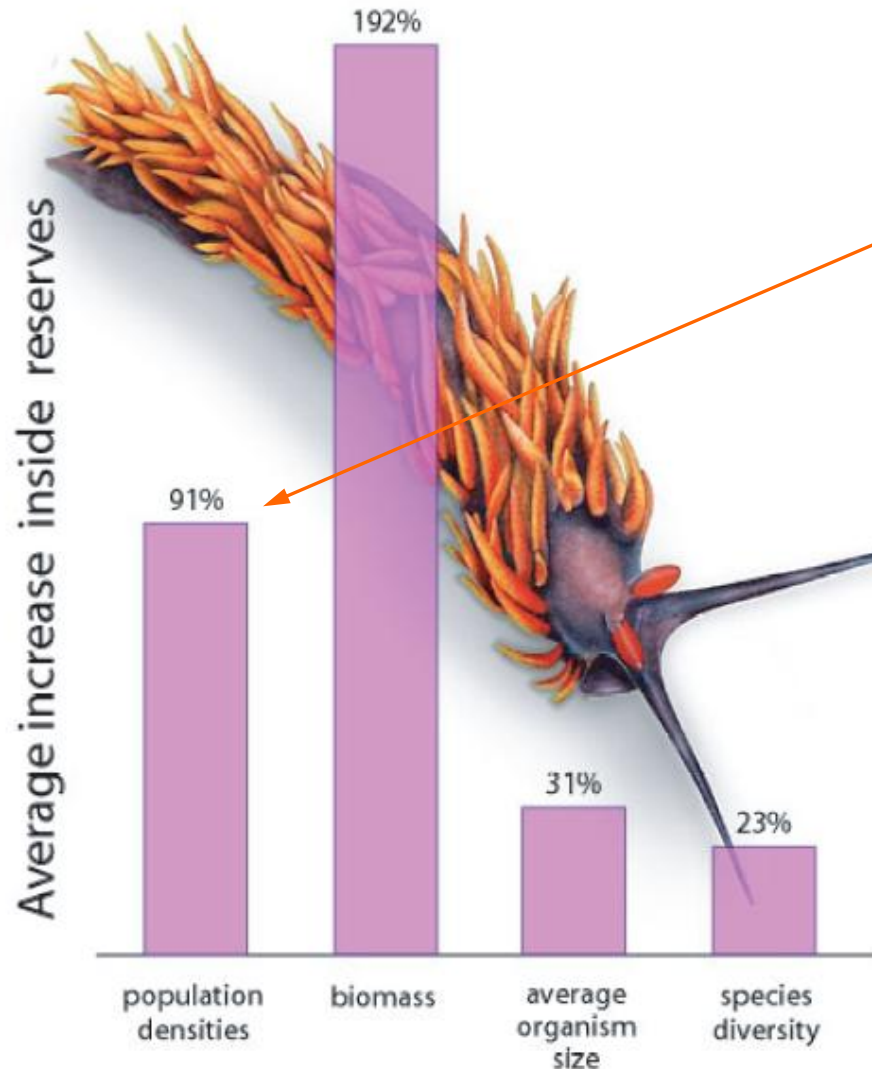
# Do Marine Reserves work?



**80 reserves, 81 studies, 102 measurements**

Halpern (2003)

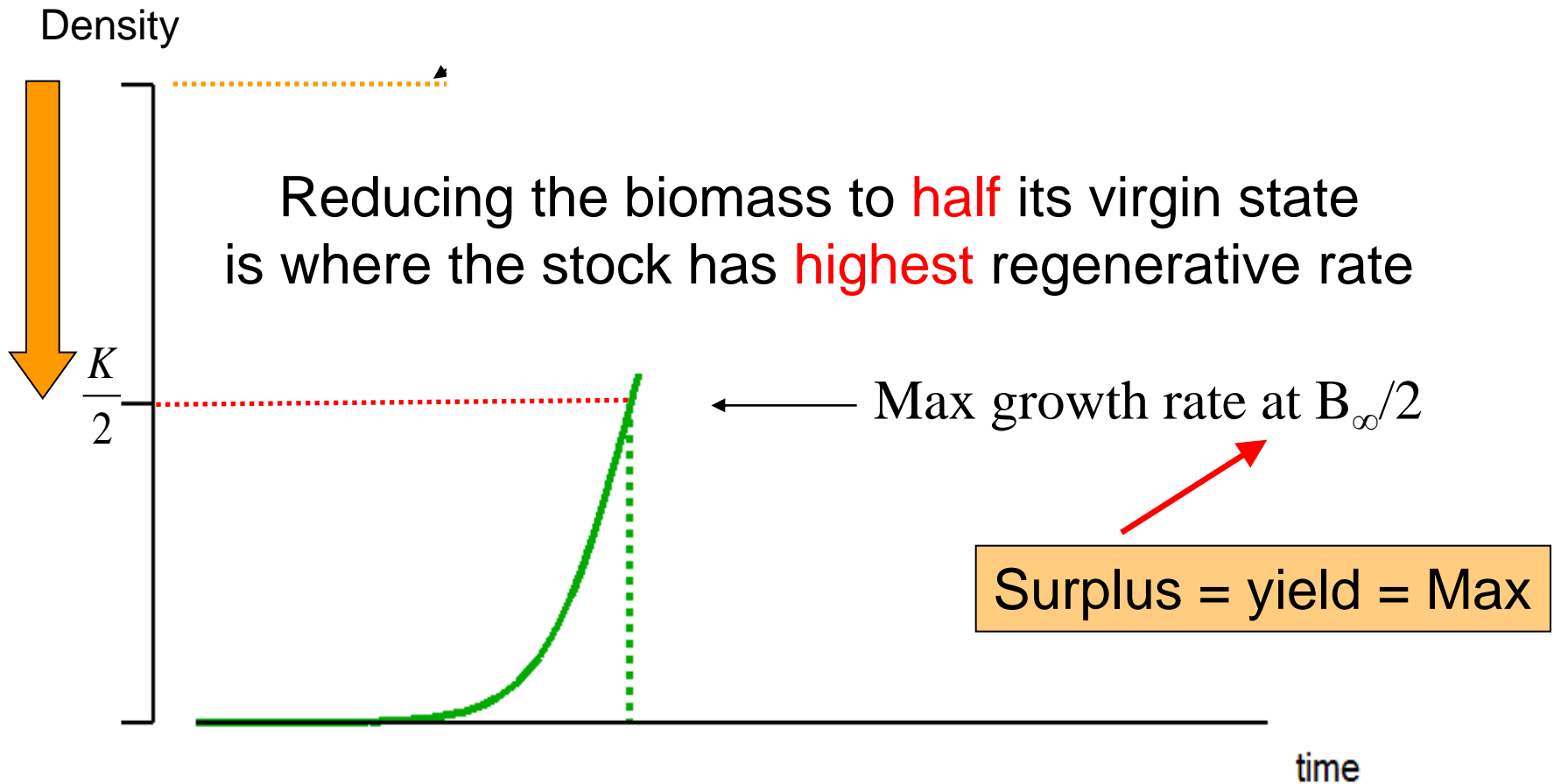
# Do Marine Reserves work?



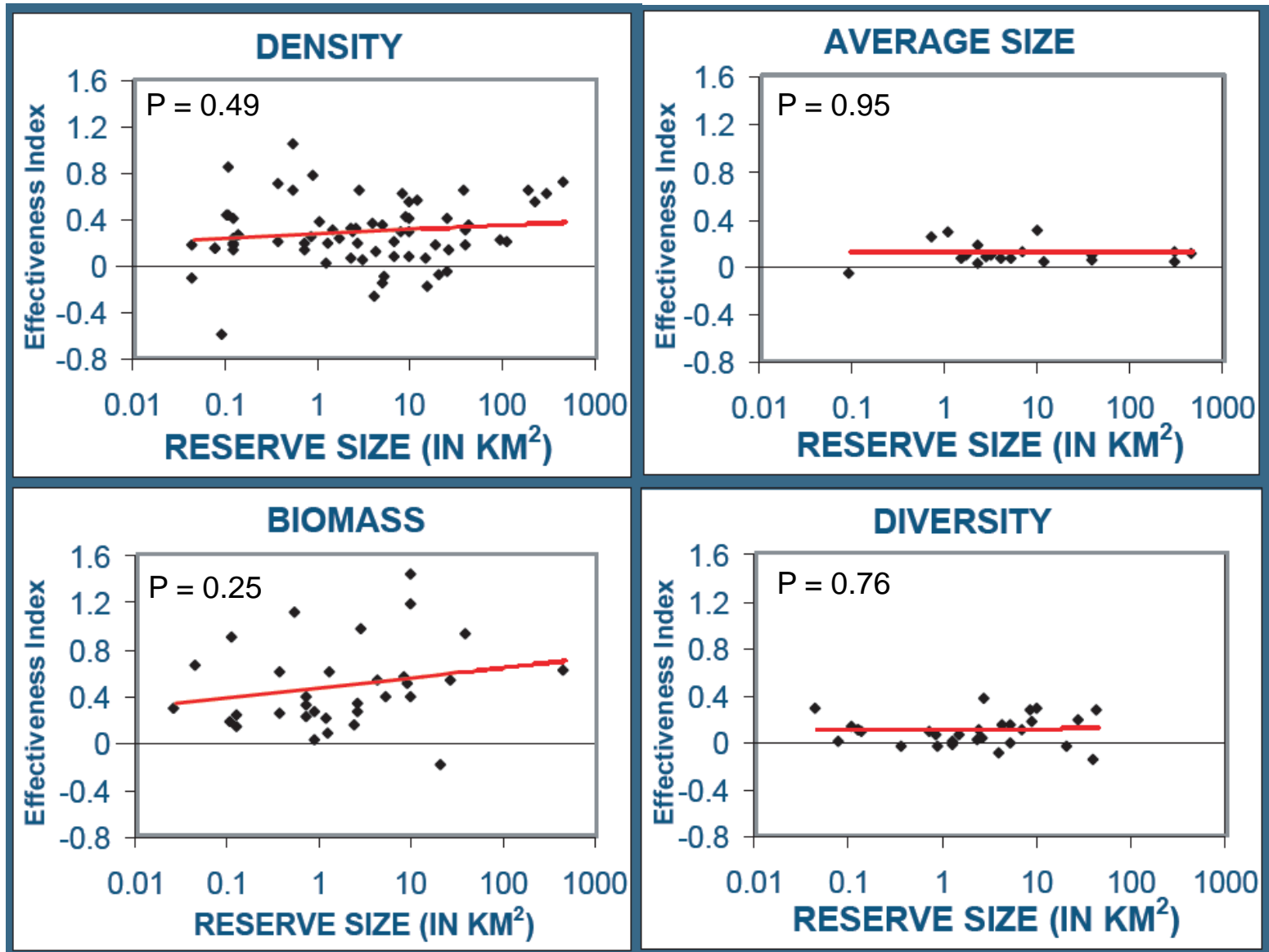
Density **doubles** inside reserves.

However, a **reduction** in density to around **half** the 'virgin' density is generally where the highest production occurs

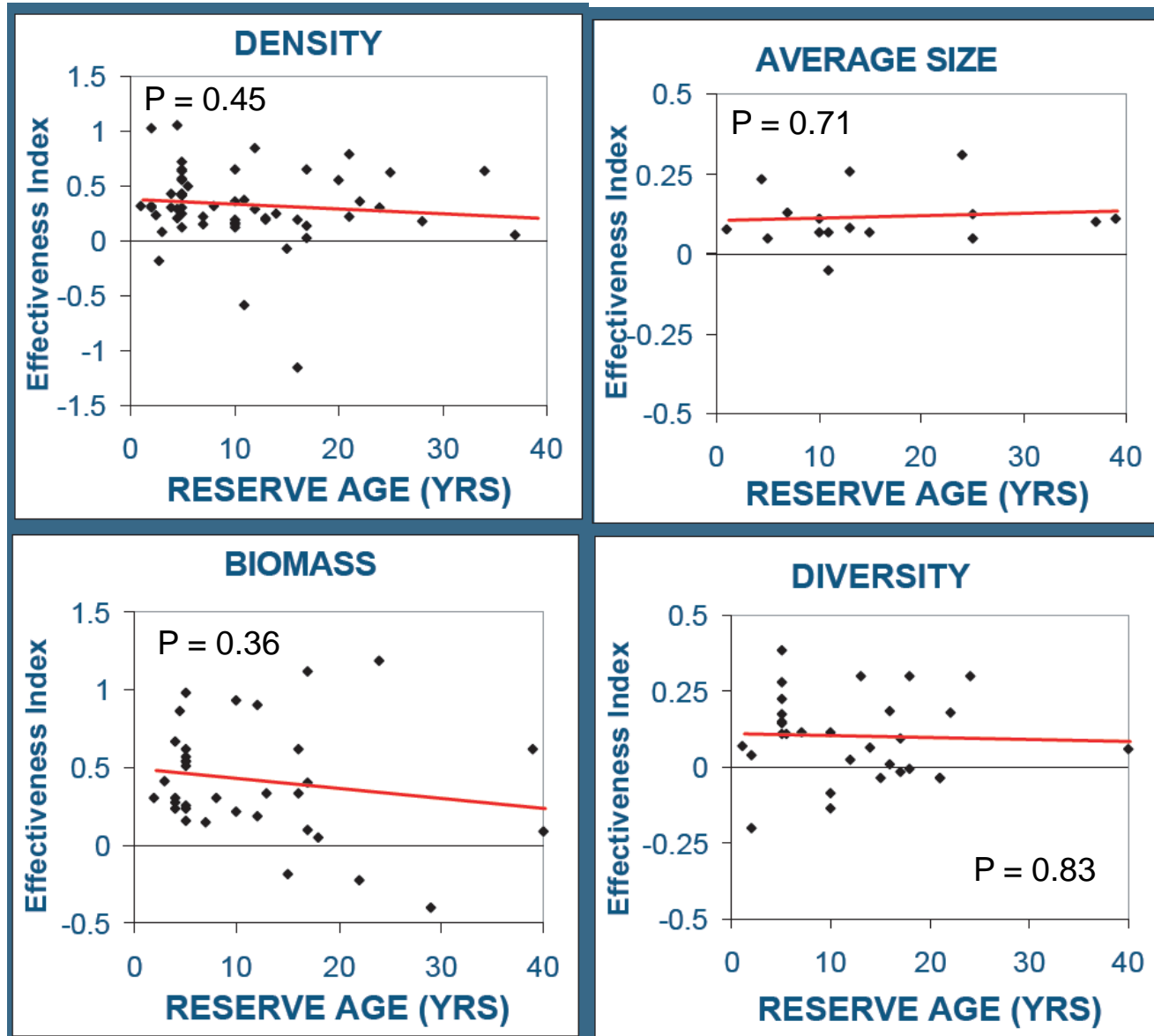
# Density dependence (Logistic growth)



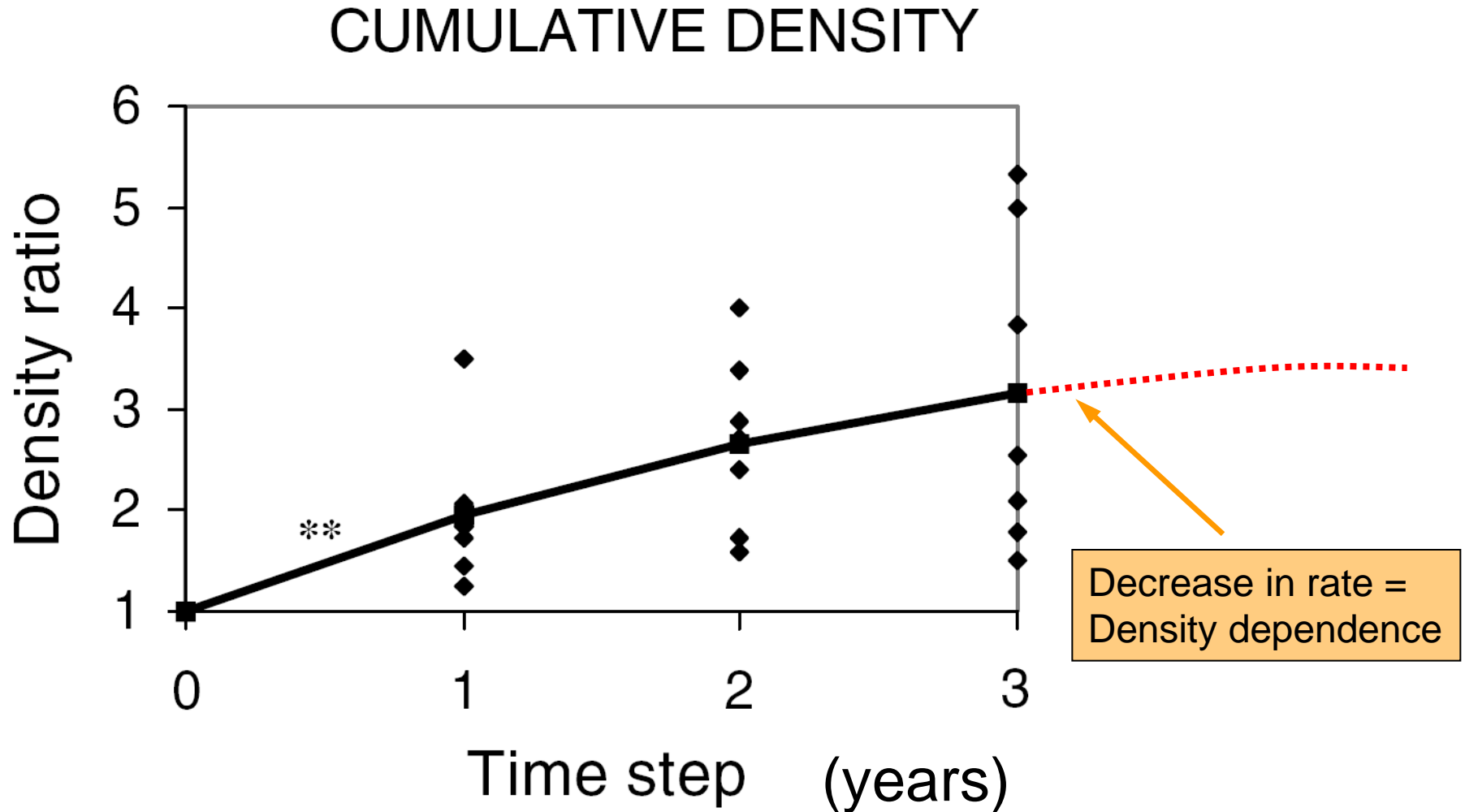
# Does reserve size matter?



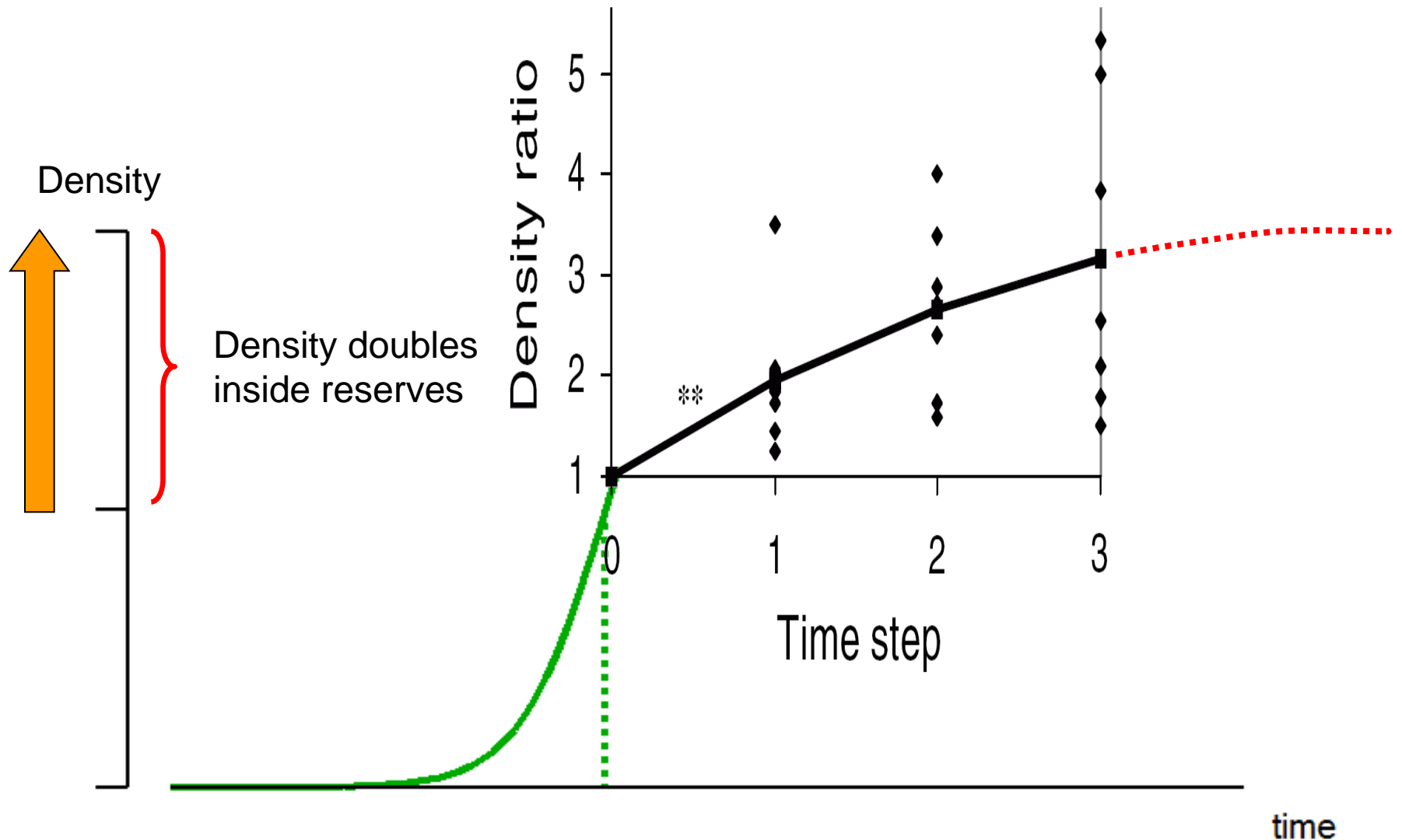
# What is the effect of time?



# How fast is regeneration?



# What we see is density dependent growth



Inside MPAs populations regenerate back at a decreasing rate until asymptote

# Thus the response is quick

**Densities** of fish and invertebrates **respond rapidly** to reserve protection, reaching average overall values within **1-3 years** (Halpern 2003), and with the **greatest rate of increase during the first year** (Halpern and Warner 2002).

This not only show **density dependence** but also the **resilience** that most marine populations have to regain from stress. In general they appear to rebuild fast when **mortality** factors are removed. But...

# When there is no response?

What these results also show, and that is perhaps the **most important**:

When there is **no response** in density after removing or lowering the fishing mortality, then the **causing agents are not fishing**, but most likely environment.

Habitat **destruction** is generally more a threat than fishing for most fish.

# Spillover effect? Example of MPA 'enhancement' on adjacent fishery

Natural fluctuations?

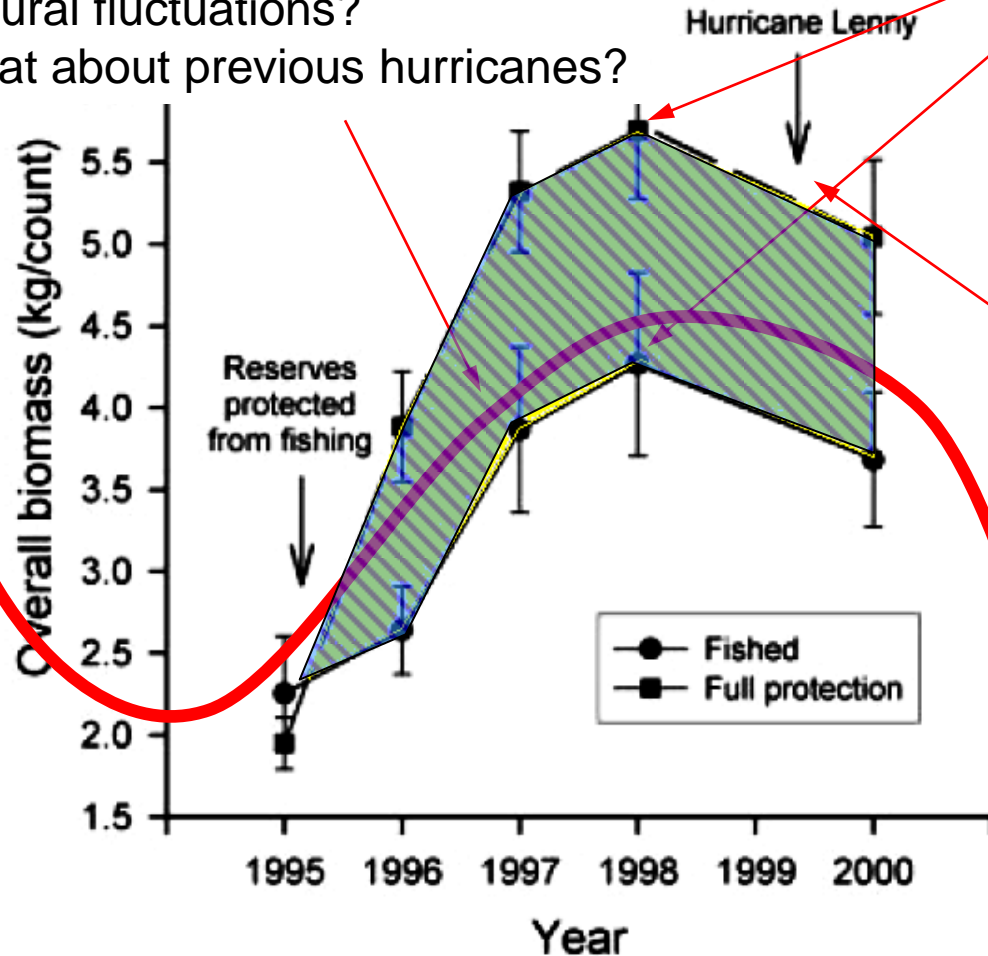
What about previous hurricanes?

Biomass **tripled inside** and **doubled outside** in 3 years.

But **no time lag** indicates a common factor. Cause-effect: MPA spillover → Outside is **inferred**

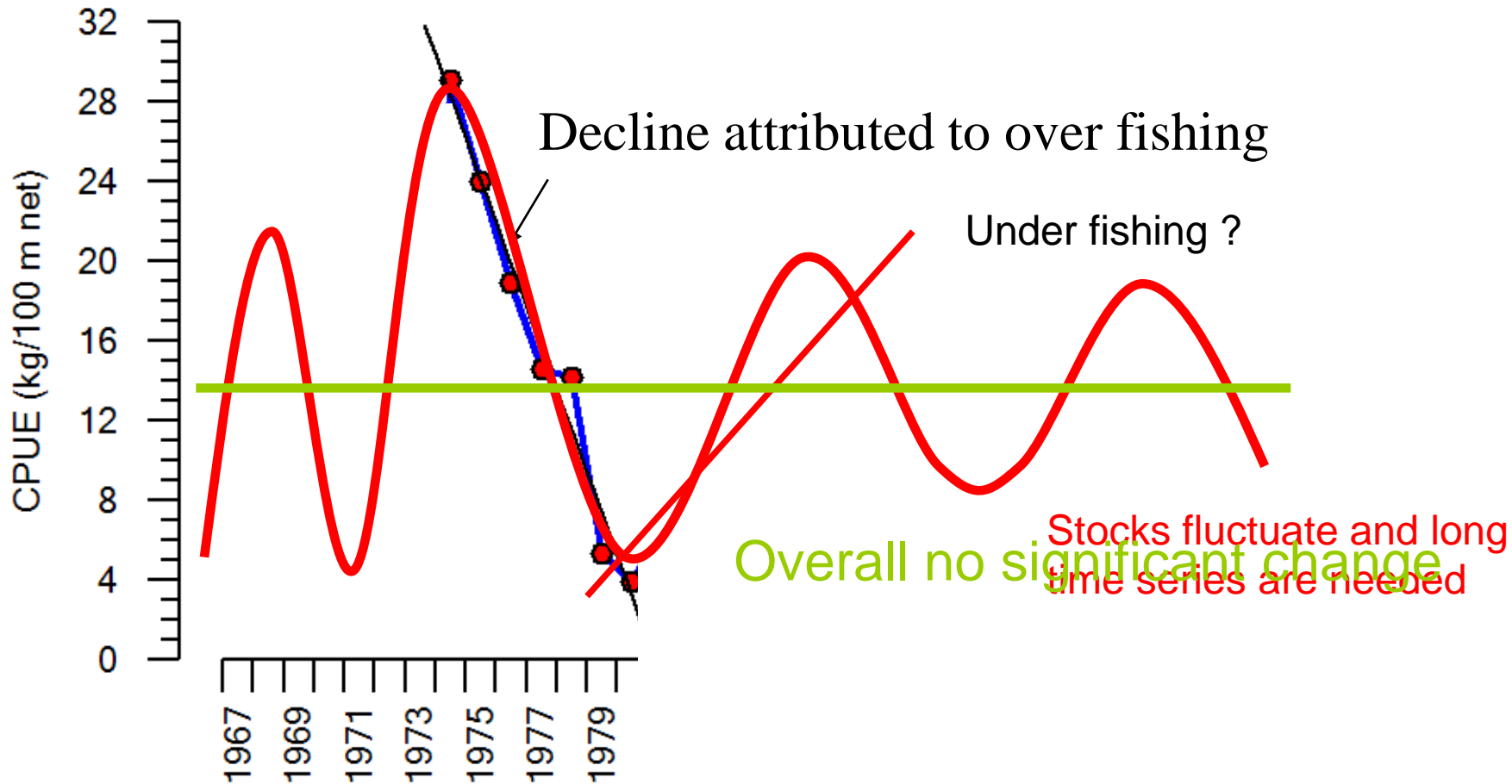
**Decrease** due to **environment** - but **increase** due to **MPA**?

All this example shows is the **difference in biomass** between a fished and a non-fished area **under environmental fluctuation** (remember density dependence)



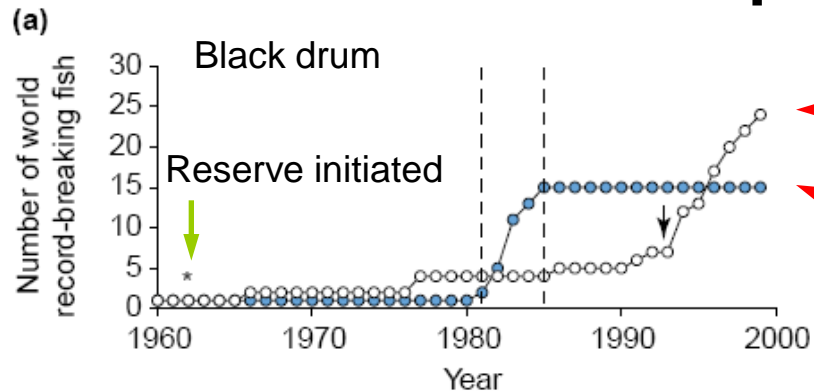
# Steady state and quick conclusions?

Lake Kariba Catch per unit effort (All species)



Environmental variation normally not included

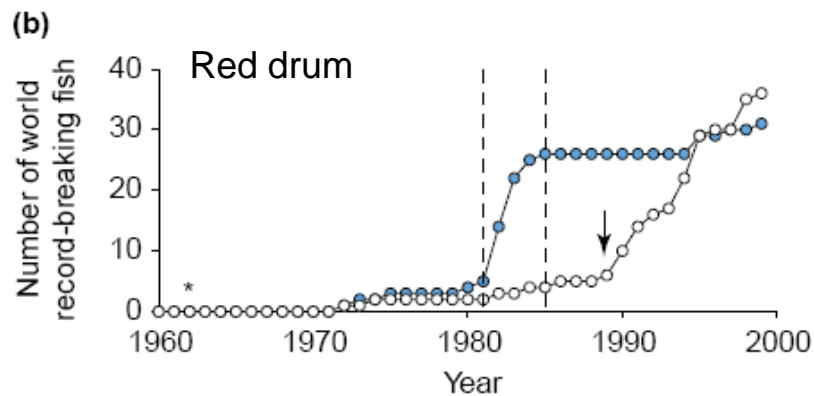
# Another 'spillover' example



World record catches cluster around Cape Canaveral reserve

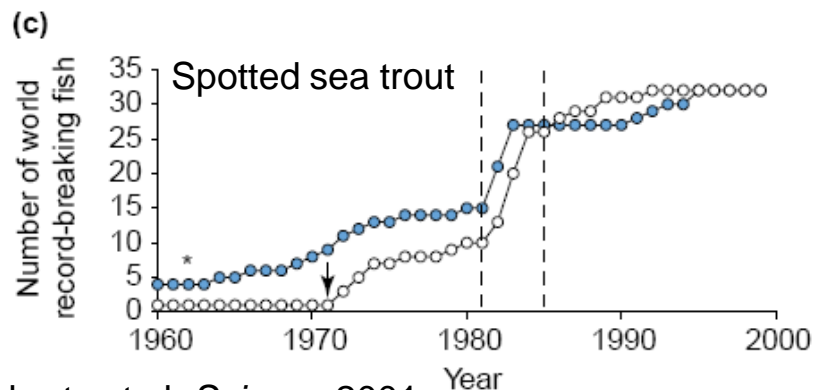
Records from rest of Florida

This case is used to show/prove that 'spillover' occurs. The largest 'trophy' specimens are caught in the vicinity of a reserve.



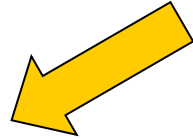
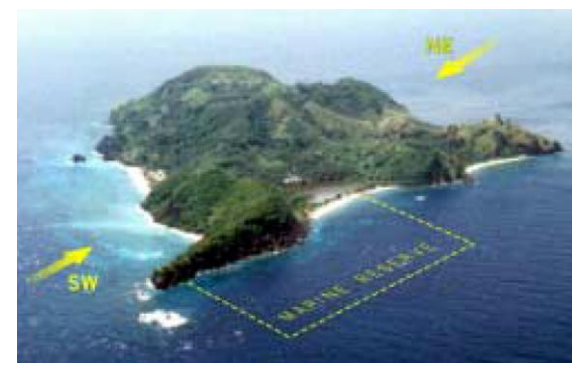
Is that fisheries enhancement?

For sports fishermen perhaps, but when fish reach trophy size the net productivity of the stock is close to zero as we know from density dependent population growth.

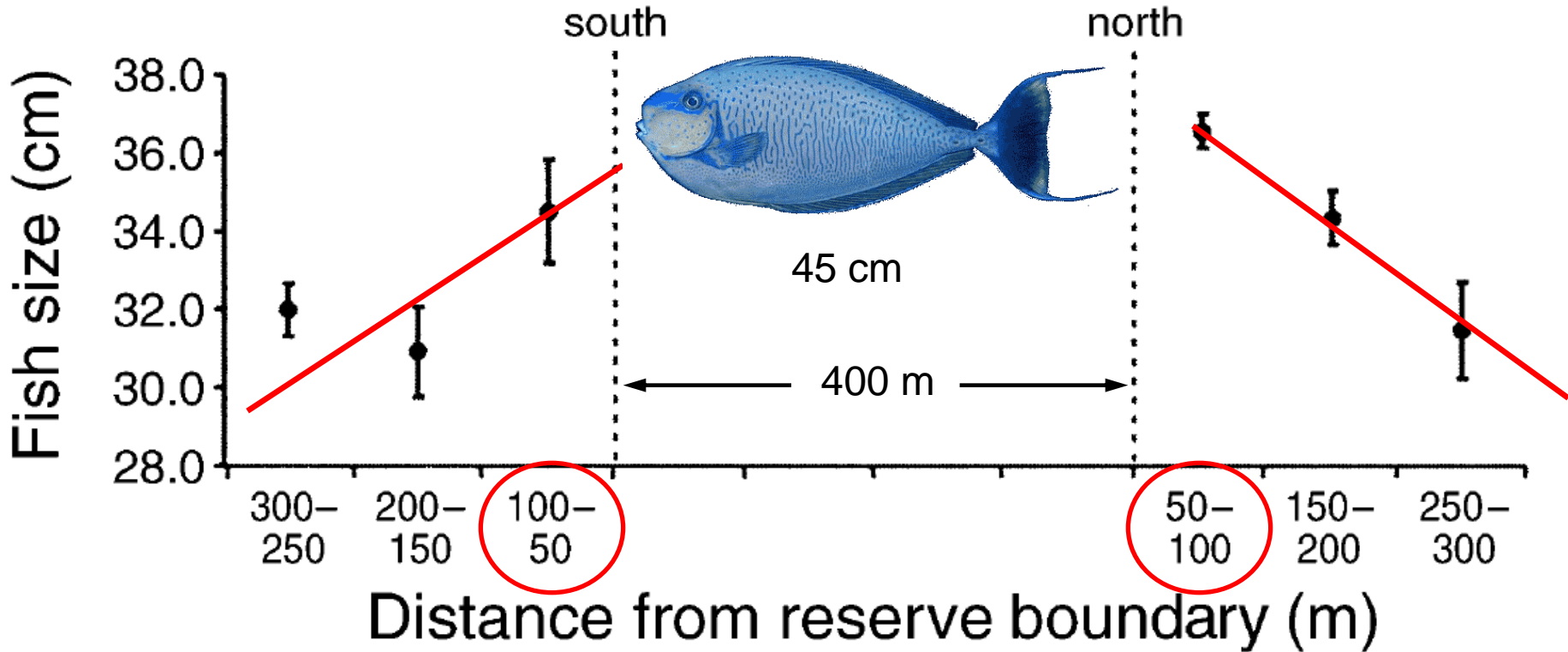


It is certainly not yield enhancement.

# ..and another 'spillover', the Philippine Apo reserve



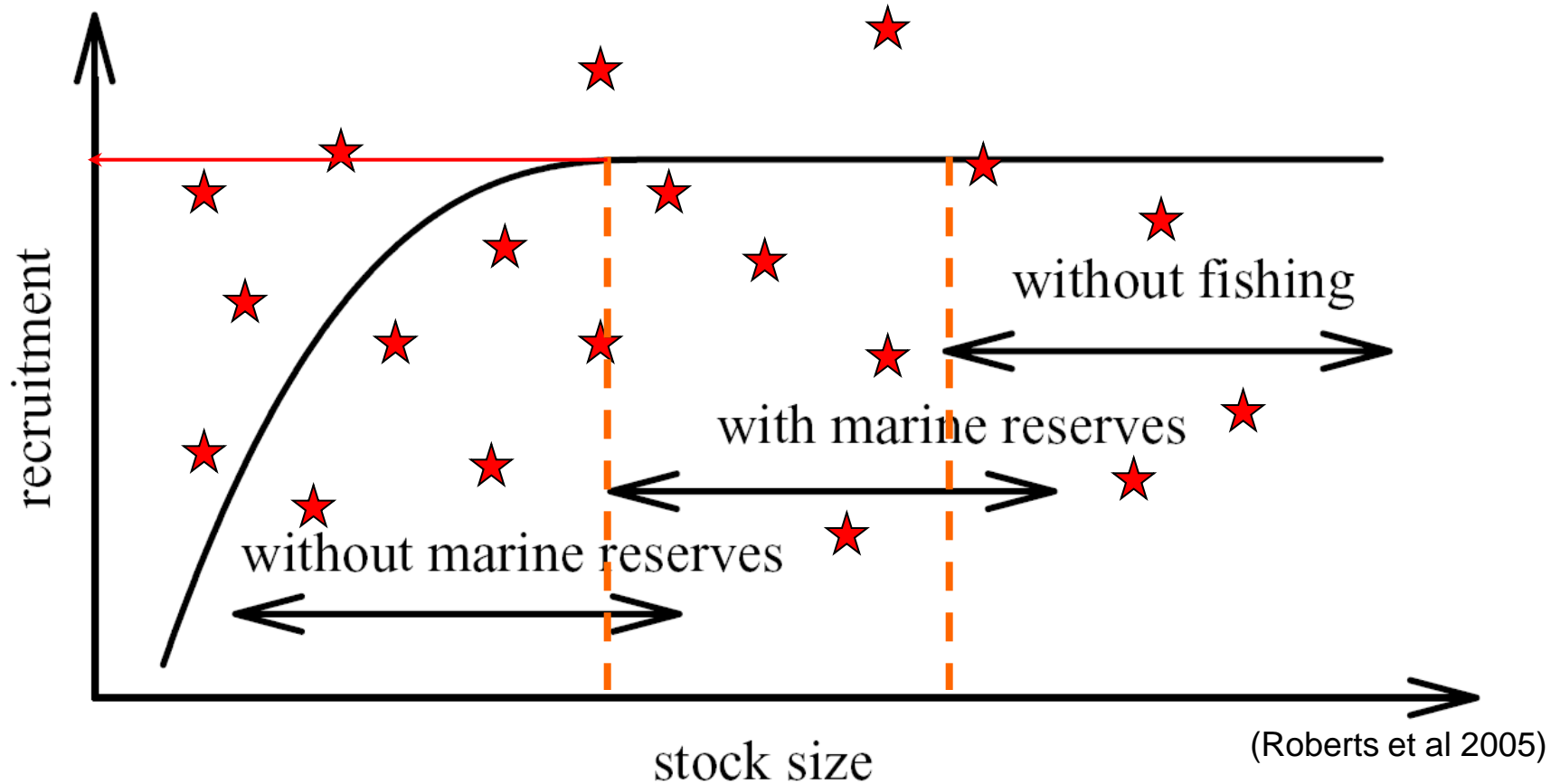
Fished area      Apo Reserve      Fished area



Abesamis and Russ 2005

Increased density and size – but no evidence of increased yields

# Recruitment effect? (no examples exist) – only theoretical models



- **Never shown** – purely theoretical (like the stock recruitment relationship)
- Density dependent mechanisms on egg/larvae still unknown (environment)
- Most heavily exploited stocks are already managed on minimum SSB
- Otherwise recruitment rarely a problem (ref. quick response to MPAs above)

# Conclusions (1)

- That MPAs increase **biomass** is true
- That they serve as **conservation** is true
- That they maintain the **aesthetic qualities** of ecosystems (e.g for tourism) is true
  
- But that they **enhance** fisheries and **increase yields** is far from compelling from both empirical and model evidence.
- Density-dependent factors will lead to **reduced** fish stock **production** in and around MPAs.

# Conclusion of some donors

- *After considerable review of empirical data and evaluation analyses, the **World Bank**, the **African Development Bank** and **other agencies** came to the conclusion that people living in protected areas are made **materially worse off and impoverished** by the introduction of “restriction of access” to natural resources, enforced as part of conservation projects (Cernea 2006)*

## Conclusions (2)

- Is therefore **counter-productive** for MPAs to be 'sold' on a **win-win** basis, including their potential to deliver fisheries benefits.
- It will distract attention from their primary objective: **conservation**, and leave their promotion open for **justified suspicion**.
- Environmentalists and conservation biologist should apply the same **rigorous standards** as other scientists to preserve credibility.

# Thank you!

- **“For every complex problem, there is an answer that is clear, simple, and wrong”.**  
(HL Mencken)
- **“Conservationists today are too often ill-trained in natural science”.**  
(GC Ray)
- **Exercise caution**  
**Apply precaution**  
**But treat precaution with caution!**  
(K Thorarinsson)