Arctic Council/PAME Workshop, Copenhagen, Denmark, 2-3 February 2017

MPAs and Networks as tools for resilience

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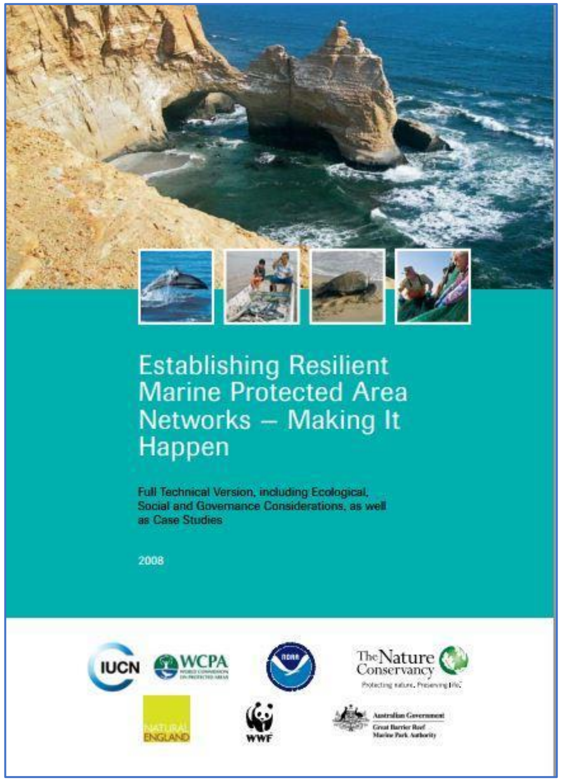
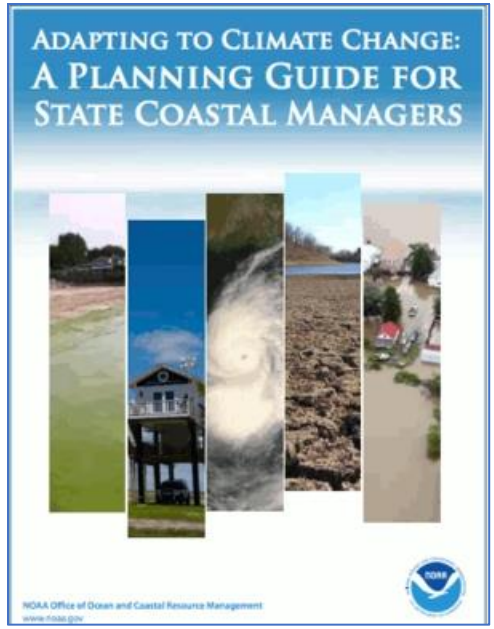
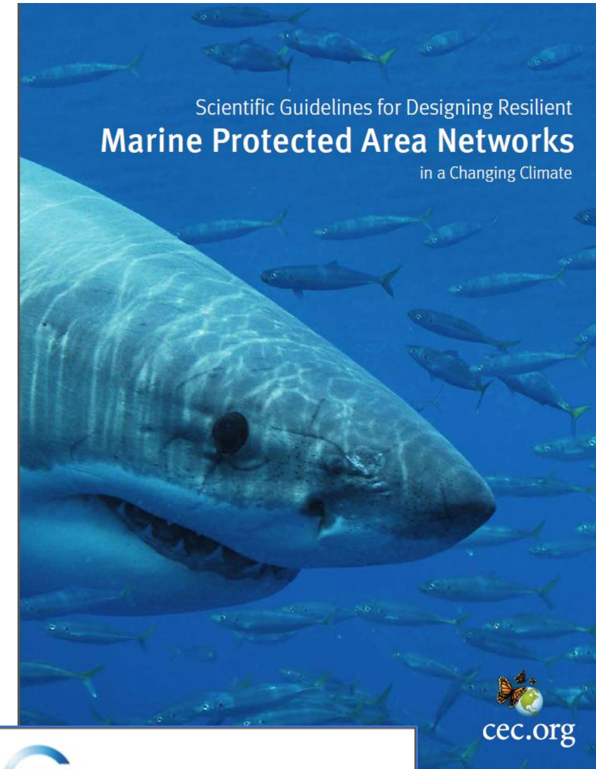
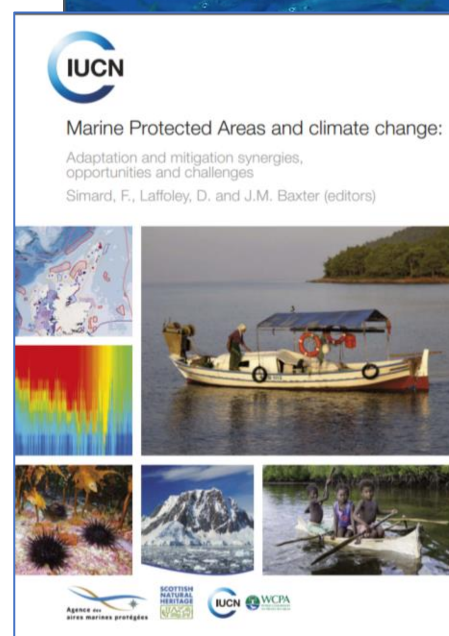
A decade of thinking









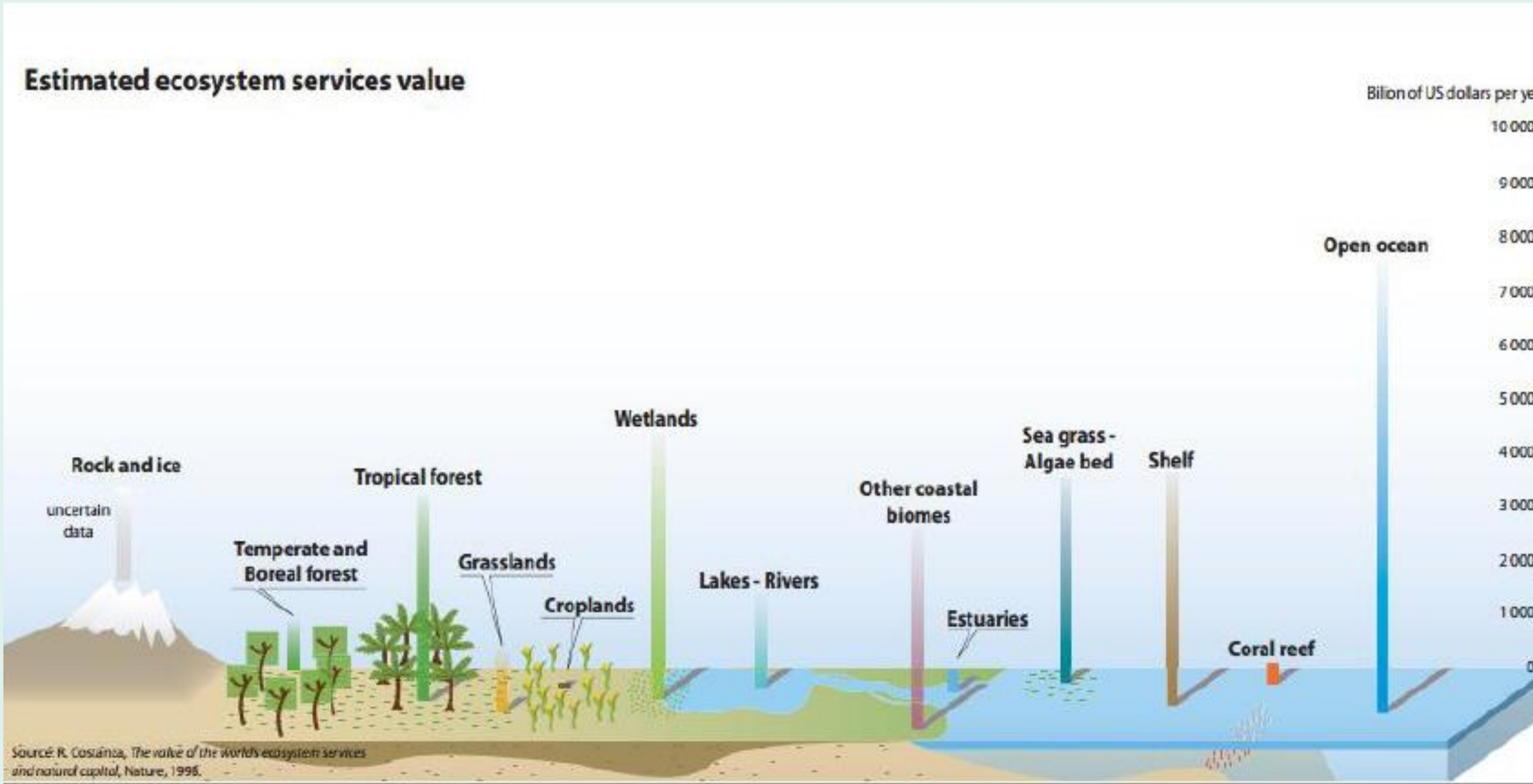
Protected Area Networks – what are we trying to do?

A collection of individual protected areas that operate cooperatively and synergistically, at various spatial scales, and with a range of protection levels, in order to fulfil ecological aims more effectively and comprehensively than individual sites could alone

The role of a network of MPAs is to *connect and protect those areas needed to bolster ecosystem functioning* so that the overall health of the ocean is not jeopardised by human uses

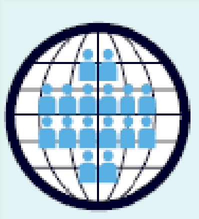
MPA networks matter for securing ocean health values

"protecting biodiversity and the essential ecosystem services it supports has become a priority for the scientific community, resource managers, and national and international policy agreements…" (Selig et al, 2014)



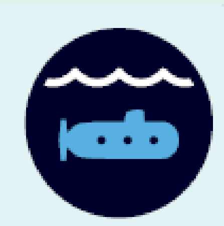
Courtesy GRID-Arendal

Causes of overall ocean decline



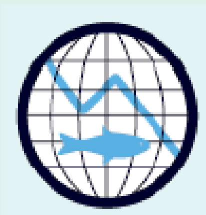
Rising Demand for Resources

- Minerals and energy
- Genetic materials
- Living marine resources



Technological Advances

- Deep sea access and exploitation
- Vessels (distance and depth)
- Increased (over)extraction
- Destructive fishing and other activities



Decline of Fish Stocks

- Overfishing
- Overcapacity
- Subsidies

Climate Change, Biodiversity and Habitat Loss

- Climate change
- Acidification
- Pollution

Weak High Seas Governance

- Patchwork/sectoral/incomplete governance
- Weak compliance and lack of enforcement
- New and emerging uses

Adapted from Global Ocean Commission Summary Report 2014

The relationship between MPA networks and resilience

Resilience or robustness – the maintenance of functioning in the face of disturbance:

- Resistance to change and inherent flexibility within which the system can return to its reference state, before the system changes its structure by changing the variables and processes that control behaviour

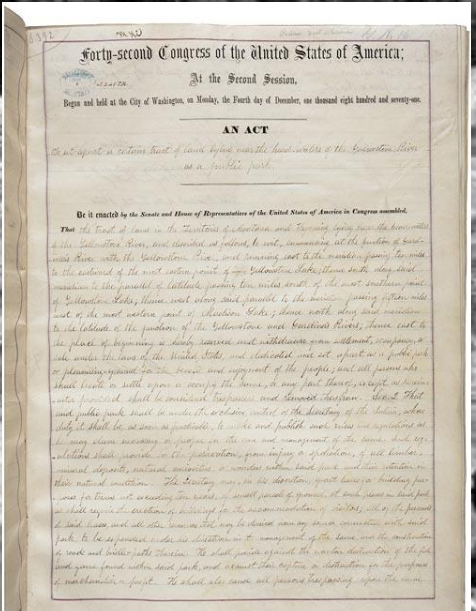
- The ability of the system to recover and stay on track despite pressures of change on the system, while retaining essentially the same function, structure, feedbacks, and therefore identity

The critical relationship between well-founded MPA networks - that secure biological diversity, its variability, ecosystem services and the underlying supporting mechanisms - and the maintenance of socio-ecological resilience which is reliant on these parameters

Early steps….

Protecting special places and their habitats and species for the future enjoyment of everyone

Continuity of existence



Forty-second Congress of the United States of America;

At the Second Session,

Begun and held at the City of Washington, on Monday, the Fourth day of December, one thousand eight hundred and seventy-one.

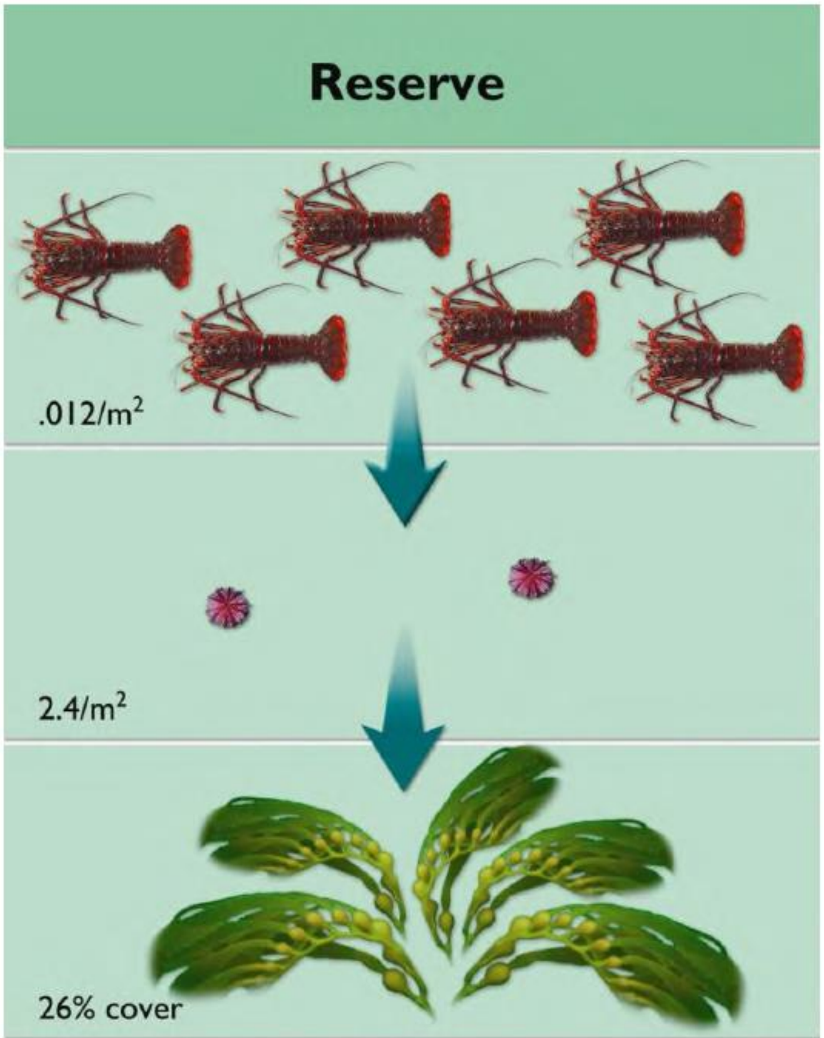
AN ACT

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

1872

http://time.com/3907099/yellowstone-first-national-park/

Managing for a changing climate: Anacapa Marine Reserve, California, United States



The reserve protects an intact food web to support a healthy ecosystem

Image: PISCO

Behrens & Lafferty 2004

Managing for a changing climate: Anacapa Marine Reserve, California, United States

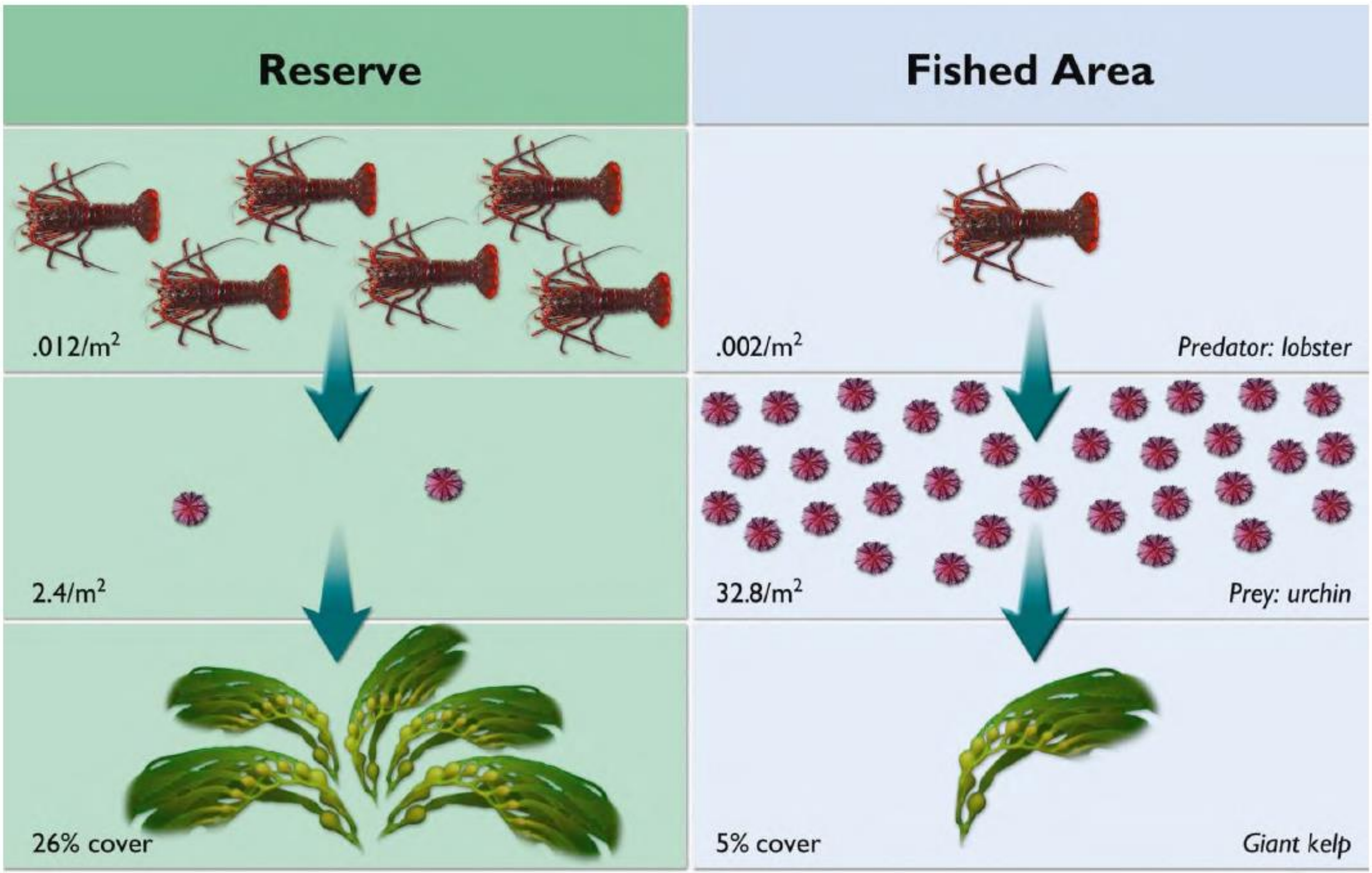
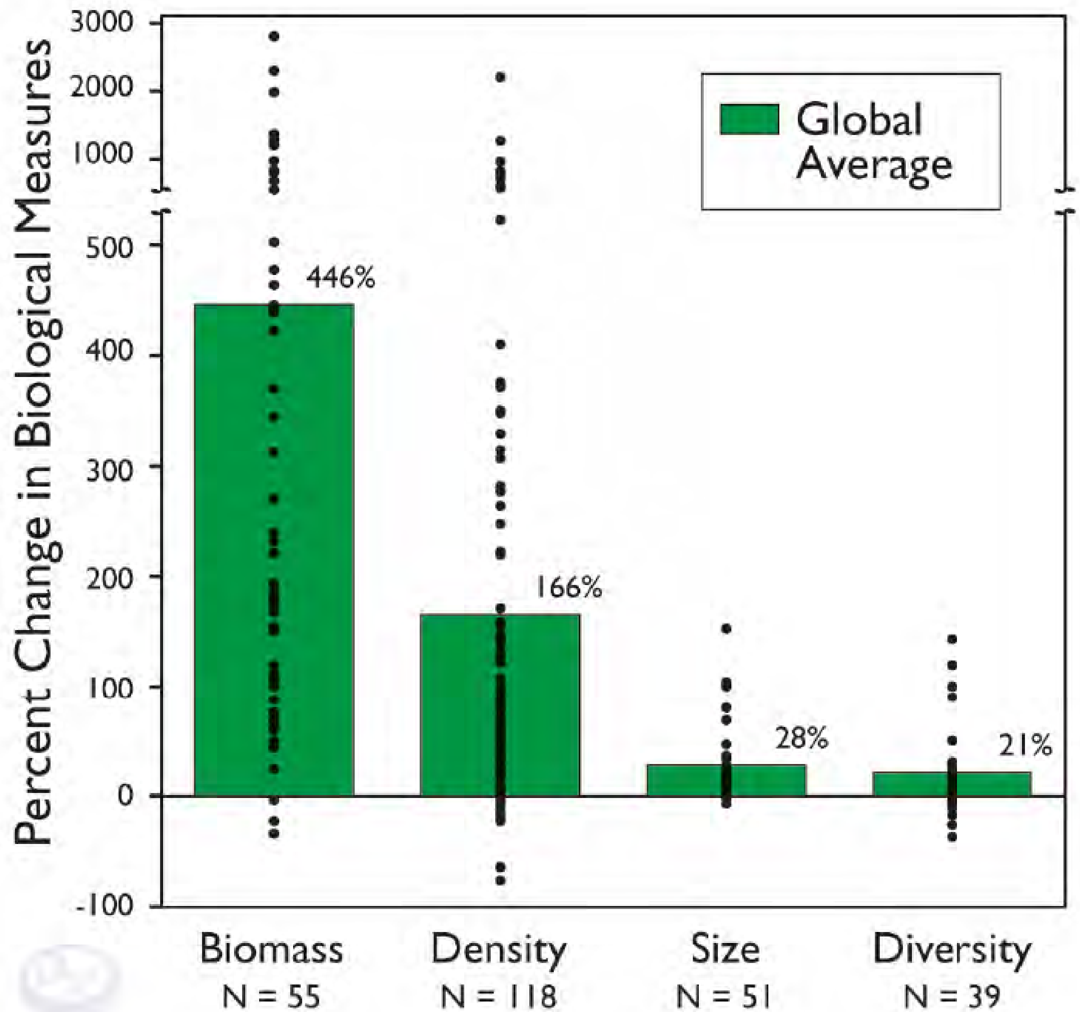


Image: PISCO

Behrens & Lafferty 2004

Are there patterns in marine reserve effects?



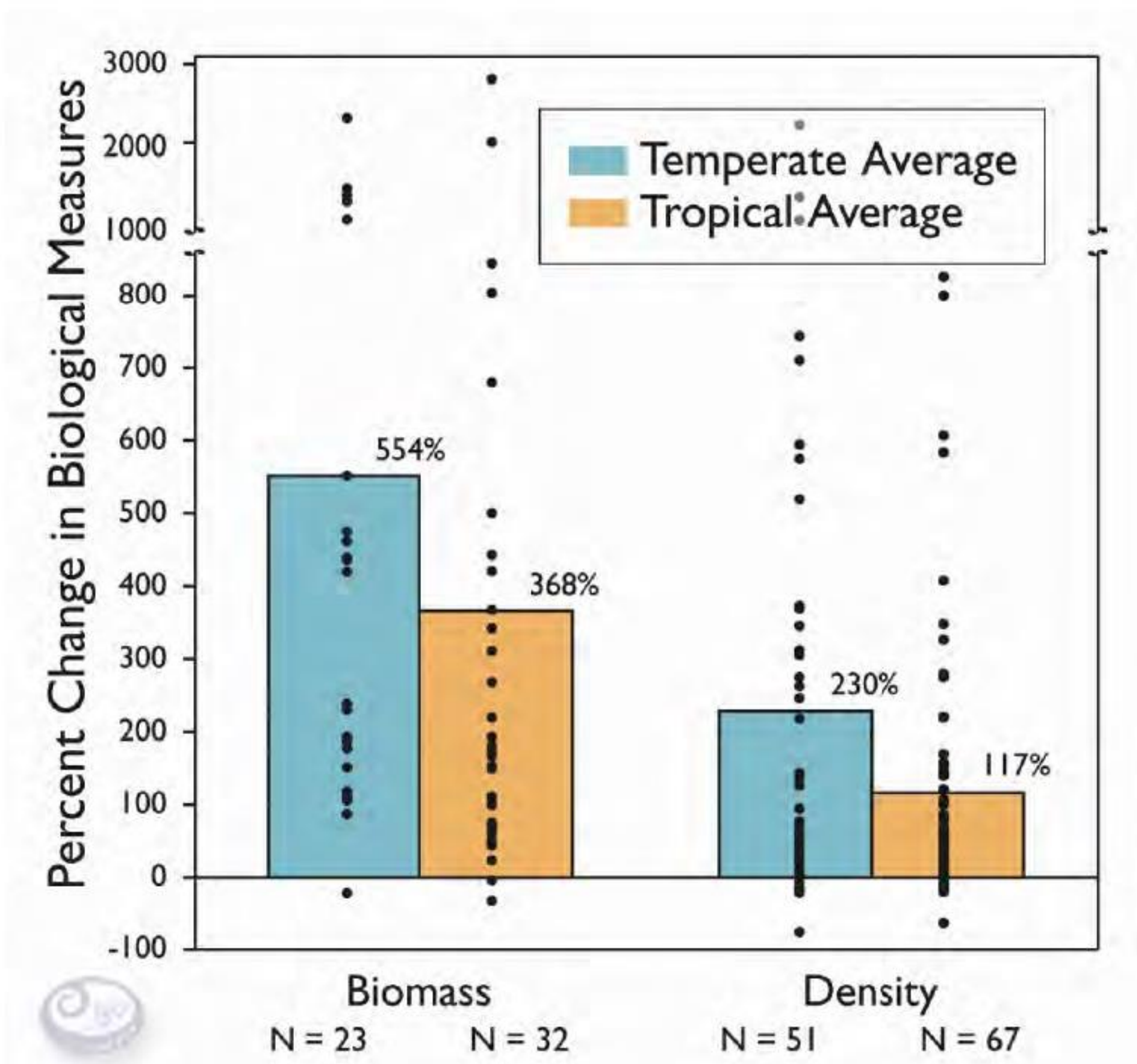
Marine reserves have:

- Greater biomass
- Greater density
- Larger sizes of individual plants and animals
- Higher biodiversity

on average than nearby non-protected areas

Lester, Halpern, Grorud-Colvert, Lubchenco, et al. 2009

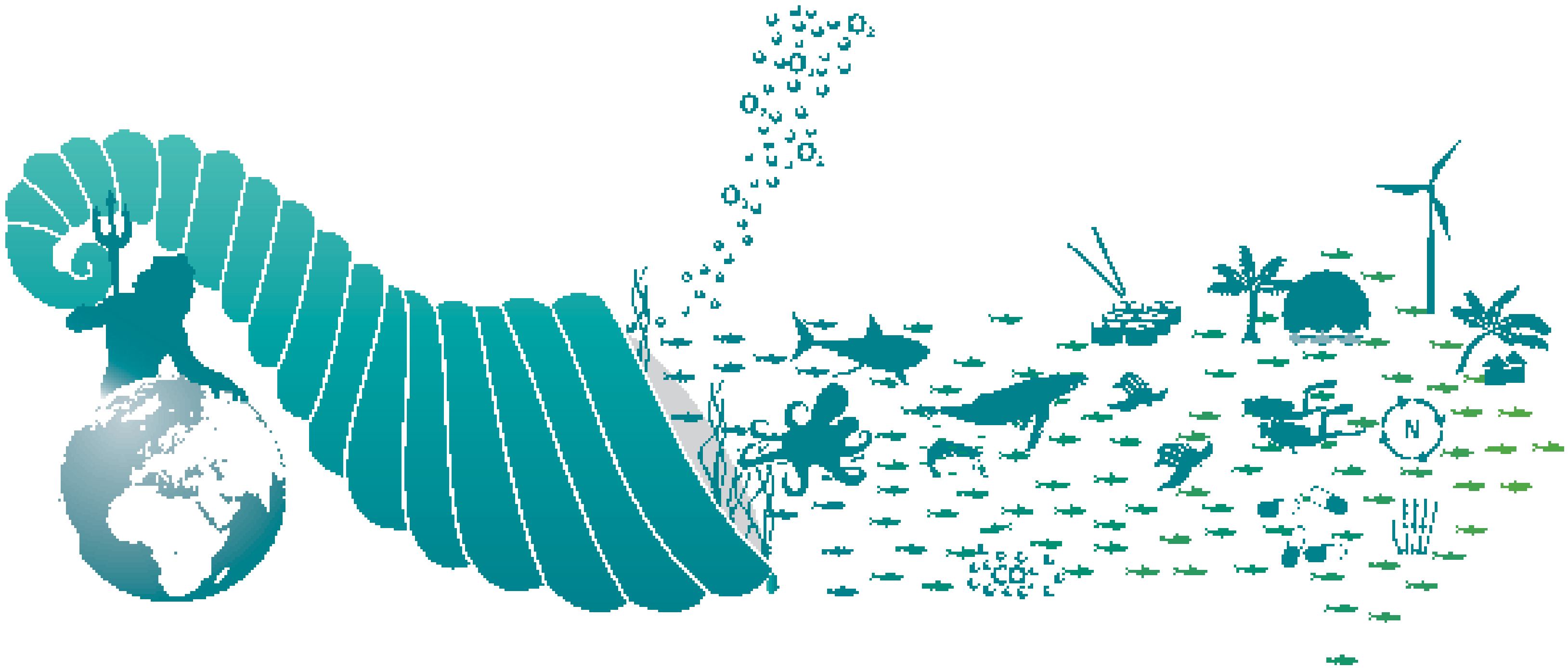
Across regions, from temperate to tropical



Lester, Halpern, Grorud-Colvert, Lubchenco, et al. 2009

Latest thinking on MPA networks and wider measures

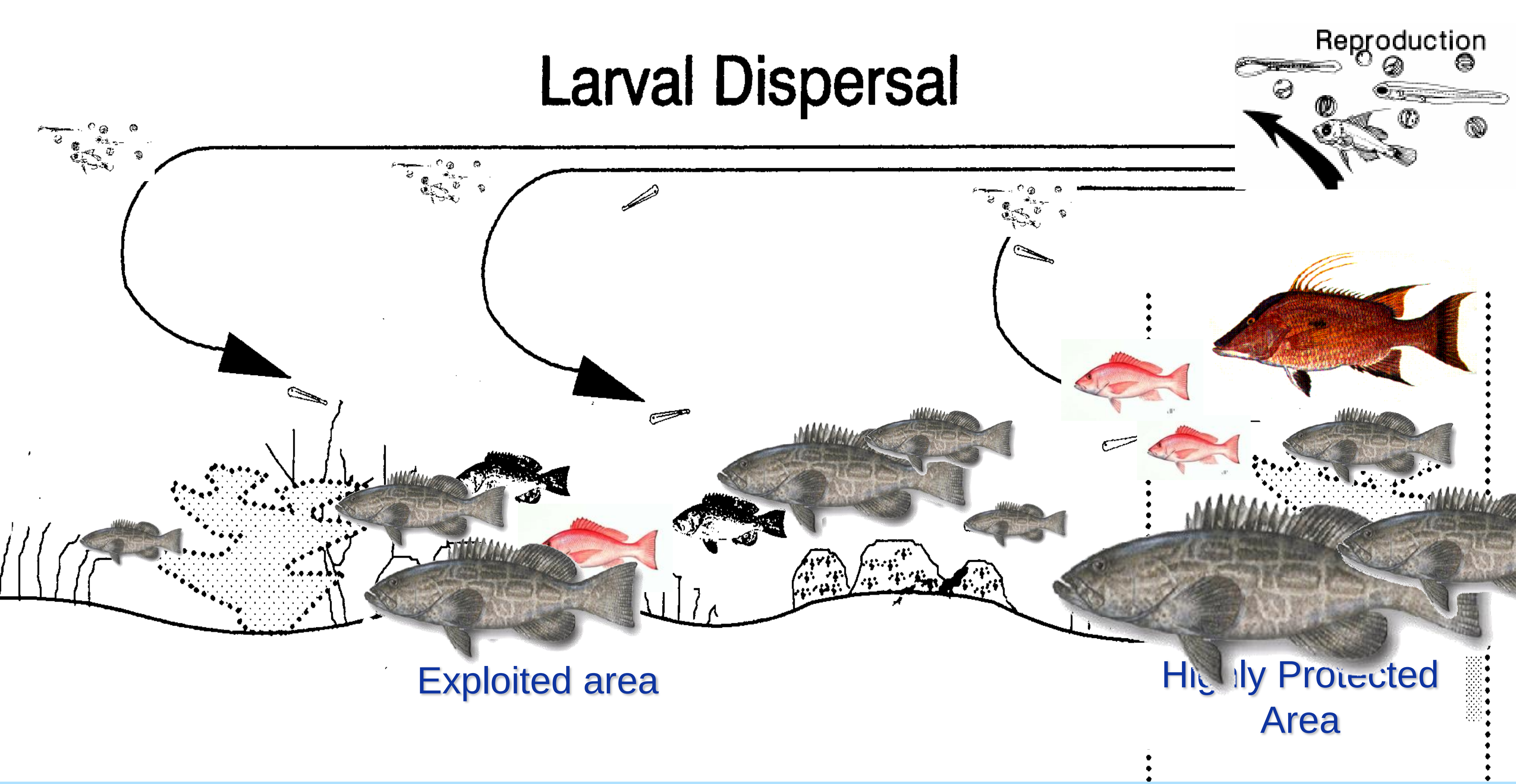
Protecting habitats, species, ecosystem, and the services they provide to the planet and human kind



https://bluesolutions.info/images/Ecosystem-Services-April-2015.png

Spillover

Reproduction & Dispersal

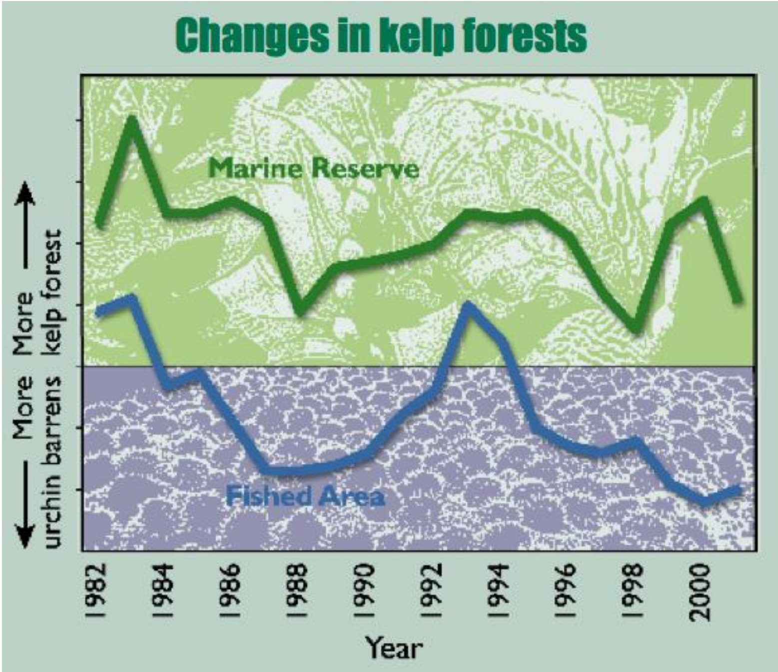


Colonization & Growth

Abundance

Diversity

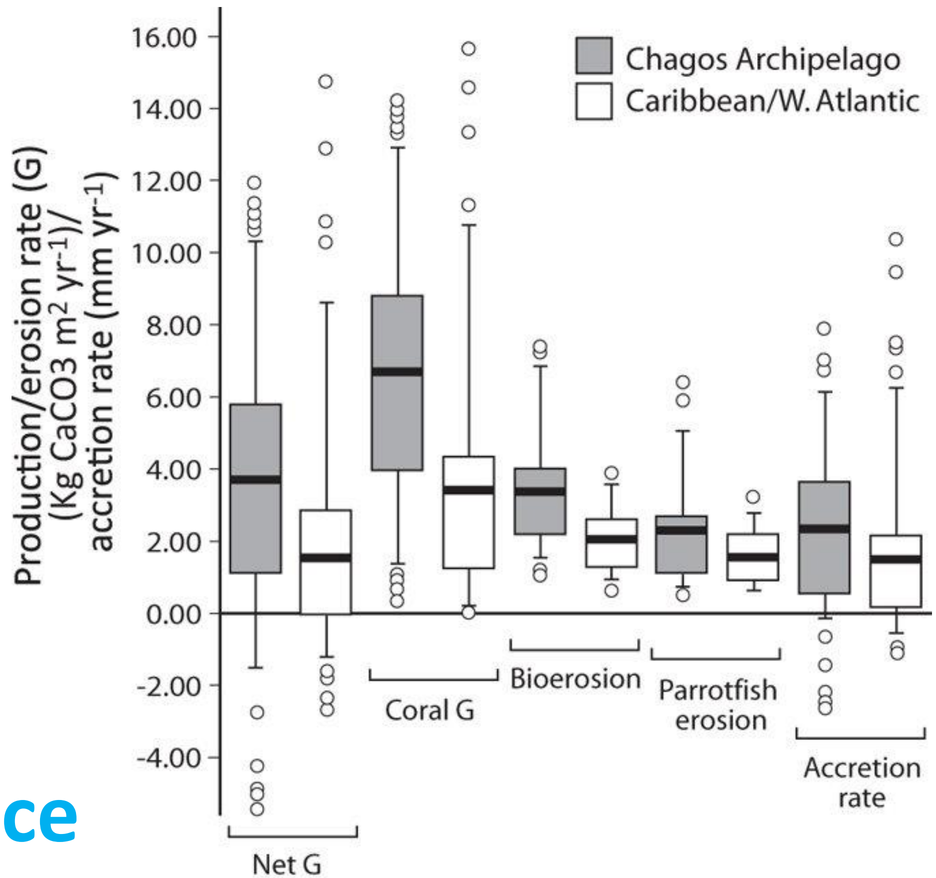
Jim Bohnsack/NOAA



Lester, Halpern, Grorud-Colvert, Lubchenco, et al. 2009

Temperate

Tropical



http://www.nature.com/articles/srep18289

Robustness and resilience

“Actions aimed at reducing the effects of local disturbances on reefs are thus critical to provide any buffering for reefs from climate-change and to instil any capacity to maintain their accretion potential that so critically underpins the provisioning of most ecosystem services”

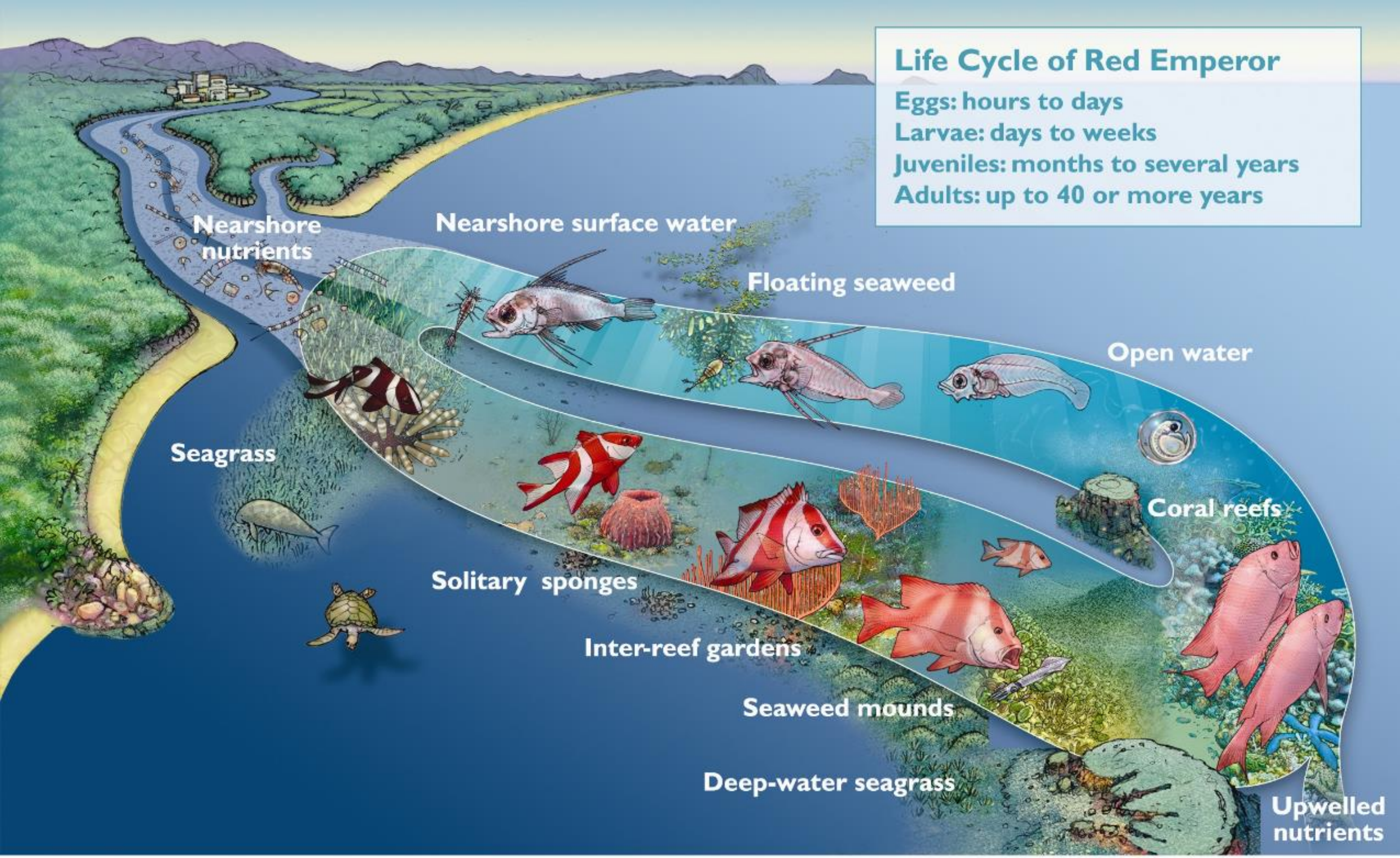
Increasing focus on MPA networks and the benefits they bring

Biodiversity cannot be secured by efforts of single MPA or an individual country.

Conservation at larger scale is required in the face of multiple stressors on the ocean – climate change including ocean warming, ocean acidification and ocean deoxygenation on top of 'traditional' region-wide stressors – such as fishing and chemical and plastic pollution

Network benefits include:

- Far greater efficiency and effectiveness of reducing risk and in enhancing resilience
- Minimize duplication of efforts and resources
- Ensuring protection of ecosystems or species that cannot be adequately protected on one country, such as migratory species
- Ensuring transboundary protected areas are given adequate attention
- Sharing effective conservation approaches across similar sites in different regions
- Developing collaboration between neighbouring countries to address common
- challenges and issues
- Strengthening capacity by sharing experiences and lessons learned, new
- technologies and management strategies, and by increasing access to relevant
- information



A red emperor uses many habitats throughout its life. Open water, floating seaweed, seagrass, sponges, and coral reefs are important for growth and survival during different life stages of this fish. *Image courtesy of Russell Kelley*

http://www.piscoweb.org/files/images/SMR/RedEmperor%20LifeCycle.JPG

Ecosystem Services – sustaining life

Provisioning Services	**Regulating Services**	**Cultural Services**
Products obtained from ecosystems	***Benefits obtained from the regulation of ecosystem services***	***Nonmaterial benefits obtained from ecosystems***
• **Food** • **Freshwater** • **Fuel wood** • **Fiber** • **Biochemicals** • **Genetic resources**	• **Climate regulation** • **Disease regulation** • **Water regulation** • **Water purification** • **Pollination**	• **Spiritual and religious** • **Recreation and ecotourism** • **Aesthetic** • **Inspirational** • **Educational** • **Sense of place** • **Cultural**

Supporting Services

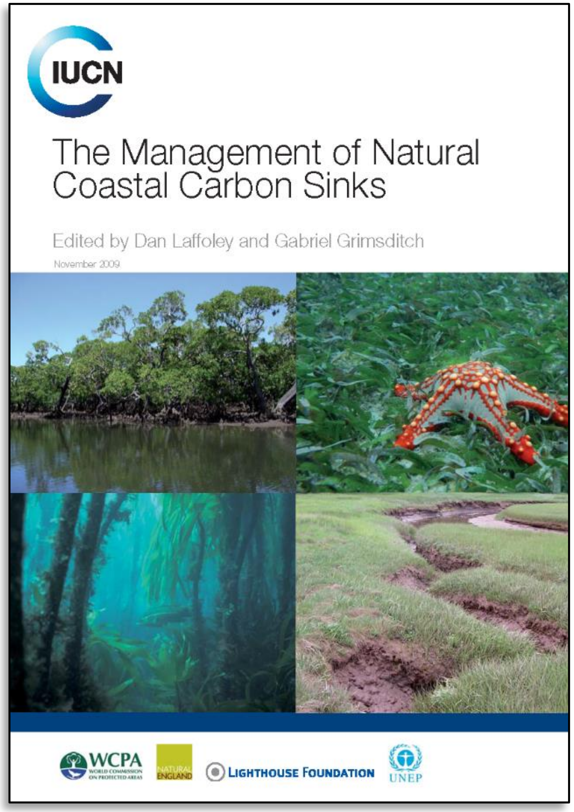
Services necessary for the production of all other ecosystem services

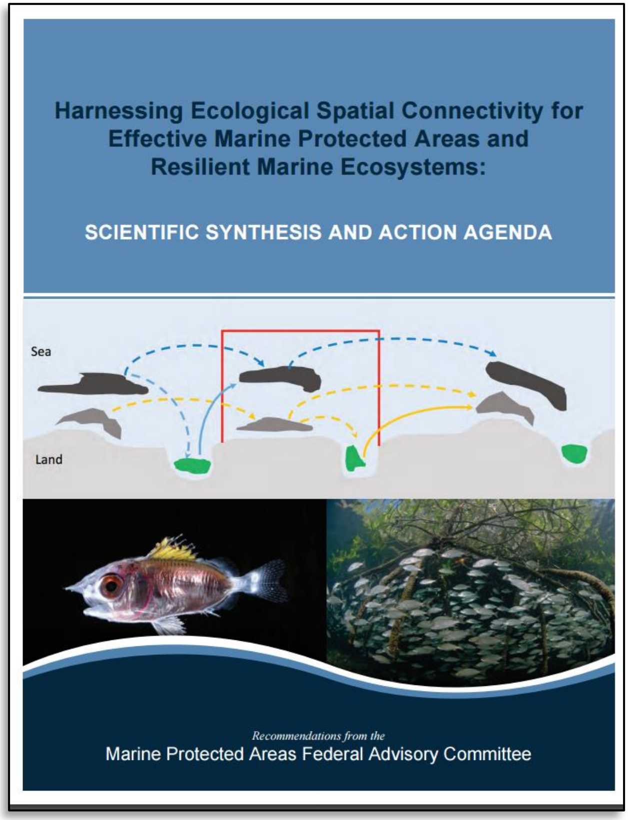
Soil/sediment formation | Nutrient cycling | Primary production

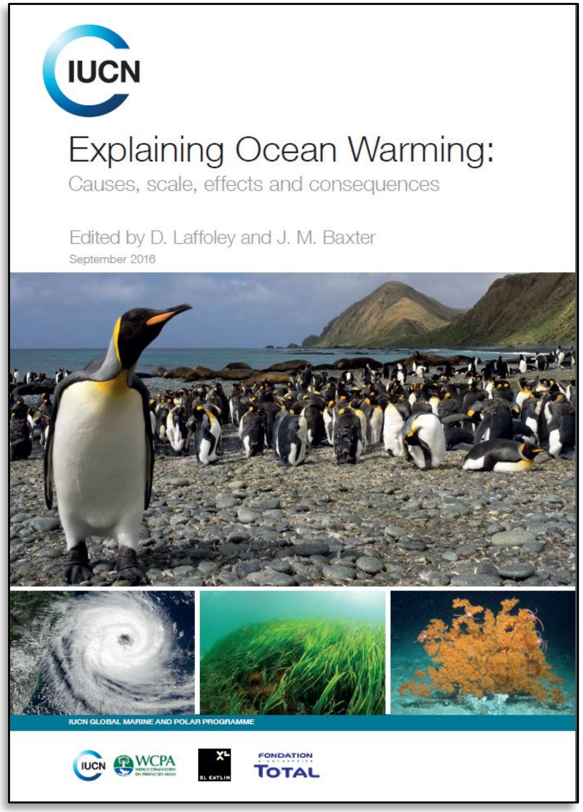
Healthy intact biodiverse marine ecosystems to supply services = well-founded MPAs and networks

Adapted from the Millennium Ecosystem Assessment

Driven a strong interest in services, connectivity and rate and direction of change of overriding drivers....

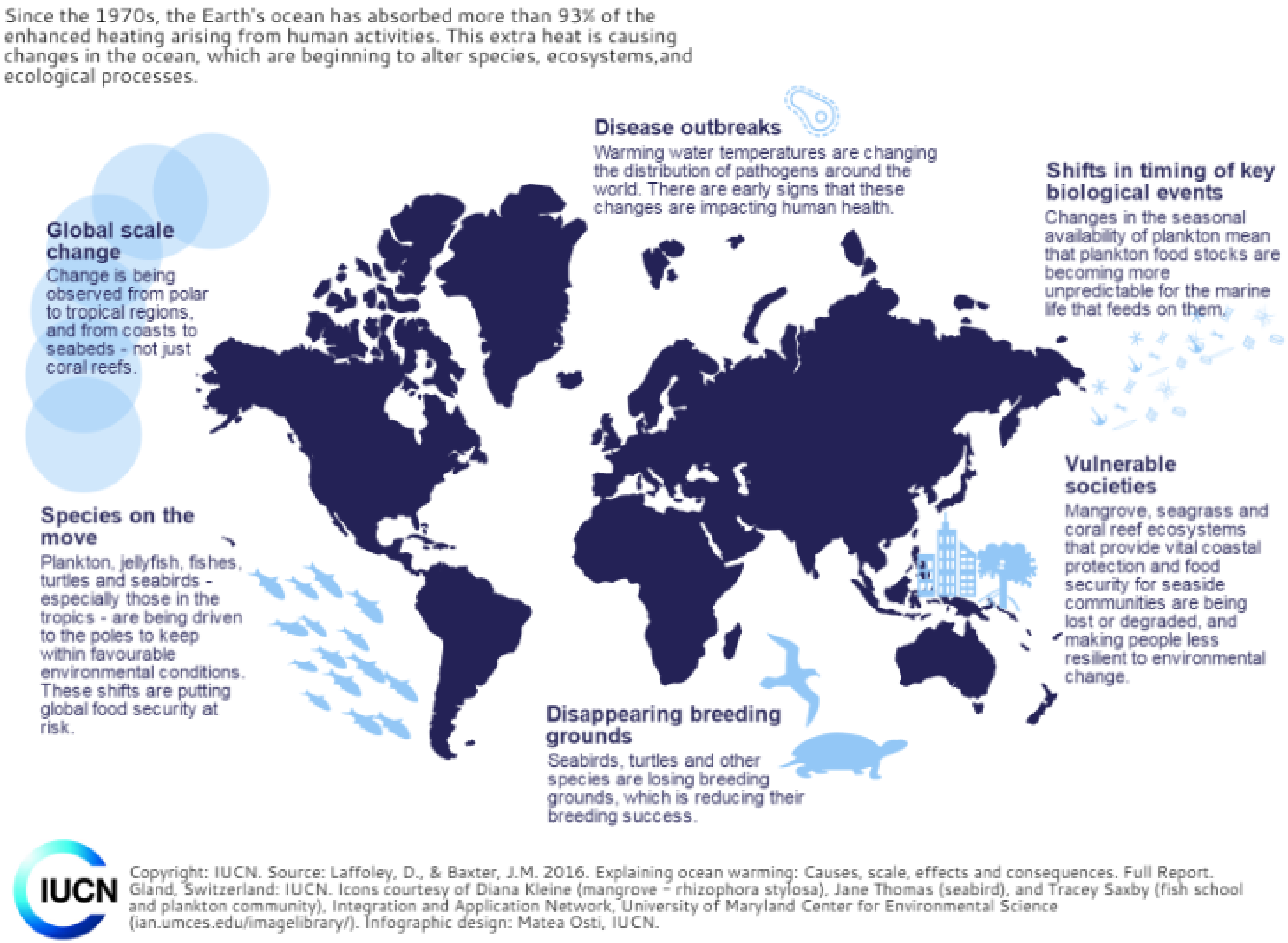






And levels of required ambition……

a warming ocean……



Marine ‘climate trajectories’

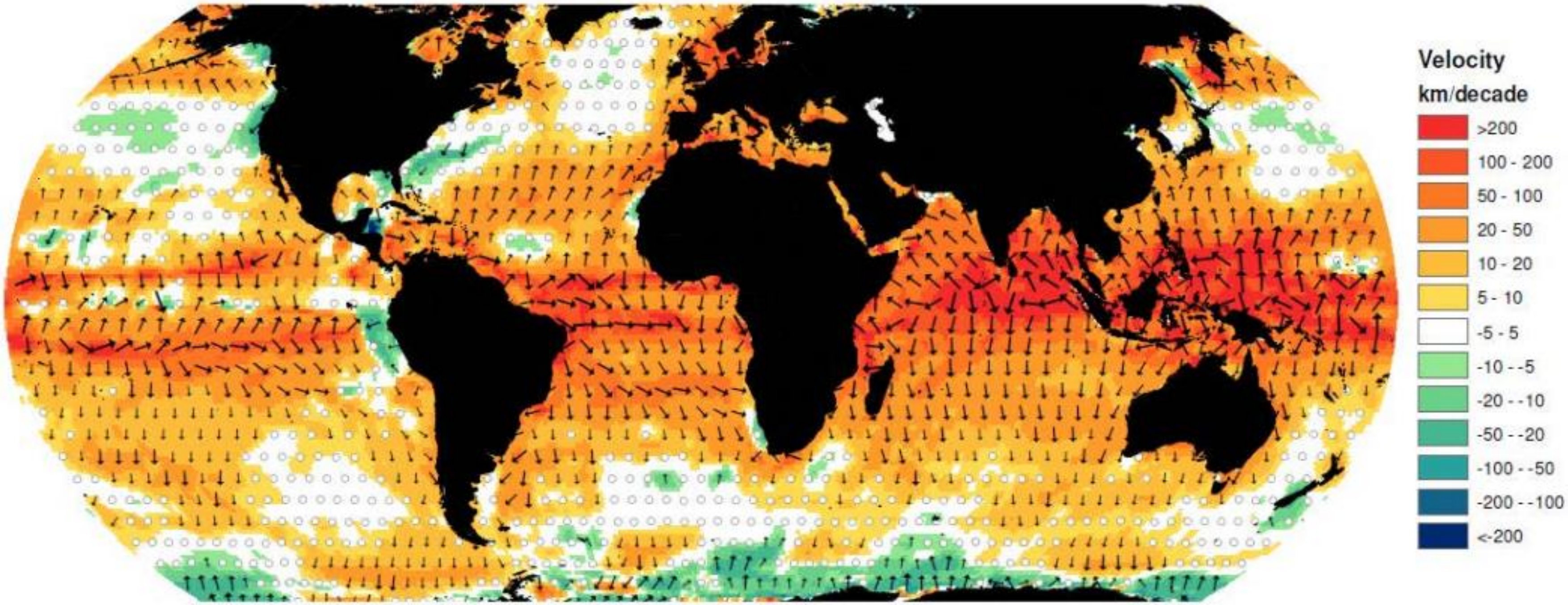
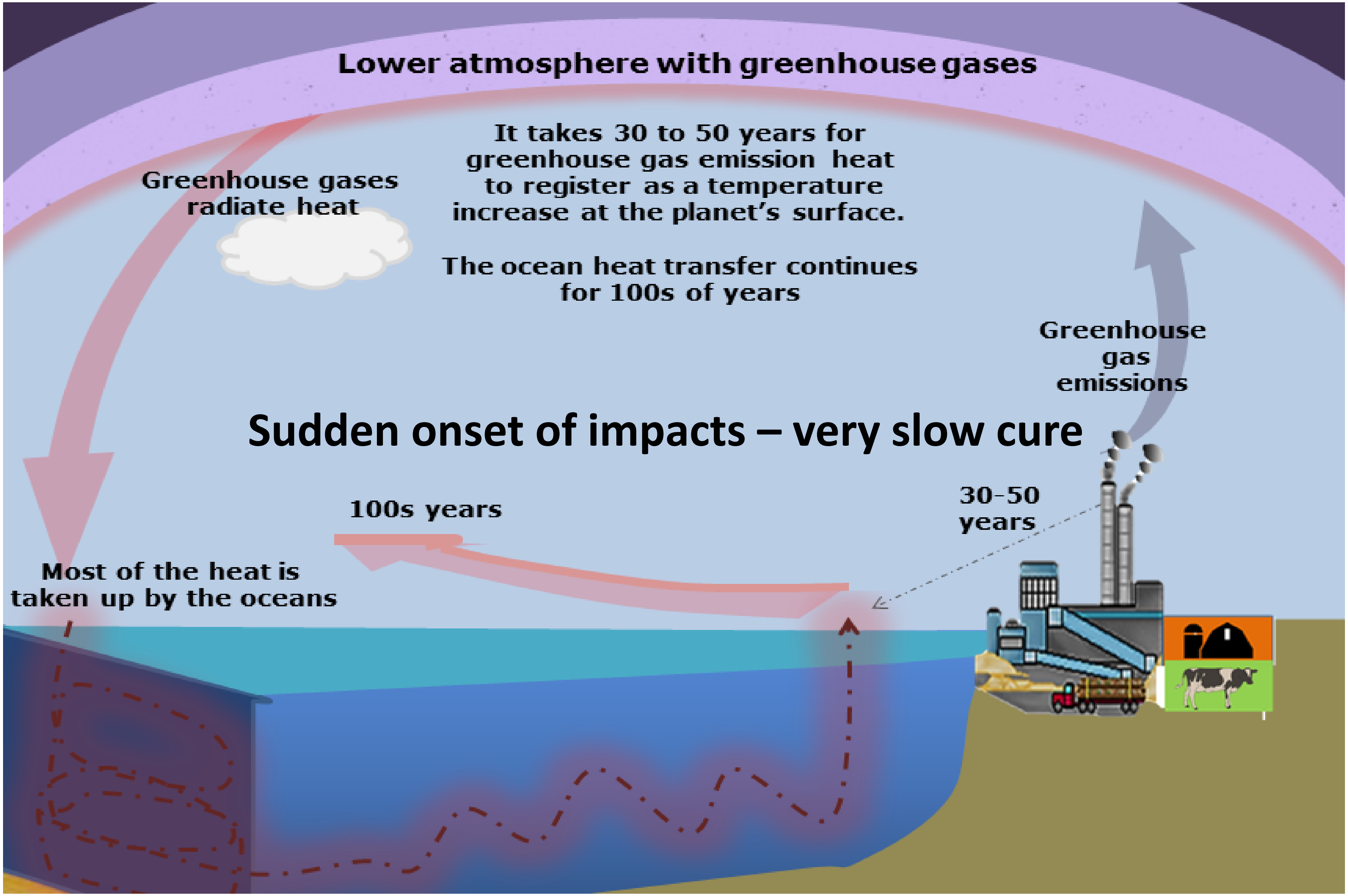


Figure 30-3: Velocity at which sea surface temperature (SST) isotherms shifted (km decade^{-1}) over the period 1960–2009 calculated using HaDISST1.1, with arrows indicating the direction and magnitude of shifts. Velocity of climate change is obtained by dividing the temperature trend in °C decade^{-1} by the local spatial gradient °C km^{-1}. The direction of movement of SST is denoted by the direction of the spatial gradient and the sign of the temperature trend: towards locally cooler areas with a local warming trend or towards locally warmer areas where temperatures are cooling. Adapted from [*Burrows et al.*, 2011].

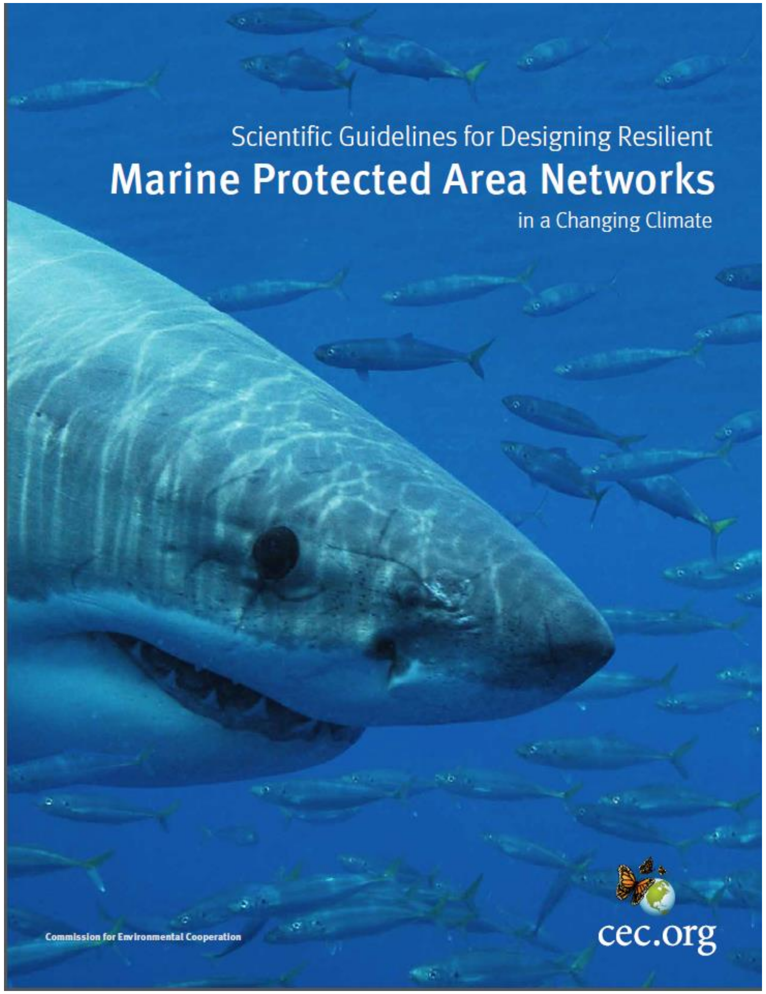
Chapter 30, AR5, IPCC



Climate system inertia
due to the ocean heat delay / lag
(the lag is the time it takes for an emission to a temperature increase registering at the surface)

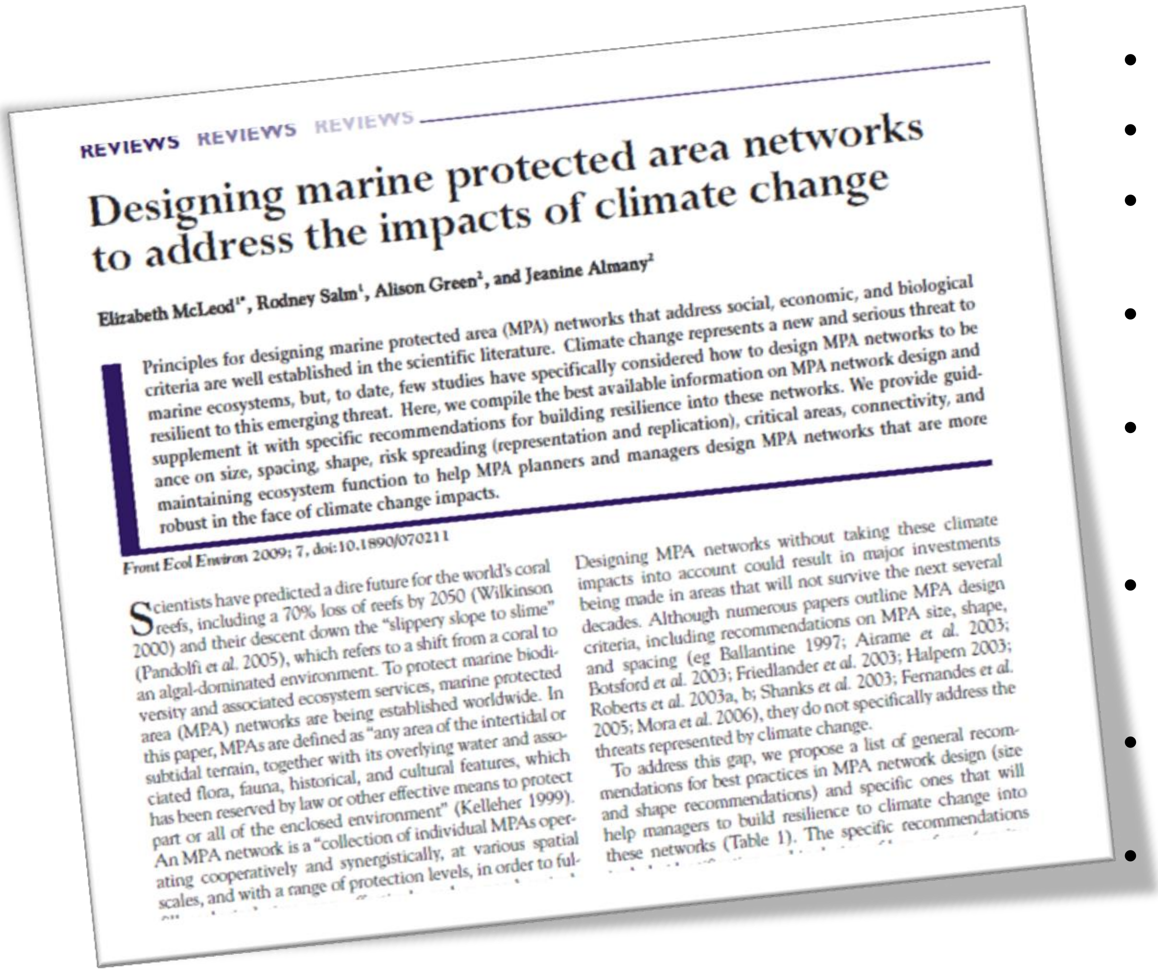
http://www.climateemergencyinstitute.com/uploads/Ocean_heat_lag_15_may.png

How do we encourage ‘resilience’ and robustness using MPA networks?



- Protect species and habitats with crucial ecosystems roles, or those of special concern
- Protect potential carbon sinks
- Protect ecological linkages and connectivity pathways for a wide range of species
- Protect the full range of biodiversity present in the target biogeographical area

Seven consequences of climate change for MPA network design?



REVIEWS REVIEWS REVIEWS

Designing marine protected area networks to address the impacts of climate change

Elizabeth McLeod[1*], Rodney Salm[1], Alison Green[2], and Jeanine Almany[2]

Principles for designing marine protected area (MPA) networks that address social, economic, and biological criteria are well established in the scientific literature. Climate change represents a new and serious threat to marine ecosystems, but, to date, few studies have specifically considered how to design MPA networks to be resilient to this emerging threat. Here, we compile the best available information on MPA network design and supplement it with specific recommendations for building resilience into these networks. We provide guidance on size, spacing, shape, risk spreading (representation and replication), critical areas, connectivity, and maintaining ecosystem function to help MPA planners and managers design MPA networks that are more robust in the face of climate change impacts.

Front Ecol Environ 2009; 7, doi:10.1890/070211

Scientists have predicted a dire future for the world's coral reefs, including a 70% loss of reefs by 2050 (Wilkinson 2000) and their descent down the "slippery slope to slime" (Pandolfi *et al.* 2005), which refers to a shift from a coral to an algal-dominated environment. To protect marine biodiversity and associated ecosystem services, marine protected area (MPA) networks are being established worldwide. In this paper, MPAs are defined as "any area of the intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical, and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment" (Kelleher 1999). An MPA network is a "collection of individual MPAs operating cooperatively and synergistically, at various spatial scales, and with a range of protection levels, in order to ful-

Designing MPA networks without taking these climate impacts into account could result in major investments being made in areas that will not survive the next several decades. Although numerous papers outline MPA design criteria, including recommendations on MPA size, shape, and spacing (eg Ballantine 1997; Airame *et al.* 2003; Botsford *et al.* 2003; Friedlander *et al.* 2003; Halpern 2003; Roberts *et al.* 2003a, b; Shanks *et al.* 2003; Fernandes *et al.* 2005; Mora et *al.* 2006), they do not specifically address the threats represented by climate change.

To address this gap, we propose a list of general recommendations for best practices in MPA network design (size and shape recommendations) and specific ones that will help managers to build resilience to climate change into these networks (Table 1). The specific recommendations

- **Size** – bigger the better
- **Shape** – keep it simple
- **Protection** – higher levels deliver greater resilience
- **Spread the risk** – representation, replication, spread, provinces
- **Critical areas** – not just biologically or ecologically important but climate-resilient locations
- **Connectivity** – mutual replenishment, whole ecological units, systems, 'future space'
- **Ecosystem functions** – functional groups, ecosystem services
- **Integration** – embed in broader management, land/sea interactions


Thank you!
Find out more @ danlaffoley.com