Building Resilient MPA Networks – Summary of Commission for Environmental Cooperation Reports

Dr. Ellen Kenchington

Department of Fisheries and Oceans, Canada

Bedford Institute of Oceanography

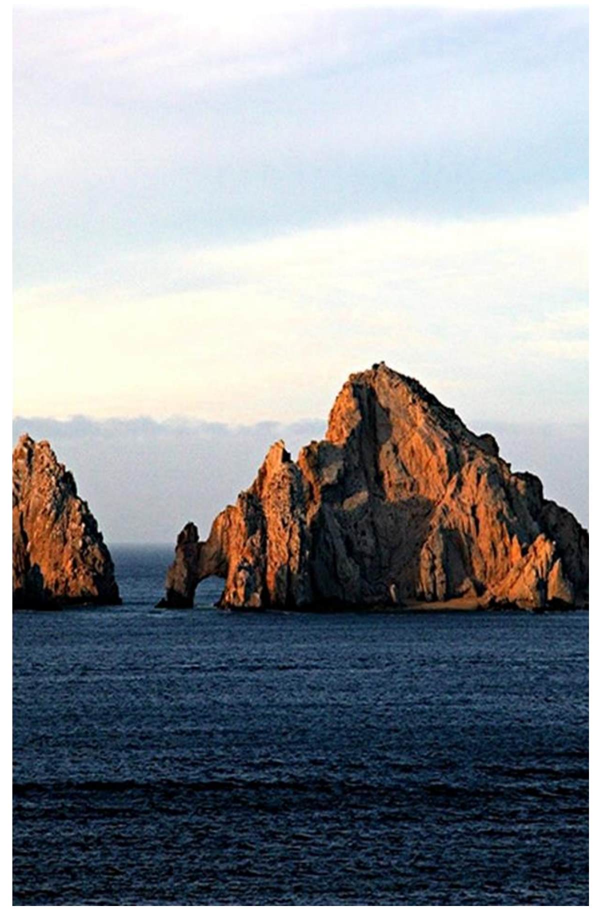
Dartmouth, Nova Scotia, Canada

Arctic Council/PAME Workshop – Science and Tools for Developing Arctic MPA Networks: Understanding MPA Networks as Tools for Resilience in a Changing Arctic
February 2-3, 2017
Copenhagen, Denmark

Commission for Environmental Cooperation (CEC)

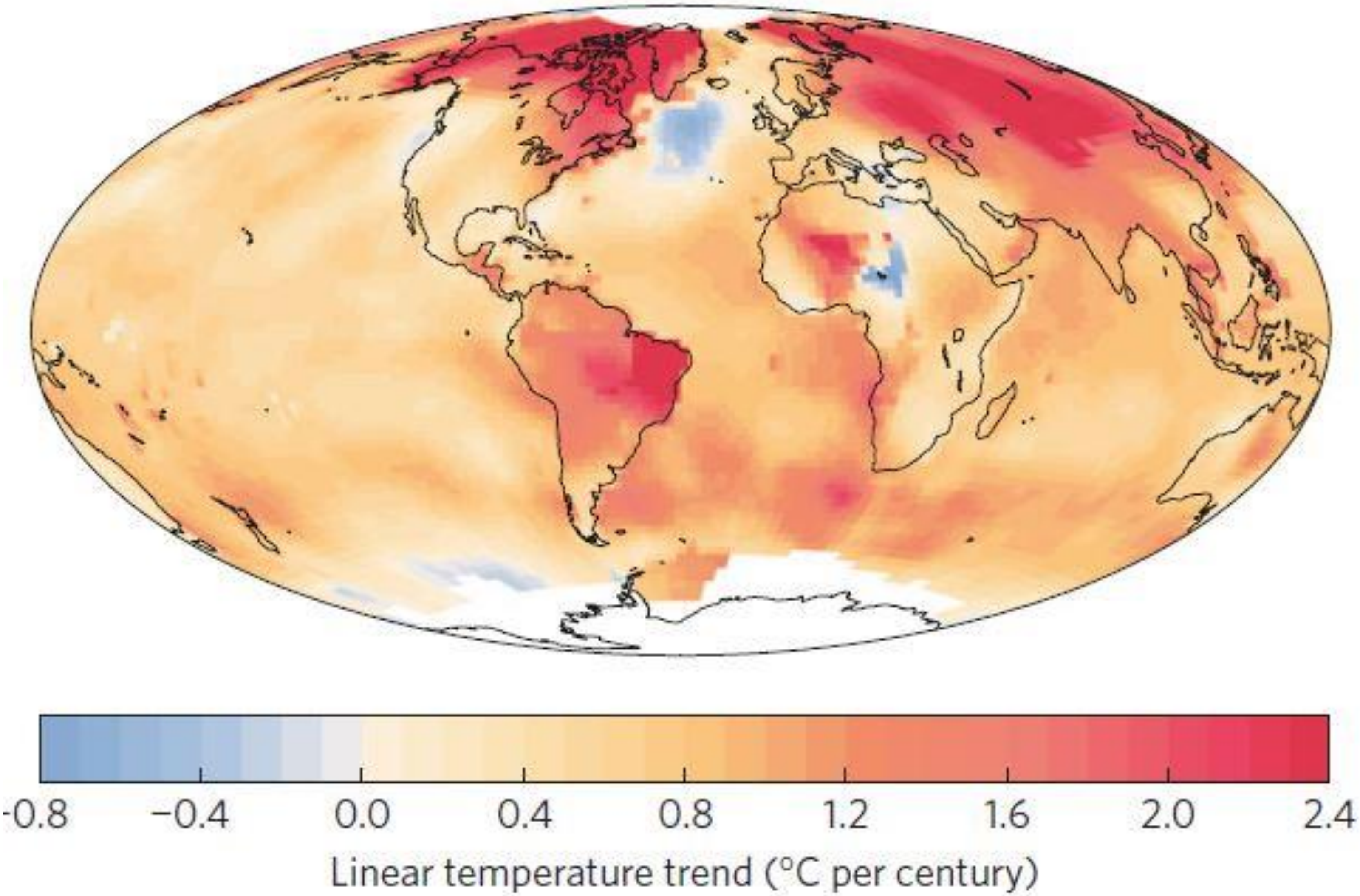
http://www.cec.org/



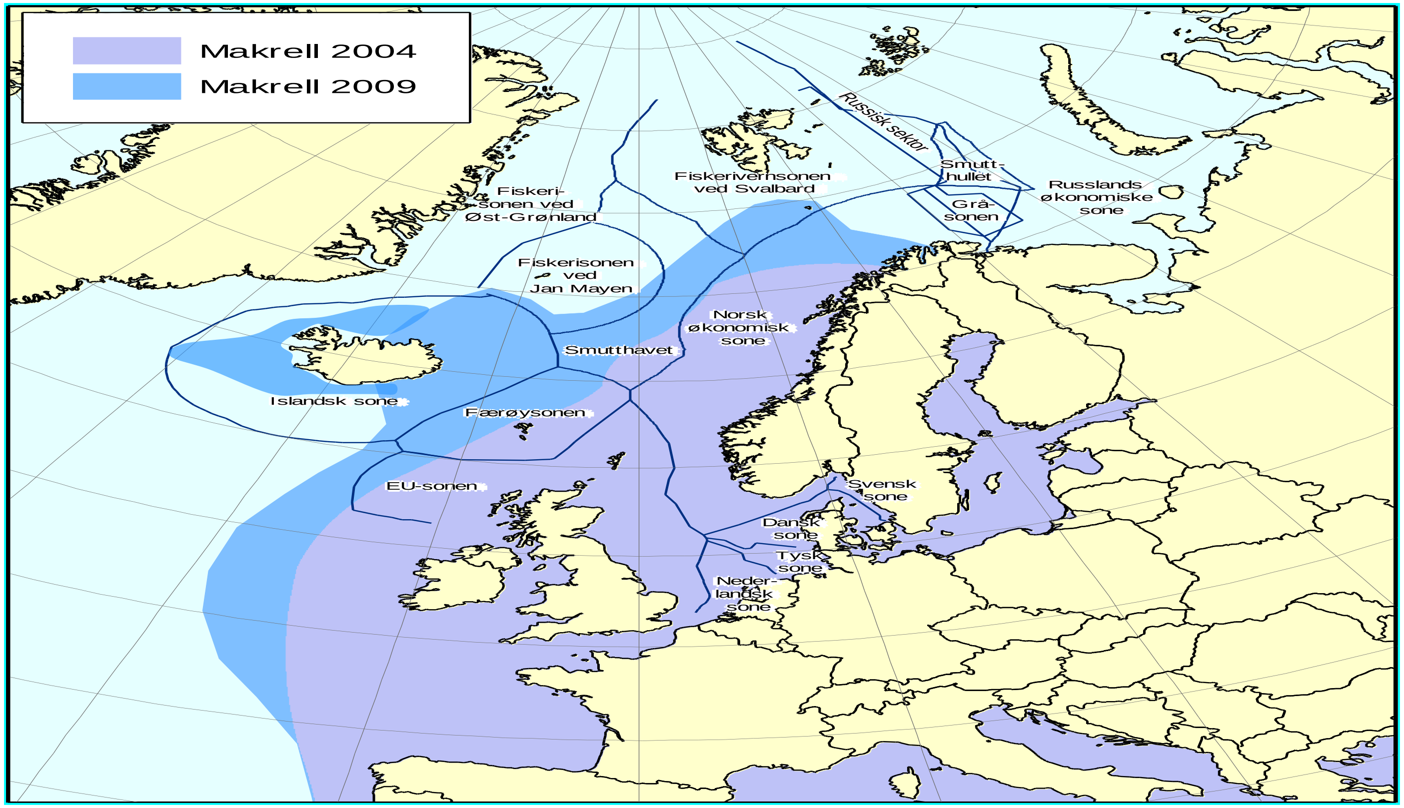


The **North American Marine Protected Areas Network (NAMPAN)** was catalyzed by a workshop in November 1999 with support from the CEC in North America's Conservation of Biodiversity Program.

The goal of NAMPAN is to work with a tri-national, multi-sectoral group of stakeholders in establishing an effective system of North American MPA networks that enhances and strengthens the protection of marine biodiversity.


-0.8
−0.4
0.0
0.4
0.8
1.2
1.6
2.0
2.4
Linear temperature trend (°C per century)

MPA networks are being designed on the basis of contemporary environmental and habitat conditions



ICES-NAMPAN Study Group on Designing Marine Protected Area (MPA) Networks in a Changing Climate (SGMPAN)

November 2010, Woods Hole, MA, USA

ICES SGMPAN REPORT 2011

SCICOM STEERING GROUP ON SUSTAINABLE USE OF ECOSYSTEMS

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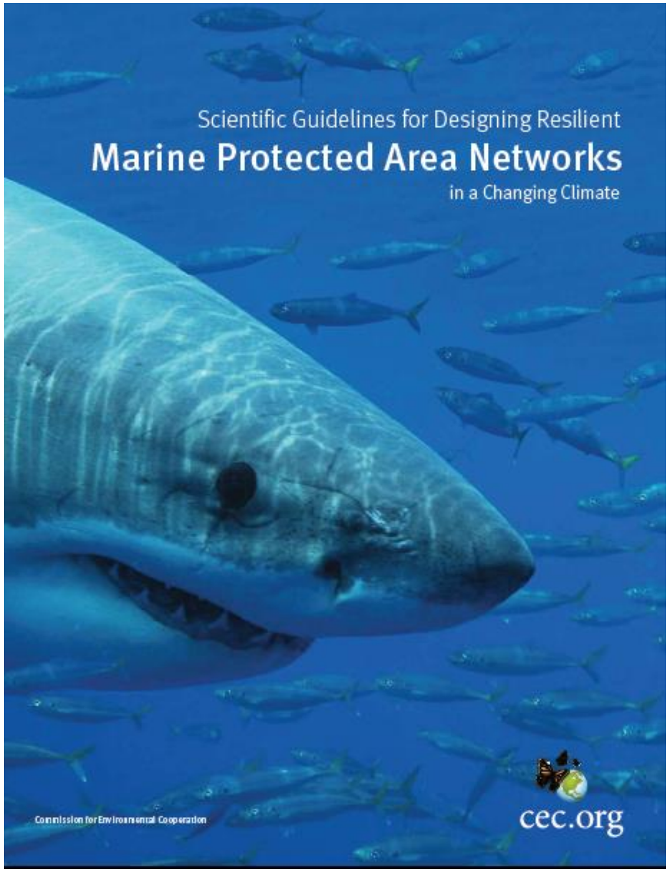
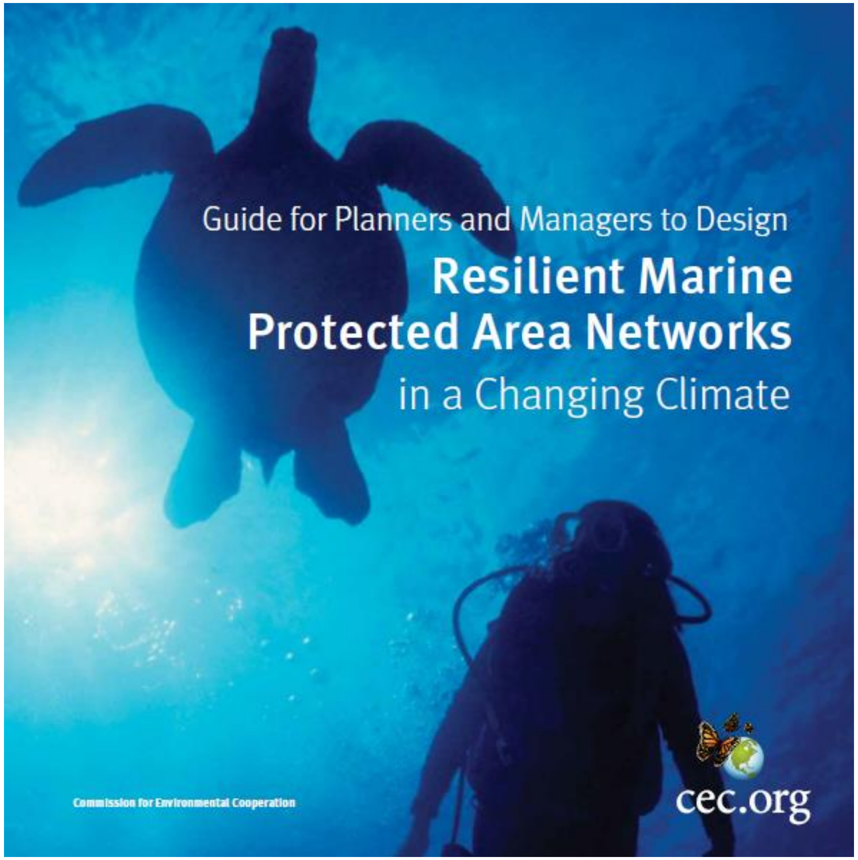
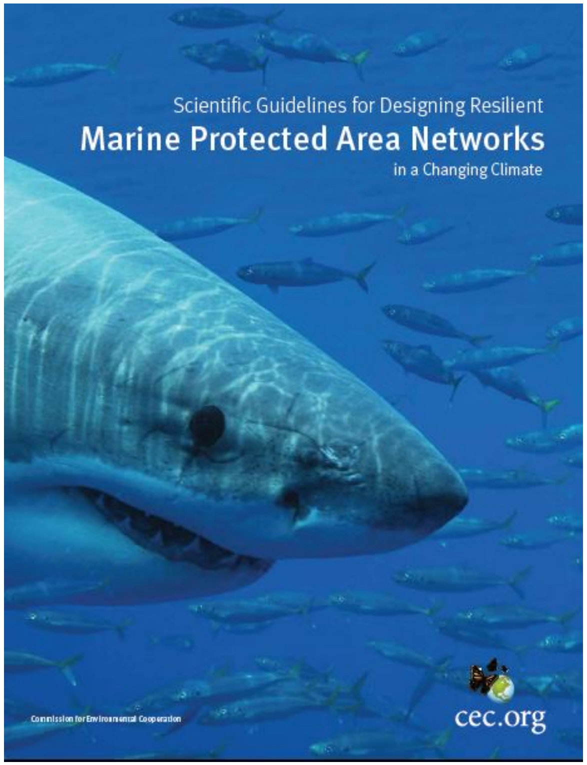

Scientific Guidelines for Designing Resilient
Marine Protected Area Networks
in a Changing Climate
Commission for Environmental Cooperation
cec.org


Guide for Planners and Managers to Design
Resilient Marine
Protected Area Networks
in a Changing Climate
Commission for Environmental Cooperation
cec.org



Guideline 1

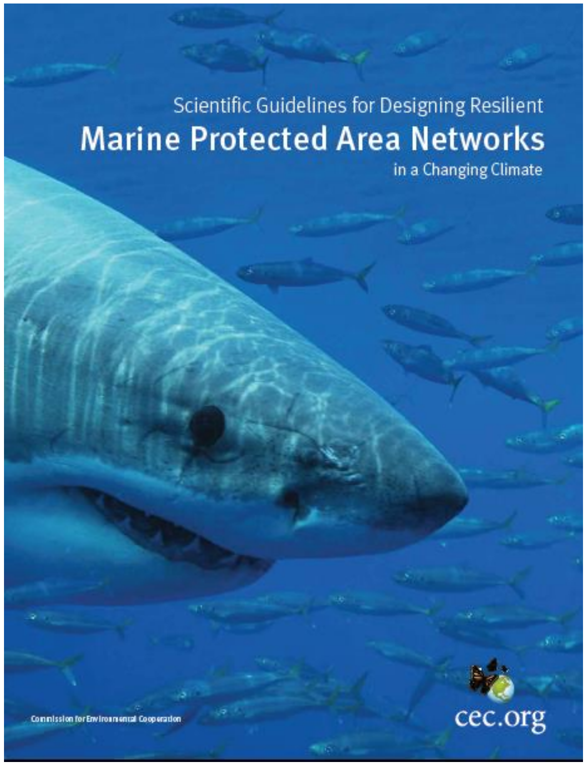
Protect Species and Habitats with Crucial Ecosystem Roles, or those of Special Conservation Concern

Step 1 Identify species and habitats with crucial ecosystem roles or those of special conservation concern.

Step 2 Identify the traits of those species/habitats identified in Step 1 that are vulnerable to projected climate change impacts.

Step 3 Determine whether the impacts of climate change on the traits identified in Step 2 can be mitigated by or adapted through MPAs or MPA networks.

Step 4 If impacts on the traits identified in Step 2 can be mitigated by MPAs or MPA networks, specialists should estimate the timescale over which their subject is expected to respond to climate change and trigger a re-evaluation of the boundaries of the MPA, or design the MPA or MPA network to be robust to these changes.



Guideline 2

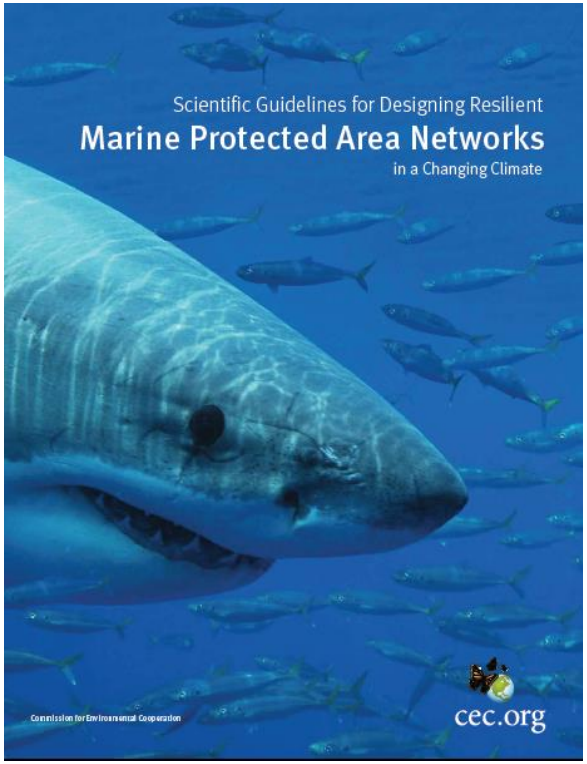
Protect Potential Carbon Sinks

Step 1 Identify habitats and species that function as potential carbon sinks

Step 2 Describe the carbon flux system, including carbon sources and the sinks identified in Step 1

Step 3 Determine whether the carbon flux system is vulnerable to impacts from climate change that can be mitigated by MPAs or MPA networks

Step 4 If impacts on the system from climate change that are identified in Step 3 can be mitigated by MPAs or MPA networks, topical specialists should estimate the trends and timescale over which the impacts are expected and trigger a re-evaluation of the boundaries of the MPA, or design the MPA or MPA network to be robust to these changes



Guideline 3

Protect Ecological Linkages and Connectivity Pathways for a Wide Range of Species

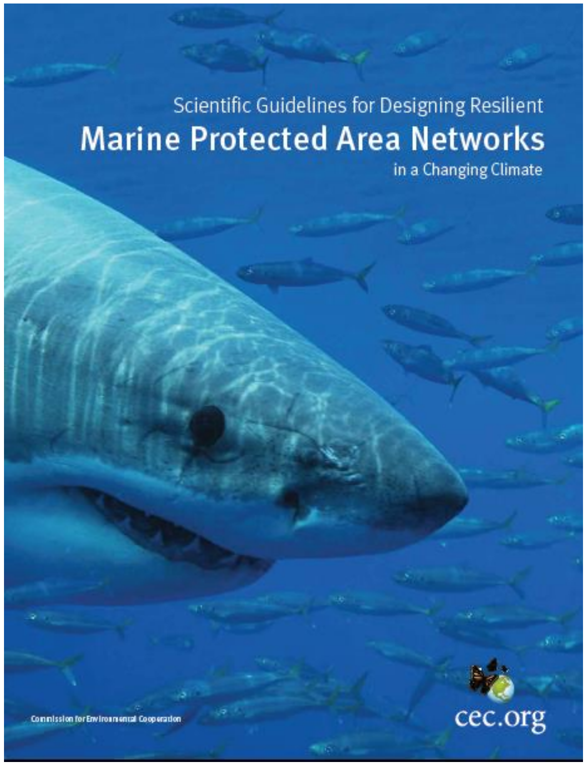
Step 1 Identify potential ecological linkages and physical drivers such as prevailing currents

Step 2 Build and apply dynamic models of adult movement and migration to test hypothesized connectivity among areas, including potential source-sink regions and migratory patterns

Step 3 Build and apply dynamic models of larval transport to estimate connectivity between regions and identify sources and sinks

Step 4 Determine whether the critical linkages and pathways identified above are vulnerable to impacts from climate change that can be mitigated by MPAs or MPA networks

Step 5 If the impacts on the linkages and pathways identified above can be mitigated by MPAs or MPA networks, specialists should estimate the timescale and distances over which the impacts may be expected and trigger a re-evaluation of the boundaries of the MPA, or design the MPA or MPA network to be robust to these changes



Guideline 4

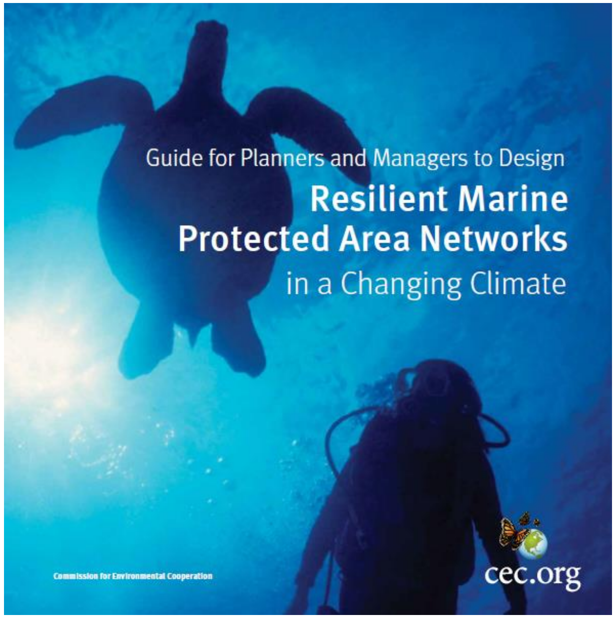
Protect the Full Range of Biodiversity Present in the Target Biogeographic Area

Step 1 Identify biodiversity in the target biogeographic area or marine ecoregion

Step 2 Assess the projected impacts from climate change as stressors and threats to the biodiversity of those areas identified in Step 1

Step 3 Determine whether the impacts on biodiversity from climate change (Step 2) can be mitigated by MPAs or MPA networks

Step 4 Assuming MPAs or MPA networks can mitigate the impacts from climate change identified in Step 3, topical specialists should predict the spatial/timescale over which their subject is expected to respond and trigger a re-evaluation of the MPA boundaries, or design the MPA or MPA network to be robust to these changes.



Guideline 1
Protect Species and Habitats with Crucial Ecosystem Roles or Those of Special Conservation Concern

Step 1
Identify species and habitats with crucial ecosystem roles or those of special conservation concern.

Step 2
Identify the traits of those species/habitats identified in Step 1 that are vulnerable to projected climate change impacts.

Step 3
Determine whether the impacts of climate change on the traits identified in Step 2 can be mitigated by or adapted through MPAs or MPA networks.

Step 4
If impacts on the traits identified in Step 2 can be mitigated by MPAs or MPA networks, specialists should estimate the timescale over which their subject is expected to respond to climate change and trigger a re-evaluation of the boundaries of the MPA, or design the MPA or MPA network to be robust to these changes.

Step 1

Identify species and habitats with crucial ecosystem roles or those of special conservation concern

Overview

The first step in the goal to protect species and habitats with crucial ecosystem roles or those of special conservation concern is to identify the species or habitats that drive or structure ecosystems and ecosystem processes. If the population or coverage of these species dwindles or disappears, as may happen with changing climatic conditions, the ecosystem can suffer far-reaching consequences.

Method

- Identify the species or habitats that are crucial to a particular species, group of species or the functioning of an ecosystem. This may include species or habitats that may differ from those already identified following other network design criteria. For example, examine the aspects of the species and habitats that are not explicitly covered by the Ecologically or Biologically Significant Areas (EBSA) criteria.[2]
- Through a separate process, identify species of special conservation concern.[3]
- Define the crucial role the species or habitat in question plays within the ecosystem.
- Map the location of the target species or habitat.
- Analyze the degree to which the target species or habitat is already protected as a part of an MPA or MPA network (including any in the designation process) and identify any that are linked over larger spatial expanses and timescales.
- Engage stakeholders throughout the process in addressing social and economic considerations.

Practical considerations

- Consider holding a science meeting to bring together national experts on each ecosystem component and gaps in scientific effort.
- Hold meetings, both at regional and local MPA levels.
- Consider using a geographic information system (GIS) to assist in the process.

Products

- A document identifying species and habitats with crucial ecosystem roles, and describing those roles specifically related to the identified species and habitats.
- Map(s) showing the locations of the species and habitats with crucial ecosystem roles (generated via GIS).

Resources

In addition to resources mentioned in the SGMPAN report (ICES 2011a), especially Chapter 6 of the report:

- EBSA criteria (GOBI 2010) and/or the EBSA identification processes in each country.
- Canada's Ecologically Significant Species identification process (DFO 2006) or other processes for identifying priority species in each country.

2. See GOBI 2010 and also http://www.gobi.org/Our%20Work, which provides examples of applying the EBSA criteria.
3. A Species of Special Conservation Concern is any species or subspecies that is undergoing a long-term decline in abundance or that is vulnerable to a significant decline due to low numbers, restricted distribution, dependence on limited habitat resources, or sensitivity to environmental disturbance. These species may or may not have crucial ecosystem roles and may or may not be protected by legislation. See http://www.cec.org/SOE/files/en/SOE_SpeciesCommon_en.pdf.

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Determine what properties of populations, habitats and ecosystems increase the resilience of marine systems to impacts of climate change in the region of the NW-Atlantic to the Caribbean

Review what properties of MPA networks are most relevant to providing the elements described

Ecosystems

Populations

Species

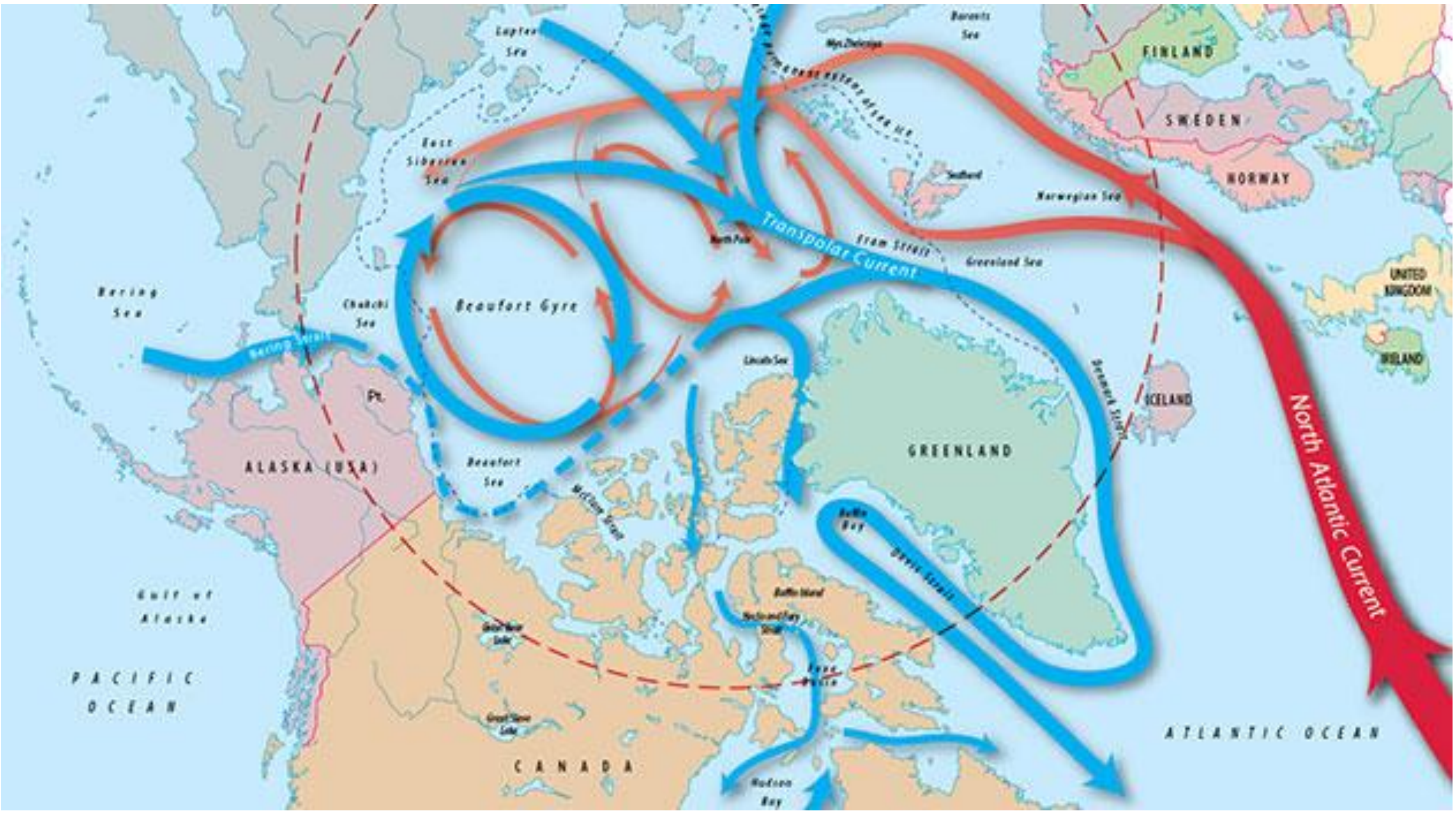
Individuals

Holling's (1973) original definition of resilience: 'the magnitude of the disturbance that a system can absorb without fundamentally changing.'

Table 3.1 Summary of properties of ecosystems, habitats, and populations related to increased resilience of marine systems.

Ecosystems	Habitats	Populations
Connectivity (spatial fluxes, trophic connections, mobile link species)	Heterogeneity	Connectivity
Abundance and size structure of upper trophic levels	Spatial arrangement and composition	Dependence on critical habitats
Community size structure of plankton	Foundation species	Sensitivity to environmental conditions
Phenological matches	Ecosystem engineers	Flexibility in migration routes
Species richness	Disturbance	Population size and age structure
Functional redundancy (taxonomic diversity)	Bathymetery, topography and rugosity	Geographic distribution
Response diversity	Transparency, suspended solids and turbidity	Number of population subunits or metapopulations
Community evenness	Habitats supporting critical life stages	Phenology
Beta-diversity	Biogeographic transition zones	
	Distance to ecotones	
	Buffer zones	
	Temperature	
	Salinity	
	Circulation and winds	

Connectivity is a property that influences the structure, diversity, productivity, dynamics, and resilience of marine ecosystems by providing feedbacks and subsidies of organisms, nutrients, and energy across ecosystem boundaries.

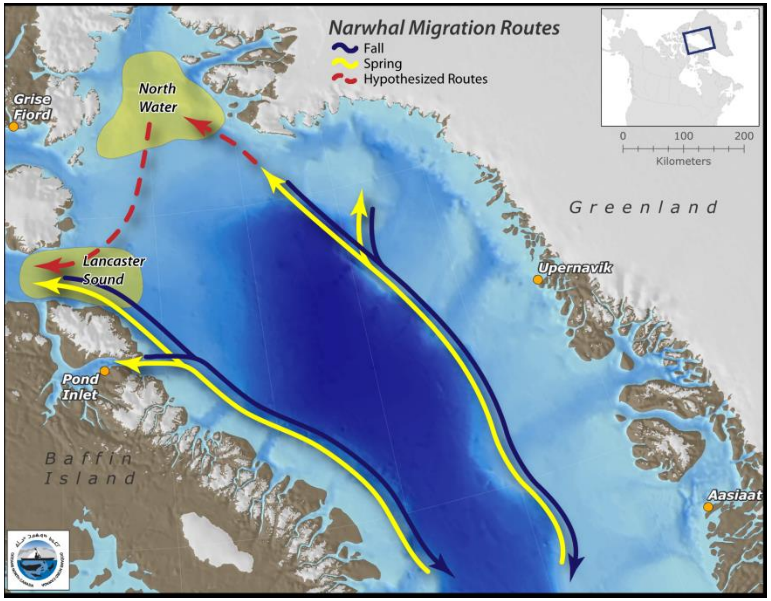


www.whoi.edu/main/topic/arctic-ocean-circulation

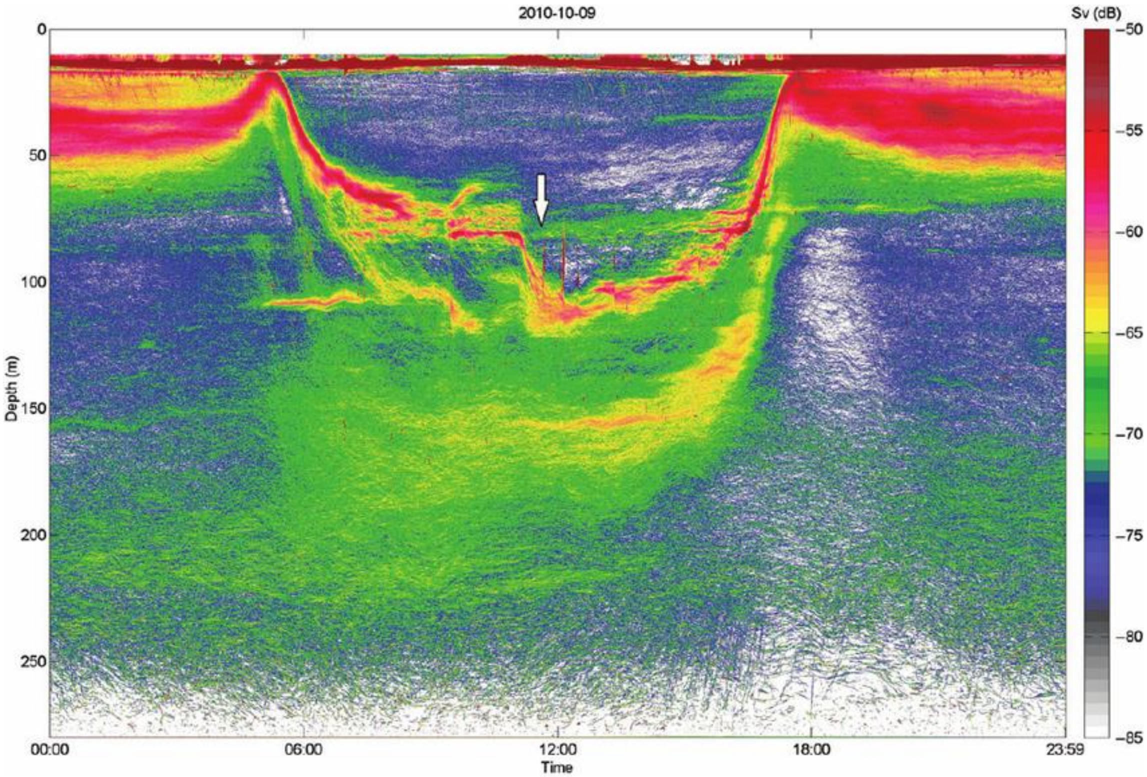
Lundberg, J., and Moberg, F. 2003. **Mobile link organisms** and ecosystem functioning: implications for ecosystem resilience and management. Ecosystems, 6: 87–98.

Connect habitats in space and time

Some Arctic species migrate across national jurisdictions requiring co-ordinated efforts (bi-lateral or even tri-lateral workshops/planning)

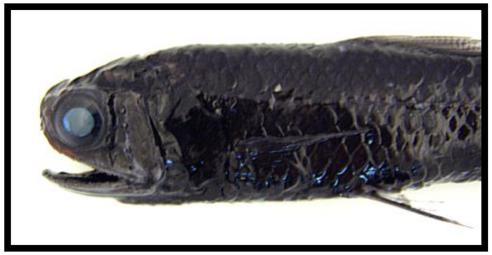


There is a need to identify these species and evaluate on a case by case basis whether climate change is expected to alter their migration routes and if possible, determine the nature of that change through evaluation of trends in tracking data



Goda et al. 2014

Viper Fish

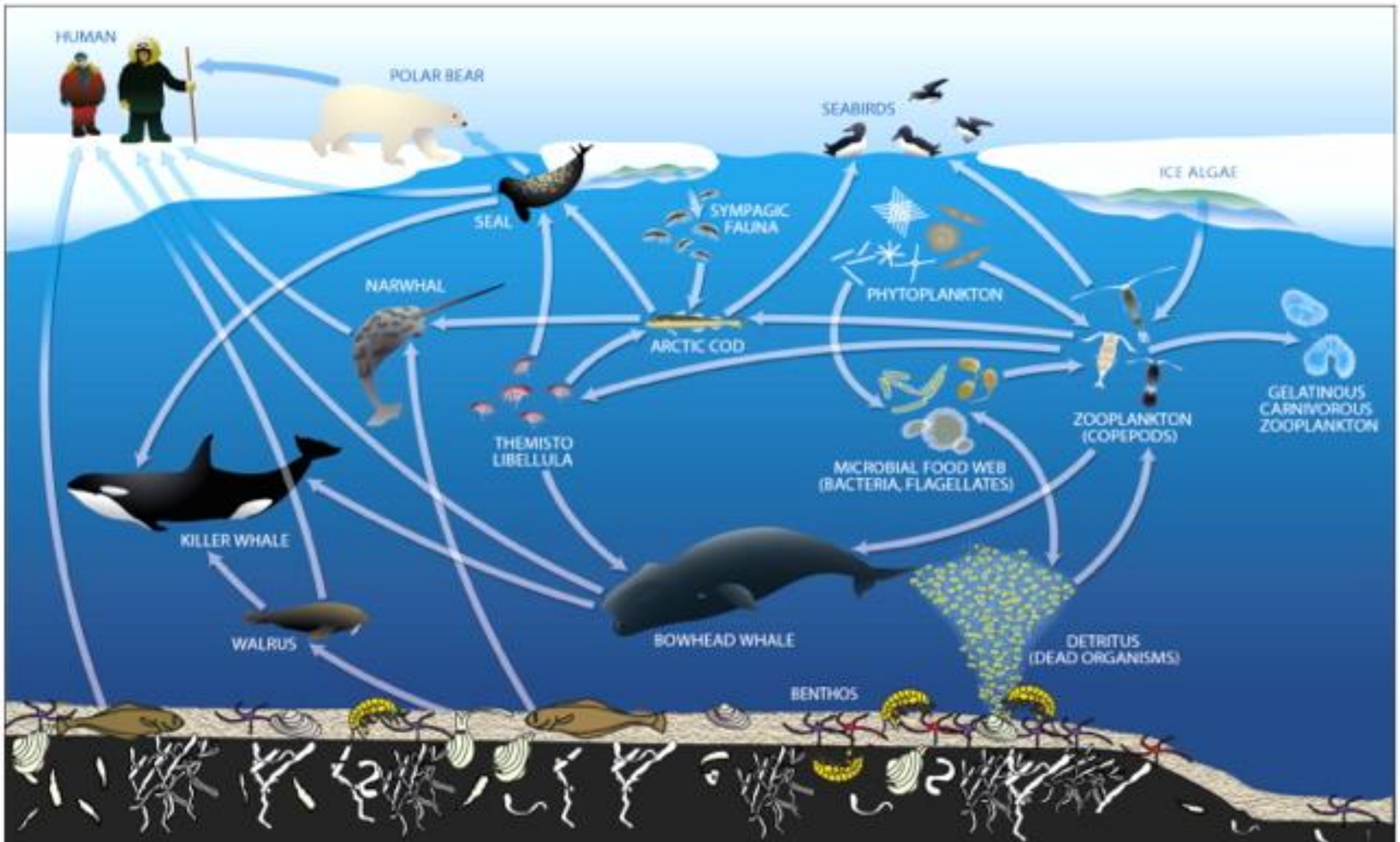


Mirror Lantern Fish

Moon Fish

Vertical Connectivity

Understanding the effects of climate change on the relative importance of top-down and bottom-up forcing is a critical research need to understand **trophic connectivity** and the resilience of ecosystems (Hoekman, 2010)



C**ommunity size structure** at the base of marine food webs is an important component of ecosystem response to climate change with implications for trophic interactions and biogeochemical cycling.

Li, W. K. W., McLaughlin, F. A., Lovejoy, C., and Carmack, E. C. 2009. Smallest algae thrive as the Arctic Ocean freshens. Science, 326: 539.

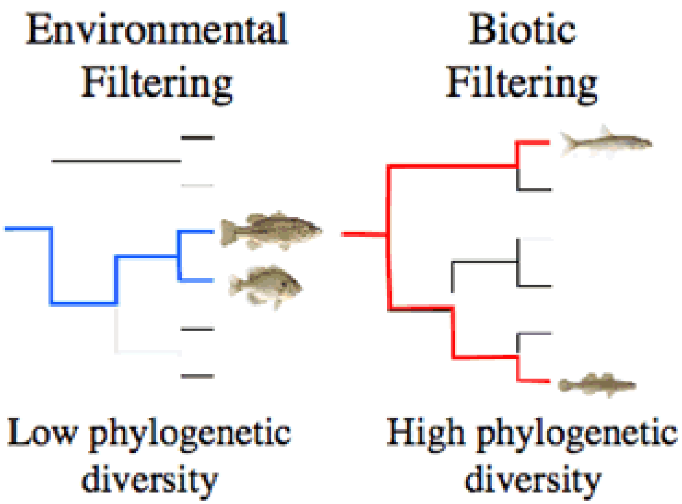
Phenology (the annual timing of ecological and biological events). Changes in phenology are important to ecosystem resilience because the rates of phenological response to climate change are expected and observed to vary across functional groups and trophic levels (Thackeray *et al*., 2010).

Timing and duration of spring bloom.

Timing and duration of ice melt.

Native Species Diversity and Habitat Heterogeneity

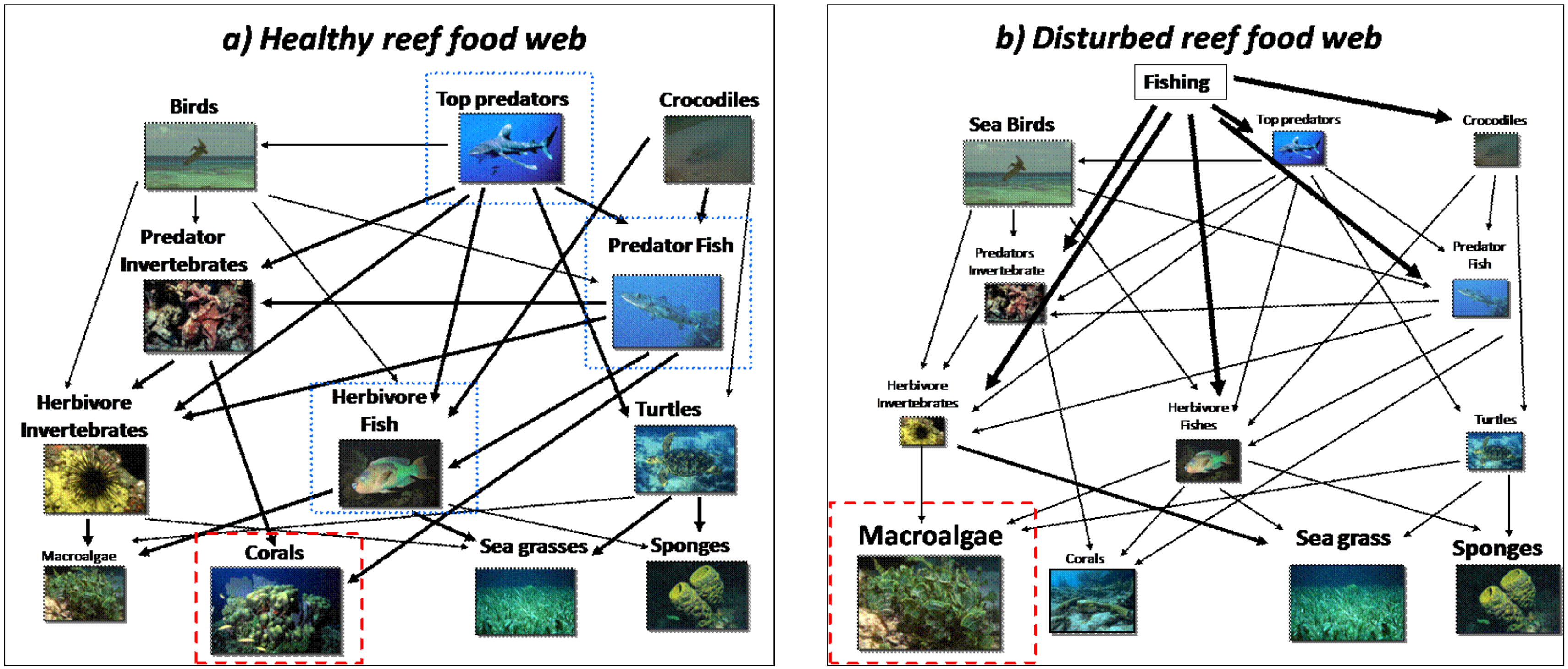
Taxonomic relatedness must be low enough to confer a certain amount of **functional redundancy** to the system, yet high enough to ensure a diversity of responses to environmental change among species contributing to the same ecosystem function (**response diversity**) (Elmqvist *et al.*, 2003).



Different types of processes thought to generate different phylogenetic patterns in community composition. If phylogenetically related species share traits that allow them to tolerate the same environmental conditions, communities are expected to contain closely related species (environmental filtering). Conversely, if related species share resources and hence strongly compete, communities are expected to contain only distantly related species (biotic filtering).

http://zoology.wisc.edu/faculty/ive/ive.html

Additional impacts such as fishing can put more pressure on climate stressed ecosystems



(from Rodriguez-Zaragoza, 2007)

Thank you to the organizers for inviting me here to speak to you on behalf of my many colleagues in the SGMPAN.

Brandi Worden
Program Operations Specialist
WWF US Arctic Field Program

and WWF Norway