# Evidence-based conservation: designing well-connected Marine Protected Areas


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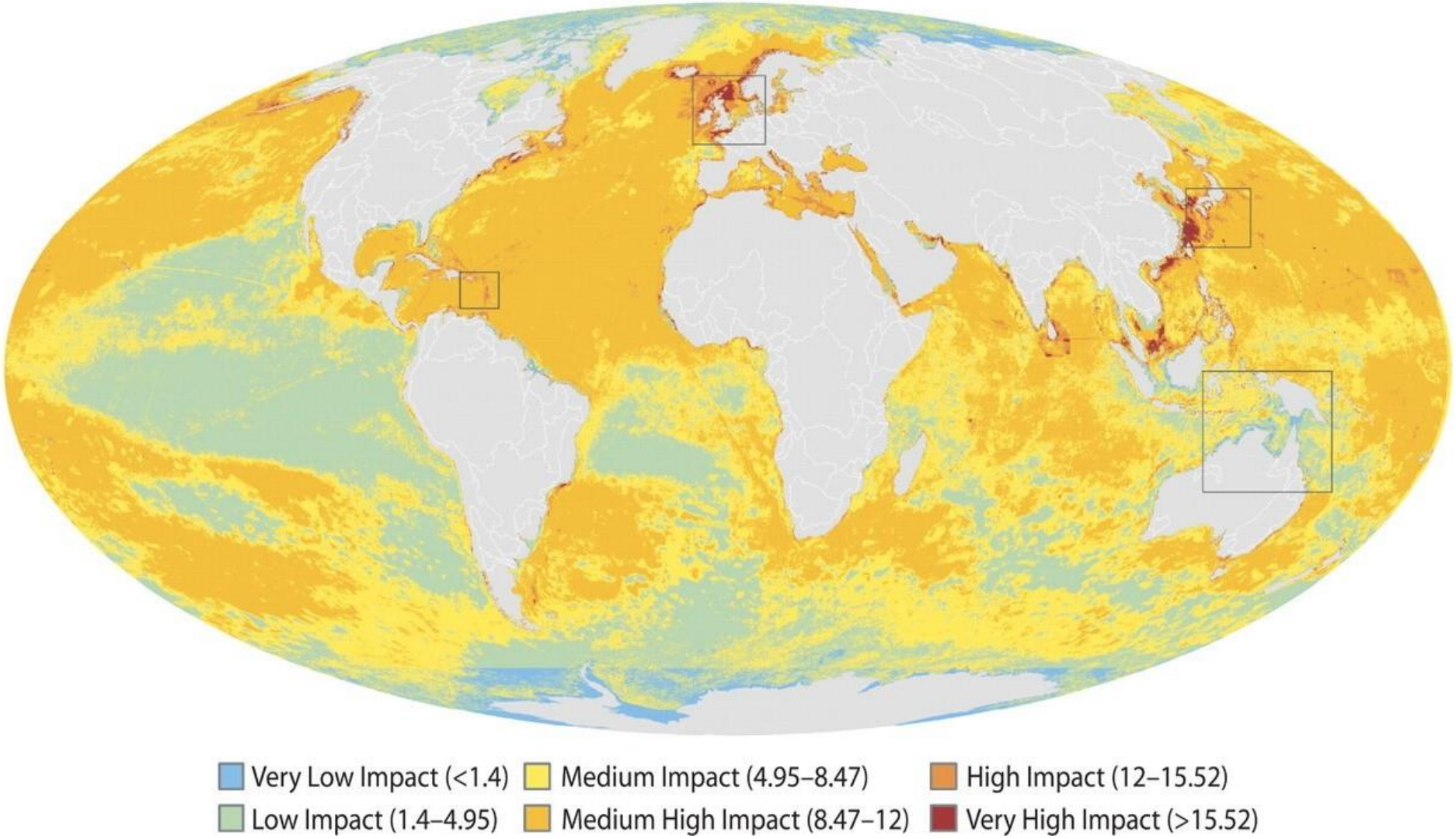
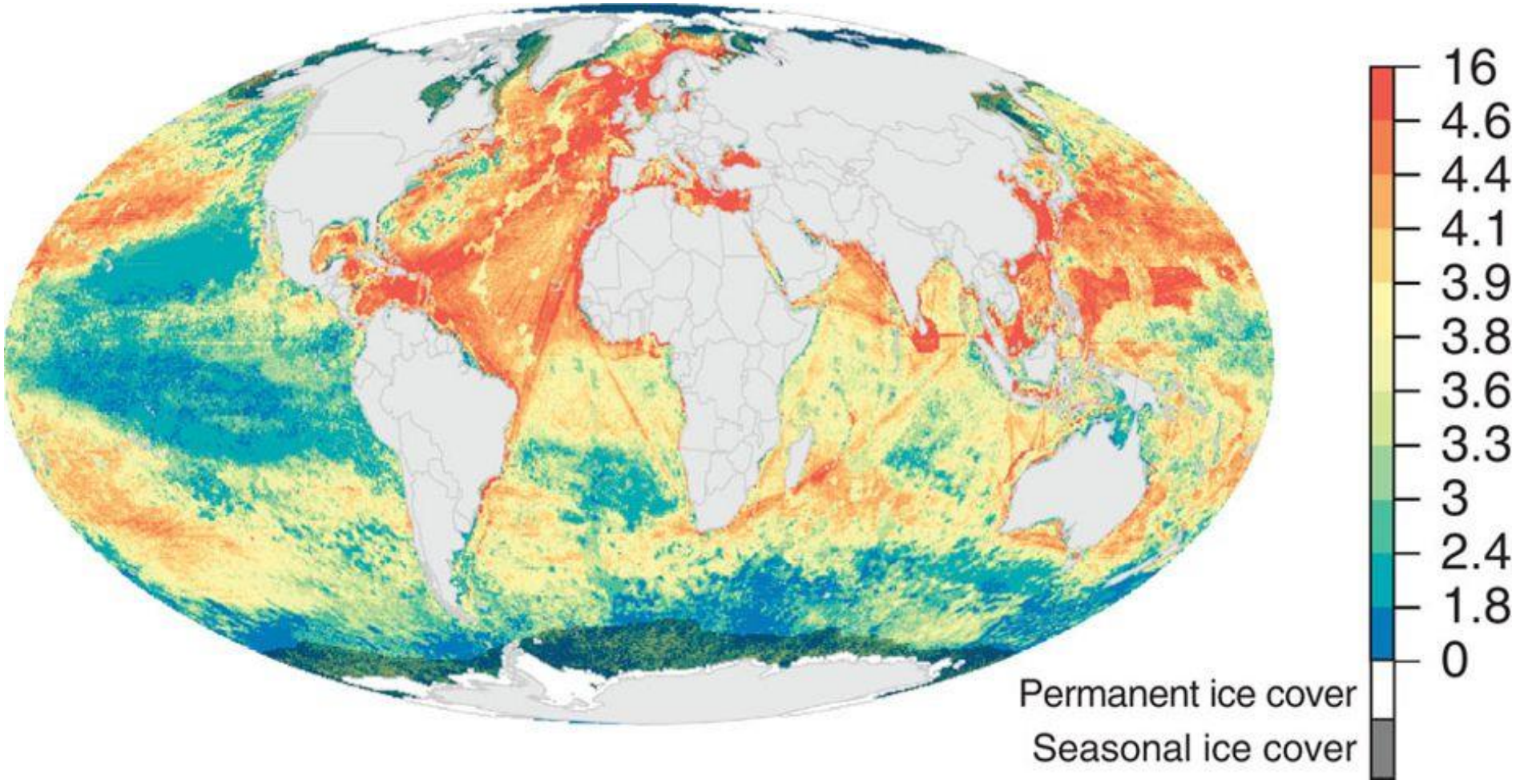
# Cumulative human impacts on 20 ocean ecosystem types - 2008



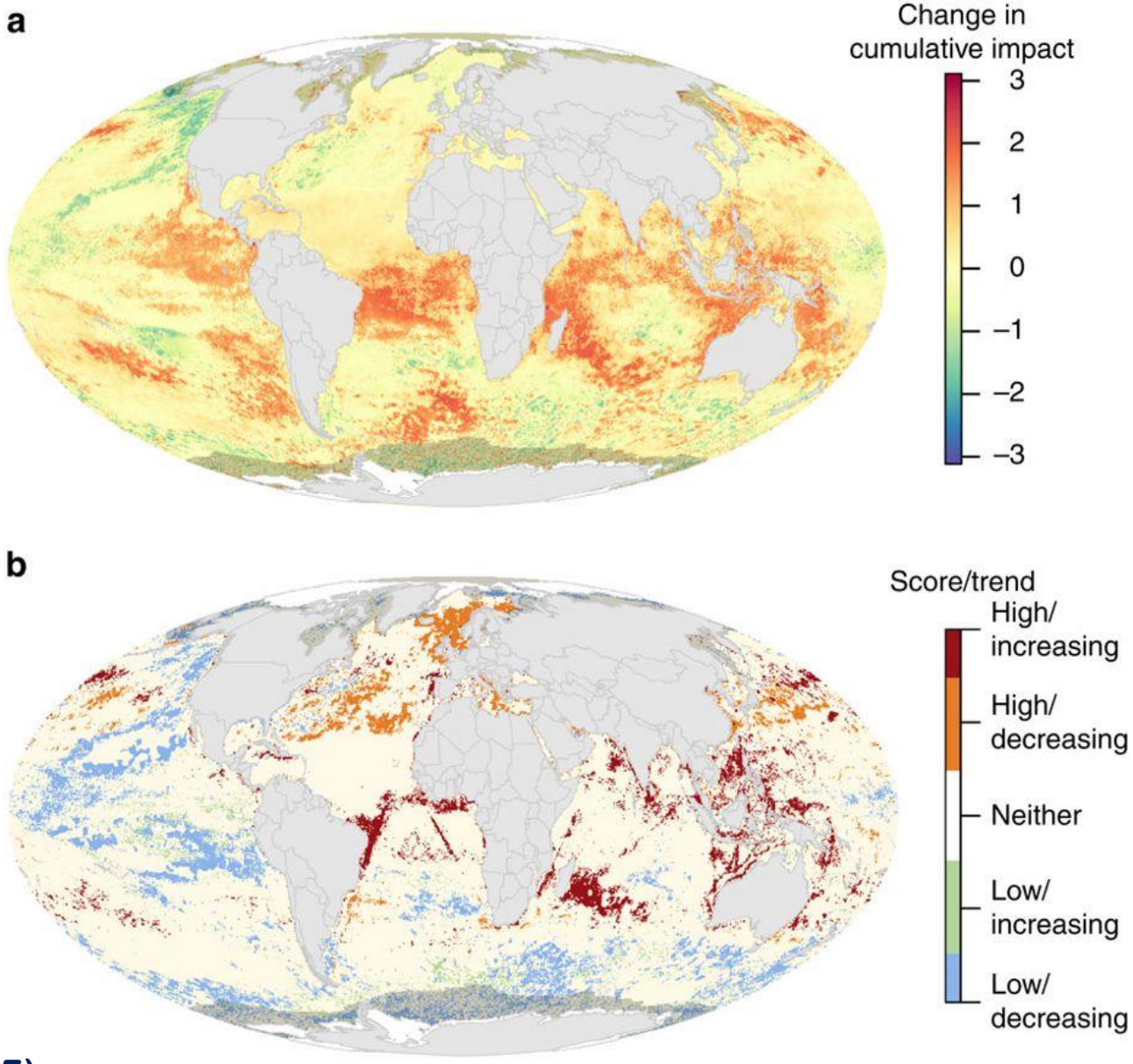

Halpern et al (2008)

# Cumulative human impacts on 19 ocean ecosystem types - 2013



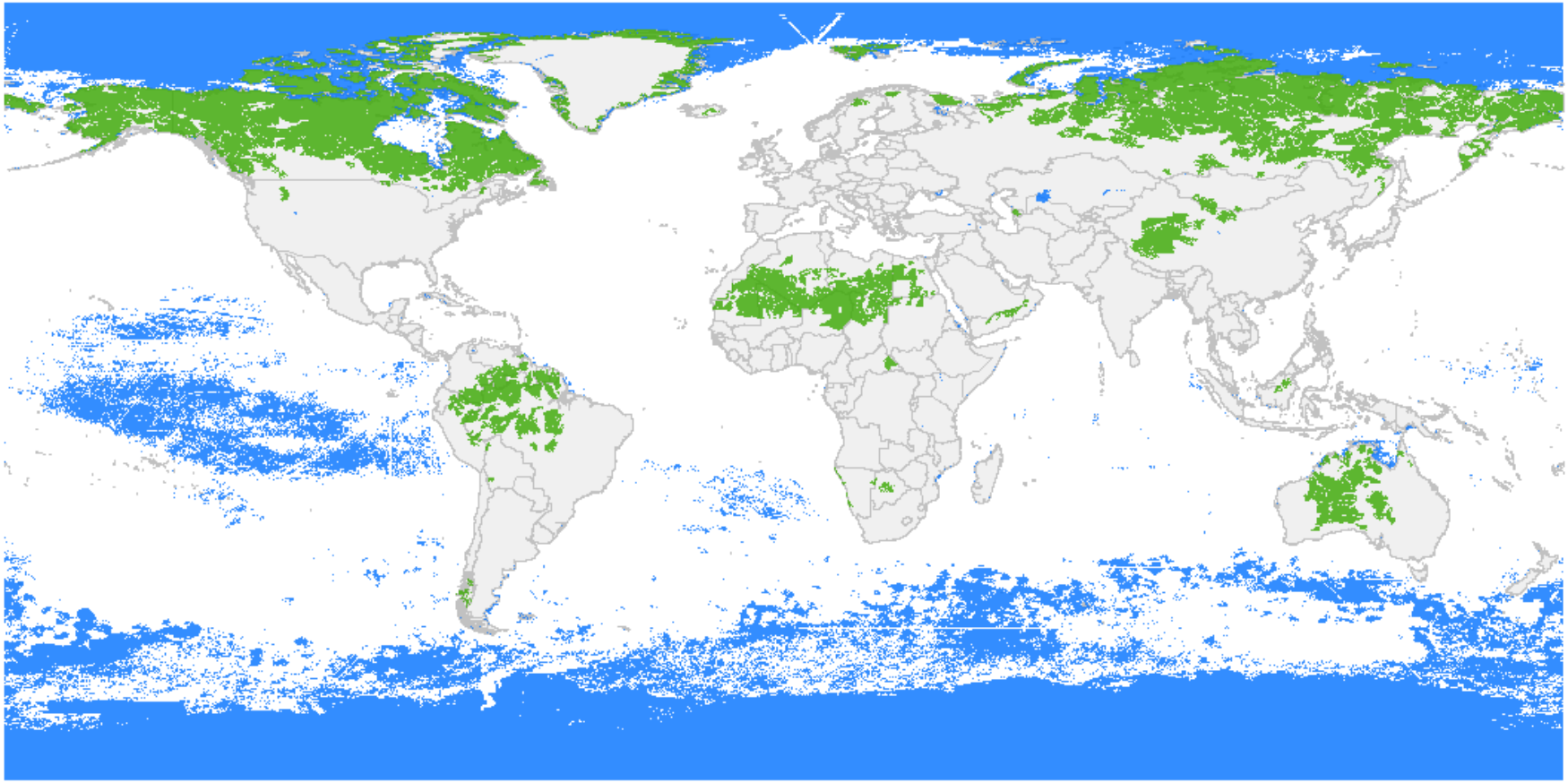

Halpern et al (2015)

# Absolute change in cumulative human impacts 2008 - 2013




Halpern et al (2015)

# Remaining wilderness

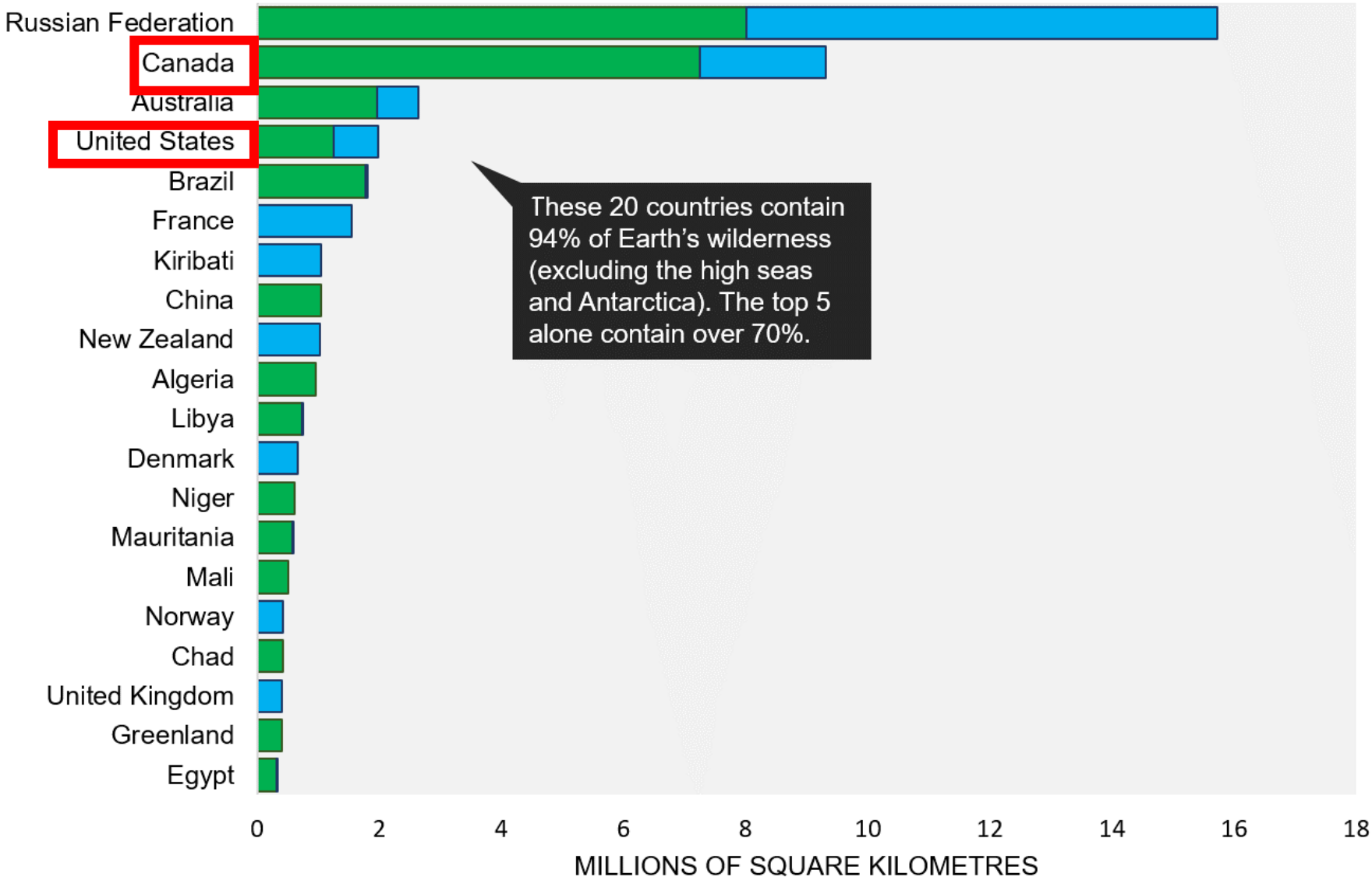


Marine Terrestrial

Watson et al. 2018

# Mega-wilderness Countries

The amount of terrestrial (green) and Marine (blue) wilderness that each country holds measured in millions of $km^2$




Watson et al. 2018

# Convention on Biological Diversity

**International legally-binding treaty with three main goals:**

1) **Conservation of biodiversity**
2) **Sustainable use of biodiversity**
3) **Fair and equitable sharing of the benefits arising from the use of genetic resources**

**Signed in 1992, entered into force in 1993**
**193 Parties**

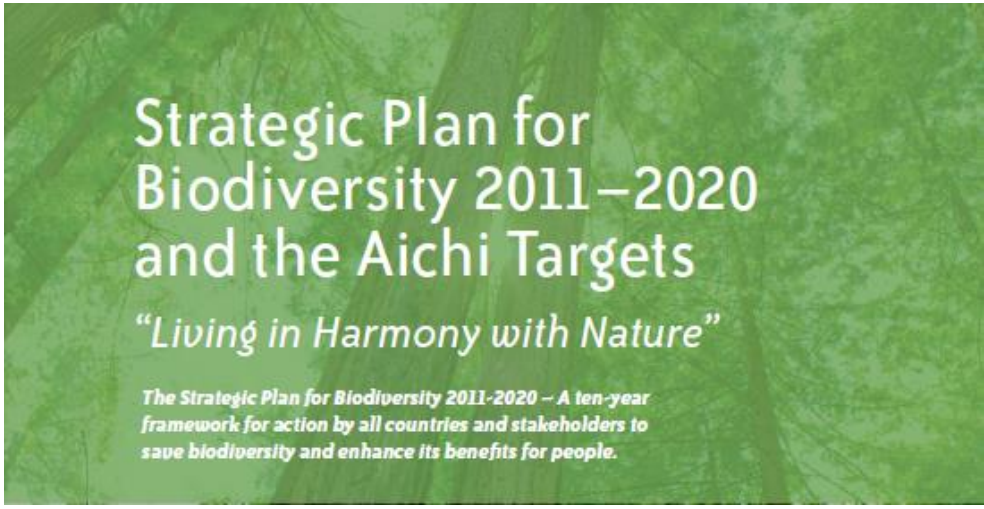
# Convention on Biological Diversity

# World fails to meet a single target to stop destruction of nature – UN report

## 'Humanity at a crossroads' after a decade in which all of the 2010 Aichi goals to protect wildlife and ecosystems have been missed

▲ Coral on the Great Barrier Reef, which has suffered its most widespread coral bleaching on record. Photograph: James Cook University/AFP via Getty Images

Convention on Biological Diversity





**By 2020, at least 17% of terrestrial and inland water and 10% of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are protected through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascapes.**

# Applying IUCN's Global Conservation Standards to Marine Protected Areas (MPA)

*Delivering effective conservation action through MPAs, to secure ocean health & sustainable development*

**1330 members from 170 countries**
**24 members from Canada including DFO**

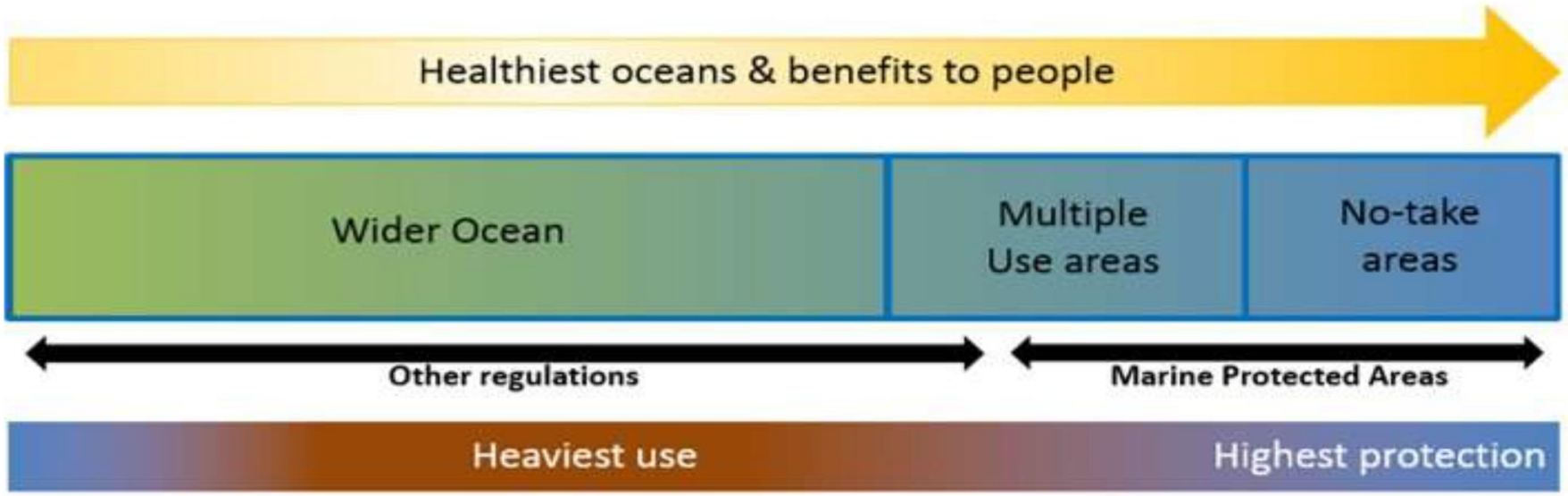
## What is a Marine Protected Area?

A clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values

# Benefits of MPAs

- Biodiversity conservation
- Improved fisheries
- Climate mitigation and resilience
- Disaster risk reduction
- Restoration
- Tourism and recreation
- Protection of cultural and spiritual resources/values
- Research and education
- Models of fair and open governance

# MPAs is one of the tools in wider ocean management




## New target proposed: 30%

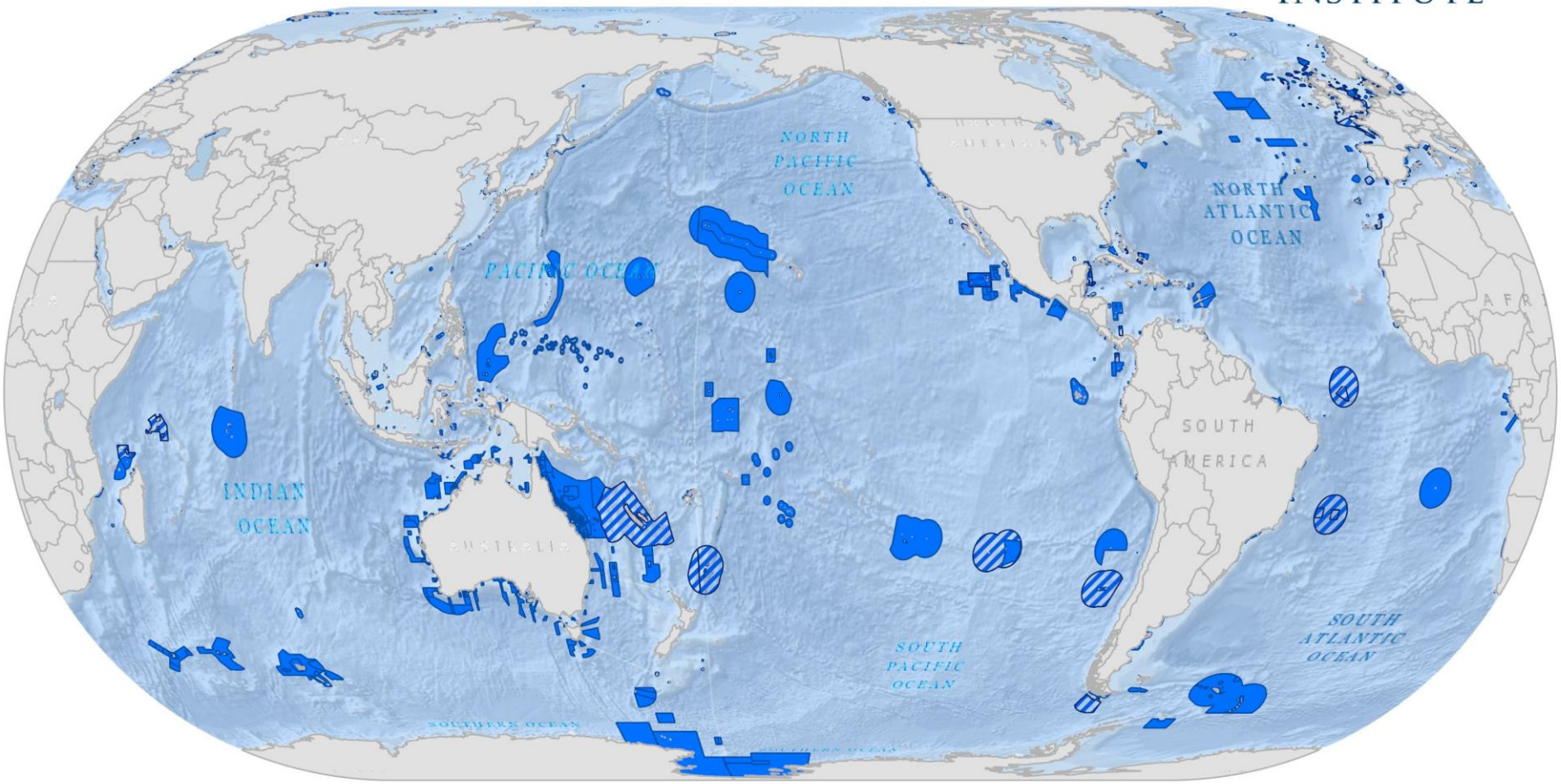
# Criteria for MPA sites

25 YEARS Convention on Biological Diversity
SAFEGUARDING LIFE ON EARTH

- Uniqueness, rarity or special character
- Special importance for life-history of species
- Importance to threatened, endangered or declining species or habitats
- Vulnerability, fragility, sensitivity or slow recovery
- Biological productivity
- Biological diversity
- Naturalness

atlas of Marine Protection
mpatlas.org

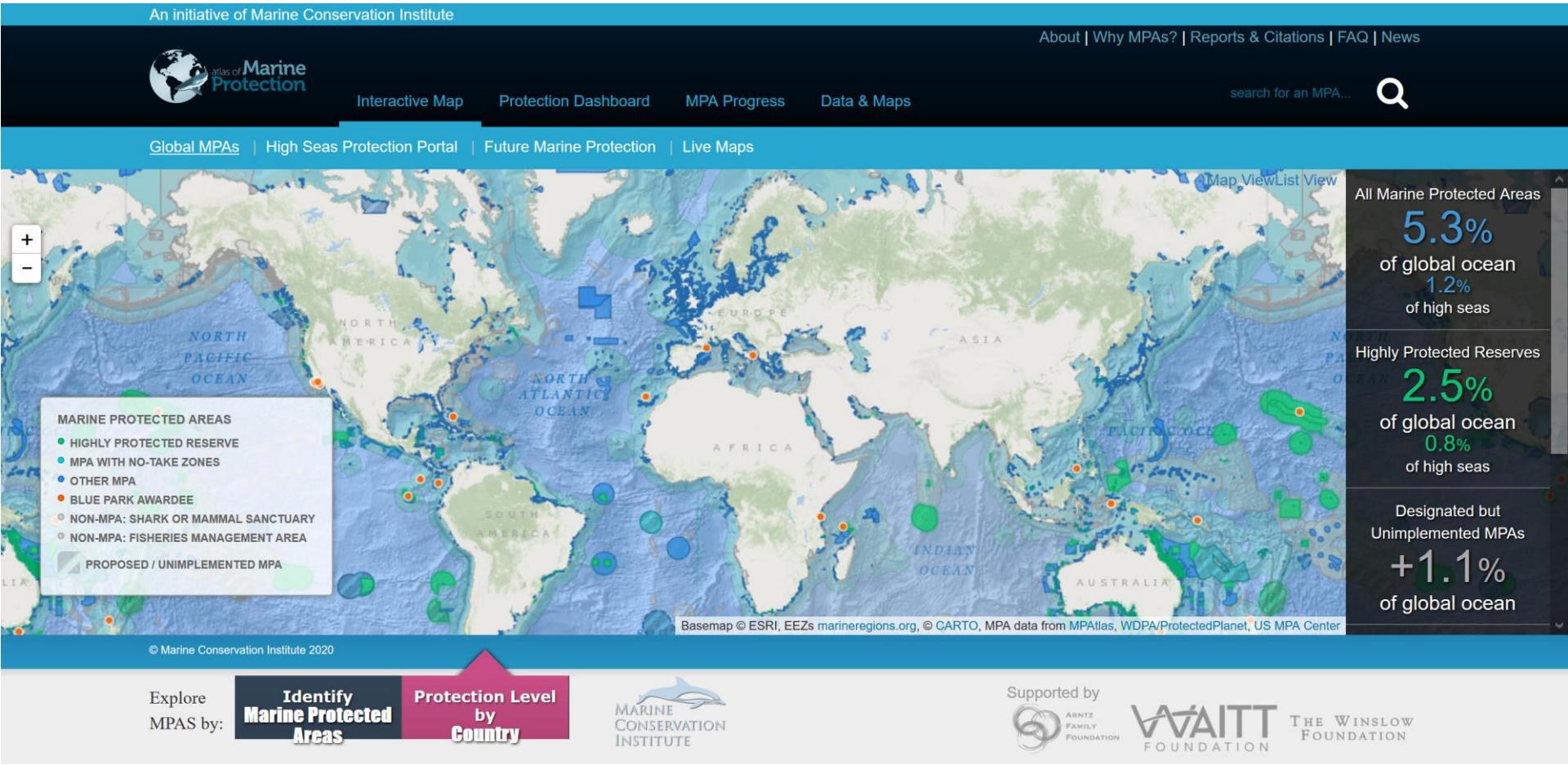
MARINE CONSERVATION INSTITUTE




Date: 1 Feb 2019

Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors, Esri, Garmin, GEBCO, NOAA NGDC, and other contributors, Atlas of Marine Protection

# Absolute numbers depend on who is counting…



Fisheries and Oceans Canada
www.dfo-mpo.gc.ca

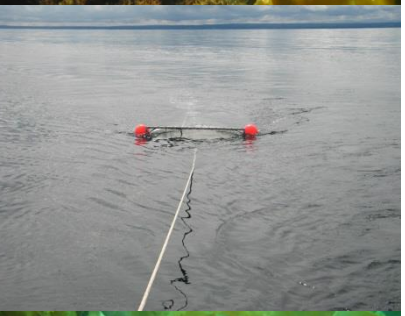
Parks Canada Parcs Canada

Environment Canada
www.ec.gc.ca


| Fisheries and Oceans Canada: *Oceans Act* Marine Protected Areas | Fisheries and Oceans Canada: Marine Refuges | Parks Canada Agency | Environement and Climate Change Canada | Joint Federal and Provincial | Provincial |
|---|---|---|---|---|---|

# Criteria for MPA networks

Convention on Biological Diversity



- MPA or OEABCM (EBSA) criteria
- Representativity
- **Connectivity**

  To maximise and enhance connectivity between individual MPAs, groups of MPAs within an area, and MPA networks in the same and/or different regions
- Replicated ecological features
- Adequate viable sites

# What is connectivity of a network?

# What if connectivity of a network breaks down?

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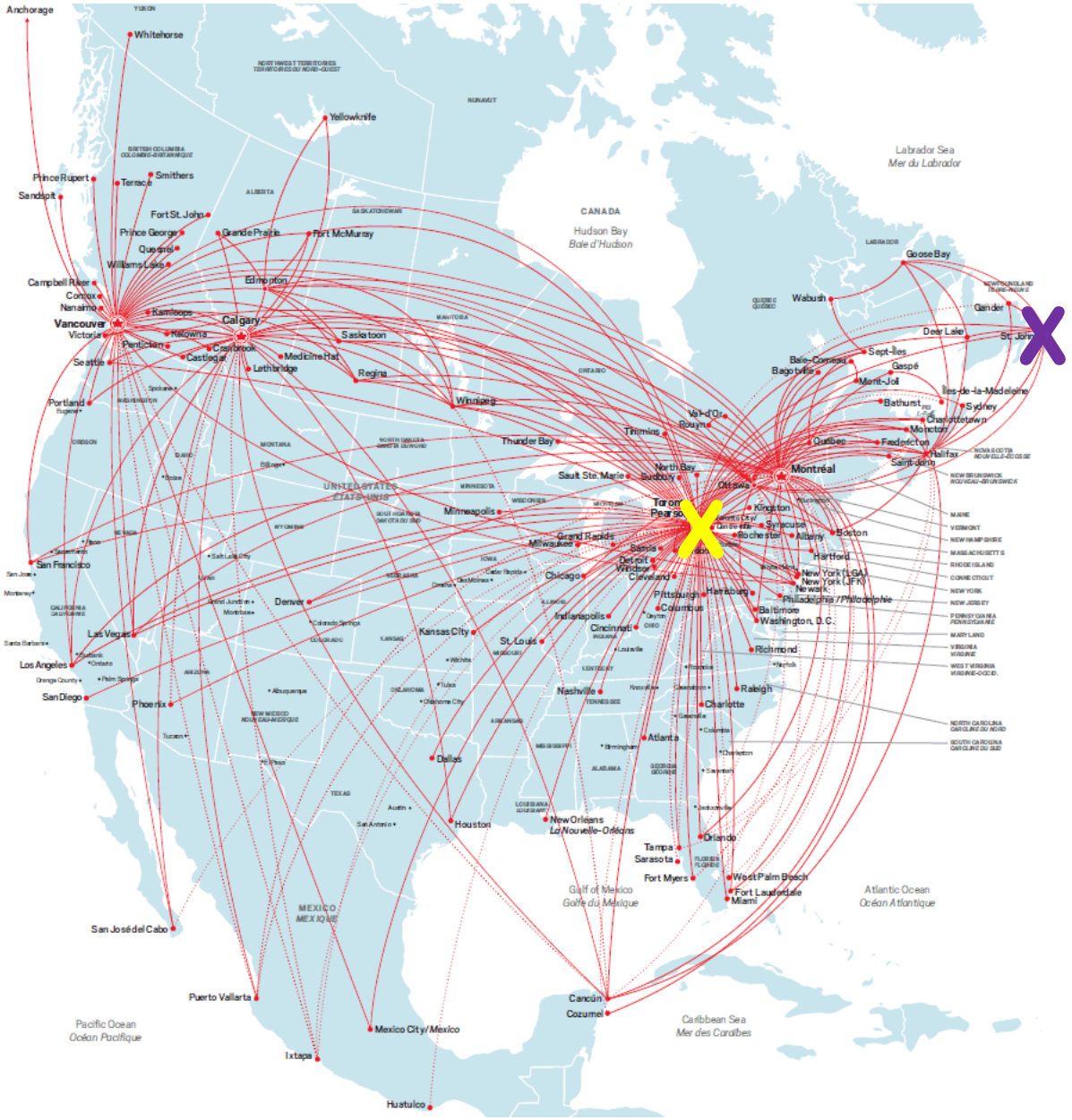
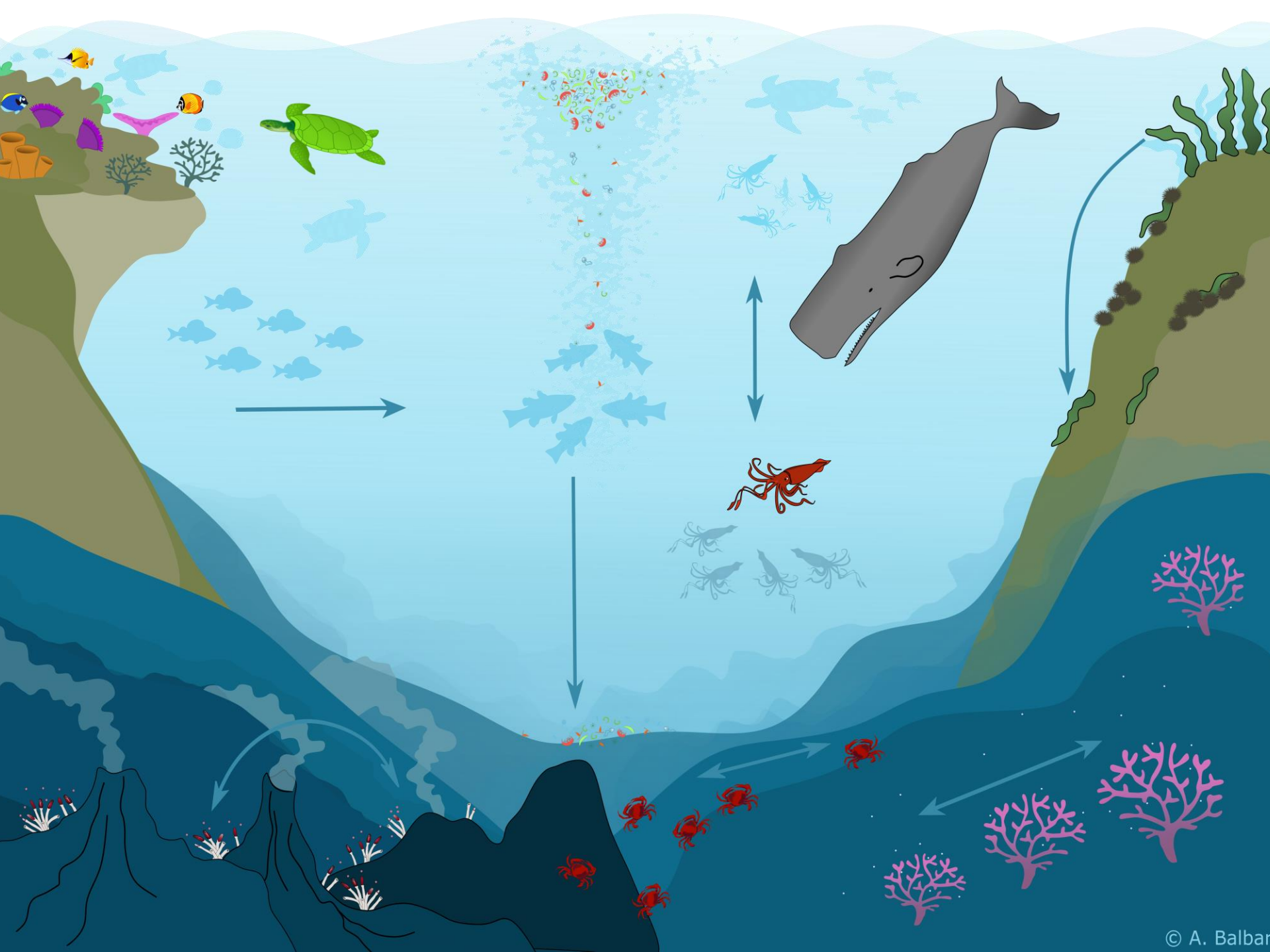
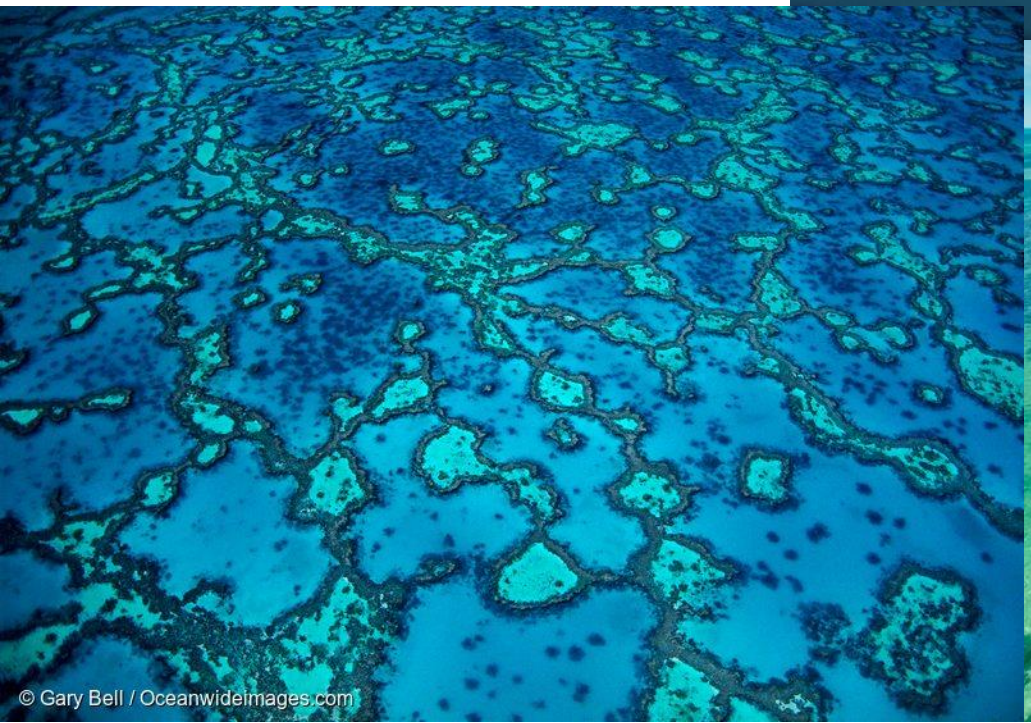
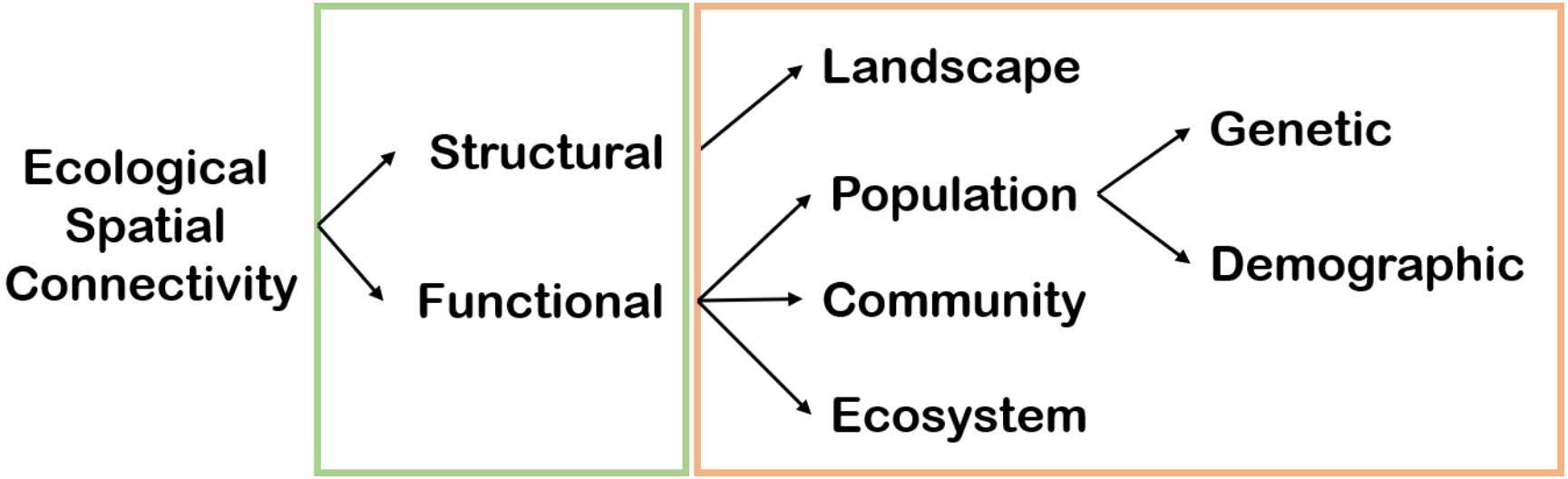



© A. Balbar

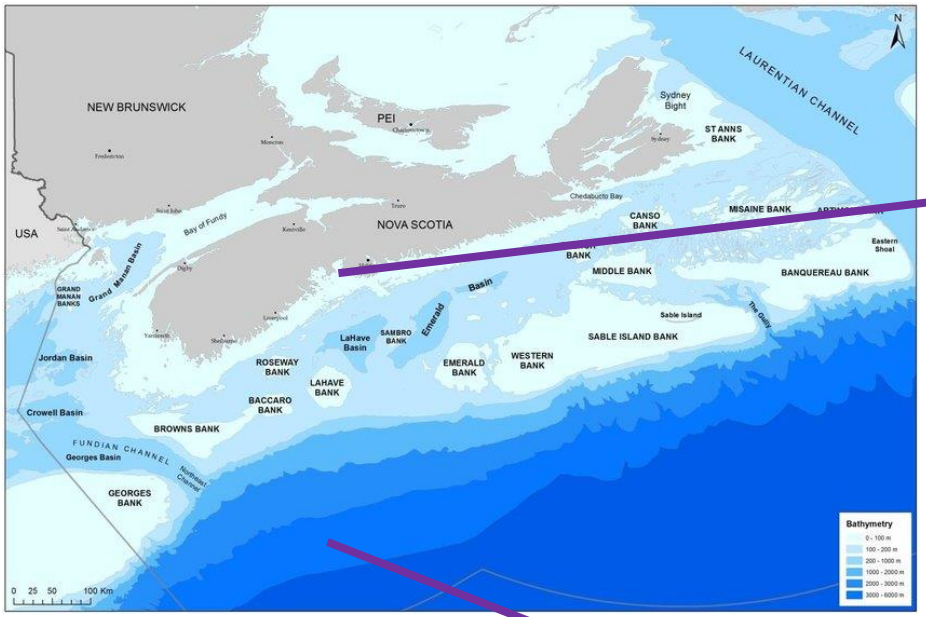
# Patchy habitats and Ecological connectivity




**Ecological connectivity:** the process by which genes, organisms, populations, species, nutrients and/or energy move among spatially distinct entities (e.g. habitats, populations, communities, ecosystems).

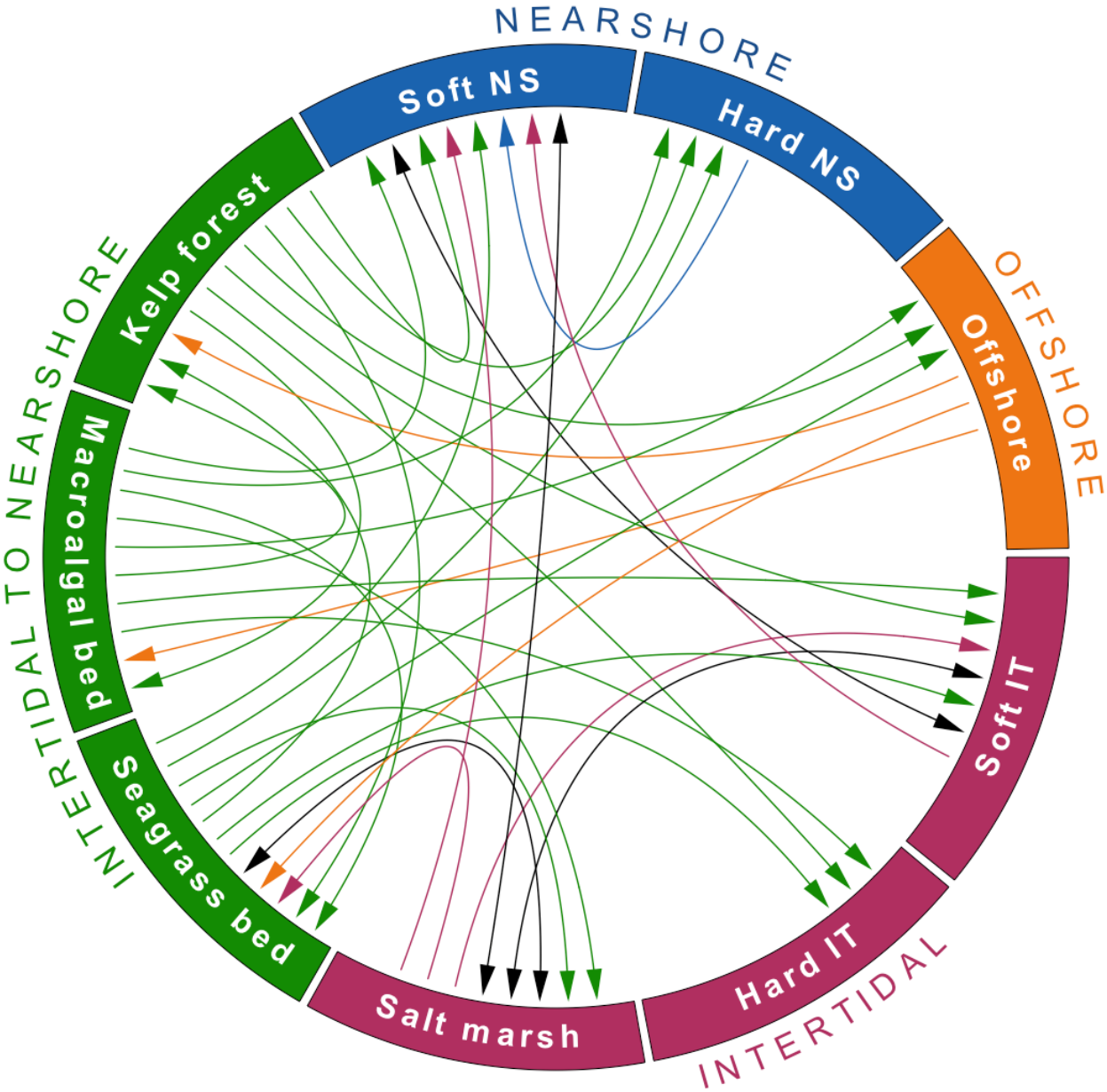


# Ecosystem connectivity



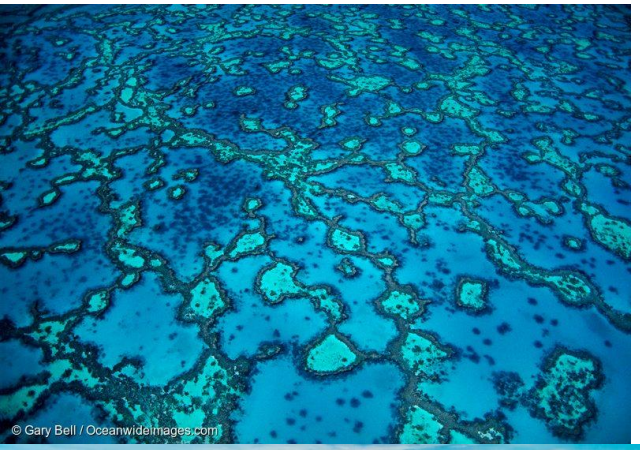

**Depth: 2885 m**

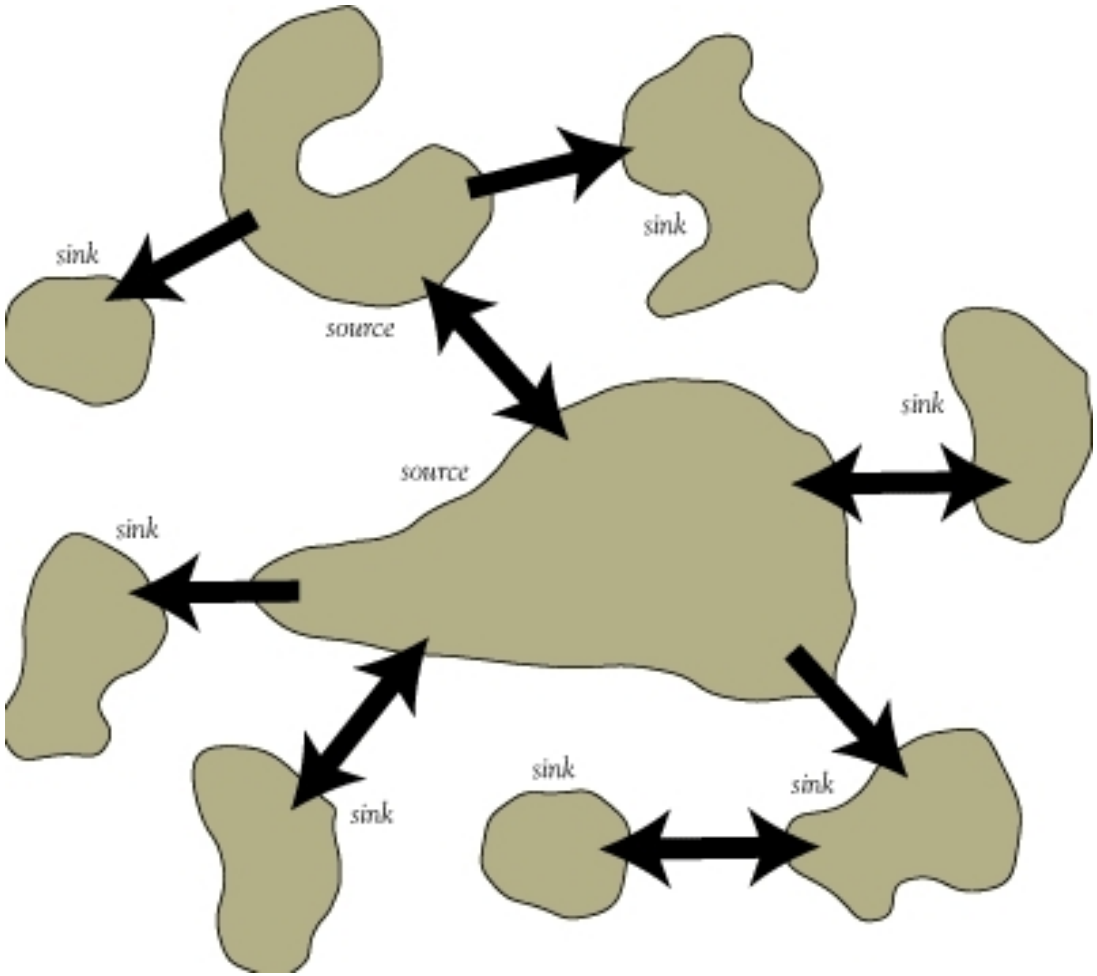
# Resource-based couplings



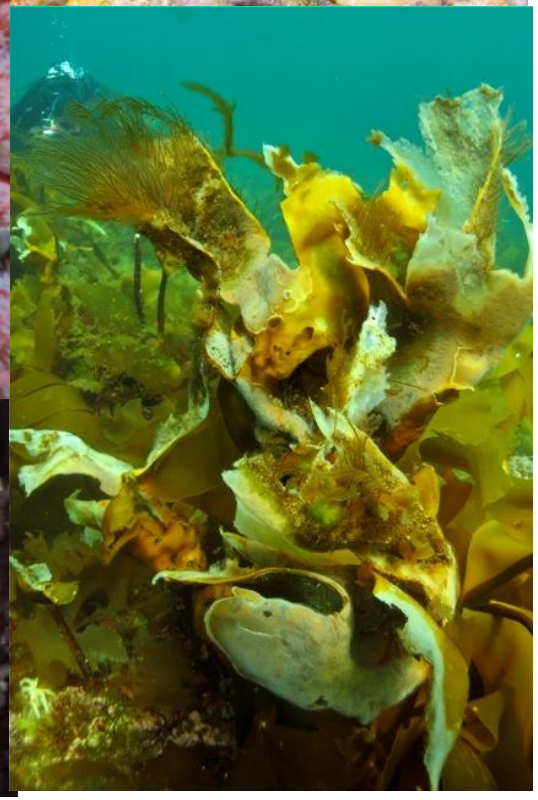

Peller et al. (in prep)

# Population connectivity

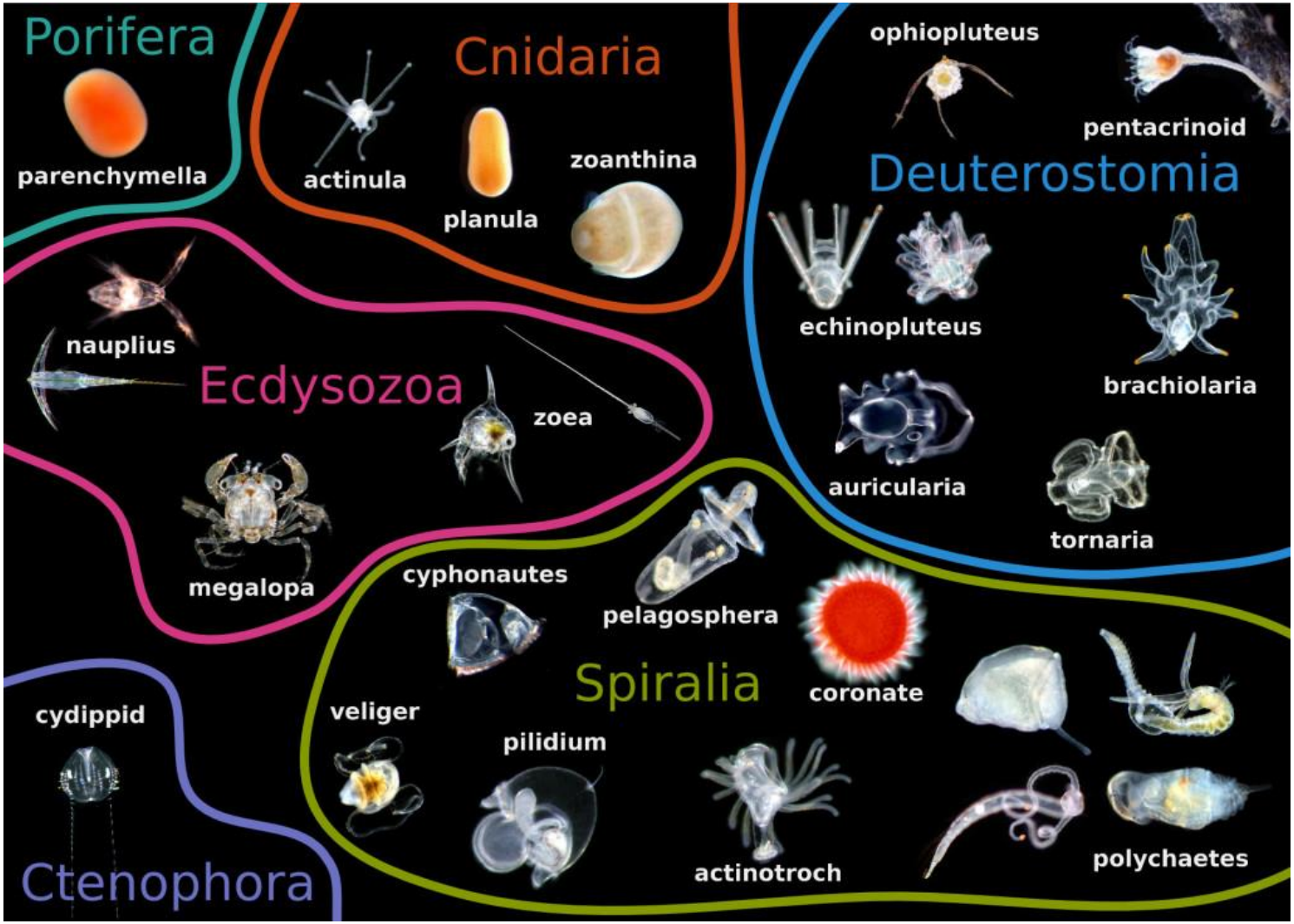


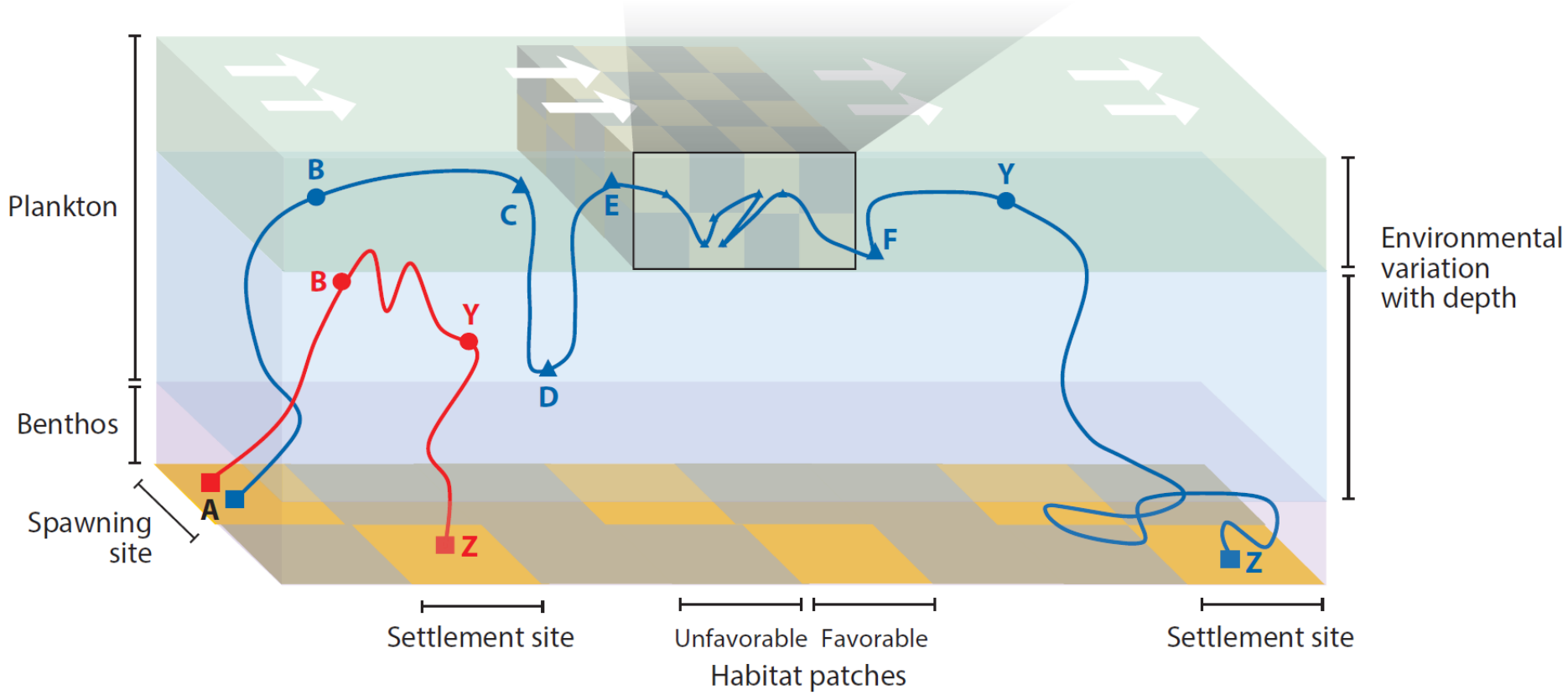
# The characters – marine benthic invertebrates

# Larvae provide connections because they move the largest distances



# Why do larvae move?



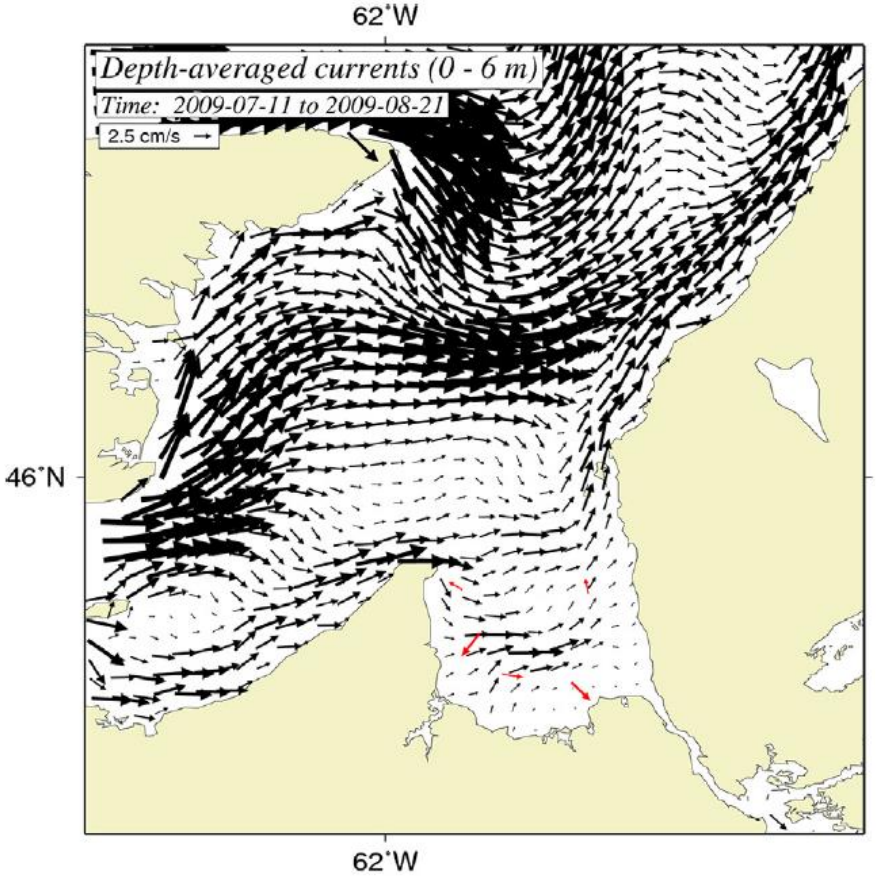

Allen et al (2018)

# Where do larvae go?

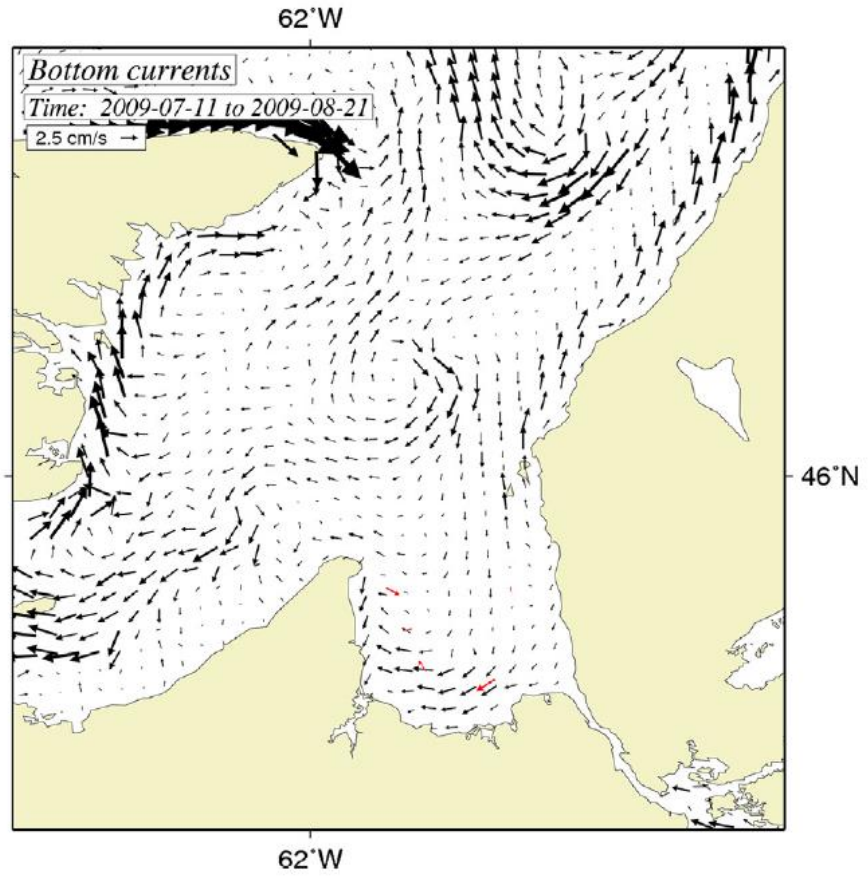
## "Bio-physical" model with virtual larvae

### *Current measurements*

**Surface**

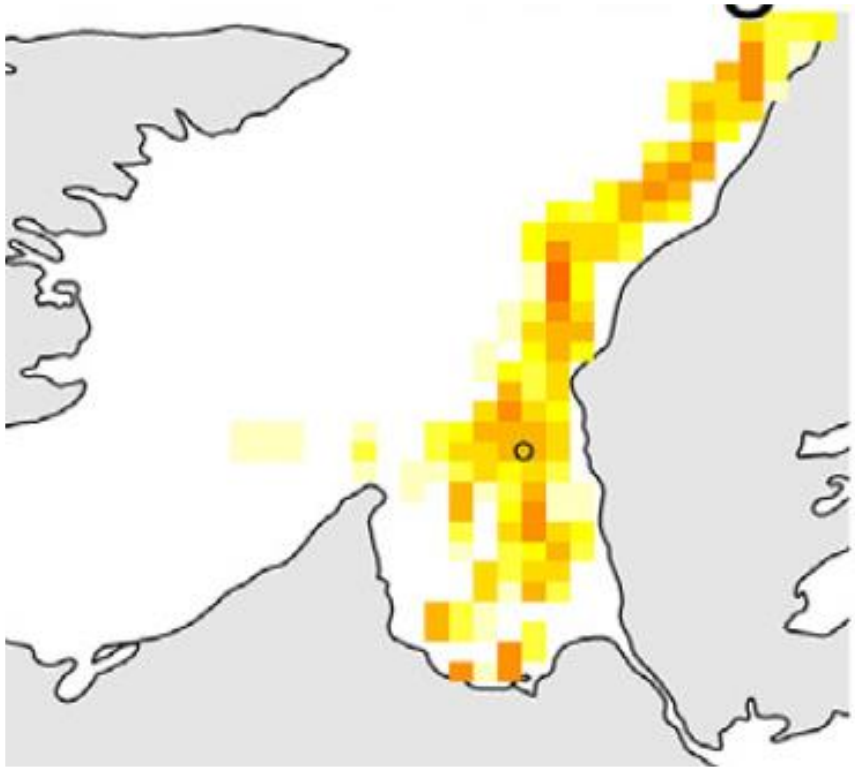



**Bottom**

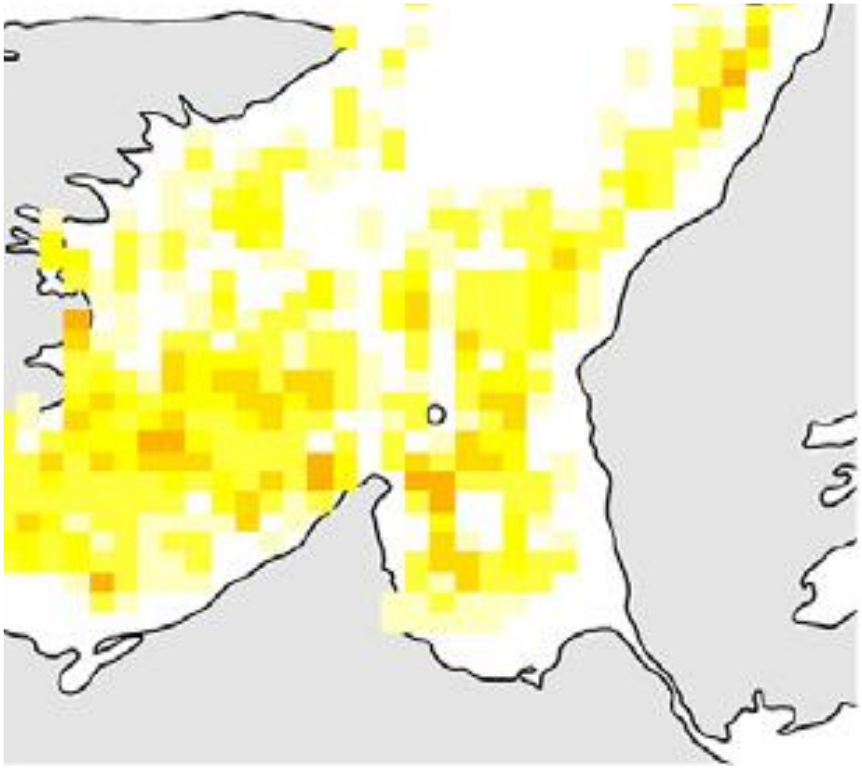


# Where do larvae go?

## Source: east



## Source: west

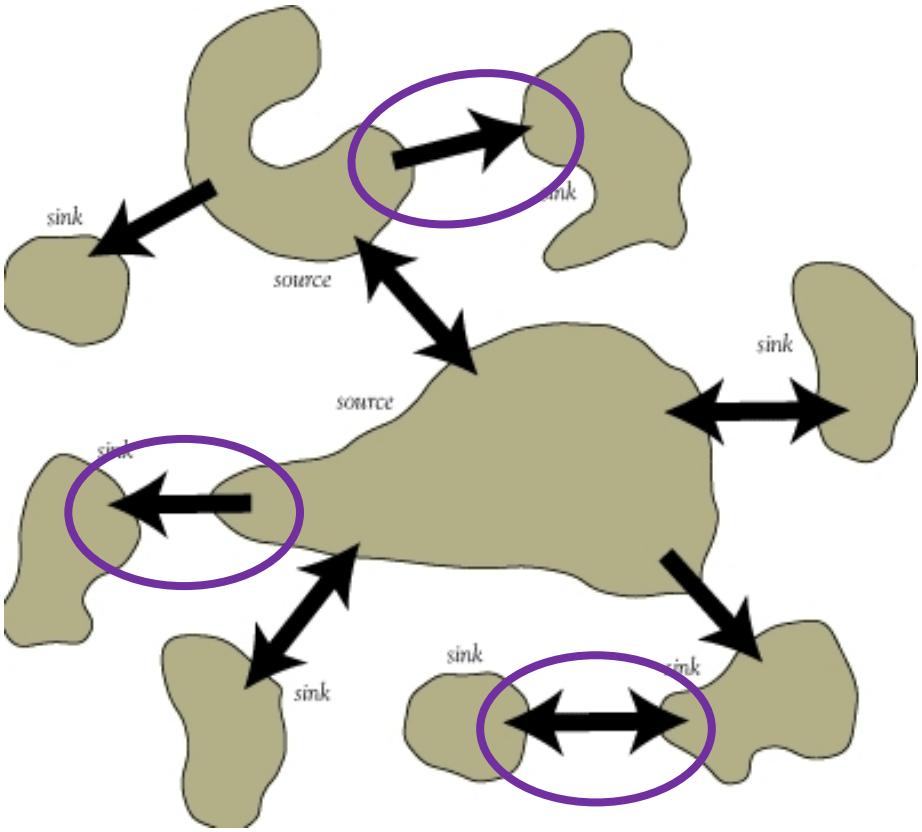


Daigle et al. (2016)

## Investigate the importance on where they go of:

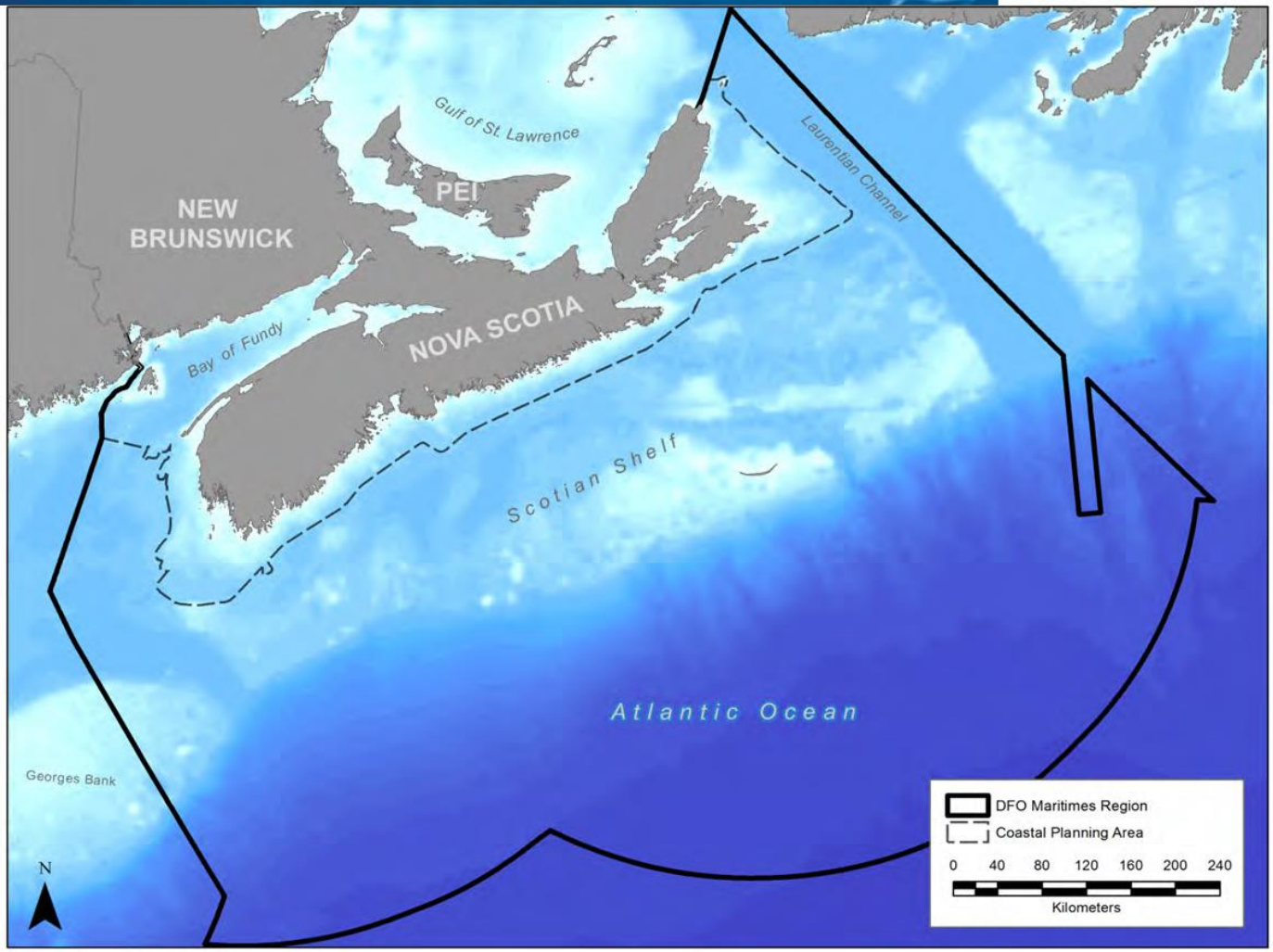
- Where do larvae come from?
- What depths are they found at?
- Do they migrate across depths during the day or because of tides?
- How long are they in the water?
- How fast do they swim?
- What time of the year are they in the water?

# Measure the importance of connections for different patches (MPAs)

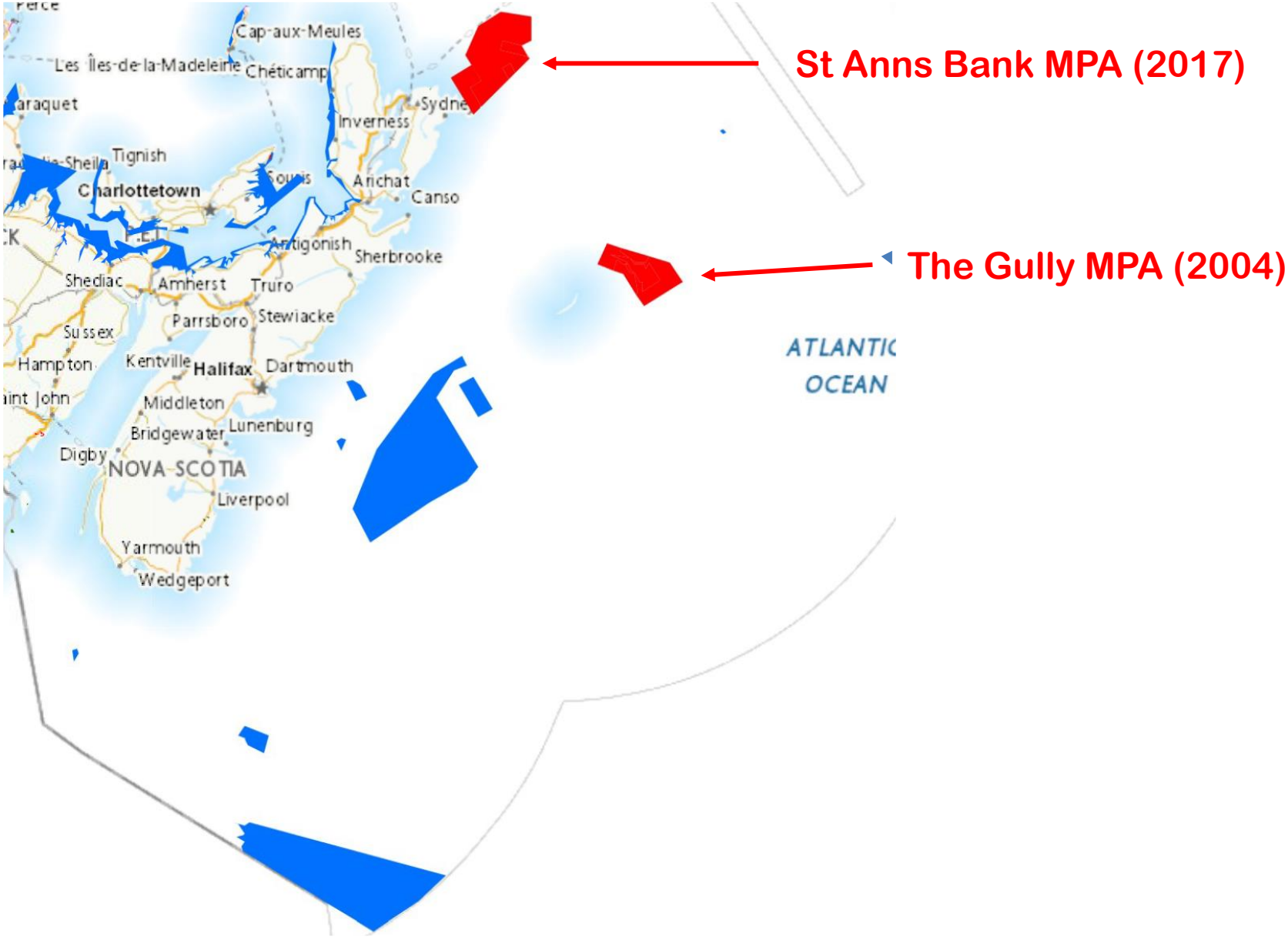


# Designing a network of MPAs in the Maritimes

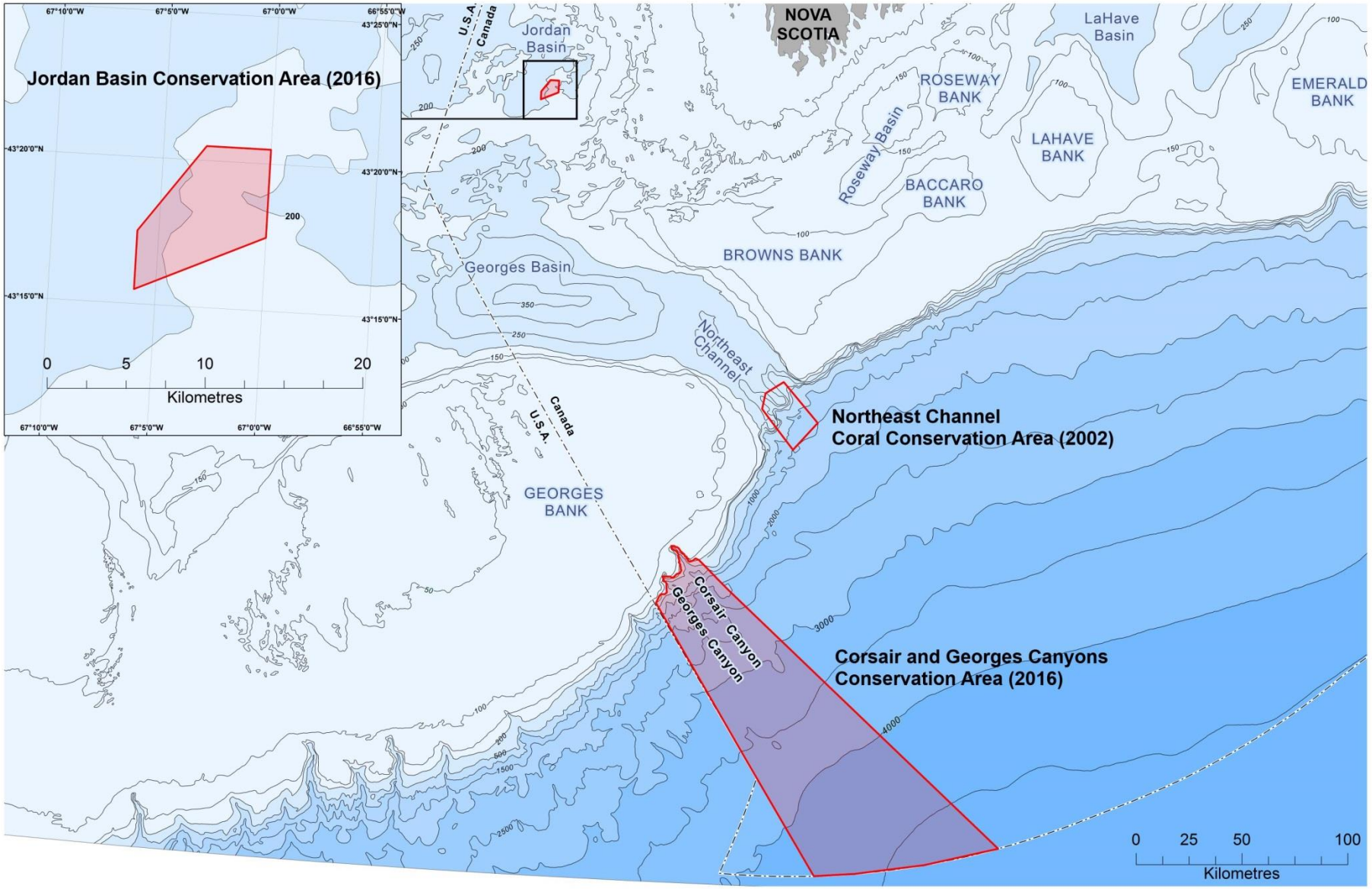
Fisheries and Oceans Canada
www.dfo-mpo.gc.ca

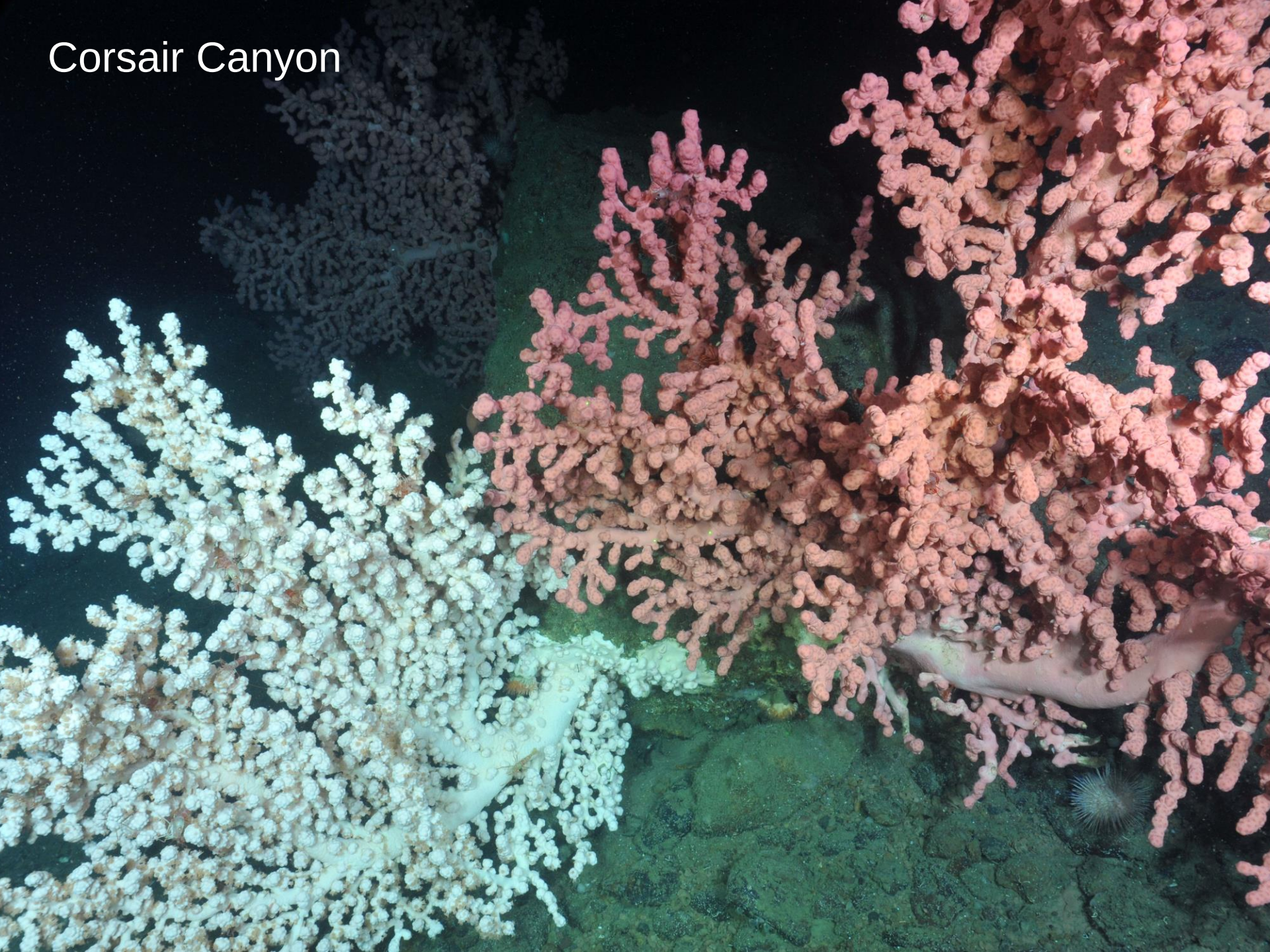


# DFO Maritimes MPAs and Marine Refuges



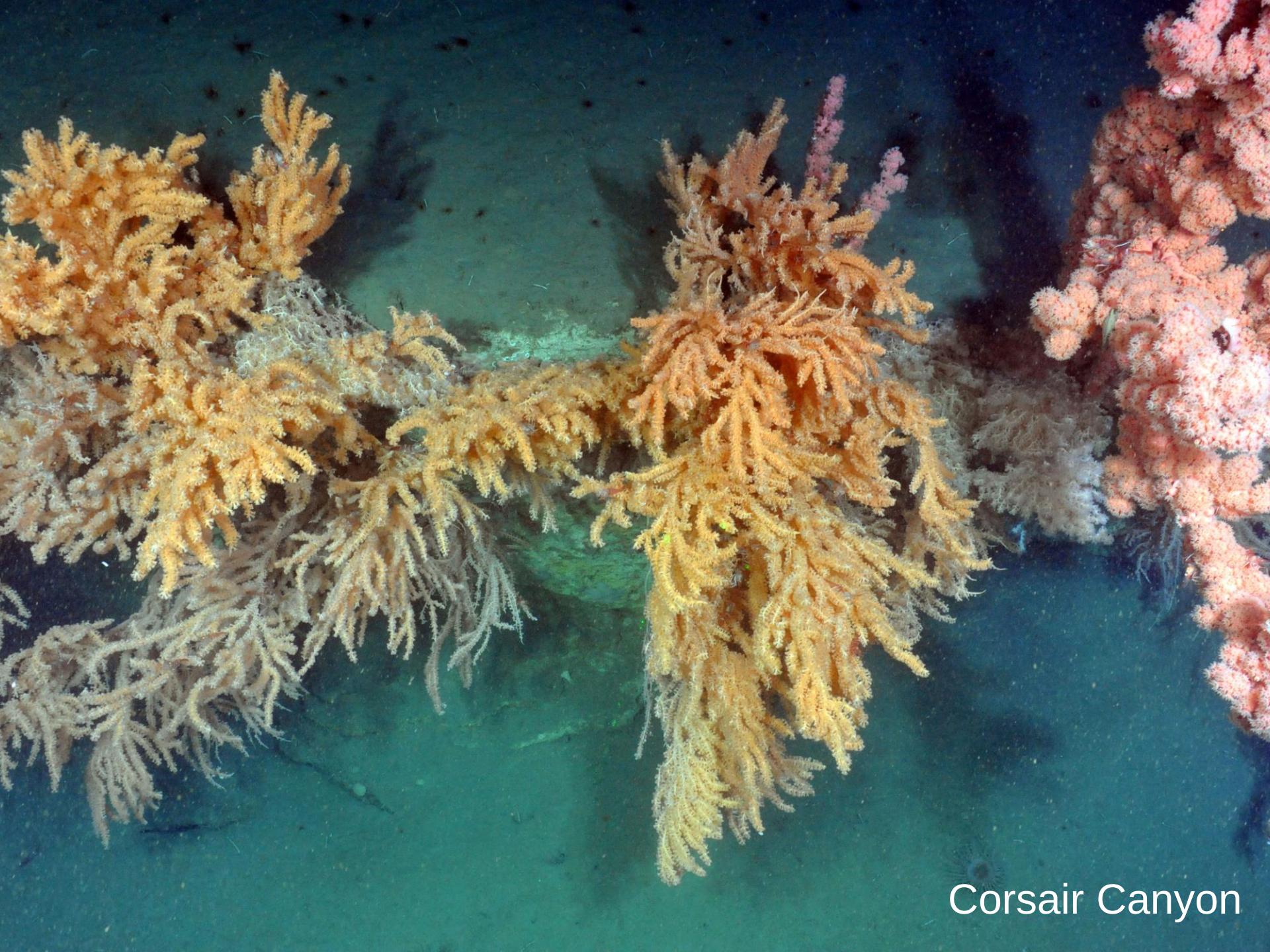
# Fisheries closures as Sensitive Benthic Areas



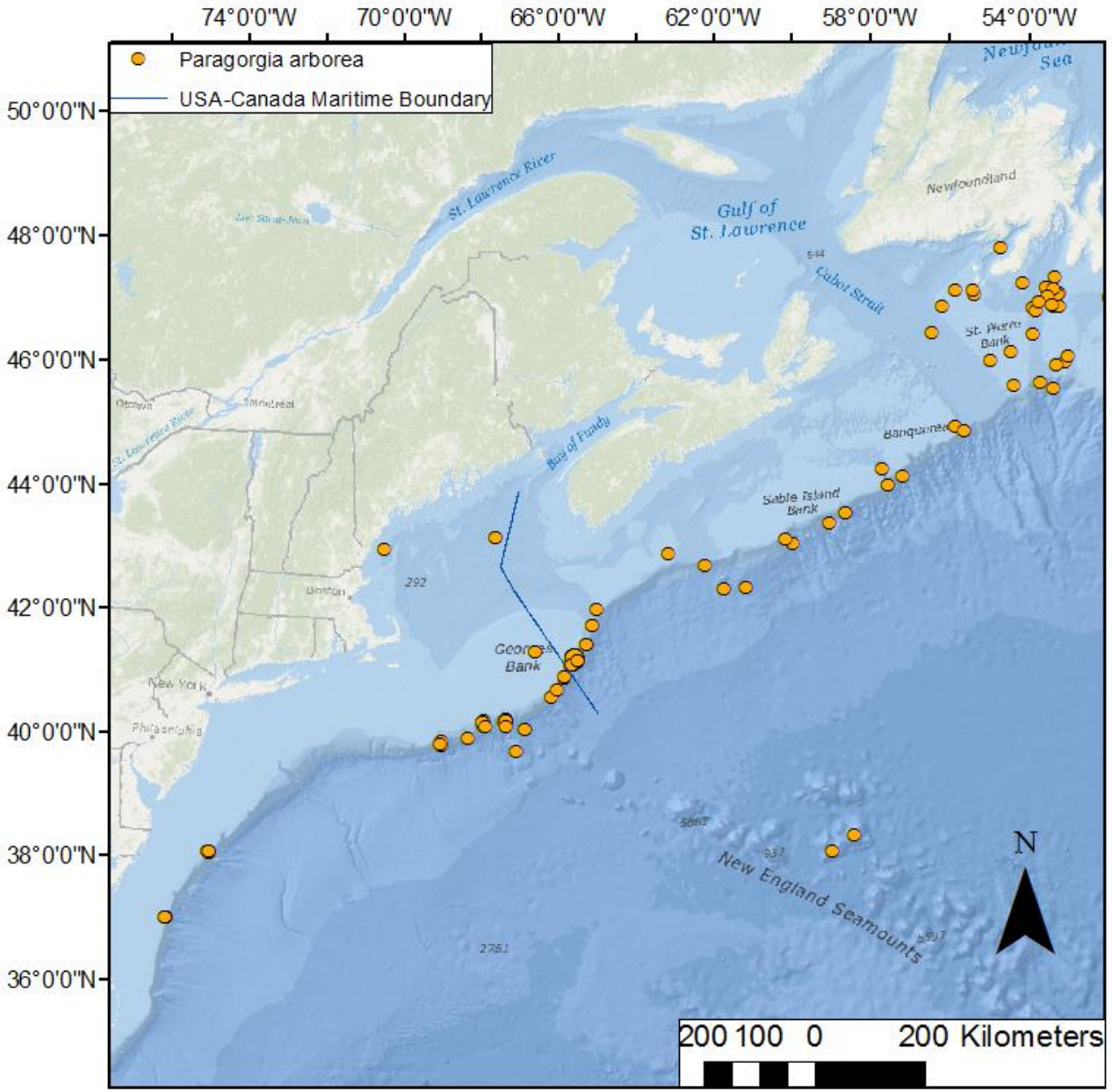

Corsair Canyon


Corsair Canyon

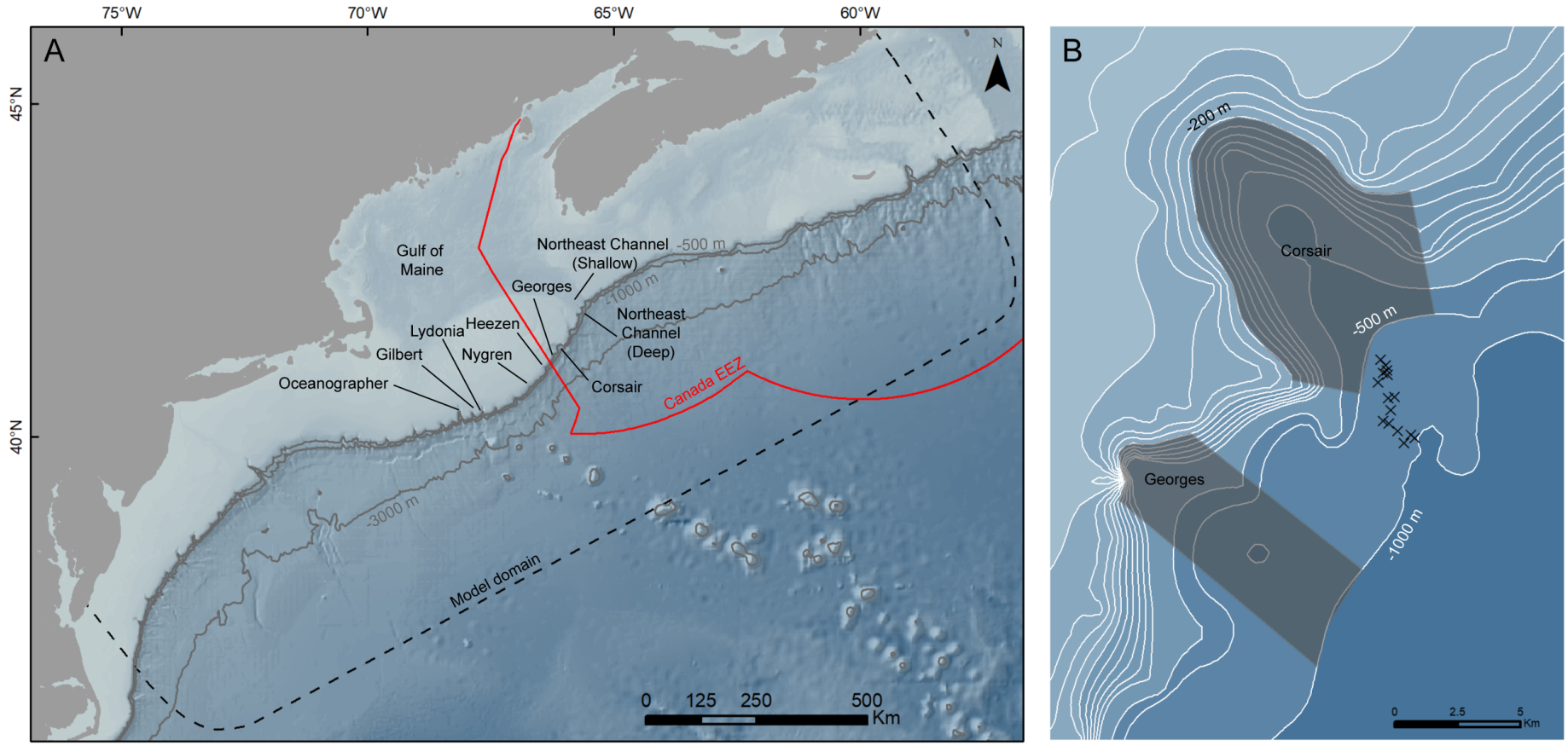

Corsair Canyon


Corsair Canyon

# Records of bubblegum coral in the region

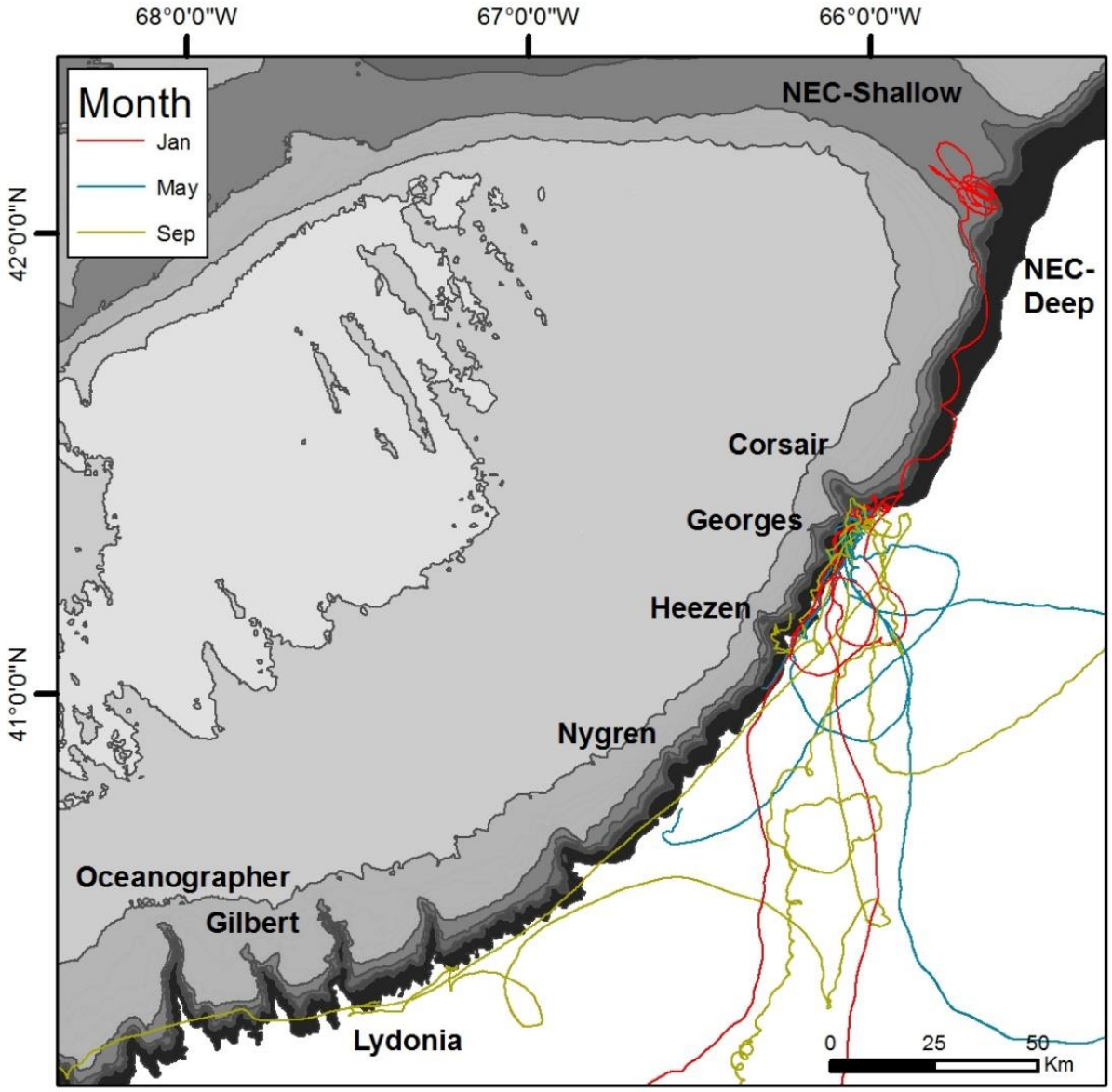


# Connectivity with Corsair Canyon
## Where do the larvae come from?




Metaxas et al. (2019)

# Tracks of virtual larvae “released” into the currents

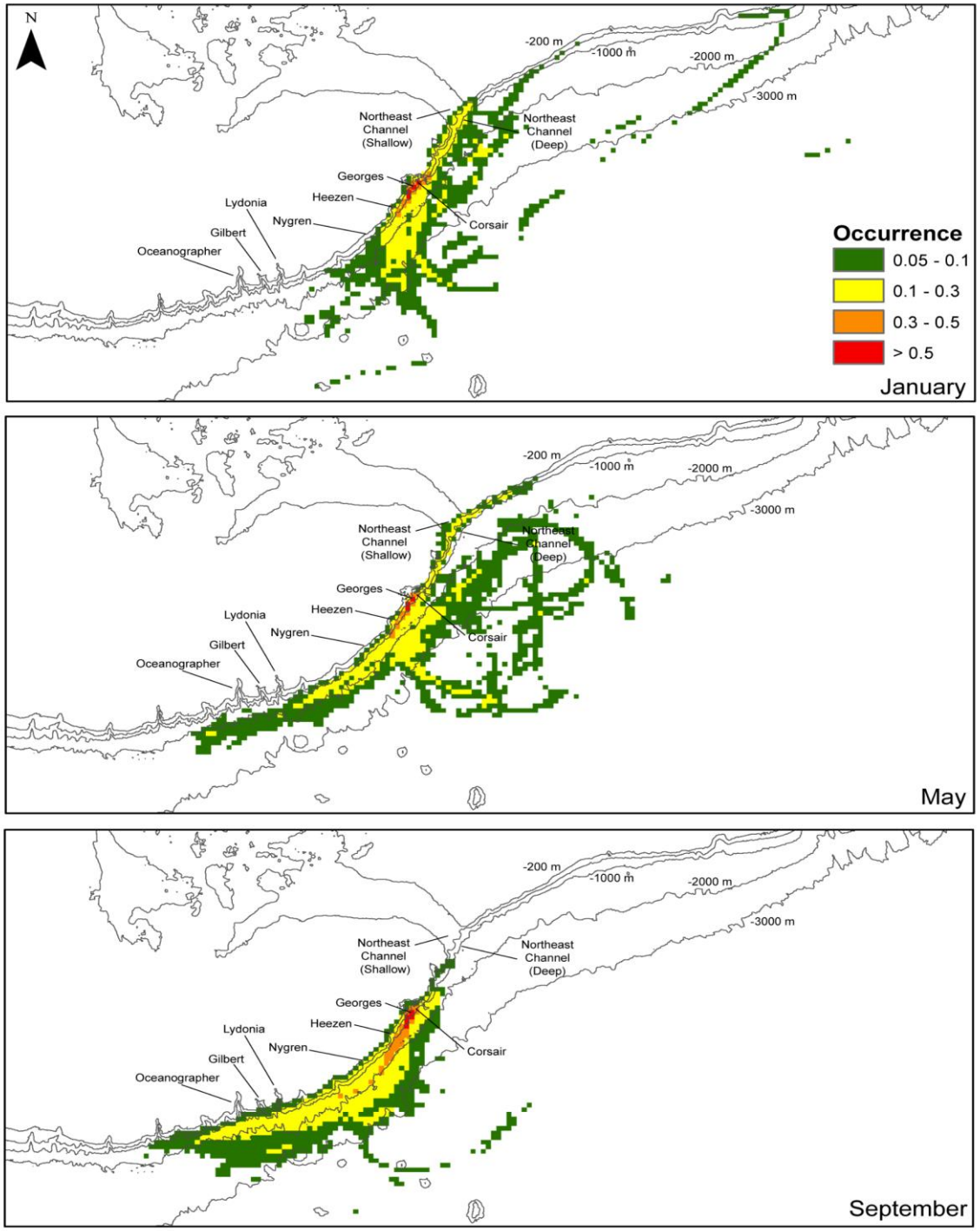


# Hydrodynamic connectivity – Corsair Canyon

January

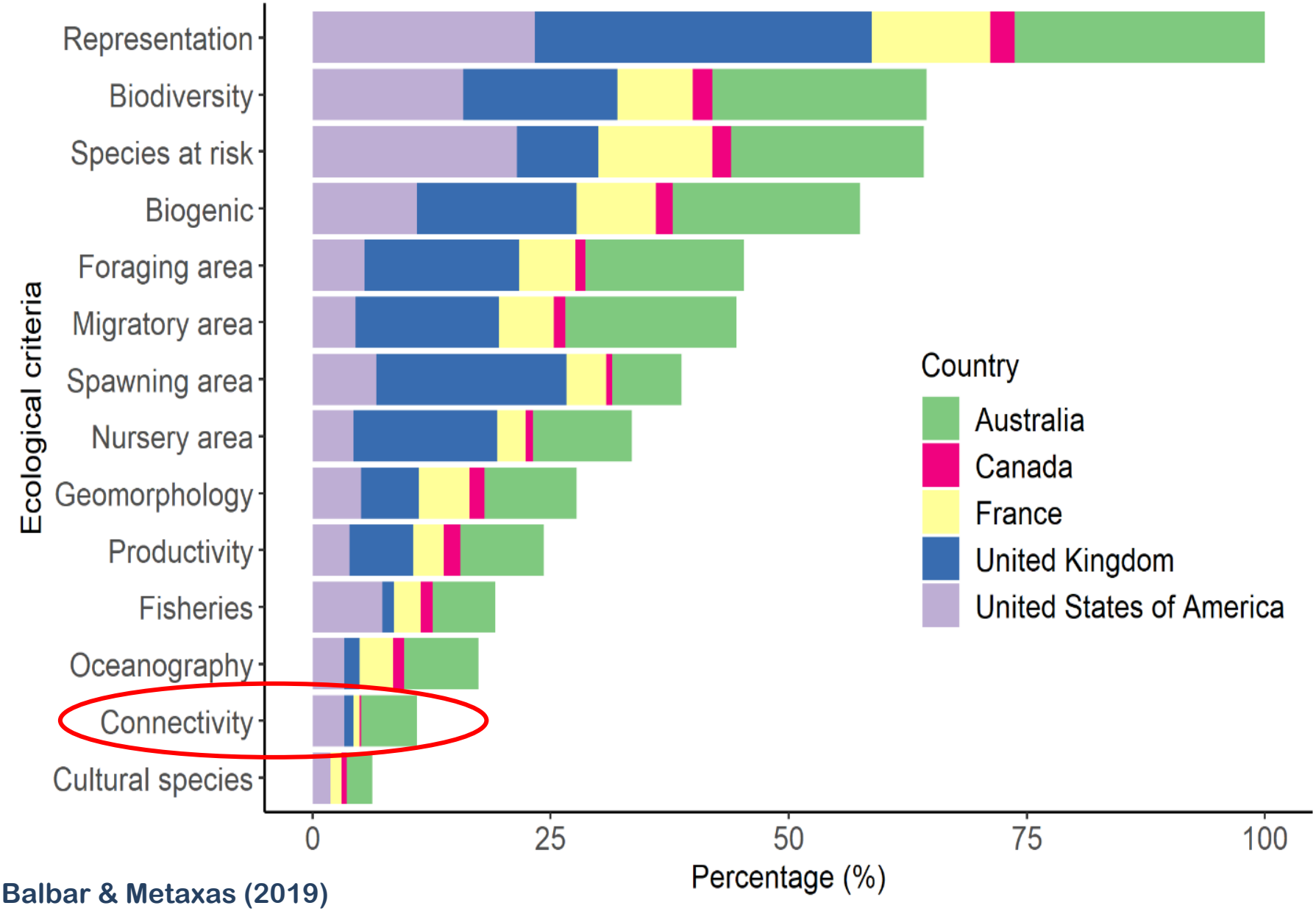
May

September



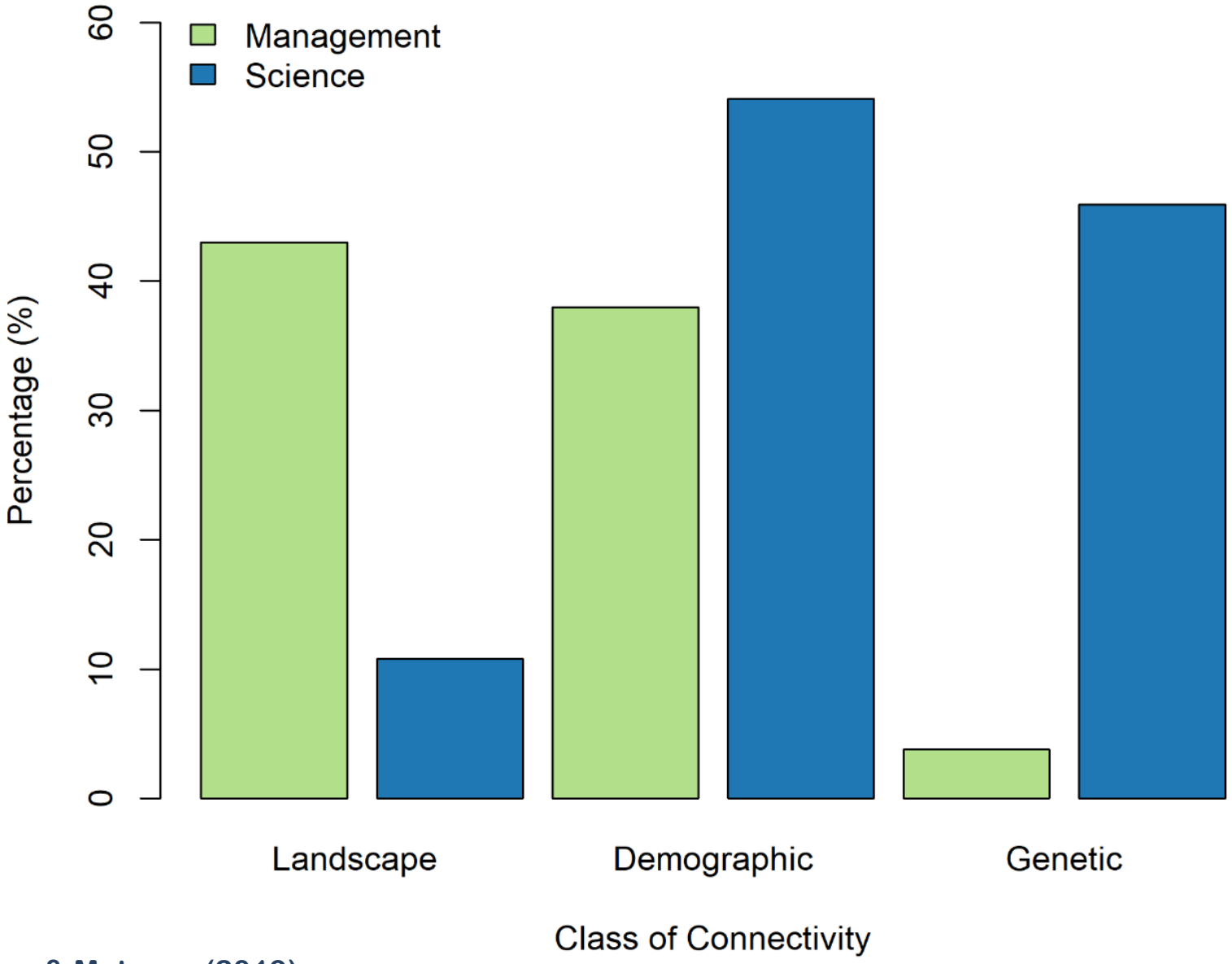

Metaxas et al. (2019)

# Ecological criteria used in the design of MPAs

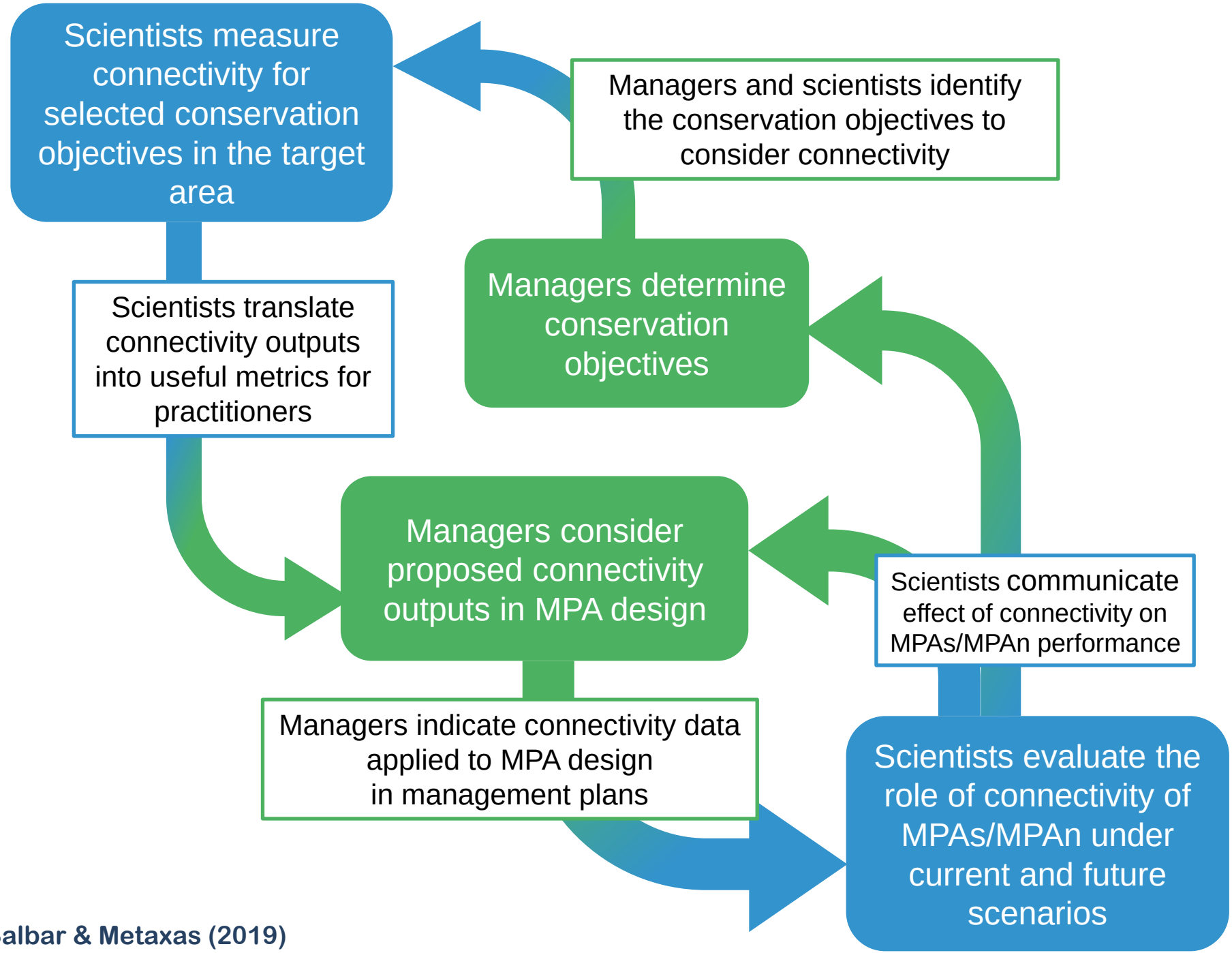



Balbar & Metaxas (2019)

# Connectivity in scientific literature versus MPA management plans

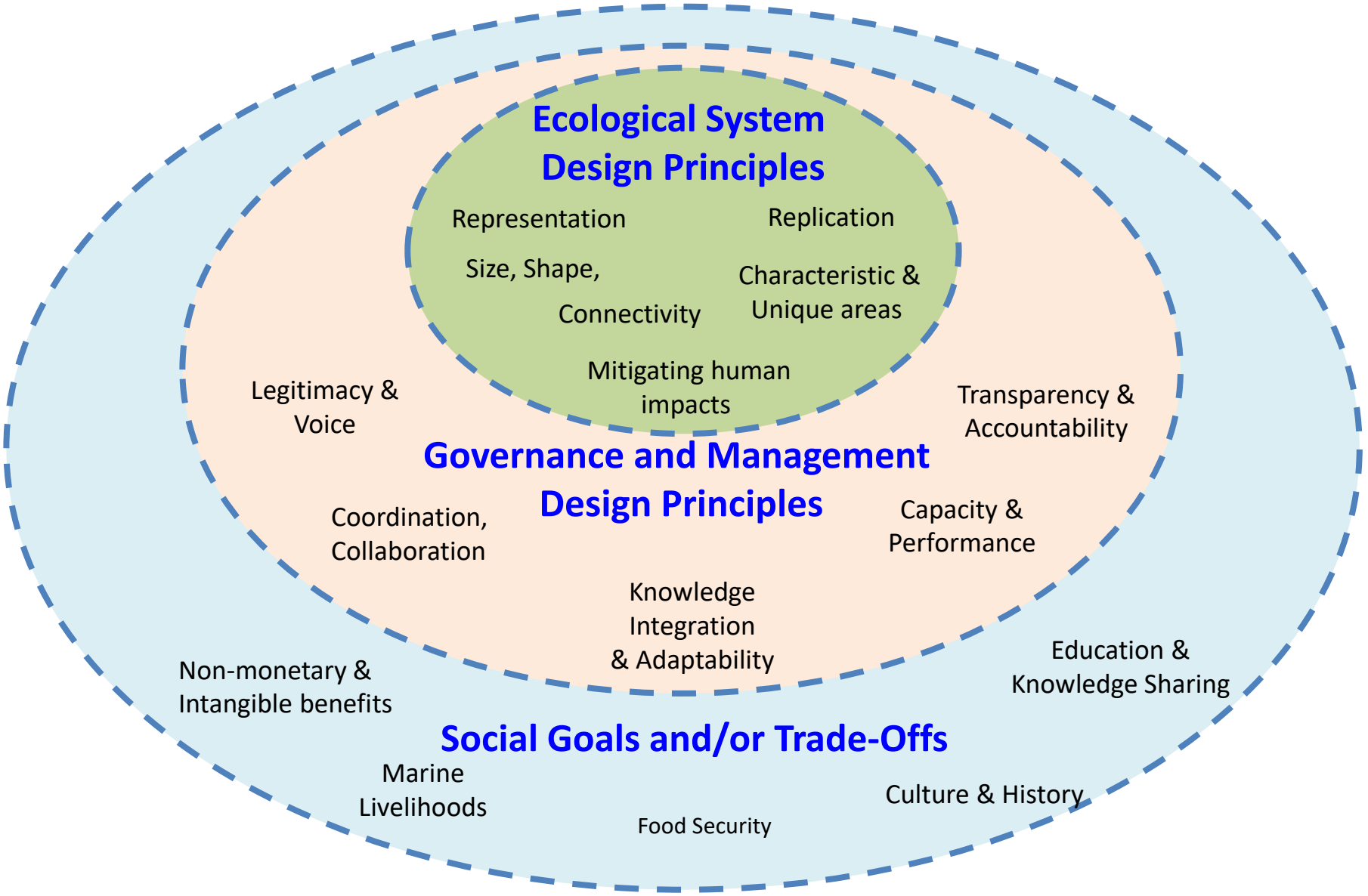



Balbar & Metaxas (2019)




**Balbar & Metaxas (2019)**

# Many things to consider in MPA network design




Burt et al. 2014 MPA Network Design Features that Support Resilient Human-Ocean Systems: Applications for B.C.