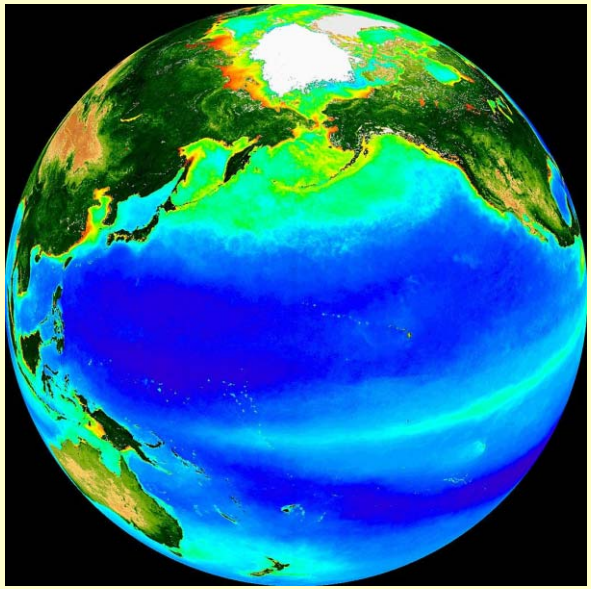
SESSION 1- APPROACHES TO COASTAL AND MARINE SPATIAL PLANNING AND MANAGEMENT

Oceanographic considerations for marine spatial planning on the high seas



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1885 International Fishers Forum

Emphasis

- Upper-trophic oceanic predators:

  - Make a living in a vast, dynamic, and heterogeneous environment
  - Respond to changes in water masses, productivity and prey availability
  - Concentrate within smaller-scale foraging areas (10s - 100s km)


Photo: Webb

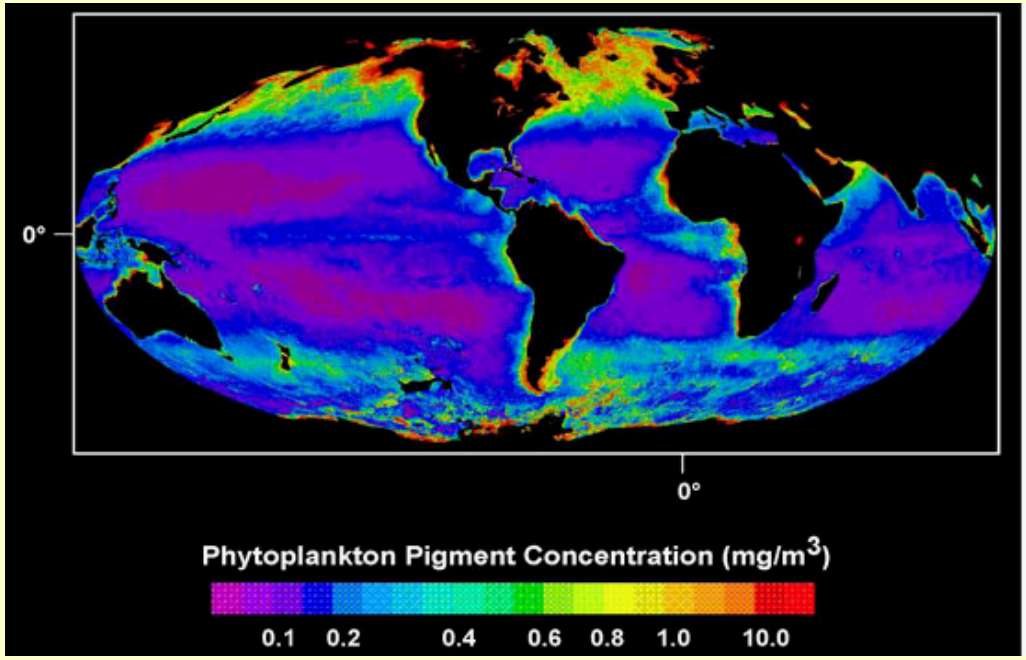

Photo: Brittain

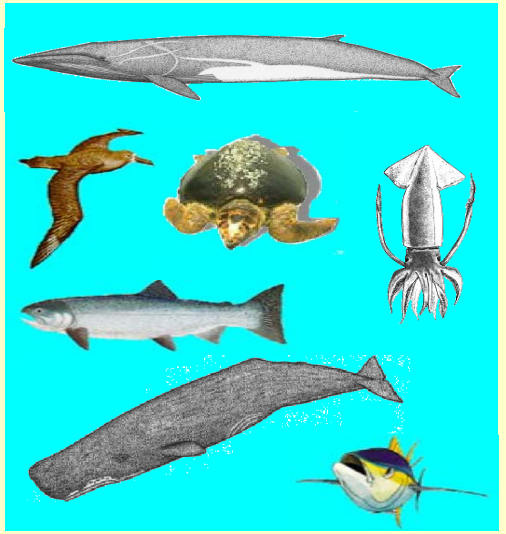
- Thus, in principle, …

Marine protected areas could be established to protect critical habitats (e.g., breeding / foraging) and "predictable" concentrations

For commercially-valuable species, harvesting areas could be identified to minimize ecological impacts associated with fishing (e.g., bycatch)

Motivation

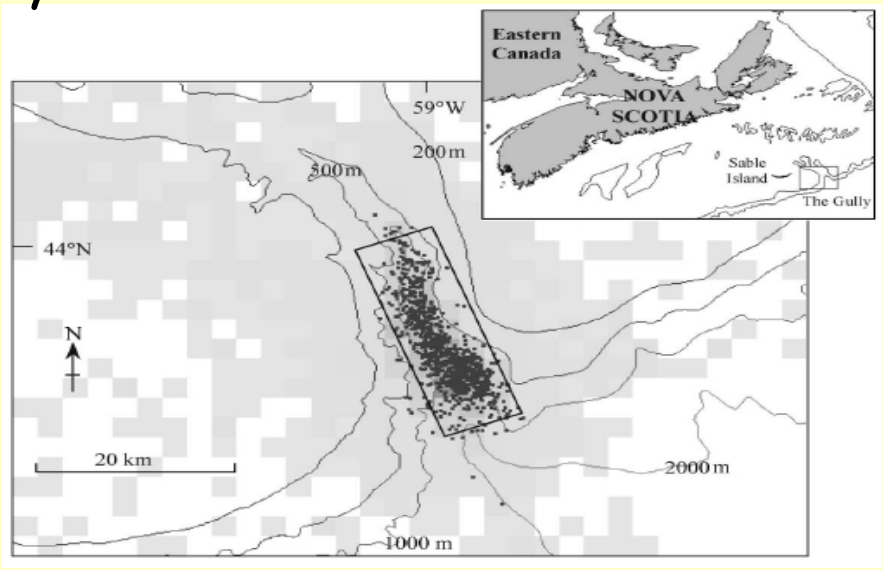




- Discuss relevant patterns and scales in pelagic systems
- Promote discussion:
  - Design concepts for pelagic MPAs
  - Challenges and Knowledge Gaps

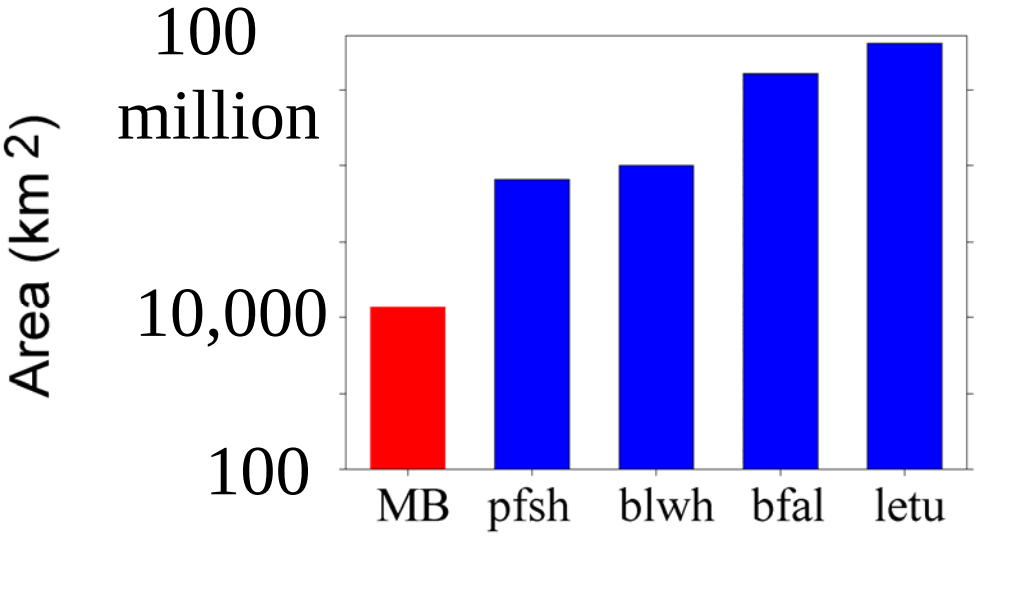
Size and Shape Matter

Protection of sessile taxa similar in marine & terrestrial systems



Bottlenose whales (1988-98)
(Hooker et al. 2002)

The ranges of many pelagic species are too large. Yet, MPAs can still play critical role

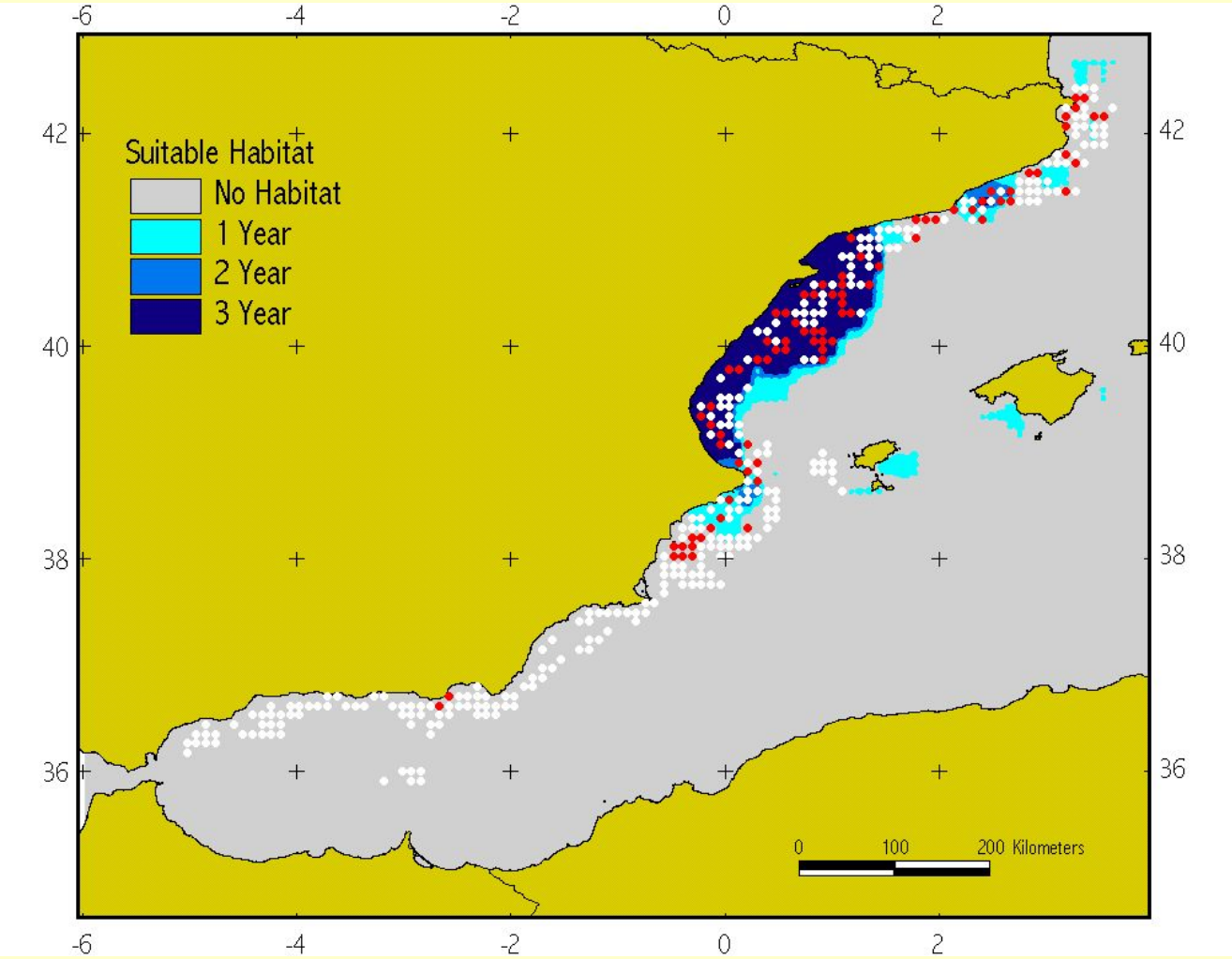


Marine Predators forage over areas 100 - 1000 times bigger than the largest CA MPA

Design Recommendation - 1

Consider the Spatial Context

Ranges Expand & Contract



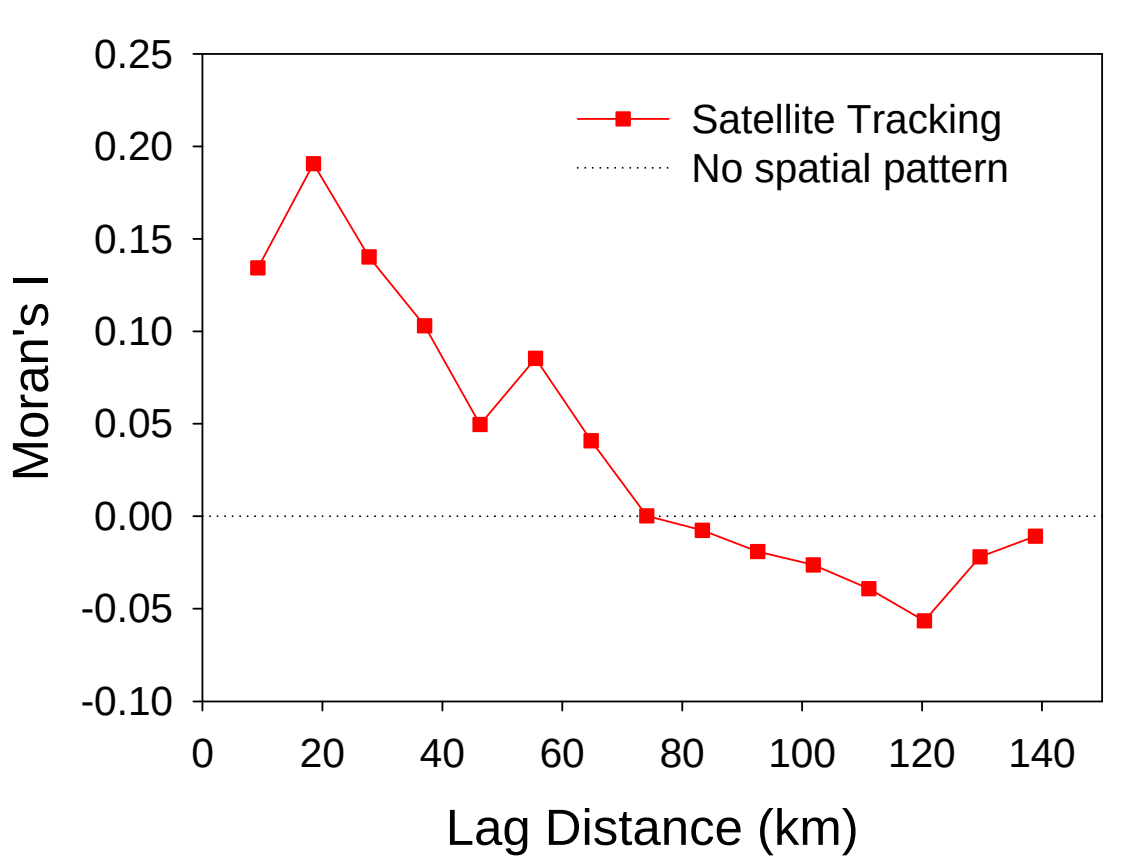
- The Balearic Shearwater inhabits productive shelves (shallow, high Chl a)

- The spatial extent of their habitat varies from year to year and can be defined probabilistically

(Louzao et al. 2006)

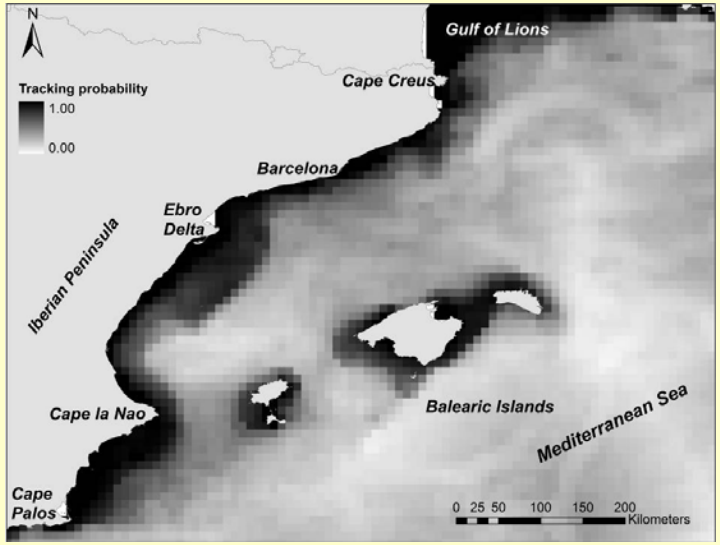
Scales of Aggregation

- Movements of individuals foragers



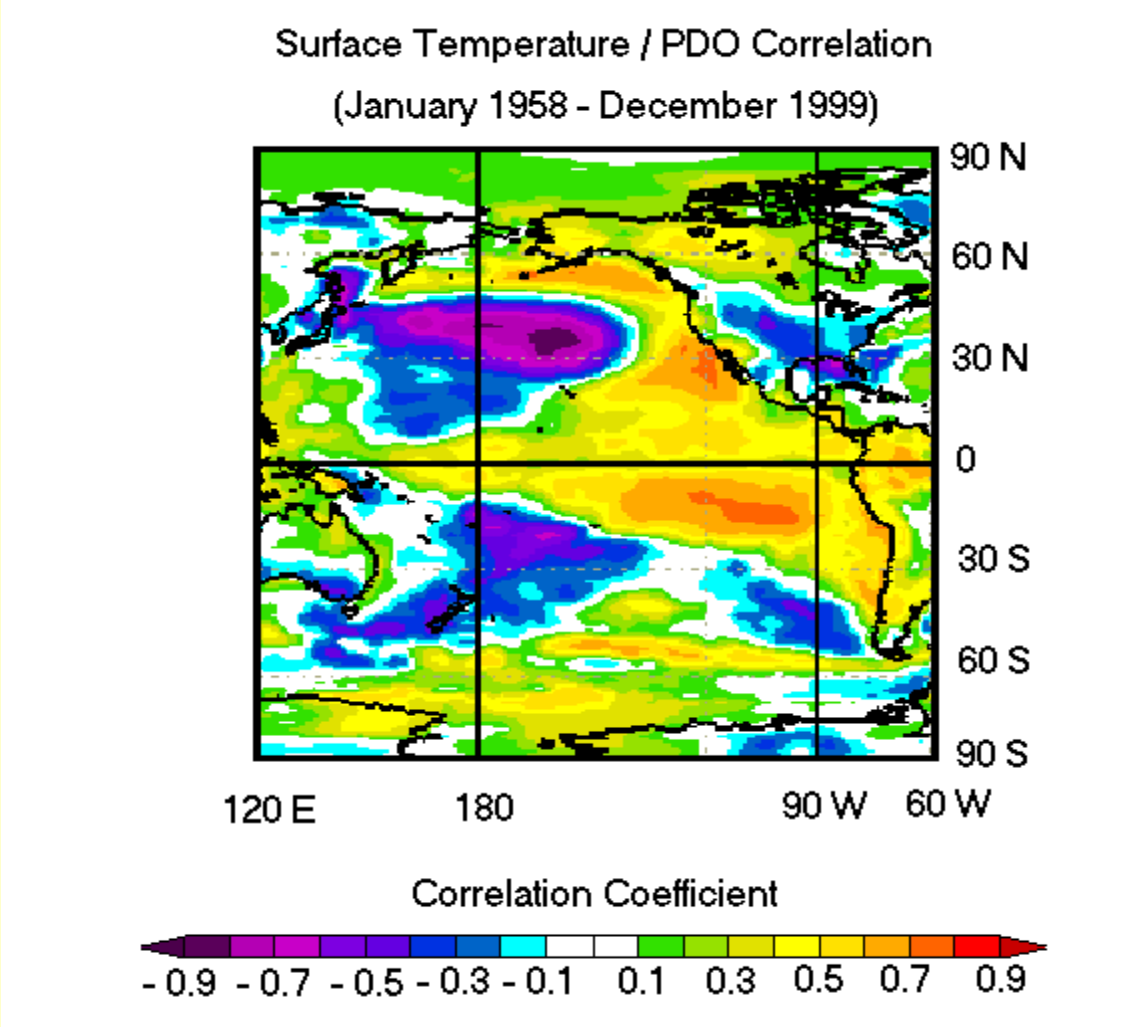
(Louzao et al. 2009)

Cory's Shearwaters tracked from colonies in the Balearic Islands



Design Recommendation - 2

Develop Dynamic Measures

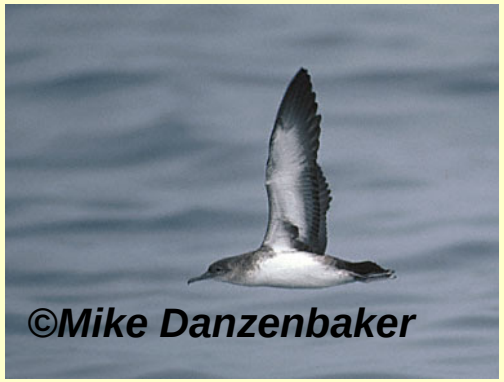


Antecedent Conditions

- Correlation with SST off southern California (1987-98)

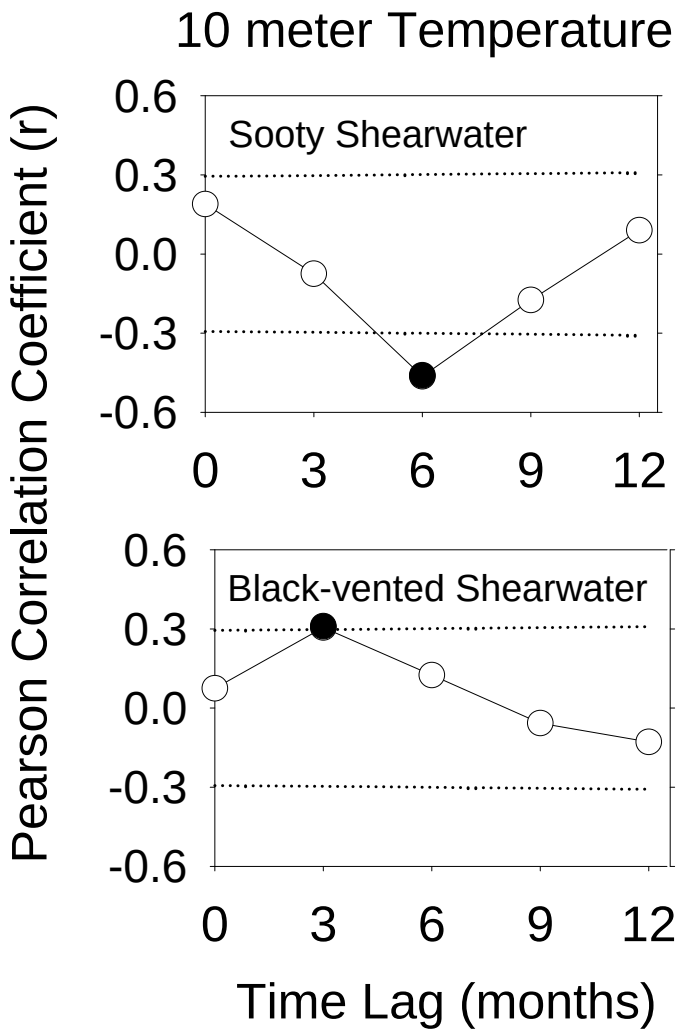
Sooty Shearwater

Avoids Warming



Black-vented Shearwater

Follows Warming



(Hyrenbach & Veit 2003)

Can Help Define "Triggers"

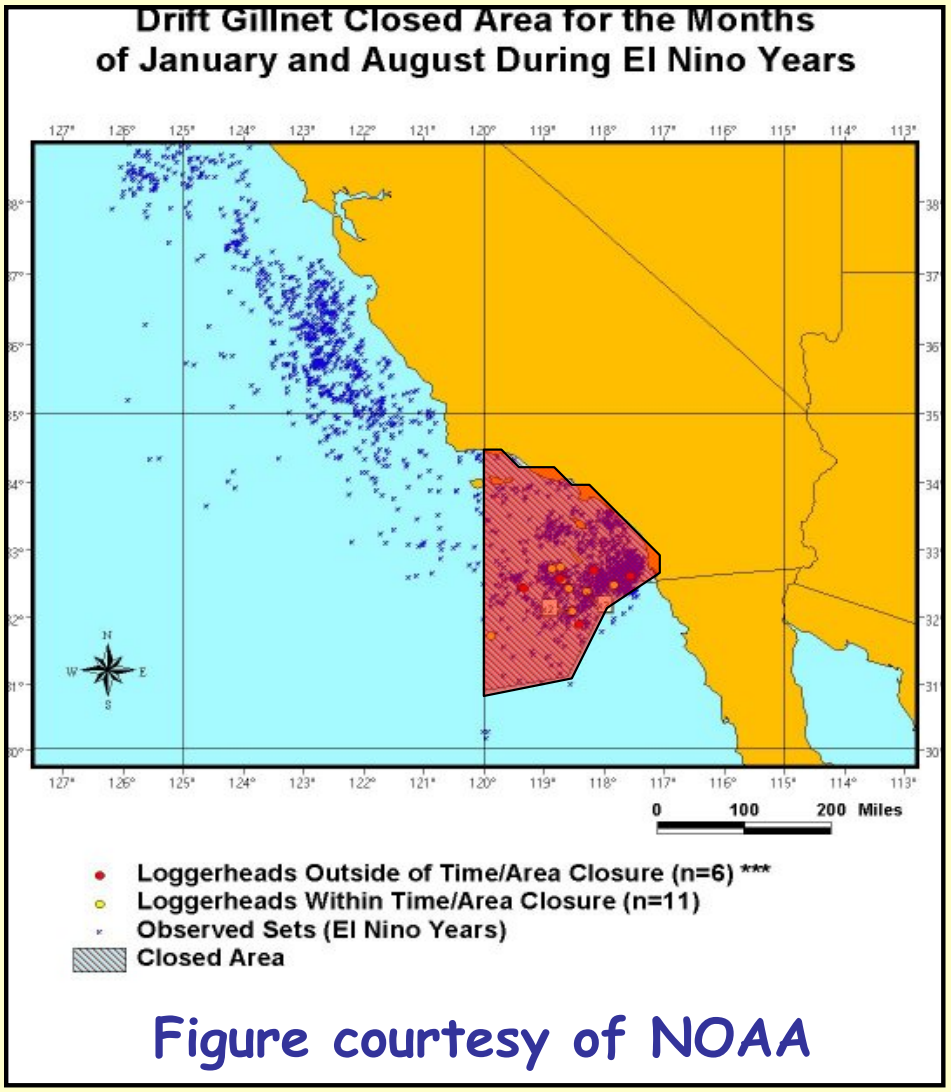
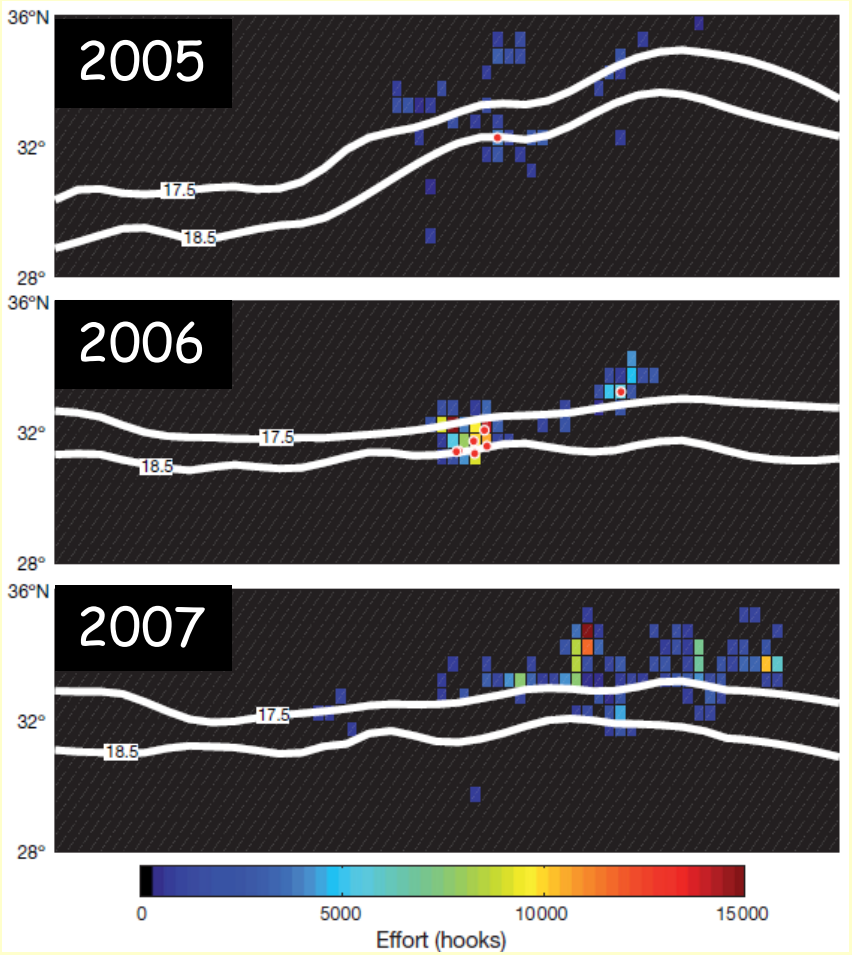


Figure courtesy of NOAA

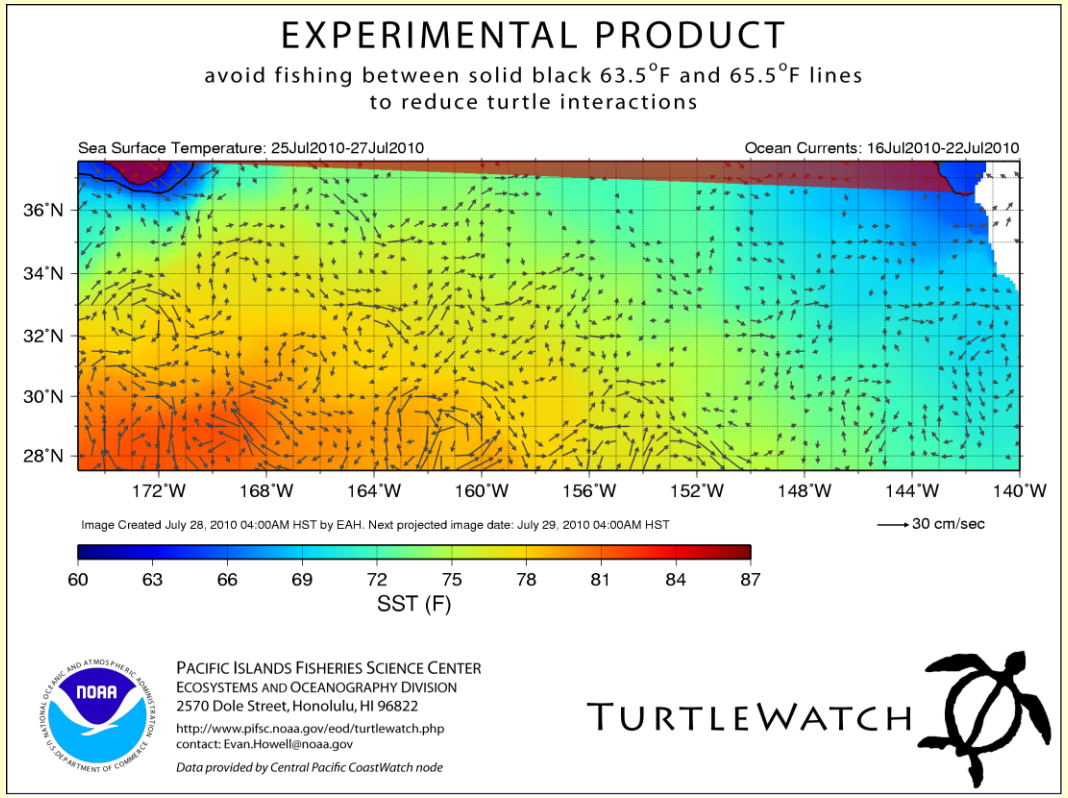
Drift gillnet closures off southern California during El Niño to mitigate loggerhead sea turtle bycatch

Challenges: Dynamic Features



(Howell et al. 2008)

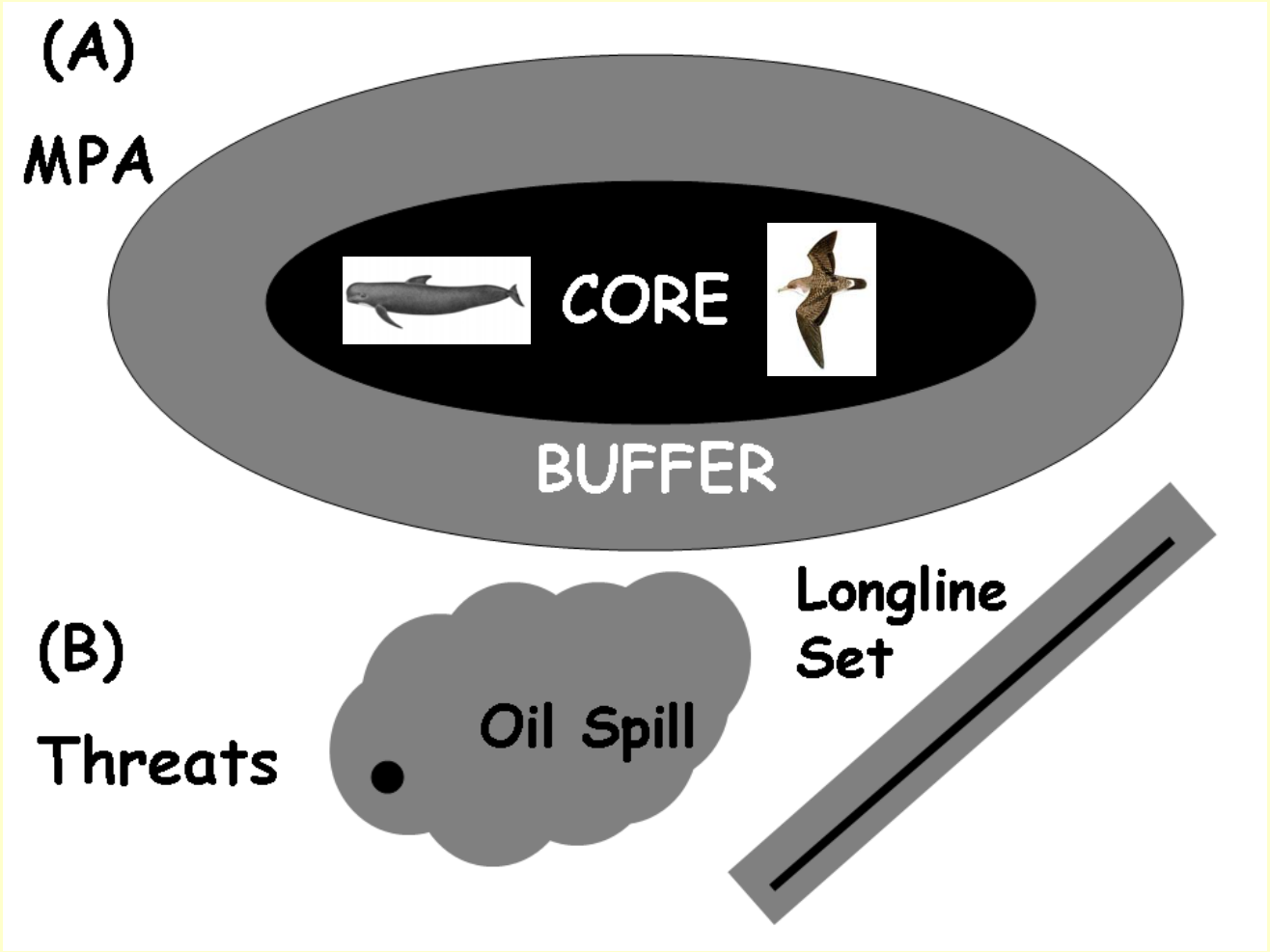
January longline fishing effort and loggerhead turtle interactions (red circles). White lines show mean monthly position of 17.5 and 18.5 °C isotherms.



NOAA PIFSC, Honolulu
(www.pifsc.noaa.gov/eod/turtlewatch.php)

Turtlewatch advisory map (July 28, 2010) showing SST contours, black geostrophic current arrows and 18.5°C isotherm (black line).

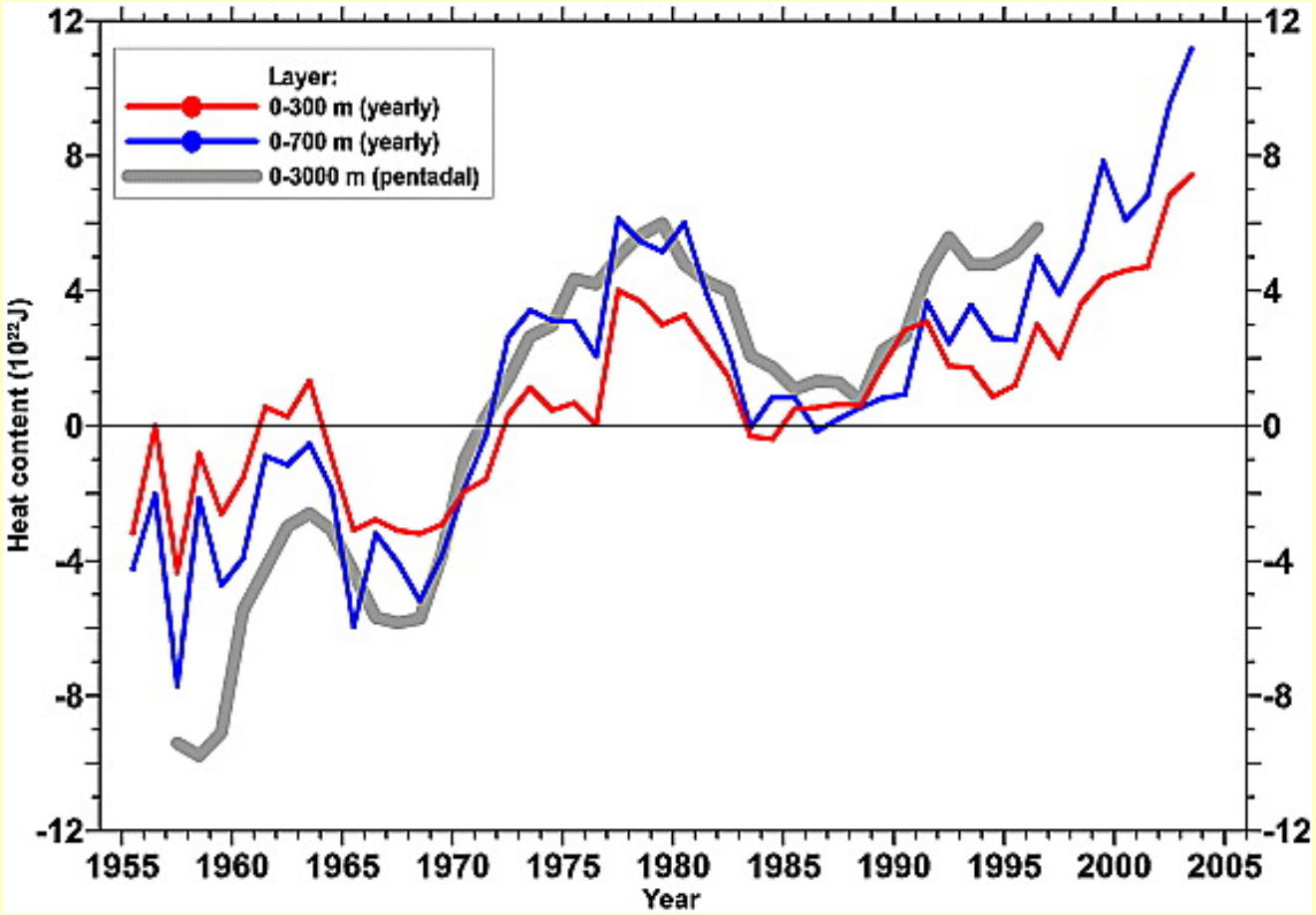
Challenges: Understanding Threats



Conceptual diagram of a core- buffer MPA (A) and the "footprint" of different threats (B)

(Hyrenbach 2008)

Challenges: Accommodate Climate



Yearly ocean heat content for the **0–300 m** and **0–700 m** layers and 5-year composites (from 1955–59 to 1994–98) of ocean heat content for the **0–3000 m** layer

(Levitus et al. 2000, 2005)

Conclusions

- In principle, MSP can be used to protect critical habitats and "predictable" concentrations

- Large MPAs May Not Suffice

- Effective MPAs Require Careful Design and Broader Scale-Explicit Management Scheme:

Consider the Spatial Context

Develop Dynamic Metrics

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Acknowledgements

INTERNATIONAL FISHERS FORUM

"Hotspot" Definitions

- ***Species:*** Foraging grounds / migratory routes
- ***Food Webs:*** Energy transfer to predators
  - Standing stocks / Aggregation
  - Indicator species with high energetic requirements (e.g., alcids, balaenopterid whales)
- ***Ecosystems:*** Localities of high biodiversity
  - Ecotones and "transition zones"
  - Areas of high species richness and diversity

(Pedersen et al., 2002; California and World Ocean)

	Species Conservation	Food-Web Conservation	Ecosystem Conservation
Metrics	Aggregation Movement	Ocean productivity Prey biomass Predator density	Species diversity Endemism
Habitats	Breeding areas Foraging areas Migration corridors	Productivity "hotspots" Prey concentrations Foraging areas	Multi-species aggregations
Processes	Breeding Feeding Migration	Upwelling regions Convergence zones Prey aggregations	Ecotones Prey patchiness Species associations

Habitat Types

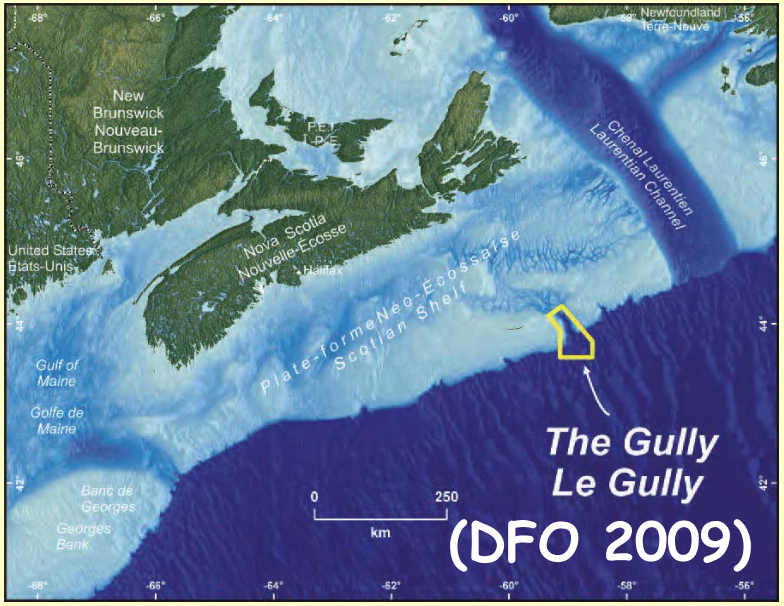
- ***Static:*** Bathymetric features

  (e.g., shelf-breaks, seamounts)

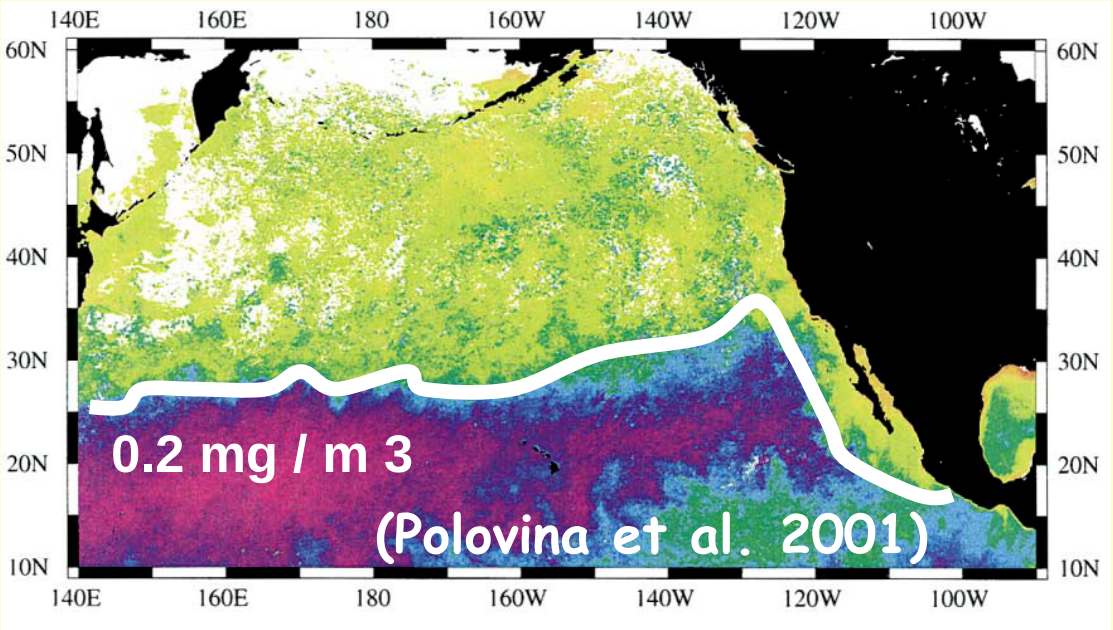
- ***Dynamic:*** Hydrographic features

  - Persistent (e.g., fronts)
  - Ephemeral (e.g., eddies)

(Hyrenbach et al. 2000)



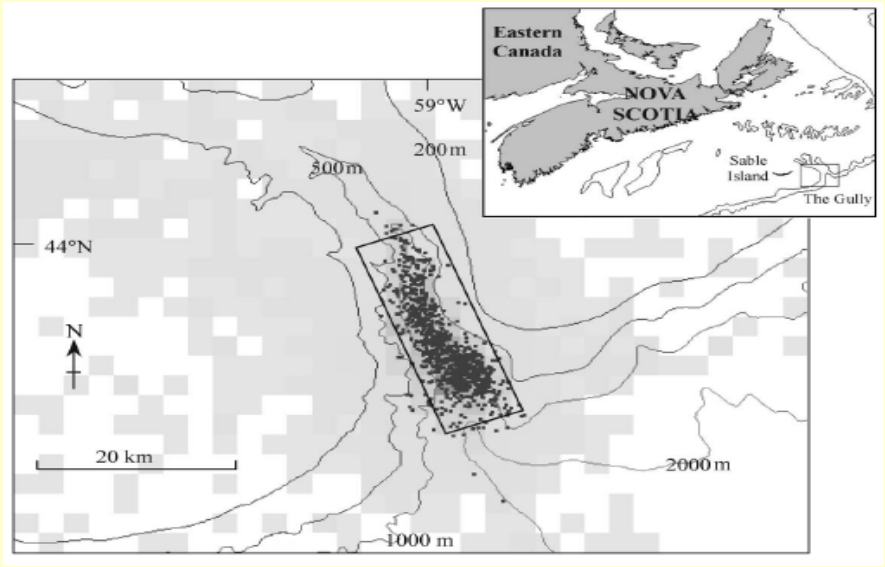
The Gully



Transition Zone Front

Static Hotspots

- Protection of sessile taxa similar in marine & terrestrial systems



Bottlenose whales (1988-98)
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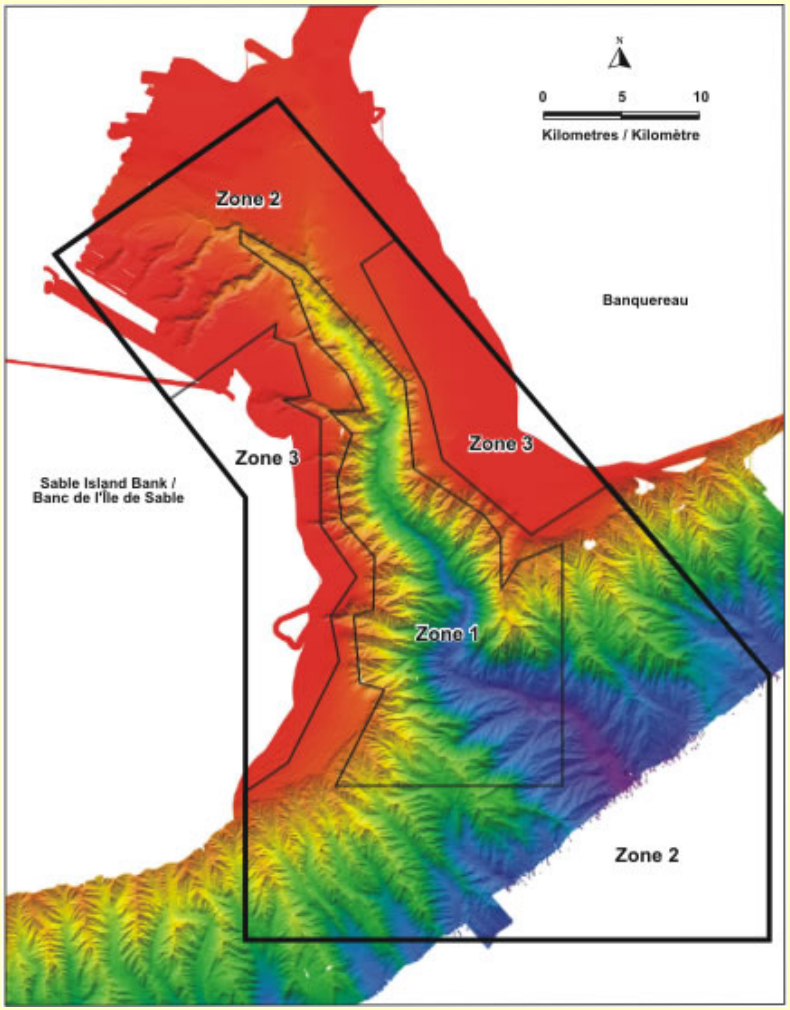
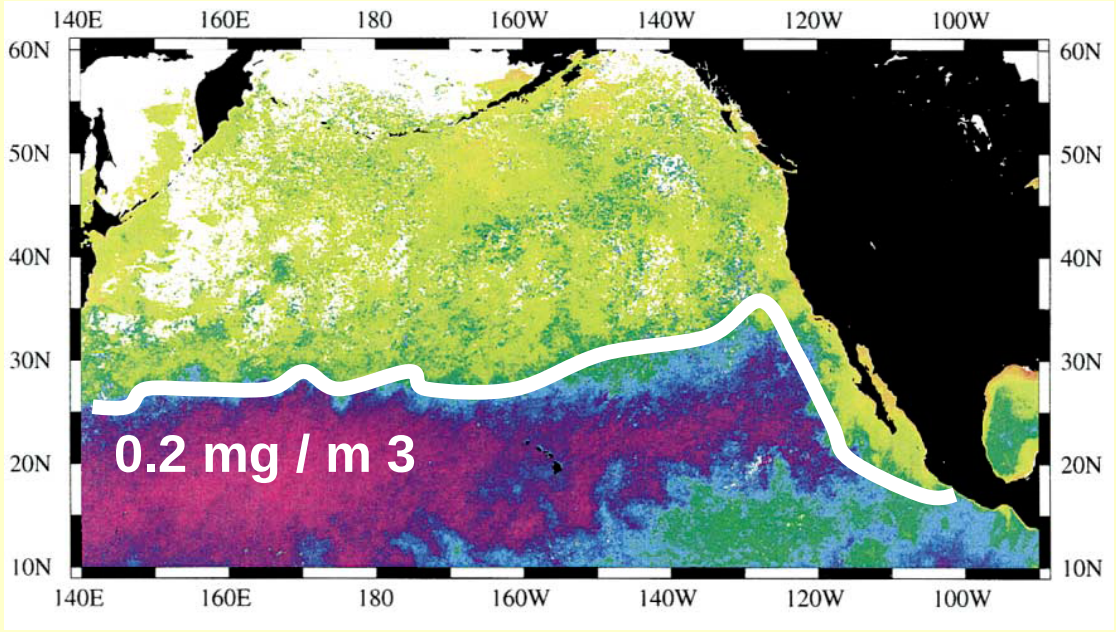


Gully MPA: 3 Zones
(DFO 2009)

Dynamic Hotspots

Loggerhead turtles migrate across Pacific along dynamic CHL front

Fisheries target albacore tuna along the same feature



(Polovina et al. 2001)