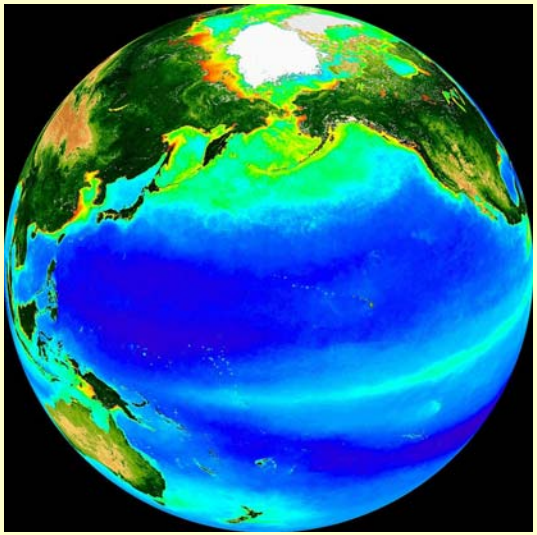
ICMMPA PANEL 3 - How can MPAs and networks of MPAs ensure threat mitigation to cetaceans?

How to deal with temporally and spatially dynamic critical habitats?



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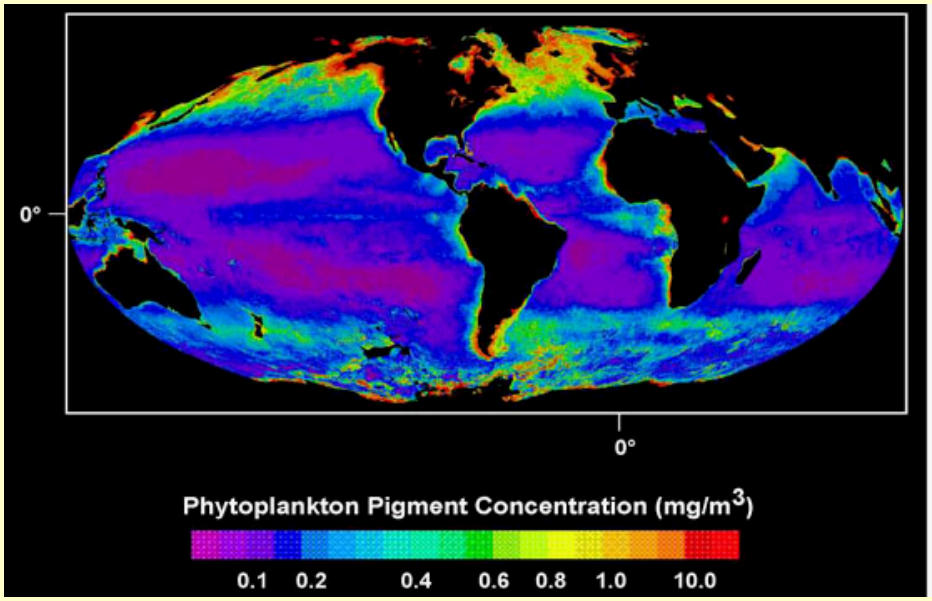
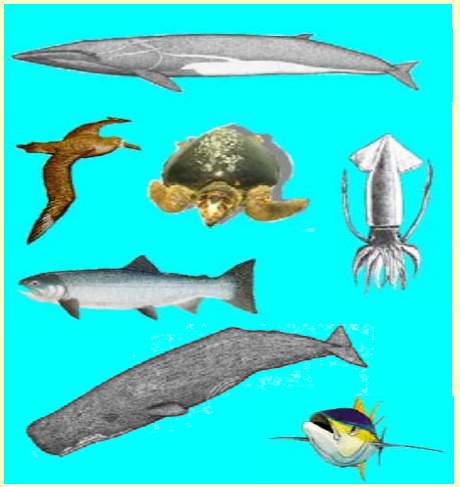
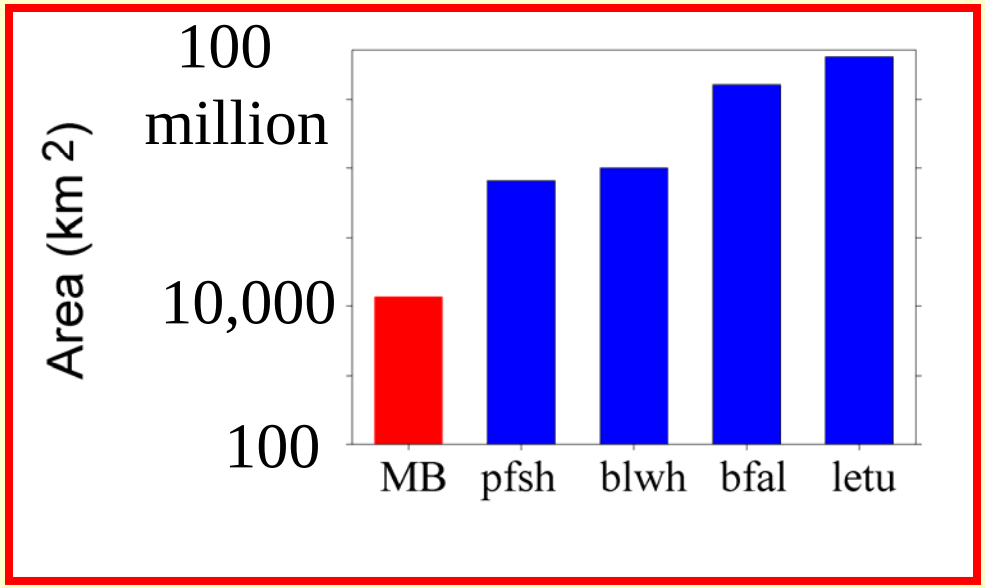
Motivation: Oceanographic Forcing



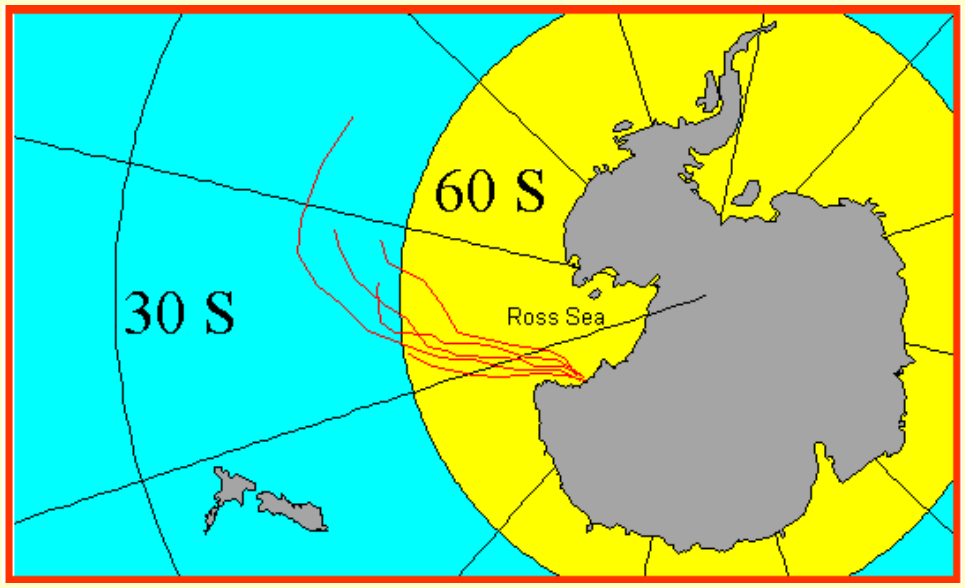


- Discuss relevant patterns and scales in pelagic systems
- Promote discussion:
  - Reserve design concepts for pelagic MPAs
  - Research needs to assess effective designs

Pelagic Reserves: Size and Shape Matter



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



Emperor Penguins forage outside of Antarctic Treaty Waters (> 60 ° S)

(Kooyman et al. 1996)

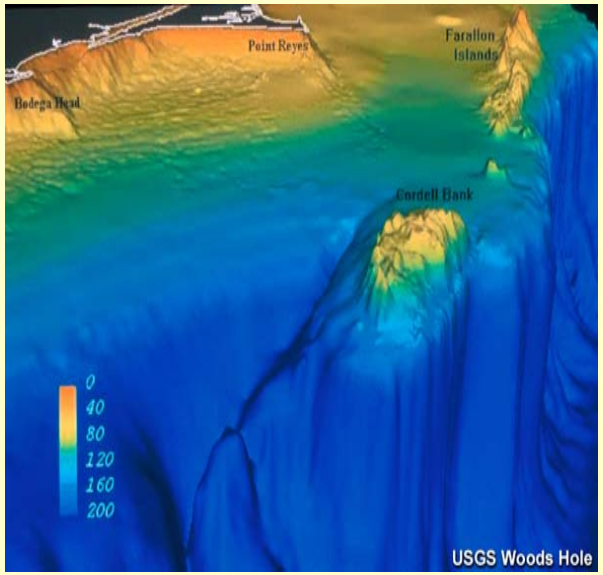
Habitat Types

- ***Static:*** Bathymetric features

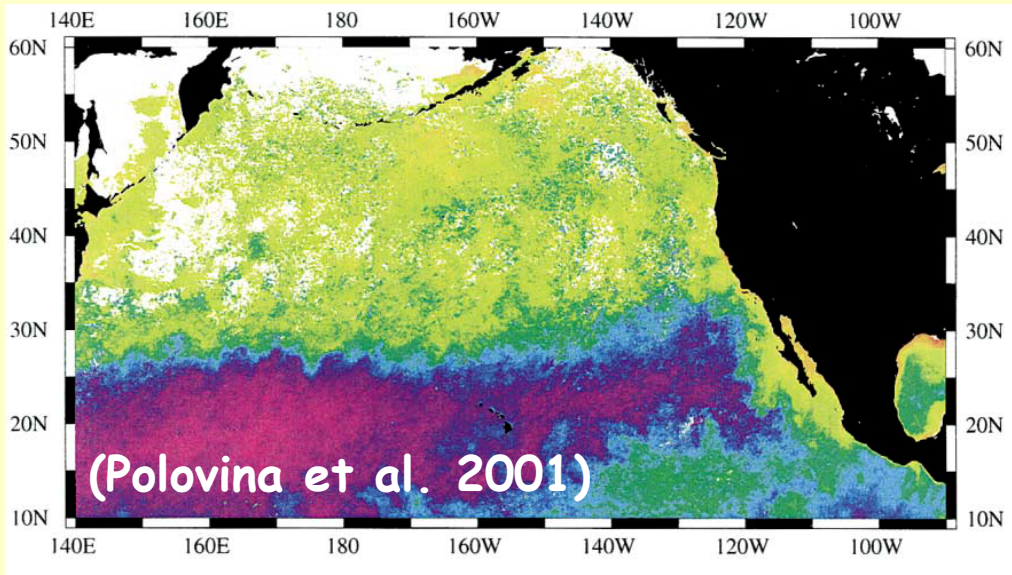
  (e.g., shelf-break, banks)

- ***Dynamic:*** Hydrographic features
  - Persistent (e.g., fronts)
  - Ephemeral (e.g., eddies)

(Hyrenbach et al. 2000)

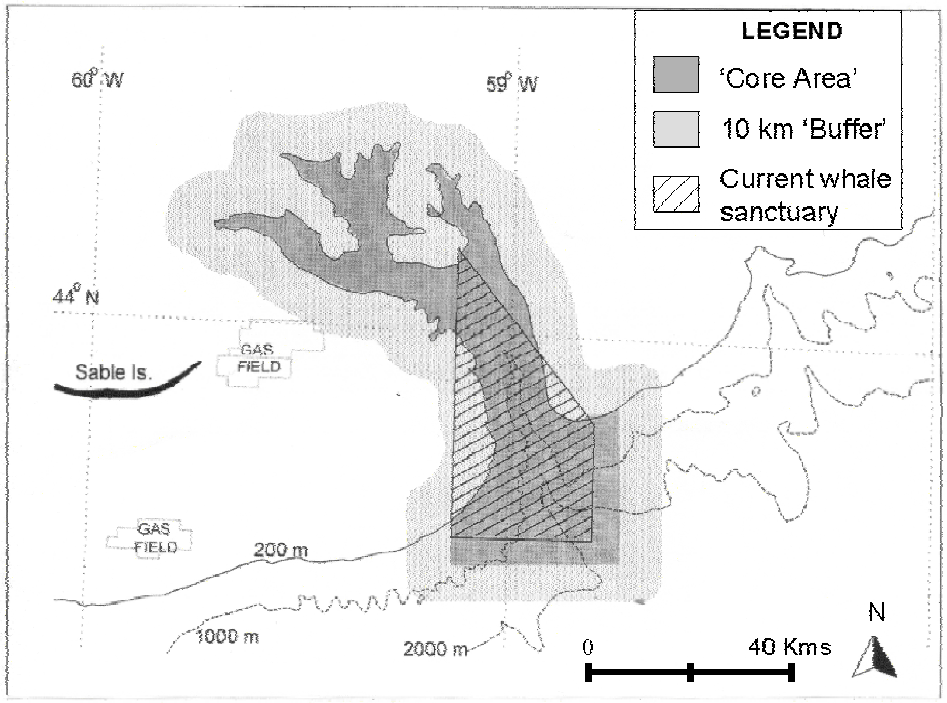


Cordell Bank



Transition Zone Front

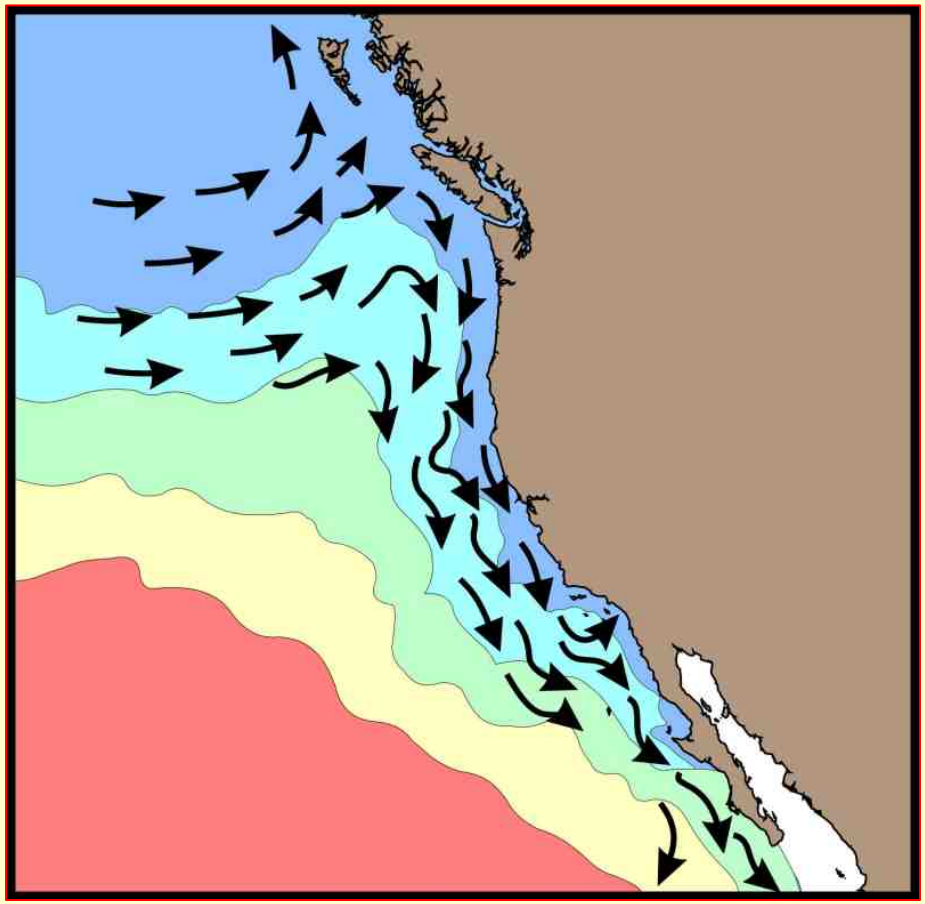
HOTSPOTS: Static Features



Bottlenose whales in the Gully
(Hooker et al. 1999)

- Protection of sessile taxa similar in marine & terrestrial systems
- For mobile species, reserve designs may require extensive buffers around habitat features

HOTSPOTS: Dynamic Habitats



- Spatially predictable ("on average")
- Some are Persistent
- Others are Recurrent
- The size and shale varies temporally

CASE STUDY: the Southern CCS

- Spring cruises

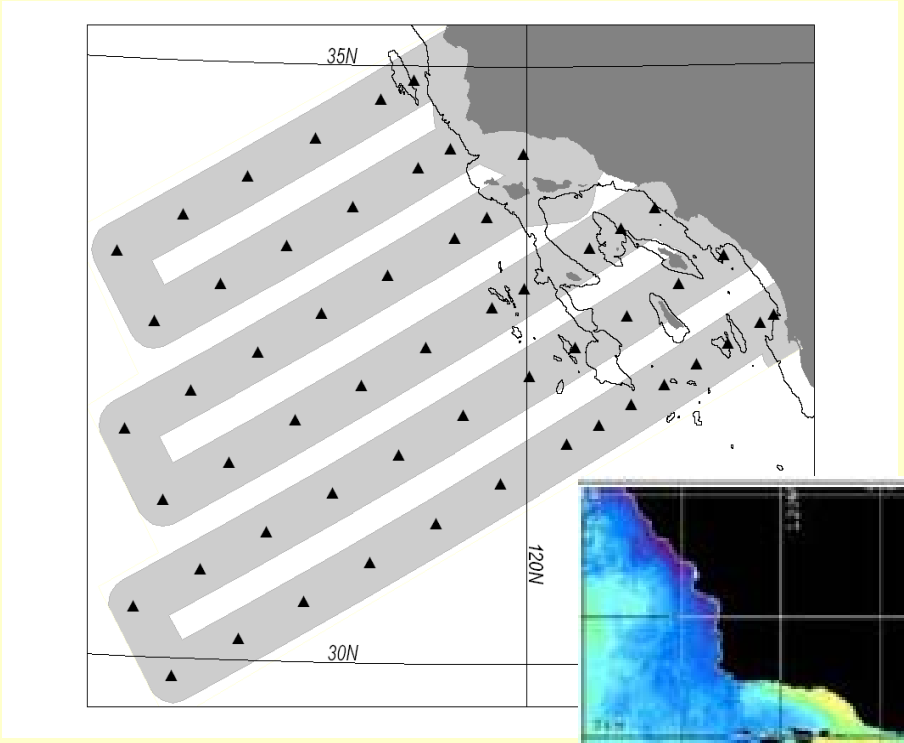
(late Feb – early May)

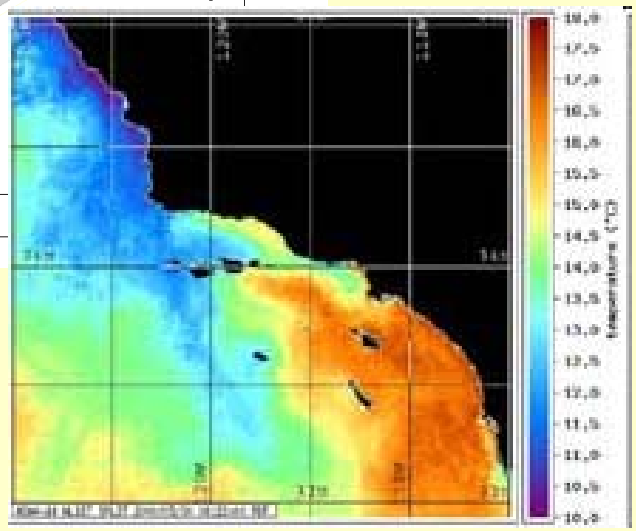
- 17 years (87 – 04)
(no data for 1999)

- 1600 km / cruise

- 66 CTD stations

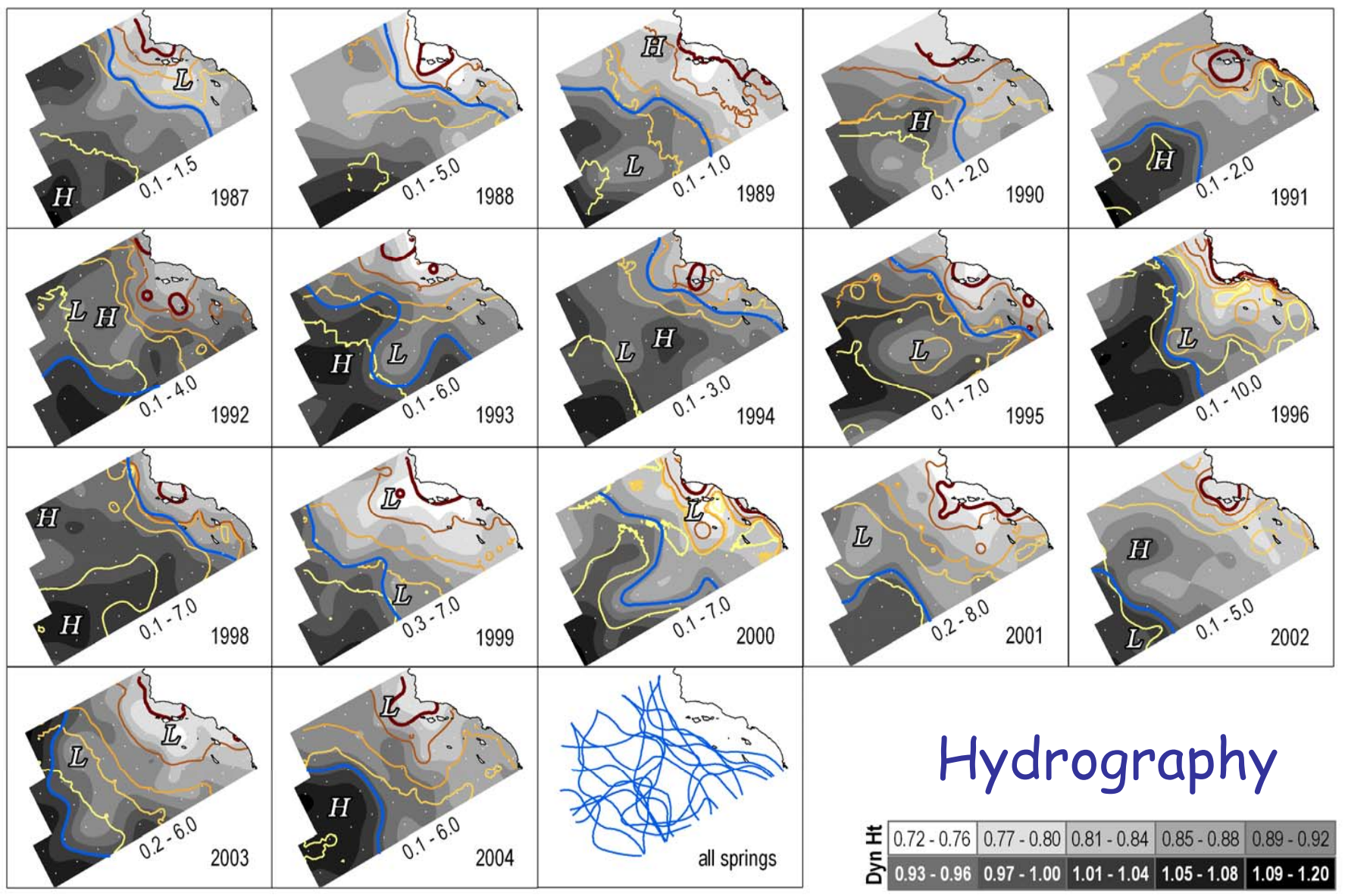
(Chl a, nutrients)





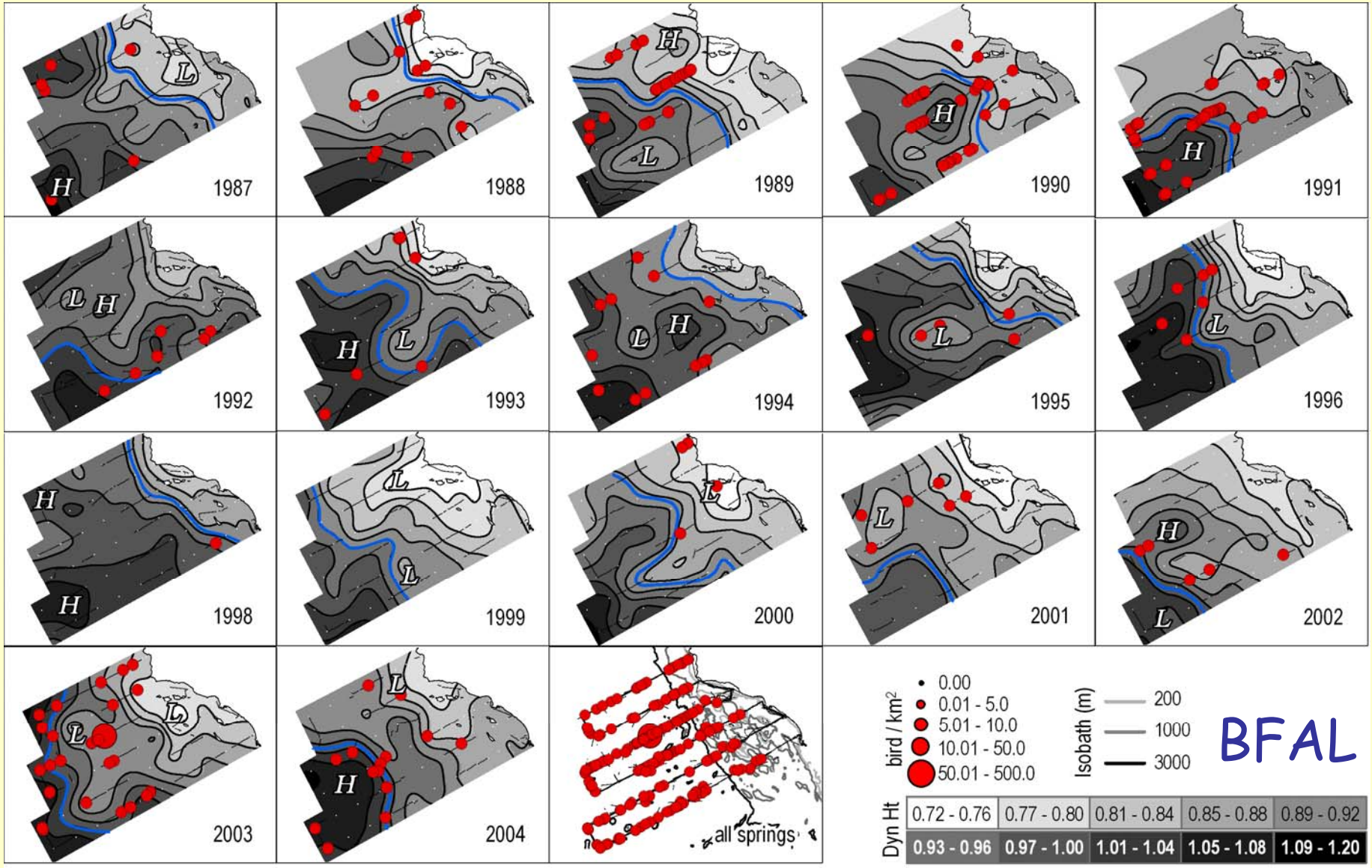
(Yen et al., in press)

A Complex and Dynamic Seascape



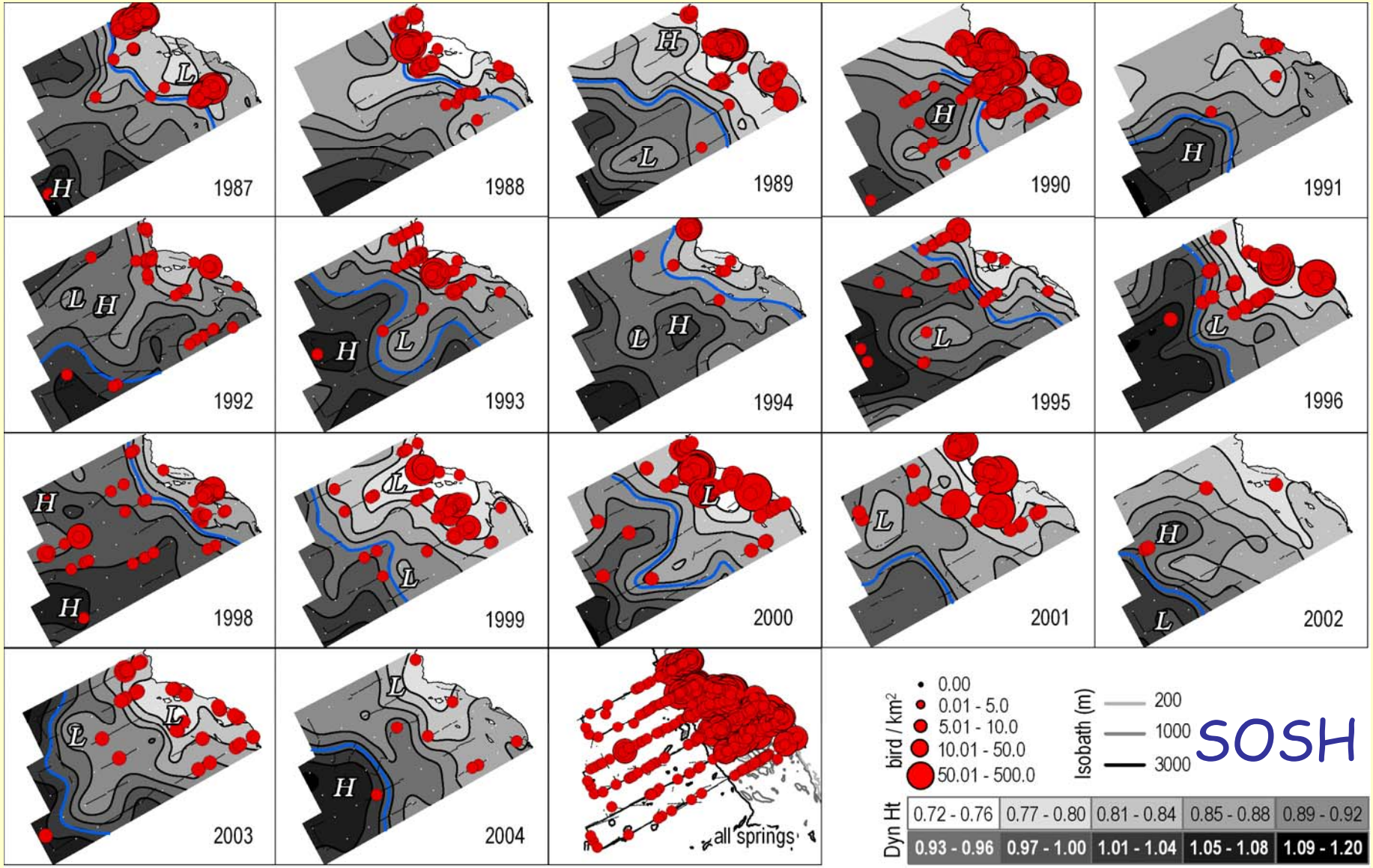
(Yen et al., 2006)

Albatross – Offshore Distribution



(Yen et al., 2006)

Shearwater – Onshore Distribution



(Yen et al., 2006)

Results – Presence / Absence

- Logistic Regression: Encounter Probability

Albatross (Oceanic)

Convergence Zones

Close - California Current
Close - high SSH regions

Shearwater (Coastal)

Upwelling Plumes

Far - California Current
Far – high SSH areas

In - low SSH regions
In - "green" water
In - nutrient-rich water

	Interpretation		Result	
Variable	BFAL	SOSH	BFAL	SOSH
CC jet	Closer	Farther	-	+
Dyn ht		Lower	+	-
Dyn ht Cl			+	+
Chl a		Greener	-	+
NO_3		Higher	-	+
L eddy			-	+
H eddy	Closer	Farther	-	+

(Yen et al., in press)

Results – Density (when present)

- Ordered Logistic Regression: Aggregation

Albatross (Oceanic)
No Aggregations

Shearwater (Coastal)
Upwelling Fronts

In - nutrient-rich water
In - low SSH waters
In – high SSH gradients

	Interpretation		Result	
Variable	BFAL	SOSH	BFAL	SOSH
CC jet			-	+
Dyn ht		Lower	+	-
Dyn ht CI		Steep	-	+
Chl a			-	+
NO_3		Higher	-	+
L eddy			-	+
H eddy			-	+

(Yen et al., in press)

Conclusions: Pelagic Systems

- MPA designs must incorporate an understanding of natural history and habitat variability

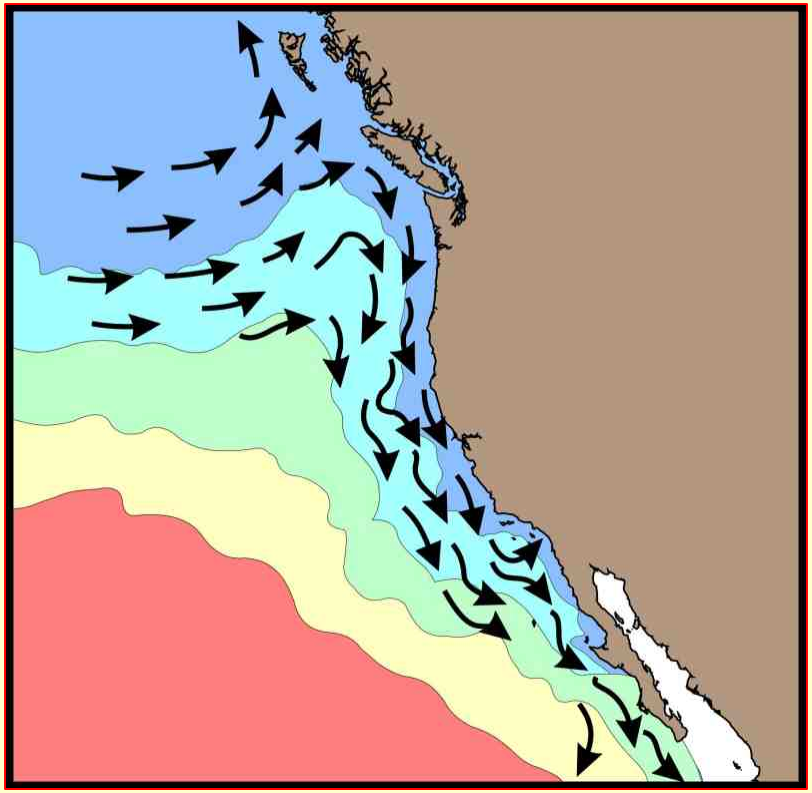
- Dynamic pelagic systems differ from terrestrial / benthic ecosystems in scale and predictability

- Yet, as in static systems, many pelagic species use predictable habitats to breed and forage. Thus, MPAs could be designed to protect these aggregations

- While "terrestrial" designs are effective in static systems, many marine habitats are not fixed in space

Conclusions: MPA Designs

- Essential to understand the physical mechanisms influencing formation and persistence of "hotspots"



- Focus research efforts on pattern and process:
  - Retention zones downstream from upwelling centers
  - Bathymetric / hydrographic gradients

- New design concepts necessary:
  - Dynamic boundaries (real-time)
  - Extensive buffers (statistics)

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Acknowledgements

The First International Conference on Marine Mammal Protected Areas