Science Informing California's Marine Life Protection Act

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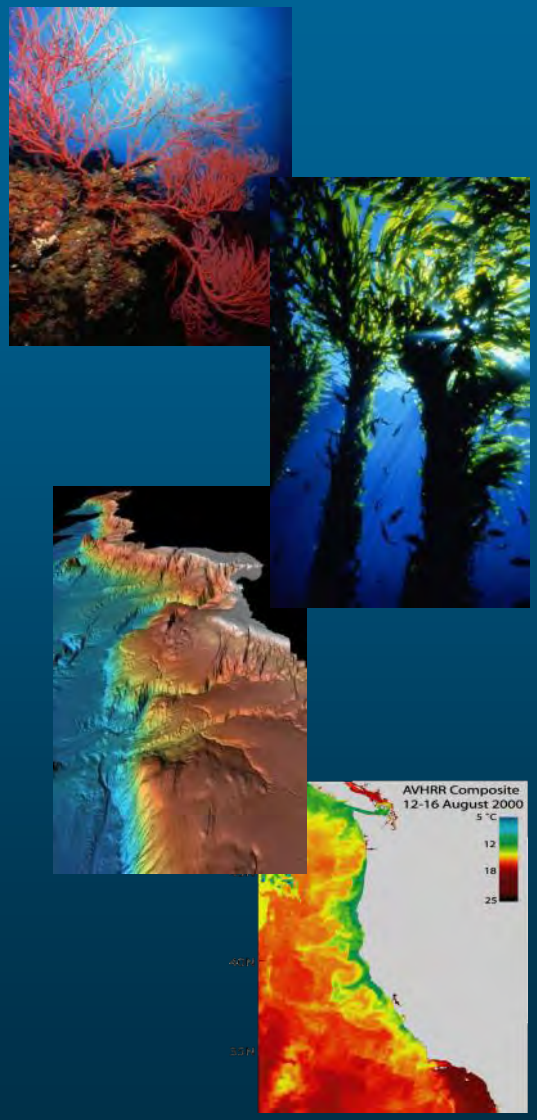
Science Advisory Team
Marine Life Protection Act

Role of the Science Advisory Team

- Develop design guidelines for an effective network of MPAs
- Convey scientific basis of guidelines to other components of the process (stakeholders and taskforce)
- Evaluate proposals and how well they meet the guidelines

Goal-based Design Guidelines

1. Protect **natural diversity** and **ecosystem functions**.
2. Sustain and restore marine life **populations**.
3. Improve recreational, educational, and study **opportunities**.
4. Protect representative and unique **habitats**.
5. Clear objectives, effective management, adequate enforcement, sound science.
6. Ensure that MPAs are designed and managed as **a network**.



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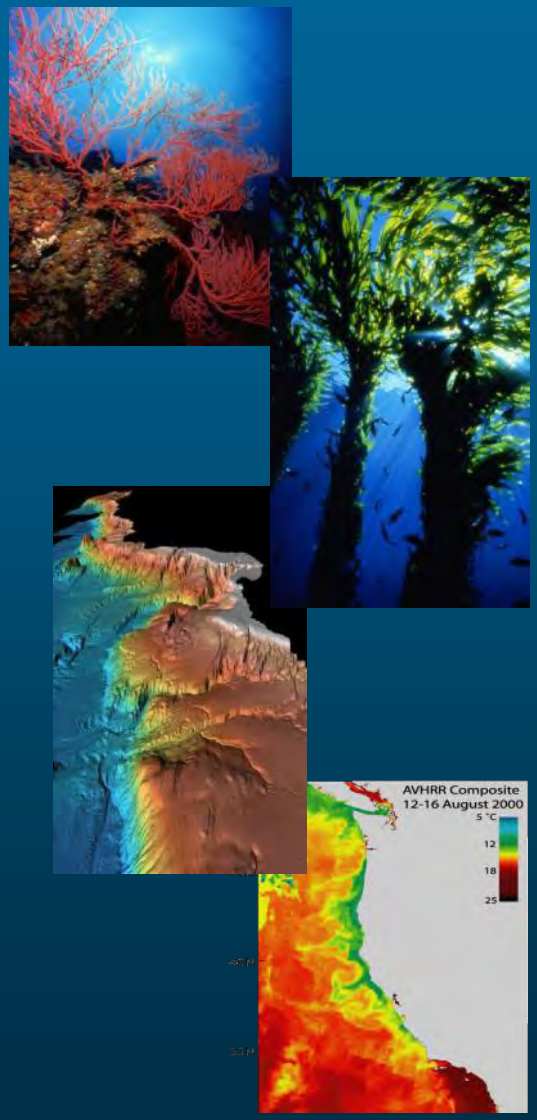
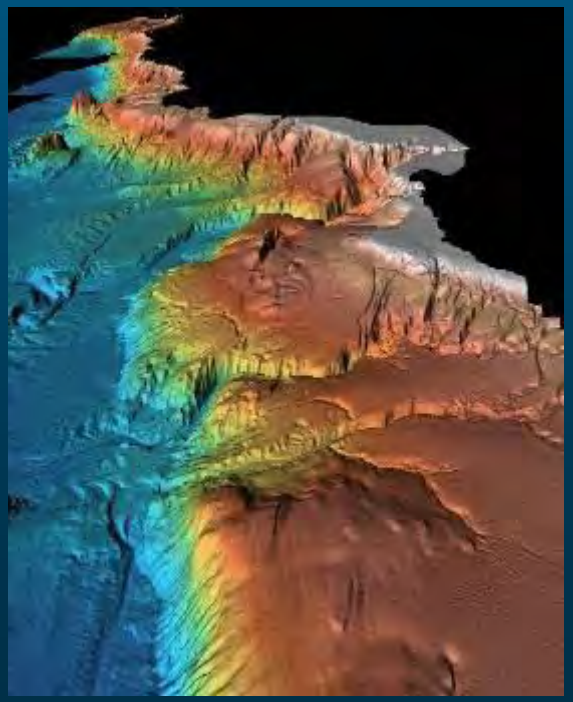
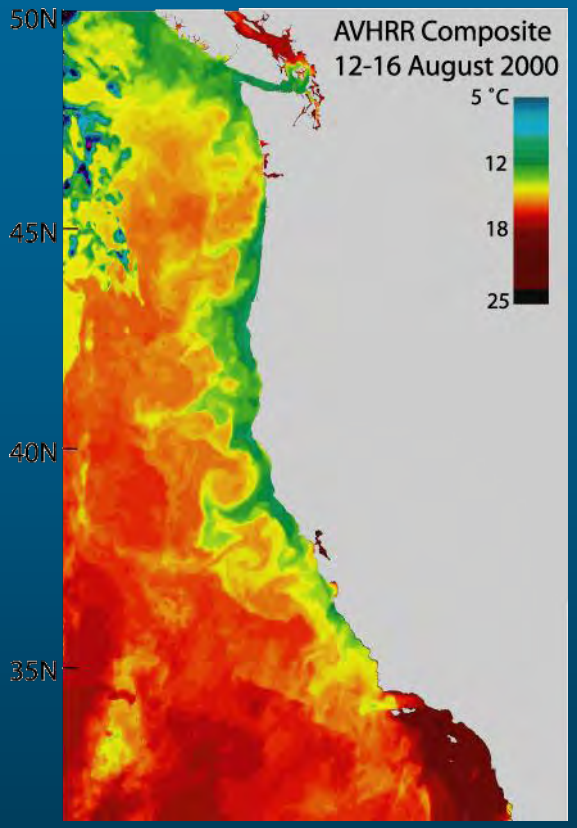


Habitats and Ecosystems

Identify Key Habitats Based On:

- Bottom Type and Depth
- Biogenic habitat
- Oceanographic features

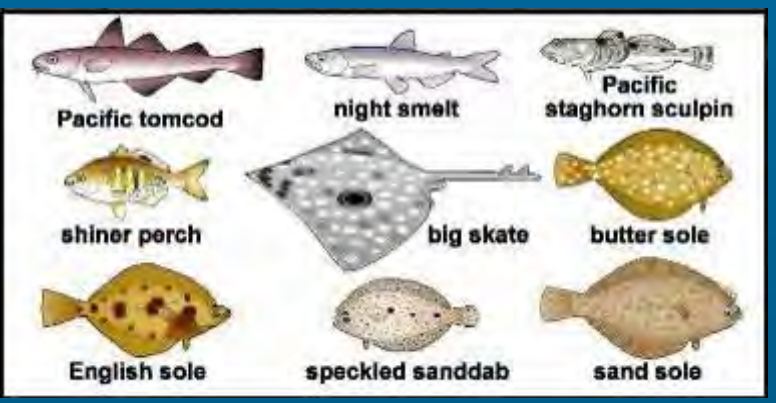




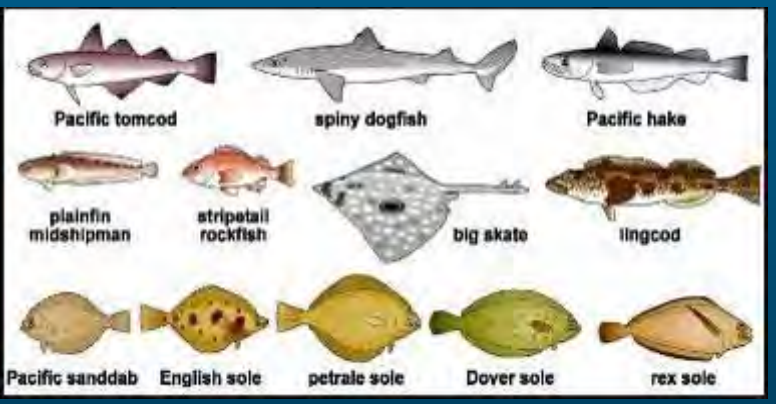
Estimate habitat distribution and abundance using GIS

Soft Bottom

Rocky Bottom



0-30 m



30-100 m

100-200 m

© Allen et al.

Habitats and Ecosystems

Key Marine Habitats

Seafloor Habitats

- Rocky reefs
- Intertidal zones
- Sandy or soft bottoms
- Underwater pinnacles
- Submarine canyons

Depth Zones

- Intertidal
- Intertidal to 30 m
- 30 to 100 m
- 100 to 200 m
- 200 m and deeper

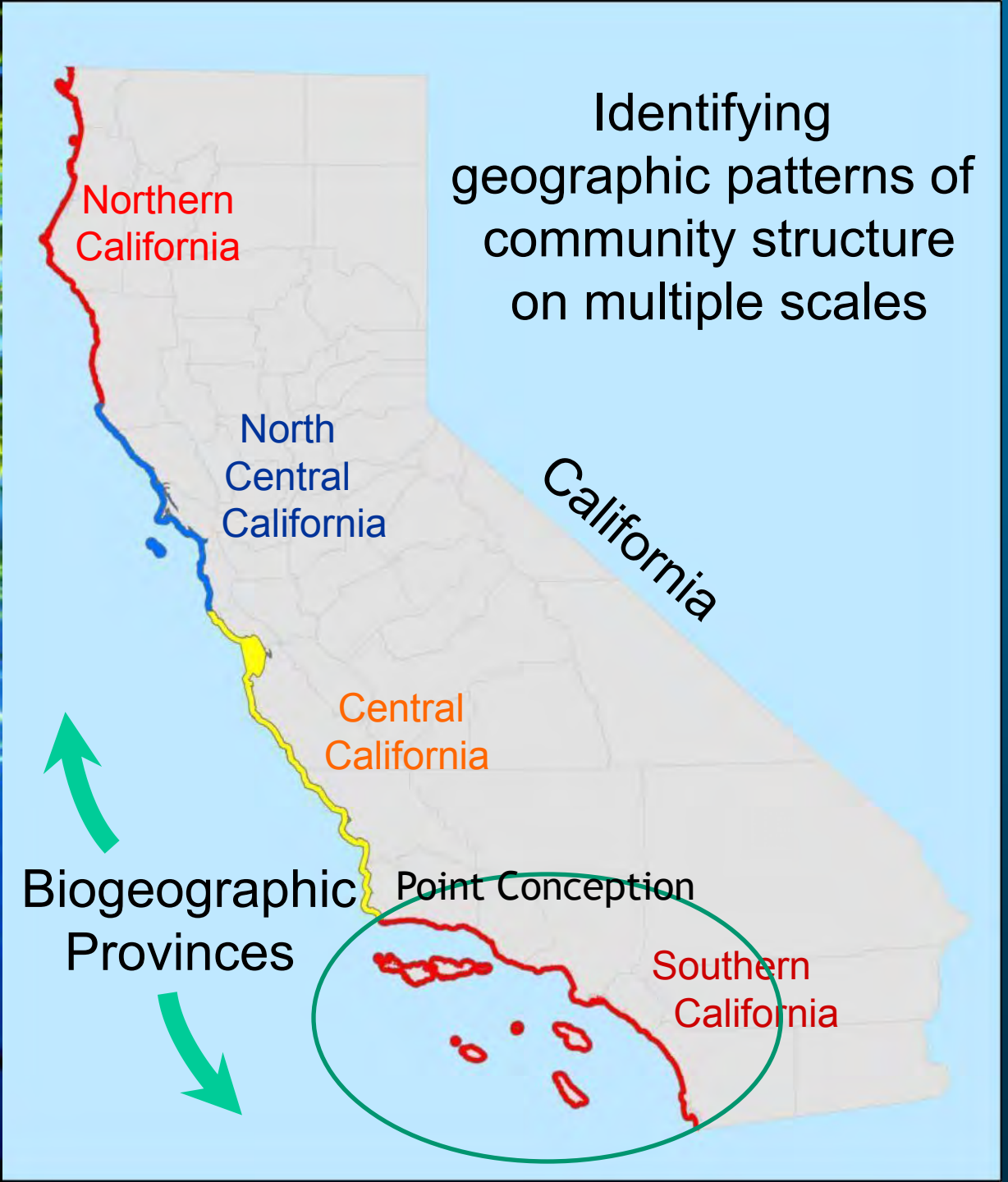
Biogenic Habitats

- Kelp forests
- Seagrass beds
- Mussel beds

Oceanographic Habitats

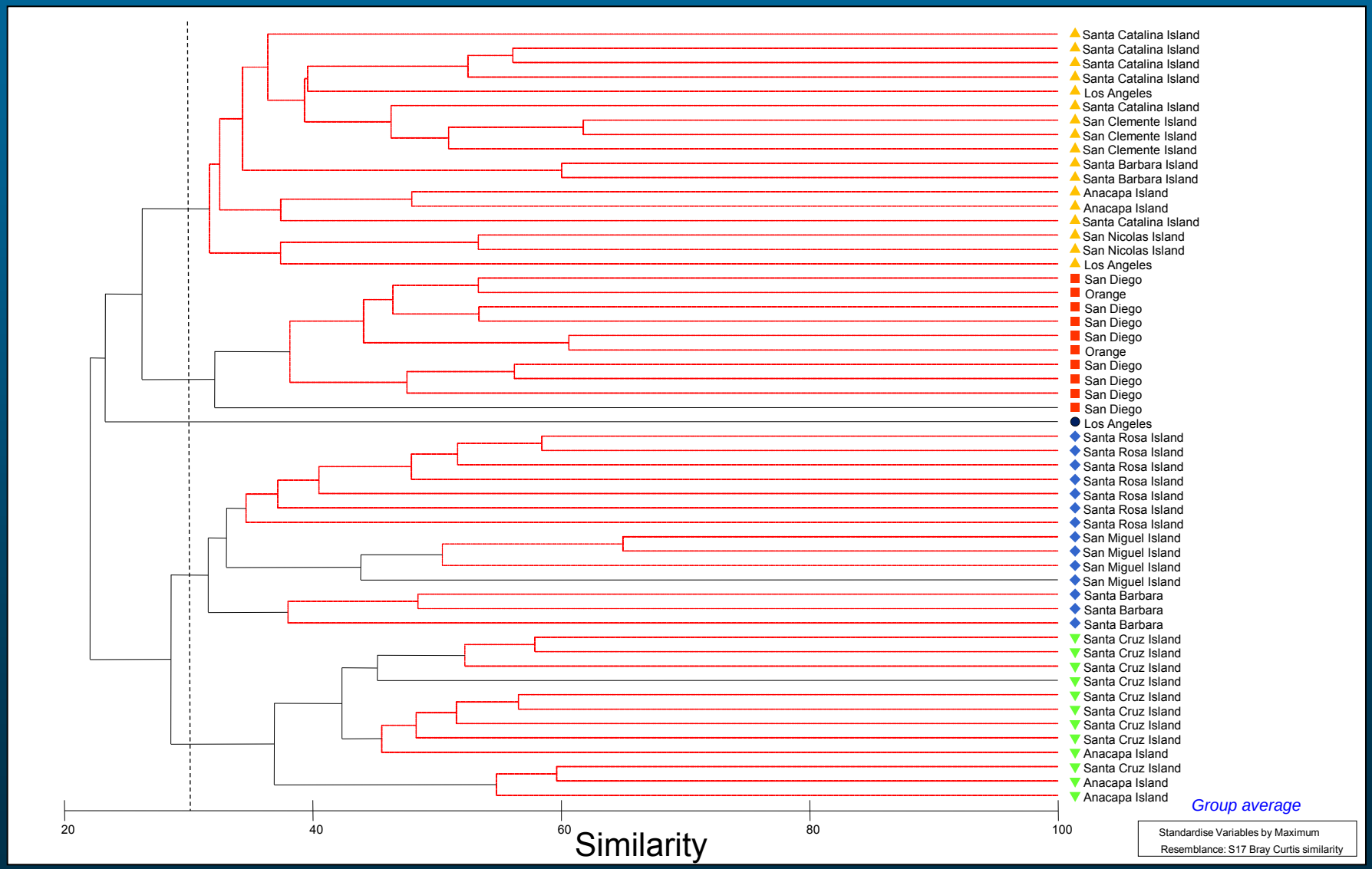
- Upwelling areas
- Freshwater plumes
- Retention zones

Identifying geographic patterns of community structure on multiple scales



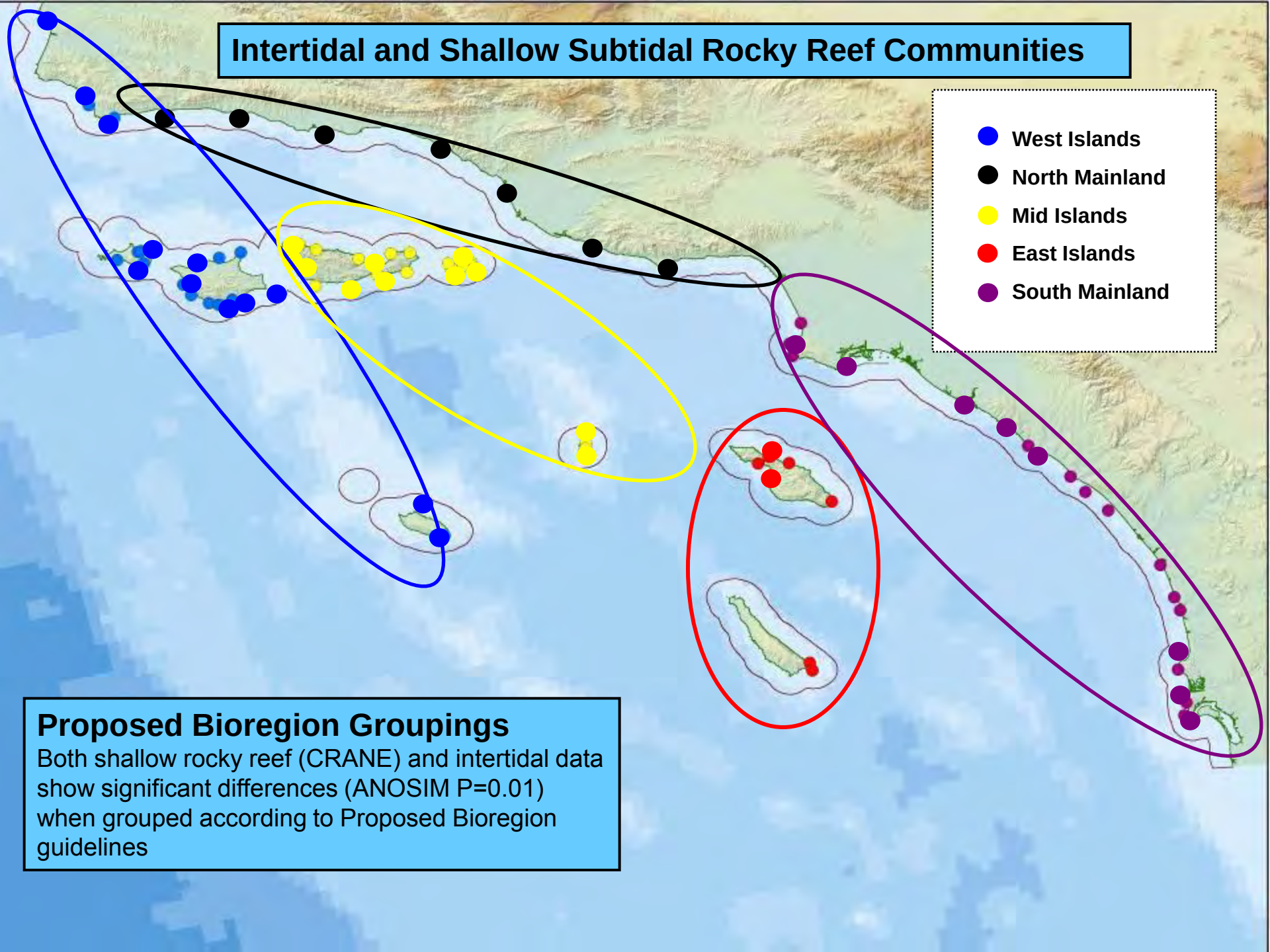
Geographic Patterns of Community Similarity

Shallow Rocky Reefs (CRANE) All Taxa



Bray Curtis similarity: clusters significantly different (SIMPROF) at 30% similarity level

Intertidal and Shallow Subtidal Rocky Reef Communities



Proposed Bioregion Groupings

Both shallow rocky reef (CRANE) and intertidal data show significant differences (ANOSIM P=0.01) when grouped according to Proposed Bioregion guidelines

Habitat Representation and Replication Guidelines

- Each key habitat should be represented in MPAs across the network (to capture species and ecosystem diversity)

- MPAs should include habitats across a range of depths from the intertidal to the deepest portions of state waters within each region.

- At least three to five replicate MPAs should be designed for each key habitat type within a biogeographic region. Preferably, one replicate within each "bioregion" (to capture diversity across environmental gradients, provide analytical power for management comparisons, and to buffer against catastrophic loss of an MPA).

Initiative defines three kinds of MPAs

- State Marine Reserves (SMR)
  - no take of any species
- State Marine Conservation Area (SMCA)
  - allow for restricted commercial or recreational take
- State Marine Park (SMP)
  - restricted recreational take only

Considering Protection in MPAs

The Question:

"How much will an ecosystem differ from an unfished ecosystem if one or more proposed activities are allowed?"

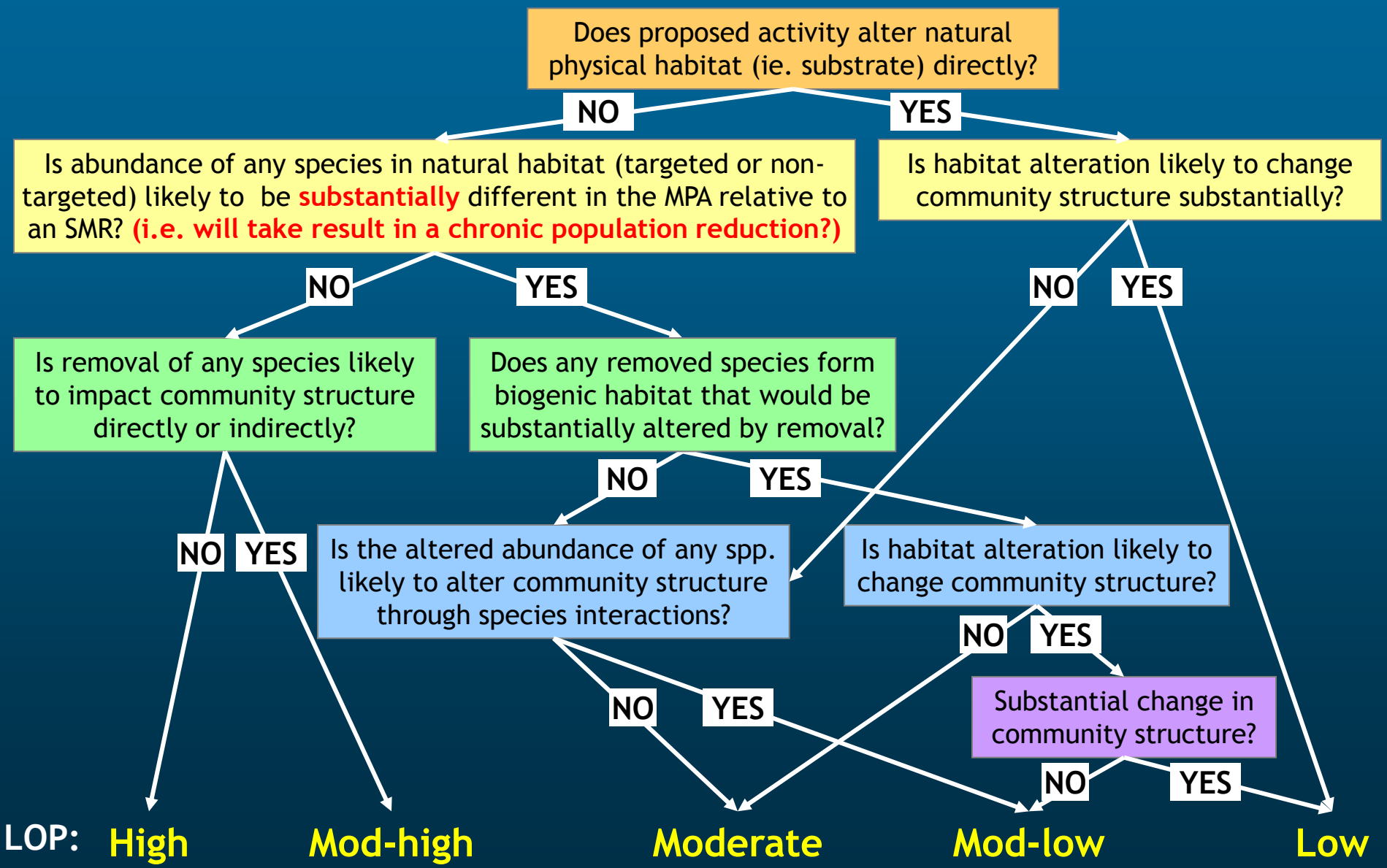
A great deal if:

- habitat is damaged
- many species are removed
- removed species play an important role in the resident ecosystem (predator, prey, competitor etc.)

Very little if:

- no habitat damage
- little associated catch
- species removed are highly mobile so MPAs won't change local abundance

Conceptual Model for Determining LOP



	Level of Protection	MPA Types	Activities associated with this protection level
	Very high	SMR	No take
	High	SMCA	**In water depth > 50m: pelagic finfish**, **bonito and white seabass** (H&L); **coastal pelagic finfish** (pelagic seine)
	Mod-high	SMCA	**Squid** (pelagic seine); **In water depth <50m: pelagic finfish, bonito and white seabass** (H&L); **coastal pelagic finfish** (pelagic seine);
	Moderate	SMCA SMP	**spot prawn** (traps/pots)**; sea cucumber** (scuba/hookah)**; grunion** (hand harvest); **abalone** (snorkel); **halibut, shore-based finfish, croaker, and flatfishes** (H&L); **clams** (hand harvest); **giant kelp** (hand harvest);
	Mod-low	SMCA SMP	**kelp bass, barred sand bass, sheephead, lingcod, cabezon, rockfish, and other reef fish** (H&L, spear, trap); **spotted sand bass and surfperches** (H&L); **lobster** (trap, hoop net, scuba); **rock scallop** (scuba), **urchin** (scuba/hookah);
	Low	SMCA SMP	**mussels** (any method); **all trawling**; **giant kelp** (mechanical harvest); **mariculture** (existing methods in NCCSR)

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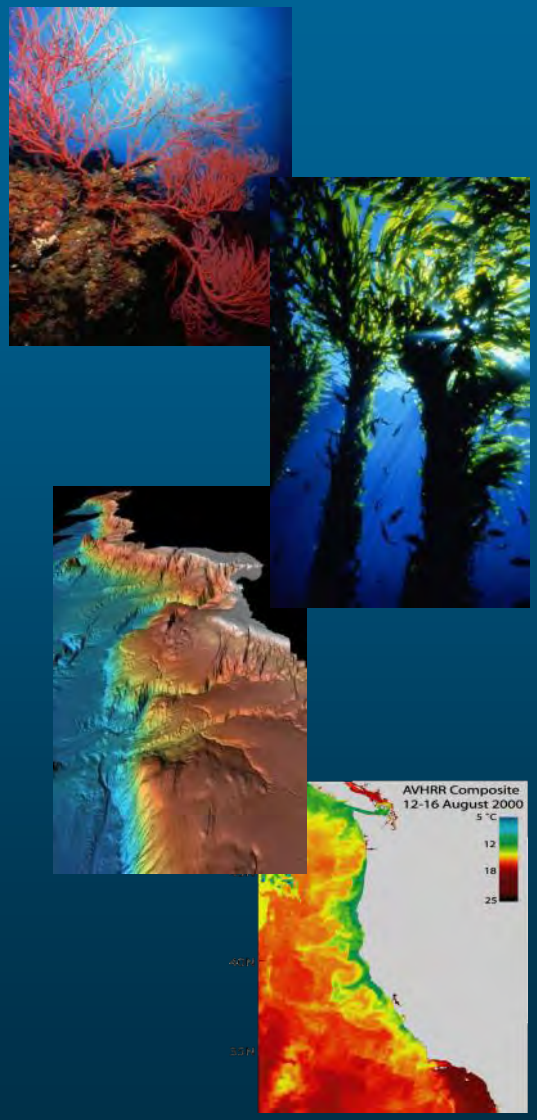
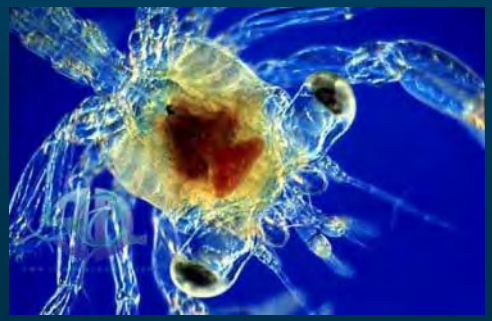


Protecting Populations

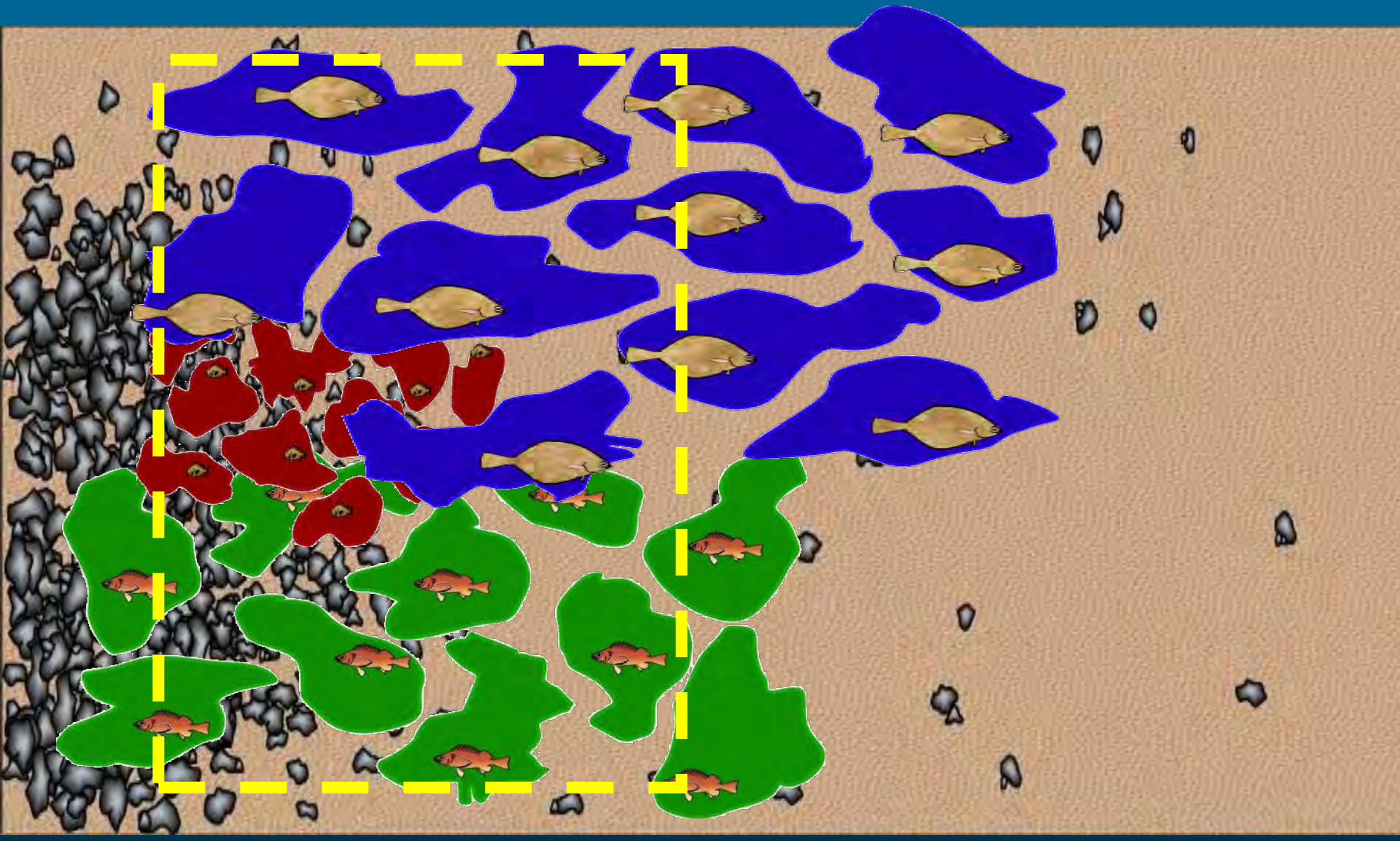
size and spacing

- MPAs must be large enough that adults don't move out of them too frequently (and become vulnerable to fishing)

- MPAs must be close enough together that sufficient larvae can move from one to the next

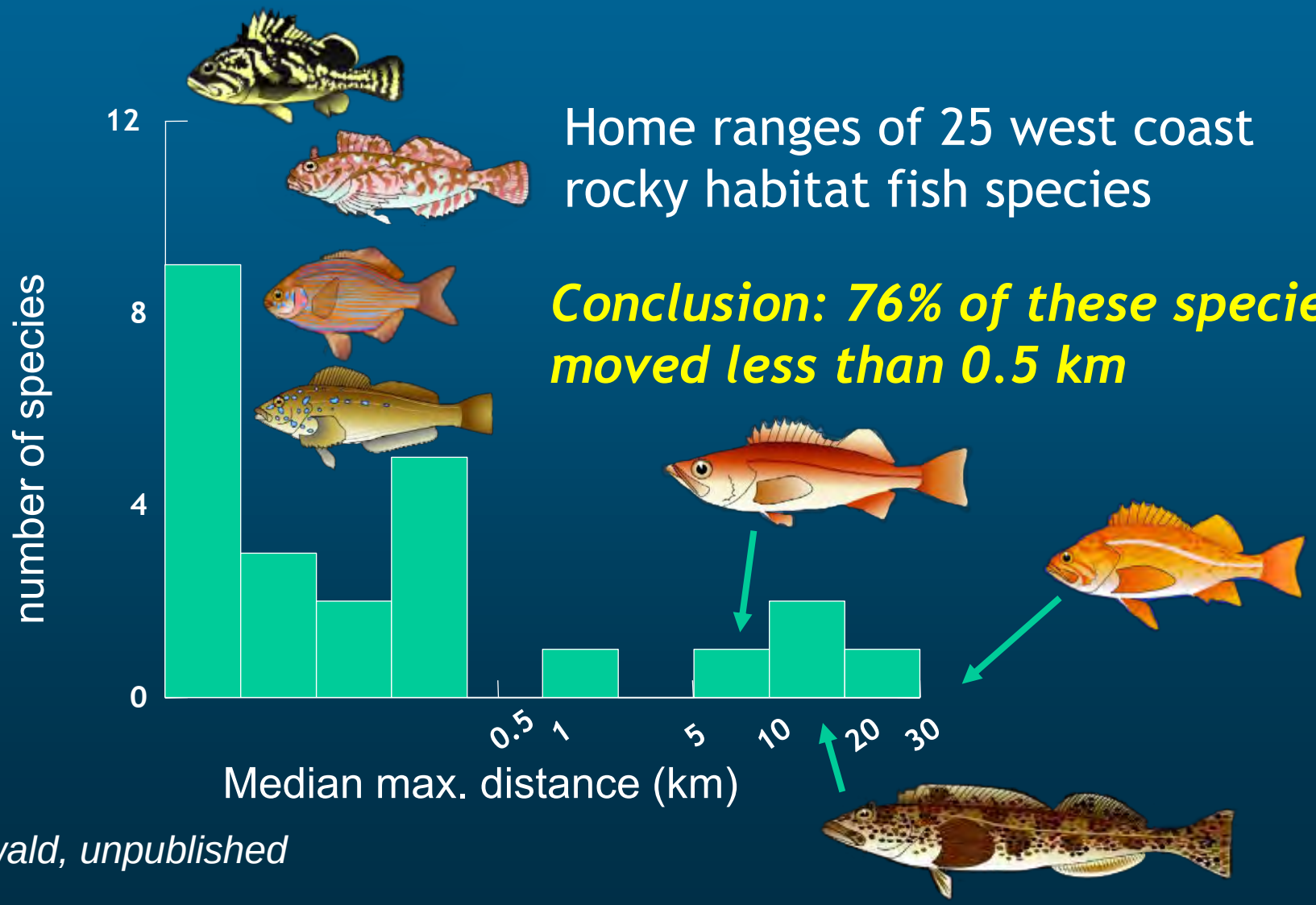


Species Movements and MPAs



10 km

Adult Movement



Home ranges of 25 west coast rocky habitat fish species

Conclusion: 76% of these species moved less than 0.5 km

Freiwald, unpublished

Size Guidelines

- Minimum alongshore span of **5 – 10 km** (3 - 6 statute miles)
- Preferably **10 – 20 km** (6 - 12 statute miles)
- Extend from the intertidal zone to deep waters (3 statute miles offshore)

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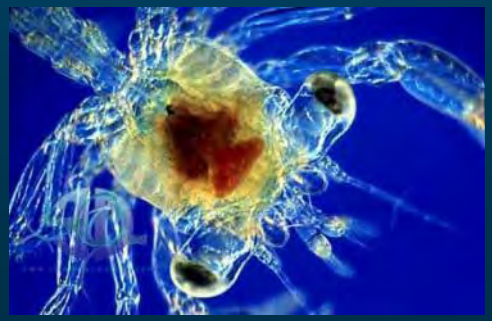
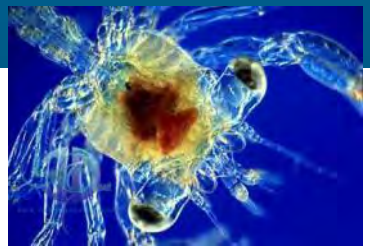
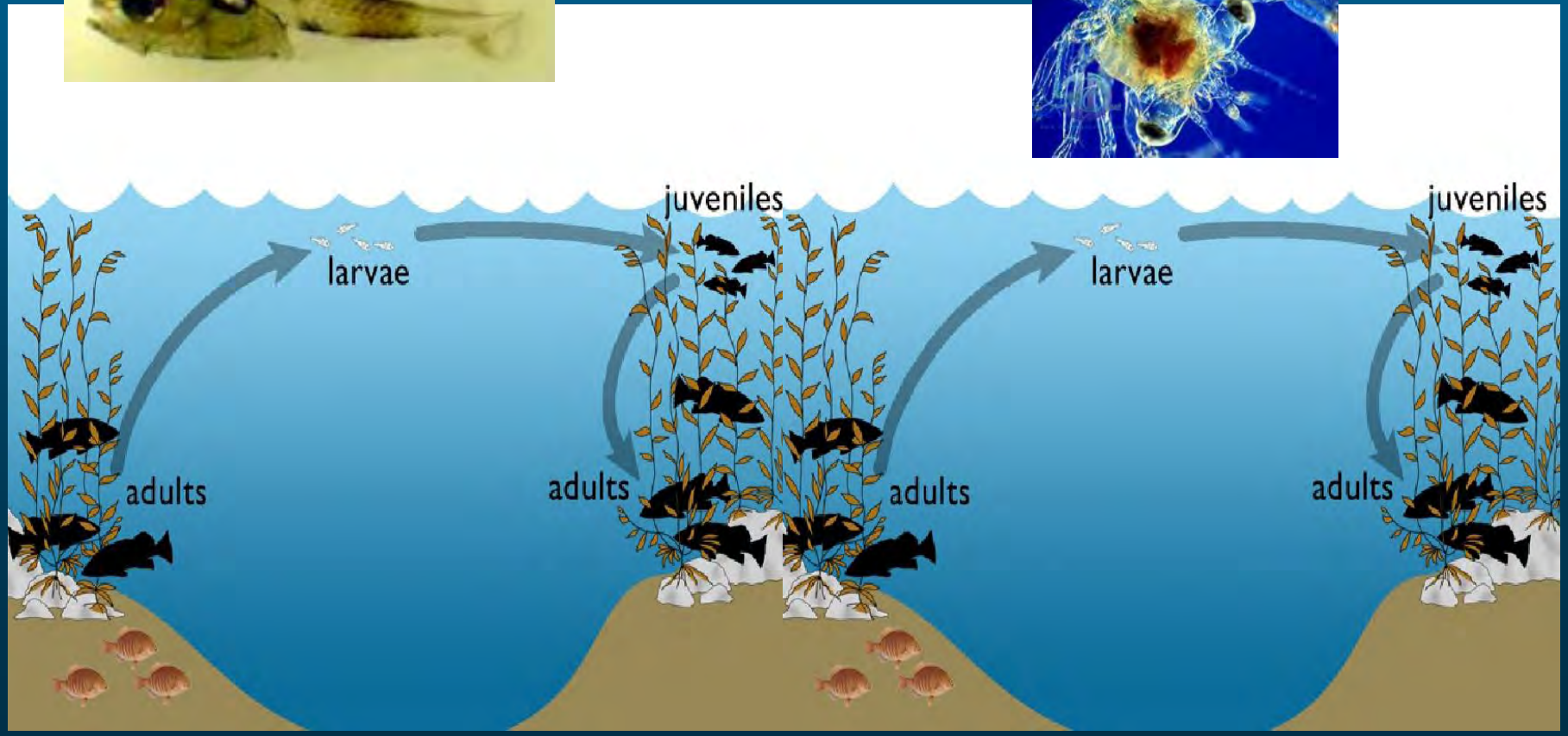
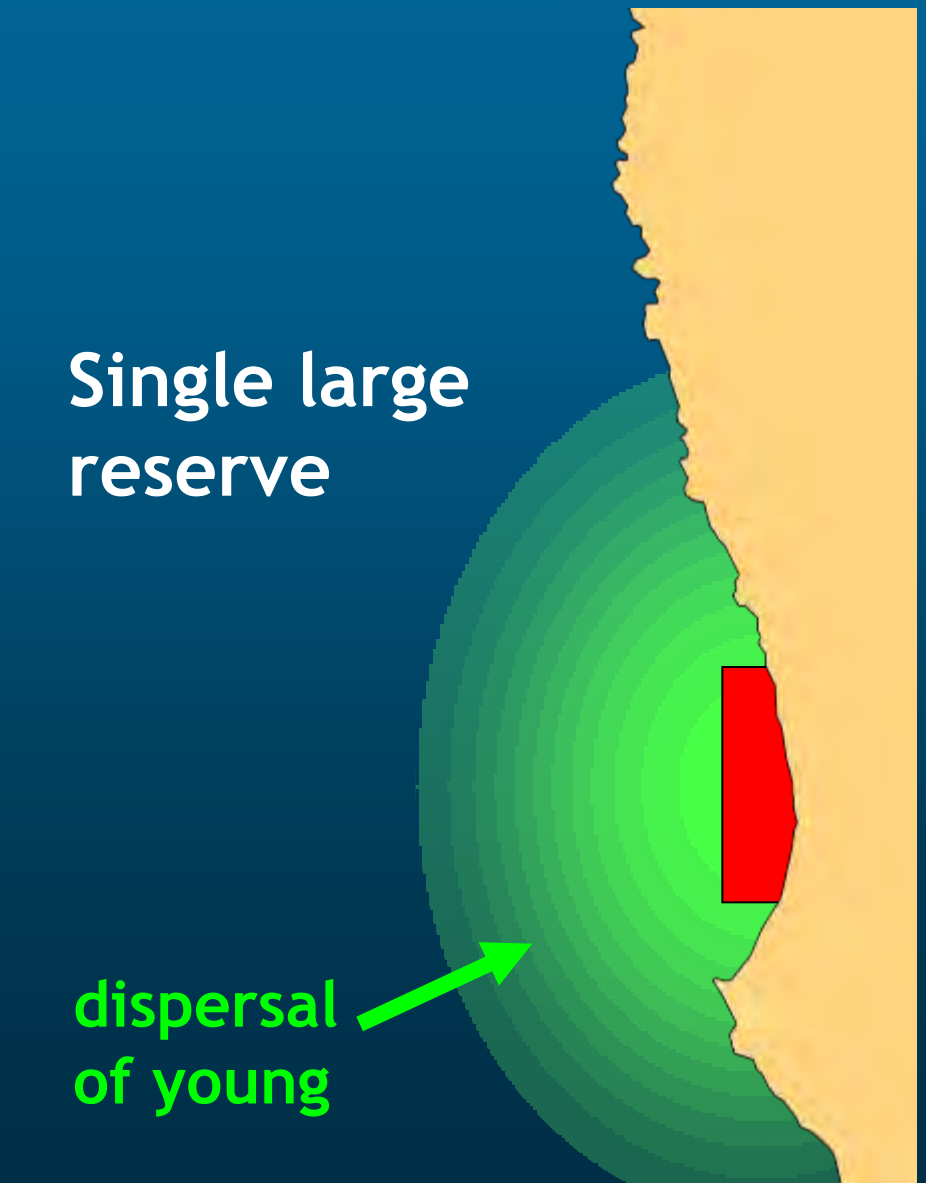


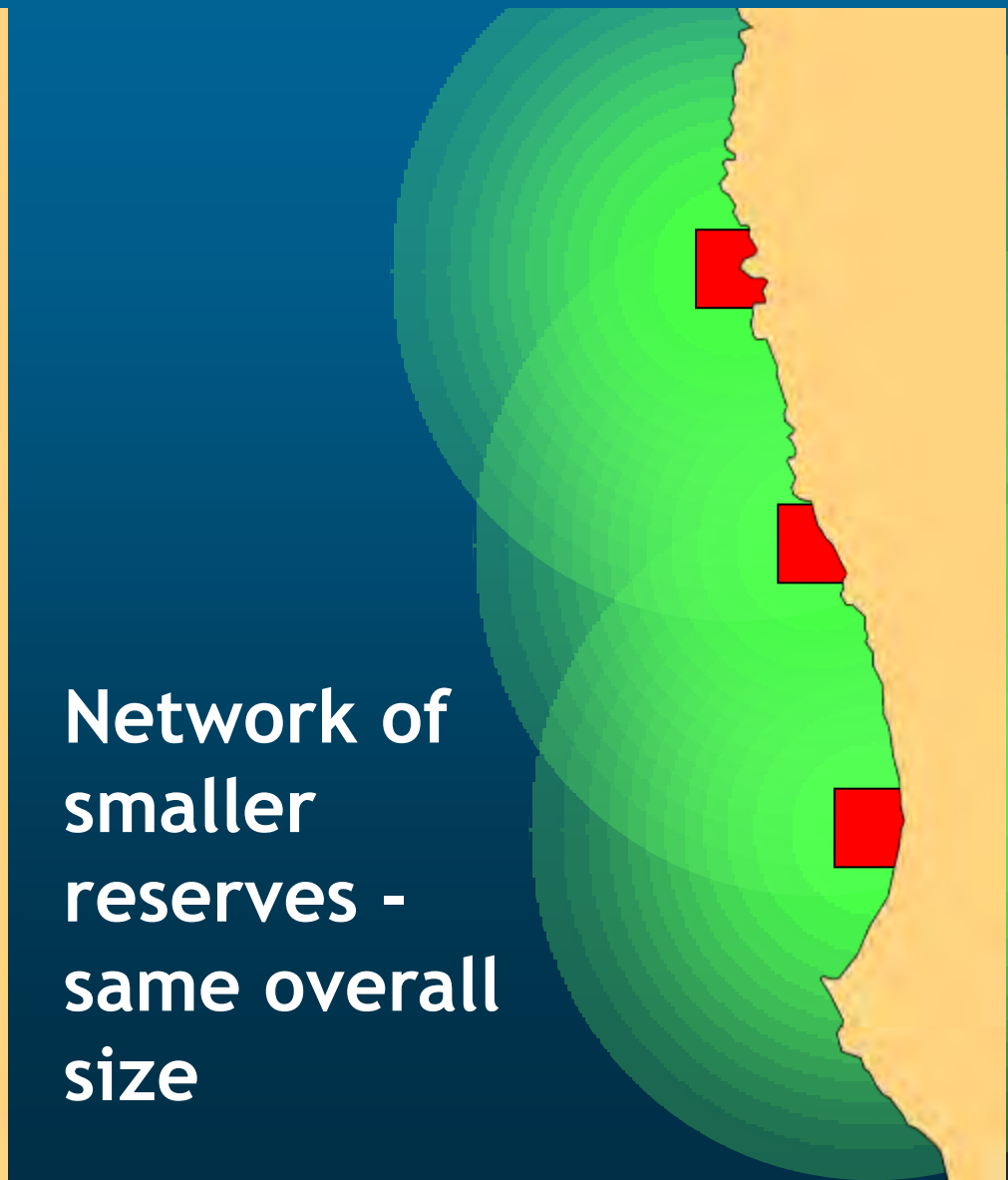
Spacing: Reserves Connected by Larval Dispersal



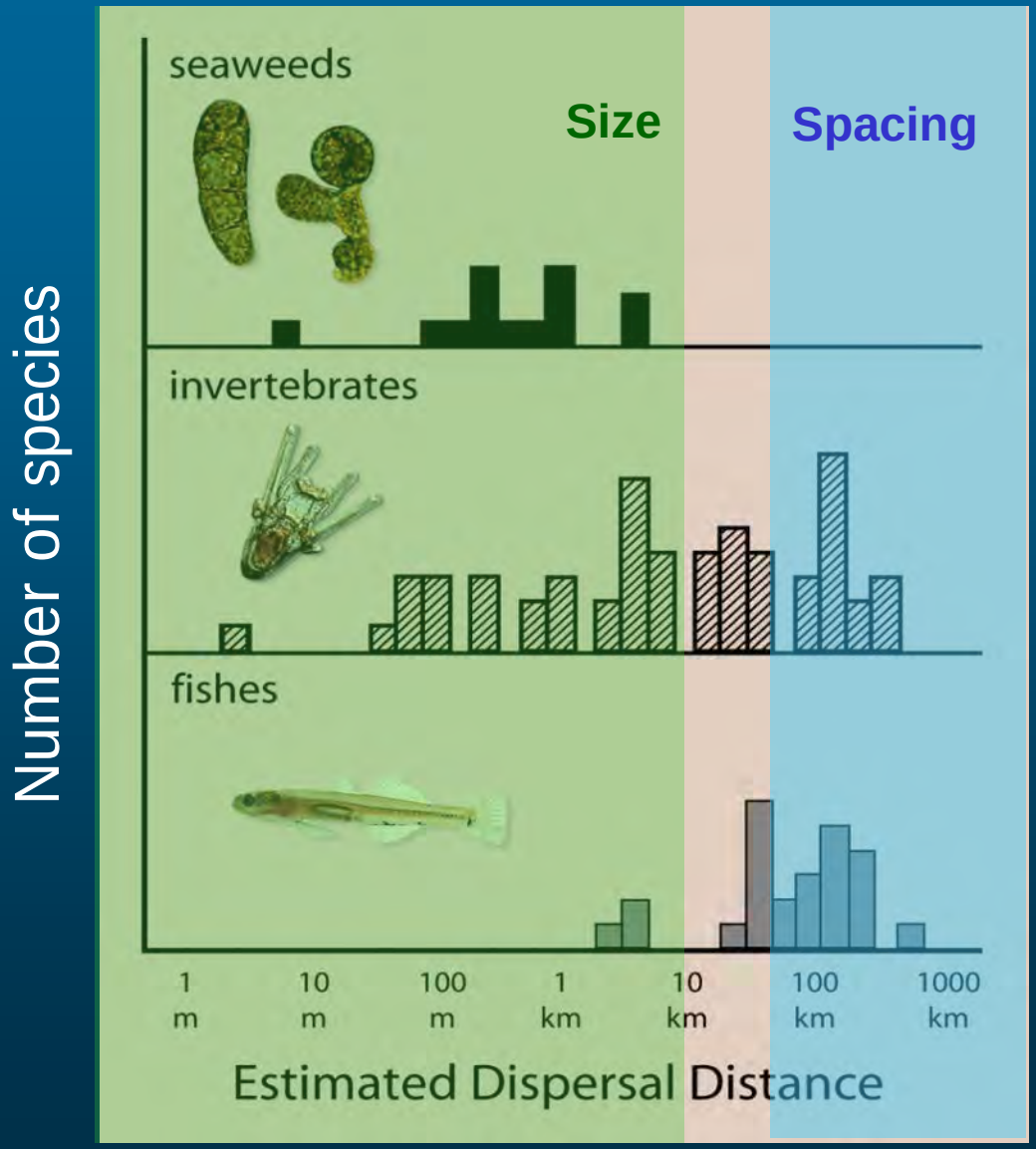


Characteristics of Networks





Size and Spacing Guidelines

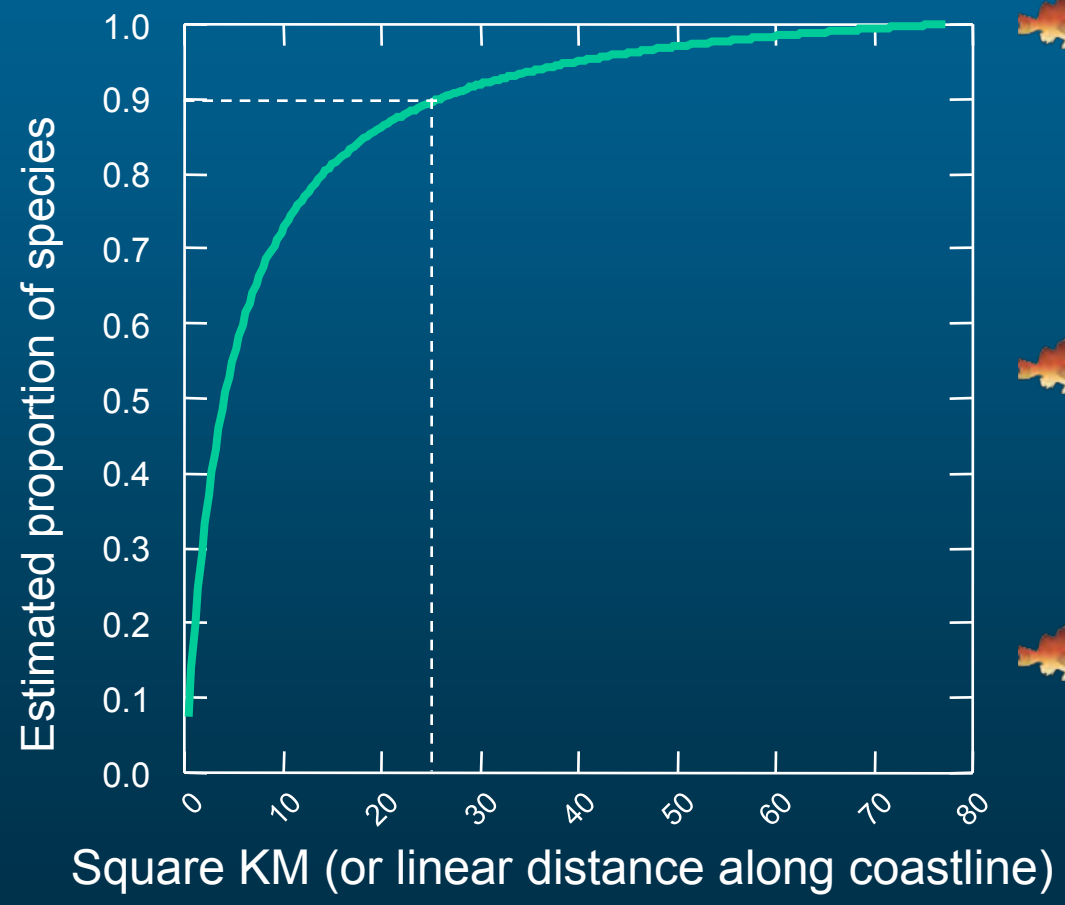


Data from Kinlan and Gaines 2003, PISCO 2007

- **Size:**
  - 5-10 km, minimum
  - 10-20 km, preferred
  - Intertidal to deep waters
- **Spacing:**
  - 50 – 100 km apart
- **Size and spacing are interrelated**
  - Smaller MPAs more reliant on connectivity

How Much Habitat is Needed?

For a habitat to contribute to a network



- Should be sufficient to encompass most of the species that live in the habitat
- Survey data shows how more area captures more species
- MLPA SAT determined that area should be sufficient to capture 90% of biodiversity

How much habitat is needed?

The amount needed varies by habitat

Habitat	Representation needed to encompass 90% of biodiversity	Data Source
Rocky Intertidal	~0.48 linear miles	PISCO Biodiversity
Shallow Rocky Reefs/Kelp Forests (0-30 M)	~1.14 linear miles	Crane Subtidal Surveys
Deep Rocky Reefs (30-100 M)	~0.20 square miles	Love surveys
Deep Rocky Reefs (100-3000 M)	~0.22 square miles	Love Surveys
Sandy Beaches	~1.14 Linear miles	Based on 0-30 m sandy habitat
Sandy Habitat (0-30 M)	~1.14 Linear miles	Based on shallow rocky reefs
Sandy Habitat (30-100 M)	~2.24 square miles	SCCWRP (BIGHT '98 & '03)
Sandy Habitat (100-200 M)	~1.10 square miles	SCCWRP (BIGHT '98 & '03)
Sandy Habitat (>200 M)	~0.46 square miles	SCCWRP (BIGHT '98 & '03)
All Sandy Habitat (>0 M)	~ 8 square miles	Preferred – integrate NMFS and SCCWRP
Estuarine Habitats	0.12 square miles (77 acres)	SONGS sampling

Summary

- reserve design guidelines based on goals
- ecological basis for design
  - location based on habitat
  - size based on adult home range
  - spacing based on larval dispersal
- science-informed guidelines, stakeholders developed reserve network
- it's not just science, successful design and implementation requires a successful process