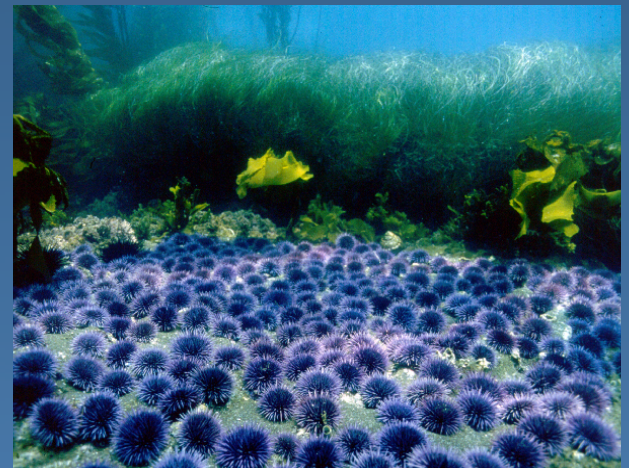
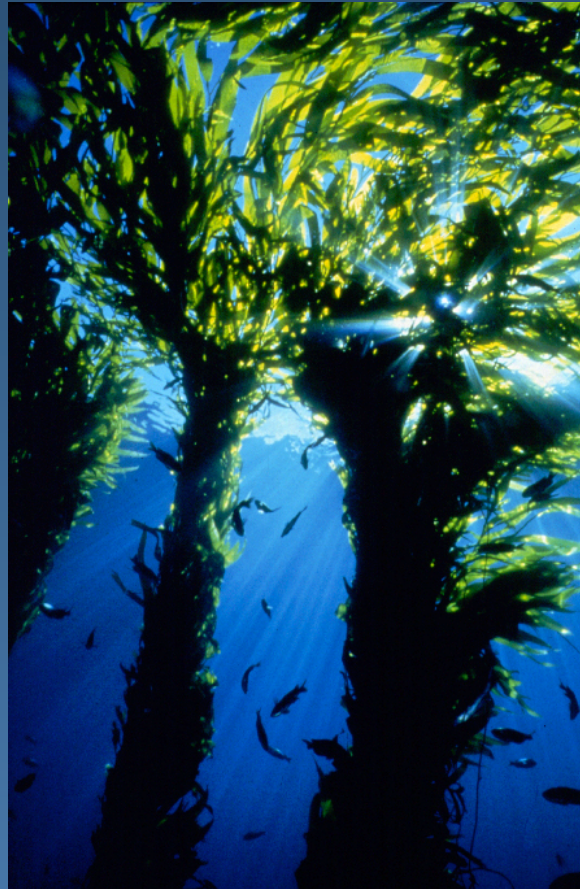
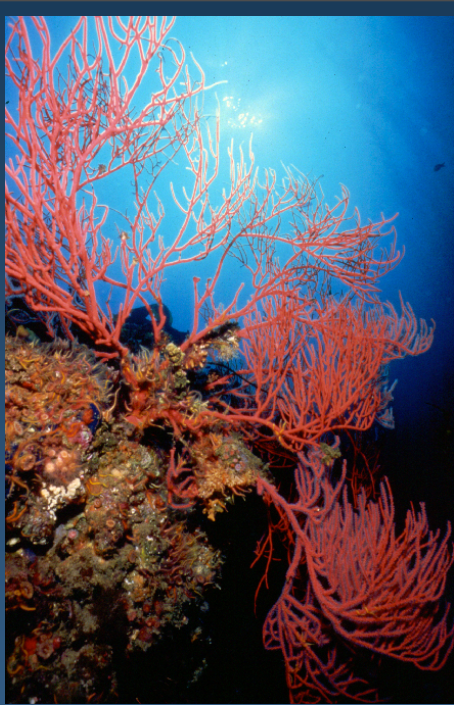


California's Marine Life Protection Act (Integrating EBM and MPAs)





MLPA Goals

1. To protect the natural diversity and abundance of marine life, and the structure, function and integrity of marine ecosystems.
2. To help sustain, conserve, and protect marine life populations, including those of economic value, and rebuild those that are depleted.
3. To improve recreational, educational, and study opportunities provided by marine ecosystems that are subject to minimal human disturbance, and to manage these uses in a manner consistent with protecting biodiversity.
4. To protect marine natural heritage, including protection of representative and unique marine life habitats in California waters for their intrinsic value.
5. To ensure that California's MPAs have clearly defined objectives, effective management measures, and adequate enforcement, and are based on sound scientific guidelines.
6. To ensure that the state's MPAs are designed and managed, to the extent possible, as a network.



MLPA Goals (key phrases)

1. To protect the natural diversity and function of **marine ecosystems**.
2. To help sustain and restore **marine life populations**.
3. To improve **recreational, educational, and study opportunities** in areas with minimal human disturbance.
4. To protect representative and unique **marine life habitats**.
5. Clear objectives, effective management, adequate enforcement.
6. To ensure that MPAs are designed and managed as **a network**.

Goals for Ecosystem-Based Management

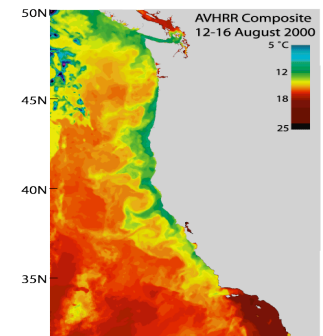
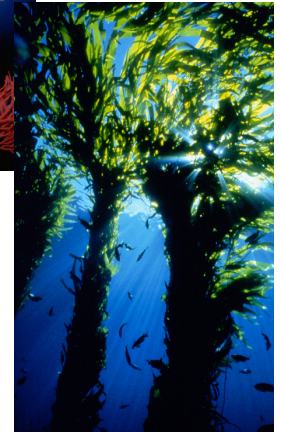
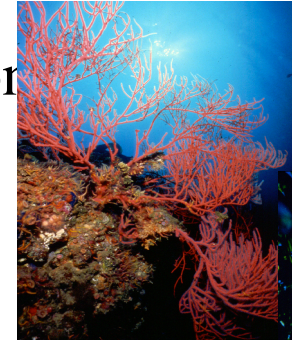


To restore and maintain ecosystems in a healthy, productive and resilient condition so that they can provide the services humans want and need.



MLPA Goals - Habitats

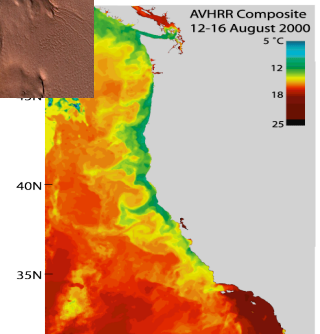
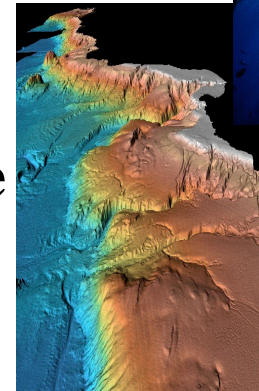
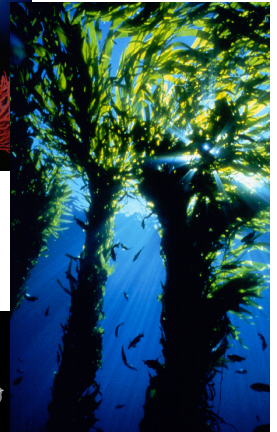
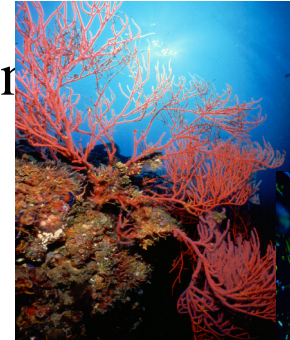
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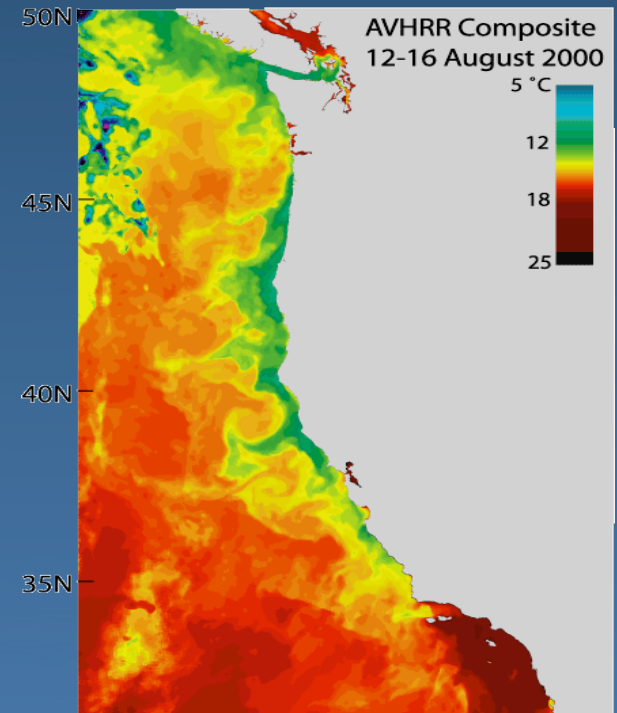
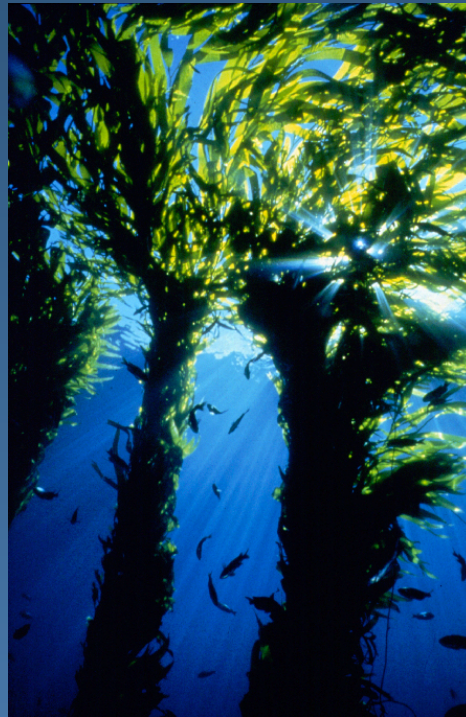
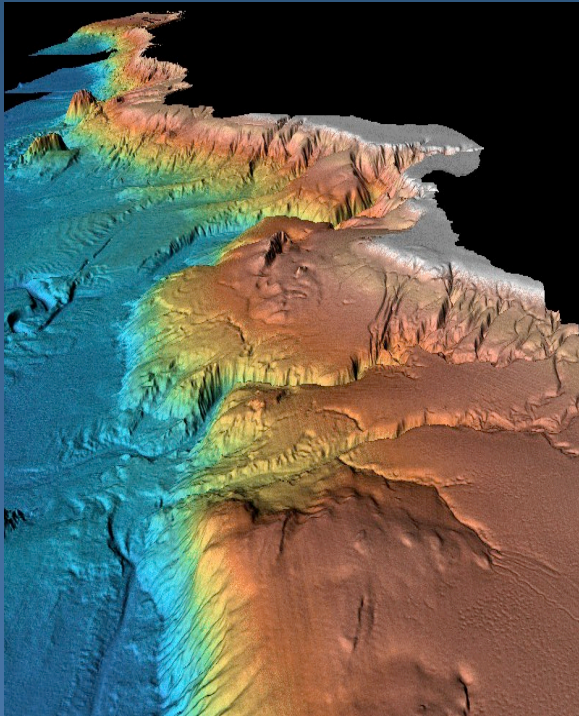
MLPA Goals - Habitats

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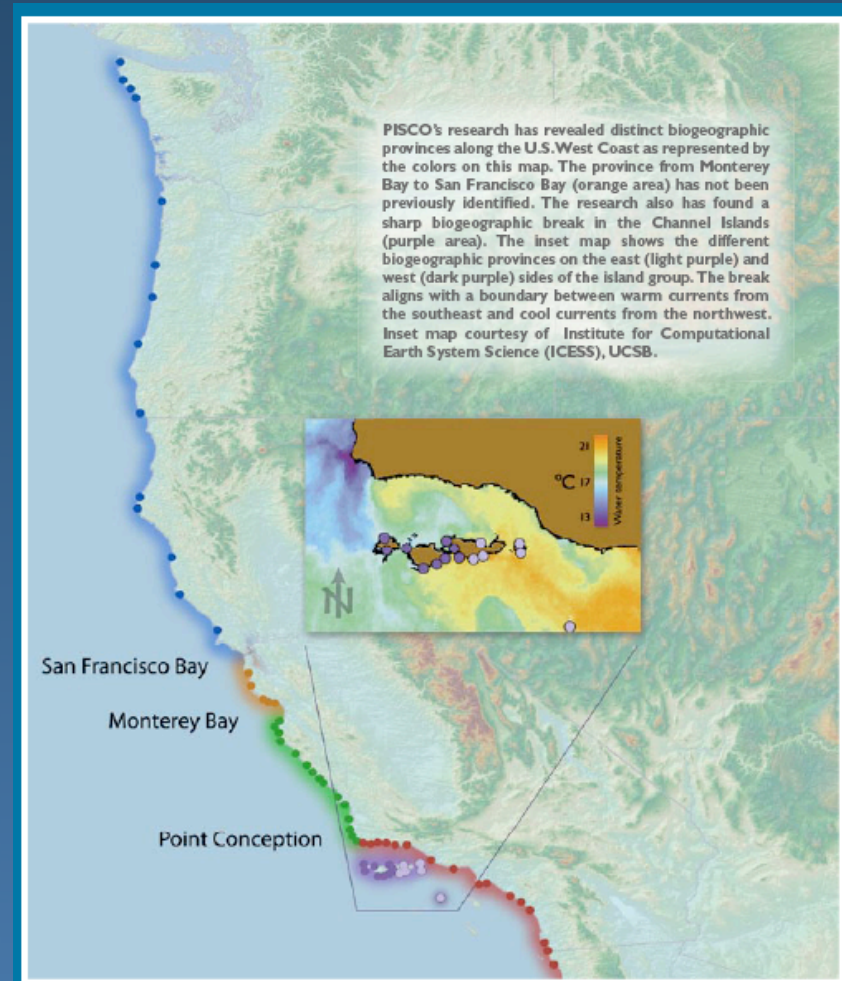
Representative

- Capture the diversity
 - Habitats

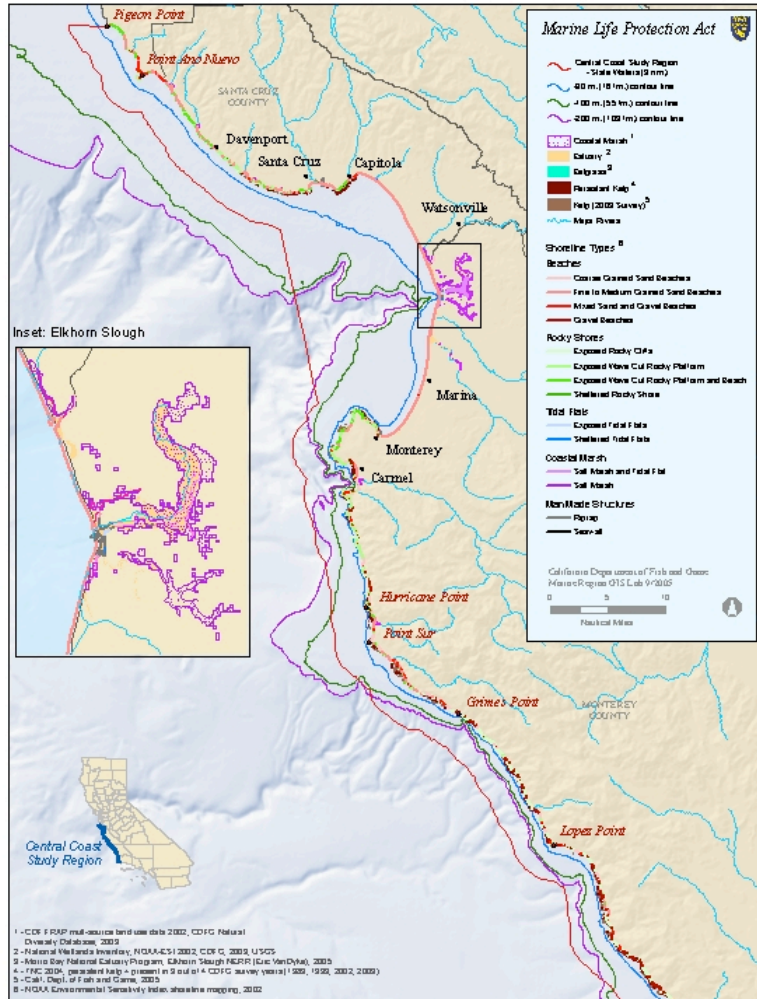


Representative

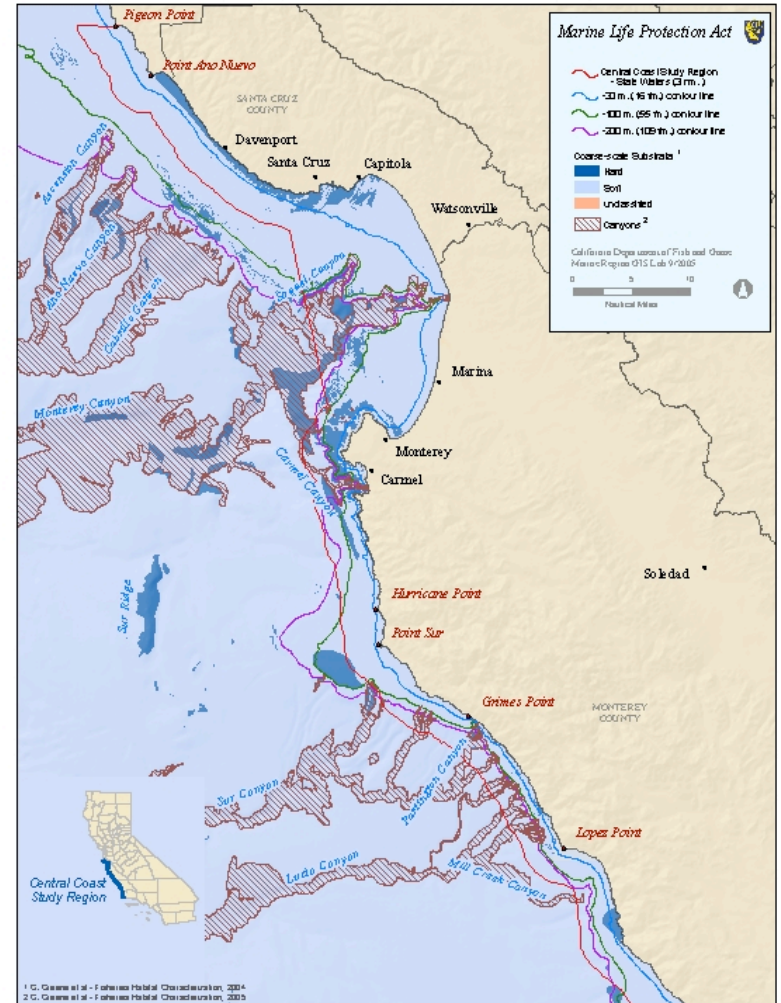
- Capture the diversity
 - Habitats
 - Biogeographic Regions



Habitat Data



Map 2a. Intertidal and Nearshore Habitats - Northern Central Coast Study Region



Map 3a. Coarse-scale Soft and Hard Bottom Habitats - Northern Central Coast Study Region

Quantify Habitat Availability

Analysis of Habitat Representation in MPA Package 0 (Existing Central Coast MPAs, 2005)

MPA Package 0 (Existing MPAs)	How measured ?	Total Amount in Study Region	Total Percent of Study Region	Amount in Existing State Marine Reserves	Percent of Total in Existing SMRs	Amount in Existing State Marine Parks	Percent of Total in Existing SMPs	Amount in Existing State Marine Conservation Areas	Percent of Total in Existing SMCAs	Amount in Existing Special Closures	Percent of Total in Existing SCs	Amount in all Existing MPAs in Study Region	Percent of Total in Existing MPAs	Spatial Data Source
Area	Area (mi ²)	1150.01		7.45	0.65%	0.00	0.00%	33.50	2.91%	2.20	0.19%	43.15	3.75%	GIS analysis
Number of MPAs				5		0		7		1		13		
HABITATS														
Sandy or gravel beaches	Linear (mi)	223.88	60.3%	5.27	2.36%	0.00	0.00%	14.42	6.45%	6.06	2.71%	25.75	11.51%	NOAA ESI 2002
Rocky intertidal and cliff	Linear (mi)	209.21	56.4%	16.71	7.99%	0.00	0.00%	12.89	6.07%	2.73	1.30%	32.13	15.36%	NOAA ESI 2002
Coastal marsh	Linear (mi)	36.53	9.8%	9.16	25.08%	0.00	0.00%	0.00	0.00%	0.00	0.00%	9.16	25.08%	NOAA ESI 2002
Tidal flats	Linear (mi)	23.48	6.3%	9.16	39.02%	0.00	0.00%	0.00	0.00%	0.00	0.00%	9.16	39.02%	NOAA ESI 2002
Surfgrass	Linear (mi)	161.09	43.4%	9.74	6.05%	0.00	0.00%	11.82	7.34%	4.59	2.85%	26.15	16.23%	Minerals Management Service / Tenera Inc.
Eelgrass	Area (mi ²)	1.07	0.1%	0.03	2.80%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.03	2.80%	Elkhorn Slough Foundation; Morro Bay National Estuary Program
Estuary	Area (mi ²)	9.83	0.9%	1.36	13.84%	0.00	0.00%	0.06	0.61%	0.00	0.00%	1.42	14.46%	Combined layer w/ data from NOAA ESI; National Wetlands Inventory; CNDDb; USGS
Soft 0-30	Area (mi ²)	270.34	23.5%	4.52	1.67%	0.00	0.00%	14.82	5.48%	1.88	0.70%	21.22	7.85%	Substrata_Proxy Layer (DFG 2005) based on fine scale (high res); coarse-scale (low res); union of all kelp as proxy for rock; CPFV rockfish fishing effort as proxy for rock
Soft 30-100	Area (mi ²)	562.38	48.9%	1.32	0.23%	0.00	0.00%	14.78	2.63%	0.00	0.00%	16.10	2.86%	same as above
Soft 100-200	Area (mi ²)	57.83	5.0%	0.00	0.00%	0.00	0.00%	0.02	0.03%	0.00	0.00%	0.02	0.03%	same as above
Soft >200	Area (mi ²)	105.52	9.2%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	same as above
Hard 0-30	Area (mi ²)	73.60	6.4%	1.04	1.41%	0.00	0.00%	2.12	2.88%	0.33	0.45%	3.49	4.74%	same as above
Hard 30-100	Area (mi ²)	40.30	3.5%	0.28	0.69%	0.00	0.00%	0.72	1.79%	0.00	0.00%	1.00	2.48%	same as above

Characterize Proposals

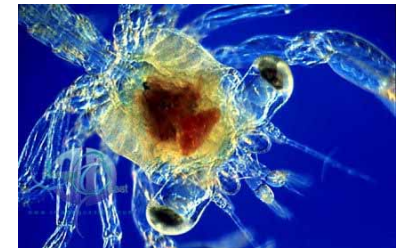
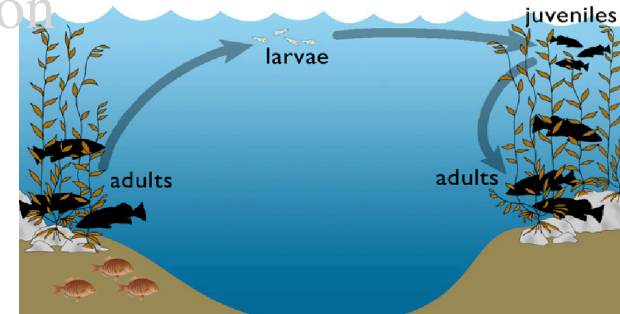
Habitat	Percentage of mapped habitat in proposed MPA designations in the study region ¹			
	SMR	SMP	SMCA	Total MPAs
Intertidal				
Sandy or gravel beaches	25.00%	1.94%	2.90%	29.83%
Rocky intertidal and cliff	34.71%	1.38%	3.63%	39.91%
Coastal marsh	30.17%	1.04%	5.31%	36.52%
Tidal flats	37.27%	0.64%	18.23%	56.14%
Seagrass beds (0-30m): Surfgrass	37.62%	2.15%	4.72%	44.48%
Seagrass beds (0-30m): Eelgrass	31.66%	0.00%	68.03%	99.71%
Estuary	31.94%	0.10%	20.04%	52.09%
Soft bottom				
0-30 meters	16.49%	1.35%	1.31%	19.15%
30-100 meters	6.07%	0.13%	6.89%	13.09%
100-200 meters	2.16%	0.00%	19.97%	22.13%
>200 meters	8.75%	0.00%	13.18%	21.93%
Hard bottom				
0-30 meters	27.64%	1.52%	1.77%	30.93%
30-100 meters	7.69%	0.00%	15.39%	23.08%
100-200m	1.71%	0.00%	37.17%	38.88%
>200 meters	2.85%	0.00%	20.36%	23.21%
Kelp forest				
Average kelp ('89, '99, '02, '03)	24.45%	4.34%	5.06%	33.85%
Persistent kelp	22.02%	8.50%	6.61%	37.13%
Submarine canyon				
0-30 meters	8.85%	0.00%	26.55%	35.40%
30-100 meters	12.89%	0.00%	2.26%	15.15%
100-200 meters	10.23%	0.00%	12.71%	22.94%
>200 meters	9.49%	0.00%	11.88%	21.37%

¹ Note: These are proposed MPA designations, NOT levels of protection assigned by the SAT.

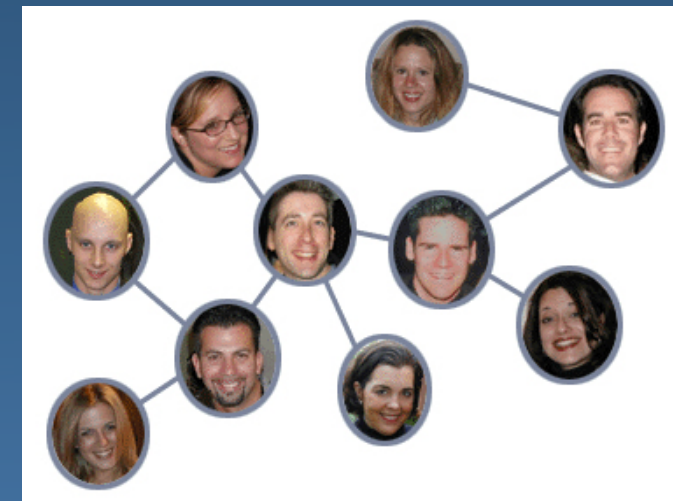
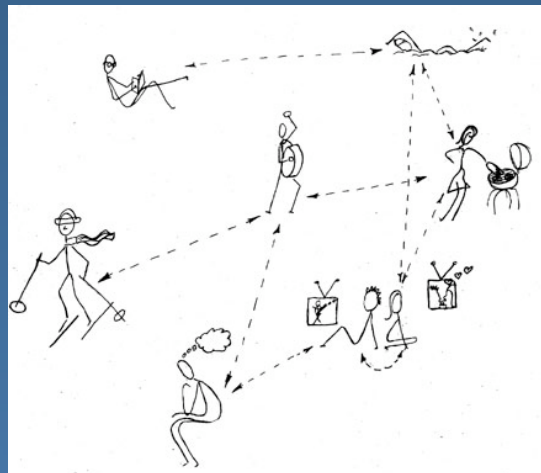
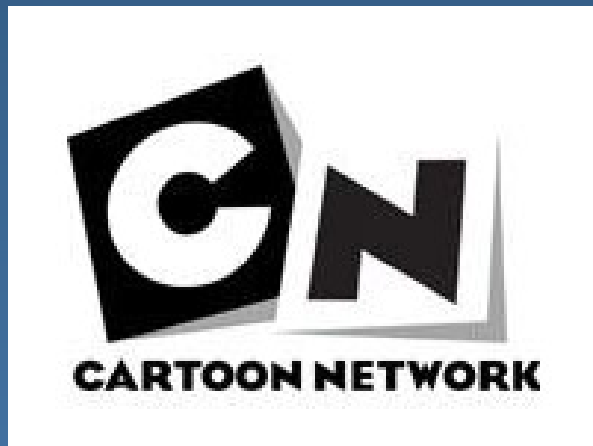
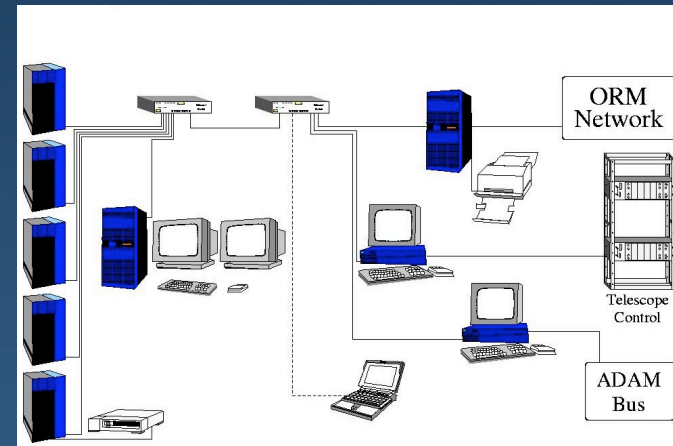
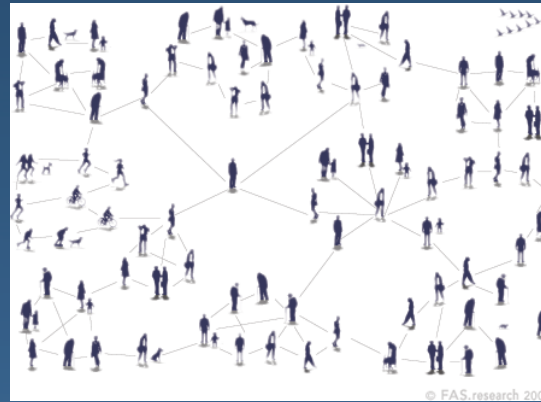


MLPA Goals - Populations

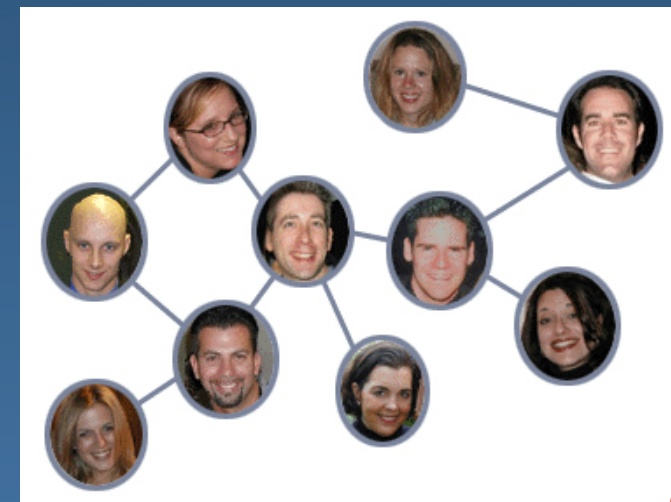
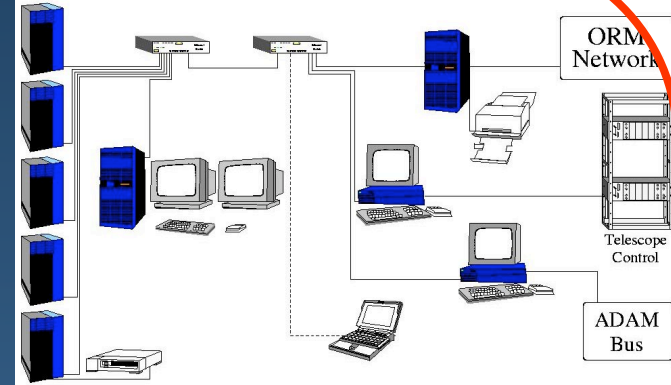
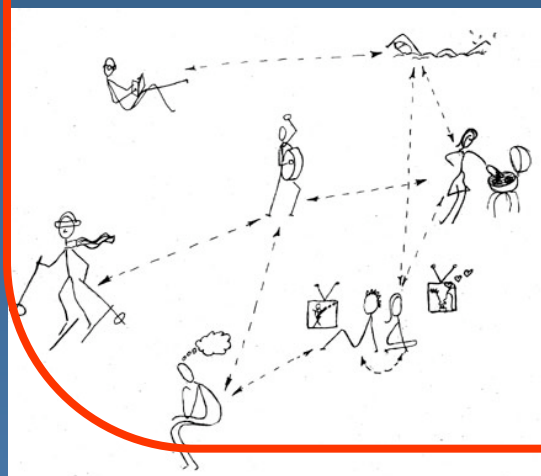
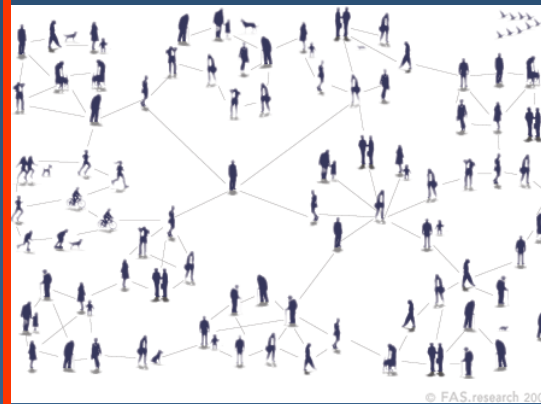
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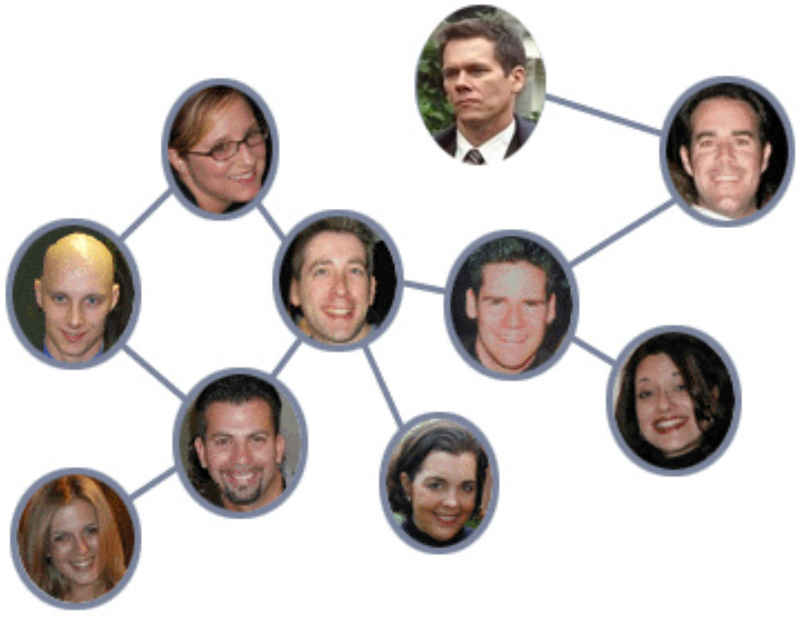
What is a Network?



What is a Network?

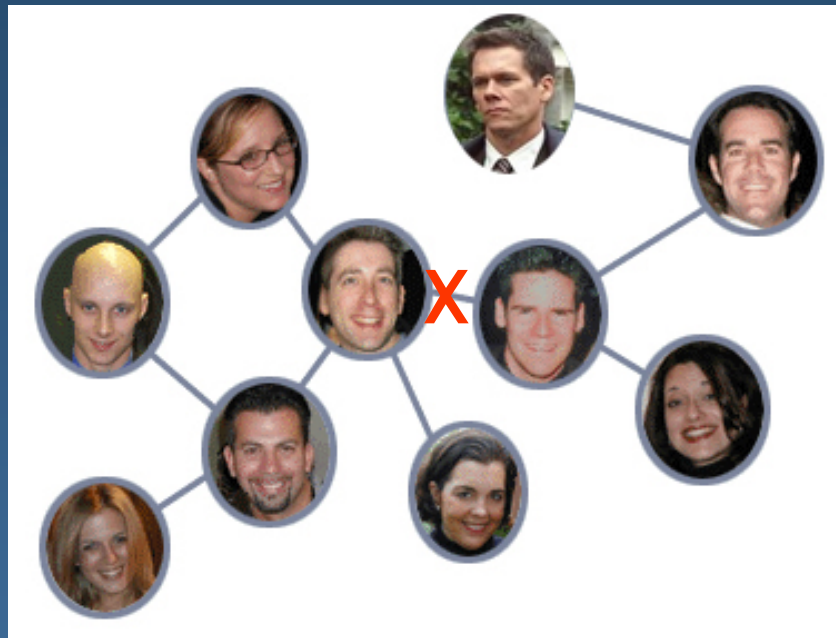


Networks Rely on Connections

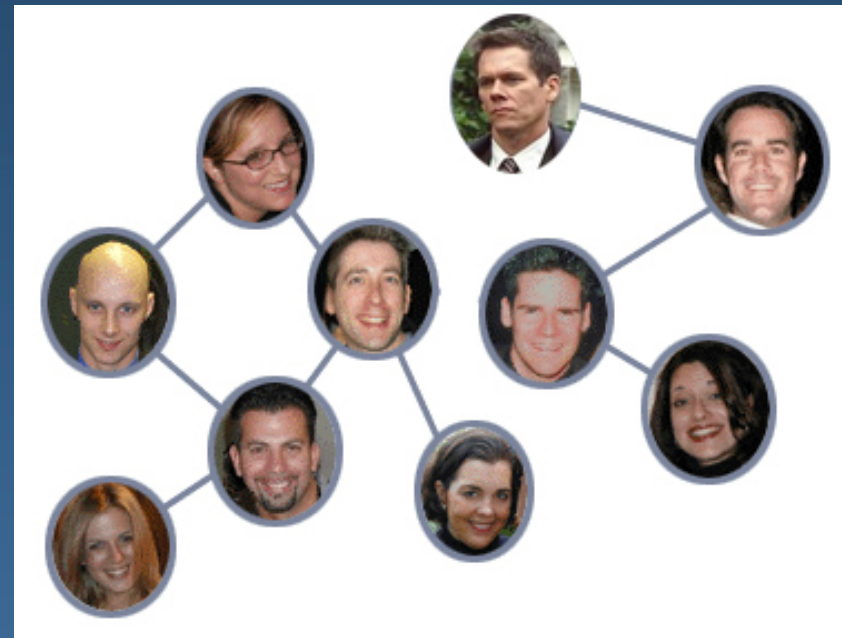


Network

Networks Rely on Connections



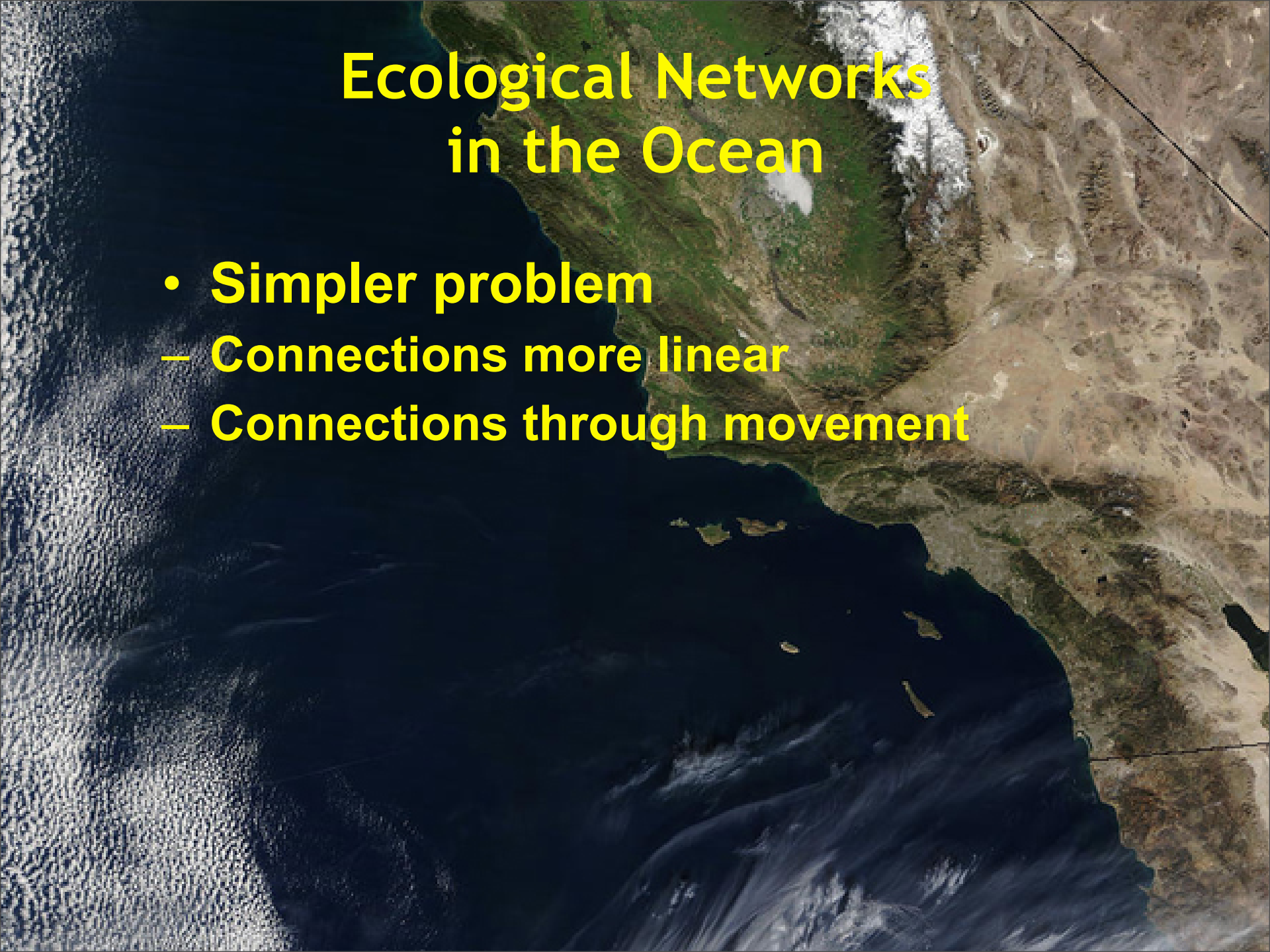
Network



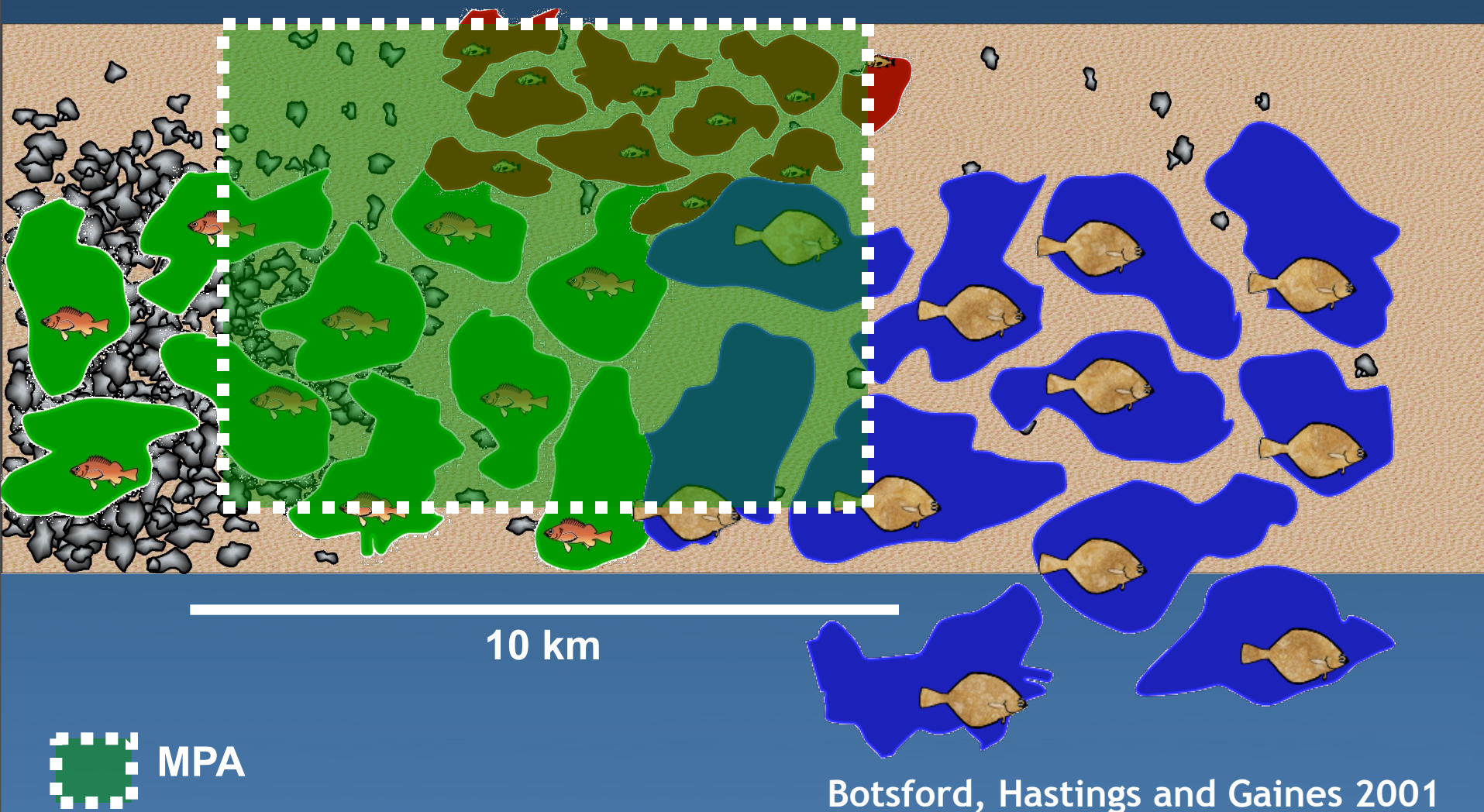
Broken Network

Ecological Networks in the Ocean


- **Simpler problem**
 - **Connections more linear**
 - **Connections through movement**



To achieve sustainable populations: MPA size > movement



Constraint: MPA Size > Avg. Movement

0 – 1 km	1 – 10 km	10 – 100 km	100 – 1000 km	> 1000 km
<p>Invertebrates</p> <ul style="list-style-type: none"> Abalone Mussel Octopus Sea Star Snail Urchin <p>Rockfishes</p> <ul style="list-style-type: none"> Blk. & Yellow China Gopher Kelp <p>Other Fishes</p> <ul style="list-style-type: none"> Gobie Sculpin 	<p>Rockfishes</p> <ul style="list-style-type: none"> Black Brown Copper Greenspotted Olive Vermilion <p>Other Fishes</p> <ul style="list-style-type: none"> Cabazon Ca. Halibut Lingcod 	<p>Invertebrates</p> <ul style="list-style-type: none"> Dung. Crab* <p>Rockfishes</p> <ul style="list-style-type: none"> Bocaccio Canary Yellowtail Widow <p>Other Fishes</p> <ul style="list-style-type: none"> Anchovy Herring Sardine <p>Birds</p> <ul style="list-style-type: none"> Gulls Cormorants <p>Mammals</p> <ul style="list-style-type: none"> Harbor Seal Otter 	<p>Fishes</p> <ul style="list-style-type: none"> Big Skate Pacific Halibut Sablefish* Salmonids* Sturgeon Whiting* <p>Birds</p> <ul style="list-style-type: none"> Gulls* <p>Mammals</p> <ul style="list-style-type: none"> Porpoises Sea Lions* 	<p>Invertebrates</p> <ul style="list-style-type: none"> Jumbo Squid* <p>Fishes</p> <ul style="list-style-type: none"> Sharks* Tunas* <p>Turtles*</p> <p>Birds</p> <ul style="list-style-type: none"> Albatross* Pelican* Shearwater* Shorebirds* Terns* <p>Mammals</p> <ul style="list-style-type: none"> Dolphins Sea Lions* Whales*

* Seasonal Migration

Constraint: MPA Size > Avg. Movement

0 – 1 km	1 – 10 km	10 – 100 km	100 – 1000 km	> 1000 km
Invertebrates Abalone Mussel Octopus Sea Star Snail Urchin Rockfishes Blk. & Yellow China Gopher Kelp Other Fishes Gobie Sculpin	Rockfishes Black Brown Copper Greenspotted Olive Vermilion Other Fishes Cabezon Ca. Halibut Lingcod 	Invertebrates Dung. Crab* Rockfishes Bocaccio Canary Yellowtail Widow Other Fishes Anchovy Herring Sardine Birds Gulls Cormorants Mammals Harbor Seal Otter	Fishes Big Skate Pacific Halibut Sablefish* Salmonids* Sturgeon Whiting* Birds Gulls* Mammals Porpoises Sea Lions*	Invertebrates Jumbo Squid* Fishes Sharks* Tunas* Turtles* Birds Albatross* Pelican* Shearwater* Shorebirds* Terns* Mammals Dolphins Sea Lions* Whales*

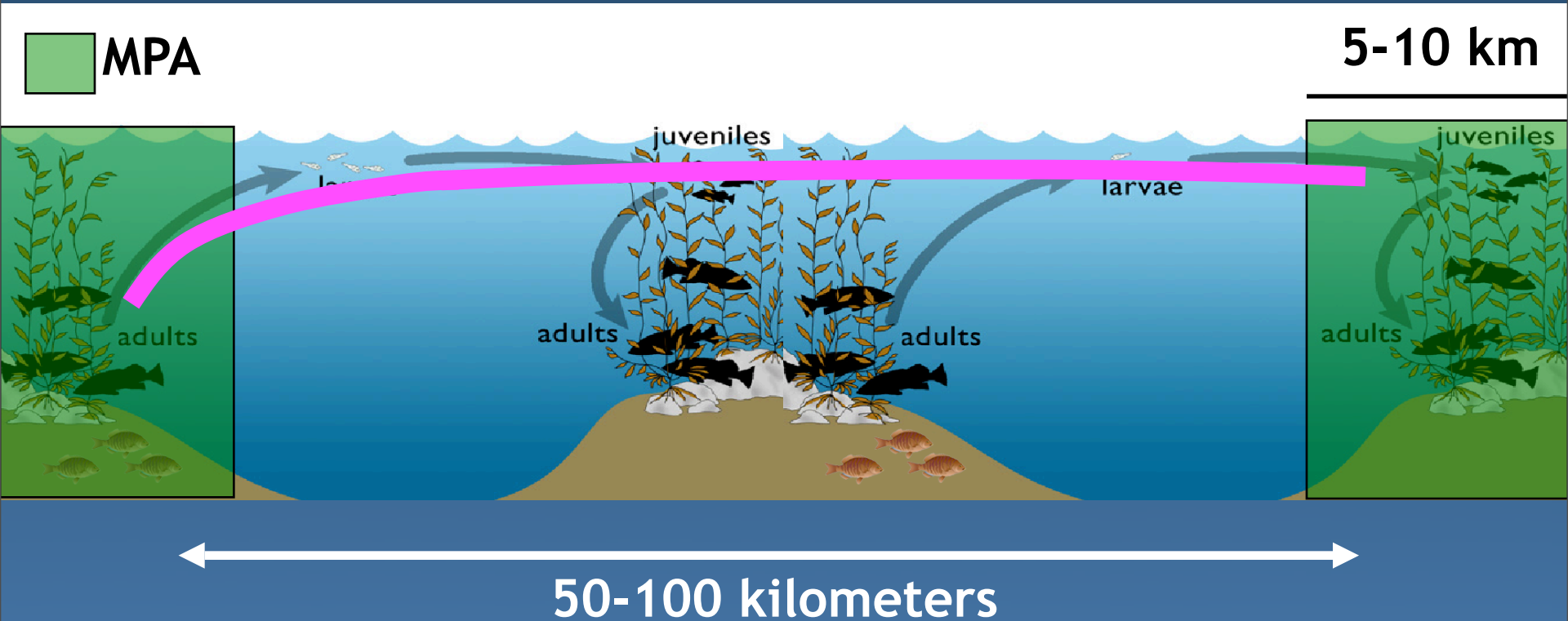
* Seasonal Migration

Limited Benefit

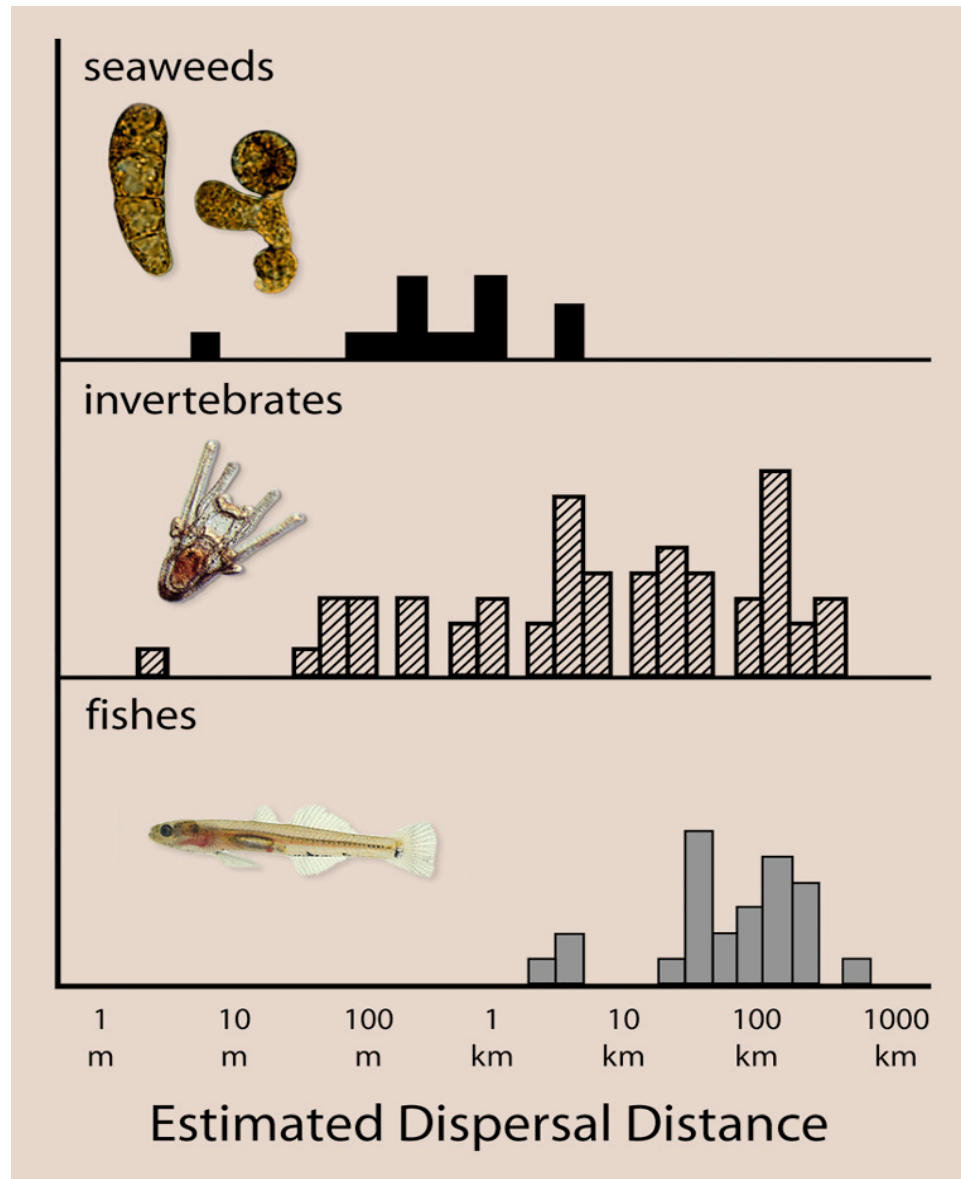
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<p>* Seasonal Migration</p>			<h2>Limited Benefit</h2>	

To contribute to an ecological network, MPAs should be placed at distances that **allow exchange of larvae** between MPAs.



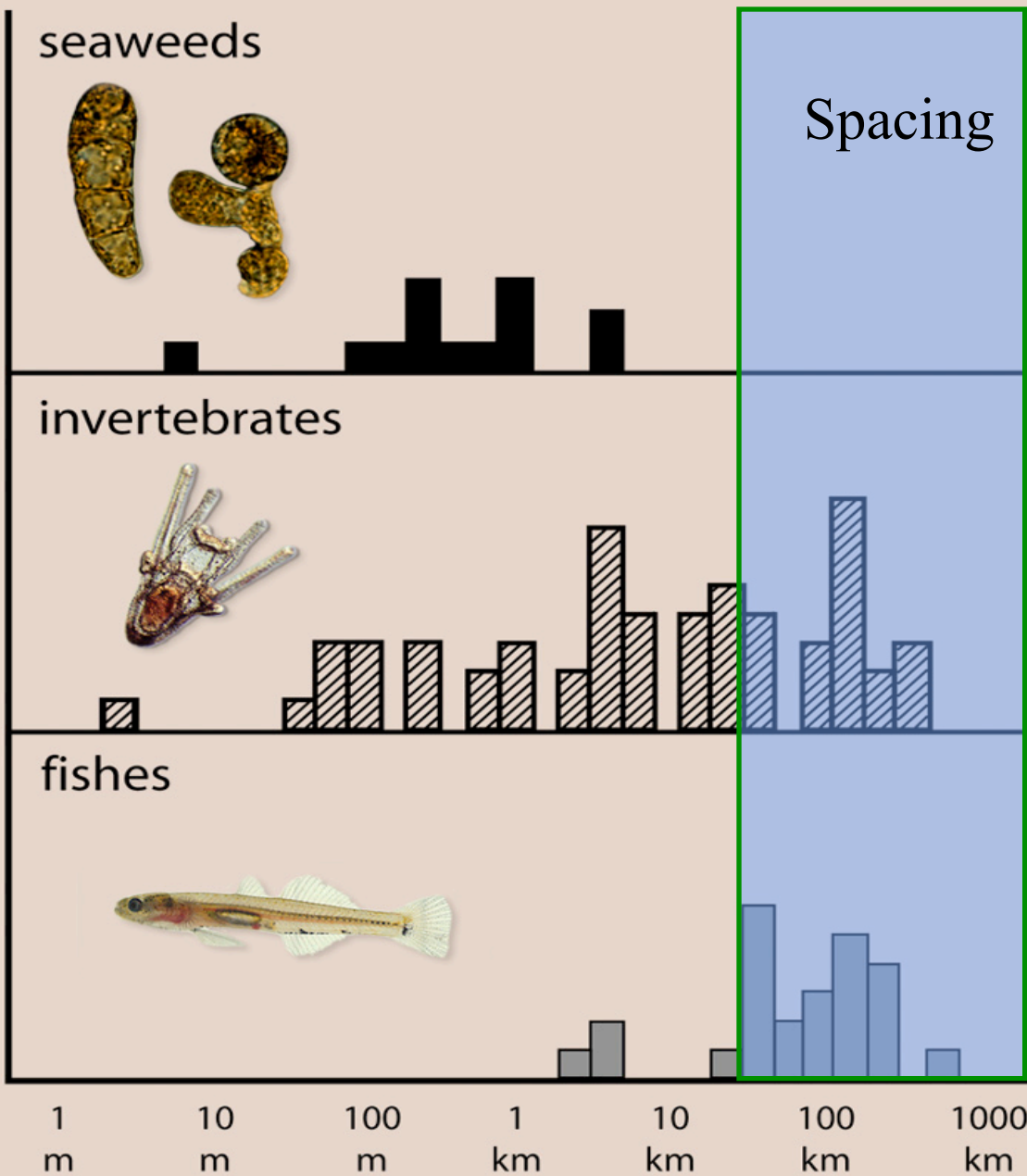
Larval Movement



Spacing Guidelines

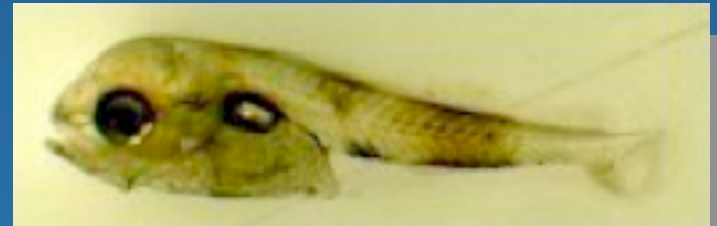
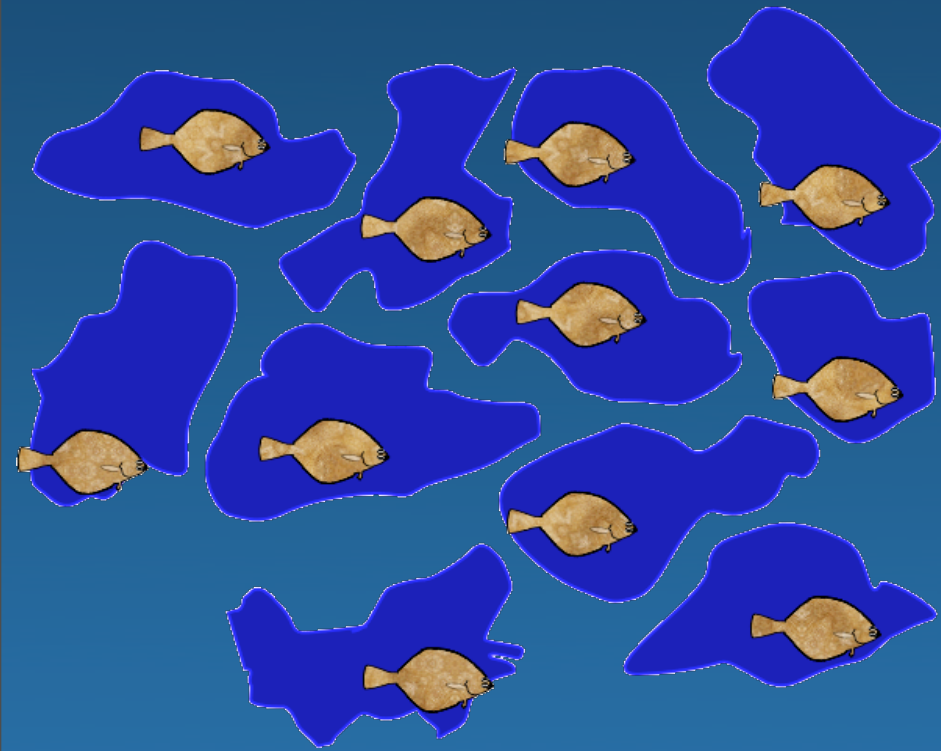
50 km
Apart

Number of species

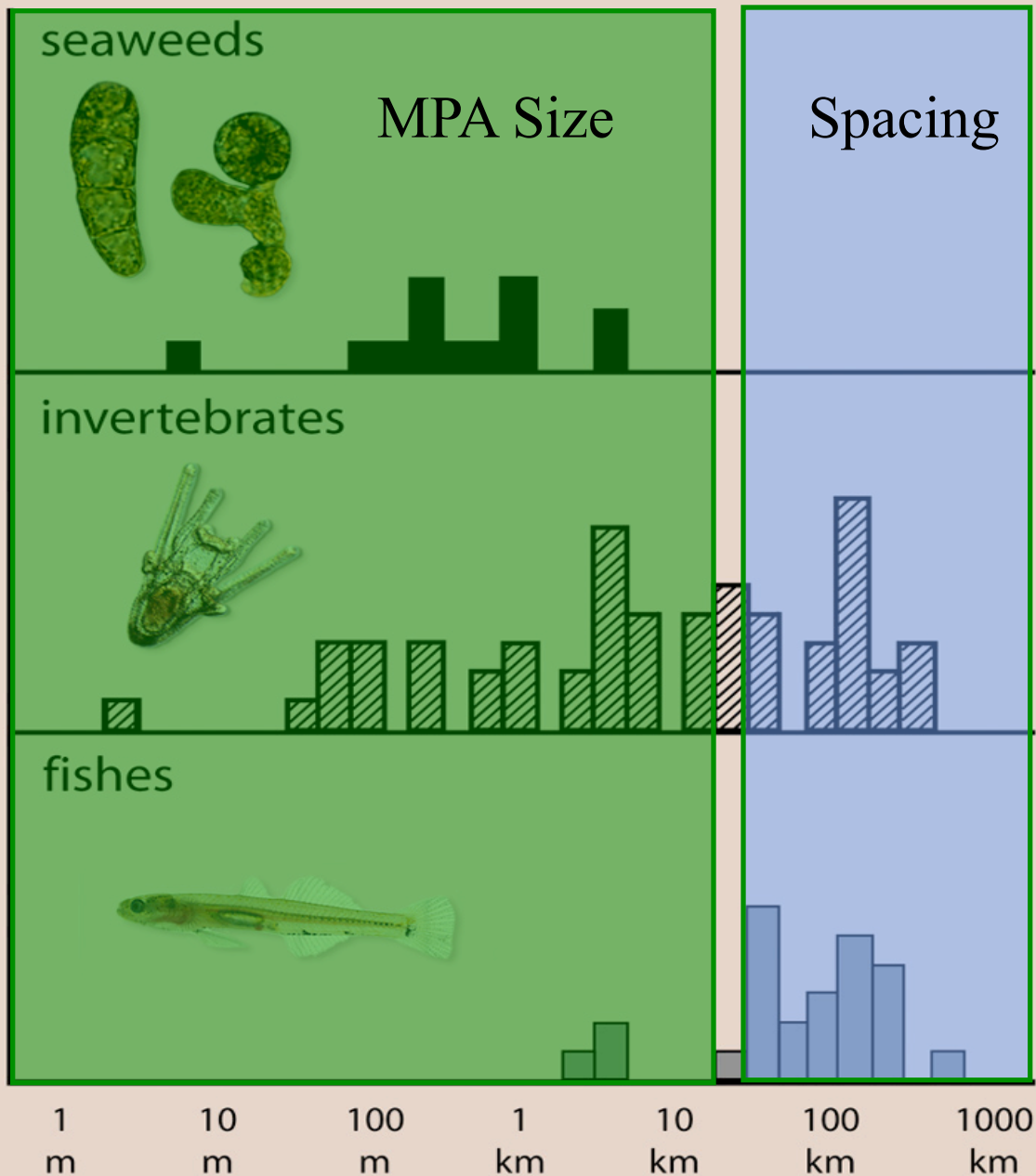


Estimated Dispersal Distance

Put Movement of Adults and Young Together



Number of species



Spacing Guidelines

20 km
Reserves

50 km
Apart

Estimated Dispersal Distance



Master Plan Framework Guidelines

- Size Guideline
 - “For an objective of protecting adult populations, based on adult neighborhood sizes and movement patterns, MPAs should have an **alongshore span of 5-10 km** (3-6 m or 2.5- 5.4 nm) of coastline, and **preferably 10-20 km** (6-12.5 m or 5.4-11 nm). Larger MPAs would be required to fully protect marine birds, mammals, and migratory fish.”



Areas: High Protection Clusters

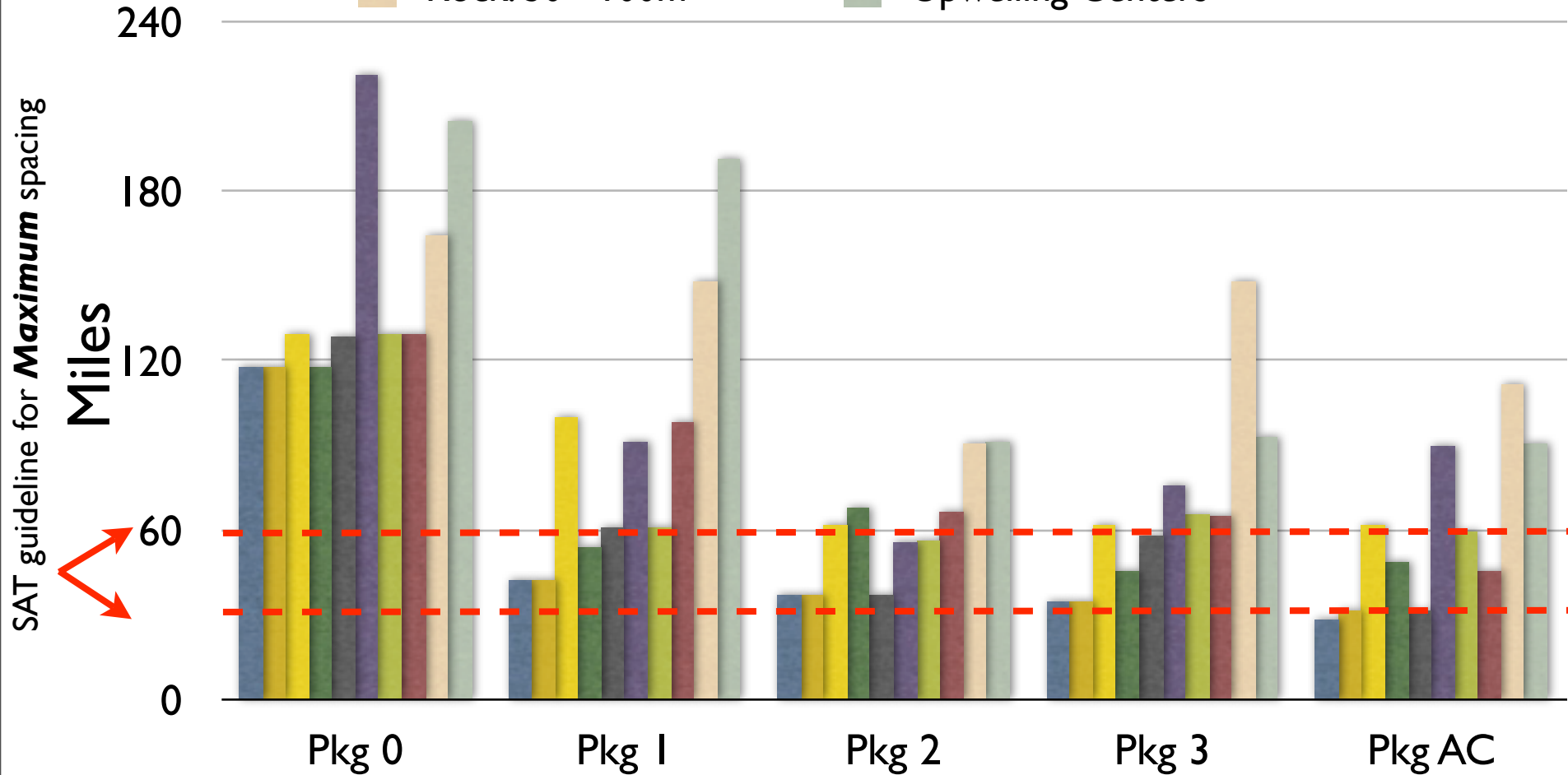
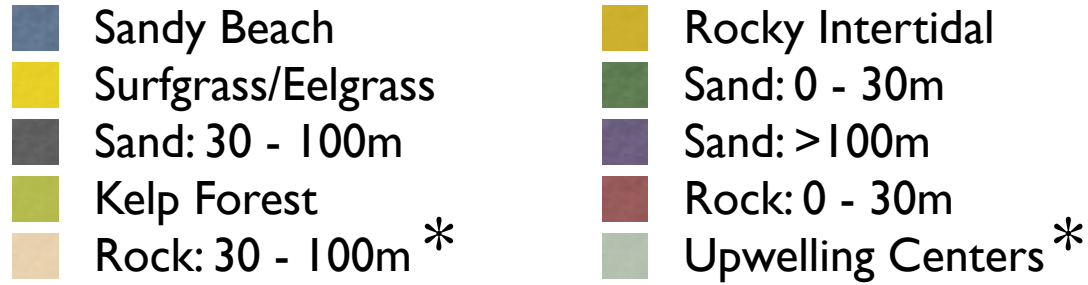
Pkg	# of MPA Clusters	Below Minimum	At Minimum	Above Minimum
I	11	45%	36%	19%
2	12	25%	17%	58%
3	13	31%	38%	31%
S	14	36%	36%	28%
AC	12	25%	25%	50%



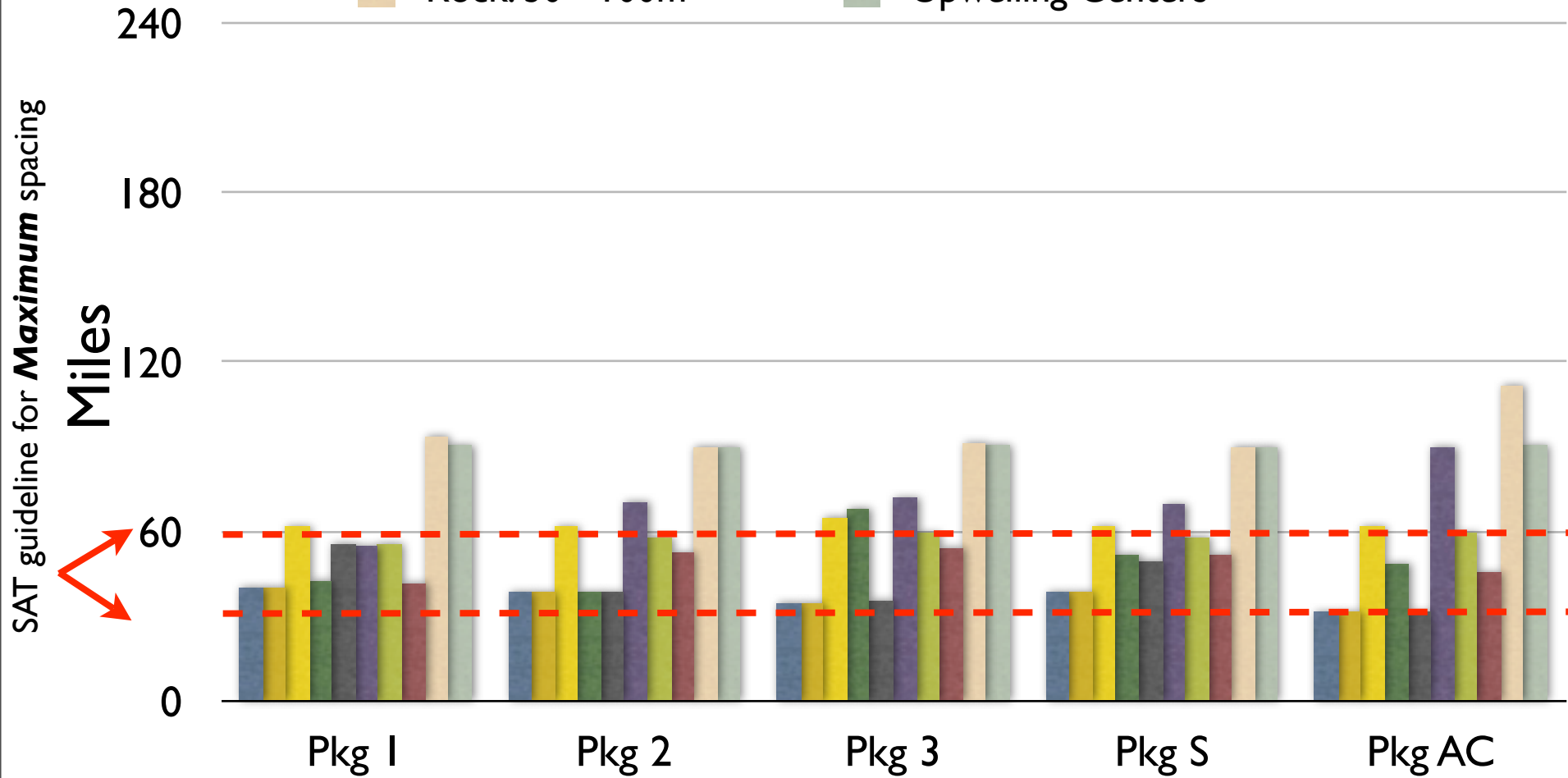
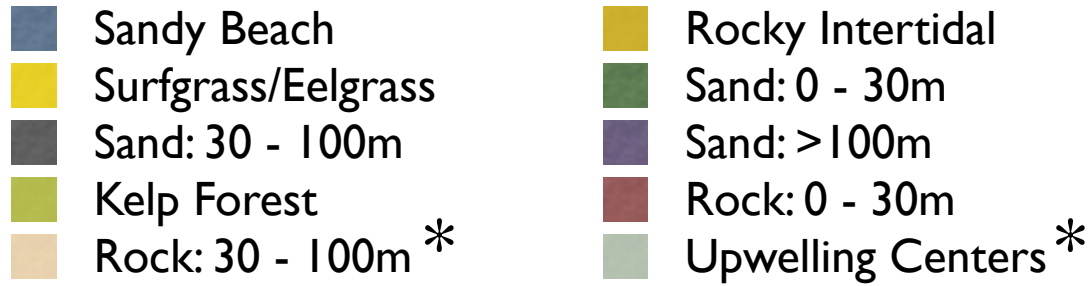
Master Plan Framework Guidelines

- Spacing
 - “For an objective of facilitating dispersal of important bottom-dwelling fish and invertebrate groups among MPAs, based on currently known scales of larval dispersal, **MPAs should be placed within 50-100 km (31-62 m or 27-54 nm)** of each other.”

Previous Analysis



Maximum Gaps



Other Analyses

- Socioeconomics
- Optimization
- Species Persistence

Commercial & Recreational Fishing



	10-Feb-10			7-Jan-10	23-Feb-10
	Package 1	Package 2	Package 3	Package AC	Package S
Area of total fishing grounds affected					
Anchovy	4.39%	7.98%	6.01%	10.62%	4.35%
Cabezon	13.27%	16.96%	14.95%	24.31%	15.82%
Dungeness crab	3.38%	7.09%	6.75%	11.77%	7.06%
Deep Nearshore Rockfish	13.02%	16.54%	14.97%	23.86%	16.46%
Halibut	9.08%	10.09%	9.50%	18.04%	9.99%
Kelp Greenling	12.33%	17.74%	16.16%	23.82%	17.43%
Lingcod	12.61%	18.44%	16.31%	23.45%	17.40%
Mackerel	6.66%	12.30%	9.41%	16.64%	6.96%
Rockfish Nearshore	11.92%	15.39%	13.70%	23.72%	14.38%
Rockfish Shelf	5.18%	13.21%	16.13%	29.16%	11.53%
Rockfish Slope	0.64%	1.10%	0.97%	6.96%	0.96%
Rock Crab	4.79%	6.63%	6.10%	9.57%	6.23%
Salmon	0.44%	1.05%	0.91%	1.47%	0.80%
Sardine	4.38%	7.91%	5.16%	10.55%	4.30%
Sablefish	0.86%	2.26%	2.26%	2.94%	2.30%
White seabass	9.47%	7.84%	8.36%	16.56%	8.50%
Surfperch	8.07%	16.77%	22.78%	15.18%	15.65%
Spot Prawn	0.87%	2.50%	2.88%	3.70%	2.88%
Squid	6.82%	10.89%	9.76%	15.65%	9.92%
Area of fishing grounds within the study area affected					
Anchovy	10.14%	18.40%	13.88%	24.55%	9.99%
Cabezon	15.11%	19.31%	17.05%	27.73%	18.05%
Dungeness crab	6.96%	14.57%	13.87%	24.18%	14.51%
Deep Nearshore Rockfish	14.39%	18.26%	16.54%	26.39%	18.20%
Halibut	11.07%	12.30%	11.59%	21.98%	12.18%
Kelp Greenling	12.74%	18.35%	16.73%	24.61%	18.03%
Lingcod	13.32%	19.53%	17.25%	24.85%	18.38%
Mackerel	9.49%	17.58%	13.44%	23.82%	9.97%
Rockfish Nearshore	13.73%	17.70%	15.73%	27.23%	16.55%
Rockfish Shelf	5.67%	14.48%	17.68%	31.97%	12.64%
Rockfish Slope	14.33%	24.76%	21.87%	32.49%	21.64%
Rock Crab	11.28%	15.59%	14.38%	22.49%	14.63%
Salmon	6.07%	13.82%	11.85%	19.26%	10.71%
Sardine	10.14%	18.40%	11.98%	24.55%	9.99%
Sablefish	8.05%	21.22%	21.22%	27.58%	21.61%
White seabass	11.56%	9.58%	10.22%	20.24%	10.36%
Surfperch	8.07%	16.79%	22.78%	15.18%	15.65%
Spot Prawn	6.49%	18.36%	21.17%	27.08%	21.12%
Squid	9.00%	14.37%	12.88%	20.64%	13.08%
Value of total fishing grounds affected					

Challenges:
Accuracy,
Spatial
Resolution

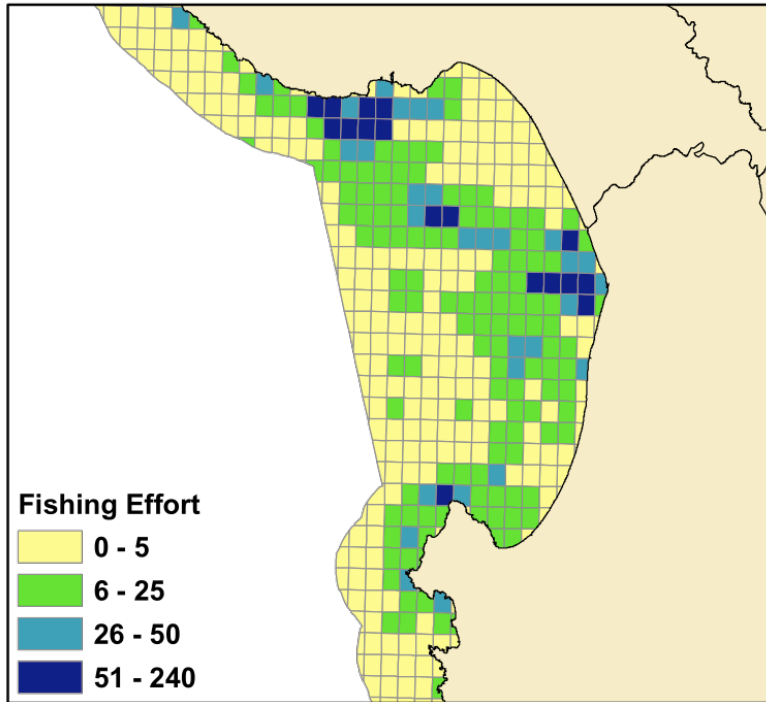
Variety of Ways to
Reduce Impacts
While Meeting
Biological Goals

Modeling Approach: MARXAN

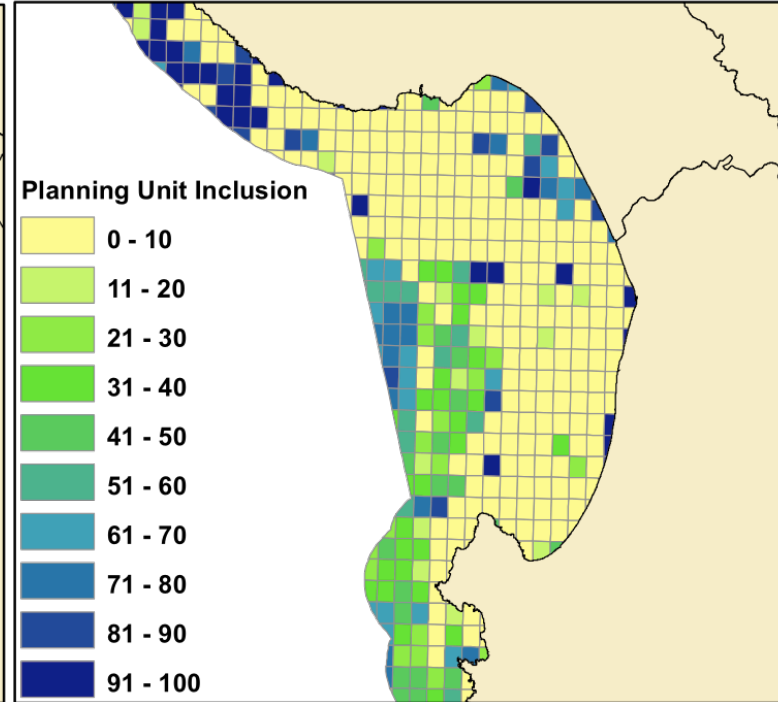
- 1 NM² planning units.
- Calculated how much of each target is in each planning unit.
- MARXAN provides potential solutions for meeting conservation goals at a “minimal cost”.



Recreational Fishing Effort



MARXAN Output





Species Persistence Model

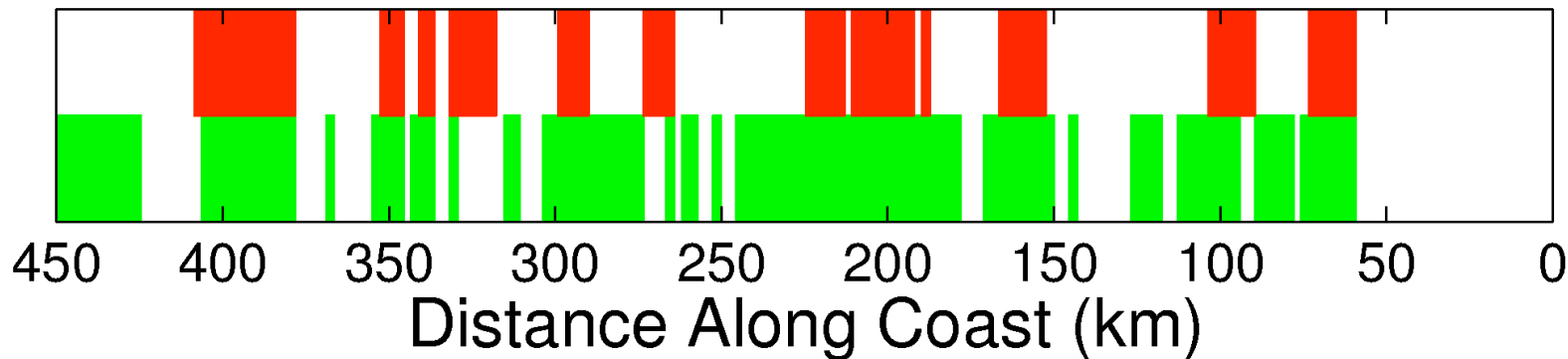
- Map Habitat and MPA distributions
- Convert to a model of the coastline
- Run model for different species



Species Persistence Model

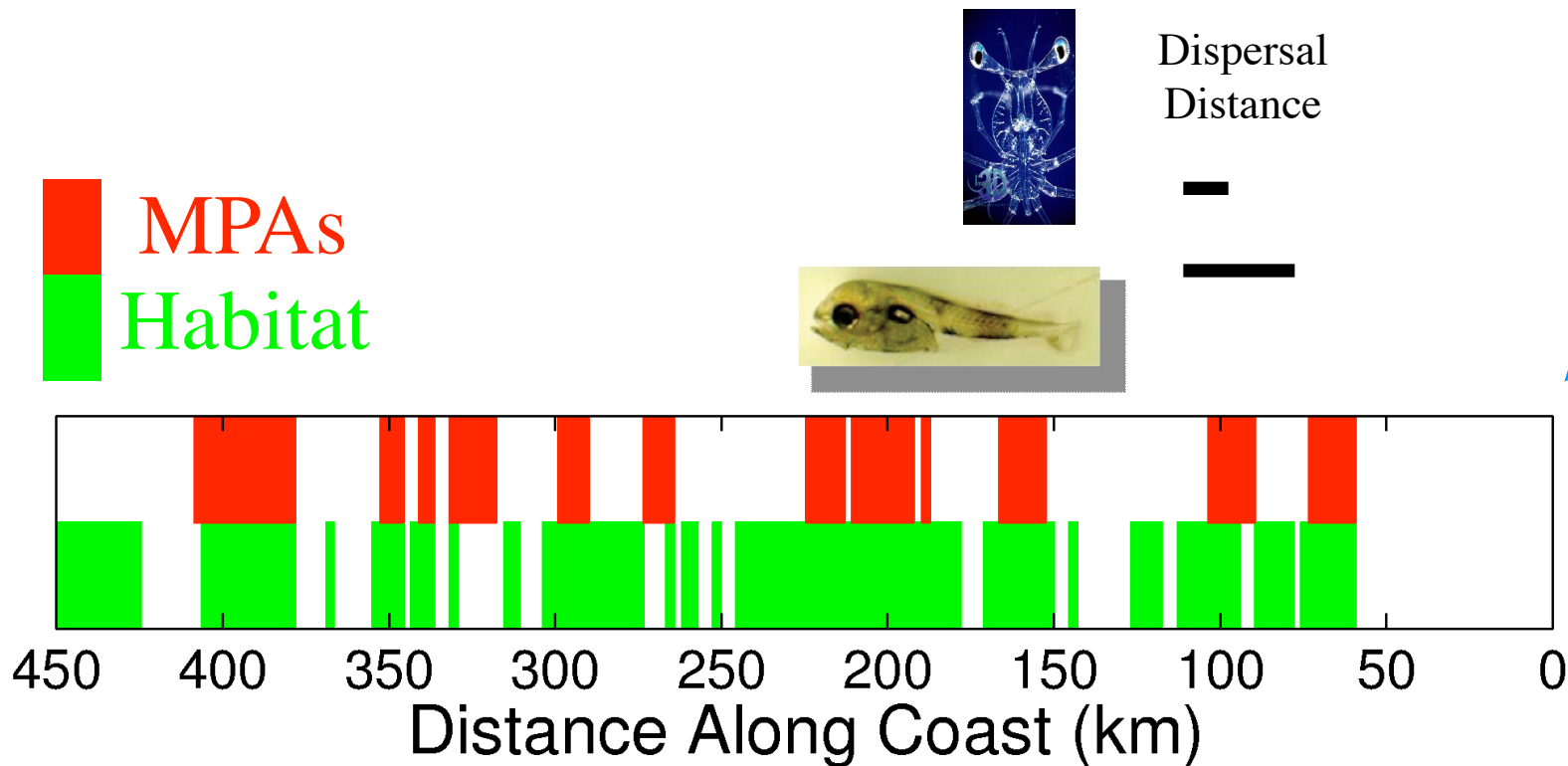
- Map Habitat and MPA distributions
- Convert to a model of the coastline
- Run model for different species

MPAs
Habitat



Species Persistence Model

- Map Habitat and MPA distributions
- Convert to a model of the coastline
- Run model for different species

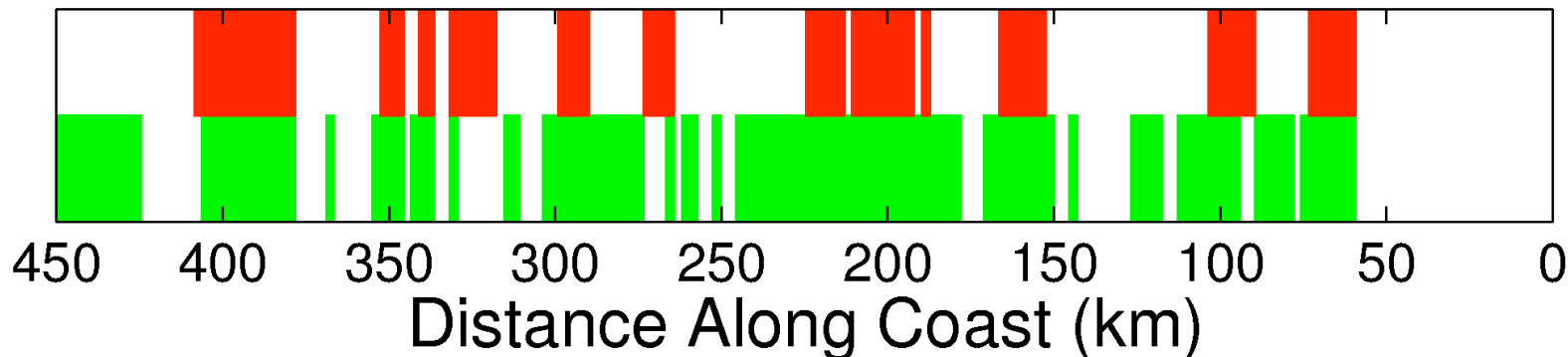


Species Persistence Model

- Egg production required for replacement
- What happens outside MPAs
 - High vs Low Fishing Mortality

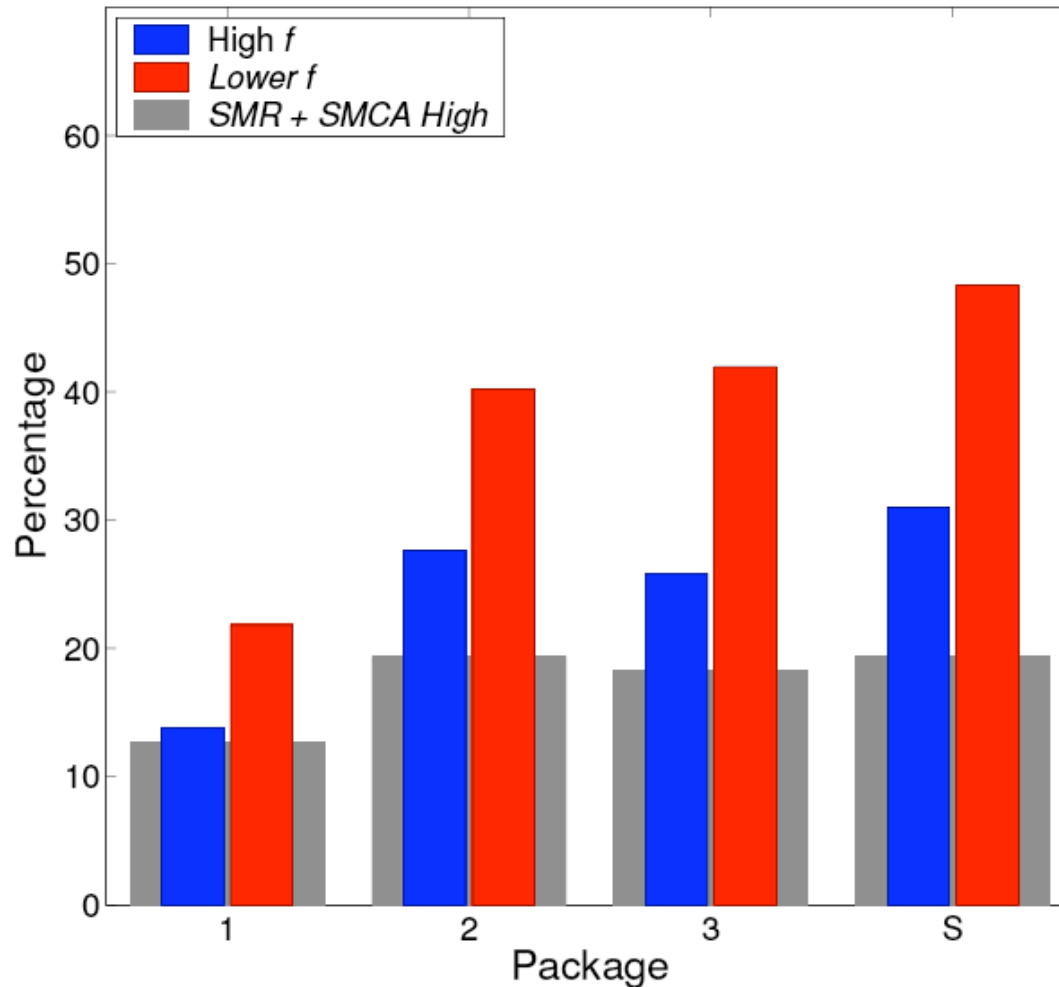


MPAs
Habitat



Rocky Reefs

30-100m Rocky Habitat
FLEP=0.2/0.3; Disp Dist = 25 km



Information Used for Planning MPAs

CA Marine Life Protection Act

- **Marine habitats and bathymetry**
- **Species distributions, abundances, status, habitat associations**
- **Species home range size and movement patterns**
- **Larval dispersal, general estimates**
- **Oceanography**
- **Natural or cultural heritage sites**
- **Consumptive activities**
- **Non-consumptive activities**
- **Cities, towns, and public access points**
- **Existing terrestrial and marine parks**

Data Challenges

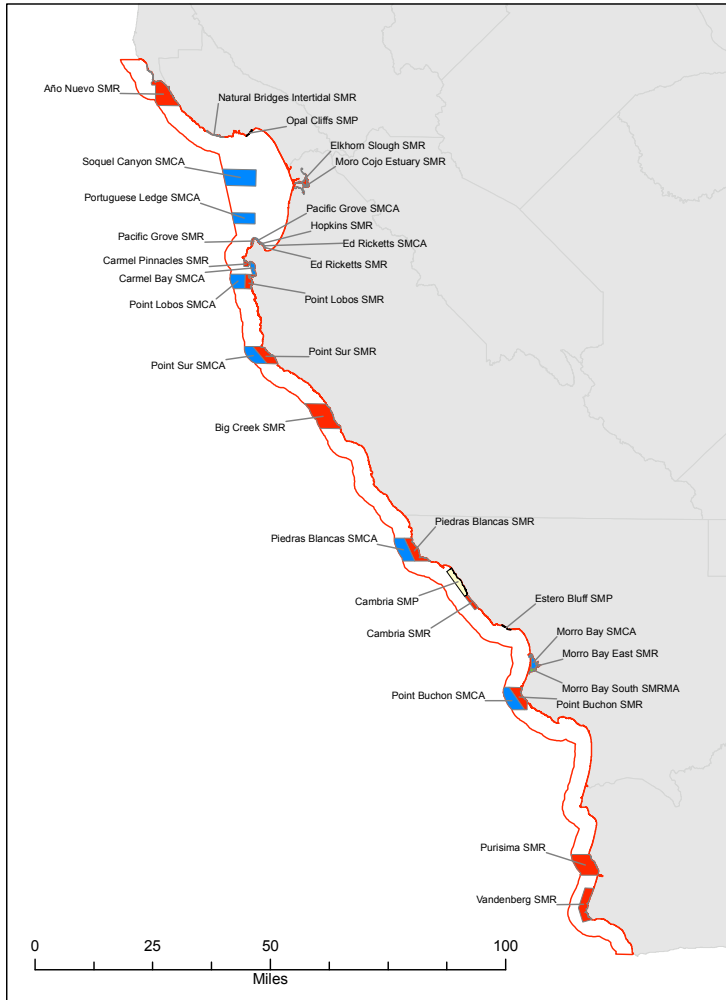


- Understand non-market values of ecosystems
- Incorporate non-market values into economic models



MPA Network Proposals

Package 3R (3/15/06 Version)



Package 2R (3/15/06 Version)

