Update on Science Advisory Team Evaluation Methods for the MLPA South Coast Study Region

Presented to the MLPA South Coast Regional Stakeholder Group
January 13, 2009 • San Diego, CA

Prepared by
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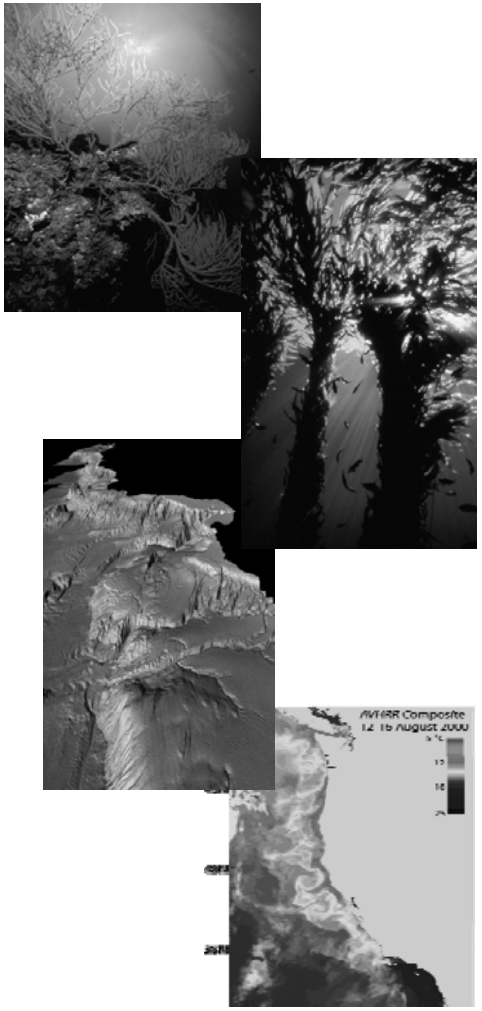
on behalf of the MLPA Master Plan Science Advisory Team

Science Guidelines and Evaluations

- Guidelines are designed to ensure that marine protected area (MPA) networks achieve the goals of the act
- SAT evaluations provide feedback about how well proposals meet the guidelines

Marine Life Protection Act Goals *

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**.



*** This is a summary of the goals in the MLPA**

SAT Evaluations

- **Protection of habitats and ecosystems**
  - Habitat Representation
  - Habitat Replication

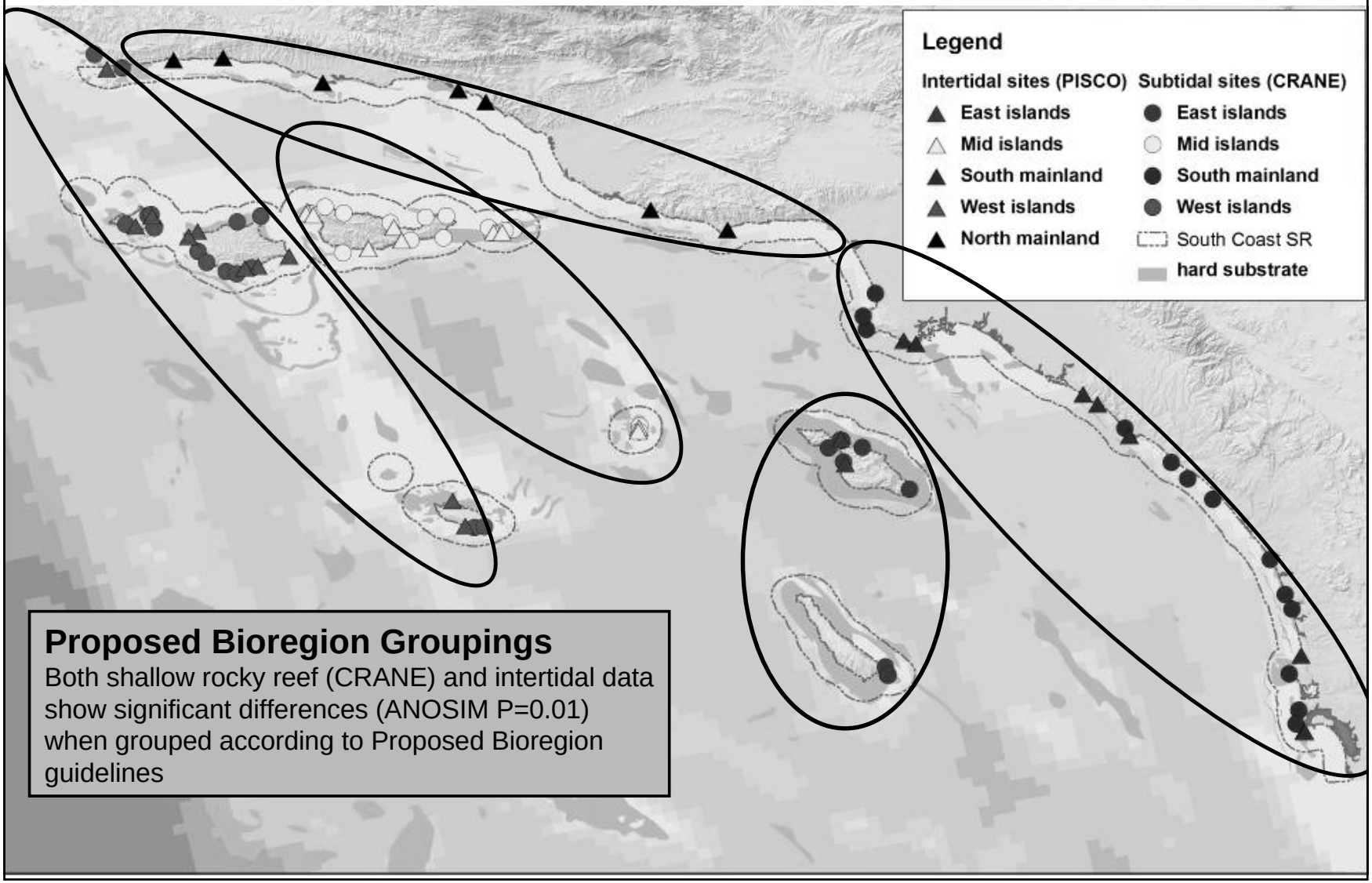
- **Protection of populations and connectivity**
  - Size
  - Spacing
  - Bioeconomic Models
  - Birds and Mammals

- **Other evaluations**
  - Water Quality

Laying the Basis for SAT Evaluations

- Understanding the environmental and geographic gradients in the study region – SAT defined bioregions
- Understanding how extractive activities impact ecosystems – SAT defined levels of protection

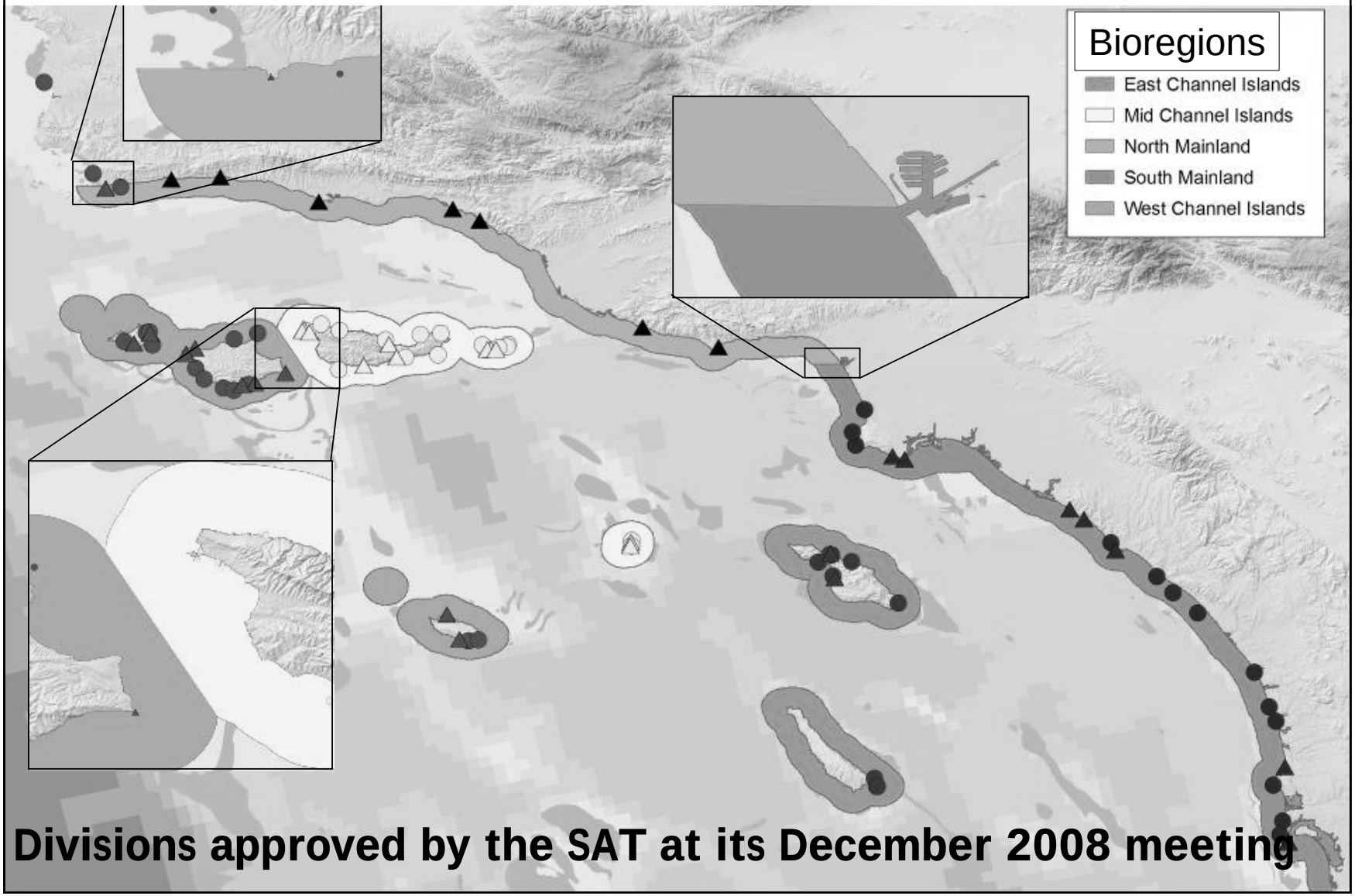
SAT Evaluation - Bioregions



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

SAT Evaluation - Bioregions



Divisions approved by the SAT at its December 2008 meeting

SAT Evaluation – Protection Levels

State Marine Reserve (SMR)

State Marine Conservation Area (SMCA)

State Marine Park (SMP)

- The protection provided to ecosystems within these MPAs may vary widely depending on allowed uses

SAT Evaluation – Protection Levels

The Question:

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

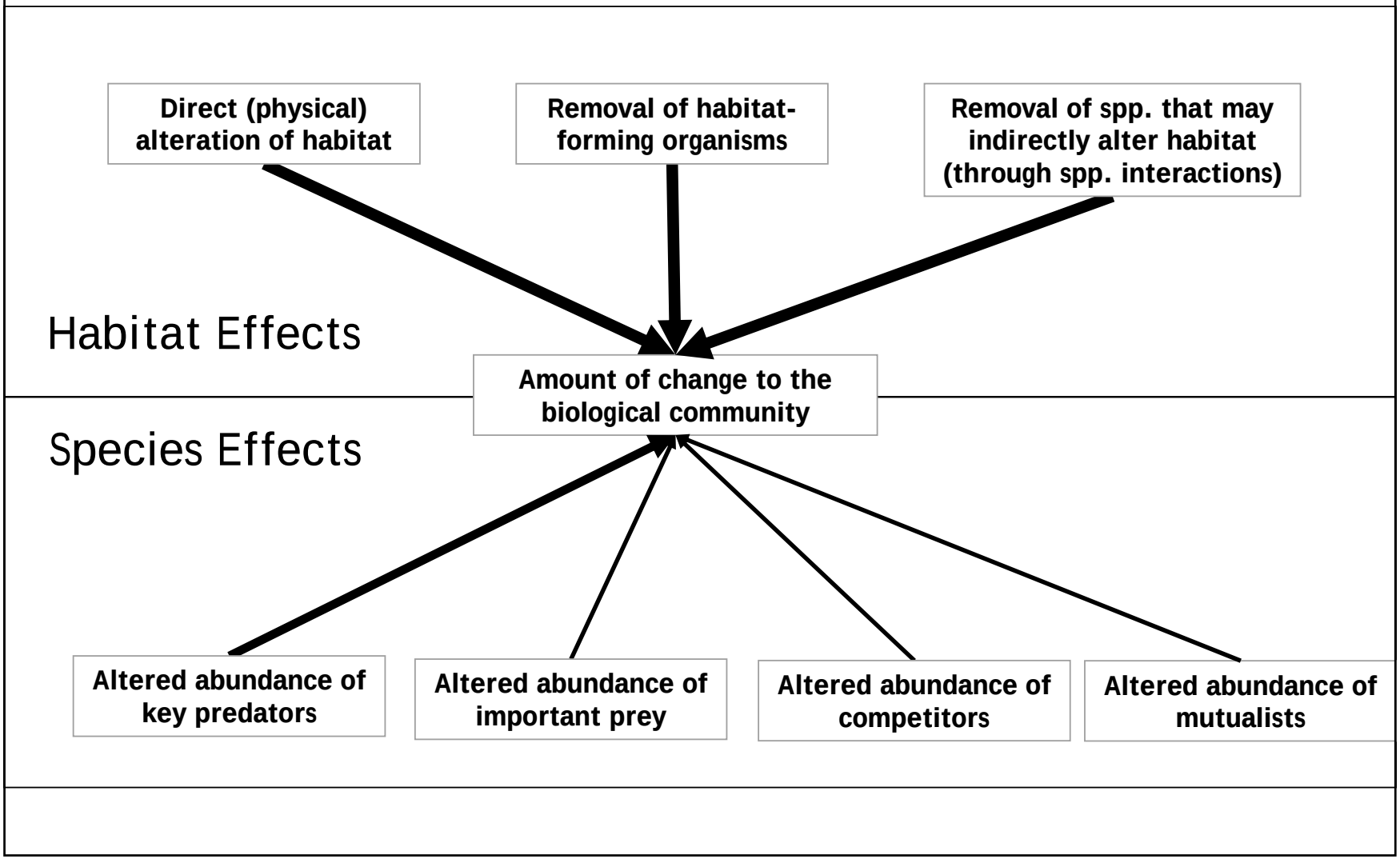
A great deal if:

- 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

Protection Levels – A Conceptual Model



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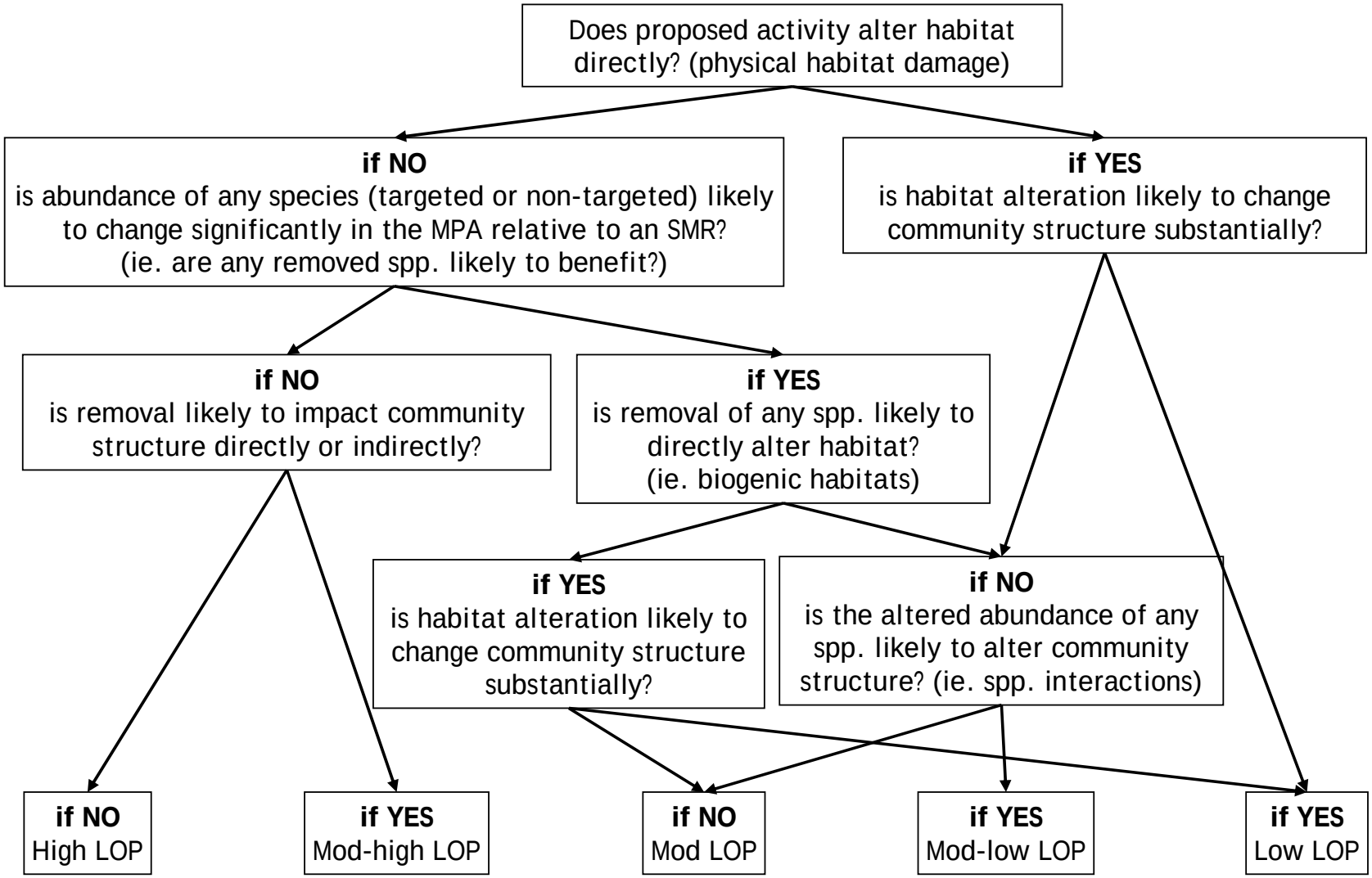

SAT Evaluation – Protection Levels

New Developments in the South Coast Study Region

Developing LOPs for new species/ fisheries:

- kelp bass (H&L or spear)
- lobster (trap, hoop net, scuba)
- barred sand bass (H&L or spear)
- grunion (hand take)
- sea cucumber (trawl, scuba)
- spot prawn (trap)
- spotted sand bass (H&L)
- bonito (H&L)
- rock scallop (scuba)
- sheephead (H&L, spear, trap)
- catch and release (H&L)

Revisiting species/fisheries from the NCCSR:

- squid (H&L, seine)
- urchin (scuba)
- white sea bass (H&L, spear)
- halibut (H&L, spear, trawl)
- coastal pelagic finfish (H&L, seine)
  - anchovy, jack mackerel, Pacific mackerel, sardine
- rock crab (trap, hoop net)
- pelagic finfish (H&L, spear)
  - barracuda, dorado, mackerel, mako shark, marlin, salmon, swordfish, thresher shark, tuna, yellowtail

SAT Evaluation – Protection Levels

New Developments in the South Coast Study Region

- Revisiting the depth distinction for pelagic finfish and coastal pelagics
- Considering cumulative impacts of multiple allowed uses in a single area
- Exploring a quantitative approach to evaluating the impact of activities on an ecosystem

Marine Life Protection Act Goals *

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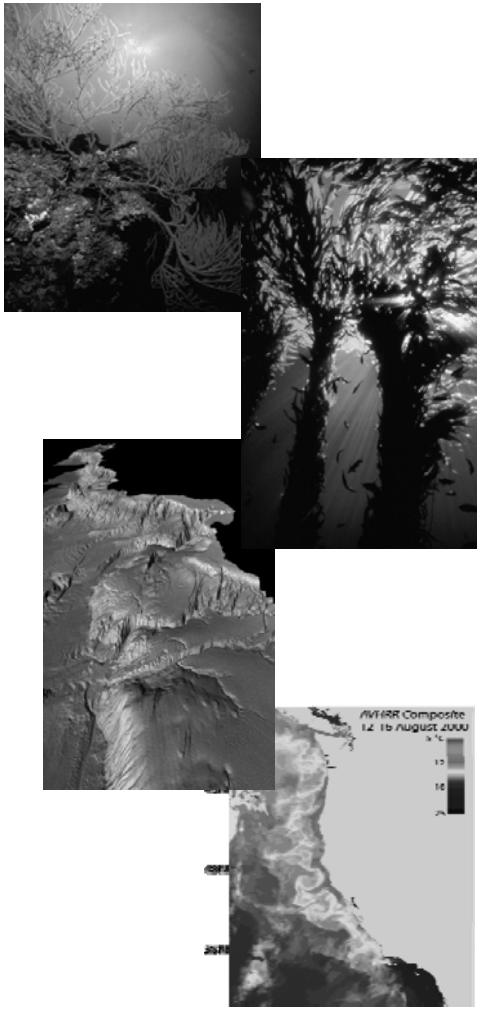


*** This is a summary of the goals in the MLPA**

Master Plan Guidance for Habitat Representation

- Every ‘key’ marine habitat should be represented in the MPA network to protect the diversity of species that live in different habitats and those that move among different habitats over their lifetime.

- ‘Key’ marine habitats should be replicated in multiple MPAs across large environmental and geographic gradients to protect the greater diversity of species and communities that occur across such gradients, and to protect species from local year-to-year fluctuations in larval production and recruitment.

Key Marine Habitats

Seafloor Habitats

- Intertidal zones
- Rocky reefs
- Sandy or soft ocean 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

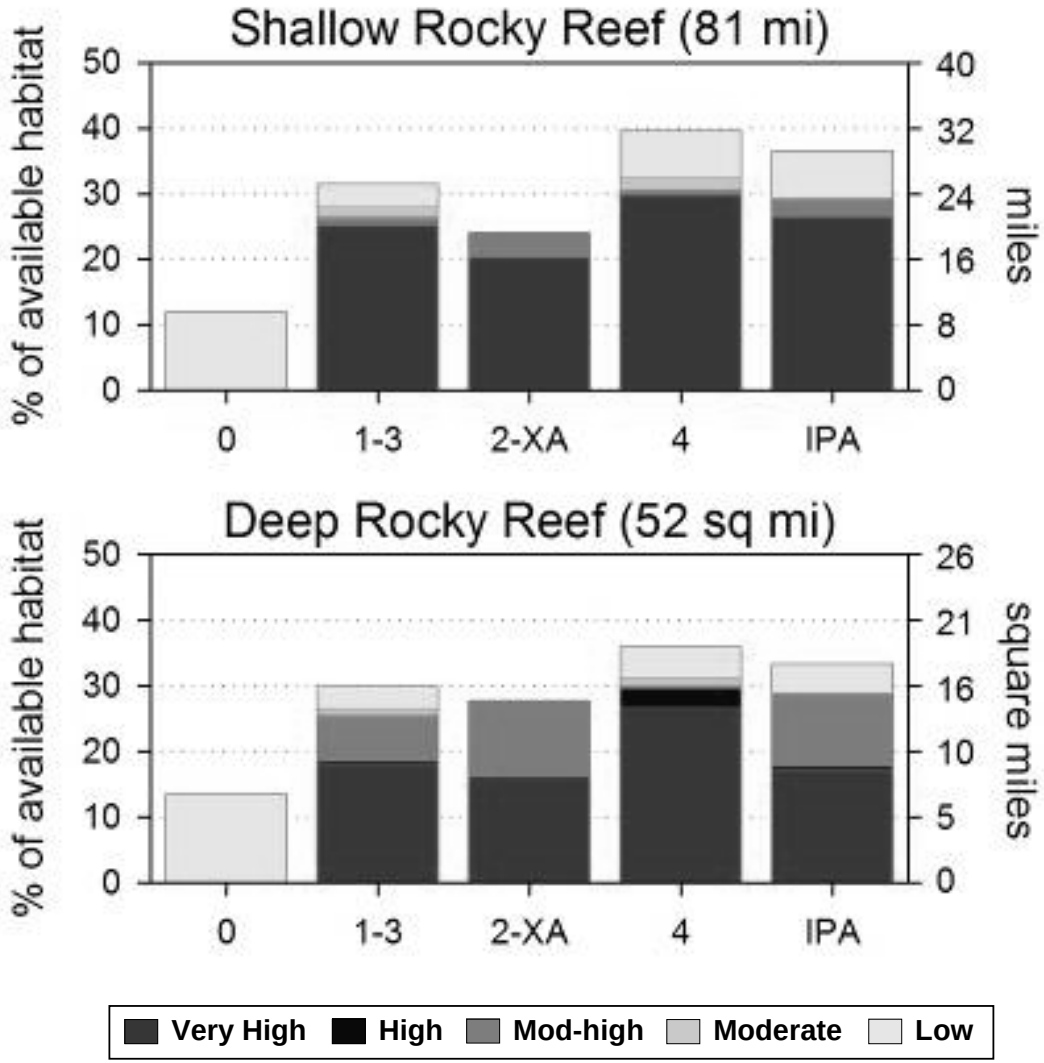
Oceanographic Habitats

- Upwelling areas
- Freshwater plumes
- Retention zones

Evaluation – Habitat Representation

- Consider the availability of habitats
  - within the entire study region
  - within each of the five (5) bioregions
- Calculate the percent of each habitat protected at each level of protection
  - within the entire study region
  - within each of the five bioregions
- Note where habitat protection is not distributed across all five bioregions

Example – Habitat Representation



Evaluation – Habitat Representation

New Developments in the South Coast Study Region

- Reviewing GIS habitat layers to assess their limitations
- Considering methods for evaluating representation of unique habitats
- Unique habitats under consideration by the SAT
  - oil seeps
  - hydrothermal vents
  - elk kelp beds
  - hydrocoral beds

Master Plan Guidance for Habitat Replication

- "Key" marine habitats should be replicated in multiple MPAs across large environmental and geographic gradients to protect the greater diversity of species and communities that occur across such gradients, and to protect species from local year-to-year fluctuations in larval production and recruitment.

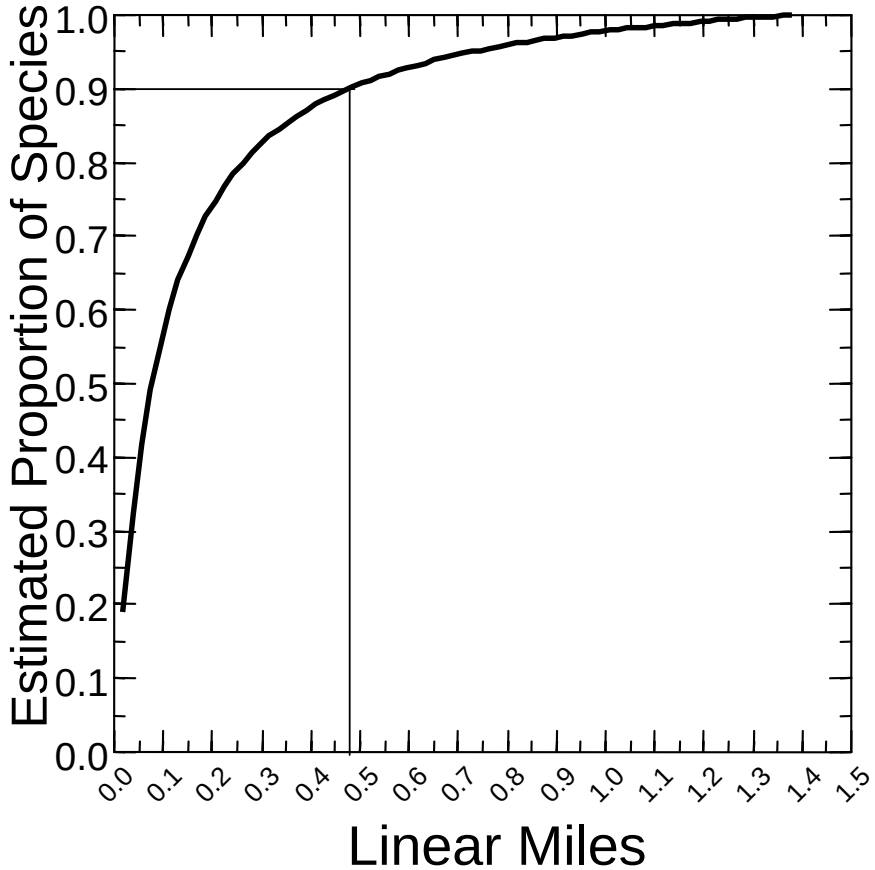
- At least three to five replicate MPAs should be designed for each habitat type within a biogeographical region to provide analytical power for management comparisons and to buffer against catastrophic loss of an MPA.

SAT Evaluation – Habitat Replication

- Most MPAs contain multiple habitats – how much of each habitat is enough?
- Part of the goal of replication is to protect "the diversity of species" in that habitat
- To count as a replicate, an MPA must contain sufficient habitat to encompass most of the species that live in that habitat

SAT Evaluation – Habitat Replication

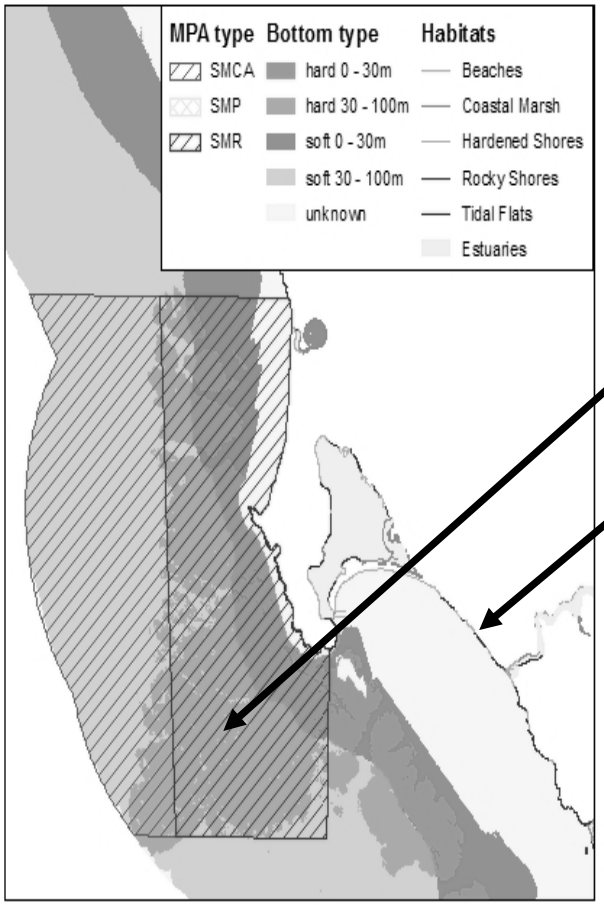
Relationship between habitat size and biodiversity



More habitat includes more species – up to a point

SAT decided that to count as a replicate, the habitat size must be large enough to encompass 90% of biodiversity

SAT Evaluation – Habitat Replication



- Habitats can be characterized as either
  - Two dimensional areas like deep rocky reefs
  - Linear features, like rocky intertidal or shallow rocky reefs

The key distinguishing characteristic is the effect of depth on the biological community

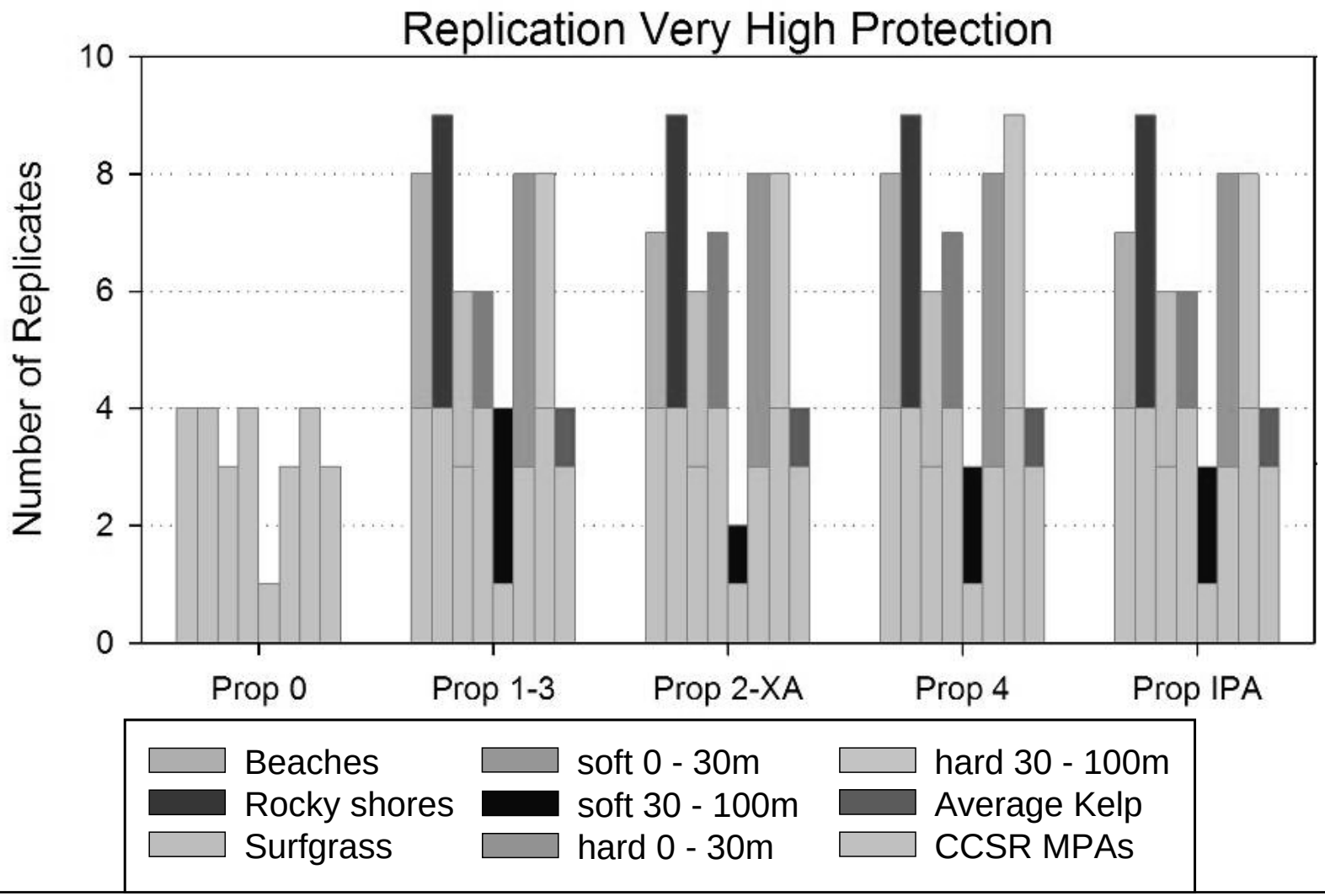
Estimates of area or distance needed to encompass 90% of biodiversity

Habitat	Southern California	North-Central California
Rocky Intertidal	~0.48 linear miles	~0.6 linear miles
Shallow Rocky Reefs/Kelp Forests (0-30 M)	~1.14 linear miles	~1.10 linear miles
Deep Rocky Reefs (30-100 M)	~0.20 square miles	~0.20 square miles
Deep Rocky Reefs (100-3000 M)	~0.22 square miles	Not done
Sandy Beaches	In development	~ 1 linear mile
Sandy Habitat (0-30 M)	In development	~1.1 linear miles
Sandy Habitat (30-100 M)	In development	~10 square miles
Estuarine Habitats	~0.12 square miles (75 acres)	~0.12 square miles (75 acres)

SAT Evaluation – Habitat Replication

- Contiguous MPAs with different allowed uses are clustered together based on level of protection
- Replication is assessed at the three highest levels of protection: mod-high, high, and very high
- Only MPAs or MPA clusters that meet the minimum size guideline are considered for replication (size guideline does not apply in estuaries)
- Only MPAs that have enough of a habitat to encompass 90% of biodiversity are considered as replicates of that habitat

Example – Habitat Replication



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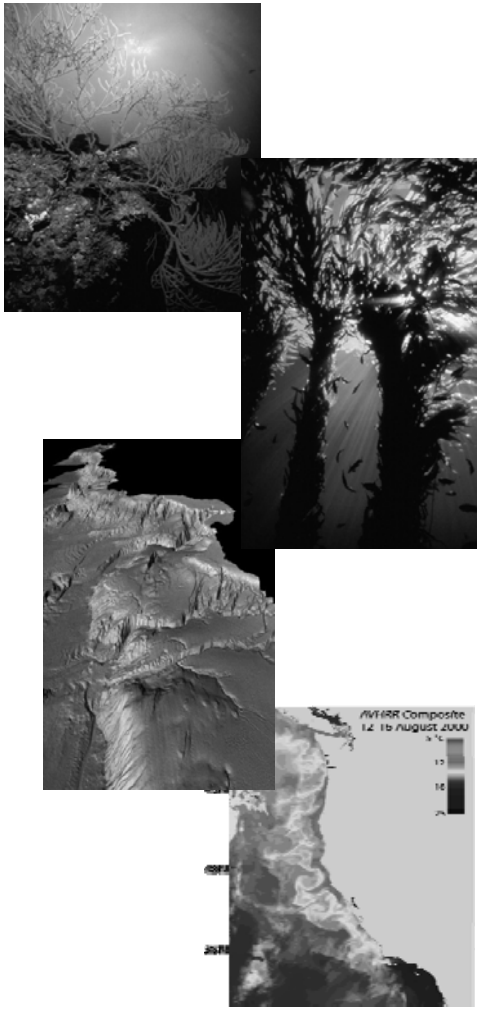

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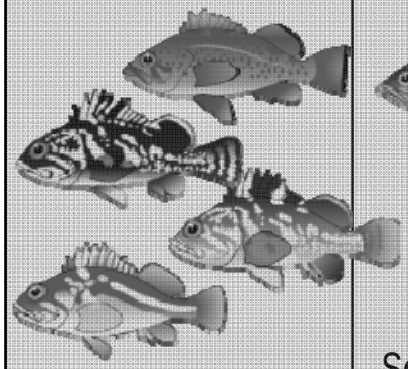
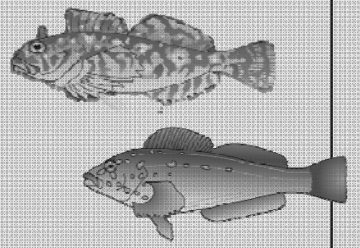
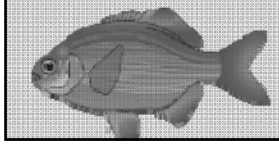
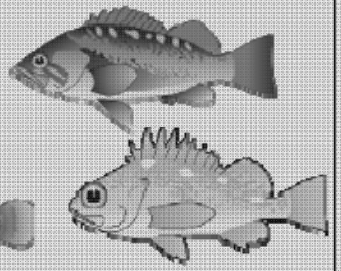
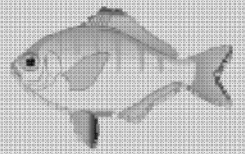
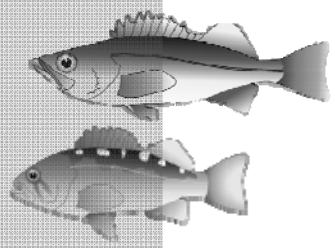
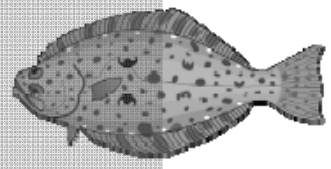
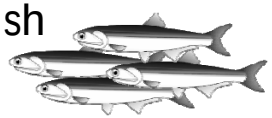
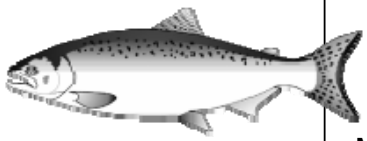
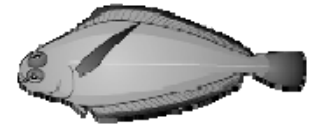
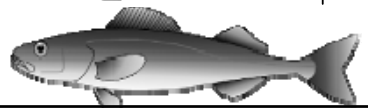
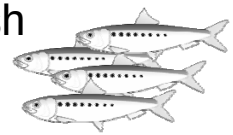
Master Plan Guidance for Size

- MPAs should have an alongshore span of 3-6 miles (5-10 kilometers or 2.5- 5.4 nautical miles) of coastline, and preferably 6-12.5 miles (10-20 kilometers or 5.4-11 nautical miles) - to protect adult populations, based on adult neighborhood sizes and movement patterns. Larger MPAs should be required to fully protect marine birds, mammals, and migratory fish.

- MPAs should extend from the intertidal zone to deep waters offshore – to protect the diversity of species that live at different depths and to accommodate the ontogenetic (age related) movement of individuals to and from nursery or spawning grounds to adult habitats.

Reserve Size and Species Protected

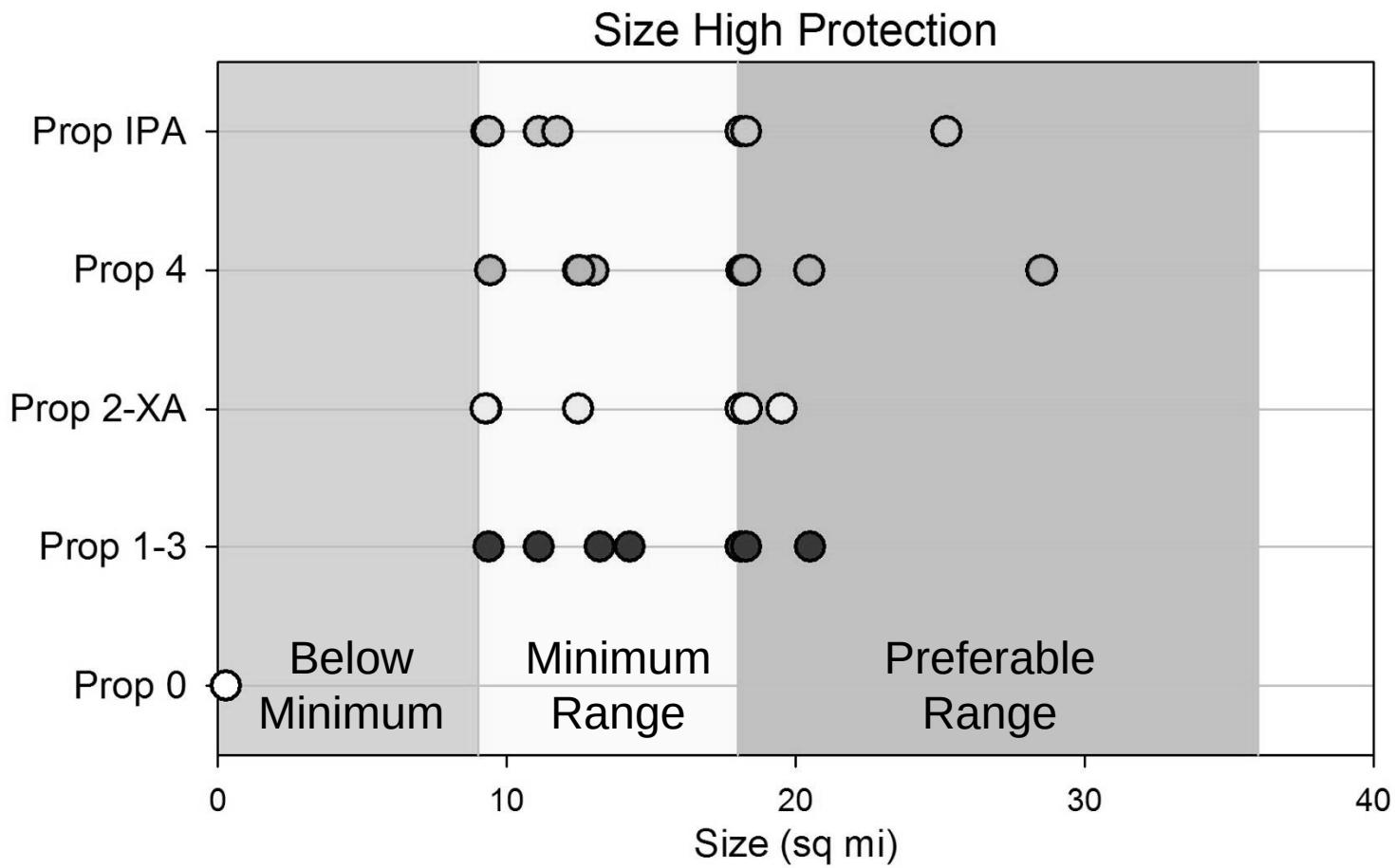
Adult Home Range Size

0 – 1 km	1 – 10 km	10 – 100 km	100 – 1000 km	> 1000 km
Many rockfish  Other reef fish  Some surfperch 	Some rockfish  Some surfperch 	Some rockfish  Other reef fish Some flatfish 	Few rockfish Some schooling fish  Salmon  More flatfish  	Some schooling fish  Tunas Many sharks

SAT Evaluation - Size

- Alongshore and offshore size guidelines are combined and simplified to yield an area guideline for evaluation
  - Minimum size range – 9-18 square miles
  - Preferred size range – 18-36 square miles
- Contiguous MPAs with different allowed uses are clustered together based on level of protection
- Replication is assessed at the three highest levels of protection: mod-high, high, and very high
- The area of each cluster is compared to the size guidelines

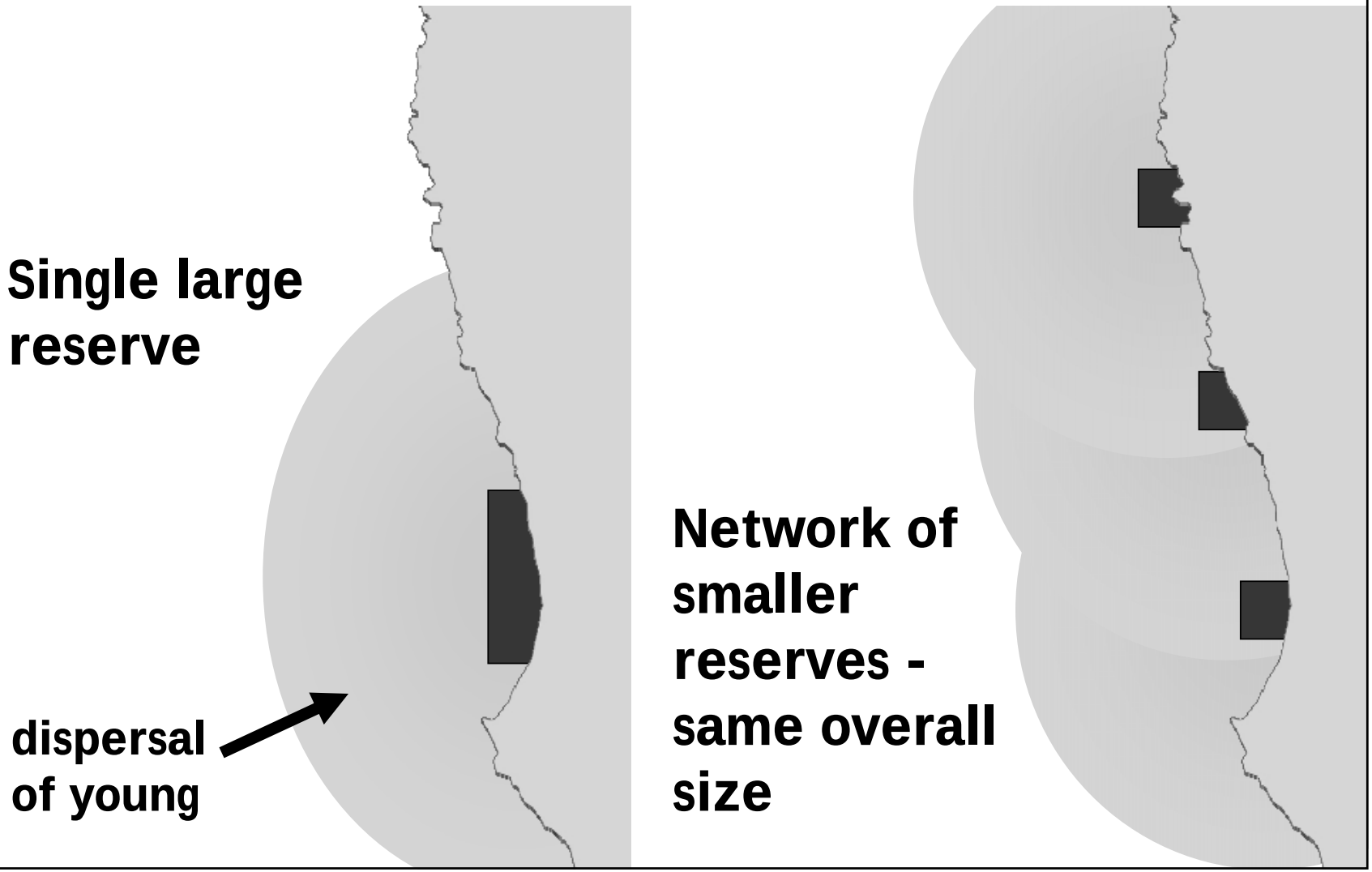
Example - Size



Master Plan Guidance for Spacing

- MPAs should be placed within 31-62 mi (50-100 kilometers or 27-54 nautical miles) of each other - to facilitate dispersal and connectedness of important bottom dwelling fish and invertebrate groups among MPAs, based on currently known scales of larval dispersal.

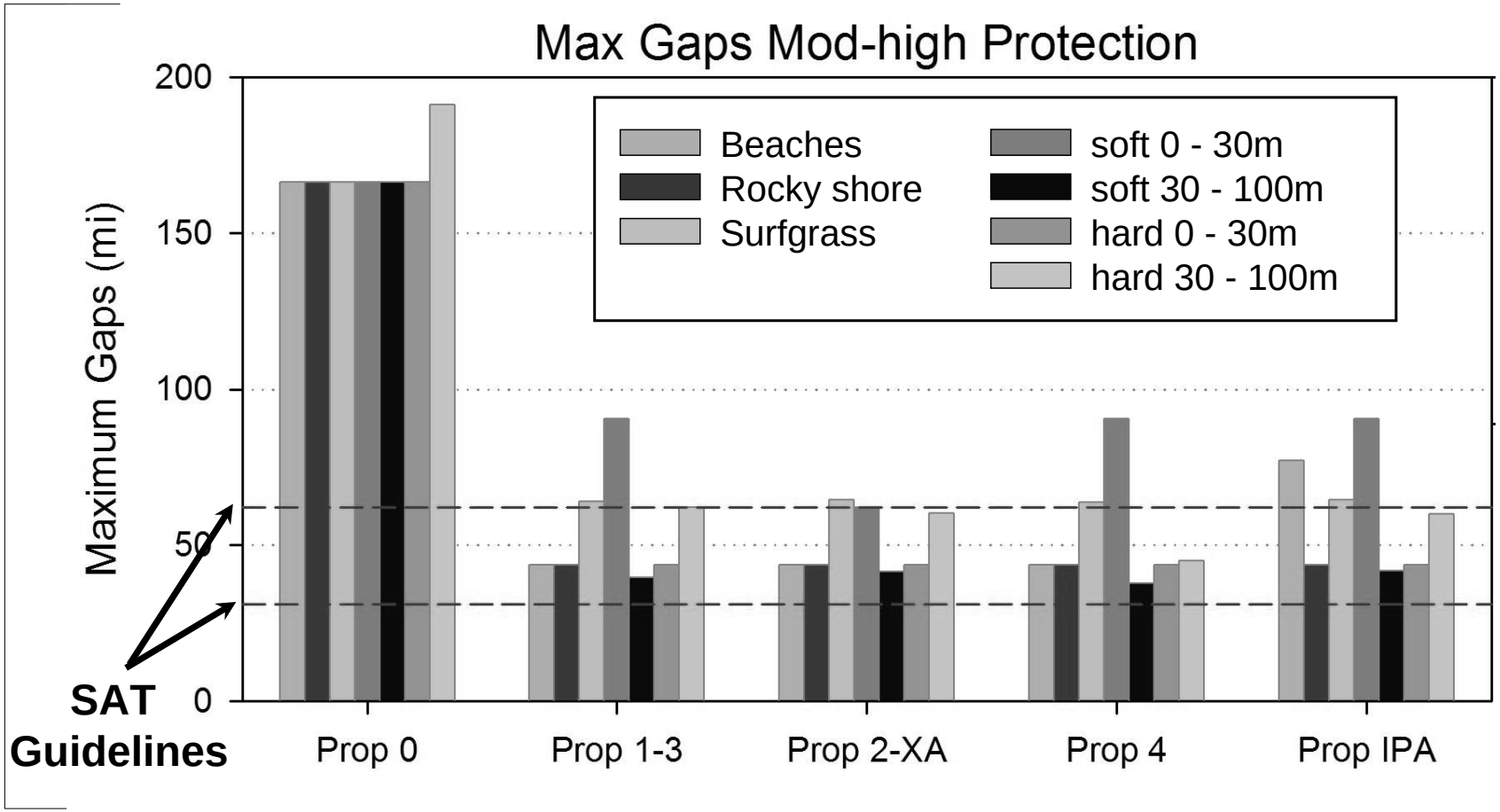
Characteristics of Larval Networks



SAT Evaluation - Spacing

- Spacing is designed to connect populations therefore:
  - MPA must contain enough appropriate habitat
  - MPA must be large enough to protect a population
- Only MPAs or MPA clusters that contain a replicate of a habitat are used in spacing analysis
  - MPA or cluster above minimum size
  - habitat protected sufficient to include 90% of biodiversity
- Spacing is conducted for each ‘key’ habitat

Example - Spacing

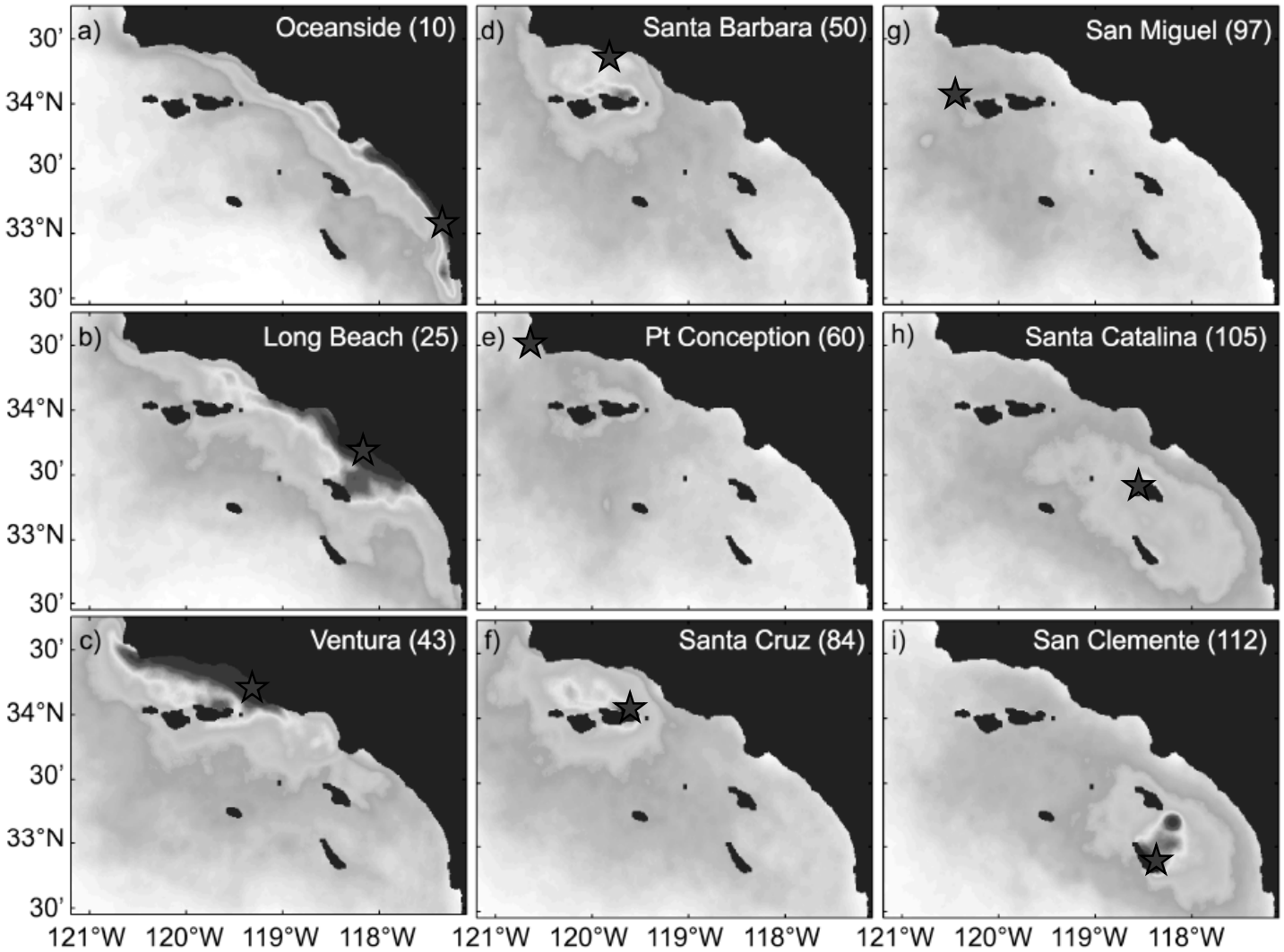


SAT Evaluation - Spacing

New Developments in the South Coast Study Region

- Oceanographic circulation models are helping the SAT assess complex patterns of larval connectivity in the study region, especially among islands
- Circulation models support straight-line spacing measurements between mainland MPAs
- Circulation models suggest that connectivity from islands to mainland is limited
- The SAT is considering how gaps in habitat distribution may impact spacing

Connectivity – 30 days dispersal



SAT Evaluation – Bioeconomic Models

- **Complex interactions:**
  MPA size and placement interacts with habitat, dispersal, home ranges, fisheries behavior to create complex spatial consequences.

- **Ecological component:**
  How will proposed MPAs affect the ecosystem and species that comprise it?

- **Bioeconomic component:**
  - Ecological predictions depend on economic behavior
  - MPA performance depends on fishery management outside MPAs

SAT Evaluation – Bioeconomic Models

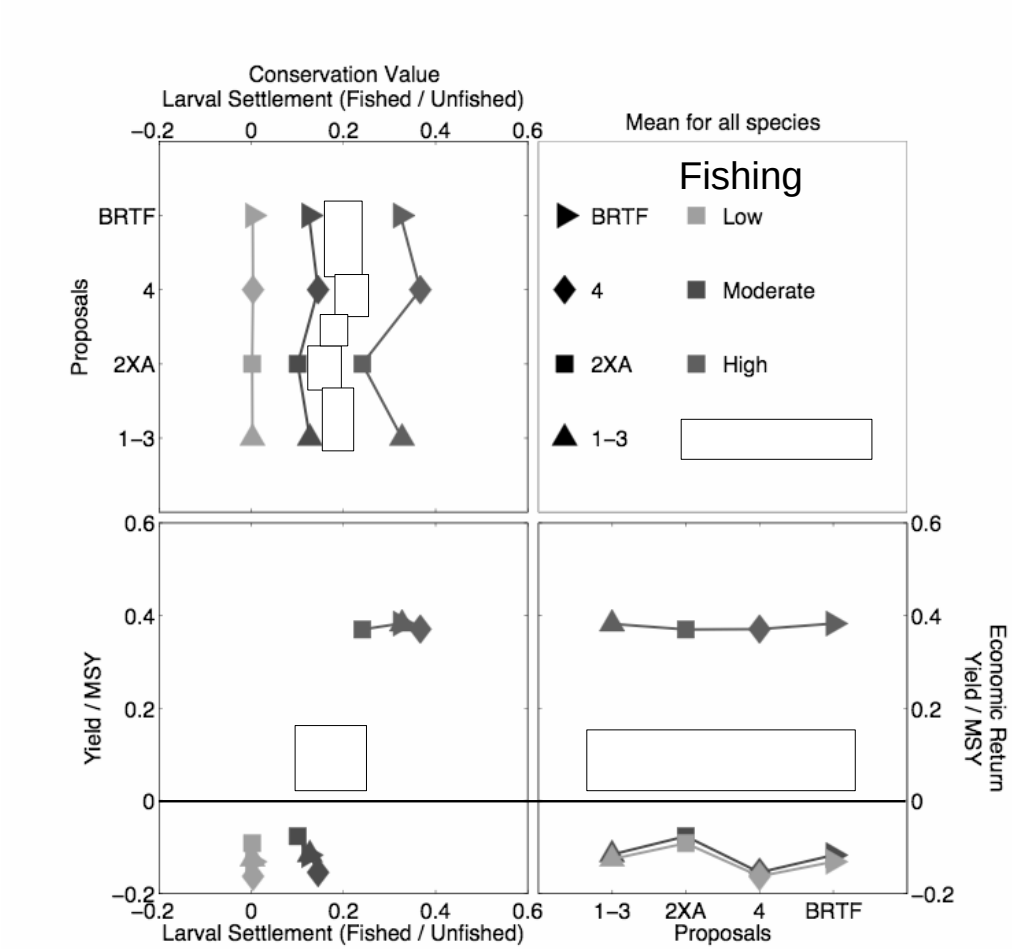
- Use spatially-explicit models to predict:
  - Biomass of different species across space
  - "Sustainability" of stock
  - Yield, Effort and Profit across space
  - Change from status quo

- Key attributes:
  - Oceanographic and habitat patterns
  - Larval dispersal
  - Adult movement
  - Parameterized for a range of life histories and habitat associations
  - Fleet behavior in response to proposed MPAs

Example – Bioeconomic Models

Conservation Value
(measured relative to unfished state)

Economic Value
(measured relative to maximum sustainable yield)



SAT Evaluation – Bioeconomic Models

New Developments in the South Coast Study Region

- Oceanographic circulation models informing larval dispersal
- Socioeconomic information for the study region
- Additional species, including those specific to the study region, across a representative range of life history traits

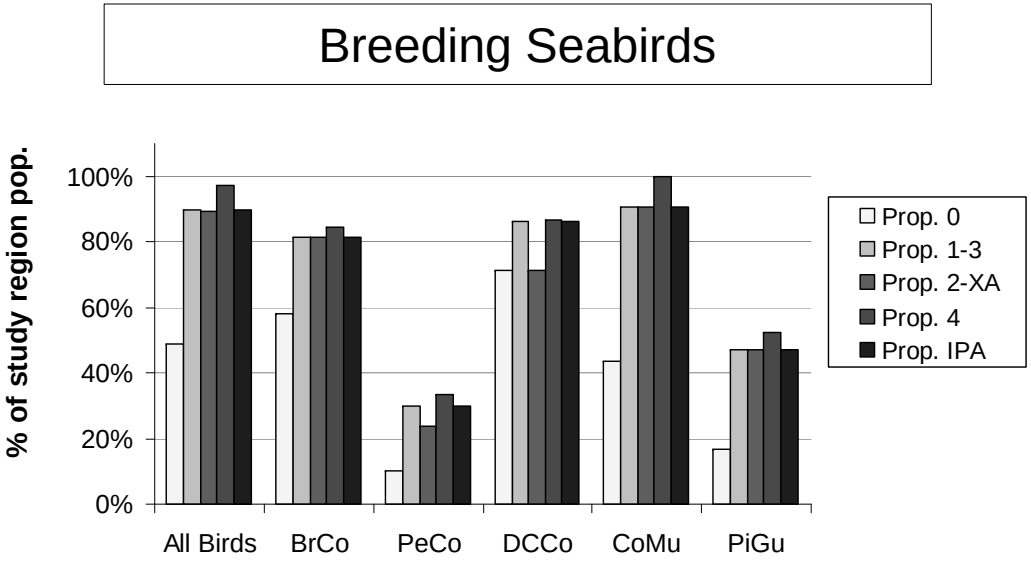
SAT Evaluation – Birds & Mammals

- MPAs can benefit marine birds and mammals by:
  - protecting forage base
  - reducing human disturbance to breeding sites, haul-outs, and roosts
- Special closures are specifically designed to reduce human disturbance at sensitive breeding sites, haul-outs and roosts
- Species that use a small near-shore forage base and/or breed in the study region are most likely to benefit from MPAs and special closures

SAT Evaluation – Birds & Mammals

- Identify proposed MPAs or special closures that contribute to protection of birds and mammals
- Identify focal species likely to benefit from MPAs and for which data are available
- Analyze the proportion (of total numbers of individuals) of breeding bird/mammal at colonies and rookeries potentially benefiting by proposed MPAs
- Analyzes the proportion of nearby foraging areas protected by MPAs, defined by evaluating protection of buffered areas around colonies and at sea foraging hotspots

Example – Birds & Mammals



SAT Guidance – Water Quality

- No guidance provided by the MLPA on how to consider water quality in siting MPAs
- The master plan states: "Placement of MPAs should take into account the adjacent terrestrial environment and associated human activities."
- SAT identifies and maps areas of water quality concern
  - power-plant intakes and discharges
  - storm water discharges
  - waste water discharges
- SAT identifies areas of water quality opportunity
  - Areas of special biological significance

SAT Evaluation – Water Quality

New Developments in the South Coast Study Region

- **No water quality evaluation done in previous study regions**
- **The SAT is developing methods to evaluate MPA proposals with respect to water quality** (for round 2)
  - **avoidance of water quality concern areas**
  - **inclusion of water quality opportunity areas**
- **Water quality is a secondary consideration in MPA design, as the MLPA does not regulate water quality**

Summary

- SAT is starting with the guidelines and evaluation methods developed in previous study regions
- Recognizing differences between the south coast study region and central coast/north central coast study regions, SAT is considering modifications for design guidance and proposal evaluation
- Continued discussion between SCRSG and SAT is key and greatly appreciated