



# Marine Life Protection Act Initiative



## **SAT Evaluations of Draft MPA Proposals North Central Coast Study Region**

**Presentation to the MLPA North Central Coast Regional Stakeholder Group**

**February 21, 2008 • San Rafael, CA**

**Presented by Dr. Mark Carr**



# Master Plan Science Advisory Team



MLPA Goals



Habitat Representation



Habitat Replication



Birds and Mammals

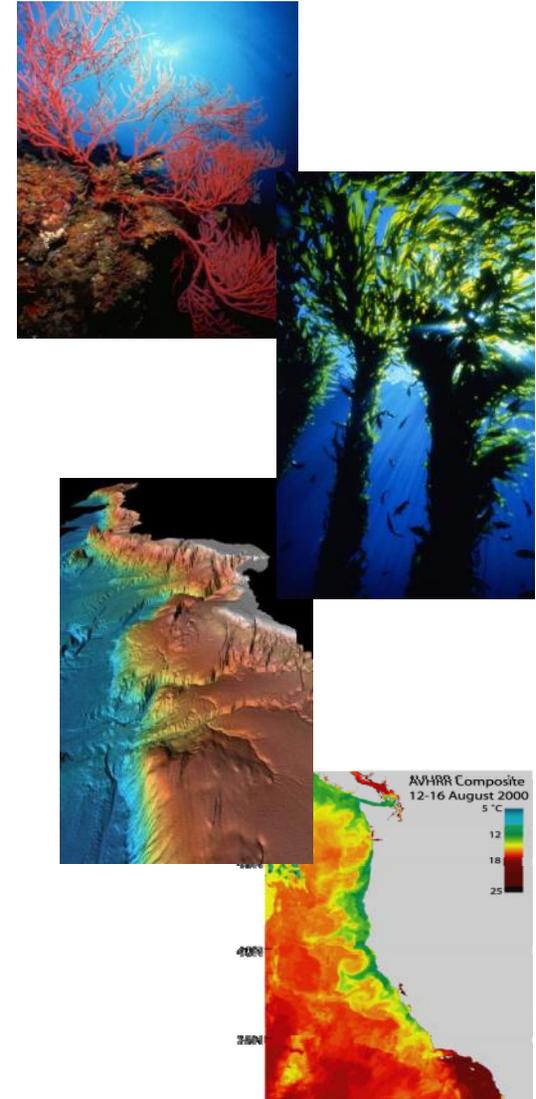


Size and Spacing (+ models)



# MLPA Goals

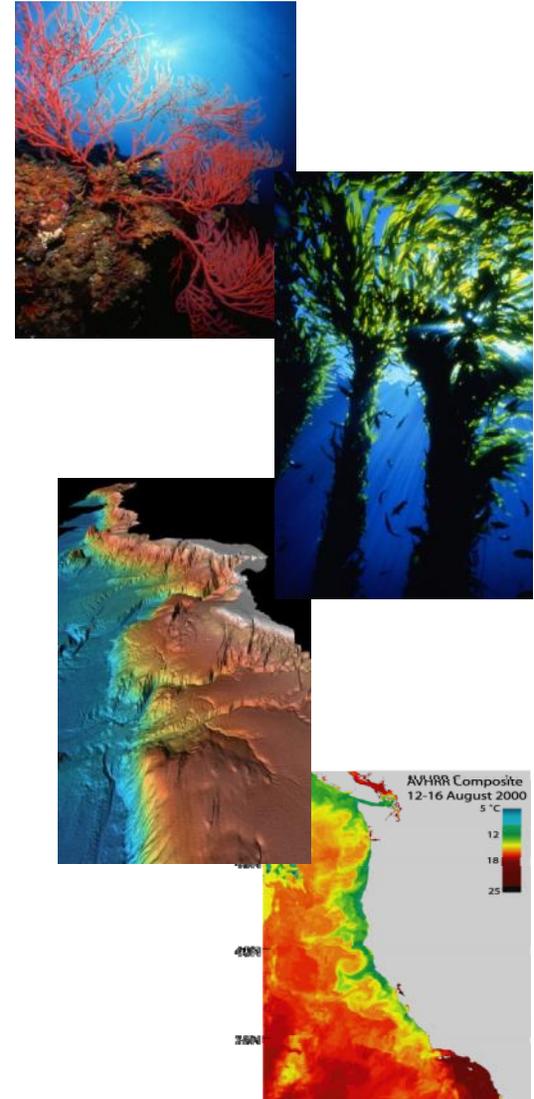
1. To protect the natural diversity and function of **marine ecosystems**.
2. To help sustain and restore **marine life populations**.
3. To improve **recreational, educational, and study opportunities** in areas with minimal human disturbance.
4. To protect representative and unique **marine life habitats**.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





# MLPA Goals: Habitats

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# Evaluation: Habitats

## Key Questions for Each Proposal

1. How well are key habitat types represented in proposed MPA proposals?
2. What are the proposed levels of protection for these habitat types?
3. How well are habitats and levels of protection distributed across the study region?



# SAT Guidelines: Levels of Protection

	Level of Protection	MPA Types	Activities Associated with this Protection Level
	Very high	SMR	No take
	High	SMCA	<b>salmon</b> (troll H&L in water greater than 50m depth), <b>sardine, anchovy, and herring</b> (pelagic seine)
	Mod-high	SMCA	<b>salmon</b> (troll H&L in water less than 50m depth)*, <b>Dungeness crab</b> (traps/pots), <b>squid</b> (pelagic seine)
	Moderate	SMCA SMP	<b>salmon</b> (non-troll H&L), <b>abalone</b> (diving), <b>halibut, white seabass, striped bass, shore-based finfish and flatfishes</b> (H&L), <b>clams</b> (hand harvest), <b>giant kelp</b> (hand harvest)
	Low-mod	SMCA SMP	<b>Urchin</b> (diving), <b>lingcod, cabezon, greenling, rockfish, and other reef fish</b> (H&L), <b>surfperches</b> (H&L), <b>mariculture</b>
	Low	SMCA SMP	<b>bull kelp and mussels</b> (any method), <b>all trawling, giant kelp</b> (mechanical harvest)

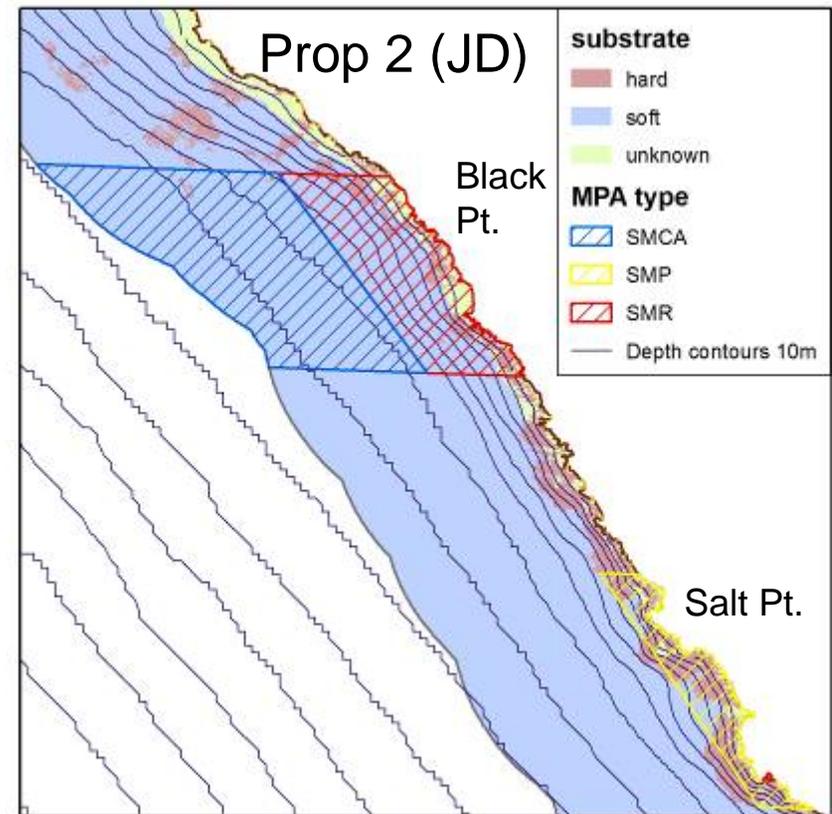
\* Note the BRTF voted to keep this mod-high LOP on Feb 14, 2008



# Results: Habitat Representation

## Similarities between proposals

-  similarities in number and location of MPAs as well as the habitats they include
-  size of MPAs varies
-  clusters of MPAs with an inshore SMR and offshore SMCA that allows various fishing activities
-  shoreline and shallow habitats are generally well represented in very high protection MPAs

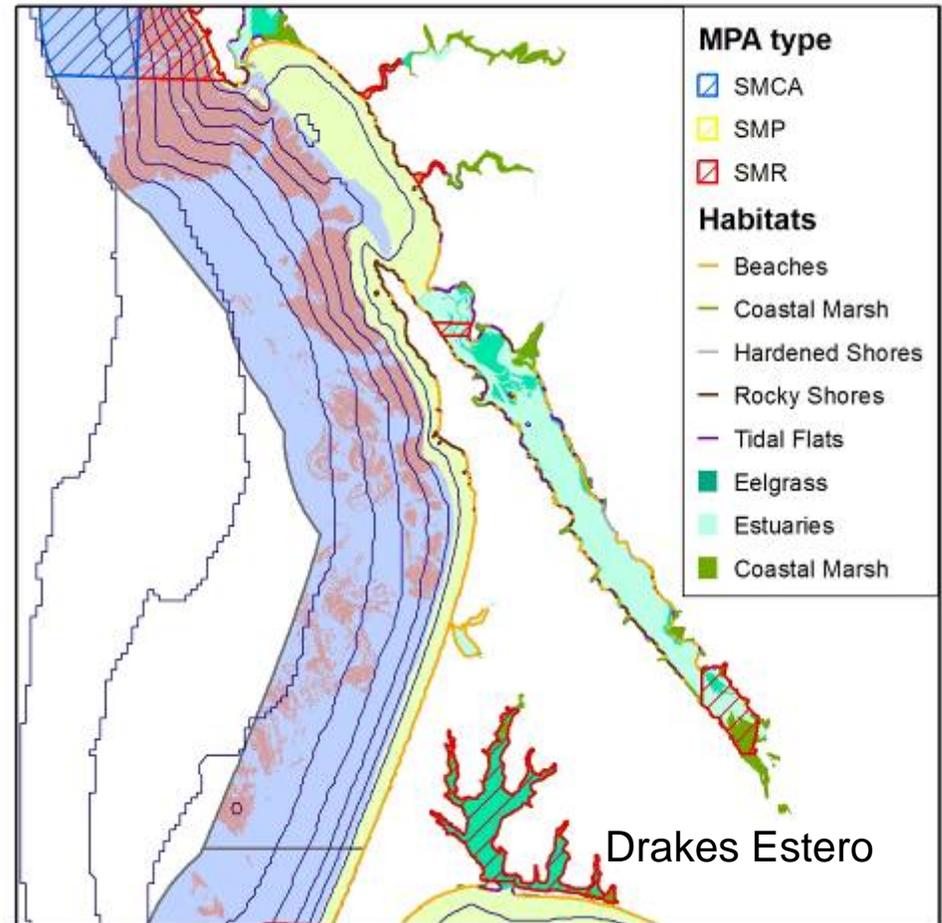




# Results: Habitat Representation

## Similarities between proposals

-  estuarine habitats are generally well represented in very high protection MPAs
-  most proposals still protect a greater portion of these habitats in the south subregion (Drakes Estero)
-  In contrast to the last round, most proposals target small estuaries in both north and south





# Results: Habitat Availability

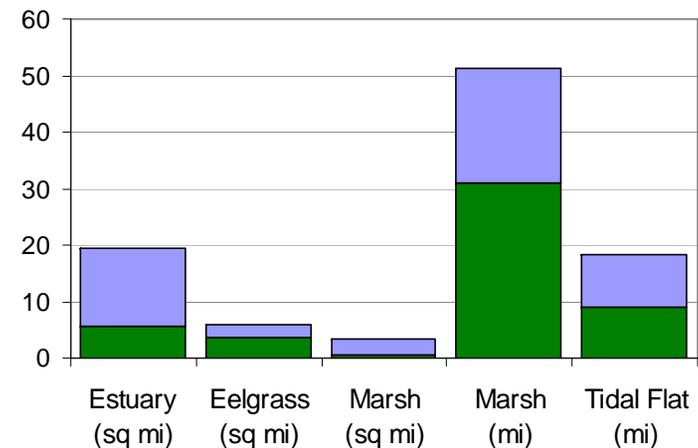
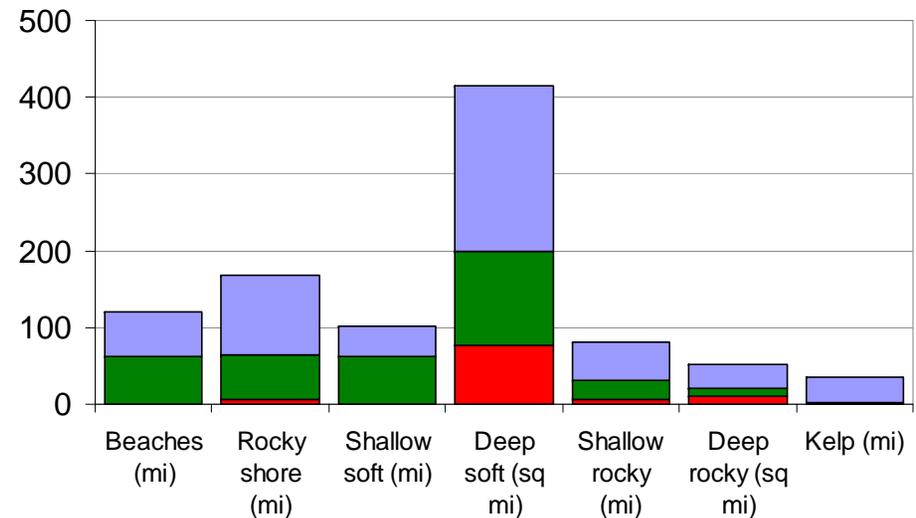
Deep soft bottom is the most abundant habitat in all subregions

More rocky shore and shallow rocky reef in the north subregion

More shallow soft bottom in the south subregion

Kelp is only mapped in the north subregion

More estuarine area in the north, but more eelgrass in the south



Farallones South North



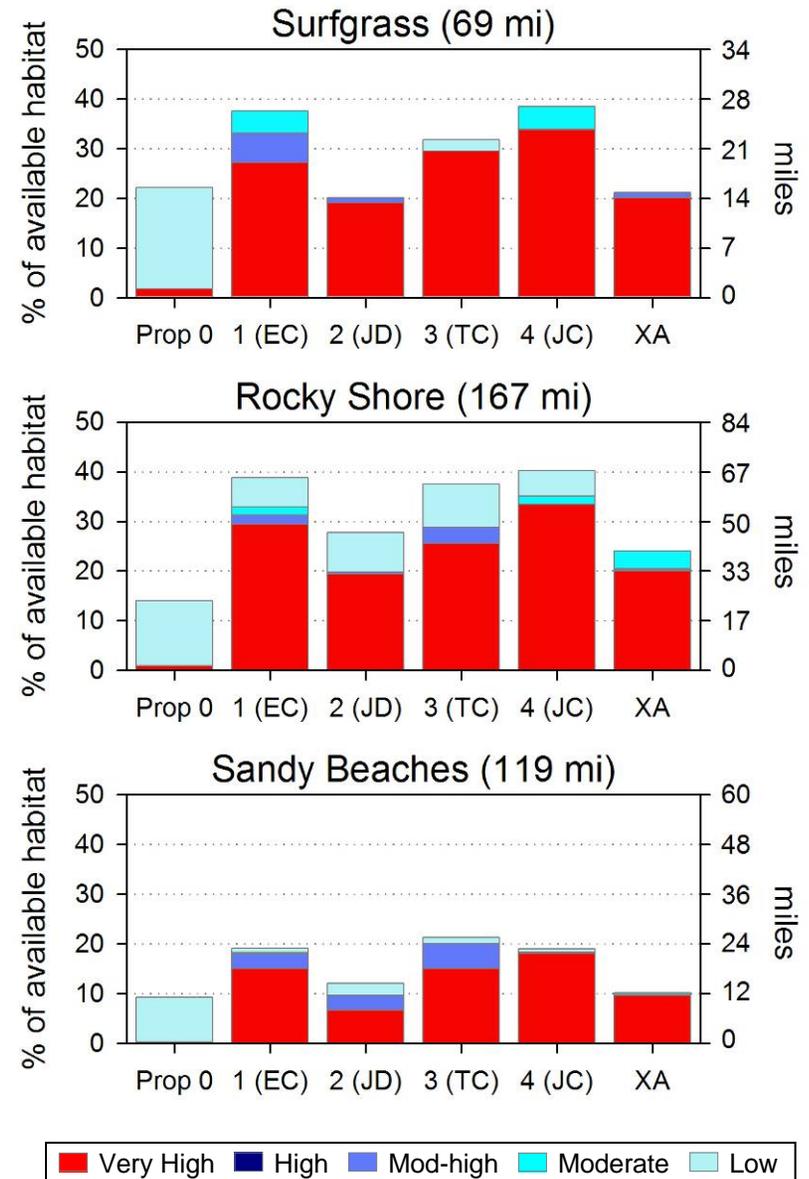
# Results: Habitat Representation

## Shoreline Habitats

Most proposals have at least 20% of rocky shore and surfgrass at very high protection, while allowing some shorefishing, abalone and urchin harvest.

Protection of sandy beach is generally lower than protection of rocky shoreline

Inclusion of **mod-high** protection affects sandy beach representation in 3 proposals (allow crabbing)





# Results: Habitat Representation

## Rock Habitats

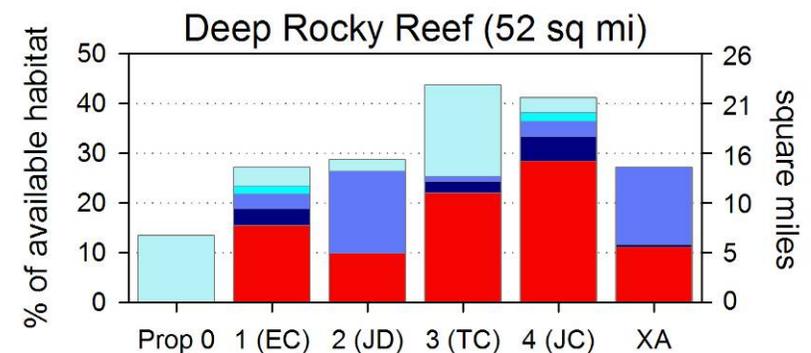
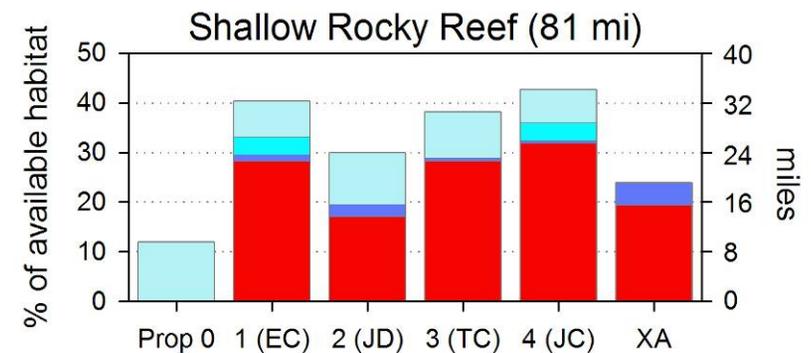
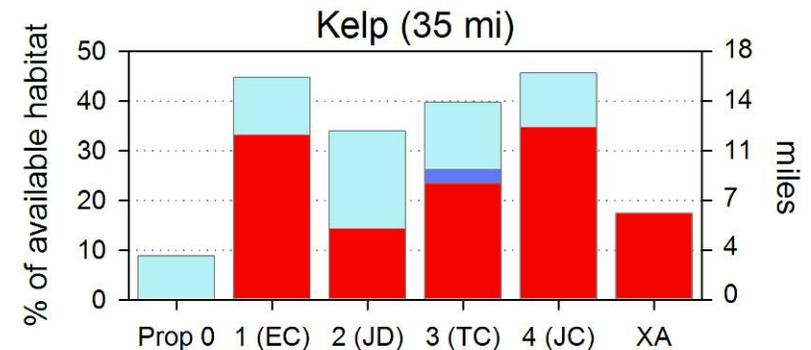
A high proportion of protected areas are in SMRs

Protection of kelp closely mirrors protection of shallow rock

Draft Proposal 4 (JC) protects the greatest proportion of all three rocky habitats above mod-high

Large areas of deep rock in **high** and **mod-high** protection due to salmon and crabbing

Some shallow rock and kelp areas in **moderate** due to shorefishing and abalone and **low** due to urchin harvest



Very High High Mod-high Moderate Low



# Results: Habitat Representation

## Soft Bottom Habitats

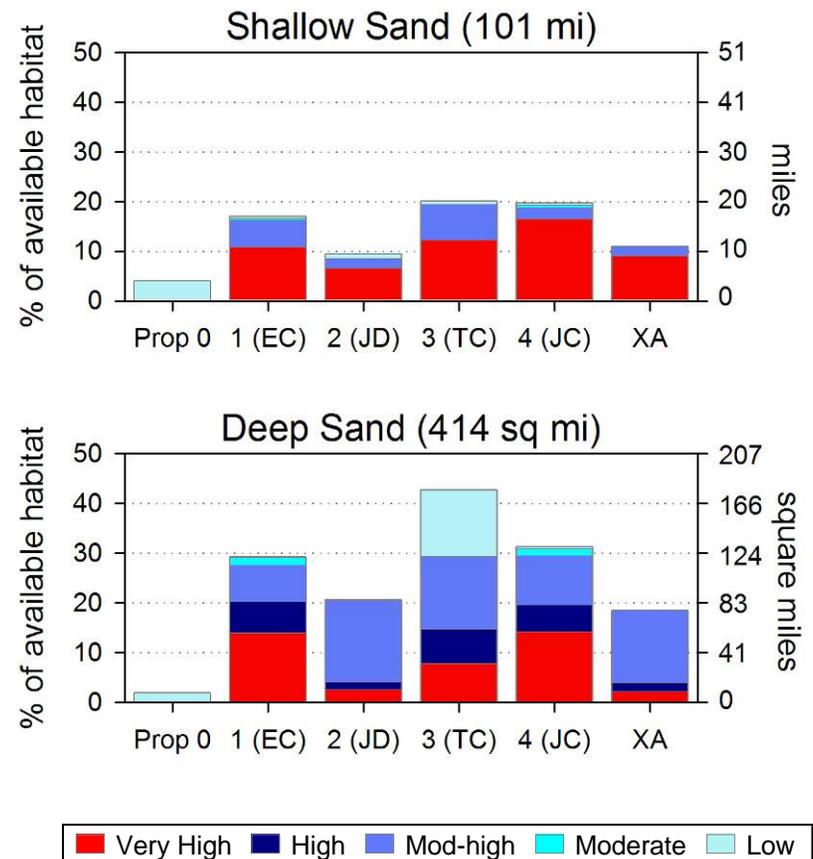
Lower representation of soft bottom habitats relative to rocky habitats

A high proportion of the protected shallow sand area is in SMRs

Some shallow sand areas in **mod-high** protection due to salmon and crab fishing

Large areas of deep sand in **high** protection due to deep water salmon trolling and **mod-high** protection due to crabbing

Low percentages but large areas of deep sand under protection



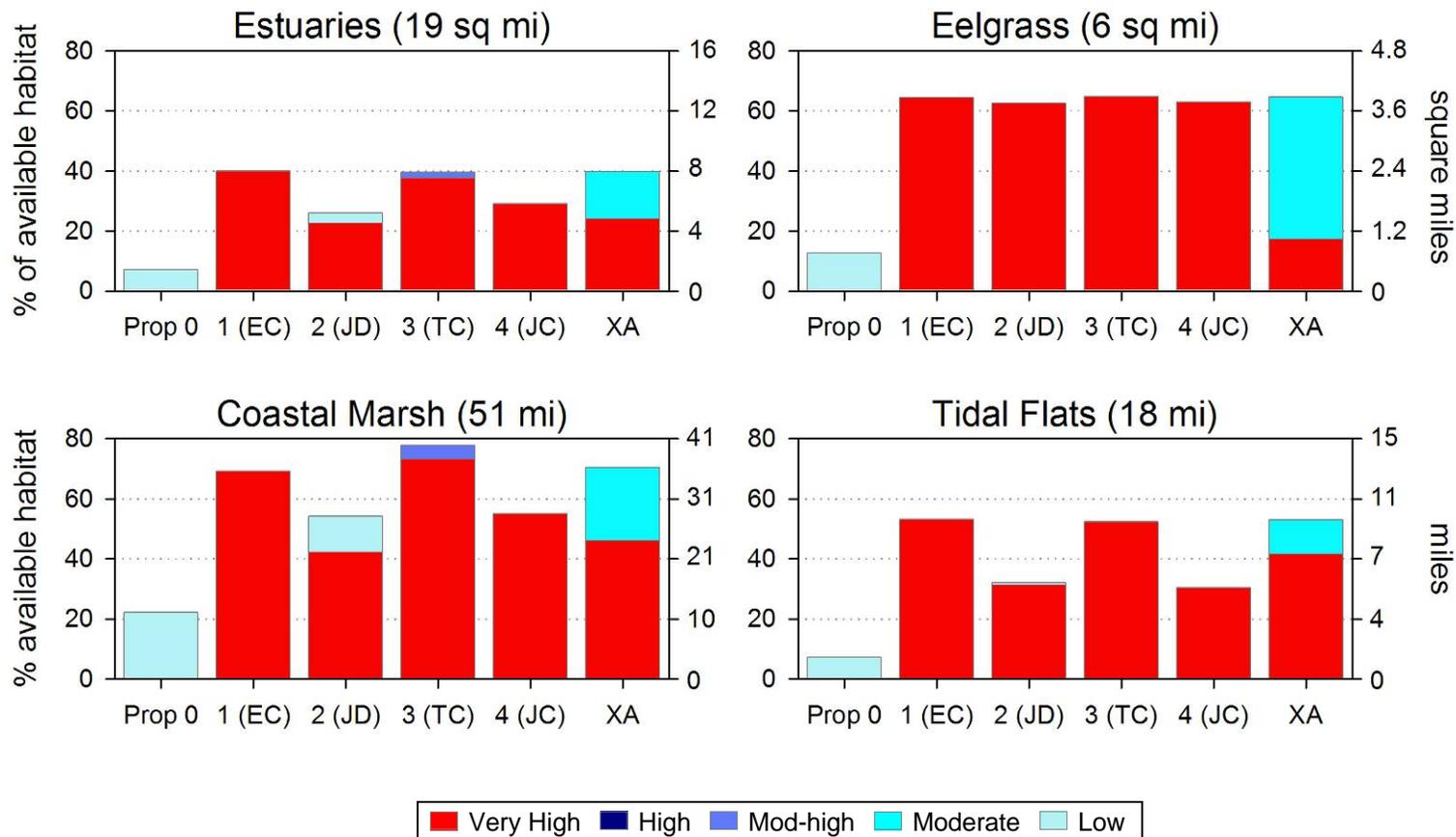


# Results: Habitat Representation

## Estuarine Habitats

Large proportions of estuarine habitats are included in SMRs

**Mod-high** protection is due to crabbing, **moderate** due to aquaculture





# Results: Habitat Representation

## Summary



Some convergence among proposals in second round



With the exception of estuarine habitats, proposals differed consistently across habitats in area protected (especially with high protection)

$$4 > 1,3 > 2, XA > 0$$



Many habitats are well represented in high levels of protection



Habitats varied markedly in allowed uses and the relative representation of levels of protection

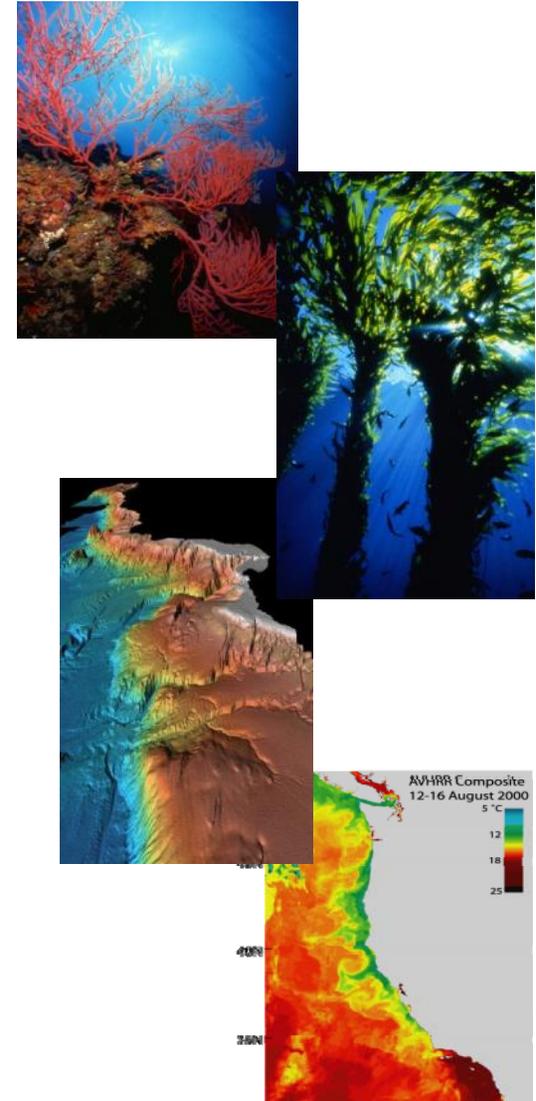


Soft habitats still not as well represented as rock habitats



# MLPA Goals: Populations

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# Results: Marine Birds



## **Breeding colonies by subregion**

**North:** Draft Proposal 3 covers most species/gross numbers

**South:** Draft proposals 1 and 4 include most seabirds

**Farallon Is:** Draft proposals 1, 3 and 4 include most seabirds



## **Seabird roosts by subregion**

**North:** Draft Proposal 3 includes most roosts

**South:** Draft Proposal 1 includes most roosts

**Farallon Is:** Draft proposals 1, 3, 4 and external A include most roosts



## **Seabird foraging areas by subregion**

Draft Proposal 3 rated highest and Draft Proposal 2 lowest



# Results: Marine Mammals



## Marine mammal rookeries by subregion

**North :** All draft proposals include 22-24% of pinnipeds, except Draft Proposal 3 (10%)

**South:** Draft proposals 1 and 3 include >90%

**Farallon Is:** Draft proposals 1, 3 and 4 include all (4 species) breeding pinnipeds (Draft Proposal 2 includes zero species and Draft External Proposal A includes two species).



## Marine mammal haul-outs by subregion

**North:** Ranges from 8% (Draft Proposal 3) to 19% (Draft Proposal 1) of population in proposed MPAs

**South:** Draft proposals 1, 3 and 4 include >80% of pinnipeds

**Farallon Is:** All draft proposals include >96% of pinnipeds. All pinnipeds at haul-outs included except 50% of Steller sealion population in Draft Proposal 2 and Draft External Proposal A



# Size Analysis Methods



Measure individual MPA lengths and area



Combine contiguous MPAs into single MPA complexes



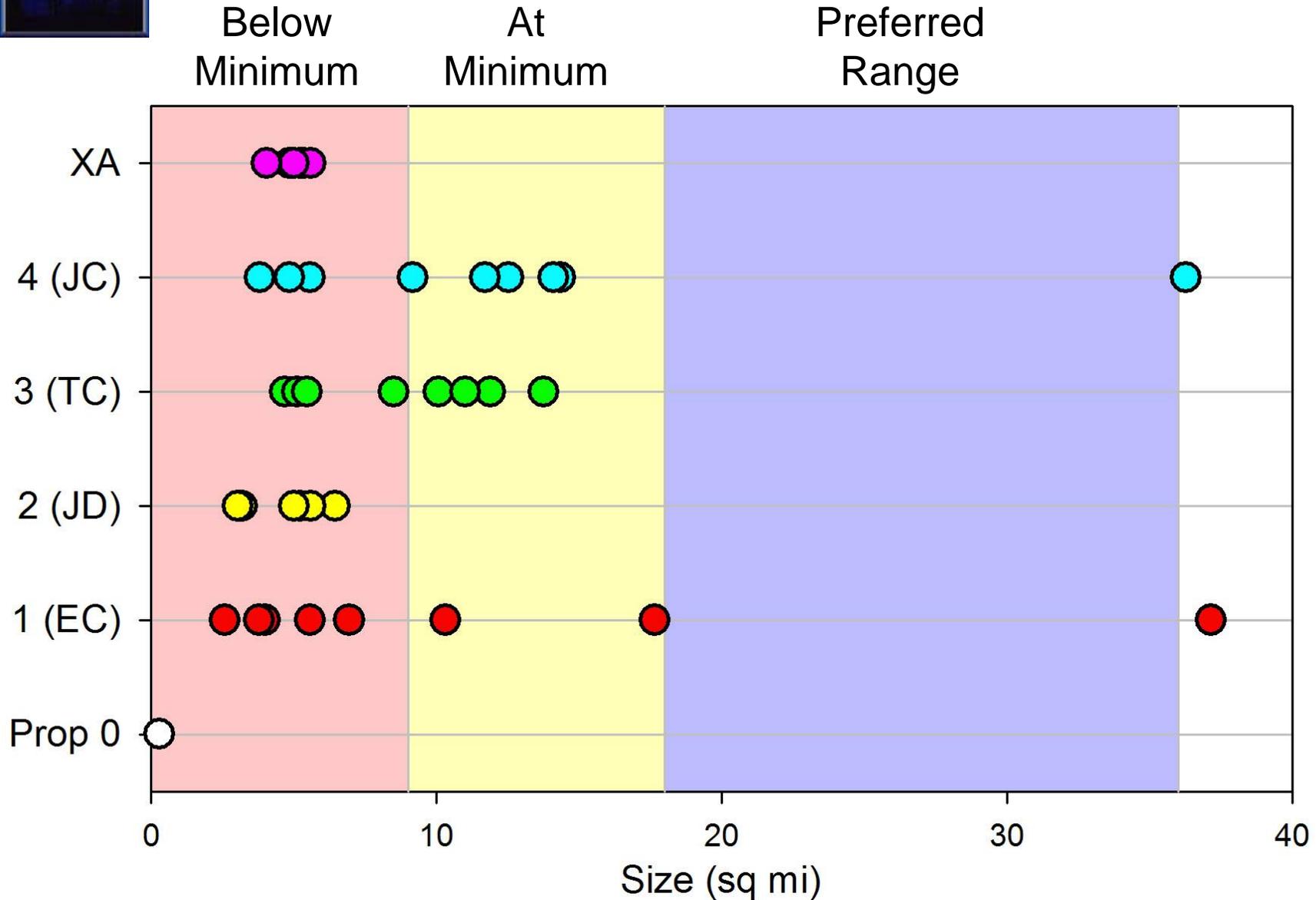
Consider level of protection



Tabulate MPA lengths and areas relative to minimum & preferred guidelines

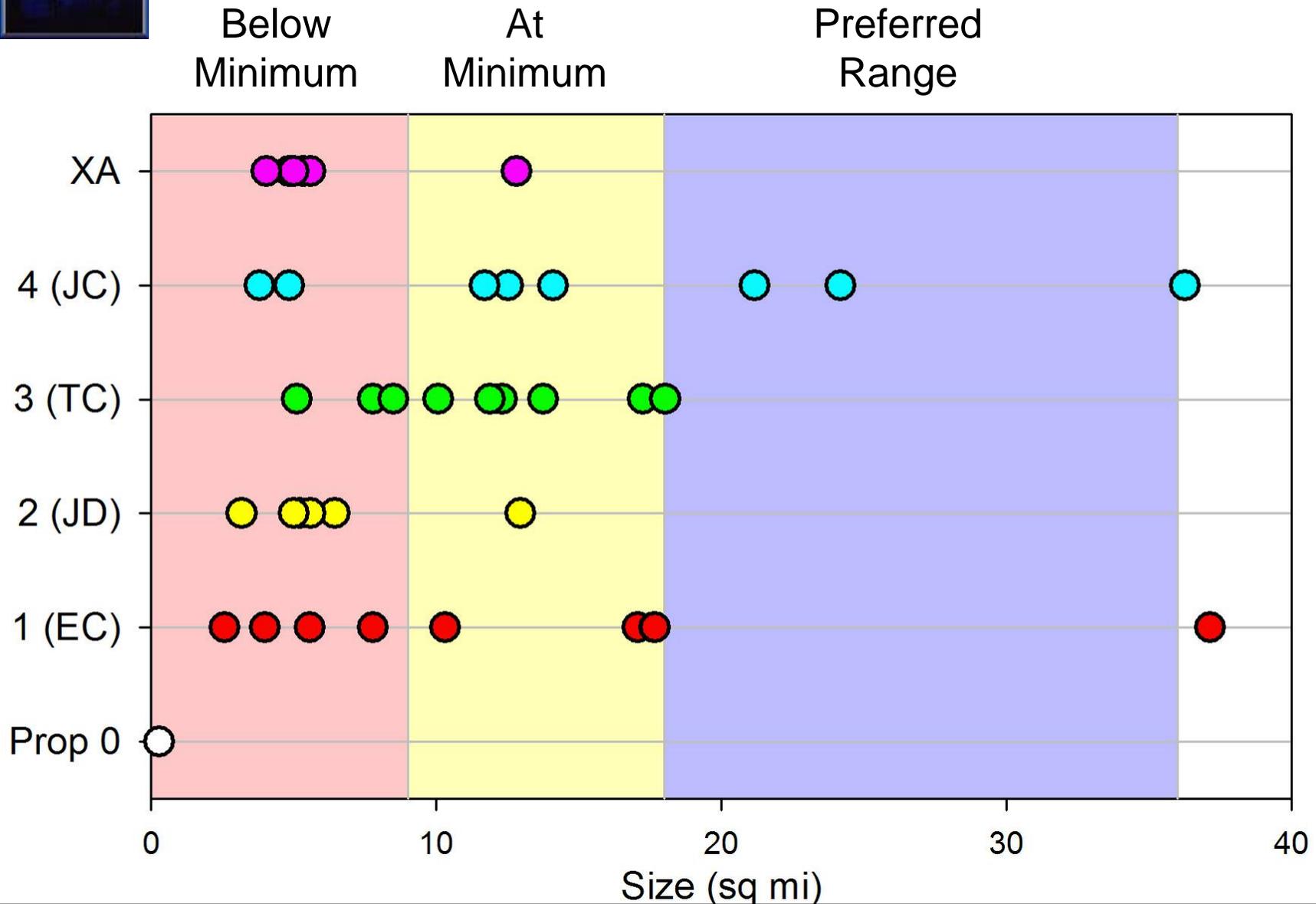


# Cluster Sizes: Very High Protection



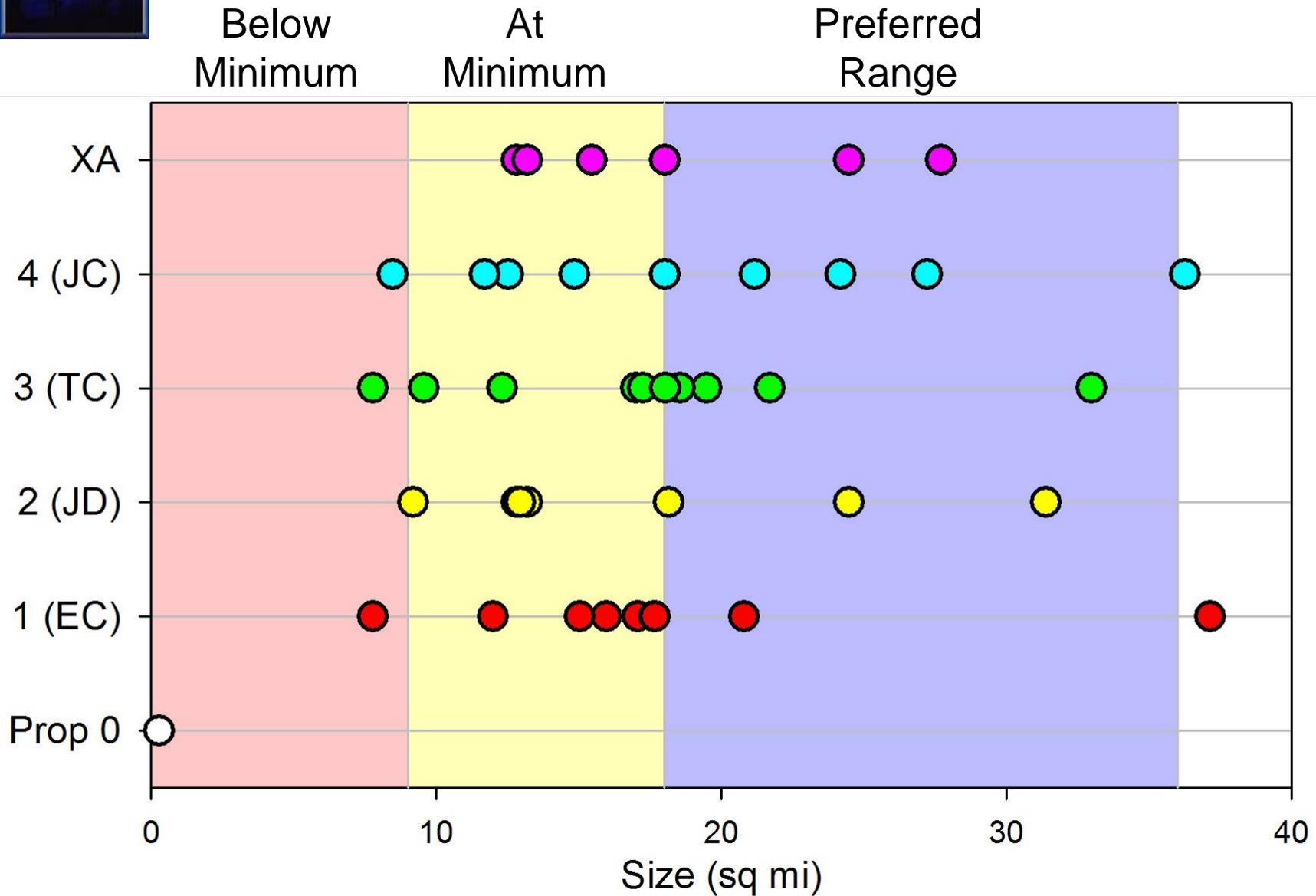


# Cluster Sizes: High Protection





# Cluster Sizes: Mod-high Protection





# MPA Size Conclusions

## With **Very High Protection:**

- Draft proposal 4 (67%) is the most consistent with the size guidelines. 4 has one reserve in the preferred size range.
- Draft proposals 3 (50%) and 1 (38%) have an intermediate fraction of reserves that meet the minimum size guidelines.
- Draft proposals 2 and external A have no marine reserves that meet the size guidelines.

## With **High Protection:**

- All proposals increase the fraction of reserves that meet at least minimum guidelines.
- The ordering of proposals remains the same.



# MPA Size Conclusions

## With **Moderate High Levels of Protection:**

- Nearly all MPA clusters in all proposals meet at least the minimum size guidelines.
- Draft Proposals 4 and 3 have the most MPA clusters in the preferred size range.



# Spacing Analysis Methods



MPAs must meet the minimum size guidelines (9 square miles) to count for spacing



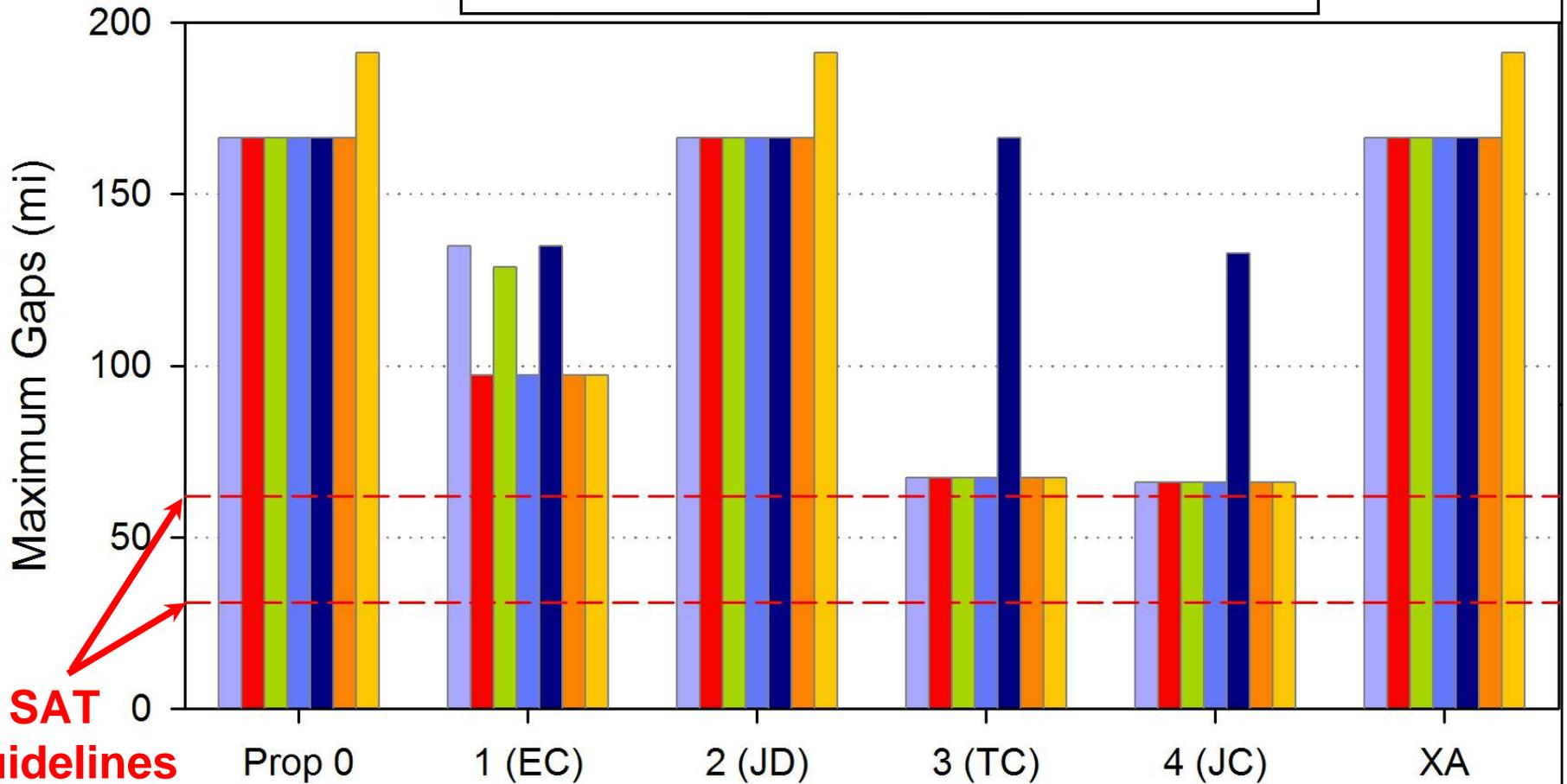
Characterize each MPA by the habitats included



For each habitat, measure the gaps between adjacent MPAs

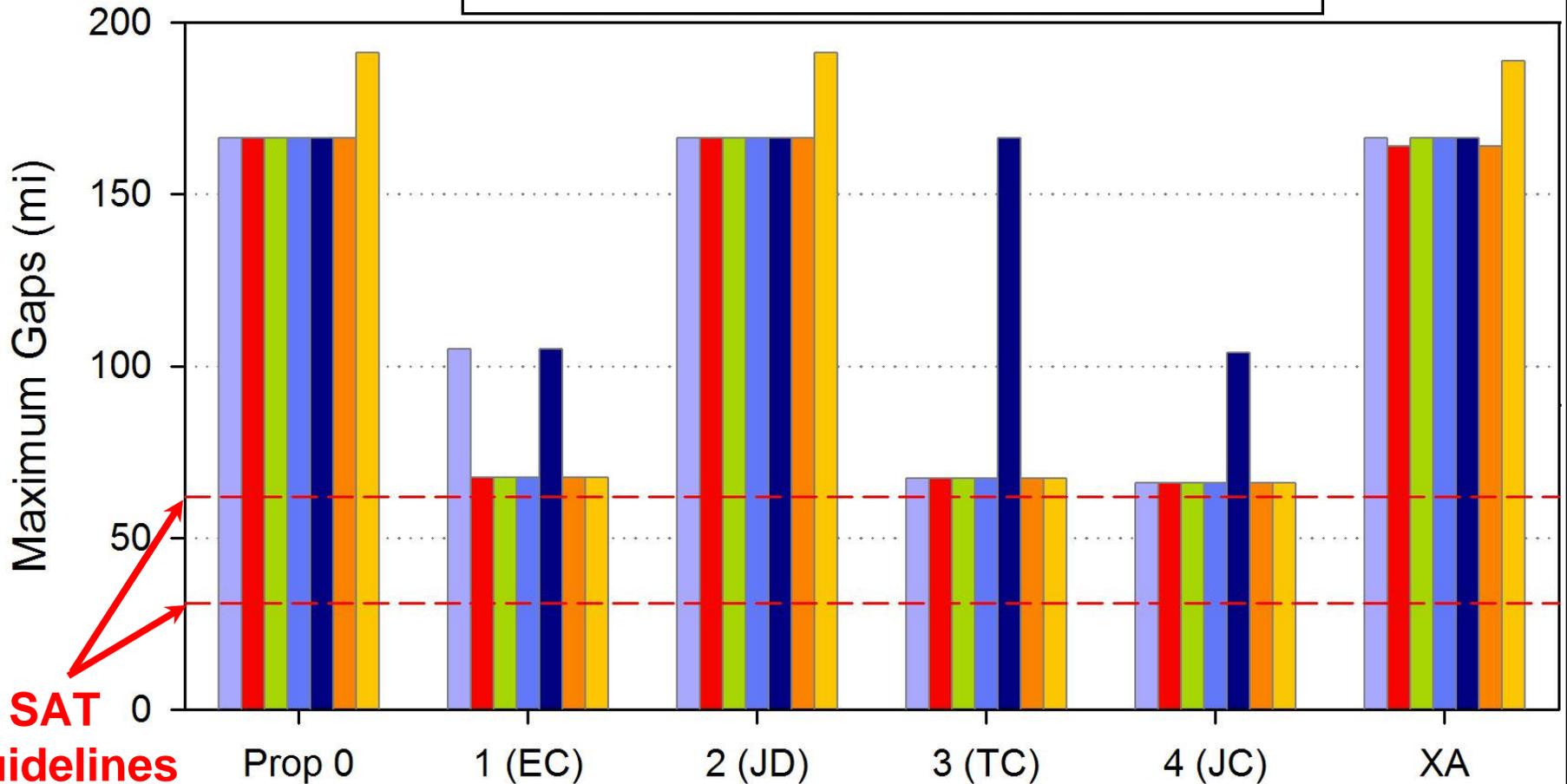


# Max Gaps: Very High Protection





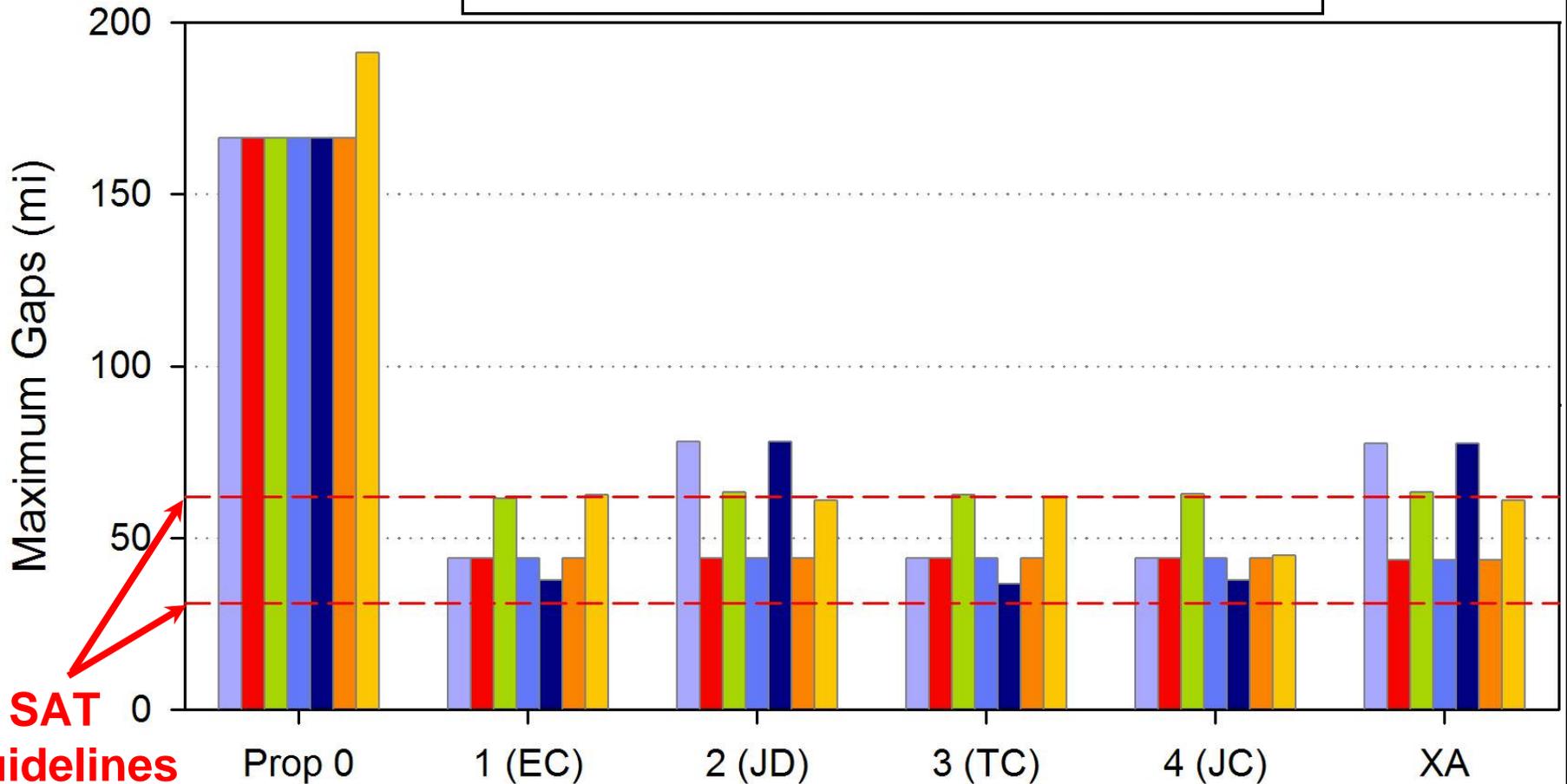
# Max Gaps: High Protection



**SAT**  
**Guidelines**



# Max Gaps: Moderate-high Protection





# MPA Spacing Conclusions

## With **Very High Protection:**

- Draft proposals 4 and 3 were close to meeting the spacing guidelines for all habitats except deep sand.
- Draft proposals 1, 2 and external A greatly exceeded the spacing guidelines for all habitats. In this group, the maximum gaps for Draft Proposal 1 were consistently smaller than those for 2 and external A

## With **High Protection:**

- All patterns remain unchanged *except*. Draft Proposal 1 now meets the spacing guidelines for all habitats except sandy beach and deep sand.



# MPA Spacing Conclusions

## With **Moderate High Levels of Protection:**

- Draft proposals 4, 3 and 1 meet the spacing guidelines for all habitats. Maximum gaps are in the middle of the recommended range for most habitats.
- Draft proposals 2 and external A meet the spacing guidelines for all habitats except two: sandy beaches and deep sand.



# Methods: Habitat Replication

## Guidelines for replication:



MPA or cluster must meet the minimum size guidelines (9 square miles)



Habitat must meet the threshold identified to encompass 90% of biodiversity in that habitat type



Estuarine MPAs do not have to meet size guidelines but must contain at least 0.12 mi<sup>2</sup> of estuarine habitat

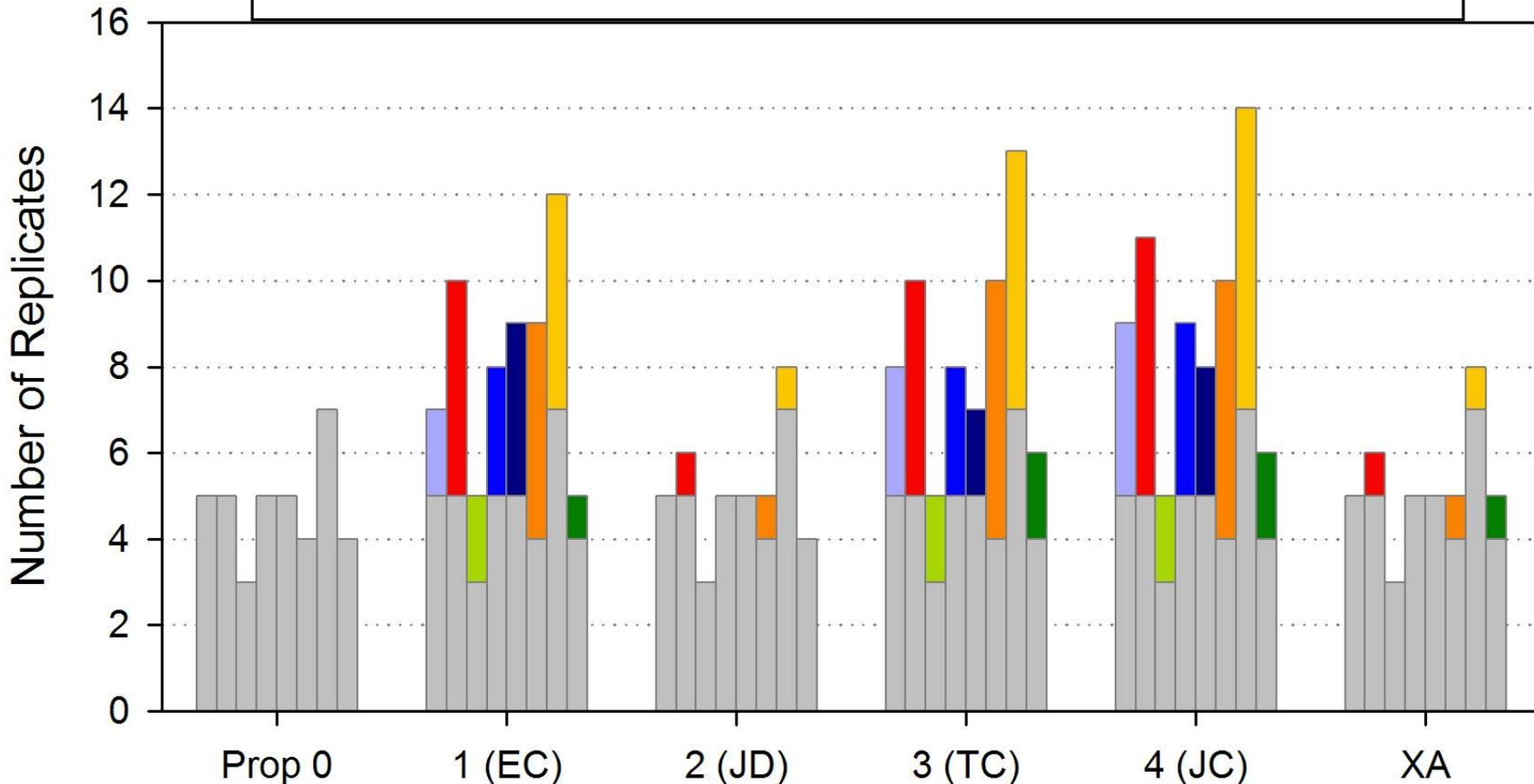
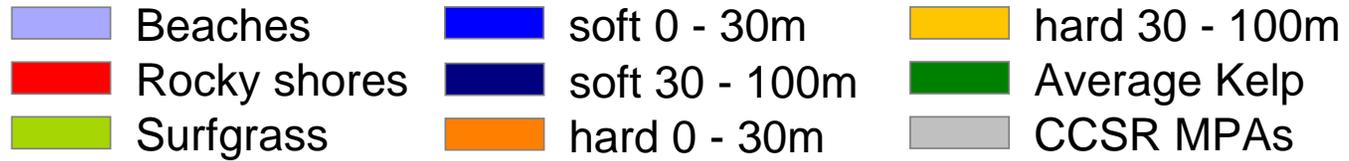


Some small estuaries (Gualala and Garcia rivers, Pescadero Creek) contain less than the minimum 0.12 mi<sup>2</sup>, but protection of these habitats still has conservation value



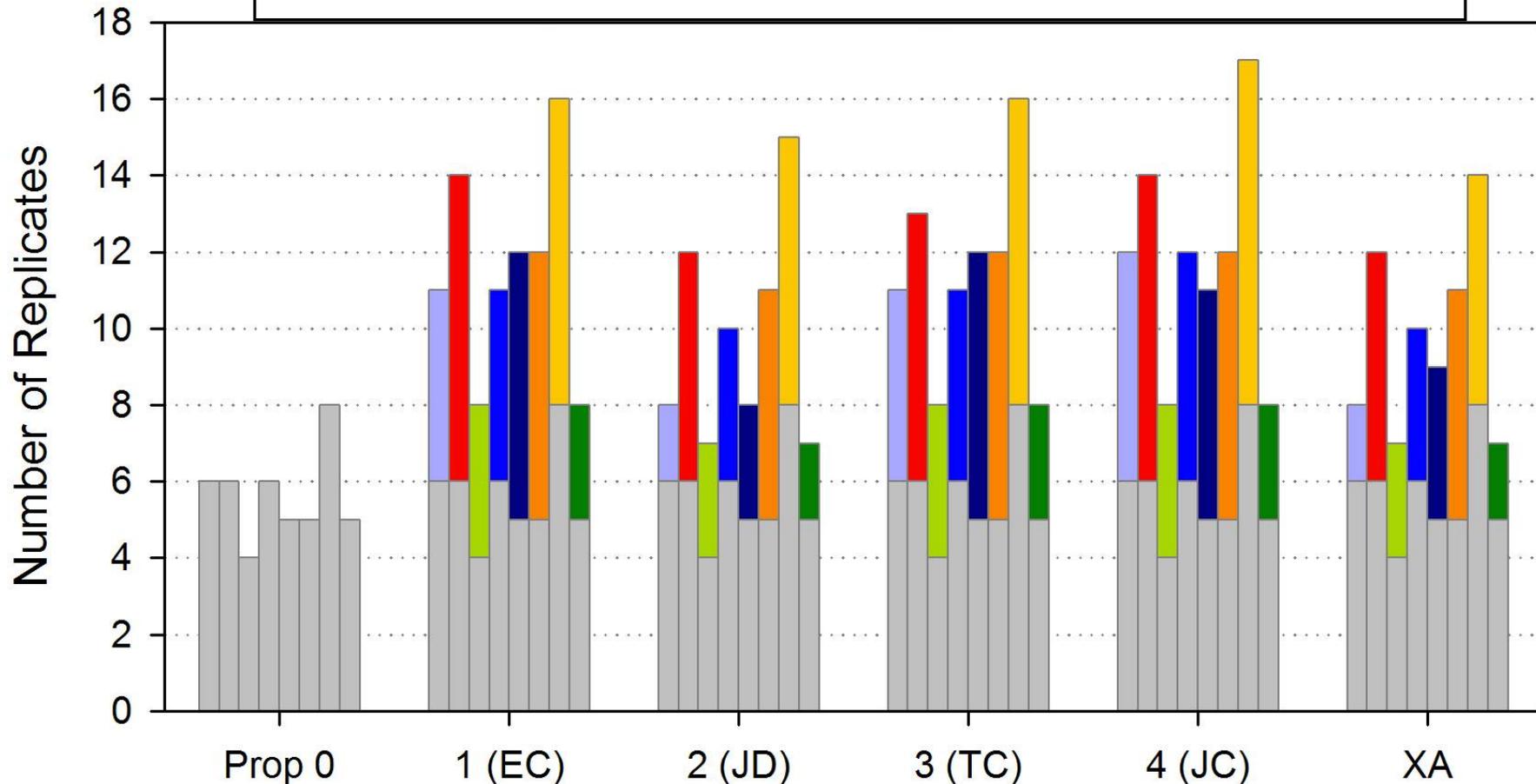
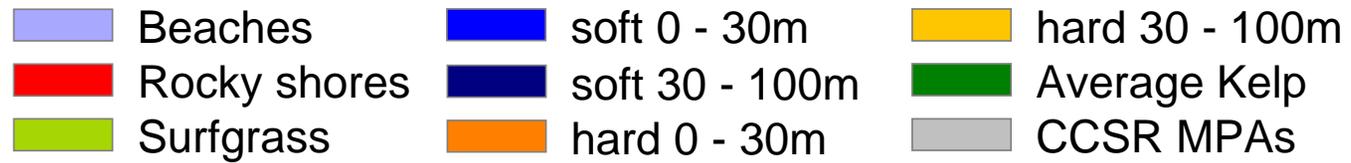


# Replication: High Protection





# Replication: Moderate-high Protection

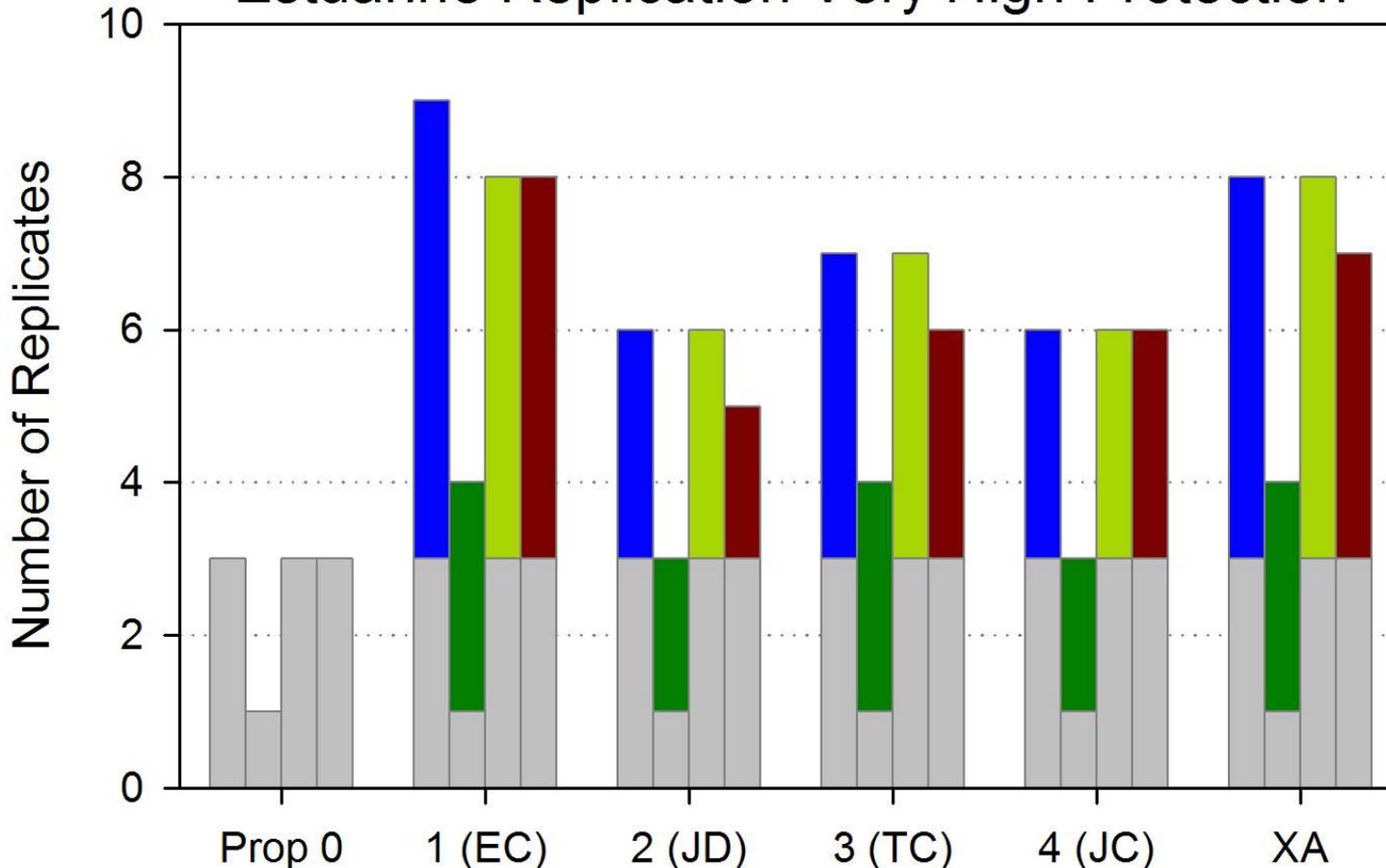




# Replication: Estuarine Habitats



## Estuarine Replication Very High Protection



Most habitats with 3-5 new replicates

Greater replication of eelgrass than CCSR

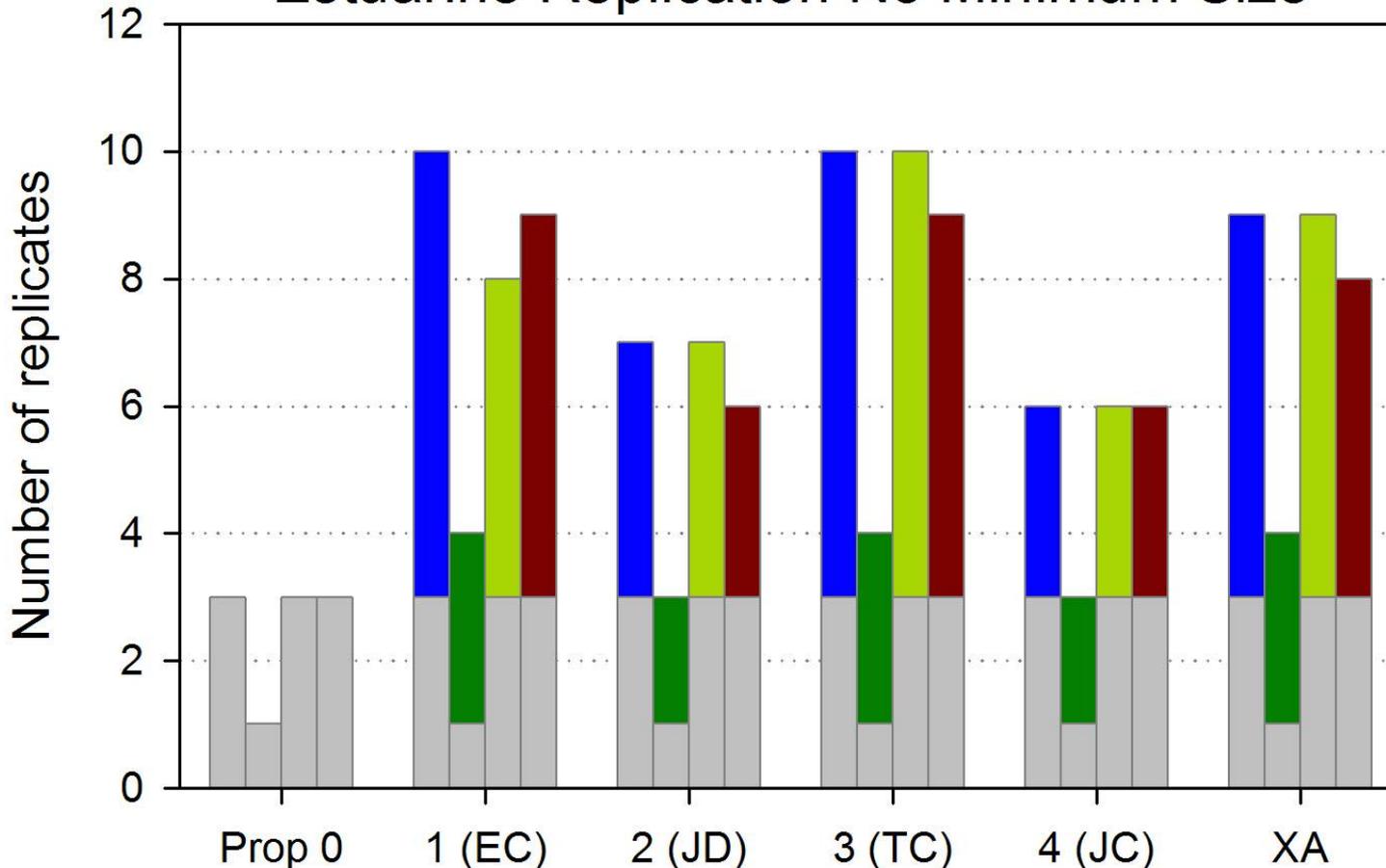
No estuarine habitats in mod-high or high LOP



# Replication: Estuarine Habitats



## Estuarine Replication No Minimum Size



Estuaries too small to meet size criterion add conservation value

Additional replicates that meet habitat size criterion



# Results: Habitat Replication

## Summary



Marked differences among proposals



Generally less replication than MLPA Central Coast Study Region (CCSR) at highest levels of protection



At the highest levels of protection,  $4 > 1, 3 > 2, XA > 0$



Fewer differences among proposals and more similar to CCSR at moderate-high levels of protection



Estuarine habitats well replicated.



# Evaluations with Models



Two models

EDOM

UCD



Equilibrium models predict the effects of MPAs into the future



Models look at individual species and do not consider complex ecosystem interactions



Levels of protection are not used in the models – instead protection is species by species



# Model Designs

## Both Models Assess

- Conservation value (abundance, sustainability)
- Economic return (yield, profit)
- Responses for multiple representative species
- Responses with different management actions
- Responses with different fishing behavior but currently fishing concentrates where fish are



# Example Species Considered

Species	Average larval dispersal distance (km)	Average home range diameter (km)
Abalone	1	1
Black Rockfish	40	6
Cabazon	100	1
Lingcod	35	15
Canary Rockfish	40	40
California Halibut	45	30
Dungeness Crab	75	14
Red Sea Urchin	50	1





# Model Insights



Increasing size and decreasing spacing leads to greater conservation value



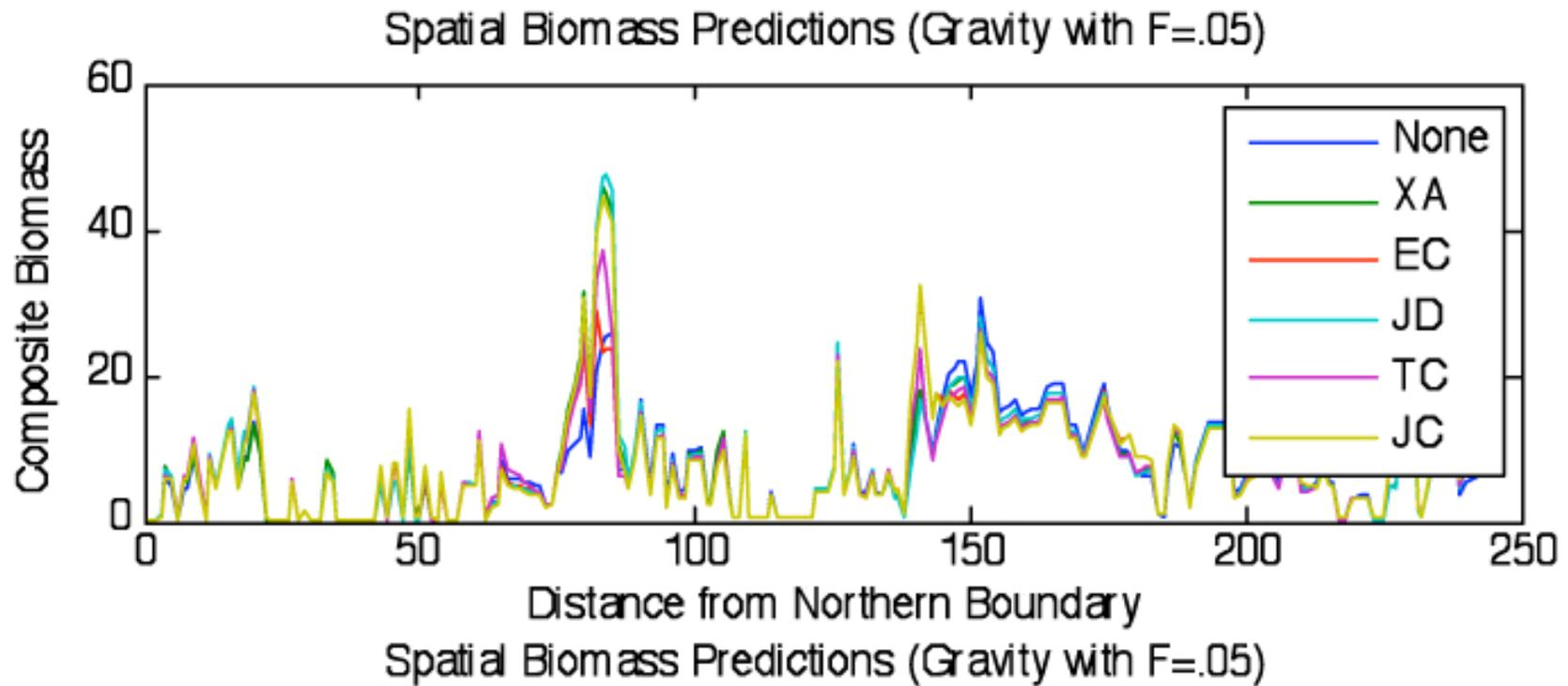
Relationship between conservation value and economic return depends on what happens outside MPAs

Unsustainable harvest - MPAs increase both conservation value and economic returns

Sustainable harvest - tradeoff between conservation and economic return



# Spatial Forecasts of Abundance



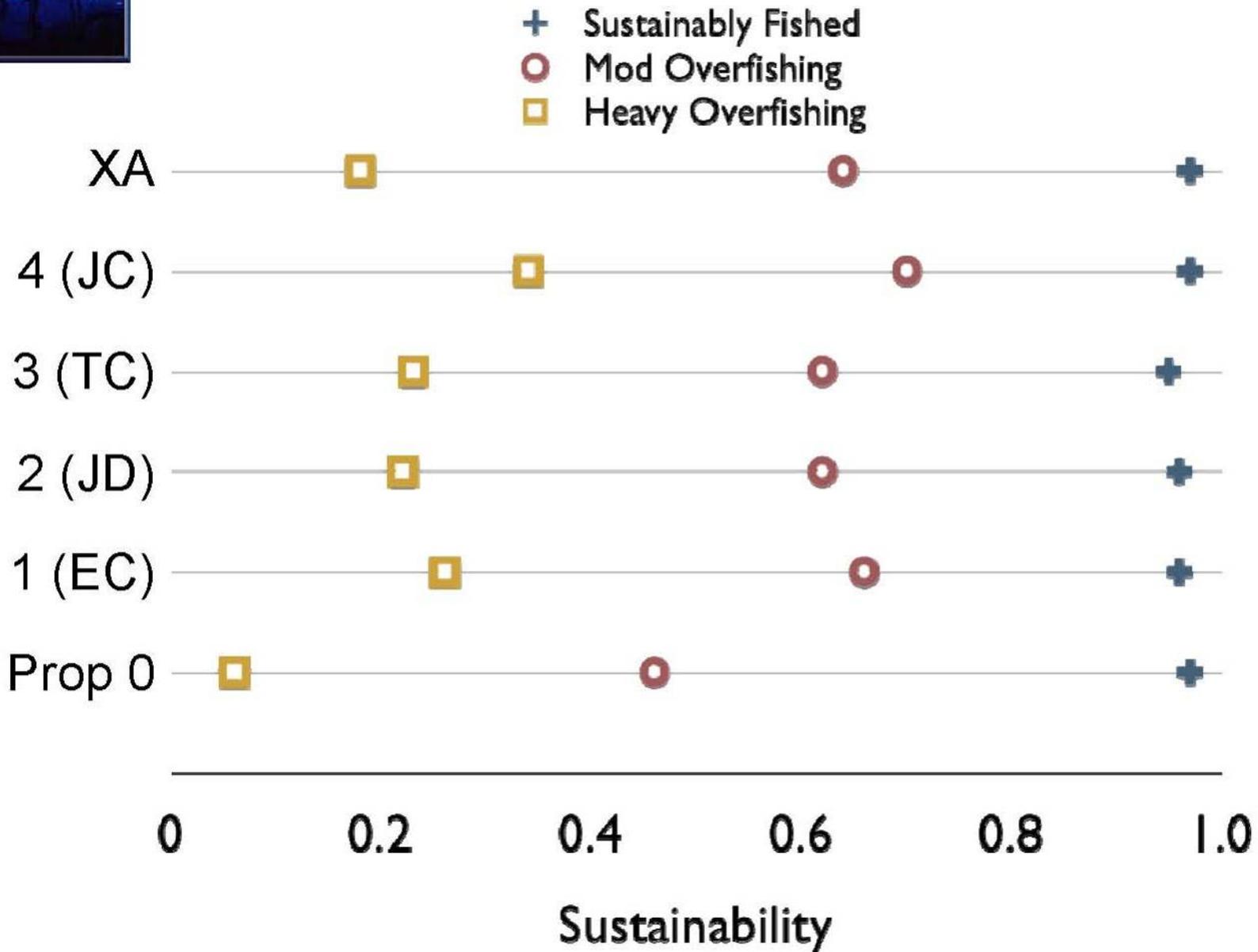


# Uses of Spatial Model Predictions

-  Forecasts which configurations should lead to higher biomass or more sustainable populations (conservation value) and/or which lead to higher yield (economic return).
-  Provide a basis for considering how to adjust MPA proposals to achieve desired conservation or economic results.

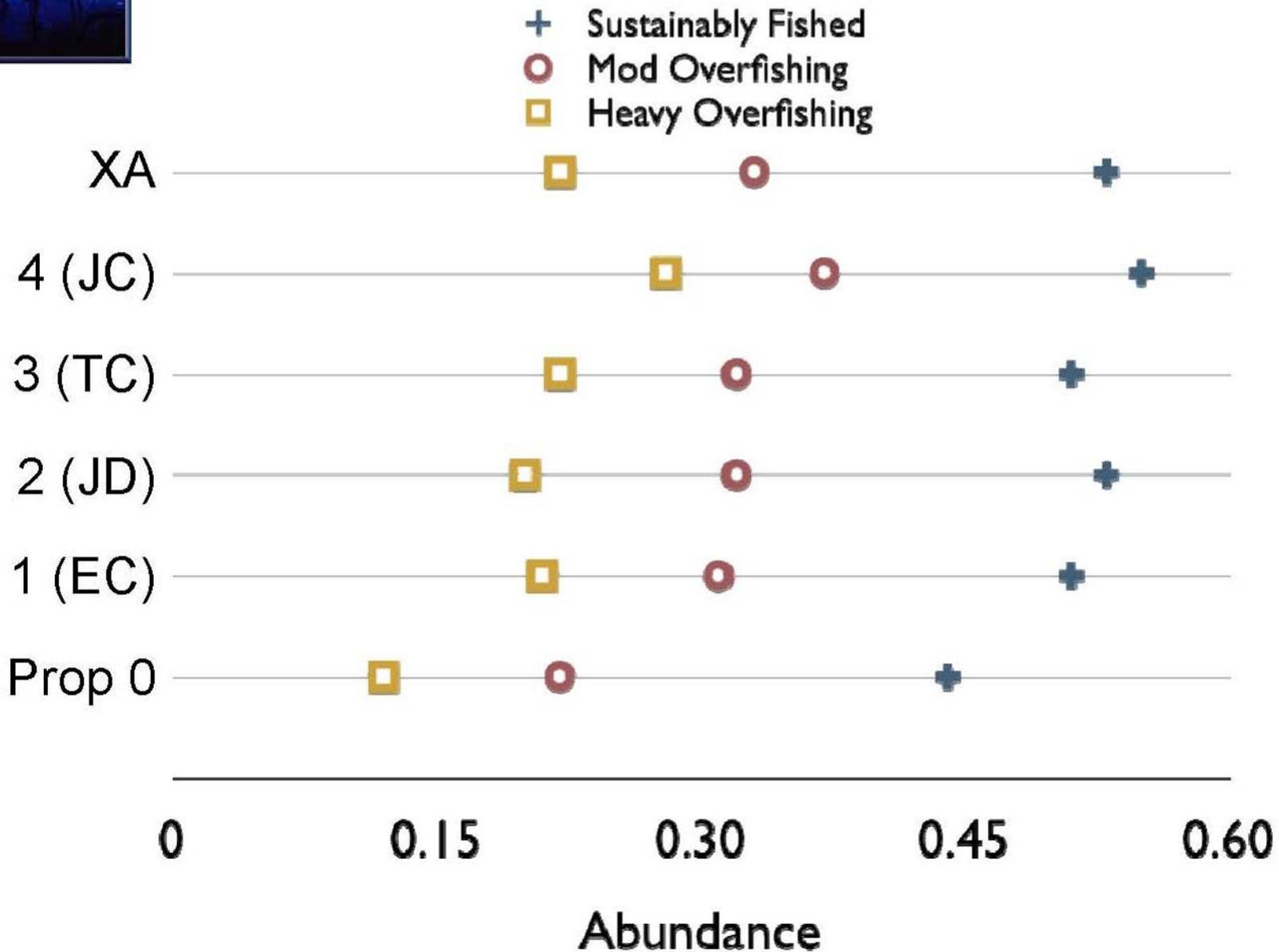


# Results from UCD Model



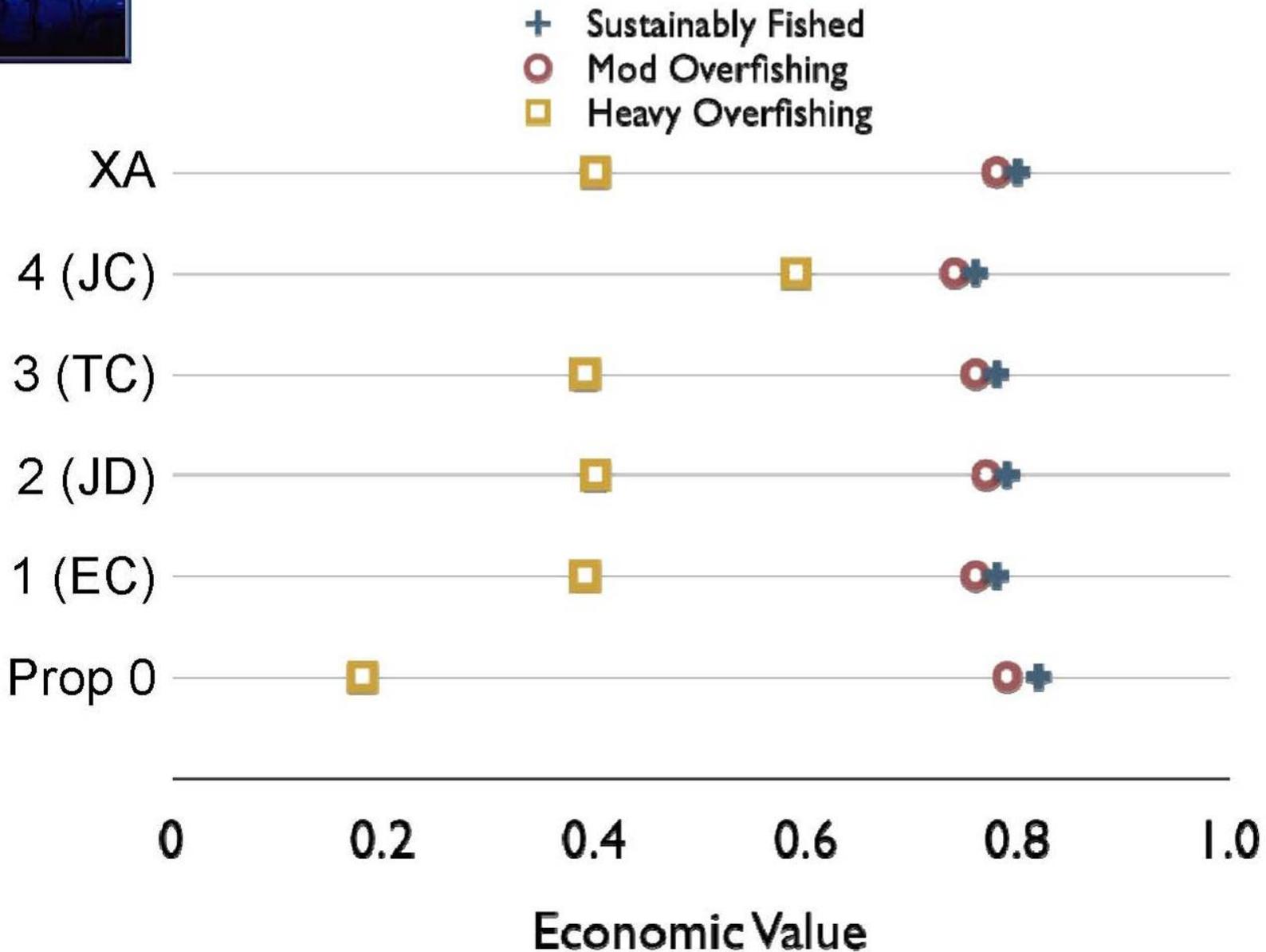


# Results from EDOM Model



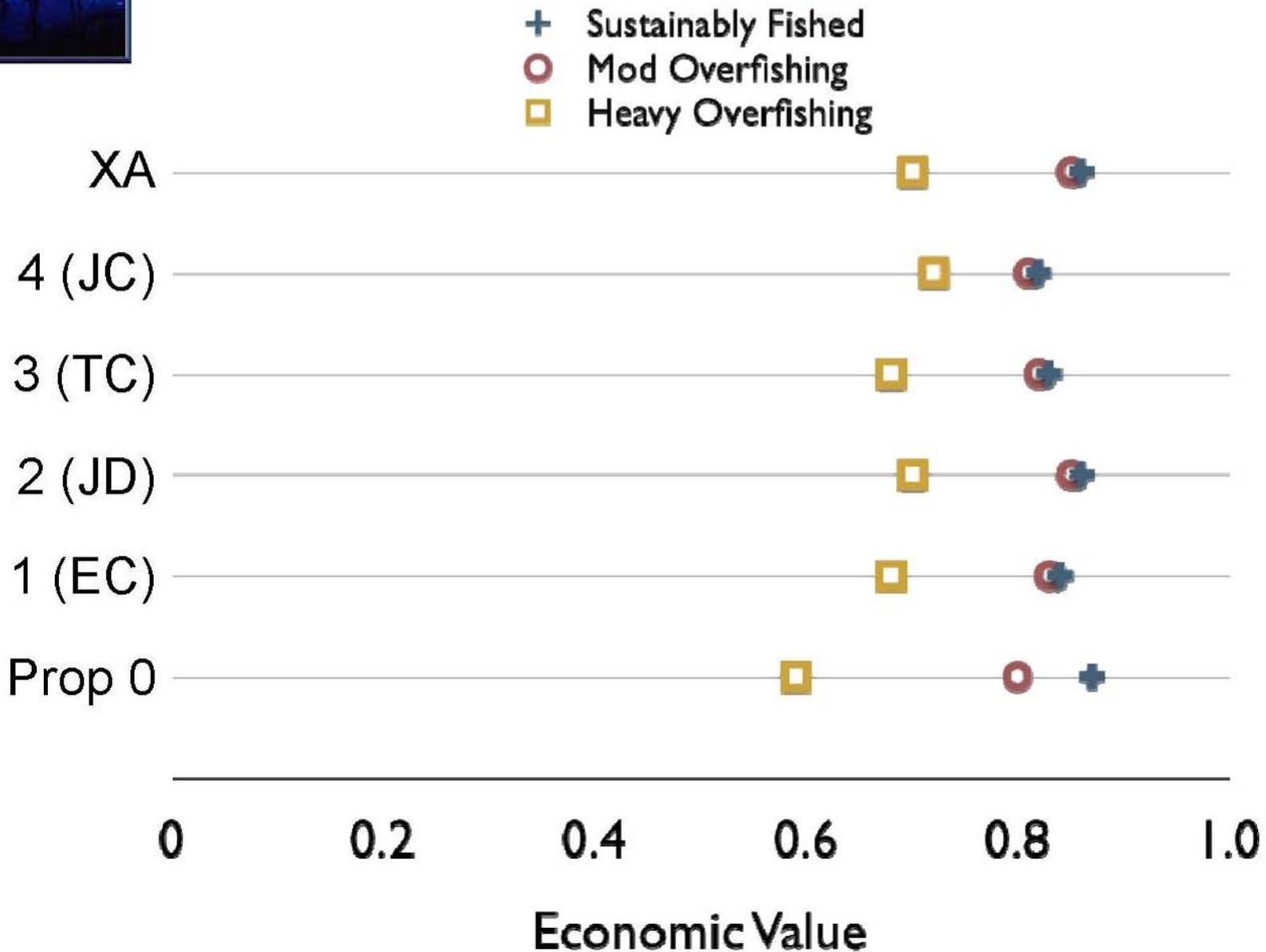


# Results from UCD Model





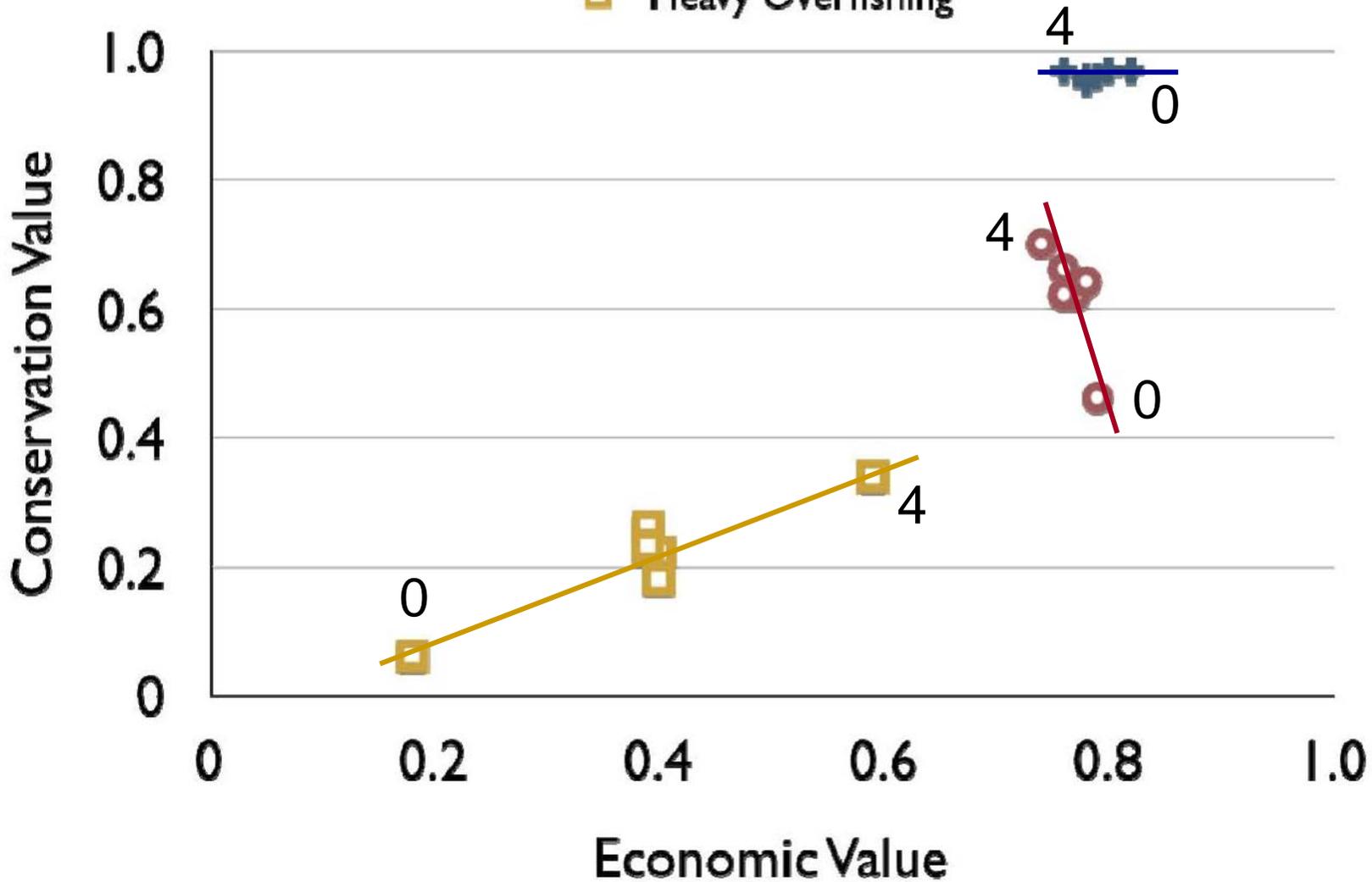
# Results from EDOM Model





# Results from UCD Model

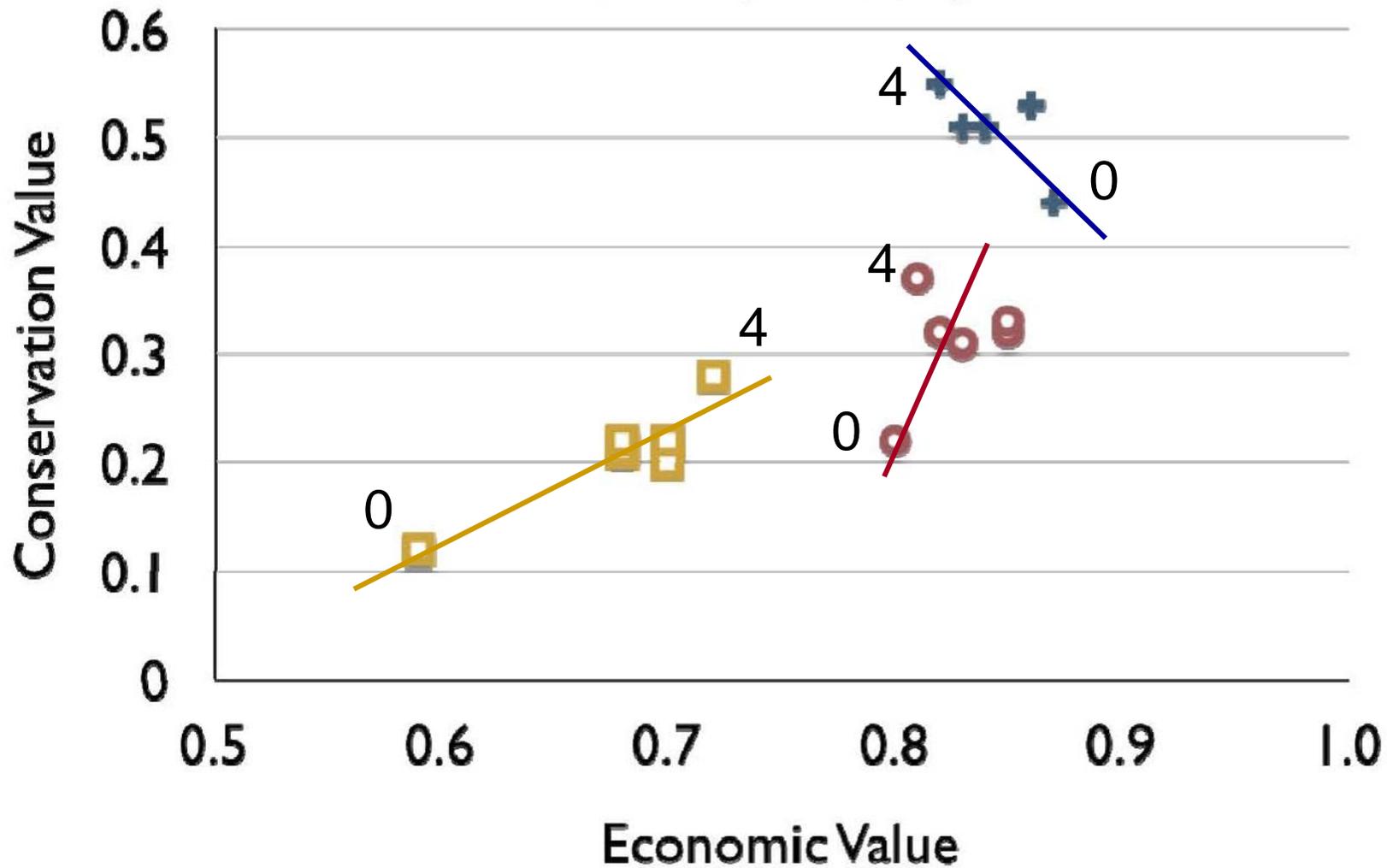
- + Sustainably Fished
- Mod Overfishing
- Heavy Overfishing





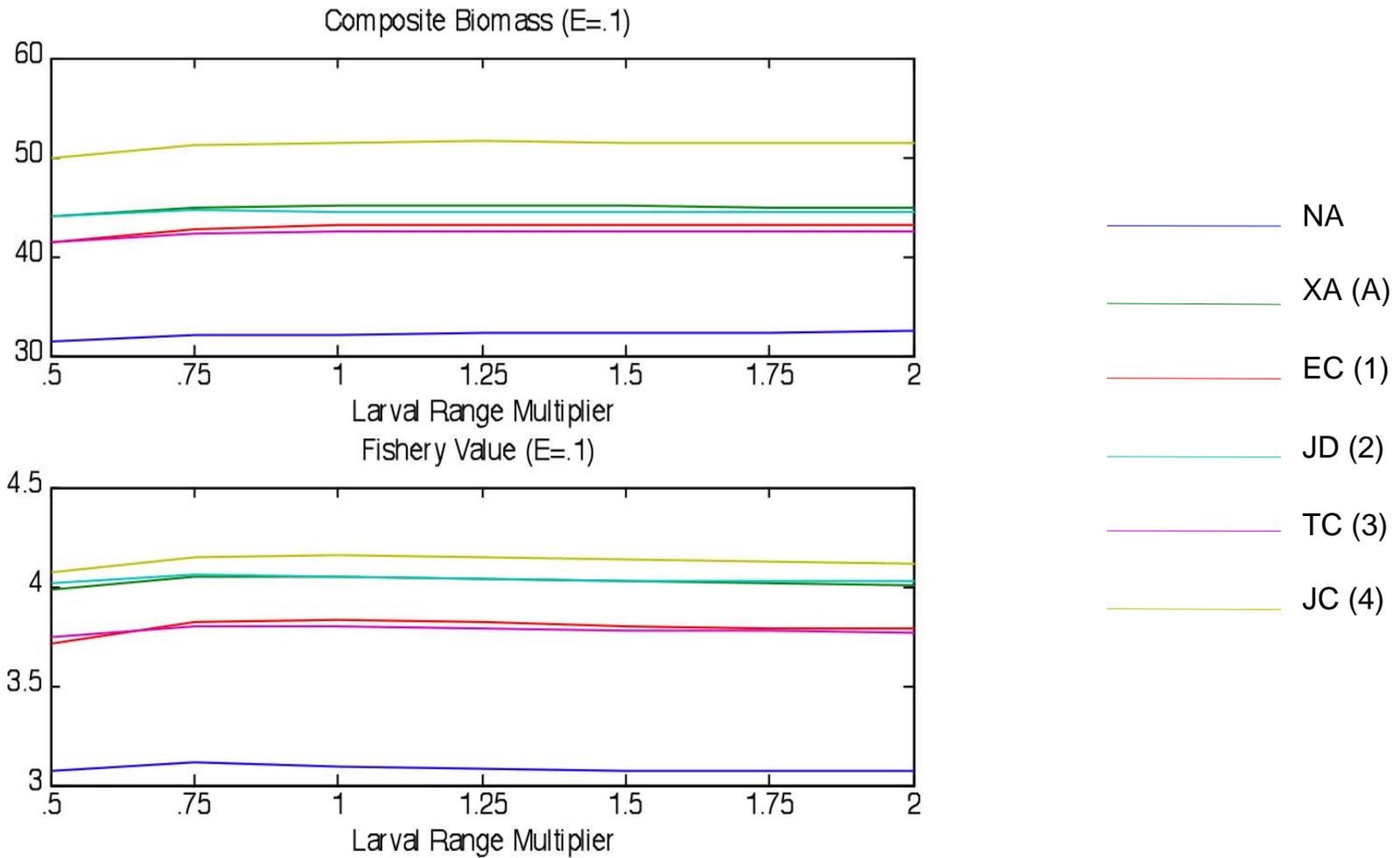
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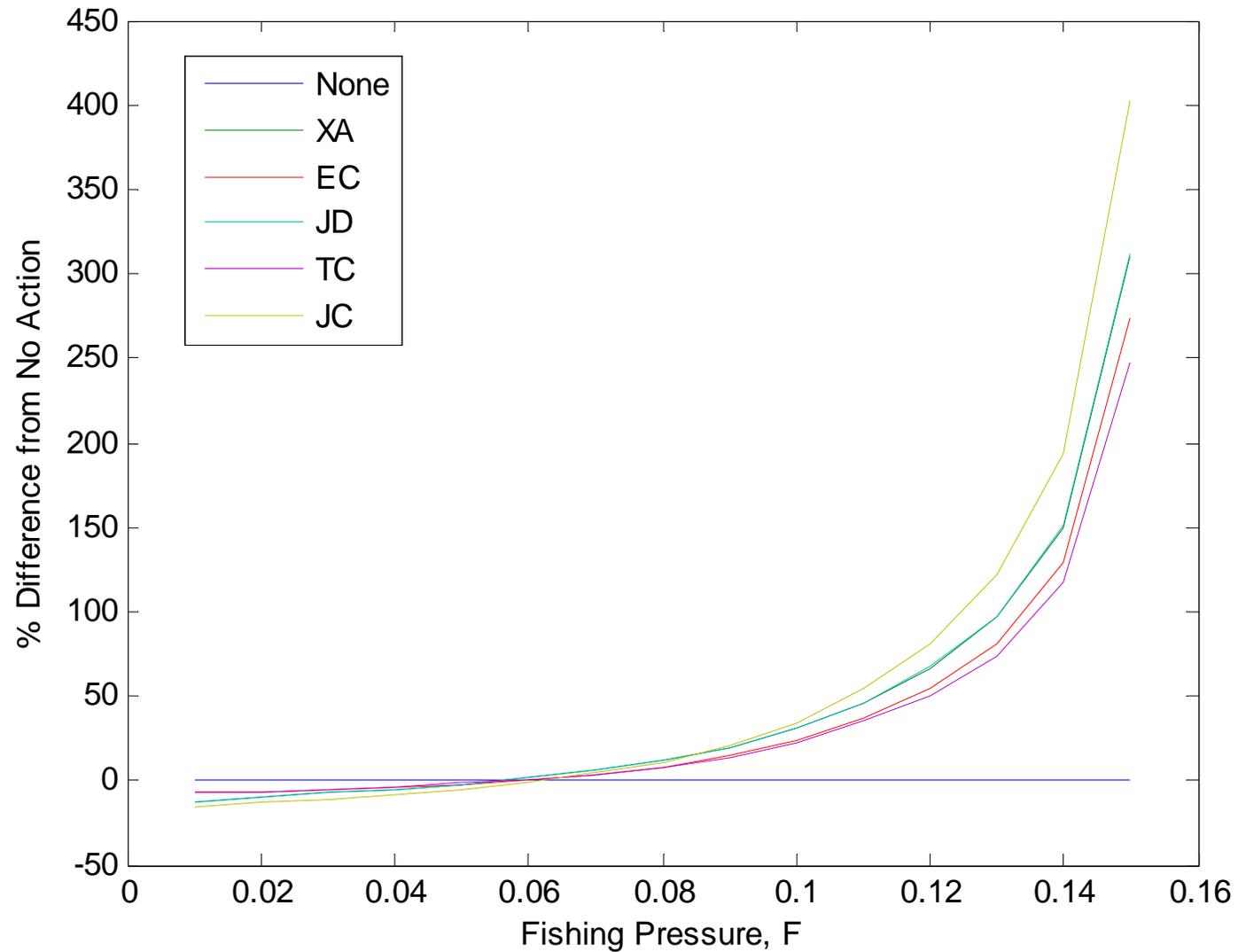


# Inensitivity to Some Assumptions





# Sensitivity to Others





# General Model Conclusions



Rank of proposals in terms of conservation value is relatively insensitive to:

- Species Differences
- Management Actions



Rank of proposals in terms of economic value strongly depends on management outside



System switches from win-win to predictable tradeoff