

Marine Life Protection Act Initiative



Draft Spatial Bioeconomic Model Evaluations of Round 1 Draft MPA Arrays/Proposals for the MLPA South Coast Study Region

Presentation to the MLPA Master Plan Science Advisory Team
April 1, 2009 • Los Angeles, CA

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Model Inputs

- **Geographic**
 - Habitat maps
 - Proposed marine protected area (MPA) boundaries and regulations
- **Species-specific**
 - Life history (growth, natural mortality, fecundity)
 - Adult movement (home range diameter)
 - Larval dispersal (pelagic larval duration, spawning season, some behavior)
 - Dispersal patterns from UC Los Angeles / UC Santa Barbara circulation model
 - Egg-recruit or settler-recruit relationship (critical to population persistence)



Model Inputs

- **Two models:** UC Davis and UC Santa Barbara
 - Structurally similar, but slightly different approaches to modeling adult movement, overall level of fishing, other details
 - Concordance in results inspire confidence that outcomes not sensitive to details of any one model



Model Inputs

- **Updates**

- Oceanography

- Dispersal matrix is species specific. Parameterized over range of oceanographic conditions (1996-2002)

- Fishing fleet model

- Fleet model – responds to spatial abundance of fish
 - Data compiled by Ecotrust, parameterization of fleet model is underway (distance, congestion, weather, etc.)

- Validation

- Preliminary model outputs evaluated by fish experts
 - Now incorporate north-south gradient in species abundance



Model Inputs: Species

- Ocean whitefish
- Black surfperch
- Opaleye
- Kelp bass
- Kelp rockfish
- Sheephead
- Red sea urchin
- California halibut



Model Outputs

- **Conservation**

- Spatial distribution of larval settlement and biomass
- Total settlement and biomass (summed over study region, weighted sum across species)

- **Economic**

- Spatial distribution of yield
- Total yield and profit (summed over study region, weighted sum across species)



Model Outputs

- **Other Data**
 - Spatial distribution of fishing effort
 - Larval connectivity patterns
- *All outputs are based on long-term equilibria*
- *Each output is calculated for a range of assumptions about future fishery management outside MPAs¹*

¹For complete list of assumptions, see evaluation methods document, Chapter 8, Appendix C.



Model Results

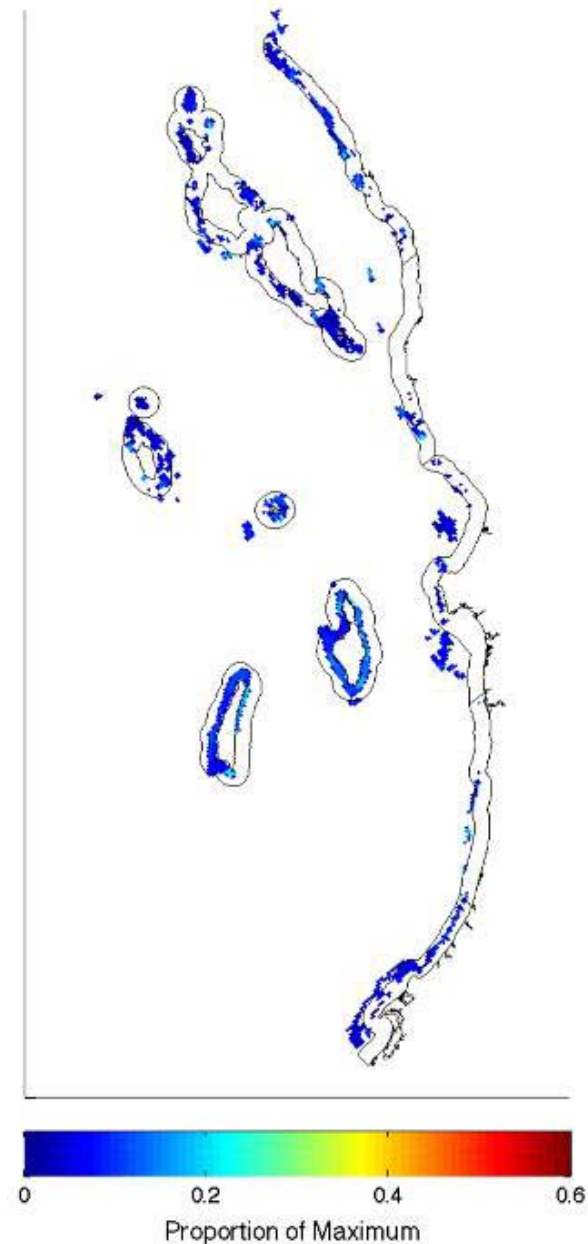
Spatial Distribution of Larval Settlement

Model: UC Davis

**Species:
Ocean Whitefish**

**Assumption:
MSY Management**

*Also run for “unsuccessful” and
“conservative” management





Model Results

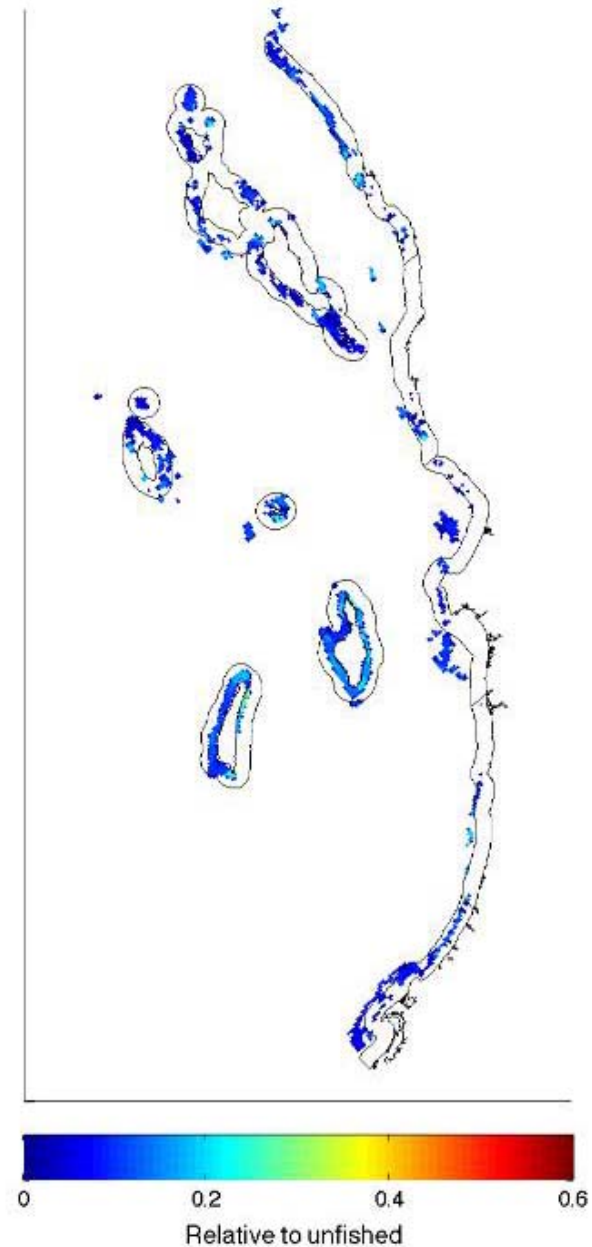
Spatial Distribution of Biomass

Model: UC Davis

**Species:
Ocean Whitefish**

**Assumption:
MSY Management**

*Also run for “unsuccessful” and
“conservative” management





Model Results

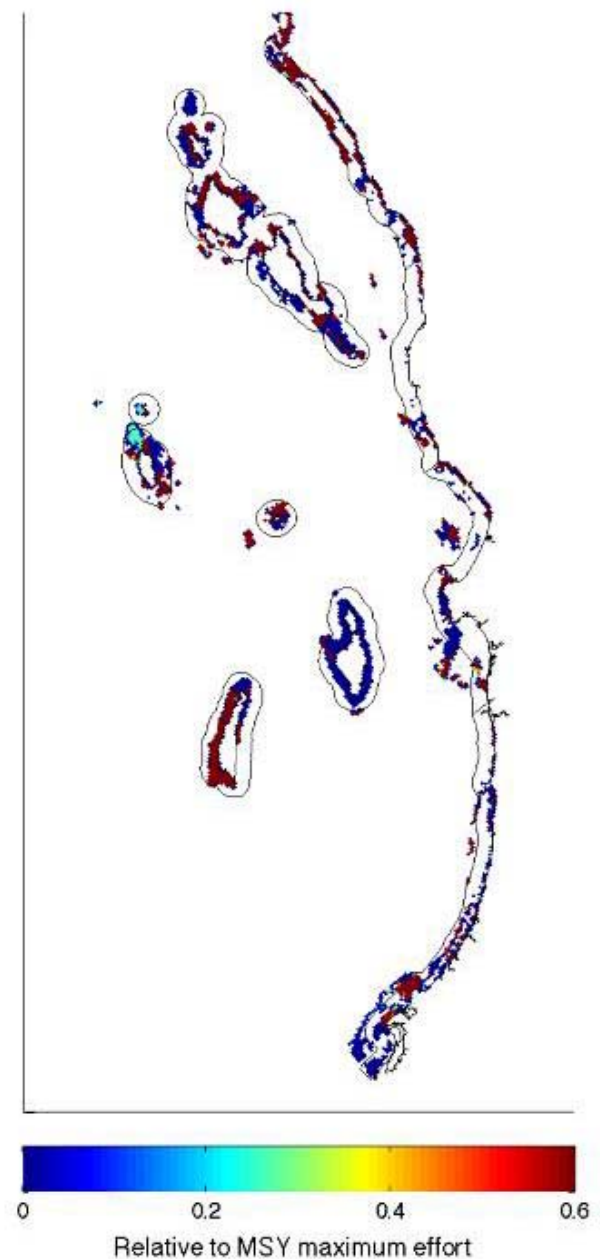
Spatial Distribution of Fishing Effort

Model: UC Santa Barbara

**Species:
Red Sea Urchin**

**Assumption:
MSY Management**

*Also run for “unsuccessful” and
“conservative” management





Model Results

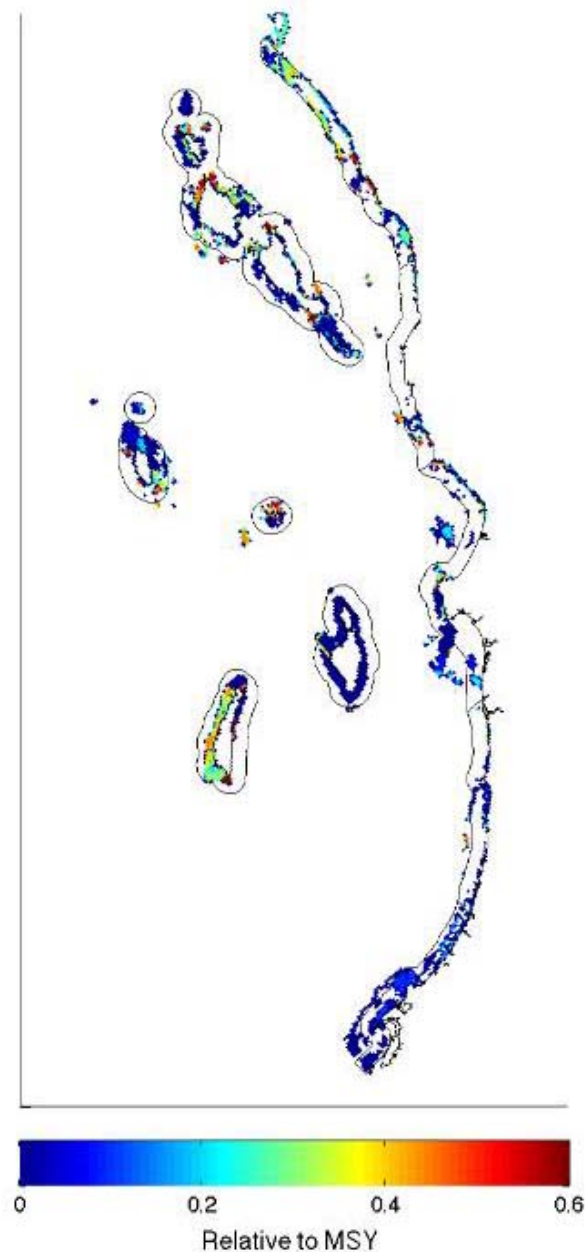
Spatial Distribution of Fishery Yield

Model: UC Santa Barbara

**Species:
Red Sea Urchin**

**Assumption:
MSY Management**

*Also run for “unsuccessful” and
“conservative” management





Model Results

Region-by-Region Biomass (MSY management, UC Davis model)

Species	MPA Array or Proposal	Total	South Mainland	North Mainland	North Islands	South Islands
Ocean Whitefish	Existing MPAs	0.41	0.41	0.43	0.49	0.37
Ocean Whitefish	External A	0.42	0.42	0.45	0.50	0.39
Ocean Whitefish	External B	0.43	0.42	0.45	0.50	0.39
Ocean Whitefish	External C	0.48	0.45	0.49	0.52	0.48

Range: 0 (no biomass) to 1 (maximum unfished biomass)

Regions:

- Southern mainland: Mexico to Long Beach
- Northern mainland: Long Beach to Point Conception
- Northern Channel Islands: San Miguel, Santa Rosa, Santa Cruz and Anacapa
- Southern Channel Islands: San Nicolas, Santa Barbara, Santa Catalina, San Clemente



Model Results

Region-by-Region Yield (MSY management, UC Davis model)

Species	MPA Array or Proposal	Total	South Mainland	North Mainland	North Islands	South Islands
Ocean Whitefish	Existing MPAs	1.00	1.00	1.00	1.00	1.00
Ocean Whitefish	External A	0.98	1.03	0.98	1.05	0.97
Ocean Whitefish	External B	0.99	1.03	0.99	1.06	0.96
Ocean Whitefish	External C	0.91	1.17	0.96	1.32	0.77

Note: Some regions see improvement in yield over existing MPAs

Regions:

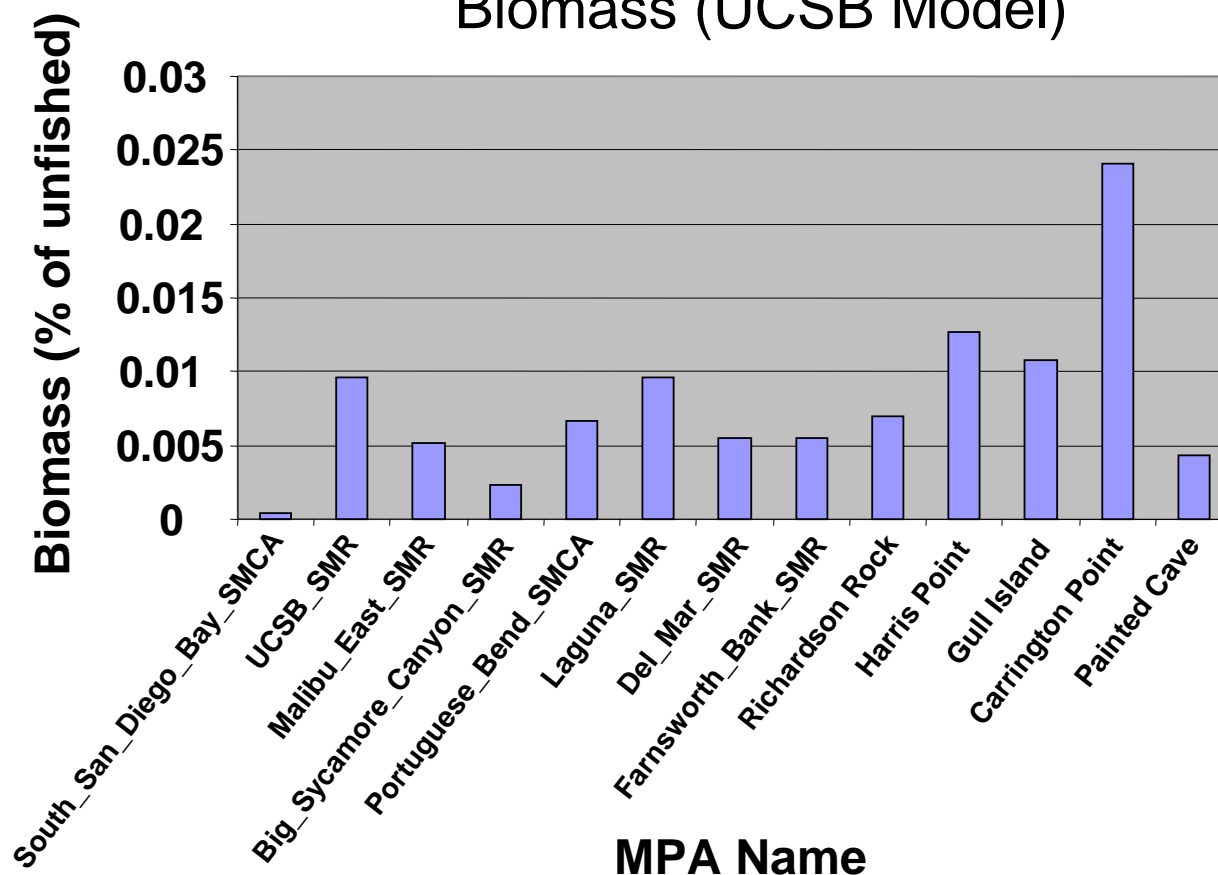
- Southern mainland: Mexico to Long Beach
- Northern mainland: Long Beach to Conception
- Northern Channel Islands: San Miguel, Santa Rosa, Santa Cruz and Anacapa
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Model Results

MPA-by-MPA Biomass (MSY management)

Biomass (UCSB Model)





Model Results

MPA-by-MPA Self-Recruitment & Persistence (MSY management)

MPA name	Species	Self recruitment (UCD)	Self persistence (UCD)
Santa Catalina Island	Ocean Whitefish	0.11	0.25
Santa Catalina Island	Black Surfperch	1.00	2.60
Santa Catalina Island	Opaleye	0.07	0.32
Santa Catalina Island	Kelp Bass	0.06	0.23
Santa Catalina Island	Kelp Rockfish	0.06	0.19
Santa Catalina Island	Sheephead	0.05	0.20
Santa Catalina Island	Red Sea Urchin	0.08	0.18
Santa Catalina Island	Halibut	0.00	0.06

Self recruitment: Fraction of settling larvae that were produced locally (Range 0 -1)

- Measure of isolation, connectedness (0 = totally isolated)

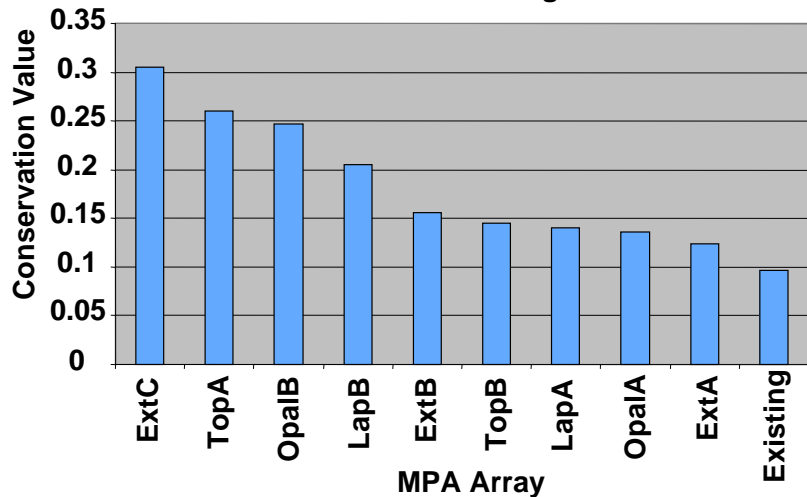
Self persistence: Measure of whether MPA is self-sufficient

- Values less than or equal to 1 are dependent on larvae from elsewhere.
- Values greater than 1 are self-sufficient.

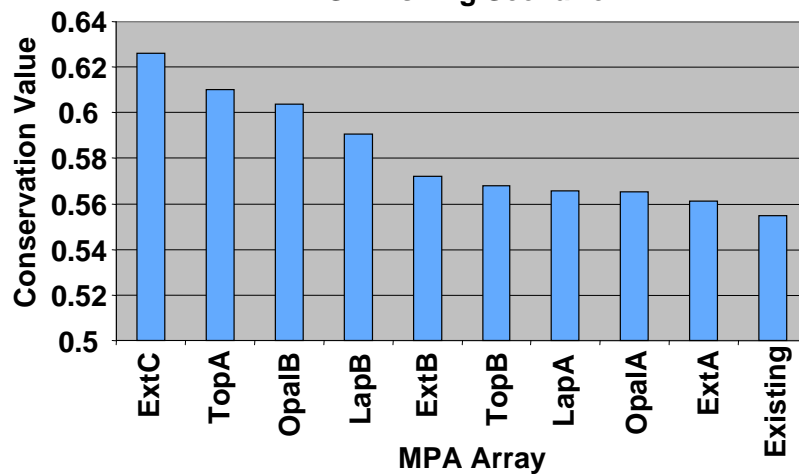


Model Results: Proposal Rank

Unsuccessful Management



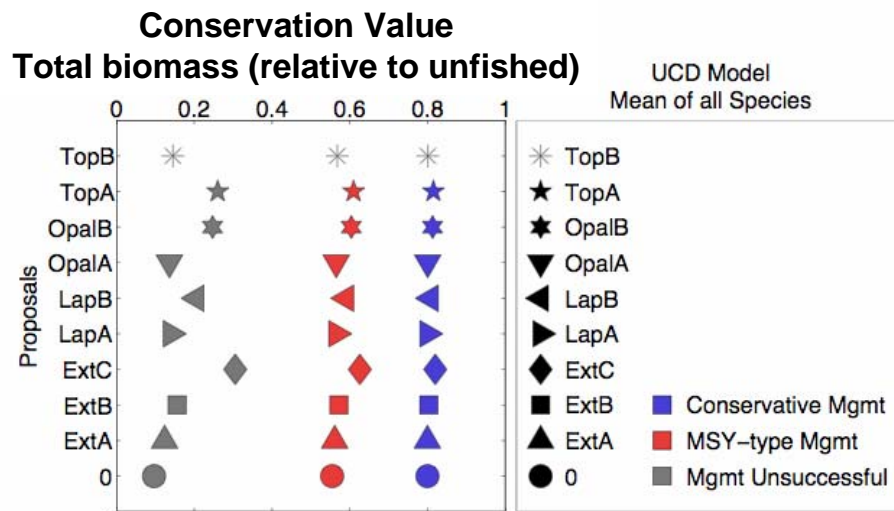
MSY Fishing Scenario



Ranking for conservation value (nearly) preserved across models and fishing scenarios

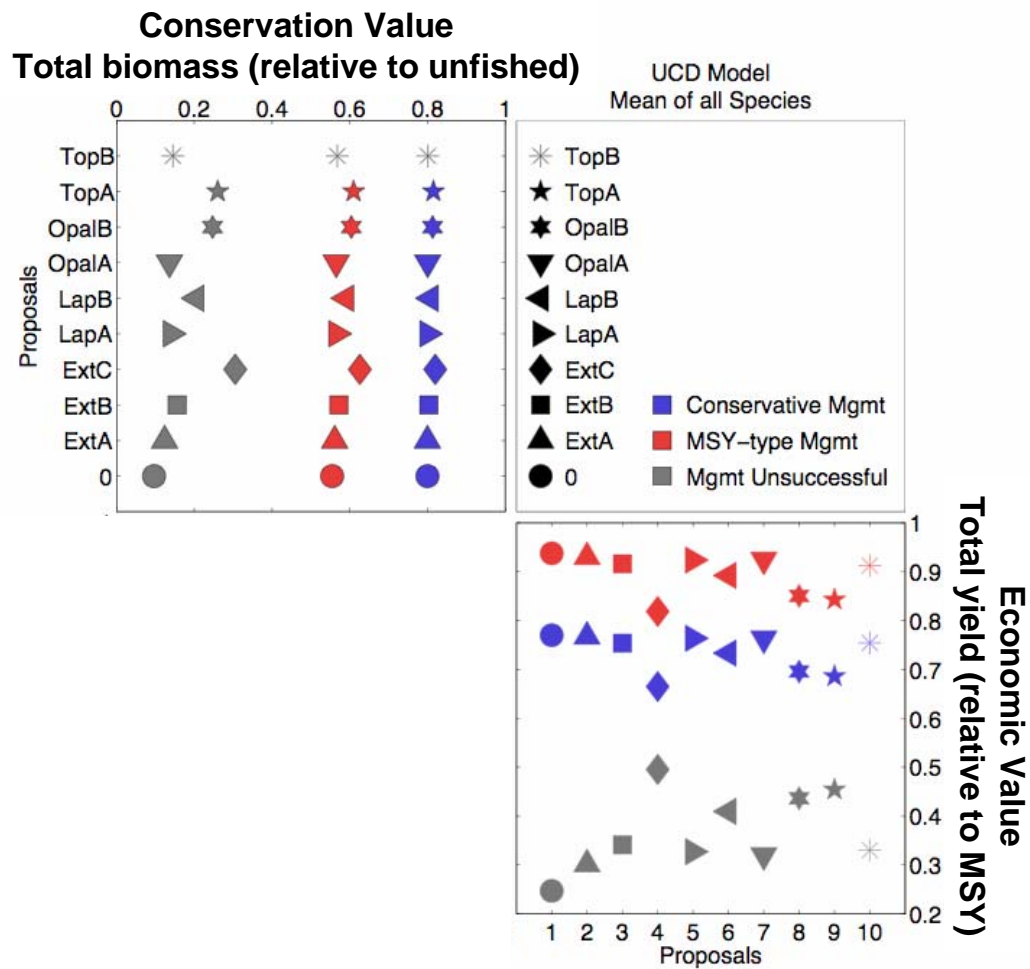


UCD Model Results: Biomass



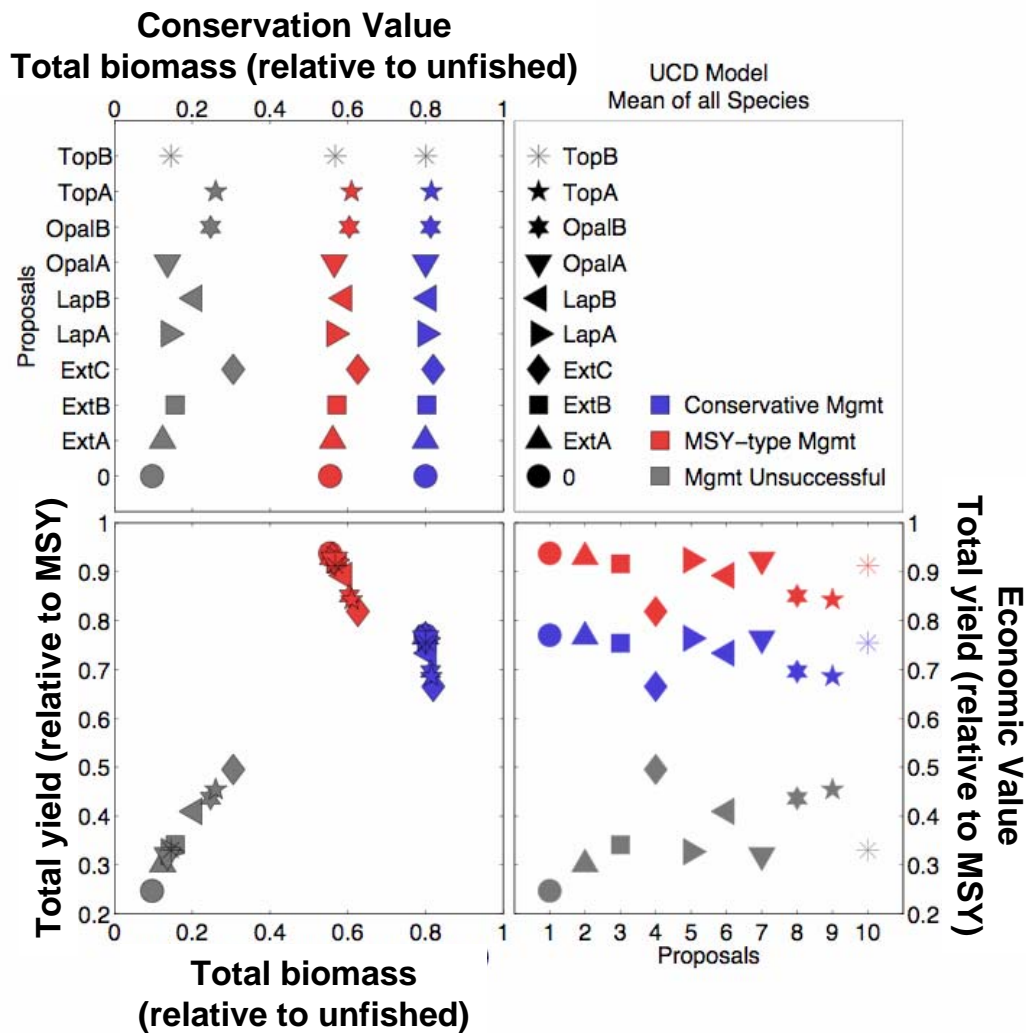


UCD Model Results: Fishery Yield



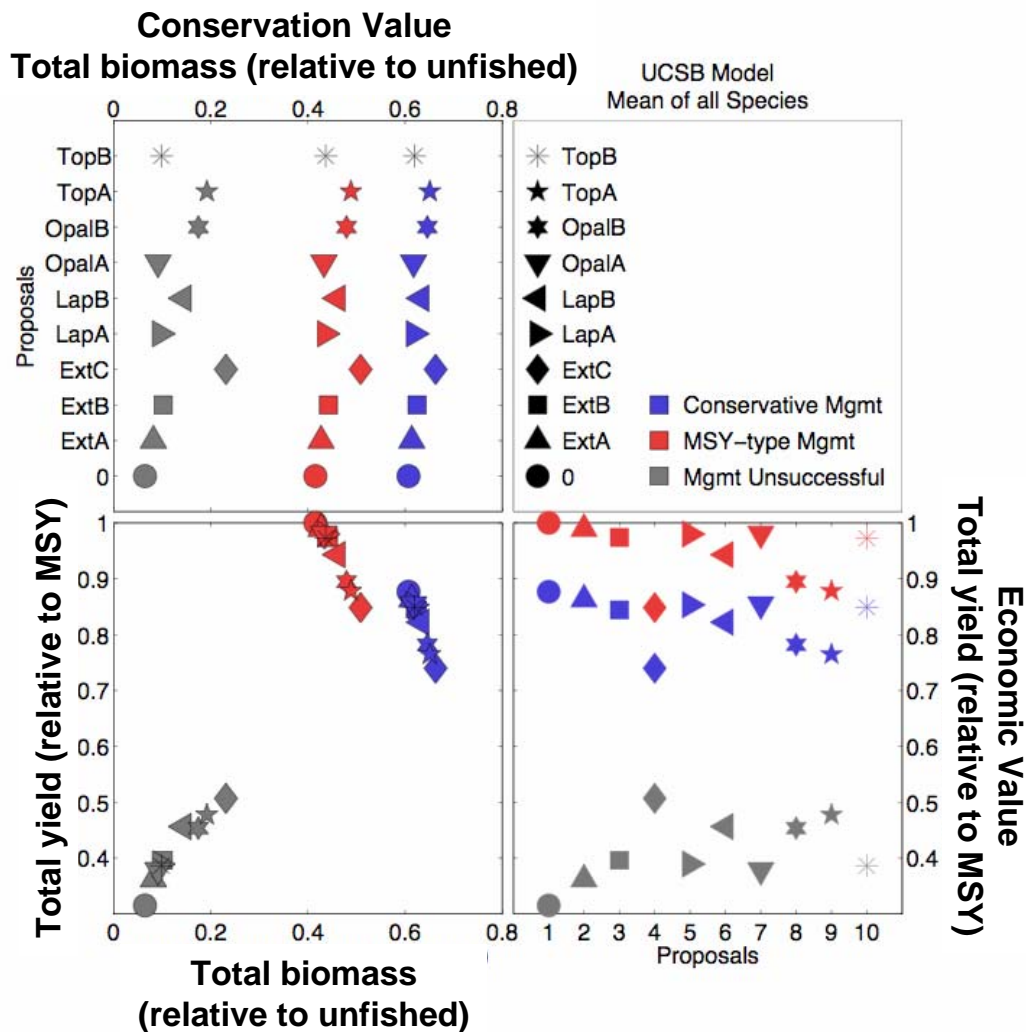


UCD Model Results: Biomass x Yield





UCSB Model Results: Biomass x Yield





Conclusions

- Models are running smoothly – output available to assist in modifying arrays and proposals
- Ranking of MPA arrays and proposals for conservation value is insensitive to (1) model and (2) assumption about fishery management outside
- Differences in fishery management outside MPAs have strong effect on model results. But given similar placement, larger MPAs lead to higher conservation value.