Marine Life Protection Act Initiative

Spatial Bioeconomic Model Evaluations of Round 1 MPA Arrays

Presentation to the MLPA Blue Ribbon Task Force
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Value of Models in MLPA Process

- To meet goals of the Marine Life Protection Act (MLPA), marine protected area (MPA) proposals must ensure population persistence
- Scientific guidelines and evaluation tools attempt to address this requirement

Value of Models in MLPA Process

- Spatially explicit bioeconomic models account for:
  - Spatial population structure, adult movement, and larval connectivity
  - Conditions outside MPAs (harvest)
  - Status and management of fished populations outside of MPAs
  - Tradeoffs (cost or benefit) between conservation and economic returns
  - Contributions from all proposed MPAs, even those that do not meet size and spacing guidelines

Overview of Models

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

Model Inputs

- Geographic
  - Habitat maps
  - Proposed 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)

Updates to Model Inputs

- Oceanography
  - Dispersal matrix is created for each species over a range of oceanographic conditions (1996-2002)
- Fishing Fleet Model
  - Data compiled by Ecotrust
  - Responds to spatial abundance of fish
  - Considers distance from port, congestion, weather, etc.
- Validation
  - Preliminary model outputs evaluated by fish experts
  - Based on feedback from experts, model now incorporates 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

- *All outputs are based on long-term equilibria*
- *Each output is calculated for a range of assumptions about future fishery management outside MPAs*[1]

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

Model Results

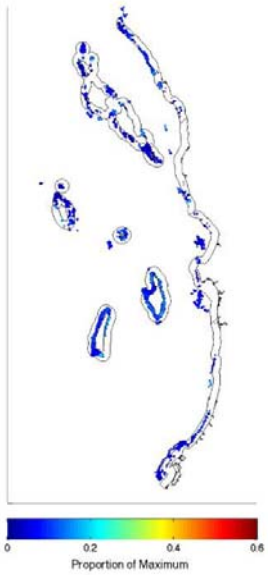
Spatial Distribution of Larval Settlement

Model: UC Davis

Species:
Ocean Whitefish

Assumption:
MSY Management

*Also run for "unsuccessful" and "conservative" management



Model Results

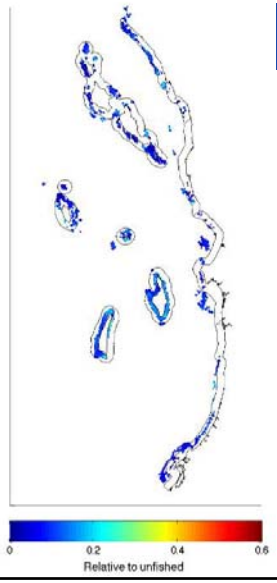
Spatial Distribution of Biomass

Model: UC Davis

Species:
Ocean Whitefish

Assumption:
MSY Management

*Also run for "unsuccessful" and "conservative" management



Model Results

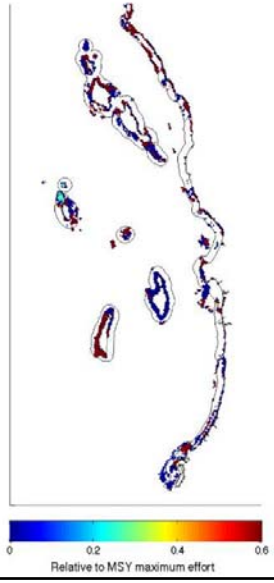
Spatial Distribution of Fishing Effort

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

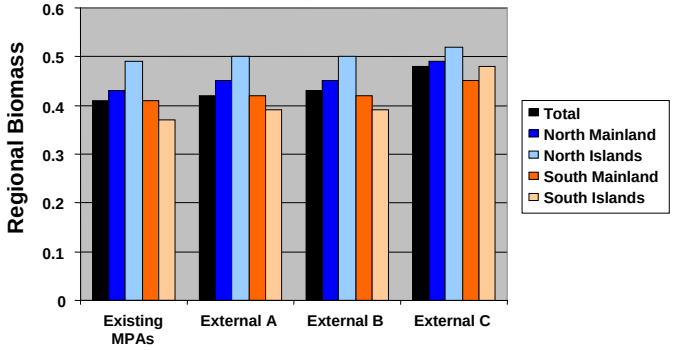
Species:
Red Sea Urchin

Assumption:
MSY Management

*Also run for "unsuccessful" and "conservative" management

Model Results

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

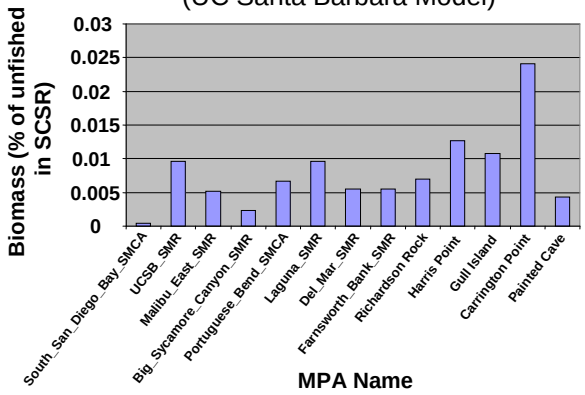


Range: 0 (no biomass) to 1 (unfished biomass)

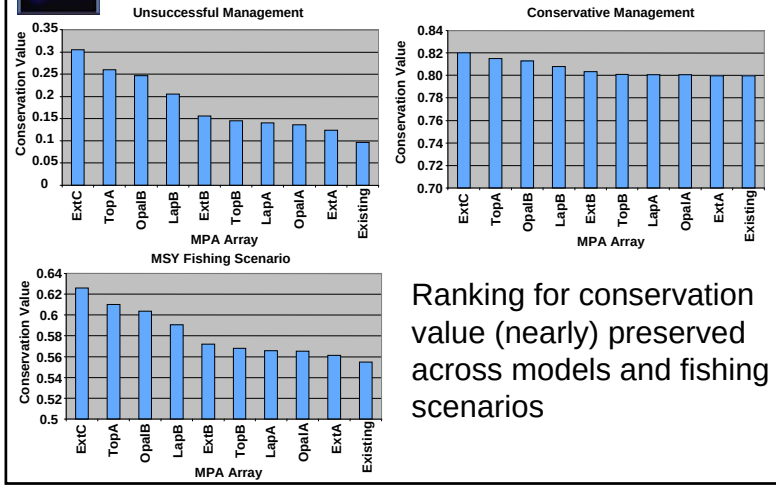
Model Results

MPA-by-MPA Biomass (MSY management)

(UC Santa Barbara Model)

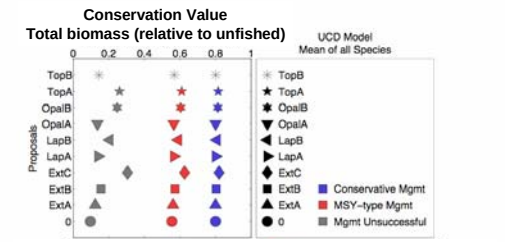


Model Results: Proposal Rank

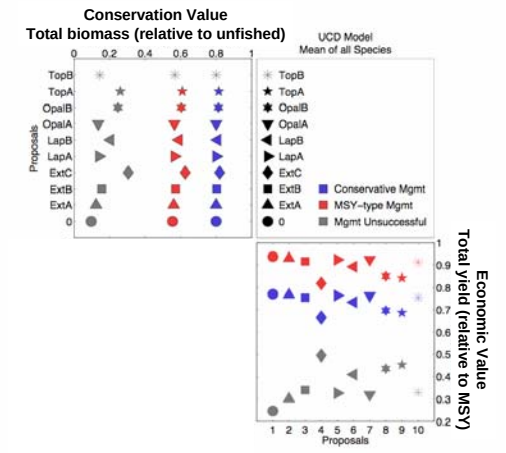


Ranking for conservation value (nearly) preserved across models and fishing scenarios

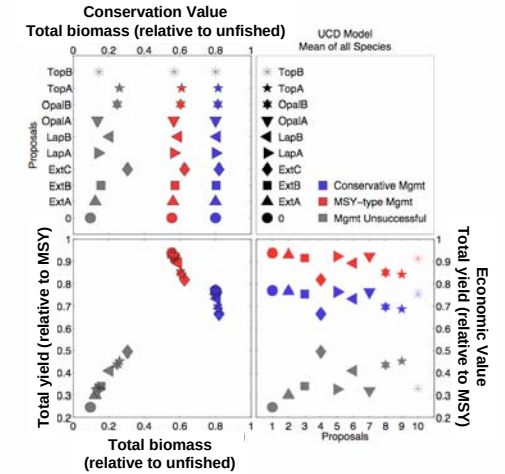
UCD Model Results: Biomass



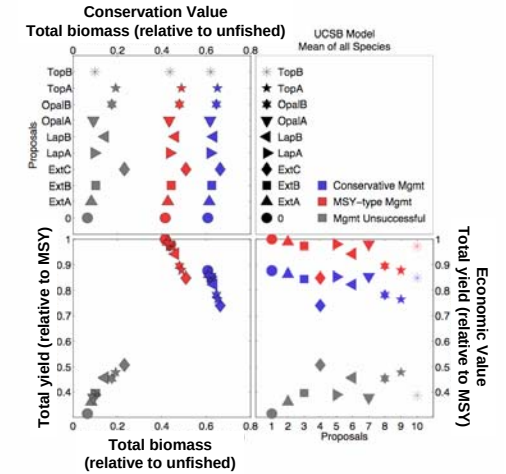
UCD Model Results: Fishery Yield



UCD Model Results: Biomass x Yield



UCSB Model Results: Biomass x Yield



Conclusions

- Models are running smoothly – output available to assist in modifying proposals
- Ranking of MPA arrays 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.