Marine Life Protection Act Initiative

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

Presentation to the MLPA South Coast Regional Stakeholder Group
April 28, 2009 • Oxnard, CA

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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

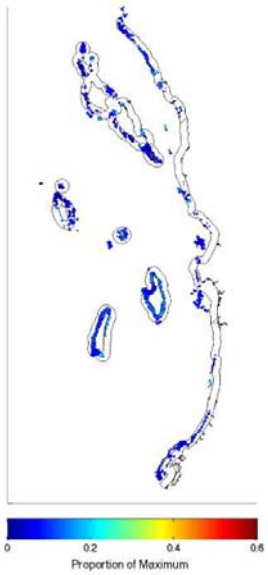
Model: UC Davis

Species:
Ocean Whitefish

Assumption:
MSY Management

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

MSY = maximum sustainable yield



Model Results

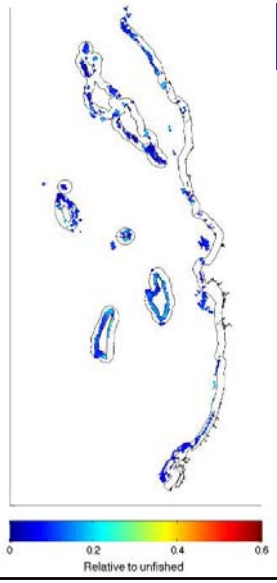
Spatial Distribution of Biomass

Model: UC Davis

Species:
Ocean Whitefish

Assumption:
MSY Management

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



Model Results

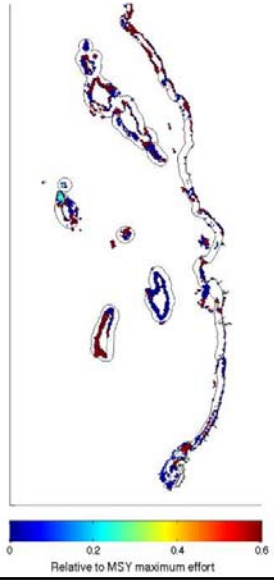
Spatial Distribution of Fishing Effort

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	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)

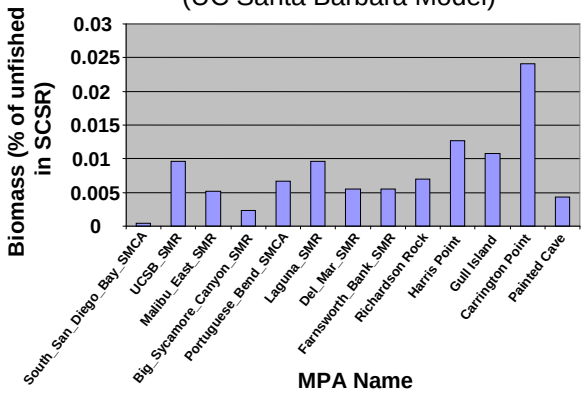
Regions:

- 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

MPA-by-MPA Biomass (MSY management)

(UC Santa Barbara Model)



Model Results

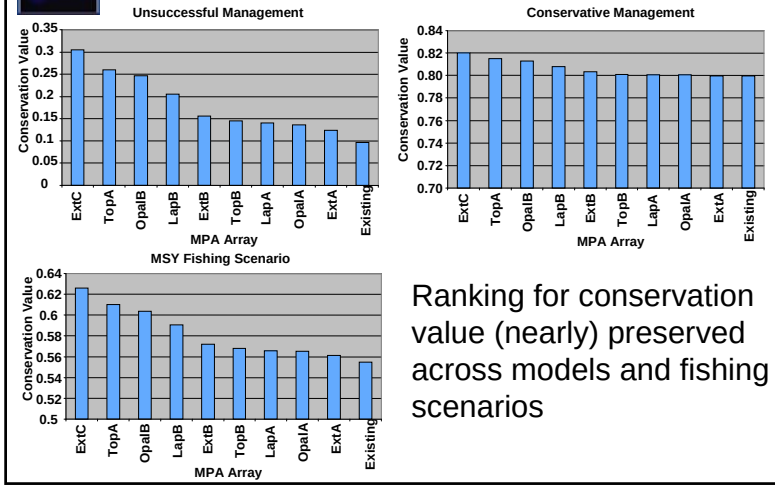
MPA-by-MPA Self-Recruitment & Persistence (MSY management)

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)

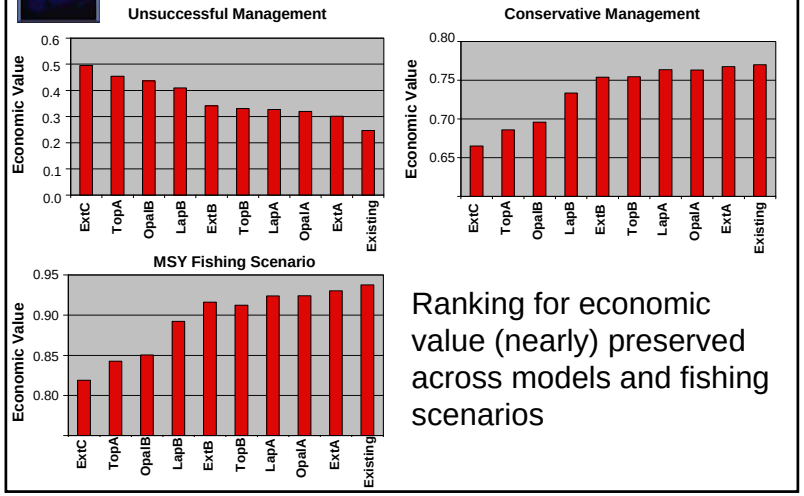
Self persistence: Measure of whether MPA is self-sufficient
- Values less than or equal to 1 are dependent on larvae from elsewhere.
- Values greater than 1 are self-sufficient.

Model Results: Array Rankings



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

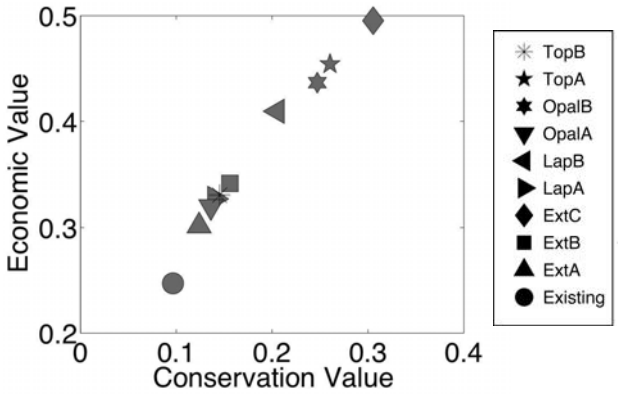
Model Results: Array Rankings



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

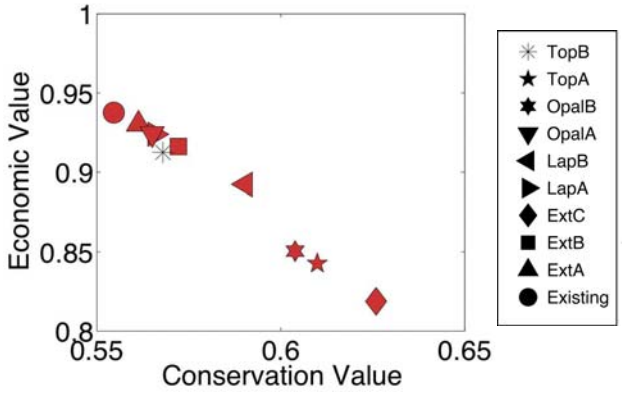
Model Results: Array Rankings

Unsuccessful Management



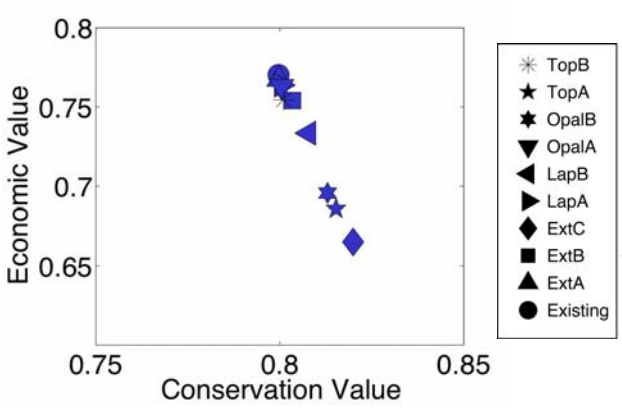
Model Results: Array Rankings

MSY-type Management



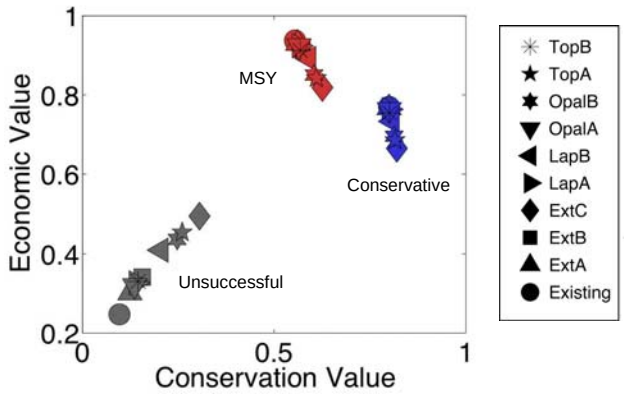
Model Results: Array Rankings

Conservative Management



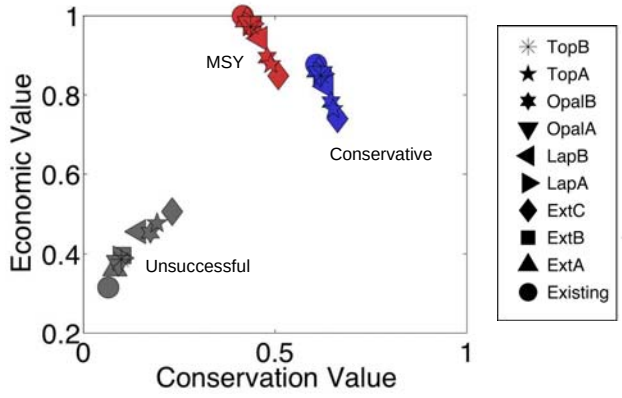
Model Results: Array Rankings

Combined Results - UCD



Model Results: Array Rankings

Combined Results - UCSB



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.