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Marine Life Protection Act Initiative

Spatial Bioeconomic Model Evaluations of Round 1 Proposed External MPA Arrays for the MLPA North Coast Study Region

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What Bioeconomic Models Do

INPUT	OUTPUT
Biology Oceanography Habitat Fishery Management MPAs (Fleet Response) (Weather)	Adult Biomass Larval Supply Fishery Yield (Connectivity)

Why Models?

- MPA size and spacing guidelines are presented as ranges of values that are minimum or maximum thresholds.
- Spatially explicit models augment the MPA size and spacing guidelines by:
  a) counting benefits of MPAs that are larger or closer to each other than size and spacing guidelines,
  b) evaluating contribution of MPAs that do not meet size and spacing guidelines,
  c) simultaneously assessing conservation and economic consequences of MPAs, and
  d) accounting for context (e.g., fleet dynamics, fishery management, location of habitat within MPAs).

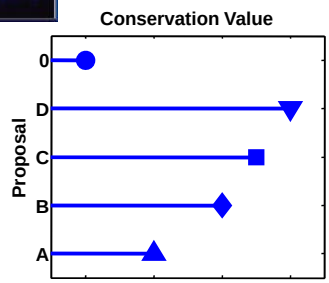
Model Inputs

- **Geographic**
  - Habitat maps
  - Ocean circulation
  - 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)
  - Egg-recruit or settler-recruit relationship
- **Fleet response**
  - Spatial abundance of fish
  - Distance from port

Model Outputs

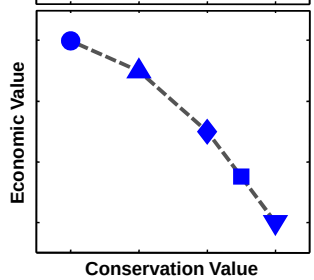
- All outputs are based on long-term steady states—*What will the system look like 30 to 50 or more years from now?*
- Each output is calculated for a range of assumptions about future fishery management outside MPAs:
  - Conservative management
  - Maximum sustainable yield (MSY)-type management
  - Unsuccessful management

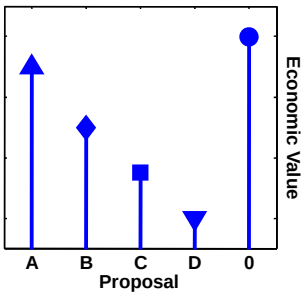
Model Results: Rankings in Context



Conservation and economic values vary together; plotting them together puts proposals in context.

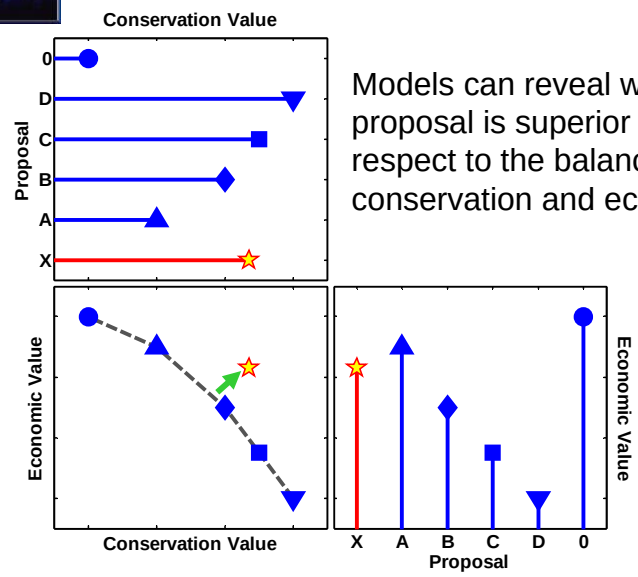
Choice of location along the conservation-economics curve is a matter of policy priorities.





Hypothetical example under MSY-type fishery management

Model Results: Rankings in Context



Models can reveal whether a proposal is superior to others with respect to the balance between conservation and economic values.

Hypothetical example under MSY-type fishery management

Model Description

- For Round 1, two models were used:
  - University of California, Davis (UCD)
  - University of California, Santa Barbara (UCSB)
- For Round 1, four species were modeled:
  - Black rockfish
  - Cabezon
  - Redtail surfperch
  - Red sea urchin

Consideration of Tribal Uses

- In Round 1, the SAT evaluated all MPAs that proposed allowing tribal uses only (including some SMCAs in ExC) as no-take SMRs because the SAT currently does not have sufficient information to consider tribal uses in evaluations.
- In subsequent rounds, the SAT will evaluate no-take areas as SMRs. MPAs that allow any type of consumptive uses will be evaluated according to the level of protection afforded by the suite of proposed uses.

Consideration of Mobile MPAs

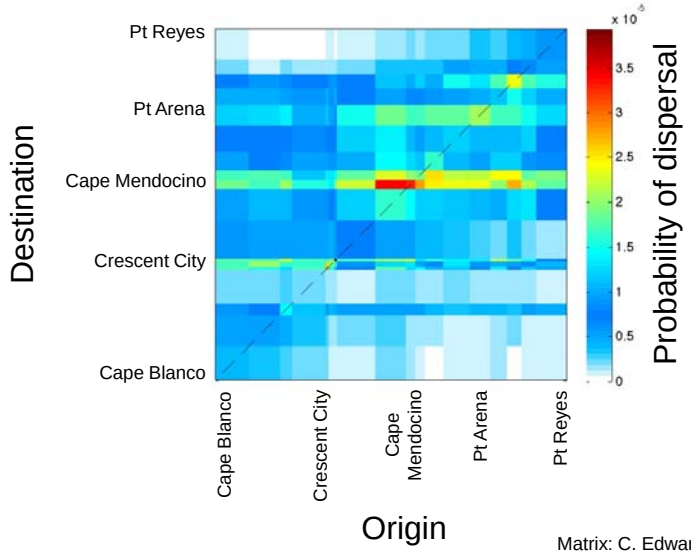
- Proposed External MPA Array A (ExA) proposed mobile MPAs that are intended to shift each year within a specified zone.
- For Round 1, these MPAs were consider static for the purpose of the modeling evaluation.
- In proposed External MPA Array A, the affected MPAs are:
  - Crescent City Mobile SMCA
  - Trinidad Mobile SMCA
  - Eureka Mobile SMCA
  - Shelter Cove Mobile SMCA
  - Noyo Mobile SMCA
  - Albion Mobile SMCA
  - Point Arena Mobile SMCA

Updates for Round 2

- Additional fine-scale habitat data will be included.
- UCSB and UCD models will be integrated.
- Three (3) more species will be modeled:
  - Red abalone
  - Brown rockfish
  - Dungeness crab
- External MPA Arrays will be rerun with updated data and model before next round.

Oceanographic Dispersal Matrix

Matrix for black rockfish (2000-2006 average)



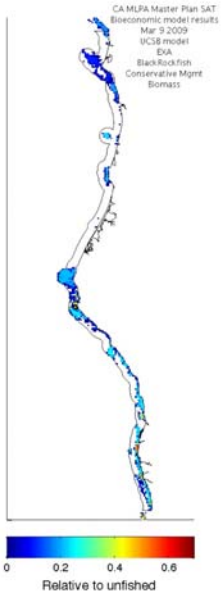
Matrix: C. Edwards & P. Drake, UCSC

Model Outputs

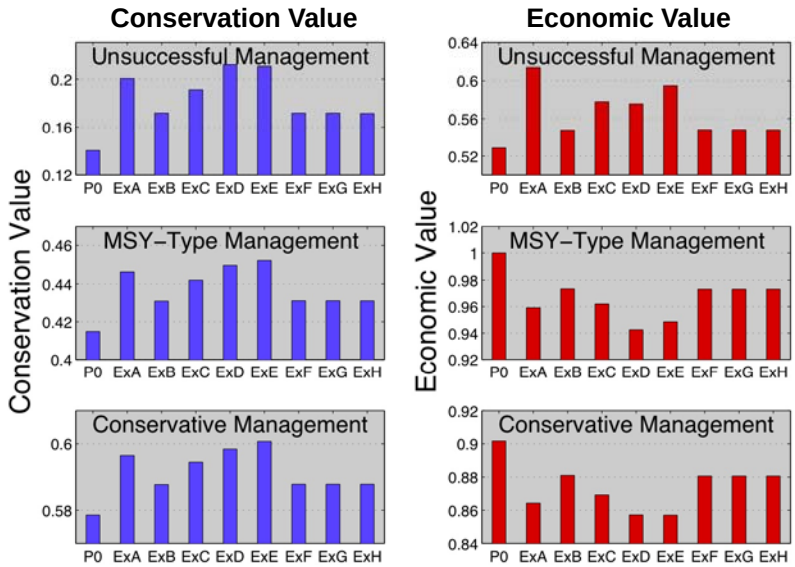
- **Conservation**
  - Maps of larval settlement and biomass
  - Total settlement and biomass (summed over study region, weighted sum across species)
- **Economic**
  - Maps of fishery yield
  - Total fishery yield (summed over study region, weighted sum across species)
- **Other Model Outputs**
  - Maps of fishing effort
  - Connectivity patterns that integrate larval production, dispersal, and settlement

Model Results: Black Rockfish Biomass

- Map represents predicted spatial distribution of biomass
- Outputs available for each:
  - Model species
  - Proposal
  - Management scenario
- Maps are posted online for:
  - Biomass
  - Fishery yield
  - Fishing effort
  - Larval production
  - Biomass for each MPA (deletion analysis)

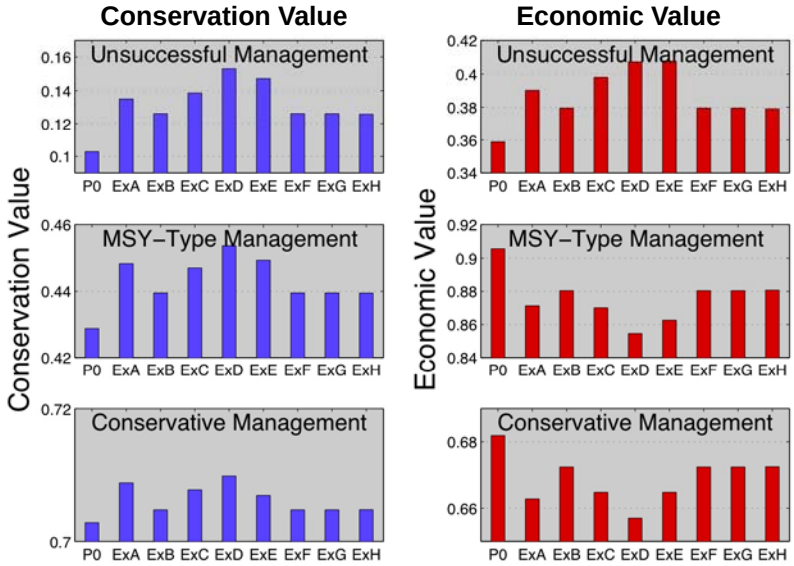


Model Outputs: Proposal Rankings



Round 1, UCSB Model

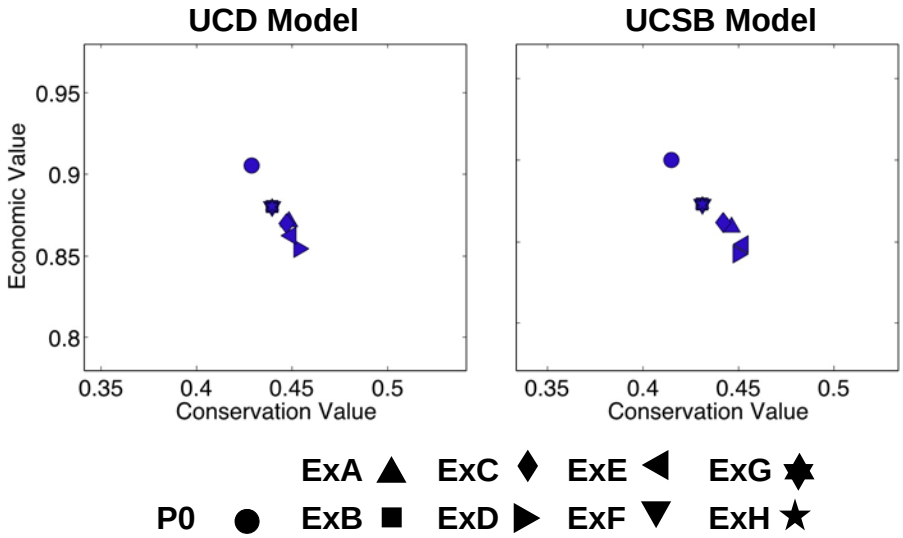
Model Outputs: Proposal Rankings



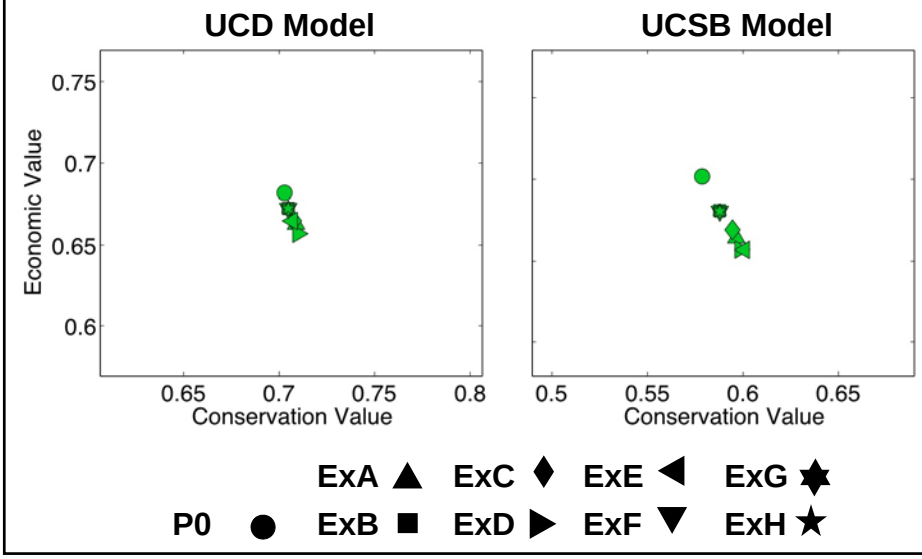
Round 1, UCD Model

Results: MSY-type Management

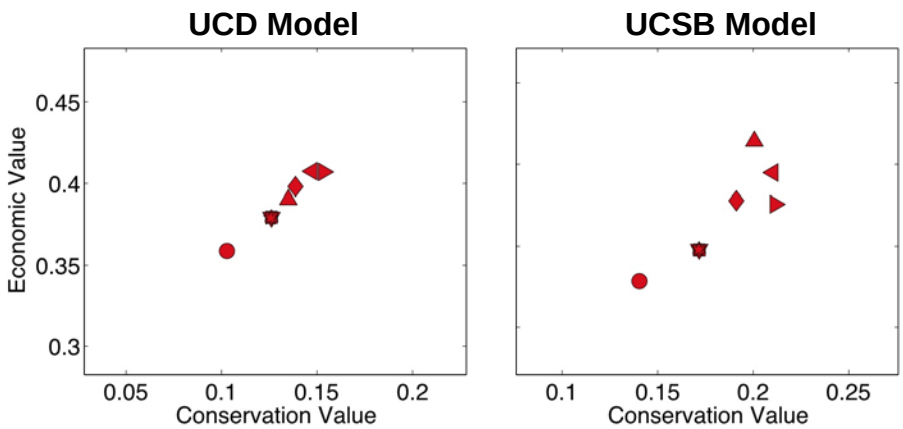
*MSY is Maximum Sustainable Yield



Results: Conservative Management

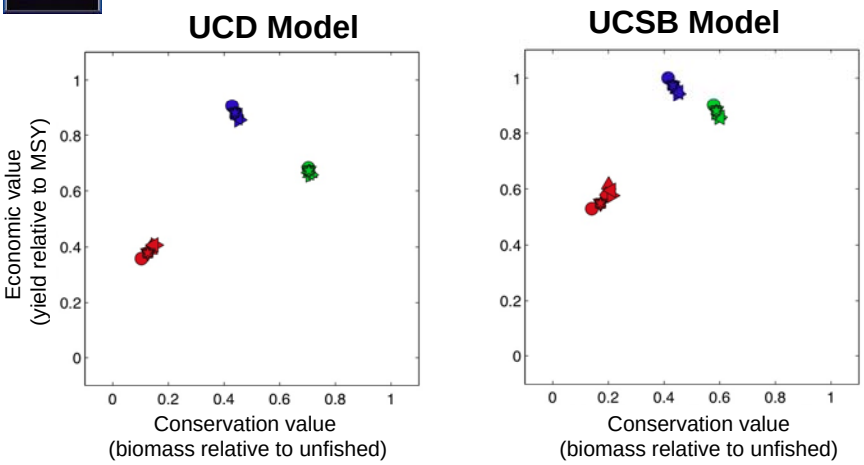


Results: Unsuccessful Management



ExA ▲ ExC ♦ ExE ◀ ExG ✸
P0 ● ExB ■ ExD ▶ ExF ▼ ExH ★

Results: All Scenarios



ExA ▲ ExC ♦ ExE ◀ ExG ✸
P0 ● ExB ■ ExD ▶ ExF ▼ ExH ★

Conclusions

- Assumptions about **fishery management** outside MPAs influenced the outcomes more than differences between proposed External MPA Arrays.
- **ExA, ExD, ExE** and **ExC** consistently had highest* conservation value; rank order varied among models and management assumptions.
- **Ex0, ExB, ExF, ExG** and **ExH** had highest* economic value for all models under MSY-type or conservative management.
- **ExA** and **ExE** (UCSB model) or **ExD** and **ExE** (UCD model) had the highest* economic value under unsuccessful management.
- All model outputs from Round 1 evaluations posted to MLPA website (www.dfg.ca.gov/mlpa)

**Outputs focus on 4 species: Black rockfish, cabezon, redtail surfperch, and red sea urchin.*