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Marine Life Protection Act Initiative

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

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Dr. Eric Bjorkstedt, Co-chair • MLPA Master Plan Science Advisory Team

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What Bioeconomic Models Do

INPUT

Biology
Oceanography
Habitat
Fishery Management
Marine Protected Areas (MPAs)
(Fleet Response)
(Weather)

OUTPUT

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:
  - counting benefits of MPAs that are larger or closer to each other than size and spacing guidelines
  - evaluating contribution of MPAs that do not meet size and spacing guidelines
  - simultaneously assessing conservation and economic consequences of MPAs
  - 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

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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

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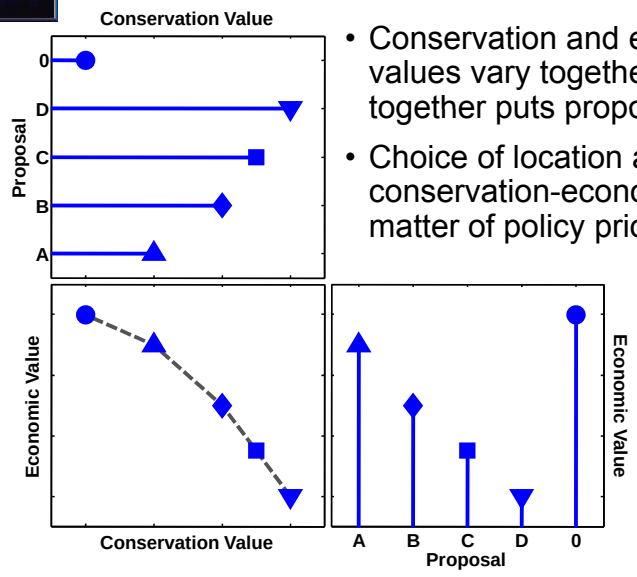
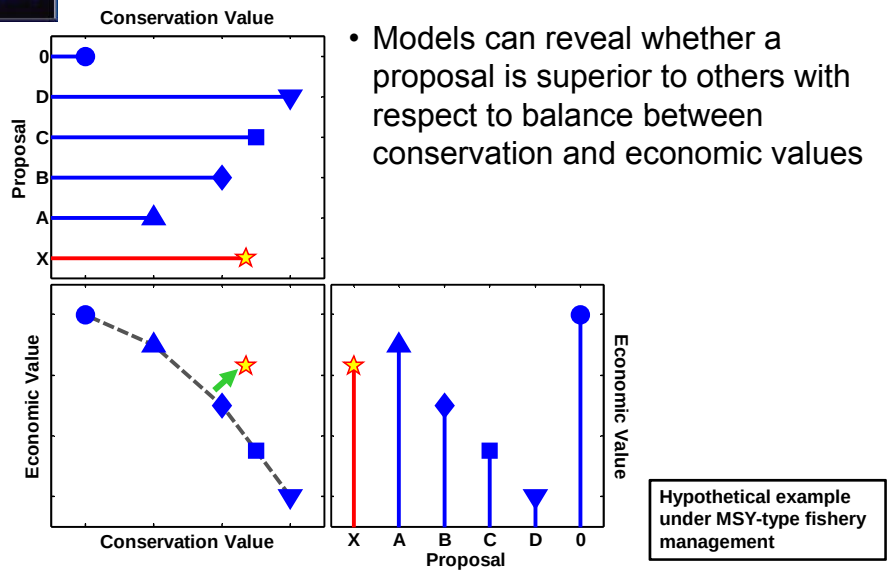
Model Results: Rankings in Context



- 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 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

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Consideration of Tribal Uses

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

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Consideration of Mobile MPAs

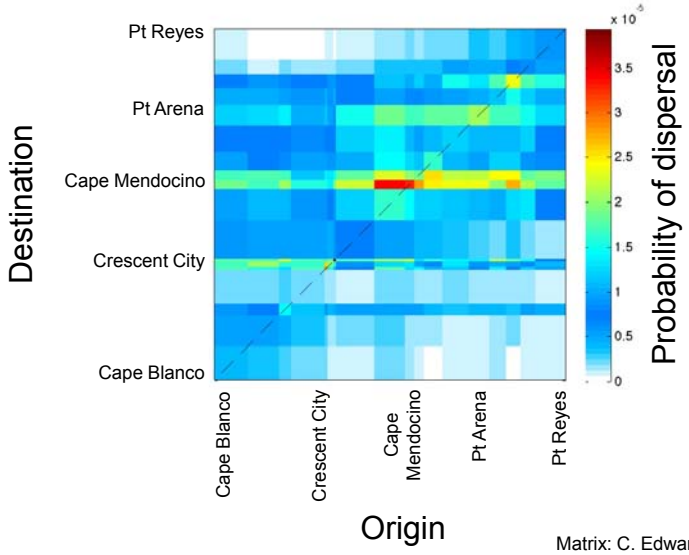
- External MPA Array A (ExA) proposed mobile MPAs that are intended to shift each year within a specified zone
- For Round 1, mobile MPAs considered static for the purpose of modeling evaluation
- In External MPA Array A, affected MPAs are:
  - Crescent City Mobile SMCA
  - Trinidad Mobile SMCA
  - Eureka 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 re-run with updated data and model before Round 2

Oceanographic Dispersal Matrix

Matrix for black rockfish (2000-2006 average)



Matrix: C. Edwards & P. Drake, UCSC

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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

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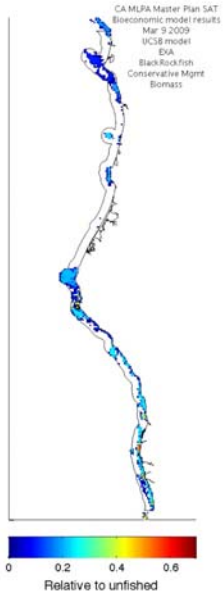
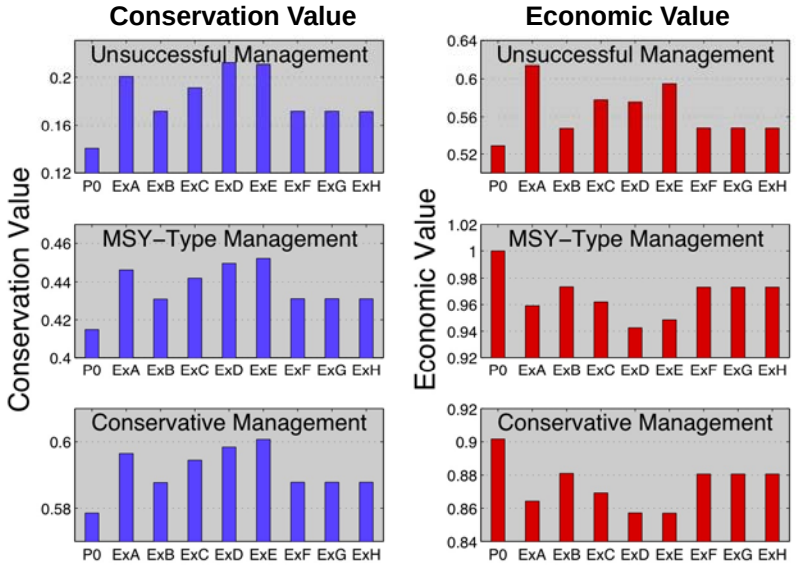
Model Results: Black Rockfish Biomass

- 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)

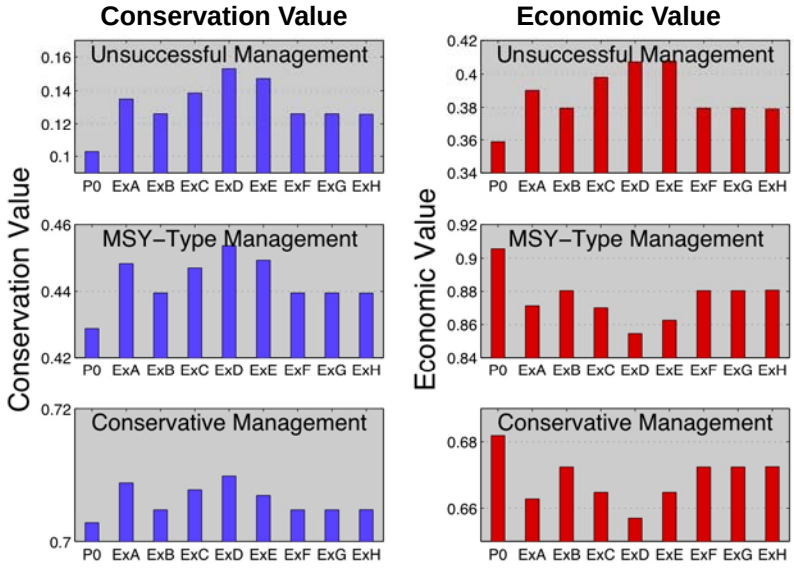


Model Outputs: Proposal Rankings



Round 1, UCSB Model

Model Outputs: Proposal Rankings



Round 1, UCD Model

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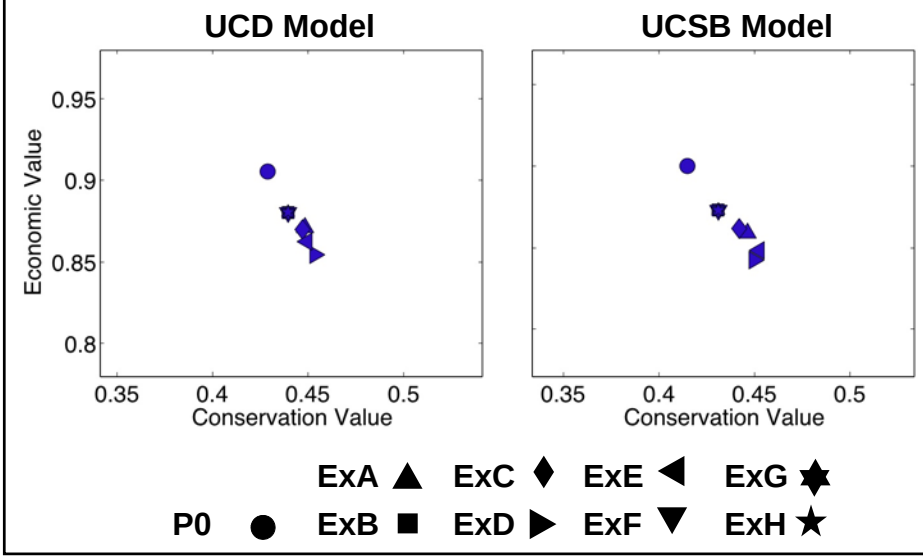
Results: MSY-type Management

*MSY is Maximum Sustainable Yield



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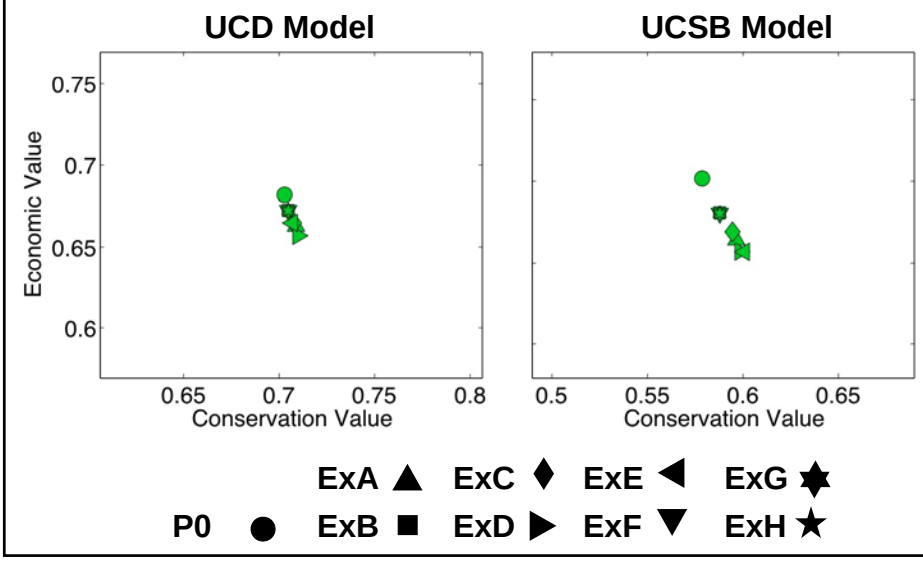
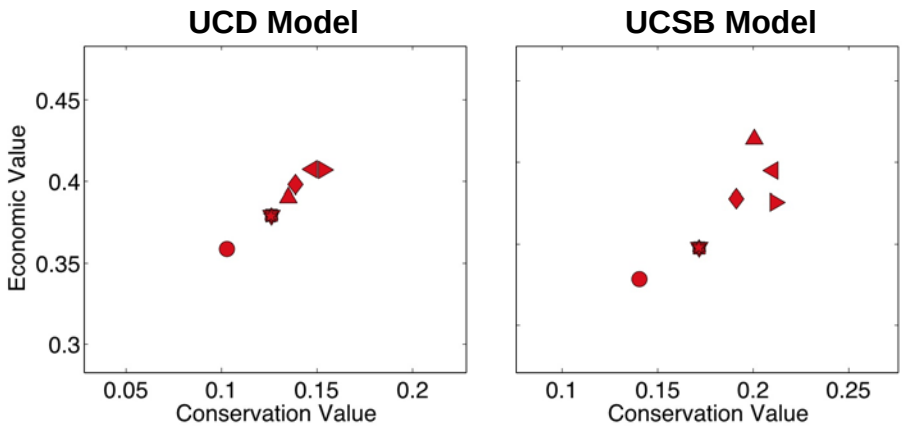
Results: Conservative Management

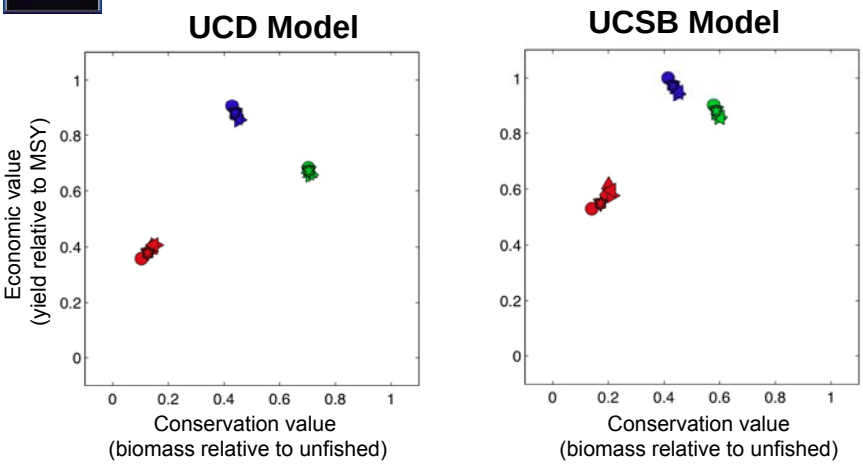


Results: Unsuccessful Management



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.*