# Marine Life Protection Act Initiative

## Spatial Bioeconomic Models for Evaluating Marine Protected Area Proposals

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**Presentation to the MLPA Master Plan Science Advisory Team**
**January 27, 2009 • Los Angeles, CA**

# Value of Models in MLPA Process

- MPA proposals **must ensure population persistence** to meet MLPA goals
- **Existing guidelines and evaluation tools** attempt to address this requirement (e.g., size and spacing guidelines)
- **Size and spacing guidelines** do not comprehensively assess the combined effects of
  - Conditions outside MPAs (harvest)
  - Spatial population structure, adult movement, and larval connectivity
  - Dynamic responses to protection or harvest outside MPAs

# Value of Models in MLPA Process

- **Spatially explicit bioeconomic models** account for these factors and also include
  - Contributions from MPAs that do not meet size and spacing guidelines
  - Status and management of fished populations outside of MPAs
  - Tradeoffs (cost or benefit) between conservation and economic returns

# 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)

# Model Inputs

- Other
  - Oceanography:  Multiple years of flow data with variable patterns
  - Behavior of fishing fleet in response to fish abundance
  - Fishery management outside of MPAs

# 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

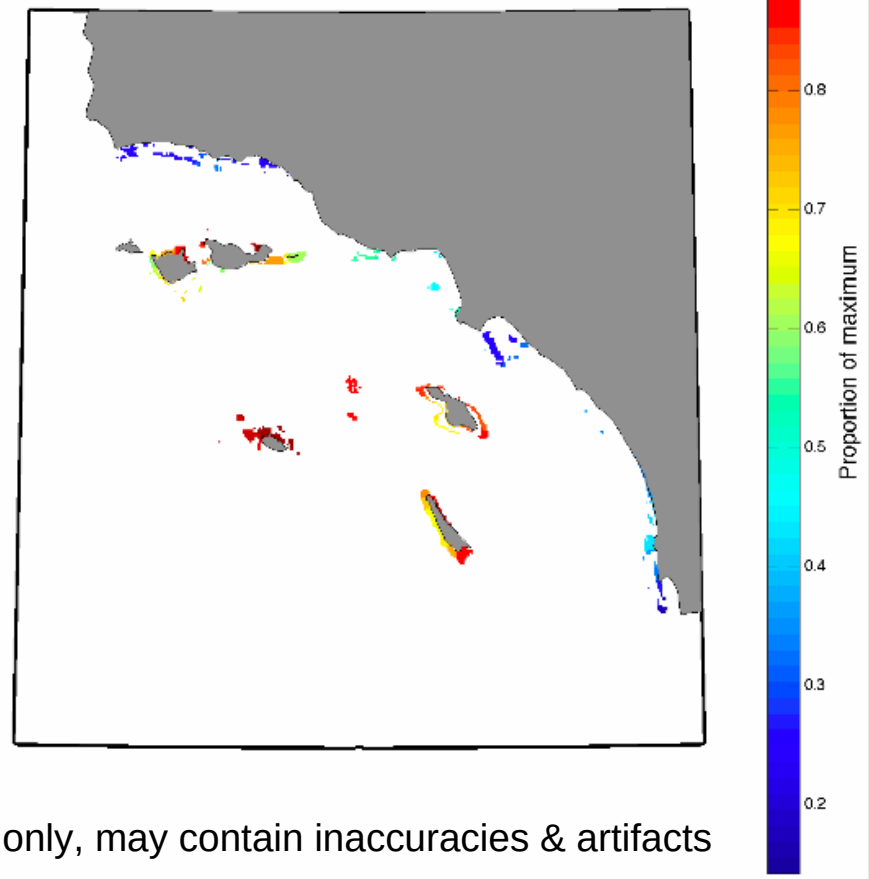
- **Other Data**
  - Spatial distribution of fishing effort
  - Larval connectivity patterns
- *All outputs are based on long-term equilibria*
- *Each output is calculated for a range of assumptions about future fishery management outside MPAs*[1]

[1]For complete list of assumptions, see evaluation methods document, Chapter 9, Appendix 1.

# Example Results[1]

## Spatial Distribution of Larval Settlement

- **Species**: Kelp Bass
- **Management Assumption**: Poor management outside MPAs
- **Larval Dispersal Data**: Mean of ROMS model years 1996-2002

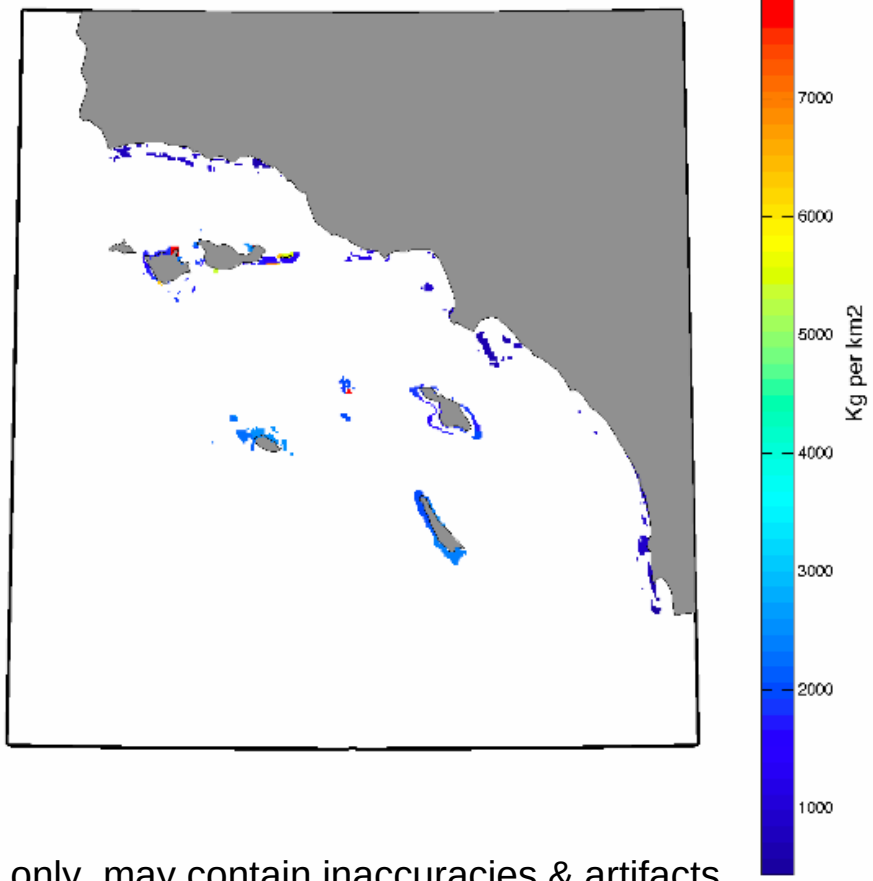



[1]UC Davis Model, preliminary example results only, may contain inaccuracies & artifacts

# Example Results[1]

## Spatial Distribution of Adult Biomass

- **Species**: Kelp Bass
- **Management Assumption**: Poor management outside MPAs
- **Larval Dispersal Data**: Mean of ROMS model years 1996-2002

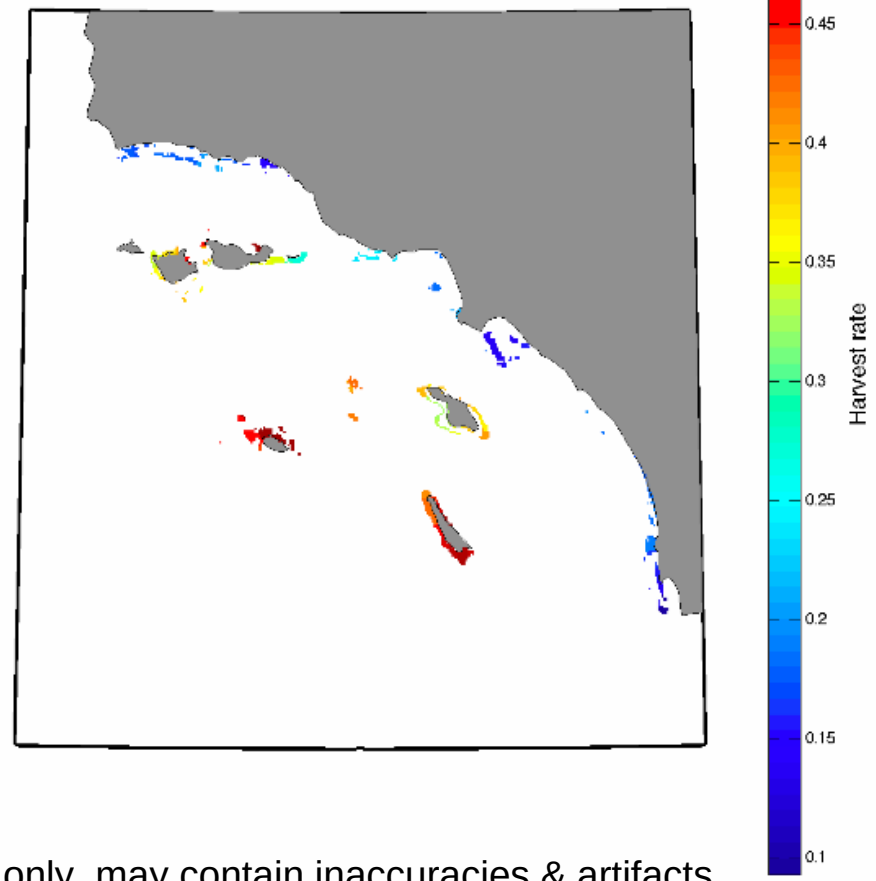



[1]UC Davis Model, preliminary example results only, may contain inaccuracies & artifacts

# Example Results

## Spatial Distribution of Fishing Effort

- **Species**: Kelp Bass
- **Management Assumption**: Poor management outside MPAs
- **Larval Dispersal Data**: Mean of ROMS model years 1996-2002

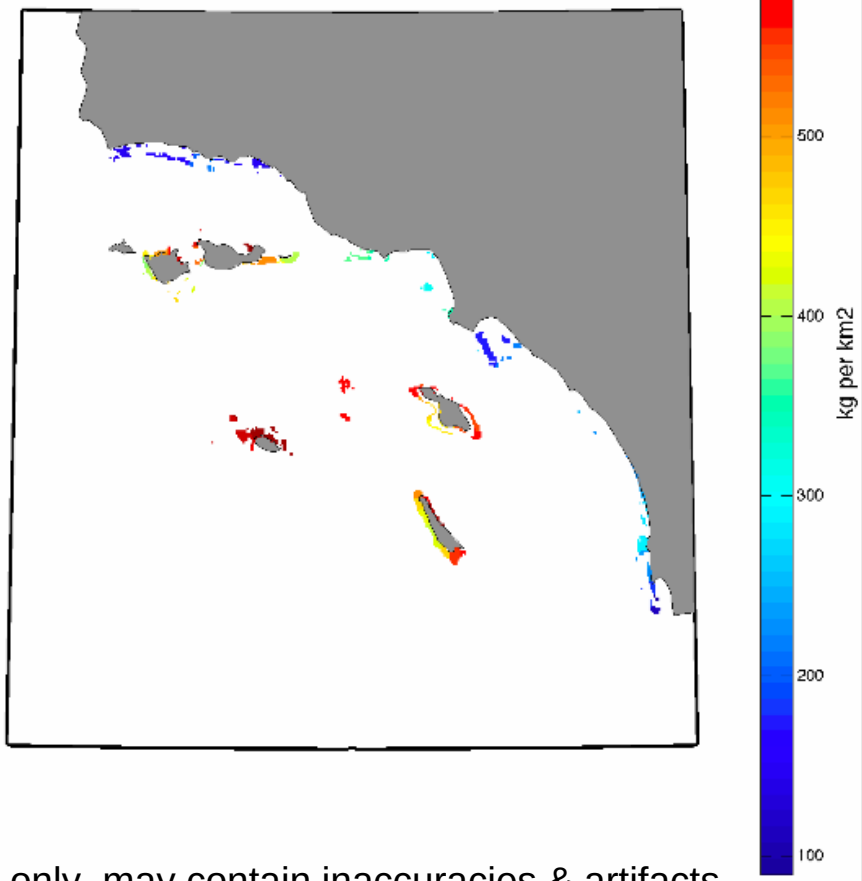



[1]UC Davis Model, preliminary example results only, may contain inaccuracies & artifacts

# Example Results[1]

## Spatial Distribution of Fishery Yield

- **Species**: Kelp Bass
- **Management Assumption**: Poor management outside MPAs
- **Larval Dispersal Data**: Mean of ROMS model years 1996-2002




[1]UC Davis Model, preliminary example results only, may contain inaccuracies & artifacts

# Example Evaluation of Proposals

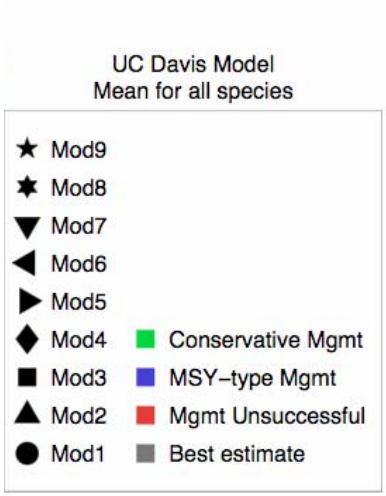
- To demonstrate modeling outputs, performed a “dummy” experiment using the existing MLPA South Coast Study Region MPAs
- Baseline for comparison:  Existing MPAs
- Nine example “proposed” MPA network components

# Example Evaluation of Proposals

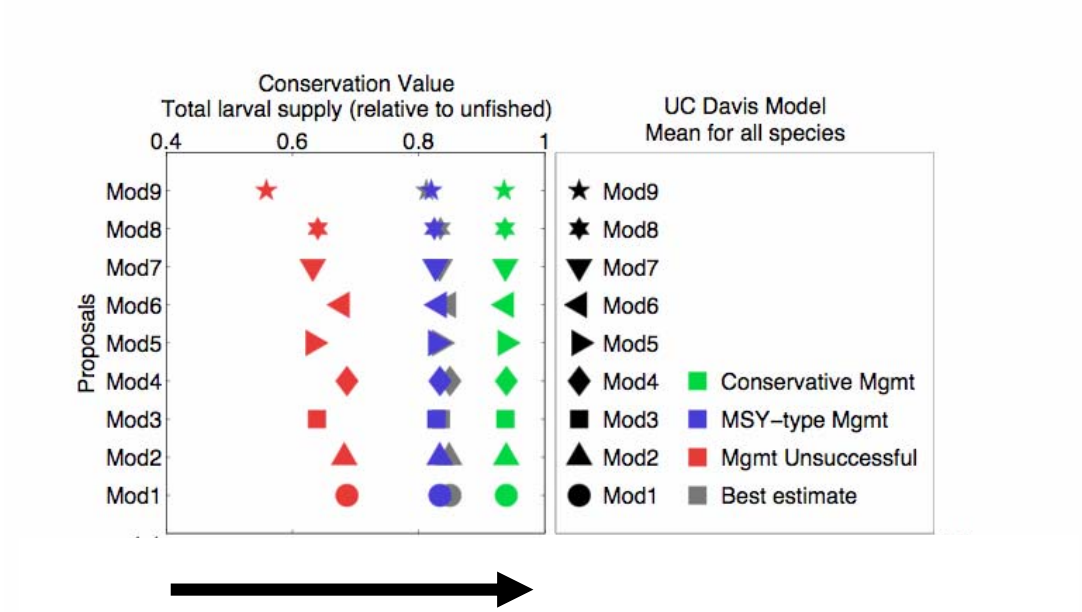
- **Each "proposal"** generated by removing 1, 3 or 5 MPAs from the Channel Islands area
- **9 arbitrary "proposals"** generated to show range of values for conservation and economic returns
- **Examples illustrate outputs** prior to submission of actual MPA proposals
- **Results are highly sensitive** to assumptions about fishery management outside of MPAs
- **For actual evaluation**, must include various future fishery management scenarios

# Example Evaluation of Proposals

- 9 proposals (“Mod1” – “Mod9”)
- 3 future management scenarios
- +1 best estimate of future scenario

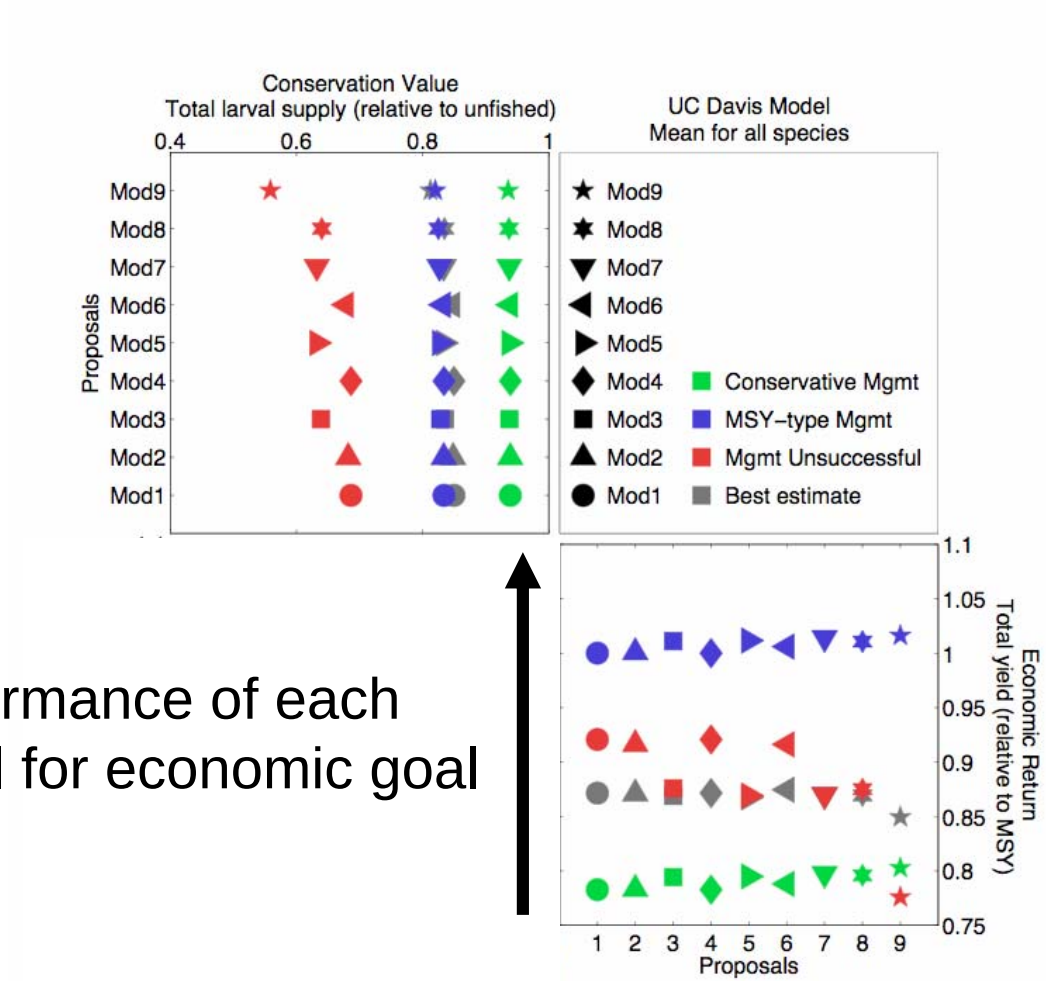


# Example Evaluation of Proposals




Performance of each proposal
for conservation goal

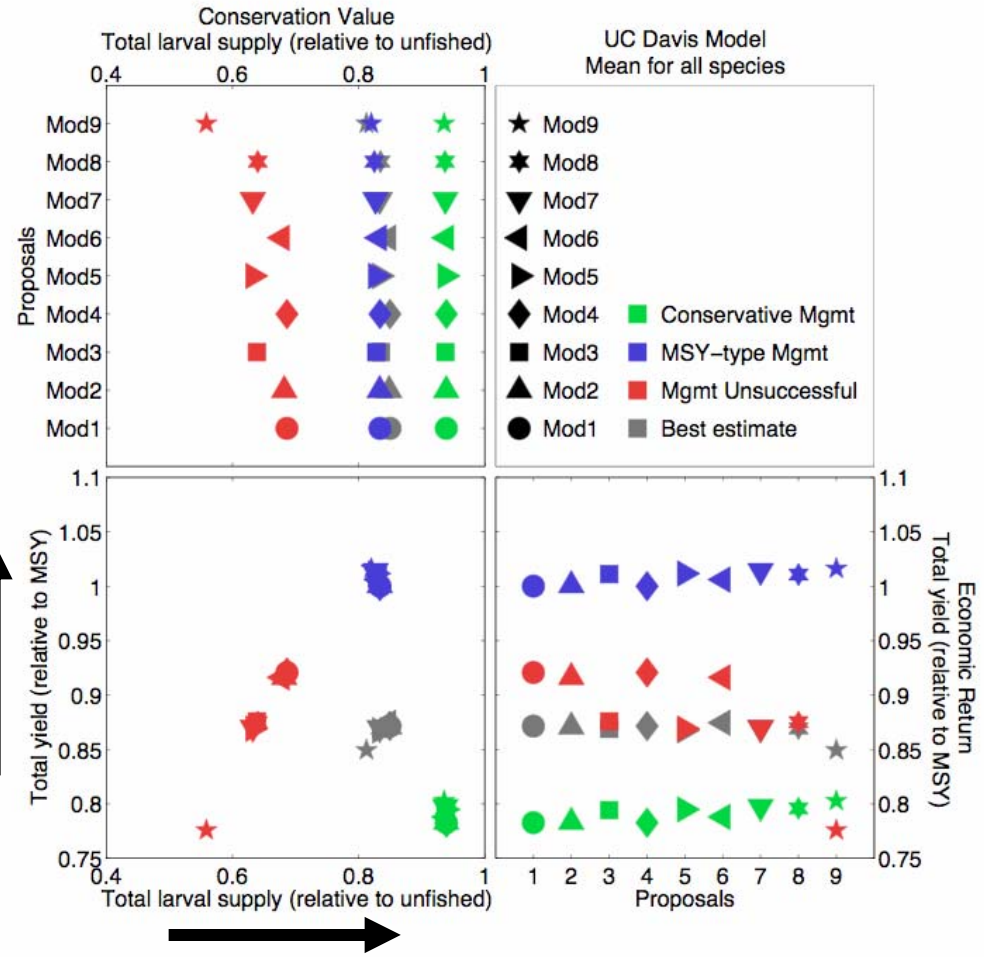
# Example Evaluation of Proposals




Performance of each proposal for economic goal

# Example Evaluation of Proposals

Potential tradeoffs between conservation and economic goals



# Summary: Models as Evaluation Tools

- Spatially explicit bioeconomic models are **conceptually similar to size and spacing guidelines** in intent, but provide:
  - More comprehensive evaluation considering population dynamics and connectivity.
  - More direct evaluation (e.g., no size or spacing thresholds)

# Summary: Models as Evaluation Tools

- **Models provide a framework** for:
  - Evaluating MPA proposals
  - Providing feedback to stakeholders for alteration/improvement of MPA proposals
- **SAT Modeling Work Group recommends**:
  - Size and spacing guidelines be used as a **starting point** for MPA design
  - Modeling provides a more **integrated** and **comprehensive** approach for subsequent evaluations and future MPA design efforts