Marine Life Protection Act Initiative

Marine Protected Area Modeling Evaluation

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Presentation to the MLPA Master Plan Science Advisory Team

January 23, 2009 • Conference call

Description of Models

- Use spatial data on habitat, fishery effort, and proposed marine protected area (MPA) locations and regulations

- Simulate population dynamics of fished species

- Generate predicted spatial distributions of conservation value and economic return for each MPA proposal

Key Changes to Models

- Two-dimensional
- Run for approximately10 representative species from southern California
- Improved larval dispersal kernel
- Spatial and temporal variability in larval dispersal
- Fleet dynamics based on fishery data

Model Elements

- Larval dispersal across patches driven by ocean currents, pelagic larval duration, and spawning season
- Larval settlement regulated to suitable habitat
- Post-settlement density-dependent mortality
- Growth and survival dynamics of the resident (adult) population
- Reproductive output increasing with adult size
- Adult movement (e.g., home ranges)
- Harvest in areas outside of MPAs

Summary of Assumptions[1]

- Larval dispersal: Adults spawn larvae within each habitat cell, potential movement estimated from ROMS

- Larval settlement: Limited by habitat availability, post-settlement mortality depends on intra-cohort density

- Growth and survival: Based on published data, egg production proportional to fish weight

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

Summary of Assumptions[1] (cont.)

- Adult movement: Move within home ranges[2,3] and to new home ranges[3]

- Fishing pressure: Fishing effort equal across space, redistributed after MPAs established[2]; fishers maximize profits[3]

[1]For complete list of assumptions, see evaluation methods document, Chapter 9, Appendix 1.
[2]University of California, Davis model
[3]University of California, Santa Barbara model

Model Outputs

- Conservation Value for ~10 species
  - Biomass[1,2]
  - Larval supply[1] (a proxy measure of population sustainability)
- Economic Return for ~10 species
  - Fish yield[1,2]
  - Fisheries profit[2]

[1]University of California, Davis model
[2]University of California, Santa Barbara model

Context for Model Evaluation

- Spatial and region-wide effects on conservation value[1]

- Spatial and region-wide effects on economic return[1]

- Spatial effects on recruitment[1]

- Spatial fishing intensity[1]

- Connectivity

- Trade-offs (plot of conservation value against economic return)

[1]For each model species and a weighted average of all model species