# Marine Life Protection Act Initiative

## Spatial Bioeconomic Model Evaluations of Round 2 MPA Proposals

**Presentation to the MLPA Blue Ribbon Task Force**
**July 28, 2009 • Santa Monica, CA**

**Presented by Dr. Christopher Costello**
**MLPA Master Plan Science Advisory Team**

## 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

- **Substrate Map**
  - Uses combination of high- and low-resolution habitat data and kelp data to reflect the best available indication of hard habitat in each location
- **Fishing Fleet Model**
  - Original model: Fleet responds to spatial abundance of fish
  - Updated model: Based on data compiled by Ecotrust
  - Updated model: Fleet responds to
    1. spatial abundance of fish
    2. distance from port
    3. higher effort further south in study region (UC Davis model only)

## Model Inputs: Species

- Ocean Whitefish
- Black Surfperch
- Opaleye
- Kelp Bass
- Kelp Rockfish
- California Sheephead
- California Halibut
- Red Sea Urchin

## 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 fishery yield
  - Total fishery yield (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 8, Appendix B.

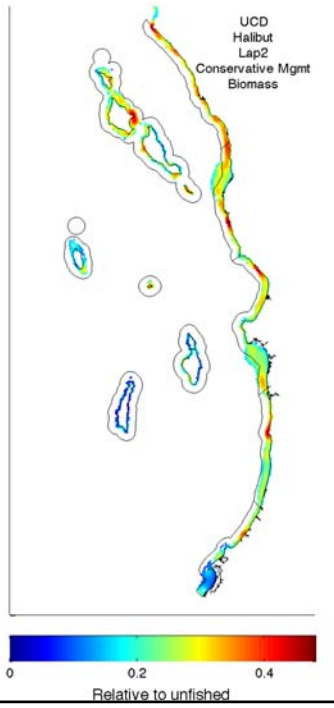
# Model Results

## Spatial Distribution of Biomass

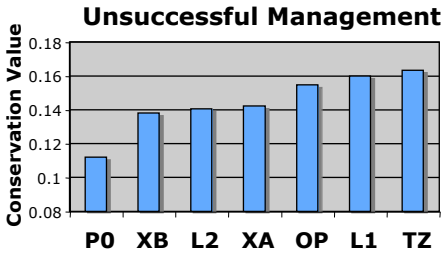
(Maps also available for recruitment, fishery yield and fishing effort)

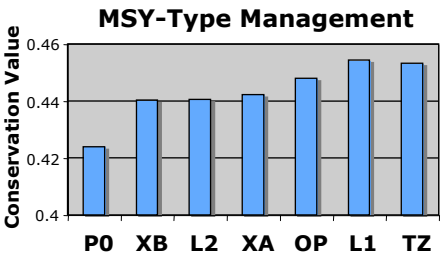
- **Example species**: Halibut
- **Example proposal**: Lapis 2
- **Management assumption***: Conservative management outside MPAs

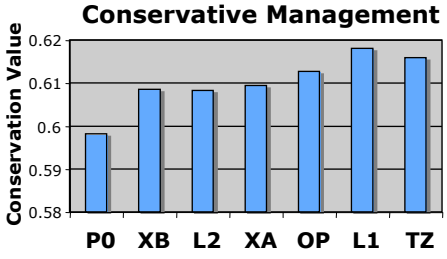
*Also run for "Unsuccessful Management" and "Maximum Sustainable Yield" (MSY-type) management




# UCSB Model Results: Original Fleet Model



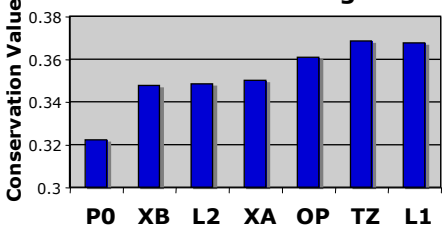




Rankings for conservation value are similar across fishing scenarios and models.

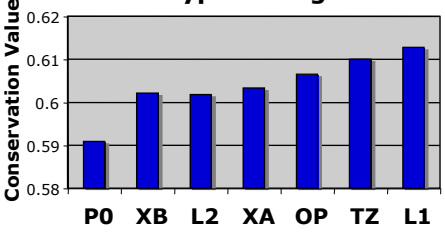
P0 = existing MPAs, L1 = Lapis 1, L2 = Lapis 2, OP = Opal, TZ = Topaz, XA = External A, XB = External B

## UCSB Model Results: Revised Fleet Model

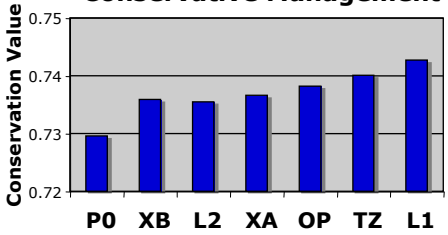
**Unsuccessful Management**




**MSY-Type Management**




**Conservative Management**

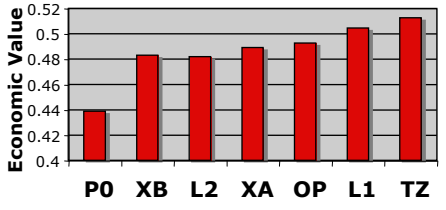



Rankings are similar across management scenarios, models and choice of fleet model.

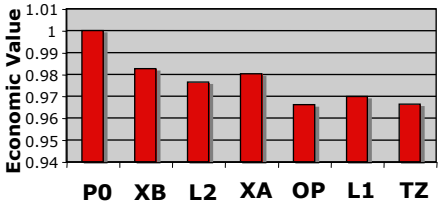
P0 = existing MPAs, L1 = Lapis 1, L2 = Lapis 2, OP = Opal, TZ = Topaz, XA = External A, XB = External B

## UCSB Model Results: Original Fleet Model

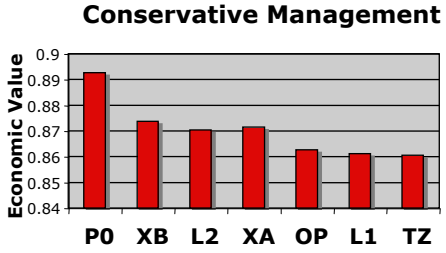
**Unsuccessful Management**




**MSY-Type Management**




**Conservative Management**

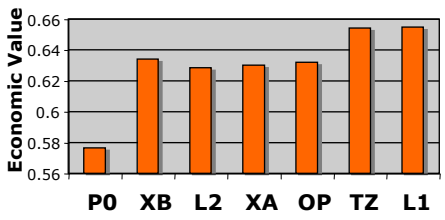



- Rankings for economic value preserved across models and for "MSY-Type" and "conservative" management.
- Rankings are reversed under "unsuccessful management."

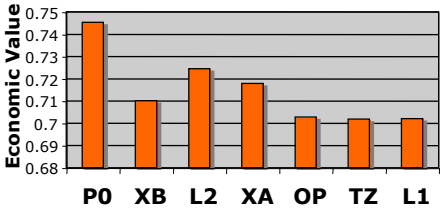
P0 = existing MPAs, L1 = Lapis 1, L2 = Lapis 2, OP = Opal, TZ = Topaz, XA = External A, XB = External B

## UCD Model Results: Revised Fleet Model

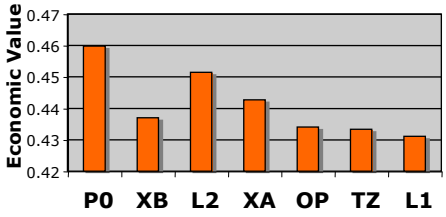
**Unsuccessful Management**




**MSY-Type Management**




**Conservative Management**

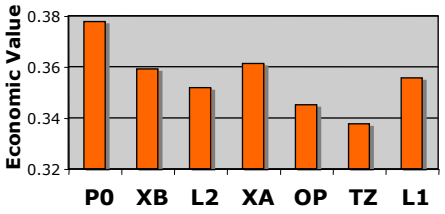



- Rankings are similar across management scenarios, except with unsuccessful management.
- Results similar to original fleet model.

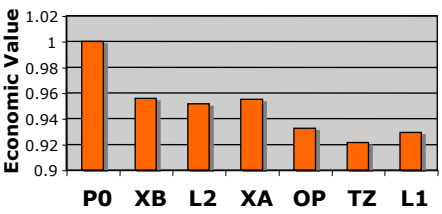
P0 = existing MPAs, L1 = Lapis 1, L2 = Lapis 2, OP = Opal, TZ = Topaz, XA = External A, XB = External B

## UCSB Model Results: Revised Fleet Model

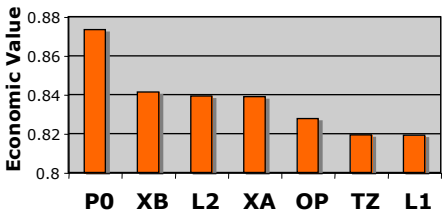
**Unsuccessful Management**




**MSY-Type Management**



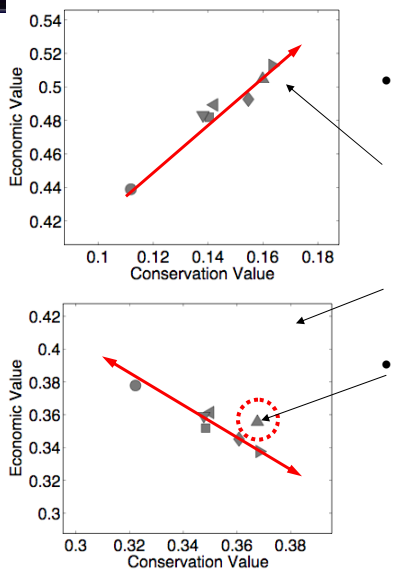

**Conservative Management**




- Rankings are similar across management scenarios, even with “unsuccessful management”.

P0 = existing MPAs, L1 = Lapis 1, L2 = Lapis 2, OP = Opal, TZ = Topaz, XA = External A, XB = External B

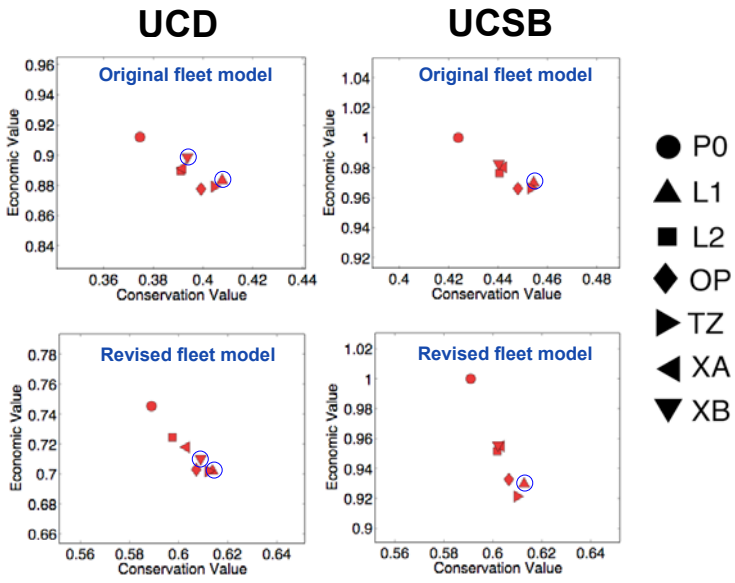
# How to Interpret Model Results




- Examine rankings for both variables simultaneously, asking:
  - Do some proposals have good scores for both economic and conservation value?
  - Or is there a trade-off between the two variables?
- Look for proposals **up** and to the **right** of the trade-off "frontier" (better than average in both variables).

# Model Results: MSY Type Management

- Trade-off in all cases.
- Lapis 1 and External B are **up** and **right** of the frontier.

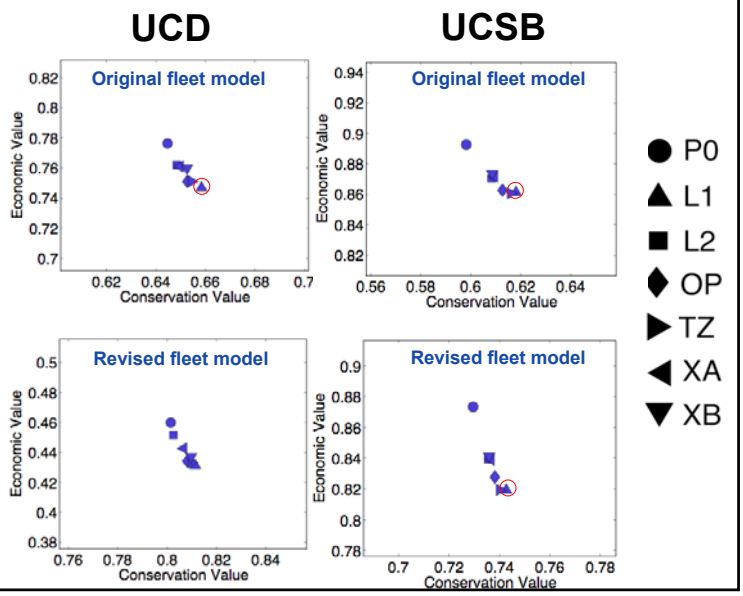



P0 = existing MPAs
L1 = Lapis 1
L2 = Lapis 2
OP = Opal
TZ = Topaz
XA = External A
XB = External B

## Model Results: Conservative Management

- Trade-off in all cases.
- L1 is barely **up** and **right** of the frontier.

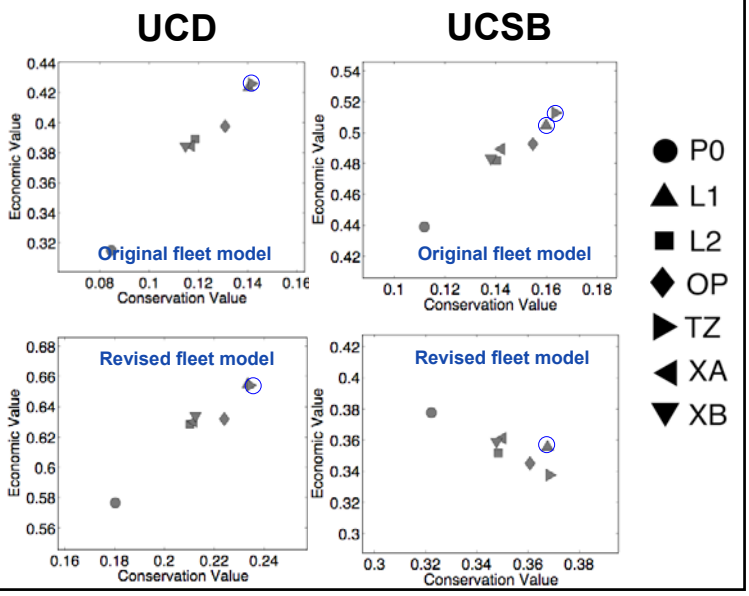
P0 = existing MPAs
L1 = Lapis 1
L2 = Lapis 2
OP = Opal
TZ = Topaz
XA = External A
XB = External B




## Model Results: Unsuccessful Management

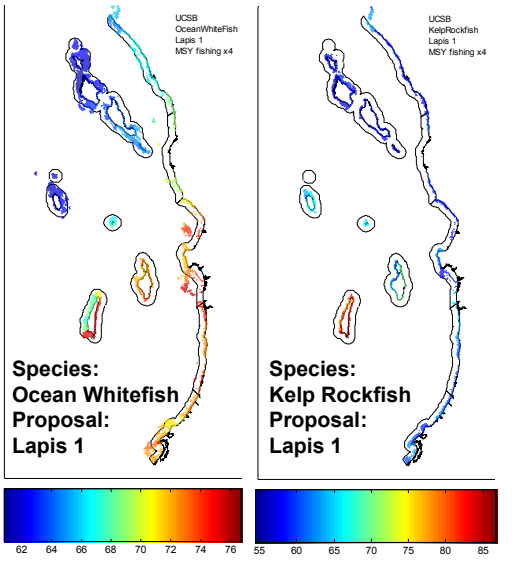
- **UCD and original UCSB fleet model:** No trade-off, Lapis 1 and Topaz perform best
- **Revised UCSB fleet model:** Trade-off, Lapis 1 is **up** and **right** of the frontier

P0 = existing MPAs
L1 = Lapis 1, L2 = Lapis 2,
OP = Opal, TZ = Topaz,
XA = External A, XB = External B



# Results: Changes in Settlement

- Maps show percent **increase in settlement**, relative to Proposal 0.
- Settlement typically increases everywhere with the addition of MPAs.
- Lower values could be improved by adding MPA area to source locations.
- Maps are available for each species, MPA proposal and level of fishing.




# Conclusions

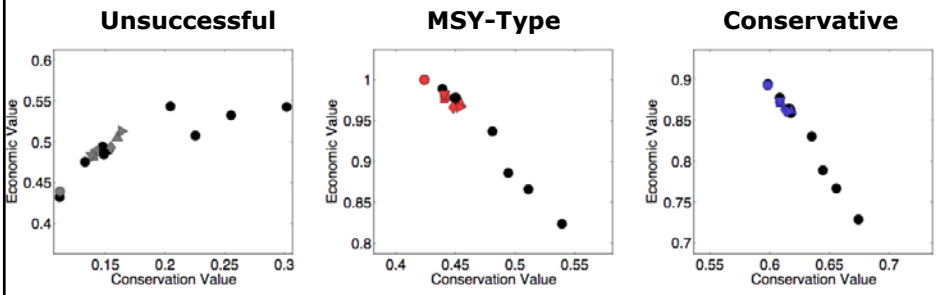
- Ranking of MPA proposals for conservation value is relatively insensitive to (1) model, (2) assumption about fishery management and (3) choice of fleet model.
- **Lapis 1** or **Topaz** had the highest predicted conservation value under all scenarios for both models.
- Rankings for economic value depend on (1) management scenario (reversed for unsuccessful management) and (2) fleet model.
- **External A** and **Lapis 2** had the highest predicted economic value for "MSY-Type Management" and "Conservative Management."

## Conclusions, continued

- Under "Unsuccessful Management," **Lapis 1** and **Topaz** had high predicted economic values, except in UCSB's revised fleet model, where economic values were similar, with **Lapis 1**, **External A** and **External B** performing best.
- **Lapis 1** usually had better than average values for both conservation and economic value.

Note: All model outputs from Round 2 evaluations are at MLPA website (www.dfg.ca.gov/mlpa).

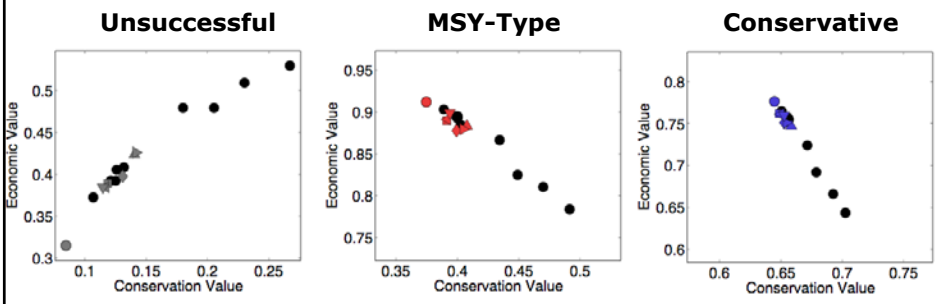
## Round 1 and Round 2 Results




- Round 1 (black circles) and Round 2 (colored markers)
- Round 2 proposals had lower conservation values, on average

From: UCSB model, run with original fleet model and updated habitat layer

# Round 1 and Round 2 Results




- Round 1 (black circles) + Round 2 (colored markers)
- Round 2 proposals had lower conservation values, on average

From: UCD model, run with original fleet model and updated habitat layer