Model Evaluations of April 2008 North Central Coast MPA Proposals

MLPA Master Plan Science Advisory Team
Modeling Sub-team

MLPA I-team staff, Bjorkstedt, Botsford, Costello, Gaines, Hilborn, Walters, White

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Basic model features

- Spatially-explicit habitat data, MPA locations, larval dispersal, adult home range, dynamics to equilibrium
- Predict equilibrium spatial larval supply, biomass, harvest

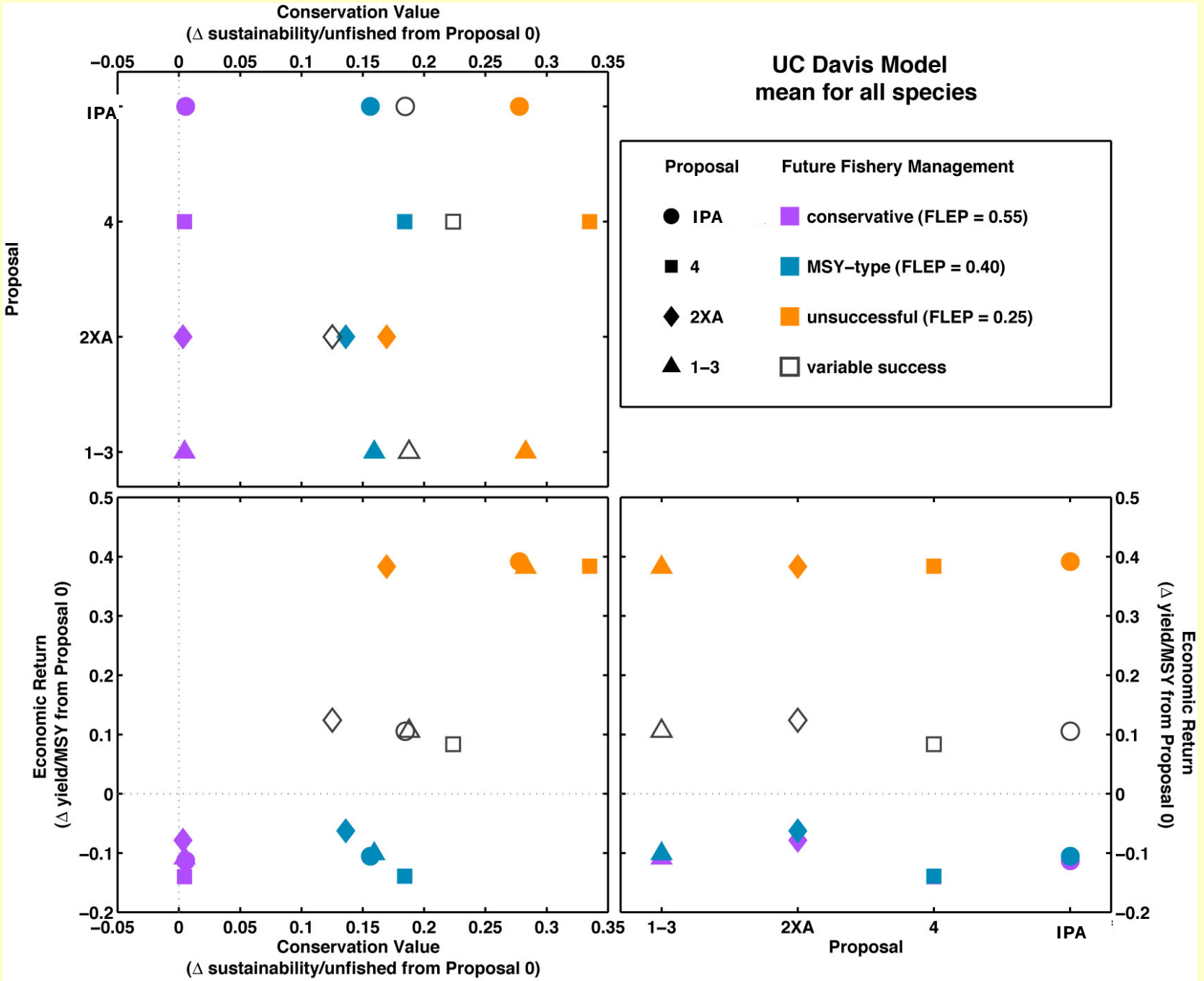
- Critical question: Future management in open areas?
- Scenarios considered:
  1. Conservative (both models)
  2. Maximum Sustainable Yield (MSY) -type (both models)
  3. Unsuccessful (both models)
  4. Current management as predictor of future (UCD only)
  5. Spatially optimized for economic returns (EDOM only)

Changes from last time…

- Presented results at BRTF meeting in April
- Key changes/additions
  - Scaled results so could easily discern differences among proposals - all are relative to Proposal 0
  - Added spatial results from both models over a range of fishery management scenarios
- Added Integrated Preferred Alternative to the comparison

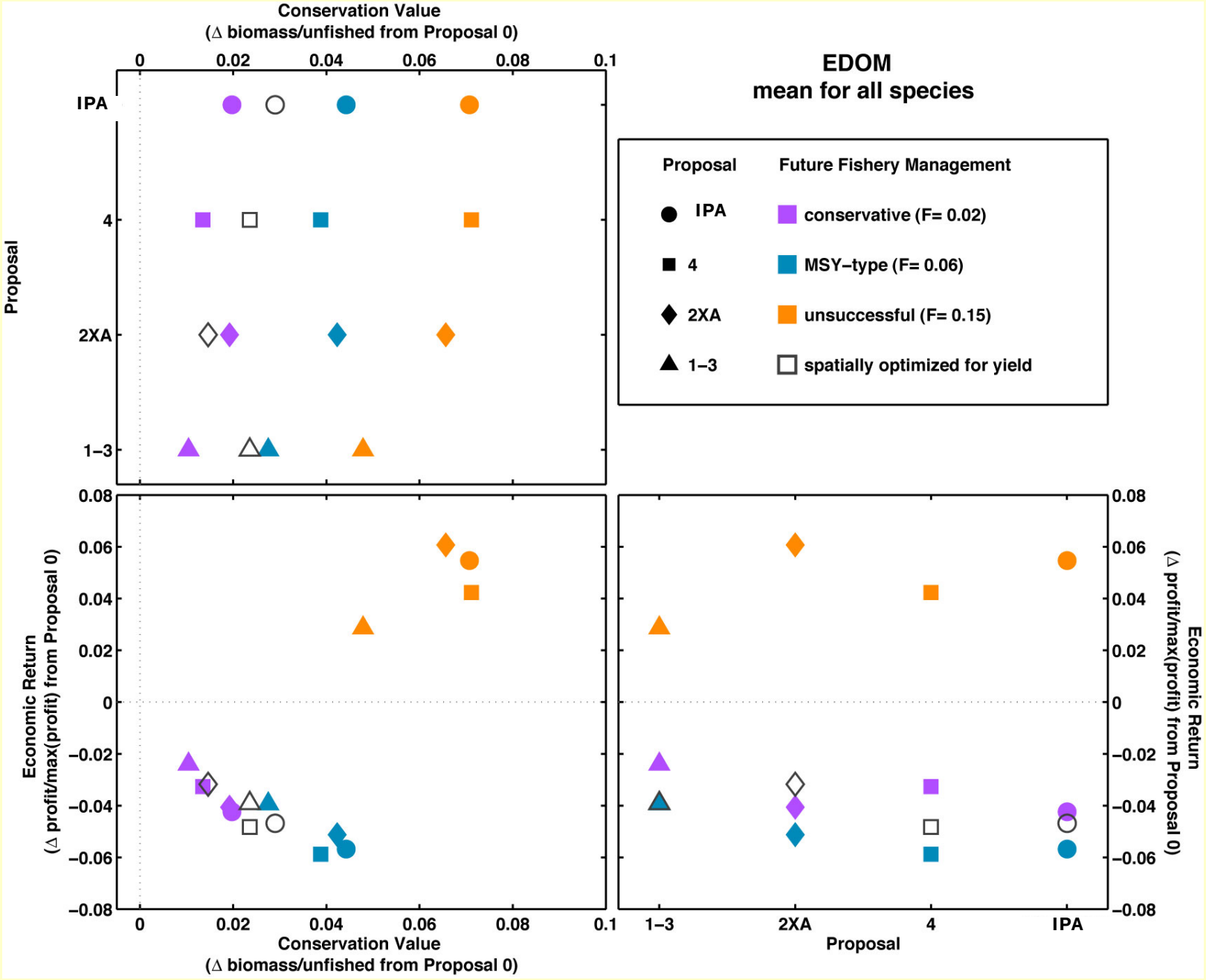
Proposal evaluations

- Four evaluations for each proposal
  1. Study-area-wide effects on biomass for range of species
     - Change from Proposal 0, as % of unfished biomass
  2. Study-area-wide effects on yield
     - Change from Proposal 0, as % of optimal yield
  3. Tradeoff between yield and biomass
  4. Spatial effects on fish populations – generate monitoring predictions?


Conservation Value
(Δ sustainability/unfished from Proposal 0)
−0.05 0 0.05 0.1 0.15 0.2 0.25 0.3 0.35
Proposal
IPA
4
2XA
1–3
UC Davis Model
mean for all species
Proposal
Future Fishery Management
IPA
4
2XA
1–3
conservative (FLEP = 0.55)
MSY–type (FLEP = 0.40)
unsuccessful (FLEP = 0.25)
variable success
Economic Return
(Δ yield/MSY from Proposal 0)
0.5 0.4 0.3 0.2 0.1 0 −0.1 −0.2
Conservation Value
(Δ sustainability/unfished from Proposal 0)
1–3 2XA 4 IPA
Proposal
Economic Return
(Δ yield/MSY from Proposal 0)

Summary of UC Davis model

- Ranking for conservation value (1 is best):
  - (1) Prop 4, (2-3) IPA/Prop 1-3, (4) Prop 2-XA
  - Differences tend to diminish as management outside becomes more conservative
  - If management very conservative, all proposals equal.
- Ranking for yield
  - (1) Prop 2-XA, (2-3) IPA/Prop 1-3, (4) Prop 4
  - If management very unsuccessful, all proposals equal
- Yield/Biomass tradeoff:
  - Integrated Preferred Alternative not obviously off of the "frontier"

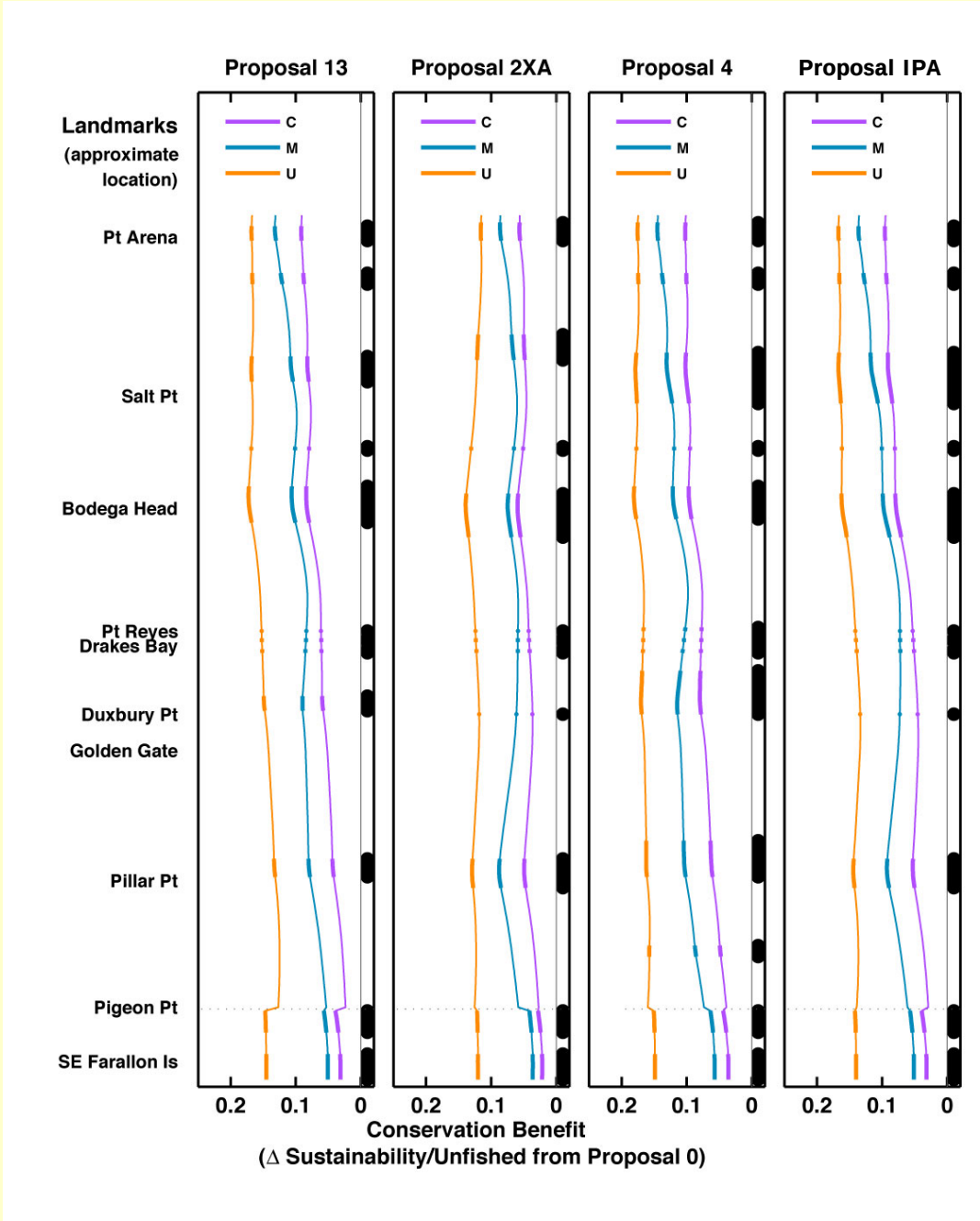

Conservation Value
(Δ biomass/unfished from Proposal 0)
0
0.02
0.04
0.06
0.08
0.1
EDOM
mean for all species
Proposal
IPA
4
2XA
1–3
Future Fishery Management
conservative (F= 0.02)
MSY–type (F= 0.06)
unsuccessful (F= 0.15)
spatially optimized for yield
Economic Return
(Δ profit/max(profit) from Proposal 0)
0.08
0.06
0.04
0.02
0
−0.02
−0.04
−0.06
−0.08
Conservation Value
(Δ biomass/unfished from Proposal 0)
Proposal

Summary of EDOM Model

- Ranking for conservation value – depends on future fishery management scenario:
  - Conservative/MSY: (1) IPA, (2) Prop 2-XA, (3) Prop 4, (4) Prop 1-3
  - Optimize Profit: (1) IPA, (2) Prop 4, (3) Prop 1-3, (4) Prop 2-XA
  - Unsuccessful: (1) Prop 4, (2) IPA, (3) Prop 2-XA, (4) Prop 1-3
- Ranking for yield – depends on future fishery management scenario:
  - Conservative: (1) Prop 1-3, (2) Prop 4, (3) Prop 2-XA, (4) IPA
  - MSY-type: (1) Prop 1-3, (2) Prop 2-XA, (3) IPA, (4) Prop 4
  - Optimize Profit: (1) Prop 2-XA, (2) Prop 1-3, (3) IPA, (4) Prop 4
  - Unsuccessful: (1) Prop 2-XA, (2) IPA, (3) Prop 4, (4) Prop 1-3
- Yield/Biomass tradeoff
  - Integrated Preferred Alternative tends to push “frontier” outwards

Spatial results

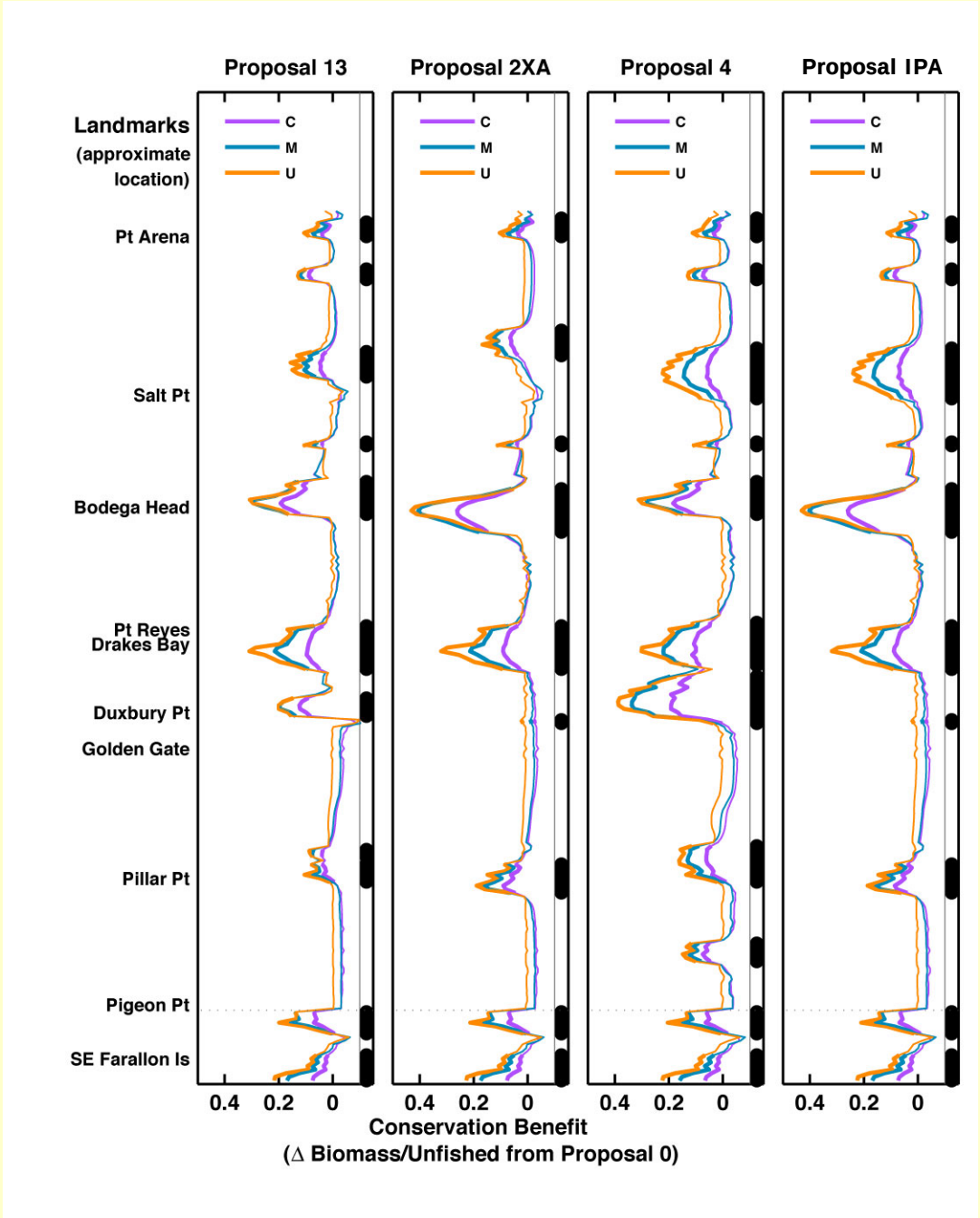
- What are spatial implications for conservation?
- MPA size and placement interacts with habitat, dispersal, home ranges to create complex spatial consequences.
- Use spatially-explicit models to predict:
  - Larval supply across space (UCD Model)
  - Biomass of modeled fish species across space (EDOM Model)



- Larval Supply tends to increase in MPAs.
- This effect is similar across proposals, but some spatial differences

- Largest change (relative to Proposal 0) occurs when future fishery management is "unsuccessful"

- How will changes in larval supply affect biomass of fish we are trying to conserve?



- Use EDOM model to predict biomass across space

- Notice large biomass increases inside MPAs
- Generates predictions for monitoring

- Largest change (relative to Proposal 0) occurs when future fishery management is "unsuccessful"