

A Model to Evaluate Sustainability and Yield of Proposed MPA Plans

UC Davis SAT Tools Contract

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What is Sustainability?

The ability of a population to avoid collapse.

The same as:

- Persistence
- Resilience
- Biomass
- Fraction of coastline persistent
- Total larval supply

Why model Sustainability?

All MLPA goals require Population Sustainability

Our models will show the BRTF the effect of proposed MPAs on population sustainability

What is yield?

Total fishery catch of a species in the
NCC Region

Why model Yield?

So the BRTF can account for the economic impact of proposed MPAs on fisheries

What does this model do?

BRTF needs to know difference between 'no action' and the effects of MPA packages

Our model summarizes long-term benefits and costs of each package, in terms of

- Sustainability
- Yield

(For five representative species)

What assumptions does it make?

- Larval dispersal patterns, by species
- Adults move within a home range
- When larvae settle, only a certain maximum number can recruit at each location in each year

Constant effort (others can be used)

- Status of species (fishing/overfishing, e.g.BRF)

not overfished

overfished

heavily overfished

What data does it use?

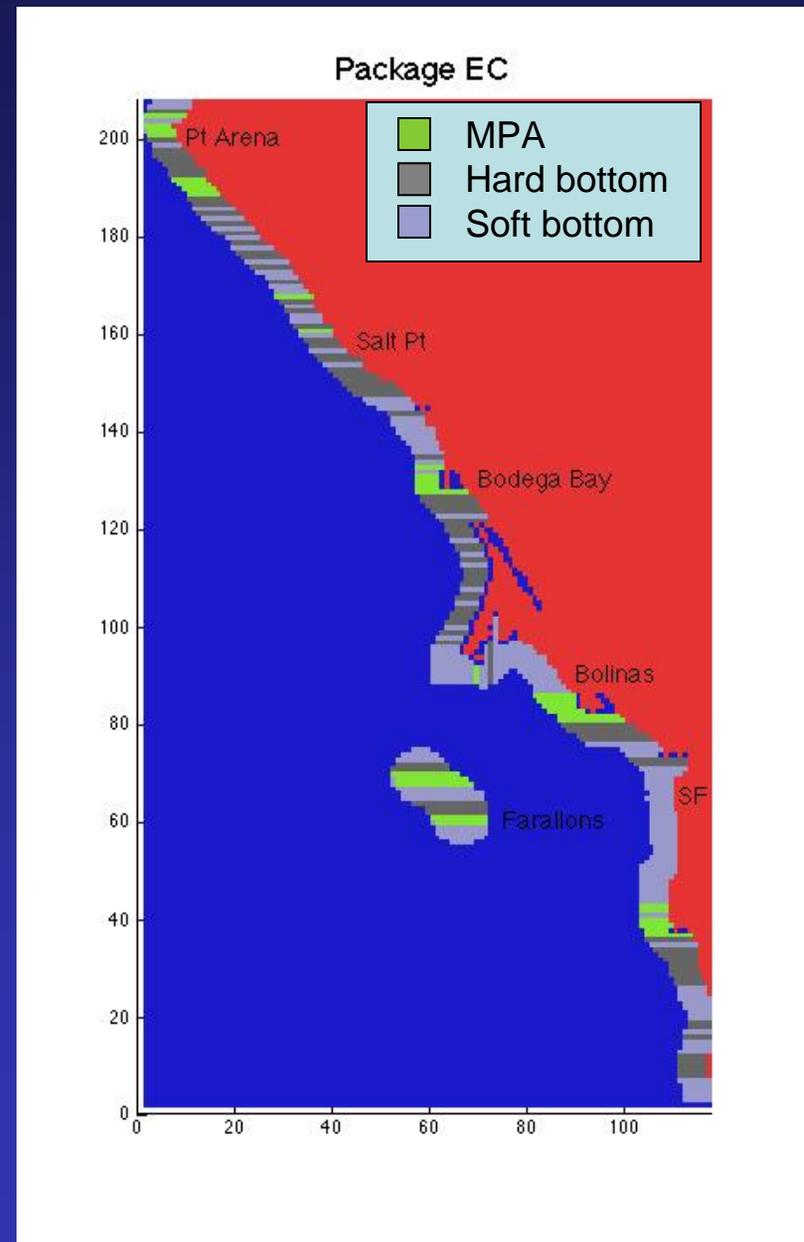
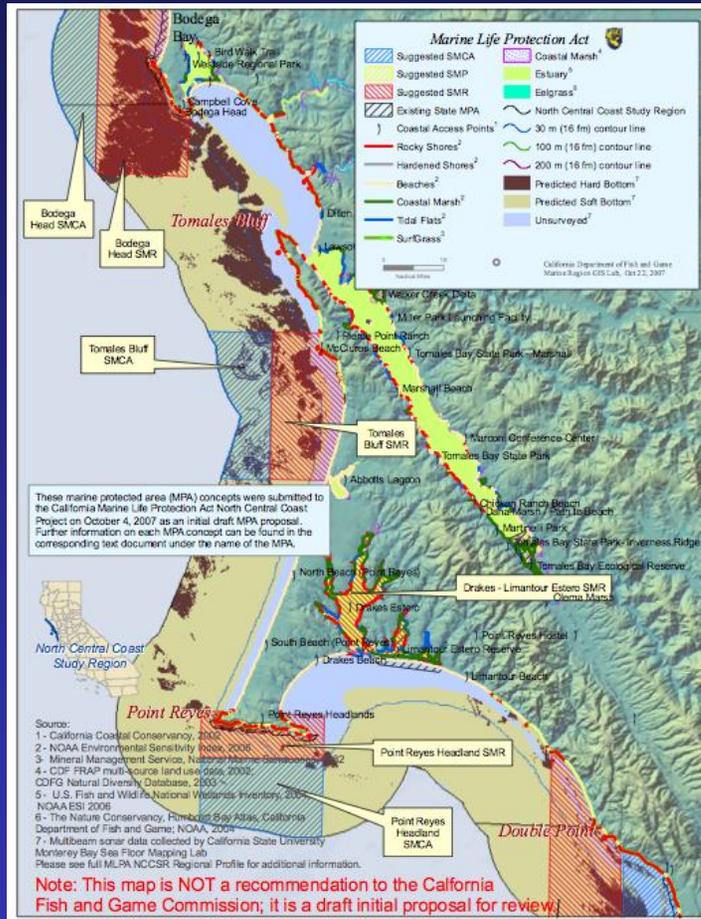
- Fishing mortality rate
- Natural mortality rate
- Growth rate
- Fecundity (number of offspring produced)
- Distribution of hard bottom habitat
- Location & regulations of proposed MPAs

Species Considered

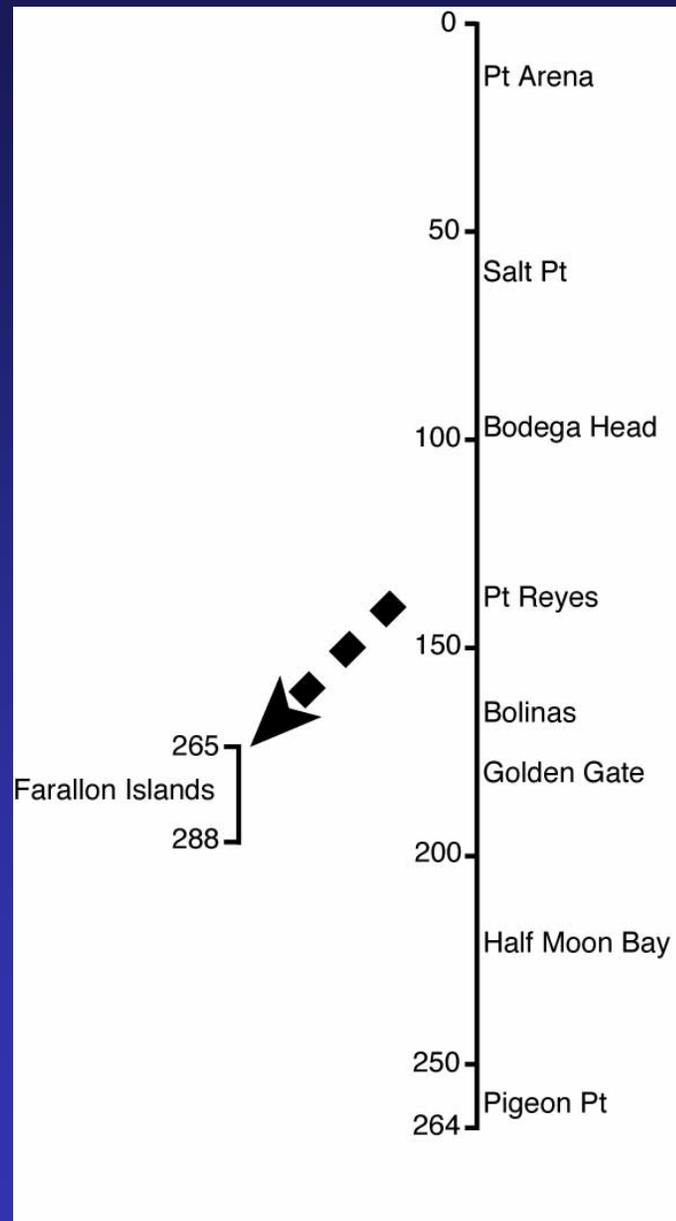
Species	Average larval dispersal distance (km)	Average homerange size (km)
Abalone	1	1
Black Rockfish	40	9
Cabezon	100	1
Lingcod	35	9
Canary Rockfish	40	14



Use one-dimensional strip along coastline



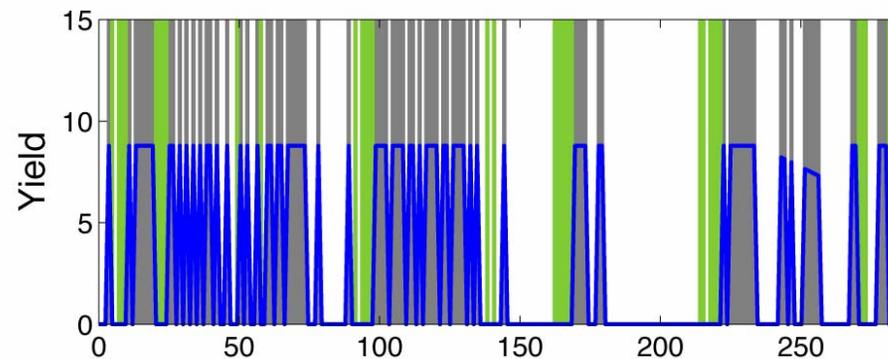
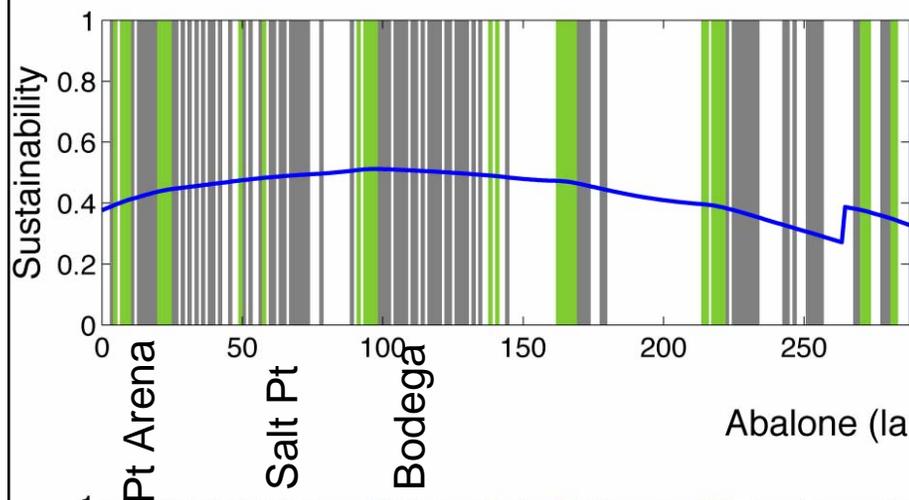
One-dimensional map



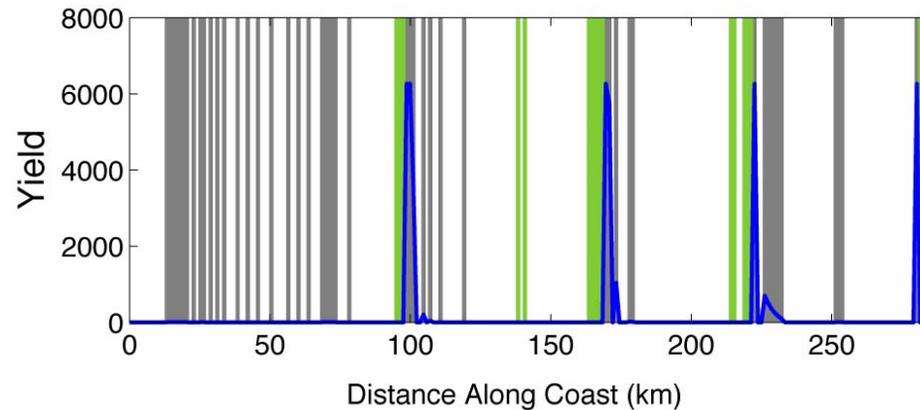
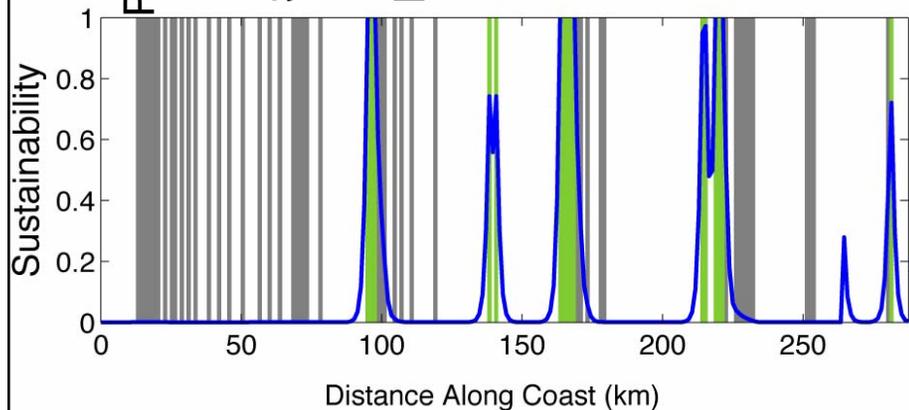
Long-term sustainability and yield for overfished case

Package 'EC', Overfished

Cabazon (larval dispersal = 100 km)

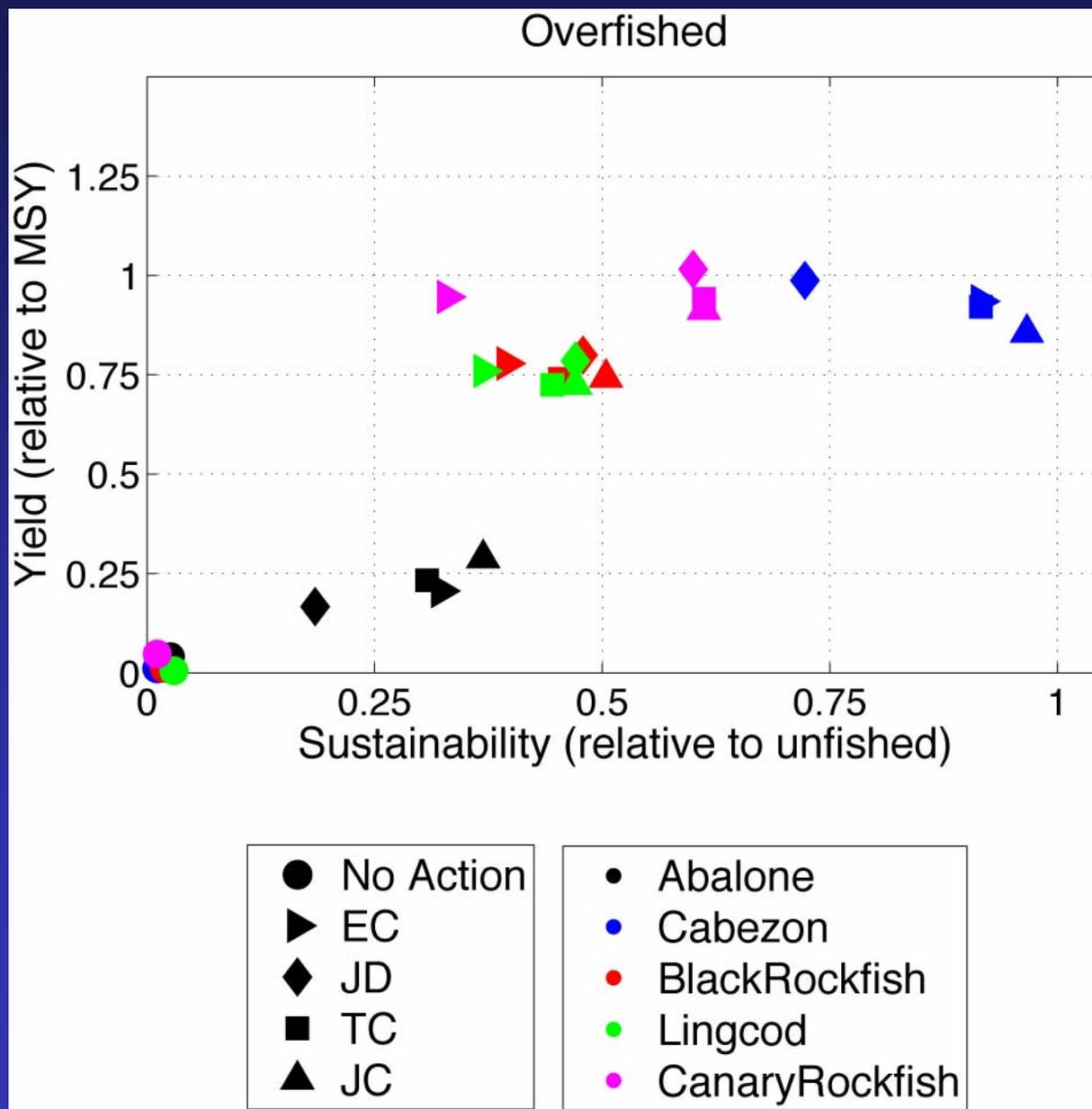


Abalone (larval dispersal = 1 km)

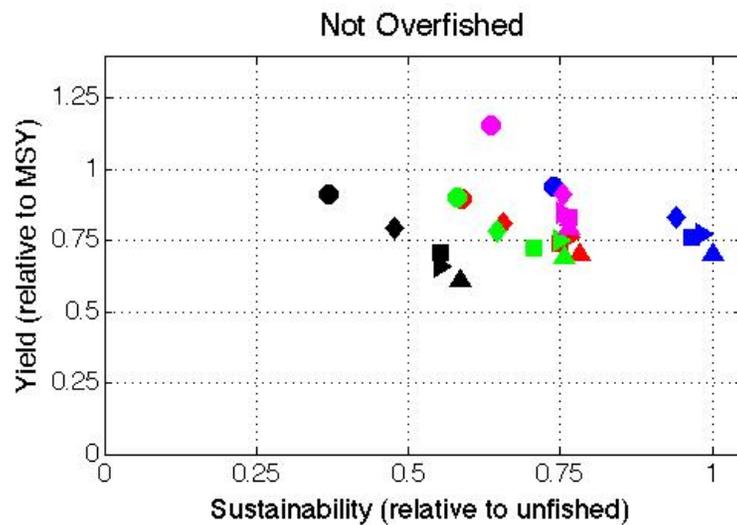
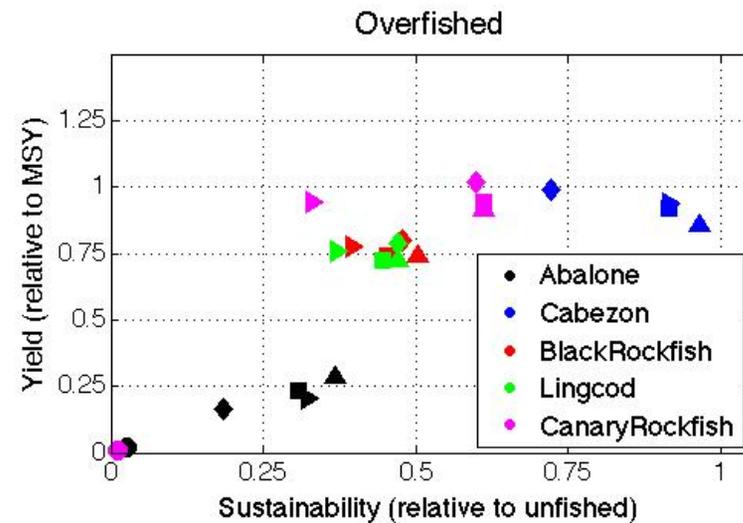
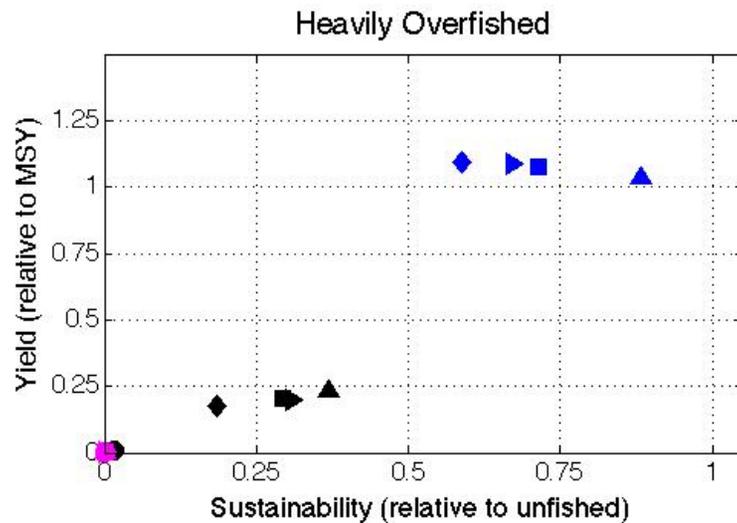


- Hard-bottom habitat (no MPA)
- Hard-bottom habitat + MPA

Example: summarizing results across NCC region

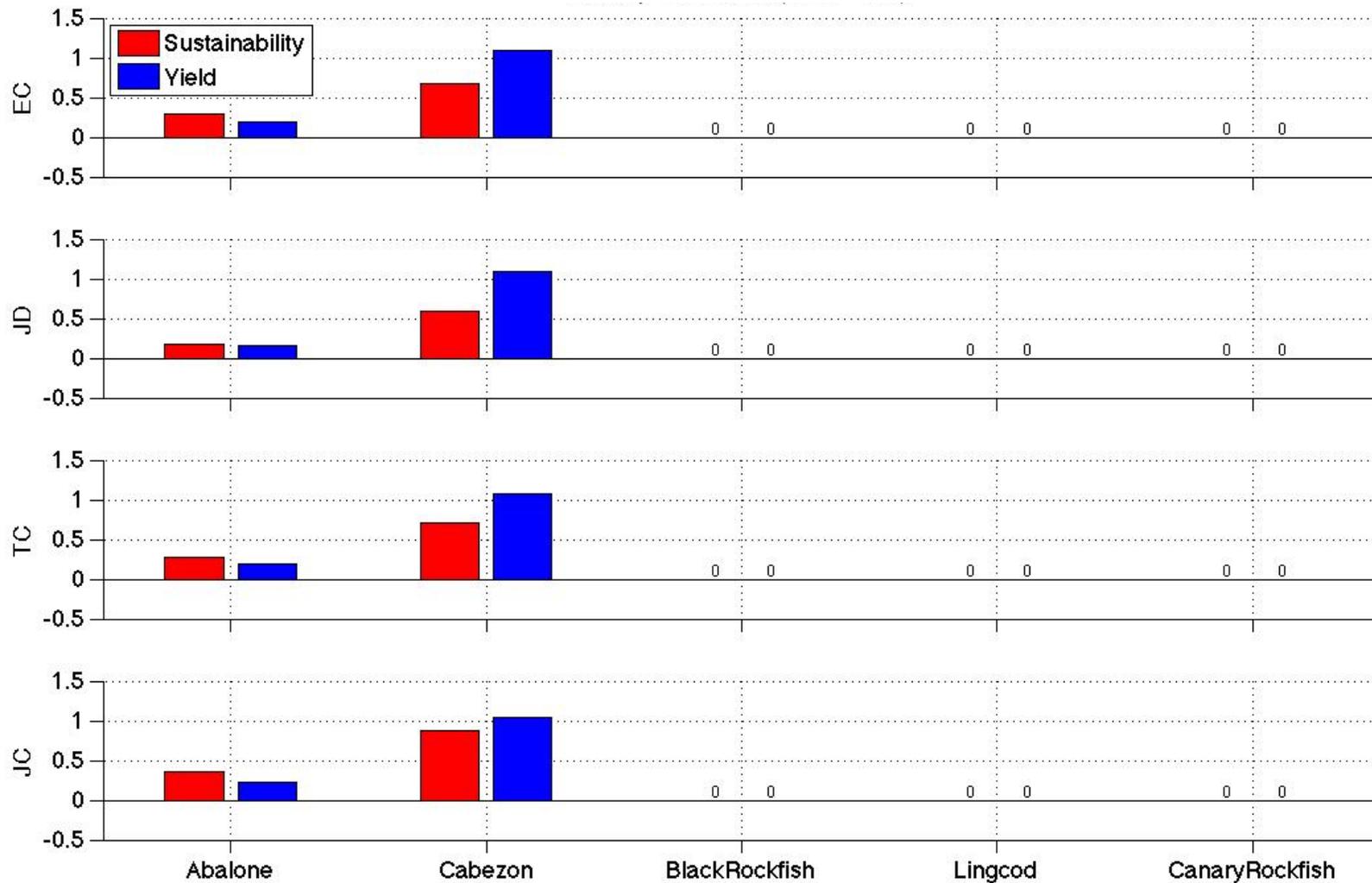


Effects of uncertainty in stock status

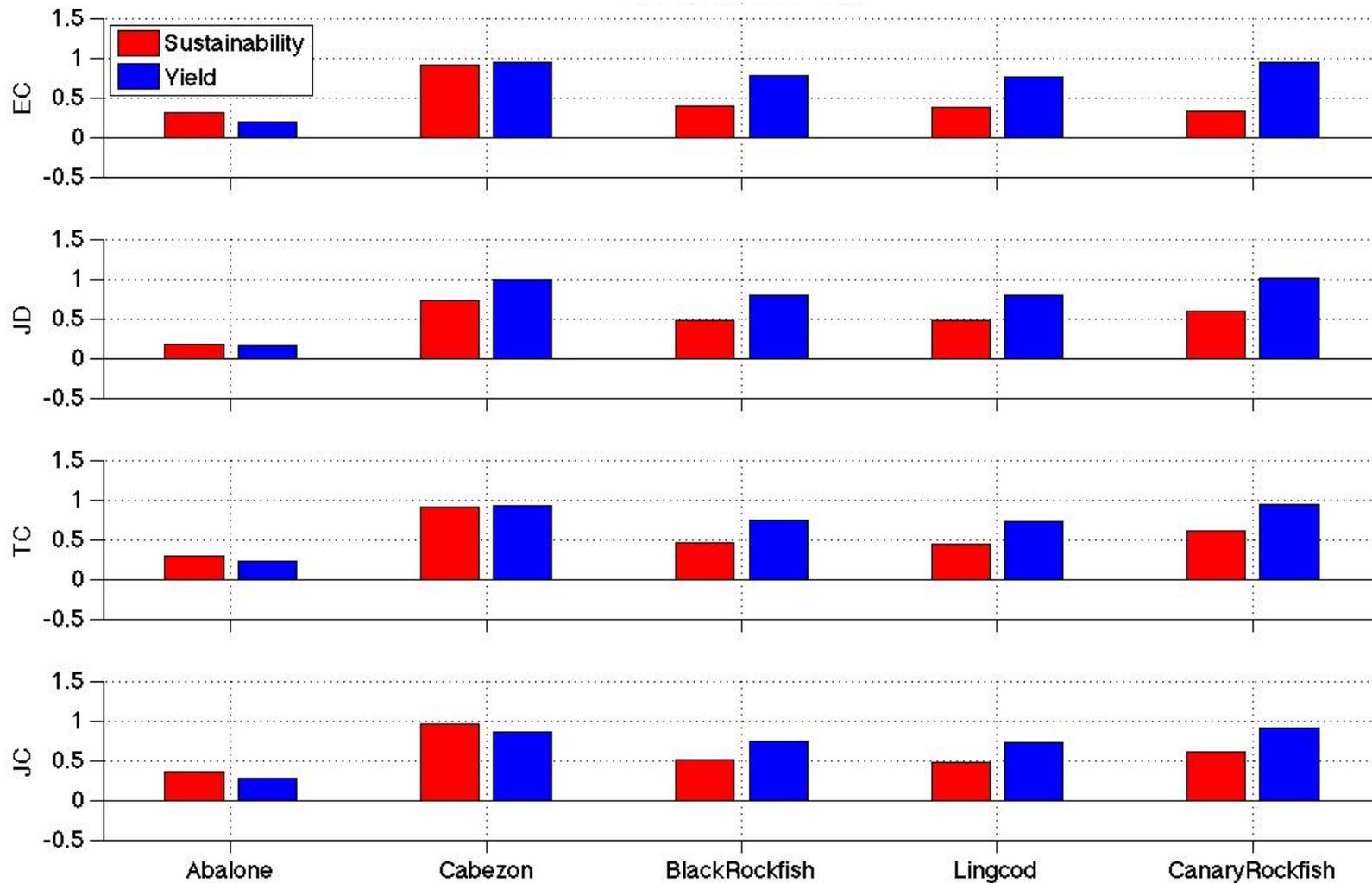


- No Action
- ▶ EC
- ◆ JD
- TC
- ▲ JC

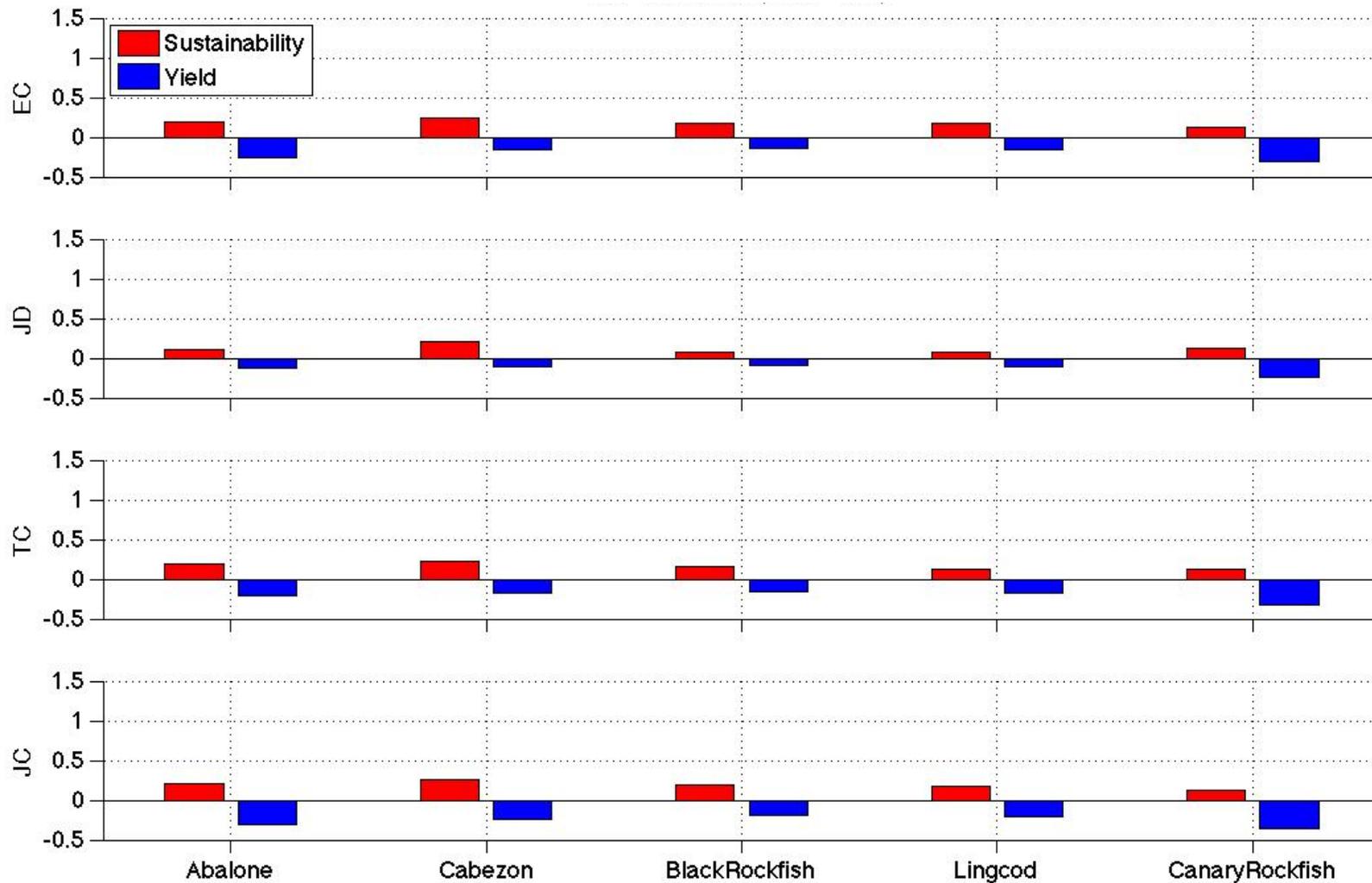
Effects on each species: heavily overfished



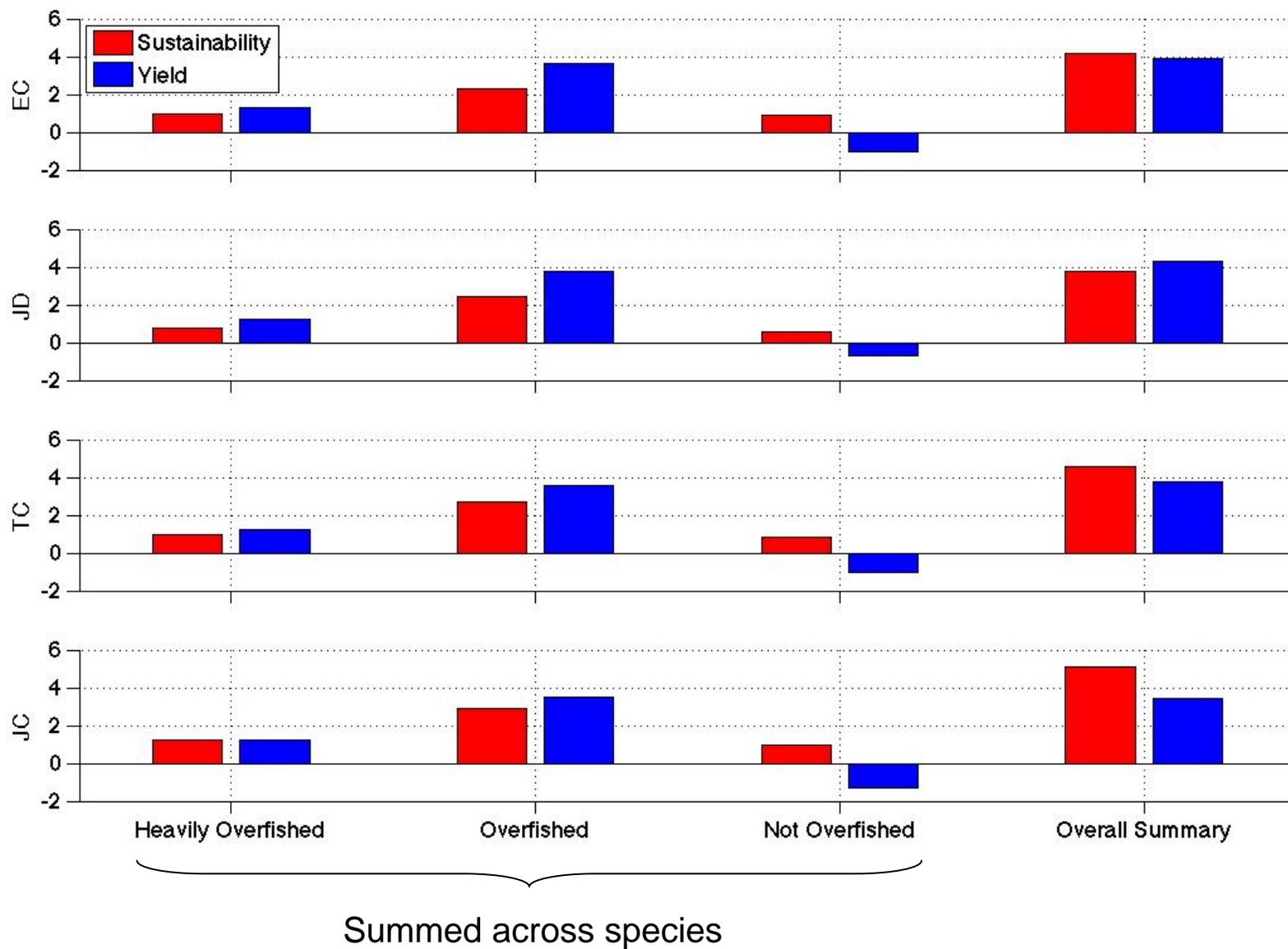
Effects on each species: less overfished



Effects on each species: not overfished

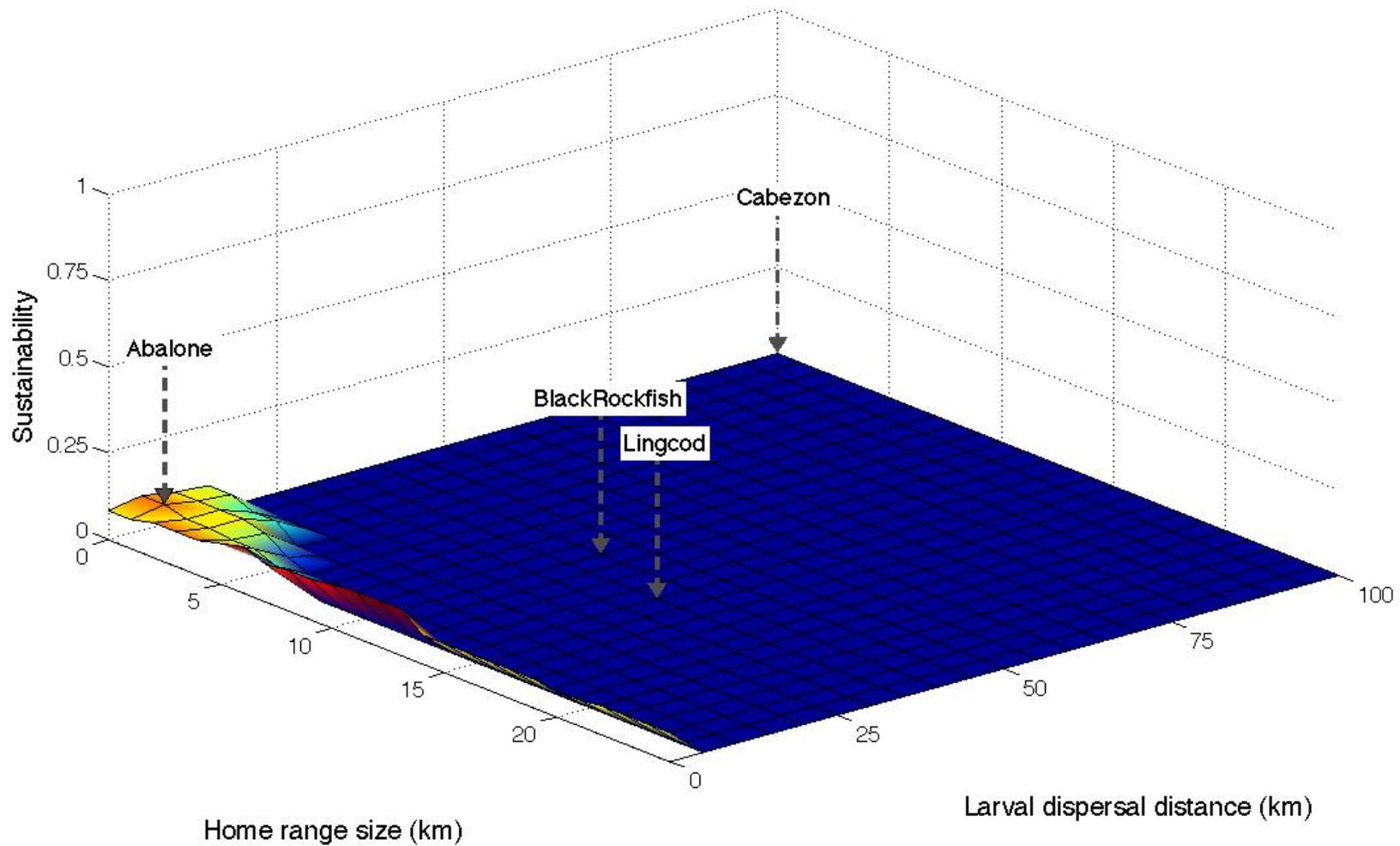


Summary: range of uncertainty in stock status



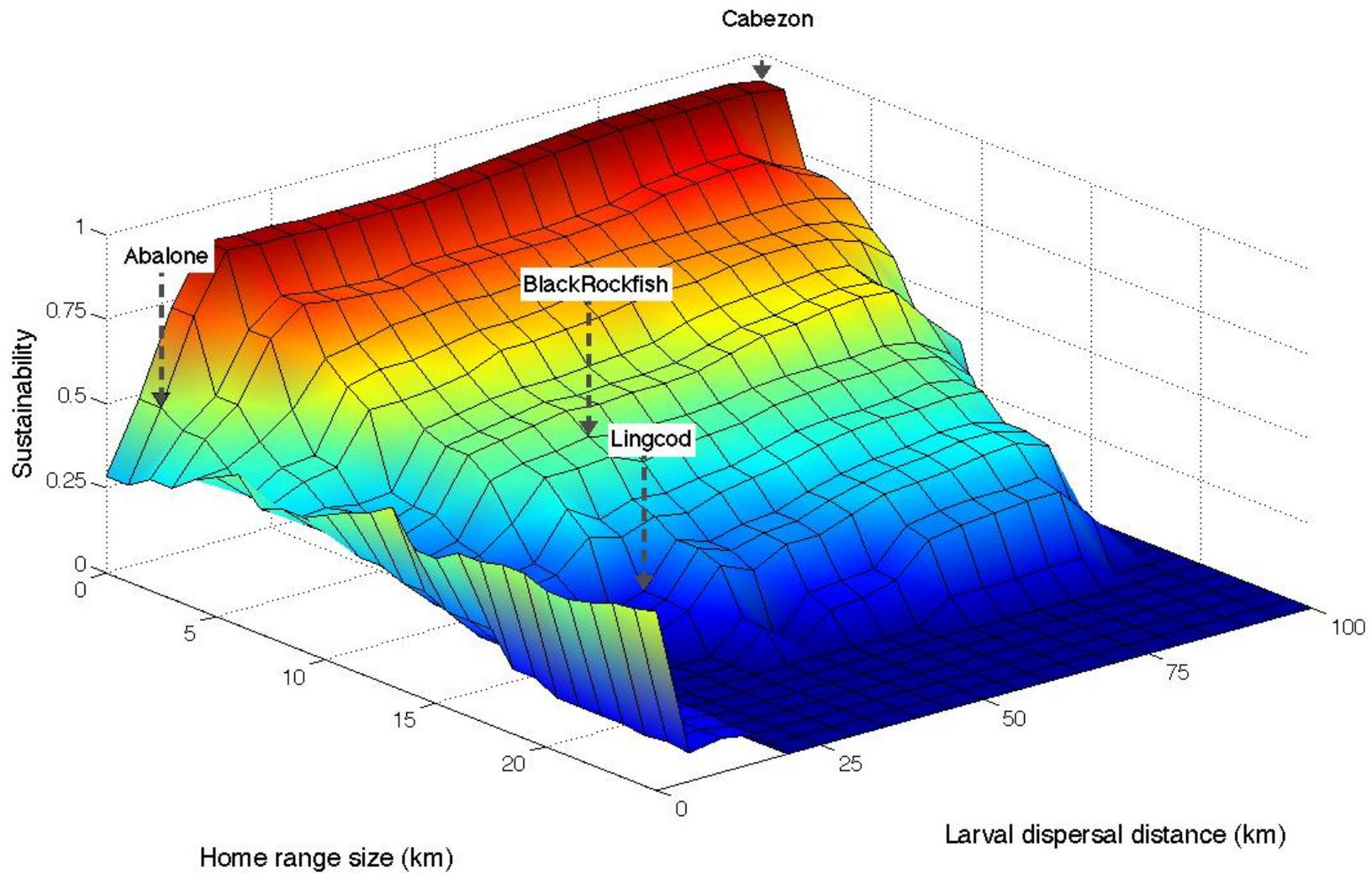
Moving beyond 5 focal species

No Action; Overfished



Moving beyond 5 focal species

Package EC; Overfished



Further work needed

What is overfishing status of each of these species?

Effects of effort shift

Two-dimensional model.

Continue working on combination with MARXAN

Fast version with graphical user interface???

Present results with fishery management changed to optimize catch???

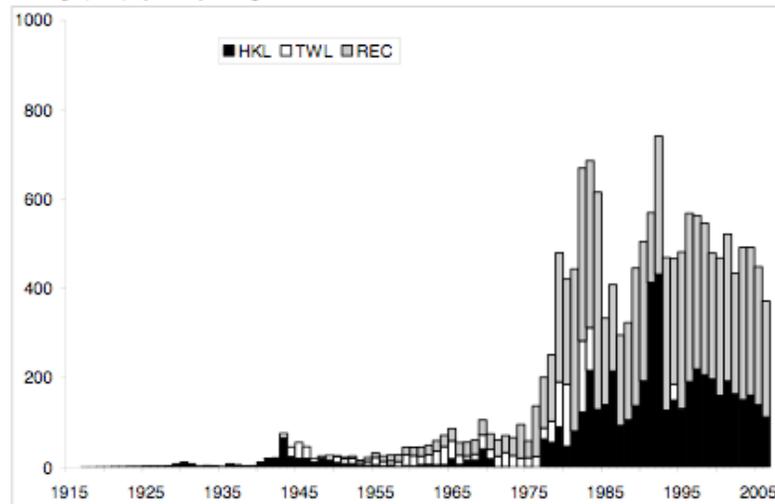
Conclusions

- MLPA goals require population sustainability
- Our model shows BRTF effects of MPAs on
 - Sustainability
 - Yield
- Results for 5 species + other 'generic' species
- MPA impacts depend on current population status
 - Considerable uncertainty about current status

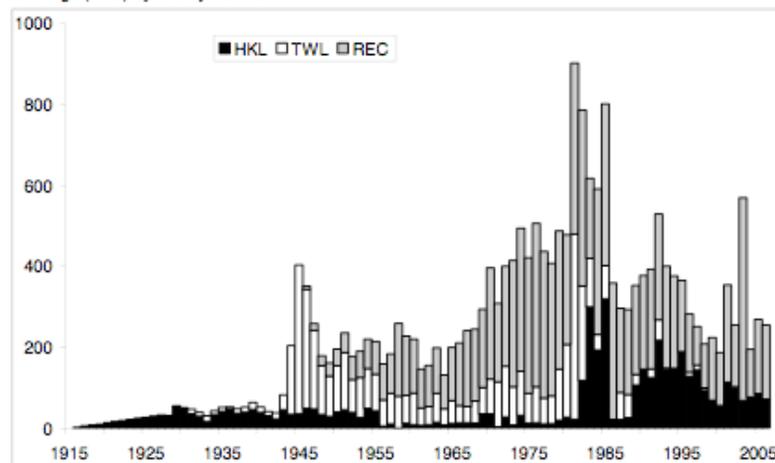
Black Rockfish Landings

Figure 2. Base landings history for black rockfish off Oregon and California.

Landings (MTs) by fishery - Oregon.



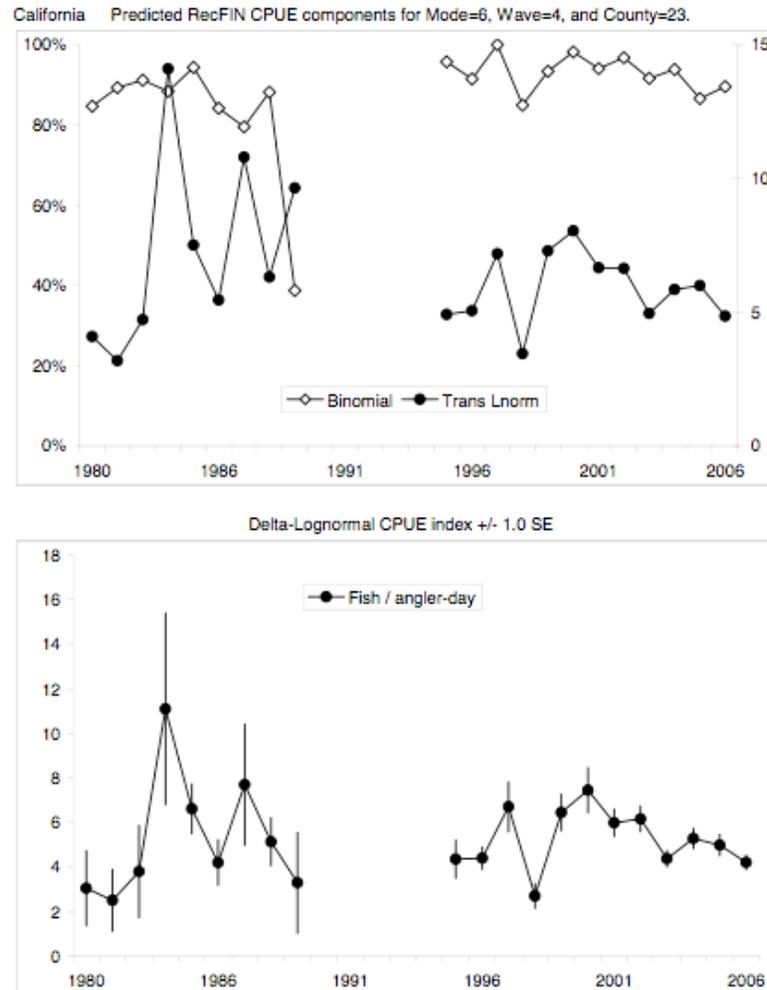
Landings (MTs) by fishery - California.



from Sampson (2007) Black Rockfish Stock Assessment

Black Rockfish Catch Per Unit Effort (CPUE)

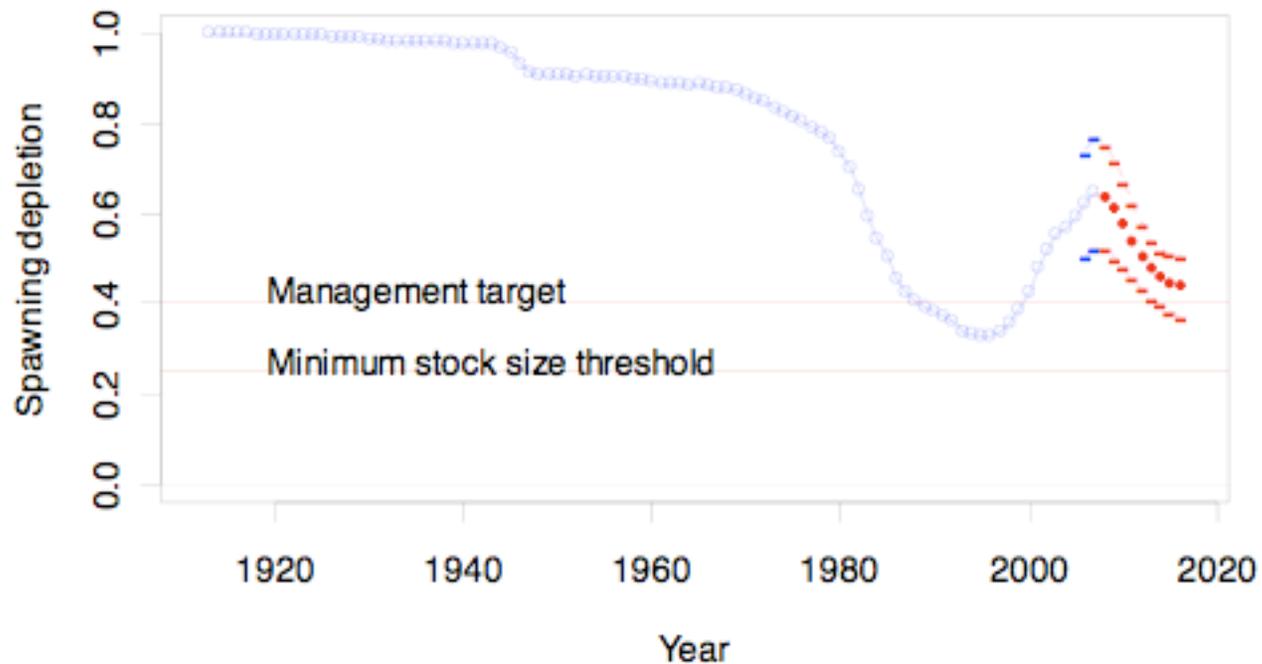
Figure 14. RecFIN CPUE abundance indices (continued).



from Sampson (2007) Black Rockfish Stock Assessment

Recent decline in predicted Black Rockfish spawning output

Figure 29. Preliminary base-run model spawning output relative to unexploited.



from Sampson (2007) Black Rockfish Stock Assessment