Seasonal Climate Predictions to Improve Fisheries Management Decisions

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Climate variability affects fish dynamics

Baumgartner et al. 1992
Often unable to set adequate coping strategies

Photos courtesy of the city of Monterey
Robust Pacific sardine-SST recruitment relationship

Poor recruitment of Pacific sardine when SST is low in southern California spawning grounds

Lindgren and Checkley 2013
Skillful SST forecast at a fishery relevant scale

Anomaly Correlation Coefficient between observations and GFDL FLOR model hindcast (reforecast) from 1982-2008
Can incorporation of climate predictions make management more effective?
How many sardines will I allow to be caught next year?
Set a Harvest Guideline (HG)

Biomass

$E_{msy}$

SST

How many sardines will I allow to be caught next year?
Compared effectiveness of four different HGs

HG1 – constant $E_{msy}$ of 0.18

HG2

HG3

HG4

Environmental Considerations

SST averaging for $E_{msy}$

Biomass

No harvest when biomass <150,000 mt
Methods

- The effectiveness of HGs assessed through a Management Strategy Evaluation (MSE)
- Stock dynamics simulated from 1945-2008 to include low-productivity conditions, across 1000 realizations of stochastic variability in recruitment and SST forecast error.
Management effectiveness evaluated through 6 performance metrics:

• Average and variability of the catch
• Average and variability of the stock biomass
• Probability of catch falling below 50,000 mt
• Probability of stock biomass falling below 400,000 mt
Results

HG1 = no SST
HG2 = past SST
HG3 = forecast SST for fishing rate
HG4 = forecast SST for fishing rate and biomass forecast

Tommasi et al. 2017, Ecological Applications
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Tested robustness of results to removal of harvest cutoff

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Conclusions

• Using SST predictions to anticipate short-term changes in stock biomass leads to more effective catch targets.

• The forecast-informed HG has to be combined with a harvest cutoff at low biomass to mitigate the risk of collapse in the event of an erroneous forecast.
Future Work

- Include full stock assessment model
- More mechanistic recruitment model
- Human dimension
- Upper trophic levels
- Apply to other species
Stock et al. 2015, *Progress in Oceanography*
Thank you!

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