Seasonal Climate Predictions to Improve Fisheries Management Decisions

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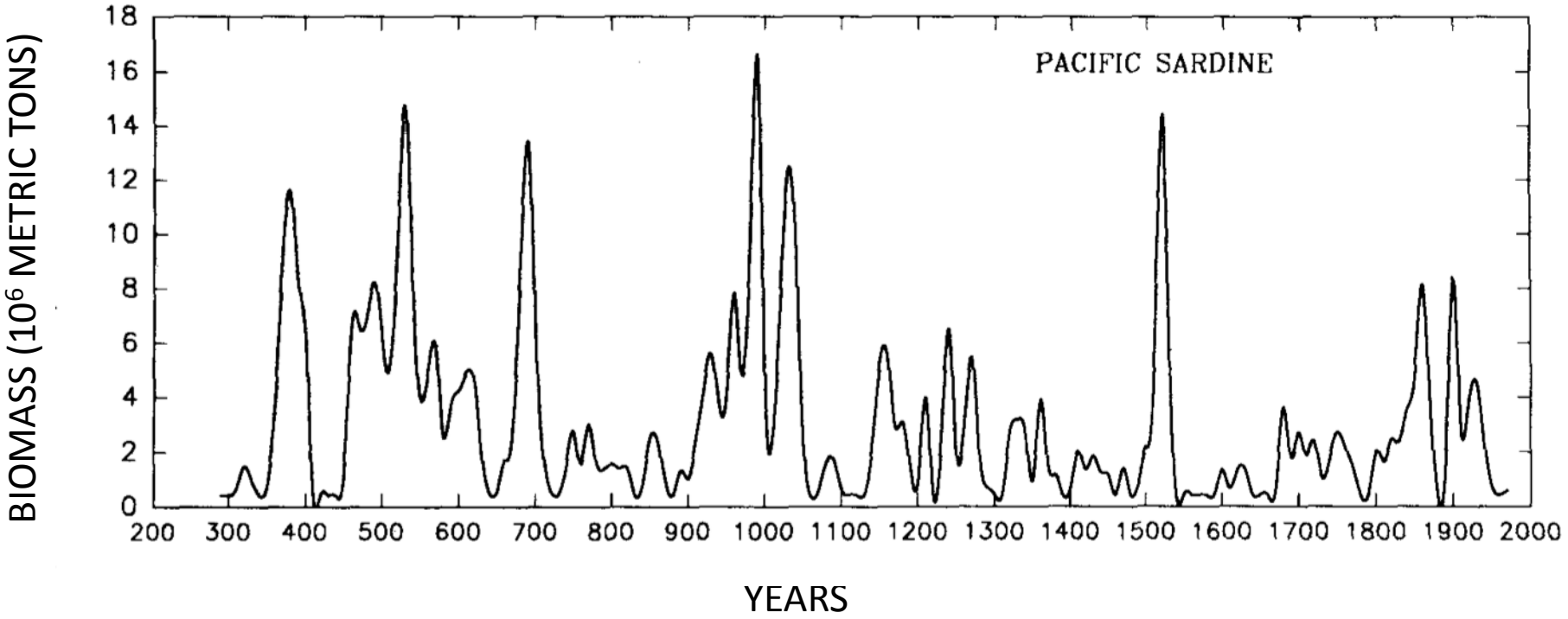
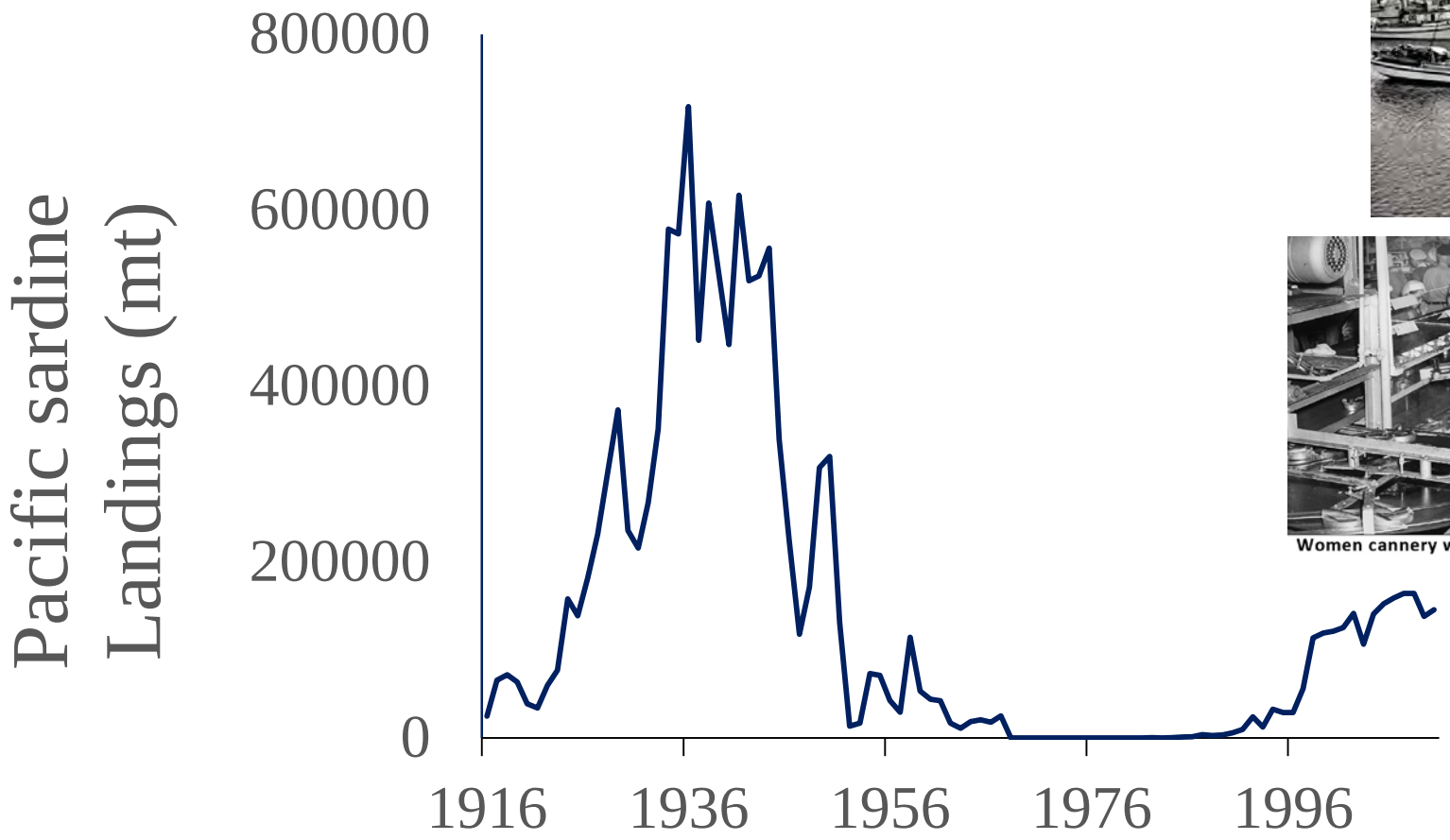
Climate variability affects fish dynamics



Baumgartner et al. 1992

Often unable to set adequate coping strategies



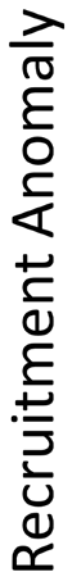
Unloading sardines - 1920s

Women cannery workers on the line - 1949

End of an Era - Cannery Row.1950

Photos courtesy of the city of Monterey

Robust Pacific sardine-SST recruitment relationship



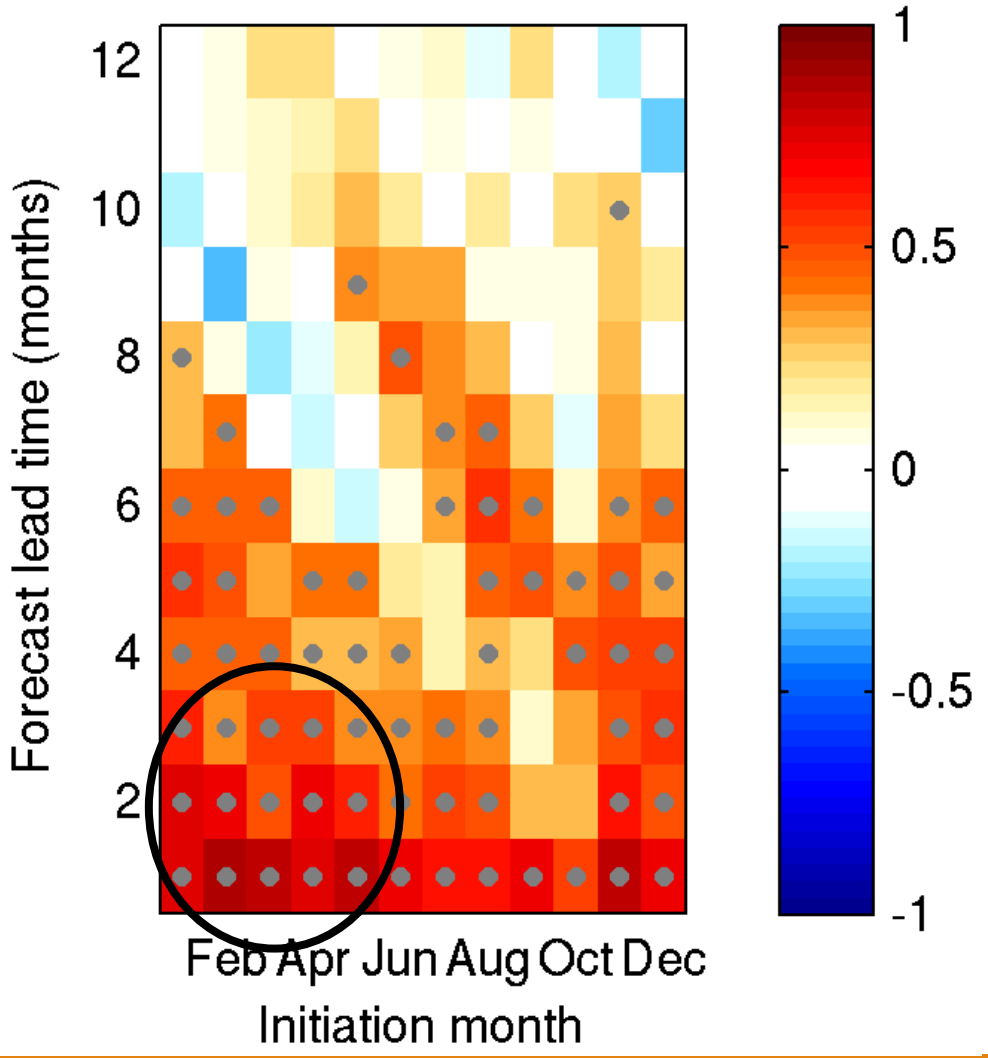
Poor recruitment of Pacific sardine when SST is low in southern California spawning grounds

SST

Lindegren 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

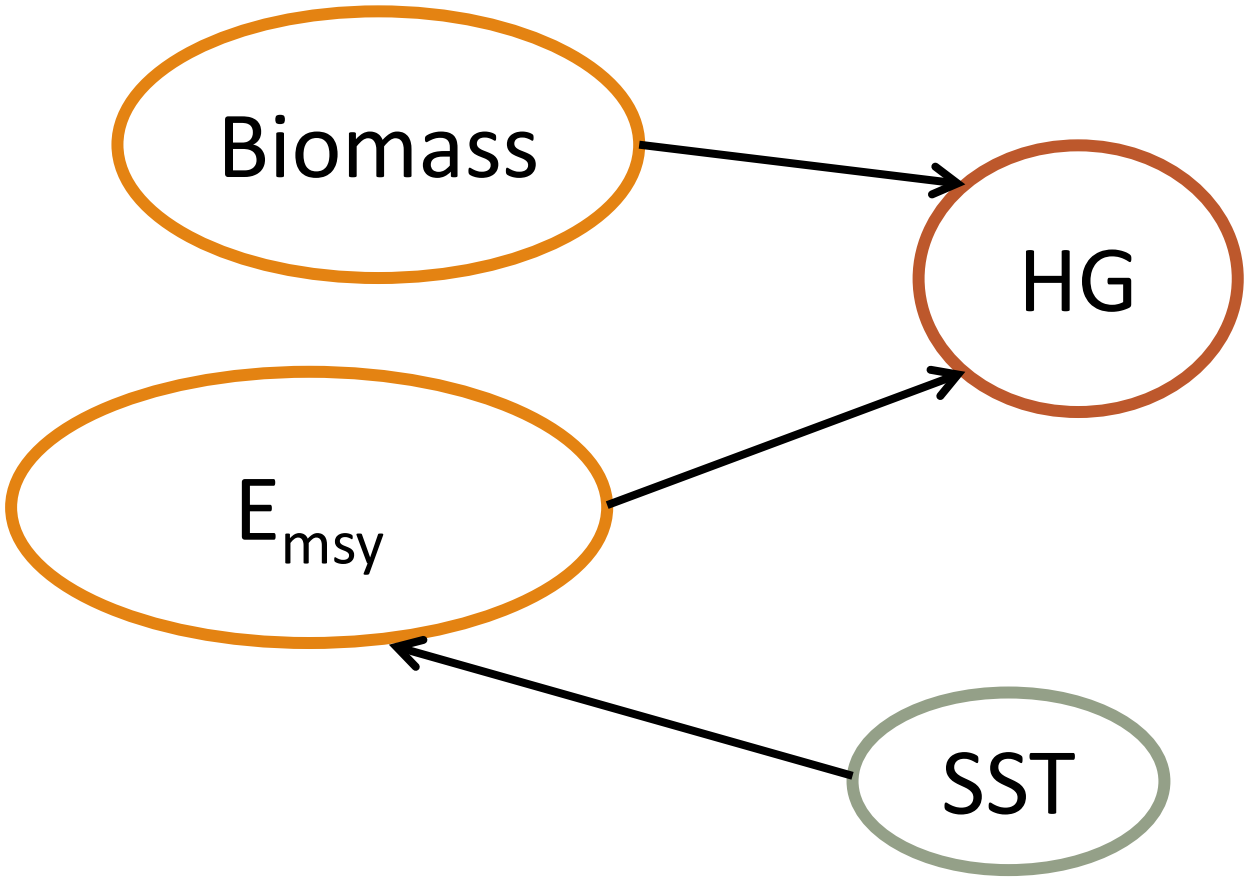


Significant at 0.05 level

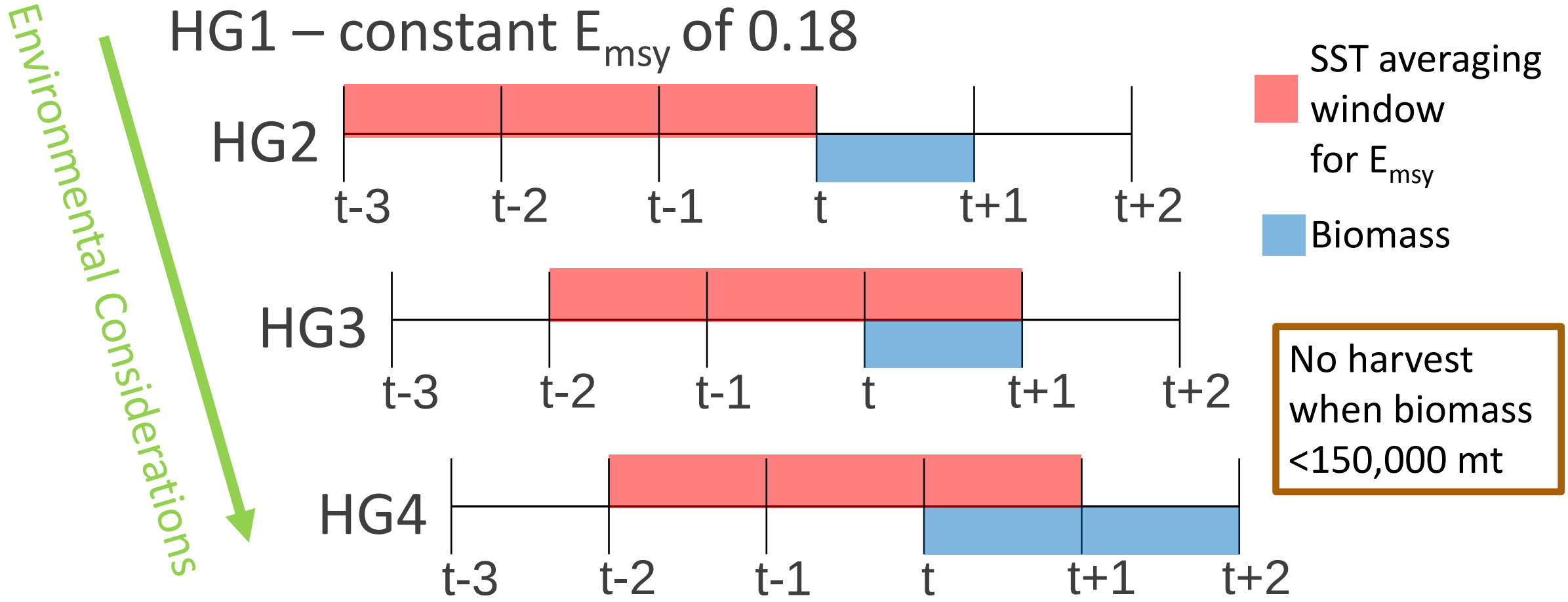
Can incorporation of climate predictions make management more effective in a dynamic environment?


How many sardines
will I allow to be
caught next year?

Set a Harvest Guideline (HG)



Compared effectiveness of four different HGs



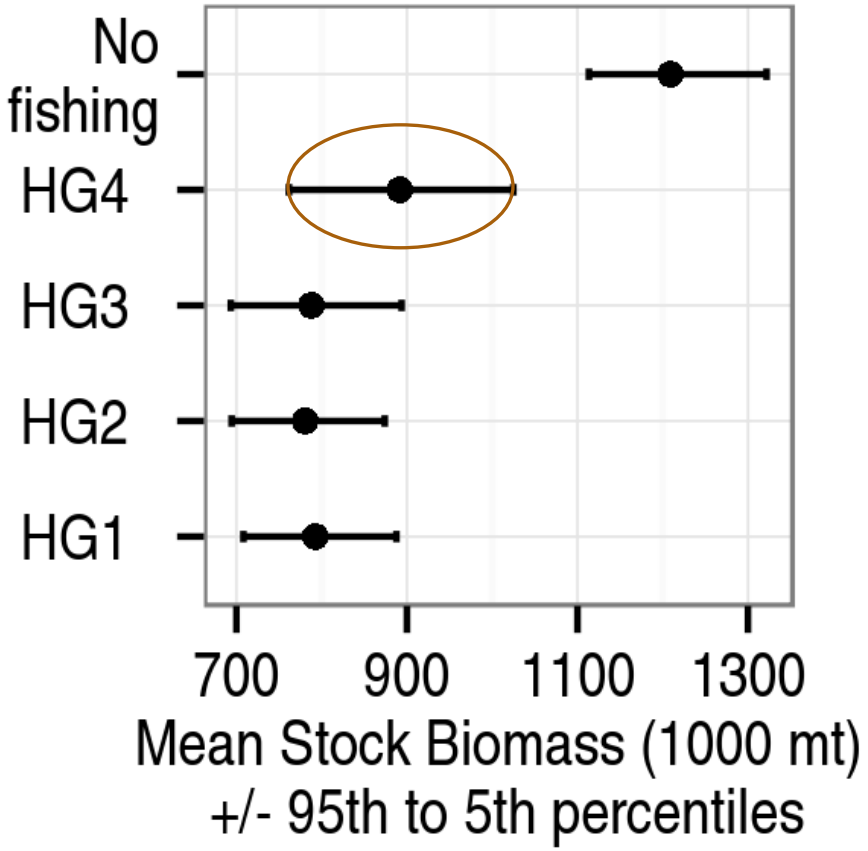
Methods

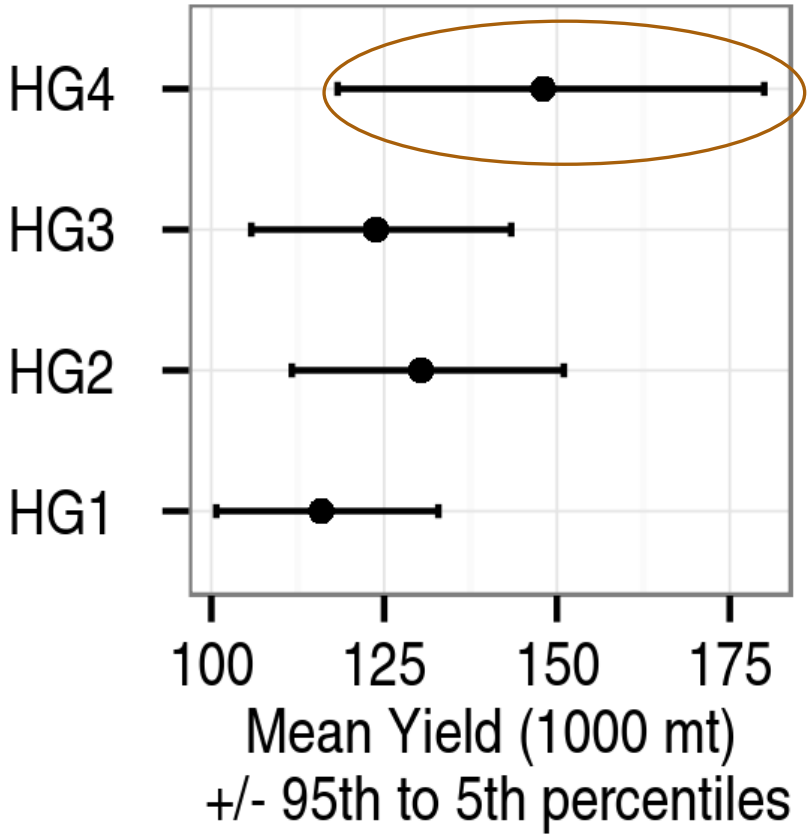
- The effectiveness of HGs assessed through a **Management Strategy Evaluation (MSE)**
- Stock dynamics simulated from **1945-2008** to include low-productivity conditions, across **1000 realizations** of stochastic variability in recruitment and SST forecast error.

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

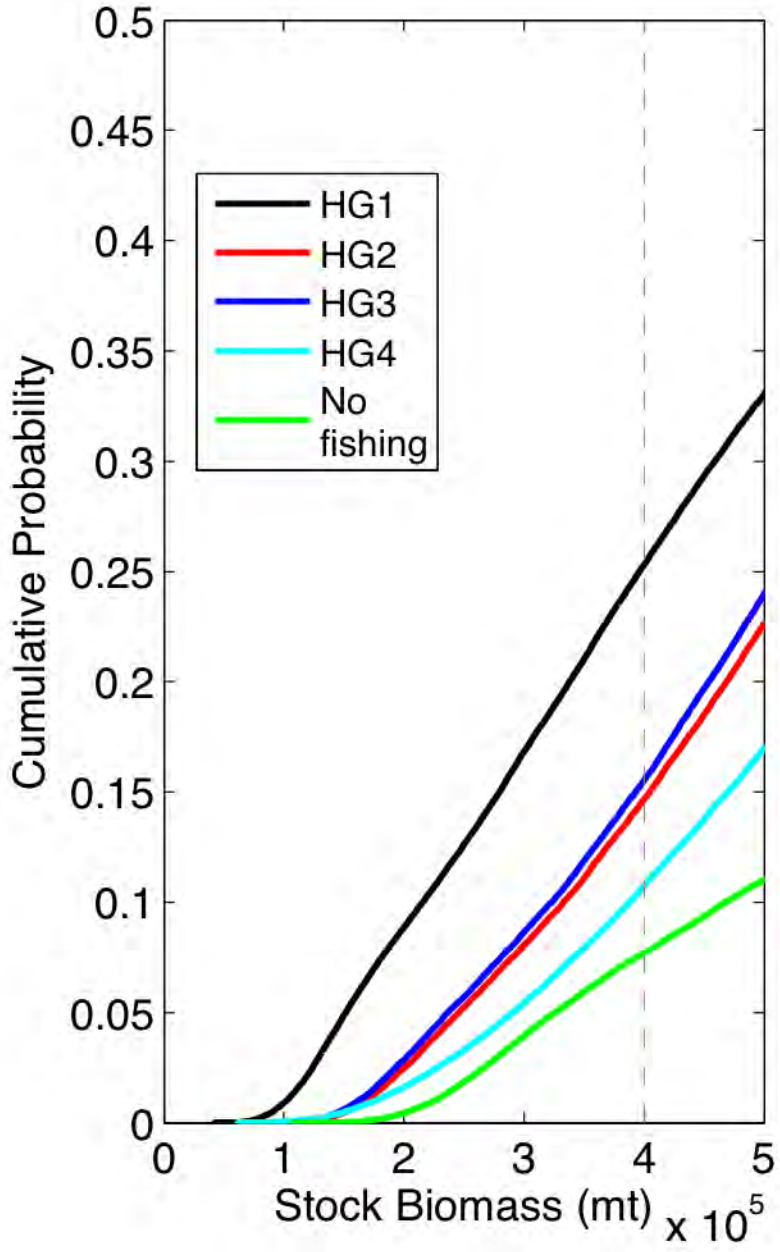


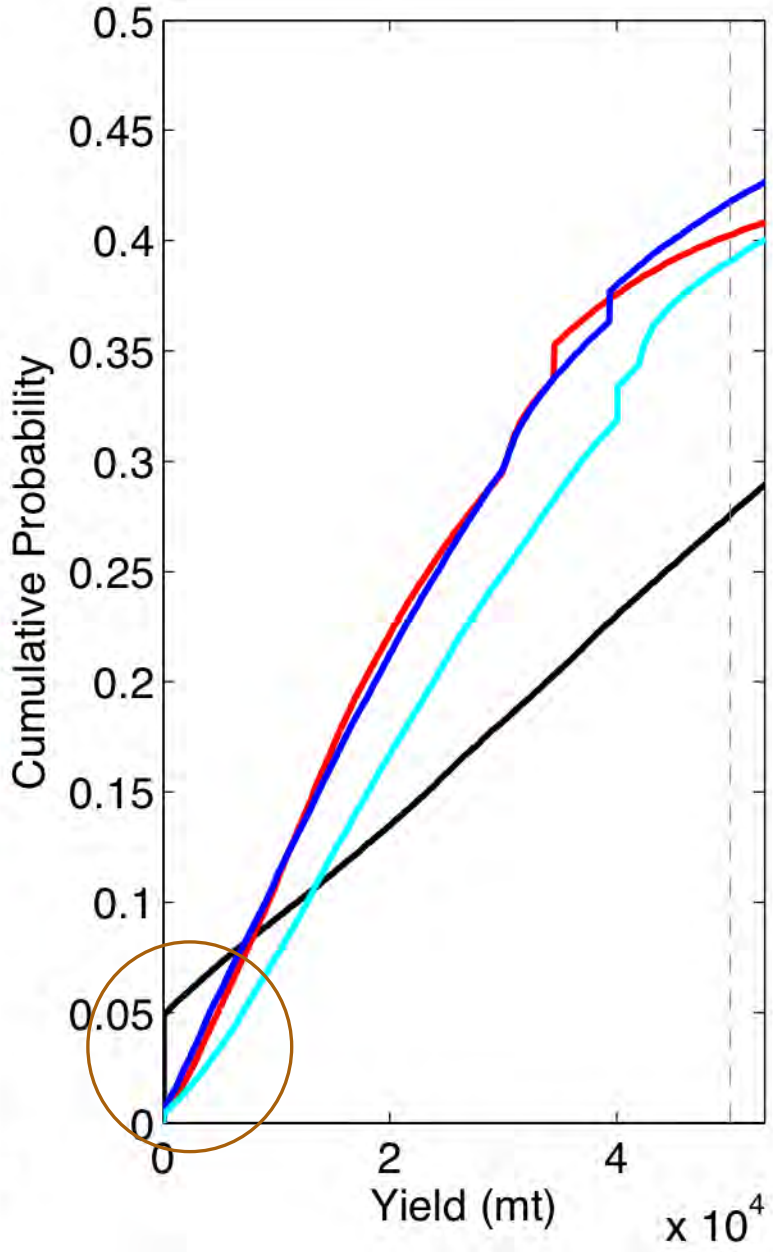


HG1 = no SST
HG2 = past SST
HG3 = forecast SST for fishing rate
HG4 = forecast SST for fishing rate and biomass forecast

Tommasi et al. 2016

Results





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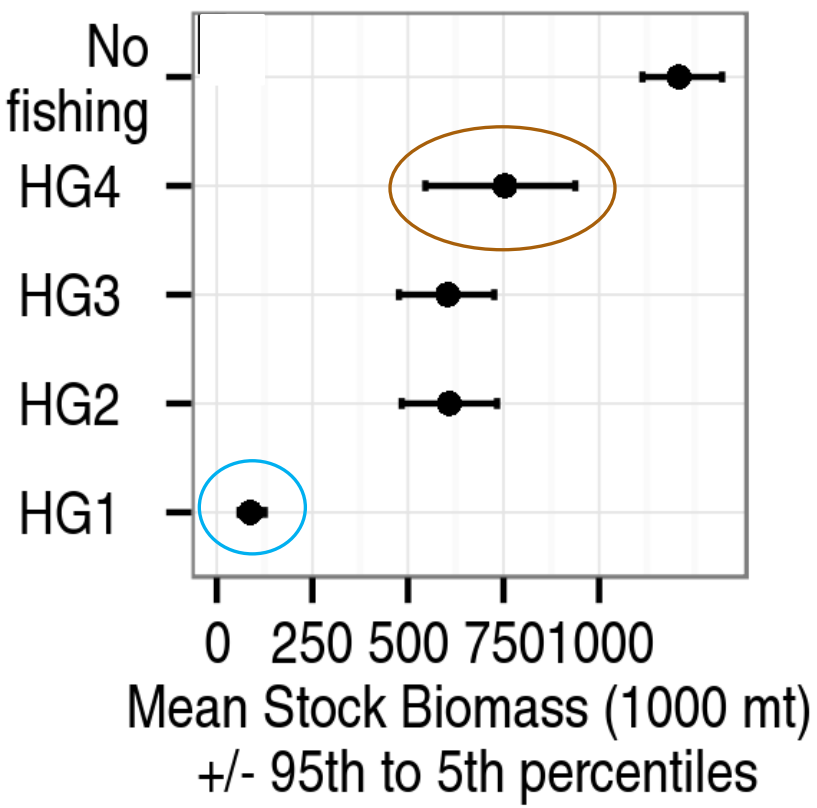
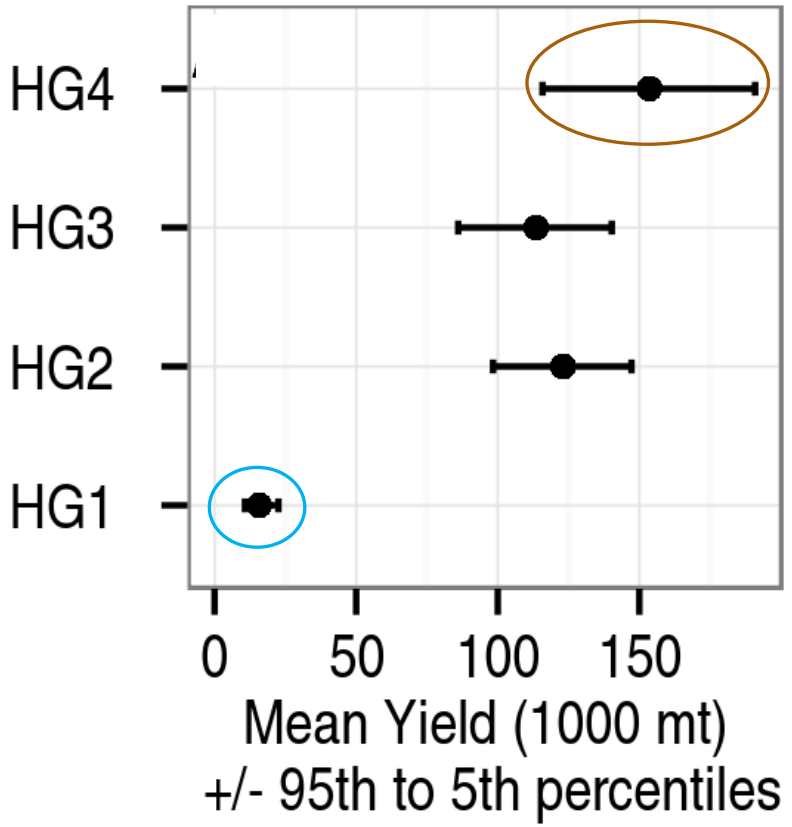
Tommasi et al. 2016

Tested robustness of results to removal of harvest cutoff





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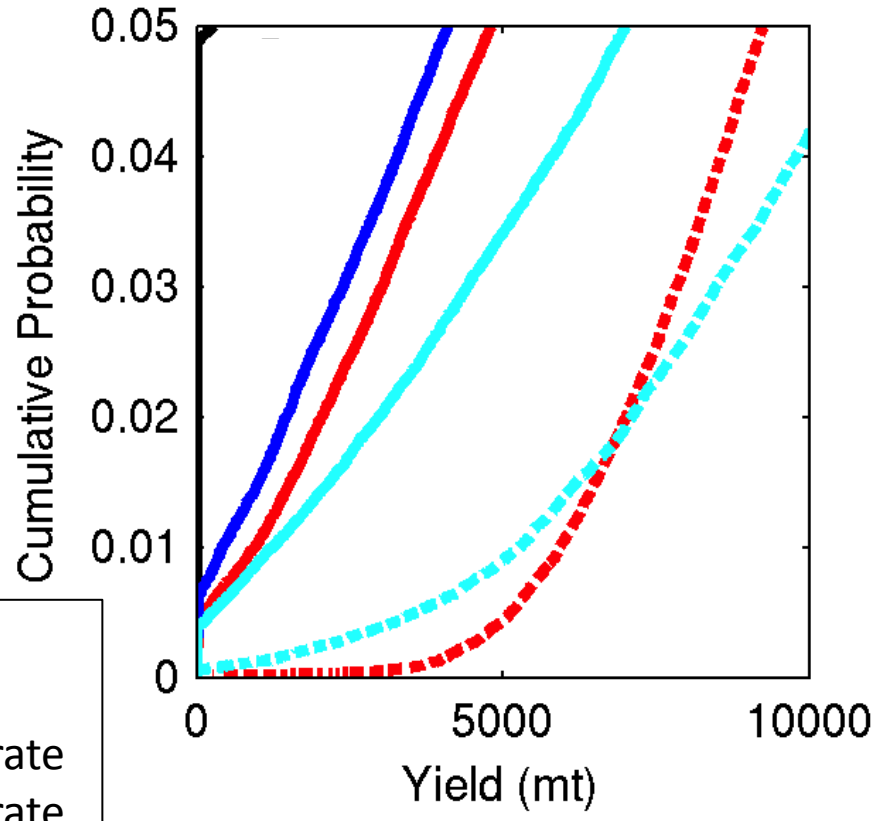
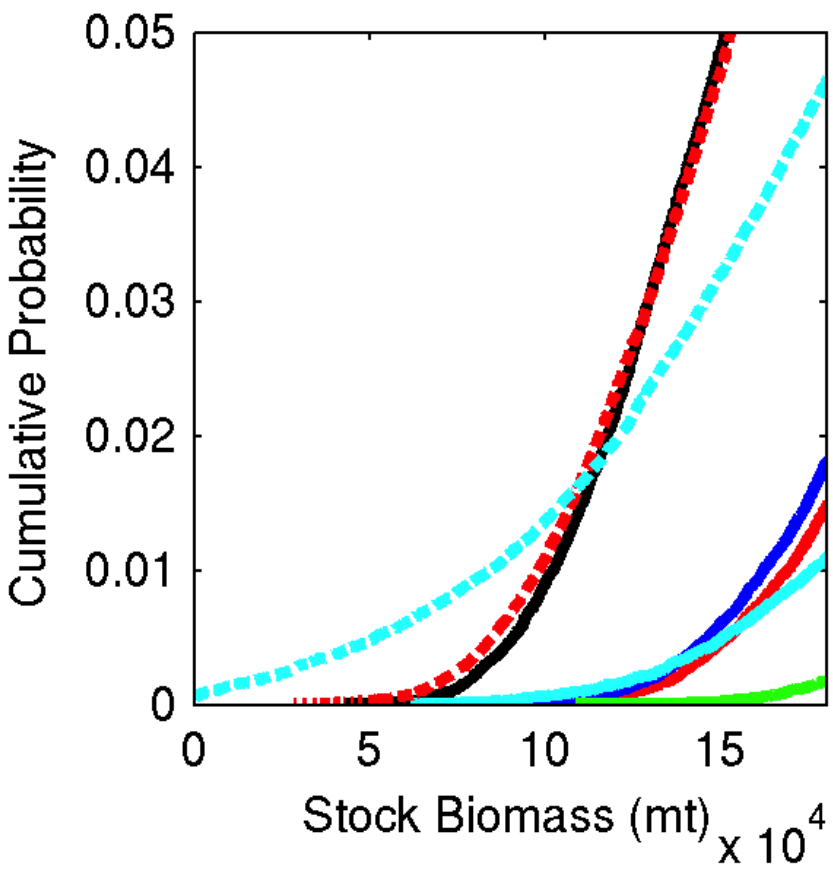
Tommasi et al. 2016

Tested robustness of results to removal of harvest cutoff

HG1
HG2
HG3
HG4
No fishing
HG2 without cutoff
HG4 without cutoff





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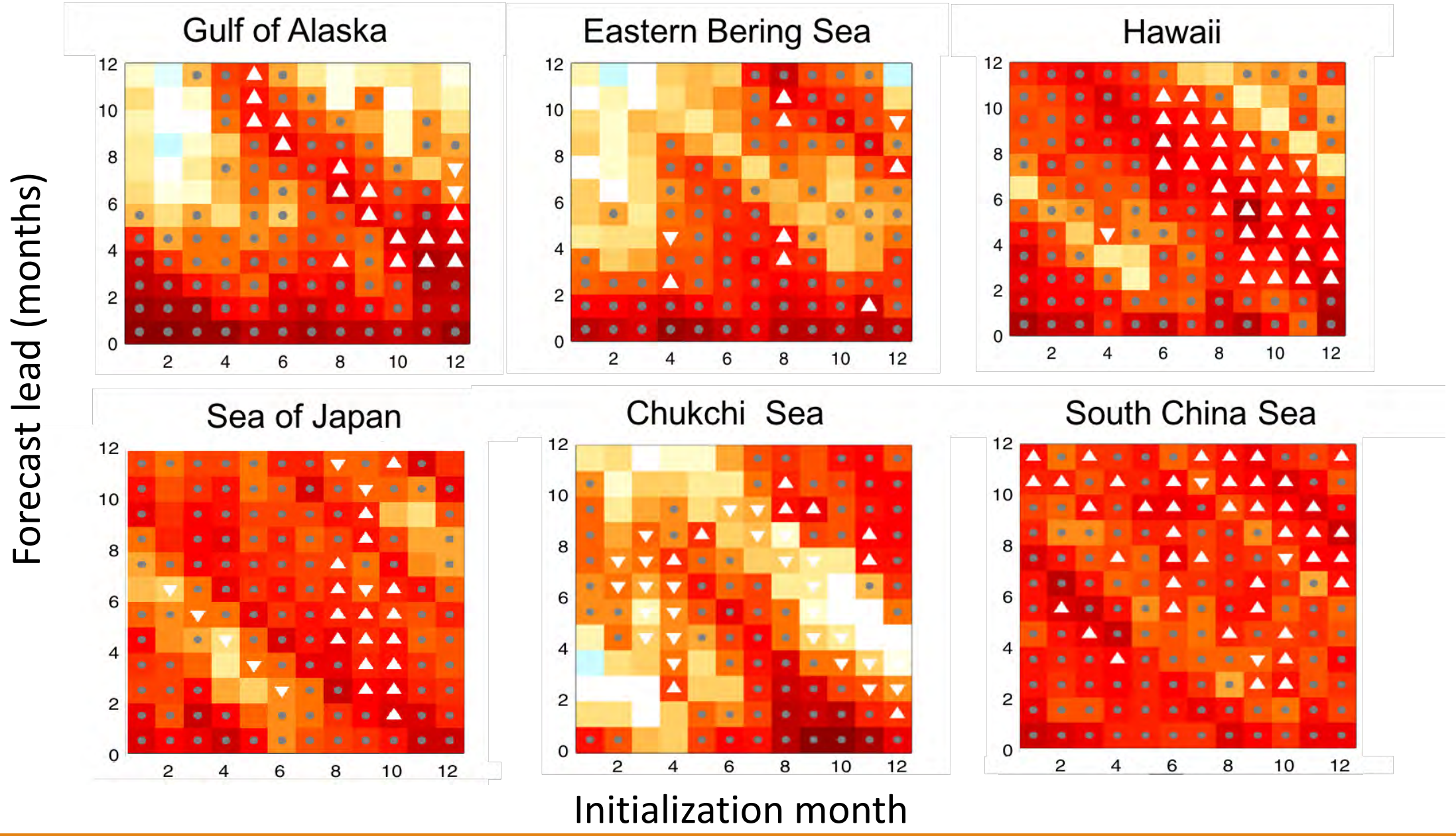
Tommasi et al. 2016

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



Stock et al., *2015*

Thank you!

For more information:

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Tommasi et al., 2016. Improved management of small pelagic fisheries through seasonal climate prediction. Ecological Applications, doi: 10.1002/eap.1458