

Rebuilding in the face of climate change

Richard Bell, Anthony Wood, Jonathan Hare, John Manderson, David Richardson, Timothy Miller

Images: Northeast Fisheries Science Center

Changes in abundance & distribution

Fishing



Drivers in Assessments •Fishing

Stochastic forcing

•Weights-at-age, Fecundity

Ecosystem



<u>Rarely include</u>Physical environmentSpecies interactions

Incorporating Ecosystem Effects

- Time consuming
- Challenging
- Relationships often fail

Potential Methods

- Mechanistic links which are consistent over time.
- Incorporate variability, without a driver (e.g. state-space models)



Age Structured Assessment Program (ASAP)

Beverton-Holt

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Legault and Restrepo 1998, Mace and Doonan 1988

Test case: Winter Flounder



Beverton-Holt recruitment function





Bell et al 2014



ASAP – E and Projections

- Fit population model with temperature dependent stockrecruit function.
- I. BASE Projection with stand assessment output mean Prod
- 2. ENVIRON Projection with recent Productivity
- 3. TEMP Projection with environmentally driven Productivity
- Project with no fishing
- Project with F=0.1
- Project with F=Fmsy =0.325
- 1000 runs

Can the stock rebuild?



Assessment output



Temperature



AR5 Earth
systems model
downscaled
to east coast
Ensemble
mean is mean
of I4 models







Recruitment

Projections





Spawning Stock Biomass

Projections



Catch

Conclusions

- Successfully incorporated the environment into an age structured stock assessment
- Productivity declines with temperature
- Incorporating the environment had little impact on the assessment output
- Incorporating the environment changed the projections
- Test Case
- Results suggest that winter flounder may not be able to rebuild to historical levels
- With no fishing the stock could still decline



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