Evaluating the Impact of Inaccurate Catch Information on Groundfish Management

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Presentation to NEFMC Groundfish Committee

8/19/2020

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SMAST

Acknowledgements

- Funding Support

New England Fishery Management Council

- Contributors to model framework: Samuel Truesdell, Gavin Fay, Jonathan Cummings, Andrew Pershing, Sarah Gaichas, Min-Yang Lee, Anna Birkenbach

- Guidance on simulation specifications from the groundfish PDT

- Review of draft report and suggestions for presenting methods and results - Tom Nies

Amendment 23 - Under Development

- This action proposes adjustments to the current groundfish monitoring program to improve the reliability and accountability of catch reporting in the commercial groundfish fishery to ensure there is precise and accurate representation of catch (landings and discards).
  - Fisheries management decisions are informed by stock assessments which incorporate catch and survey time series, as well as biological information, to estimate the exploitable biomass of stocks.
  - Misreported catch is a problem for many fisheries globally and was recently identified as a concern in the New England groundfish fishery because of problems with monitoring, enforcement, and economic incentives for mis-reporting.

New England Groundfish Monitoring

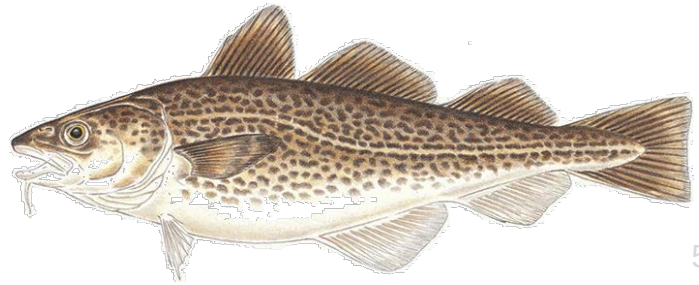
- Analyses conducted by the Groundfish PDT suggested an “observer effect”:
  - differences between observed and unobserved trips
  - incentives to discard some species on some trips in certain years (e.g., Gulf of Maine Atlantic cod, 2015-2017)
  - approximated the potential magnitude of under-reported catch
- Results suggest an underestimation of total discards and catch, but the magnitude and timing are uncertain.

Council Contract to GMRI-SMAST

- The fishery monitoring plan is one aspect of the ‘management procedure’ that can be evaluated to assess performance and impact on achieving management objectives.
- Management Strategy Evaluation can be used to evaluate the impact of misreported catch on stock assessment results and management recommendations.
- **Goal:** Simulation test a range of underestimated catch scenarios and evaluate the impact on the performance of the stock assessment and management.
- Simulations were conditioned to be similar to the Gulf of Maine cod stock, assessment and management.

If unreported catch is occurring, how does it impact:

  - performance of the stock assessment?
  - achievement of management objectives?
  - stock rebuilding?



Council Contract to GMRI-SMAST

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Designed to inform:

- How does under-reported catch affect assessments and catch advice?

What it's NOT designed to inform:

- Is the current catch data biased?
- What is the cause of bad catch data?
- This work DOES NOT consider other uncertainties in science and management: bad survey data, imprecise recreational catch, inaccurate stock assessment assumptions (e.g., natural mortality), uncertain age/size composition, etc.

Under-reported catch was isolated to see how it affects assessments and management.

Working Group

Aug. 21, 2020 SSC sub-panel Peer Review Webinar

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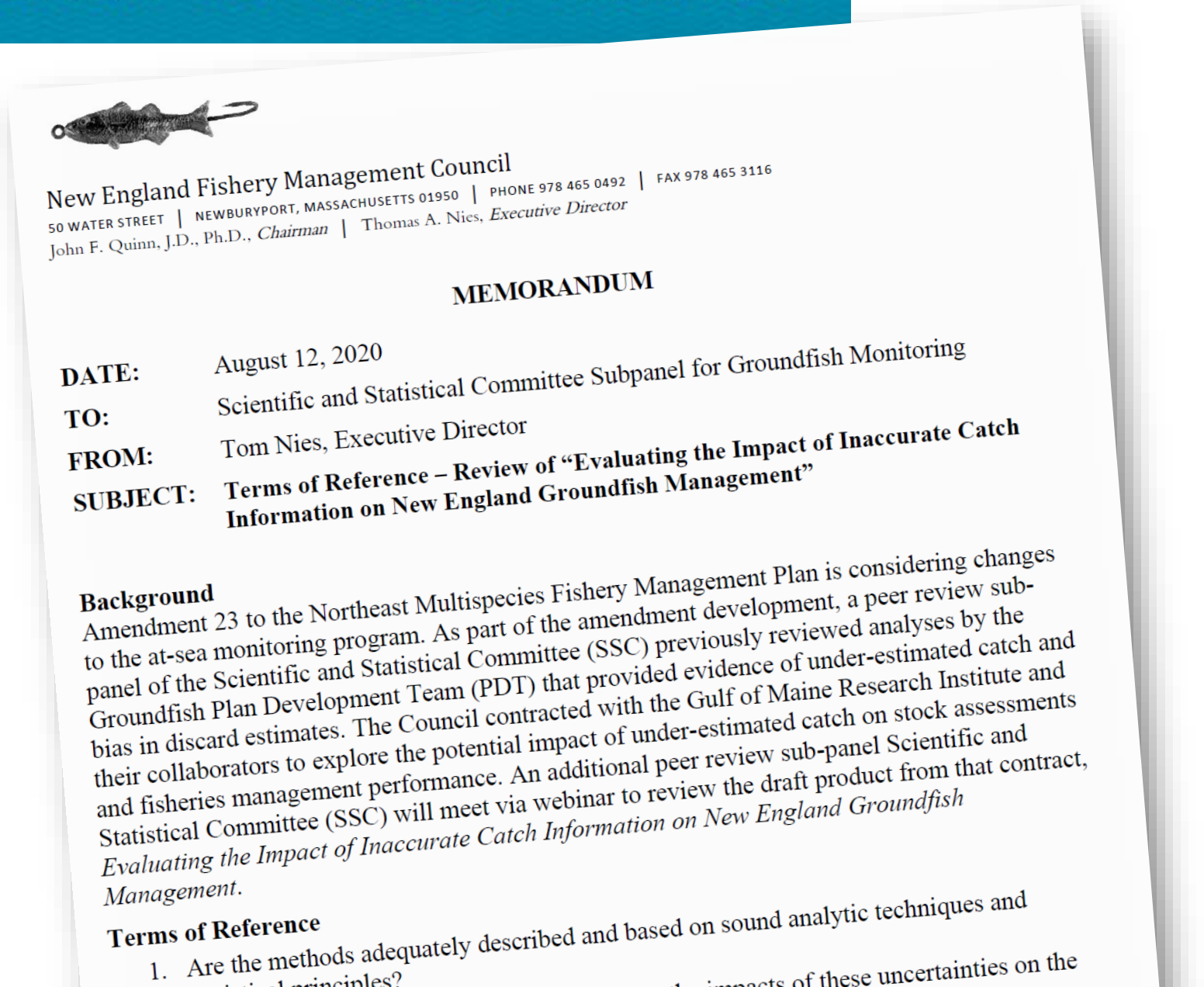
- A peer review sub-panel of the Scientific and Statistical Committee (SSC) will meet via webinar to review the draft product from the GMRI contract for "Evaluating the Impact of Inaccurate Catch Information on New England Groundfish Management".



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John F. Quinn, J.D., Ph.D., *Chairman* | Thomas A. Nies, *Executive Director*

MEMORANDUM

DATE: August 12, 2020

TO: Scientific and Statistical Committee Subpanel for Groundfish Monitoring

FROM: Tom Nies, Executive Director

SUBJECT: **Terms of Reference – Review of "Evaluating the Impact of Inaccurate Catch Information on New England Groundfish Management"**

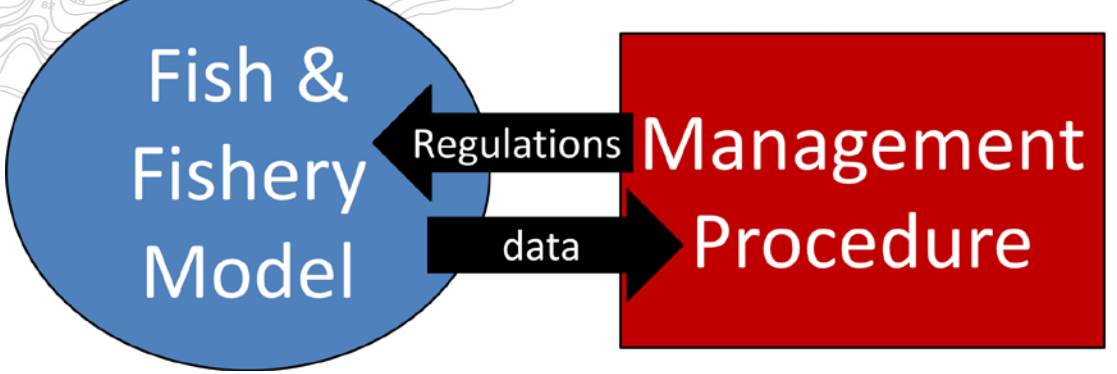
Background

Amendment 23 to the Northeast Multispecies Fishery Management Plan is considering changes to the at-sea monitoring program. As part of the amendment development, a peer review sub-panel of the Scientific and Statistical Committee (SSC) previously reviewed analyses by the Groundfish Plan Development Team (PDT) that provided evidence of under-estimated catch and bias in discard estimates. The Council contracted with the Gulf of Maine Research Institute and their collaborators to explore the potential impact of under-estimated catch on stock assessments and fisheries management performance. An additional peer review sub-panel Scientific and Statistical Committee (SSC) will meet via webinar to review the draft product from that contract, *Evaluating the Impact of Inaccurate Catch Information on New England Groundfish Management*.

Terms of Reference

1. Are the methods adequately described and based on sound analytic techniques and

“Management Strategy Evaluation”



- Management
  - Managing human activities to meet societal objectives
  - For example, managing groundfish fisheries for optimum yield while avoiding overfishing and rebuild stocks
- Strategy
  - A long-term plan designed to achieve a major objective
  - For example, a fishery management plan
- Evaluation
  - Testing how well management options meet objectives
  - For example, how does under-reported catch influence the ability to meet groundfish management objectives?
- *Ideally, Management Strategy Evaluations involve stakeholder engagement, but the first iterations (like this one) are based on objectives in the management plan, routine indicators, recent stock assessments and available information.*

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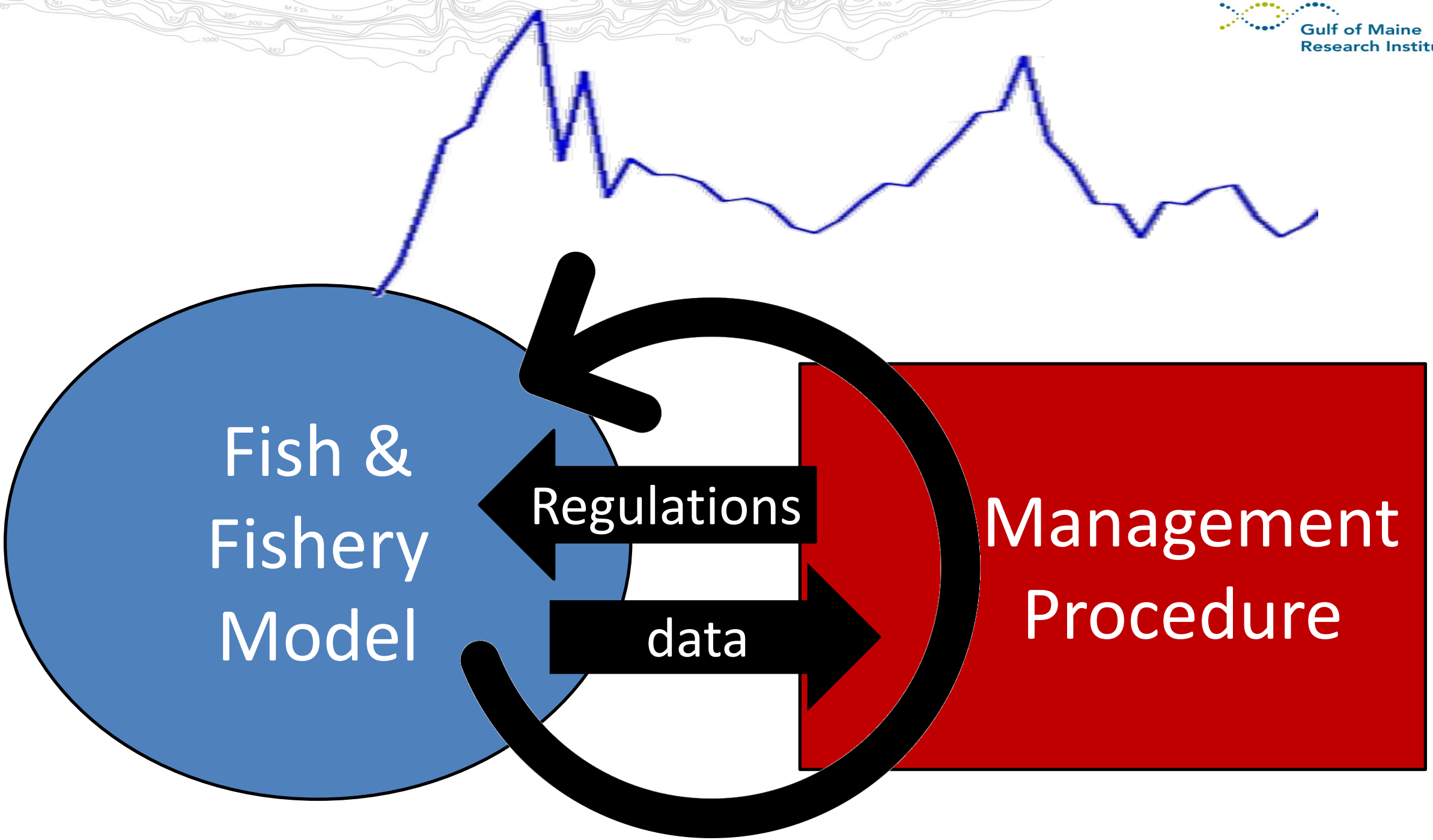
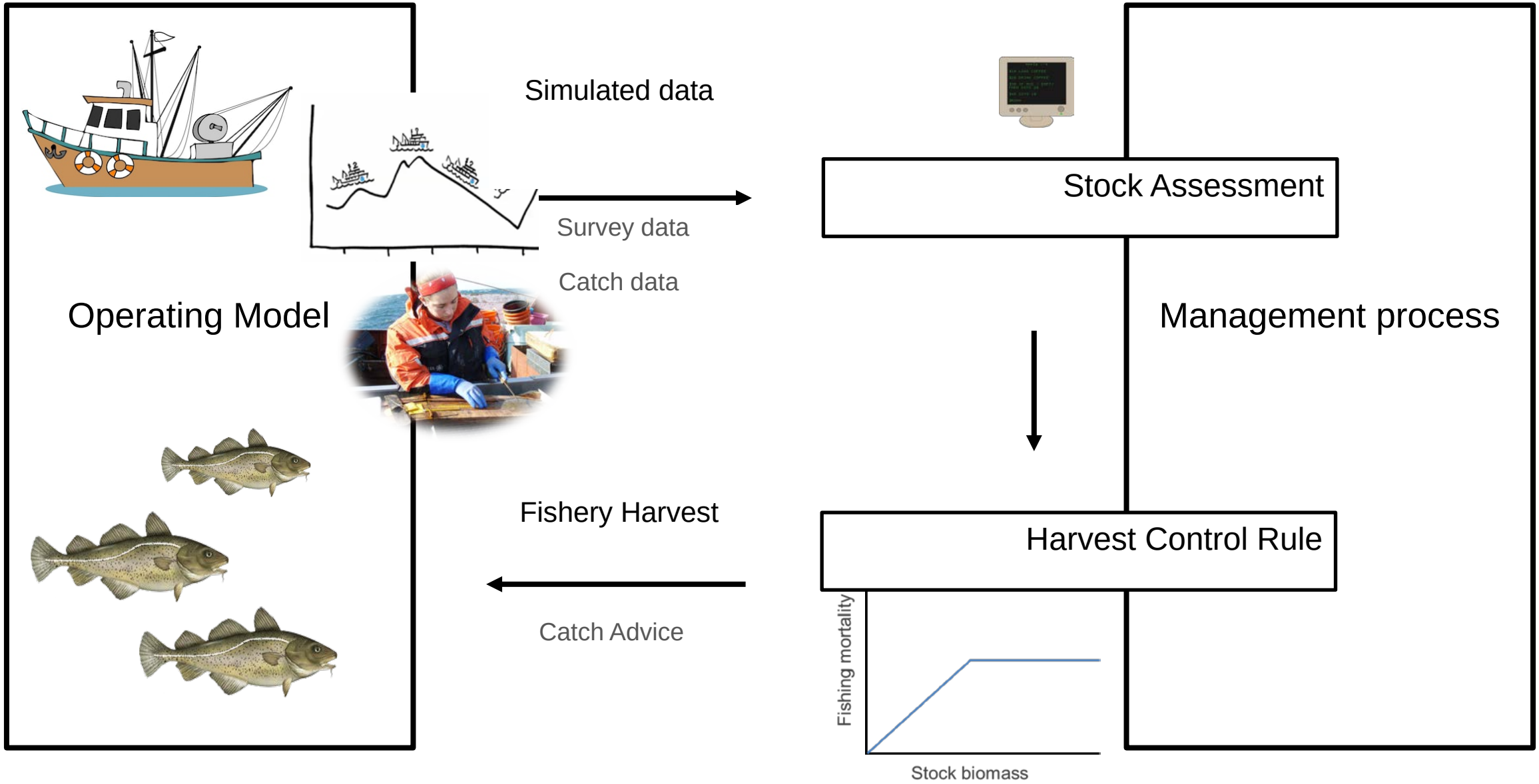


Simulation Testing Framework



Timing of Underestimated Catch Scenarios

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The year in which bias in catch reporting started is unknown, so we explored two alternative scenarios.

“Constant bias”: Bias was applied across all years of the simulation.

“Changepoint in bias”: Bias was initiated in 2015 with no bias prior to 2015, based on incentive analysis for Gulf of Maine cod.

Range of Underestimated Catch Scenarios

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We simulated the range of catch bias suggested by the PDT

Perfect reporting of catch: Base case

Biased reporting of catch: up to 200% (i.e., actual catch is up to 3x greater than reported, or reported catch is as low as one-third the actual catch)

Scenario	Bias
Perfect reporting	0%
Moderate bias in reporting	50%
Large bias in reporting	125%
Extreme bias in reporting	200%

Measuring Impacts

Stock Impacts:

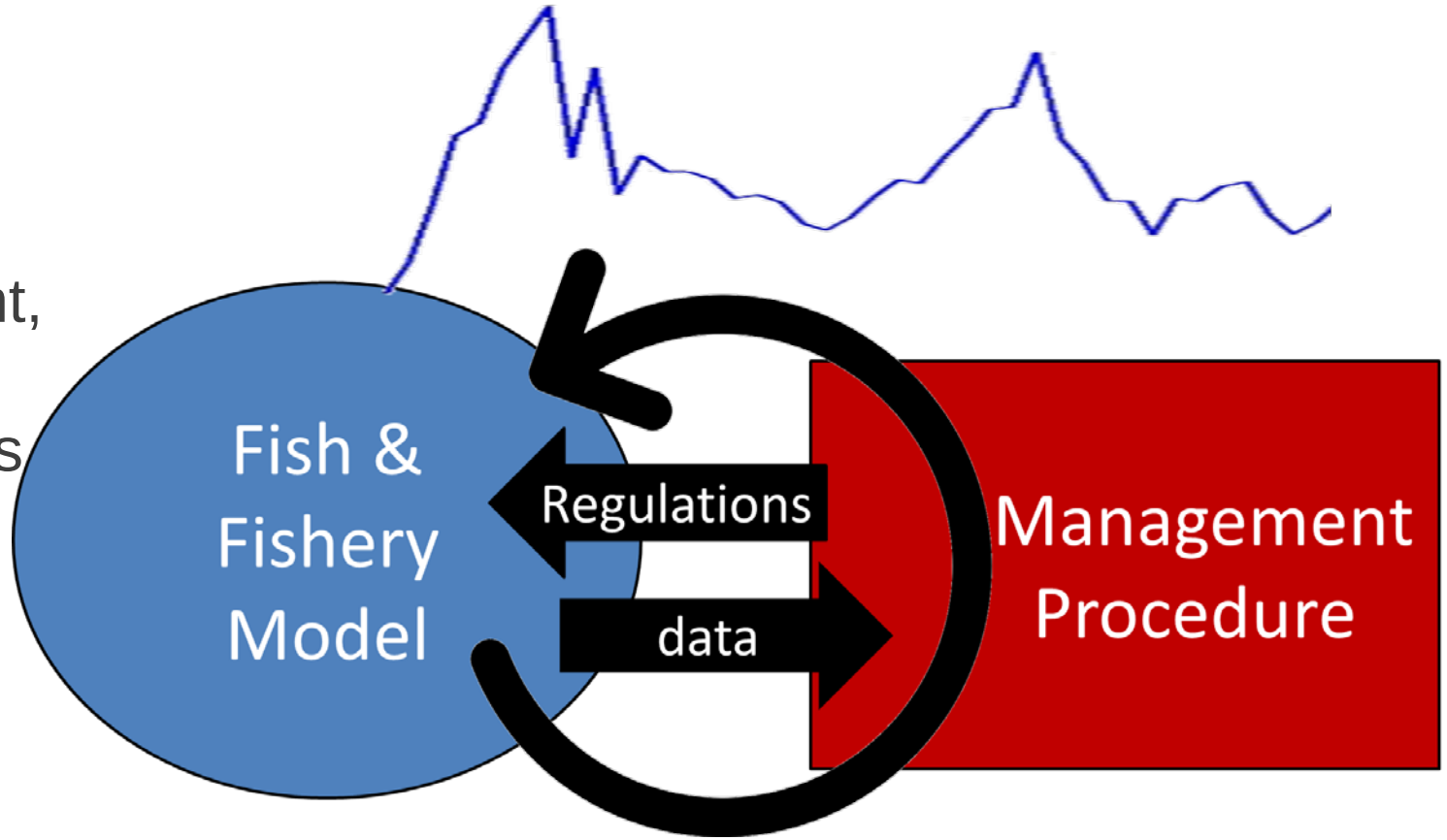
- “True” stock SSB, recruitment, fishing mortality, and catch.

Assessment performance:

- Estimated stock SSB, recruitment, fishing mortality, and catch that are different from the ‘true’ values

Management performance:

- We compared the biological reference points, biomass and stock status metrics.



Summary of Scenarios

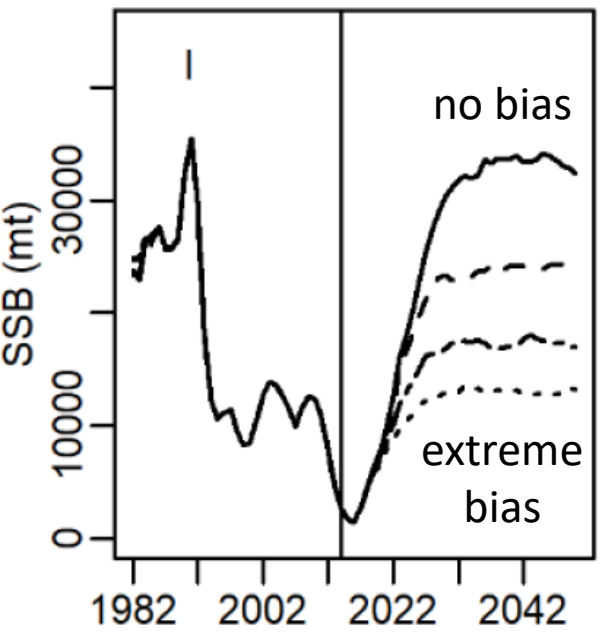
- Two virtual realities of cod-like population (constant or increased natural mortality)
- Two scenarios of catch bias timing (constant, change-point)
- Four scenarios of catch bias magnitude (0, 50,125, 200%)
- Two harvest control rules (constant target fishing, ‘sliding ramp for rebuilding plan’)

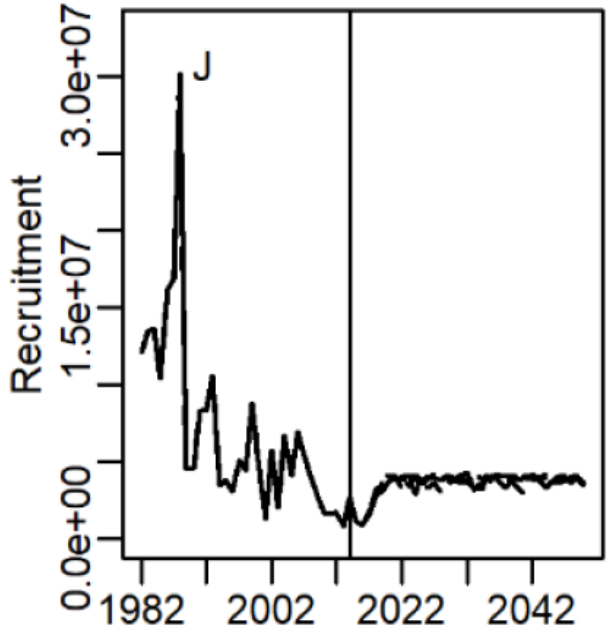
In all scenarios:

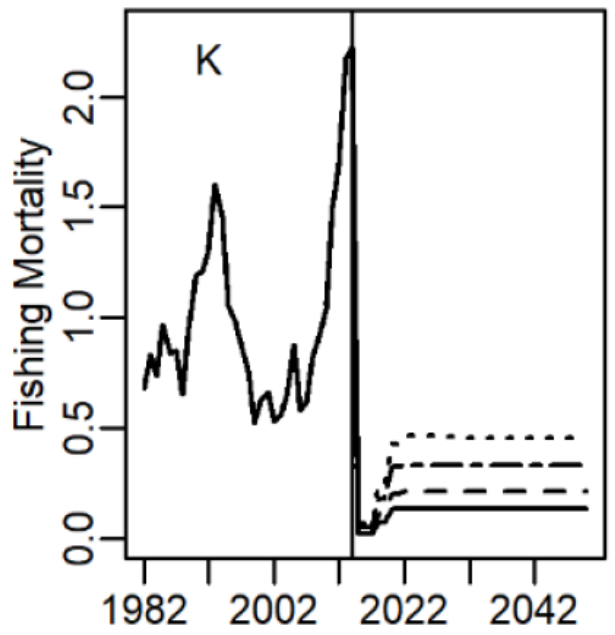
- Historical stock trajectories are reconstructed from 1980-2014
- Management procedure is initiated in 2015 and projected to 2050.

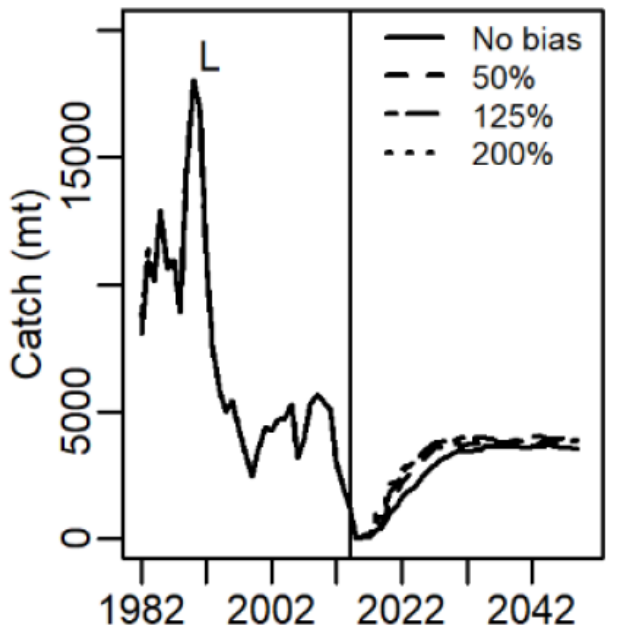
Example Results – Effect on 'True' Population and Fishery

- Change in bias, constant natural mortality, sliding harvest rule









- More rebuilding with less bias
  - Similar recruitment among scenarios
    - More fishing mortality with more bias
      - Similar catch among scenarios

Summary of Findings - Stock Trajectories

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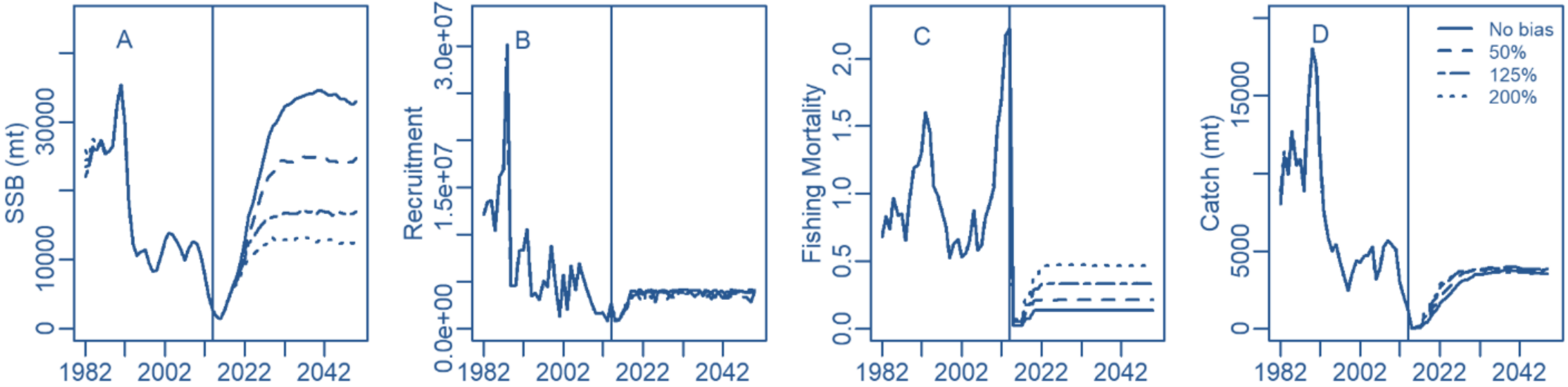
- Scenarios with no catch bias exhibited accelerated rebuilding and were characterized by accurate stock assessment performance and effective management as evidenced by the stock transitioning to no overfishing and not overfished status during the projection period.
- Biased catch information resulted in lower stock biomass with increasing bias in catch reporting.
- Scenarios that assumed increased natural mortality did not achieve the same rebuilding and management outcomes as constant natural mortality assumption.

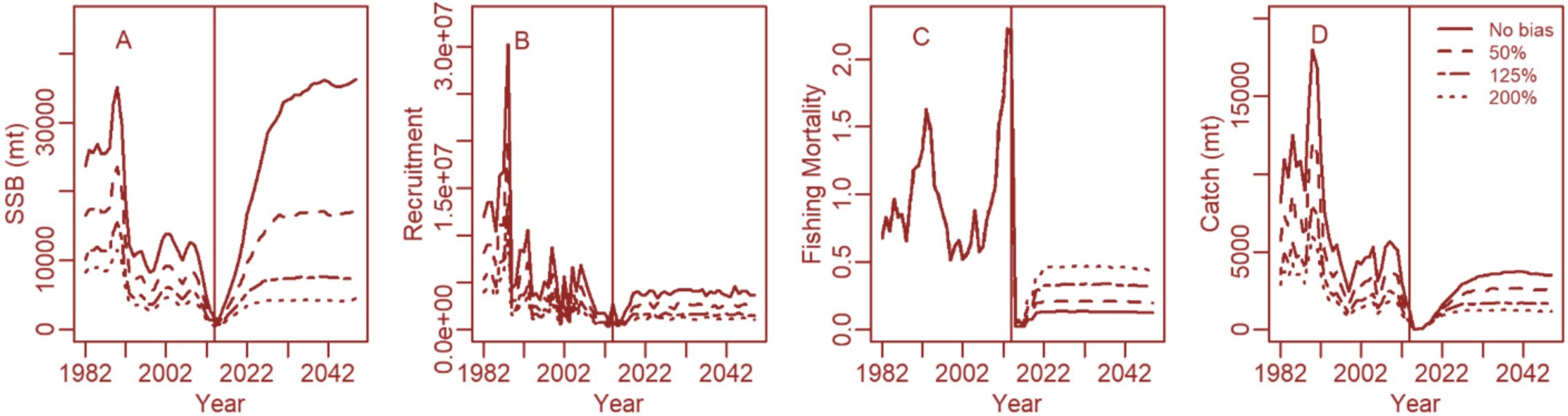
Example Results – Stock Assessment Performance

- Change in bias, constant natural mortality, sliding harvest rule

Operating Model ('true values')



Estimation Model (estimated values)



Summary of Findings - Stock Assessment Performance

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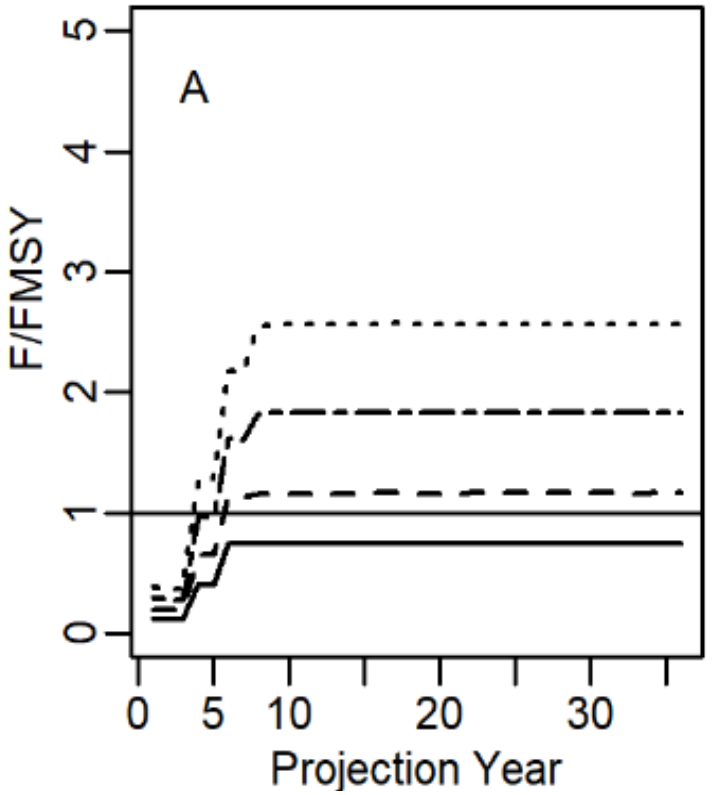
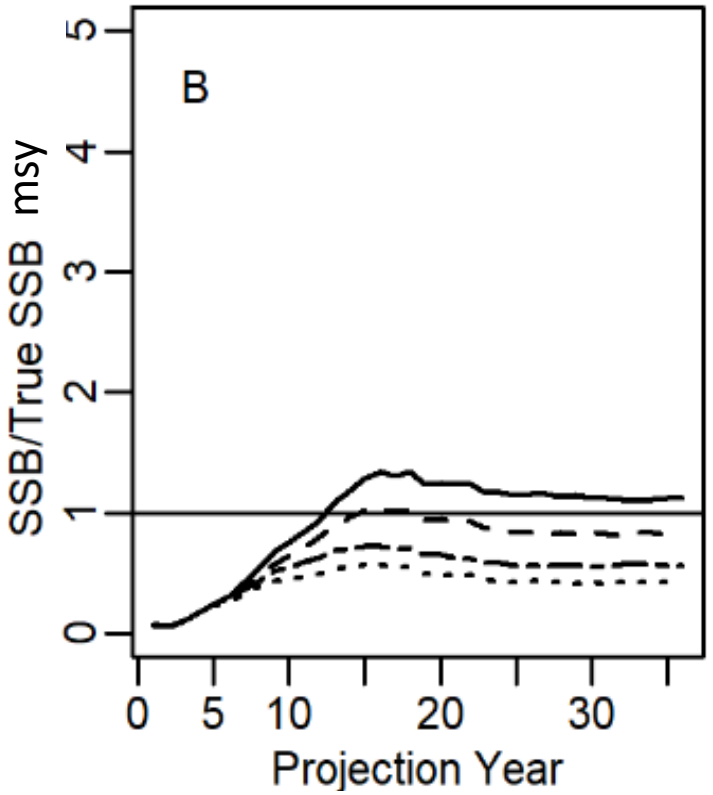
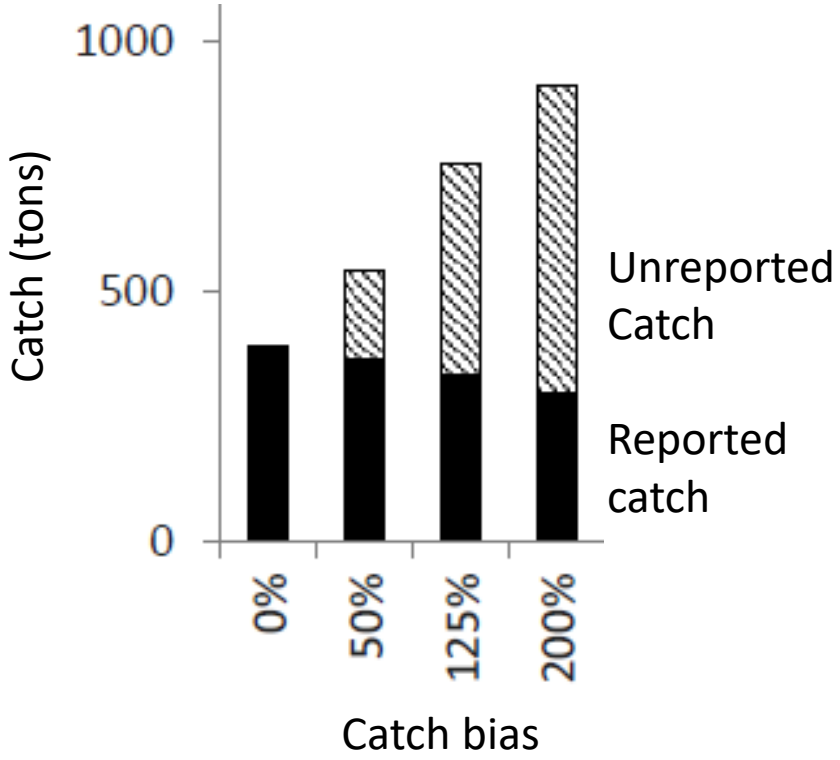
- Constant catch bias:
  - Assessments exhibited consistent underestimation of recruitment and SSB with underestimation increasing with increased bias in catch reporting.
  - Fishing mortality estimates remained unbiased because they were informed by unbiased age composition data.
- Changepoint in catch bias (starting in 2015):
  - Assessments initially performed well for 10-15 years, then performance increasingly degraded.
  - Retrospective inconsistency decreased in updated estimates of spawning stock biomass and increased in updated estimates of fishing mortality.

Example Results – Management Performance

- Change in bias, constant natural mortality, sliding harvest rule
- Catch bias leads to overfishing and failure to rebuild
- Future catch projections (years 1-5) suggest that reported catch slightly decreases with the magnitude of catch bias (but actual catch increases with the magnitude of catch bias).







Summary of Findings

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Management Performance:

- Estimated stock status was similar to true stock status determinations under constant catch bias scenarios.
- Changepoint catch bias scenarios exhibited instances of misperception of stock status.

Conclusions:

- Improvement of catch reporting has the potential to improve stock assessment and management performance and contribute to achieving rebuilding plans
- High to extreme bias in catch reporting was detrimental to sustainable management
- <50% catch bias had more limited impacts on assessment and management performance in the context of risk adverse management.

Caveats

- Results are conditional on the specification of the models and scenarios.
- Simulations focus on impact of one factor, but there are other factors that can influence assessment and management performance.
- Simulations assume a representative operating model and a correctly specified assessment model (other than catch bias).
- Additional sources of uncertainty could be explored.
  - For example, we're working with the Council to extend these analyses for evaluating the performance of alternative harvest control rules for stock assessments that exhibit retrospective patterns.

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Questions?

Constant Catch Bias Scenarios

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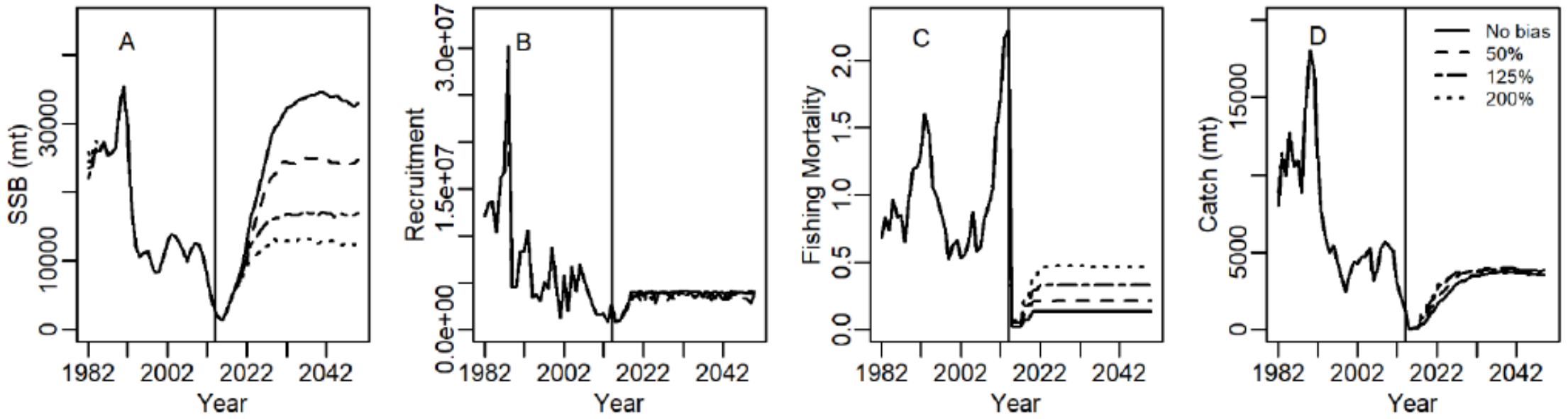
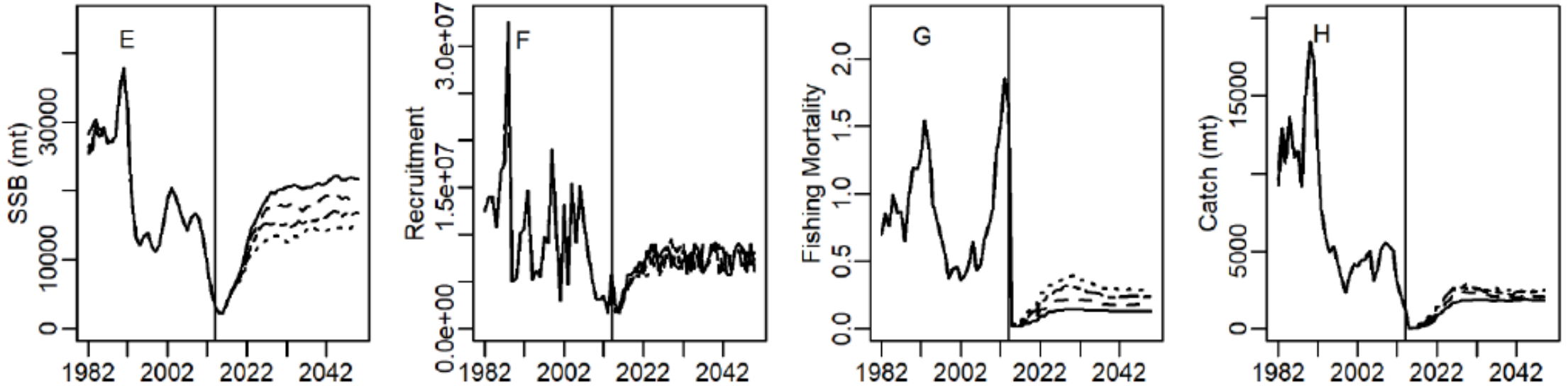
Constant catch bias, M = 0.2, sliding harvest control rule



Constant catch bias, M-ramp, sliding harvest control rule



Changepoint Catch Bias Scenarios

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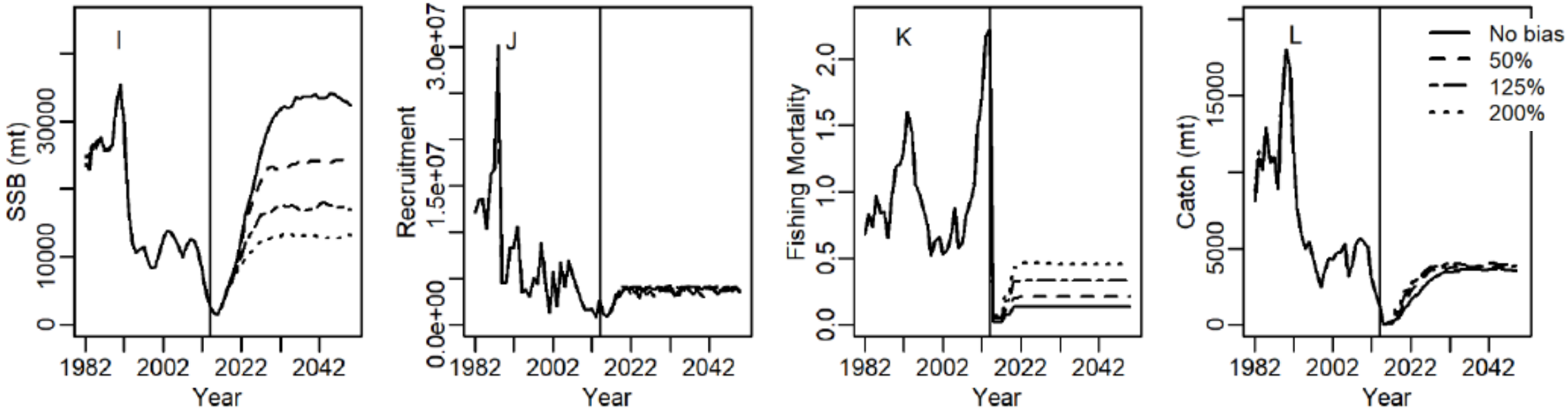
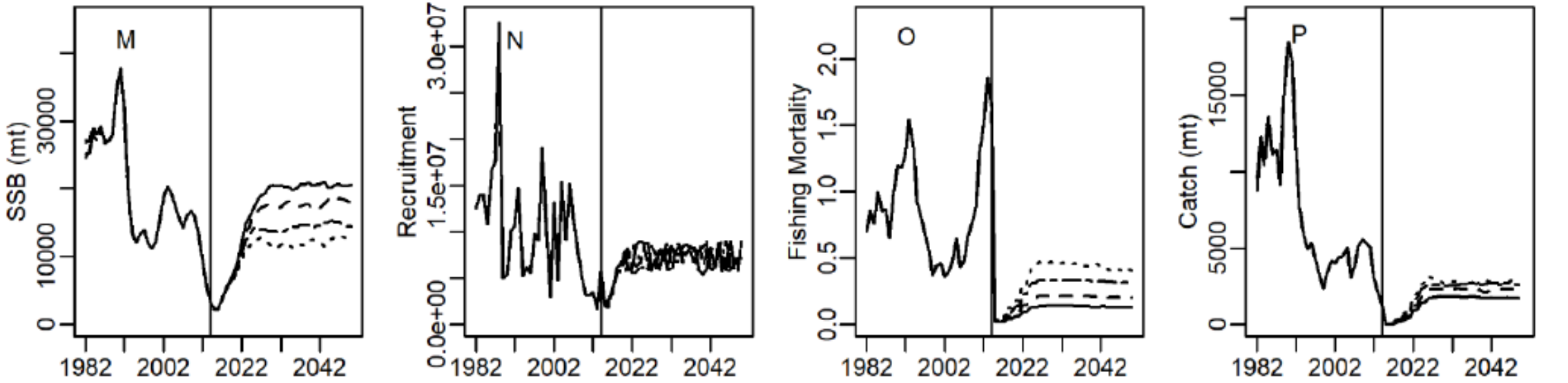
Changepoint catch bias, M = 0.2, sliding harvest control rule



Changepoint catch bias, M-ramp, sliding harvest control rule



Constant Catch Bias Scenarios – Stock Status

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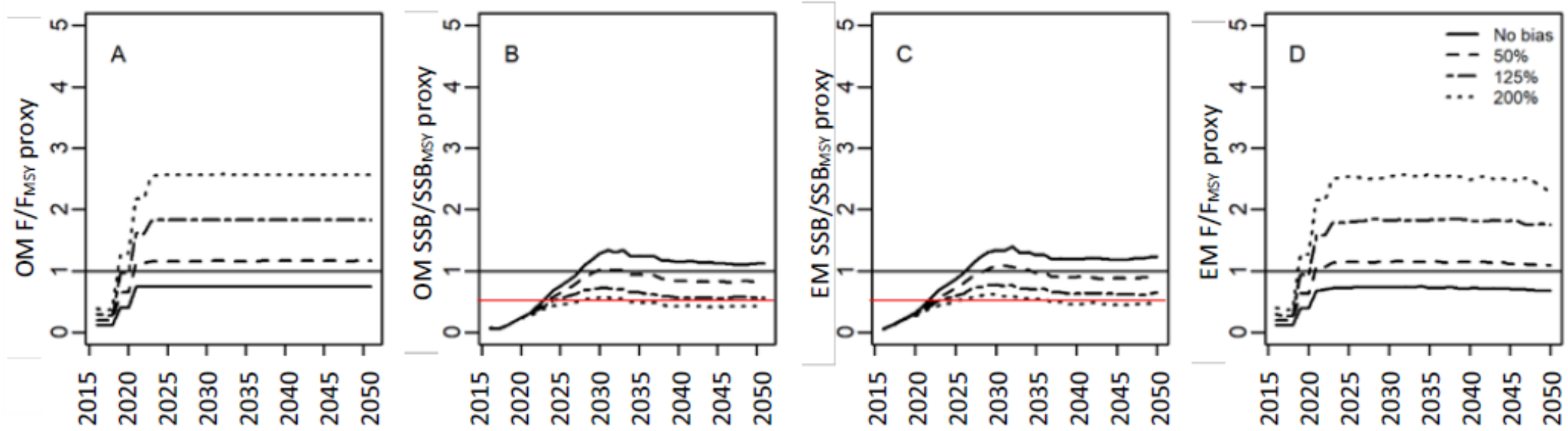
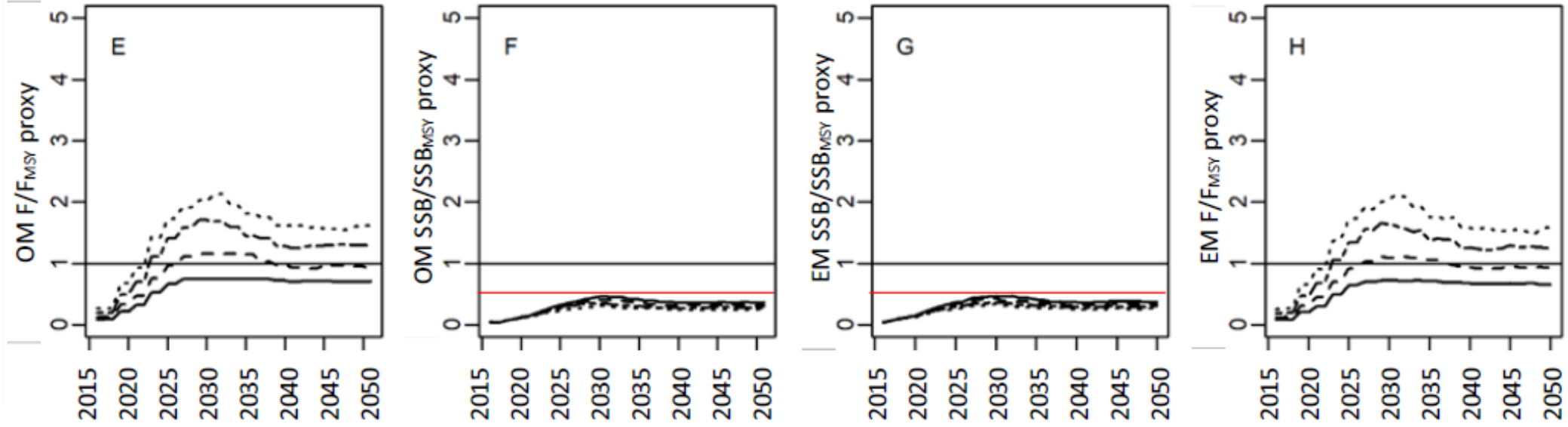
Constant catch bias, M = 0.2, sliding harvest control rule



Constant catch bias, M-ramp, sliding harvest control rule



Changepoint Catch Bias Scenarios – Stock Status

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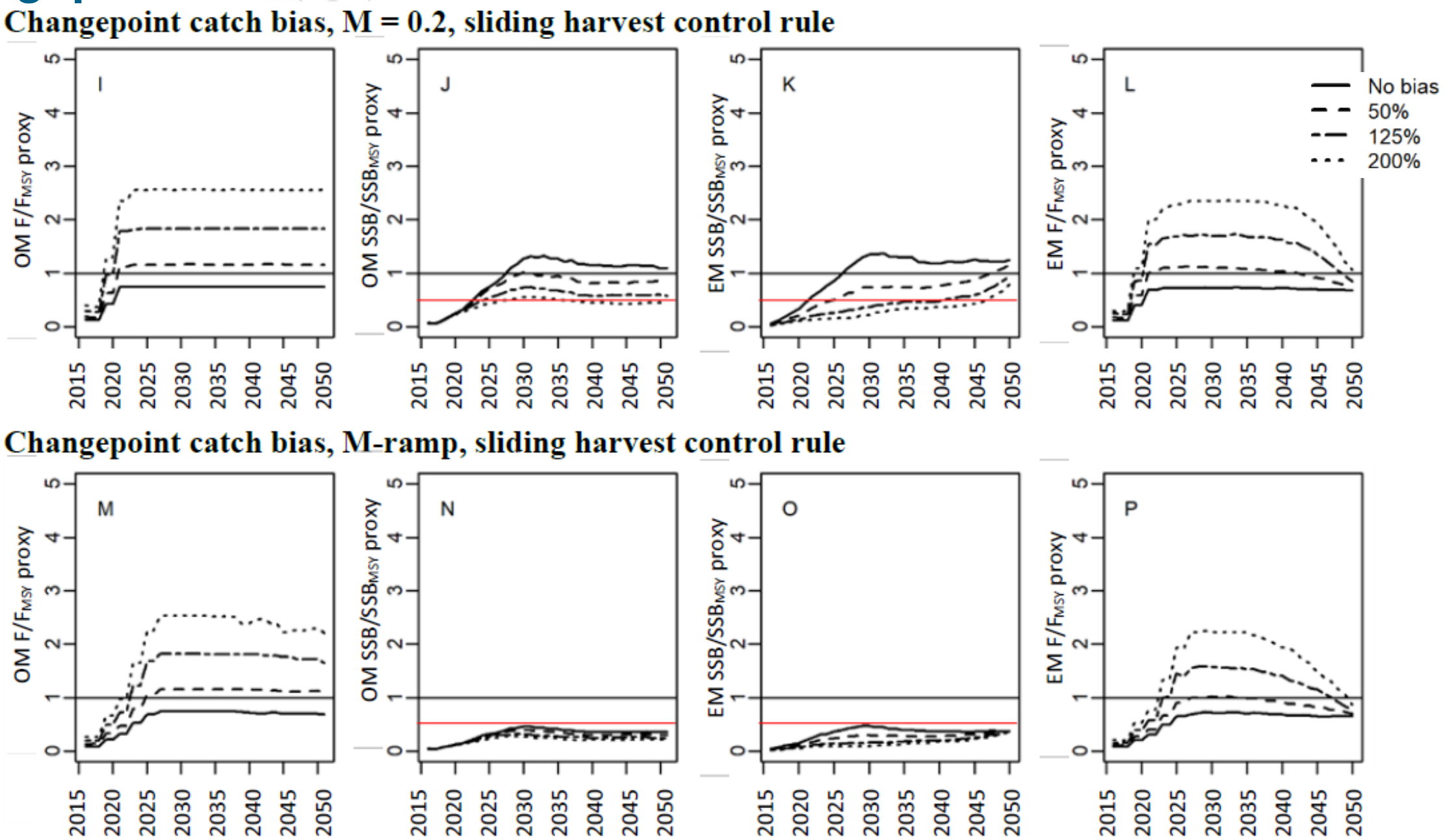
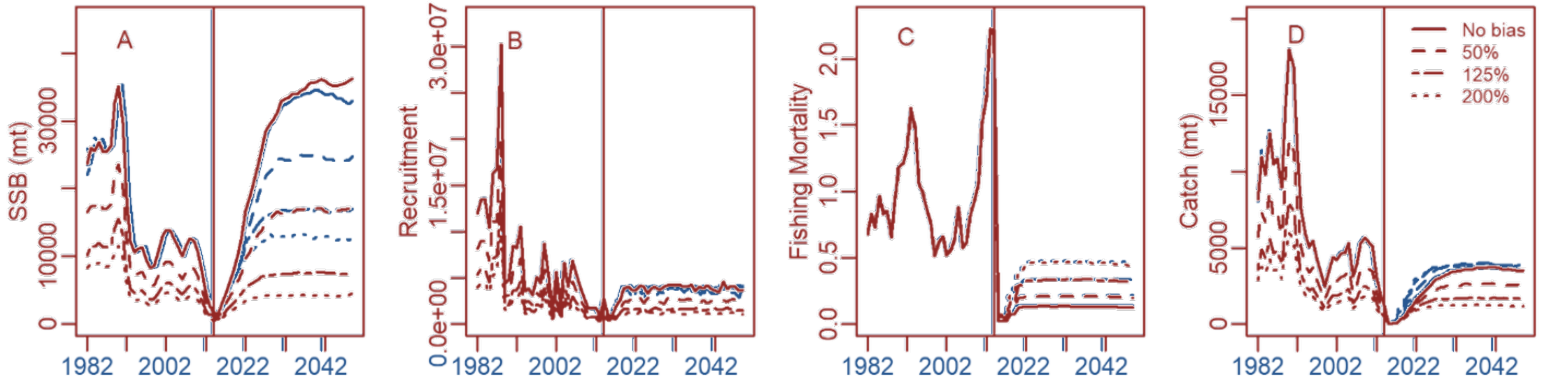


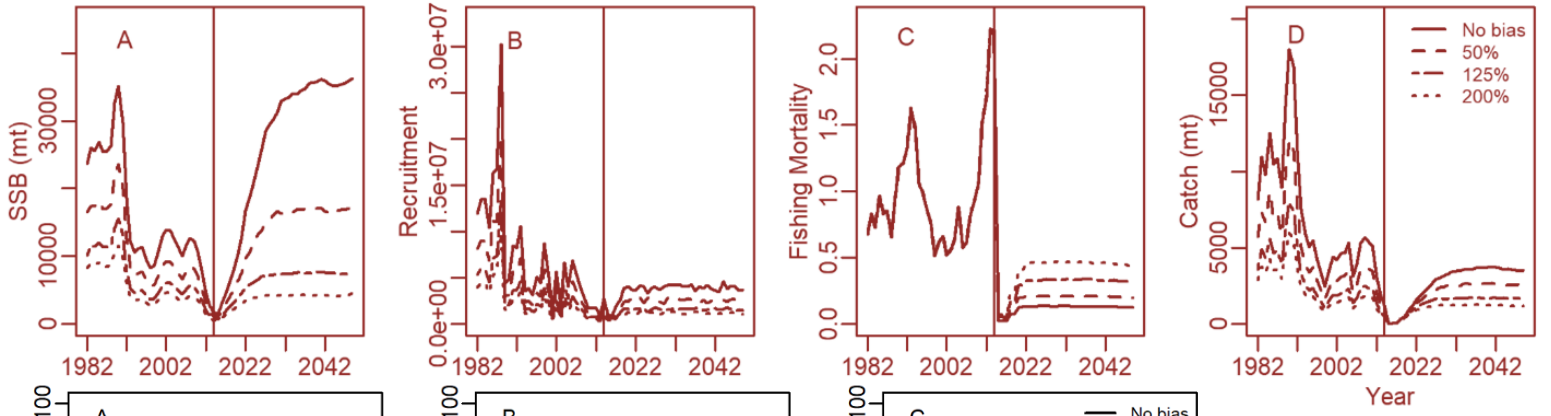
Stock Assessment Performance: Comparison Operating Model to Estimation Model

Constant catch bias, M = 0.2, sliding harvest control rule

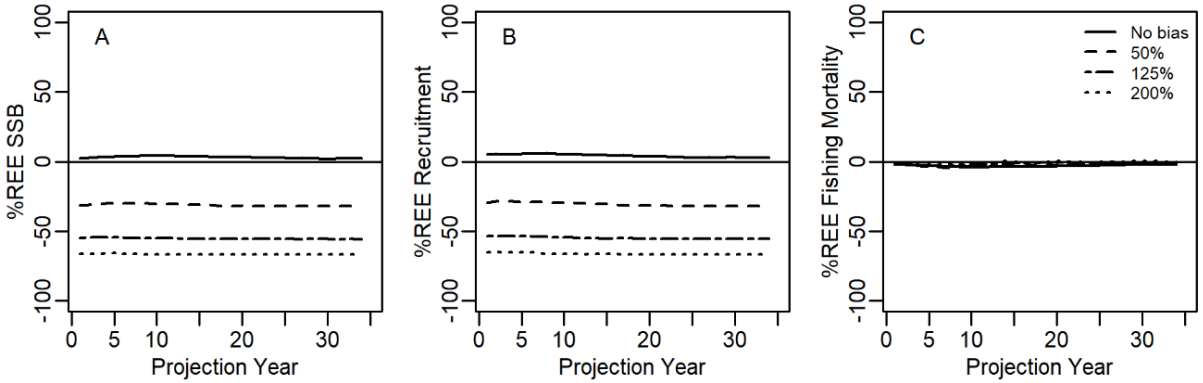
Operating Model



Estimation Model



Error in Estimation Model



Stock Assessment Performance: Comparison Operating Model to Estimation Model

Constant catch bias, M-ramp, sliding harvest control rule

Operating Model

Estimation Model

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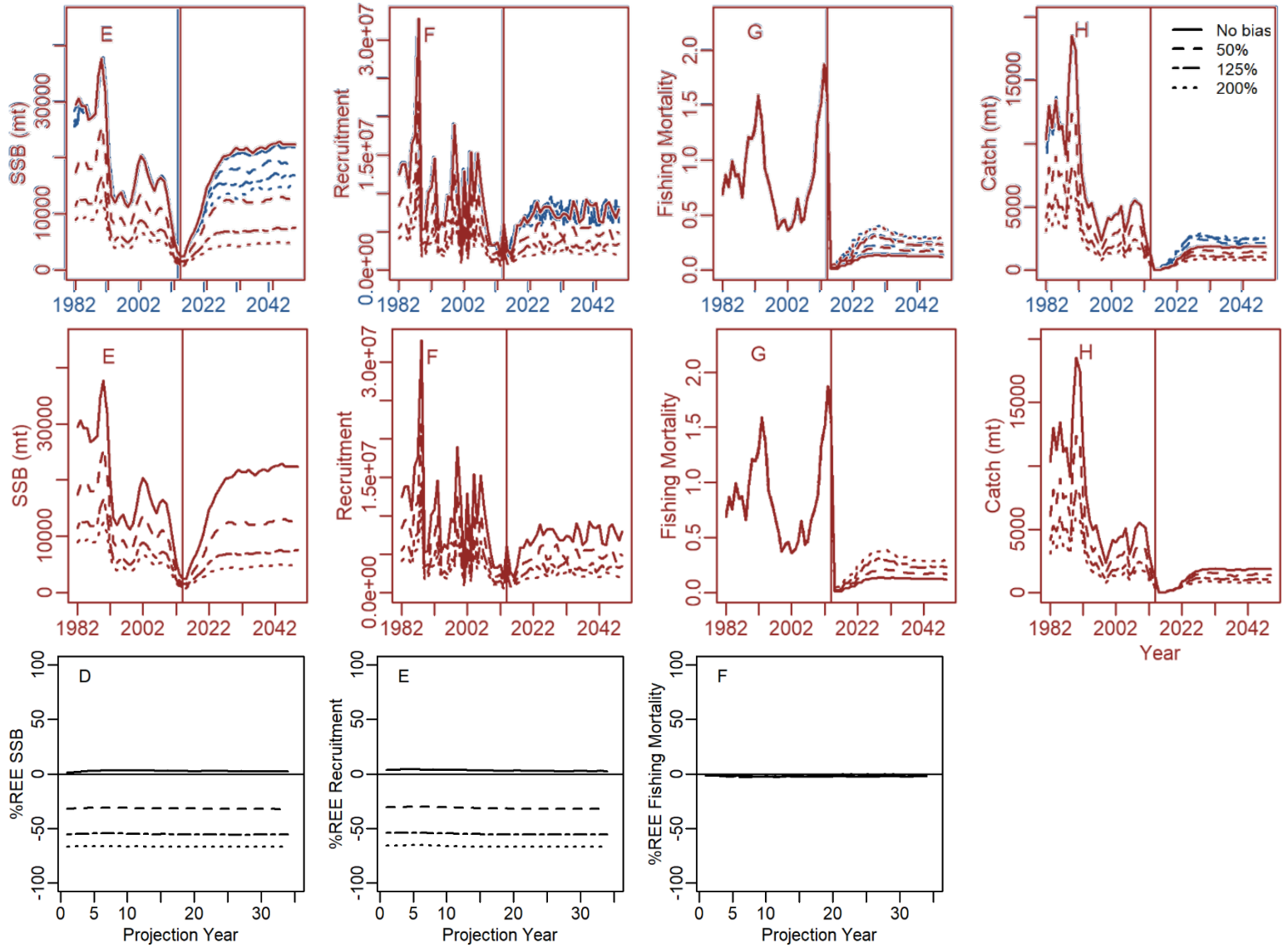

Groundfish PDT Analysis

The PDT approximation of upper range of bias in catch reporting was adjusted to represent the proportional representation of recreational and commercial catch.

Approximately 50% of Gulf of Maine cod catch is commercial.