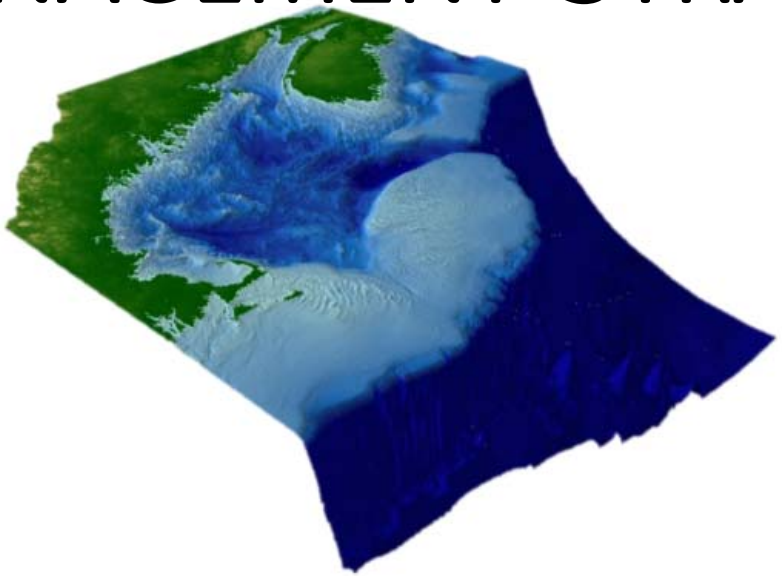
External Peer Review of Ecosystem-Based Fishery Management Strategy



Review Panel Members

Dr. Keith Brander
Dr. Villy Christensen
Dr. Daniel Howell
Dr. Lisa Kerr (Chair)

Background

- The **goal** of the review was to evaluate a proposed strategy for implementing Ecosystem Based Fishery Management for the New England Fishery Management Council.
- This was a **research-track review**, focused on evaluating the conceptual framework of the proposed EBFM strategy and a worked example of its application to the Georges Bank ecosystem.
- The goal was not to evaluate the output of the EBFM procedure for use in management at this stage.

Review Panel

Dr. Lisa Kerr (Chair): Vice Chair of the NEFMC Science and Statistical Committee and a research scientist with the Gulf of Maine Research Institute.

<u>Center for Independent Expert Reviewers:</u>

Dr. Keith Brander: Senior Researcher at Technical University of Denmark, Lyngby Denmark with a background in integrating ecosystem effects into fisheries assessment and management.

Dr. Villy Christensen: Professor at the University of British Columbia specializing in ecosystem modelling.

Dr. Daniel Howell: Fisheries Mathematical Modeller at the Institute of Marine Research, Norway with expertise in multi-species modeling and management strategy evaluation.

Review Activities

During the review, the NEFMC tasked the Panel with two objectives:

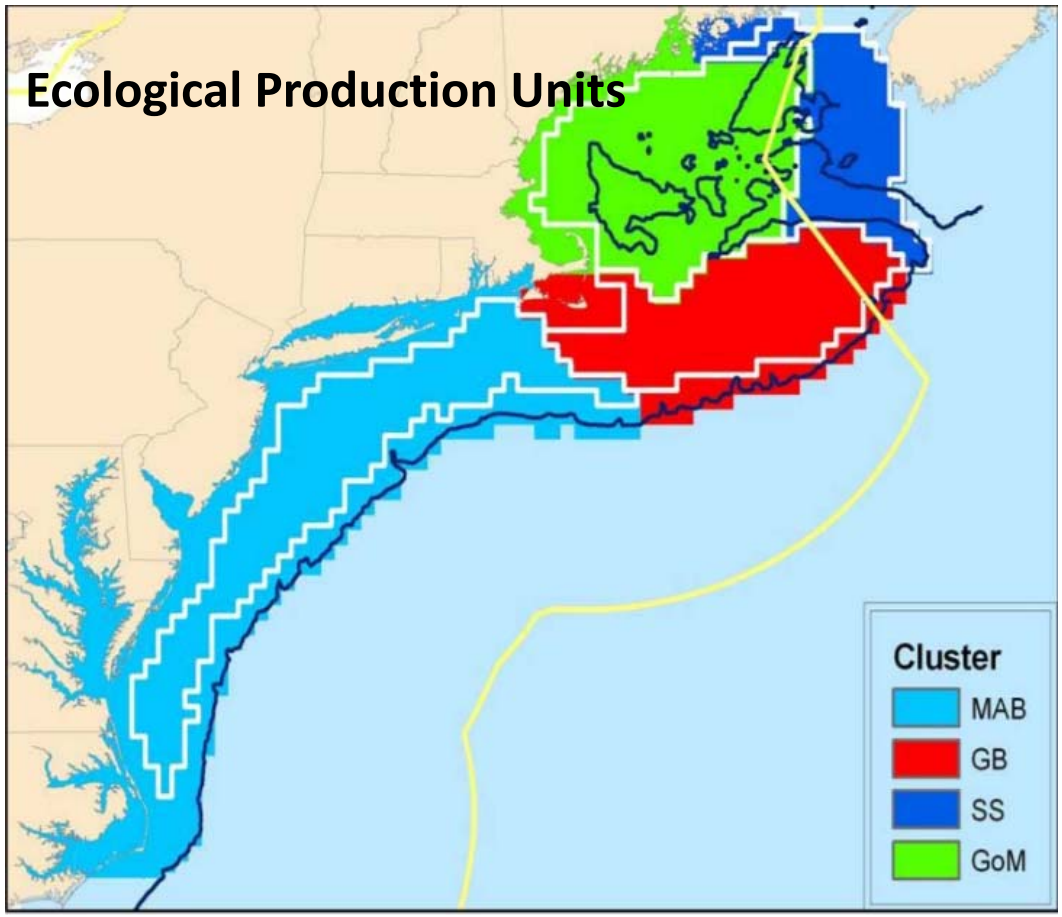
1) Review a proposed implementation of Ecosystem Based Fishery Management for the New England Fishery Management Council.
2) Review the proposed strategy for implementing EBFM on Georges Bank.

Outline of Presentation

- Summary of each Term of Reference considered in the review process.

- Brief synthesis of Panelists' feedback on areas of strength, areas of concern, and recommendations for improvement of the EBFM procedure.

ToR 1: Evaluate the approach used to identify Ecological Production Units on the Northeast Shelf of the United States and the strengths and weaknesses of using these Ecological Production Units as the spatial footprint for Ecosystem Based Fisheries Management in the region



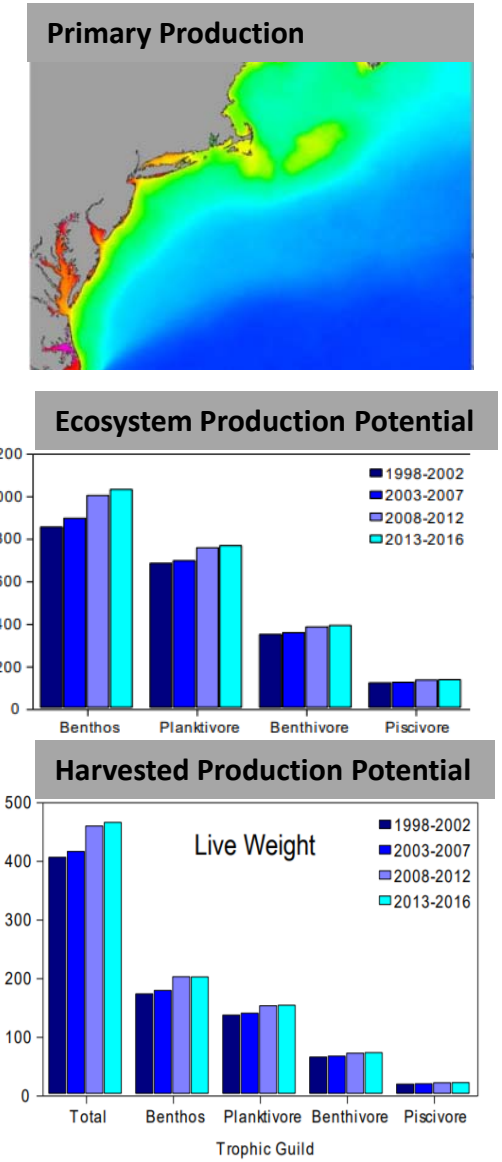
- **Goal:** to identify geographically-defined ecological production units
- Informed by
  1) Physical oceanography
  2) Hydrographic variables
  3) Biological variables

ToR 1: Evaluate the approach used to identify Ecological Production Units on the Northeast Shelf of the United States and the strengths and weaknesses of using these Ecological Production Units as the spatial footprint for Ecosystem Based Fisheries Management in the region

REVIEW PANEL RESPONSE

Strengths	• Scientifically rigorous method • Comparable to previous findings
Concerns	• Dynamics of boundaries • Connectivity between ecological production units • Missing information on upper trophic levels • New management boundaries may create new difficulties
Recommendations	The Panel found the methods for defining EPUs to be reasonable and recommends the approach continue to be refined.

ToR 2: Evaluate the methods for estimating ecosystem productivity for the Georges Bank Ecological Production Unit and advise on the suitability of the above methods for defining limits on ecosystem removals as part of a management procedure.



- **Goal:** estimate total ecosystem production potential.

- Informed by:
  1) Primary production
  2) Pathway of energy flow
  3) Energy transfer efficiency

- Estimates of the production by functional group was calculated based on applying a 20 % exploitation rate on each functional group (Moiseev 1994).

ToR 2: Evaluate the methods for estimating ecosystem productivity for the Georges Bank Ecological Production Unit and advise on the suitability of the above methods for defining limits on ecosystem removals as part of a management procedure.

REVIEW PANEL RESPONSE

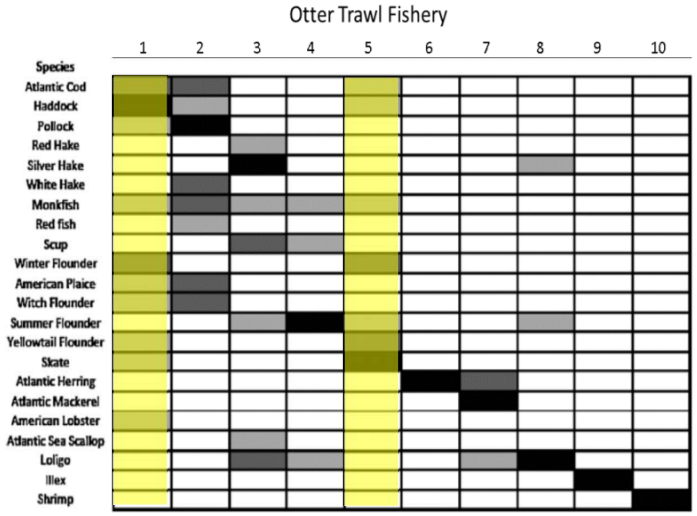
Strengths	• Scientifically rigorous method • Appropriate for tracking trends • Comparable to previous findings
Concerns	• High uncertainty in estimate • Consider alternative approaches • Missing information on upper trophic levels
Recommendations	The Panel viewed the methods for estimating ecosystem productivity as a useful means of tracking an important metric of ecosystem status. However, they did not advise using this for defining limits on fishery removals.

ToR 3: Evaluate the approach and rationale for specifying Fishery Functional Groups as proposed management units.

- **Goal:** Define fishery functional groups as management units.
- Fishery Functional Groups are species that are caught together, have similar life history characteristics, and play similar roles in the transfer of energy in the system.

Informed by:

1) Catch Characteristic by Fleet



2) Trophic Guild

Benthivores
Planktivores
Mesoplanktivores
Macroplanktivores
Piscivores
Macrozoo-Piscivores

3) Life History

Intrinsic rate of increase
Mean trophic level
Individual growth rate
Age-at-maturation
Longevity
Maximum size
Fecundity

ToR 3: Evaluate the approach and rationale for specifying Fishery Functional Groups as proposed management units.

REVIEW PANEL RESPONSE

Strengths	• Scientifically rigorous method • Addresses technical interactions
Concerns	• Appropriateness of fishery functional groups as management units • Dynamics of fishery functional groups • Individual species/stock concerns
Recommendations	The Panel found the definition of fishery functional groups to be a reasonable approach and recommends further examination of the appropriateness of this unit for management.

ToR 4: Comment on the applicability and utility of the strawman management objectives and associated performance metrics which were used to guide the development of operating models.

Sample Strategic Objectives:

1) Maintain/restore sustainable production levels (ecosystem)
2) Maintain/restore biomass levels (functional group/species)
3) Maintain/restore functional trophic structure

Sample Operational Objectives:

1) Ecosystem and community/aggregate fishing mortality and or total catch is below a dynamic threshold
2) Fishing-related mortality for threatened/endangered/protected species is minimized
3) Managed and protected species biomass is above established minimum threshold
4) Maintain ecosystem structure within historical variation recognizing inherent dynamic properties of the system
5) Maintain habitat productivity and diversity
6) Habitat structure and function are maintained for exploited species
7) Minimize the risk of permanent habitat impacts

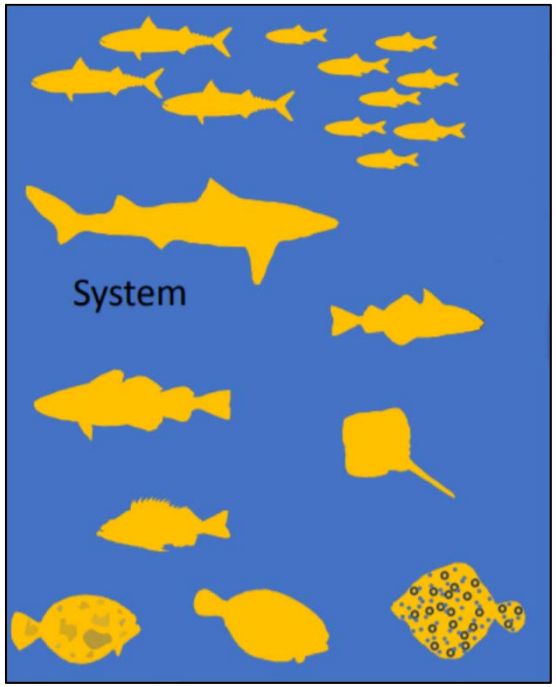
ToR 4: Comment on the applicability and utility of the strawman management objectives and associated performance metrics which were used to guide the development of operating models.

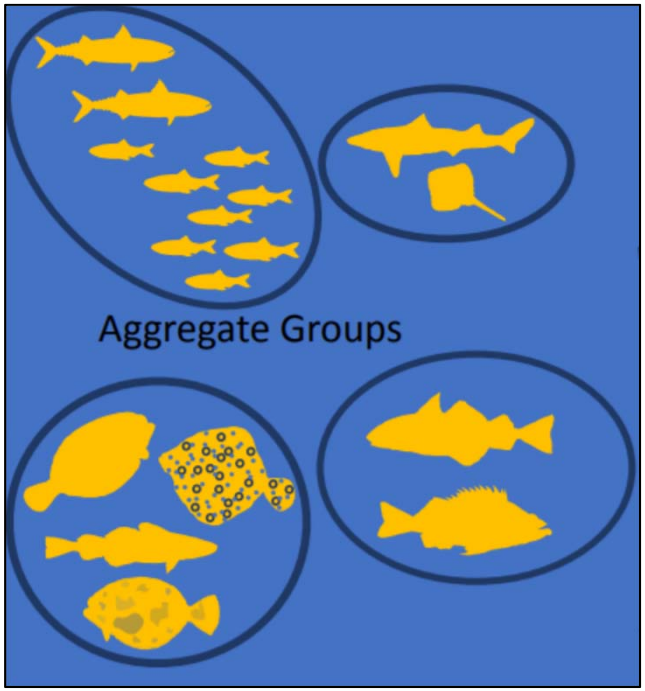
REVIEW PANEL RESPONSE

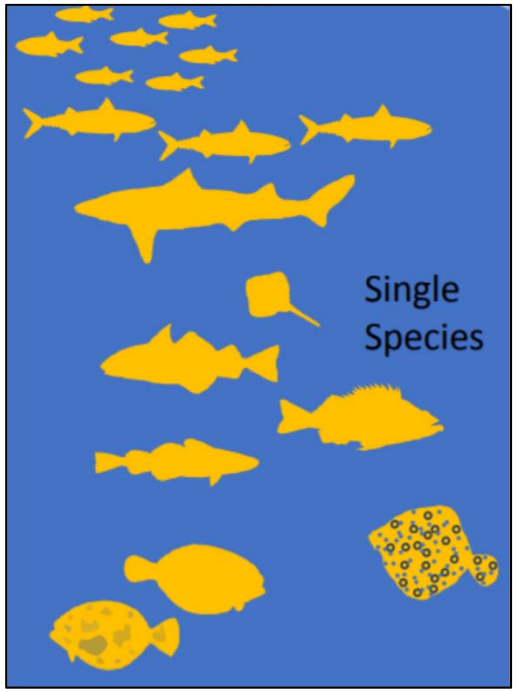
Strengths	• Reasonable, high level objectives.
Concerns	• Limited in scope • Strawman objectives limit model structure • Strategic and operational objectives not linked
Recommendations	The Panel viewed the strawman management objectives as a reasonable starting point and anticipates that these will be expanded upon through the stakeholder engagement process.

ToR 5: Evaluate the utility of the proposed management reference points as part of a management control rule for ecosystem-based fishery management.

Ecosystem Production Unit: Overall catch cap	Fishery Functional Group: Ceilings on catch and biomass floors	Individual Species: Biomass floors





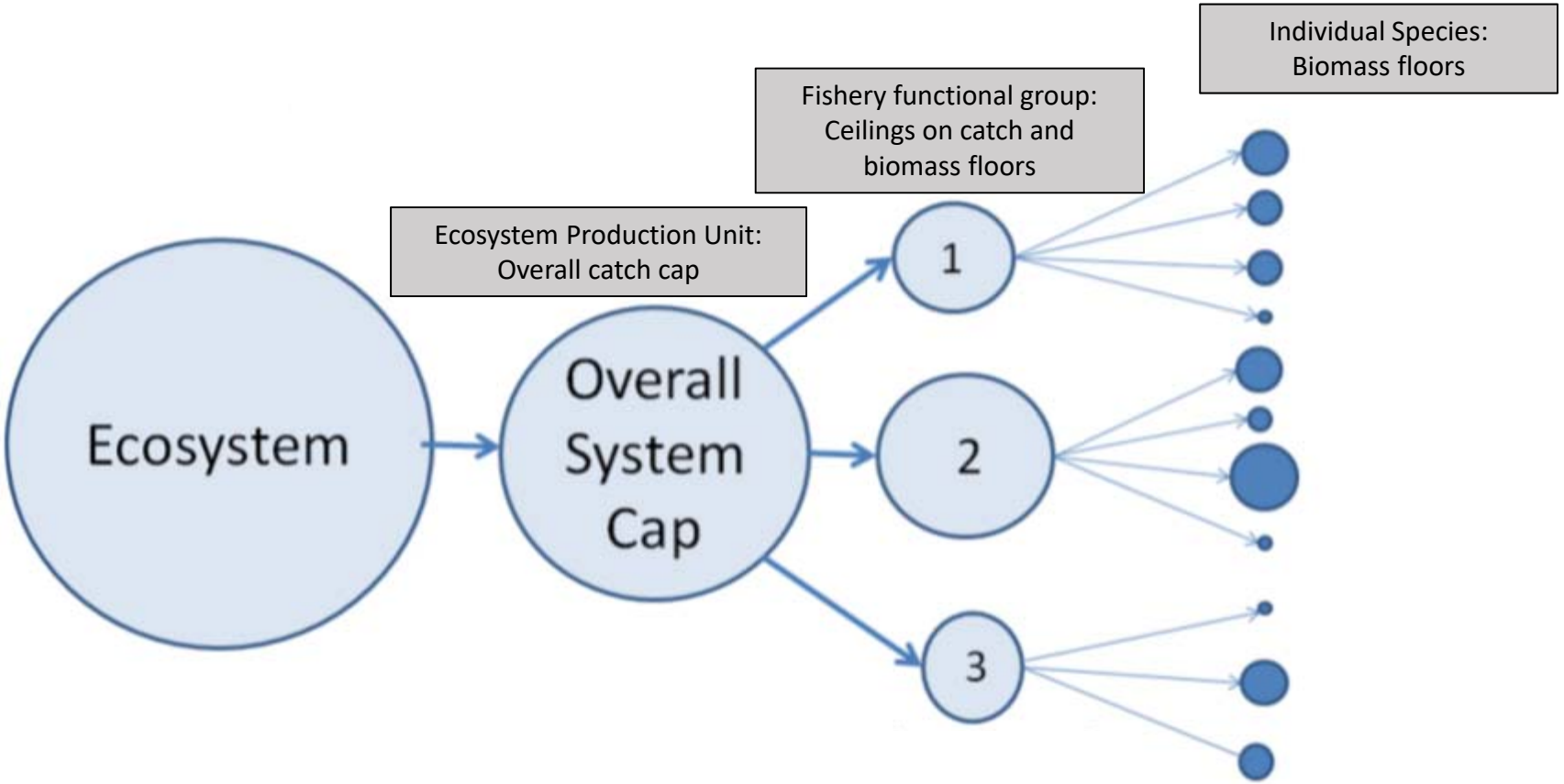


- Ceiling: Ecosystem catch cap % of production

- Ceiling: FFG catch cap % of production
- Floor: Biomass of FFG not to fall below 20% of unfished biomass

- Floor: Biomass of species not to fall below 20% of unfished biomass

ToR 5: Evaluate the utility of the proposed management reference points as part of a management control rule for ecosystem-based fishery management.

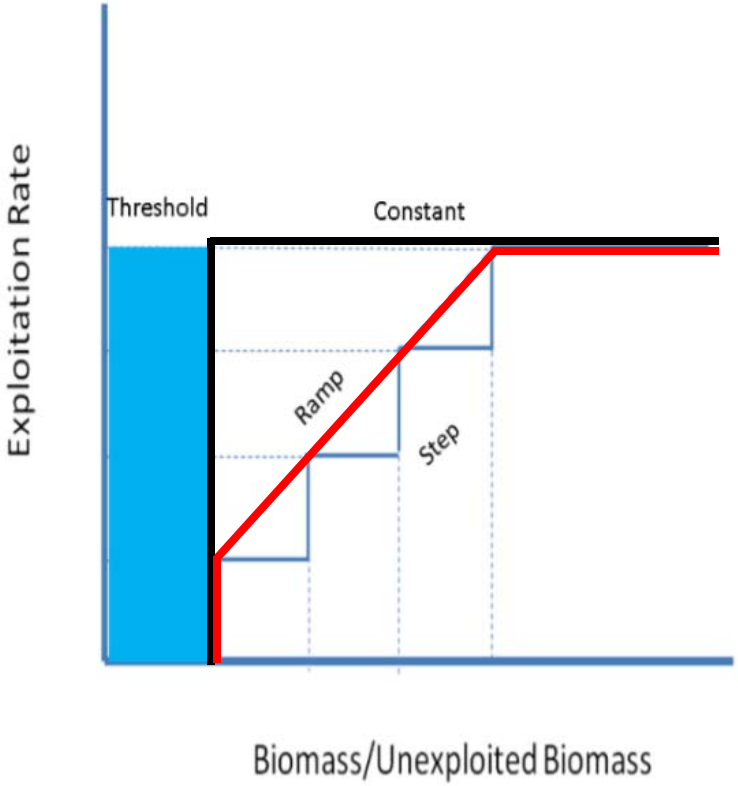


ToR 5: Evaluate the utility of the proposed management reference points as part of a management control rule for ecosystem-based fishery management.

REVIEW PANEL RESPONSE

Strengths	• Reasonable approach
Concerns	• Definition of biomass floors • Definition of ecosystem ceiling • Definition of fishery functional group ceiling • Dynamics of reference points
Recommendations	The Panel approved of the general approach of defining floors and ceilings for use as reference points. However, there was concern about how these numbers would be estimated and applied.

ToR 6: Review harvest control rules embodying the proposed floors and ceilings approach using the ceiling reference points in ToR 5 to cap removals at the Ecological Production Unit and Functional Group levels, while ensuring that no species biomass falls below the single species floor reference points.



- Two main forms of harvest control rules:

1) Threshold exploitation
2) Ramp-down exploitation

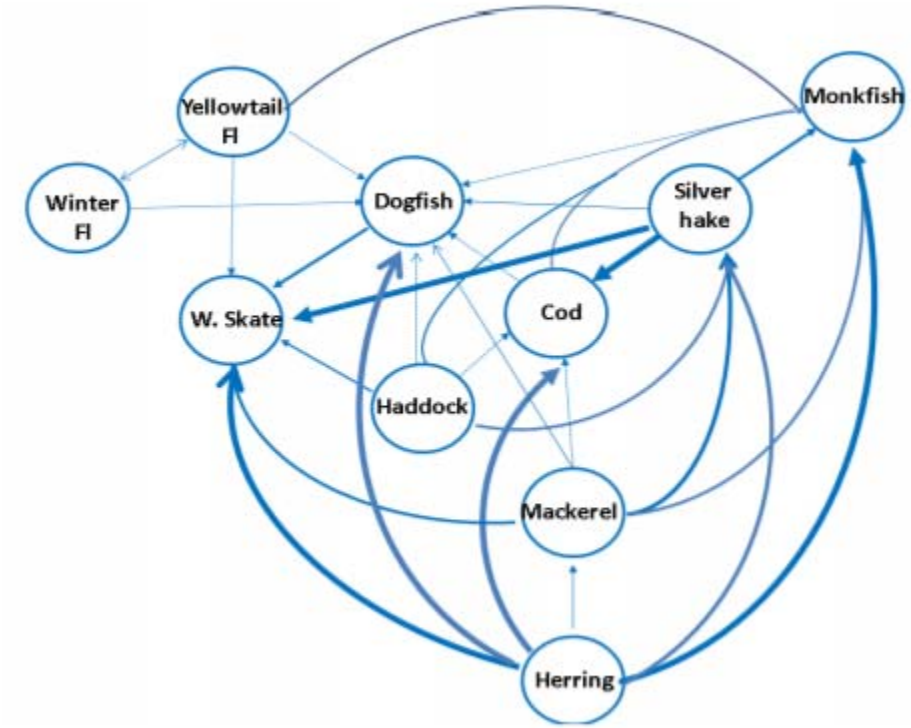
ToR 6: Review harvest control rules embodying the proposed floors and ceilings approach using the ceiling reference points in ToR 5 to cap removals at the Ecological Production Unit and Functional Group levels, while ensuring that no species biomass falls below the single species floor reference points.

REVIEW PANEL RESPONSE

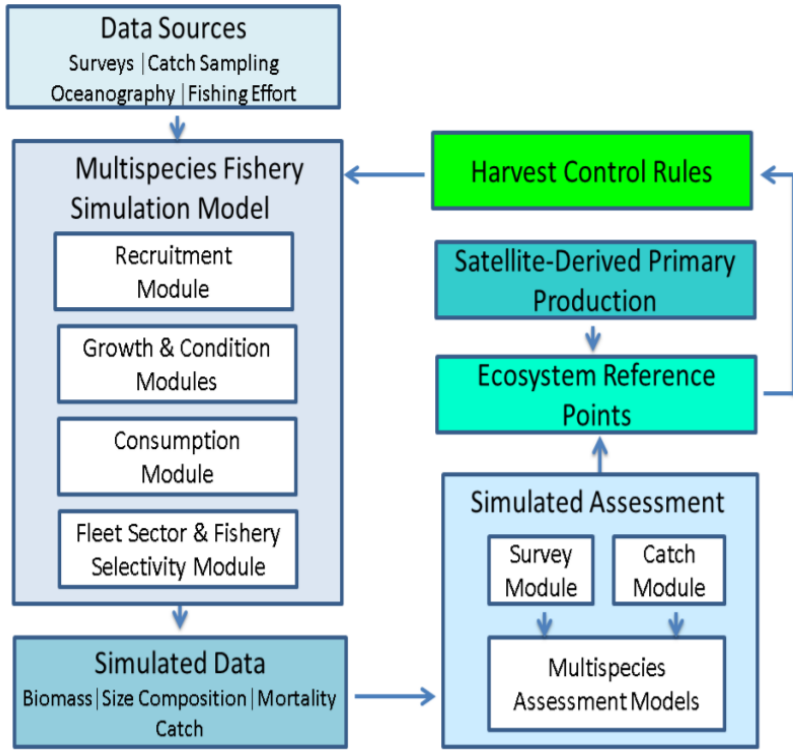
Strengths	• Reasonable approach
Concerns	• Definition of triggers and thresholds • Lack of status quo comparison • Form of harvest control rule (HCR) • Ramp-down HCR trigger • Consider hybrid approach • Simulation testing
Recommendations	The Panel viewed the HCRs as a reasonable starting point, but recommends that more HCRs are explored and compared to the current harvest strategies. The Panel was concerned about the estimation of reference points.

ToR 7: Review the structure and application of operating models for Georges Bank.

Hydra Structure

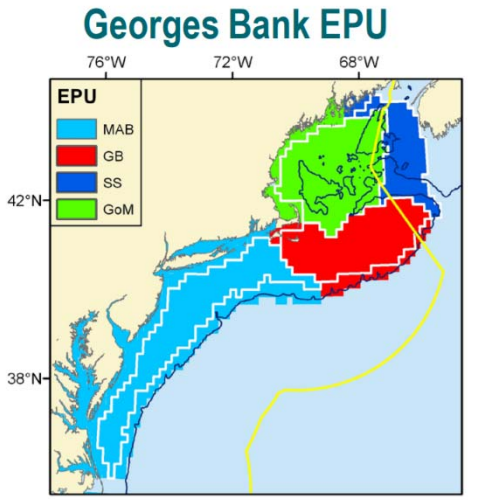


Hydra Application



ToR 7: Review the structure and application of operating models for Georges Bank.

Kraken Structure

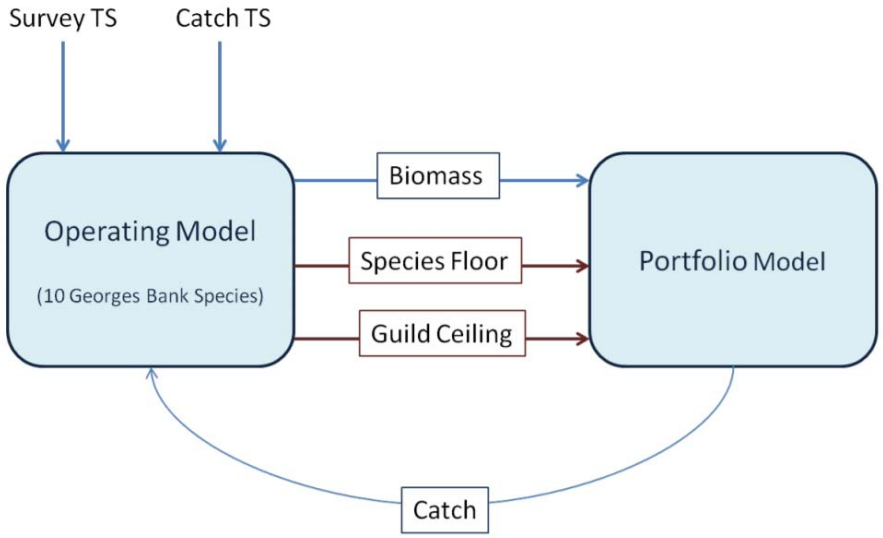


Atlantic cod
Goosefish
Spiny dogfish
Skates (Little and Winter)
Silver hake
Haddock
Yellowtail flounder
Winter flounder
Atlantic herring
Mackerel

Guilds

Piscivore Benthivore Mesoplanktivore

Kraken Application



ToR 7: Review the structure and application of operating models for Georges Bank.

REVIEW PANEL RESPONSE

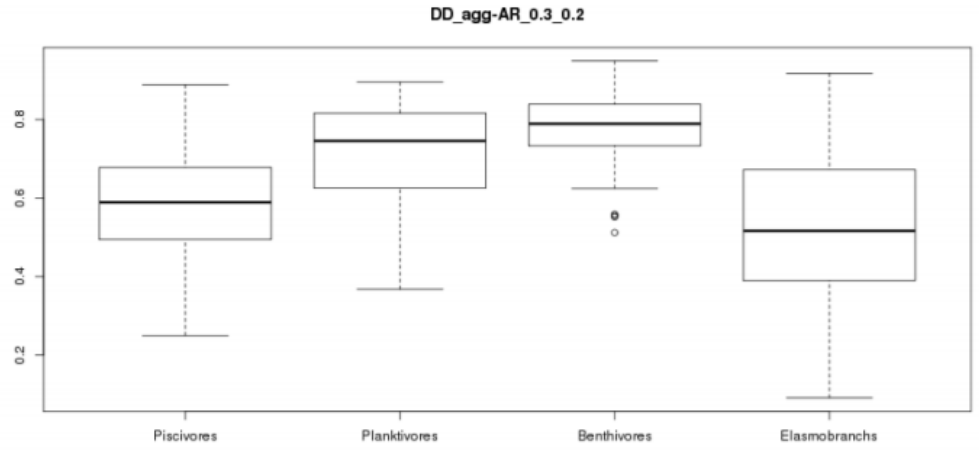
Strengths	• Hydra model is a good structure for this purpose. • Kraken model is simpler and enables different application. • Good practice to have alternative models
Concerns	• Hydra scope and structure • Hydra trophic interactions • Hydra stock recruit relationships • Further development of Kraken model is needed. • Range of model complexity • Hydra and Kraken model performance uncertain • Application of operating models
Recommendations	The Panel viewed the development of two multispecies operating models with varying levels of complexity as good practice for testing the EBFM procedure. The Panel recommends evaluating whether models can produce credible results.

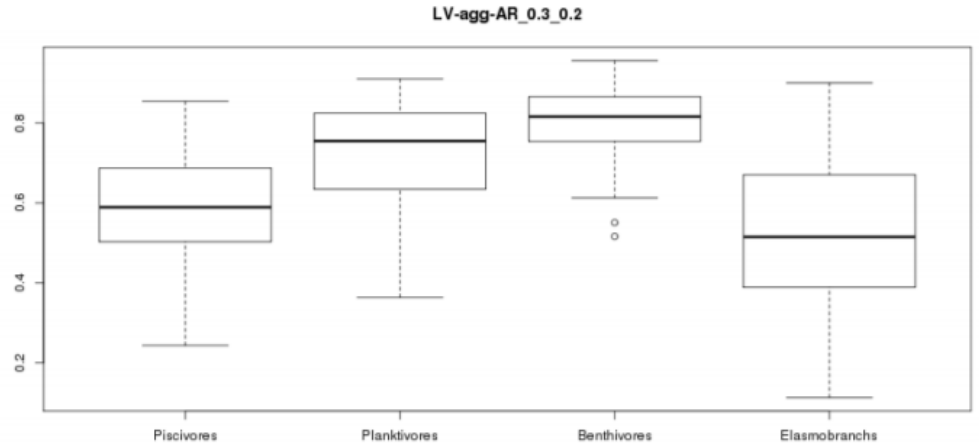
ToR 8: Review ecosystem assessment models and required data sources, as applied to the simulated data from the operating models in ToR 7.

1) Model-Free Simulated Survey Index

2) Multispecies Production Model

3) Multispecies Delay-Difference





ToR 8: Review ecosystem assessment models and required data sources, as applied to the simulated data from the operating models in ToR 7.

REVIEW PANEL RESPONSE

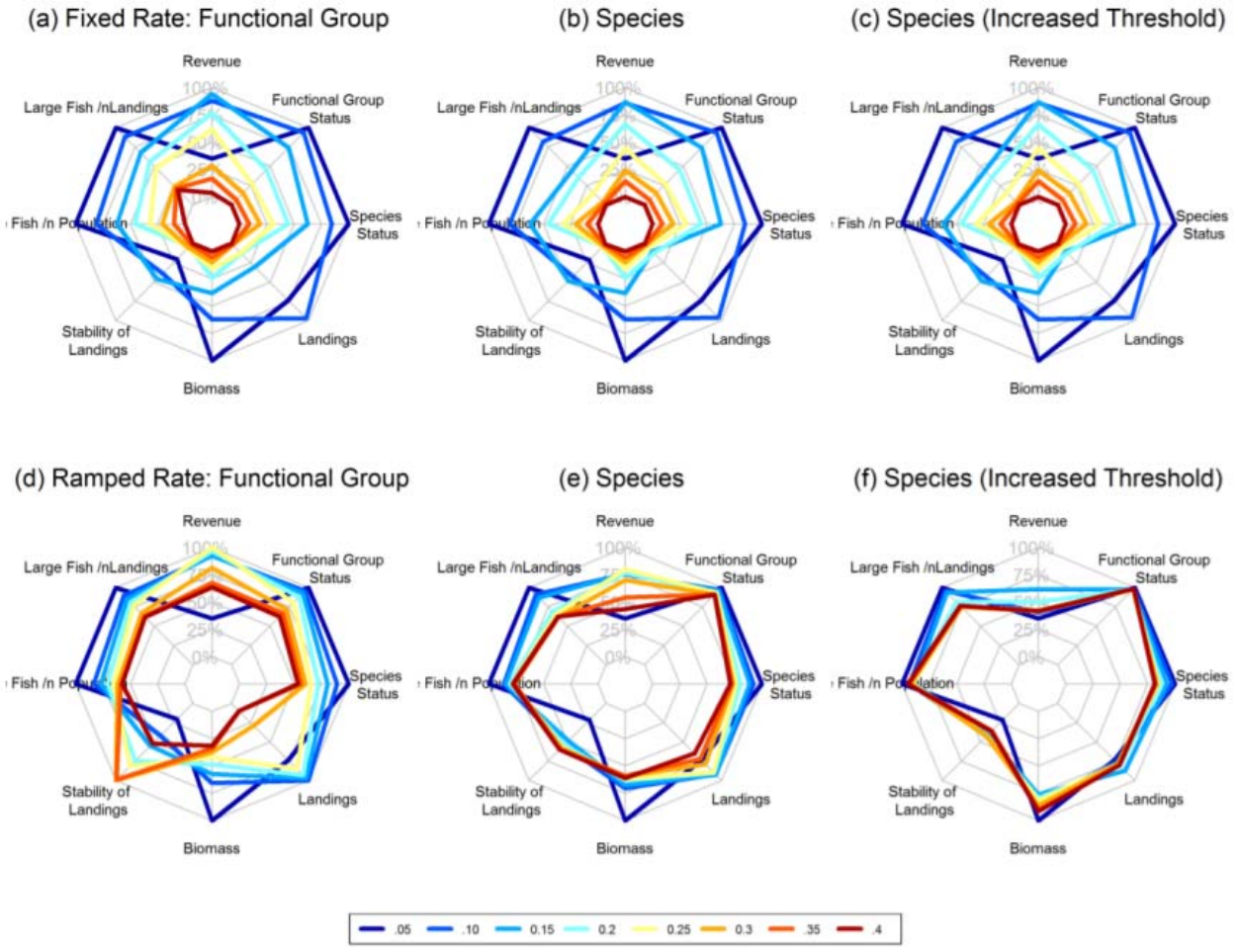
Strengths	• Comparison of multiple models
Concerns	• No comparison of multispecies vs. single species assessment models. • Testing alternative assessments and HCRs
Recommendations	The Panel viewed the comparison of alternative models as a good approach. The Panel recommends: 1) comparison of multispecies and single species assessment models and 2) testing assessments and HCRs separately.

ToR 9: Review simulation tests and performance of the proposed management procedure incorporating the floors and ceilings approach, given the set of EBFM goals and objectives.

Performance of Harvest Control Rules

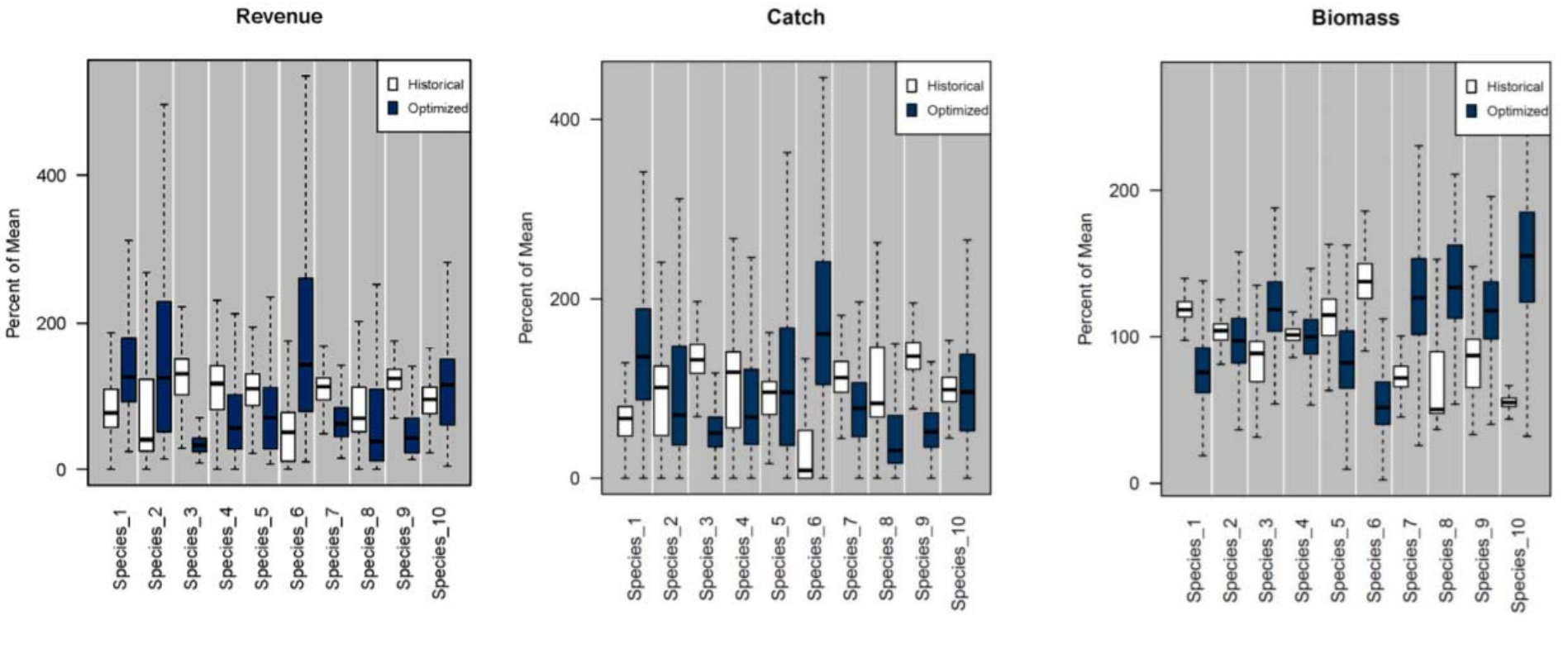
Fixed Rate HCR

Ramped Rate HCR



ToR 9: Review simulation tests and performance of the proposed management procedure incorporating the floors and ceilings approach, given the set of EBFM goals and objectives.

Portfolio Analysis



ToR 9: Review simulation tests and performance of the proposed management procedure incorporating the floors and ceilings approach, given the set of EBFM goals and objectives.

REVIEW PANEL RESPONSE

Strengths	• Reasonable performance • Evaluation of ceilings
Concerns	• Limited simulation testing • Presentation of HCR testing results • Exploitation rates in HCR testing • Alternative performance metrics • Portfolio analysis
Recommendations	The Panel noted that the initial results seem reasonable, however, the performance of the EBFM procedure cannot be fully evaluated without a broader representation of simulation results.

Conclusions

- The Panel recognized the extensive work that went into developing the proposed strategy for implementing EBFM for the NEFMC and in demonstrating the approach in a worked example for the Georges Bank ecosystem.
- Feedback and recommendations were intended to improve the EBFM approach.
- Overall, the Panel concluded that the materials presented during the review represented good progress toward an EBFM procedure, however, further work is needed to refine the approach before it is implemented by the NEFMC.
- The EBFM team has responded to the peer review and work is ongoing to improve aspects of the EBFM procedure.

Additional Information

- Full peer review report and program response: https://www.nefsc.noaa.gov/program_review/reports2018.html
- For the full details of the individual review of each Panelist see:
  - Appendix V (Dr. Keith Brander),
  - Appendix VI (Dr. Villy Christensen),
  - Appendix VII (Dr. Daniel Howell).