



NOAA
FISHERIES

Overview of the 2022 Gulf of Maine - Georges Bank American Plaice Research Track Assessment

#1



Hippoglossoides platessoides

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NEFSC

Population Dynamics Branch

NEFMC

September 28, 2022

Terms of Reference (TORs)

1. Identify relevant ecosystem and climate influences on the stock...
2. Estimate catch from all sources including landings and discards...
3. Present the survey data used in the assessment...
4. Estimate annual fishing mortality, recruitment and stock biomass...
5. Define status determination criteria...
6. Develop appropriate methods for producing projections...
7. Report on the status of research recommendations...
8. Develop a backup assessment approach...

Introductions - WG Members



Steve Cadrin
(SMAST, chair)



Larry Alade
(NEFSC, lead analyst)



Jamie Cournane
(NEFMC)



Alex Hansell
(NEFSC)



Dan Hennen
(NEFSC)



Lisa Kerr
(GMRI)



Rajeev Kumar
(Canada DFO)



Tyler Pavlowich
(NEFSC)



Dave Richardson
(NEFSC)

Introductions – Other Major Contributors



Amanda Hart
(SMAST/GMRI)



Jamie Behan
(GMRI)



Paul Nitschke
(NEFSC)



Tim Miller
(NEFSC)



Andy Jones
(NEFSC)



Cate O'Keefe
(Fishery Applications)



Cole Carrano
(SMAST)



Keith Hankowsky
(SMAST)



Lucy McGinnis
(SMAST)



Max Grezlik
(SMAST)



Shakira Goffe
(UMES)



Ashley Silver
(UMES)



Mel Sanderson
(CCCFA)

General Working Group Approach

- A series of 15 half-day hybrid meetings and meetings with fishermen.
 - Working Group members contributed to specific tasks
 - Input and contributions from non-Working Group members was welcome
 - Working papers were reviewed for discussions and consensus decisions
 - Rapporteurs documented decisions and rationale
- Chair compiled the Working Group report with information from working papers and rapporteur notes.



Meetings with Fishermen

- The Northeast Seafood Coalition hosted a meeting in Gloucester (September 24, 2021) and a follow-up meeting with fishermen was in Portland ME (November 3, 2021).
- An interactive dashboard application was demonstrated to interactively examine survey and fishery catch data for plaice.
- General discussion topics included
 - Impacts of fishery management measures on plaice landings
 - Distribution changes and catch rates
 - Survey catches of plaice
- Subsequent email correspondence
 - Maximum catch rates
 - Discard mortality



Pre-Research Track Assessment

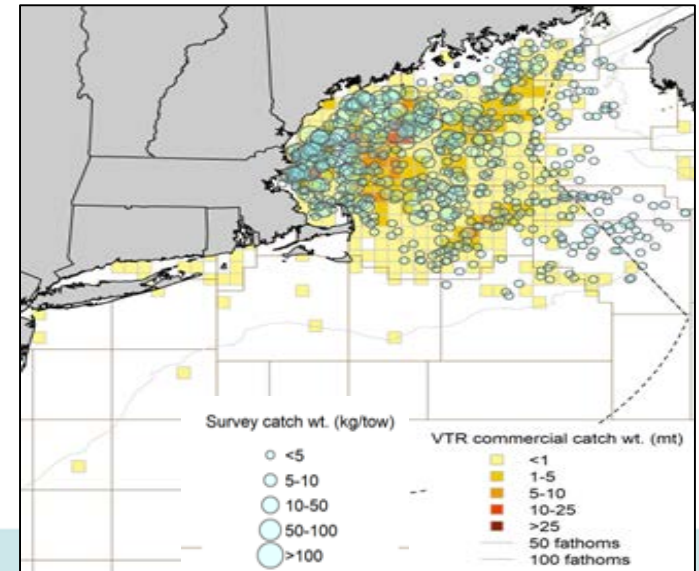
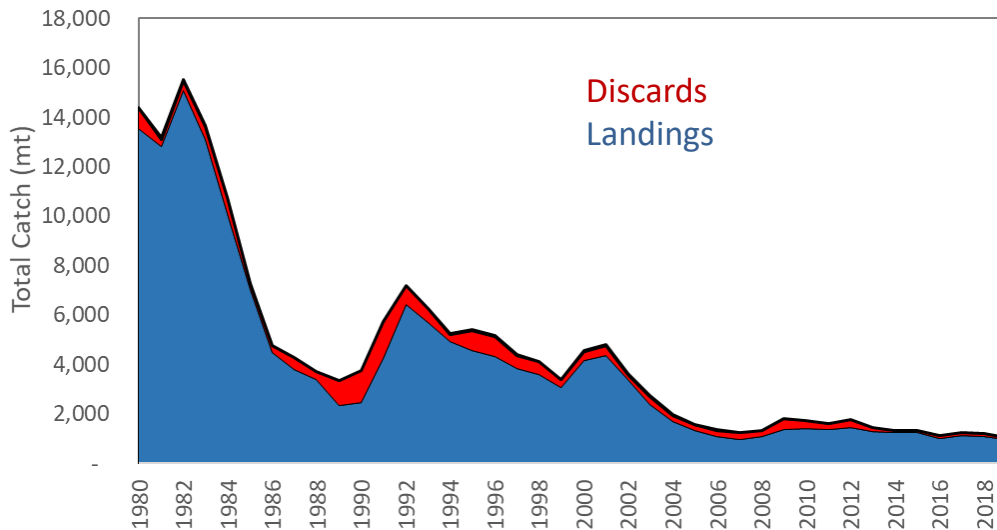
- **2019 Management Track**
- **Age-Structured Model:** (Virtual Population Analyses)
- **Terminal year = 2018**
- **Reference Points:**
 - $F_{40\%} = F_{MSY} Proxy = 0.258$
 - MSY Proxy = 3,301 mt
 - $SSB_{MSY} Proxy = 15,293$ mt
- **Stock Status:**
 - Not overfished: $SSB_{2018} \sim 147\%$ of $SSB_{MSY} Proxy = 22,490$ mt (retro adjusted)
 - Overfishing was *not* occurring: $F_{2018} \sim 27\%$ of $F_{40\%} = 0.07$ (retro adjusted)

TOR 1. Ecosystem & Climate Influences

- Ecosystem influences (Temperature, NAO, AMO) were considered in several subsequent ToRs.
 - ToR2 Fishery Data
 - Decadal shifts in growth reflected in ToR2 age composition and weight at age
 - Depth and temperature considered in fishery catch standardization.
 - ToR3 Survey Data - Factors of survey catchability were investigated for integrating inshore and offshore surveys.
 - ToR4 Assessment Models
 - Environmental covariates of recruitment and survey catchability were explored.
 - Shifts in depth distribution were considered in the exclusion of inshore survey indices.
 - ToRs5-6 Reference Points & Projections - Environmental conditions were considered for assumptions about recruitment and weight-at-age in reference points
 - ToR7 - environmental analyses led to several research recommendations.

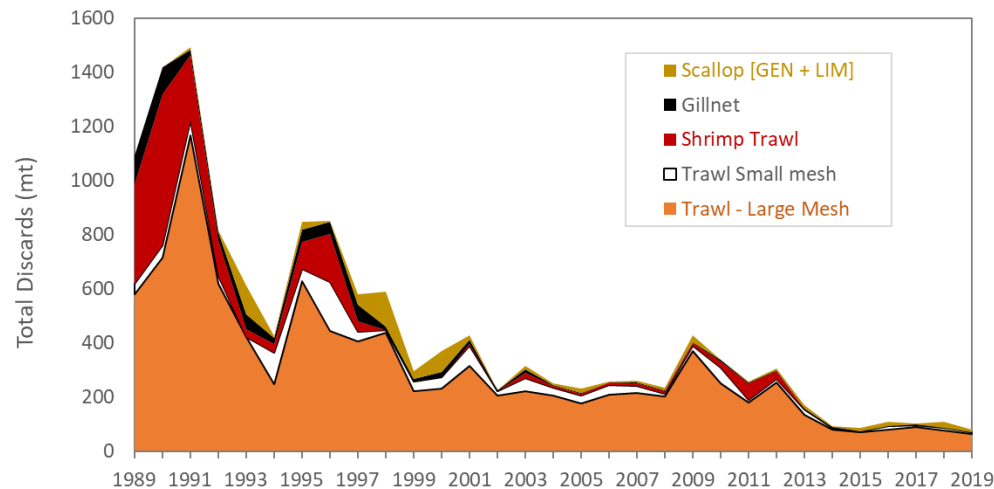
TOR2. Fishery Data

- Since 1980, total catch decreased from ~15,000 mt/year to ~1000 mt/year.
- Commercial landings were 88% of the total catch.
 - Most landings were from the Gulf of Maine and the northern edge of Georges Bank.
 - Almost all landings were from trawl trips, and the proportion from large vessels recently increased.



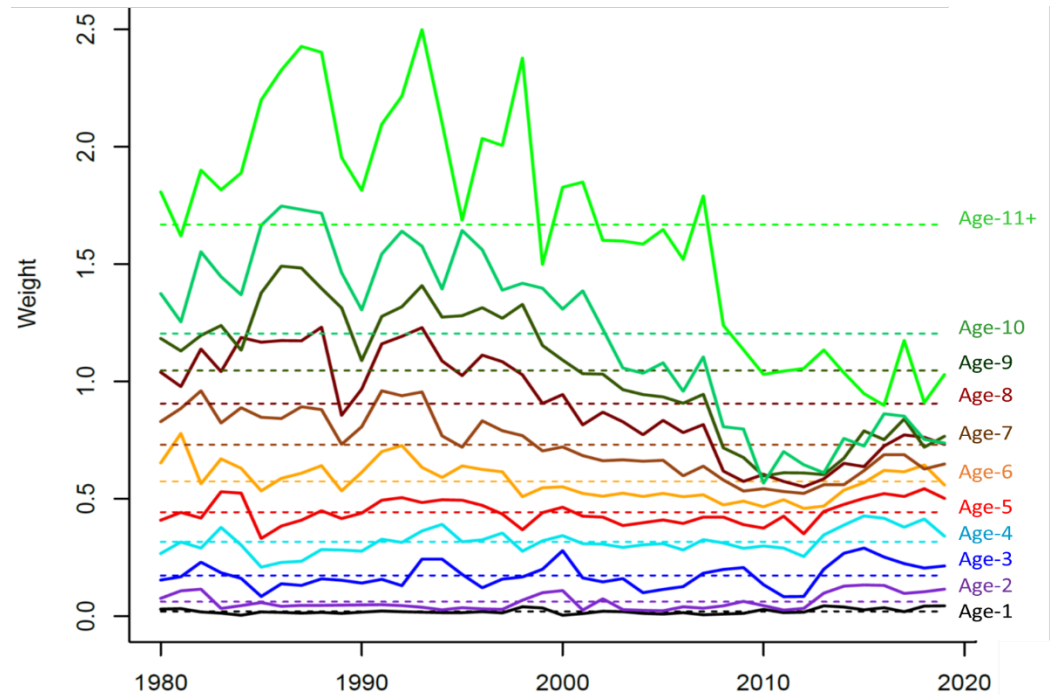
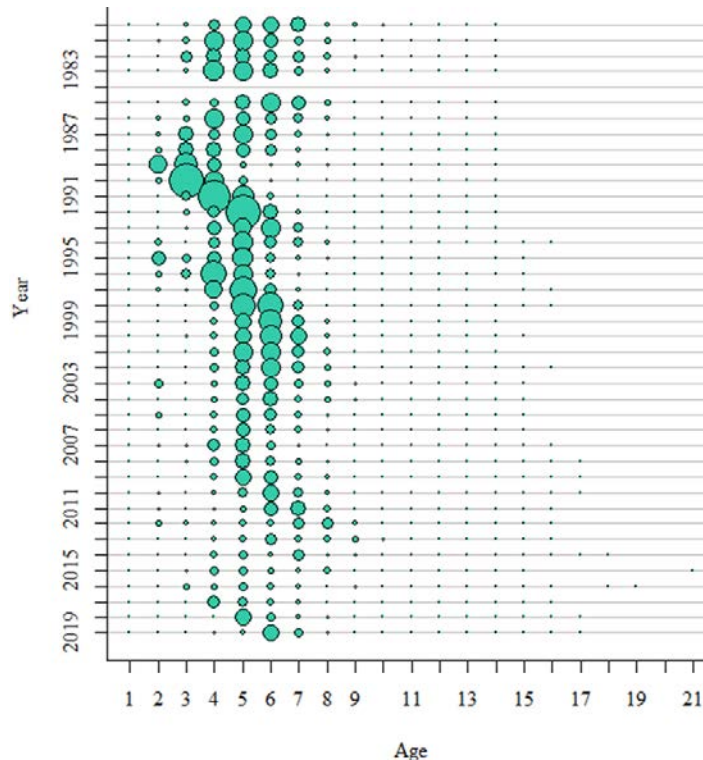
TOR2. Fishery Data

- Discards were 15%-40% of total catch until 1992, but <10% of total catch since 2014, resulting from the **Nordmore Grate** and **decreased minimum legal size**.
- Most discards were from the large-mesh trawl fleet
 - considerable discards from the shrimp fishery in late-1980s-early-1990s
 - relatively few discards from the small-mesh trawl, gillnet and scallop dredge fisheries.



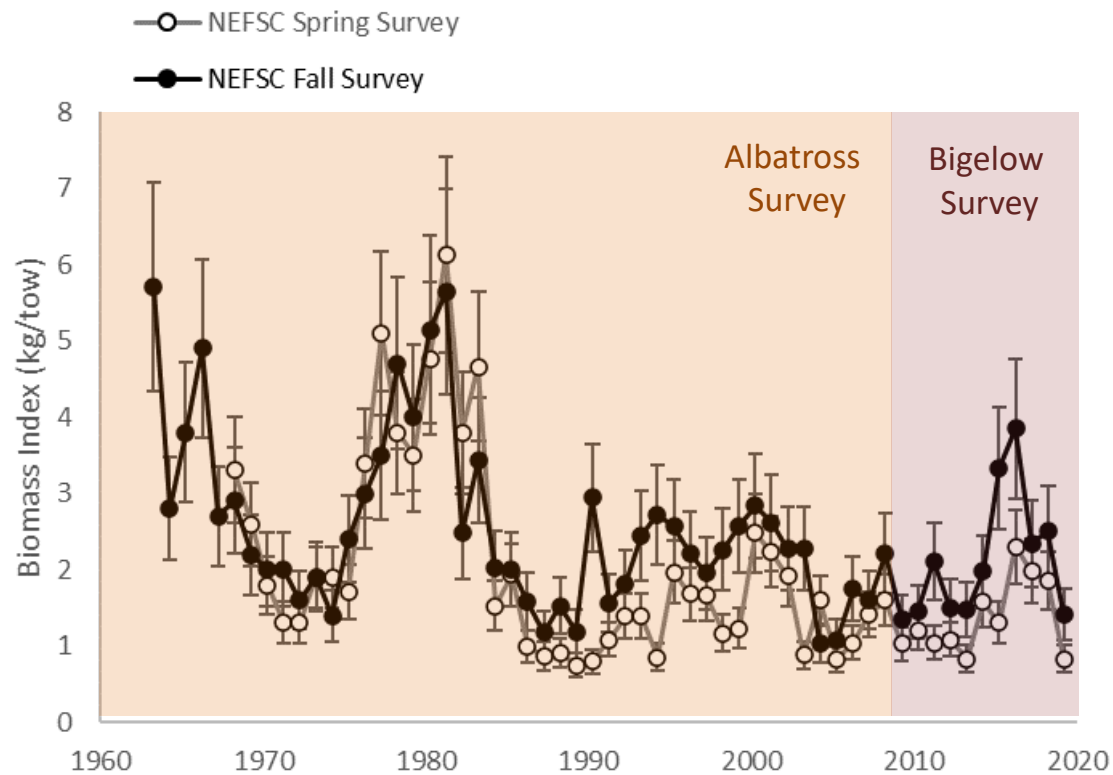
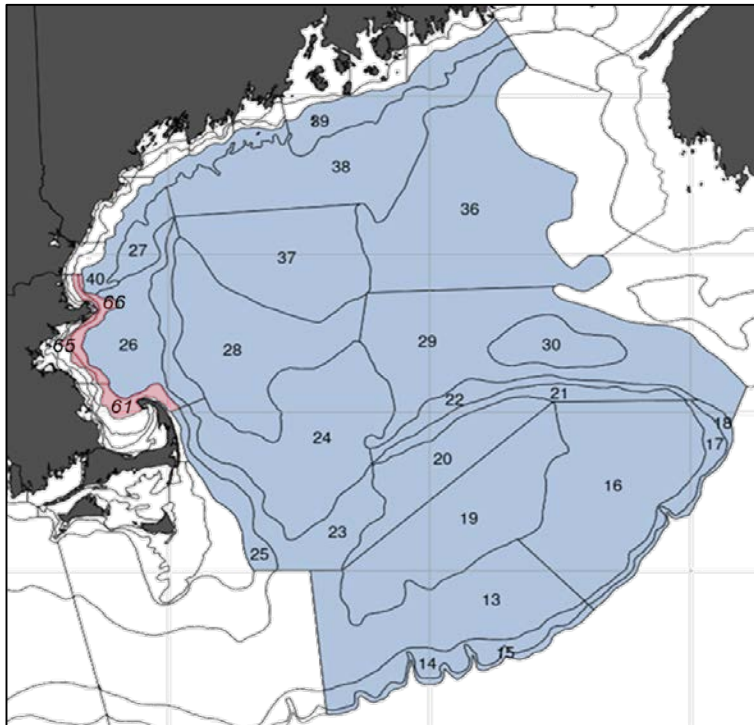
TOR2. Fishery Data

- Fishery catch is composed primarily of ages 2-6.
 - Cohort tracking is relatively strong
 - Mean weight-at-age of the catch decreased for ages 7+ since the 1990s.



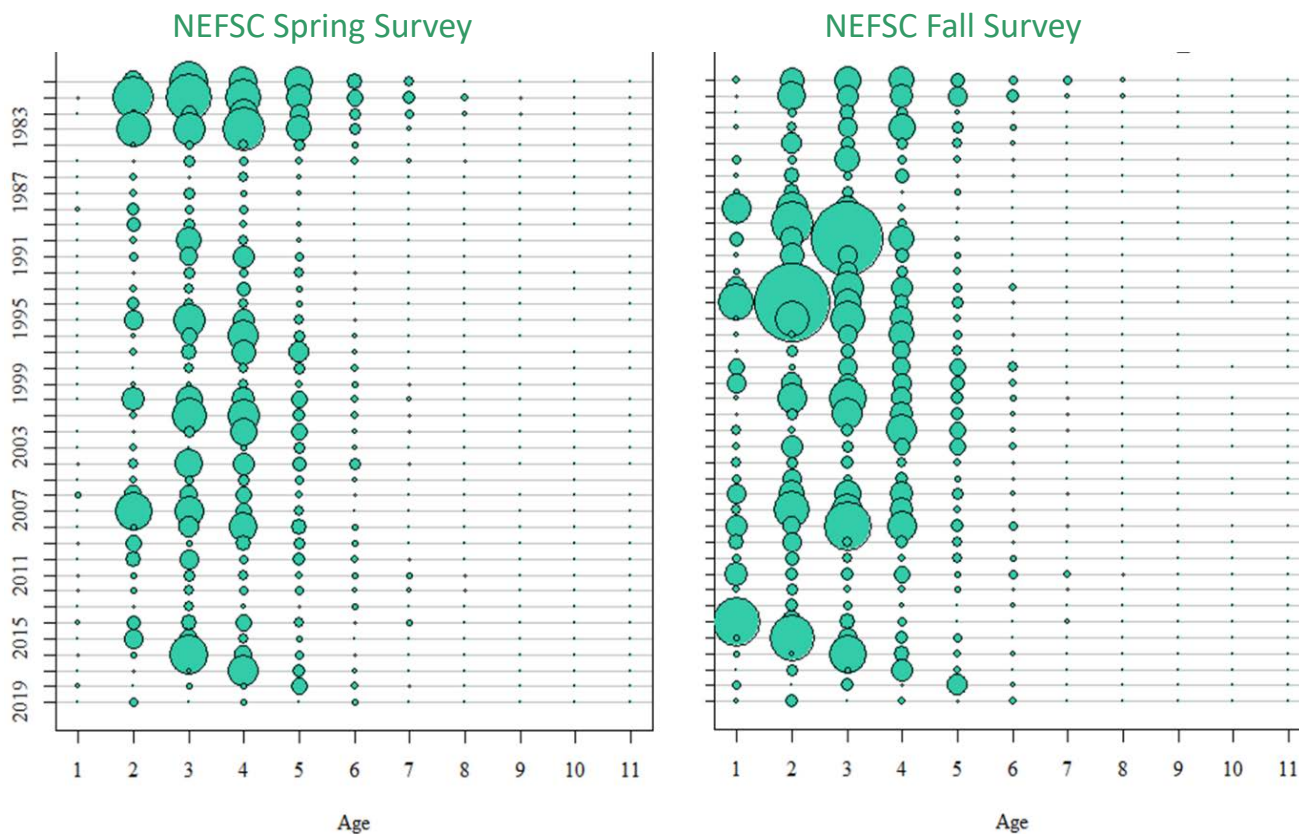
TOR3 – Survey Data

- Northeast Fisheries Science Center (NEFSC) survey indices suggest that the stock peaked in the early 1960s, late 1970s-early 1980s, and the late 2010s.



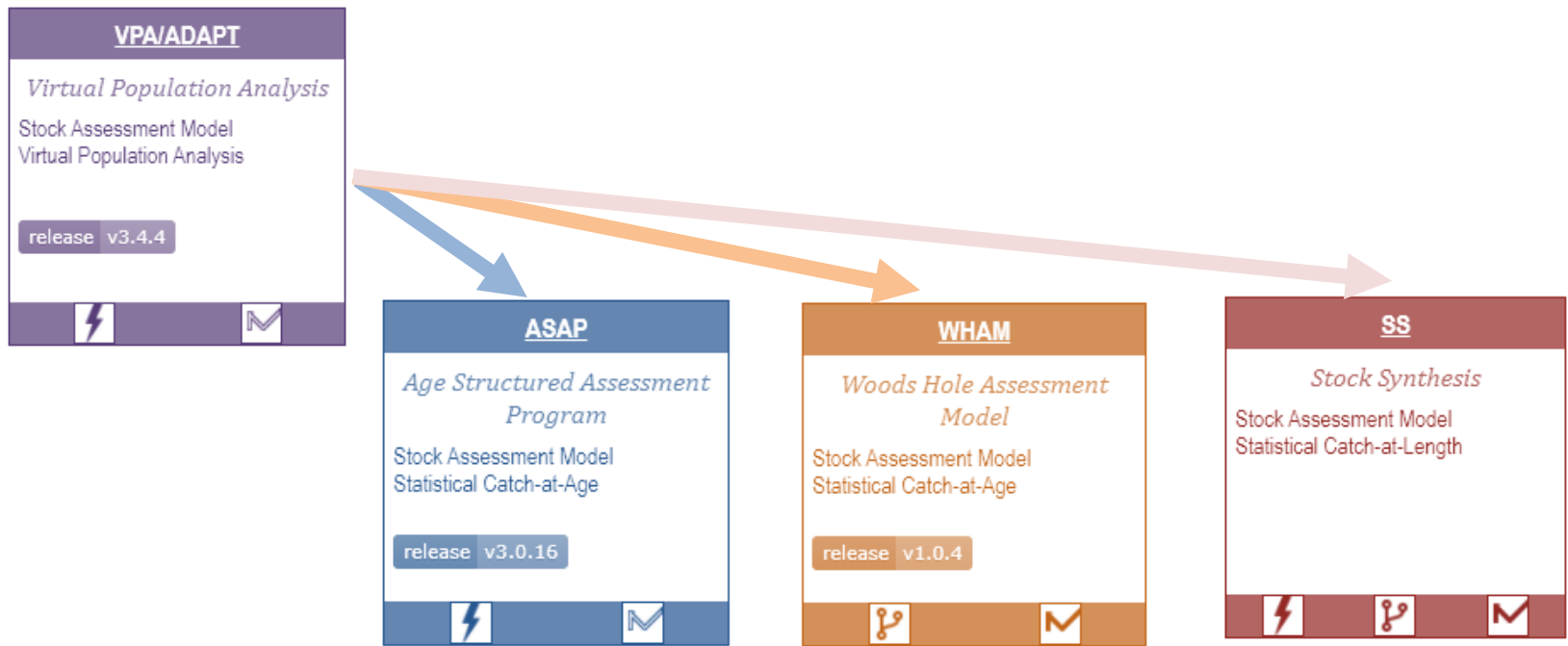
TOR3 – Survey Data

- NEFSC survey indices of abundance at age suggest the same strong year-classes as the fishery catch-at-age and good cohort tracking.



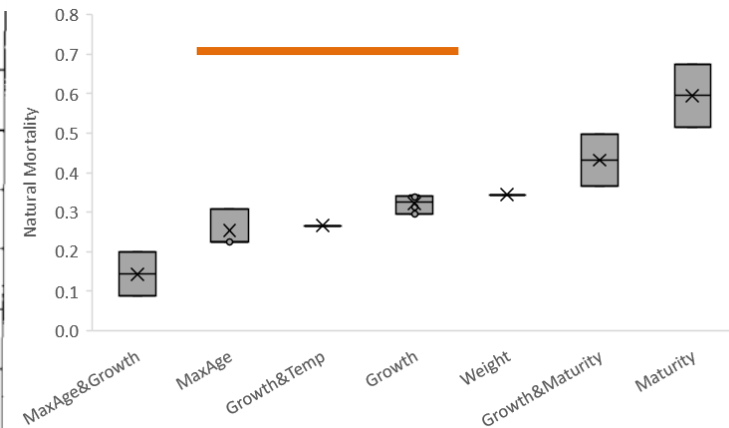
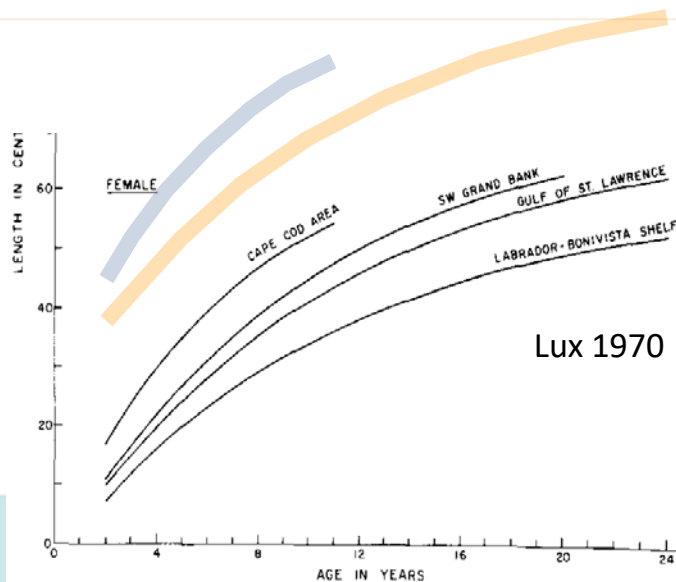
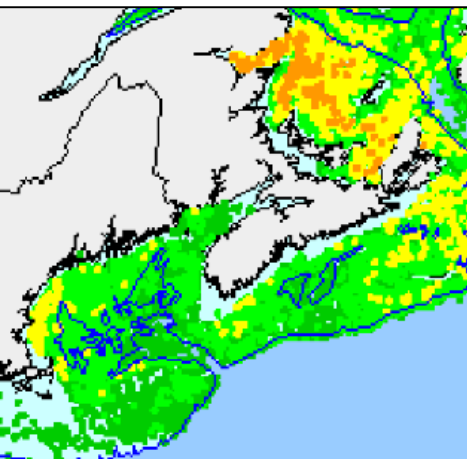
TOR4 – Assessment Models

- A wide range of approaches to stock assessment modeling were explored for this research track assessment.
 - Assumed biological parameters were reconsidered.
 - Several forms of integrated statistical catch-at-age model were applied.



TOR4 – Assessment Models

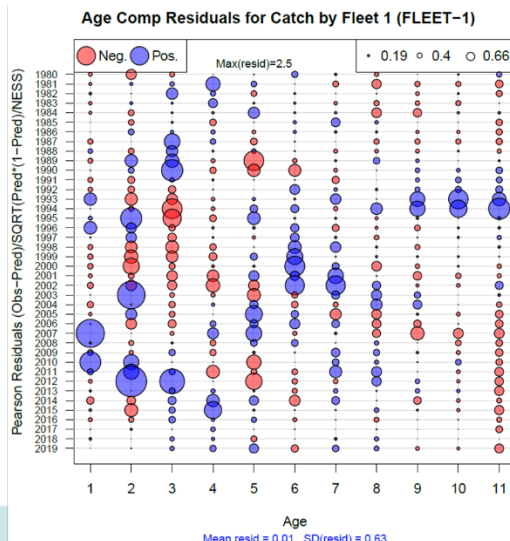
- Previous stock assessments of American plaice in US waters, assumed a lifetime constant natural mortality rate ($M=0.2$) based on relative abundance of ages 9+ from an **unexploited plaice population in the Gulf of St. Lawrence**.
 - Plaice in US waters have significantly different life history than those in Canadian waters.
 - Several life-history based M estimators were applied to the available information for American plaice in US waters.
 - Estimates based on maximum age and growth were relatively consistent and supported a revised assumption of natural mortality ($M=0.3$).



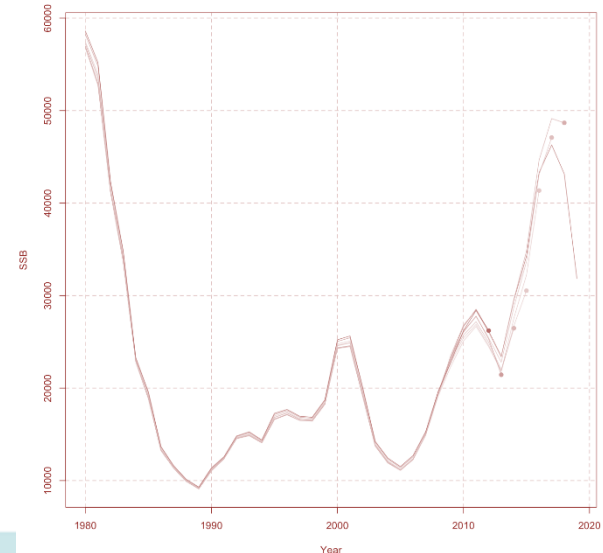
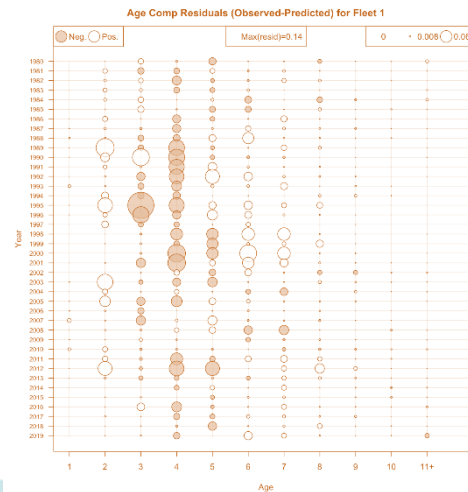
TOR4 – Assessment Models

- WHAM is proposed as the basis for status determination and catch advice.
 - WHAM is a state-space age-structured stock assessment model that fits to aggregated catch, stock index, and age composition data, and can include process errors and environmental covariates.
 - Candidate model runs **fit the available data well**, had high prediction skill and **high retrospective consistency**.

ASAP



WHAM



TOR4: WHAM (Woods hole Assessment Model)

- **Can incorporate process error**
 - Transition in NAA (including recruitment)
 - Selectivity
 - Natural mortality (M)
 - Catchability (q)
- **Process error random effects with correlation structures**
 - iid
 - AR1(Year or age/parameter)
 - 2DAR1 (year+ age or year + parameter)
- **Age Composition likelihoods**
 - Multinomial, Dirichlet-multinomial, Dirichlet, **logistic-normal**

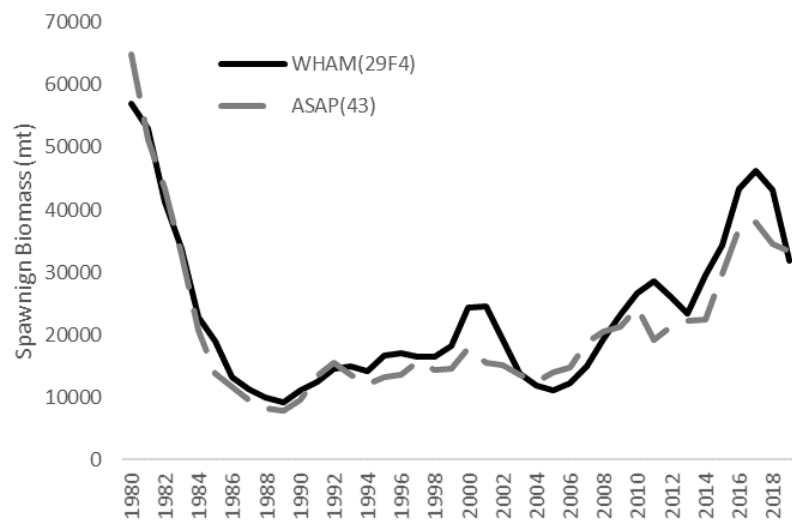
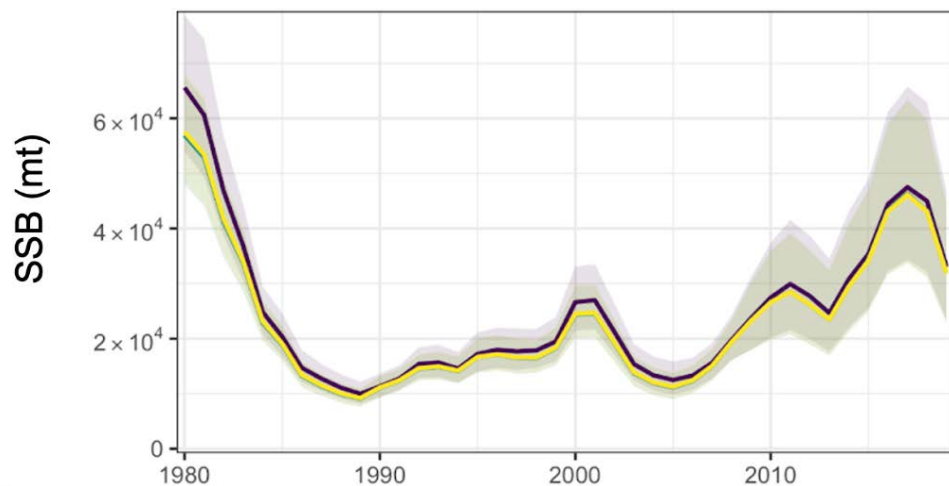
TOR4 – Plaice Assessment Model Specification

- Time Series: 1980-2019; Ages 11+
- Fishery Catch
 - Single fleet Commercial landings and discards
 - Fleet Selectivity: Time and age varying processes; logistic with iid random effects
- NEFSC Survey Indices
 - Fall and Spring Albatross Series (1980-2008)
 - Fall and Spring Bigelow Series (2009-2019)
 - Index Selectivity: Time invariant-at-age with a single age fixed at 1.0 (Spr. Alb = Age4; Spr. Big = Age5; Fall Alb = Age 11; Fall Big = Age 5)
- Age composition is logistic normal, zeros are treated as missing
- Maturity: Age-specific and time invariant
- Natural Mortality = 0.3

TOR4 – Assessment Models

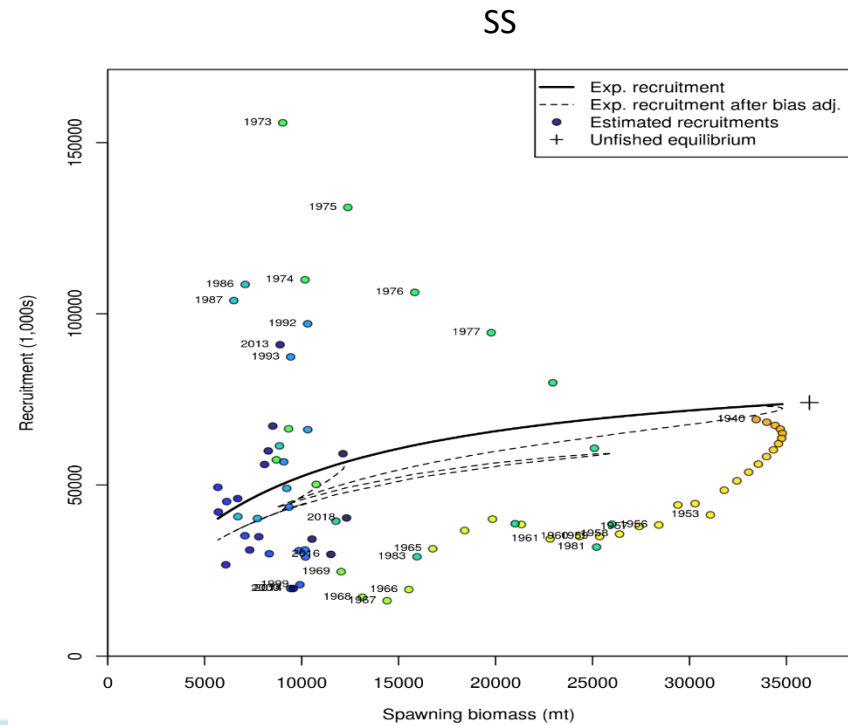
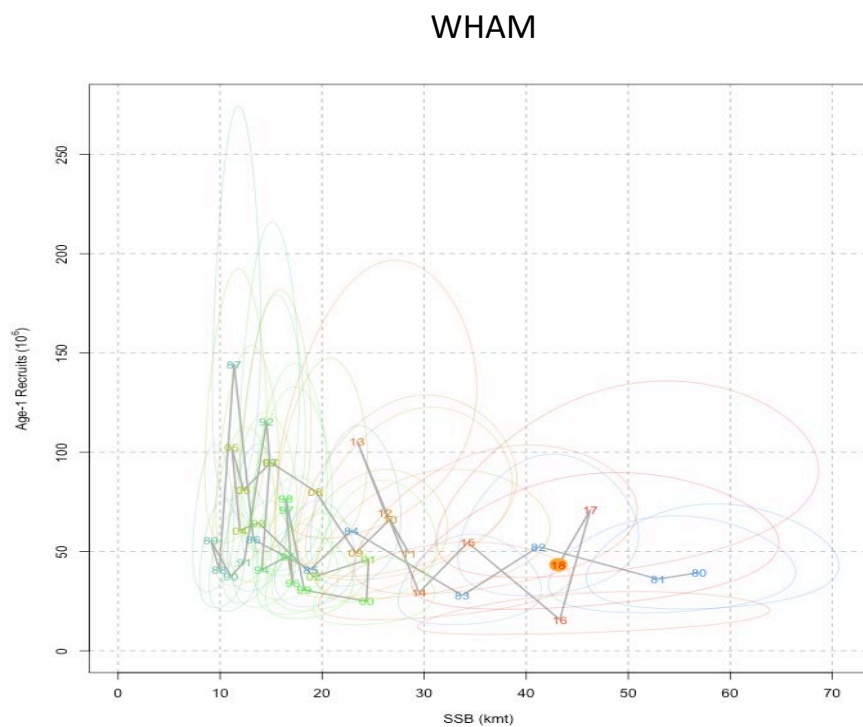
- All candidate model runs indicate that the stock was relatively abundant at the start of the assessment series, decreased in the 1980s from relatively high fishing mortality, and has gradually rebuilt since then to relatively high abundance between 2014-2019, while fishing mortality decreased over the same period.
- These general results were supported by all WHAM candidate runs as well as ASAP, SS and VPA.

Candidate WHAM runs



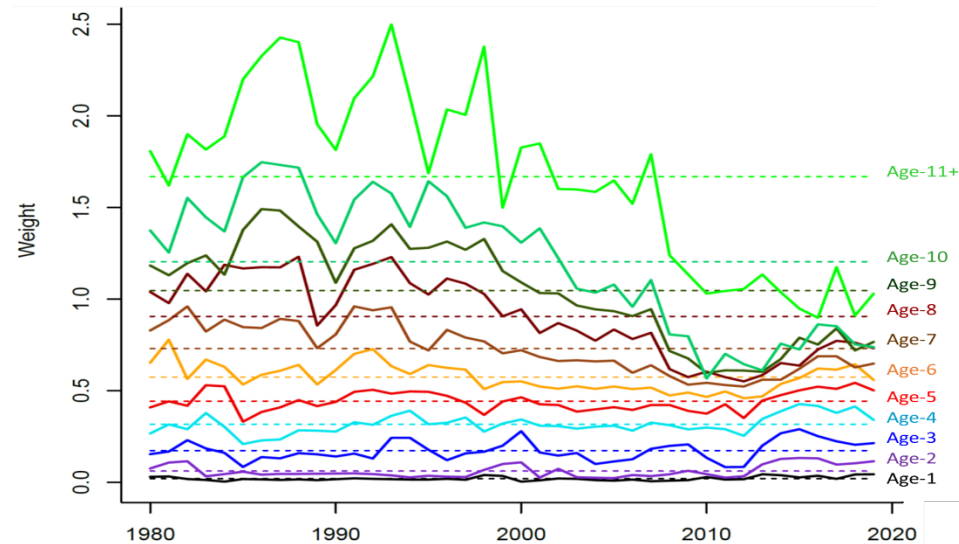
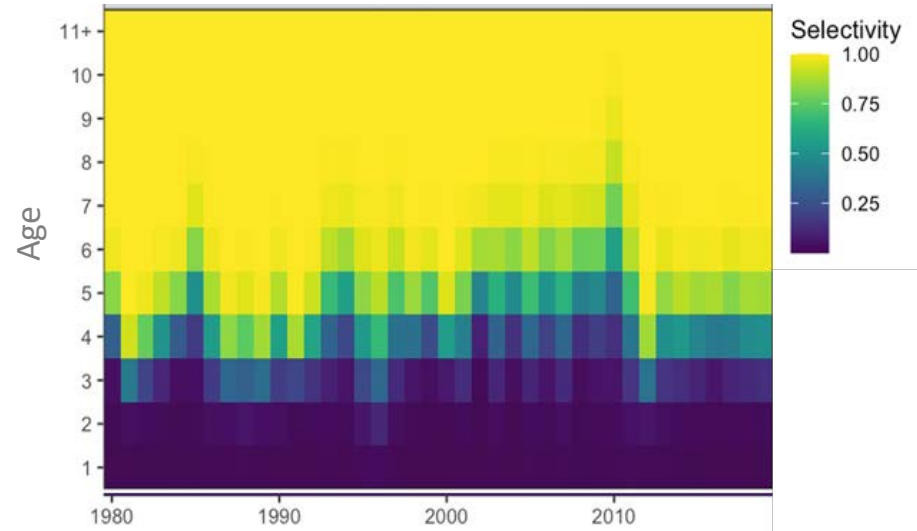
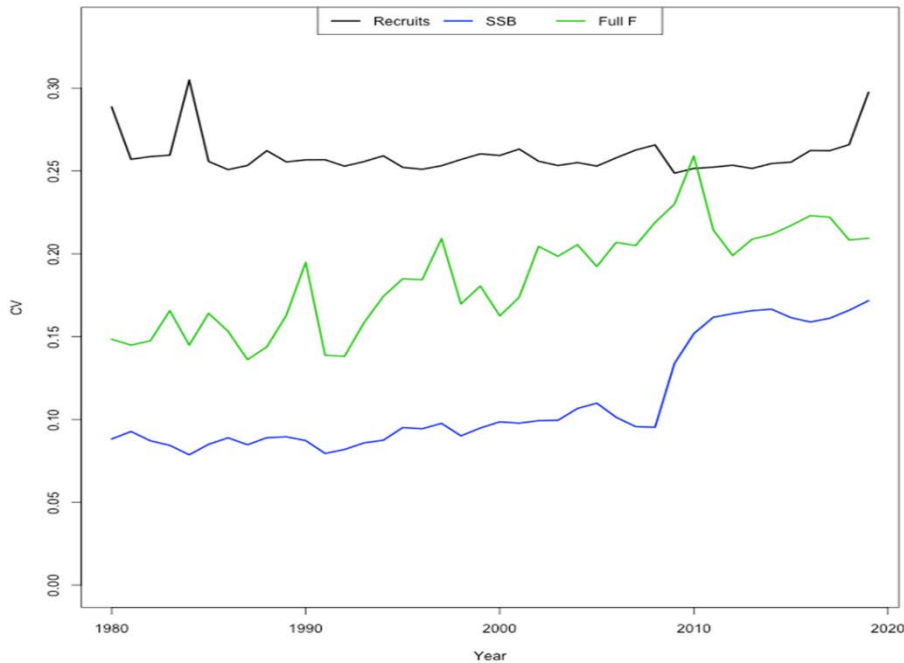
TOR5. Status Determination Criteria

- The current overfishing definition is $F_{40\%}$ and the current rebuilding target is $SSB_{F40\%}$.
- The stock-recruit relationship was re-examined to confirm the justification for using $F_{40\%}$ and $SSB_{F40\%}$ as MSY proxy reference points



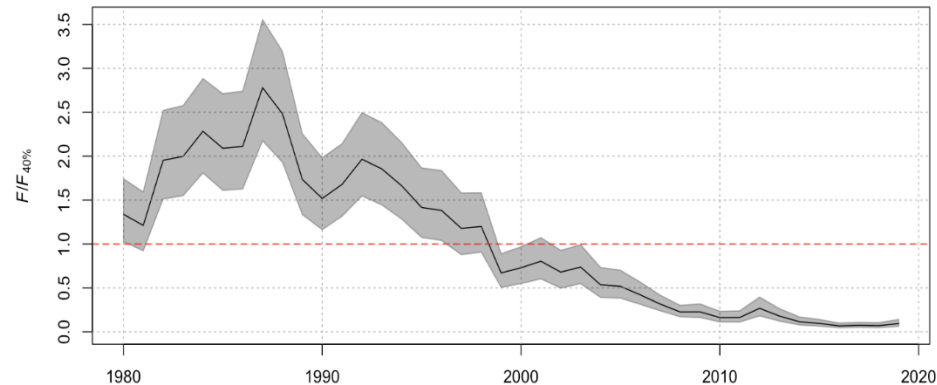
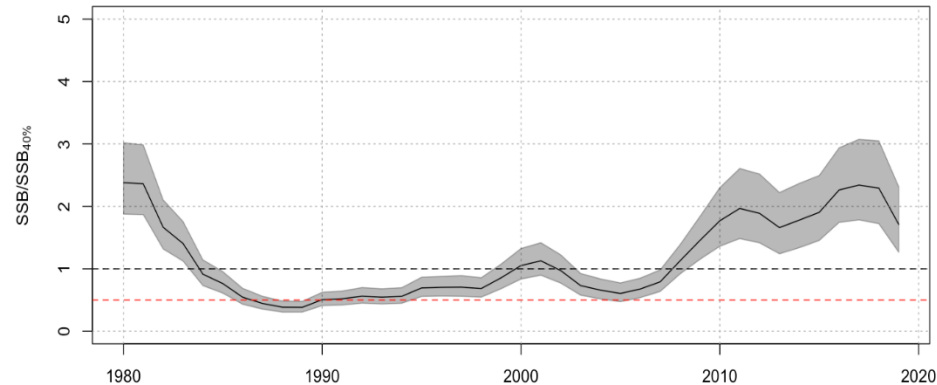
ToR5. Stock Determination

- Reference points assumed the entire time series of recruitment and recent 5-year estimates of selectivity and observations of weight-at-age.



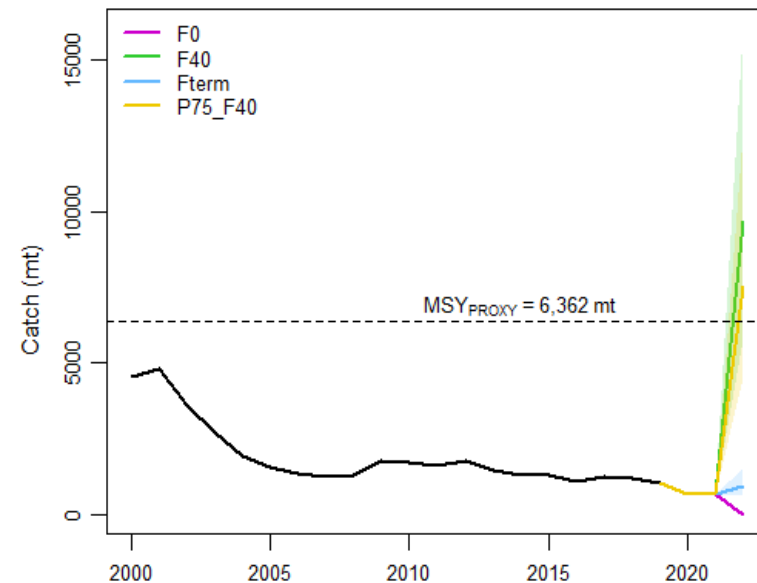
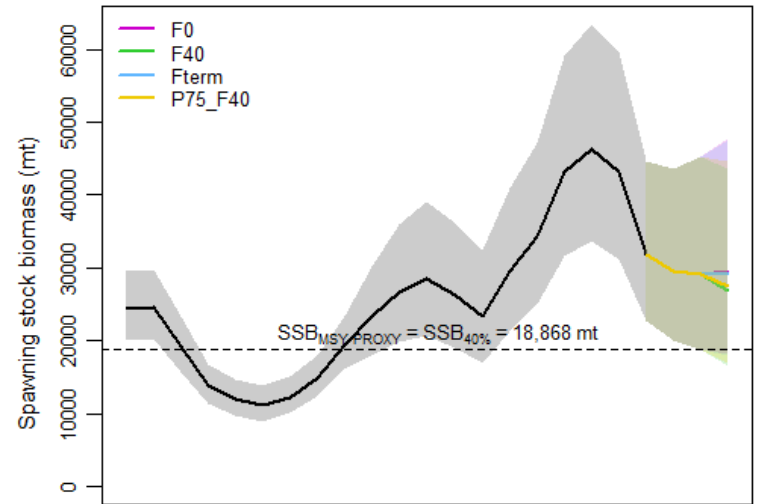
TOR5. Status Determination Criteria

- WHAM (run29F4) estimated $F_{40\%}=0.42$ and $SSB_{F40\%}=18,868$ mt.
- Stock Status
 - ‘Overfishing’ from 1980 to 1998 depleted the stock to ‘overfished’ in late 1980s
 - Fishing mortality has been less than $F_{40\%}$ since 1998
 - Stock rebuilt to significantly greater than $SSB_{F40\%}$ in 2019.
 - The current stock is not overfished, and overfishing is not occurring.



ToR6. Projections

- Projections assume 2020 and 2021 catch, future recruitment based on the entire time series of recruitment and recent 5-year estimates of selectivity and observations of weight-at-age.
- Projected stock size is maintained at status-quo fishing mortality, decreases at $F_{40\%}$ or the management target $75\%F_{40\%}$, but remained greater than $SSB_{F_{40\%}}$ for all $F > 0$ projections.
- Projected catches are maintained at status-quo fishing mortality and substantially increase at $F_{40\%}$ or the management target $75\%F_{40\%}$.

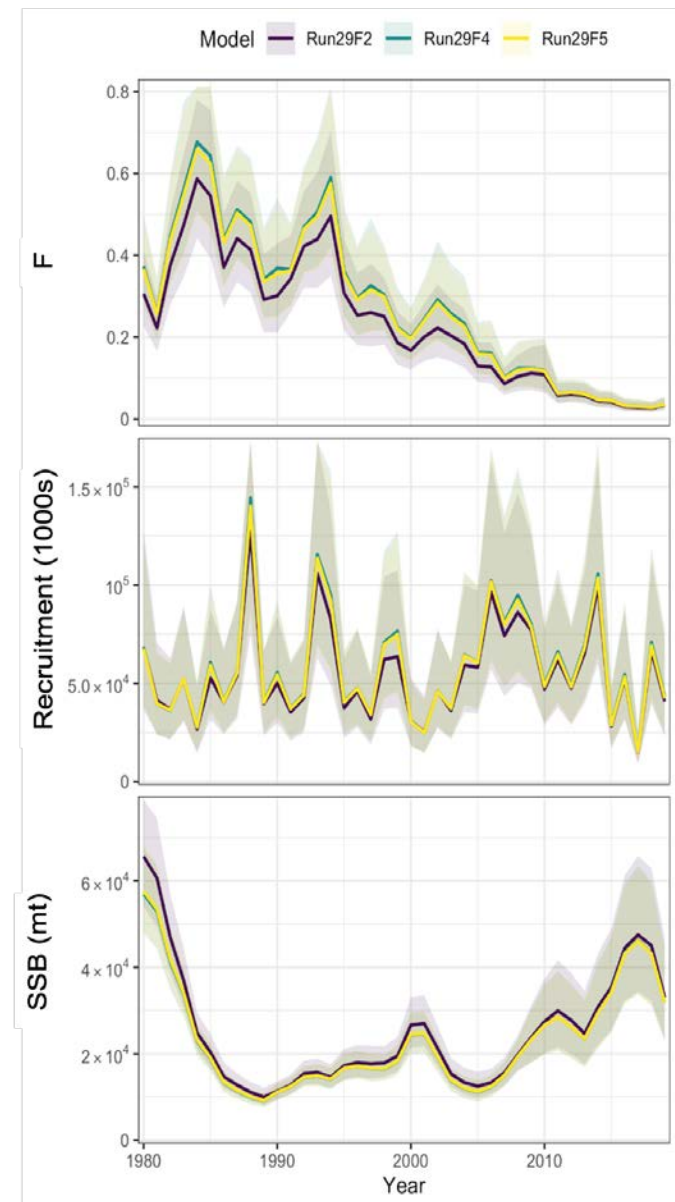


TOR7. Research Recommendations

- All previous research recommendations were addressed by this research track assessment (except processing inshore survey age samples).
- The Working Group proposes several new research recommendations for improving data and models.
 - Streamlined estimation of commercial catch, including integration of information on from electronic monitoring, would promote reproducibility.
 - The Gulf of Maine scallop fishery should be included in discards as it expands.
 - Process otolith samples from 1975-1979 fishery, Massachusetts and the Maine-New Hampshire surveys.
 - Spatiotemporal integration of federal and state surveys should be explored further.
 - Several technical aspects of specifying environmental effects in stock assessment models also need development.

TOR8. 'Backup Plan'

- Simulation testing by the Index-Based Methods Working Group indicated that empirical approaches perform no better than models with diagnostic problems.
- Empirical approaches suggested that the area-swept survey biomass or catch curves are not appropriate for plaice (domed survey selectivity, recent Z 's $< M$).
- If the proposed assessment approach does not meet the standards of peer review or is rejected in a future management track assessment, an alternative model be developed to integrate information from catch, age composition and indices.



Acknowledgments

- Years of work by many people:

- **Previous assessment leads** (Loretta O’Brien, Mark Terceiro), age readers (Josh Dayton, Louise Dery, Christine Esteves), survey staff, observers, port samplers and fishermen
- **Rapporteurs:** Keith Hankowsky, Max Grezlik, Cole Carrano, Lucy McGinnis
- Jackie O’Del, Vito Giacalone, and Maggie Raymond **organized meetings with fishermen.**
- Greg DeCelles & John Manderson contributed to **fishermen interviews.**
- Michele Traver & Alexander Dunn provided **logistical support.**

- **Partly funded by**

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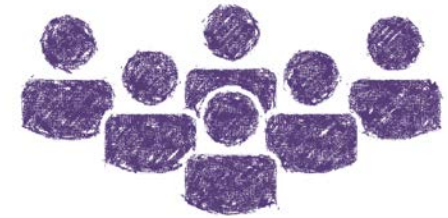
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ALLIANCE**

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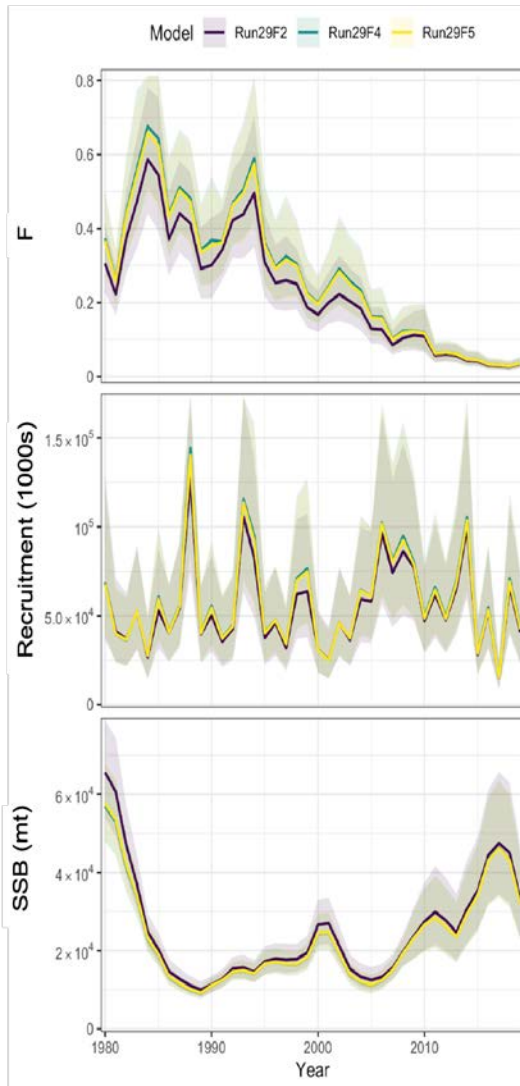


Questions?



2022

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