

Gulf of Maine Northern Shrimp



Stock Assessment Update 2021

Prepared by the

ASMFC Northern Shrimp Technical Committee

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with

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Outline

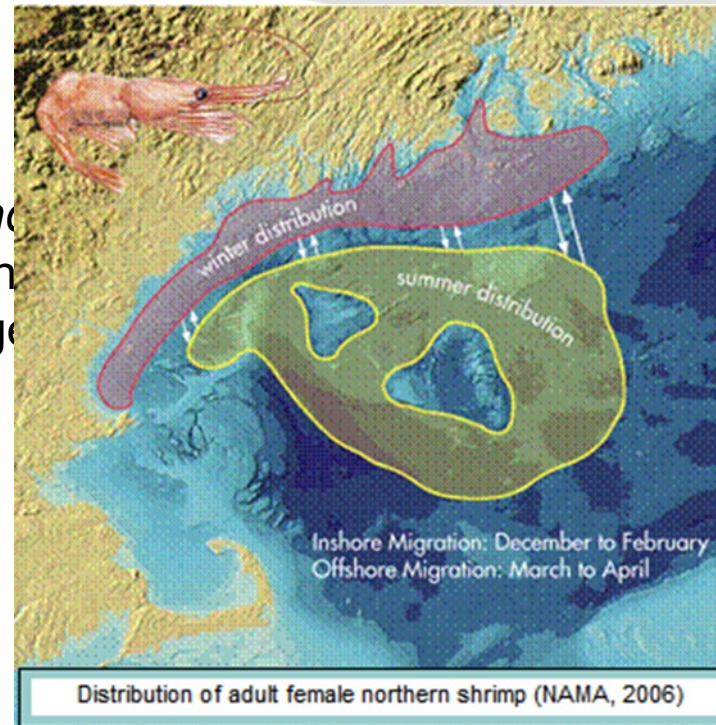


- Review of Northern Shrimp Biology
- Summary of New Assessment Data Since the 2019 Update
- 2021 Stock Assessment Update Results

Northern Shrimp Biology



Northern Shrimp (*Pandalus borealis*) are at the southern range, and are a good bottom habitats, 4–6 °C. Deep water, 90–180 m soft bottom habitats, 4–6 °C. Females migrate inshore to hatch eggs in winter and return offshore in spring. Larvae/juveniles stay inshore ~1 year, then migrate offshore.



Northern Shrimp Biology

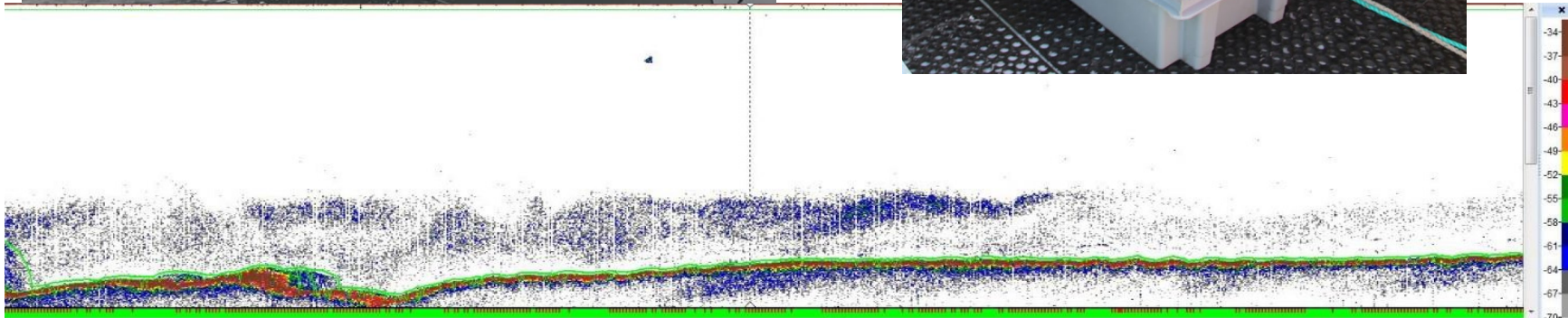


- Protandric hermaphrodites —
Lifespan ~5 yrs:
Mature as male,
mate in summer (age 2½),
transition to female (3),
mate as female (3½ – 4½)
- Most desirable fishery
product at ~age 4-5 (female)
- Fishery reflects weak / strong
year classes

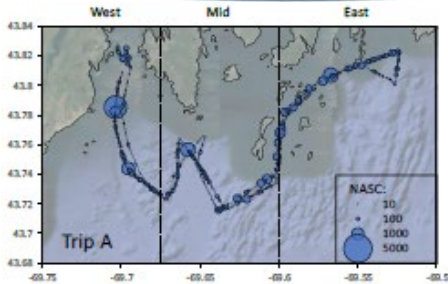


Photo by Mike Kersula ME DMR

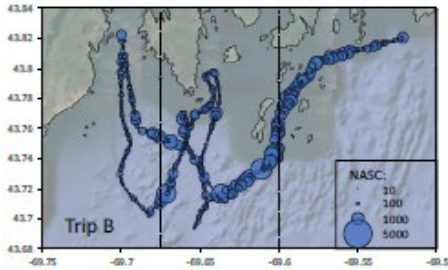
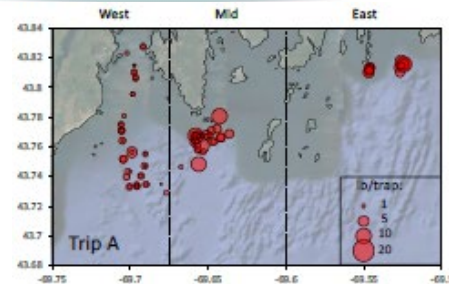
2020 Maine Winter Acoustic/Trap Survey



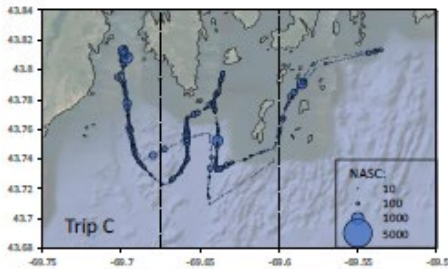
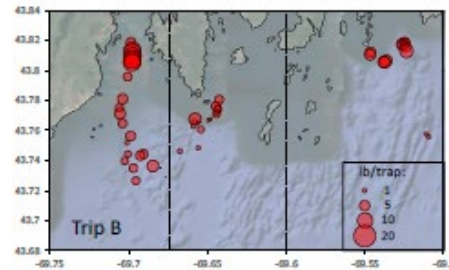
2020 Maine Winter Acoustic/Trap Survey



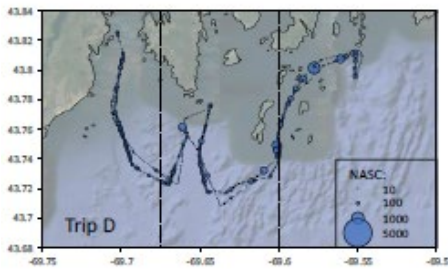
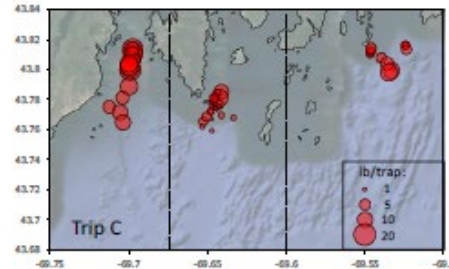
Jan. 31



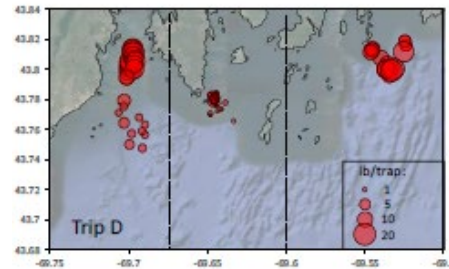
Feb. 8
(full moon)



Feb. 16



Feb. 22
(new moon)



Acoustic Signal

Trapper Catch Rates (Lbs per Trap-Haul)

2021 Assessment Update



- In 2018 we presented an updated assessment based on the 2018 benchmark assessment.
- In 2019 we reported additional data:
 - 2019 ME-NH spring inshore survey,
 - 2019 summer survey, 2019 environmental data, and
 - 2018 NEFSC fall survey (and predation) data.
- There was no report in 2020.
- For 2021 we present an updated assessment in a slimmer new standardized format, with additional data:
 - 2020 trap catches and samples,
 - 2021 ME-NH spring inshore survey,
 - 2021 summer survey, 2021 environmental data, and
 - 2019 NEFSC fall survey (and predation) data.

Assessment Data



Fishery-Dependent

- Landings data from old assessment reports (1985-1989), NMFS online landings database (1990-2000), and more recent vessel trip reports (2001–2013)
- 1985–2013 port samples
- 2014–2020 winter research catches and samples

Fishery-Independent

- Environmental data including predation data from fall NEFSC surveys
- Resource surveys

Resource Surveys



- *ASMFC Summer Shrimp Survey (1984–2021)
- *NEFSC Fall Bottom Trawl Survey (1986–2008;2009–2019)
- *ME/NH Spring Inshore Trawl Survey (2003-2021)
- Used model-based (standardized) indices (vs design-based)

*None of these surveys were conducted in 2020.



Summer Shrimp Survey



- *RV Gloria Michelle* received new winches and doors in 2017. Portuguese doors were replaced with Bison doors.
- Calibration tows (39 paired tows) were conducted during 2017–2019
- Timothy J. Miller and Peter Chase analyzed the data and concluded there were no significant differences in catch efficiency between the two gear configurations. (See Appendix 2)



U. Maine Model



- Developed as part of the 2014 benchmark assessment by Drs. Yong Chen and Jie Cao (University of Maine) in collaboration with the NSTC.
- Based on the length-structured model used to assess American lobster.
- Published in CJFAS (Cao et al, 2017a & b)
- Passed review by the 2018 SARC
- Approved for management use Oct. 2018.

Traffic Light Approach (TLA)



- Annual indices categorized as:
 - **Green** = favorable
 - **Yellow** = intermediate
 - **Red** = unfavorable
- Defined conditions relative to references:
 - 1984–2017 time series 20th and 80th percentiles

2021 Summer Shrimp Survey



- 60 useable tows successfully completed, during a shortened survey due to COVID19 restrictions.

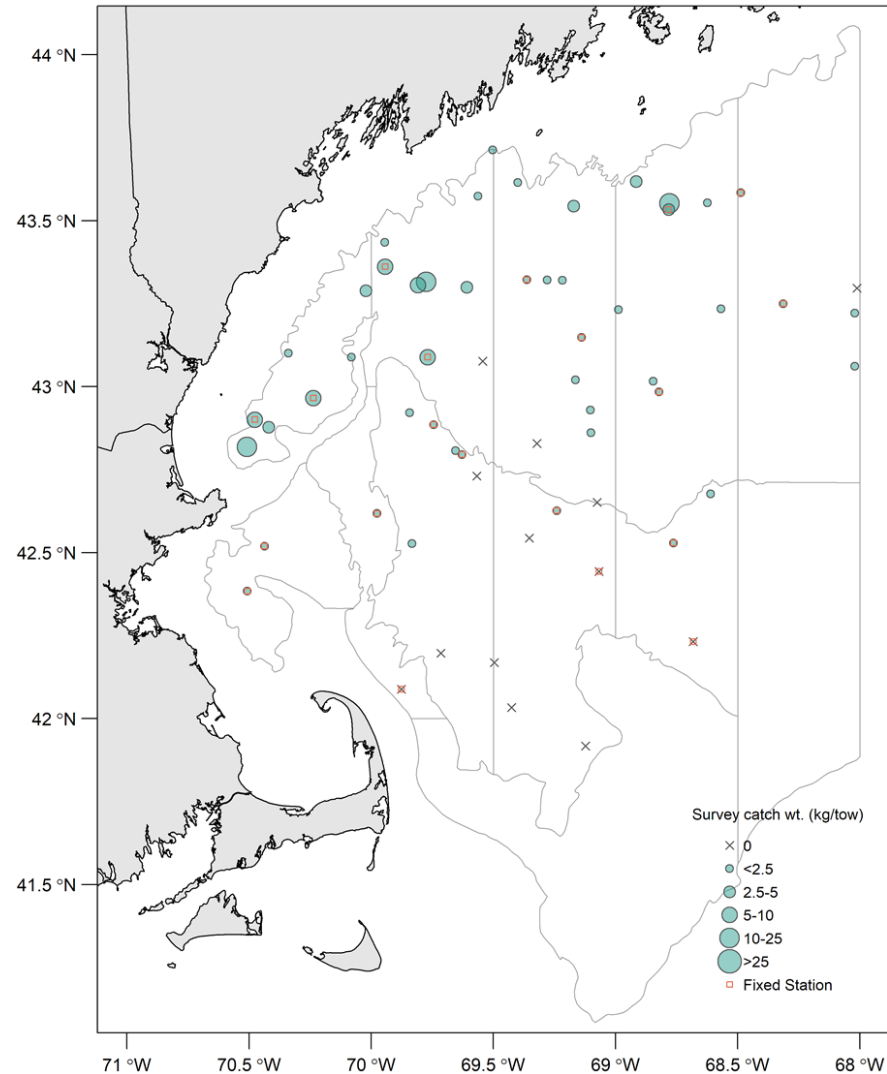


Figure 2, p 21

2021 Summer Shrimp Survey



Abundance
2021 value was a
new time-series low.

Biomass
2021 value was a
new time-series low.

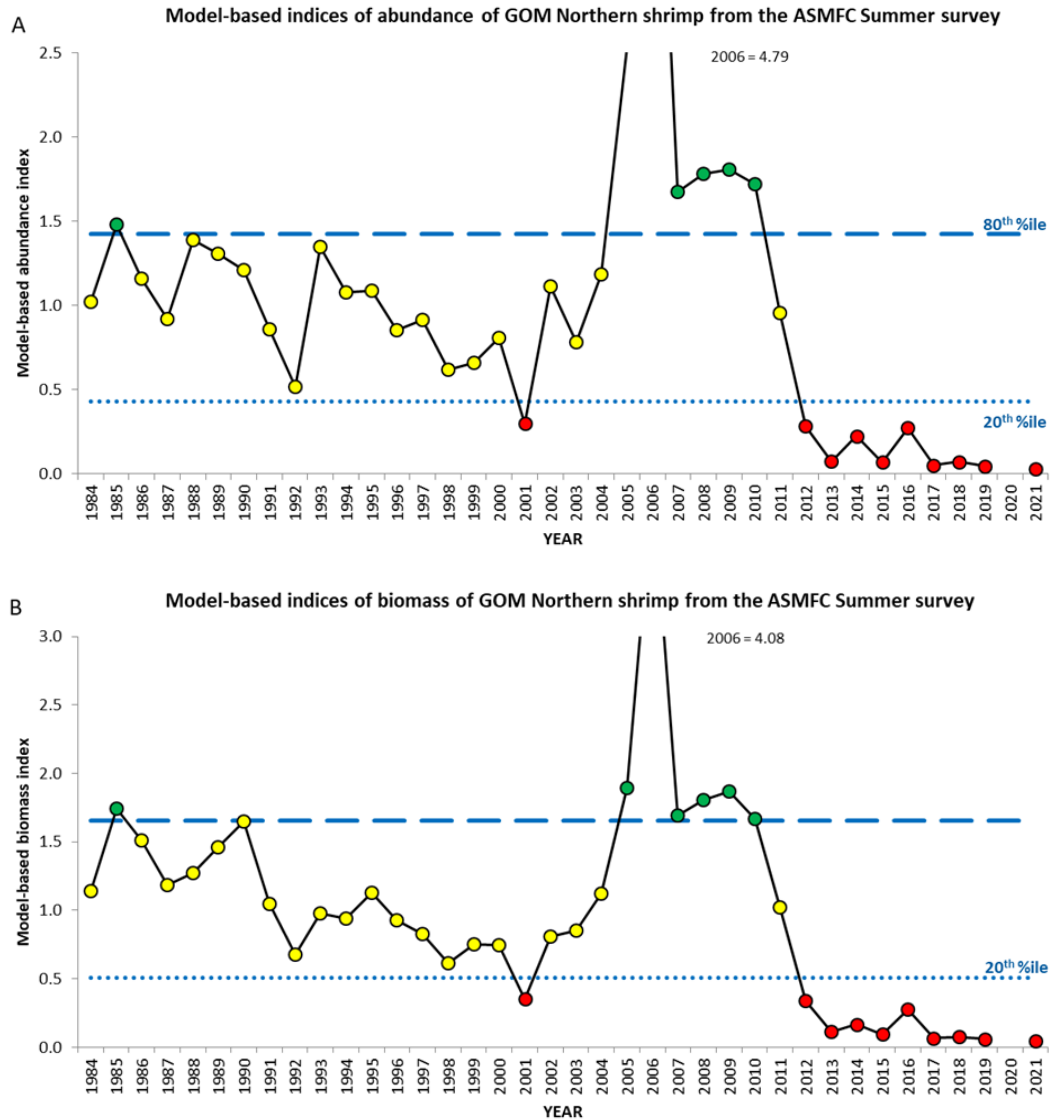
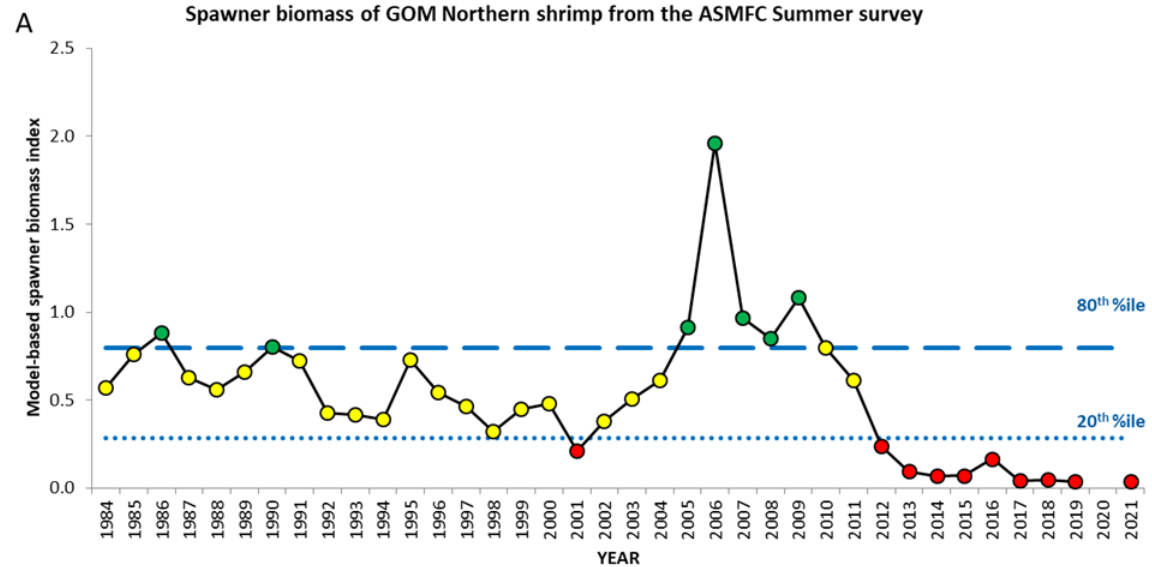


Figure 6, p 25

2021 Summer Shrimp Survey



Spawning Stock
Biomass
(female biomass)
2021 value was
second-lowest in
the time series



Recruits
(age 1.5 numbers)
2021 value was a
new time-series low.

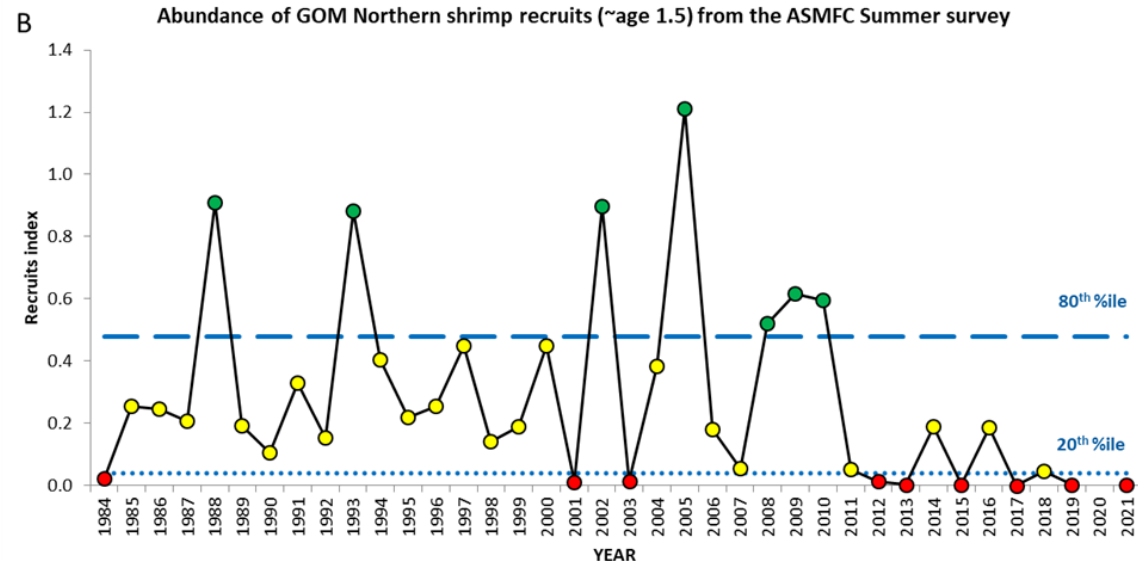


Figure 7, p 26

NEFSC Fall Surveys



- The *Albatross* survey ended in 2008
- 2019 had the second lowest total abundance in the *Bigelow's* 11-year time-series (2009-2017)
- There have been 7 consecutive years of low abundance

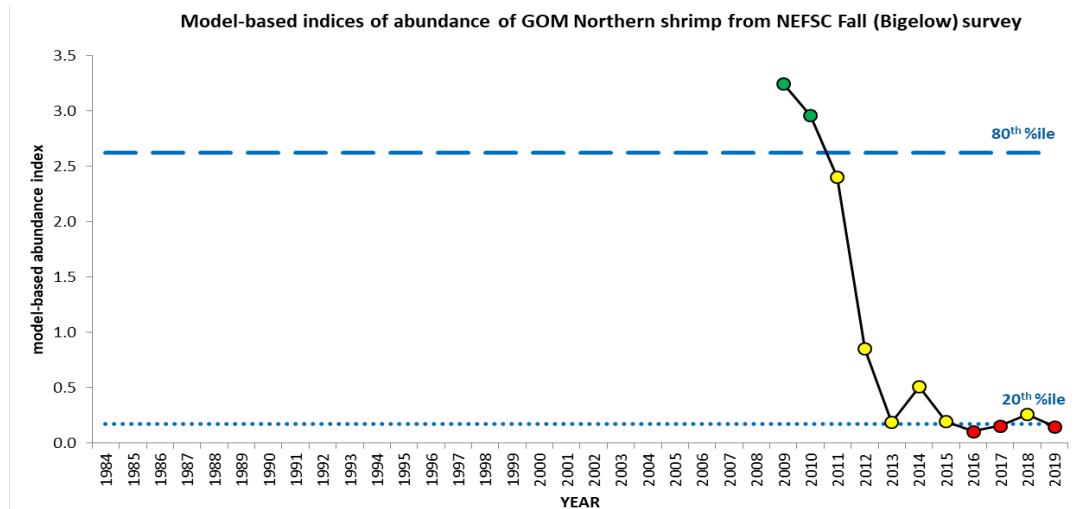
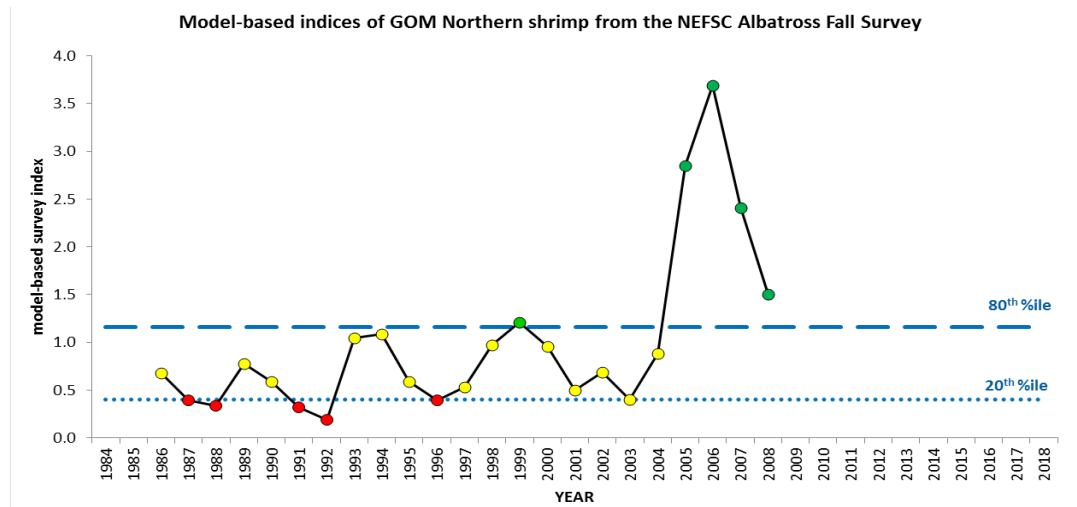


Figure 8, p 27

Environmental Conditions



A. Predation pressure

B. Summer bottom temperature

C. spring bottom temperature

D. Winter sea surface temperature

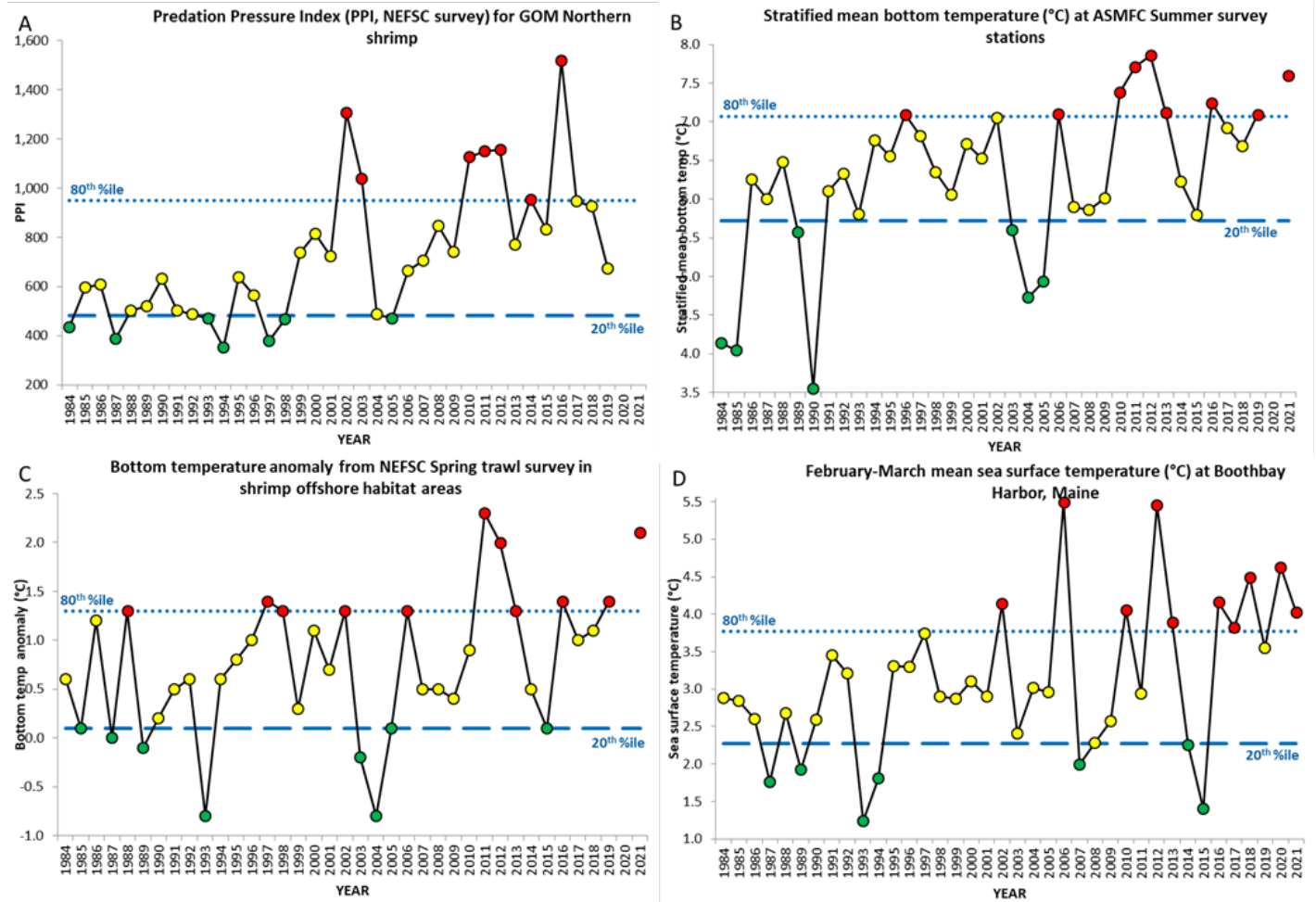


Figure 9, p 28

UME Model Results



Fishing Mortality (F) (with 95% confidence intervals)

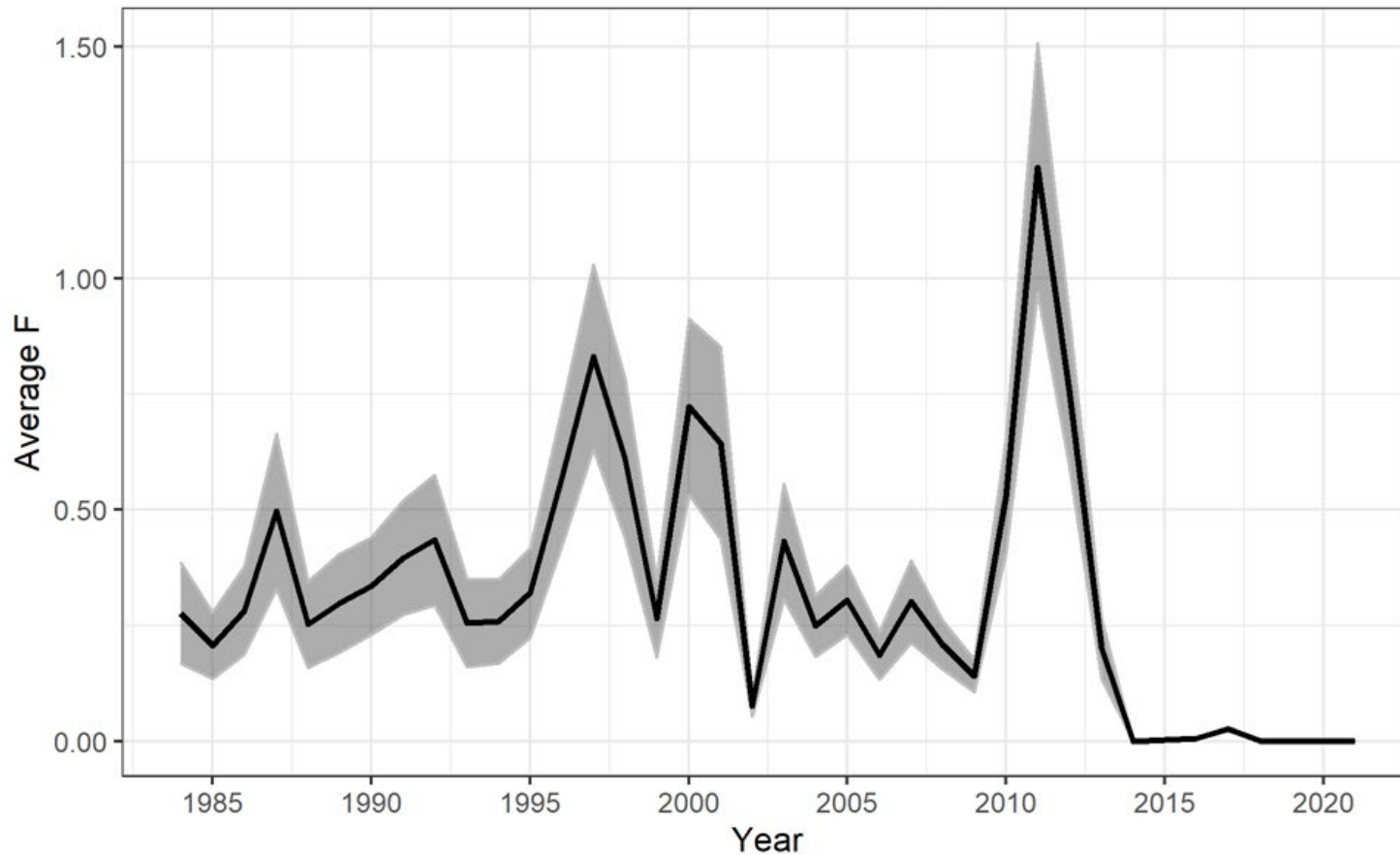


Figure 11, p 30

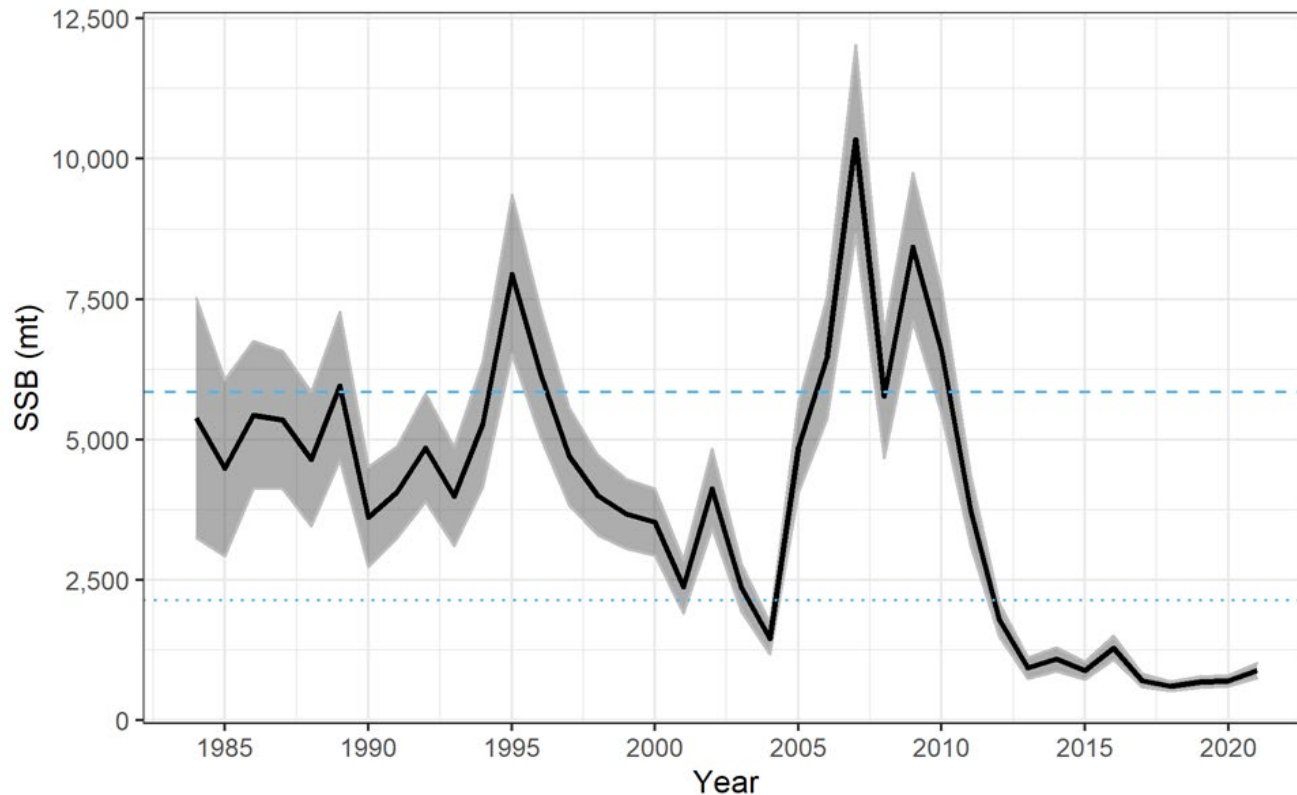
UME Model Results



Spawning Stock Biomass (with 95% confidence intervals)

SSB has been low (less than 1500 mt) for 9 years.

SSB₂₀₂₁ is estimated to be 887 mt.

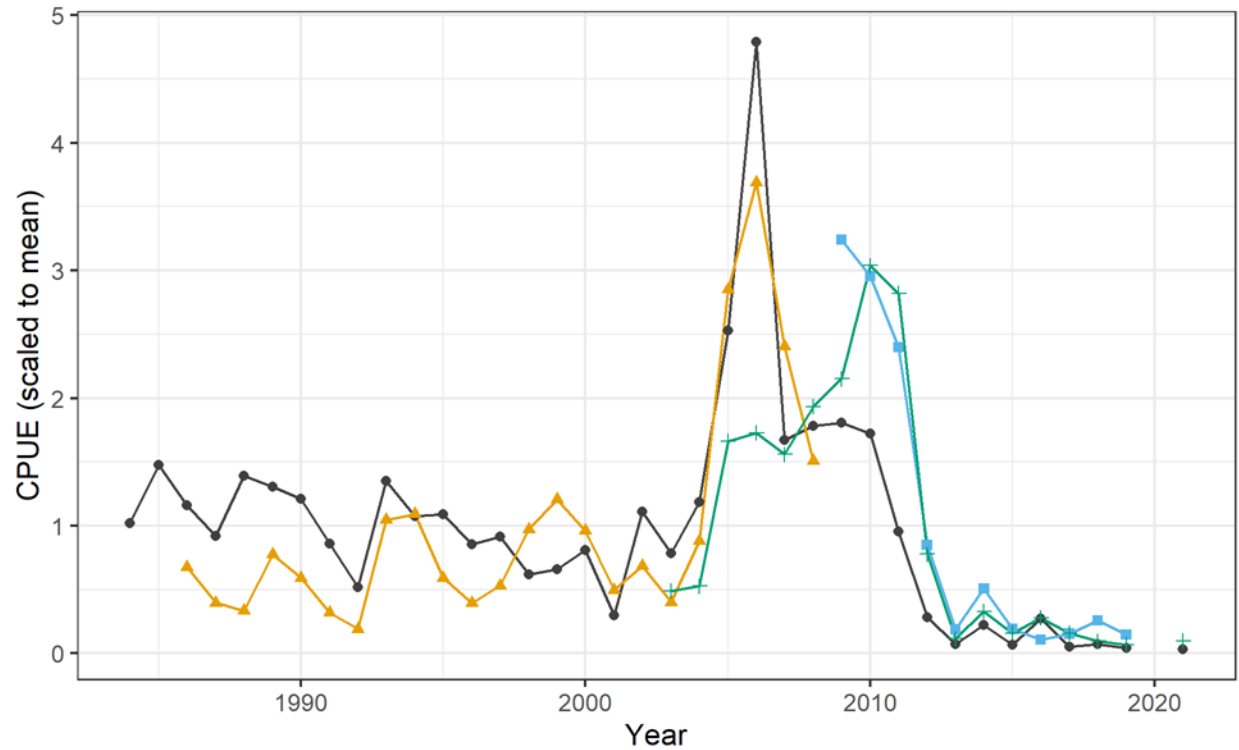


Dashed lines indicate the 80th and 20th percentiles of the 1984-2017 SSB estimates.

Resource Surveys



All three survey biomass indices were at or near time-series lows in their most recent year.



Survey —●— ASMFC Summer Survey —▲— NEFSC Fall Albatross —■— NEFSC Fall Bigelow —+— ME-NH Spring

Figure 3, p 22

2021 Stock Status



- Indices of total and spawning biomass have remained very low for the past nine years, including 2021.
- Recruitment failure (below the 20th %) has been observed in six of the past nine years and the other three were below average.
- Stock status continues to be poor.

Questions ?





Northern Shrimp Projections

Katie Drew, ASMFC

Dec. 17, 2021

Projections

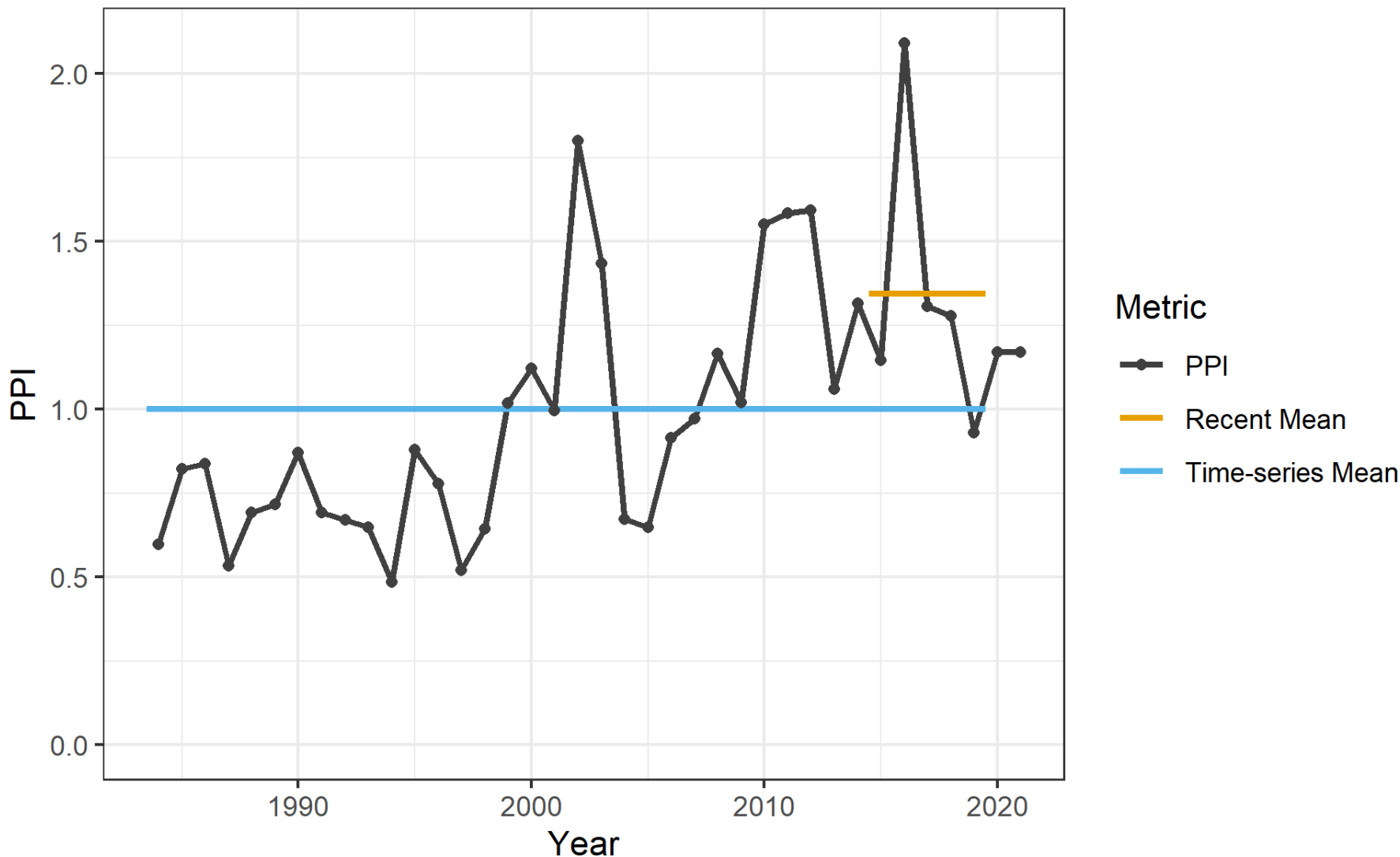
- Long-term: 50 years
 - Different M and recruitment scenarios
 - $F=0$
- Short-term: 5 years
 - Different M and recruitment scenarios
 - Different F scenarios

M (Natural Mortality) Scenarios



- **Recent M:** mean of the last 5 years of observed M (2015-2019)
- **Time-series M:** mean of the entire time series of observed M (1984-2019)

M (Natural Mortality) Scenarios

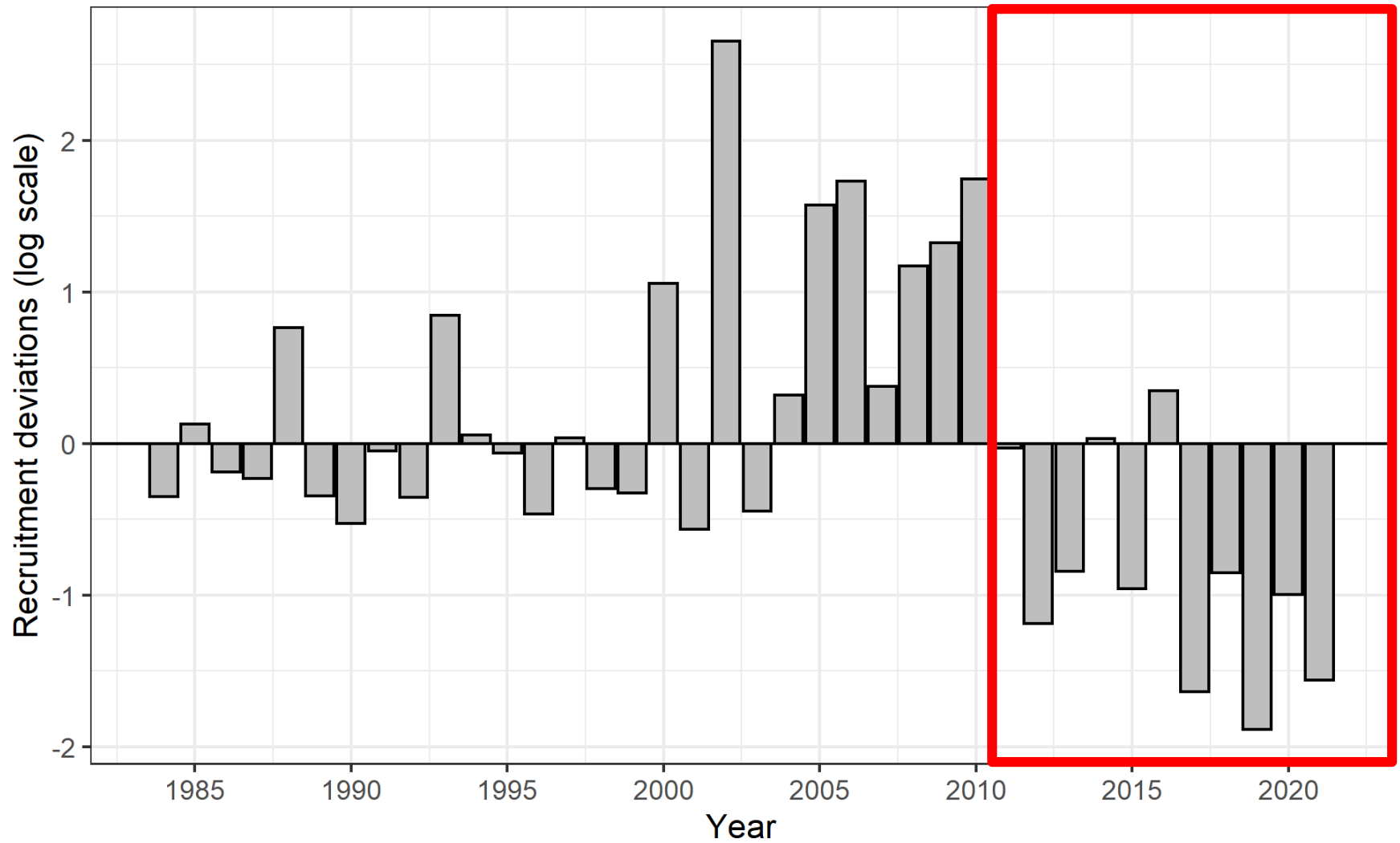


Recruitment Scenarios



- **Recent recruitment:** median and standard deviation of the most recent 11 years of observed recruitment (2011-2021)
- **Time-series recruitment:** median and standard deviation of entire time-series of observed recruitment (1984-2021)

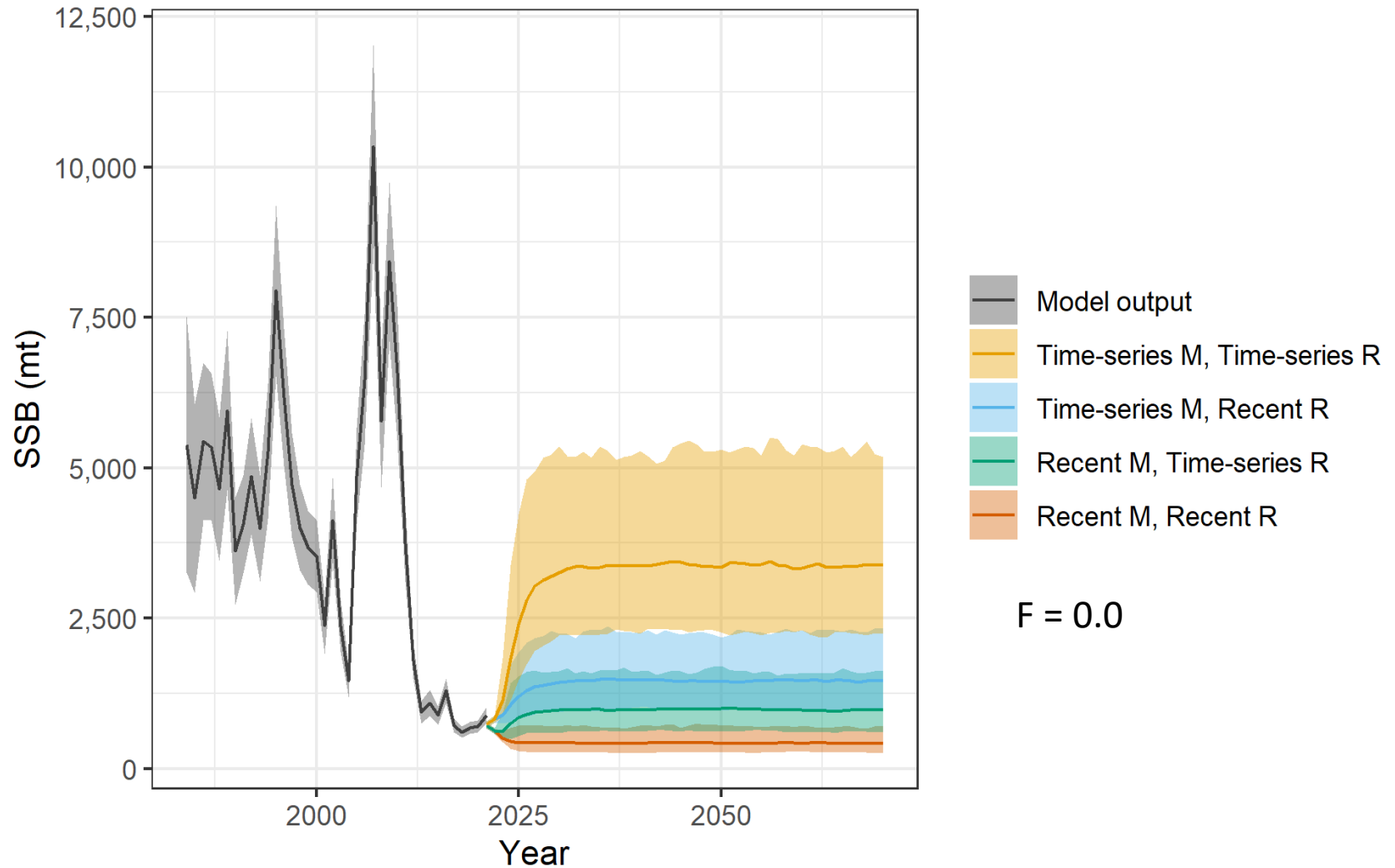
Recruitment Scenarios



Long-Term Projections



Spawning Stock Biomass

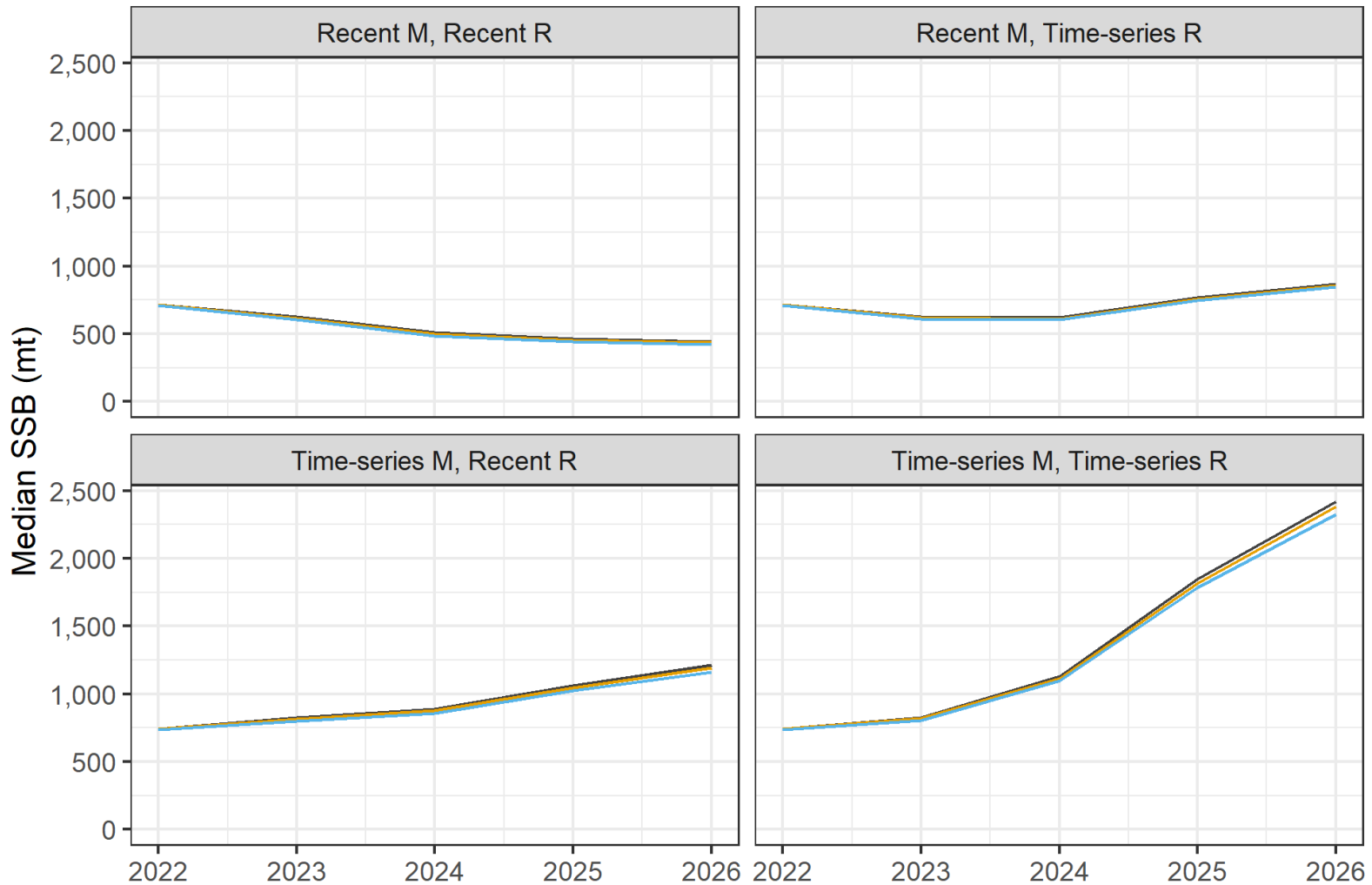


Short-Term Projections



- Same M and recruitment scenarios
- 3 F scenarios:
 - $F=0$
 - $F=0.0224$, trap & trawl fishery (average of research period, 2014-2018)
 - $F=0.05$, trap only (max of research period)

Short-Term Projections



— F = 0 — F = 2014-2018 avg, trawl & trap — F = 2014-2018 max, trap only

Short-Term Projections



Recent M, Recent Recruitment

F Scenario	2022 Catch	2026 Catch	2021 SSB	2026 SSB
F=0	0 mt	0 mt	887 mt	444 mt
F=0.0224	7.1 mt (trawl), 0.8 mt (trap)	4.3 mt (trawl), 0.5 mt (trap)	887 mt	436 mt
F=0.05	0 mt (trawl), 21.2 mt (trap)	0 mt (trawl), 11.9 mt (trap)	887 mt	423 mt

TC Recommendations



TC recommends the moratorium on all fishing be extended, including a moratorium on research trips

TC Recommendations



- Poor stock status and resource conditions (low abundance, negative environmental conditions, high predation levels) →
 No biological justification for harvest
- Consistent with FMP objectives to maintain shrimp stock at sustainable levels that will support a viable fishery & minimize impacts on other resources (e.g., shrimp predators)



Summer Shrimp Survey



Length and Sex-Stage Composition

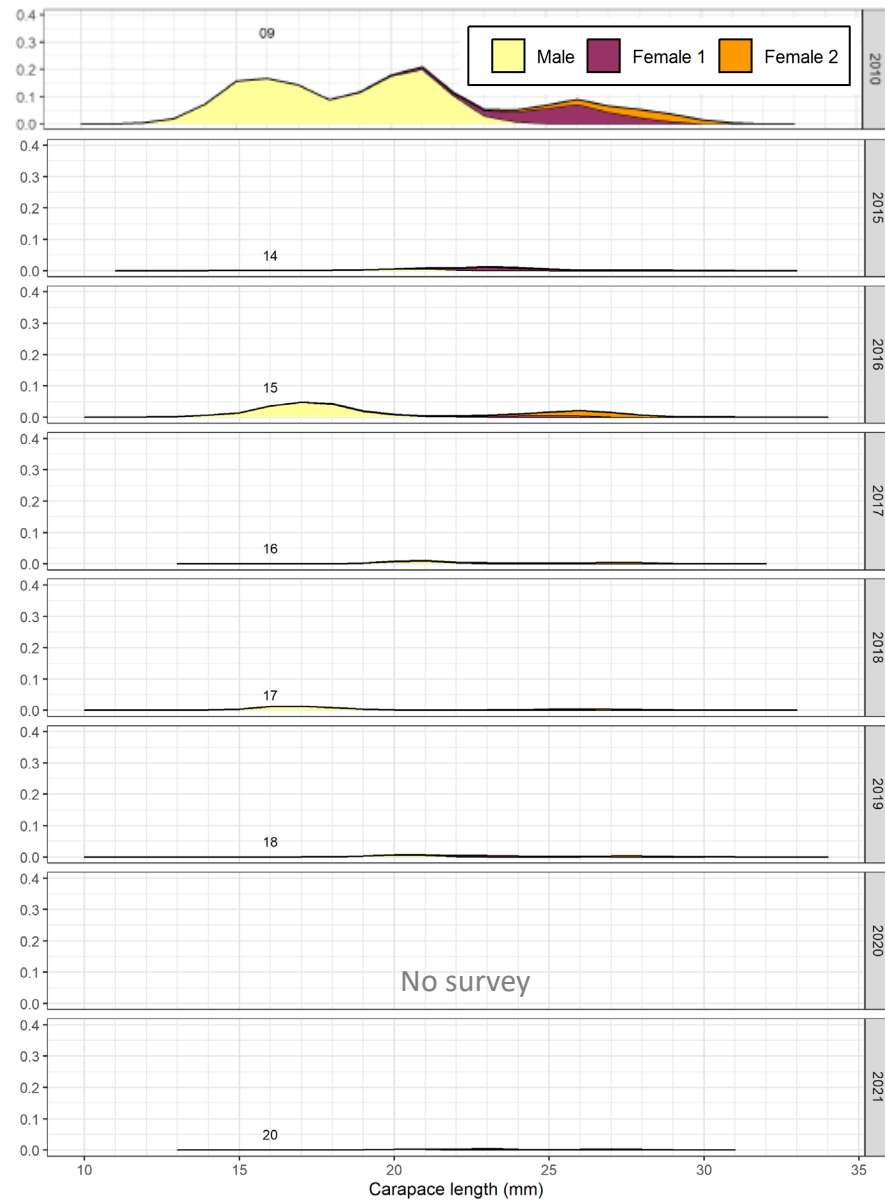
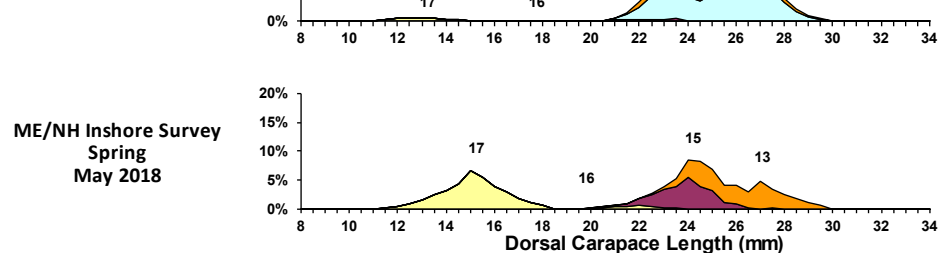
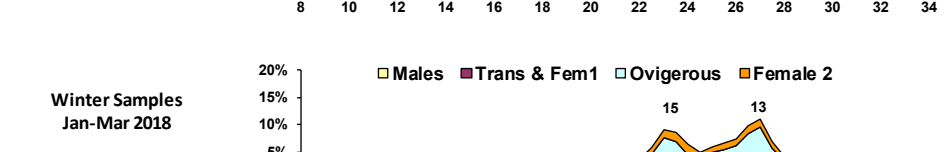
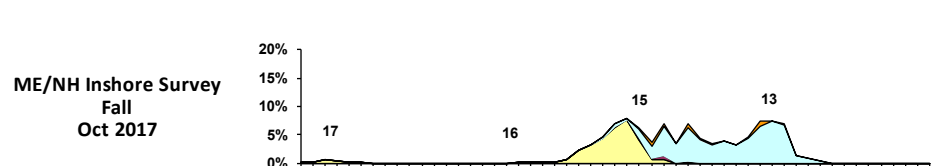
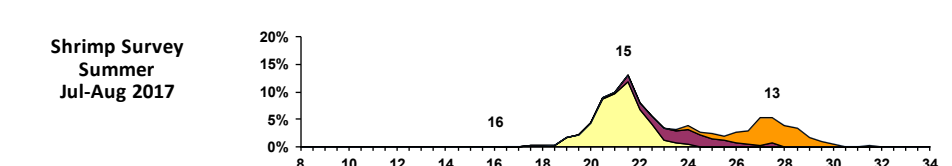
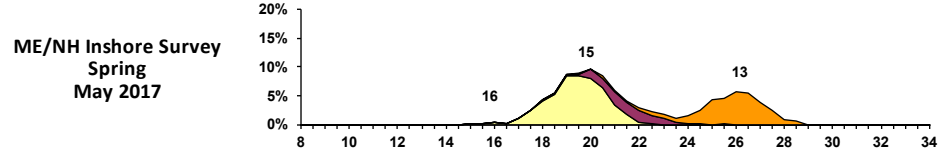
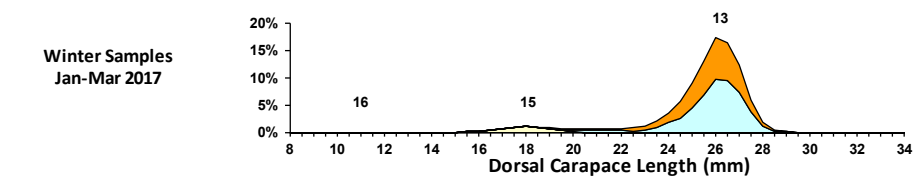
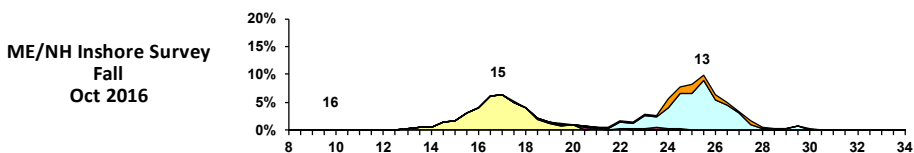
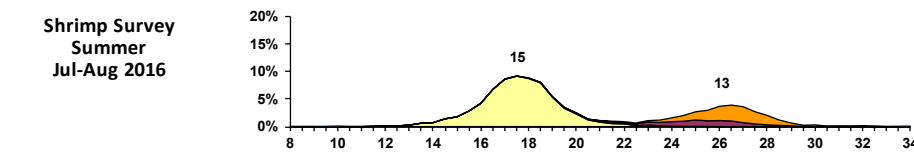
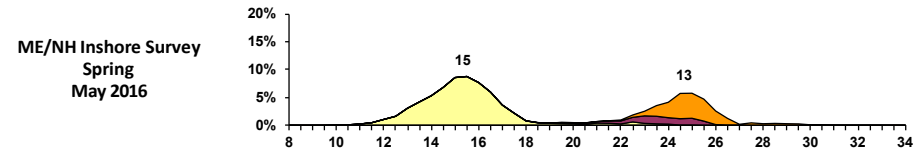
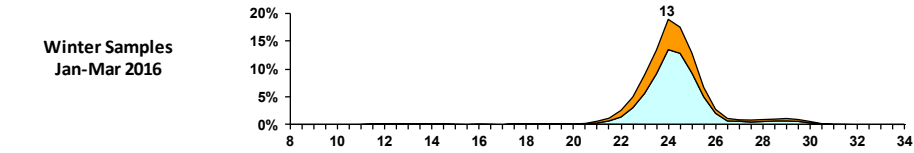
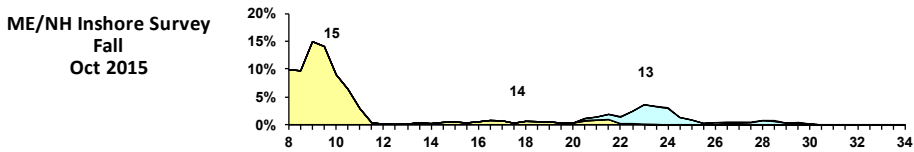
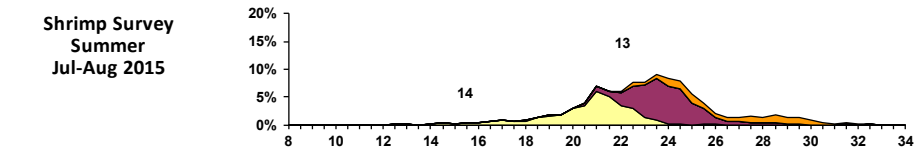
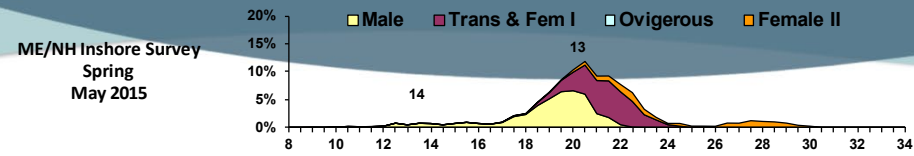
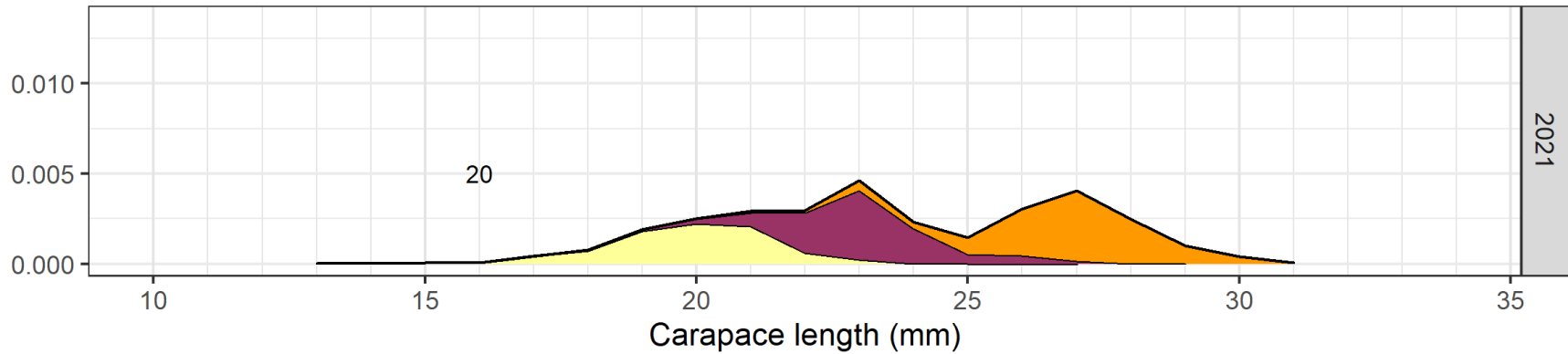


Figure 2, Appendix 3

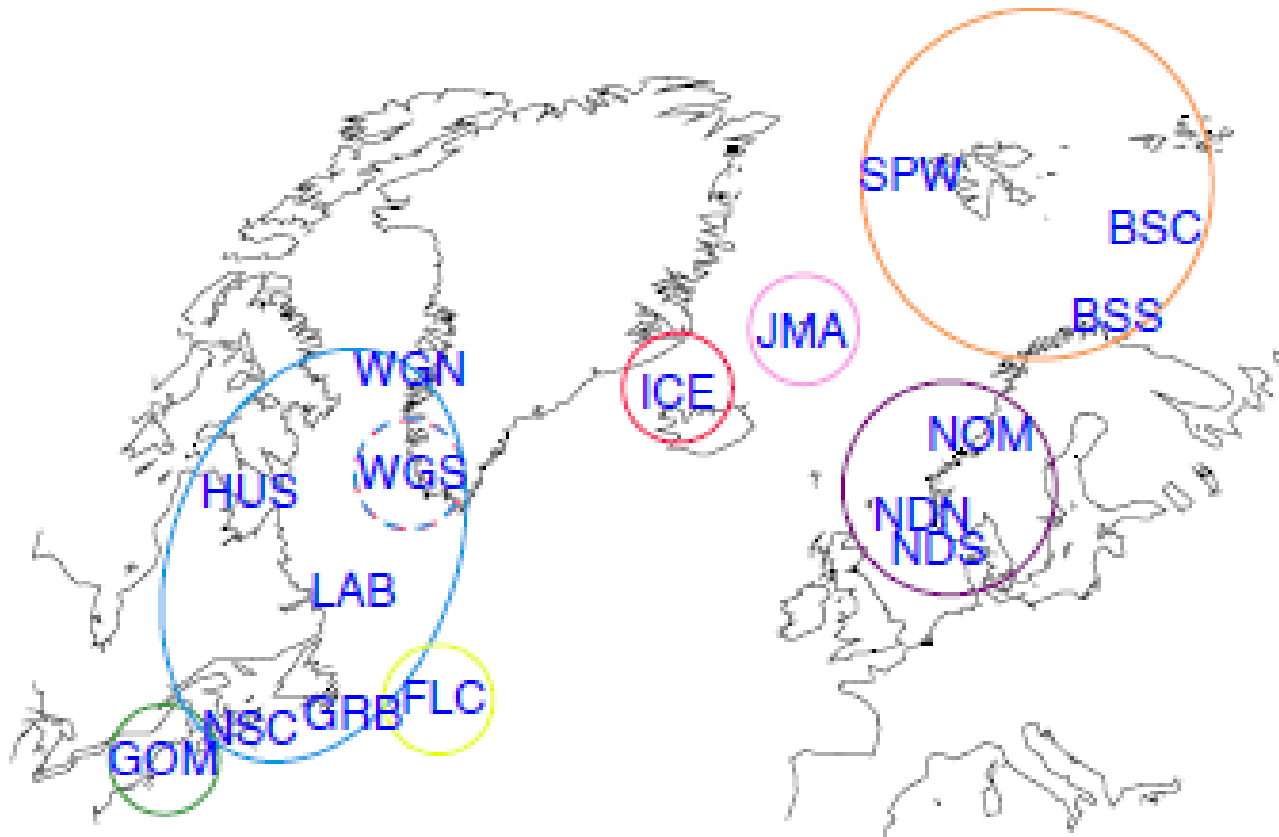


Legend: Males (yellow), Trans & Fem1 (purple), Ovigerous (light blue), Female 2 (orange)

Summer Survey 2021



Genetically distinct populations

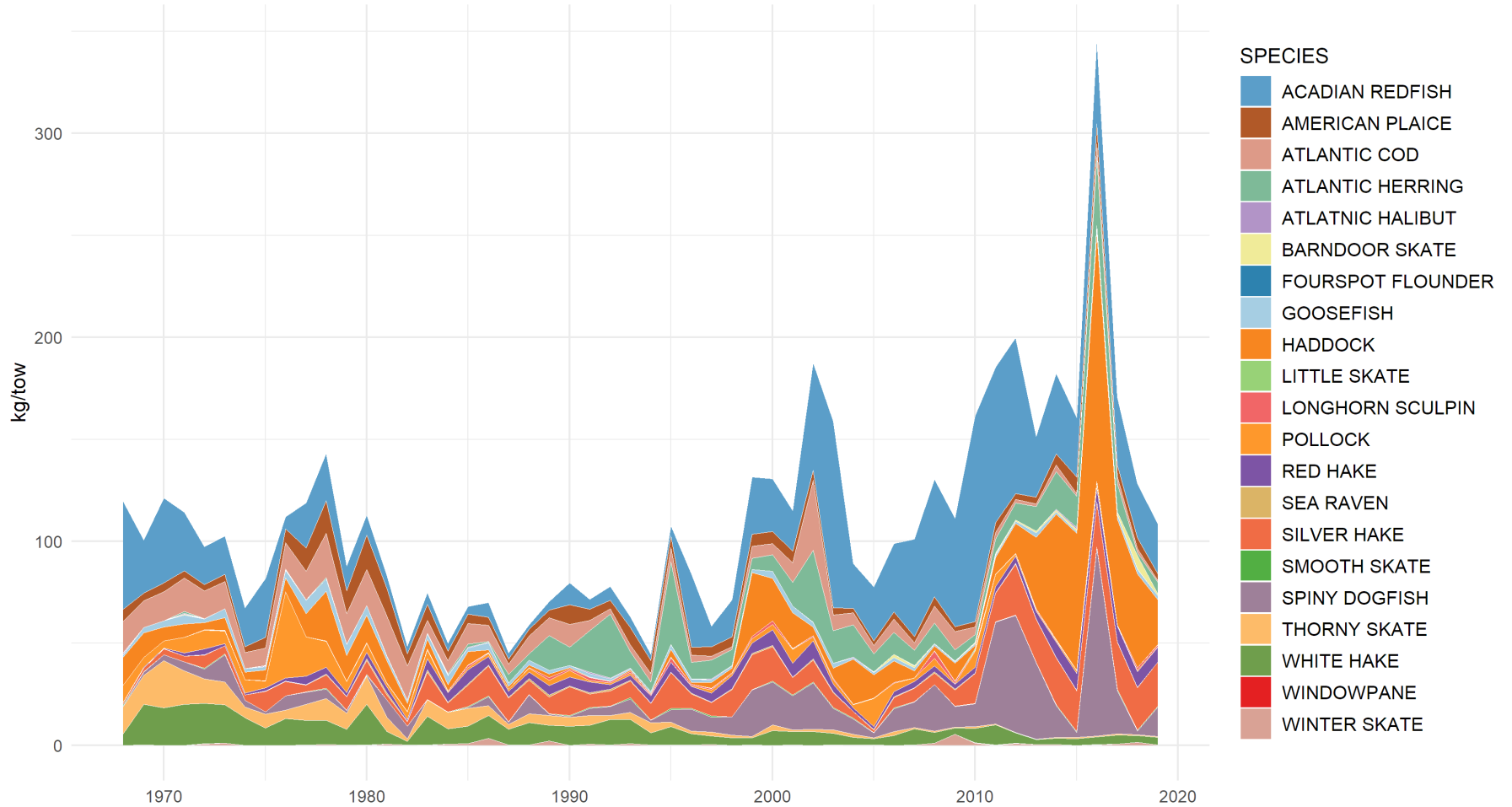


- Gulf of Maine samples appeared distinct from other western samples and instead appeared more similar to Norwegian samples (P.E. Jorde et al. 2015)

2021 TLA – Predation



Predator Biomass Indices



State of Other Stocks

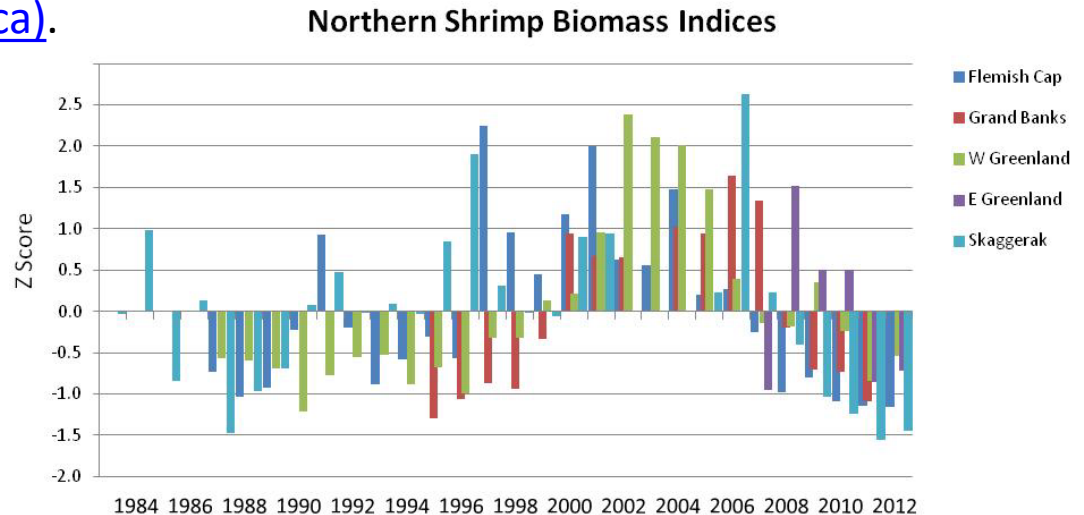


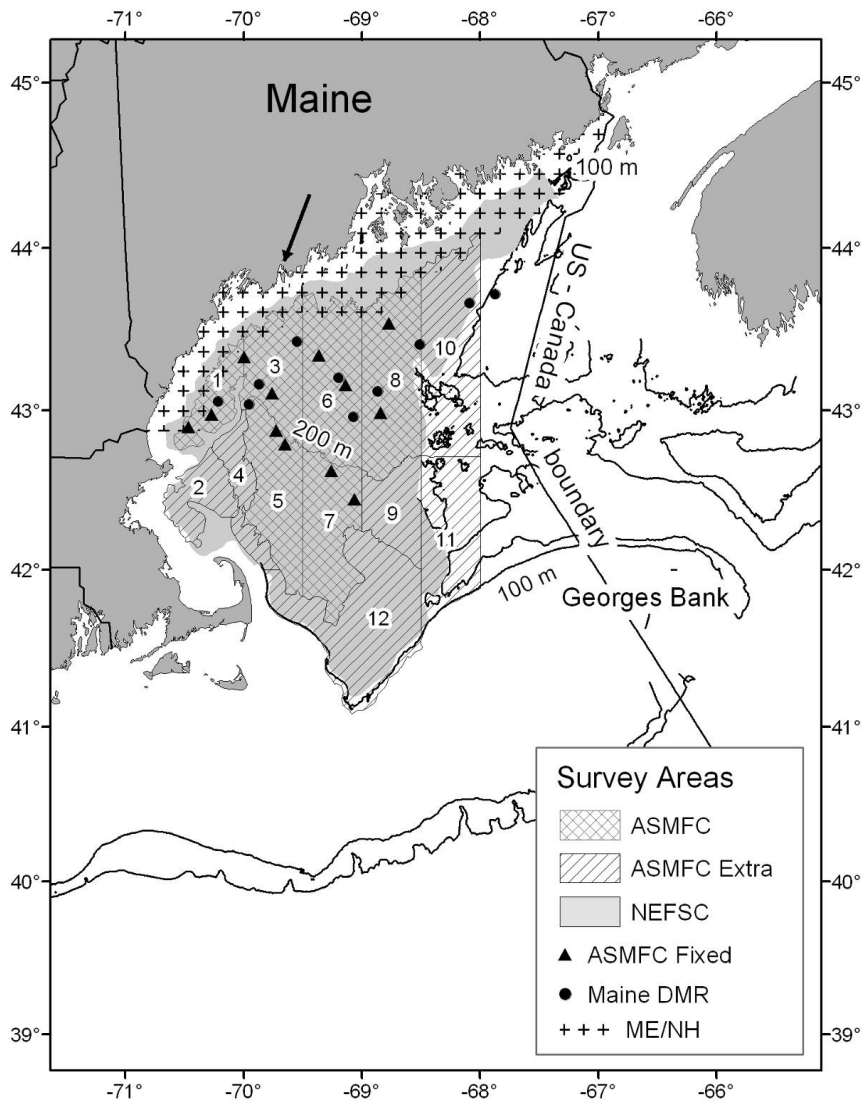
The **Grand Bank** stock is way down. See pp 9-10 at <https://www.ices.dk/sites/pub/Publication%20Reports/Expert%20Group%20Report/Fisheries%20Resources%20Steering%20Group/2020/NIPAG/scs20-21.pdf>.

Newfoundland and Labrador stocks are also down, perhaps due to higher fish predation – see <https://waves-vagues.dfo-mpo.gc.ca/Library/4097568x.pdf>.

The **Gulf of St. Lawrence** area is showing mixed results among 4 regions <https://waves-vagues.dfo-mpo.gc.ca/Library/40901373.pdf>.

The latest I have on the **Scotian Shelf** (2018) says the stock has declined pretty steadily since 2004 [Assessment of Northern Shrimp on the Eastern Scotian Shelf \(SFAs 13-15\) \(dfo-mpo.gc.ca\)](https://waves-vagues.dfo-mpo.gc.ca/Library/40901373.pdf).





Summer Shrimp Survey



Length and Sex-Stage Composition

Recent data with expanded scale

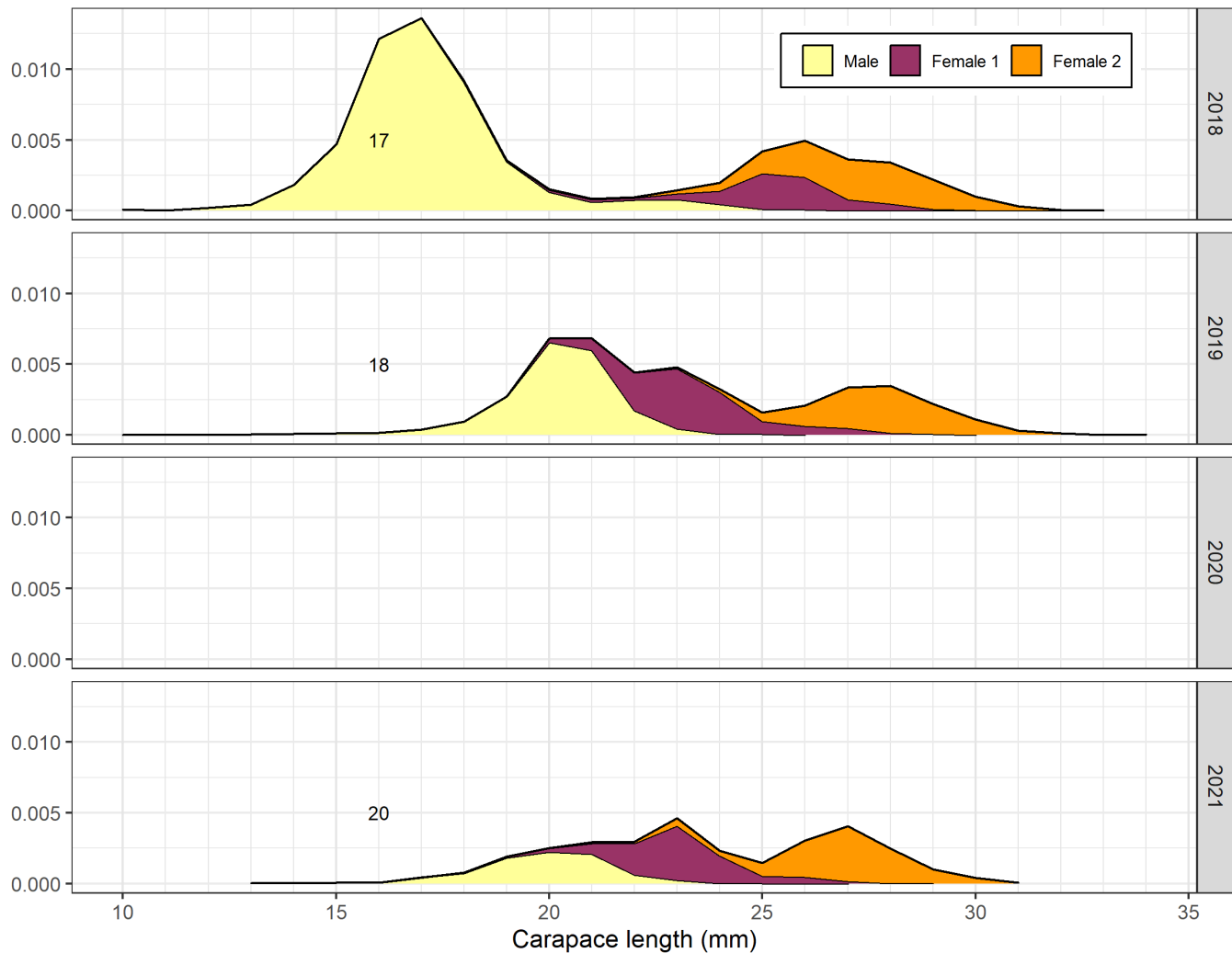


Figure 3, Appendix 3



Northern Shrimp Management Strategy Work Group Update



Northern Shrimp Section
December 2021

Background



- November 2018 Section motion:
“Move to establish a Work Group made up of Section and Plan Development Team members to adjust management strategies based on ASMFC policy regarding changes in species abundance and distribution resulting from climate change.”
- The Work Group (WG) has met 4 times 2020-2021



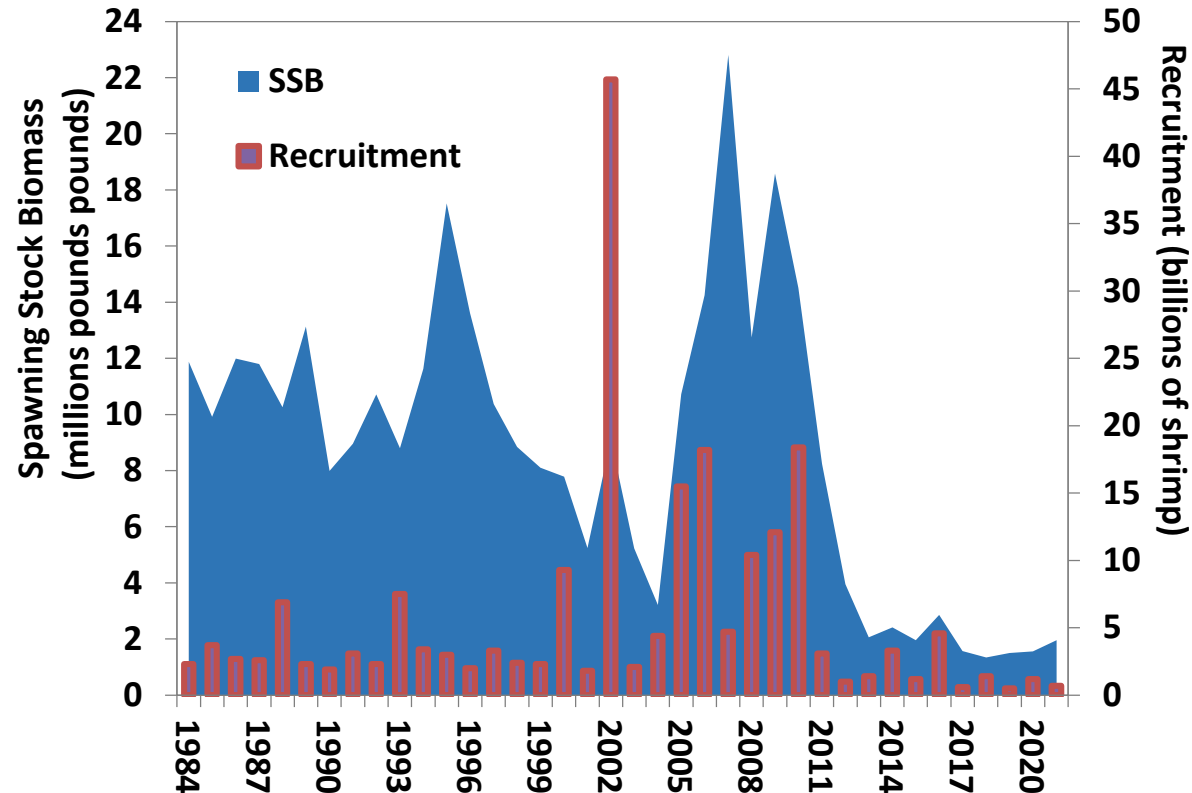
Statement of the Problem



- The 2021 stock assessment update indicates the stock remains depleted
- Fishing moratorium in place since 2014, scheduled to expire in 2021

Northern Shrimp Spawning Stock Biomass and Recruitment

Source: ASMFC Stock Assessment Update, 2021



Management Scenarios



- WG has developed four management scenarios for Section consideration
 - Continuation of the fishing moratorium
 - Personal use fishery
 - Commercial fishery operates under the existing fishery management plan
 - Economically-driven commercial fishery



Continuation of the fishing moratorium



- The current moratorium remains in place with continued monitoring for signs of improving stock health
- Challenges: economic, cultural, will survey funding continue?
- Benefits: ecosystem benefits (shrimp as forage), best chance of rebuilding, aligns with MSA NS1

(Optimum Yield - Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry.)



Personal use fishery



- Personal consumption only (no commercial sale of shrimp)
- This could be accomplished with a small possession limit, a limited season, and/or potential gear restrictions (likely trap only)
- Challenges: concerns about NS1, enforcement, controlling participation, how would permitting/licensing work?
- Benefits: Cultural value, smaller impact on stock



Com fishery operates under existing FMP



- Limited fishery. Use existing management tools such as fishing seasons, trip limits, trap limits, and days out of the fishery.
- Challenges: negative impact on stock, NS1 concerns and conflicts with rebuilding plan
- Benefits: Economic (may be limited), increases understanding of stock, diversifies income streams



Economically-driven com fishery



- Harvesters decide their own level of fishing effort based on a personal calculation of the cost of fishing weighed against the revenue they expect to earn.
- Very limited use of traditional management measures
- Challenges: substantial concerns about MSA NS1, great risk of further depletion of stock, potential loss of current ecosystem services
- Benefits: simple management scheme, maintains fishery access



Northern Shrimp WG Recommendation



- WG does not recommend the economically-driven commercial fishery option
 - Greatest threat to deplete stock
 - Lessens ecosystem services that shrimp provide
 - Conflicts with National Standard 1 (part of fishery operates in federal waters)



Questions?





Northern Shrimp Advisory Panel Recommendations



Northern Shrimp Section Meeting
December 2021

Meeting Overview



- Meeting held on Thursday, December 16th
- Four AP members in attendance
 - Gary Libby (AP Chair)
 - Peter Kendall
 - John Seiders
 - Mark Bennett
- Reviewed 2021 stock assessment report & updates from management strategy work group



Comments on Fishing Moratorium

- Fishing moratorium has not worked for rebuilding the stock
- AP supports outsourcing survey to commercial harvesters
 - AP members think that industry members could conduct survey more cost efficiently and effectively
 - AP questioned whether survey data accurately captures stock health



Comments on Personal Use Fishery

- Some support from AP members
 - 20 traps, open a couple days a week
 - Opening up a personal use fishery could be problematic to enforce and difficult to prevent illegal sale of shrimp



Comments on Small Commercial Fishery

- Some AP members prefer a limited commercial fishery, low trip limits, limited season
- One AP member was concerned this wouldn't be approved by the Section



Comments on Small Research Set Aside Fishery

- AP supports research set aside (where shrimp are still able to be sold), and data can be used to improve understanding of stock.
 - 10 day season, low trip limit suggested.
 - Level of landings will help answer question: Is there a disconnect between summer survey data and what commercial harvesters can catch?
 - This is a research tool, not likely to provide much revenue



Comments on Implementation of Research Fishery for 2022:

- Two AP members thought it was too late to implement something other than a moratorium this year. This should be planned for next year.
- Two AP member thought something could be implemented for this year. Really depends on what type of management system is implemented by the Section.

