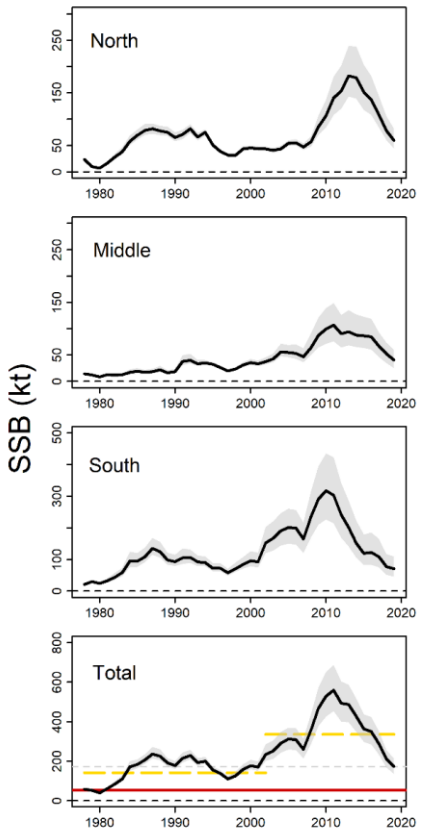
4T Atlantic herring
Fall spawners assessment

Science advice bullet points

- The SSB of fall spawning herring in 2020 is virtually certain (100%) to be in the Cautious Zone of the Precautionary Approach Framework.
- Under current conditions of high natural mortality, constant fishing mortality, declines in weight-at-age, and low recruitment, it is unlikely that SSB will increase in the short term (2021 and 2022) or the long term (2029). Reducing fishing mortality will slightly reduce the probabilities of declines in the short and long term projections. It is unlikely (0-33%) that SSB will increase by 2022 at any catch option.
- The preliminary estimated landings of the fall spawning herring component were 16,742 t from a 25,000 t TAC in 2018 and 15,544 t from a 22,500 t TAC in 2019. Average fishing mortality exceeded the provisional harvest decision rule of the Precautionary Approach Framework for most of the 1990s and 2000s but is currently below the provisional harvest decision rule at stable levels.

Science advice bullet points

- Recruitment has been declining since 2006 and reached the lowest levels of the time series in recent years. Environmental conditions that promote high recruitment require the synchronicity of temperature, zooplankton abundance, and timing of the release of herring larvae. The occurrence of future environmental conditions for successful fall spawning herring recruitment cannot be predicted.
- Natural mortality estimates for ages 2 to 6 decreased over the time series, with trends that matched the declines seen in the abundance of Atlantic cod in the sGSL. For ages 7 to 11+, annual natural mortality estimates increased sharply in 2004 to reach a peak in the mid-2010s and has since stabilized at values of approximately 55%.
- For both spring and fall spawners, the increasing trend in natural mortality of ages 7 to 11+ was correlated with the increase in grey seal and Atlantic bluefin tuna abundance over the same time period.
- Statistical catch at age models that incorporated changes in catchability in the fixed gear fishery and changes in natural mortality have been used for the first time in this assessment.



Spawning stock biomass (SSB)

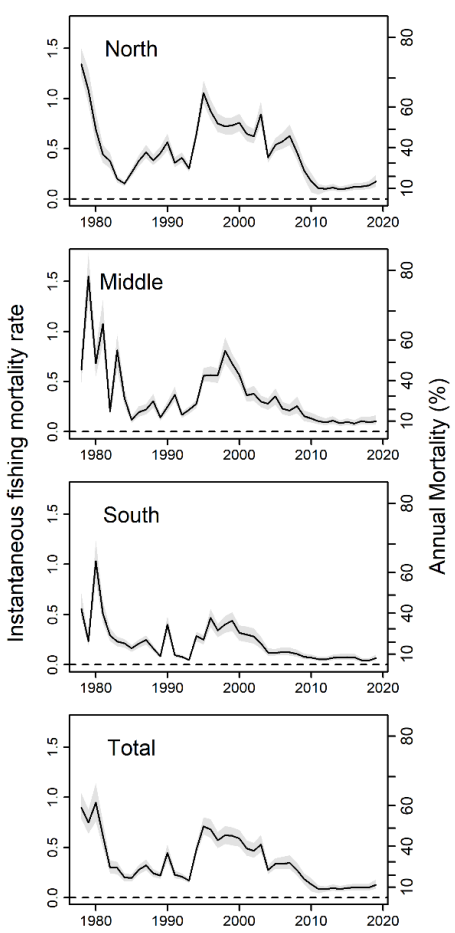
Decline in all regions and in total SSB

Decline since 2011

2018: 210,945 t

2019 : 174,049 t

Cautious Zone since 2017



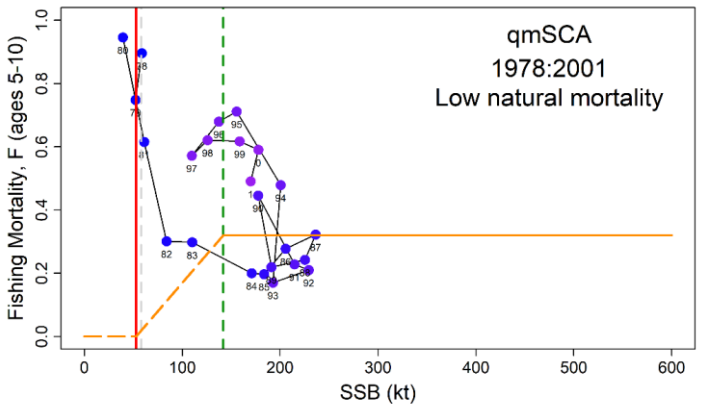
Fishing mortality

High in 1978-1980

High in late 1990s to early 2000s

2018 : 9.5%

2019 : 11.9%



Fishing mortality

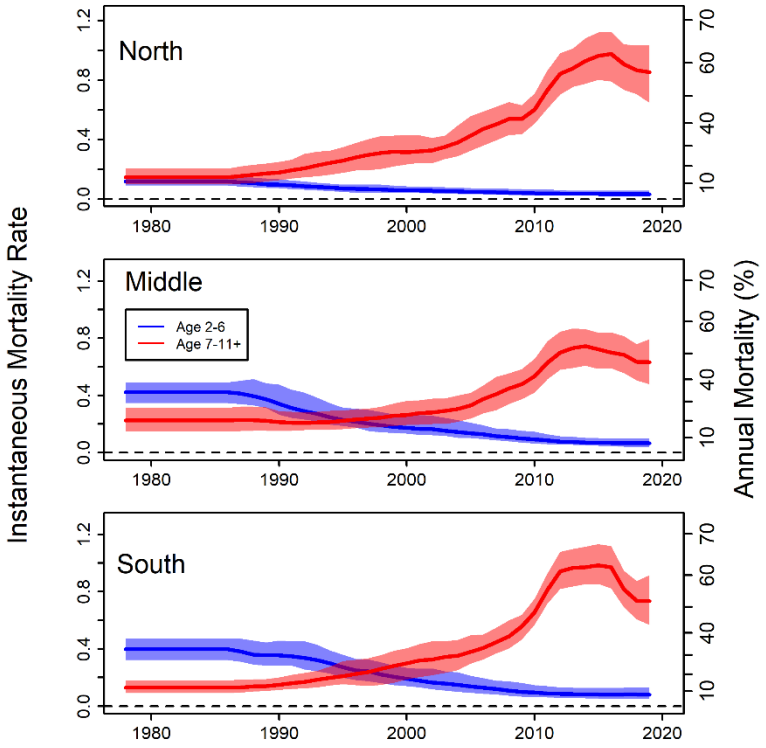
Exceed provisional Precautionary Approach removal reference:

19 of 42 years

2018 : Under the removal reference

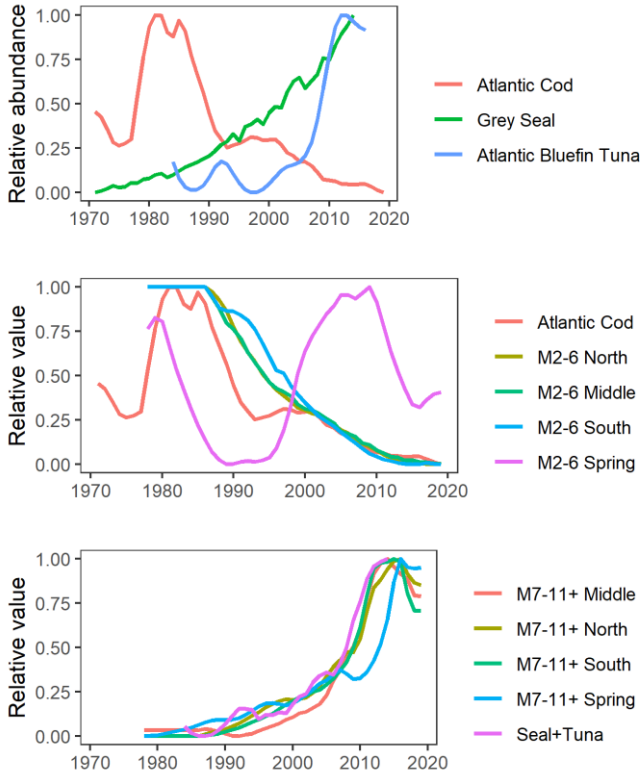
2019 : On the removal reference

*Revised for next assessment



Natural mortality

Predation from all sources
Ages 2 to 6: decrease
Ages 7 to 11+ : increase until mid-2010s
2019: 55%

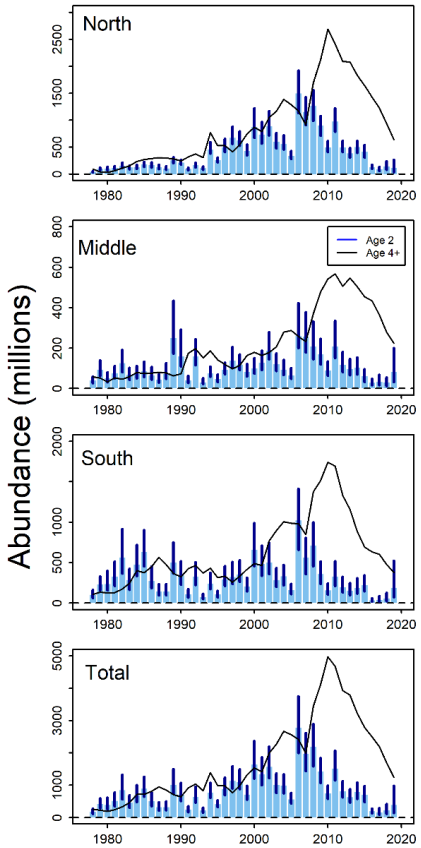


Natural mortality

Predation from all sources

Ages 2-6: simultaneous with decline in cod

Increase in natural mortality for ages 7 to 11+ simultaneous with increase in grey seal and bluefin tuna abundance



Recruitment

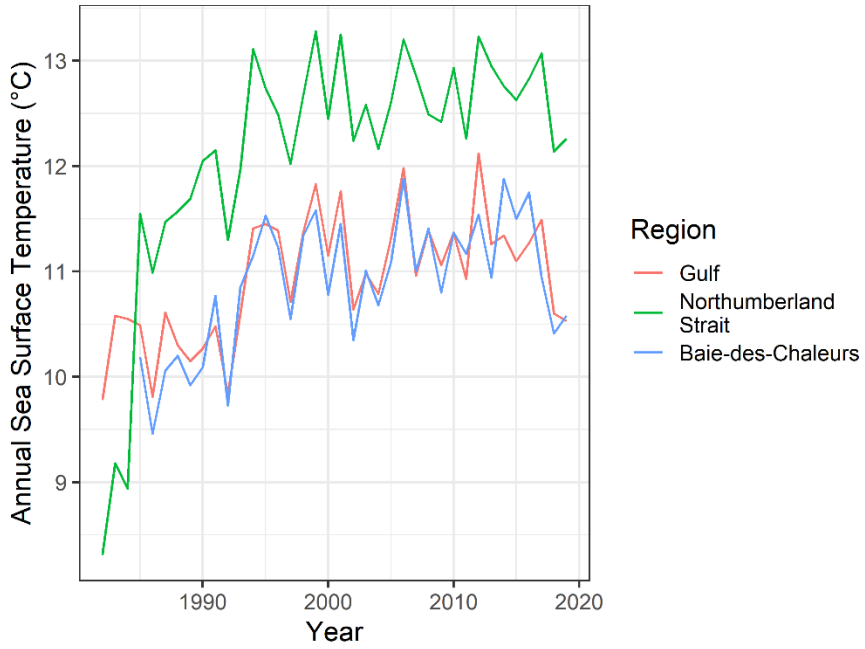
Highest in between 2000 and 2009

Decrease since 2005

Lowest in 2016 to 2018

Followed by a decline in 4+ fish

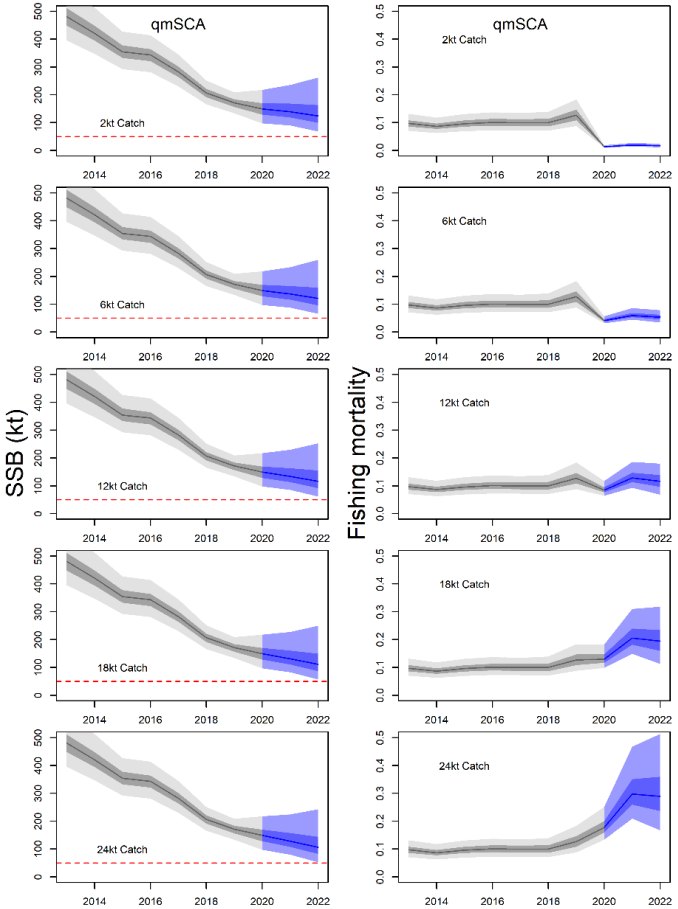
Recruitment



Good recruitment requires:
Warm water
Warm water zooplankton abundance

The Gulf is warming but the timing of the required abundance of zooplankton and herring larvae did not align in recent years

SSB Fishing mortality



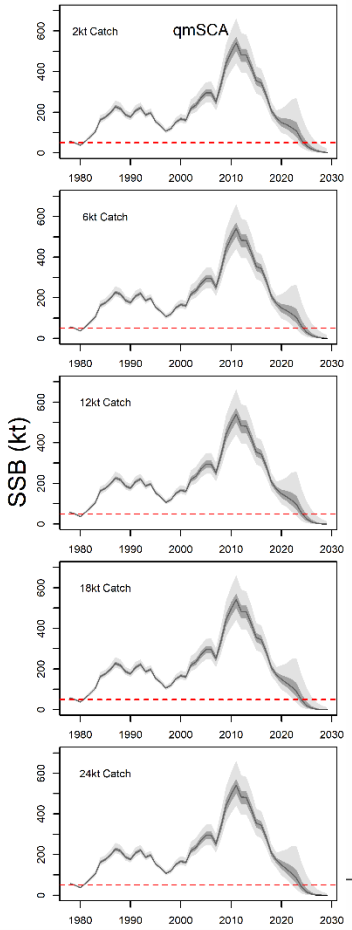
Projections

Cautious zone 2019 to 2022

SSB decrease at all catch options

12,000 tons catch: same fishing mortality

8,000 tons catch: decrease fishing mortality



Projections

Ten years SSB projections

Continuous decline 2020 to 2029

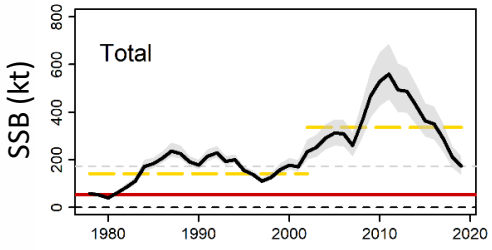
SSB decrease all catch options

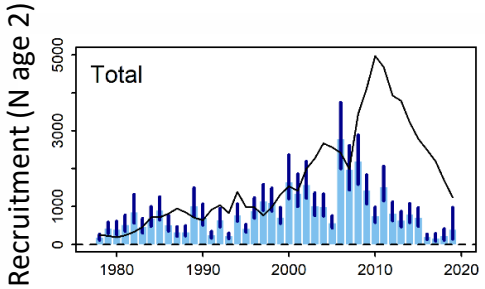
Critical Zone by 2025

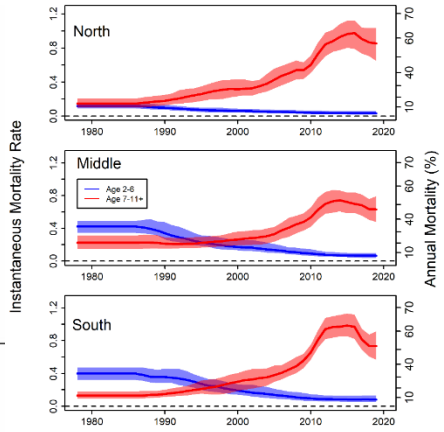
Table 1. Risk analysis table of annual catch options (between 2,000 and 24,000 tons) for 2020 and 2021 and subsequent years until 2028, with predicted resulting SSB (kt) in 2021, 2022 and 2029, resulting probabilities (%) of SSB being greater than the LRP, resulting probabilities of increases in SSB by 5%, and resulting fully-recruited fishing mortality rate (F_{5-10}) for the fall spawner component of Atlantic herring from the southern Gulf of St. Lawrence.

		Catch option (t)						
Stock characteristic	Year	2,000	4,000	8,000	12,000	16,000	20,000	24,000
SSB (kt)	2021	144.4	143.3	141.2	139.5	137.4	135.5	133.6
	2022	131.2	129.4	126.8	123.1	119.9	116.9	114.1
	2029	2.6	1.7	0.6	0.3	0.2	0.1	0.1
SSB > LRP	2021	100%	100%	100%	100%	100%	100%	100%
	2022	100%	100%	100%	100%	100%	100%	100%
	2029	0%	0%	0%	0%	0%	0%	0%
5% increase in SSB	2021	29%	27%	25%	23%	22%	19%	17%
	2022	29%	28%	28%	27%	25%	25%	23%
F_{5-10}	2020	0.01	0.03	0.06	0.08	0.11	0.14	0.18
	2021	0.02	0.04	0.08	0.13	0.18	0.24	0.30

2,000 tons catch options for 2020 and 2021 offers the best chance of increasing SSB by 2022. At all catch levels, it is unlikely (23% to 29%) that SSB will increase by 5% by 2022

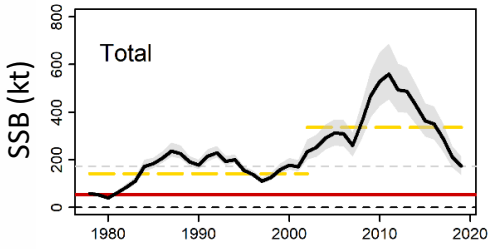


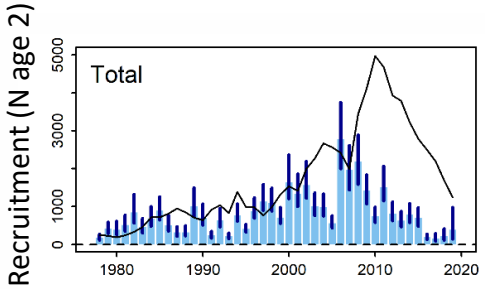


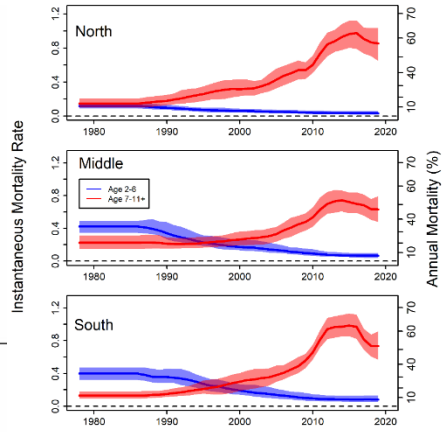


Summary

1. The assessment confirmed that the fall spawning herring stock component has been in the Cautious Zone of the Precautionary Approach (PA) framework since 2017.
2. SSB has been rapidly declining since 2011 while there continues to be a directed commercial fishery (gillnet and seiner).
3. In addition to fishing pressure the stock suffers from low recruitment, high natural mortality, declining weight-at-age, and continued environmental change.
4. Prospects for this stock to rebuild are uncertain. As the sGSL ecosystem is changing, the synchronicity of the required zooplankton abundance and quality with the timing of the release of herring larvae is unpredictable







Summary

5. Under current conditions, it is unlikely (23 to 29%) that fall herring biomass will increase in the short term (2021 and 2022) for all TAC options being considered.

6. Long term projections show SSB in the Critical Zone by 2025 and a predicted continuous decline until 2029.

7. The Precautionary Approach specifies that:

   - “In the Cautious Zone, fisheries management actions should promote stock rebuilding towards the Healthy zone. The removal rate should not exceed the Removal reference.”