Analysis of Northeast Atlantic Atlanto-Scandian herring: Estimate of time to reach Blim at current fishing pressure

Background

At the meeting on the 24th January 2024 the NAPA Steering Committee's requested an analysis of the Atlanto-Scandian herring (ASH) stock in relation to the predicted time to reach B_{lim}.

Definition: B_{lim} is defined:

- by ICES as the "*Limit reference point for spawning stock biomass (SSB)*"
- By the EU as "*the spawning stock biomass reference point provided for in the best available scientific advice, in particular by ICES or a similar independent scientific body recognised at Union or international level, below which there may be reduced reproductive capacity*"
- by Pew Fisheries Trust as "*Biomass limit reference points define the danger zone for a stock, the point beyond which its reproduction is at higher risk, and therefore a state that should be avoided.*".

Of the three stocks that are included within the NAPA FIPs, ASH is the one in the least satisfactory condition. ICES describes the ASH stock surveys as "fairly consistent in showing the stock slowly decreasing" with one year class only (year 7) significant in maintaining biomass in November 2023 at the NEAFC Annual Meeting. Current fishing exploitation rates are in excess of scientific advice by between 30% to 37%, 2020-2022.

Approach

ICES information extracted from the most recent report of the Working Group on Widely Distributed Stocks (WGWIDE), published in September 2023[1], provided the foundational data for this analysis in order to be consistent with the provision of scientific advice on ASH. These data were used to provide estimates of when the fishery falls below Blim based on F (fishing mortality rate) and future recruitment.

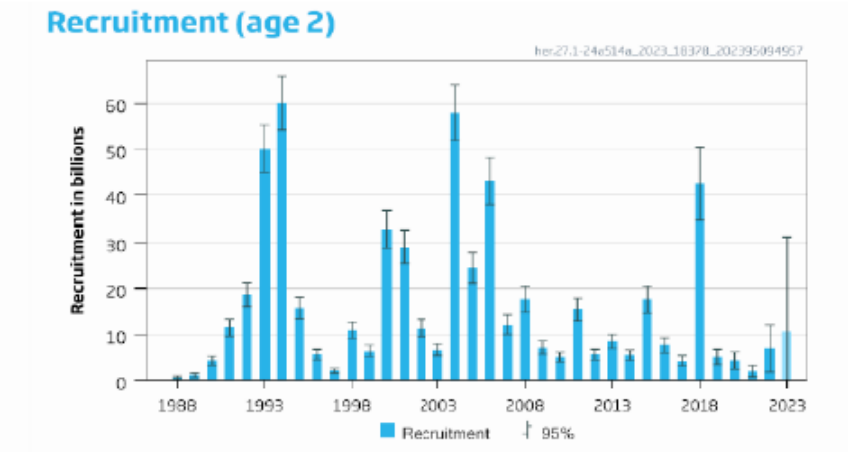
The model is built from ICES data and estimates for:

- Start number by year class
- Natural mortality
- Average weight by year class
- Proportion of mature fish by year class
- Relative vulnerability to fishing by year class
- Harvest rate by year class

[1] ICES. 2023. Working Group on Widely Distributed Stocks (WGWIDE). ICES Scientific Reports. 5:82. 980 pp. https://doi.org/10.17895/ices.pub.24025482

These figures were then sued for providing estimates for SSB in future years, taking into account differential impacts on year classes.

When and if B_{lim} is reached depends on the fishing mortality rate (F) and recruitment. The estimate for F from assumed 2023 catches in the 2023 report (0.186) exceeds F_{MSY} (0.157). Recruitment is variable, but sitting around 5 billion per annum (age 2):



ICES reviewed reference points for ASH in 2018 and set a B_{lim} of 2.5 million tonnes at that time. ICES reports SSB in September 2023 to be 3.059 million tonnes (below MSY $B_{trigger}$ of 3.184 million tonnes).

Results

Estimates for the year at which B_{lim} will be reached are presented as a function of different levels of F and recruitment. The impact of these factors was calculated over a wide range of values for both parameters:

	Average Recruitment								
2026	4,000	6,000	8,000	10,000	12,000	14,000	16,000	18,000	20,000
0.110	2028	2029	2031	0	0	0	0	0	0
0.115	2028	2028	2030	0	0	0	0	0	0
0.120	2027	2028	2029	0	0	0	0	0	0
0.125	2027	2028	2029	0	0	0	0	0	0
0.130	2027	2027	2028	2032	0	0	0	0	0
0.135	2027	2027	2028	2030	0	0	0	0	0
0.140	2027	2027	2027	2029	0	0	0	0	0
0.145	2027	2027	2027	2028	0	0	0	0	0
0.150	2027	2027	2027	2027	0	0	0	0	0
0.155	2027	2027	2027	2027	2030	0	0	0	0
0.160	2026	2026	2027	2027	2027	0	0	0	0
0.165	2026	2026	2026	2027	2027	0	0	0	0
0.170	2026	2026	2026	2026	2026	2027	0	0	0
0.175	2026	2026	2026	2026	2026	2026	0	0	0
0.180	2026	2026	2026	2026	2026	2026	2026	2026	0
0.185	2026	2026	2026	2026	2026	2026	2026	2026	2026
0.190	2026	2026	2026	2026	2026	2026	2026	2026	2026
0.195	2026	2026	2026	2026	2026	2026	2026	2026	2026
0.200	2026	2026	2026	2026	2026	2026	2026	2026	2026

With current F sitting at 0.186 and recruitment at 5,000 (billion) fish (based on the last 5 years, approximately), the estimate for the first year of reaching B_{lim} with ASH is 2026.

Going by the definitions above, B_{lim} is the point at which recruitment may be expected to be in decline, but this needs to be understood in the context of the high variability in recruitment. Should that recruitment change significantly, then there will be an impact on the estimates.

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