

# Atlantic Herring Rebuilding Strategies

## Herring Plan Development Team Report

Scientific and Statistical Committee meeting

March 26, 2021



New England  
Fishery Management Council

# SSC Terms of Reference (TORs)

## Review initial projections for Atlantic herring rebuilding plan

1. Two sets of projections with different assumptions about recruitment (“Average” (AVG) and autocorrelated recruitment (AR)).  
Are these projections technically sound and appropriate ways to evaluate the potential impacts? Do the projections capture the potential states of nature appropriately?
2. Two sets of projections to evaluate longer-term impacts (Either maintain the “same” control rule or “change” after resource is rebuilt).  
Are the projections technically sound based on the scenarios used?



# Initial projections for rebuilding plan (Doc. #1.2 – Herring PDT Memo)

- Herring declared overfished in October 2020 – 15 months to develop rebuilding plan (Final action before Jan 2022).
- Several meetings of PDT, AP, Cmte to develop action (Nov. – Mar.)
- Initial rebuilding strategies and projections

**Section 1.0** – Background

**Section 2.0** – A8 ABC control rule and recent projections

**Section 3.0** – Preliminary Committee input

**Section 4.0** – Initial PDT analysis

**Section 5.0** – SSC TORs

3 Attachments: Detailed results, Generation time methods, Autocorrelated recruitment methods



# Sec. 1.0 Background

- Most recent assessment of At. Herring completed in June 2020 – stock status changed to overfished, overfishing not occurring (**Doc. #1.4, Fig. 1**).
- Rebuilding plan requirements specified in Magnuson Act and National Standard 1 guidelines (**Doc. #1.5**).
- Rebuilding should be as short as possible and “shall not exceed ten years, except in cases where the biology of the stock” or some other considerations “dictate otherwise.”
- Rebuilding timeframe should consider:
  - status and biology of stock
  - needs of community
  - recommendations of international organizations
  - interactions with marine ecosystem



# Sec. 2.0 Amendment 8 ABC control rule (CR)

- Management Strategy Evaluation (MSE) process used to develop and analyze At. Herring CR options.
- Council approved a new CR in Dec. 2018, final rule effective Feb. 2021 (Fig. 2).
- Same CR used in 2019-present on short-term basis.
- Rational: it meets specific criteria; it explicitly accounts for the role of herring as forage in the ecosystem and uncertainty by limiting fishing mortality at 80% of  $F_{MSY}$ ; it balances the goals and objectives of the plan and is considered a compromise balancing forage uses, revenue for the directed fishery, and predator industries.
- Amendment 8 did consider what should happen if the stock becomes overfished; guidance states that if the linear decline in  $F$  is enough to meet rebuilding requirements, then the control rule should be adhered to.



# Sec. 3.0 Initial Committee Input

- Motions to include “ABC CR” and “7constant” in plan.
- Motions to consider “AVG” and “AR” recruitment.
- Evaluation of  $F=0$ , as required. Not an alternative in the rebuilding plan.
- Explore projections that use a different rule once stock is rebuilt, “SAME” compared to “CHANGE”.
- Discussion of Year 1 as 2022, 2-year bridge needed (2020-2021).



# Sec. 4.0 Initial PDT Analyses

1. Table of required rebuilding terms and definitions (Table 2, p.7)
2. Summary of PDT analyses and initial projections – pages 8-22
3. PDT findings – 5 summary comments (p. 23)



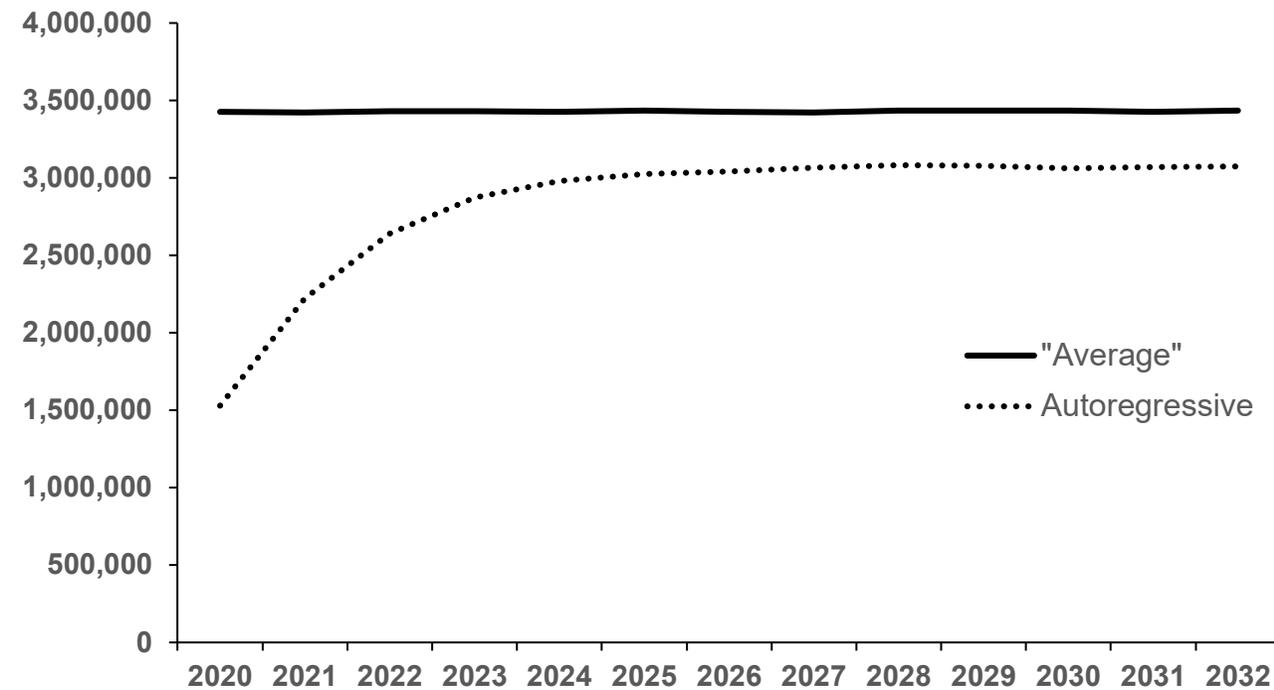
# Part 1: Table 2 – p.7

- From Assessment: MSY, Bmsy, Fmsy, overfished, MSST, overfishing, MFMT.
- Tmin: if  $F=0$ , At. herring stock estimated to be rebuilt in 4-5 years.
- Tmax: since Tmin is  $<10$  years, then Tmax = 10 years.
- Ttarget: short as possible with considerations (current range is 5-9 years).
- Generation time (G): age herring successfully spawn = 6 years (see A2).
- Frebuild: varies by alternative, defined by Ttarget selected in rebuilding plan.



# Part 2: PDT analyses to date

- How to address uncertainty about recruitment? Concern for several years (Fig. 3).
- Empirical dynamic modeling (EDM) not feasible at this time – may be possible to investigate further in 2022 assessment (NEFSC letter – Doc.#1.3).
- PDT explored autocorrelation instead. Annual recruitment depends on recruitment from previous year and some noise (Fig.4 on right).
- Statistically significant results (A2).
- *What does this mean?*  
Low recruitment projected in the short-term, and recruitment more “average” in the long term.



# Also, what happens after the stock is rebuilt?

- To help evaluate longer-term impacts of different rebuilding strategies the PDT developed projections that keep the rule the same for the entire time series (SAME) compared to projections that change the CR the year after the stock is projected to rebuild, in this case the rule reverts to the Amendment 8 ABC CR (CHANGE).



# Table 4 - Updated Projections – 10 runs!

Run	Alternative Name	Description
1	ABC_CR_AVG_SAME	Amendment 8 ABC CR - average recruitment - same rule throughout
2	ABC_CR_AR_SAME	Amendment 8 ABC CR - autocorrelated recruitment - same rule throughout
3	7Constant_AVG_SAME	Constant F based on 7 year rebuild - average recruitment - same rule throughout
4	7Constant_AR_SAME	Constant F based on 7 year rebuild - autocorrelated recruitment - same rule throughout
5	7Constant_AVG_CHANGE	Constant F based on 7 year rebuild - average recruitment - A8 CR after rebuilt
6	7Constant_AR_CHANGE	Constant F based on 7 year rebuild - autocorrelated recruitment - A8 CR after rebuilt
7	FZERO_AVG_SAME	F=0 - average recruitment - same rule throughout
8	FZERO_AR_SAME	F=0 - autocorrelated recruitment - same rule throughout
9	FZERO_AVG_CHANGE	F=0 - average recruitment - A8 CR after rebuilt
10	FZERO_AR_CHANGE	F=0 - autocorrelated recruitment - A8 CR after rebuilt



## Table 5 – Compares near and mid-term impacts (Year rebuilt - 50% Probability of Rebuilding)

Run	Projection name	Year Rebuilt	# of Years
★ 1	ABC_CR_AVG_SAME	2026	5
2	ABC_CR_AR_SAME	2030	9
3	7Constant_AVG_SAME	2028	7
4	7Constant_AR_SAME	2028	7
★ 5	7Constant_AVG_CHANGE	2028	7
6	7Constant_AR_CHANGE	2028	7
7	FZERO_AVG_SAME	2025	4
8	FZERO_AR_SAME	2026	5
9	FZERO_AVG_CHANGE	2025	4
10	FZERO_AR_CHANGE	2026	5

★ = Alternative in Rebuilding plan



# Summary of projection assumptions

- 2 Bridge Years – 2020 and 2021  
(2019 is final year of assessment, assume ABC fully harvested in both years)
- Year One – 2022
  - Note: action would not be effective on January 1, 2022, likely within the first quarter
- Recruitment – “Average” - use of full time-series; “autocorrelated” recruitment
- Rebuilding strategies – Alternative 1 – A8 ABC CR  
Alternative 2 – constant F (7 year rebuilt)  
F=0, not an alternative, for analysis
- Assumptions after stock rebuilt – “same” rule or “change” reverts to A8 ABC CR



# Preliminary Results

## ***Figures 5 - 12:***

- *Compare probability overfished, projected ABCs, projected fishing mortality, projected SSB, probability overfishing, projected OFLs, SSB/SSB<sub>msy</sub>, and probability of rebuilt resource.*

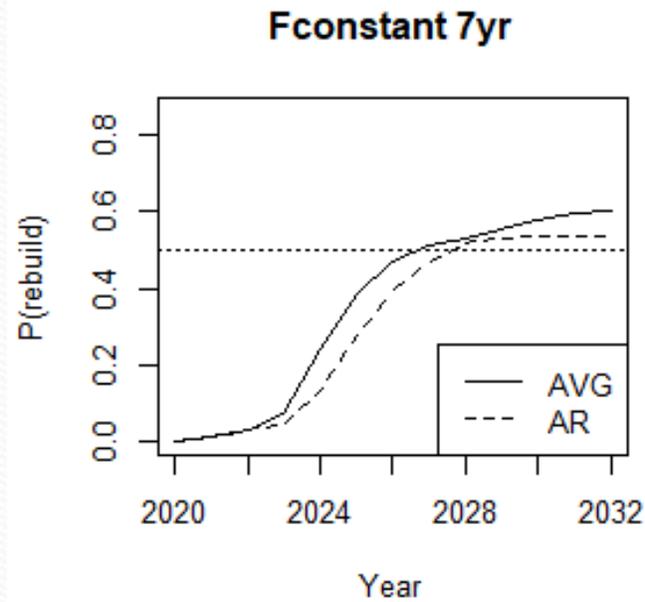
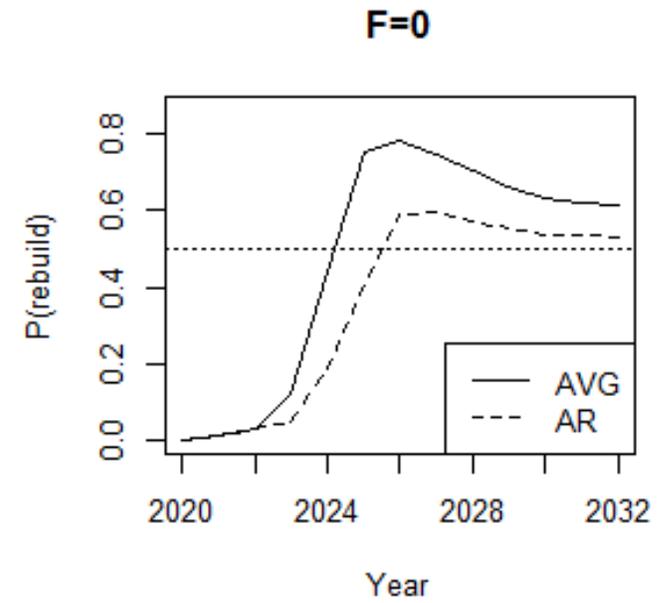
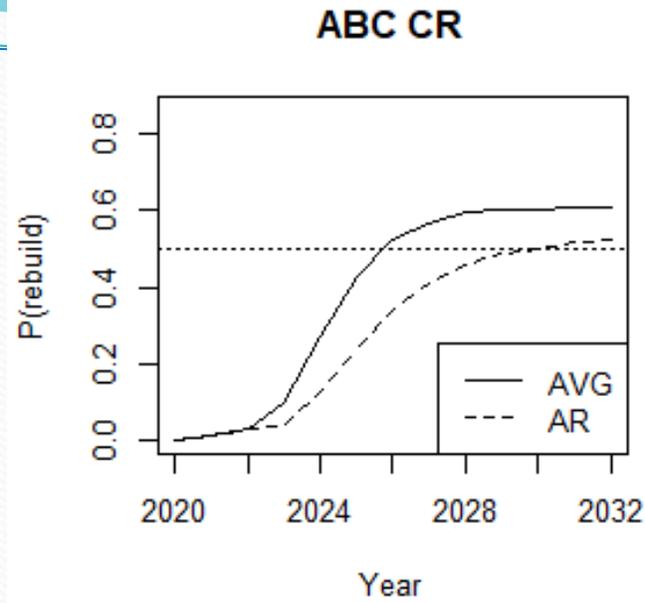
***Table 6 – Projected annual ABCs***

***Table 7 – Projected annual SSBs***

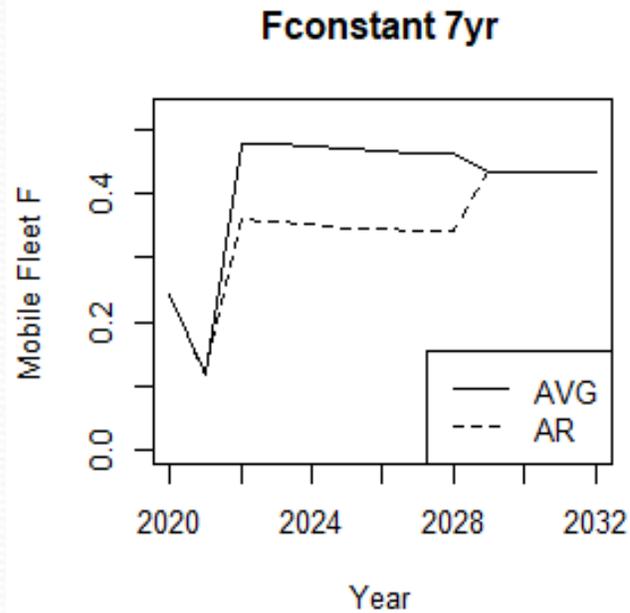
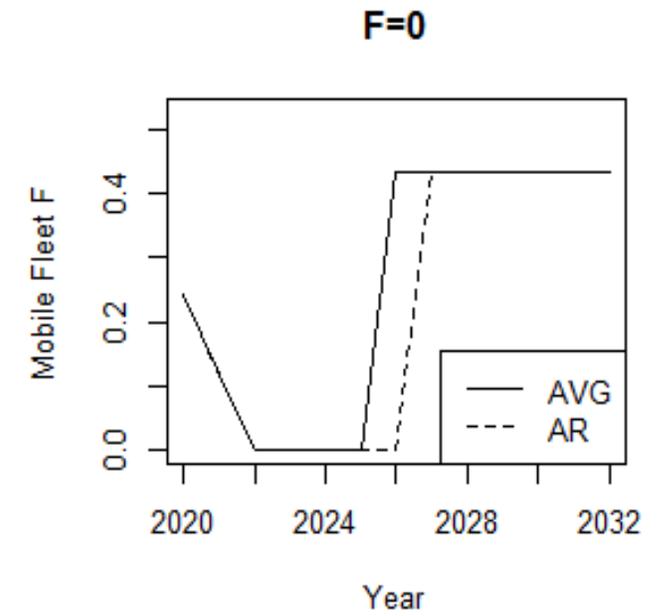
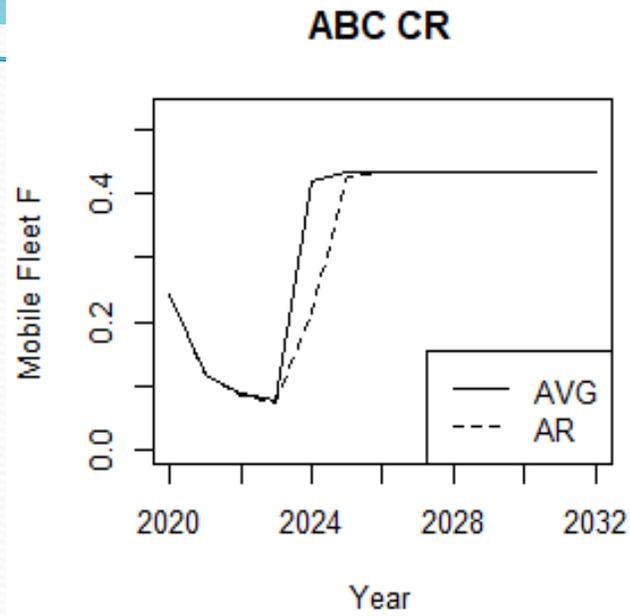
***Attachment 1 – detailed tables for each projection***



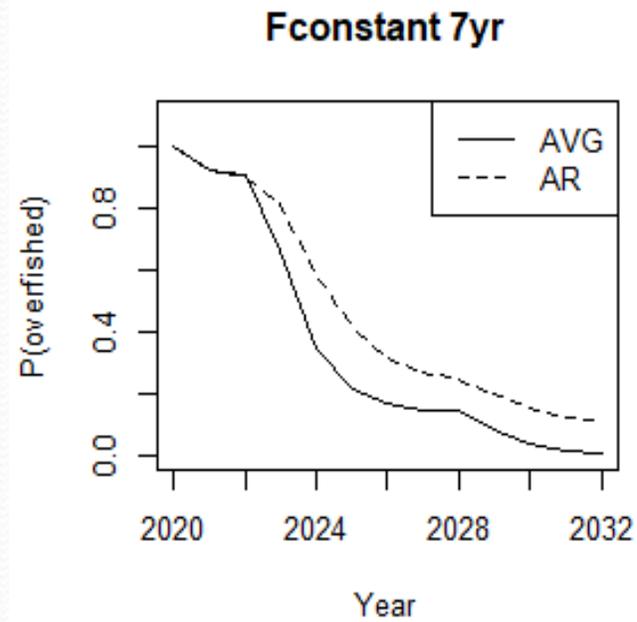
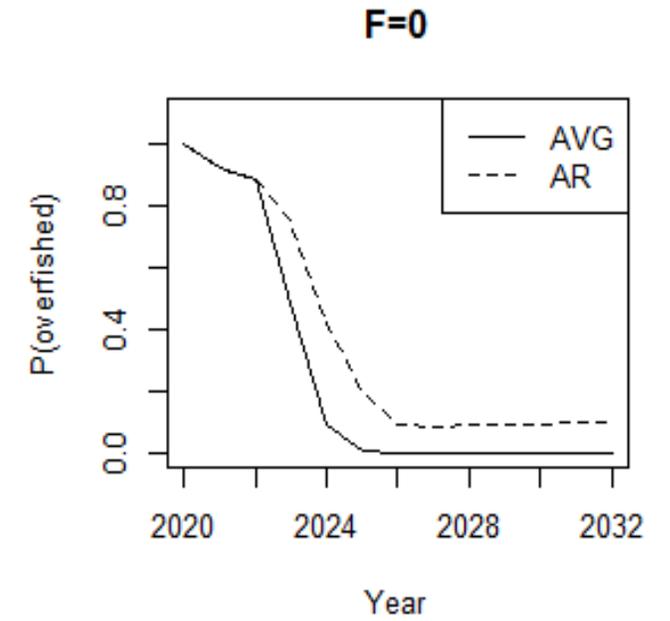
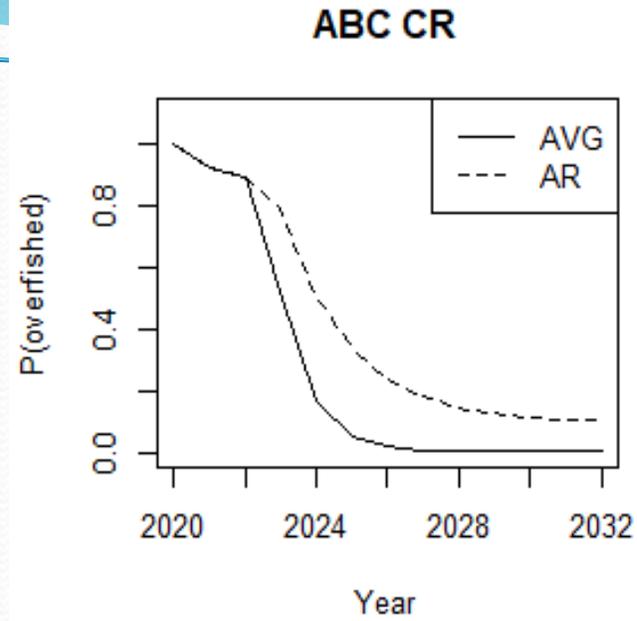
# Probability of Rebuilt Resource (Figure 12)



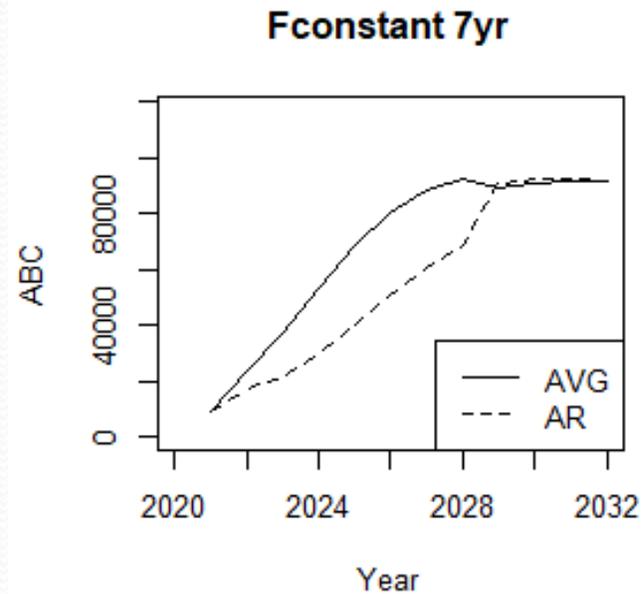
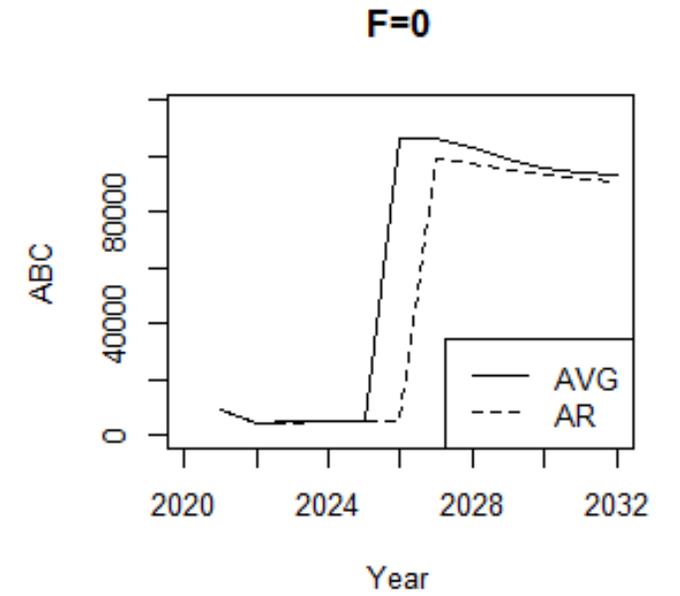
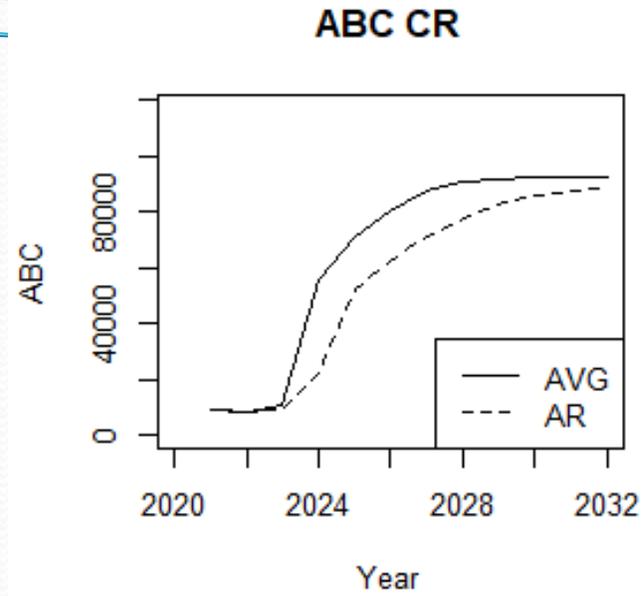
# Projected fishing mortality (F) (Figure 7)



# Probability stock is overfished (Figure 5)



# Projected ABCs (Figure 6 and Table 6)



# Part 3: PDT Findings – page 22

- 1. There is a statistically significant level of autocorrelation in the time series, and the PDT has more confidence in the AR projections than the AVG projections given recent trends of below average recruitment. The PDT believes the AR approach is less arbitrary and more justified than other approaches and supports including AR projections in this rebuilding action to help evaluate impacts. The PDT also supports investigation of different recruitment assumptions in the next herring assessment (2022).*
- 2. The PDT recommends that the harvest control rule adopted under Amendment 8 should be the default position for this rebuilding plan.*
- 3. By design the Amendment 8 biomass-based control rule uses a relatively risk-averse fishing mortality rate when stock size is low and increases fishing mortality up to 80% of  $F_{msy}$  when biomass is relatively high ( $>50\%$   $SSB_{msy}$  proxy).*
- 4. Amendment 8 considered the tradeoffs of various control rules using a detailed MSE process. The control rule was ultimately selected to meet specified objectives; therefore, if the Committee decides to recommend using a different control rule for this rebuilding plan very, strong rationale should be provided.*
- 5. The PDT has less confidence in the long-term projections (2028+); therefore, more attention should be given to the short and mid-term results.*



# Agenda for Today: SSC TORs

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