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MEMORANDUM

DATE: May 27, 2021

TO: Herring Committee

FROM: Herring Plan Development Team (PDT)

SUBJECT: **Additional rebuilding projections to evaluate risk and uncertainty related to future herring recruitment**

The PDT prepared this memo following SSC discussion of preliminary rebuilding plan projections developed for Atlantic herring. Additional sensitivity analyses have been completed to further evaluate the potential risk and uncertainty associated with future herring recruitment. The PDT reviewed these results via webinar on May 19, 2021 and developed a handful of PDT findings that summarize the results to support Committee development of a rebuilding plan for Atlantic herring.

Section 1.0 of this memo includes background information on the sensitivity analyses prepared to date, Section 2.0 includes the preliminary results, and Section 3.0 summarizes the high-level PDT findings related to these analyses. The PDT is seeking feedback from the AP and Committee on these additional analyses, are there specific suggestions for how the results should be summarized to support decision-making.

1.0 Background on updated rebuilding projections

During initial development of this rebuilding plan, the Herring Committee expressed concern that recruitment in the herring fishery has been well below average for the last seven year in a row. The Committee requested the PDT take this into account somehow in the analyses of rebuilding plan alternatives and evaluate what would happen if recruitment did not return to more average levels and remained low for the near term. The Committee specifically requested the PDT explore empirical dynamic modeling (EDM) if time permitted. For this tasking item, the PDT reviewed Munch et al. 2018 and concluded that it would not be feasible or appropriate for the PDT to incorporate EDM in this rebuilding plan. The goal of EDM is to improve forecasting of future biomass by leveraging patterns in the data. In the case of herring, using EDM would try to improve the prediction of recruitment, possibly by incorporating additional variables such as temperature and water quality. EDM appears to be a promising method, but its application to fisheries is new and therefore requires additional time to conduct thorough analyses and review.

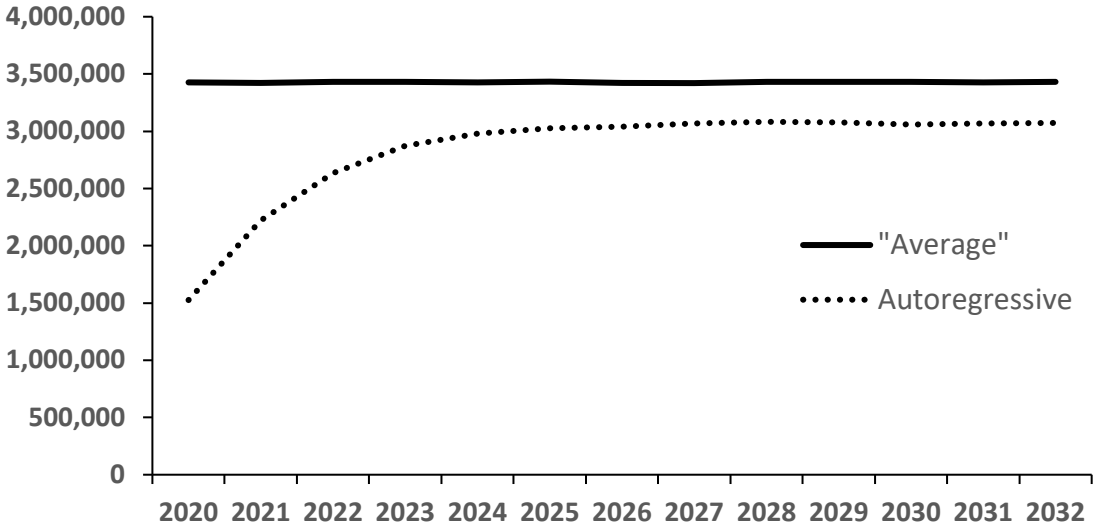
Instead, the PDT developed additional projections assuming recruitment is "autocorrelated". When using autoregressive (AR; or autocorrelated) recruitment, annual recruitment values depend on recruitment from the previous year and some random noise. The PDT prepared these additional projections to demonstrate the potential impacts of a slower return to near average recruitment levels, which is essentially the

assumption used in the projections included in the last herring assessment as well as the alternatives developed to date for the rebuilding plan (Framework 9). The degree of autocorrelation was estimated via linear regression between sequential recruitments, and the regression was found to be significant.

The short-term consequence of AR is that the projected recruitments in the near term will be more like the current state. For example, recruitment is currently low and so the projected recruitments will remain relatively low until the random noise aspect of the process produces improved recruitment. In the long-term, the AR process still reverts to a similar average level of recruitment as the "average recruitment" assumption, but it does so more slowly (Figure 1). The PDT discussed that this approach is likely superior to defining an ad-hoc "below average" recruitment series, or truncated number of years to define recruitment (i.e. most recent 5 or 10 years).

Assuming autocorrelation is one method to approximate continued lower recruitment as a short-term property of the stock, but the long-term properties of the stock are assumed to remain "average" in terms of recruitment. When the Atlantic herring management track assessment is updated in 2022 it is feasible that the long-term properties of the stock (i.e. recruitment assumptions) could be re-evaluated, potentially adjusting biological reference points. But for this rebuilding plan, the current reference points will be used, as updated in the 2020 management track assessment.

Figure 1 - Median recruitment values for the "average" (in bold) versus autoregressive (AR) recruitment (dashed line) used in projections (2020-2032).



The PDT presented initial rebuilding projections to the SSC on March 26, 2021 for review and feedback. Specifically, the SSC was requested to review both sets of projections developed using two different assumptions about recruitment, "average" and "autocorrelated" recruitment. The following paragraphs are taken from the SSC Report to the Council from that meeting. "The SSC felt that all the techniques being used in the rebuilding analyses prepared to date were both technically sound and appropriate, though some were more realistic than others, and some had more or less risk associated with them as described below. The SSC was also asked to comment on whether the suite of projections capture the potential states of nature appropriately. The SSC had commented in the past that the standard approach for using average recruitment from the entire time series could be a risky assumption that could lead to optimistic rebuilding of the population if average recruitment were not achieved during the rebuilding period. The

SSC felt that the autocorrelated recruitment method developed by the PDT was a good technique to better capture the short-term properties of recruitment, and therefore felt that this was a good addition to the recruitment assumptions for the projections.

While this method was a better method for capturing short-term recruitment trends, the SSC felt the longer-term recruitment trends were still uncertain. There are dynamics occurring that are not yet captured by the quantitative process that should continue to be explored as ways to define additional states of nature. There have been changes to copepod assemblages in the GOM, there is an interaction with the haddock population and herring recruitment, and other environmental covariates may also influence the herring population through recruitment. These all impact the possible states of nature and could be investigated further in the future, though the SSC recognizes these investigations are likely not viable for development in the current rebuilding plan. The SSC appreciated the PDT exploration of other modeling techniques such as empirical dynamic modeling as alternatives to the autocorrelation approach, and the SSC supports the continuation of these explorations into the next assessment process."

During the SSC discussion, one suggestion was made that an additional way to evaluate risk would be to develop additional projections that assume the original ABCs projected under one assumption of recruitment are caught, but later the other assumption of recruitment. For example, if ABC are calculated assuming average recruitment, but recruitment ends up being more similar to AR recruitment (lower than average in the near term), than harvesting the original ABC will take higher fishing mortality rates. In this example realized biomass would be lower than under original projections and if ABC remained the same, fishing mortality would increase higher than projections to attain the original ABC. In addition, the same approach could be applied in the reverse, realized biomass could be higher than assumed. In this case, if the same ABC is harvested using AR projections but biomass is higher than projected then lower fishing mortality rates would occur, and biomass would rebuild faster than the original AR projections. These additional projections were completed to help evaluate what could happen if the allocated catch is harvested (the full ABC in this case), but biomass is either higher or lower than anticipated. The PDT decided to explore this suggestion and reviewed preliminary results on the May 19, 2021 webinar.

For each alternative (ABC CR and 7year constant) there are now four projection runs to consider. The first run is the primary projection that informs the details of the rebuilding plan alternative, and the remaining three runs were prepared as sensitivity analyses to help evaluate the risk and uncertainty associated with future herring recruitment.

1. Assuming "average" recruitment
2. Assuming "autocorrelated" recruitment
3. Assuming ABC is caught based on AVG projection values, but later AR recruitment is realized
4. Assuming ABC is caught based on AR projection values, but later AVG recruitment is realized.

The "new" projections, runs 3 and 4 above, are included in Section 2.0 (Tables 2 and 4). The "original" projections, average and AR recruitment are included again as Tables 1 and 3 below. The year the stock is projected to rebuild under these various conditions is shaded; note that if ABCs are based on AVG recruitment, but AR recruitment occurs, and the full ABC is harvested the stock does not rebuild within ten years under either alternative (ABC CR or 7year constant).

2.0 Updated projection results

Table 1 – Projection results for ABC CR. TOP: Assuming average recruitment; BOTTOM: Assuming AR recruitment (the year with shading indicates the year the stock is projected to rebuild)

Year	Mobile Fleet F	SSB	P (overfishing)	P (overfished)	OFL	ABC	SSB/ SSBmsy	P (rebuild)	P (fishery closure)
2020	0.243	56375	0.002	0.999	–	–	0.21	0	0.005
2021	0.119	48760	0	0.918	23424	9483	0.181	0.017	0.066
2022	0.088	45876	0	0.893	26283	8722	0.171	0.031	0.115
2023	0.077	130736	0	0.521	44660	11036	0.486	0.097	0.001
2024	0.419	206057	0.29	0.174	69575	56070	0.766	0.274	0.000
2025	0.434	250790	0.323	0.06	85649	70950	0.932	0.428	0.000
2026	0.434	274581	0.321	0.024	97048	80407	1.021	0.525	0.000
2027	0.434	284774	0.321	0.014	105158	87217	1.059	0.569	0.000
2028	0.434	289764	0.322	0.01	108837	90302	1.077	0.594	0.000
2029	0.434	291899	0.321	0.009	110165	91422	1.085	0.603	0.000
2030	0.434	293070	0.321	0.008	110776	91942	1.089	0.605	0.000
2031	0.434	293119	0.321	0.008	110964	92089	1.09	0.609	0.000
2032	0.434	293798	0.322	0.008	111186	92298	1.092	0.61	0.000

Year	Mobile Fleet F	SSB	P (overfishing)	P (overfished)	OFL	ABC	SSB/ SSBmsy	P(rebuild)	P (fishery closure)
2020	0.243	56376	0.002	0.999	–	–	0.21	0	0.005
2021	0.119	48572	0	0.918	23348	9483	0.181	0.017	0.067
2022	0.087	45252	0	0.893	23339	8199	0.168	0.03	0.128
2023	0.074	79371	0	0.792	31968	8951	0.295	0.04	0.014
2024	0.212	132737	0.069	0.509	47185	22615	0.493	0.129	0.002
2025	0.427	173793	0.363	0.337	63615	52273	0.646	0.244	0.001
2026	0.434	207676	0.378	0.241	75170	62439	0.772	0.341	0.000
2027	0.434	233610	0.386	0.186	85729	71192	0.868	0.411	0.000
2028	0.434	251379	0.389	0.151	93883	77954	0.934	0.456	0.000
2029	0.434	262998	0.39	0.132	99498	82587	0.978	0.486	0.000
2030	0.434	270117	0.389	0.121	103185	85683	1.004	0.503	0.000
2031	0.434	275484	0.388	0.114	105624	87707	1.024	0.516	0.000
2032	0.434	278532	0.387	0.11	107027	88862	1.035	0.522	0.000

Table 2 – Projection results for ABC CR. TOP: Assuming ABC from average recruitment caught, but AR recruitment later realized; BOTTOM: Assuming ABC from AR recruitment caught, but AVG recruitment later realized (the year with shading indicates the year the stock is projected to rebuild).

	Mobile Fleet F	SSB	P (overfishing)	P (overfished)	OFL	ABC	SSB/ SSBmsy	P (rebuild)	P (fishery closure)
2020	0.243	56376	0.002	0.999	–	–	0.210	0.000	0.005
2021	0.119	48571	0.000	0.918	23350	9483	0.181	0.017	0.067
2022	0.101	44781	0.000	0.890	23376	8722	0.166	0.031	0.157
2023	0.112	77932	0.002	0.778	31931	11036	0.290	0.048	0.046
2024	0.673	109547	0.618	0.594	46880	56070	0.407	0.133	0.093
2025	0.716	134955	0.625	0.499	55818	70950	0.502	0.235	0.134
2026	0.700	158981	0.603	0.447	64141	80407	0.591	0.314	0.156
2027	0.669	179306	0.577	0.419	72024	87217	0.667	0.365	0.168
2028	0.627	196910	0.551	0.397	78697	90302	0.732	0.399	0.172
2029	0.581	213571	0.523	0.379	84631	91422	0.794	0.428	0.170
2030	0.542	230032	0.500	0.364	90315	91942	0.855	0.450	0.165
2031	0.509	243510	0.479	0.349	95279	92089	0.905	0.469	0.159
2032	0.487	254394	0.466	0.338	99132	92298	0.946	0.482	0.153

	Mobile Fleet F	SSB	P (overfishing)	P (overfished)	OFL	ABC	SSB/ SSBmsy	P (rebuild)	P (fishery closure)
2020	0.243	56377	0.002	0.999	–	–	0.210	0.000	0.005
2021	0.119	48761	0.000	0.918	23418	9483	0.181	0.017	0.066
2022	0.076	46136	0.000	0.887	26269	8199	0.172	0.031	0.126
2023	0.051	132487	0.000	0.511	44905	8951	0.493	0.113	0.004
2024	0.135	232861	0.002	0.146	70498	22615	0.866	0.386	0.000
2025	0.269	298075	0.060	0.062	94921	52273	1.108	0.589	0.000
2026	0.276	335153	0.069	0.041	111142	62439	1.246	0.683	0.000
2027	0.283	352127	0.081	0.036	123796	71192	1.309	0.722	0.000
2028	0.296	359968	0.099	0.037	130381	77954	1.338	0.735	0.001
2029	0.311	359495	0.120	0.040	132257	82587	1.336	0.730	0.001
2030	0.325	355845	0.142	0.045	131899	85683	1.323	0.721	0.001
2031	0.338	349852	0.164	0.051	130599	87707	1.301	0.706	0.002
2032	0.348	344361	0.184	0.057	128931	88862	1.280	0.692	0.003

Table 3 – Projection results for 7constant same rule throughout. TOP: Assuming average recruitment; BOTTOM: Assuming AR recruitment (the year with shading indicates the year the stock is projected to rebuild)

Year	Mobile Fleet F	SSB	P (overfishing)	P (overfished)	OFL	ABC	SSB/ SSBmsy	P (rebuild)	P (fishery closure)
2020	0.243	56375	0.002	0.999	–	–	0.21	0	0.005
2021	0.119	48760	0	0.918	23424	9483	0.181	0.017	0.066
2022	0.478	36837	0.389	0.918	26283	24035	0.137	0.017	0.327
2023	0.478	102719	0.407	0.698	40546	36672	0.382	0.033	0.058
2024	0.478	172560	0.402	0.287	59278	53361	0.641	0.157	0.020
2025	0.478	222353	0.395	0.105	76272	68565	0.827	0.311	0.014
2026	0.478	251118	0.389	0.045	88984	79978	0.934	0.42	0.012
2027	0.478	265059	0.386	0.025	97967	88112	0.985	0.482	0.013
2028	0.478	271805	0.387	0.018	102626	92327	1.01	0.513	0.014
2029	0.478	274762	0.386	0.016	104587	94104	1.021	0.526	0.002
2030	0.478	276441	0.388	0.015	105495	94932	1.028	0.533	0.000
2031	0.478	276772	0.386	0.014	105807	95203	1.029	0.535	0.000
2032	0.478	277428	0.388	0.014	106098	95453	1.031	0.538	0.000

Year	Mobile Fleet F	SSB	P (overfishing)	P (overfished)	OFL	ABC	SSB/ SSBmsy	P(rebuild)	P (fishery closure)
2020	0.243	56376	0.002	0.999	–	–	0.21	0	0.005
2021	0.119	48572	0	0.918	23348	9483	0.181	0.017	0.067
2022	0.36	38735	0.181	0.913	23339	17771	0.144	0.024	0.290
2023	0.36	63696	0.258	0.866	29252	21711	0.237	0.018	0.145
2024	0.36	109404	0.288	0.628	41208	29864	0.407	0.081	0.084
2025	0.36	159163	0.295	0.395	56112	40162	0.592	0.21	0.066
2026	0.36	206061	0.3	0.25	71247	50644	0.766	0.34	0.060
2027	0.36	243174	0.308	0.171	85550	60663	0.904	0.437	0.061
2028	0.36	268946	0.314	0.127	96933	68717	1	0.5	0.065
2029	0.36	286322	0.317	0.103	105064	74476	1.064	0.54	0.030
2030	0.36	297100	0.32	0.089	110667	78502	1.104	0.565	0.005
2031	0.36	304849	0.322	0.081	114244	81027	1.133	0.582	0.001
2032	0.36	308766	0.322	0.076	116417	82531	1.148	0.592	0.000

Table 4 – Projection results for 7constant same rule throughout. TOP: Assuming ABC from average recruitment caught but AR recruitment later realized; BOTTOM: Assuming BAC from AR recruitment caught but AVG recruitment later realized (the year with shading indicates the year the stock is projected to rebuild).

	Mobile Fleet F	SSB	P (overfishing)	P (overfished)	OFL	ABC	SSB/ SSBmsy	P (rebuild)	P (fishery closure)
2020	0.243	56376	0.002	0.999	–	–	0.210	0.000	0.005
2021	0.119	48571	0.000	0.918	23350	9483	0.181	0.017	0.067
2022	0.565	34231	0.532	0.903	23376	24035	0.127	0.030	0.375
2023	0.780	50339	0.678	0.848	27788	36672	0.187	0.035	0.279
2024	0.849	80753	0.690	0.685	36972	53361	0.300	0.104	0.220
2025	0.838	110531	0.670	0.563	47563	68565	0.411	0.205	0.209
2026	0.796	138085	0.639	0.492	57341	79978	0.513	0.286	0.203
2027	0.752	160712	0.612	0.454	66033	88112	0.597	0.342	0.201
2028	0.700	179559	0.585	0.427	73344	92327	0.668	0.378	0.198
2029	0.648	196777	0.556	0.405	79640	94104	0.732	0.408	0.193
2030	0.602	213421	0.533	0.388	85388	94932	0.793	0.430	0.186
2031	0.563	227269	0.512	0.373	90373	95203	0.845	0.449	0.178
2032	0.538	238016	0.497	0.360	94245	95453	0.885	0.462	0.171

	Mobile Fleet F	SSB	P (overfishing)	P (overfished)	OFL	ABC	SSB/ SSBmsy	P (rebuild)	P (fishery closure)
2020	0.243	56377	0.002	0.999	–	–	0.210	0.000	0.005
2021	0.119	48761	0.000	0.918	23418	9483	0.181	0.017	0.066
2022	0.308	40213	0.087	0.897	26269	17771	0.149	0.031	0.252
2023	0.230	116882	0.051	0.596	42339	21711	0.435	0.092	0.024
2024	0.211	209572	0.038	0.219	65033	29864	0.779	0.319	0.003
2025	0.215	284862	0.034	0.083	88089	40162	1.059	0.548	0.001
2026	0.224	335690	0.034	0.041	107909	50644	1.248	0.684	0.000
2027	0.234	363357	0.039	0.028	124150	60663	1.351	0.751	0.000
2028	0.248	378367	0.048	0.024	133929	68717	1.407	0.779	0.000
2029	0.262	382526	0.059	0.025	138152	74476	1.422	0.785	0.000
2030	0.276	381124	0.073	0.026	139193	78502	1.417	0.780	0.001
2031	0.288	376556	0.087	0.030	138599	81027	1.400	0.769	0.001
2032	0.297	371616	0.100	0.033	137340	82531	1.381	0.758	0.001

3.0 PDT Findings

The PDT reviewed these projections via webinar on May 19, 2021. The PDT plans to include these additional runs in Framework 9 to help characterize the risk and uncertainty of the rebuilding plan alternatives. Initial discussion points are summarized here; the AP and Committee are asked to provide specific suggestions for how these results should be summarized to support decision-making for this rebuilding plan.

1. Projections for rebuilding plan alternative vs. sensitivity runs

The rebuilding plan needs to be clear about distinguishing between rebuilding plan alternatives and sensitivity runs. So far, there are two rebuilding plan alternatives (ABC CR and constant F for 7 years) in this action, and they use the same projection assumptions as the last assessment (e.g., average recruitment). The fishing mortality rates produced from the projections using the same assumptions as the last assessment ("base-case") are the Frebuild values that would be used in the rebuilding plan. The PDT also created a handful of sensitivity runs that modify assumptions about recruitment to evaluate uncertainty (e.g., autocorrelated recruitment).

The PDT discussed that the assessment process is the more appropriate place to evaluate long-term recruitment assumptions because it is primarily a scientific question, versus adjusting these assumptions during development of a rebuilding plan. However, including additional runs that evaluate different states of nature can be informative to evaluate risk and uncertainty; therefore, including them in the analyses is beneficial. However, the document needs to be clear that these are not separate alternatives that can be chosen in this action.

The PDT plans to investigate whether the flexibility is any different in a rebuilding plan versus a regular specifications process in terms of selecting an ABC that is different than the ABC produced by the rebuilding fishing mortality produced by the base-case projection for the proposed alternative. Specifically, could the SSC and/or Council recommend a different ABC incorporating the sensitivity runs? Furthermore, can the fishing mortality rate produced by the average recruitment (base case) projection be used to set specifications, but can the rebuilding timeframe (number of years it takes to rebuild the resource) be adjusted to account for risk in the projections? Specifically, can the fishing mortality rates be used to set ABC, but if the average recruitment projection estimates the stock can rebuild in seven years, could the Council set the rebuilding timeframe higher (e.g. ten years) to account for uncertainty in the projections? The PDT will investigate these issues further as this action develops.

2. Probability of fishery closure and risks of low biomass

The PDT discussed that it would be informative to include another metric for probability of fishery closure. The Amendment 8 ABC control rule sets ABC equal to zero (fishery closure) when biomass is estimated to be less than 10% of SSB_{MSY}. For some of the projections that ratio is very close to 10%, especially when recruitment is autocorrelated (low recruitment in the near term). If recruitment does not improve the higher F strategy (7yr constant) has higher risks of closing the fishery (>37% in one case) in terms of closing the fishery due to biomass falling below 10% SSB_{MSY}.

In addition, there is fairly strong evidence that several herring populations are subject to Allee effects[1]; the productivity (per-capita recruitment) of the populations becomes reduced at low stock size. Several papers suggest that a goal of management should be to avoid very low stock sizes. There are risks that Atlantic herring recruitment may remain poor in the near term, but it is also possible that the adults that do spawn will not be as productive, causing further depletion, an outcome not included in the current projections and sensitivity runs for Framework 9.

3. Stock does not rebuild in 10 years for some scenarios under lower recruitment

For both alternatives (ABC CR and 7year constant), when ABC is defined assuming average recruitment, but AR recruitment is realized, the stock will not rebuild within ten years (See Tables 2 and 4). This should be considered when developing a rebuilding plan. It is important to recognize that even if fishing mortality is kept very low, the stock may not rebuild as scheduled unless recruitment improves.

4. Consideration of risk

There appears to be little risk in assuming AR recruitment, even if there is an unlikely immediate return to more average levels of recruitment. In fact, that scenario (AR in AVG runs) results in the fastest rebuilding and least amount of SSB depletion. In contrast, there is a large risk in expecting AVG recruitment because if that is not achieved the stock will likely not rebuild in ten years and end up taking SSB to its lowest historical point. Because herring is an important prey species in the region ecosystem considerations should be taken into consideration as well when developing rebuilding plan alternatives.

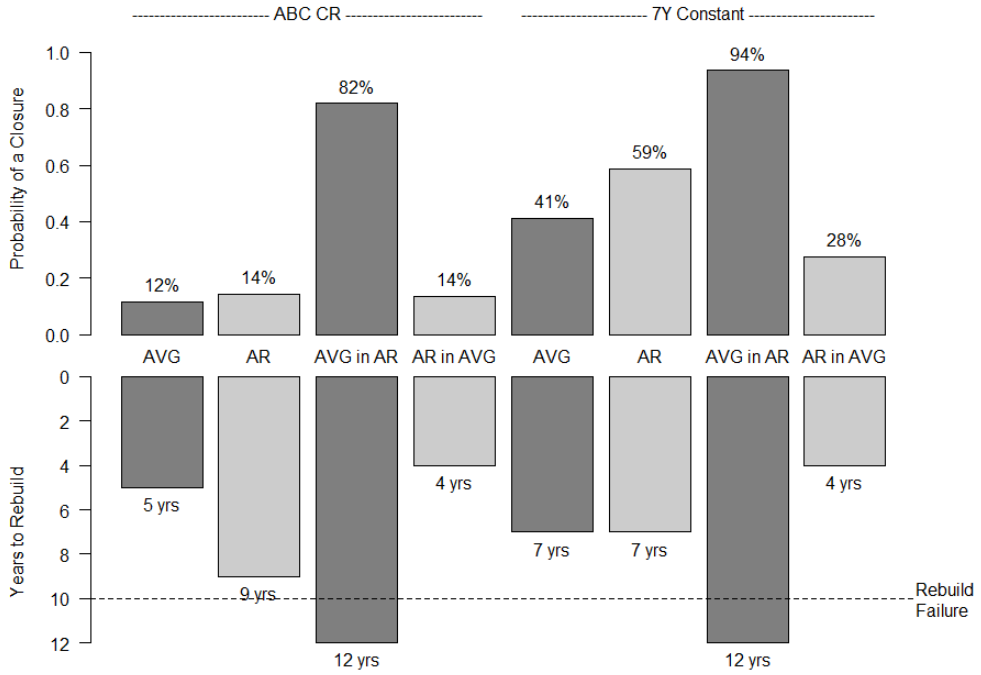
5. Presentation of results

The PDT discussed how these results should be presented in the rebuilding plan. As this document moves forward there will be an opportunity to explore different tables and figures displaying the results. The PDT has included several examples below and is looking for input from the Committee; are these approaches useful, specific suggestions to consider?

The PDT explored bar charts to compare performance of two metrics at once across all runs. Higher bars indicate "poor" performance and results closer to zero (shorter bars) suggest more desirable performance. Figure 2 below compares probability of a fishery closure (ABC=0) at least once during the next 10 years, and number of years it takes the stock to rebuild. Darker bars are results for scenarios that would implement a rebuilding plan based on average recruitment (AVG), and lighter bars represent the results for runs that assume AR recruitment. This figure summarizes the two primary risks embedded in these options: 1) a constant fishing mortality rate results in a much higher probability of a closure, and 2) if management assumes recruitment will be average and it is not (AVG in AR runs) the fishery is very likely to close regardless of the rebuilding plan selected.

[1] For more information see references attached to this memo.

Figure 2 – Bar chart comparing performance of rebuilding plan alternatives (ABC CR and 7Y constant) for probability of a fishery closure (top bars) and number of years it takes the resource to rebuild (bottom bars)



The PDT also explored developing radar plots to present the tradeoffs between rebuilding and short-term ABC. Figure 2 below compares the results for several metrics at once for both alternatives (ABC CR in blue and 7yr constant in red). For these figures the farther out the results are from the center indicates "good" performance and results closer to the center are less desirable. In summary, these plots show that allocating higher ABCs in the near term has higher risks of a fishery closure (ABC=0). The radar plots also show that both options have similar total catch over the next 10 years. Finally, there are summary tables that can be developed to compare results as well. The PDT has included one example that compares the near-term results (FY2022) and mid-term results (FY2026) across several metrics (Table 5).

Figure 3 – Draft radar plot comparing two rebuilding alternatives (ABC CR in blue and 7yr constant in red) across several metrics (number of years for rebuilt, lowest ABC over the next 12 years, sum of ABCs over the next 12 years, probability of fishery closure ABC=0)

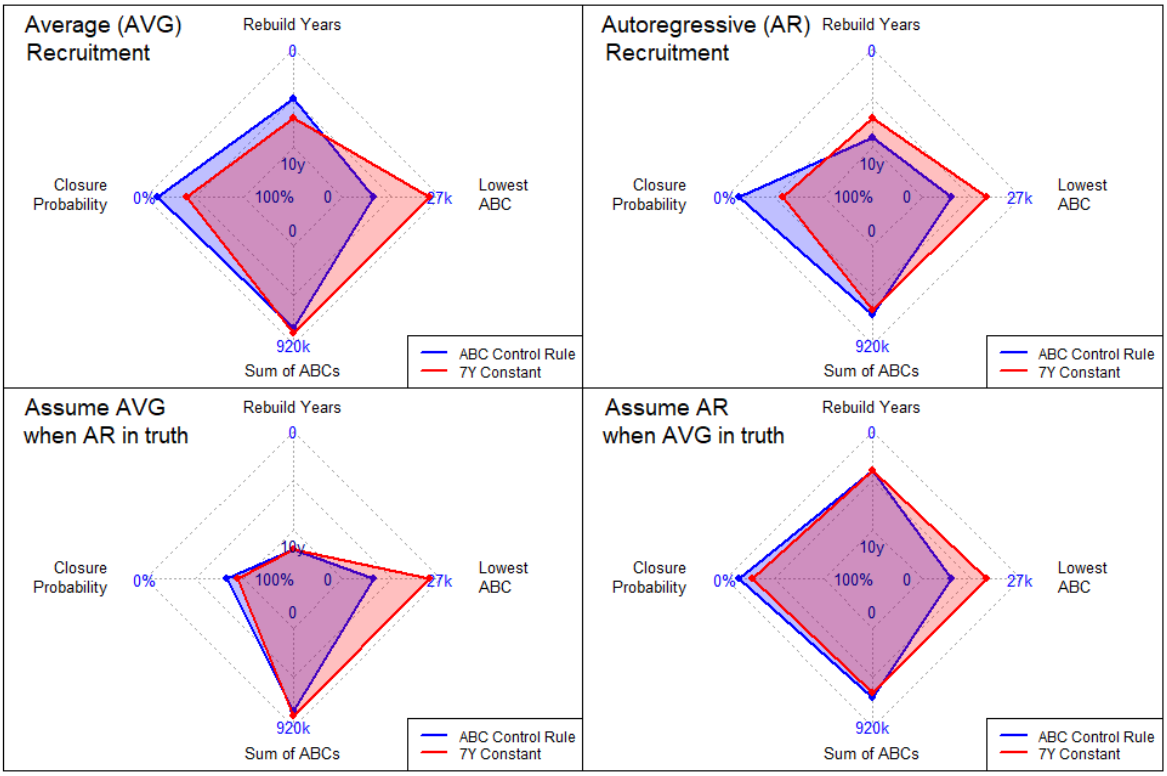


Table 5 - Example of summary table that can be produced to compare alternatives

		F 2022	F 2026	P ofd 2022	P ofd 2026	ABC 2022	ABC 2026	P reb 2022	P reb 2026	Year reb
Alt. 2	AVG	0.09	0.43	89%	2%	8,722	80,407	3%	53%	2026
	AR	0.09	0.43	89%	2%	8,199	62,439	3%	34%	2030
	AVG in AR	*0.10*	*0.70*	*89%*	*45%*	*8,722*	*80,407*	*3%*	*31%*	*2032 +*
	AR in AVG	*0.08*	*0.28*	*89%*	*4%*	*8,199*	*62,439*	*3%*	*68%*	*2025*
Alt. 3	AVG	0.48	0.48	92%	5%	24,035	79,978	2%	42%	2028
	AR	0.36	0.36	92%	25%	17,771	50,644	2%	34%	2028
	AVG in AR	*0.57*	*0.80*	*90%*	*50%*	*24,035*	*79,978*	*3%*	*29%*	*2032 +*
	AR in AVG	*0.31*	*0.22*	*90%*	*3%*	*17,771*	*50,644*	*3%*	*68%*	*2025*

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