Red Snapper Projections part three

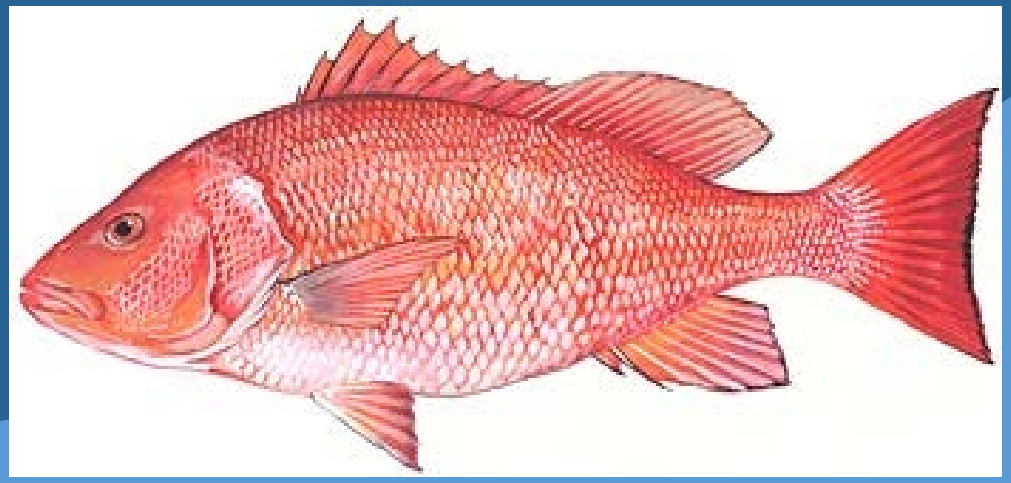
NOAA FISHERIES

Sustainable Fisheries Branch

Beaufort, NC

SSC meeting

October 2016



Request 1

"For management benchmarks of F_{max} and $F_{20\%}$, provide the associated fishing mortality rate and MSST, as well as equilibrium stock biomass, spawning stock biomass proxy (expressed in egg production as used in the SEDAR 41 assessment) and yield in pounds and numbers. For F_{max}, also provide the associated %SPR."

Results:

- F_{max} is 0.217
- $F_{20\%}$ is 0.212
- F_{max} corresponds to $F_{19.5\%SPR}$
- A new set of management benchmarks is provided using F_{max} and $F_{20\%}$:

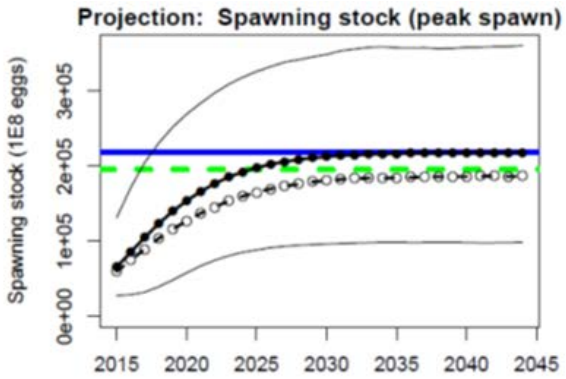
	MSST	SSB(1E8)	B (mt)	R(num)	L.klb	L.knum	D.klb	D.knum
F_{max}	159318	212424	2858.006	446465	446.214	36.539	391.831	63.701
$F_{20\%}$	163684	218245	2899.811	446276	446.27	36.336	388.766	62.75

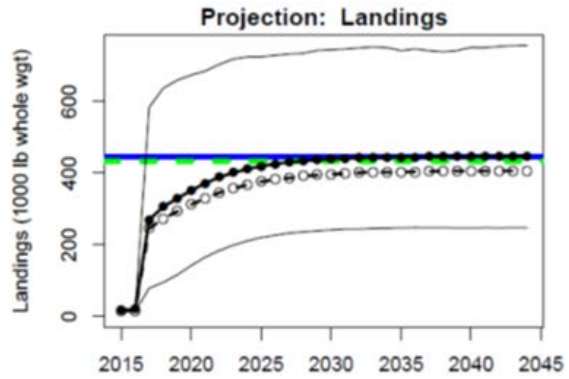
Request 2

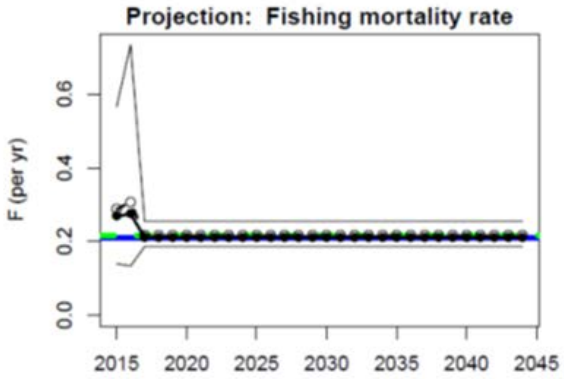
"Provide projections to 2044 (the end of the rebuilding period) based on fixed fishing mortality at F_{max} and $F_{20\%SPR}$. Include the full suite of projection outputs as provided for SEDAR 41 projections."

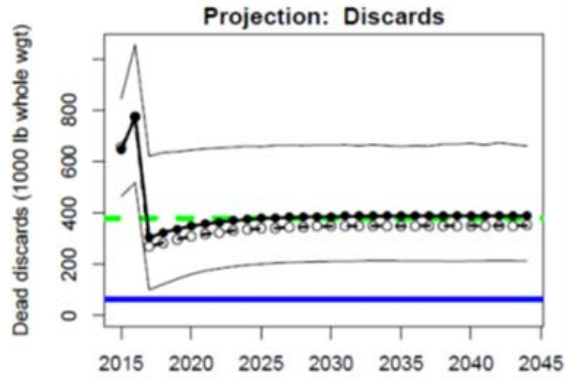
Results:

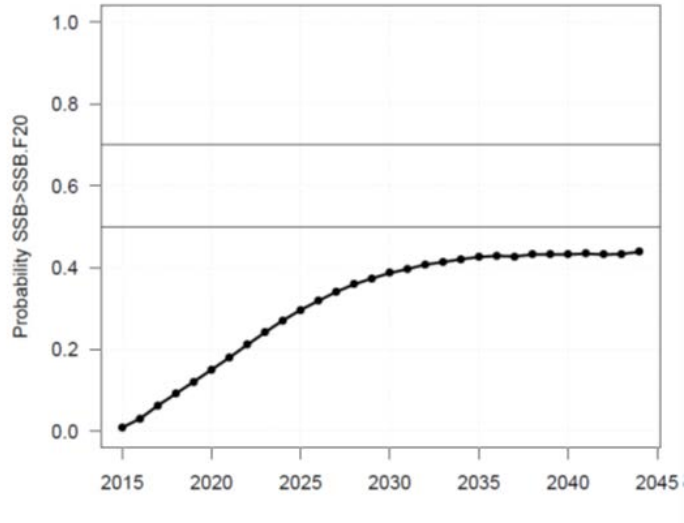
- Management was assumed to begin in 2017 and the projection methodology is identical to that which was used for projections based on $F_{30\%}$.
- Both projection scenarios show that the stock does not rebuild with 50% probability by 2044.

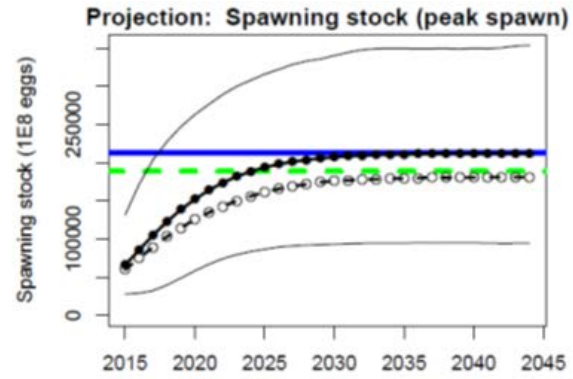

Projection: Spawning stock (peak spawn)
Spawning stock (1E8 eggs)
0e+00
1e+05
2e+05
3e+05
2015
2020
2025
2030
2035
2040
2045

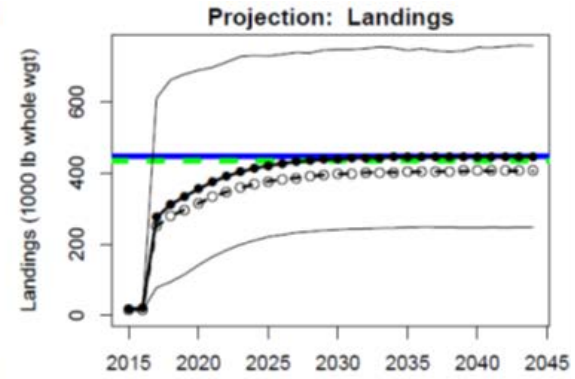

Projection: Landings
Landings (1000 lb whole wgt)
0
200
400
600
2015
2020
2025
2030
2035
2040
2045

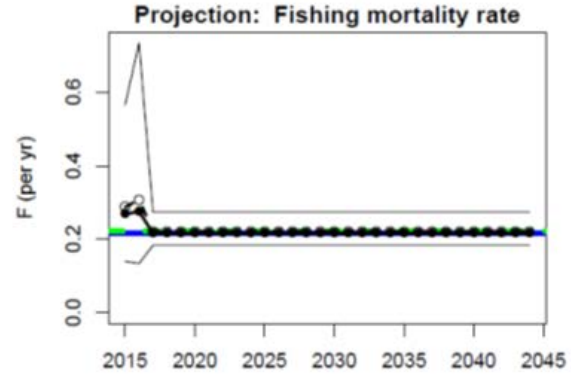

Projection: Fishing mortality rate
F (per yr)
0.0
0.2
0.4
0.6
2015
2020
2025
2030
2035
2040
2045

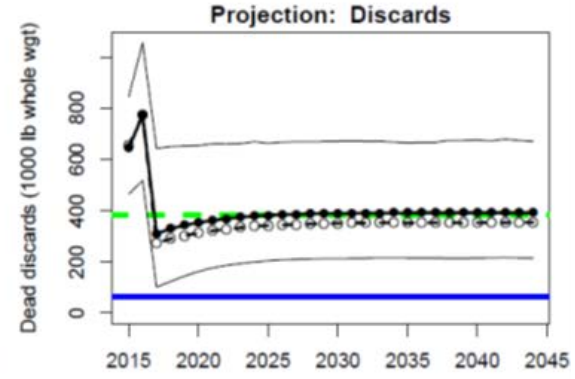

Projection: Discards
Dead discards (1000 lb whole wgt)
0
200
400
600
800
2015
2020
2025
2030
2035
2040
2045

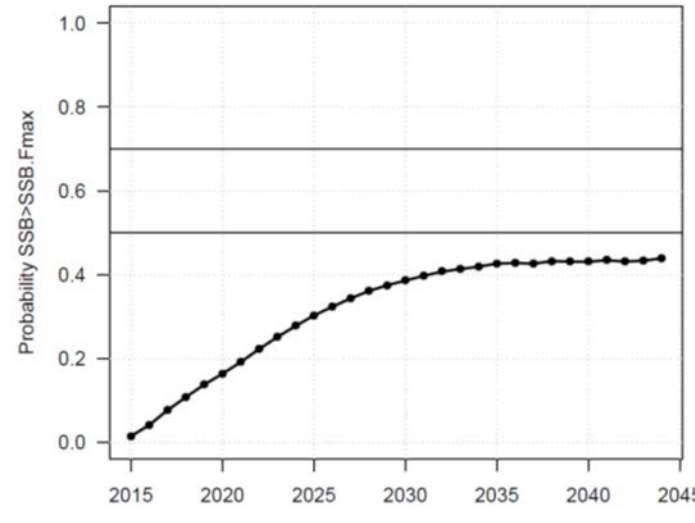

Probability SSB>SSB.F20
0.0
0.2
0.4
0.6
0.8
1.0
2015
2020
2025
2030
2035
2040
2045


Projection: Spawning stock (peak spawn)
Spawning stock (1E8 eggs)
0
100000
250000
2015
2020
2025
2030
2035
2040
2045


Projection: Landings
Landings (1000 lb whole wgt)
0
200
400
600
2015
2020
2025
2030
2035
2040
2045


Projection: Fishing mortality rate
F (per yr)
0.0
0.2
0.4
0.6
2015
2020
2025
2030
2035
2040
2045


Projection: Discards
Dead discards (1000 lb whole wgt)
0
200
400
600
800
2015
2020
2025
2030
2035
2040
2045

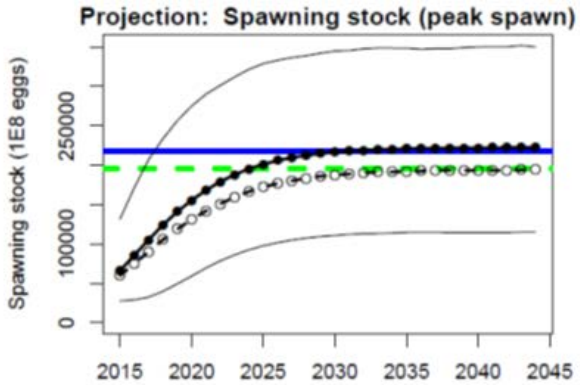

Probability SSB>SSB.Fmax
0.0
0.2
0.4
0.6
0.8
1.0
2015
2020
2025
2030
2035
2040
2045

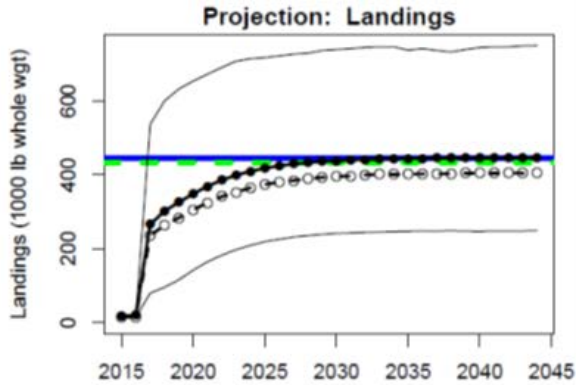
Request 3

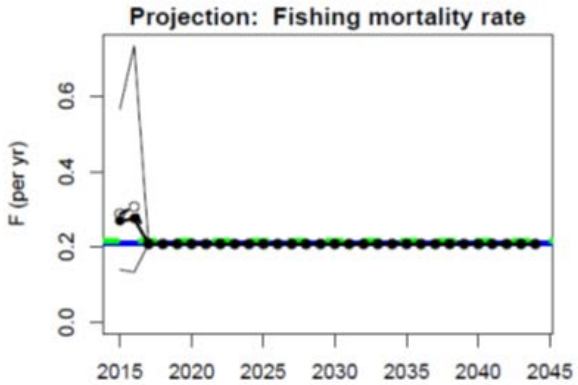
"Provide projections of $F_{rebuild}$ based on a 50% probability of rebuilding the stock by 2044 based on MFMT proxies of F_{max} and $F_{20\%SPR}$. Include the full suite of projection outputs as provided for SEDAR 41 projections."

Results:

- The fishing mortality that allows the stock to rebuild with 50% probability to $F_{20\%}$ benchmarks is 0.2087.
- The fishing mortality that allows the stock to rebuild with 50% probability to F_{max} benchmarks is 0.214.


Projection: Spawning stock (peak spawn)
Spawning stock (1E8 eggs)
0
100000
250000
2015
2020
2025
2030
2035
2040
2045


Projection: Landings
Landings (1000 lb whole wgt)
0
200
400
600
2015
2020
2025
2030
2035
2040
2045


Projection: Fishing mortality rate
F (per yr)
0.0
0.2
0.4
0.6
2015
2020
2025
2030
2035
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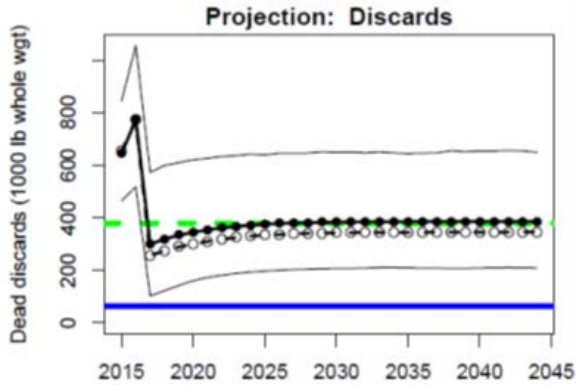
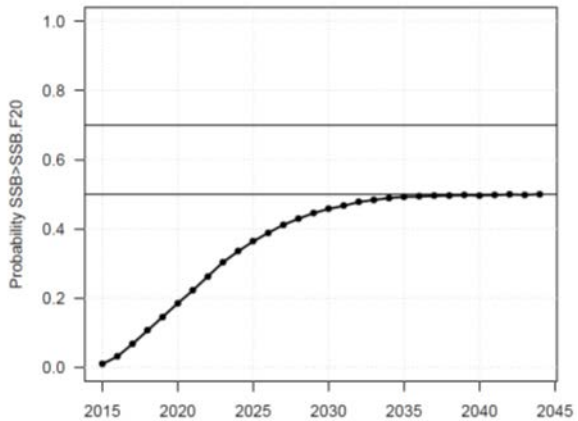
2045


Projection: Discards
Dead discards (1000 lb whole wgt)
0
200
400
600
800
2015
2020
2025
2030
2035
2040
2045


Probability SSB>SSB.F20
0.0
0.2
0.4
0.6
0.8
1.0
2015
2020
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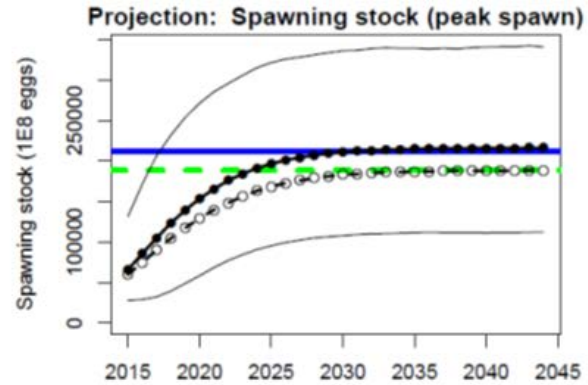
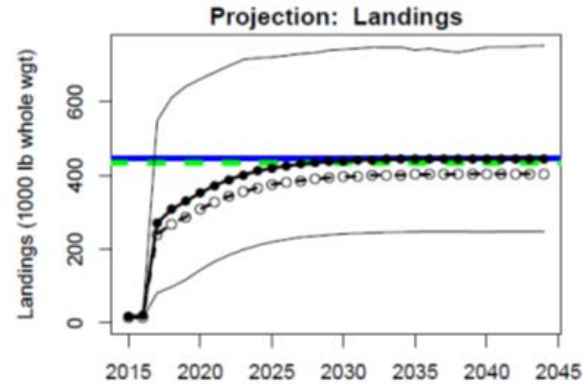

Projection: Spawning stock (peak spawn)
Spawning stock (1E8 eggs)
0
100000
250000
2015
2020
2025
2030
2035
2040
2045


Projection: Landings
Landings (1000 lb whole wgt)
0
200
400
600
2015
2020
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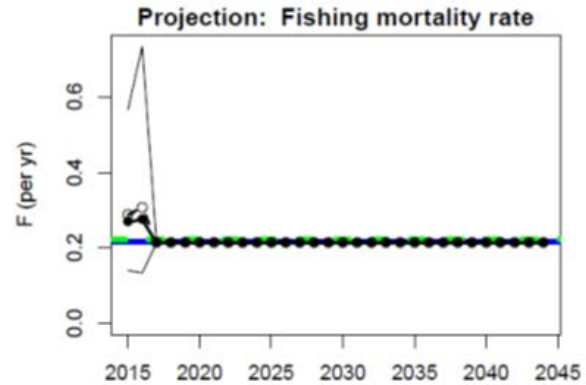
2045


Projection: Fishing mortality rate
F (per yr)
0.0
0.2
0.4
0.6
2015
2020
2025
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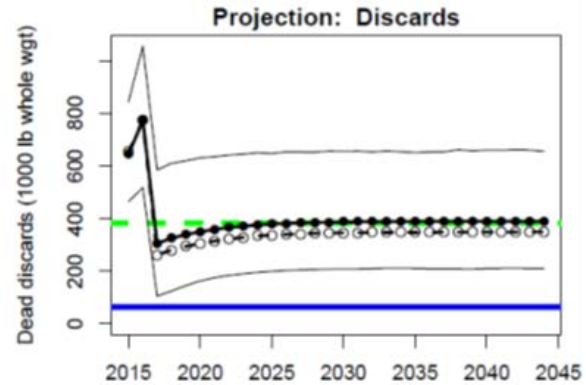
2045


Projection: Discards
Dead discards (1000 lb whole wgt)
0
200
400
600
800
2015
2020
2025
2030
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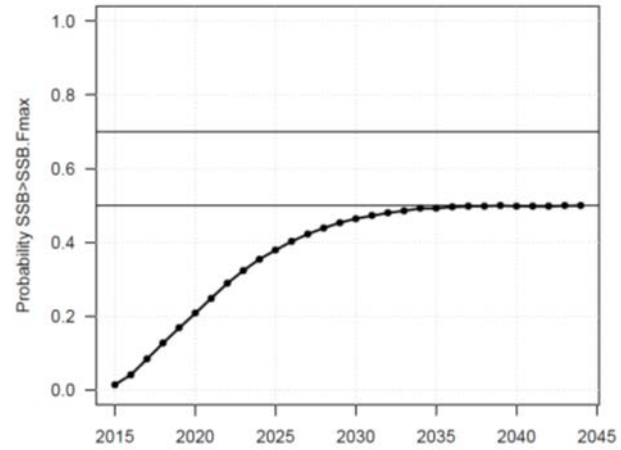
2040
2045


Probability SSB>SSB.Fmax
0.0
0.2
0.4
0.6
0.8
1.0
2015
2020
2025
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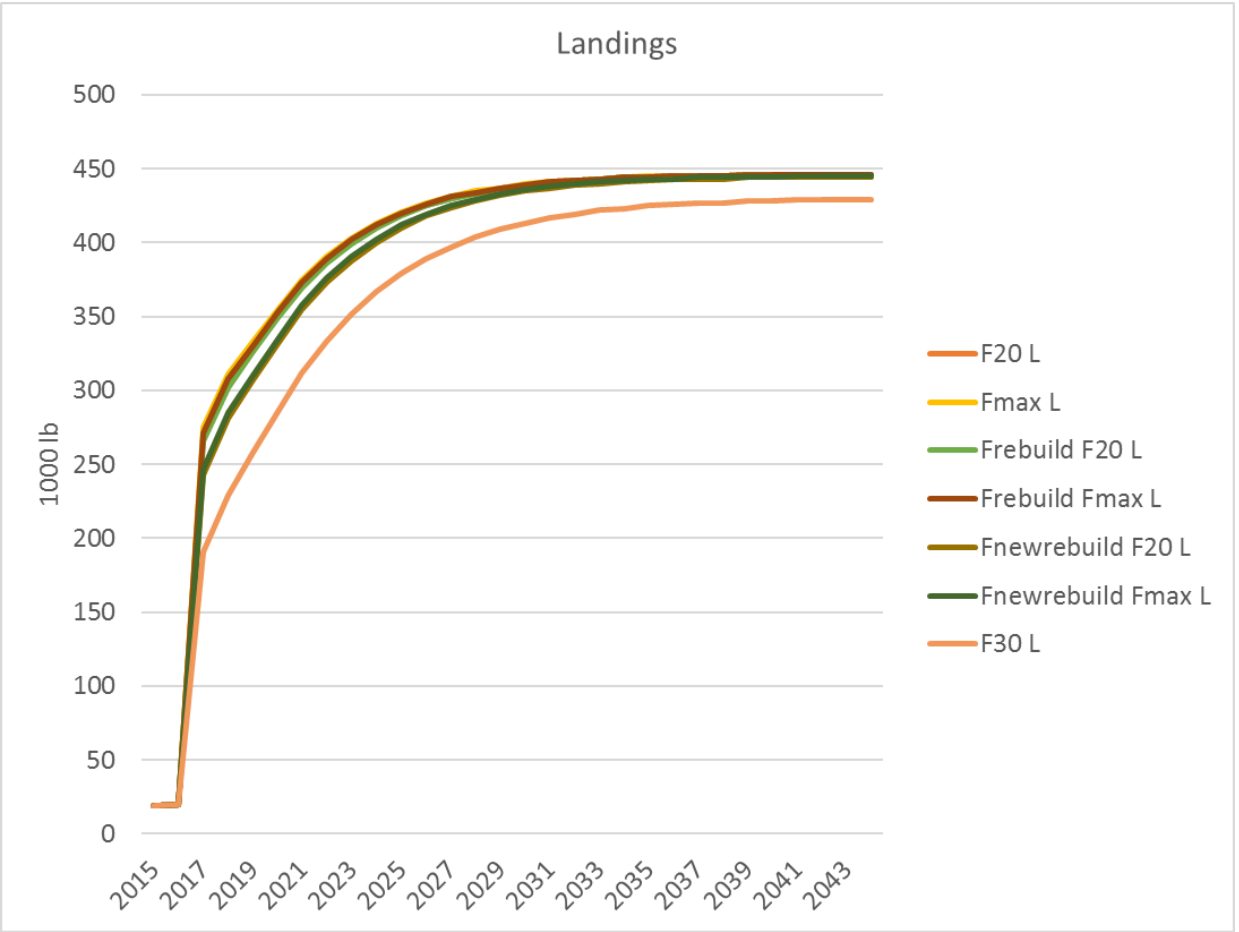
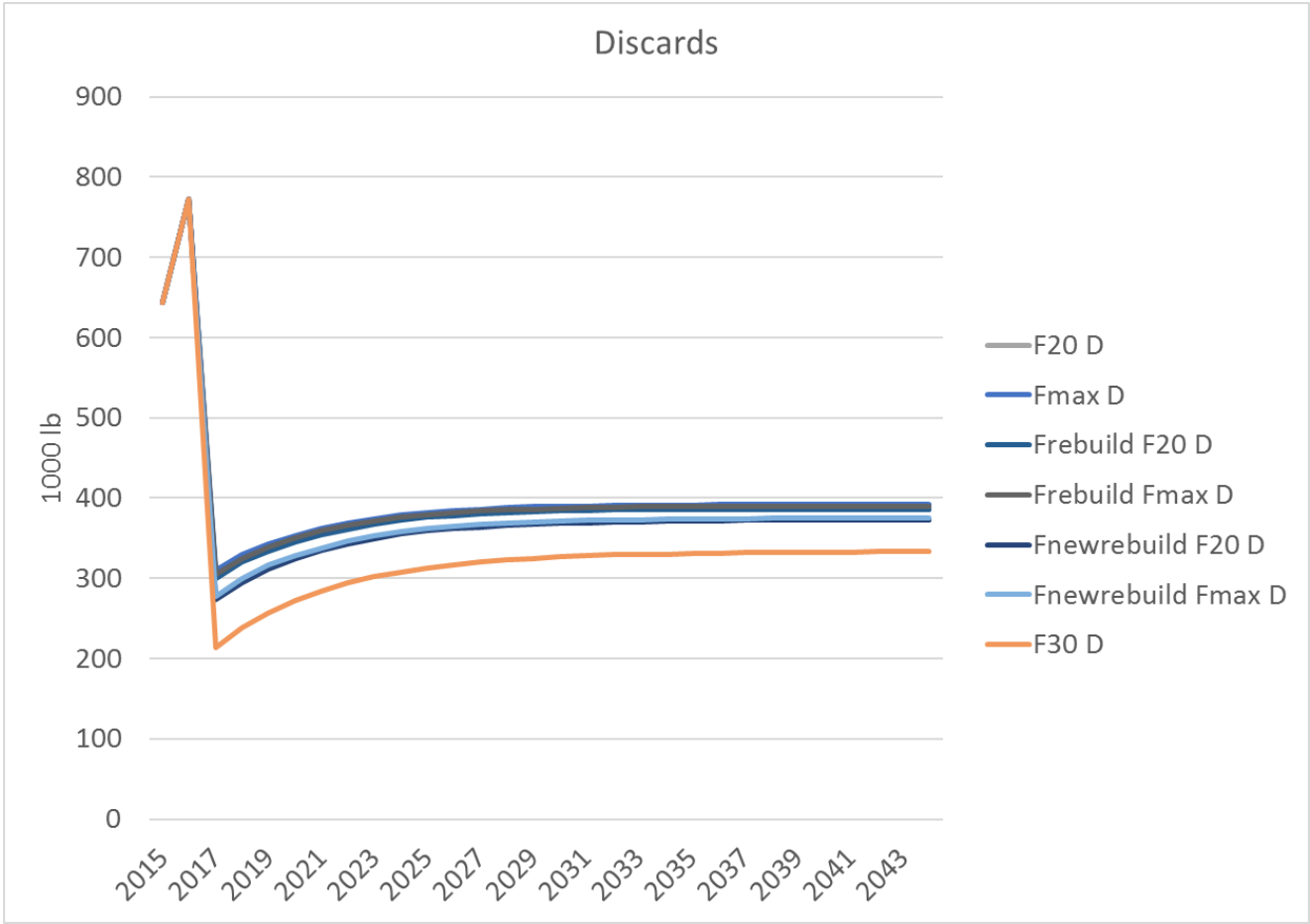
Comparing projections





Further Analysis

- The memo and SAFMC motion requested ‘additional runs,’ which were interpreted to mean projection analyses.
- The SEFSC further interpreted the motion language ‘provide advice regarding risk’ as a request for a scientific analysis of the probability of overfishing for the various reference points, including F_{max} and $F_{20\%SPR}$.
  - The Council did not have their current control rule when developing the rebuilding plan for Red Snapper.
  - The rebuilding plan was set to recover to $F_{30\%}$ with 50% probability by 2044.

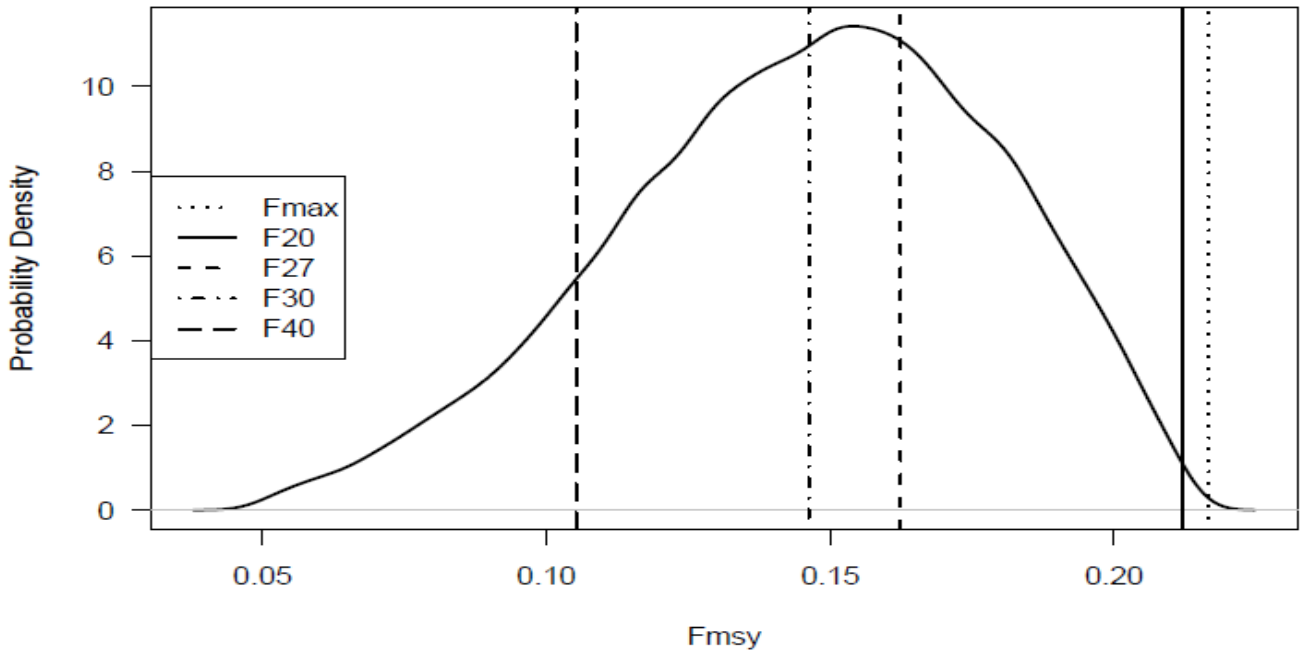
Potential Reference Points

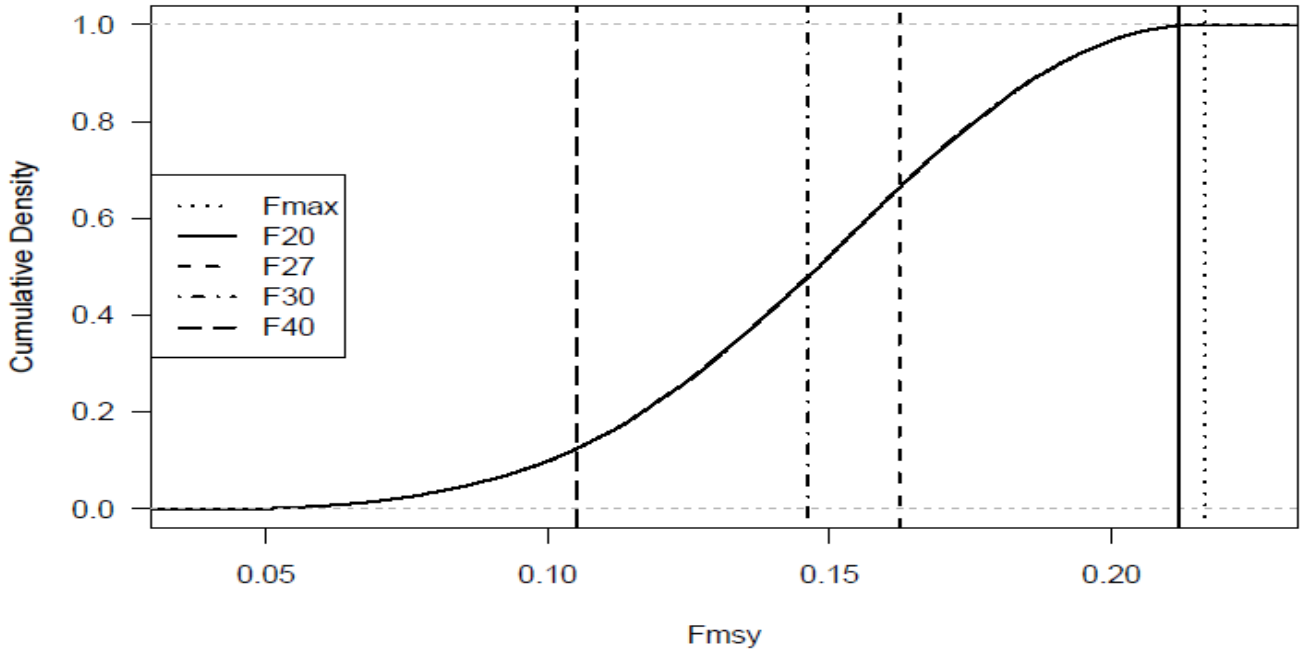
- The SEDAR 41 assessment provided an estimate of mean recruitment, and deviations around that mean rather than steepness.
  - The available stock-recruitment observations for Red Snapper in the South Atlantic (SA) were insufficient to uniquely identify a stock-recruitment relationship to directly estimate MSY-based benchmarks for stock size and fishing mortality.
- The National Standard Guidelines have recommended use of SPR as proxies for the purpose of estimating MFMT and MSST levels.
  - Initial scientific guidance indicated that SPRs in the range of 30-40% were reasonable proxies for MSY quantities for a range of fish stocks.
    - The precise SPR associated with MSY is dependent on the actual underlying stock-recruitment relationship and fishery characteristics.
  - For the last benchmark assessment and subsequent rebuilding plan, the SAFMCset a proxy of 30% SPR.

Our approach

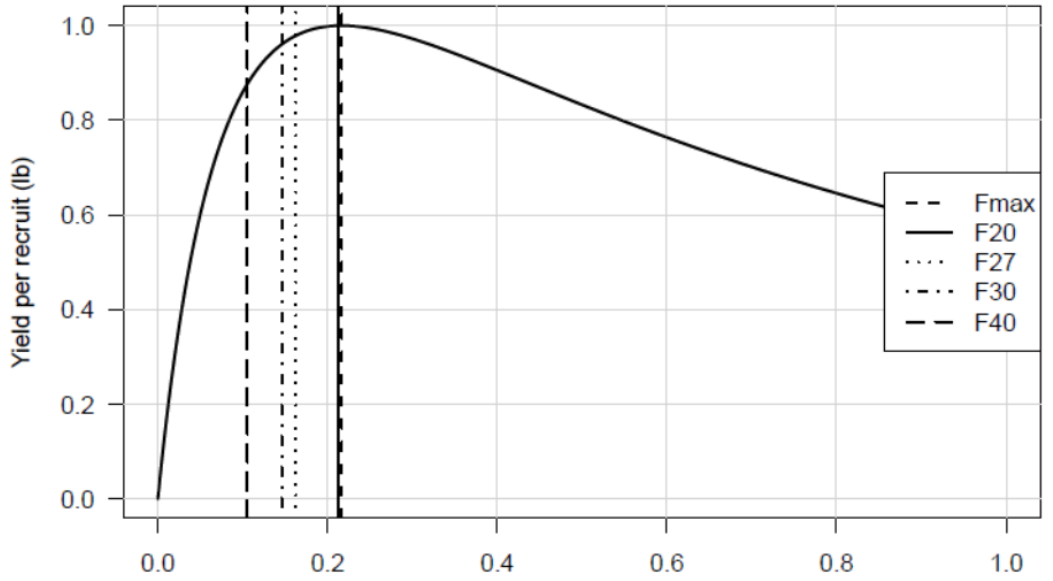
- The meta-analysis of Shertzer and Conn (2012) provides a good basis to judge what an approximate value of steepness would be for a Red Snapper-like species.
  - The mean steepness of 0.84 in the meta-analysis corresponds to $F_{27\%}$, but we need a distribution of F_{msy} to account for the uncertainty in that F proxy.
  - Drawing values of steepness from the beta distribution described in Shertzer and Conn (2012), we calculated F_{msy} holding all other model parameters to the base model values.

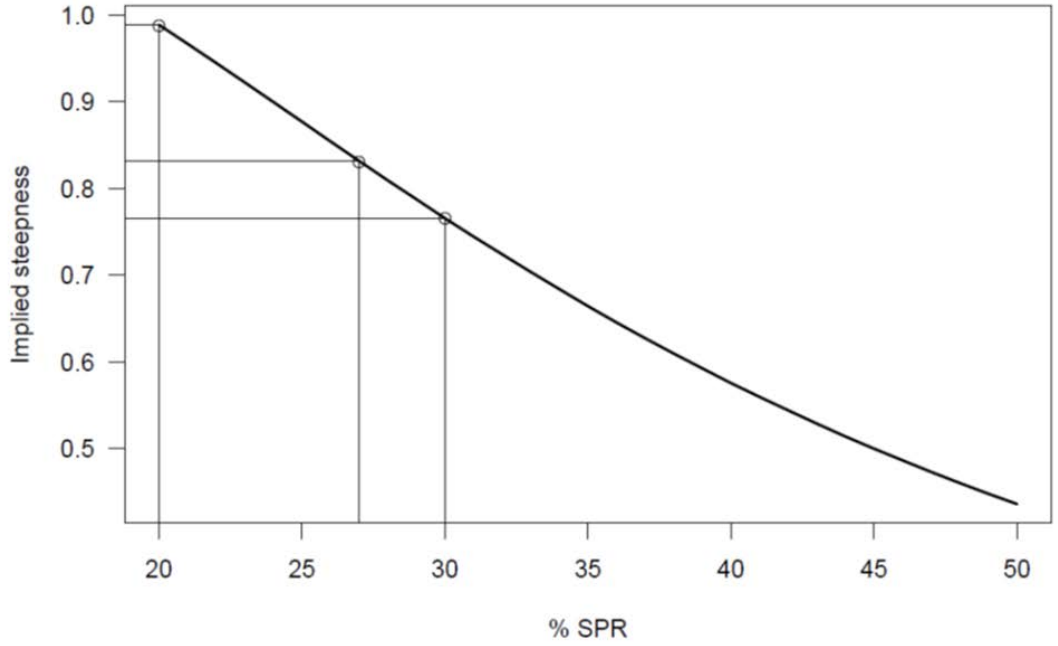
- The further into the tails the F_{msy} proxy, the higher the probability of under or overfishing.
- A proxy in the portion of the curve with more probability density would lower the probability of overfishing or underfishing.
- Therefore, an appropriate SPR proxy for Red Snapper that also takes into account both the biology and similarity with species represented in the meta-analysis and the probability of over or underfishing would be **$F_{27\%SPR}$ = 0.1624.**

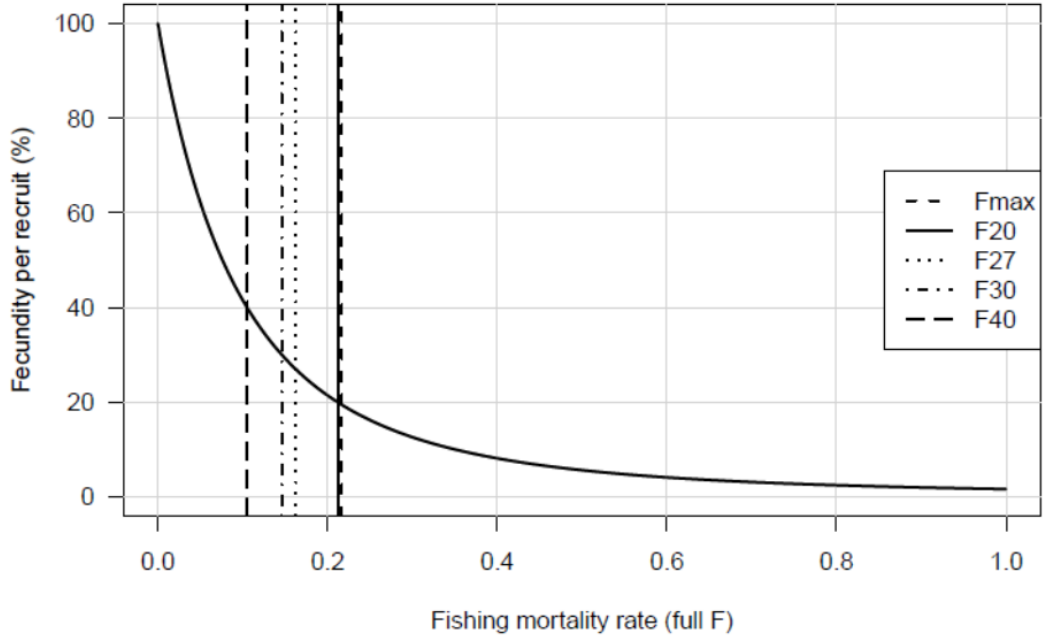




Yield per recruit and fecundity per recruit







Projections using the SAFMC's current control rule.

- Next, we consulted the SAFMC's control rule, as well as the value calculated for Red Snapper for the last benchmark assessment (P*=0.3, inferring 70% probability of rebuilding).
- Using the descriptions of the tiers within each dimension, we scored the current Red Snapper assessment as follows (resulting in a 67.5% probability of rebuilding):
  - Dimension I – 2.5
  - Dimension II – 2.5
  - Dimension III – 7.5
  - Dimension IV – 5
- Using the new value, we carried out two additional rebuilding projections.
  - The fishing mortality that allows the stock to rebuild with 67.5% probability to the $F_{20\%}$ SSB benchmark is 0.189.
  - The fishing mortality that allows the stock to rebuild with 67.5% probability to the F_{max} SSB benchmark is 0.1927.

Request 4

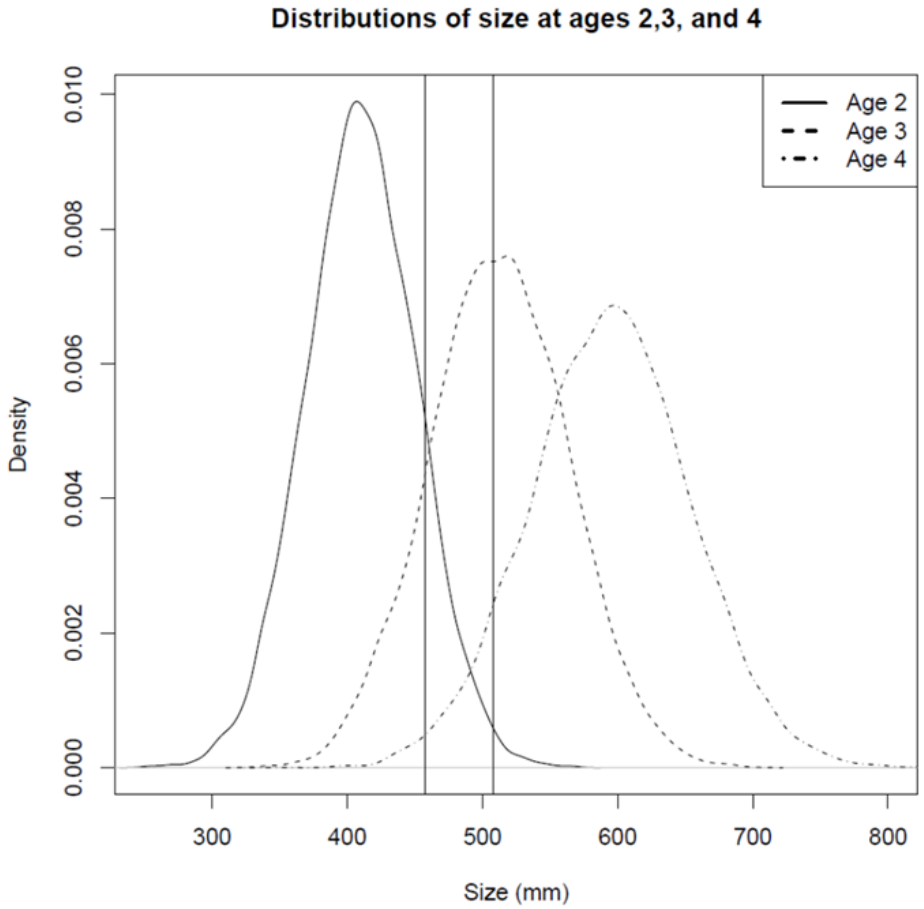
“Evaluate the impacts of 18” and 20” total length minimum size limits on future selectivity and current reference point values and rebuilding projections. Provide management benchmark info as requested in #1, and projection results as requested in #2 and #3, based on the selectivity patterns associated with the alternative size limits.”

Our approach

- The current assessment has selectivities in three time blocks:
  - Before the 20” size limit
  - During the 20” size limit
  - During the mini-season and moratorium
    - All fish are discarded during the moratorium, and there is no size limit during the mini-season.
- We assumed the request to mean the reference points requested in their most recent memo, and we assumed that the 18” size limit would act more as a size limit did during the 20” size limit rather than during a mini-season.
- The 20” size limit has been represented in the current assessment, but we do not have any data to investigate how the selectivity or fishing behavior would be effected if there was a size limit during a mini-season with a bag limit.

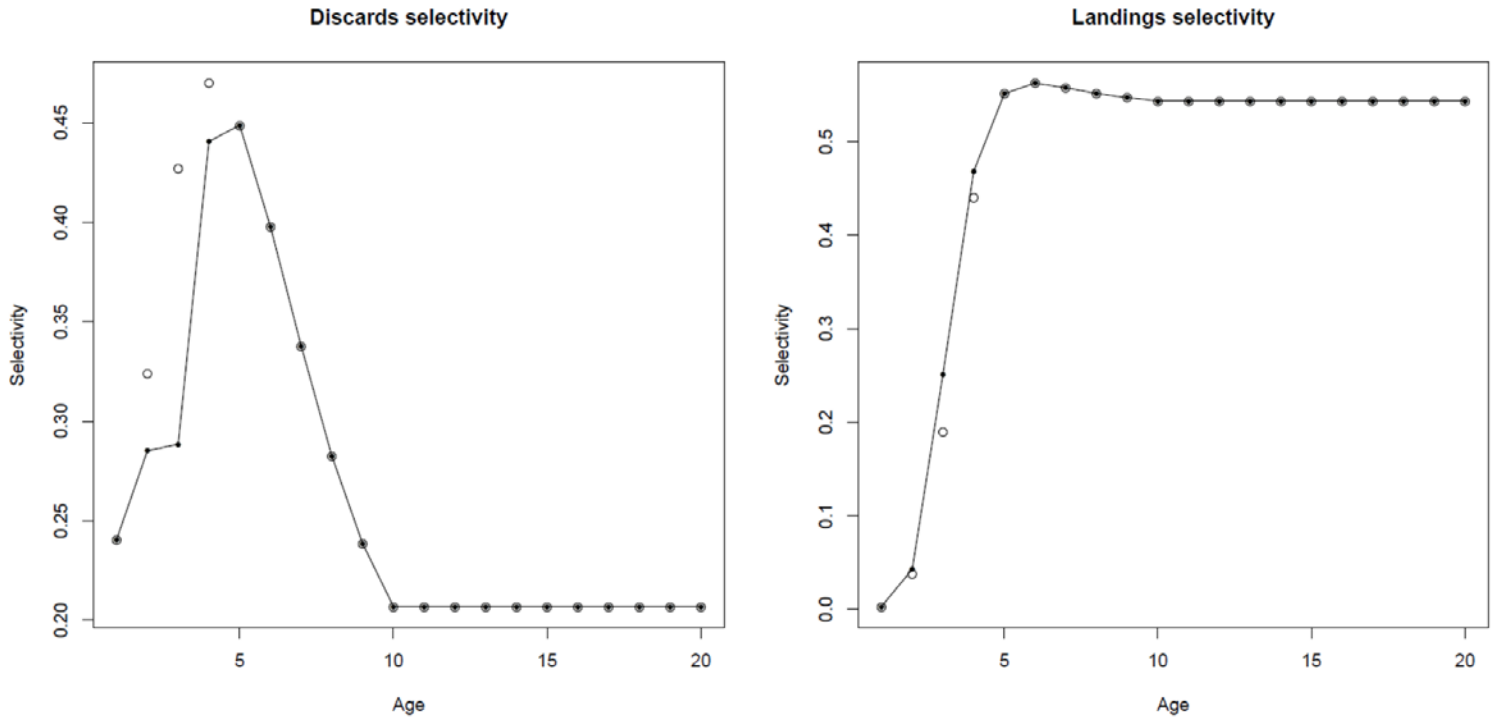
Our approach

- Using the variability in size at age we calculate the distribution of size at age for ages 2, 3, and 4.
  - An 18” fish is approximately 2.5 years old, and a 20” fish is approximately 3 years old.
  - There is no probability of a 457 mm (18 inch) fish being one year old.
  - The overlap of the distributions show that either size limit can correspond to age 2, 3, or 4 with different probabilities.



Our approach

- We used the change in probability of being each age at each size limit and adjusted the total landings and discards selectivity curves accordingly.
- It shows a maximum effect because a smaller proportion of the total selectivity would be affected if this exercise were completed for each fleet's selectivity in only the terminal time block (mini-season selectivity).
- The new landings and discards selectivity :



Projections using the new selectivities

- We conducted a deterministic projection using these new selectivity curves.
- There is a slight increase in the overall landings taken by the end of the projections (460 klb v. 446 klb), but a larger decrease in the allowable discards (362 klb v. 392 klb).

Overall Caveats

All projections should be interpreted in light of the model assumptions and key aspects of the data. Some major considerations are the following:

- In general, projections of fish stocks are highly uncertain, particularly in the long term (e.g., beyond 5–10 years).
- Fisheries were assumed to continue fishing at their estimated current proportions of total effort, using the estimated current selectivity patterns. New management regulations that alter those proportions or selectivities would likely affect projection results.
- The projections assumed no spawner-recruit relationship applies in the future and that past deviations represent future uncertainty in recruitment. If future recruitment is characterized by runs of large or small year classes, possibly due to environmental or ecological conditions, stock projections may be affected. If future average recruitment increases with increasing stock size, benchmarks and projections will be affected.