SEDAR 28 Gulf of Mexico Cobia Update Assessment

Sustainable Fisheries Division, SEFSC

July 21, 2020

SEDAR 28 Update Outline

- Terms of Reference
- Overview
- Data
- Base Model
  - Development
  - Fit
  - Results
  - Diagnostics
- Projections
  - Settings
  - Results
- Summary

SEDAR 28 Update
Terms of Reference

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Terms of Reference

1. Update the approved SEDAR 28 Gulf of Mexico cobia base model with data through 2018.
2. Document any changes or corrections made to model and input data sets and provide updated input data tables. Provide commercial and recreational landings and discards in pounds and numbers.
3. Update model parameter estimates and their variances, model uncertainties, estimates of stock status and management benchmarks, and provide the probability of overfishing occurring at specified future harvest and exploitation levels.
4. Develop a stock assessment update report to address these TORS and fully document the input data and results of the stock assessment update.

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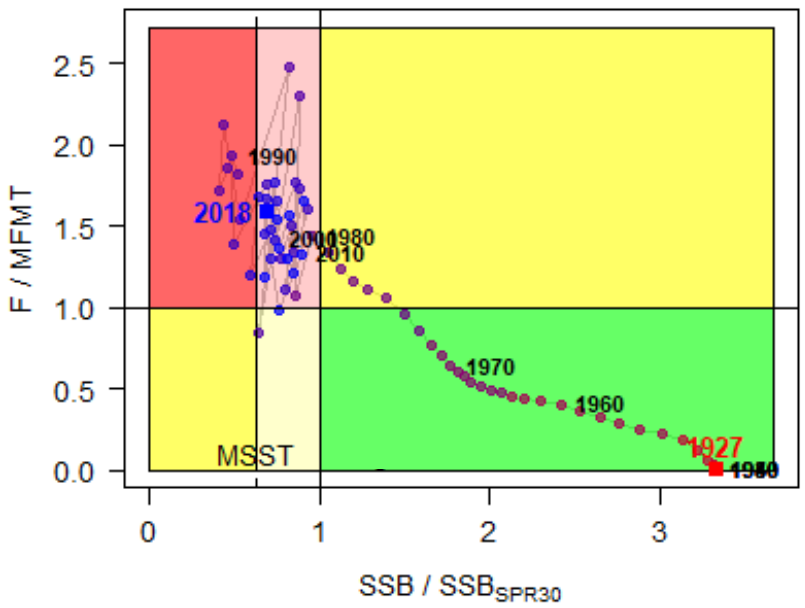
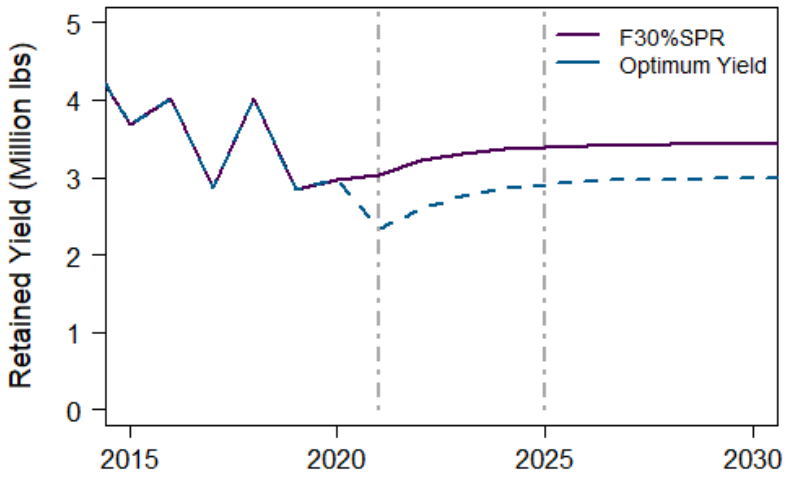
Overview

- The approved SEDAR 28 Gulf of Mexico cobia base model was updated with data through 2018
- Where practicable, the SEDAR 28 update base model used the same data sets as the SEDAR 28 base model with an updated time series
- Key changes from SEDAR 28 include incorporating the Fishing Effort Survey (FES) adjustments to the recreational catch and no longer estimating growth or shrimp selectivity in the assessment
- The stock assessment update report fully documents the input data and results of the SEDAR 28 update base model
- **The update base model found that Cobia in the Gulf of Mexico is undergoing overfishing but not overfished. In 2018, the stock was being harvested at 144% of MFMT and SSB was 111% of MSST.**
- **The update base model projections indicate that a reduction in yield is required in the near-term in order to allow the stock to build towards the SPR 30% MSY Proxy**





SEDAR 28 Update
Data

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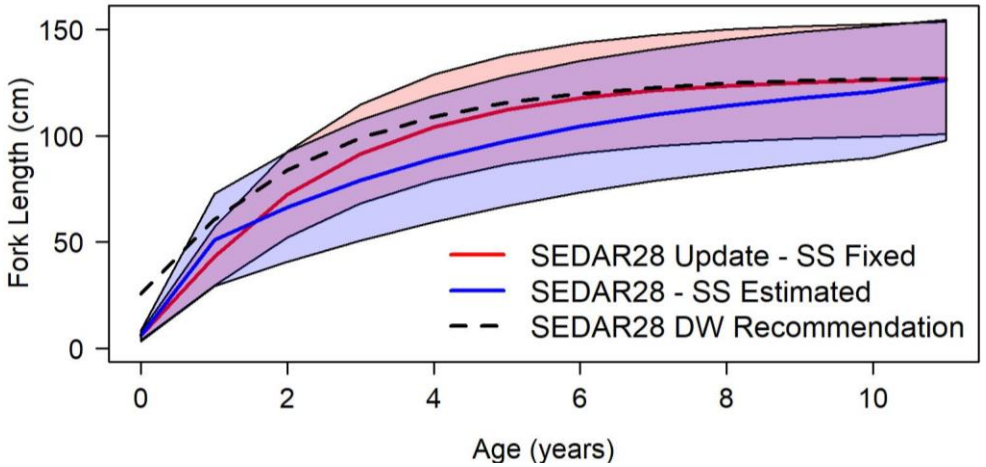
Data – Overview

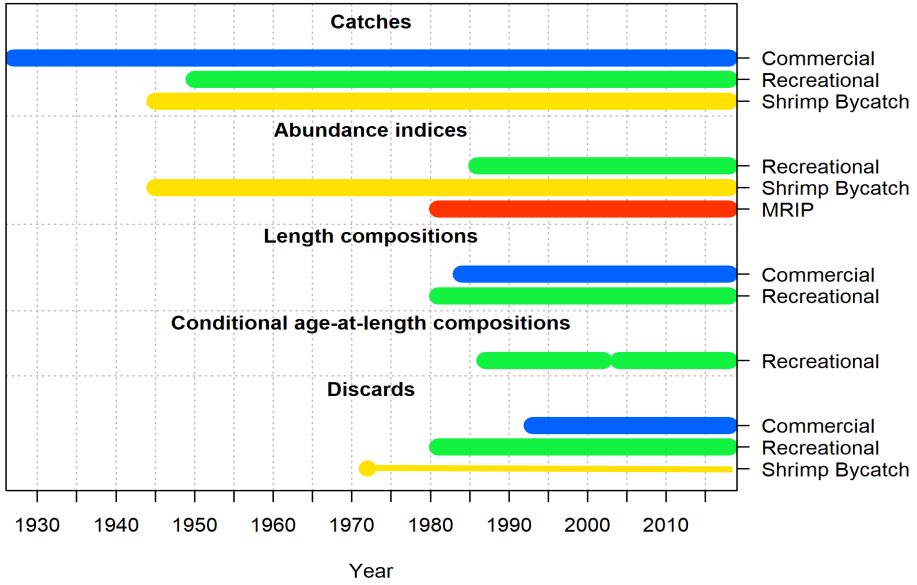
Life History

- Length-Weight Conversions
- Growth
- Reproduction
- Natural Mortality
- Release Mortality



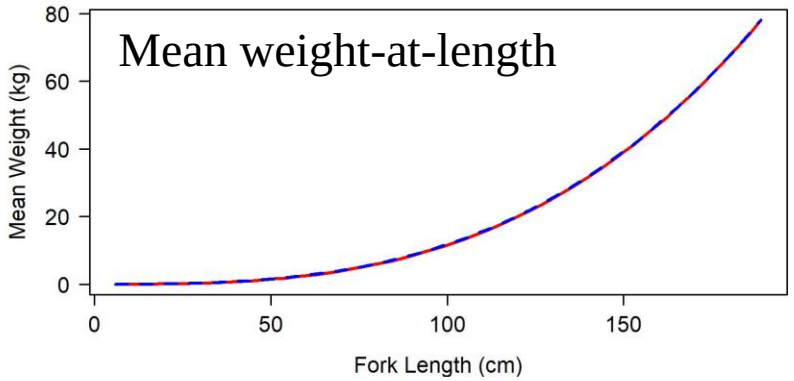
Fishery-Dependent Data

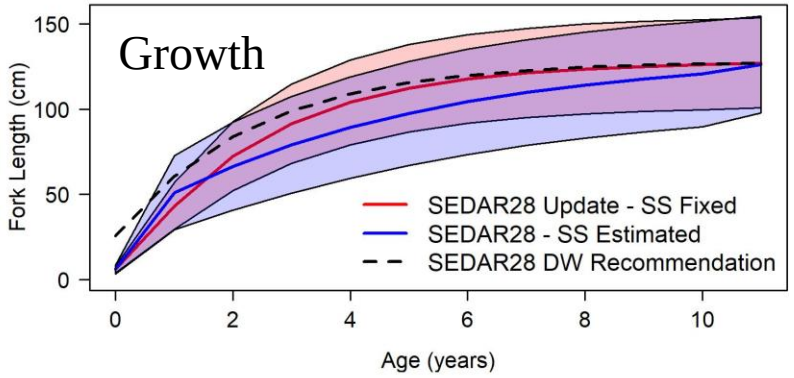
- Recreational Landings and Discards
- Commercial Landings and Discards
- Shrimp Bycatch and Effort Index
- Recreational CPUE: MRIP and Headboat
- Commercial Length Compositions
- Recreational Length Compositions
- Recreational Age Compositions

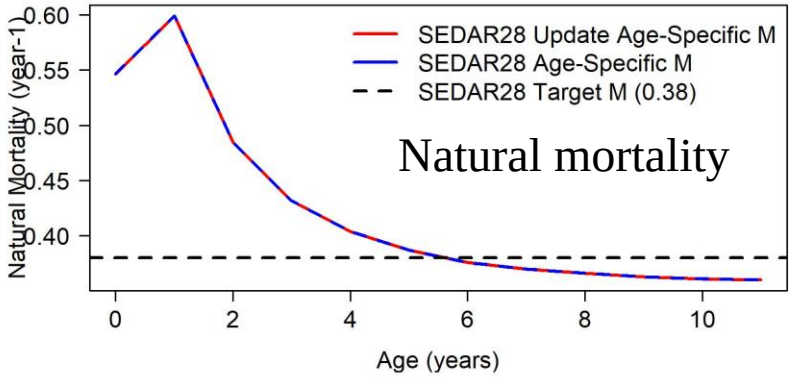


Data – Life History

Topic	Decision
Length-Weight Conversion	Unchanged
Maturity	Unchanged
SSB Metric	Unchanged
Fecundity	Unchanged
Natural Mortality	Unchanged
Age and Growth	Fixed L_{max} and K to SEDAR 28 DW Recommendation

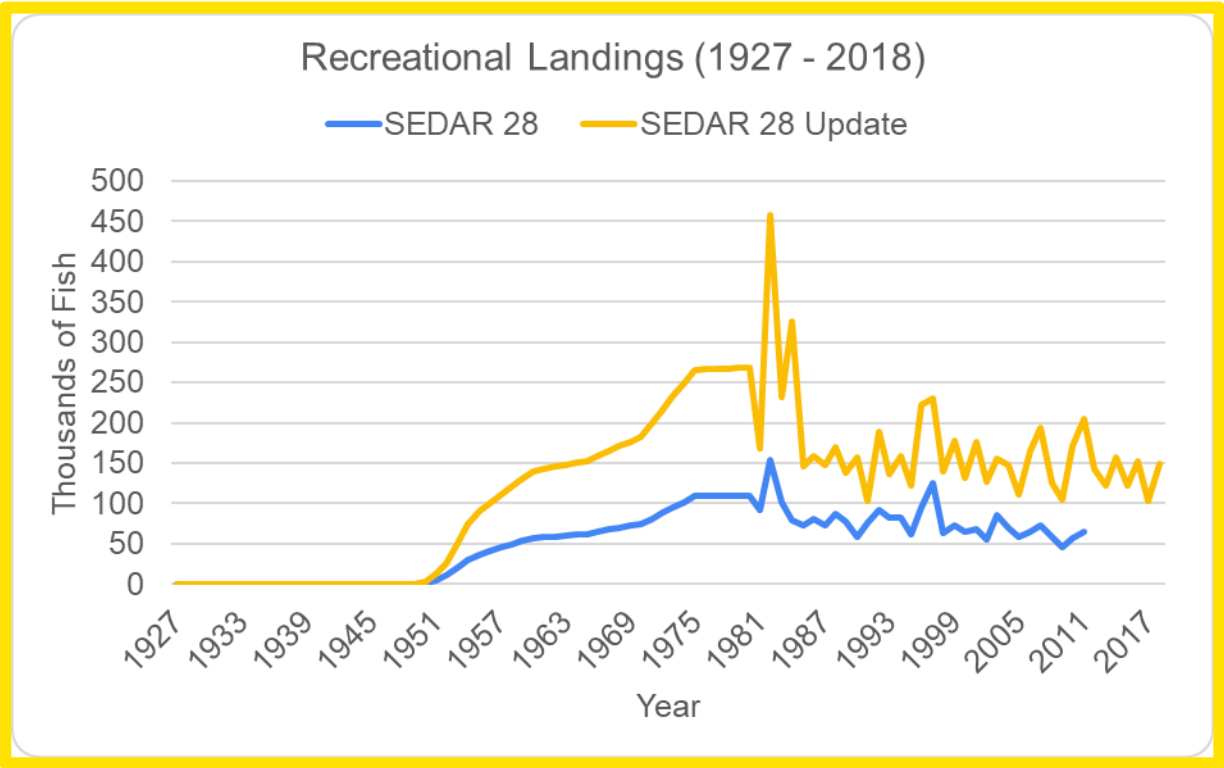


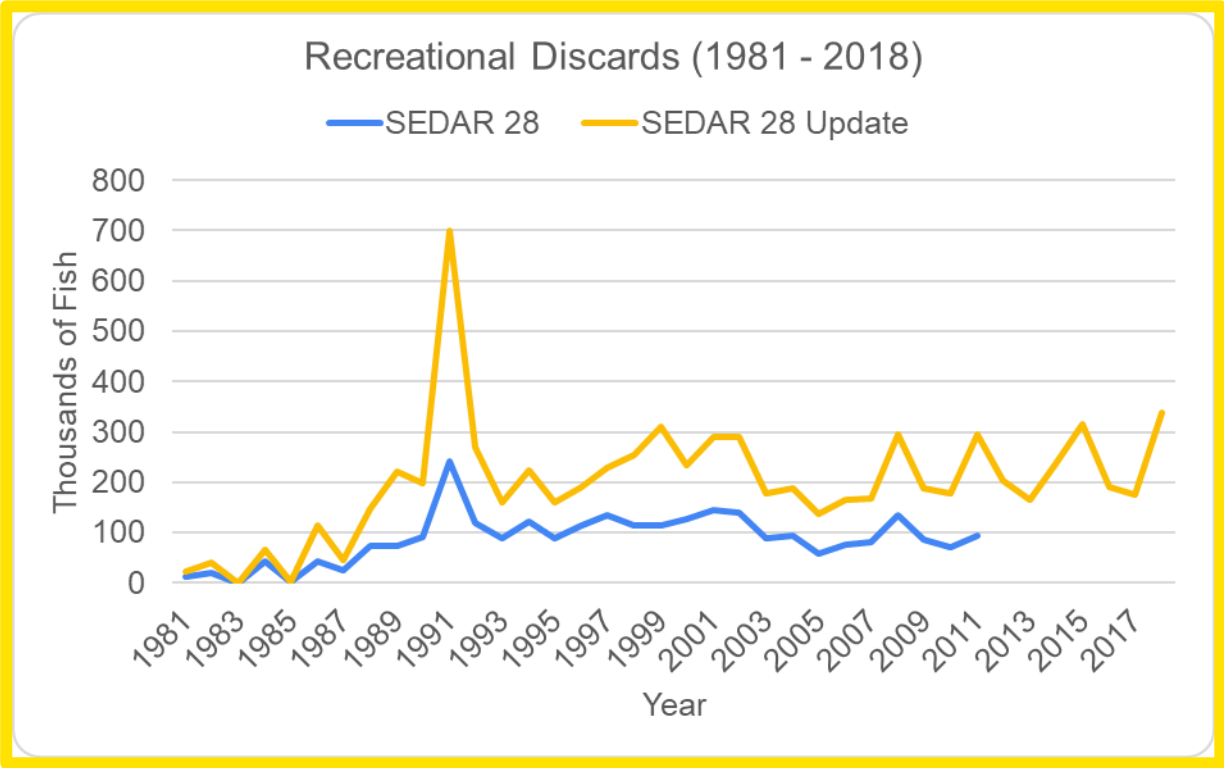




Data – Recreational – Landings and Discards

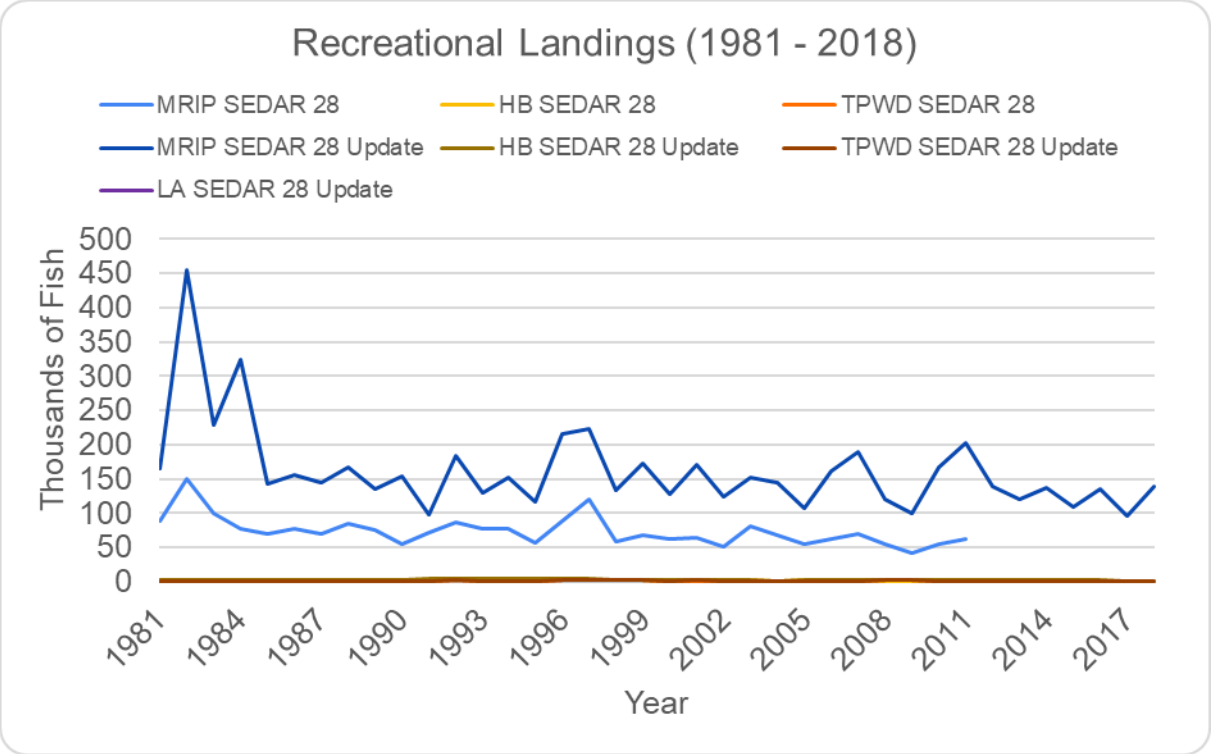
Topic	Decision
Recreational Landings	Use new MRIP-Fishing Effort Survey [FES]-adjusted WP-02
Recreational Discards	Use new MRIP-Fishing Effort Survey [FES]-adjusted WP-02

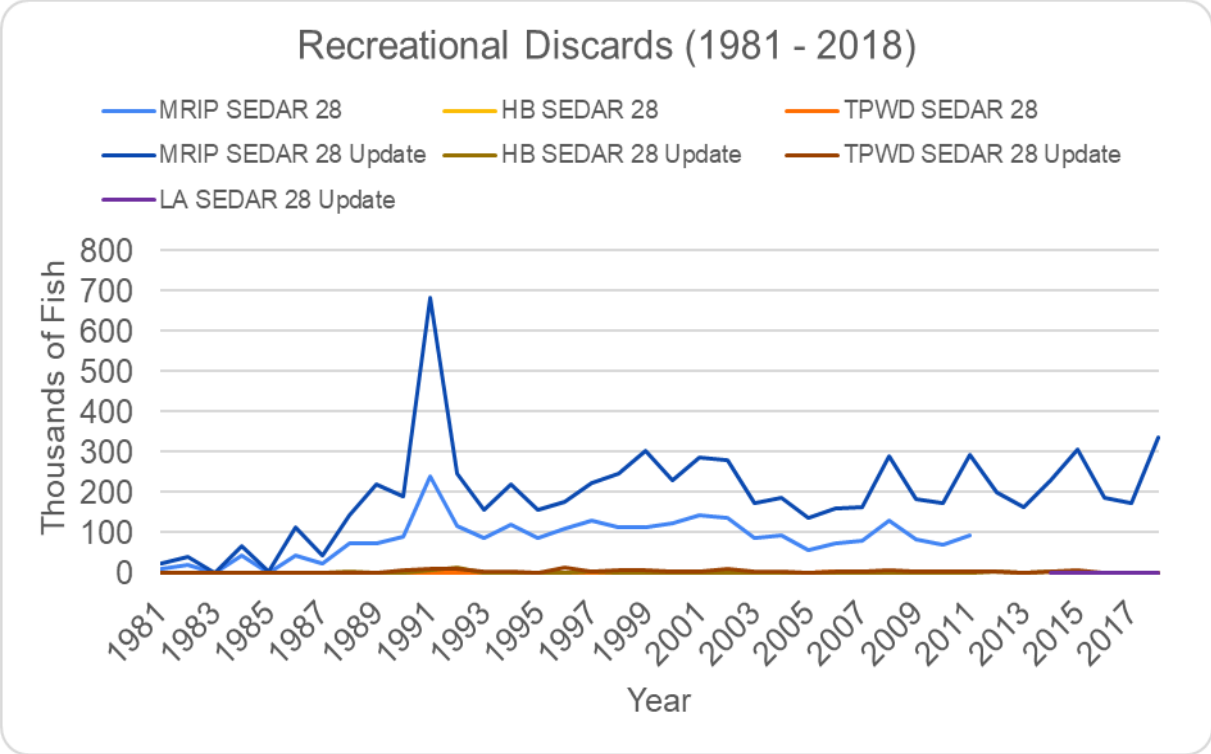




Data – Recreational – Landings and Discards (continued)

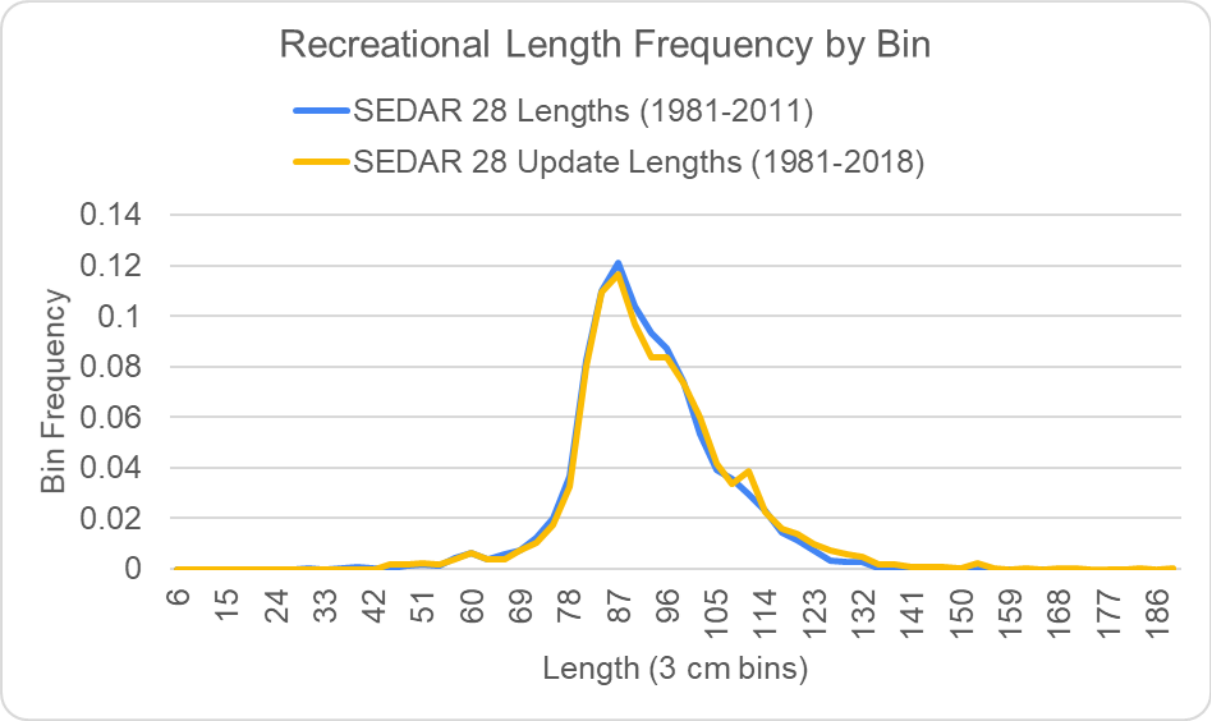
Topic	Decision
Recreational Landings	Use new MRIP-Fishing Effort Survey [FES]-adjusted WP-02
Recreational Discards	Use new MRIP-Fishing Effort Survey [FES]-adjusted WP-02

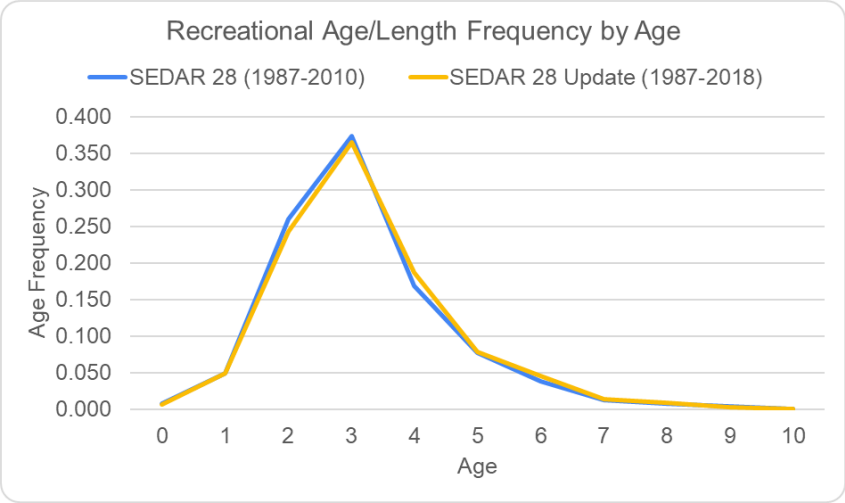


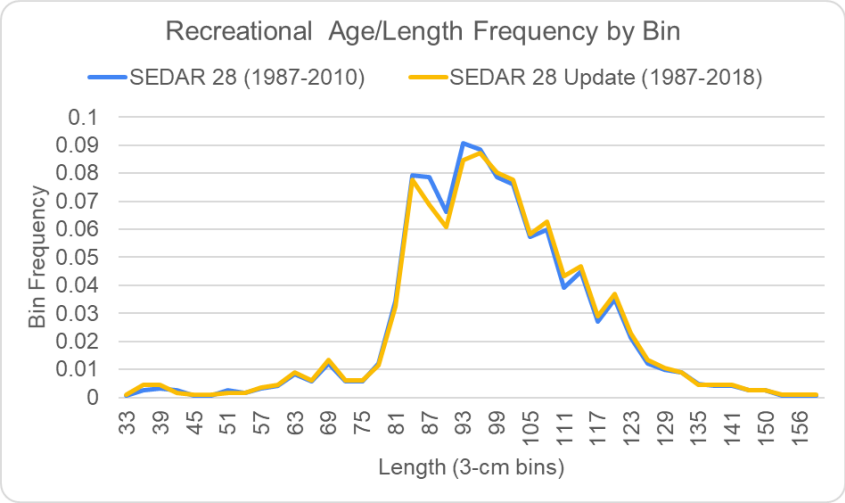


Data – Recreational – Lengths and Ages

Topic	Decision
Recreational Lengths	No sample size cap
Recreational Ages	Unchanged

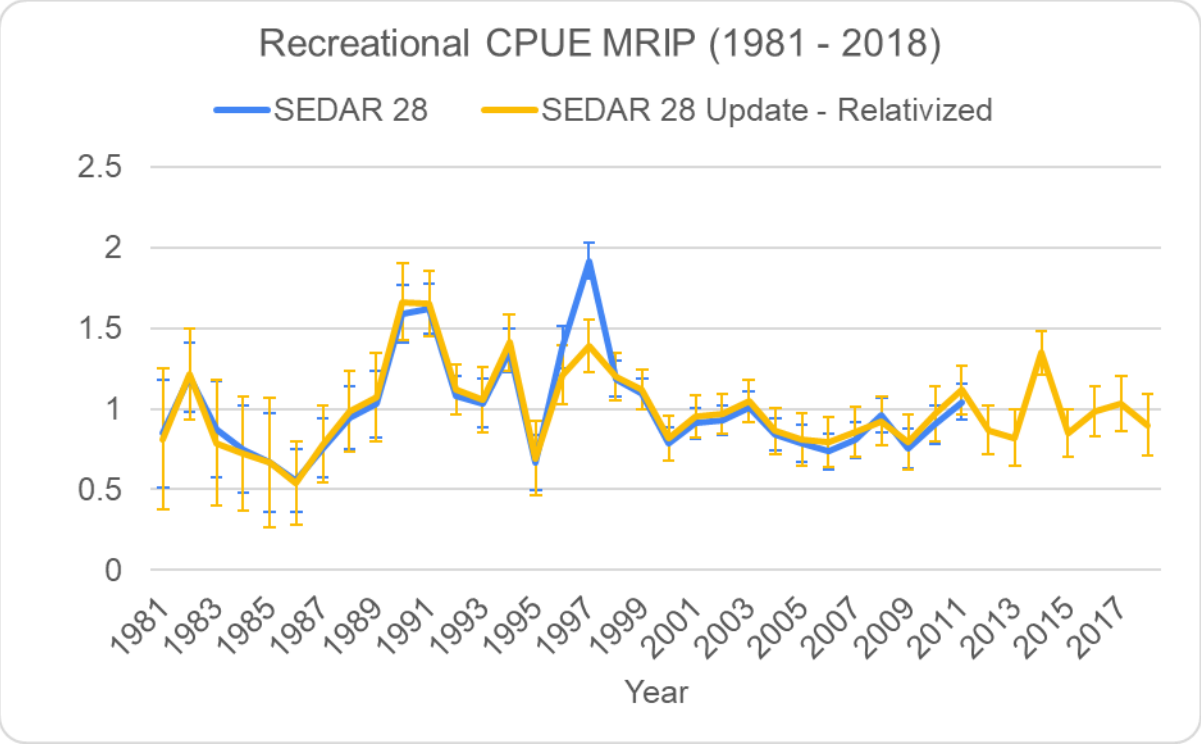


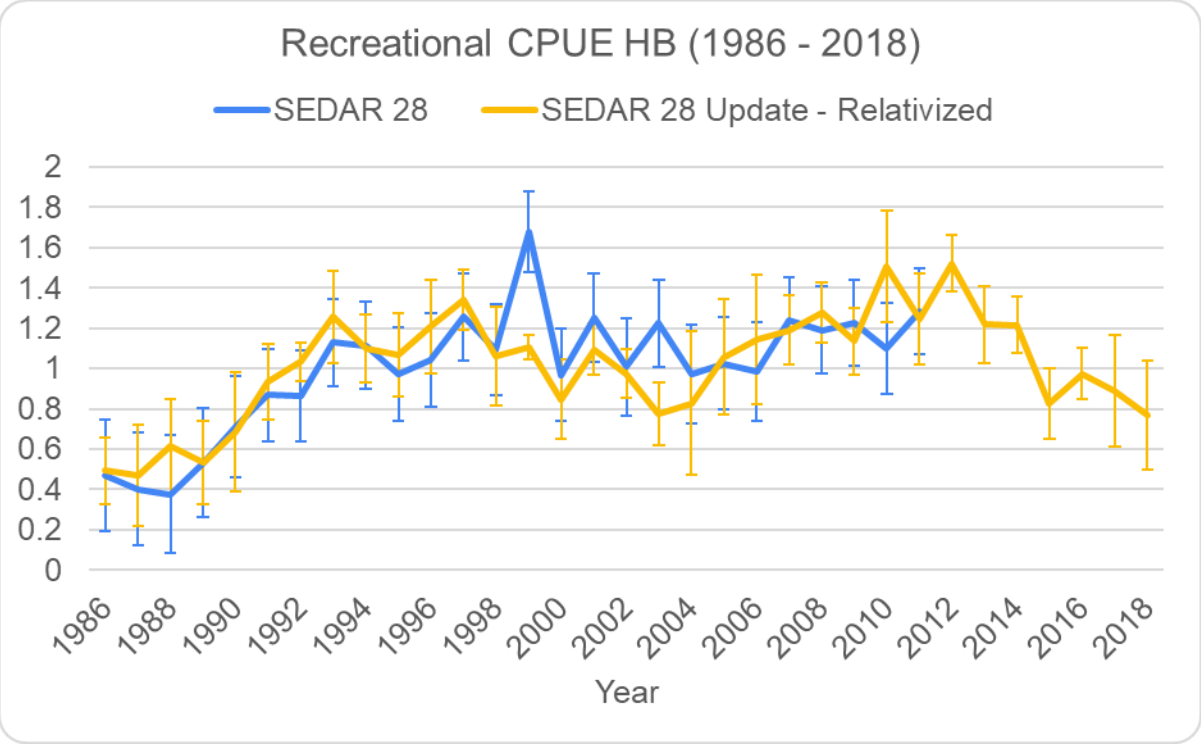




Data – Recreational – Indices

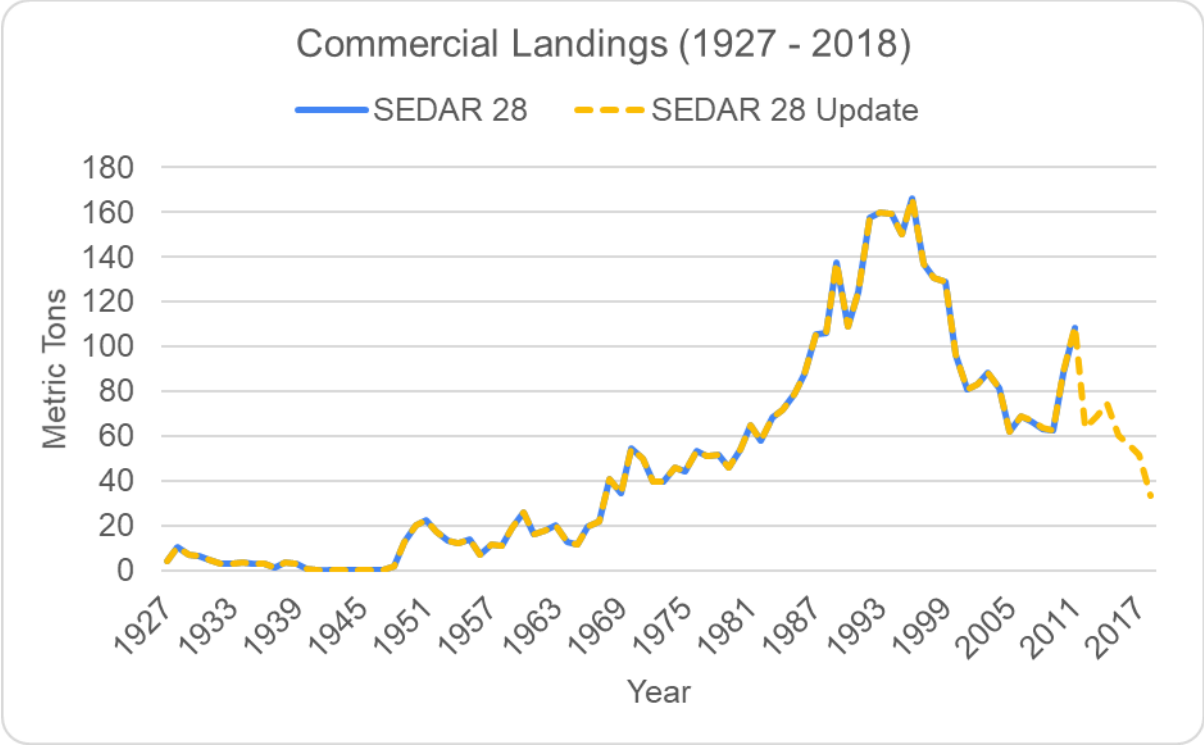
Topic	Decision
MRIP CPUE Index	CV relativized to 0.2
Headboat CPUE Index	Use core vessel identification and zero-inflated models WP-05; CV relativized to 0.2

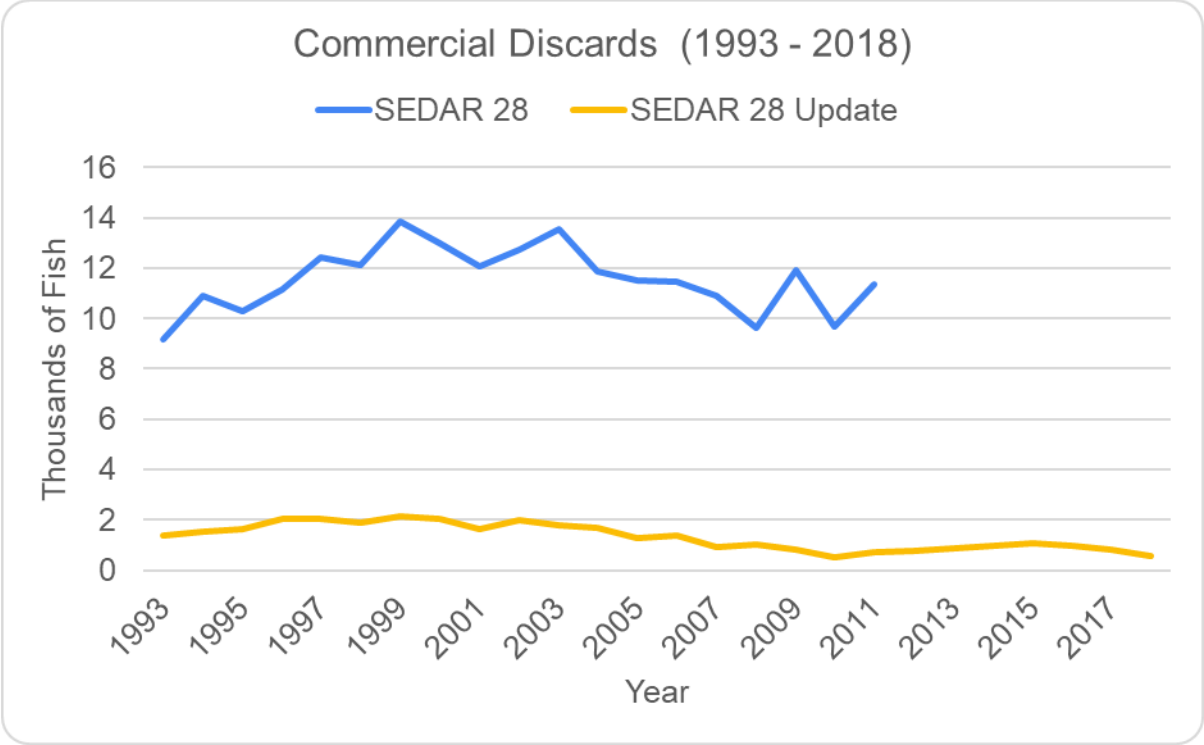




Data – Commercial – Landings and Discards

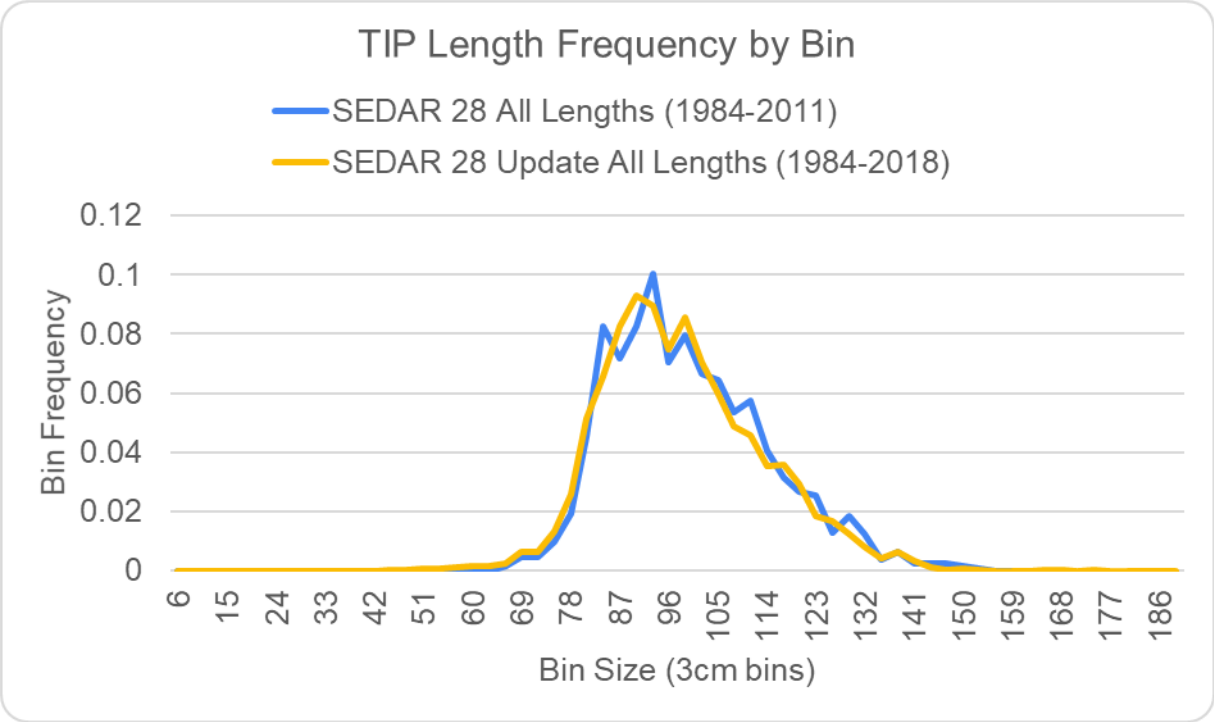
Topic	Decision
Commercial Landings	Unchanged
Commercial Discards	CPUE expansion using coastal observer program in conjunction with total fishing effort from the commercial reef fish logbook program (used consistently in recent reef fish assessments) WP-06

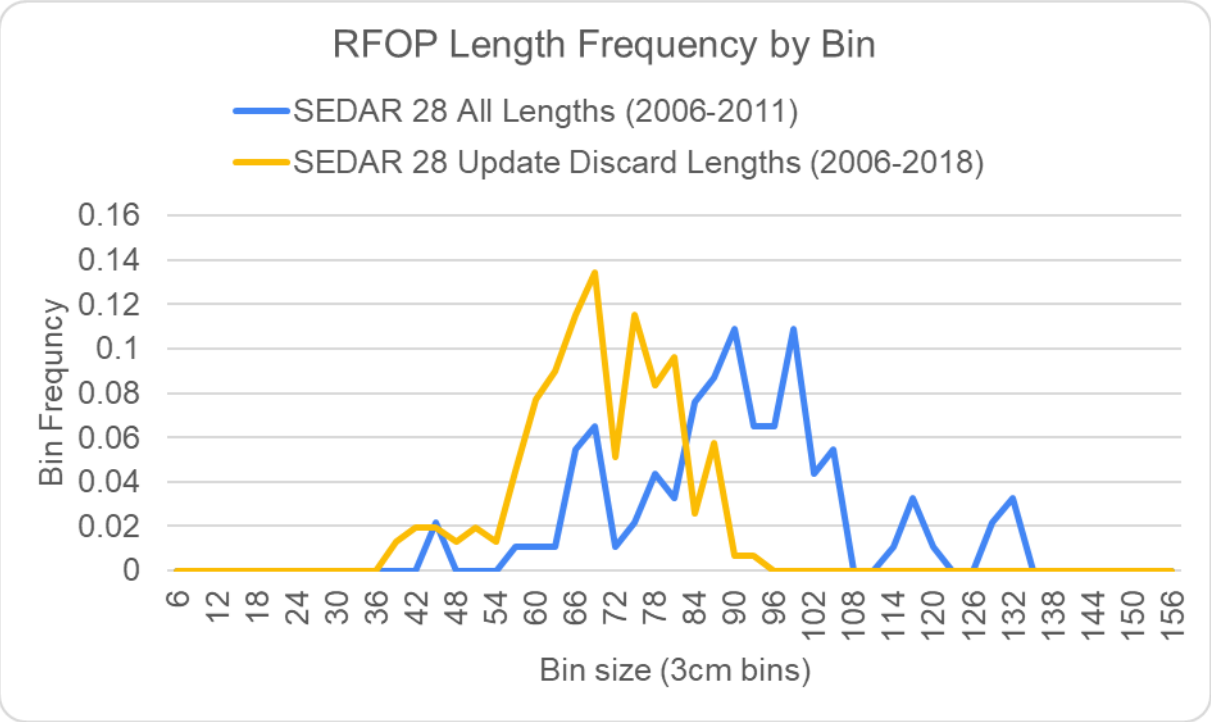




Data – Commercial – Lengths

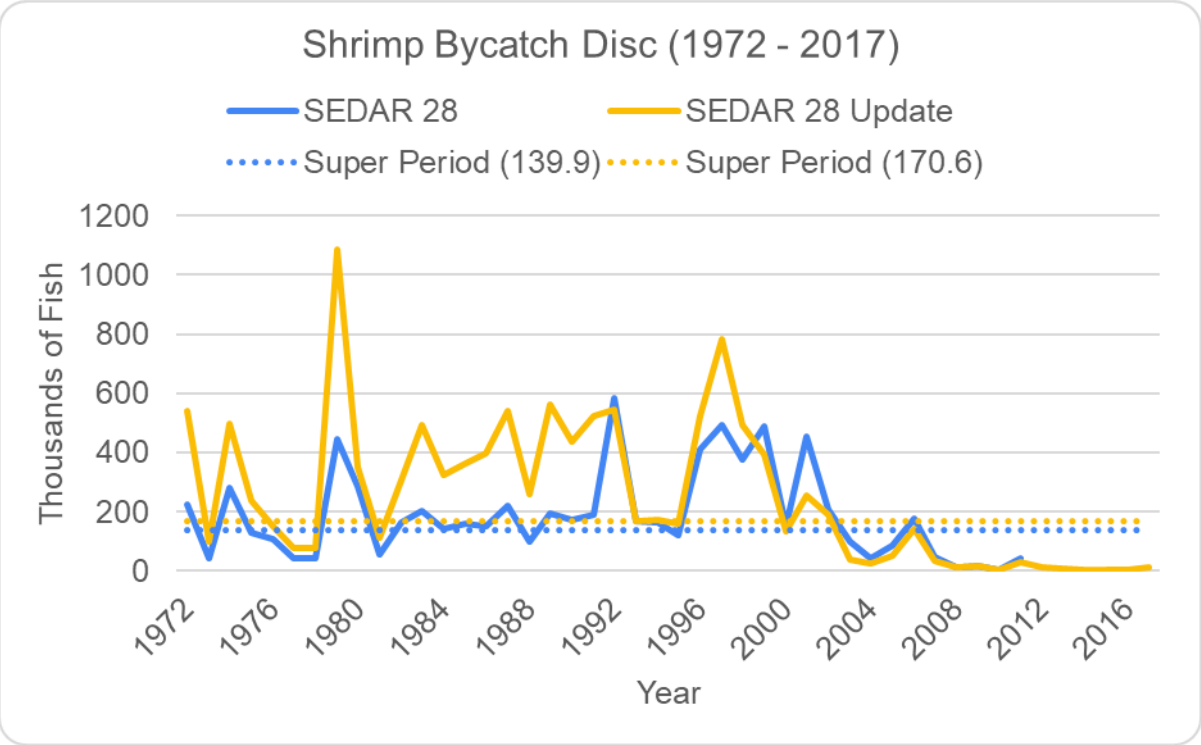
Topic	Decision
Commercial Lengths TIP	TIP length data weighted to better reflect the size composition of landings WP-04; No sample size cap
Commercial Lengths RFOP	Use the length composition data of discarded fish only

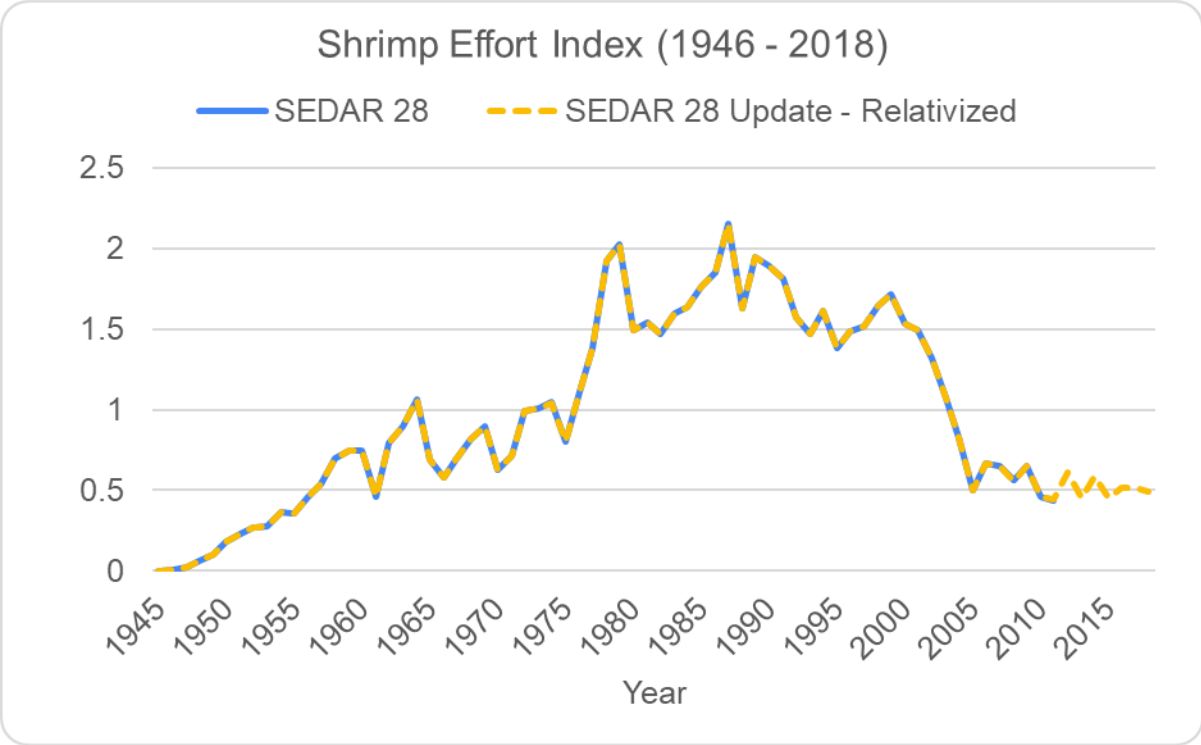




Data Summary – Shrimp Bycatch

Topic	Decision
Shrimp Bycatch	Incorporate use of bycatch reduction devices into the analysis WP-07
Shrimp Effort Index	CV relativized 0.20 for all years





SEDAR 28 Update
Base Model

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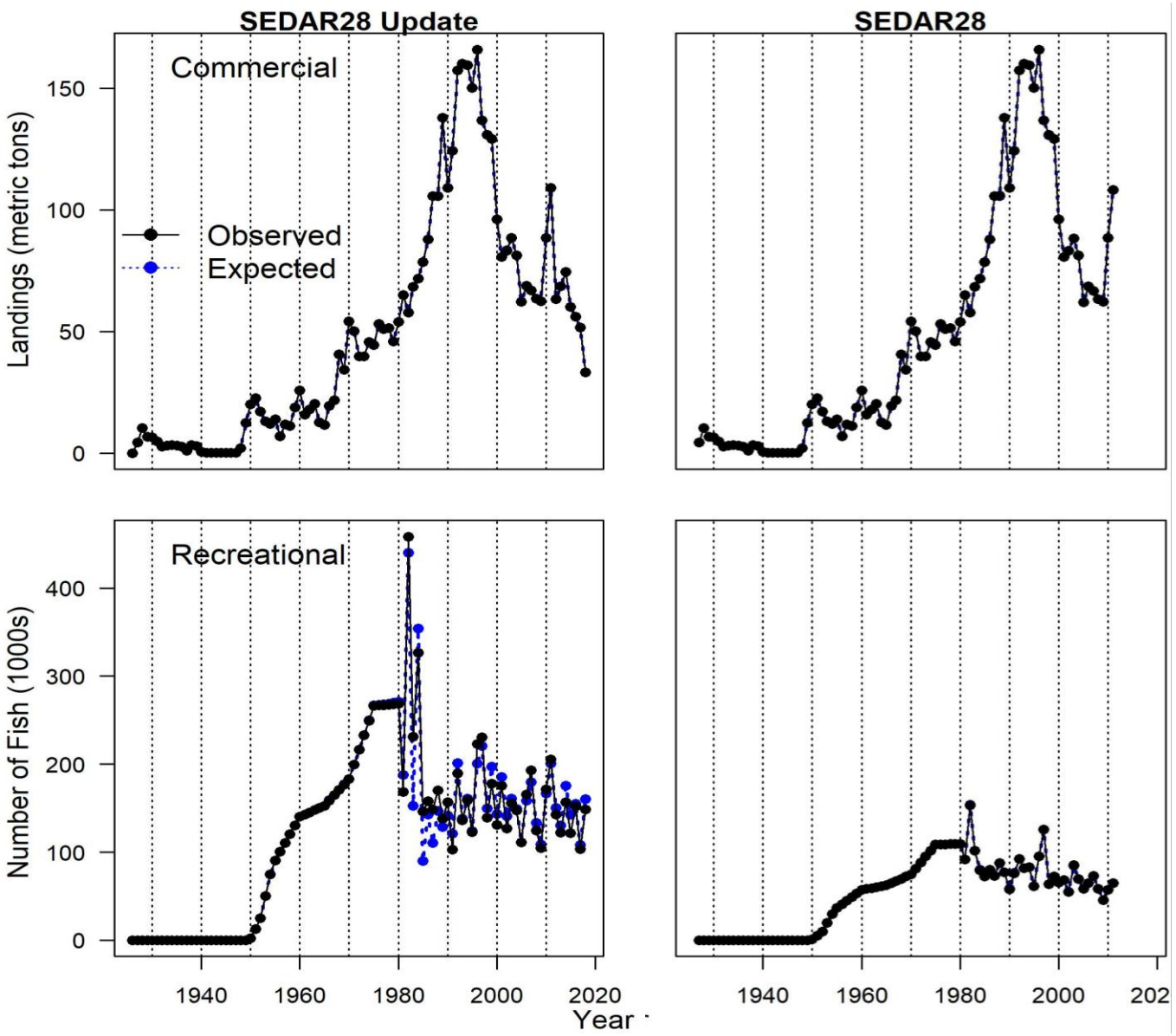
Base Model – Development

Fixed Parameters in bold

Model	Description	SS Version	NLL	Steepness	Sigma R	Ln(R0)	Virgin SSB	Virgin Recruitment (1000s)	L_{max}	K
S28	SEDAR 28 (2013) Stock Assessment Report Base Model; terminal year 2011	3.24	1127.21	0.925	**0.6**	6.94	7235.4	1033.13	133.3	0.21
Step 1	S28 model + rec. landings updated to FES estimates; terminal year 2011	3.24	1176.81	0.664	**0.6**	7.81	17642.4	2455.41	140.5	0.18
Step 2	S28 model + all data inputs updated through terminal year 2018	3.24	3164.28	0.713	**0.6**	7.84	15952.2	2546.16	110.5	0.37
Step 3a	Step 2 model + fixed steepness of 0.8	3.24	3146.15	**0.800**	**0.6**	7.71	14446.4	2231.90	113.9	0.33
Step 3b	Step 2 model + fixed shrimp selectivity + fixed Lmax and K	3.24	3301.15	0.913	**0.6**	7.41	15497.9	1658.40	**128.1**	**0.42**
Step 4	Step 3b model + Francis reweighting and variance adjustment	3.24	279.742	0.789	**0.6**	7.55	18007.0	1904.46	**128.1**	**0.42**
S28U	Step 4 model transitioned to SS3.30 to facilitate mean recruitment projections	3.3	279.795	0.789	**0.6**	7.55	18016.5	1905.64	**128.1**	**0.42**

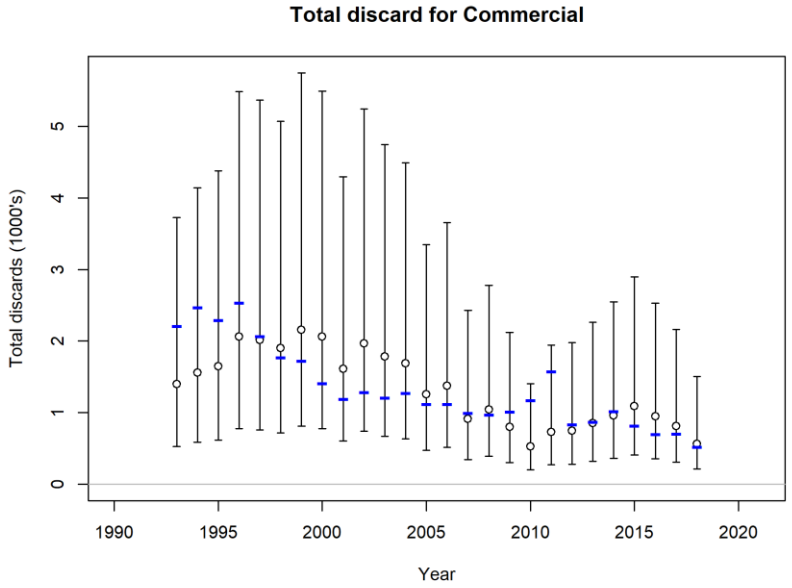
Base Model – Fit

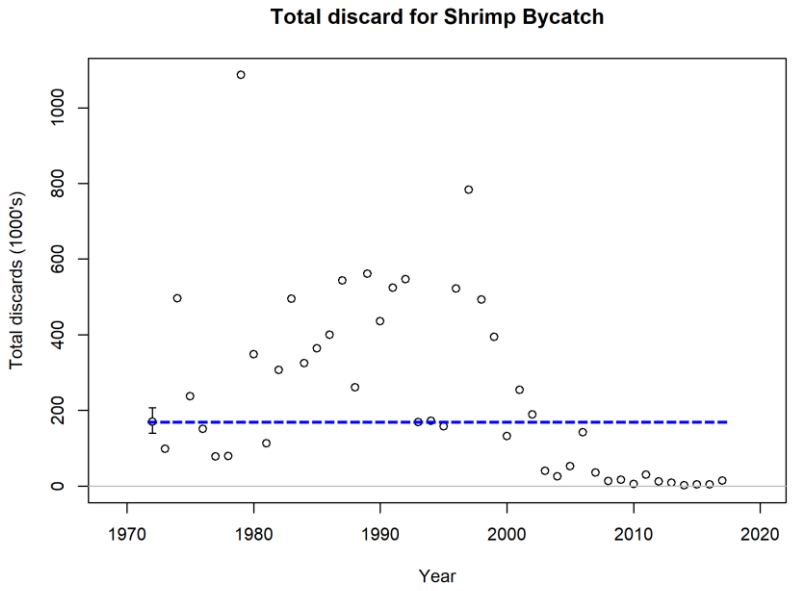
Landings

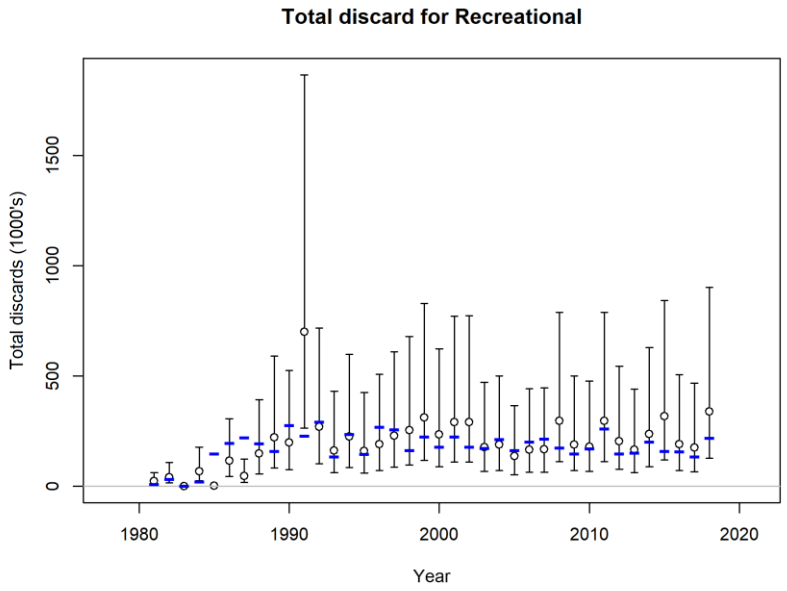


Base Model – Fit

Discards

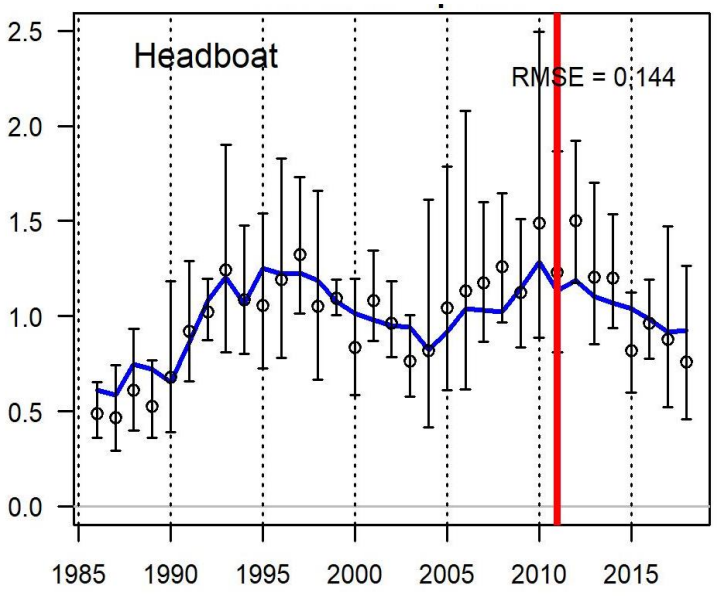


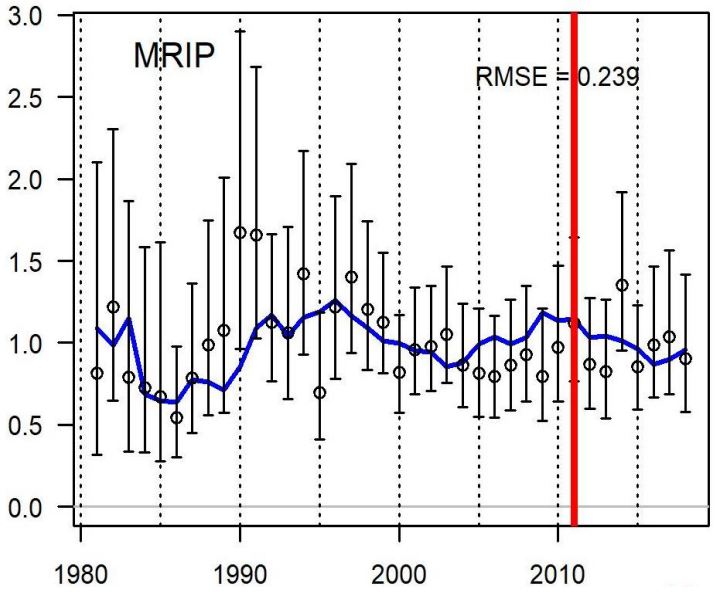


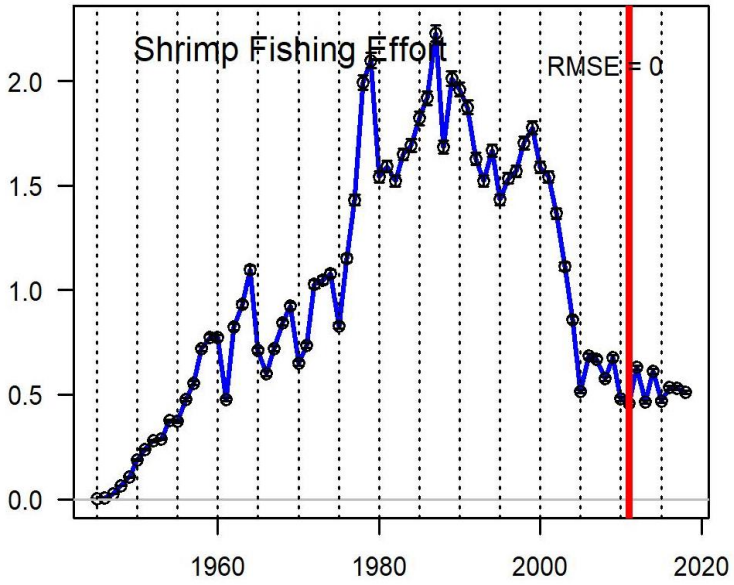


Base Model – Fit

Indices

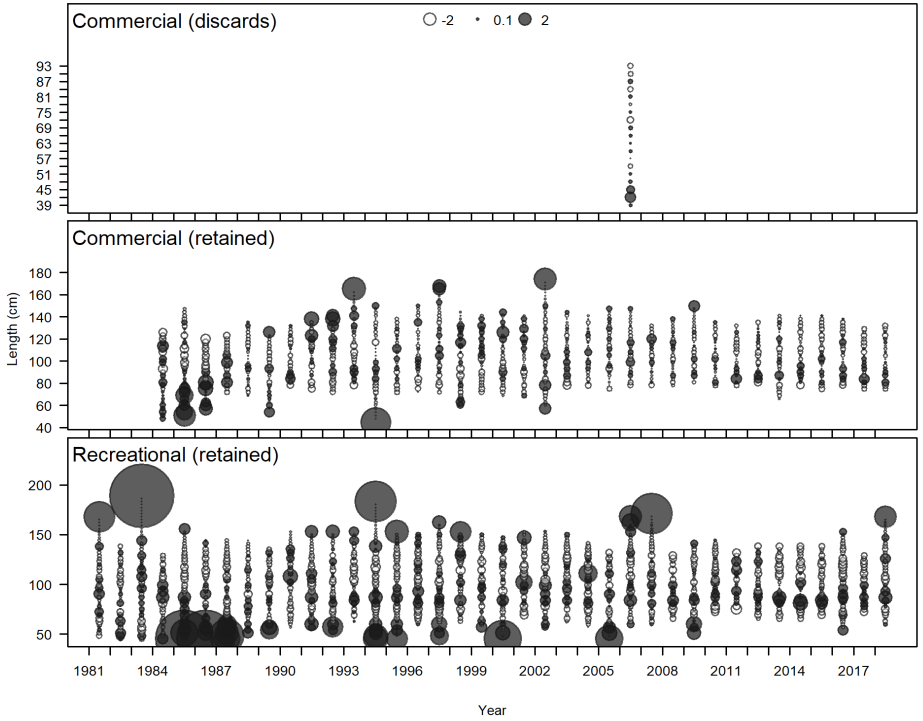


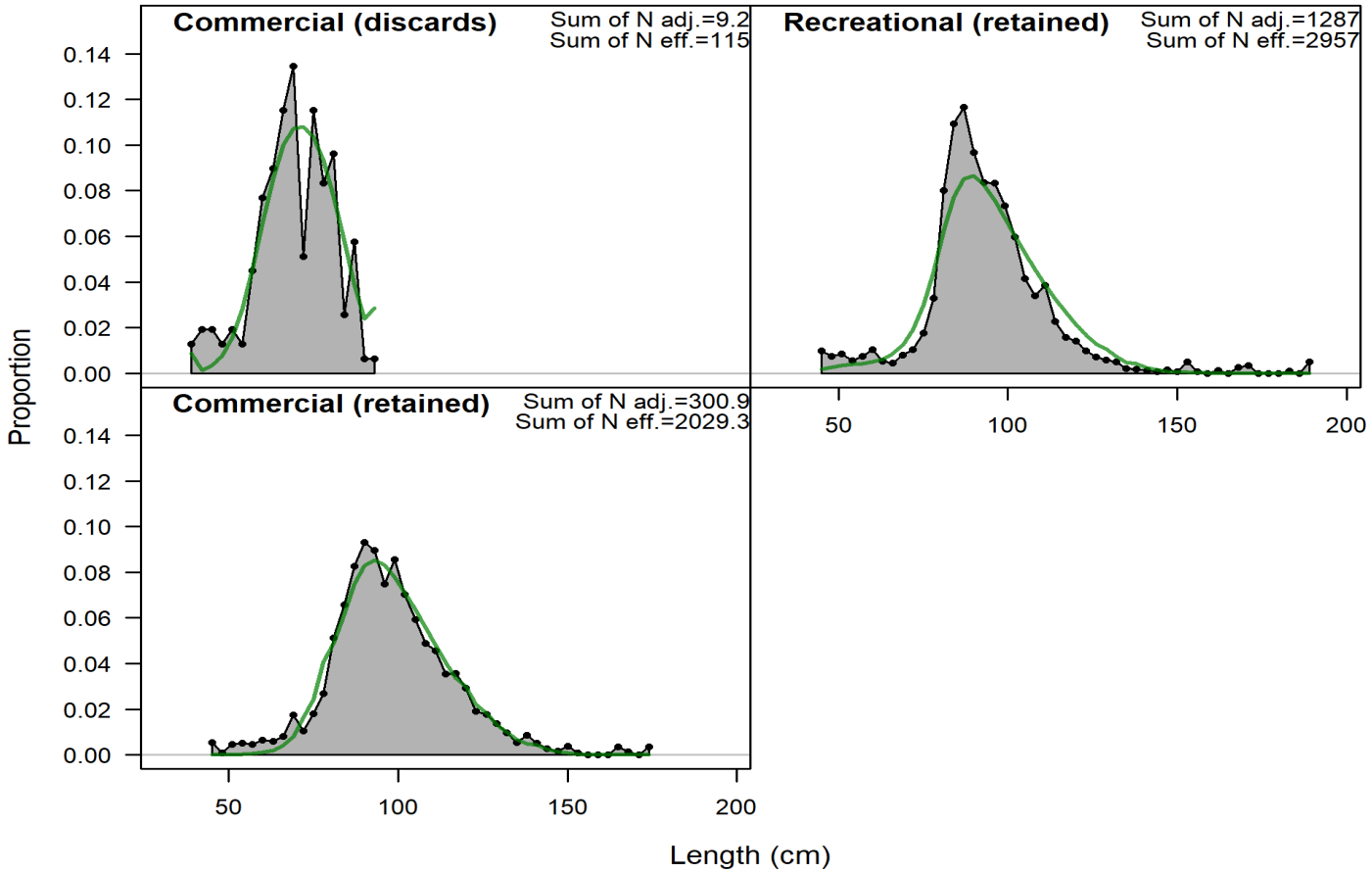




Base Model – Fit

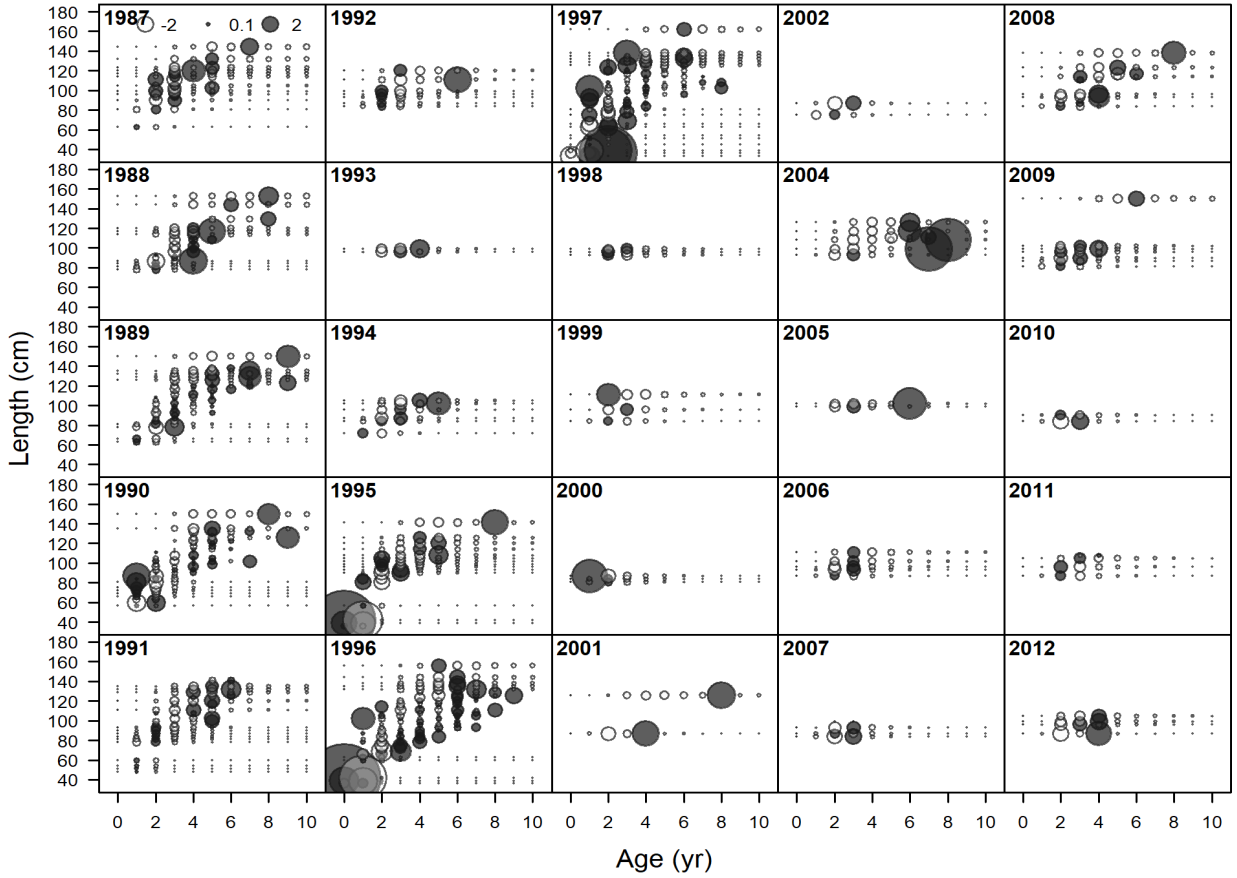
Length Data

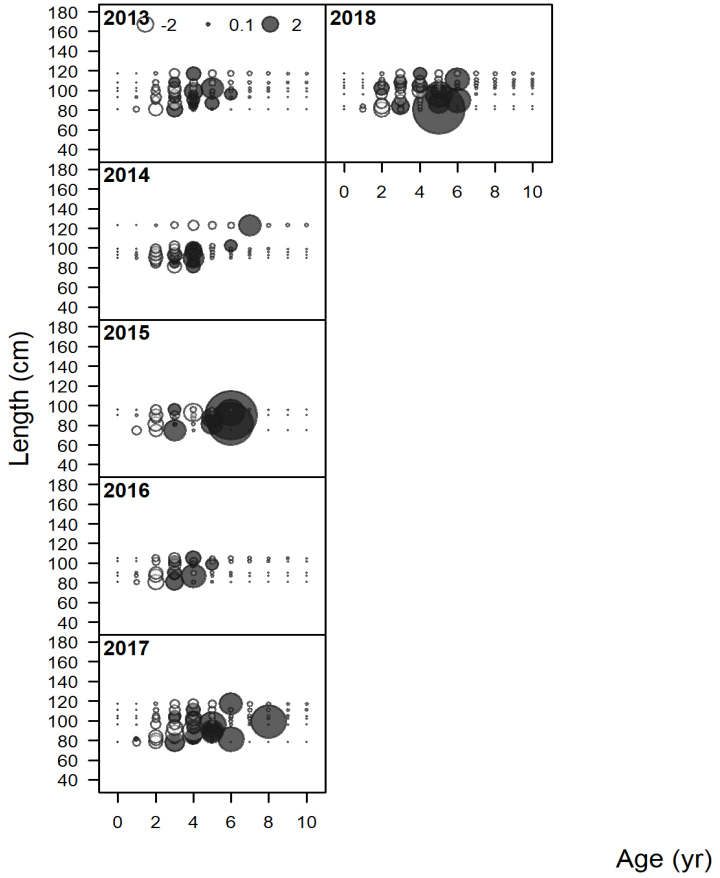




Base Model – Fit

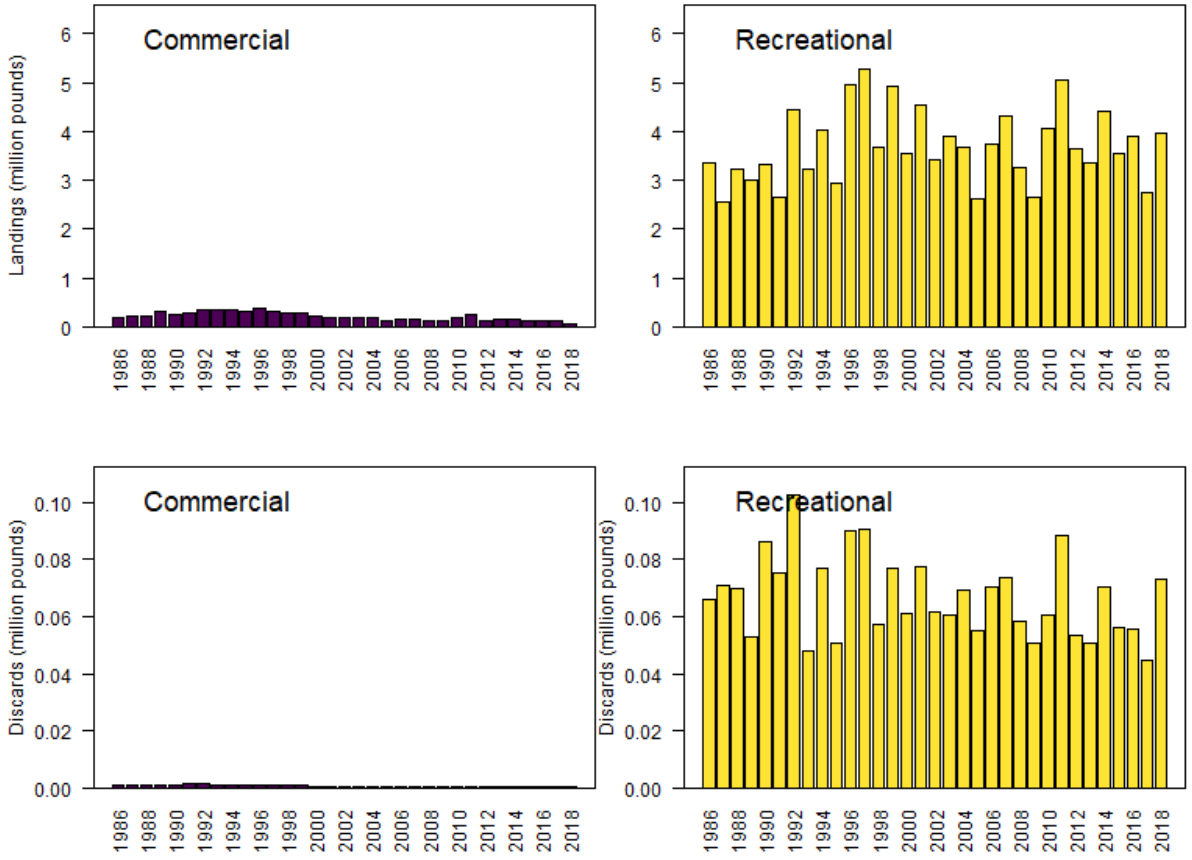
Age Data



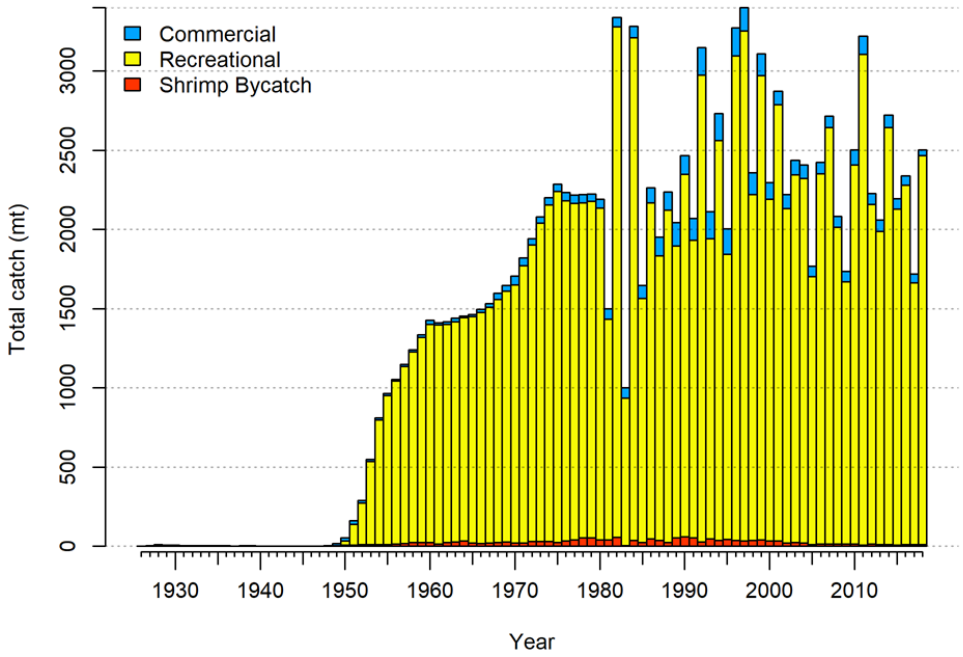


Base Model – Results

Landings and discard estimates for commercial and recreational fisheries in millions of pounds, 1986-2018.



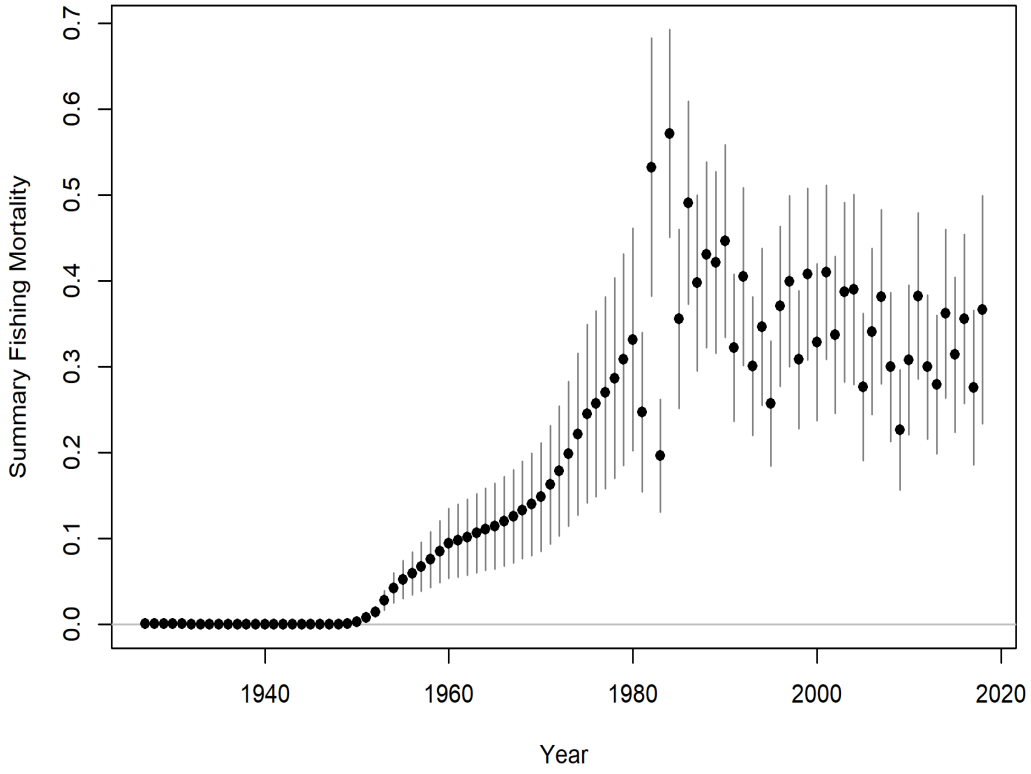
Estimated catch history, includes both landings and discards in metric tons, 1927-2018.

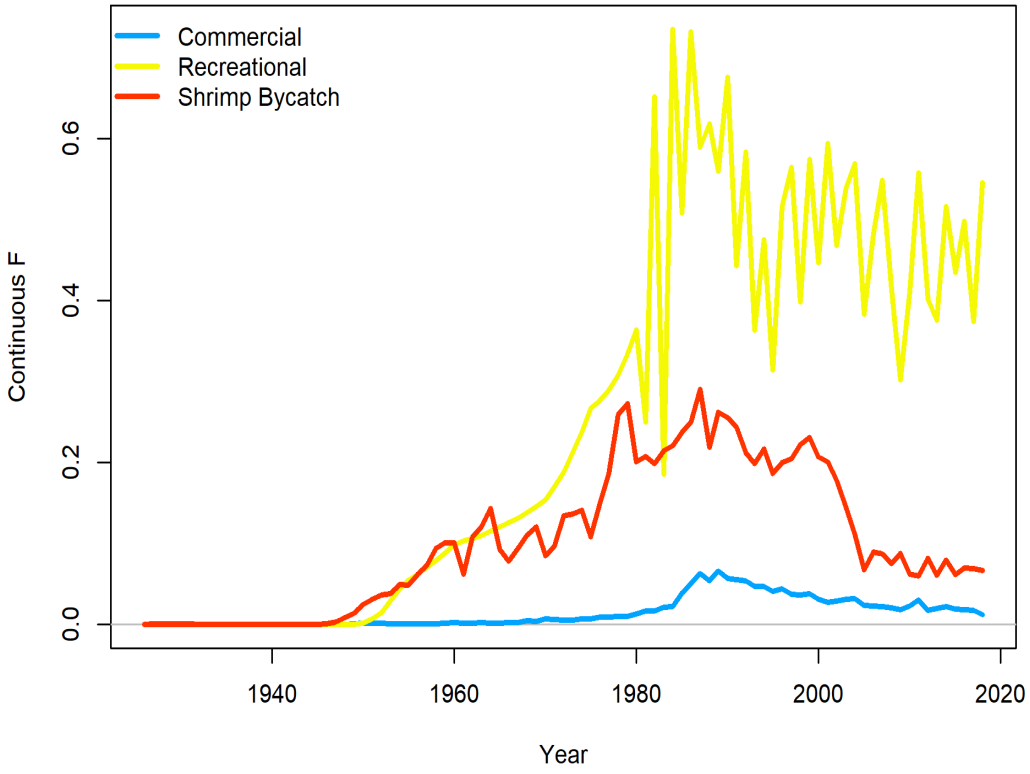


Base Model – Results

Annual exploitation rate (total kill/total biomass) [left]

Fleet-specific estimates of instantaneous fishing mortality rate [right]

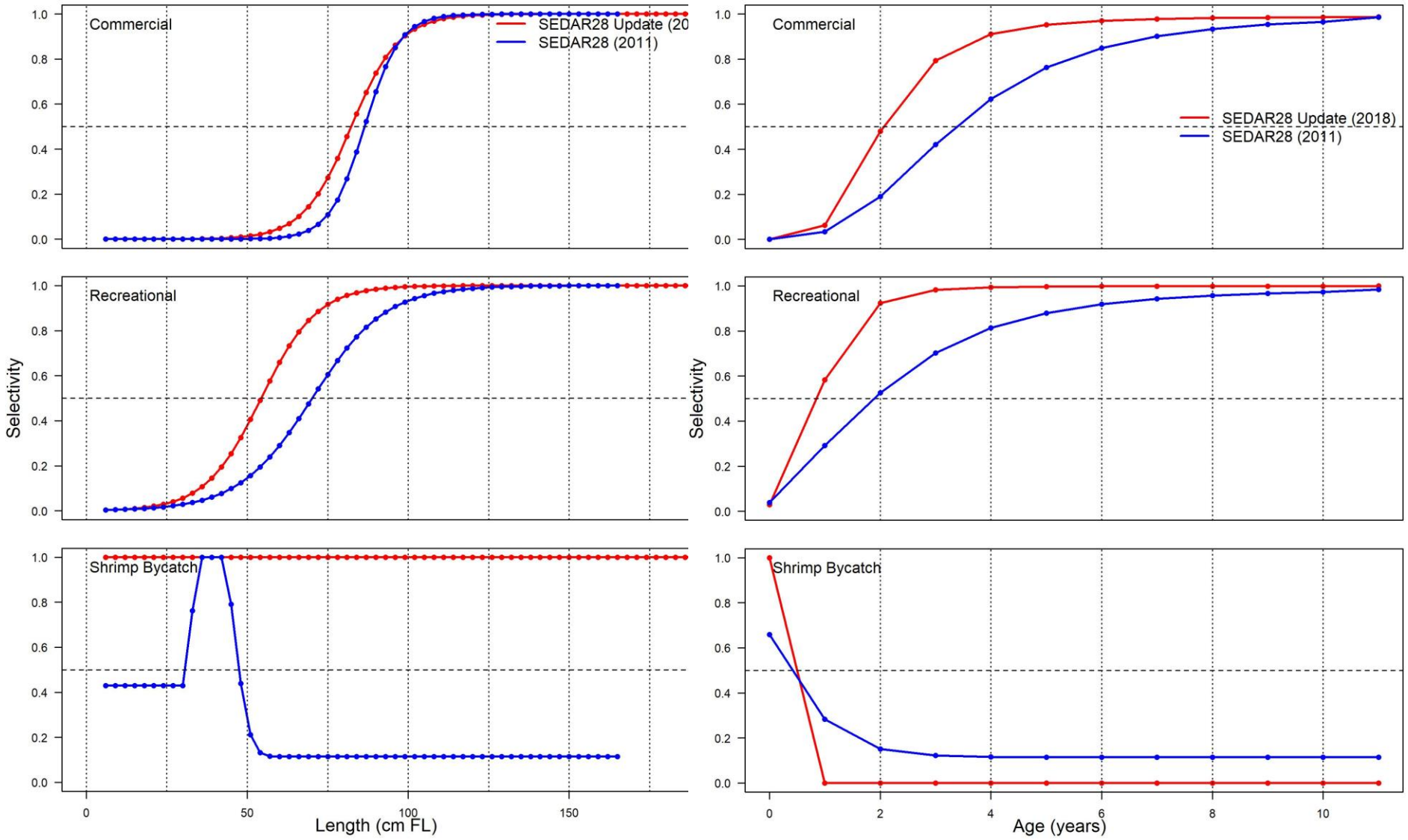




Base Model – Results

Length selectivity [left]

Age selectivity [right]



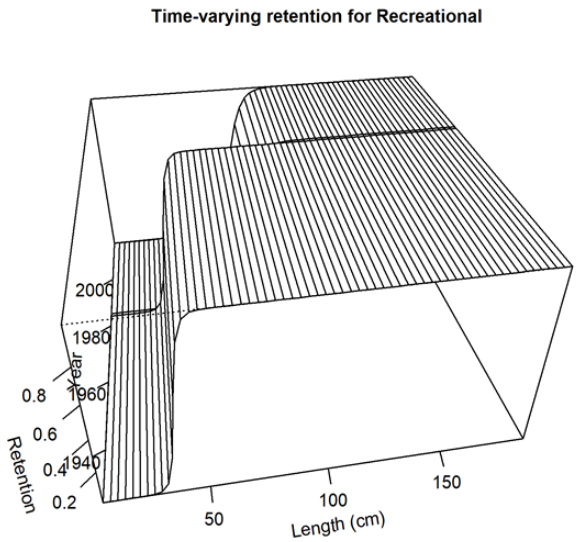
Base Model – Results

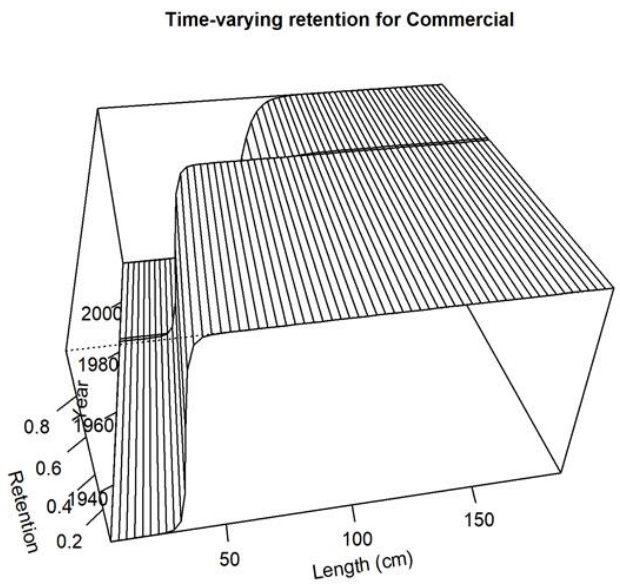
Retention

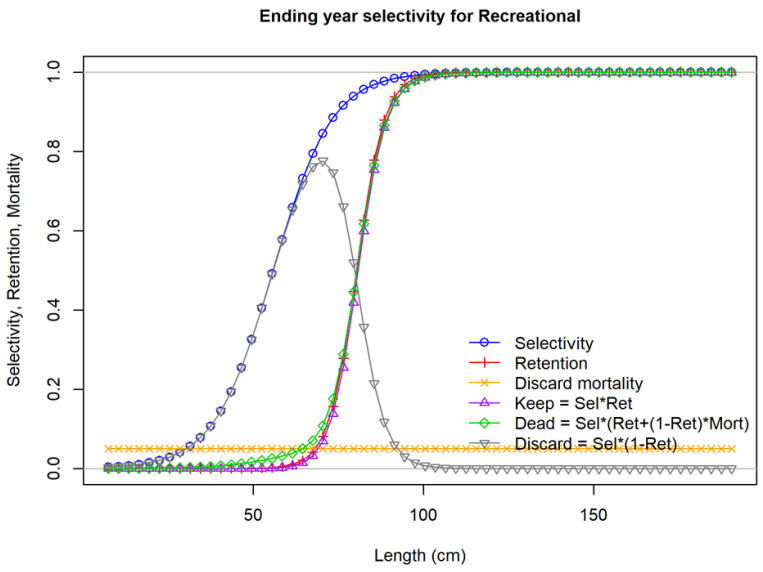
Knife edge in earlier years at 40 cm FL (16 in)

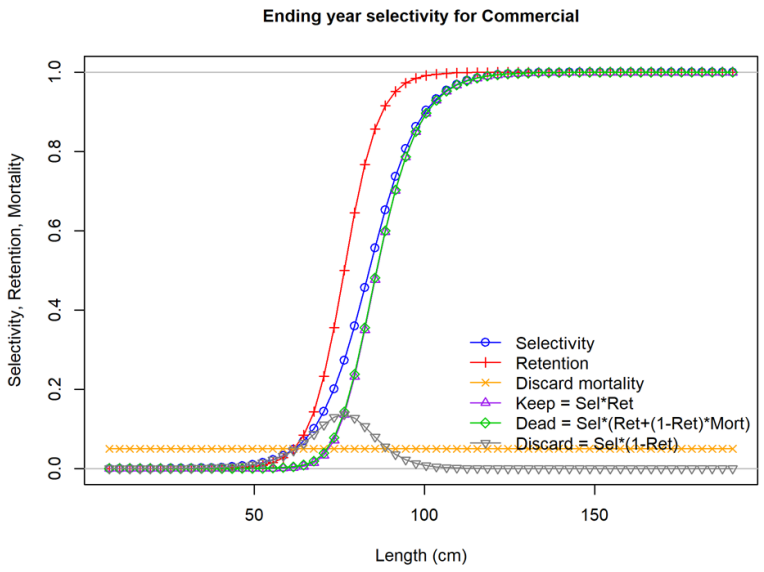
In later years, inflection at 76 cm FL (30 in) for commercial and at 80 cm FL for recreational (31.5 in)

Retention combined with selectivity results in higher discard rates modeled for the recreational fleet than the commercial fleet



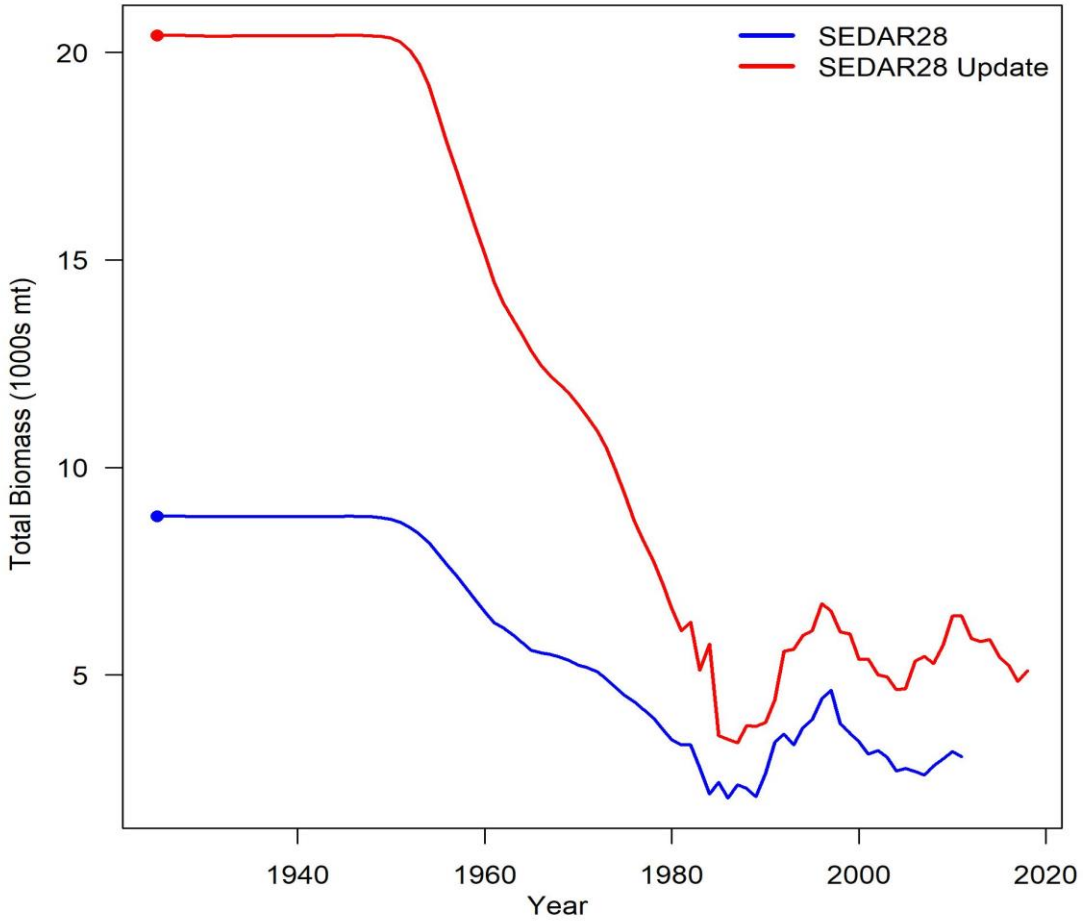


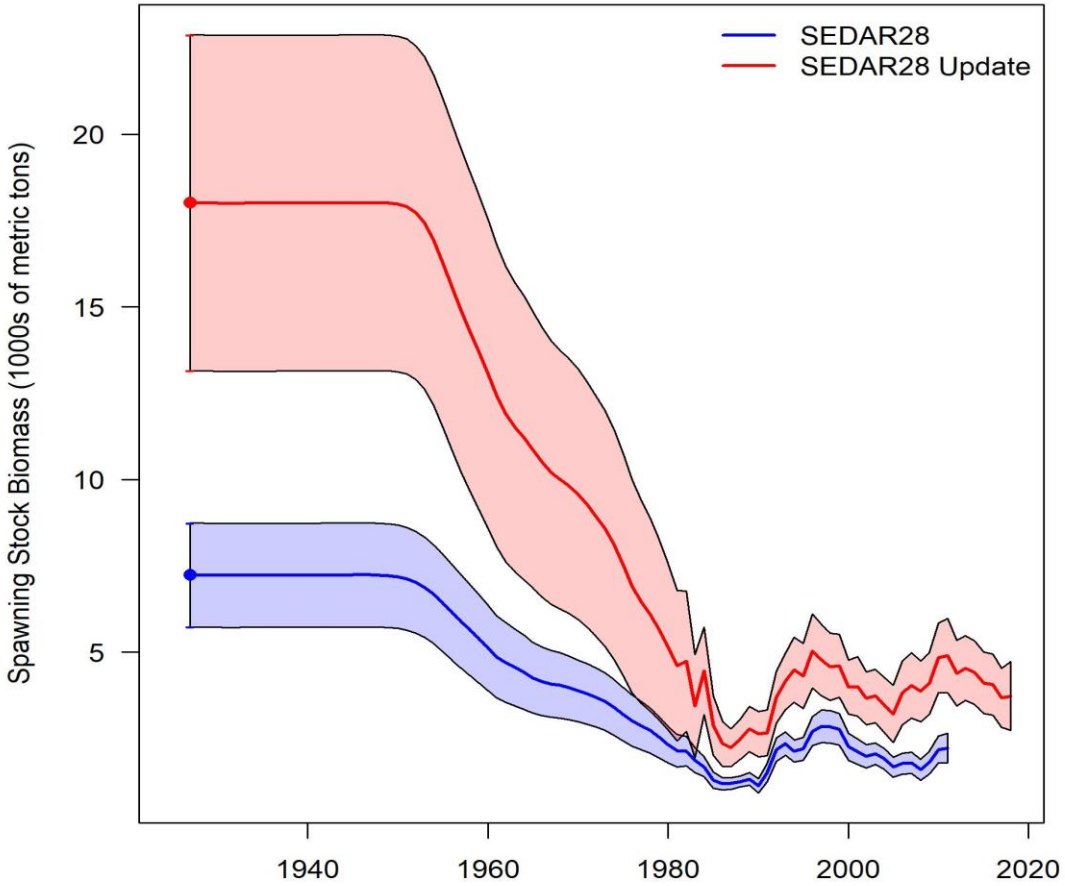




Base Model – Results

Estimate of total biomass [left] and spawning stock biomass [right]

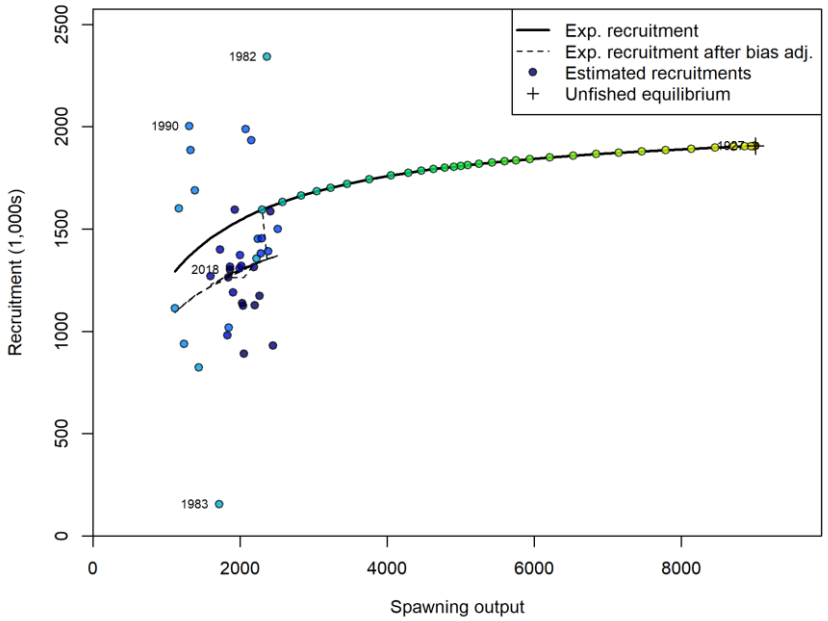


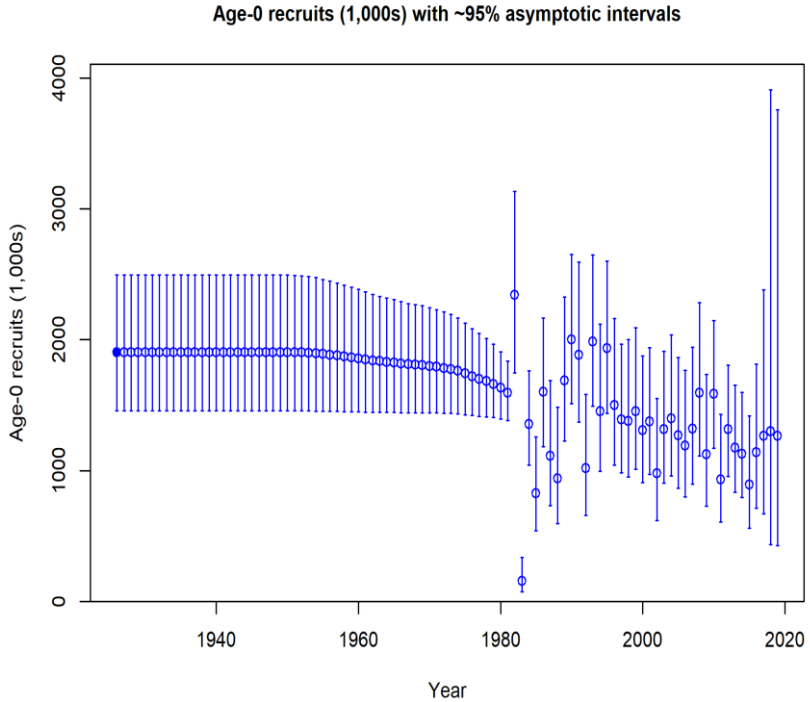


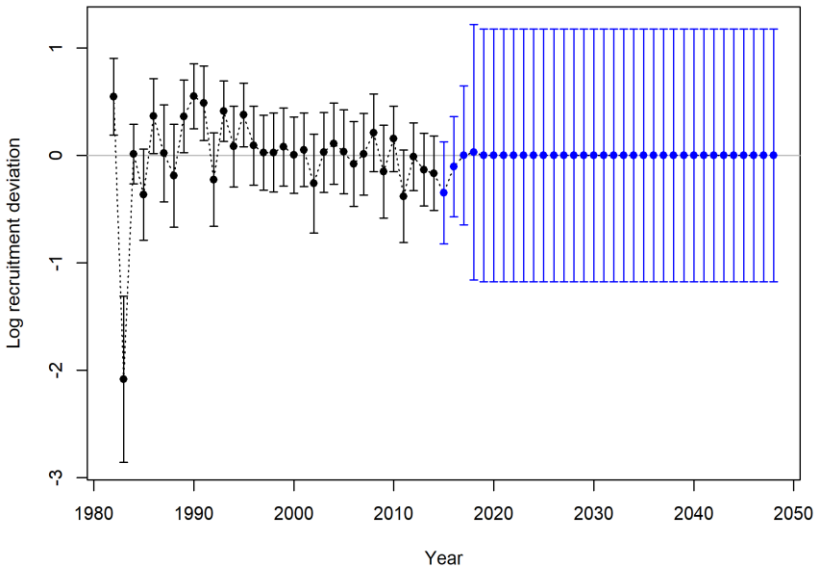
Base Model – Results

Spawner recruitment relationship poorly defined

Highest recruitment in 1982 (2.34 Million) and lowest in 1983 (0.16 million)

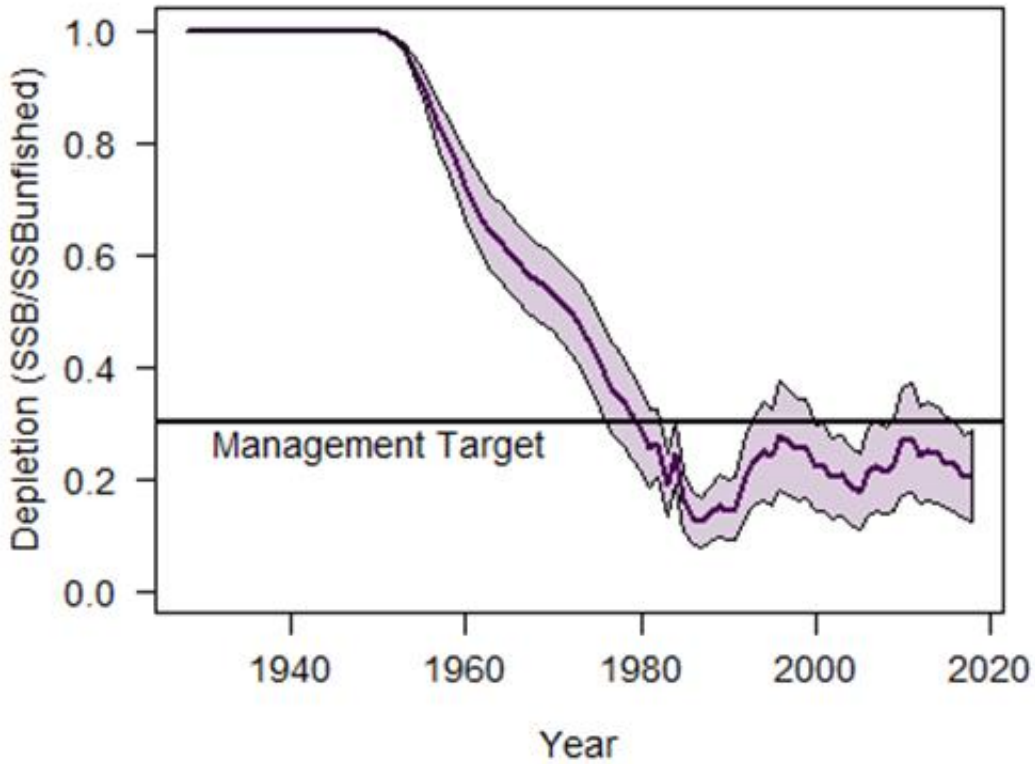


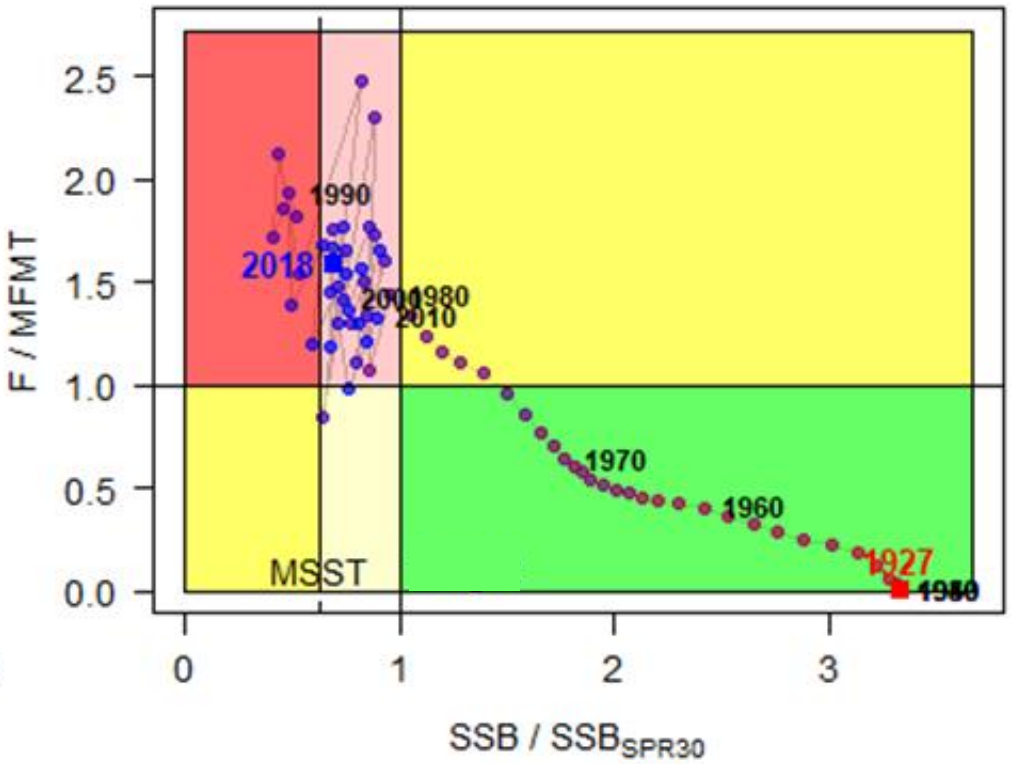




Base Model – Results

- Cobia in the Gulf of Mexico is undergoing overfishing but not overfished
- Terminal year depletion estimate of 21% (SSB_{2018}/SSB_0) remains below the SSB at 30% SPR
- The Kobe plot illustrates that over the course of the years included in the assessment (i.e., 1927 - 2018), the stock has experienced overfishing every year from 1975 through 2018 with the exception of 1983 and 2009

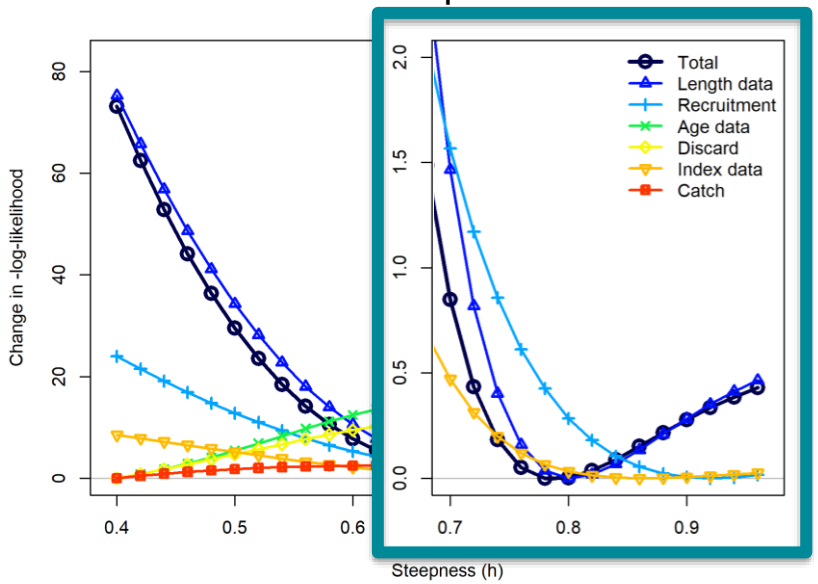




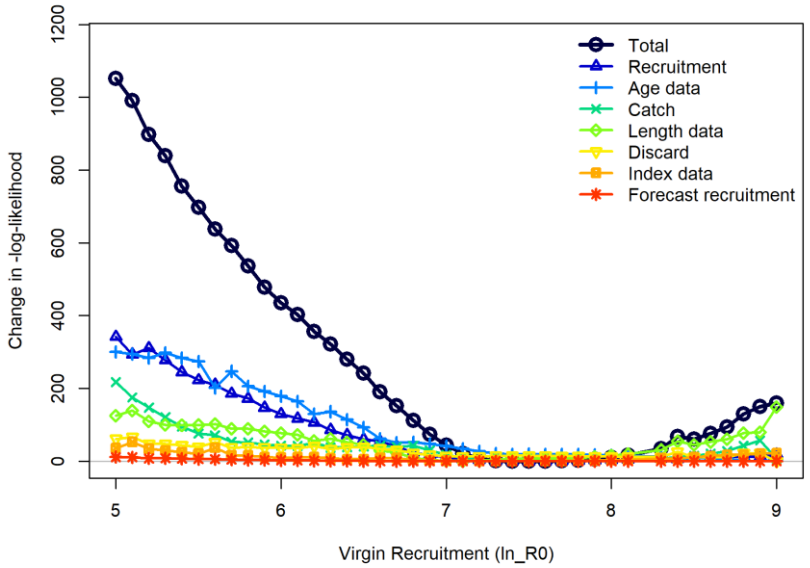
Base Model – Diagnostics

Likelihood Profiles

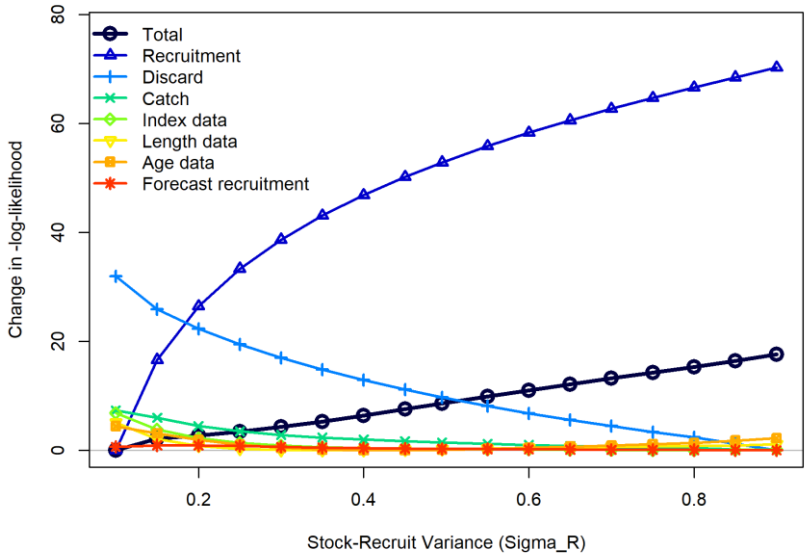
Estimated Steepness = 0.789

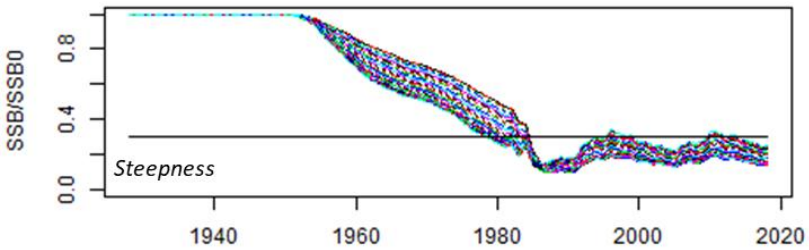


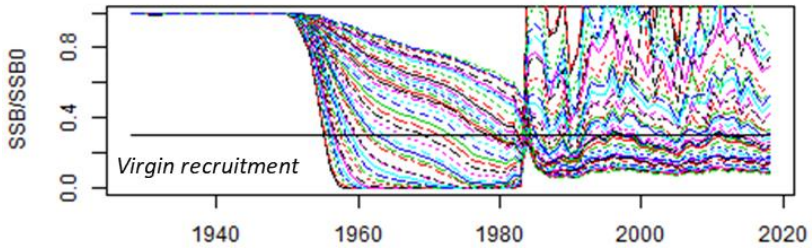
Estimated Ln(R0) = 7.55

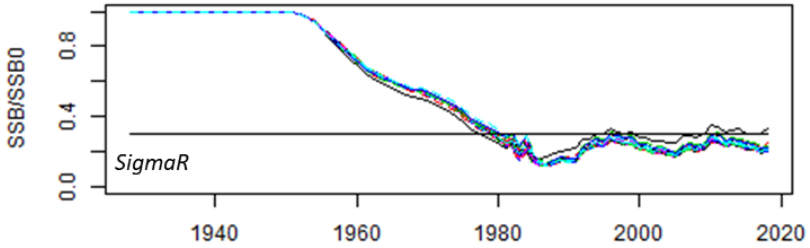


Fixed Sigma R = 0.6





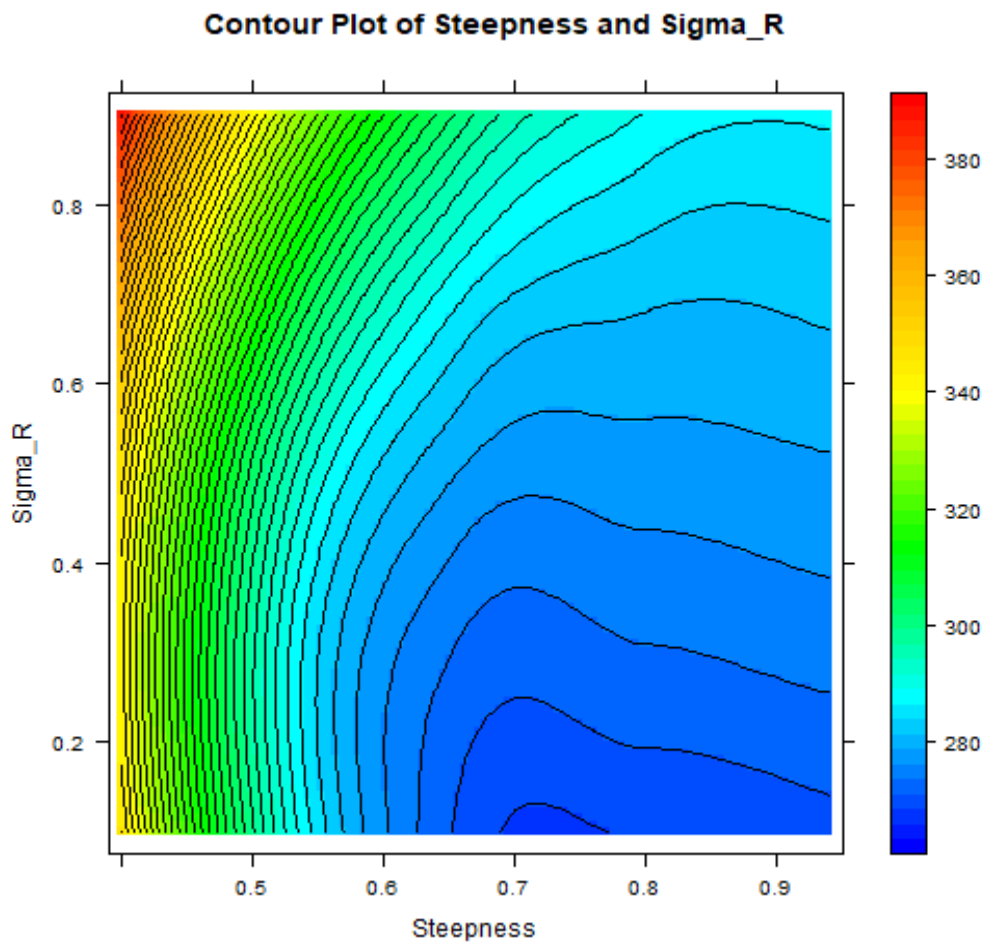




Base Model – Diagnostics

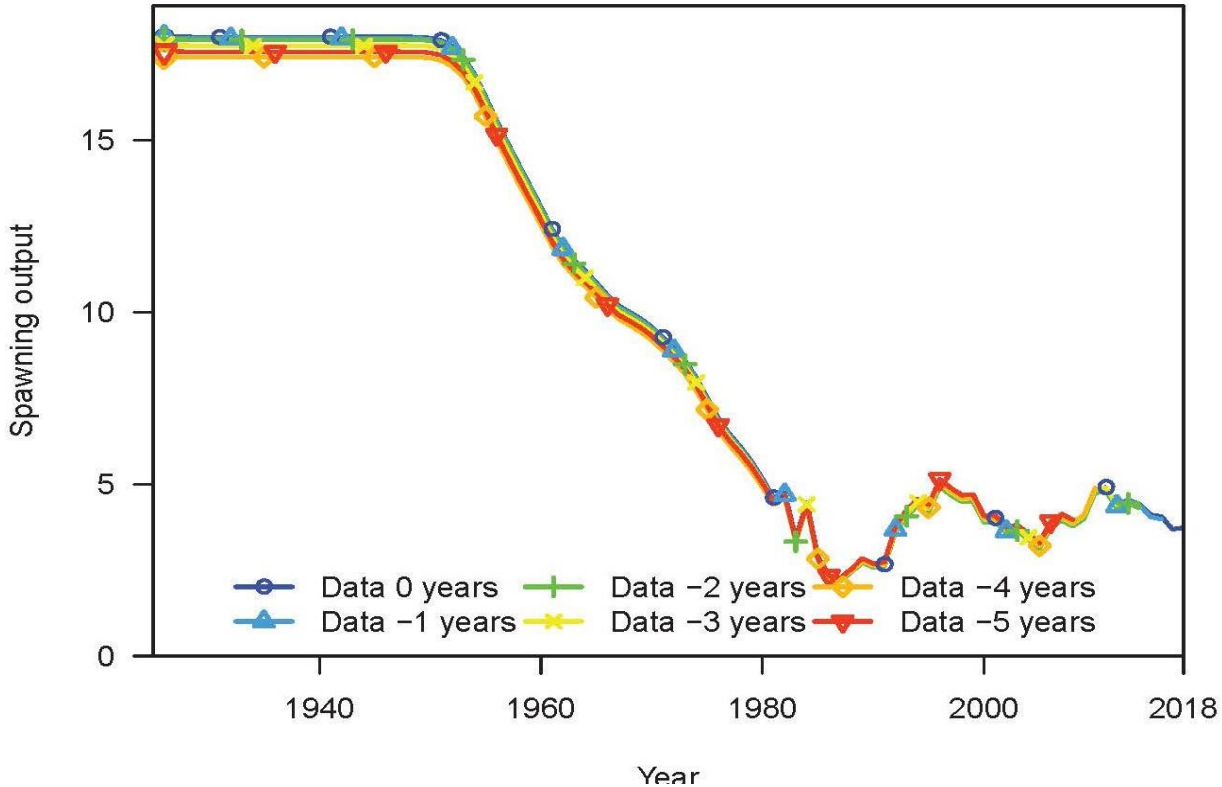
Profile likelihood contour plot of recruitment variance against steepness.

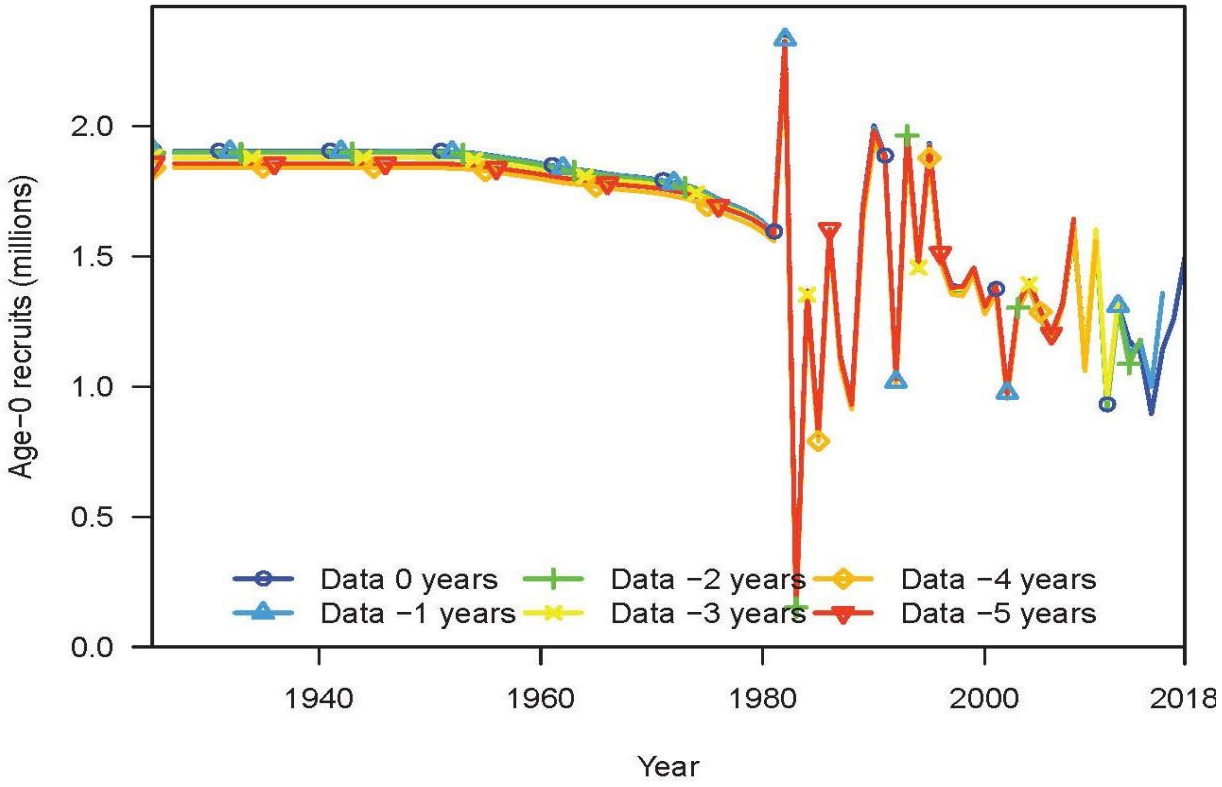
Steepness values above 0.6 and the associated σR pairings below 0.6 are almost equally probably given the data.



Base Model – Diagnostics

Retrospectives illustrate a strong level of consistency within the model



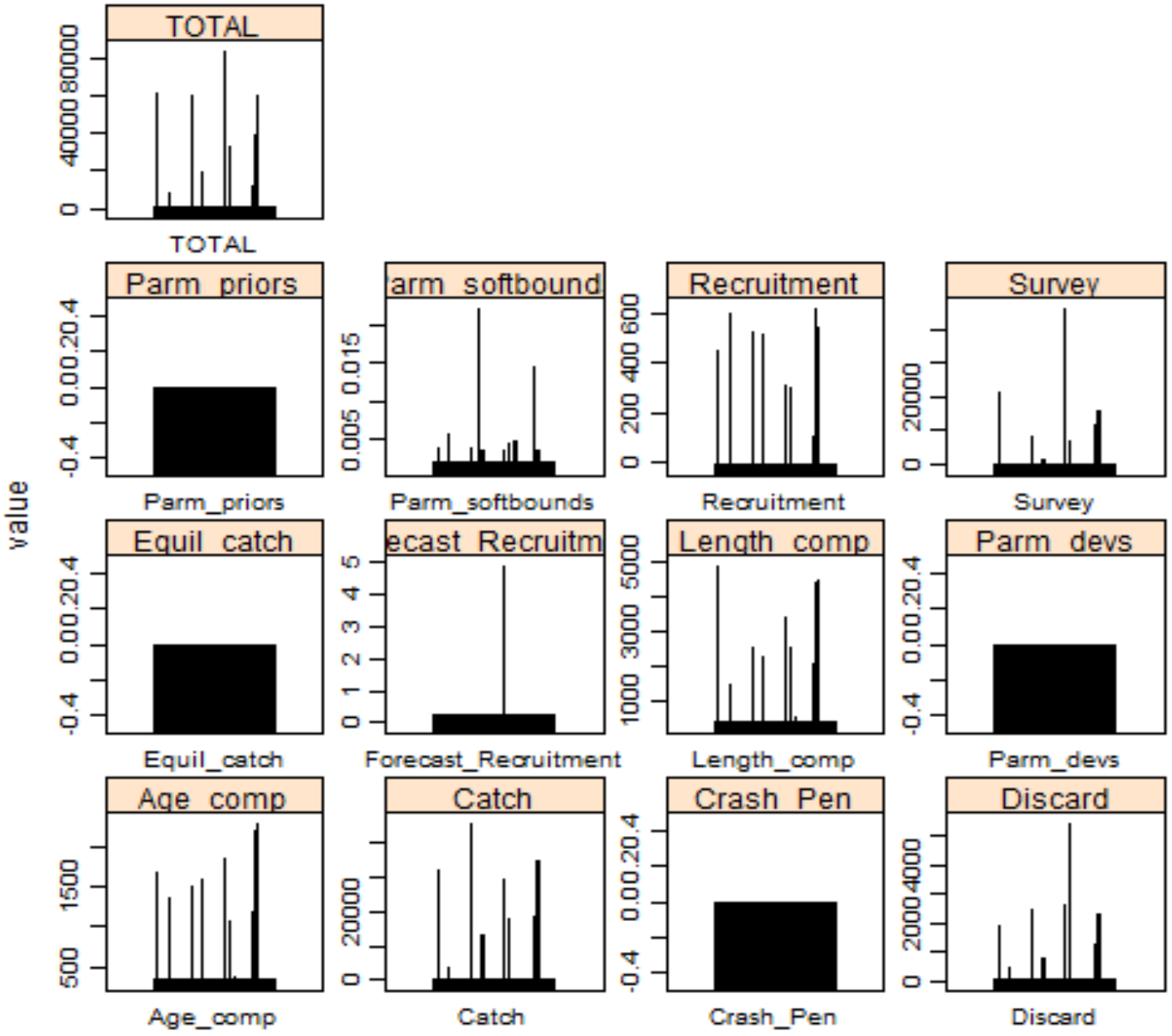


Base Model – Diagnostics

Jitter indicates that the model is fairly stable.

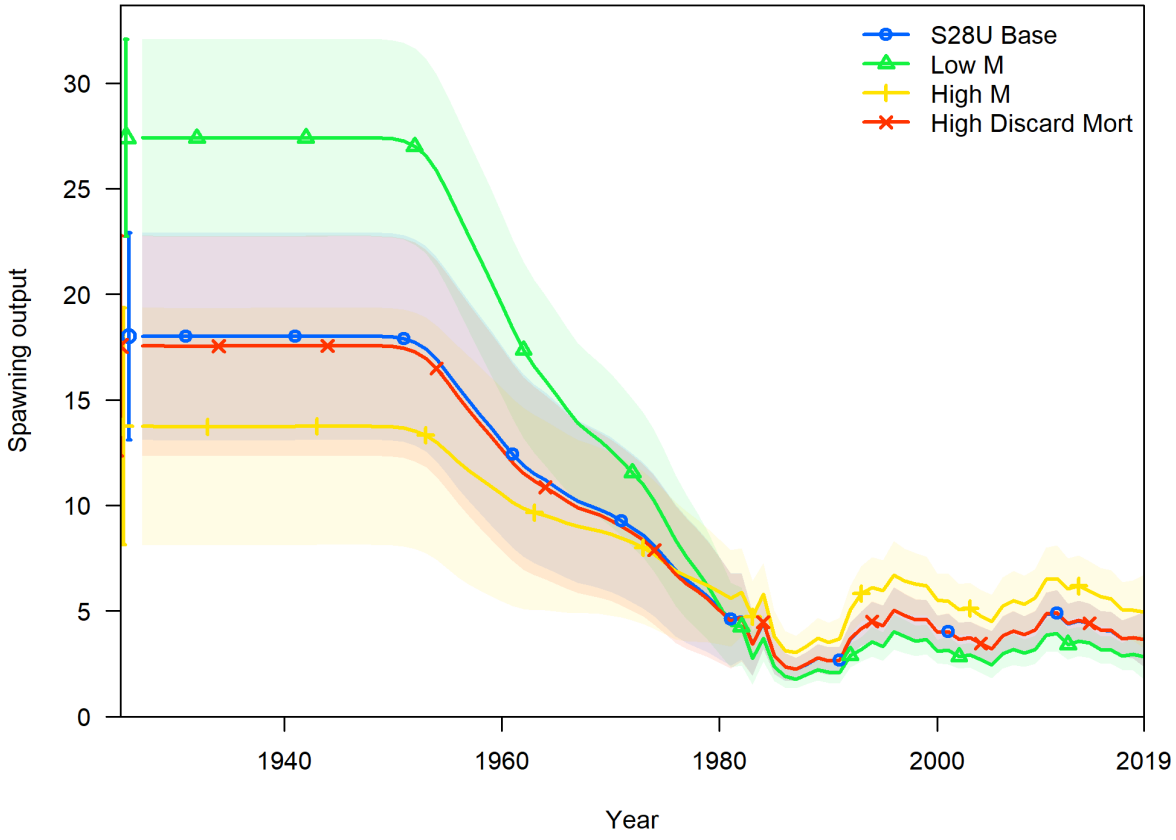
Each panel gives the results of 200 model runs where the starting parameter values for each run were randomly changed ('jittered') by 20% from the base model best fit values.

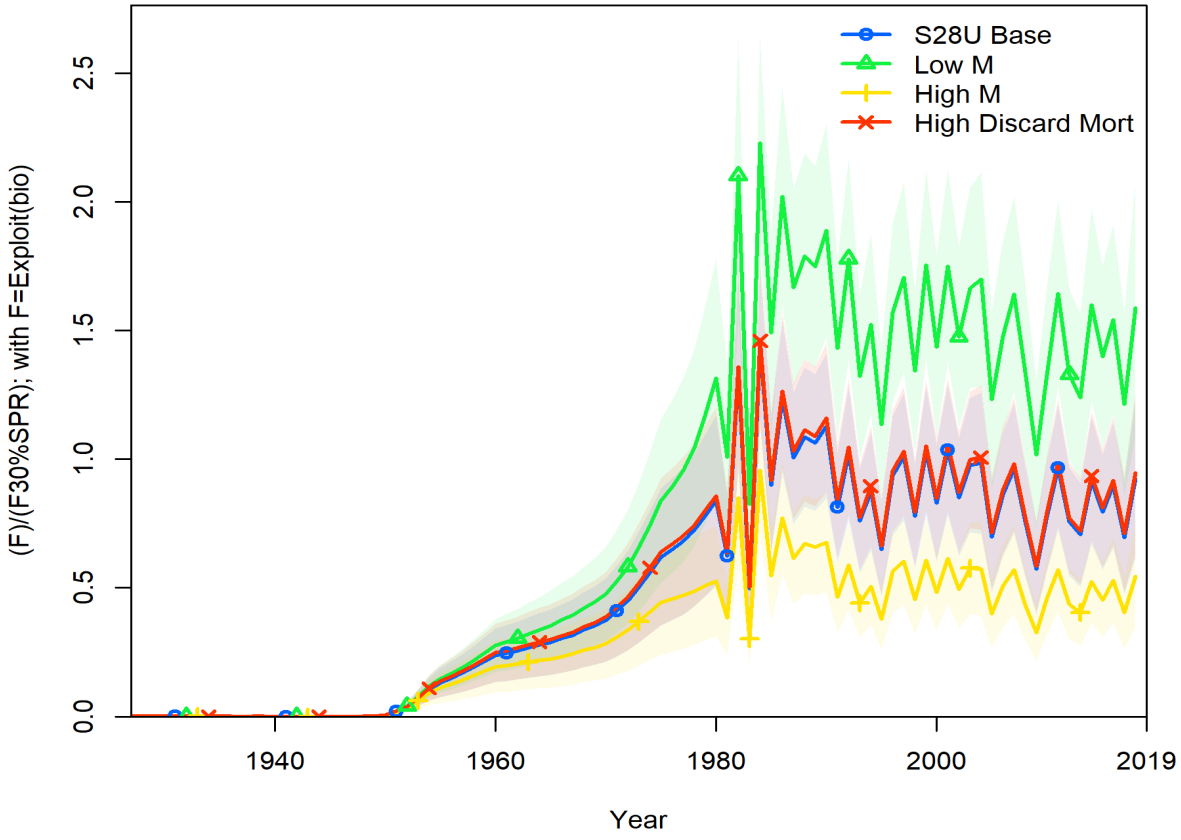
The model was able to converge to same likelihood of the base model in 94% of runs and no runs demonstrated a lower negative log-likelihood solution



Base Model – Diagnostics

Sensitivity Runs





SEDAR 28 Update
Projections

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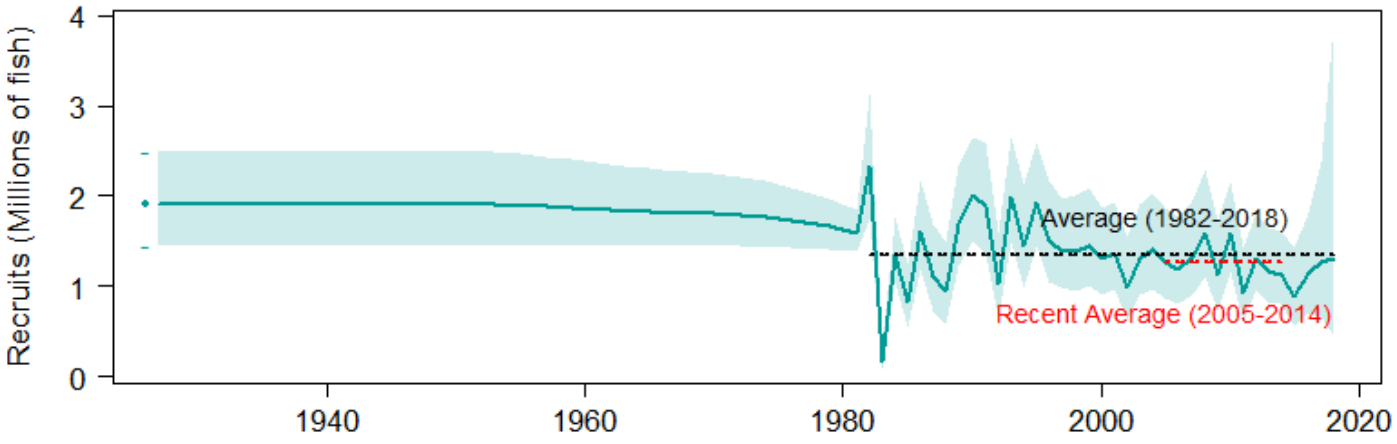
Projection – Settings

Assumptions

- Proxies were calculated based on long-term 30 year projections
  - Equilibrium assumed over last 5 years (2044-2048)
- MSST = $SSB_{SPR30\%}$* (1-M), where M = 0.38 y^{-1} for the base model
- Recruitment was fixed as recent mean (2005-2014)
  - Stock-recruit function parameters were not reliably estimated (i.e., uninformative S/R data and high correlation among parameters)



Projections – Settings

Parameter	Value	Comment
Relative F	Average from 2016-2018	Average relative fishing mortality over terminal three years (2016-2018) of model
Selectivity	Estimates from 2018	Fleet specific selectivity estimated in terminal year
Recruitment	1,263,050	Bias adjusted geometric mean recruitment averaged over recent time period (2005-2014) Time-invariant in projections
Shrimp Bycatch	F = 0.0684	Average shrimp bycatch fishing mortality over terminal three years (2016-2018) of model Time-invariant in projetions
2019 Landings	Comm. = 15.98 (mt ww), Rec. = 125,043 fish	Provisional 2019 Landings adjusted to FES (SERO)
2020 Landings	Comm. = 33.61 (mt ww), Rec. = 125,731 fish	Three year (2017-2019) average

Projections – Settings

Uncertainty

- Fixing recruitment and other parameters (e.g., M) reduced the amount of uncertainty carried through in the projections
- Uncertainty around forecast yield appears too small to support use of P* approach to setting ABC
- Alternate approach for accounting for uncertainty (e.g. 75%F_{SPR30}) is recommended

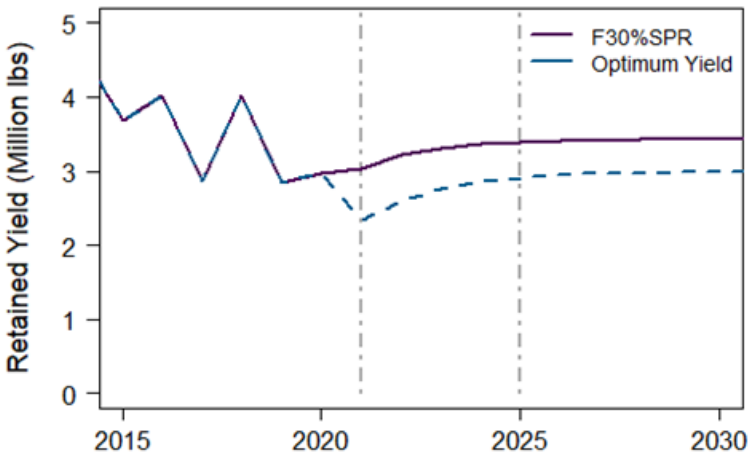
Projections – Results

Mortality Rate Criteria		
$F_{SPR30\%}$	Equilibrium F that achieves $SPR_{30\%}$	0.231
MFMT $F_{SPR30\%}$	$F_{SPR30\%}$	0.231
F at Optimum Yield	0.75 * Directed F at $F_{SPR30\%}$	0.179
$F_{Current}$	Average (F_{2016} - F_{2018})	0.33
$F_{Current}/MFMT_{FSPR30\%}$	Current stock status based on $F_{SPR30\%}$	1.44
Biomass Criteria		
$SSB_{FSPR30\%}$	Equilibrium SSB at $F_{SPR30\%}$	5406
$MSST_{FSPR30\%}$	$(1-M)*SSB_{FSPR30\%}$	3352
SSB at Optimum Yield	Equilibrium SSB when Directed F = 0.75 * Directed F at $F_{SPR30\%}$	6227
SSB_0	Virgin SSB	18016
$SSB_{Current}$	SSB_{2018}	3725
$SSB_{Current}/ SSB_{FSPR30\%}$	Current stock status based on $SSB_{FSPR30\%}$	0.69
$SSB_{Current}/ MSST_{FSPR30\%}$	Current stock status based on $MSST_{FSPR30\%}$	1.11
$SSB_{Current}/ SSB_0$	2018 SPR	0.21

Projections – Results

Projections at SPR

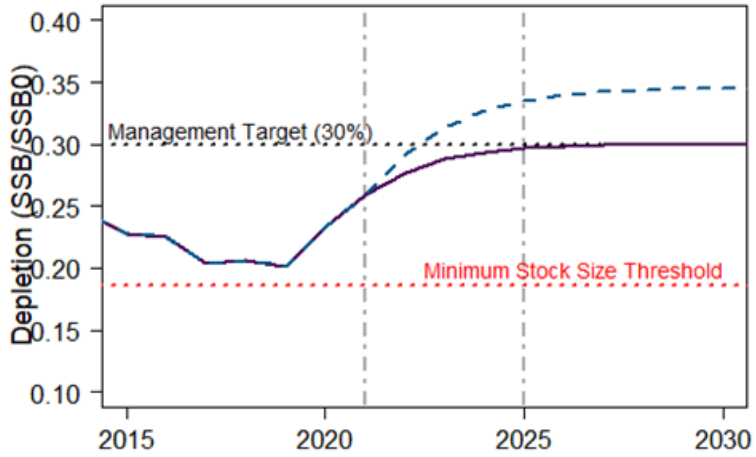
ABC based on P* of 0.398



YEAR	R	F	F/MFMT	SSB	$SSB/SSB_{FSPR30\%}$	SSB/MSST	SSB/SSB_0	OFL	ABC
2021	1263.05	0.230	0.996	4.66E+03	0.86	1.39	0.26	3.03	2.81
2022	1263.05	0.231	0.999	4.99E+03	0.92	1.49	0.28	3.21	3.06
2023	1263.05	0.231	1.000	5.19E+03	0.96	1.55	0.29	3.31	3.21
2024	1263.05	0.231	1.000	5.29E+03	0.98	1.58	0.29	3.37	3.30
2025	1263.05	0.231	1.000	5.35E+03	0.99	1.59	0.30	3.40	3.34
2026	1263.05	0.231	1.000	5.37E+03	0.99	1.60	0.30	3.41	3.36
2027	1263.05	0.231	1.000	5.39E+03	1.00	1.61	0.30	3.42	3.37
2028	1263.05	0.231	1.000	5.40E+03	1.00	1.61	0.30	3.42	3.38
2029	1263.05	0.231	1.000	5.40E+03	1.00	1.61	0.30	3.42	3.38
2030	1263.05	0.231	1.000	5.40E+03	1.00	1.61	0.30	3.43	3.38

Projections at OY

Directed F = 0.75*Directed F at $F_{SPR30\%}$



YEAR	R	F	F/MFMT	SSB	$SSB/SSB_{FSPR30\%}$	SSB/MSST	SSB/SSB_0	OY
2021	1263.05	0.178	0.771	4.66E+03	0.86	1.39	0.26	2.34
2022	1263.05	0.179	0.775	5.26E+03	0.97	1.57	0.29	2.60
2023	1263.05	0.179	0.777	5.66E+03	1.05	1.69	0.31	2.76
2024	1263.05	0.180	0.778	5.90E+03	1.09	1.76	0.33	2.86
2025	1263.05	0.180	0.778	6.04E+03	1.12	1.80	0.34	2.91
2026	1263.05	0.180	0.778	6.12E+03	1.13	1.83	0.34	2.95
2027	1263.05	0.180	0.778	6.17E+03	1.14	1.84	0.34	2.96
2028	1263.05	0.180	0.778	6.19E+03	1.15	1.85	0.34	2.97
2029	1263.05	0.180	0.778	6.21E+03	1.15	1.85	0.34	2.98
2030	1263.05	0.180	0.778	6.22E+03	1.15	1.85	0.35	2.98

Projections – Results for SEDAR 28 with FES Landings

- Updating the SEDAR 28 base model with the FES recreational landings resulted in notably increased estimates of virgin spawning stock biomass, recruitment, and projected yields
- Had the FES recreational landings been available during SEDAR 28 the equilibrium yield estimate would have been about 4.87 million pounds rather than the 2.66 million pounds estimated at the time
- Assuming the ABC from the hypothetical SEDAR 28 FES run had been about 4.5 million pounds, the current recommendation of around 3 million pounds would represent a roughly 33% decrease in yield rather than the large increase in yield that it appears to be.

Model	Terminal Year	SSB	R	F_{SPR30}	SSB_0	SSB_{FSPR30}	Equil. Yield
SEDAR 28	2011	1896	751.5	0.378	7235	2065	2.66
SEDAR 28 FES	2011	3643	1429.5	0.094	17642	5280	4.87
SEDAR 28 Update	2018	3956	1270.9	0.231	18016	5406	3.43

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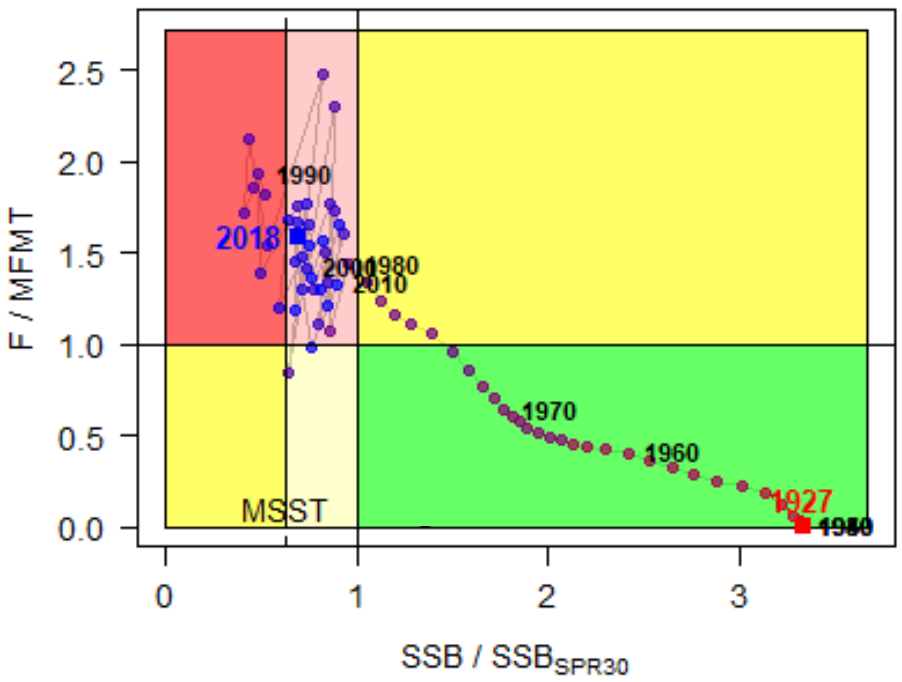
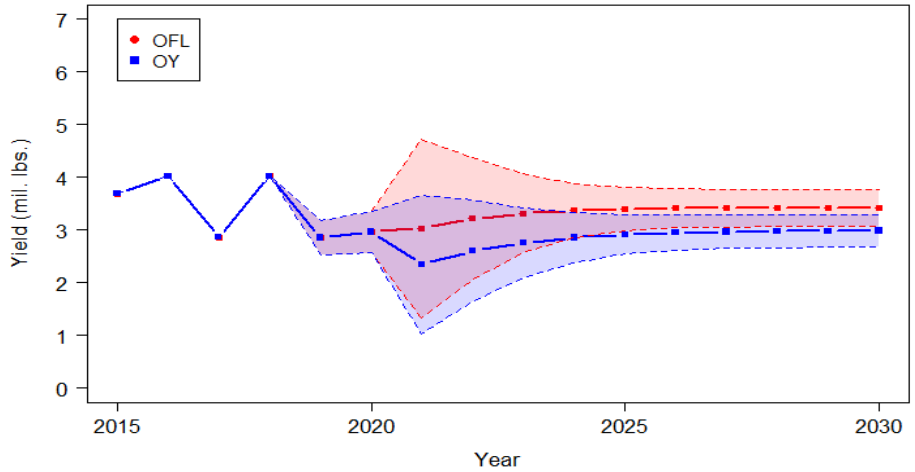
Summary

- Gulf of Mexico cobia are in a precarious state with overfishing occurring and biomass at reduced levels (depletion estimate SSB_{2018}/SSB_0 = 21%).
- The transition from the CHTS recreational landings estimates to the FES recreational landings estimates contributed to the majority of the change in yield recommendations when compared to SEDAR 28.
- The current projections should be updated regularly to account for changes in recruitment dynamics.





SEDAR 28 Update
Questions?