SEDAR 81: US Gulf of Mexico Spanish Mackerel

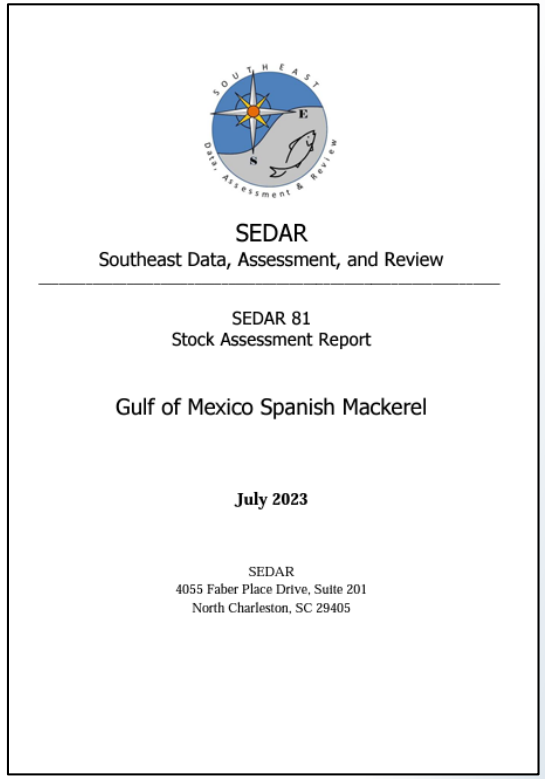
Operational Assessment

Gulf Branch SFD
NOAA Fisheries - SEFSC

SSC Meeting • July 2023 • Tampa, FL

Outline

- Overview
- Data
- Results
- Diagnostics
- Sensitivity Runs
- Conclusions & Recommendations
- Benchmarks, Stock Status and Projections



SEDAR
Southeast Data, Assessment, and Review

SEDAR 81
Stock Assessment Report

Gulf of Mexico Spanish Mackerel

July 2023

SEDAR
4055 Faber Place Drive, Suite 201
North Charleston, SC 29405

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Overview

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TORs – *No topical WG*

SEDAR 81: Gulf of Mexico Spanish Mackerel

Operational Assessment Terms of Reference

October 2021

Updated: June 2023

1. Update the approved SEDAR 28 Gulf of Mexico Spanish mackerel base model with data through 2021.

2. Document any changes or corrections made to model and input datasets and provide updated input data tables.
   - Document changes in MRIP data, both pre- and post-recalibration, in terms of the magnitude of changes to catch and effort.
     - Generate a catch equivalency table to describe the catch recommendati0ons which would have resulted had MRIP-FES data been used in SEDAR 28.
   - Include available length frequency for the commercial fleet(s).
   - Update life history data (e.g., growth, reproduction, mortality) if warranted.
     - Consider age-dependent versus constant natural mortality estimates.
   - Characterize any differences in annual commercial and recreational landings data from the SEDAR 28 stock assessment greater than 5% in any year, respecting appropriate data currenc

3. To the extent possible, the following should be considered for inclusion in the model:
   - Consider whether steepness can be estimated, with or without a prior. If steepness is fixed, evaluate the sensitivity of that assumption.

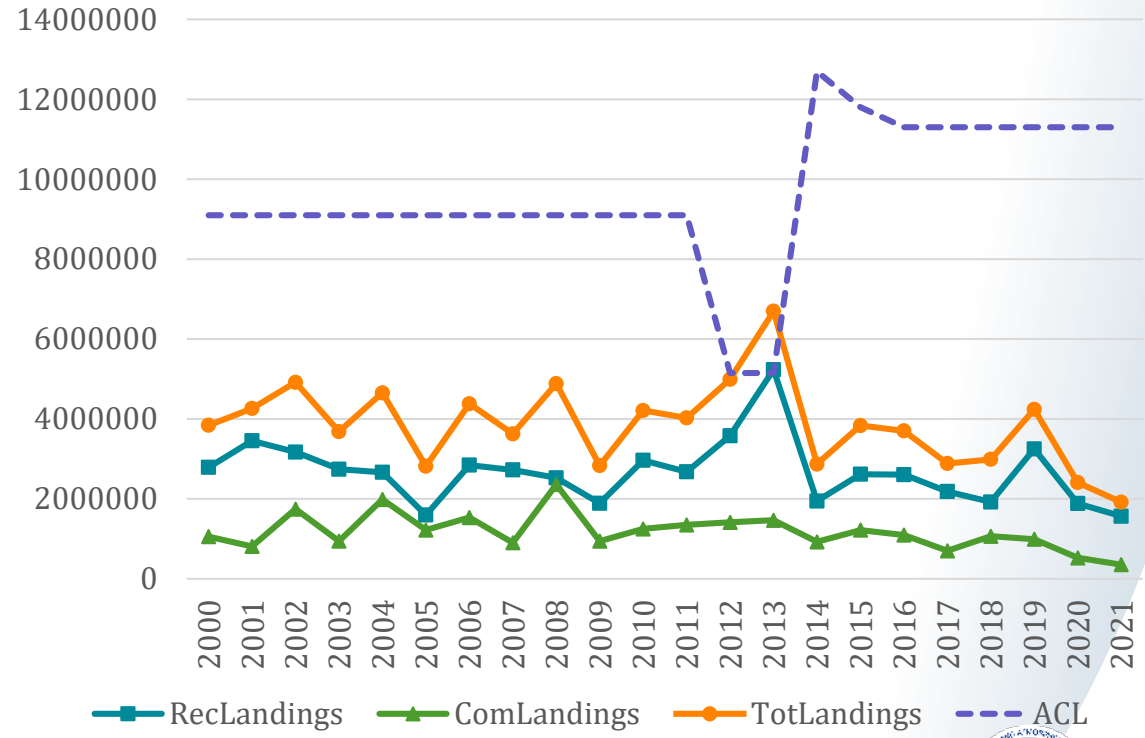
4. Update model parameter estimates and their variances, model uncertainties, estimates of stock status and management benchmarks, and provide the probability of overfishing occurring at specified future harvest and exploitation levels. Provide commercial and recreational landings and discards in pounds and numbers.
   - Use the following status determination criteria (SDC):
     - MSY proxy = yield at F_{MSY} or $F_{Rebuild}$ (if overfished)
     - MSST = (1-M)*SSB_{MSY}
     - MFMT = F_{MSY} and $F_{Rebuild}$ (if overfished)
     - OY = ACL as defined by the Gulf and South Atlantic Councils in CMP Amendment 18 (GMFMC and SAFMC 2011).
     - If different SDC are recommended, provide outputs for both the current and recommended SDC.
   - Unless otherwise recommended, use the geometric mean of the previous three years' fishing mortality to determine $F_{Current}$. If an alternative approach is recommended, provide justification and outputs for the current and alternative approach.
   - Describe changes in catch advice as they relate to the use of FES-adjusted MRIP recreational catch and effort data, versus changes related to stock abundance.
   - Provide yield and spawning stock biomass streams for the overfishing limit and acceptable biological catch in pounds:
     - Annually for five years
     - Under a "constant catch" scenario for both three and five years
     - For the equilibrium yield at F_{MSY}, when estimable

5. Develop a stock assessment report to address these ToRs and fully document the input data and results of the stock assessment.

Management

- Stock Boundaries
  - Fish landed **north of US Highway 1** in Monroe County Florida are assigned to the Gulf of Mexico stock and managed by the GMFMC

- Management actions WP-01
  - 12 in **minimum size limit** since 1983
  - **Bag limits** since 1987
  - **ACL** since 1983 (commercial and recreational combined)
  - **Spatial closures** and **prohibited gears**



https://www.fisheries.noaa.gov/gulf-mexico-historical-stock-landings-and-annual-catch-limit-monitoring#spanish-mackerel

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Working papers

Document #	Title	Authors
SEDAR81-WP-01	Summary of **Management Actions** for Spanish Mackerel (*Scomberomorus maculatus*) from the Gulf of Mexico as Documented within the Management History Database	K. Godwin, G. Malone, S. Atkinson, A. Rios
SEDAR81-WP-02	General **Recreational Survey Data** for Spanish Mackerel in the Gulf of Mexico	Matthew A. Nuttall
SEDAR81-WP-03	**A review of** Gulf of Mexico Spanish mackerel (*Scomberomorus maculatus*) **age data**, 1987 -2021, from various age-data sources	Chris Palmer and Beverly Barnett
SEDAR81-WP-04	**Commercial Landings** of Gulf of Mexico Spanish Mackerel (*Scomberomorus maculatus*) 1887-2021	M. Refik Orhun, Sarina F. Atkinson, Michaela E. Pawluk
SEDAR81-WP-05	Calculated **discards** of Spanish Mackerel from the **commercial** fishing vessels in the Gulf of Mexico	Sarina Atkinson and Kevin McCarthy
SEDAR81-WP-06	Gulf of Mexico Spanish Mackerel (*Scomberomorus maculatus*) **Recreational Landings Length and Age Compositions**	Molly H. Stevens
SEDAR81-WP-07	Gulf of Mexico Spanish Mackerel (*Scomberomorus maculatus*) **Commercial Landings Length and Age Compositions**	Molly H. Stevens
SEDAR81-WP-08	Annual **indices of abundance** of Gulf of Mexico Spanish Mackerel **from Florida commercial trip tickets**, 1986-2021	Joe O'Hop and Steve Brown
SEDAR81-WP-09	Spanish Mackerel **Abundance Indices from SEAMAP Groundfish Surveys** in the Northern Gulf of Mexico	Adam G. Pollack and David S. Hanisko

SEDAR 81 Overview

The Base Model indicates that the GOM Spanish Mackerel stock is currently **not overfished and not undergoing overfishing** .

Notable changes compared with the SEDAR 28 Benchmark assessment model:

- **Start year** changed from 1886 to 1986
- Recreational landings and discards changed from CHTS to **FES**
- **Recreational fleet split** into 3 components (Charter/Headboat, Private, Shore) and annual CVs provided
- **Recreational discard length data** included to inform retention curve
- Commercial **Handline** fleet modelled **as total catch** (vs. landings and discards separate in SEDAR 28)
- **MRFSS** index **dropped**
- **SEAMAP** Trawl index **separated** into early and late index
- Internal Lorenzen scaling for M with defined **settlement month**
- **Dirichlet Multinomial** re-weighting or composition data

- **Corrections to SEDAR 28**
  - Maturity function
  - Minimum size limit time block

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Data

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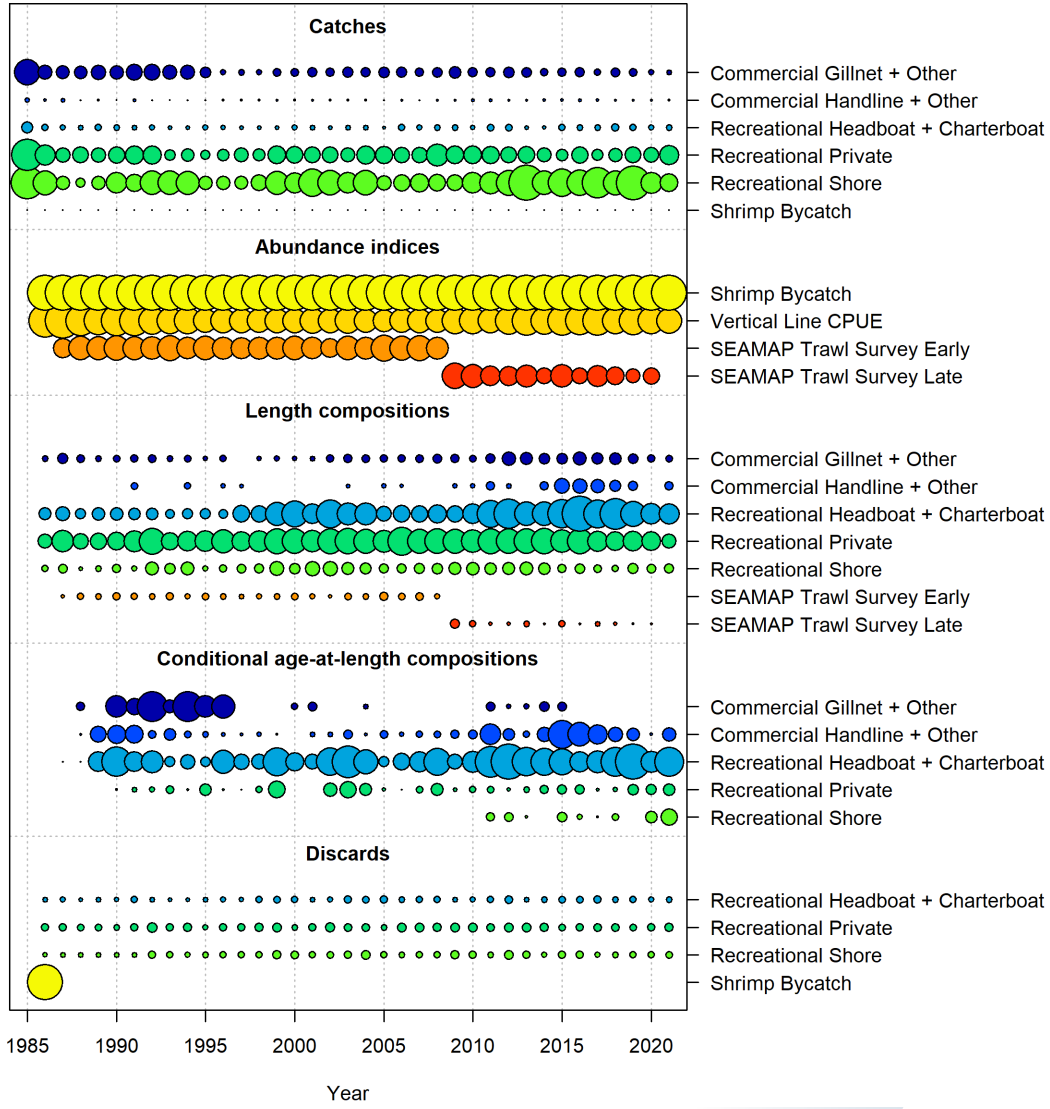
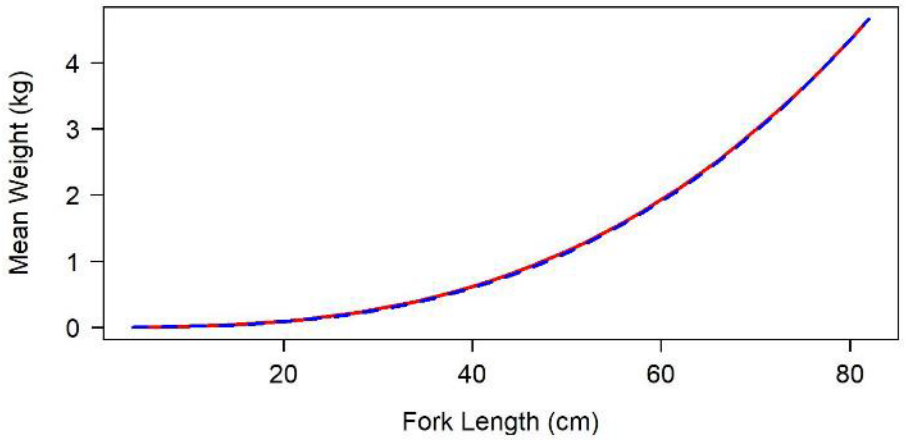
Model structure

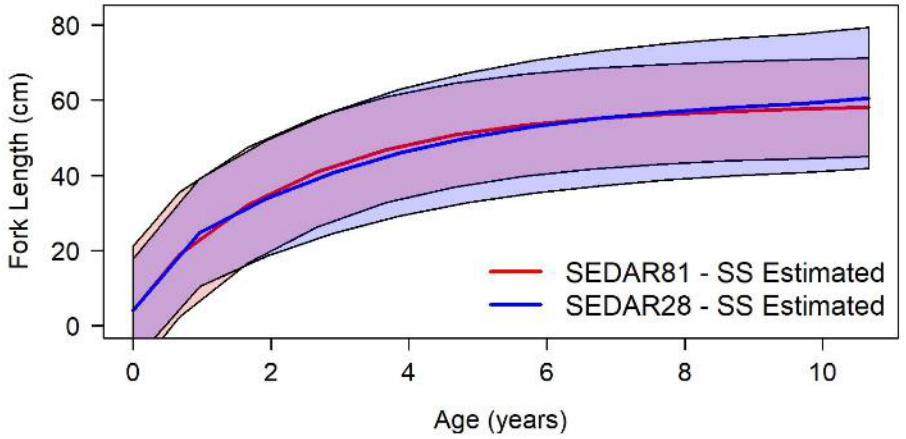
- Years
  - 1986-2021
- Fleets
  - 2 commercial
    - Gillnet (GN) + Other (OTH)
    - Handline (HL) + Other (OTH)
  - 3 recreational
    - Headboat (HB) & Charterboat (CH)
    - Private (PR)
    - Shore (SH)
  - Shrimp bycatch (dead discards; median value scaled by effort)
- Indices
  - Commercial VL
  - SEAMAP Trawl (early and late)
  - Shrimp effort (for scaling annual discards)
- Age and length compositions

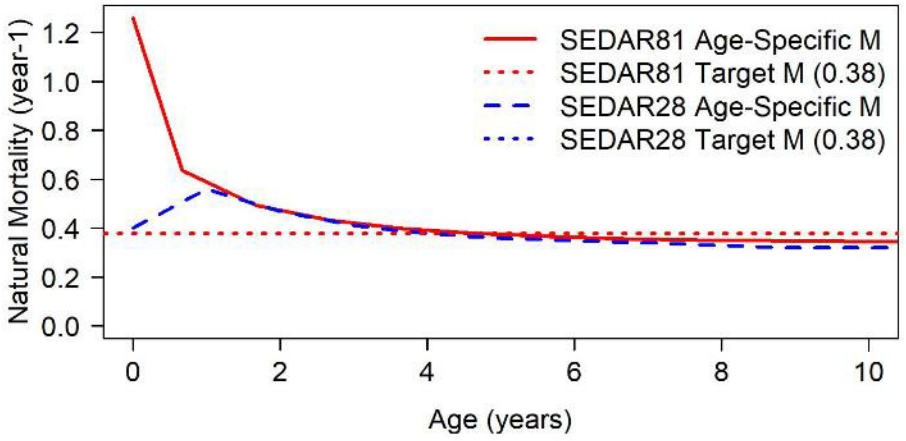


Life History

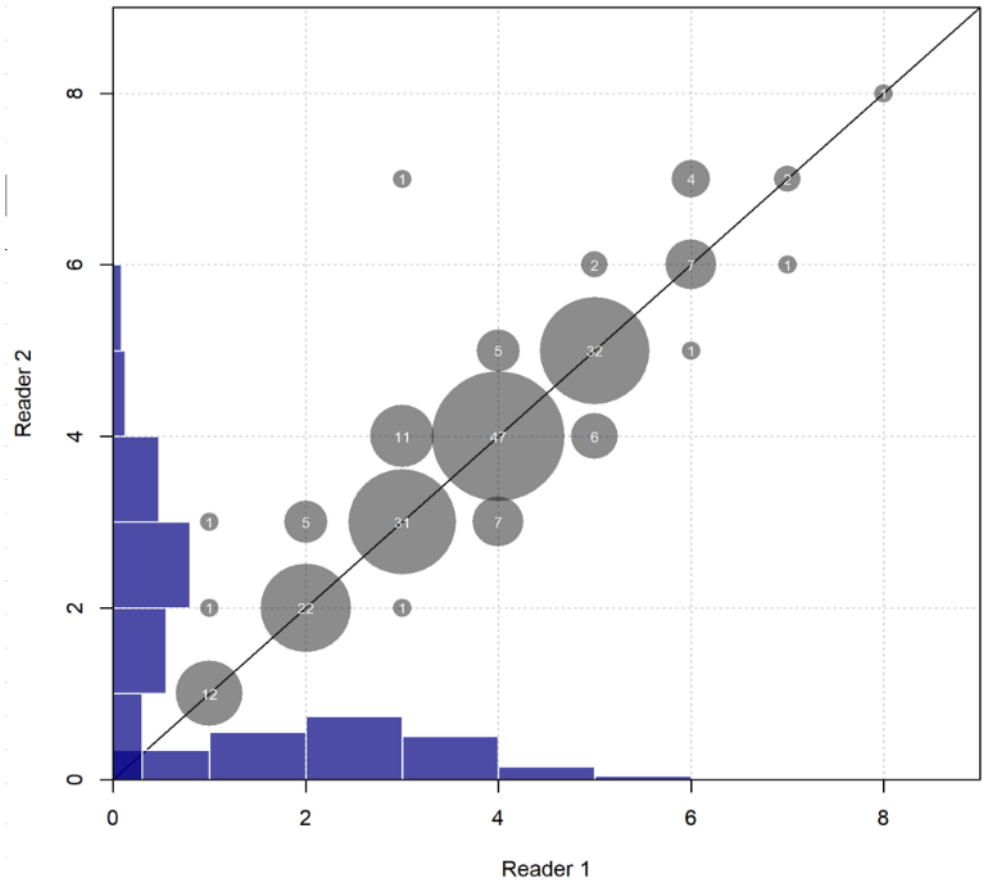
Data Component	Decision
Sex ratio	• Unchanged 1:1 (single sex model)
Weight-Length	• Unchanged
Age and Growth WP-03	• Additional age-length pairs (~20,000 total). Von Bertalanffy parameters estimated internally as in SEDAR 28, sexes combined. • Ageing error matrix
Settlement timing	• May 1st (Finucane and Collins, 1986)
Natural Mortality	• Internal Lorenzen scaling to Hoenig point estimate of 0.38 (max age 11) *Sensitivity run with Hamel (2015) point estimate of 0.49*

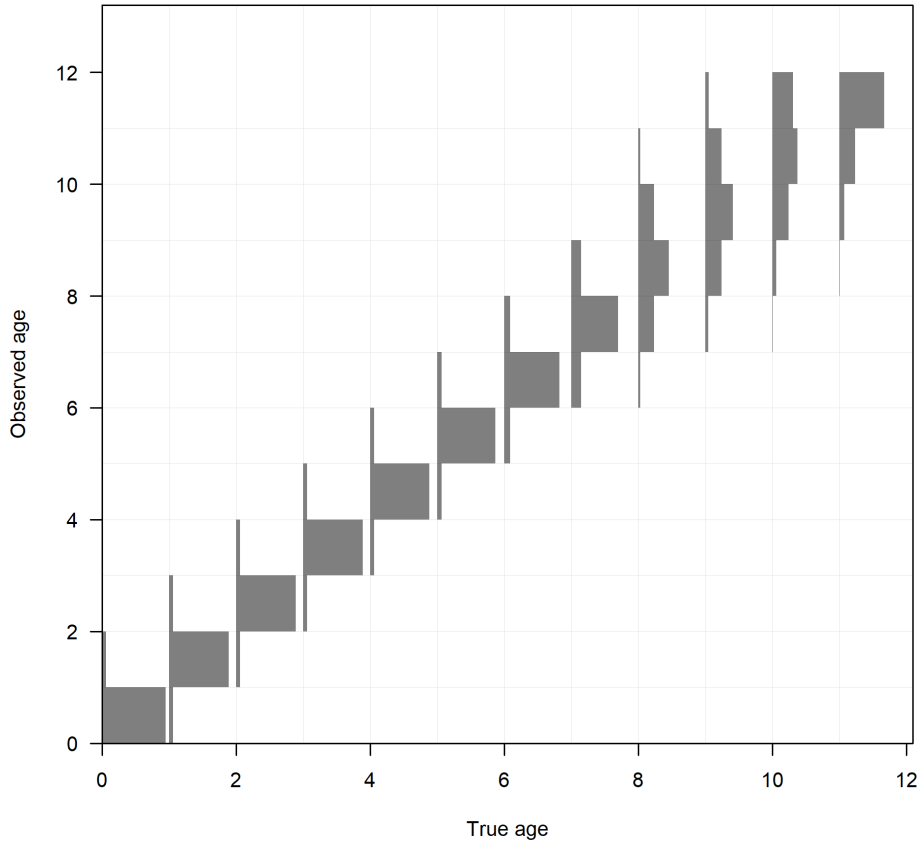






Ageing Error





Blind double reads from a single reader (no reference set available) of 200 otoliths ranging ages 1-8

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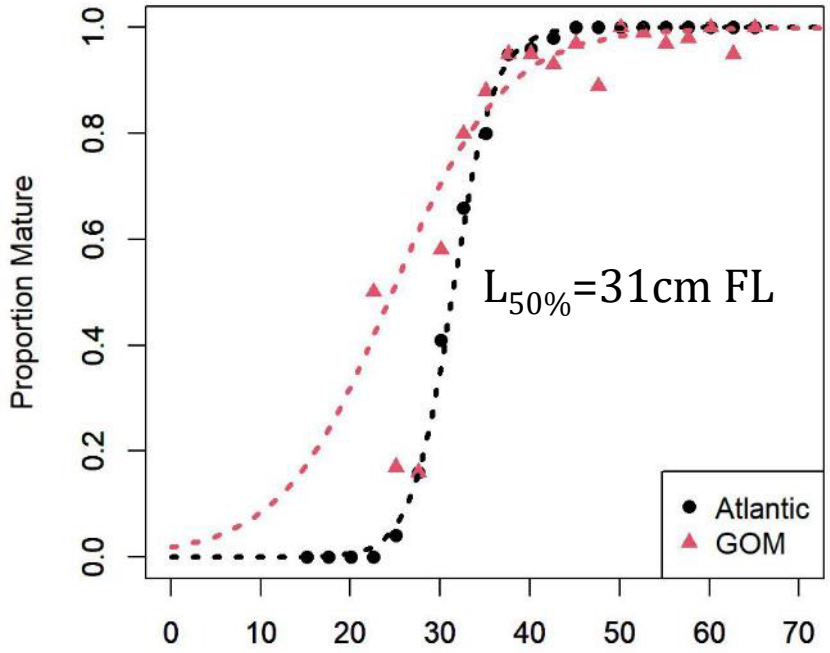
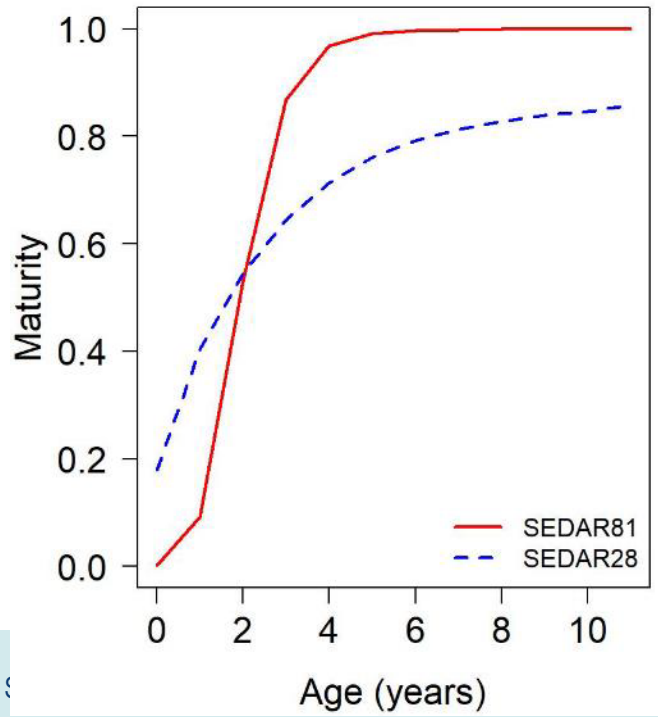
Life History

Data Component	Decision
Maturity	• *Error in SEDAR 28* • Corrected in SEDAR 81 : SATL samples, sexes combined (SEDAR 28 decision)
Fecundity	• Equivalent to female SSB (unchanged)

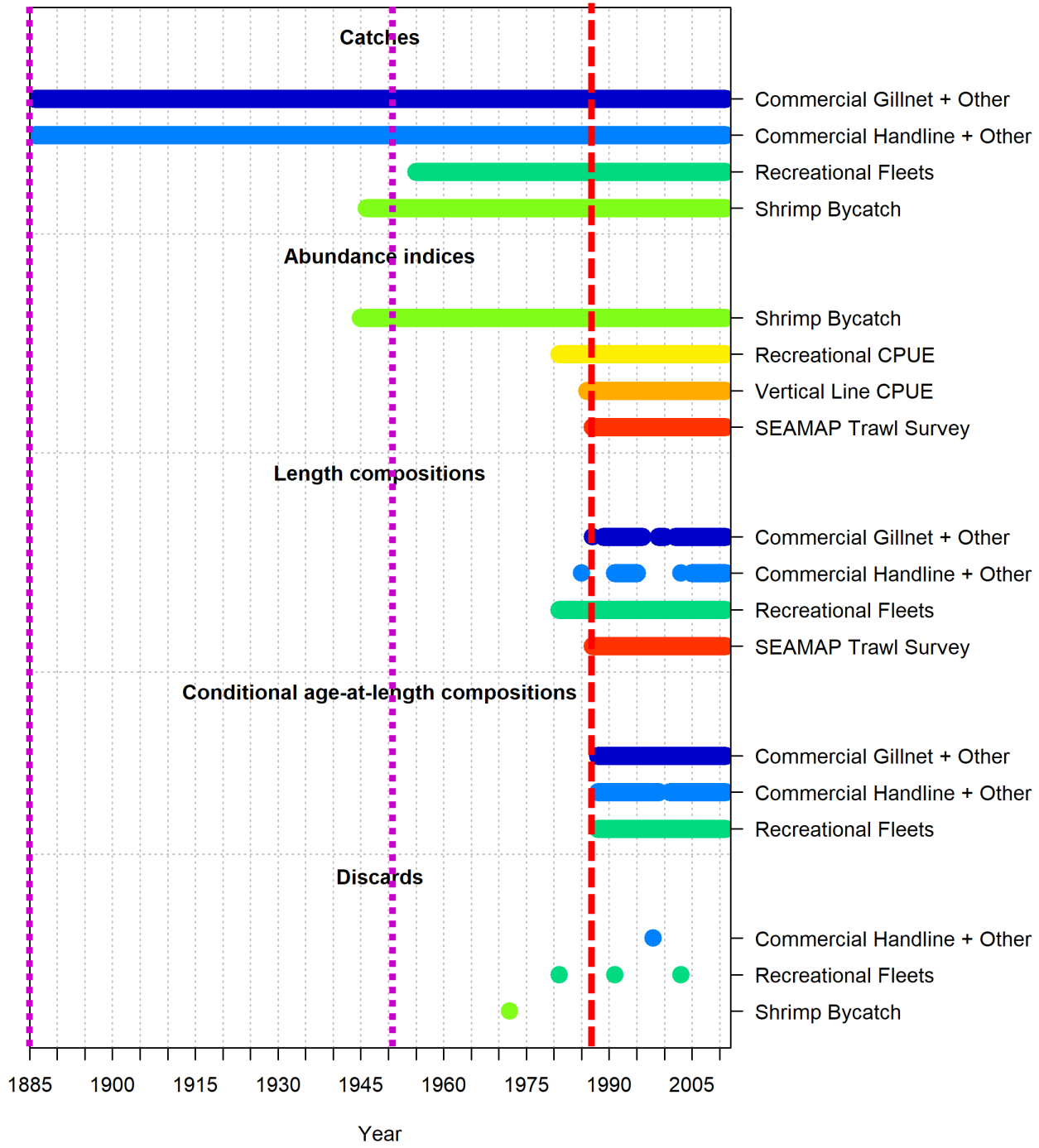
Stock-Recruitment	• Beverton-Holt (unchanged)
	  • Recruitment variability (SigmaR) fixed at .7
	  • Steepness (h) fixed at .8
	Sensitivity runs to estimate h and test alternative values





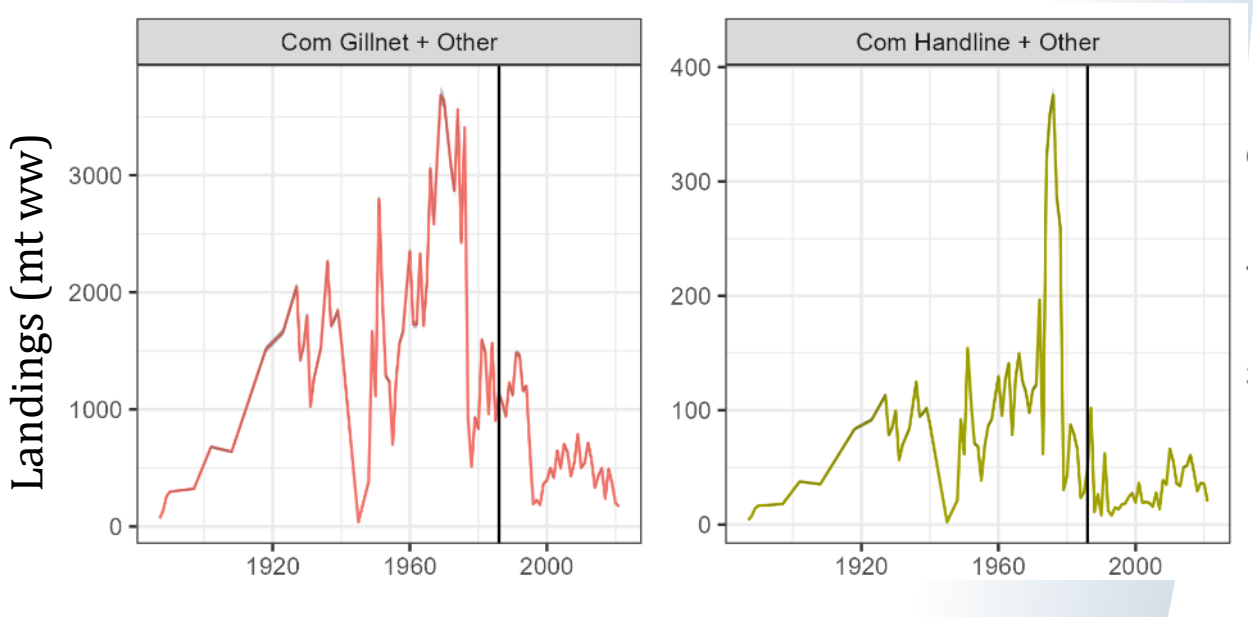
Start Year

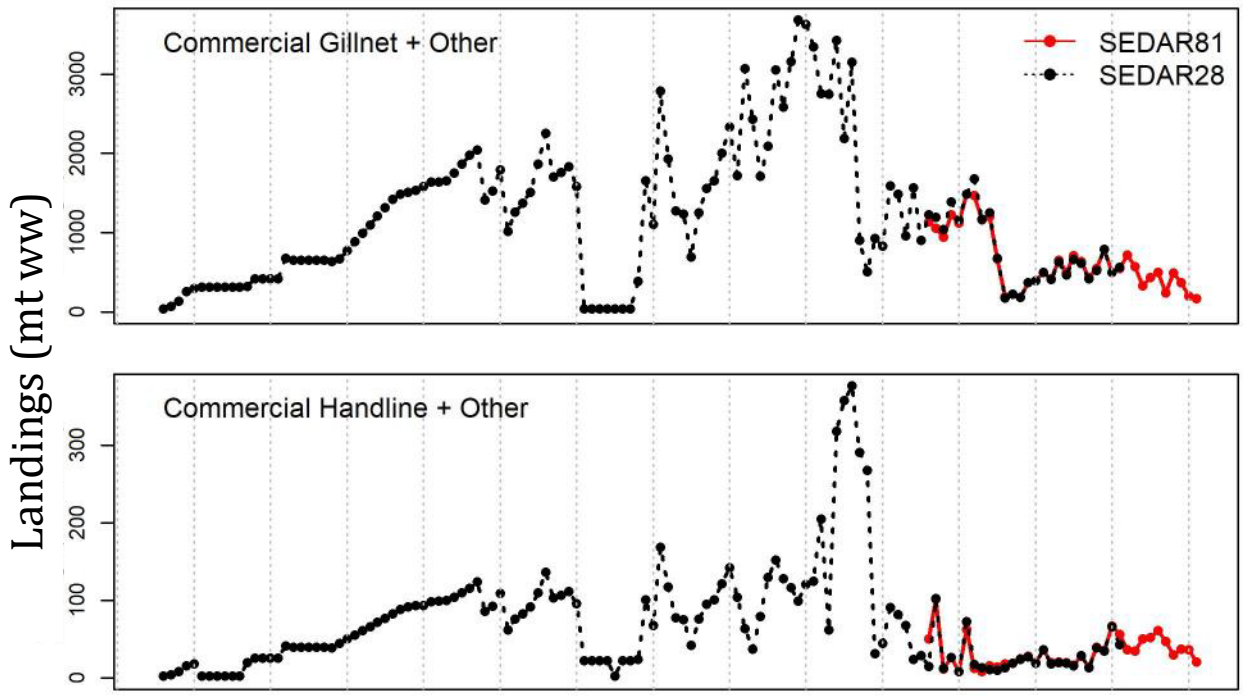
- SEDAR 28: 1886 (unfished conditions)
- SEDAR 81: 1986
  - Attempted 1886, 1950



Commercial Landings

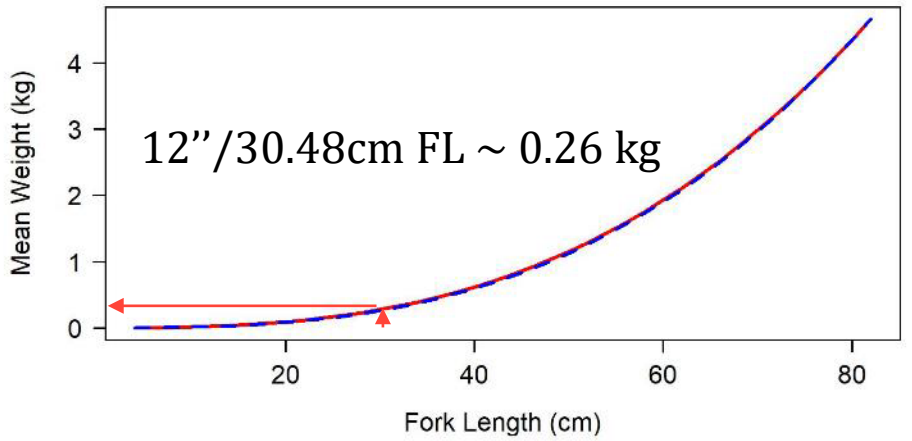
Data Component	Decision
Landings WP-04	• Same 2 fleets : GN + other, HL + other • HL : landings + dead discards
CVs	• Unchanged 0.01



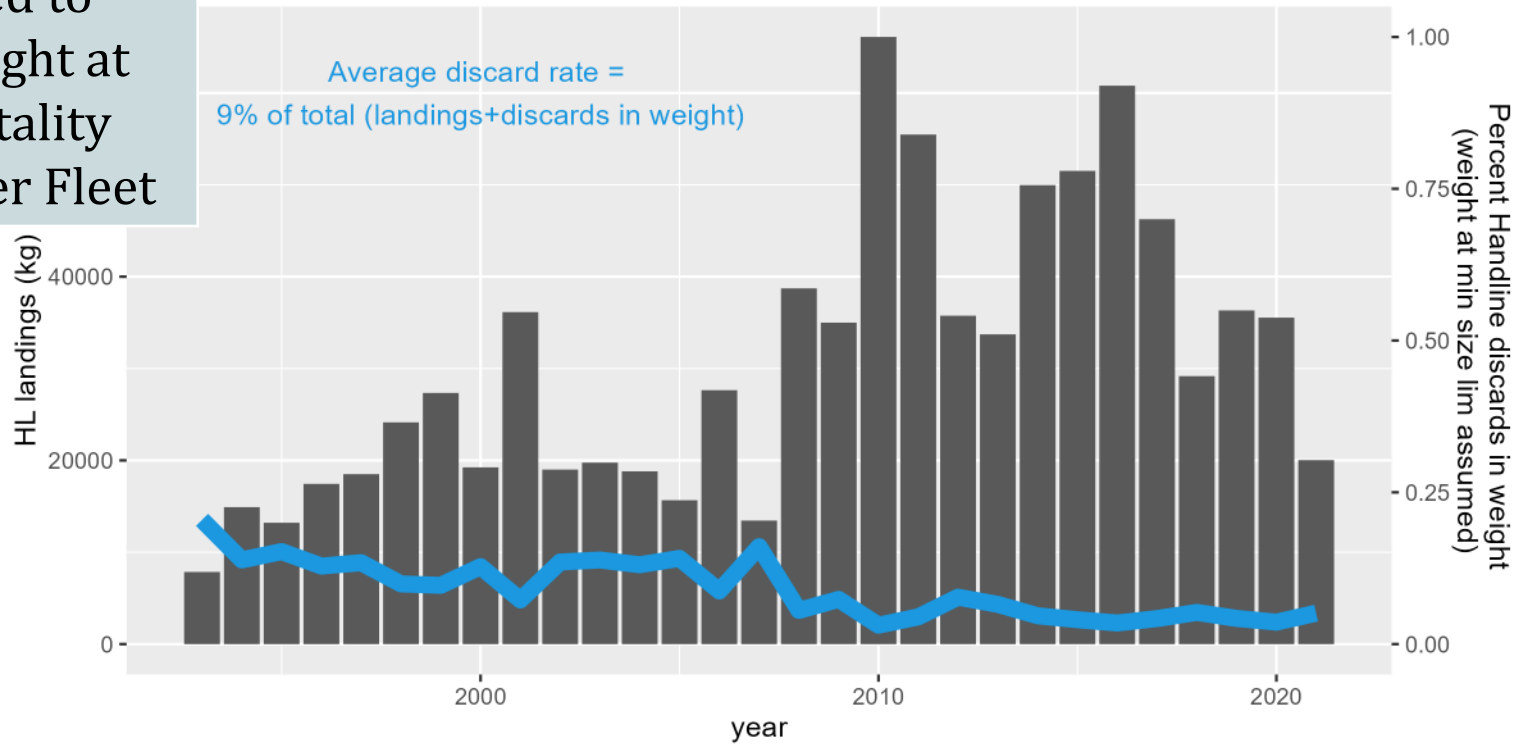


Commercial Discards

Data Component	Decision
Discards WP-05	• GN : unchanged, none • HL : dead discards added to landings (assuming weight at size limit and 10% mortality rate) ~ 1% of HL + Other Fleet



Insufficient data to estimate discards from reef fish observer data. Instead, discard rates computed from the discard logbook data (02-21) and applied to gear specific total effort from the coastal logbook program (93-21)



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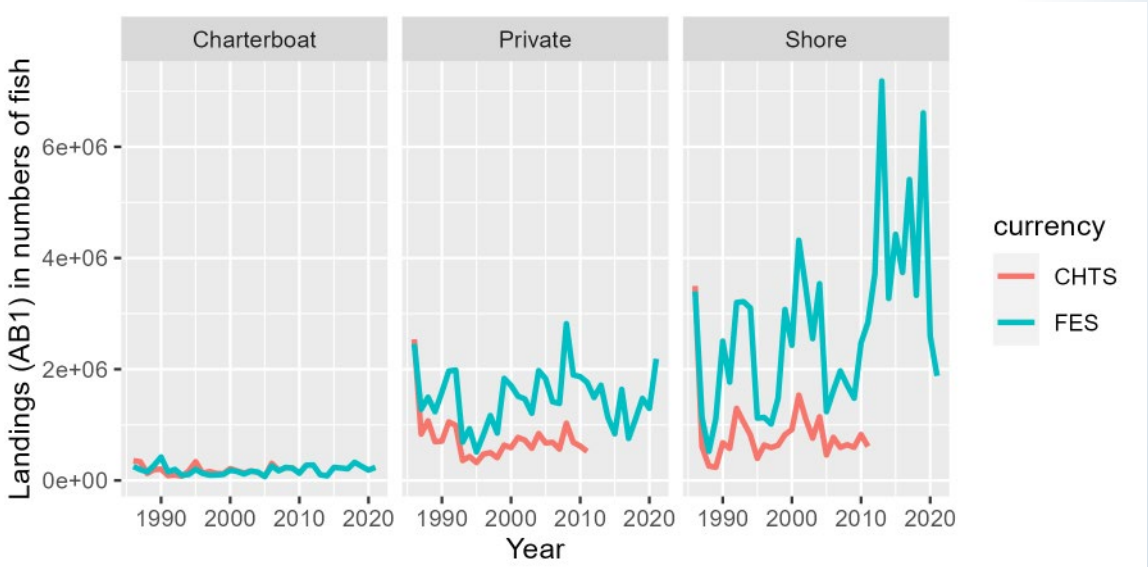
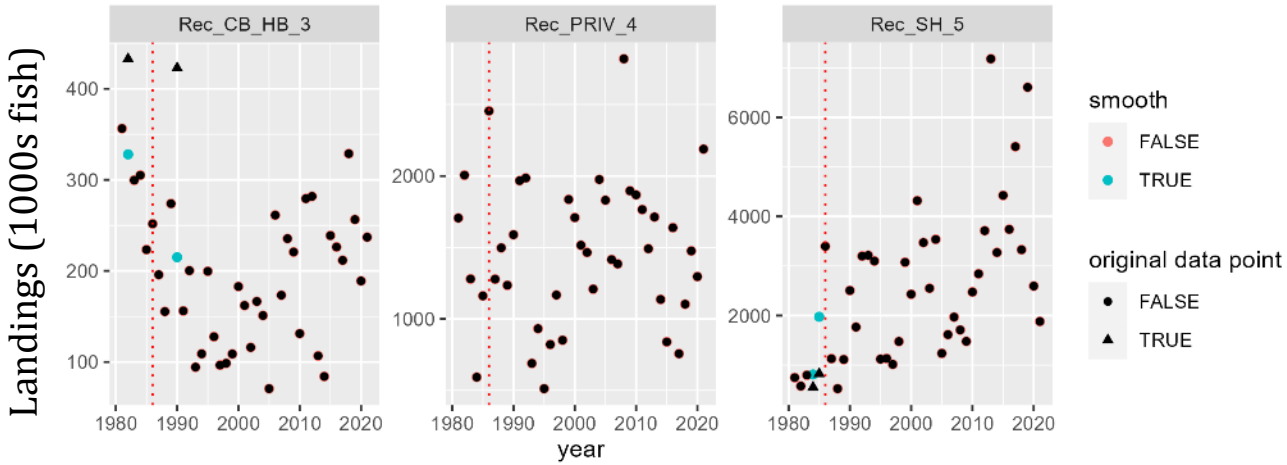
Recreational Landings

Data Component	Decision
Landings WP-02	• Split into 3 fleets • CH, PR, SH : fully calibrated (APAIS + FES) estimates. Replace values with CV≥0.5 by mean of 2 neighboring years. • HB : SRHS
CVs	• CH, PR, SH : MRIP CVs (0.1-0.5) • HB: SRHS proxy CVs provided (n: num of reported trips, N: num estimated trips, L: landings, i: year, j: region/state) $\text{proxyCV}_i = 1 - \sum_{j=1}^{n}\left[\left(\frac{n_{ij}}{N_{ij}}\right) * \left(\frac{L_{ij}}{L_i}\right)\right] + 0.05$





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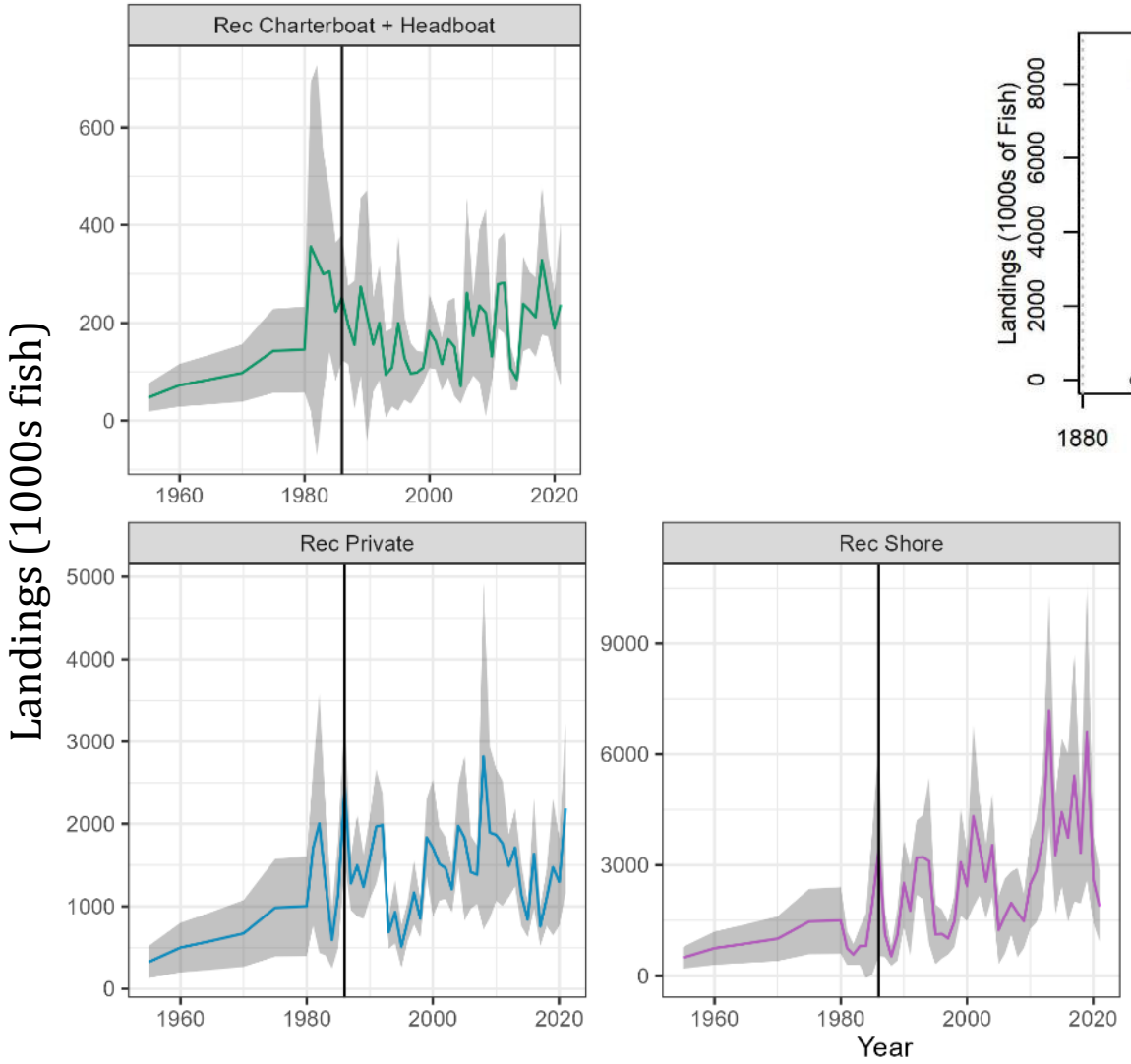
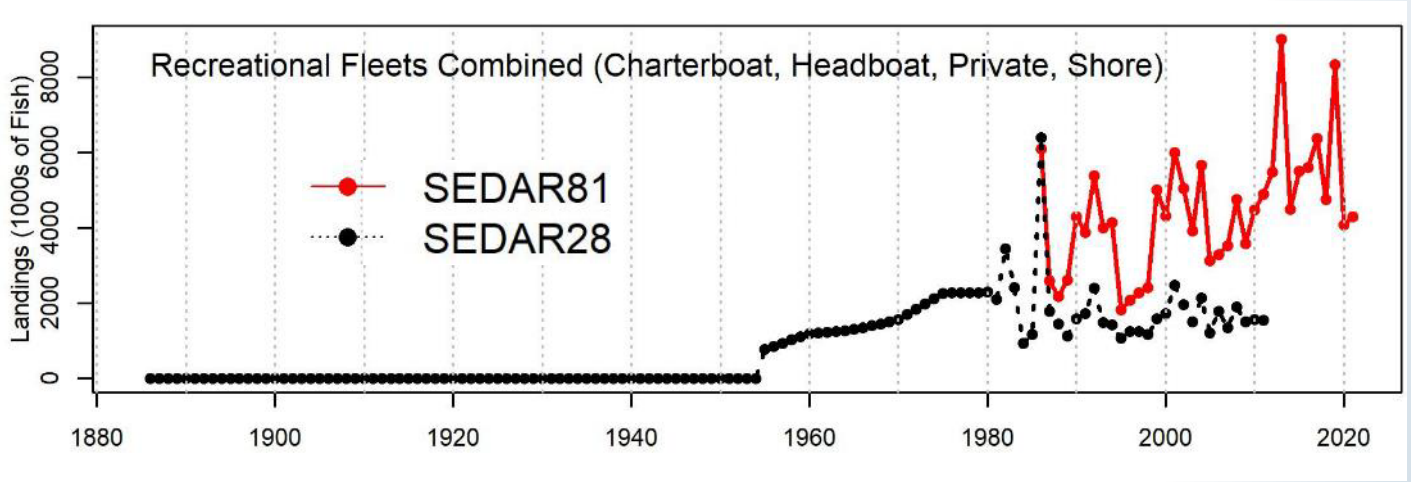
Recreational Landings





⚠ CHTS vs FES

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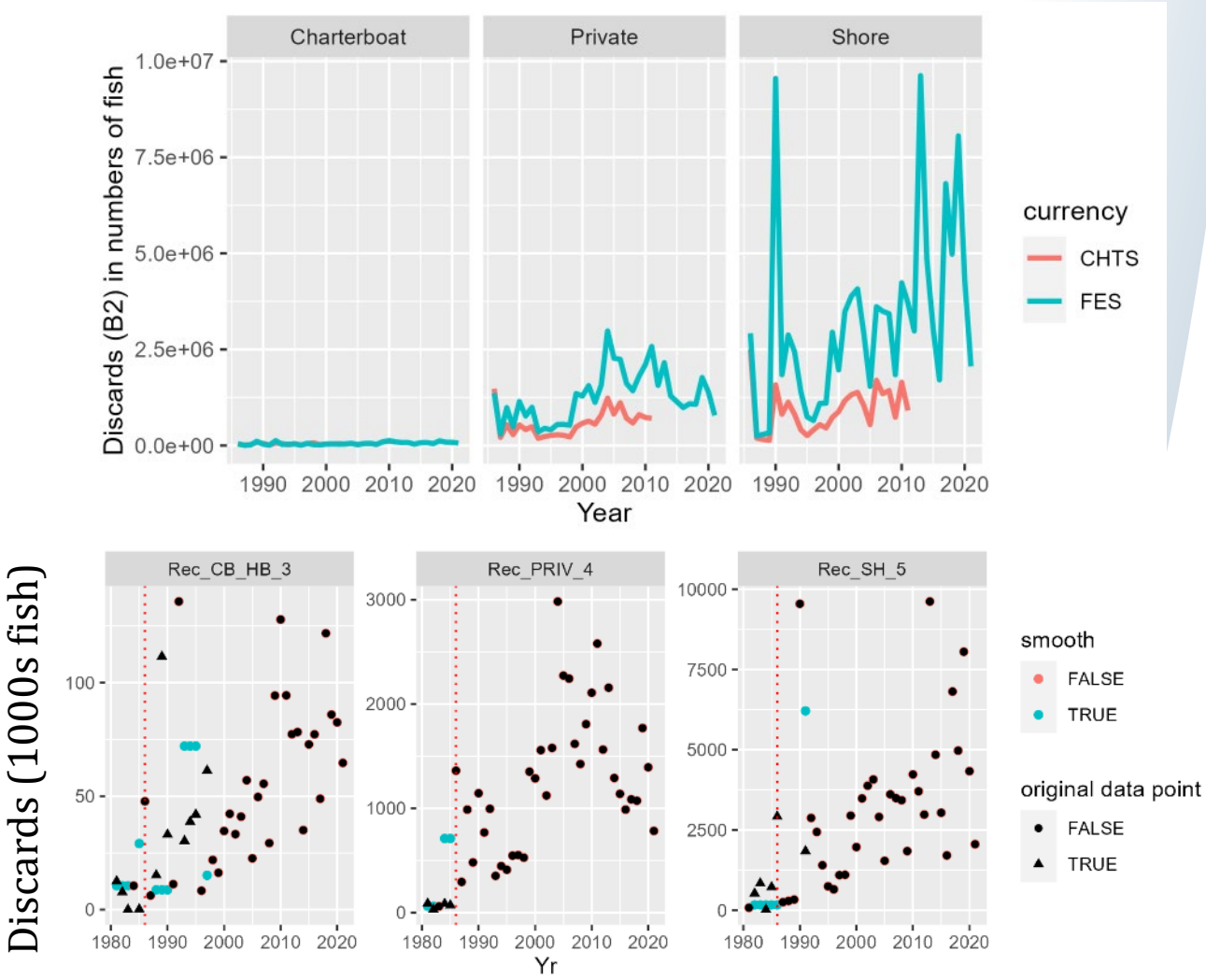
Recreational Discards

Data Component	Decision
Discards WP-02	• Split into 3 fleets • CH, PR, SH : fully calibrated (APAIS + FES) estimates. Replace values with CV>=0.5 by mean of 2 neighboring years. • HB: SRHS 2004-2021; SEDAR Best Practices super ratio approach 1986-2003
CVs	• CH, PR, SH : MRIP CVs • HB: CH discard CVs for 1986-2003; SRHS landings CV for 2004-2021
Mortality	• Unchanged (20%)



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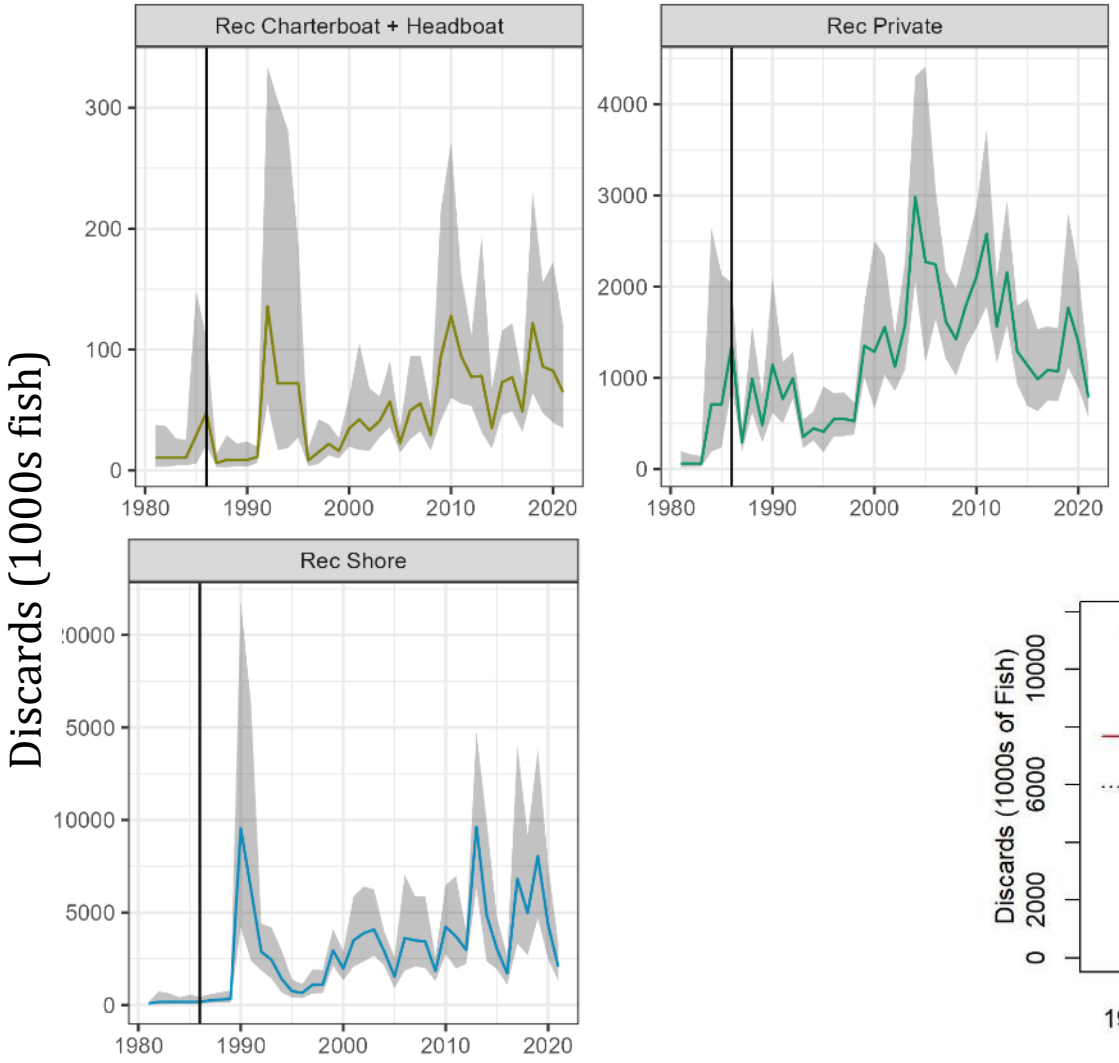
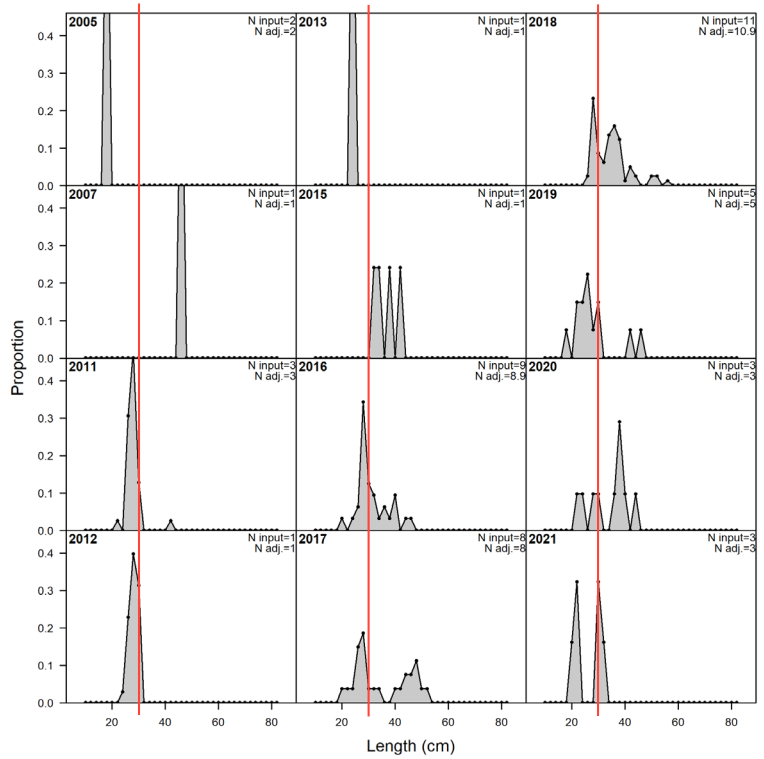
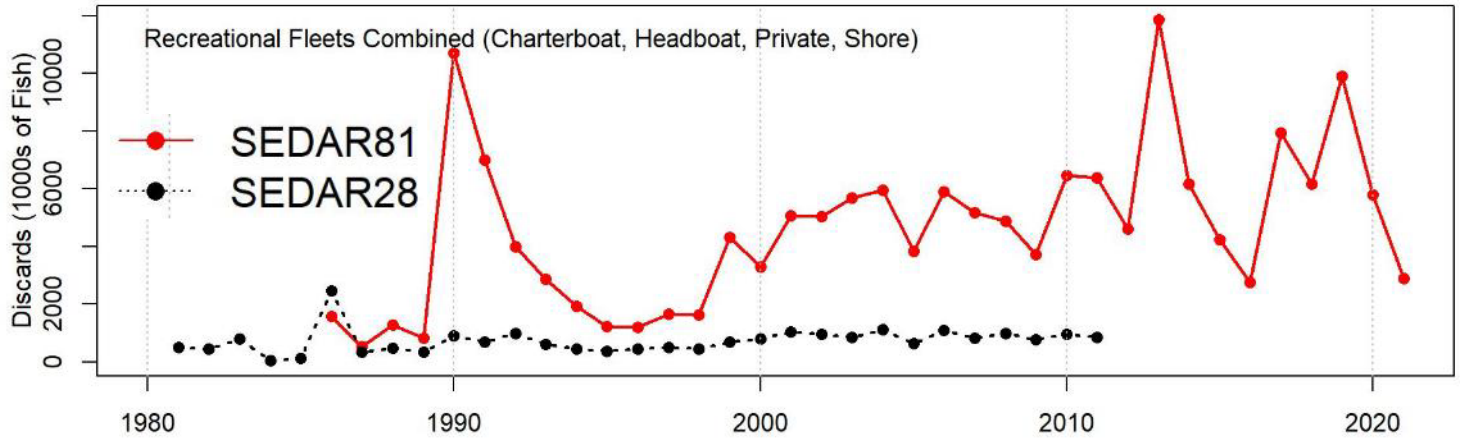
Recreational Discards





CHTS vs FES



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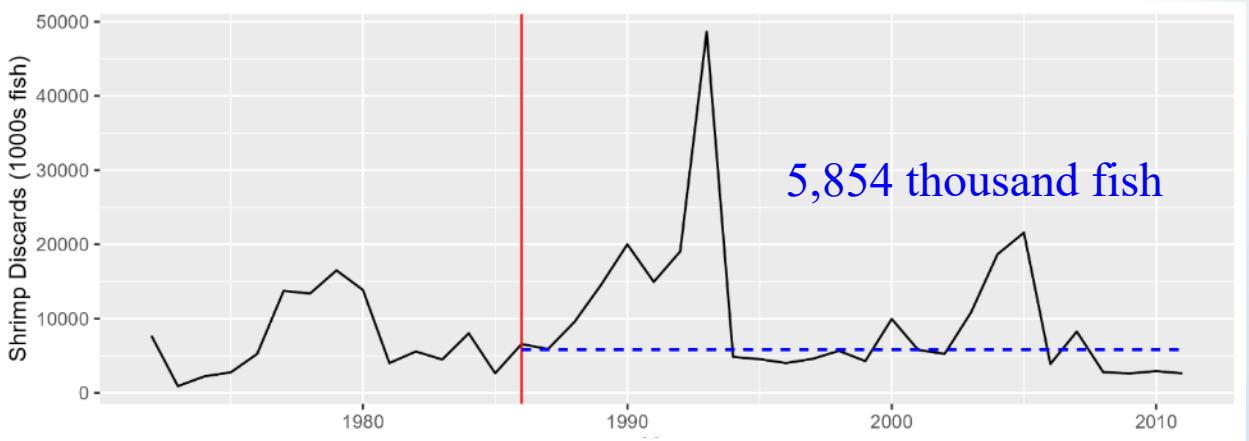
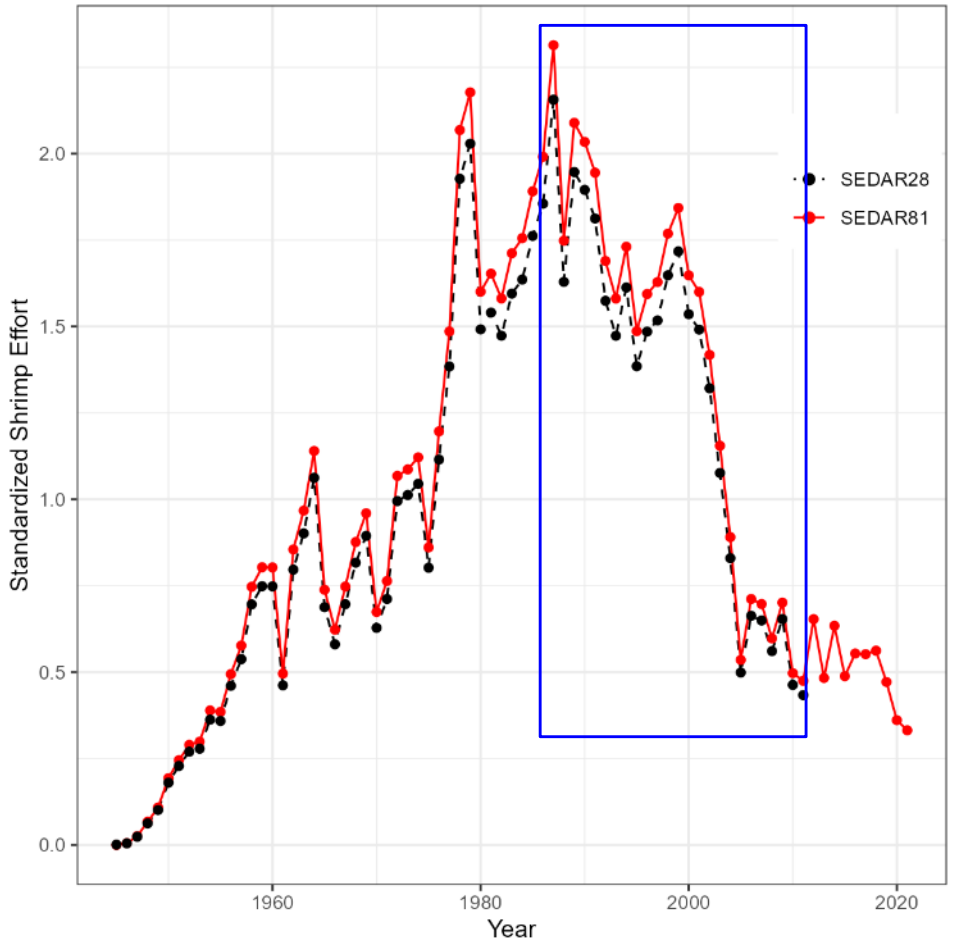
Shrimp Bycatch

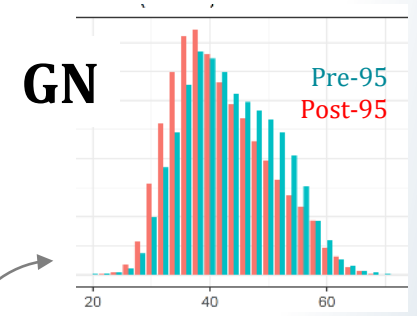
Data Component	Decision
Discards	• 1972-2011 (No update; Linton, 2012; Nichols 2004) • Median value 1986-2011 input as super period (CV 0.01)
Effort	• Updated to 2020 (same methodology as S28; Nance 2004) • 2021 point estimate using new estimation method currently in development (Anon. 2023)



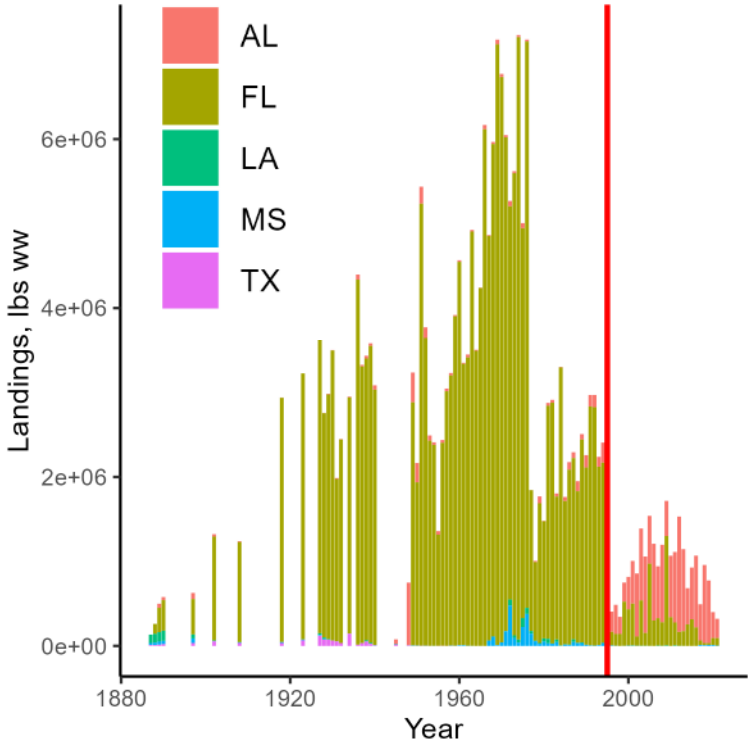


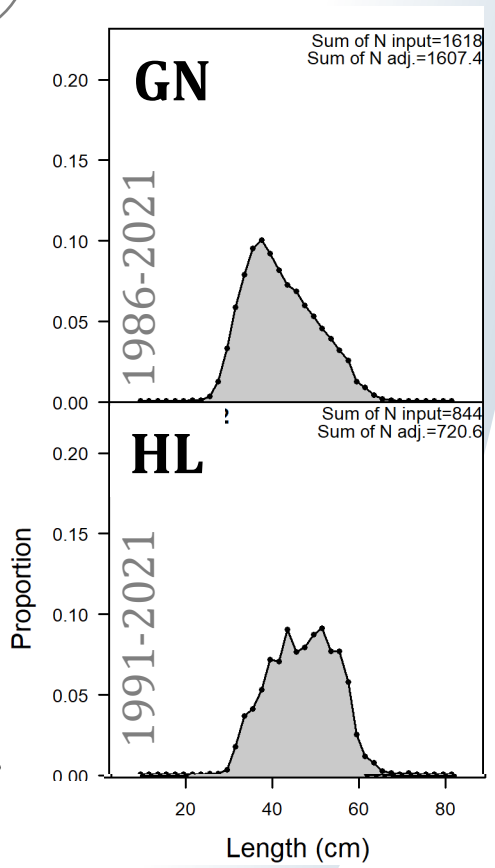
Composition Data : Commercial

Data Component	Decision
Lengths (retained) WP-07	• Nominal in SEDAR 28, weighted annually by spatially stratified landings in SEDAR 81 (CIE reviewer recommendation) • Sample sizes: number of fish in SEDAR 28, number of trips in SEDAR 81 • Dirichlet Multinomial re-weighting procedure
Lengths (discarded)	• Insufficient data available from the RFOP (32 fish between 2006 and 2020).



FL GN Ban - 1995 time block





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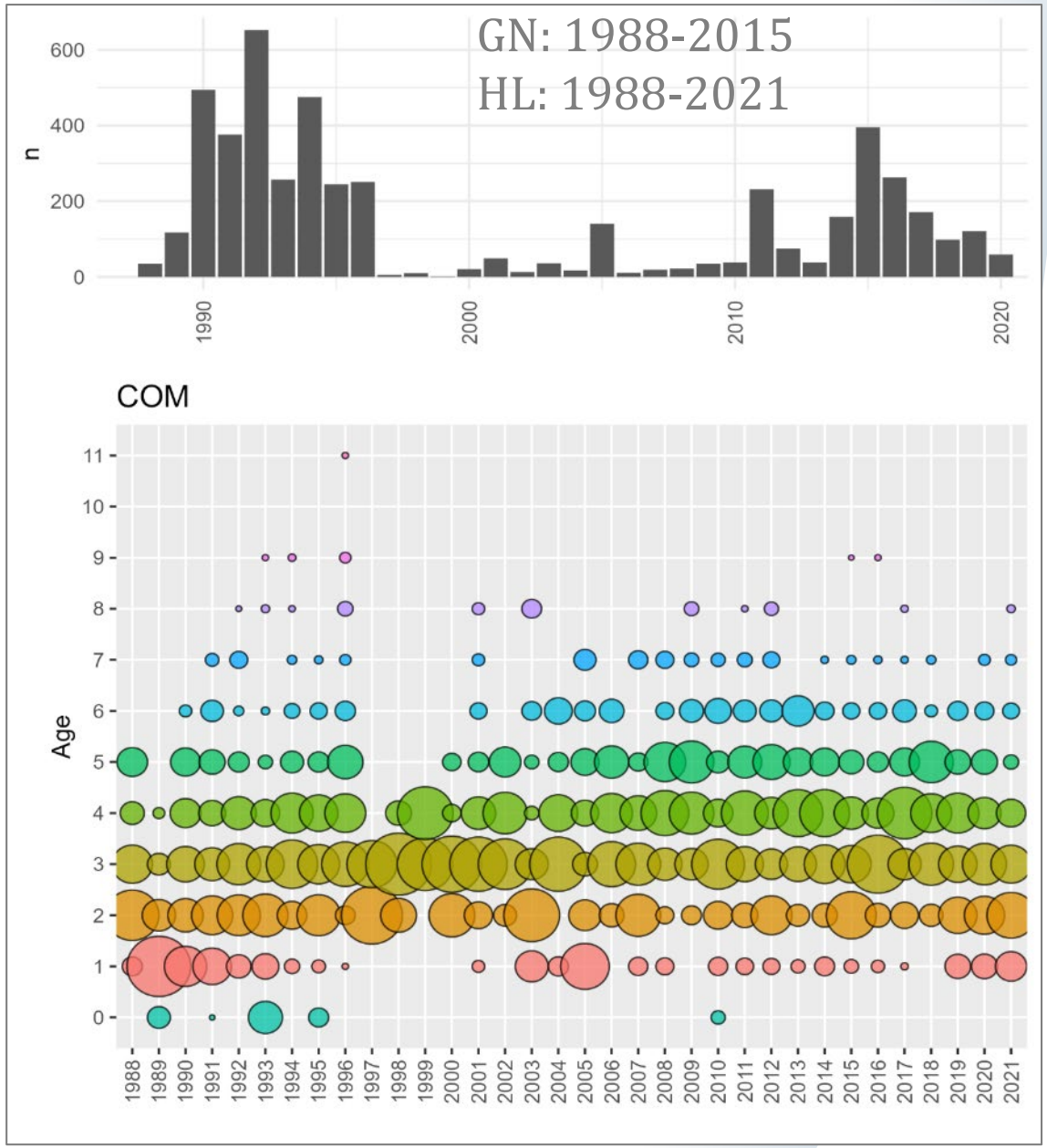
Composition Data : Commercial

Data Component	Decision
Ages (retained) WP-07	• Conditional on length. • Sample sizes: number of fish • Dirichlet Multinomial re-weighting procedure



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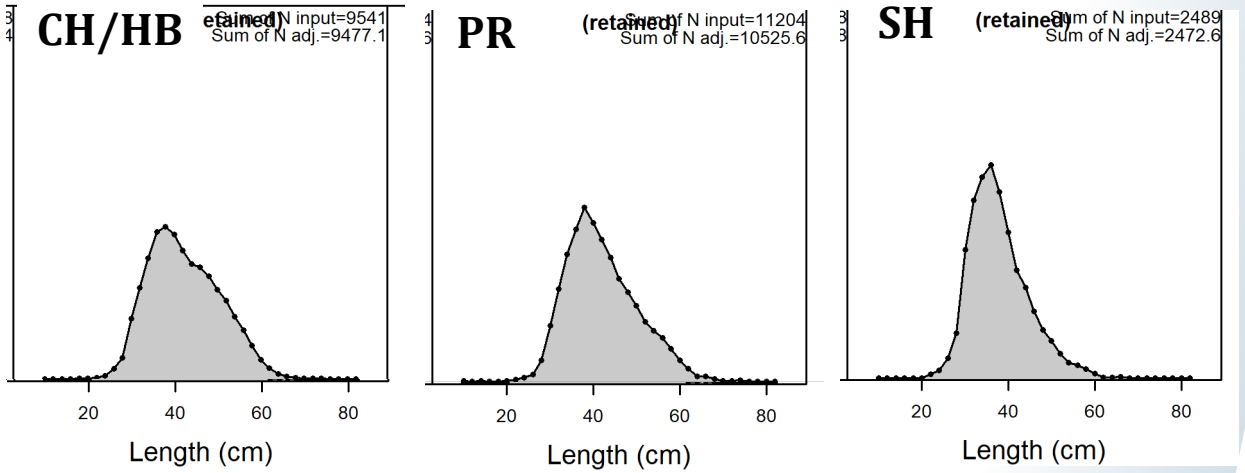
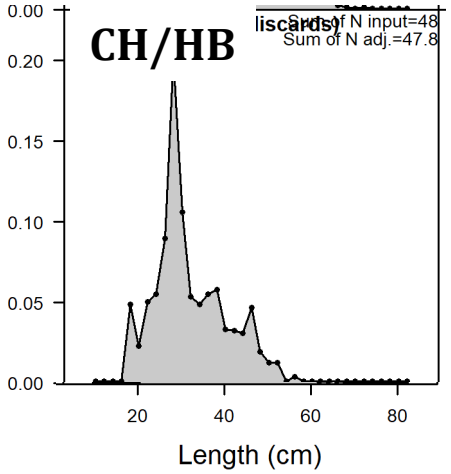
Composition Data : Recreational

Data Component	Decision
Lengths (retained) WP-06	• Nominal in SEDAR 28, weighted annually by spatially stratified landings in SEDAR 81 (CIE reviewer recommendation) • Sample sizes: number of fish in SEDAR 28, number of trips in SEDAR 81 • Dirichlet Multinomial re-weighting procedure
Lengths (discarded)	• FWC FWRI at sea observer program (282 samples, 95% HB, 5% CH)

Retained: 1988-2021



Discarded: 2005-2021



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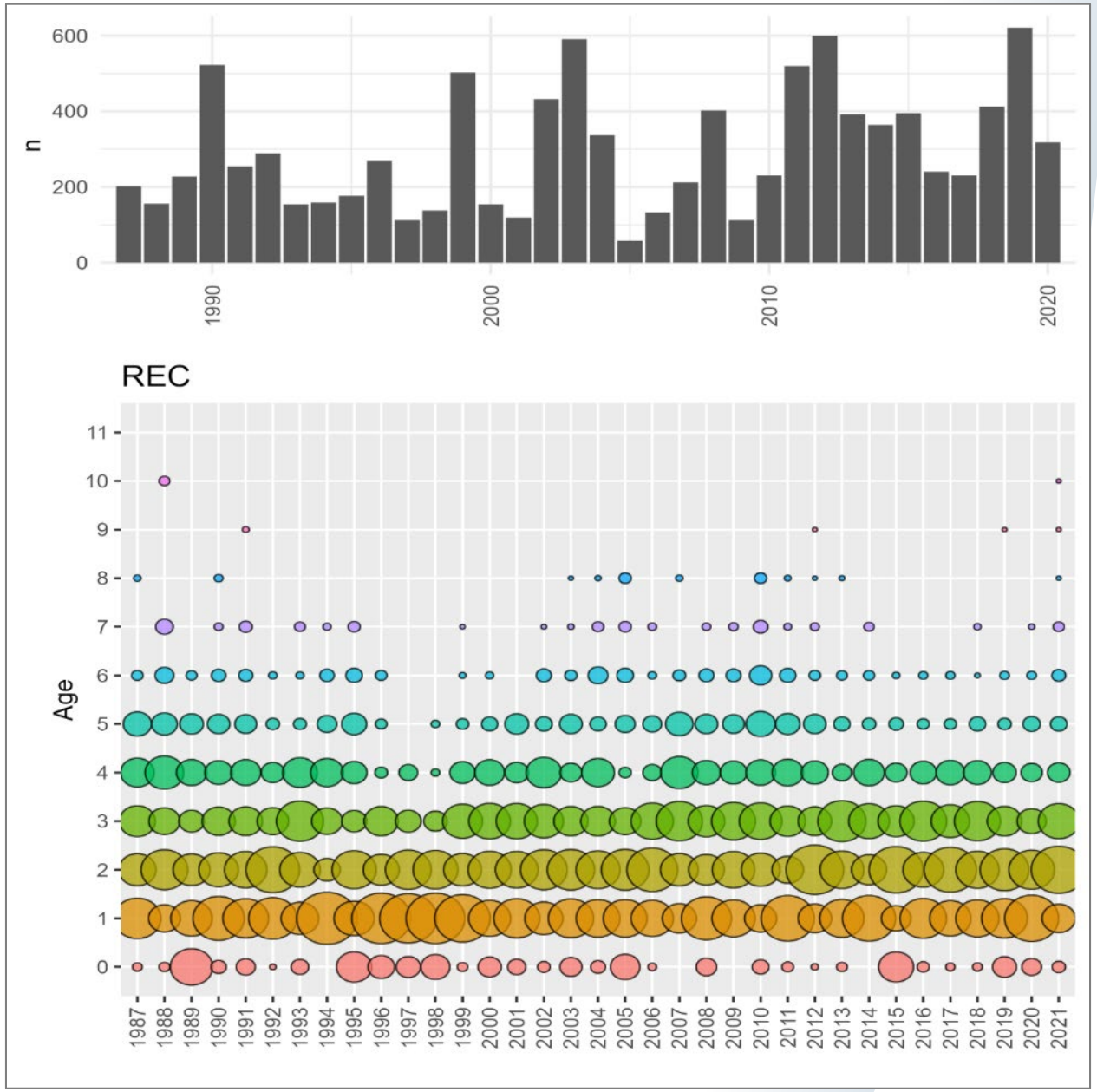
Composition Data : Recreational

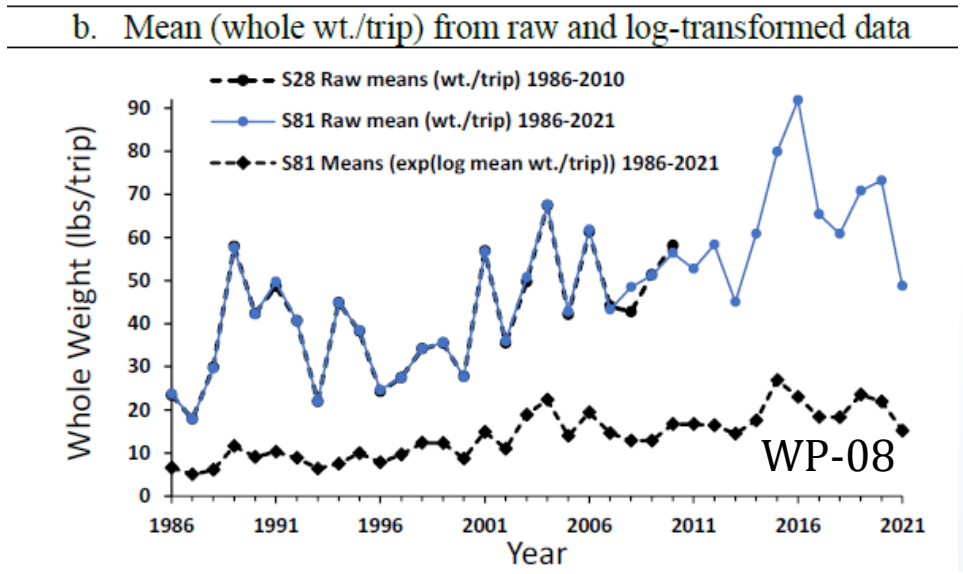
Data Component	Decision
Ages (retained) WP-06	• Conditional on length. • Sample sizes: number of fish • Dirichlet Multinomial re-weighting procedure

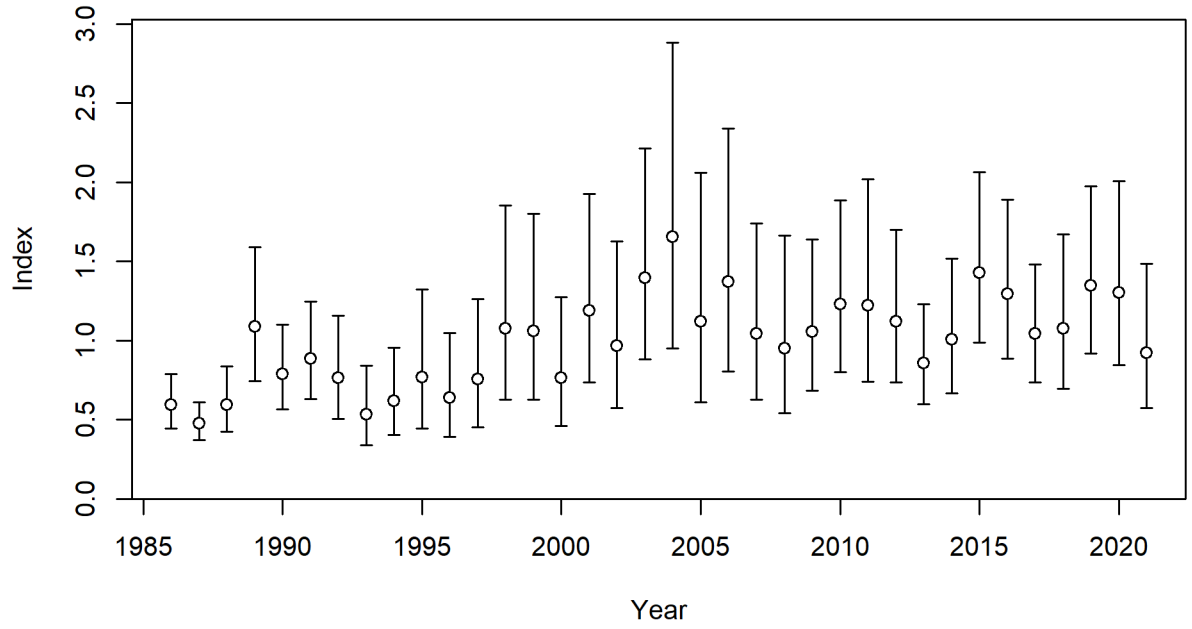
Ages:
CH/HB: 1987-2015
PR: 1990-2021
SH: 2011-2021 (sporadic)



FD Indices

Data Component	Decision
MRFSS CPUE Index	• Dropped (Fitzpatrick and Williams 2022) • Very low proportion of successful trips (<5%)
VL CPUE Index WP-08	• GLM: Ln pounds of Spanish Mackerel per trip ~ year, month, inshore benthic species presence, reef fish species presence and FL regulatory area code (O'Hop and Brown 2023) • CVs scaled up such that average matches minimum CV of the SEAMAP index





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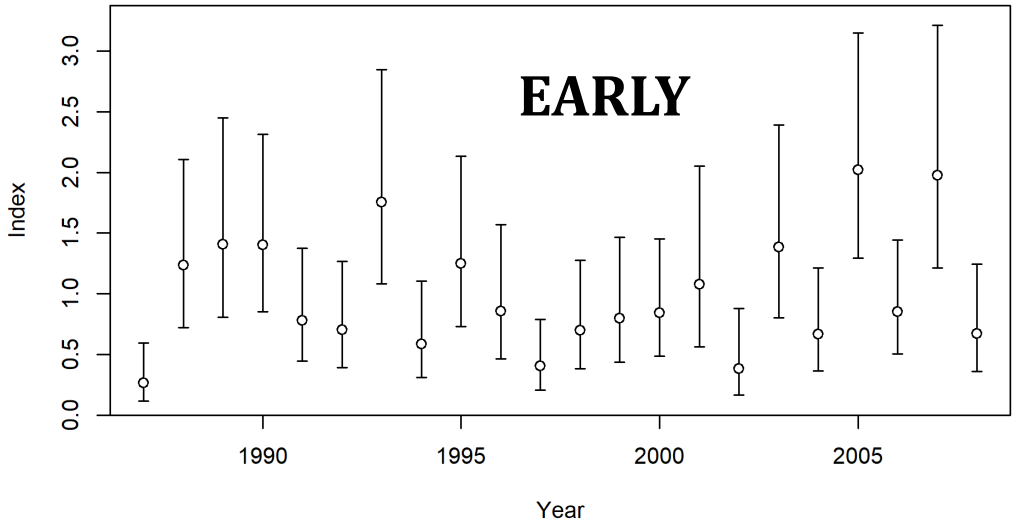
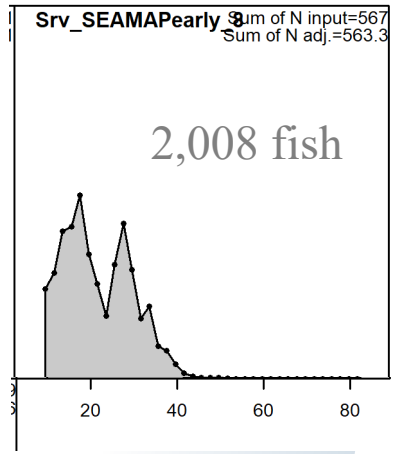
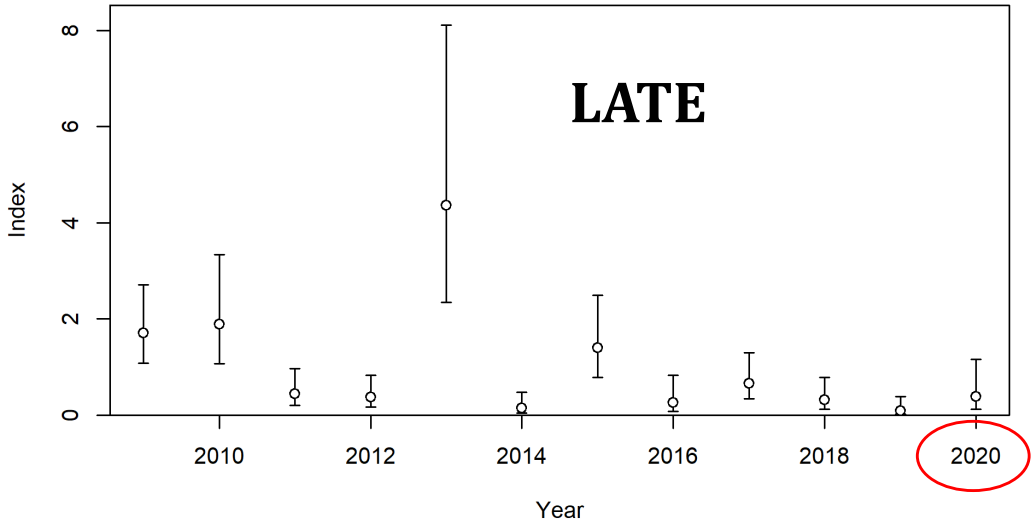
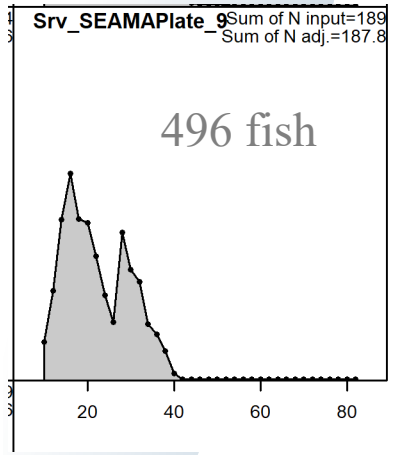
FI Indices

Data Component	Decision
SEAMAP Index WP-09	• Split: early (pre 2008, NW/Central GOM), late (post 2008, entire Northern GOM) • Delta-lognormal model (number per trawl hour) • Variables considered: year, depth, time of day (day/night), paired statistical zone, and season









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Results

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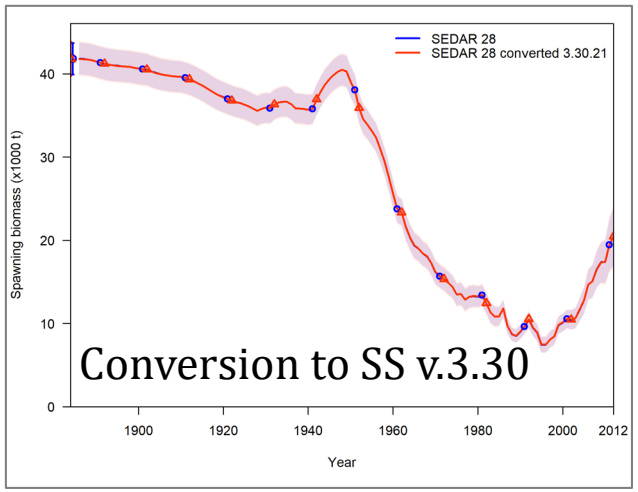
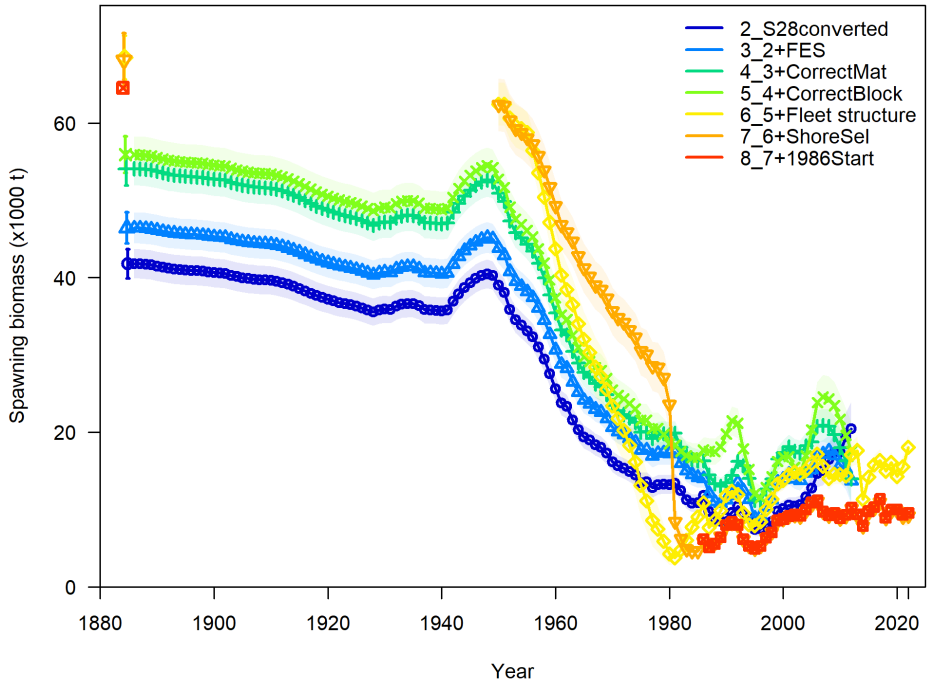
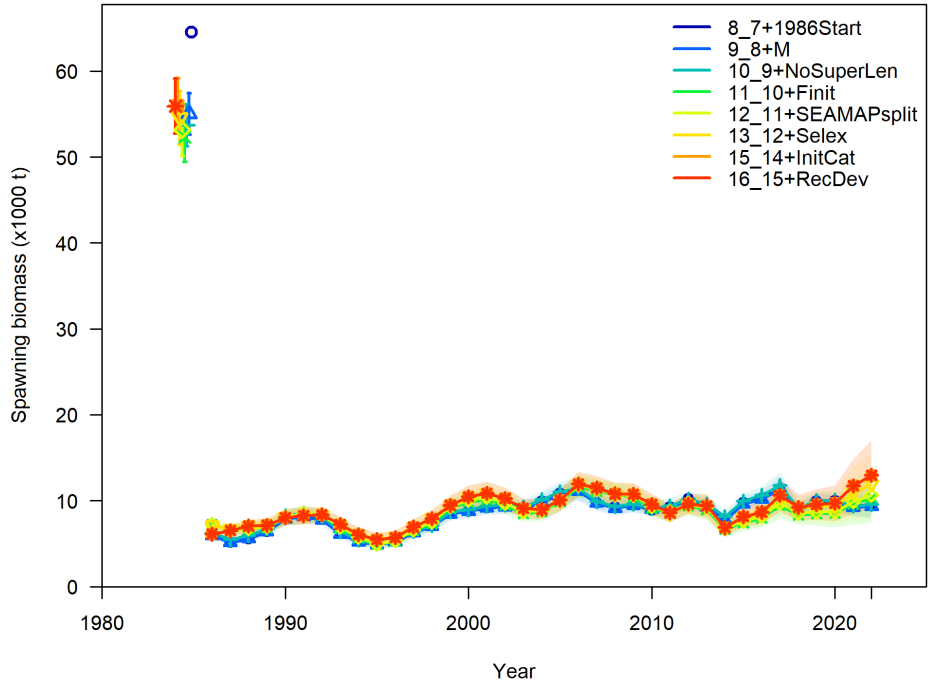
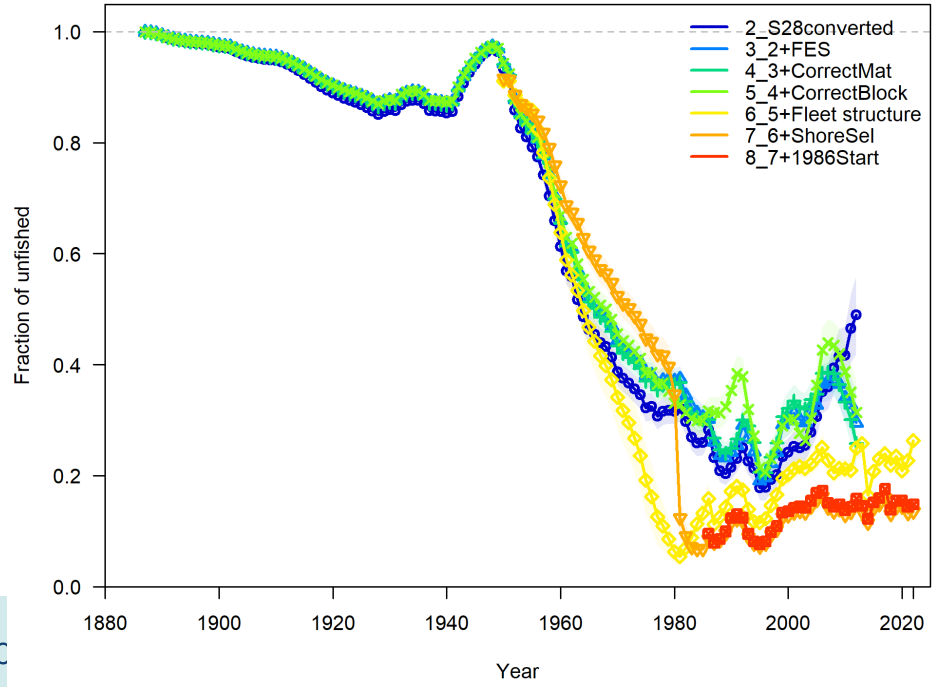
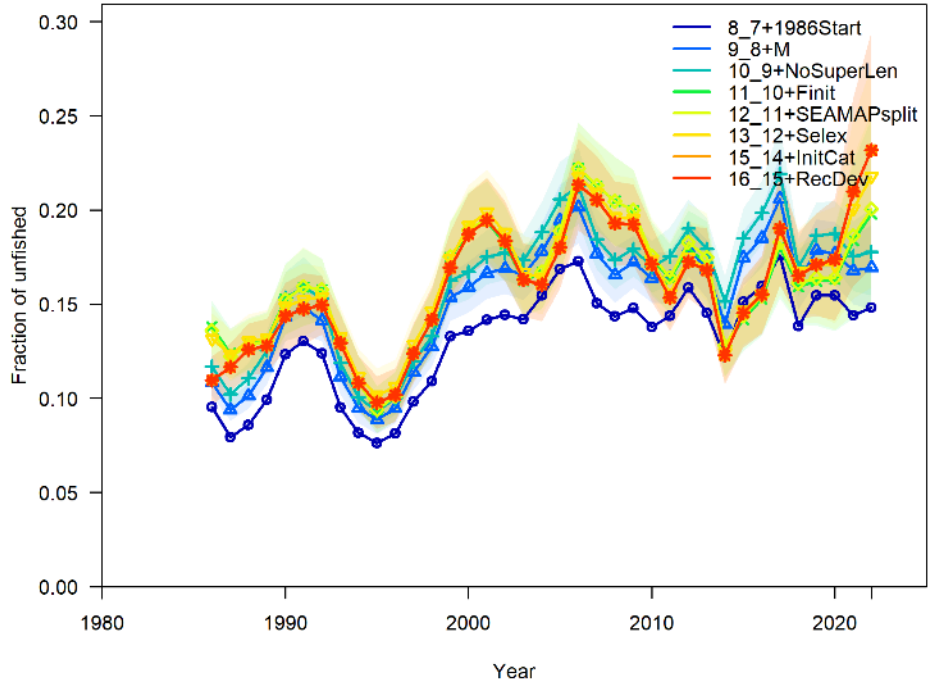
Bridging Analysis



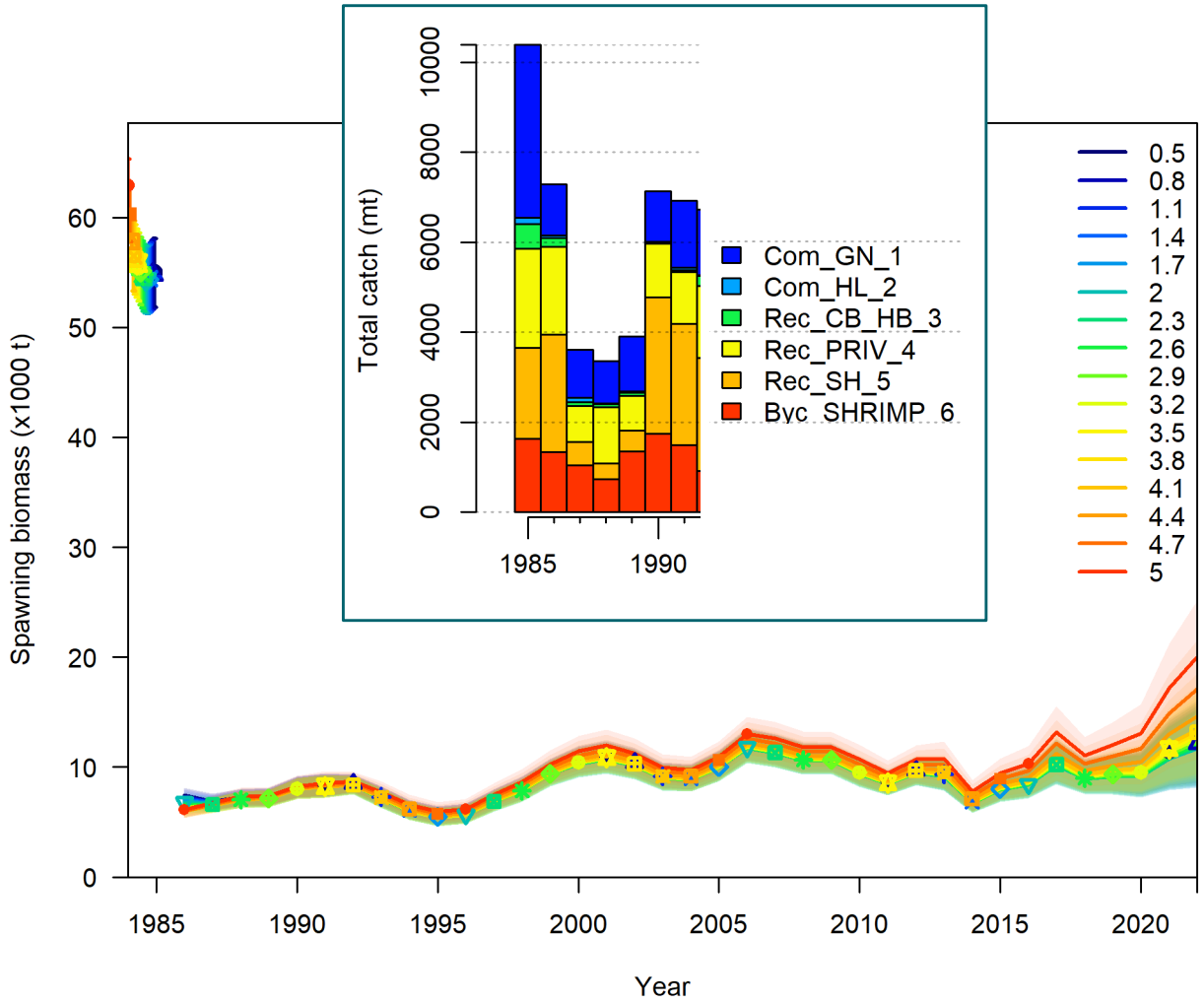


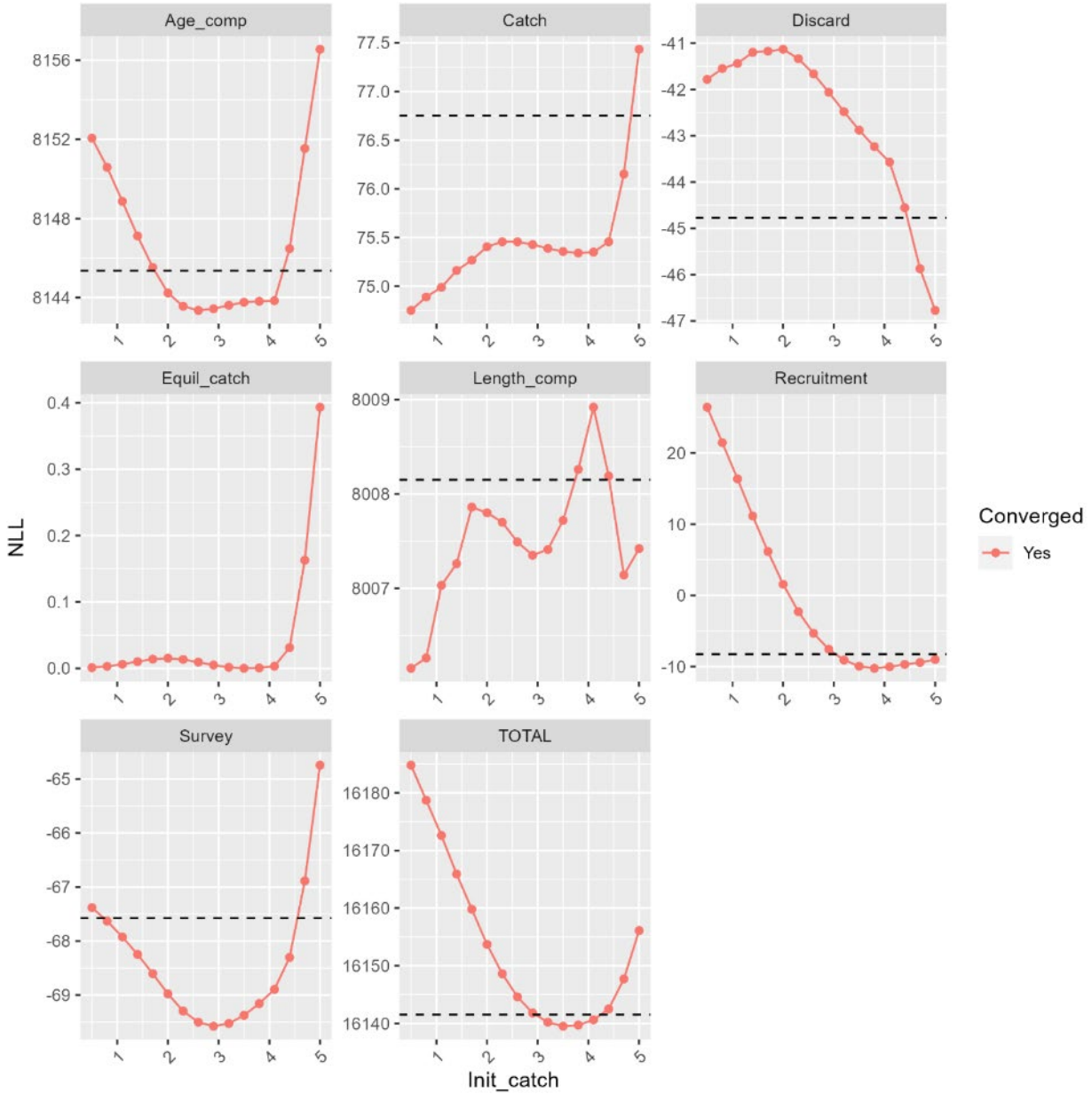




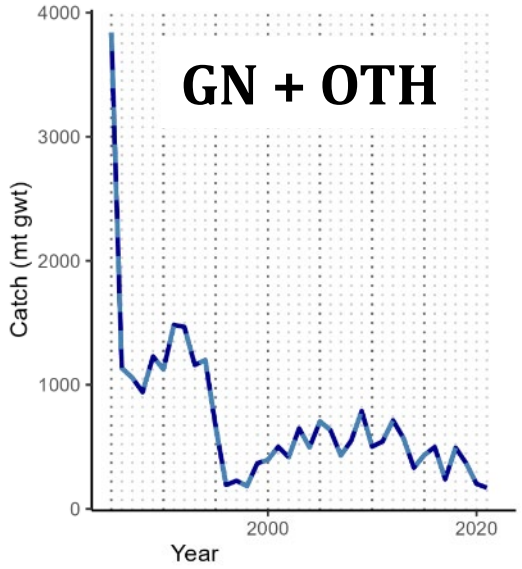


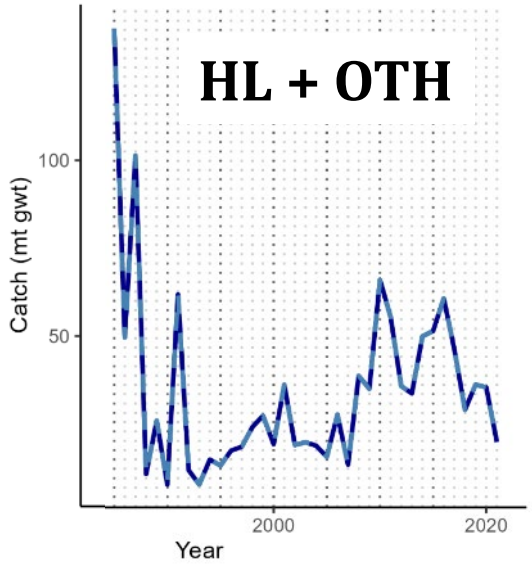
Initial Conditions

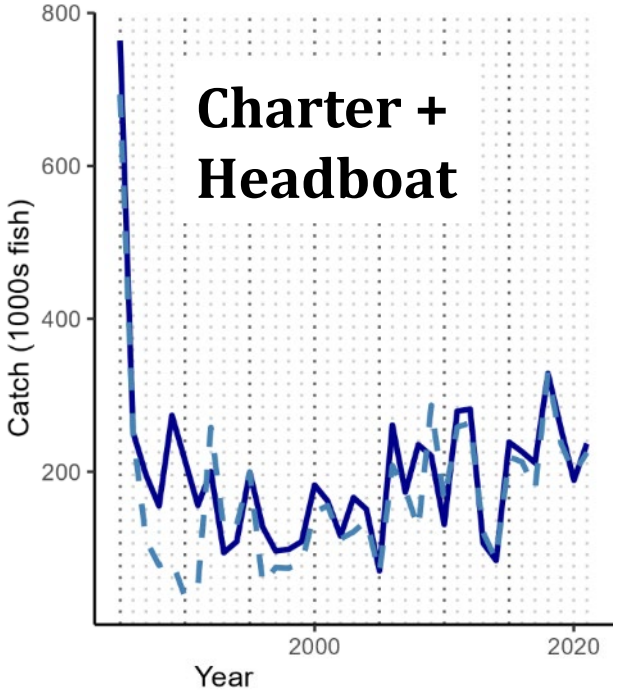


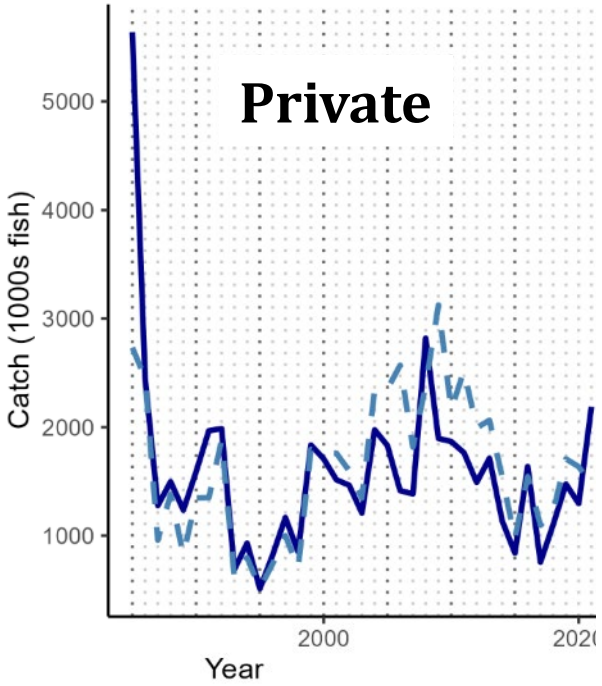


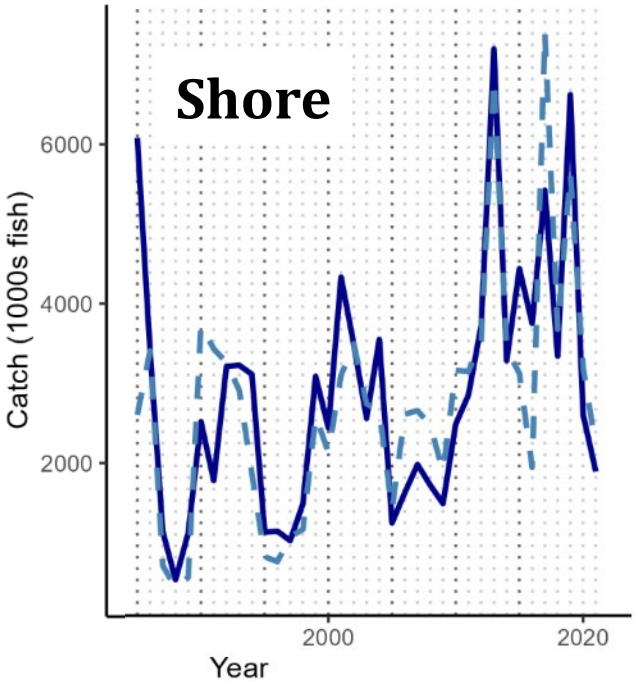
Catches

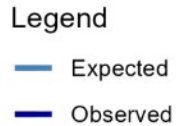












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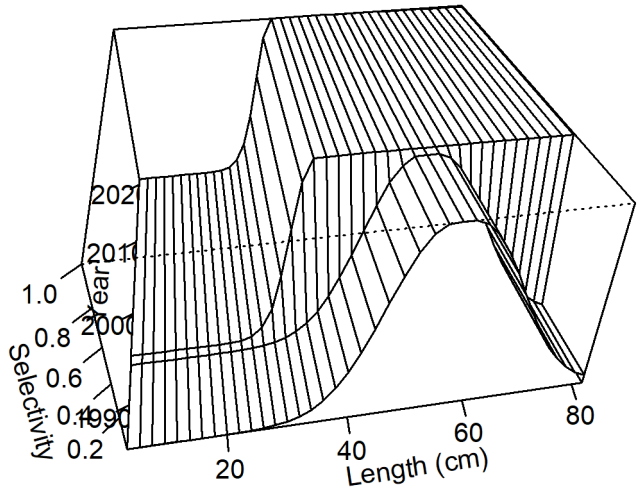
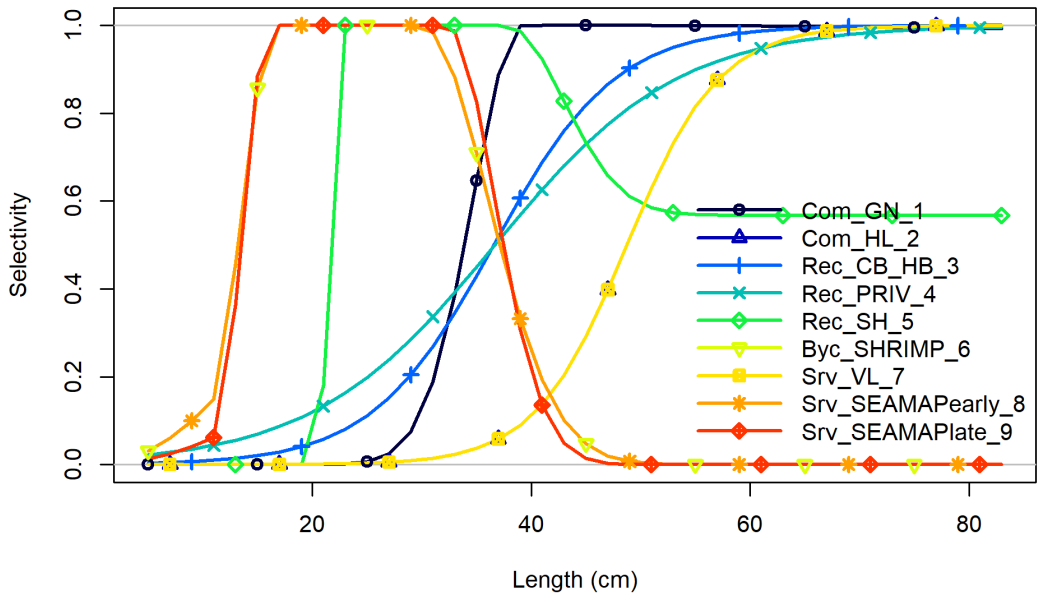
Selectivity



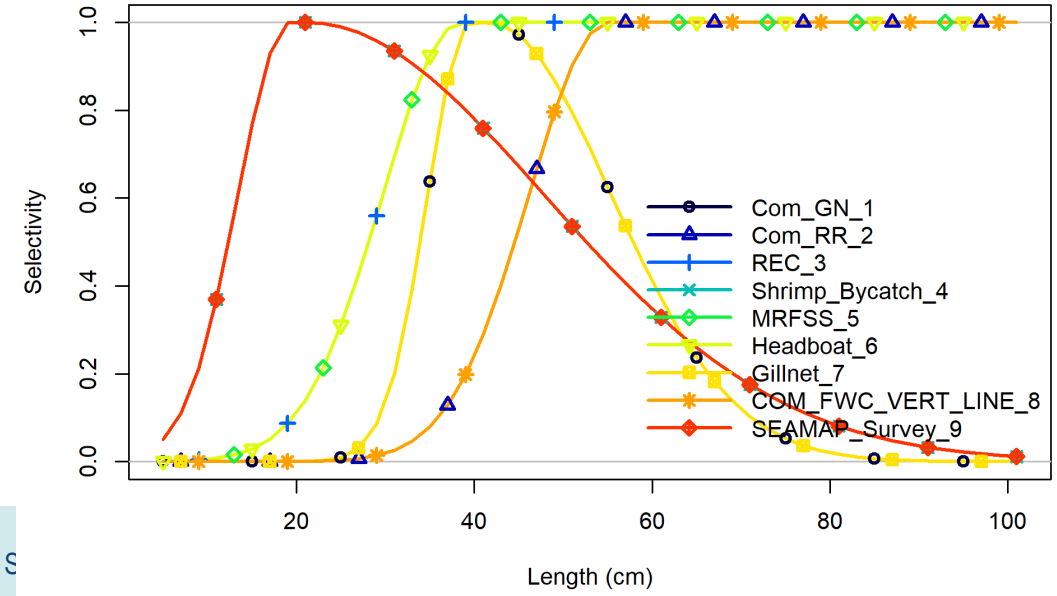
GN 1995 time block

- Logistic: HL (mirror VL index), CH/HB, PR
- Double-normal: GN, SH, SEAMAP early (mirror Shrimp Bycatch), SEAMAP late

SEDAR 81

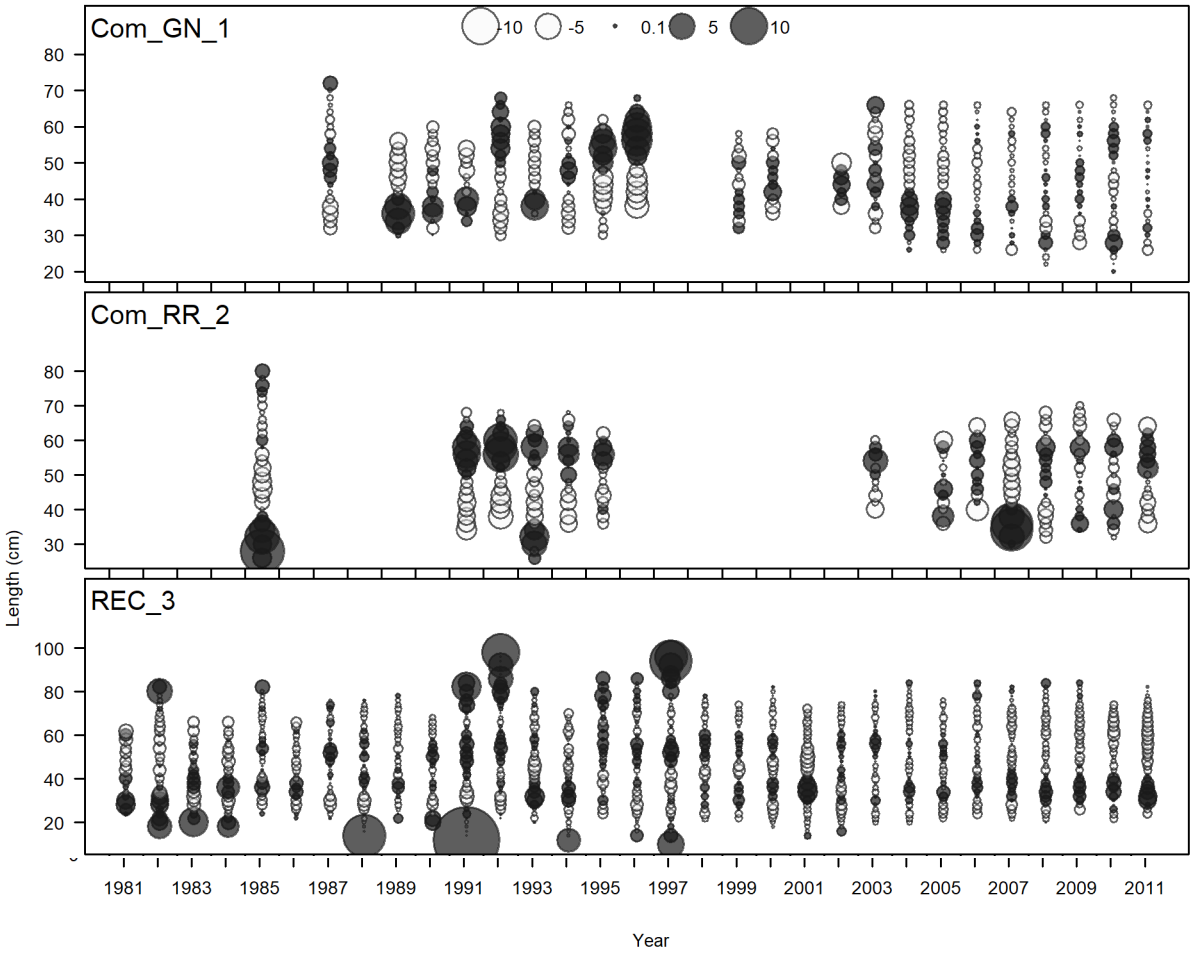


SEDAR 28



Length Compositions

SEDAR 28

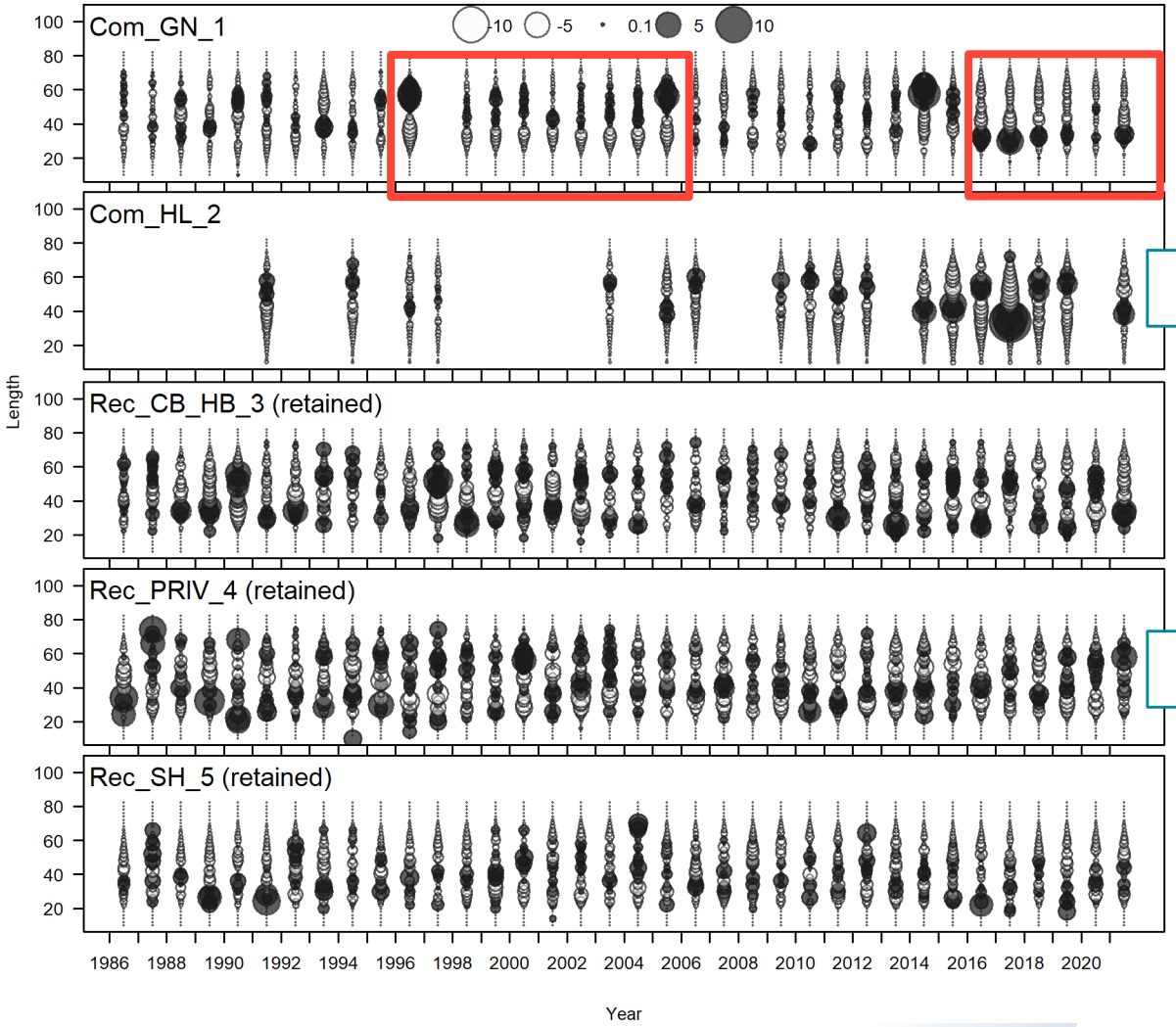


SEDAR 81

D-M

85%

94%



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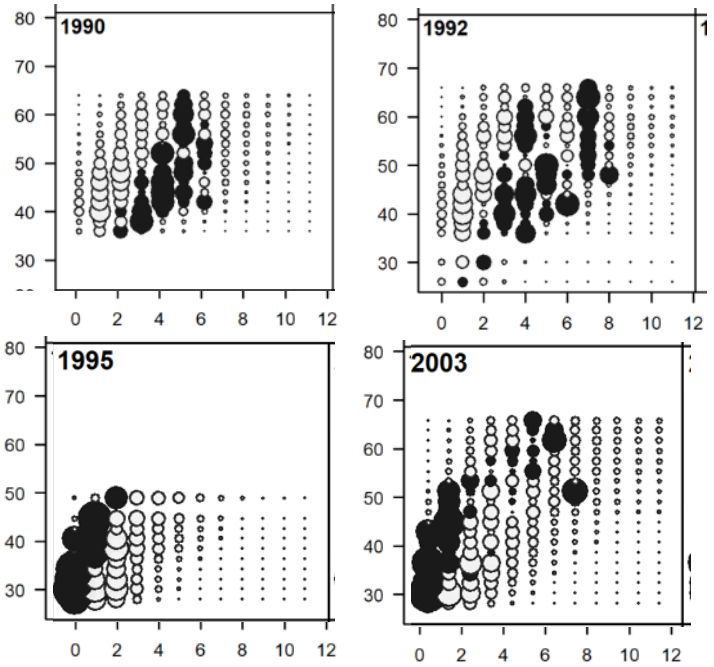
Age Compositions

- Generally good fits in years with large sample sizes
- Some years show trends in residuals

GN

PR



- Predicted mean age:
  - GN: 3-4
  - HL: 2(early)-4(late)
  - HB/CH: 2-3
  - PR: 2-3
  - SH: 2

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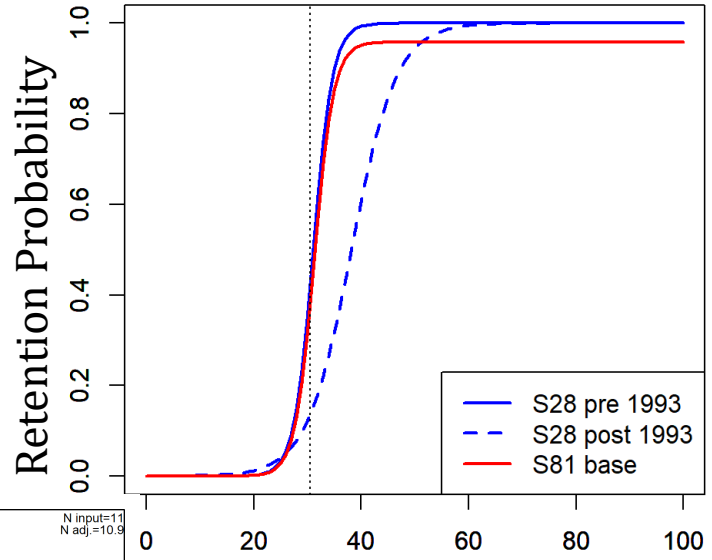
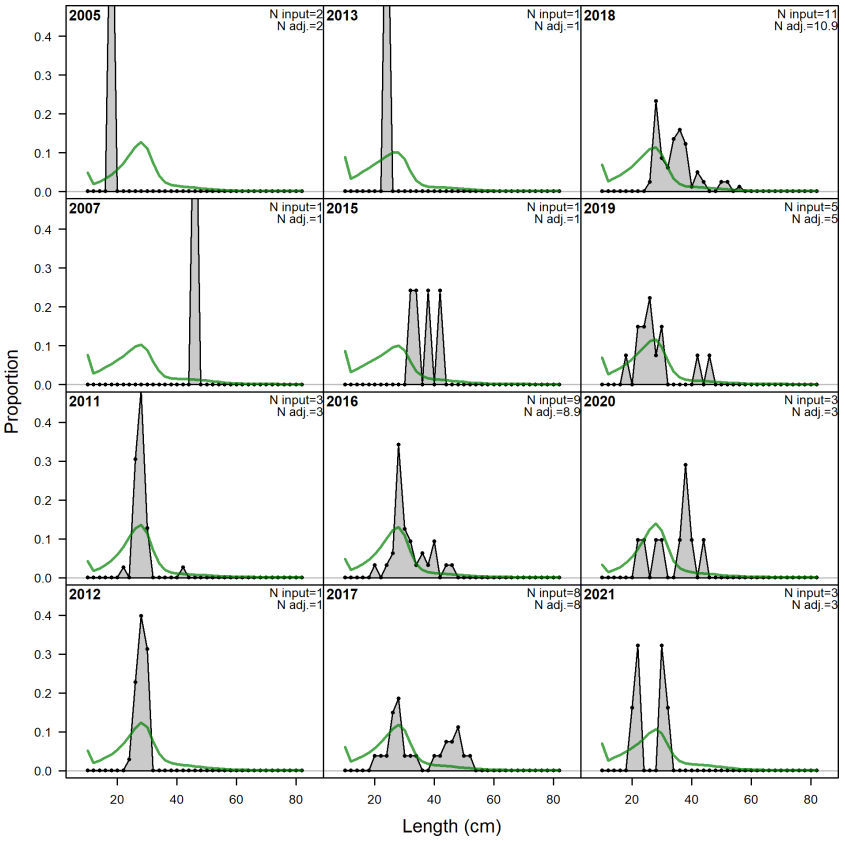
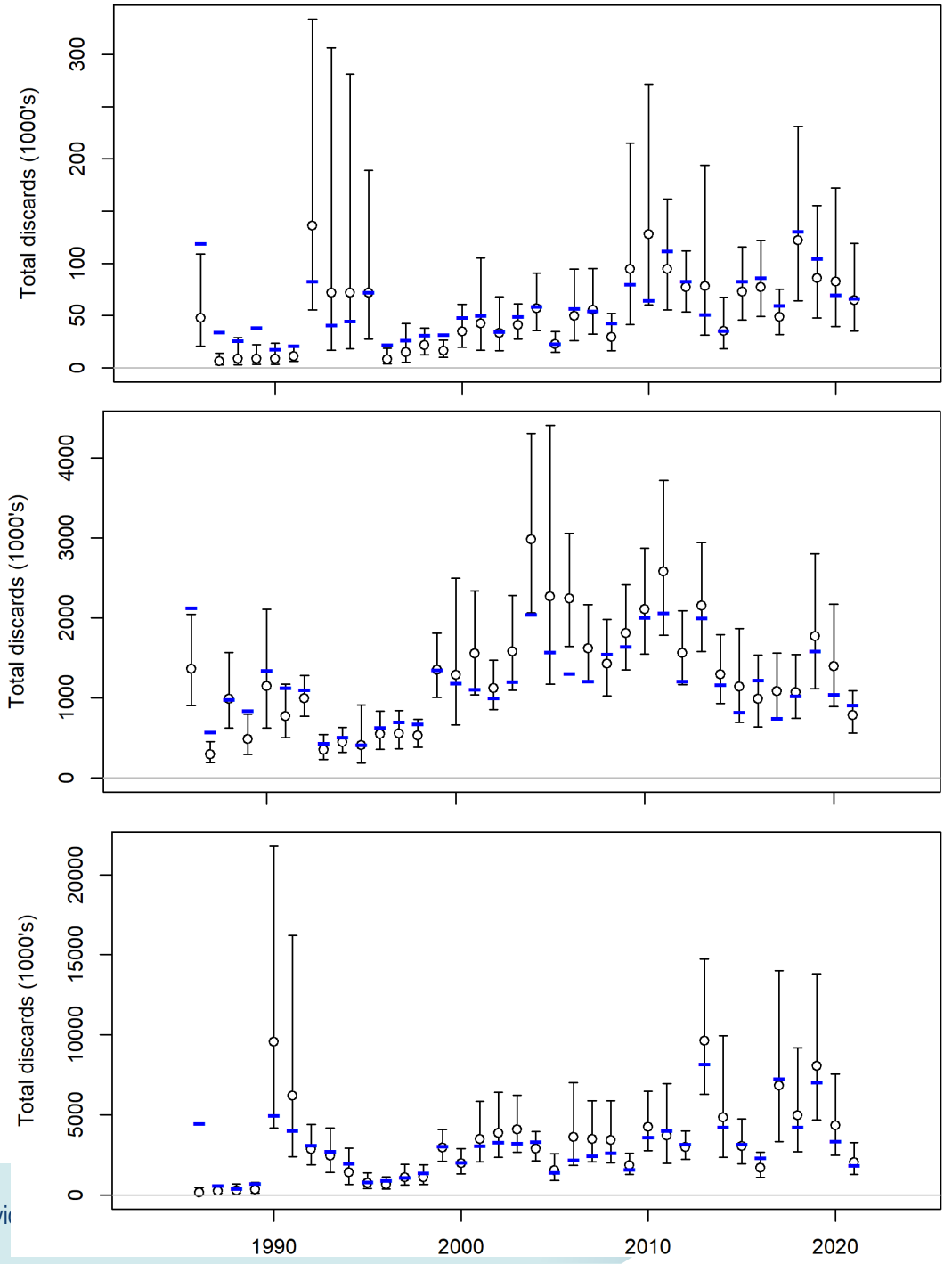
Recreational Discards







Index Fits

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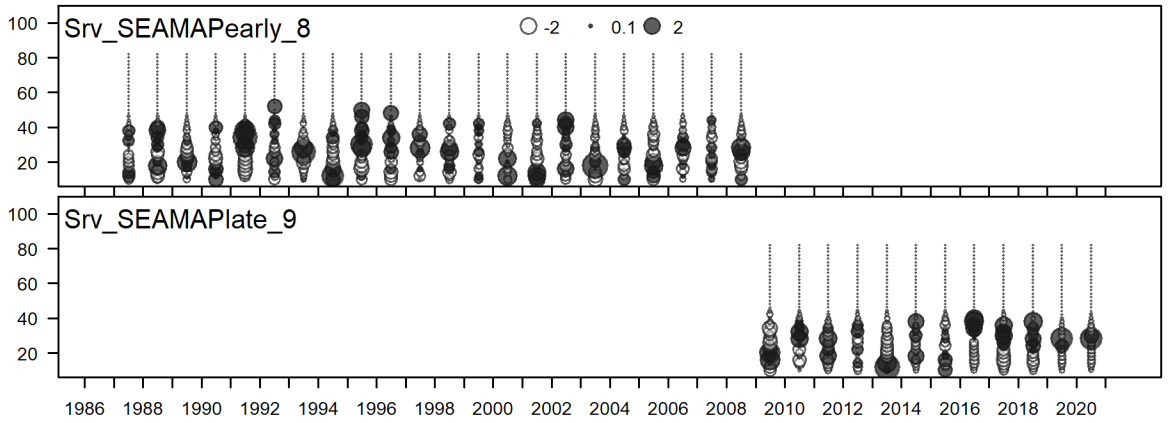

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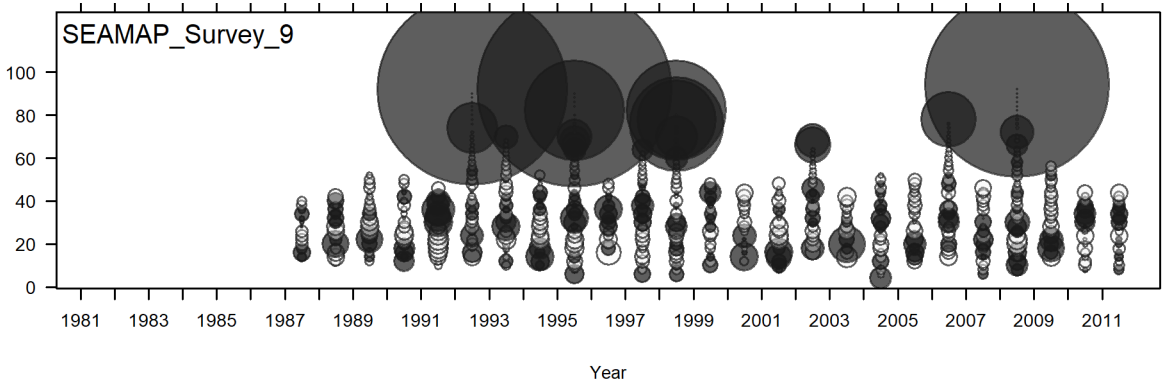

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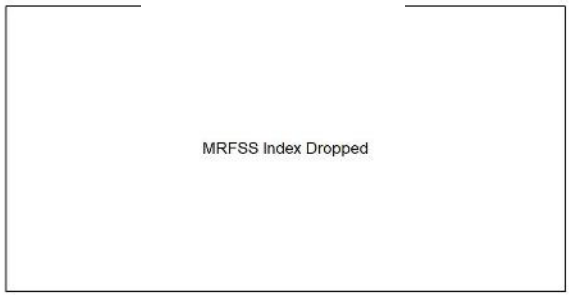

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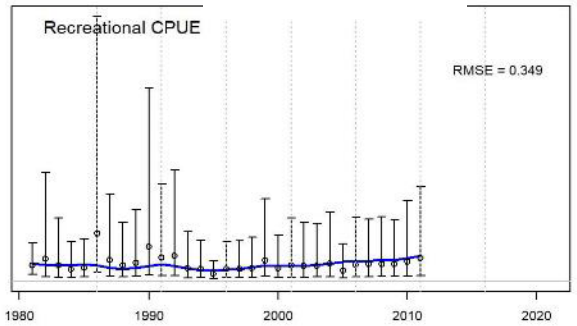
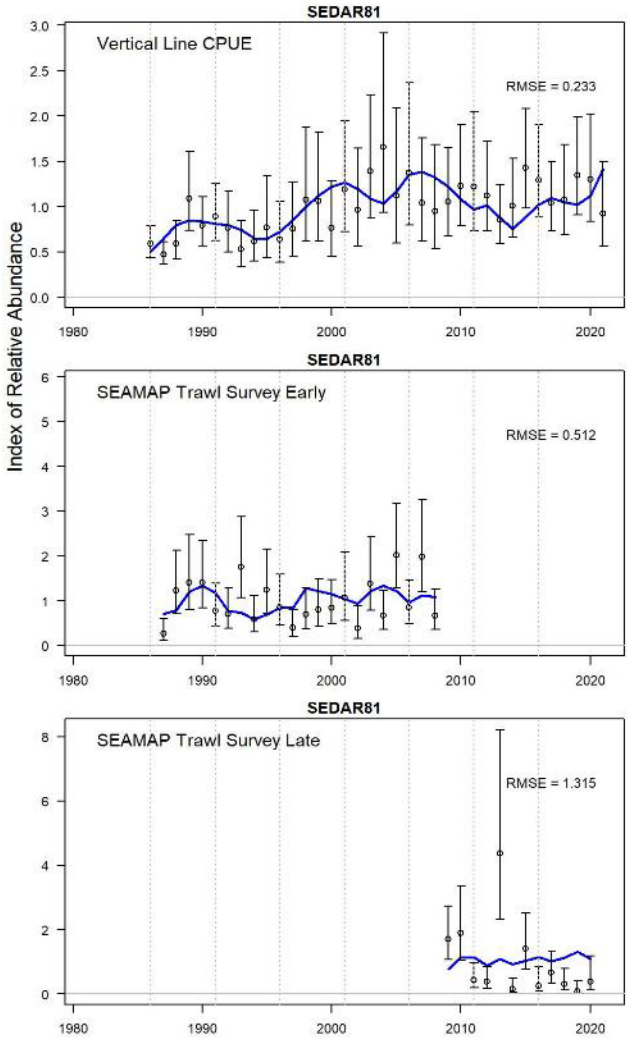
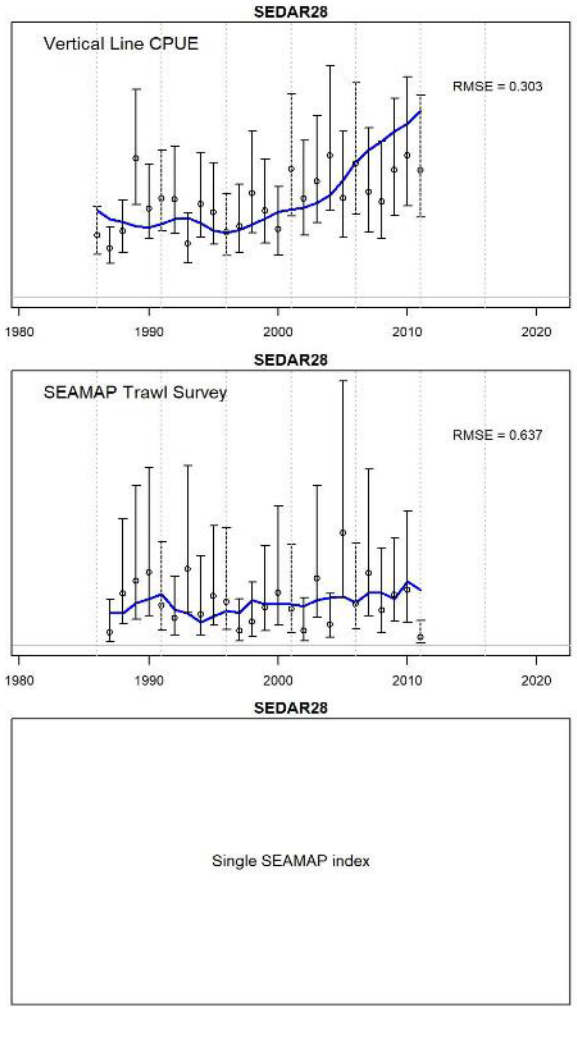
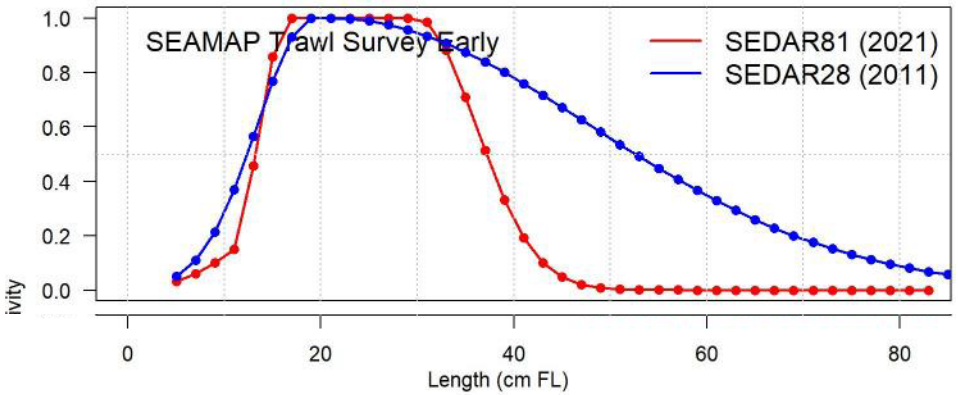
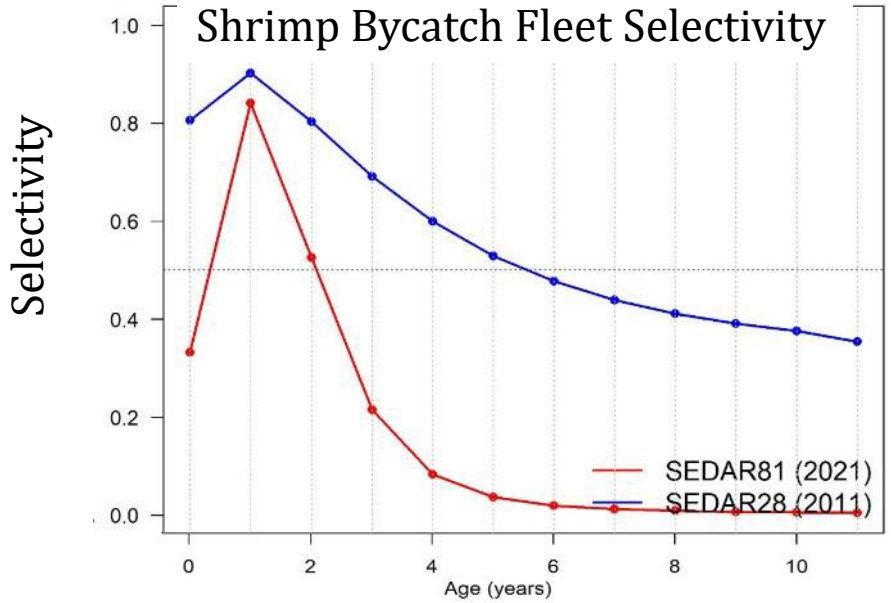


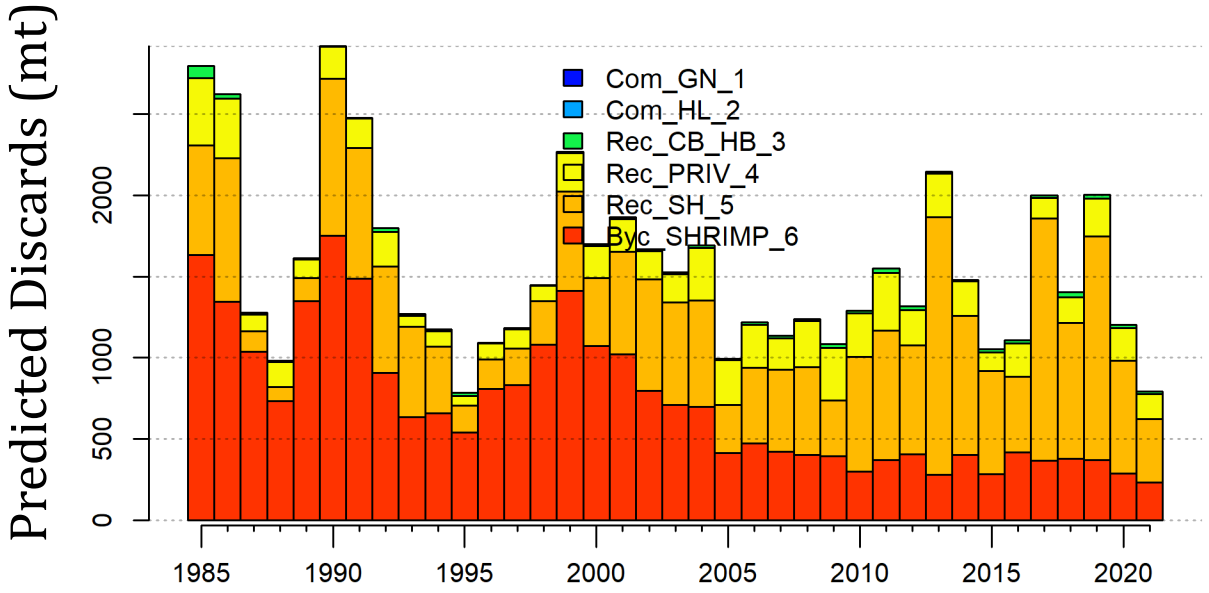


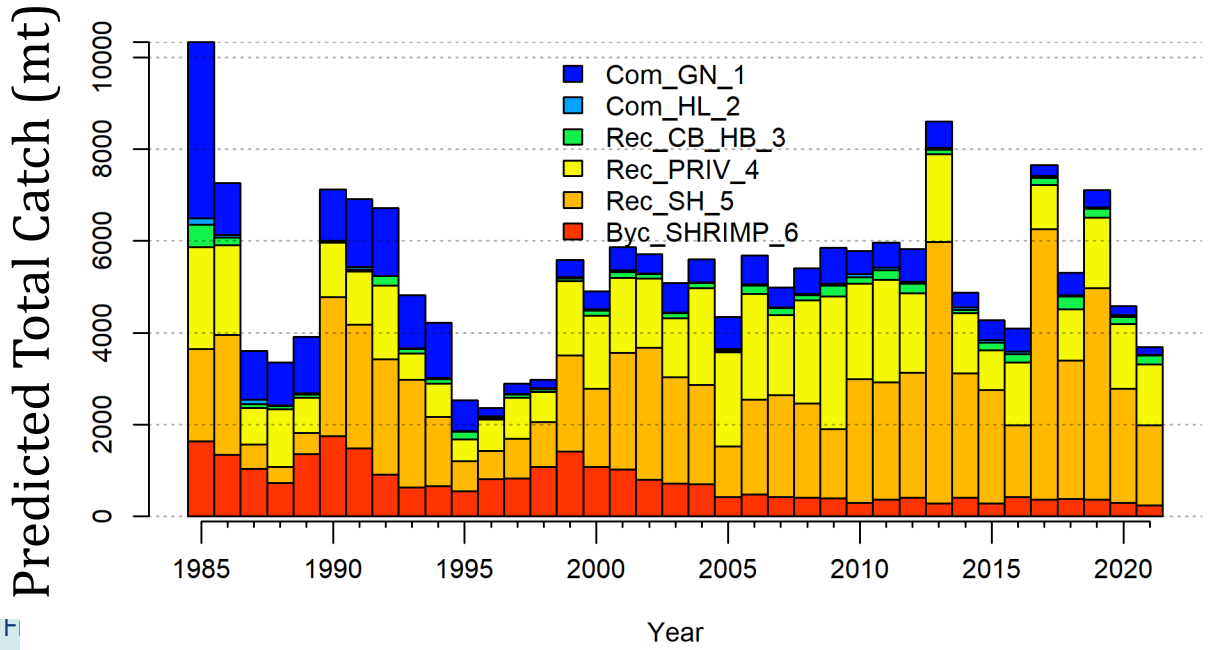


Shrimp Bycatch

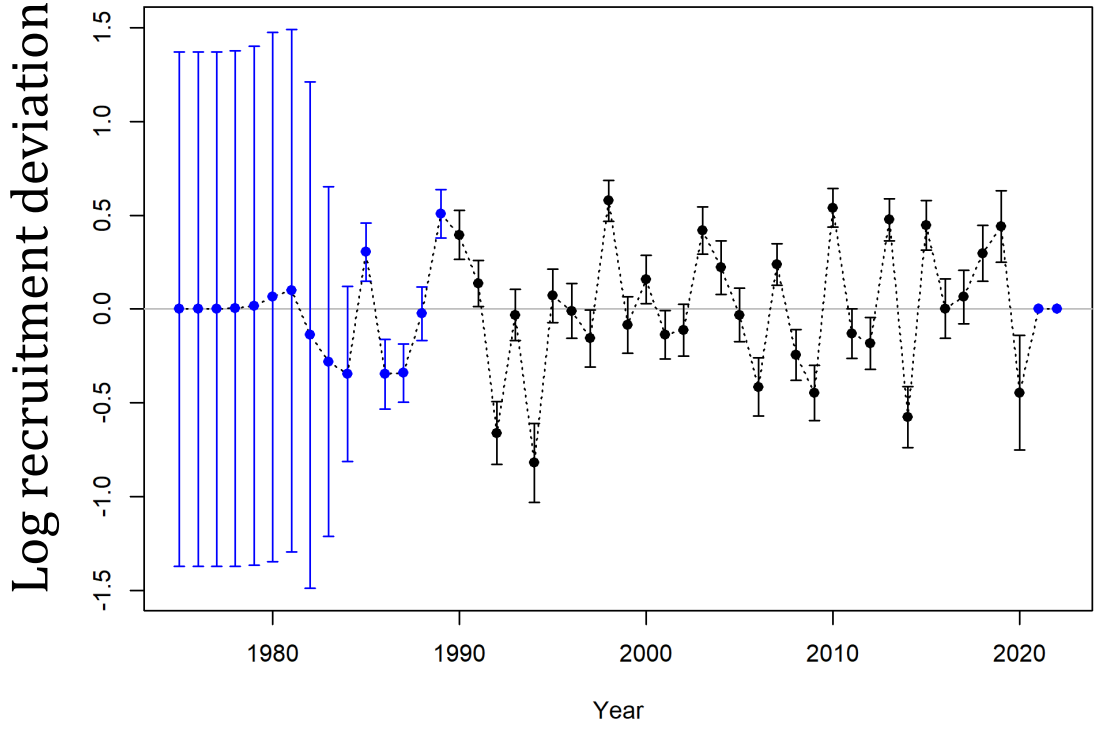


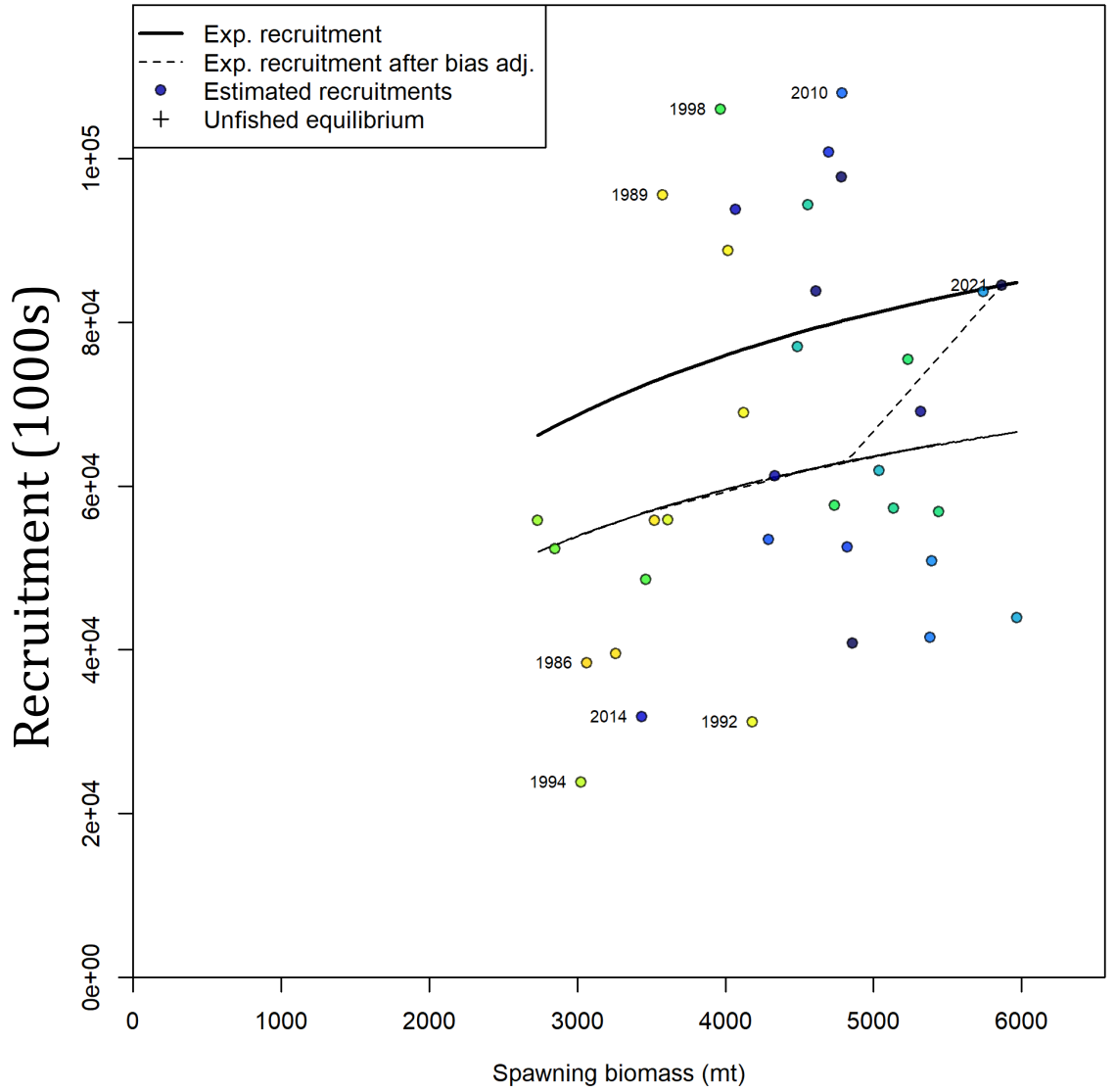






Recruitment





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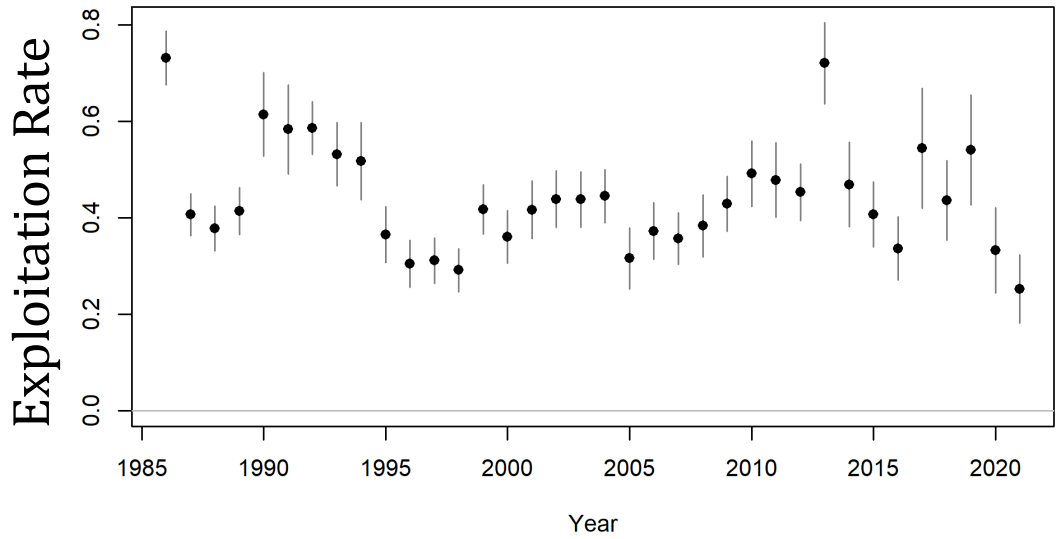
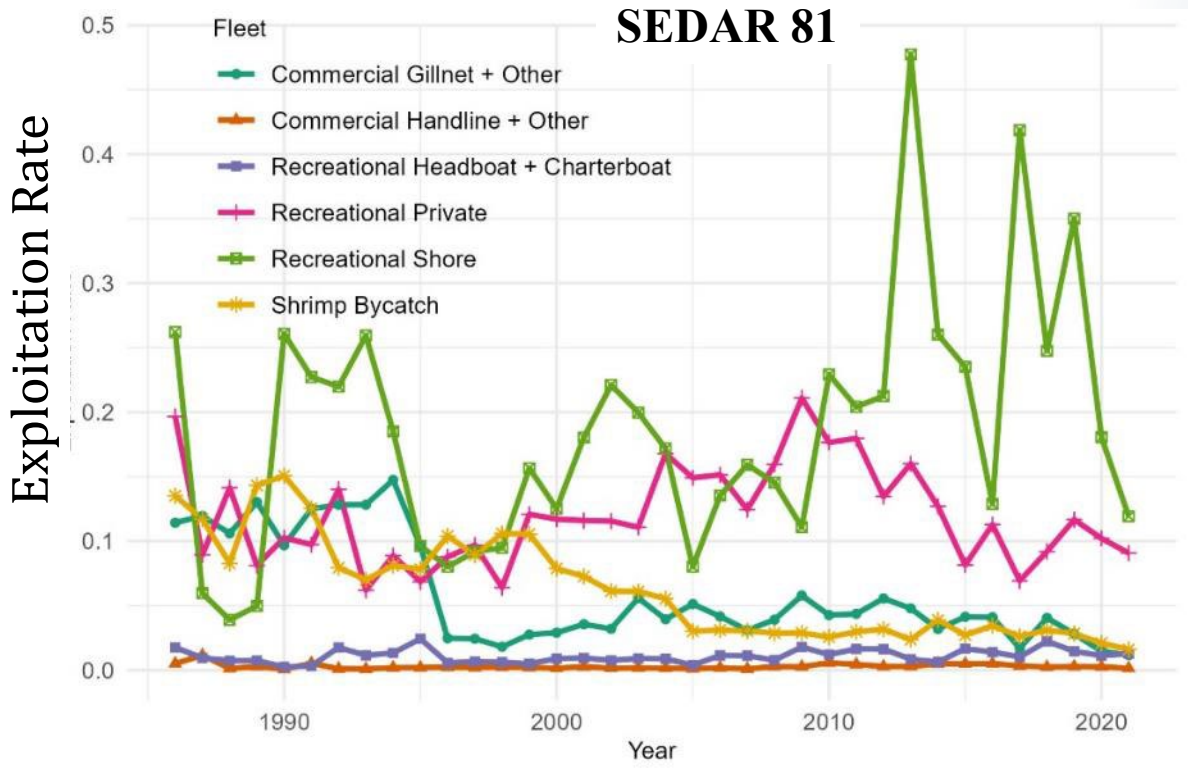
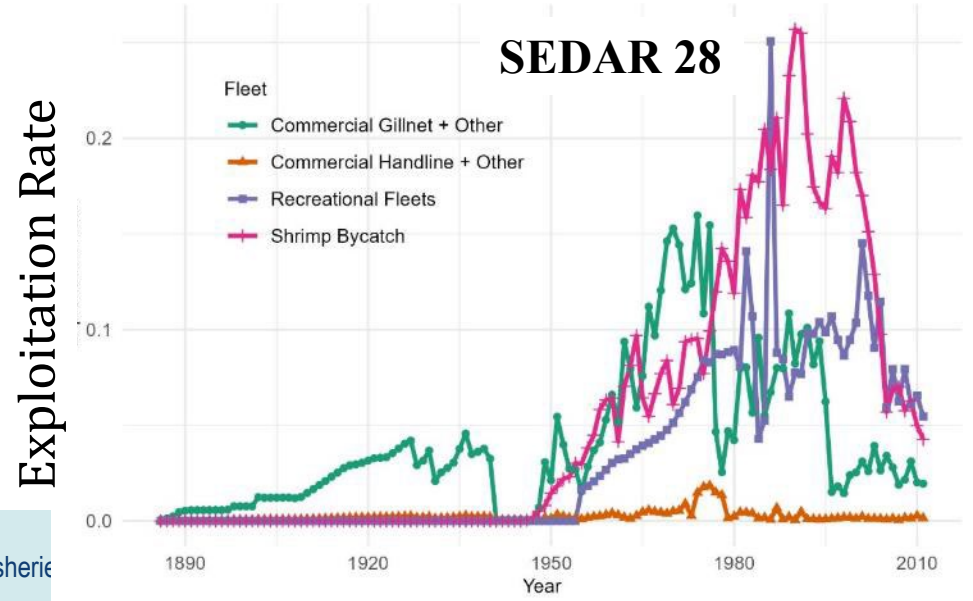
Exploitation Rate







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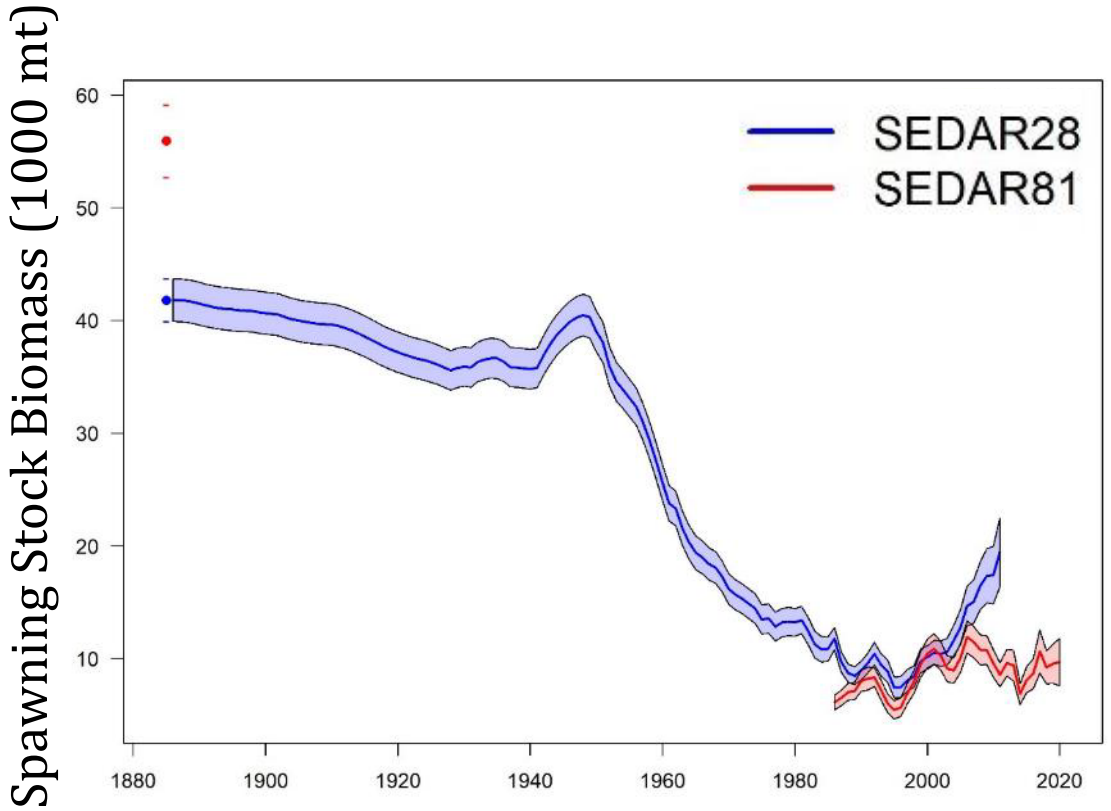
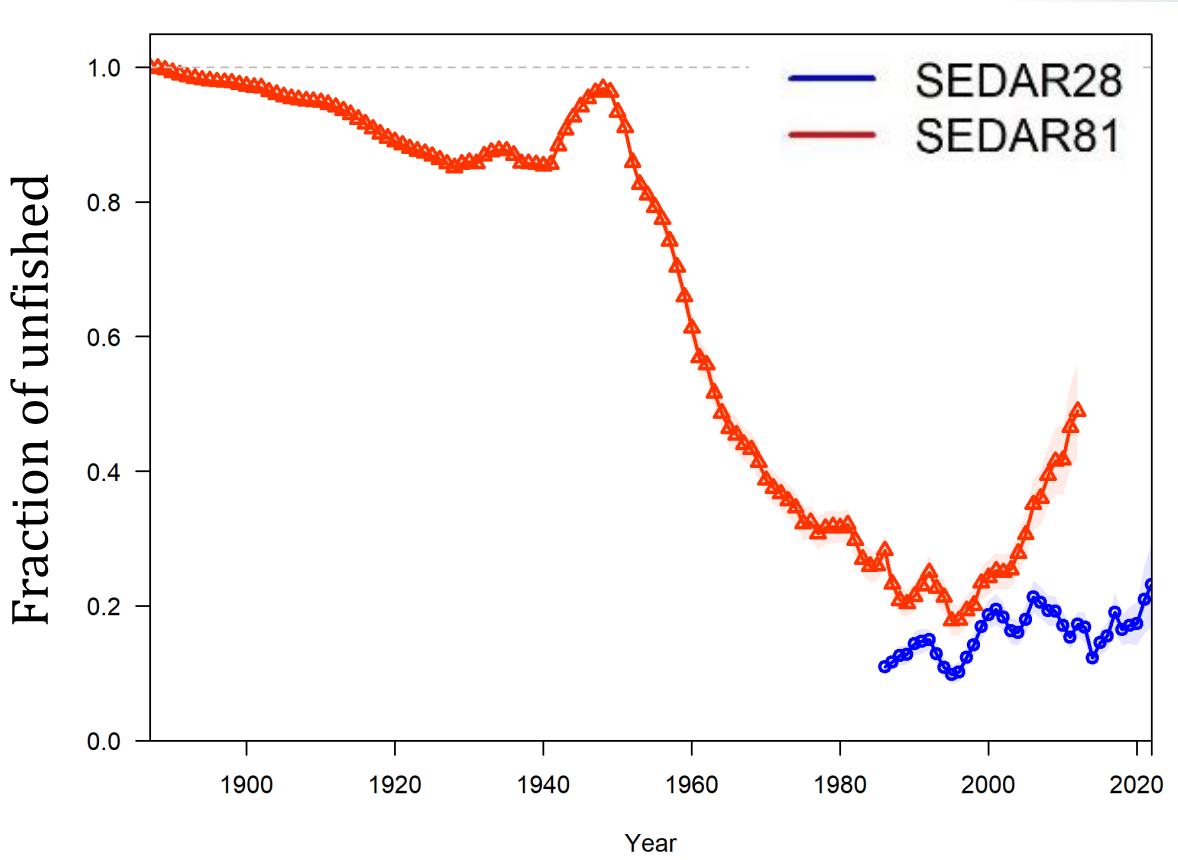
SSB and SSB/SSB_0 trajectories





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Diagnostics

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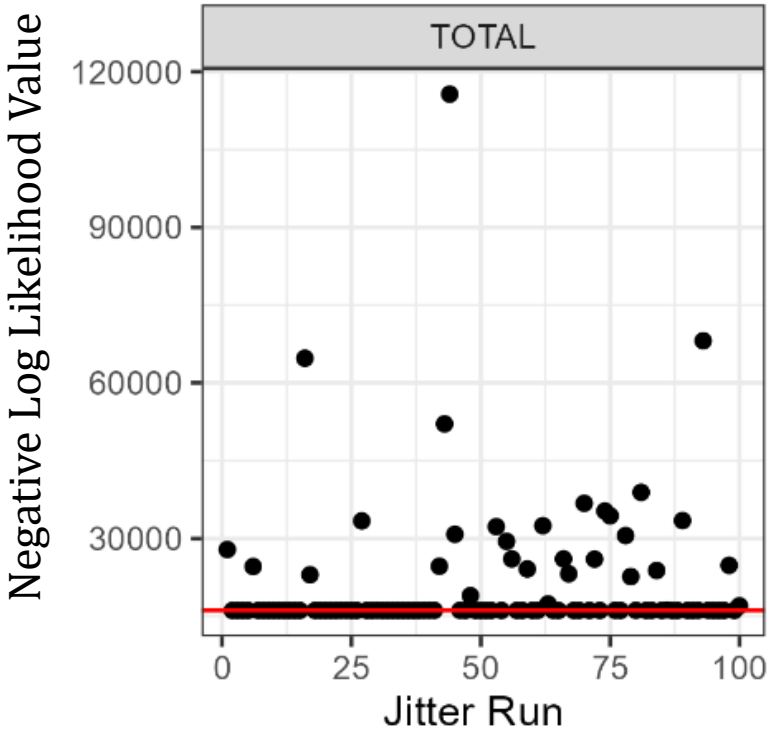
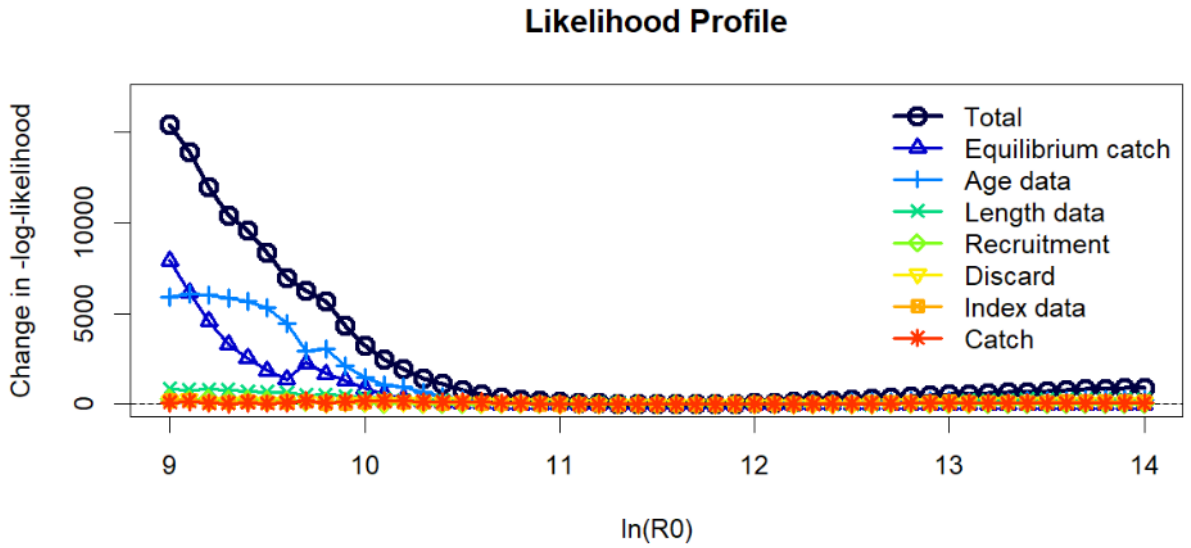
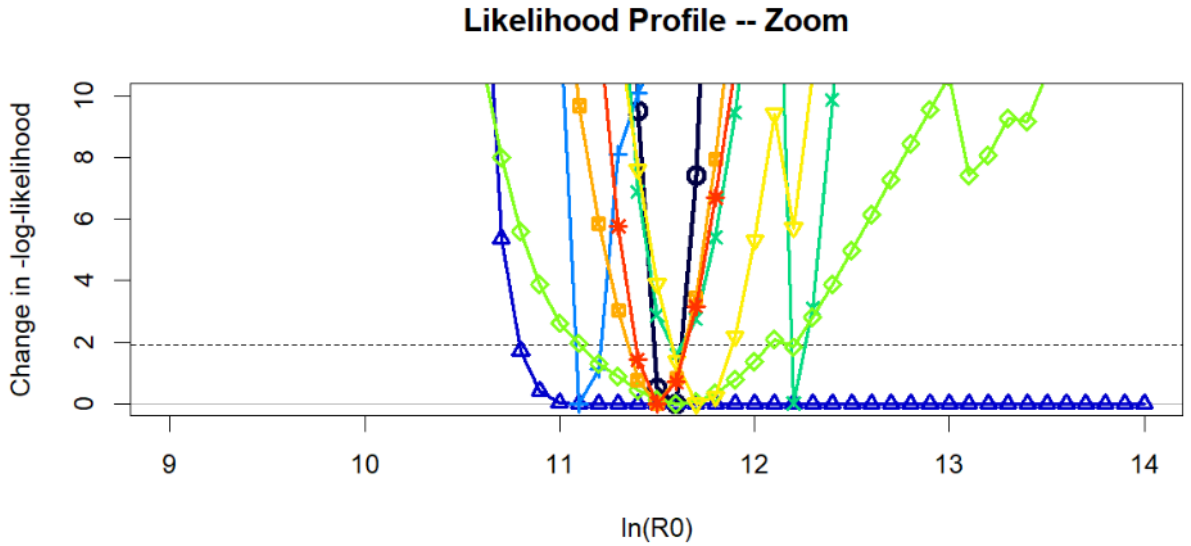
Jitter & R0 Profile







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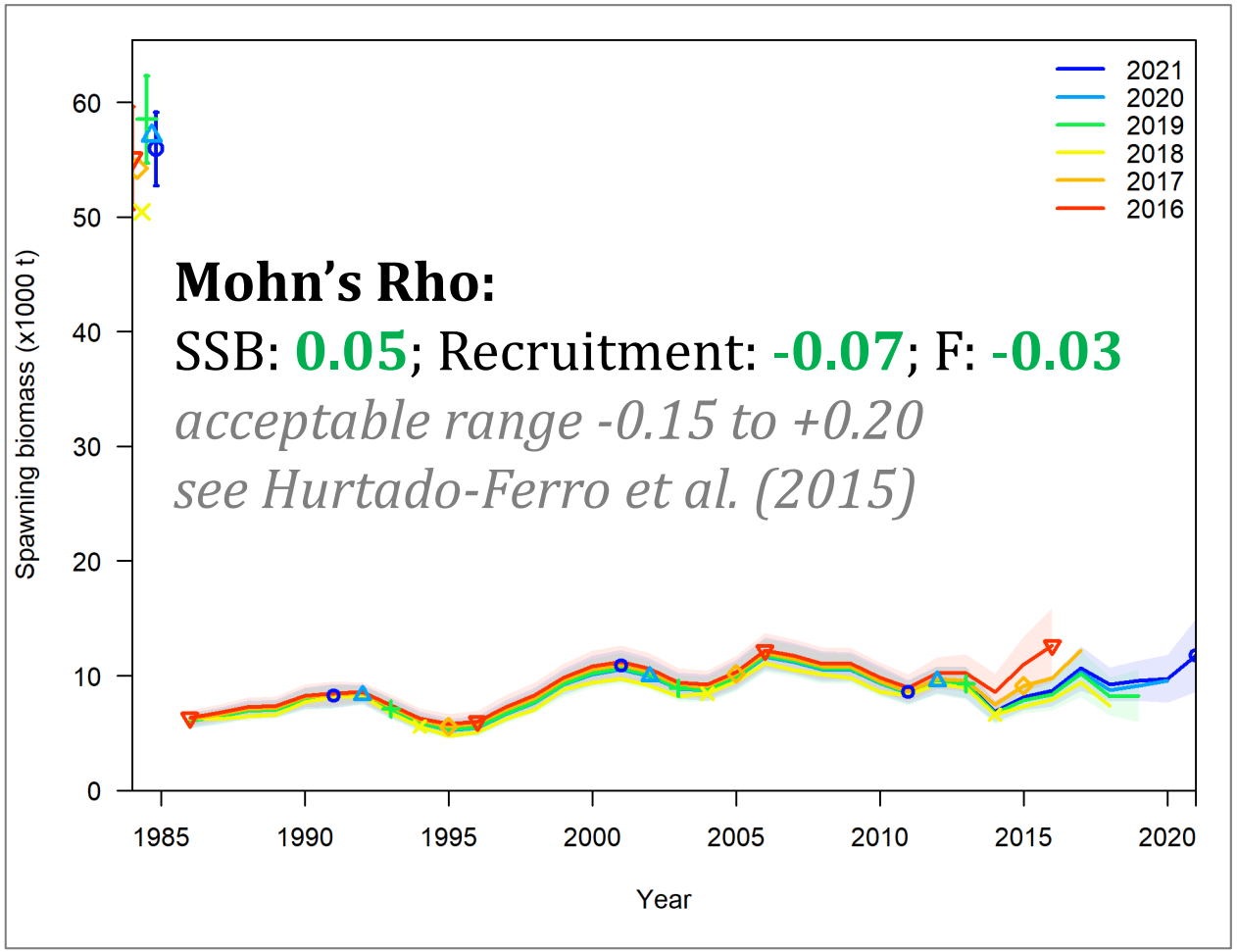
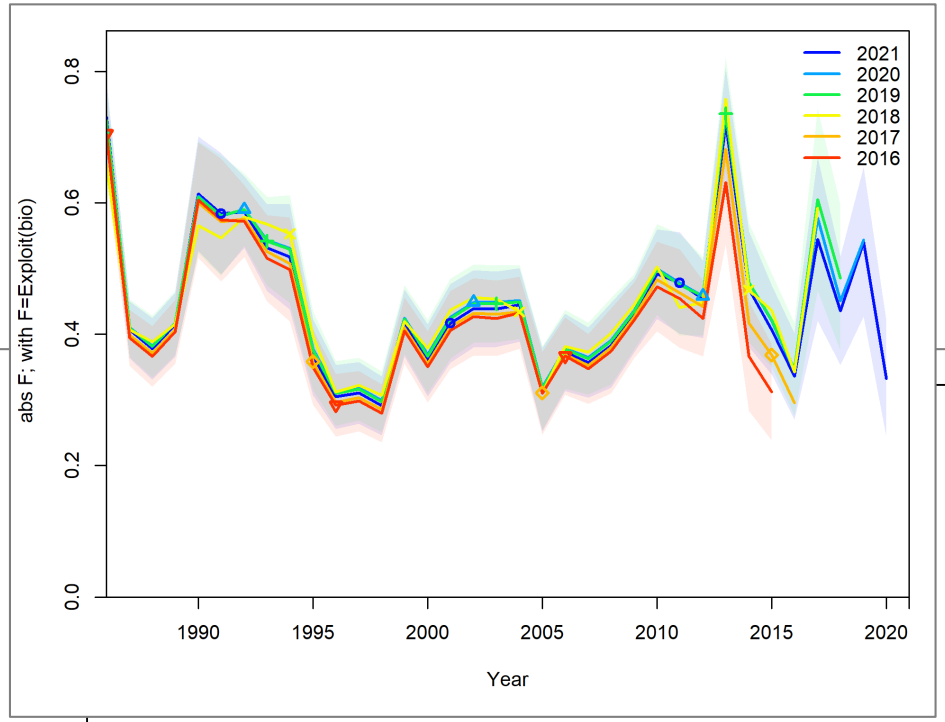
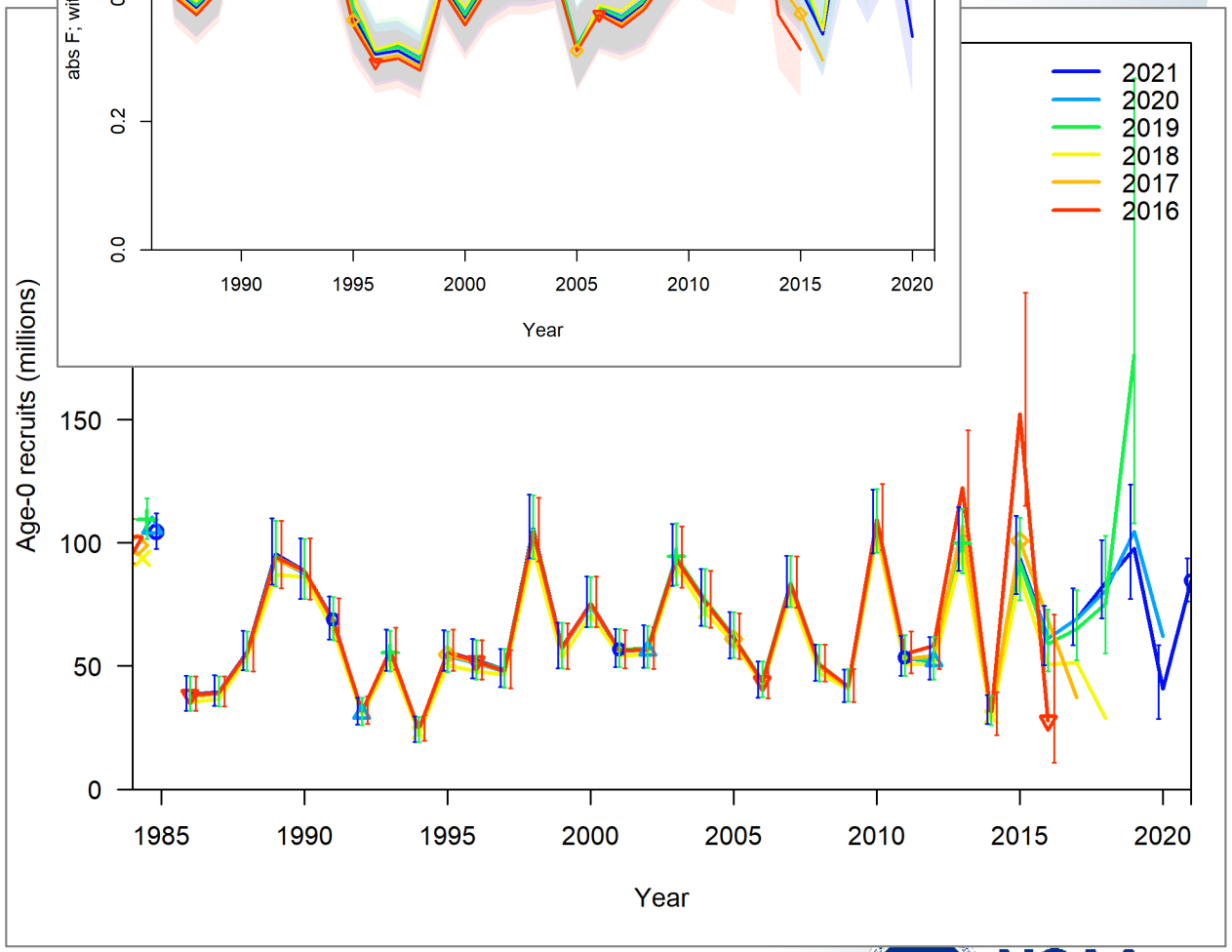
Retrospective Analysis







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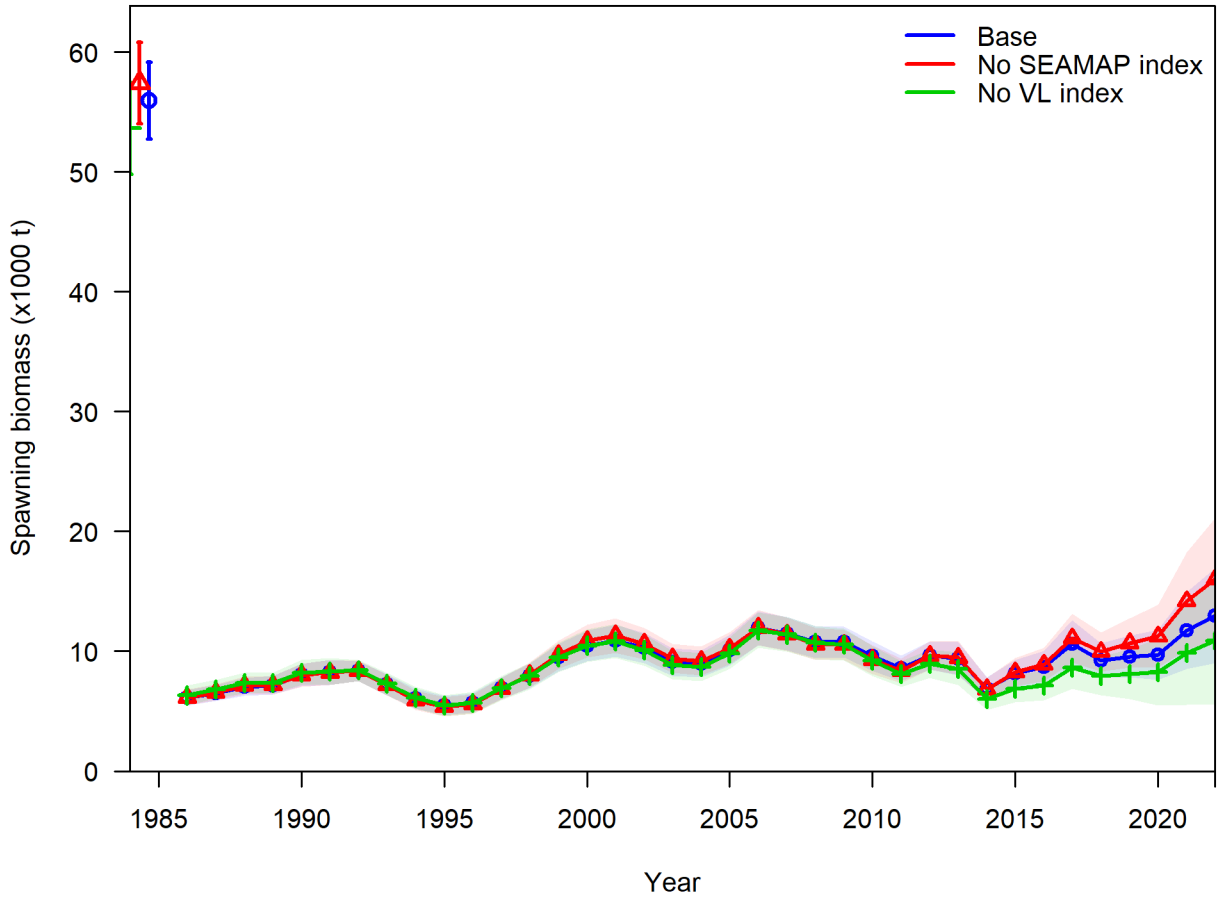
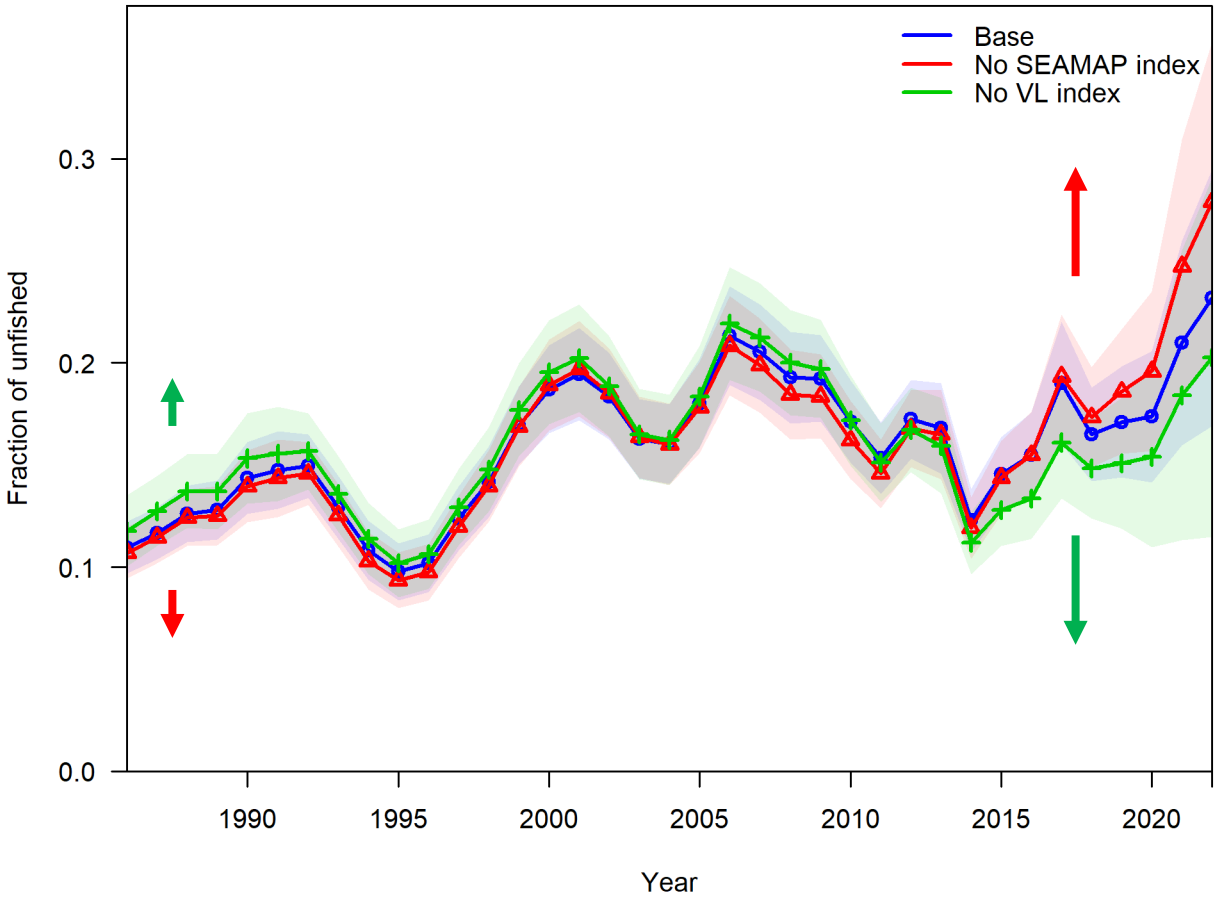
Jack-knife





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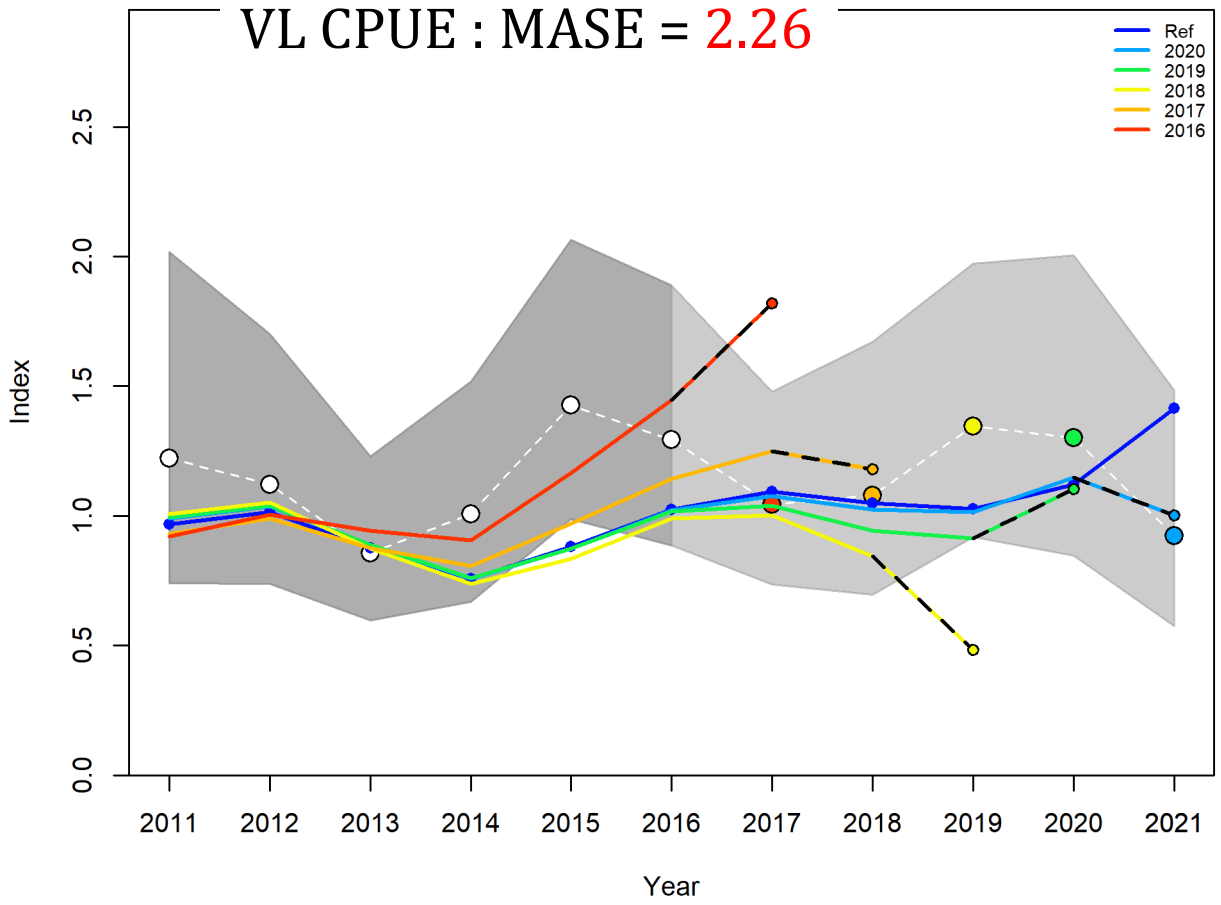
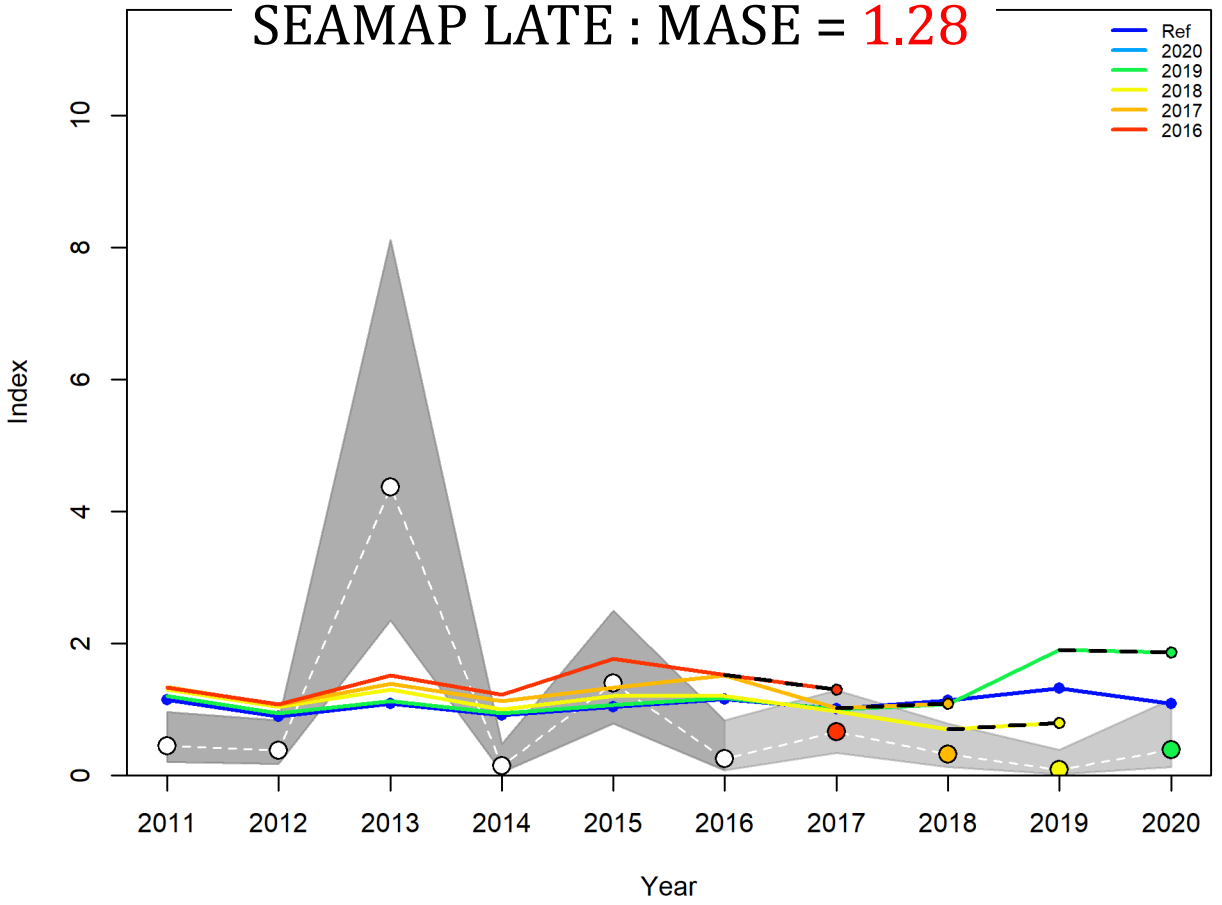
Hindcasting cross-validation





Sensitivity Runs

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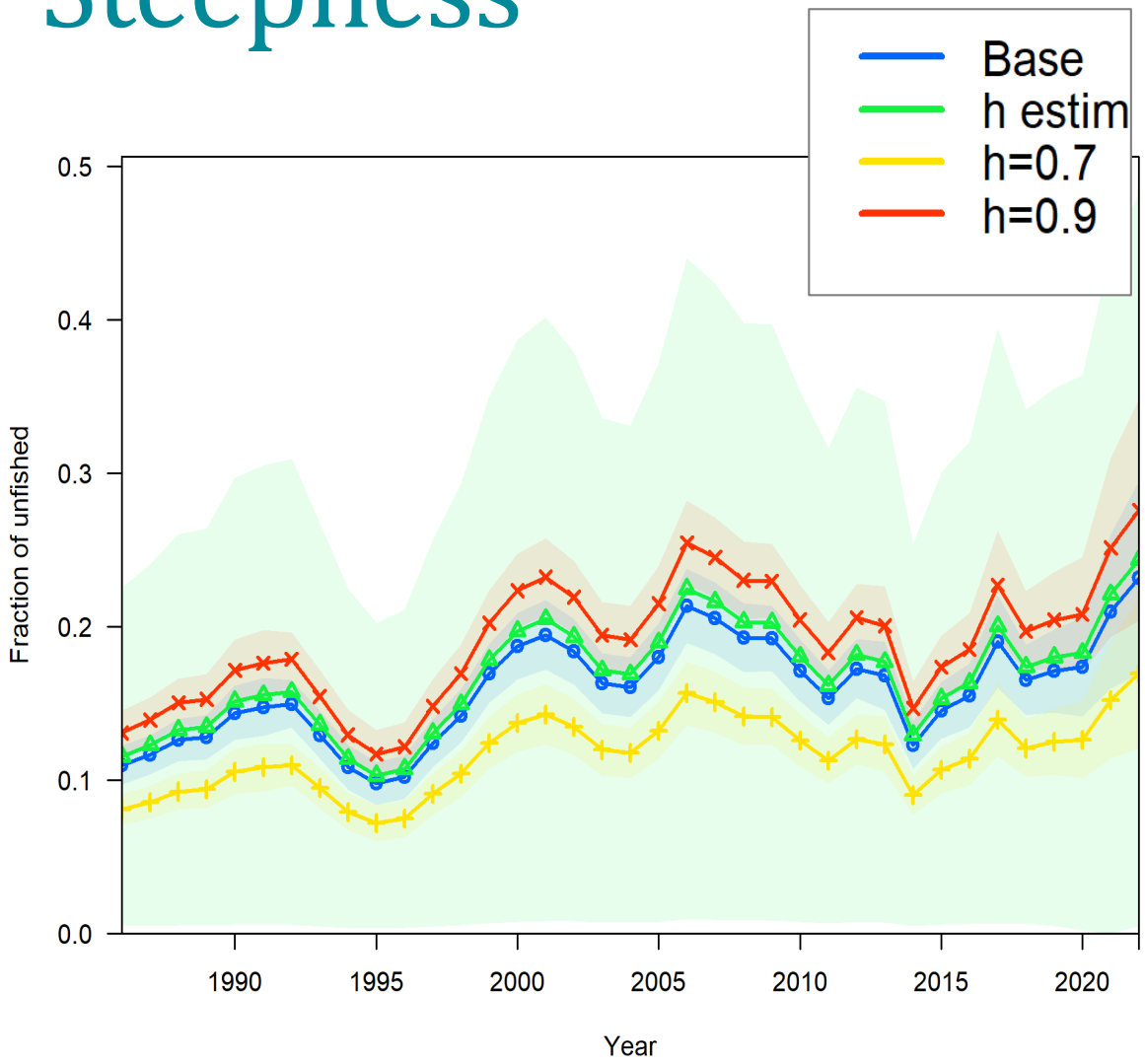
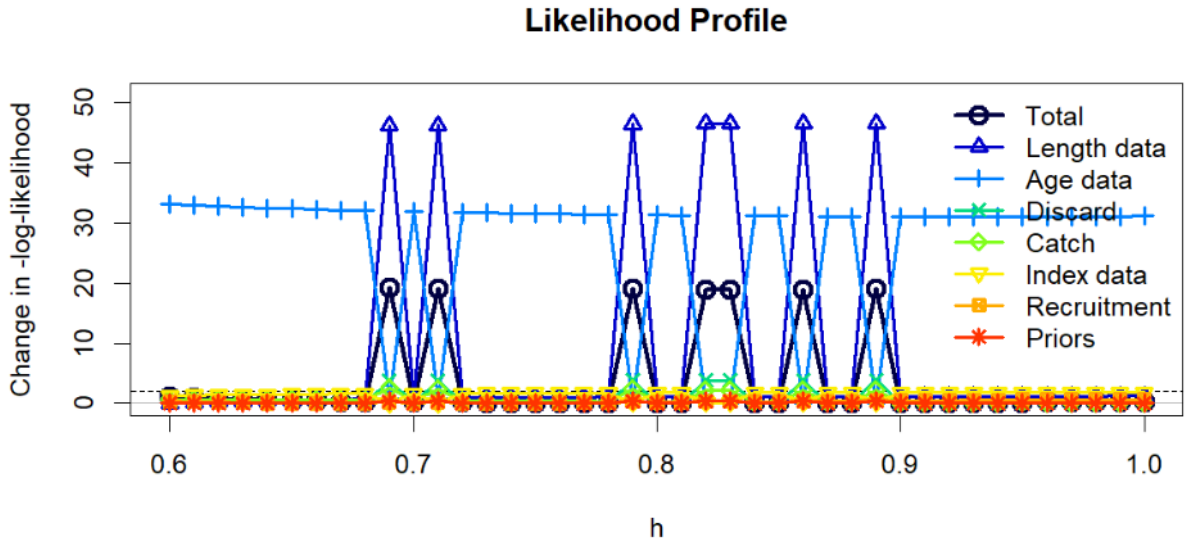
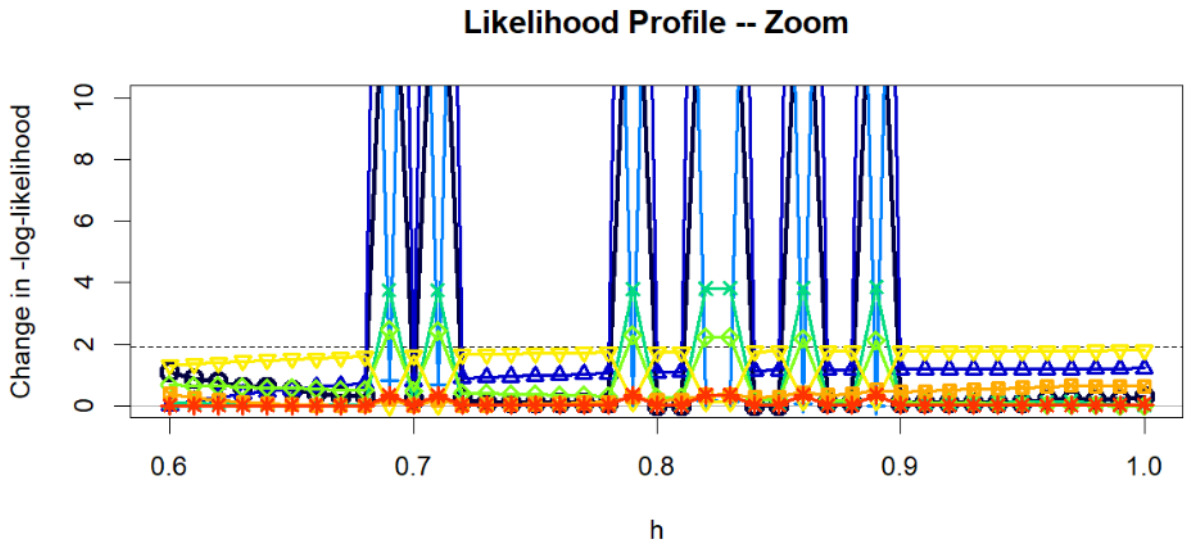
Steepness







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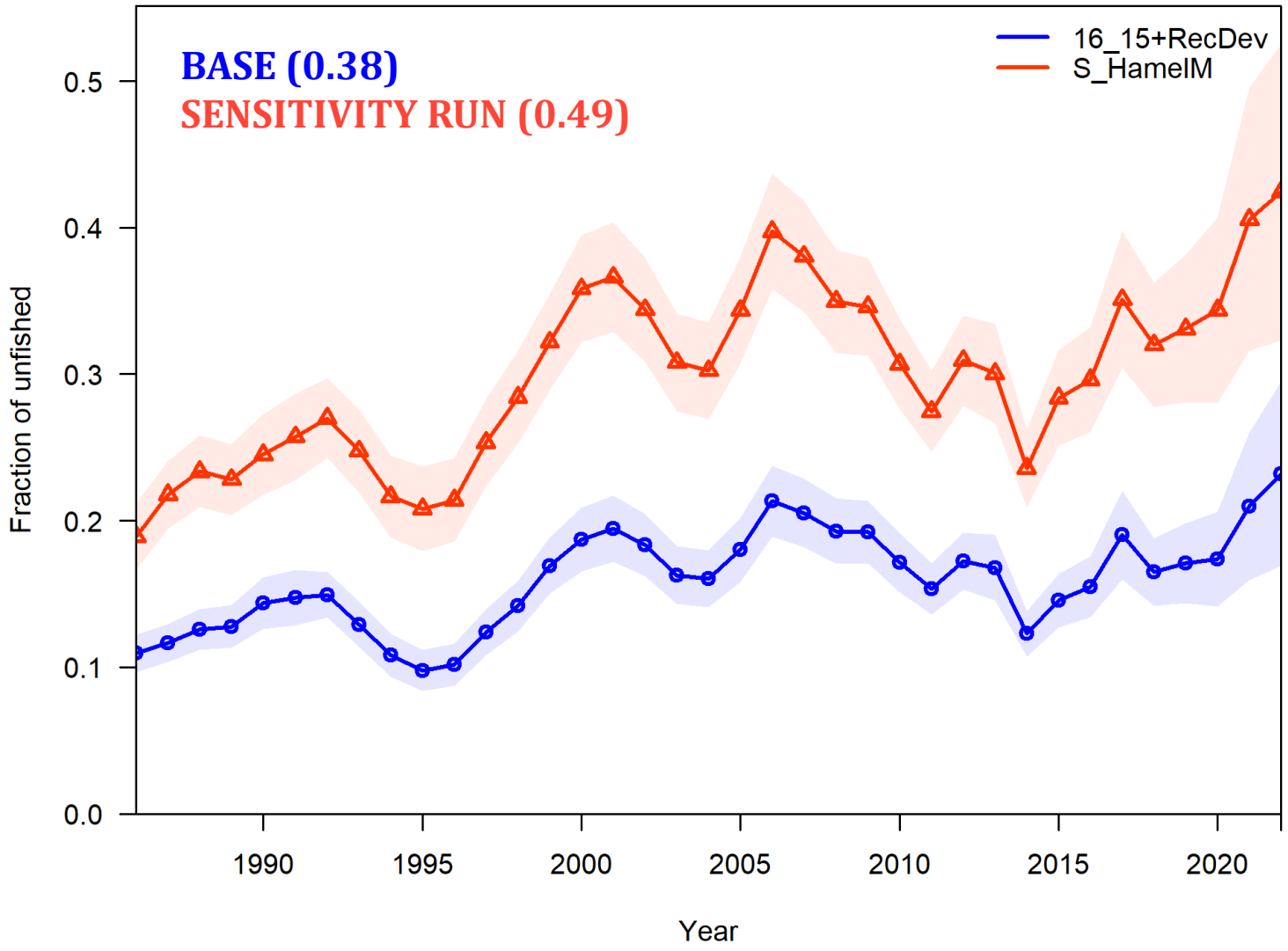
Mortality : 0.38 vs. 0.49



$$M = \frac{5.4}{A_{max}}$$

Hamel (2015)

Hamel and Cope (2022)

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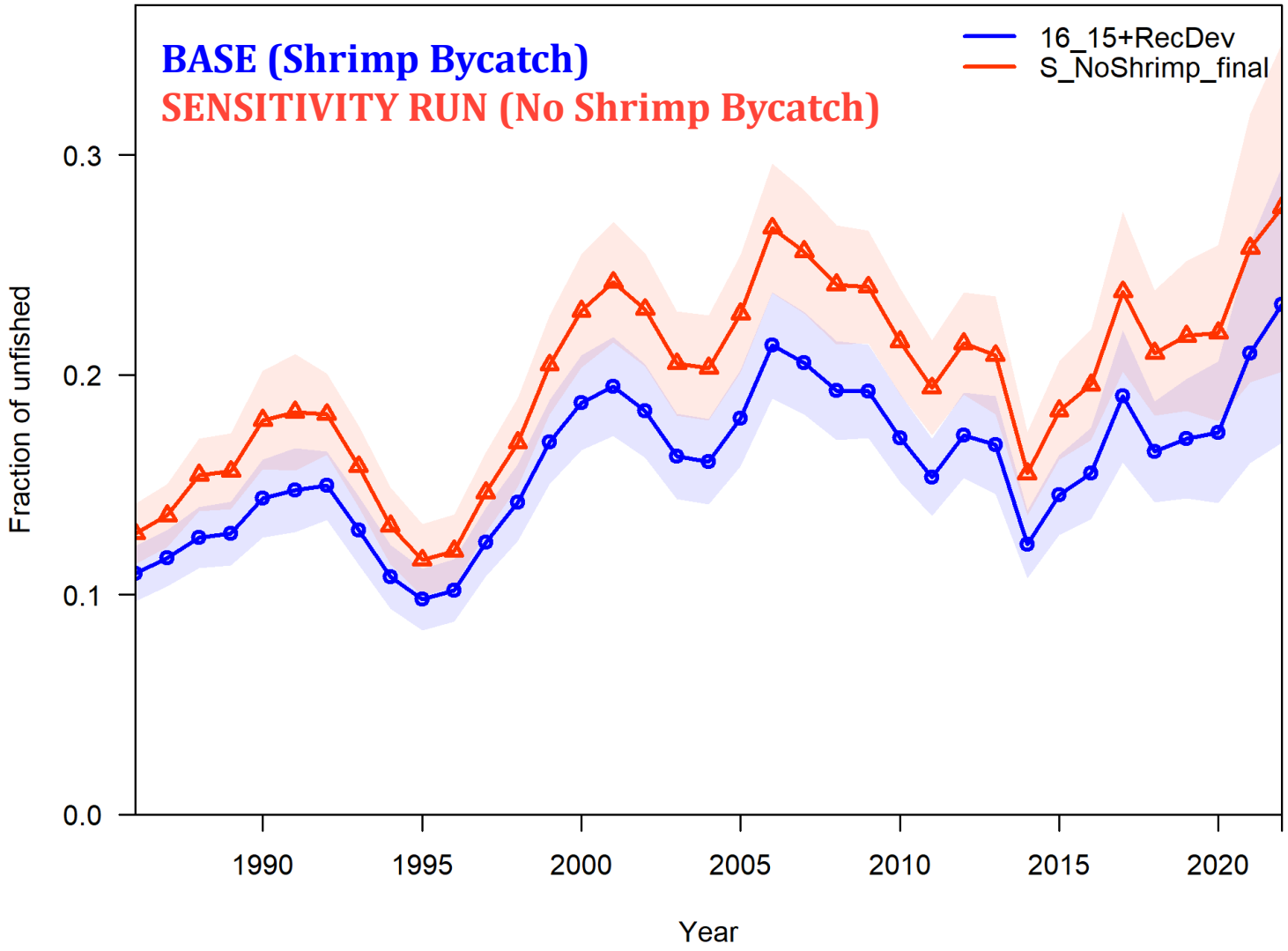
Shrimp Bycatch



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Conclusions & Recommendations

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Conclusions & Recommendations

- Improvements
  - Characterization of recreational fleets' selectivity and retention
    - Splitting into 3 components
    - Post stratification of length data
    - Some discard length data to inform retention
  - Fit to the VL index
  - Maturity function (correction)
  - Improved diagnostics

- Some issues remain
  - Poor prediction skills of indices
  - Uncertainty in shrimp bycatch time series
  - Sensitivity to fixed values of M, steepness, sigmaR
  - Gaps in sampling for composition data
  - Insufficient discard length data
  - Trade-offs between fitting to length vs. fitting to age data (likelihood profiles)
  - Misfits to GN length compositions

Benchmarks, Stock Status and Projections

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Catch Equivalency Table

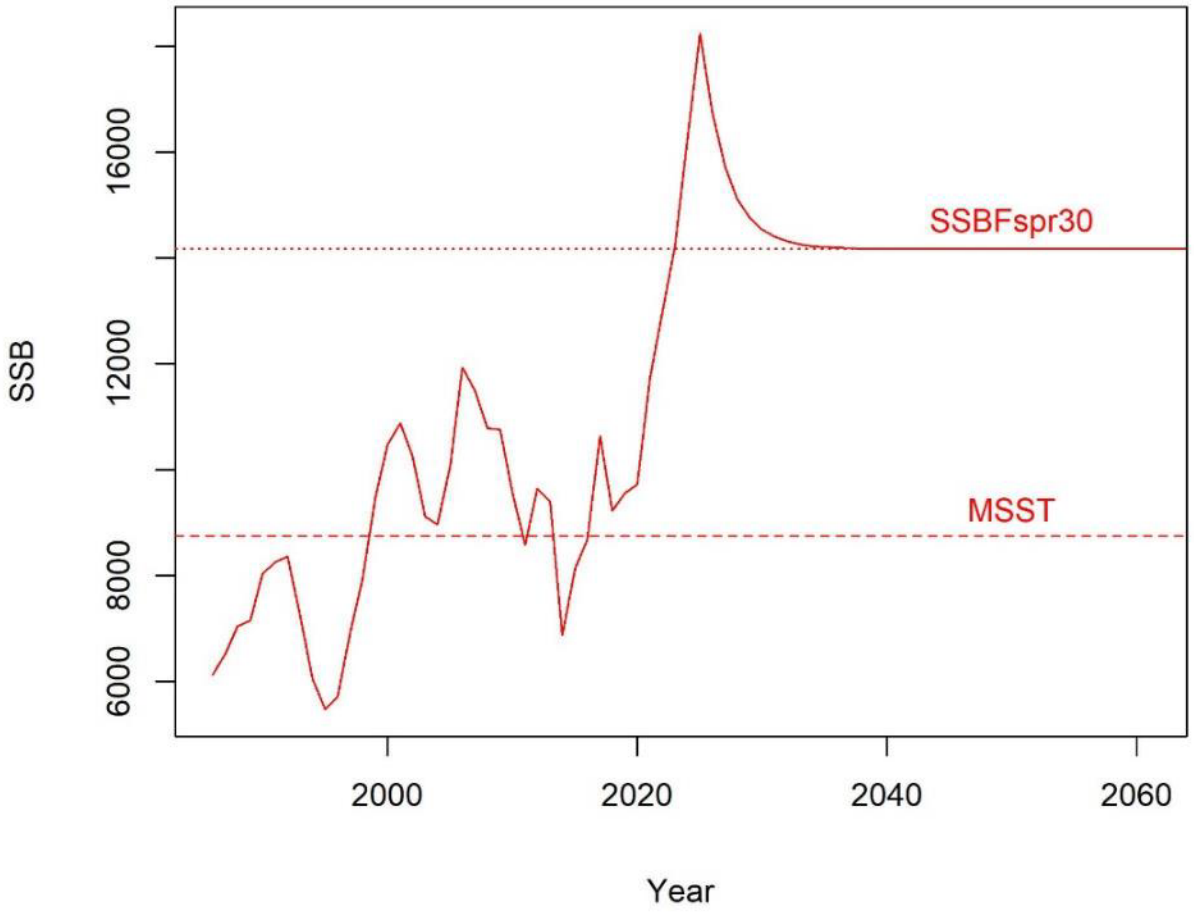
Year	SEDAR 28 CHTS OFL (stochastic)	SEDAR 28 CHTS OFL (deterministic)	SEDAR 28 FES OFL (deterministic)	% Difference OFL CHTS vs. FES (deterministic)
2013	14,396,226	13,340,707	15,980,894	20
2014	12,897,078	12,086,476	14,772,100	22
2015	12,059,320	11,311,376	14,433,537	28
2016	11,530,209	10,831,056	14,313,782	32
2017	11,133,375	10,522,276	14,240,611	35
2018	10,824,727	10,319,782	14,188,582	37
2019	10,670,403	10,183,294	14,151,632	39

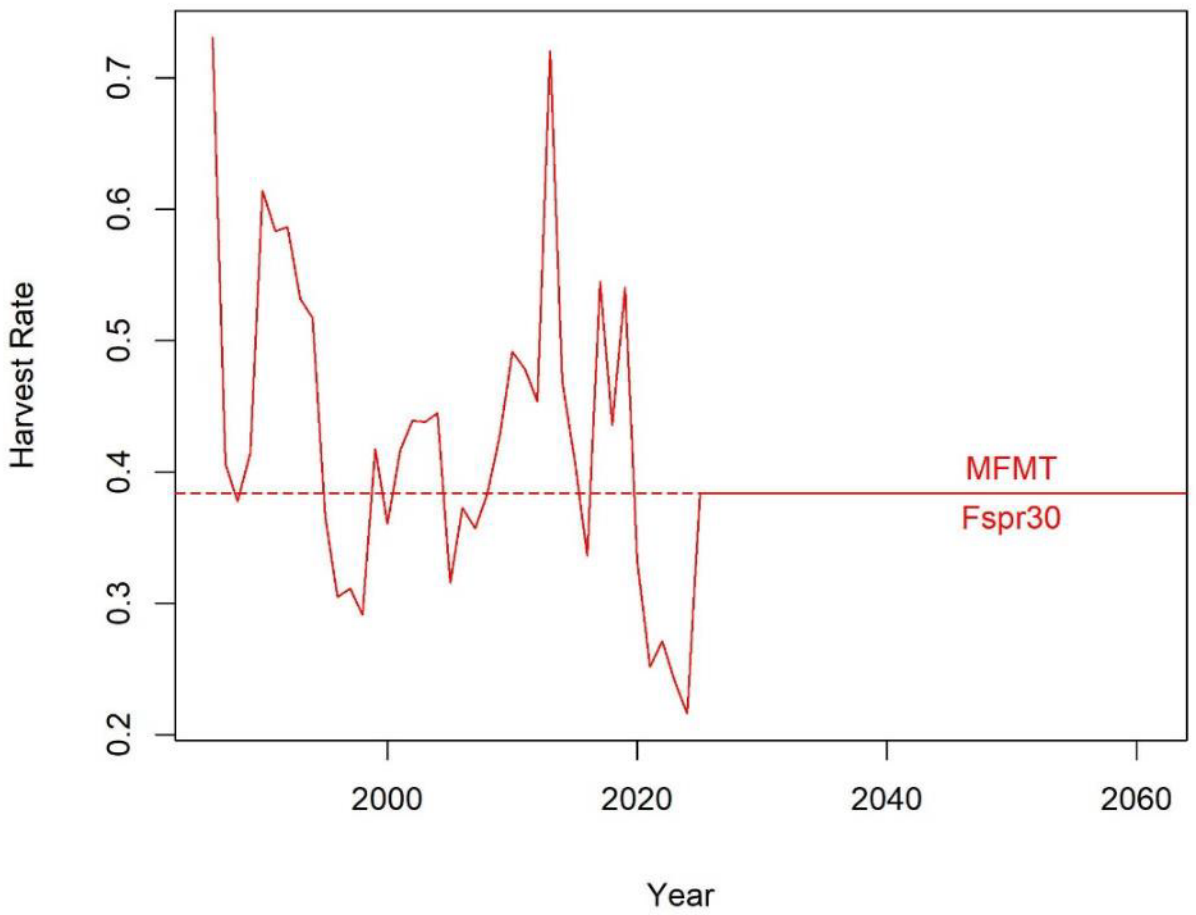
Projections Settings

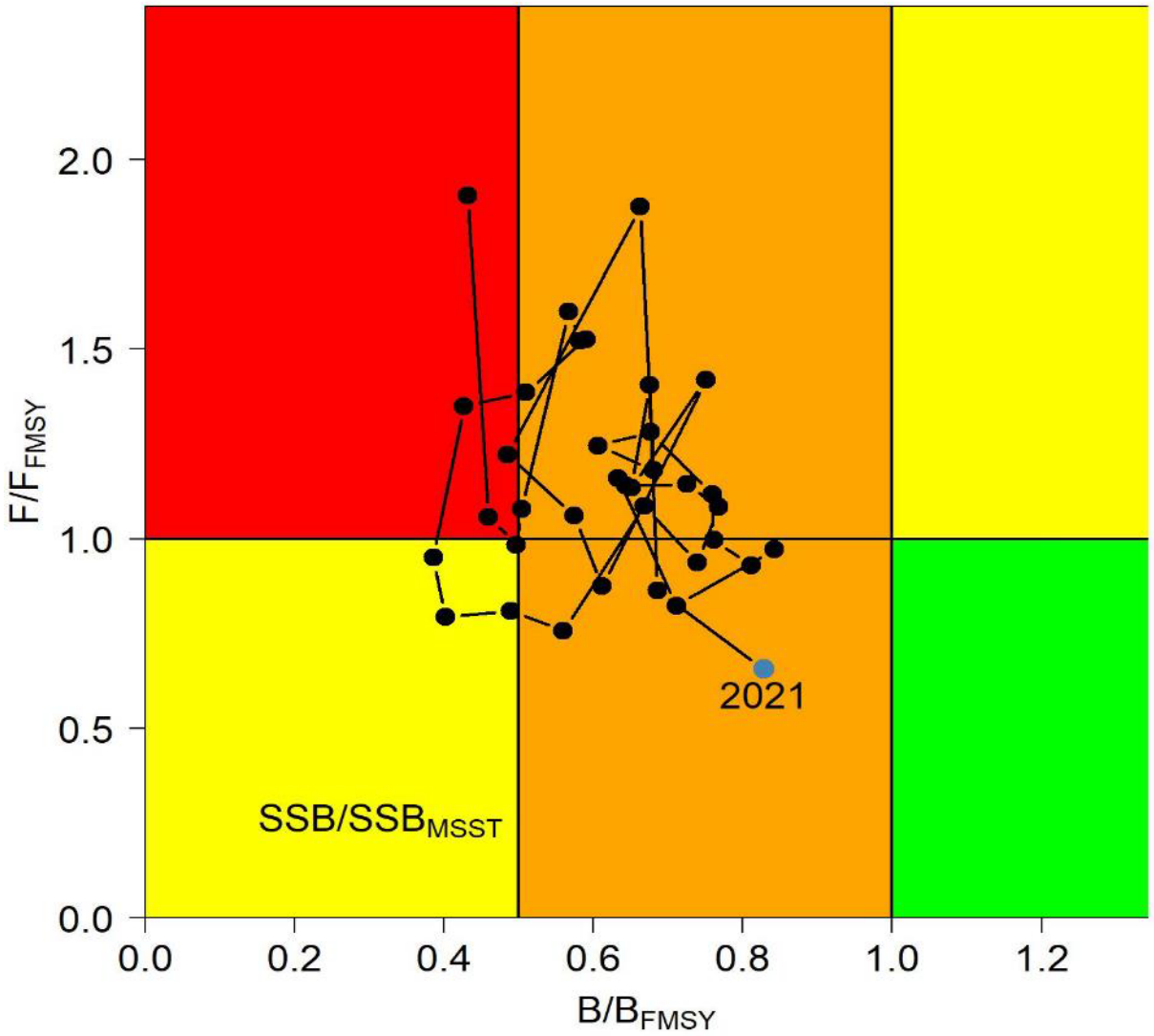
Parameter	Value	Comment
Relative F	Average from 2019 - 2021	Average relative fishing mortality over terminal three years
Selectivity	Average from 2019 - 2021	Fleet specific selectivity estimated in terminal year
Retention	Average from 2019 - 2021	Fleet specific retention estimated in terminal year
Recruitment	Beverton-Holt	Derived from the Beverton-Holt stock-recruitment relationship
Interim Landings (2022-2024)	148.51/173.55/173.55 mt (Comm. GN) 14.12/23.23/23.23 mt (Comm. HL) 175.77/200.56/200.56 thousands of fish (HB/CB) 1245.29/1576.32/1576.32 thousands of fish (PR) 3025.09/2500.46/2500.46 thousands of fish (SH)	Final landings estimates provided for 2022; For 2023-2024, used 3-year average of landings (2020-2022)
Shrimp bycatch F	0.06	Average F over 2015-2019
Allocation Ratio	None	

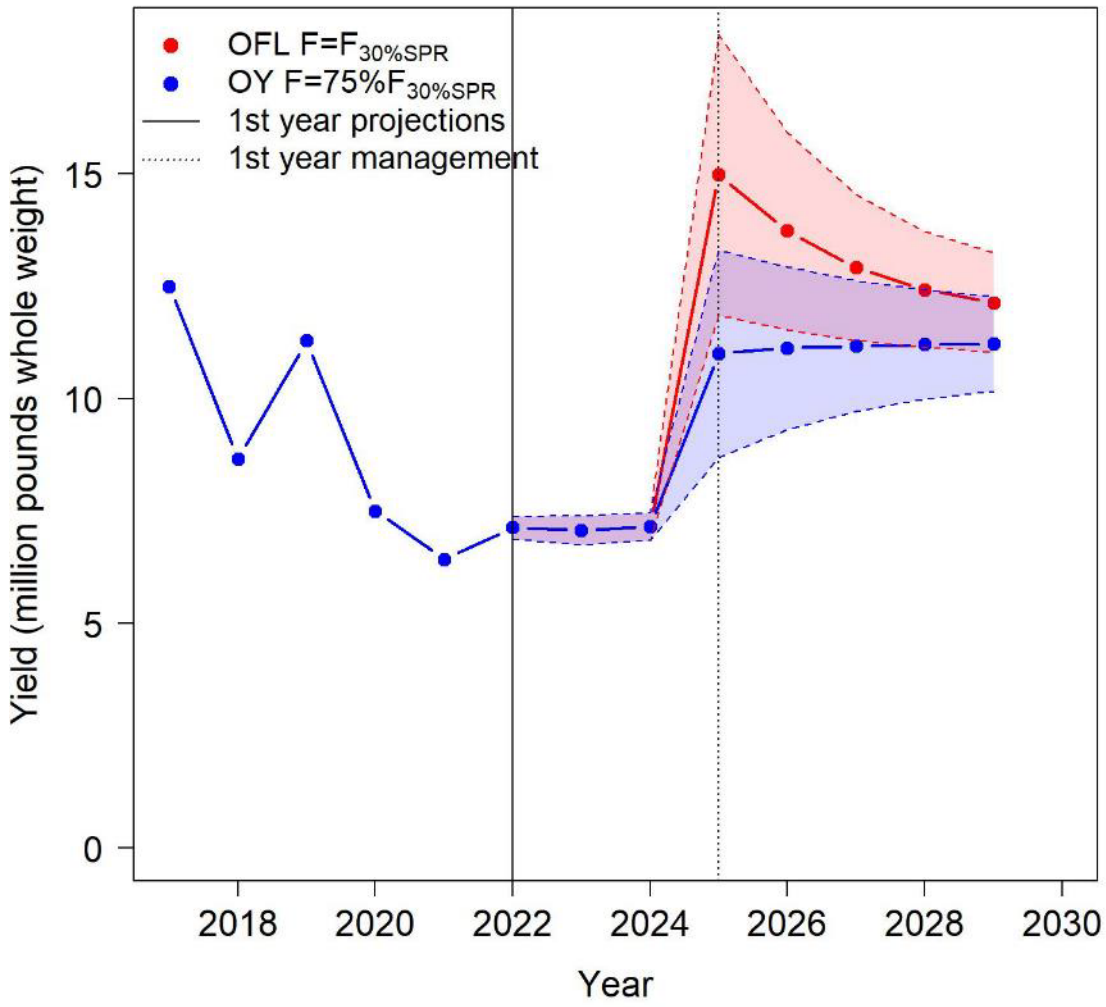
MSRA benchmarks and reference points

Criteria	Definition	Value
Base M	Target M for fully selected ages in the Lorenzen (2005) scaling	0.38
Steepness	Steepness of the Beverton-Holt stock-recruit relationship (fixed)	0.80
R0	Virgin Recruitment (1000s)	104,409
Generation Time	Fecundity-weighted mean age	5
SSB0	Virgin spawning stock biomass (mt)	55,928
	Mortality Rate Criteria	
$F_{MSYproxy}$	$F_{30\%SPR}$	0.38
MFMT	$F_{MSYproxy}$	0.38
$F_{current}$	Geometric mean of the last 3 years of the assessment ($F_{2019-2021}$), including shrimp bycatch fleet	0.36
$F_{current}$/MFMT	Current stock status based on MFMT	**0.93**
	Biomass Criteria	
$SSB_{MSYproxy}$	Equilibrium SSB at $F_{30\%SPR}$	14,168
MSST	(1-M)* $SSB_{MSYproxy}$	8,754
$SSB_{current}$	SSB_{2021}	11,734
$SSB_{current}/SSB_{FMSY}$	Current stock status based on $SSB_{F30\%SPR}$	0.83
$SSB_{current}$/MSST	Current stock status based on MSST	**1.34**
$SSB_{current}$/SSB0	SSB ratio in 2021	0.21


SSB
16000
12000
8000
6000
SSBFspr30
MSST
2000
2020
2040
2060
Year


Harvest Rate
0.7
0.6
0.5
0.4
0.3
0.2
MFMT
Fspr30
2000
2020
2040
2060
Year


2.0
1.5
1.0
0.5
0.0
F/F_FMSY
0.0
0.2
0.4
0.6
0.8
1.0
1.2
B/B_FMSY
2021
SSB/SSB_MSST


OFL F=F30%SPR
OY F=75%F30%SPR
1st year projections
1st year management
Yield (million pounds whole weight)
0
5
10
15
2018
2020
2022
2024
2026
2028
2030
Year

OFL Projections : $F=F_{30\%SPR}$

Year	R (1000s)	F	F/FMSY	SSB (mt)	SSB/ SSBFMSY	SSB/ MSST	SSB/SSB0	OFL (mp ww)
2022	86,494	0.271	0.71	12,964	0.915	1.481	0.232	7.131
2023	88,258	0.240	0.62	14,238	1.005	1.626	0.255	7.069
2024	90,542	0.216	0.56	16,208	1.144	1.852	0.290	7.157
2025	92,472	0.384	1.00	18,244	1.288	2.084	0.326	14.980
2026	91,102	0.384	1.00	16,759	1.183	1.914	0.300	13.732
2027	90,031	0.384	1.00	15,731	1.110	1.797	0.281	12.915
2028	89,339	0.384	1.00	15,120	1.067	1.727	0.270	12.429
2029	88,905	0.384	1.00	14,756	1.041	1.686	0.264	12.137

Constant catch

- three-year (2025-2027) : 13.876 mp ww
- five-year (2025-2029): 13.239 mp ww

ABC Projections : F=75%$F_{30\%SPR}$

Year	R (1000s)	F	F/FMSY	SSB (mt)	SSB/ SSBFMSY	SSB/ MSST	SSB/SSB0	OY (mp ww)
2022	86,494	0.271	0.71	12,964	0.915	1.481	0.232	7.131
2023	88,257	0.240	0.62	14,238	1.005	1.627	0.255	7.069
2024	90,541	0.216	0.56	16,208	1.144	1.852	0.290	7.157
2025	92,471	0.288	0.75	18,244	1.288	2.084	0.326	11.004
2026	91,101	0.288	0.75	18,483	1.305	2.111	0.330	11.128
2027	90,031	0.288	0.75	18,561	1.310	2.120	0.332	11.175
2028	89,338	0.288	0.75	18,603	1.313	2.125	0.333	11.201
2029	88,905	0.288	0.75	18,629	1.315	2.128	0.333	11.217

Constant catch

- three-year (2025-2027) : 11.102 mp ww
- five-year (2025-2029): 11.145 mp ww

Thank You.
Questions?

The SEDAR 81 Operational for Gulf of Mexico Spanish Mackerel would not have been possible without the efforts of the numerous NMFS, SEFSC, SERO, ACCSP and GMFMC staff along with the many academic and research partners involved throughout the Gulf of Mexico and South Atlantic. The following agencies contributed to the assessment and deserve notable attention and thanks for efforts extended to developing data inputs: NOAA SEFSC Fisheries Statistics Division (FSD), NOAA SEFSC Panama City Laboratory, NOAA SEFSC Mississippi Laboratories, NOAA Southeast Regional Office (SERO), Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, NOAA SEFSC Beaufort Laboratory, Cooperative Institute for Marine and Atmospheric Studies, Rosenstiel School for Marine and Atmospheric Science, and the Gulf States Marine Fisheries Commission.

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