SEDAR 79: Mutton Snapper

Joint SSC Review

FWRI Stock Assessment Group, St. Petersburg, FL

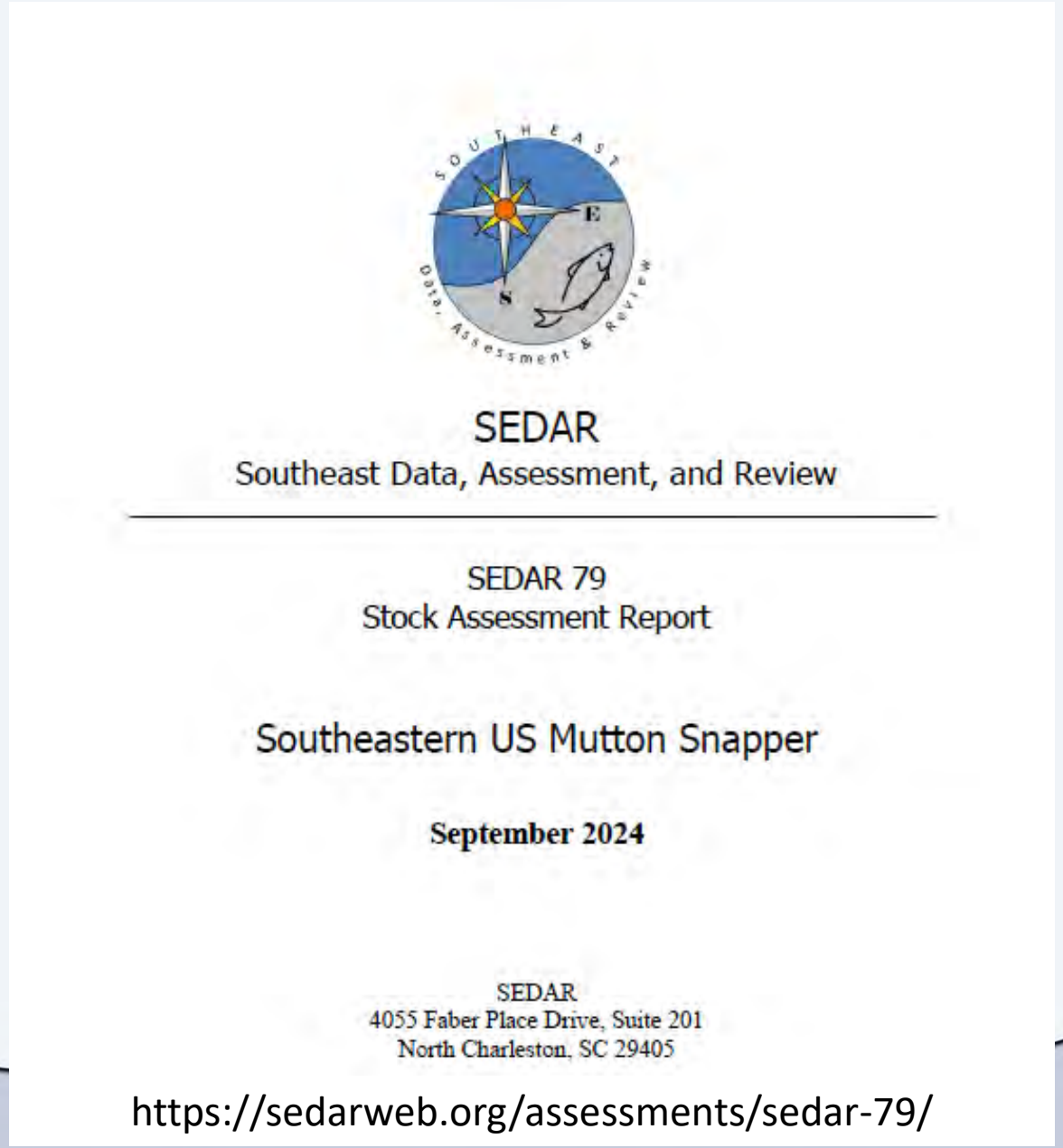
February 25, 2025

Outline

- Intro, Management, & Assessment History
- Data Inputs
  - Life History Inputs
  - Length Comps
  - Conditional Age-at-Length
  - Landings and Releases
  - Indices
- Base Model Configuration
- Base Model Fits & Diagnostics
- Results & Stock Status
- Sensitivity Runs & Uncertainty

SEDAR 79 Schedule

Data Evaluation Workshop…..Aug 21-25, 2023
Assessment webinars……Feb – July 2024
Review Workshop……Sept 10-12, 2024



SEDAR
Southeast Data, Assessment, and Review

SEDAR 79
Stock Assessment Report

Southeastern US Mutton Snapper

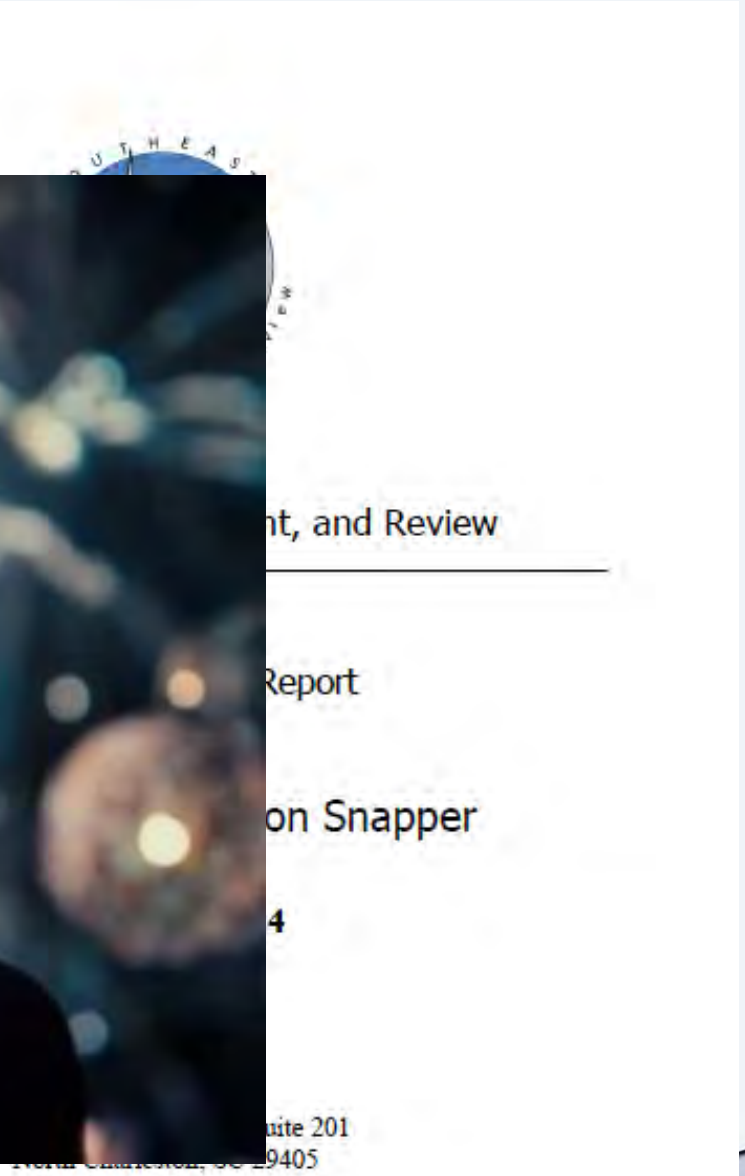
September 2024

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

https://sedarweb.org/assessments/sedar-79/

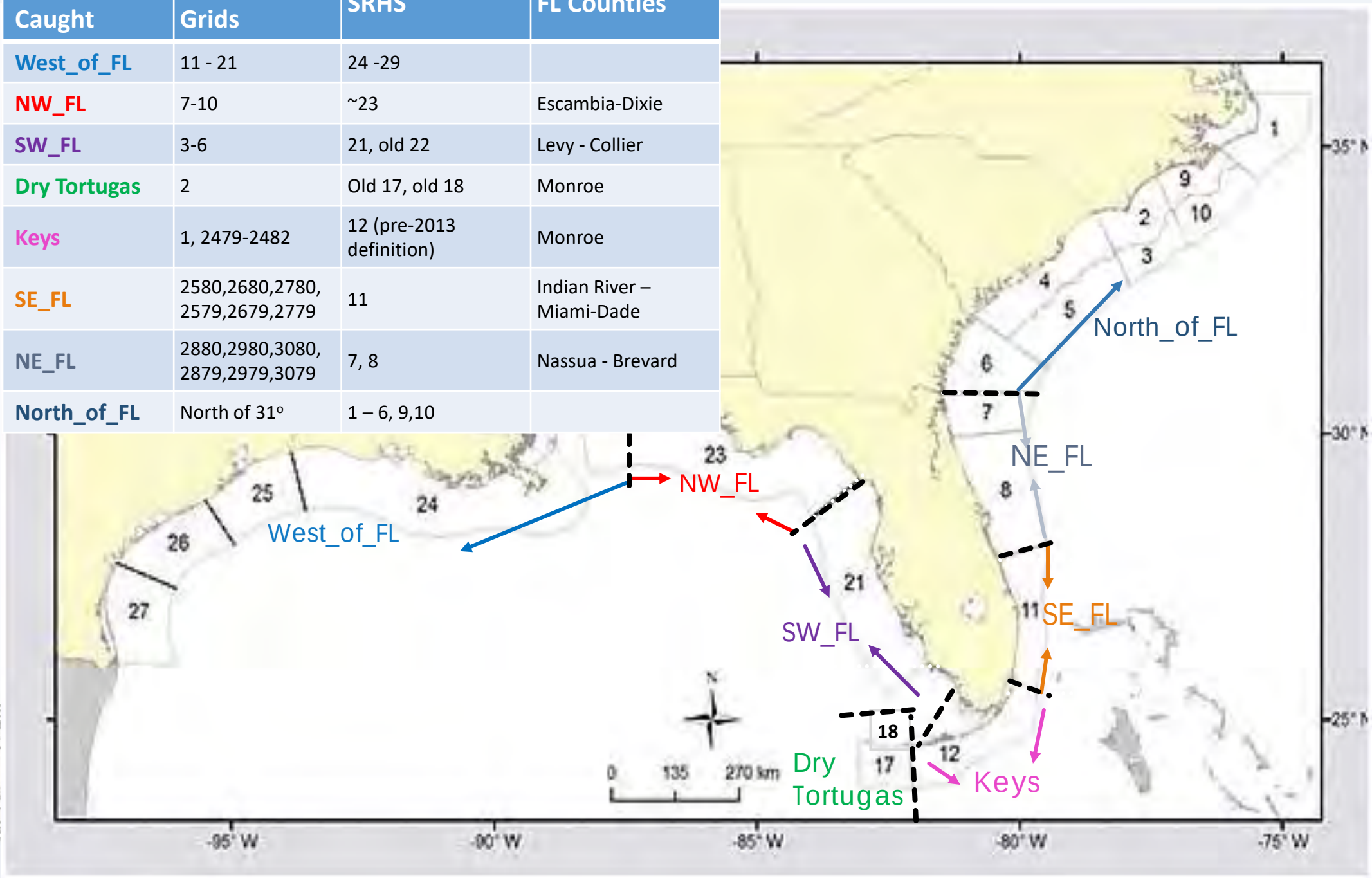
SEDAR 79 Schedule

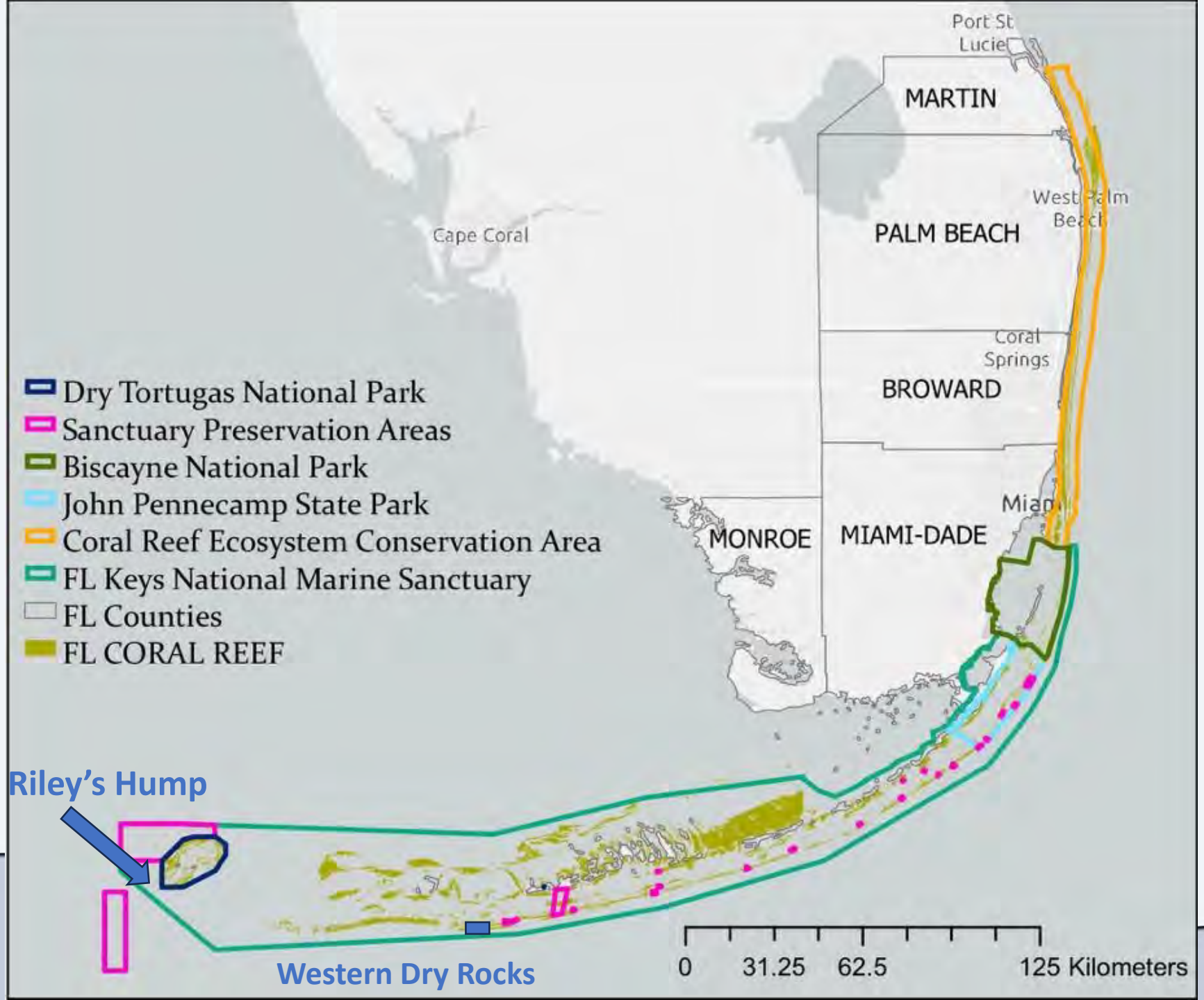
Data Evaluation W
Assessment webir
Review Workshop



https://sedarweb.org/assessments/sedar-79/

Region Caught	Statistical Grids	SRHS	FL Counties
West_of_FL	11 - 21	24 -29	
NW_FL	7-10	~23	Escambia-Dixie
SW_FL	3-6	21, old 22	Levy - Collier
Dry Tortugas	2	Old 17, old 18	Monroe
Keys	1, 2479-2482	12 (pre-2013 definition)	Monroe
SE_FL	2580,2680,2780, 2579,2679,2779	11	Indian River – Miami-Dade
NE_FL	2880,2980,3080, 2879,2979,3079	7, 8	Nassua - Brevard
North_of_FL	North of 31°	1 – 6, 9,10	





Zuercher et al. 2020

Size Limit History

South Atlantic Federal (3 - 200 Miles)

- 12” (30.5 cm) TL (1/1992 – 1/1995)
- 16” (40.6 cm) TL (1/1995 – 2/2018)
- 18” (45.7 cm) TL (2/2018 – present)

Gulf Federal (10 -200 Miles)

- 12” (30.5 cm) TL (2/1990 – 11/1999)
- 16” (40.6 cm) TL (11/1999 – 7/2018)
- 18” (45.7 cm) TL (7/2018- present)

FL State Waters South Atlantic (0 - 3 Miles) **& Gulf** (0 -10 Miles)

- 12” (30.5 cm) TL (7/1985 – 2/1994)
- 16” (40.6 cm) TL (3/1994 – 12/2016)
- 18” (45.7 cm) TL (1/2017 – present)

Quota History (CHTS units)

South Atlantic

Commercial ACL

- 157,707 lbs (4/2012 – 2/2018)
- 104,231 lbs (2/2018 – 12/2018)
- 107,981 lbs (1/2019 – 12/2019)
- 111,354 lbs (1/2020 – present)

Recreational ACL

- 768,893 **lbs** (4/2012 – 2/2018)
- 121,318 fish (2/2018 – 12/2018)
- 124,766 fish (1/2019 – 12/2019)
- 127,115 fish (1/2020 – present)

Gulf

Combined ACL

- 203,000 lbs (1/2012 – 12/2017)
- 134,424 lbs (1/2018 – 12/2018)
- 139,392 lbs (1/2019 – 12/2019)
- 143,694 lbs (1/2020 – present)

*No closures have occurred due to reaching the ACL

Assessment History

SEDAR 15A Benchmark

- ASAP v2 – Statistical Catch-At-Age Model
- **1981-2006**, Single Stock, Ages 1 – 25+
- 5 fleets – All Dome Shaped Selectivity
  - Commercial Hook and Line, Commercial Longline, Commercial Other, Headboat, General Rec (MRFSS)
- 11 Indices of Abundance
  - 5 FD – Selectivity linked to fleets
  - 6 FI – Dome shaped selectivity

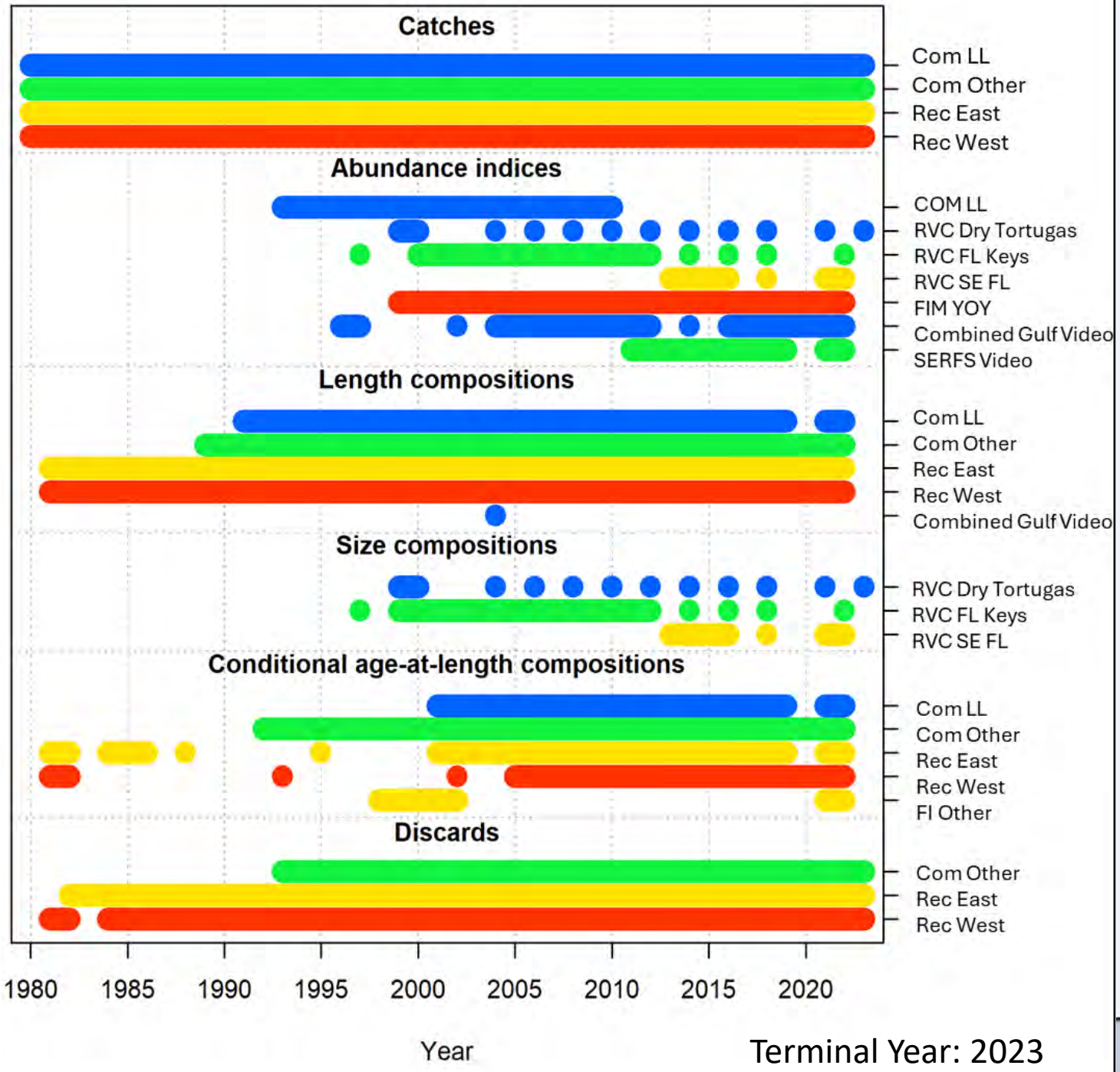
Base Model Results: not overfished, overfishing is not occurring

SEDAR 15AU Update

- ASAP v3 – Statistical Catch-At-Age Model
- **1981-2013**, Single Stock, Ages 1 – 25+
- 4 fleets – Com: flat top, Rec: dome shaped
  - Commercial Hook and Line/Other, Commercial Longline, Headboat, General Rec (MRFSS)
- 7 Indices of Abundance
  - 4 FD – Selectivity linked to fleets
  - 3 FI – Dome shaped selectivity

Base Model Results: not overfished, overfishing is not occurring

Base Model Data Inputs



Terminal Year: 2023

Data Inputs through 2023

- Commercial Landings
  - Due to time constraints, commercial landings from outside of FL in 2023 were not included (these have contributed at most 11.87% of the commercial landings with an average contribution of 2.33%).
- Commercial Releases
  - 2023 extrapolated as average of 2020-2022.
- Recreational Landings and Releases
- RVC Dry Tortugas Index and Length Comps

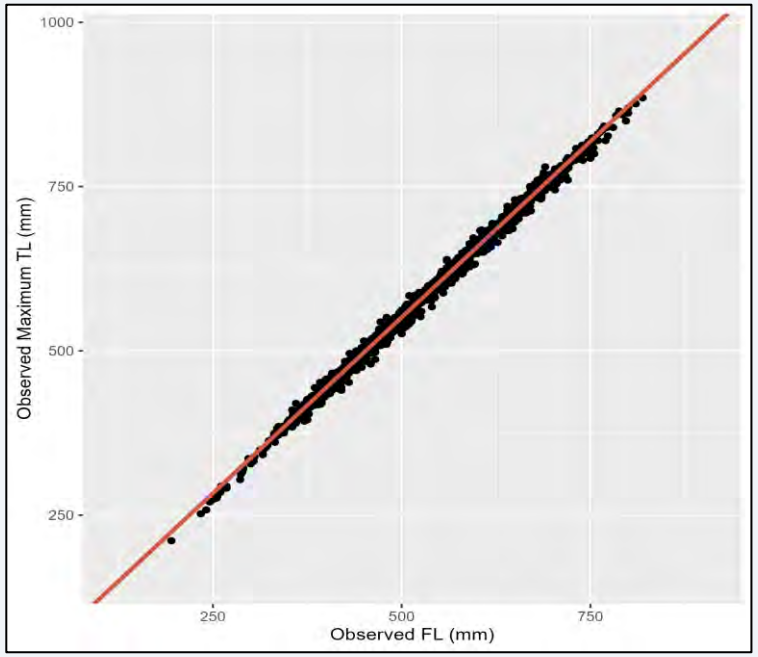
Life History

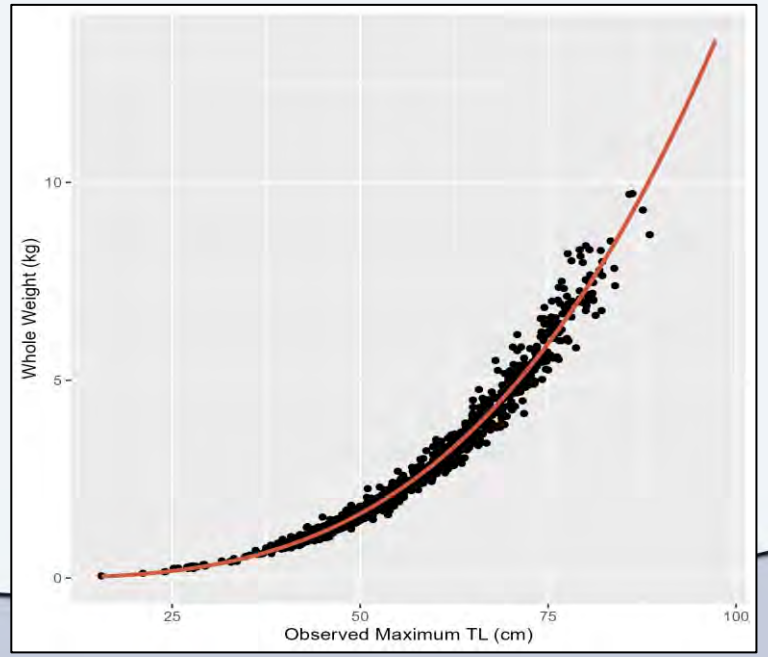
Unit Stock Definition

- Multiple genetics (mitochondrial and microsatellites DNA) studies did **not** find evidence of heterogeneity using samples from Florida to Cuban waters.
- However, the Florida Current may serve as an effective barrier to recruitment to the Florida Keys and Southeast Florida from populations in Cuban waters and other parts of the Caribbean Sea
  - SEDAR 79 and past assessments have assumed genetic connectivity with areas beyond southeast US waters is likely to be low.
  - Assume a single closed population in the SAFMC and GMFMC jurisdictions for the purpose of stock assessment and management.

Main Data Inputs: Life History

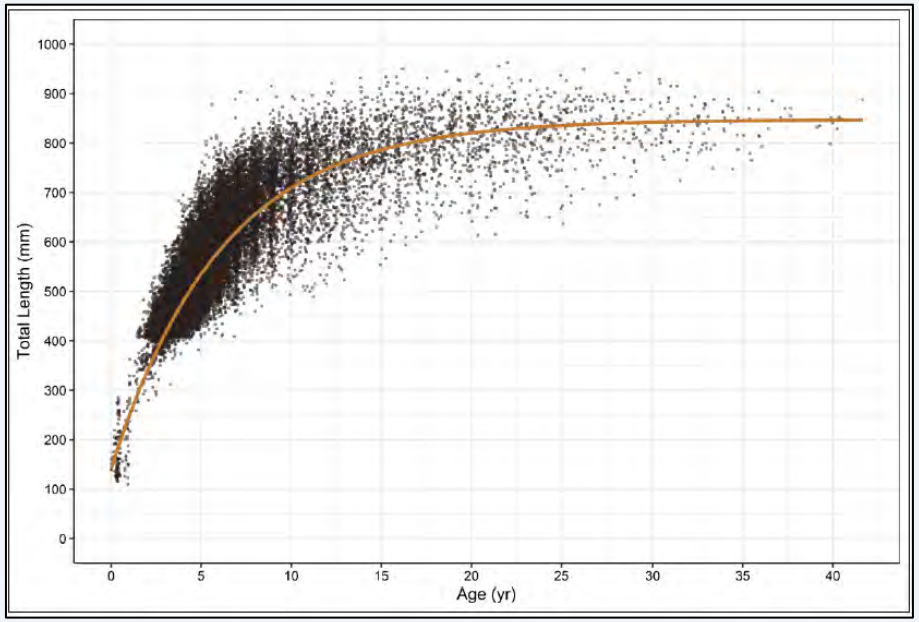
- Length – Length
  - E.g. MaxTL (mm) = 15.5 + 1.07*FL (mm)
- Gutted Weight to Whole Weight (Com Landings)
  - Whole weight = 1.11*Gutted Weight
- Length – Weight Relationship
  - Whole Weight (kg) = 6.63E−06*MaxTL (cm)$^{3.1601}$
  - 18” (45.7 cm) fish ≈ 2.57 lbs (1.17 kg)
- Sex Ratio ≈ 1:1 → fraction female = 0.50
- Fecundity (eggs) = SSB

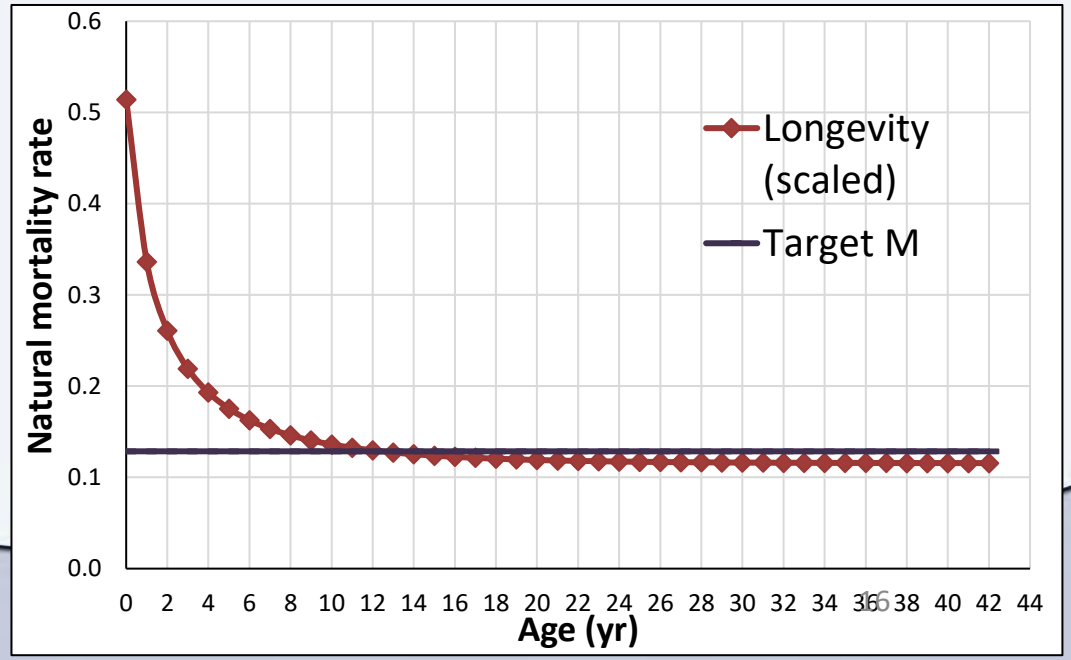




Main Data Inputs: Life History

- Initial Values for Growth
  - Based on size-truncated von Bertalanffy model (DW-22; n = 24,234 otoliths; 1977 – 2022)
    - L_{inf} = 847 mm Max TL, k = 0.163, t0 = -1.12
- No Sexual Dimorphism
- Natural Mortality
  - Hamel and Cope (2022) longevity-based constant M
    - M = 0.129
  - Inversely related to fish length following Lorenzen (2022) scaled to ages 3 – 42 (SAR Table 2.13.10)
    - M = 0.235 at age 3
- Release Mortality
  - All Fleets: 30% with 15% and 45% sensitivities

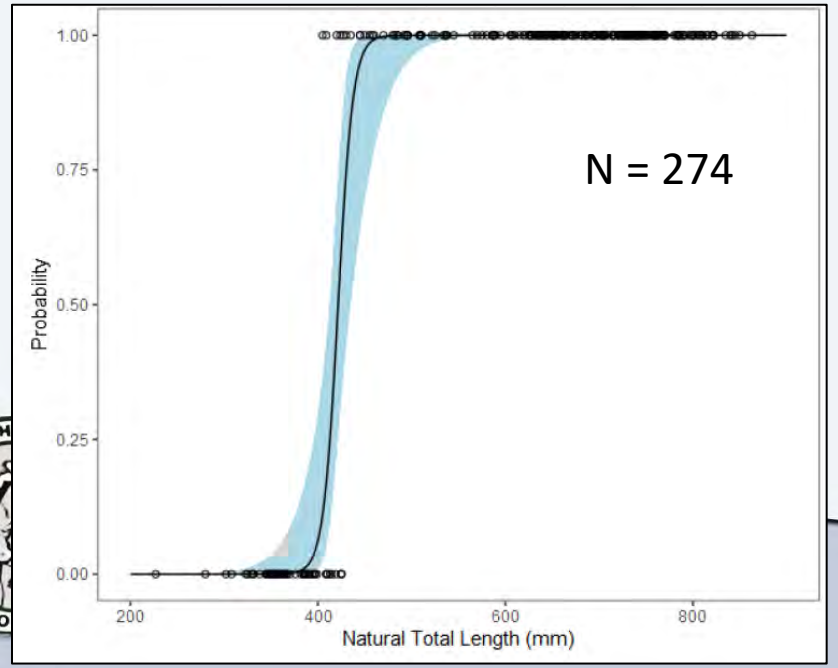




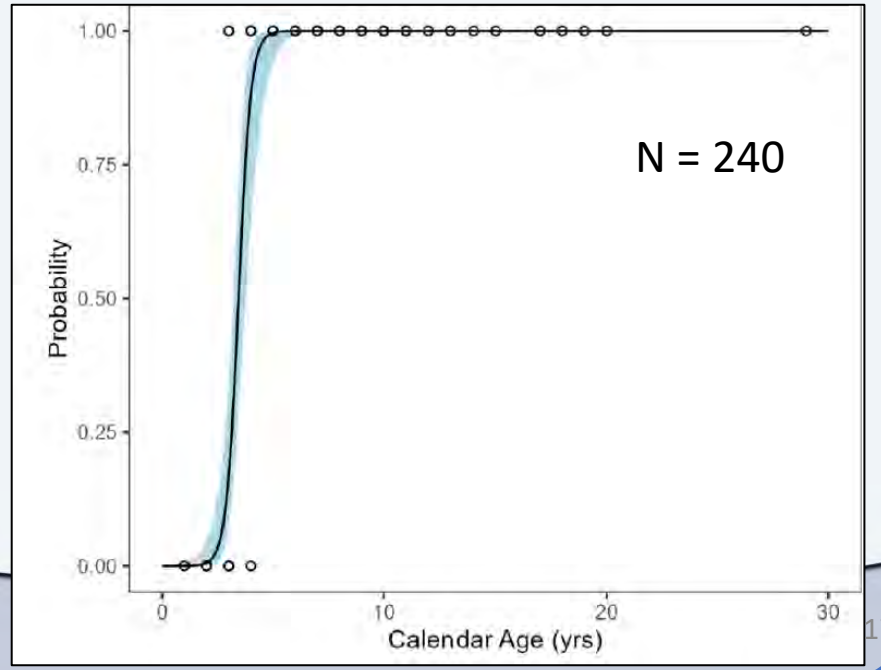
Main Data Inputs: Life History

- Size/Age at Maturity (DW-12)
  - Logistic Regression that includes all sampling months and spawning capable or actively spawning females assigned through histology or macroscopic staging in the mature group.

- L50 = 422 mm natural TL; se = 198 mm
- Slope = 0.126; se = 0.042
- Intercept = -53.021 mm nat TL; se = 17.497 mm

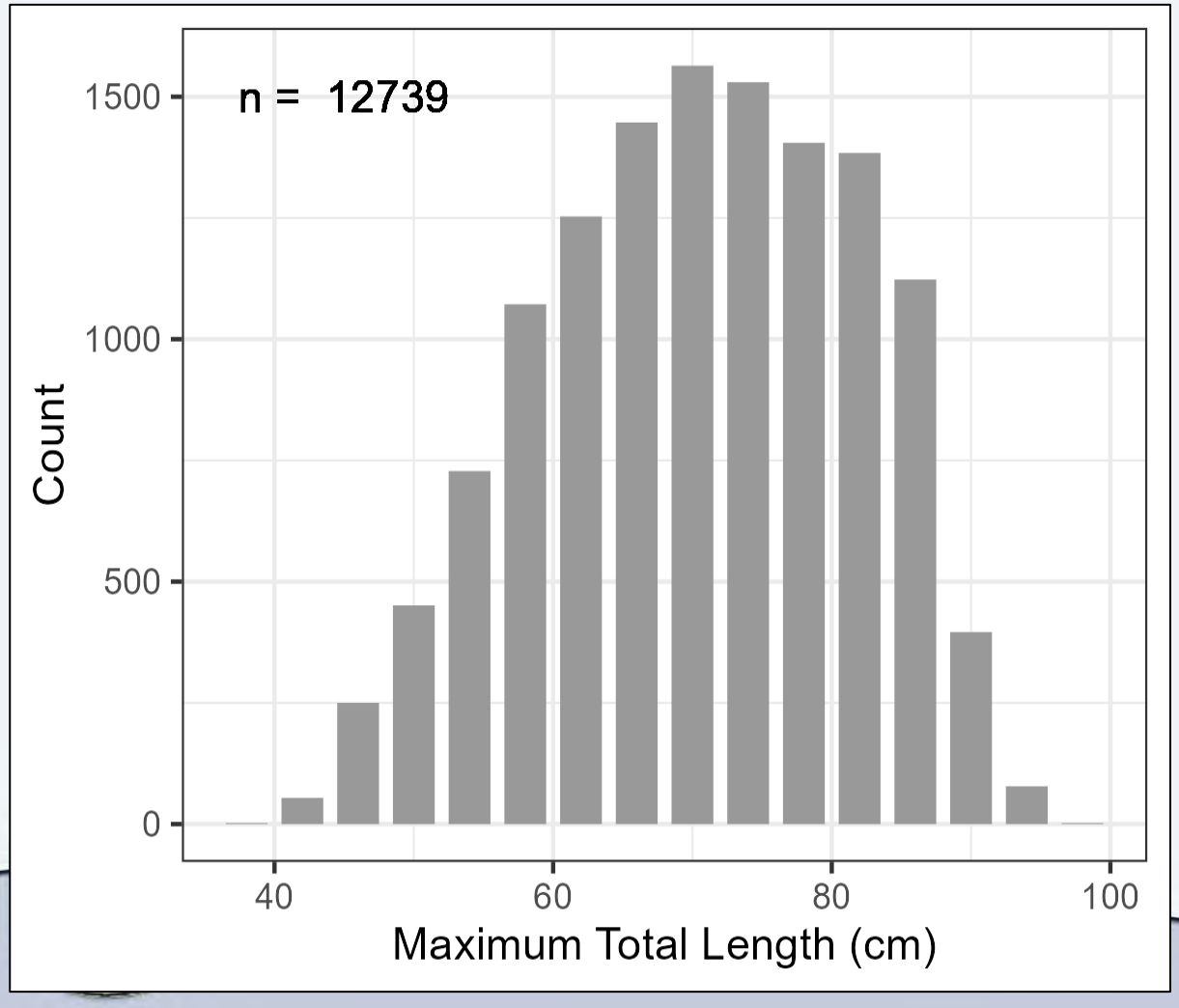


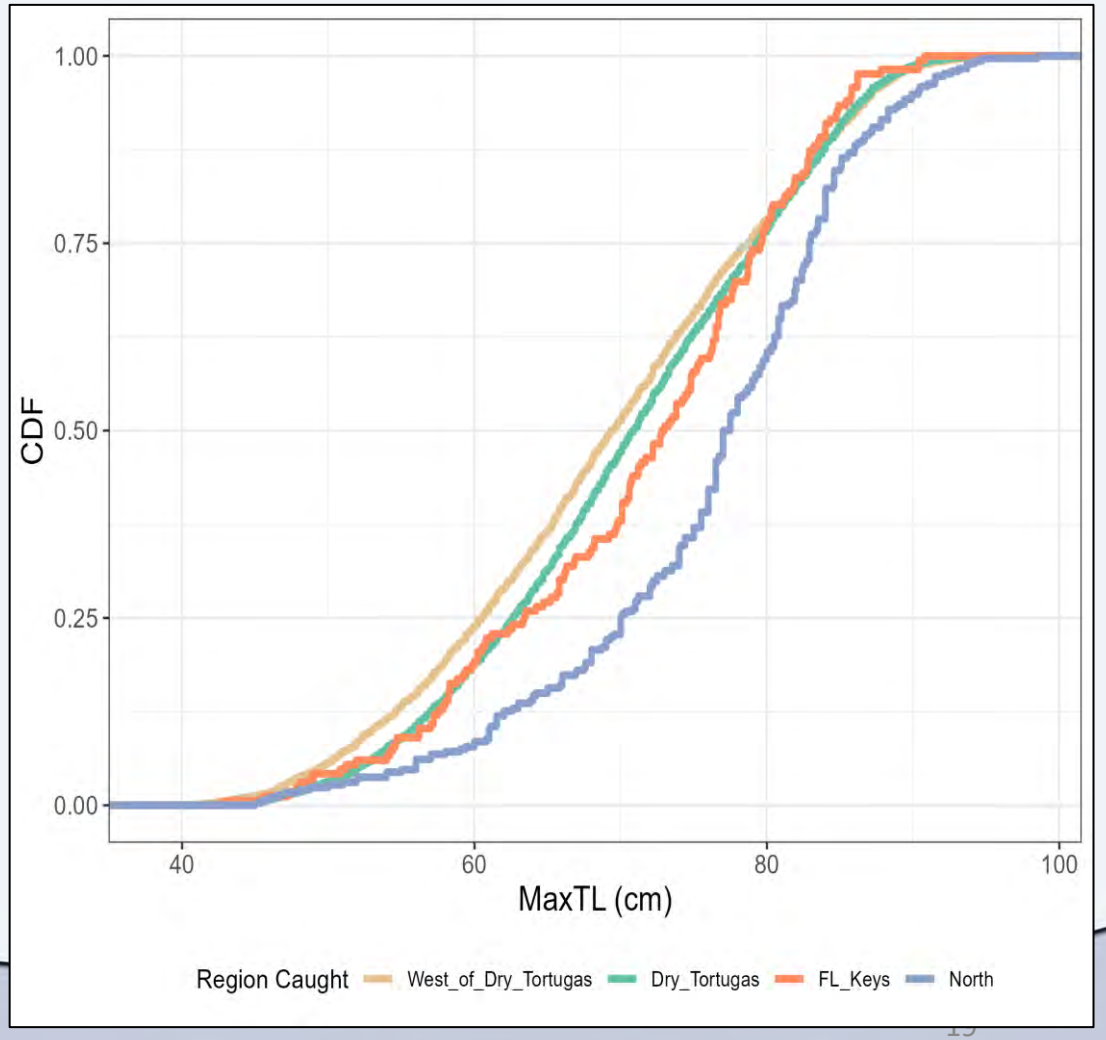
- A50 = 3.5 years; se = 1.1 years
- Slope = 2.535; se = 0.787
- Intercept = -6.1 years; se = 2.1 years



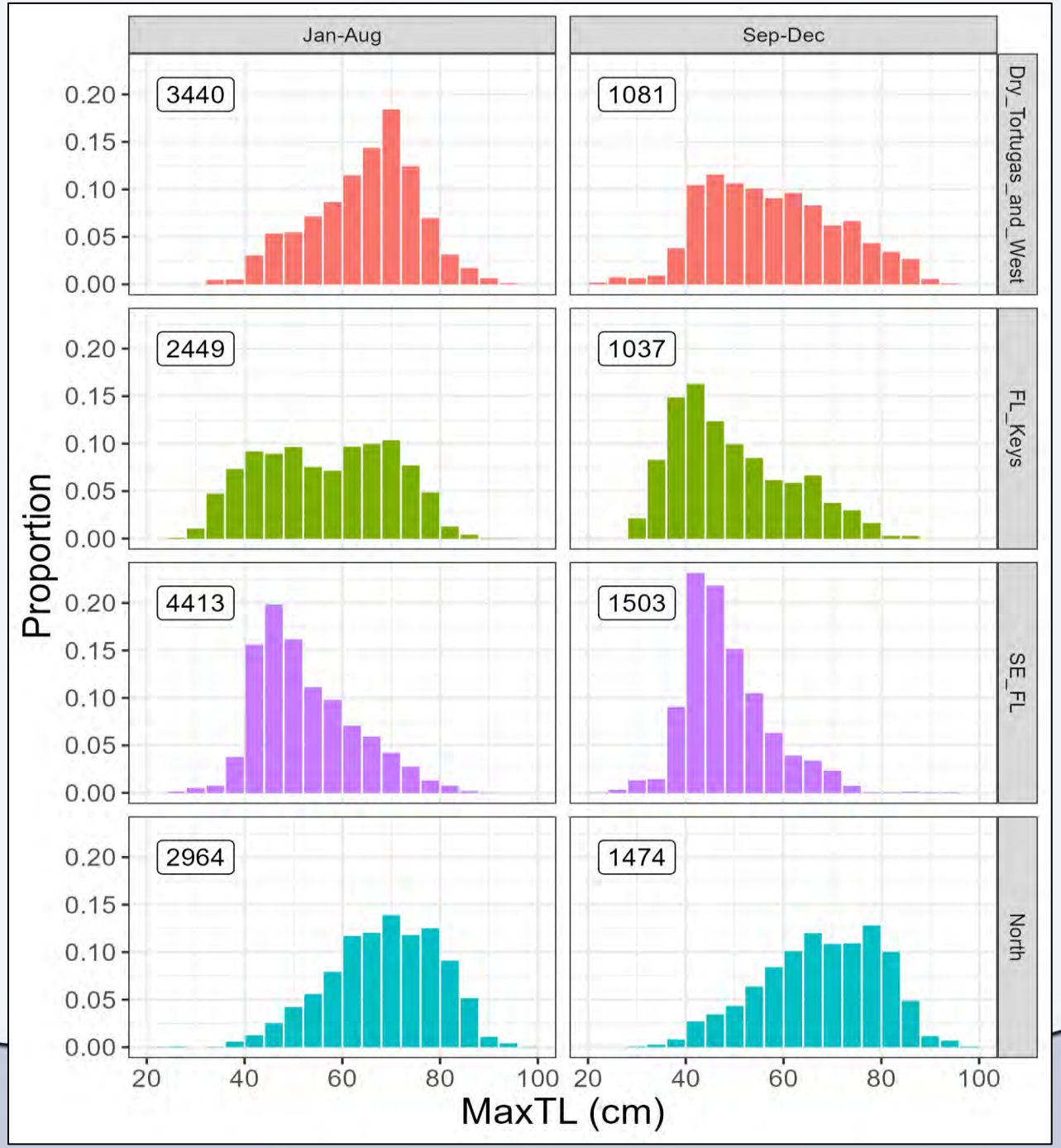
Length Comps

Com Longline Retained Lengths by Region

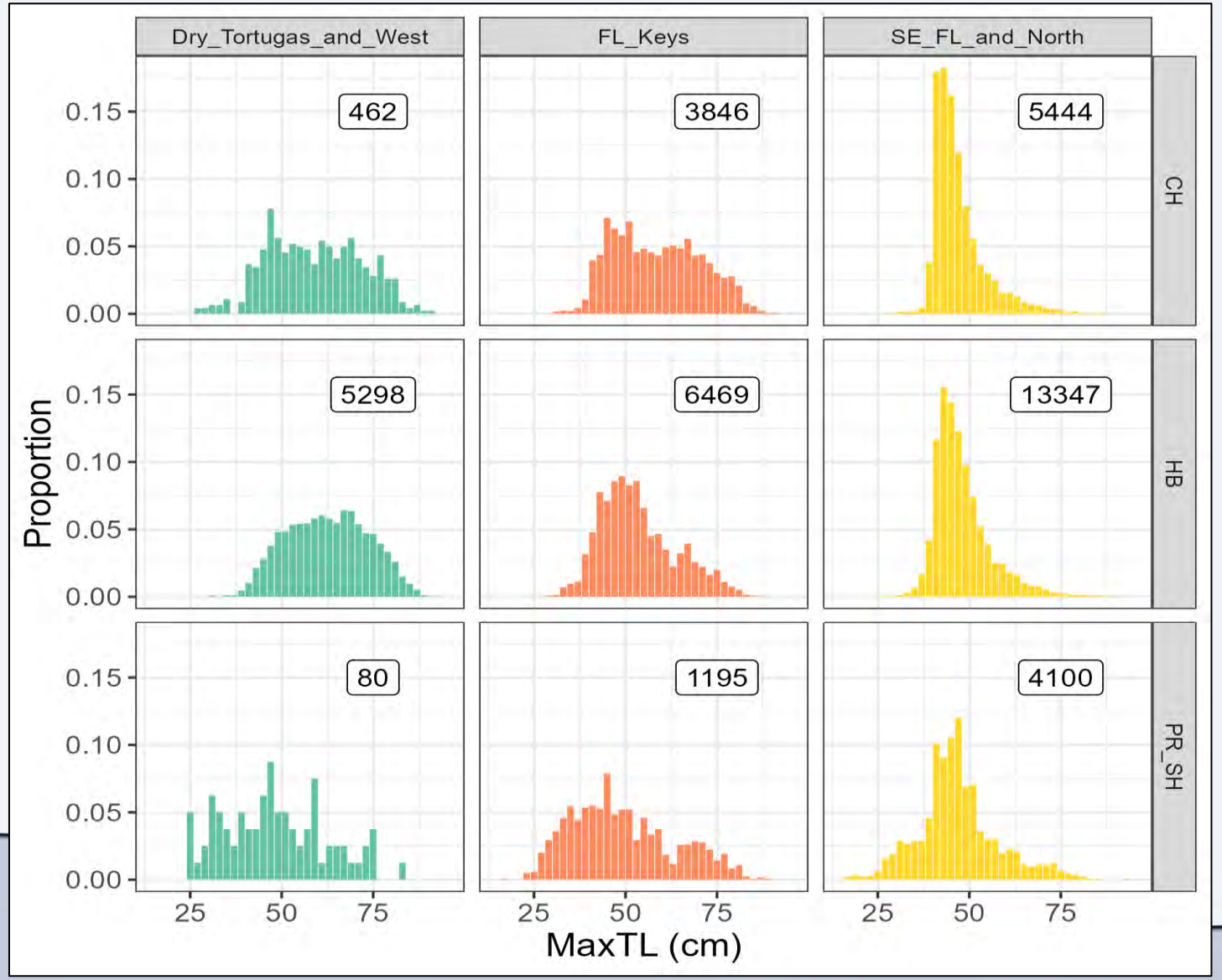


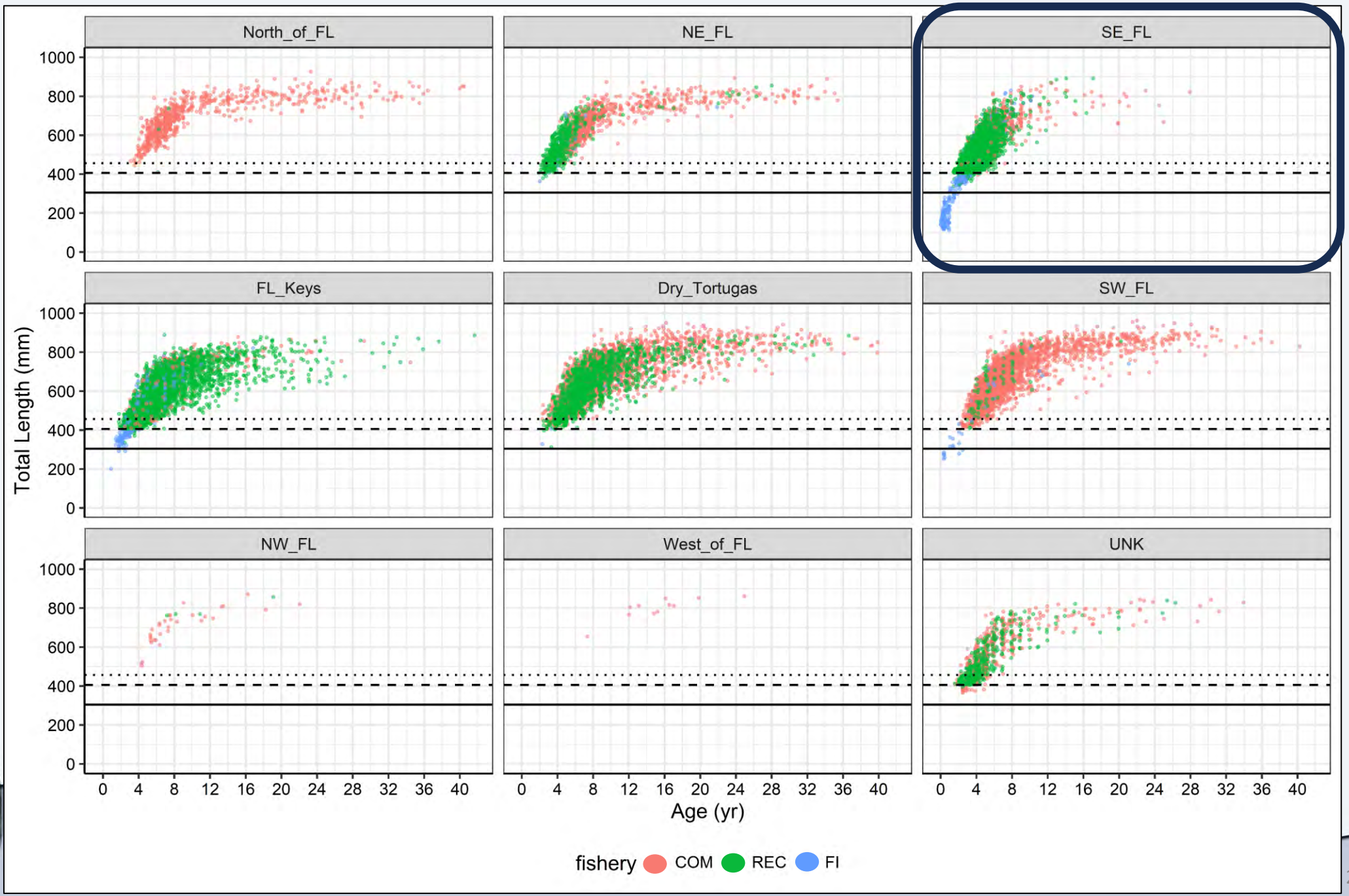


Com ‘Other’ Retained Lengths by Region & Season



Recreational Retained Lengths by Region & Mode




North_of_FL
NE_FL
SE_FL
FL_Keys
Dry_Tortugas
SW_FL
NW_FL
West_of_FL
UNK
Total Length (mm)
0
200
400
600
800
1000
0
4
8
12
16
20
24
28
32
36
40
Age (yr)
fishery
COM
REC
FI

Base Model Fleet Configuration

- Commercial Longline – includes all regions
- Commercial Other – includes all regions.
  - The sampled length and age comps for these regions differ enough to warrant separating them by region. However, sample sizes are very limited, especially in the FL Keys from 1999 through 2007.
- Rec East – SE FL and North (includes all modes)
- Rec West – FL Keys and Gulf (includes all modes)

Max TL (4 cm bins)

- Fleet length comps are catch-weighted

SEDAR 79–AW–1

Weighted Length Compositions for U.S. Mutton Snapper (*Lutjanus analis*)

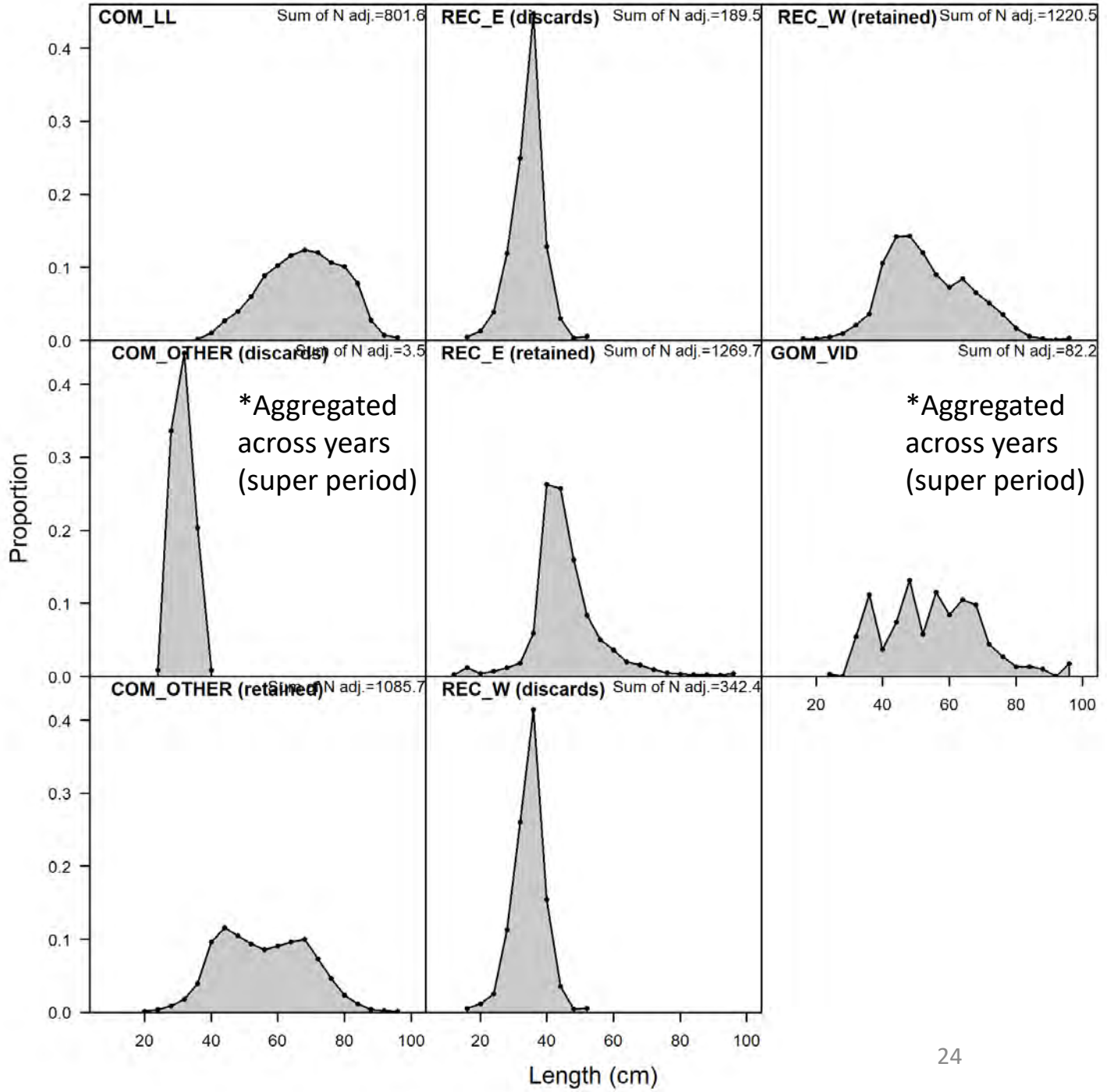
Shanae D. Allen

Florida Fish and Wildlife Research Institute
100 8th Ave SE
St. Petersburg FL 33701

June 18, 2024

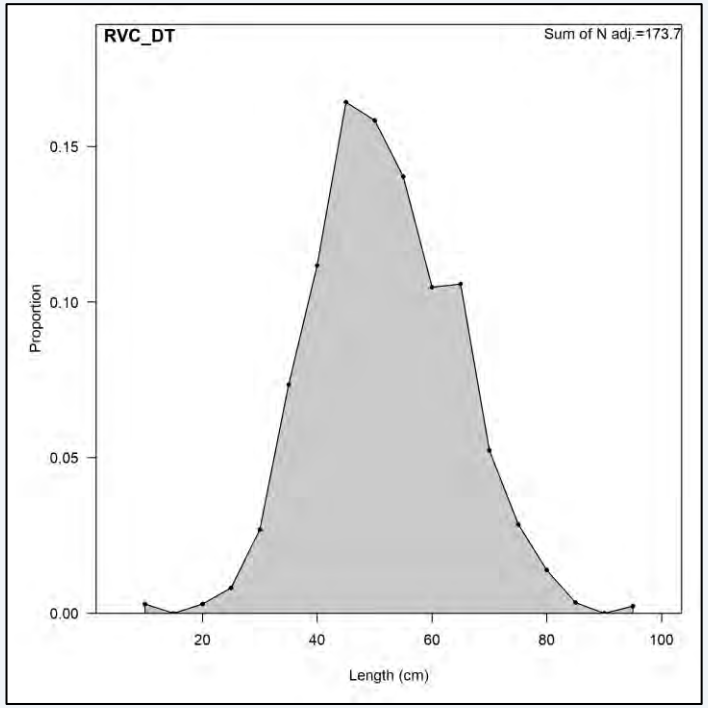
Introduction

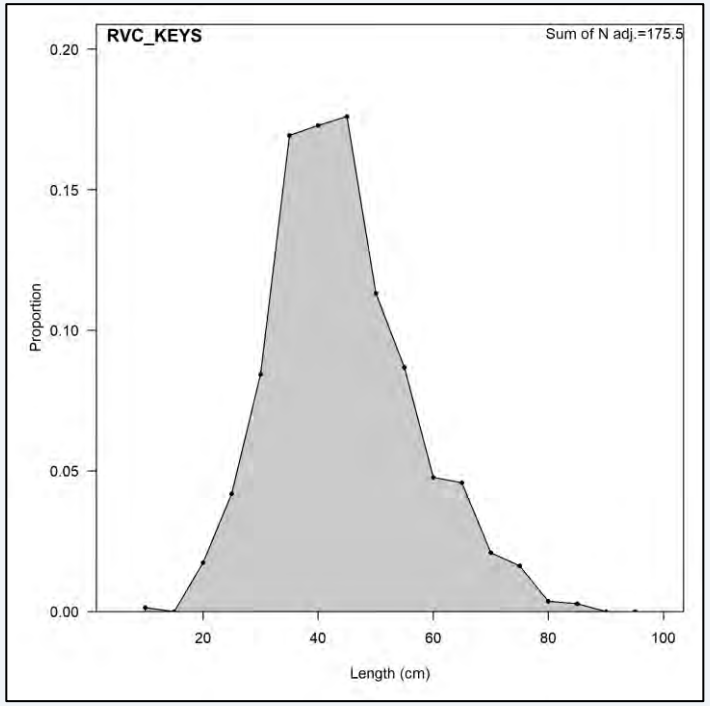
Weighted length compositions for SEDAR 79 were compiled for catch (landings and releases) of Mutton Snapper (*Lutjanus analis*) in the South Atlantic and Gulf of Mexico by fishery and primary gear type. Raw length composition data from fishery dependent sources may be a biased reflection of the length composition of the catch due to uneven sampling in space and time. Therefore, when calculating landings- and releases-at-length (LAL/RAL, fish landed or released per length bin in numbers), it is recommended to weight the sampled lengths of landed or released fish at the finest possible scale by the inverse of sampling proportion (SEDAR 2016; Maunder et al. 2020). Weighting the sampled lengths at the finest possible strata ensures the LAL/RAL are as representative of the catch as possible; however, if

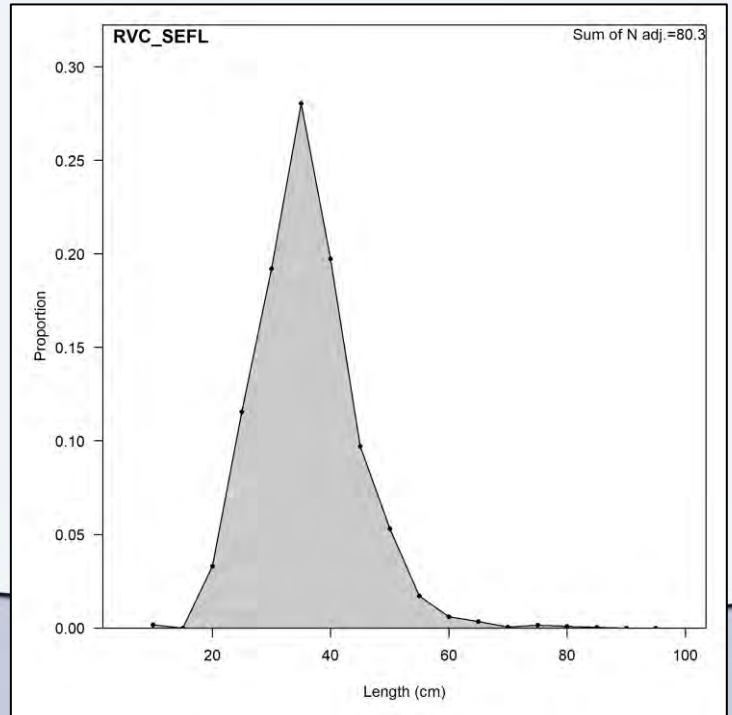


Max TL (5 cm bins)

- Index length comps are index-weighted

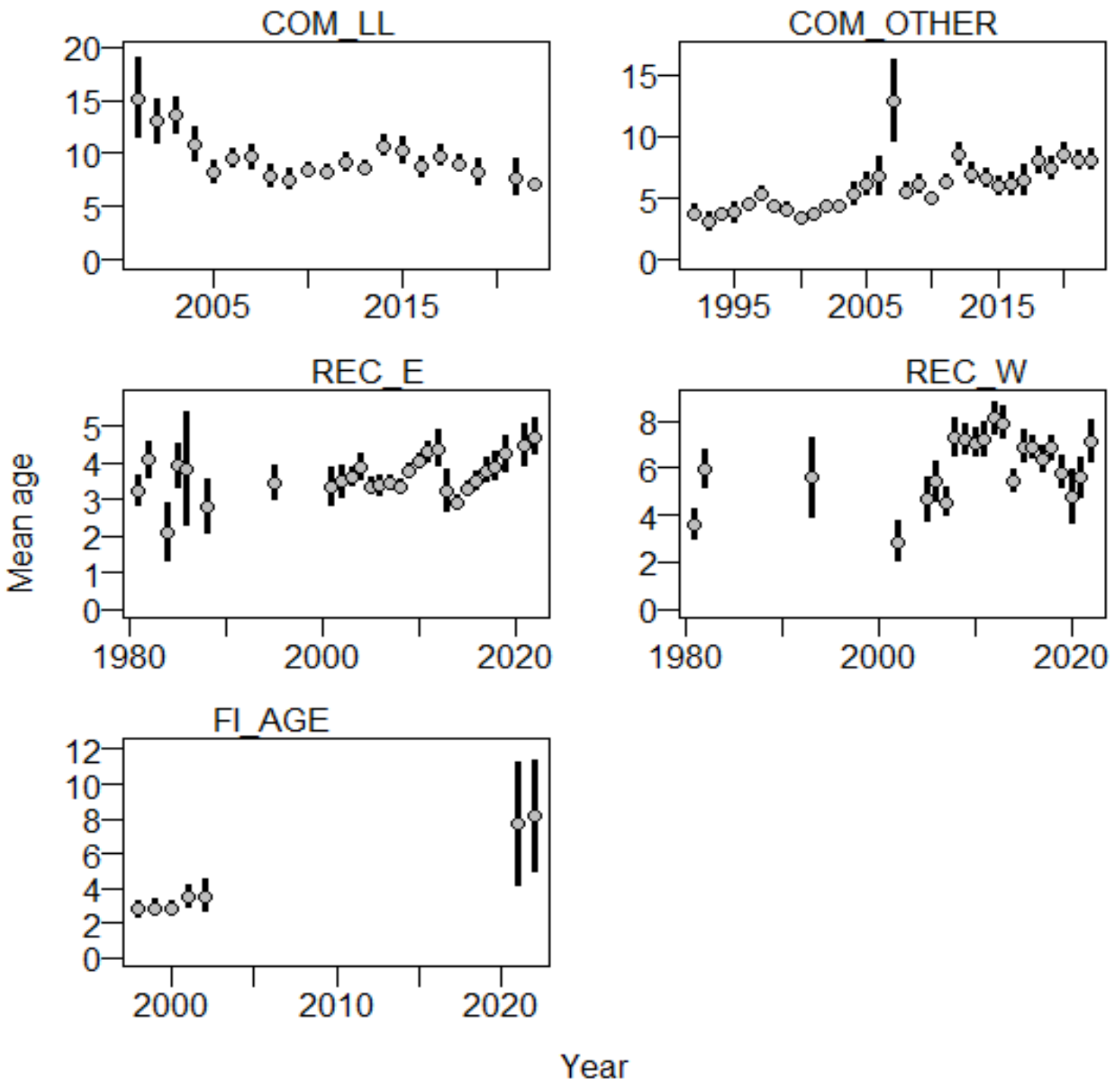






Conditional Age-at-Length

Mean Age by Year & Fleet



Landings and Releases

FL State Reef Fish Survey

- Goal: Improve data for the private boat segment of the recreational reef fish fishery
  - Accounts for majority of recreational catch
  - Difficult to monitor with a general survey
  - Large number of participants, dispersed, open access
  - Reef trips constitute a small portion of overall recreational effort

- FL Gulf Reef Fish Survey expanded statewide in July 2020 & renamed the State Reef Fish Survey
  - Mail survey of fishing effort – Separate from MRIP-FES
  - Angler intercept survey for CPUE – MRIP-APAIS and SRFS combined


Certification Review of Florida's Proposed MRIP-SRFS Calibration Methodology for Mutton and Yellowtail Snapper

NOAA Fisheries Office of Science and Technology and the Southeast Fishery Science Center

SEDAR96-RD-01

July 2024

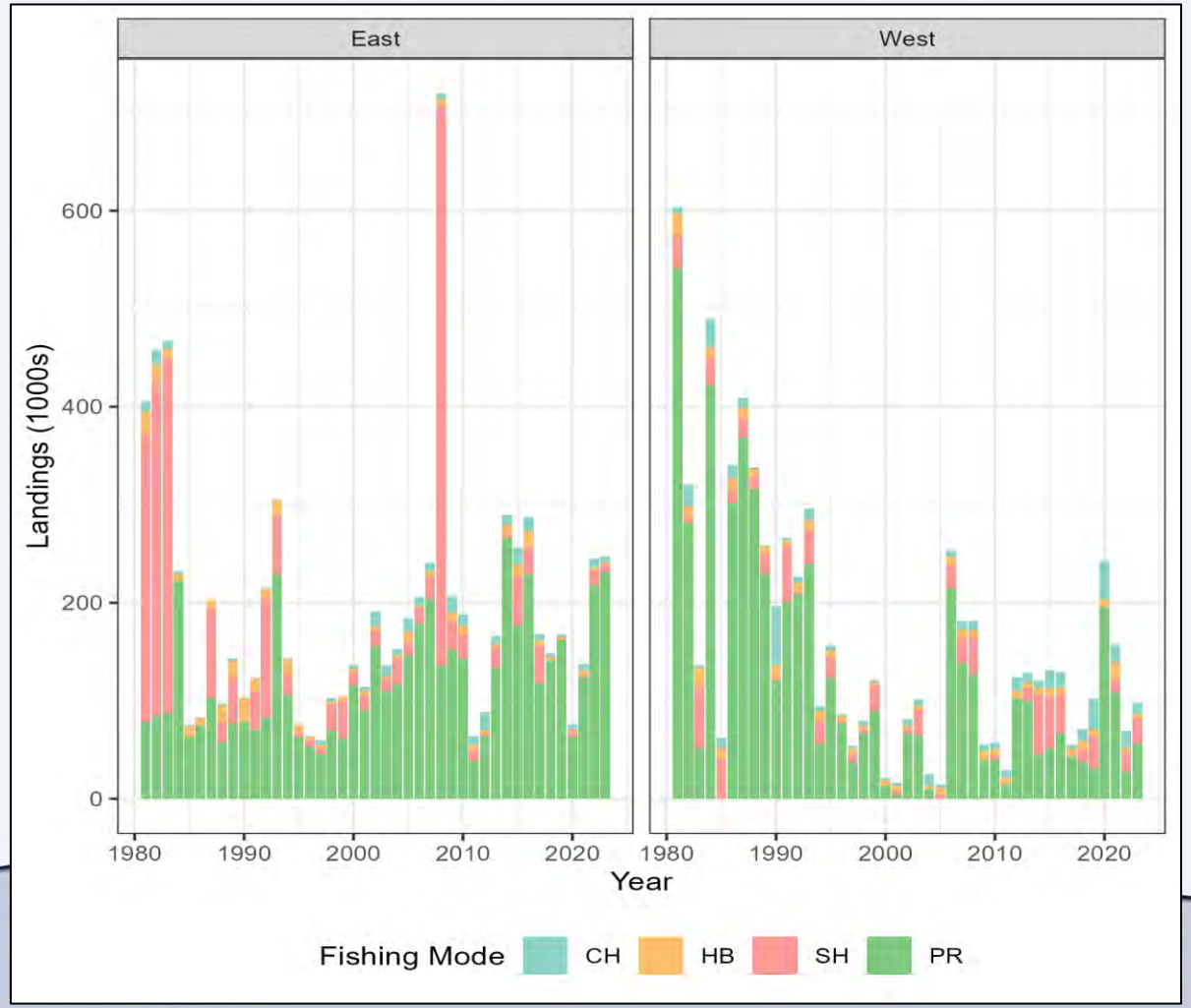
Rec data including FL State Reef Fish Survey

Rec Landings and Releases incorporating SRFS includes:

- Headboat data from SRHS
- Charter data from MRIP-FHS
- Shore mode data from MRIP-FES
- Non-FL Private mode data from MRIP-FES
- FL Private mode data from SRFS (2021-2023)
- MRIP-FES calibrated to SRFS (1981-2020)
  - SEDAR79-AP-02

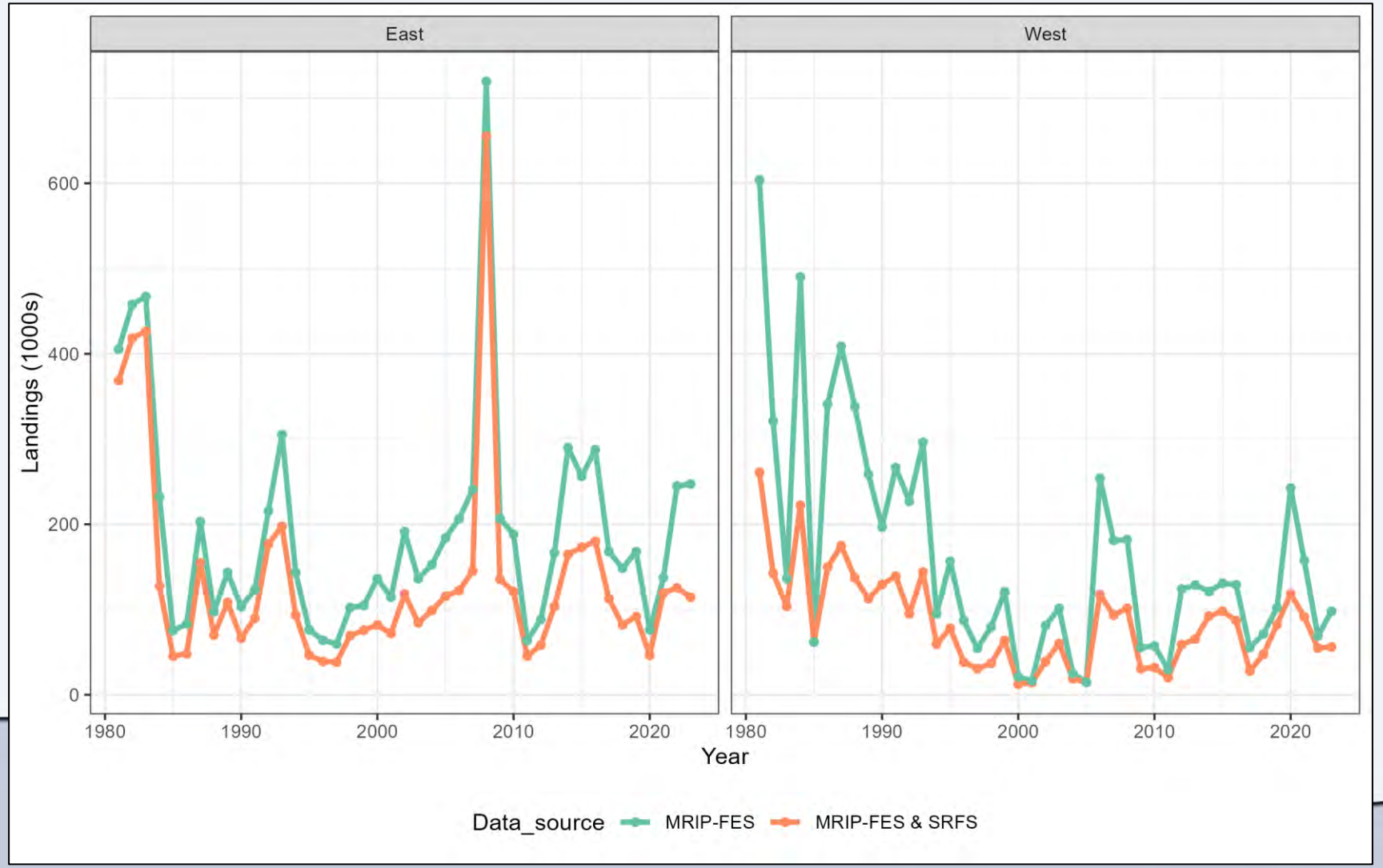
Estimate Type	Region	Ratio
Landings (lbs)	East	0.54
	West	0.28
Landings (num)	East	0.53
	West	0.36
Releases (num)	East	0.55
	West	0.48

MRIP-FES Landings

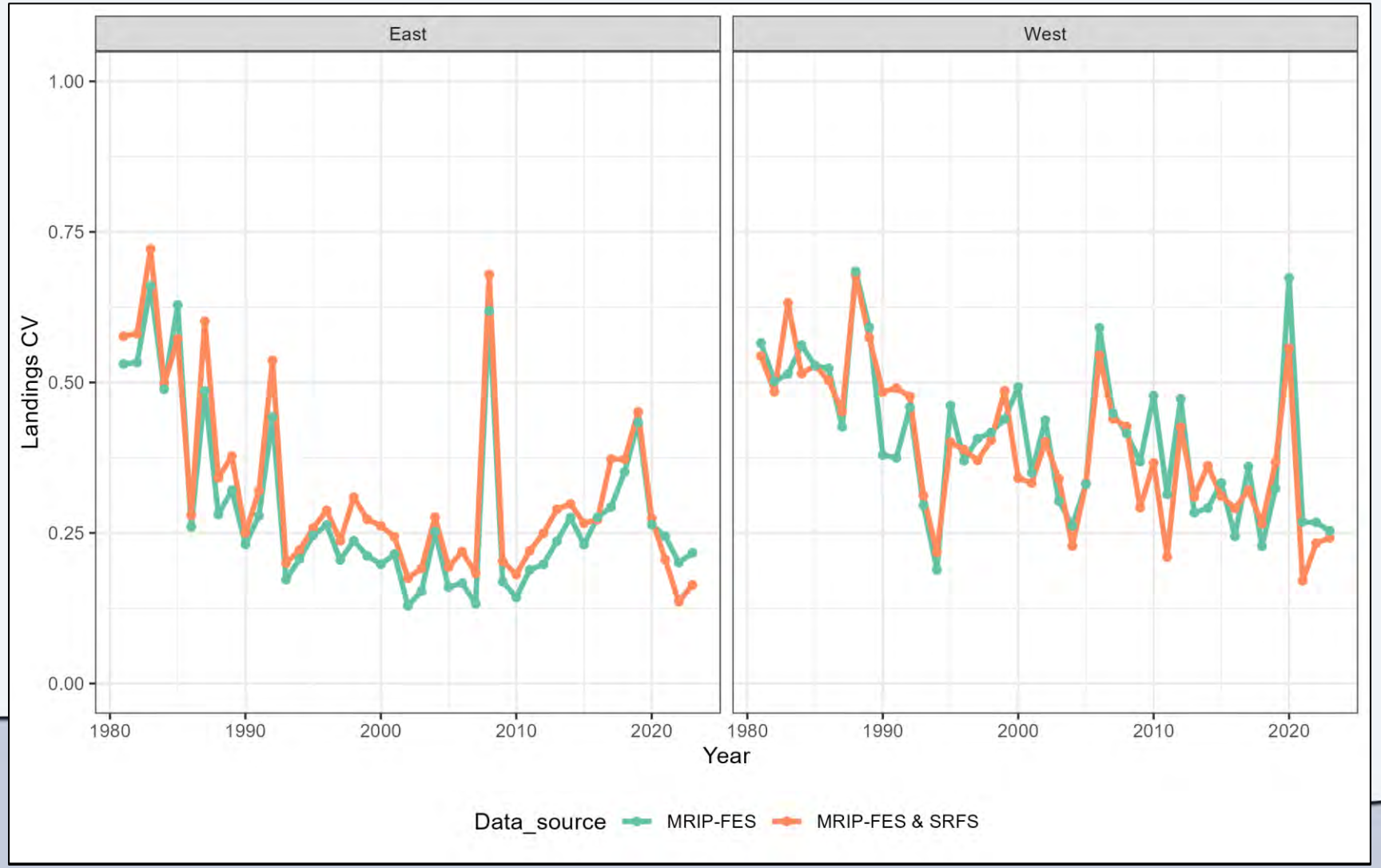


SRFS-calibrated Landings

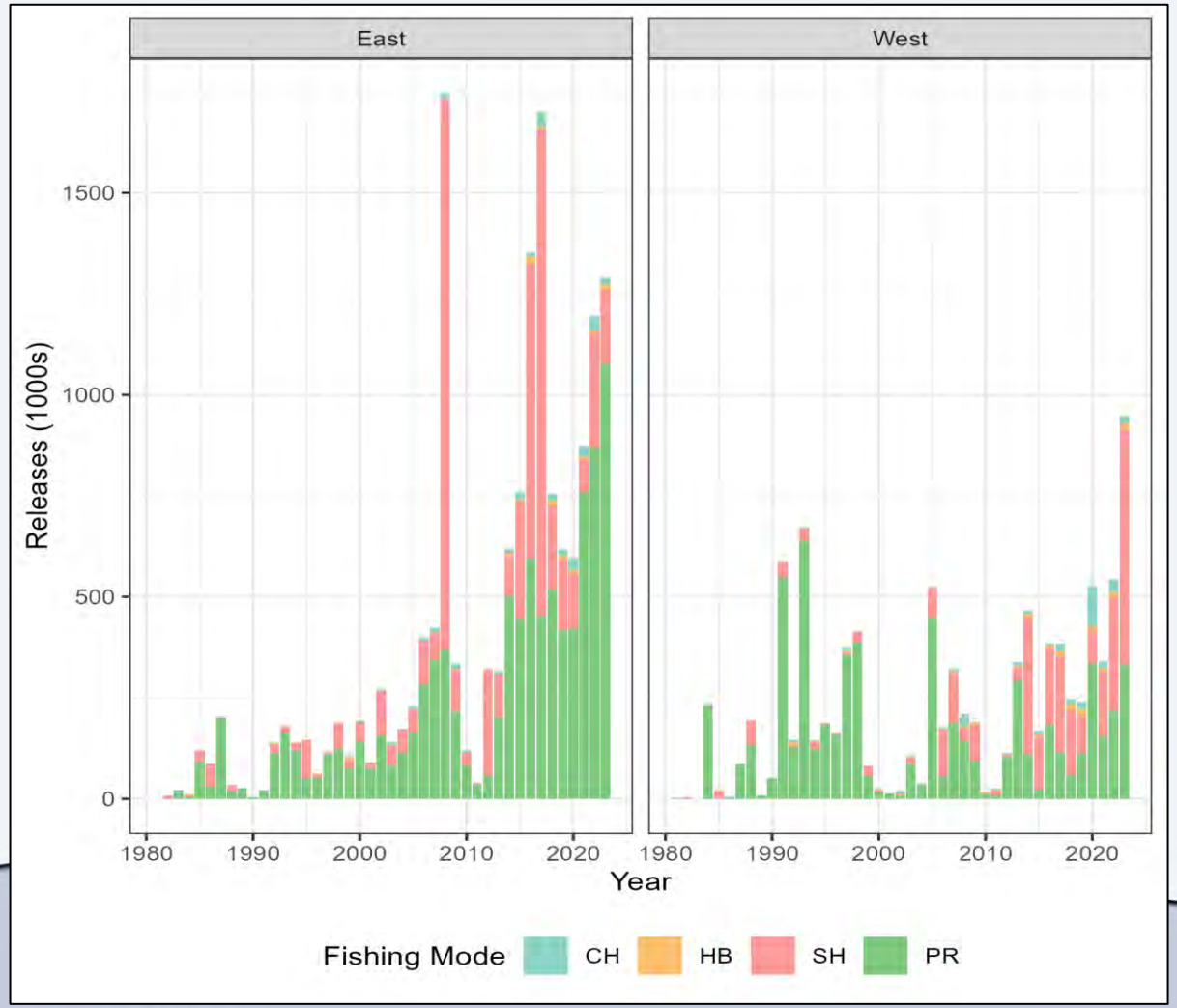
Rec Total Landings (1000s)



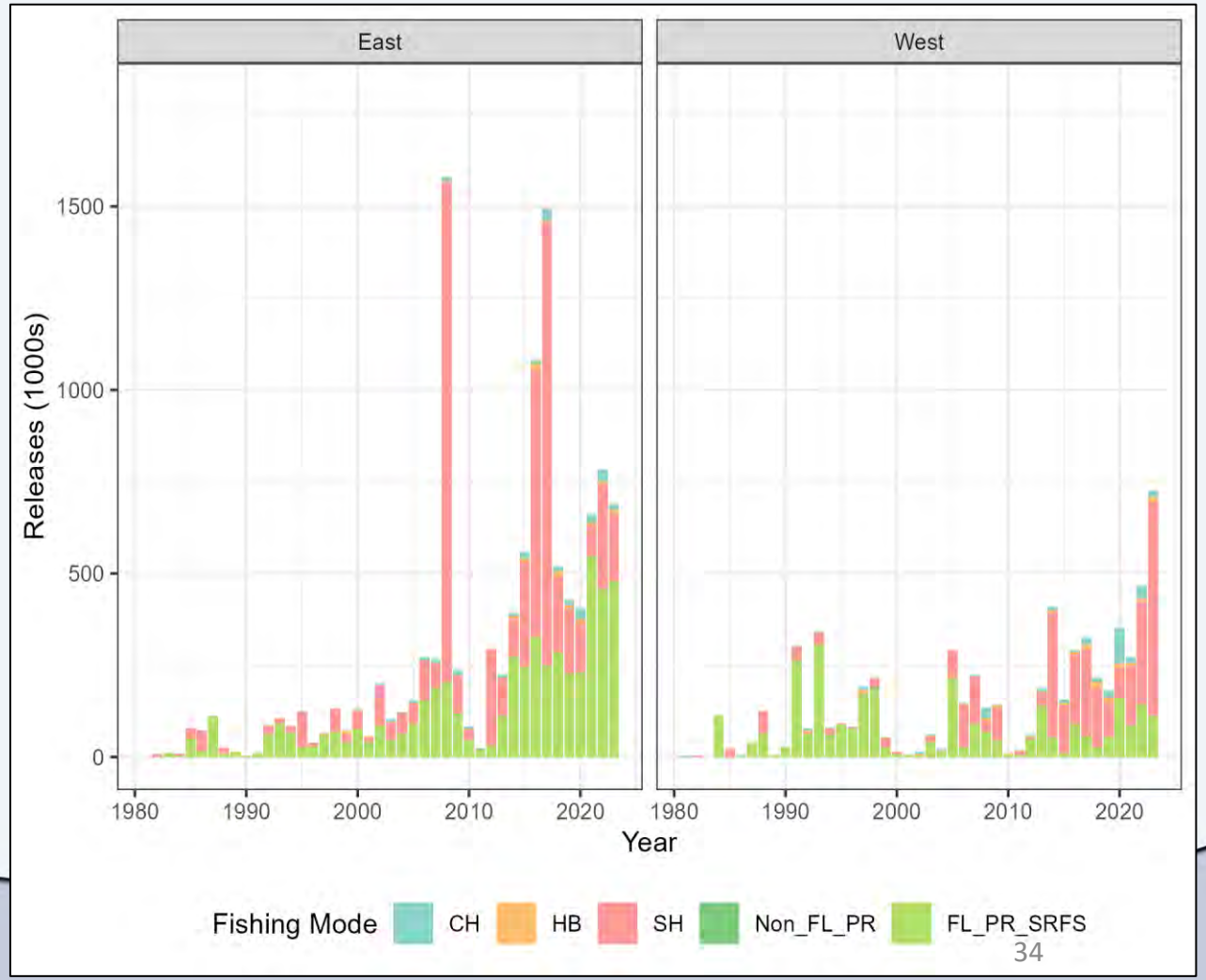
Rec Landings CVs



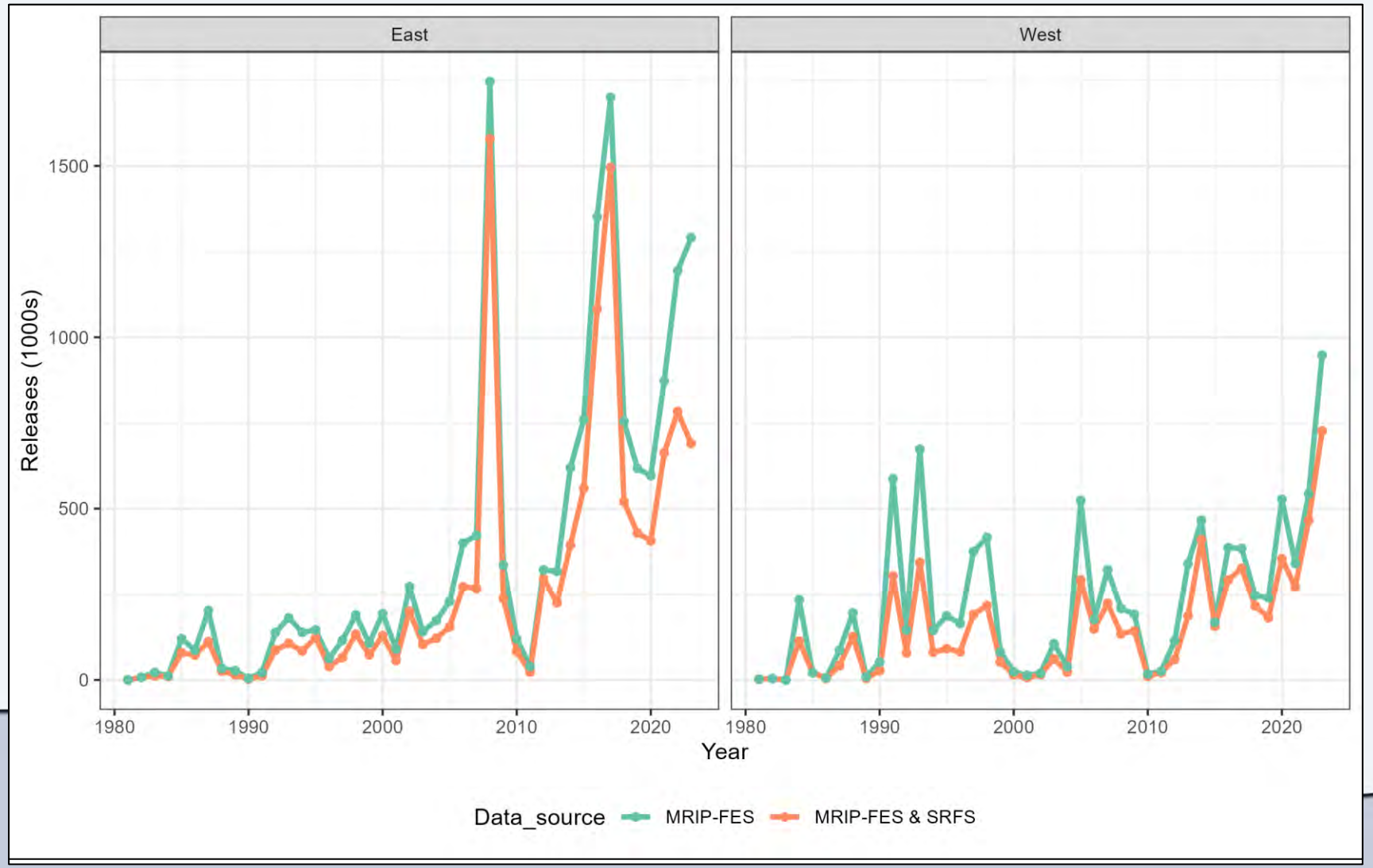
MRIP-FES Releases



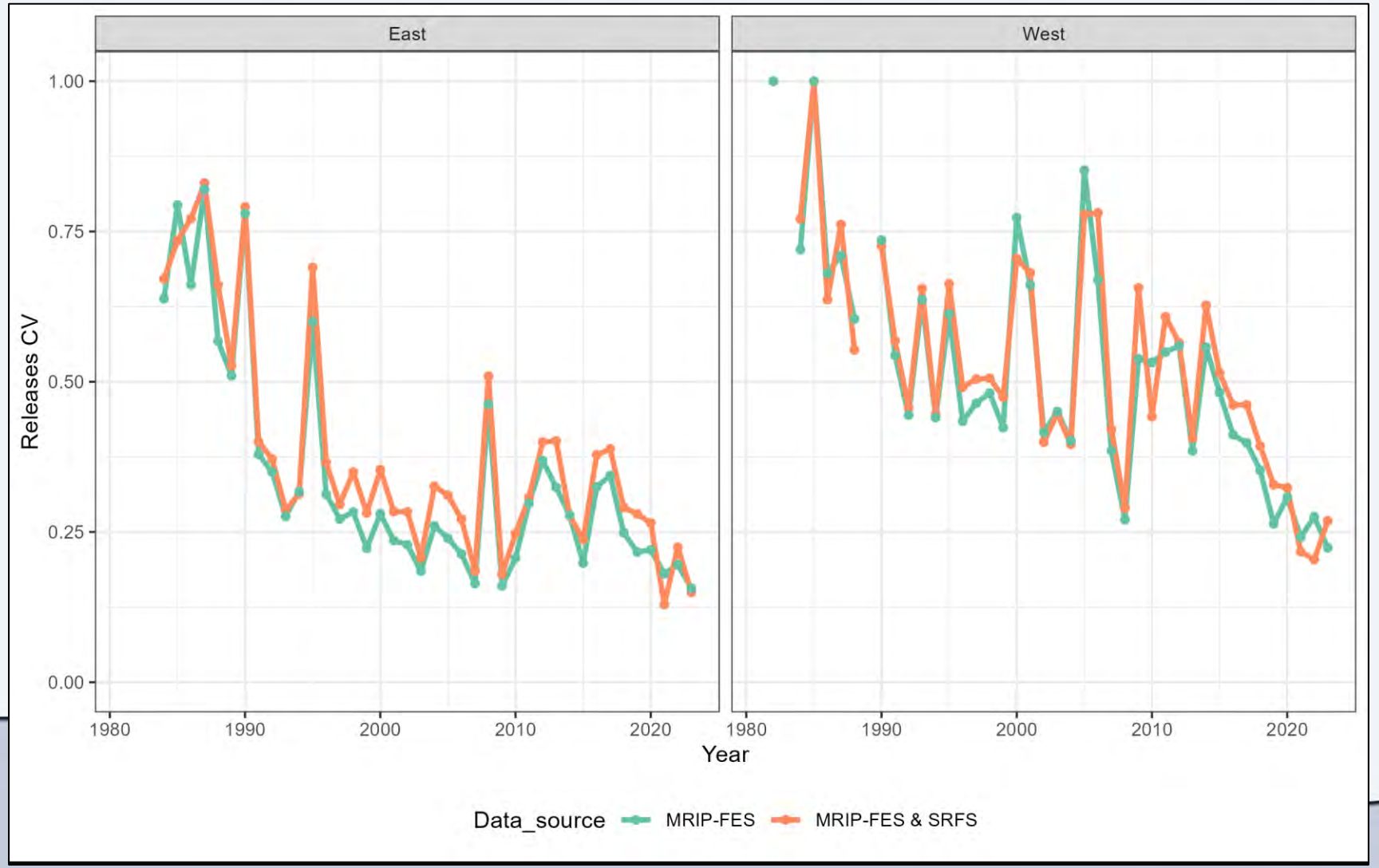
SRFS-calibrated Releases



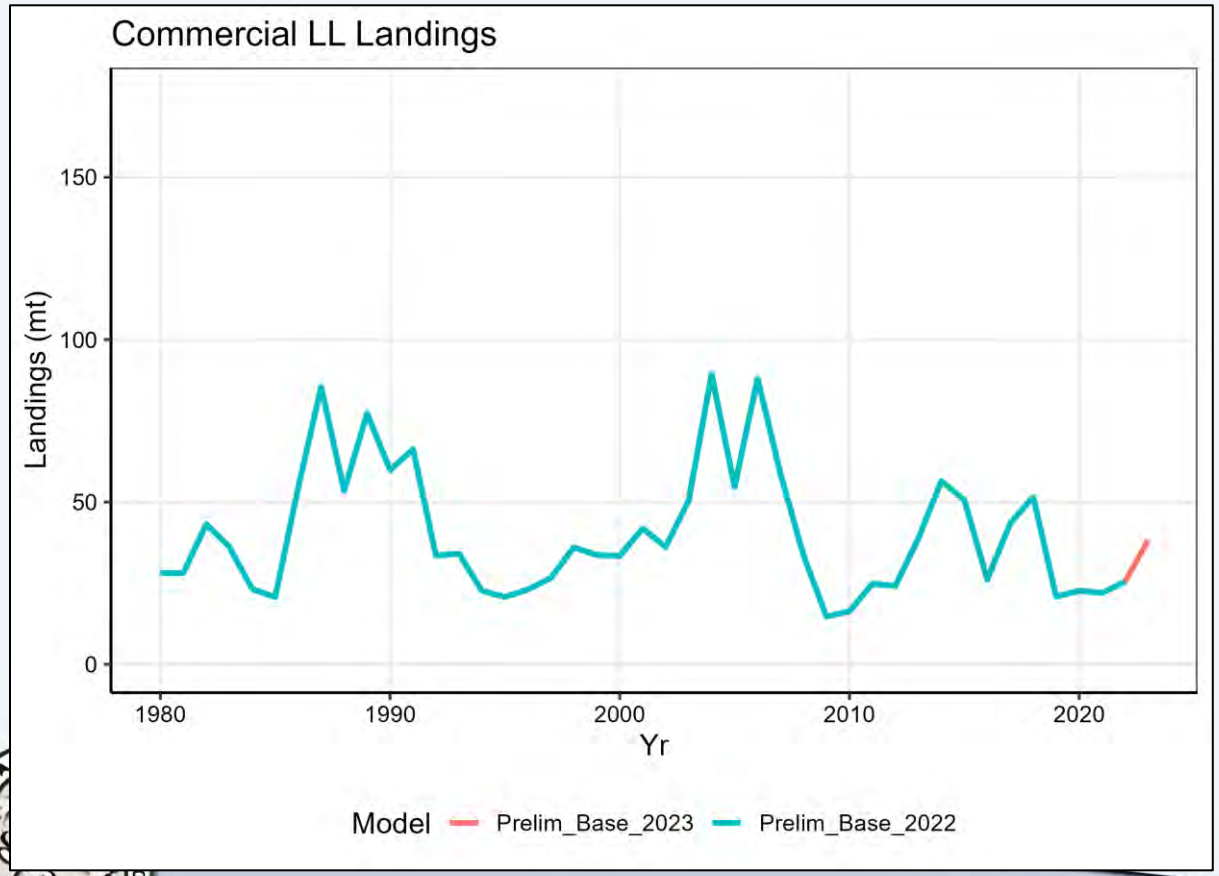
Rec Total Releases (1000s)

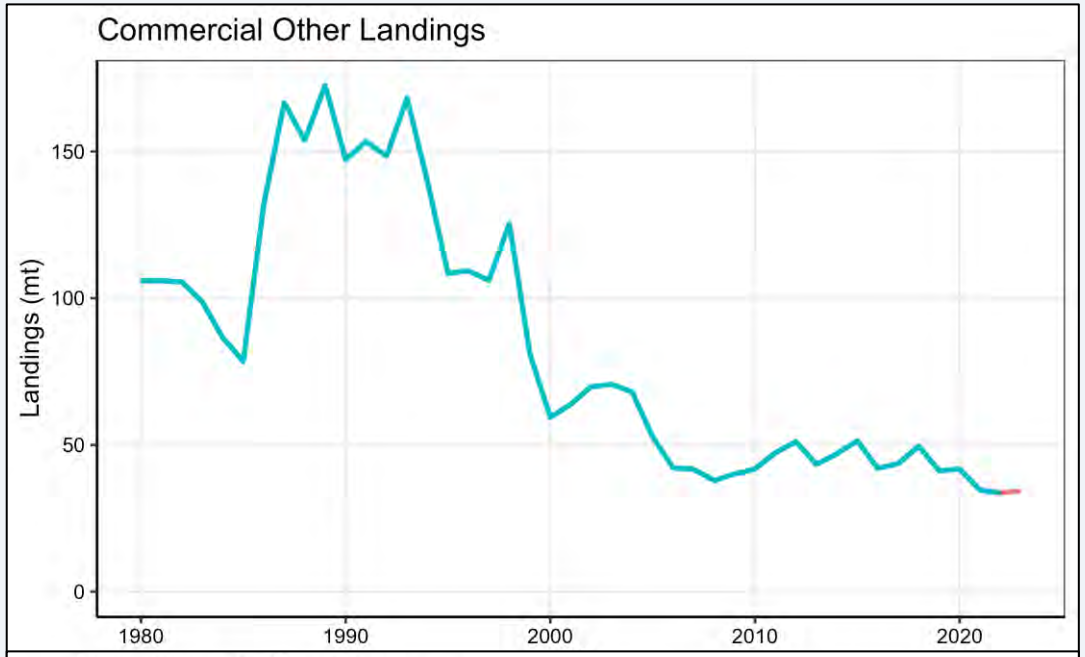


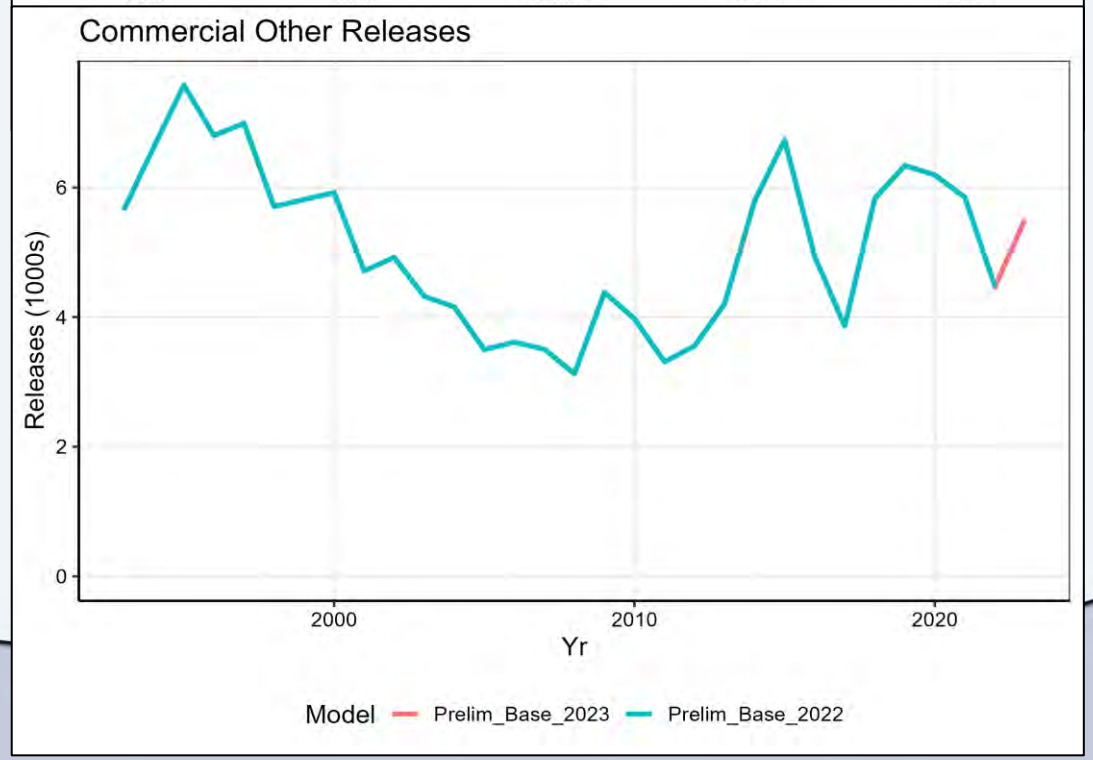
Rec Releases CVs



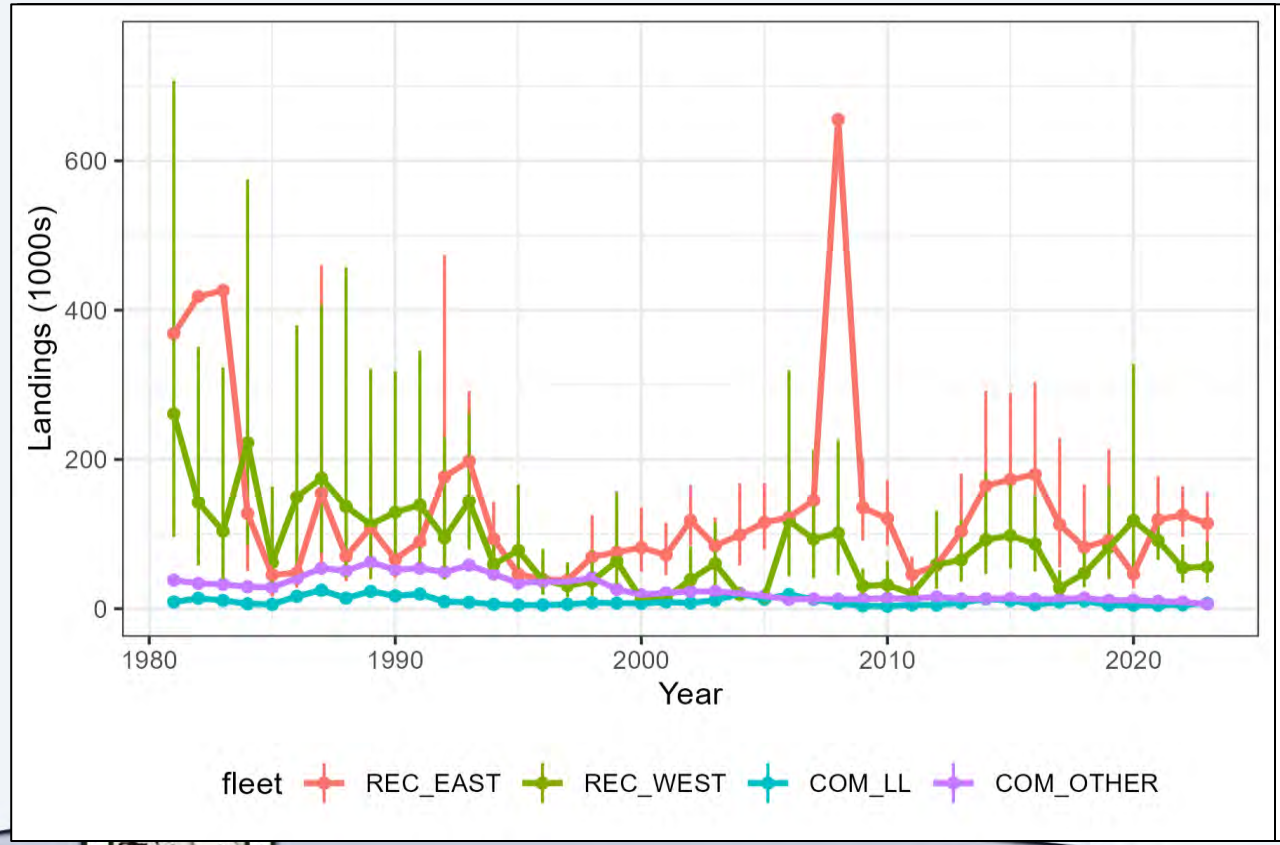
Commercial Landings and Releases

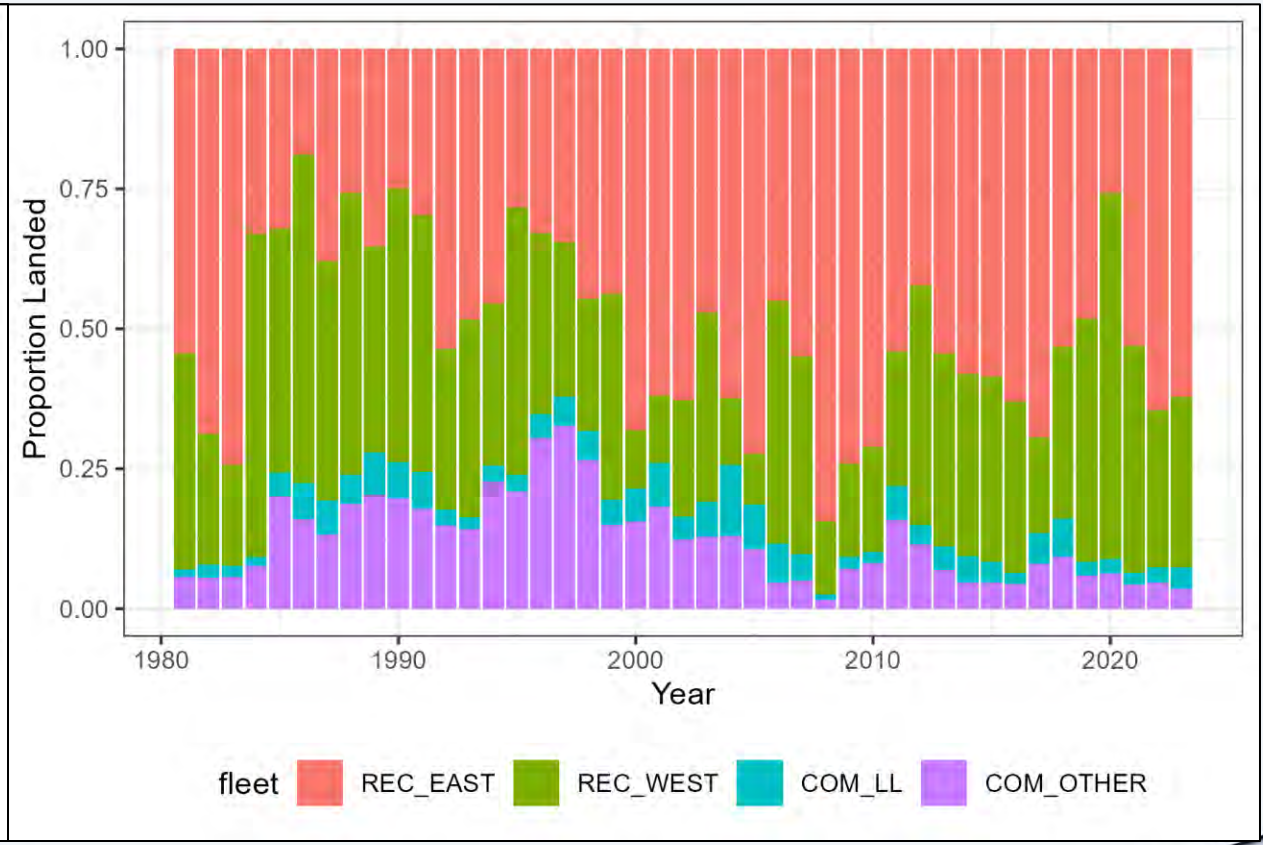




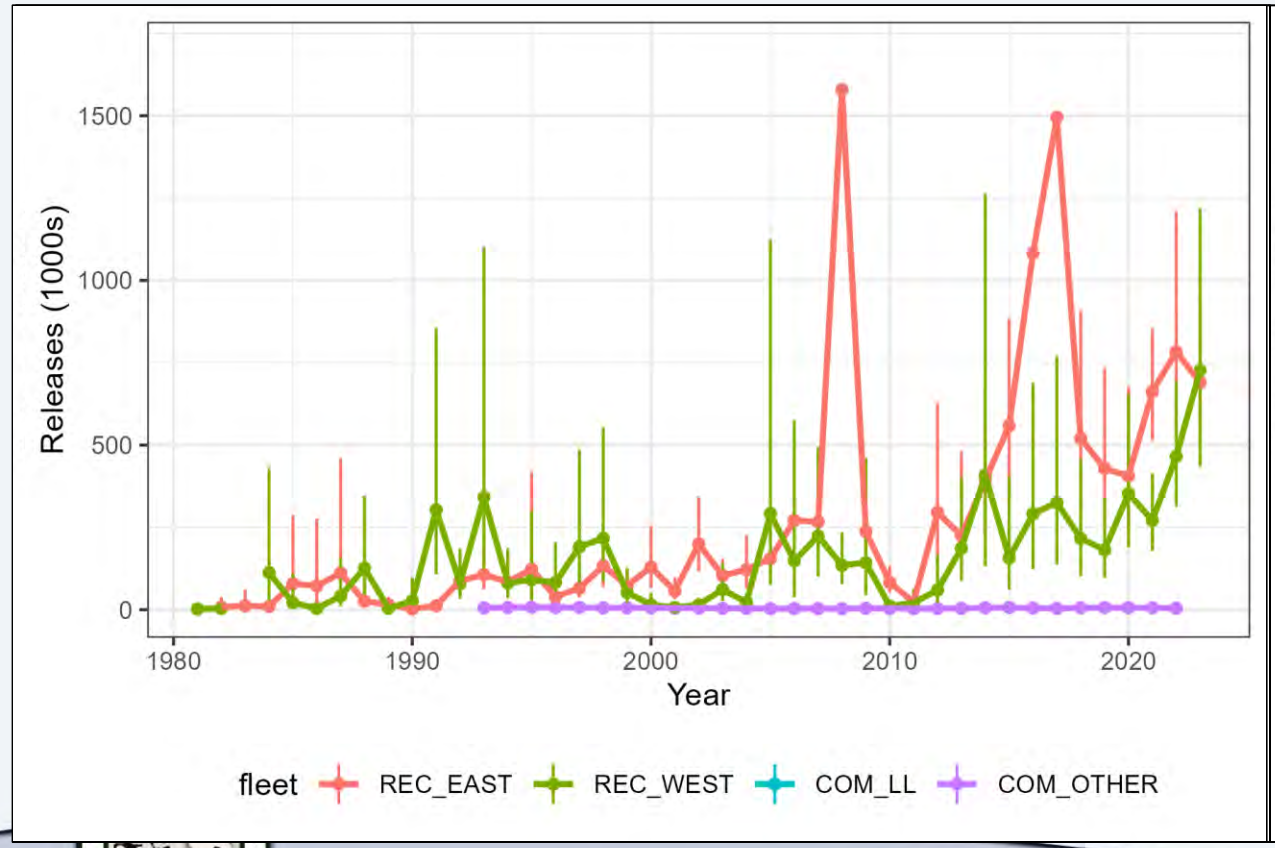


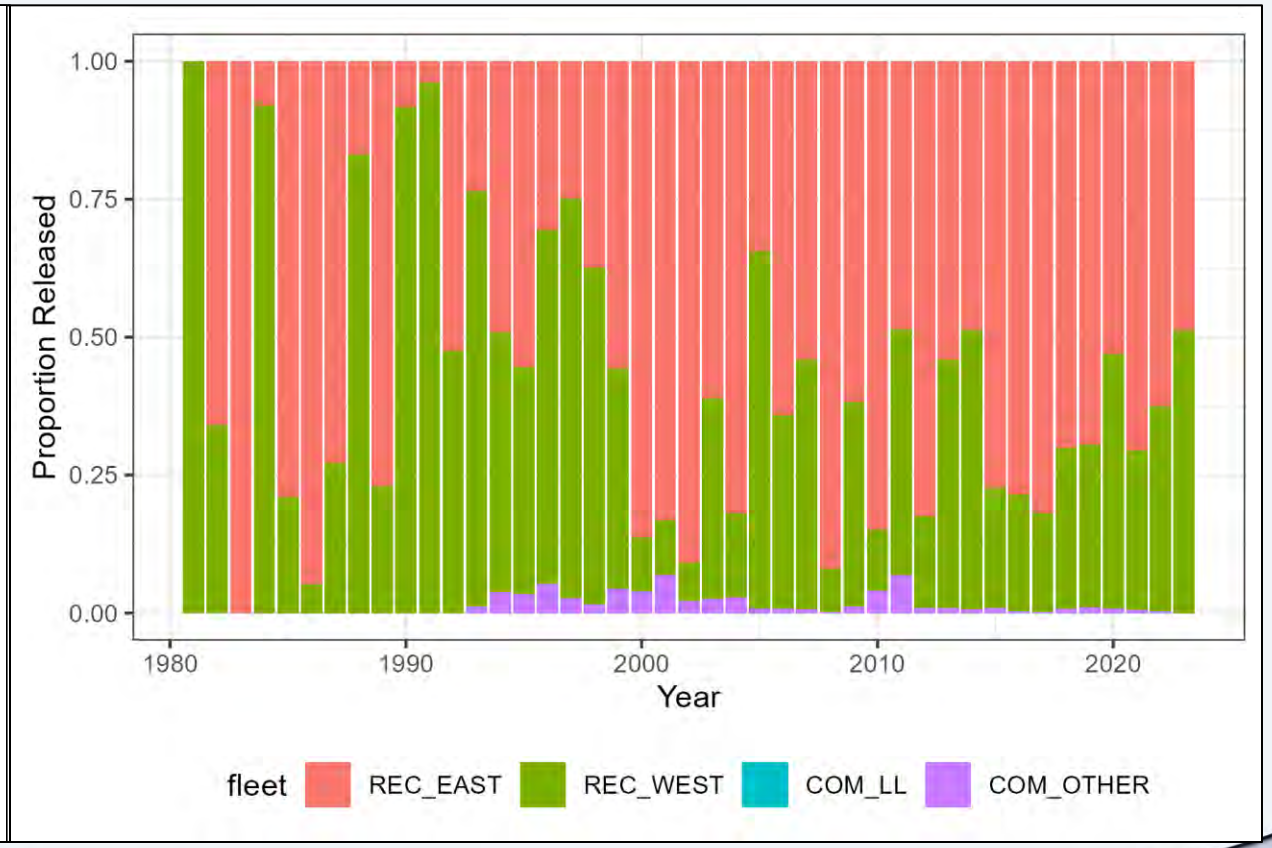
Landings (1000s) by Fleet (inc SRFS)





Releases (1000s) by Fleet (inc SRFS)

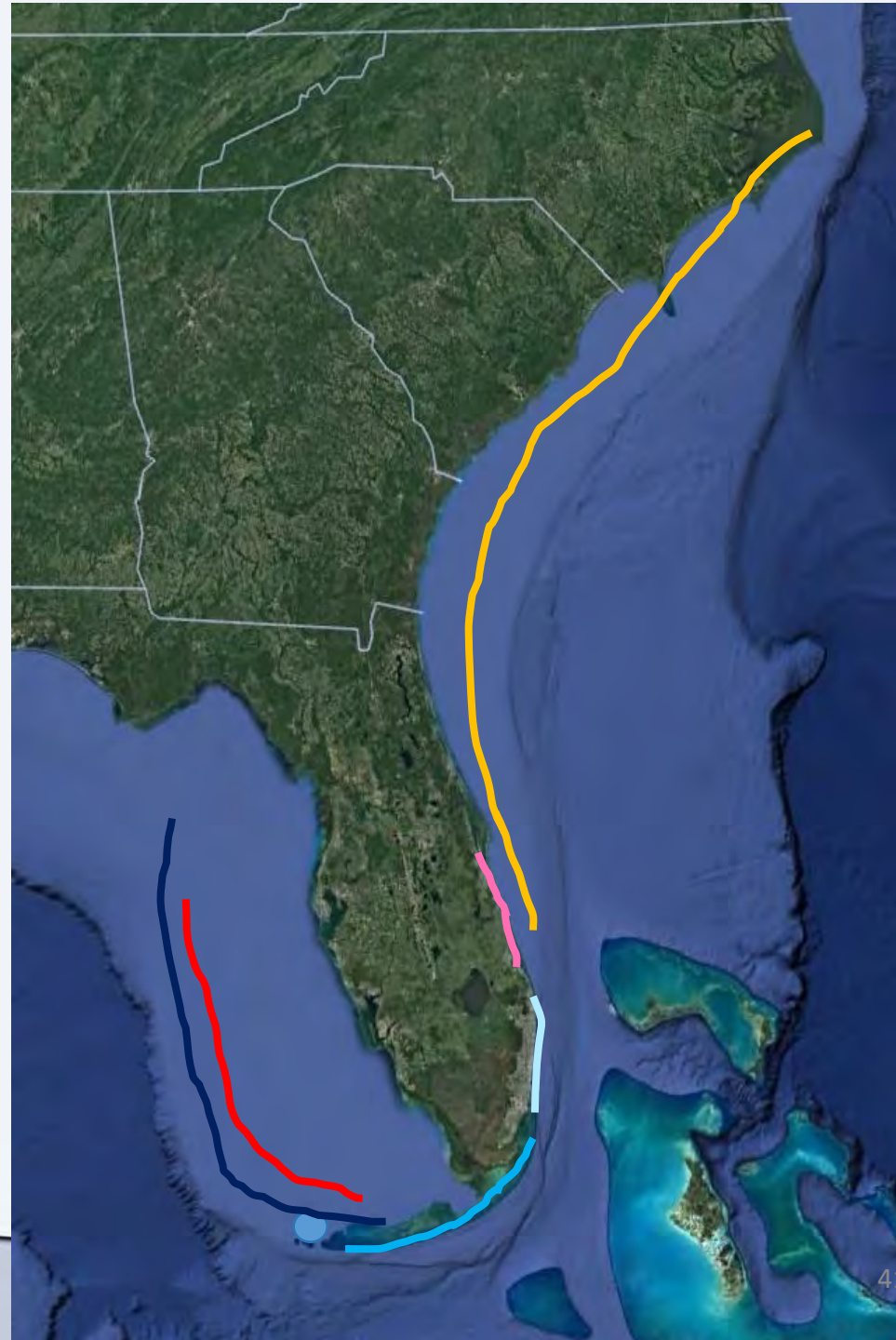




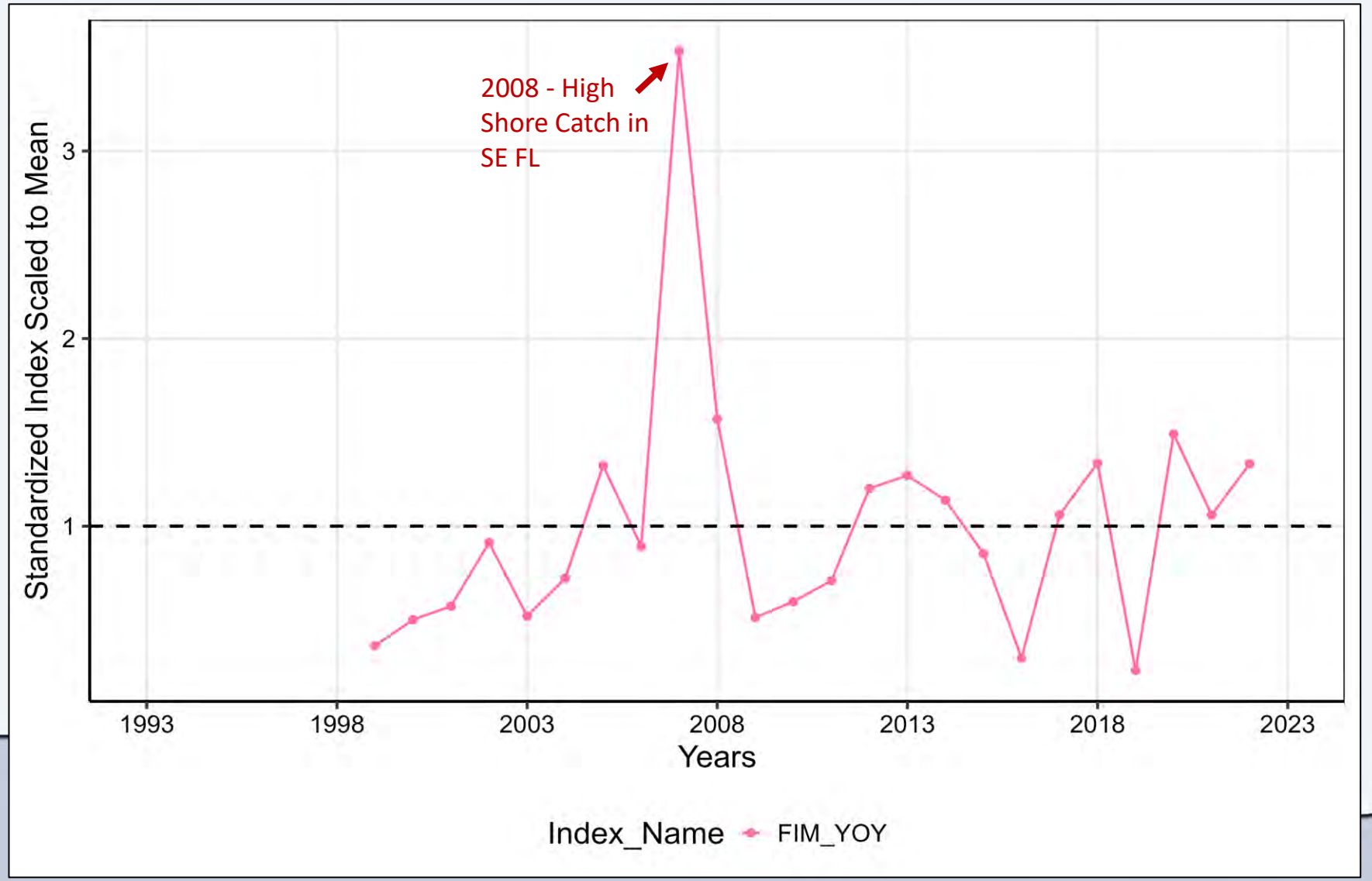
Indices

Main Data Inputs: Indices

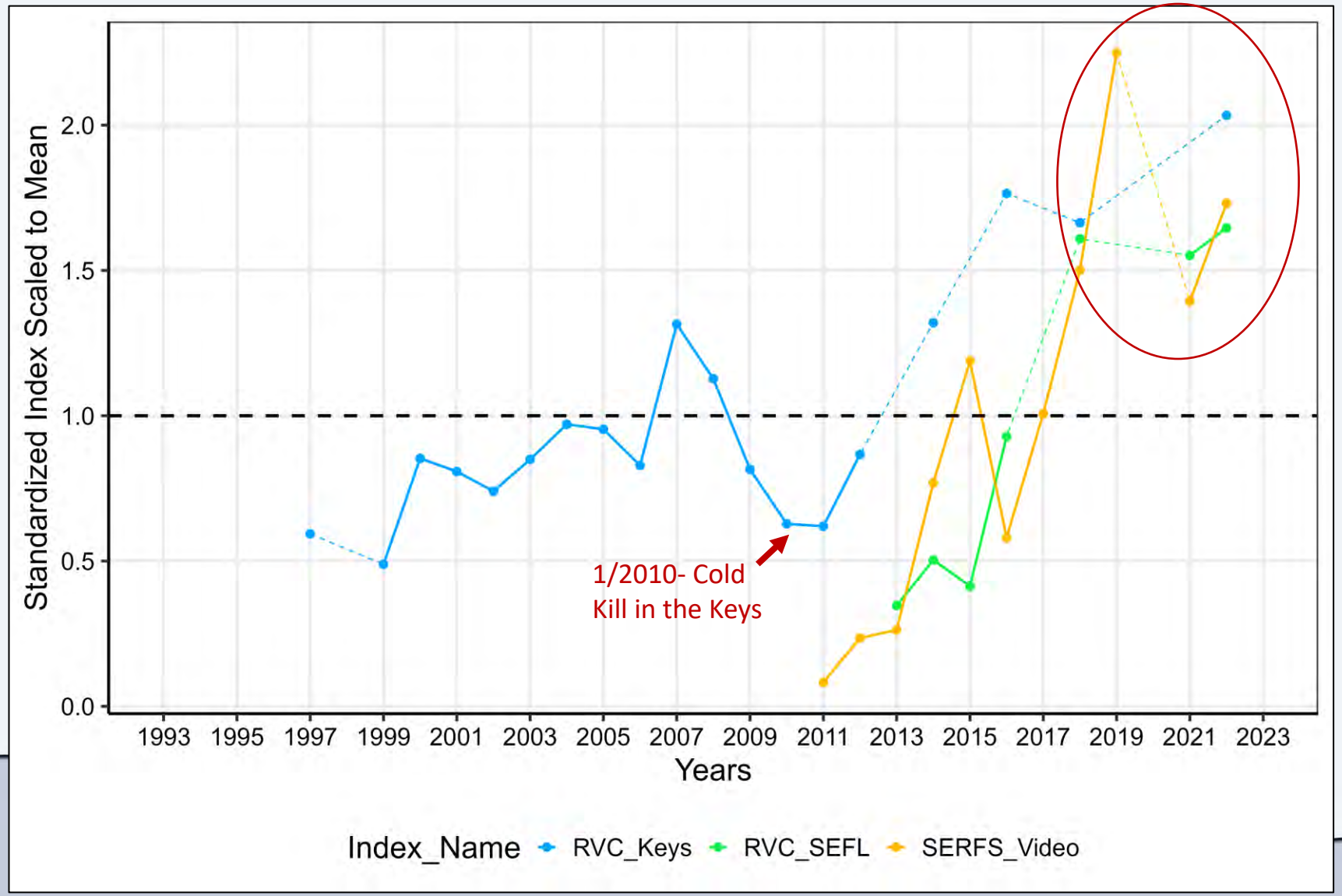
Index	FD or FI	Time Series	Num of Years	Targets	Lengths	Ages
SERFS Video	FI	2010-2022	12	Post YOY	No	No
FIM Indian River Lagoon	FI	1999-2022	24	YOY	Yes	Few
RVC SE FL RVC FL Keys RVC Dry Tortugas	FI	1997-2023	7 19 12	Post YOY	Yes	No
Combined Gulf Video	FI	1996-2022	20	Post YOY	Yes	No
Commercial Longline	FD	1993-2010	17	Adults	Yes	Yes



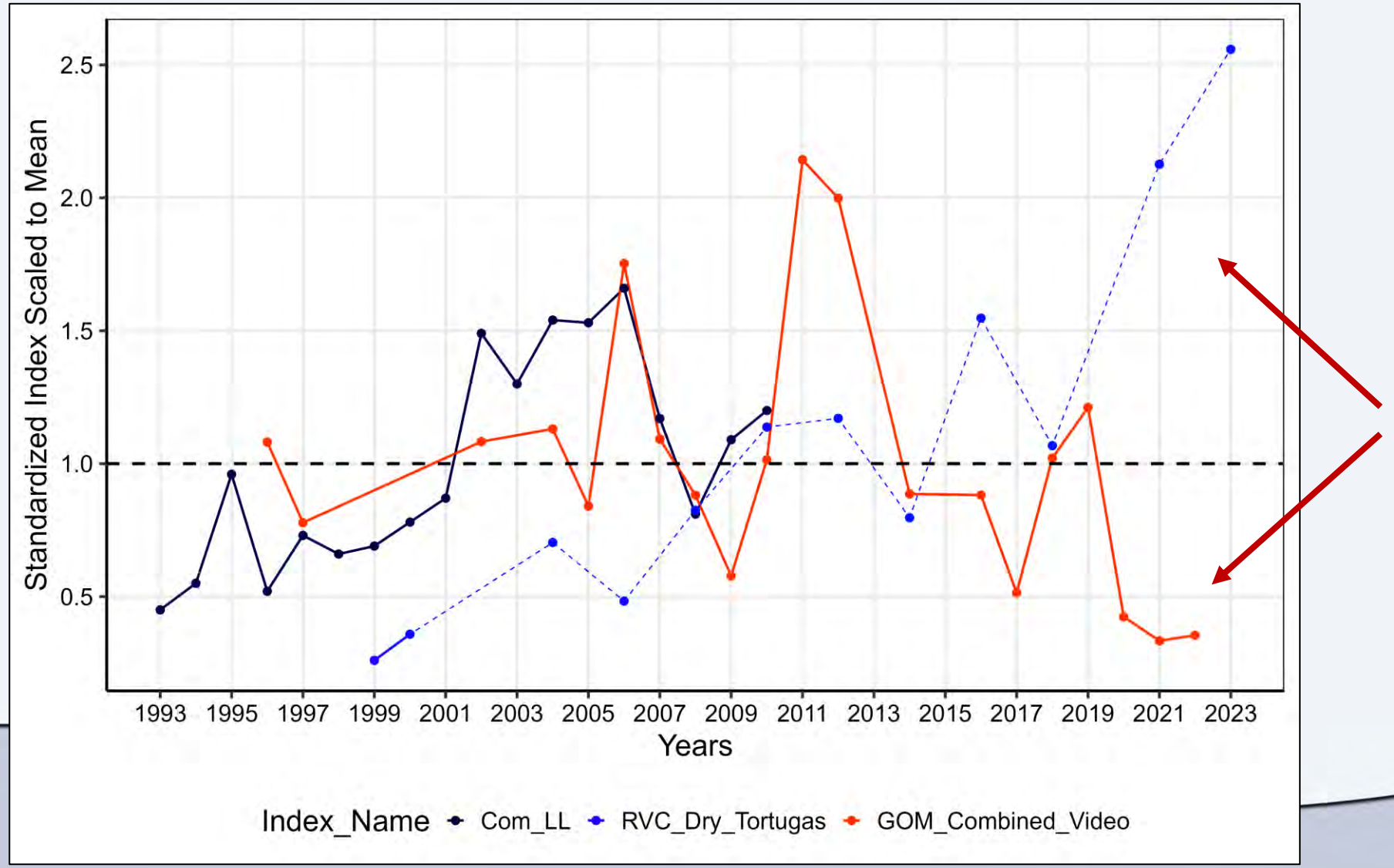
Indian River YOY Index



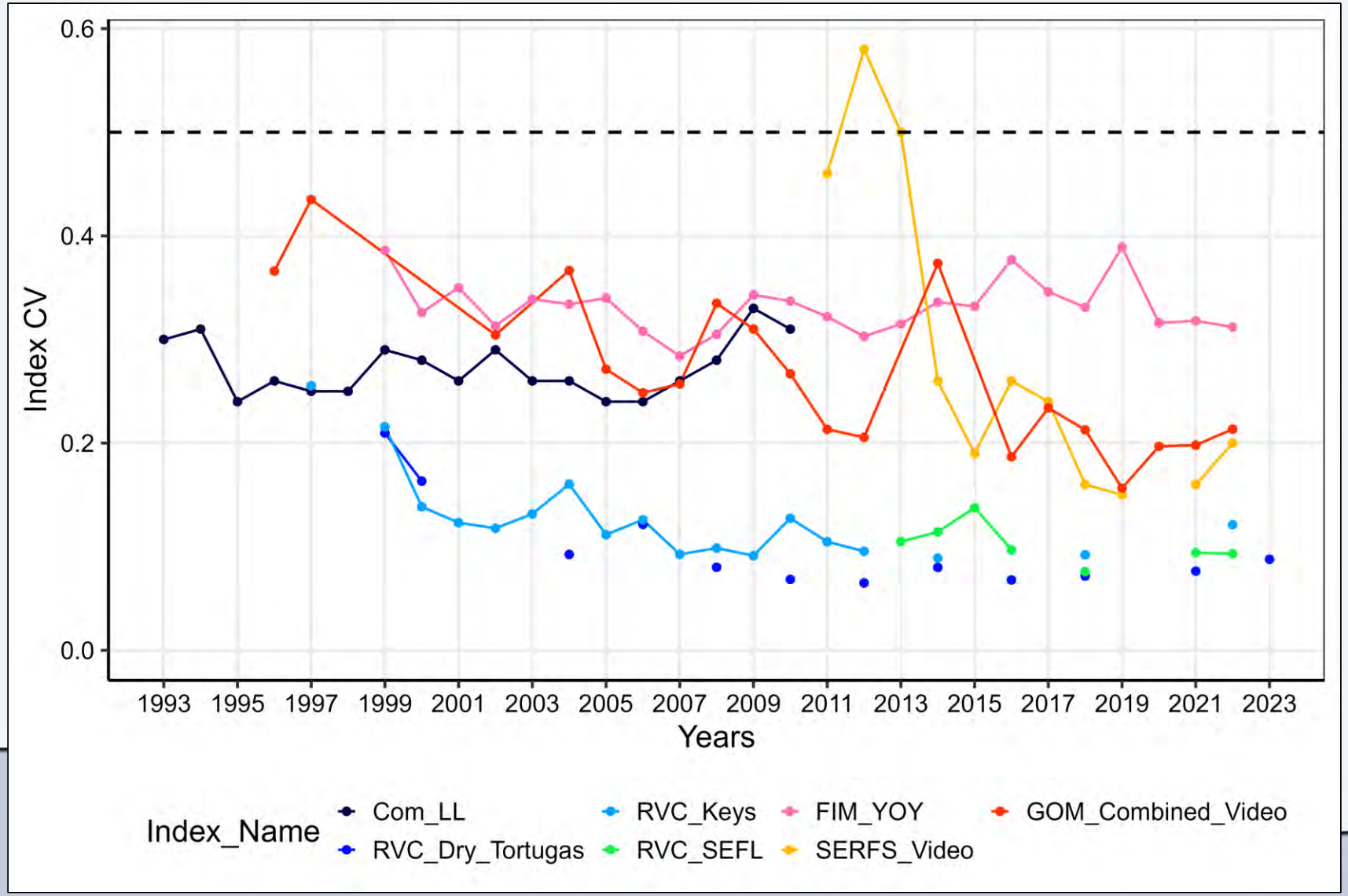
FL Keys/East Coast Post YOY Indices

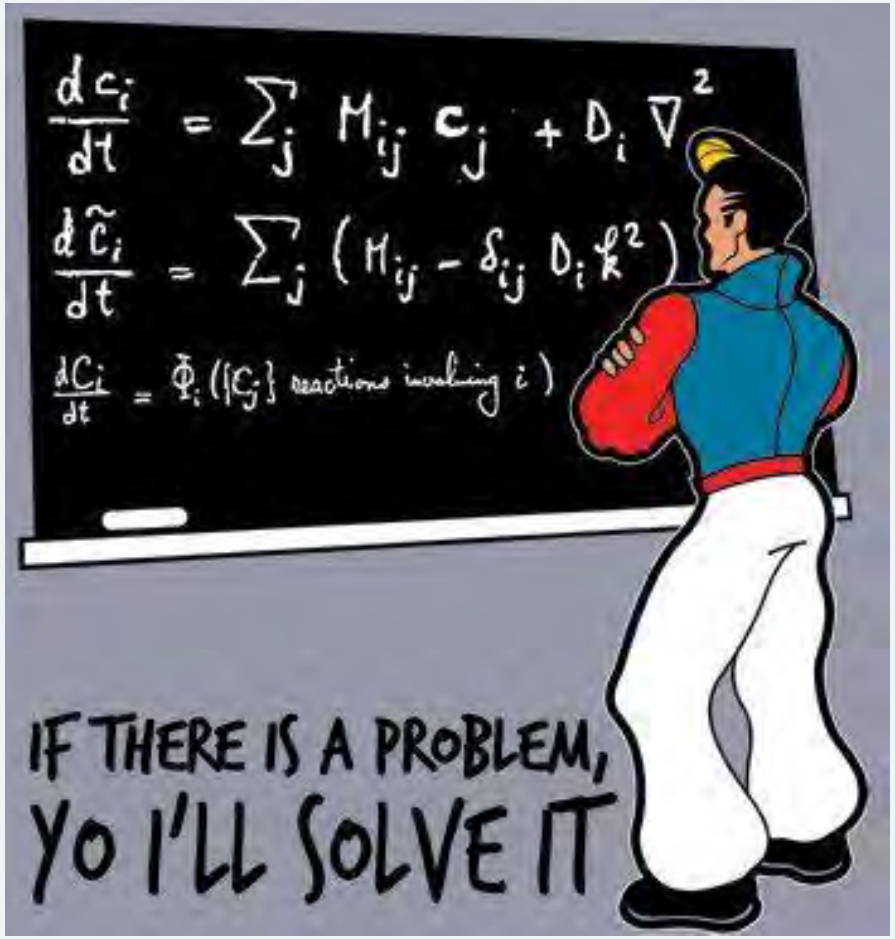


GOM/Dry Tortugas Post YOY Indices



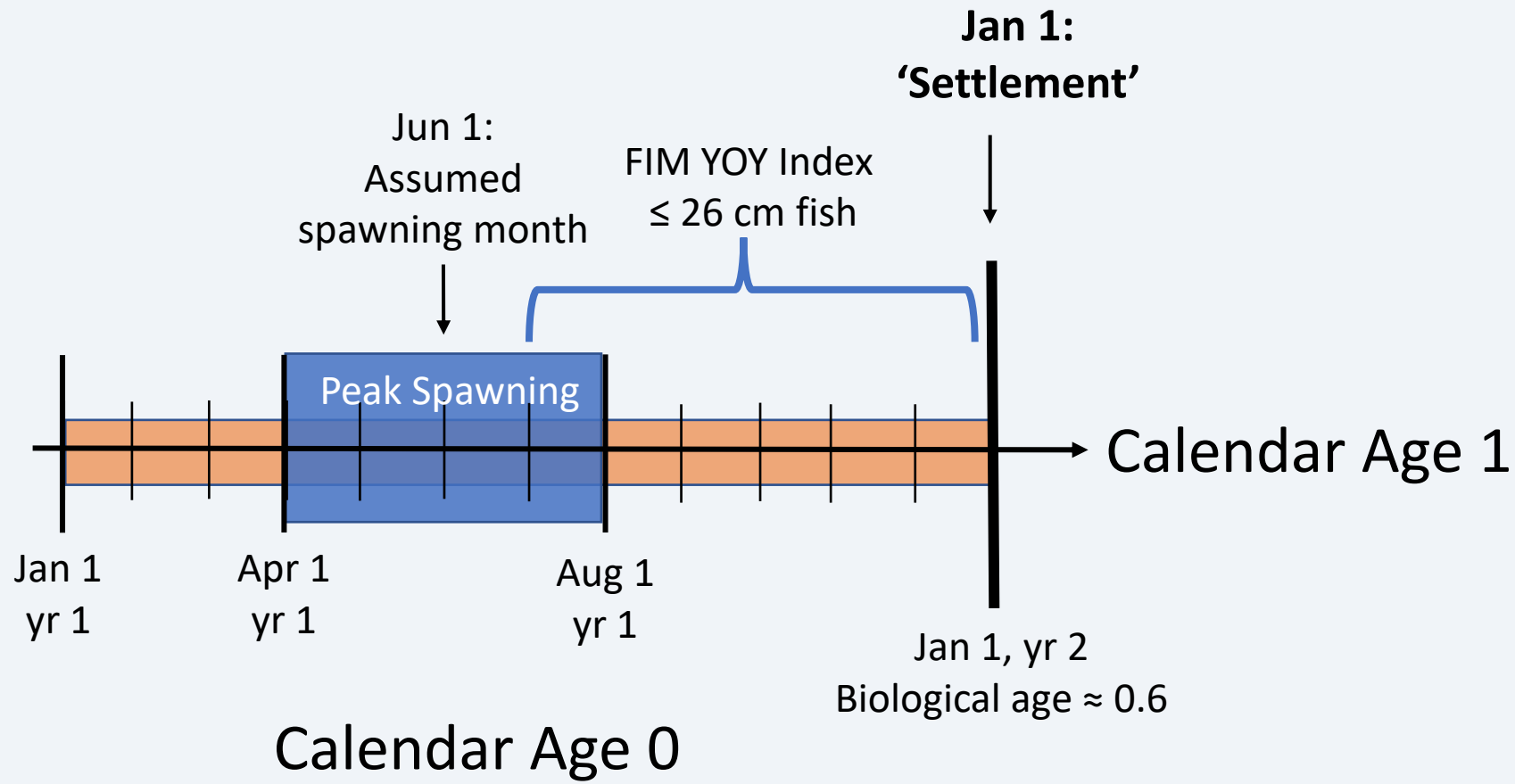
Main Data Inputs: Index CVs





Stock Synthesis Base Model

Visualizing spawning, settlement, and growth



Stock Synthesis Model Configuration

Stock Synthesis v. 3.30.22.1

- Moderate complexity: 1 season, 1 area
- Years: 1981 - 2023
- Spawning: June 1
- Settlement: January at Age 1/8 cm.
  - Growth immediately follows VB growth
- Combined sex model with female SSB
- Initial numbers at age are not influenced by equilibrium catch values
- Steepness was not used in the initial equilibrium calculation

Life History

- Estimated growth using external growth model inputs as initial guesses
- 40 ages in the model (1-40)
- Natural mortality: Lorenzen with Fixed Average M for ages 3-40
- Maturity: Fixed age-logistic
- Fecundity = Spawning biomass at length
- Length-Weight: Fixed

Stock Synthesis Model Configuration

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Stock Synthesis Model Configuration

Length Composition Data (4 cm bins)

- Commercial LL
  - Landings
- Commercial Other
  - Landings, Discards -All years combined
- Rec East
  - Landings and Discards
- Rec West
  - Landings and Discards
- GOM Combined Video
  - All years combined

General Size Composition Data (5 cm bins)

- RVC Dry Tortugas, FL Keys, SE FL

Conditional Age-at-Length Data

- Commercial LL Landings
- Commercial Other Landings
- Rec East Landings
- Rec West Landings
- Fishery-independent sources

Stock Synthesis Model Configuration

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  - Landings
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- Commercial Other Landings
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- Rec West Landings
- Fishery-independent sources

Stock Synthesis Model Configuration

Fleet Selectivity

- Commercial Longline
  - Selectivity: Simple logistic (flat-topped)
- Commercial Other
  - Selectivity: Simple logistic (flat-topped)
  - Estimated Retention (flat-topped)
    - Blocks: 1992-2017, 2018-2022
  - Discard Mortality = 30%
- Rec East & West
  - EAST Selectivity: Double normal (dome)
  - WEST Selectivity: Double normal (dome)
  - Estimated Retention (flat-topped)
    - Blocks: 1995-2017, 2018-2022
  - Discard Mortality = 30%

Index Selectivity

- Commercial LL CPUE
  - Linked to Commercial LL fleet
- GOM Combined Video Index
  - Selectivity: Simple logistic (flat-topped)
  - Changes in Catchability: 2016-2019 & 2020-2022
- RVC Dry Tortugas, FL Keys
  - Selectivity: Double normal (dome)
- RVC SE FL
  - Selectivity: Inverse logistic (dome)
- FIM Inshore YOY
  - Selectivity: Full selectivity for age 1 only
- SERFS Video
  - Selectivity: Assume Full selectivity for ages 3-40

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  - Selectivity: Full selectivity for age 1 only
- SERFS Video
  - Selectivity: Assume Full selectivity for ages 3-40

Stock Synthesis Model Configuration

Recruitment Dynamics

- Beverton-Holt stock-recruitment relationship
  - Virgin recruitment in log-space (*ln(R0)*), the standard deviation of log of recruitment (*sigmaR*), and *steepness* estimated in model
  - Steepness was **not** used in the initial equilibrium calculation

    → Initial equilibrium catch was not large enough to have reduced expected recruitment below unfished levels.
- Simple recruitment deviations
  - no sum-to-zero constraint
- Early and Main recruitment deviations
  - 1970-1985; 1986 – 2022
- Bias adjustments (following Methot and Taylor 2011)

Stock Synthesis Model Configuration

Error Structure

- Log-normal for all landings, indices, and Rec discard data
- Normal for commercial discards
- Multinomial for all length and conditional age-at-length

Data Weighting

- Length composition and conditional age-at-length data
- Initial sample sizes: 0.5*number of trips (Length) or 0.5*number of fish (CAAL)
- Iterative Francis reweighting applied separately to retained and discarded lengths

Model Convergence Criteria

- Total likelihood (sum of individual data source component's likelihoods)
- Invertible Hessian matrix
- Maximum gradient <0.0001

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Model Convergence Criteria

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- Invertible Hessian matrix
- Maximum gradient <0.0001

Stock Synthesis Model Configuration

Parameters

- 202 out of 241 parameters estimated

‘Non-Trivial’ Fixed Parameters

- Commercial Other retention prior to 1992 forced to 0 (discard fraction = 0)

Priors

- Symmetric betas on initial fishing mortality rates for Commercial LL, Commercial Other, Rec East, and Rec West

Lambdas

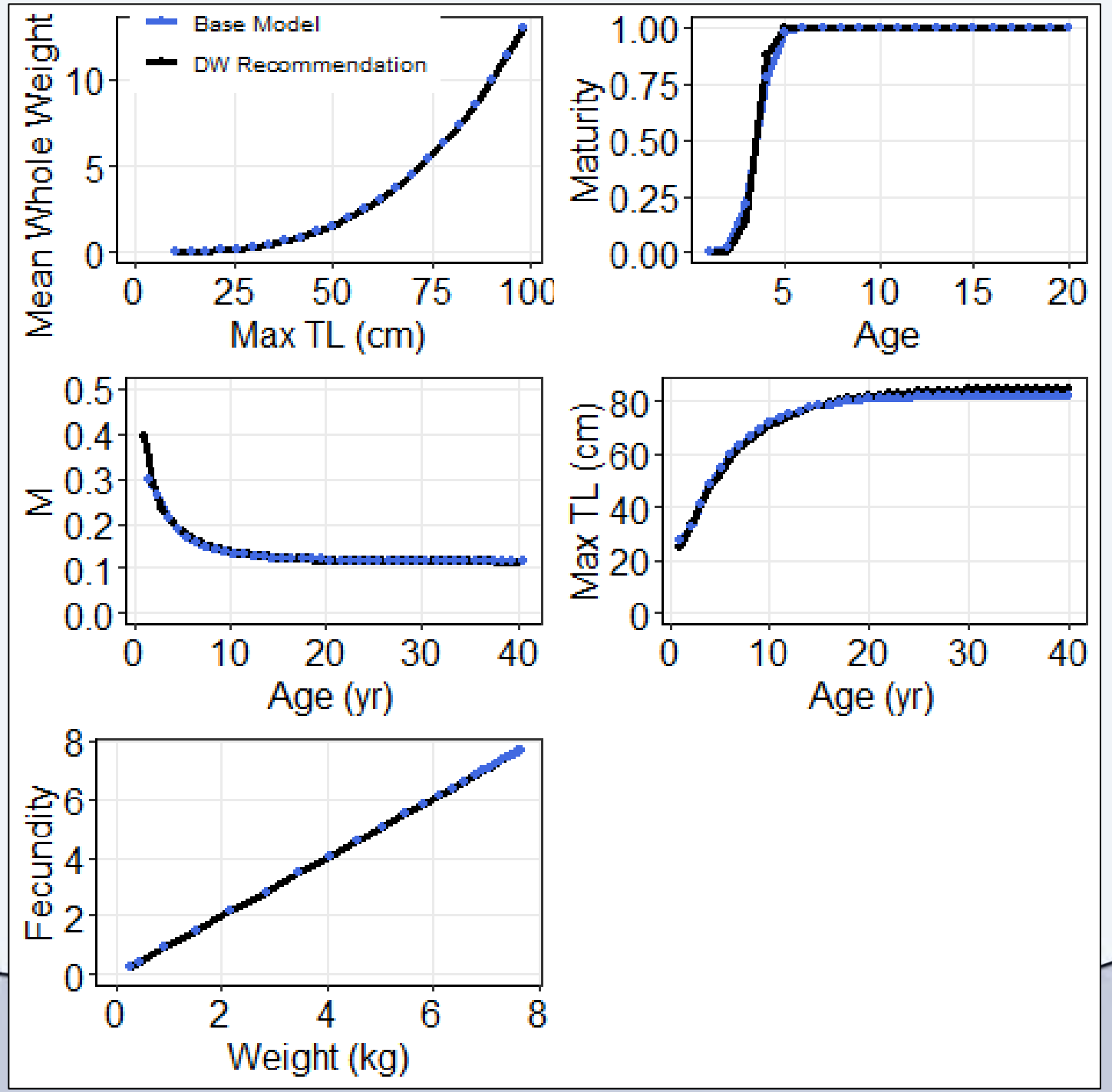
- No emphasis on model fit (=0) for initial equilibrium catch for all fleets
- Low emphasis on fitting commercial ‘other’ discards (=0.01; Alhale et al. 2024)

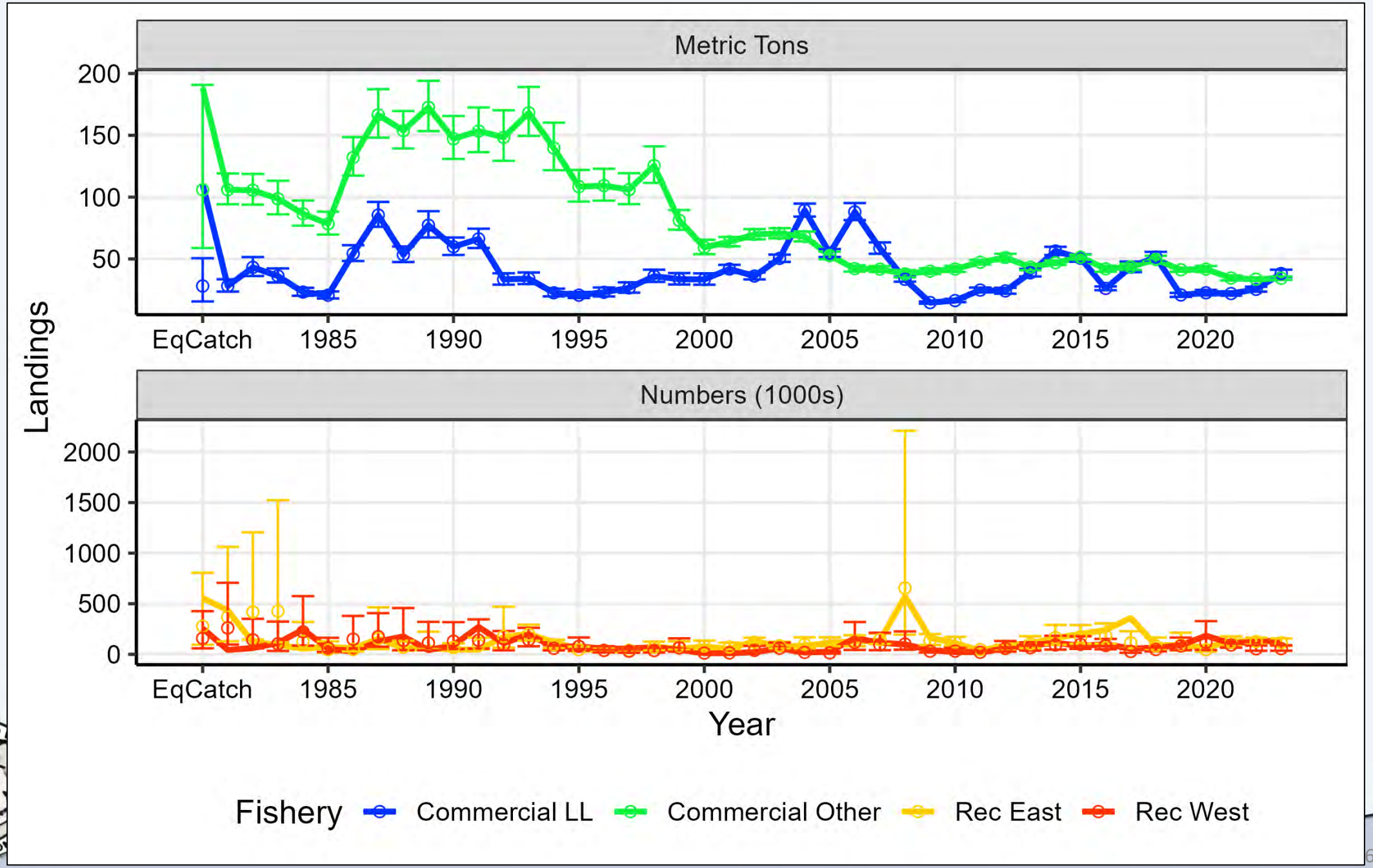
Reported Fishing Mortality Rates

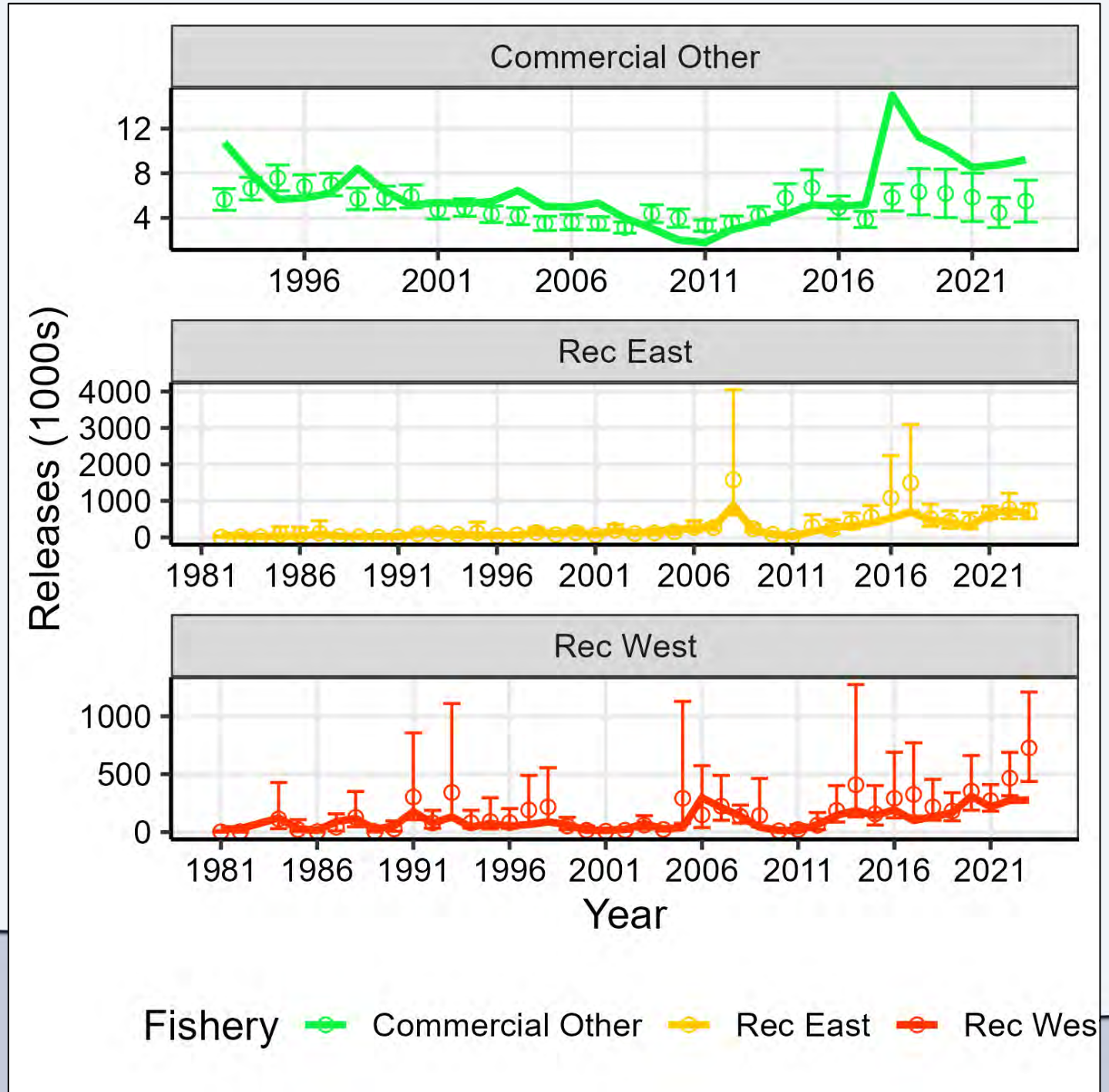
- Age 3

Base Model Fits & Diagnostics

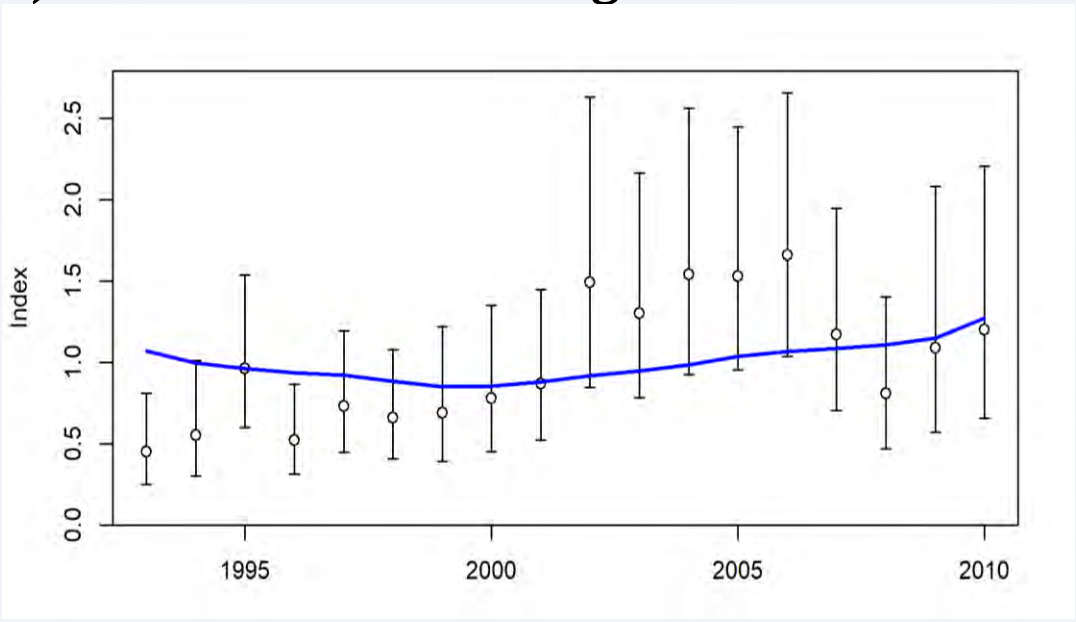
Life History



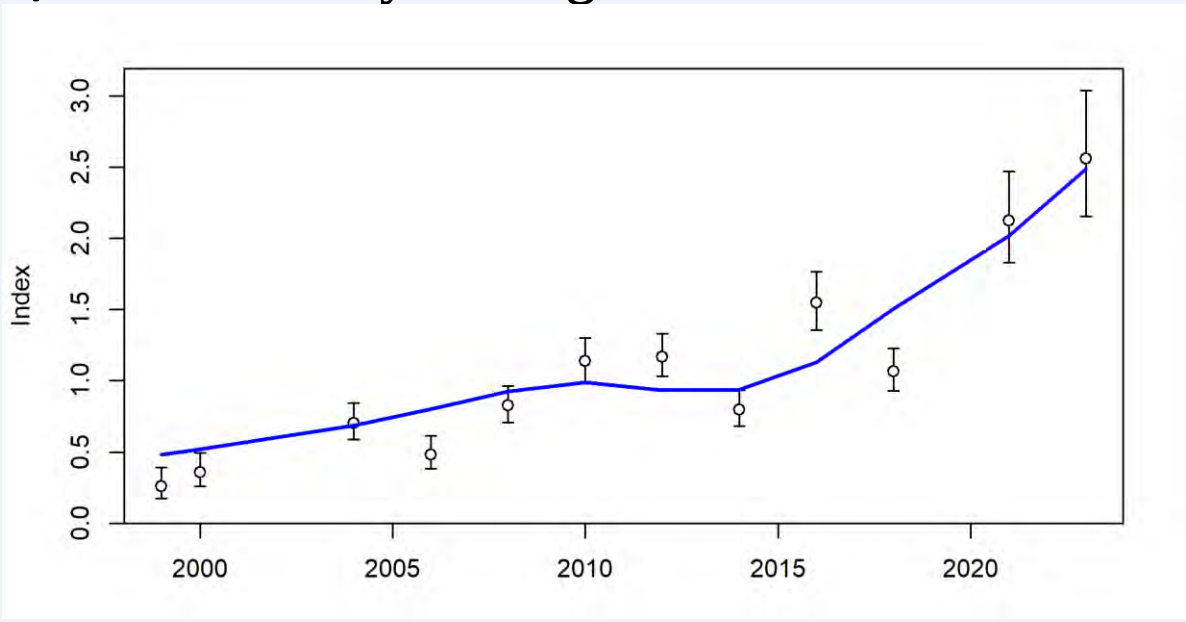

Metric Tons
200
150
100
50
Landings
EqCatch
1985
1990
1995
2000
2005
2010
2015
2020
Numbers (1000s)
2000
1500
1000
500
0
EqCatch
1985
1990
1995
2000
2005
2010
2015
2020
Year
Fishery
Commercial LL
Commercial Other
Rec East
Rec West


Commercial Other
12
8
4
1996
2001
2006
2011
2016
2021
Releases (1000s)
Rec East
4000
3000
2000
1000
0
1981
1986
1991
1996
2001
2006
2011
2016
2021
Rec West
1000
500
0
1981
1986
1991
1996
2001
2006
2011
2016
2021
Year
Fishery
Commercial Other
Rec East
Rec Wes

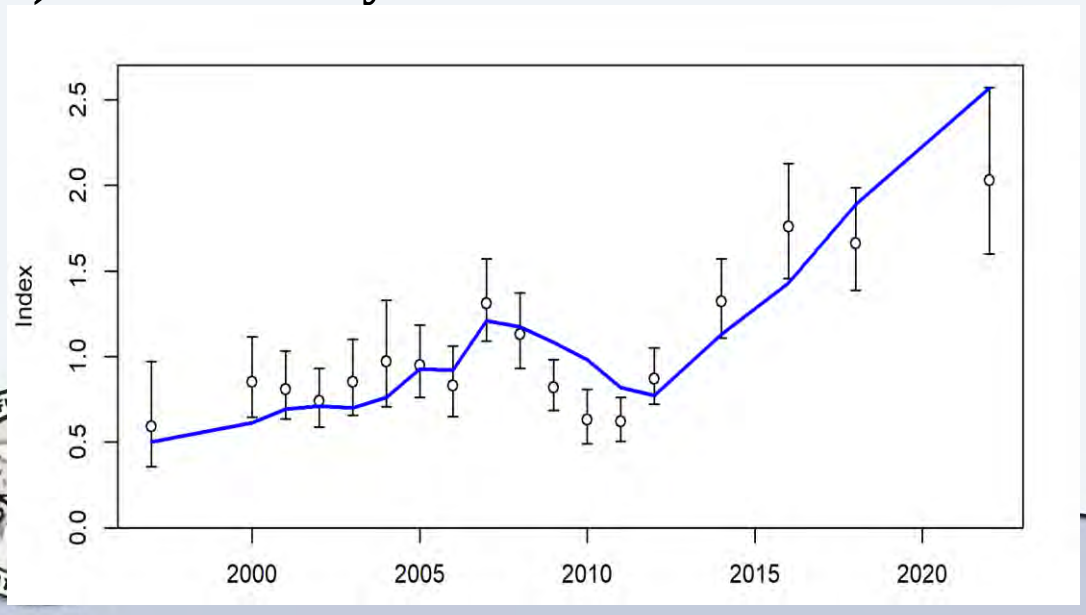
a) Commercial Longline



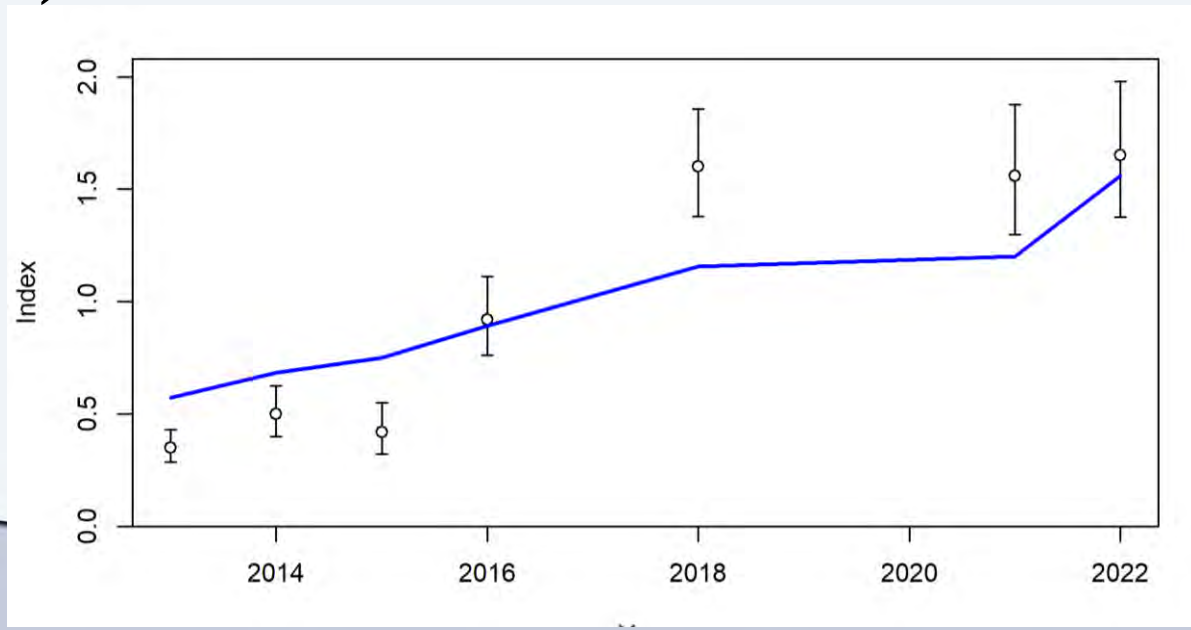
b) RVC Dry Tortugas



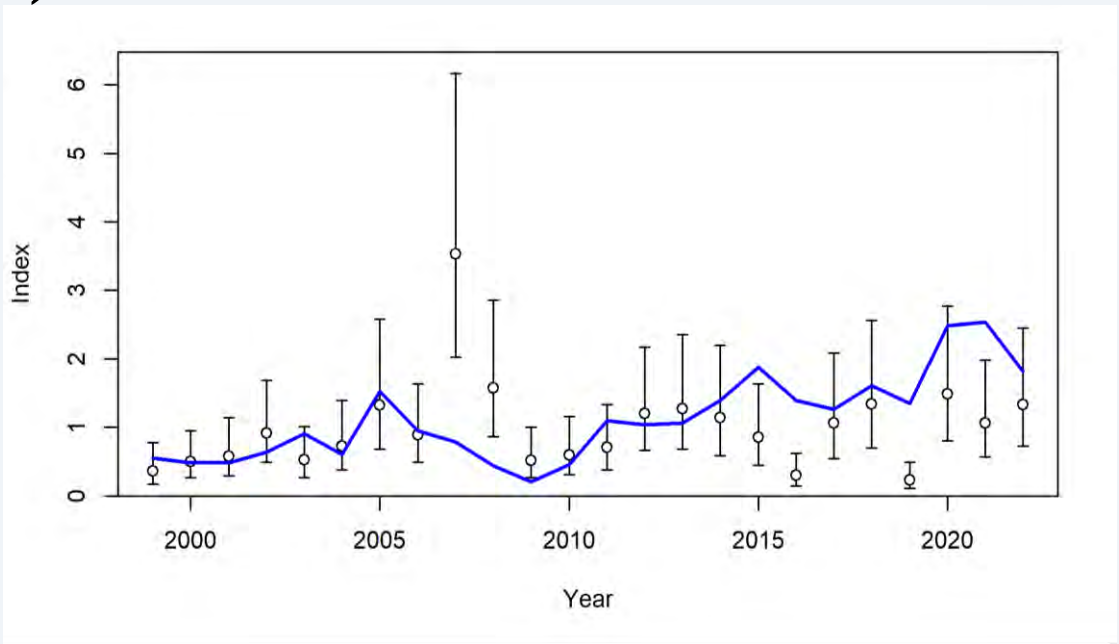
c) RVC FL Keys



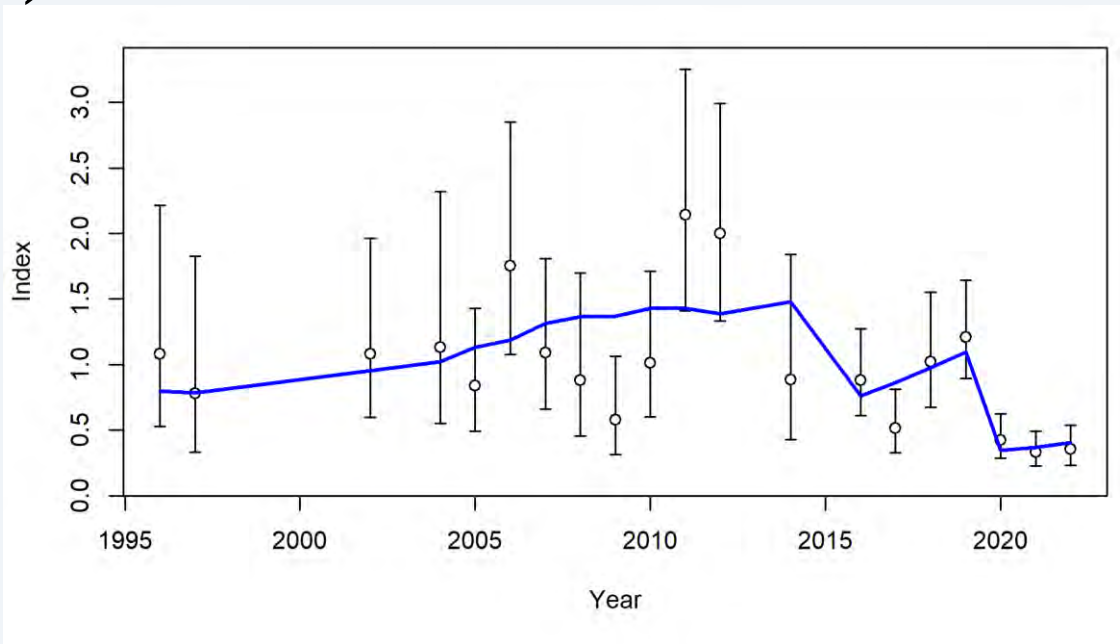
d) RVC SE FL



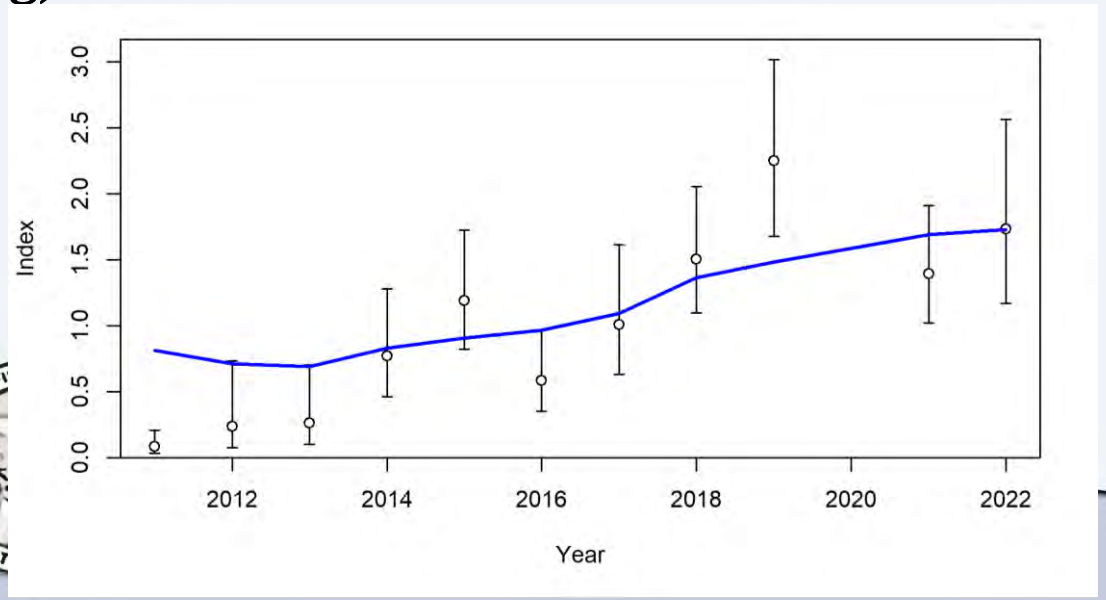
e) FIM YOY



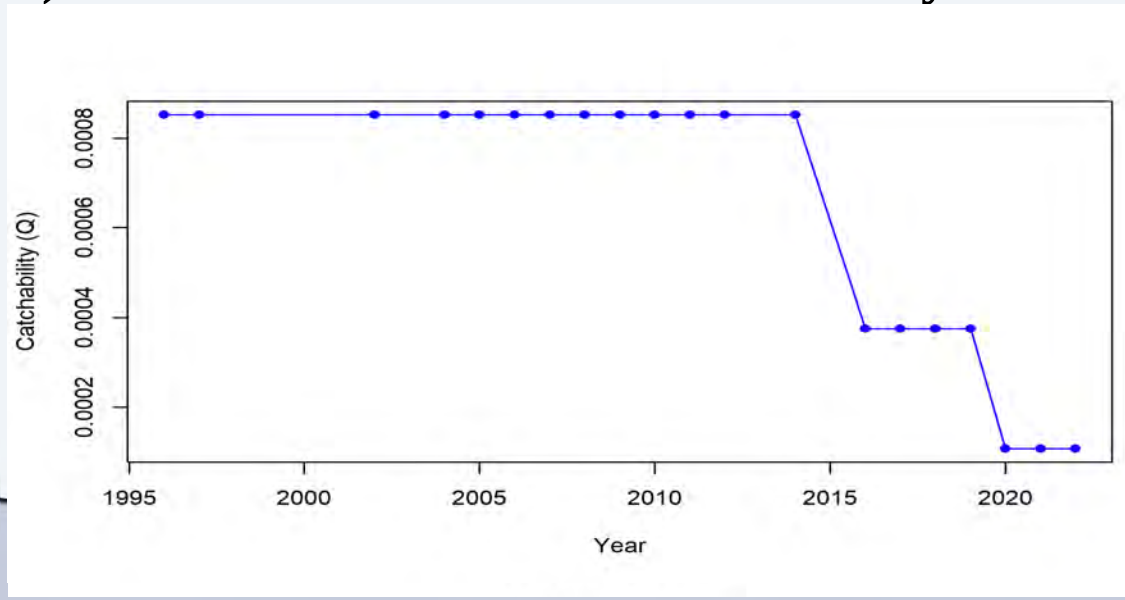
f) Gulf Combined Video

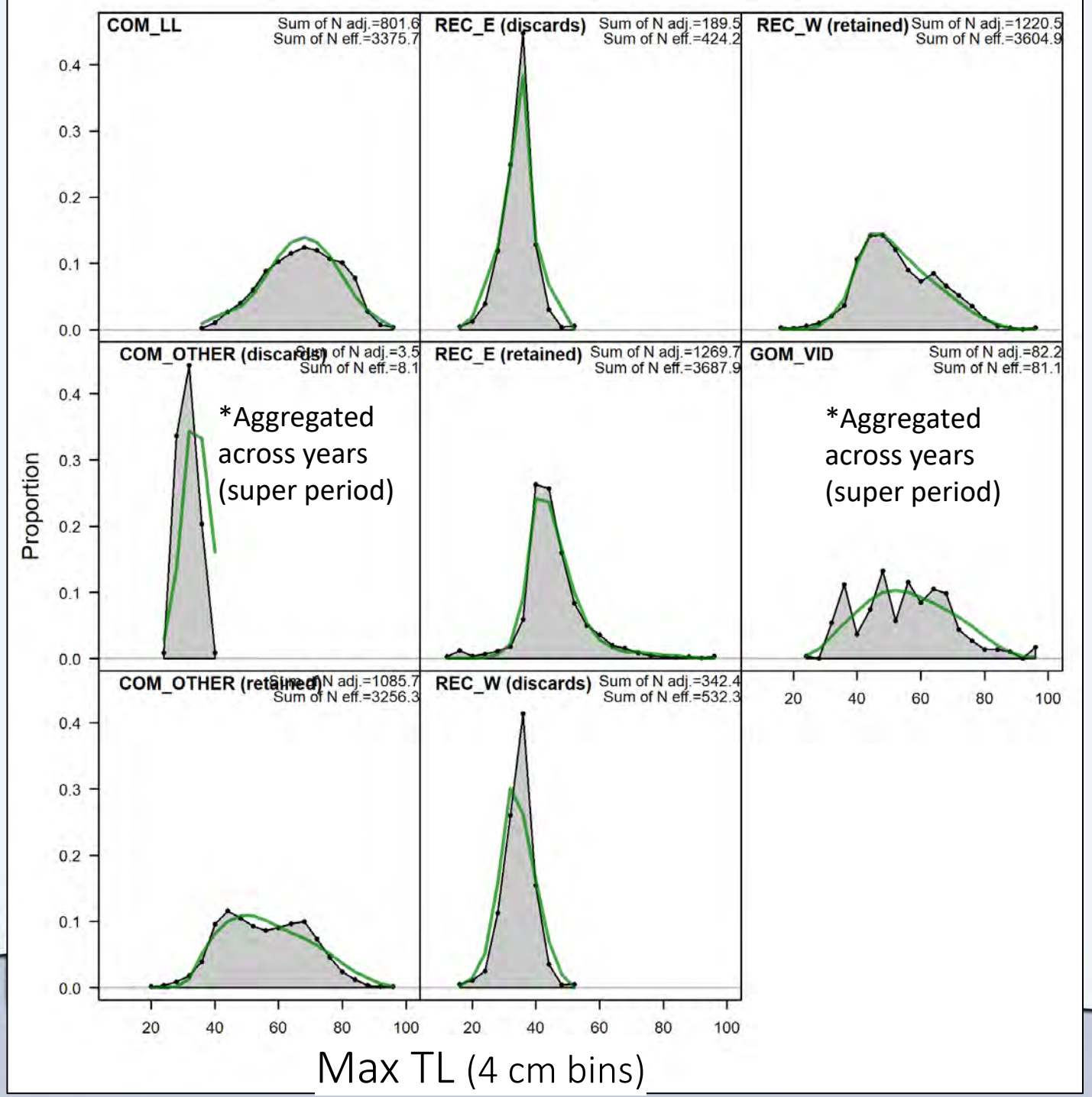


g) SERFS Video

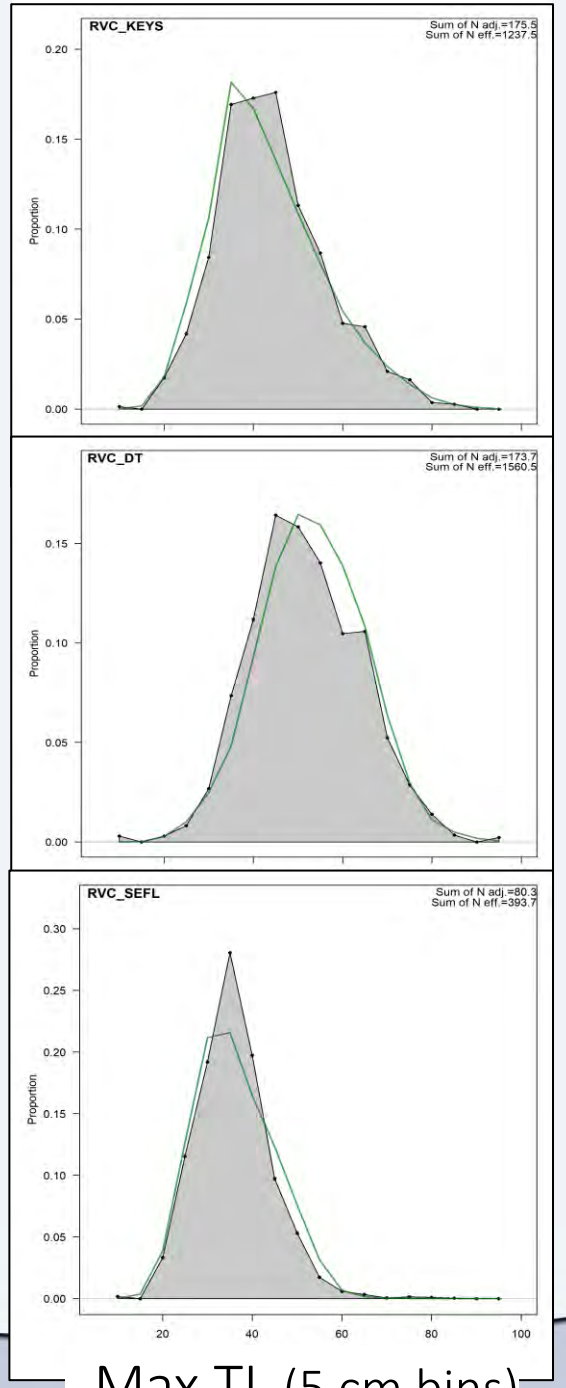


h) Gulf Combined Video Catchability



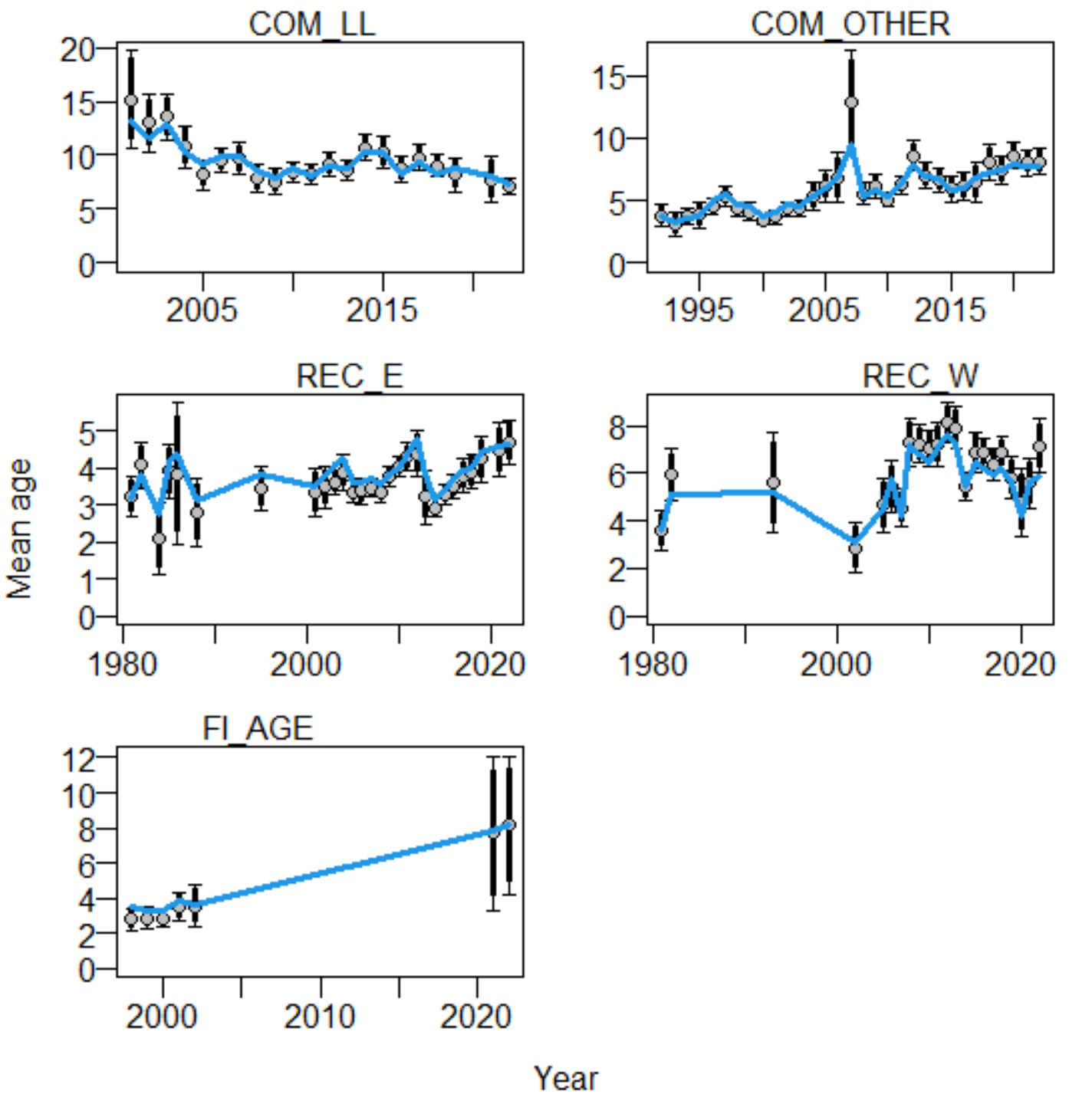


Max TL (4 cm bins)



Max TL (5 cm bins)

Mean Age by Year & Fleet



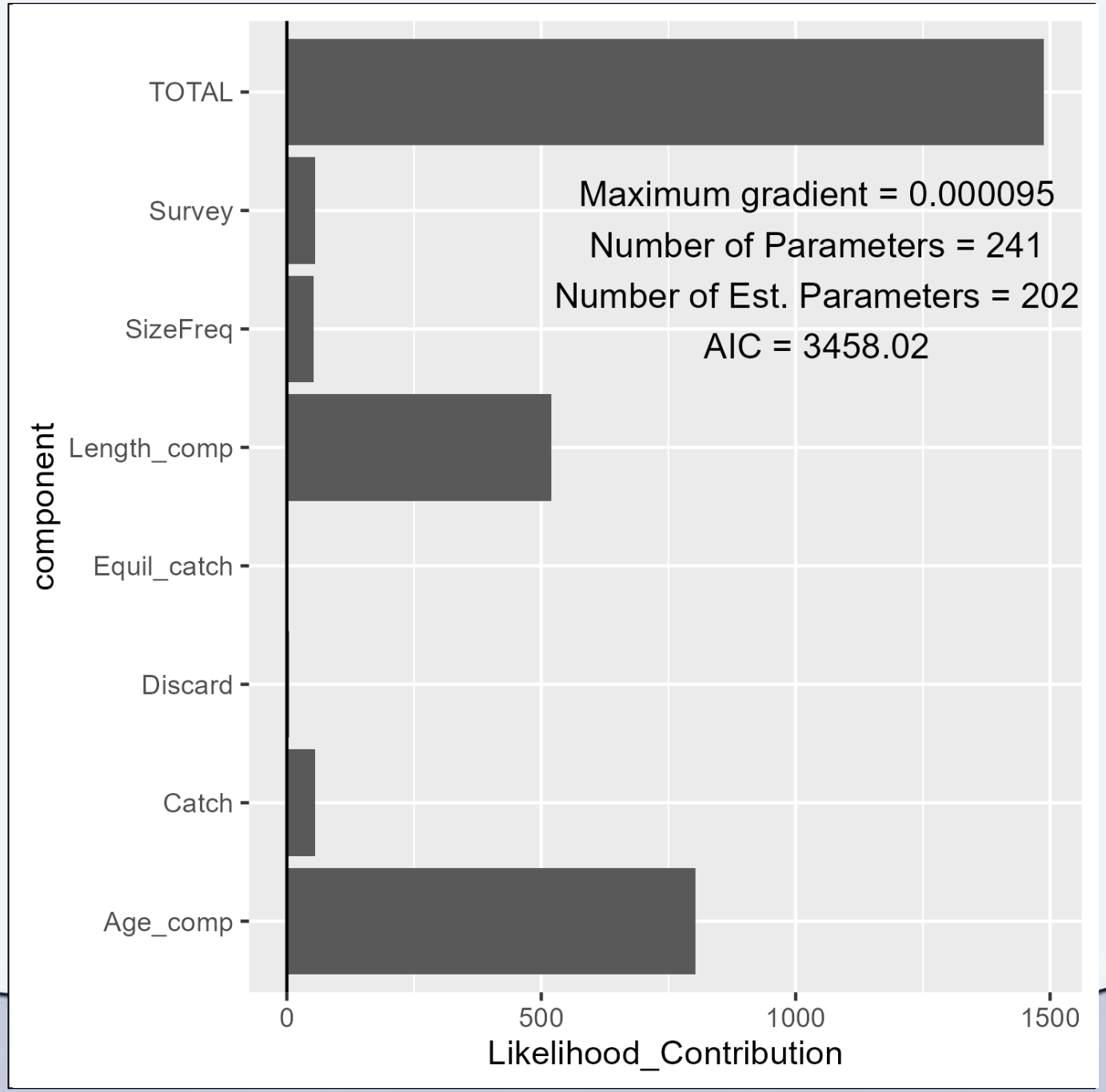
Model Diagnostics*

- Uncertainty and Correlation Analysis of Estimated Parameters
- Goodness of Fit and Residual Analysis (Runs Test)
- Model Convergence (Jitter Analysis)
- Model Consistency (Retrospective Analysis)
- Model Validation/Prediction Skill (via hindcast cross-validation)
- Likelihood Profiling on R0, Steepness, Base M
- Compare to an age-structured production model (ASPM)

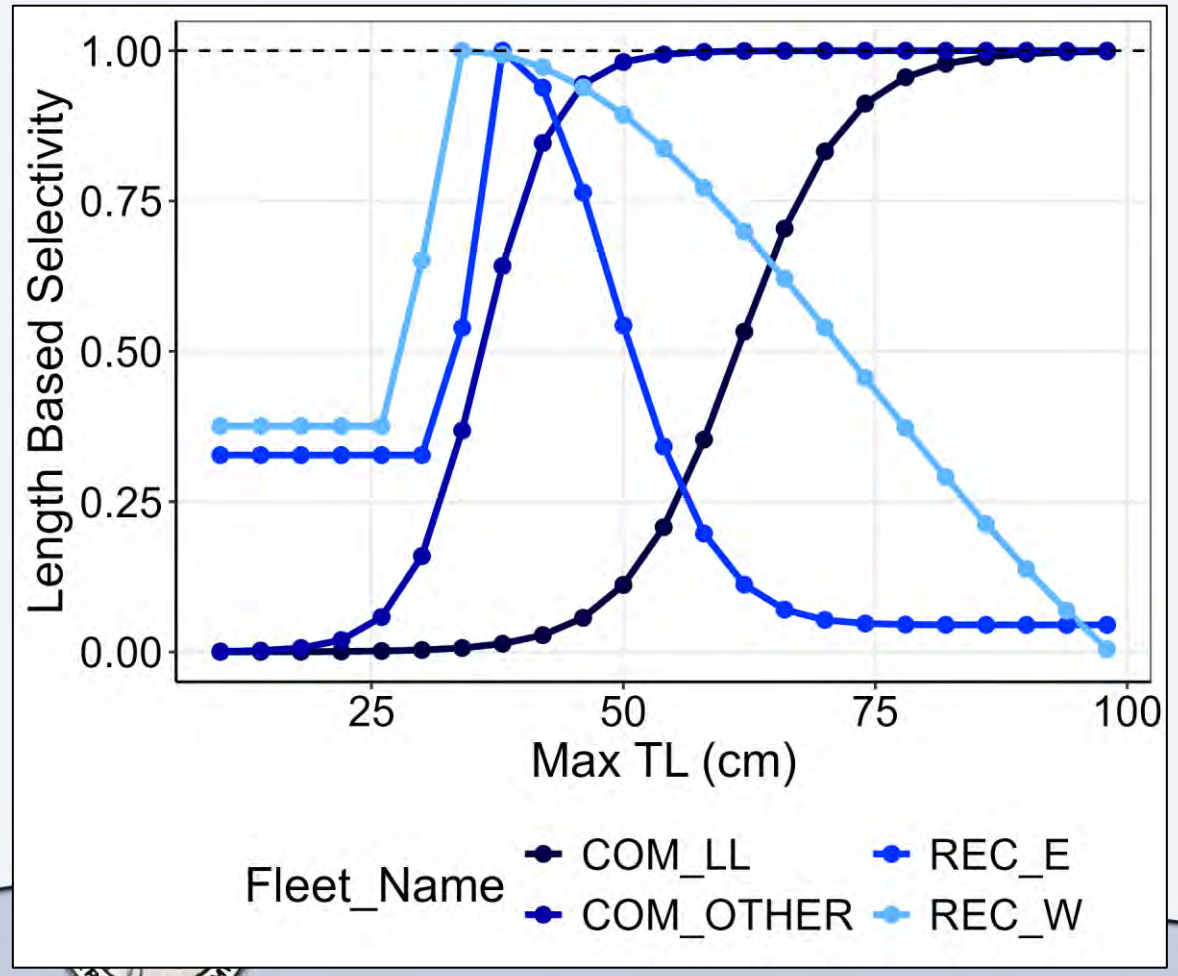
*Carvalho et al., 2021. A cookbook for using model diagnostics in integrated stock assessments. *Fisheries Research*, 240

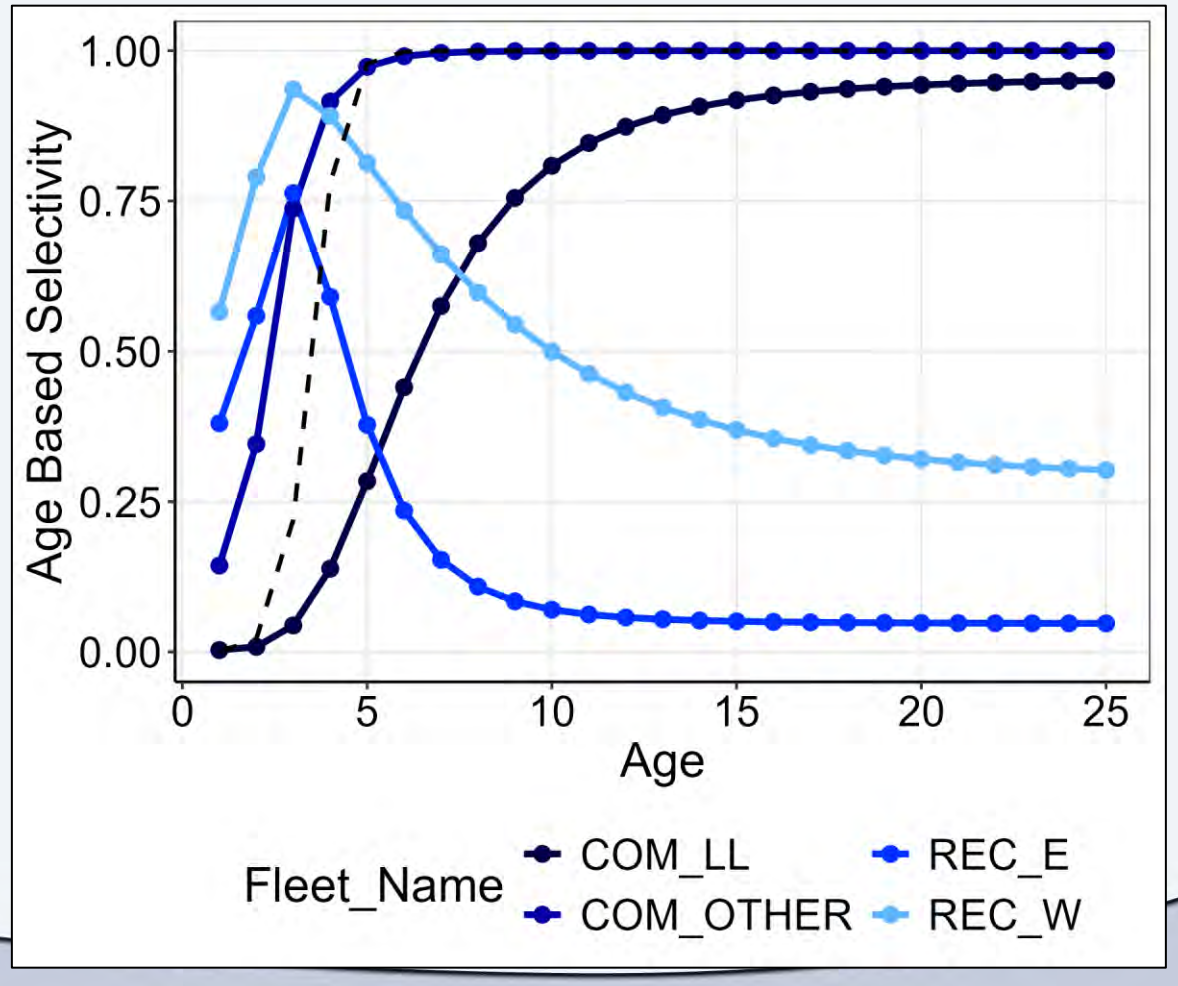
Base Model Estimated Parameters

Log-Likelihood

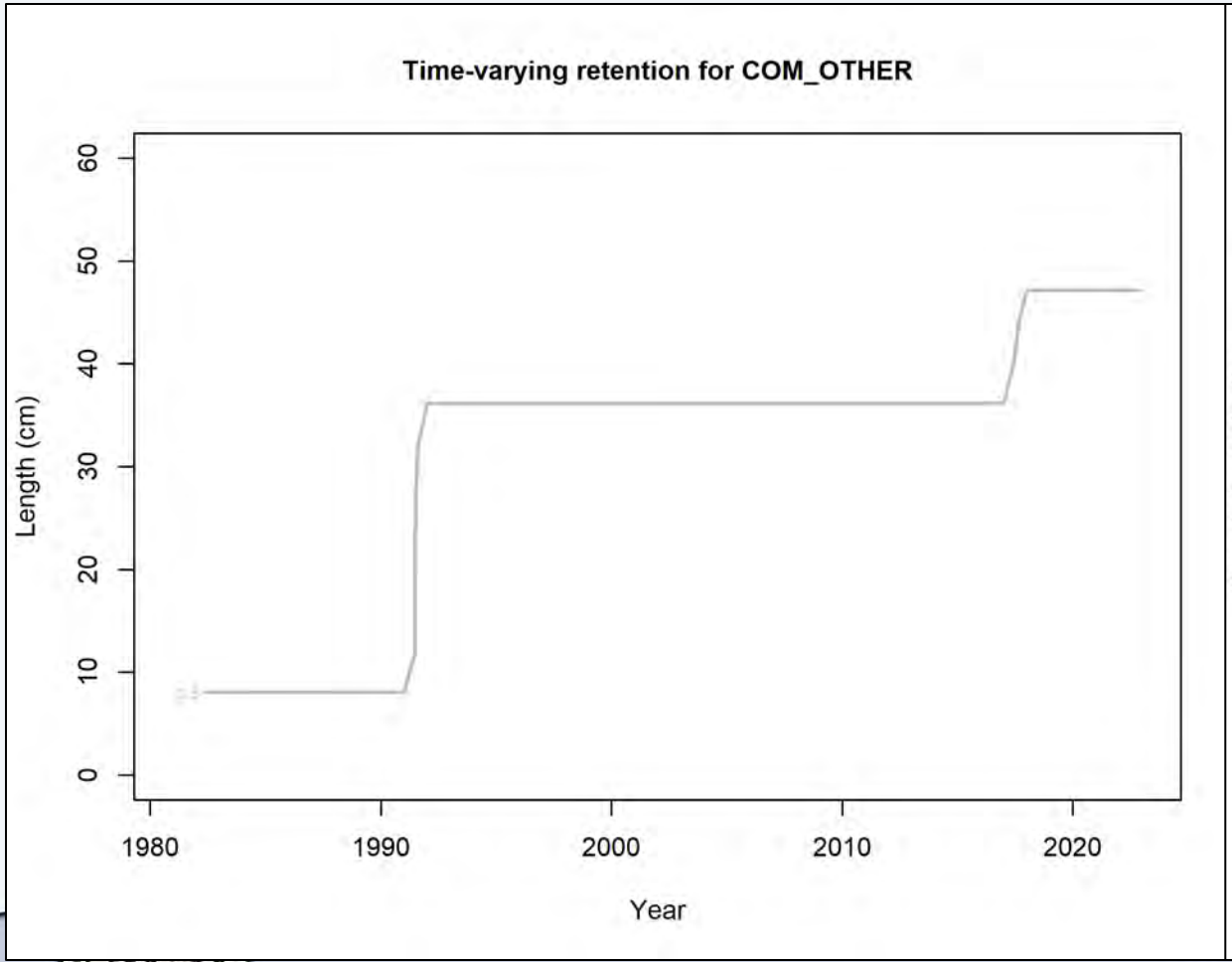


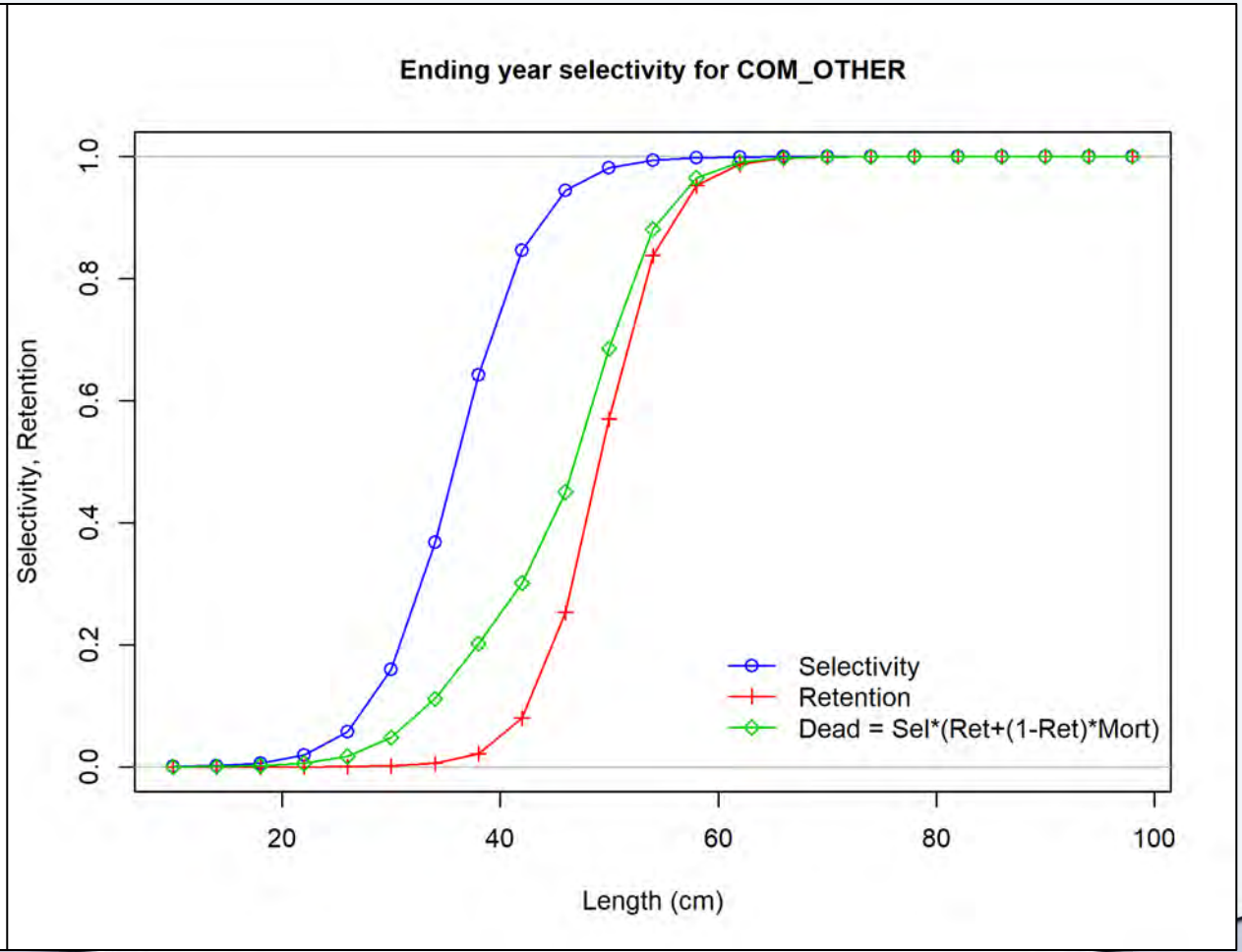
Fleet Selectivity



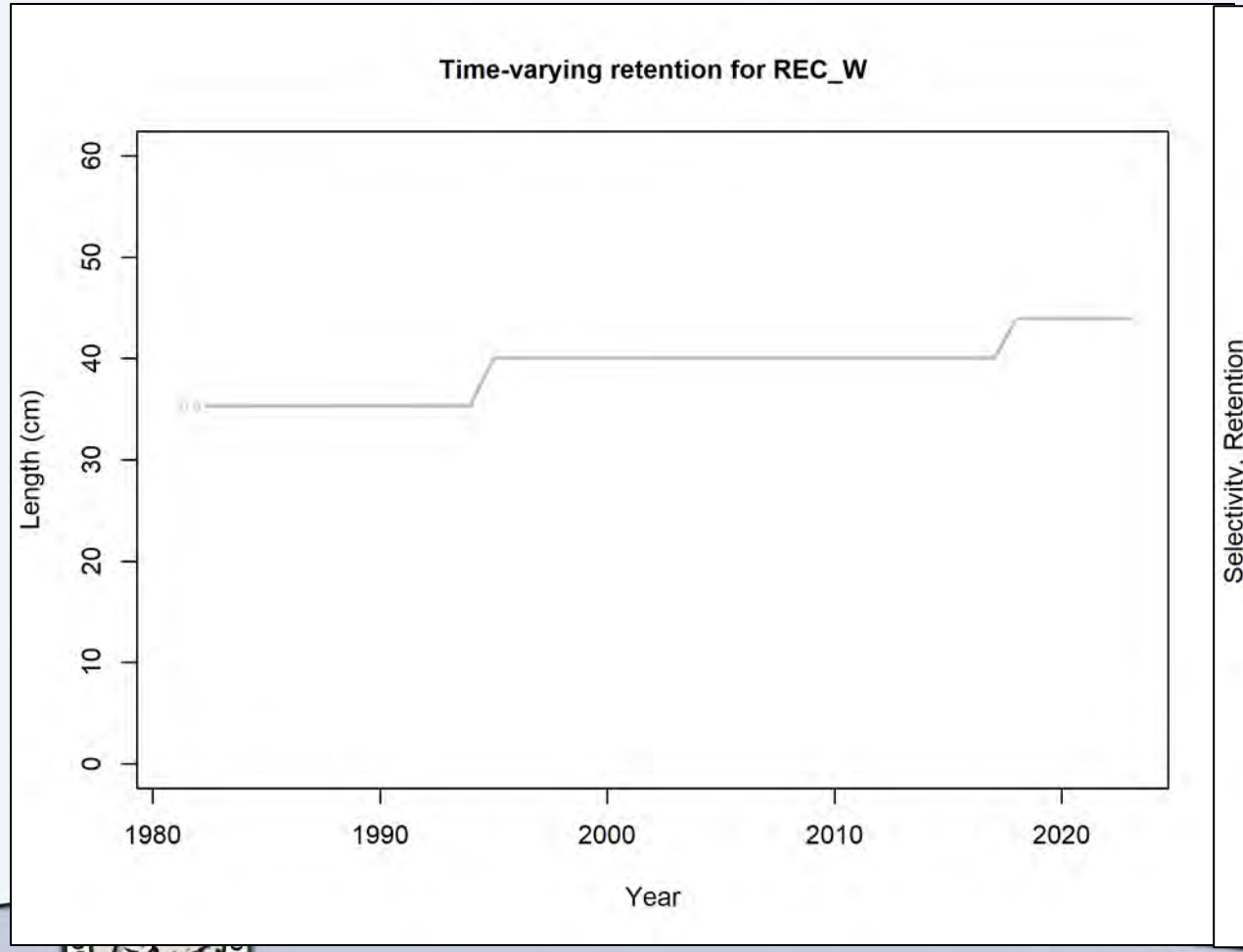


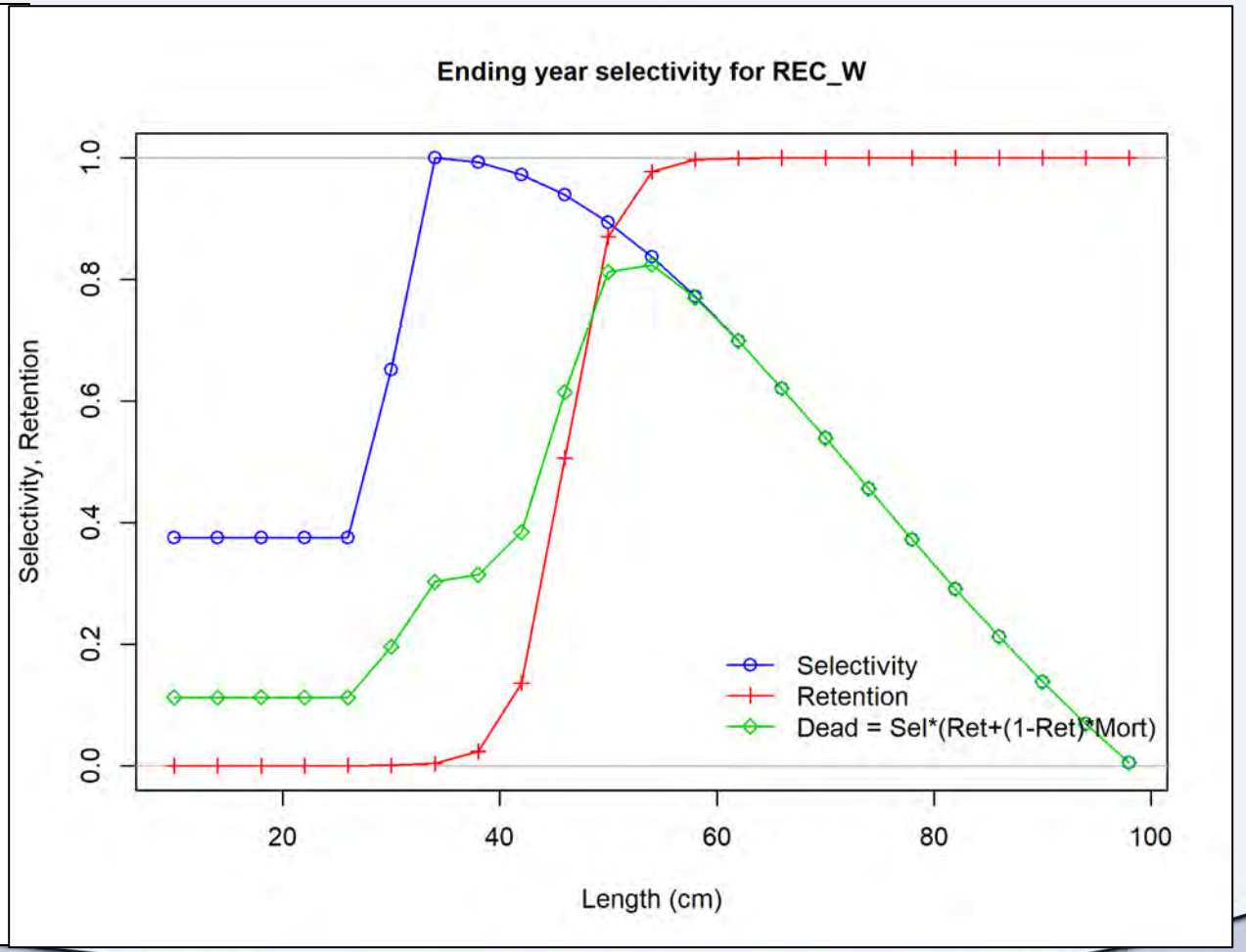
Com OTHER Retention



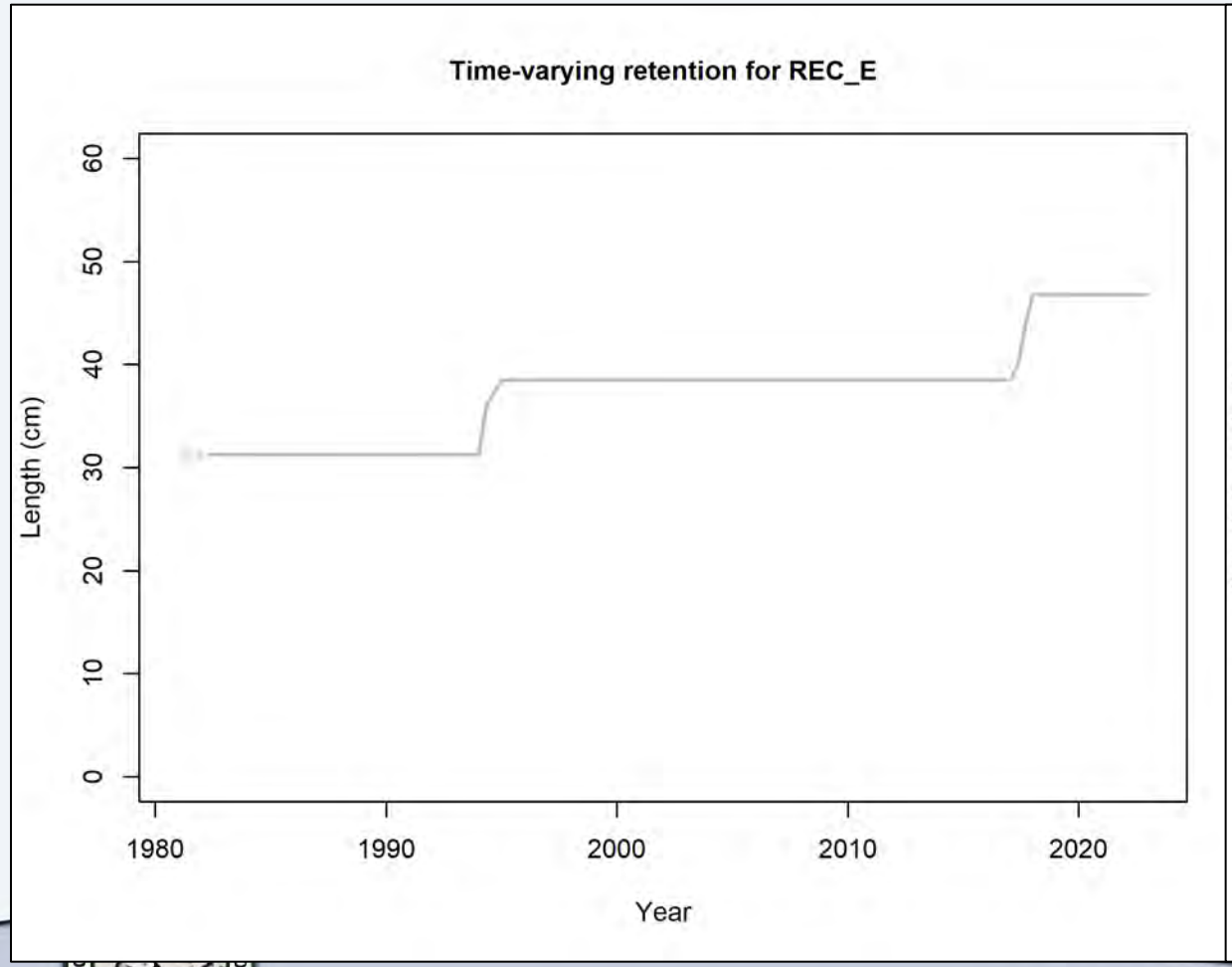


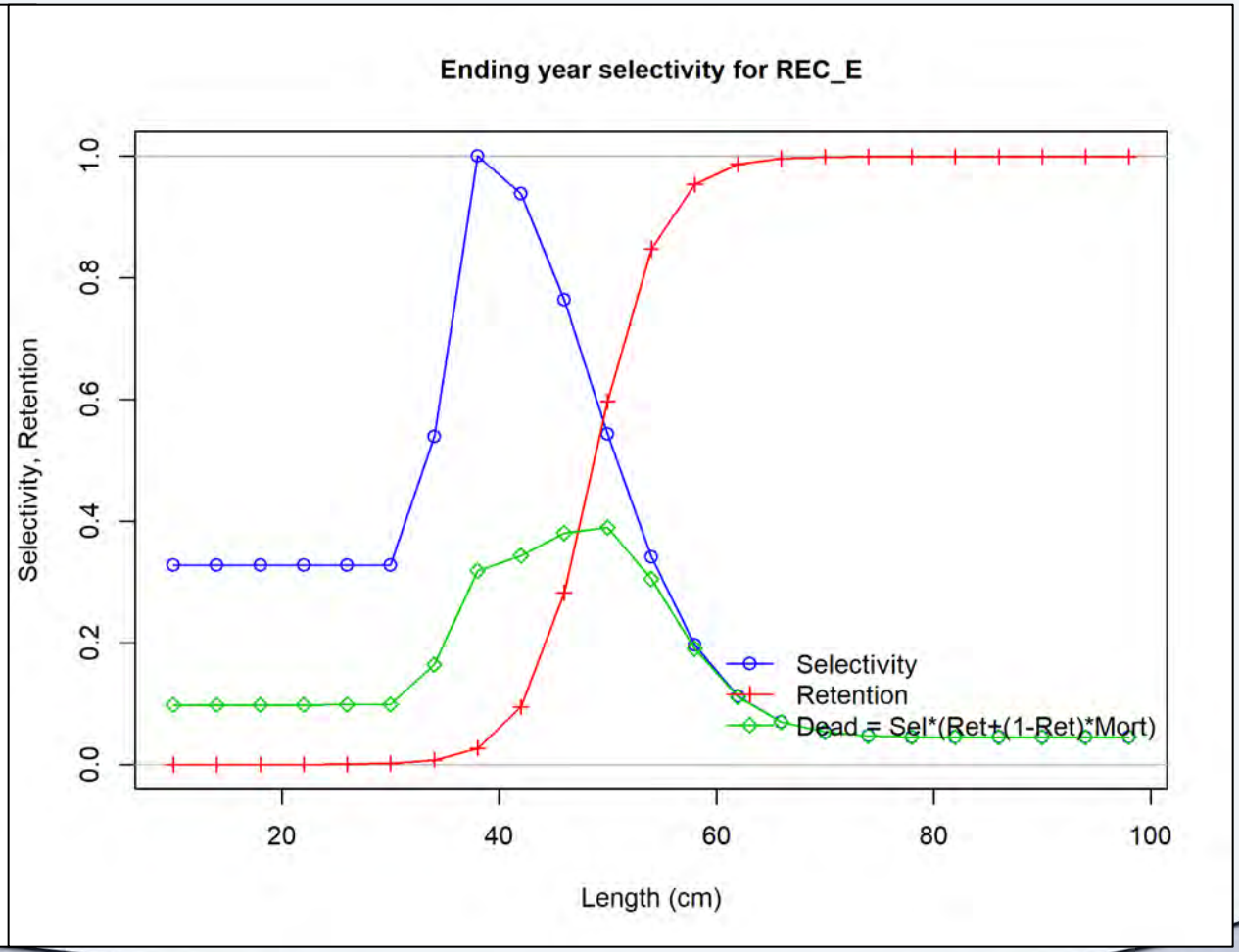
Rec WEST Retention



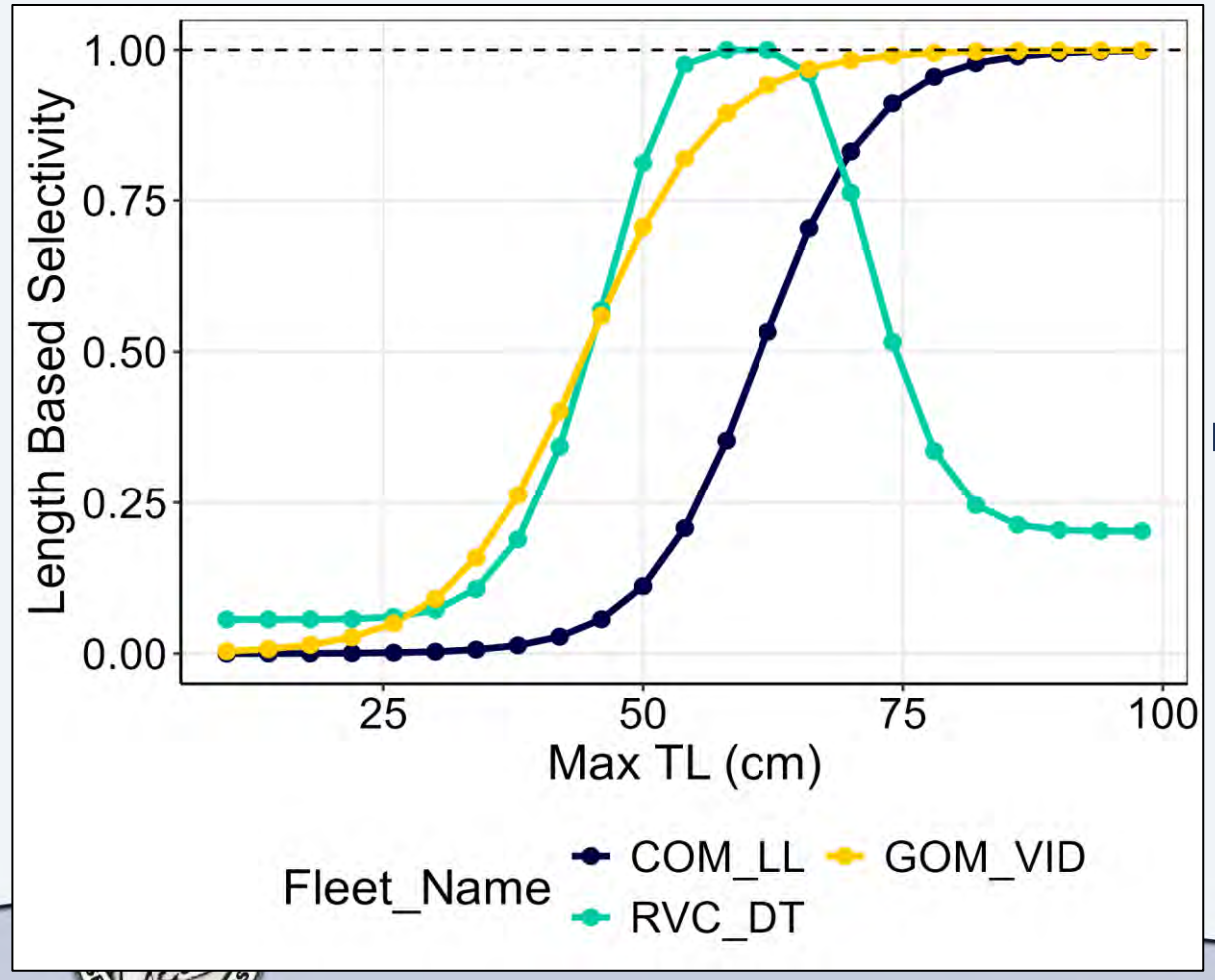


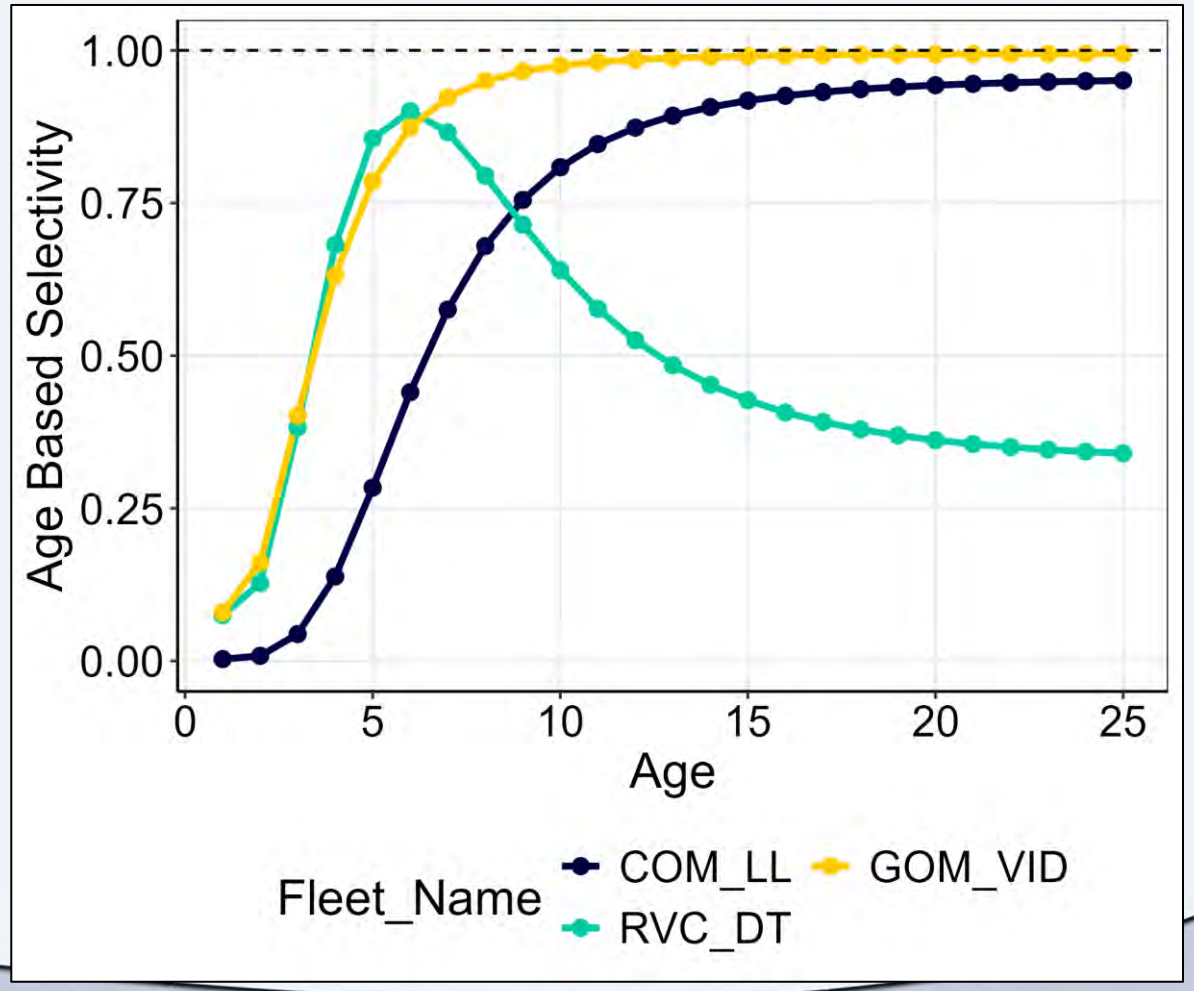
Rec EAST Retention



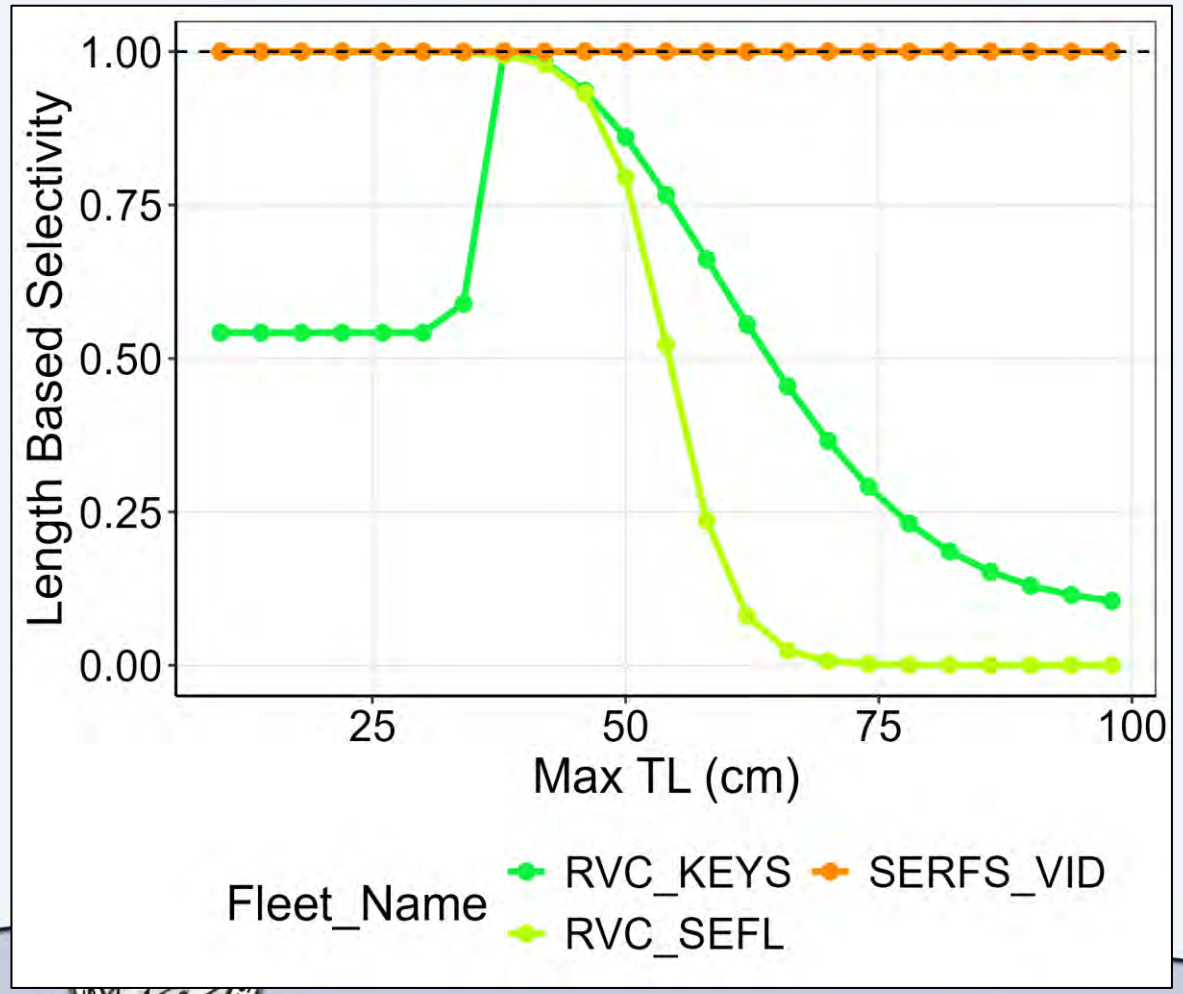


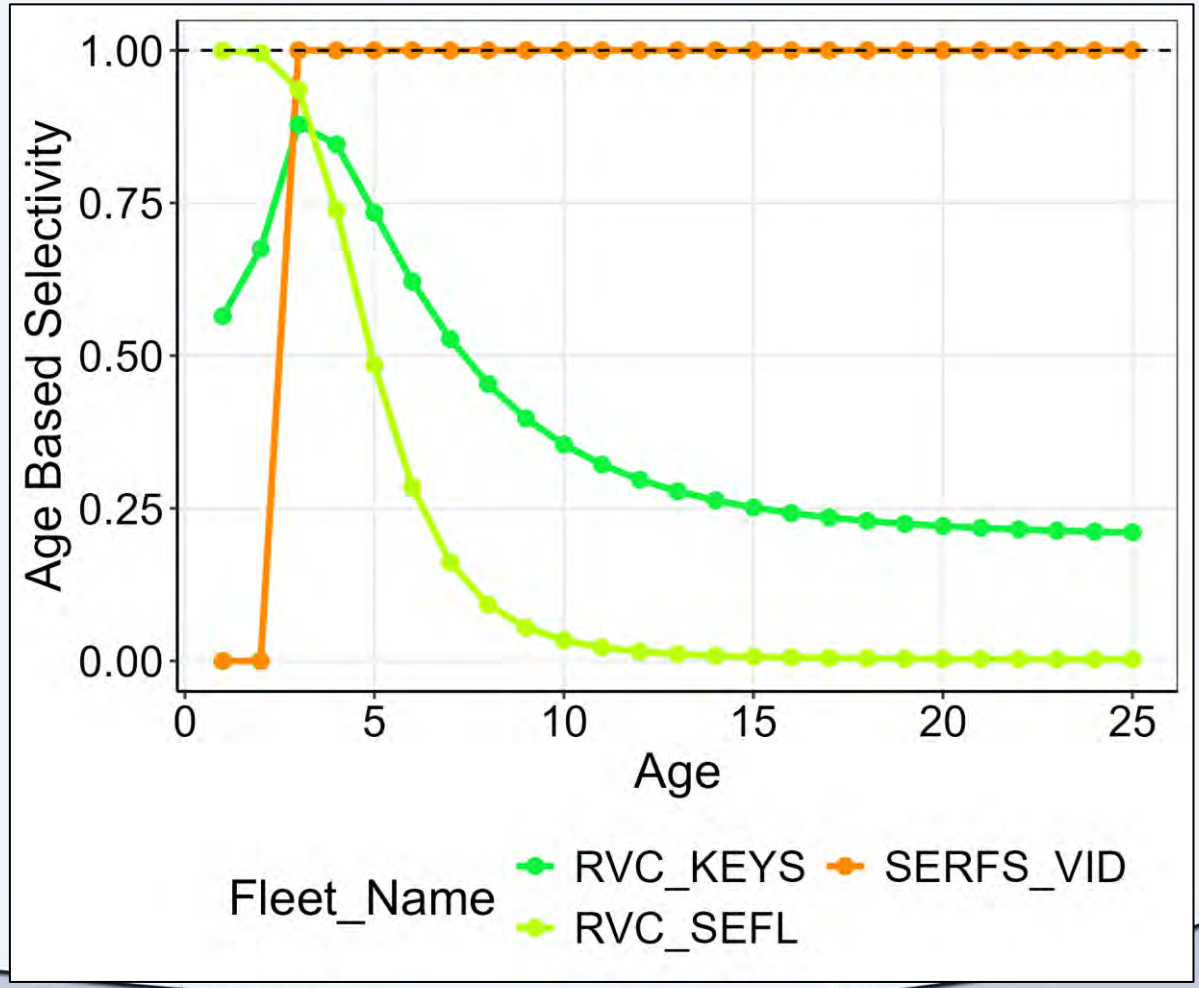
Index Selectivity (Gulf)





Index Selectivity (South Atlantic)





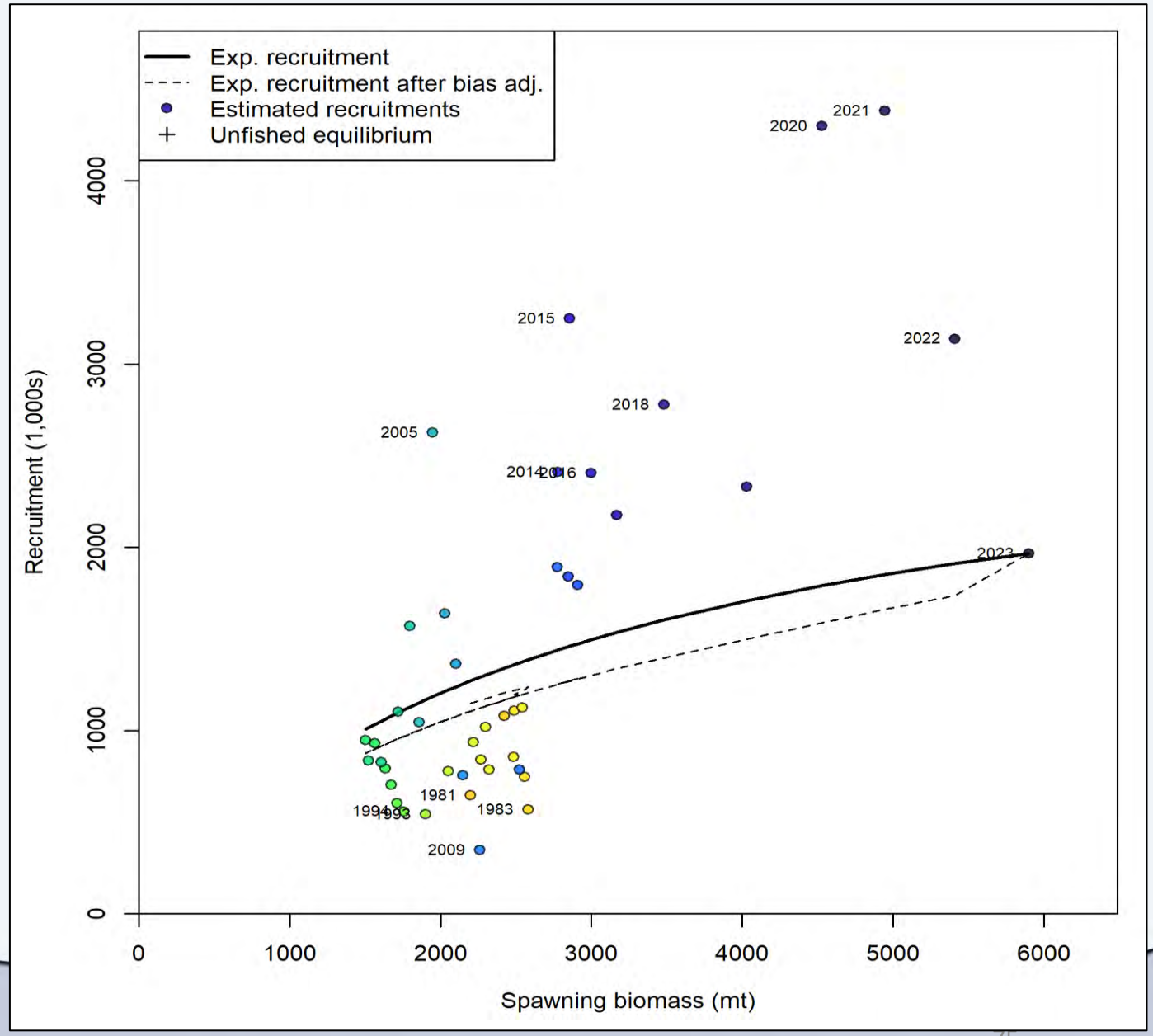
Stock Recruit Curve

SSB_0: 17,778 mt

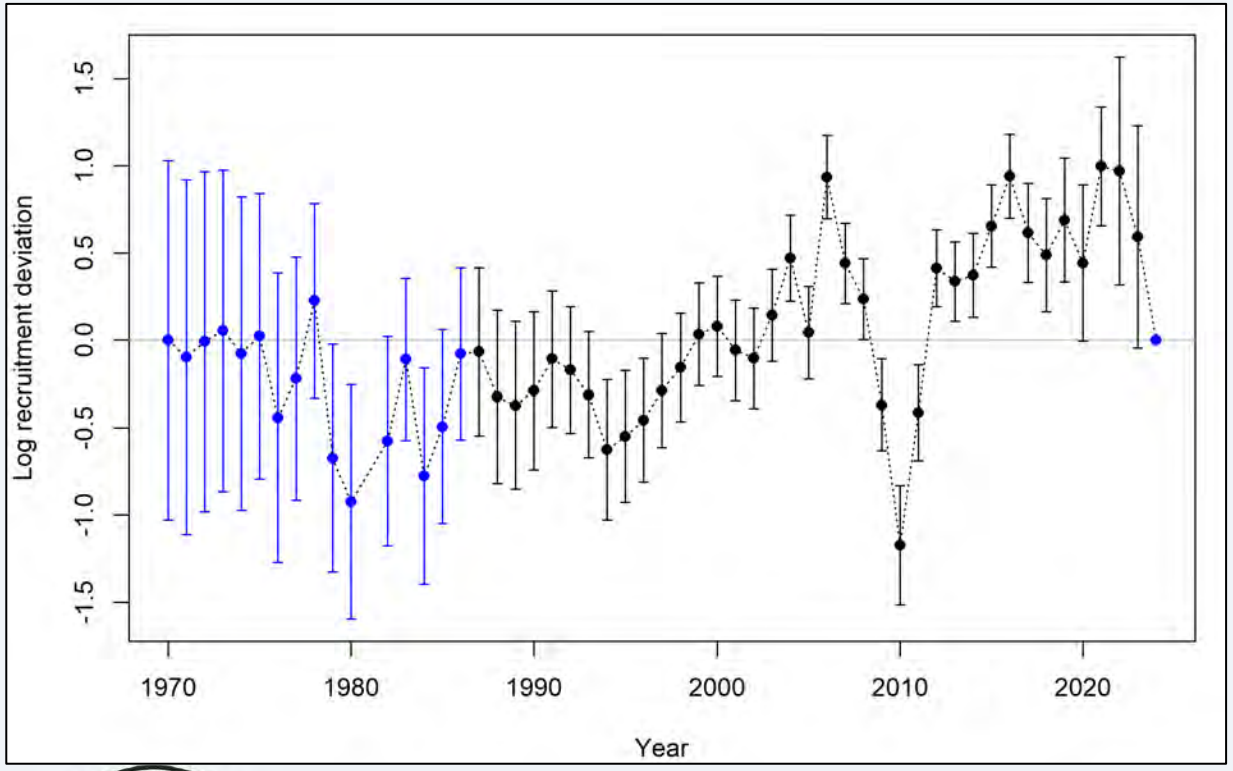
RO: 2.513 million

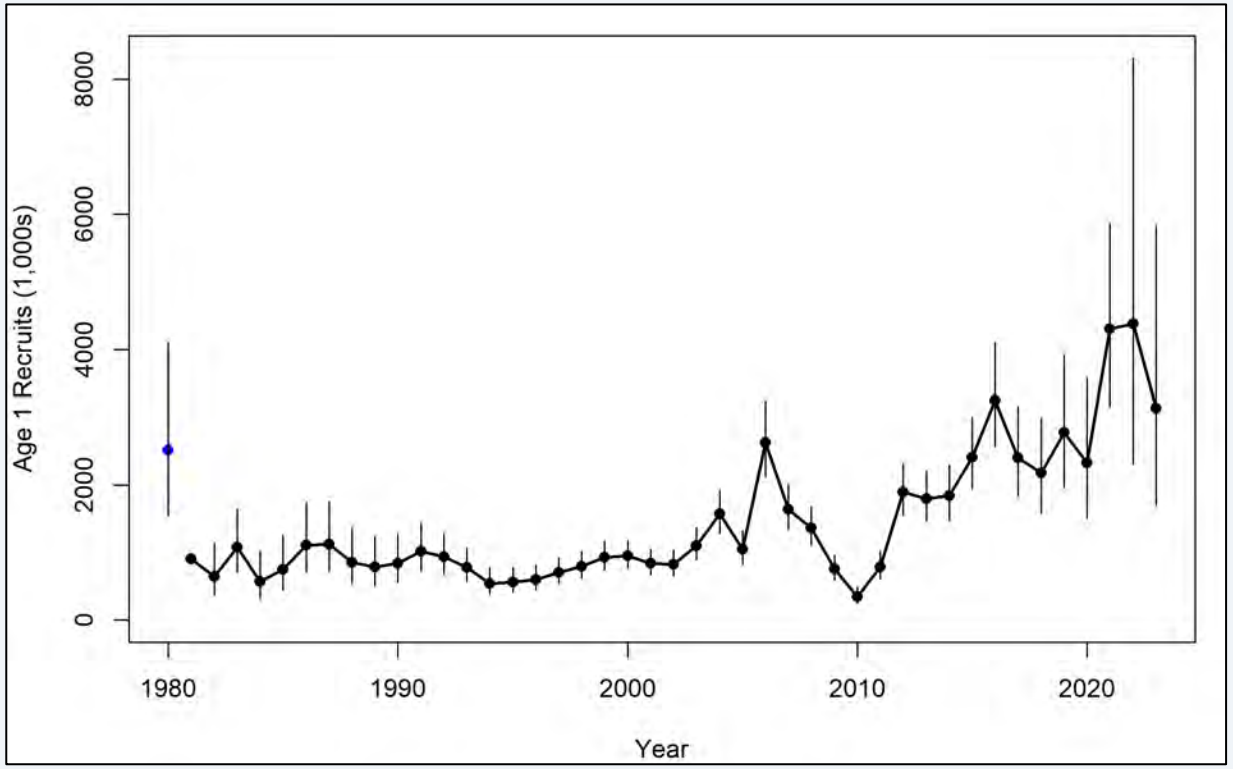
h: 0.64

σ_R: 0.55



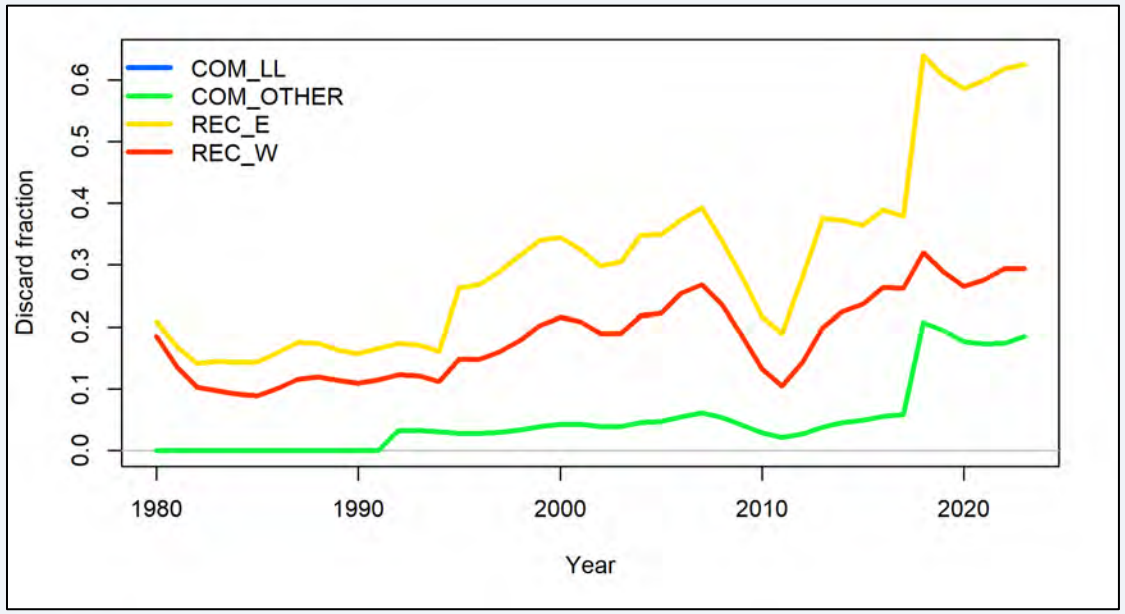
Age 1 Recruits

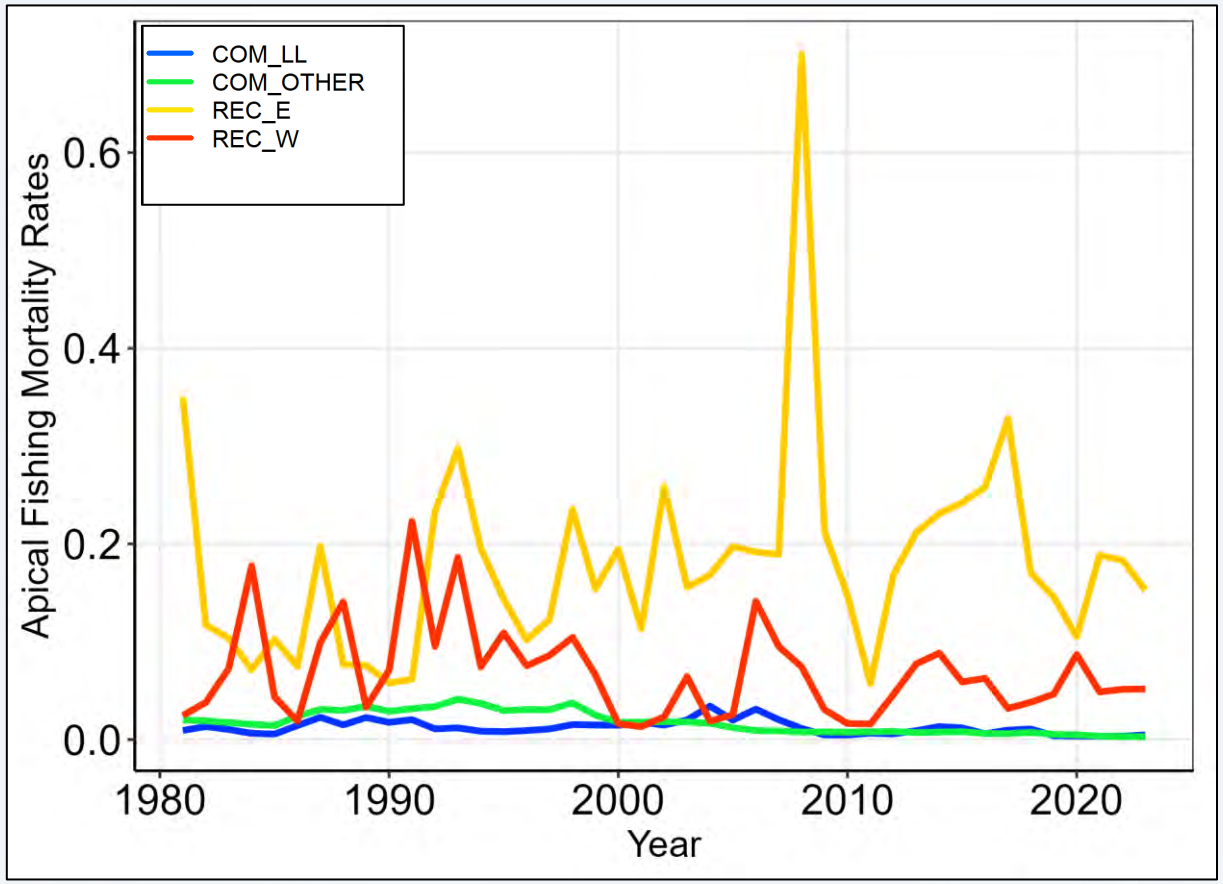




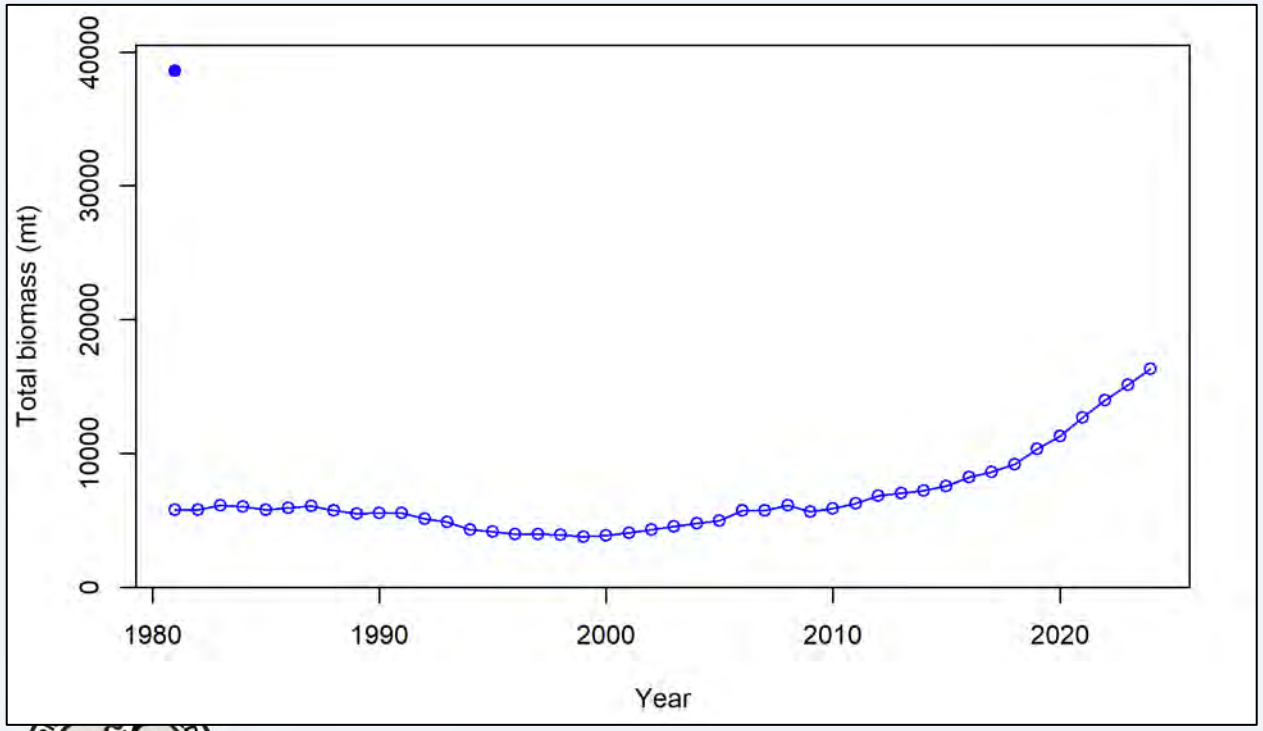
Base Model Results

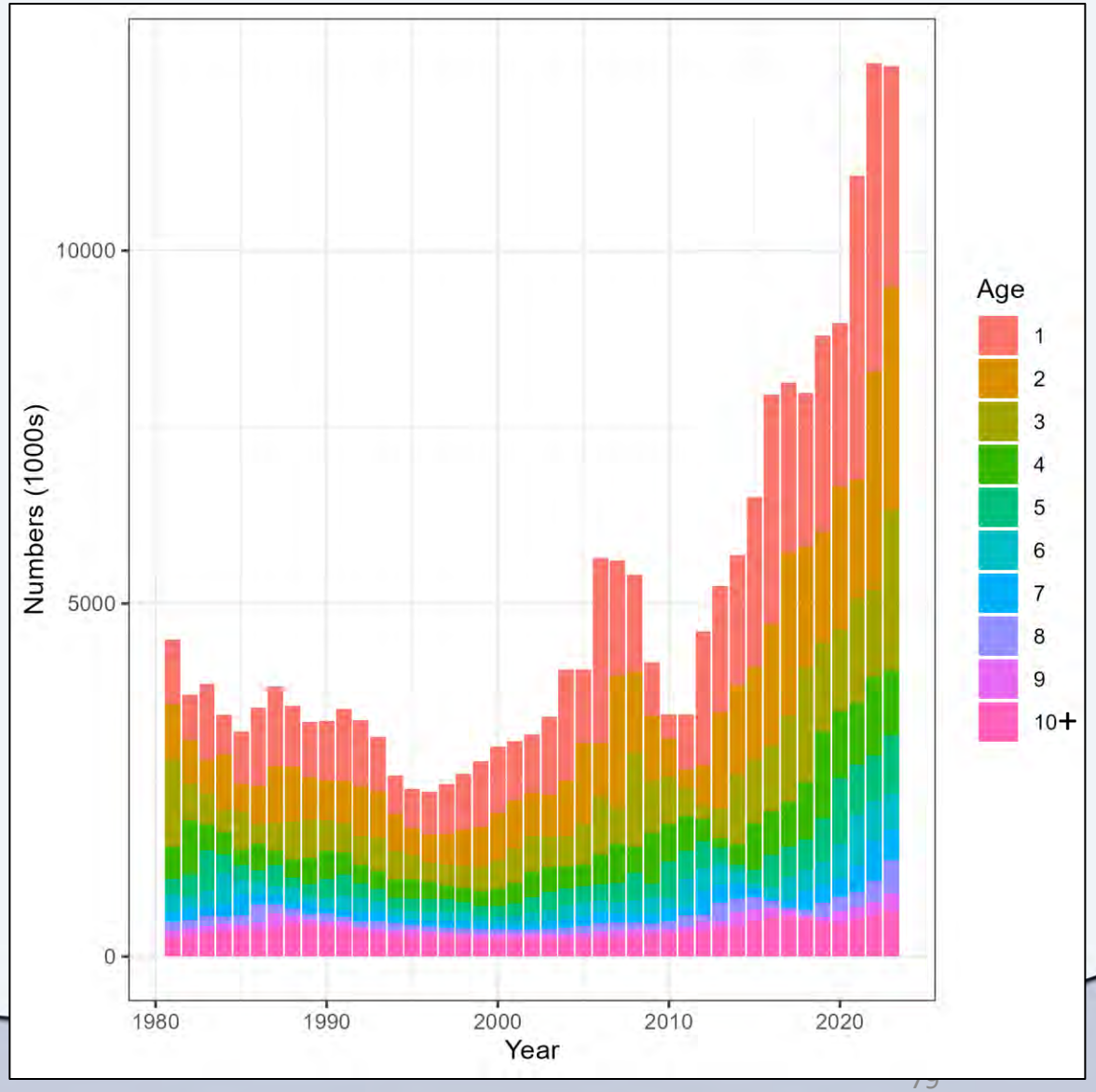
Discard Fractions and Apical Fs



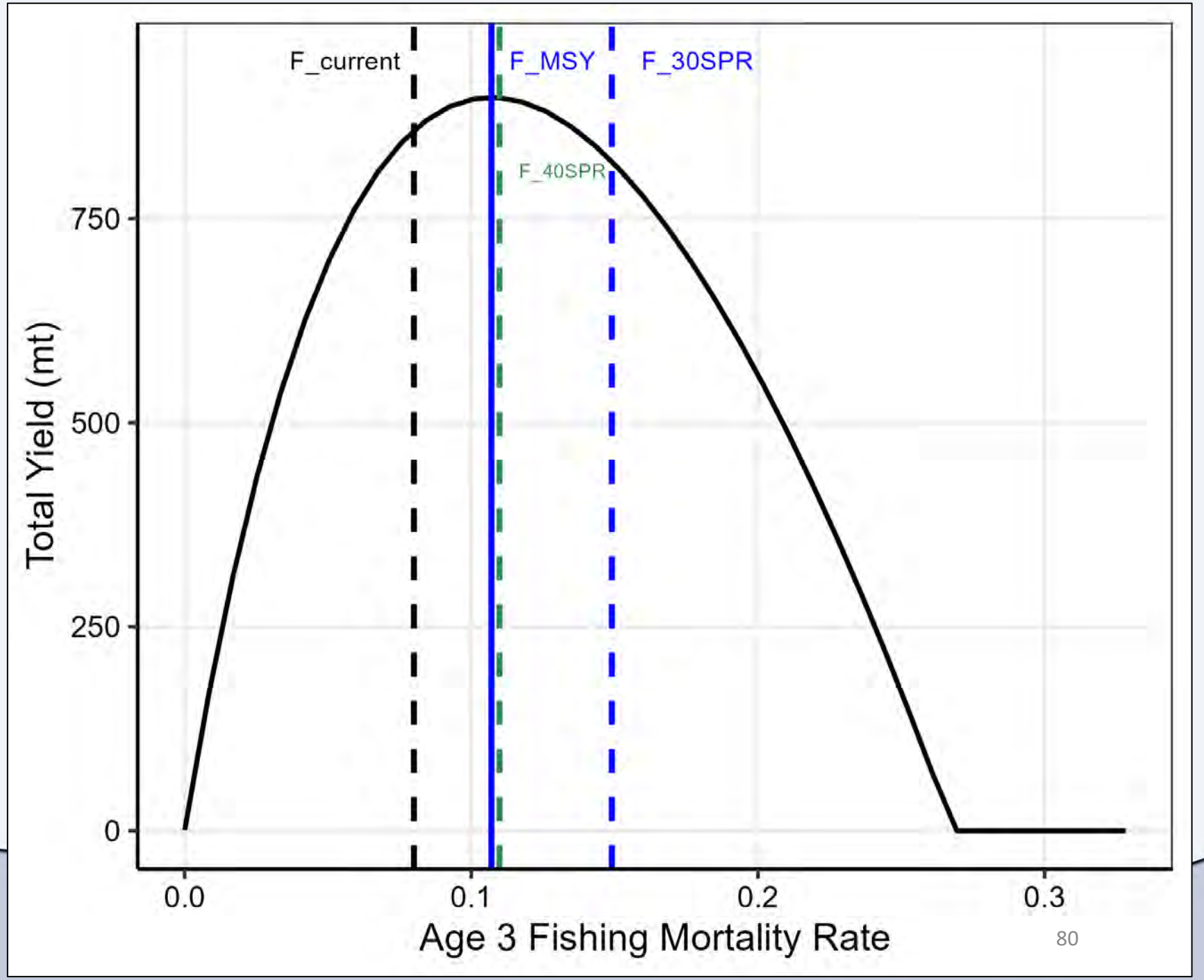


Total Biomass and Numbers at Age



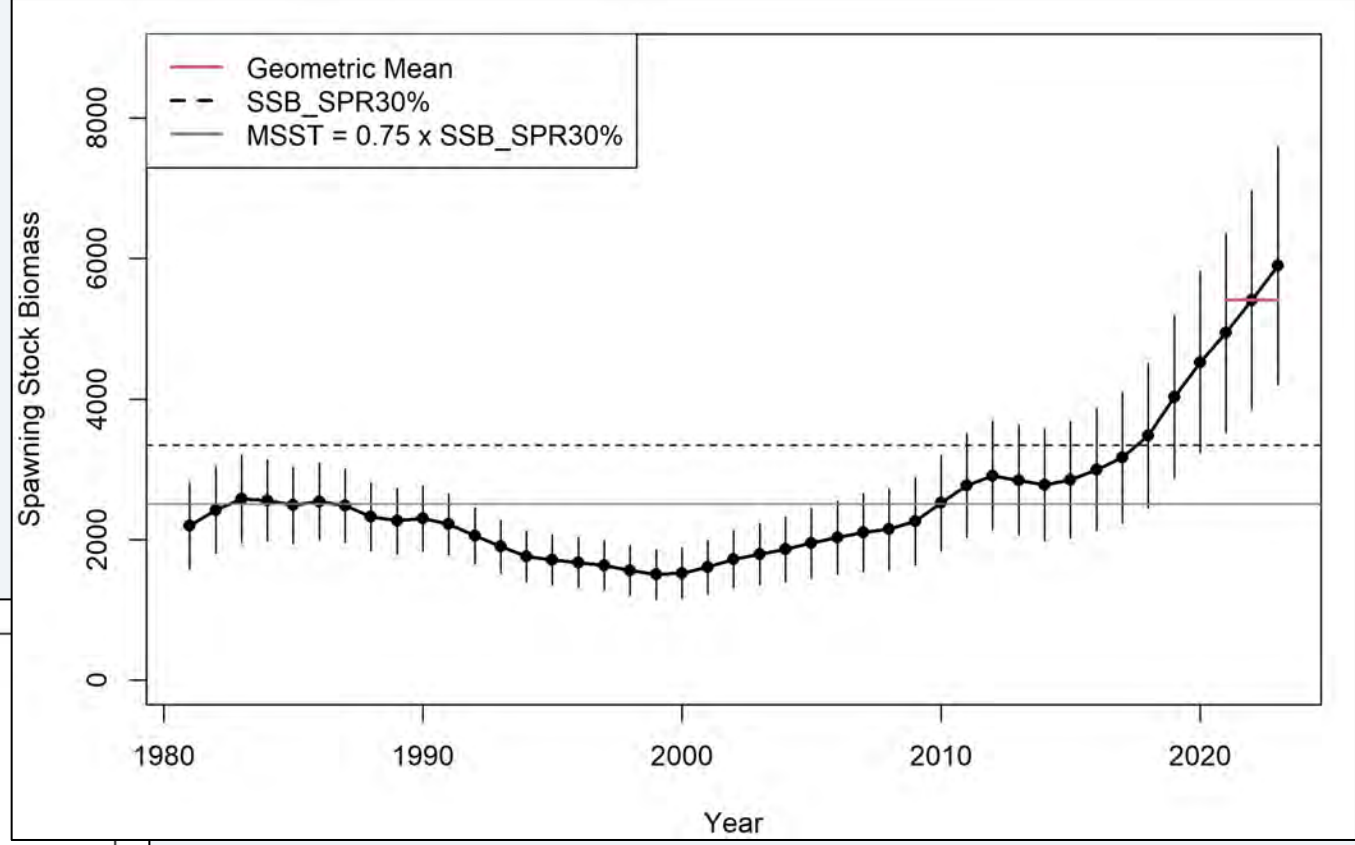


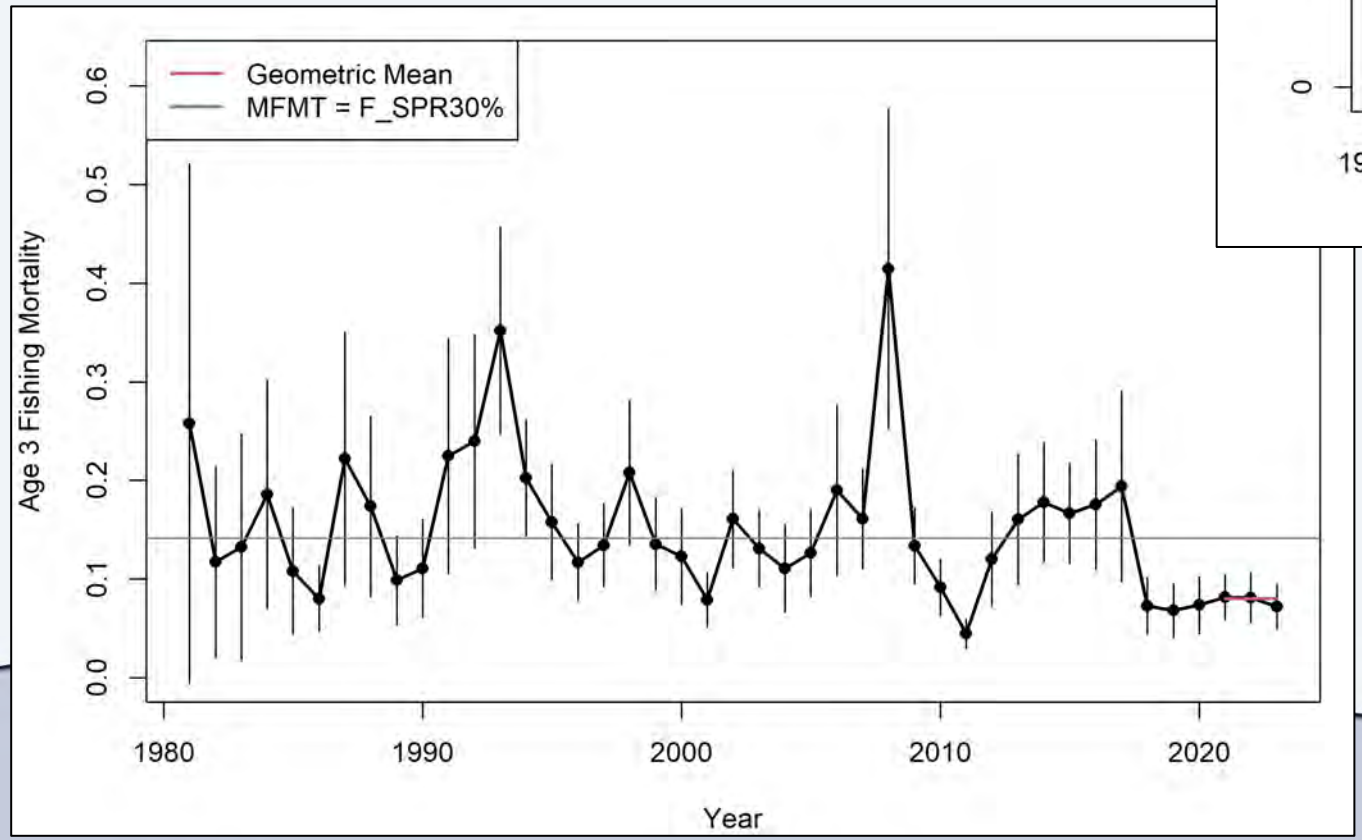
Yield Curve


F_current
F_MSY
F_30SPR
F_40SPR
750
500
250
0
Total Yield (mt)
0.0
0.1
0.2
0.3
Age 3 Fishing Mortality Rate

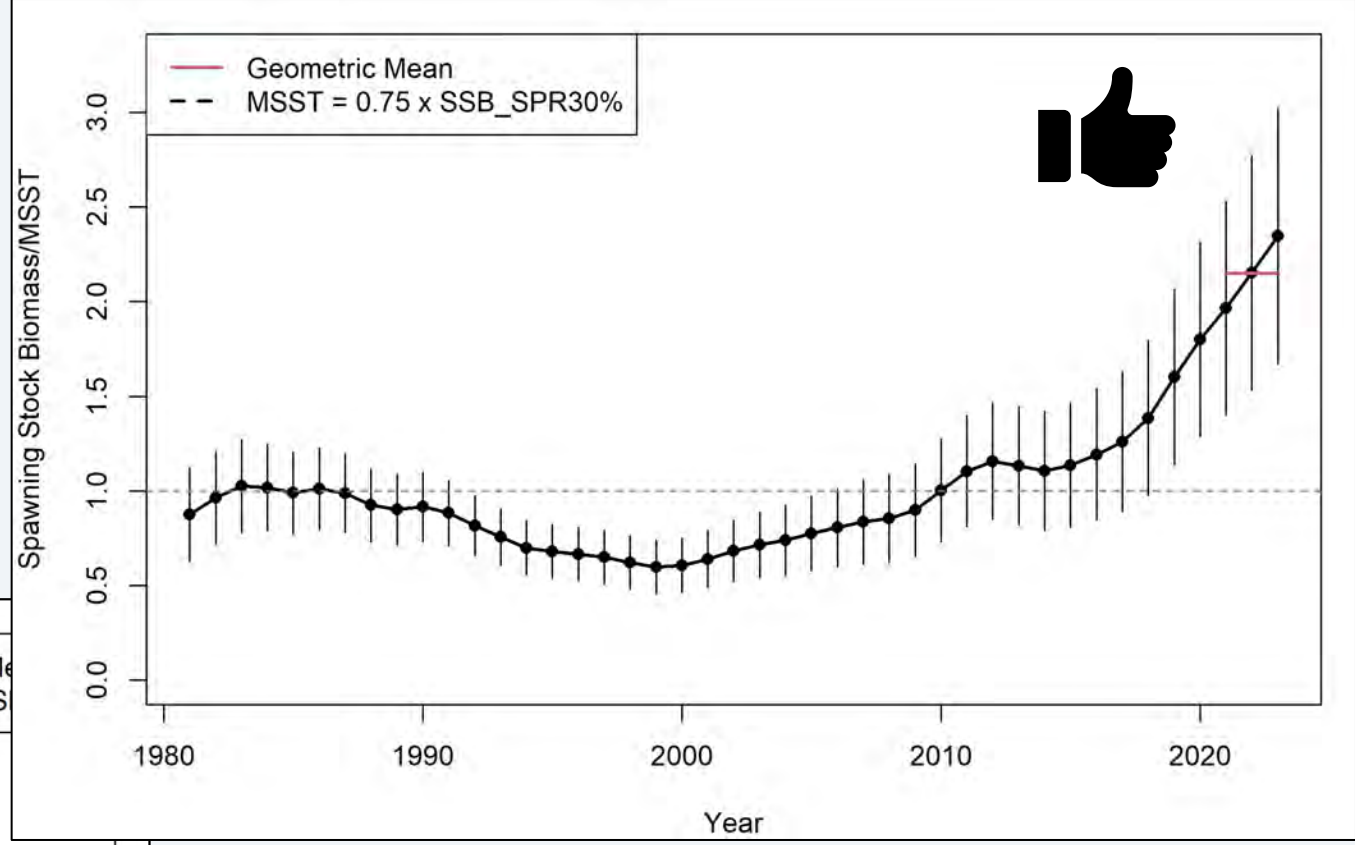
South Atlantic and Gulf of Mexico Fishery Management Councils (Amendment 41)		
Criteria	Definition	Base Model Value
$F_{30\%SPR}$	The fishing mortality rate associated with 30% SPR and the proxy used for F_{MSY}	0.149 yr^{-1}
$F_{40\%SPR}$	The fishing mortality rate associated with 40% SPR and the proxy used for F_{OY}	0.11 yr^{-1}
MFMT (Maximum Fishing Mortality Threshold)	$F_{30\%\ SPR}$	0.149 yr^{-1}
F_{OY}	$F_{40\%SPR}$	0.11 yr^{-1}
$F_{current}$ (recent average fishing mortality rate on age-3 fish)	The geometric mean of F on age-3 fish for 2021 - 2023	0.08 yr^{-1}
$SSB_{F30\%SPR}$	The estimated spawning stock biomass associated with F at 30% SPR	3,352 mt (7,389,895 lbs.)
MSST (Minimum Stock Size Threshold)	$0.75*SSB_{F30\%SPR}$	2,514 mt (5,542,421 lbs.)
$SSB_{current}$ (recent average of SSB)	The geometric mean of SSB for 2021 - 2023	5,403 mt (11,911,576 lbs.)
MSY proxy (Maximum Sustainable Yield Proxy)	Yield at $F_{30\%SPR}$	681.87 mt (1,503,266 lbs.)

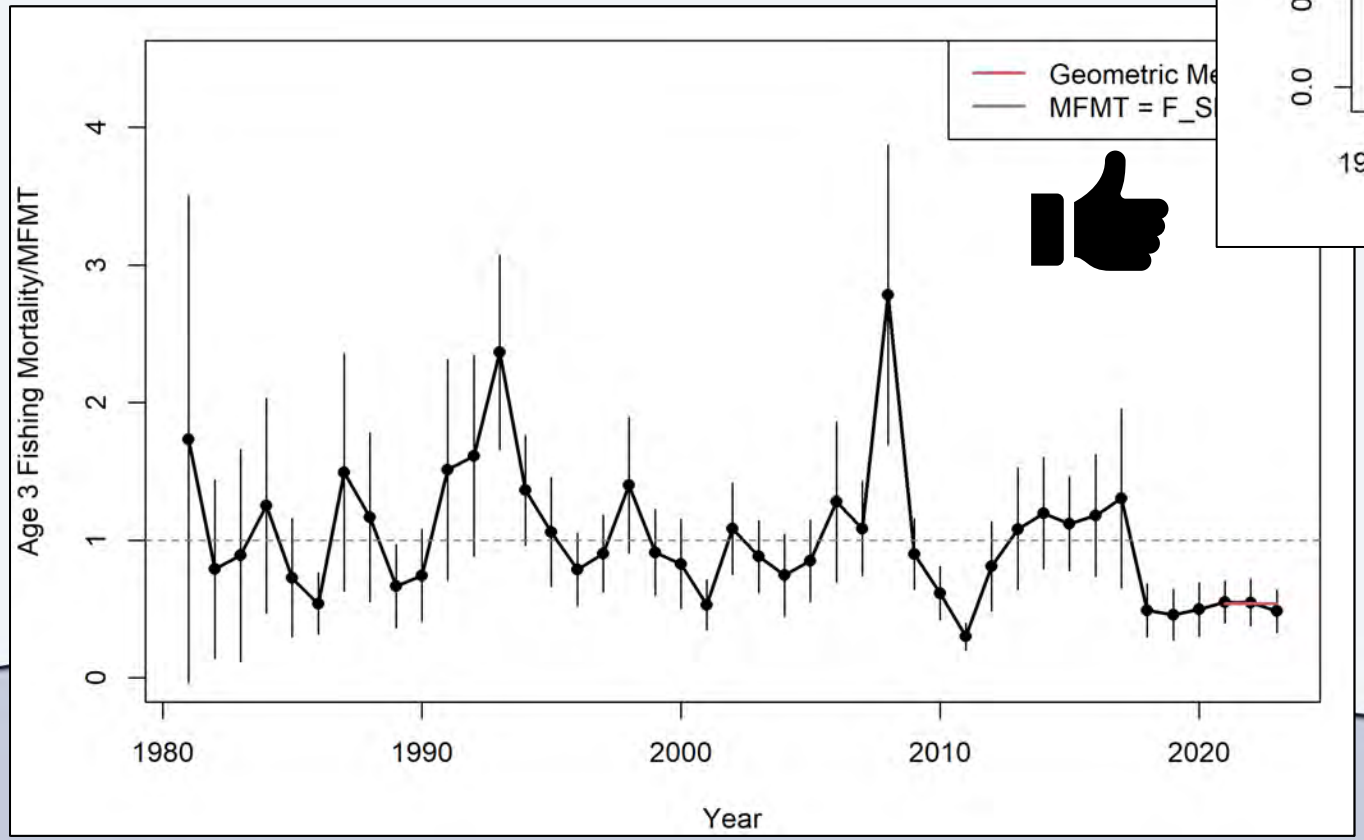
Results
MSY proxy= 30%SPR



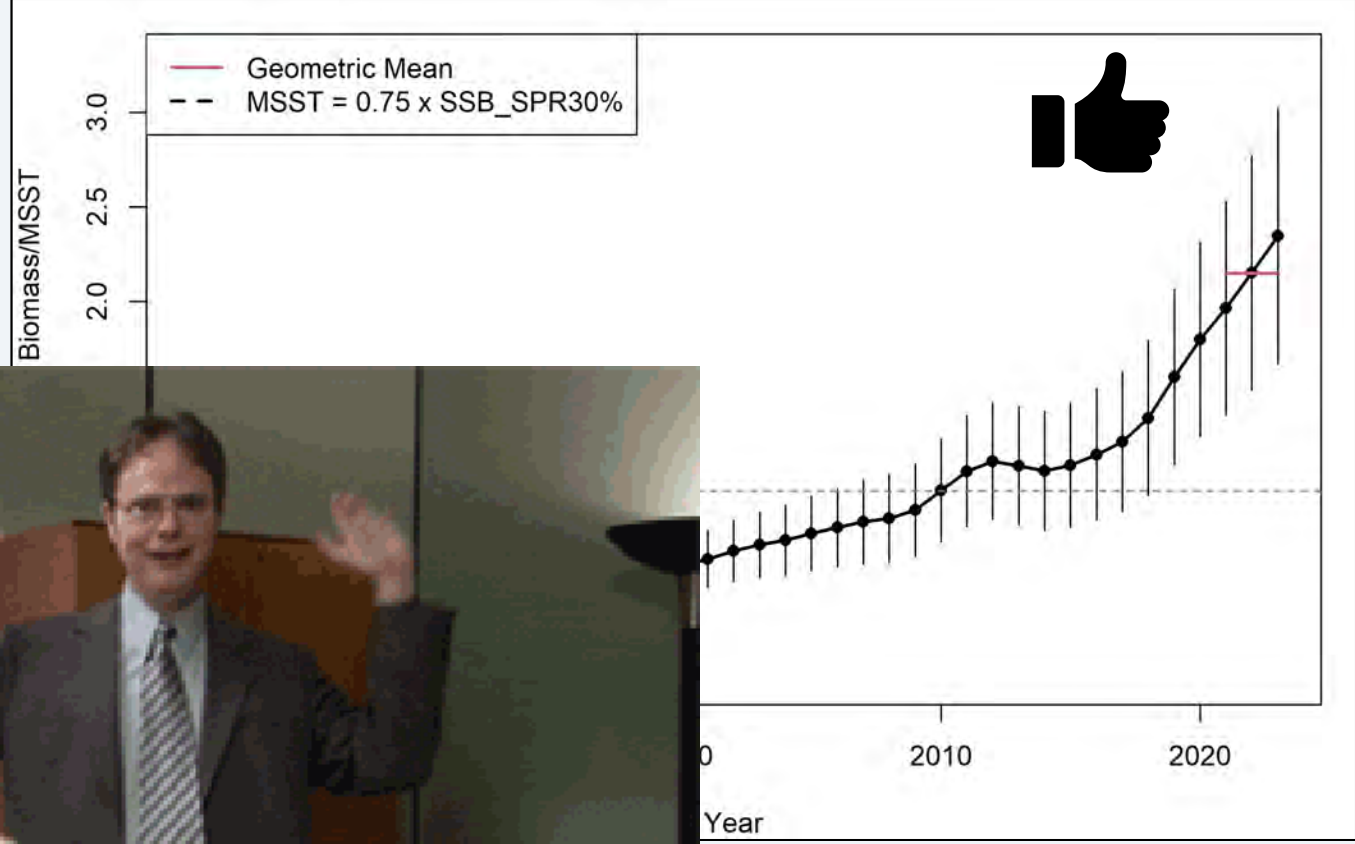


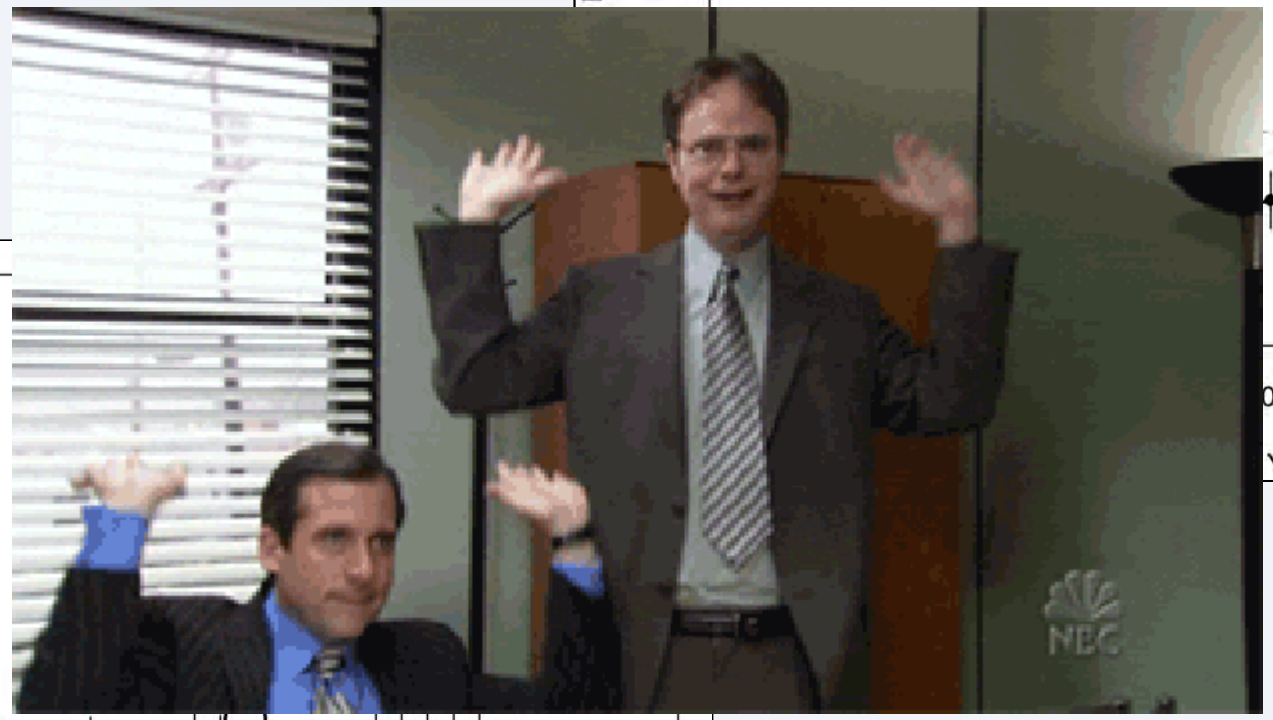
Results
MSY proxy= 30%SPR

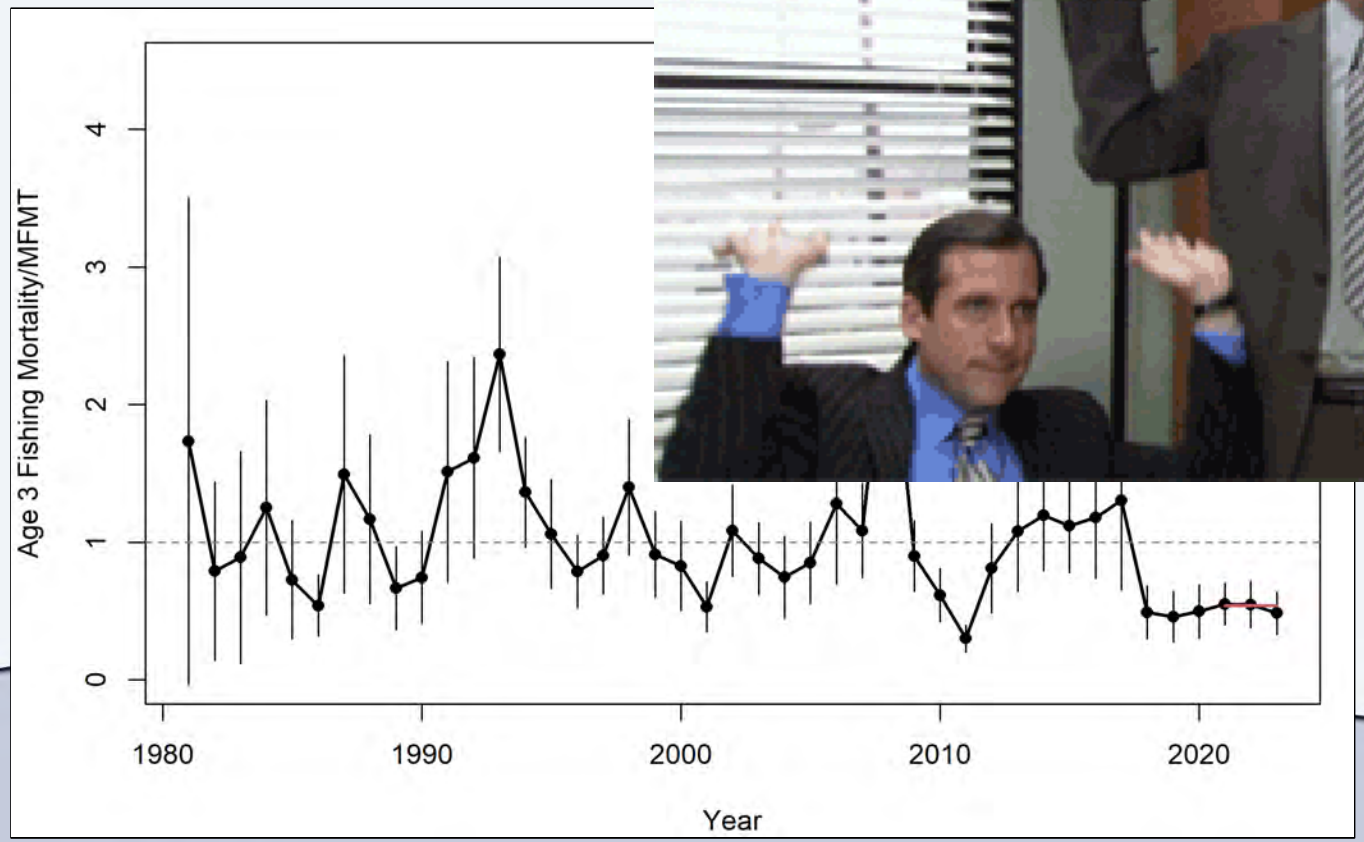




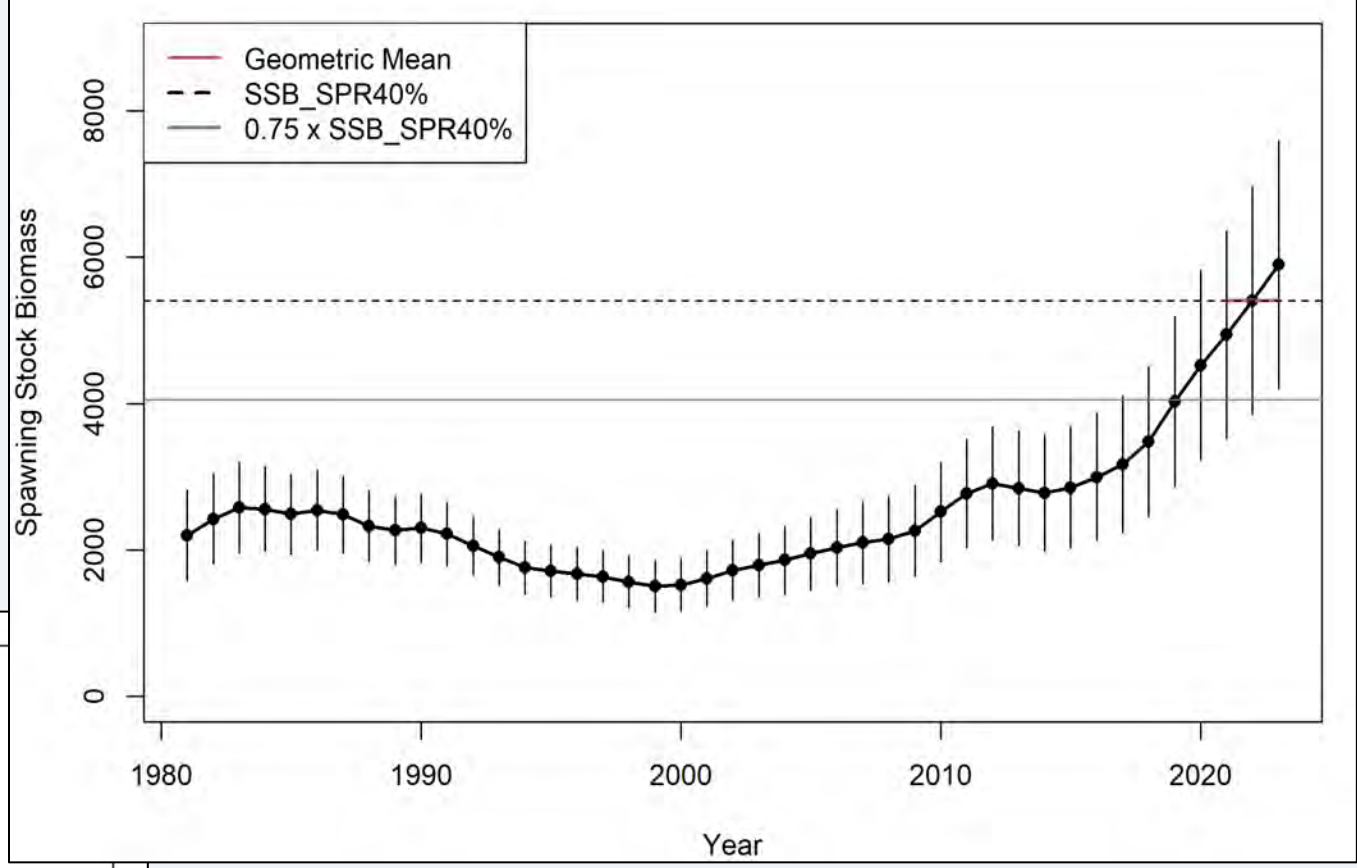
Results
MSY proxy= 30%SPR

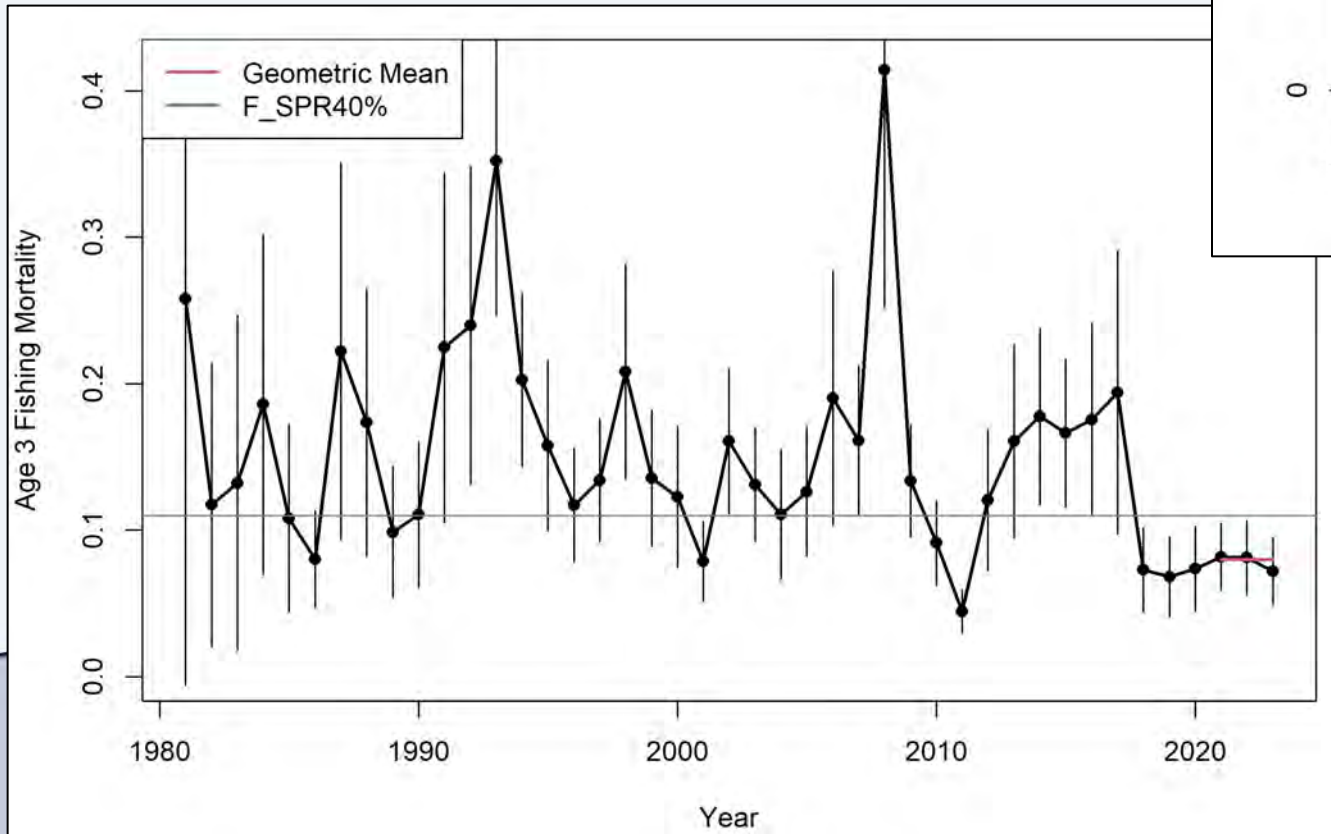




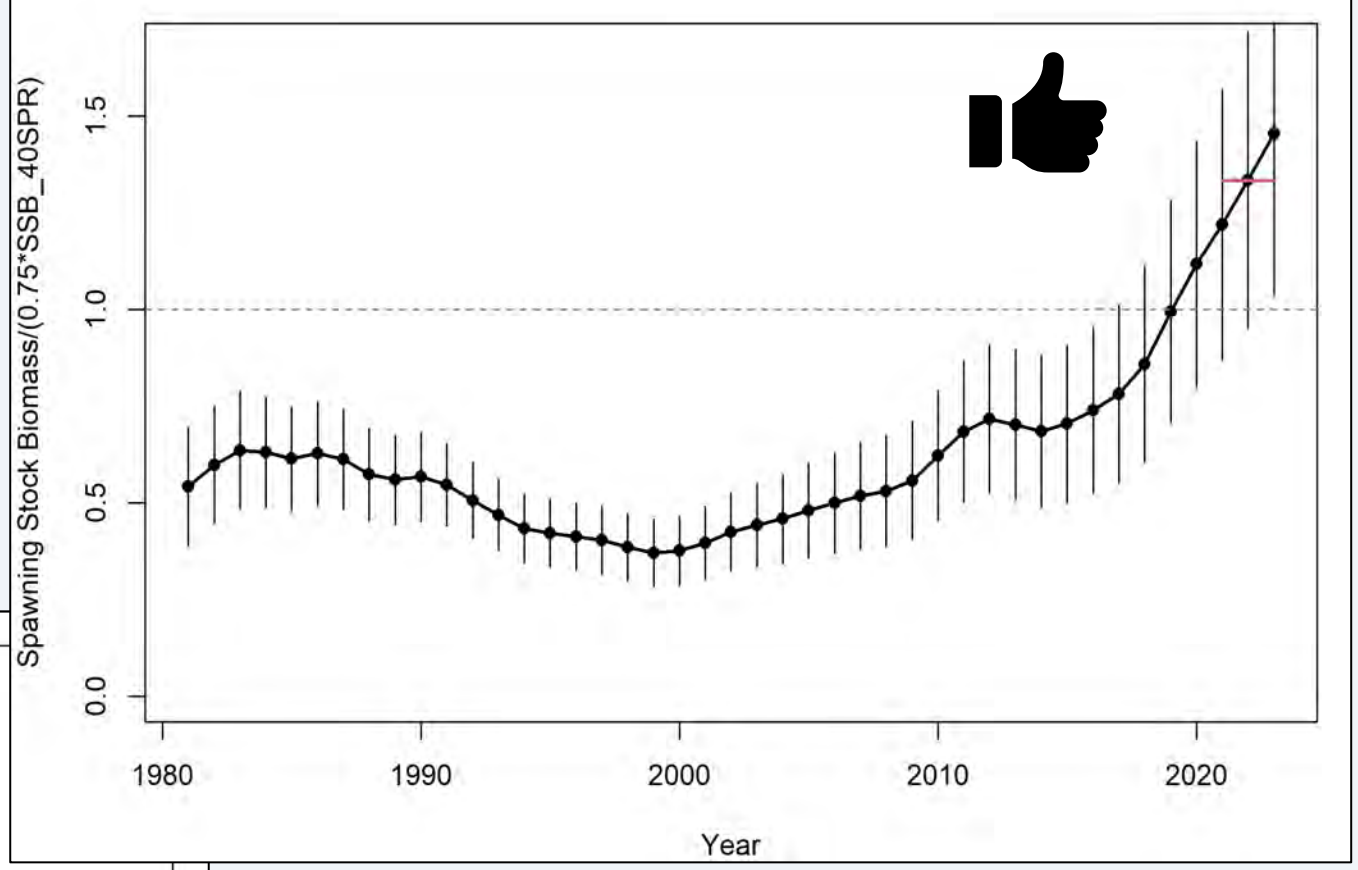


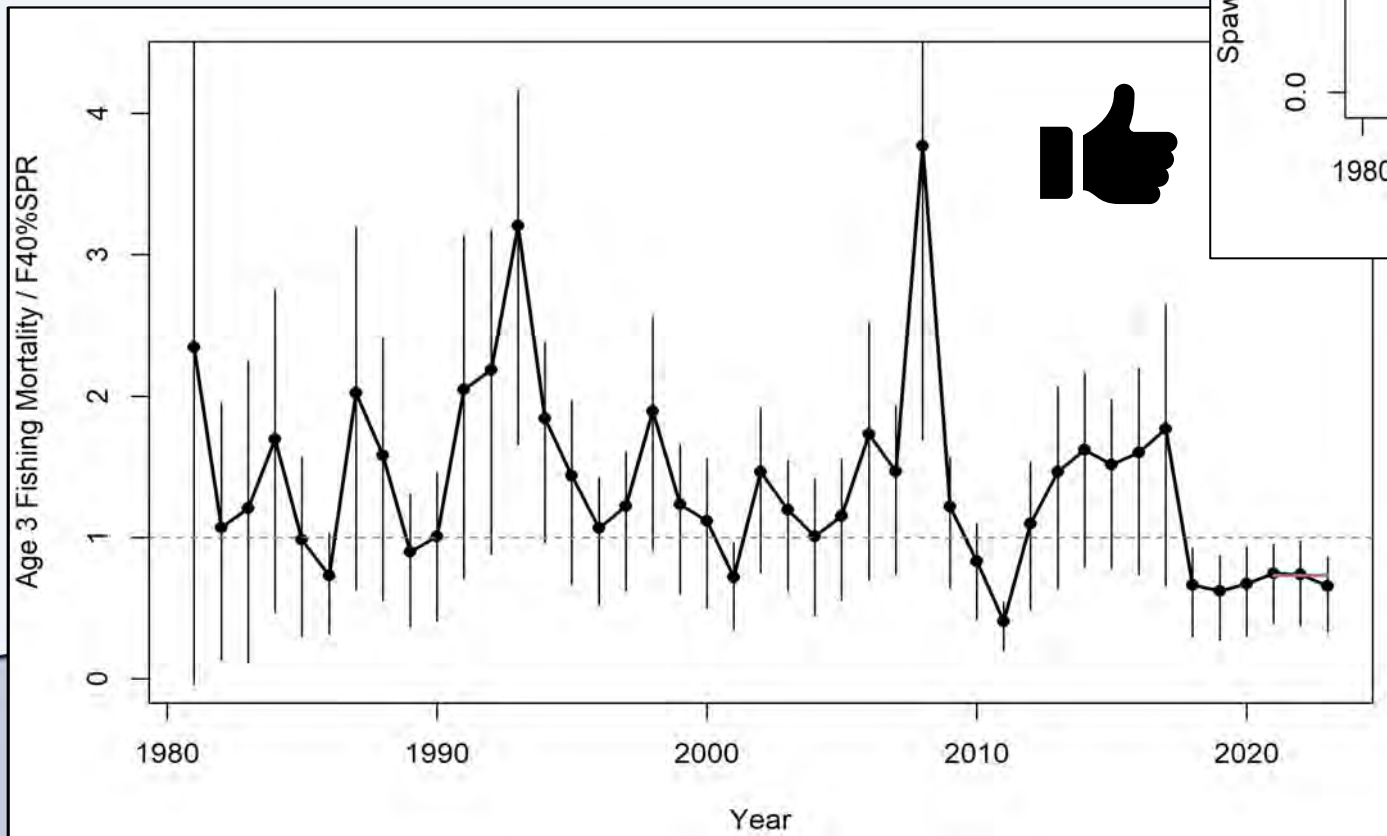
Results
MSY proxy= 40%SPR





Results
MSY proxy= 40%SPR

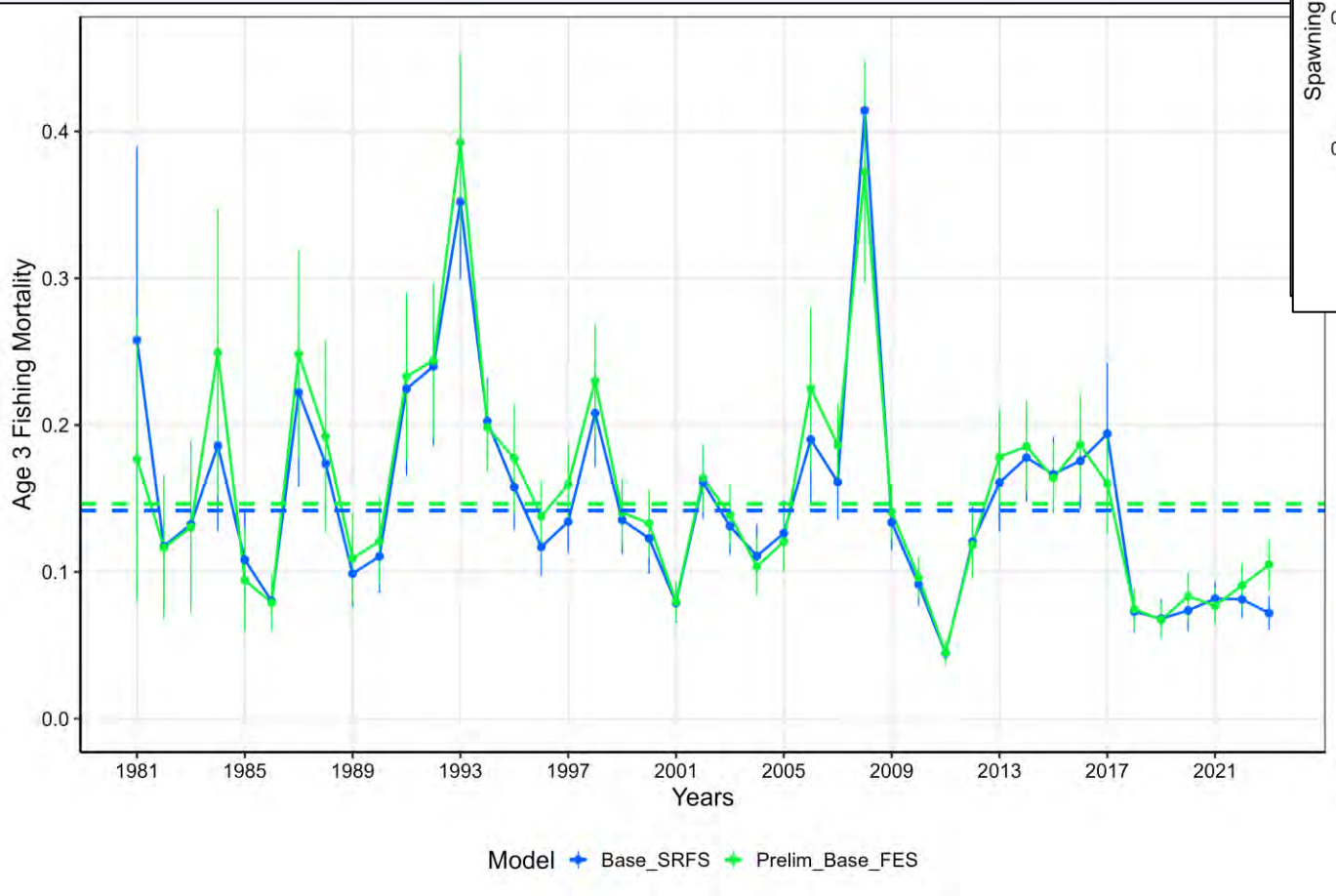


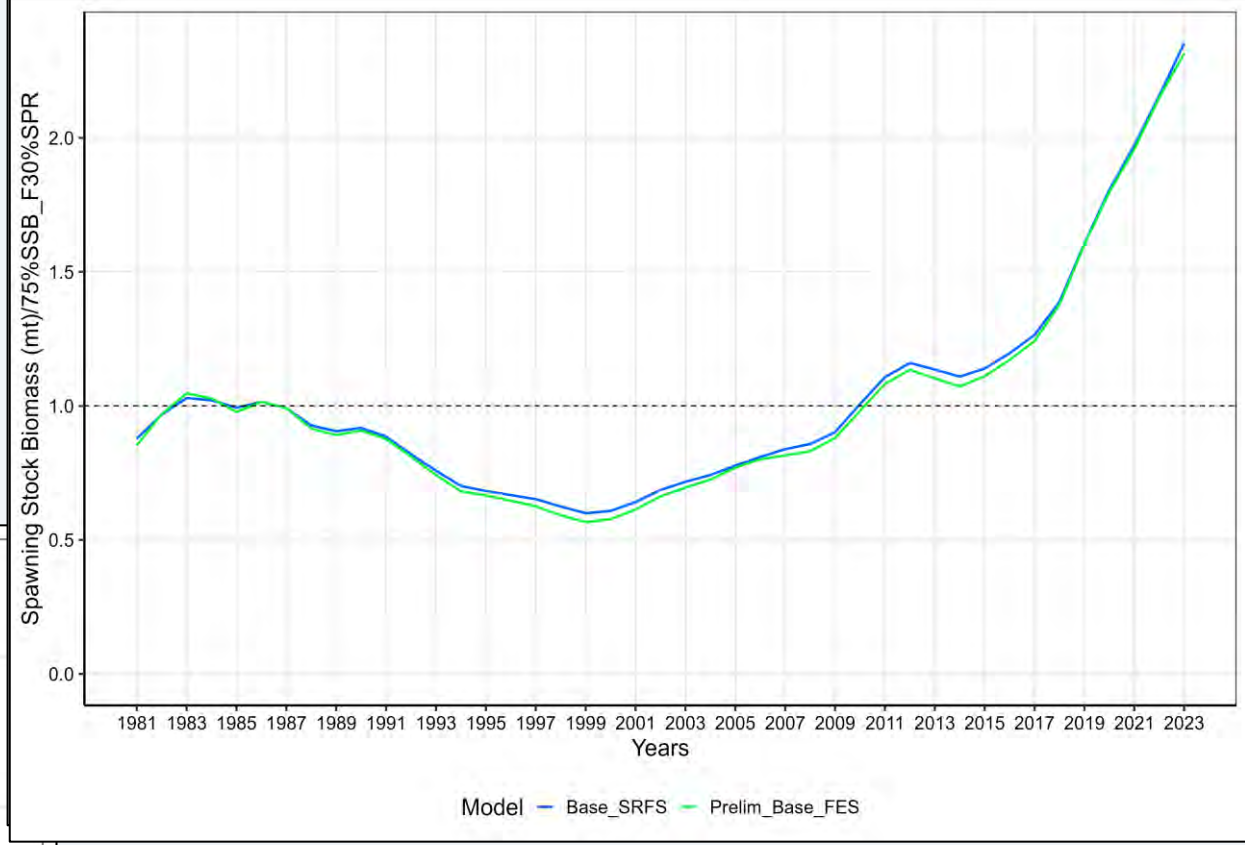


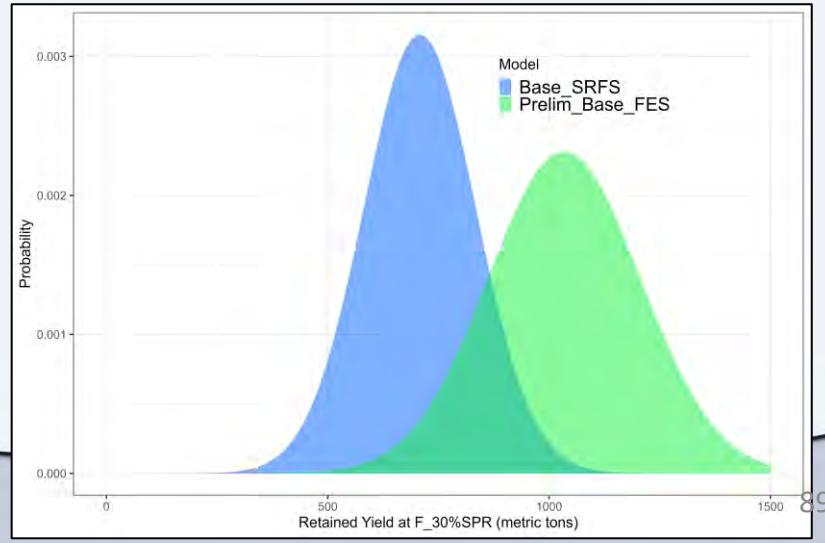
Sensitivity Runs & Uncertainty

Sensitivity Run	SSBcurrent	75%SSB_30SPR	SSBcurrent/ 75%SSB_30SPR	Fcurrent	F_30SPR	Fcurrent/ F_30SPR
Base Model	5,403	2,514	2.15	0.08	0.15	0.54
Start Year = 1986	5,708	2,545	2.24	0.08	0.15	0.53
Release Mortality = 15%	5,361	2,250	2.38	0.06	0.12	0.50
Release Mortality = 45%	5,681	2,739	2.07	0.09	0.17	0.53
Steepness = 1	5,003	2,209	2.26	0.08	0.15	0.53
Jack-Knife Analysis (leave one index out)	-	-	-	-	-	-
Remove FIM YOY and COM LL Indices	4,681	2,665	1.76	0.07	0.15	0.47
Remove first 3 years from SERFS video index	5,309	2,482	2.14	0.08	0.15	0.54
Include RVC FL Keys 1999 Data Point	5,429	2,511	2.16	0.08	0.15	0.54
Estimate F parameters for all fleets	5,400	2,506	2.15	0.08	0.15	0.53
Rec East = Rec West Selectivity	3,455	2,662	1.30	0.06	0.08	0.76
Rec Fleet Selectivity = Single Logistic	3,796	2,690	1.41	0.05	0.07	0.72
MRIP-FES Rec Landings and Releases	7,796	3,709	2.10	0.09	0.15	0.59

MRIP-FES Private Mode Landings & Releases



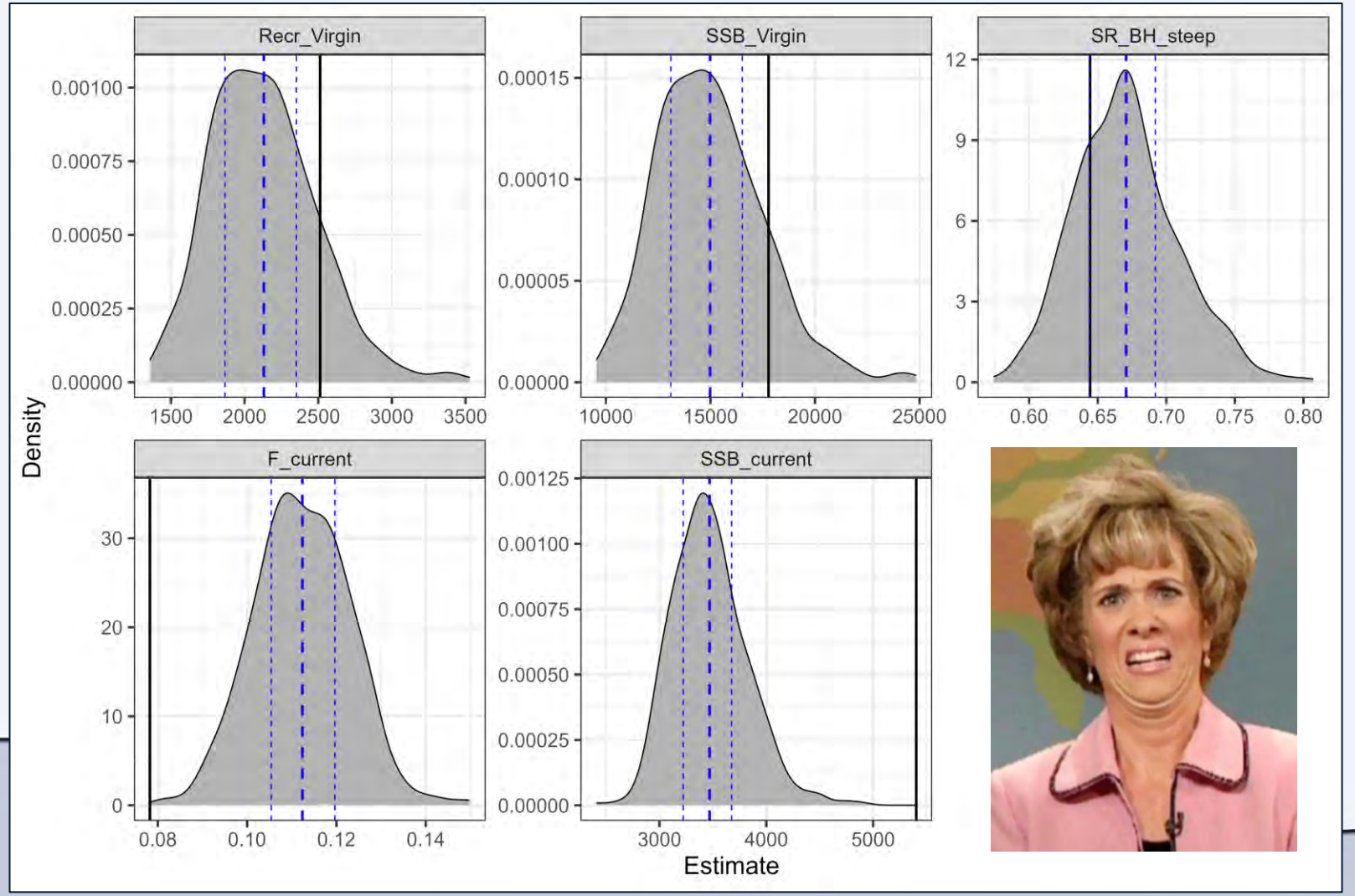


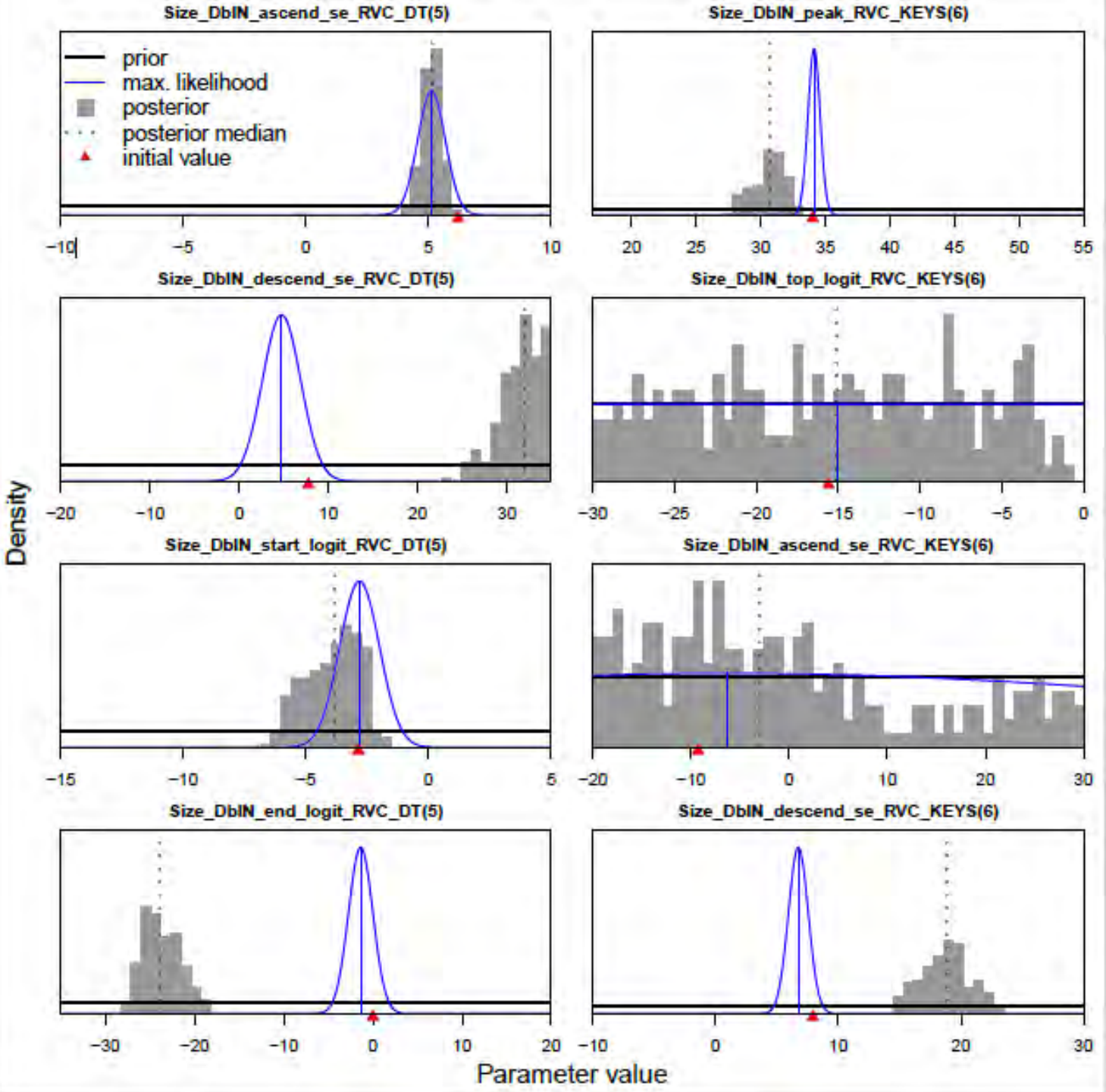


MCMC Analysis

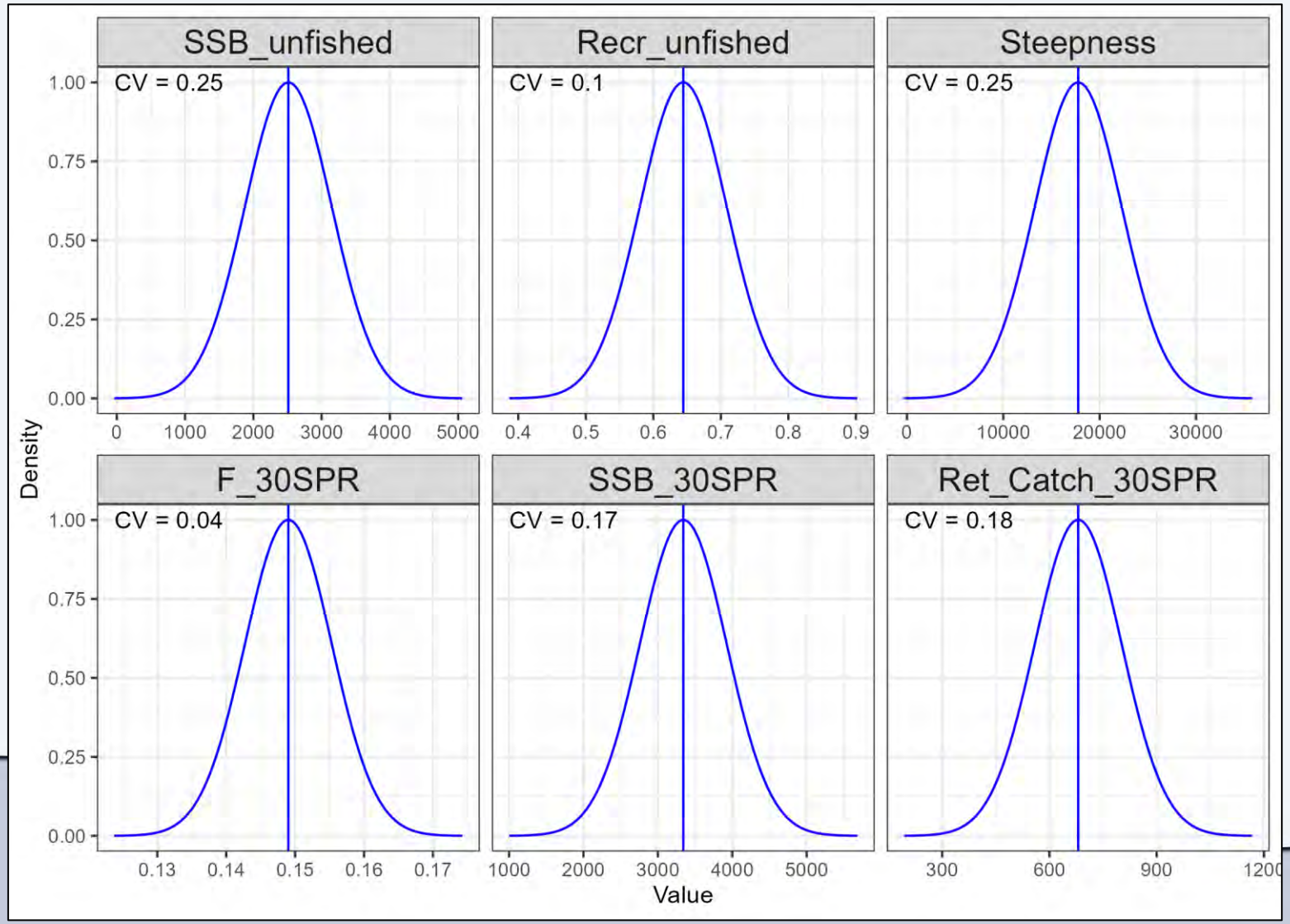
- Generate posterior distributions of model parameters and derived quantities
- Due to time constraints only a single converged chain of MCMC draws was produced
  - 563 iterations saved from 10,000,000 (500 burn in)
- Single-chain convergence assessed using Geweke's diagnostic to determine whether the mean of the first 10% of the chain is not significantly different from the last 50% of the chain. Also visually inspected trace plots

MCMC Analysis




Size_DblN_ascend_se_RVC_DT(5)
Size_DblN_peak_RVC_KEYS(6)
prior
max. likelihood
posterior
posterior median
initial value
Size_DblN_descend_se_RVC_DT(5)
Size_DblN_top_logit_RVC_KEYS(6)
Density
Size_DblN_start_logit_RVC_DT(5)
Size_DblN_ascend_se_RVC_KEYS(6)
Size_DblN_end_logit_RVC_DT(5)
Size_DblN_descend_se_RVC_KEYS(6)
Parameter value

Approximate Distributions



Review Panel Recommendations

- Investigate the stock structure through tagging experiments and genetics.
- Use spatial models to estimate abundance from indices and reconsider the use of the COM Longline CPUE.
- Improve the sampling design of the recreational fishery that may under-sample large/old fish, and that could lead to overestimation of the stock size.
- Obtain release mortality rates for Mutton Snapper.
- Resolve MCMC analysis issues and enable stochastic projections in the future.
- Use a fishing mortality rate of F = 0.11 as the benchmark for stock status (~$F_{MSY,}$ $F_{40\%SPR}$, and 75% of $F_{30\%SPR}$).

Feeley et al. 2018

Life History Overview

- Tropical reef species associated with coral reef areas in the western Atlantic Ocean.
  - Maryland to southeastern Brazil.
  - Populations from U.S. waters are believed to belong to a single stock. Most abundant in South FL.
- Juveniles inhabit nearshore bays, seagrass beds, and mangroves before shifting to reefs.
- Observed maximum age = 42 years.
- Forms large spawning/pre-spawning aggregations, peaking April through July
- Primarily hook & line fishery
  - Targeted by commercial and recreational anglers in both state and federal waters

UF Nick Haddad

Spatial Closures

- Dry Tortugas:
  - Riley's Hump: 1994 – 2002: May 1 – June 30
  - Tortugas Reserve: 2002 – Present: year-round
  - Pulley Ridge: 2006 – Present: bottom gears prohibited year-round
  - Research Natural Area within Dry Tortugas National Park: 2007 – Present: fishing and anchoring prohibited inside 46-square-mile marine sanctuary
- FL Keys
  - Western Dry Rocks (10 mi SW of Key West): 2021 – Present: April 1 – July 31

Tortugas Reef Survey
(Photo: FKNMS)

Trip Limit History – Federal Waters

South Atlantic (3 - 200 Miles)

Commercial

- 5 fish per person/day limit from April – June and 500-pound commercial vessel limit for July – March (2/2018 – present)

Recreational

- Included in the aggregate daily bag limit of 10 snappers (1/1992 – present)
- 5 fish per person per day included in the aggregate daily bag limit of 10 snappers (2/2018 – present)

Gulf (10 -200 Miles)

Commercial

- None

Recreational

- 10 snapper aggregate in the 20-reef fish aggregate (1/1984 – 7/2018)
- 5 fish per person per day included in the aggregate daily bag limit of 10 snappers (7/2018 – present)

Trip Limit History – FL State Waters

Commercial - Trip Limit Per Boat/Day

- Restricts all harvest in May and June to the bag limit (12/1992 – 1/2017)
- **South Atlantic** (0 - 3 Miles): 5 fish per person/day limit from April – June and 500-pound commercial vessel limit for July – March (1/2017 – present)

Recreational - Bag Limit Per Person/Day

- Included in the aggregate daily bag limit of 10 snappers (1/1992 – present)
- Restricts all harvest in May and June to the bag limit (12/1992 – 1/2017)
- 5 fish per person per day included in the aggregate daily bag limit of 10 snappers (2/2017 – present)

Base Model Data Inputs

- Stock structure and management unit
- Life history Age and growth
  - Natural mortality
  - Maturity
  - Fecundity
  - Sex ratio
  - Release mortality
- Landings
  - Commercial Longline (metric tons): 1981 – 2023
  - Commercial Other (metric tons): 1981 – 2023
  - Recreational East (thousands of fish): 1981 – 2023
  - Recreational West (thousands of fish): 1981 – 2023
- Releases (thousands of fish)
  - Commercial Other: 1993 – 2023
  - Recreational East: 1981 – 2023
  - Recreational West: 1981 – 2023
- Length composition of landings (8:96 cm Maximum Total Length [Max TL], 4 cm Max TL bins)
  - Commercial Longline: 1991 – 2022
  - Commercial Other: 1989 – 2022
  - Recreational East: 1981 – 2022
  - Recreational West: 1981 – 2022
- Conditional age-at-length (1-year age bins starting at age 1, plus group for ages 40 and older)
  - Commercial Longline landings: 2001 – 2022
  - Commercial Other landings: 1992 – 2022
  - Recreational East: 1981 – 2022
  - Recreational West: 1981 – 2022
  - Fishery-independent sources: 1998-2002, 2021-2022
- Length composition of releases (8:96 cm Maximum Total Length [Max TL], 4 cm Max TL bins)
  - Commercial Other: 2013-2017
  - Recreational East: 2005 – 2023
  - Recreational West: 2005 – 2023

Base Model Data Inputs (cont.)

- Abundance indices
  - Fishery-independent
    - RVC Dry Tortugas: 1999-2000, 2004, 2006, 2008, 2010, 2012, 2014, 2016, 2018, 2021, 2023
    - RVC FL Keys: 1997, 2000 – 2012, 2014, 2016, 2018, 2022
    - RVC SE FL: 2013 – 2016, 2018, 2021-2022
    - FIM YOY: 1999 – 2022
    - Combined Gulf Video: 1996-1997, 2002, 2004-2012, 2014, 2016-2022
    - SERFS Video: 2011-2019, 2021-2022
  - Fishery-dependent
    - Commercial longline: 1993 – 2010
- Length composition from abundance indices (8:96 cm Maximum Total Length [Max TL], 4 cm Max TL bins)
  - GOM Combined Video: 2004-2021 (all years combined)
  - Commercial longline retained lengths
- Length composition from abundance indices (10:95 cm Maximum Total Length [Max TL], 5 cm Max TL bins)
  - RVC Dry Tortugas: 1999-2000, 2004, 2006, 2008, 2010, 2012, 2014, 2016, 2018, 2021, 2023
  - RVC FL Keys: 1997, 2000 – 2012, 2014, 2016, 2018, 2022
  - RVC SE FL: 2013 – 2016, 2018, 2021-2022

Main Data Inputs: Retained Length Compositions

- Commercial LL (1984 – 2022)
  - Central 80th Percentile of Max Total Lengths: 55 – 85 cm
- Commercial Other (1981 – 2022)
  - Central 80th Percentile of Max Total Lengths: 42 – 77 cm
- Rec West (1981 – 2022)
  - Central 80th Percentile of Max Total Lengths: 41 – 70 cm
- Rec East (1981 – 2022)
  - Central 80th Percentile of Max Total Lengths: 41 – 53 cm

Main Data Inputs: FI Index Length Compositions

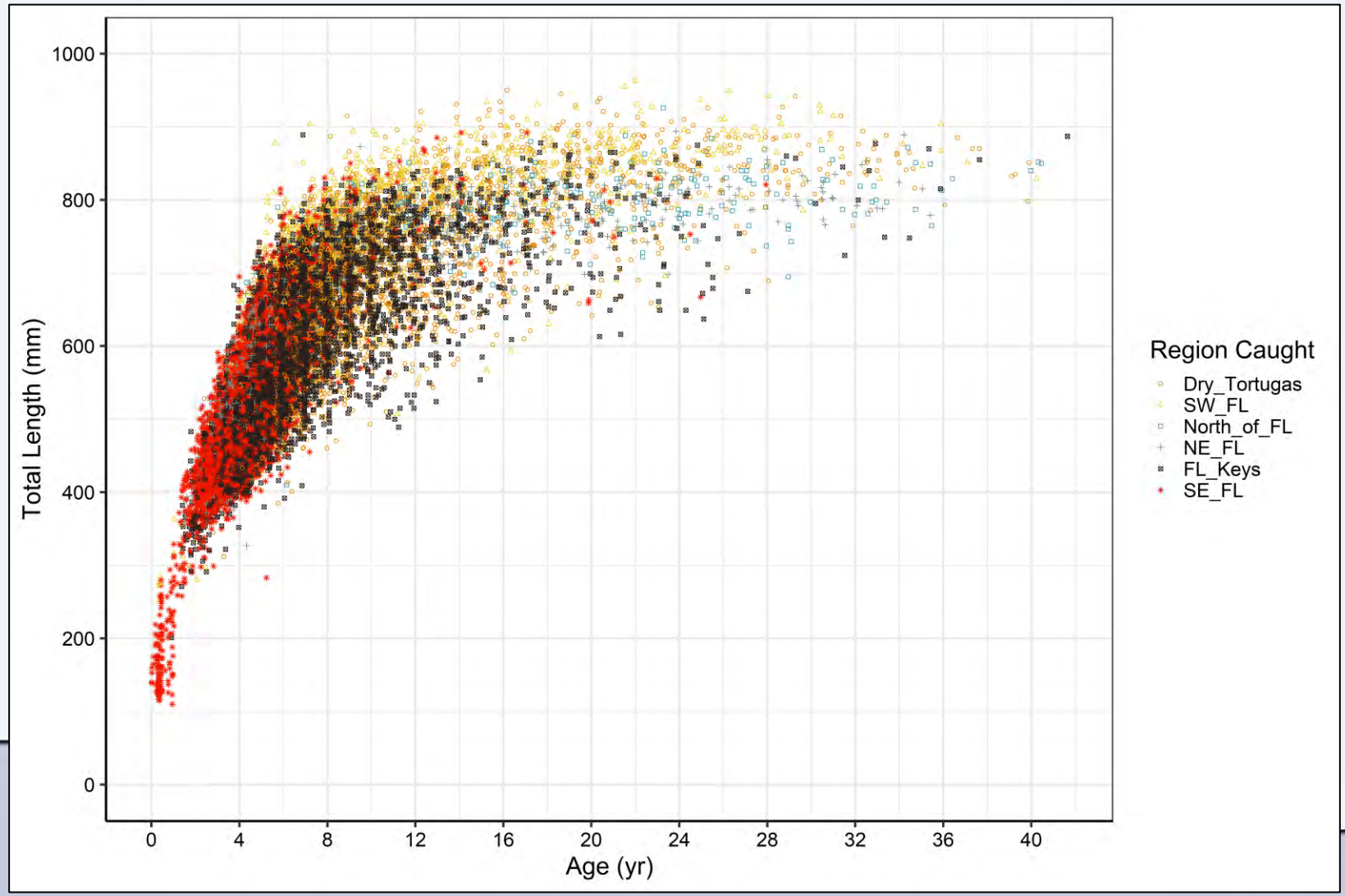
- GOM Combined Video Index (1996 – 2021)
  - Interquartile Range of Max Total Lengths: 46 - 66 cm (full range: 27 - 105 cm)
- RVC Dry Tortugas (1999 – 2021)
  - Interquartile Range of Max Total Lengths: 44 - 62 cm (full range: 15 to 101 cm)
- RVC FL Keys (1997 – 2022)
  - Interquartile Range of Max Total Lengths: 36 -50 cm (full range: 4 - 87 cm)
- RVC SE FL (2013 – 2022)
  - Interquartile Range of Max Total Lengths: 33 - 42 cm (full range: 3 - 82 cm)

Main Data Inputs: Released Length Compositions

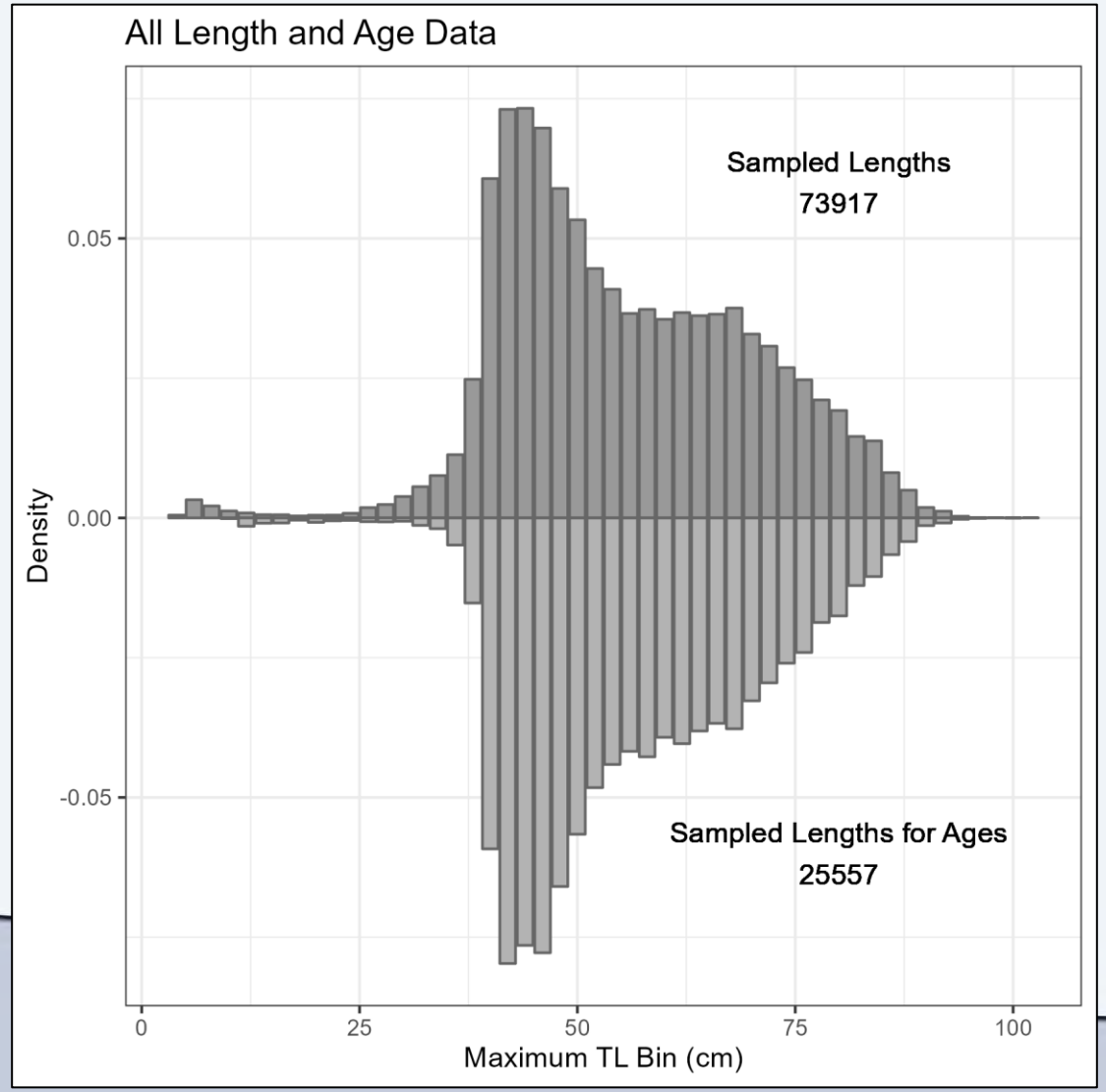
- Commercial Other (n_trips=14)
  - RFOP vertical line trip data (2009 – 2021)
  - Max Total Lengths: 26 – 40 cm

- Recreational East & West (n_trips=1,159)
  - Charter/Headboat At-Sea Observers (2005 – 2022)
  - Max Total Lengths: 18 – 54 cm

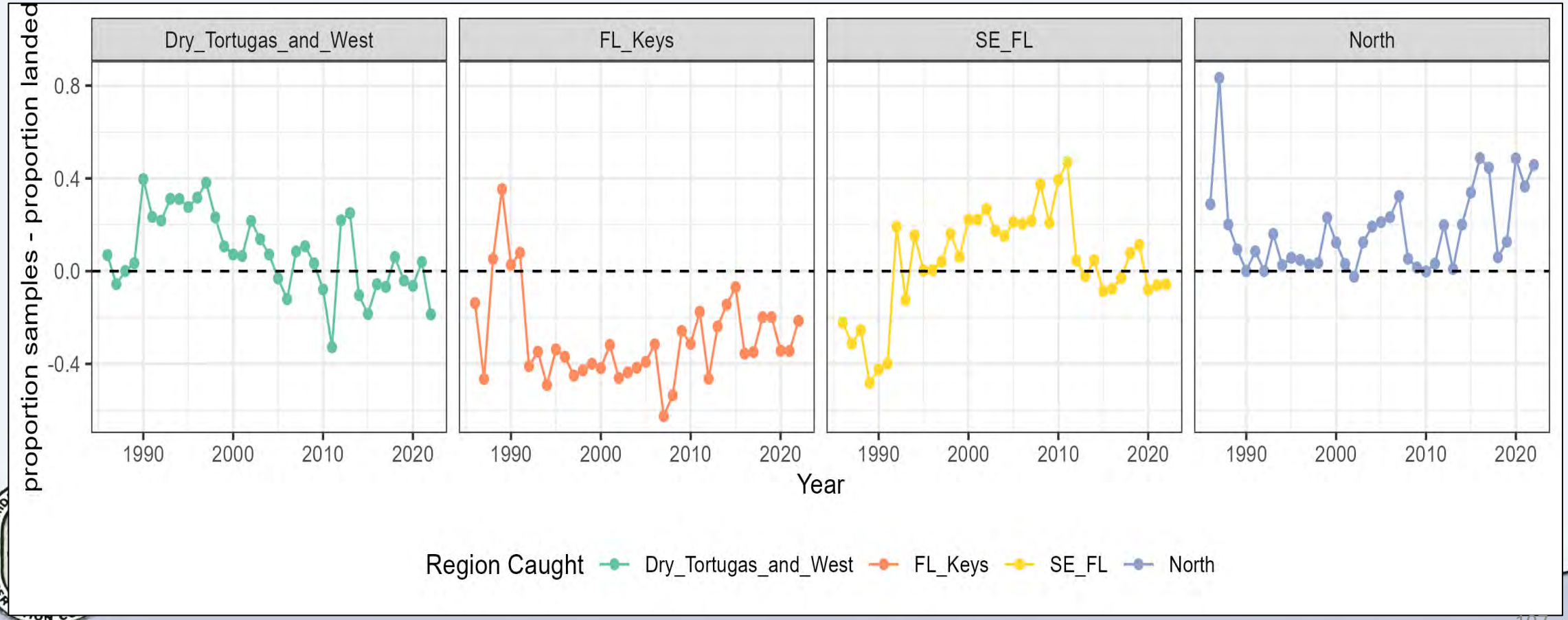
Length vs Age by Region



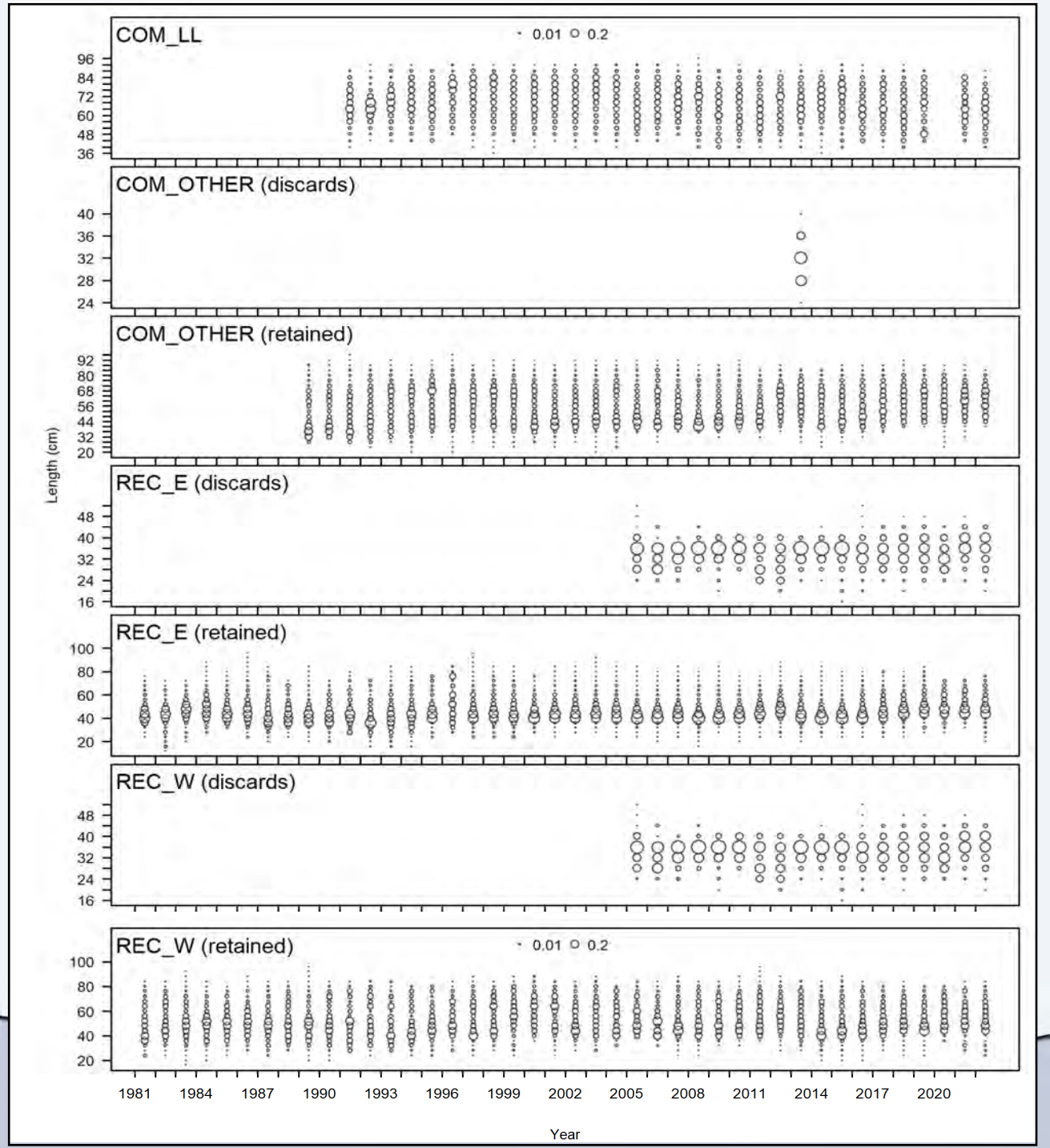
Sampled Lengths vs Sampled Lengths for Ages



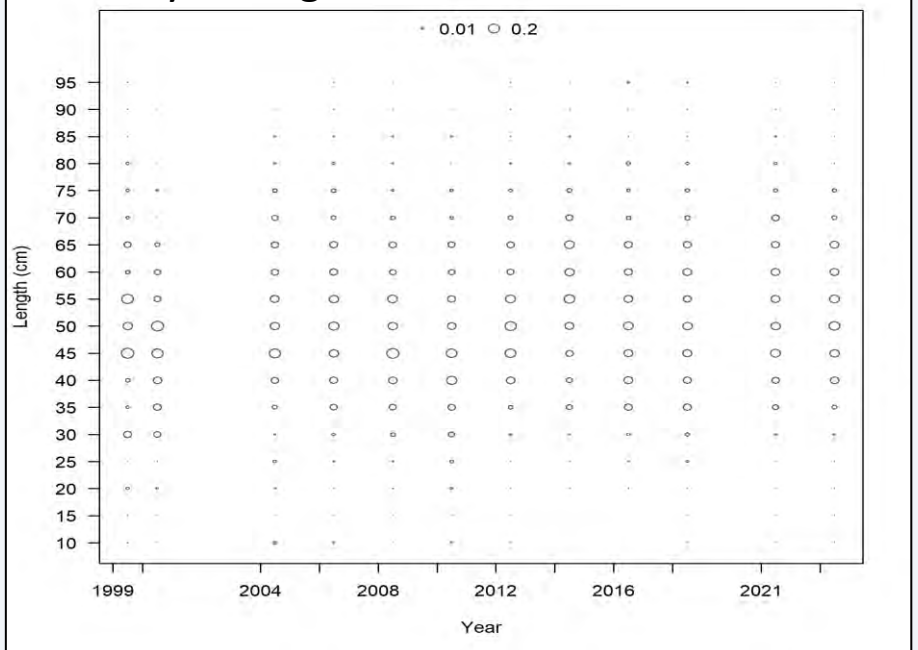
Com Other Sampling vs Landed Proportions



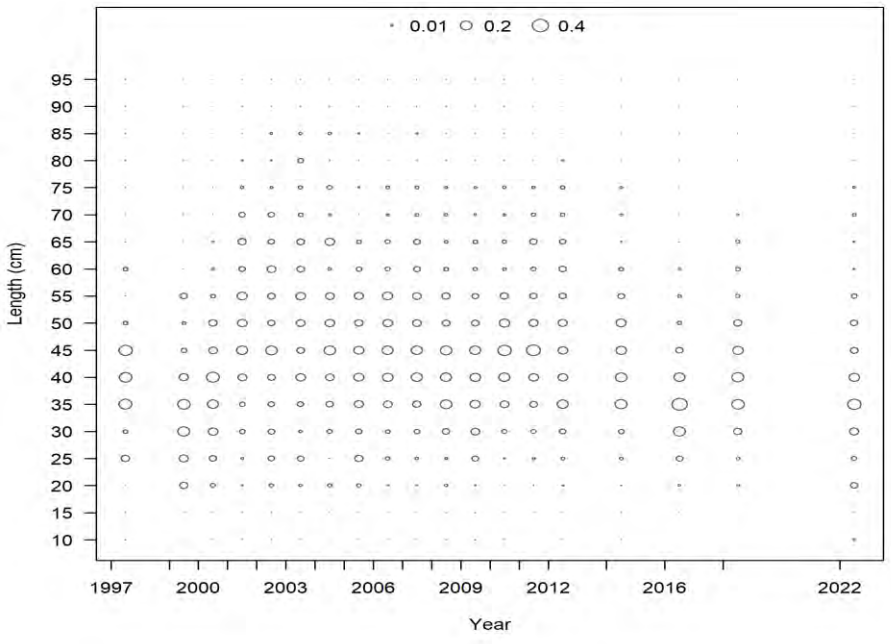

Dream Catcher Charters
Key West, Florida
1-305-292-7212
Photo: Capt. Steven Lamp


COM_LL
0.01
0.2
COM_OTHER (discards)
COM_OTHER (retained)
REC_E (discards)
REC_E (retained)
REC_W (discards)
REC_W (retained)
Length (cm)
Year
1981
1984
1987
1990
1993
1996
1999
2002
2005
2008
2011
2014
2017
2020

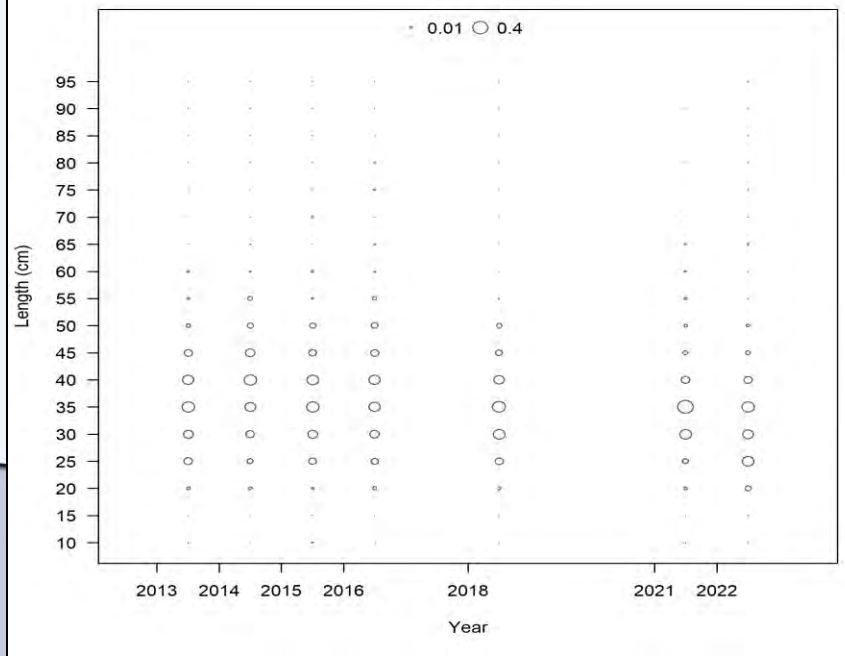
Dry Tortugas RVC



FL Keys RVC



SE FL RVC



Commercial Longline

	Max TL Bins (4 cm)																							
Year	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84	88	92	96	**N**
1992	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
1993	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	4	1	2	1	0	0	0	11
1994	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	2	0	1	0	0	0	5
1995	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	3
1997	0	0	0	0	0	0	0	0	0	0	2	4	3	1	4	3	1	2	4	0	0	0	0	24
1998	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	3
1999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	3	0	0	0	5
2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	2	1	1	0	0	9
2001	0	0	0	0	0	0	0	0	0	0	1	2	4	7	2	4	3	5	9	9	3	3	0	52
2002	0	0	0	0	0	0	0	0	0	1	4	5	6	10	9	10	6	8	10	15	8	1	0	93
2003	0	0	0	0	0	0	0	0	0	5	7	7	5	7	7	9	6	12	19	32	21	7	0	144
2004	0	0	0	0	0	0	0	0	1	4	12	14	7	9	12	11	11	8	17	15	11	3	0	135
2005	0	0	0	0	0	0	0	0	0	3	7	15	22	20	17	20	13	15	11	12	9	2	0	166
2006	0	0	0	0	0	0	0	0	0	6	14	24	47	45	47	41	44	36	39	40	14	4	0	401
2007	0	0	0	0	0	0	0	0	0	0	7	12	25	23	27	33	36	20	23	18	5	1	0	230
2008	0	0	0	0	0	0	0	0	7	8	18	13	15	16	18	31	31	19	17	10	4	0	1	208
2009	0	0	0	0	0	0	0	0	6	14	7	9	10	20	11	17	12	16	6	3	5	0	0	136
2010	0	0	0	0	0	0	0	0	5	16	24	28	44	34	29	40	47	40	21	23	14	0	0	365
2011	0	0	0	0	0	0	0	0	2	9	15	28	28	29	27	27	17	12	16	12	5	0	0	227
2012	0	0	0	0	0	0	0	0	1	5	13	22	30	27	26	27	46	23	19	20	1	0	0	260
2013	0	0	0	0	0	0	0	0	3	2	9	7	30	41	36	36	31	21	18	16	4	1	0	255
2014	0	0	0	0	0	0	0	1	0	1	3	7	21	27	42	41	43	44	31	24	2	0	0	287
2015	0	0	0	0	0	0	0	0	3	6	2	3	10	22	14	15	21	25	23	14	2	2	0	162
2016	0	0	0	0	0	0	0	0	0	8	7	13	8	18	18	14	8	11	9	5	1	1	0	121
2017	0	0	0	0	0	0	0	0	1	5	10	18	23	23	34	26	23	26	28	15	4	0	0	236
2018	0	0	0	0	0	0	0	0	9	23	22	29	40	40	30	41	34	29	22	13	4	1	0	337
2019	0	0	0	0	0	0	0	0	0	4	13	3	7	5	11	14	9	8	8	6	1	0	0	89
2020	0	0	0	0	0	0	0	0	1	1	1	2	1	4	2	0	2	2	1	0	0	0	0	17
2021	0	0	0	0	0	0	0	0	0	2	3	3	5	7	8	5	5	3	5	3	0	0	0	49
2022	0	0	0	0	0	0	0	0	3	20	11	22	31	28	38	36	31	17	11	1	1	0	0	250

Commercial Other

	Max TL Bins (4 cm)																								
Year	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84	88	92	96	**N**
1992	0	0	0	0	1	1	0	7	11	9	8	4	2	5	2	1	1	0	0	0	0	0	0	52
1993	0	0	0	0	0	0	0	11	7	4	6	5	2	0	0	1	0	0	0	0	0	0	0	36
1994	0	0	0	0	0	0	0	7	14	10	15	4	2	4	1	0	1	0	0	0	0	0	0	58
1995	0	0	0	0	0	0	0	0	8	8	5	4	4	1	0	1	0	2	0	0	0	0	0	33
1996	0	0	0	0	0	0	0	2	18	34	28	19	15	6	12	6	3	2	5	0	0	0	0	150
1997	0	0	0	0	0	0	0	10	22	22	36	23	22	25	24	7	6	2	6	0	0	0	0	205
1998	0	0	0	0	0	1	3	7	36	40	22	23	26	13	13	11	1	2	1	0	0	0	0	199
1999	0	0	0	0	0	0	1	18	38	36	36	21	24	16	18	4	2	1	4	0	0	0	0	219
2000	0	0	0	0	0	3	3	23	53	36	28	15	16	10	6	4	3	2	0	0	0	0	0	202
2001	0	0	0	0	0	1	1	18	71	61	32	25	15	7	8	7	7	2	2	1	0	0	0	258
2002	0	0	0	0	0	1	0	19	56	60	40	38	42	26	15	10	7	1	1	1	0	0	0	317
2003	0	0	0	1	0	0	1	5	31	65	63	32	20	11	14	8	3	2	2	0	2	0	0	260
2004	0	0	0	0	0	0	0	0	22	34	29	17	16	9	7	11	11	5	3	2	0	0	0	166
2005	0	0	0	0	0	0	0	1	16	41	24	18	18	12	13	8	9	7	7	4	0	0	0	178
2006	0	0	0	0	0	1	0	2	26	15	8	7	7	14	10	9	9	15	7	4	0	1	0	135
2007	0	0	0	0	0	0	0	0	5	0	5	1	3	5	5	11	5	11	8	4	0	0	0	63
2008	0	0	0	0	0	0	0	5	106	80	40	27	11	16	14	16	13	25	10	1	1	0	0	365
2009	0	0	0	0	0	0	0	6	46	60	40	20	15	16	16	14	17	11	11	4	2	0	0	278
2010	0	0	0	0	0	0	0	4	50	101	100	67	54	49	29	24	12	14	6	4	1	1	0	516
2011	0	0	0	0	0	0	0	1	24	75	83	84	75	64	42	33	18	27	12	5	0	0	0	543
2012	0	0	0	0	0	0	0	0	7	16	27	27	35	35	49	54	47	14	8	6	1	0	0	326
2013	0	0	0	0	0	1	2	4	10	22	22	38	32	22	32	26	29	16	4	0	0	0	0	260
2014	0	0	0	0	1	1	0	0	31	18	26	16	16	26	32	43	26	8	3	4	0	0	1	252
2015	0	0	0	0	0	1	1	6	20	36	15	19	7	17	10	18	14	5	4	0	0	0	0	173
2016	0	0	0	0	0	0	0	1	18	19	25	25	27	10	9	6	9	8	6	2	0	0	0	165
2017	0	0	0	0	0	0	0	3	9	13	8	15	8	14	18	14	12	9	4	2	1	0	0	130
2018	0	0	0	0	0	0	0	0	7	21	20	23	24	27	23	18	18	14	11	0	0	0	0	206
2019	0	0	0	0	0	0	0	0	3	30	46	36	36	36	35	51	23	30	10	7	2	0	0	345
2020	0	0	0	0	1	0	0	0	5	23	36	61	62	54	59	66	63	53	32	4	1	0	0	520
2021	0	0	0	0	0	0	1	0	0	17	26	31	46	87	75	68	49	33	16	4	3	0	0	456
2022	0	0	0	0	0	0	0	0	2	13	24	22	58	73	87	73	46	39	17	2	0	0	0	456

Rec West

	Max TL Bins (4 cm)																							
Year	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84	88	92	96	N
1981	0	0	0	0	0	0	1	12	12	10	5	2	3	4	6	3	3	2	0	0	0	0	0	63
1982	0	0	0	0	0	0	0	4	18	18	11	11	10	8	7	10	3	2	1	1	0	0	0	104
1985	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1991	0	0	0	0	0	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	4
1993	0	0	0	0	0	0	0	0	3	2	6	7	7	1	2	2	1	1	0	0	0	0	0	32
1994	0	0	0	0	0	0	0	0	0	3	2	3	2	2	1	3	1	2	0	0	0	0	0	19
1995	0	0	0	0	0	0	0	1	3	9	2	1	1	4	0	1	0	0	0	0	0	0	0	22
1996	0	0	0	0	0	0	0	0	5	3	4	1	1	0	0	0	0	0	0	0	0	0	0	14
1997	0	0	0	0	0	0	0	0	5	2	3	1	0	1	0	0	0	0	0	0	0	0	0	12
2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
2001	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
2002	0	0	0	0	0	0	0	6	2	8	4	3	3	3	2	0	1	2	0	0	0	0	0	34
2003	0	0	0	0	0	0	0	0	1	0	1	0	2	0	3	1	1	0	1	0	0	0	0	10
2004	0	0	0	0	0	0	0	0	5	1	1	1	2	1	2	1	0	1	0	0	0	0	0	15
2005	0	0	0	0	0	0	0	0	6	5	10	9	5	5	3	3	1	3	2	2	0	0	0	54
2006	0	0	0	0	0	0	0	0	13	10	7	6	7	6	7	8	6	5	1	1	0	0	0	77
2007	0	0	0	0	0	0	0	1	6	22	22	9	4	6	2	2	0	1	2	0	0	0	0	77
2008	0	0	0	0	0	0	1	2	20	17	49	36	21	28	33	43	21	24	15	7	0	0	0	317
2009	0	0	0	0	0	0	0	0	37	52	60	52	52	46	50	43	42	20	21	6	0	0	0	481
2010	0	0	0	0	0	0	0	3	39	55	40	24	41	35	48	32	27	22	4	1	1	0	0	372
2011	0	0	0	0	0	0	0	1	24	33	38	37	40	53	32	38	41	25	13	3	0	0	1	379
2012	0	0	0	0	0	0	1	1	13	43	47	55	64	51	53	60	34	37	26	16	3	0	0	504
2013	0	0	0	0	0	0	0	2	21	35	44	40	48	42	29	34	24	23	16	5	0	0	0	363
2014	0	0	0	0	0	0	3	3	72	56	22	28	23	23	27	34	13	5	4	1	0	0	0	314
2015	0	0	0	0	0	0	0	3	57	67	37	37	30	21	44	29	26	11	14	5	1	0	0	382
2016	0	0	0	0	0	0	0	9	82	106	86	57	65	65	68	47	39	28	11	5	0	0	0	668
2017	0	0	0	0	0	0	2	8	53	55	74	78	56	43	45	35	25	16	9	0	0	0	0	499
2018	0	0	0	0	0	0	1	1	11	81	107	81	60	48	56	52	37	16	6	2	0	0	0	559
2019	0	0	0	0	0	0	2	0	3	68	54	40	31	12	18	20	12	8	4	0	0	0	0	272
2020	0	0	0	0	0	0	0	1	0	7	9	2	3	2	2	3	2	0	0	0	0	0	0	31
2021	0	0	0	0	0	0	0	0	0	7	17	14	9	9	9	4	1	5	2	0	0	0	0	77
2022	0	0	0	0	1	0	0	0	0	25	27	23	19	16	13	17	8	4	2	0	0	0	0	155

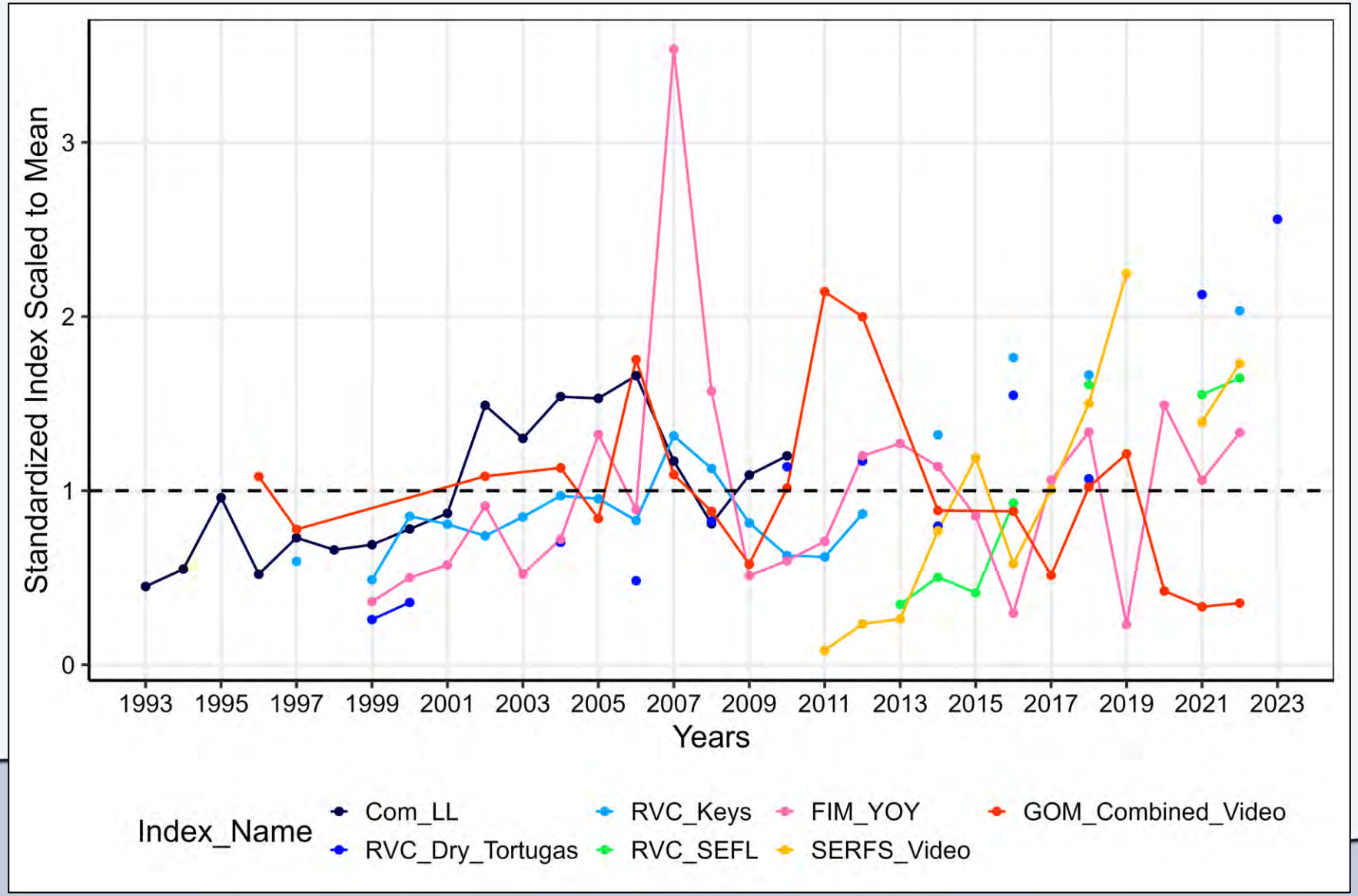
Rec East

	Max TL Bins (4 cm)																							
Year	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84	88	92	96	N
1981	0	0	0	0	0	0	1	21	26	28	6	1	1	1	0	0	1	0	0	0	0	0	0	86
1982	0	0	0	0	0	0	0	4	17	24	11	6	1	1	1	0	0	0	0	0	0	0	0	65
1983	0	0	0	0	0	0	0	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	4
1984	0	0	0	0	0	0	1	4	11	3	2	3	3	3	2	0	0	0	0	0	0	0	0	32
1985	0	0	0	0	0	0	1	3	17	21	19	7	5	8	2	1	1	1	1	0	0	0	0	87
1986	0	0	0	0	0	0	0	2	3	8	5	4	5	2	1	1	1	0	1	0	0	0	0	33
1987	0	0	0	0	0	0	1	1	3	2	0	3	2	0	2	0	0	0	0	0	0	0	0	14
1988	0	0	0	0	0	0	3	3	6	8	4	3	2	2	1	1	0	0	0	0	0	0	0	33
1990	0	0	0	0	0	0	0	0	0	0	0	3	0	3	0	0	0	0	0	0	0	0	0	6
1991	0	0	0	0	0	0	0	0	1	1	1	0	2	2	0	0	0	0	0	0	0	0	0	7
1992	0	0	0	0	0	0	0	1	1	0	0	1	1	0	1	0	0	0	0	0	0	0	0	5
1993	0	0	0	0	0	0	1	2	5	1	1	2	3	1	1	1	1	2	0	0	0	0	0	21
1994	0	0	0	0	0	0	0	0	0	2	2	0	2	1	0	1	1	1	0	0	0	0	0	10
1995	0	0	0	0	0	0	0	1	30	32	15	12	4	5	4	1	0	0	0	0	0	0	0	104
1996	0	0	0	0	0	0	0	0	2	3	2	1	0	1	0	0	1	0	0	0	0	0	0	10
1997	0	0	0	0	0	0	0	0	1	3	1	2	0	0	0	0	0	0	0	1	0	0	0	8
2000	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	3
2001	0	0	0	0	0	0	0	0	15	9	5	2	7	0	0	0	0	0	0	0	0	0	0	38
2002	0	0	0	0	0	0	0	1	27	15	18	9	4	6	1	1	2	0	0	0	0	0	0	84
2003	0	0	0	0	0	0	0	3	74	100	55	38	24	12	7	6	1	2	0	0	2	0	0	324
2004	0	0	0	0	0	0	0	5	67	45	51	33	12	10	7	11	3	2	1	0	0	0	0	247
2005	0	0	0	0	0	0	1	19	188	122	51	26	16	9	6	5	5	3	0	0	0	0	0	451
2006	0	0	0	0	0	0	0	14	89	65	31	14	6	6	6	2	1	0	0	0	0	0	0	234
2007	0	0	0	0	0	0	1	15	170	177	126	49	26	19	6	4	4	0	1	1	0	0	0	599
2008	0	0	0	0	0	0	0	11	217	127	57	28	13	16	7	7	2	2	0	0	0	0	0	487
2009	0	0	0	0	0	0	0	27	240	165	81	38	19	21	11	6	5	0	0	0	0	0	0	613
2010	0	0	0	0	0	0	0	14	201	200	130	59	31	16	10	2	2	2	0	0	0	0	0	667
2011	0	0	0	0	0	0	0	4	80	121	61	41	19	17	7	6	0	0	0	0	0	0	0	356
2012	0	0	0	0	0	0	0	1	15	27	30	24	17	6	5	1	1	1	0	0	1	0	0	129
2013	0	0	0	0	0	0	1	1	36	38	11	6	5	7	0	2	2	2	0	0	0	0	0	111
2014	0	0	0	0	0	0	2	6	162	64	42	13	10	2	1	0	0	1	2	1	0	0	0	306
2015	0	0	0	0	0	0	0	4	140	77	30	21	6	6	1	2	0	0	1	0	0	0	0	288
2016	0	0	0	0	0	0	0	4	121	84	52	22	17	16	5	4	3	1	2	0	0	0	0	331
2017	0	0	0	0	0	0	0	9	40	55	33	23	19	11	9	4	1	0	0	0	0	0	0	204
2018	0	0	0	0	0	0	0	2	11	61	38	22	5	15	3	3	1	0	0	0	0	0	0	161
2019	0	0	0	0	0	1	0	0	4	35	31	23	9	7	9	2	3	1	3	1	0	0	0	129
2020	0	0	0	0	0	0	0	0	1	5	4	4	1	3	1	0	0	0	0	0	0	0	0	19
2021	0	0	0	0	0	0	0	0	4	31	26	10	13	7	6	2	4	0	0	0	0	0	0	103
2022	0	0	0	0	1	0	0	0	2	62	60	14	15	14	7	7	2	4	0	0	0	0	0	188

Fishery Independent Sources

	Max TL Bins (4 cm)																							
Year	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84	88	92	96	**N**
1998	2	31	20	11	3	0	2	8	21	40	24	17	6	6	6	6	0	0	1	0	0	0	0	204
1999	1	14	2	12	6	6	1	5	29	32	19	11	7	6	3	5	1	1	1	0	0	0	0	162
2000	0	13	6	3	6	6	21	48	66	29	20	7	13	9	6	5	2	3	2	0	0	0	0	265
2001	0	3	5	4	3	4	7	18	54	40	27	13	6	9	5	5	6	3	2	0	0	0	0	214
2002	0	1	0	2	0	0	8	28	19	3	13	12	4	5	6	4	3	1	0	0	0	0	0	109
2007	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	4
2008	0	0	0	0	0	0	1	0	1	0	0	0	1	2	2	0	0	0	0	0	0	0	0	7
2009	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	1	0	0	0	0	0	0	0	6
2010	0	0	0	0	0	0	0	0	0	3	0	1	0	1	0	1	0	0	0	0	0	0	0	6
2011	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	3
2012	0	0	0	0	0	1	0	0	0	0	0	1	2	1	1	1	1	0	0	1	0	0	0	9
2013	0	0	0	0	1	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	4
2014	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	3
2015	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	3
2016	0	0	0	0	1	1	0	1	0	0	0	1	2	0	1	2	2	0	0	0	0	0	0	11
2017	0	0	0	0	0	0	1	0	0	1	1	1	0	1	1	0	0	0	0	0	0	0	0	6
2018	0	0	0	0	1	0	2	3	3	3	0	0	1	1	1	1	2	0	1	0	0	0	0	19
2019	0	0	0	0	2	0	0	0	0	0	0	0	1	2	5	5	1	2	2	0	0	0	0	20
2020	0	0	0	0	0	0	0	0	0	1	2	2	0	1	1	5	1	1	1	0	0	0	0	15
2021	0	0	0	0	0	0	0	0	2	0	0	3	6	12	12	5	7	11	2	0	0	0	0	60
2022	0	0	0	0	0	0	1	1	1	1	3	5	5	9	14	12	15	9	2	1	0	0	0	79

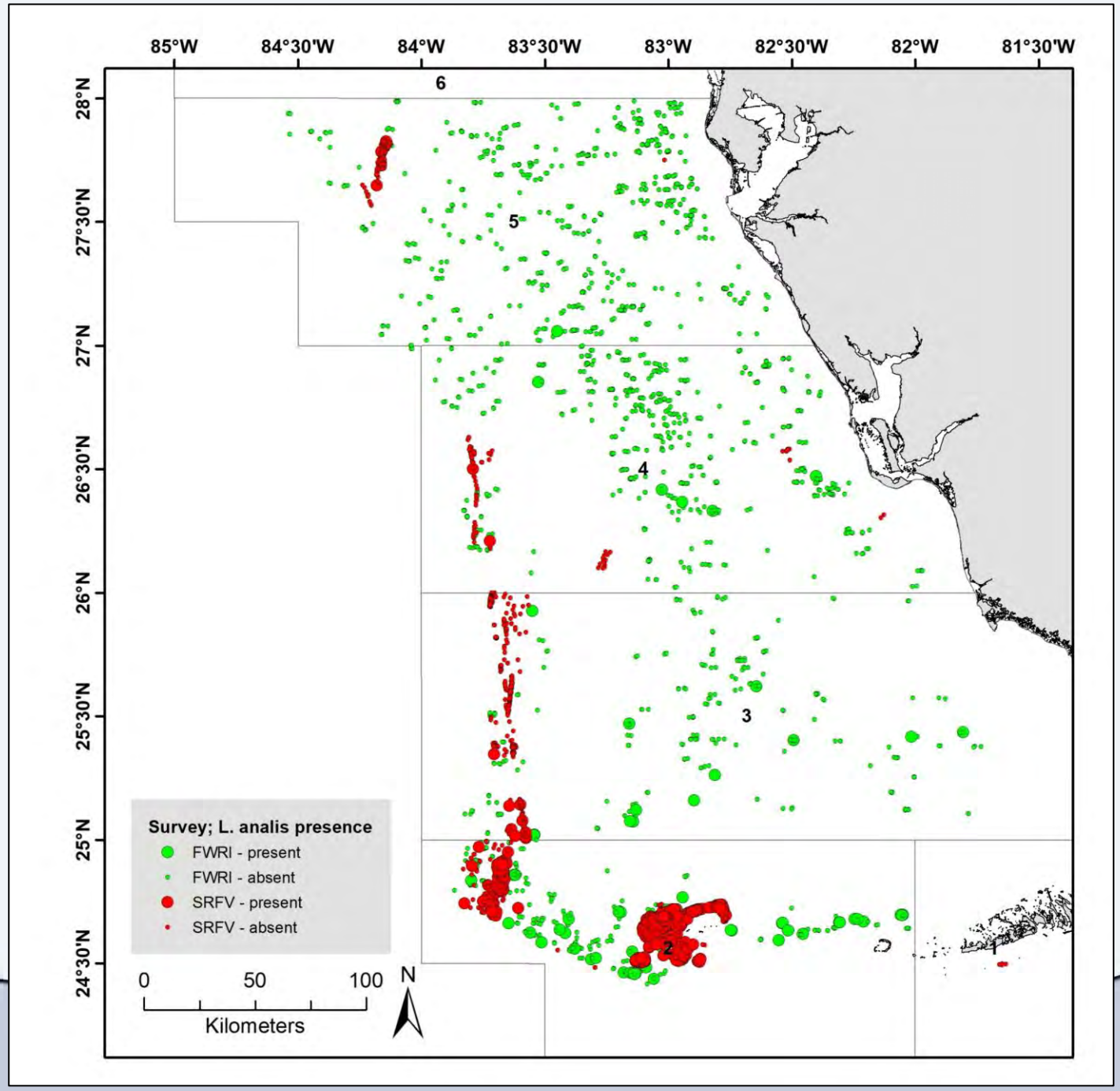
Main Data Inputs: Indices



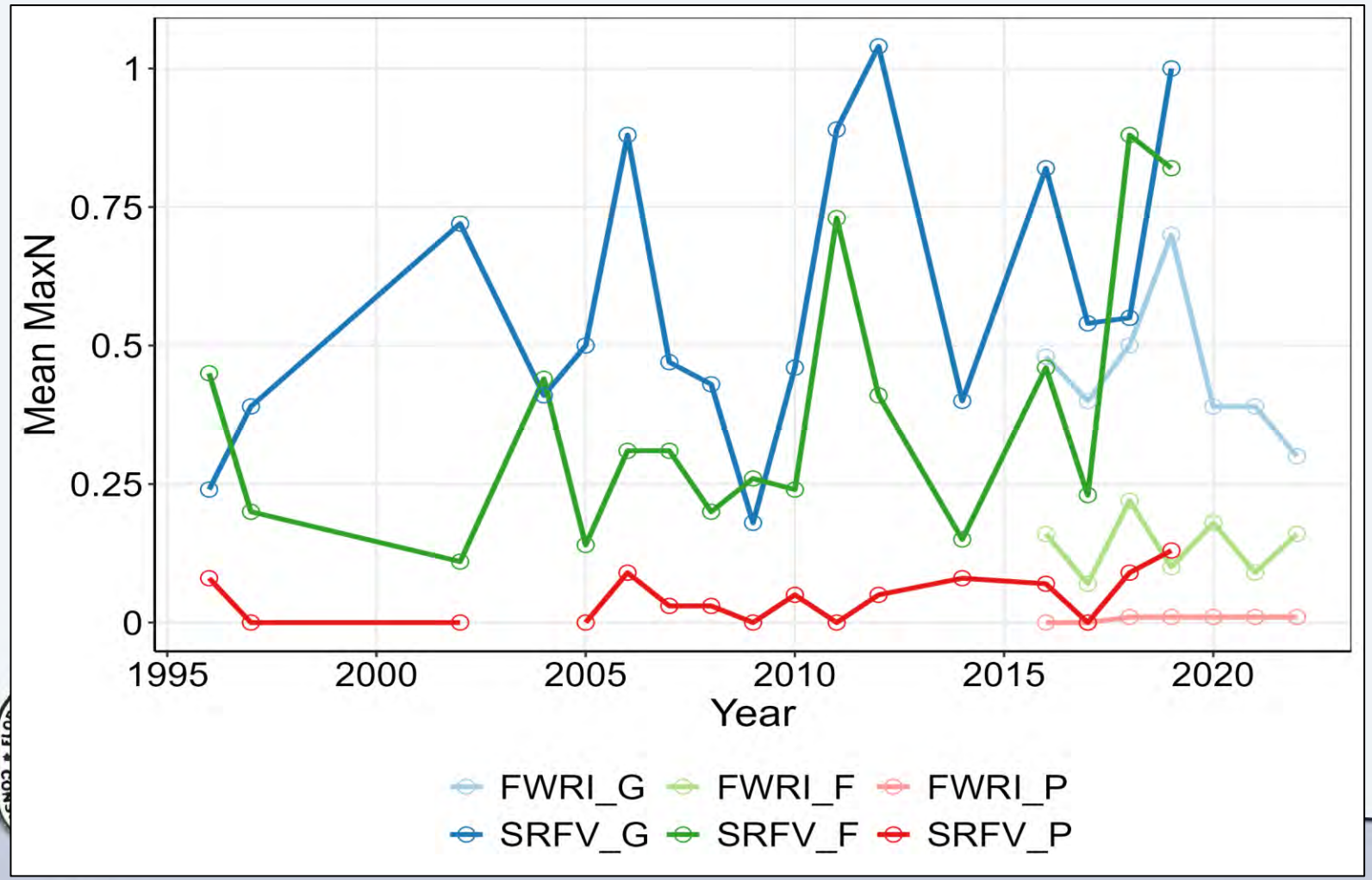
Gulf Combined Video Survey

Spatial Coverage

- Natural Habitat only
- Stat zones 2-5
- Less than 110 m
- SEAMAP (SRFV) 1993-2019
- FWRI 2010-2015
  - Zones 4 and 5
- FWRI 2016-2019
  - Zones 2-5
- FWRI 2020 - Present
  - G-FISHER design



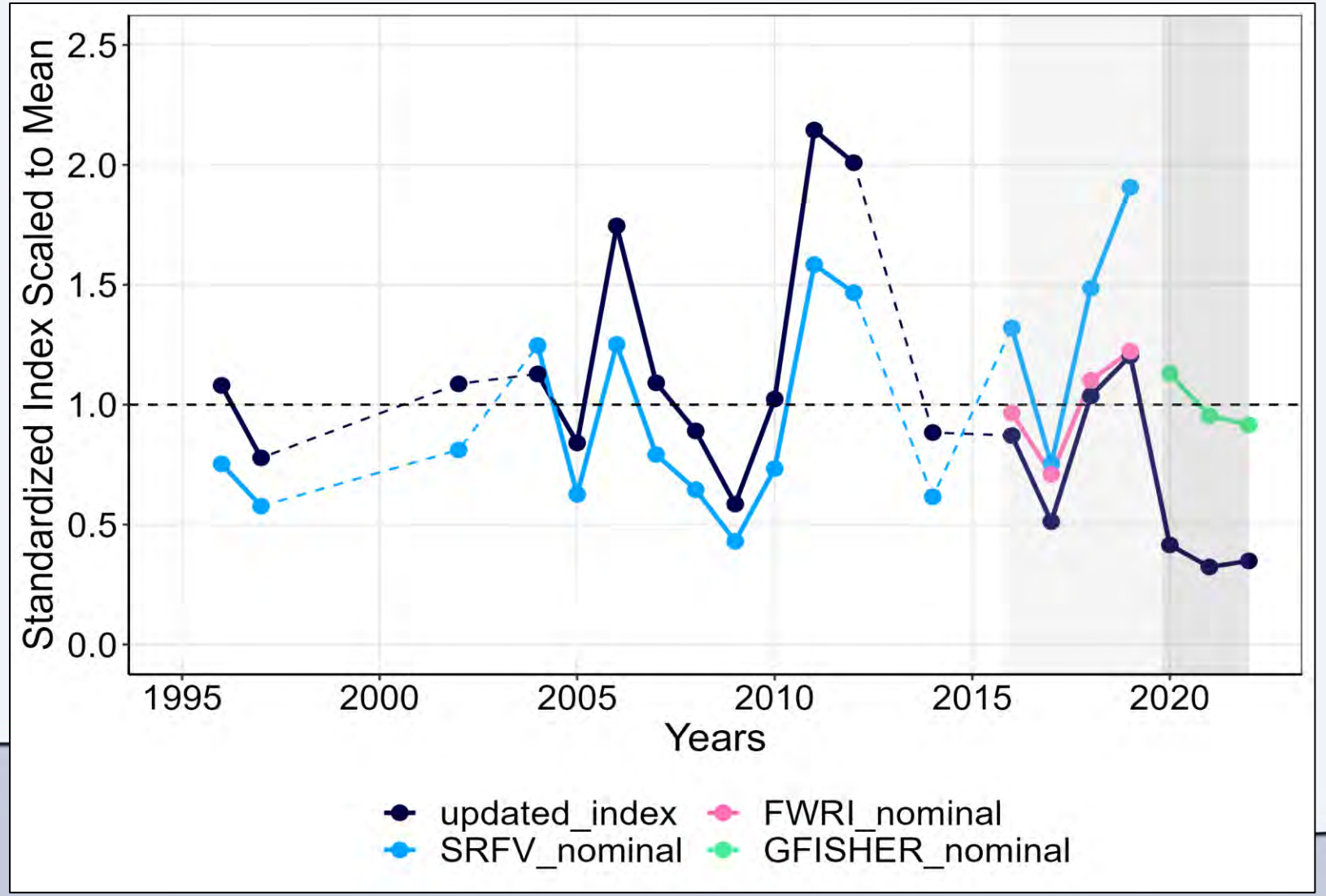
Mean MaxN by Lab, Habitat, and Year



	SRFV	FWRI
Good	0.28	0.11
Fair	0.29	0.22
Poor	**0.43**	**0.67**

	SRFV	FWRI	GFISHER
Good	0.28	0.07	0.25
Fair	0.29	0.31	
Poor	**0.43**	**0.62**	**0.75**

GOM Video Index vs Normalized Nominal Means



Assessment Panel Recommendations

- Allow for a decrease in survey catchability (q) to account for the increased spatial coverage in mostly poor Mutton habitat in the FWRI and GFISHER surveys.
  - In the Base Model, allow for a change in catchability (q) from 2016-2019 (FWRI) and from 2020-2022 (GFISHER).

Stock Synthesis Model Configuration

Fleets (Fmethod=4)

- Commercial LL
  - Landings (mt, fit exactly)
- Commercial Other
  - Landings (mt, fit exactly) and discards (numbers)
- Rec East (All Modes)
  - Landings and discards (numbers, not fit exactly)
- Rec West (All Modes)
  - Landings and discards (numbers, not fit exactly)

Surveys

- Commercial LL CPUE
  - Retained lbs/number of sets/number of hooks per set
- GOM Combined Video
  - Weighted Mean of Max N (numbers)
  - Changes in Catchability: 2016-2019 & 2020-2022
- RVC – Dry Tortugas, FL Keys, SE FL
  - Number of fish/diver 'cylinder'
- FIM Indian River YOY
  - Recruitment index (type 33)
  - total catch/set (numbers)
- SERFS Video
  - SumCount (numbers)

Stock Synthesis Model Configuration

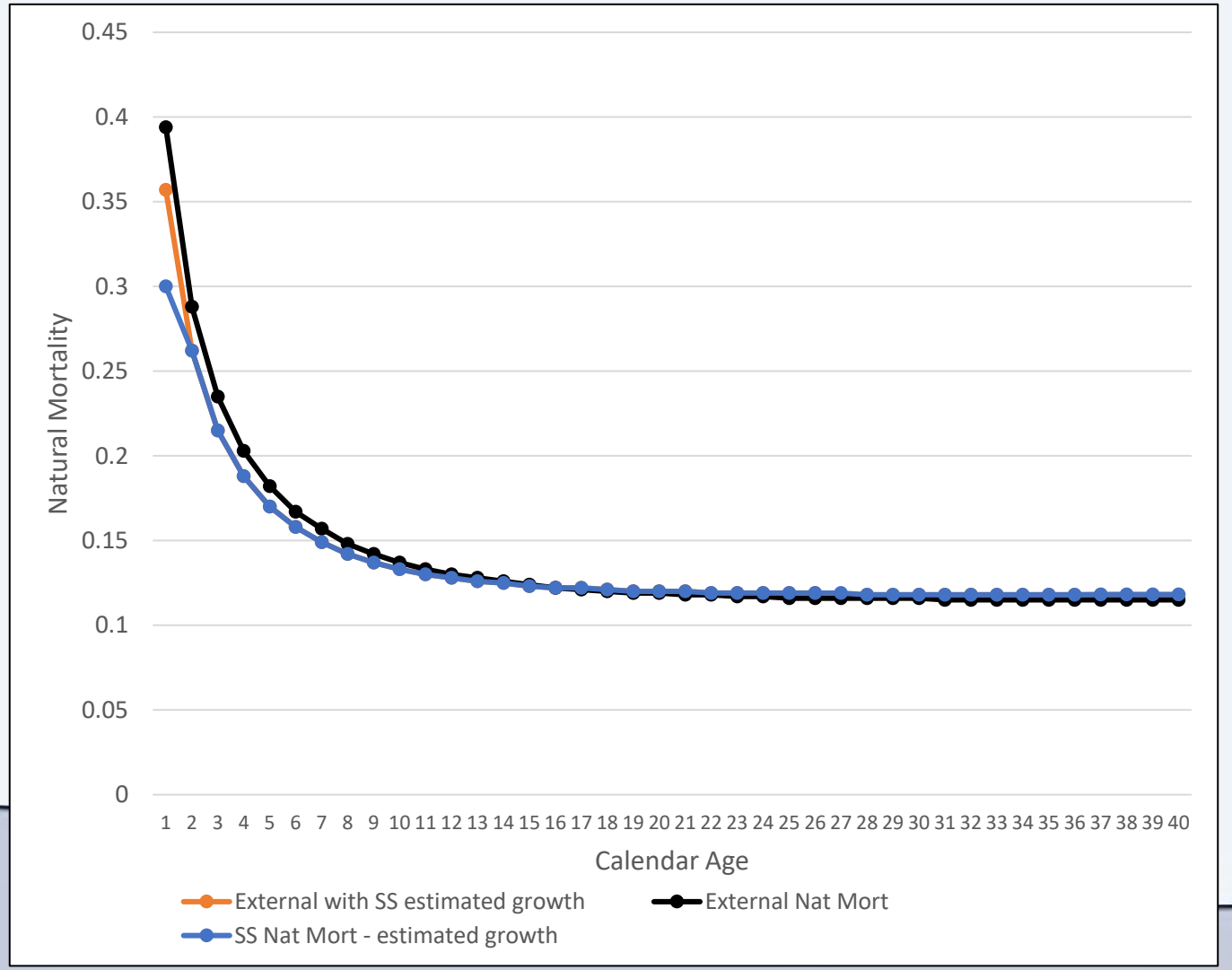
Fleets (Fmethod=4)

- Commercial LL
  - Landings (mt, fit exactly)
- Commercial Other
  - Landings (mt, fit exactly) and discards (numbers)
- Rec East (All Modes)
  - Landings and discards (numbers, not fit exactly)
- Rec West (All Modes)
  - Landings and discards (numbers, not fit exactly)

Surveys

- Commercial LL CPUE
  - Retained lbs/number of sets/number of hooks per set
- GOM Combined Video
  - Weighted Mean of Max N (numbers)
  - Changes in Catchability: 2016-2019 & 2020-2022
- RVC – Dry Tortugas, FL Keys, SE FL
  - Number of fish/diver 'cylinder'
- FIM Indian River YOY
  - Recruitment index (type 33)
  - total catch/set (numbers)
- SERFS Video
  - SumCount (numbers)

SS Natural Mortality vs External Model



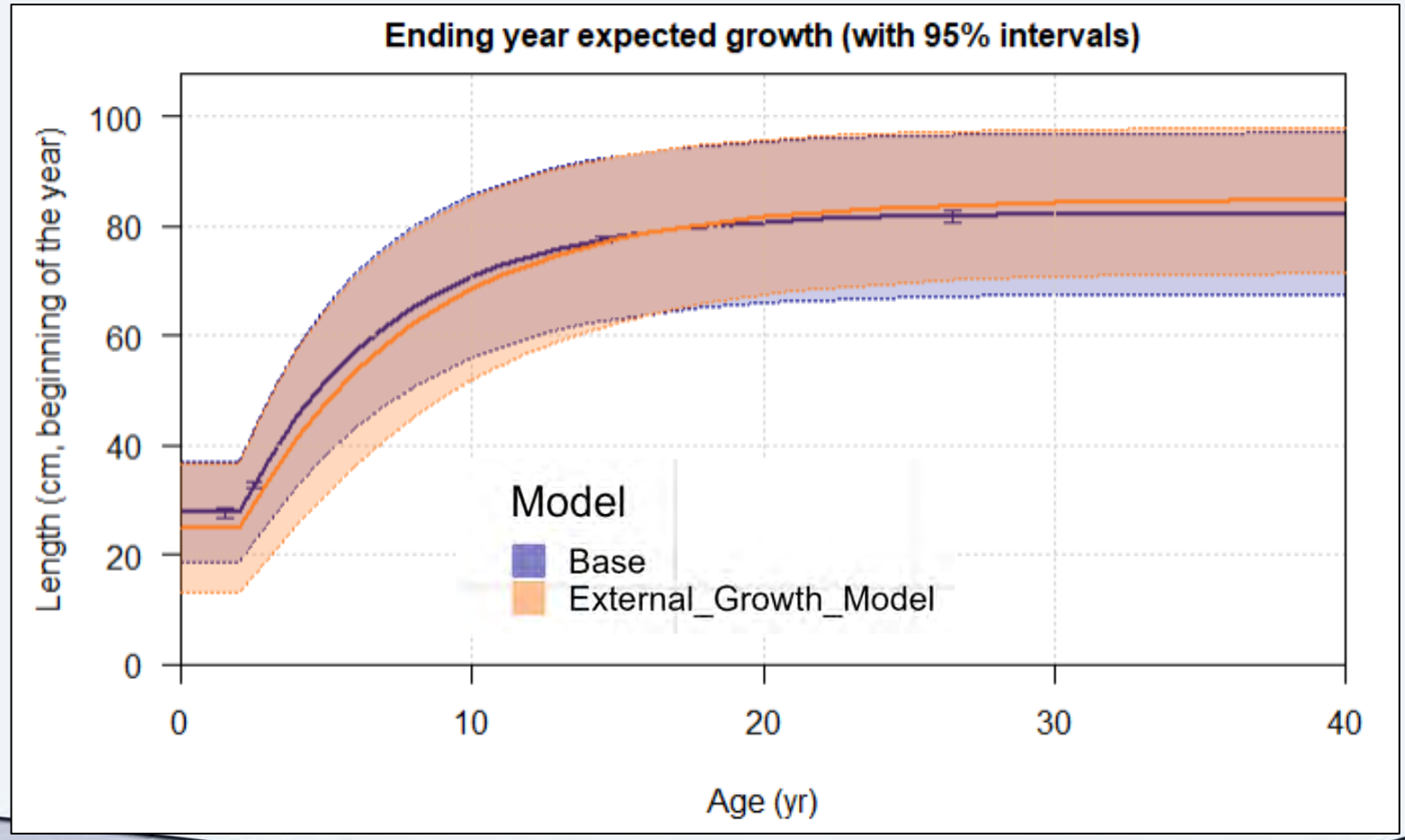
von Bertalanffy Growth Comparison

SS Model (blue)

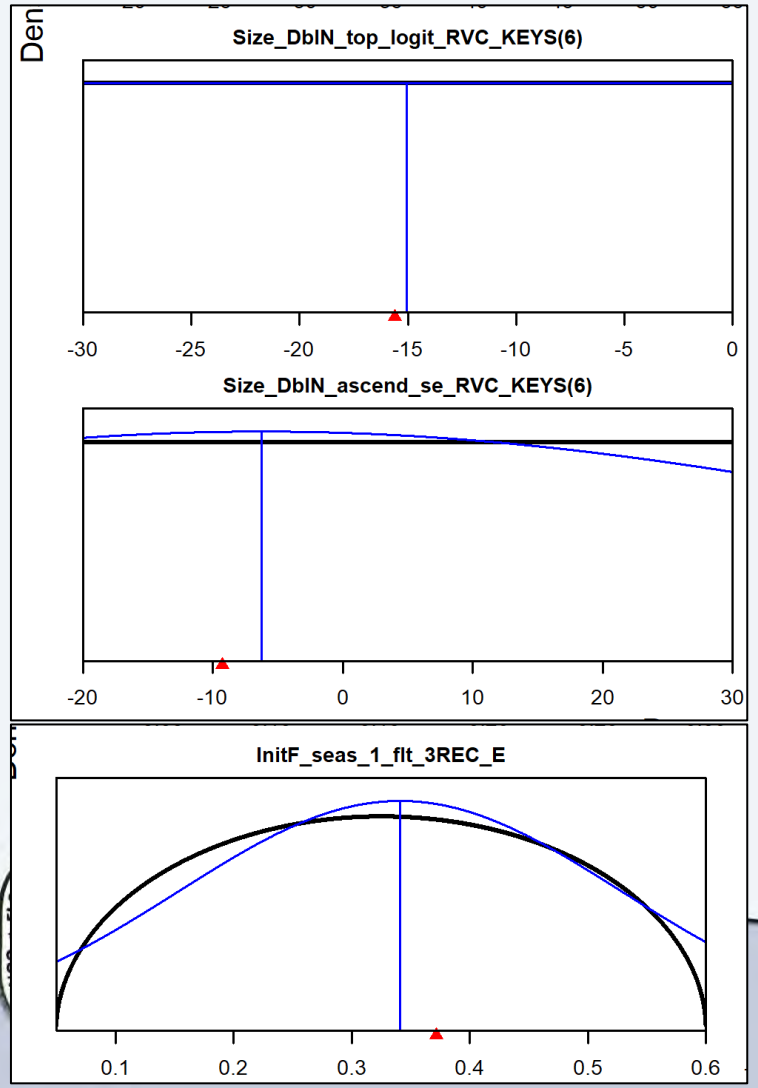
- L_{inf}: 82.3 cm
- k: 0.195 year^{-1}
- CV_{young}: 0.17
- CV_{old}: 0.09

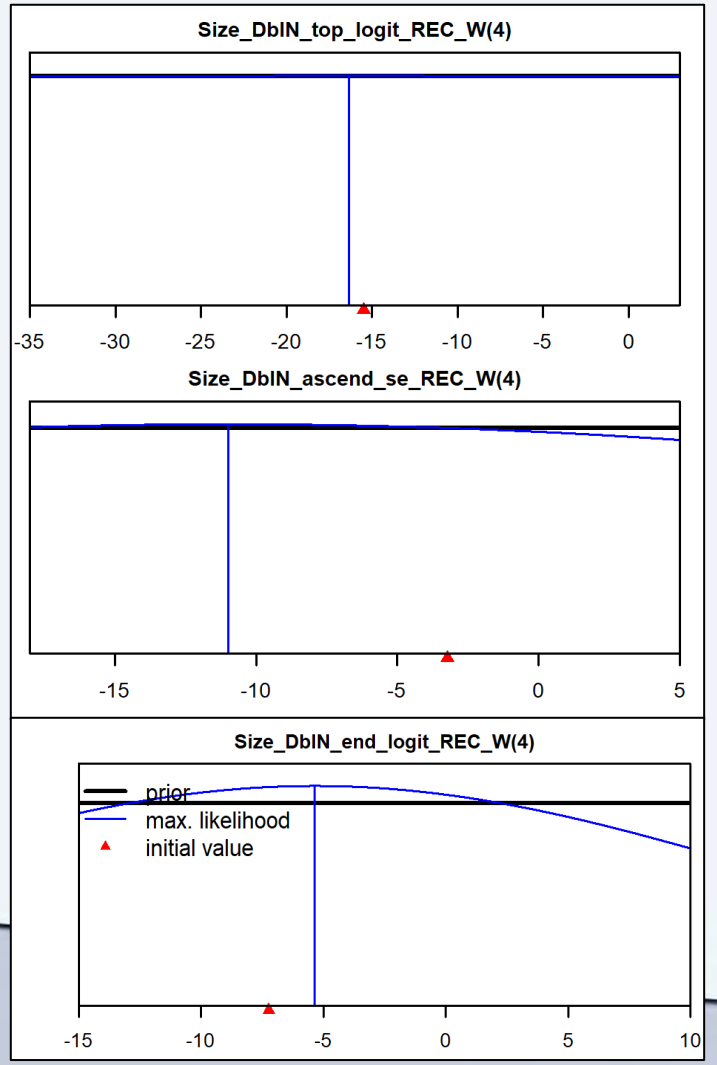
Size-truncated external model (pink)

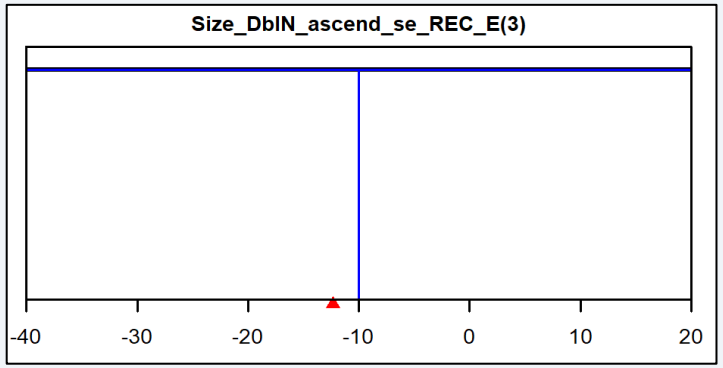
- L_{inf}: 84.7 cm
- k: 0.16 year^{-1}
- CV_{young}: 0.14
- CV_{old}: 0.03

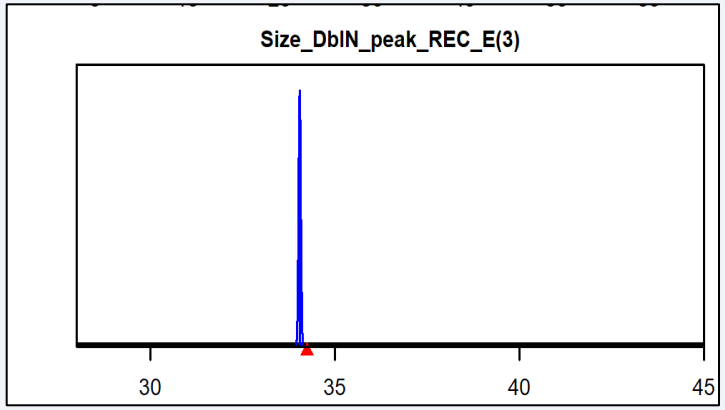


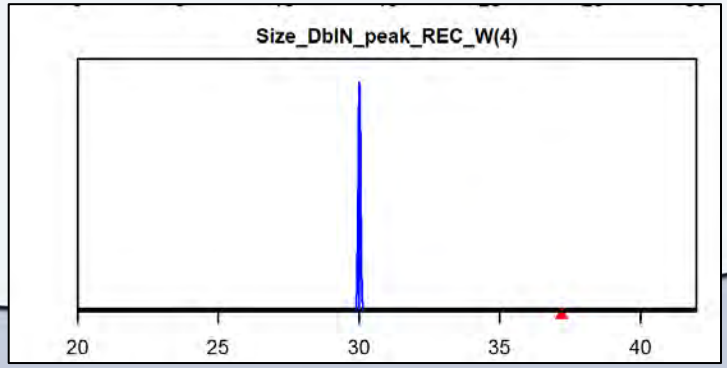
“Problem” Parameters









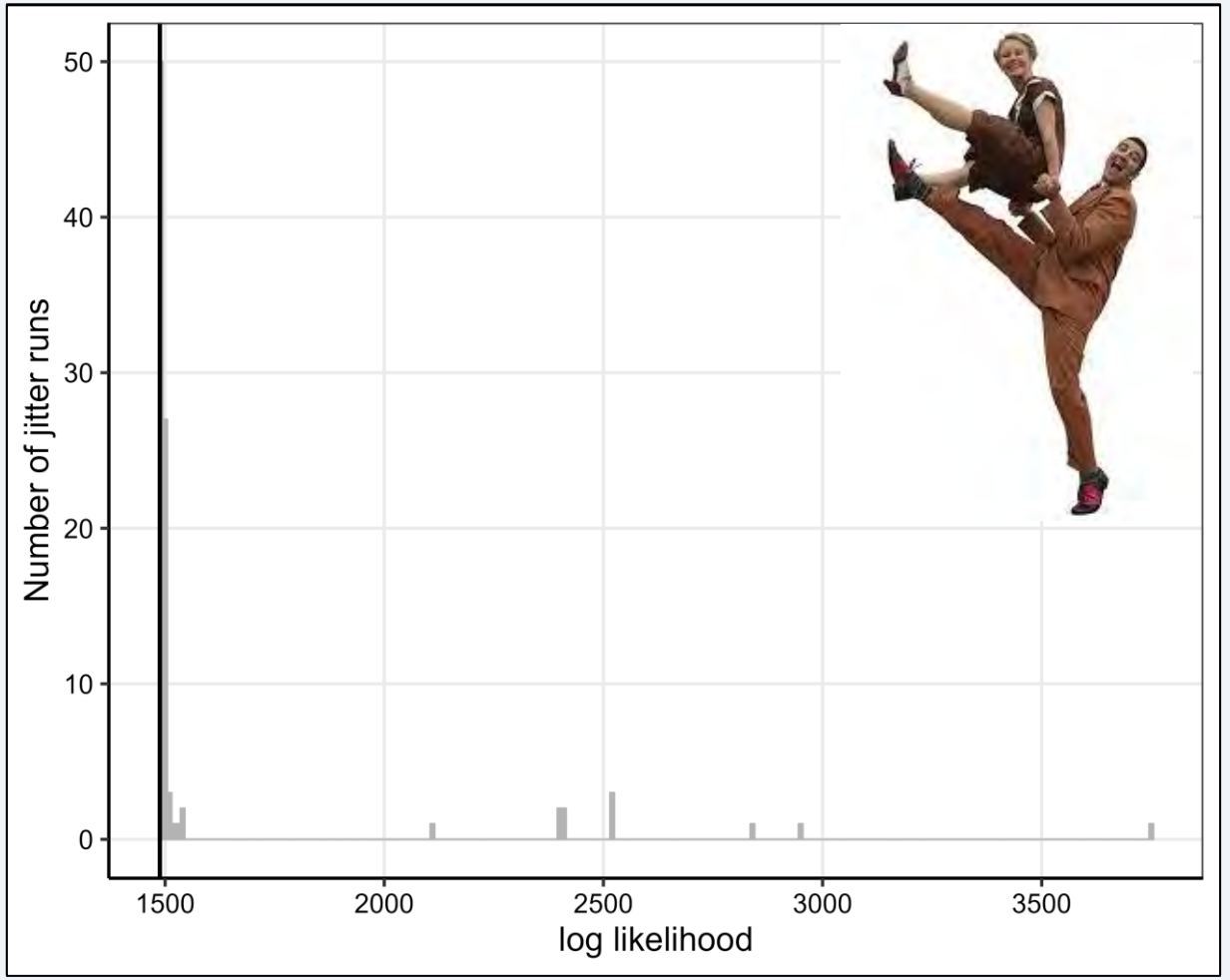


Correlated Parameters (correlation coefficient > 0.7)

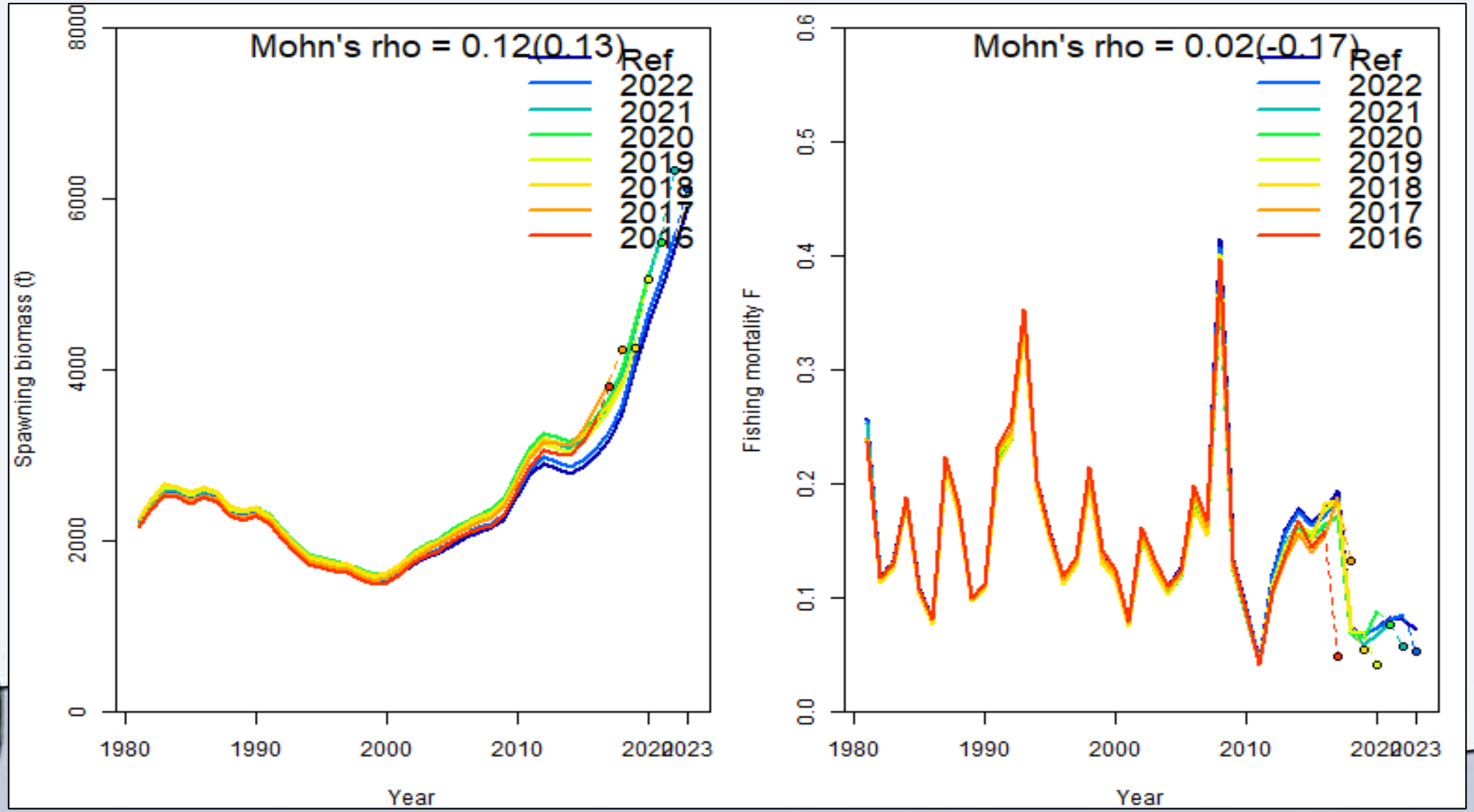
Parameter 1	Parameter 2	Correlation
Retain_L_infl_REC_E(3)_BLK2mult_1995	Retain_L_infl_REC_E(3)	-0.99
Retain_L_infl_REC_W(4)_BLK2mult_1995	Retain_L_infl_REC_W(4)	-0.95
Retain_L_width_REC_E(3)_BLK2mult_1995	Retain_L_width_REC_E(3)	-0.92
Size_DblN_ascend_se_RVC_DT(5)	Size_DblN_peak_RVC_DT(5)	0.91
Size_DblN_end_logit_RVC_KEYS(6)	Size_DblN_descend_se_RVC_KEYS(6)	-0.90
Size_DblN_descend_se_REC_E(3)	Size_DblN_top_logit_REC_E(3)	-0.89
Retain_L_infl_REC_W(4)_BLK2mult_2018	Retain_L_infl_REC_W(4)	-0.89
Retain_L_infl_REC_E(3)_BLK2mult_2018	Retain_L_infl_REC_E(3)	-0.89
Retain_L_infl_REC_E(3)_BLK2mult_2018	Retain_L_infl_REC_E(3)_BLK2mult_1995	0.88
Retain_L_width_REC_W(4)_BLK2mult_1995	Retain_L_width_REC_W(4)	-0.87
Retain_L_infl_REC_W(4)_BLK2mult_2018	Retain_L_infl_REC_W(4)_BLK2mult_1995	0.86
Size_95%width_COM_LL(1)	Size_inflection_COM_LL(1)	0.83
Size_DblN_end_logit_REC_W(4)	Size_DblN_descend_se_REC_W(4)	-0.82
VonBert_K_Fem_GP_1	L_at_Amax_Fem_GP_1	-0.82
Size_DblN_descend_se_RVC_DT(5)	Size_DblN_top_logit_RVC_DT(5)	-0.82
Retain_L_width_COM_OTHER(2)_BLK1add_2018	Retain_L_infl_COM_OTHER(2)_BLK1add_2018	0.81
Size_DblN_end_logit_RVC_DT(5)	Size_DblN_descend_se_RVC_DT(5)	-0.80
Size_95%width_GOM_VID(9)	Size_inflection_GOM_VID(9)	0.77
Retain_L_width_REC_E(3)_BLK2mult_2018	Retain_L_width_REC_E(3)	-0.76
Size_inflection_GOM_VID(9)	LnQ_base_GOM_VID(9)	0.76
SR_BH_steep	SR_LN(R0)	-0.72
Retain_L_width_REC_E(3)_BLK2mult_2018	Retain_L_width_REC_E(3)_BLK2mult_1995	0.71
CV_young_Fem_GP_1	L_at_Amin_Fem_GP_1	-0.70

Jitterbug Analysis

- Jittered starting values 10% for 200 runs
- Only 5 runs had max gradient < 0.0001 👎
- 95 runs had max gradient < 0.05
- **No run had a LL value less than the base model** 👍



Retrospective Analysis



Prediction Skill (9 yr hindcast cross validation)

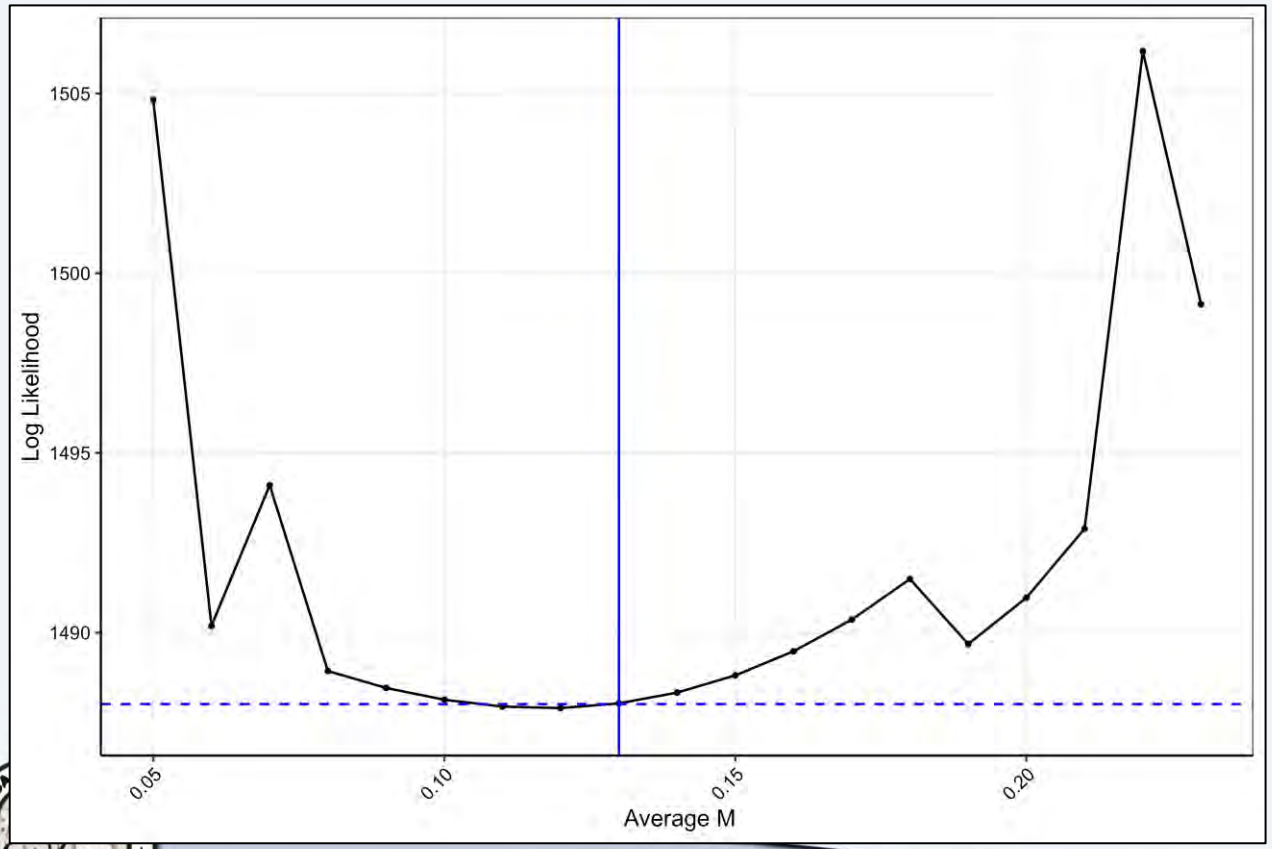
MASE (Mean Absolute Scaled Error) = Average of mean absolute error of prediction residuals (MAE.PR)/Naive Predictions (MAE.base)

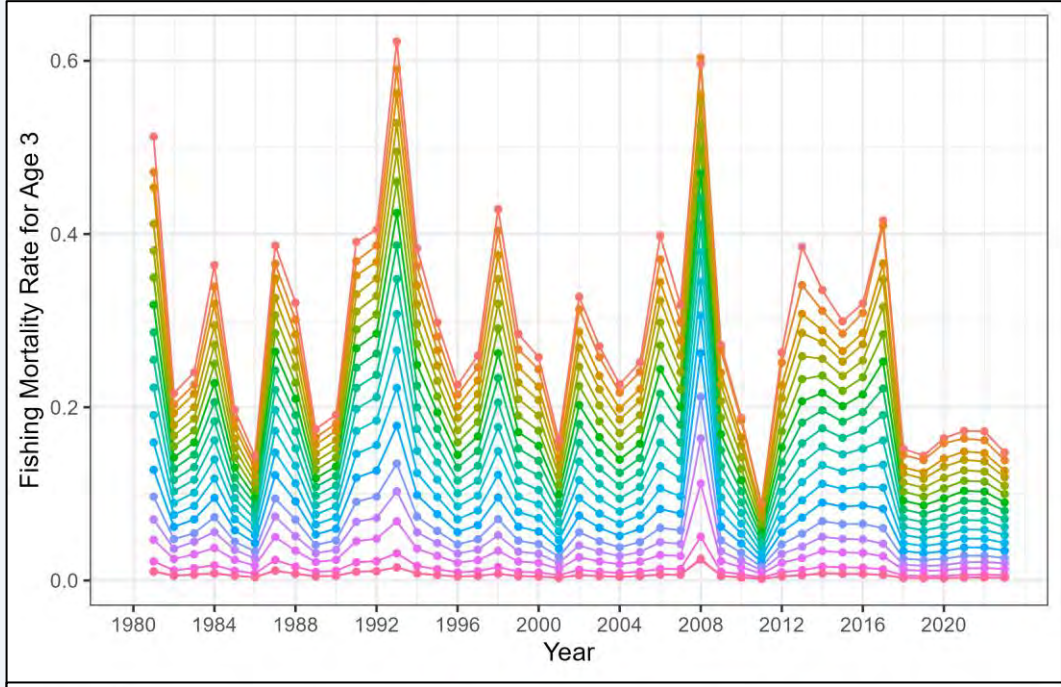
Index	MASE	MAE.PR	MAE.base	N_years
RVC_DT	0.47	0.22	0.48	4
RVC_KEYS	1.16	0.21	0.18	3
RVC_SEFL	1.88	0.60	0.32	5
FIM_YOY	0.54	0.48	0.88	8
GOM_VID	1.17	0.46	0.39	7
SERFS_VID	0.74	0.34	0.46	7
Joint	0.81	0.41	0.50	34

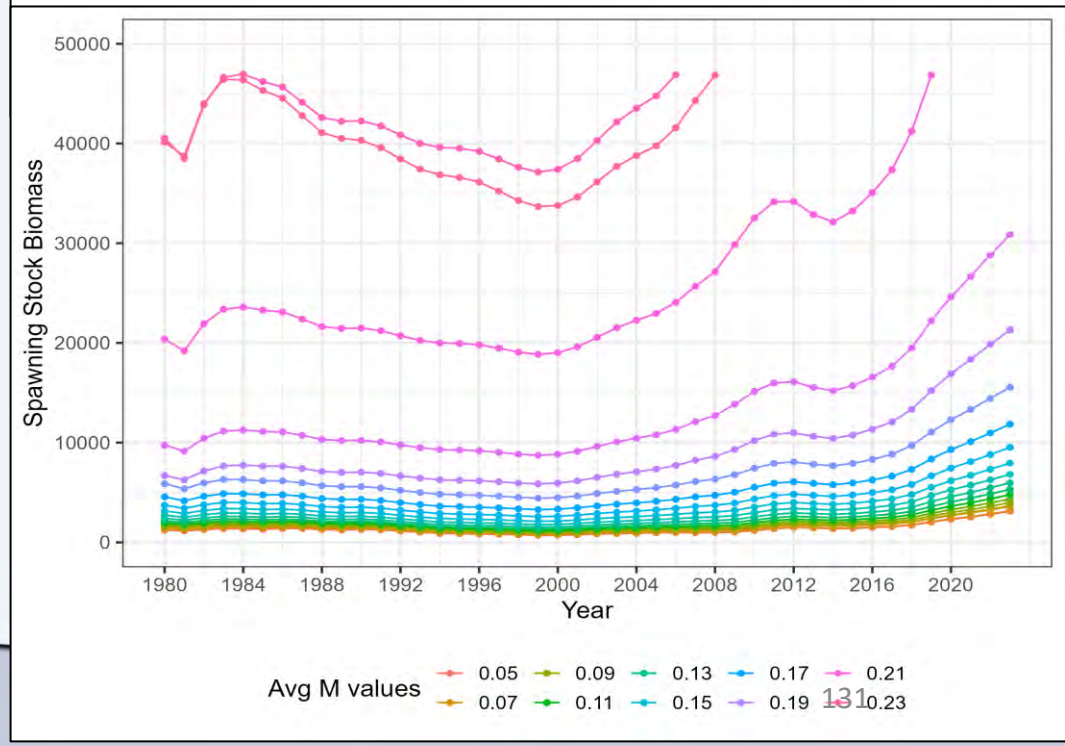
Parameter Profiling

- Hold a parameter value constant at a chosen value and estimate the remaining parameters
- All runs are presented, even those that had high gradients or non-positive definite hessians
- Fixed peak selectivity parameters for REC East and REC West fleets

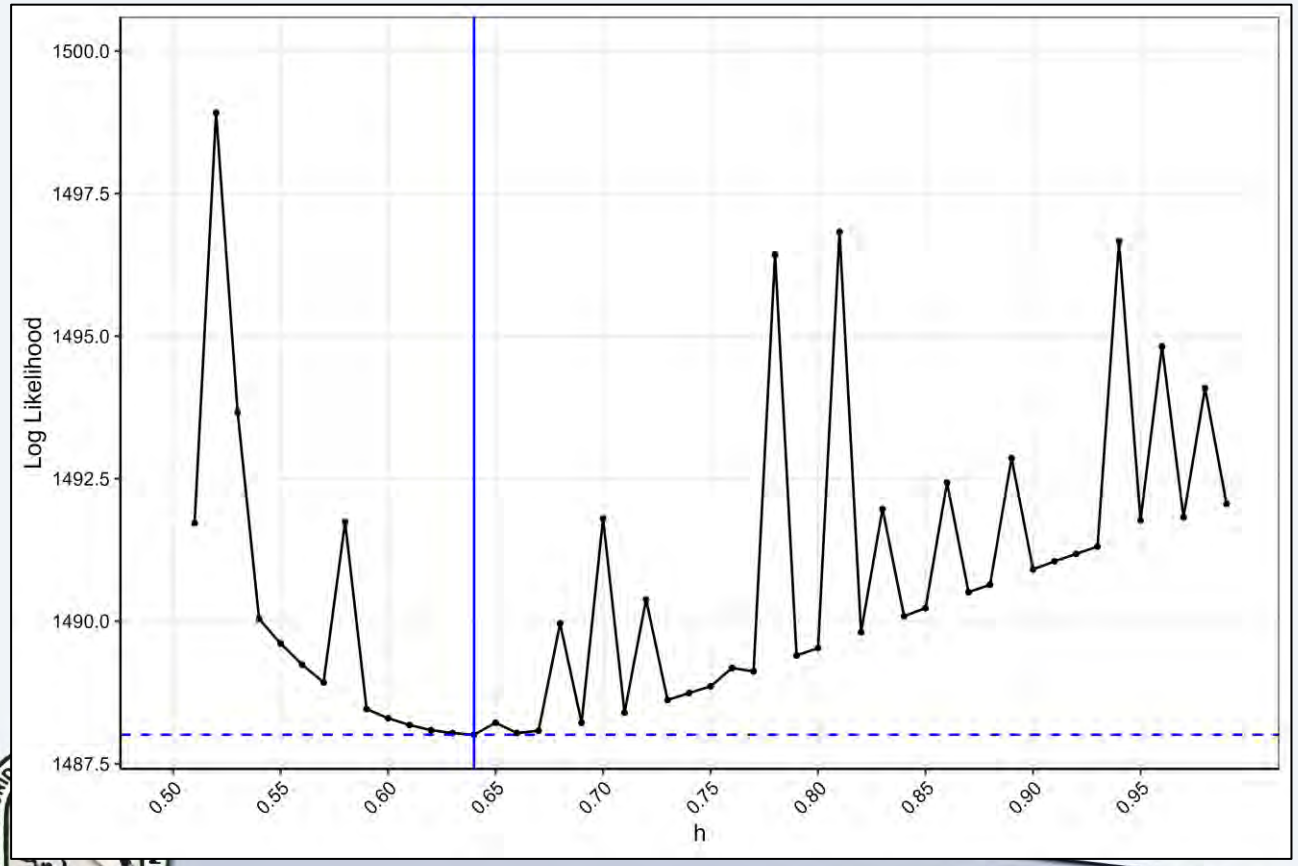
Profiling on Base M

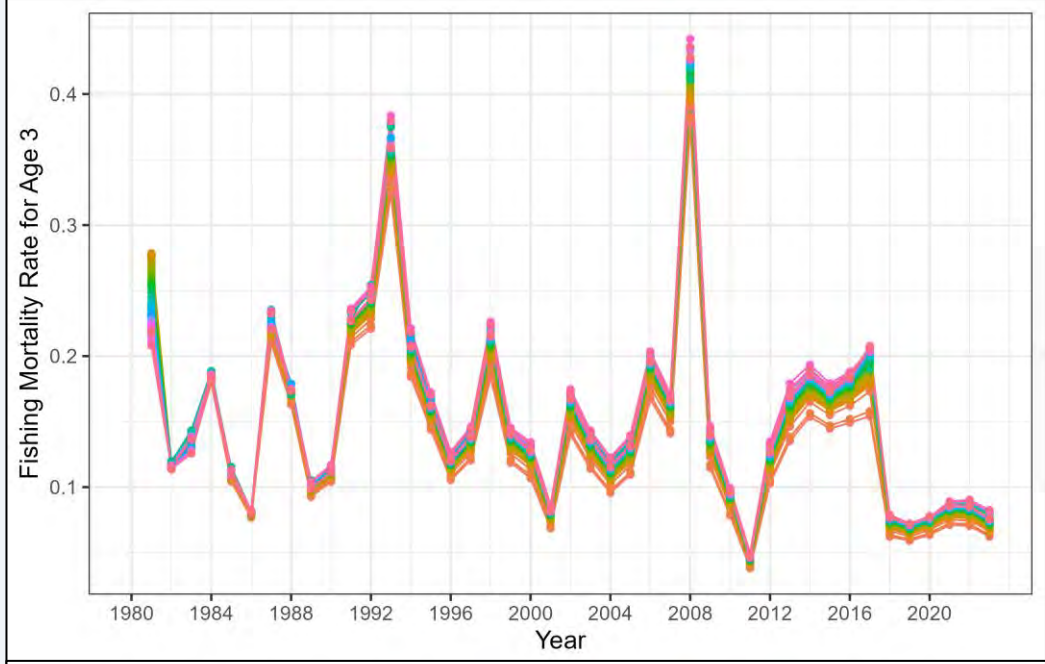


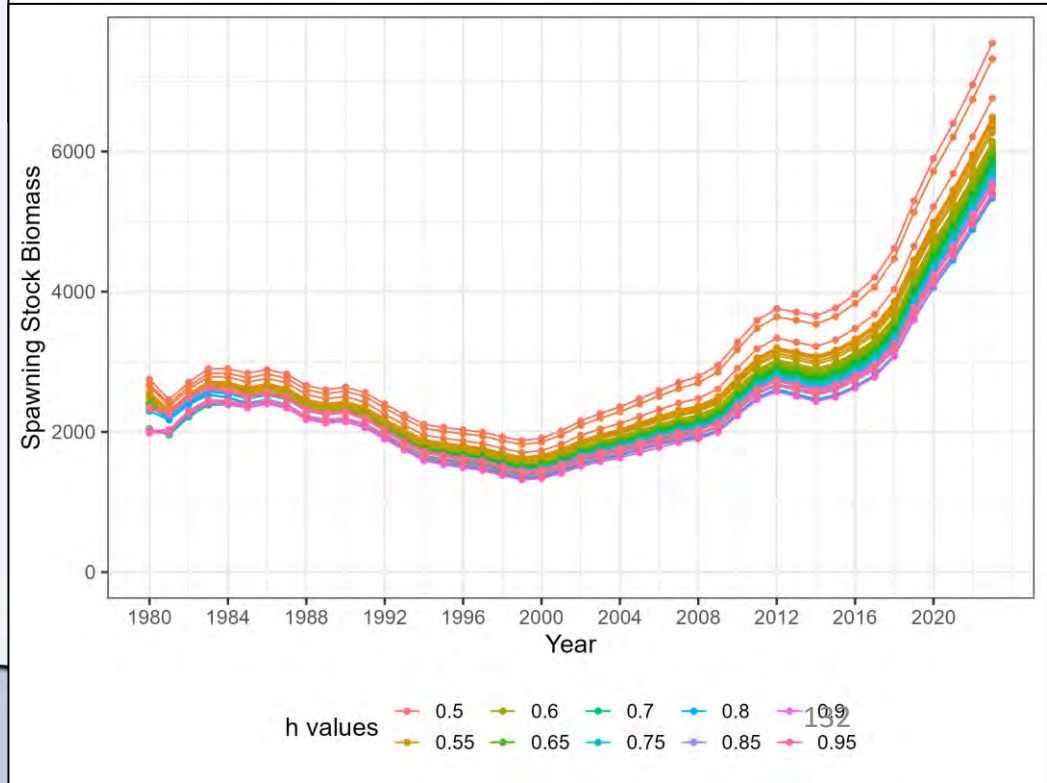




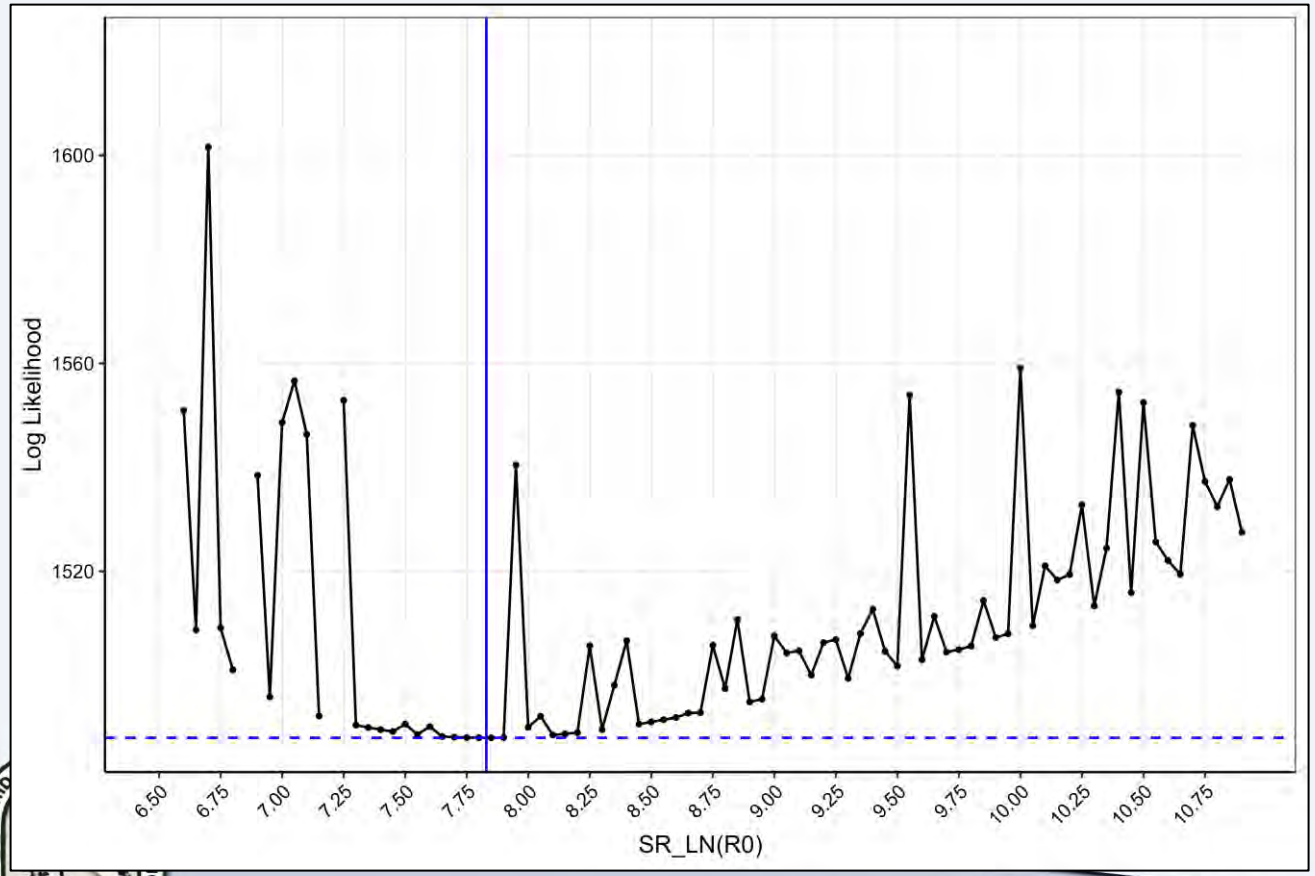
Profiling on Steepness

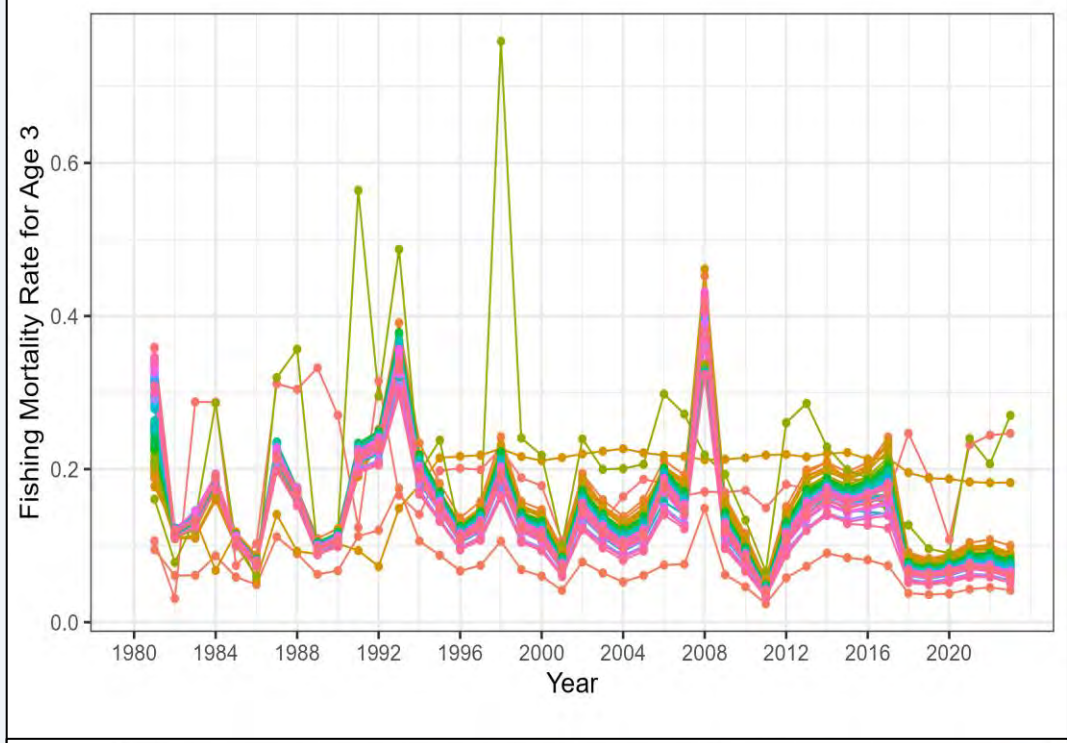


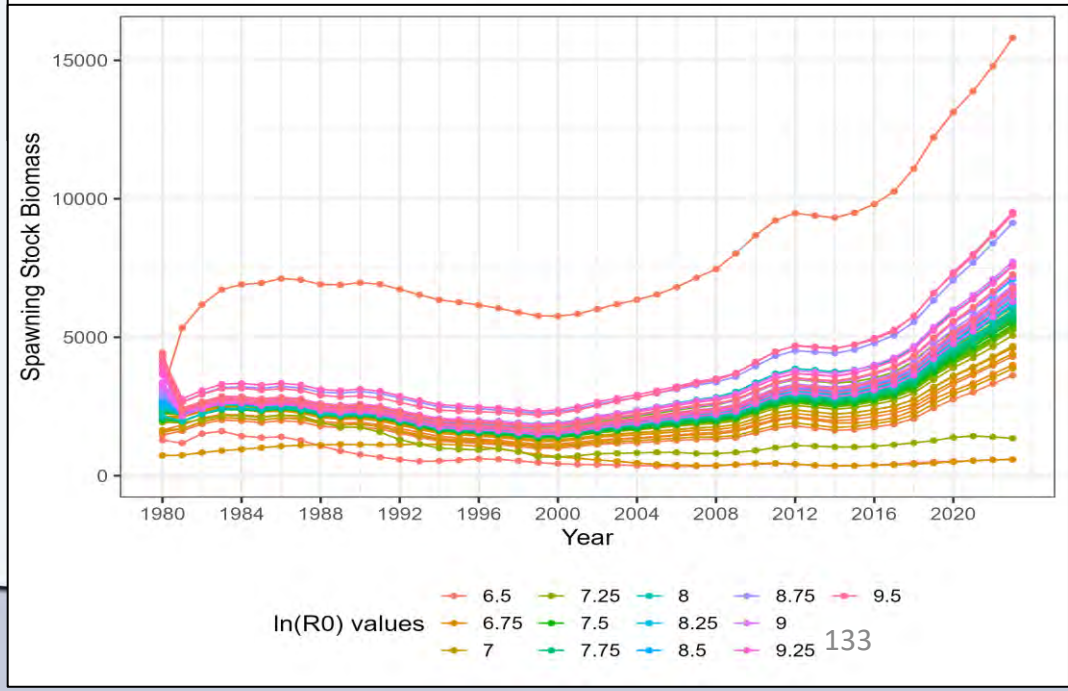




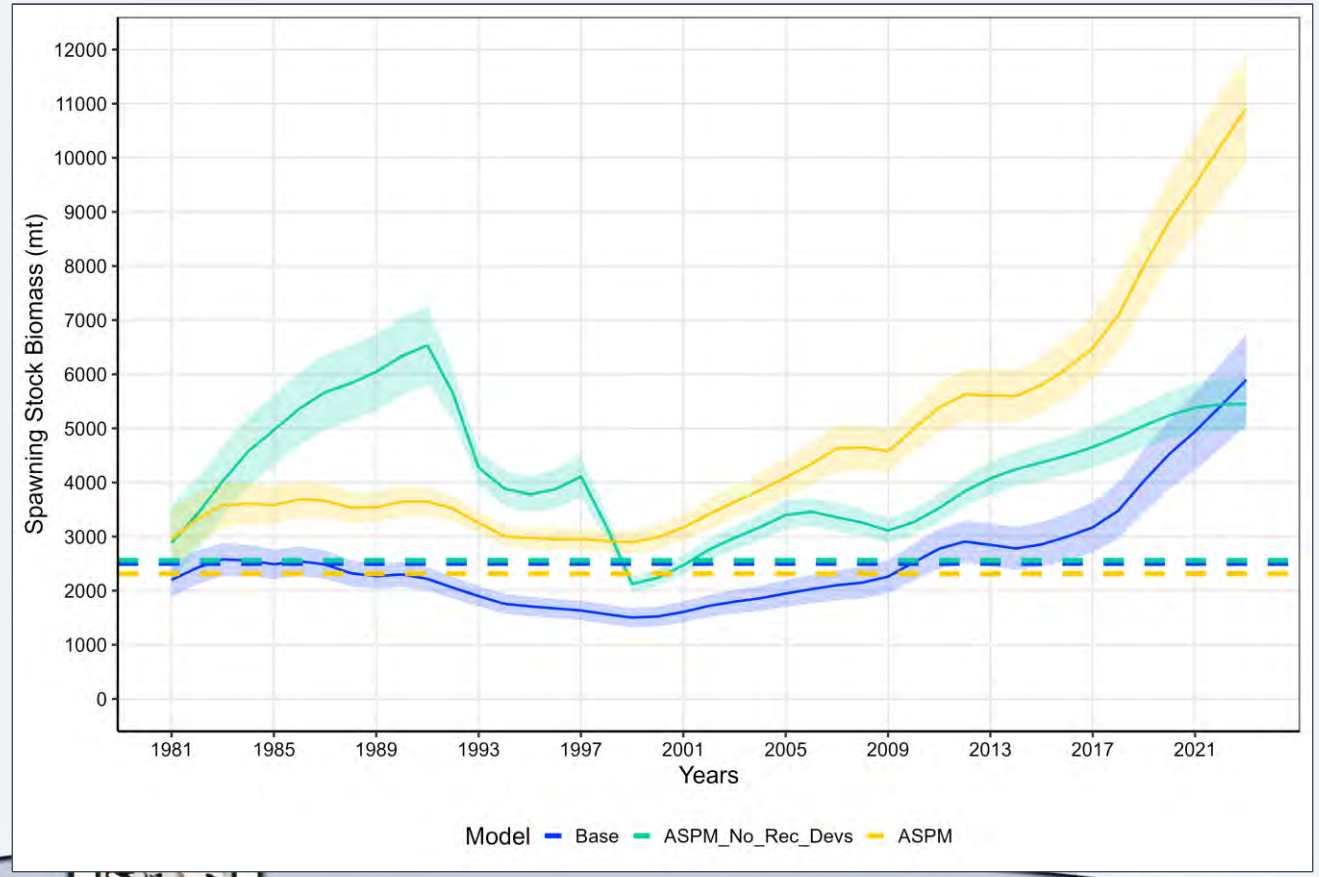
Profiling on R0

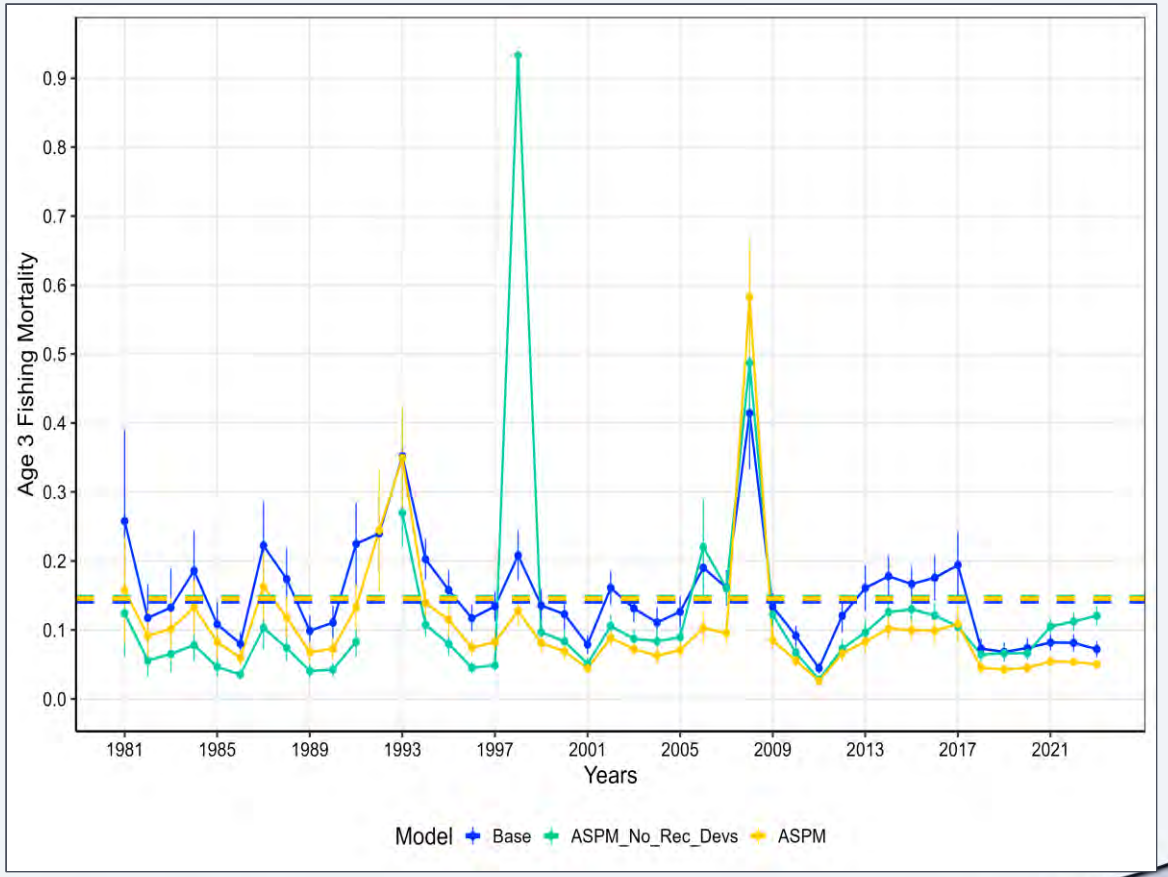




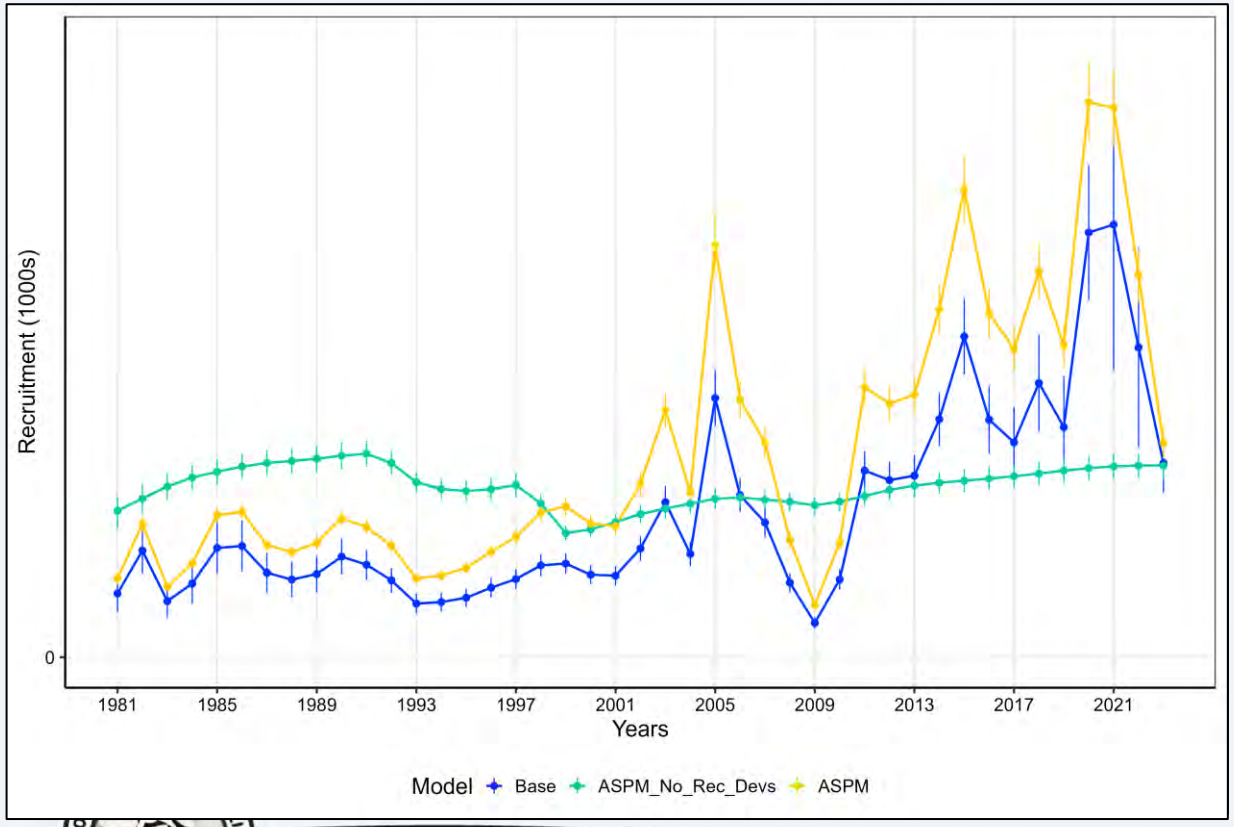


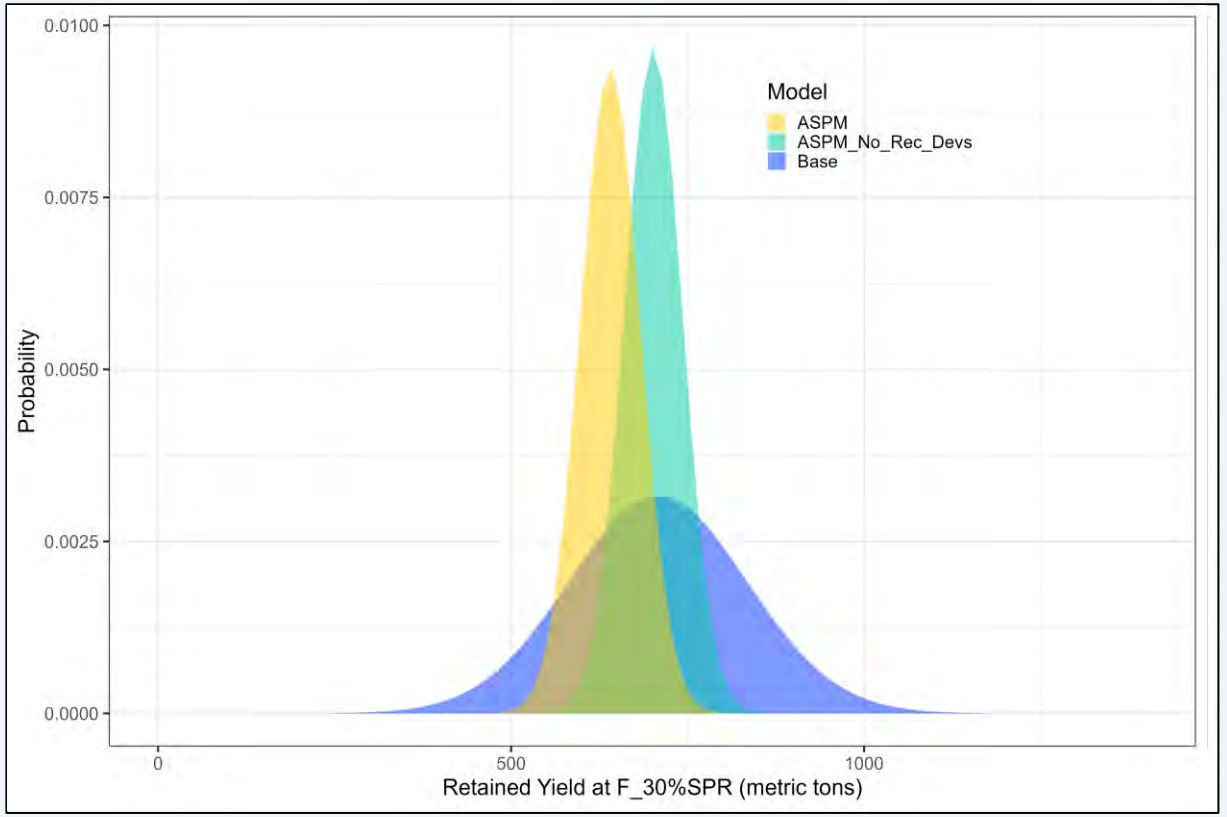
Age-Structured Production Model



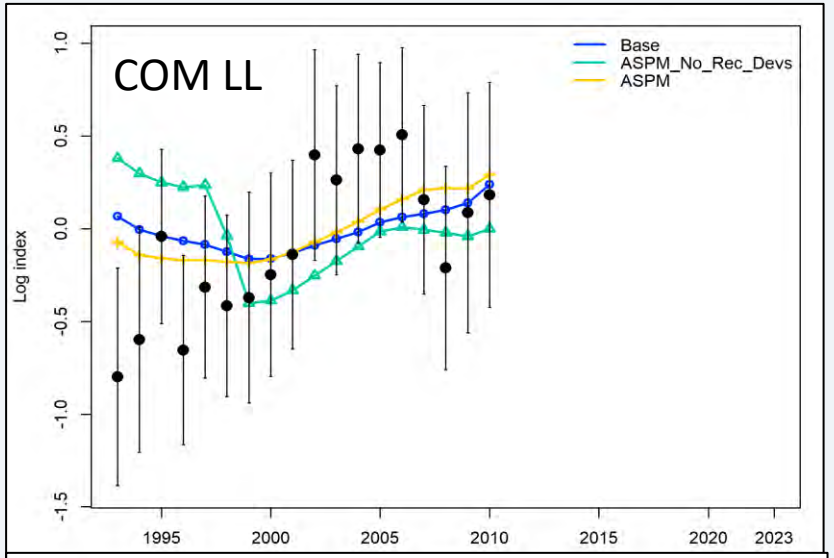


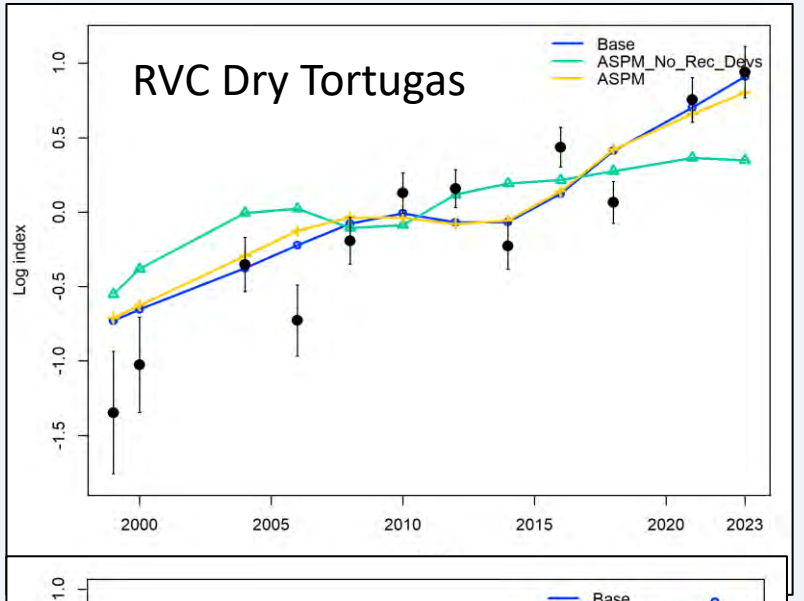
Age-Structured Production Model

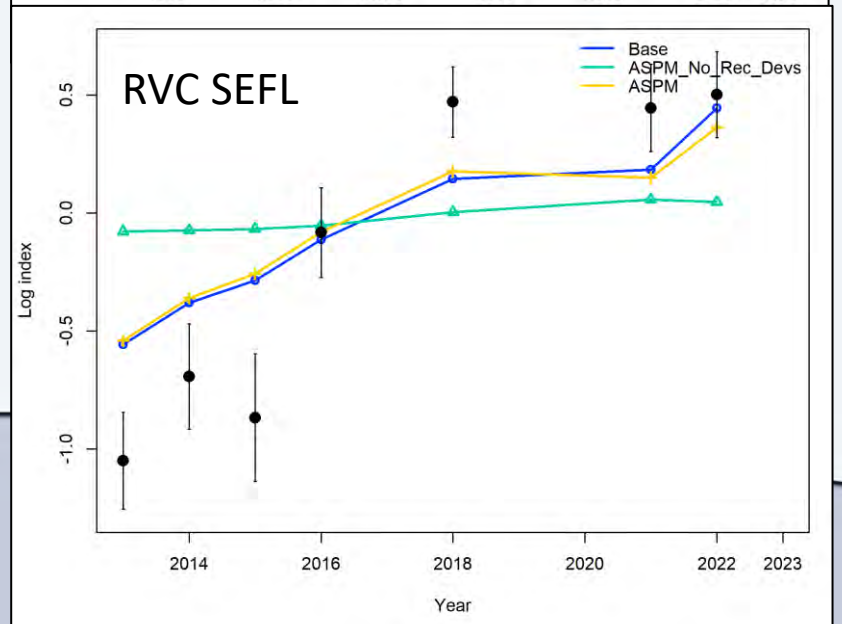


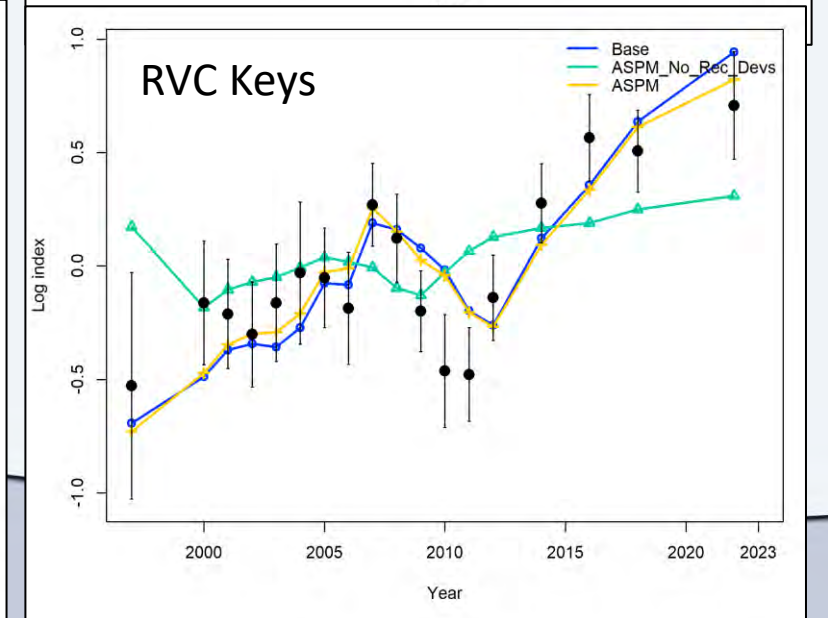


Age-Structured Production Model









Age-Structured Production Model