SEDAR 85 – Gulf of Mexico Yellowedge Grouper (*Hyporthodus flavolimbatus*)

NOAA FISHERIES

SEFSC
Gulf Fisheries Branch

Operational Assessment
Gulf SSC Review

February 27, 2024

Outline

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

Year	2023	2024
January	Operational Assessment (OA)	
February		SSC
March		
April		
May		
June		
July		
August		
September		
October		
November		
December		

SEDAR
Southeast Data, Assessment, and Review

SEDAR 85
Stock Assessment Report

Gulf of Mexico Yellowedge Grouper

November 2023

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

Overview

SEDAR 85: Gulf of Mexico Yellowedge Grouper

Operational Assessment Terms of Reference

April 2022

1. Update the approved SEDAR 22 Gulf of Mexico Yellowedge Grouper 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 by mode if possible.
   - Include available length frequency for the commercial fleet(s).
   - Update life history data (e.g., growth, reproduction, mortality) if warranted.
   - Consider the SEFSC's improved approach for estimating commercial discards and determine how the IFQ program affected discards.

3. To the extent possible, the following should be considered for inclusion in the model:
   - Consider potential effects of red tide on yellowedge grouper, with consideration of past red tide events in 2005, 2014, 2018, and 2021.
   - Consider whether steepness can be estimated, with or without a prior. If steepness is fixed, evaluate the sensitivity of that assumption.
   - Consider the effects of the *Deepwater Horizon* MC252 oil spill from April 2010 on the yellowedge grouper stock.

East vs West separation

- Larger and older Yellowedge in the West (Cook 2007)
- Captures differences in habitat types across the Gulf
- Supported by Prytherch (1983) grouping of fishing areas

SEDAR 22 attempted to use 3 areas during Data Workshop, but fell back on 2 areas (East, West) later in the process

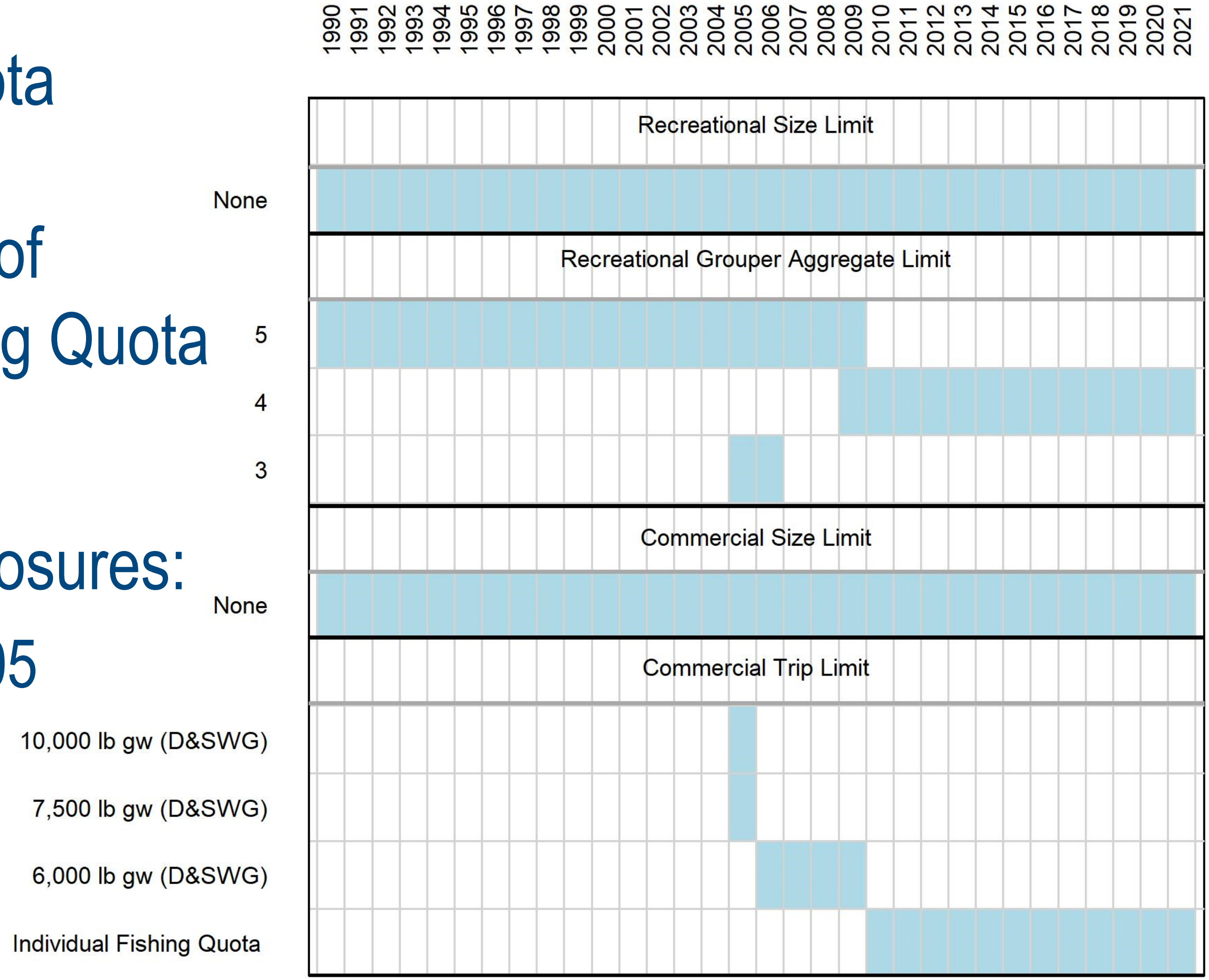
Figure 2.2. Spatial representation of fishing locations for the early (1982-1983) deepwater longline fleet (Prytherch 1983). A key point is the lack of separation between the "Northern" and "Eastern" grounds.

Gulf Yellowedge Grouper regulations

Commercial quota closures before implementation of Individual Fishing Quota (IFQ)

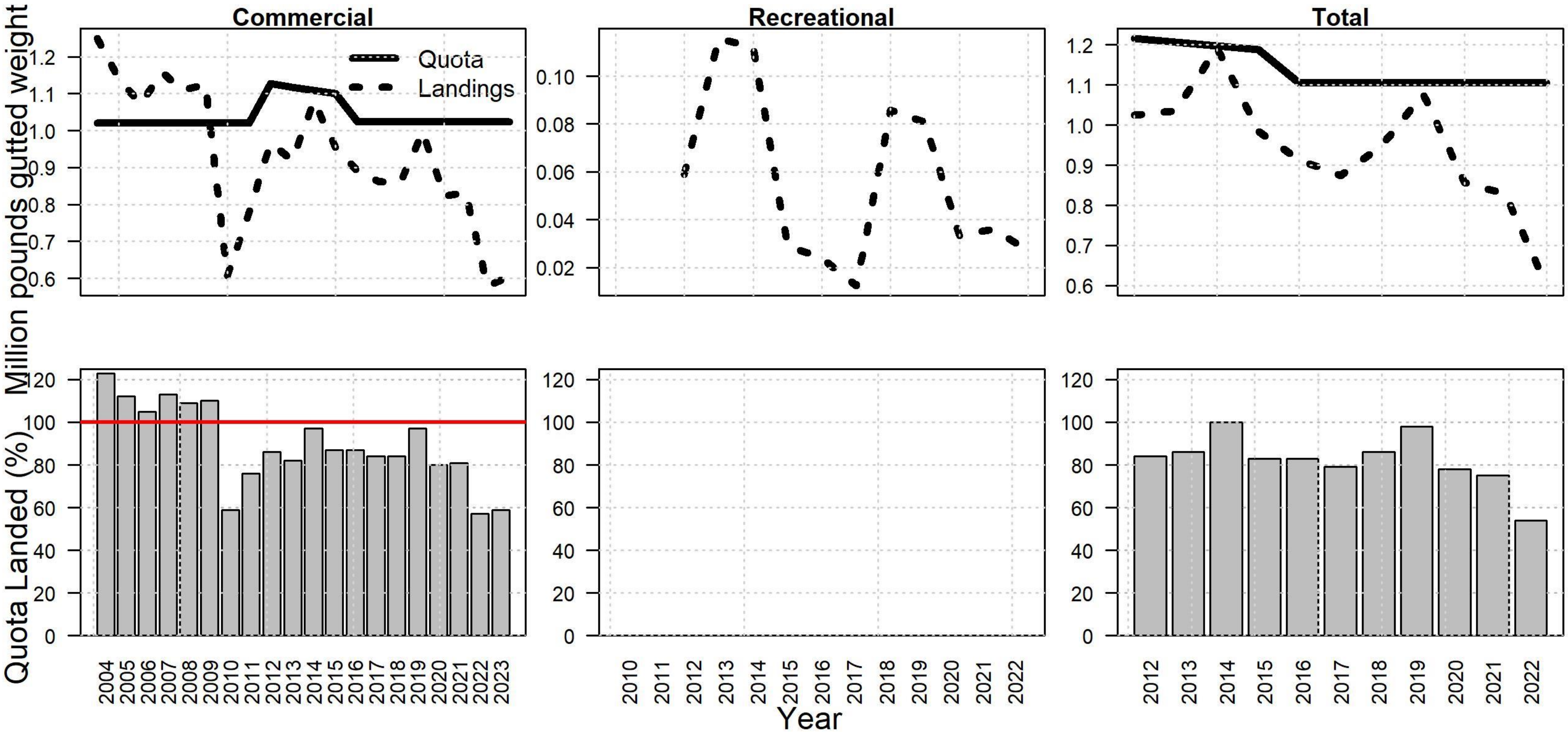
Rec seasonal closures:

- 11/1-12/31/2005



Deep Water Grouper*

*Includes Yellowedge Grouper, Speckled Hind, Warsaw Grouper, and Snowy Grouper



2004-2009: https://www.fisheries.noaa.gov/southeast/commercial-fishing/gulf-mexico-historical-commercial-landings-and-annual-catch-limit (accessed 12/12/2023)

2010-2022: https://secatchshares.fisheries.noaa.gov/getQuotasAndCatchAllowancesReport (accessed 12/12/2023)

2012-2021: https://www.fisheries.noaa.gov/gulf-mexico-historical-stock-landings-and-annual-catch-limit-monitoring (accessed 12/12/2023)

2022 (preliminary): https://www.fisheries.noaa.gov/southeast/resources-fishing/2022-preliminary-gulf-mexico-stock-annual-catch-limit-landings (accessed 12/12/2023)

2012-2021: https://www.fisheries.noaa.gov/gulf-mexico-historical-stock-landings-and-annual-catch-limit-monitoring (accessed 12/12/2023)

2022 (preliminary): https://www.fisheries.noaa.gov/southeast/resources-fishing/2022-preliminary-gulf-mexico-stock-annual-catch-limit-landings (accessed 12/12/2023)

Working papers

Document #	Title	Authors
SEDAR85-WP-01	SEDAR **Metadata** and QAQC	FWRI – Fisheries Independent Monitoring
SEDAR85-WP-02	**Headboat** Data for Yellowedge Grouper in the US Gulf of Mexico	Robin T. Cheshire, Kenneth Brennan, and Matthew E. Green
SEDAR85-WP-03	General **Recreational Survey Data** for Yellowedge Grouper in the Gulf of Mexico	Samantha M. Binion-Rock and Matthew A. Nuttall
SEDAR85-WP-04	Gulf of Mexico Yellowedge Grouper (Hyporthodus flavolimbatus) **Commercial Landings Length and Age Compositions**	Micki Pawluk
SEDAR85-WP-05	Shark Bottom Longline Observer Program **Metadata**	Gary Decossas and Alyssa Mathers
SEDAR85-WP-06	CPUE Expansion Estimation for **Commercial Discards** of Gulf of Mexico Yellowedge Grouper (*Hyporthodus flavolimbatus*)	Sarina Atkinson, Steven G. Smith, Gary Decossas
SEDAR85-WP-07	**Commercial Landings** of Gulf of Mexico Yellowedge Grouper (*Hyporthodus flavolimbatus*)	Micki Pawluk and Sarina Atkinson
SEDAR85-WP-08	**A Review** of the Gulf of Mexico yellowedge grouper (Hyporthodus flavolimbatus) **Age-length Data**, 1977-2021	Ashley Pacicco, Laura Thornton, Steve Garner, Beverly Barnett
SEDAR85-WP-09	Yellowedge Grouper **Abundance Indices from NMFS Bottom Longline Surveys** in the Northern Gulf of Mexico	Adam G. Pollack and David S. Hanisko

SEDAR 85 Overview

The Base Model indicates that the GOM Yellowedge Grouper stock is currently **not overfished and not undergoing overfishing*** (*at 30% SPR)

Notable changes compared with the SEDAR 22 Benchmark assessment model (end year 2009):

- Improved **commercial landings estimates** and incorporation of **more uncertainty** in model
- Improved **commercial discards** using the catch per unit of effort (CPUE)-expansion approach
- Recreational landings and discards changed from Marine Recreational Fisheries Statistics Survey (MRFSS) to Marine Recreational Information Program Fishing Effort Survey (**MRIP-FES)**
- Re-evaluated the representativeness and reliability of **sex-specific composition data** as well as all composition data streams (e.g., **exclude small sample sizes & non-representative data**)
- Used **weighted length compositions** for fisheries data where possible
- Switched to **nominal age compositions** instead of conditional age-at-length compositions because of concerns over violating assumptions
- **Corrected** the *a* parameter of the **length-weight relationship**
- Updated the **first age mature, first age male**, and fixed the **hermaphroditism transition rate**
- Fixed **steepness** at a biologically plausible estimate and recruitment variability (**SigmaR**) at a more realistic value
- **Dirichlet-Multinomial** approach for age and length compositions

Data Review

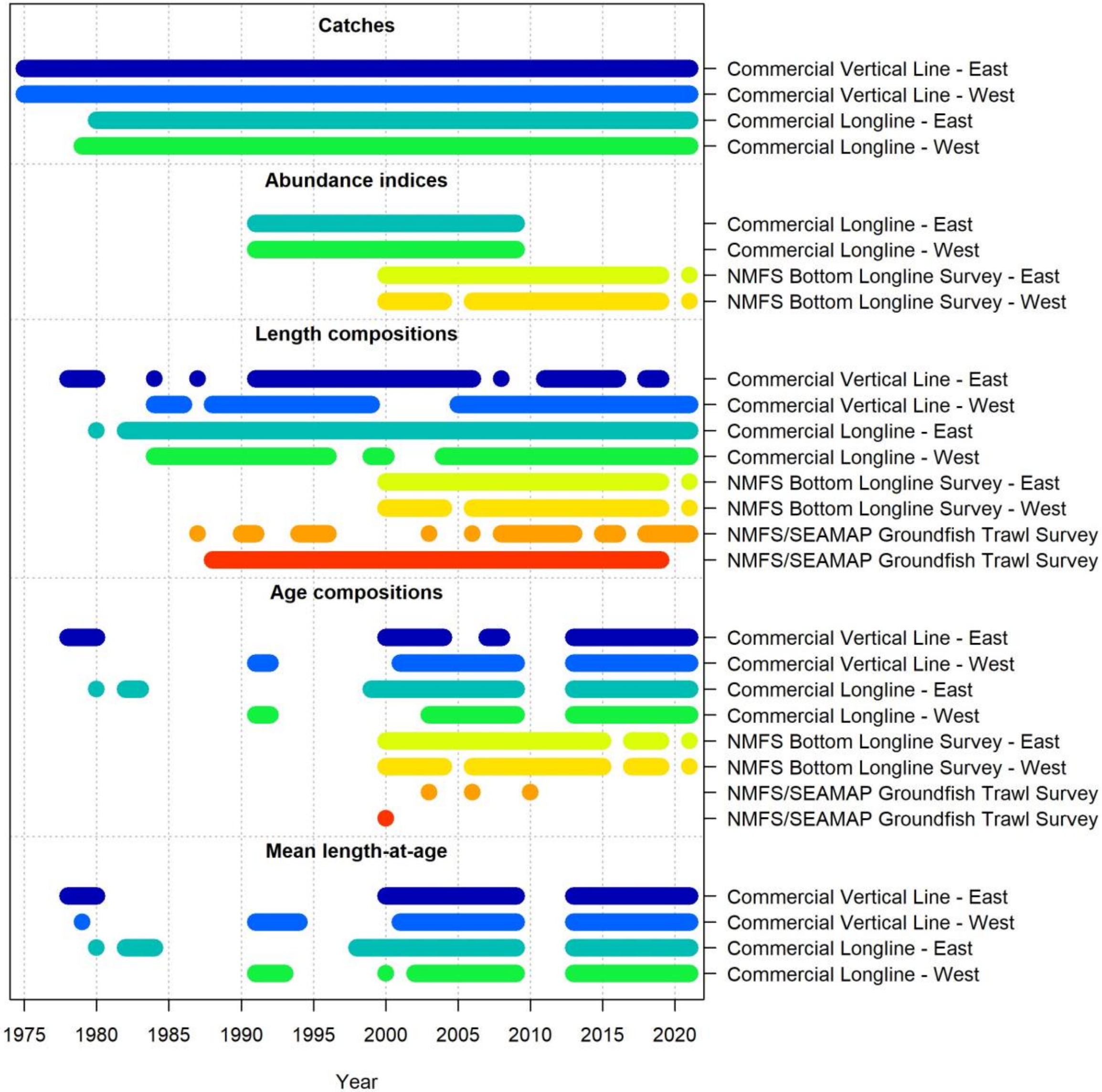
1. Update the approved SEDAR 22 Gulf of Mexico Yellowedge Grouper base model with data through 2021.

2. Document any changes or corrections made to model and input datasets and provide updated input data tables.

Model structure

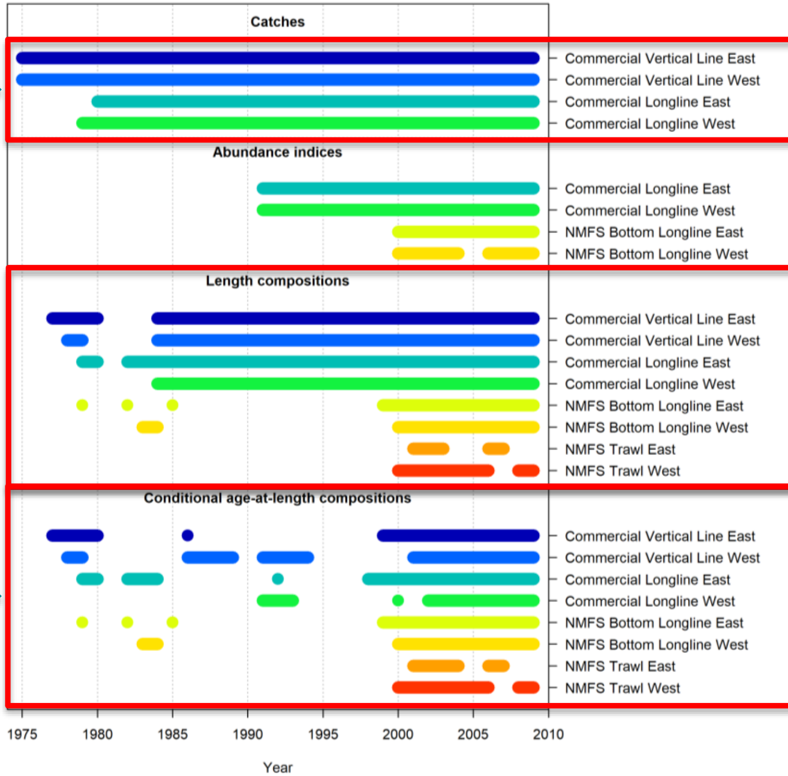
- 1975-2021
  - Starts at unfished conditions
- Two areas:
  - East, West
- All fleets and surveys have both length and age compositions

SEDAR 85 Base Model

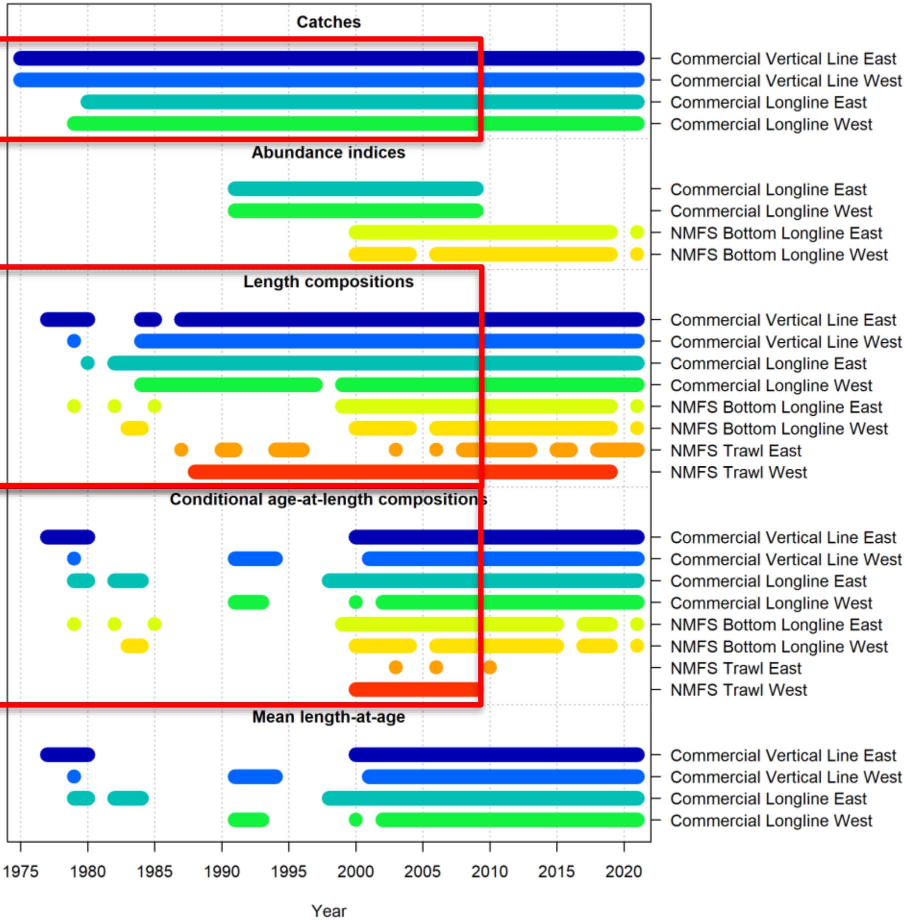


Differences in data submitted ("Continuity")

SEDAR 22 (Benchmark)



SEDAR 85 (Operational)



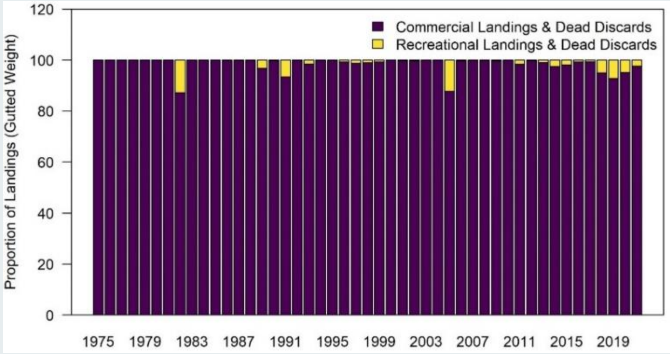
Data Updates Topical Working Group (TWG)

- July 20, 2023 – presented check-in on data issues to Gulf SSC and requested development of TWG for further review
- August 18 and 23, 2023 – met offline with TWG members to discuss data inputs in detail and large differences identified from SEDAR 22 data inputs
- September 15, 2023 – met via webinar to review data issues and make recommendations

Data issue #1: sex-specific composition data

Issue	TWG Recommendations
Quality – sex assigned macroscopically (visually, most common) vs histologically (more accurate, especially for hermaphroditic species)	- Lump with unsexed composition data and use weighted length compositions for fisheries when feasible
Quantity – small sample sizes (< 30 lengths) do not warrant fitting to compositions by sex	- Exclude years with < 30 lengths for fishery data - Use all fishery-independent data regardless of sample size
Hermaphroditism transition estimated in SEDAR 22 model, but estimation not recommended if data are limited	- Fix hermaphroditism transition at values recommended for SEDAR 22

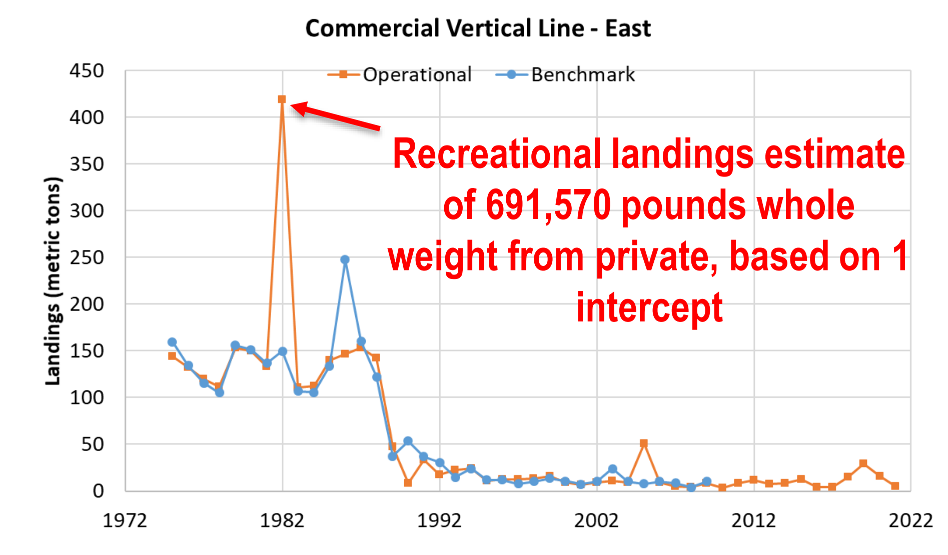
Data issue #2: Landings

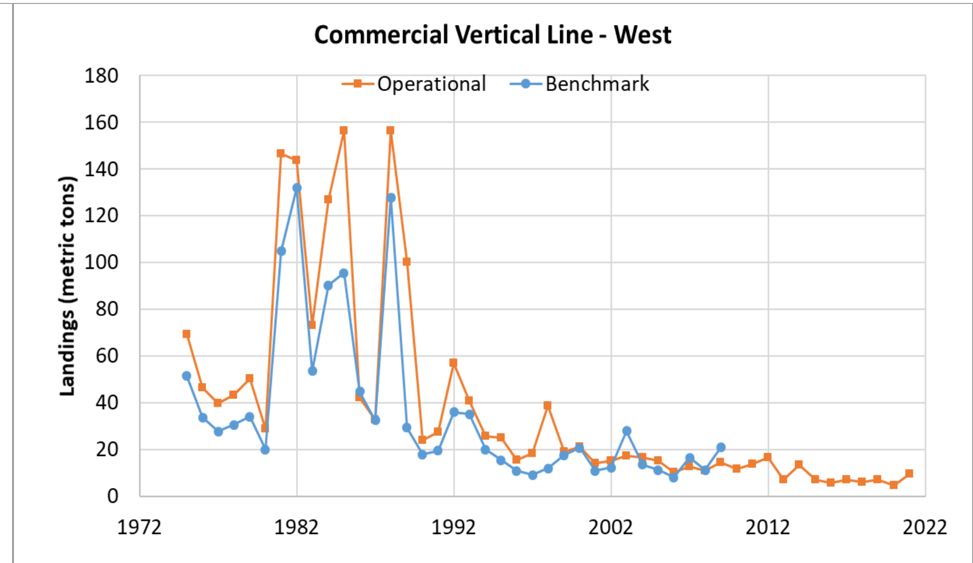
Issue	TWG Recommendations
Commercial landings diverge considerably from SEDAR 22 estimates	- Use as provided given improved methodologies
Recreational landings revised using MRIP-FES 	- Use as provided, except for 1982 value which is questionable; replace with mean of 1981-1985 • Consistent with decisions made for Gag during SEDAR 72
Landings uncertainty not considered in SEDAR 22 base model (SE of 0.01)	- Increase error for landings inputs to better capture uncertainty, particularly in early years

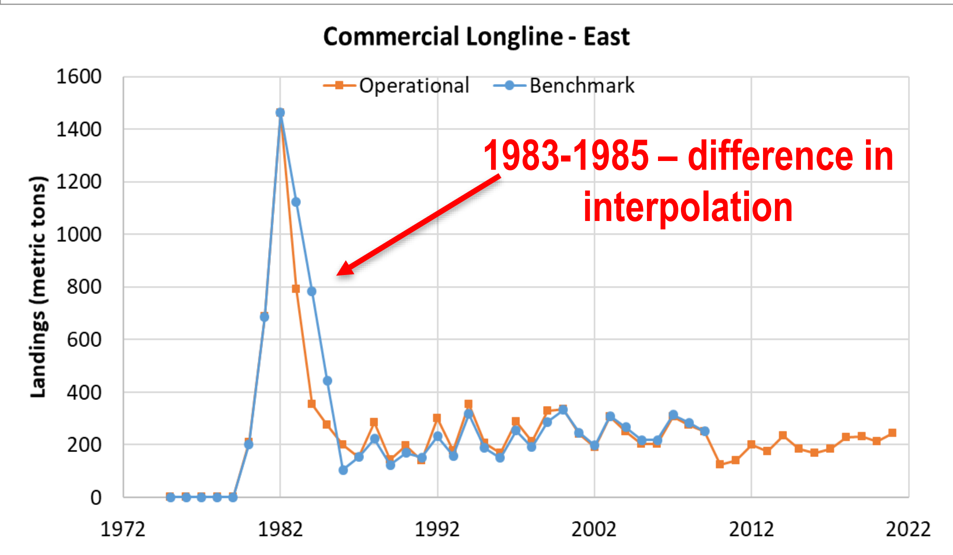
Landings

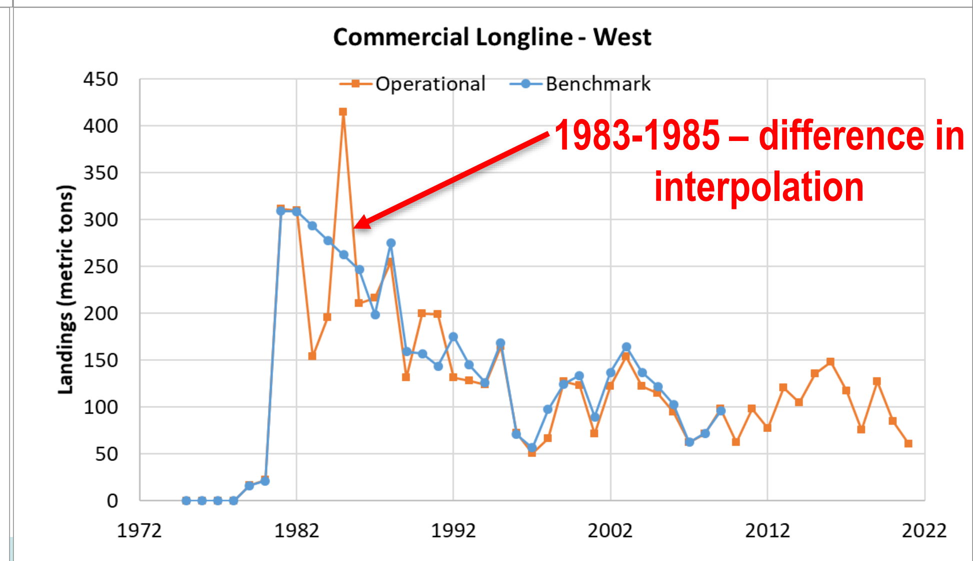
Vertical line - includes Commercial Other Gears and Recreational landings and dead discards

Longline - includes Commercial Longline dead discards









A note on landings uncertainty in SEDAR 22

Sensitivity run conducted for 1979-1982 Longline East

Low landings scenario assumes:

- No Yellowedge landings in area 7 (too shallow)
- Area 6 more similar to the SE than NE
    - SE has a lower proportion of unclassified groupers assigned to Yellowedge when compared to NE

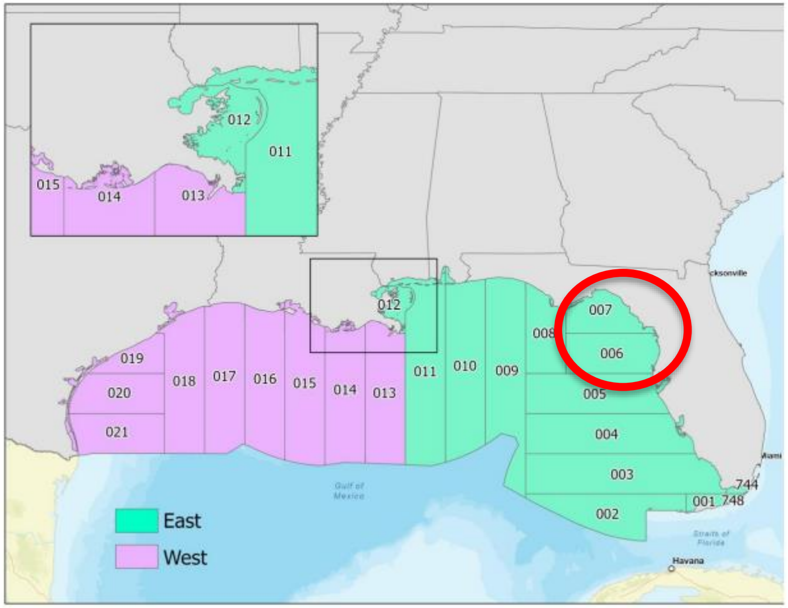


Figure 1: Gulf of Mexico commercial fishing areas.

Reviewed in WP-07

ALS = Accumulated Landings System

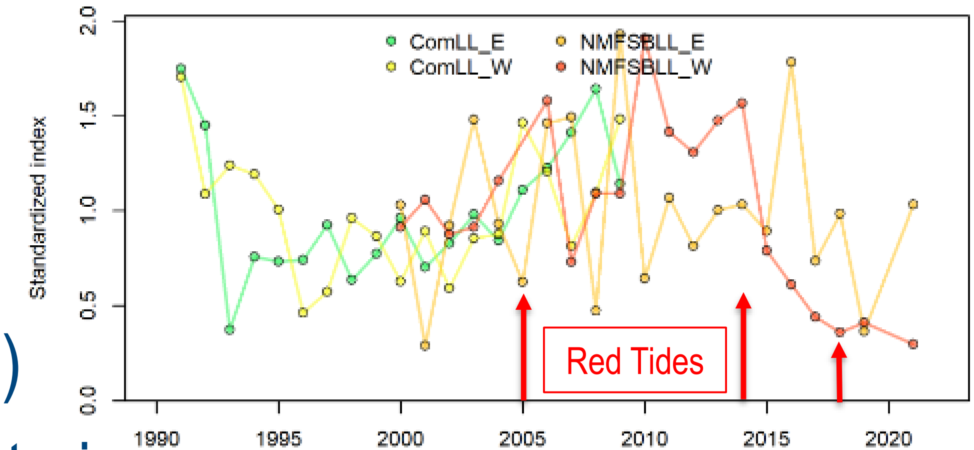
Landings uncertainty for SEDAR 85

- Borrowed approach from South Atlantic and weighted by state landings since Yellowedge are caught throughout Gulf

Year	Texas	Louisiana	Mississippi	Alabama	Florida	Comments
1962-1976	0.2	0.2	0.2	0.2	0.2	Annual state summaries
1977-1985	0.1	0.1	0.1	0.1	0.1	Monthly state summaries
1986-1999	0.1	0.1	0.1	0.1	0.05	Florida starts state trip ticket, used in ALS 1986
2000-2001	0.1	0.05	0.1	0.1	0.05	Louisiana starts state trip ticket 1997; used in ALS 2000
2002-2009	0.1	0.05	0.1	0.05	0.05	Alabama starts state trip ticket, used in ALS 2002
2010-present	0.1	0.05	0.1	0.05	0.05	Deep Water and Shallow Water Grouper IFQ starts 2010 (use 0.01 as done for scamp and gag)
2014-present	0.05	0.05	0.05	0.05	0.05	Texas (2008) and Mississippi (2012) state trip tickets begin; used in ALS 2014 [MS may change to 2015]

Ecosystem considerations: red tide

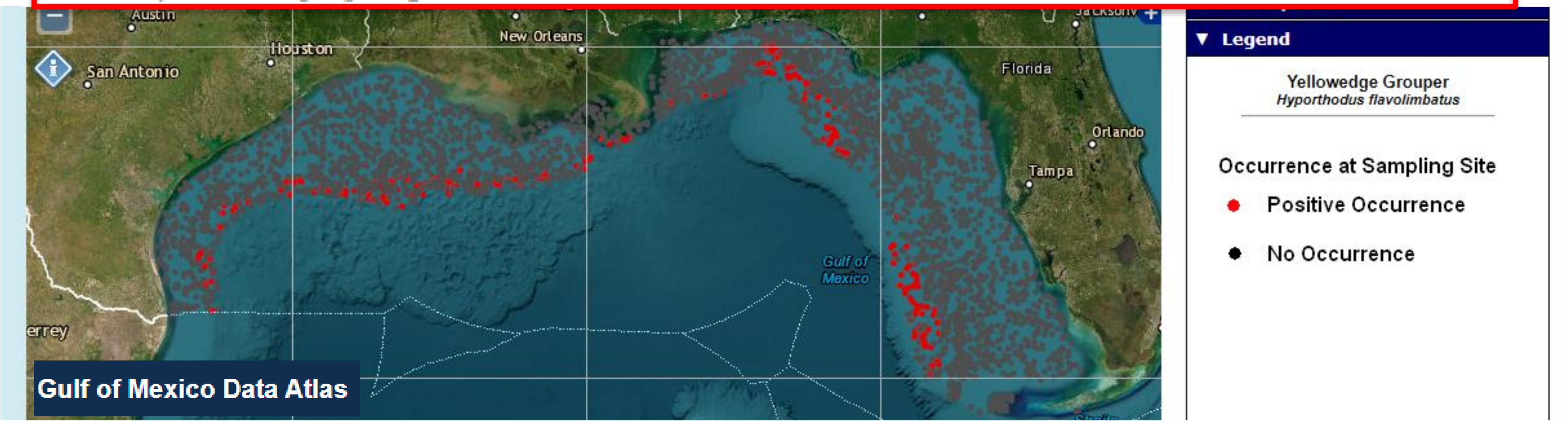
3. To the extent possible, the following should be considered for inclusion in the model:
   - Consider potential effects of red tide on yellowedge grouper, with consideration of past red tide events in 2005, 2014, 2018, and 2021.

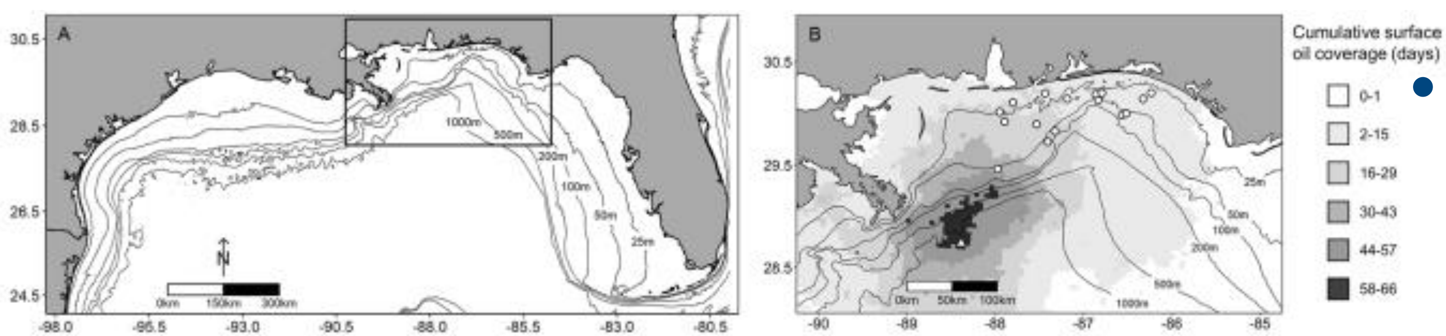


- Not identified in literature:
  - 1971 (Smith 1975)
  - 2014 (Driggers et al. 2015)
  - Blake et al. (2023) oral histories
- West Florida Shelf Ecospace results available but need review of inputs/outputs for Yellowedge
  - Minor red tide mortality estimates (Vilas et al. 2023 Shiny App)

Ecosystem considerations: DWH

3. To the extent possible, the following should be considered for inclusion in the model:
   - Consider the effects of the *Deepwater Horizon* MC252 oil spill from April 2010 on the yellowedge grouper stock.





- Mechanism unclear for inclusion in assessment

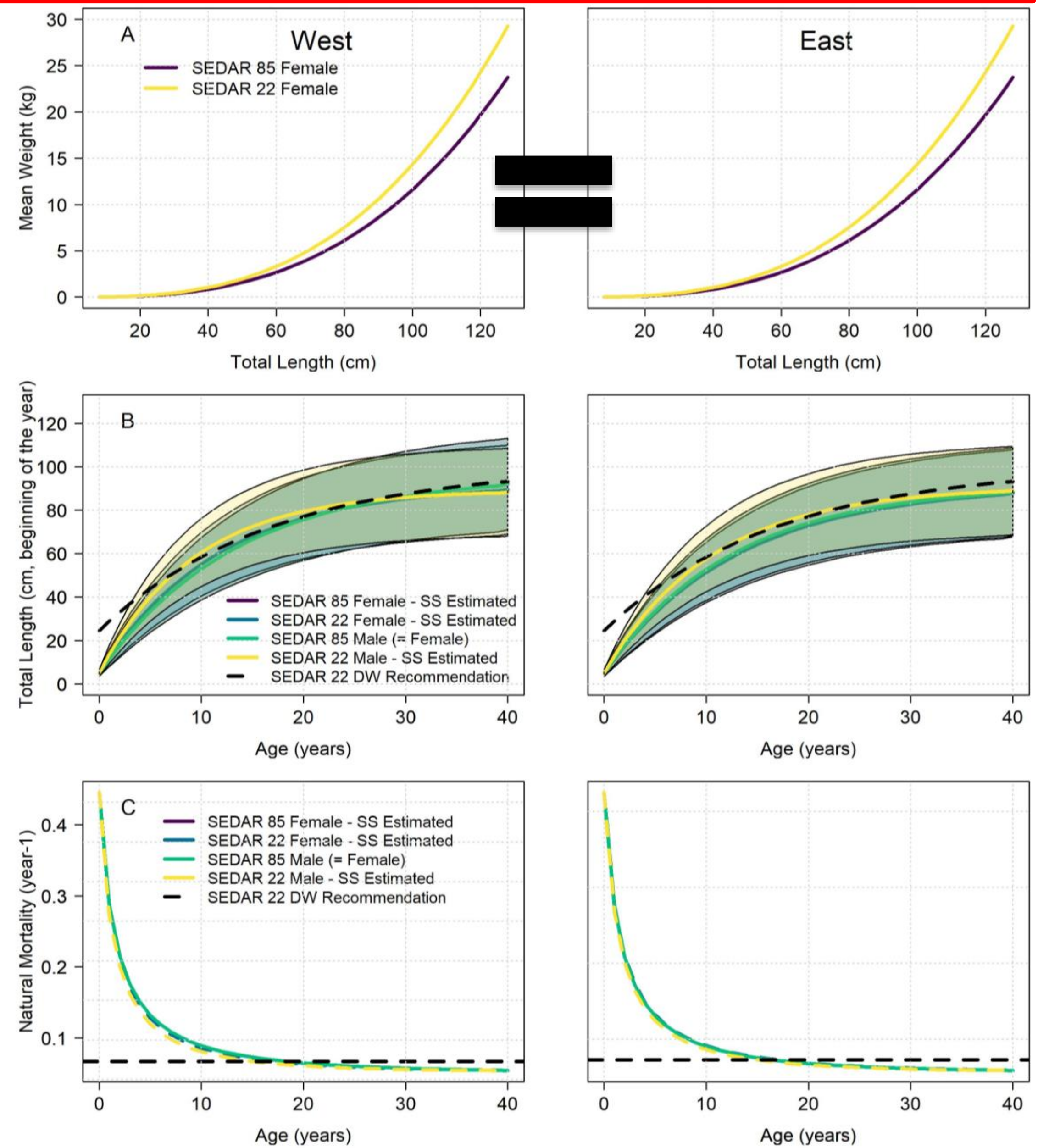
Lewis et al. 2020 (SEDAR68-RD44)

Figure 1. Map of the northern Gulf of Mexico (**A**) and sampling region (**B**). Panel B shows the location of the Deepwater Horizon blowout at the Mississippi Canyon-252 wellhead (triangle), and the natural reefs surveyed from 2009 to 2010 (circles). The shaded area represents the cumulative surface oil coverage in days. Maps were produced in R version 3.5.1[77].

- Update life history data (e.g., growth, reproduction, mortality) if warranted.

Life history

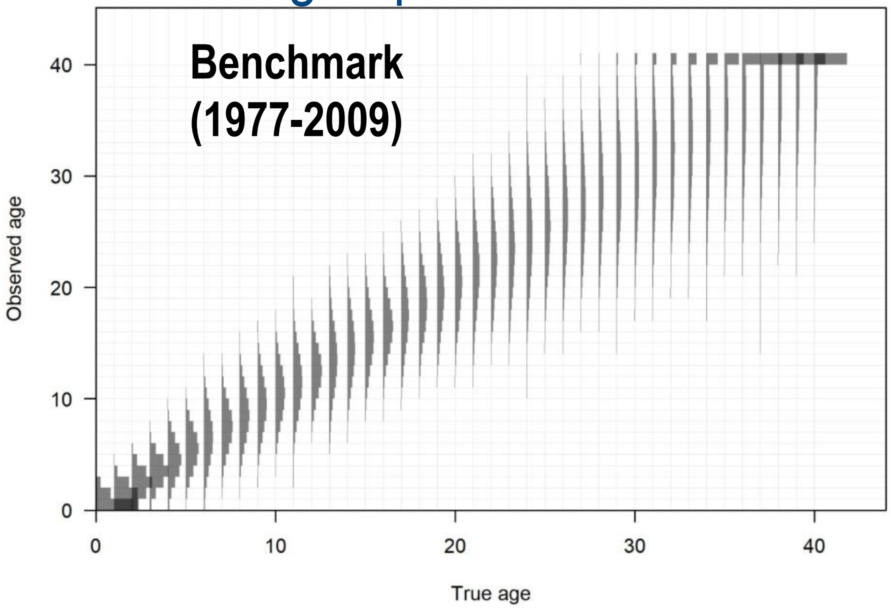
Data Component	Decision
Weight-Length	- Corrected *a* parameter
Age and Growth **WP-08**	- Maintained regional differences, but not by sex - Started from SEDAR 22 recommended parameters - Ageing error matrix for new age data
Natural Mortality	- Internal Lorenzen scaling with reference age of 15 years and point estimate of 0.073

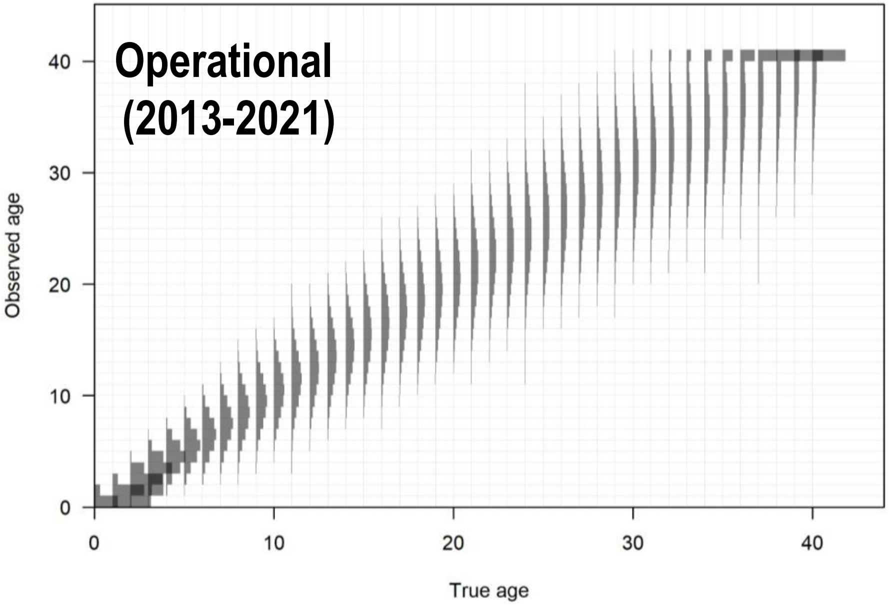


Ageing error matrix for newly aged OA data

- Account for ageing error between readers
  - 2010-2012 more similar to the Benchmark years based on readers

40+ = Plus group

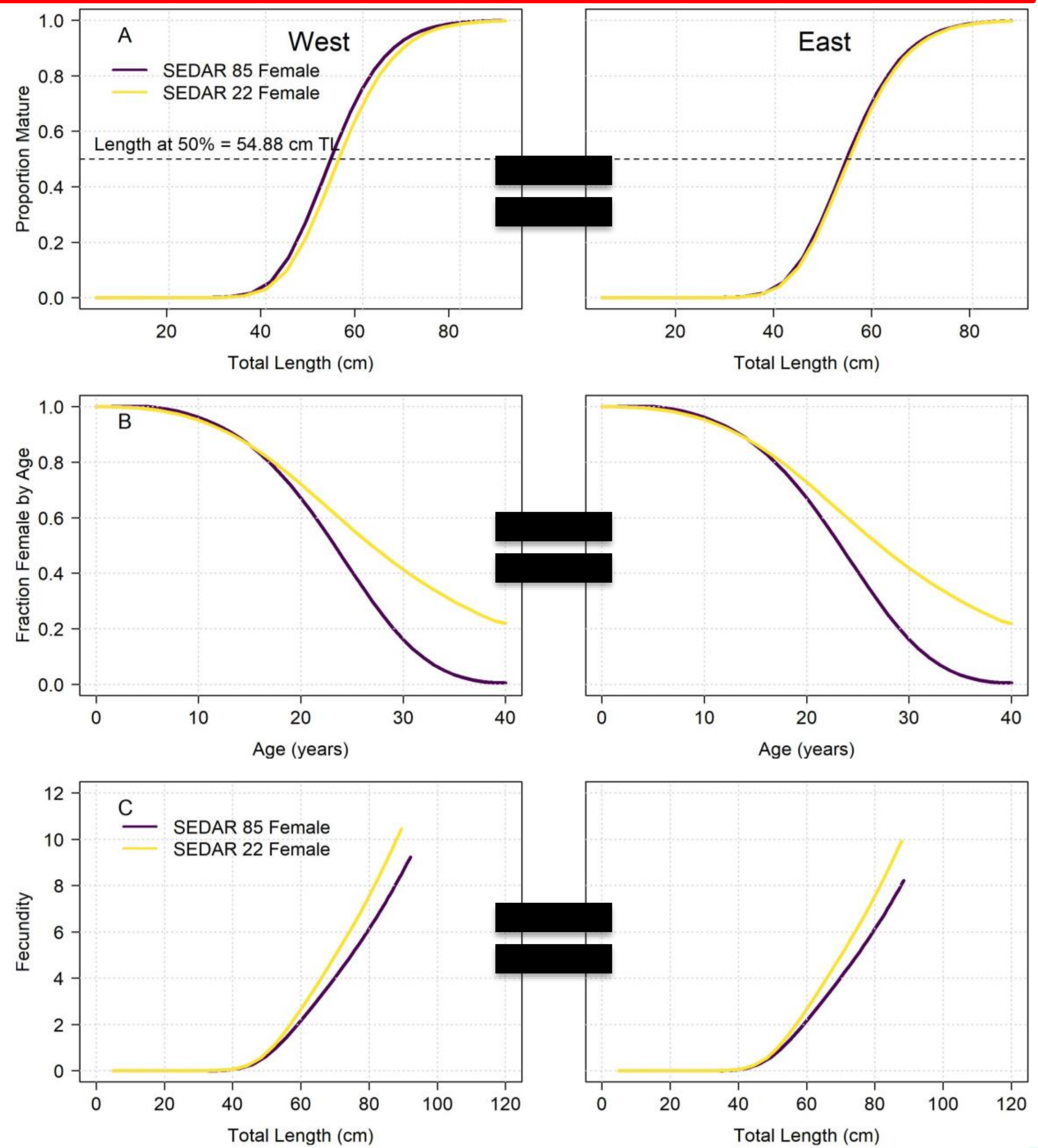




- Update life history data (e.g., growth, reproduction, mortality) if warranted.

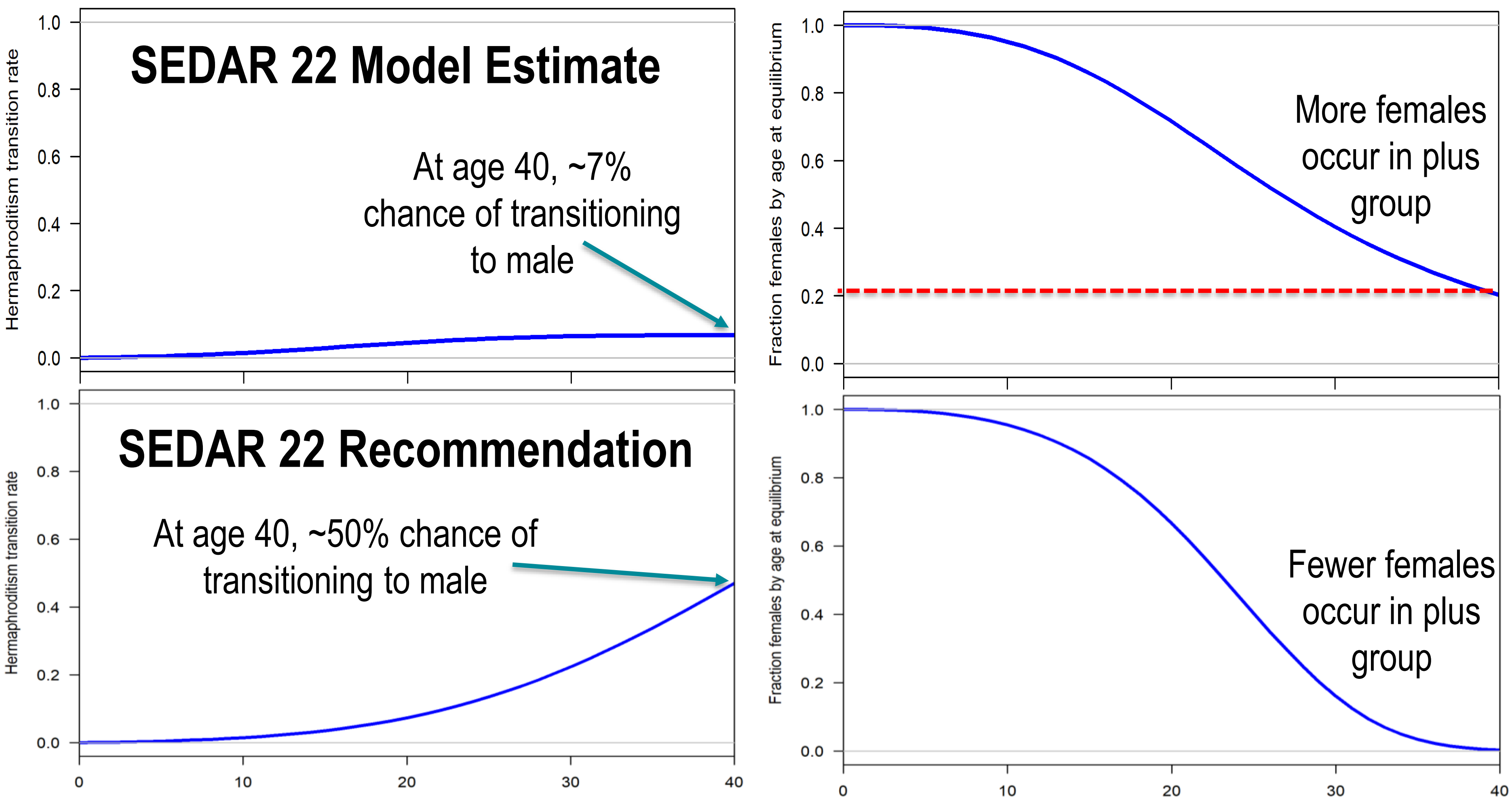
Life history

Data Component	Decision
Maturity	- Unchanged - Function of length
Hermaphroditism transition rate	- Fixed at SEDAR 22 recommended parameters because of removal of sex-specific data (not estimable)
Sex ratio at birth	- Unchanged - 100% female
Fecundity	- Used corrected *a* parameter from length-weight equation - Equivalent to SSB



Hermaphroditism transition rate

- Modeled as the proportion of individuals transitioning at a given age using a scaled cumulative normal distribution



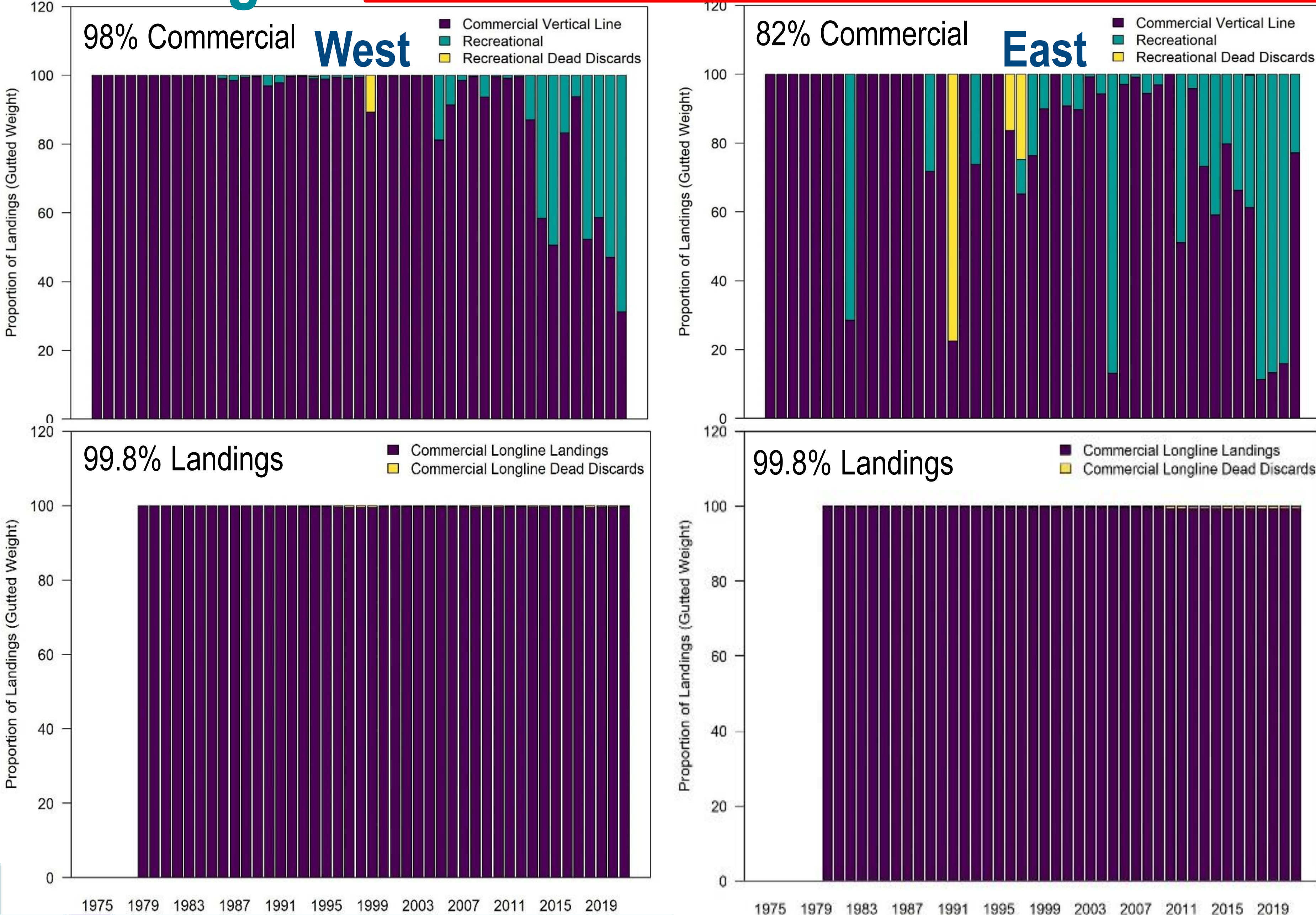
Beverton-Holt stock recruitment model

- Estimating:
  - Virgin recruitment [ln(R_0)]: unexploited equilibrium recruitment on log-scale
  - Recruitment deviations from 1975-2012
  - Recruitment apportionment parameter
- Steepness:
  - Not estimable (via diagnostics), fixed at biologically plausible estimate obtained from FishLife (0.827)
- SigmaR:
  - Not estimable (via diagnostics), fixed at 0.5

Landings

- Consider the SEFSC's improved approach for estimating commercial discards and determine how the IFQ program affected discards.

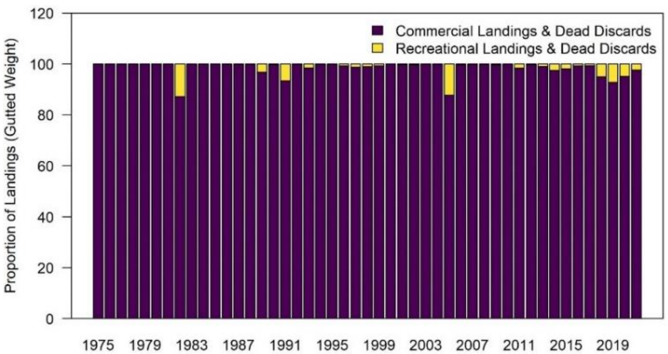
WP-06

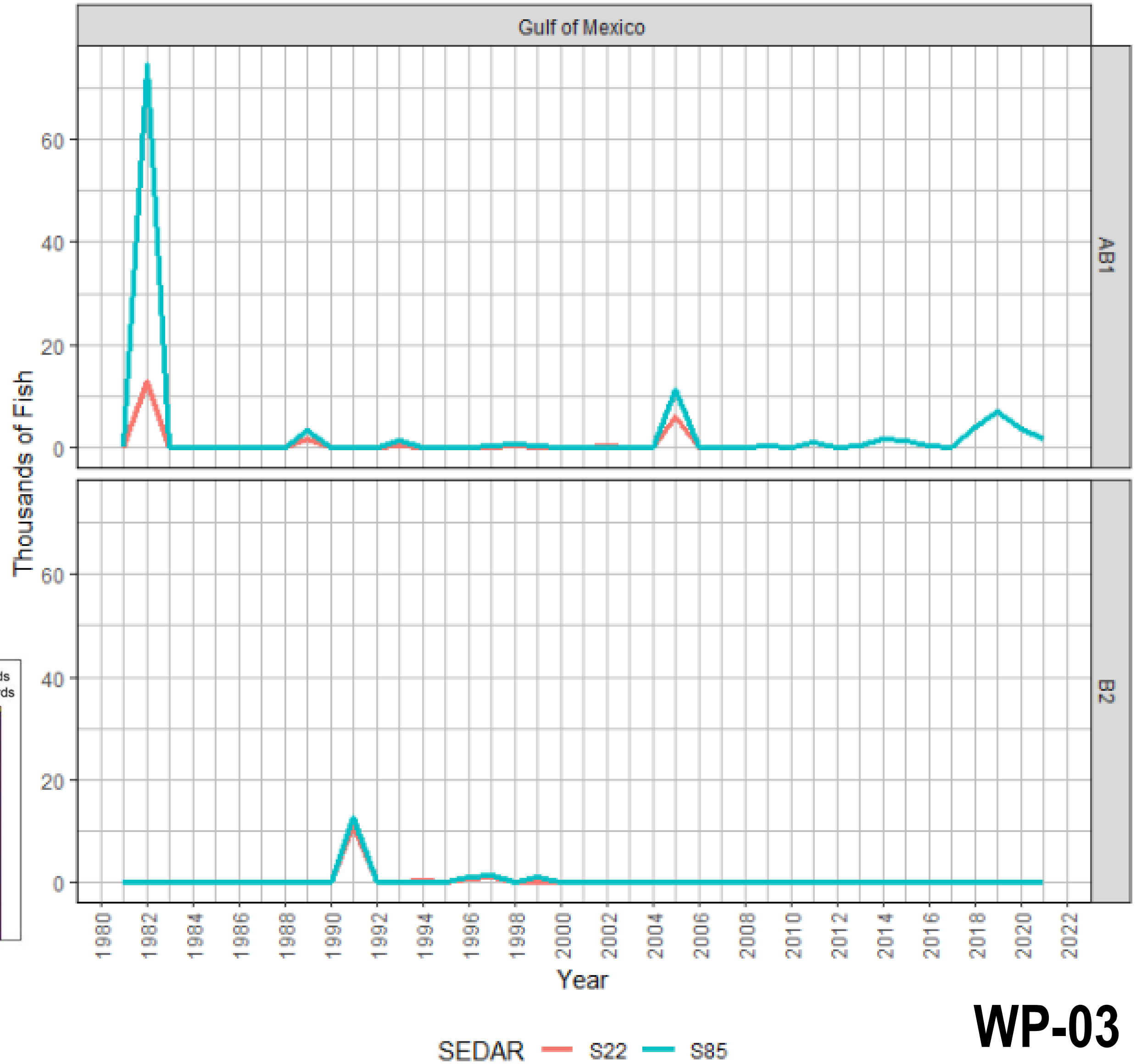


- Document changes in MRIP data, both pre- and post-recalibration, in terms of the magnitude of changes to catch and effort by mode if possible.

MRIP data

- SEDAR 22 used MRFSS data
- Large differences in a few years, but still minor overall





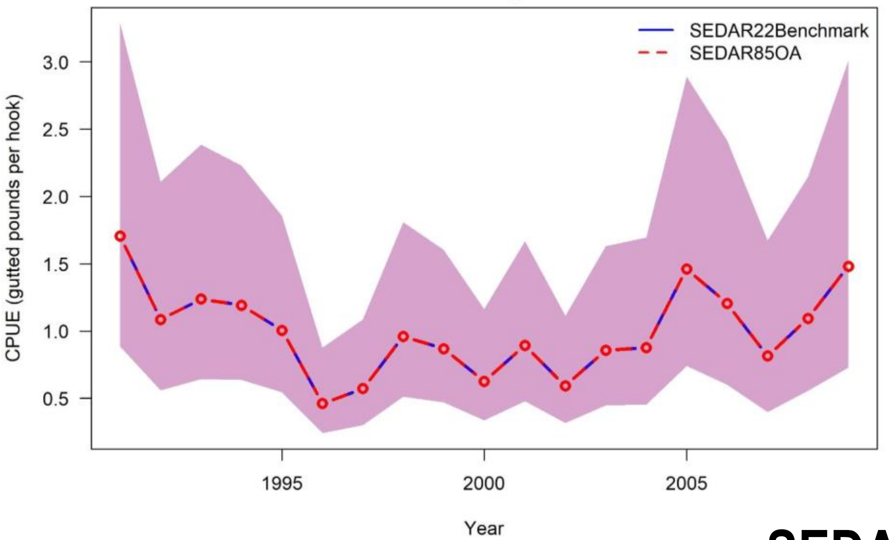
WP-03

Indices of relative abundance

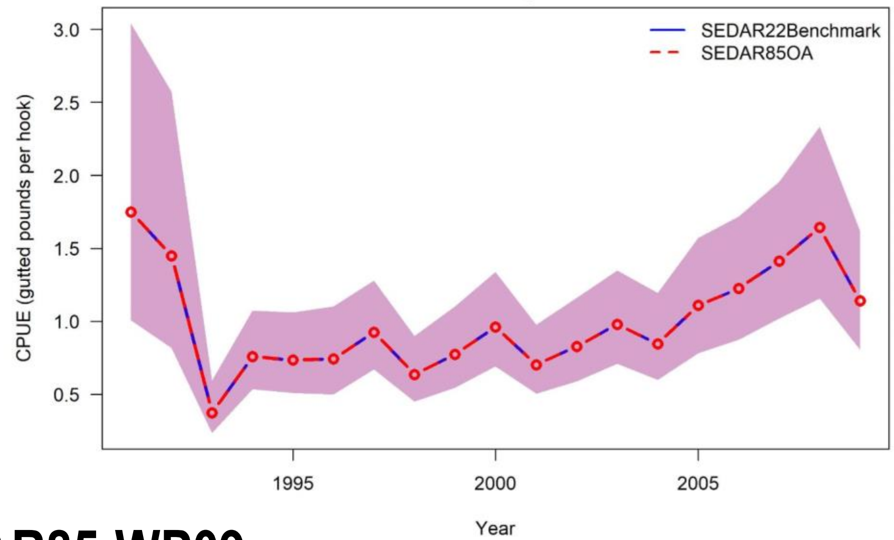
CV converted to SE:

$$log_e(SE) = \sqrt{(log_e(1 + CV^2))}$$

Commercial Longline - West

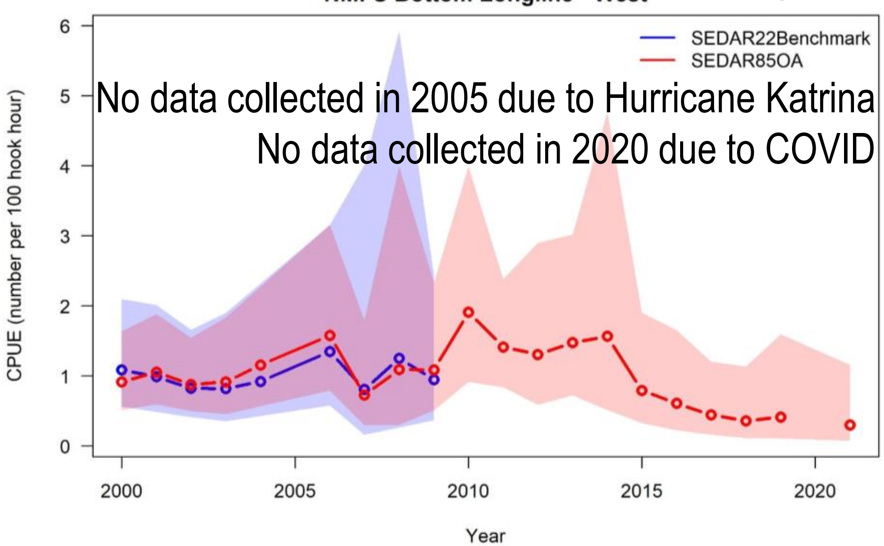


Commercial Longline - East

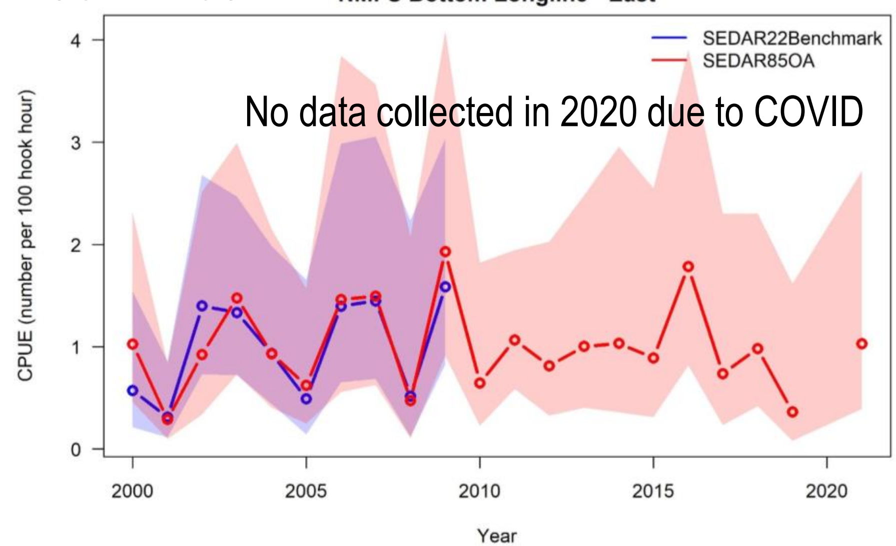


SEDAR85-WP09

NMFS Bottom Longline - West

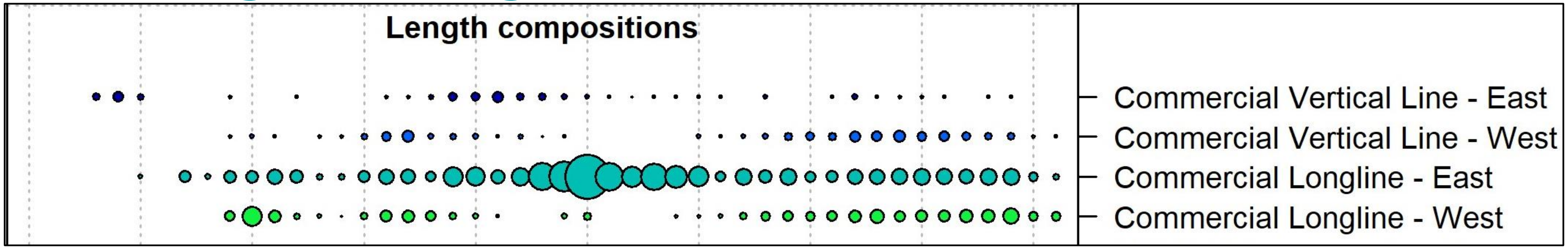


NMFS Bottom Longline - East

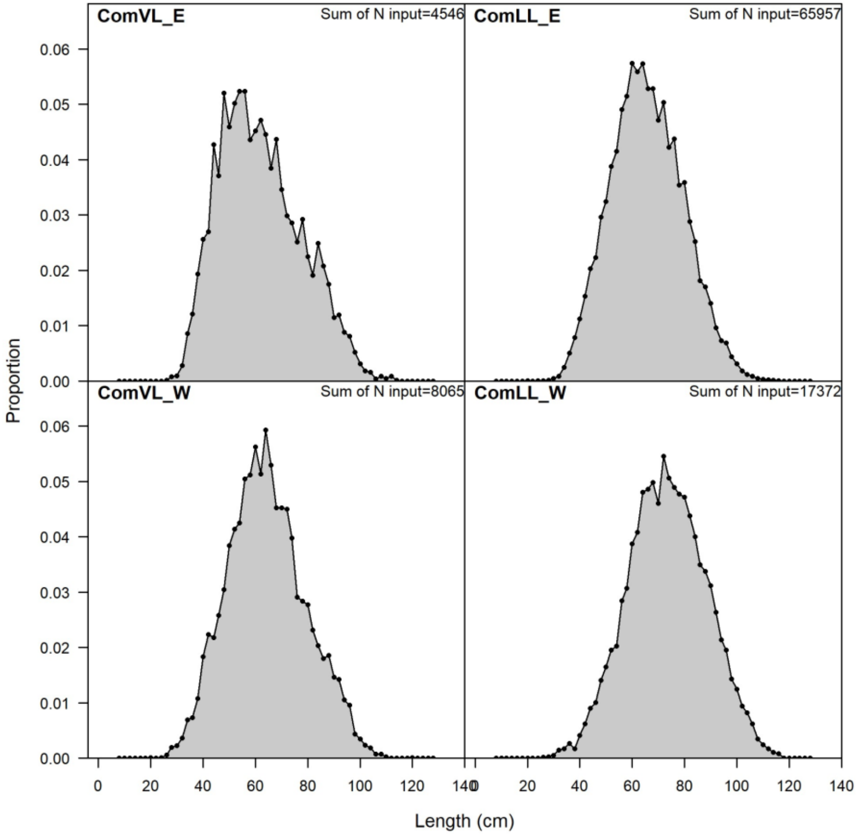


- Include available length frequency for the commercial fleet(s).

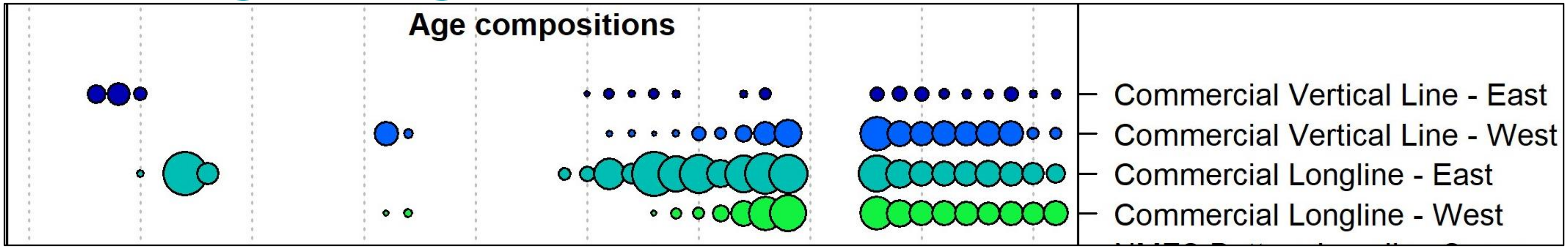
Landings – length composition data



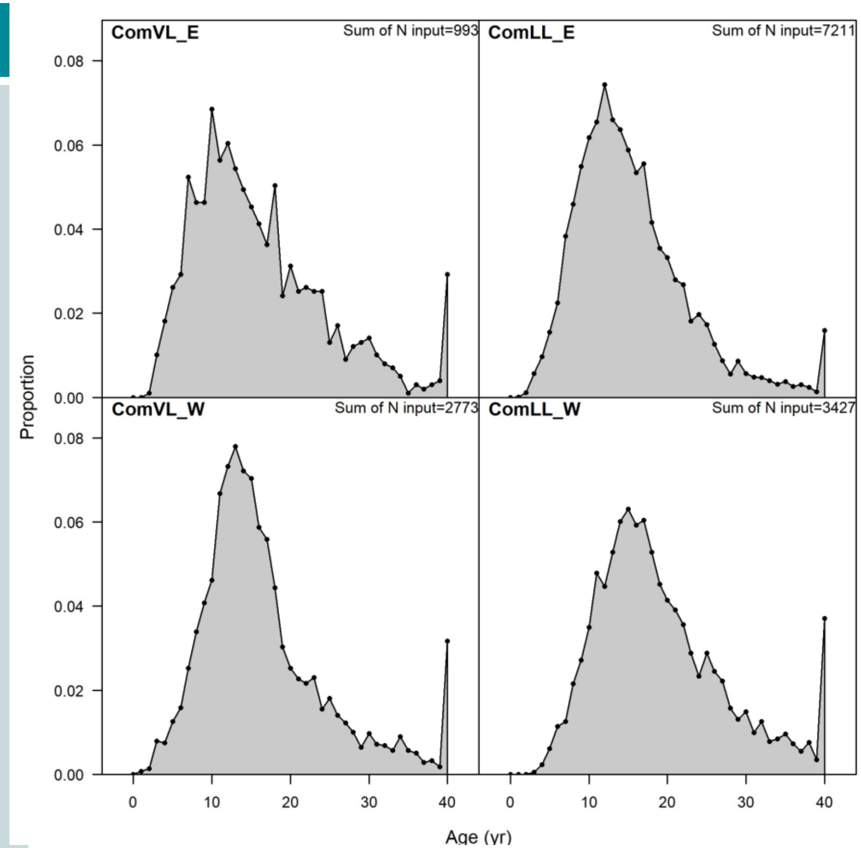
Component	Decision
Lengths (retained) **WP-04**	- **Data**: all combined (unsexed, male, female) - **Composition**: nominal in SEDAR 22, weighted annually by spatially stratified landings in SEDAR 85 for East - **Sample sizes**: number of fish in SEDAR 85 and SEDAR 22 - **Exclusions**: fleet/year combinations with < 30 lengths
Lengths (discarded) **WP-06**	- Limited discards added to landings, lengths not included



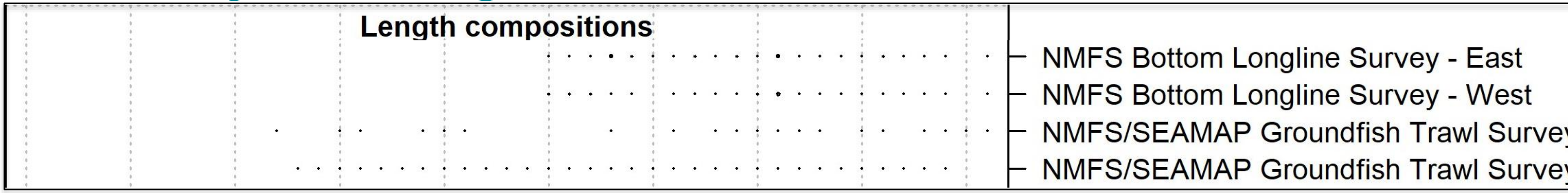
Landings – age composition data



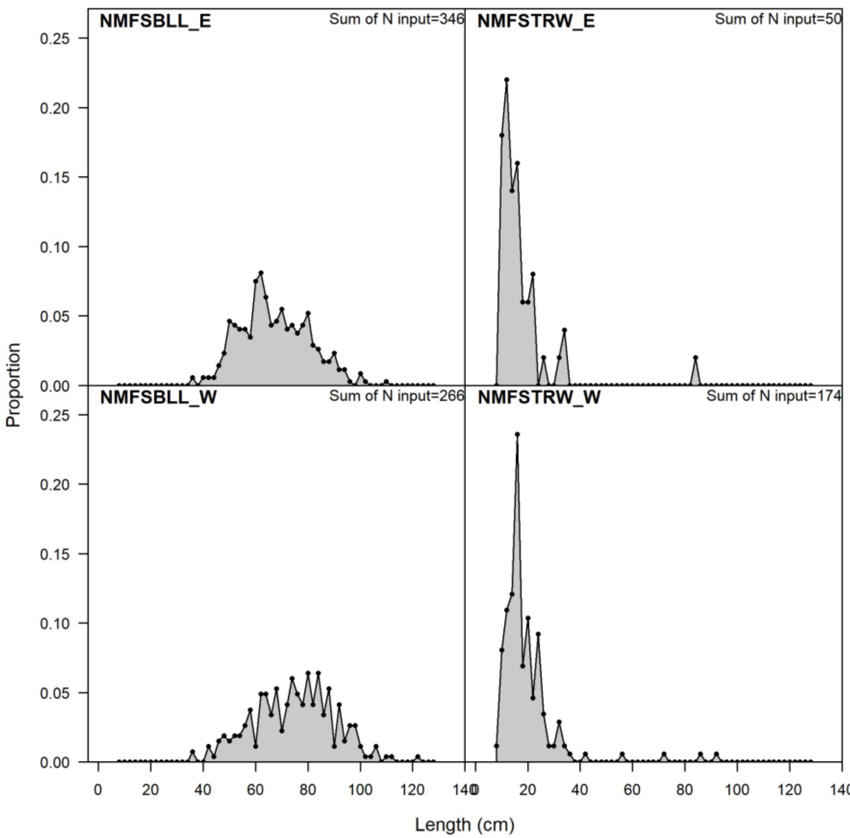
Component	Decision
Ages (retained) **WP-04**	- **Data**: all combined (unsexed, male, female) - **Composition**: conditional age-at-length in SEDAR 22, nominal in SEDAR 85 due to concerns over assumptions and poor fits - **Sample sizes**: number of ages in SEDAR 85 and SEDAR 22 - **Exclusions**: fleet/year combinations with fewer than 10 ages - **Exclusions**: non-representative data - Commercial 2010-2012



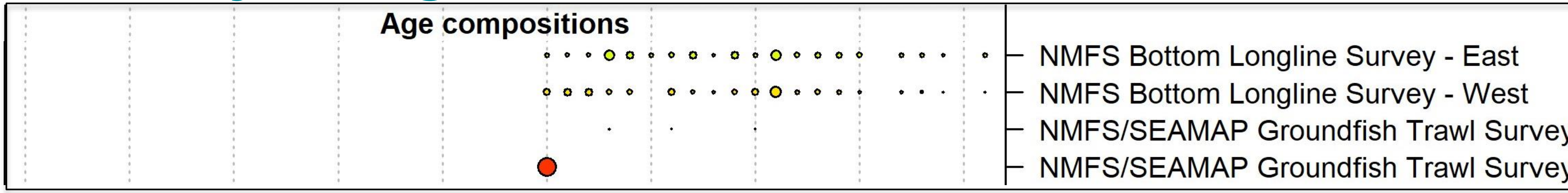
Surveys – length composition data



Component	Decision
Lengths **WP-09**	- **Data**: all combined (unsexed, male, female) - **Composition**: nominal in SEDAR 22 and SEDAR 85 - **Sample sizes**: number of fish in SEDAR 85 and SEDAR 22 - **Exclusions:** non-representative data - NMFS Bottom Longline pre-2000

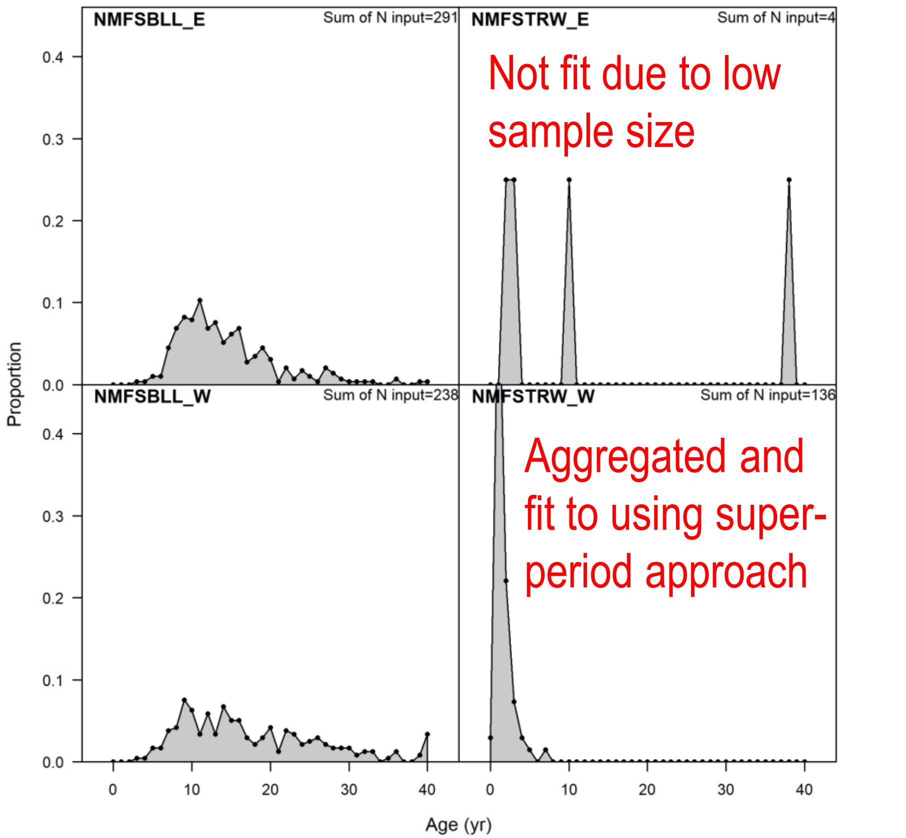


Surveys – age composition data



Component	Decision

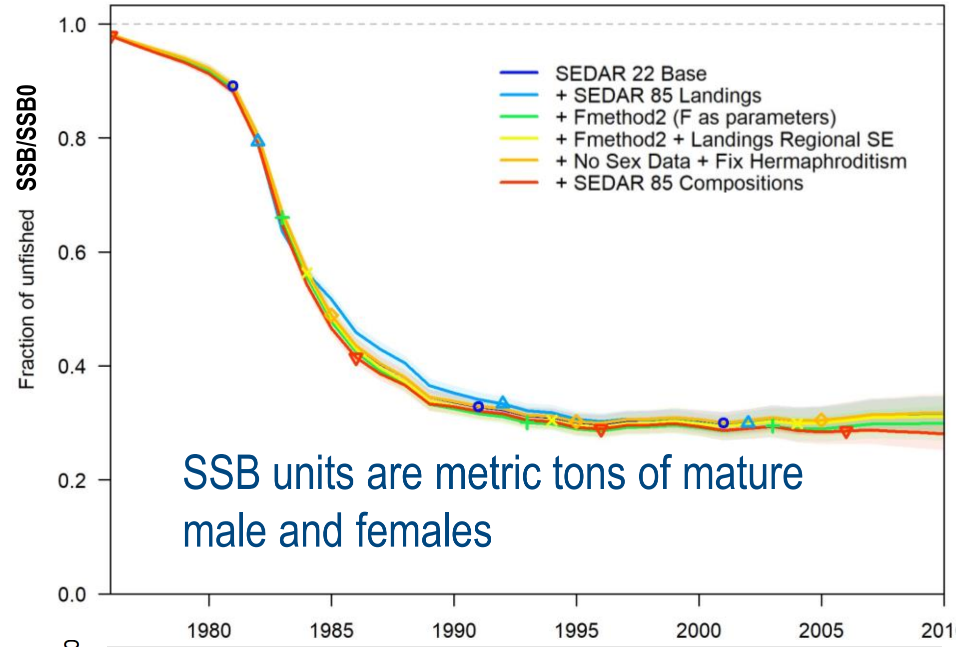
Ages	- **Data**: all combined (unsexed, male, female)
	- **Composition**: conditional age-at-length in SEDAR 22, nominal in SEDAR 85 due to concerns over assumptions and poor fits
	- **Sample sizes**: number of ages in SEDAR 85 and SEDAR 22
	- **Exclusions:** non-representative data
	    - NMFS Bottom Longline pre-2000
	    - NMFS/SEAMAP Groundfish Trawl East

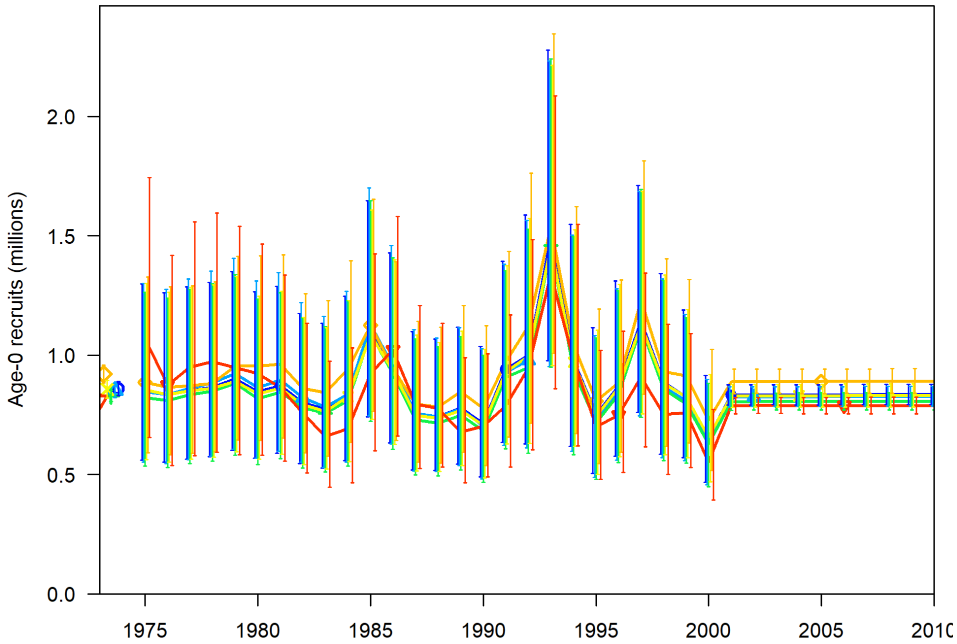


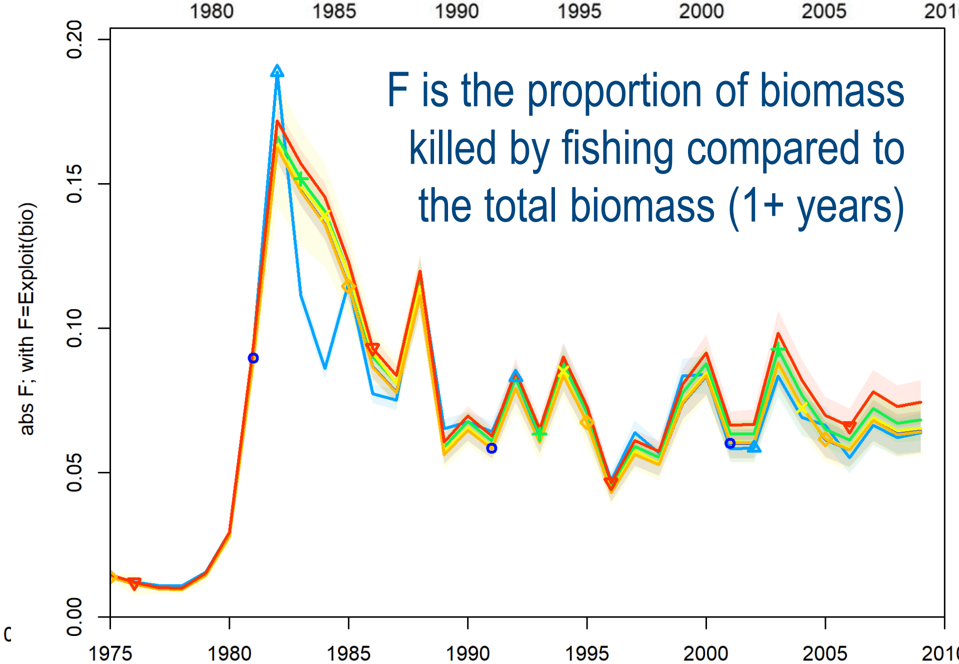
Results

Data changes to SEDAR 22 Model

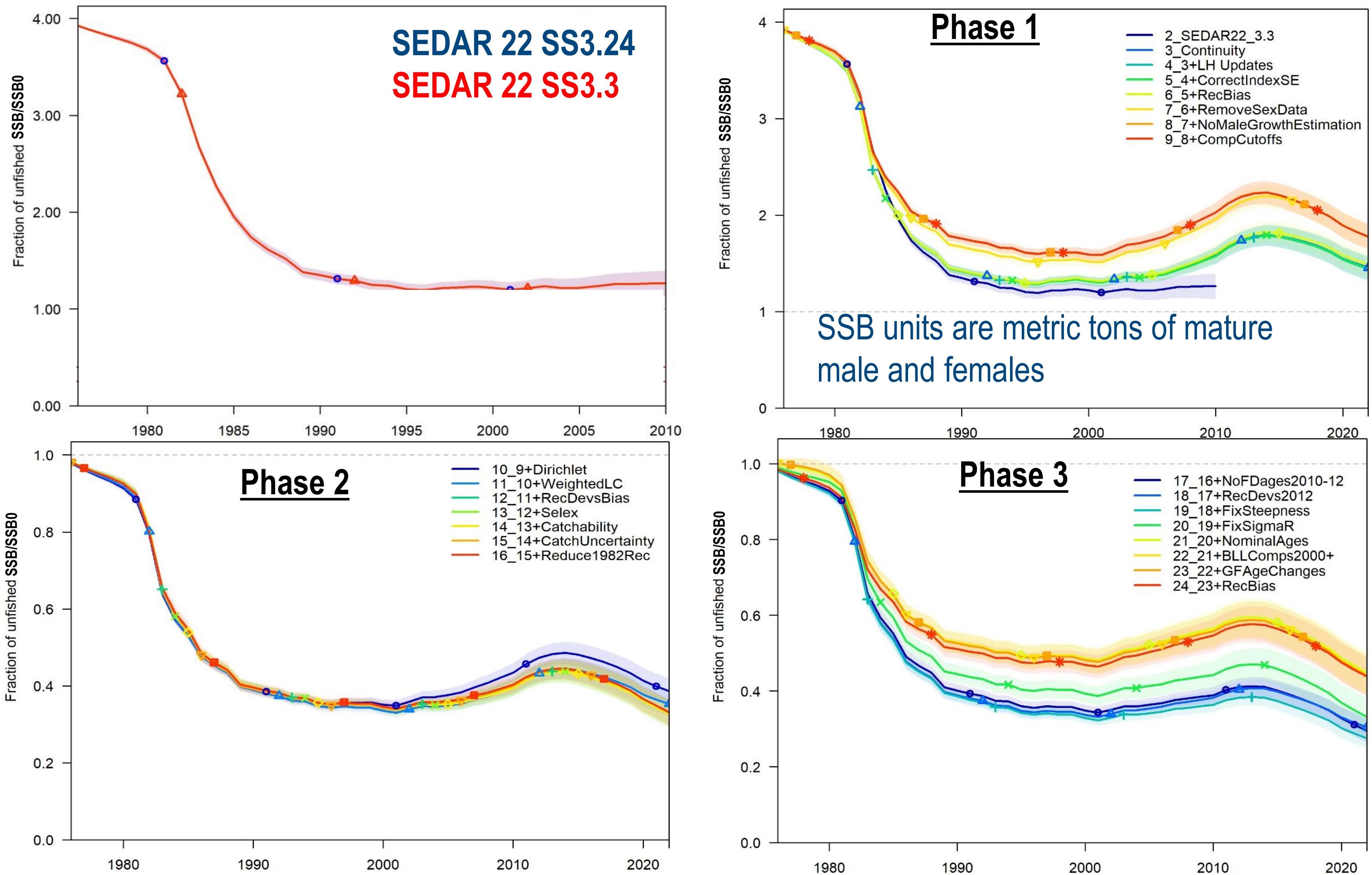
- Noticeable differences for:
  - SEDAR 85 compositions
  - F when using SEDAR 85 landings or more uncertainty





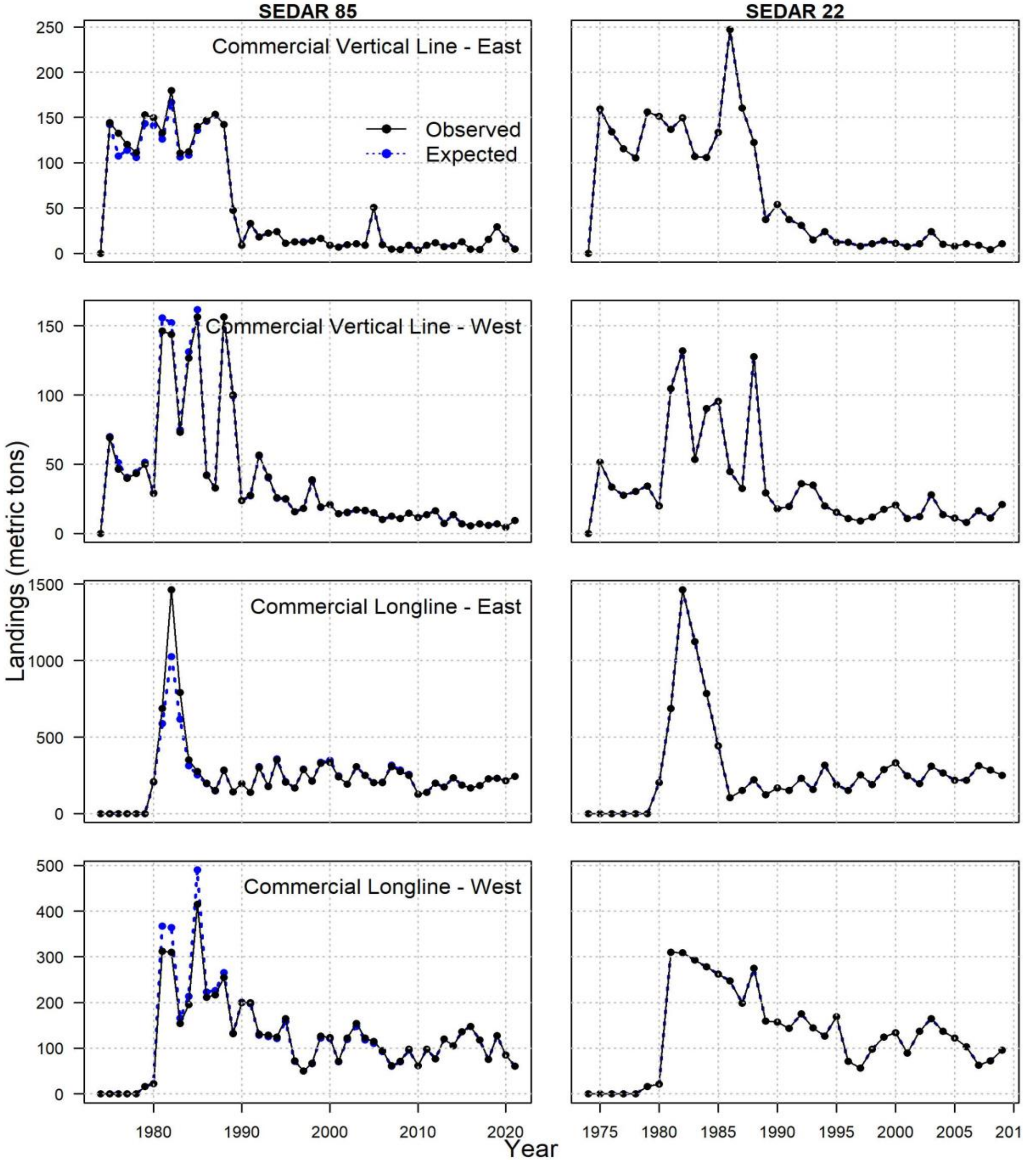


Bridging Analysis: Fraction of unfished SSB



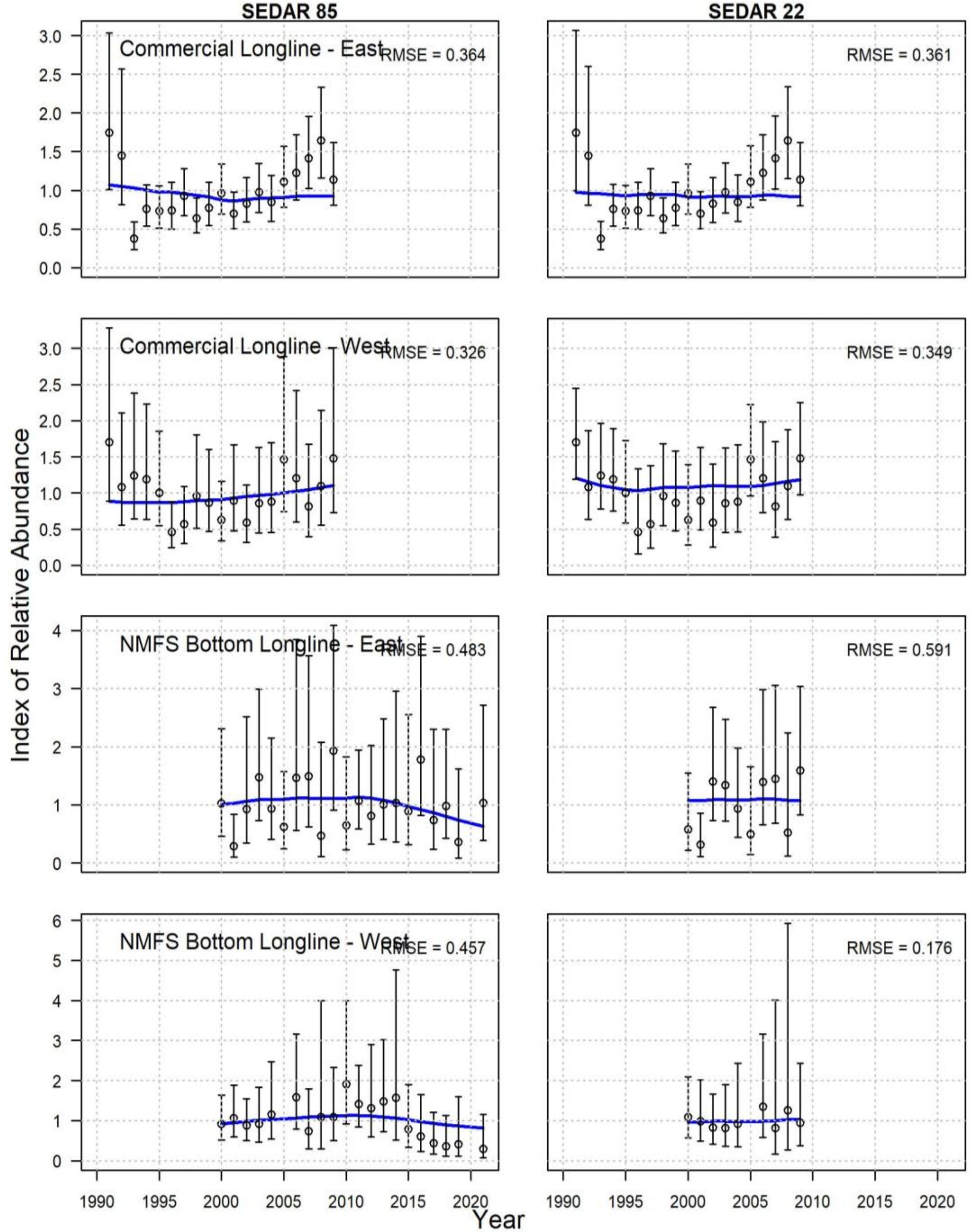
Landings

- More uncertainty in earlier years (pre-1986) leads to poorer fits
- Tight fits from 2010+ (IFQ years log-scale SE = 0.01)



Indices

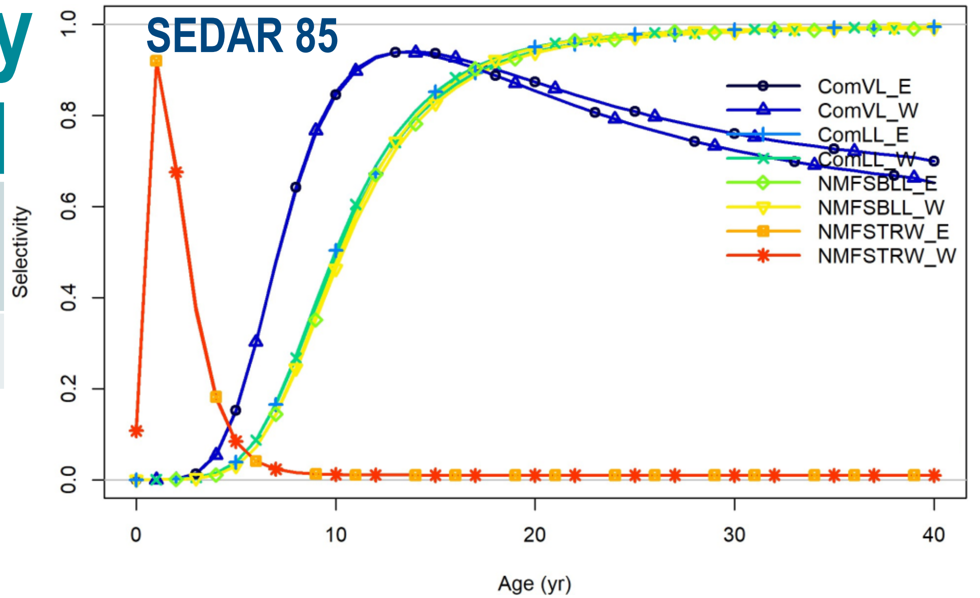
- Fits remain poor for all indices
- Model predicts relatively flat indices, as observed in SEDAR 22 model

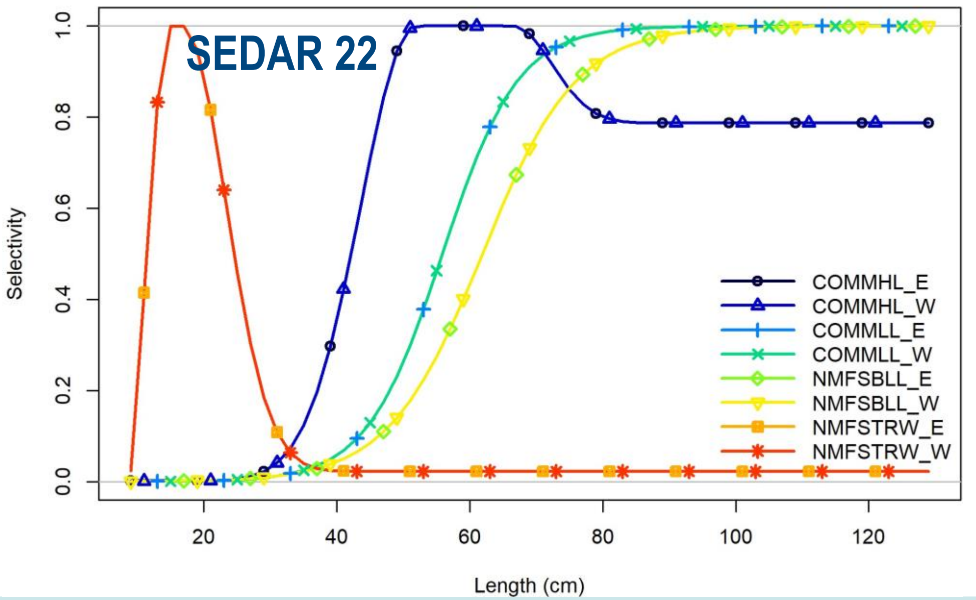


Length-based Selectivity

Logistic	Dome-shaped
Commercial Longline	Commercial Vertical Line
NMFS Bottom Longline	NMFS/SEAMAP Trawl

- Assumed constant selectivity for all fleets and surveys
  - Removed time-varying selectivity used in SEDAR 22 because of limited improvement in model fit



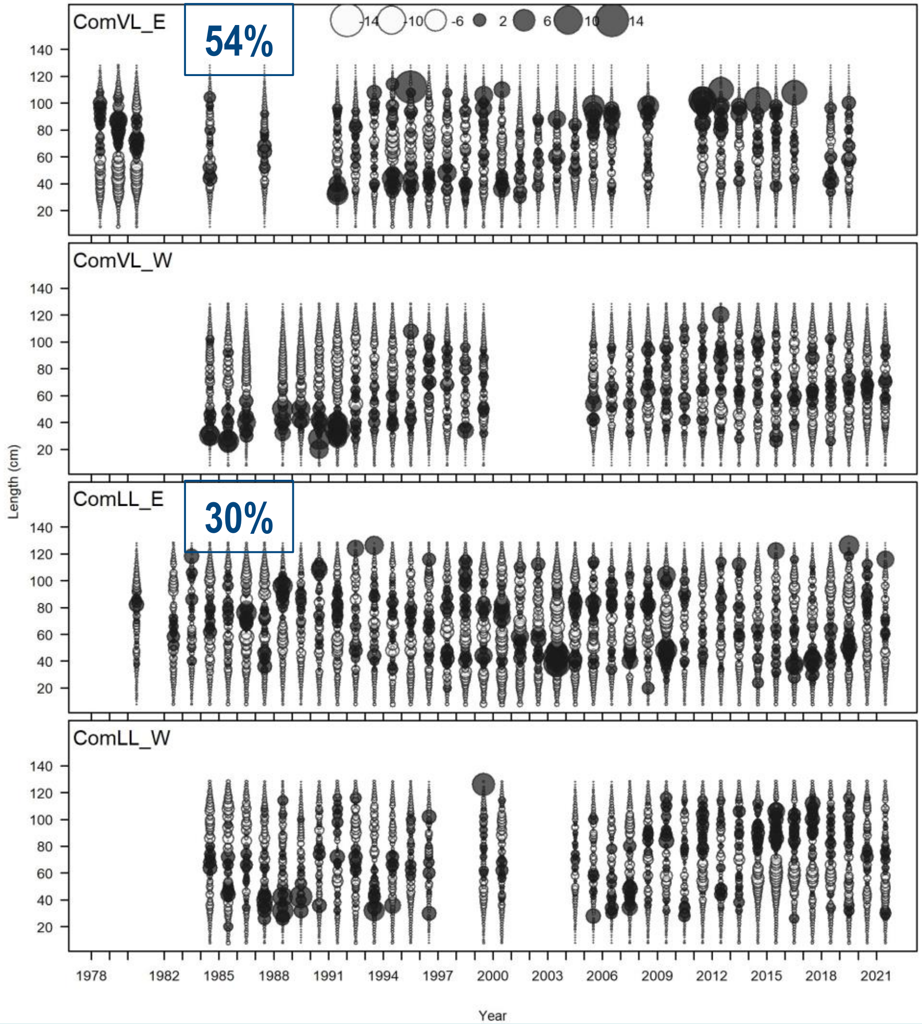


Length Comps

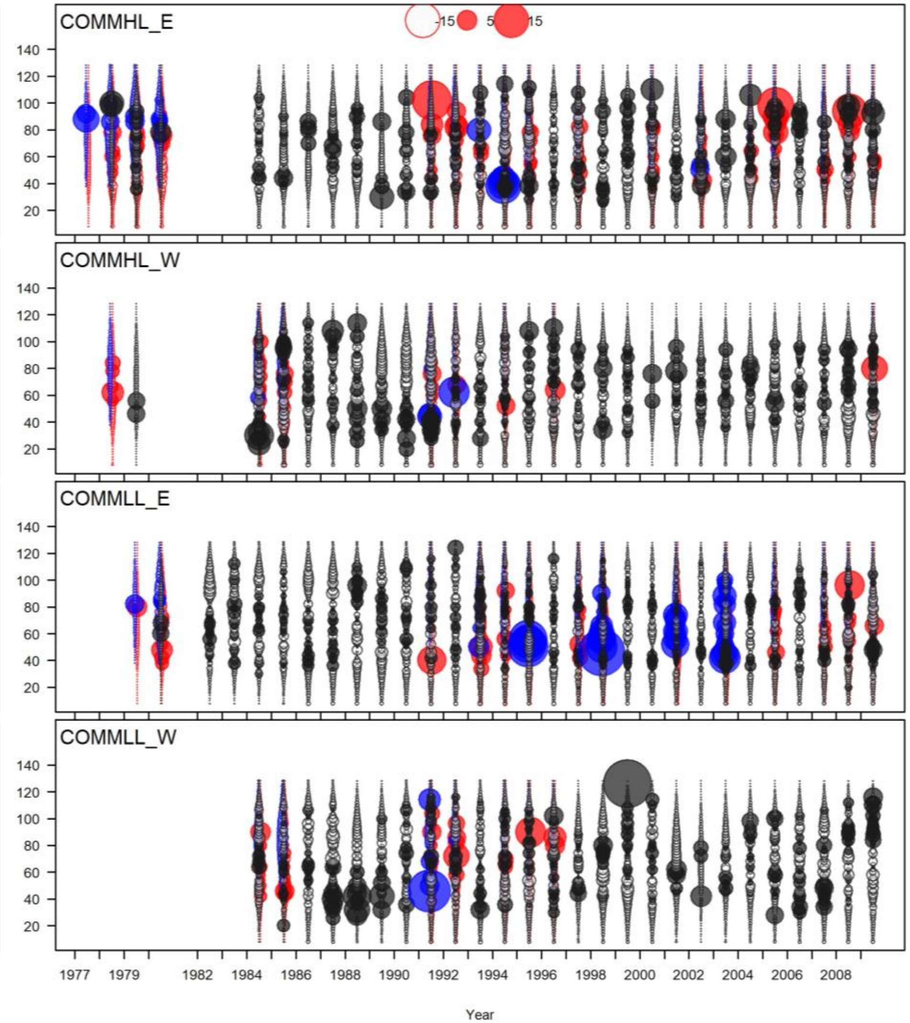
- Closed = + (observed > expected)
- Open = - (observed < expected)

D-M

SEDAR 85



SEDAR 22

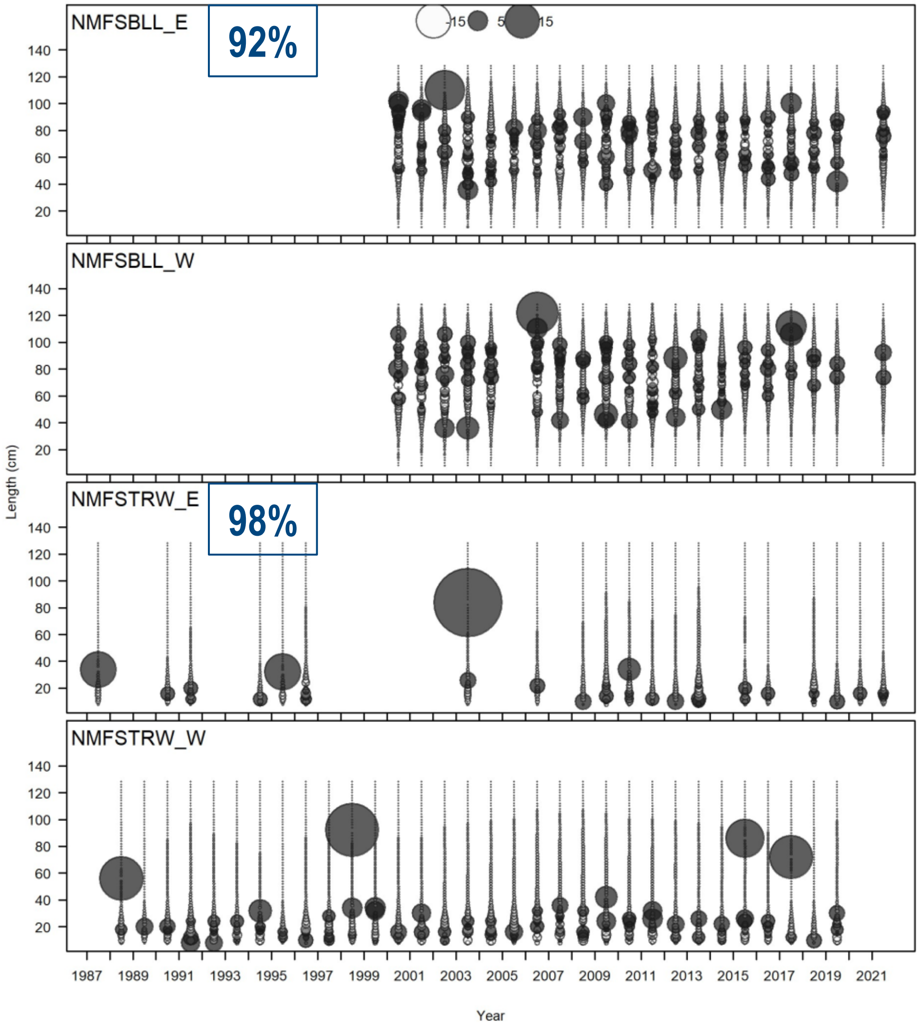


- Closed = + (observed > expected)
- Open = - (observed < expected)

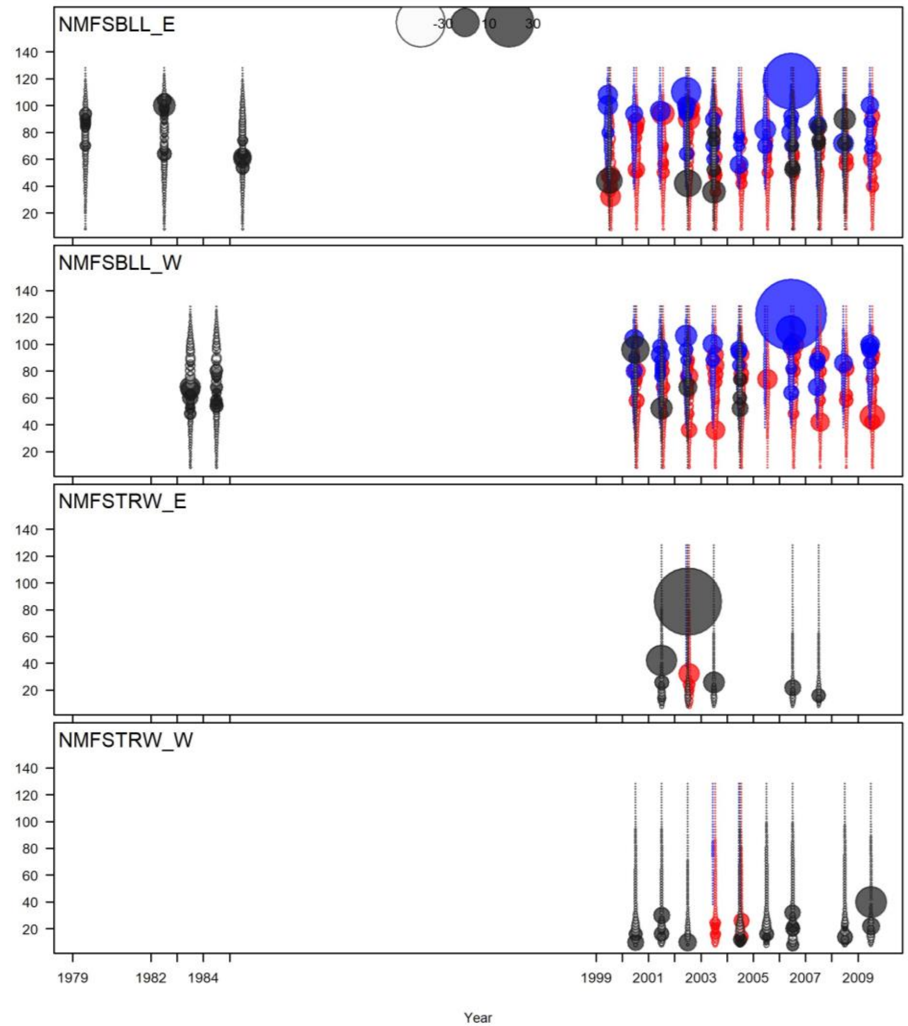
Length Comps

D-M

SEDAR 85



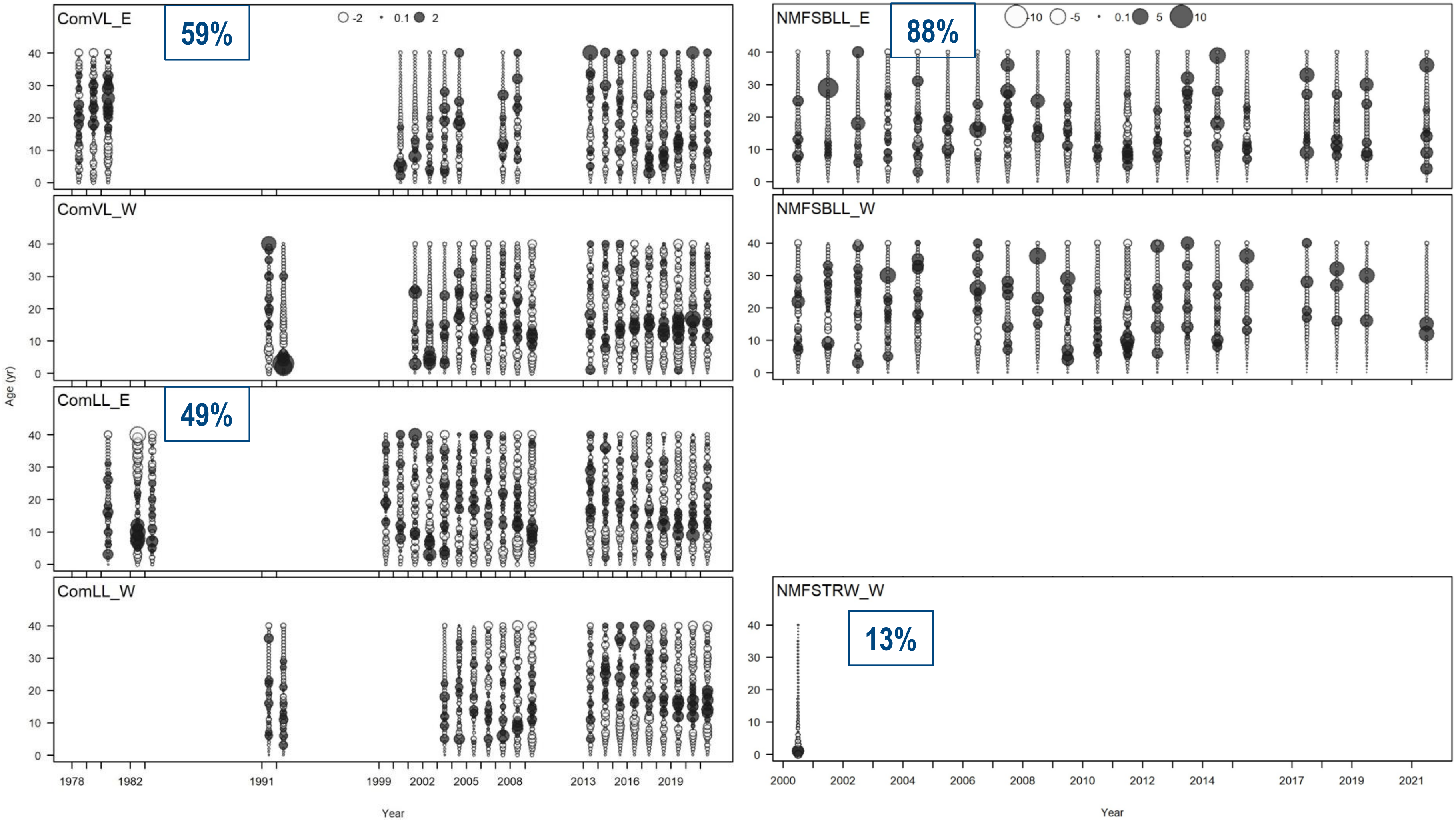
SEDAR 22



SEDAR 85 Age Comps

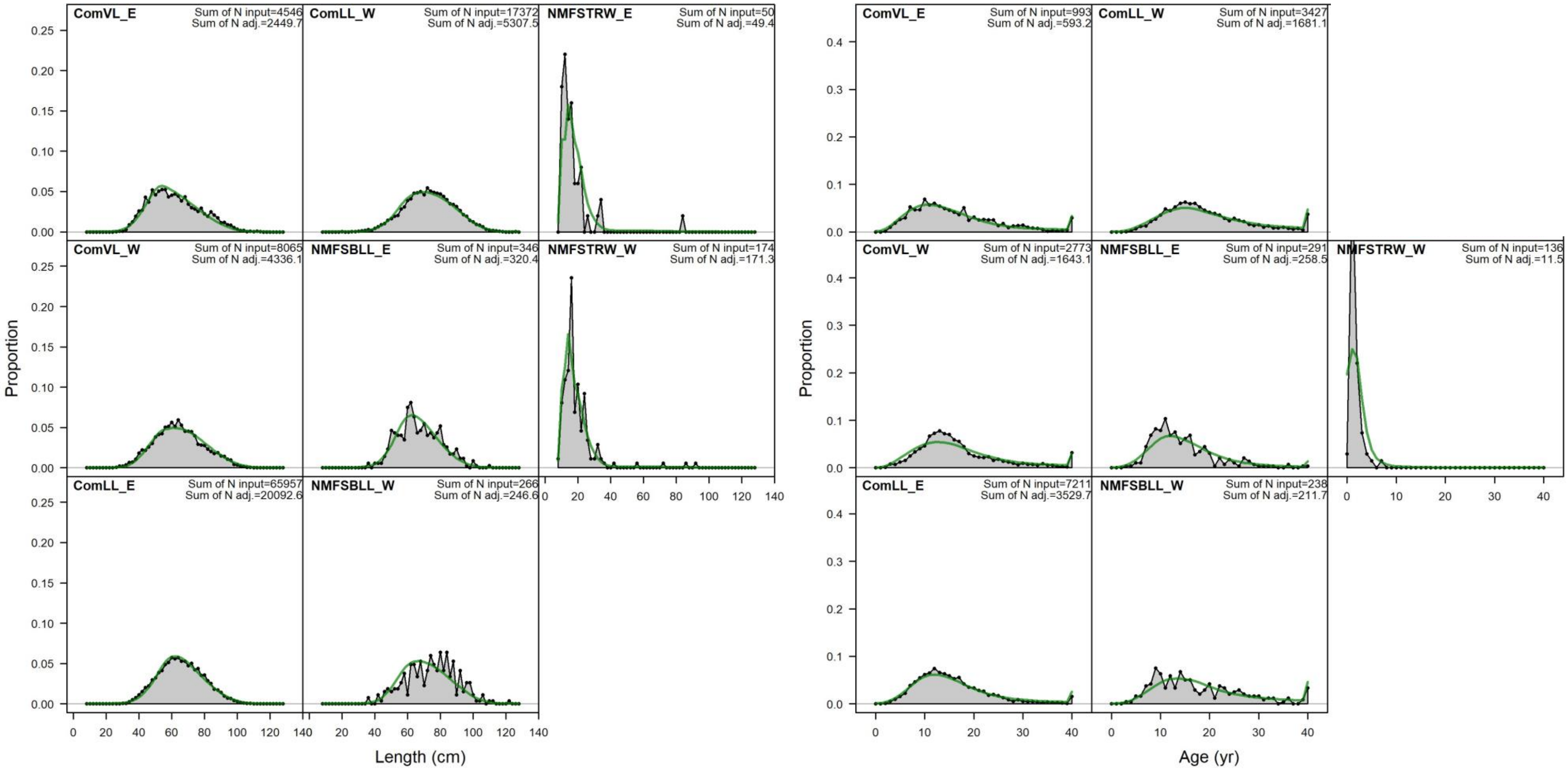
- Closed = + (observed > expected)
- Open = - (observed < expected)

D-M



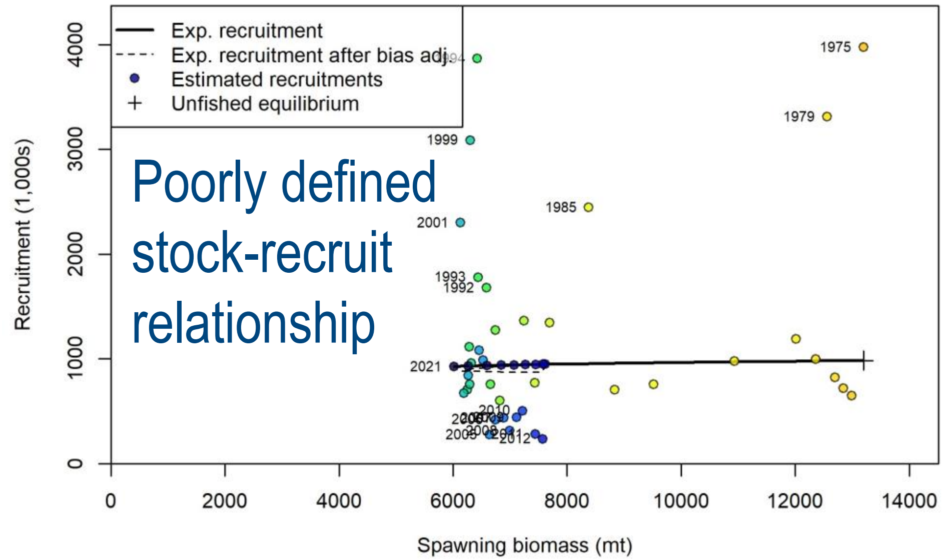
Tradeoffs between fitting compositions

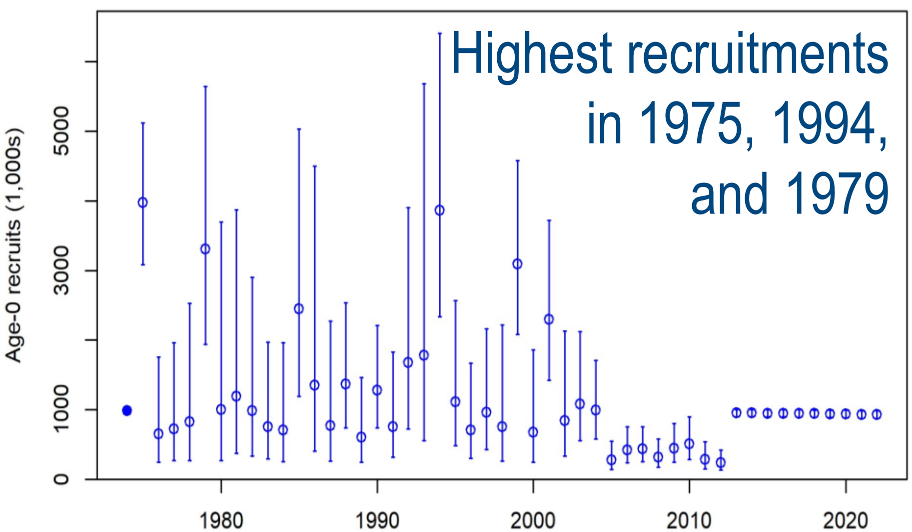
- Not as pronounced as for other species (e.g., scamp)

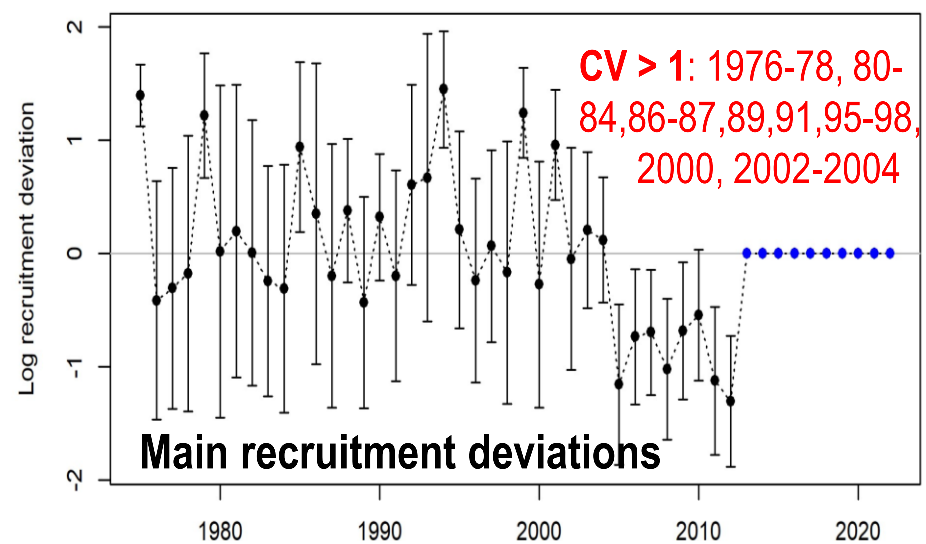


Recruitment

Parameter	Value (CV)
Ln(R0)	6.893 (0.004)
Steepness	0.827 (NA)
SigmaR	0.5 (NA)
Recruitment distribution	-0.109 (0.36)

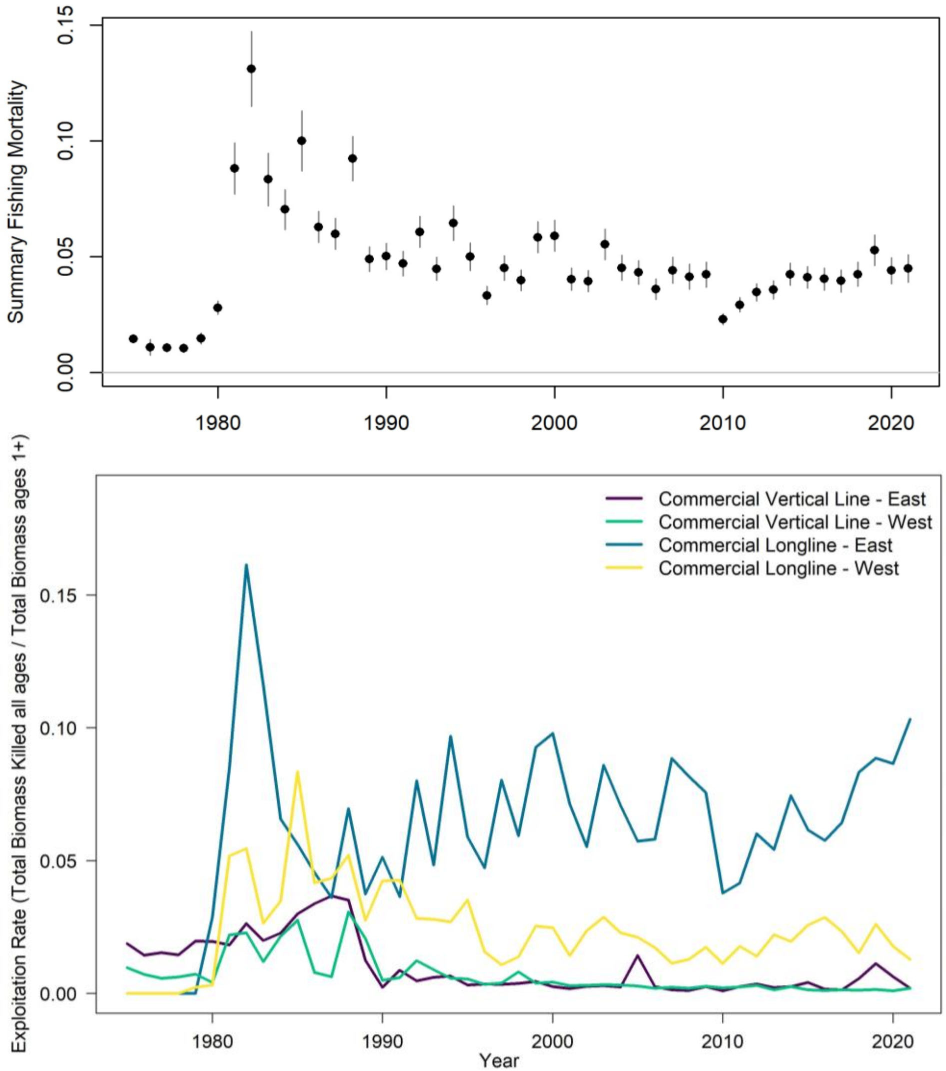




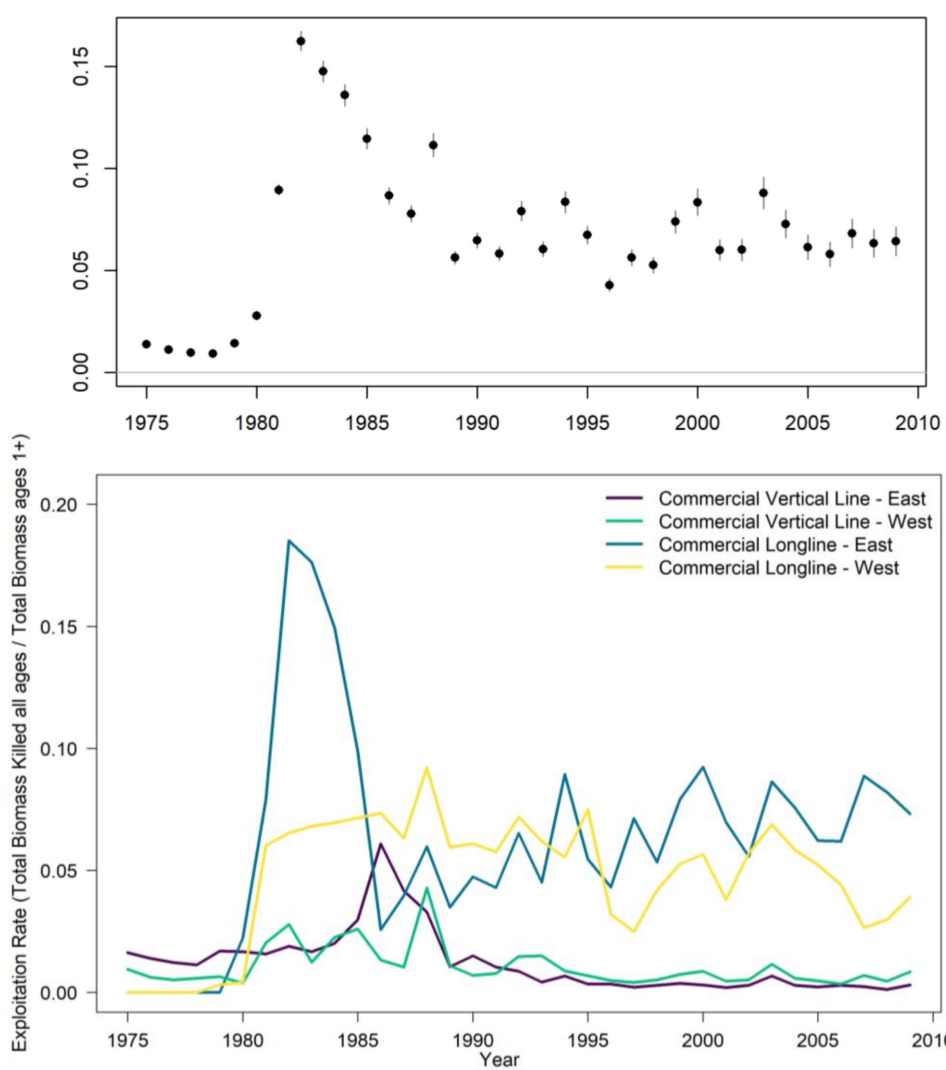


Exploitation Rate

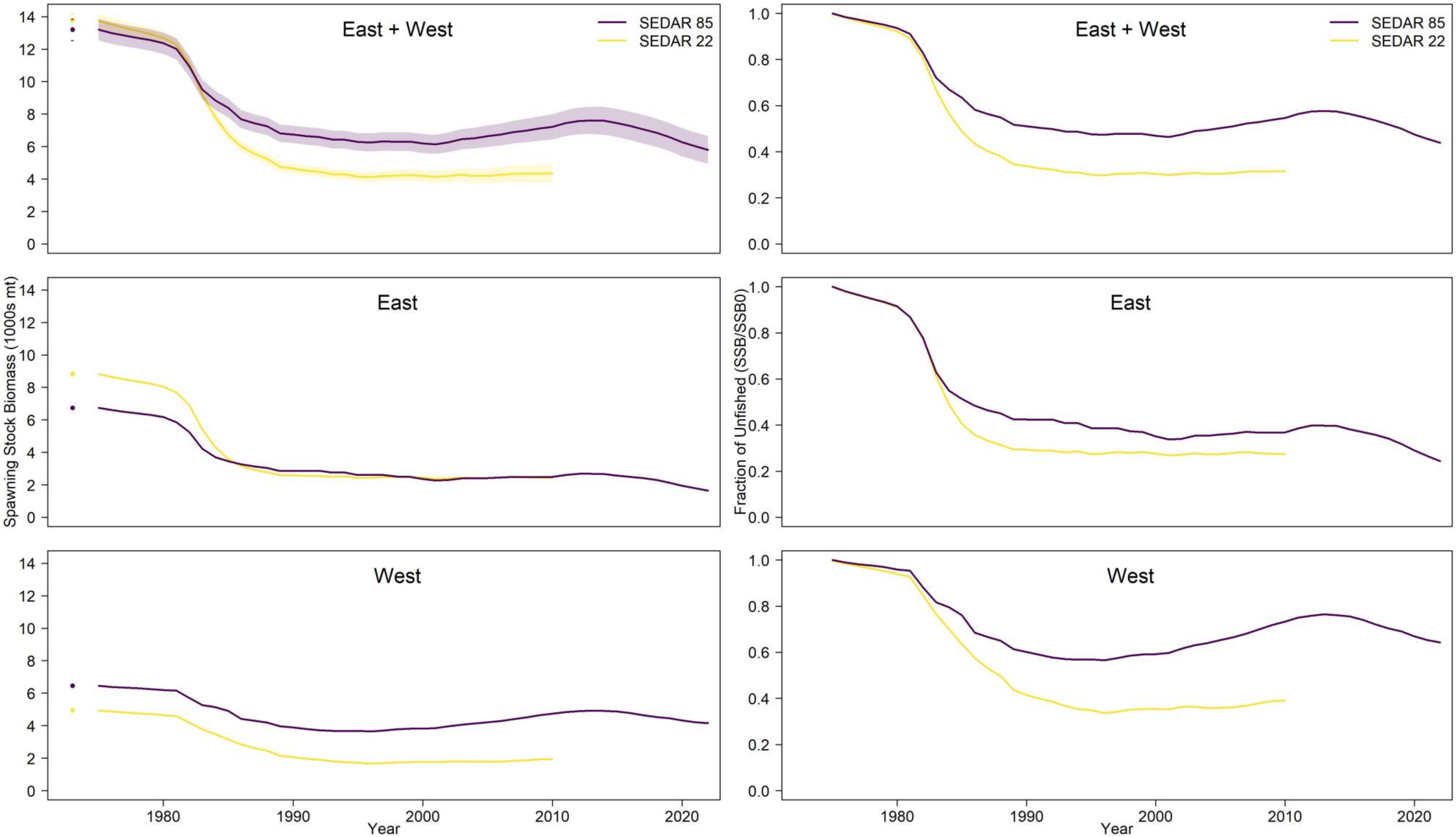
SEDAR 85



SEDAR 22



SSB and SSB/SSB0 trajectories



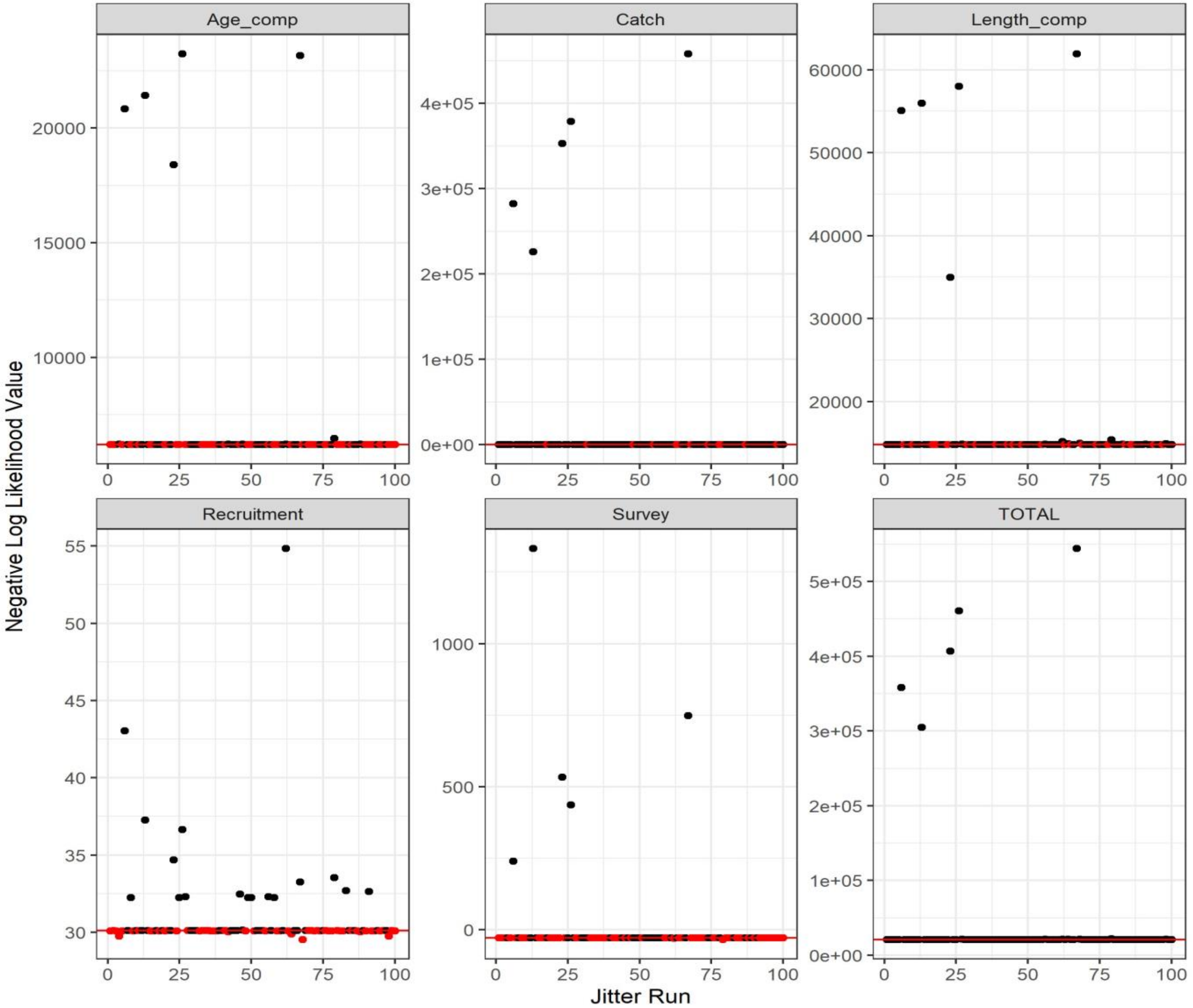
Diagnostics

Jitter analysis

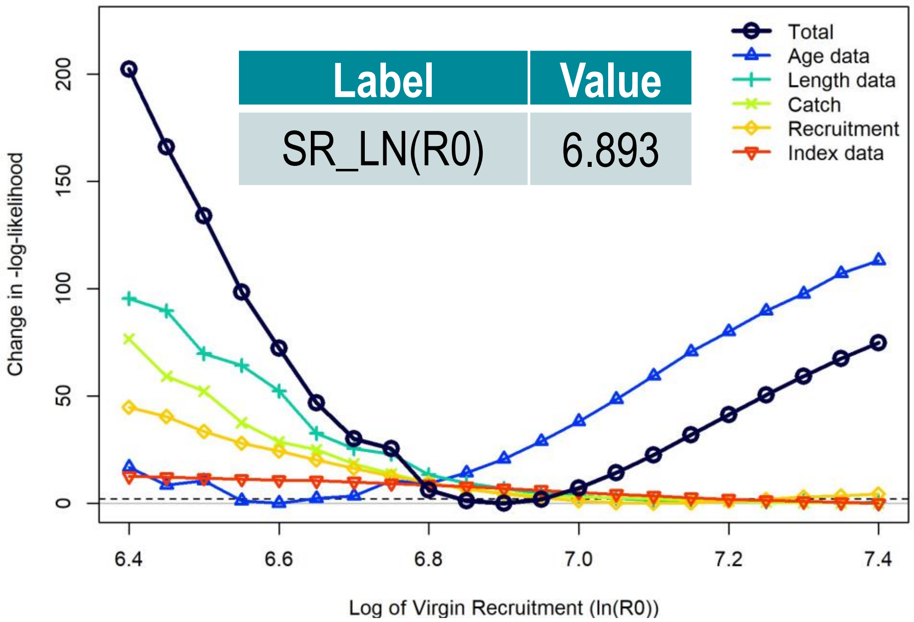
- No runs revealed a lower NLL than the base
- Majority of runs result in similar trajectories
- Of 100 runs:

Results	Percent
Same NLL	29
Within 1 NLL	76

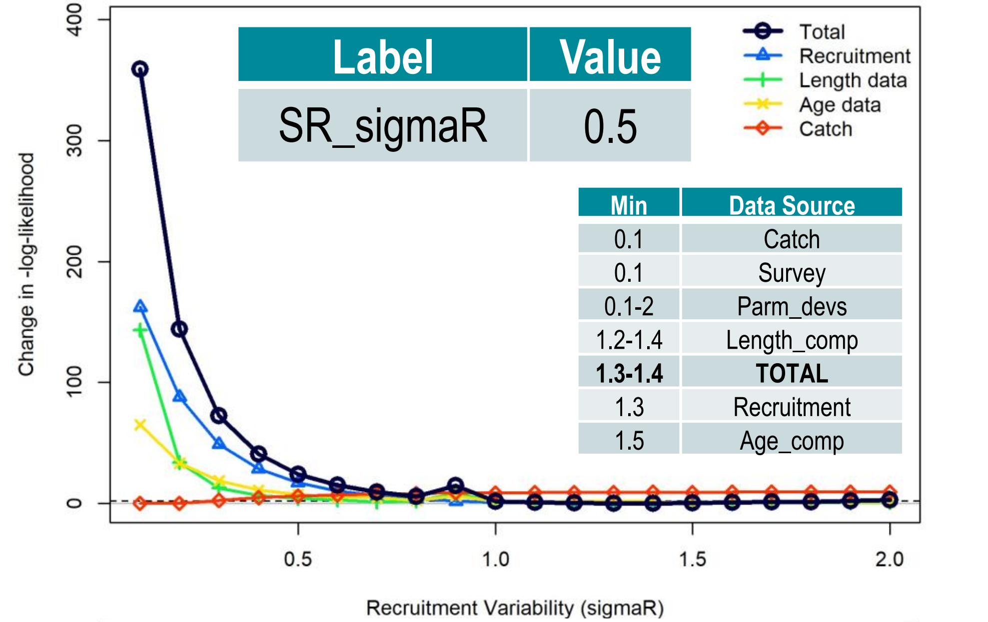
NLL = negative log-likelihood



Likelihood profiles

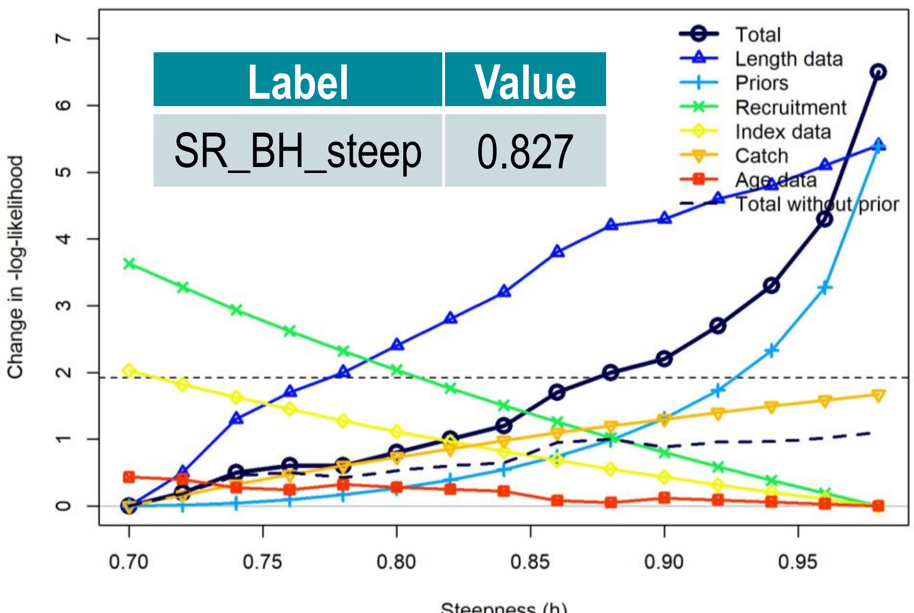


Label	Value
SR_LN(R0)	6.893

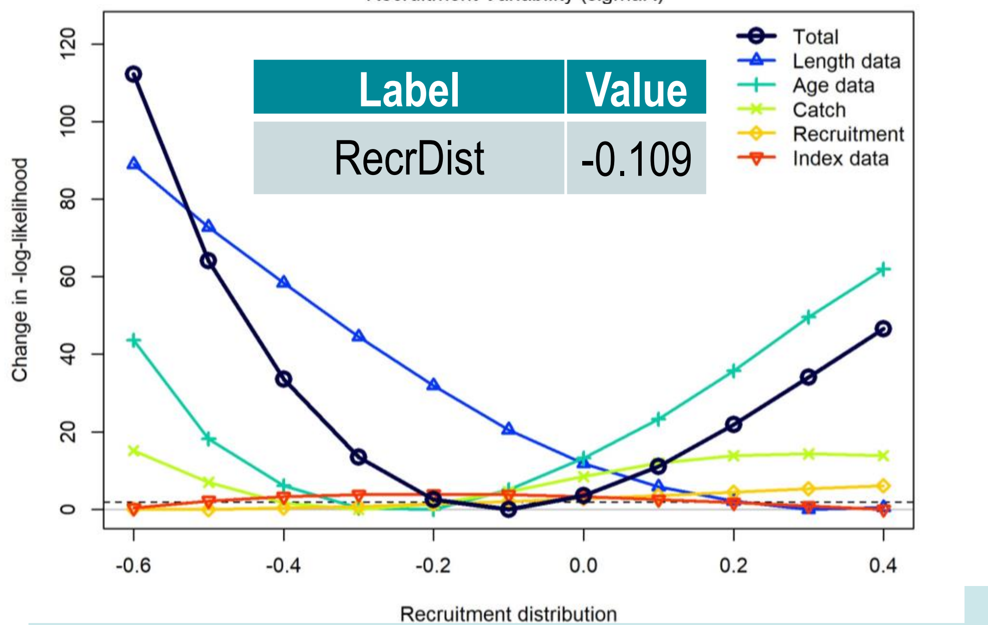


Label	Value
SR_sigmaR	0.5

Min	Data Source
0.1	Catch
0.1	Survey
0.1-2	Parm_devs
1.2-1.4	Length_comp
1.3-1.4	**TOTAL**
1.3	Recruitment
1.5	Age_comp



Label	Value
SR_BH_steep	0.827

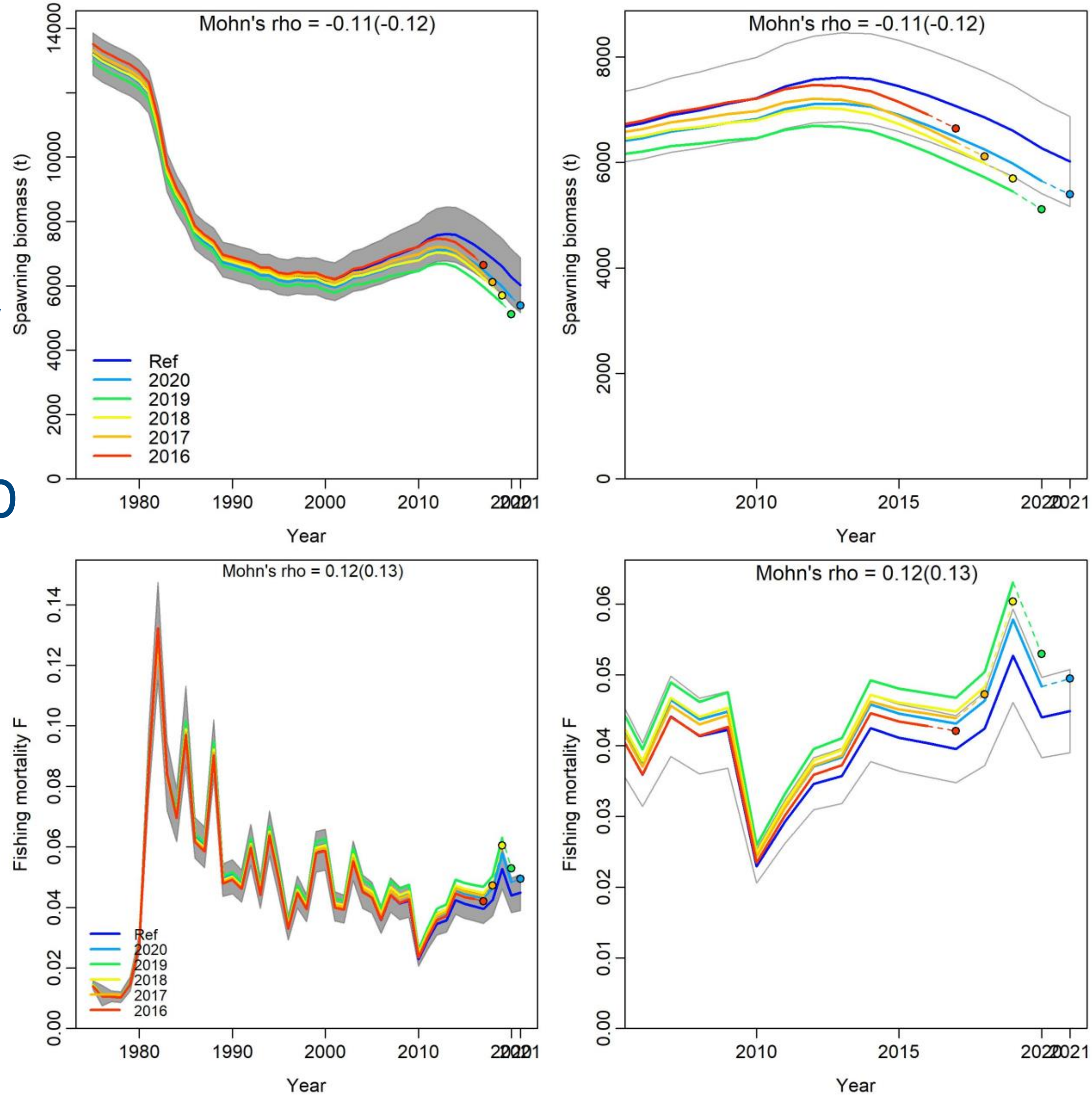


Label	Value
RecrDist	-0.109

Retrospective bias

- Acceptable range for long-lived species (-0.15 to 0.2; Hurtado et al. 2015):

- SSB = **-0.11**
- Recruitment = **-0.02**
- F = **0.12**



Additional diagnostics (Carvalho et al. 2021)

- Runs test: Non-random patterns in residuals evident

Data Source	ComVL E	ComVL W	ComLL E	ComLL W	BLL E	BLL W	Trawl E	Trawl W
Index	-	-	X	X	X	X	-	-
Age	X	X	X	X	X	X	-	-
Length	X	X	X	X	X	X	X	X

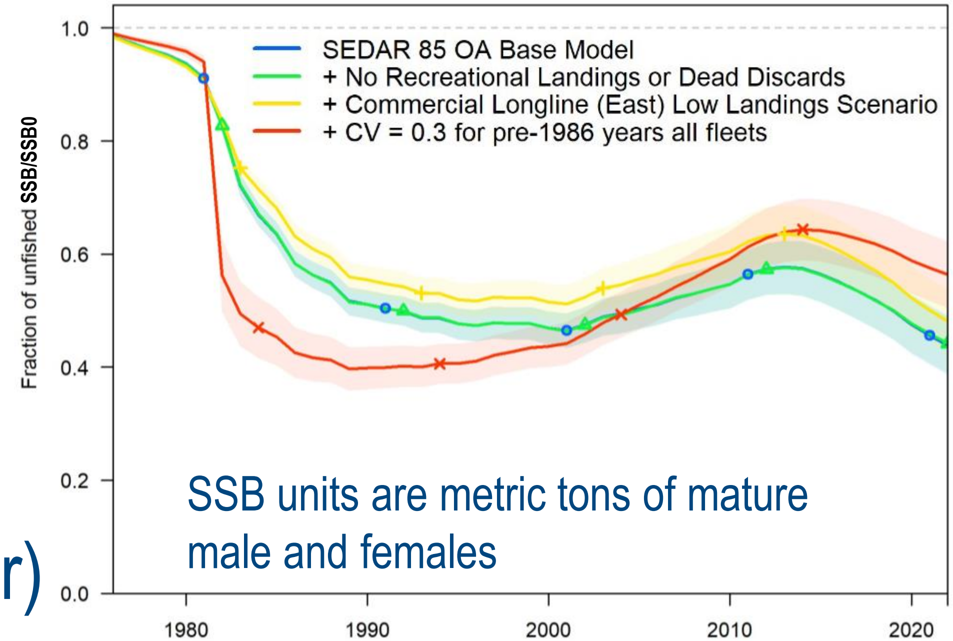
- Hindcast: Poor predictive skill remains for some data

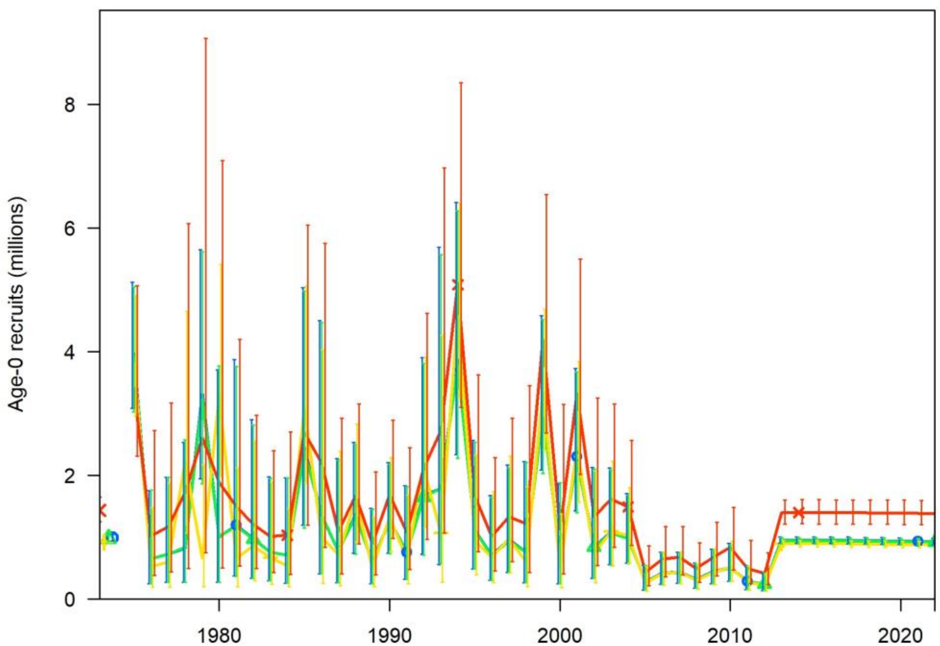
Data Source	ComVL E	ComVL W	ComLL E	ComLL W	BLL E	BLL W	Trawl E	Trawl W
Index	-	-	-	-	X	X	-	-
Age	X	X	X	X	X	X	-	-
Length	X	X	X	X	X	X	X	X

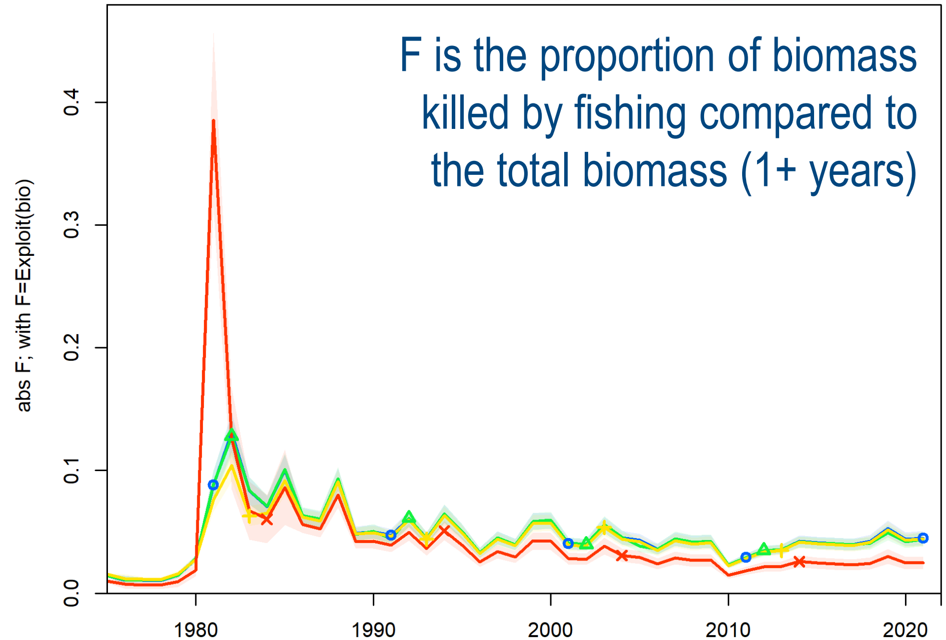
Sensitivity Runs

Landings

- Large impact of early uncertainty
- No noticeable impact from recreational data (very minor)



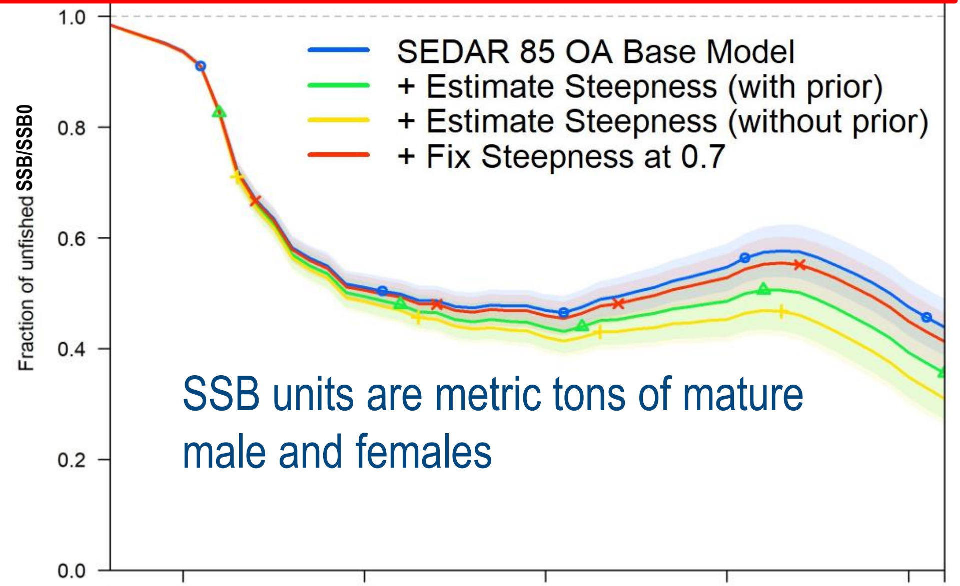


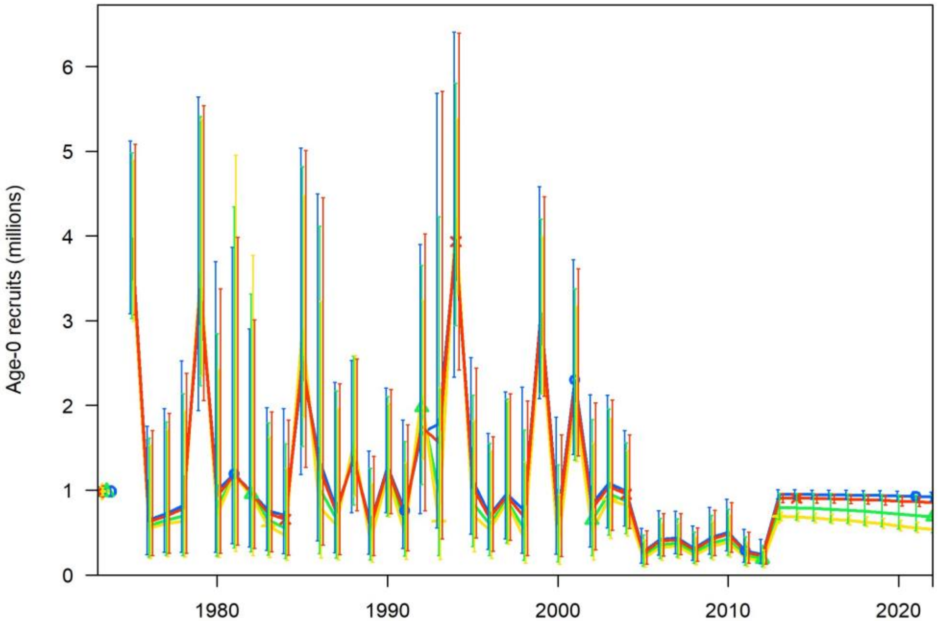


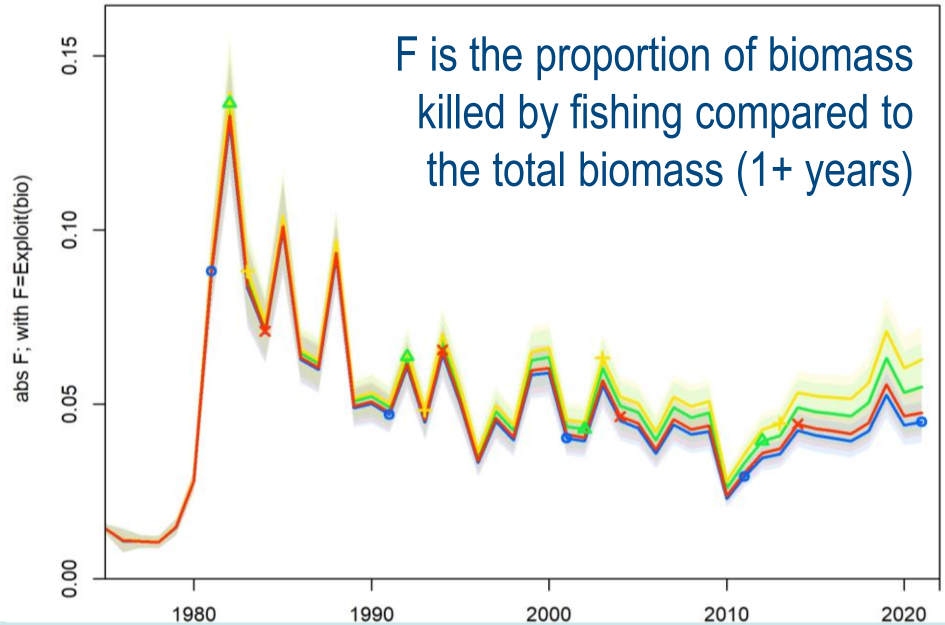
- Consider whether steepness can be estimated, with or without a prior. If steepness is fixed, evaluate the sensitivity of that assumption.

Steepness

Model Run	Steepness
SEDAR85 OA Base Model	0.827 (NA)
+ Estimate (with prior)	0.508 (0.177)
+ Estimate (without prior)	0.4 (0)
+ Fix steepness	0.7 (NA)

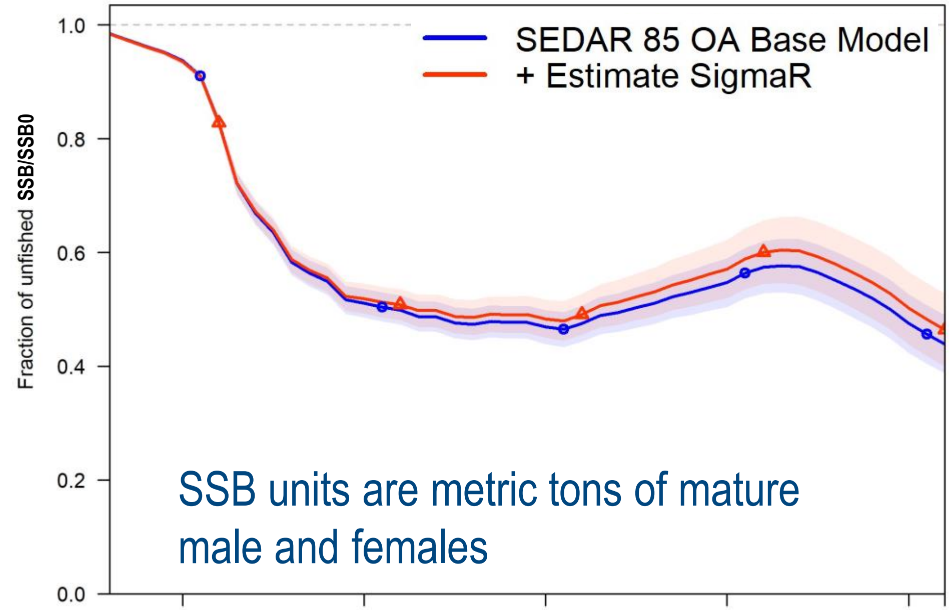


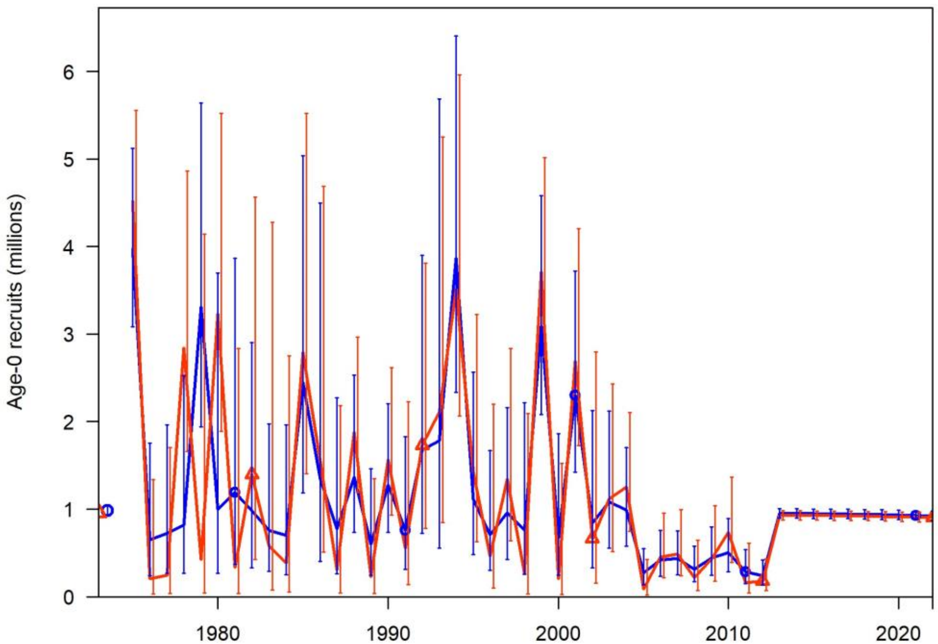


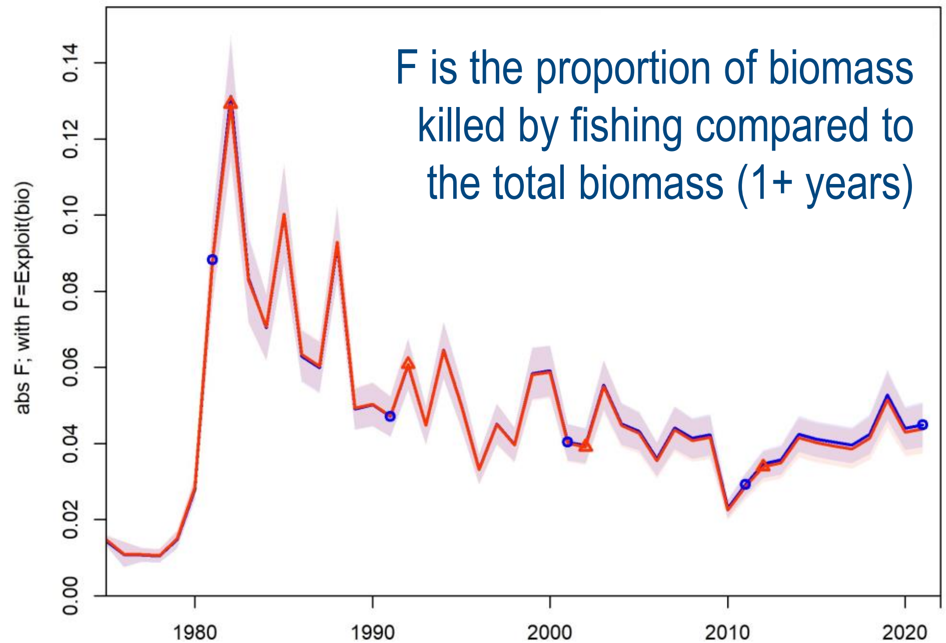


SigmaR

- Freely estimated at 1.4, but does not have a large impact on SSB ratio or F estimates



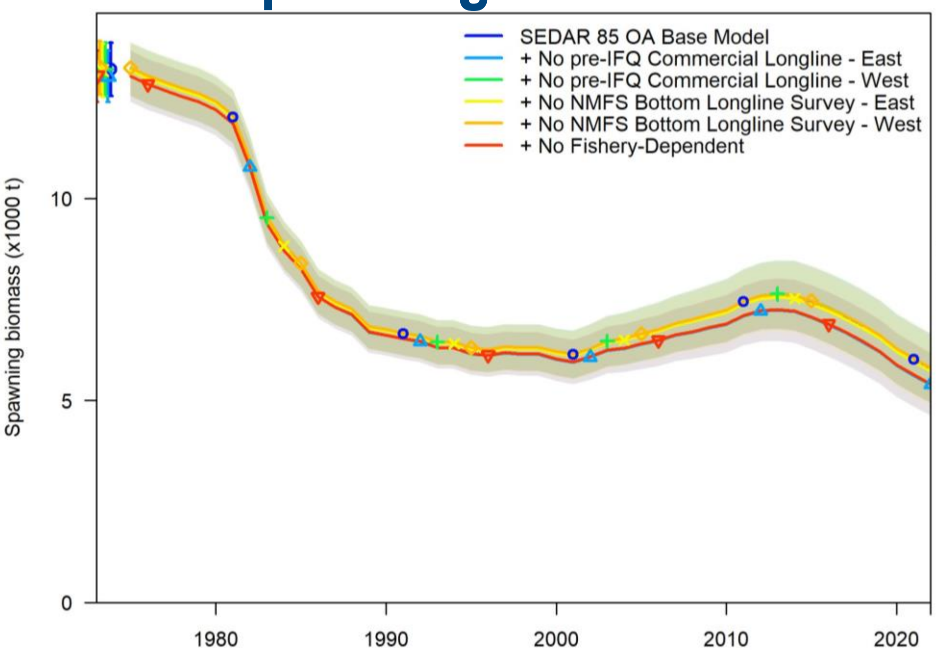




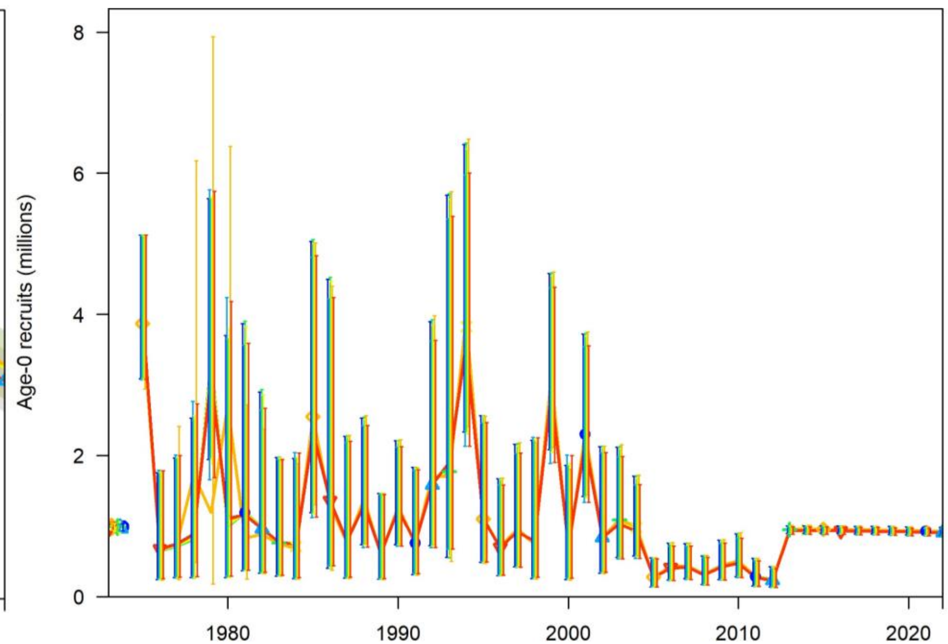
Index Jack-knife runs

- Purpose: determine which index or indices were most influential on derived quantities

Spawning biomass



Recruits



- Removal of CommLL E index (and all fishery-dependent indices) leads to slight divergence in the end of time series

Conclusions

- SEDAR 85 OA Base Model incorporated the best available data, addressed the TORs, and showed an improved model with better fits and diagnostics

<u>Improvements</u>

- Data inputs from best practices methods
- Captures more uncertainty in landings
- Reduced stratification (sex-specific data)

<u>Outstanding Issues</u>

- Historical landings
- Poor fits to indices
- Limited survey data
- Recruitment uncertainty
- Compositions (representativeness)

Research Recommendations

Stock Structure

- Better understanding of the population genetics throughout the Gulf of Mexico and connectivity with the Atlantic

Age and Growth

- Investigate methods to better collect age structure samples randomly and systematically from all fishing sectors
- Continue collaboration with ageing facilities throughout the Gulf of Mexico and South Atlantic. These efforts will include the annual reading of references sets for Yellowedge Grouper and other reef fish, and annual meetings to review the interpretation of ageing structures and the timing of annual band deposition

Natural Mortality

- Explore more direct approaches to estimating natural mortality (e.g., Mark-recapture approaches (conventional, telemetry, or close-kin))
- Explore ways to better reflect uncertainty around the mortality at age vector

Reproduction

- Continue data collection for maturity, sex transition, and fecundity as detailed in the SEDAR 22 Benchmark Assessment DW Report Recommendations

Discard Mortality

- Continue data collection from observer programs or electronic monitoring programs (e.g., SEDAR68-DW-22)

Commercial Landings

- Explore approaches for assigning uncertainty estimates to commercial landings and revisit estimation of historic landings

Recreational Landings and Discards

- Further develop best practices for correcting for prominent peaks and troughs in the recreational landings and discards where uncertainty is high and estimates are driven by few but influential intercept records

CPUE Indices

- Consider developing indices of relative abundance from observer program data (e.g., SEDAR68-AW-04). Observer data would provide finer spatial resolution, a more accurate measure of CPUE, size frequency and discard information

Age and length composition

- Quantify and evaluate appropriate modeling and weighting procedures of length and age compositions to ensure age and length composition inputs are representative of the segment of the population being modeled

Selectivity and catchability

- Further investigate and quantify changes in selectivity/catchability through time to improve fit to the length and age compositions

Surveys

- Improve precision in survey abundance indices by increasing the number of samples, including expansion into deeper water
- Increase collection of length and age information for compositions

Benchmarks, Stock Status and Projections

TORs

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 or MSY proxy ($F_{30\%SPR}$) = yield at F_{MSY}
     - MSST = $0.75 * B_{MSY}$
     - MFMT = F_{MSY} (or proxy) and $F_{Rebuild}$ (if overfished)
     - OY = 90% of MSY or MSY proxy ($F_{30\%SPR}$), per Reef Fish Amendment 48
     - If different SDC are recommended, provide outputs for both the current and recommended SDC.
   - 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.
   - 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.
   - 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

Catch Equivalency Table

- 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.

Year	SEDAR 22 MRFSS OFL	SEDAR 22 FES/Comm OFL	%Difference OFL
2012	0.913	0.940	3
2013	0.903	0.926	3
2014	0.893	0.912	2
2015	0.883	0.899	2

- An MRIP-FES only projection was not feasible because the SEDAR 22 landings vector (including a breakdown by data source) could not be recreated.

Projection settings

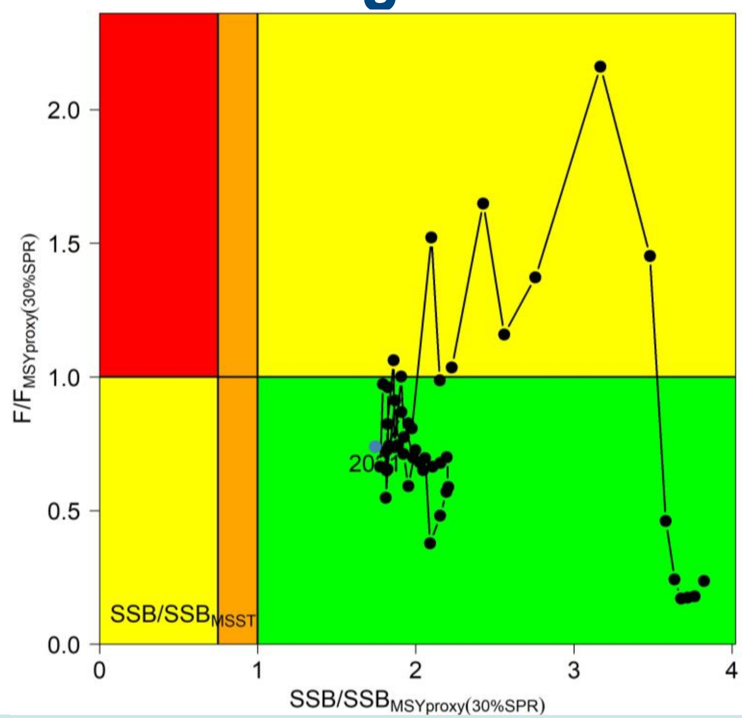
Parameter	Value	Comment
Relative F	Average from 2019-2021	Average relative fishing mortality (apical F) over terminal three years
Selectivity	Average from 2019-2021	Fleet specific selectivity estimated over terminal three years
Recruitment	Beverton-Holt stock-recruitment relationship	Derived from the model estimated Beverton-Holt stock-recruitment relationship
Interim Landings (2022-2024)	9.04/9.78 metric tons (Commercial Vertical Line - East) 12.53/8.86 metric tons (Commercial Vertical Line - West) 161.73/206.42 metric tons (Commercial Longline - East) 34.38/60.01 metric tons (Commercial Longline - West)	Landings provided for 2022 For 2023 and 2024, used 3-year average (2020-2022)
Allocation Ratio	None	

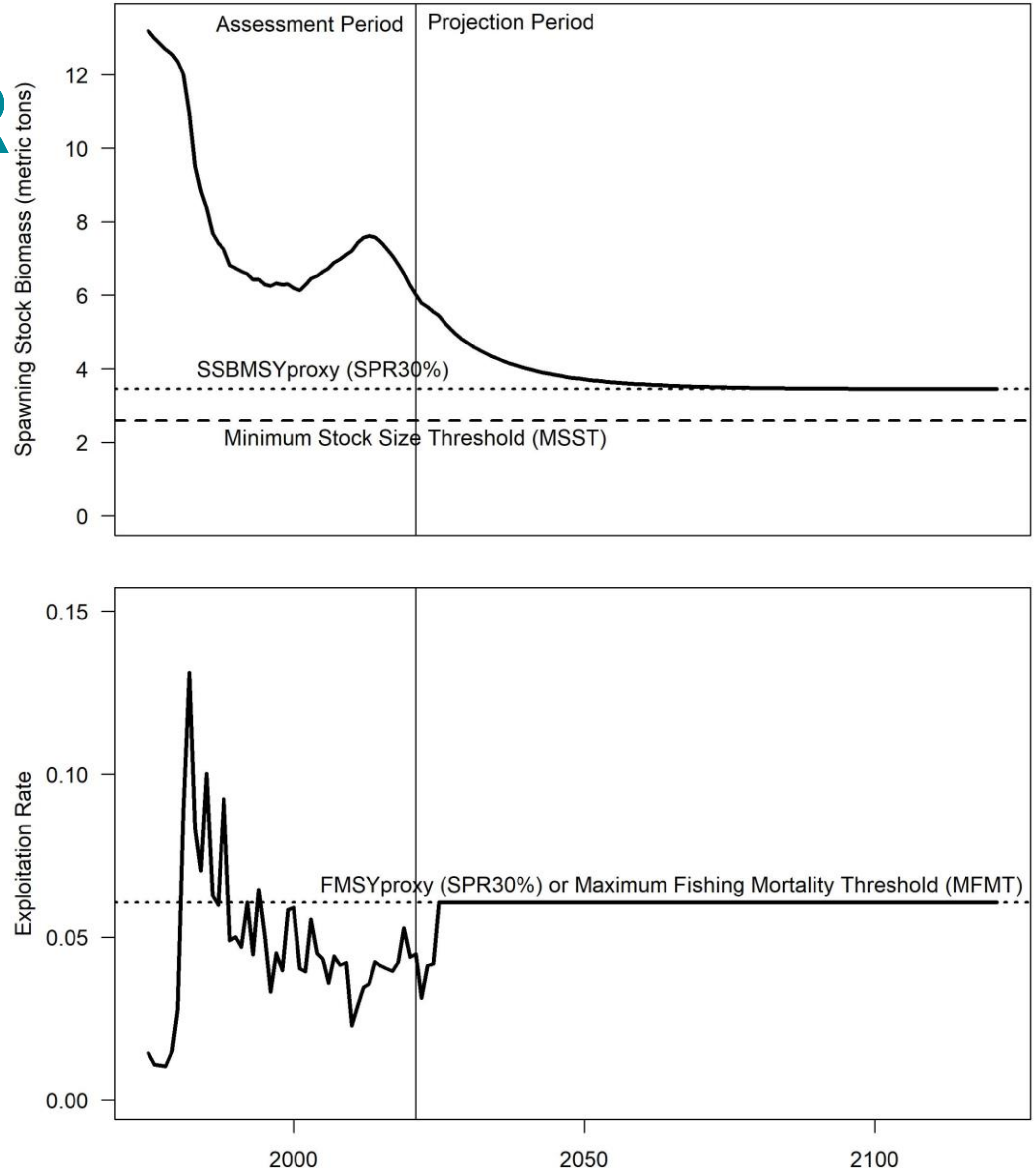
MSRA Benchmarks & Reference Points: 30%SPR

Criteria	Definition	Value
Steepness	Steepness of the Beverton-Holt stock-recruit relationship (fixed)	0.827
R0	Virgin recruitment (1,000s)	985
Generation Time	Fecundity-weighted mean age	18.17
SSB0	Virgin spawning stock biomass (mt)	13,197
	Mortality Rate Criteria	
$F_{MSYproxy}$	Equilibrium F that achieves 30%SPR	0.061
MFMT	$F_{MSYproxy}$	0.061
$F_{current}$	Geometric mean of the last 3 years of the assessment ($F_{2019-2021}$)	0.047
$F_{current}$/MFMT	Current stock status based on MFMT	**0.775**
	Biomass Criteria	
$SSB_{MSYproxy}$	Equilibrium SSB at $F_{30\%SPR}$	3,452
MSST	0.75 * $SSB_{30\%SPR}$	2,589
$SSB_{current}$	SSB in 2021	6,017
$SSB_{current}/SSB_{FMSYproxy}$	Current stock status based on $SSB_{30\%SPR}$ (Equilibrium)	1.74
$SSB_{current}$/MSST	Current stock status based on MSST	**2.32**
$SSB_{current}$/SSB0	SSB ratio in 2021	0.46

Stock Status: 30%SPR

- Gulf of Mexico Yellowedge Grouper is **not overfished nor undergoing overfishing at 30% SPR**



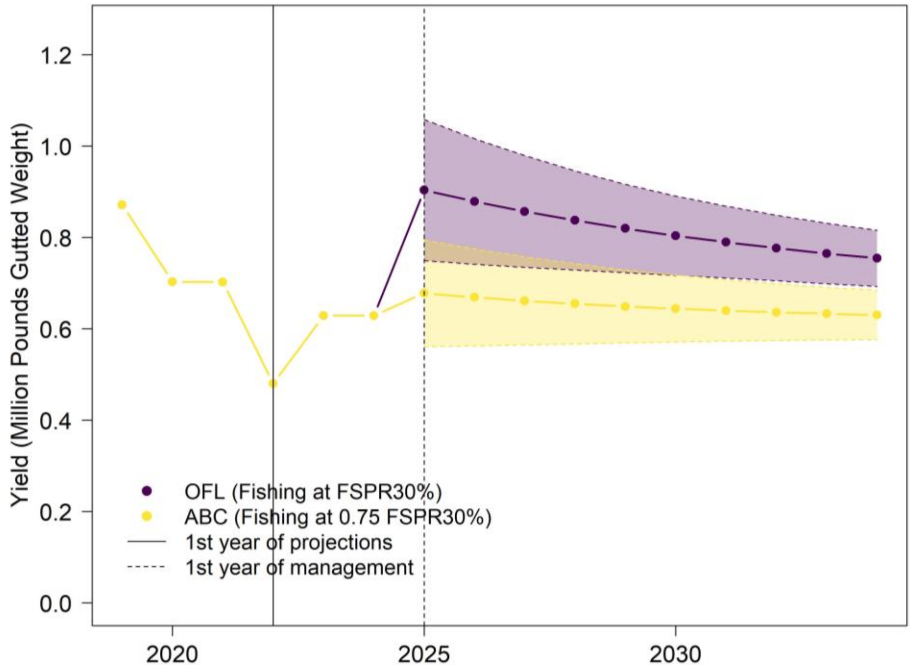


OFL Projections: $F=F_{30\%SPR}$

Year	Recr (1000s)	F	$F/F_{30\%SPR}$	SSB (mt)	$SSB/SSB_{30\%SPR}$	SSB/ MSST	SSB ratio	OFL (mp gw)
2025	917.079	0.061	1	5,443	1.577	2.102	0.412	0.904
2026	913.109	0.061	1	5,250	1.521	2.028	0.398	0.879
2027	909.473	0.061	1	5,083	1.472	1.963	0.385	0.857
2028	906.148	0.061	1	4,939	1.431	1.907	0.374	0.837
2029	903.059	0.061	1	4,810	1.393	1.858	0.365	0.820

- Assuming recruitment from stock-recruit curve throughout projections

Years	Constant Catch
Three (2025-2027)	0.880 mp gw
Five (2025-2029)	0.859 mp gw

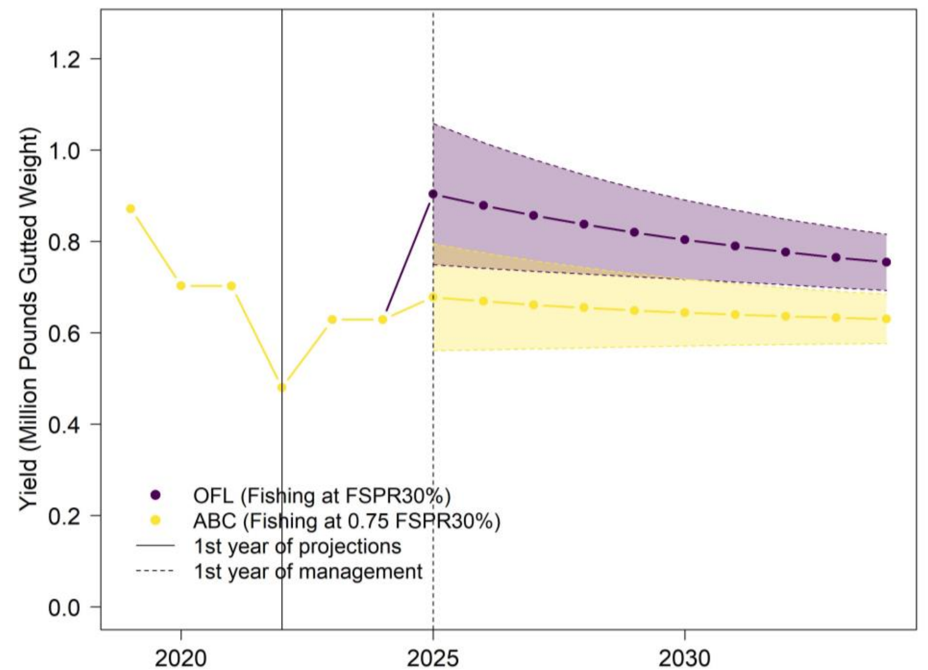


ABC Projections: $F=0.75*F_{30\%SPR}$

Year	Recr (1000s)	F	$F/F_{30\%SPR}$	SSB (mt)	$SSB/SSB_{30\%SPR}$	SSB/ MSST	SSB ratio	Yield (mp gw)
2025	917.079	0.046	0.75	5,443	1.577	2.102	0.412	0.678
2026	914.947	0.046	0.75	5,338	1.546	2.062	0.405	0.669
2027	913.172	0.046	0.75	5,253	1.522	2.029	0.398	0.661
2028	911.708	0.046	0.75	5,185	1.502	2.002	0.393	0.655
2029	910.459	0.046	0.75	5,127	1.485	1.980	0.389	0.649

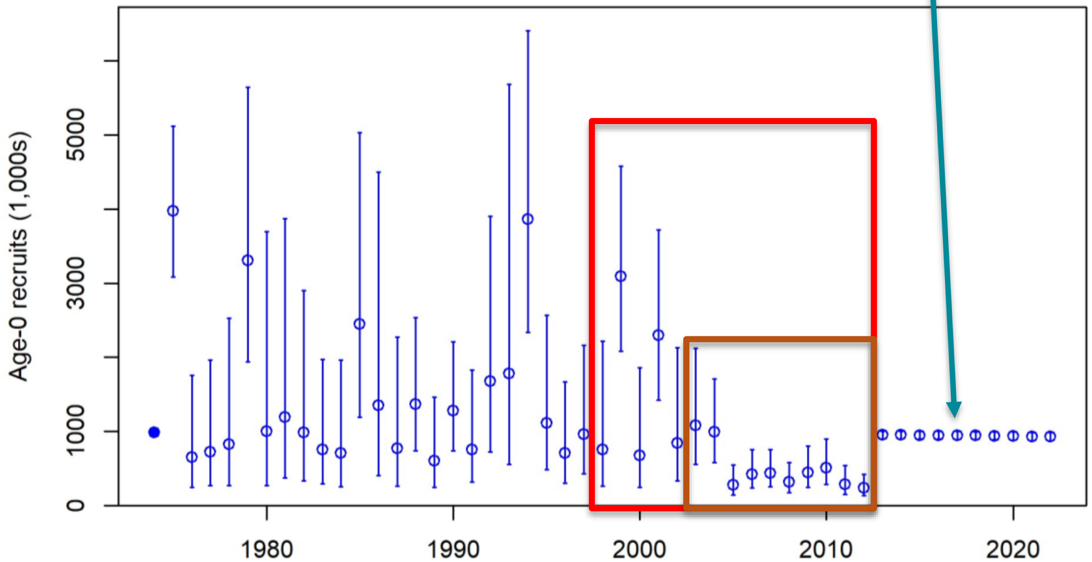
- Assuming recruitment from stock-recruit curve throughout projections

Years	Constant Catch
Three (2025-2027)	0.669 mp gw
Five (2025-2029)	0.662 mp gw



Questions regarding projection settings

1. Higher SPR proxy for calculating benchmarks?
2. Recruitment assumption for catch advice?
   - 2013-2021 estimates derived from the stock-recruit curve in base model overly optimistic
   - Use recent average recruitment where estimated?



last 15 years estimated (1998-2012)

last 10 years estimated (2003-2012)

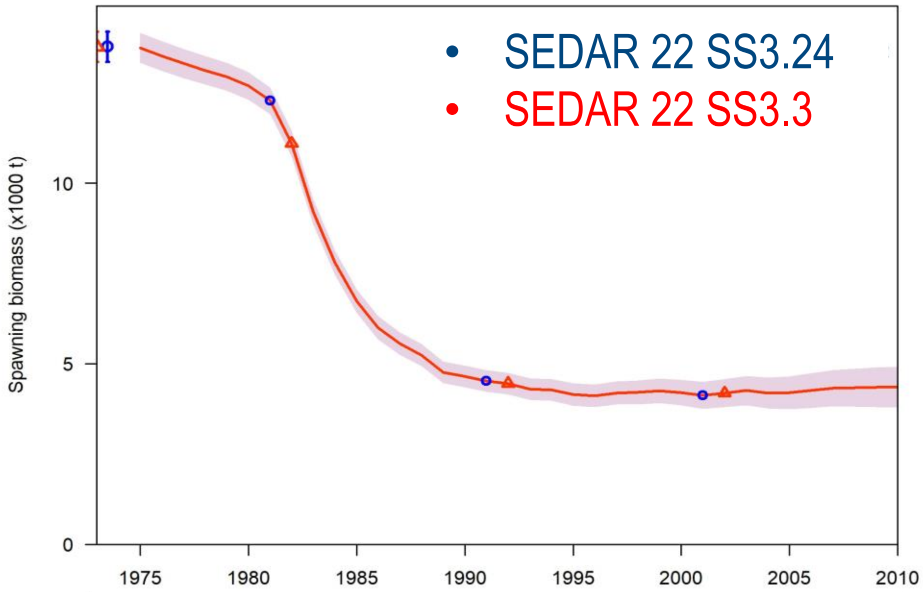
Thank you for your attention!

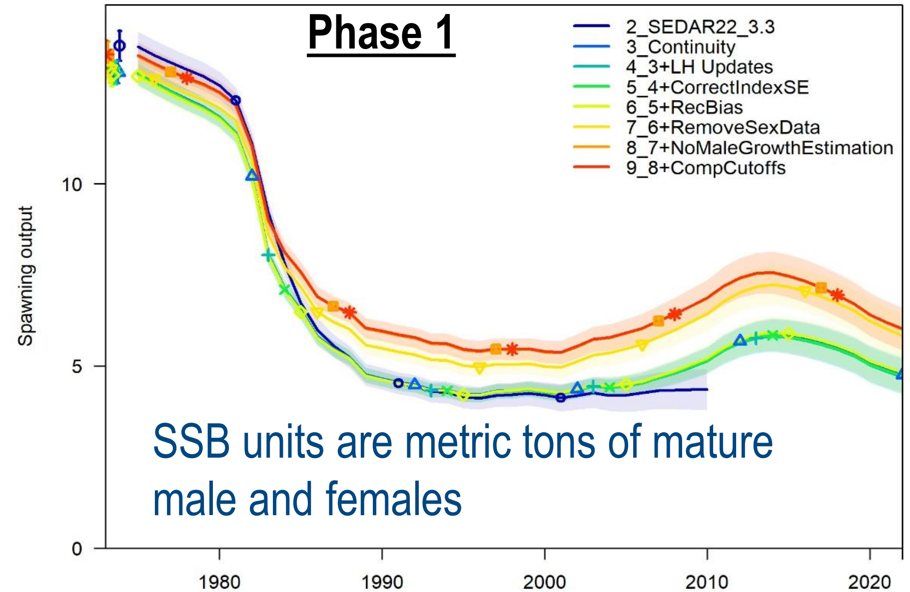
Questions?

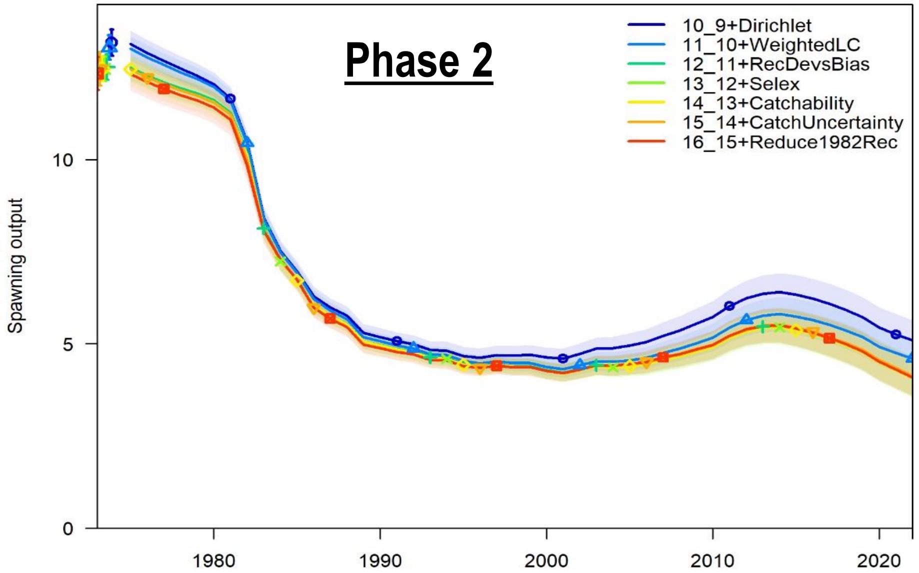
The SEDAR 85 Operational Assessment for Gulf of Mexico Yellowedge Grouper would not have been possible without the efforts of the numerous SEFSC, SERO, and GMFMC staff along with the many state, academic, and research partners involved throughout the Gulf of Mexico. The following agencies contributed 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, and the Gulf States Marine Fisheries Commission. Special thanks are also extended to the Data Updates TWG members for their rapid and helpful guidance with model development.

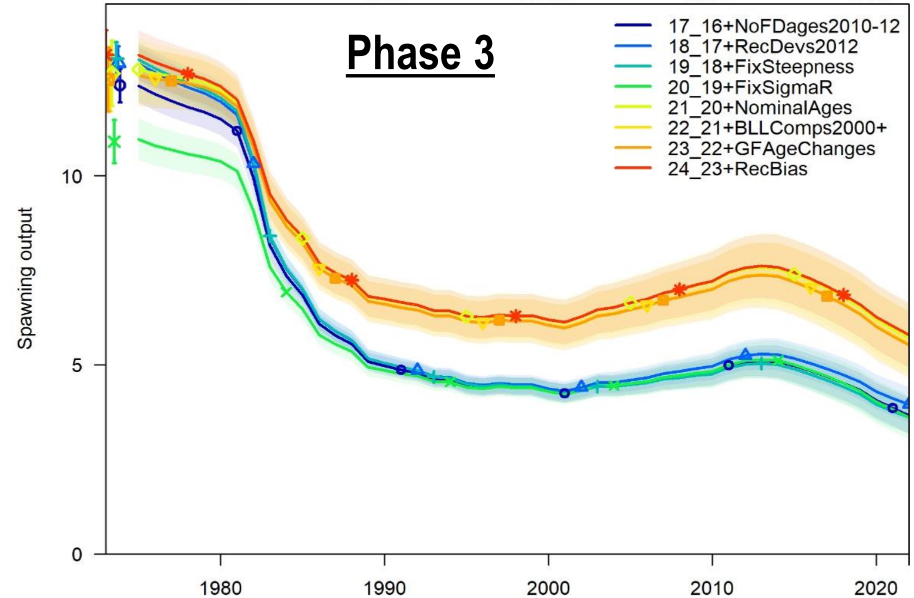
Extra Slides

Bridging Analysis: SSB

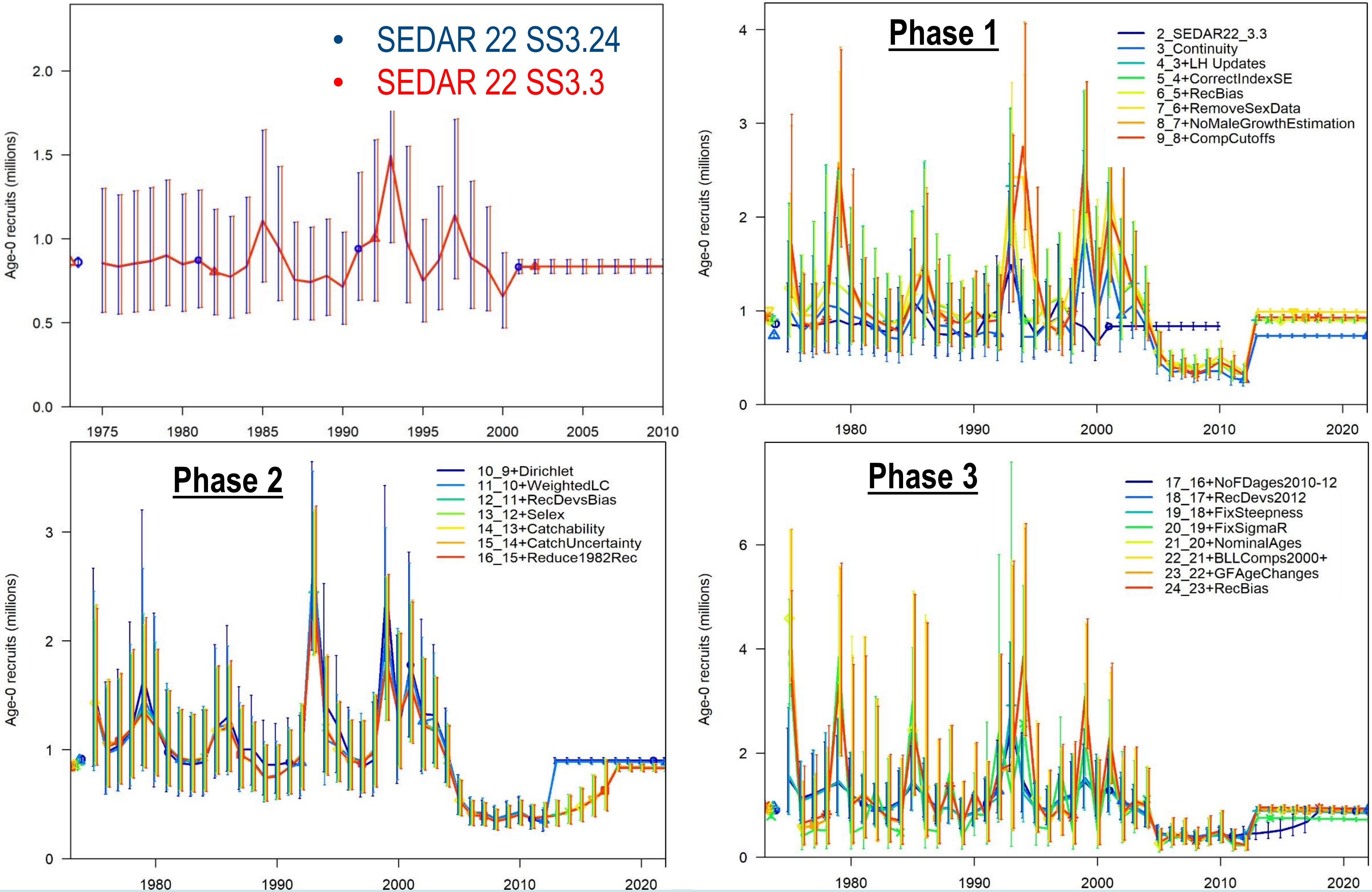








Bridging Analysis: Recruitment



Bridging Analysis: Fishing mortality