SEDAR 74 Review

SEFSC responses and lessons learned

GMFMC SSC meeting, 2/28/2024

Review Workshop Participants

From the Center for Independent Experts:
Patrick Cordue, Matt Cieri, and Edwin Fuglebakk

From the SSC:
Jim Nance (chair), Mike Allen, Sean Powers, and Steven Saul

From the SEFSC:
Matt Smith, LaTreese Denson, and Katie Siegfried

Observers and Council Representatives:
Pat Neukam, Dylan Hubbard, JD Dugas, and Tom Frazer

General Overview

Conclusion:

"... the current model configuration proposed by the Team is not ready for further development via the Operational Assessment process without considerable additional work, and likely re-review by outside reviewers."

- A day and half each of presentations and deliberations.
- Two supplemental presentations were provided to cover the age and length composition concerns and the effects of MRIP-FES (not presented).

Issues Noted by the Reviewers

Main:

- Research Track criticisms
- Treatment of the age and length compositions
- Stock ID conclusions
- The Great Red Snapper Count
- Uncertainty in landings and discards

Additional:

- Treatment of steepness and recruitment deviation constraints
- Scaling the index CVs and index re-weighting
- Max age and plus group determination
- Overall model uncertainty characterization

Main Issues

Research Track Criticisms:

- No continuity or bridging analysis
- Placeholder data are not acceptable (e.g. unweighted compositions).
- No projections or catch advice
- No status determination
- No base model diagnostics
- Delays catch advice, and an operational-type assessment should be run simultaneously to provide catch advice.

Responses to the RT Criticisms:

- A Research Track was meant to start from scratch, in which case a continuity is not necessary or relevant. True continuities are only useful when only recent data are being updated.
- A bridging analysis is a useful tool during model building, and is done when possible. For SEDAR 74, a bridging analysis from 2 to 3 areas would have been difficult to interpret. E.g. Which data sources are causing which shifts, or is the change in model fits due to the additional area?

Responses to the RT Criticisms:

- Research Track assessments were meant to lighten the load on data providers and allow for preliminary data to be used during model building.
- Preliminary data do have their issues, and many preliminary data sources were used that were intended to be revisited (shrimp bycatch/effort, rec landings assumptions, comp weighting, survey ages, etc.).
- Having the OA in the future led to more preliminary data decisions.

Responses to the RT Criticisms:

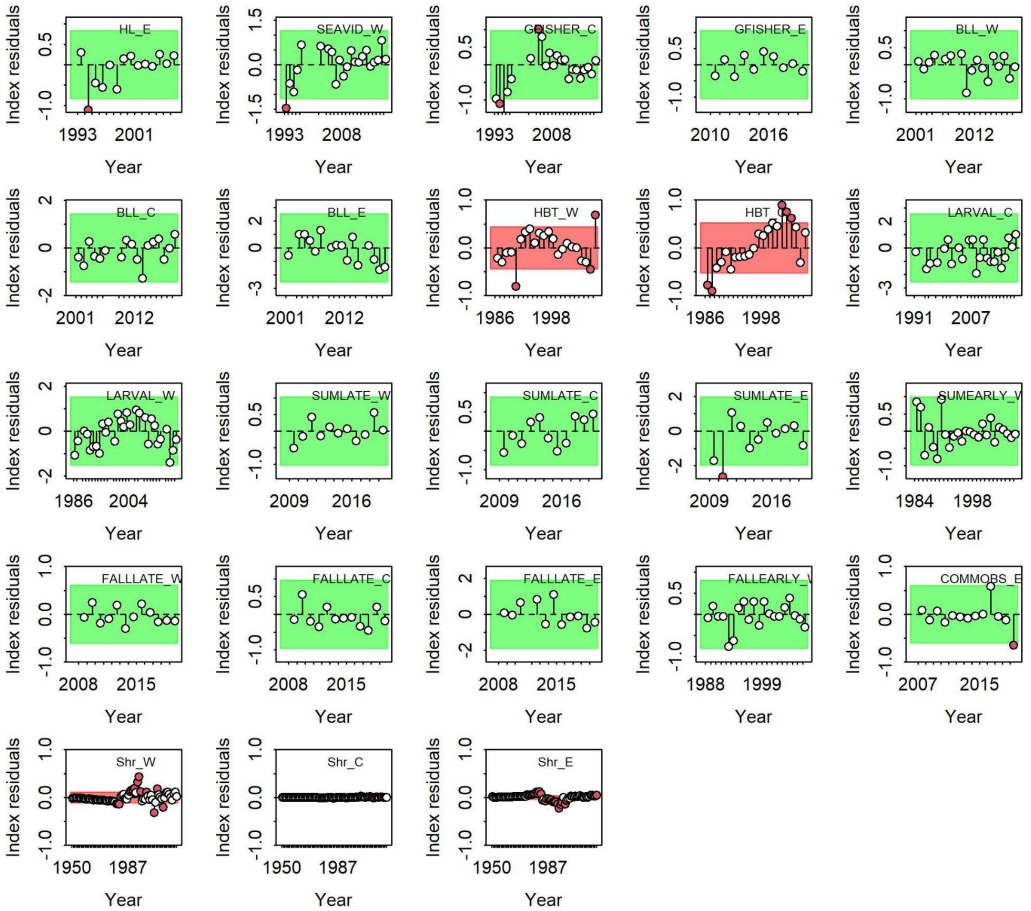
- One of the objectives of a Research Track was to create a model structure, while projections and catch advice were provided as follow up step for the OA.
- The status is determined via equilibrium projections, which were not run for the RT. Additionally, status should only be provided when all data are finalized.
- We did not provide the final, base run diagnostics, but a number of other diagnostics were provided throughout the presentation, assessment report, and assessment process.
- We could not support an RT and OA simultaneously.

Responses to Research Track Criticisms: Diagnostics and Sensitivities

- The reviewers wanted more diagnostics, specifically base model diagnostics.
  - We are defining the base run diagnostics as jitters, retrospectives, full hindcasting, and likelihood profiling over all key parameters.
  - We argue that base run diagnostics are not relevant when the data are not finalized.
    - Likelihood profiling example: the profile likelihood will change when data are added, removed, or other data are fit differently. When data are preliminary, the profile likelihoods will only show the best *preliminary* estimate.
- We provided a number of sensitivities, and no further sensitivities were requested during the workshop from the CIE reviewers.

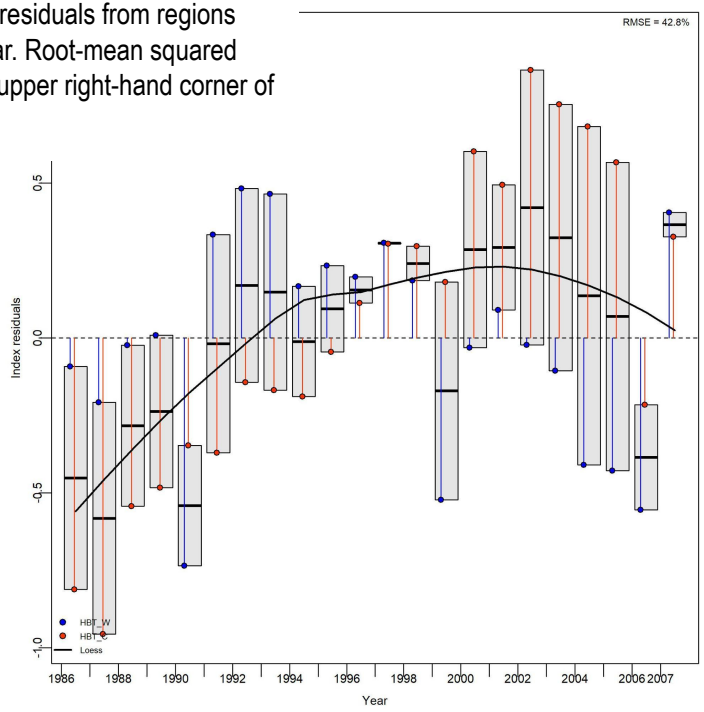
Examples of diagnostics provided:

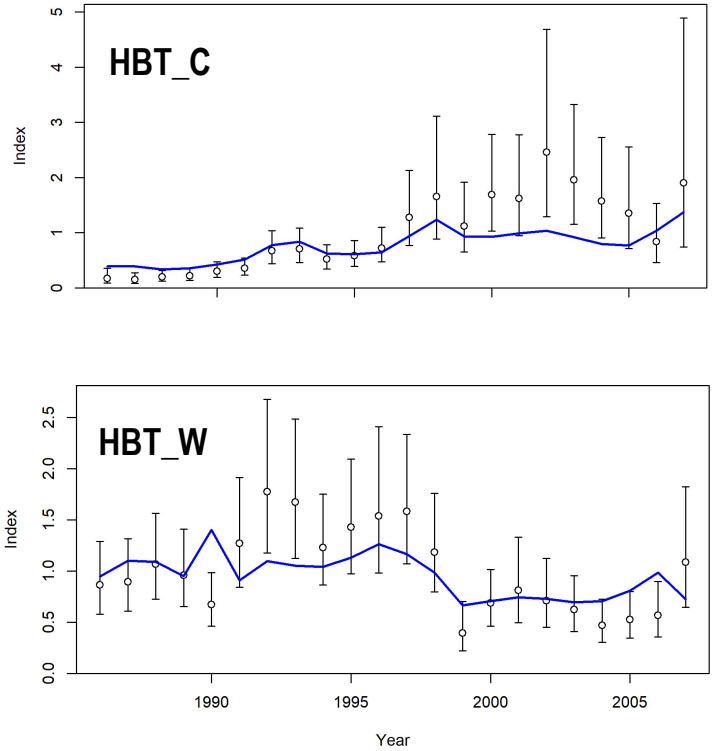
Index Residuals



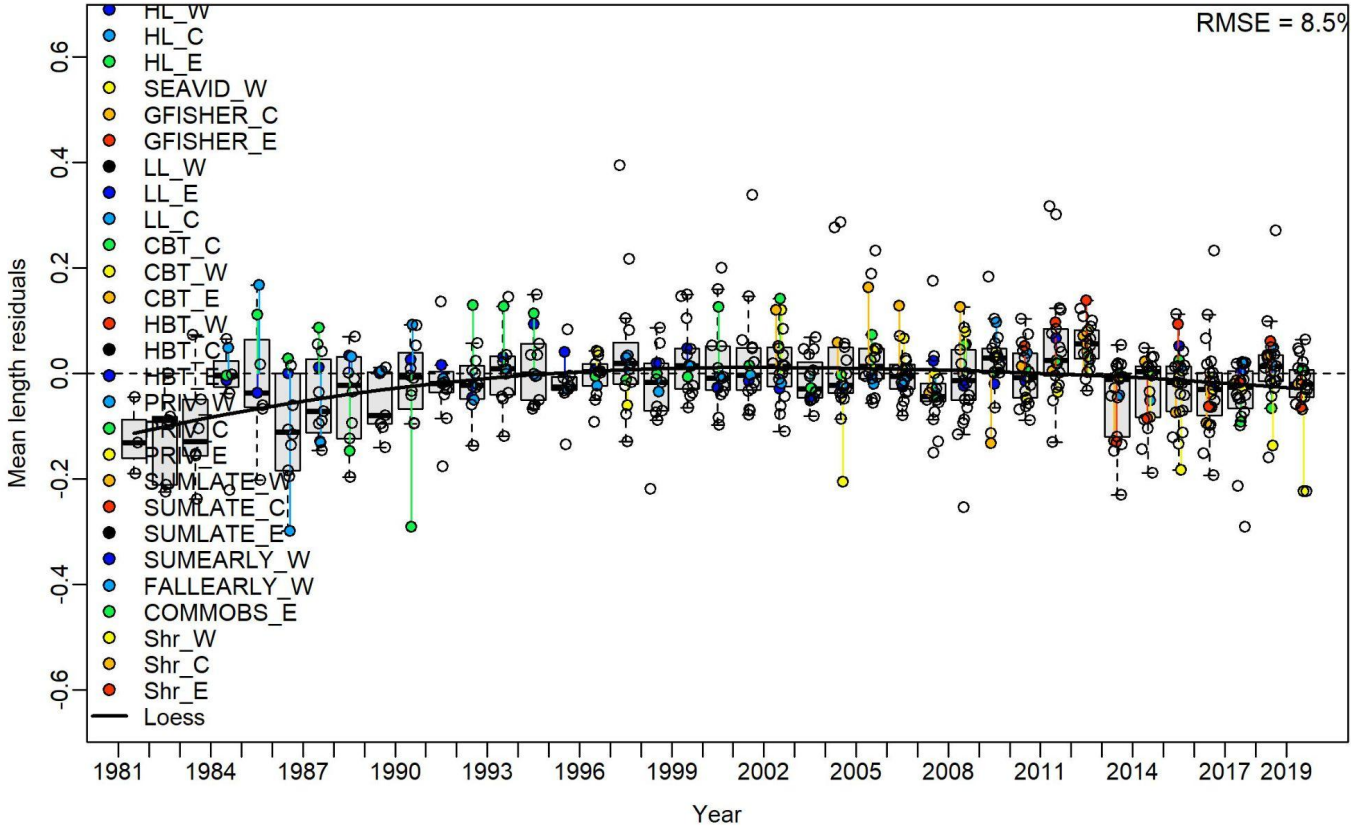
Diagnostics used to examine Headboat index fit

Vertical lines with points show the mean inde residuals by region, and solid black lines show loess smoother through the residuals. Boxplots indicate the median and quantiles in the cases where mean index residuals from regions were available for any given year. Root-mean squared error (RMSE) is included in the upper right-hand corner of the plot.





Residuals of Fits to Mean Length



Vertical lines with points show the mean length residuals by fleet, and solid black lines show loess smoother through the residuals. Boxplots indicate the median and quantiles in the cases where mean length residuals from multiple fleets are available for any given year. Root-mean squared errors (RMSE) are included in the upper right-hand corner of the plot.

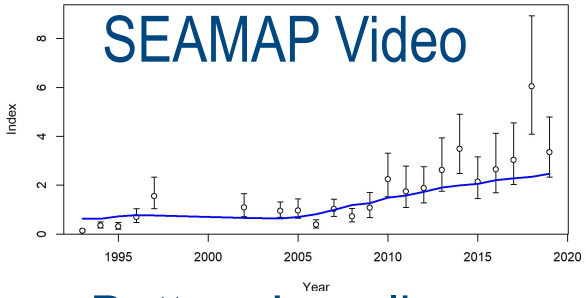
Parameter Correlations - examining high correlation

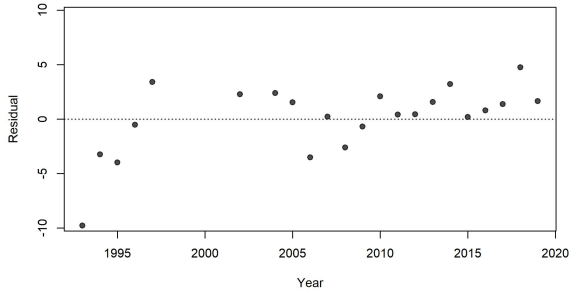
Parameter 1	Parameter 2	Correlation
Size_DblN_ascend_se_HL_C(2)_BLK4repl_2007	Size_DblN_peak_HL_C(2)_BLK4repl_2007	0.951
Size_DblN_ascend_se_HBT_W(16)_BLK5repl_1995	Size_DblN_peak_HBT_W(16)_BLK5repl_1995	0.962
Size_DblN_ascend_se_HBT_C(17)_BLK5repl_1995	Size_DblN_peak_HBT_C(17)_BLK5repl_1995	0.966
Size_DblN_ascend_se_HL_E(3)_BLK4repl_2007	Size_DblN_peak_HL_E(3)_BLK4repl_2007	0.968
Size_DblN_ascend_se_PRIV_W(19)_BLK5repl_1995	Size_DblN_peak_PRIV_W(19)_BLK5repl_1995	0.971
Size_DblN_ascend_se_CBT_W(14)	Size_DblN_peak_CBT_W(14)	0.975
Size_DblN_ascend_se_CBT_W(14)_BLK5repl_1995	Size_DblN_peak_CBT_W(14)_BLK5repl_1995	0.979
Size_DblN_ascend_se_CBT_C(13)_BLK5repl_1995	Size_DblN_peak_CBT_C(13)_BLK5repl_1995	0.995

Western Region Indices:

Standard Deviations of the Normalized Residuals

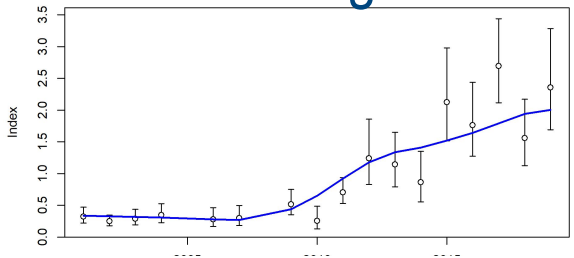
SEAMAP Video

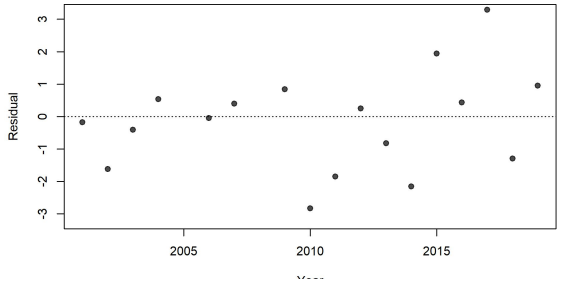




SDNR =3.17

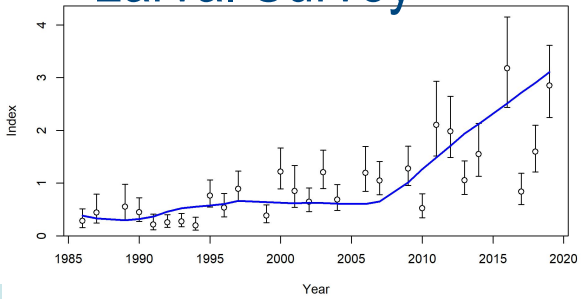
Bottom Longline

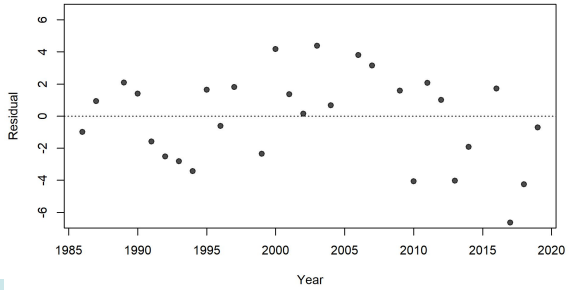




SDNR =1.54

Larval Survey





SDNR =2.81

Sensitivities provided - Dynamic Maturity

Based on suggestions from the LHWG time varying maturity sensitivities were conducted.

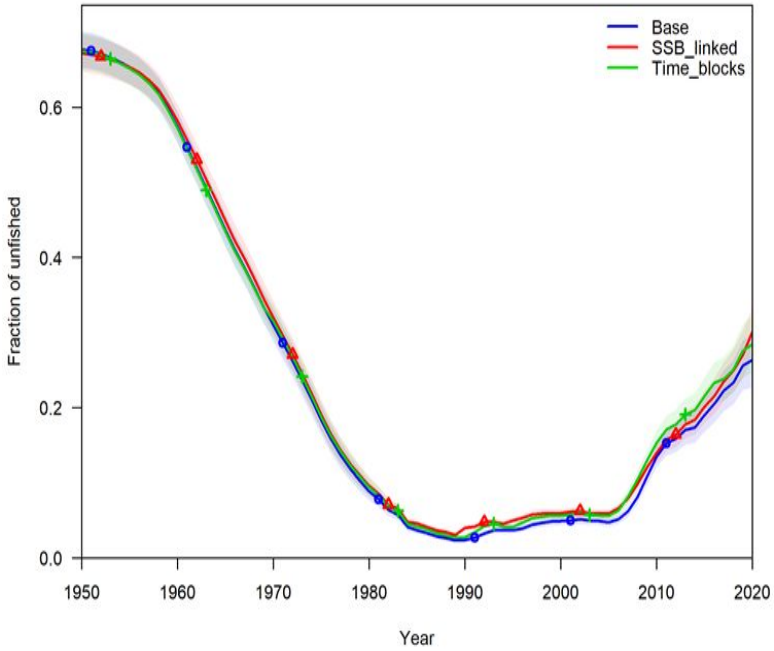
1. Using separate parameter blocks for changes in A_{50} and A_{slope} over three time periods.
2. A_{50} and A_{slope} as functions of Spawning Stock Biomass (i.e., fish mature at younger ages when stock sizes are low)

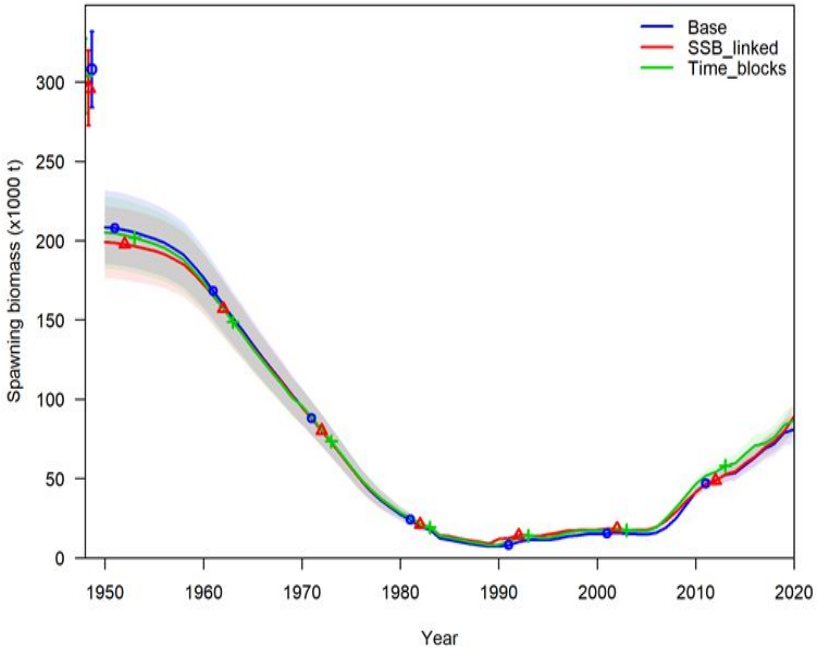
Year	Parameter	East	Central	West
1970	M_{A50}	1.49	1.49	1.71
	$M\ Slope_{A50}$	-2.39	-2.39	-1.99
1991	M_{A50}	1.39	1.39	1.51
	$M\ Slope_{A50}$	-3.61	-3.61	-3.21
2009	M_{A50}	1.49	1.49	1.71
	$M\ Slope_{A50}$	-2.39	-2.39	-1.99

$$P_y = P_{base} + P_t * E_y$$

Where:
y = year
Py = Maturity slope or A50 in year, y
Pbase = Base Maturity slope or A50 (1950)
Pt = Scaling parameter (i.e., effect size)
Ey = Log(SSBy/SSB0) in year, y

Sensitivities - Dynamic Maturity





Will go over the GRSC runs later on in the presentation…

Given that…

- We agree that the research track has not realized its original potential in that:
  - The data providers are impacted more, not less;
  - We can not look into everything people/we would like to research during a research track;
  - Allowing for the use of preliminary data may cause some delay in addressing data issues;
  - A full assessment process without catch advice is frustrating and resource intensive; and
  - We agree it is difficult to review a model structure with so many inputs and variables that may change.
- Moving to a benchmark-style assessment process will alleviate many of these concerns and constraints.

Issues Noted by the Reviewers

Main:

- Research Track criticisms
- **Treatment of the age and length compositions**
- Stock ID conclusions
- The Great Red Snapper Count
- Uncertainty in landings and discards

Additional:

- Treatment of steepness and recruitment deviation constraints
- Scaling the index CVs and index re-weighting
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- Overall model uncertainty characterization

Issues with the Age and Length Compositions

Reviewer criticisms:

- Use of unweighted composition data.
  - Panel stated that the use of un-scaled (unweighted) composition data made it impossible to evaluate the model since the data fits and derived parameters would change substantially with finalized data.
- Use of length composition to model directed fleet selectivity.
  - Panel indicated that the loss of cohort information resulting from the exclusion of age composition data from directed fleet selectivity modeling exceeded any benefit derived from the improved fits to discards, landings, and composition data obtained by using length composition.

Response: Use of Unweighted Length and Age Compositions

- Only nominal compositions were prepared for the DW, as per usual.
  - Weighted age compositions, conditional age-at-length, and mean length at age were provided later for all directed fleets.
  - Typically composition development continues into the AW phase.
- Nominal length compositions were used because the length frequency distributions suggested that weighting would have a limited impact (nominal~weighted).
- Weighted age compositions were evaluated during the assessment webinars (though improvements can be made).

Treatment of the Length Compositions - justification of limited impact of weighting

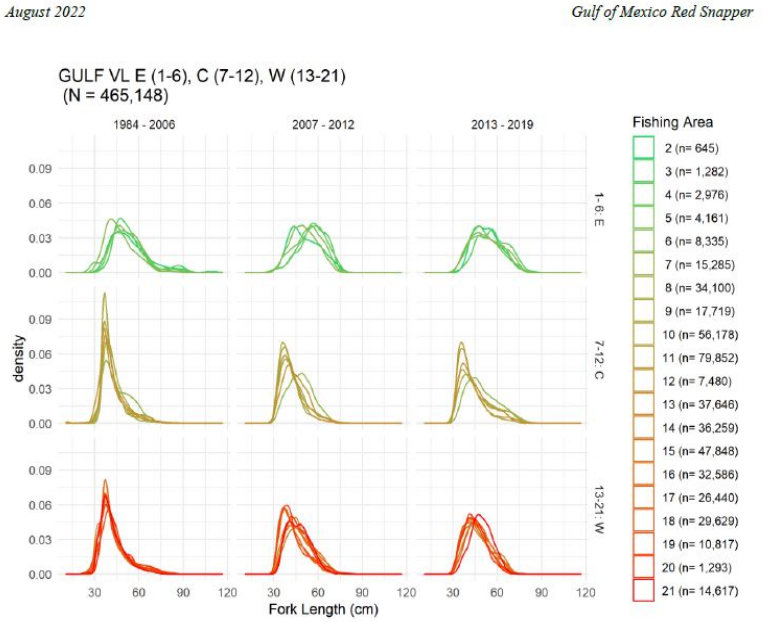


Figure 3.6.1, Red snapper vertical line TIP length distributions in the finest spatial resolution possible for each stock (rows) and time period (columns) where green represents the easternmost fishing area and transitions to red in the west. 2007-2012 represents a time of rebuilding and is expected to have shifting compositions during the stock recovery.

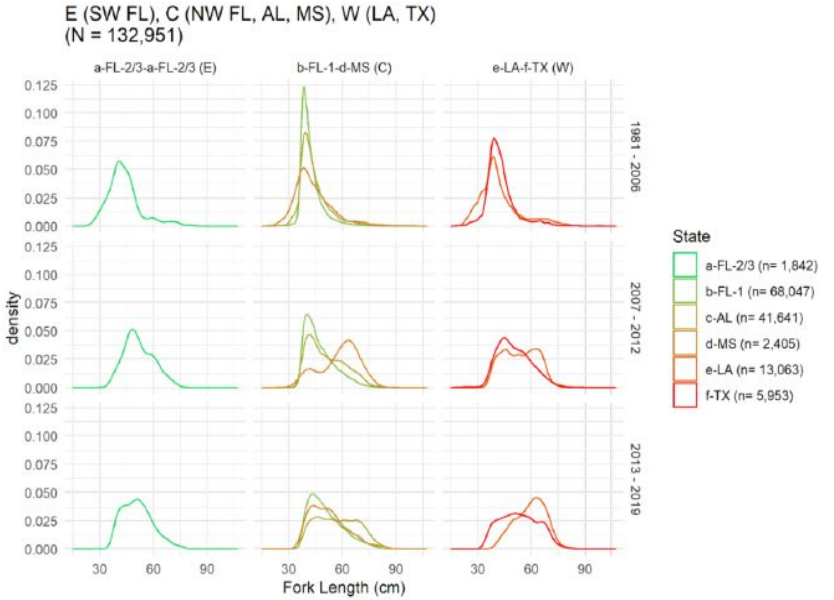


Figure 4.13.8. Red snapper charter boat length compositions at the finest spatial resolution by MRIP sampling domains where color gradients are shown from east (green) to west (red) and paneled by stock (columns) and time periods (rows).

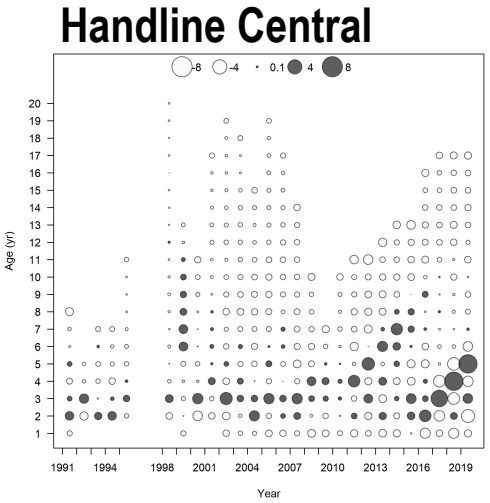
Low variance within areas suggests that weighting lengths would have limited impact.

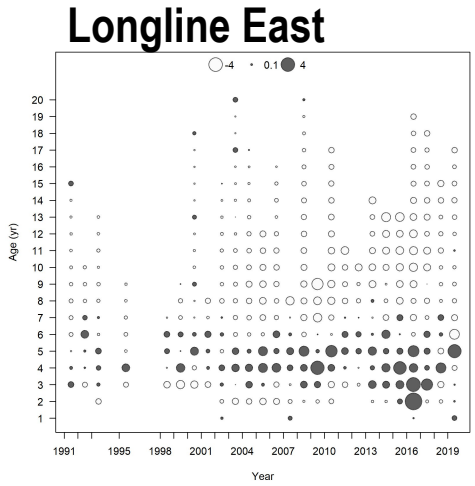
Response to the omission of age compositions

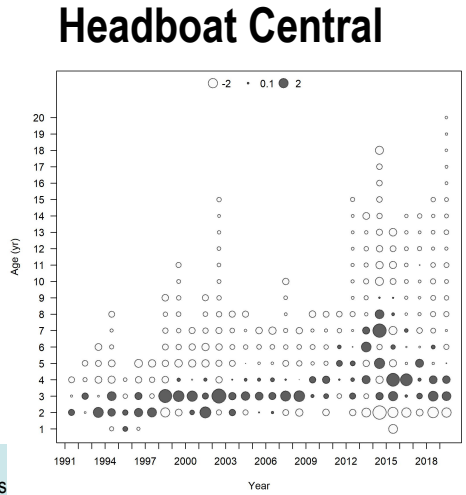
- Model tension apparent when trying to fit landings and discards using different selectivity and retention forms (age vs. length).
- Concerns over non-representativeness of age samples identified through NMFS Length and Age Composition Workshop as well as in the SEDAR 52 report.
- Information on cohort strength still available through survey age comps. (begin in 2001 vs 1991 for FD comp).

Model issues with age-based selectivity for directed fleets

- Highly patterned composition residuals present in most cases.
- Selectivity or retention blocks may help but would not coincide with management changes.

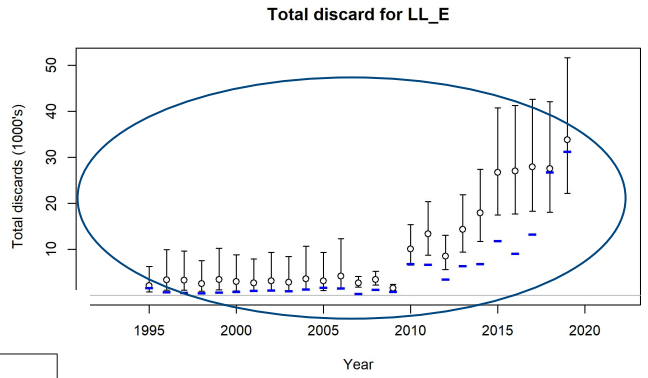


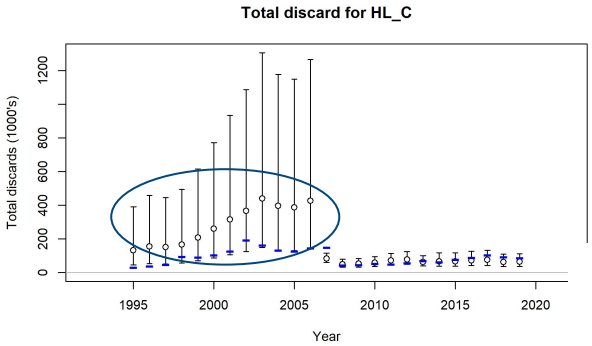


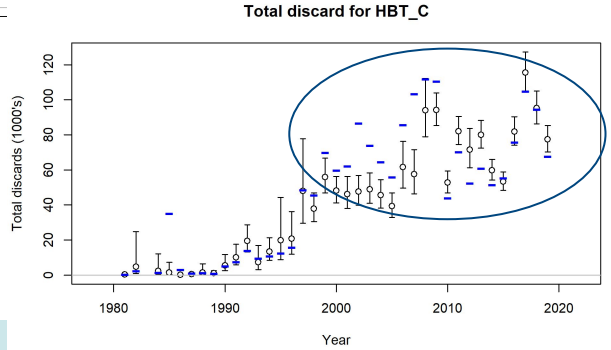


Model issues with age-based selectivity for directed fleets

- Misfit to discards commonly observed especially for time-blocks with uniformed retention parameters.
- Not fitting discards well was a main criticism of SEDAR 52.

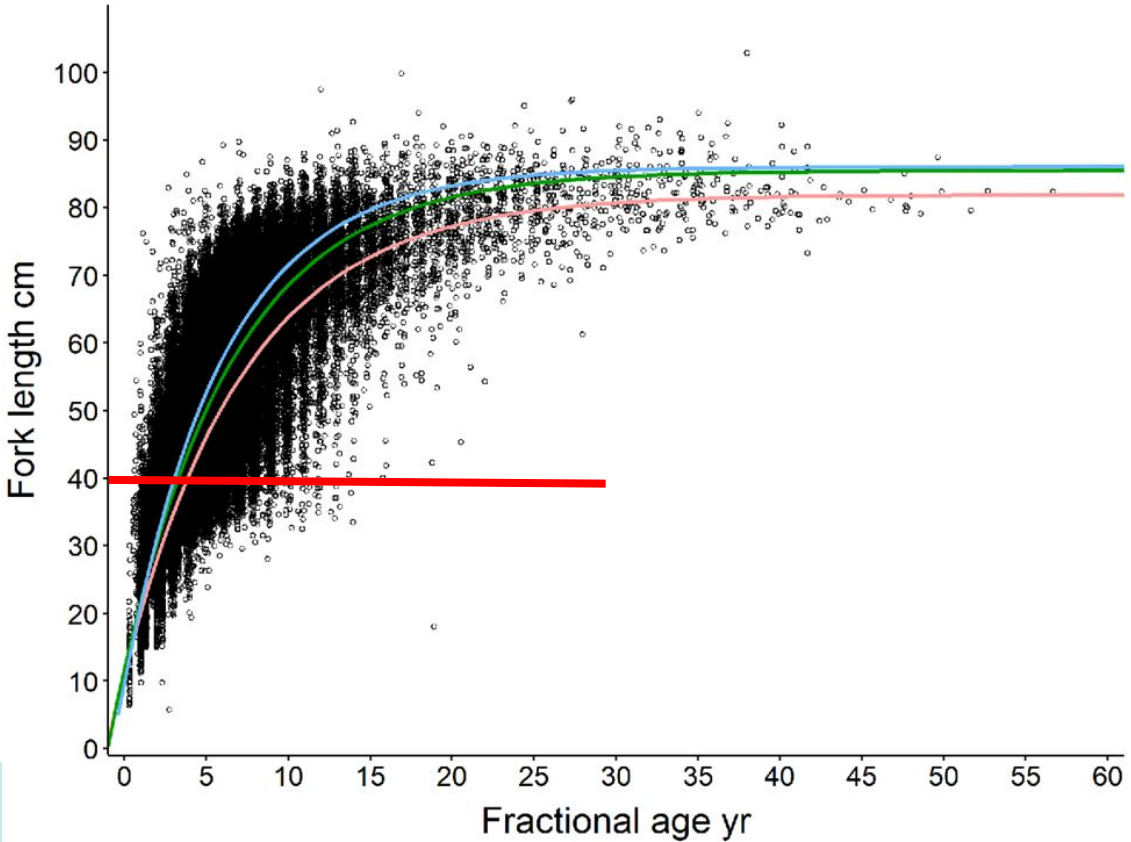






Model issues with age-based selectivity for directed fleets

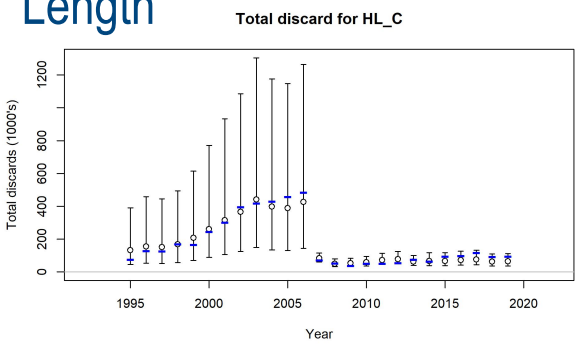
- Highly variable size-at-age thought to contribute to the tension produced by age-based selectivity and length-based retention.
- Ages 0-15 observed below current recreational minimum size (40.64 cm).

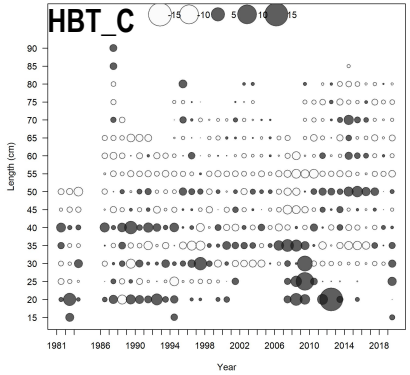


Model issues with age-based selectivity for directed fleets

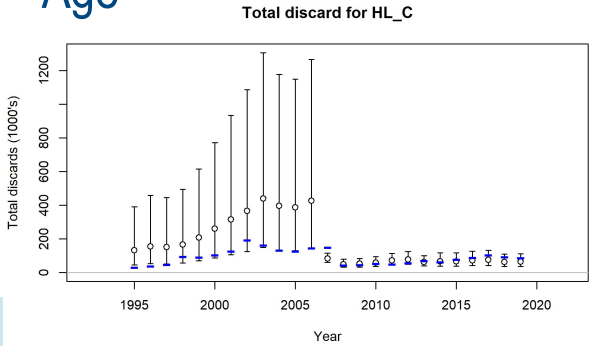
- Basing both the selectivity and retention processes on length alleviated many of the fit issues.

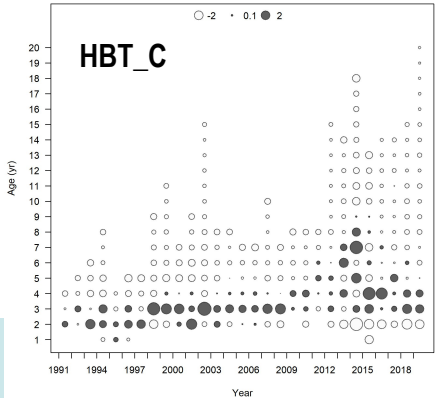
Length





Age





Possible non-representativeness in the Commercial Handline age sub-sampling: example

- Prior to 2013, sub-sampling was based on region landed in the East (FL, AL, MS) and West (LA, TX) GOM by **interview** number
  - Targeted 100 otoliths per two-month wave per region landed
  - Most port samplers at that time were collecting approximately 30 otoliths from red snapper per interview
  - This resulted in **approximately 3 trips being sampled for all 100 otoliths**
- From 2013 on, sub-sampling was based on individual fish instead of interview number
  - Prior to Biological Sampling Database (BSD) development, it was necessary to manually enter all individual fish data in order to subsample by fish (only done for grouper spp.)

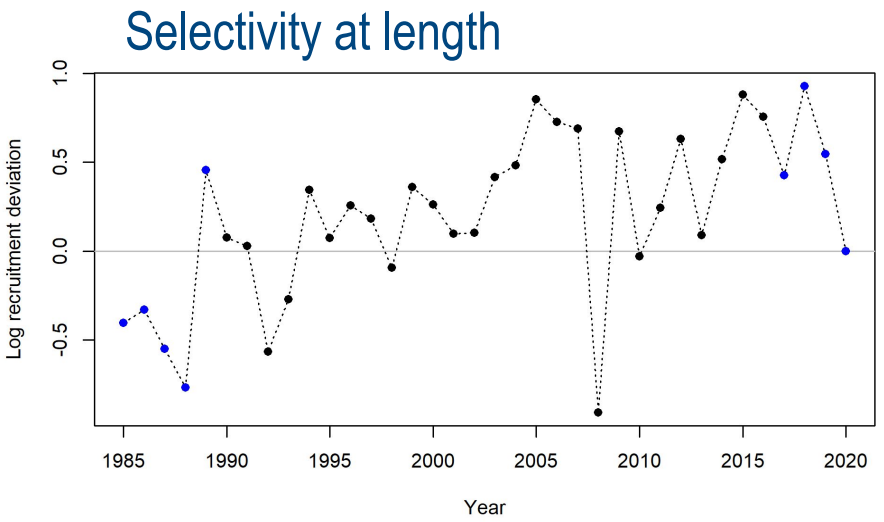
Possible non-representativeness Commercial Handline age sub-sampling

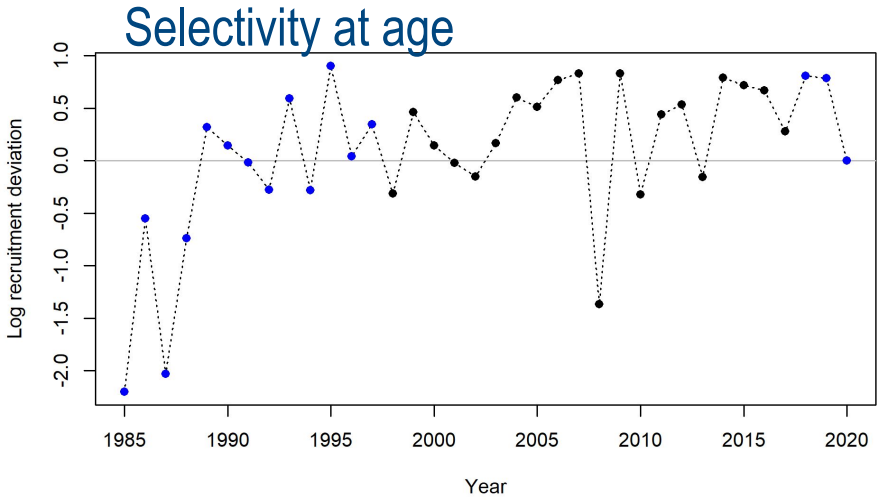
- Through our recent Length and Age Composition Workshop we determined that some potentially biased sampling in the 1990s for directed fleets occurred.
- Also, otolith sampling eventually exceeded our capacity to process these samples, resulting in varying sub-sampling techniques through time which could arbitrarily bias the resulting age compositions.
- The stratification for this subsampling (1-4, 5-7, 8-12, etc) does not match our current stock id boundaries (1-6, 7-12, 13-21).
- The issues needed to be worked out prior to the OA.

Addressing the concern about cohort information

Both models estimate comparable recruitment dynamics back to the mid-90s and identify similar major deviations.

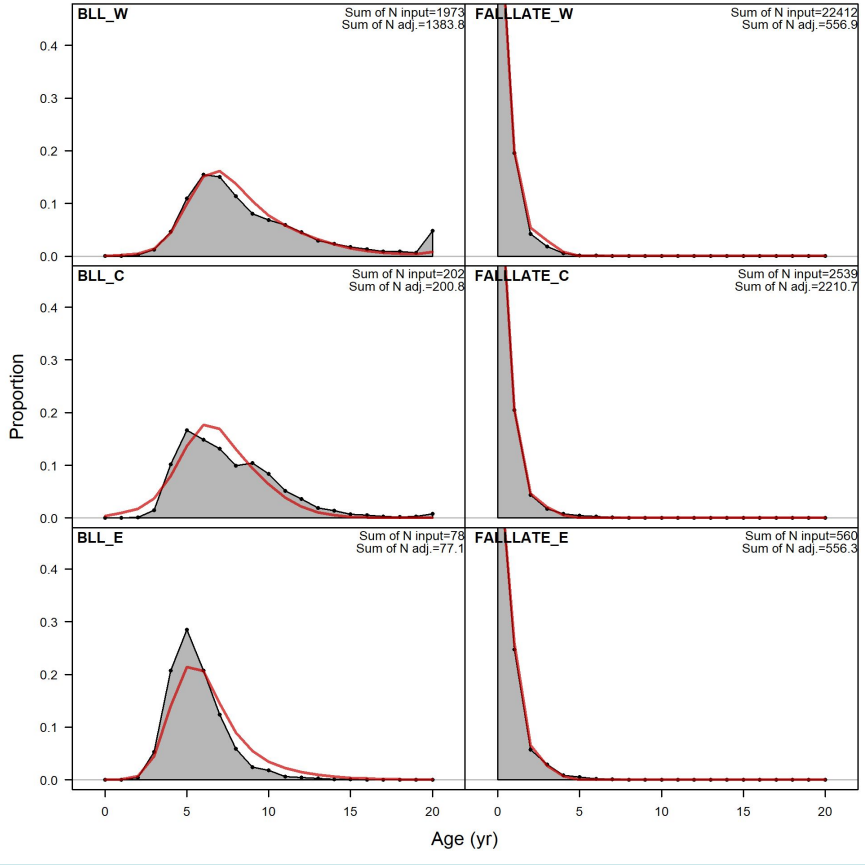
Not perfect comparison due to additional model building for length model.





Age Composition included

Survey age composition was included in the assessment with the hopes of including more from the trawl surveys during the OA.



What we plan to do:

- Finish our work on the ageing data
  - Complete descriptions of subsampling and any sampling issues in general that would affect the usefulness of the age data in assessments.
    - Provide that work for evaluation at a data workshop.
- Compare the unweighted and weighted age compositions, and length compositions more explicitly.
  - Exploratory data analysis - plots, distributions, and weighting method descriptions will be provided.
- Provide literature that discusses the use of length and age compositions in integrated catch-age models (this is an active area of research)
- During the assessment phase, we will show the impact of different assumptions about selectivity, as well as any changes in fits to compositions.
  - This will also be impacted if we change assumptions about uncertainty in the landings and discard data.

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Main:

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- **Stock ID conclusions**
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- Uncertainty in landings and discards

Additional:

- Treatment of steepness and recruitment deviation constraints
- Scaling the index CVs and index re-weighting
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Stock ID Issue

CIE: “The data did not support a three area model.” “In particular, the eastern area was quite data poor and many of the parameters had to be borrowed from the central region. “...the Review Panel thought that a return to the two-area model (as a base model) would be more appropriate for now.”

Discussion:

- The eastern data are lacking on their own in certain sectors
  - We mirrored (borrowed from) the Central region where needed.
- The stock ID report was ambiguous about support for the three area model as well. The RTA allowed us to attempt a three-area model and highlight strengths and weaknesses of the approach.
- Stock ID issue confounded the review
  - CIE review for Stock ID may have been helpful and we may have avoided this change later in the process.
  - Revisiting the stock ID at the Review should not have been an indictment on the whole model building exercise.

What we plan to do:

We can revert to the two area model split at the Mississippi river outflow, as was used in SEDAR 52.

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The Great Red Snapper Count issues

From the reviewers:

"It was premature to include the GRSC estimates in the model as potential biases have not been quantified and composition data were not available."

- They argue that the count is not a true absolute abundance estimate and should not be treated as such.
- The reviewers recommended that more effort is needed from a separate research team to determine priors for estimating catchability.
- There was discussion at the review about whether the GRSC was meant to be used in the assessment.
- CIE said it can be used as an ancillary piece of information even if the count itself is not fit in the model, and that the comps should be used (somehow).

Was it an absolute abundance estimate?

- The title of the project funded by Congress:

  'Estimating the absolute abundance of red snapper in the U.S. Gulf of Mexico'

- There was discussion about the potential issues with the GRSC amongst the ADT and other participants during the SEDAR 74 assessment webinars.
  - Is the catchability of the different survey methods/gear the same?
  - Is the GRSC truly selecting for all age 2+ fish across the GOM?
  - Is the estimate from the GRSC more reliable than other data in the model that may conflict with it?

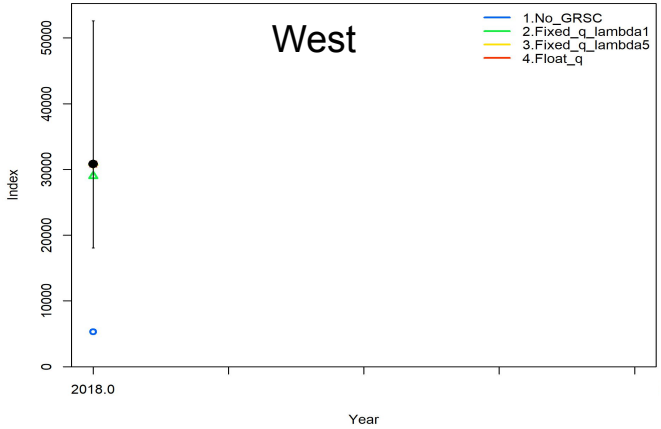
Great Red Snapper Count: Length compositions

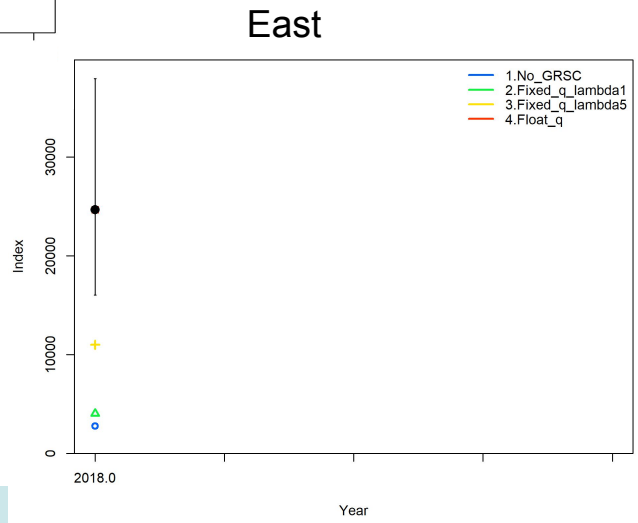
- Provided length composition data was not representative of the entire GOM, and needed to be parsed into the three areas.
- Data Set 1:
  - Includes 2010-2020
  - No indication of # measured vs seen (sampling protocol, max,etc.?)
  - Only Alabama and Texas in 2018
  - VLL, BLL, ROV
  - Multiple habitat types
  - Data sources: ○ TAMCC, TWDP_ARP, TWDP_SEAMAP, University of South Alabama
- Data Set 2:
  - Assuming from one source across entire GOM FL shelf
  - Stereocamera/Lasers for measurement, multiple habitat types, number seen vs measured available, max 24 measured at a site

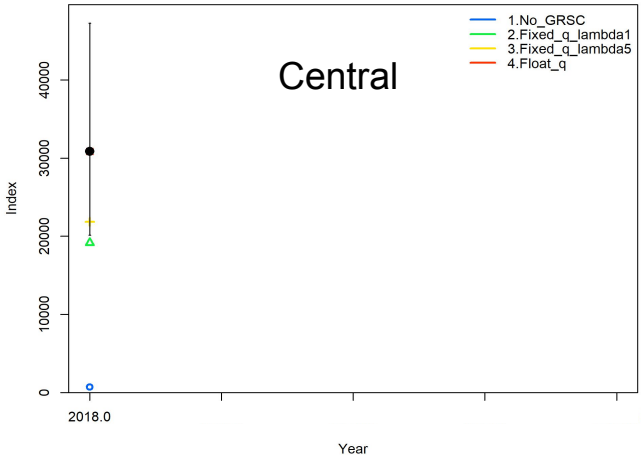
GRSC - How the data were used in the model

- Included as an index of absolute abundance in one year (2018) by region.
- Incorporated as region-specific with the catchability coefficient (q) fixed at 1.
  - Sensitivities suggest model tends to ignore the GRSC, in order to fit longer term data, if q is not fixed at 1.
- Given equal model weight as other data sources (Lambda = 1), which was a decision of the ADT after sensitivity analysis.
- Selectivity in the East was fixed at 100% for ages 2+, and set to 0 for ages 0 and 1.
- For the West and Central regions, selectivity was estimated for ages 2+, and fixed at 0 or ages 0 and 1.
- Multiple sensitivities were conducted:
  - Alternate catchability coefficient parameterizations.
    - A proxy for the way the survey methods would encounter fish.
  - Increased data weighting
    - Determine the agreement or lack thereof of other data sources with the GRSC.
  - 100% selectivity of age 2+ in all regions.
    - The GRSC was a provided as a total count of red snapper in the GOM age 2+, and this sensitivity allowed us to test the assumption of all fish age 2+

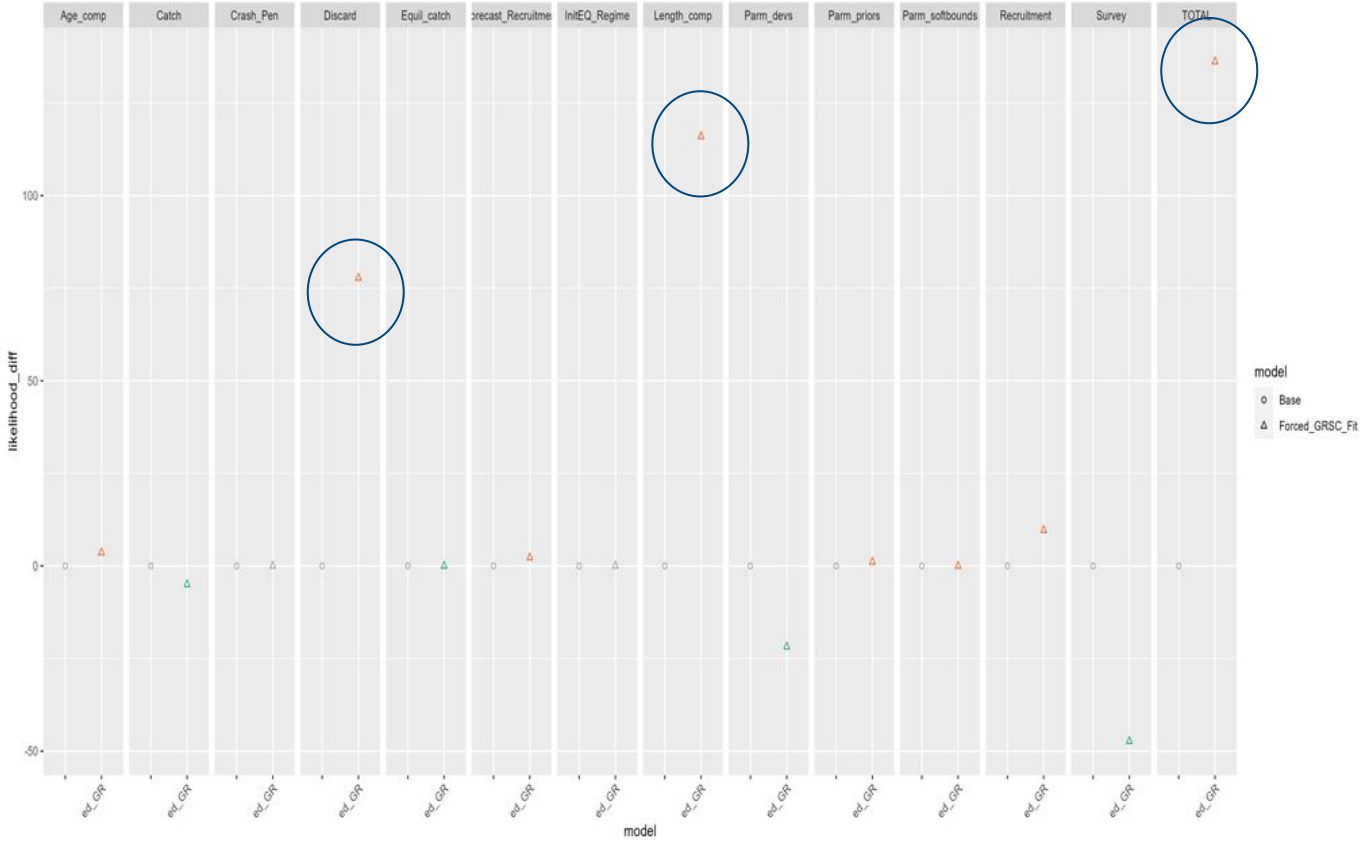
Sensitivity - GRSC Catchability Coefficient (q)





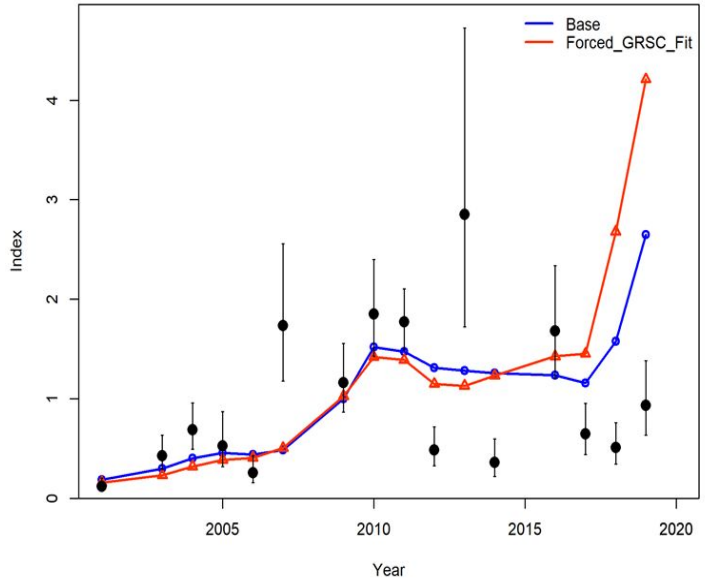


Sensitivities - GRSC Weighting

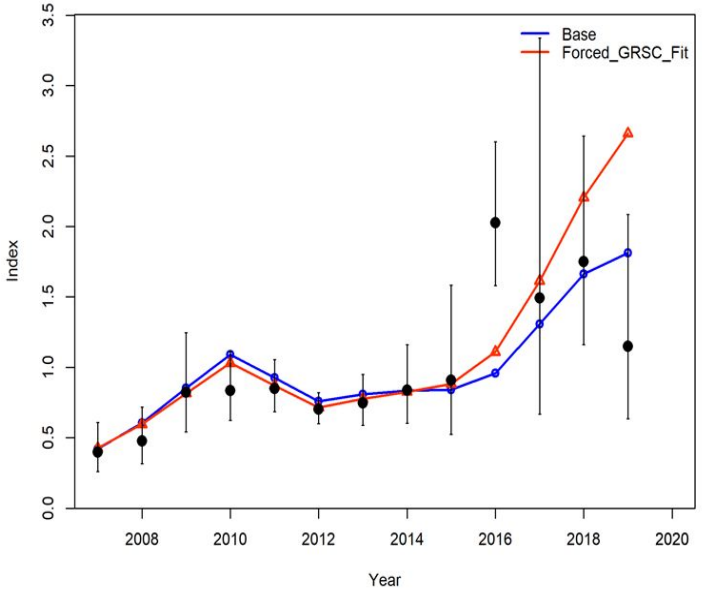


Sensitivities - GRSC Weighting

Bottom Longline



Commercial Reef Fish

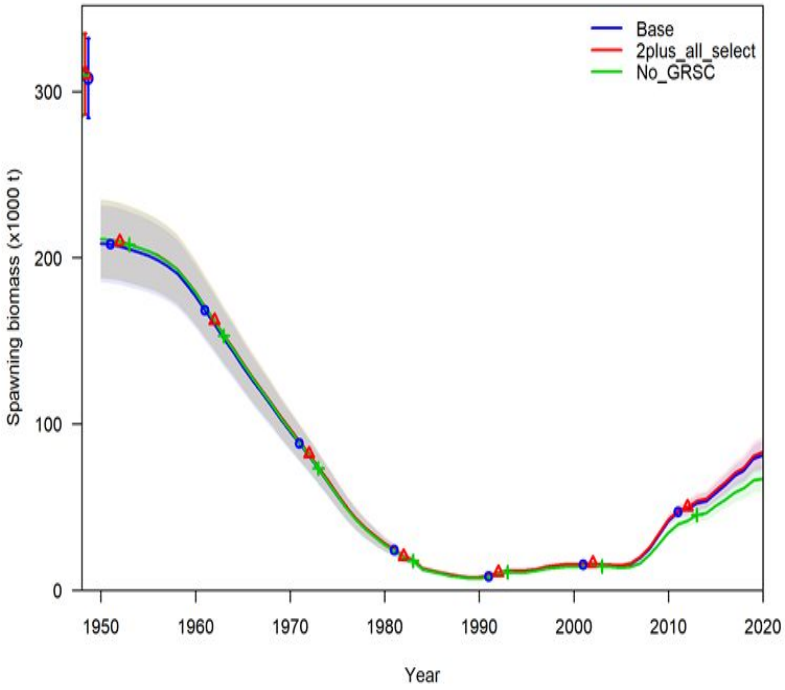


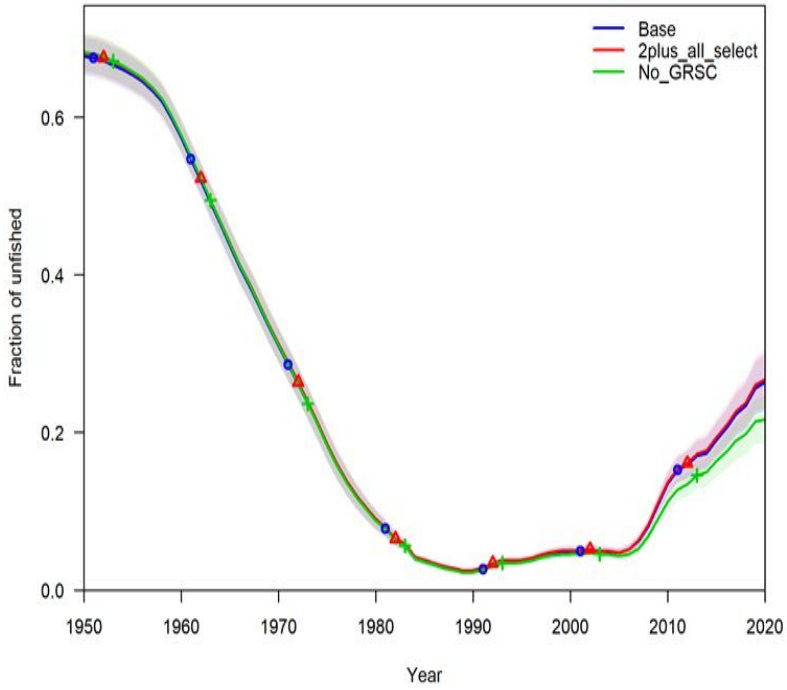
Sensitivities - GRSC Selectivity

Due to concerns that the GRSC length comp data did not cover the entire GOM in the year when the count was estimated, two sensitivities were conducted.

1. No GRSC estimates used in the model.
2. GRSC estimates are included in the assessment model and the selectivity is assumed to be 100% of all fish age-2+.

Sensitivities - GRSC - Selectivity





CIE comment about data available from the GRSC

- They assert there are data for estimating q and capturing other sources of variability (uncertainty in habitat mapping) available from the PIs.
- They argue that the biases for methods used be quantified by a separate research team, as that work requires specialized knowledge.
- The biases would then be used to create priors for the catchability coefficients of each survey method.

What to do next?

- The CIE reviewers suggest a separate research team, ideally in consultation with GRSC PIs, explore and quantify biases in the study.
  - Is this possible?
- They recommended length compositions from the GRSC be used to inform selectivity, as they do not agree that the estimate is for all fish aged 2+.
  - We explained the data available to us, and that it did not cover the GOM. Therefore, assumptions would still need to be made.
- They suggest we use the GRSC to 'groundtruth' or validate the assessment results.
  - Without accurate selectivity or catchability (both scalars on the abundance), that is not yet possible.
- A recent Council motion asked that the GRSC be considered in the TORs for the next assessment.
  - It was considered in multiple ways for SEDAR 74, and we would need detailed suggestions, in addition to what the reviewers suggest, to do anything different than what has already been attempted.

Issues Noted by the Reviewers

Main:

- Research Track criticisms
- Treatment of the age and length compositions
- Stock ID conclusions
- The Great Red Snapper Count
- **Uncertainty in landings and discards**

Additional:

- Treatment of steepness and recruitment deviation constraints
- Scaling the index CVs and index re-weighting
- Max age and plus group determination
- Overall model uncertainty characterization

Uncertainty in the Landings and Discards issues

- The reviewers recommended fitting landings and discards closely out of necessity, regardless of the level of uncertainty.
  - Their justification: Catch-age models have to know the removals exactly in order to estimate biomass. Otherwise it "Can undermine the basis of these types of models".
- They also suggest folding the discards into the landings in order to eliminate parameters.
- They argue that we should have the option to smooth points in the discards and landings where anomalies occur.

Fitting landings and discards exactly?

- We know our removals data are uncertain, and that uncertainty will need to be characterized, especially the recreational landings and discards.
- Including uncertainty in the landings and discards, at least in a preparatory step can help the analysts determine which data may contradict landings trends and why.
- Integrated catch-at-age models should be able to incorporate uncertainty in landings and/or discards if the other data are of good quality (Punt et al. 2014[1] and Maunder and Punt 2013[2]).

1.https://doi.org/10.1016/j.fishres.2013.06.003

2.https://doi.org/10.1016/j.fishres.2012.07.025

Should we combine landings and discards?

No. Combining discards and landings will make it difficult to provide management advice that does not include discards, and it ignores different selectivity and retention in open vs. closed seasons.

Other reviewer's comments about discard modeling:

SEDAR 68 (Scamp):

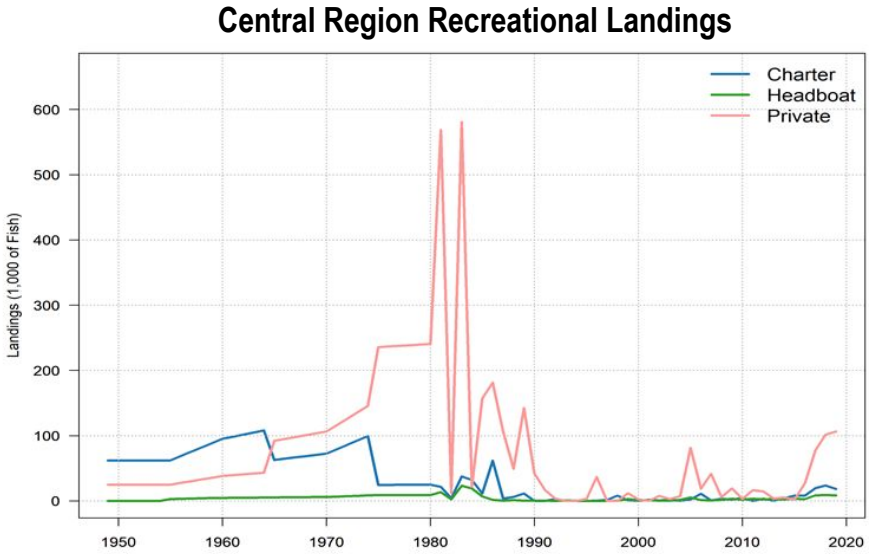
"Currently the Model does not support an option to model discards with a retention function and appears to require this catch category to be modelled as a separate fleet. This does not reflect the way the observations are collected and the model needs to be enhanced to allow discards to be modelled with a separate retention function for the fleet concerned."

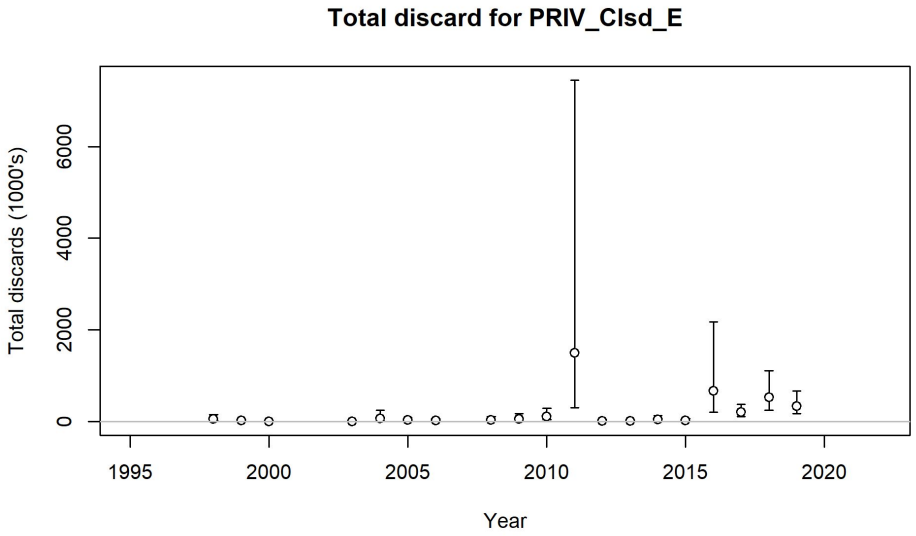
Shertzer et al. (2021*) paper states that it's unclear that it depends on the error types (observational and process error) in the discard data and whether the data support a separate selectivity and/or retention function.

*https://doi.org/10.3390/fishes7010007

Smoothing anomalous points

Examples of anomalies in the catch statistics for RS





Smoothing:

- We have smoothed anomalous points several times within the past few assessments (notably in Gag, Gray Snapper, and Spanish Mackerel).
- We will continue to examine the data critically and determine where smoothing is warranted.

Additional issues

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Steepness and recruitment deviations issues

- The reviewers disagreed with fixing steepness at 0.99, “While the stock recruitment relationship may be weak, it is clear that very low stock sizes must produce very low recruitment, and that should preferably be reflected in the model.”
  - Different recommendations from different panelist:
    - Fix to a congener value - this CIE panel.
    - Estimate with an informative prior - previous CIE panels
- The direct cause of shifts in stock productivity are currently unclear, so the reviewers stated that we should constrain recruitment deviations.
  - We argue that unconstrained recruitment deviations improved model parsimony.
    - New SS projection flexibility allows forecast recruitment to be decoupled from the SR parameters allowing either approach to produce roughly equivalent reference points and stock status estimates.

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Scaling and/or Re-Weighting the indices

- We did not re-weight as that is only appropriate when finalizing a base model with final and complete data.
- Tend to iteratively re-weight indices based on the uncertainty and SDNR evaluation.
- We also tend to scale the FD indices to the minimum CV in the FI indices in order to not allow FD indices to dominate the trend in the assessment.
- We can change the way we scale the fishery-dependent indices to be sure we do not lose the interannual variability
    - Will be a moot point if we drop the FD indices as suggested.

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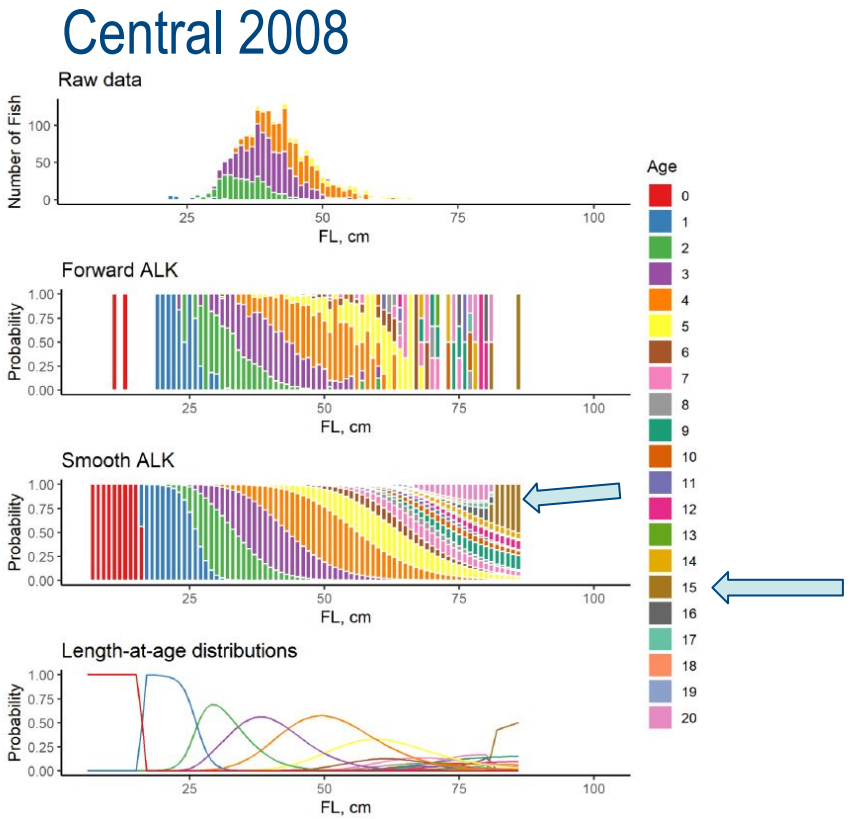
Max Age and Plus Group Determination

- Increasing max age beyond the 20 plus group is ill-advised
  - The vast majority of our age data is <15 years, and we indicated this to the reviewers and in our working papers.
  - Adding the extra years will only add to run times and will make our ALKs unusable
    - Nominal ages were very noisy
    - Lack of paired age and length samples in the east especially
    - Lack of age zero samples in all regions



Ailloud, Lisa E. 2022. Gulf of Mexico Red Snapper (Lutjanus campechanus) Smooth Age Length Keys. SEDAR74-DW-20. SEDAR, North Charleston, SC. 98 pp.

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- **Overall model uncertainty characterization**

Overall model uncertainty issues

- Reviewers indicated that the model is too complex and suggest some ways to simplify the model:
  - 3->2 areas ✅
  - Combine landings with discards ❎
  - Remove fishery dependent indices (try)
- Generally we gain insight as to whether a model is overparameterized using model fits and diagnostics, not the number of parameters.
- They also state that there are too many parameters, but do not discuss an ideal parameter-to-data ratio.
  - We plan to address this more pointedly as we approach a base model run.

Overall model uncertainty

- We will investigate characterizing the uncertainty of landings and discards using their CVs as well as through sensitivity analysis.
  - The uncertainty in steepness and natural mortality tend to have the largest impact on the model, not the uncertainty in landings and discards.
  - It would be useful to discuss more about how the SSC can use uncertainty from the model when setting ABCs, as the central tendency of the projections is nearly always used.

How to move forward assessing Red Snapper?

- We recommend moving forward with a benchmark-like process (DW, Assessment webinars, and a RW)
  - Suggested topics to revisit:
    - Recreational landings and discard data
      - It is important to have an agreed upon approach for red snapper, so that the catch advice is either in the same units used to monitor, or can be converted relatively easily.
    - Age and length compositions, including ALKs
    - Revert stock ID to two areas
    - Evaluate steepness, natural mortality and landings uncertainty through sensitivities
    - Start year evaluation
    - Shrimp bycatch (will have a separate CIE review)
    - GRSC - but how?


Thank you!