SEDAR 74 Gulf of Mexico Red Snapper Stock Assessment: Assessment Webinar 5

NOAA FISHERIES

LaTreese Denson
Matthew Smith

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Outline

- Present the case for the Hybrid model structure.
- Highlight known issues with Hybrid and discuss possible solutions.
- Detail planned sensitivity runs

The case for the Hybrid model

Review of Model Structure Options

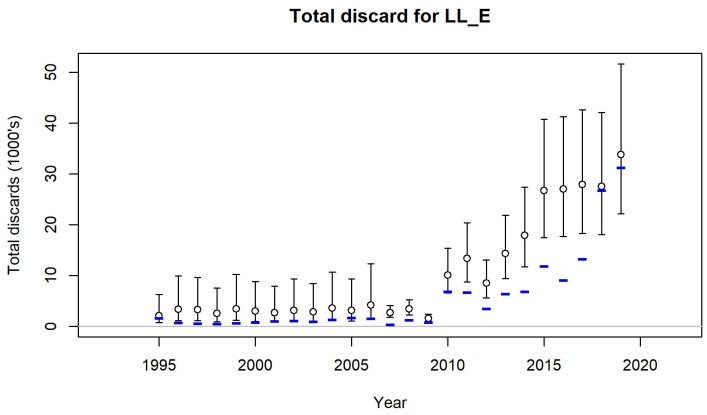
- Age only, Length only, Hybrid (age and length)
  - Composition data is the primary difference among models
- All three are still under development at differing, but similar levels of progress.
- All structures include all available data with some exceptions (e.g., no age-based early trawl comp.)
- All structures converge to reasonable solutions with satisfactory gradients and invertible hessians

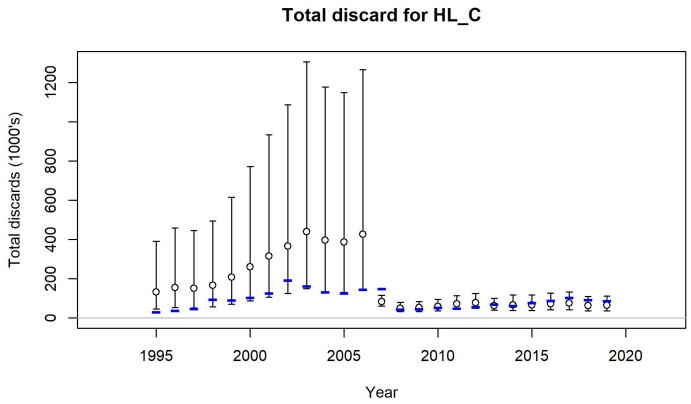
Age Based Model

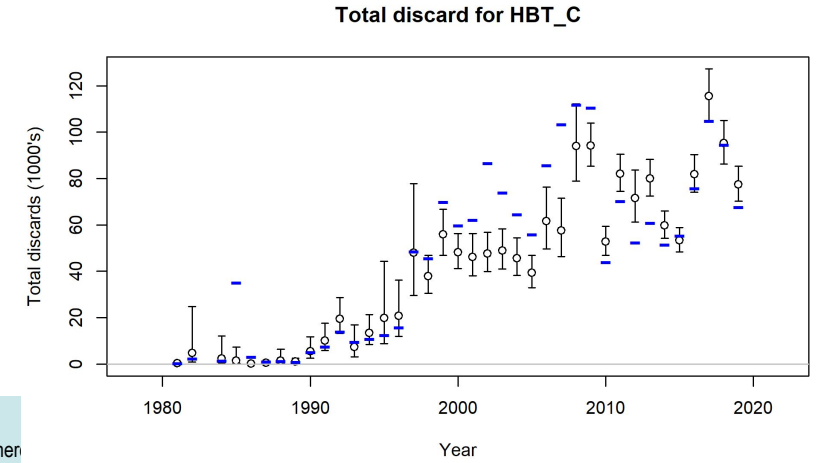
- Initial model developed following S52 model structure.
- Required extensive development to transition to new SS version and 3 area model structure.
- Uses real age data for directed fleet landings and BLL survey
- Uses length-converted age for all other comps.
  - Provided via annual ALK's
- Performs reasonably well but has unresolved issues with selectivity/retention fits and trawl survey age composition.

Age Based Model Issues

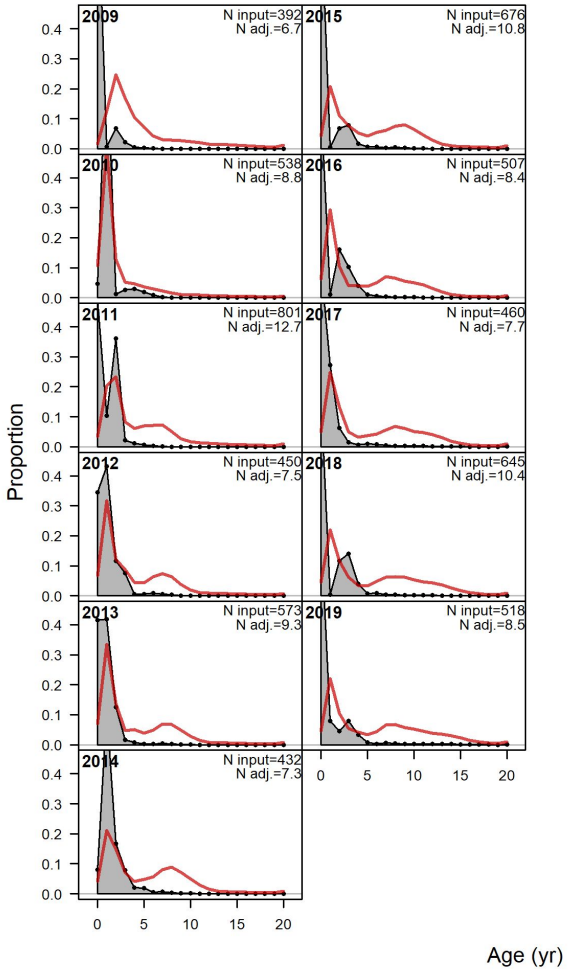
- Selectivity in age vs. retention in Length forced mis-fit to discard data to accommodate catch history and retained comp







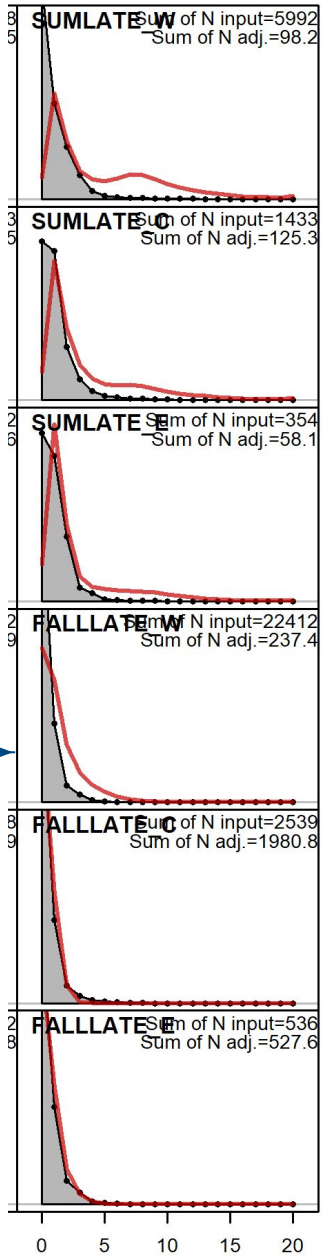
Age Based Model Issues



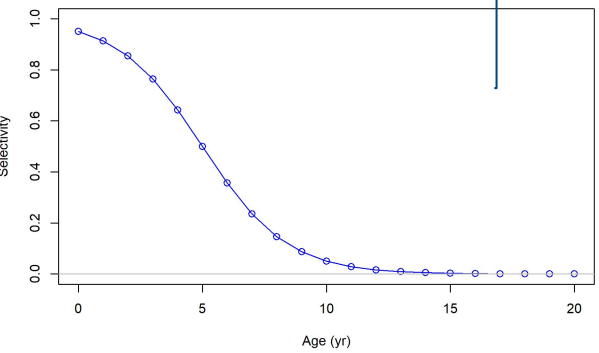
- Can't fit trawl composition well
  - ALK's were poorly estimated for young fish due to incomplete sampling and ageing of small/young red snapper
  - Example - 2015,2016,2018 - ALK assigns no fish to age 1

Age Based Model Issues

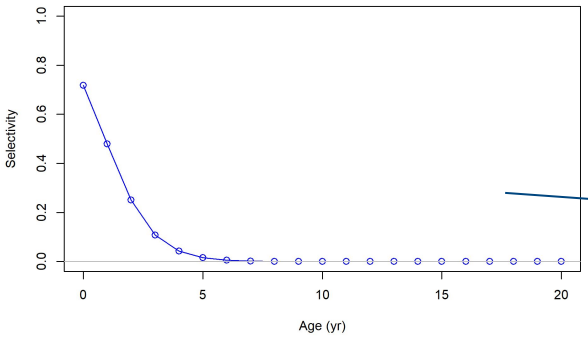
- Tension between Summer trawl, fall trawl, and shrimp (all essentially indexing YOY fish) results in some model instability and varying degrees of data misfit



Fall Late West



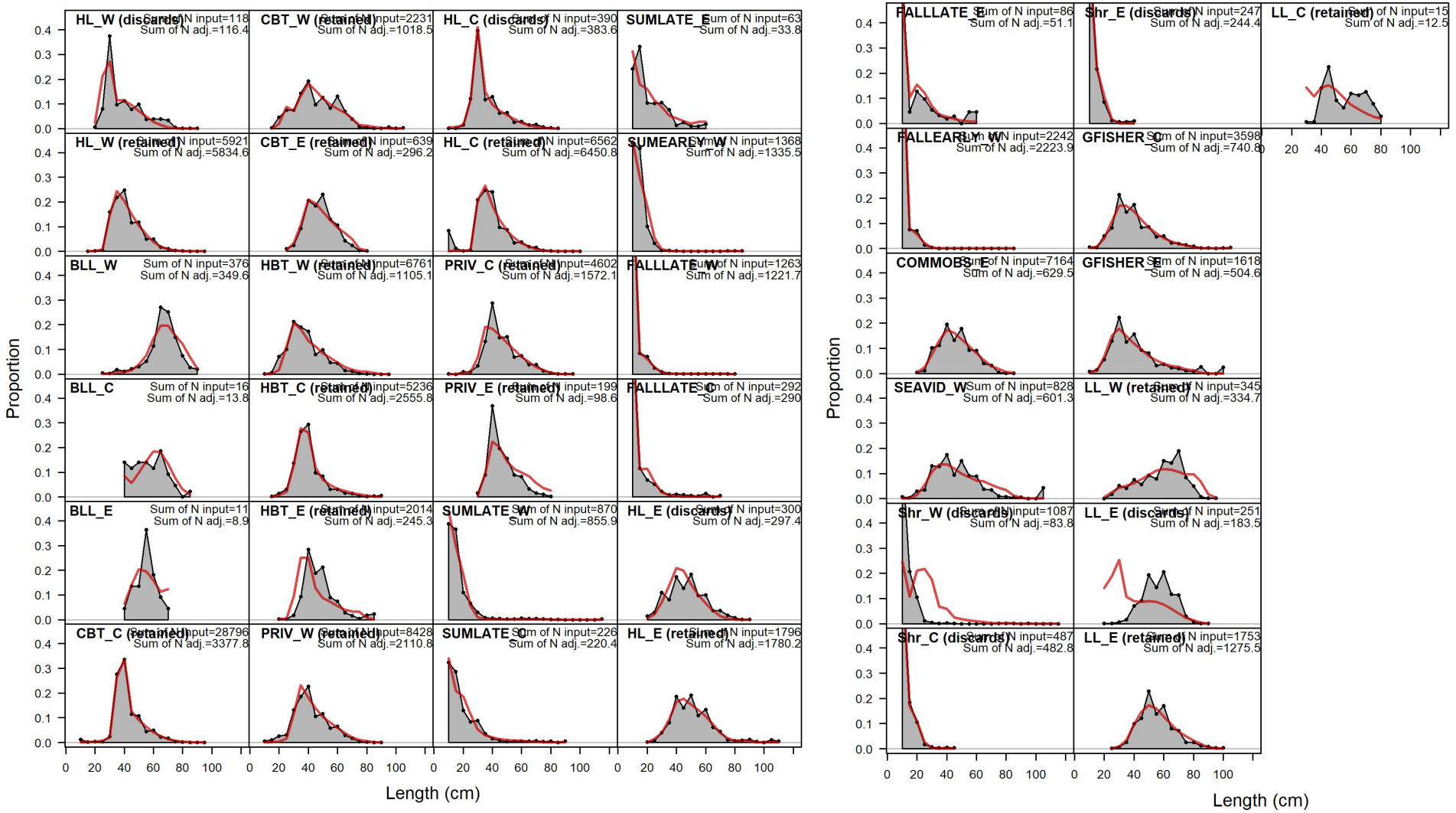
Fall Late East



Length Based Model

- Uses real length composition data for all directed fleet landings and discards as well as surveys.
- Closer to “first principles” (i.e., gear/fisheries /management interact with the stock through size not age)
- Fits to composition are generally good and selectivity/retention functional forms are plausible and more intuitive

Agg Selectivity by model - Length

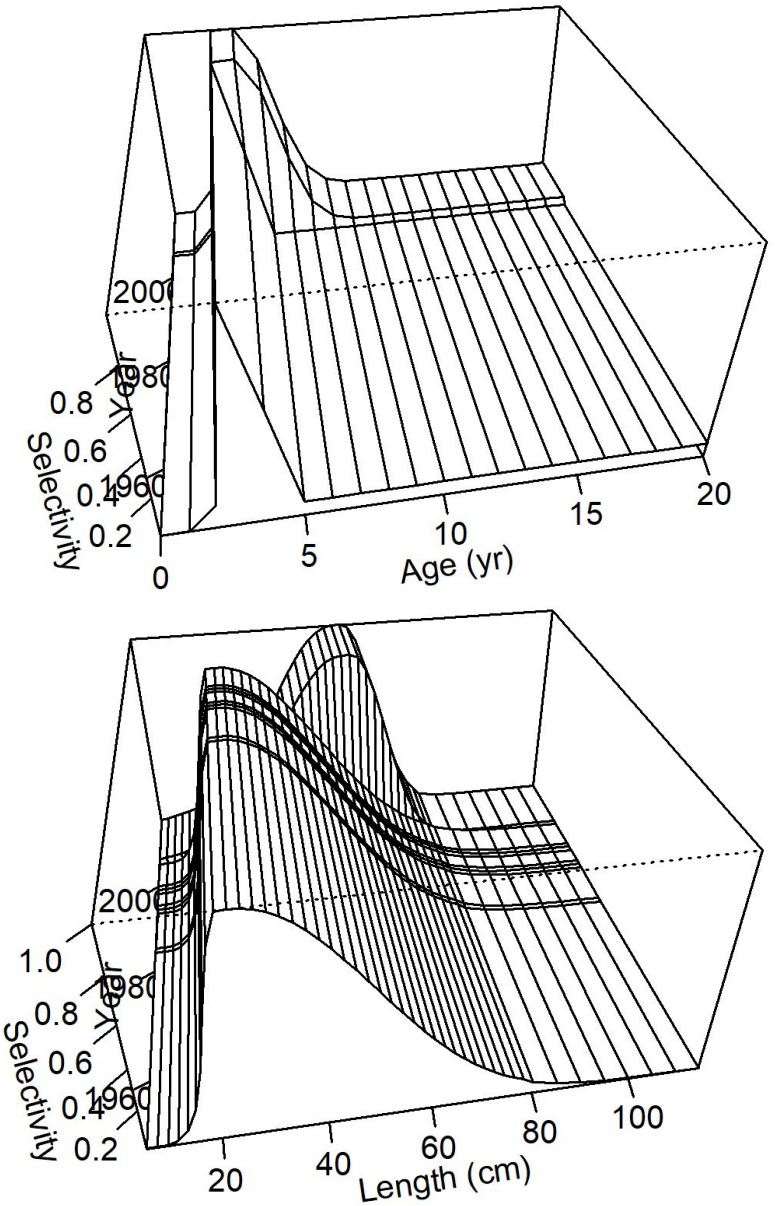


Selectivity Forms

Example

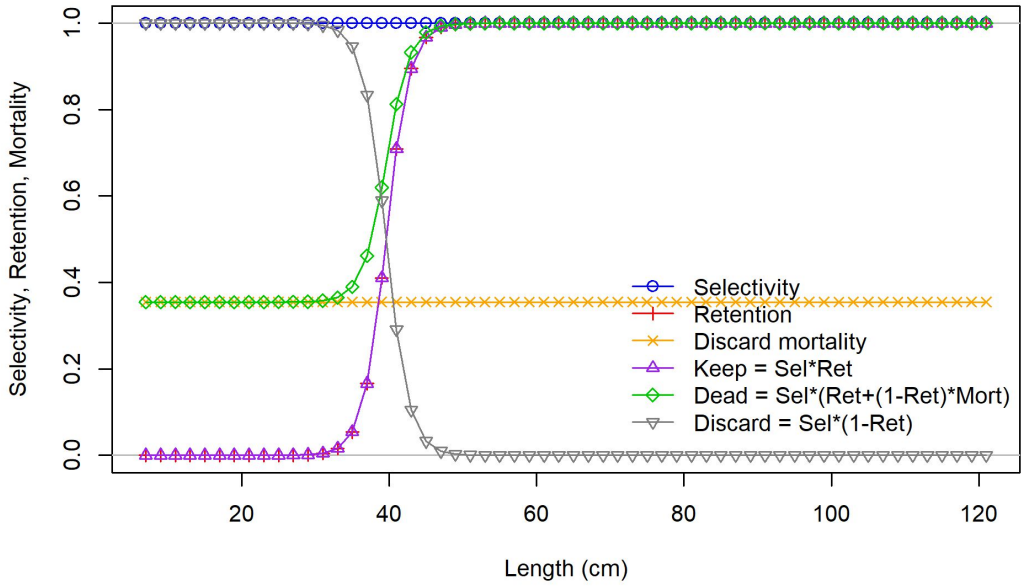
Private West - Age (top) vs. Length (bottom)

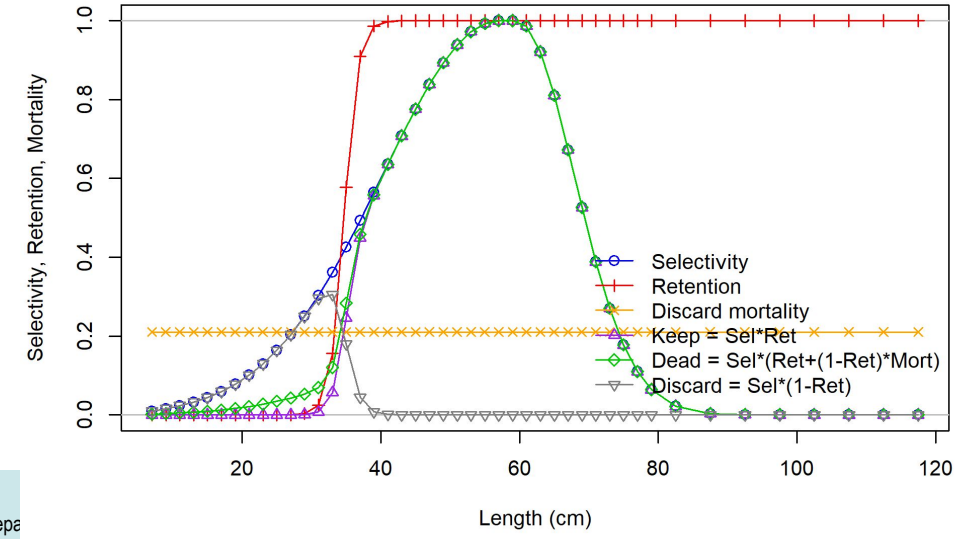
Length-based generally resulted in smoother selectivity forms that intuitively work with retention functions, simplifying model interpretation



Retentions

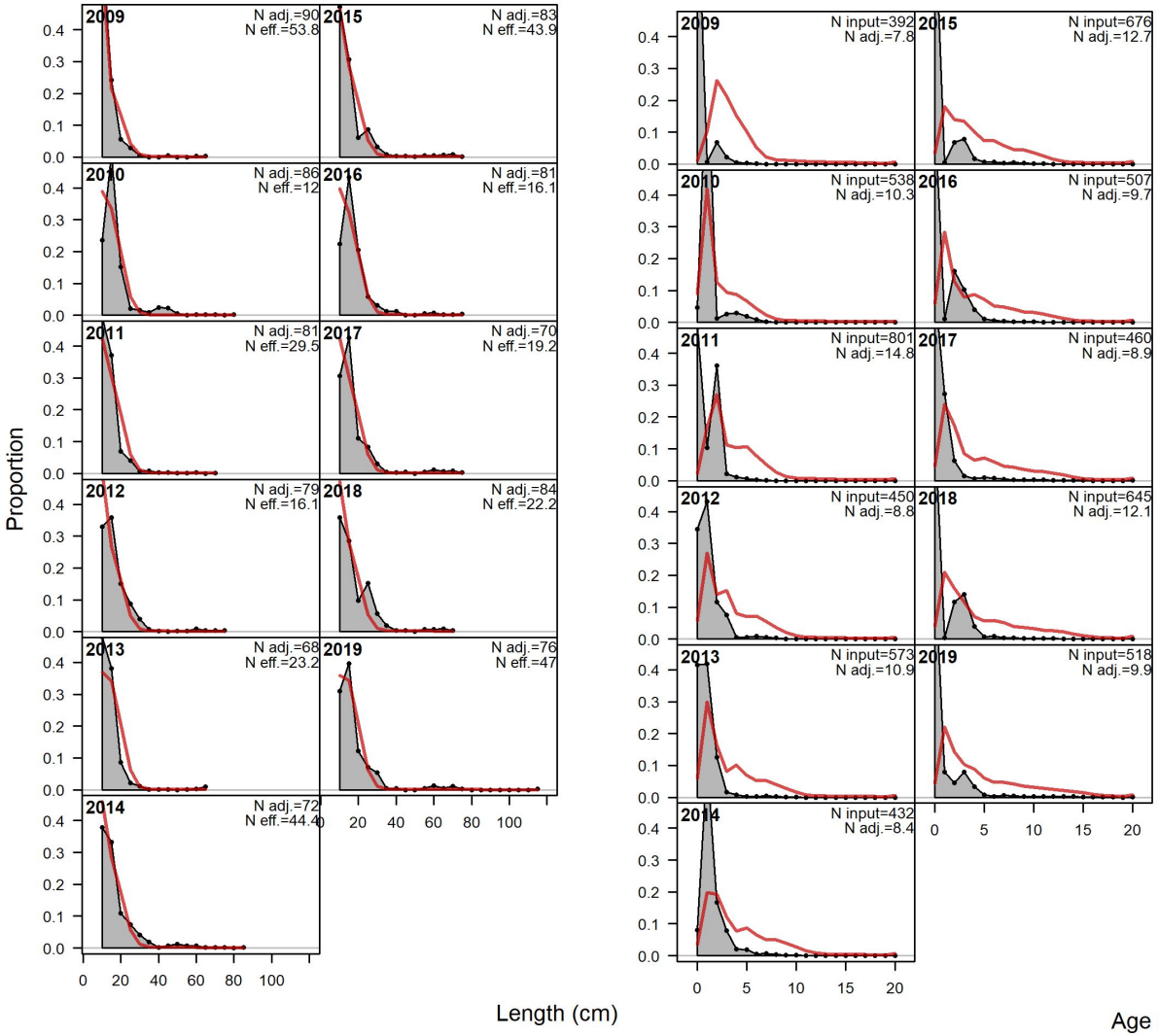
Retention forms similar between Private west age (top) and length (bottom). Note Age selectivity not shown in top plot





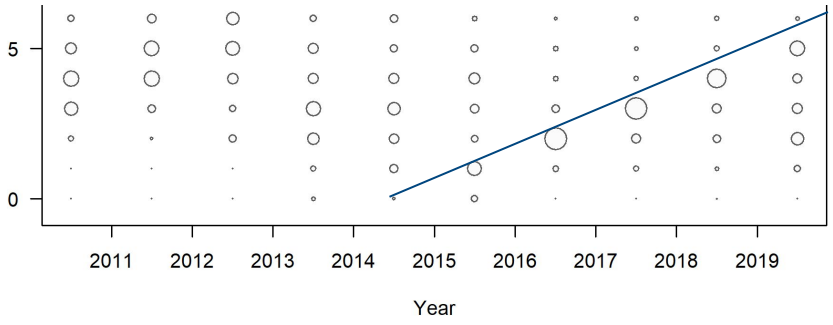
Length Based Model

- Capable of fitting the trawl survey composition.

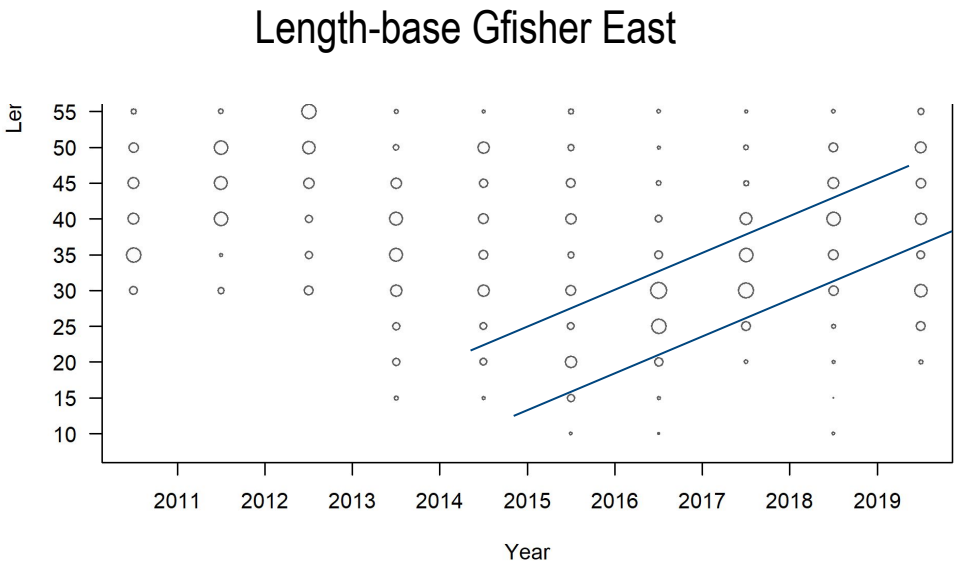


Length Based Model

- Use of length composition for surveys appears to reduce their power for identifying cohorts resulting in strong years classes being “smeared” across multiple years



Age-base Gfisher East



Hybrid Model (age and length based)

- Uses length composition for directed fleets (landings & discards).
- Uses length composition for Video surveys since no real age data exist.
- Uses early trawl length composition data for which no ALK exists

- GOAL: Use real age composition for surveys (BLL, Fall and Summer Trawl) to maximize cohort information

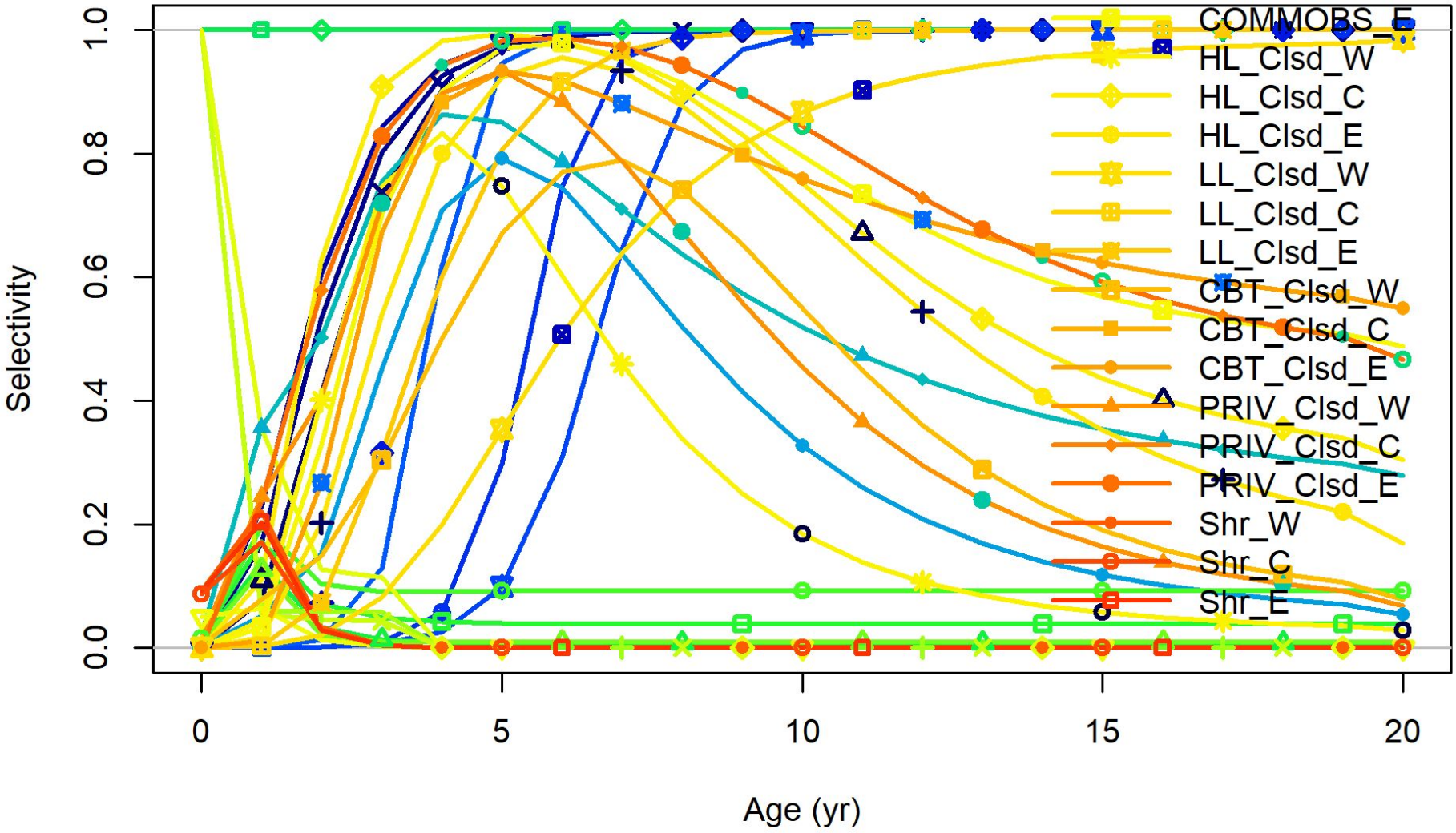
- CURRENTLY: Uses real age composition for BLL, length-converted age for Fall Trawl, and length comp for Summer

Hybrid Model (age and length based)

- Analytical Team recommends using the hybrid model structure for S74.
  - Produces comparable population estimates, data fits, and diagnostic results to the Age and Length only model structures.
  - Utilizes “native” composition, reducing translation errors external to the model.
  - Makes use of more robust and longer time-series of composition data.
  - Incorporates survey age data for better cohort tracking.
  - Establishes framework for including real age composition for the trawl surveys in the OA

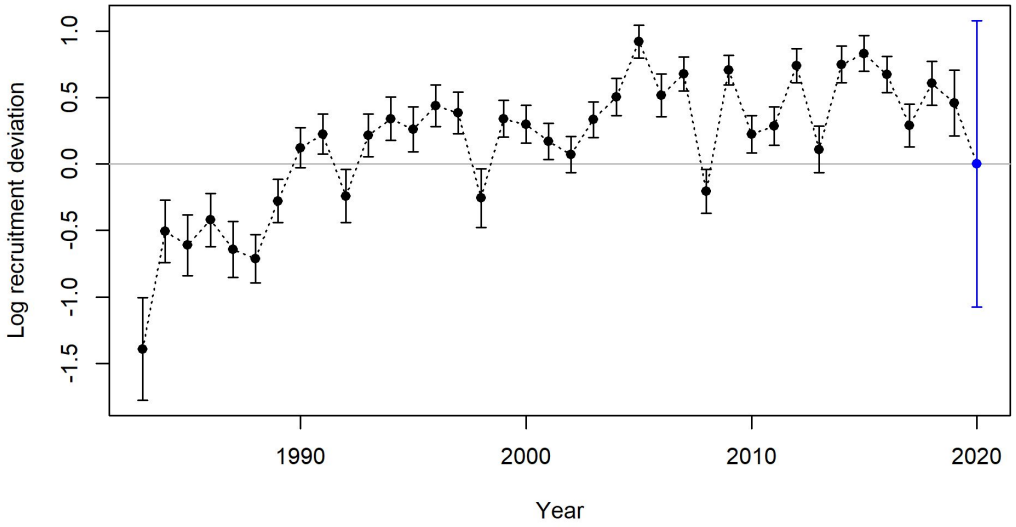
Hybrid Model Review

Selectivity



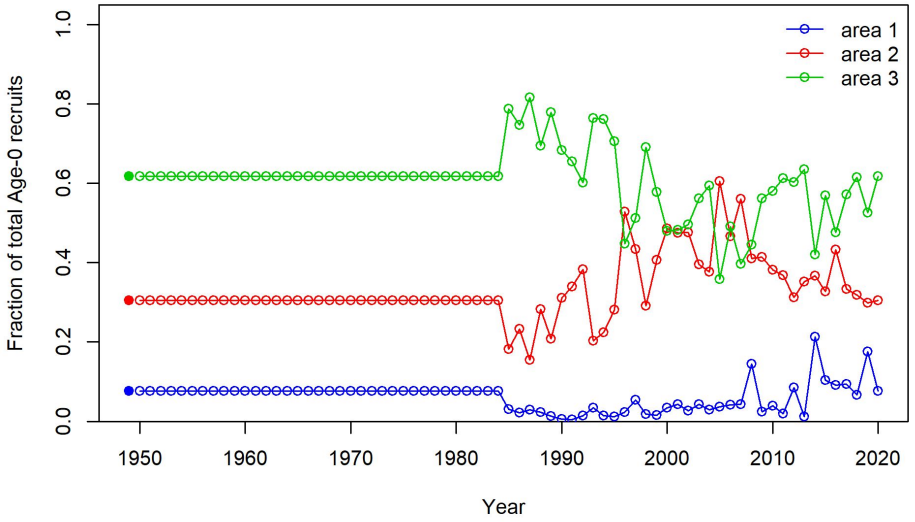
Estimated Selectivities converging on plausible and smooth functional forms

Recruitment



Simple recruitment devs. vector estimated with no R0 block

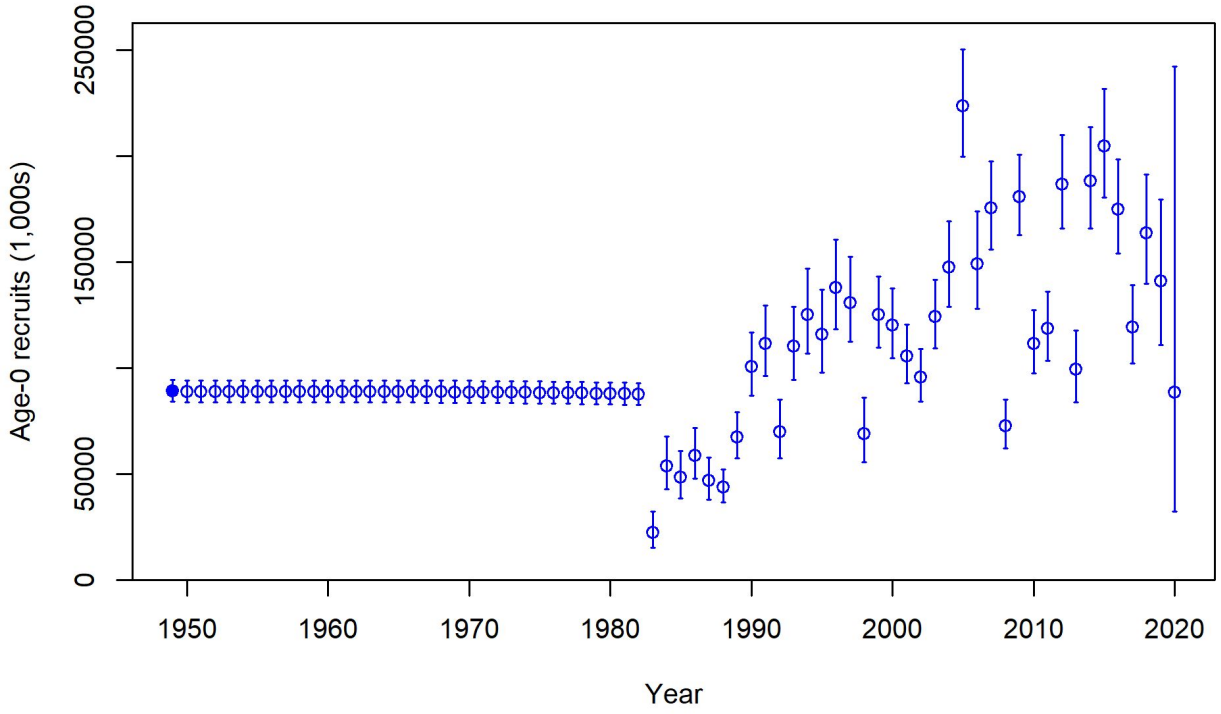
Apportionment variability constrained and among region pattern consistent



R0 Block Removal

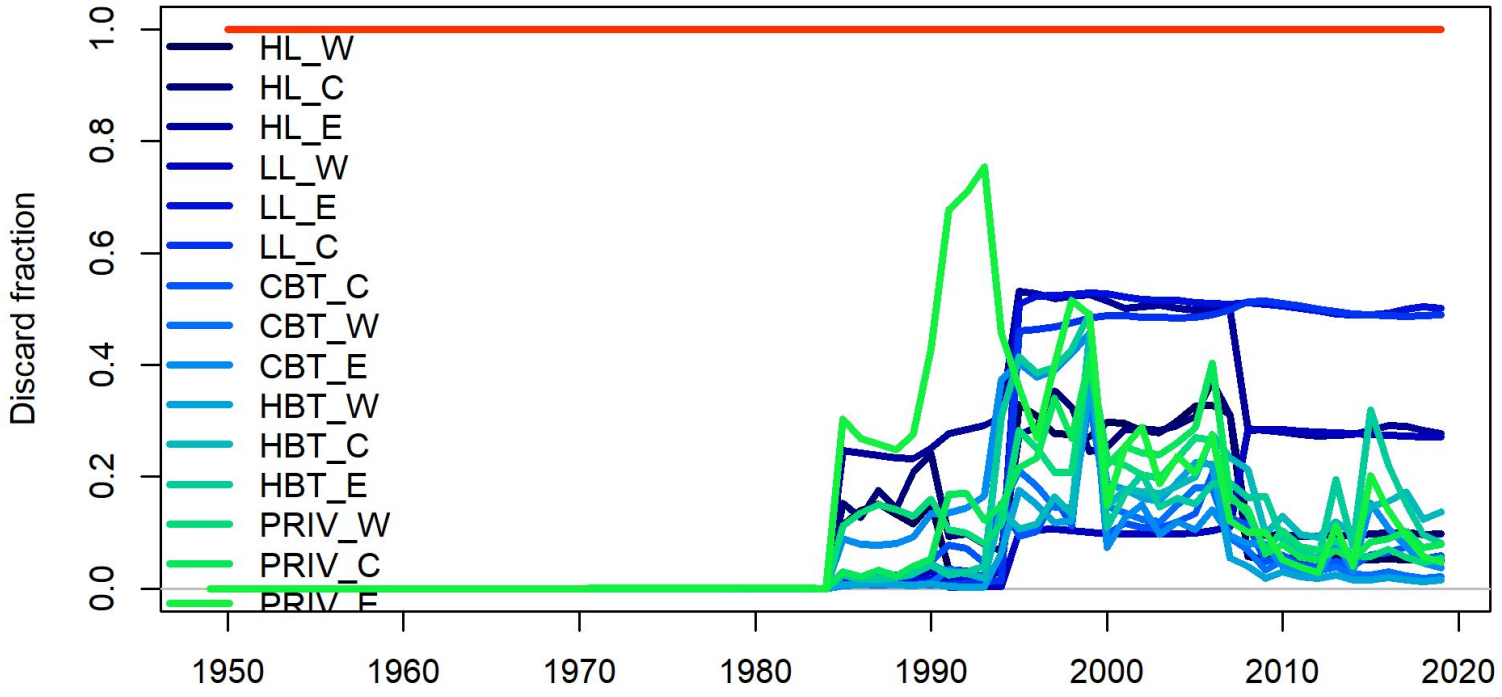
Simple recruitment deviations start the same year as the old R0 block.

Deviations are not zero sum constrained and can therefore achieve same result as R0 block and zero sum constrained deviations.

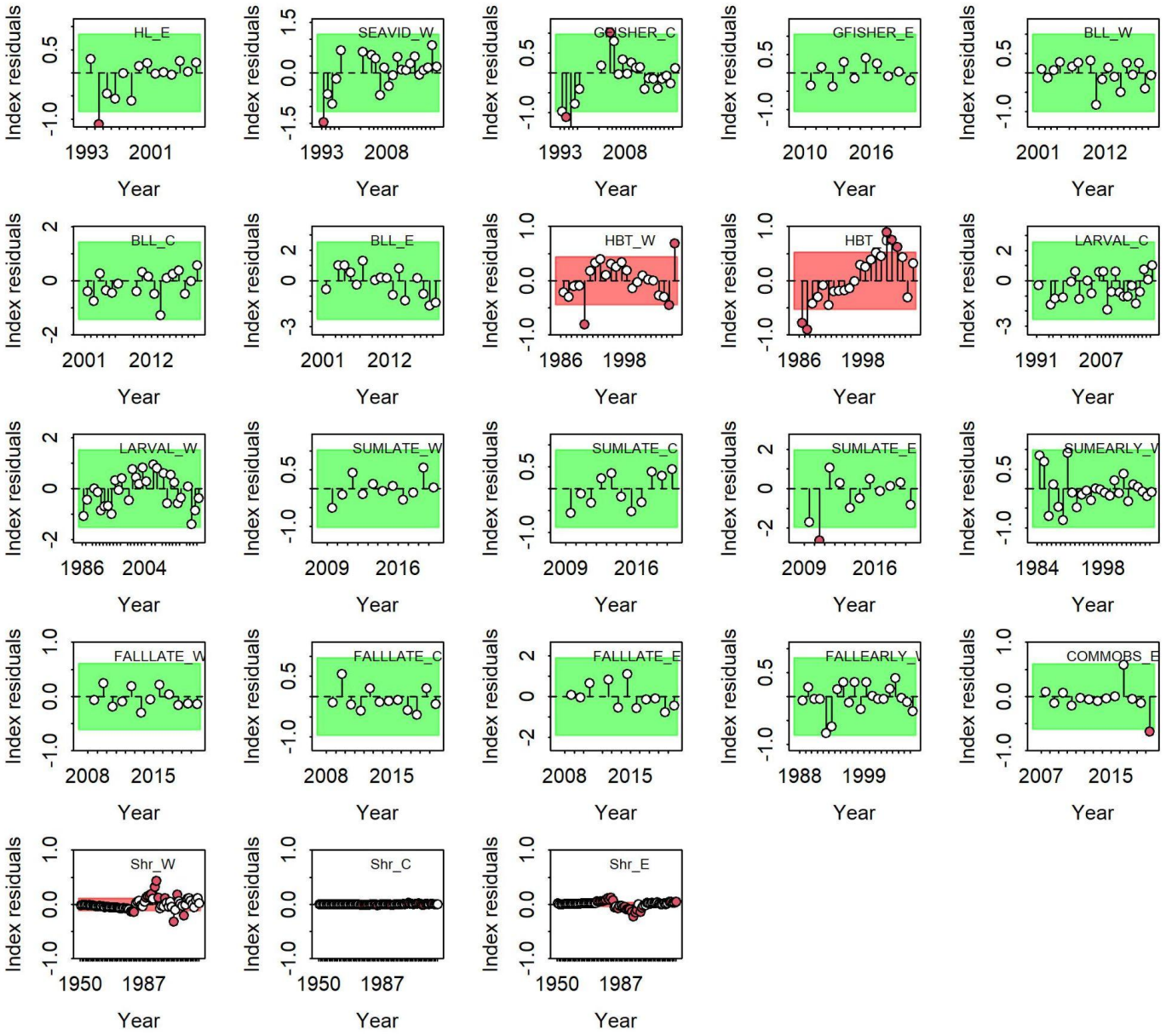


Discards

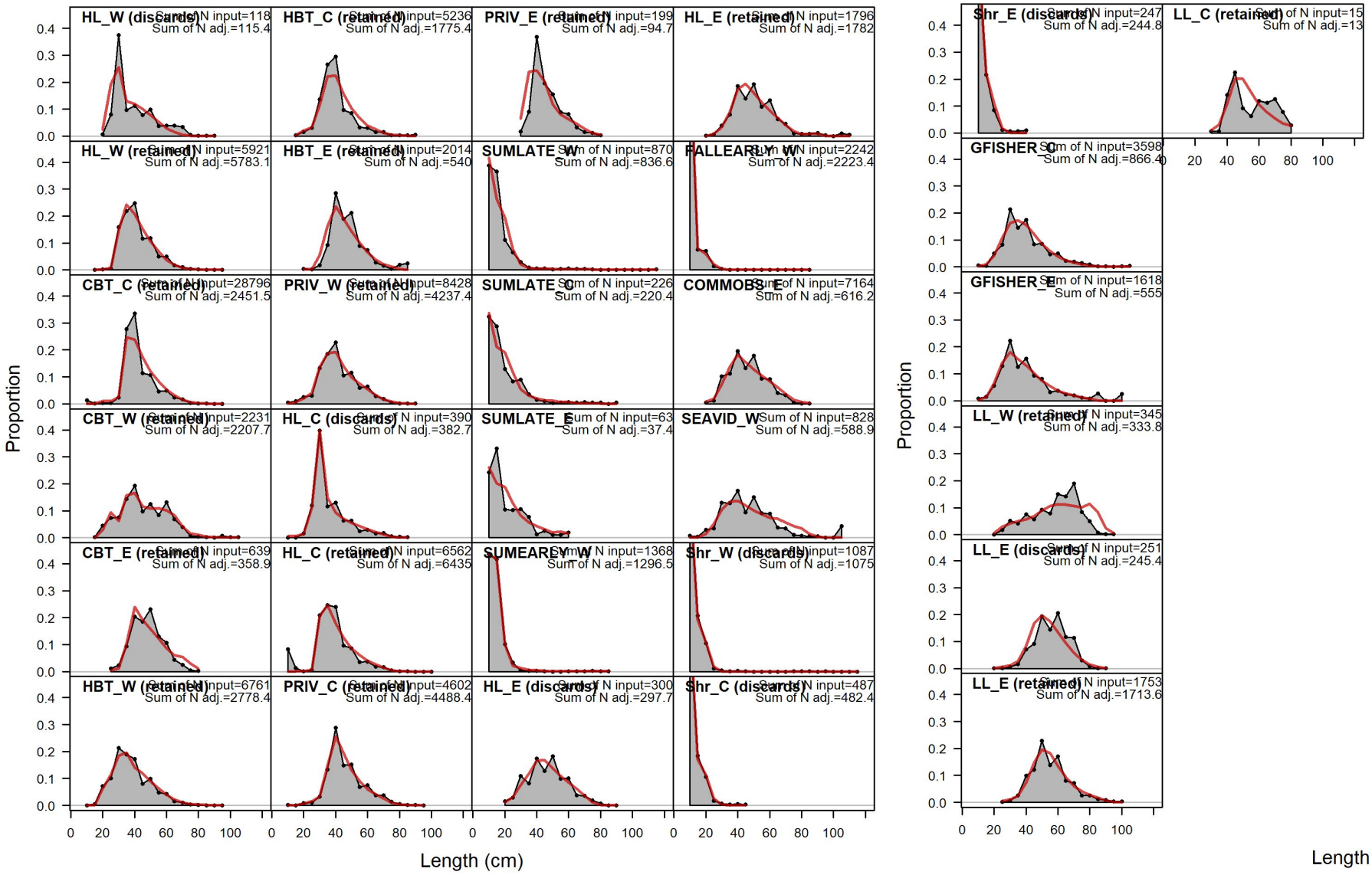
Discard magnitudes and comp fit (when available) are performing well for most fleets. Patterns persist in a few comm. fleets that may be indicative of retention misspecification



Indices

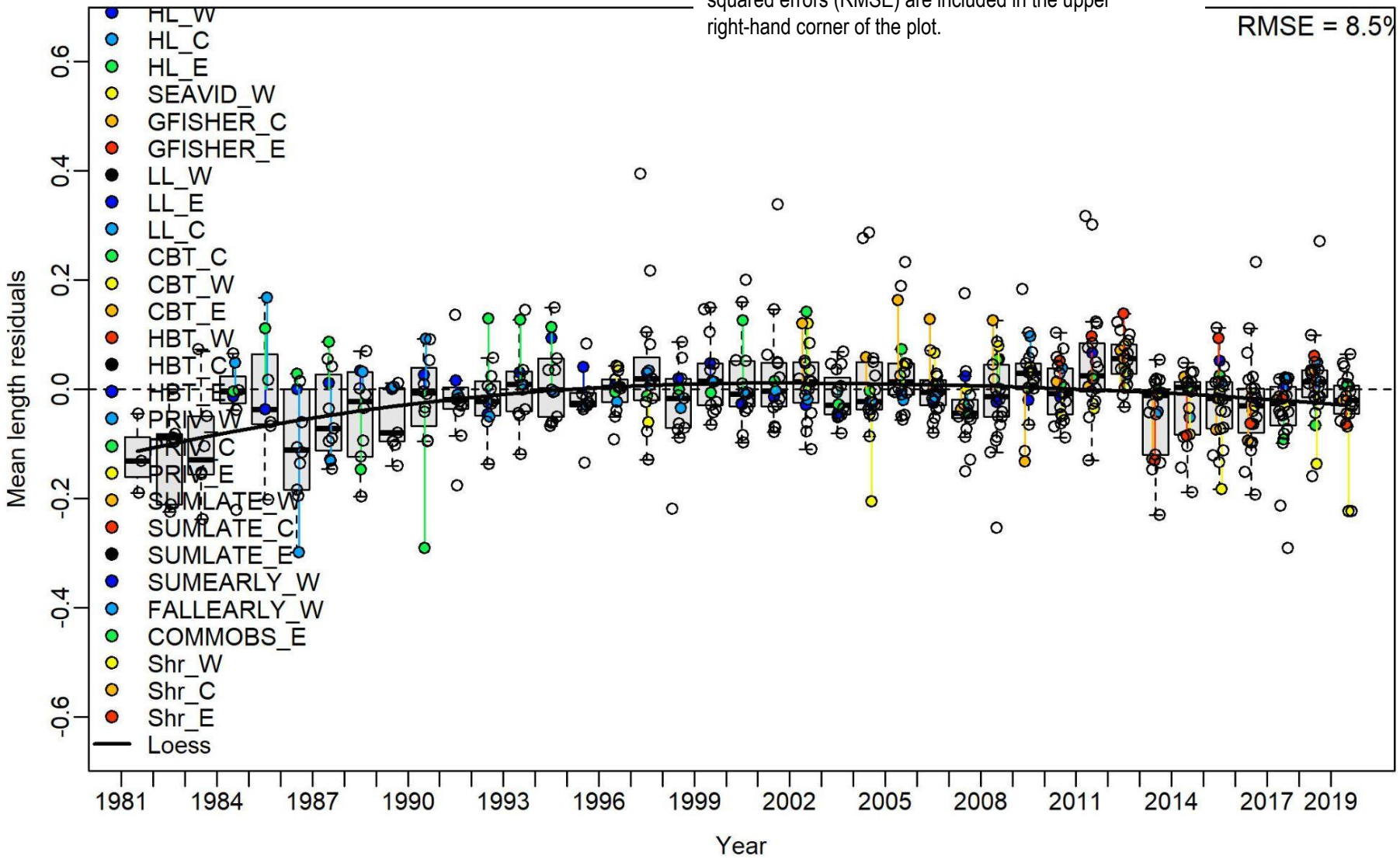

HL_E
SEAVID_W
GFISHER_C
GFISHER_E
BLL_W
BLL_C
BLL_E
HBT_W
HBT_E
LARVAL_C
LARVAL_W
SUMLATE_W
SUMLATE_C
SUMLATE_E
SUMEARLY_W
FALLLATE_W
FALLLATE_C
FALLLATE_E
FALLEARLY_W
COMMOBS_E
Shr_W
Shr_C
Shr_E
Index residuals
Year

Length Composition

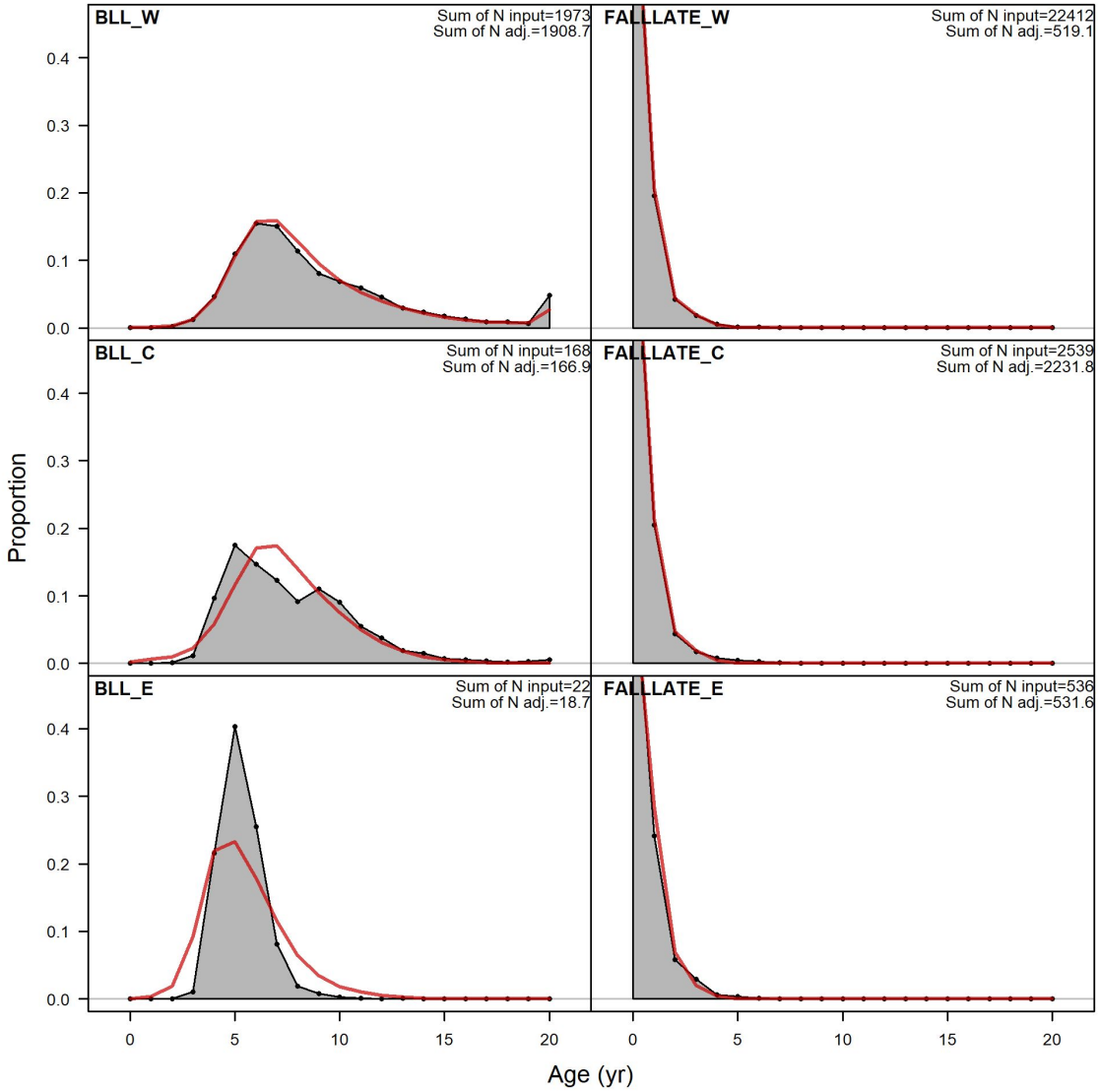


Length Composition

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.

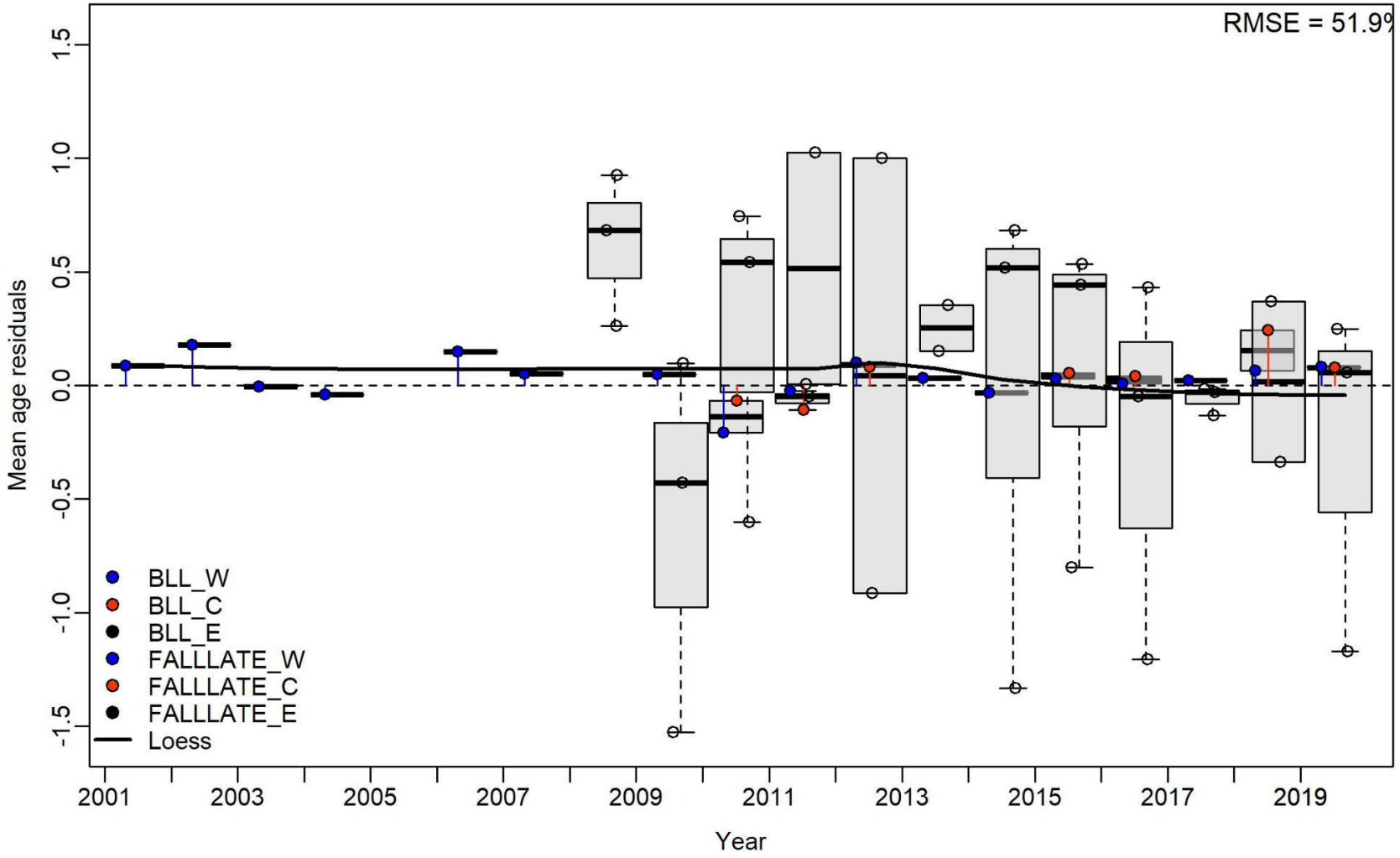


Age Composition

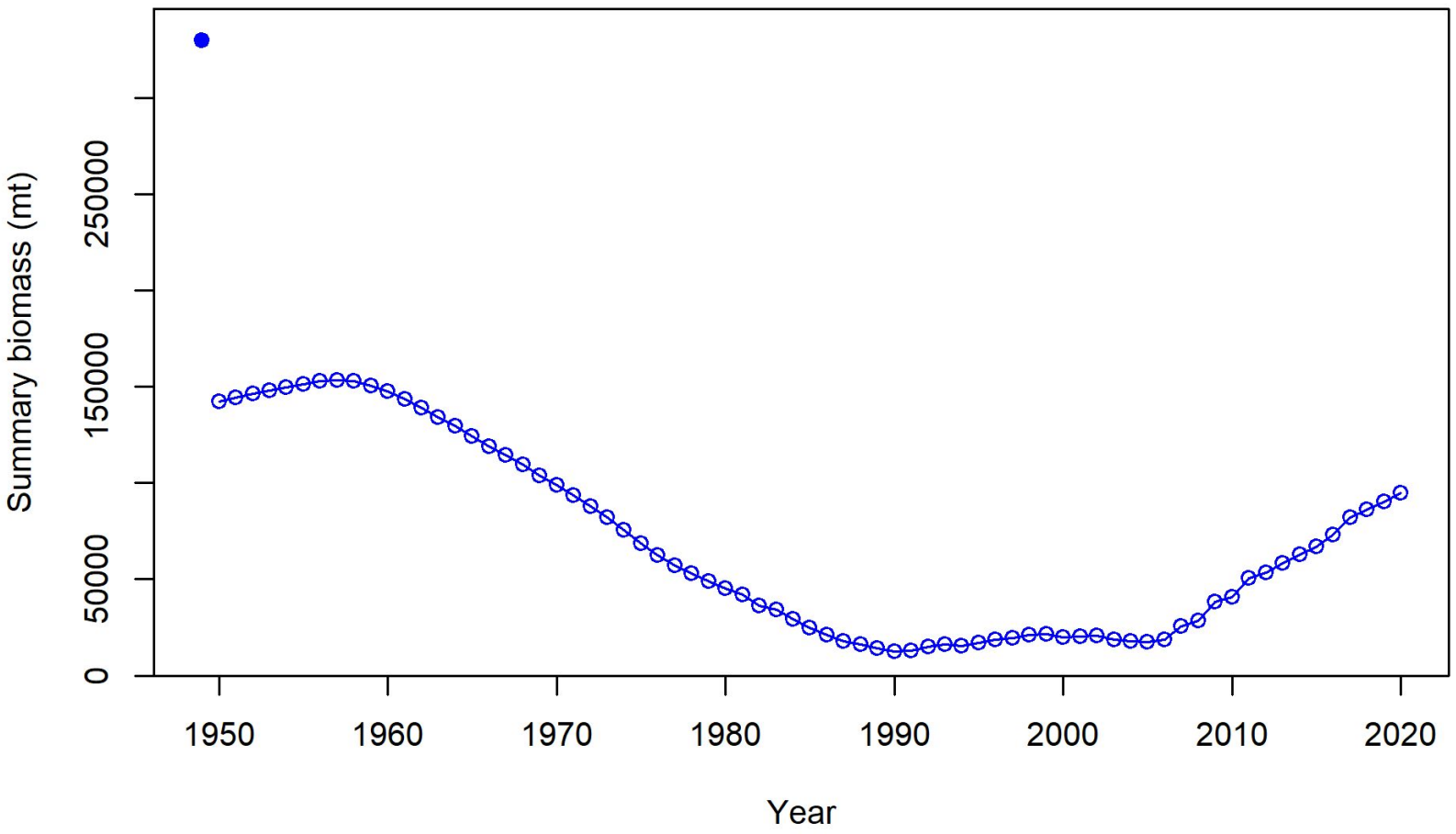


For OA we anticipate Summer trawl being included as age and possibly the video surveys depending on the results of sensitivity runs.

Age Composition



Biomass



Summary biomass is Age 2+ fish. NOT FINAL, but developing models indicate continued stock recovery since SEDAR 52.

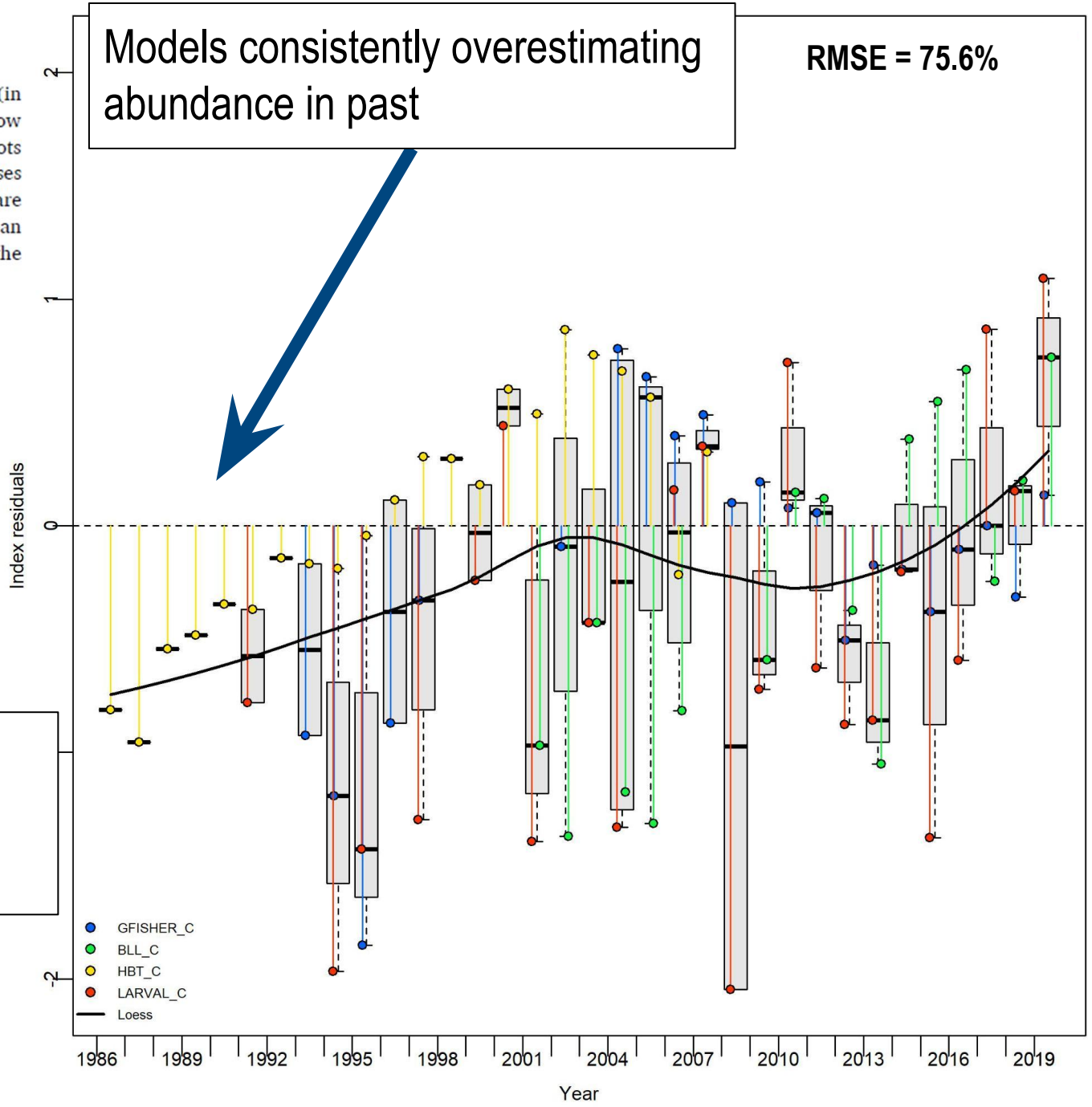
General Model Issues

Model Structure Problems

- Possible model misspecification
- Headboat survey fits
- Summer trawl conflicts

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

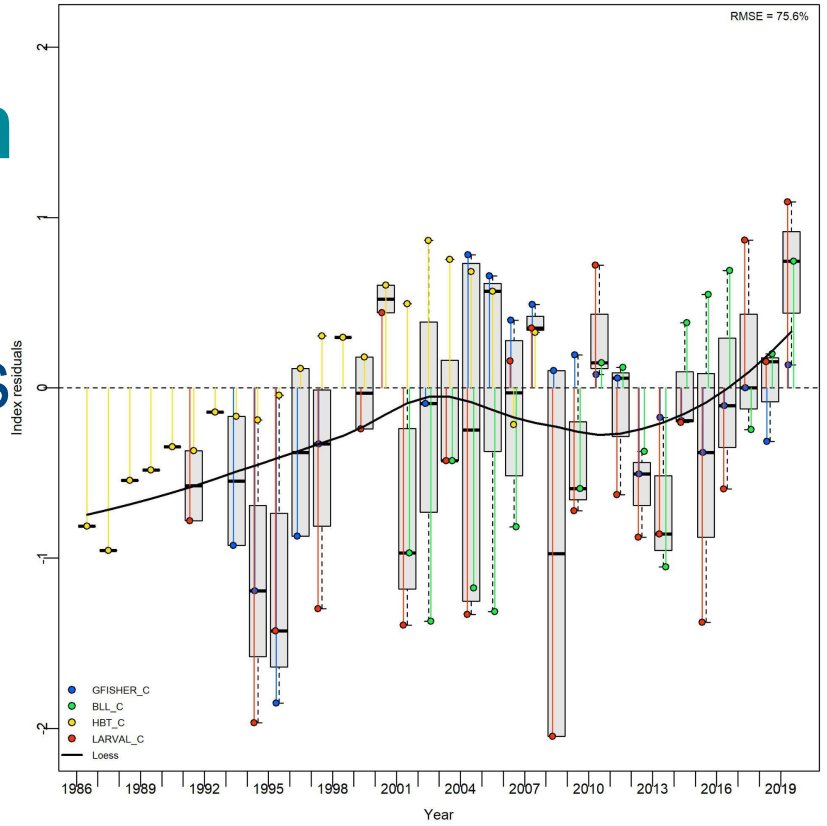
Models consistently overestimating abundance in past



Data consistently indicating low abundance pre-2000

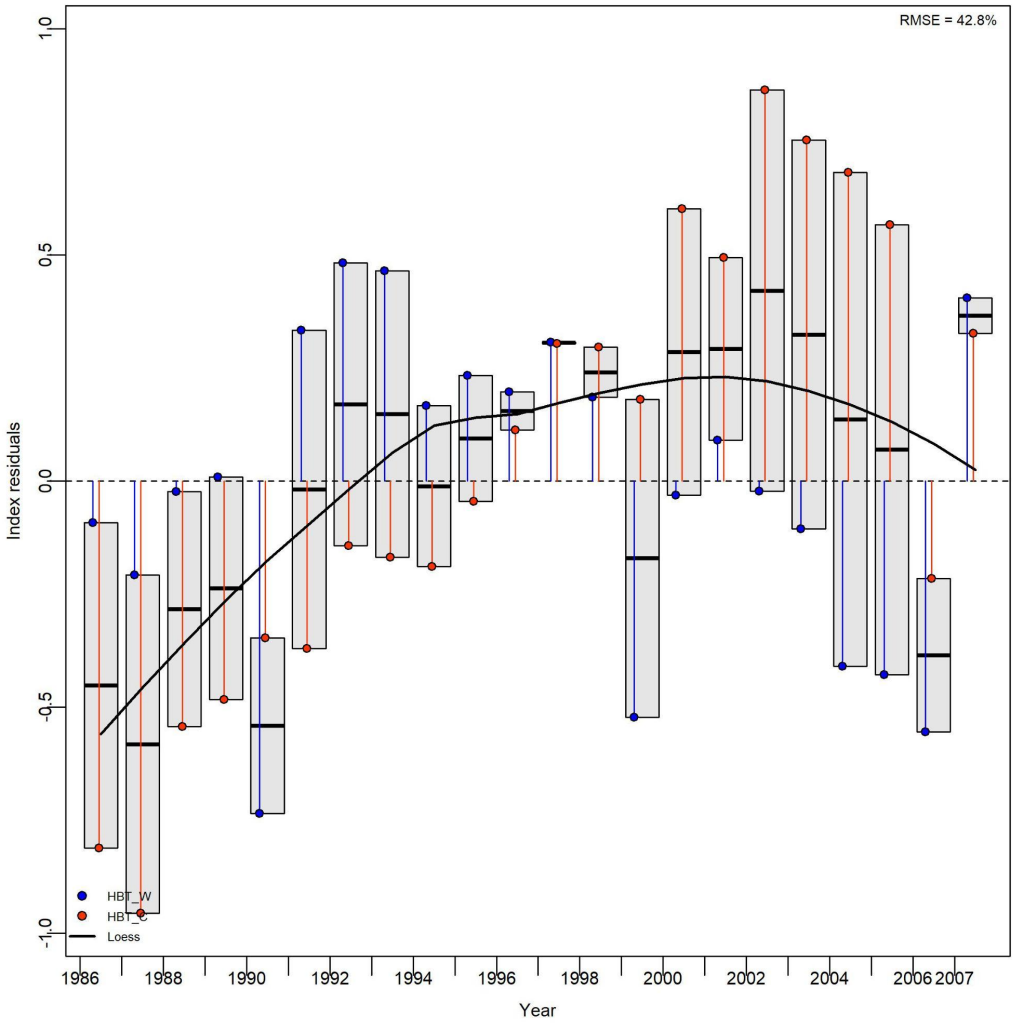
Possible Misspecification

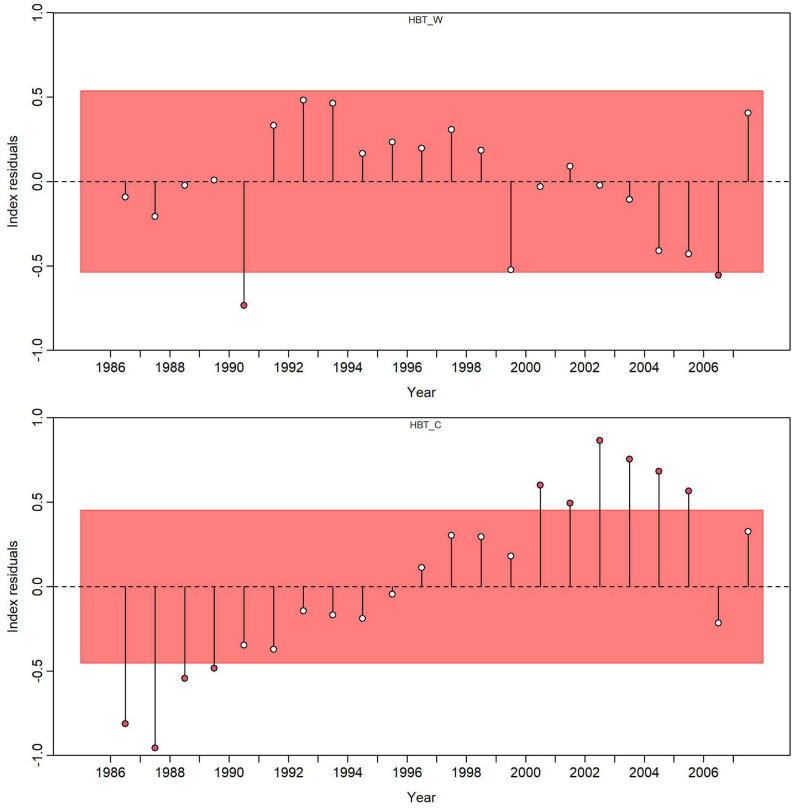
- Possibly related to way recruitment and/or initial F's being handled.
- Trials planned:
  - Increase CV's on equilibrium catch
  - Remove problem data (more later)



HBT surveys (Hybrid)

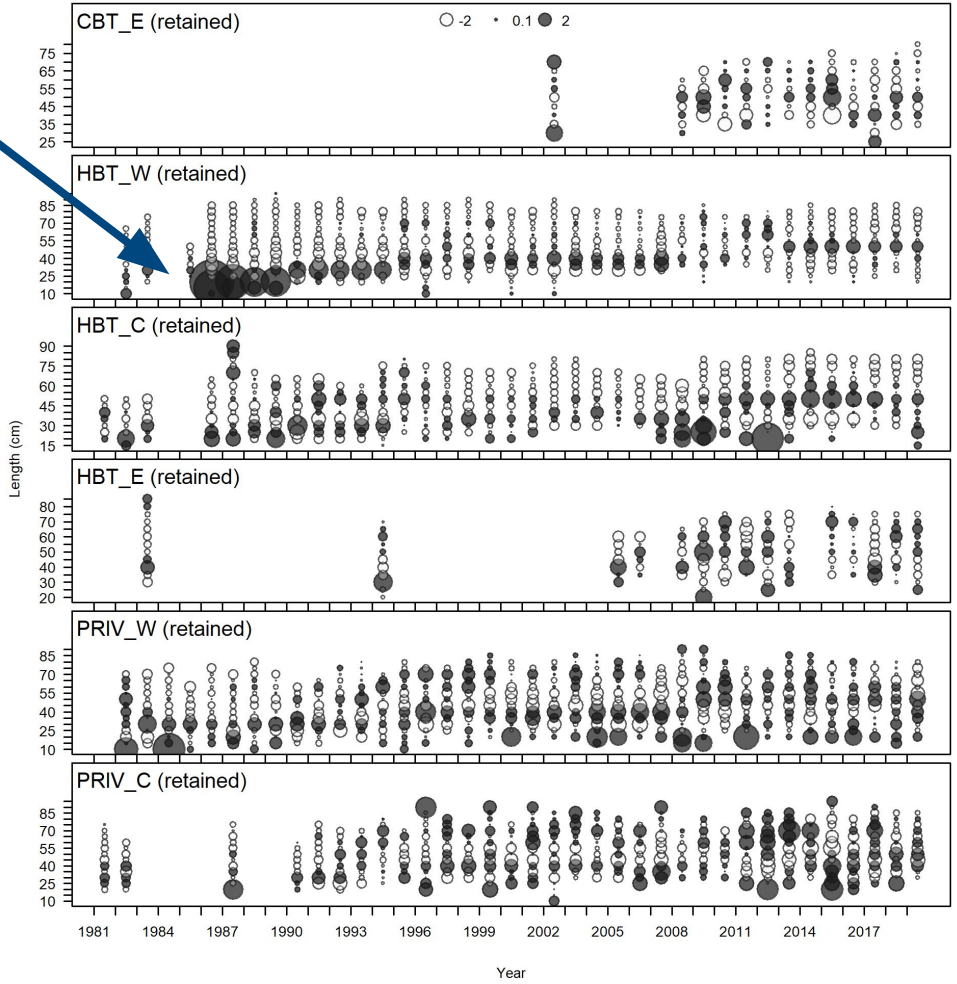
HBT surveys are an issue

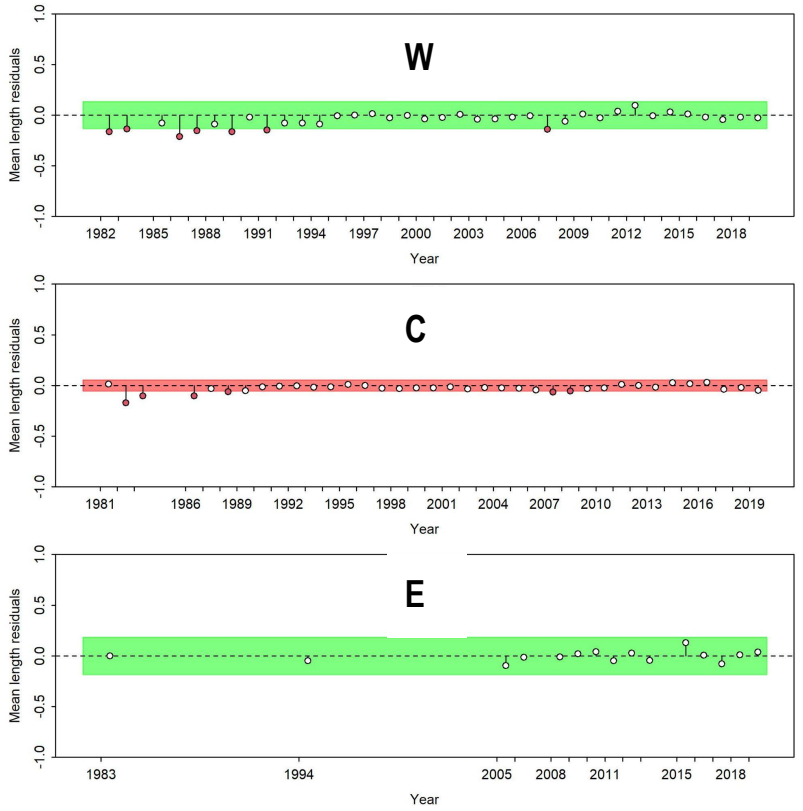




Residual pattern could be tied to index development or model misspecification.

HBT surveys (Hybrid)

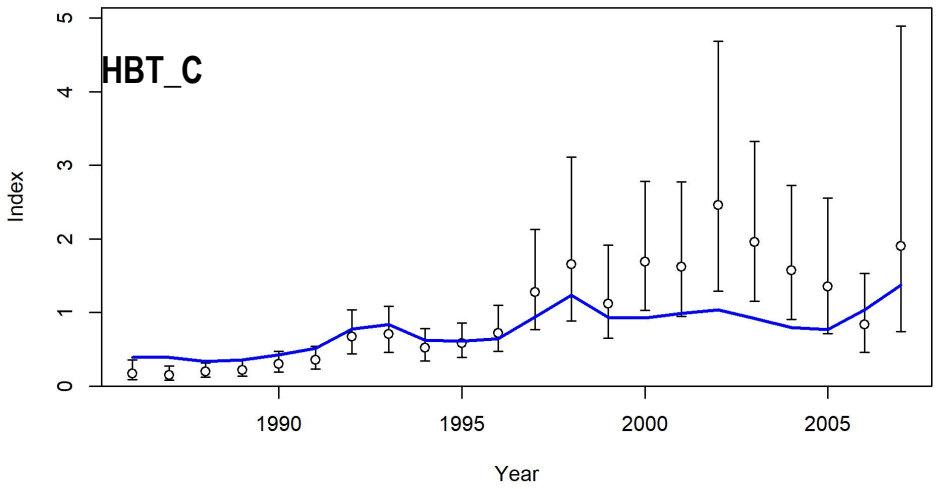




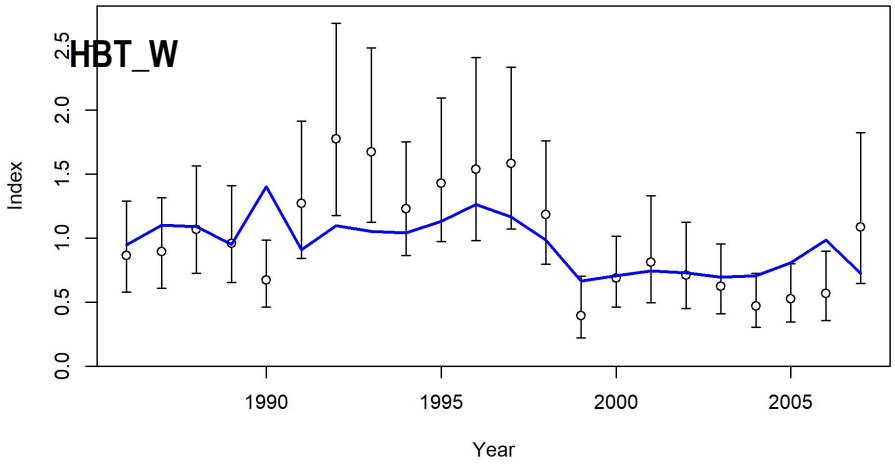
Not as concerned about the comp. But residual pattern in HBT and CBT fleets may indicate selectivity and/or retention misspecification for for-hire fleets.

HBT surveys (Hybrid)

- Surveys fit poorly, were derived from FD data, and included only for their temporal coverage.

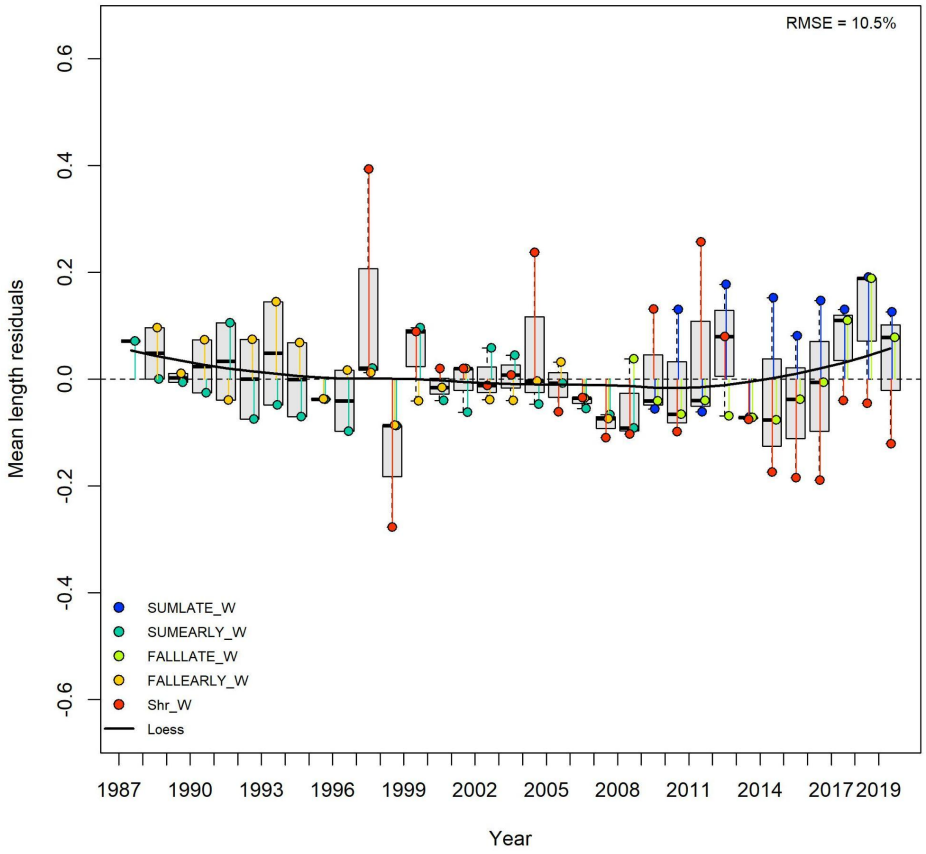


- Propose testing models with one or both HBT index(s) removed.

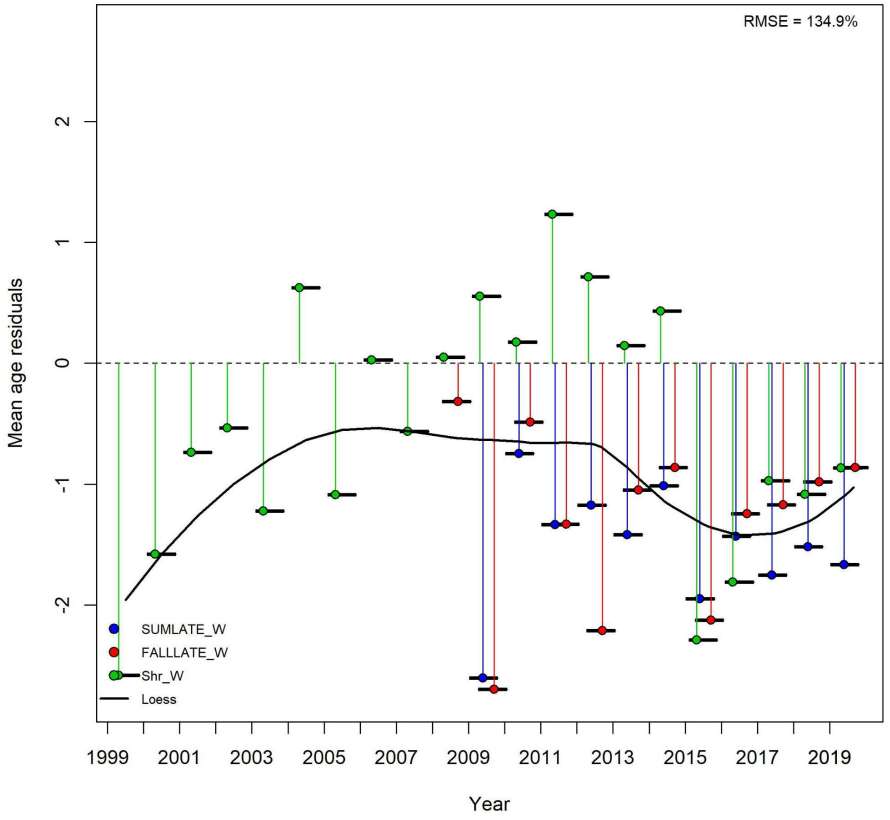


Poor Summer Trawl Age Comp Fit

Length



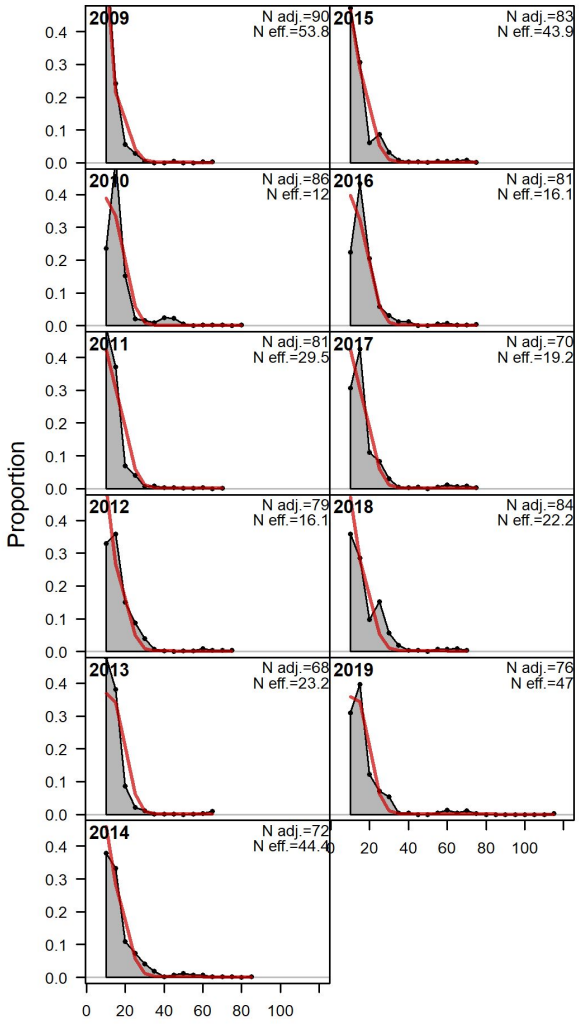
Age



Summer trawl ALK converted mean age, consistently over estimated.

Summer Trawl West Annual Comps

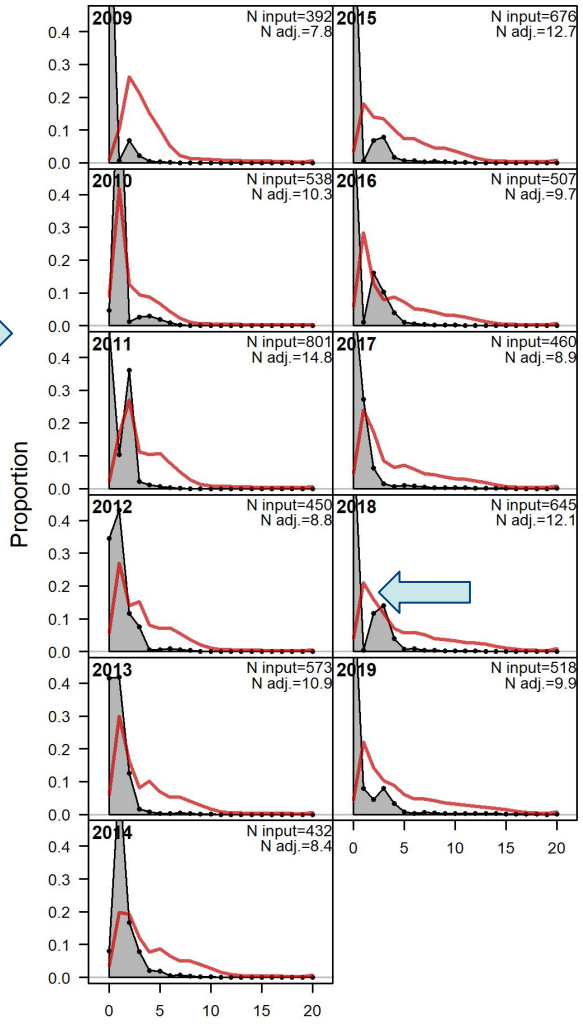
Length



External ALK

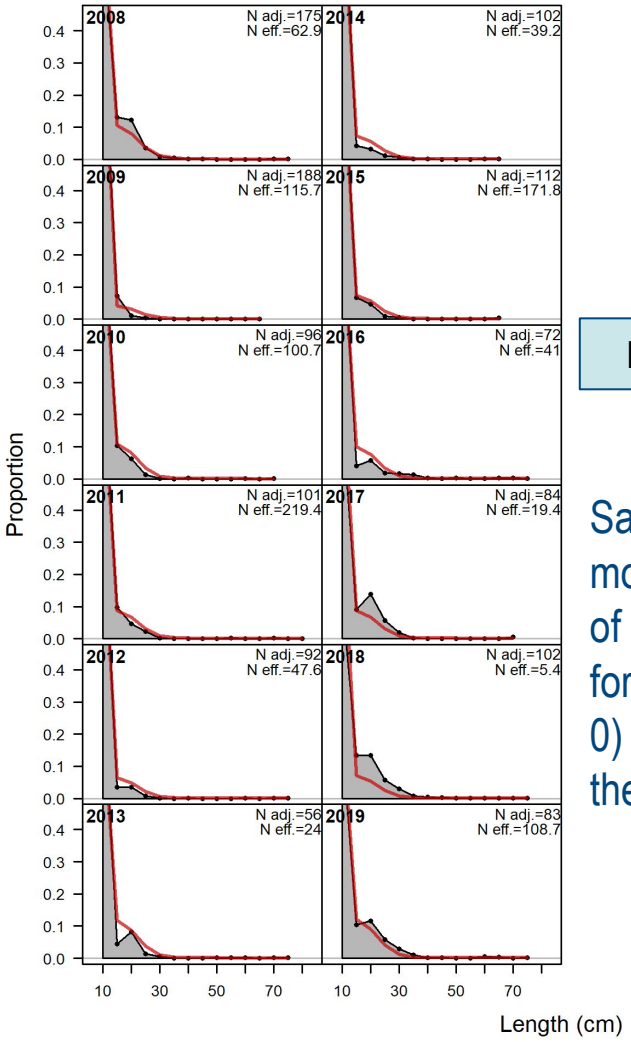
ALK's were poorly estimated for young fish due to wide range of length samples for small/young red snapper (age 0 and 1s)

Age



Fall Trawl West Annual Comps

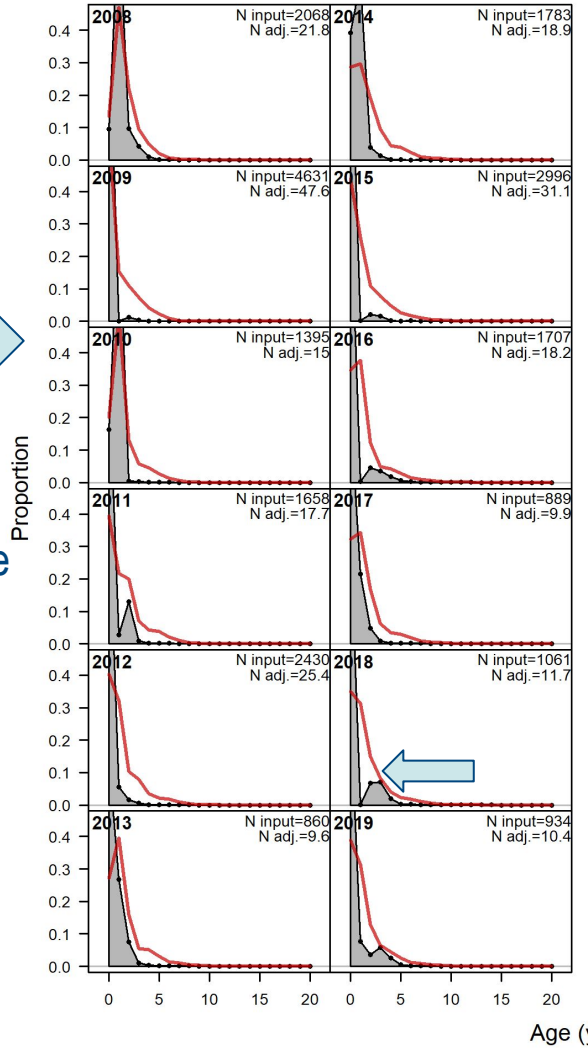
Length



External ALK

Same ALK but more precise range of length samples for young fish (age 0) due to timing of the survey.

Age



Trawl survey summary

- Lack of real age data makes full evaluation of trawl surveys impossible.
- Propose - including trawls in RT (Fall with length-converted age, Summer with Length).
- At OA use real age if available and evaluate trawl surveys, or eliminate Summer trawl if age composition is not yet available.

Next Steps

Work Left to Do

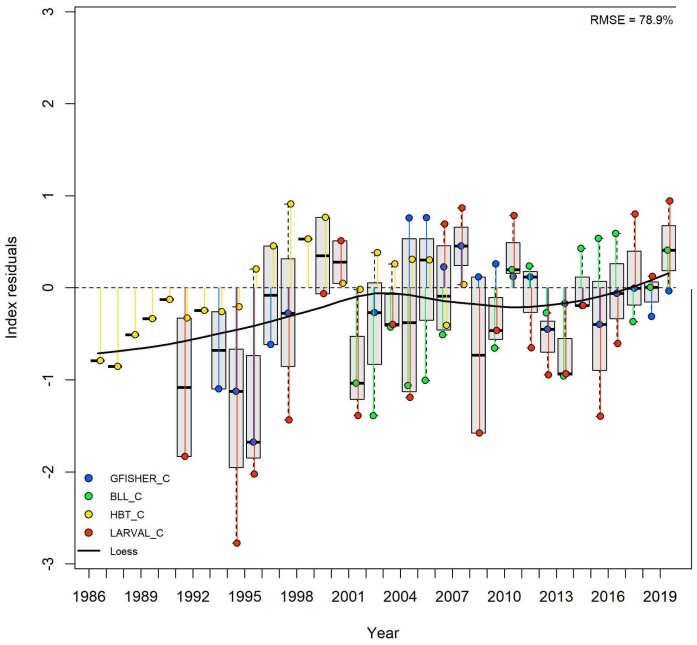
Data considerations and model selection:

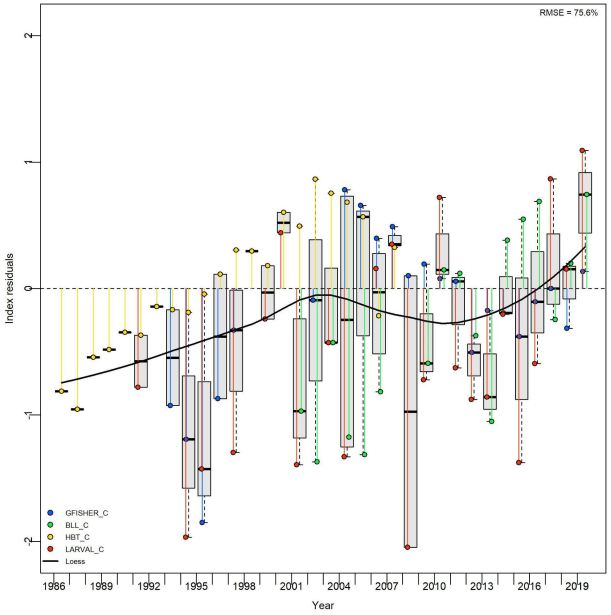
- Improving fit and/or eliminating conflicting data
- Finalize biology and update to spawning stock biomass for reference points
- Great Red Snapper Count
- Diagnostics (runstests, profiles, jack knife, retrospective analyses, etc.)

Discussion/Questions

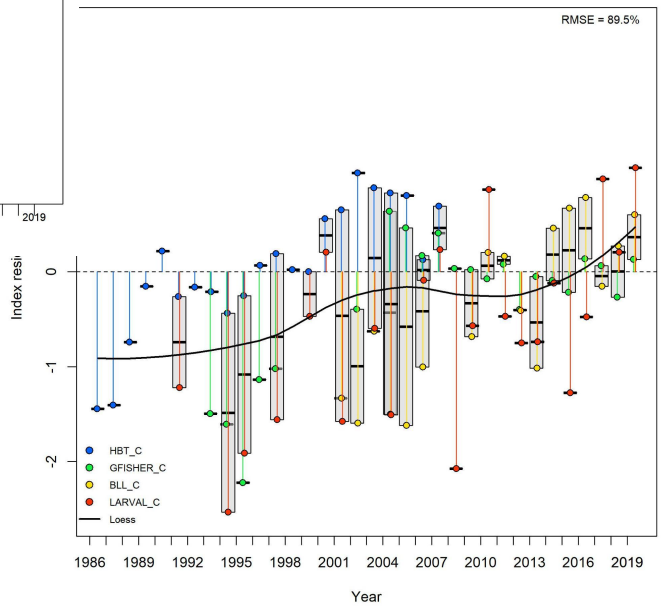
Central 2 plus indices data conflict Hybrid

Length



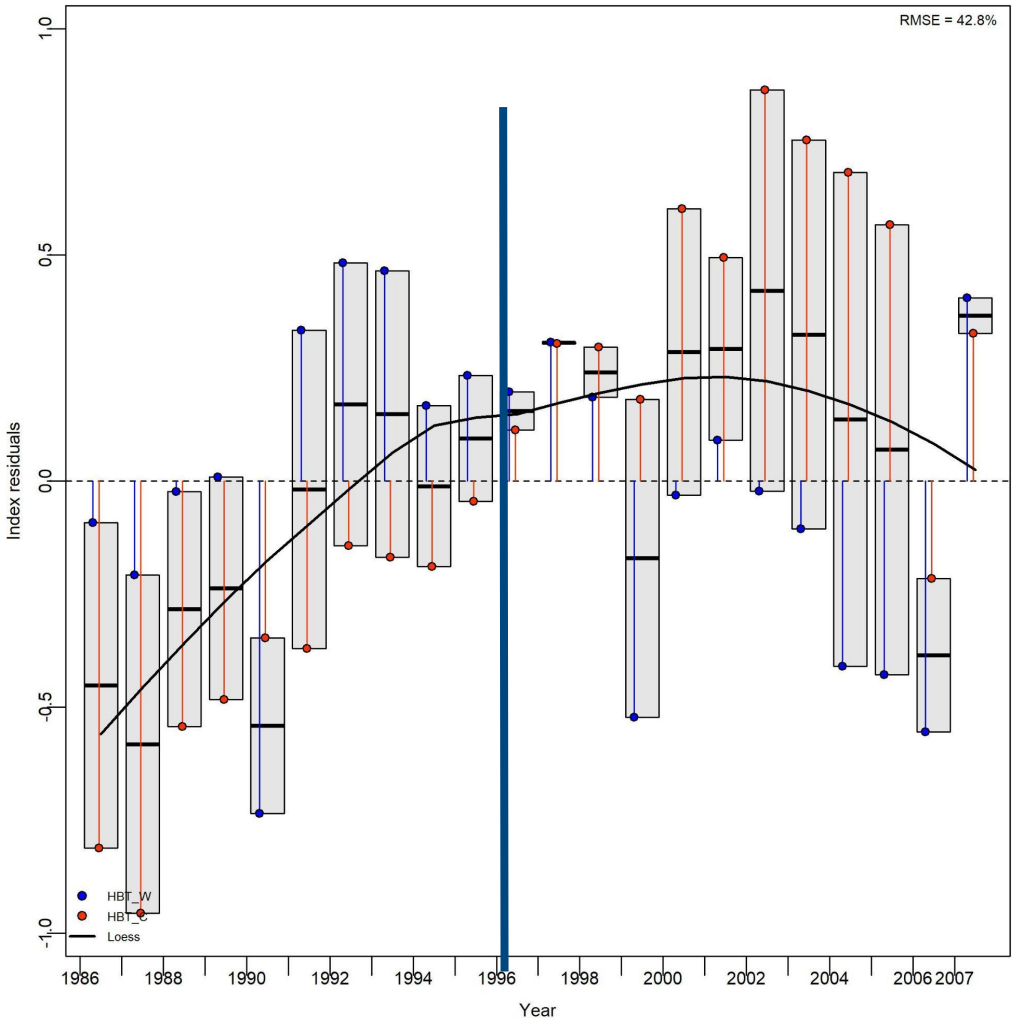


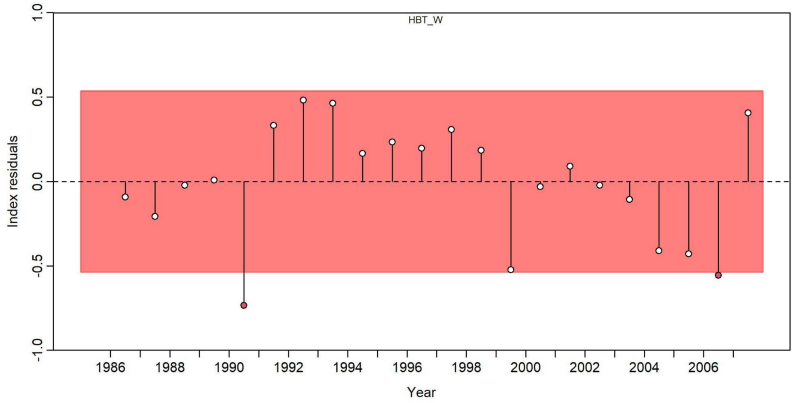
Age

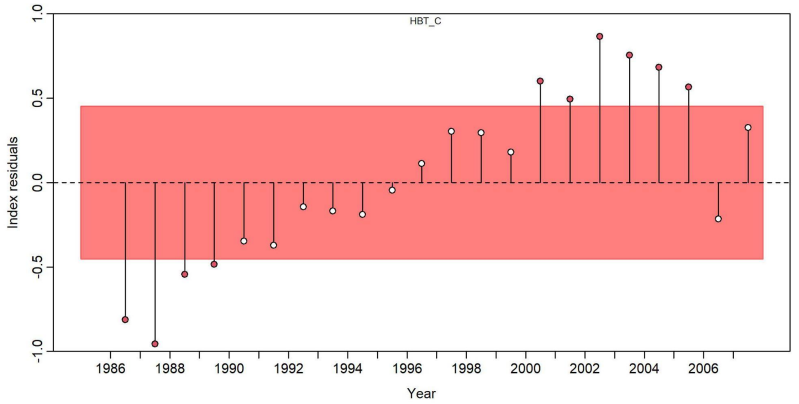


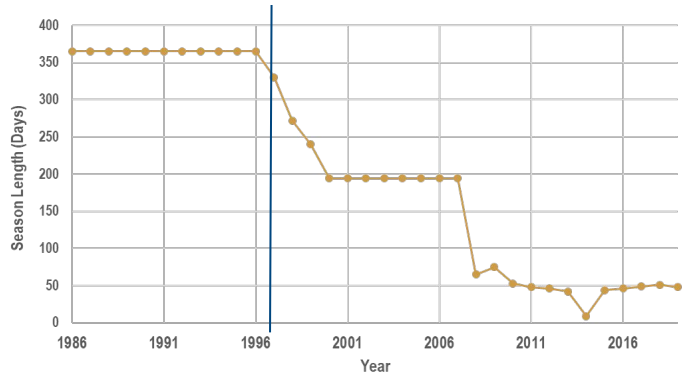
HBT surveys (Hybrid)

HBT surveys are an issue









Hybrid Composition Proposal

	Original Hybrid units based on 1st principles	Native Data Units	Final Hybrid Suggestion based on model exploration
HL	Length	Length and Age	Length (reduces model tension)
LL	Length	Length and Age	Length (reduces model tension)
Video (Gfisher, SEAVID)	Length	Length	Length ?
BLL	Age	Age	Age (because of native units and reasonable fit)
SUM Trawl	Age	Length and Age	Length until native age is available (reasonable fit but possible trade offs and uncertain data)
Fall Trawl	Age	Length and Age	ALK ages until native age is available
HBT	Length	Length and Age	Length
CBT	Length	Length and Age	Length
PRIV	Length	Length and Age	Length
Shrimp	Length	Length	Length