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SEFSC

Gulf Branch
Miami, FL

SEDAR 68 – Gulf Scamp ***(Mycteroperca phenax)***

Research Track
Assessment Review

November 18, 2021

Outline

- Review Workshop summary
- Data review
- Model configuration
- Assessment results and diagnostics
- Considerations for 2022 Operational Assessment

Scamp Grouper: *Mycteroperca phenax*



| Year | 2019 | 2020 | 2021 | 2022 |
|-----------|------------------|---|-------------------------|------------------------|
| January | Appointments | Data Process & Virtual Data Workshop (DW) | Assessment Process (AP) | Operational Assessment |
| February | | | | |
| March | | | | |
| April | | | | |
| May | | | | |
| June | Stock ID Process | | Review Workshop (RW) | |
| July | | | | |
| August | | | | |
| September | | | | |
| October | | | | |
| November | Data Process | | SSC | |
| December | | Assessment Process (AP) | | |

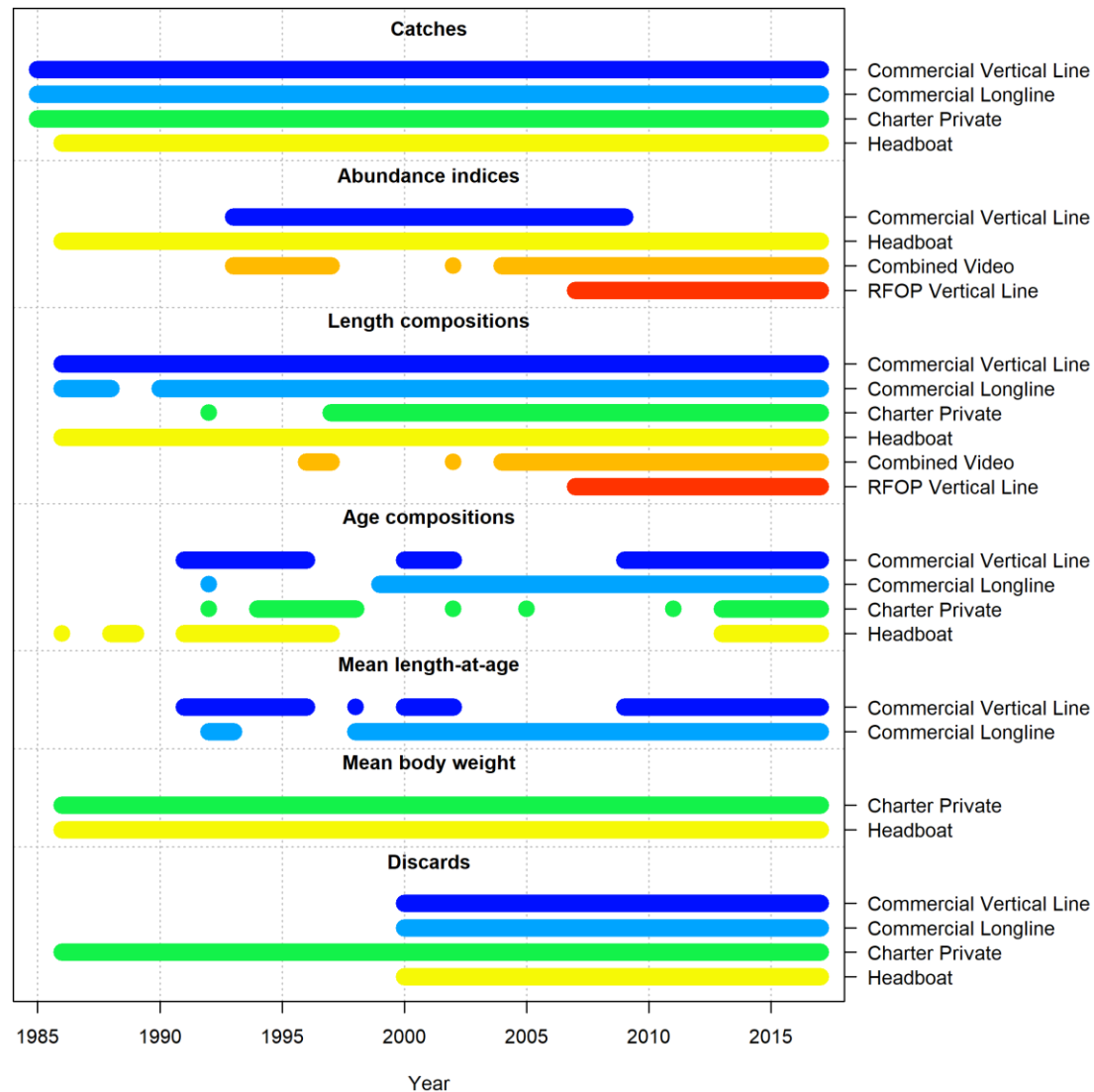
Review Workshop - summary of key issues

| Issue | AP Base | RW Base | Justification |
|---|--|---|--|
| Plus group length bin for observed data | 129 cm Fork Length (FL; largest size in commercial composition data) | 84 cm FL | Max length much larger than von Bertalanffy asymptotic length (L_{∞}) |
| Age-0 M | 0.49 per year | 0.53 per year | Considered too low |
| Recreational landings input* | Weight; compared mean body weight of scamp landed by each recreational fleet as predicted by assessment model to observed mean body weight (SEDAR68-RW-01) | Numbers; fit to mean body weight of scamp landed by each recreational fleet | Recreational surveys consistently sample numbers; include mean weight to guide model predictions |
| Conditional age-at-length data* | Input for commercial fleets | Reverted to nominal age compositions | Concerned over representativeness of data, sampling issues brought up after AP |

Review Workshop - summary of key issues

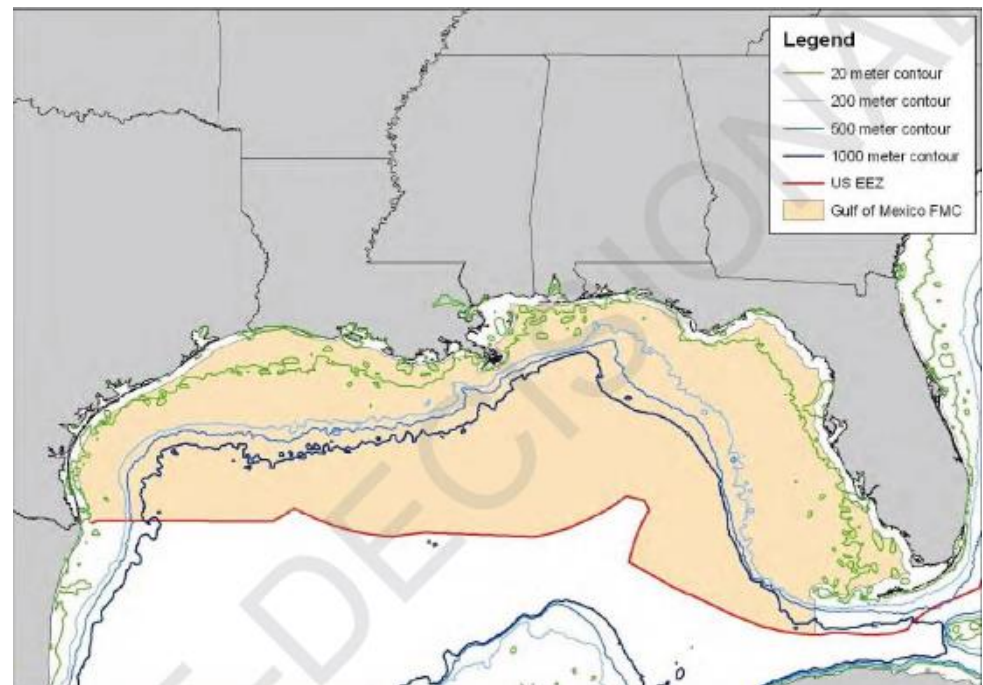
| Issue | AP Base | RW Base | Justification |
|----------------------|---|---|---|
| Dirichlet parameters | Upper bound of 10, all estimated | Upper bound of 5, fix those bounding near 5 | No weighting needed for values > 5; fewer parameters |
| Indices of Abundance | Variance adjustment added to standard error for each index (Francis re-weighting) | Estimate extra standard deviation parameter for each index of abundance | Allow model to downweight poorly fit surveys in the model |
| Retention | Fixed inflection points at size limits for most blocks | Estimate all inflection points | High discards predicted by assessment model in 1990s appeared unrealistic |
| Steepness | Estimated (0.95) using a prior | Fixed at 0.69 | Steepness not estimable, better to fix at a biologically plausible value |

Data Review



Stock ID Workshop (SEDAR68-SID-05)

- Gulf of Mexico stock is separated from the South Atlantic at council boundary line (U.S. Highway 1 in Florida Keys)
 - Found no evidence of biological substructure supporting deviation from management boundary at this time
- Include yellowmouth grouper
 - Limited data (SEDAR49)



Gulf scamp regulations

Com quota closures:

- 11/25-12/31/2004
- 10/10-12/31/2005

Rec seasonal closures:

- 11/1-12/31/2005
- 2/1-3/31/2010 (-2013)
- 2/1-3/31/2014+
(seaward of 20 fathoms)

Florida 20" TL

Florida 16" TL

Federal 16" TL

5

4

3

Florida 20" TL

Florida 16" TL

Federal 16" TL

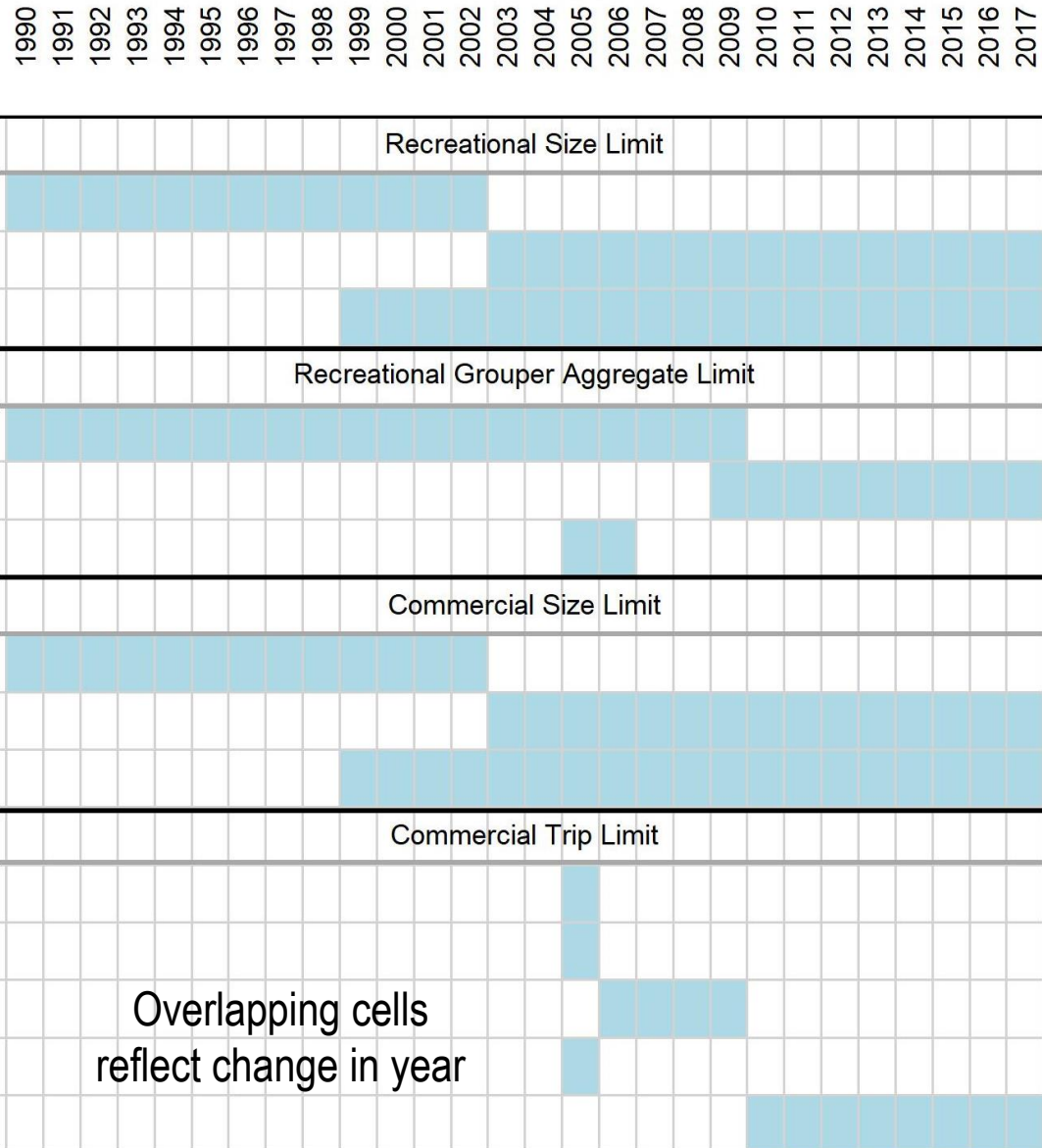
10,000 lbs gw (D&SWG)

7,500 lbs gw (D&SWG)

6,000 lbs gw (D&SWG)

5,500 lbs gw (SWG)

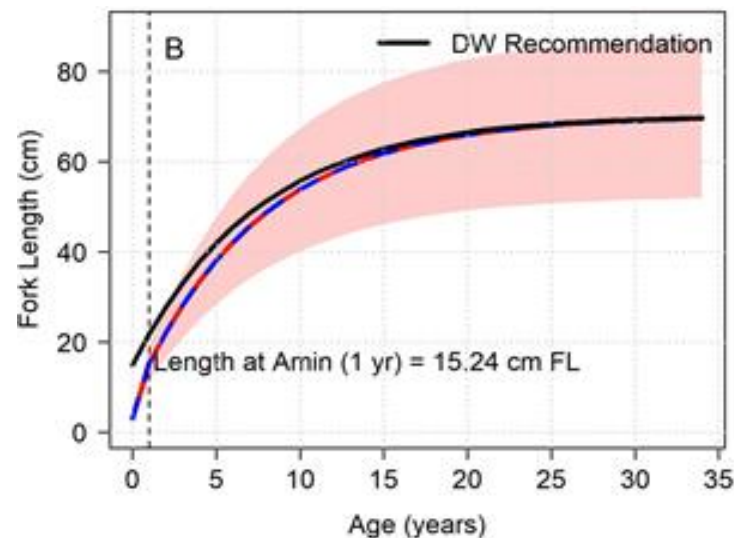
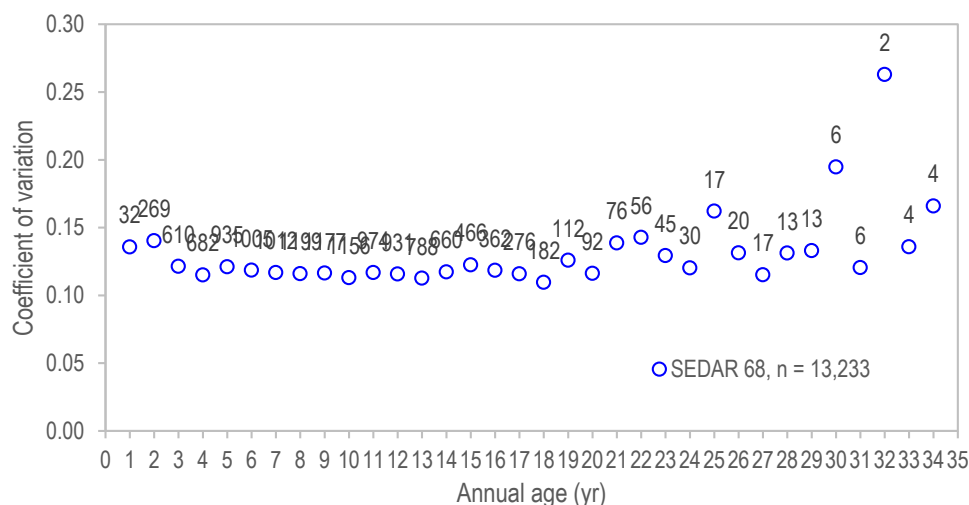
Individual Fishing Quota



Age and growth

- Von B: $l_a = l_{\infty}(1 - e^{-K(a-t_0)})$
- Size-modified growth model (both sexes) takes into account the non-random sampling due to minimum size restrictions (Diaz et al. 2004); growth curve fixed in Stock Synthesis
- Constant CV on mean size-at-age used

| Parameter | SEDAR 68 |
|--------------|-----------|
| L_{∞} | 70.222 cm |
| K | 0.134 |
| CV | 0.130 |



Age and growth concerns*

- RW Panel concerned over the discrepancy between: $L_{\infty} = 70.222$ cm FL

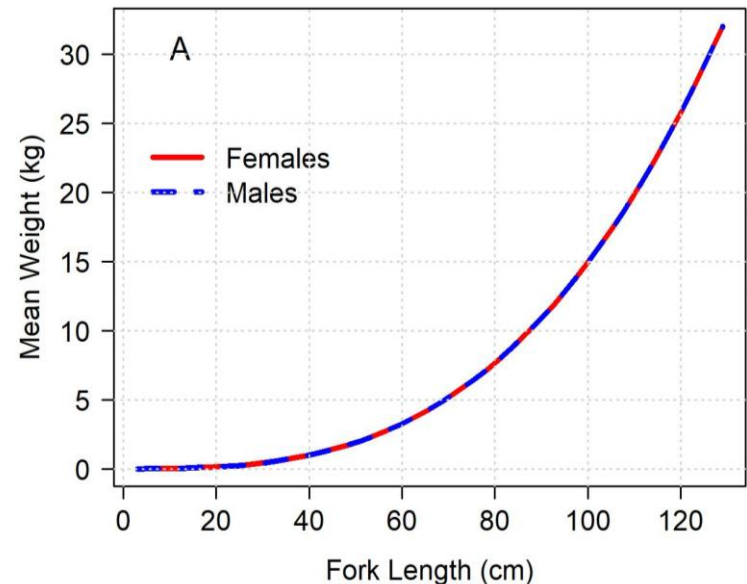
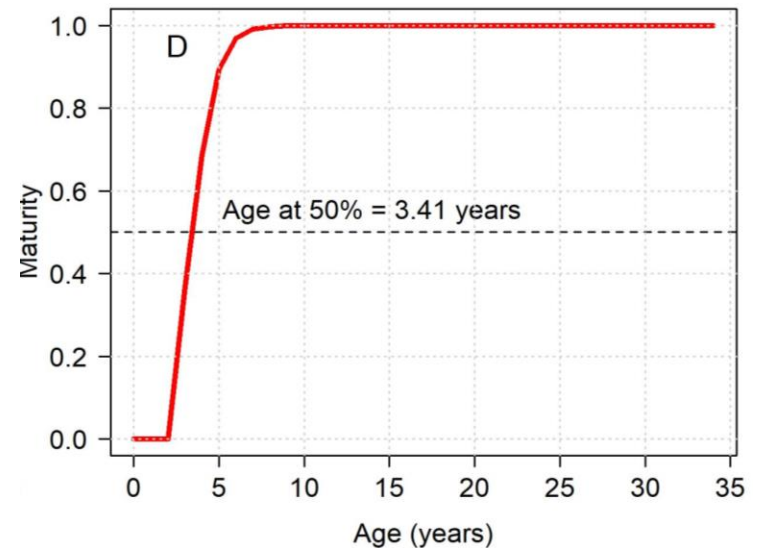
| Data Source | Mean (Range) | FL \geq 84 cm FL |
|-------------------|-------------------------|--------------------|
| Growth curve data | 52.9 cm FL (15.7 – 107) | 0.18% |

- Maximum length = 129 cm FL (commercial composition)

| Length Composition | Discards \geq 84 cm FL | Landings \geq 84 cm FL |
|------------------------------|--------------------------|--------------------------|
| Commercial Vertical Line | None | 0.2% |
| Commercial Longline | None | 0.07% |
| Recreational Charter Private | None | 0.5% |
| Headboat | None | 0.5% |
| Video Survey | None (12 – 84 cm FL) | |
| RFOP Vertical Line Survey | None (21 – 81 cm FL) | |

Maturity and meristics

- Logit fit revealed the best fit for female age at functional maturity
 - First age mature at 3 years
- Length-weight relationship units:
 - Centimeters (cm) fork length
 - Kilograms (kg) gutted weight
- Both relationships fixed in assessment model



Hermaphroditism in Stock Synthesis

- Requires the transition rate of females to males
 - Need the Gaussian parameters (μ , σ) for the probability of switching to male which provides the observed (fitted) proportions male
- Minimize the sums of squares (SS) between:

- **probability of transitioning** =
$$\frac{NM_{age}}{NM_{age} + NF_{age}}$$

$$NM_{age} = NM_{age-1} + NF_{age-1} \times prob.\,transition_{age-1}$$

$$NF_{age} = NF_{age-1} \times (1 - prob.\,transition_{age-1})$$

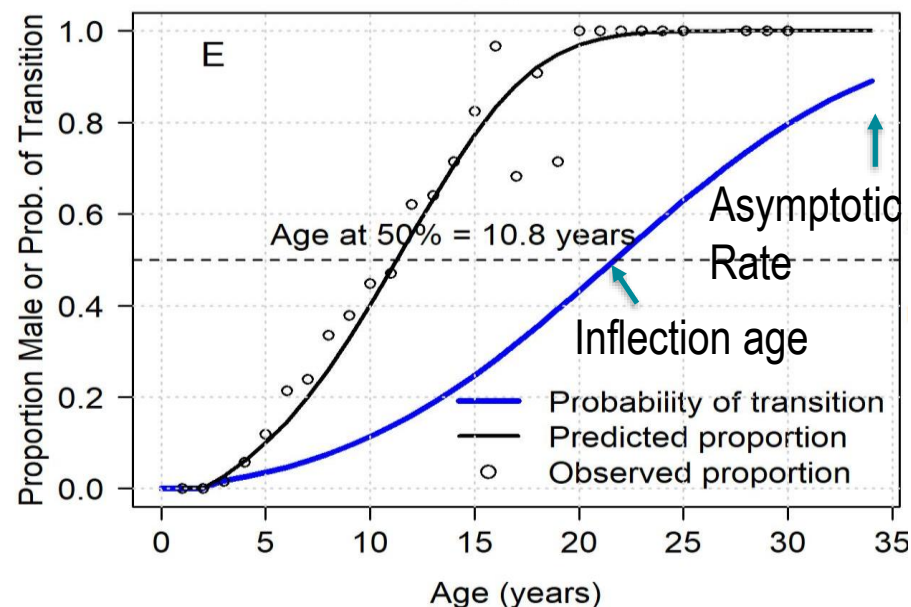
$prob.\,transition_{age}$ = normal distribution function with μ , σ

- **Fitted proportion male-at-age**

Hermaphroditism for Scamp

- Two gender model
- Transition starts at age-3 (youngest male observed)
 - New feature added into SS to specify first age for transition

| Parameter | Value | Status |
|----------------------|--------|--------|
| Inflection Age (mu) | 21.525 | Fixed |
| StDev in Age (sigma) | 10.141 | Fixed |
| Asymptotic Rate | 0.891 | Fixed |

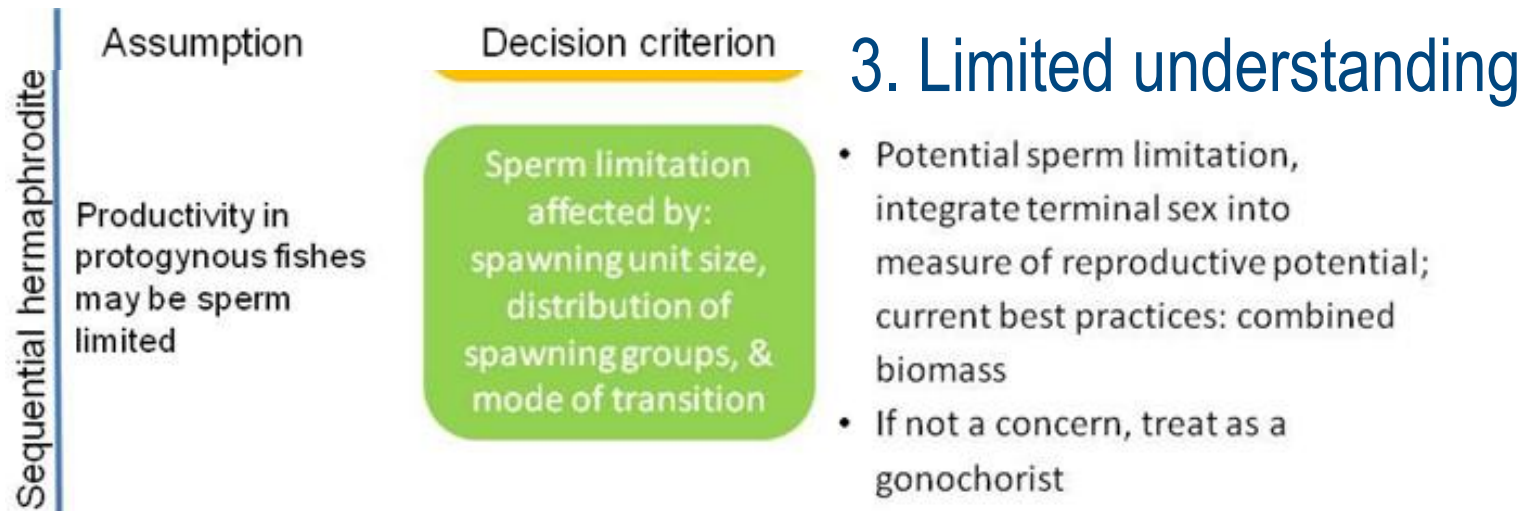


Total $N = 1,934$

Female $N = 1,237$ (64%) Male $N = 697$ (36%)

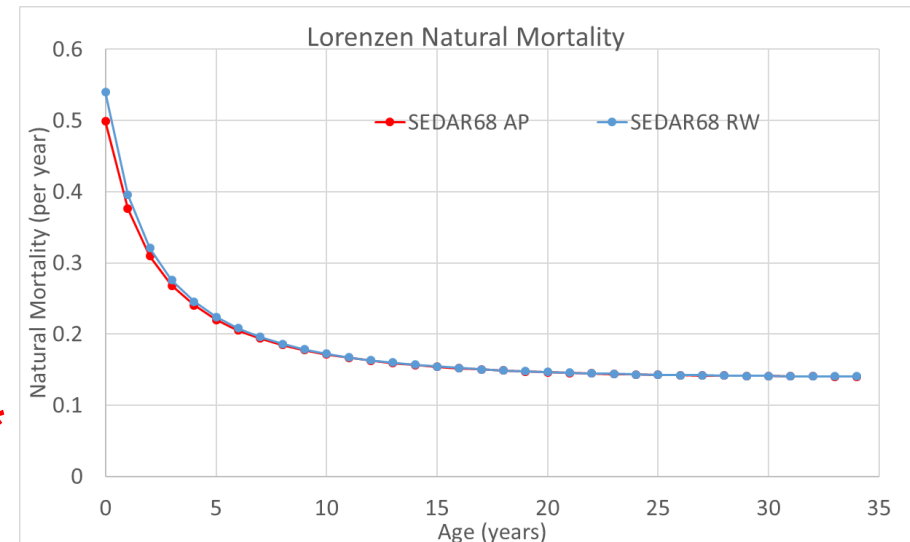
Measure of reproductive potential

- In absence of fecundity estimates, DW recommended male and female combined SSB (in metric tons):
 1. Scamp do not exhibit a 1:1 sex ratio
 - 18% (Coleman et al. 1996) – 37% (SEDAR68-DW25)
 2. Significant differences between size and age at sex exist



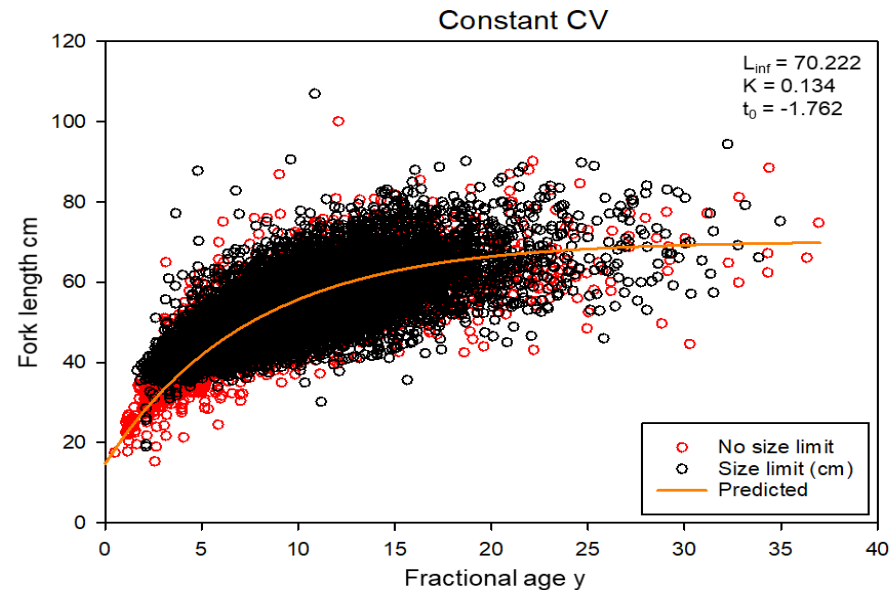
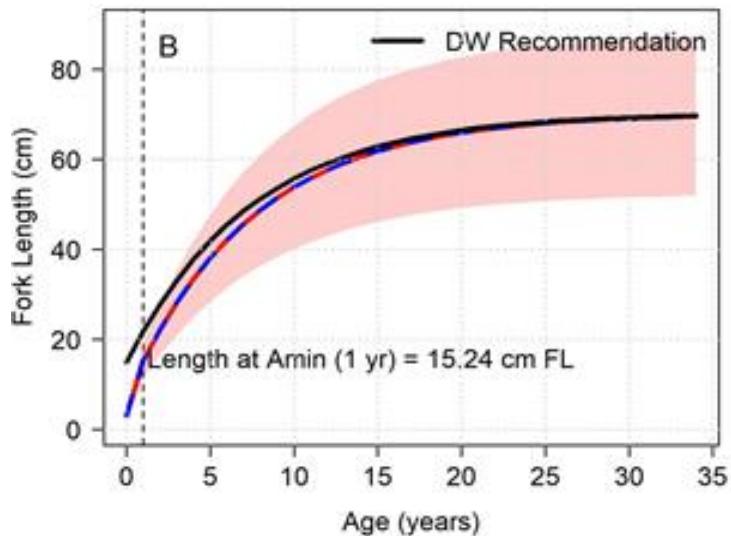
Age-specific natural mortality – Lorenzen

- Used Lorenzen (2000) estimator which assumes a size-dependent mortality schedule in which instantaneous mortality rate at age is inversely proportional to length at age
- Input as a fixed vector
- Male and female assumed identical
- Adjusted to account for peak spawning in mid-April*
 - Removed during RW, but further review supports the approach presented by AP



Age/growth and natural mortality*

- Difference between externally estimated Lorenzen curve and the curve estimated within Stock Synthesis due to growth curve



| FRACTIONAL_AGE | FINAL_FL_CM | SPECIES | SOURCE | COUNTY LANDED | GEAR_NAME |
|----------------|-------------|-----------------------------|----------|---------------|--|
| 2.5763 | 15.3 | Mycteroperca interstitialis | MSLAB | NE GOM | Trawl |
| 0.5 | 17.5 | Mycteroperca phenax | FWRI-FIM | | 12.8-m Trawl (SEAMap Cruises - SA and GOM) |
| 1.17 | 17.8 | Mycteroperca phenax | FWRI-FIM | | 12.8-m Trawl (SEAMap Cruises - SA and GOM) |
| 2.6448 | 19.0 | Mycteroperca phenax | PCLAB | ELBOW REEF | Hand-Line |
| 2.1273 | 19.0 | Mycteroperca phenax | PCLAB | BAY | Spear |
| 1.6454 | 19.6 | Mycteroperca phenax | PCLAB | JOHN'S 248 | Hand-Line |
| 2.1273 | 19.6 | Mycteroperca phenax | PCLAB | BAY | Spear |

Discard mortality estimates

- Bootstrapped predictions following Pulver (2017) approach using:
 - Reef Fish Observer Program data:

| Region | Gear | Mean Depth (m) | Immediate – Not Vented | Immediate –Vented | Delayed Mortality | Total Discard Mortality |
|--------|------|----------------|------------------------|-------------------|-------------------|-------------------------|
| GoM | BLL | 72.1 | 53% (48-59%) | 47% (42-53%) | 32% (19-47%) | 68% (57-75%) |
| GoM | VL | 54.1 | 29% (24-34%) | 23% (18-27%) | 26% (16-37%) | 47% (40-51%) |

- Headboat data:
 - Headboat: 26% (16-40%)
 - Charter-Private assumed similar by Discard Mortality WG because of similar depths fished

*Start year of 1986 because of high uncertainty pre-1986

Commercial landings (gutted weight)

| Data Source | Years | Notes |
|--|-----------|-----------------|
| Annual Landings System (ALS; SEFSC) | 1986-2017 | Texas - Alabama |
| Florida Trip Ticket Program (ACCSP) | 1986-2017 | West Florida |
| Individual Fishing Quota (IFQ) Program | 2010-2017 | All states |

Uncertainty (log-scale SE):

- **1986*-2009:** 0.05 following guidelines from South Atlantic for Florida
- **2010-2017:** 0.01 due to implementation of IFQ

*Start year of 1986 because of high uncertainty pre-1986

Recreational landings (numbers or weight)

| Data Source | Years | Notes |
|--|-----------|---|
| Marine Recreational Information Program (MRIP) | 1986-2017 | Continuous time series; uses Fishing Effort Survey and includes the Access Point Angler Intercept Survey adjustment; excludes shore mode and Monroe County; annual CVs available (mean 0.46, range 0.21 – 0.89); SEDAR 68-DW-13 |
| Louisiana Creel Survey | 2014-2017 | Survey began in 2014; private/shore reported together; provided in native units (i.e., not calibrated to MRIP) |
| Texas Parks and Wildlife Department (TPWD) | 1986-2017 | Survey began in 1983; details on data source provided in SEDAR70-WP-03 |
| Southeast Region Headboat Survey (SRHS) | 1986-2017 | Census of logbooks described in Fitzpatrick et al. (2017); annual CVs available (mean 0.03 , range 0 – 0.10); SEDAR68-DW-31 |

Uncertainty (log-scale SE):

- **1986*-2017:** 0.3 for both fleets but actual CVs used in AP sensitivity run

Inclusion of recreational landings*

- Traditionally input as numbers of fish in Gulf assessments
 - Recreational surveys designed to sample numbers, weight information incomplete (Detloff and Matter 2019)
 - Weight estimation approach developed following implementation of annual catch limits for use by management (Matter and Turner 2010)
 - Multiplies numbers by average weights by strata

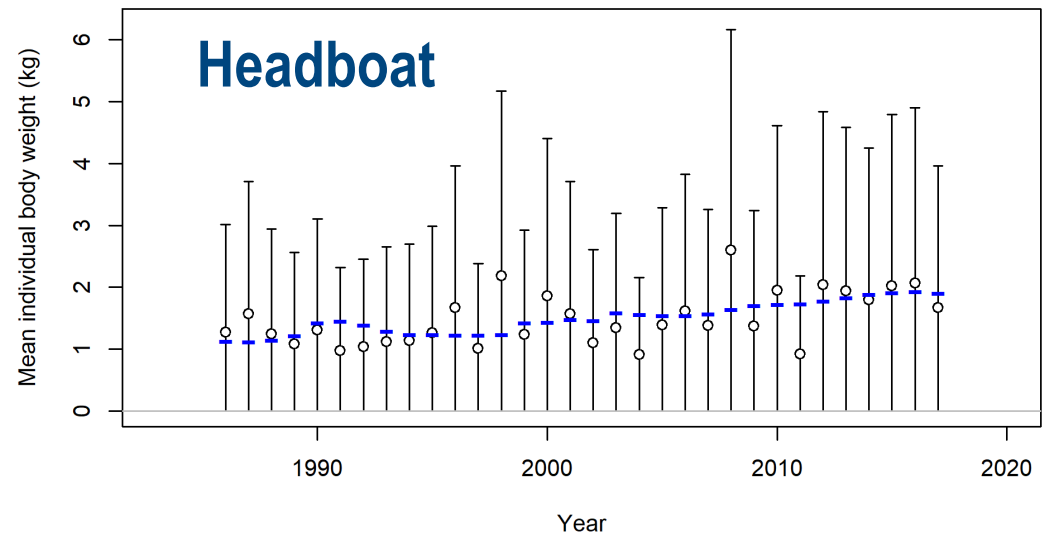
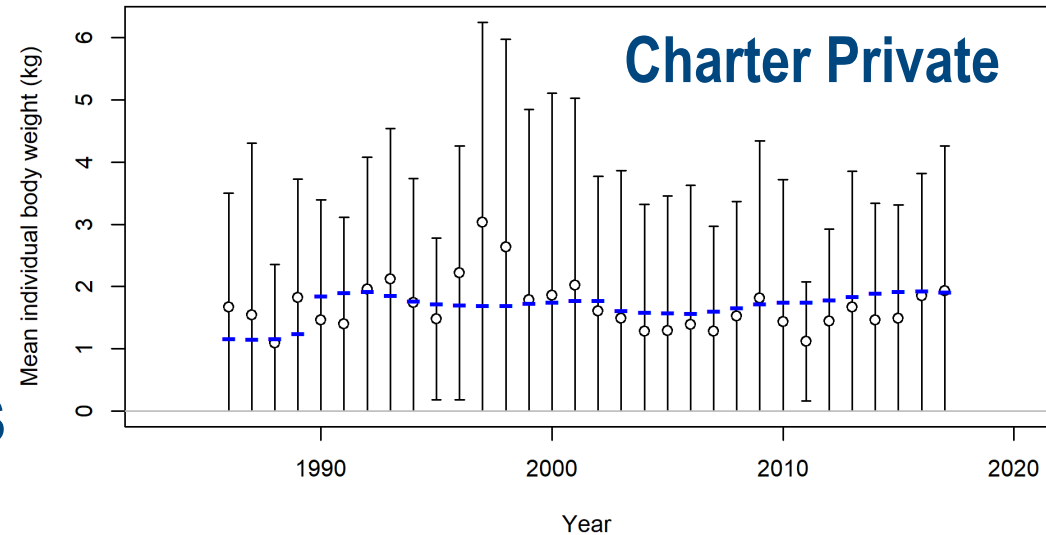
| Species | Region | Year | State | Mode | Wave | Area Fished |
|---------|--------|------|-------|------|------|-------------|
|---------|--------|------|-------|------|------|-------------|

Resolution: Coarsest  Finest

Mean body weight of recreational landings*

- Input recreational landings in numbers
- Fit to mean body weight from recreational surveys
 - Observed - raw data observations
 - Derived - ACL monitoring

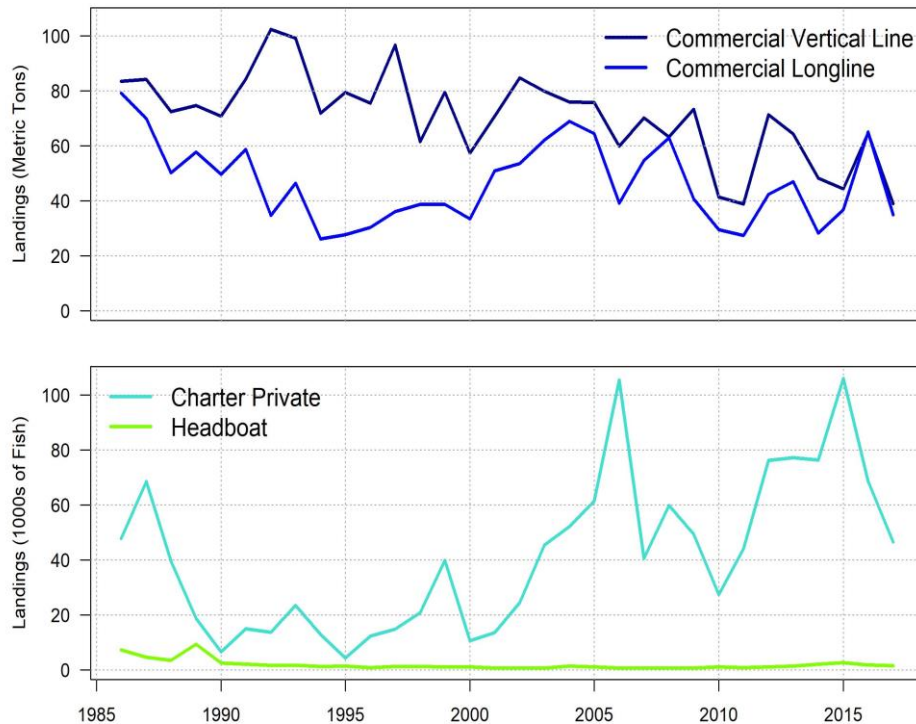
$$MW_{year} = \frac{Weight\ estimate_{year}}{Numbers\ estimate_{year}}$$



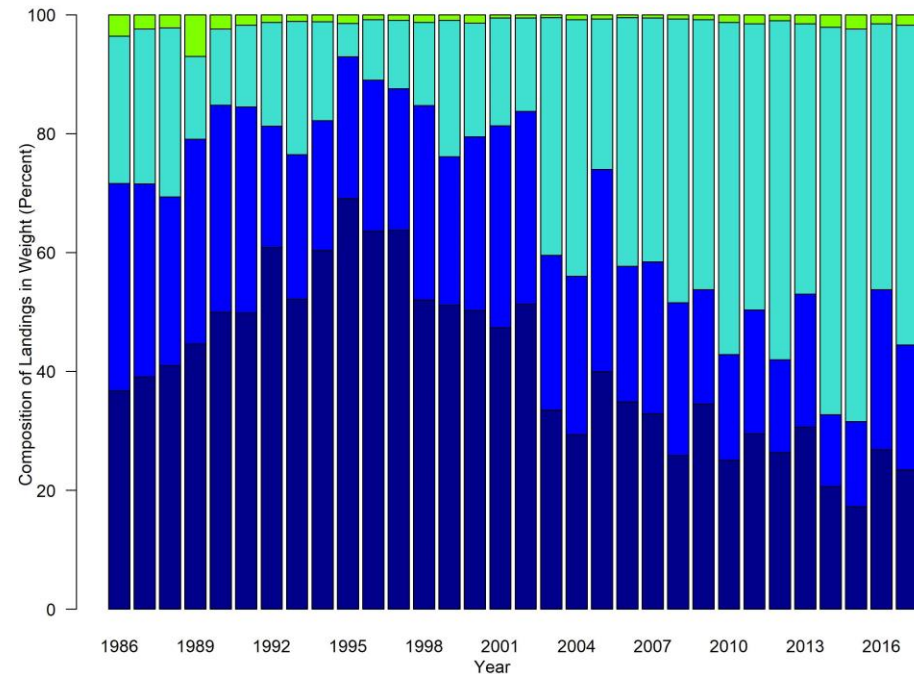
Landings comparison

- Generally dominated by commercial fleets, but recreational Charter Private landings have increased in recent years

Input landings



Assessment predicted landings



Commercial total discards*

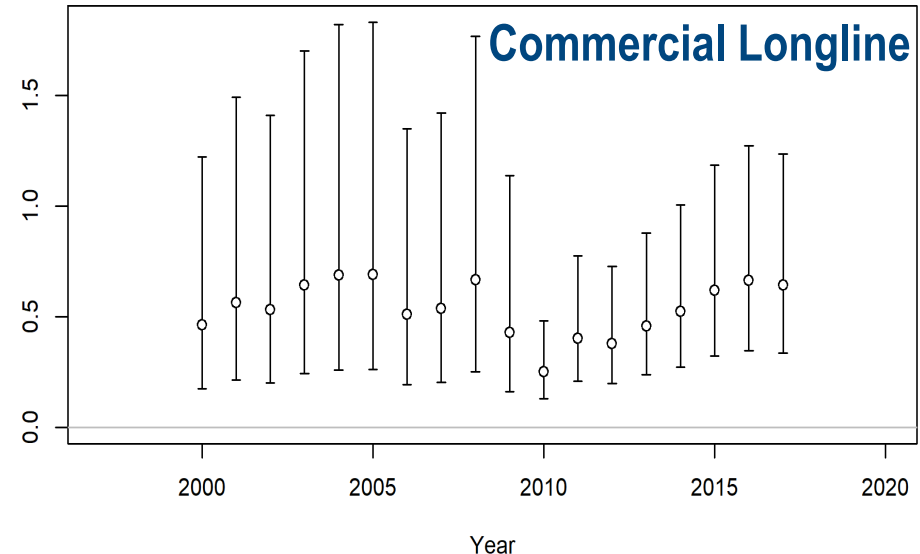
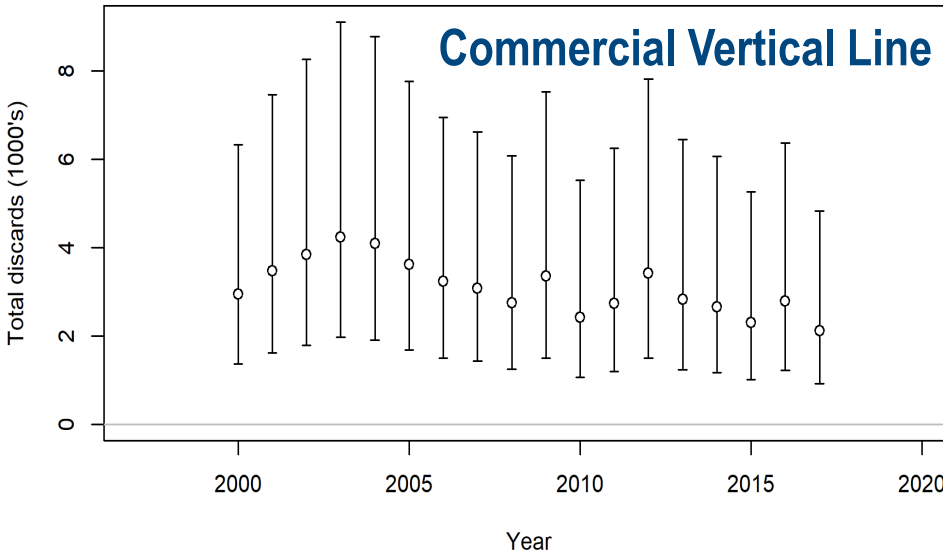
*before applying
discard mortality

- Catch per unit effort (CPUE) expansion approach:

$$\text{total Catch} = \frac{\text{Catch}}{\text{Effort}} \times \text{Total Effort}$$

Observer Program

Commercial logbooks

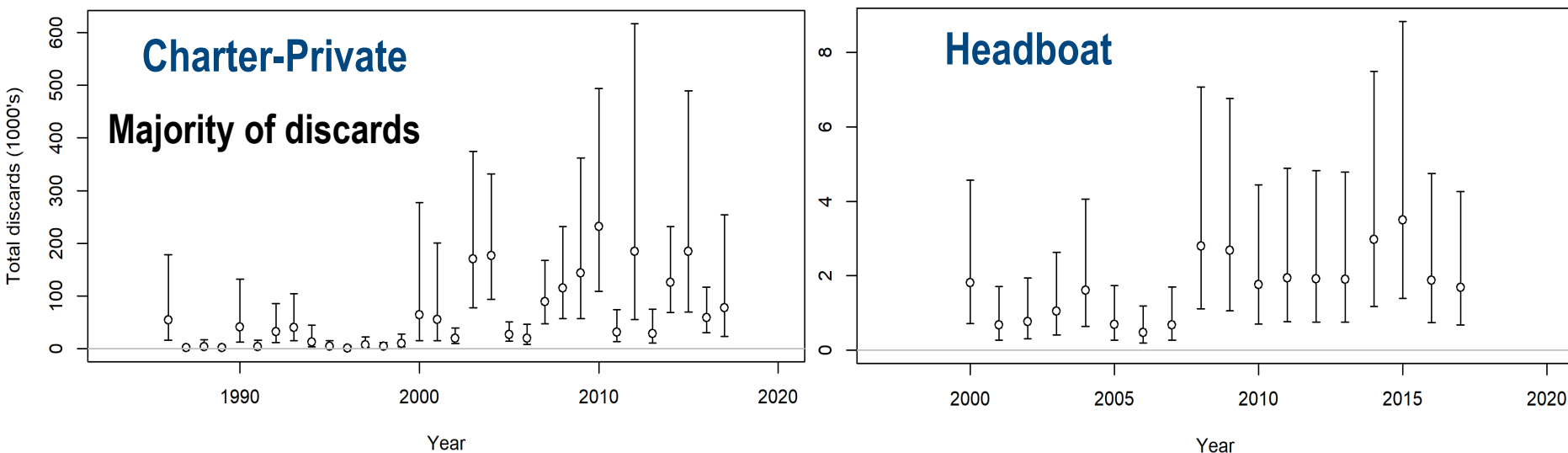


Assuming log-normal distribution and using uncertainty estimates as provided

Recreational total discards*

*before applying
discard mortality

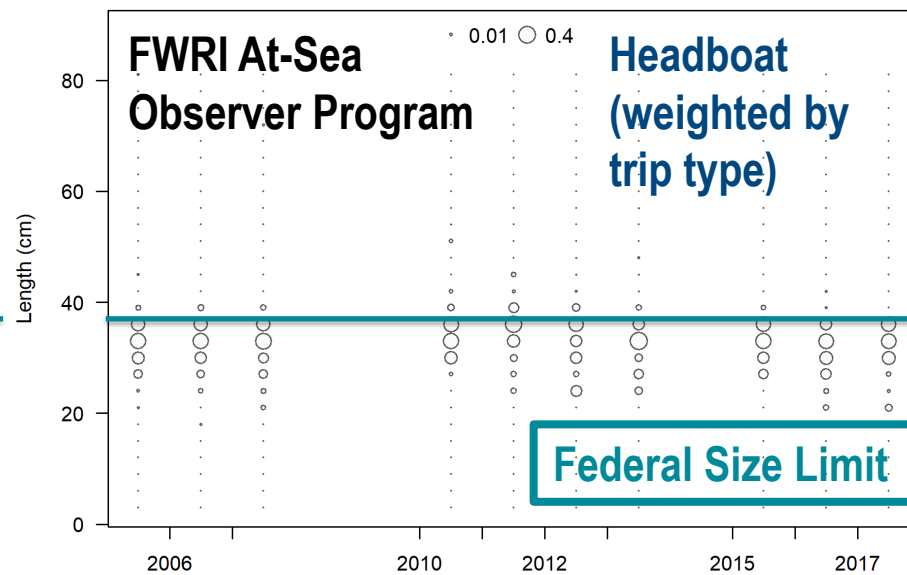
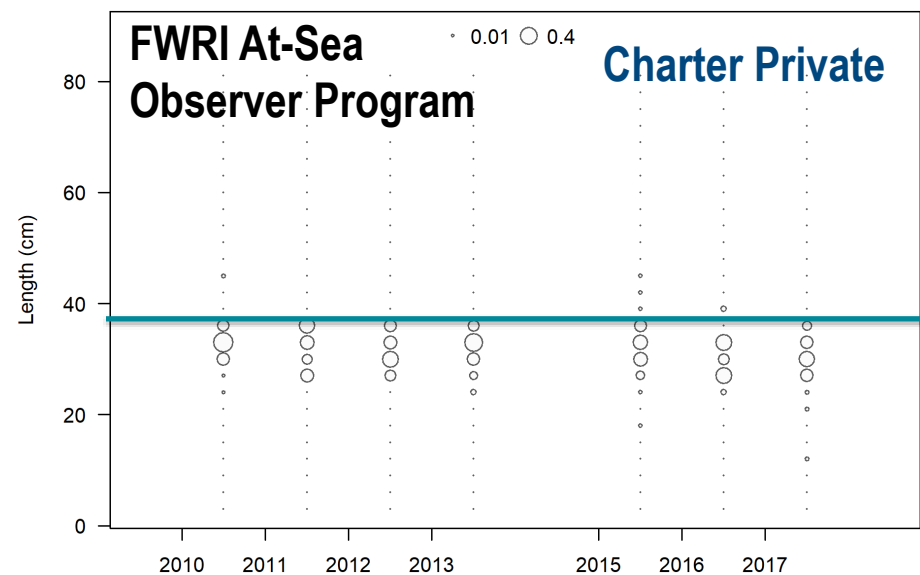
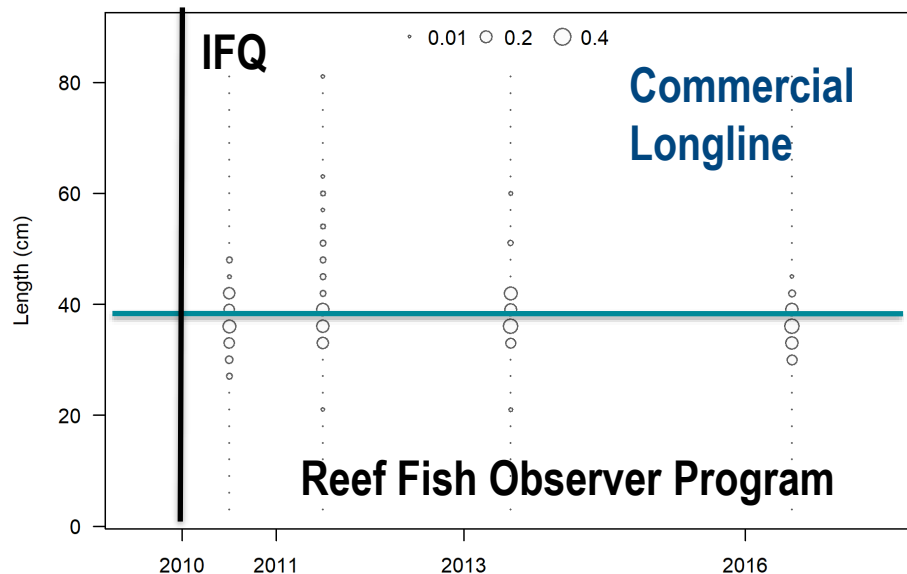
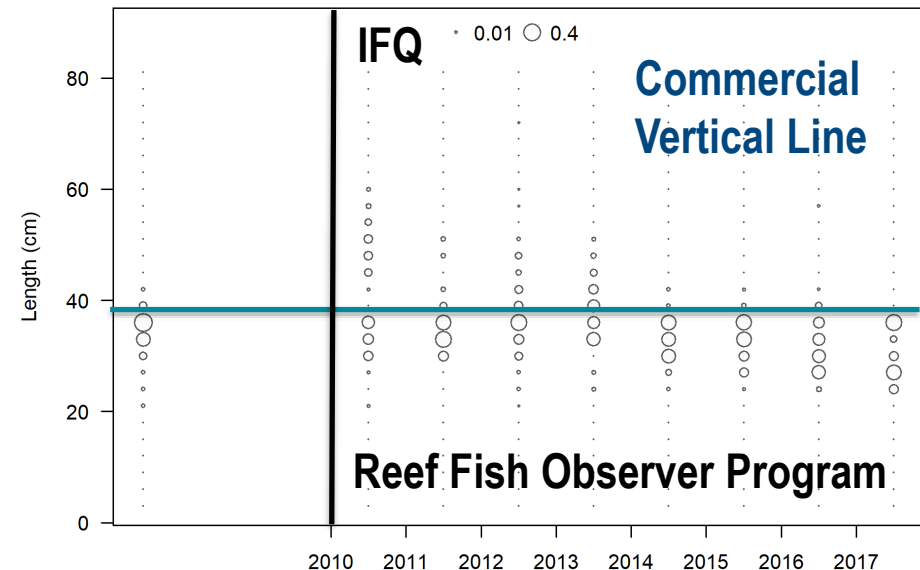
| Data Source | Notes |
|-------------|---|
| MRIP | Self-reported discards, High CVs (mean 0.57, range: 0.32-1; SEDAR68-DW-09) |
| LA Creel | Not reported; MRIP discards in LA prior to 2014 sparse, assumed negligible |
| TPWD | Not reported; rarely landed in TX, assumed negligible |
| SRHS | Self-reported 2004-2018; 2000-2003 estimated using proxy of mean SRHS discard ratio (2004-2018); no error estimates provided (assumed CV = 0.5) |



Assuming log-normal distribution and using uncertainty estimates as provided

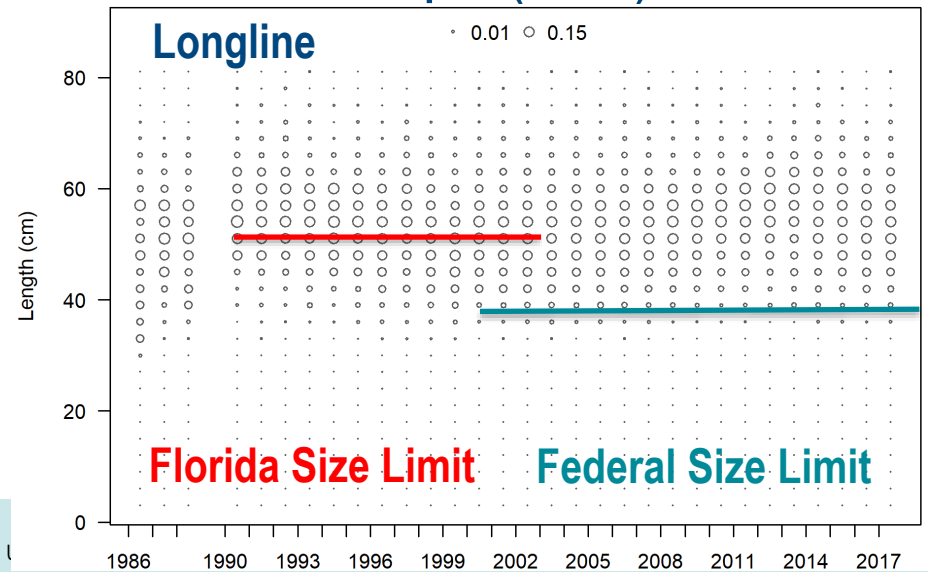
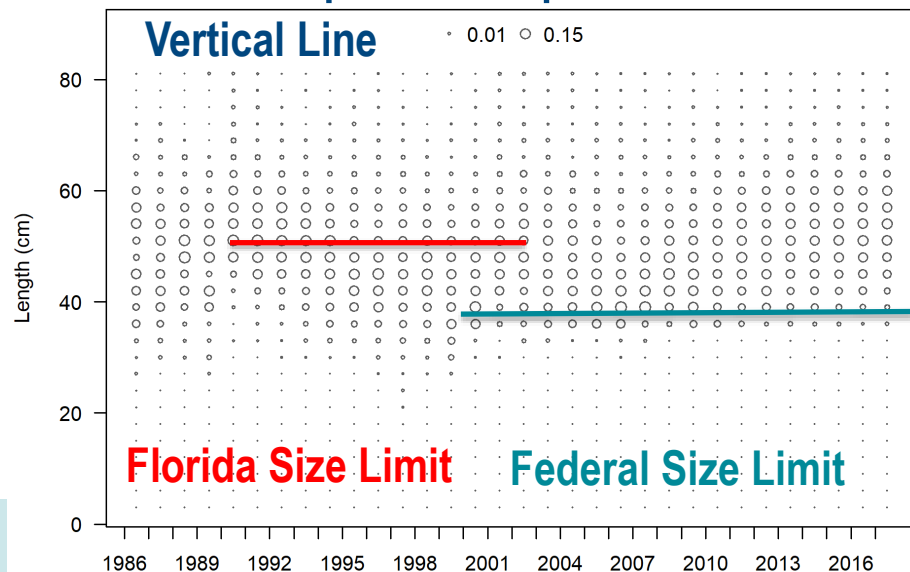
Length compositions - discards

Input sample sizes are the number of trips (≥ 10)



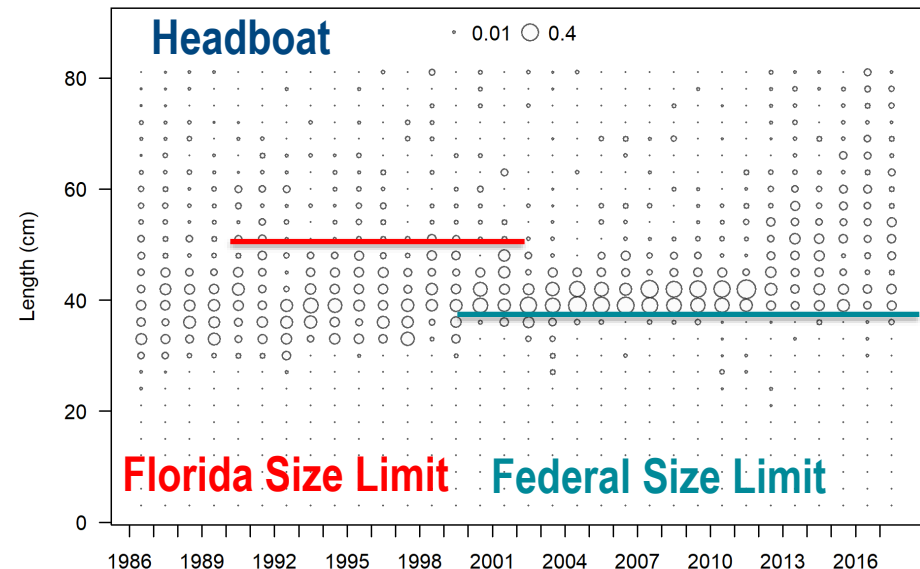
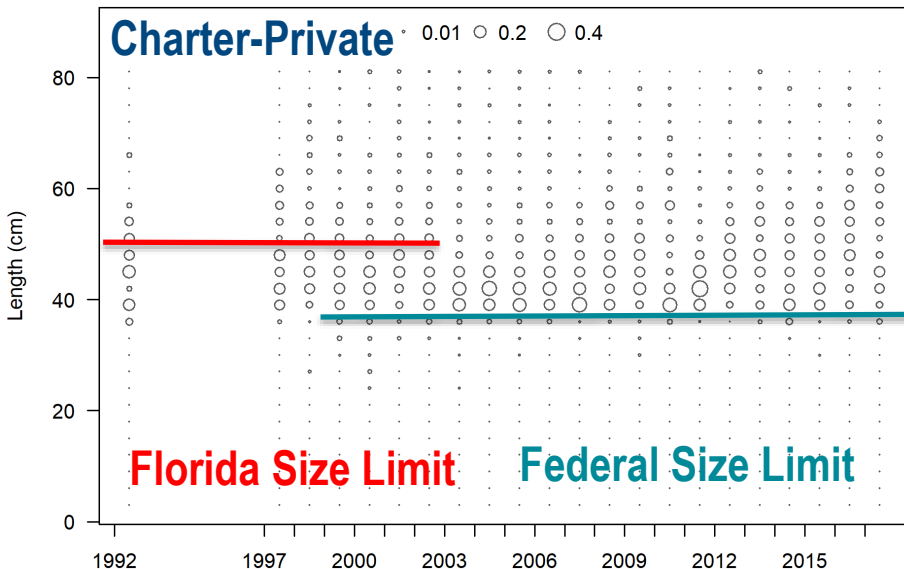
Commercial length compositions - landings

- Data were obtained from the trip intercept program (TIP) and GulfFIN and aggregated into three major sub-regions (SE, NE, and West Gulf)
 - Weighted based on the distribution of landings estimates among sub-regions (SEDAR68-AW-01)
 - Input sample sizes are the number of trips (≥ 10)



Recreational length compositions - landings

- Data were obtained from MRIP (formerly MRFSS), TPWD, SRHS and GulfFIN
 - Weighted based on the distribution of landings estimates among sub-regions not feasible (SEDAR68-AW-01)
 - Input sample sizes are the number of trips (≥ 10)

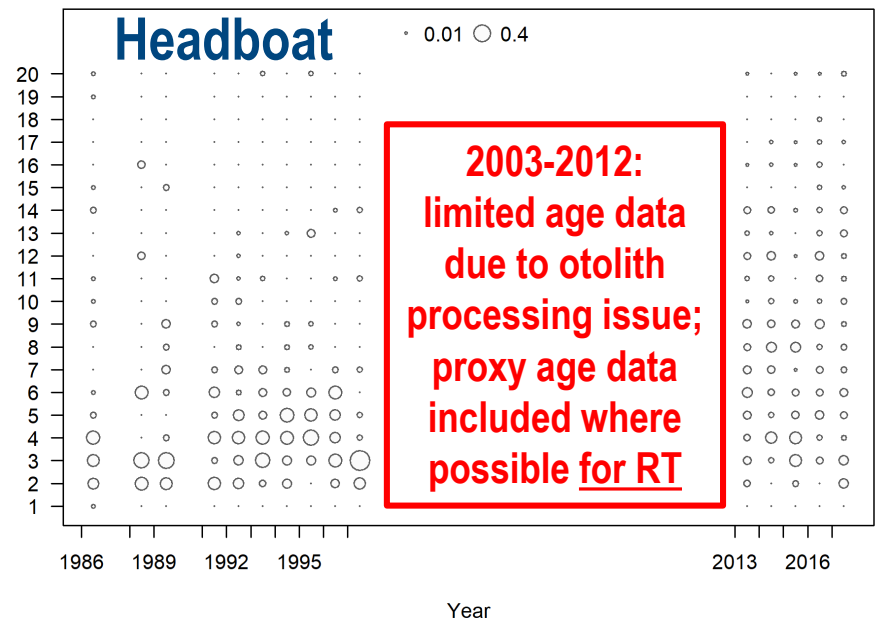
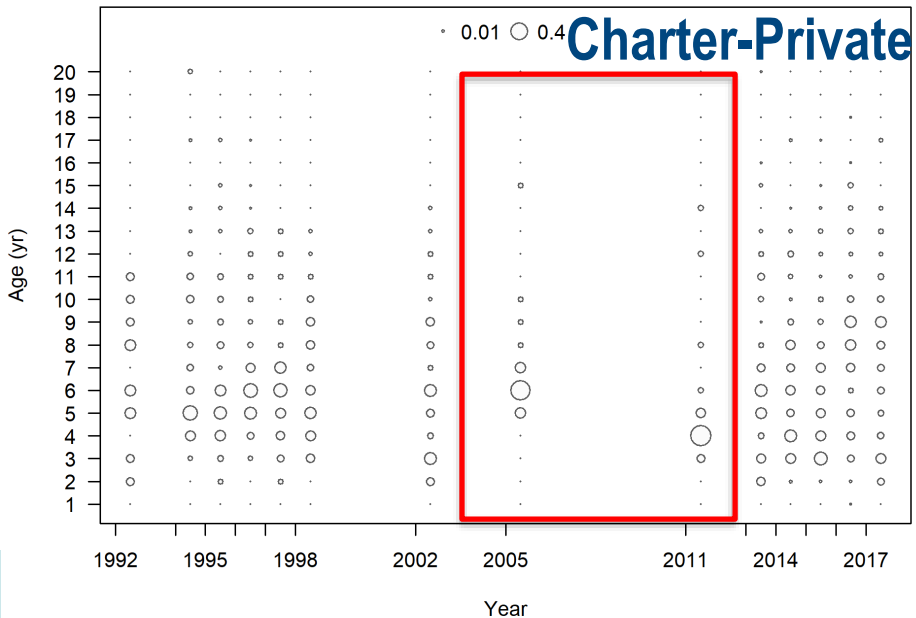
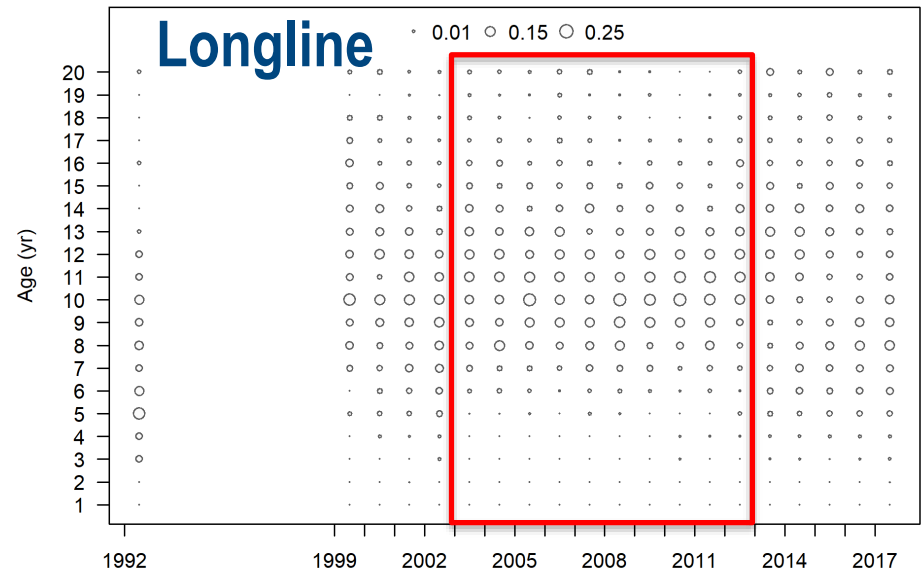
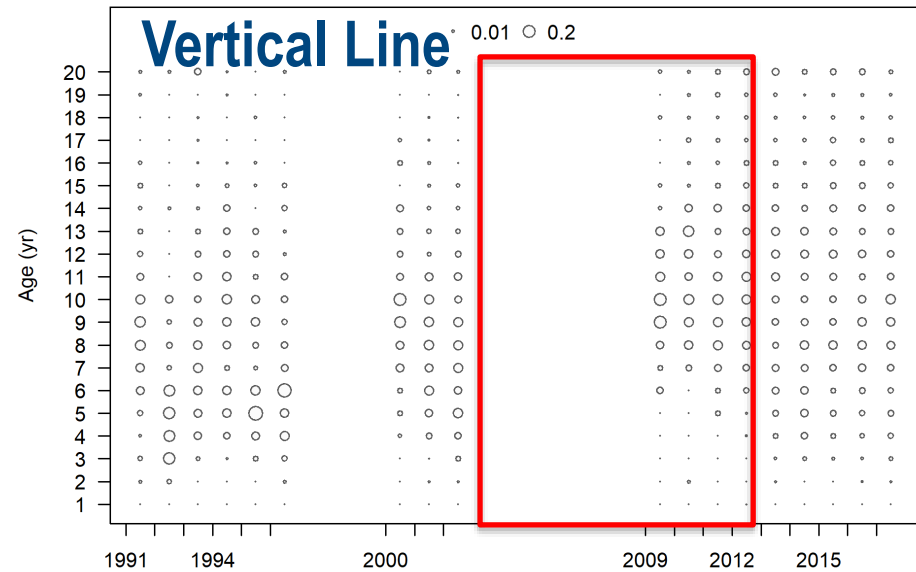


Commercial age data*

- ADT proposed:
 - Including length compositions of both discarded and retained scamp
 - Using length-based selectivity for all fleets
 - Including conditional age-at-length for commercial fleets and nominal age compositions for recreational fleets
- Post-AP, concerns over representativeness of conditional age-at-length data
 - Similar issue discussed during SEDAR 72 (Gulf gag grouper)

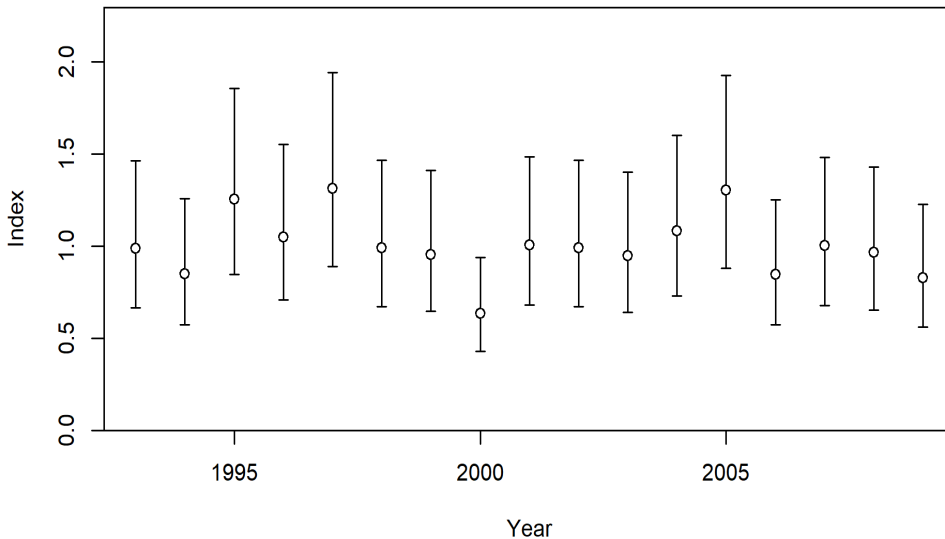
Nominal age composition

Input sample sizes are the number of trips (≥ 10)

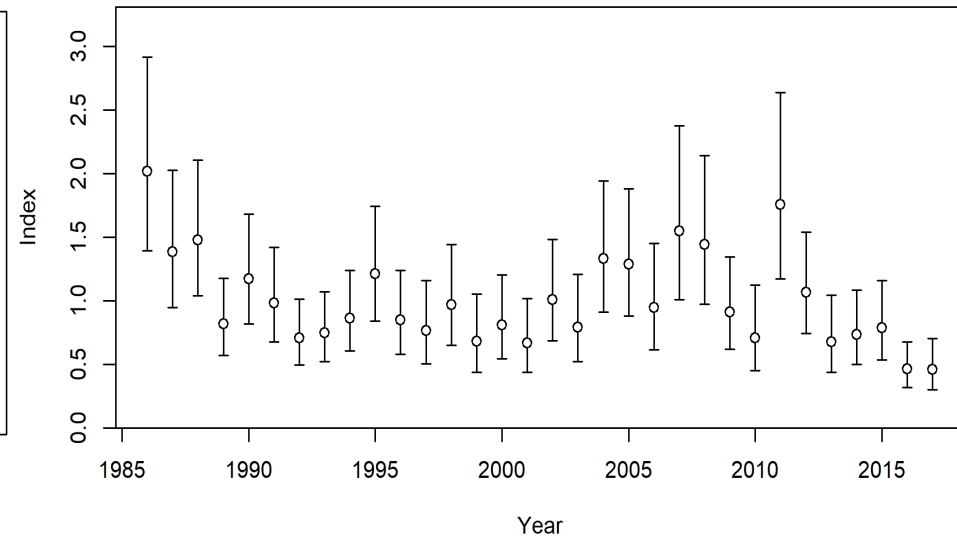


Indices of relative abundance (fishery CPUE)

Pre-IFQ Commercial Vertical Line



Headboat

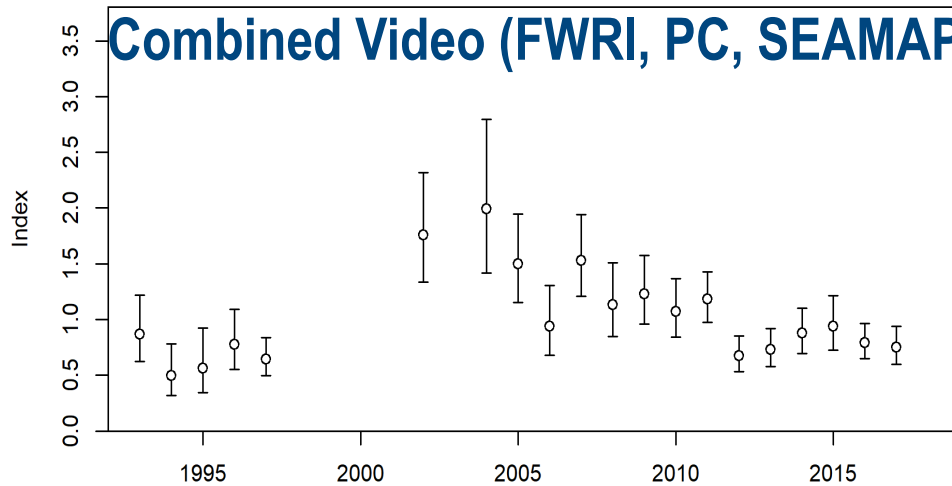


- CV converted to SE: $\log_e(SE) = \sqrt{(\log_e(1 + CV^2))}$
- Standard errors for each CPUE index scaled to a common mean of 0.2 (sensu Francis et al. 2003)
 - Same scale of uncertainty

Surveys

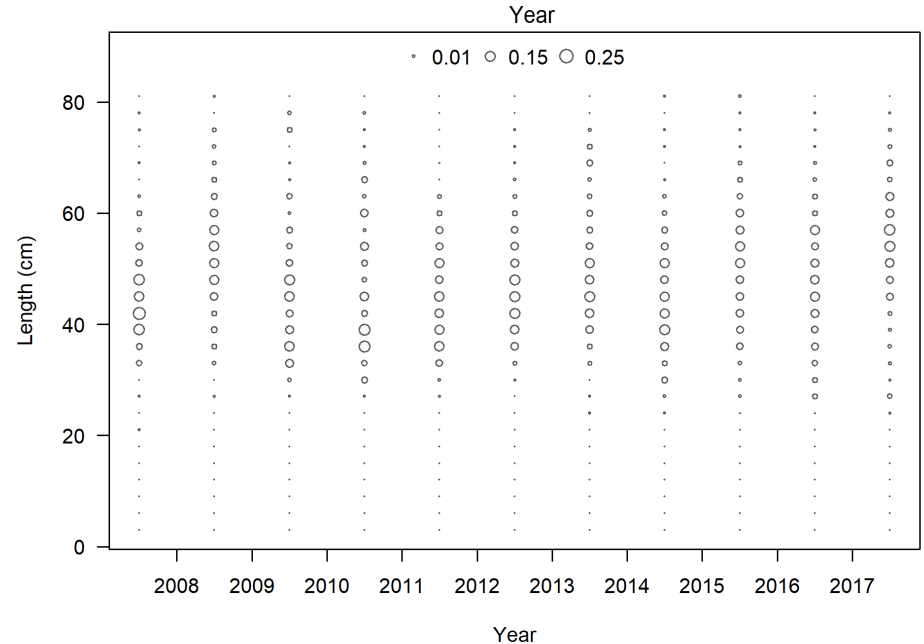
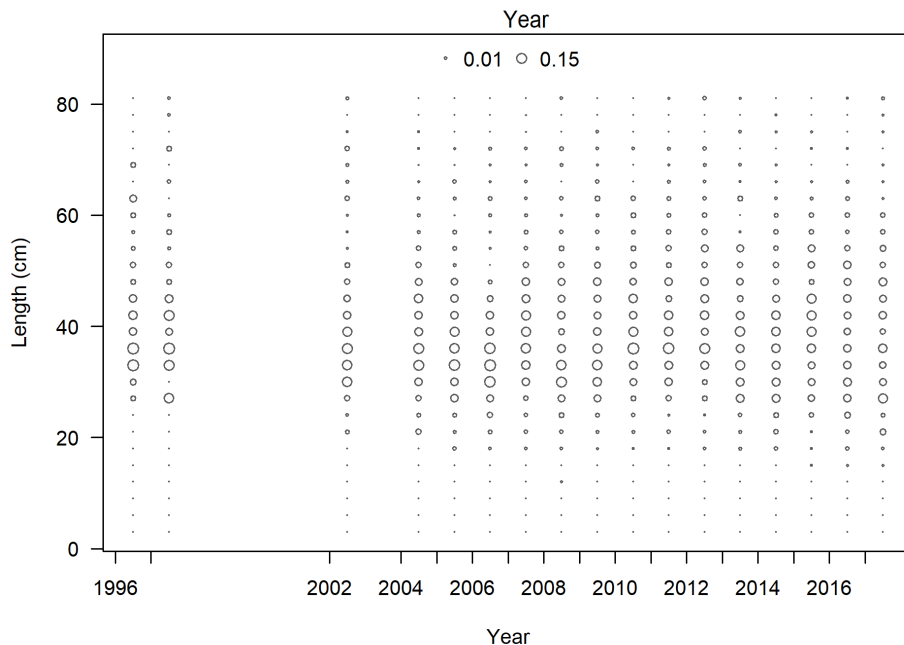
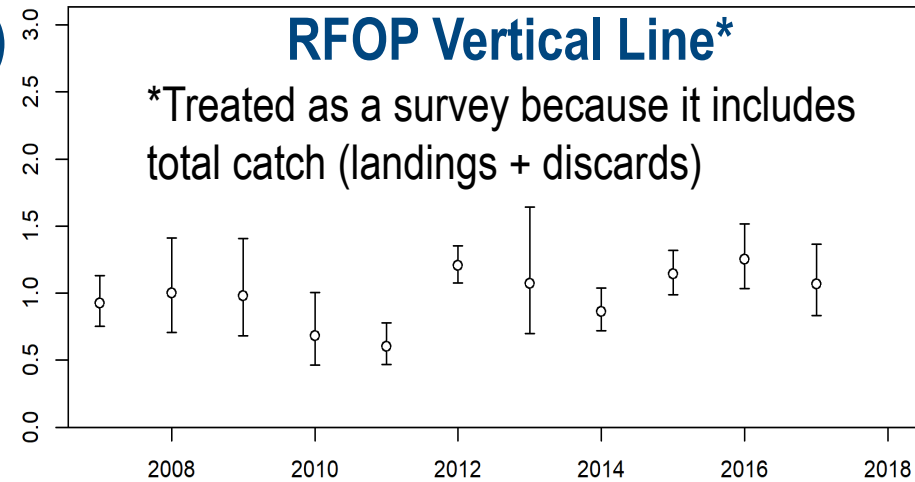
Length composition input sample sizes = number of stations or sampling units (≥ 10)

Combined Video (FWRI, PC, SEAMAP)



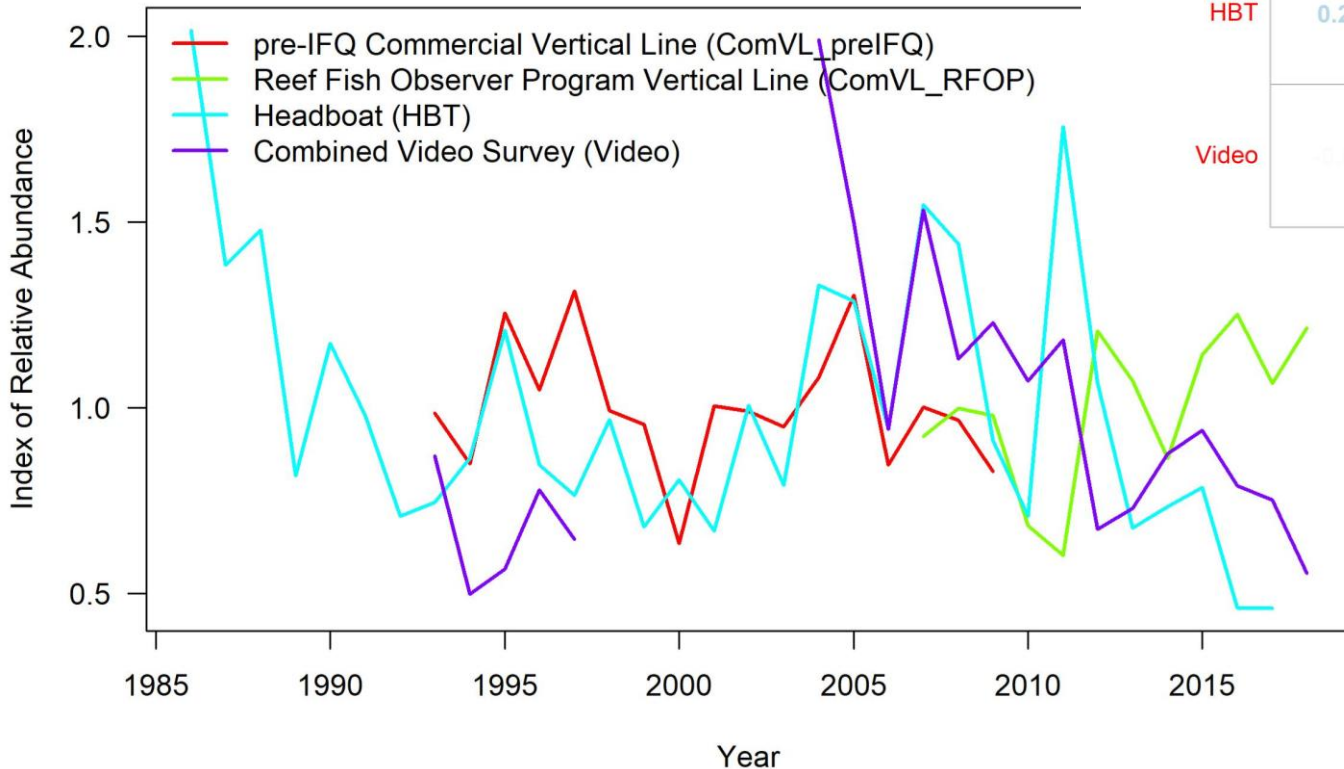
RFOP Vertical Line*

*Treated as a survey because it includes total catch (landings + discards)



Indices of relative abundance

- Recent declines evident, except for **RFOP Vertical Line index**

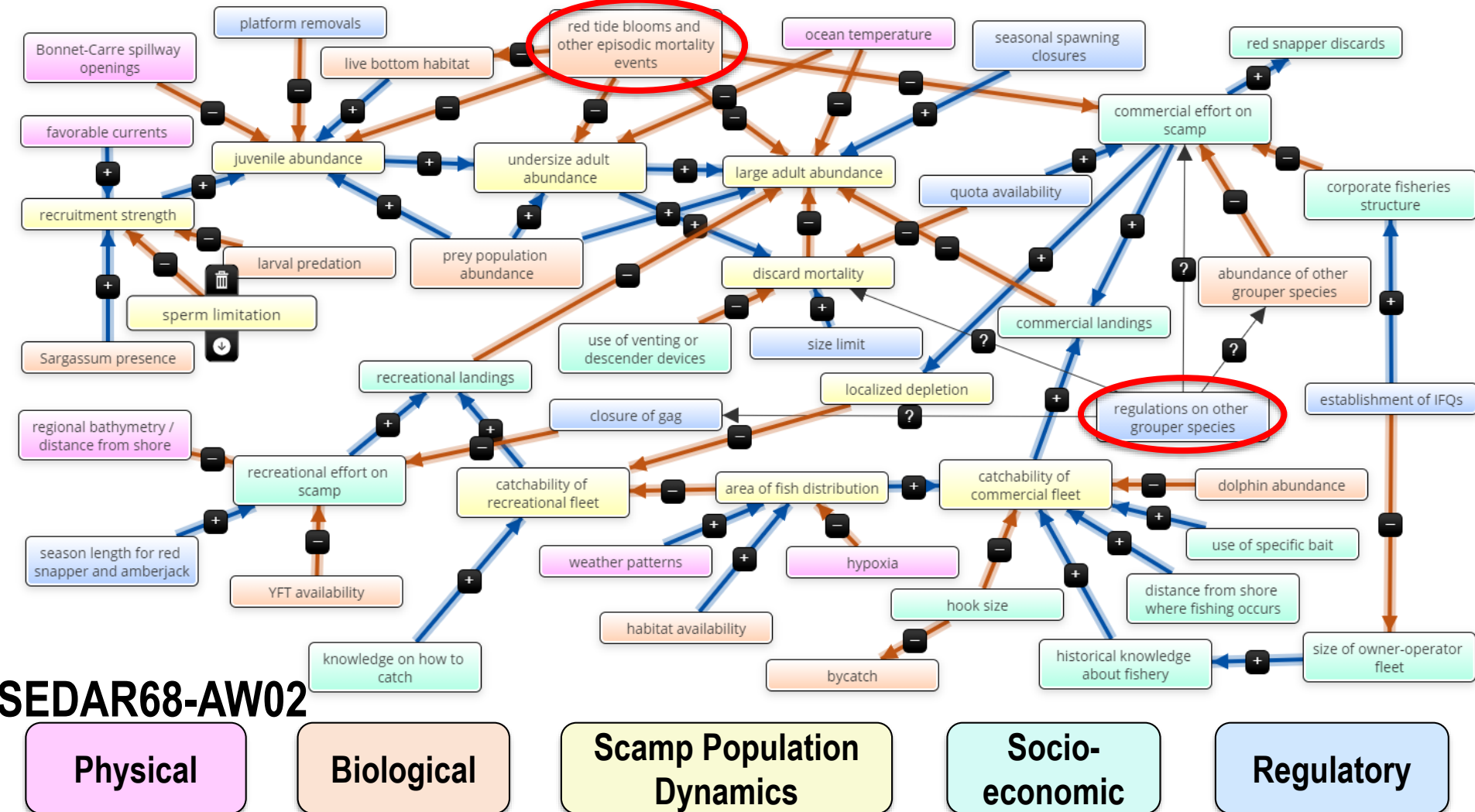


Correlations

| | ComVL_preIFQ | ComVL_RFOP | HBT | Video |
|--------------|--------------|------------|-------|-------|
| ComVL_preIFQ | 1 | -0.46 | 0.28 | -0.02 |
| ComVL_RFOP | -0.46 | 1 | -0.48 | -0.6 |
| HBT | 0.28 | -0.48 | 1 | 0.52 |
| Video | -0.02 | -0.6 | 0.52 | 1 |

Scamp-centric system conceptual model for the GOM

Relationships are **working hypotheses**, not necessarily known truths



SEDAR68-AW02

Physical

Biological

Scamp Population Dynamics

Socio-economic

Regulatory



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SEDAR68-AW02

Red tide/Hypoxia

- Red tide rarely mentioned in SEDAR 68 documentation
- Limited overlap between scamp distribution (Brothers et al. 2020) and CTD data (Turley et al. 2021)

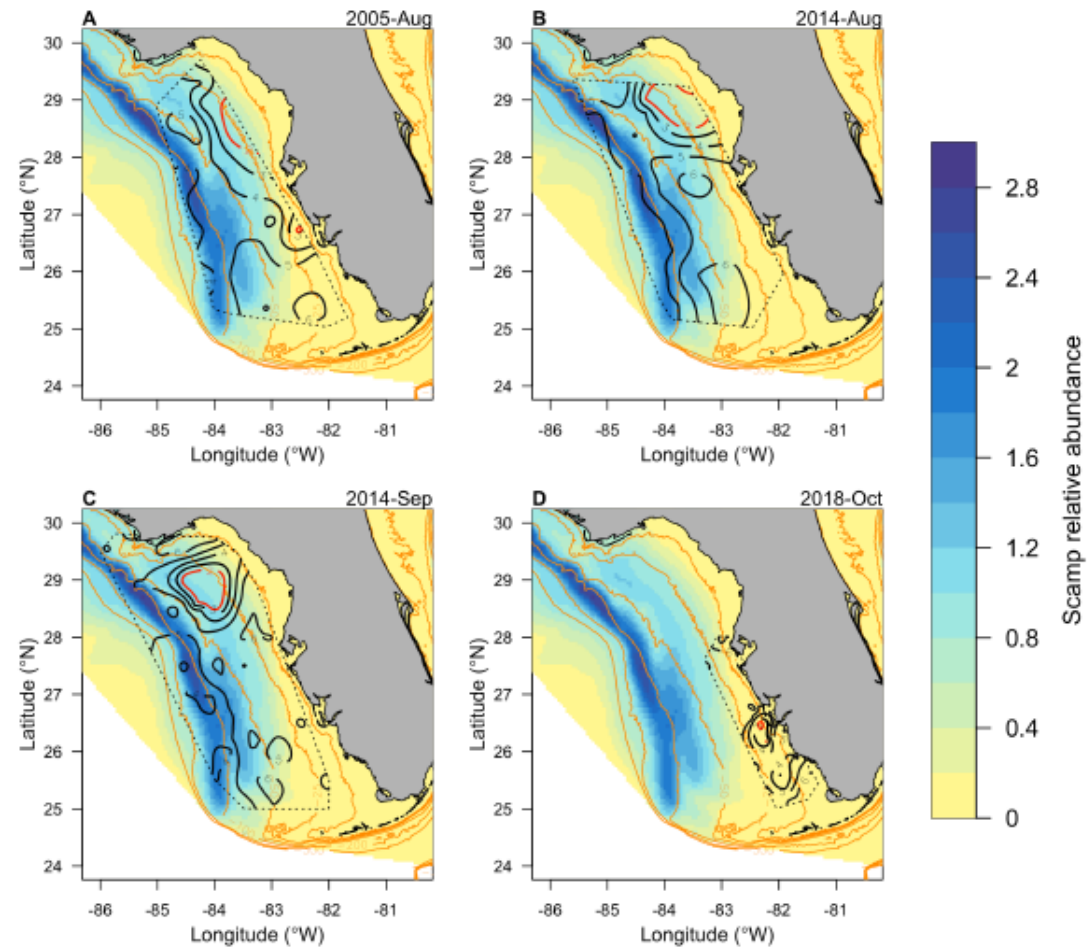


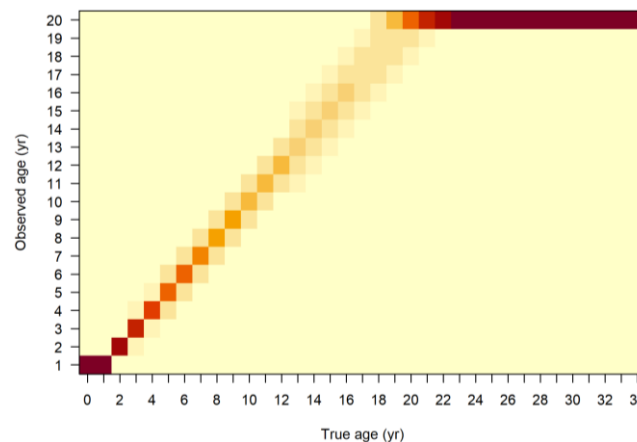
Figure displays the overlap between the output of a scamp distribution model (filled contours) and interpolated bottom oxygen concentrations (black and red contour lines) from CTD data. The four plots represent the months in which hypoxic events were evident in two or more CTD casts per month across data available in 2003-2019. Red contours lines correspond to dissolved oxygen 2 mg/l or less, which is the typical literature value considered to be hypoxic. The dashed black line indicates the convex hull used for the boundary of the interpolation surface. Bathymetric contours at 10, 25, 50, 100, 200, and 300m are in orange.

Assessment model configuration



SS model configuration

- 1 area, 1 season model
- Two gender model (males and females treated identically)
- Maturity and protogyny a function of age
 - Hermaphroditism function in Stock Synthesis
- Combined male and female SSB (metric tons)
- von Bertalanffy growth (fixed except estimating length at minimum age [1-year])
- Lorenzen natural mortality (fixed)
- Ageing error matrix included



SS model configuration cont'd

- Stock not assumed to be at unexploited equilibrium level at start of time series, therefore estimated initial F values for all fleets except Headboat:
 - Initial equilibrium catch = 1986-1990 mean catch for fleet
 - Headboat catches minor throughout time series
- Use Continuous F method
 - Recommended where catch is known imprecisely
 - Large errors on recreational Charter Private and Headboat landings (log-scale SE = 0.3)

SS model configuration cont'd

- Estimated extra standard deviation parameter for each index of abundance*
 - Removes the need for Francis iterative reweighting approach for indices (applied in SEDAR 68 AP Base Model)
- Constant catchability
- Ages 1-34 modeled, with 20+ as a plus group
 - Plus group based on saturation of the life history parameters
 - < 4% of data over age 20
- Dirichlet* multinomial error distribution for composition data (Thorson et al. 2017)

Beverton-Holt stock recruitment model

- Estimating:
 - Virgin recruitment [$\ln(R_0)$]: unexploited equilibrium recruitment on log-scale
 - SigmaR: standard deviation in recruitment
 - Recruitment deviations from 1986-2014
- Steepness*: fraction of the unexploited recruits produced at 20% of the equilibrium spawning biomass level
 - Could not be estimated
 - RW Panel fixed at 0.69

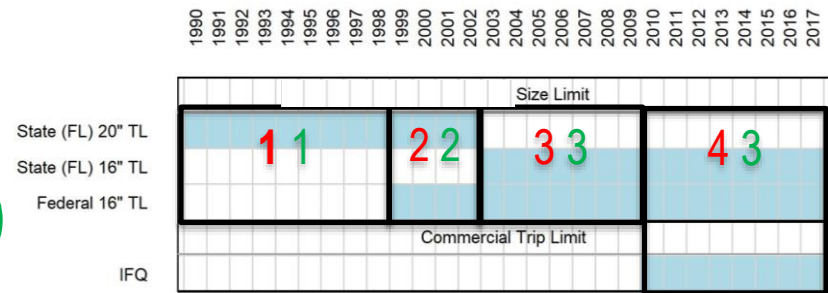
| Source | Steepness | CV |
|----------------------|---------------|----------|
| FishLife – species | 0.7777 | 0.2718 |
| South Atlantic | 0.57 | 0.1853 |
| Weighted Mean | 0.6935 | - |

Selectivity and Retention*

- Length-based selectivity used for fleets/surveys

| Logistic | Dome-shaped |
|--------------------------|------------------------------|
| Commercial Vertical Line | Recreational Charter Private |
| Commercial Longline | Recreational Headboat |
| Video | |
| RFOP Vertical Line | |

- Assumed constant selectivity for all fleets and surveys
- Modeled time-varying retention to account for changes in management regulations
 - Commercial (4 blocks)
 - Recreational: (3 blocks)



Time-varying Retention*

- Assumed all fish caught before size limits were retained (with exception of Recreational Charter Private for which discard data exist prior to 1999)
- Estimating inflection points and width parameters
- Asymptote:
 - Commercial: assumed full retention above the size limit until implementation of the IFQ in 2010
 - Recreational: estimated asymptote since not all scamp are retained (e.g., bag limit)

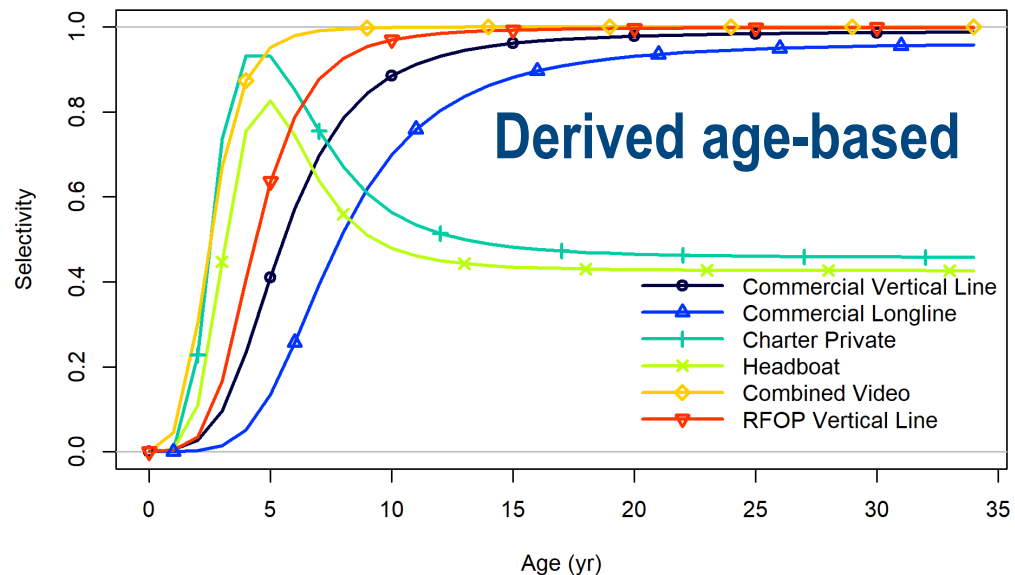
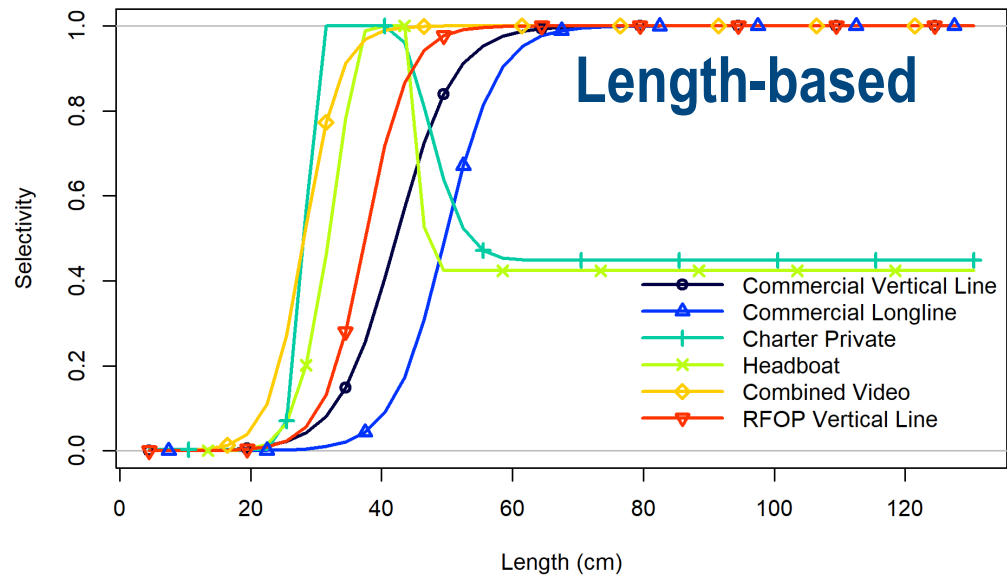
Assessment model results



Selectivity

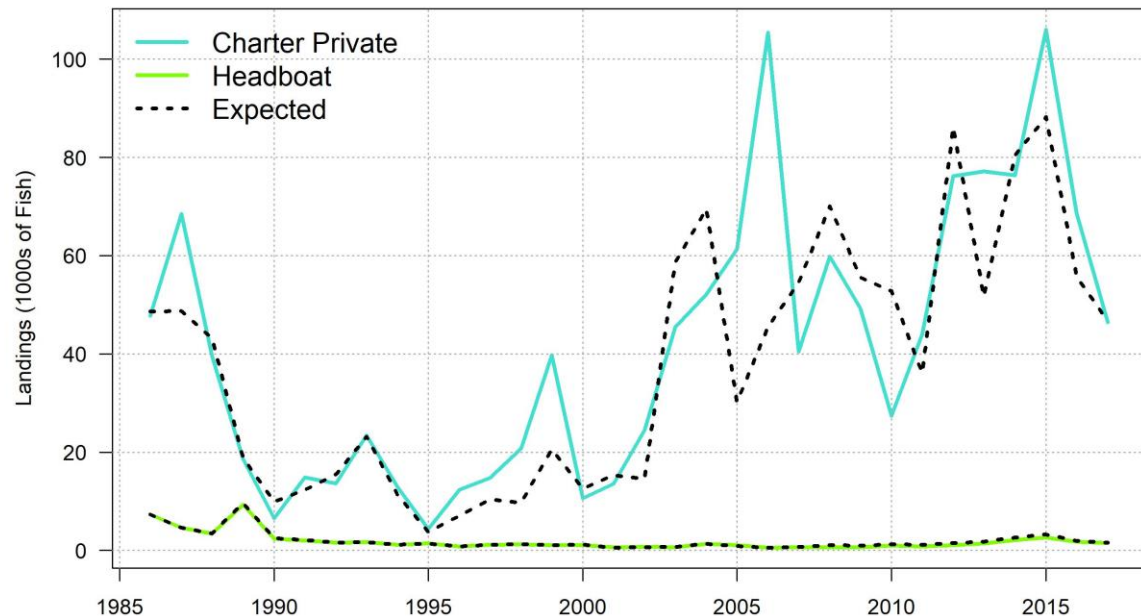
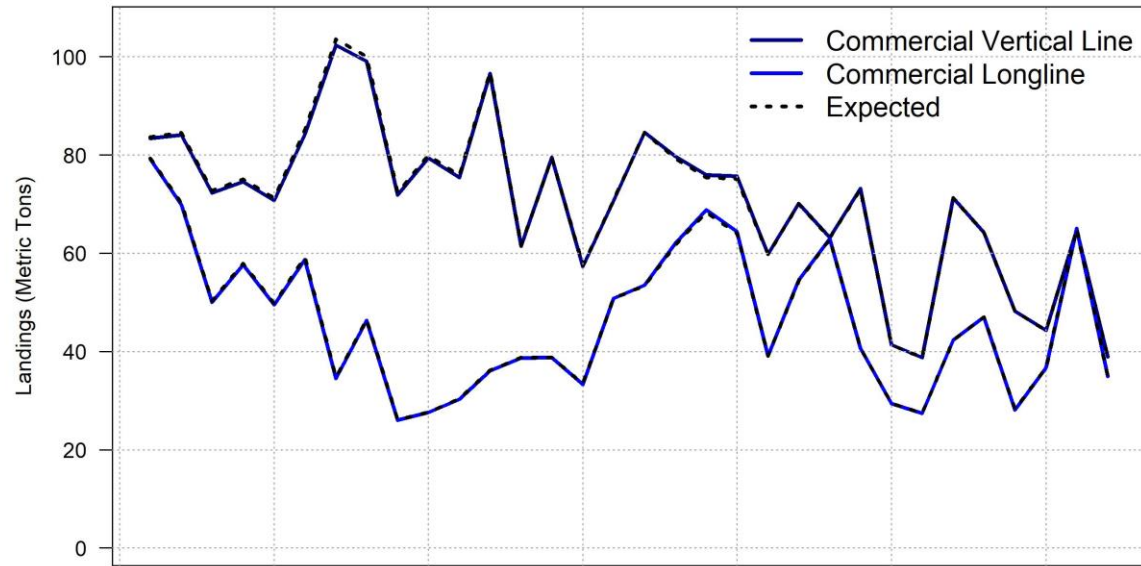
CV>1 in RW Base:

- Headboat
- Descending limb



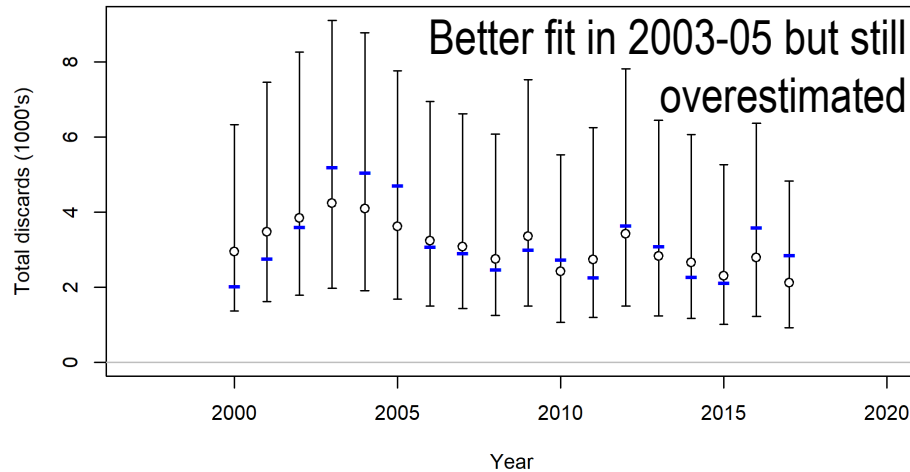
Landings

- Commercial SE = 0.05 (IFQ years SE = 0.01)
- Recreational SE fixed at 0.3
 - Using CVs as provided tested in a sensitivity run during AP

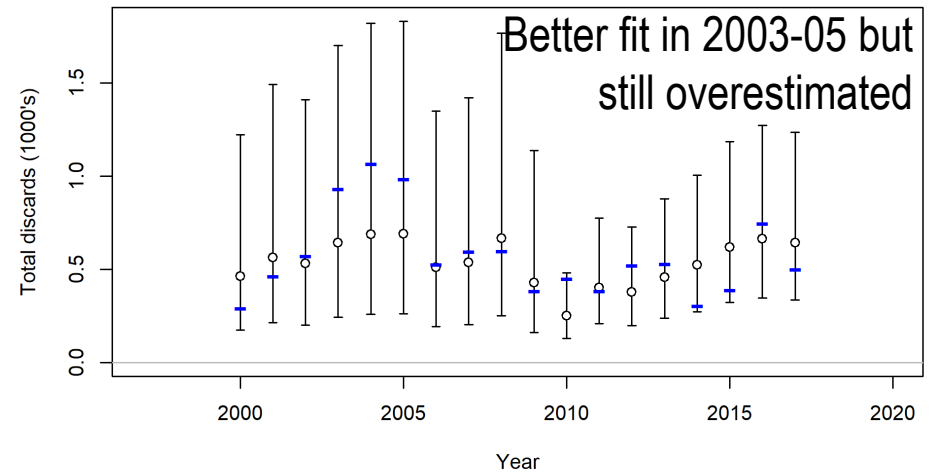


Total discards (before applying discard mortality)

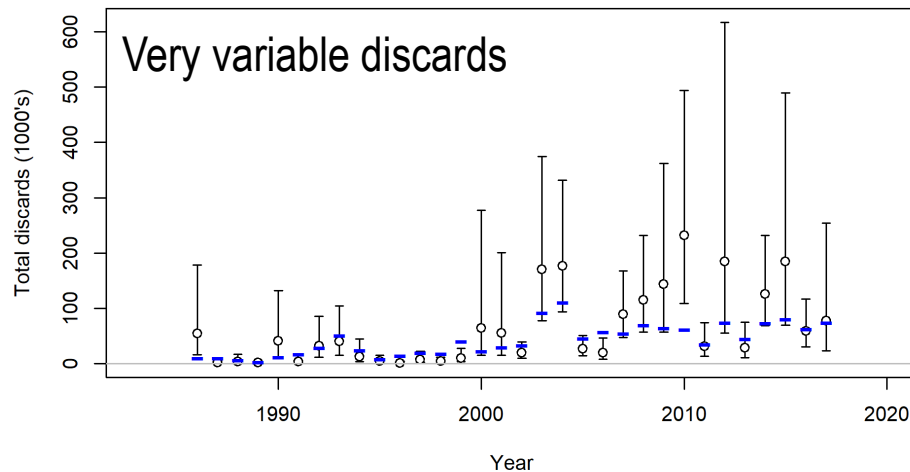
Commercial Vertical Line



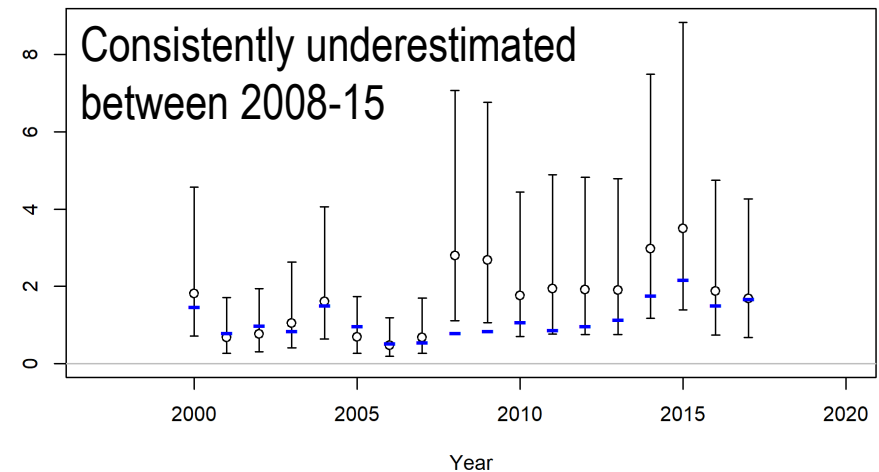
Commercial Longline



Charter Private



Headboat



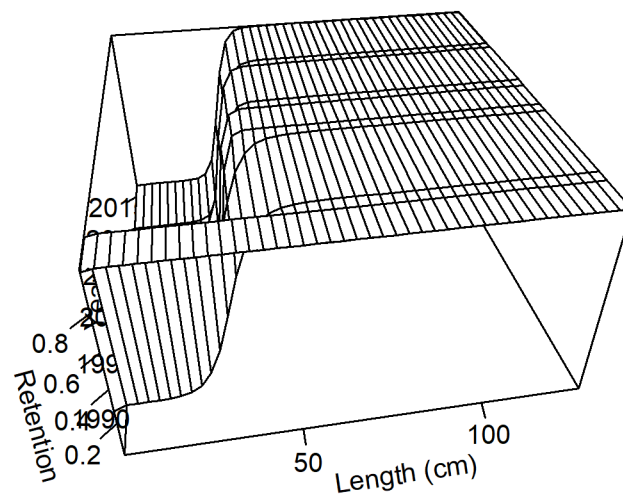
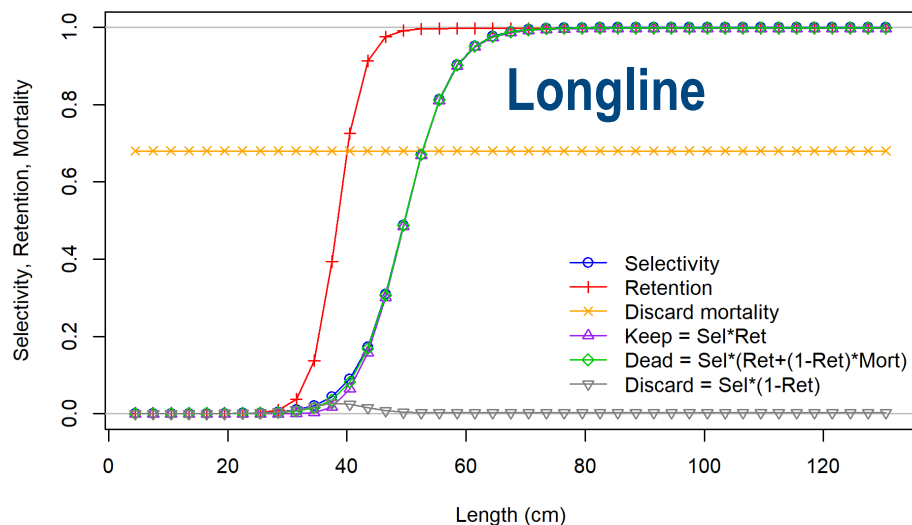
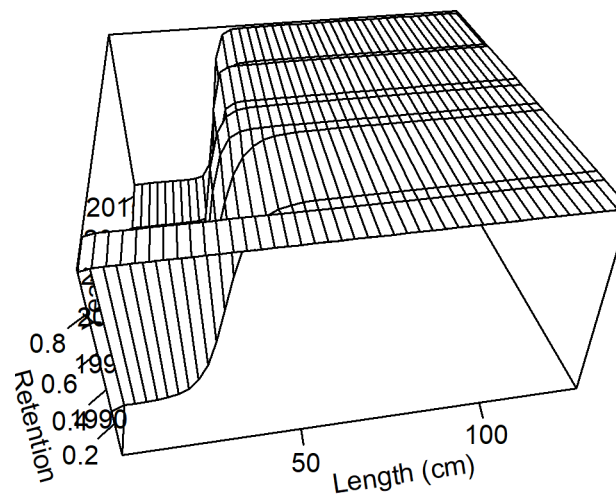
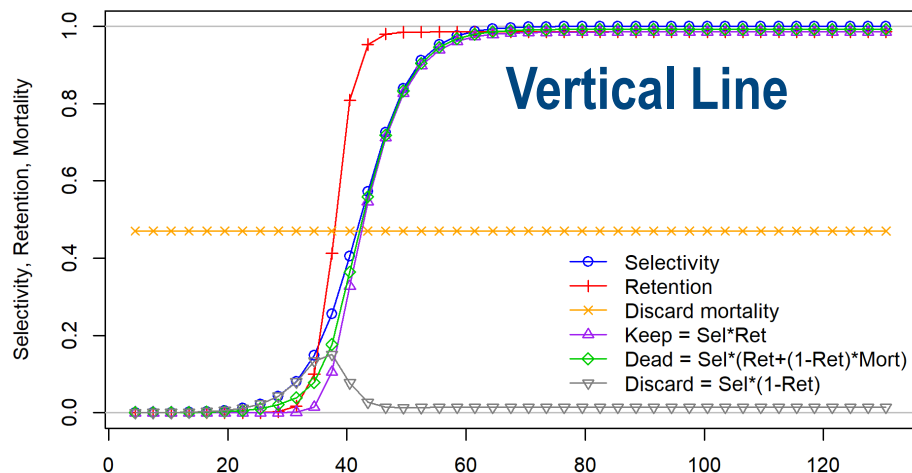
Estimated Dirichlet parameters

| ln(DM_theta) | Value (CV) |
|------------------------------------|-----------------|
| Commercial Vertical Line (length) | 4.979 (NA) |
| Commercial Longline (length) | 4.996 (NA) |
| Charter Private (length) | 4.923 (NA) |
| Headboat (length) | 4.517 (0.155) |
| Combined Video Survey (length) | 4.401 (0.175) |
| RFOP Vertical Line Survey (length) | -2.042 (-0.046) |
| Commercial Vertical Line (age) | 1.99 (0.296) |
| Commercial Longline (age) | 0.179 (1.056) |
| Charter Private (age) | 1.712 (0.244) |
| Headboat (age) | 1.24 (0.271) |

- Lowest for RFOP length data and fishery age comps
- Adjusted sample size converges to the input sample size at large values (~5)

Commercial

No selectivity or retention parameters with CV > 1

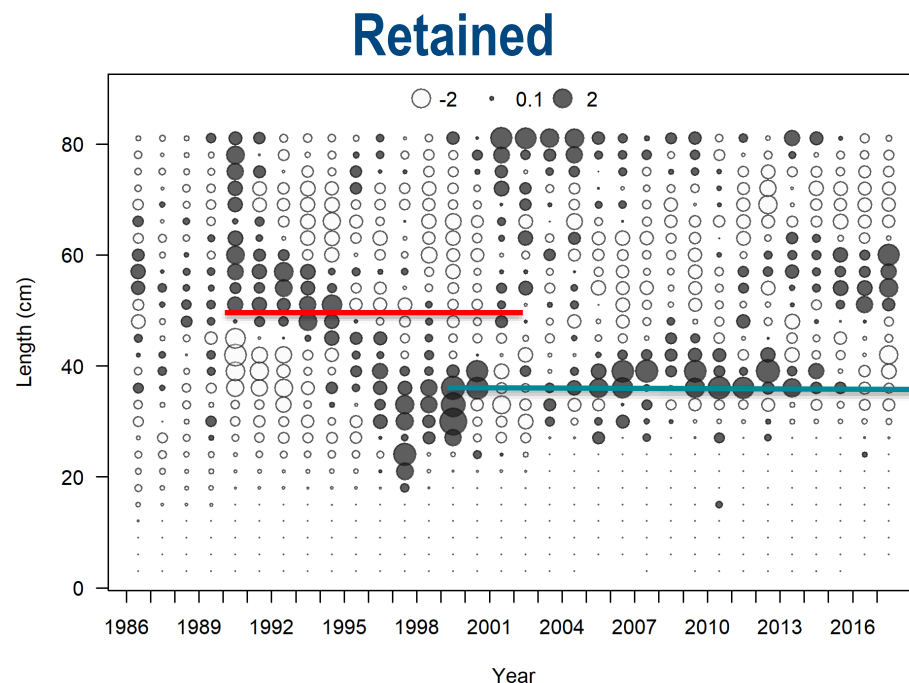
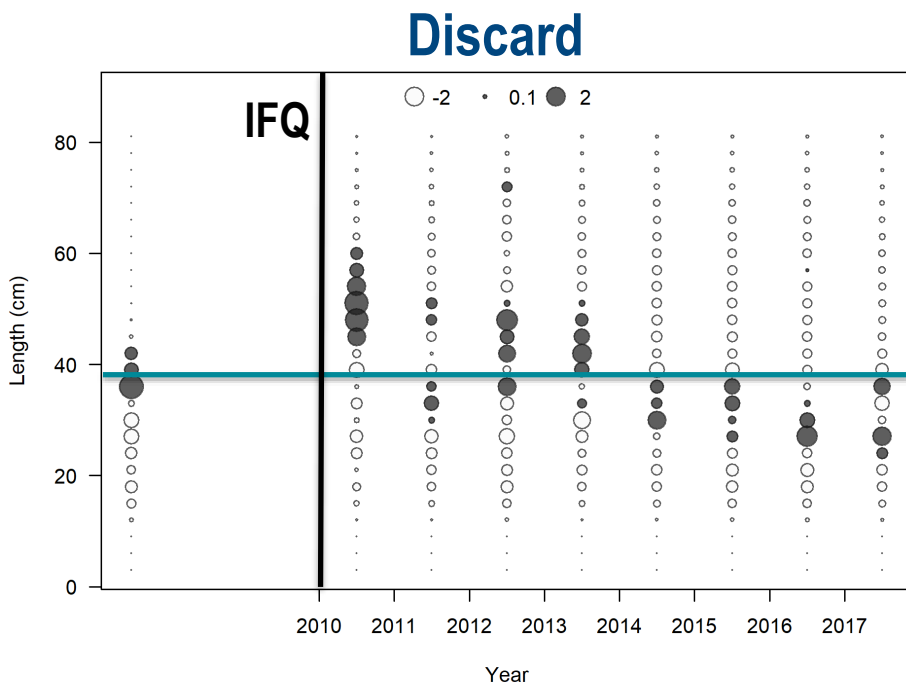


Commercial Vertical Line

- Patterns evident in residuals for retained composition
 - Closed = + (observed > expected)
 - Open = - (observed < expected)

Federal Size Limit

Florida Size Limit



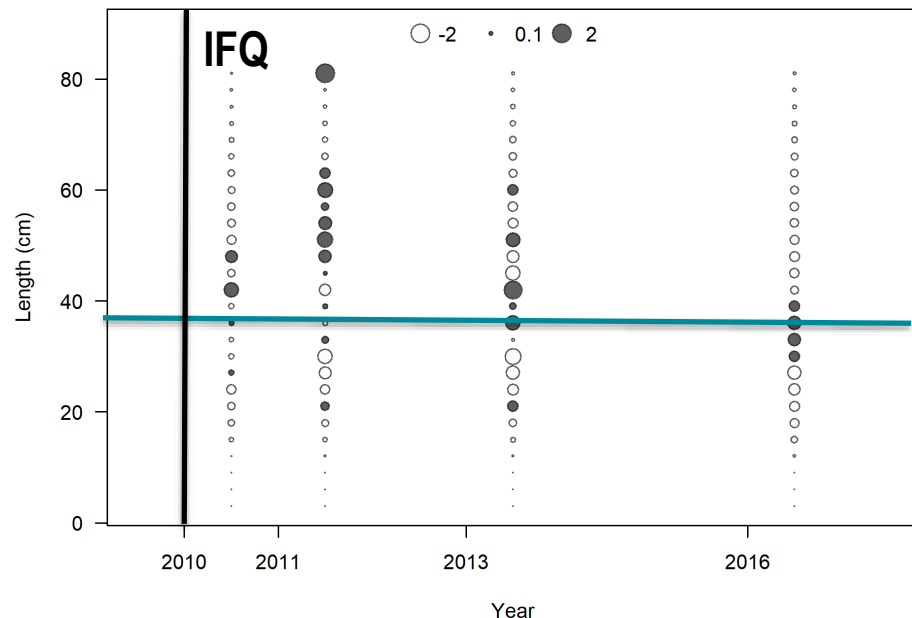
Commercial Longline

- Patterns evident in residuals for retained composition
 - Closed = + (observed > expected)
 - Open = - (observed < expected)

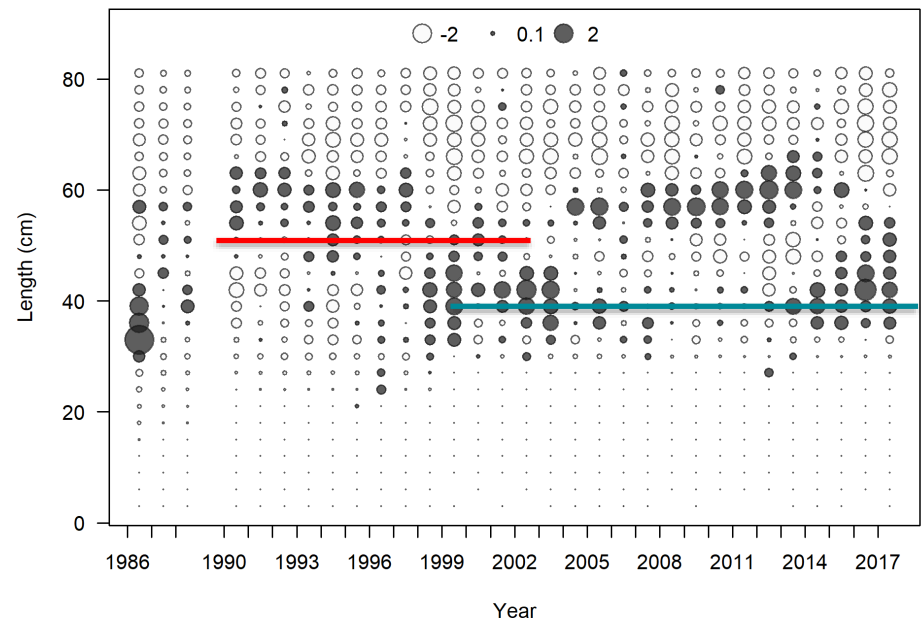
Federal Size Limit

Florida Size Limit

Discard



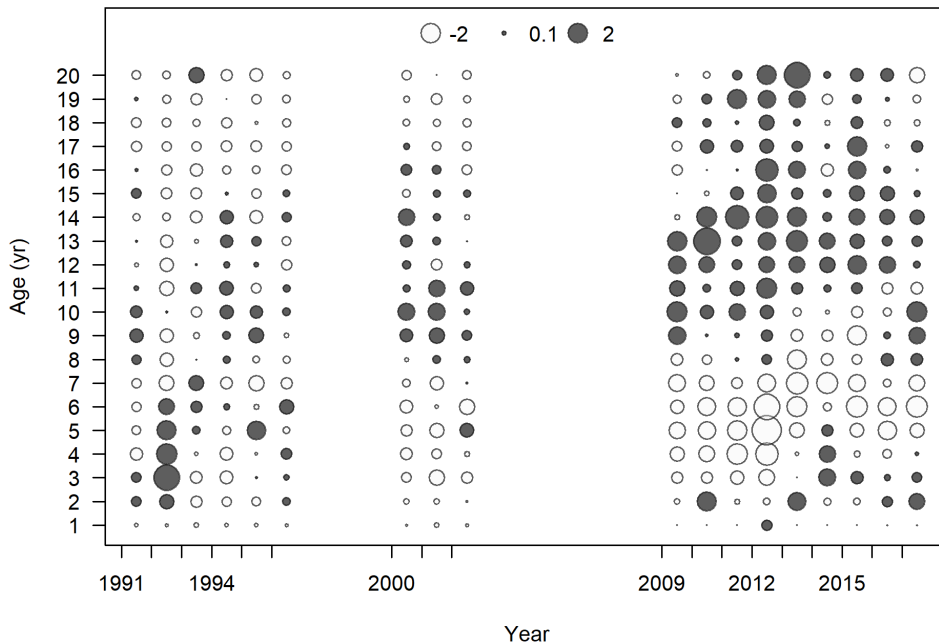
Retained



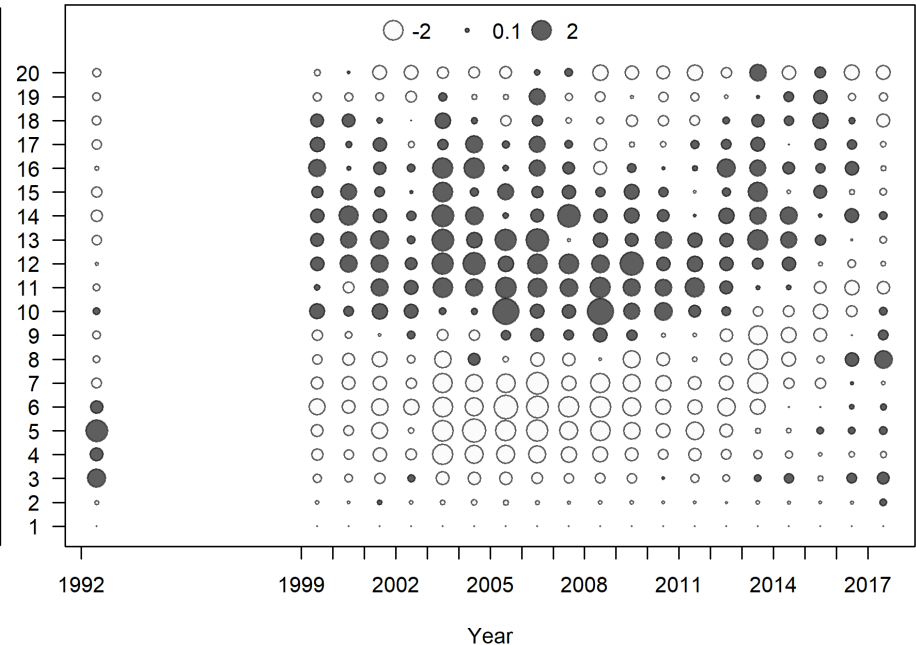
Commercial age composition (nominal)

- Relatively small residuals, but patterns evident
 - Closed = + (observed > expected)
 - Open = - (observed < expected)

Vertical Line



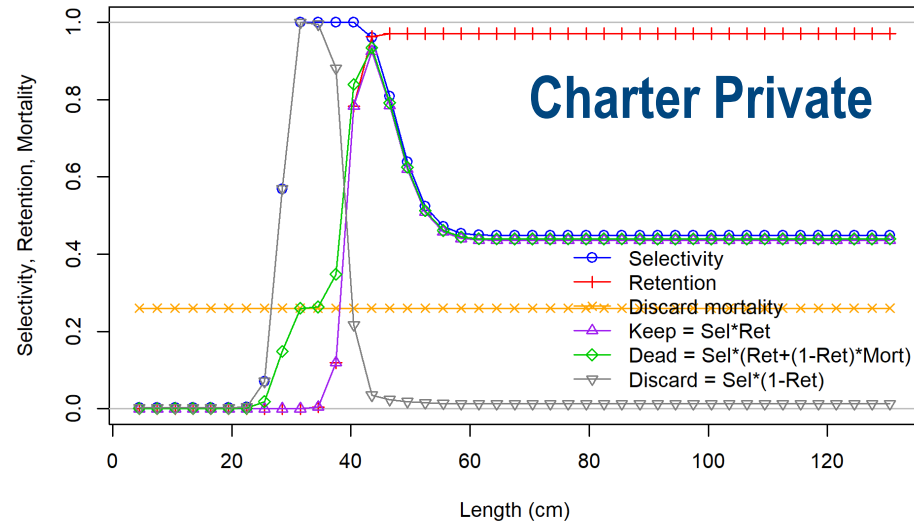
Longline



Recreational

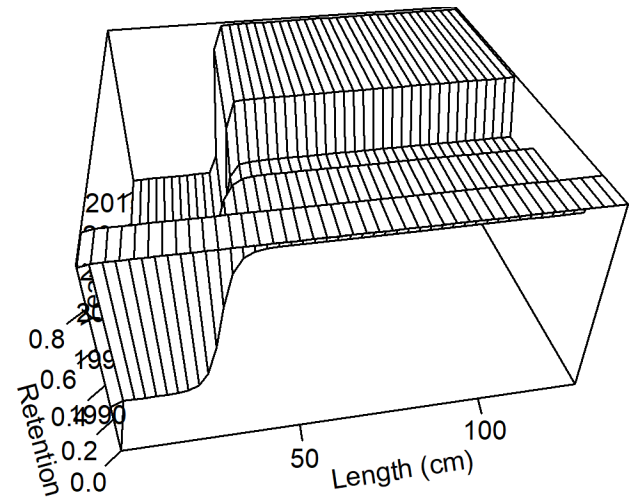
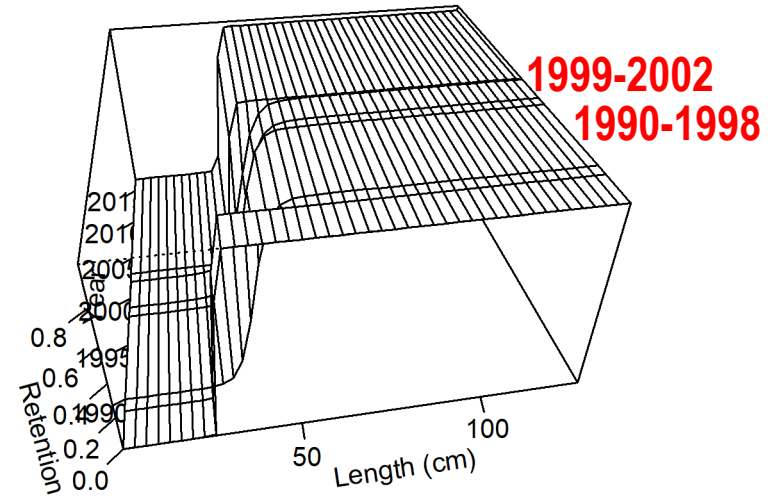
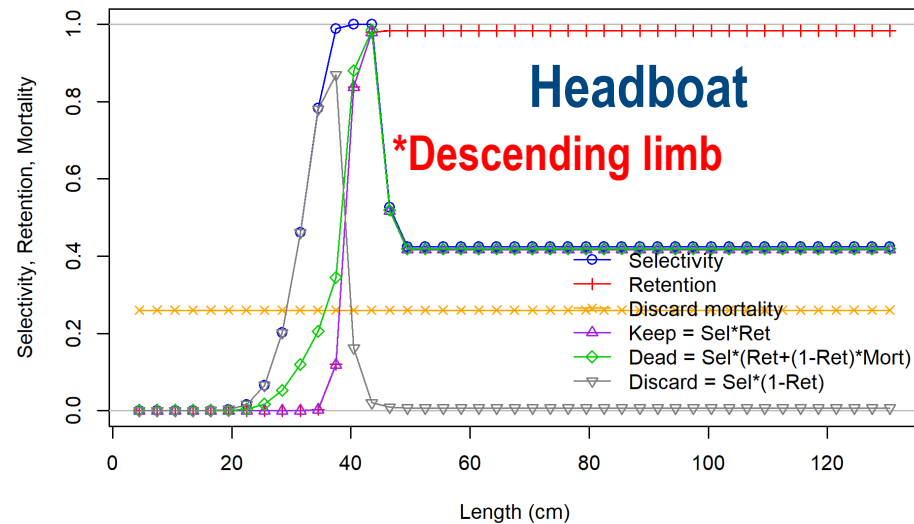
Selectivity or retention parameters with CV > 1

Charter Private



Headboat

*Descending limb



Charter Private length composition

- Patterns evident in residuals for retained composition, which also show relatively large magnitude

- Closed = + (observed > expected)

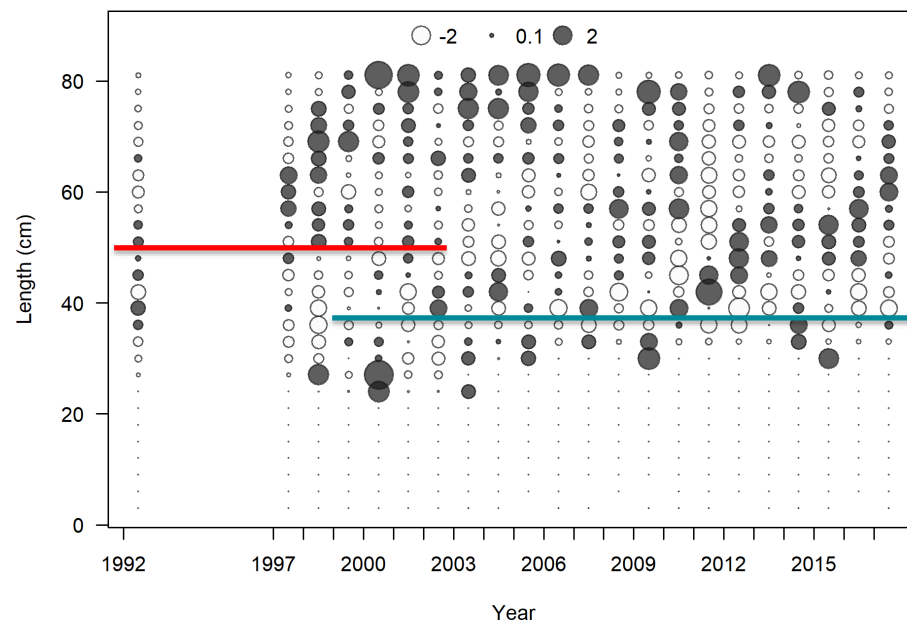
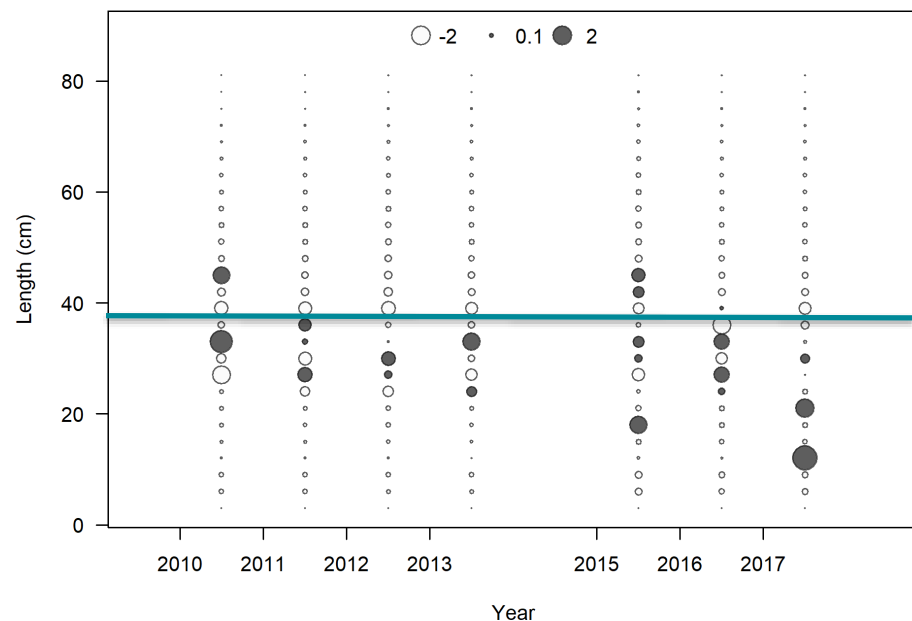
- Open = - (observed < expected)

Discard

Federal Size Limit

Florida Size Limit

Retained

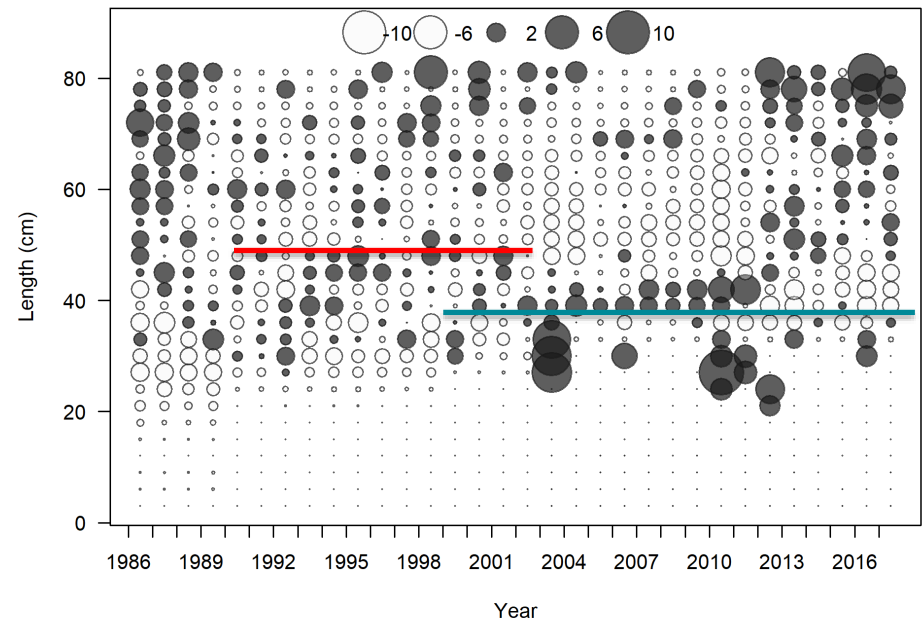
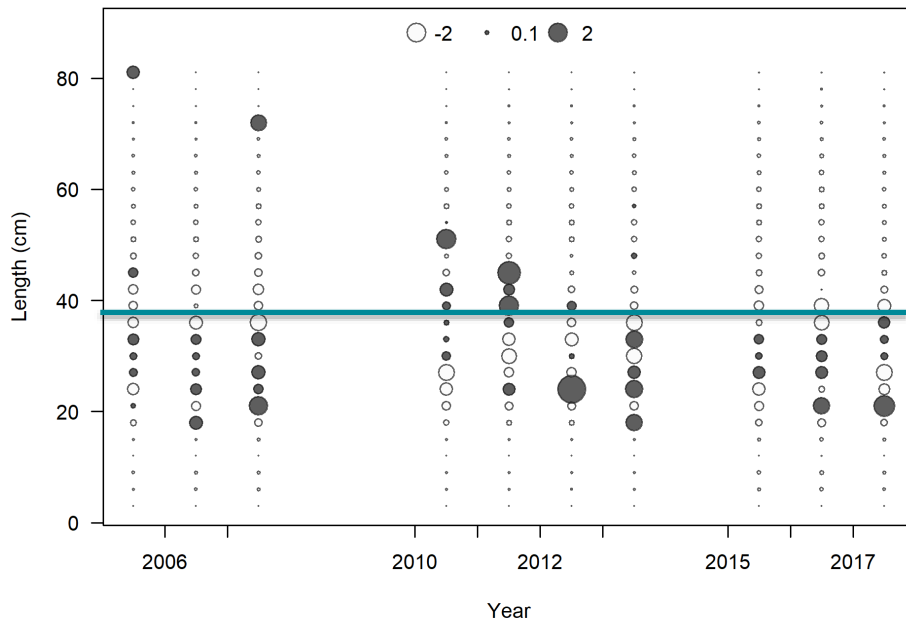


Headboat length composition

- Patterns evident in residuals for retained composition, which also show relatively large magnitude
 - Closed = + (observed > expected)
 - Open = - (observed < expected)

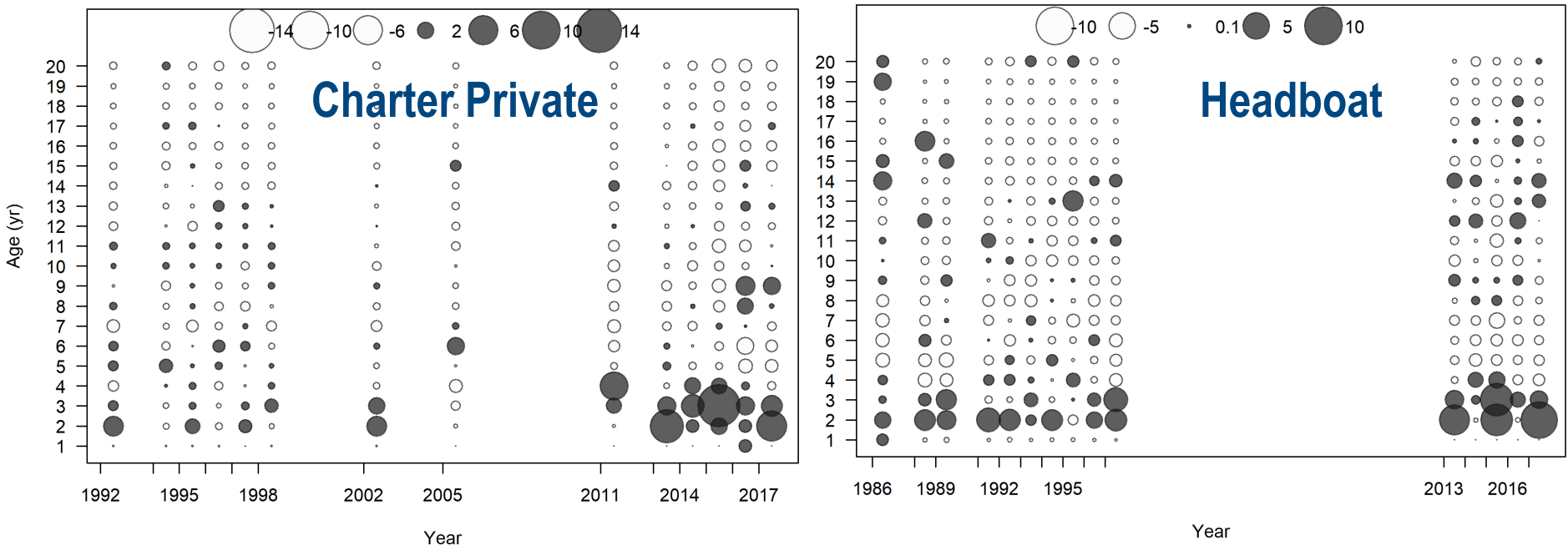
Federal Size Limit

Florida Size Limit

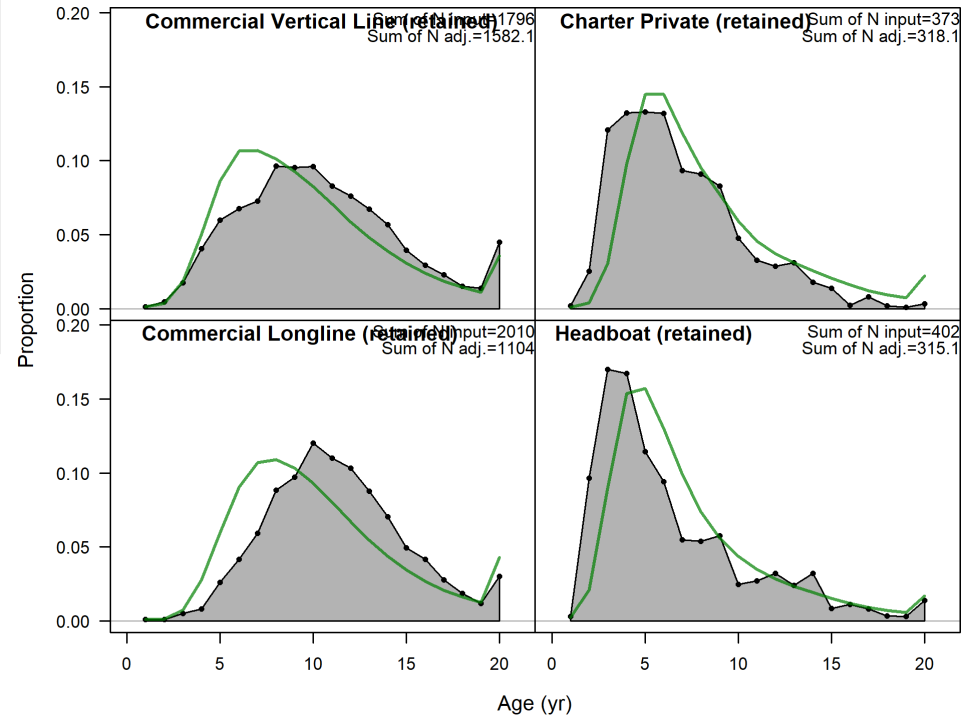
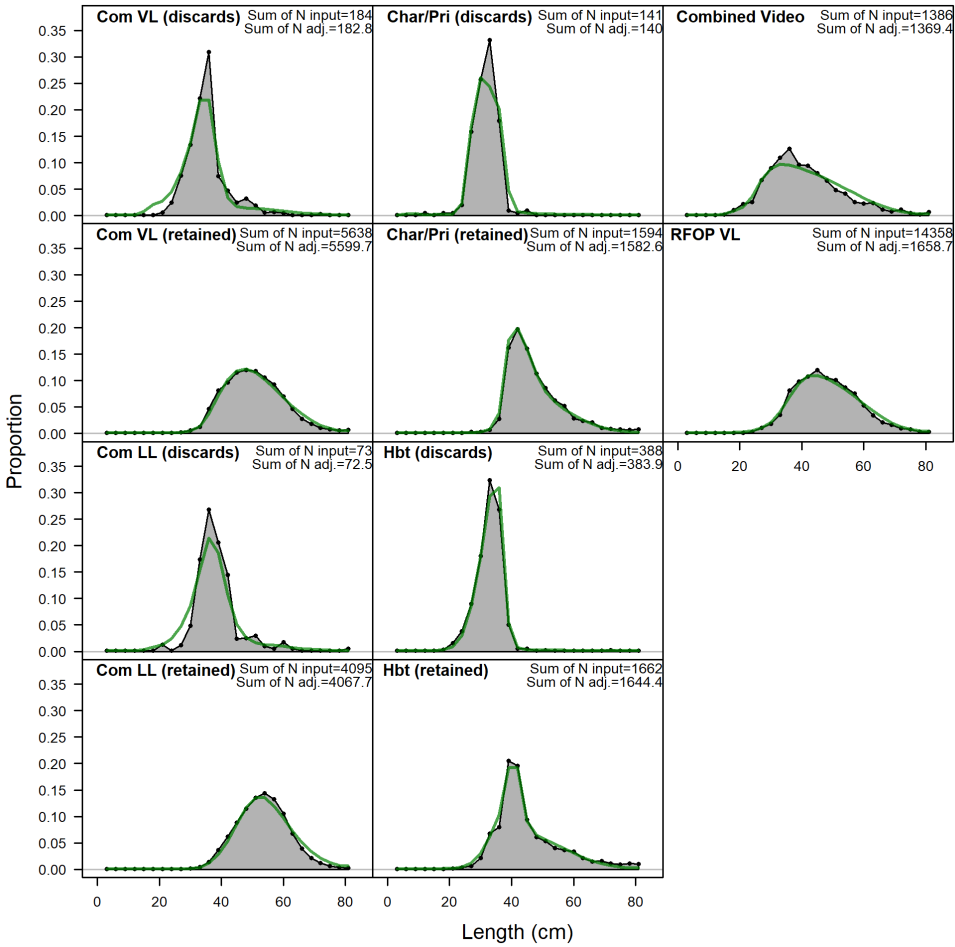


Recreational age composition (nominal)

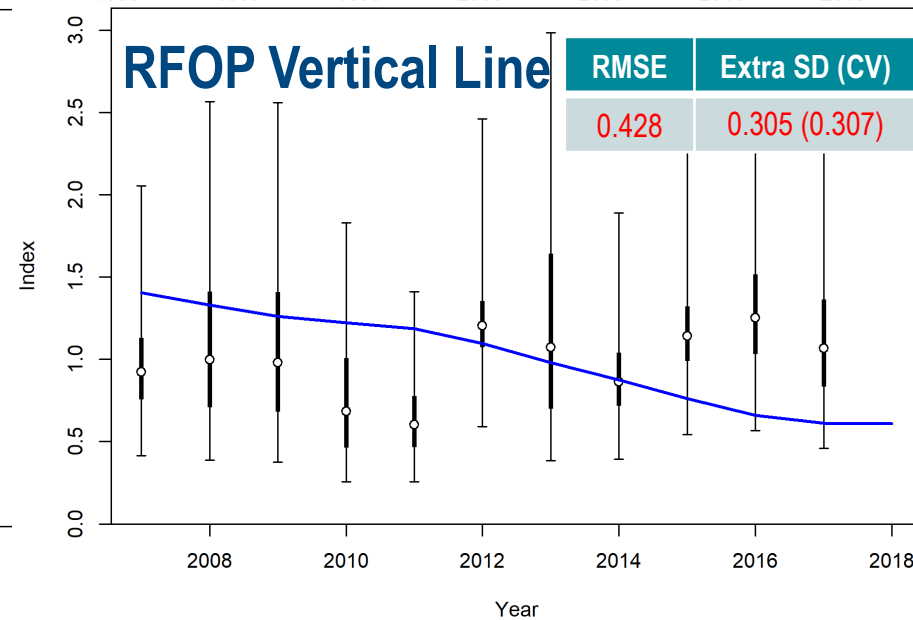
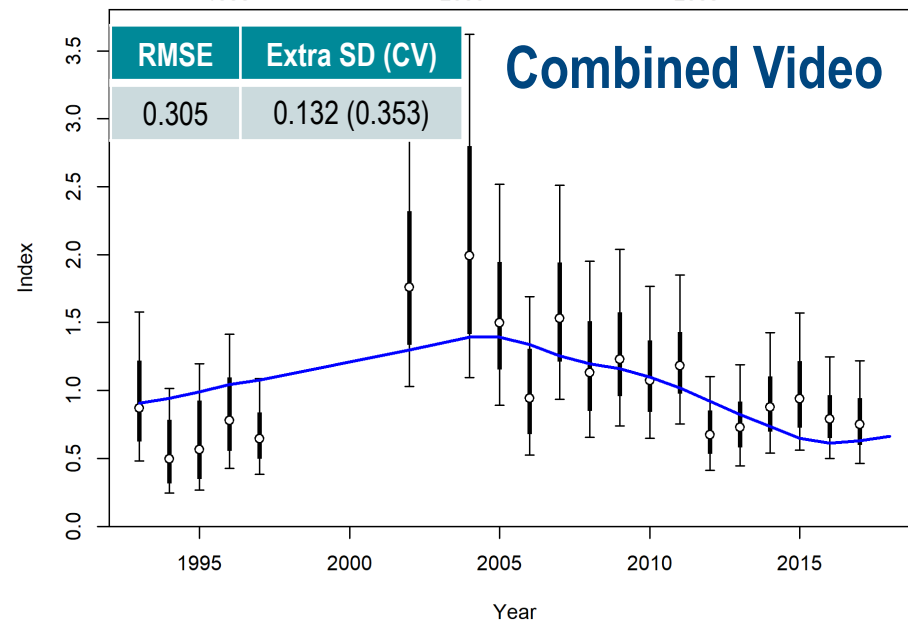
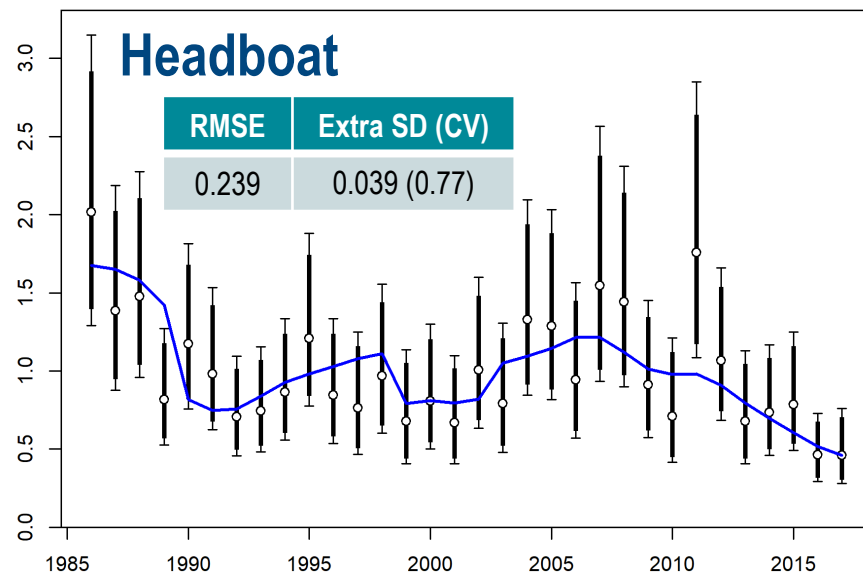
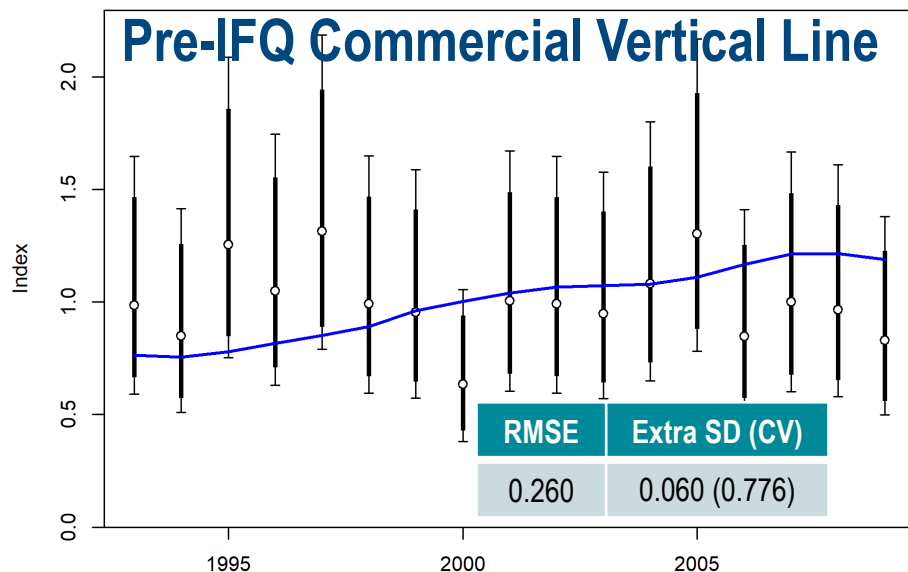
- Large residuals for younger ages throughout time series for headboat, but especially from 2013-2017 for both fleets
- Need a better understanding of regulations for other species or spatial distribution of fisheries



Tradeoffs between fitting compositions

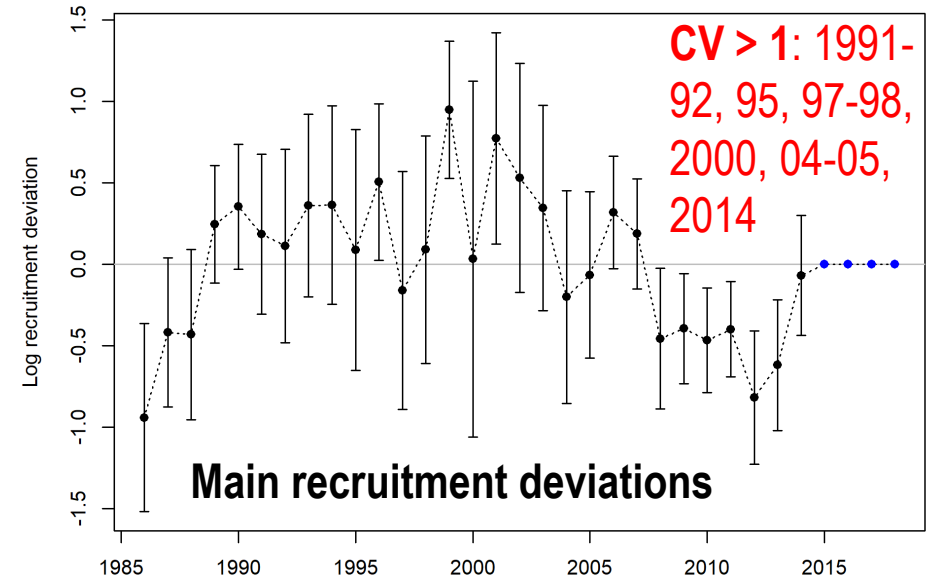
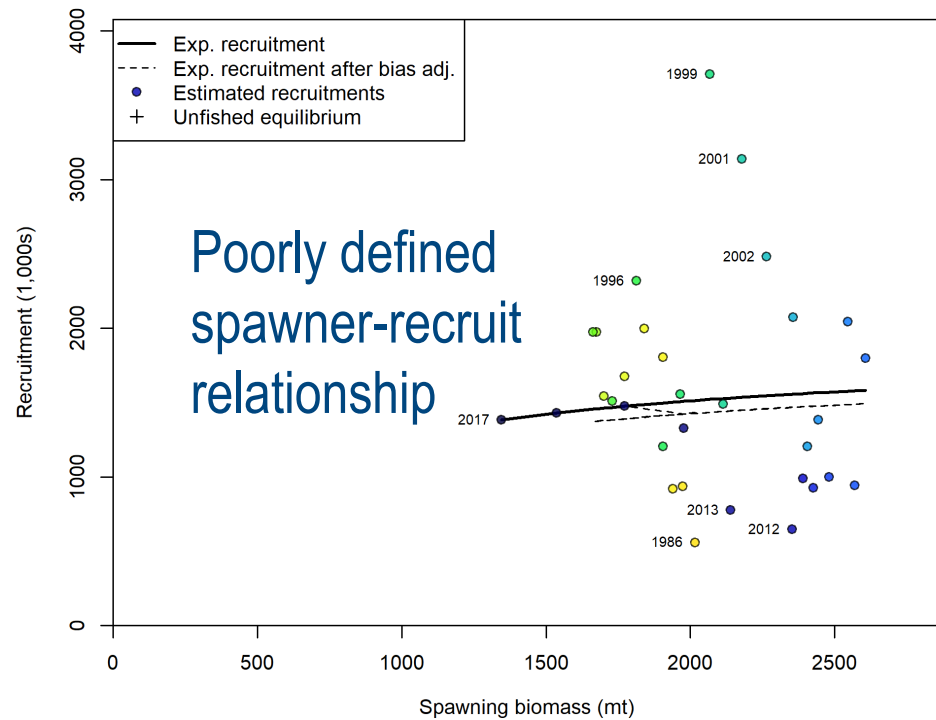
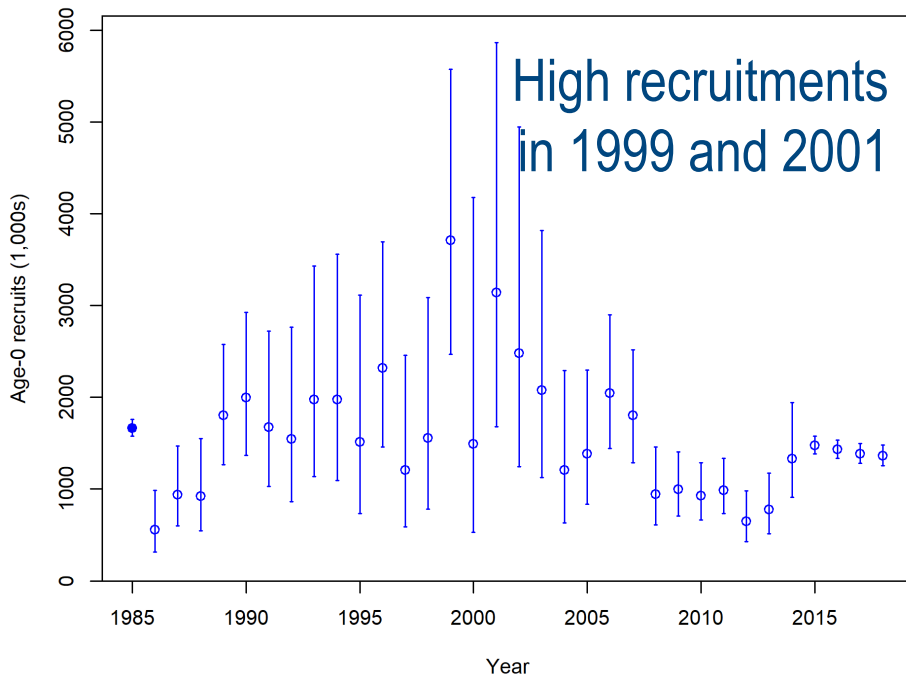


Indices of relative abundance

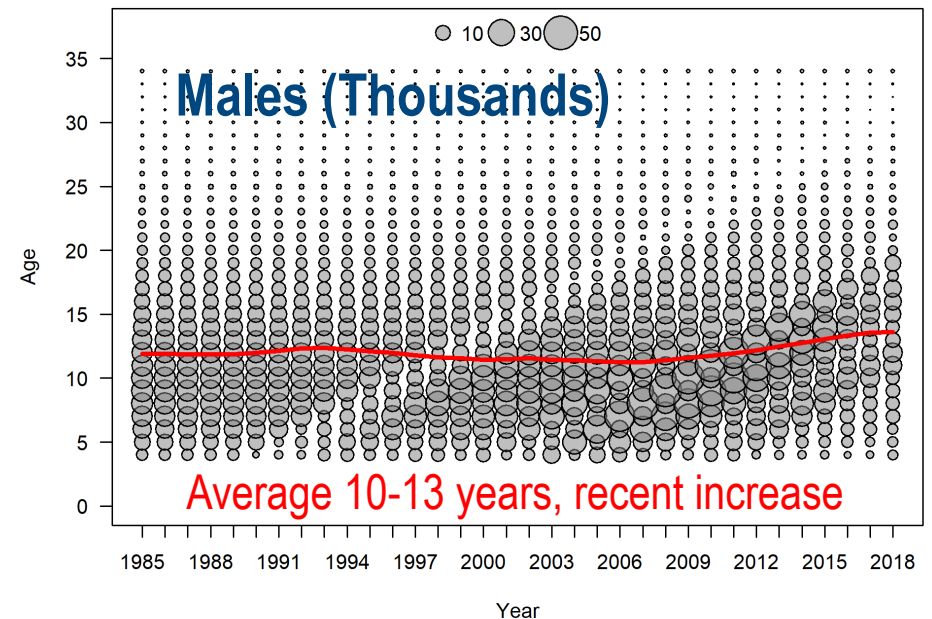
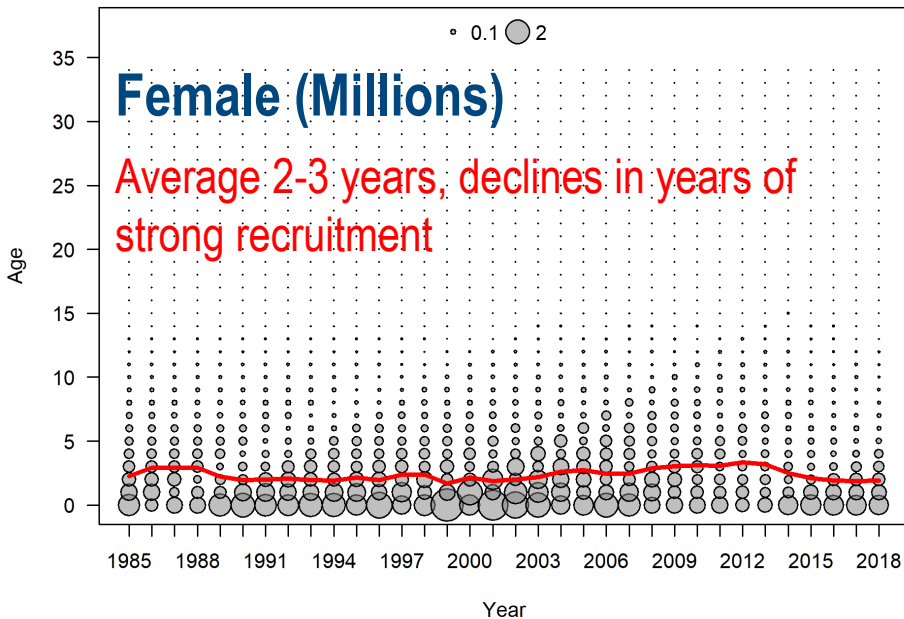
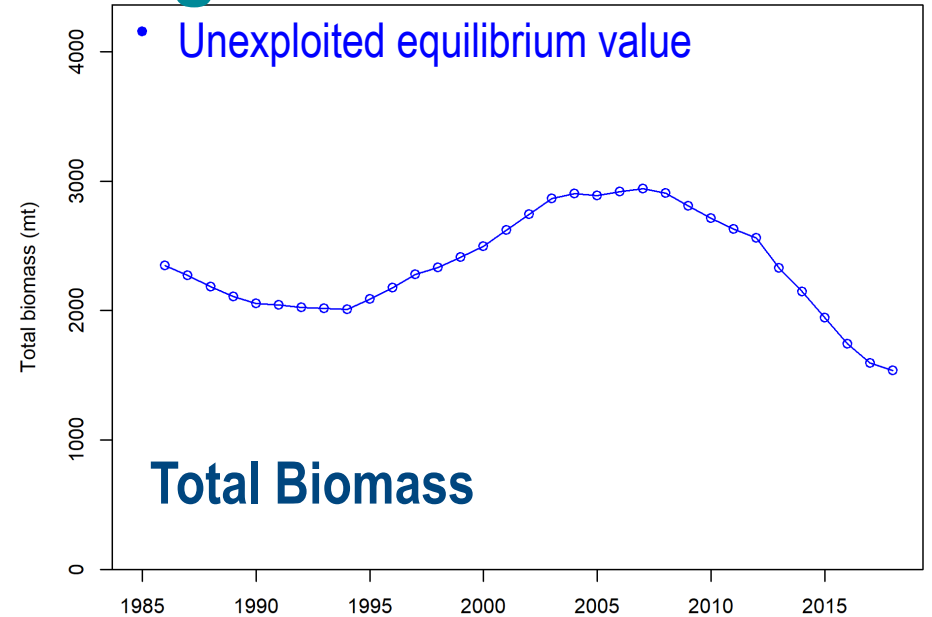
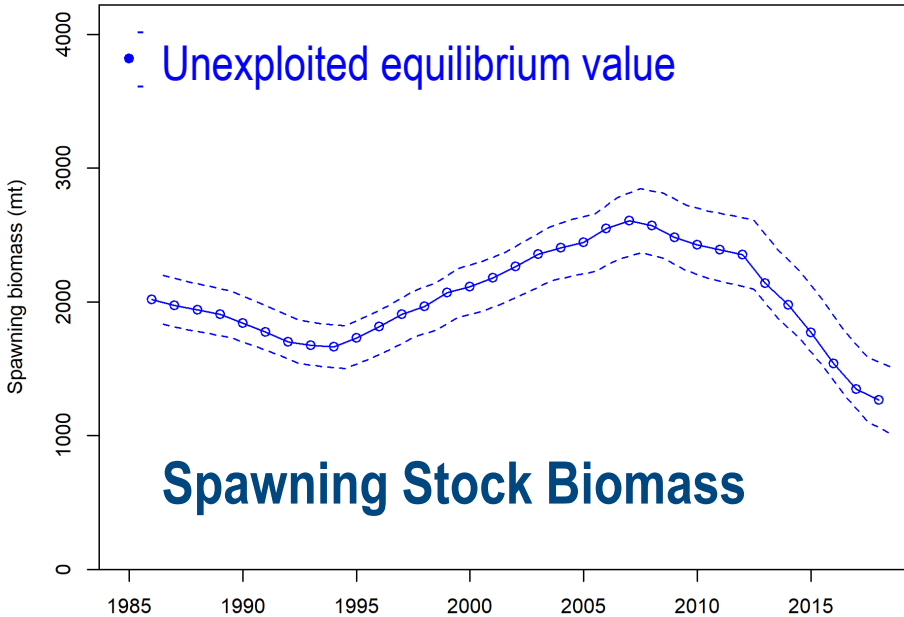


Recruitment

| Parameter | Value (CV) |
|------------|---------------|
| $\ln(R_0)$ | 7.417 (0.004) |
| R_0 | 1,664,034 |
| Steepness | 0.6935 (NA) |
| SigmaR | 0.445 (0.128) |

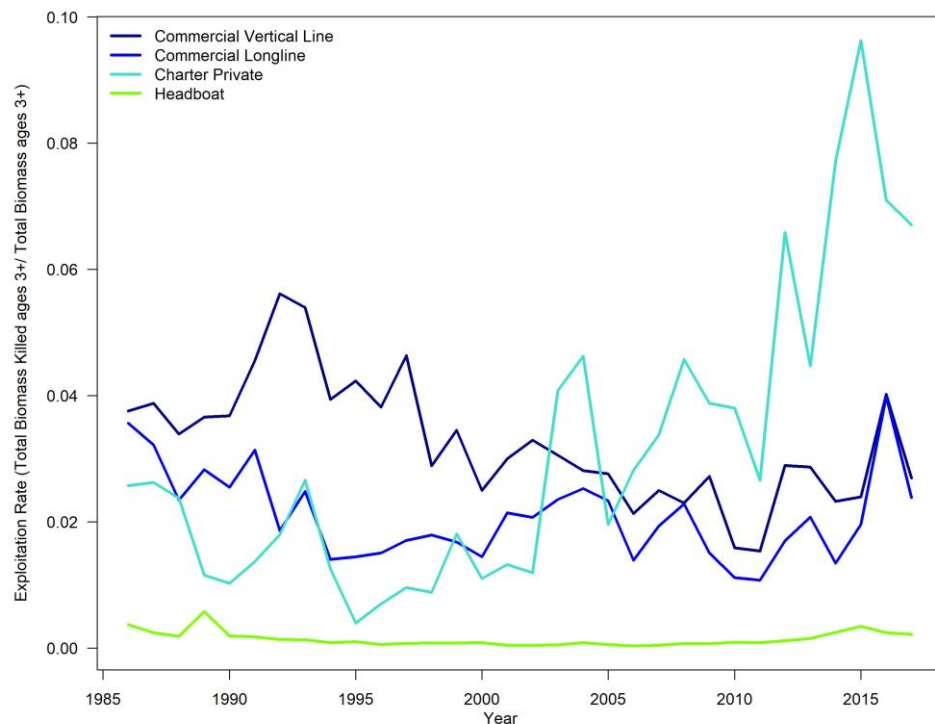
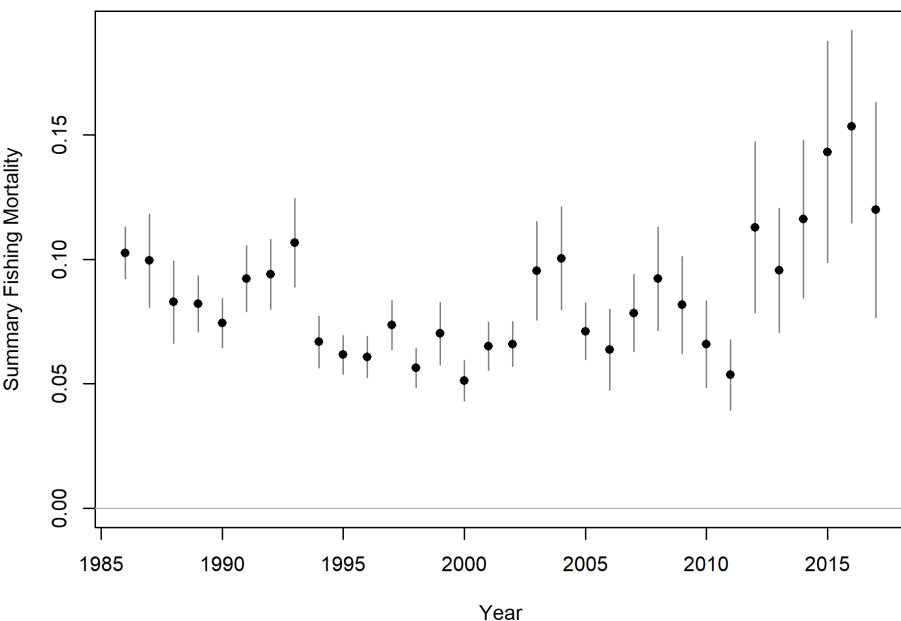


Biomass and Numbers-at-Age



Fishing Mortality

| | Com VL | Com LL | Charter Private | Headboat |
|-----------|-----------------|-----------------|------------------|----------|
| Initial F | 0.05 (0.084) | 0.053 (0.09) | 0.029 (0.072) | None |



- Higher exploitation in recent years due to increased Charter Private

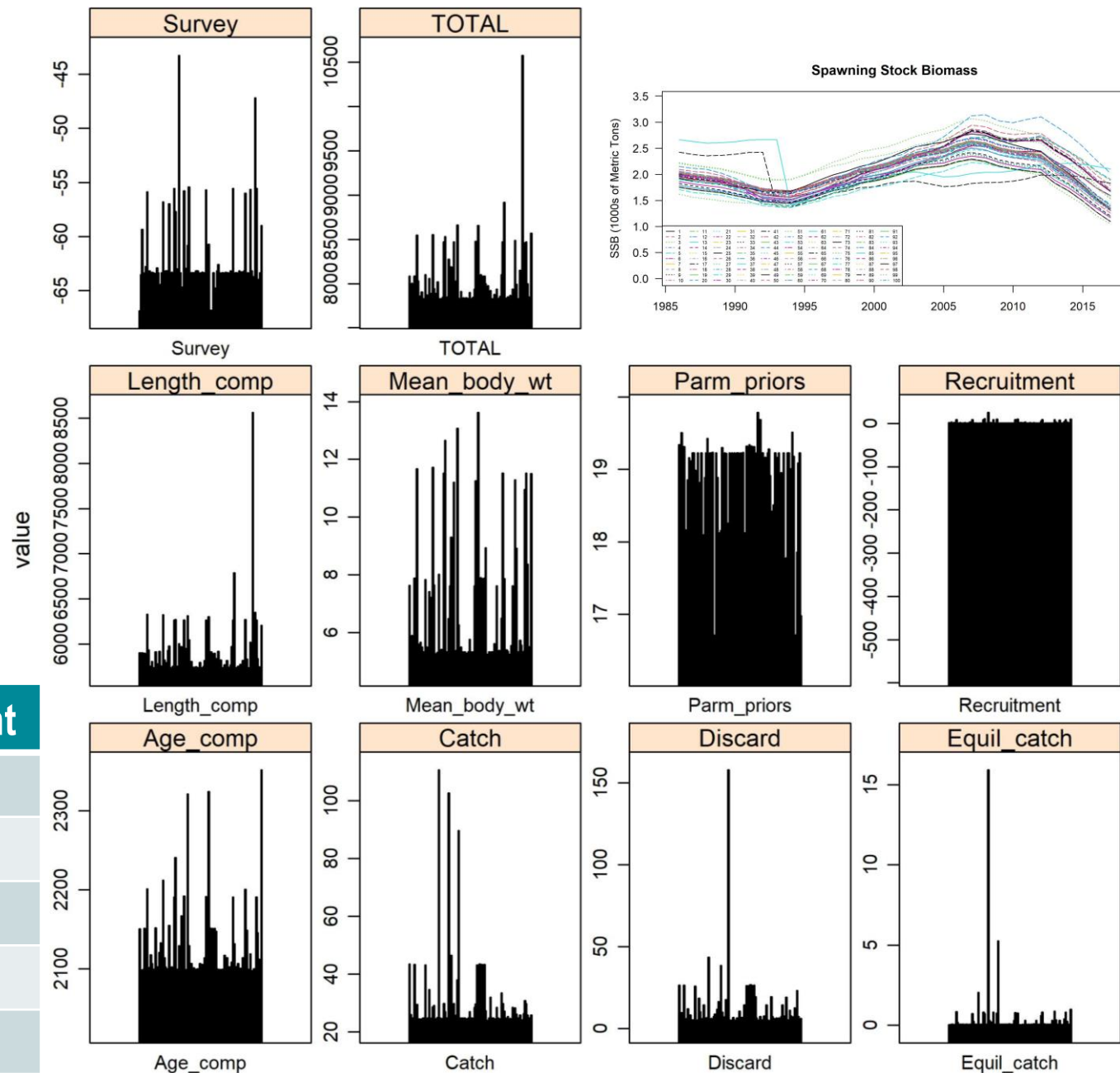
Diagnostics



Jitter analysis

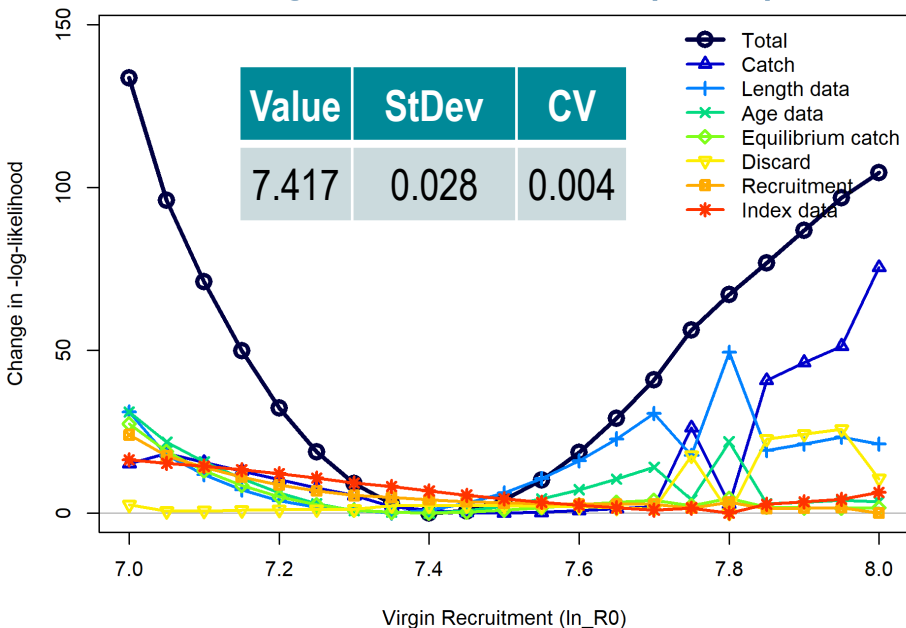
- Majority of runs result in similar trends, but see poorly defined minimum NLL
- Of 100 runs:

| Results | Percent |
|---------------|---------|
| Same NLL | 20 |
| Within 1 NLL | 21 |
| Within 5 NLL | 30 |
| Within 25 NLL | 44 |
| Within 50 NLL | 50 |



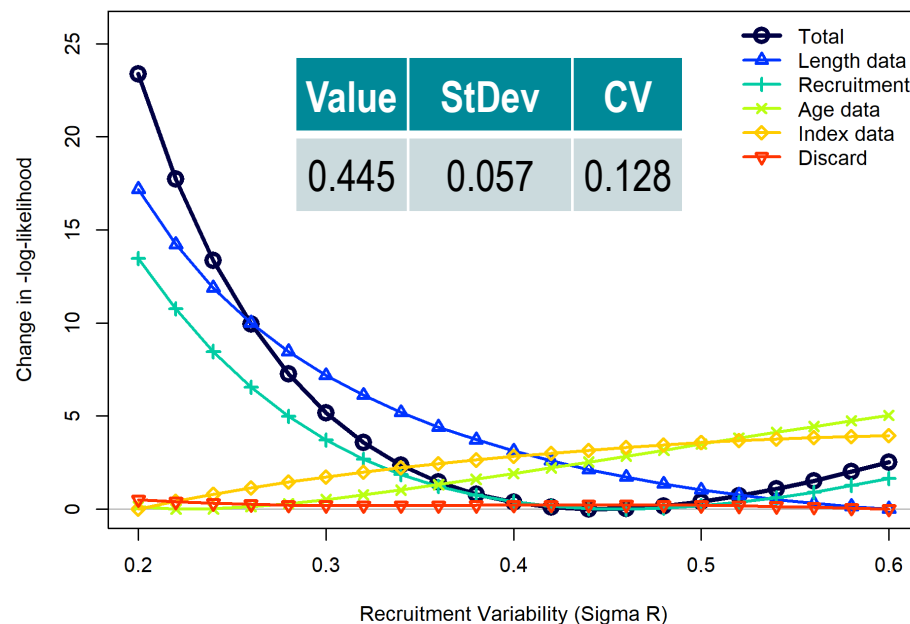
Likelihood profiles

Virgin recruitment (lnR0)



- Total NLL Minimum: 7.45
- 7.4-7.45 within 2 NLL
- **Indices** support higher value

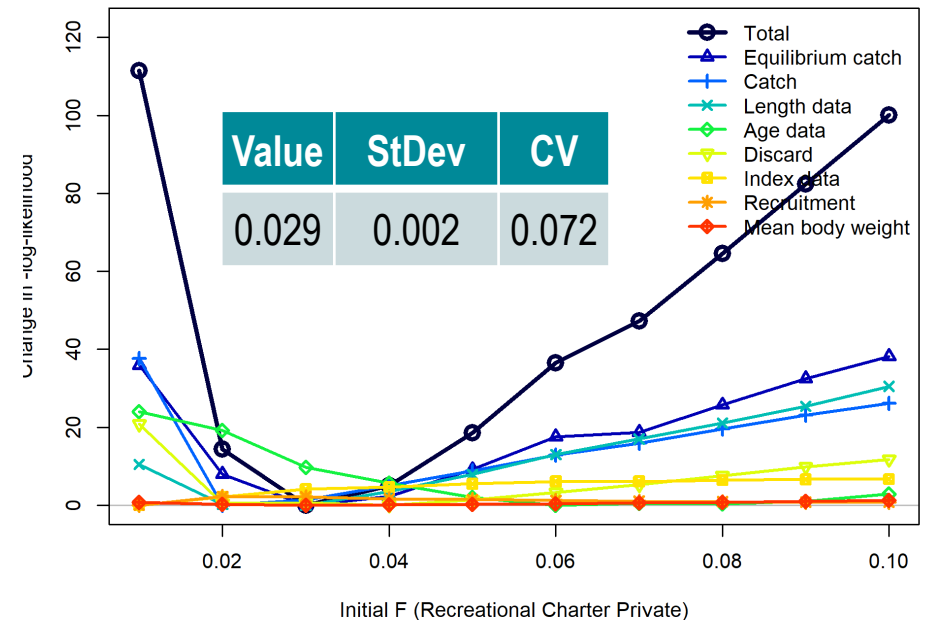
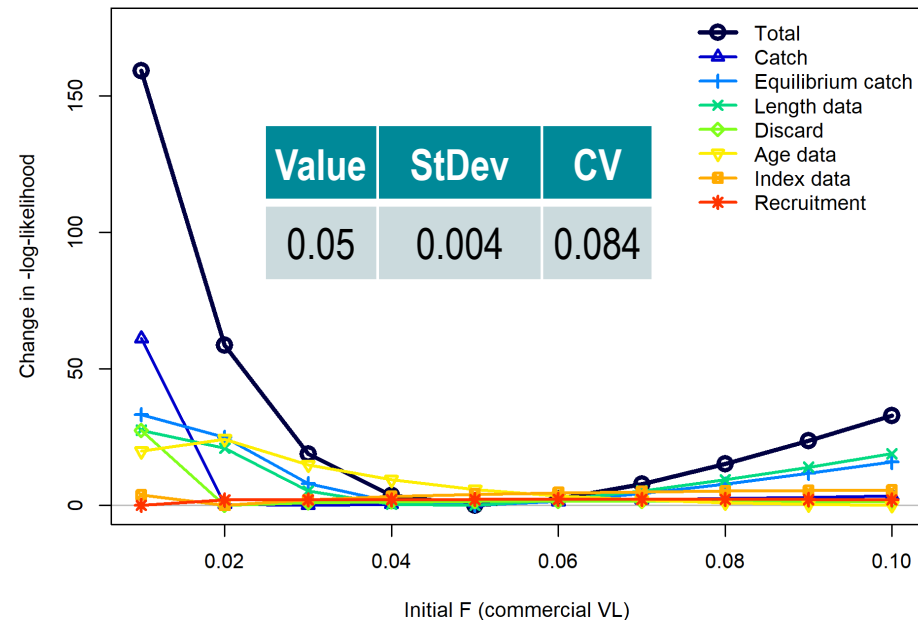
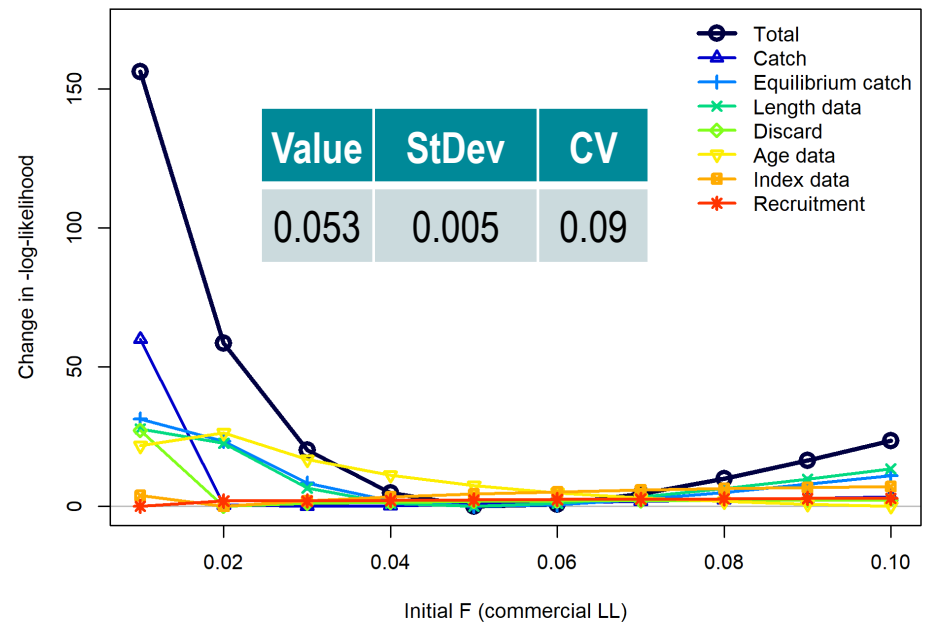
Recruitment variability (sigmaR)



- Total NLL Minimum: 0.44
- 0.28-0.46 within 2 NLL
- **Index** and **Age** support low, **Length** supports high value

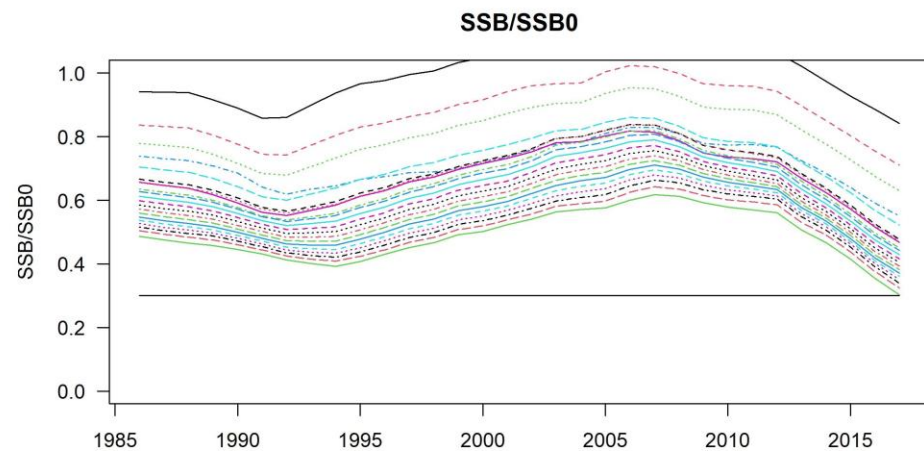
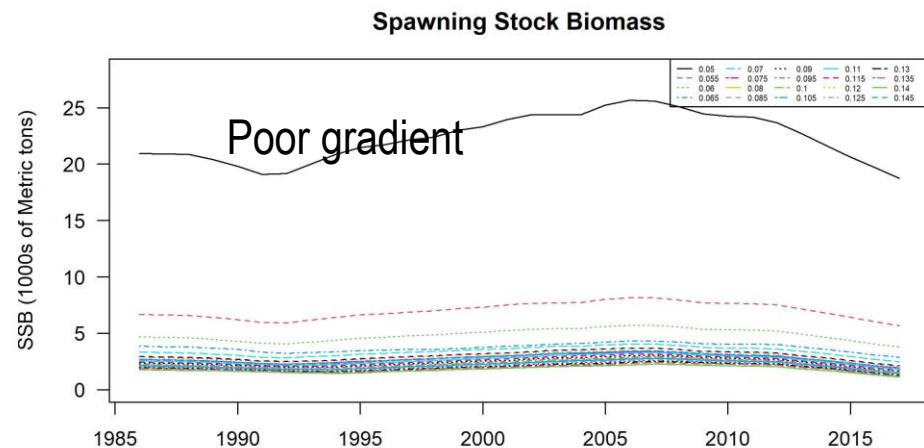
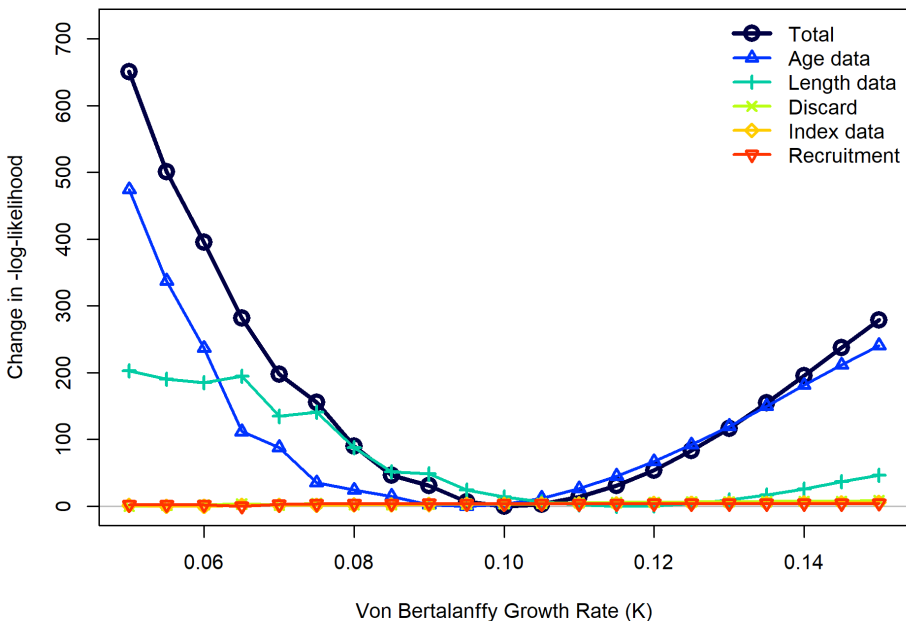
Likelihood profile: Initial F

- Most data sources show minimum close to model estimate



Likelihood profile: K

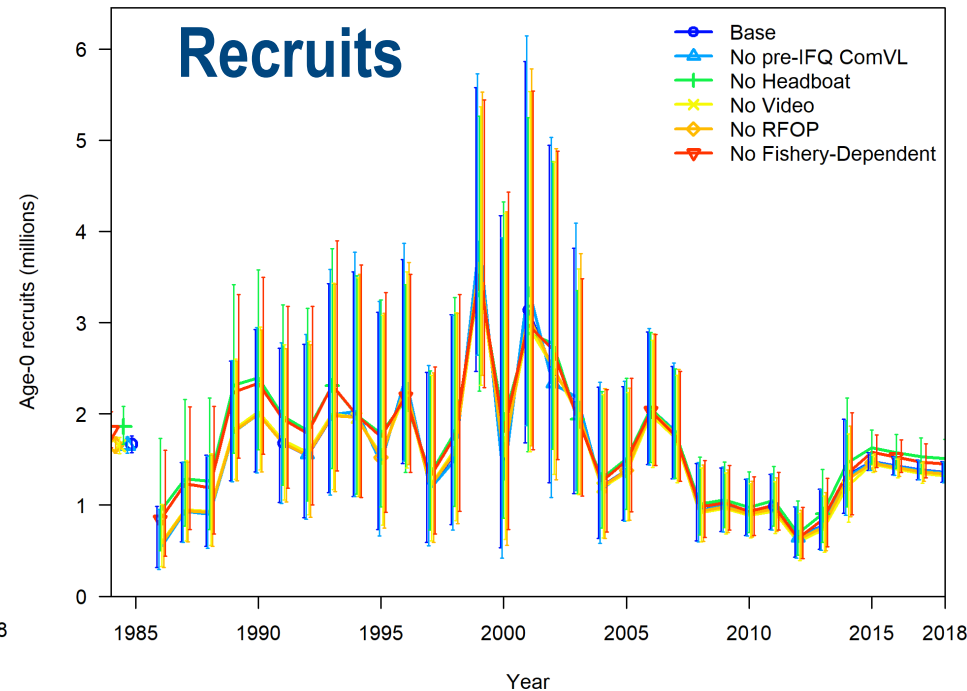
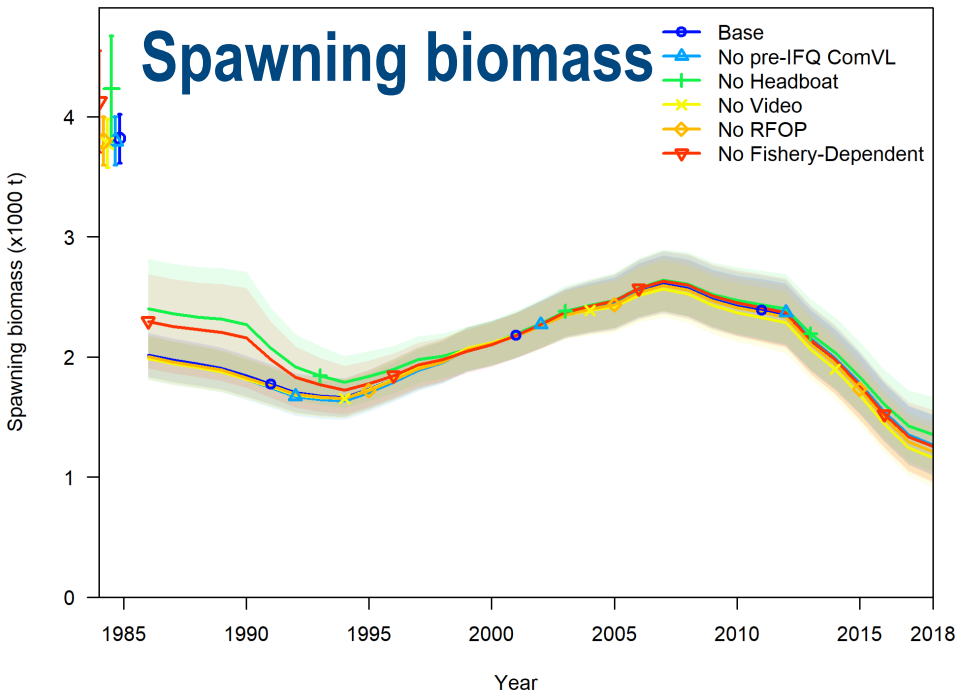
- Total NLL Minimum: 0.105
- None within 2 NLL
- **Age** supports 0.10, **Length** support 0.115



| Label | Value | StDev | CV |
|-------|---------|-------|----|
| K | 0.13406 | - | - |

Index Jack-knife runs

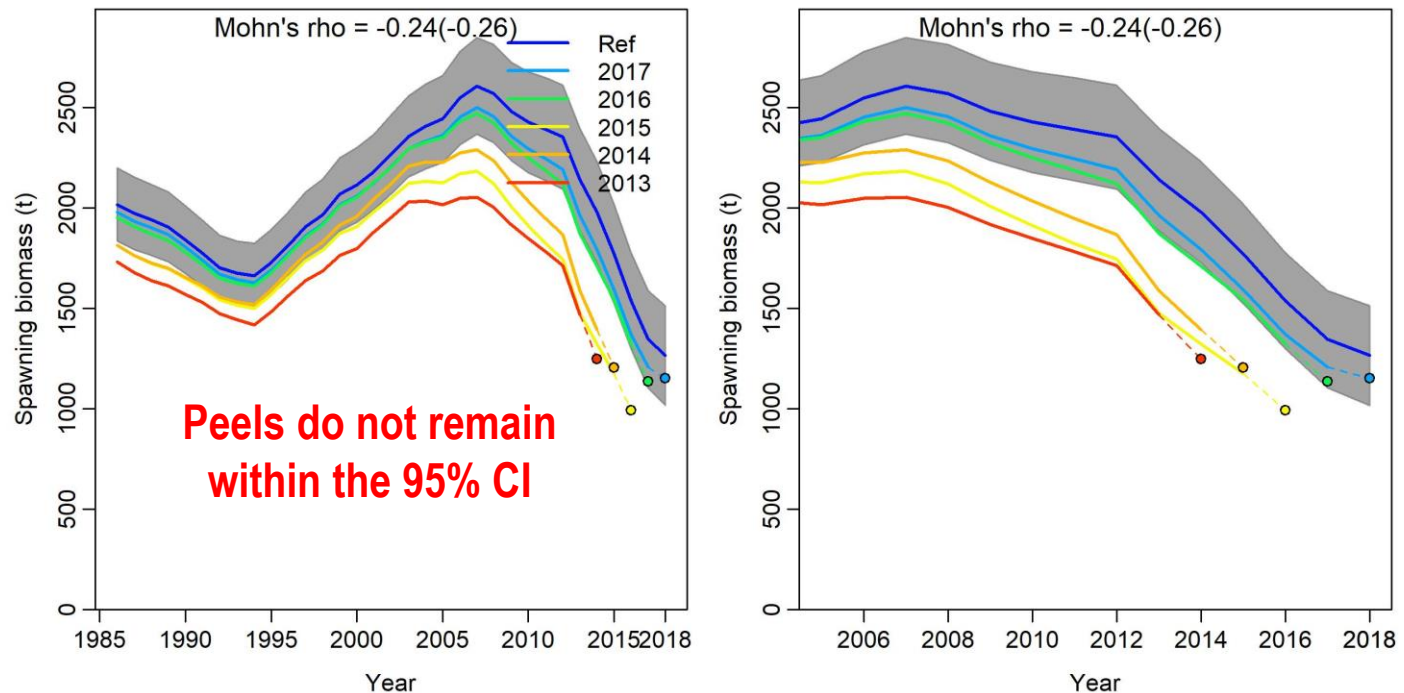
- Purpose: determine which index or indices were most influential on derived quantities



- Exclusion of Video index or RFOP index leads to slightly lower SSB in recent years

Retrospective bias

- Large retro bias falls outside the acceptable thresholds for long-lived species (-0.15 to 0.2; Hurtado et al. 2015)
- ρ_F is slightly more negative (-0.26)



Additional diagnostics (Carvahlo et al. 2021)

- Non-random patterns in residuals evident

| Data Source | ComVL | ComLL | Charter Private | Headboat | Video | RFOP Vertical Line |
|-------------|-------|-------|-----------------|----------|-------|--------------------|
| Index | X | - | - | X | X | X |
| Age | X | X | X | X | - | - |
| Length | X | X | X | X | X | X |

- Poor predictive skill

| Data Source | ComVL | ComLL | Charter Private | Headboat | Video | RFOP Vertical Line |
|-------------|-------|-------|-----------------|----------|-------|--------------------|
| Index | - | - | - | X | X | X |
| Age | X | X | X | X | - | - |
| Length | X | X | X | X | X | X |

Sensitivity to assumptions

AP Base:

- Recreational landings standard errors (SEs)
- Steepness
- Natural mortality (low and high)
- Fraction of male contribution to SSB
- Estimate growth parameters

RW Base:

- Estimate growth parameters

Outstanding modeling issues

- Age and growth
 - Re-evaluate maximum size and asymptotic size in light of modeling issues noted during RW
 - 2003-2012 age data and re-estimation of growth curve
 - Re-evaluate representativeness of length and age data
 - Update ageing error matrix for Gulf samples only
- Selectivity and retention
 - Consider using priors or fixing some selectivity and retention parameters to stabilize model
- Investigate retrospective bias

Review Workshop recommendations

Short-term

Fleet-specific plots of the spatial distribution of each fishery to interpret changes in length/age composition over time

Adjust the L_{∞} to be better informed by the Life History Working Group

Long-term

Investigate the taxonomic status of yellowmouth; develop a time series of their proportion over time

Further investigate changes in reporting of recreational landings from all data sources and how the changes contribute to imprecision in the series

Consider the ROV data collected by Lewis et al. (2020)

More age samples for each fleet

More effort should be given to formally evaluate and incorporate ecosystem considerations

Consideration of environmental factors/ecosystem

Ensemble modeling approach to integrate main sources of uncertainty

Develop artificial intelligence approaches as well as additional automation for image processing and for reading and analysis of video, otoliths, gonad sections and other samples

Questions?

Thank you for your attention!



Extra Slides



Data inputs

- **Landings**
 - Vertical line **GWT**: 1986-2017 (include “Other”)
 - Longline **GWT**: 1986-2017
 - Private/Charter GWT or **Numbers**: 1986-2017
 - Headboat GWT or **Numbers**: 1986-2017
- **Discards**
 - Vertical line GWT or **Numbers**: 2000-2006 (reconstructed), 2007-2017 (NMFS observer program)
 - Longline GWT or **Numbers**: 2000-2006 (reconstructed), 2007-2017 (NMFS observer program)
 - Private/Charter **Numbers**: 1986-2017
 - Headboat **Numbers**: 2000-2017
- **Length composition of discards**
 - Vertical line **Nominal**: 2006-2017 (NMFS observer program)
 - Longline **Nominal**: 2006-2017 (NMFS observer program)
 - Charter **Nominal**: 2010-2017 (FWC observer program)
 - Headboat **Weighted** (by trip type): 2005-2007, 2010-2017 (FWC observer program)
- **Length composition of retained catch**
 - Vertical line **Weighted**: 1986-2017
 - Longline **Weighted**: 1986-2017
 - Charter **Nominal**: 1992, 1997-2017
 - Headboat **Nominal**: 1986-2017
- **Mean body weight of retained catch**
 - Charter: 1986-2017
 - Headboat: 1986-2017
- **Age composition of retained catch (Nominal)**
 - Vertical line: 1991-2017 (incomplete)
 - Longline: 1992-2017 (incomplete)
 - Private/Charter: 1991-2017 (incomplete)
 - Headboat: 1991-2017 (incomplete)
- **Abundance indices**
 - Vertical line: 1993-2009 (pre-IFQ)
 - Headboat: 1986-2017
 - Video survey (FWRI, PC, SEAMAP): 1993-1997, 2002, 2004-2017
 - RFOP vertical line: 2007-2017
- **Length composition of survey data**
 - Combined video survey: 1996-2017 (incomplete)
 - RFOP vertical line: 2007-2017

