SEDAR 68 – Gulf Scamp (*Mycteroperca phenax*)

Review Workshop

Data

NOAA FISHERIES
Gulf Branch,
Miami, FL

August 30, 2021

Outline

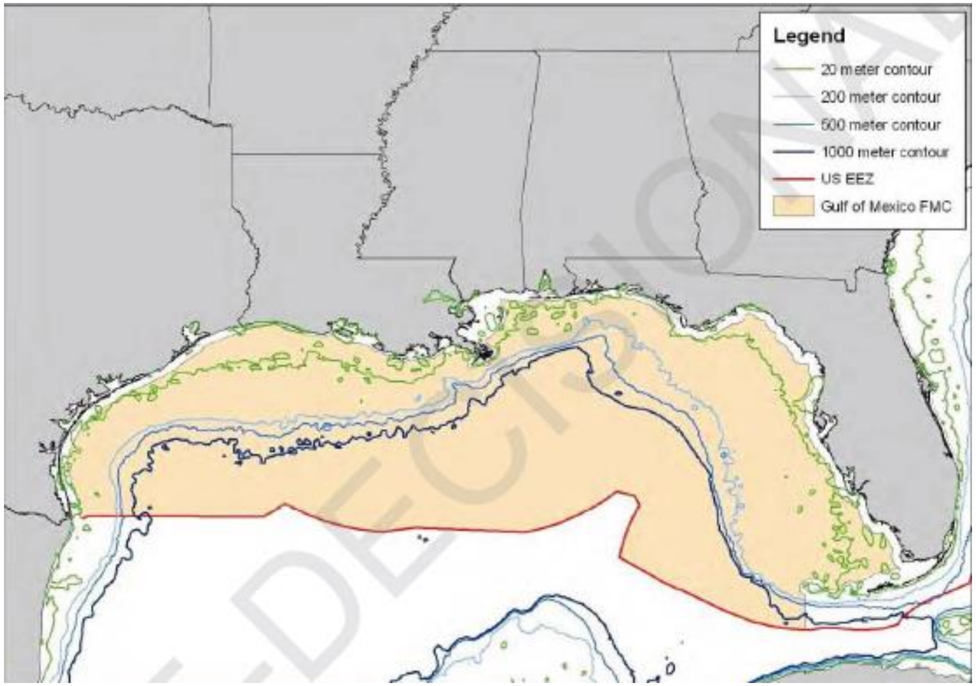
Scamp Grouper: *Mycteroperca phenax*

- Data Review
  - Stock definition
  - Regulations
  - Life history
  - Removals
  - Size compositions
  - Age compositions
  - Index of abundance
  - Survey length composition

- Assessment model
  - Base configuration
  - Base results
  - Diagnostics
  - Sensitivities

Stock/Management boundary

- Gulf of Mexico stock is separated from the South Atlantic at council boundary line (U.S. Highway 1 in Florida Keys)
- Supported by Stock ID Workshop (SEDAR68-SID-05)
    - Found no evidence of biological substructure supporting deviation from management boundary

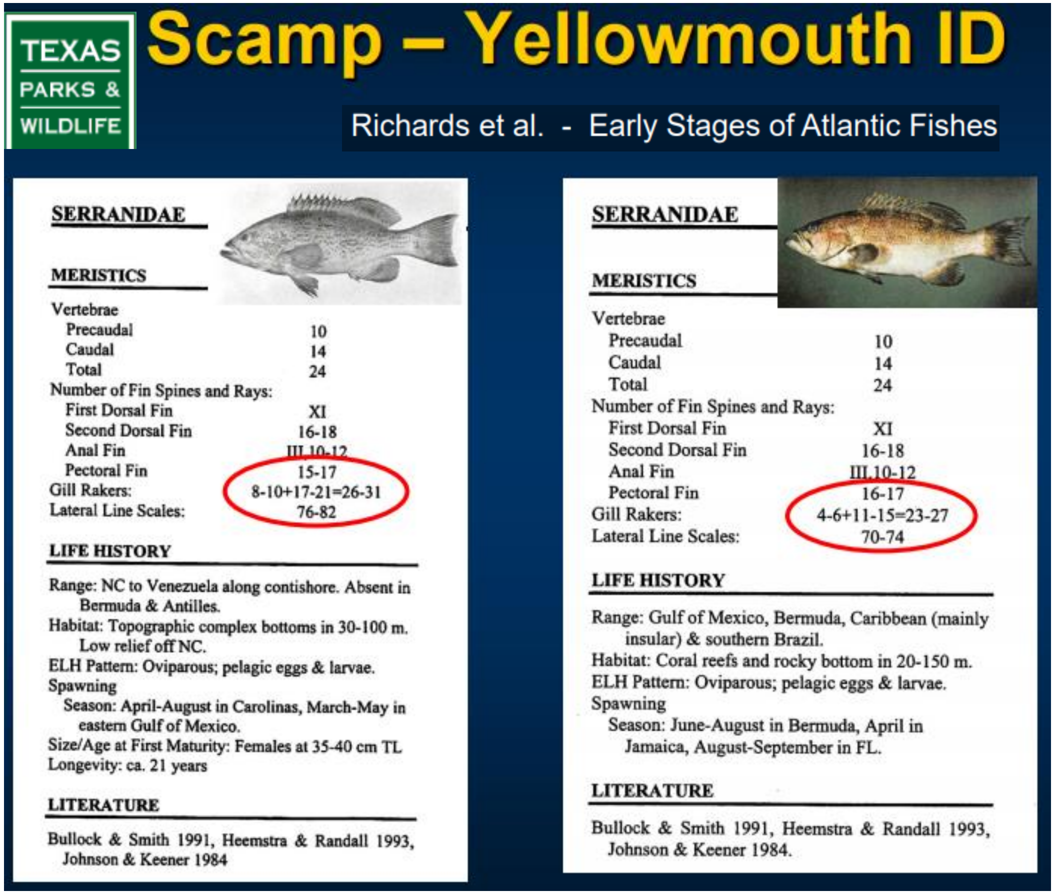


Stock ID Workshop recommendation

- Assess scamp and yellowmouth grouper as a complex due to misidentification issues
  - Scamp represent majority of available data

SEDAR68 Stock ID Life History WG Webinar 2:

- Focused on difficulty identifying each species



Gulf assessment history

- Scamp grouper:
  - None
- Yellowmouth grouper:
  - SEDAR 49 AW Panel recommended that Yellowmouth Grouper be considered during the upcoming Scamp assessment:
    - Severe data limitations surrounding misidentification
    - Sporadic data inputs (generally confidential)
    - Misidentification issues
    - Yellowmouth Grouper represents the minority of the combined catches

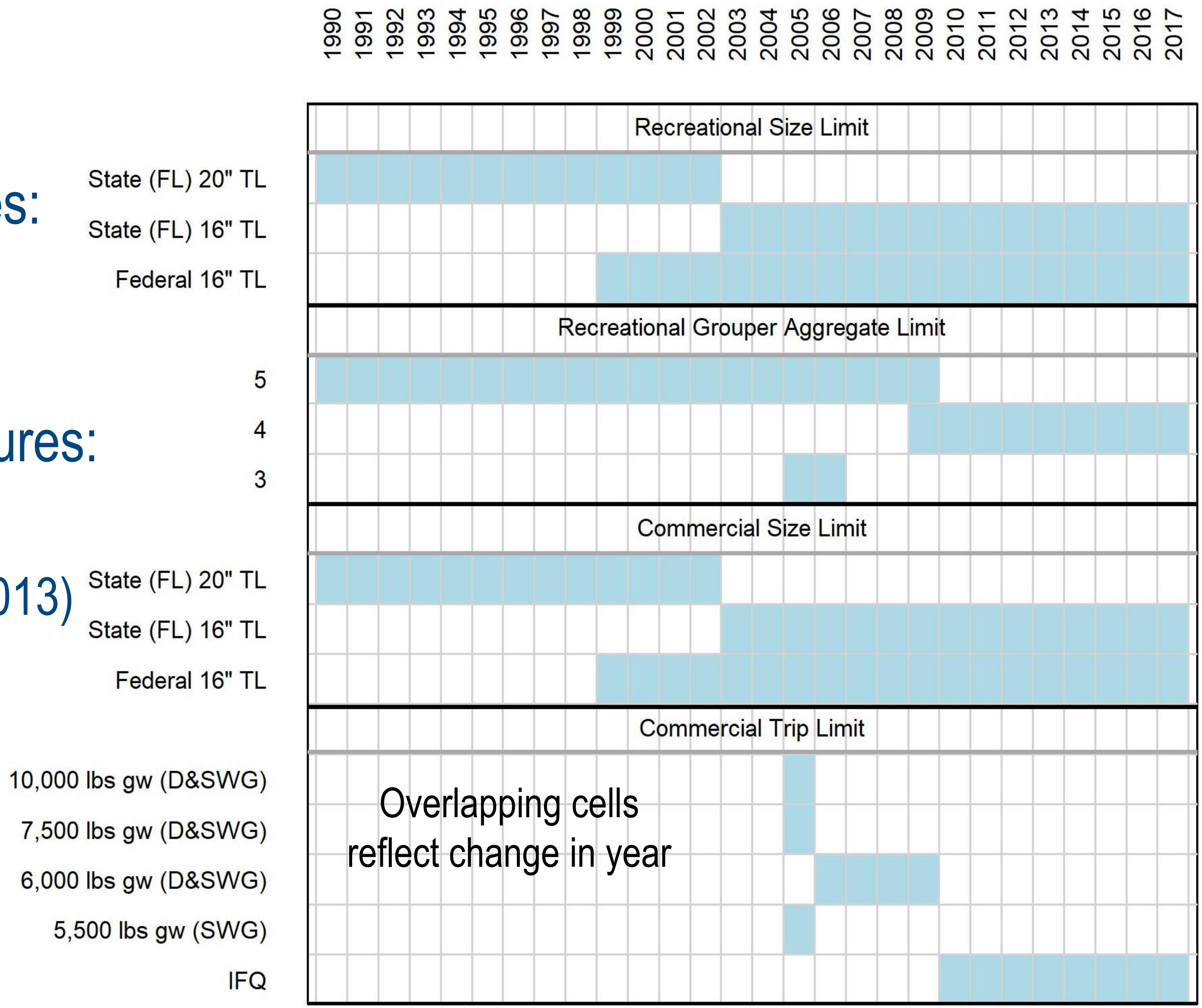
Gulf Scamp regulations

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)

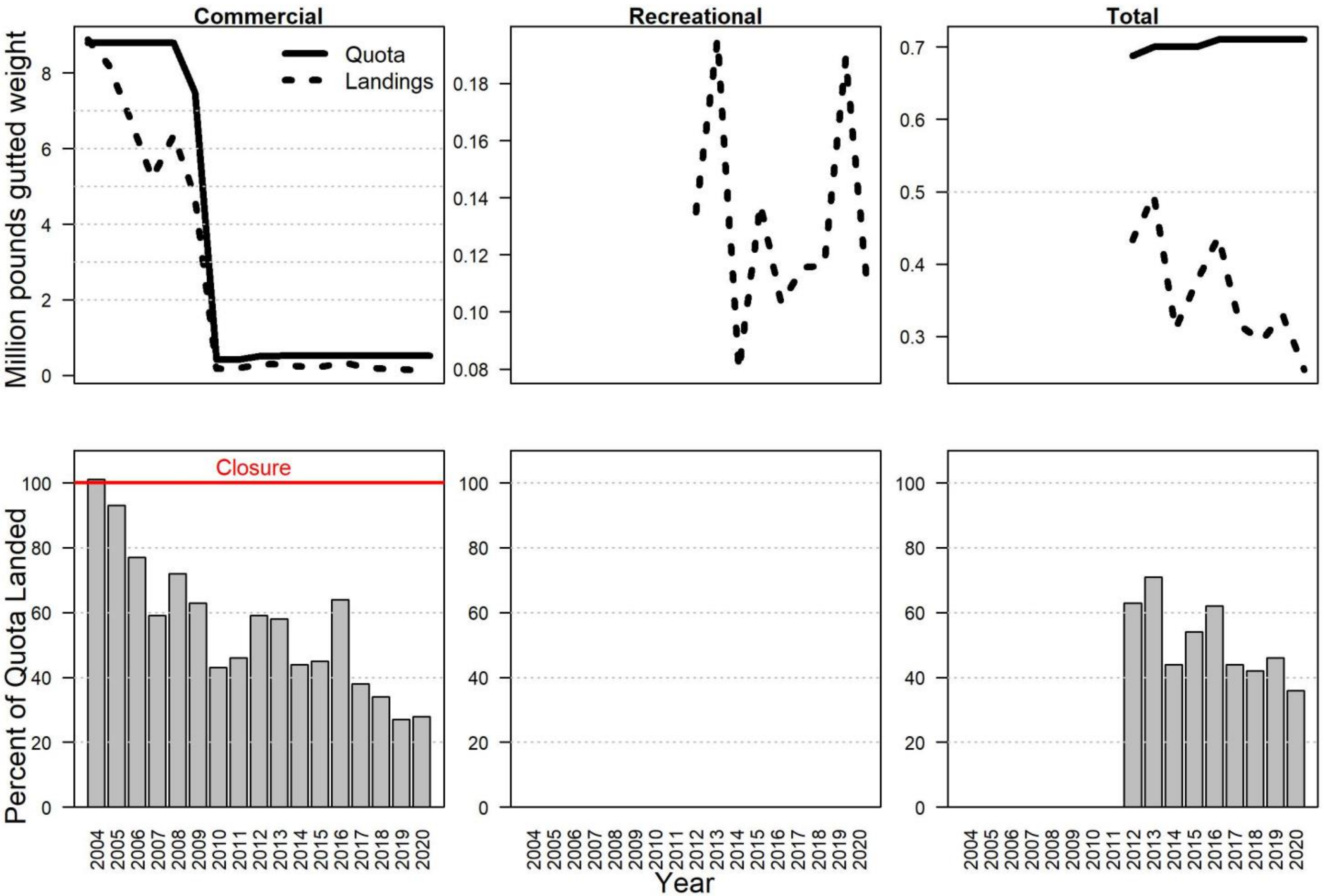


Grouper-Tilefish Individual Fishing Quota (IFQ) program

- Implemented in 2010 (Amendment 29)
  - Aimed to reduce overcapacity of the grouper-tilefish fishing fleet, increase harvesting efficiency, and eliminate the race to fish
  - *http://portal.southeast.fisheries.noaa.gov/cs/main.html*

- Has led to development of separate CPUE indices both pre-IFQ (through 2009) and post-IFQ (2010 onward) due to concerns over changes in fishing practices

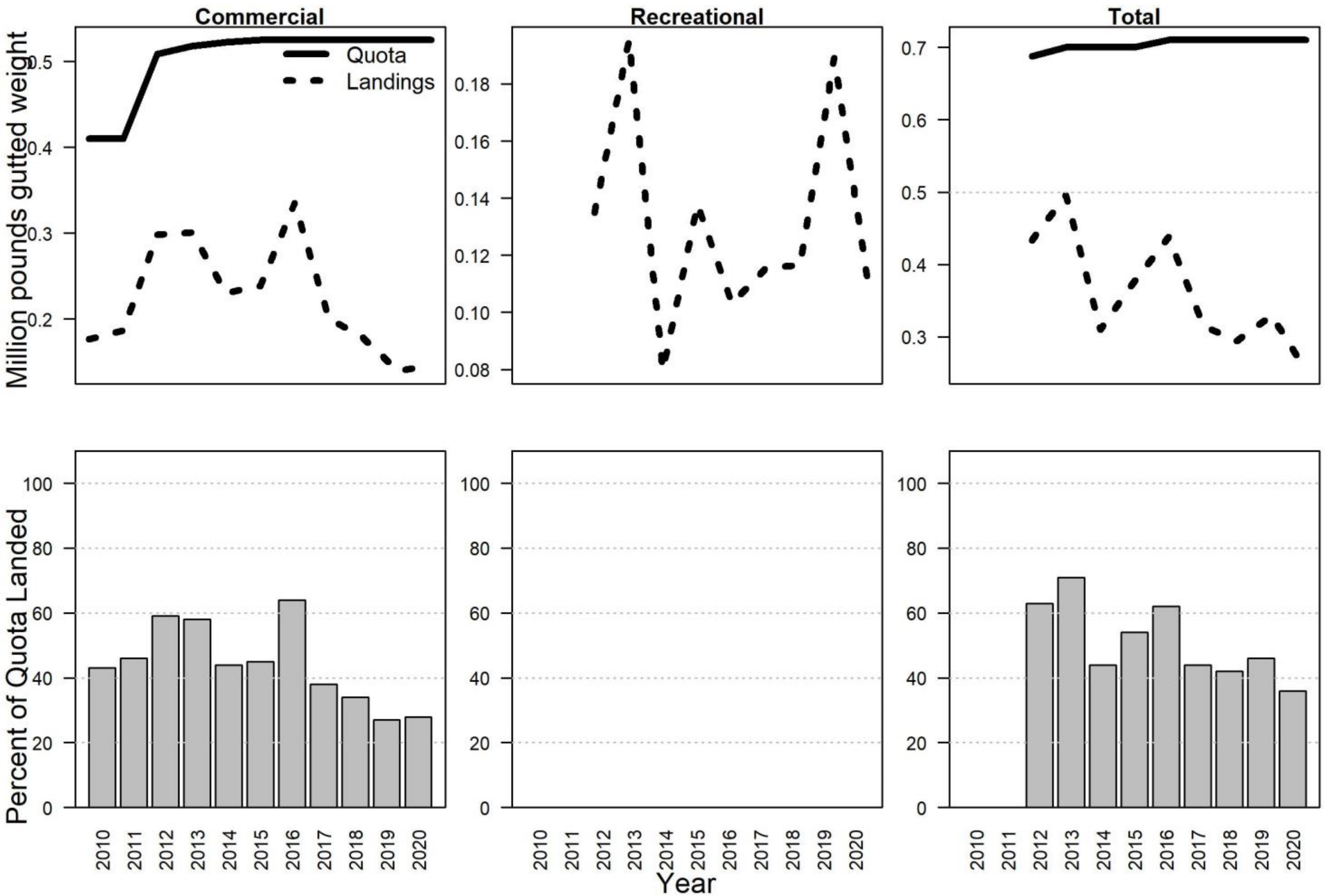
Quotas – Shallow Water Grouper (includes gag and red grouper)



Commercial
2004-2018 ACL/ACT/Landings Data: Historical landings (https://www.fisheries.noaa.gov/southeast/gulf-mexico-historical-commercial-landings-and-annual-catch-limit-monitoring)
2019-2020 ACT/Landings Data: IFQ (https://portal.southeast.fisheries.noaa.gov/reports/cs/CommercialQuotasCatchAllowanceTable_Dec3_2019.pdf)

Recreational
2010-2020 Landings Data: Historical landings (https://www.fisheries.noaa.gov/gulf-mexico-historical-stock-landings-and-annual-catch-limit-monitoring)

Quotas – Shallow Water Grouper (minus gag and red grouper)



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2010-2018 Landings Data: Historical landings (https://www.fisheries.noaa.gov/gulf-mexico-historical-stock-landings-and-annual-catch-limit-monitoring)

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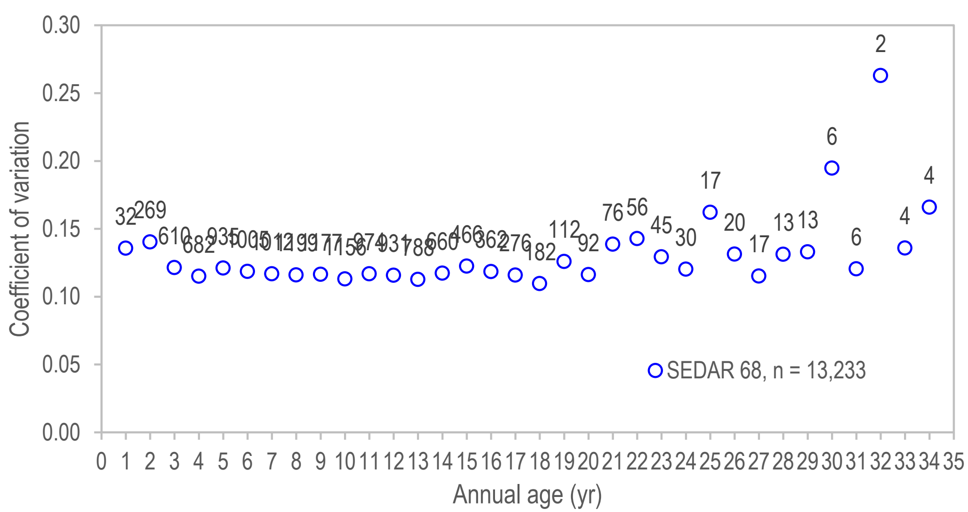
  - Life history
  - Removals
  - Size compositions
  - Age compositions
  - Index of abundance
  - Survey length composition

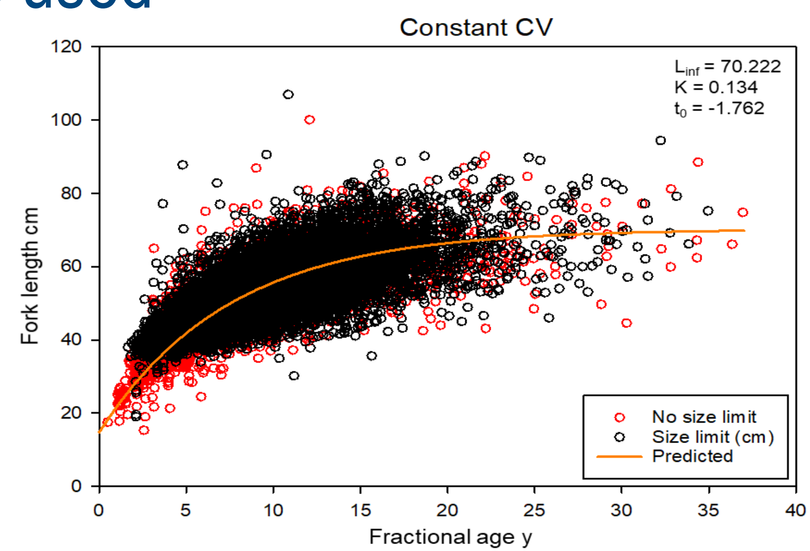
- Age and growth
- Ageing error
- Reproductive biology
  - Maturity
  - Hermaphroditism
  - Fecundity
- Meristics
- Natural mortality
- Discard mortality

Age and Growth

Parameter	SEDAR68	Alt (increase linearly w/ age)
L_∞	**70.222 cm**	69.752
K	**0.134**	0.139
t_0	**-1.762**	-1.689
CV	**0.130**	0.118, 0.140

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



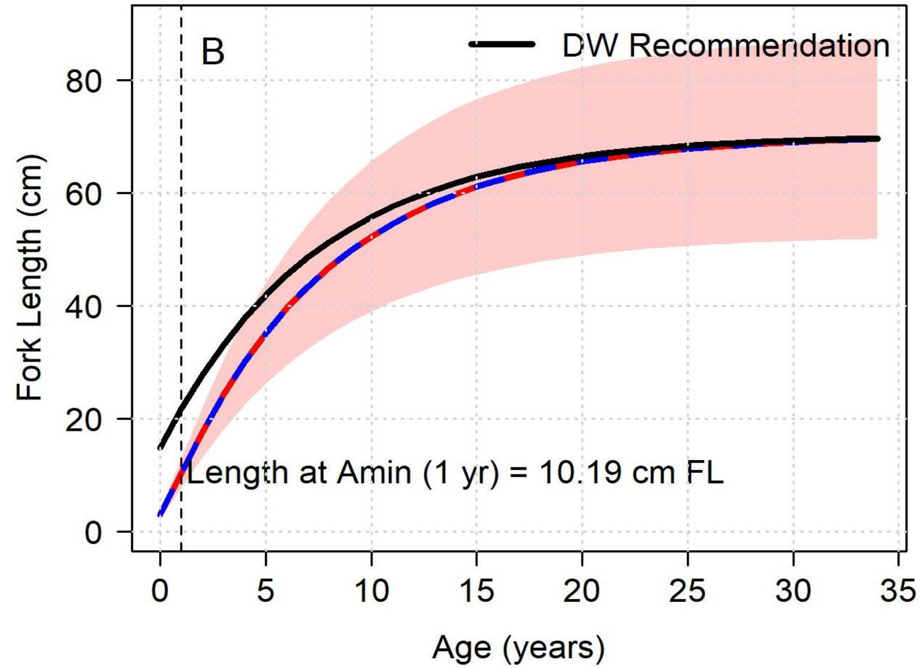


Population growth curve

- Growth curve for population was fixed in assessment model, with the exception of the length at the minimum age

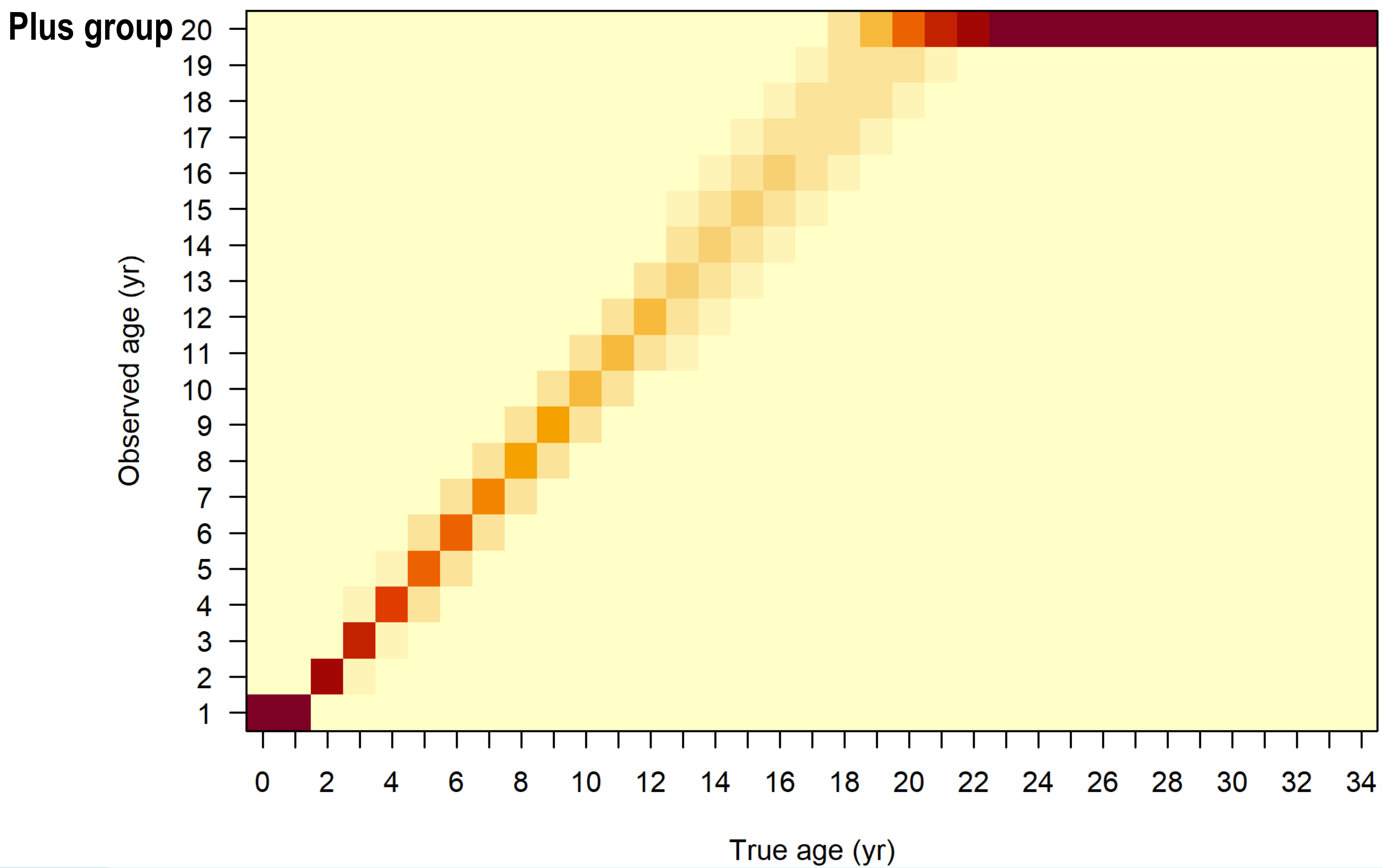
Parameter	Value	Status
L_{Amin}	19.8 cm FL*	Estimated
L_∞	70.222 cm	Fixed
K	0.134	Fixed
t_0	-1.762	Not used in SS
CV	0.130	Fixed

*Starting value of 19.8 cm FL for L_{Amin} based on age-1 length after adjusting for peak spawning in mid-April



Recommended and estimated growth curves (shaded area indicates the 95% distribution of length-at-age)

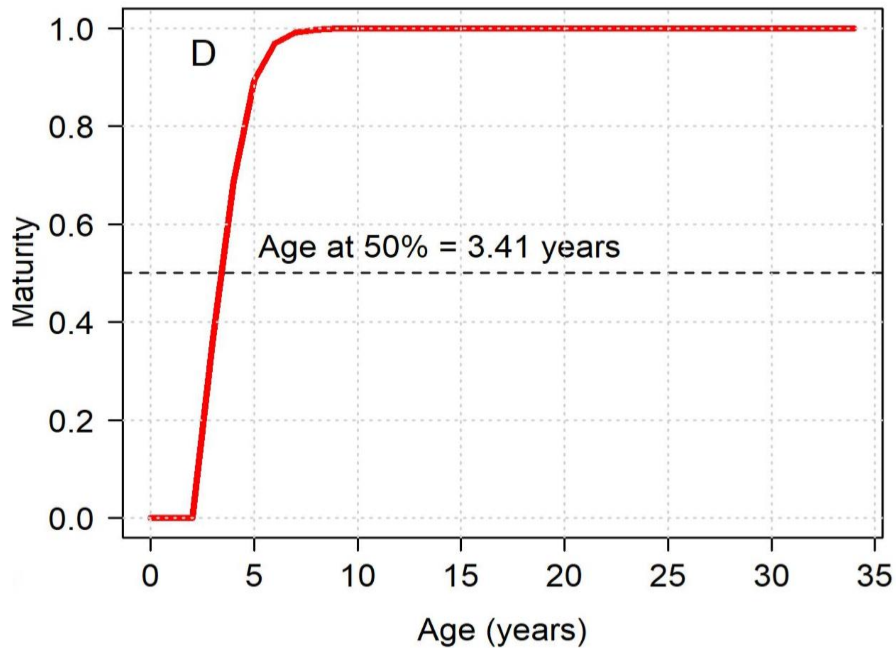
Ageing error matrix



Maturity-at-age

- Logit fit revealed the best fit for female age at functional maturity
- First age mature = 3 years
- Relationship fixed in assessment model

Parameter	Value	Status
Mat50%	3.407	Fixed
Maturity Slope	-1.3346	Fixed



maturity-at-age

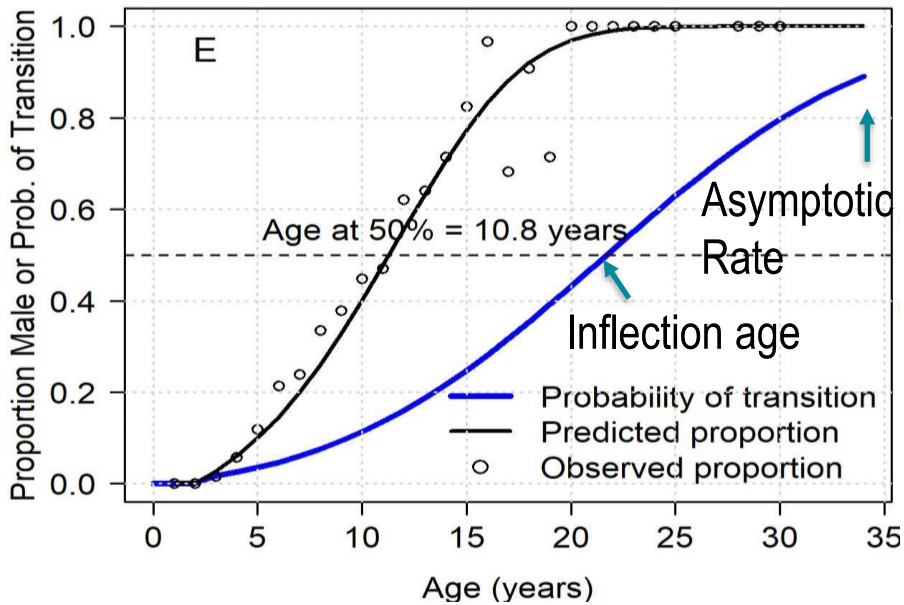
Hermaphroditism in Stock Synthesis

- Requires two gender model
- Hermaphroditism feature in SS
  - Defines the probability of transition rate of females to males using a cumulative normal distribution
    1. Inflection age: 50% of individuals transition to male
    2. Standard deviation (in age): controls how quickly the asymptote is reached
    3. Asymptotic rate: asymptotic proportion of transition
       - 1 = all females have transitioned by the max age (i.e., plus group),
       - <1 = females still present in plus group

Hermaphroditism for Scamp

- Starting at age-3 (youngest male observed)
  - New feature added into SS to specify first age for transition
  - Proportion male shown but not required by SS as an input

Parameter	Value	Status
Inflection Age	21.525	Fixed
StDev in Age	10.141	Fixed
Asymptotic Rate	0.891	Fixed

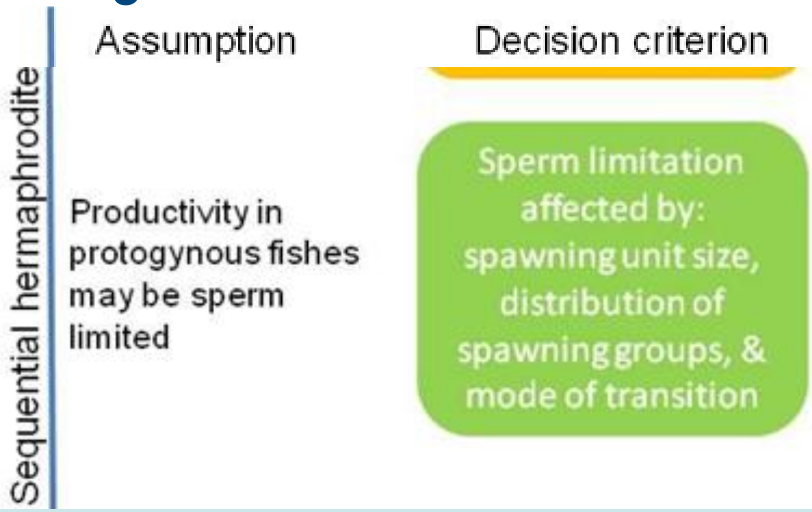


Total N = 1,934

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

Measure of reproductive potential

- In absence of fecundity estimates, SEDAR68 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

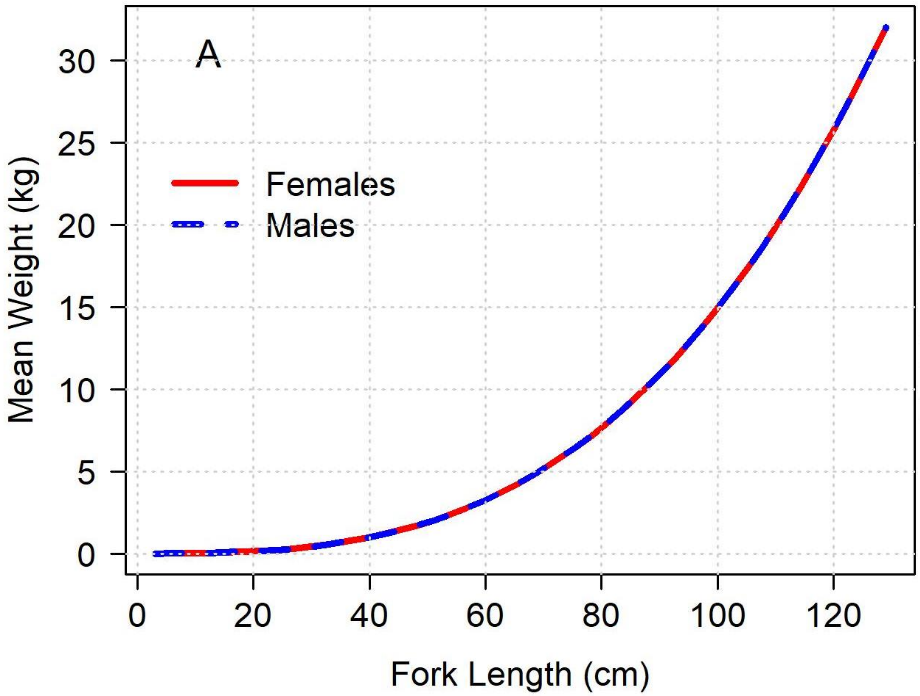


3. Limited understanding
   - Potential sperm limitation, integrate terminal sex into measure of reproductive potential; current best practices: combined biomass
   - If not a concern, treat as a gonochorist

Meristics

Regression	Equation	statistic	N	Data Range
Max TL to FL	FL = 2.30 + max_TL * 0.87	r^2=0.99	2,994	Max TL: 18.7 – 100.1; FL: 17.8 – 94.4
Nat TL to FL	FL = 1.77 + nat_TL * 0.89	r^2=0.99	3,205	Nat TL: 16.7 – 97.6; FL: 16.0 – 94.4
FL to GWT	GWT= 1.19 E^{-05} * ($FL^{3.04}$)	MSE = 0.016	30,798	FL: 22.0 – 117.0; GWT: 0.050 – 25.58
WWT to GWT	GWT = 0.95 WWT	r^2=0.9987	396	WWT: 0.136 – 7.8; GWT: NA

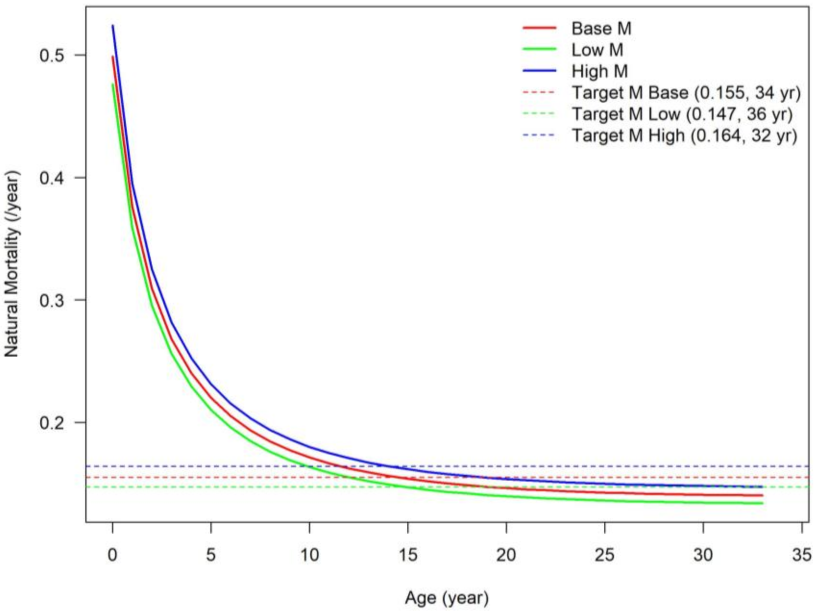
- Length-weight relationship fixed in the assessment model
- Body weight units:
    - Centimeters (cm) fork length
    - Kilograms (kg) gutted weight



mean body weight-at-length

Age-specific natural mortality – Lorenzen

- DW recommended the Lorenzen (1996): 3.69*Wgt^(-0.305)
- Updated to Lorenzen (2000) estimator which assumes a size-dependent mortality schedule in which instantaneous mortality rate at age is inversely proportional to length at age
  - Adjusted to account for peak spawning in mid-April
  - Input as a fixed vector
  - Male and female assumed identical



Age-specific M vector accounting for spawn shift

- $L_t = L_{inf} \times \left(1 - exp^{-K*(a_t - t_0 + 0.5 - spawn\ shift}\right)$
  - Includes a 0.5 shift to midyear & Apr 15 shift
- $M_y = -\log\left(\frac{L_t}{L_t + L_{inf} \times exp^{K \times (a_{t+1} - a_t)} - 1}\right)\frac{M_1}{L_{inf} \times K}$
- First age at vulnerability to fishery = age 6
- Target M = 0.155 (Then et al., serranids data only; max age = 34)
- VB growth parameters (SEDAR68)

Lorenzen, K., 2000. Allometry of natural mortality as a basis for assessing optimal release size in fish-stocking programmes. *Canadian Journal of Fisheries and Aquatic Sciences*, *57*(12), pp.2374-2381.

Lorenzen, K. 2005. Population dynamics and potential of fisheries stock enhancement: practical theory for assessment and policy analysis. Philosophical Transactions of the Royal Society of London. Fisheries Theme Issue 2004

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%)

- Bootstrapped predictions following Pulver (2017) approach using headboat data
  - Headboat: 26% (16-40%)
  - Charter-Private: 26% (16-40%)
    - Assumed similar to headboat because of similar fishing depth

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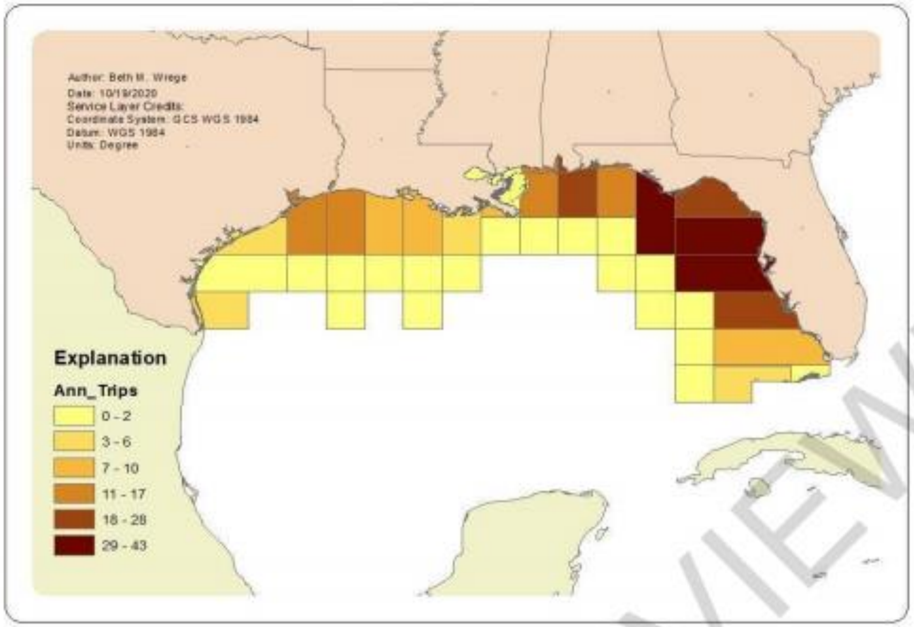
Commercial landings (gutted weight)

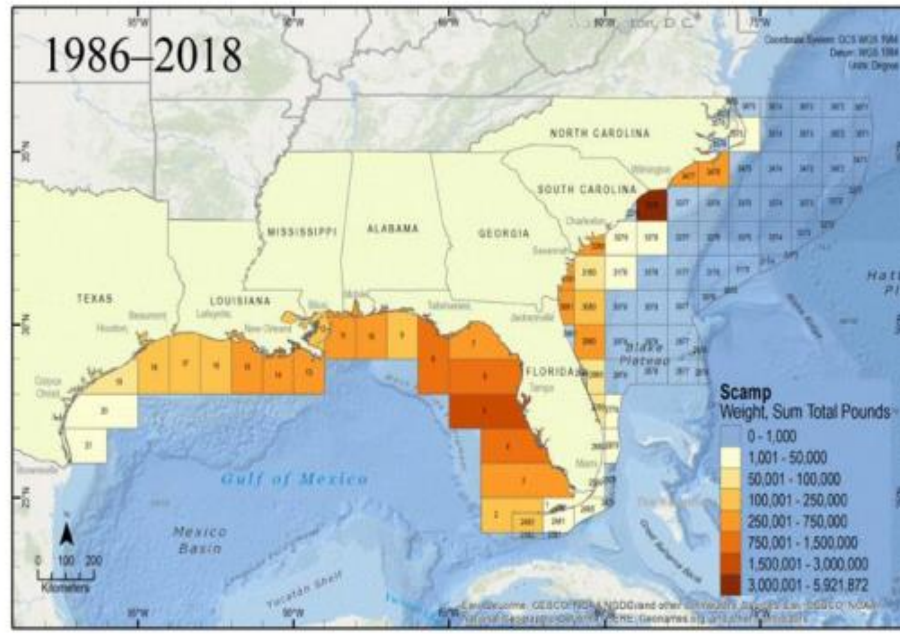
Data Source	Years	Notes
Annual Landings System (ALS; SEFSC)	1986-2017	Texas - Alabama
Florida Trip Ticket Program (ACCSP)	1986-2017	West Florida
Individual Fishing Quota (IFQ) Program	2010-2017	All states
~~Historical landings~~	~~1962-1985~~	• ~~Not recommended for use by SEDAR68 DW Commercial Working Group due to concerns over assumptions made to partition unclassified groupers~~

Commercial landings and effort by area

Mean trips from Coastal Fisheries Logbook Program



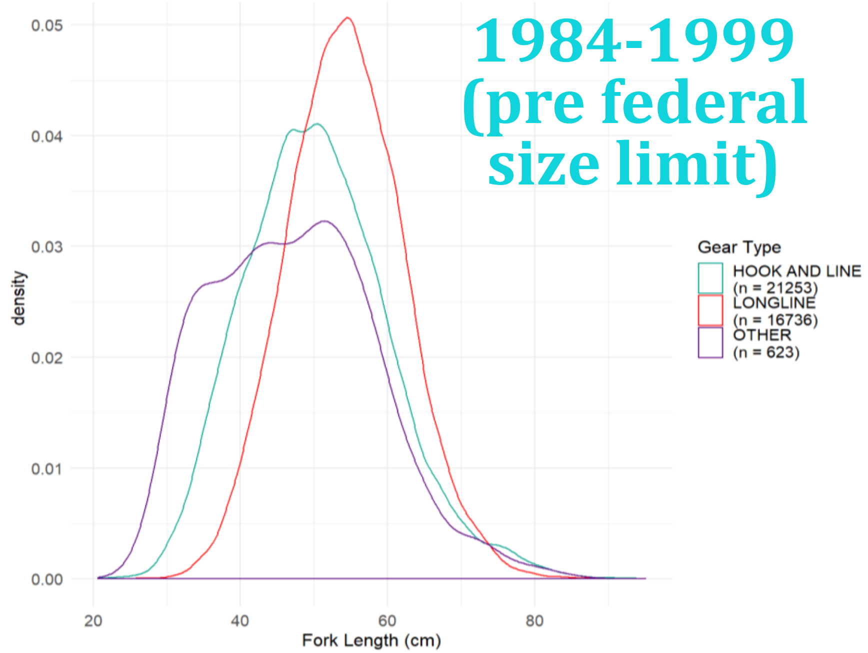
Total landings (pounds)

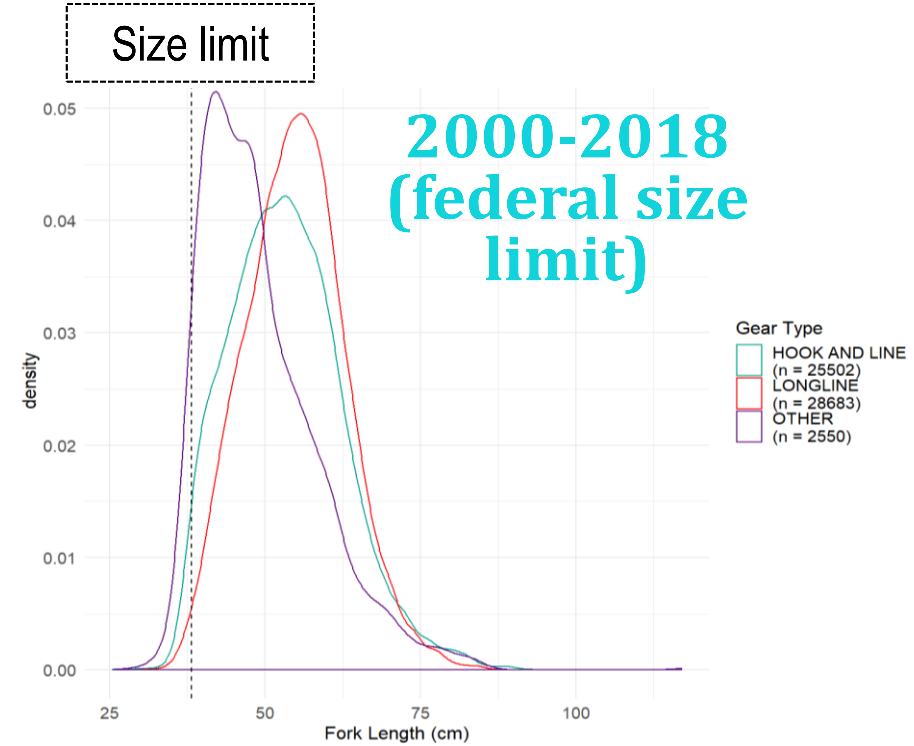


- Landed throughout Gulf, but mostly off of Florida

Commercial fleet designation

1. Commercial Vertical Line (i.e., hook and line)
    - “Other” gears lumped in based on similarities in size distributions (mean of 10% total landings, 0.6% - 27.5%)
2. Commercial Longline





Commercial landings uncertainty

- **1986-2009**: 0.05 following guidelines from South Atlantic (Table 3.4 in SA report adapted for Gulf)
- **2010-2017**: used 0.01 due to implementation of individual fishing quota (IFQ)

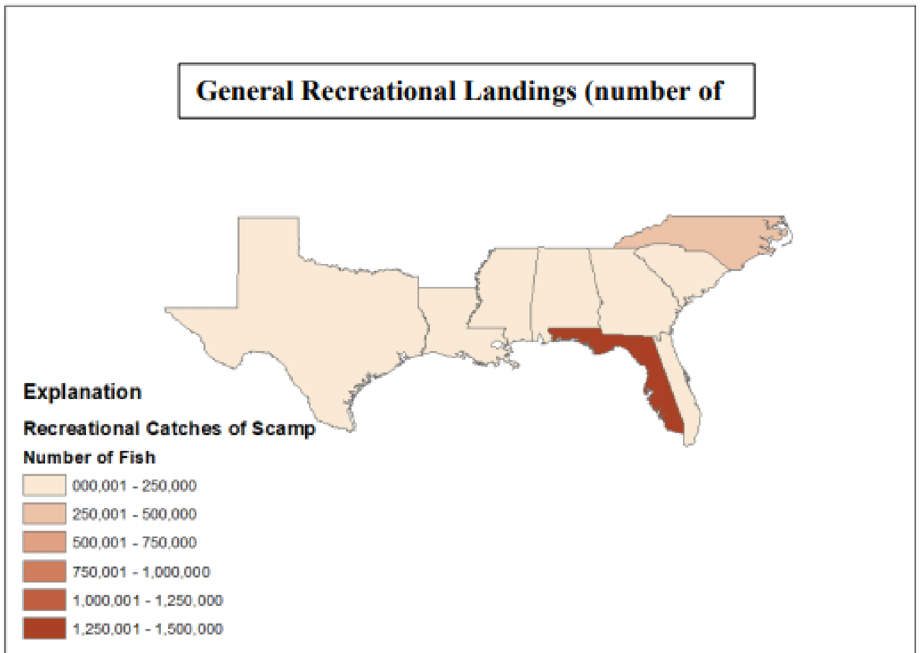
Year	TX	LA	MS	AL	FL - GOM	Comments
1986-1999	0.1	0.1	0.1	0.1	**0.05**	Florida starts state trip ticket, used in ALS 1986
2000-2001	0.1	0.05	0.1	0.1	**0.05**	Louisiana starts state trip ticket 1997; used in ALS 2000
2002-2009	0.1	0.05	0.1	0.05	**0.05**	Alabama starts state trip ticket, used in ALS 2002
2010-present	0.1	0.05	0.1	0.05	0.05	Shallow Water Grouper IFQ starts 2010
2014-present	0.05	0.05	0.05	0.05	0.05	Texas (2008) and Mississippi (2012) state trip tickets begin; used in ALS 2014 [MS may change to 2015]

Recreational landings (numbers or weights)

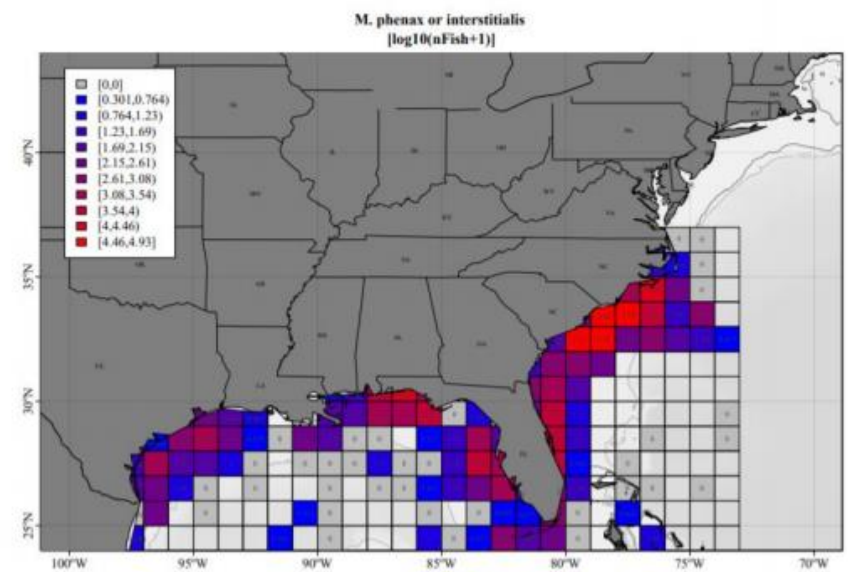
Data Source	Years	Notes
Marine Recreational Information Program (MRIP)	1981-2017	Continuous time series that uses the Fishing Effort Survey and includes the Access Point Angler Intercept Survey (APAIS) adjustment; excludes shore mode and Monroe County; SEDAR 68-DW-13
Louisiana Creel Survey	2014-2017	Survey began in 2014 Private/shore reported together Provided in native units (i.e., not calibrated to MRIP)
Texas Parks and Wildlife Department (TPWD)	1983-2017	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)
~~Historical~~	~~1950-1980~~	~~**Numbers only**; back-calculated using CPUE (SEDAR68-DW-12); Not included in base model due to model start in 1986 driven largely by commercial landings quality~~

Recreational landings by area

Charter Private landings (whole pounds) from MRIP, LA Creel, and TPWD



Headboat landings(number) from SRHS



Recreational fleet designation

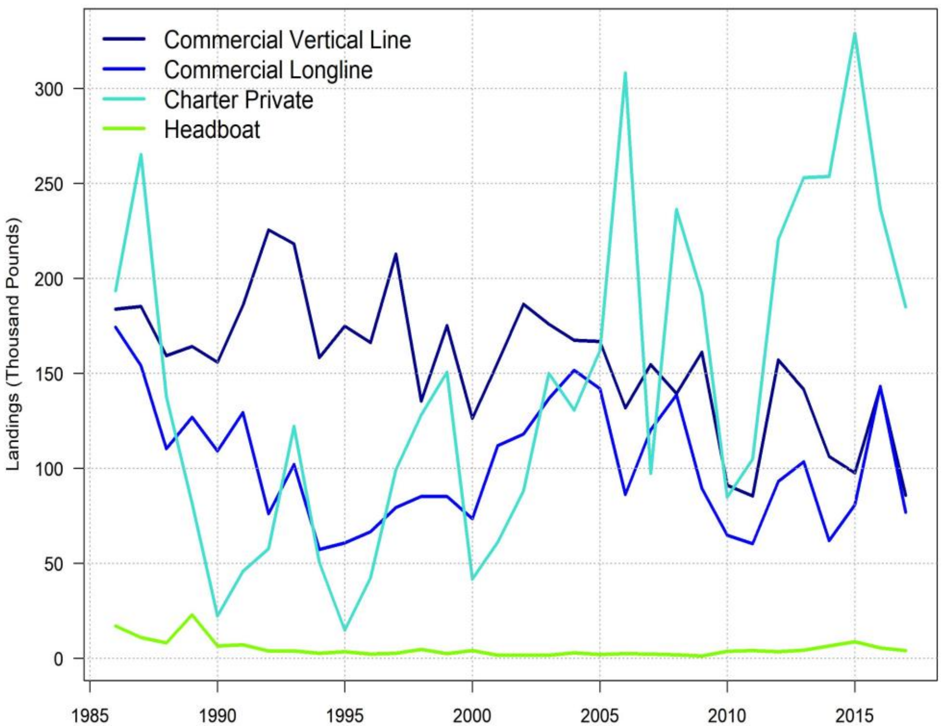
Small contribution to data

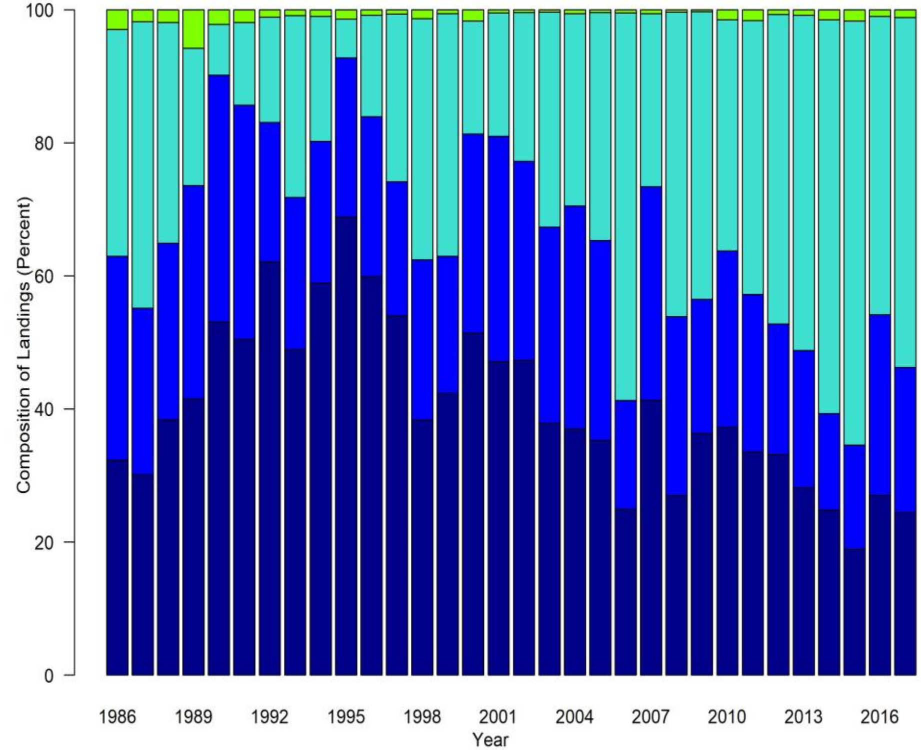
1. Charter Private
2. Headboat

Type of data	Charter	Private	Headboat
1986-2017 landings - numbers (with CV) or weights (without CV)	32% N 36% W	64% N 61% W	4% N 3% W
Historical landings (numbers)*	X – can split using ratio method		
Discards - numbers (with CV)	8% N	90% N	2% N
Landings length comp	58% N (49% Trips)		42% N (51% Trips)
Landings age comp (raw data)**	54% N (39% Trips)	6% N (8% Trips)	40% N (53% Trips)
Discard length comp	18% N (27% Trips)	None	82% N (73% Trips)
Indices	None (limited data)		1986-2017

Landings comparison

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





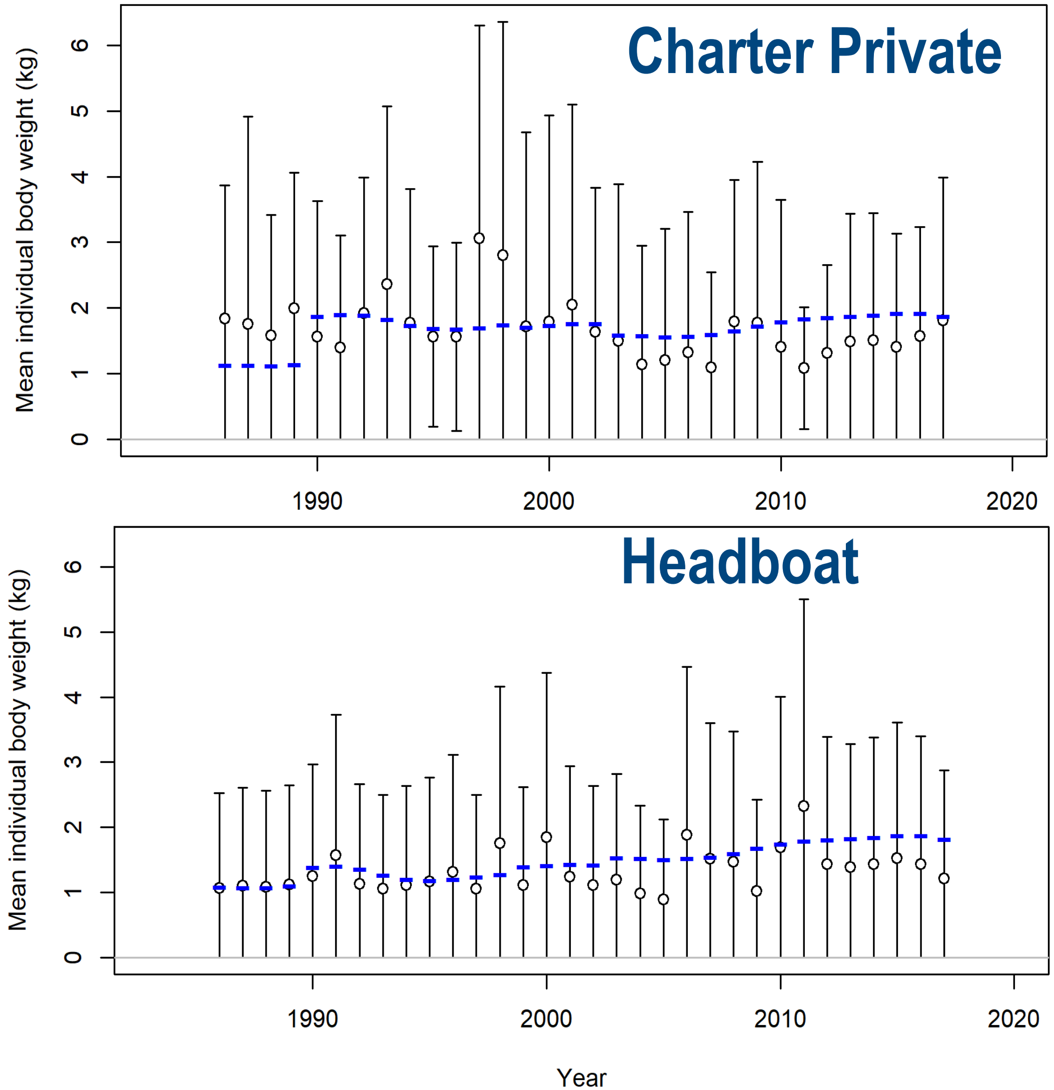
Inclusion of recreational landings

- 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

Approach taken during SEDAR68 AP

- Input recreational landings in weights
  - Expected mean weight similar to derived mean weight (weight/numbers from ACL monitoring)
  - **Note:** SEDAR68 AP Base is not fitting to mean weight, just using it as a check

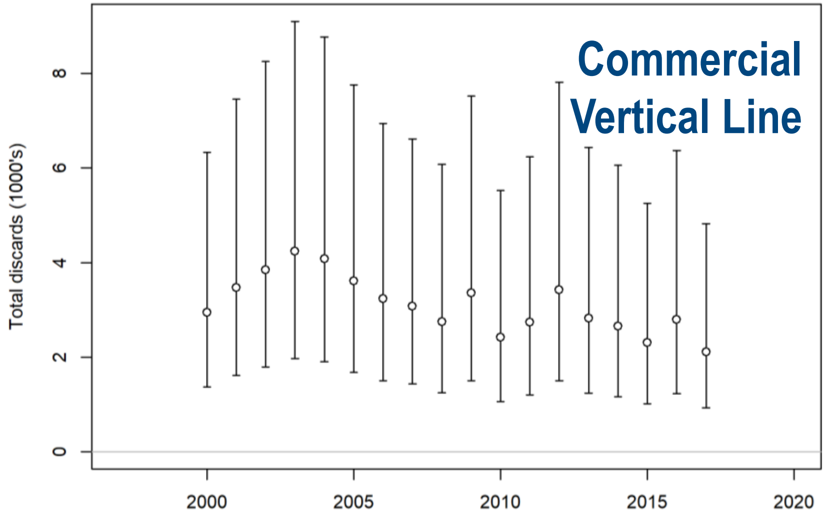


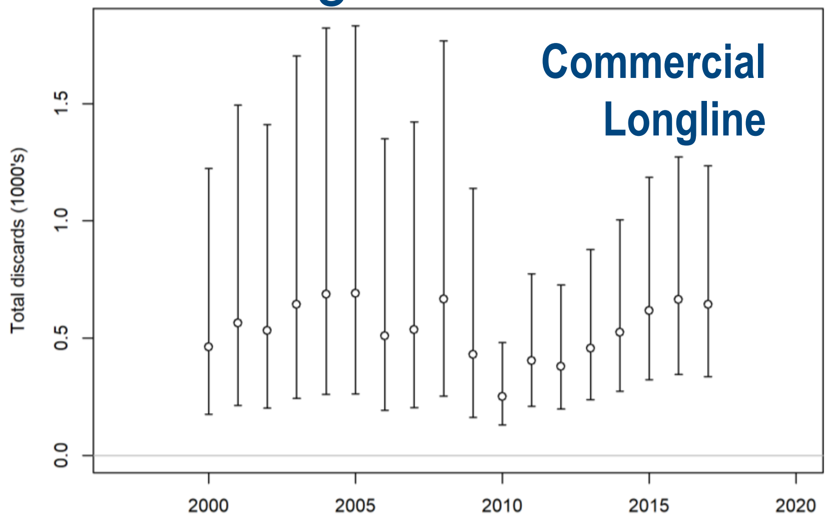
Commercial discards

- Catch per unit effort (CPUE) expansion approach to calculate total catch

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

  - CPUE data from Coastal Observer Program
  - Total Effort from Commercial Reef Logbooks

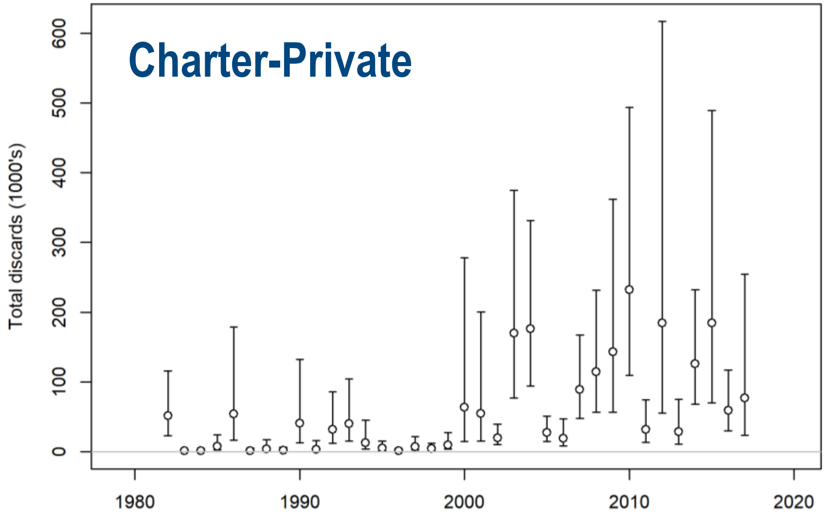


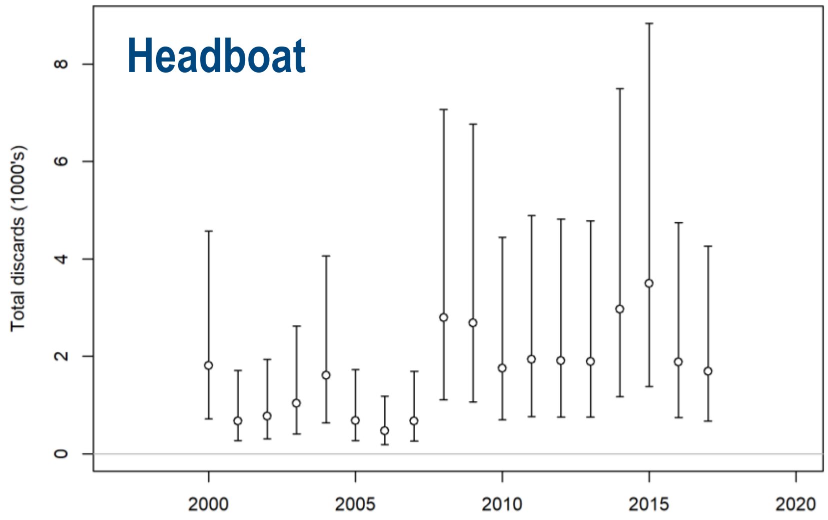


SEDAR68 AP Base assumes log-normal distribution for discards

Recreational discards

Data Source	Notes
MRIP	Self-reported discards, High CVs (mean 0.57, range: 0.32-1; SEDAR68-DW-09)
LA Creel	Discards not reported; MRIP discards in LA prior to 2014 sparse, considered negligible
TPWD	Discards not reported; Rarely landed in TX, so discards 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)

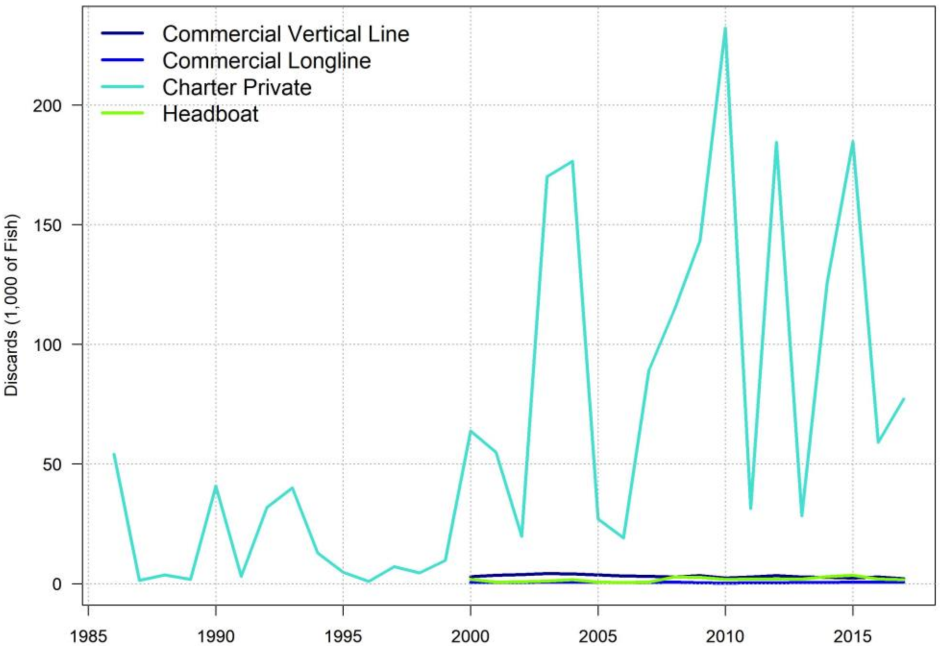


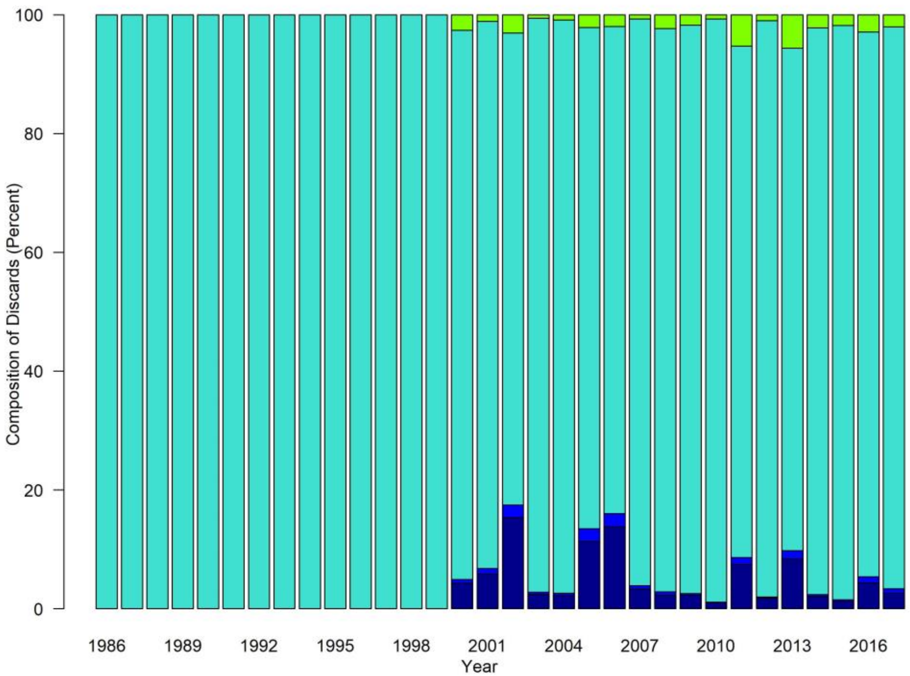


SEDAR68 AP Base assumes log-normal distribution for discards

Discard comparison

- Majority of discards are from recreational Charter Private fishery





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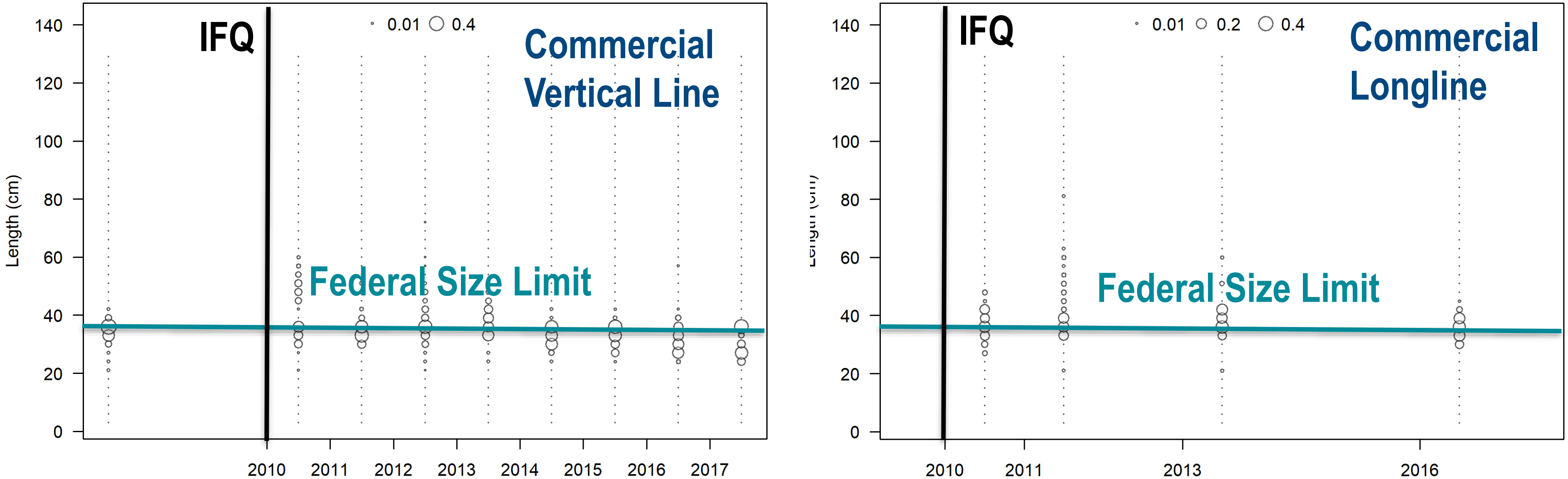
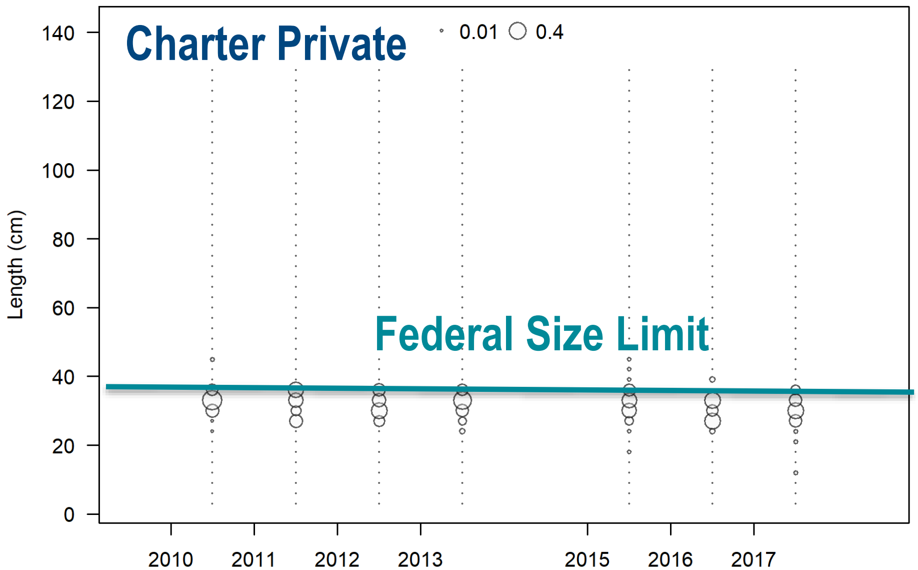
Commercial length compositions - discards

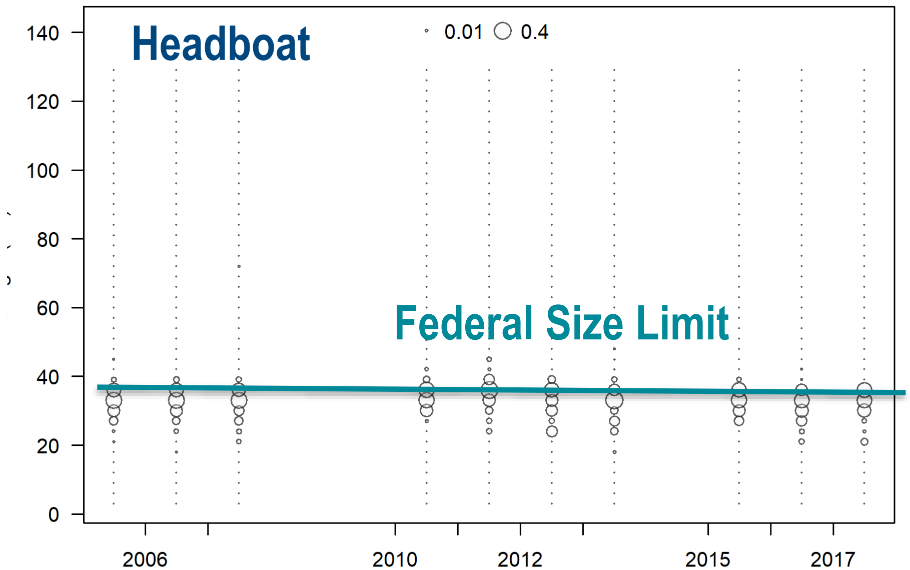
- Reef Fish Observer Program
  - Collects specific catch and bycatch information for selected vessels and information collected includes trip, gear, and geographic characteristics
  - Input sample sizes are the number of trips (≥10)



Recreational length compositions - discards

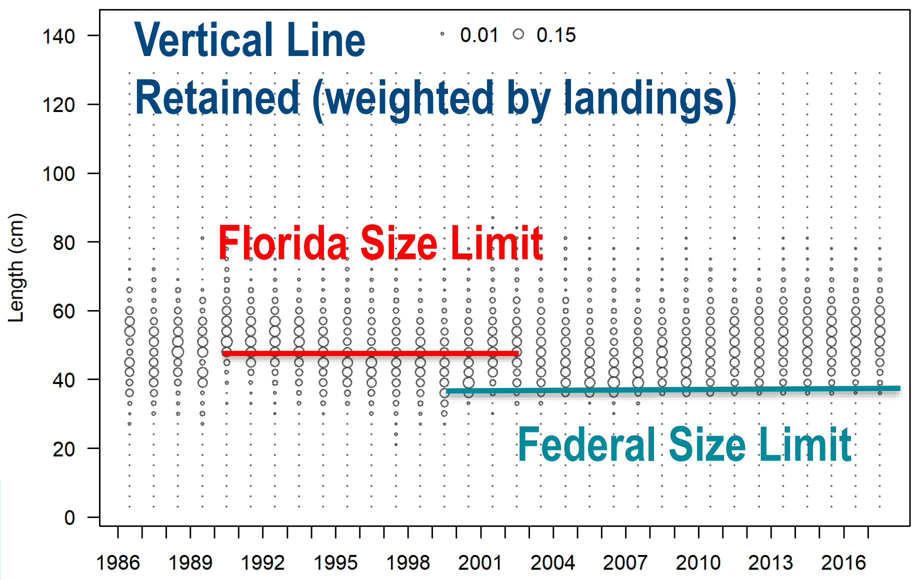
- FWRI At-sea Observer Program
  - Cooperative vessels randomly selected year-round for observer coverage
  - Weighting factors for Headboat based on different trip-types
  - Input sample sizes are the number of trips (≥10)

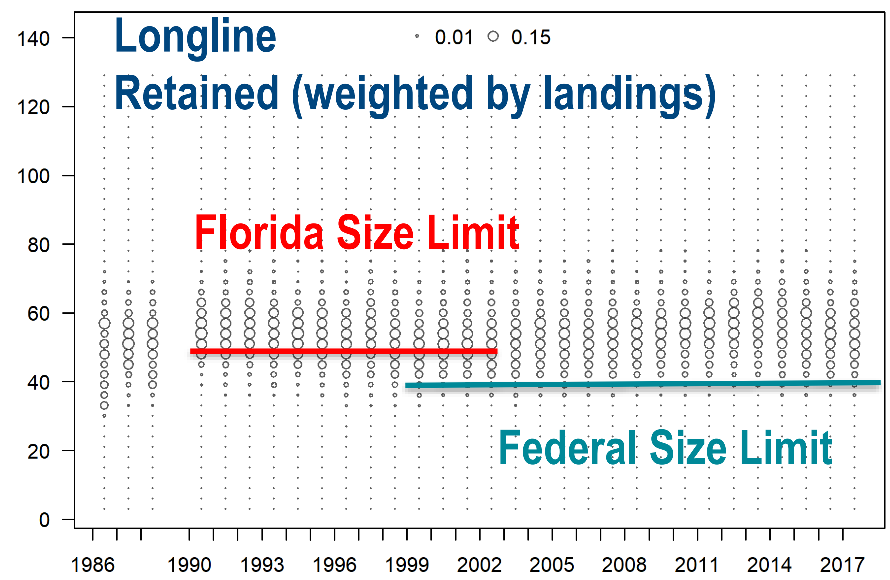




Commercial length compositions - landings

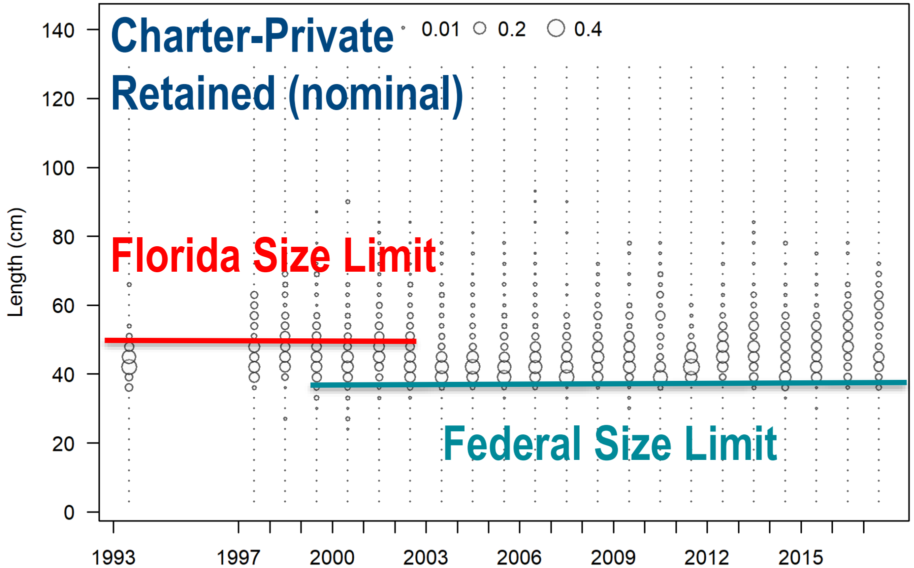
- Data were obtained from the trip intercept program (TIP) and GulfFIN and aggregated into three major sub-regions (SE, NE, and West Gulf)
  - Weighted based on the distribution of landings estimates among sub-regions (SEDAR68-AW-01)
  - Input sample sizes are the number of trips (≥10)

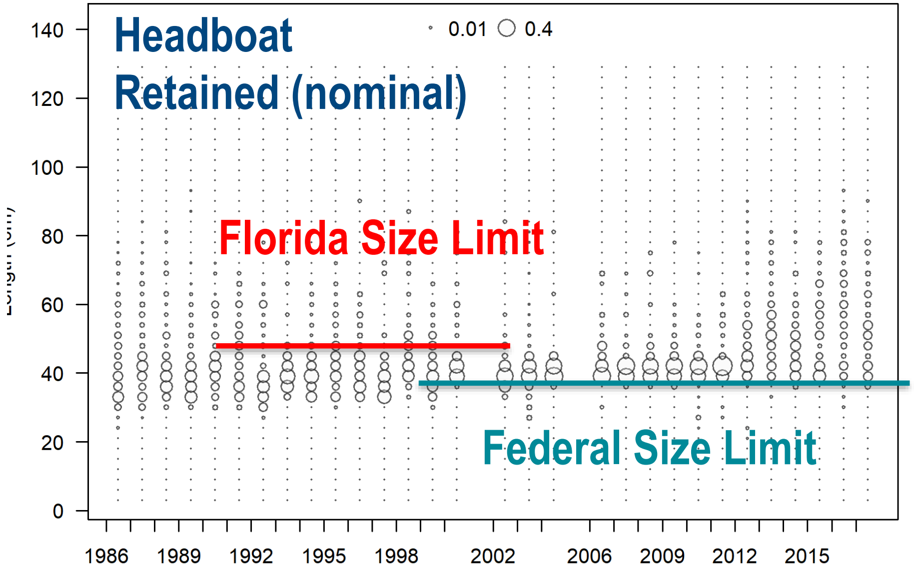




Recreational length compositions - landings

- 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)





Outline

- Data Review
  - Stock definition
  - Regulations
  - Life history
  - Removals
  - Size compositions
  - **Age compositions**
  - Index of abundance
  - Survey length composition

Age compositions

- Nominal age compositions and age compositions weighted by length compositions were provided during the AP for commercial fleets
  - ADT supported including length compositions of both discarded and retained scamp and using length-based selectivity for all fleets
  - ADT did not support using weighted age compositions for commercial fleets because of double counting of length data; supported conditional age-at-length
  - ADT supported using nominal age compositions for recreational fleets

Conditional age-at-length

Advantages:

- Avoids double use of fish for both age and size information - age conditional on length
- Contains more detailed information about the relationship between size and age – can estimate growth
- Can directly match the protocols of the sampling program when age data are collected in a length-stratified program

Disadvantages:

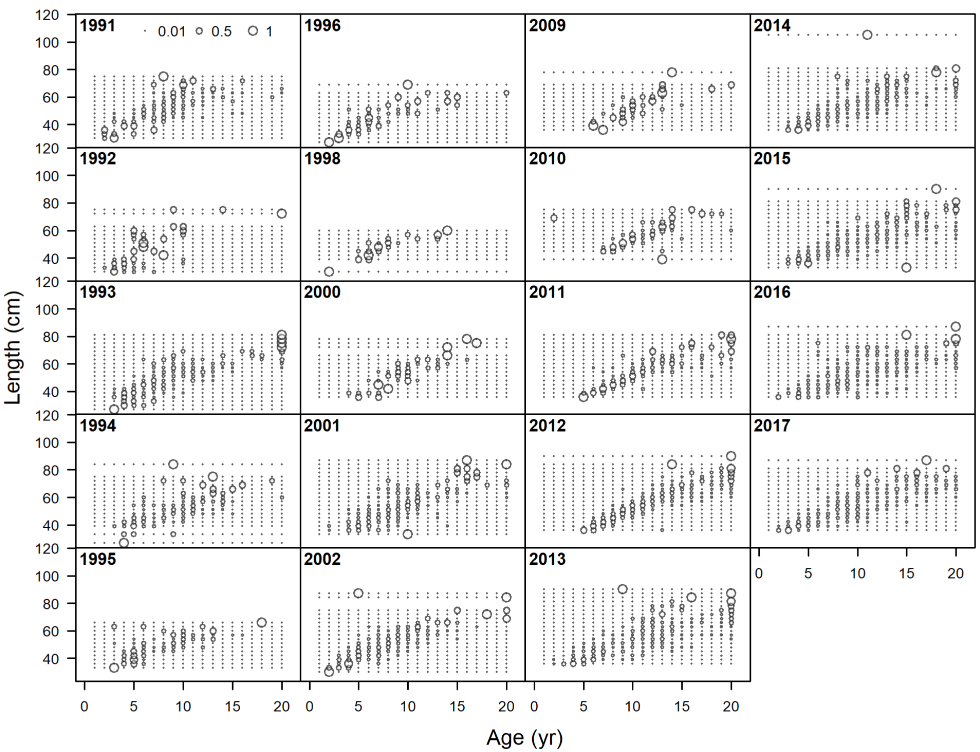
- Need to be very careful with data and assumptions- simulations show potential for biased growth estimates

Commercial Vertical Line

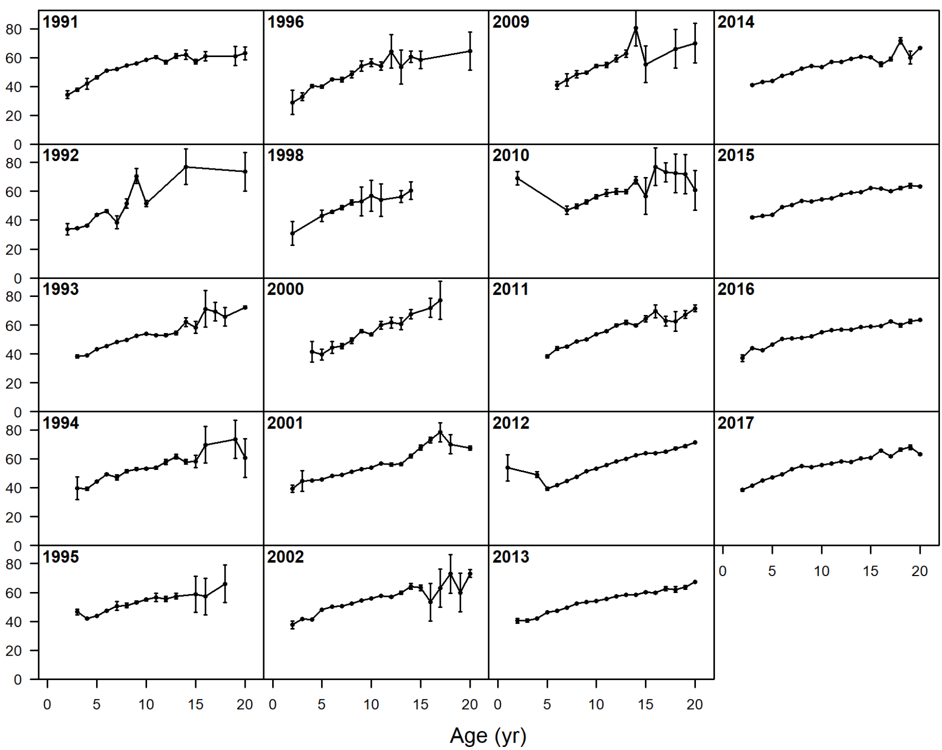
Limited age data between 2003-2012 due to otolith processing issue; proxy age data included where possible

- Mean length included in model as a check of predicted mean length-at-age (not included in likelihood)

Conditional age-at-length



Mean length-at-age

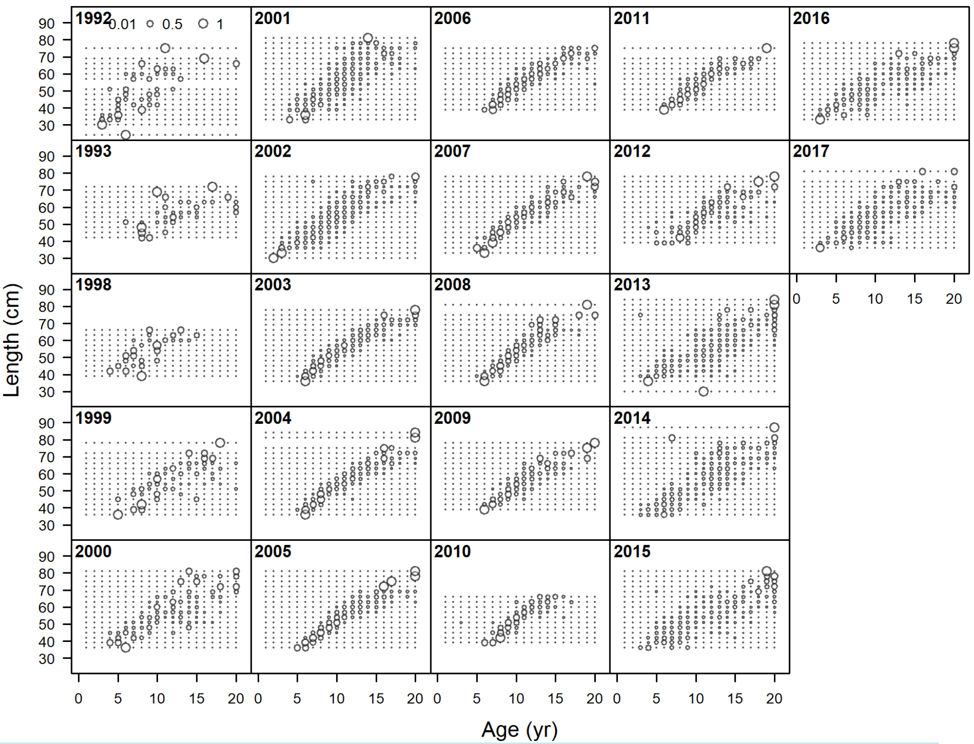


Commercial Longline

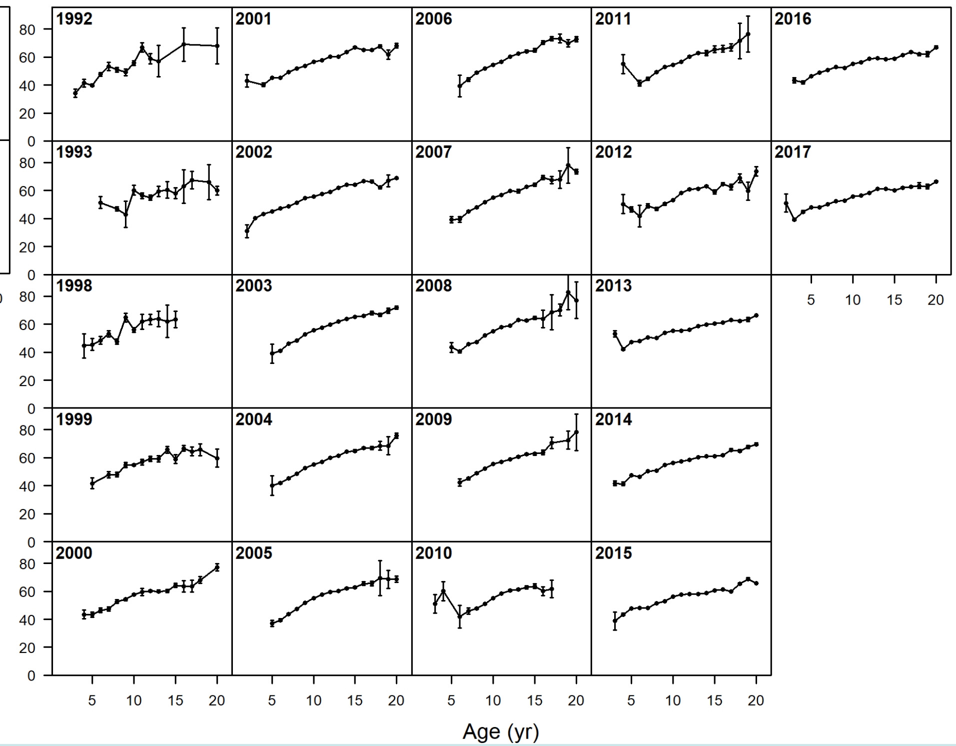
Limited age data between 2003-2012 due to otolith processing issue; proxy age data included where possible

- Mean length included in model as a check of predicted mean length-at-age (not included in likelihood)

Conditional age-at-length



Mean length-at-age

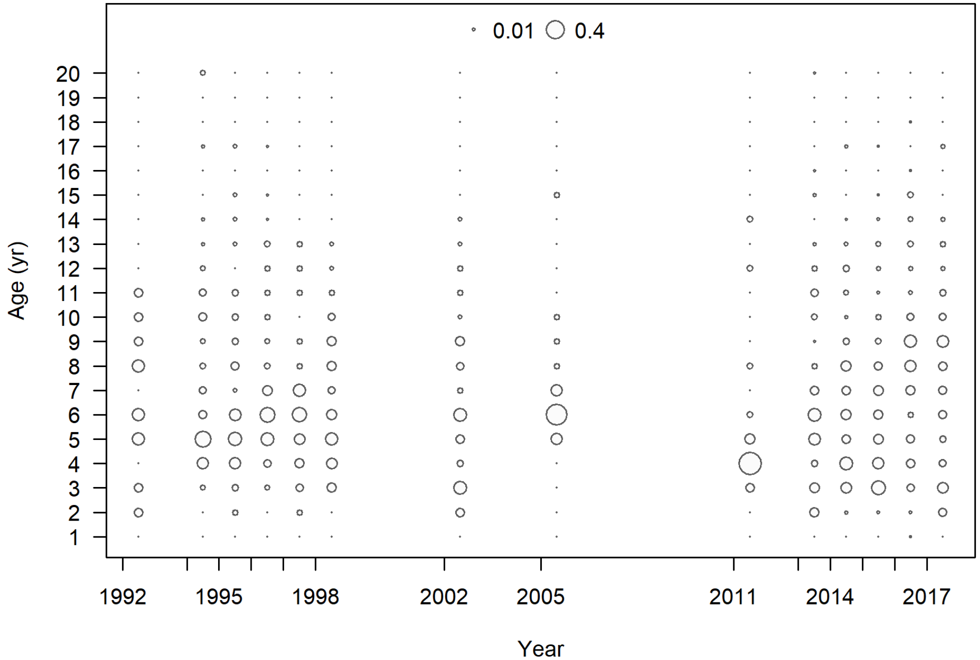


Limited age data between 2003-2012 due to otolith processing issue; proxy age data included where possible

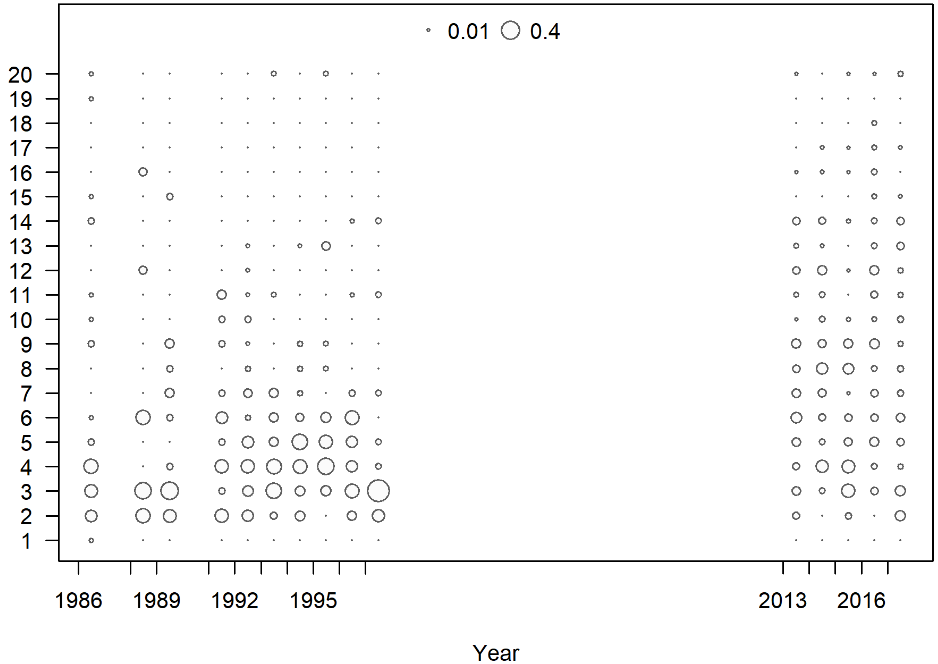
Recreational age composition

- Nominal compositions provided due to insufficient samples per strata for weighting procedure
- Input sample sizes are the number of trips (≥10)

Charter-Private

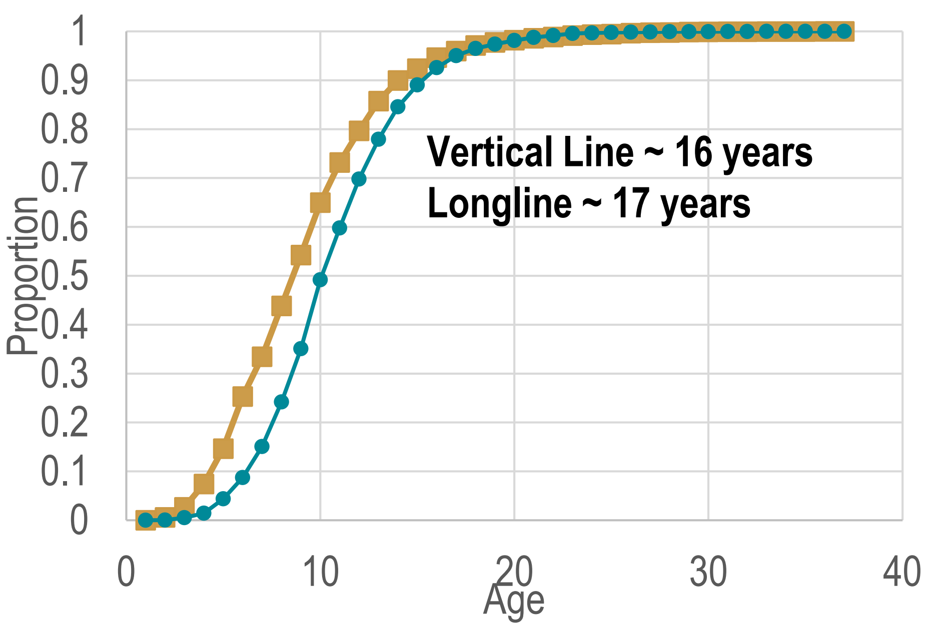


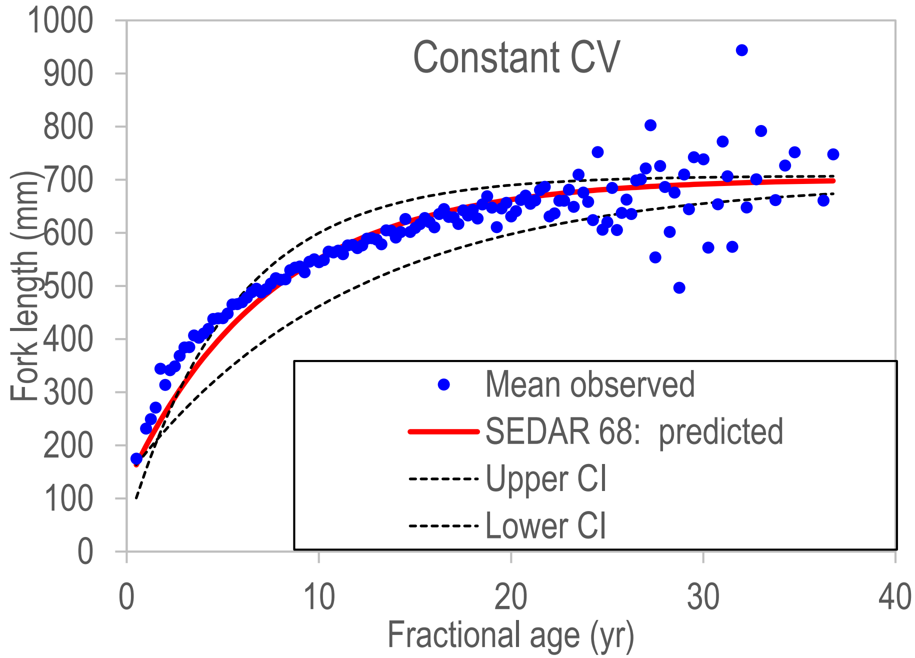
Headboat



Determination of plus group

- 95% of age composition data occurs around 17 years
- LH data plateaus at older age (> 20 years)
- 94% probability of being male at age 18, 97% at age 20





Likelihood for composition data

- Gulf assessments previously used multinomial error distributions for composition data
- ADT recommended moving to a Dirichlet multinomial error distribution for composition data (Thorson et al. 2017)
  - Better accounts for correlation in sampling
  - Self-weighting (no need for iterative reweighting the comps' likelihoods)
  - Allows for zeros in the data

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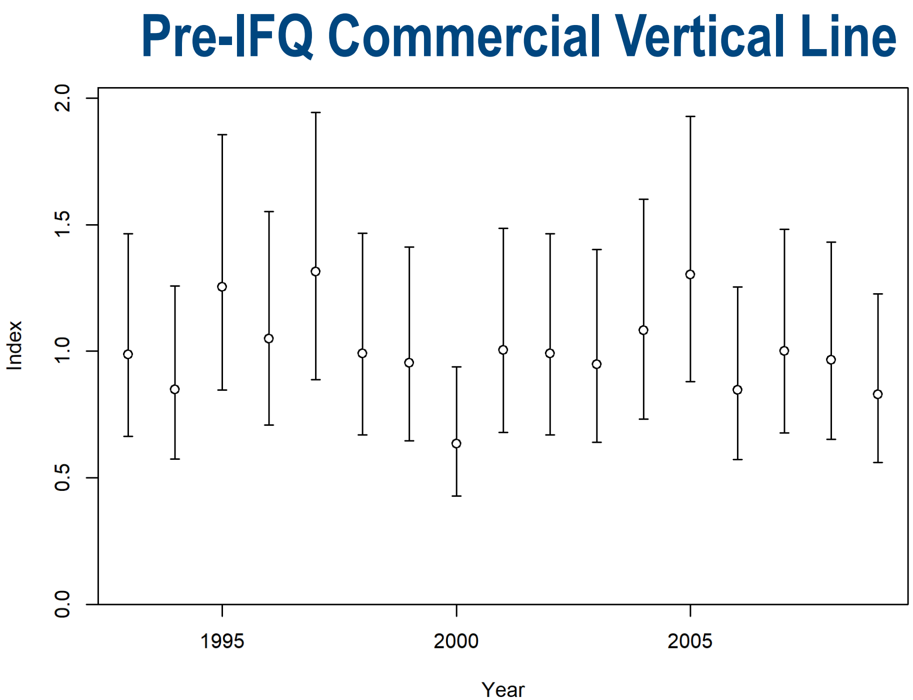
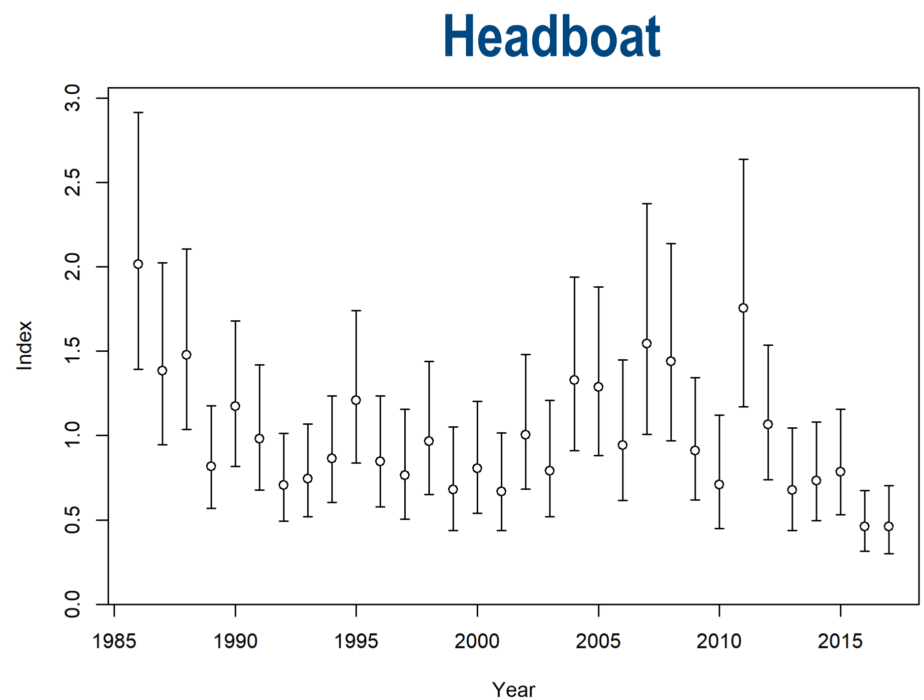
Indices of relative abundance

Source	Recommended and caveats
Pre-IFQ (1993-2009) Vertical Line	Yes, but landings only
Pre-IFQ (1993-2009) Longline	No – poor diagnostics, concerns over regulations affecting index
Post-IFQ (2010+) Vertical Line	No – poor diagnostics, concerns over IFQ affecting index, limited contrast
Post-IFQ (2010+) Longline	No – concerns over IFQ affecting index, limited contrast
Reef Fish Observer Program (RFOP) Vertical Line	Yes – total catch, finer resolution of data
Headboat Survey	Yes, but landings only
Combined Video	Yes – sole fishery-independent index

Indices of relative abundance (fishery CPUE)



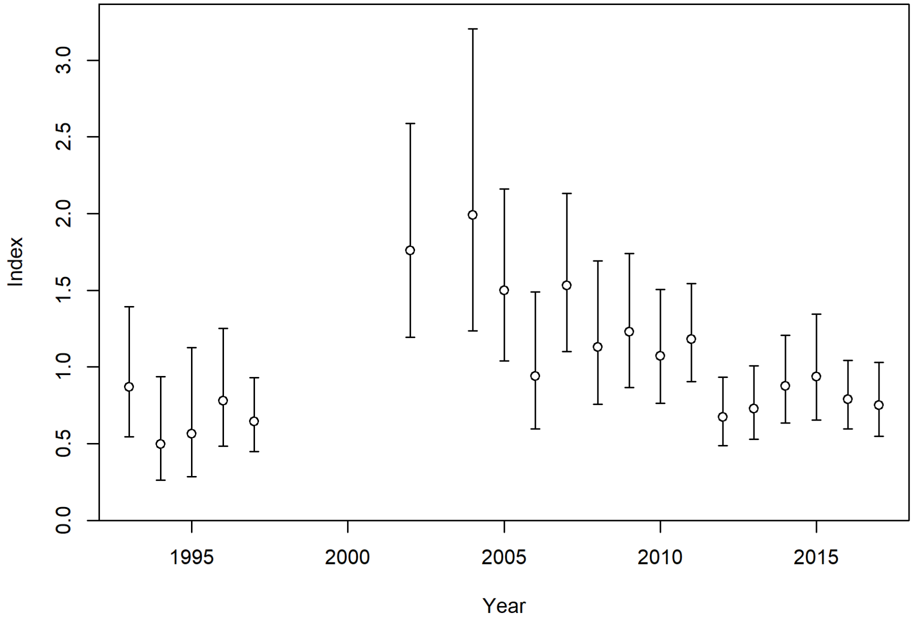


- CV converted to SE: $log_e(SE) = \sqrt{(log_e(1 + CV^2))}$
- Standard errors for each CPUE index scaled to a common mean of 0.2 (sensu Francis et al. 2003)
  - Same scale of uncertainty

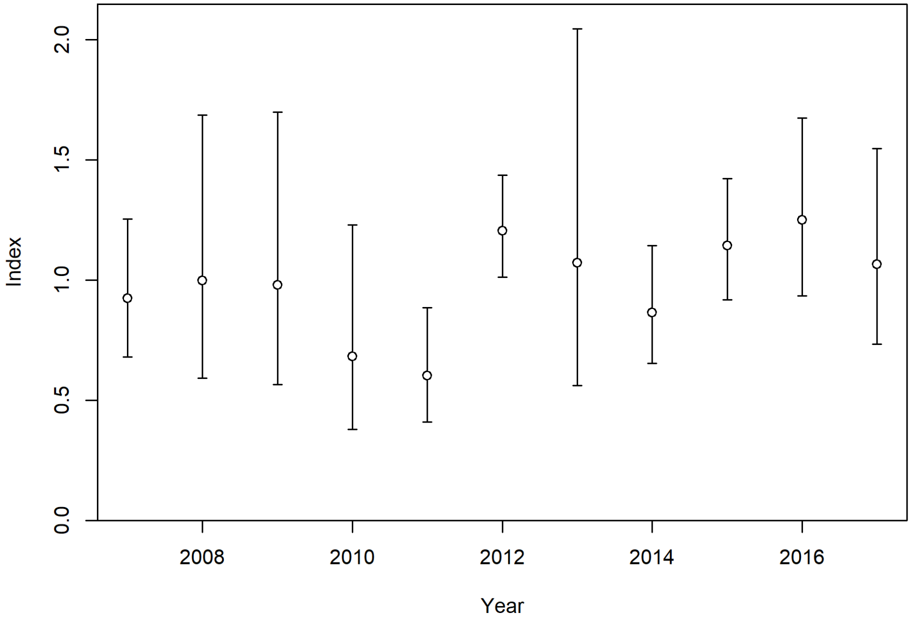
Indices of relative abundance (surveys)

- Standard errors for each index used as provided
- RFOP index treated as a survey in Stock Synthesis because it includes total catch (landings + discards)

Combined Video (FWRI, PC, SEAMAP)

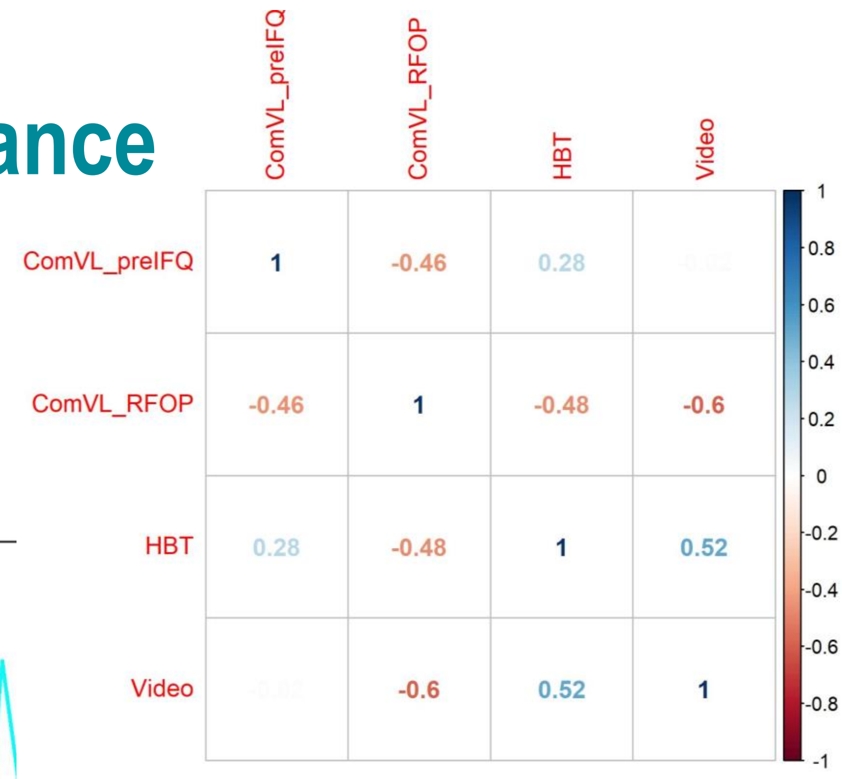


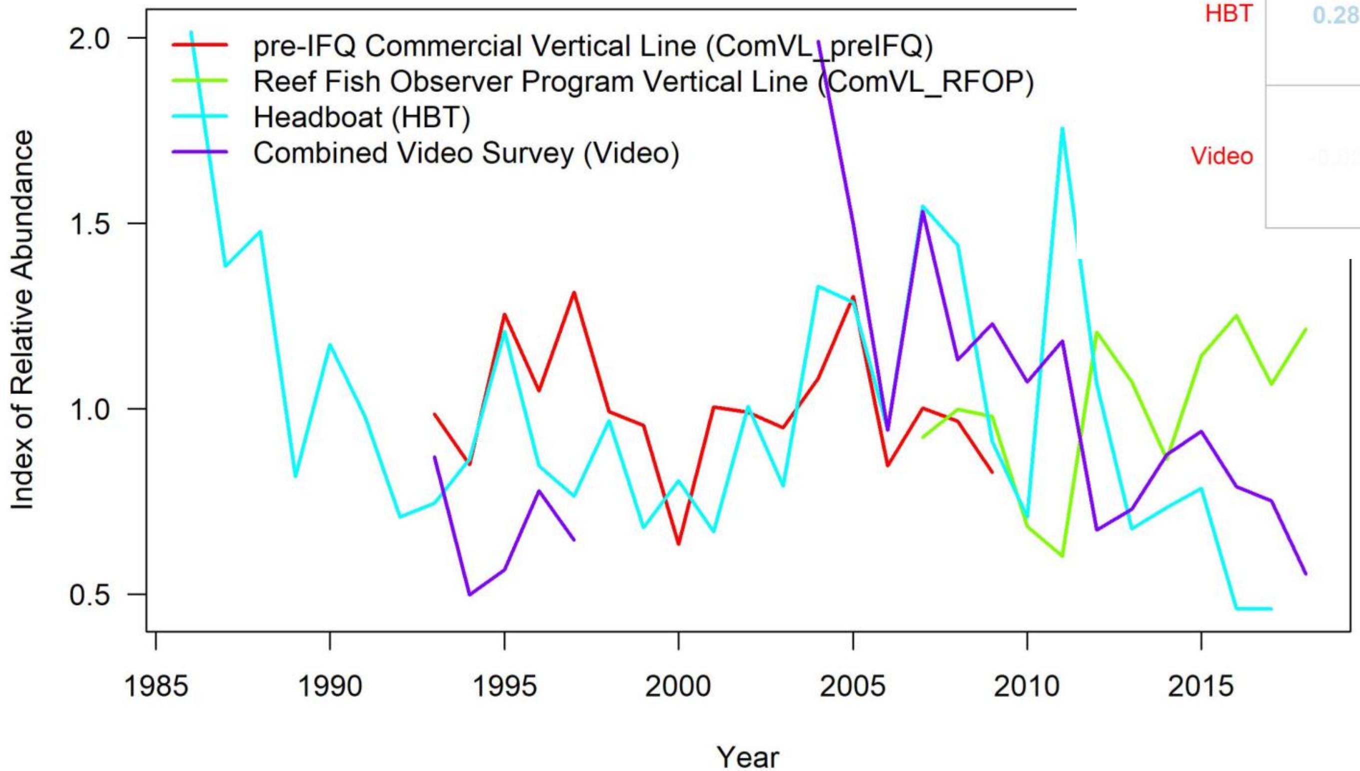
RFOP Vertical Line



Indices of relative abundance

- Recent declines evident, except for RFOP Vertical Line index





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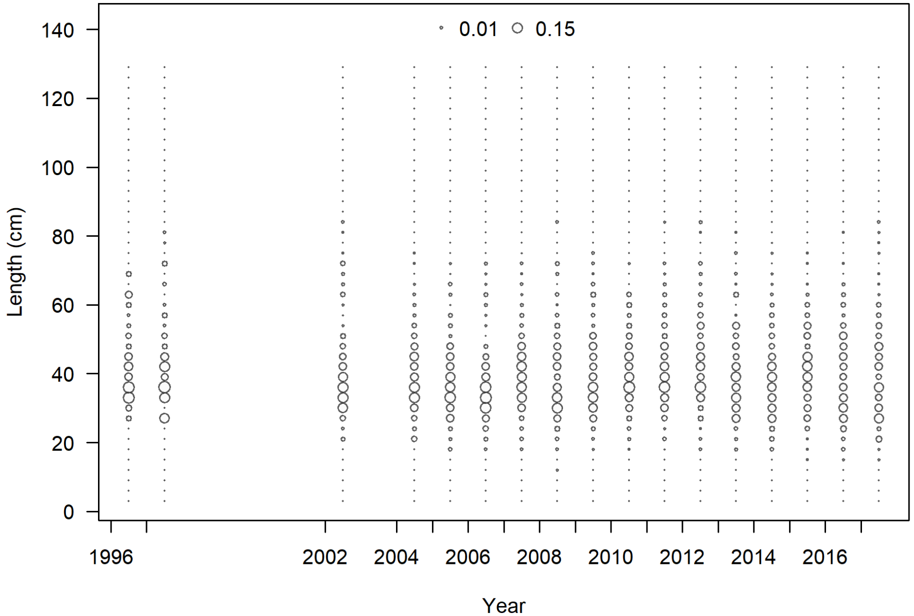
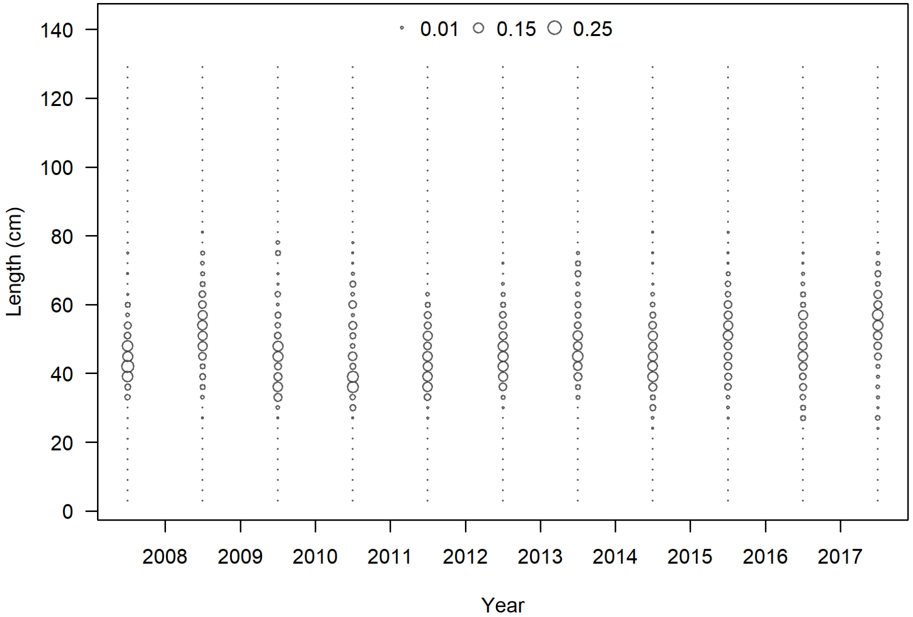
  - **Survey length composition**

Survey length composition

Combined Video



RFOP Vertical Line



- Input sample sizes = number of stations or sampling units (≥ 10)

Ecosystem considerations: red tide

- Infrequently mentioned throughout literature
  - Mentioned in 1 response in GMFMC Fishy Survey (SEDAR68-RD41)
  - Scamp documented in 1971 red tide event (Smith 1975)
  - Scamp grouper mentioned in single red tide oral history interview (out of 64) conducted by Southeast Fisheries Science Center

Red tide/Hypoxia

- Limited overlap
- CTD data
  - Detailed in Turley et al. 2021 (SEDAR72-WP10)
- Scamp distribution map
  - Detailed in Brothers et al. 2020 (SEDAR68-SID02)

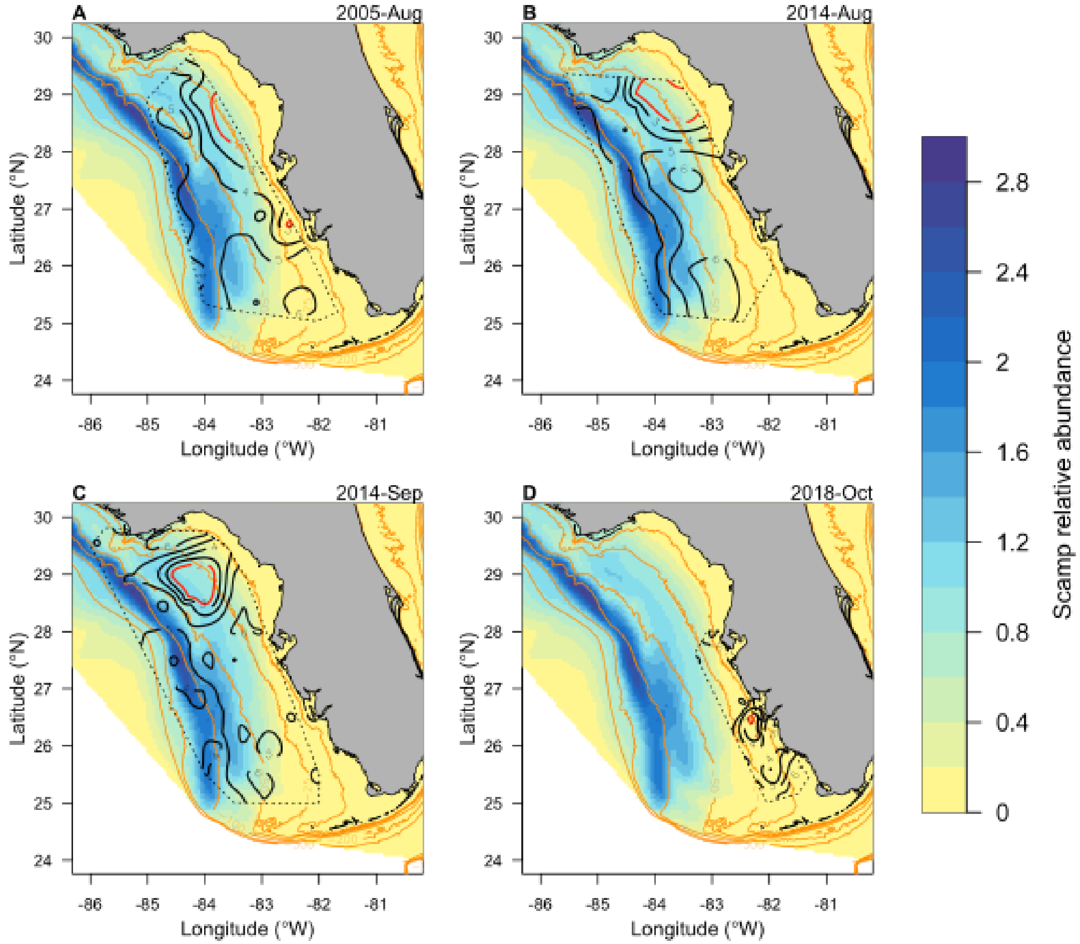


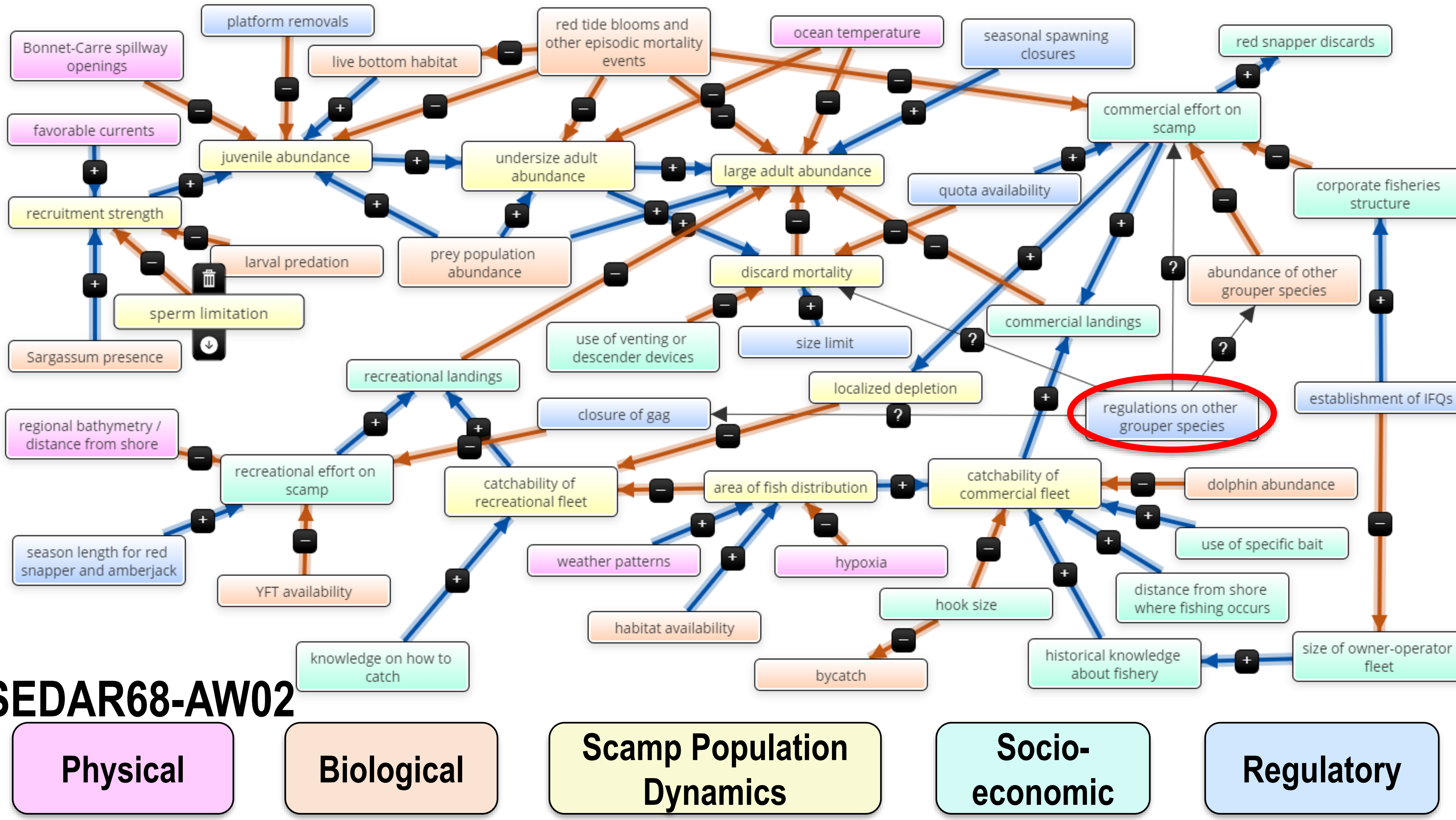
Figure displays the overlap between the output of a scamp distribution model (filled contours) and interpolated bottom oxygen concentrations (black and red contour lines) from CTD data. The four plots represent the months in which hypoxic events were evident in two or more CTD casts per month across 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.

Pilot study of conceptual mapping exercise

- Virtual (due to travel restrictions)
- **Purpose**: identify drivers and linkages that are most likely to have high influence on the system
- **Approach**: Incorporated information from eight survey respondents (with either online or phone responses) and previously underutilized information (e.g., the "Something's Fishy" survey)
  - Four fishermen, four SEDAR participants
  - Input is somewhat limited and the results may not represent a comprehensive summary regarding the species

Scamp-centric system conceptual model for the GOM

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

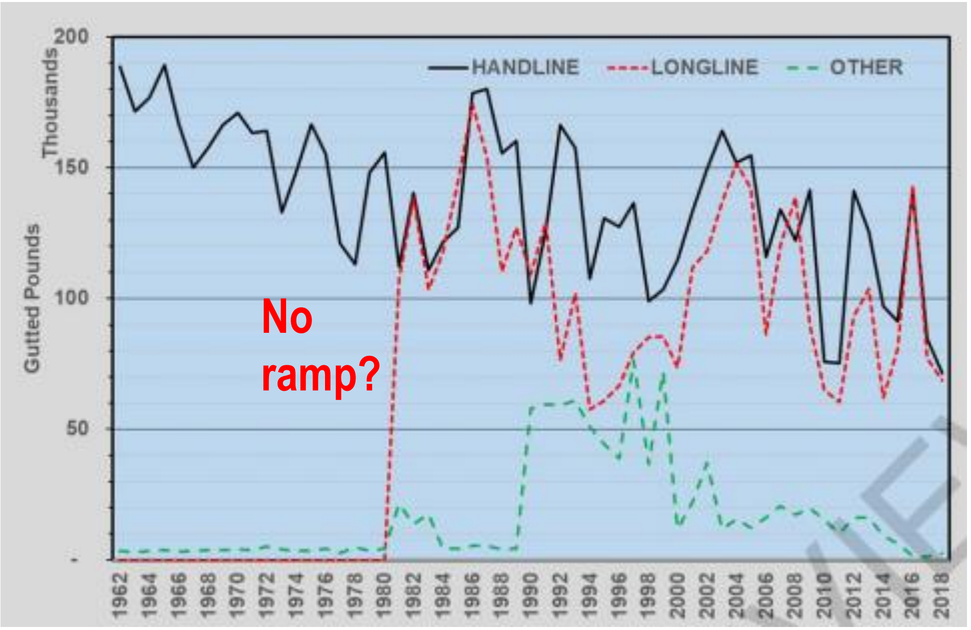


SEDAR68-AW02

Start Year

- Started model in 1986
  - Majority of data
  - Highly uncertain landings before 1986
  - Recommendation by Commercial DW Working Group because of high uncertainty in species-specific landings

Figure 3.3A in SEDAR68 Gulf DW Report



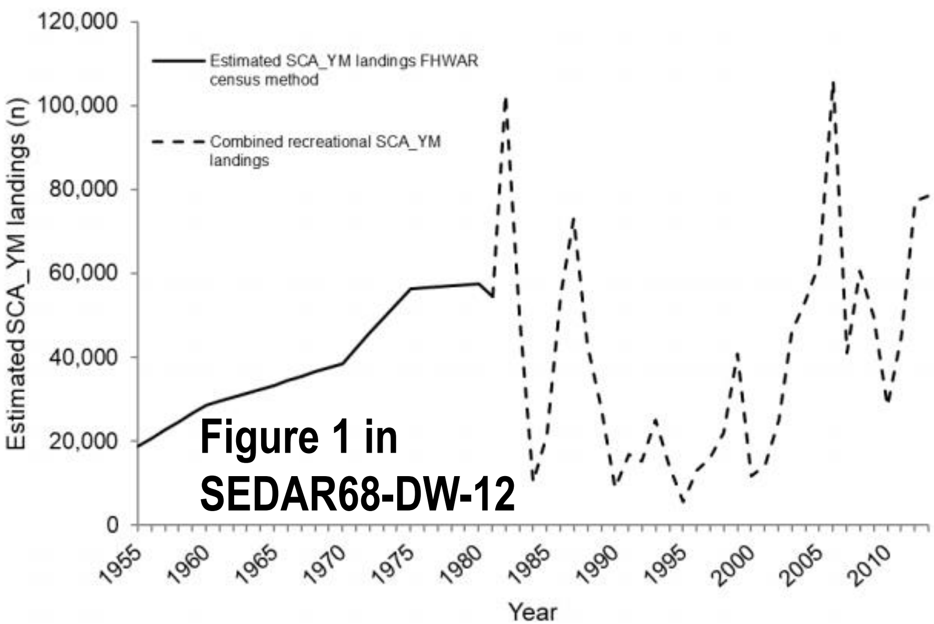


Figure 1 in SEDAR68-DW-12

Questions about the data?