

# SEDAR 64: Yellowtail Snapper Main Data Inputs

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FWRI Stock Assessment Group, St. Petersburg, FL  
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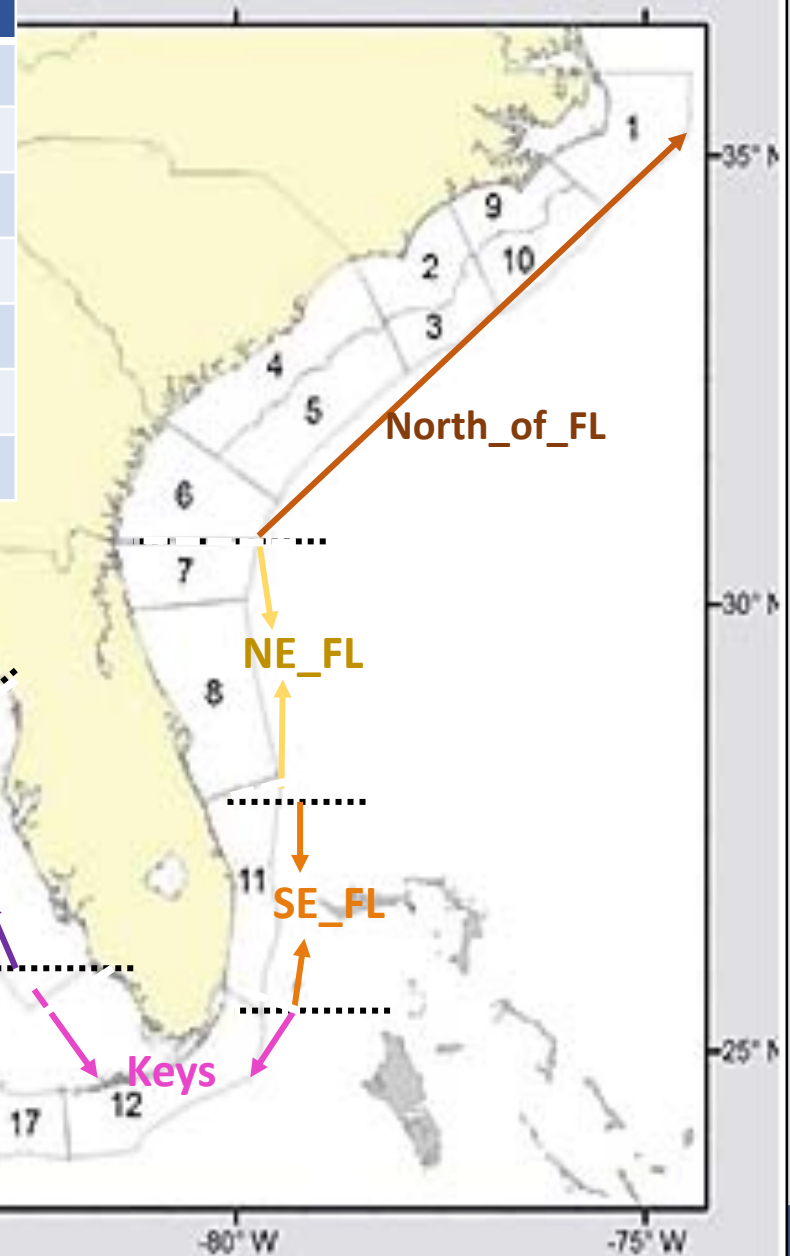
# SEDAR 64: Yellowtail Snapper

Main Data Inputs

**Spatial Delineations**



Area	FL Counties	MRIP For Hire	NMFS Shrimp	SRHS
West_of_FL	-	-	11 - 23	24 - 29
NW_FL	Escambia-Dixie	1	7-10	~23
SW_FL	Levy - Collier	2	3-6	21, old 18
Keys	Monroe	3	1, 2, 748	17, 12
SE_FL	Indian River – Miami-Dade	4	736 - 744	11
NE_FL	Nassua - Brevard	5	722 - 732	7, 8
North_of_FL	-	-	< 722	1-6,9,10





# SEDAR 64: Yellowtail Snapper

## Main Data Inputs

### Life History



# Yellowtail Snapper Genetic Studies

- South Florida vs Eastern Caribbean (Saillant et al. 2012 )
  - 4 groupings: FL Keys, west coast of Puerto Rico, east coast of Puerto Rico and St Thomas, offshore of St. Croix
- Brazil vs Belize (Vasconcellos et al. 2008; da Silva et al. 2015)
  - Separate Stocks
- South Florida vs Western Caribbean/North FL/West of FL
  - Unknown but these fish likely do not contribute to spawning stock biomass due to the GOM Loop Current dynamics



# Yellowtail Snapper Age Data

## Data sources (1980 – 2017)

- Fishery-dependent sources
  - TIP, SRHS, MRIP, Garcia et al. (2003)
- Fishery-independent sources
  - FWRI (FIM, Fish Bio), Vose and Shank (2003)
- Filtered data from SE U.S Atlantic and GOM waters (n = 48,212 otoliths; FD = 46,324; FI = 1,888)
- 99% of age data from Florida (n = 47,886 otoliths)

## Age Structure

- 0 – 20 years in Florida
- Up to age-28 sampled off the Carolinas
- In Florida
  - 58% were age-2 and -3
  - 90% were ages 2 – 6

## Location within Florida

- 61% from Florida Keys; 35% from southeast Florida



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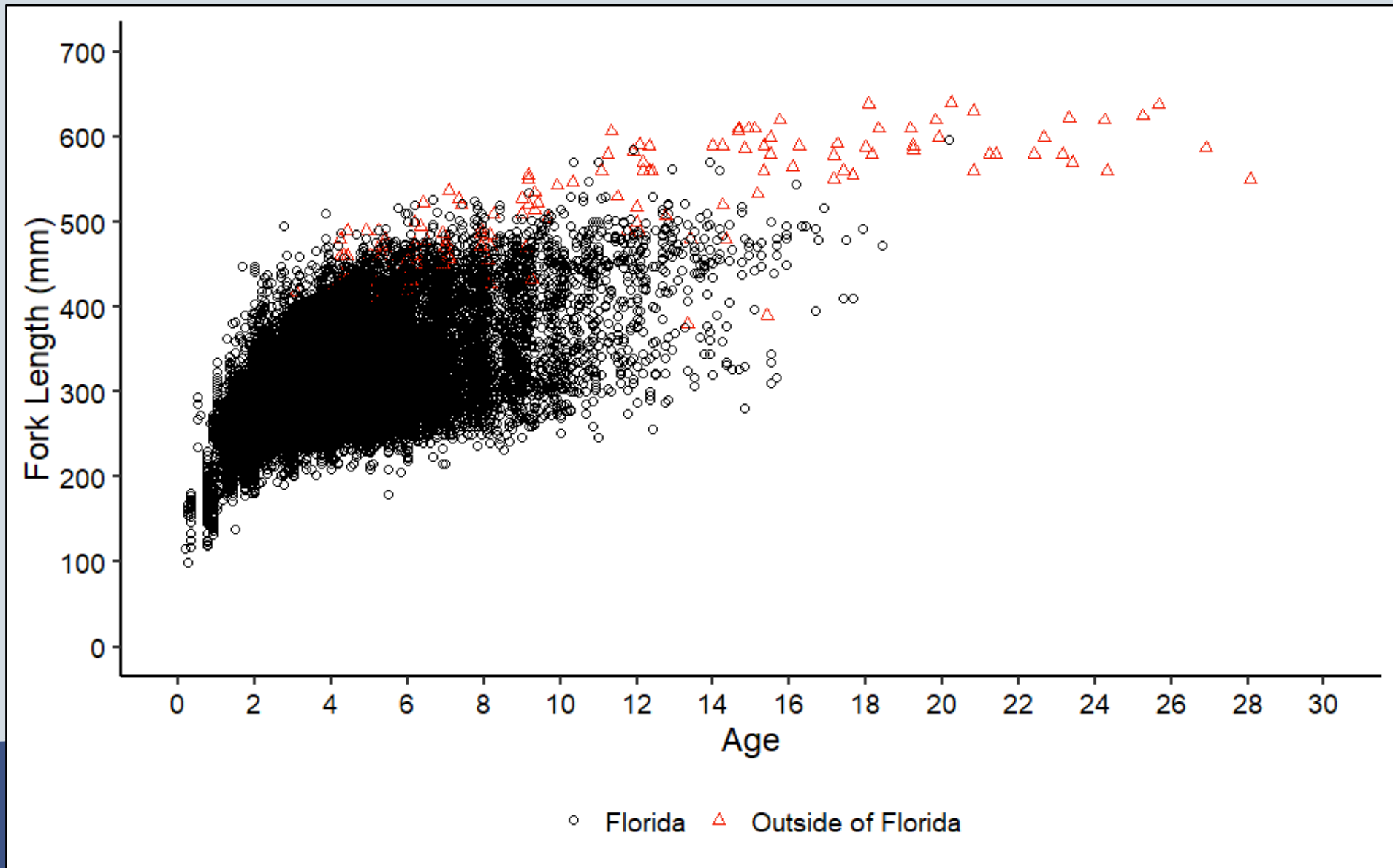
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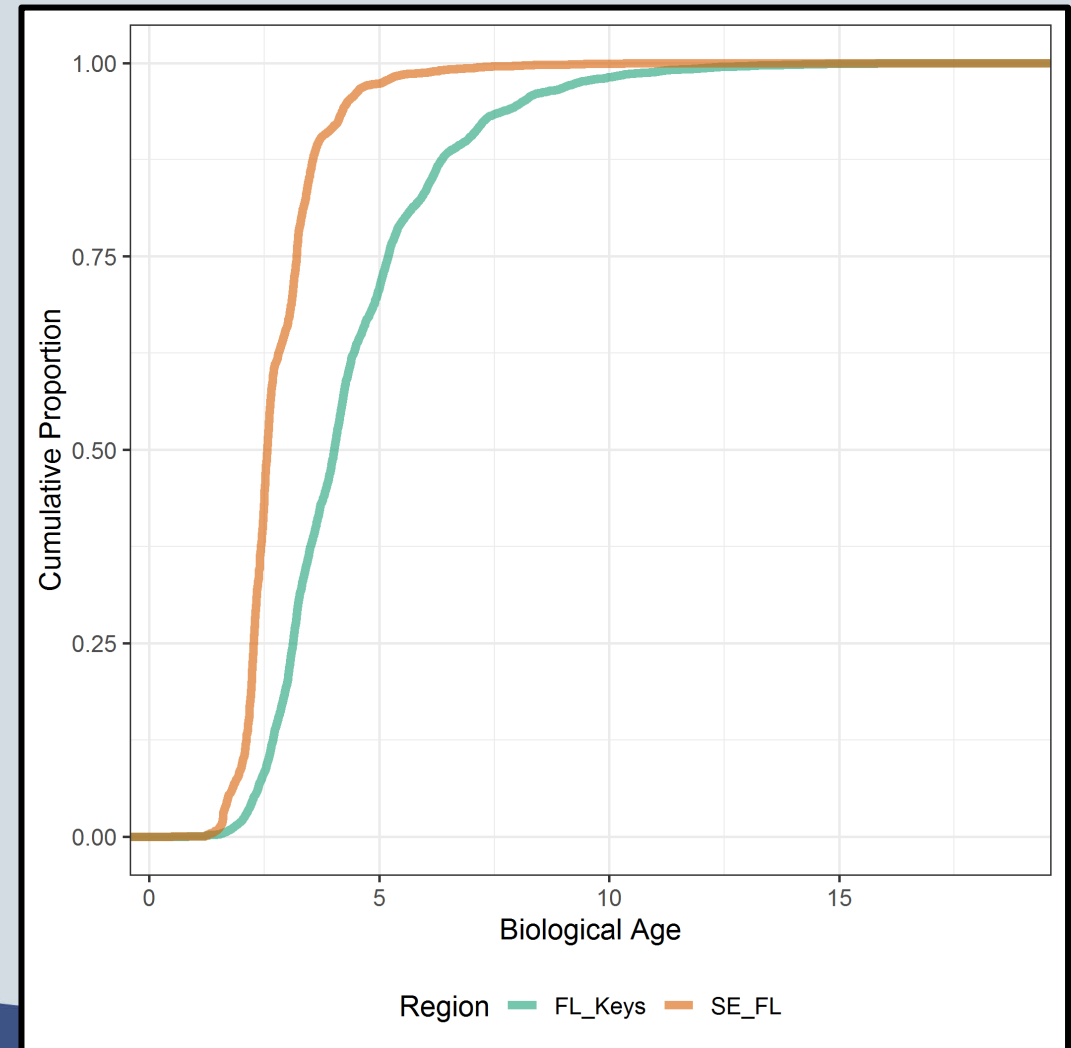
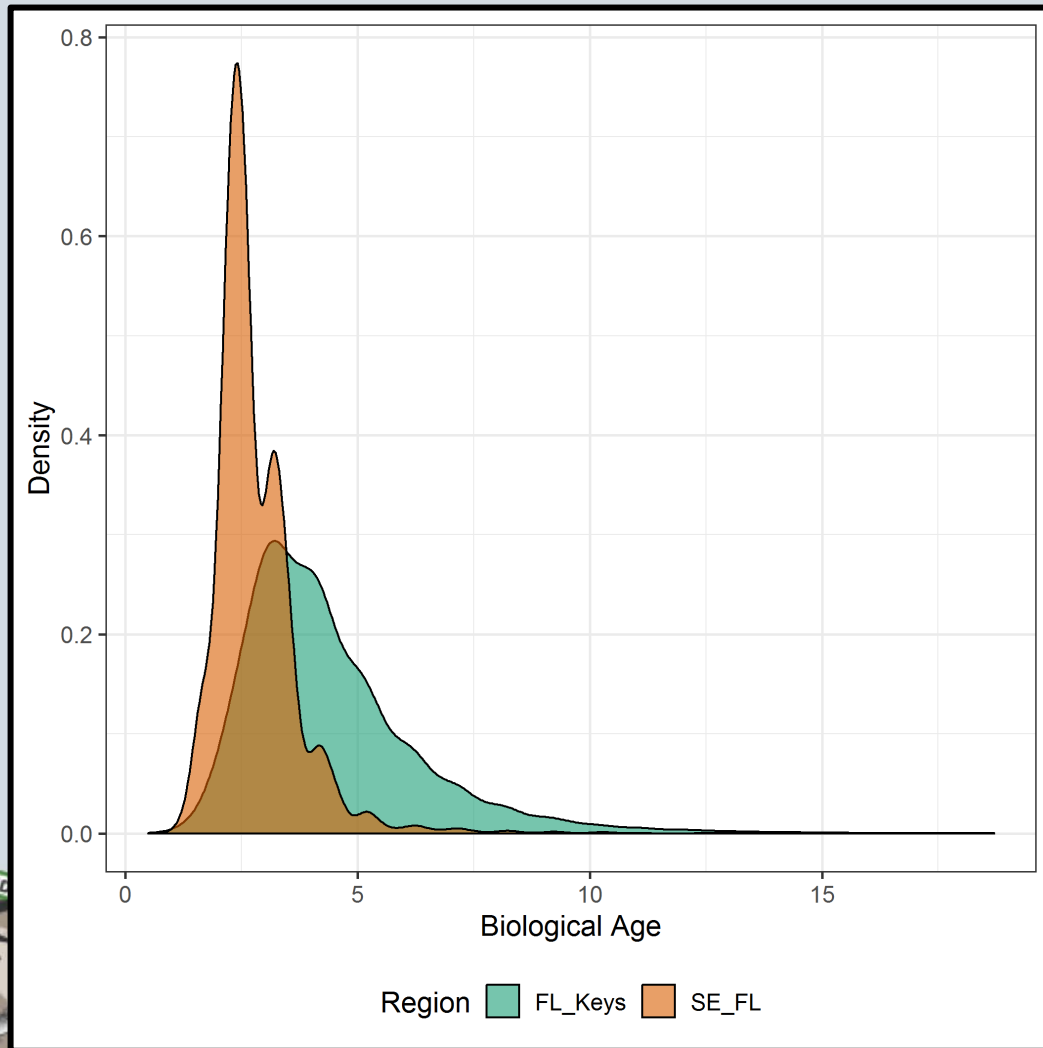


# Yellowtail Snapper Age Data





# Yellowtail Snapper Age Data



# External Growth Model

## Size-truncated von Bertalanffy growth model (Diaz et al. 2004)

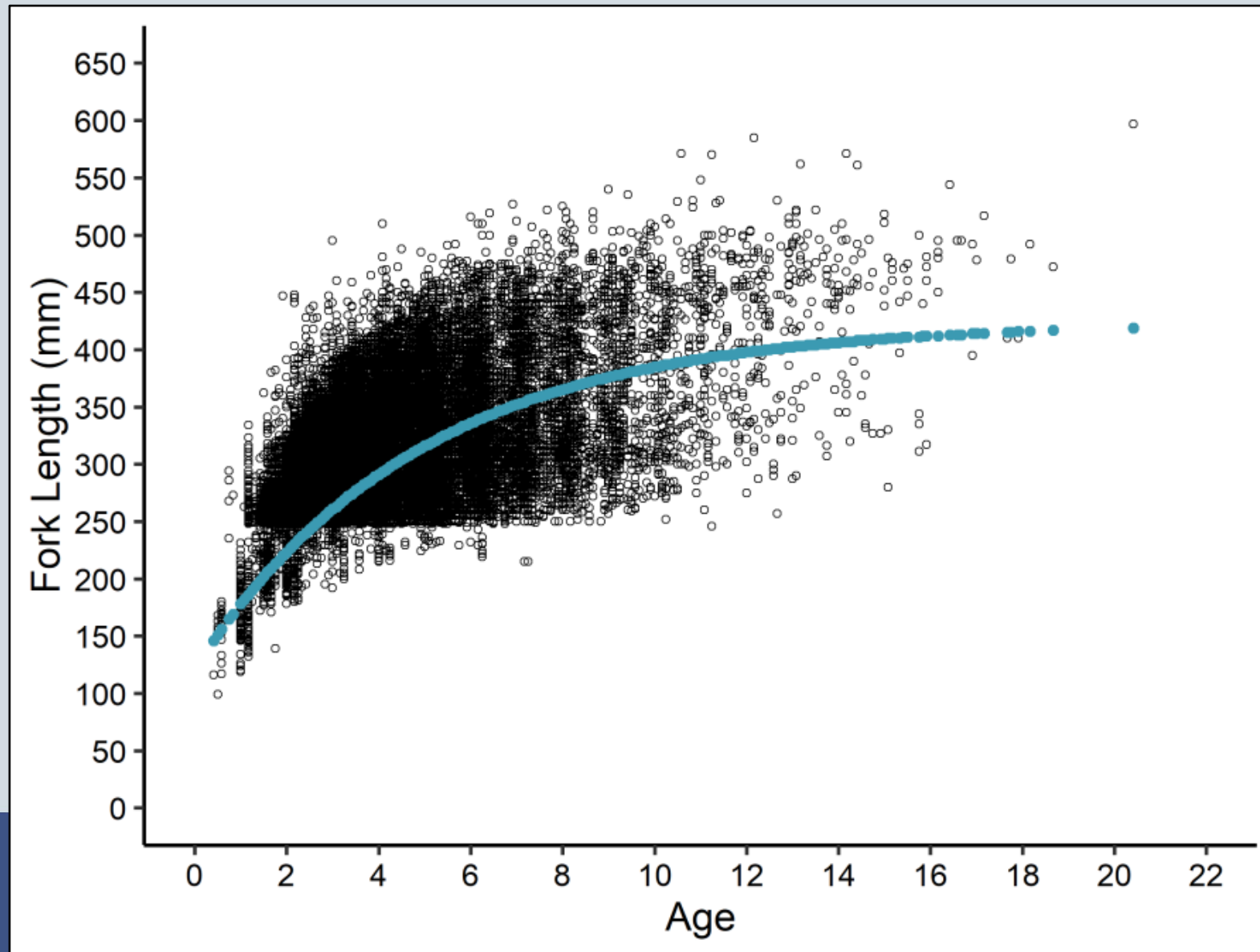
- Truncated at minimum size limit (12 inch TL or approx. 24.8 cm FL) for fishery-dependent data starting 8/31/83 (SAFMC Snapper-Grouper FMP)
- Inverse weighted; age 12+ group
- Constant CV for length-at-age
- $n = 45,833$  otoliths

## Estimated Parameters using Florida data

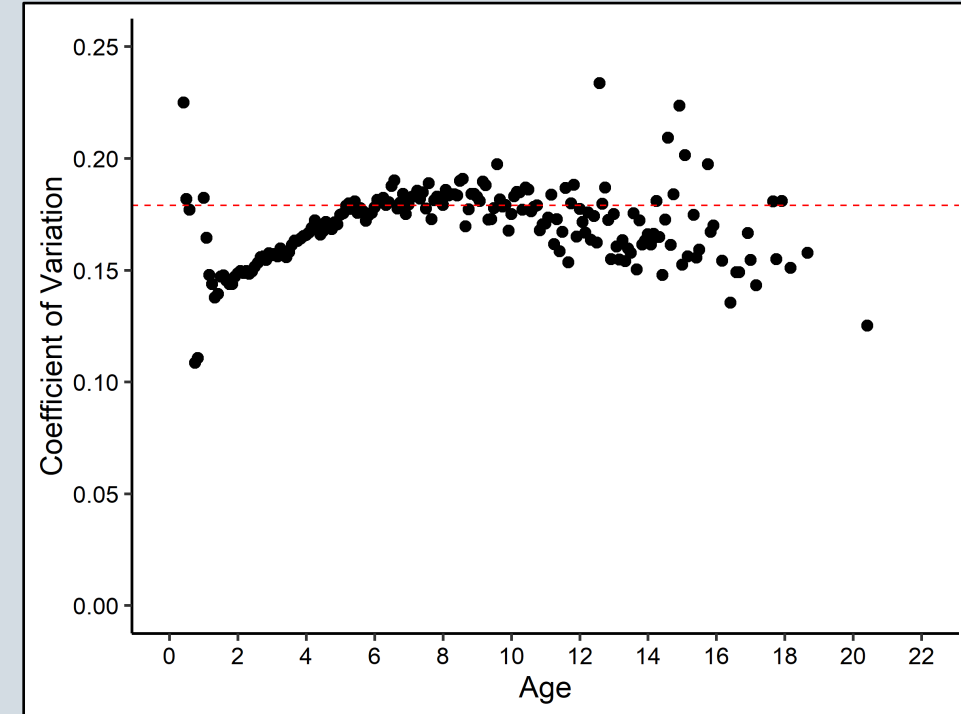
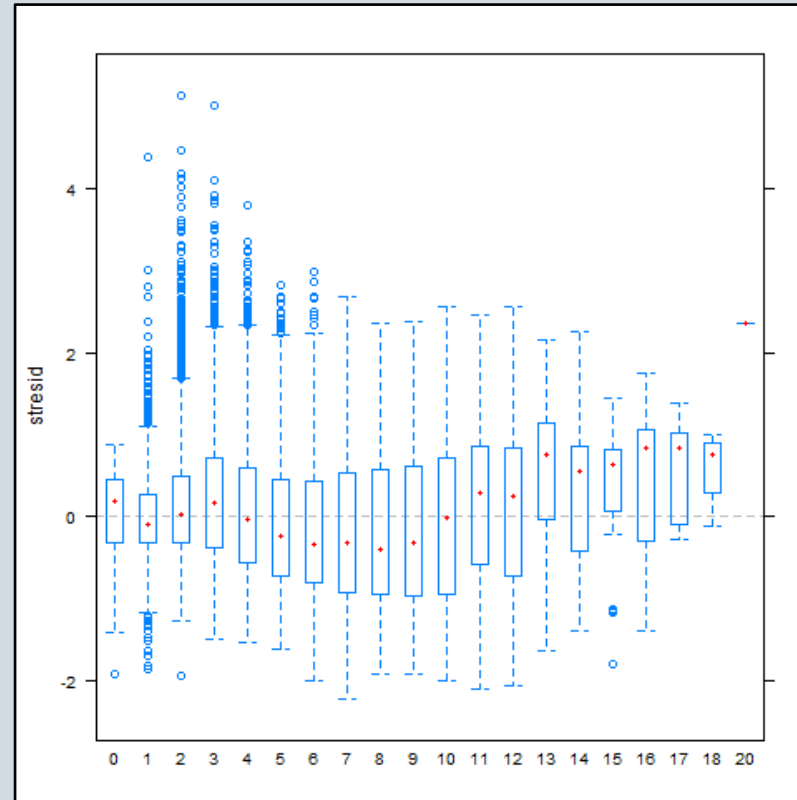
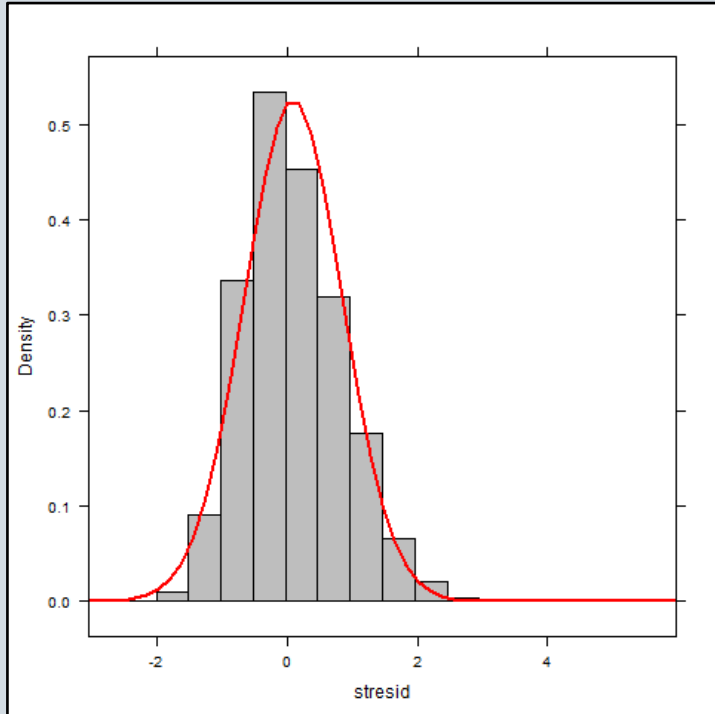
- $L_{inf} = 42.3$  cm fork length
- $k = 0.207 \text{ yr}^{-1}$
- $t_0 = -1.636$  year
- $CV = 0.179$



# Yellowtail Snapper Age Data



# Yellowtail Snapper Age Data



# Yellowtail Snapper Morphometrics

## Length-Weight

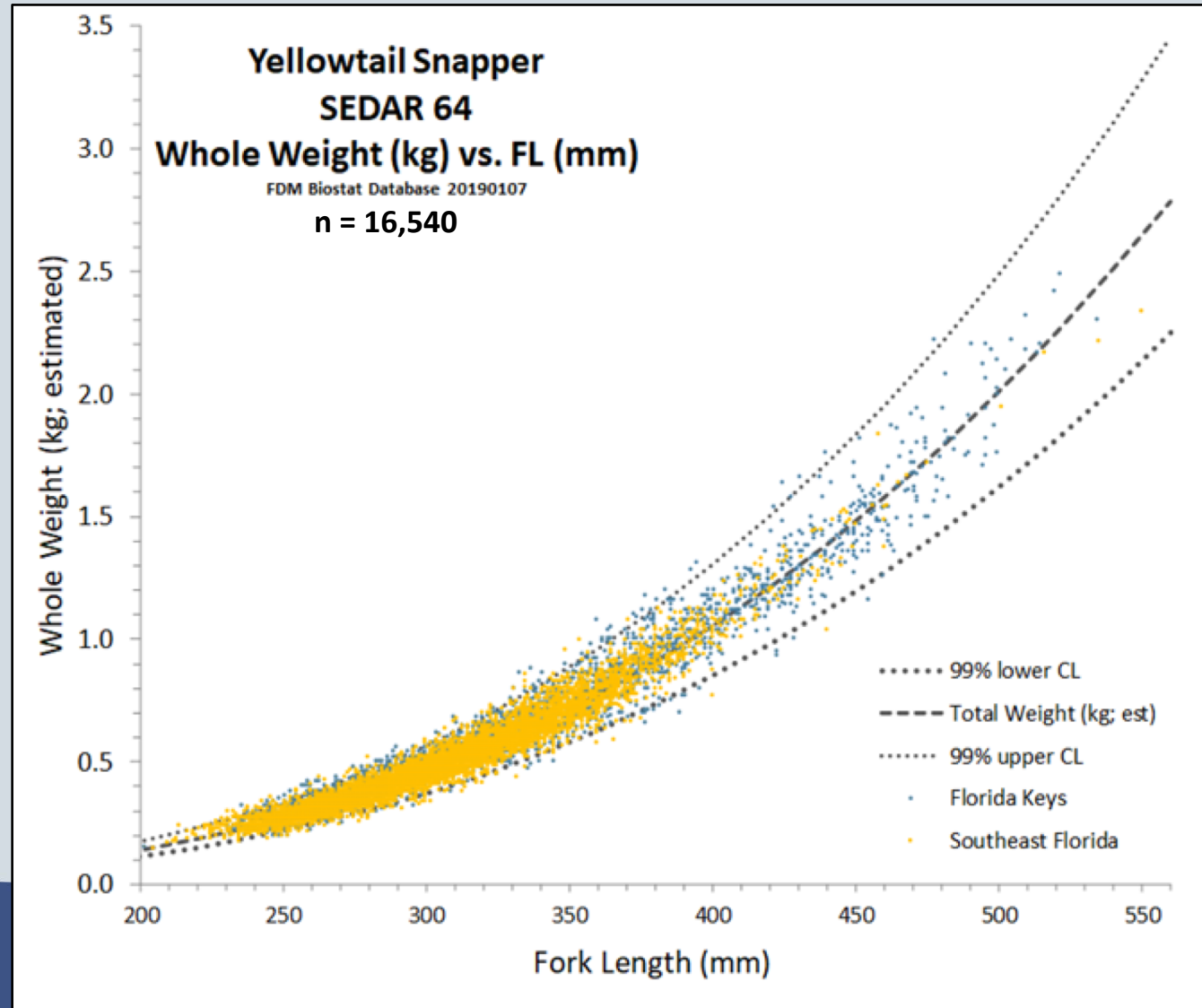
Source	Y [kg]	a	b	X[cm]	n	Min [cm]	Max [cm]
SEDAR 64	TW	2.574E-05	2.8797	FL	16,540	20.2	55.0
	TW	2.459E-05	2.7487	TL <sub>relaxed</sub>	10,792	24.7	69.7
	TW	1.959E-05	2.7849	TL <sub>max</sub>	1,763	28.4	65.4

## Length-Length

Source	Y (mm)	a (mm)	b	X (mm)	n	Min X (mm)	Max X (mm)	Avg. X* (mm)	Adj. r <sup>2</sup>
SEDAR 64	SL <sup>a</sup>	-8.55	0.896	FL	5,873	230	548	309.8	0.99
	TL <sub>relaxed</sub> <sup>b**</sup>	-14.72	1.273	FL	16,212	205	550	304.8	0.98
	TL <sub>max</sub> <sup>c</sup>	-16.41	1.297	FL	6,827	225	548	308.1	0.99



# Yellowtail Snapper Length-Weight



# Yellowtail Snapper Natural Mortality

## DW discussions and decisions

- Recommended Hoenig<sub>alltaxa</sub> (1983) using the maximum age = 28 yr (entire range)
- M inversely related to fish length and follows Lorenzen (2005)
- Sensitivity runs
  - Florida waters (age-20) and hypothetical max age in next assessment (age-33)

## AW discussions and decisions

- Life history data needs to be consistent and provide management advice for Florida-based fishery
  - Recommended base model use maximum age = 20 yr (Florida waters)
  - Explore k-based methods as sensitivity runs



# Yellowtail Snapper Natural Mortality

## Instantaneous Natural Mortality (Hoenig<sub>all taxa</sub> 1983)

- $e^{(1.44-0.982*\ln(t_{max}))}$ 
  - $t_{max}$  for Florida is age-20
- $M_{\text{Hoenig(all taxa)}} = 0.223 \text{ yr}^{-1}$

## Age-specific Natural Mortality (Lorenzen 2005)

- $M(a) = -\ln\left(\frac{L(a)}{L(a)+L_{\infty}(\exp(k(a_{max}-ac)))-1}\right) * \frac{-MrLr}{L_{\infty}k}$
- $M_r = 0.223 \text{ yr}^{-1}$ 
  - Scaled between ages 3 – 20
- Size-truncated VB growth parameters:  $L_{inf}, k$
- $M(a) = 0.558 \text{ yr}^{-1} - 0.198 \text{ yr}^{-1}$  for ages 0 – 20





# Yellowtail Snapper Maturity

## Data source

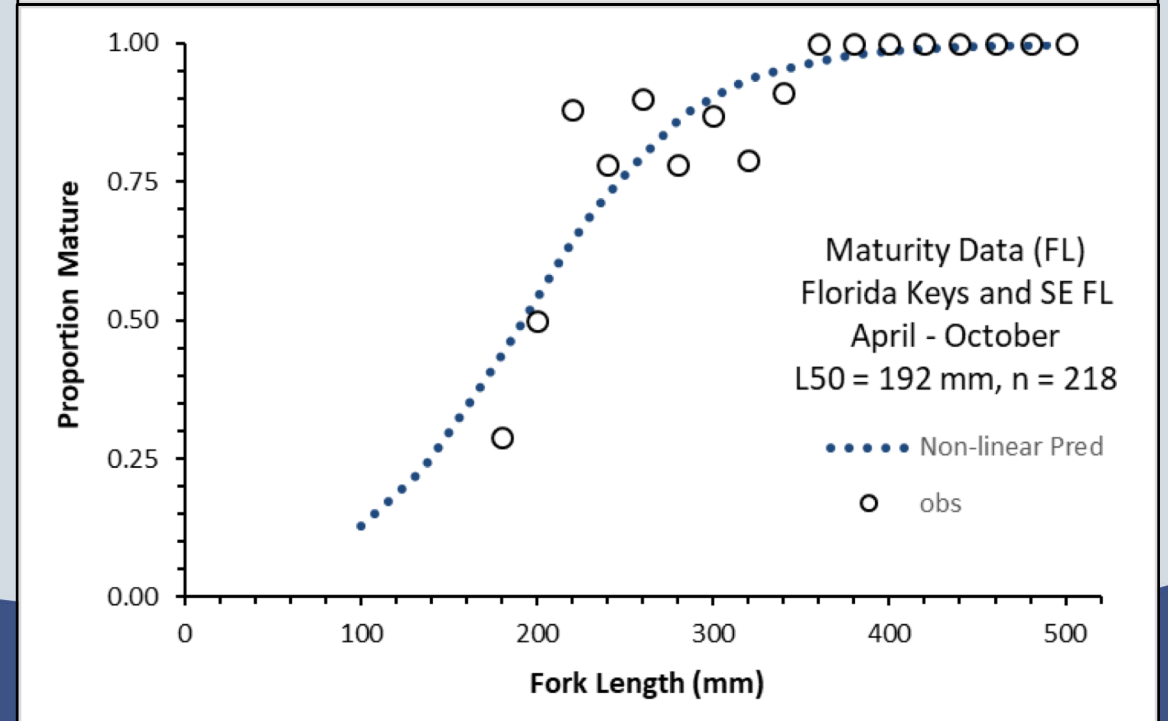
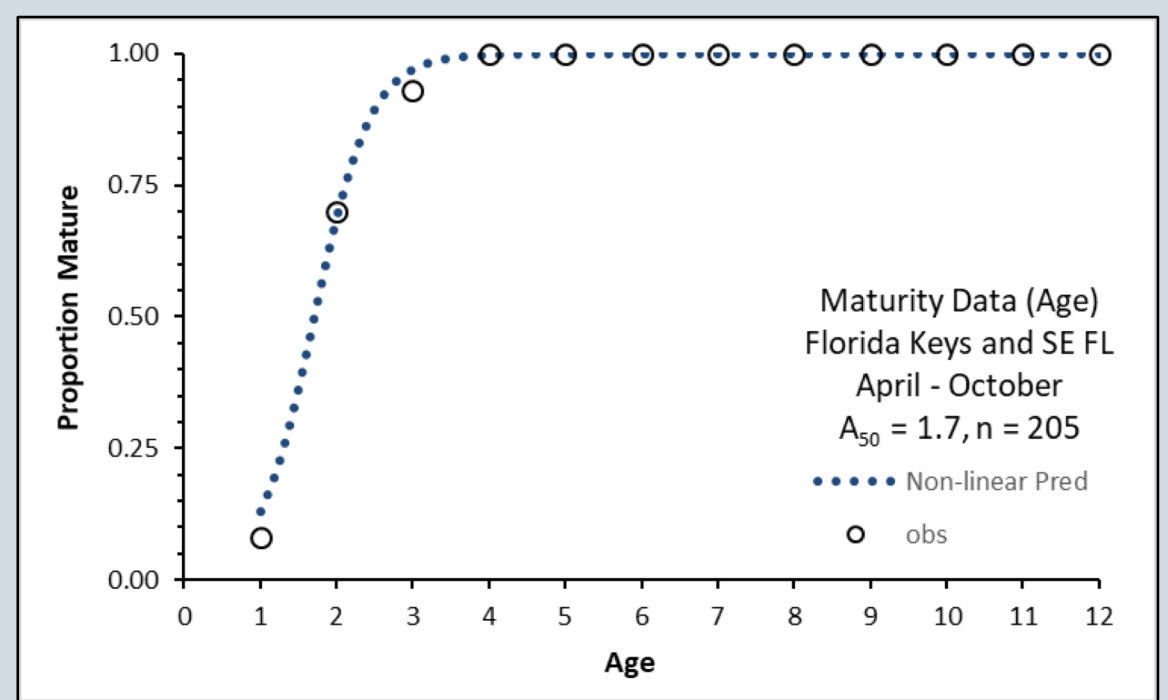
- Barbieri and Colvocoresses (2003)
- Florida Keys and southeast Florida

## Age-at-maturity

- 205 samples
- $A_{50} = 1.7$  years old; 1.5 – 1.9 yr old 95% CI
  - PROC NLIN (SAS v.9)

## Size-at-maturity

- 218 samples
- $L_{50} = 192$  mm FL; 162 – 222 mm FL 95% CI
  - PROC NLIN (SAS v.9)



# Yellowtail Snapper Fecundity

## **Fecundity**

- Estimates of fecundity in Yellowtail Snapper are limited
- FL Keys: 11,000 – 1,391,000 eggs (n = 44; Collins and Finucane 1989)
- Campeche Banks: 14,102 – 164,756 eggs; Batch fecundity =  $1.45 * FL_{cm}^{3.05}$  (n=41; Trejo-Martínez et al. 2011)
- Cuba: Fecundity =  $1,097 * FL_{cm}^{2.88}$  (n=60; Carrillo de Albornoz and E. Grillo 1993)

## **Sex ratios (male:female)**

- 1:1.04 in the Florida Keys (Grimes 1987)
- 1:1.3 and 1:1.4 in Jamaica and Cuba (Grimes 1987)
- 1:1 on Campeche Banks (Trejo-Martínez et al. 2011)





# SEDAR 64: Yellowtail Snapper

## Main Data Inputs

### **Landings and Discards**





# Landings

- Commercial Fleet
  - Florida's Marine Trip Ticket Program and NOAA ALS
  - Florida only data used from 1992 – 2017 (available beginning in 1962)
  - Standard errors (in log-space) weighted by landings (0.05 – 0.1)
- Headboat Fleet
  - Southeast Region Headboat Survey (SRHS)
  - Florida only data used from 1992 – 2017 (available beginning in 1981)
  - No variance estimates due to survey design
    - Standard errors (in log space) assumed equal to 0.25 and constant through time
- MRIP Fleet
  - Marine Recreational Information Program; Fully calibrated (APAIS, FES, and FHS)
  - Florida only data used from 1992 – 2017 (available beginning in 1981)
    - Modes: Private, Shore, and Charter.
  - CVs provided by SEFSC and transformed to standard errors (in log-space; 0.09 – 0.36)



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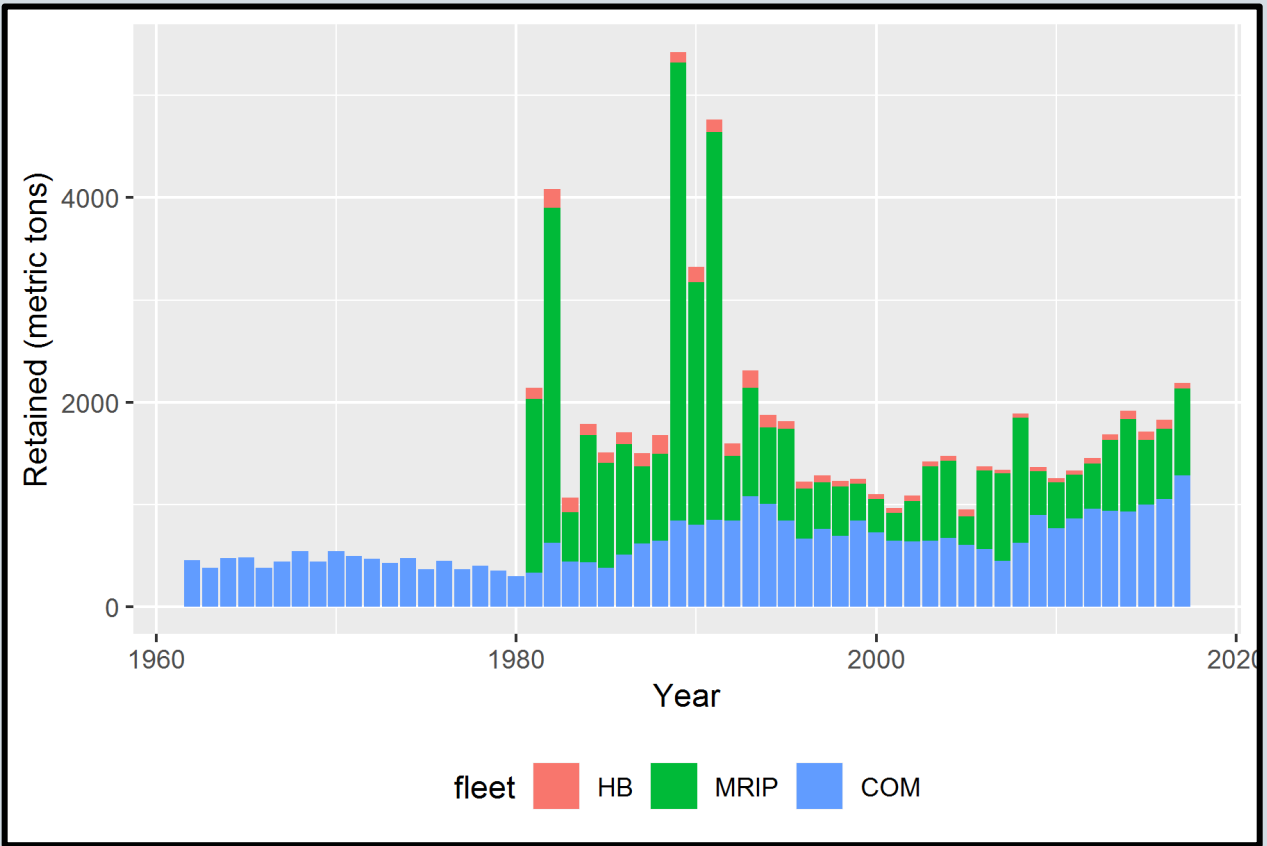
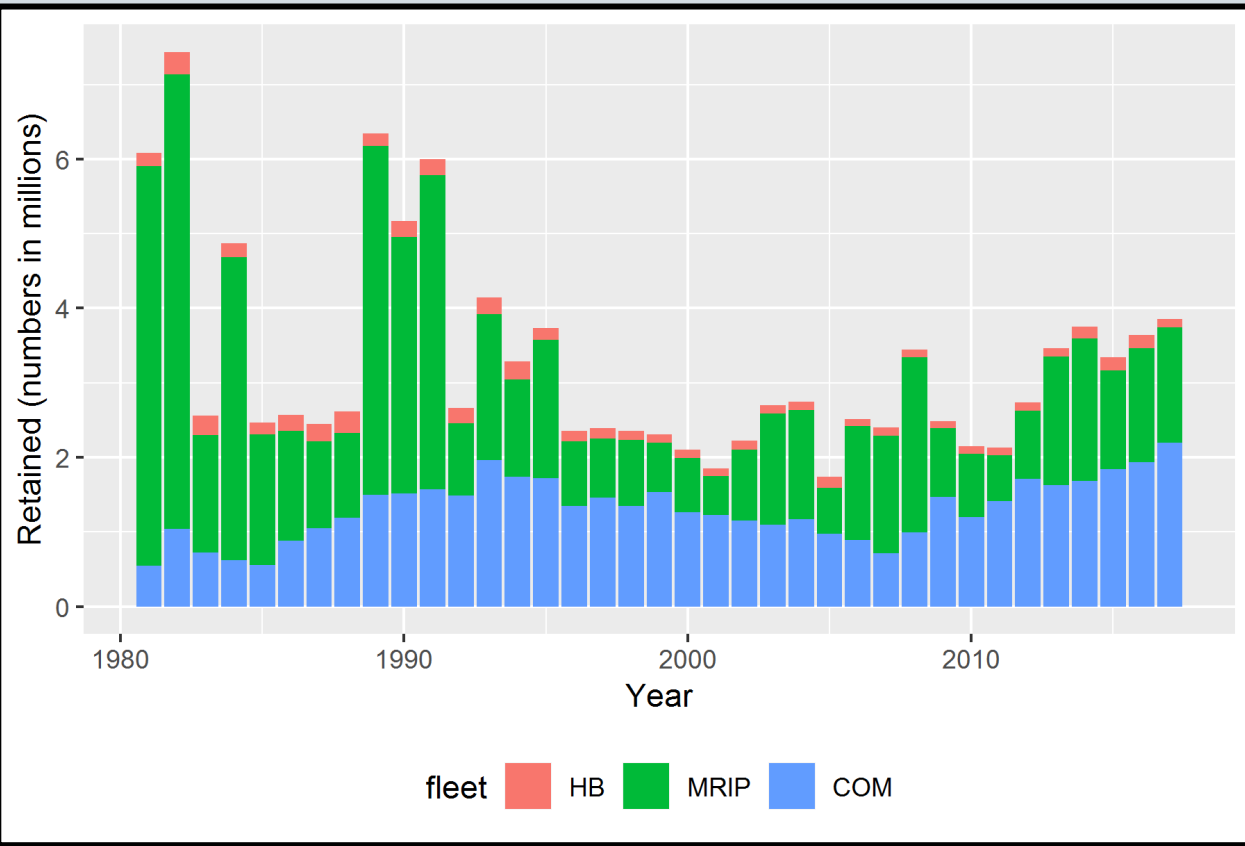


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# Landings by Fleet





# Discards

- Commercial Fleet
  - Effort and discard rate data from vertical line trips in southern Florida reported in the CFLP between 2002 – 2017
  - For years 1993 – 2001, discard rates were averaged for years 2002 – 2006 and used with available effort data
  - CVs provided by SEFSC using the 'standard' S32 method (CVs = 1.94 – 5.61)
- Headboat Fleet
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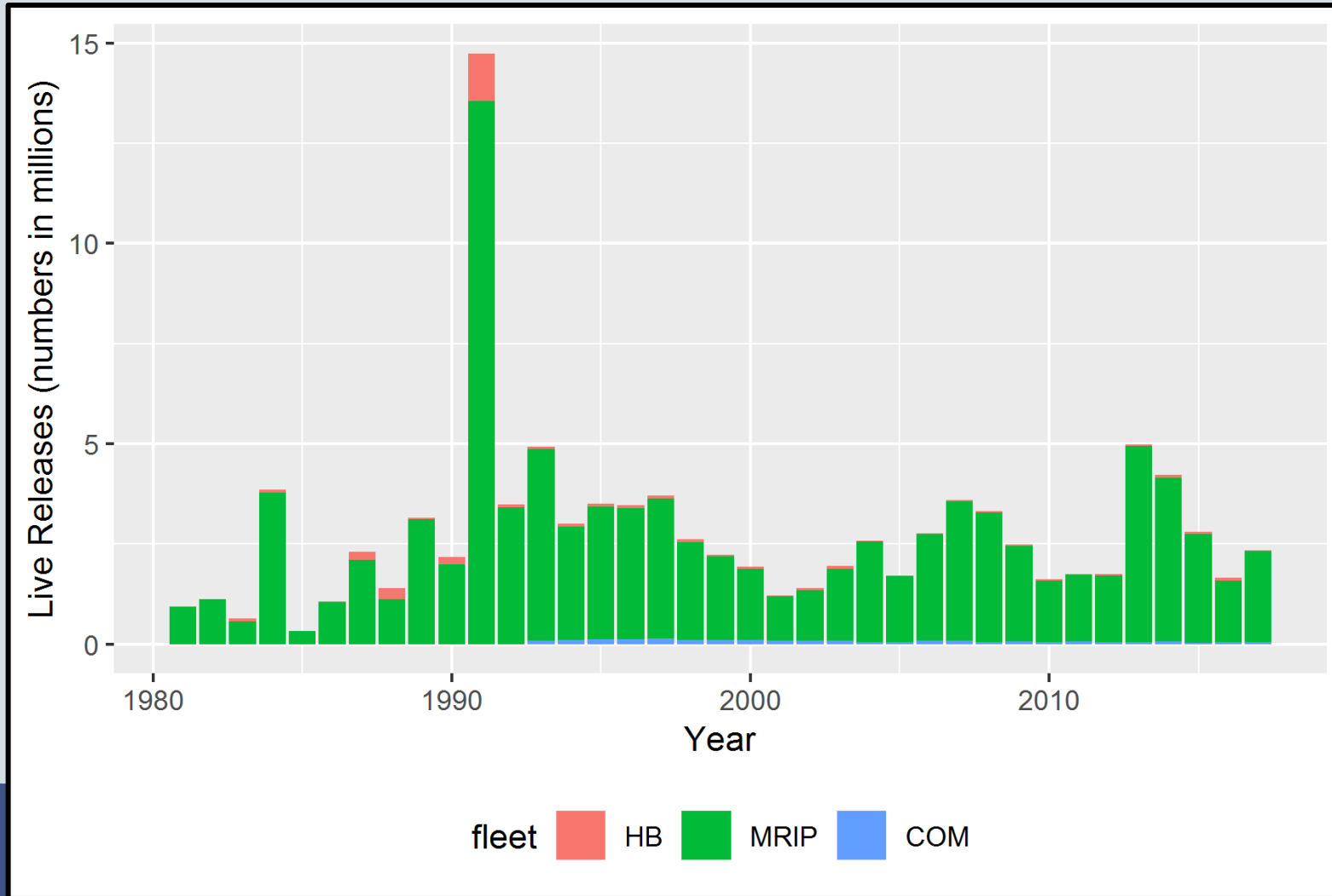


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# Discards by Fleet





# SEDAR 64: Yellowtail Snapper

## Main Data Inputs

### Indices



# Indices of Abundance and Biomass

## Fishery-Independent

- Reef Fish Visual Census (RVC)
  - Florida Keys (1997 – 2016), Dry Tortugas (1999 – 2016), southeast Florida (2012 – 2016)
  - Two-stage SRS design using divers in water <30 m
  - Habitat strata varied by region
  - Juvenile and subadult (1 – 18 cm)
  - Adult (19+ cm)
- Indices were constructed by combining data in overlapping years for the Florida Keys and the Dry Tortugas
  - New habitat strata codes
  - 1999, 2000, biennially 2004 – 2016
  - Juvenile and adult indices of abundance (number of fish/diver 'cylinder')



<https://www.fisheries.noaa.gov/southeast/science-data/reef-ecology-unit>



# Indices of Abundance and Biomass

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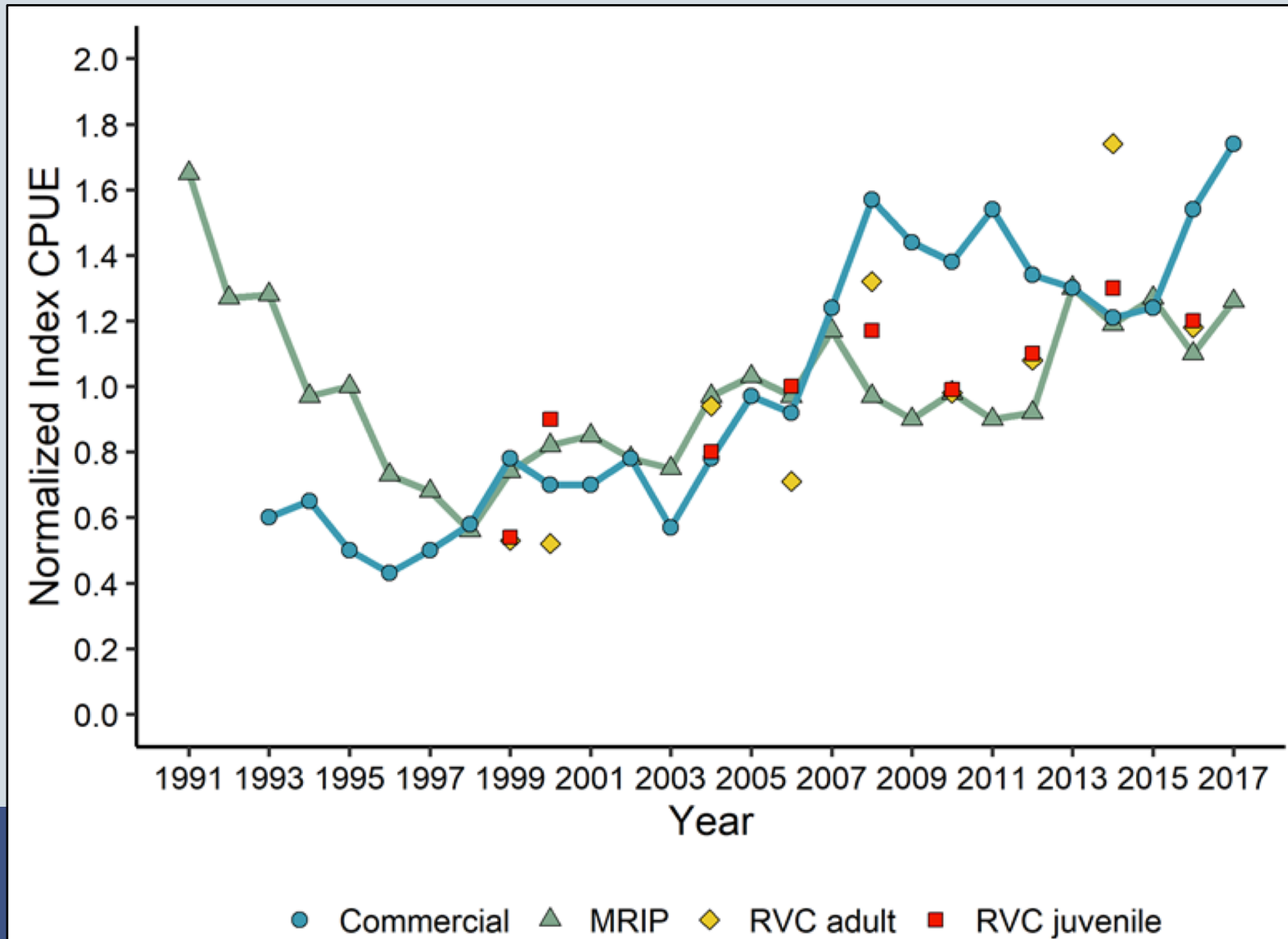
## Fishery-Dependent

- Commercial vertical line
  - CFLP data from 1993 – 2017
  - Southern Florida (southeast Florida through Sarasota and the Dry Tortugas)
  - Index of biomass (lbs of fish/hook hours fished)
- MRIP
  - MRIP total catch data from 1991 – 2017
  - Southeast Florida and the Florida Keys (including the Dry Tortugas)
  - Index of abundance (number of fish/trip)





# Indices of Abundance and Biomass





# SEDAR 64: Yellowtail Snapper

Main Data Inputs

**Length Compositions**



# Retained Length Compositions

## Commercial (TIP)

- 1992 – 2017 (n=135,960)
- 14 – 68 cm FL

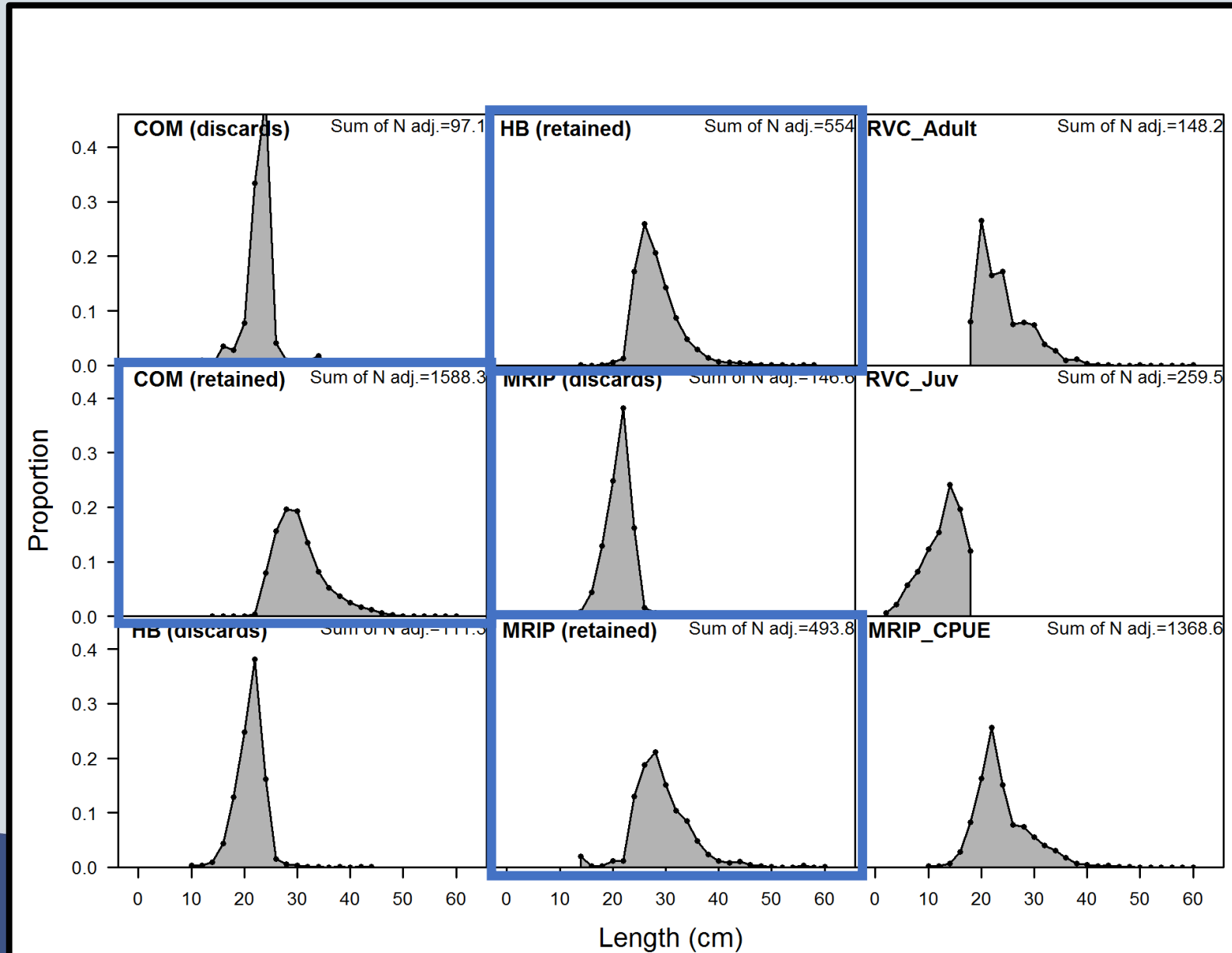
## Headboat (SRHS)

- 1992 – 2017 (n=64,107)
- 14 – 58 cm FL

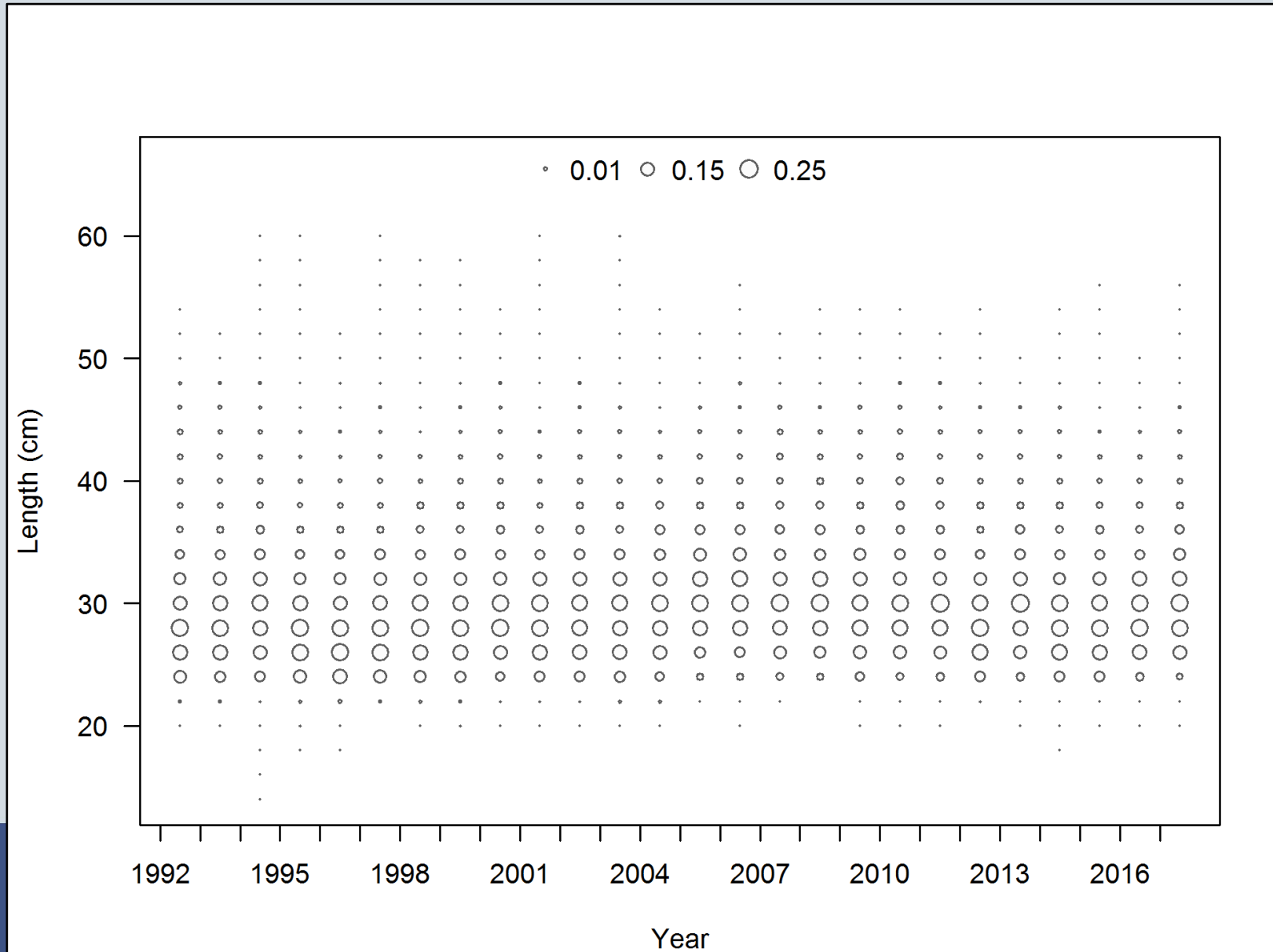
## MRIP (MRIP)

- 1992 – 2017 (n=15,749)
- 10 – 78 cm FL

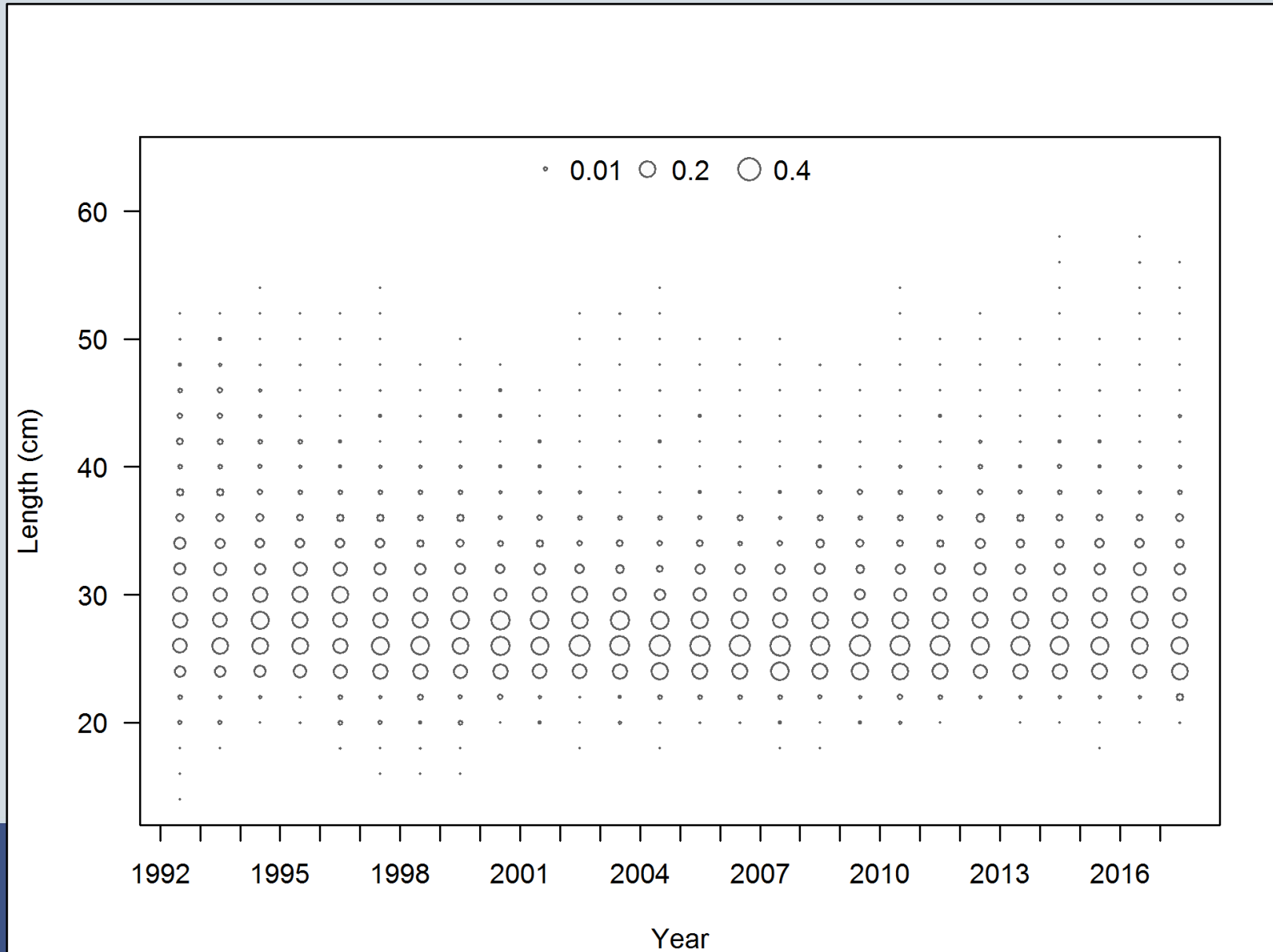
All weighted by landings



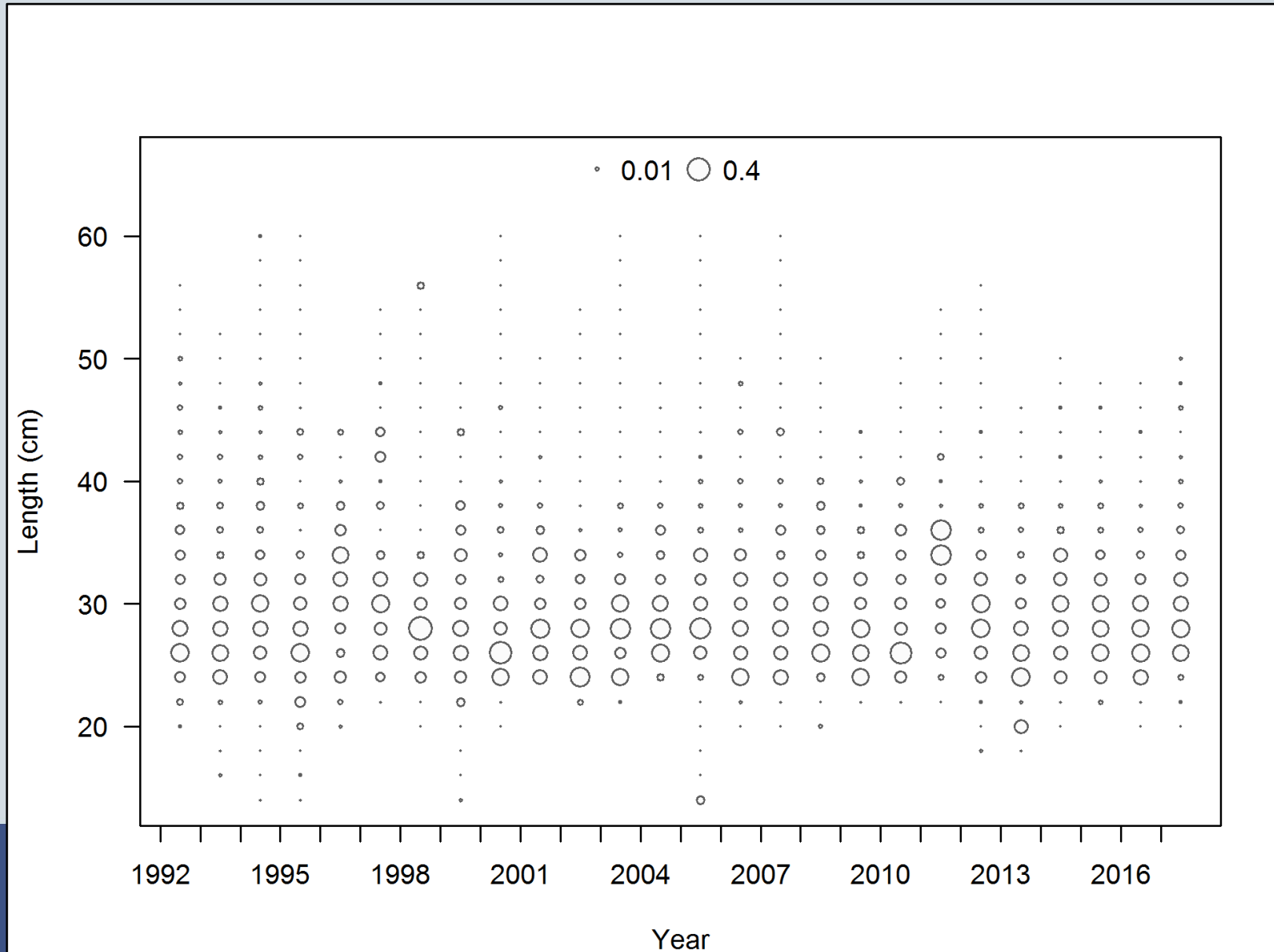
# Retained Length Compositions: Commercial



# Retained Length Compositions: Headboat



# Retained Length Compositions: MRIP



# Discard Length Compositions

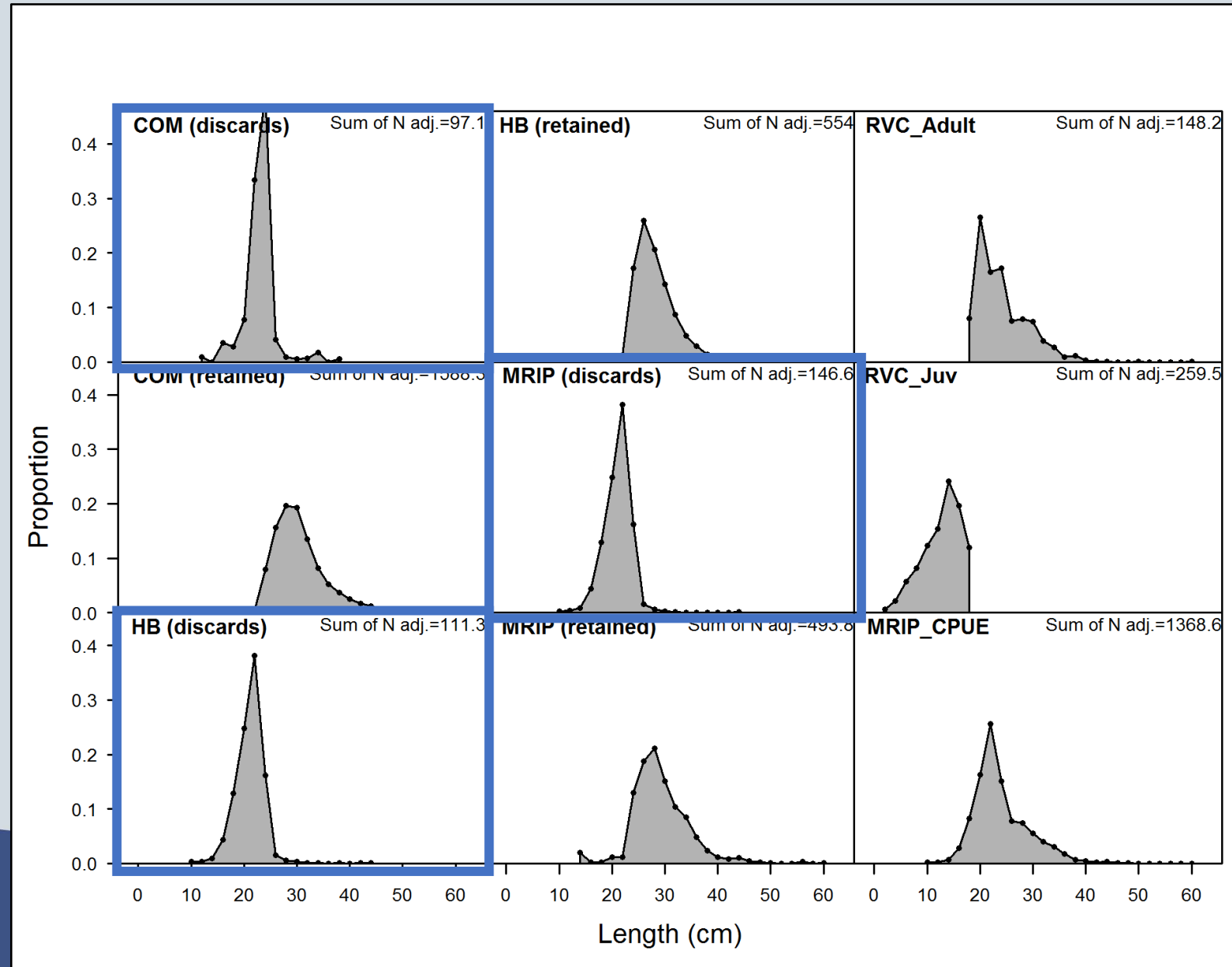
## Commercial

- Reef Fish & Shark Observer Program
- 2009 – 2017 (n=868)
- 12 – 38 cm FL

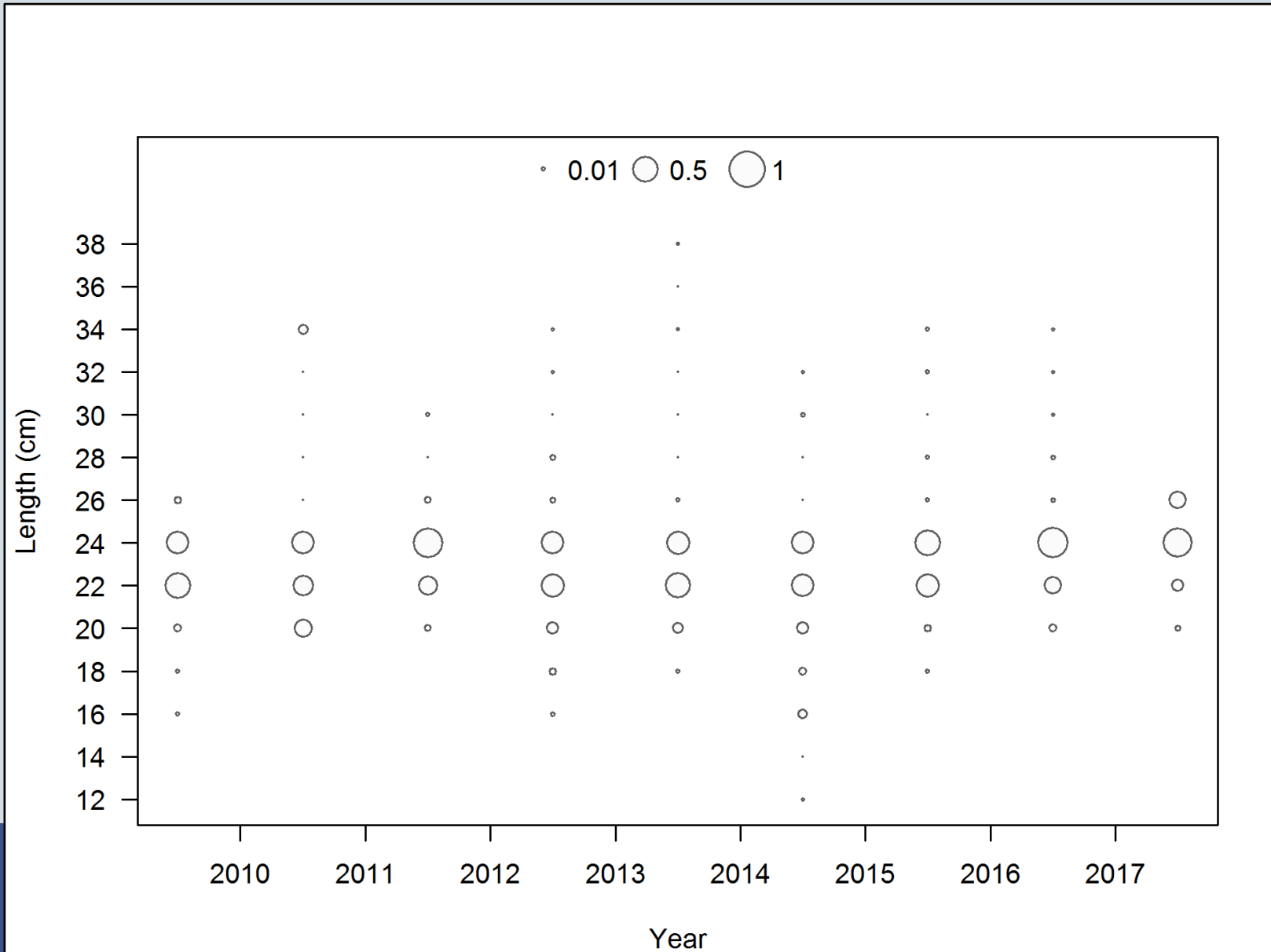
## Headboat and MRIP

- Headboat/Charter At-Sea Observer data combined
- 2005 – 2017 (n=7,243)
- 10 – 44 cm FL

All weighted by discards

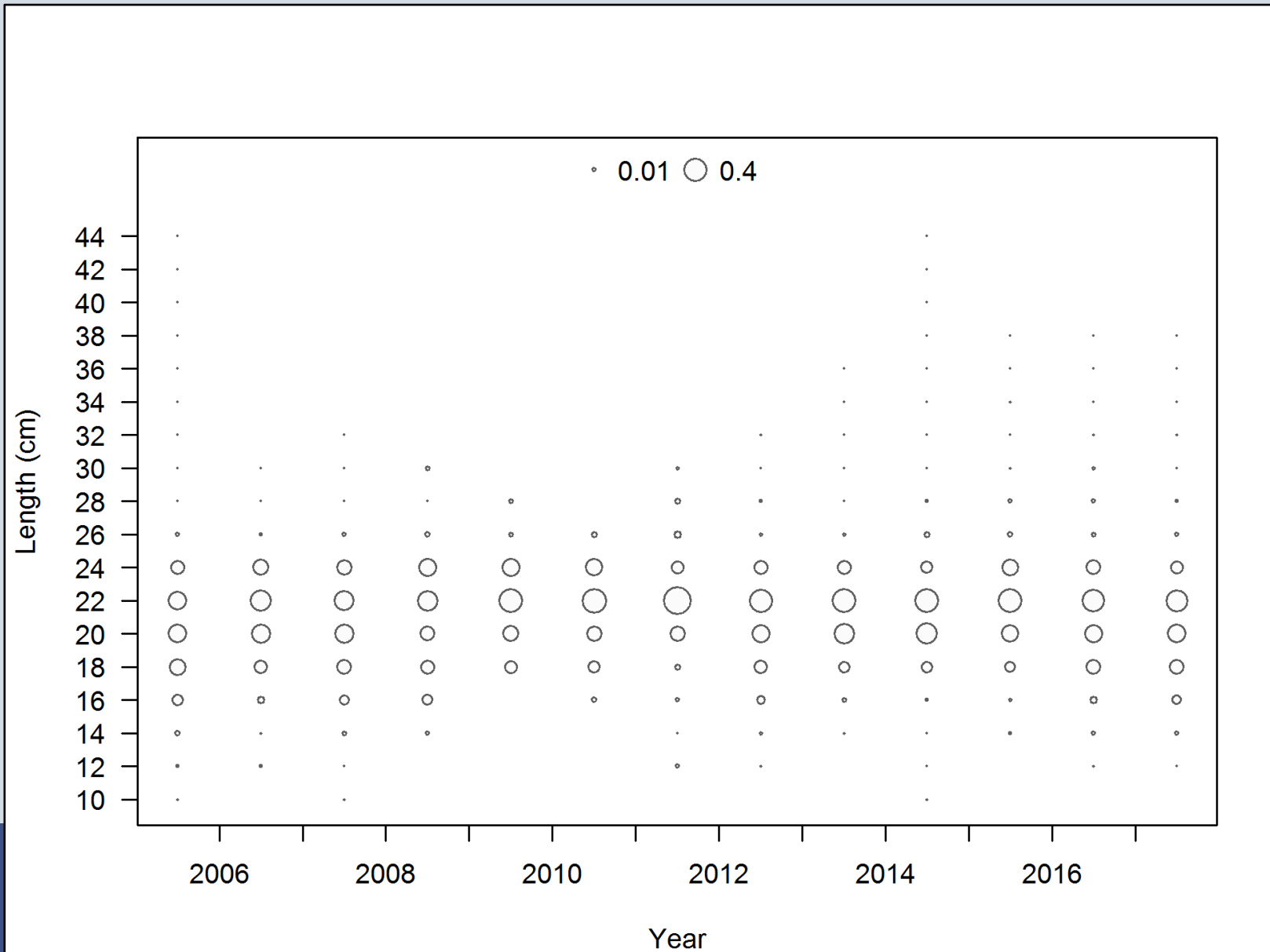


# Discard Length Compositions: Commercial





# Discard Length Compositions: Headboat/MRIP



# RVC Length Compositions

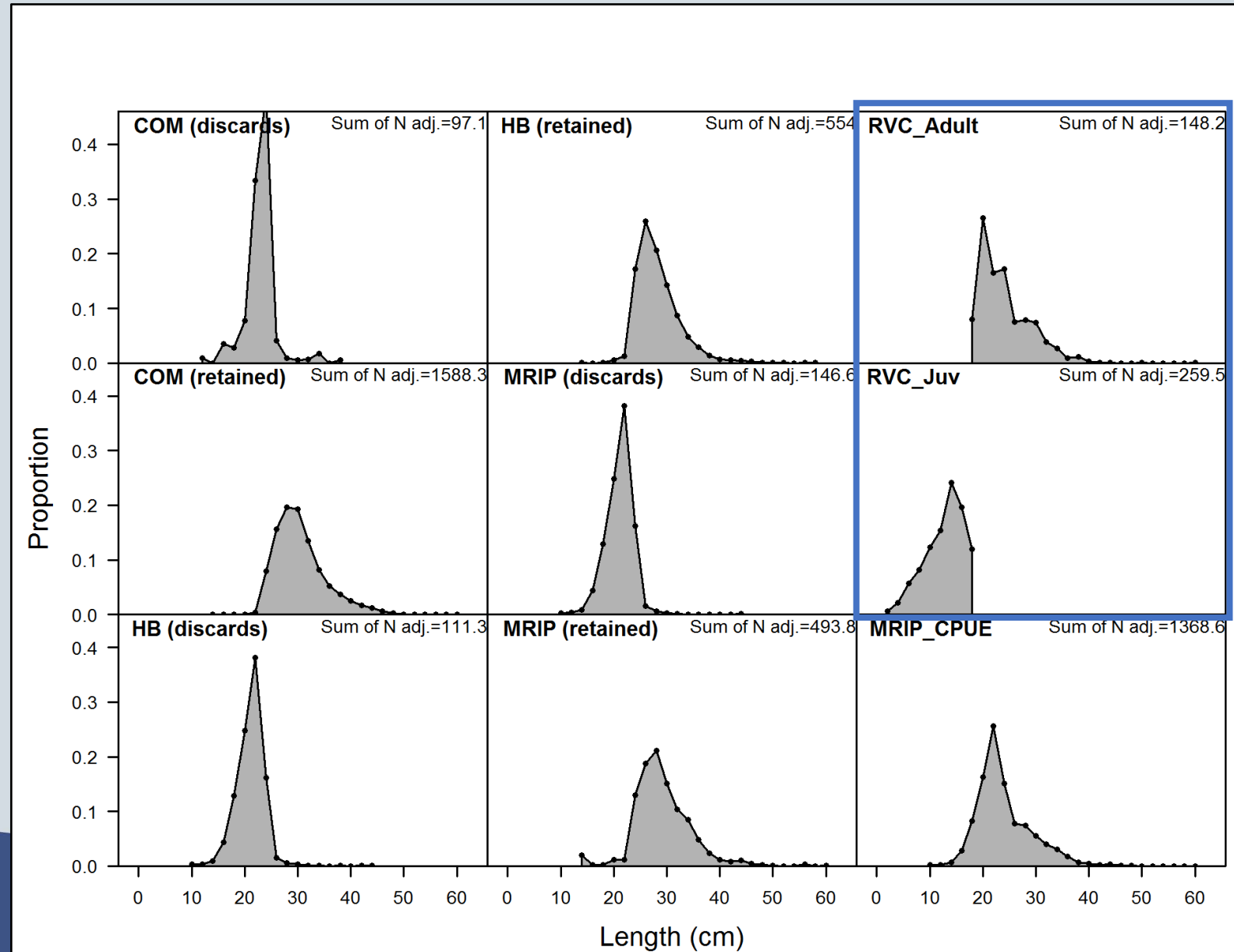
## RVC Adult

- 1999 – 2016 (n=44,401)
- 19 – 64 cm FL

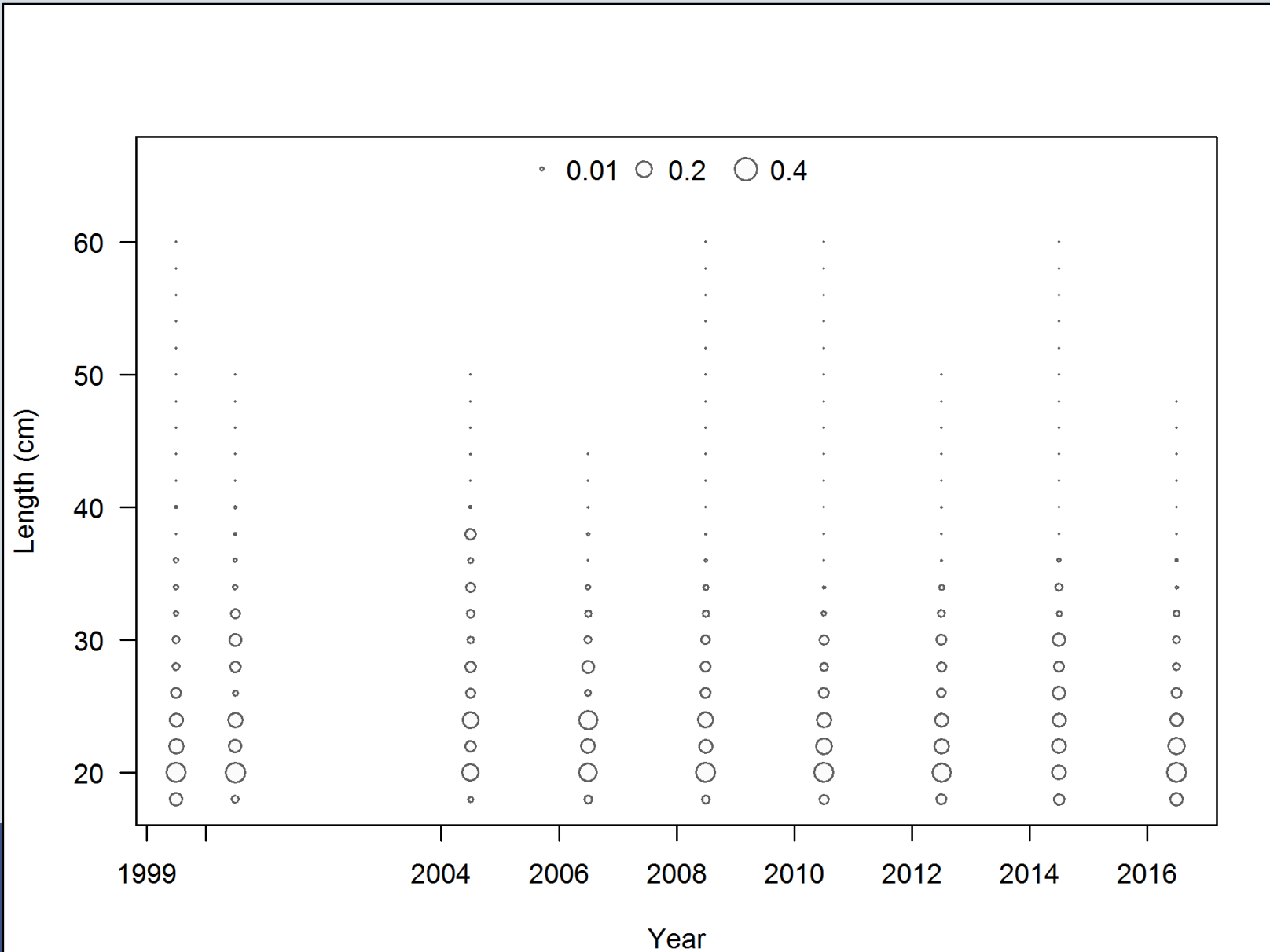
## RVC Juvenile

- 1999 – 2016 (n=41,904)
- 2 – 18 cm FL

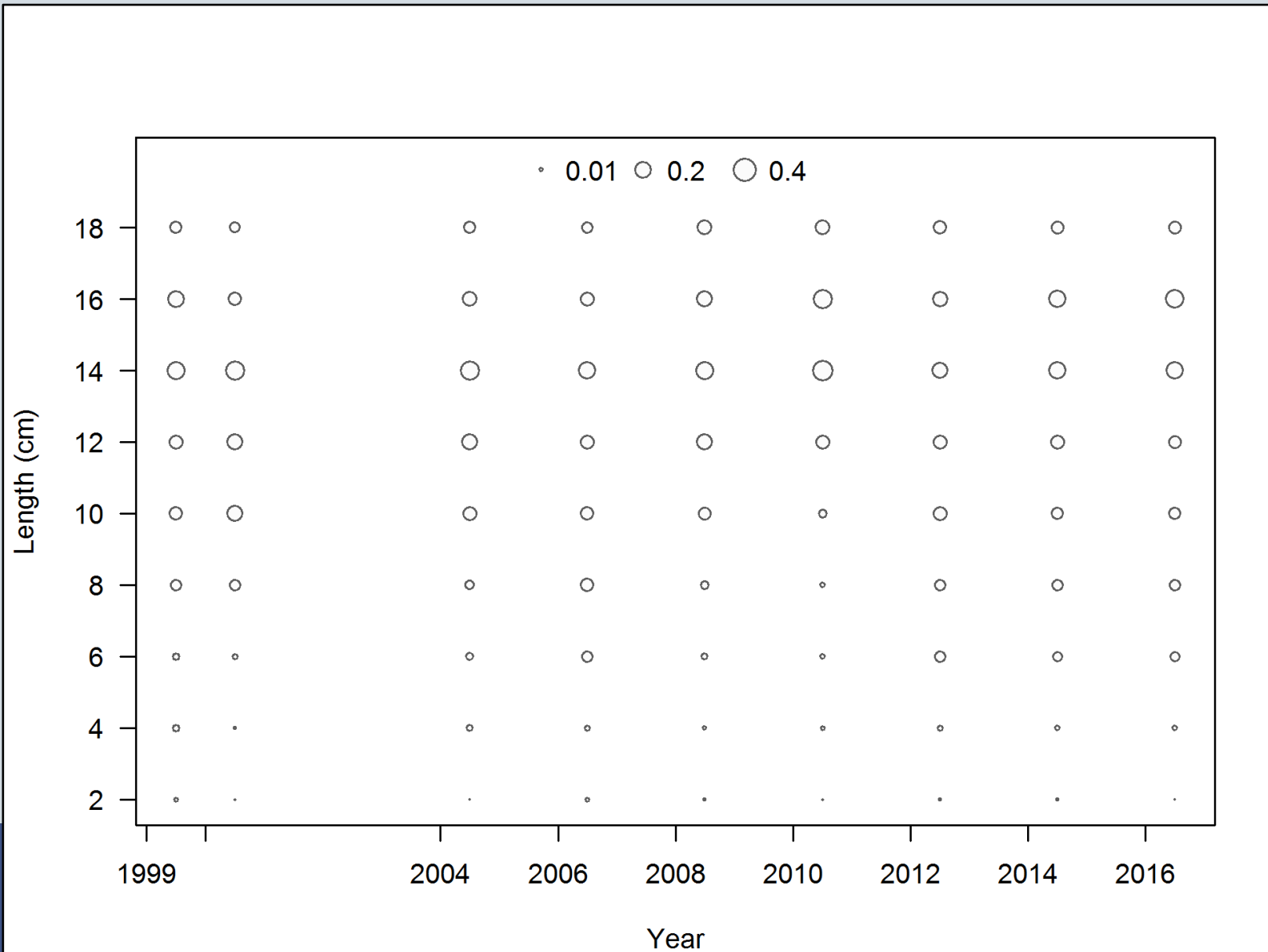
Weighted by number of SSUs



# Length Compositions: RVC Adult



# Length Compositions: RVC Juvenile

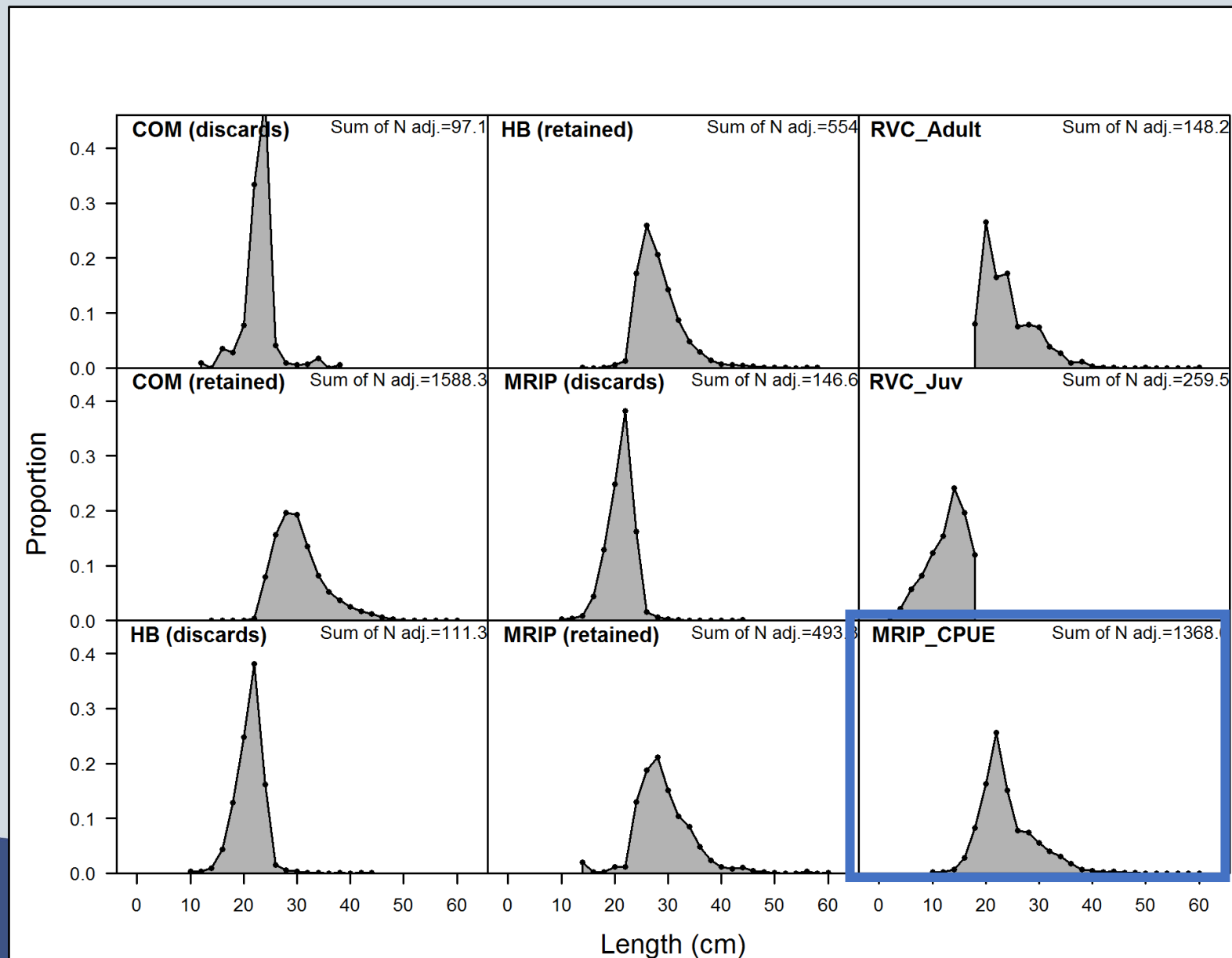


# MRIP CPUE Length Compositions

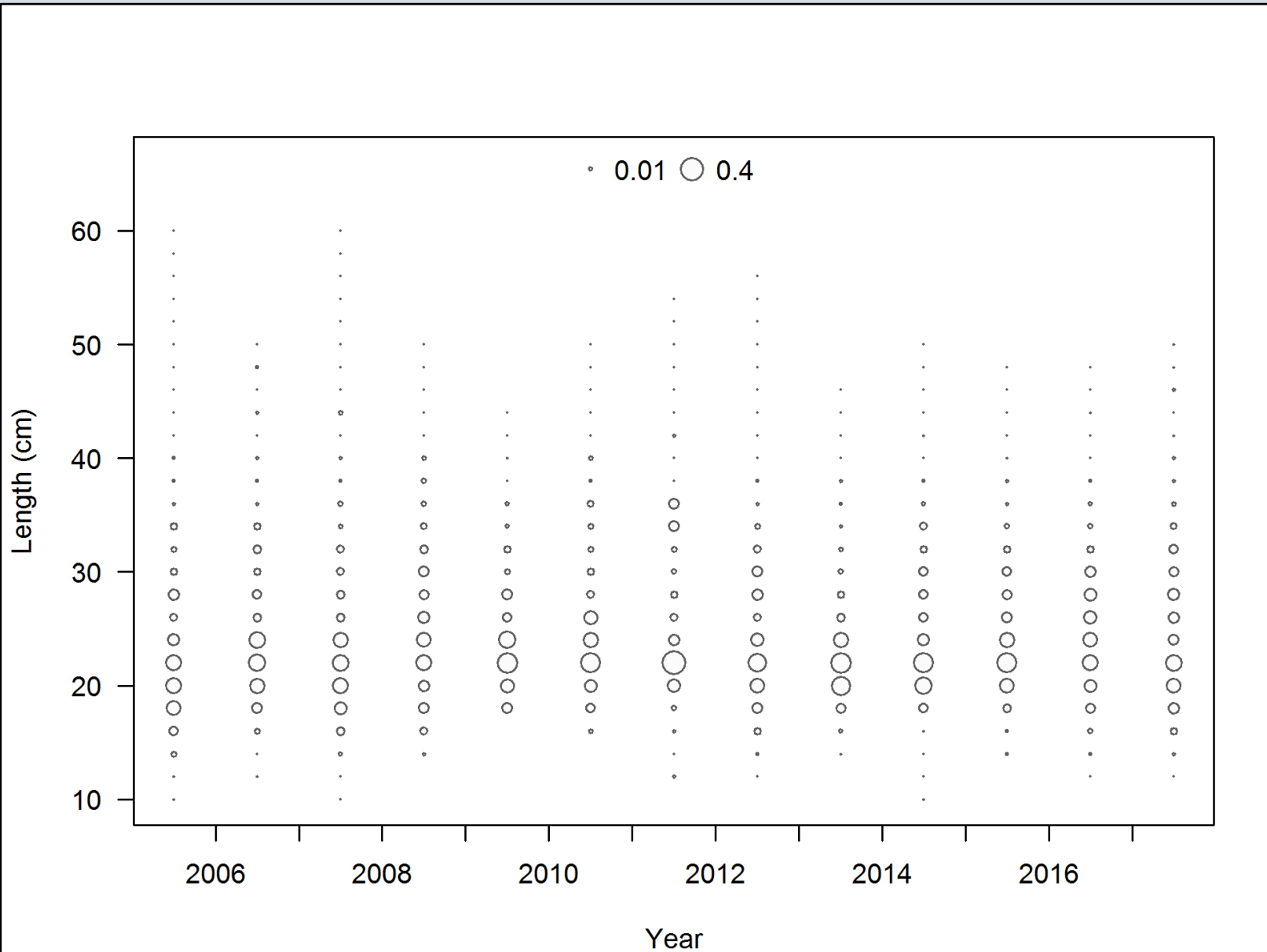
## MRIP CPUE

- Combined retained and discarded lengths
- 2005 – 2017 (n=22,992)
- 10 – 76 cm FL

Sum of discards at length and retained at length



# Length Compositions: MRIP CPUE





# SEDAR 64: Yellowtail Snapper

## Main Data Inputs

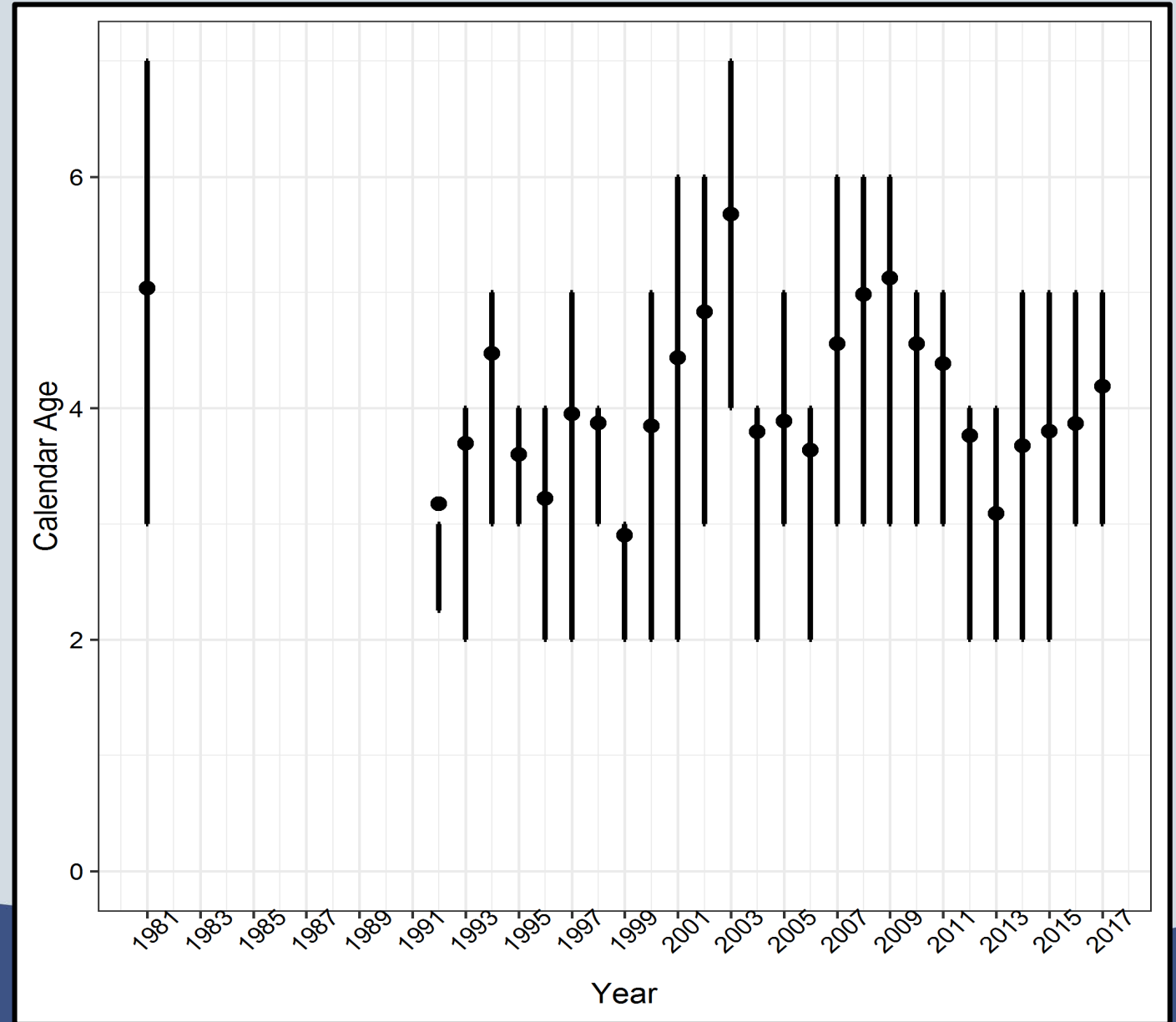
### Conditional Age-at-length



# Annual Mean Ages by Fleet

## Commercial

- Sources: TIP, SRHS, Unknown
- 1981 – 2017
- 21,671 otoliths
- Ages 1 – 18

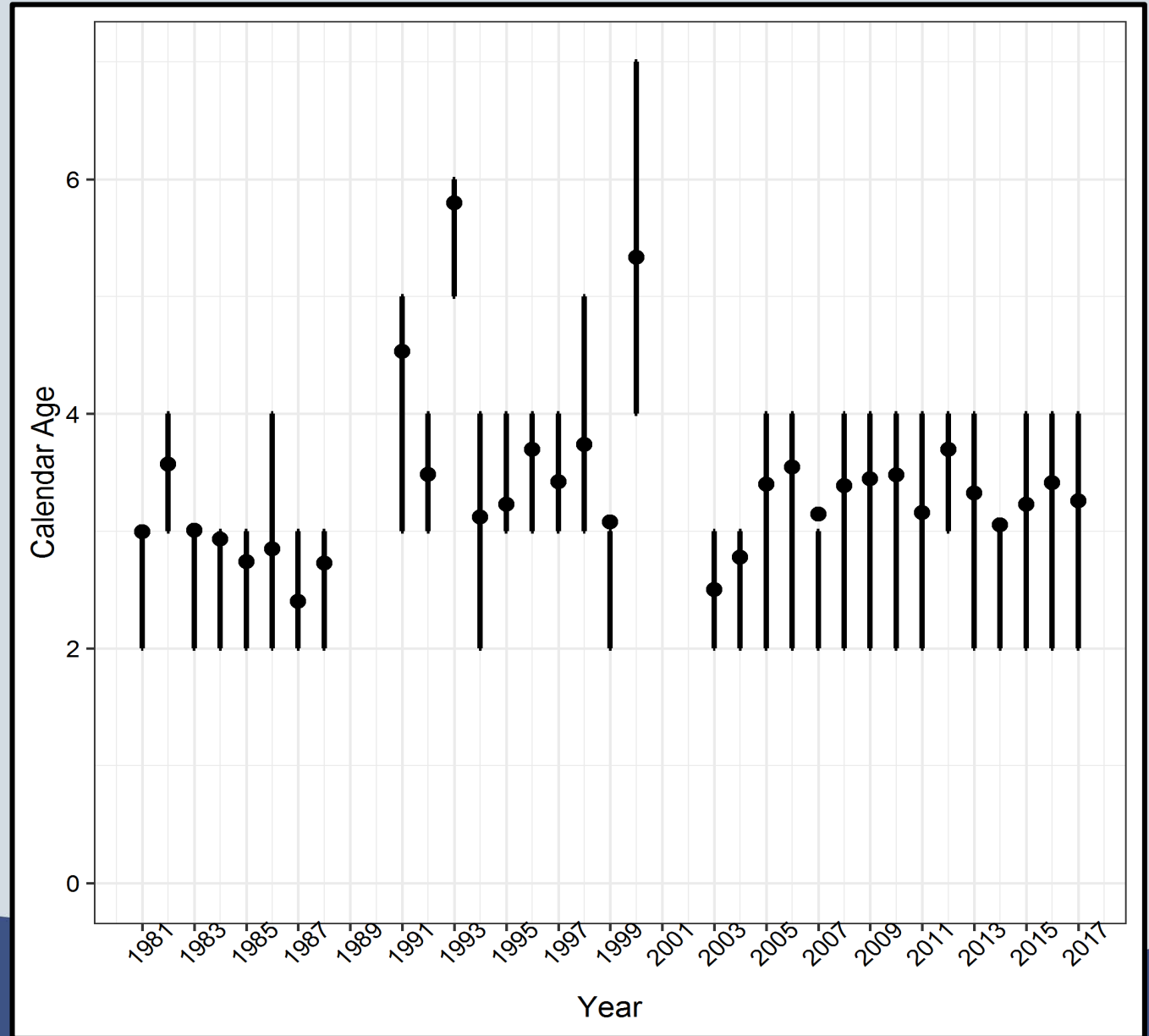




# Annual Mean Ages by Fleet

## Headboat

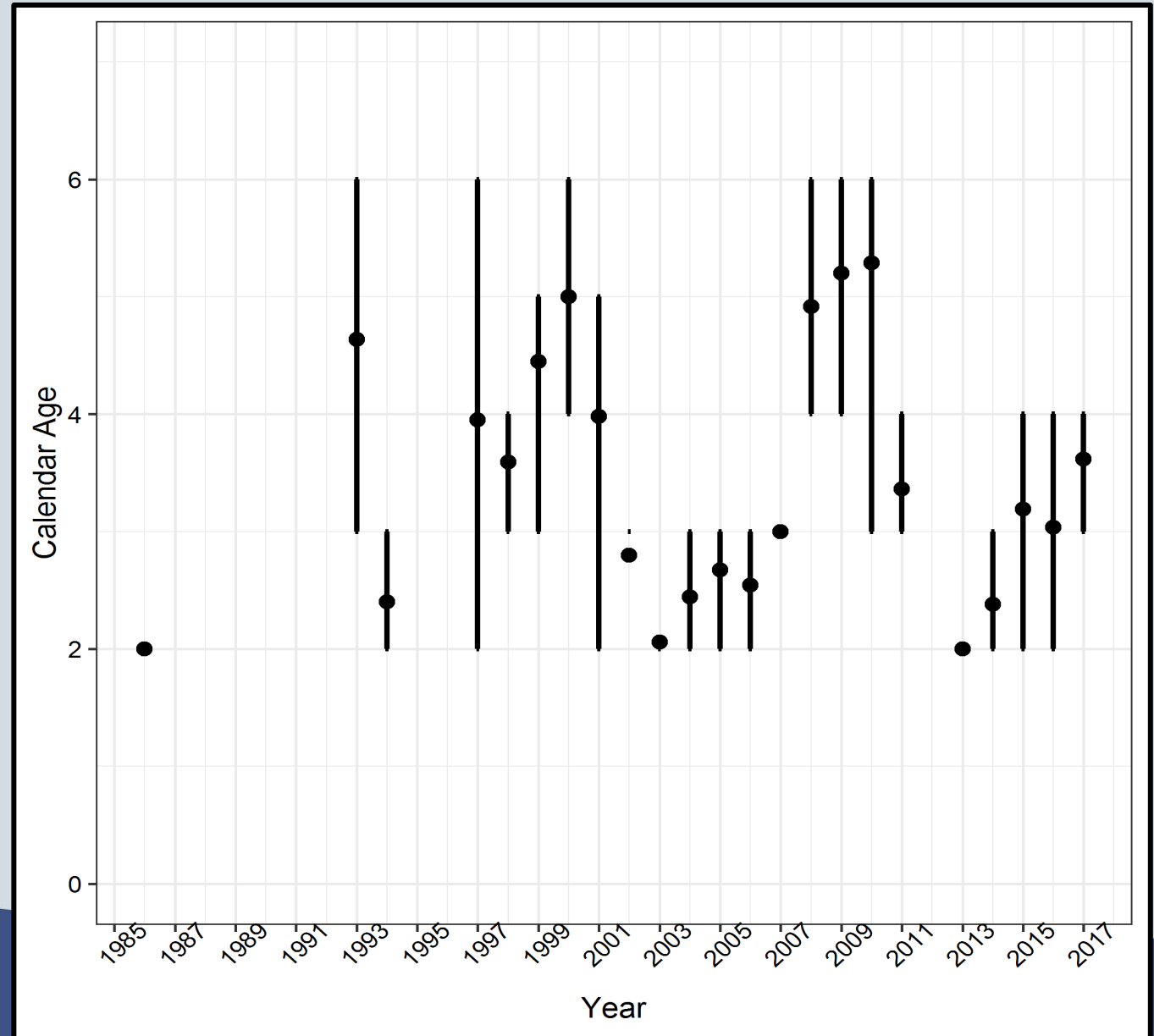
- Sources: SRHS, TIP, At-Sea, GRFS/MARFIN
- 1981 – 2017
- 20,679 otoliths
- Ages 1 – 20



# Annual Mean Ages by Fleet

## MRIP

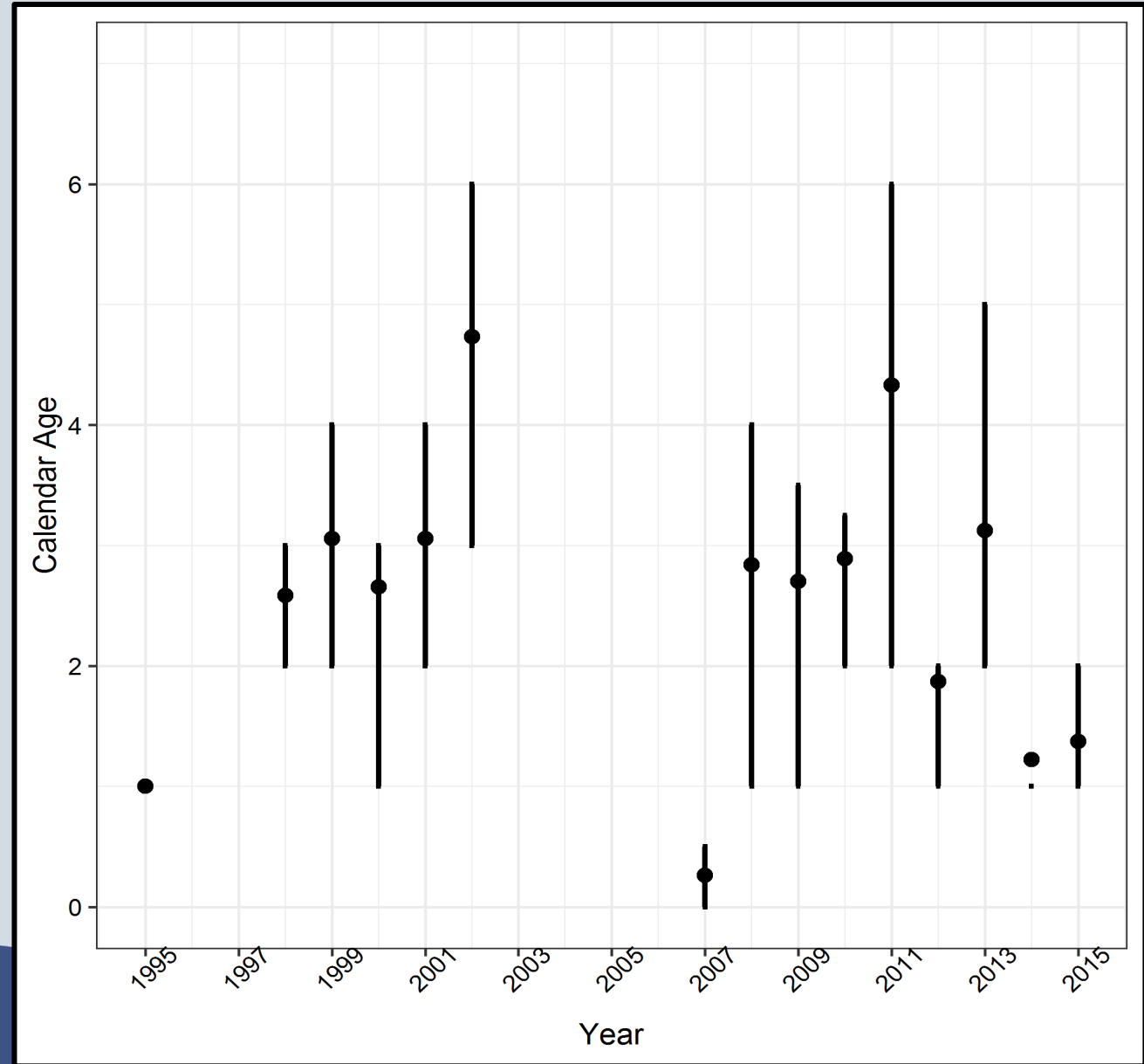
- Sources: GRFS/MARFIN, At Sea, SRHS, TIP, Unknown
- 1985 – 2017
- 2,234 otoliths
- Ages 1 – 16

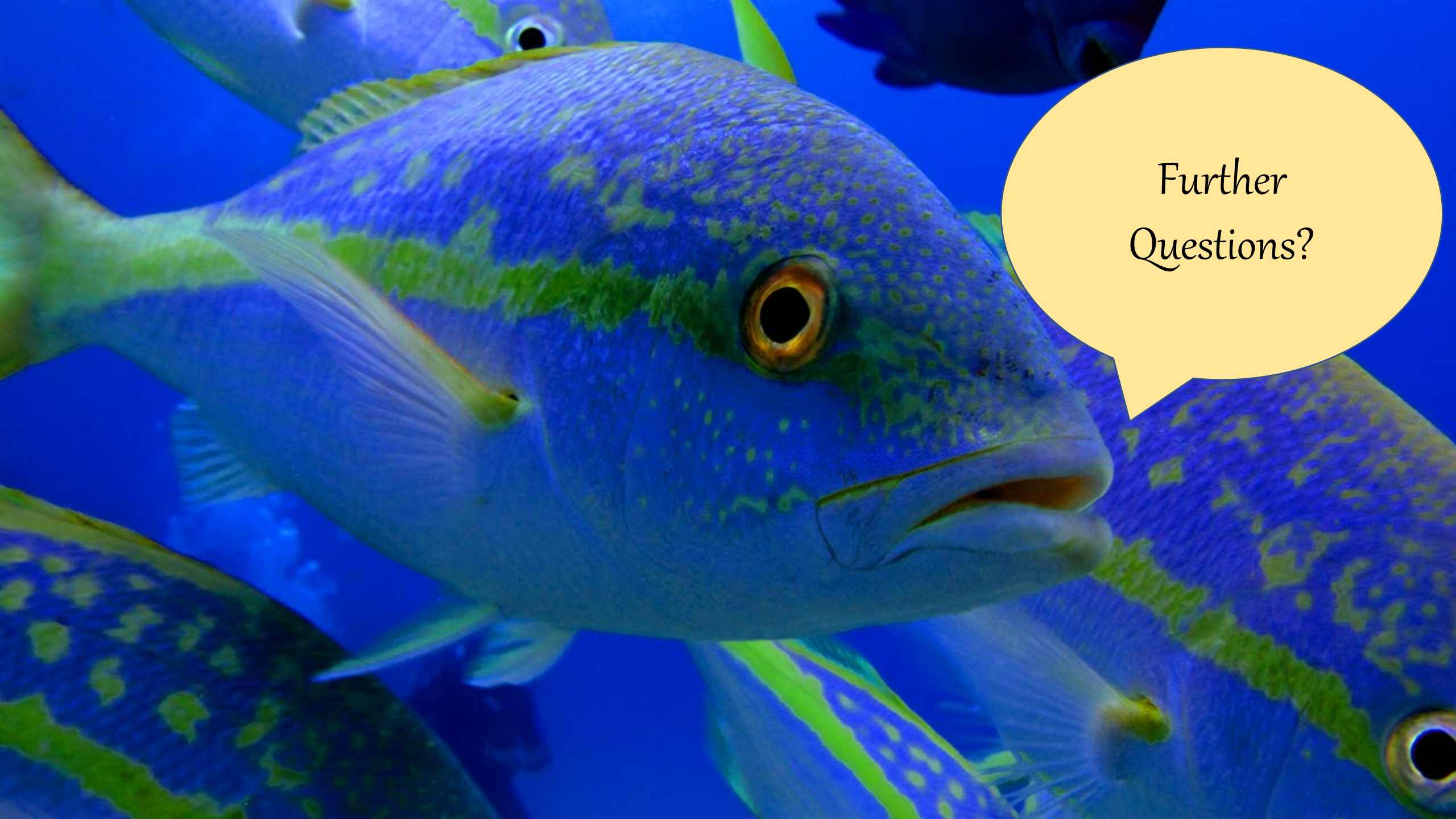


# Annual Mean Ages by Fleet

## Fishery-independent

- Sources: FIM FWRI, Vose & Shank (2003)
- 1995 – 2015
- 1,888 otoliths
- Ages 0 – 13





Further  
Questions?

# Yellowtail Snapper Natural Mortality

## Beverton-Holt life history invariants

- M/k ratio (Jensen 1996)
  - $M = 1.5k \quad \rightarrow \quad M = 1.5(0.207) \quad \rightarrow \quad M = 0.311 \text{ yr}^{-1}$
- Yellowtail Snapper  $M/k = 1.076$ 
  - Hordyk et al. (2015) describes M/k ratios ranging from 0.12 – 3.52 for several species

## Charnov et al. (2013)

- $$M(a) = k \left( \frac{L^\infty}{L(a)} \right)^{1.5}$$

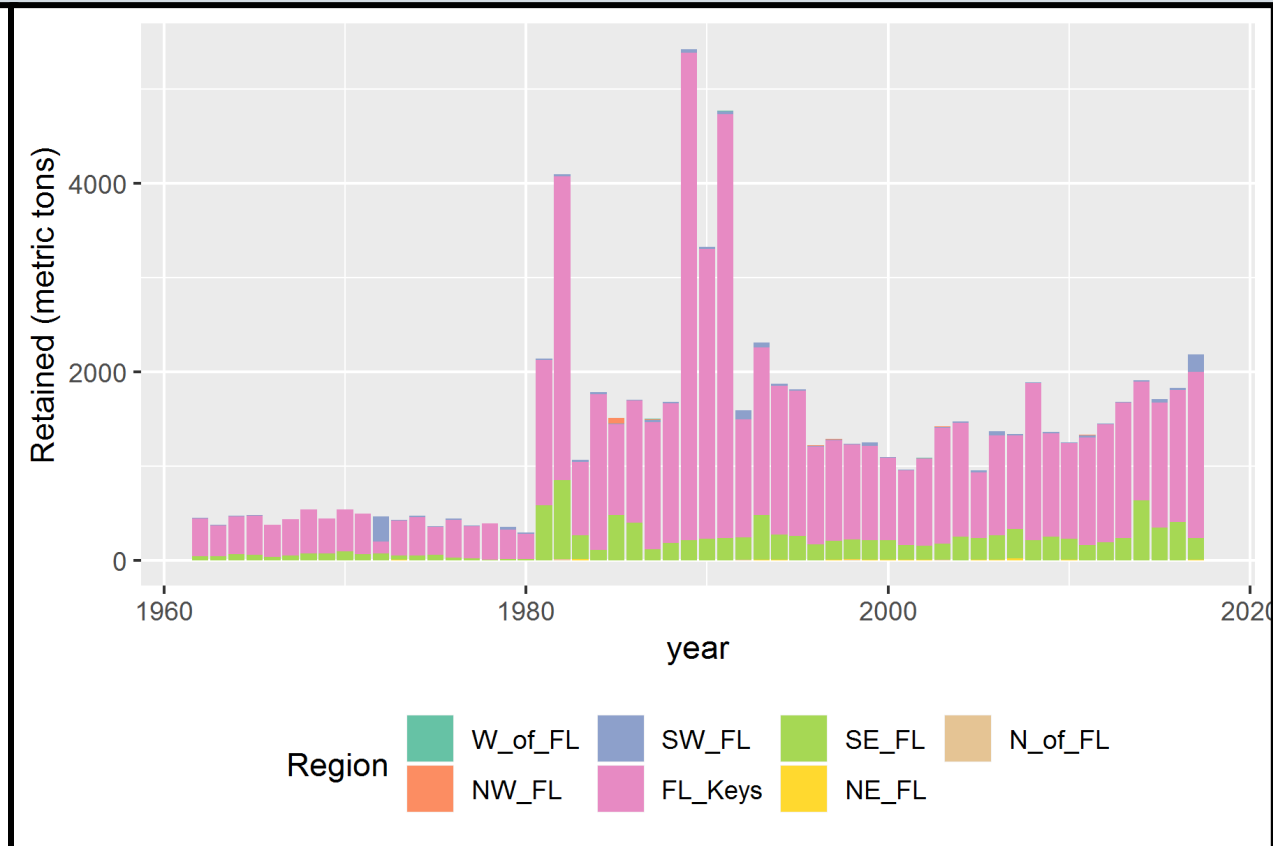
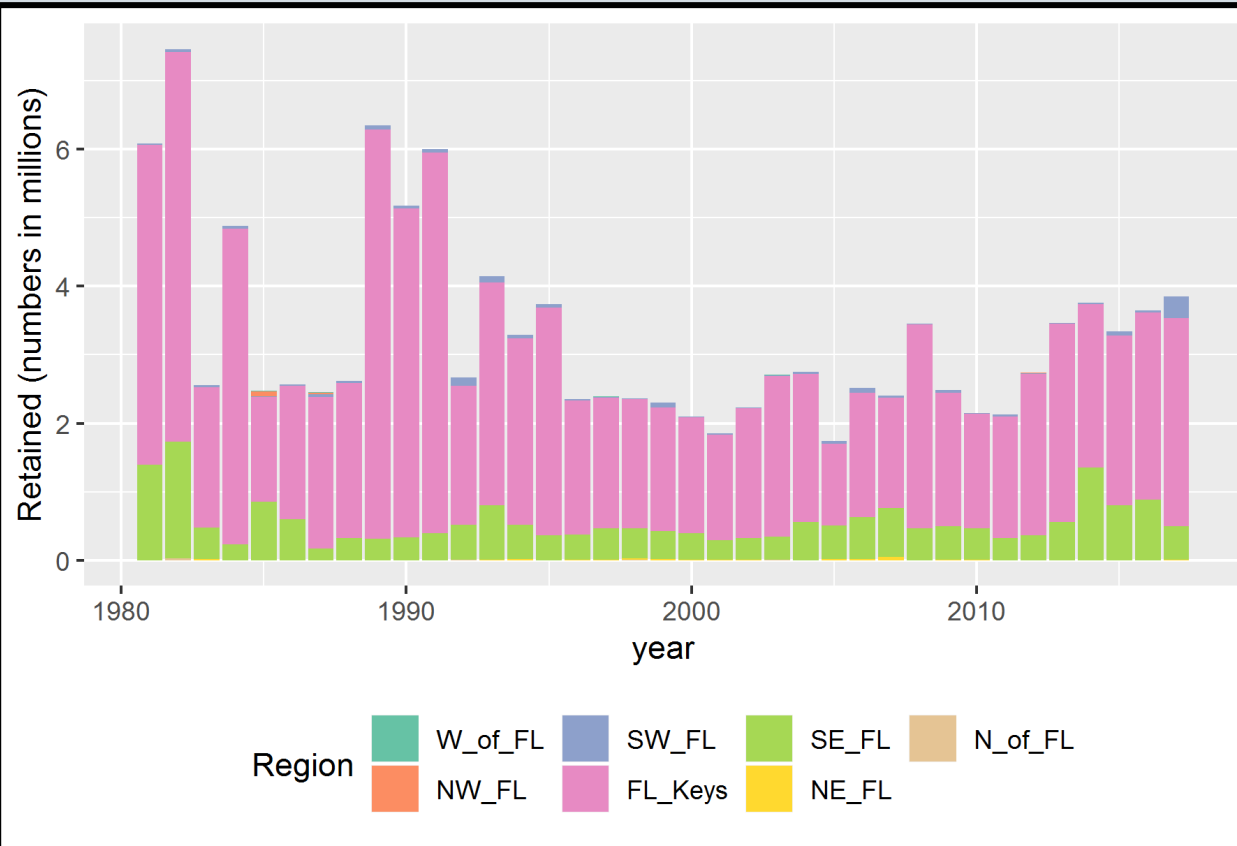
These and other  $k$ -based methods explored were found unreasonable and estimated high mortality rates at young ages



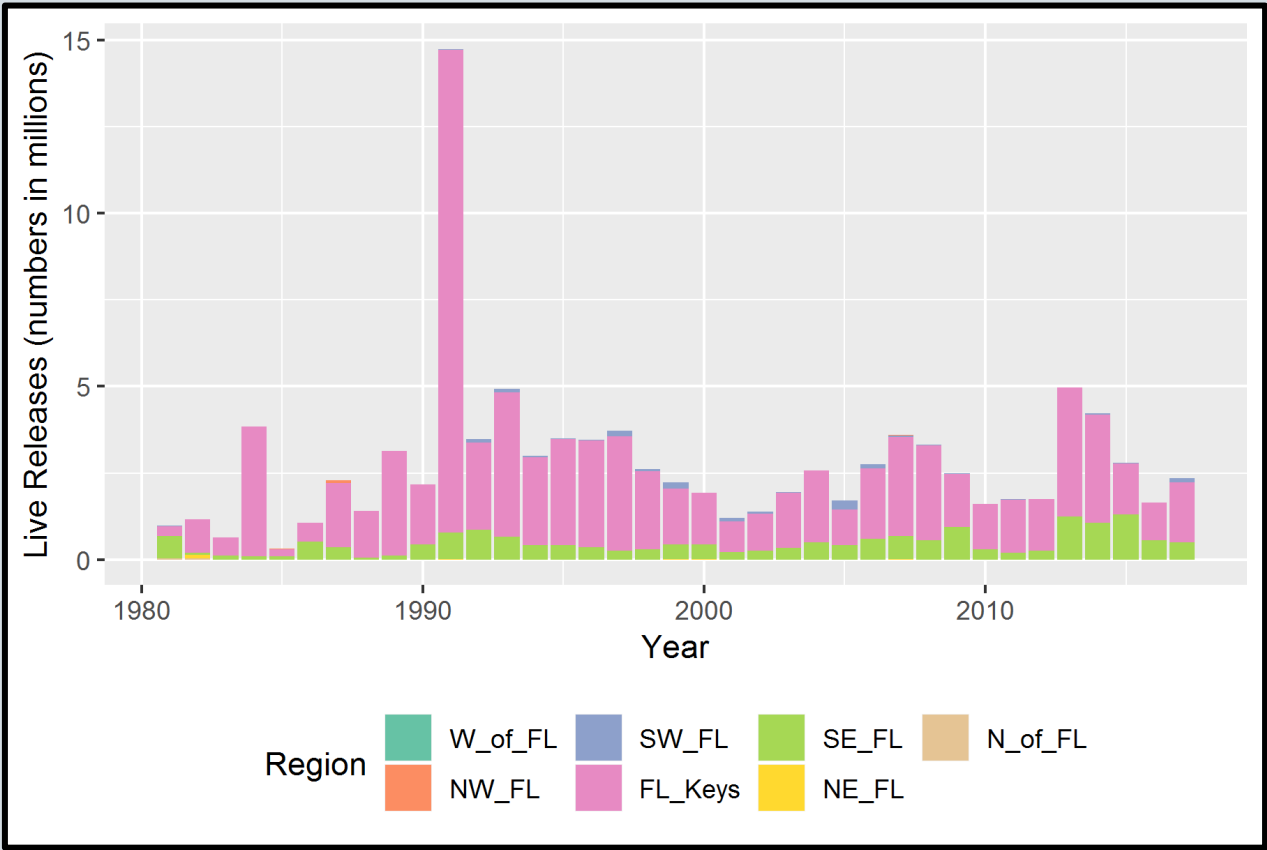
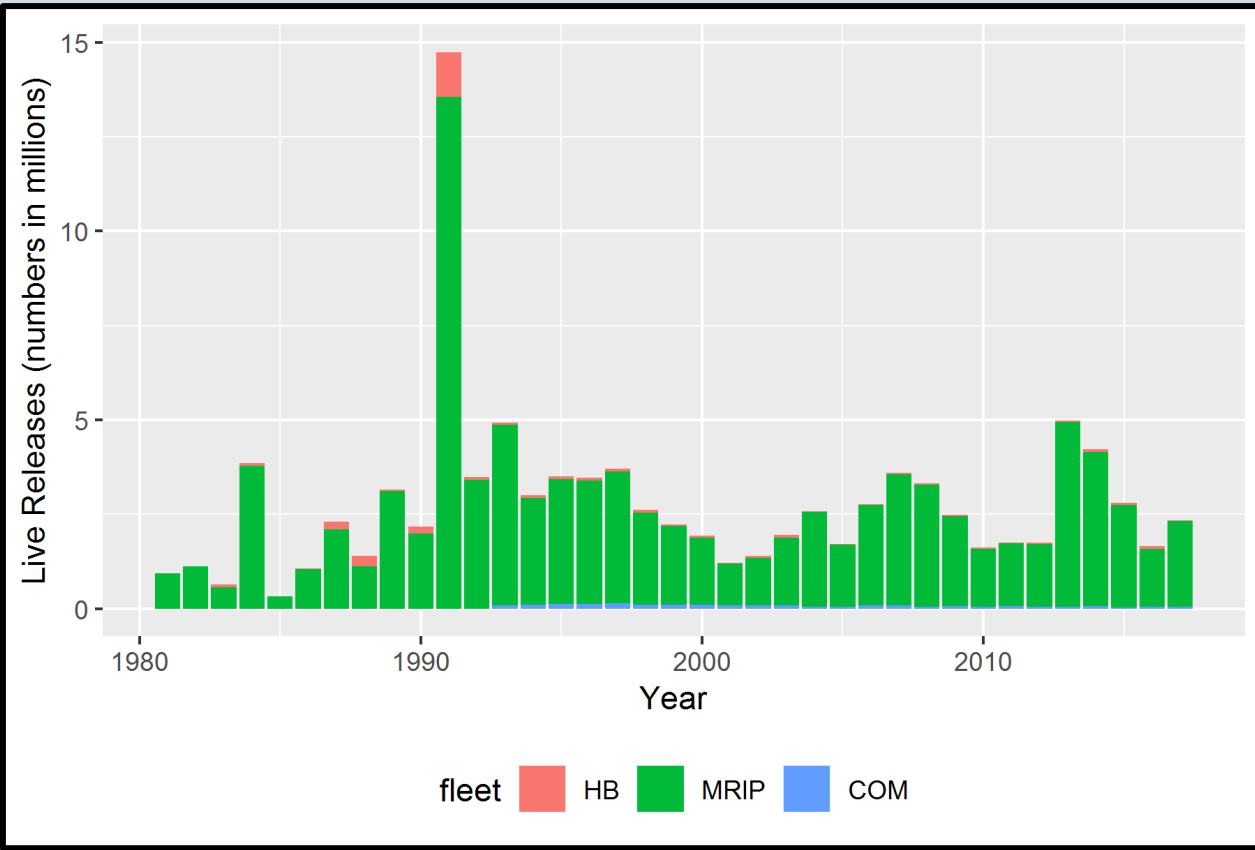
		M-at-age		Survival proportions-at-age	
Age	Length (cm)	Base Model	Base Model	Jensen (1996)	Charnov et al. (2013)
0	12	0.558	1.000	1.000	1.000
1	18	0.414	0.572	0.446	0.261
2	22	0.343	0.378	0.245	0.122
3	26	0.301	0.269	0.149	0.071
4	29	0.273	0.199	0.097	0.046
5	32	0.255	0.151	0.065	0.032
6	34	0.241	0.117	0.045	0.023
7	35	0.231	0.092	0.032	0.018
8	37	0.224	0.073	0.023	0.013
9	38	0.218	0.058	0.016	0.010
10	38	0.214	0.047	0.012	0.008
11	39	0.210	0.038	0.009	0.006
12	40	0.208	0.031	0.006	0.005
13	40	0.205	0.025	0.005	0.004
14	41	0.204	0.020	0.004	0.003
15	41	0.202	0.017	0.003	0.003
16	41	0.201	0.014	0.002	0.002
17	41	0.200	0.011	0.001	0.002
18	42	0.200	0.009	0.001	0.001
19	42	0.199	0.007	0.001	0.001
20	42	0.198	0.006	0.001	0.001



# Landings by Region

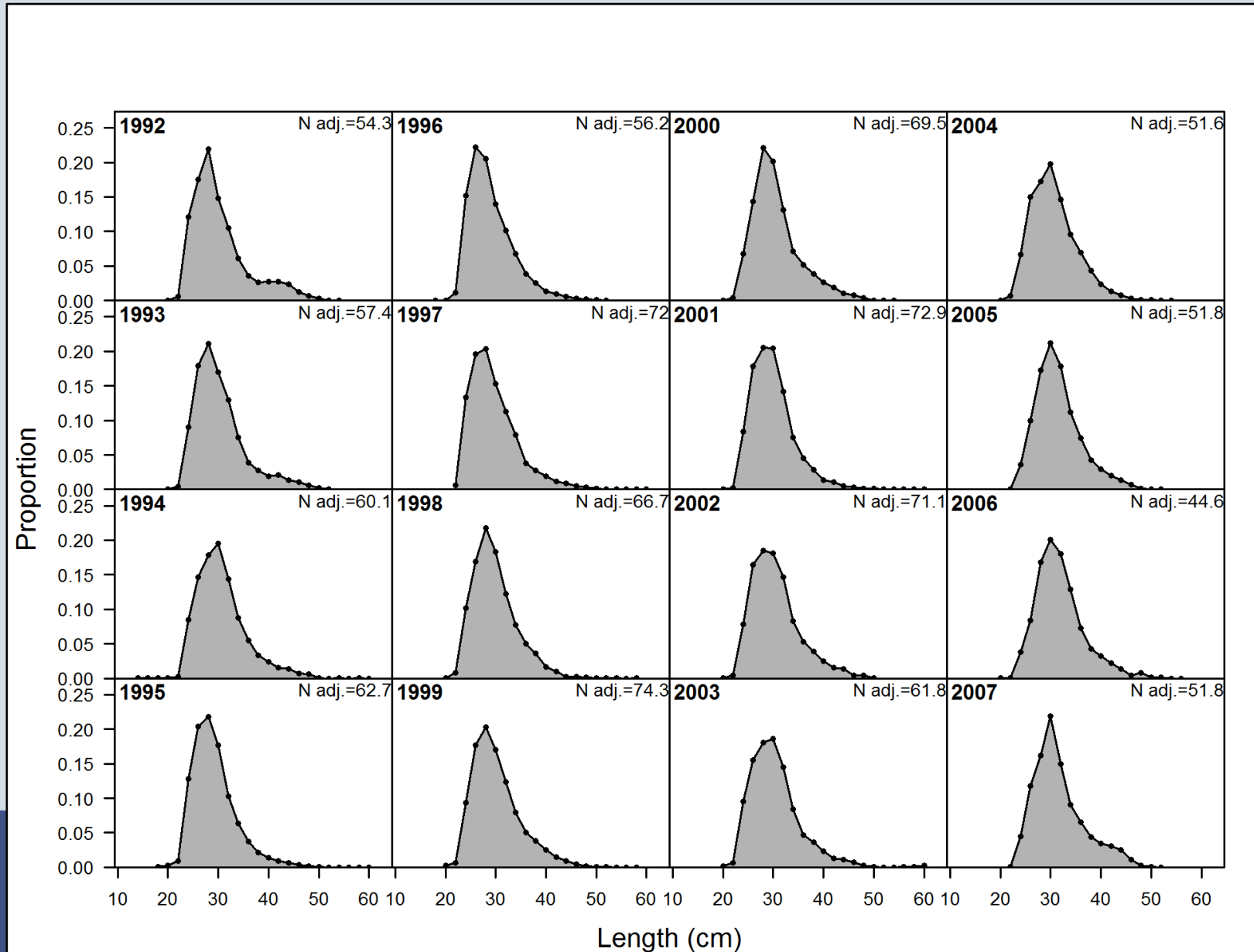


# Discards by Fleet and Region

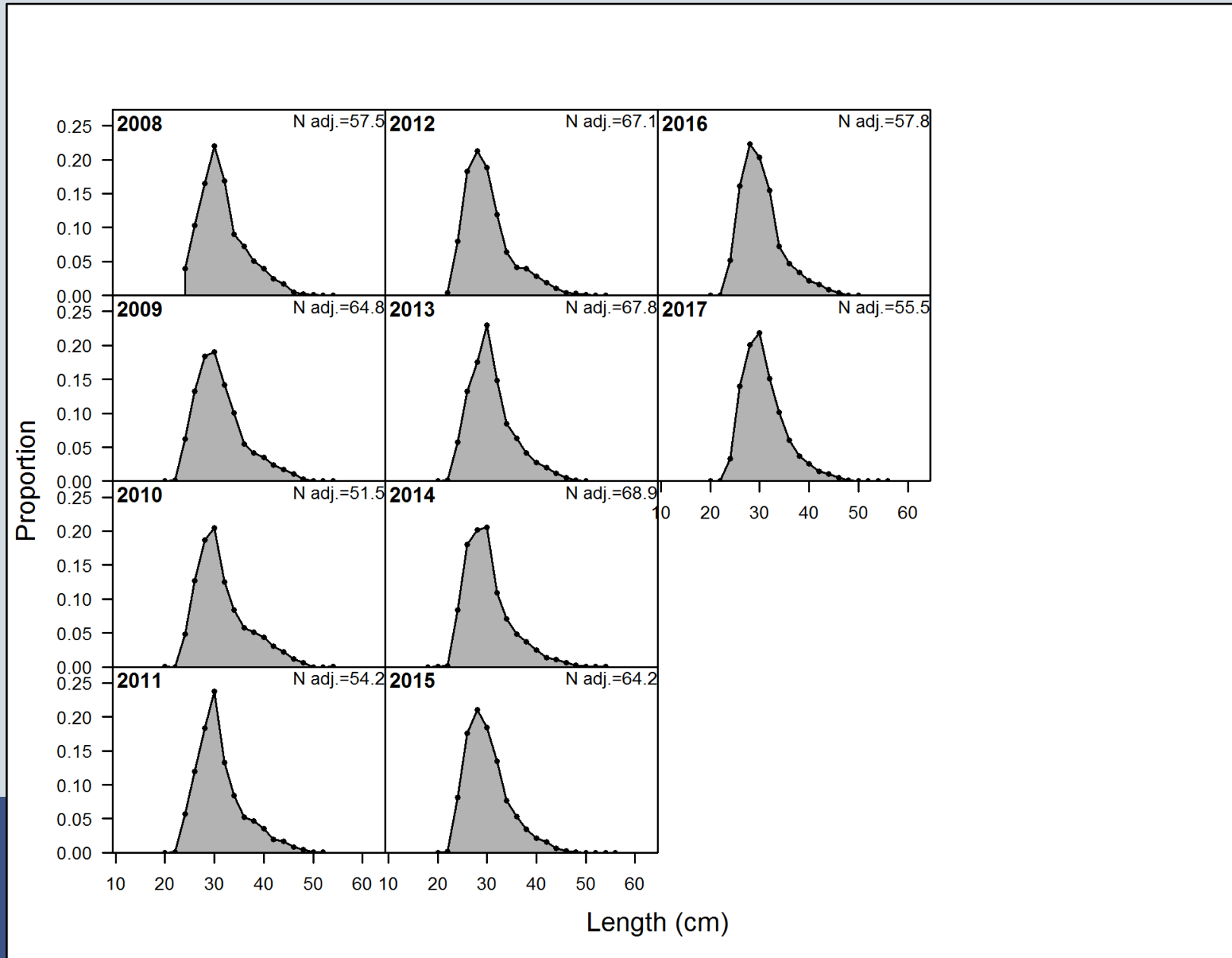




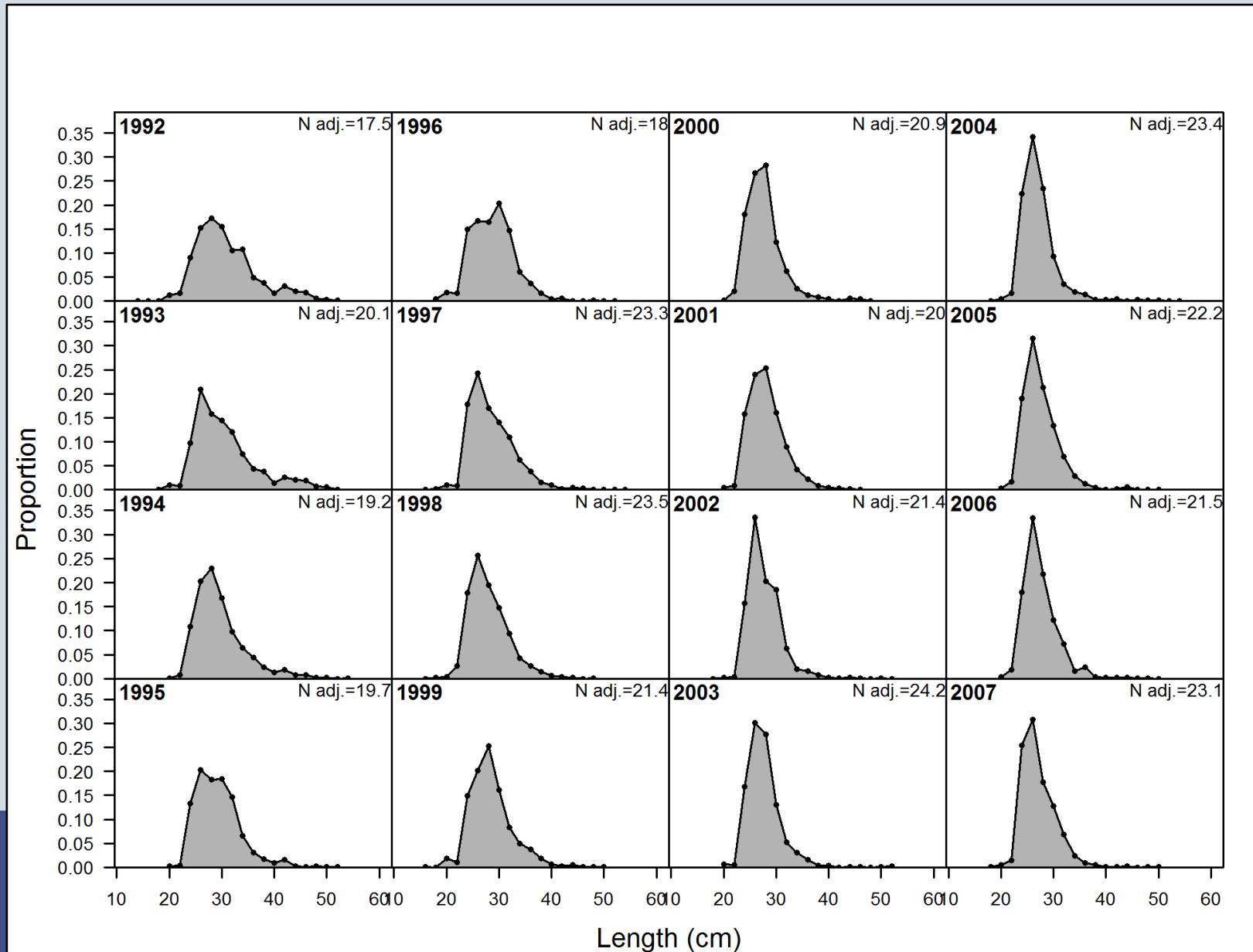
# Retained Length Compositions: Commercial



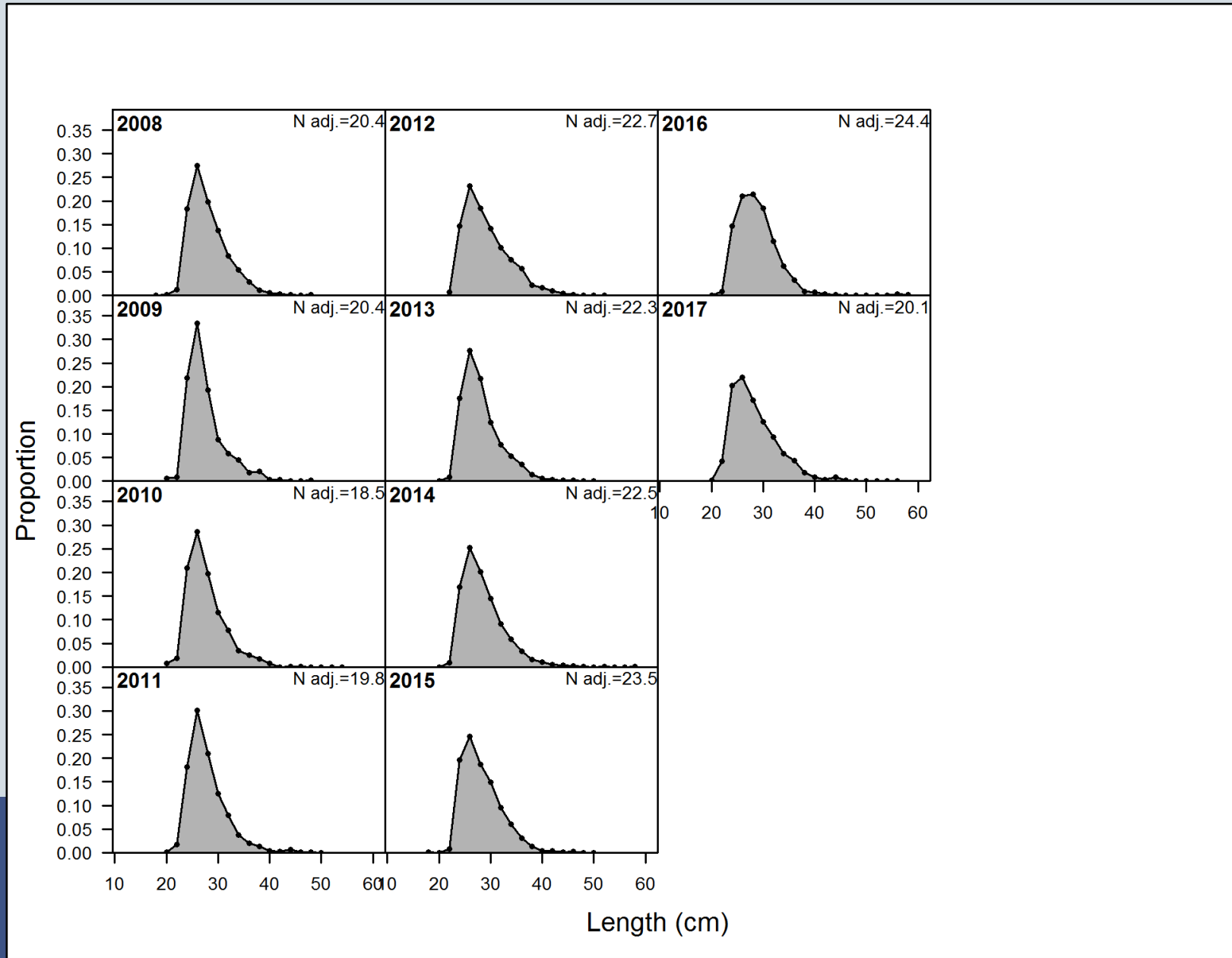
# Retained Length Compositions: Commercial



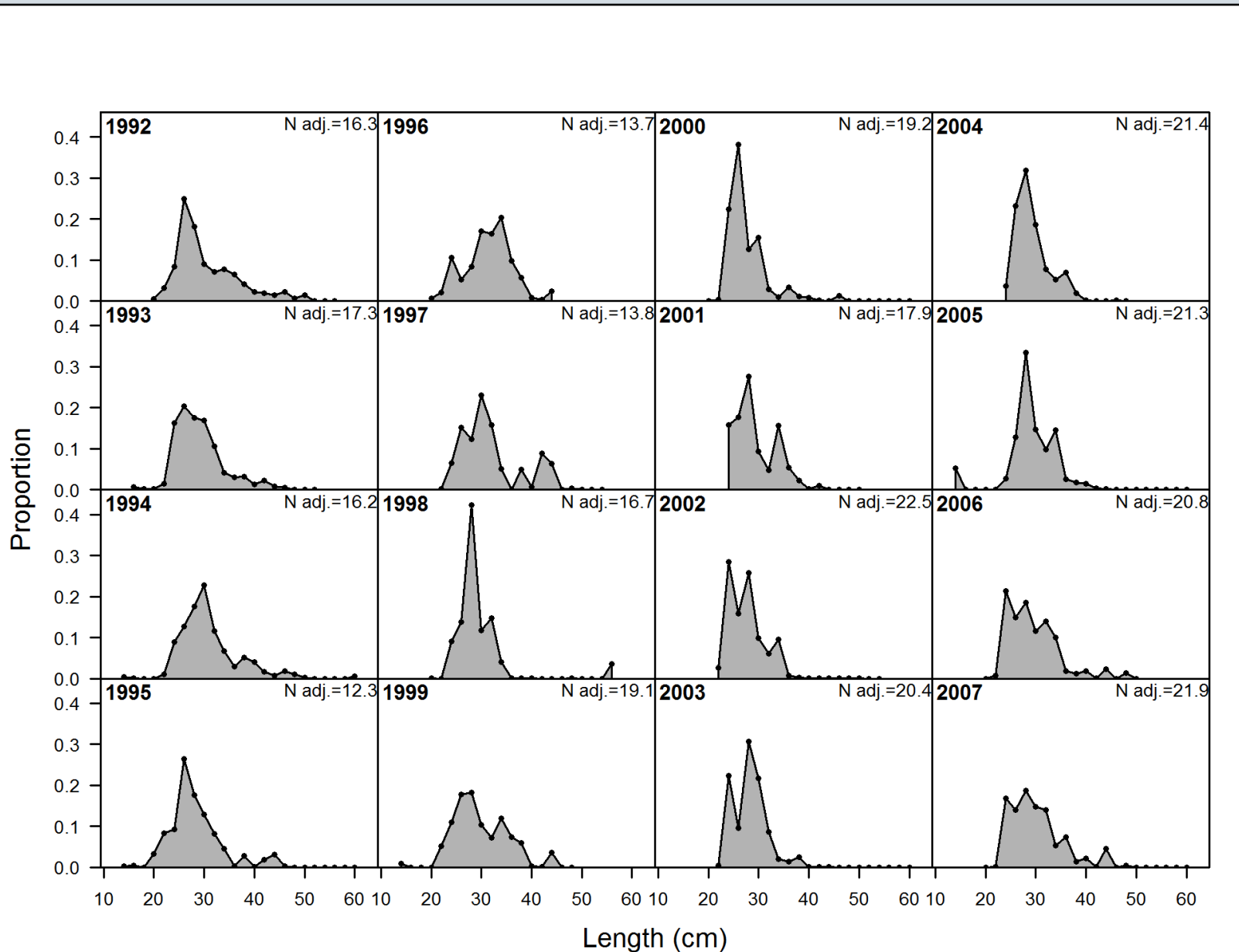
# Retained Length Compositions: Headboat



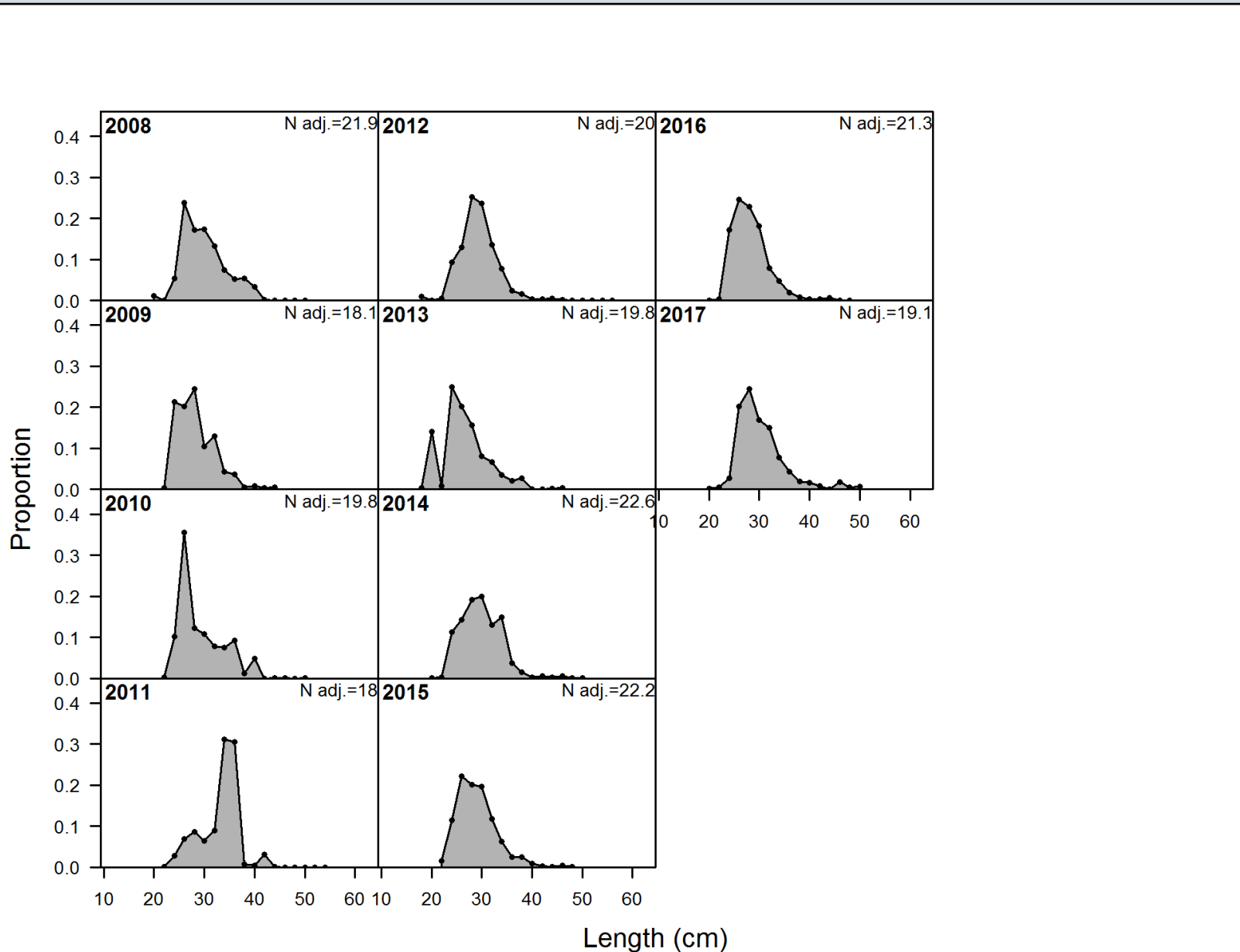
# Retained Length Compositions: Headboat



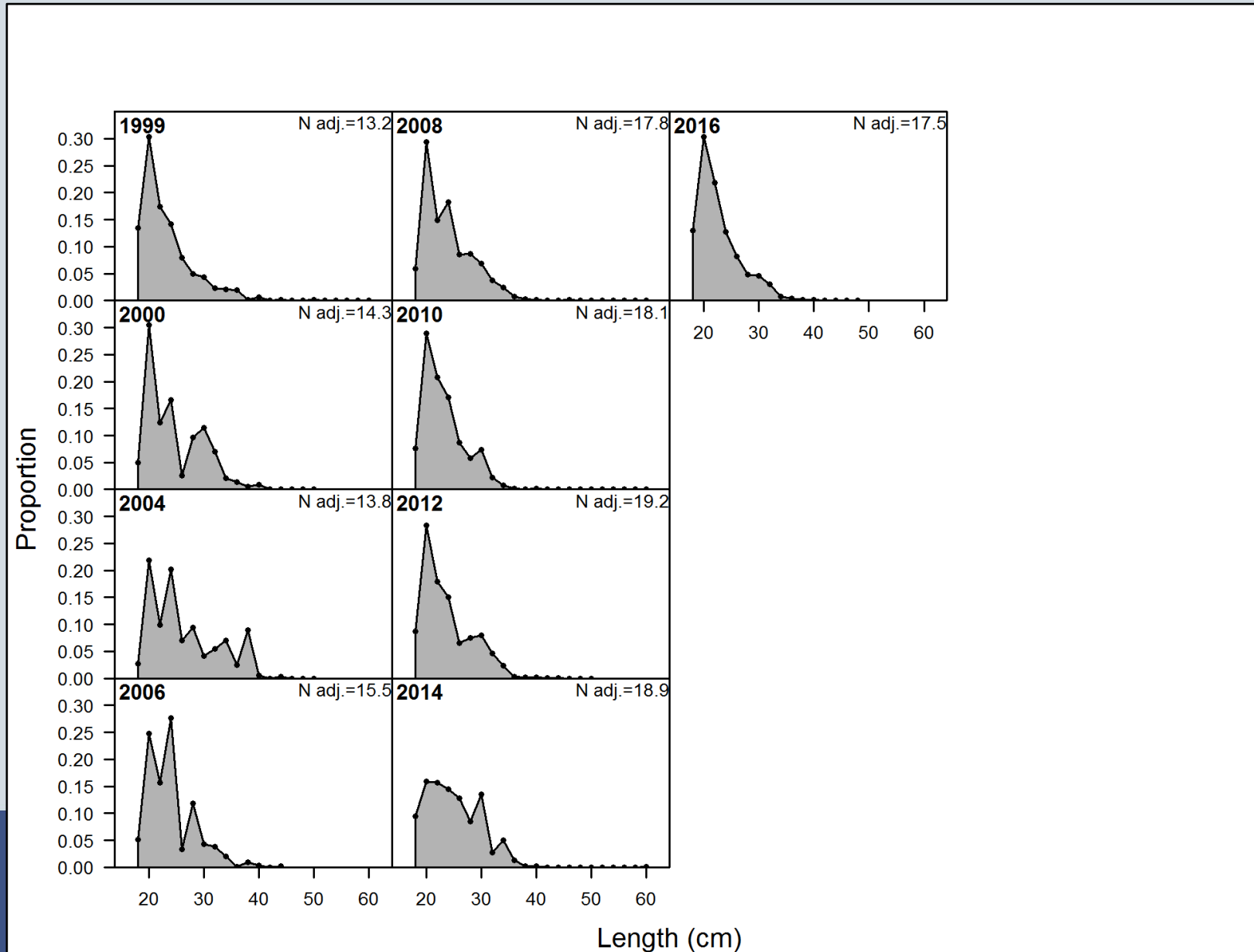
# Retained Length Compositions: MRIP



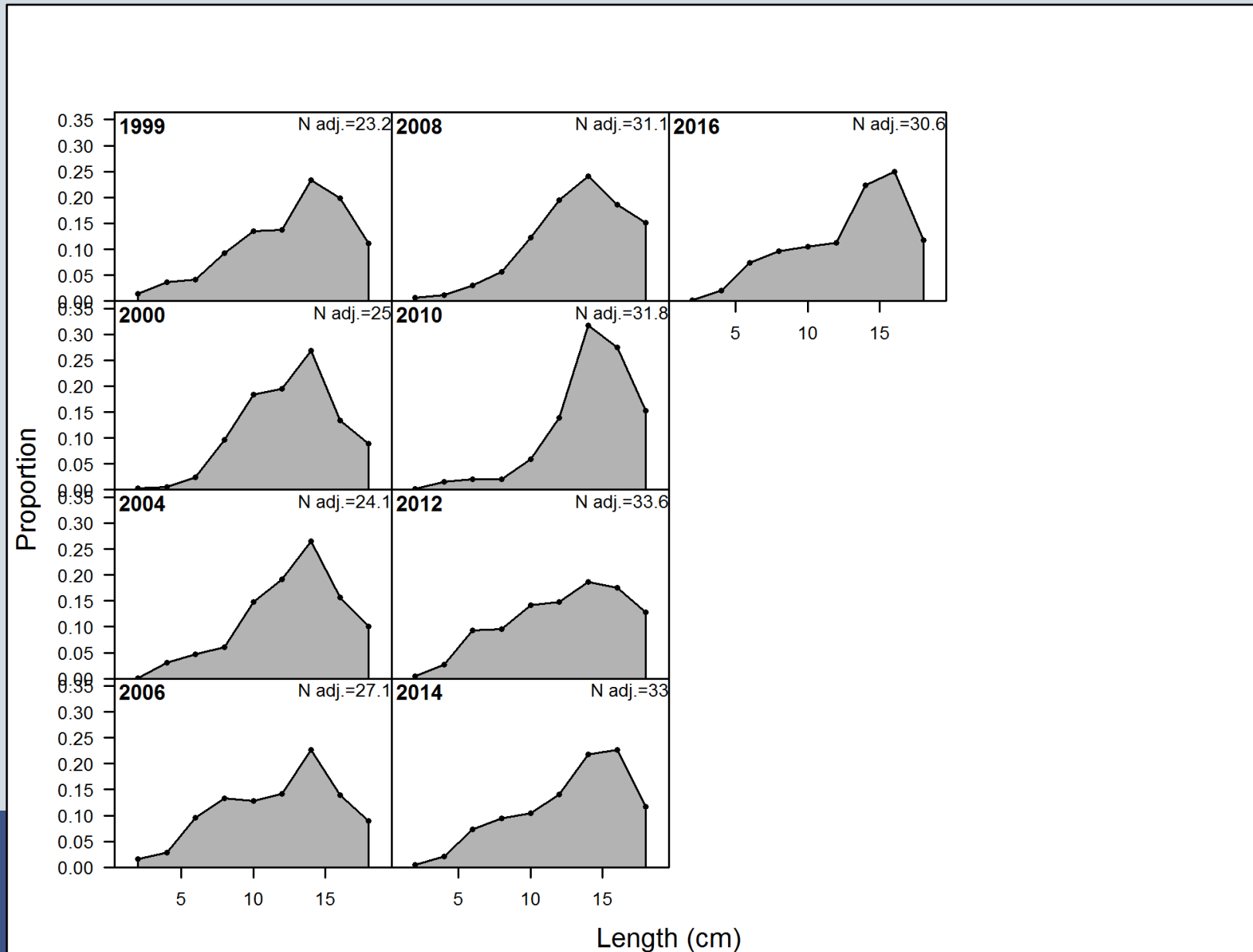
# Retained Length Compositions: MRIP



# Observed Length Compositions: RVC Adult

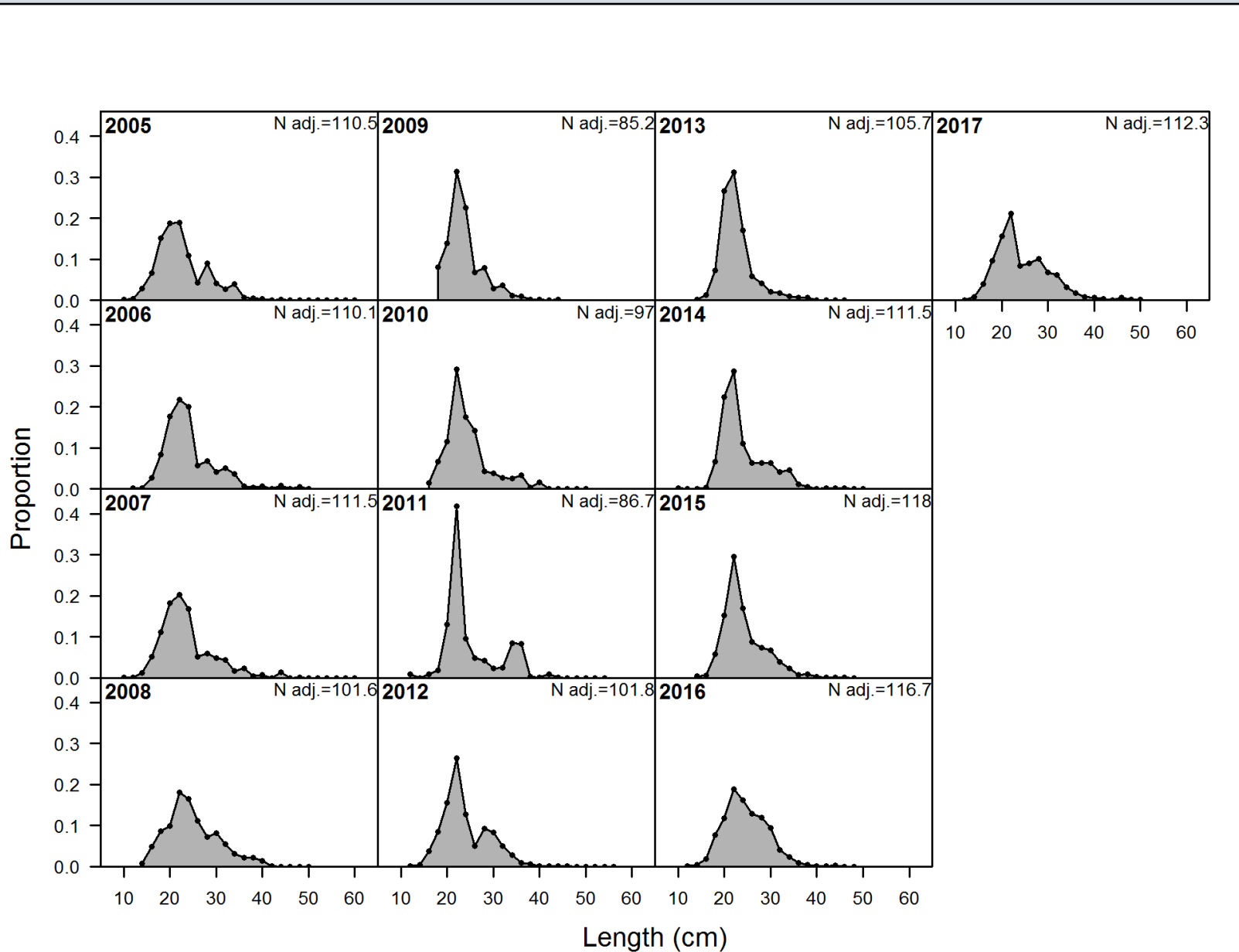


# Observed Length Compositions: RVC Juvenile

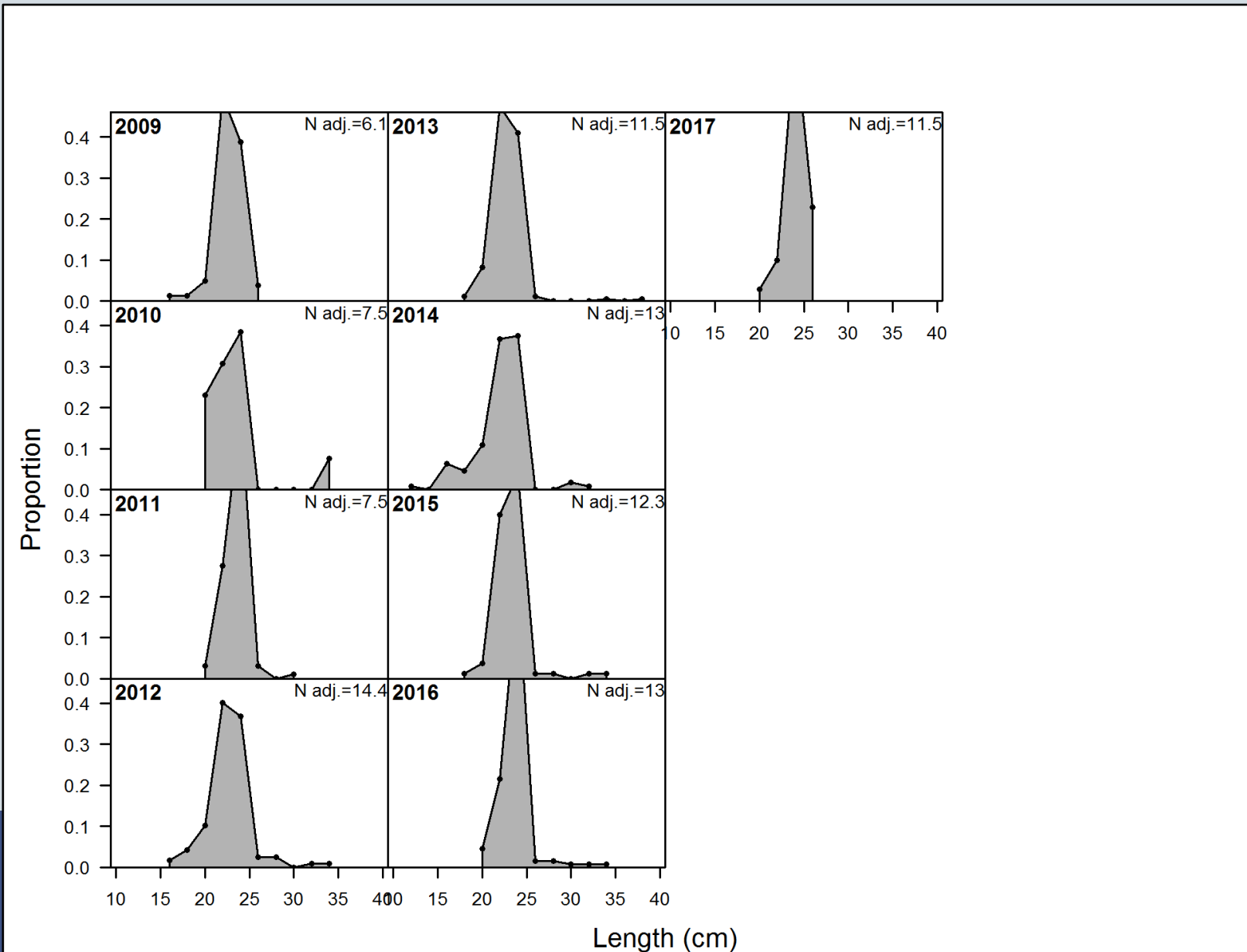




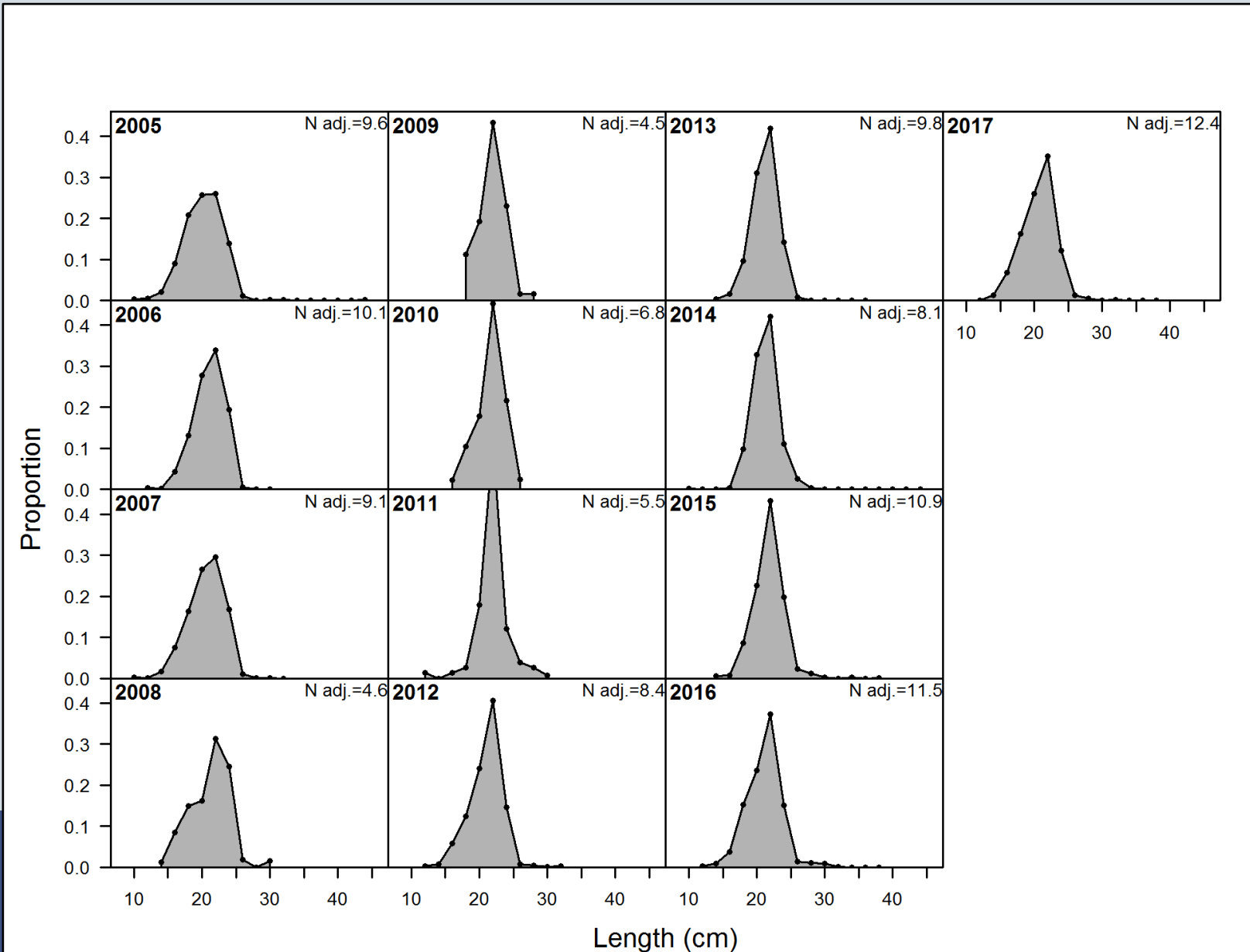
# Length Compositions: MRIP CPUE



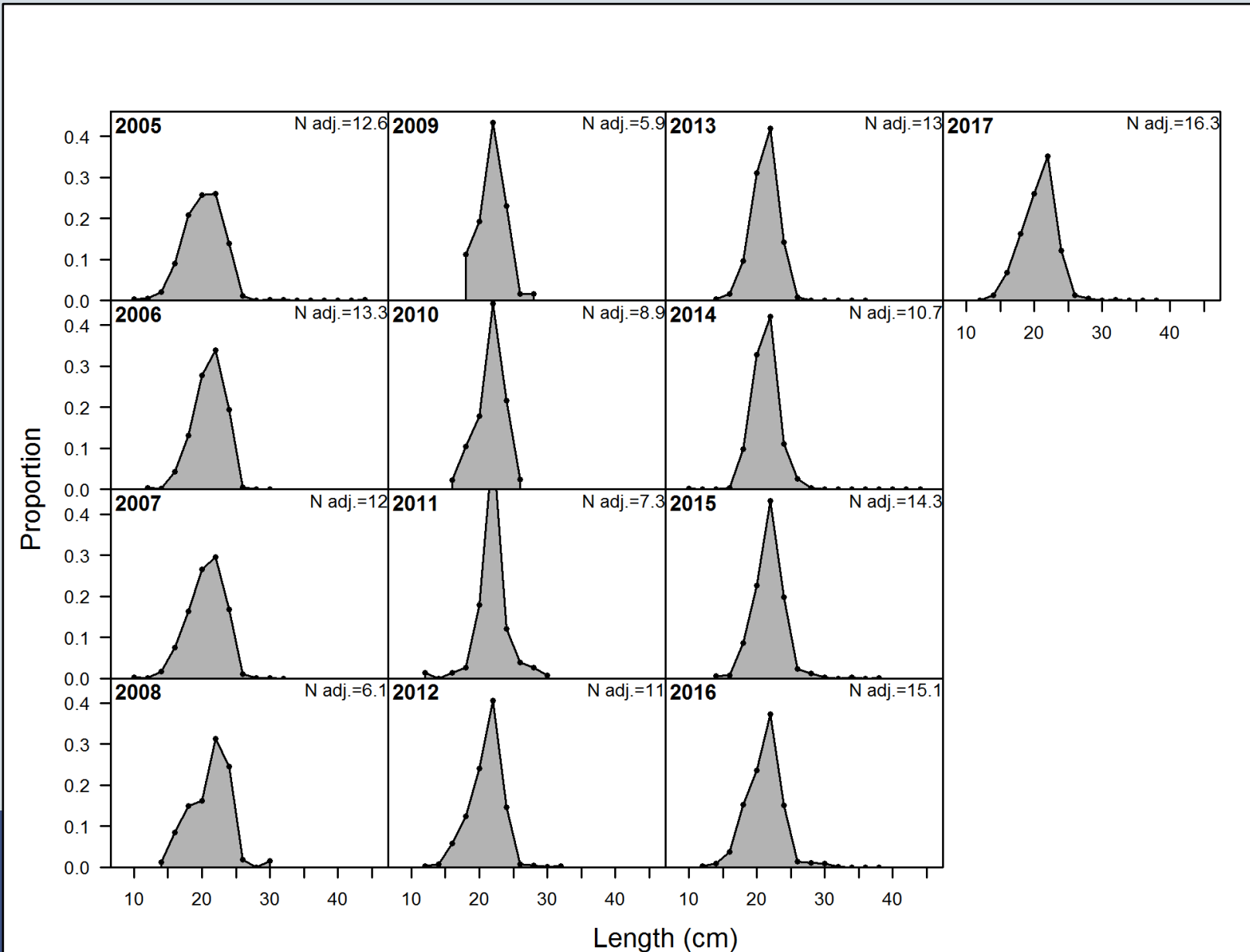
# Discard Length Compositions: Commercial



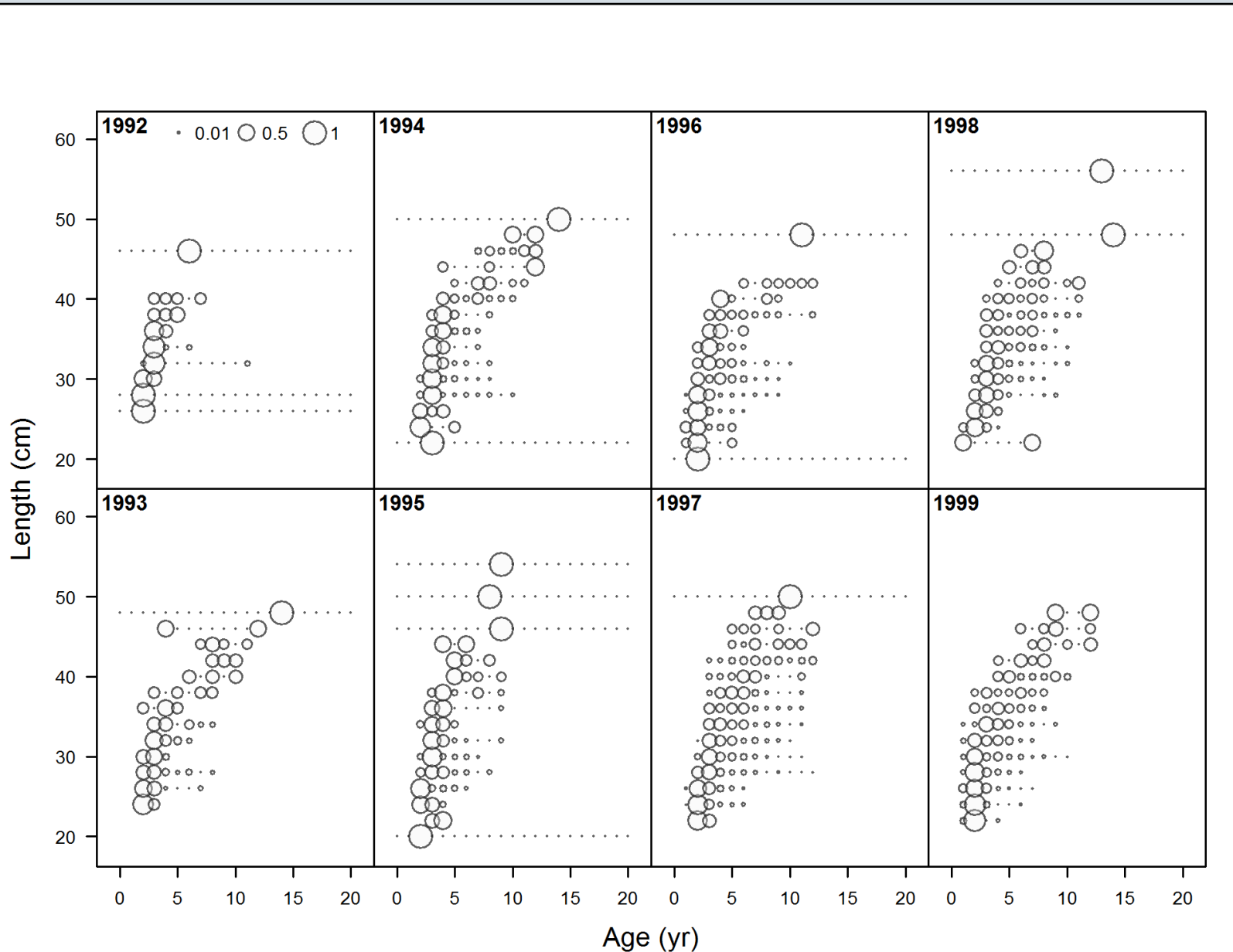
# Discard Length Compositions: Headboat



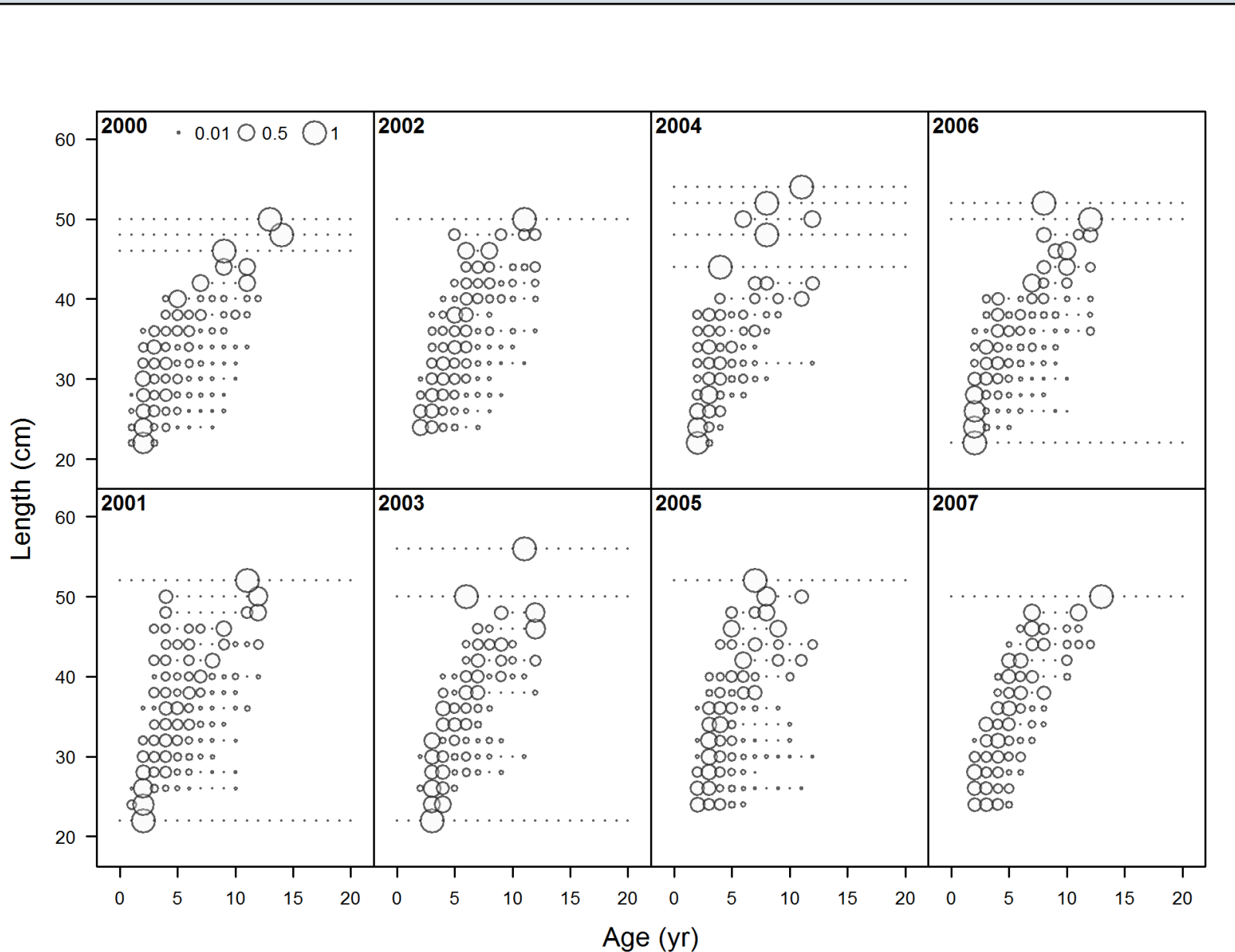
# Discard Length Compositions: MRIP



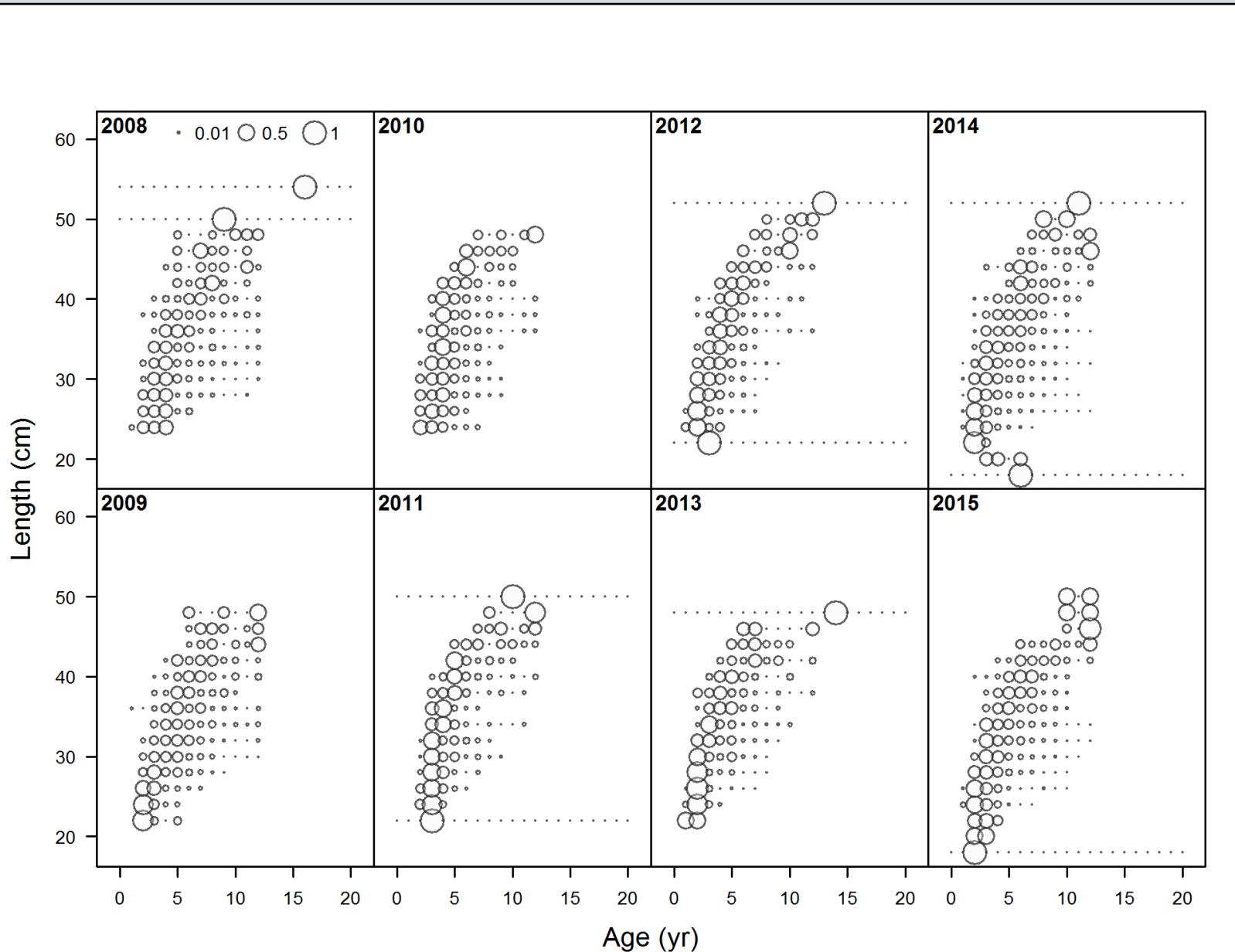
# Retained Conditional Age-at-Length: Commercial



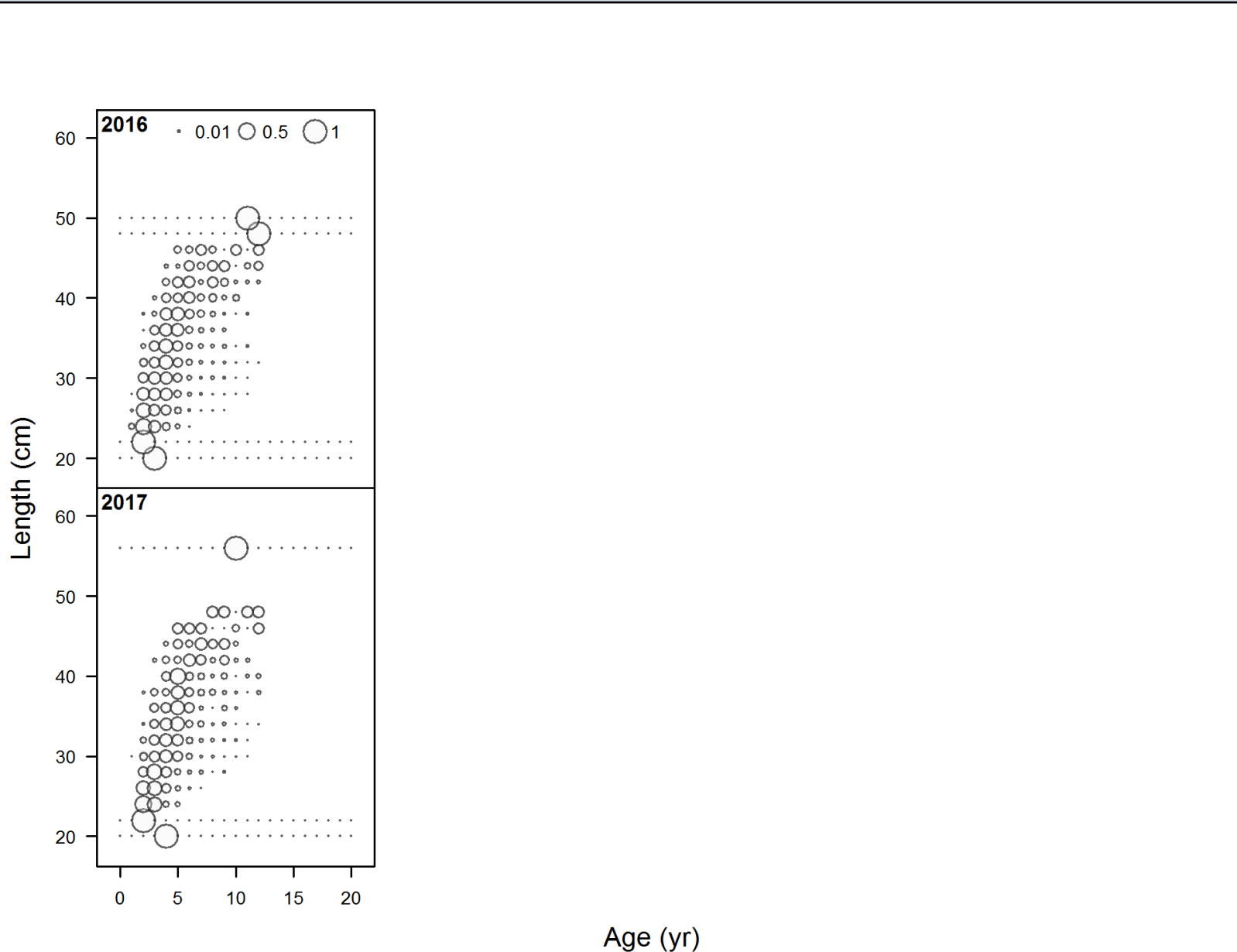
# Retained Conditional Age-at-Length: Commercial



# Retained Conditional Age-at-Length: Commercial

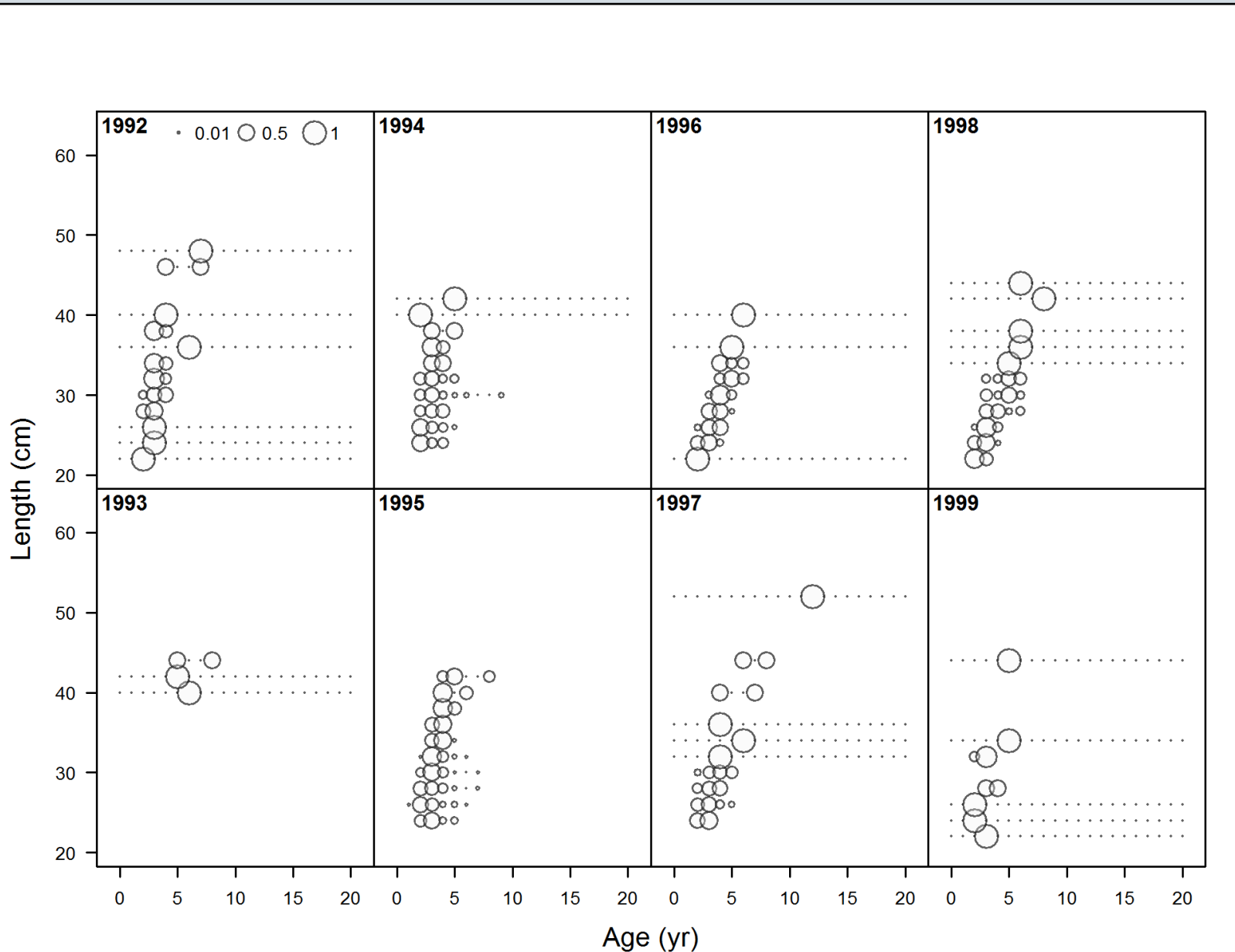


# Retained Conditional Age-at-Length: Commercial

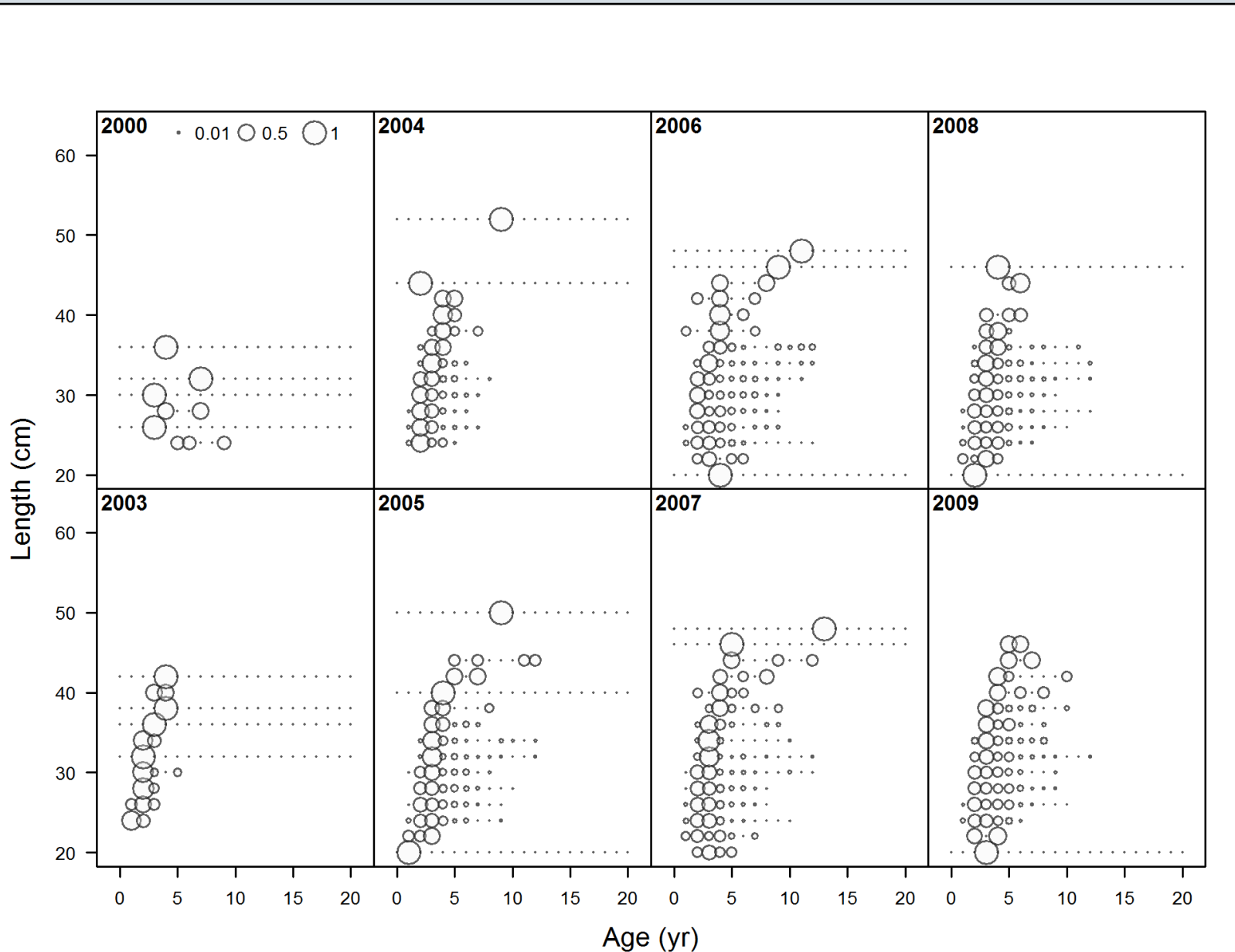




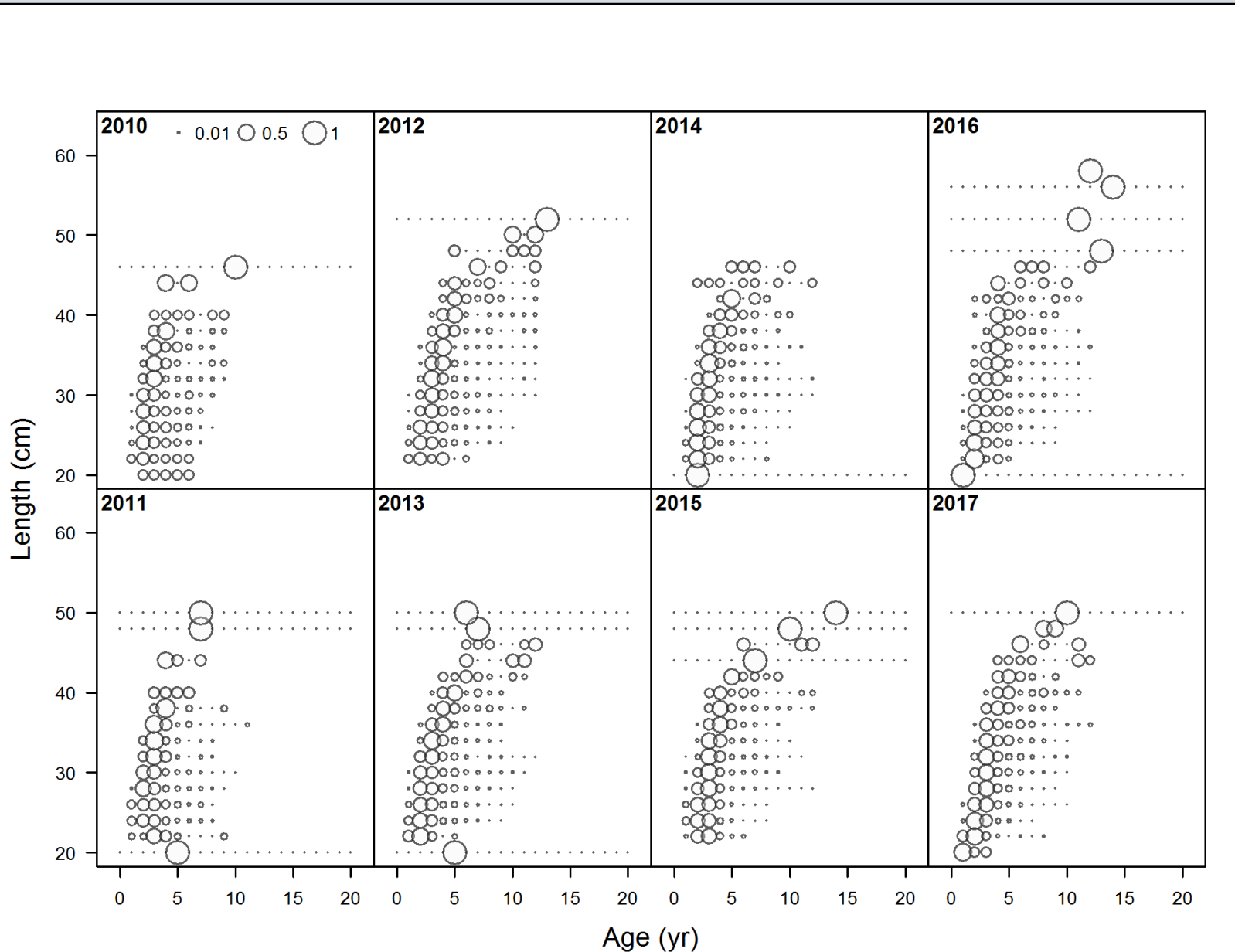
# Retained Conditional Age-at-Length: Headboat



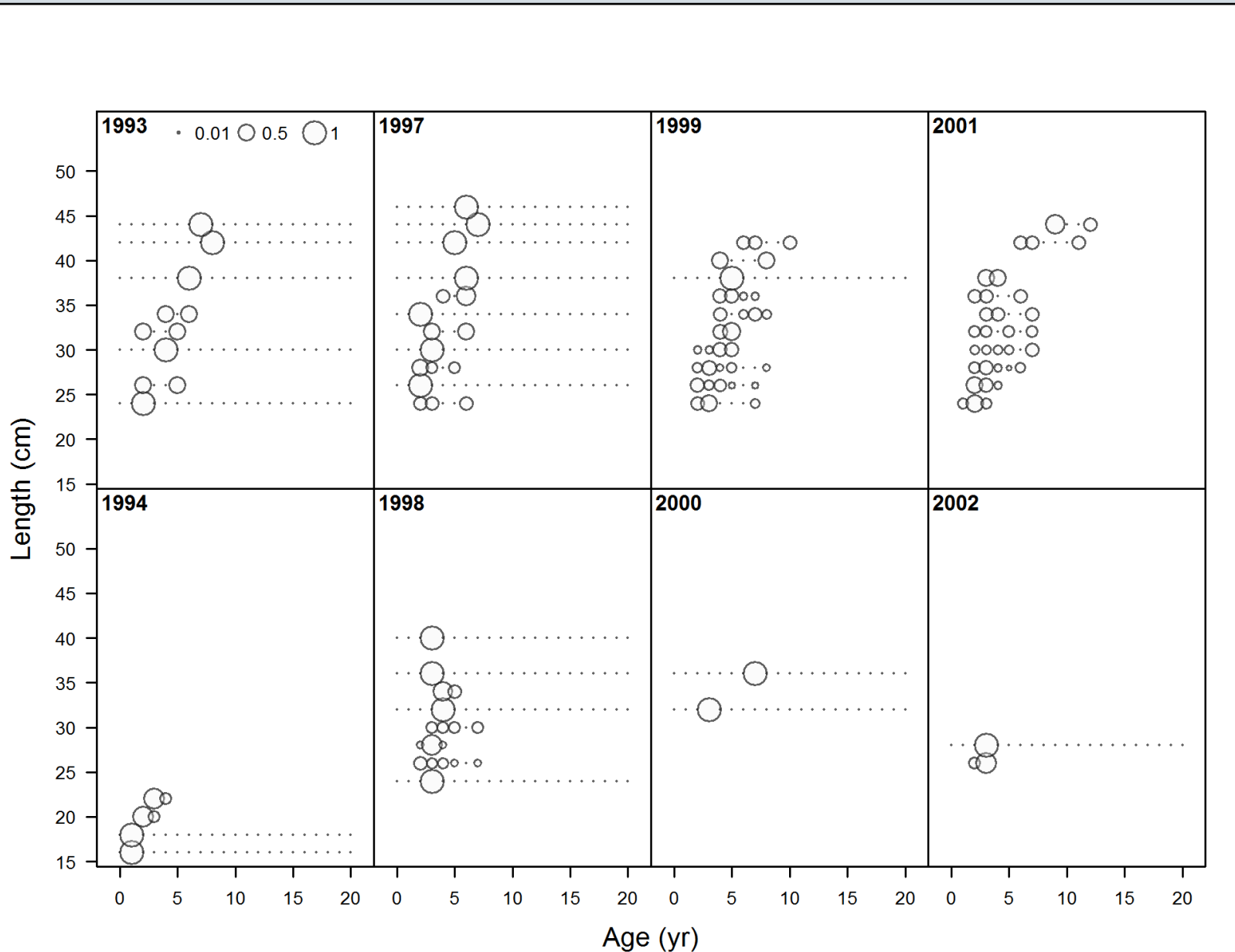
# Retained Conditional Age-at-Length: Headboat



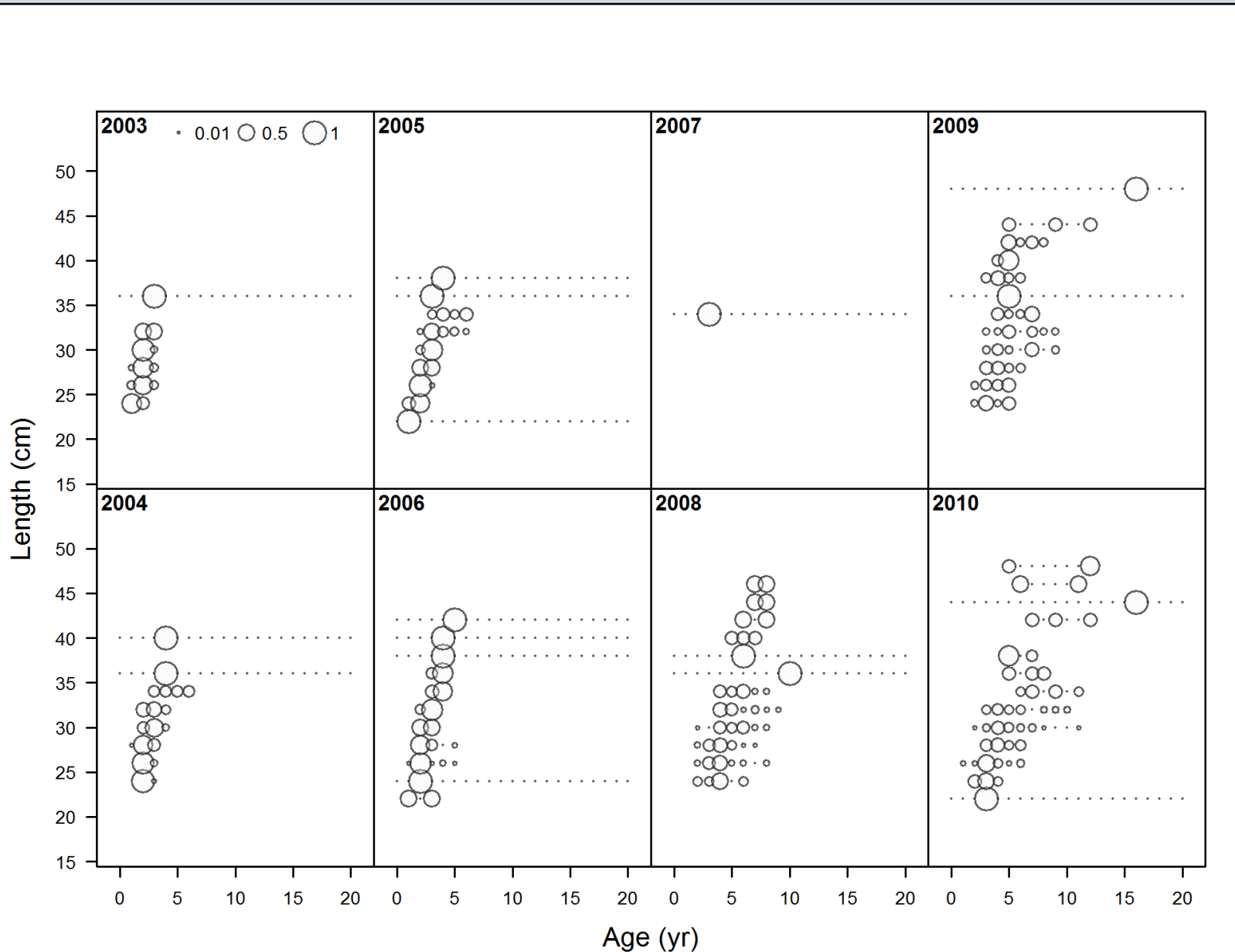
# Retained Conditional Age-at-Length: Headboat



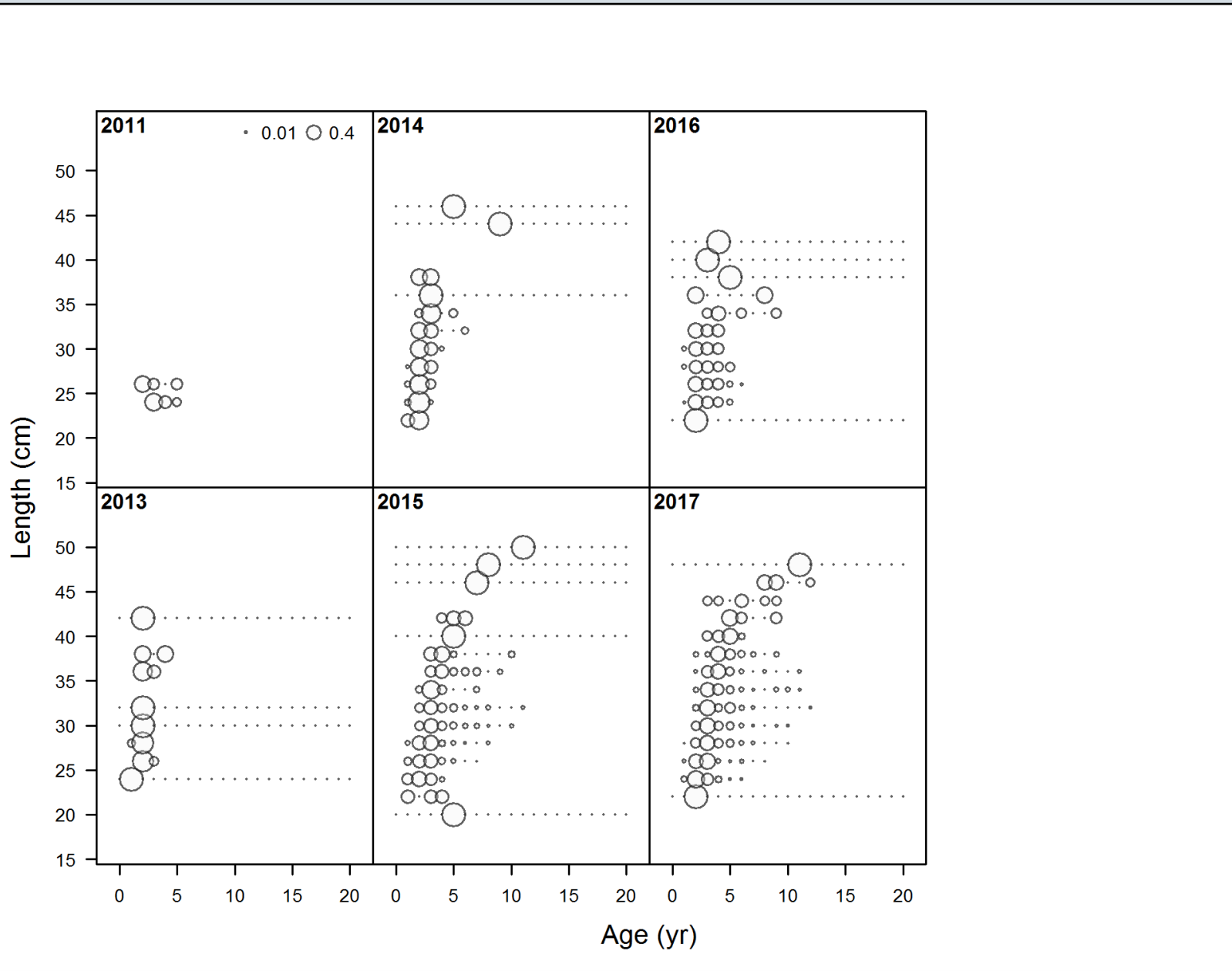
# Retained Conditional Age-at-Length: MRIP



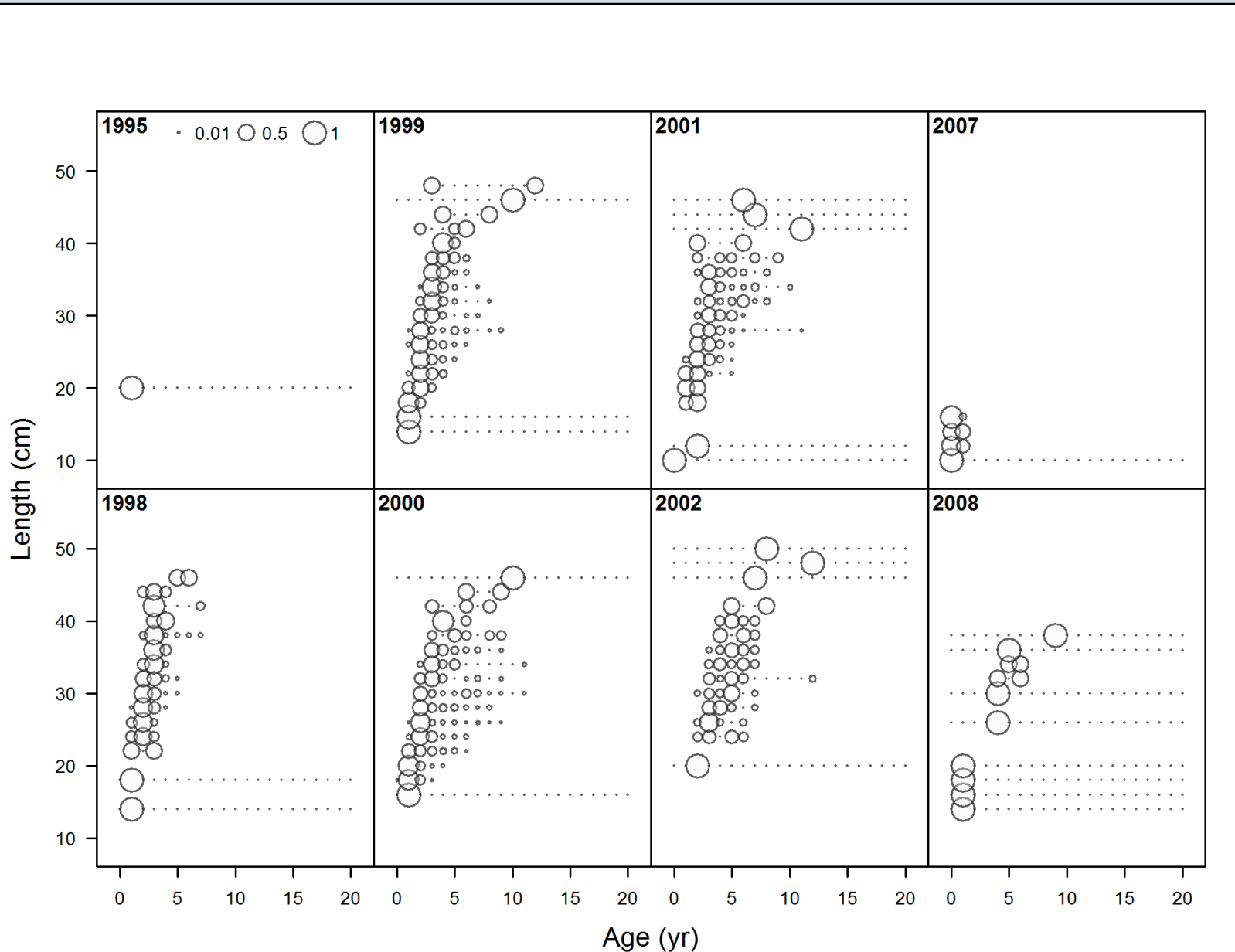
# Retained Conditional Age-at-Length: MRIP



# Retained Conditional Age-at-Length: MRIP



# Conditional Age-at-Length: FI



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