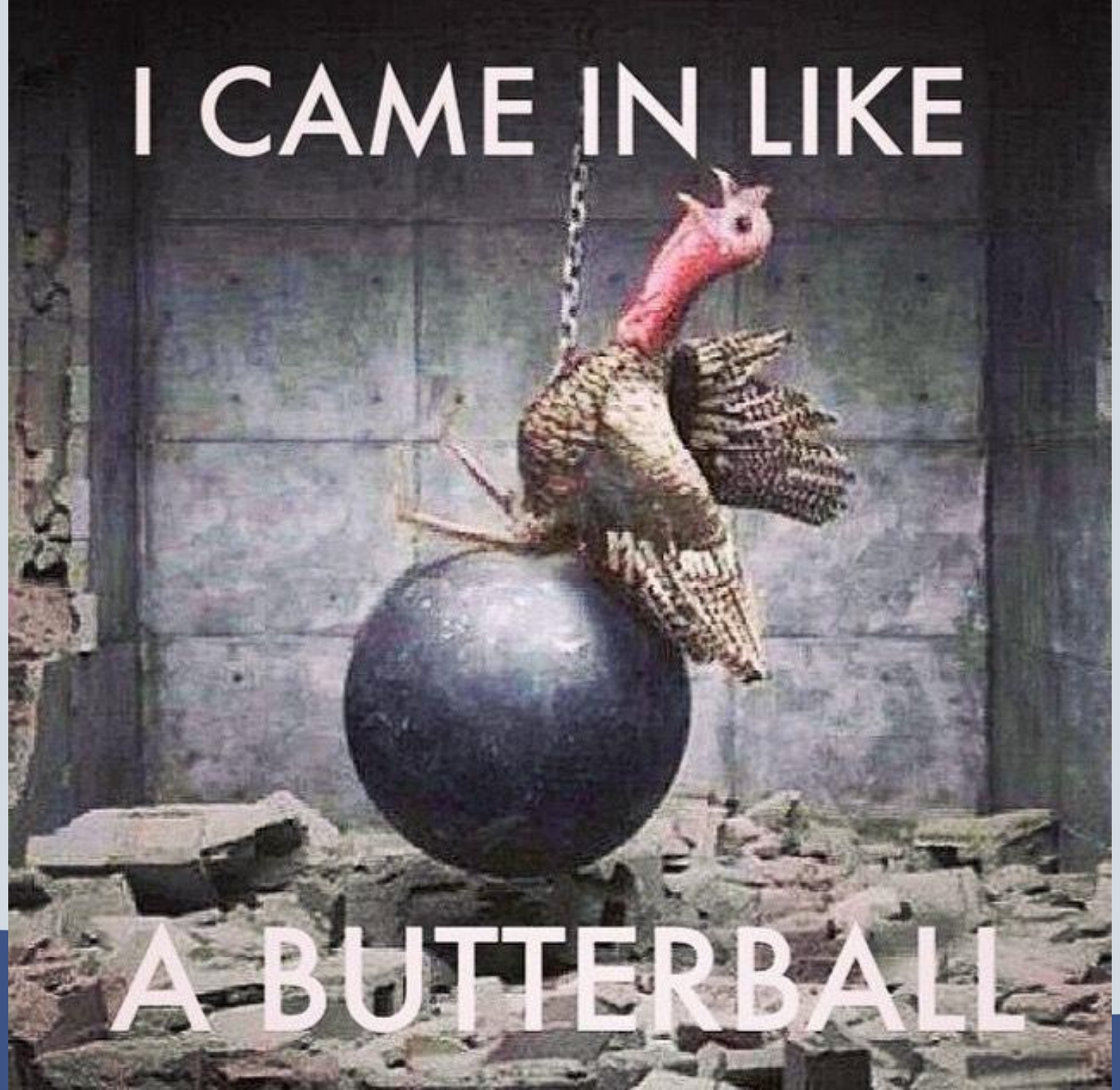
SEDAR 79: Mutton Snapper

Pre-Assessment Webinar

FWRI Stock Assessment Group

St. Petersburg, FL

11/28/2023

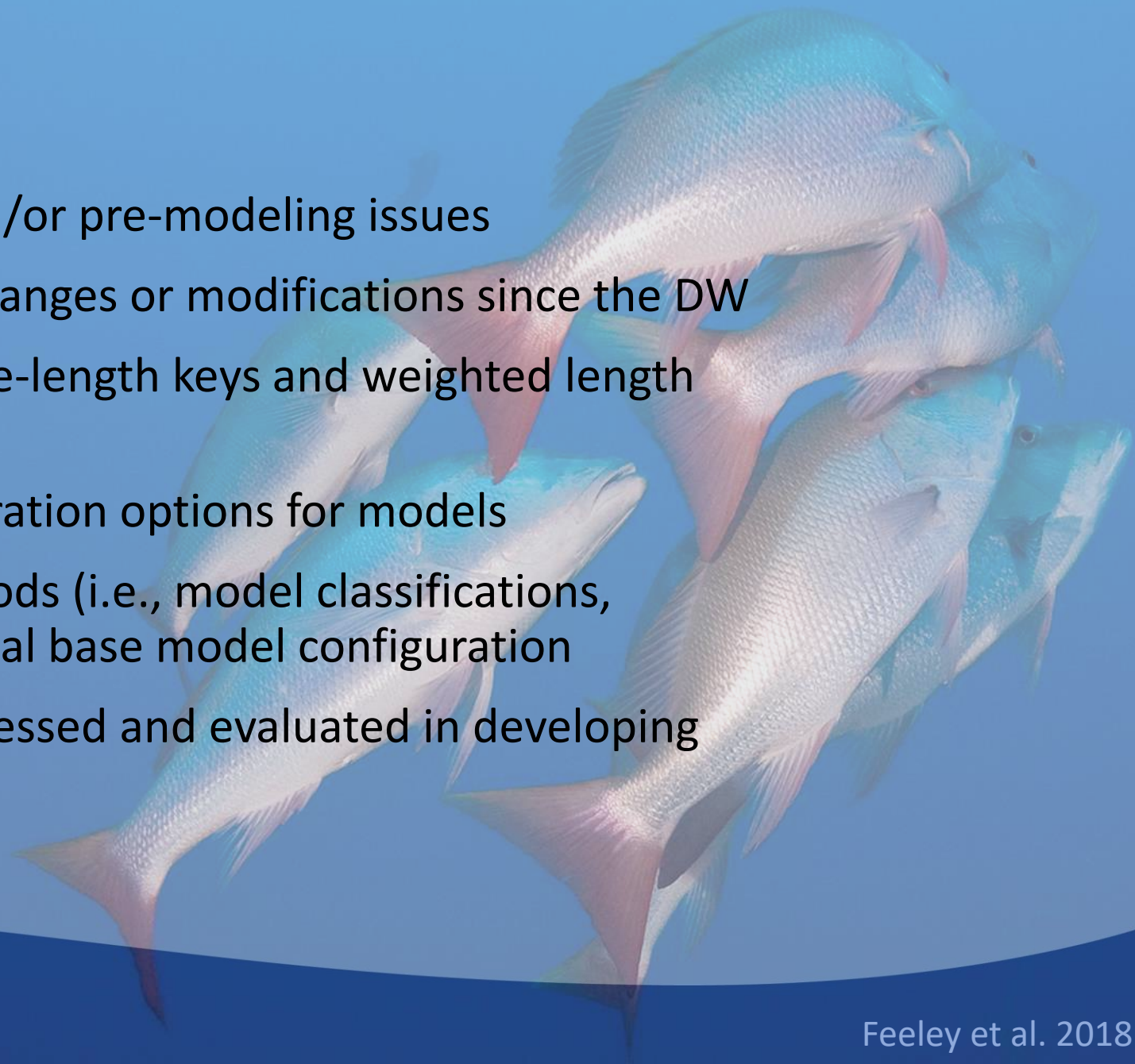

I CAME IN LIKE
A BUTTERBALL

Updated Schedule

- **Reason for delaying assessment: To allow time to calibrate the FWC State Reef Fish Survey to the MRIP FES time series and use as a sensitivity or base run input**
- Assessment Milestone I webinar……..week of February 19th, 2023
- Assessment Milestone II webinar……..week of April 1st, 2024
- Assessment Milestone III webinar……..week of May 13th, 2024
- Assessment Milestone IV webinar……..week of July 7th, 2024
  - Goals: Review sensitivities and uncertainty evaluations. Review projection results. Review Assessment report and responses to ToRs
  - Depends on data being available by **mid-May or early June** at the latest. Gives 1-1.5 months to run 2 models (data through 2023, and data through 2023 and SRFS)
- Review Workshop: (St. Petersburg, FL)……September 10-12, 2024

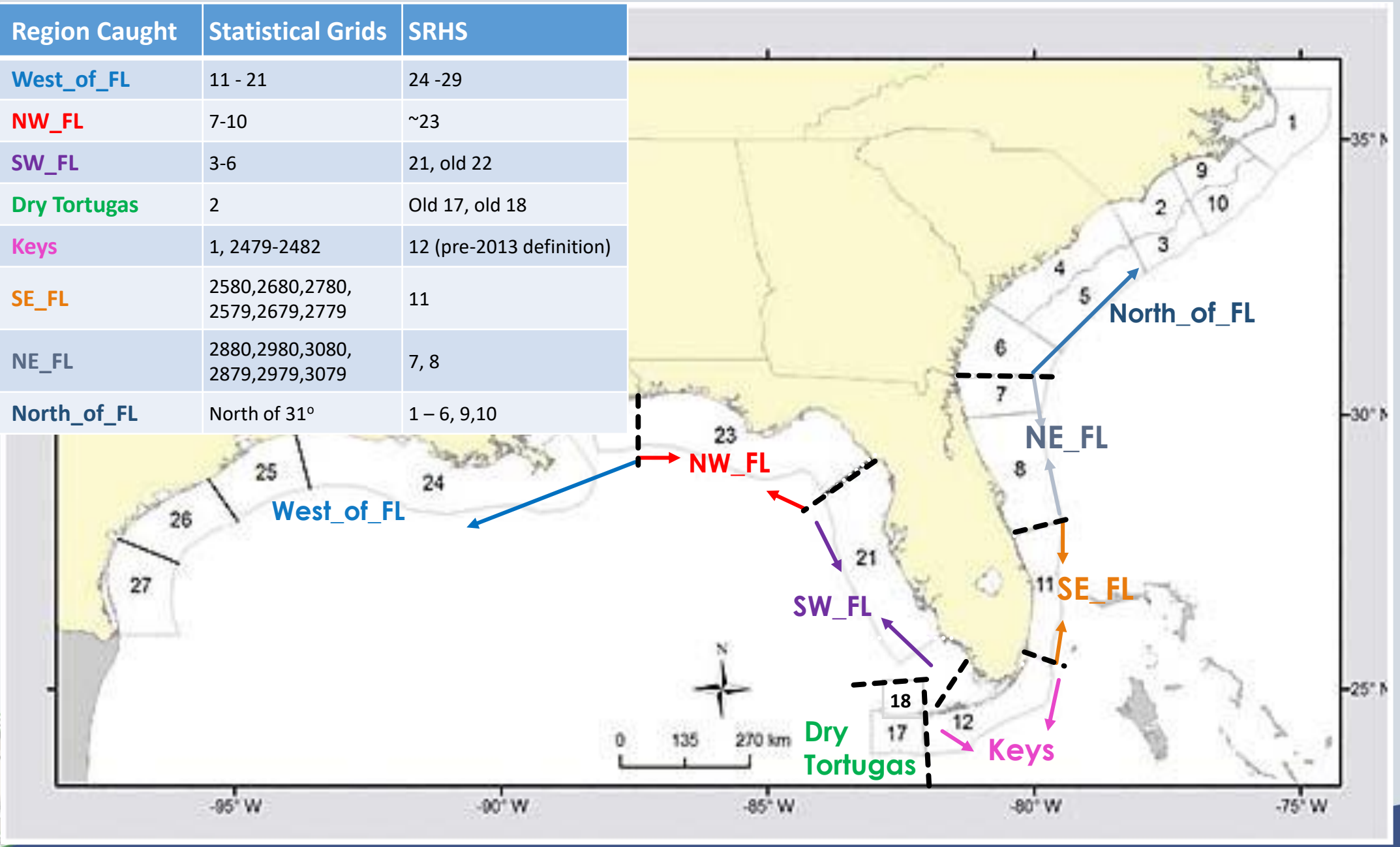
Goals

- Discuss any remaining data and/or pre-modeling issues
- Review and finalize any data changes or modifications since the DW
- Review methods to develop age-length keys and weighted length and age compositions
- Consider methods and configuration options for models
- Recommend assessment methods (i.e., model classifications, packages) to pursue for potential base model configuration
- Identify likely issues to be addressed and evaluated in developing the base model



Feeley et al. 2018

Region Caught	Statistical Grids	SRHS
West_of_FL	11 - 21	24 -29
NW_FL	7-10	~23
SW_FL	3-6	21, old 22
Dry Tortugas	2	Old 17, old 18
Keys	1, 2479-2482	12 (pre-2013 definition)
SE_FL	2580,2680,2780, 2579,2679,2779	11
NE_FL	2880,2980,3080, 2879,2979,3079	7, 8
North_of_FL	North of 31°	1 – 6, 9,10



Updated Data Sources Since Data Workshop

- Commercial landings in numbers
- MRIP landings, discards, CVs, and lengths by region: East (SE FL and north) and West (FL Keys and west)
- FIM Inshore Seine YOY index updated through 2022
- A few age records were corrected (n=56) as well as some trip identifiers in Age/Length data
- SRHS landings, discards, and bio samples by region caught (i.e., fish caught in the Dry Tortugas are identified)

Expected Data Sources

- Through 2022
  - GOM Camera Survey Index (Jan 2024)
- Through 2023 (available by May/early June 2024 at the latest)
  - Landings
    - MRIP ✓
    - SRFS ✓
    - COM ✓
    - HB ✓
  - Discards
    - MRIP ✓
    - SRFS ✓
    - COM X
    - HB ✓
  - Indices
    - RVC ✓
    - SERFS Cam X
    - GOM Cam Survey X
    - FIM YOY ✓
  - Lengths
    - MRIP ✓
    - COM ✓
    - HB ✓
    - RVC ✓
    - FIM YOY ✓
  - Ages ✓

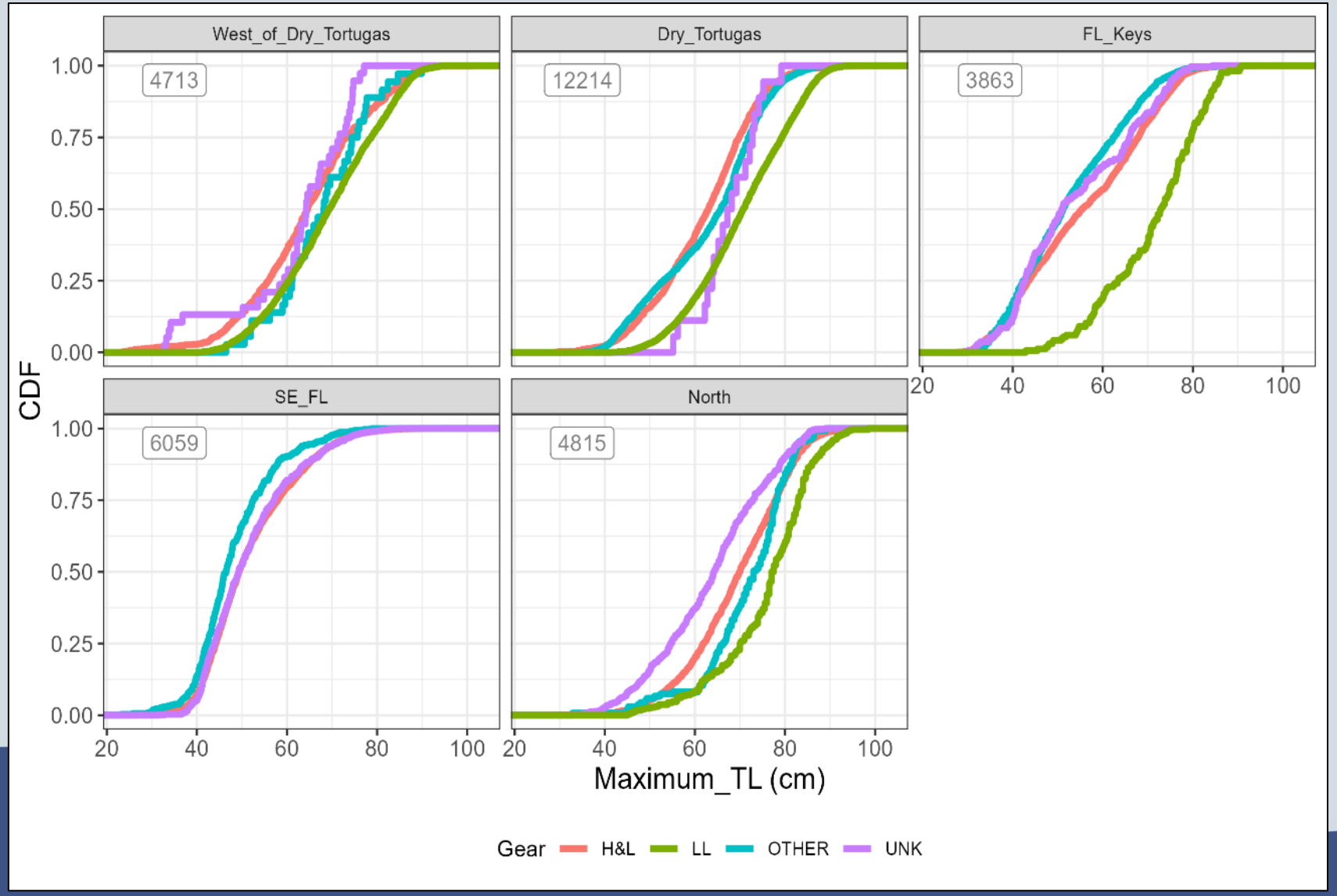
Landings-Weighted Length Frequencies

Commercial

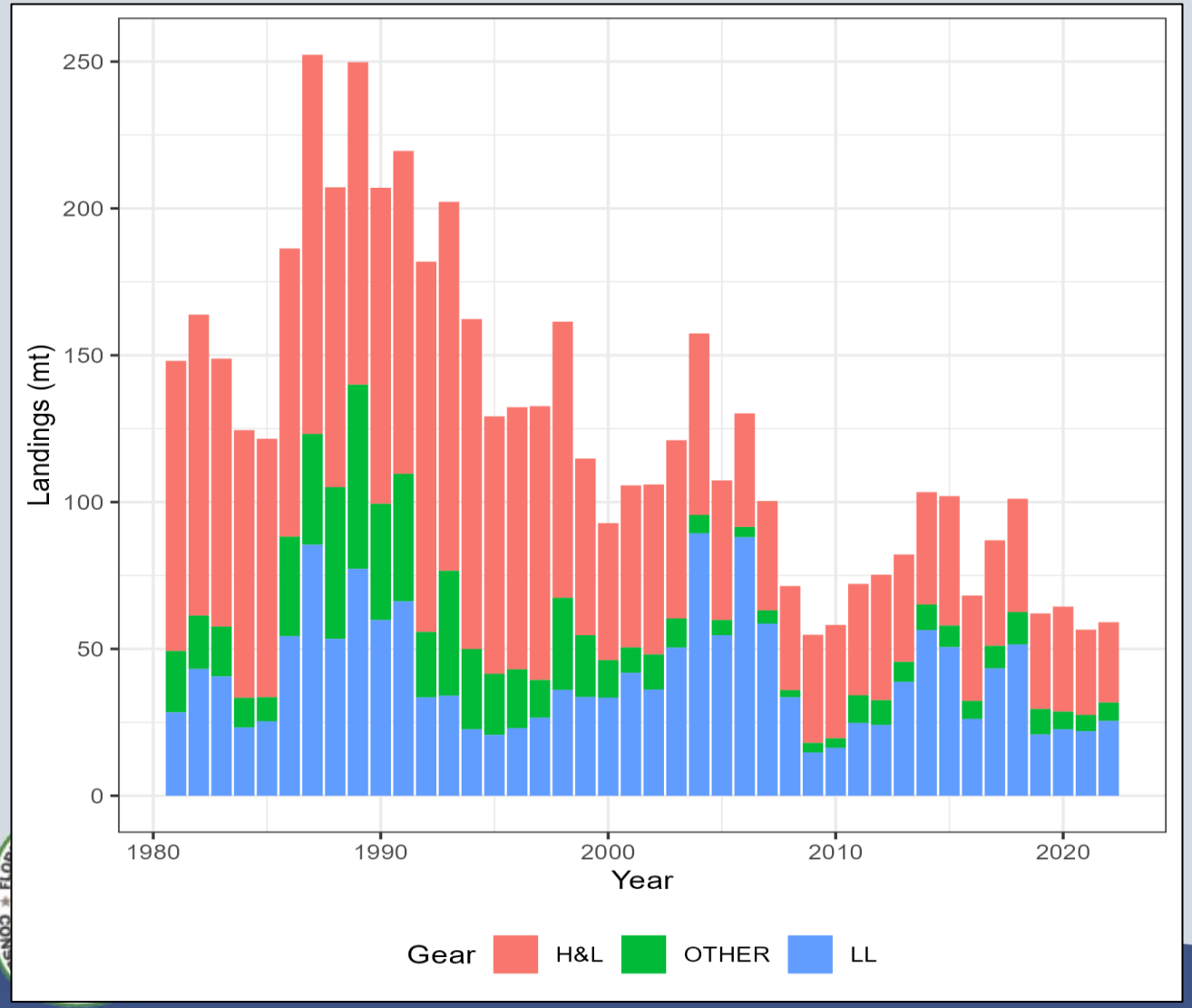
Why weight sampled lengths and ages?

- Size samples are often collected unevenly in space and time.
- To be representative of the size of fish being removed by fisheries, statistical correction of size composition data is required by reweighting using either landings or releases.
- Do so in a way that removes apparent noise in fishery-level size compositions driven by strata with low levels of sampling (WCPFC-SC19-2023).

Commercial lengths by Gear and Region

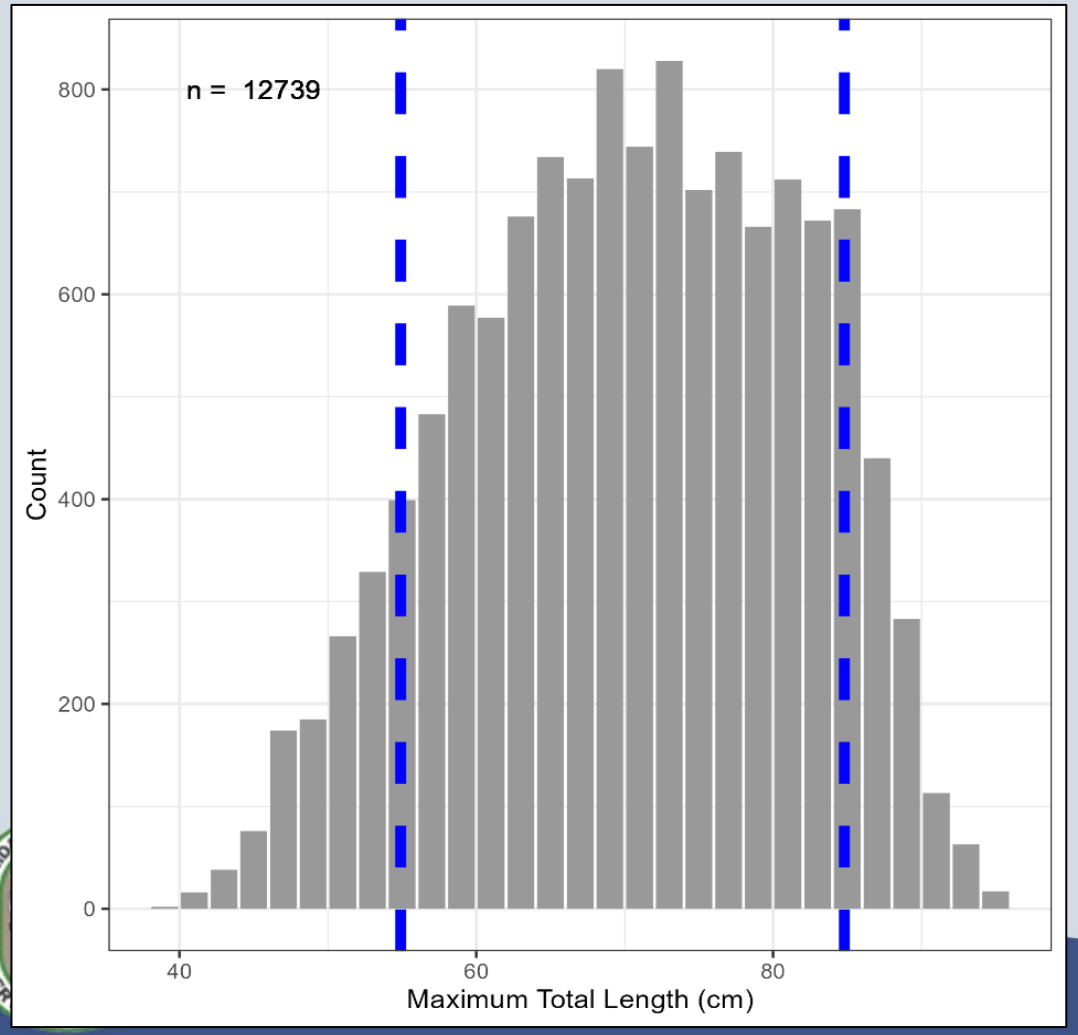


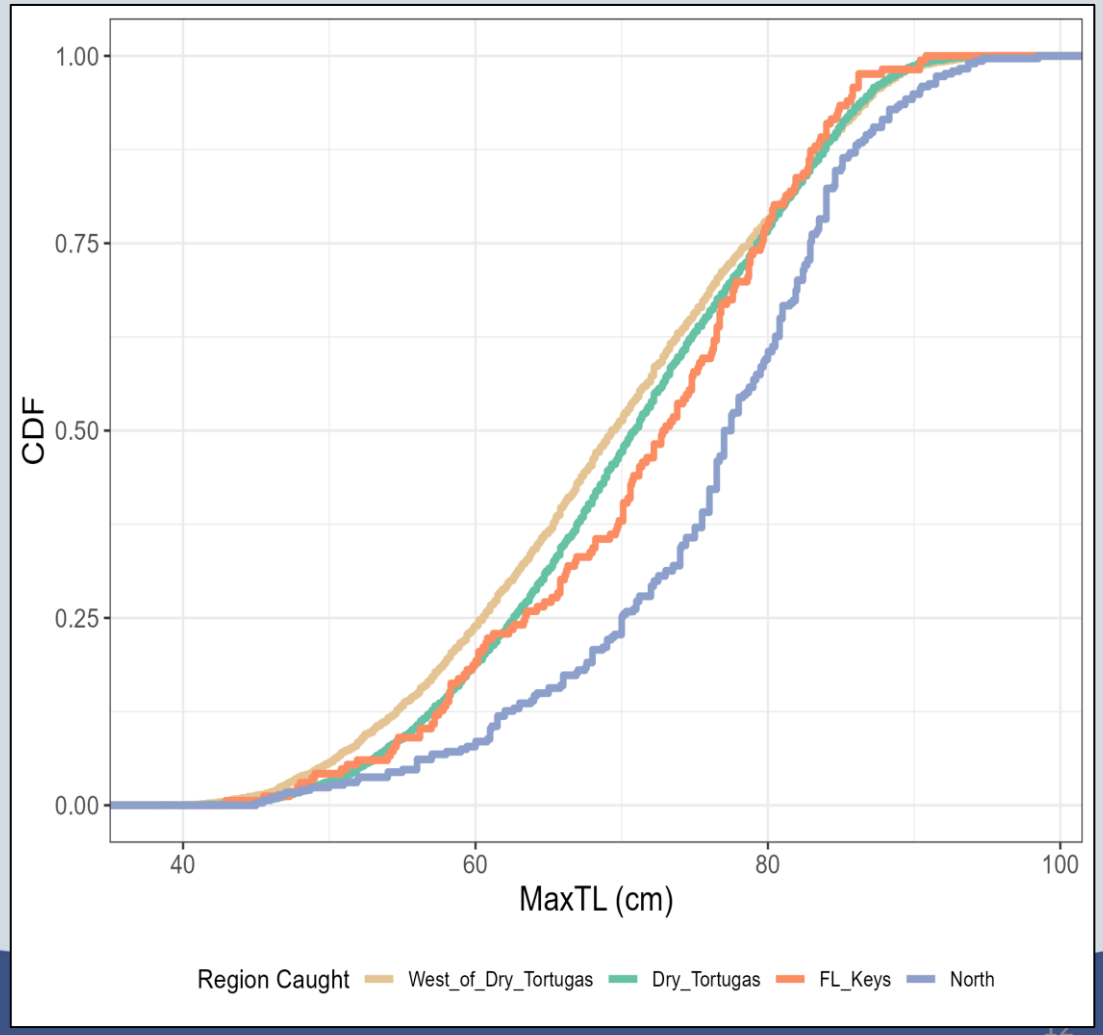
Commercial Landings by Gear



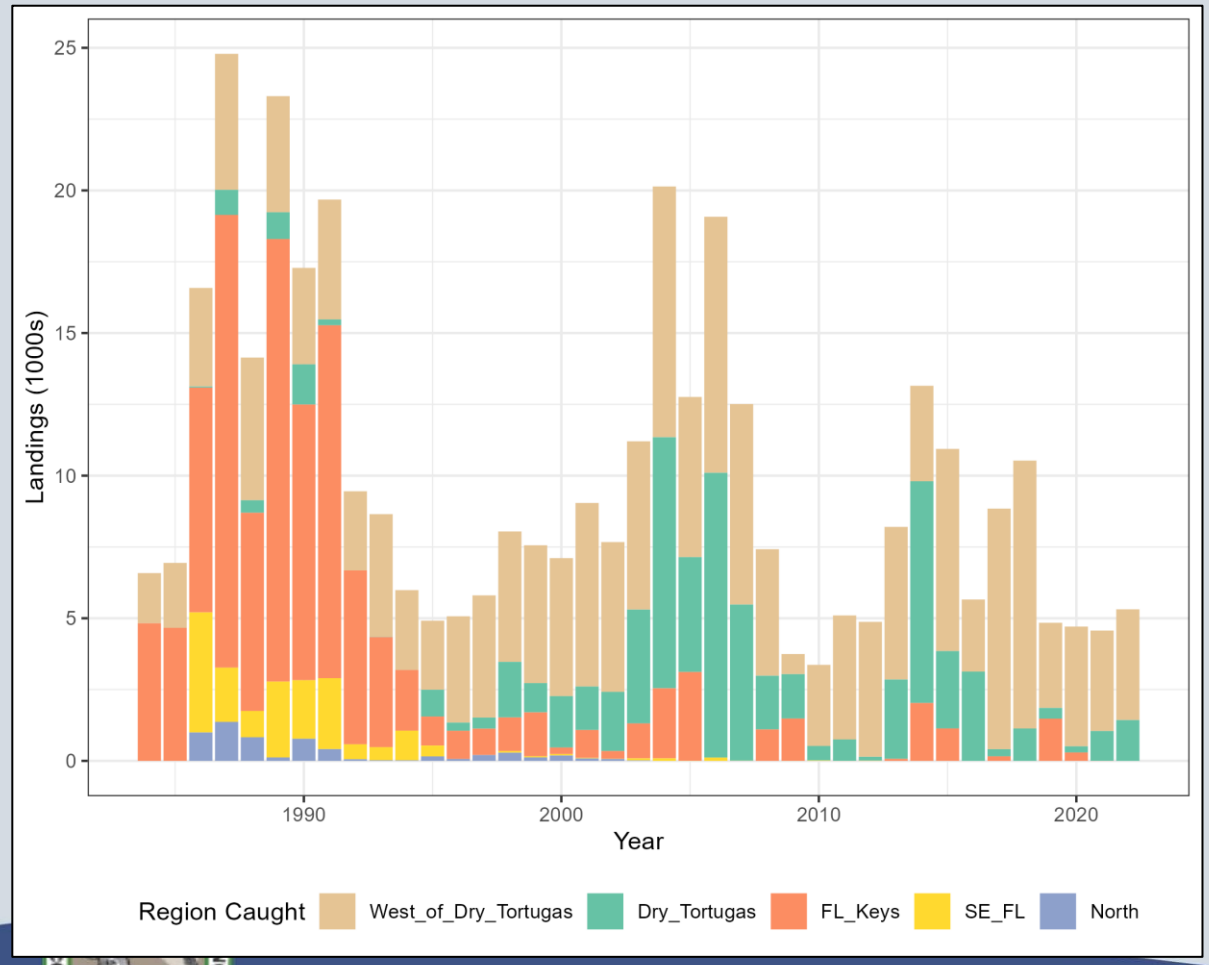
- Low landings from 'Other' geartypes
- Length distributions are mostly similar among hook and line, other, and unknown geartypes. Some differences observed but sample sizes are low
- **Decision: Keep Longline gear separate and combine Hook and Line, Other, and Unknown gears.**

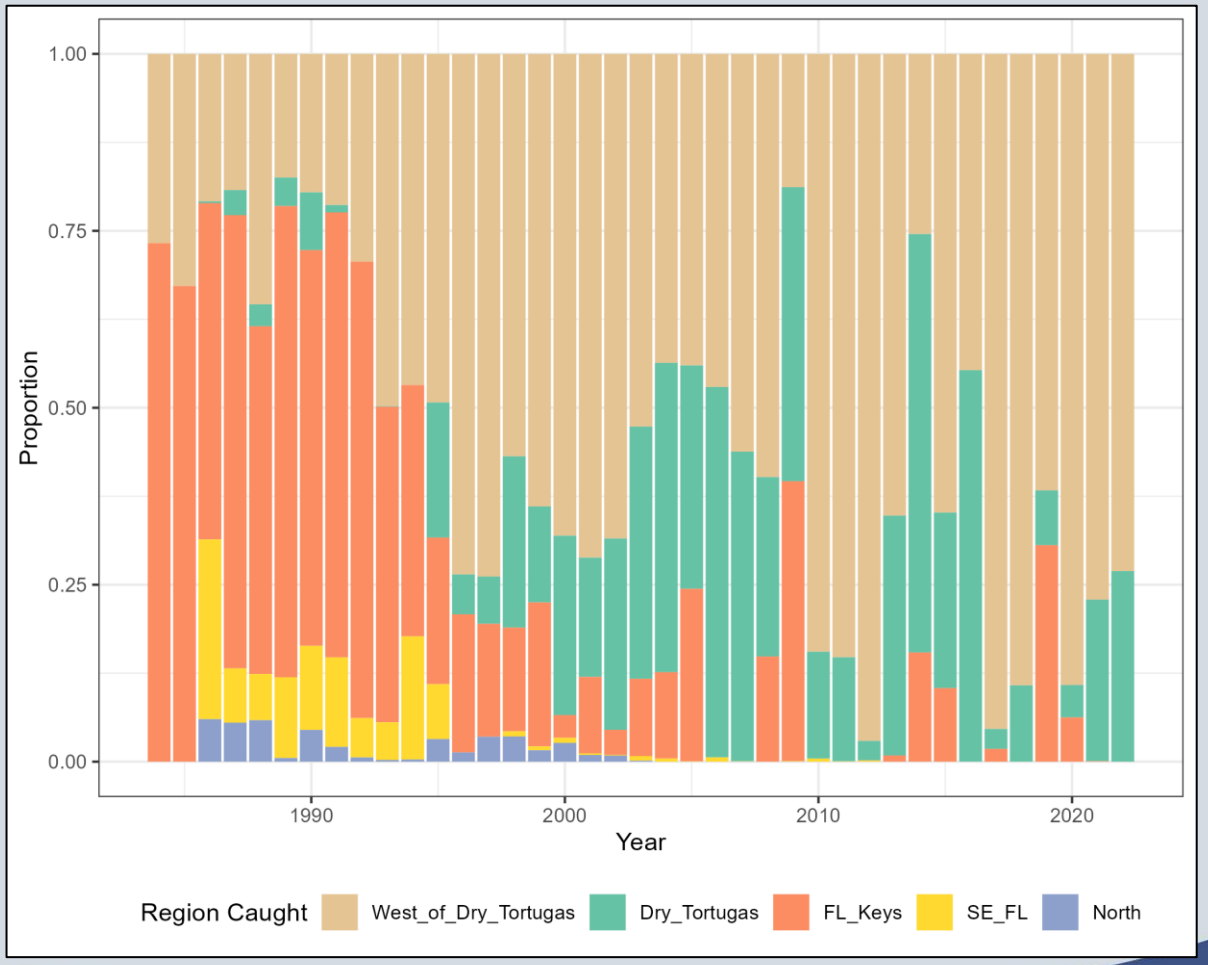
Commercial Longline Retained Lengths





Commercial Longline Landings By Region Caught

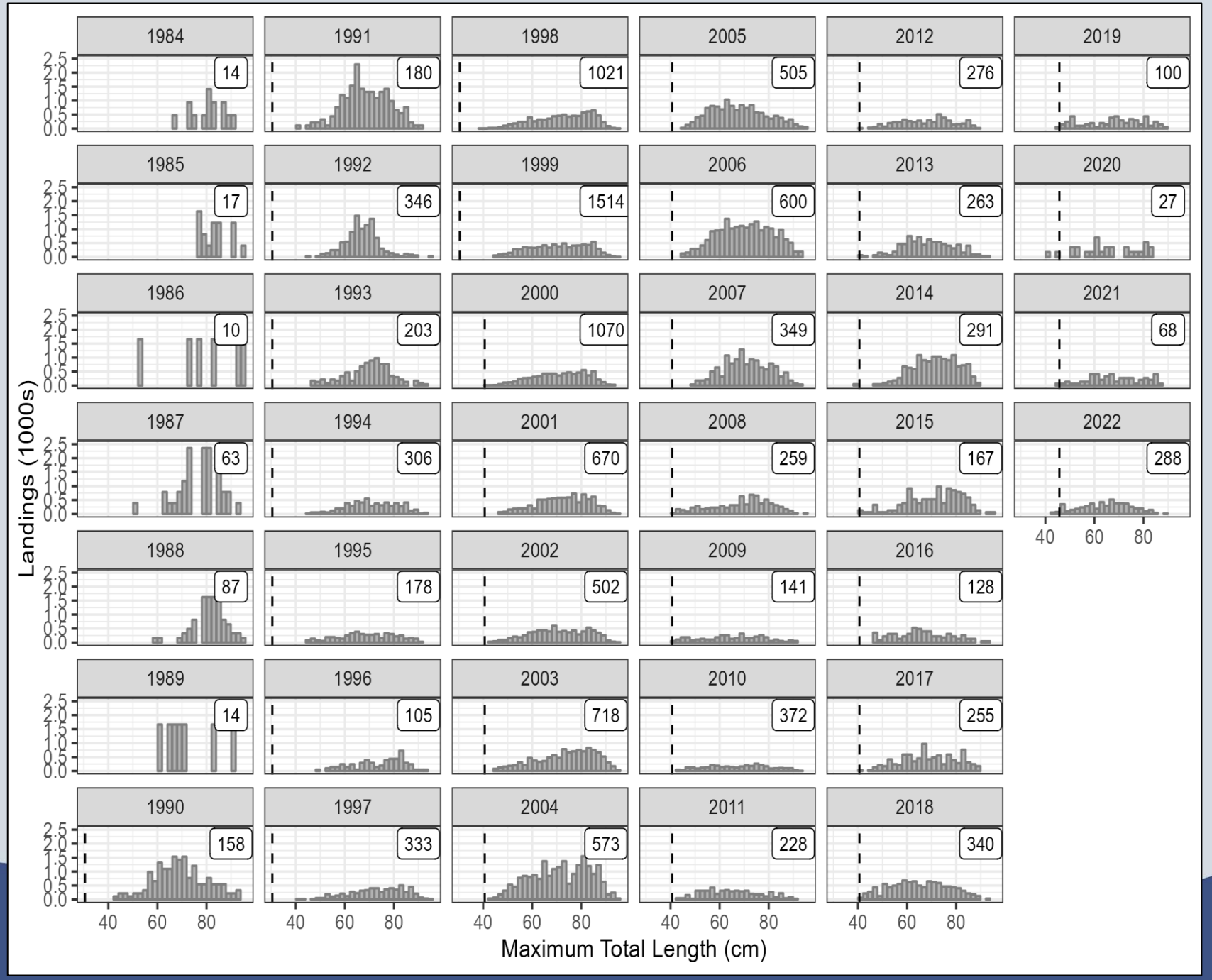




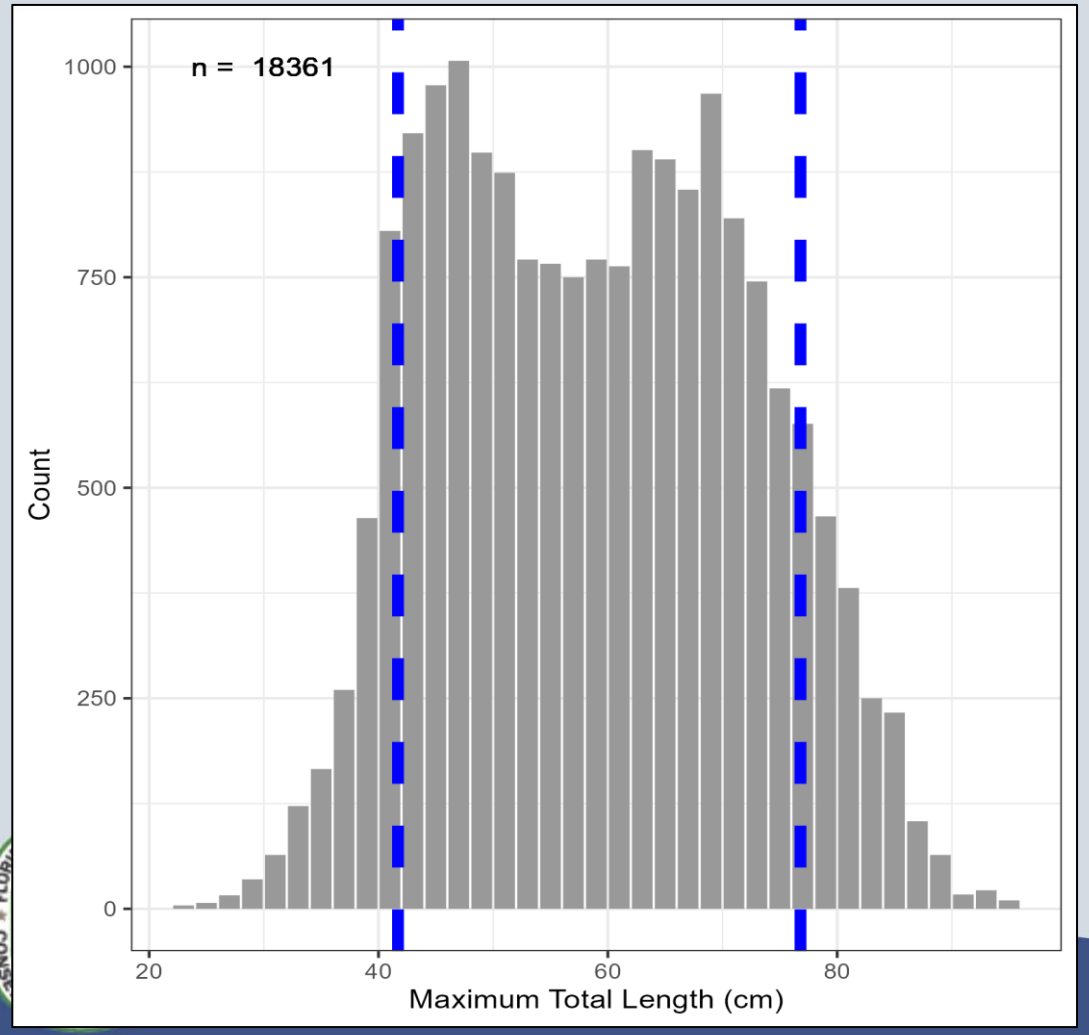
Explorations and Resulting Decisions

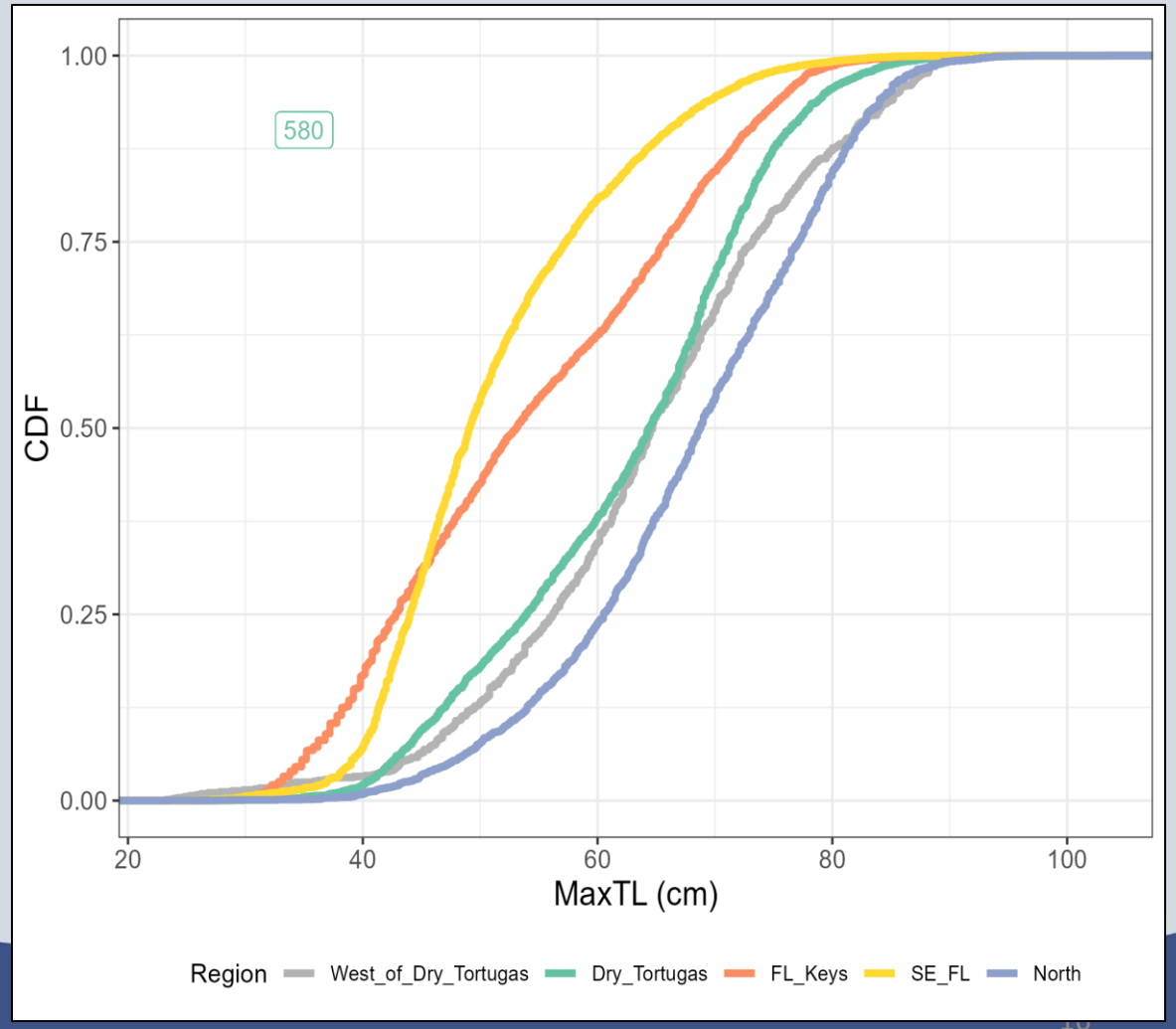
1. Sampled lengths from the longline fleet are very similar among regions and months.
2. **Decision: Combine sampled longline lengths across all regions and months and weight the length comps by annual longline landings.**

Commercial Longline Landings-at-Length

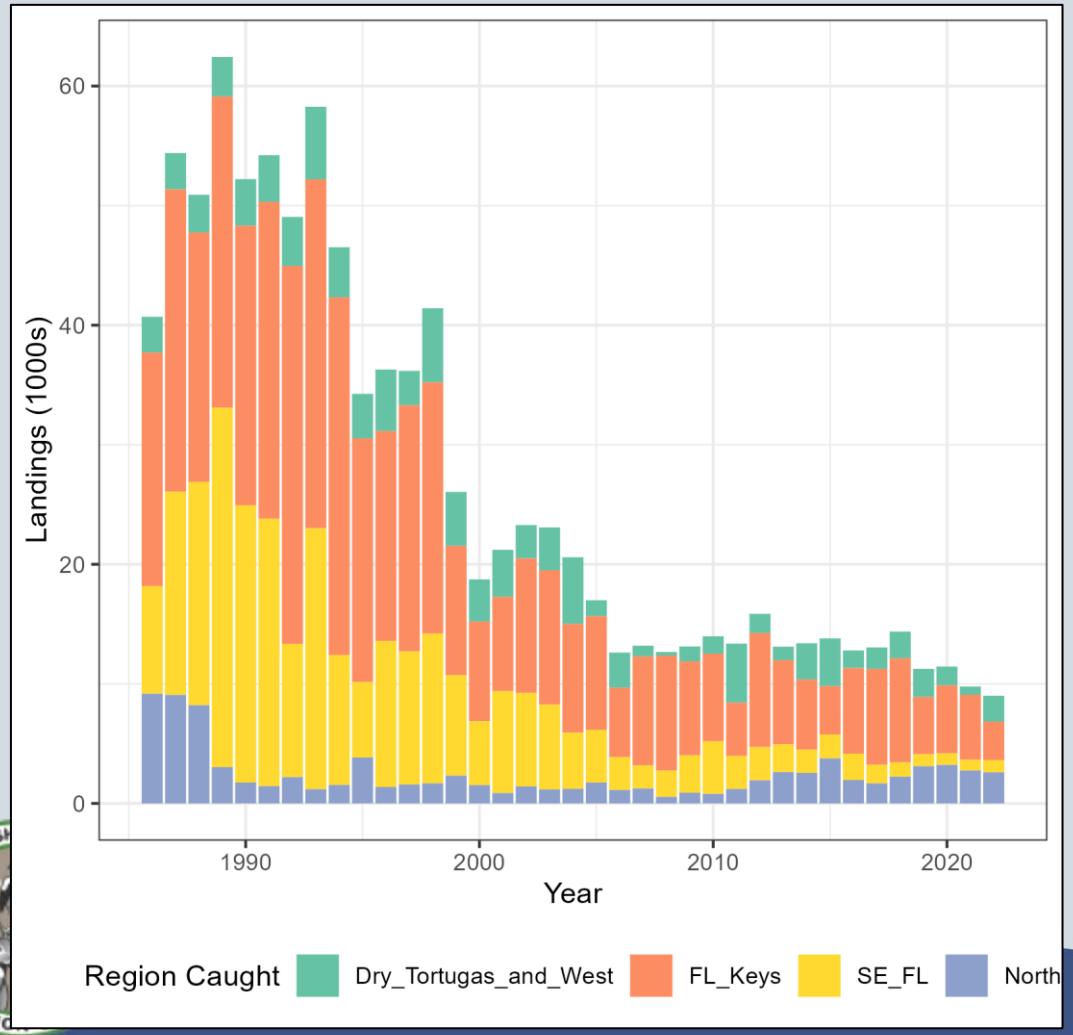


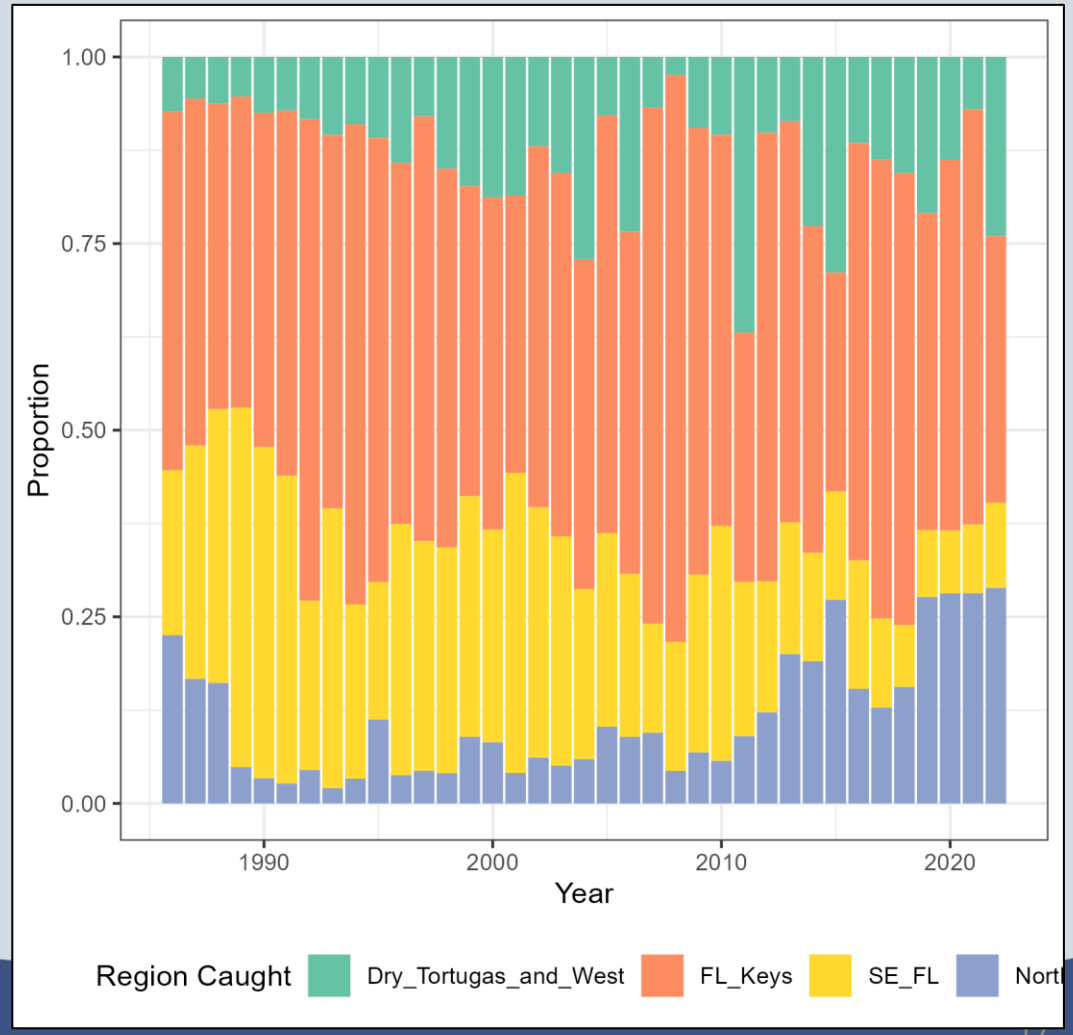
Commercial ‘Other’ Retained Lengths



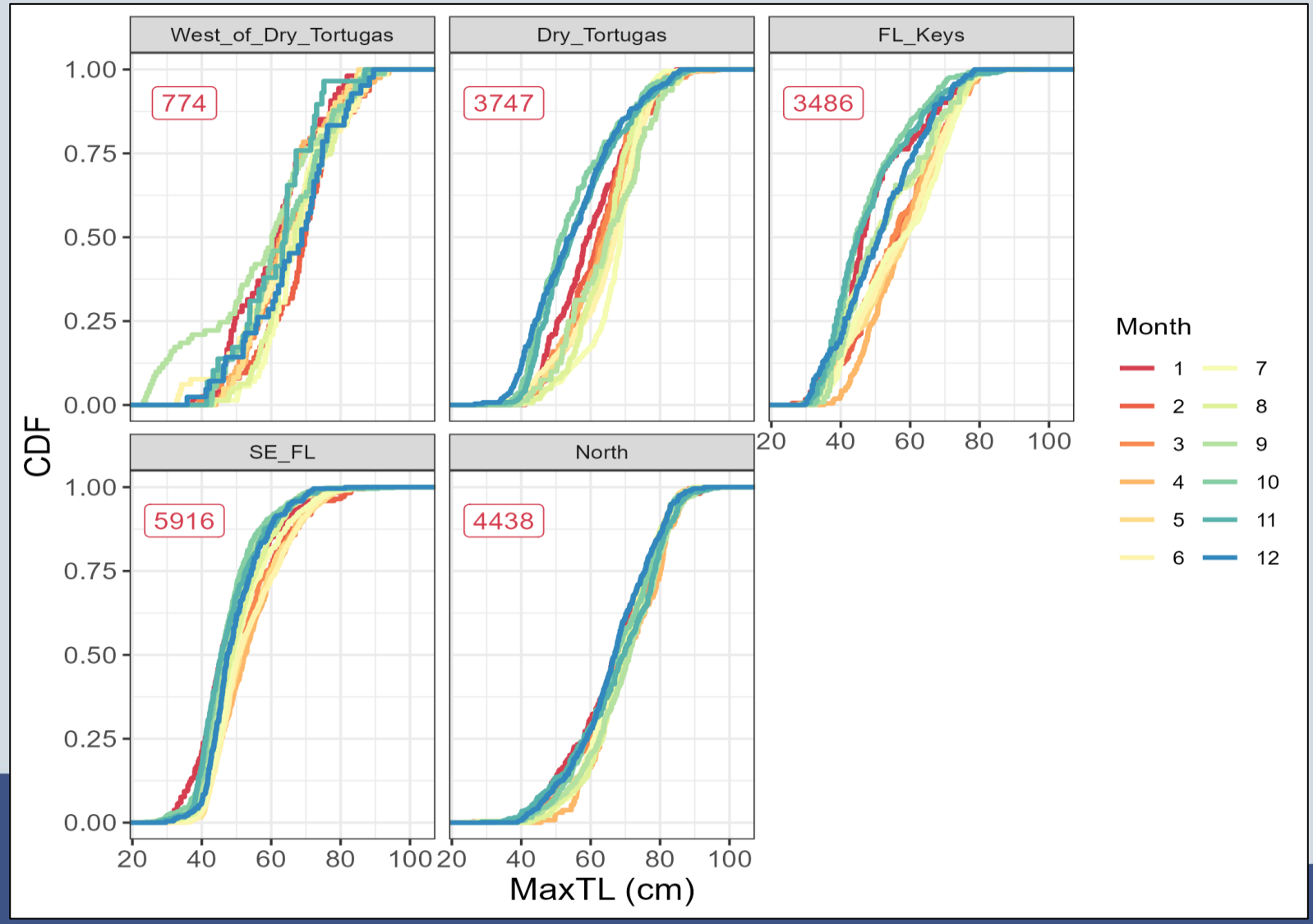


Commercial ‘Other’ Landings By Region Caught

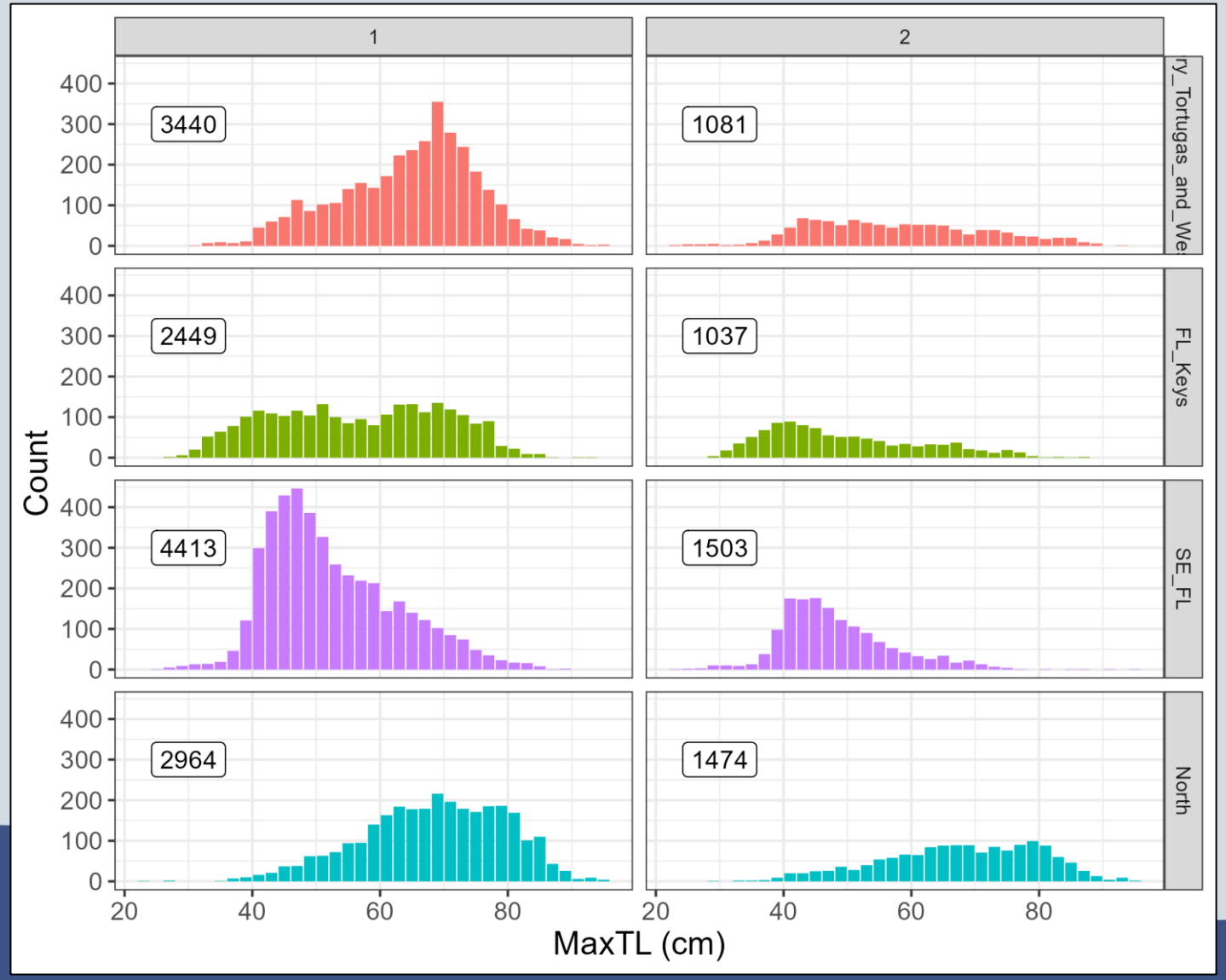




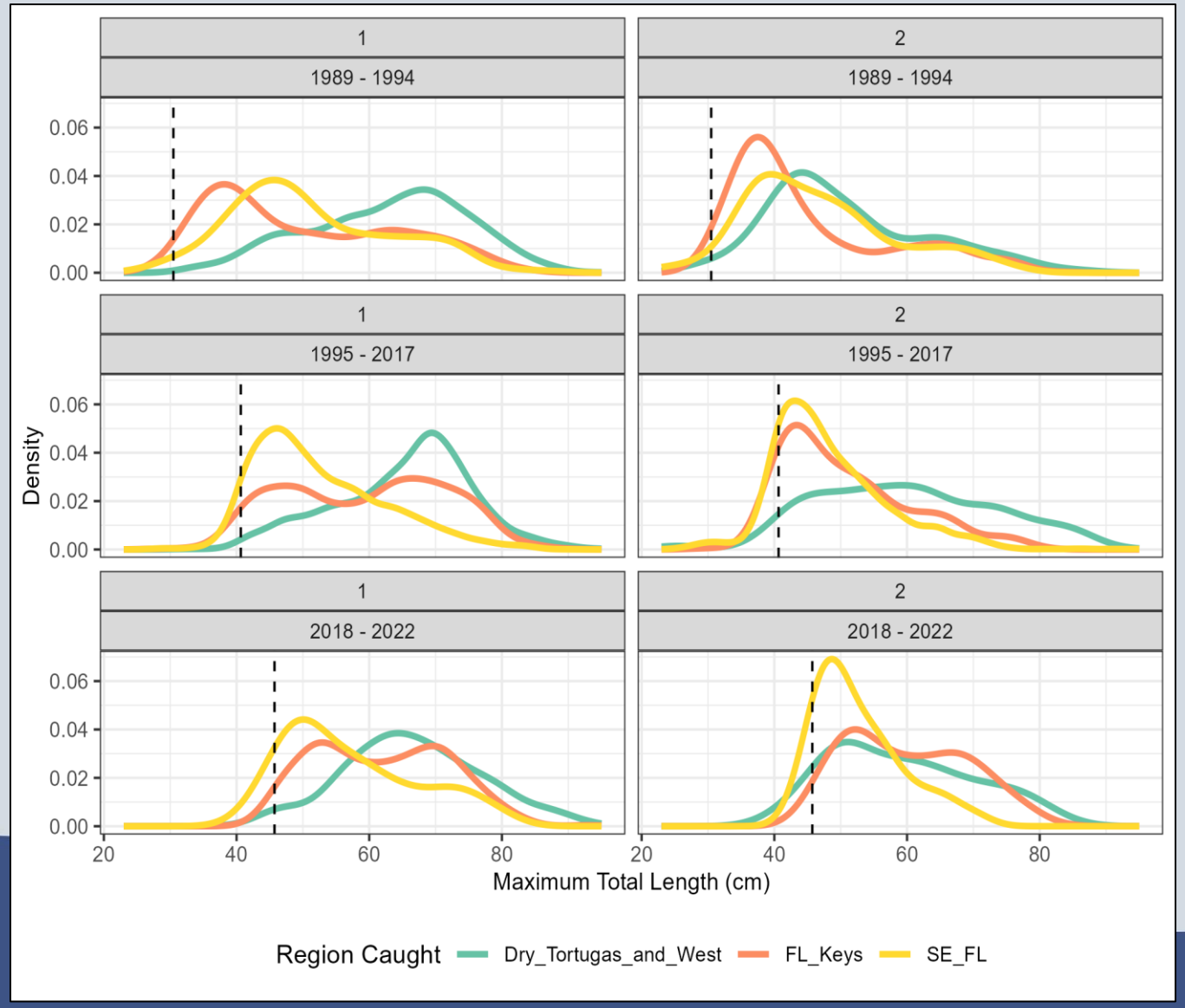
Commercial ‘Other’ Retained Lengths



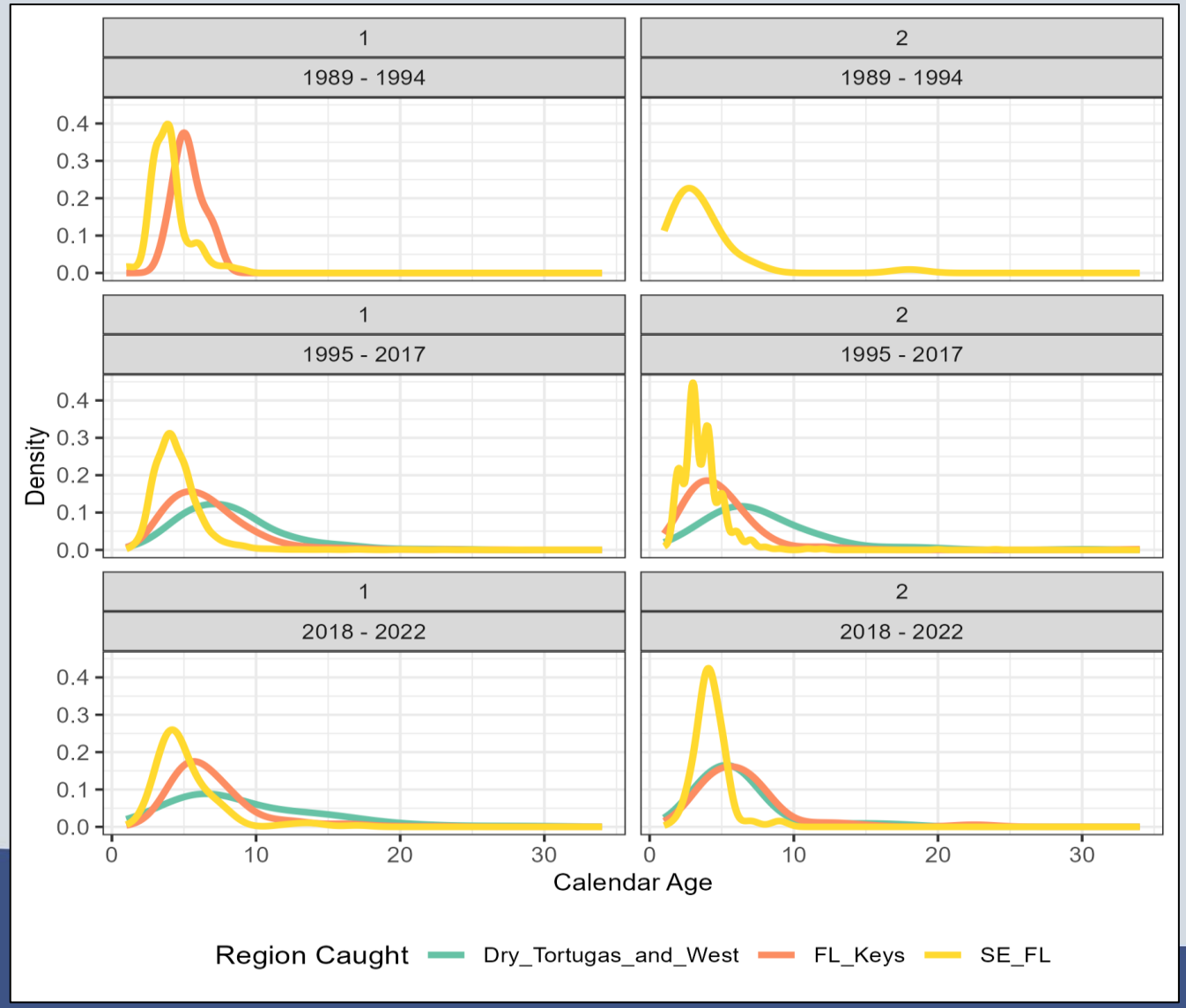
Commercial ‘Other’ Retained Lengths



Commercial ‘Other’ Retained Lengths



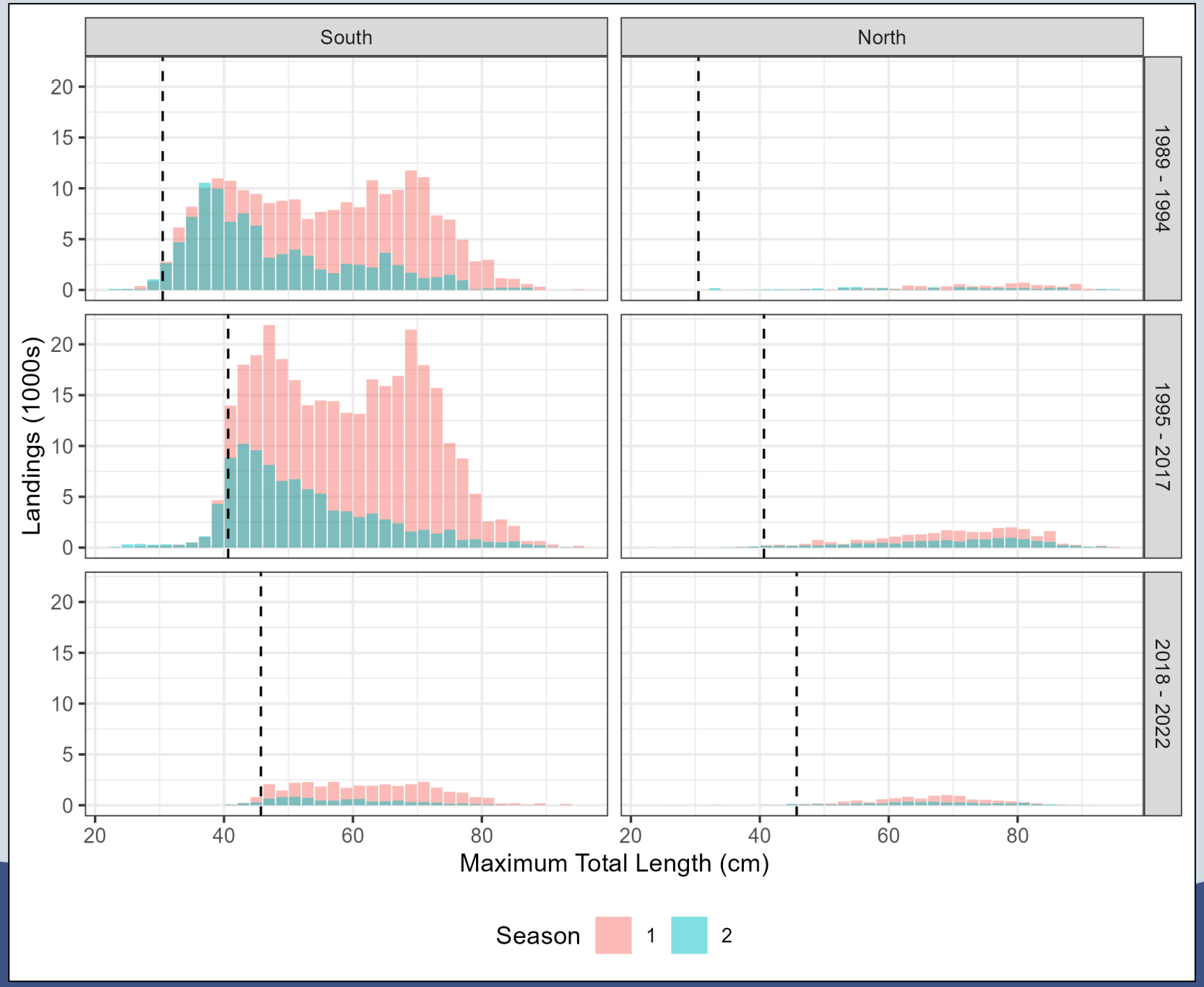
Commercial ‘Other’ Retained Ages



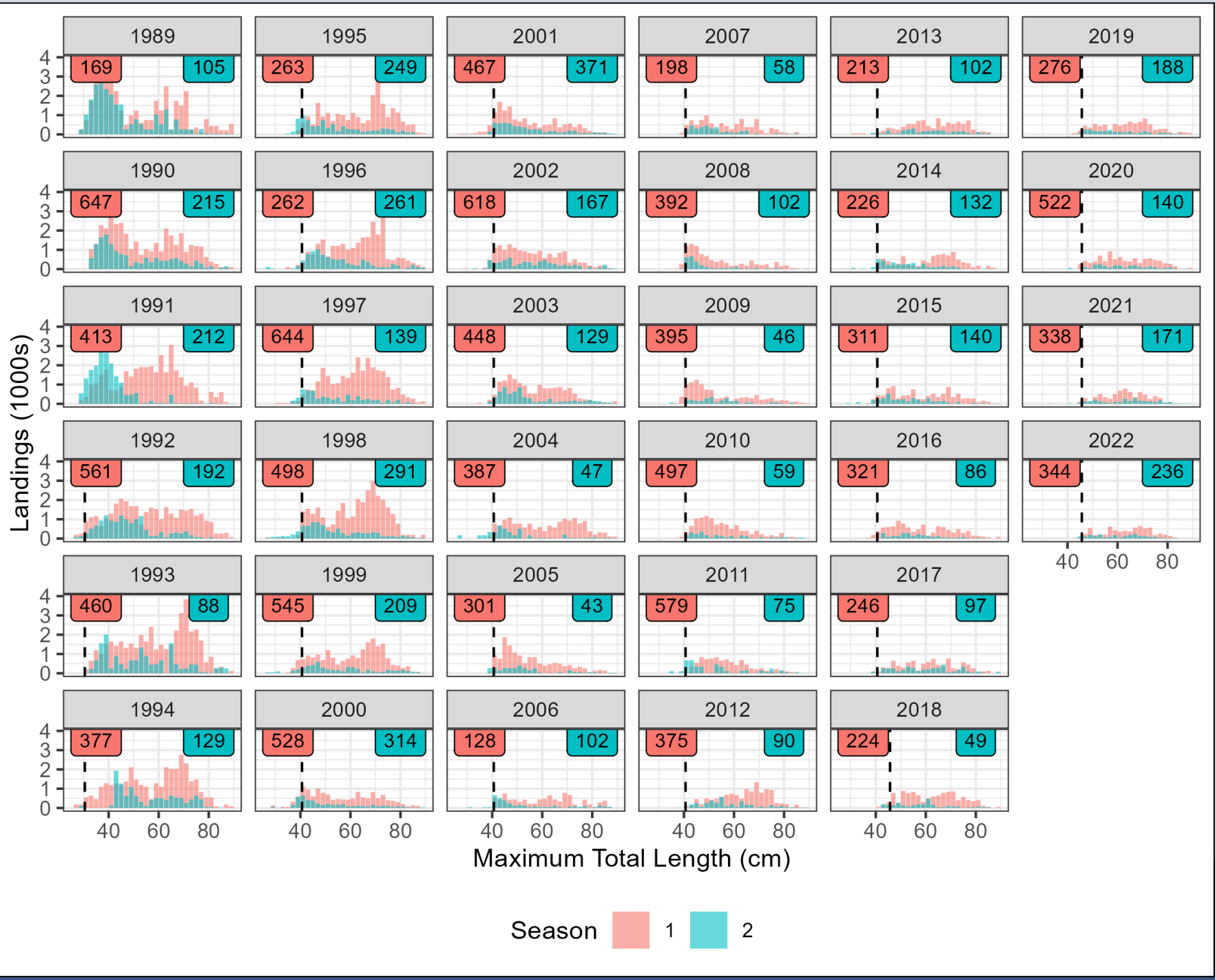
Explorations and Resulting Decisions

1. The FL Keys region makes up most of the landings since 1986. The proportion of landings from SE FL have steadily declined, particularly since 2013, but have increased in the North.
2. The sampled length and age comps for these regions differ enough to warrant weighting them separately. However, sample sizes are very limited, especially in the FL Keys from 1999 through 2007.
3. **Decision: Combine these three regions by season and weight the length comps by the landings by grouped region (North and South), season, and year.**

Commercial ‘Other’ Landings-at-Length



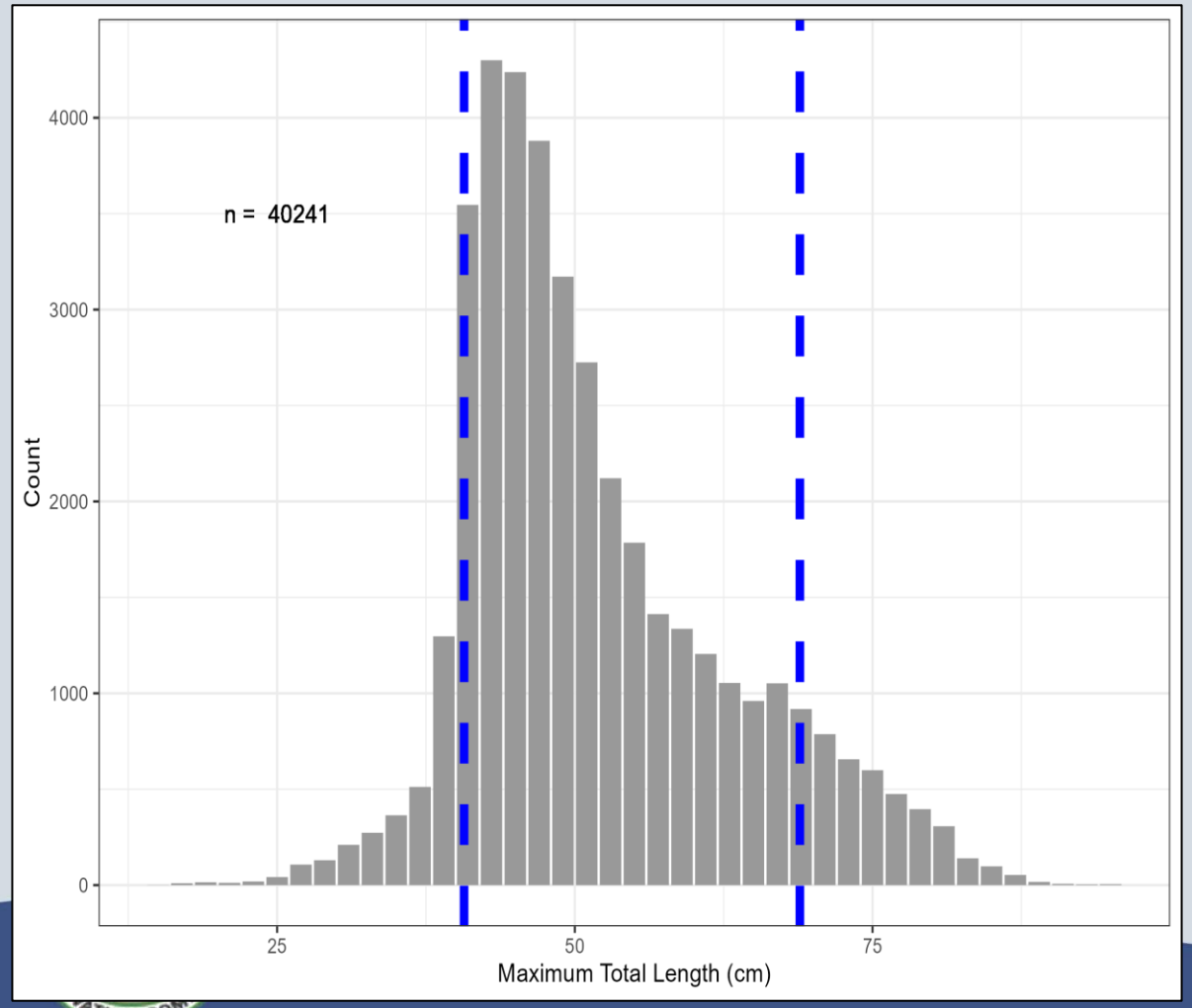
Commercial ‘Other’ Landings-at-Length

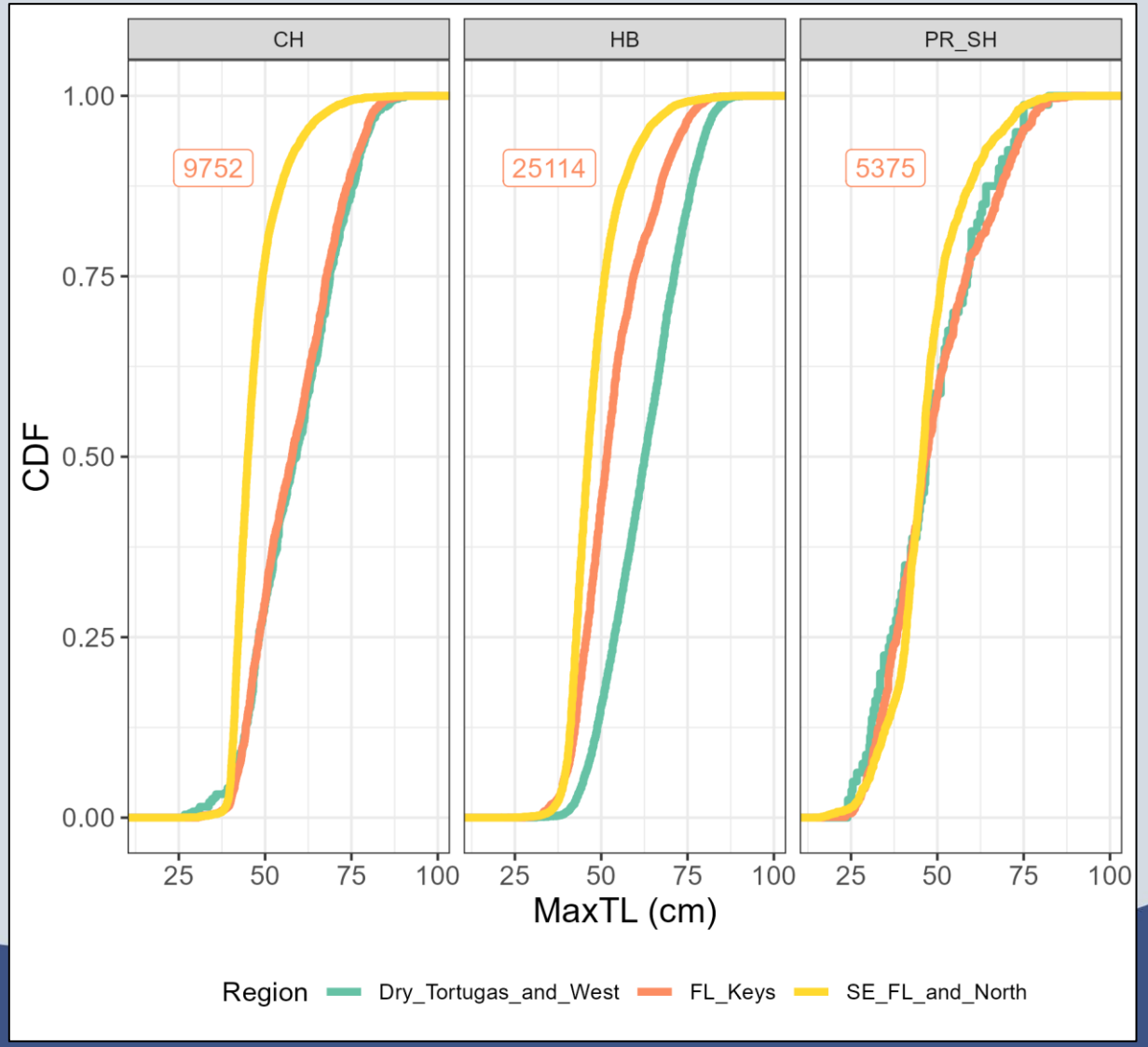


Landings-Weighted Length Frequencies

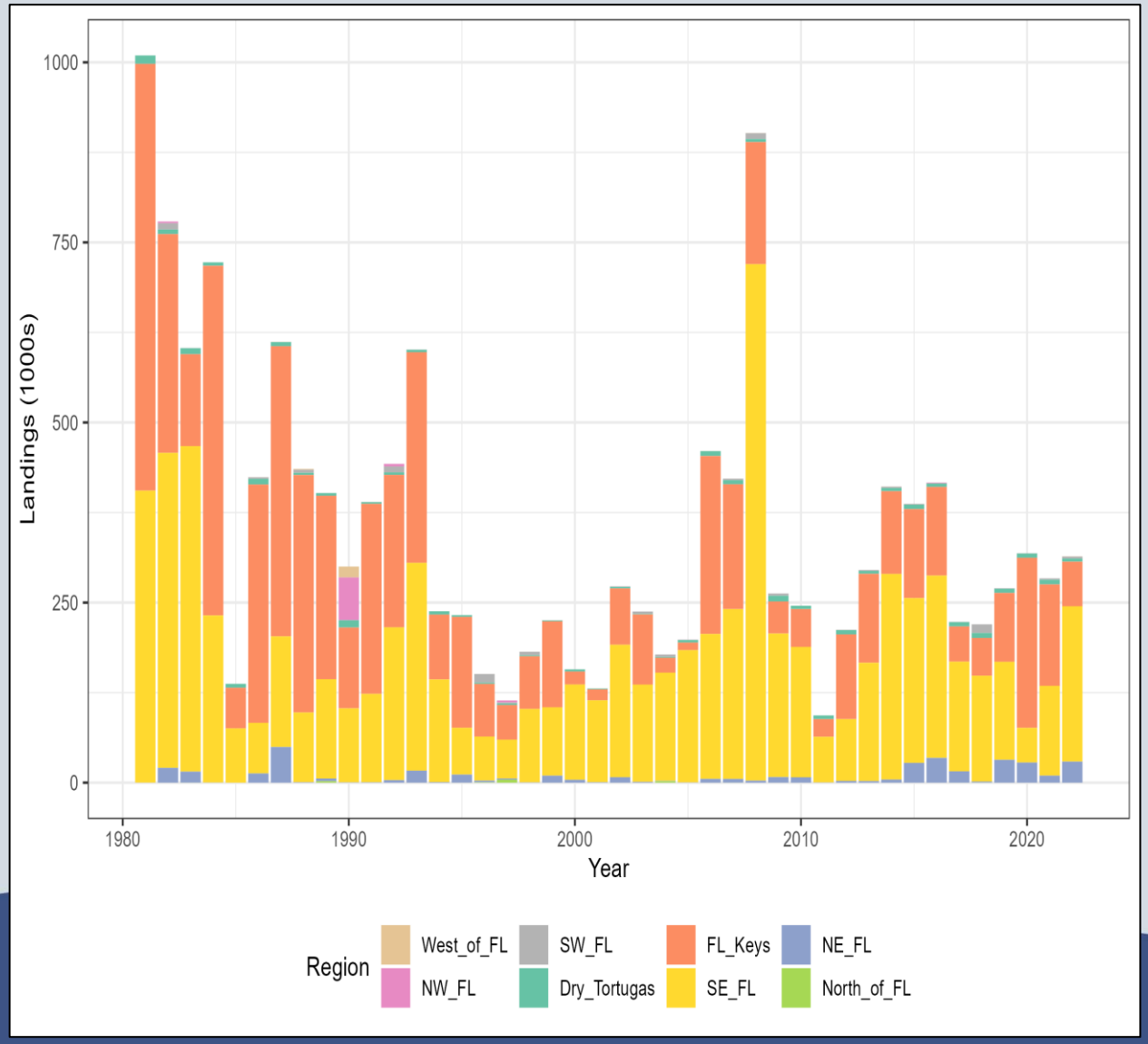
Recreational

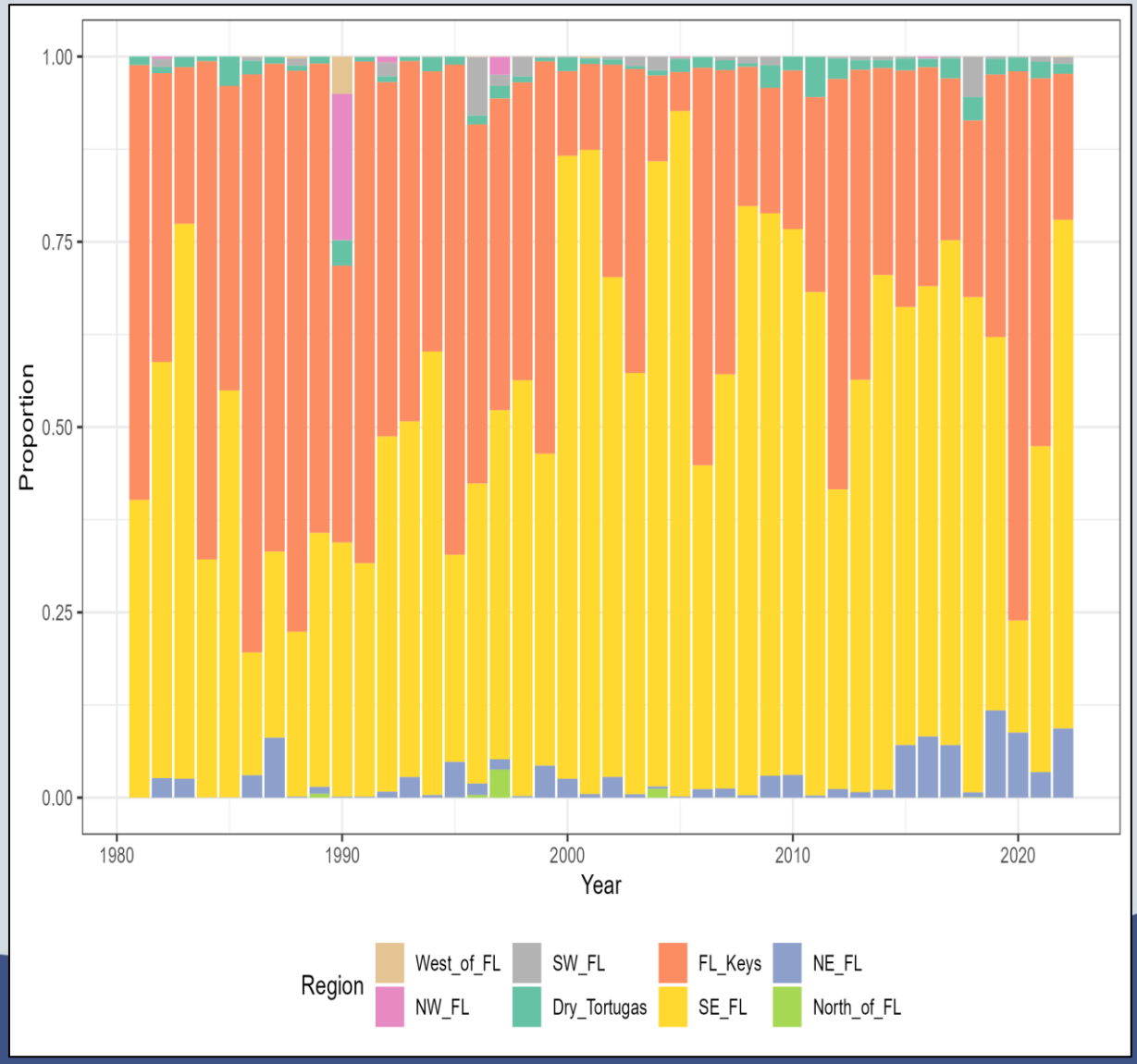
Recreational Retained Lengths



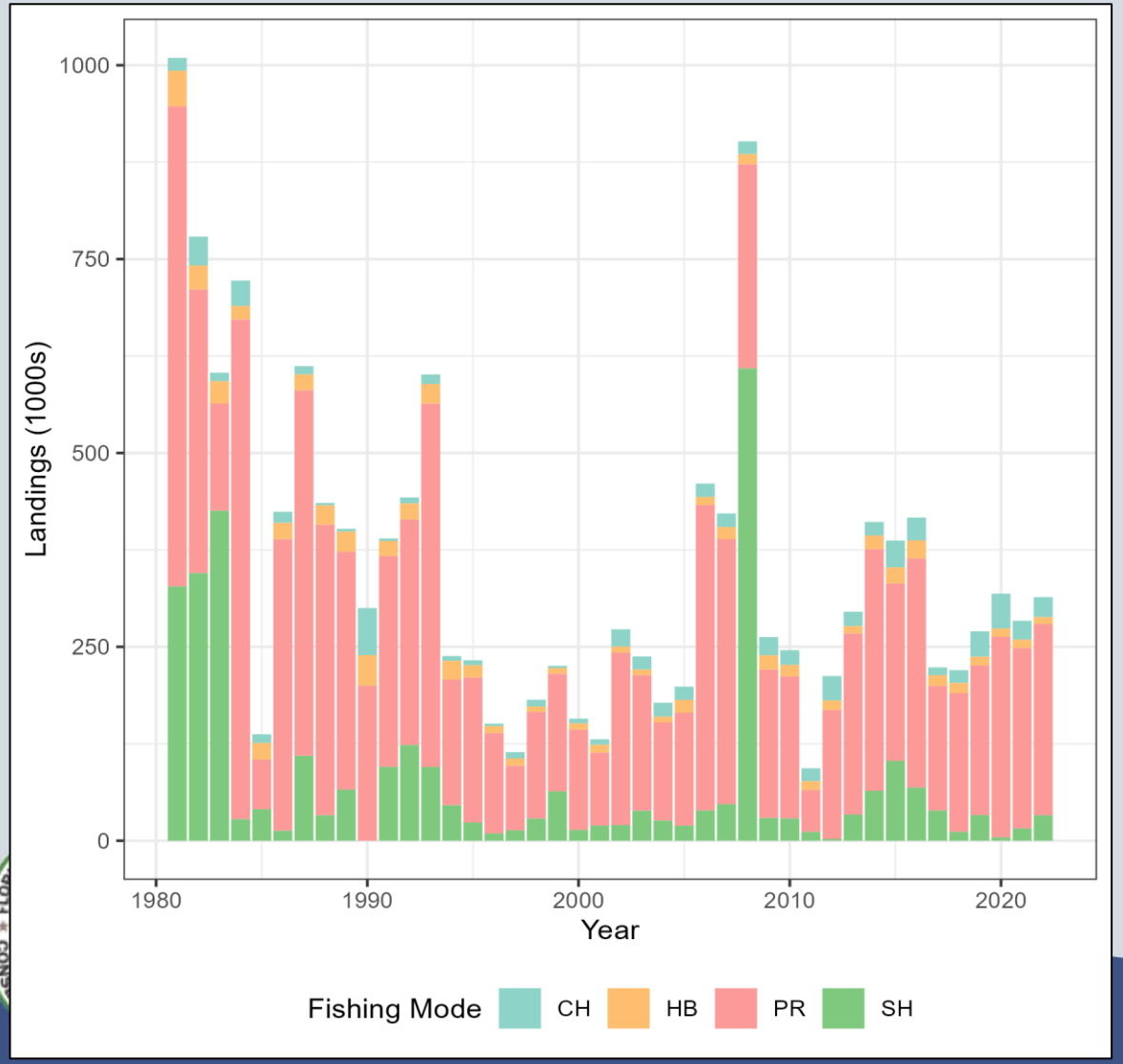


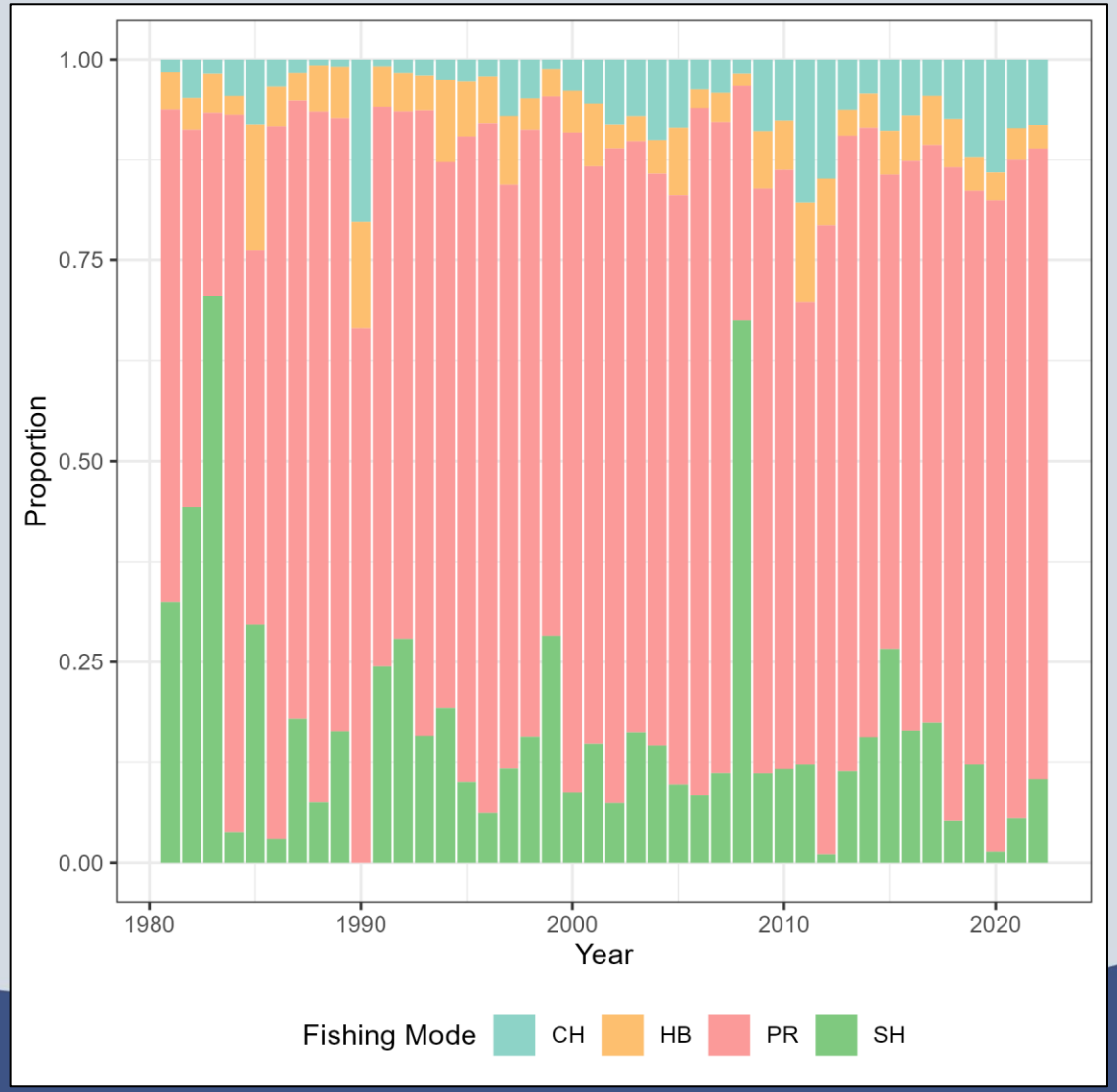
Recreational Landings By Region Caught



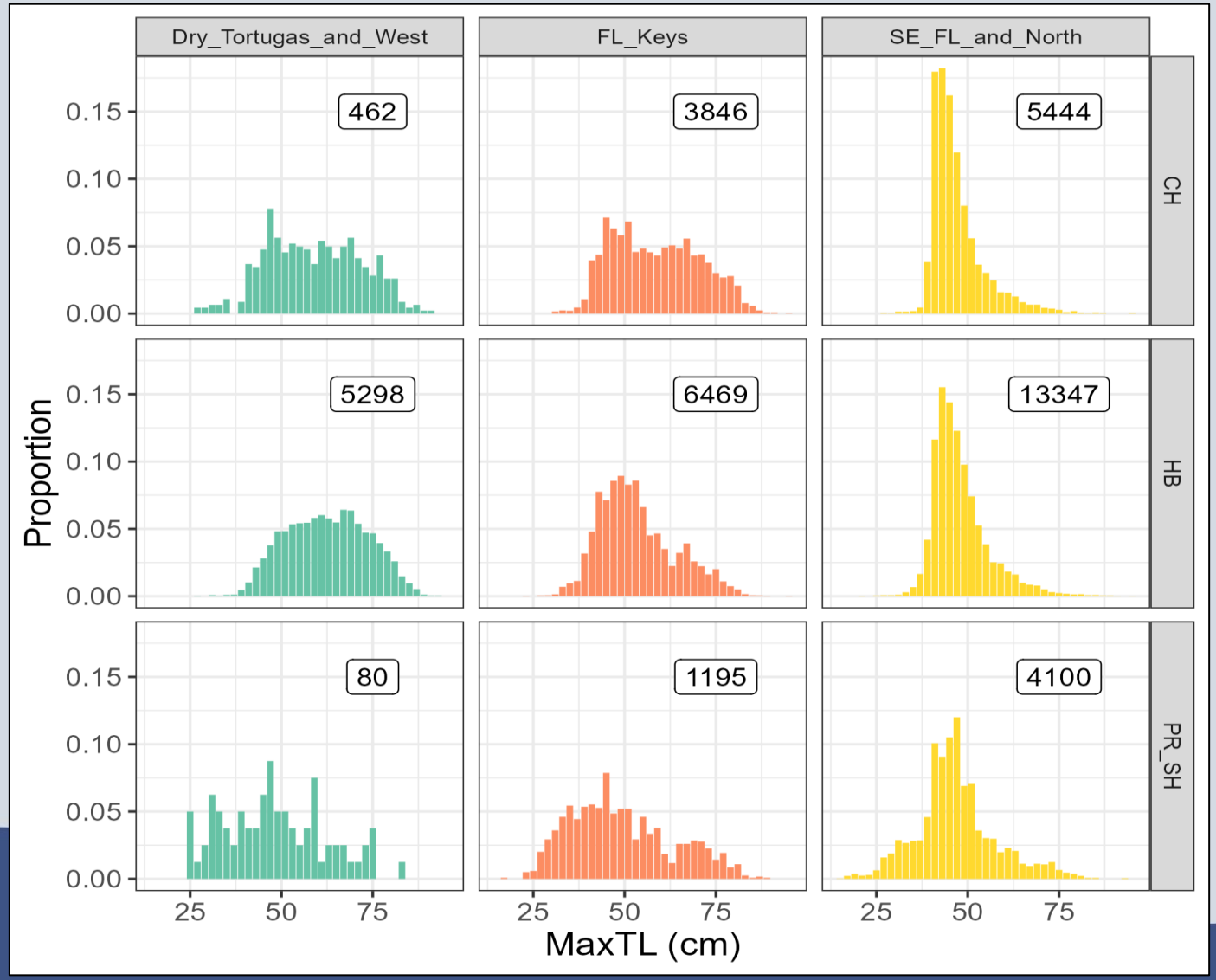


Recreational Landings By Fishing Mode

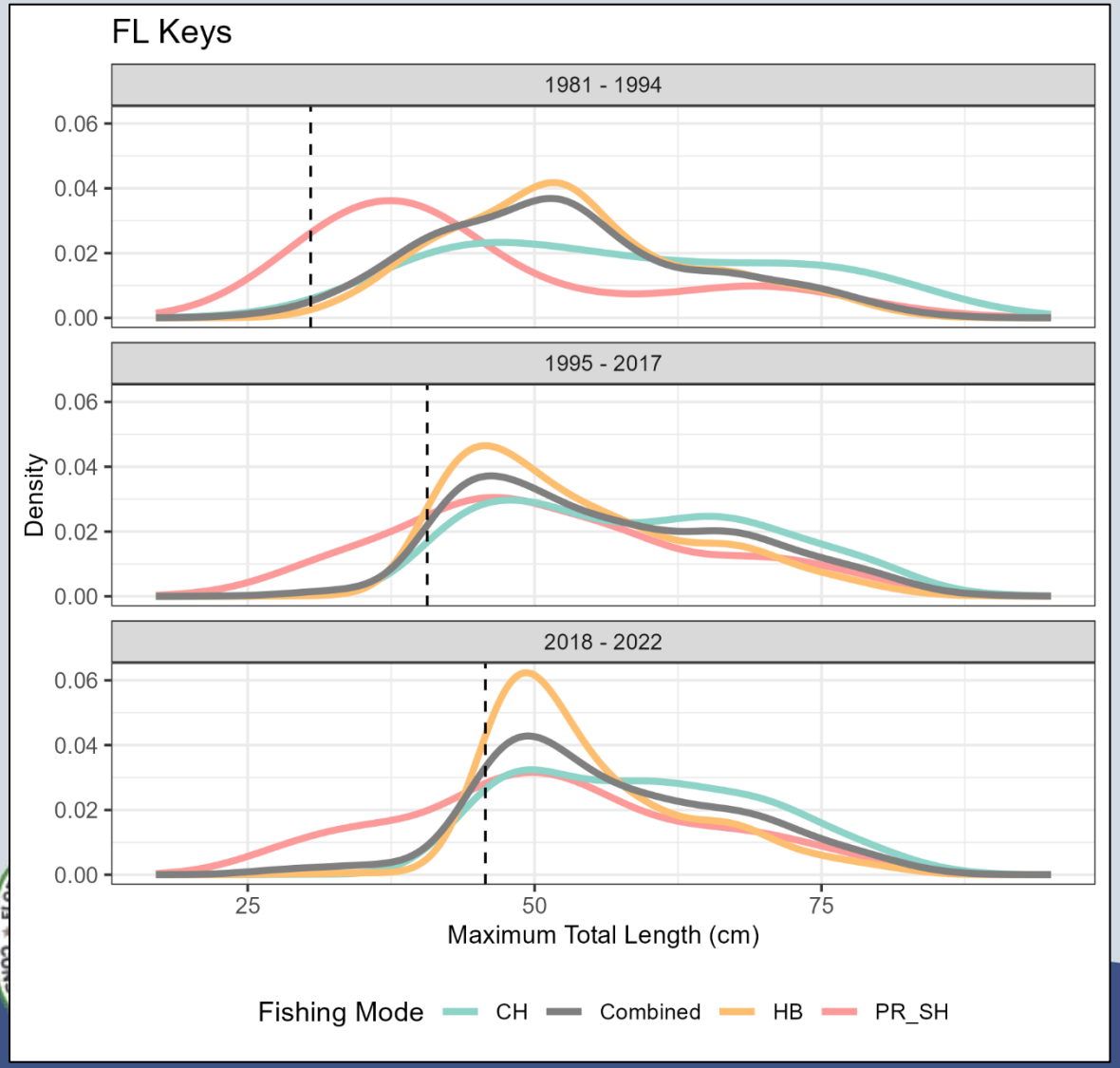


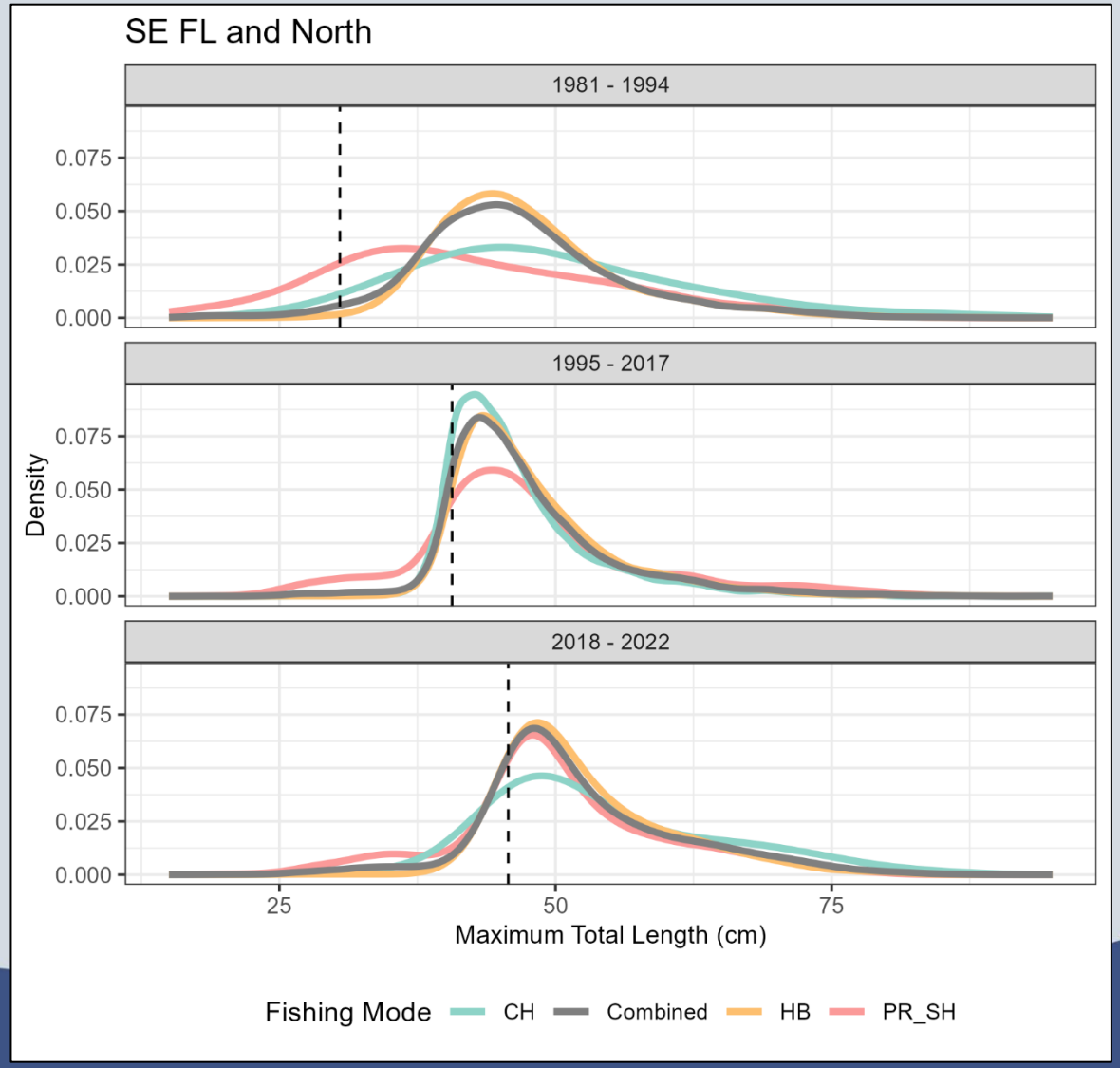


Recreational Retained Lengths



Recreational Retained Lengths

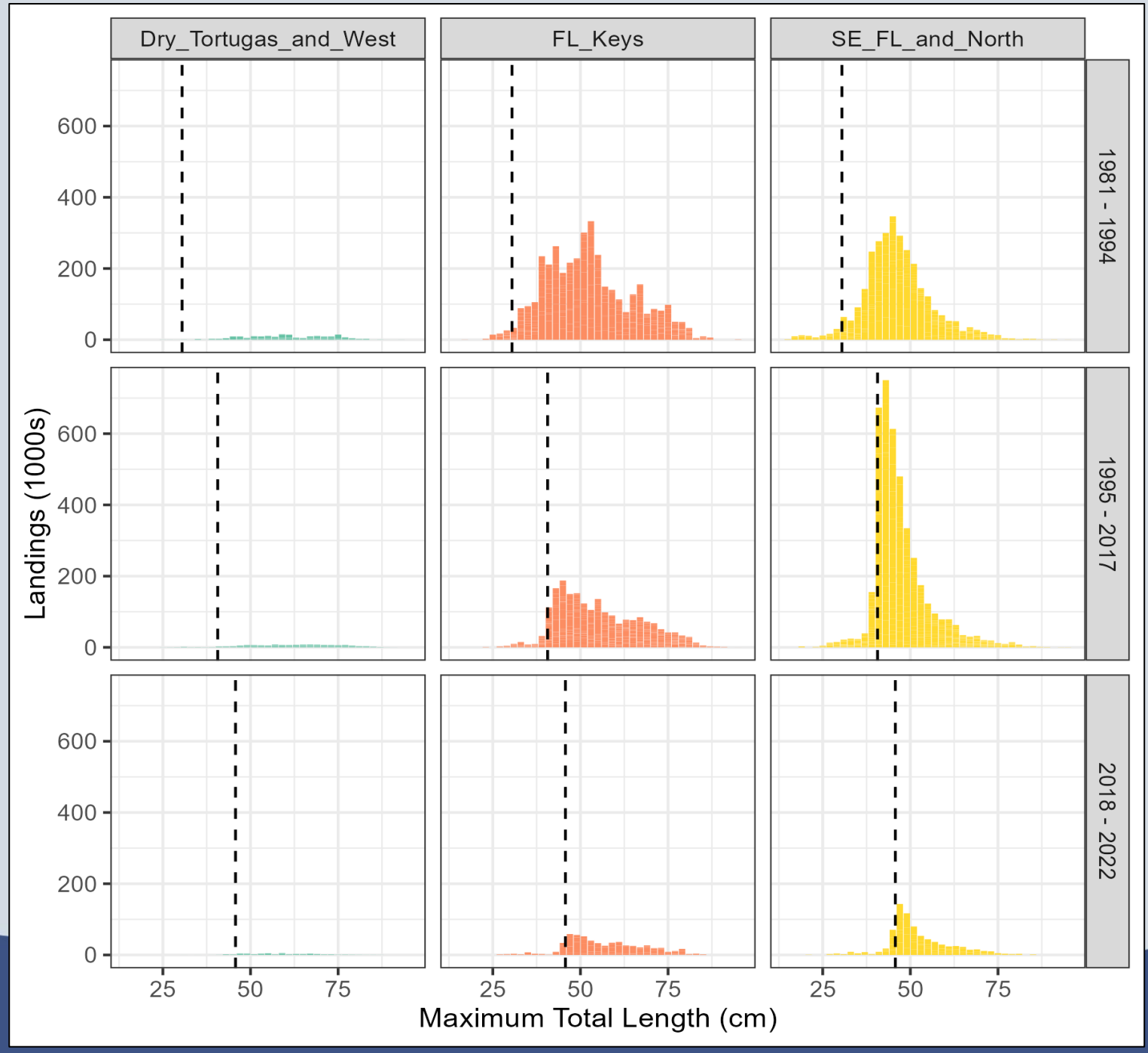




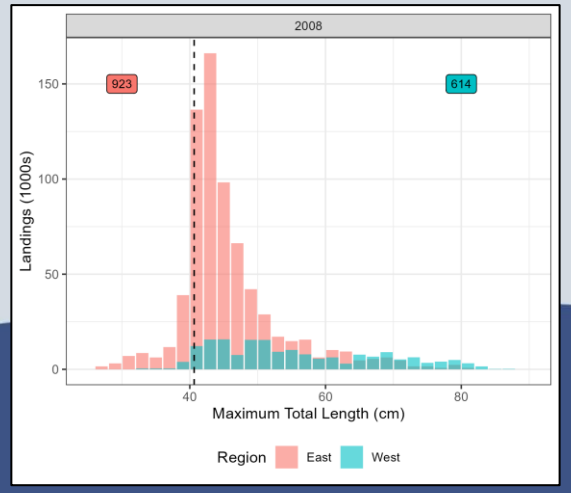
Explorations and Resulting Decisions

1. The FL Keys and SE FL account for most of the landings since 1981.
2. The private mode contributes the highest proportion of landings but few lengths.
3. The private mode may retain smaller fish compared to for-hire modes, particularly in the FL Keys. However, sample sizes are very limited and necessitate borrowing from other fishing modes.
4. **Decision: Combine sampled lengths across all fishing modes within regions and weight the length comps by the landings by region and year.**

Recreational Landings-at-Length



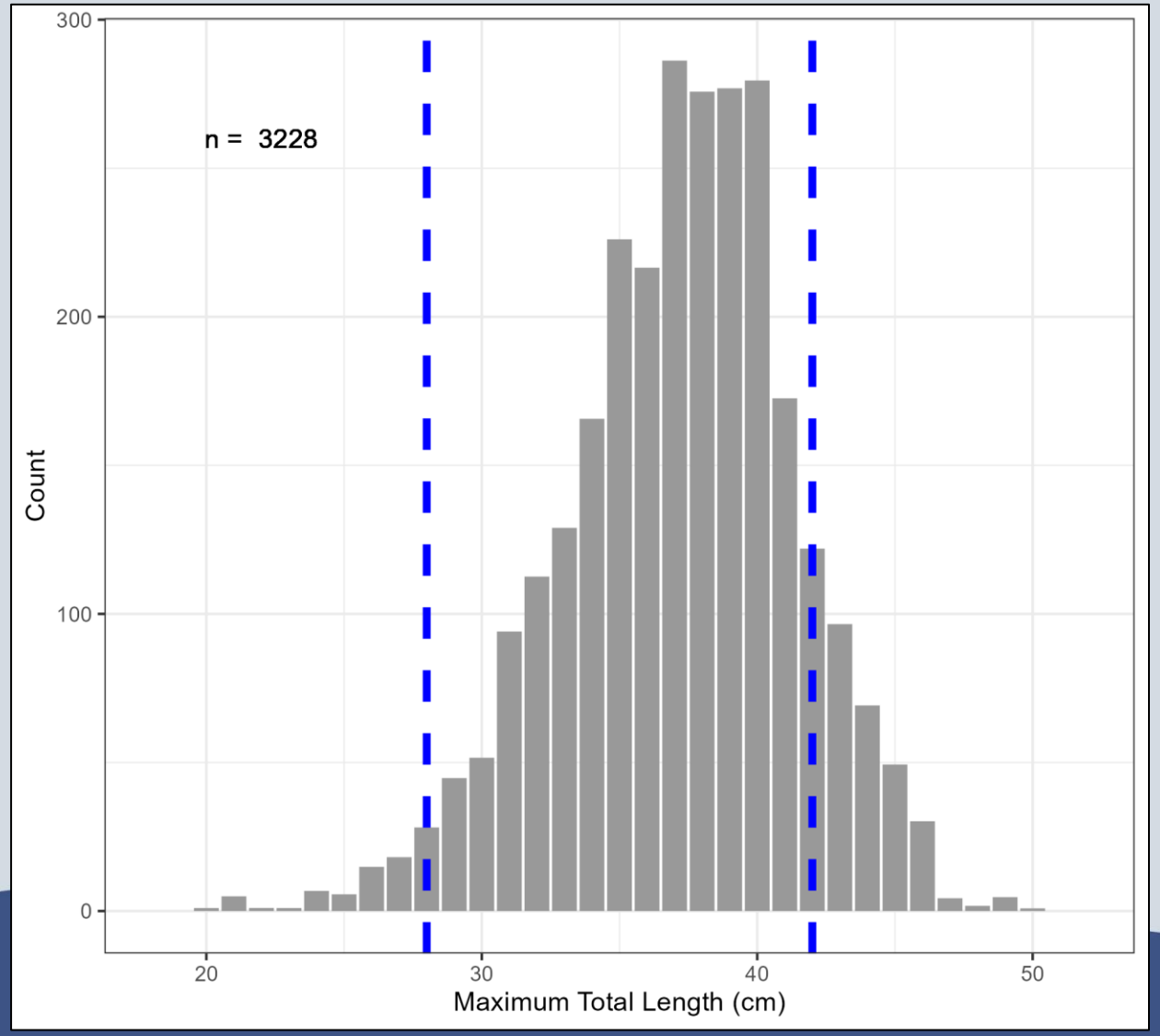
Recreational Landings-at-Length

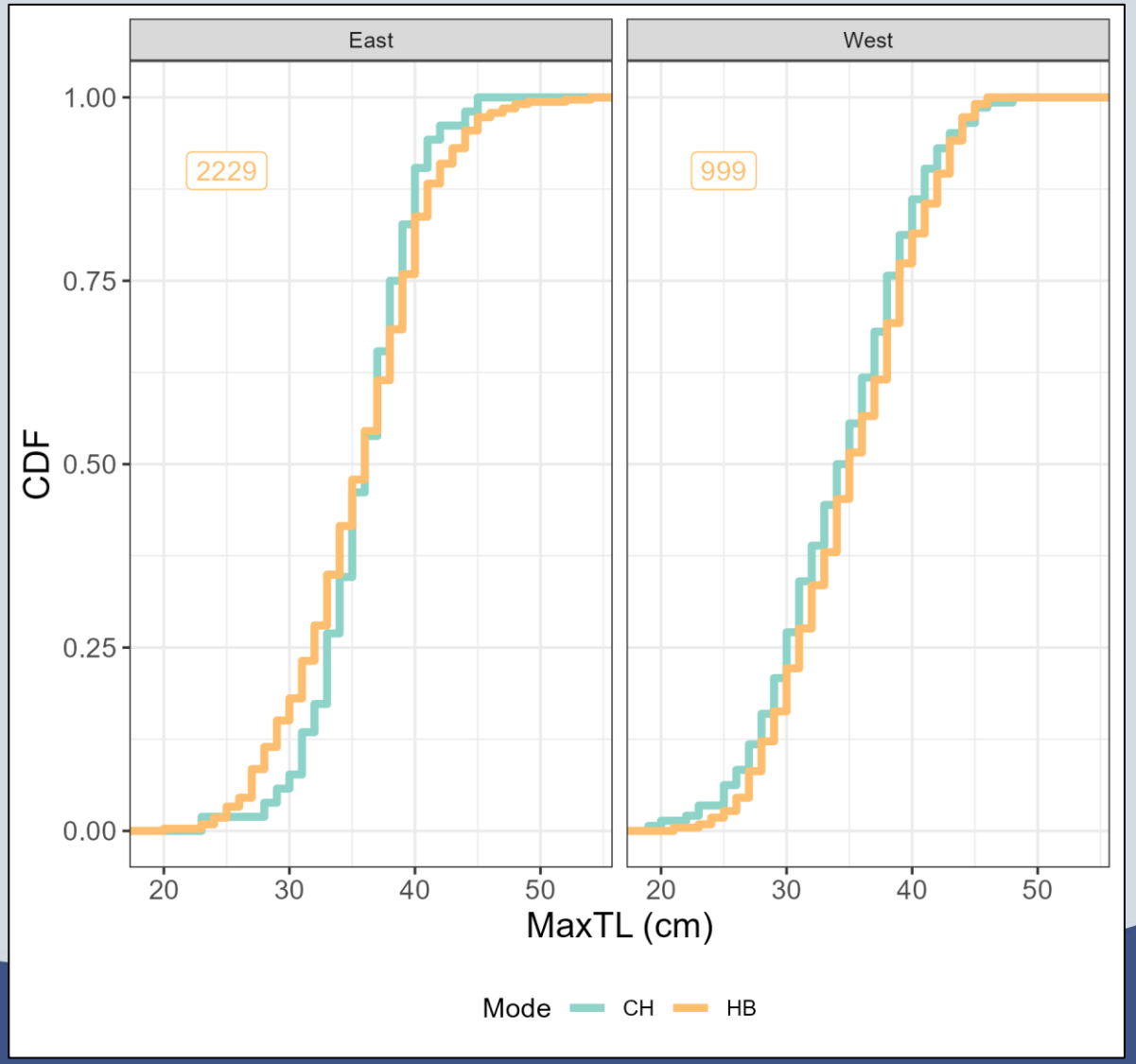


Discards-Weighted Length Frequencies

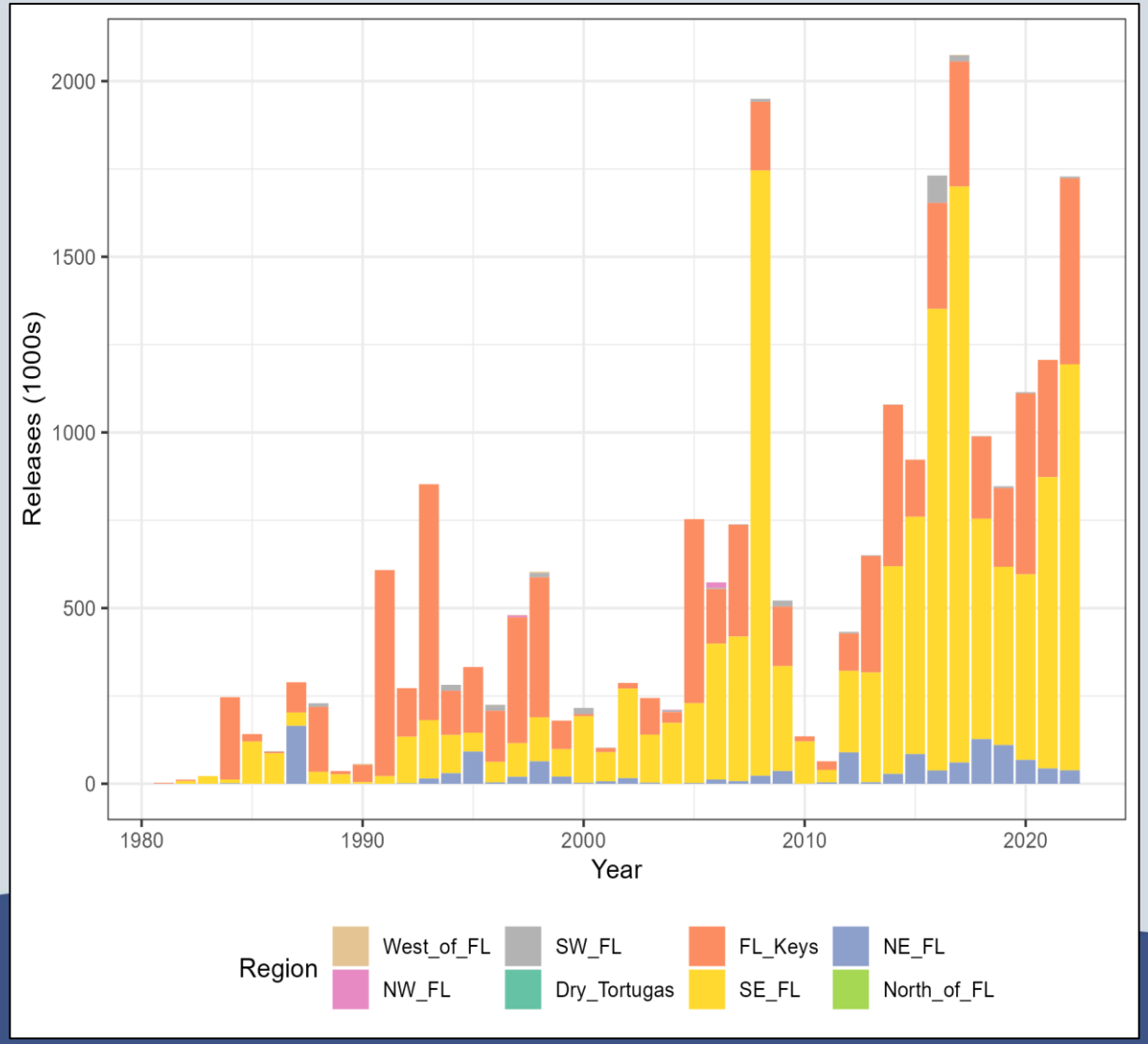
Recreational

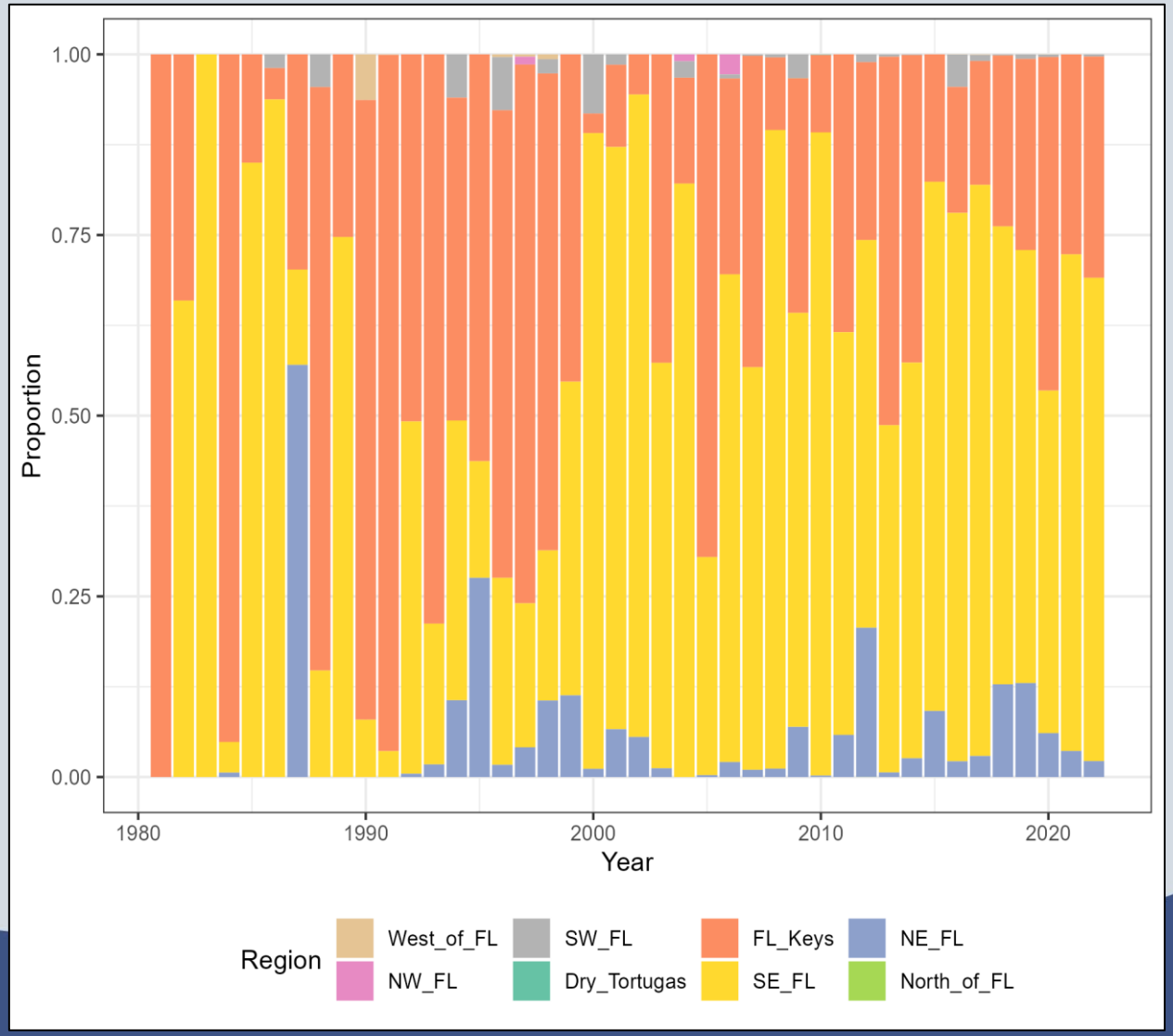
Recreational Released Lengths



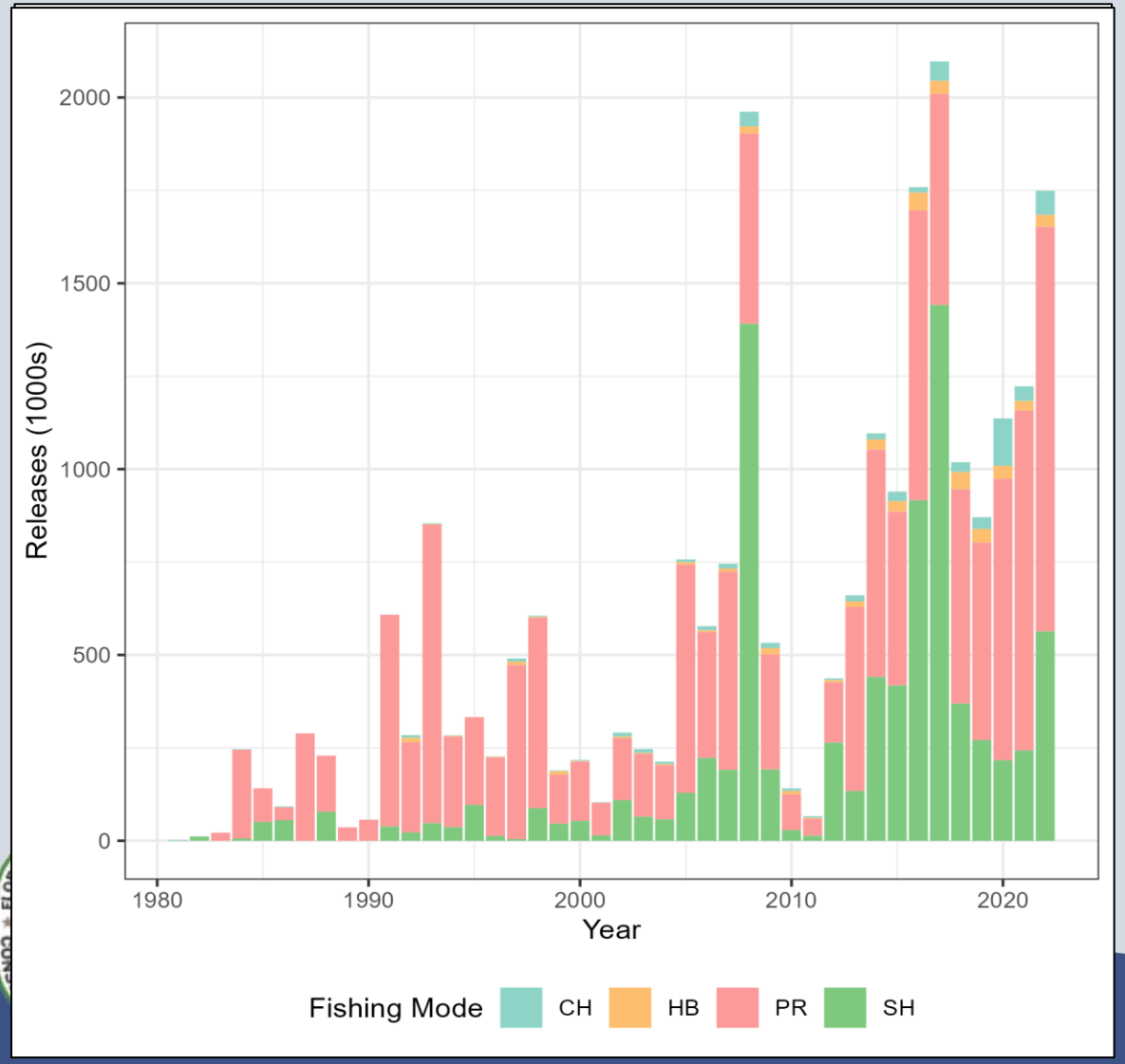


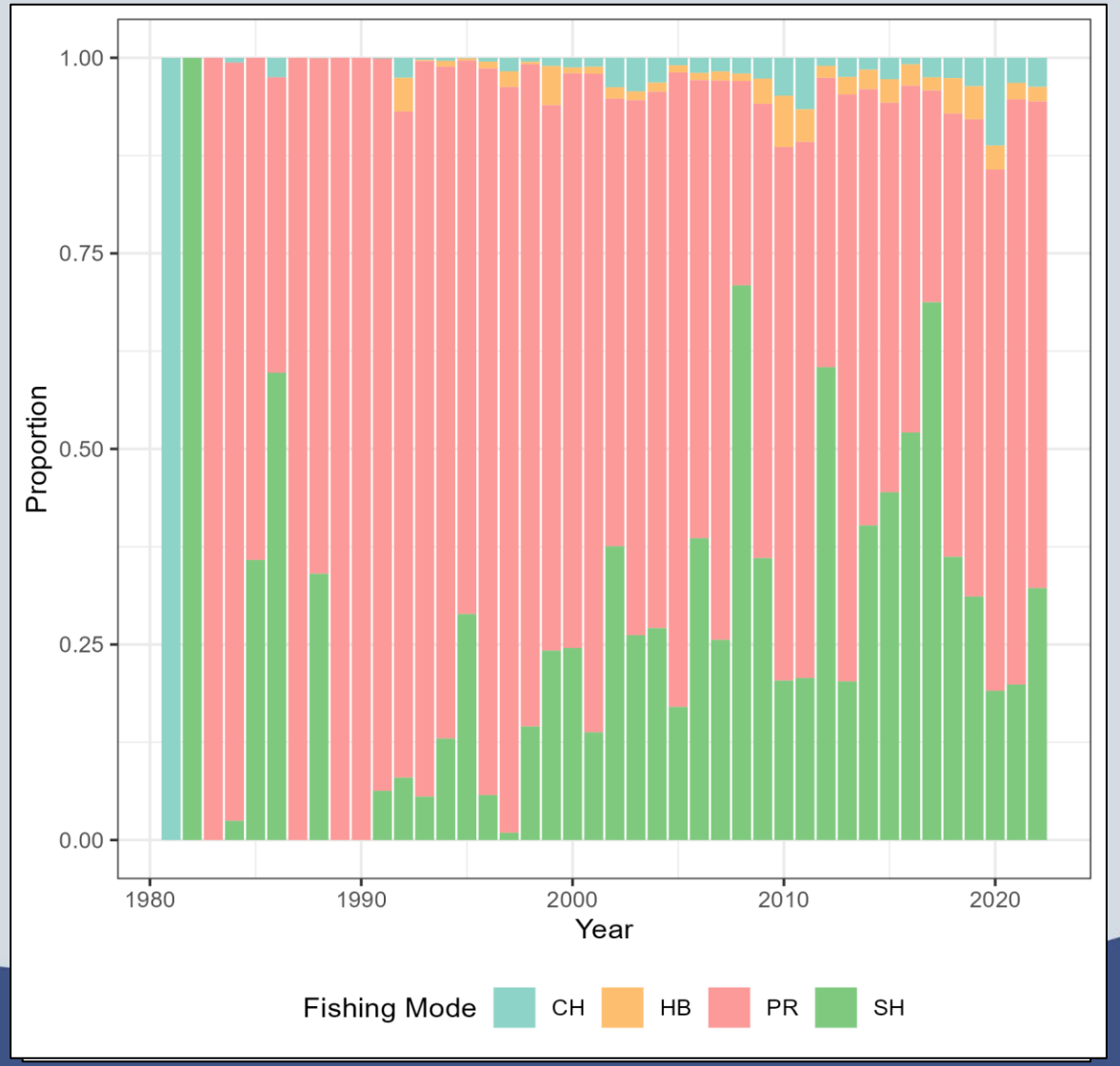
Recreational Releases By Region Caught



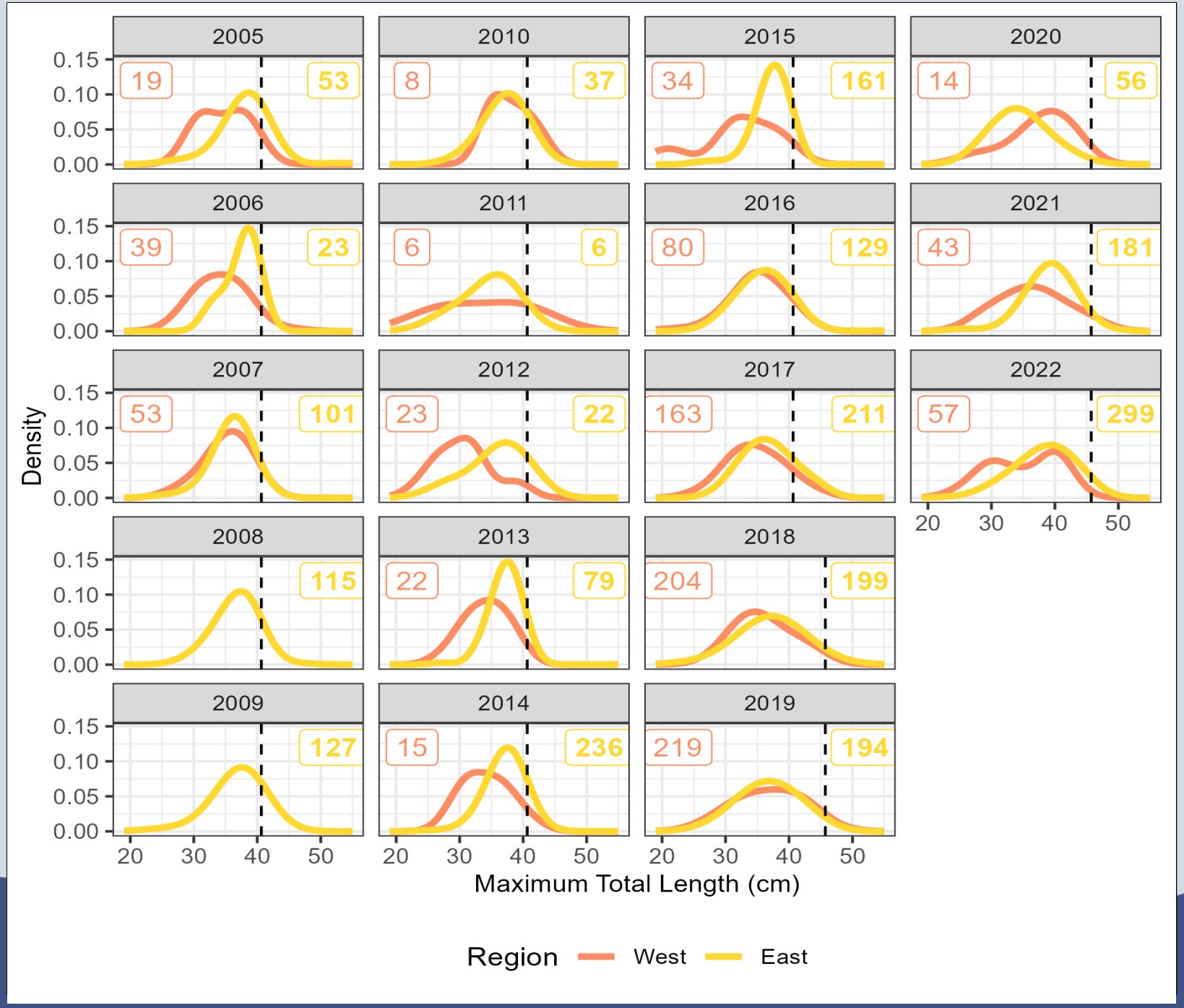


Recreational Releases By Mode





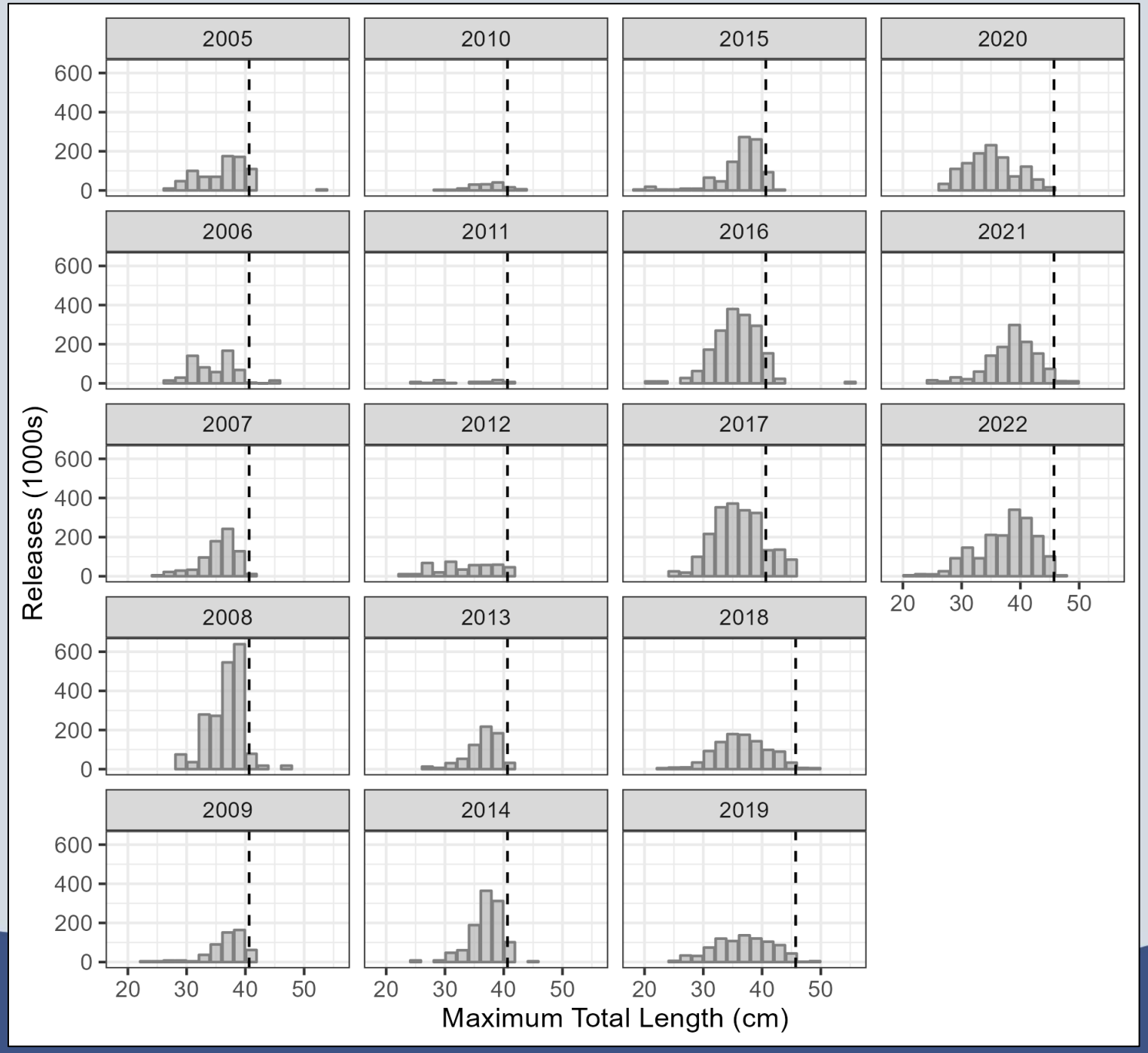
Recreational Release Lengths



Explorations and Resulting Decisions

1. The FL Keys and SE FL account for most of the releases since 1981.
2. The private and shore modes account for nearly all releases but no release lengths.
3. Headboat and Charter release lengths are very similar. Larger fish may be released in the East region compared to the West, but sample sizes are insufficient.
4. **Decision: Combine sampled release lengths for headboat and charter modes and weight the length comps by the releases by year.**

Recreational Releases-at-Length



Upcoming Tasks

1. Consider weighting length comps for the Commercial Longline Index by using area-weighting (Maunder et al. 2020).
2. Consider methods to infer recreational release lengths prior to 2005.
3. Estimate Releases-at-length for the commercial ‘Other’ fleet.

Age-Length Keys and Catch-at-age

Catch-At-Age

- Multiply Catch-At-Length (CAL) matrices by Age-Length-Key (ALK) to estimate Catch-At-Length and Age (CALA)

CAL ✖ ALK = CALA

$$\begin{bmatrix} L_1 \\ L_2 \\ L_3 \\ L_4 \end{bmatrix} \times \begin{array}{c} \\ L_1 \\ L_2 \\ L_3 \\ L_4 \end{array} \begin{array}{c} \begin{array}{cccc} A_0 & A_1 & A_2 & A_3 \end{array} \\ \begin{bmatrix} P_{A0,L1} & P_{A1,L1} & P_{A2,L1} & P_{A3,L1} \\ P_{A0,L2} & P_{A1,L2} & P_{A2,L2} & P_{A3,L2} \\ P_{A0,L3} & P_{A1,L3} & P_{A2,L3} & P_{A3,L3} \\ P_{A0,L4} & P_{A1,L4} & P_{A2,L4} & P_{A3,L4} \end{bmatrix} \end{array} = \begin{array}{c} \\ L_1 \\ L_2 \\ L_3 \\ L_4 \end{array} \begin{array}{c} \begin{array}{cccc} A_0 & A_1 & A_2 & A_3 \end{array} \\ \begin{bmatrix} C_{A0,L1} & C_{A1,L1} & C_{A2,L1} & C_{A3,L1} \\ C_{A0,L2} & C_{A1,L2} & C_{A2,L2} & C_{A3,L2} \\ C_{A0,L3} & C_{A1,L3} & C_{A2,L3} & C_{A3,L3} \\ C_{A0,L4} & C_{A1,L4} & C_{A2,L4} & C_{A3,L4} \end{bmatrix} \end{array}$$

- $P_{A0,L1}$ = Proportion of the number of fish in length bin 1 that are age 0
- Rows of ALK sum to 1: $P_{A0,L1} + P_{A1,L1} + P_{A2,L1} + P_{A3,L1} = 1$
- Catch At Age (CAA) is estimated by summing over lengths (i.e. columns) of the CALA matrix

ALK Methodology (Work in Progress)

1. Ideally ALKs would year, region, fleet, and survey-specific and by sex if sexually dimorphic.
2. To increase sample sizes, ALKs must be aggregated across some strata. Resulting in ALKs by year and fleet, for example.
3. An age distribution for a length bin in a given year and fleet is estimated (i.e., smoothed) if the number of fish aged in that bin is less than 5 (Coggins et al. 2013).
4. Estimation is done by fitting a multinomial generalized linear model (GLM) with the vglm package in R.
5. Example Covariates: length bin, year, fleet (e.g. REC EAST/REC WEST/ COM OTHER/COM LL/FI), plus interaction terms with age

Modelling Platforms

Age Structured Assessment Program (ASAP version 3.0)

- Forward-projecting statistical catch-at-age model written in ADMB
- Age- and year-specific values (e.g. nat. mortality, avg. catch weight, avg. spawning weight, etc.)
- Compositions and selectivities are age-based. Landings and discards are in metric tons.
- Starts at calendar age = 1
- Requires more pre-processing of data (e.g., ALK and Catch-at-age).
- Estimates population numbers, fishing mortality rates, stock-recruit params, F and reference points pertaining to MSY or MSY proxies, F corresponding to yield per recruit (F0.1, Fmax)
- Uncertainty for F, SSB, Jan-1 biomass, and MSY related reference points characterized via Monte Carlo Markov Chain (MCMC)
- Stochastic projections made via AgePro
- Model diagnostics available (e.g. retrospective analysis, model fit summaries, R compatible outfile)

Stock Synthesis (version 3.30.22?)

- Integrated statistical catch-at-age model (Methot and Wetzel 2013)
- Less processing of data inputs compared to ASAP (e.g., lengths and landings can be in numbers, internal catch-at-age calculation)
- Allows for additional options for model configuration (e.g., selectivity function types, blocks, seasons, recruitment timing, etc.)
- Compositions and selectivities can be length- or age-based
- Estimates population numbers, spawning biomass, fishing mortality rates, stock-recruit params, reference points pertaining to MSY or MSY-proxies (SPR), F pertaining to spawning-potential ratios (Fxx%SPR), etc.
- Projections made via an additional user-specified estimation phase
- Model uncertainty characterized via bootstrapping, likelihood profiling, and MCMC
- Model diagnostics available (e.g., jitter analysis, retrospective analysis, model fit summaries, R4SS, sensitivity analyses)

Some Model Quirks:

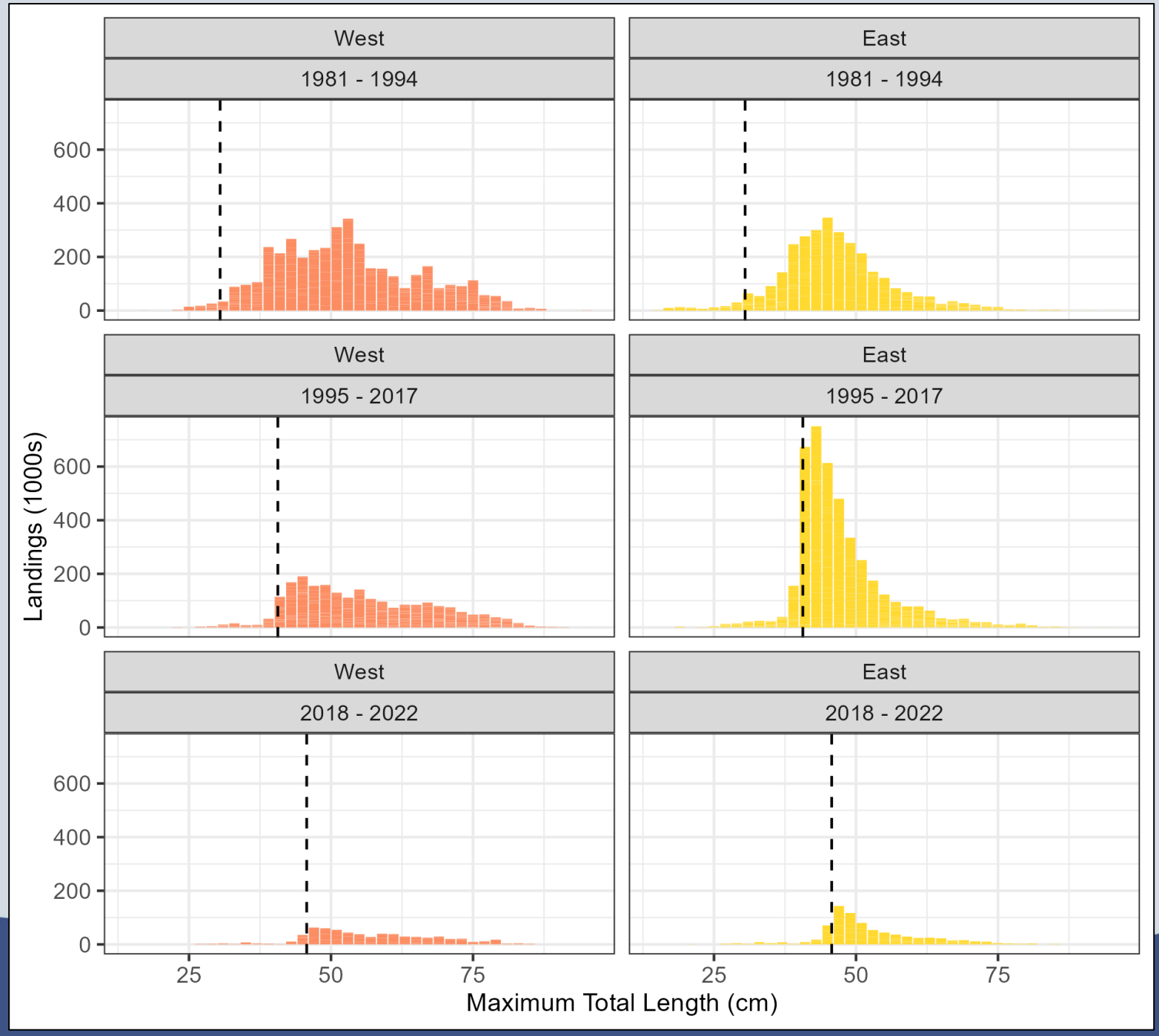
- ASAP v.3
  - 1 season model (i.e., annual)
  - Spawning can be anytime during the year and recruits enter Jan 1 the following year at age 1.
  - Landings and releases in numbers must be converted to metric tons.
  - No internal bias correction for recruits
  - Mean Weights-at-age and release proportion at age are known without error

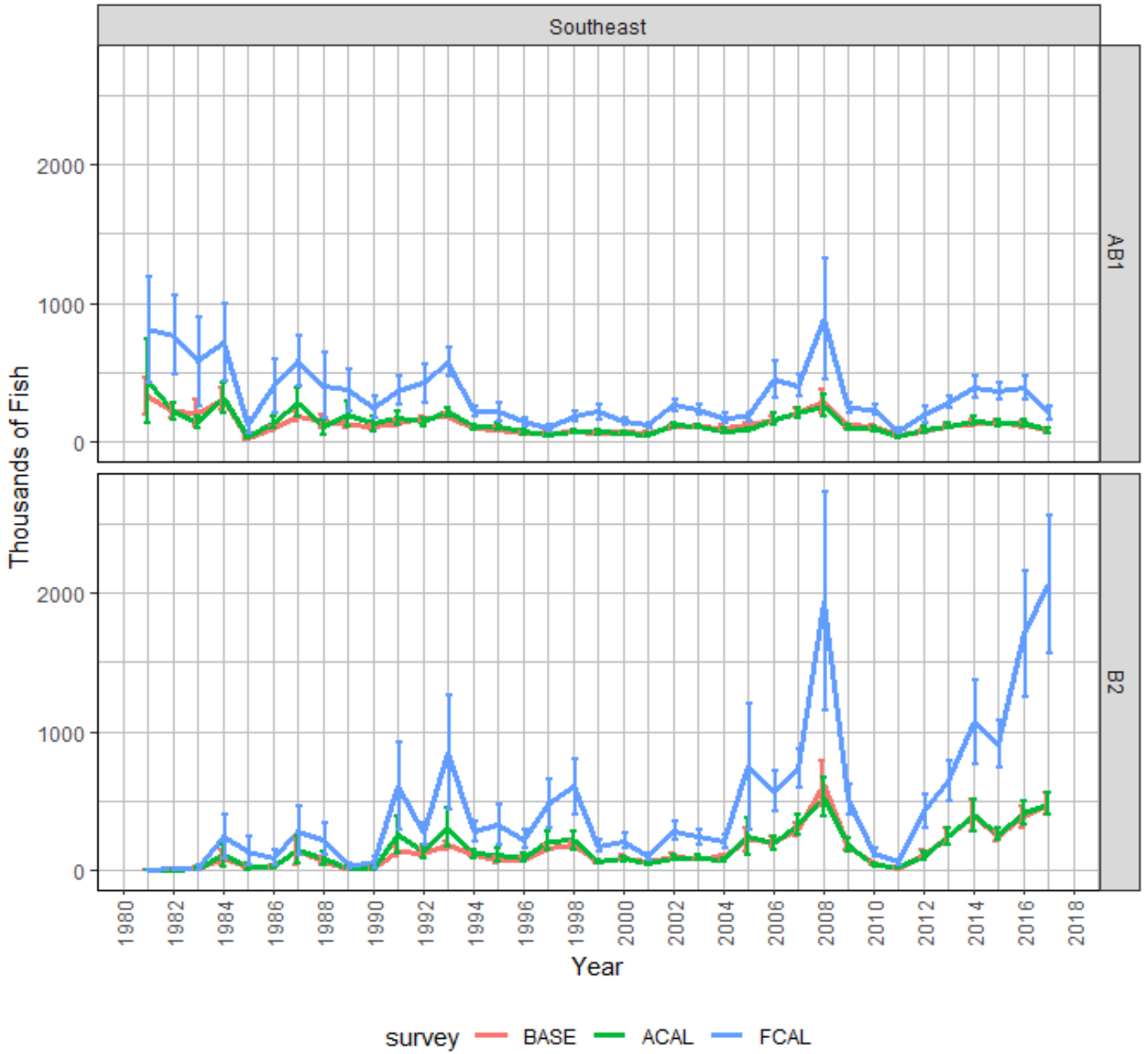
Some Model Quirks:

- Stock Synthesis (SS v.3.30.14)
  - Usually fits landings exactly at the expense of other data sources (e.g., indices).
  - 1 season model (i.e., annual)
    - Spawning occurs on Jan 1 → 'settlement' can occur at any time during the year.
    - Spawning after Jan 1 → 'settlement' must occur in the following year.
  - 2 season model (e.g., season 1 = Jan – Aug; season 2 = Sept – Dec)
    - spawning can occur anytime in season 1 and settlement can occur anytime in season 2 (e.g., spawning on June 1 with settlement in Sept)
    - Landings, length/age comps, etc. must be split by season

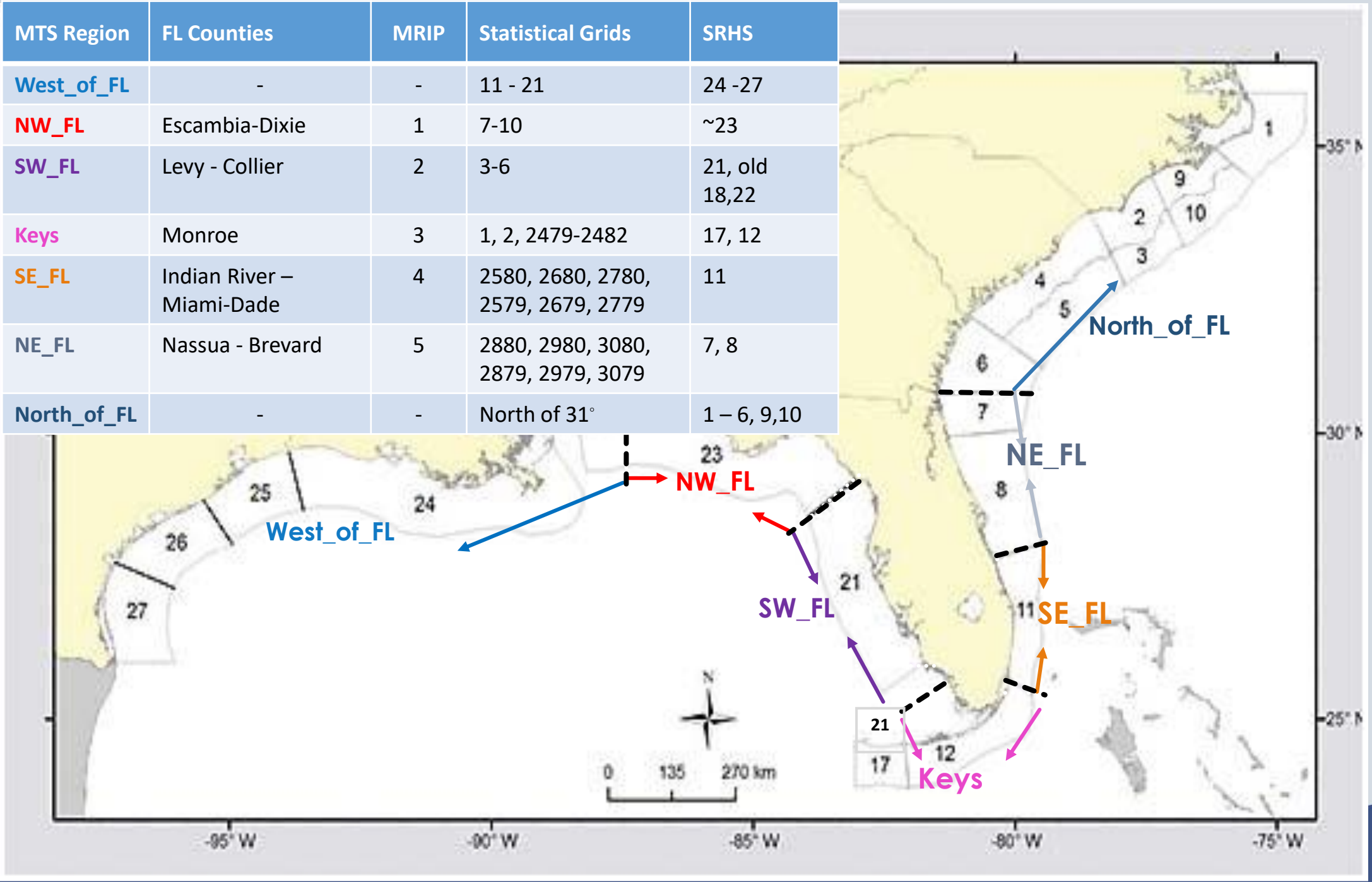
Feeley et al. 2018

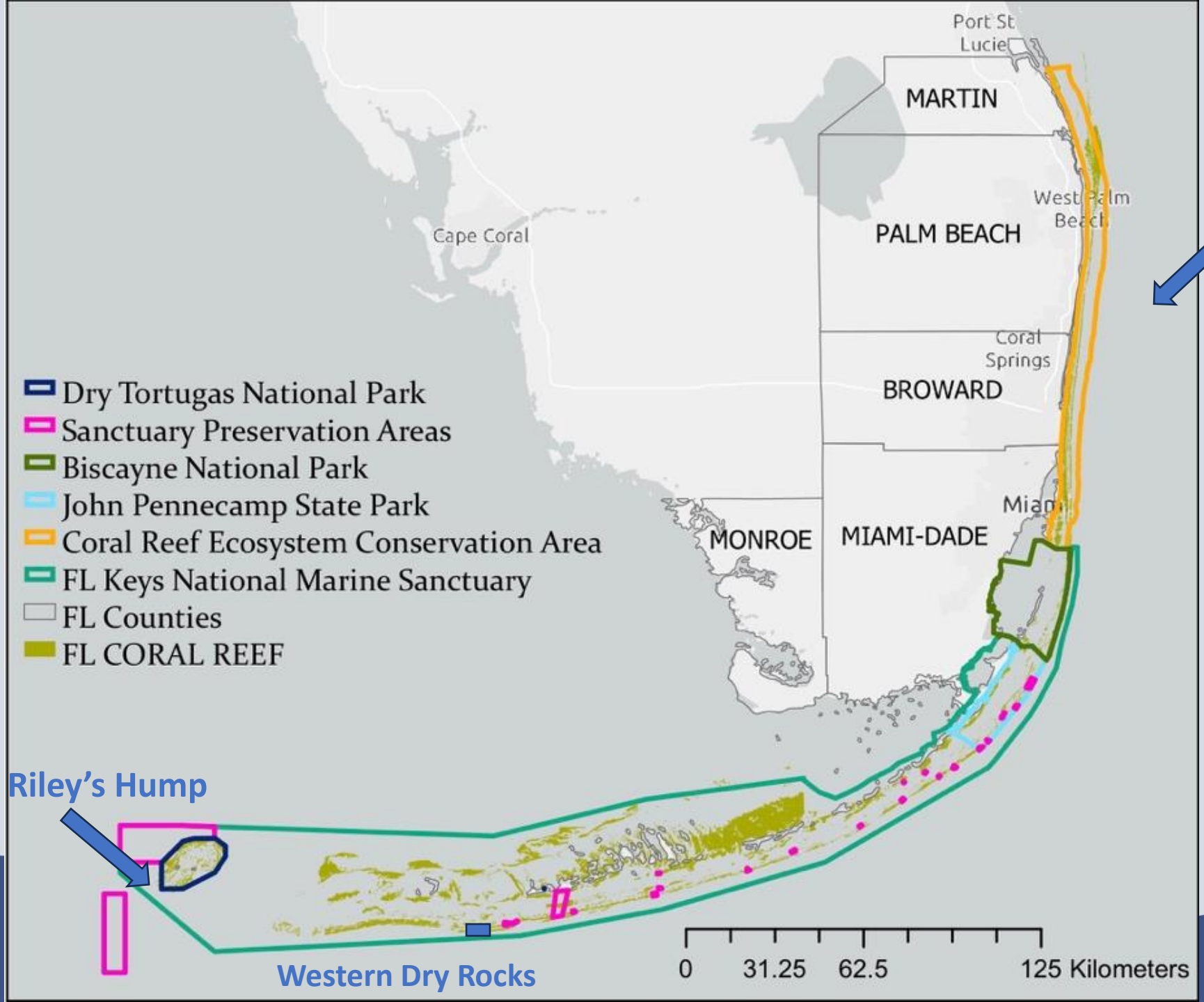
Recreational Landings-at-Length




Southeast
AB1
B2
Thousands of Fish
2000
1000
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Year
survey
BASE
ACAL
FCAL

MTS Region	FL Counties	MRIP	Statistical Grids	SRHS
West_of_FL	-	-	11 - 21	24 -27
NW_FL	Escambia-Dixie	1	7-10	~23
SW_FL	Levy - Collier	2	3-6	21, old 18,22
Keys	Monroe	3	1, 2, 2479-2482	17, 12
SE_FL	Indian River – Miami-Dade	4	2580, 2680, 2780, 2579, 2679, 2779	11
NE_FL	Nassua - Brevard	5	2880, 2980, 3080, 2879, 2979, 3079	7, 8
North_of_FL	-	-	North of 31°	1 – 6, 9,10





From Zuercher et al. 2020

Year	Dry_Tortugas_and_West			FL_Keys			SE_FL			North		
	Jan - Aug	Sep - Dec	Total	Jan - Aug	Sep - Dec	Total	Jan - Aug	Sep - Dec	Total	Jan - Aug	Sep - Dec	Total
1986	0	5	5	2	10	12	0	0	0	7	11	18
1987	0	0	0	0	0	0	0	0	0	30	9	39
1988	2	3	5	19	18	37	9	0	9	24	5	29
1989	1	23	24	142	69	211	0	0	0	26	13	39
1990	368	38	406	248	162	410	17	0	17	14	15	29
1991	171	20	191	213	142	355	6	3	9	23	47	70
1992	156	71	227	152	25	177	225	90	315	28	6	34
1993	196	32	228	68	16	84	116	21	137	80	19	99
1994	126	77	203	51	26	77	189	7	196	11	19	30
1995	128	69	197	5	127	132	85	11	96	45	42	87
1996	147	93	240	23	37	60	68	110	178	24	21	45
1997	307	54	361	85	8	93	216	57	273	36	20	56
1998	196	105	301	57	6	63	218	147	365	27	33	60
1999	172	39	211	12	0	12	244	46	290	117	124	241
2000	173	46	219	17	6	23	221	206	427	117	56	173
2001	101	109	210	44	1	45	276	247	523	46	14	60
2002	214	50	264	15	3	18	369	105	474	20	9	29
2003	139	30	169	14	15	29	212	66	278	83	18	101
2004	146	3	149	9	2	11	147	18	165	85	24	109
2005	13	3	16	58	0	58	145	17	162	85	23	108
2006	13	13	26	12	21	33	54	43	97	49	25	74
2007	33	6	39	17	0	17	57	36	93	91	16	107
2008	58	7	65	108	3	111	194	76	270	32	16	48
2009	53	4	57	135	15	150	181	16	197	26	11	37
2010	13	1	14	100	17	117	374	20	394	10	21	31
2011	22	5	27	91	13	104	428	15	443	38	42	80
2012	132	17	149	52	12	64	83	20	103	108	41	149
2013	57	49	106	79	15	94	27	22	49	50	16	66
2014	42	2	44	78	27	105	53	16	69	53	87	140
2015	38	9	47	55	46	101	20	7	27	198	78	276
2016	17	7	24	54	29	83	32	7	39	218	43	261
2017	17	7	24	61	30	91	22	9	31	146	51	197
2018	49	10	59	99	12	111	37	7	44	39	20	59
2019	64	14	78	66	39	105	59	35	94	87	100	187
2020	43	6	49	70	32	102	2	1	3	407	101	508
2021	25	31	56	72	36	108	13	3	16	228	101	329
2022	8	23	31	66	17	83	14	19	33	256	177	433
Total	3440	1081	4521	2449	1037	3486	4413	1503	5916	2964	1474	4438

From Zuercher et al. 2020