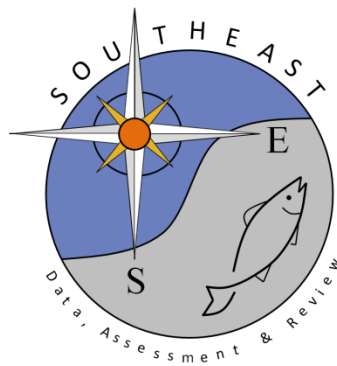


Gulf of Mexico Red Grouper (**Epinephelus morio**) length and age compositions from the recreational fishery

Samantha M. Binion-Rock

SEDAR88-WP-06

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Samantha M. Binion-Rock

NOAA Southeast Fisheries Science Center, 101 Pivers Island Road, Beaufort, NC 28516

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Introduction

This document outlines the data and methodologies used to estimate length and age compositions of recreational landings for the SEDAR 88 Gulf of Mexico Red Grouper (*Epinephelus morio*) stock assessment. For SEDAR 61, only lengths from the Marine Recreational Information Program (MRIP) and Southeast Regional Headboat Survey (SRHS) were included for length composition development (further discussed below). For SEDAR 88, additional lengths from multiple data sources were included in length composition development. All age data sources included in the SEDAR 61 age compositions were also included in SEDAR 88. Ages from FL Fish and Wildlife Research Institute's (FWRI) REPBIO sampling program were also included in SEDAR 88, which were not available for SEDAR 61.

The following data products were developed for SEDAR 88: nominal and weighted length compositions, nominal and weighted age compositions, conditional age-at-length (CAAL), and mean length-at-age (MLAA).

Data Description

SEDAR 88 assesses all Gulf of Mexico Red Grouper in federal waters extending from the Texas/Mexico border and eastward to the Monroe-Dade county line. Numerous programs contributed samples for length and age compositions (Tables 1&2). The sampling programs contributing the largest numbers of length and/or age samples are described below.

Marine Recreational Information Program (MRIP)

MRIP (formally known as the Marine Recreational Fishing Statistics Survey, MRFSS) began in March 1981. In the Gulf of Mexico, the MRIP survey is currently conducted in FL, AL, and MS. MRIP was also conducted in LA from 1981-2013. The access point angler intercept survey (APAIS) component of MRIP collects information on recreational catch and fishing trip characteristics, including fish lengths and weights, from anglers at public marine fishing access sites. In the Gulf of Mexico, APAIS samples recreational fishers from private, shore, and charterboat modes. APAIS also sampled headboats in the Gulf of Mexico from 1981-1985 (Matter and Nuttall 2020). APAIS sampling was temporarily suspending during Wave 2 in 2020 because of the COVID pandemic and resumed in all states by August 2020 (Wave 4), however, sampling of fish lengths and weights were reduced due to social distancing guidelines and field

officer safety protocols (NMFS OST 2023). For intercepted angler trips where both fish length and weight are missing, MRIP uses hot and cold-deck imputation to impute lengths (NMFS OST 2023). MRIP samples from Monroe County were excluded for Red Grouper as all MRIP samples are assigned to the South Atlantic. The majority of fish sampled for length were provided by MRIP (n=15,125).

Southeast Regional Headboat Survey (SRHS)

The SRHS program estimates landings and effort for headboat vessels. In the Gulf of Mexico, the SRHS program began in 1986 and extends from Monroe County, FL to South Padre Island, TX (Cheshire et al. 2023). Biological samples (e.g. length, weight, and otoliths) are collected as part of the SRHS dockside intercept sampling program (DISP) component of the SRHS program (Fitzpatrick et al. 2017). DISP sampling was temporarily suspended in March 2020 due to the COVID pandemic and no biological samples were collected. DISP biological sampling resumed in July 2021 once NMFS/SEFSC safety measures were approved (Cheshire et al. 2023). SRHS sampled 4,665 Red Groupers for length and of those fish, 681 were also sampled for age.

Gulf States Marine Fisheries Commission Fisheries Information Network (GulfFIN)

GulfFIN is a cooperative program among state and federal agencies that collects, manages, and provides data to support fisheries management within the Gulf of Mexico (<https://www.gsmfc.org/fin>). The programs providing the largest numbers of Red Grouper length and age samples through GulfFIN include the Florida State Reef Fish Survey (SRFS), FWRI At-Sea Observer Program (FWRI-OBS), and RECFIN. SRFS began in May 2015 on the west coast of Florida (excluding the Florida Keys). Biological data from reef fish species harvested from private recreational anglers are collected as part of the dockside intercept component of the SRFS program. SRFS provided 938 length samples and 529 age samples. The FWRI-OBS program began in 2015 and fishery observers collect biological information on catch and regulatory discards from headboat and charterboat modes. FWRI-OBS provided 1,707 Red Grouper age samples. RECFIN consists of short-term projects and opportunistic biological sampling and provided data between 2001-2017 on the FL Gulf Coast. Over 1,700 fish were provided by RECFIN for length and age compositions. Sampling assignments were not conducted using a randomized methodology to maximize the number of biological samples collected, however, fish were not sampled in a biased fashion (Cermak, pers com 2023).

Trip Interview Program (TIP)

TIP samplers collect biological information from dock and fish house interviews throughout the Gulf of Mexico. The focus of TIP is to sample commercial fisheries, however, TIP samplers will opportunistically sample recreational for-hire vessels as time allows (B. Barnett, pers comm 2024). From 1991-2019, TIP sampled 997 Red Groupers from recreational vessels for lengths and 906 of those fish were also sampled for age.

Fleet Structure

Following SEDAR 61, one recreational fleet was defined that combines fish sampled from private, charterboat, and headboat modes. Shore mode was excluded from analyses, as only 30 Red Grouper were sampled for length and none were sampled for age.

Changes from SEDAR 61

In SEDAR 61, the length compositions for private and charterboat modes included lengths imputed from MRIP using the hot deck/cold deck procedure and used the variable 'WP_SIZE' as a sampling weight to expand the number of observations instead of each fish constituting a single sample. At the time of SEDAR 61, the decision to use imputed length and WP_SIZE was based on additional analyses reviewed by the Assessment Panel and guidance provided by the Office of Science and Technology (detailed in SEDAR 61 SAR). During SEDAR 61, WP_SIZE was only available for fish sampled from MRIP, so private and charterboat length compositions only included MRIP samples and length samples from other data sources were excluded. This was justified because 82.8% of the length data for charterboat and 90.9% of length data from the private mode were from MRIP. Nominal length compositions were developed separately for private/charterboat and headboat and then used to weight the age composition for each mode. Lastly, a single age composition for the combined recreational fleet was determined by weighting the charter/private age composition and the headboat age composition by their respective landings.

The hot deck/cold deck imputation procedure uses complete records, where both length and weight are available, to fill in records with missing lengths and weights. Five rounds of imputation are conducted. For the first round, only records from the same year, wave, sub-region, state, mode, area-fished, and species are used to impute missing records. If there are not enough records to meet the minimum sample size required for imputation, then the imputation procedure moves to the next round. During each round of imputation, the strata being included become progressively more aggregated and for round five, records from the current and previous year, sub-region, and species are used for imputation (NMFS OST 2023). Imputed lengths were excluded from SEDAR 88 over concerns about the potential of imputed lengths coming from the previous year and not being representative of the current year. GOM Red Grouper are well-sampled by MRIP and the annual distribution of imputed lengths and observed lengths were similar. However, for species that are not as well-sampled, the distributions of observed and imputed lengths are less similar. Comparisons demonstrating these behaviors of imputed and observed lengths for species of varying data availability are included in the Appendix.

WP_SIZE is the sample weight for a fish and represents the expanded catch estimate for that fish. WP_SIZE is highly variable and can range from 0.001 to over 100,000. The highly variable nature of WP_SIZE can lead to 'spiky' length compositions, especially for species and/or years where sample sizes are lower. WP_SIZE was not used for SEDAR 88. The SRFS Topical Working Group conducted a thorough review of the distributions of WP_SIZE and its influence on length compositions and agreed the best practice is to not use WP_SIZE. Comparisons of nominal length compositions produced using the current best practice approach (e.g. excluding WP_SIZE) and using WP_SIZE to produce the expanded sampling size are available in the Appendix.

Since WP_SIZE was not used in SEDAR 88 length composition development, all modes were combined as a single length composition from the beginning, instead of having nominal length compositions developed separately for charter/private and headboat modes. Lengths for the private and charterboat modes from samples collected from non-MRIP programs were also able to be included since WP_SIZE was not used (Table 1). A life-history template was developed by the SEFSC Biology and Life History Branch to standardize SEDAR data provision. Length and

age data providers used this template for SEDAR 88 and this allowed for records between the size-only and age data to be matched and for duplicate records to be identified. The use of the life-history template allowed for 2,712 unique records from the age data to be added to the size-only data for length composition development.

These changes, including samples from non-MRIP sources, combining the modes into a single fleet, and adding the unique records from the age data increased the sample sizes for SEDAR 88 compared to SEDAR 61. Only nominal length compositions were developed for SEDAR 61 because sample sizes were not sufficient for weighting. Sample sizes for SEDAR 88 were sufficient for developing weighted length compositions and samples were weighted by region (North vs South). More details of the weighting procedure are provided in the following section.

Length Compositions of Recreational Landings

Nominal and weighted length compositions were developed for SEDAR 88. Fish were assigned to 2 cm bins with bins ranging from 2 cm - 110 cm Fork Length. The label represents the floor of the bin. Fishery-dependent sampling is typically opportunistic and sampled lengths may not be representative of the true landings composition of recreational Red Grouper in the Gulf of Mexico. Possible sampling bias in the collection of length samples are typically removed by weighting the length compositions with the associated landings on the finest spatial and temporal scale available without losing data. For the Gulf of Mexico compositions, multiple weighting approaches were considered, including fishing mode (charter, private, headboat), state vs federal waters, and region (North vs South). Length distributions were similar when comparing across fishing mode or by state vs federal waters. When the distributions were compared by region (Figure 1), size differences were observed and fish from the North Gulf of Mexico were often larger than fish from the South Gulf of Mexico. The North region was defined as TX, LA, MS, AL, SRHS areas 23-29, and the FL Panhandle counties from Escambia east to Dixie. The South region contains the SRHS areas 18, 21, and 22 and the FL counties Levy south to Monroe. Weighting by both mode and region was also considered, however, the majority of length-only samples are from the charterboat mode and sample sizes were not large enough in the private and headboat modes to support this stratification (Table 3). Sample sizes for each mode, by region, for the length and age data and length distributions by region and mode are available in the Appendix (Tables A1-A2, Figure A13).

Nominal length compositions are only presented if there were a minimum of 30 fish per year sampled for length. For weighted length compositions, only sub-regions with a minimum of 30 fish per year were retained (Table 4, Fig. 2).

Age Compositions of Recreational Landings

Nominal and weighted age compositions, CAAL, and MLAA were calculated for the combined recreational fleet. The age compositions are weighted to account for potential sampling biases associated with fishery-dependent data. The weighting method is adapted from Chih (2009) and a reweighting factor (RW) was estimated within year i , length bin j , and subregion r and corrects the composition of the age data to more closely represent the final length composition of landings. The reweighting factor $RW_{i,j,r}$ is calculated as

$$RW_{i,j,r} = \frac{LC_{i,j,r}}{a_{i,j,r}/a_{i,r}}$$

where $LC_{i,j,r}$ is the length composition from the length-only data, $a_{i,j,r}$ is the number of age samples in year i , length bin j , and subregion r , and $a_{i,r}$ are the total number of age samples in year i and subregion r . With this method, if there were age samples in $a_{i,j,r}$ not represented in $LC_{i,j,r}$ they are down-weighted to zero and effectively dropped from further analysis. The final weighted age compositions were estimated as

$$AC_{i,k} = \sum_{j,r} \left(RW_{i,j,r} * \frac{a_{i,j,k,r}}{a_{i,r}} \right)$$

where all length bins j within age class k were summed and then rescaled to sum to 1 across each year.

CAAL is the proportion of fish at age within a given length bin. CAAL is calculated as

$$CAAL_{i,j,k} = \frac{a_{i,j,k}}{a_{i,j}}$$

where $a_{i,j,k}$ is the number of age samples in year i , length bin j , and age class k and $a_{i,j}$ is the number of age samples in year i and length bin j .

MLAA is the average length for each age and is calculated as

$$MLAA_{i,k} = \frac{\sum L_{i,k}}{a_{i,k}}$$

where L are lengths, a is the number of associated sample sizes, i is year, and k is age class. MLAA are provided to aid in model diagnostics.

A comparison of the length distributions between the length-only and age data are presented in Figure 3. Nominal age compositions are only presented if there were a minimum of 10 fish per year sampled for age. For weighted age compositions, only subregions with a minimum of 10 fish per year were retained (Table 5). CAAL and MLAA are presented in Figures 4 and 5, respectively. The final weighted age composition is presented in Fig 6. For SEDAR 88, weighting did not make a large difference in the age compositions. Even with the changes in methodology between SEDAR 61 and SEDAR 88, there is generally good agreement between the weighted age compositions. However, the 1991 weighted age composition was excluded from the assessment model for SEDAR 61 (SEDAR 61 SAR) because of an erroneous spike for the 20+ age group and that spike is no longer present using the updated best practice methods for SEDAR 88 (Figure 7).

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Tables

Table 1: Number of Red Grouper sampled for length by each data source.

Year	CO-OP	FIN-BIOSTAT	FIN-OBS	FWRI	FWRI-OBS	HB	MARFIN	MRFSS	MRIP	PCLAB	RECFIN	REPBIO	SRFS	SRHS	TIP	TPWD	UN
1986	0	0	0	0	0	0	0	0	60	0	0	0	0	369	0	0	0
1987	0	0	0	0	0	0	0	0	126	0	0	0	0	544	0	0	0
1988	0	0	0	0	0	0	0	0	212	0	0	0	0	350	0	0	0
1989	0	0	0	0	0	0	0	0	202	0	0	0	0	699	0	0	0
1990	0	0	0	0	0	0	0	0	57	0	0	0	0	239	0	0	0
1991	0	0	0	0	0	0	0	0	104	0	0	0	0	102	7	0	0
1992	0	0	0	0	0	0	0	0	345	0	0	0	0	54	30	0	1
1993	0	0	0	0	0	0	0	0	149	0	0	0	0	33	67	0	0
1994	0	0	0	0	0	0	0	0	168	0	0	0	0	52	85	0	0
1995	0	0	0	0	0	0	0	0	174	0	0	0	0	57	130	0	0
1996	0	0	0	0	0	0	0	0	68	0	0	0	0	71	176	0	0
1997	0	0	0	0	0	0	0	0	74	0	0	0	0	47	100	0	0
1998	0	0	0	0	0	0	0	0	196	0	0	0	0	40	117	0	0
1999	0	0	0	0	0	0	0	0	375	0	0	0	0	108	80	0	0
2000	0	0	0	0	0	0	0	0	515	20	0	0	0	69	28	0	0
2001	0	0	0	0	0	0	0	21	484	11	5	0	0	52	9	0	0
2002	0	5	0	0	0	0	0	9	604	204	132	0	0	135	26	0	1
2003	1	10	0	2	0	0	0	2	744	24	113	0	0	219	17	0	0
2004	0	28	0	1	0	0	0	68	1,504	7	46	0	0	173	11	0	0
2005	0	8	12	0	0	0	0	0	1,170	0	72	0	0	72	5	0	0
2006	0	3	0	0	0	0	0	0	452	11	35	0	0	79	10	0	0
2007	0	2	1	0	0	0	0	6	294	0	21	0	0	93	28	1	0

Year	CO- OP	FIN- BIOSTAT	FIN- OBS	FWRI	FWRI- OBS	HB	MARFIN	MRFSS	MRIP	PCLAB	RECFIN	REPBIO	SRFS	SRHS	TIP	TPWD	UN
2008	0	0	0	0	0	0	0	16	266	0	122	0	0	89	24	1	0
2009	0	1	0	0	91	0	0	7	172	0	163	0	0	50	16	0	0
2010	0	7	0	0	169	0	0	35	258	1	226	0	0	52	7	0	0
2011	0	9	0	0	158	0	0	48	371	4	370	0	0	93	0	0	0
2012	0	4	0	0	246	0	0	18	698	34	141	0	0	151	16	0	0
2013	0	0	0	0	165	0	0	0	841	8	194	0	0	155	0	0	0
2014	0	3	0	0	77	16	0	0	1,231	15	113	0	0	114	0	0	0
2015	0	0	0	0	60	0	0	0	909	24	3	0	183	65	0	0	0
2016	0	5	0	0	71	0	0	0	694	18	7	0	168	49	0	0	0
2017	0	0	0	0	66	0	12	0	325	29	7	0	139	21	0	0	0
2018	0	0	0	0	37	0	100	0	253	17	0	6	105	33	0	0	0
2019	0	1	0	0	44	0	2	0	307	60	0	192	121	56	8	0	0
2020	0	0	0	0	1	0	0	0	130	37	0	100	118	11	0	0	0
2021	0	1	0	0	39	0	0	0	401	115	0	134	70	20	0	0	0
2022	0	0	0	0	108	0	0	0	192	36	0	62	34	49	0	0	0

Table 2: Number of Red Grouper sampled for age by each data source.

Year	CO-OP	FIN- BIOSTAT	FIN- OBS	FWRI	FWRI- OBS	MRFSS	PCLAB	RECFIN	REPBIO	SRFS	SRHS	TIP	UN
1986	0	0	0	0	0	0	0	0	0	0	8	0	0
1987	0	0	0	0	0	0	0	0	0	0	11	0	0
1988	0	0	0	0	0	0	0	0	0	0	10	0	0
1989	0	0	0	0	0	0	0	0	0	0	11	0	0
1991	0	0	0	0	0	0	0	0	0	0	32	5	0
1992	0	0	0	0	0	0	0	0	0	0	31	29	0
1993	0	0	0	0	0	0	0	0	0	0	18	65	0
1994	0	0	0	0	0	0	0	0	0	0	23	78	0
1995	0	0	0	0	0	0	0	0	0	0	30	114	0
1996	0	0	0	0	0	0	0	0	0	0	33	148	0
1997	0	0	0	0	0	0	0	0	0	0	10	88	0
1998	0	0	0	0	0	0	0	0	0	0	0	97	0
1999	0	0	0	0	0	33	0	0	0	0	2	79	0
2000	0	0	0	0	0	12	20	0	0	0	11	28	0
2001	0	0	0	0	0	31	11	0	0	0	0	7	0
2002	0	5	0	0	0	3	203	110	0	0	1	26	1
2003	1	6	0	2	0	14	24	106	0	0	29	17	0
2004	0	14	0	0	0	68	7	75	0	0	41	11	0
2005	0	3	18	0	0	0	0	62	0	0	29	5	0
2006	0	2	0	0	0	0	11	31	0	0	21	10	0
2007	0	2	1	0	0	6	0	30	0	0	21	28	0
2008	0	0	0	0	0	18	0	98	0	0	9	24	0
2009	0	1	0	0	105	8	0	86	0	0	9	16	0
2010	0	7	0	0	109	35	1	213	0	0	18	7	0
2011	0	8	0	0	63	68	4	375	0	0	35	0	0

Year	CO-OP	FIN- BIOSTAT	FIN- OBS	FWRI	FWRI- OBS	MRFSS	PCLAB	RECFIN	REPBIO	SRFS	SRHS	TIP	UN
2012	0	2	0	0	40	18	34	134	0	0	33	16	0
2013	0	0	0	0	81	0	8	181	0	0	16	0	0
2014	0	2	0	0	9	0	15	110	0	0	27	0	0
2015	0	0	0	0	205	0	24	46	0	45	41	0	0
2016	0	4	0	0	246	0	18	43	0	62	28	0	0
2017	0	0	0	0	133	0	29	3	0	82	7	0	0
2018	0	0	0	0	146	0	16	9	4	83	18	0	0
2019	0	1	0	0	244	0	60	0	169	98	50	8	0
2020	0	0	0	0	64	0	36	0	88	97	9	0	0
2021	0	1	0	0	160	0	115	0	117	45	4	0	0
2022	0	0	0	0	102	0	36	0	56	17	5	0	0

Table 3: Number of Red Grouper sampled for lengths from each mode (CB = charterboat, HB = headboat, and PR = private).

Year	CB	HB	PR
1986	39	369	21
1987	26	544	100
1988	30	350	182
1989	50	699	152
1990	13	239	44
1991	15	107	91
1992	145	56	229
1993	81	36	132
1994	135	58	112
1995	172	85	104
1996	197	81	37
1997	113	67	41
1998	202	65	86
1999	311	115	137
2000	416	72	144
2001	402	53	127
2002	804	184	128
2003	754	220	158
2004	1,406	173	259
2005	1,161	98	80
2006	451	91	48
2007	270	95	81
2008	288	142	88
2009	292	144	64
2010	475	158	122
2011	742	233	78
2012	854	286	168
2013	886	225	252
2014	1,125	145	299
2015	777	71	396
2016	621	96	295
2017	336	51	212

Year	CB	HB	PR
2018	383	55	113
2019	487	100	204
2020	245	12	140
2021	641	35	104
2022	319	88	74

Table 4: Number of fish (nfish) and trips (ntrip), by region, where Red Grouper were sampled for length. There were 2 samples in 2004 and 1 sample in 2006 and 2014 (4 total) where region could not be assigned.

Year	nfish_North	ntrip_North	nfish_South	ntrip_South
1986	41	25	388	157
1987	59	44	611	228
1988	66	36	496	165
1989	40	30	861	177
1990	22	16	274	94
1991	33	25	180	69
1992	39	31	391	143
1993	88	48	161	68
1994	121	59	184	69
1995	146	61	215	71
1996	211	72	104	44
1997	111	48	110	56
1998	170	68	183	108
1999	136	74	427	167
2000	239	103	393	123
2001	233	100	349	126
2002	651	257	465	241
2003	603	297	529	276
2004	1,163	437	673	300
2005	1,041	384	298	134
2006	477	218	112	52
2007	259	149	187	84
2008	147	87	371	225
2009	75	56	425	315
2010	168	135	587	453
2011	259	206	794	580
2012	326	232	982	463
2013	150	135	1,212	506
2014	155	121	1,414	396
2015	79	59	1,165	350
2016	71	50	941	368
2017	53	35	546	255

Year	nfish_North	ntrip_North	nfish_South	ntrip_South
2018	58	41	493	175
2019	112	76	679	268
2020	64	36	333	133
2021	160	78	620	198
2022	79	41	402	204

Table 5: Number of fish (nfish) and trips (ntrips), by region, where Red Grouper were sampled for ages. Columns labeled ‘_NA’ are for samples where region could not be assigned.

Year	nfish_North	ntrip_North	nfish_South	ntrip_South	nfish_NA	ntrip_NA
1986	0	0	7	3	1	1
1987	0	0	7	7	4	4
1988	0	0	2	2	8	8
1989	0	0	8	5	3	3
1991	5	4	23	12	9	7
1992	26	20	28	15	6	5
1993	74	39	9	7	0	0
1994	91	43	10	9	0	0
1995	114	45	30	23	0	0
1996	181	64	0	0	0	0
1997	82	38	16	10	0	0
1998	92	29	5	5	0	0
1999	74	30	40	7	0	0
2000	22	11	49	10	0	0
2001	23	8	26	11	0	0
2002	226	58	123	54	0	0
2003	70	42	129	74	0	0
2004	67	37	147	43	2	1
2005	72	37	45	34	0	0
2006	54	27	20	13	1	1
2007	39	20	49	23	0	0
2008	20	15	129	50	0	0
2009	32	21	193	88	0	0
2010	77	50	313	141	0	0
2011	94	62	459	87	0	0
2012	150	99	127	35	0	0
2013	106	69	179	41	1	1
2014	99	60	64	19	0	0
2015	88	71	273	101	0	0
2016	80	58	321	148	0	0
2017	34	23	213	112	7	6
2018	33	29	225	111	18	13

Year	nfish_North	ntrip_North	nfish_South	ntrip_South	nfish_NA	ntrip_NA
2019	80	47	500	223	50	34
2020	47	27	233	101	14	10
2021	133	57	305	111	4	3
2022	43	20	168	74	5	5

Figures

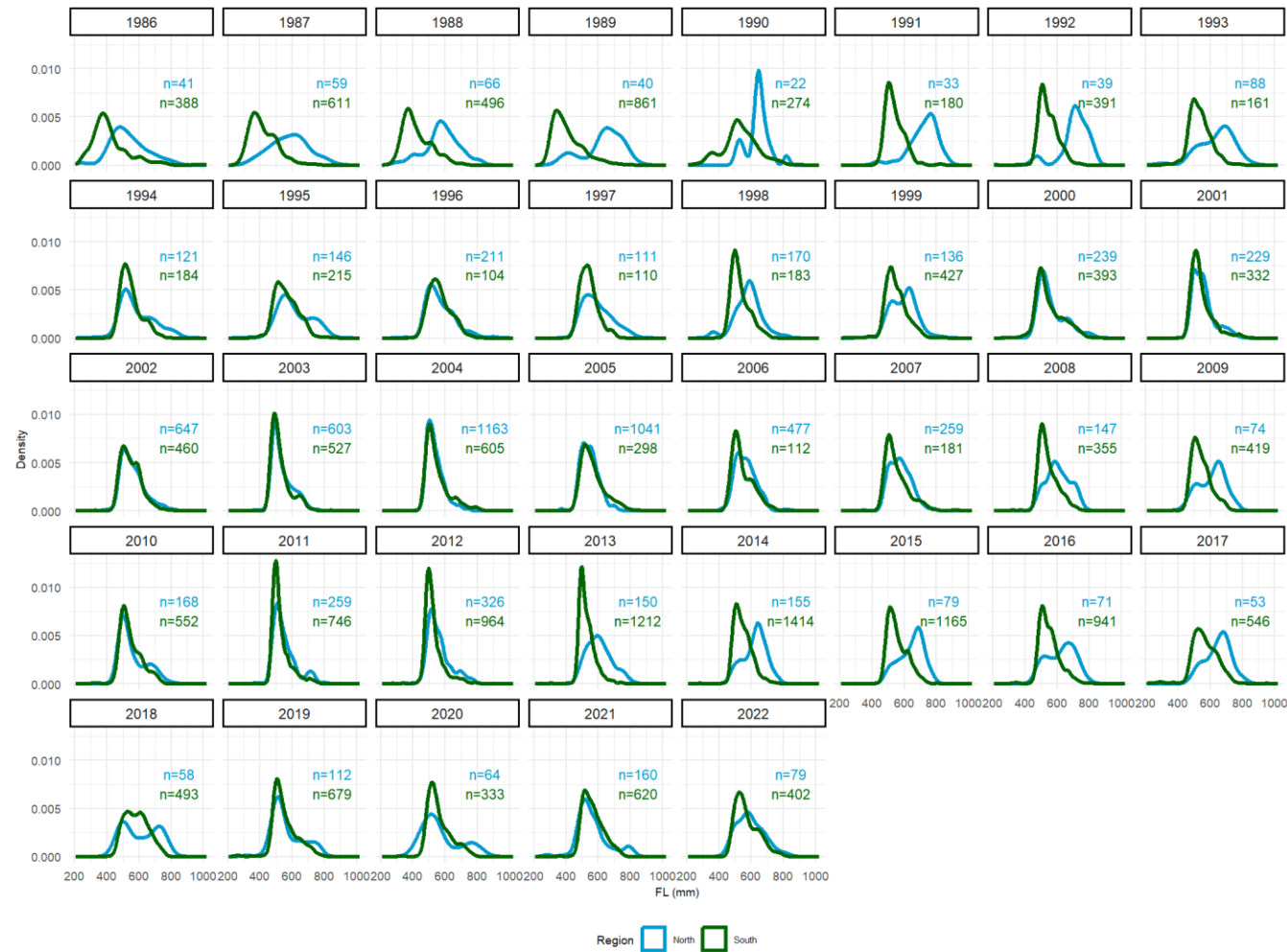


Figure 1: Comparing length distributions of Red Grouper from North (blue) and South (green) Regions.

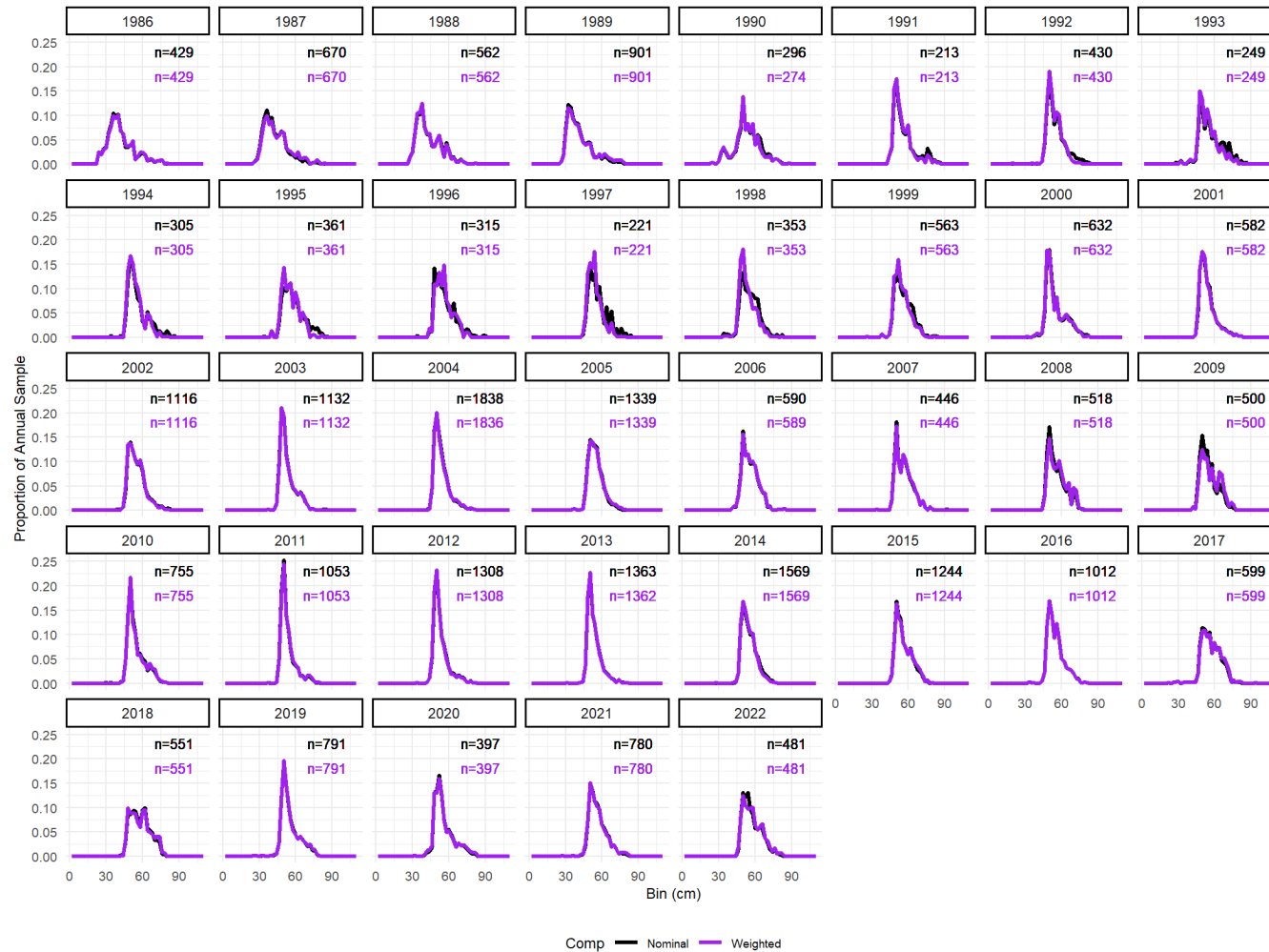


Figure 2: Nominal (black) and weighted (purple) length compositions for Red Grouper. Bins represent fork length.

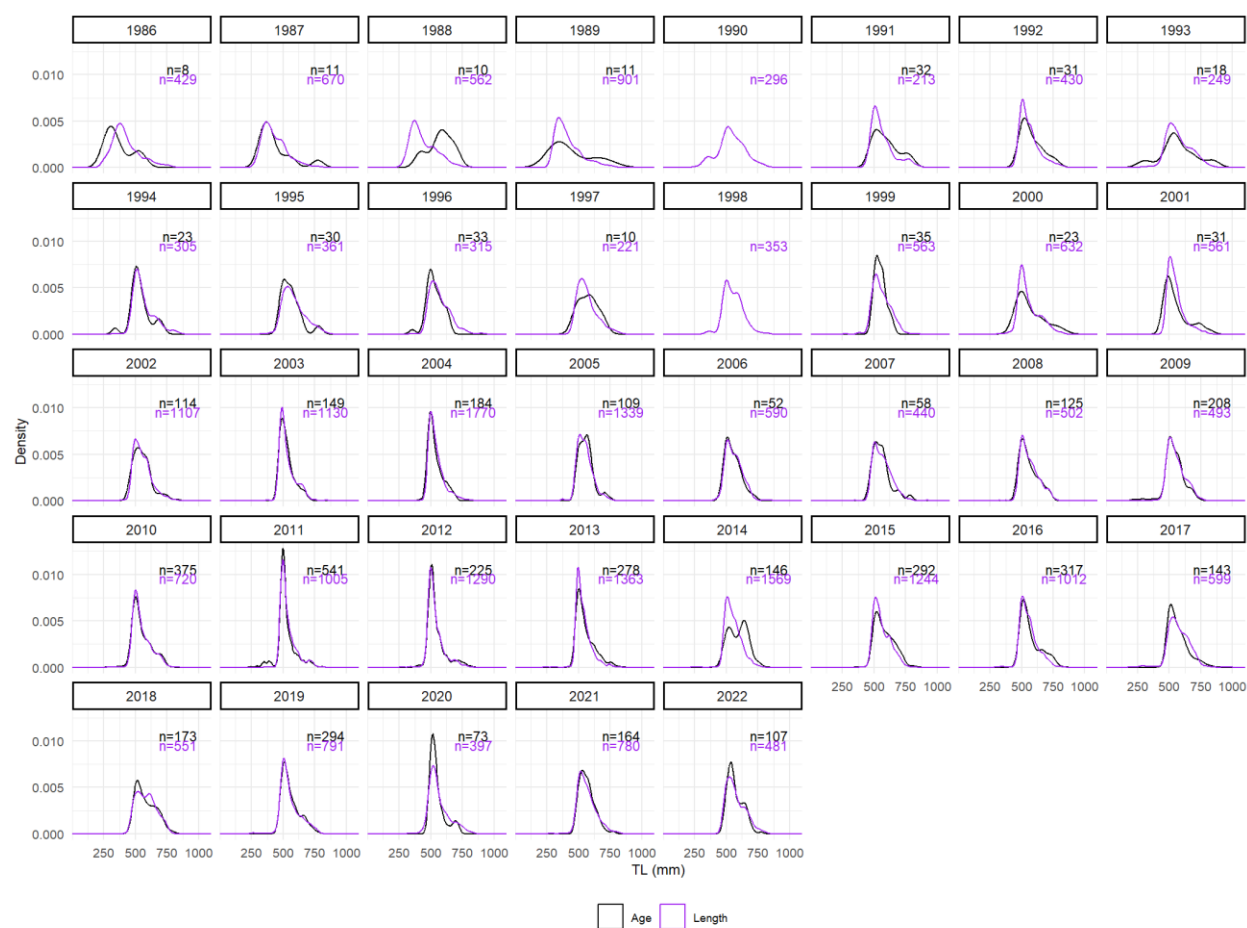


Figure 3: Comparison of length distributions between the length-only (purple) and age (black) data sets for Red Grouper.

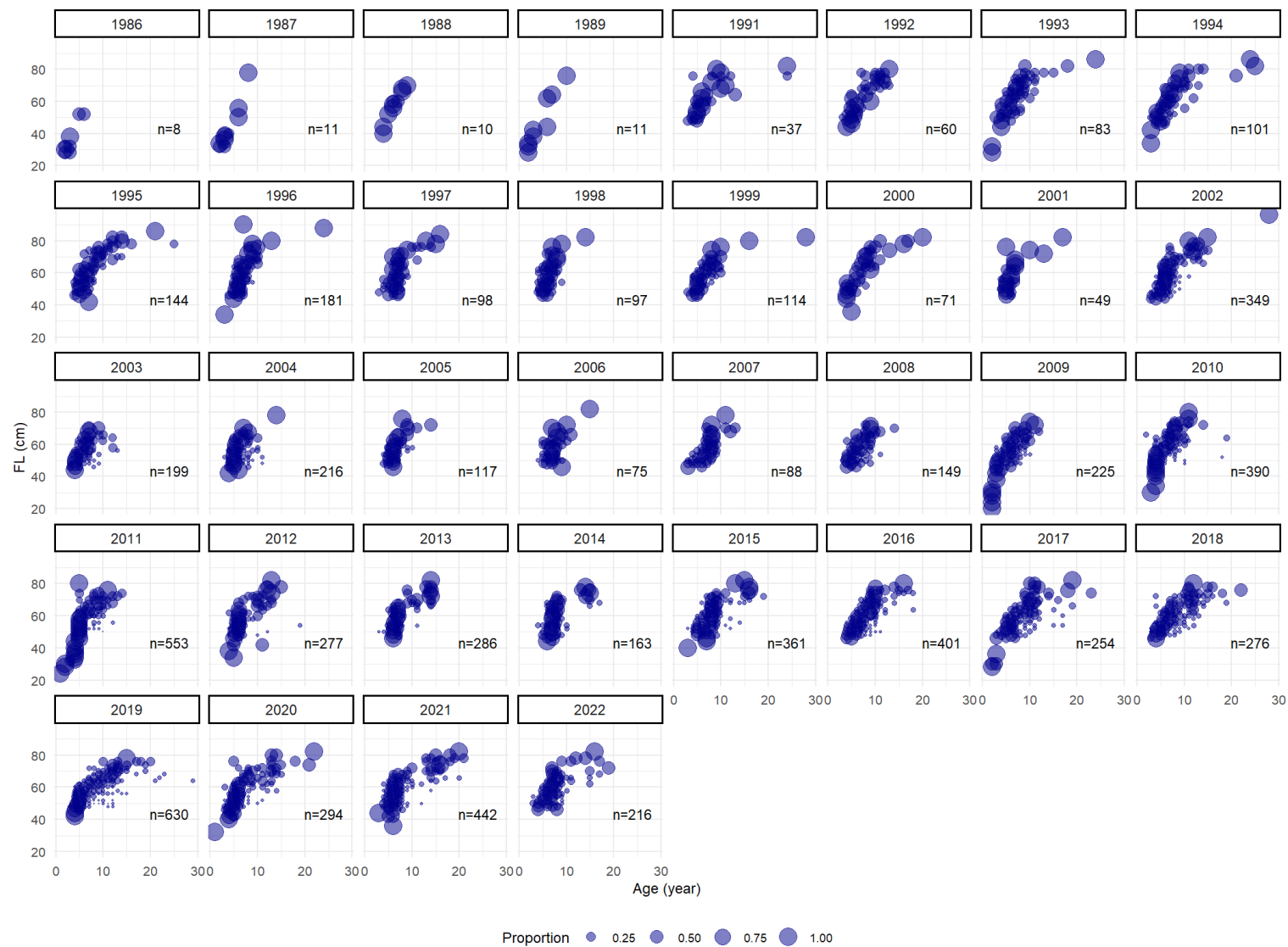


Figure 4: Conditional age-at-length (CAAL) for Red Grouper.

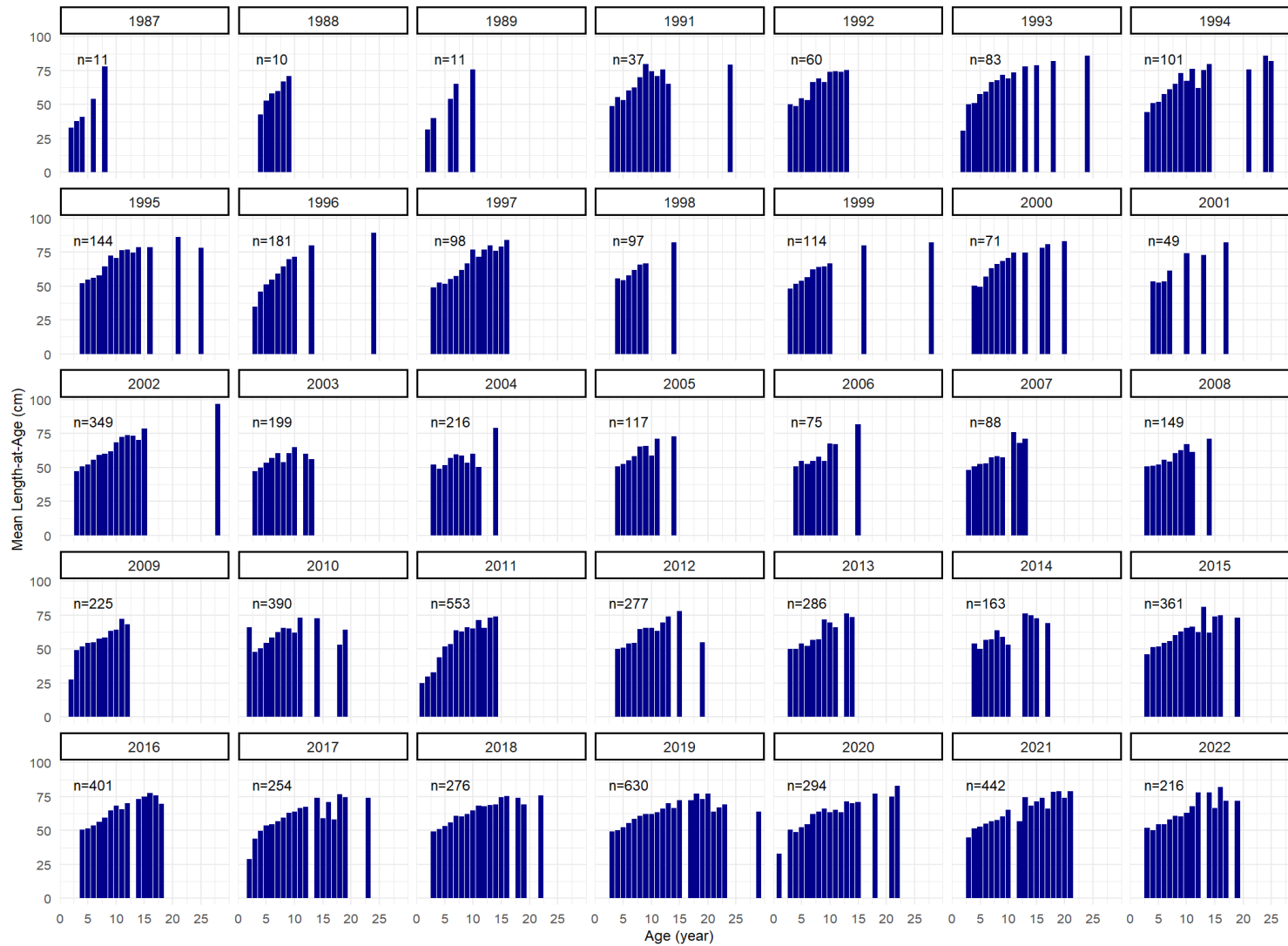


Figure 5: Mean length-at-age (MLAA) for Red Grouper.

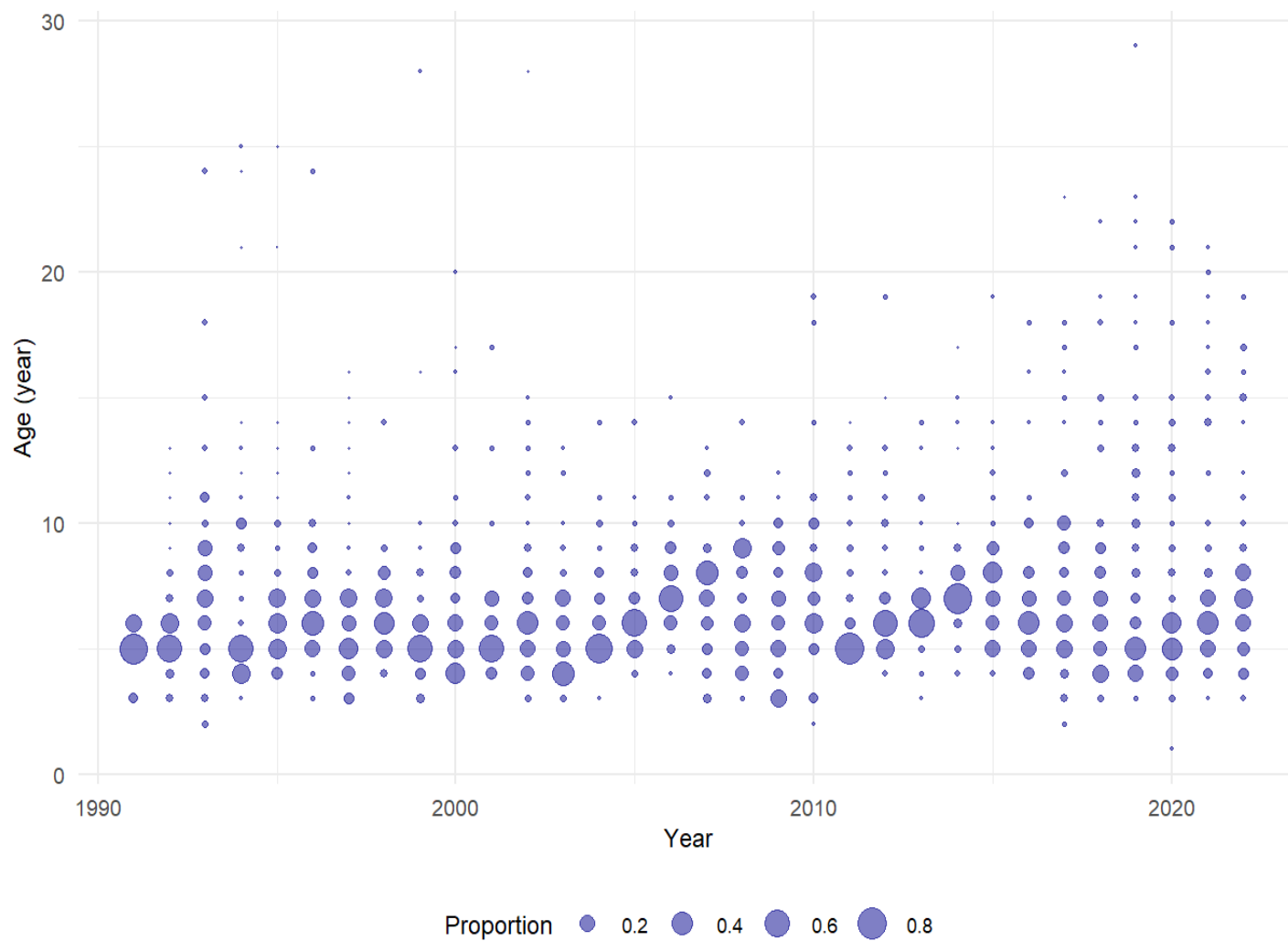


Figure 6: Final weighted age composition for Red Grouper.

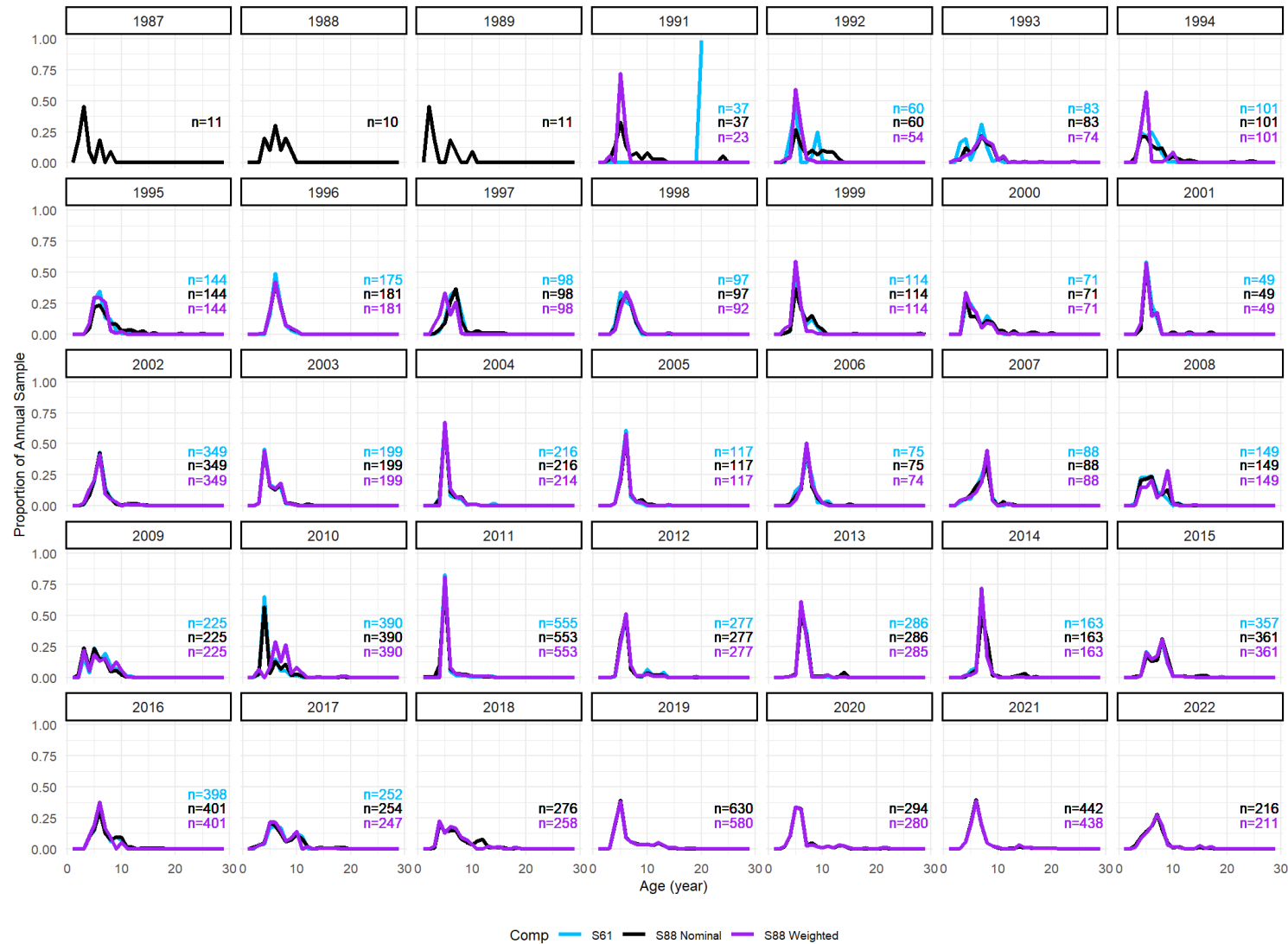


Figure 7: Comparison of nominal (black) and weighted age (purple) compositions from SEDAR 88 and weighted age (blue) compositions from SEDAR 61.

Appendix

Imputed Lengths and WP_SIZE

The impacts of including imputed lengths and using WP_SIZE to expand the number of fish was evaluated on four different species: Red Grouper, Gray Triggerfish, Snowy Grouper, and Scamp. Gulf of Mexico Red Grouper (SEDAR 88) and South Atlantic Gray Triggerfish (SEDAR 81) are both well-sampled species while South Atlantic Snowy Grouper (SEDAR 36 Update) and South Atlantic Scamp (SEDAR 68) are not as well-sampled and have lower sample sizes. For each species, the data used for the evaluations are the same data that were provided for the initial assessment and only include data from MRIP. Three figures are provided for each species (1) a comparison of the length distribution of observed lengths vs imputed lengths, (2) the annual distribution of WP_SIZE, and (3) comparison of nominal length compositions using only observed lengths, including imputed lengths, and including imputed lengths and using WP_SIZE. WP_SIZE is scaled to include imputed lengths. The sum of WP_SIZE at the trip level is equal to the expanded catch estimate for that trip. If imputed lengths are excluded, WP_SIZE has to be rescaled so the sum of WP_SIZE for the fish with observed lengths equals the expanded catch estimate, so using WP_SIZE with only observed lengths was not explored.

For Gulf of Mexico Red Grouper and South Atlantic Gray Triggerfish, there was high agreement between the distributions between observed and imputed lengths. The most pronounced differences are for years with smaller sample sizes. The differences are more pronounced and more common across years for South Atlantic Snowy Grouper and South Atlantic Scamp. For the well-sampled species, the inclusion of imputed lengths and WP_SIZE generally did not have a large influence on the final compositions, however, there are years where the compositions including WP_SIZE are spikier. The influence of imputed lengths and WP_SIZE are more pronounced for the species that are not as well-sampled. Many of the spikes, such as the spikes in 2010 for Snowy Grouper and 2003 Scamp are driven by samples with imputed lengths and large WP_SIZE estimates.

SEDAR 88 Gulf of Mexico Red Grouper



Figure A1: Comparison of length distributions of fish with observed lengths (black) and fish with imputed lengths (purple) from S88 Gulf of Mexico Red Grouper.

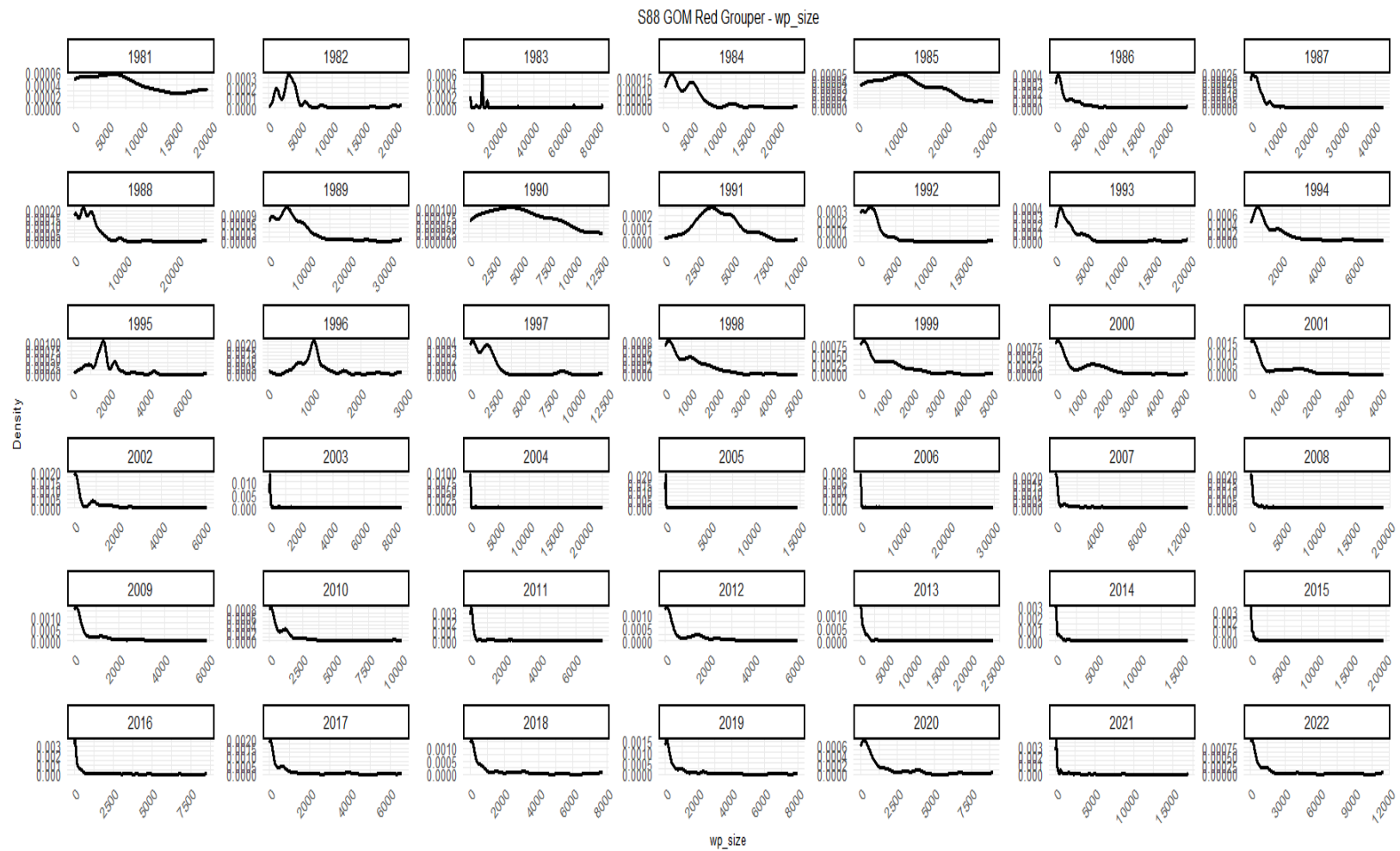


Figure A2: Annual values of WP_SIZE for S88 Gulf of Mexico Red Grouper. Note the difference in the y-axis scale.

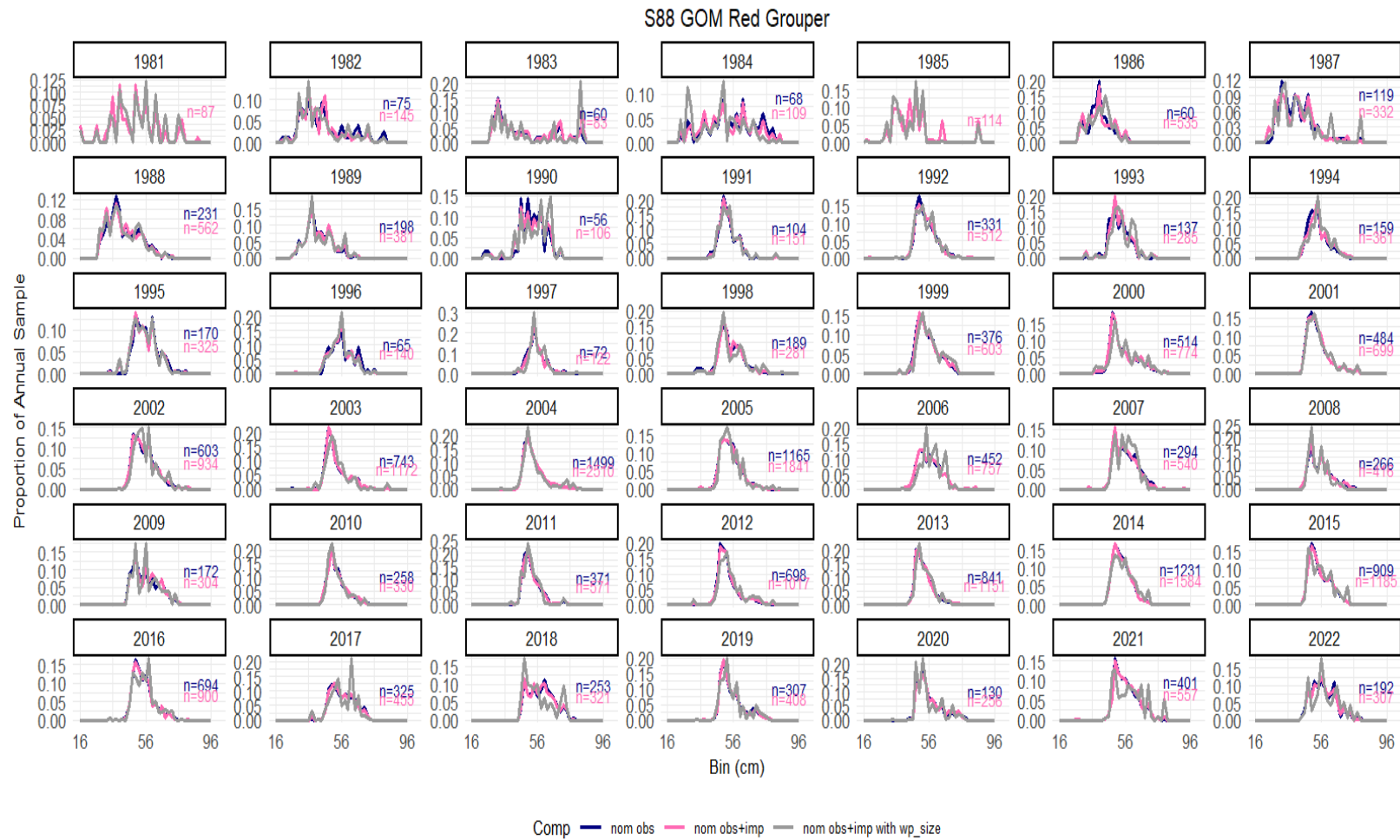


Figure A3: Comparison of nominal length compositions using only observed lengths (dark blue), including imputed lengths (pink), and including imputed lengths and using WP_SIZE (gray) for S88 Gulf of Mexico Red Grouper.

SEDAR 82 South Atlantic Gray Triggerfish

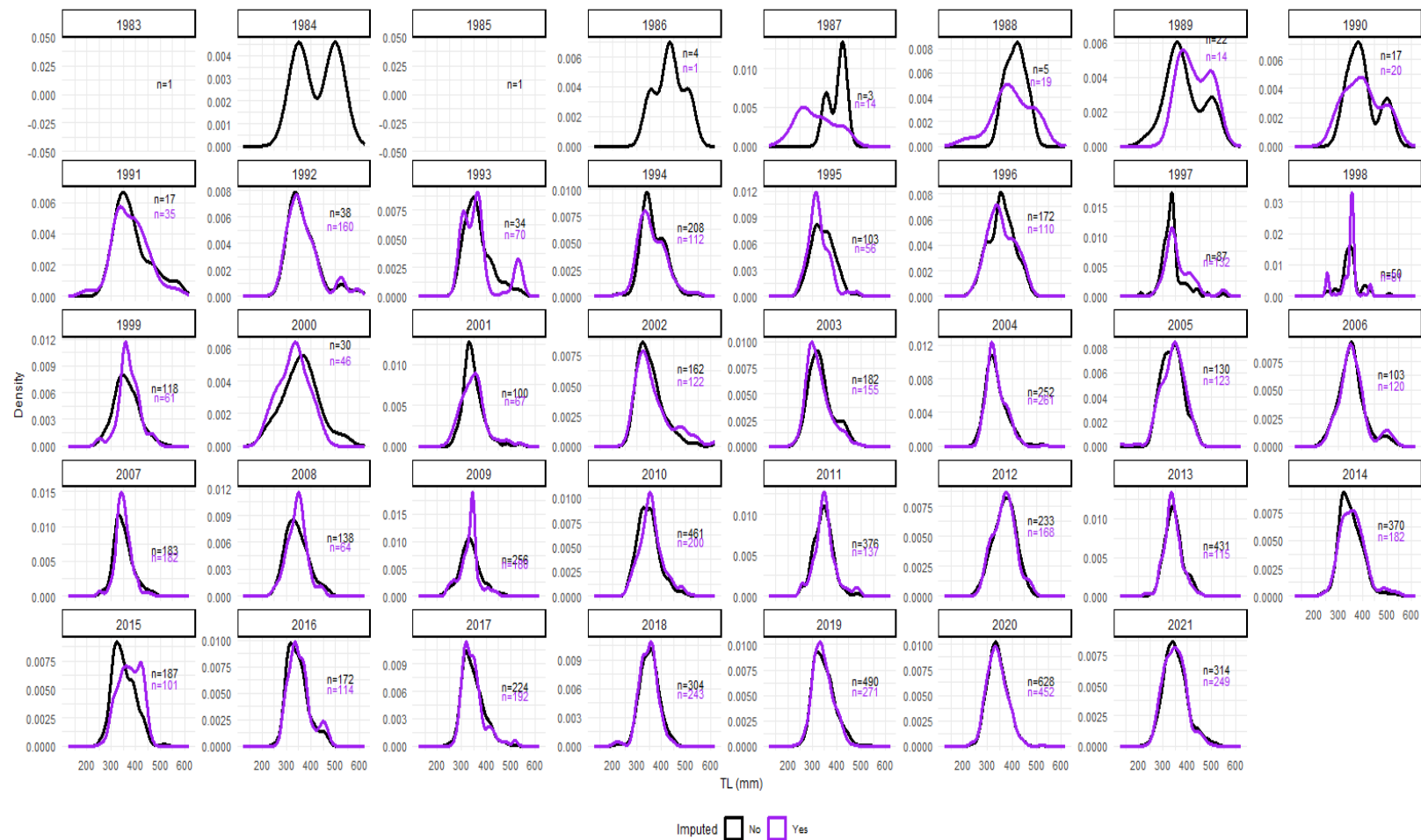


Figure A4: Comparison of length distributions of fish with observed lengths (black) and fish with imputed lengths (purple) from S82 South Atlantic Gray Triggerfish.

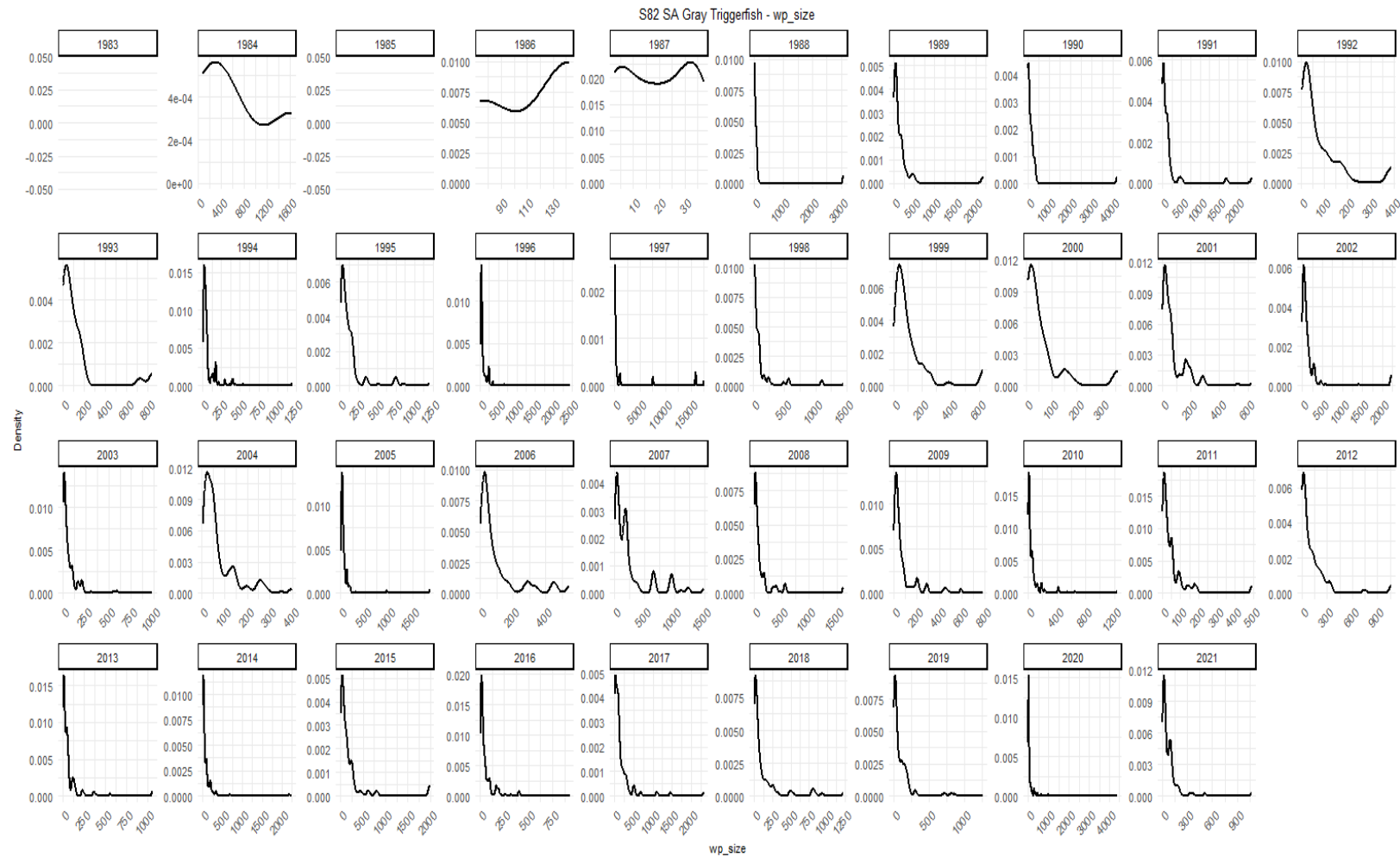


Figure A5: Annual values of WP_SIZE for S82 South Atlantic Gray Triggerfish. Note the difference in the y-axis scale.

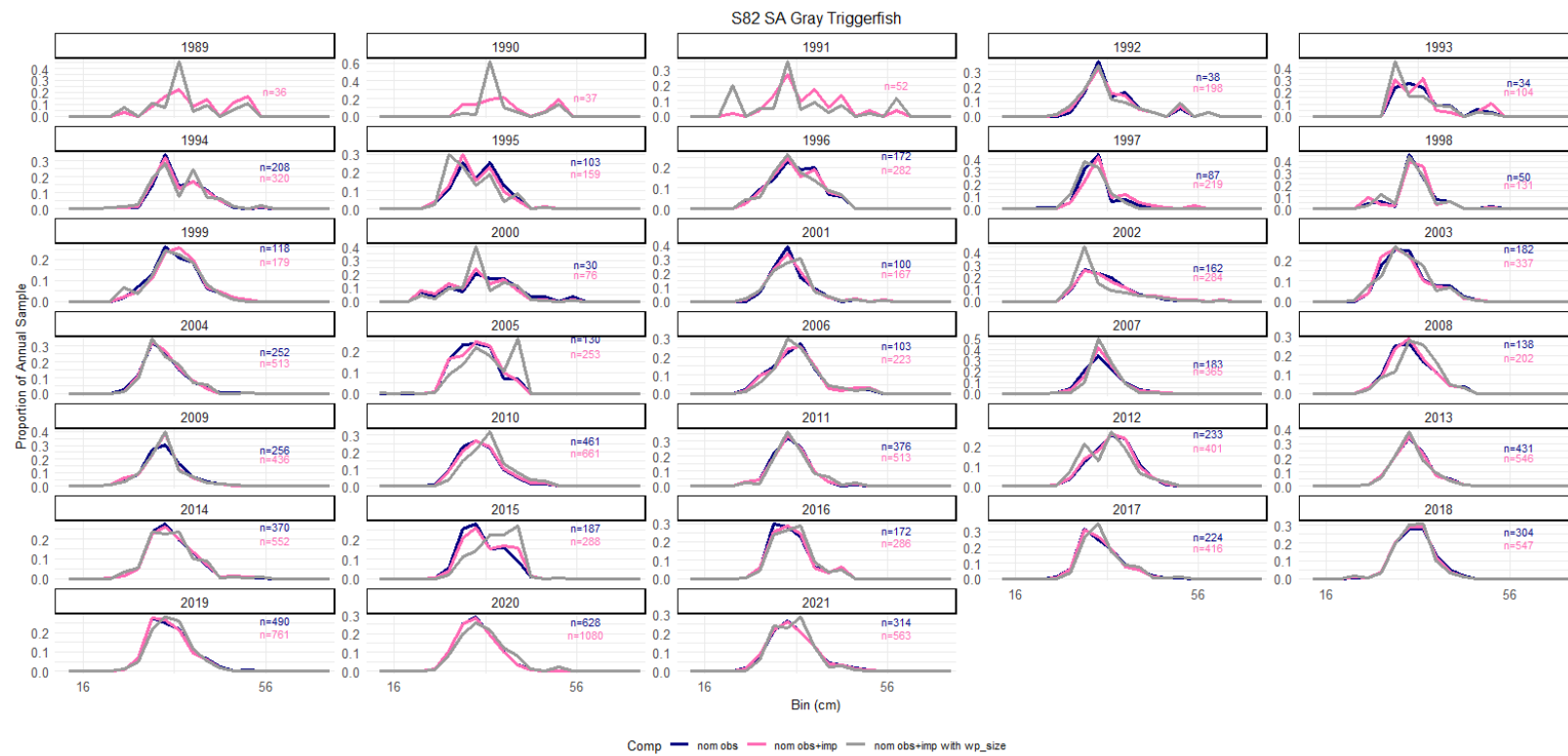


Figure A6: Comparison of nominal length compositions using only observed lengths (dark blue), including imputed lengths (pink), and including imputed lengths and using WP_SIZE (gray) for S82 Gray Triggerfish.

SEDAR 36U South Atlantic Snowy Grouper

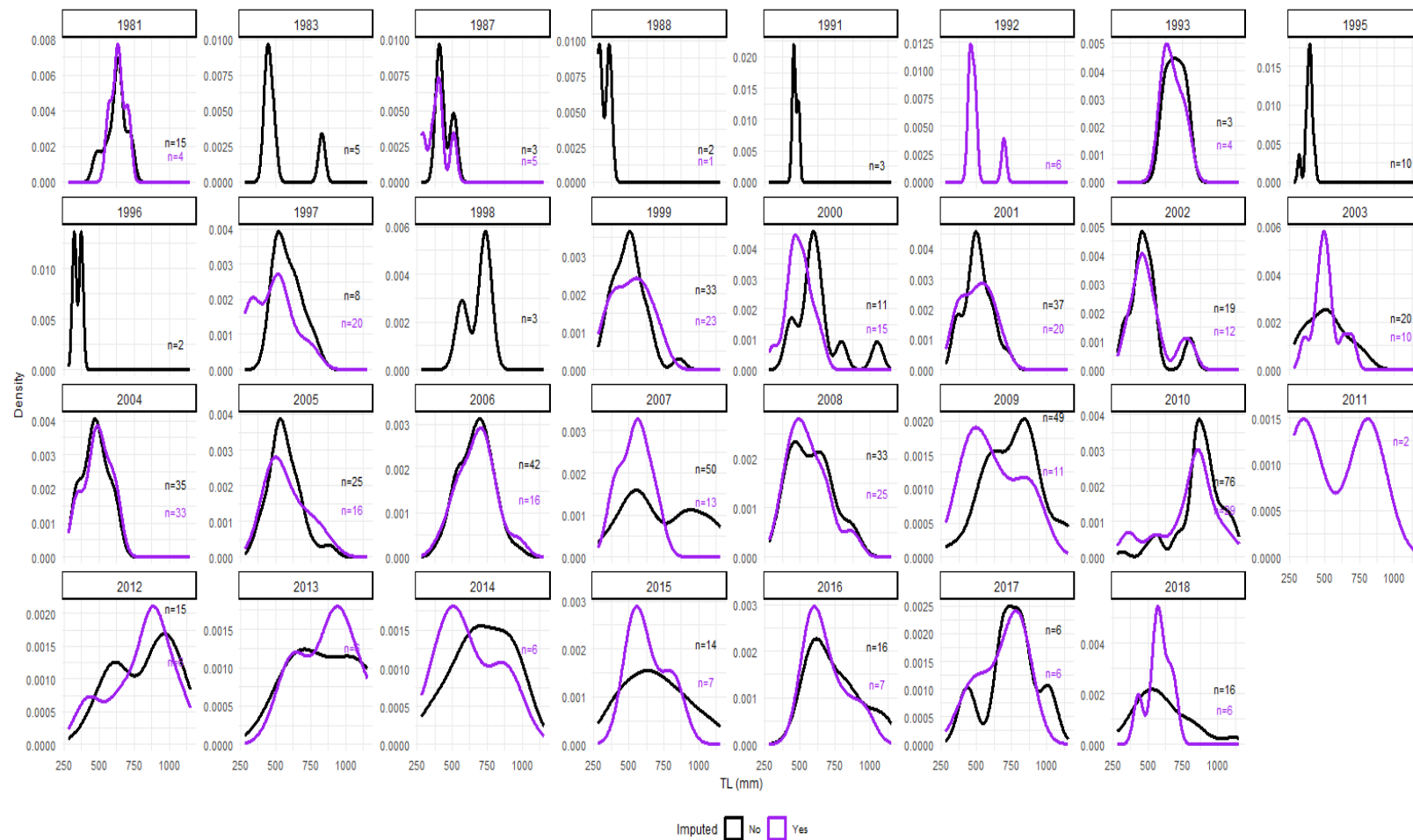


Figure A7: Comparison of length distributions of fish with observed lengths (black) and fish with imputed lengths (purple) from S36U South Atlantic Snowy Grouper.

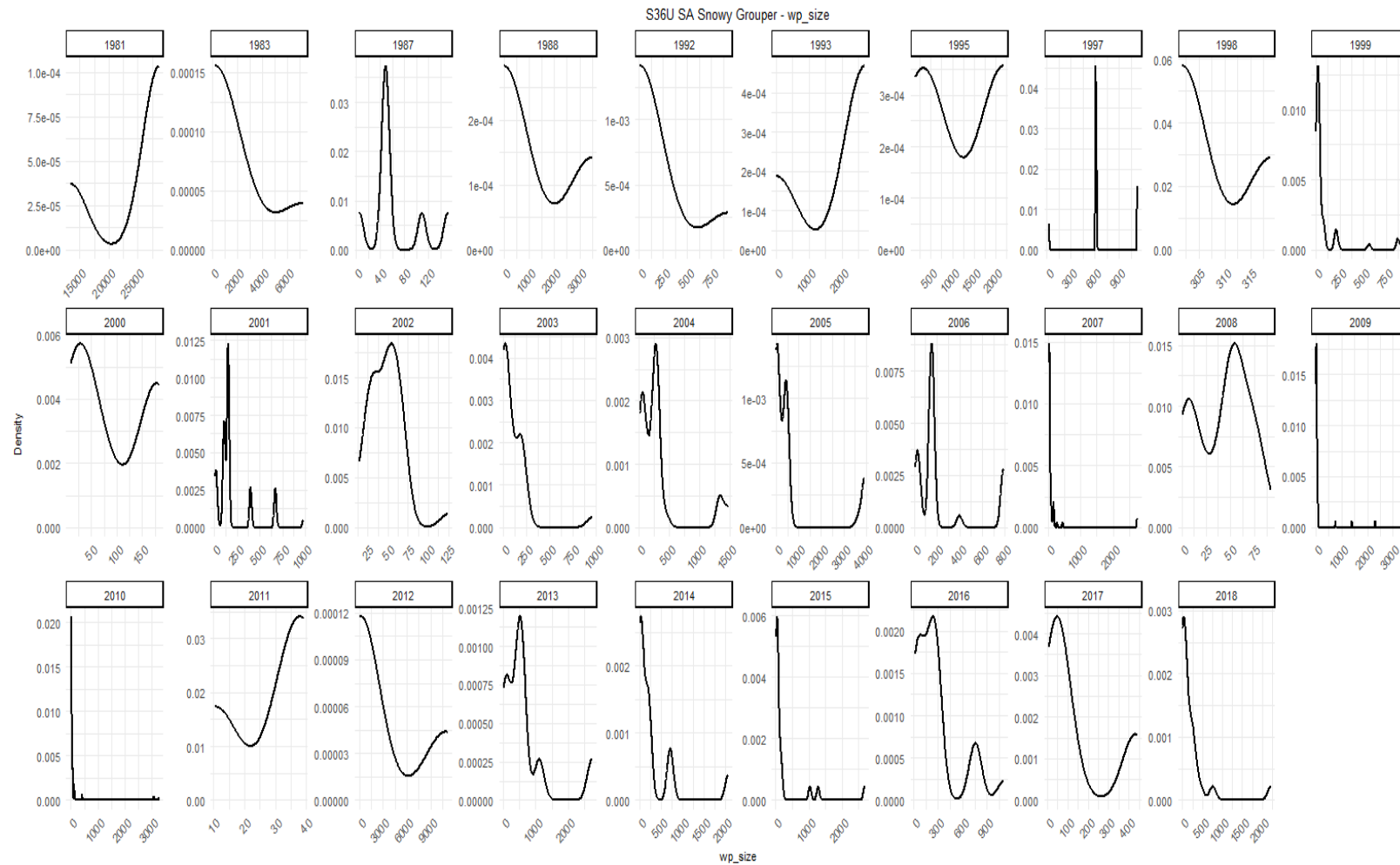


Figure A8: Annual values of WP_SIZE for S36U South Atlantic Snowy Grouper. Note the difference in the y-axis scale.

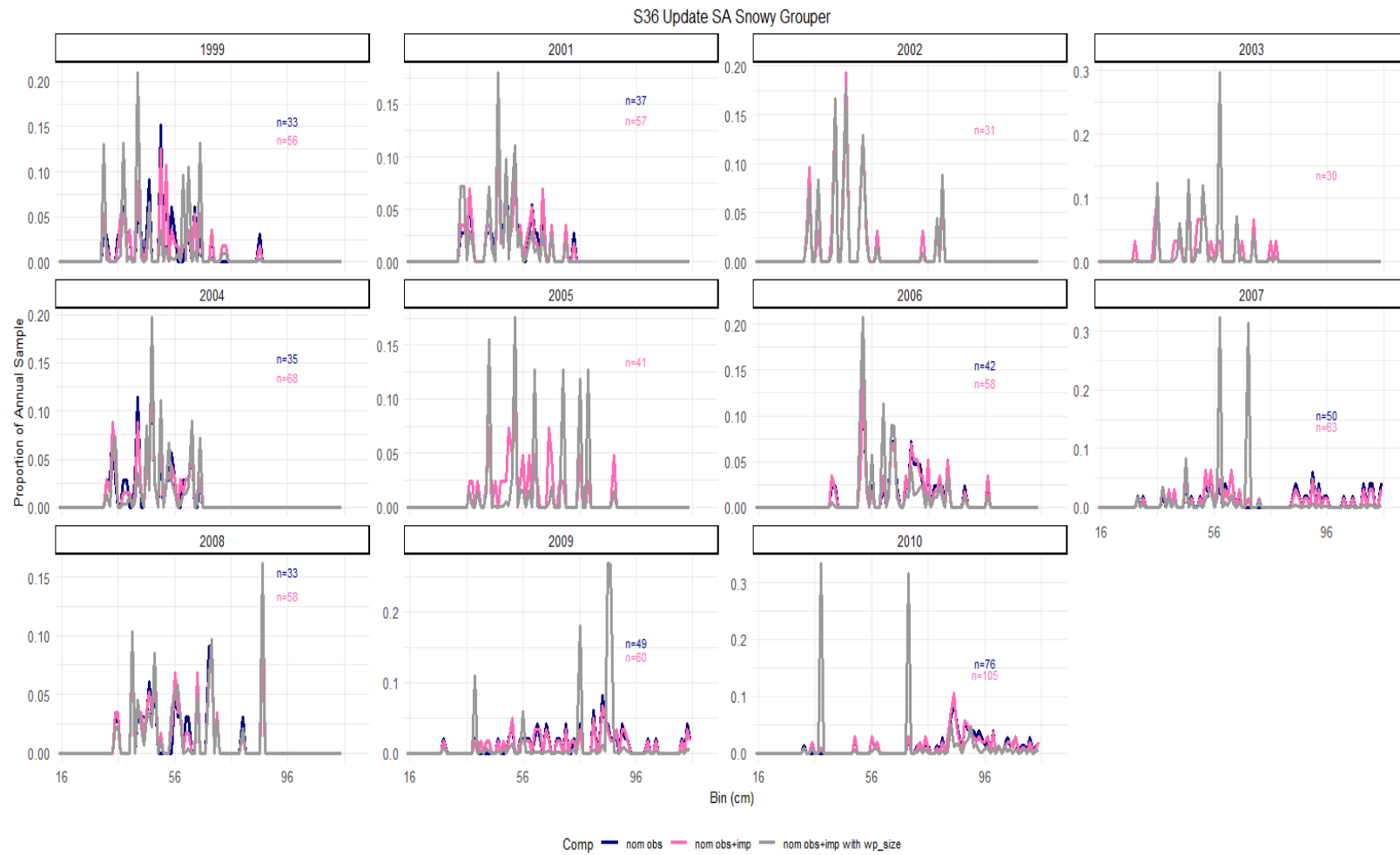


Figure A9: Comparison of nominal length compositions using only observed lengths (dark blue), including imputed lengths (pink), and including imputed lengths and using WP_SIZE (gray) for S36 Snowy Grouper.

SEDAR 68 South Atlantic Scamp

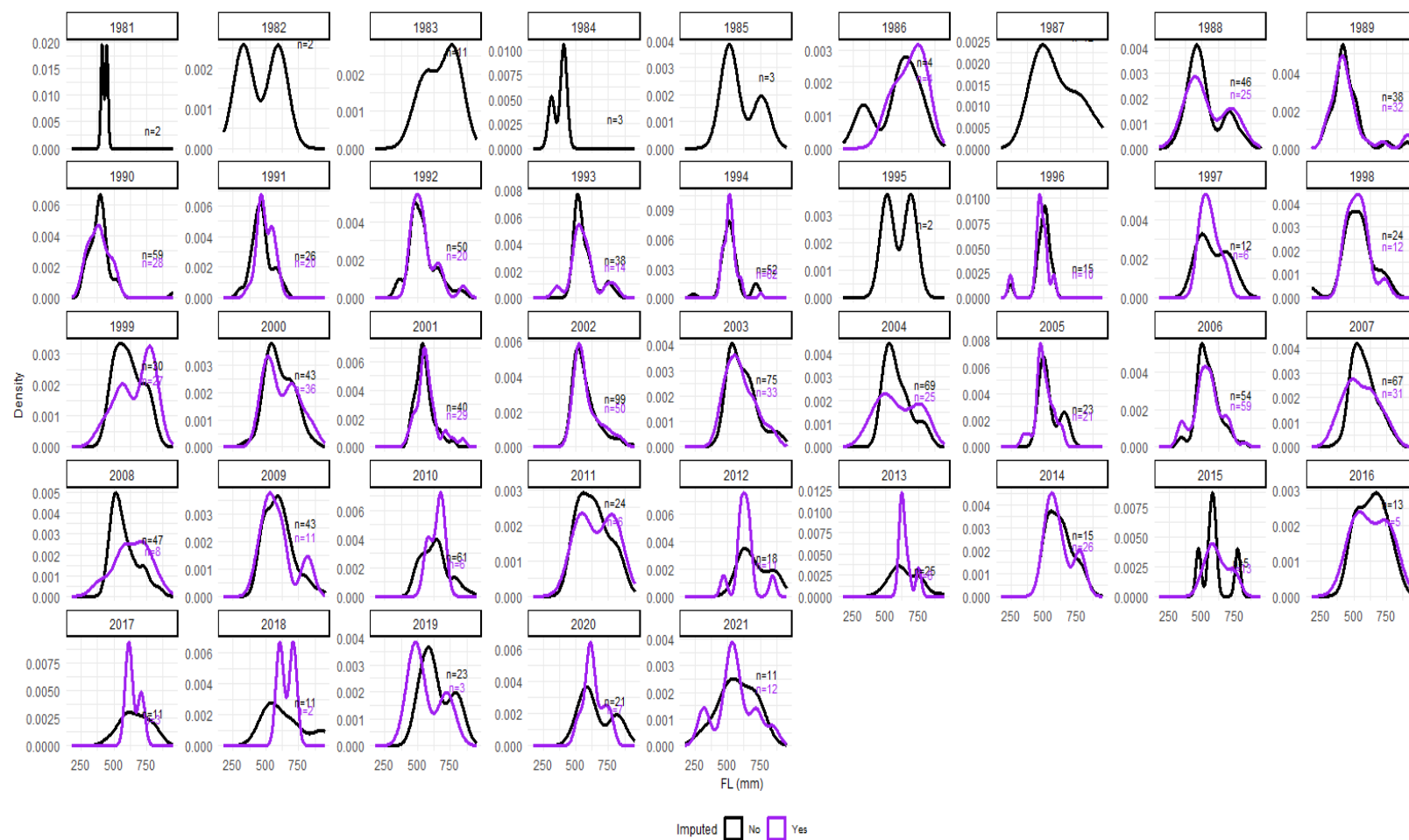


Figure A10. Comparison of length distributions of fish with observed lengths (black) and fish with imputed lengths (purple) from S68 South Atlantic Scamp.

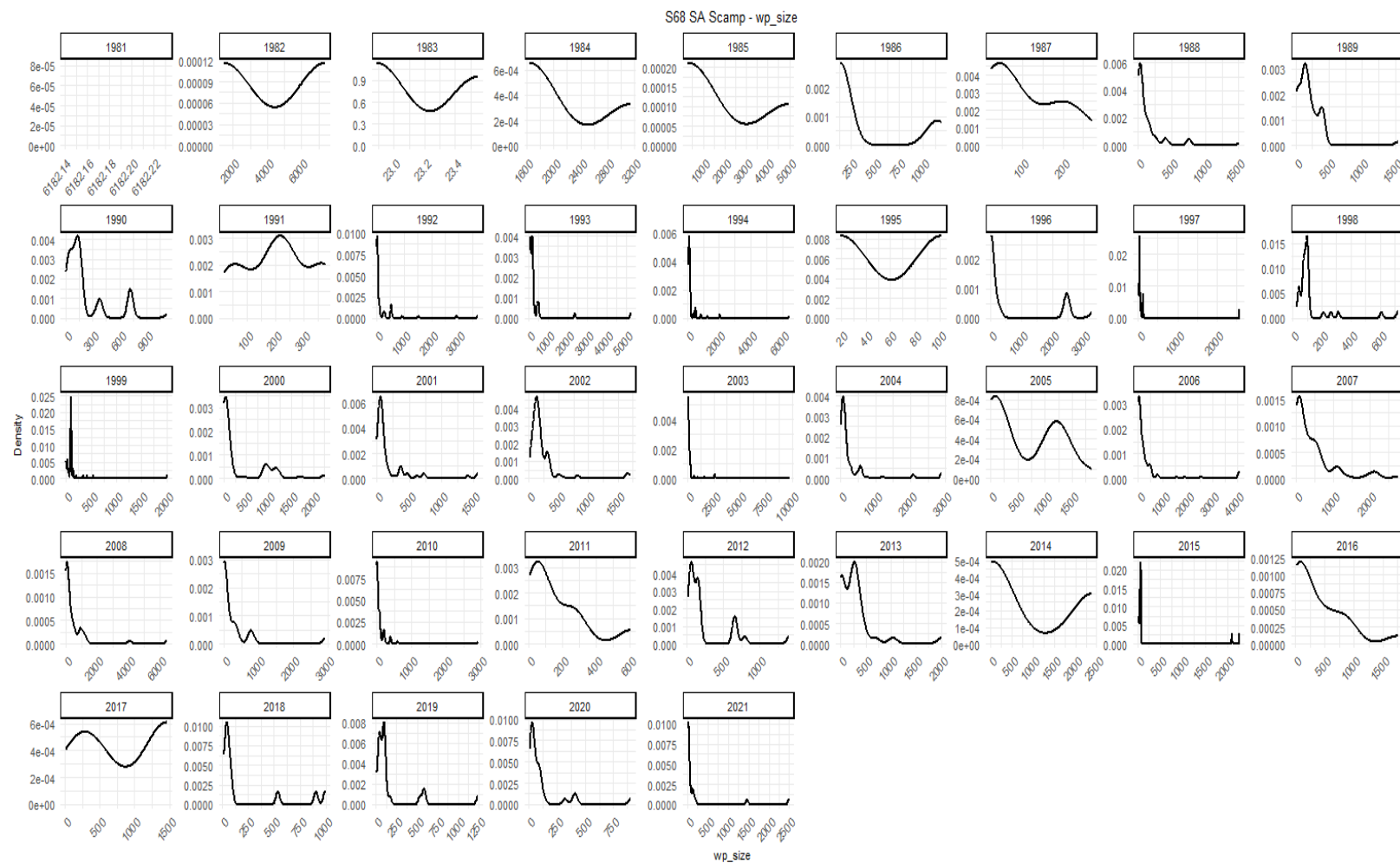


Figure A11: Annual values of WP_SIZE for S68 South Atlantic Scamp. Note the difference in the y-axis scale.

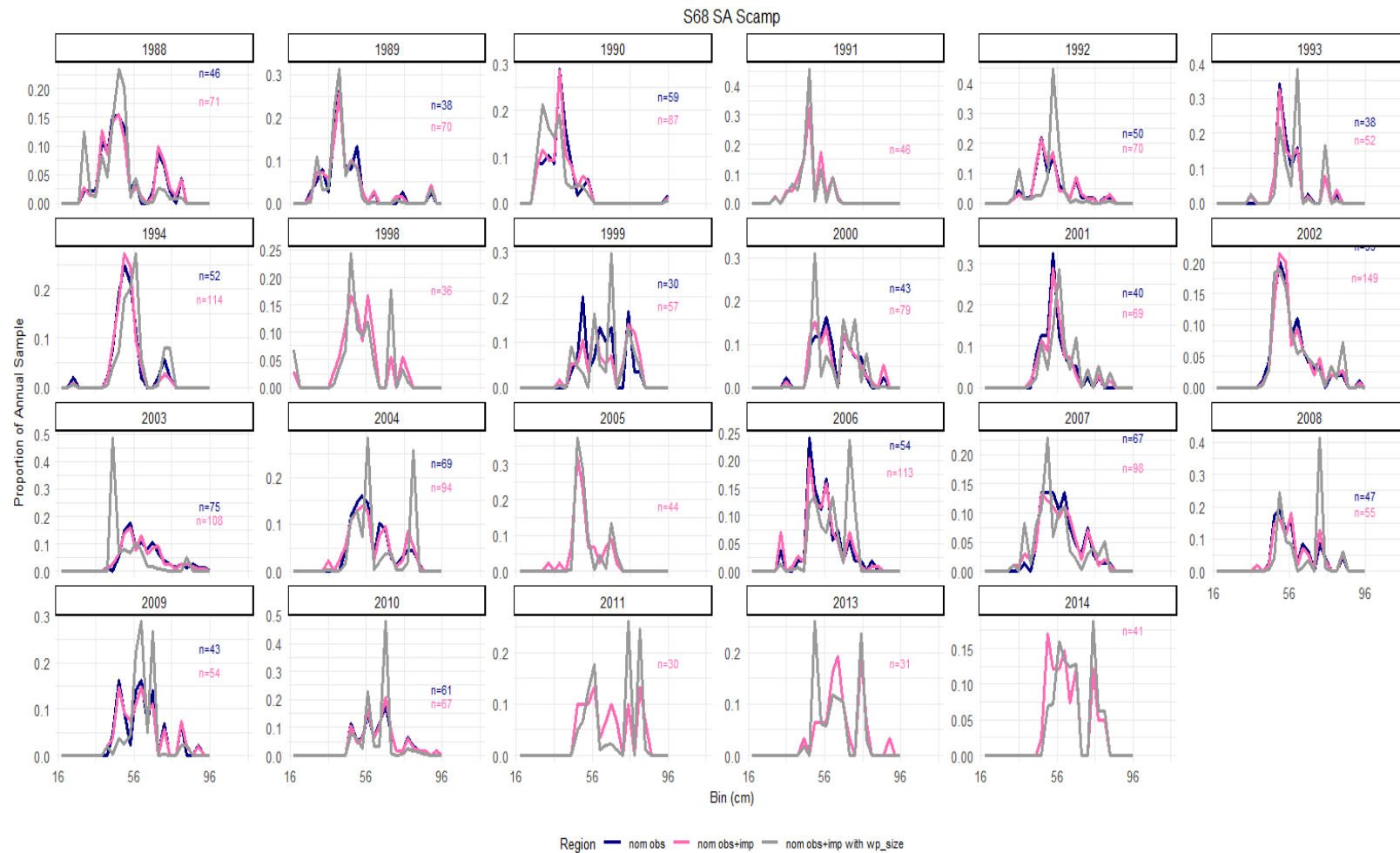


Figure A12: Comparison of nominal length compositions using only observed lengths (dark blue), including imputed lengths (pink), and including imputed lengths and using WP_SIZE (gray) for S68 South Atlantic Scamp.

Sample Sizes and Length Distribution by Region and Fishing Mode

The below tables show the samples sizes for the length-only (Table A1) and age (Table A2) data by region and fishing mode. The majority of samples are from the charterboat fleet and for the majority of years the data for the headboat and private modes are not sufficient to support the 30 samples per region and mode for the size-only data and 10 samples per region and mode for the age data. Figure A13 shows the length distribution of the samples split by region and fishing mode. Differences in the length distributions can generally be attributed to region and the fishing modes within a region have more similar distributions.

Table A1: Number of fish, by region and mode (CB = charterboat, HB = headboat, and PR = Private) sampled for lengths.

Year	North_CB	South_CB	North_HB	South_HB	North_PR	South_PR
1986	2	37	33	336	6	15
1987	9	17	42	502	8	92
1988	0	30	39	311	27	155
1989	1	49	39	660	0	152
1990	0	13	19	220	3	41
1991	3	12	29	78	1	90
1992	29	116	10	46	0	229
1993	59	22	25	11	4	128
1994	81	54	37	21	3	109
1995	103	69	43	42	0	104
1996	167	30	42	39	2	35
1997	79	34	31	36	1	40
1998	124	78	37	28	9	77
1999	111	200	20	95	5	132
2000	182	234	23	49	34	110
2001	175	227	23	30	35	92
2002	521	283	98	86	32	96
2003	456	298	98	122	49	109
2004	981	425	105	68	77	180
2005	960	201	53	45	28	52
2006	396	55	51	40	30	17
2007	186	84	31	64	42	39
2008	107	181	17	125	23	65

Year	North_CB	South_CB	North_HB	South_HB	North_PR	South_PR
2009	60	232	7	137	8	56
2010	125	350	20	138	23	99
2011	200	542	46	187	13	65
2012	265	589	43	243	18	150
2013	118	768	29	196	3	248
2014	106	1,019	24	121	25	274
2015	45	732	6	65	28	368
2016	45	576	3	93	23	272
2017	32	304	3	48	18	194
2018	31	352	4	51	23	90
2019	78	409	19	81	15	189
2020	53	192	2	10	9	131
2021	140	501	3	32	17	87
2022	52	267	7	81	20	54

Table A2: Number of fish, by region and mode (CB = charterboat, HB = headboat, and PR = Private) sampled for ages.

Year	North_CB	South_CB	North_HB	South_HB	North_PR	South_PR
1986	0	0	0	7	0	0
1987	0	0	0	7	0	0
1988	0	0	0	2	0	0
1989	0	0	0	8	0	0
1991	1	0	4	23	0	0
1992	24	2	2	25	0	1
1993	58	3	16	5	0	1
1994	72	0	19	10	0	0
1995	91	0	23	30	0	0
1996	139	0	42	0	0	0
1997	61	0	21	7	0	9
1998	71	1	21	0	0	4
1999	65	39	8	0	1	1
2000	19	40	3	9	0	0
2001	22	24	1	0	0	2
2002	179	115	44	6	3	2
2003	52	49	17	13	1	67
2004	32	112	34	9	1	26
2005	52	12	19	33	1	0
2006	28	10	24	9	2	1
2007	17	35	22	6	0	8
2008	10	63	10	34	0	32
2009	22	68	9	100	1	25
2010	57	206	17	69	3	38
2011	60	353	34	80	0	26
2012	114	110	35	4	1	13
2013	79	137	27	18	0	24
2014	69	45	23	7	7	12
2015	52	174	18	53	18	46
2016	57	170	5	94	18	57
2017	26	113	4	17	4	83
2018	21	164	4	27	8	34
2019	72	355	2	53	6	92

Year	North_CB	South_CB	North_HB	South_HB	North_PR	South_PR
2020	40	147	1	5	6	81
2021	120	247	3	18	10	40
2022	39	140	0	13	4	15

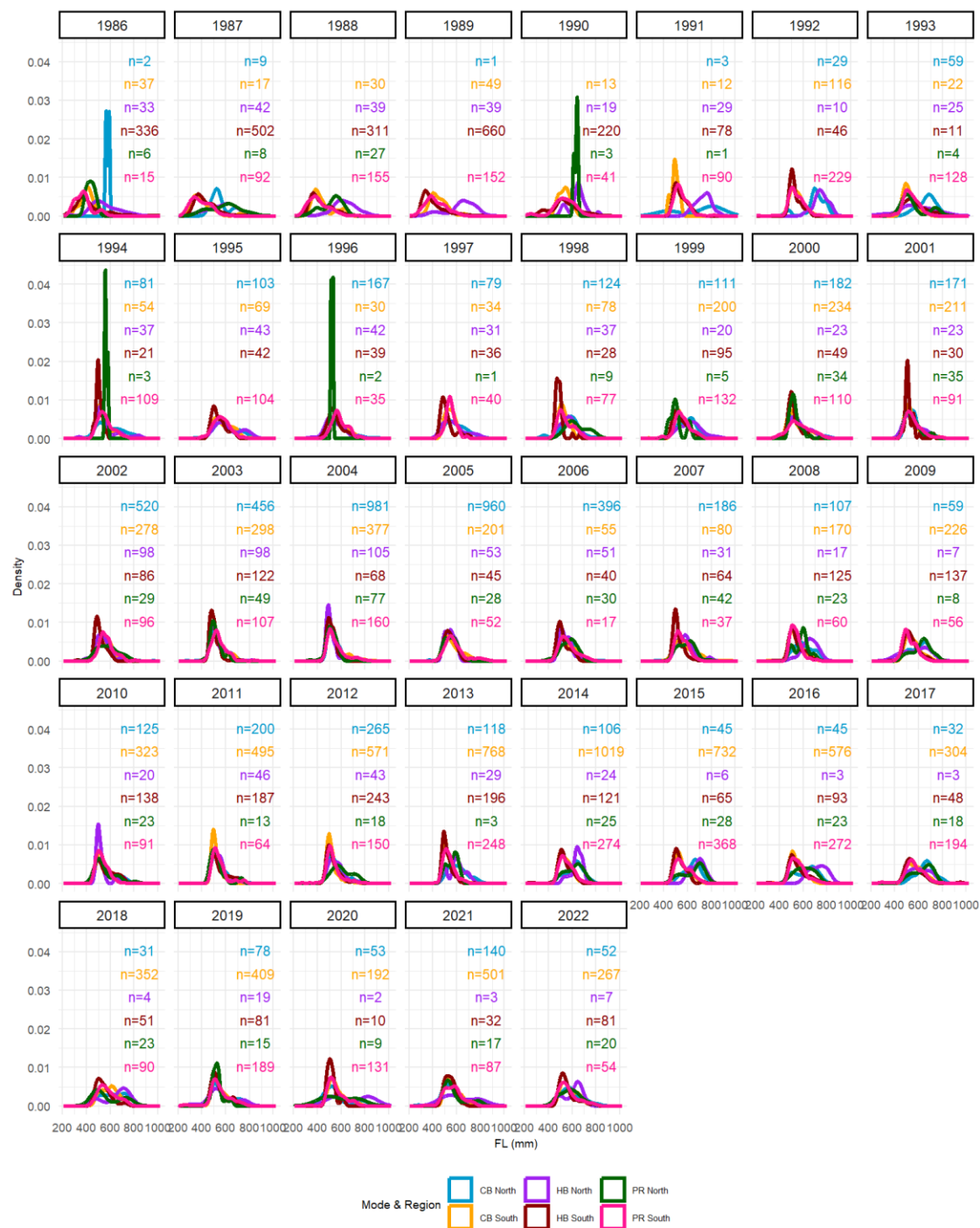


Figure A13. Comparison of length distributions by region and mode for Red Grouper.