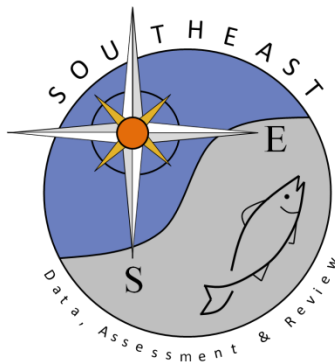


# Gulf of America King Mackerel (*Scomberomorus cavalla*) Length and Age Compositions for the Commercial Handline and Gillnet Fisheries

Micki Pawluk

SEDAR99-WP-06

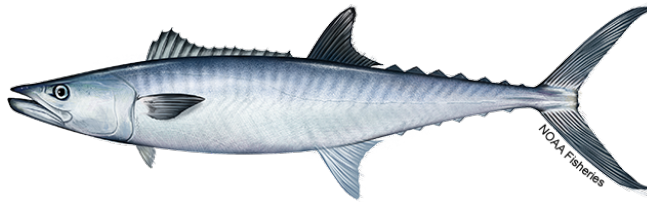
10 April 2026



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Please cite this document as:

Pawluk, Micki. 2026. Gulf of America King Mackerel (*Scomberomorus cavalla*) Length and Age Compositions for the Commercial Handline and Gillnet Fisheries. SEDAR99-WP-06. SEDAR, North Charleston, SC. 66 pp.



**Gulf of America King Mackerel (*Scomberomorus cavalla*)  
Length and Age Compositions for the Commercial Handline  
and Gillnet Fisheries**

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Submitted: April 2026

## Introduction

This document outlines the data and methodologies used to estimate length and age compositions of the commercial handline and gillnet fisheries for the SEDAR 99 Gulf of America (formerly Gulf of Mexico, hereafter referred to as “Gulf”) King Mackerel Assessment. These compositions were estimated using data sources approved in SEDAR 38 and used in SEDAR 38U. Annual nominal and weighted length and age compositions are presented here, as well as conditional age at length and mean length at age.

## Data Description

SEDAR 99 assesses all Gulf King Mackerel in federal waters from the Florida Keys west to the Texas-Mexico border, with landings occurring within the defined “mixing zone” (Figure 1) being split 50/50 between the Gulf and South Atlantic during the winter months (Nov – Mar), and 100% of landings being attributed to the South Atlantic during all other seasons. Because landings from the mixing zone are only considered to contribute to the gulf at 50% during winter, and not at all during non-winter months, biological samples from the mixing zone have been excluded. The mixing zone is defined as the areas South of US 1 in the Key West and Marathon areas (Area 1.0, 1.9, 748.0, 748.9), and the Atlantic side of the Tortugas (Area 2.2, 2.9) (Figure 1, top panel). In cases where subarea information was not available (length data, some age data), samples falling within areas 1 & 2 were considered to be from the mixing zone and were therefore excluded (Figure 1, bottom panel). Therefore, biological samples from areas 1 & 2 are only included when subarea information was available, and the subarea pertained to the Gulf stock.

For this assessment, compositions were estimated for two fleets, commercial handline, and gillnet, as a sex-aggregated model and for a sex-specific model. When weighting by landings, the Gulf was split into two subregions (east and west) for weighting. The east and west subregions are defined using statistical zones with the east comprising zones 3 – 12, and the west comprising zones 13 – 21 and are shown in Figure 1. For the gillnet fleet, no samples were available from the western subregion, and therefore, no weighting was done by landings, nominal ages were reweighted by nominal length compositions. For the landings, landings from other gears are combined into the Handline+ fleet. However, for length and age compositions only handline samples are used and samples from other gears are excluded. This is to avoid bias in the compositions due to the majority of the landings data coming from handline gears compared to “other” gears. The commercial data source utilized to generate the length and age compositions for the commercial fleets consists of length samples from the Trip Interview Program (Beggerly *et al.* 2022), and age samples collected by federal and state sampling programs.

## Commercial Length Compositions of Landings

### Length Samples

Length samples of commercial landings were obtained from the TIP database maintained by the NMFS Southeast Fisheries Science Center (SEFSC), and from the GulfFIN database, and were filtered to remove biases that include samples from pooled trips and any size or effort bias. Samples from the handline and gillnet fisheries were available from calendar year 1984 onward. For this assessment, fishing year is used, where the fishing year begins July 1<sup>st</sup> and ends June

30<sup>th</sup>, meaning some available samples come from fishing year 1983, however, as this is only a partial fishing year within the length data, these samples are recommended to be dropped.

These data were compiled using length bins of 5 centimeters (cm) with the floor of the bin being labeled. Total length in cm ( $TL$ ) and standard length in cm ( $SL$ ) were converted to fork length in cm ( $FL$ ) using the following conversion equations:

$$FL = -4.28 + 0.963 * TL$$

$$FL = 0.663 + 1.051 * SL$$

A minimum length bin of 20 cm was used, and a maximum length bin of 160 cm was used, with fish falling outside of this range being pooled in the smallest or largest bin. Any fish lengths greater than 200 cm  $FL$  were deleted and assumed to be errors.

### Nominal length Compositions

Nominal length compositions for the commercial handline fleet (HL) and commercial gillnet fleet (GN) were estimated for King Mackerel landings from the GMFMC/SAFMC boundary to the TX/Mexico border for a sex-aggregated model as well as for a sex-specific model. Annual nominal length compositions were estimated using length bins of 5 cm, where for each year  $i$ , sex  $s$ , and length bin  $j$ ,

$$LC_{i,s,j} = \frac{n_{i,s,j}}{n_{i,s}}$$

where  $n_{i,s,j}$  is the number of samples in year  $i$ , sex  $s$  and length bin  $j$ ;  $n_{i,s}$  is the number of samples in year  $i$  and sex  $s$  (i.e., summed across length bins); and  $LC_{i,s,j}$  is the proportion of the total number of sampled fish in each year  $i$  and sex  $s$  within each length bin  $j$ . For the aggregated sex model, the same equation is used, with the exception that there is no grouping by sex.

Annual nominal length compositions for the sex-aggregated model are shown by gear in Figure 2. Annual nominal length compositions for the sex-specific model are shown by sex in Figures 3 and 4 for handline and gillnet, respectively. Annual sample sizes of commercial lengths and trips are shown for the sex-aggregated model in Tables 1 and 2 for commercial handline and gillnet, respectively. Annual sample sizes of commercial handline lengths and trips are shown for the sex-specific model in Tables 3 and 4 for female and male, respectively. Annual sample sizes of commercial gillnet lengths and trips are shown for the sex-specific model in Tables 5 and 6 for female and male, respectively. Tables 1 – 6 show sample sizes by weighting strata (Year & Subregion) as well as annual totals. For the nominal compositions, the total column is used to identify years with sufficient samples. Years with fewer than 30 length samples or fewer than 10 trips are recommended to be dropped from further analyses. All available years are presented in Tables 1 – 6, regardless of the recommendation to drop.

## Weighted length compositions

In order to account for potential spatial bias in sampling effort, and account for the spatial distribution of fishing effort, nominal length compositions were re-weighted using the landings proportions by subregion (East: areas 744, 748, 1 - 12, West: areas 13 - 21). Note that in this case, landings from the mixing zone were included when calculating proportions, although samples from the mixing zone are not included in the length data. This is due to the fact that only 50% of mixing zone landings during winter, and no mixing zone landings in other seasons contribute to the gulf landings totals, and biological samples cannot be split in this manner. Length sample sizes and number of trips are provided by weighting strata in Tables 1 – 6. Weighting strata (sex aggregated: year, gear, and subregion; sex-specific: year, gear, sex, and subregion) with fewer than 30 length samples or fewer than 10 trips are recommended to be dropped from further analyses and have been highlighted in red. For the commercial gillnet fleet, no samples were available from the West subregion, therefore no weighted length compositions were appropriate. Instead of weighting the ages by weighted length compositions, for gillnet the ages were weighted by the nominal length compositions.

For the commercial handline fleet, weighting strata-specific nominal length compositions were estimated using length bins of 5 cm, where for each year  $i$ , length bin  $j$ , subregion  $r$ , and sex  $s$

$$LC_{i,j,r,s} = \frac{n_{i,j,r,s}}{n_{i,r,s}}$$

$n_{i,j,r,s}$  is the number of samples in year  $i$ , subregion  $r$ , sex  $s$ , and length bin  $j$ ;  $n_{i,r,s}$  is the number of samples in year  $i$  and subregion  $r$ , and sex  $s$  (i.e., summed across length bins); and  $LC_{i,j,r,s}$  is the proportion of the total number of sampled fish in each year  $i$  and subregion  $r$ , and sex  $s$ , within each length bin  $j$ . Next, the weighting strata-specific length compositions were weighted based on the proportion of landings in each subregion  $r$  and year  $i$ .

Proportions of annual landings from each subregion  $r$  in year  $i$ ,  $p_{i,r}$ , were used to weight the strata-specific length compositions,  $LC_{i,j,r,s}$ , which were then summed across subregions  $r$

$$LC_{i,j,s} = \sum_r (LC_{i,j,r,s} * p_{i,r})$$

resulting in the final weighted estimates of landings length compositions,  $LC_{i,j,s}$ . This procedure would down-weight, for example, any instances where 60% of the length samples come from a subregion that only accounts for 20% of the landings for that fleet. Annual proportions of landings by subregion were used in the weighting process, however, to protect confidentiality of the landings data, proportions are presented by time block in this report. The proportions of landings by management period (1984 – 2006; 2007 – 2023) and subregion,  $p_{i,r}$  are presented for commercial handline in Table 7. A split of the time series at 2007 was used due to the implementation of the Red Snapper IFQ often leading to changes in fishing behavior when comparing before and after implementation. No landings proportions are presented for commercial gillnet as there were no length samples from the west subregion, as mentioned above. The effects of this weighting procedure are shown in Figure 5 for the sex aggregated model, and Figures 6 and 7 for HL – female and HL – male respectively. The effects of

weighting are minimal in many years. The weighted length compositions for the commercial handline fleet are recommended for use in the model for years with sufficient sample sizes.

## Commercial Age Compositions of Landings

### Age Samples

The commercial age samples were a subset of the length samples. Age data compiled by the SEFSC Panama City Laboratory were filtered to remove duplicated and biased data. For the commercial age compositions, a plus group of 12 was used, meaning all ages 12+ have been grouped into the same age bin.

### Nominal Age Compositions

Nominal age compositions were estimated for the commercial handline fleet (HL) and gillnet fleet (GN) in each year for each sex. Any strata with fewer than 10 age samples were recommended to be dropped. Nominal age compositions of landings were estimated using the following equation within each year  $i$ , sex  $s$ , and age bin  $k$ ,

$$AC_{i,r,k} = \frac{a_{i,s,k}}{a_{i,s}}$$

where  $a_{i,s,k}$  is the number of age samples in year  $i$ , sex  $s$ , and age bin  $k$ ;  $a_{i,s}$  is the number of age samples in year  $i$  and sex  $s$ ; and  $AC_{i,s,k}$  is the proportion of the total number of sampled fish in each year  $i$  and sex  $s$  within each age bin  $k$ . A minimum sample size threshold was recommended annually within each year stratum,  $AC_{i,s}$ , where these were recommended to be dropped and excluded from further analyses if  $a_{i,s} < 10$ .

The annual nominal age compositions for the sex-aggregated model are shown by gear in Figure 8. For the sex-specific model, annual nominal age compositions are shown by sex in Figures 9 and 10 for the commercial handline and gillnet fisheries, respectively. Bubble plots showing the annual age compositions for the sex-aggregated model are shown in Figures 11 and 12 for handline and gillnet, respectively. Bubble plots showing the annual age compositions for the sex-specific model are shown in Figures 13 – 16 for handline female, handline male, gillnet female and gillnet male, respectively. Annual sample sizes of commercial ages and trips by gear group are shown for the sex-aggregated model in Table 8, and for the sex-specific model in Table 9.

### Weighted Age Compositions

In order to account for potential sampling biases in the age data, the nominal age compositions are typically re-weighted by the weighted length compositions. In order for the data to be deemed sufficient for weighted age compositions, each stratum must contain a minimum of 10 ages, and there must be a corresponding weighted length composition (i.e. there must be a minimum of 30 lengths in both the East and the West). As there were insufficient data to provide any weighted length compositions for gillnet, the nominal age compositions were instead re-weighted by the nominal length compositions. Weighting of the nominal age compositions was done for both sex-specific and sex-aggregated models. In order to be included in the model, weighted ages must meet the minimum age sample and trip size requirements, as well as have a valid weighted length composition (or valid nominal composition). Summaries of data

availability (including the availability of weighted age compositions) are shown in Tables 10 and 11 for the sex-aggregated and sex-specific models respectively.

In order to weight the nominal age compositions, first a re-weighting factor,  $RW_{i,s,j}$ , was calculated within each year  $i$  sex  $s$  and length bin  $j$  to correct the composition of the age data (number of age samples in each length bin divided by the annual total) to more closely represent the final length composition of the landings. The re-weighting factor was calculated as follows,

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

where  $LC_{i,s,j}$  is the weighted length composition in year  $i$  sex  $s$  and length bin  $j$ ,  $a_{i,s,j}$  is the number of age samples in year  $i$  sex  $s$  and length bin  $j$ , and  $a_{i,s}$  is the number of age samples in year  $i$  and sex  $s$ . Under this methodology, if there were age samples  $a_{i,s,j}$  not represented in  $LC_{i,s,j}$ , they were down-weighted to zero and effectively dropped from further analysis. The final commercial weighted age compositions were estimated as

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

where all length bins  $j$  within an age class  $k$  were summed, then re-scaled to sum to 1 across each year. The re-weighting factor will up-weight ages from less represented length bins and will generate a more representative estimate of landings' age compositions. Effects of the age composition weighting procedure for the sex-aggregated model are shown in Figures 17 and 18 for the commercial handline and gillnet fleets, respectively. Effects of the age composition weighting procedure for the sex-specific model are shown in Figures 19 – 22 for handline female, handline male, gillnet female and gillnet male, respectively. In all cases, the figures show minimal differences between composition types in most years. Additionally, bubble plots showing the final weighted age distributions for the sex-aggregated model are shown in Figures 23 and 24, for the commercial handline and gillnet fleets, respectively. Bubble plots showing the final weighted age distributions for the sex-specific model are shown in Figures 25 – 28 for handline female, handline male, gillnet female and gillnet male, respectively.

## Commercial Conditional Age-at-Length

Conditional age-at-length (CAAL) is the proportion of fish, at age, in a given length bin. When data are sufficient (i.e. wide spread of ages and lengths represented), CAAL is considered to be more informative than length and age compositions because it can be used to directly estimate the length-at-age process and the variability in length-at-age (Taylor and Methot 2013; Piner et al. 2016; Lee et al. 2019). Another benefit of CAAL is that it avoids double use of fish for both age and length compositions, especially when age compositions are weighted by the length compositions.

For each commercial fleet (handline, gillnet) conditional age-at-length was estimated where for each year  $i$ , sex  $s$ , length bin  $j$ , and age class  $k$

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

$a_{i,s,j,k}$  is the number of age samples in year  $i$ , sex  $s$ , lower inclusive length bin  $j$ , and age class  $k$ ;  $a_{i,s,j}$  is the number of age samples in year  $i$ , sex  $s$ , and lower inclusive length bin  $j$ ; and  $CAAL_{i,s,j,k}$  is the proportion of fish samples in year  $i$ , sex  $s$ , and length bin  $j$  within age class  $k$ . **Error! Reference source not found.** Conditional age-at-length by year is shown for the sex-aggregated model in Figures 29 and 30 for commercial handline and gillnet, respectively. Conditional age-at-length by year is shown for the sex-specific model in Figures 31 – 34 for handline female, handline male, gillnet female and gillnet male, respectively.

Data availability summarized across nominal lengths, nominal ages, weighted lengths, weighted ages, and conditional age at length are provided in Tables 10 and 11 for the sex-aggregated model and sex specific model respectively. Mean length at age is excluded from these tables, as it is not a model input subject to sample size limitations, but rather a diagnostic tool for the analyst.

### Commercial Mean Length-at-Age

Fleet-specific mean length-at-age and associated sample sizes were also provided to the lead analyst to aid in model diagnostics. Mean length-at-age,  $MLAA_{i,k}$ , was estimated as the sum of all lengths  $L_{i,s,k}$  divided by the associated sample sizes  $a_{i,s,k}$  within each year  $i$ , sex  $s$ , and age class  $k$ .

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

The mean length-at-age by year for the sex-aggregated model is shown in Figures 35 and 36 for commercial handline and gillnet fleets, respectively. The mean length-at-age by year for the sex-specific model is shown in Figures 37 – 40 for handline female, handline male, gillnet female and gillnet male, respectively.

## References

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## Tables

**Table 1.** Annual number of Gulf King Mackerel commercial **handline (HL)** length samples and associated trips by subregion, and totals across subregion, for the **sex-aggregated model**. Years not meeting the recommended **30 fish** or **10 trip** minimum filter are highlighted in **red**. When evaluating data for nominal compositions, the sample sizes from the Total columns are used. When evaluating data for weighted compositions, the sample sizes from the East and West columns are used. Any year with either too few fish or too few trips is recommended to be dropped.

Fishing Year	East		West		Total	
	# of Fish	# of Trips	# of Fish	# of Trips	# of Fish	# of Trips
1984	662	20	12417	336	13079	356
1985	176	9	3309	145	3485	154
1986	57	4	916	58	973	62
1987	1298	25	425	18	1723	43
1988	26	2	380	15	406	17
1989	85	4	1306	46	1391	50
1990	25	3	242	16	267	19
1991	149	15	1725	72	1874	87
1992	253	14	2952	128	3205	142
1993	393	25	470	24	863	49
1994	800	35	309	12	1109	47
1995	636	40	16	1	652	41
1996	787	39	0	0	787	39
1997	1151	48	413	20	1564	68
1998	848	41	0	0	848	41
1999	930	49	0	0	930	49
2000	824	53	25	1	849	54
2001	598	41	169	10	767	51
2002	293	28	615	35	908	63
2003	398	35	643	37	1041	72
2004	252	31	659	49	911	80
2005	131	10	606	39	737	49
2006	214	18	708	31	922	49
2007	51	8	915	39	966	47
2008	114	14	881	36	995	50
2009	241	21	1005	41	1246	62
2010	90	6	957	44	1047	50
2011	133	13	2447	141	2580	154
2012	316	19	2846	172	3162	191
2013	655	42	2883	203	3538	245
2014	625	23	2834	212	3459	235
2015	683	37	5663	301	6346	338
2016	584	37	4222	229	4806	266
2017	216	24	4405	211	4621	235

2018	642	49	3475	204	4117	253
2019	832	68	3783	234	4615	302
2020	290	28	387	26	677	54
2021	949	82	634	53	1583	135
2022	796	70	657	55	1453	125
2023	725	56	596	41	1321	97

**Table 2.** Annual number of Gulf King Mackerel commercial **gillnet (GN)** length samples and associated trips by subregion, and totals across subregion, for the **sex-aggregated model**. Years not meeting the recommended **30** fish or **10** trip minimum filter are highlighted in **red**. When evaluating data for nominal compositions, the sample sizes from the Total columns are used. When evaluating data for weighted compositions, the sample sizes from the East and West columns are used. Any year with either too few fish or too few trips is recommended to be dropped.

Fishing Year	East		West		Total	
	# of Fish	# of Trips	# of Fish	# of Trips	# of Fish	# of Trips
1984	79	1	0	0	79	1
1985	175	2	0	0	175	2
1986	110	3	0	0	110	3
1987	0	0	0	0	0	0
1988	0	0	0	0	0	0
1989	0	0	0	0	0	0
1990	0	0	0	0	0	0
1991	0	0	0	0	0	0
1992	0	0	0	0	0	0
1993	0	0	0	0	0	0
1994	1	1	0	0	1	1
1995	40	2	0	0	40	2
1996	0	0	0	0	0	0
1997	435	9	0	0	435	9
1998	1192	17	0	0	1192	17
1999	0	0	0	0	0	0
2000	50	1	0	0	50	1
2001	0	0	0	0	0	0
2002	3	2	0	0	3	2
2003	0	0	0	0	0	0
2004	0	0	0	0	0	0
2005	33	1	0	0	33	1
2006	37	1	0	0	37	1
2007	333	11	0	0	333	11
2008	216	9	0	0	216	9
2009	426	14	0	0	426	14
2010	388	11	0	0	388	11
2011	317	6	0	0	317	6
2012	687	8	0	0	687	8
2013	622	25	0	0	622	25
2014	690	24	0	0	690	24
2015	692	17	0	0	692	17
2016	249	9	0	0	249	9
2017	183	5	0	0	183	5
2018	139	4	0	0	139	4
2019	63	4	0	0	63	4

2020	0	0	0	0	0	0
2021	0	0	0	0	0	0
2022	80	3	0	0	80	3
2023	93	5	0	0	93	5

**Table 3.** Annual number of **female** Gulf King Mackerel commercial **handline (HL)** length samples and associated trips by subregion, and totals across subregion, for the **sex-specific model**. Years not meeting the recommended **30** fish or **10** trip minimum filter are highlighted in **red**. When evaluating data for nominal compositions, the sample sizes from the Total columns are used. When evaluating data for weighted compositions, the sample sizes from the East and West columns are used. Any year with either too few fish or too few trips is recommended to be dropped.

Fishing Year	Female					
	East		West		Female Total	
	# of Fish	# of Trips	# of Fish	# of Trips	# of Fish	# of Trips
1984	253	14	7449	325	7702	339
1985	108	8	1982	133	2090	141
1986	10	3	463	46	473	49
1987	308	13	152	11	460	24
1988	5	1	202	14	207	15
1989	0	0	572	30	572	30
1990	18	3	9	2	27	5
1991	8	3	672	51	680	54
1992	0	0	780	46	780	46
1993	36	8	207	23	243	31
1994	10	2	4	2	14	4
1995	108	4	0	0	108	4
1996	11	2	0	0	11	2
1997	68	12	176	13	244	25
1998	111	6	0	0	111	6
1999	83	7	0	0	83	7
2000	73	7	0	0	73	7
2001	239	31	61	8	300	39
2002	138	14	248	26	386	40
2003	183	27	265	35	448	62
2004	113	24	393	47	506	71
2005	45	5	368	39	413	44
2006	79	7	395	31	474	38
2007	7	2	528	38	535	40
2008	40	8	490	35	530	43
2009	49	8	571	40	620	48
2010	21	3	628	44	649	47
2011	42	4	1303	139	1345	143
2012	85	8	1597	168	1682	176
2013	267	29	1399	196	1666	225
2014	34	7	1352	199	1386	206
2015	134	16	3660	297	3794	313
2016	229	22	2575	221	2804	243
2017	48	4	2821	209	2869	213

2018	180	26	1969	194	2149	220
2019	163	34	2297	223	2460	257
2020	80	15	261	25	341	40
2021	215	41	324	48	539	89
2022	150	30	359	49	509	79
2023	118	24	364	39	482	63

**Table 4.** Annual number of **male** Gulf King Mackerel commercial **handline (HL)** length samples and associated trips by subregion, and totals across subregion, for the **sex-specific model**. Years not meeting the recommended **30** fish or **10** trip minimum filter are highlighted in **red**. When evaluating data for nominal compositions, the sample sizes from the Total columns are used. When evaluating data for weighted compositions, the sample sizes from the East and West columns are used. Any year with either too few fish or too few trips is recommended to be dropped.

Fishing Year	Male					
	East		West		Male Total	
	# of Fish	# of Trips	# of Fish	# of Trips	# of Fish	# of Trips
1984	214	14	4418	302	4632	316
1985	68	7	1121	111	1189	118
1986	6	1	354	41	360	42
1987	194	11	161	12	355	23
1988	2	1	167	14	169	15
1989	0	0	174	30	174	30
1990	7	3	1	1	8	4
1991	9	3	400	48	409	51
1992	0	0	345	40	345	40
1993	42	7	247	23	289	30
1994	8	1	0	0	8	1
1995	120	4	0	0	120	4
1996	1	1	0	0	1	1
1997	45	11	122	13	167	24
1998	92	6	0	0	92	6
1999	70	7	0	0	70	7
2000	59	6	0	0	59	6
2001	183	29	85	8	268	37
2002	71	14	316	32	387	46
2003	125	25	348	31	473	56
2004	101	22	249	46	350	68
2005	19	4	234	35	253	39
2006	13	5	313	28	326	33
2007	3	2	385	35	388	37
2008	28	7	390	31	418	38
2009	14	7	434	39	448	46
2010	16	2	329	41	345	43
2011	24	4	1140	133	1164	137
2012	35	7	1161	156	1196	163
2013	191	26	1428	181	1619	207
2014	35	6	1439	197	1474	203
2015	55	17	1993	280	2048	297
2016	83	20	1613	207	1696	227
2017	11	3	1575	192	1586	195

2018	121	19	1452	184	1573	203
2019	133	30	1392	199	1525	229
2020	100	17	126	24	226	41
2021	173	38	307	44	480	82
2022	88	28	297	51	385	79
2023	71	17	232	34	303	51

**Table 5.** Annual number of **female** Gulf King Mackerel commercial **gillnet (GN)** length samples and associated trips by subregion, and totals across subregion, for the **sex-specific model**. Years not meeting the recommended **30** fish or **10** trip minimum filter are highlighted in **red**. When evaluating data for nominal compositions, the sample sizes from the Total columns are used. When evaluating data for weighted compositions, the sample sizes from the East and West columns are used. Any year with either too few fish or too few trips is recommended to be dropped.

Fishing Year	Female					
	East		West		Female Total	
	# of Fish	# of Trips	# of Fish	# of Trips	# of Fish	# of Trips
1984	33	1	0	0	33	1
1985	76	2	0	0	76	2
1986	31	1	0	0	31	1
1987	0	0	0	0	0	0
1988	0	0	0	0	0	0
1989	0	0	0	0	0	0
1990	0	0	0	0	0	0
1991	0	0	0	0	0	0
1992	0	0	0	0	0	0
1993	0	0	0	0	0	0
1994	0	0	0	0	0	0
1995	13	2	0	0	13	2
1996	0	0	0	0	0	0
1997	234	9	0	0	234	9
1998	539	16	0	0	539	16
1999	0	0	0	0	0	0
2000	28	1	0	0	28	1
2001	0	0	0	0	0	0
2002	0	0	0	0	0	0
2003	0	0	0	0	0	0
2004	0	0	0	0	0	0
2005	15	1	0	0	15	1
2006	31	1	0	0	31	1
2007	171	10	0	0	171	10
2008	114	4	0	0	114	4
2009	202	9	0	0	202	9
2010	171	10	0	0	171	10
2011	147	2	0	0	147	2
2012	114	5	0	0	114	5
2013	259	14	0	0	259	14
2014	371	17	0	0	371	17
2015	198	9	0	0	198	9
2016	138	4	0	0	138	4
2017	101	3	0	0	101	3
2018	44	3	0	0	44	3

2019	22	2	0	0	22	2
2020	0	0	0	0	0	0
2021	0	0	0	0	0	0
2022	46	3	0	0	46	3
2023	53	5	0	0	53	5

**Table 6.** Annual number of **male** Gulf King Mackerel commercial **gillnet (GN)** length samples and associated trips by subregion, and totals across subregion, for the **sex-specific model**. Years not meeting the recommended **30** fish or **10** trip minimum filter are highlighted in **red**. When evaluating data for nominal compositions, the sample sizes from the Total columns are used. When evaluating data for weighted compositions, the sample sizes from the East and West columns are used. Any year with either too few fish or too few trips is recommended to be dropped.

Fishing Year	Male					
	East		West		Male Total	
	# of Fish	# of Trips	# of Fish	# of Trips	# of Fish	# of Trips
1984	25	1	0	0	25	1
1985	78	2	0	0	78	2
1986	25	1	0	0	25	1
1987	0	0	0	0	0	0
1988	0	0	0	0	0	0
1989	0	0	0	0	0	0
1990	0	0	0	0	0	0
1991	0	0	0	0	0	0
1992	0	0	0	0	0	0
1993	0	0	0	0	0	0
1994	0	0	0	0	0	0
1995	3	2	0	0	3	2
1996	0	0	0	0	0	0
1997	201	9	0	0	201	9
1998	621	17	0	0	621	17
1999	0	0	0	0	0	0
2000	22	1	0	0	22	1
2001	0	0	0	0	0	0
2002	0	0	0	0	0	0
2003	0	0	0	0	0	0
2004	0	0	0	0	0	0
2005	18	1	0	0	18	1
2006	6	1	0	0	6	1
2007	157	10	0	0	157	10
2008	88	4	0	0	88	4
2009	137	7	0	0	137	7
2010	160	10	0	0	160	10
2011	166	2	0	0	166	2
2012	125	5	0	0	125	5
2013	307	13	0	0	307	13
2014	300	17	0	0	300	17
2015	156	9	0	0	156	9
2016	102	4	0	0	102	4
2017	79	3	0	0	79	3
2018	48	3	0	0	48	3

2019	38	2	0	0	38	2
2020	0	0	0	0	0	0
2021	0	0	0	0	0	0
2022	34	3	0	0	34	3
2023	40	5	0	0	40	5

**Table 7.** Proportion of landings by subregion for two time blocks (Pre and Post Red Snapper IFQ) for the commercial **handline fleet**. Landings proportions are not presented for gillnet, as there are no weighted length compositions provided for gillnet.

Management Period	East	West
1984 - 2006	0.3596	0.6404
2007 - 2024	0.6276	0.3724

**Table 8.** Annual number of Gulf King Mackerel commercial age samples and associated trips by gear for the sex-aggregated model. Years not meeting the recommended 10 fish or 10 trip minimum filter are highlighted in red. Any year with either too few fish or too few trips is recommended to be dropped.

Fishing Year	Handline		Gillnet	
	# of Fish	# of Trips	# of Fish	# of Trips
1986	25	6	0	0
1987	10	3	0	0
1988	19	1	0	0
1989	4	3	0	0
1990	0	0	0	0
1991	248	34	0	0
1992	128	19	0	0
1993	645	107	6	1
1994	201	21	0	0
1995	310	16	16	1
1996	58	6	0	0
1997	135	10	0	0
1998	54	6	9	1
1999	85	9	0	0
2000	63	22	18	1
2001	378	36	0	0
2002	357	30	0	0
2003	438	42	0	0
2004	367	39	0	0
2005	391	48	0	0
2006	328	44	0	0
2007	914	81	235	16
2008	898	49	135	12
2009	1006	61	242	16
2010	955	51	222	13
2011	1295	152	262	6
2012	1138	157	476	12
2013	655	143	266	16
2014	641	183	202	17
2015	512	226	159	9
2016	388	188	167	8
2017	342	133	136	6
2018	444	166	53	2
2019	826	233	55	2
2020	146	34	0	0
2021	636	98	0	0
2022	608	84	69	3
2023	581	51	57	3

**Table 9.** Annual number of Gulf King Mackerel commercial age samples and associated trips by gear and sex for the sex-specific model. Years not meeting the recommended 10 fish or 10 trip minimum filter are highlighted in red. Any year with either too few fish or too few trips is recommended to be dropped.

Fishing Year	Handline				Gillnet			
	Female		Male		Female		Male	
	# of Fish	# of Trips	# of Fish	# of Trips	# of Fish	# of Trips	# of Fish	# of Trips
1986	13	6	12	5	0	0	0	0
1987	7	3	3	2	0	0	0	0
1988	15	1	4	1	0	0	0	0
1989	4	3	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0
1991	155	31	93	19	0	0	0	0
1992	78	18	50	11	0	0	0	0
1993	379	93	260	83	4	1	1	1
1994	123	19	76	18	0	0	0	0
1995	163	15	147	15	13	1	3	1
1996	50	6	8	2	0	0	0	0
1997	99	9	36	9	0	0	0	0
1998	32	6	22	6	2	1	7	1
1999	55	8	30	8	0	0	0	0
2000	34	13	29	14	11	1	7	1
2001	187	36	191	33	0	0	0	0
2002	198	28	153	28	0	0	0	0
2003	207	40	220	38	0	0	0	0
2004	190	34	176	33	0	0	0	0
2005	234	45	141	38	0	0	0	0
2006	174	43	153	36	0	0	0	0
2007	510	45	360	37	127	12	106	13
2008	495	44	401	41	70	11	65	11
2009	568	57	435	51	146	15	96	13
2010	628	50	327	45	125	13	97	11
2011	689	145	606	131	133	6	129	6
2012	668	138	466	107	269	12	207	11
2013	438	126	217	90	143	16	123	15
2014	465	167	175	98	108	17	94	16
2015	343	191	169	112	96	9	63	8
2016	266	149	120	86	70	8	42	7
2017	181	92	66	54	69	6	67	6
2018	282	133	148	88	27	2	26	2
2019	622	209	187	116	22	2	33	2
2020	94	28	40	19	0	0	0	0
2021	288	75	177	58	0	0	0	0
2022	280	62	204	58	43	3	26	3

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2023	310	47	206	37	32	3	25	3
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Figures

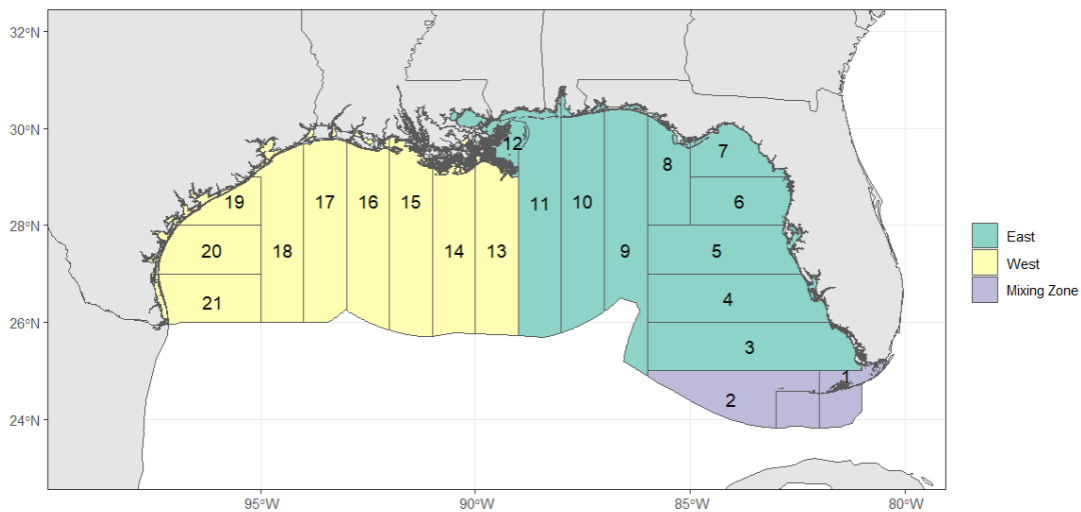
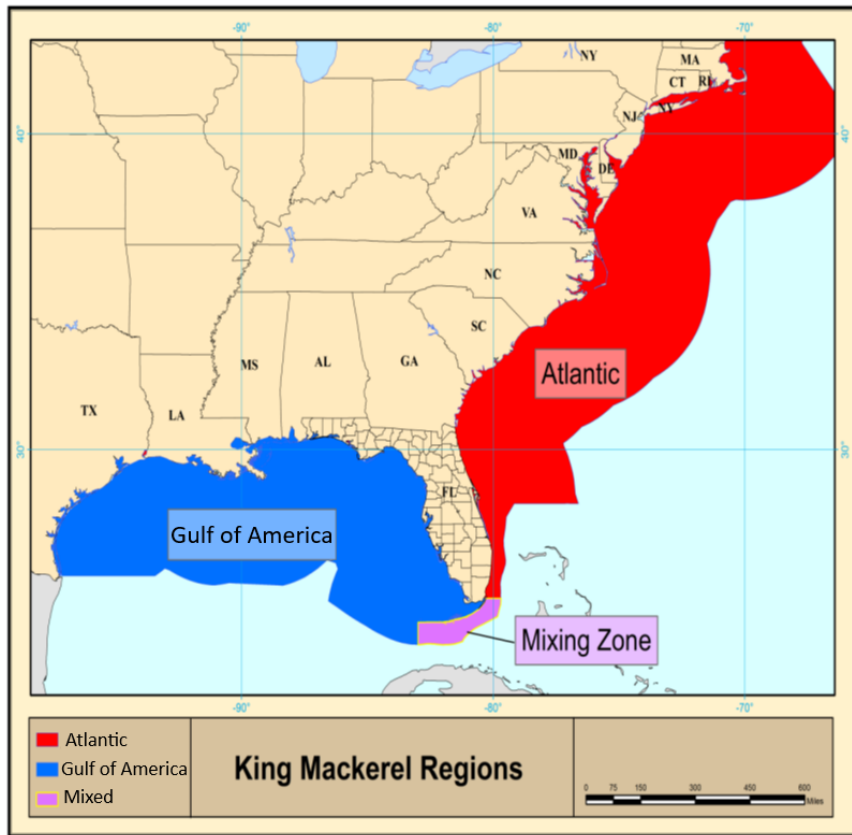


Figure 1. Gulf King Mackerel stock assessment regions (top panel), and Gulf commercial subregions used for weighting (bottom panel). Note that, the boundary between mixing zone and Gulf in the top panel includes subarea information, while the bottom panel depicts the case where subarea information is not available.

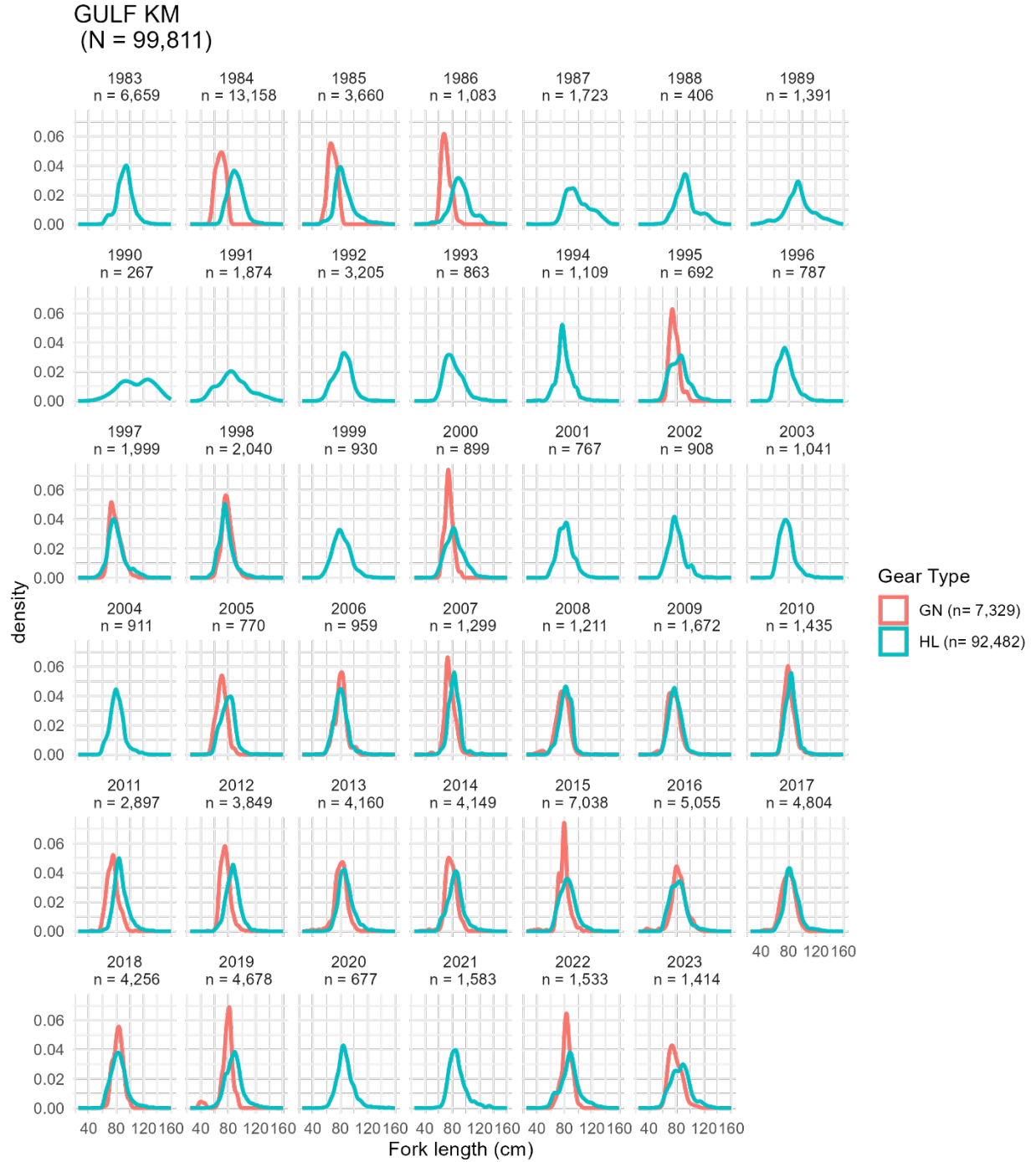


Figure 2. Annual nominal length distributions for the Gulf King Mackerel commercial handline and gillnet fisheries for the *sex-aggregated model*.

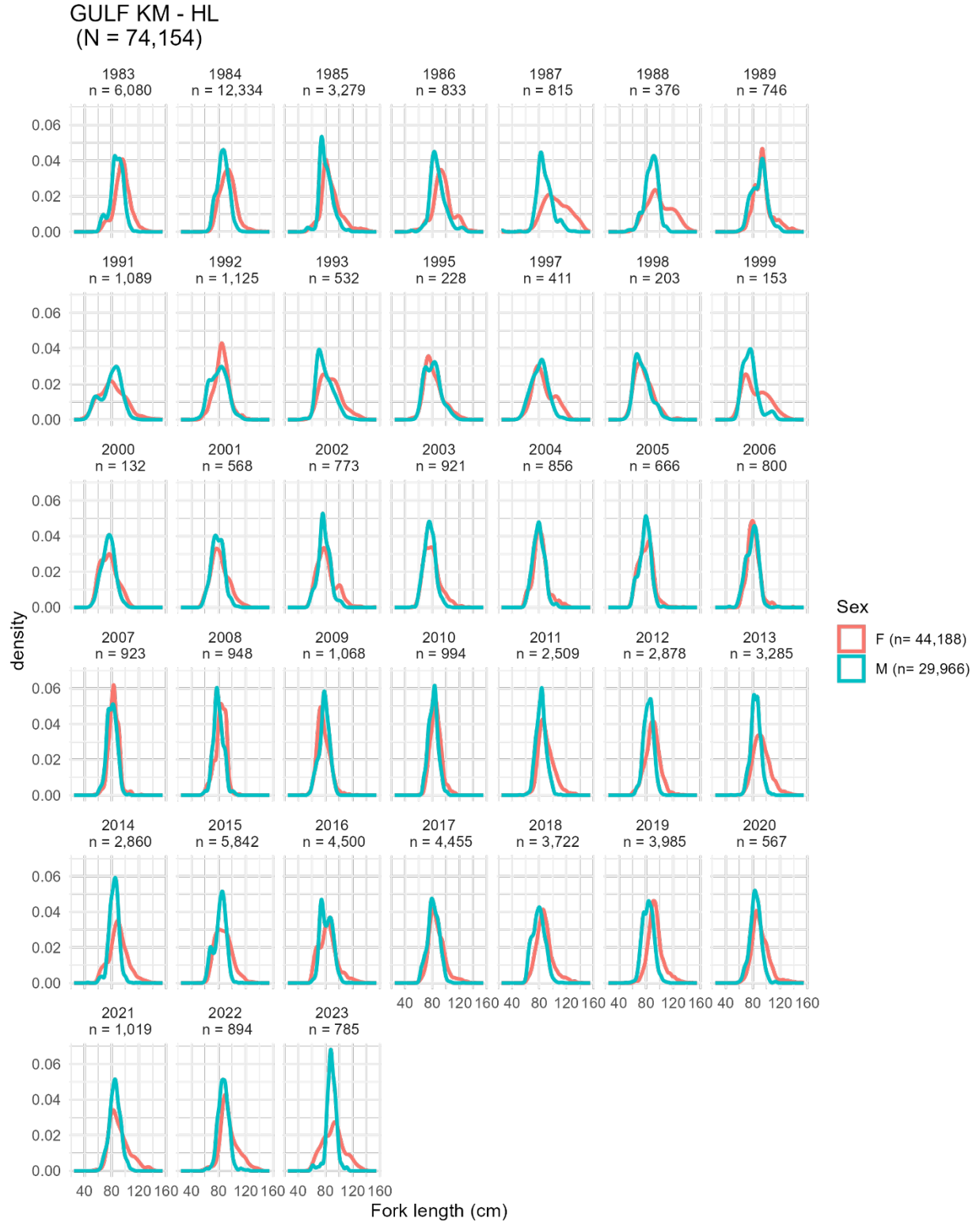
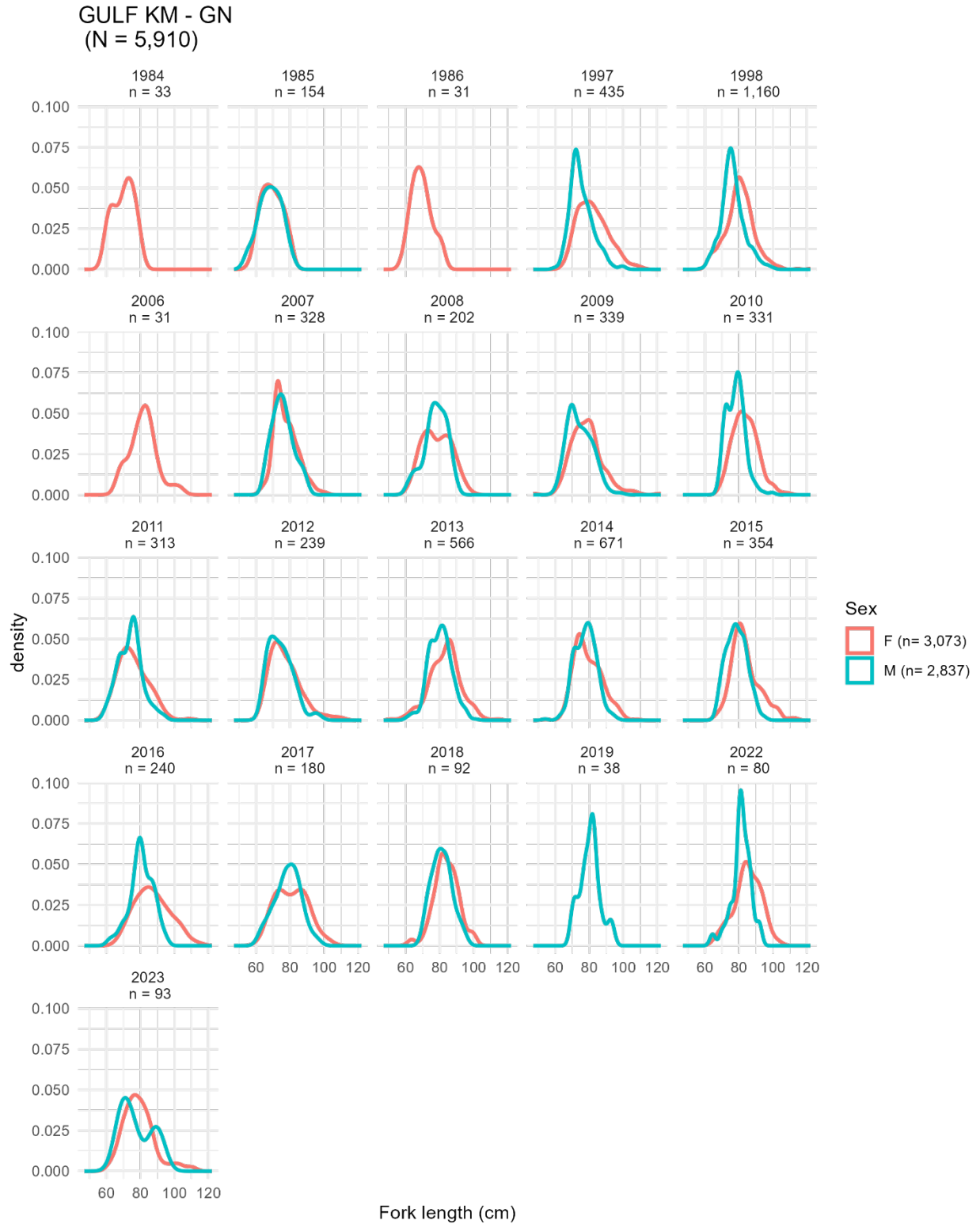


Figure 3. Annual nominal length distributions by sex for the Gulf King Mackerel commercial handline fishery for the sex-specific model.



*Figure 4. Annual nominal length distributions by sex for the Gulf King Mackerel commercial gillnet fishery for the sex-specific model.*

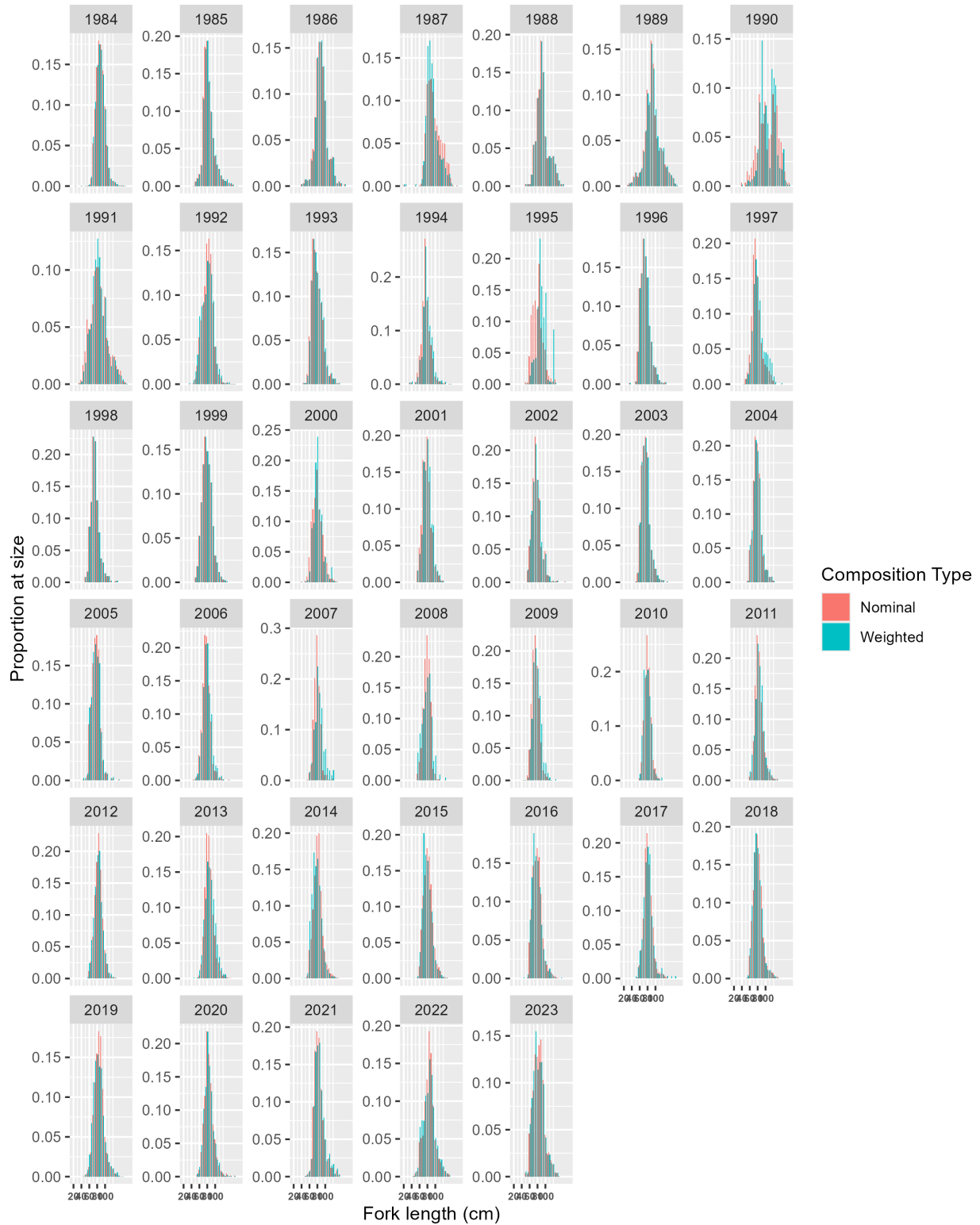


Figure 5. Annual comparison of the nominal and weighted length compositions for the Gulf King Mackerel commercial **handline fishery** for the **sex-aggregated model**.

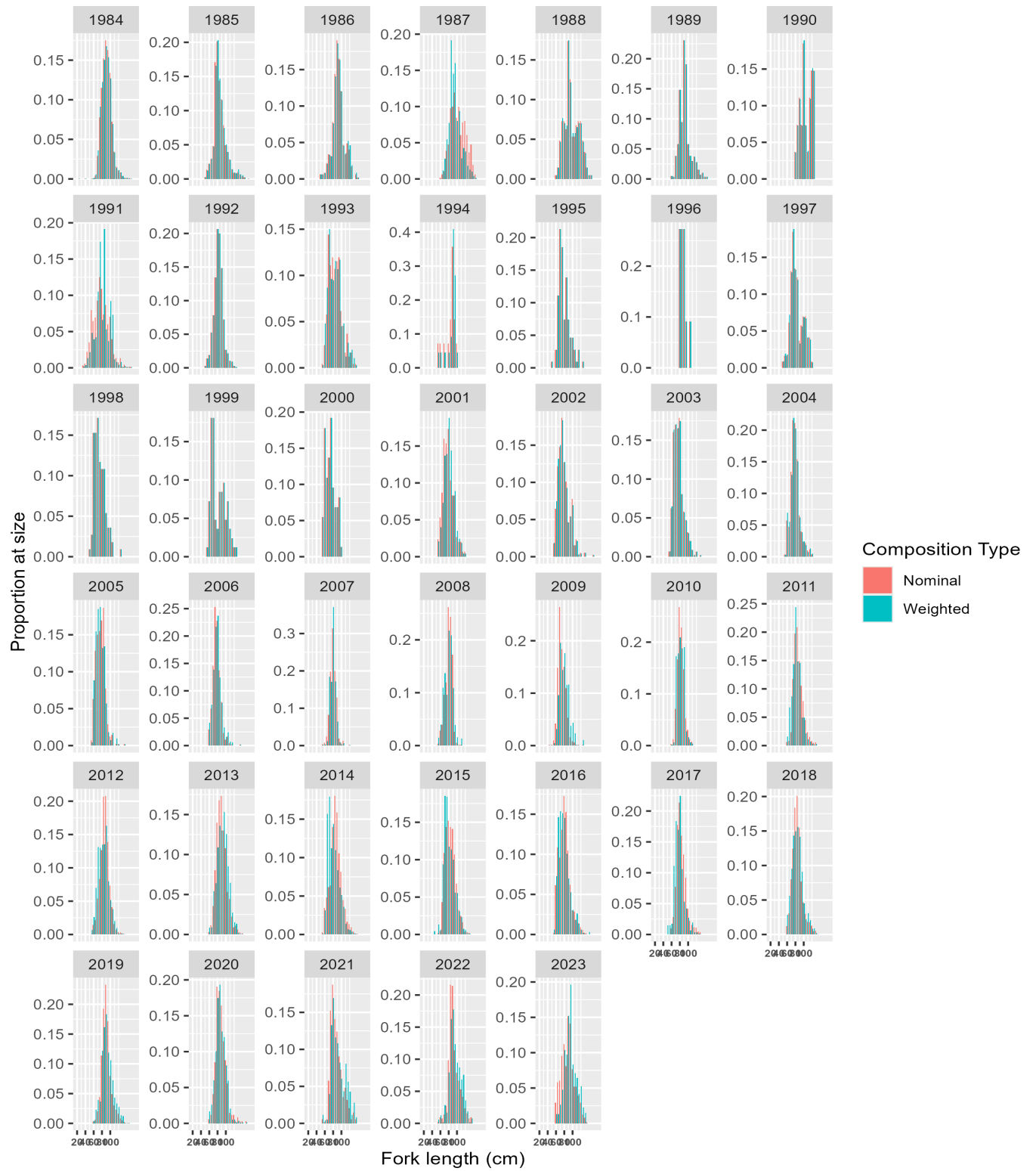


Figure 6. Annual comparison of the nominal and weighted length compositions for the *female Gulf King Mackerel commercial handline fishery for the sex-specific model.*

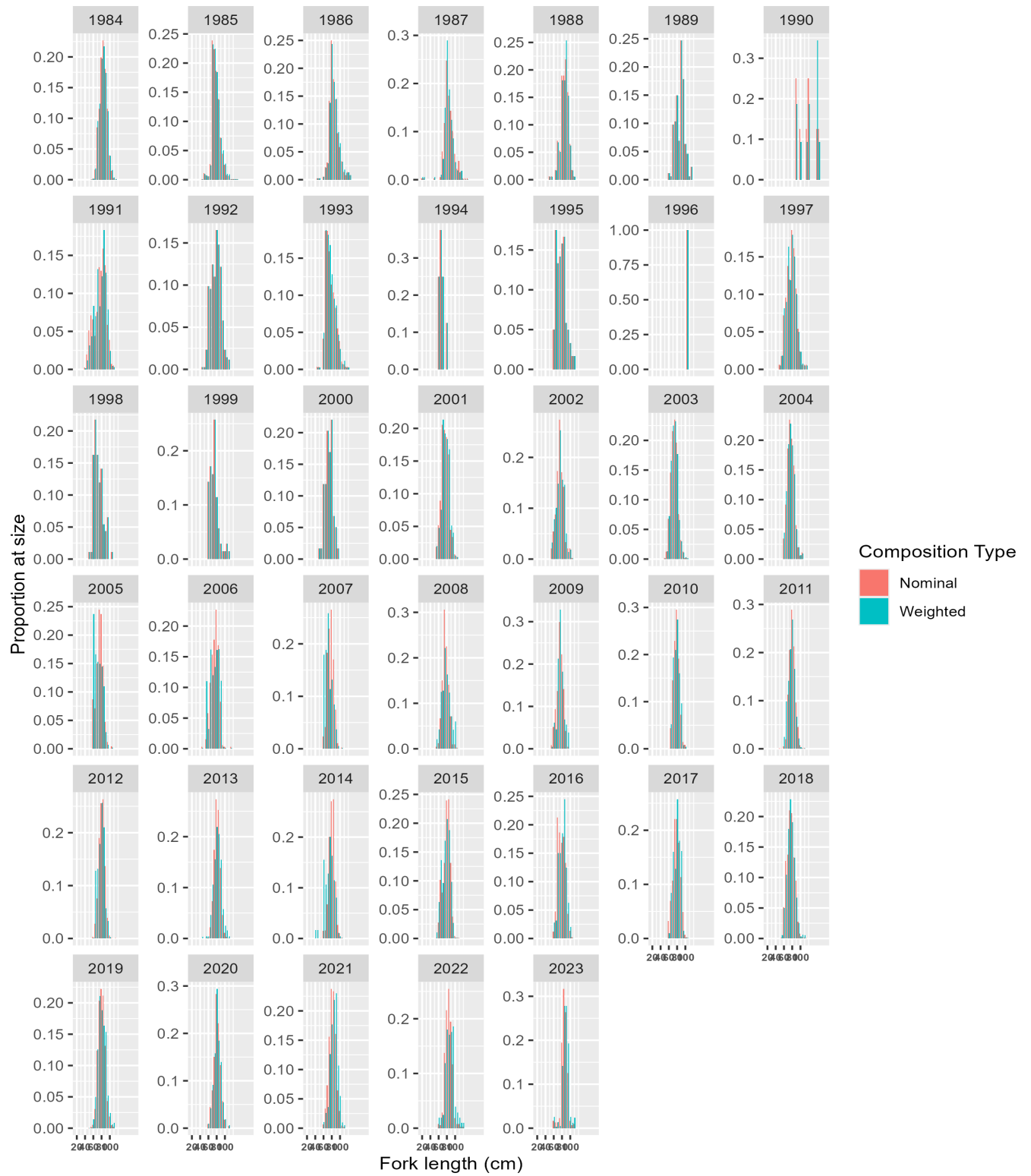


Figure 7. Annual comparison of the nominal and weighted length compositions for the *male* Gulf King Mackerel commercial *handline* fishery for the *sex-specific* model.

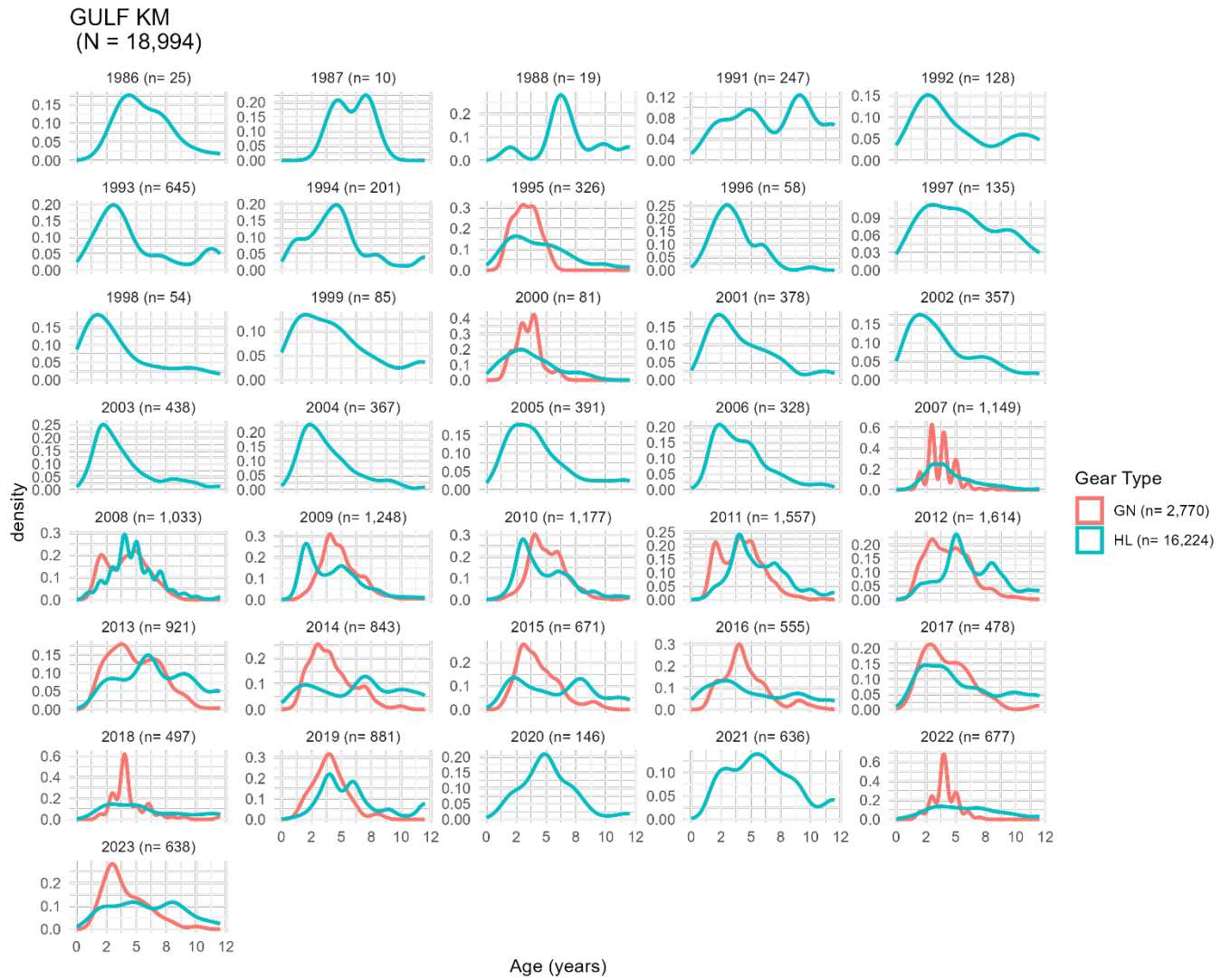


Figure 8. Annual nominal age compositions for the Gulf King Mackerel commercial handline and gillnet fisheries for the sex-aggregated model.

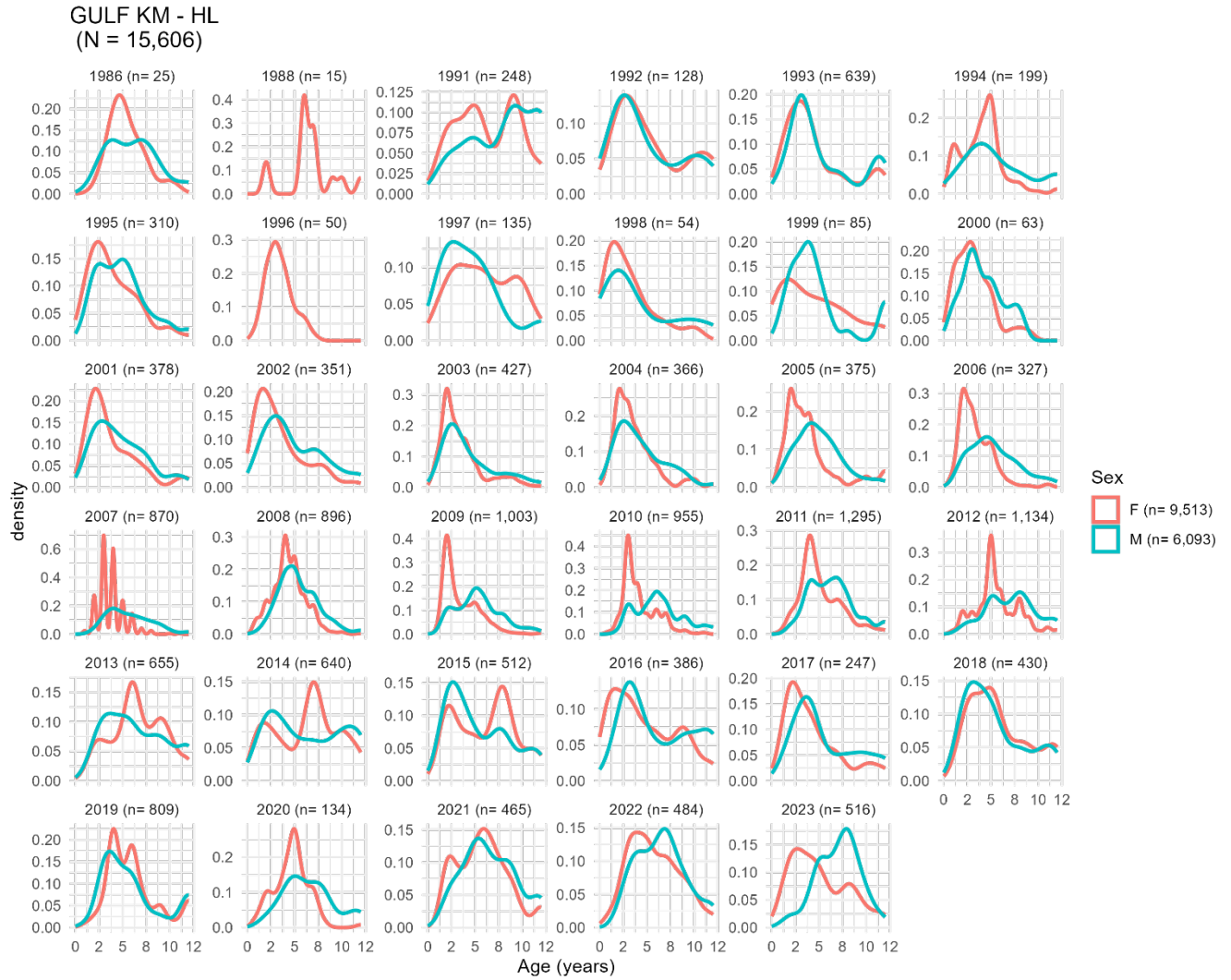
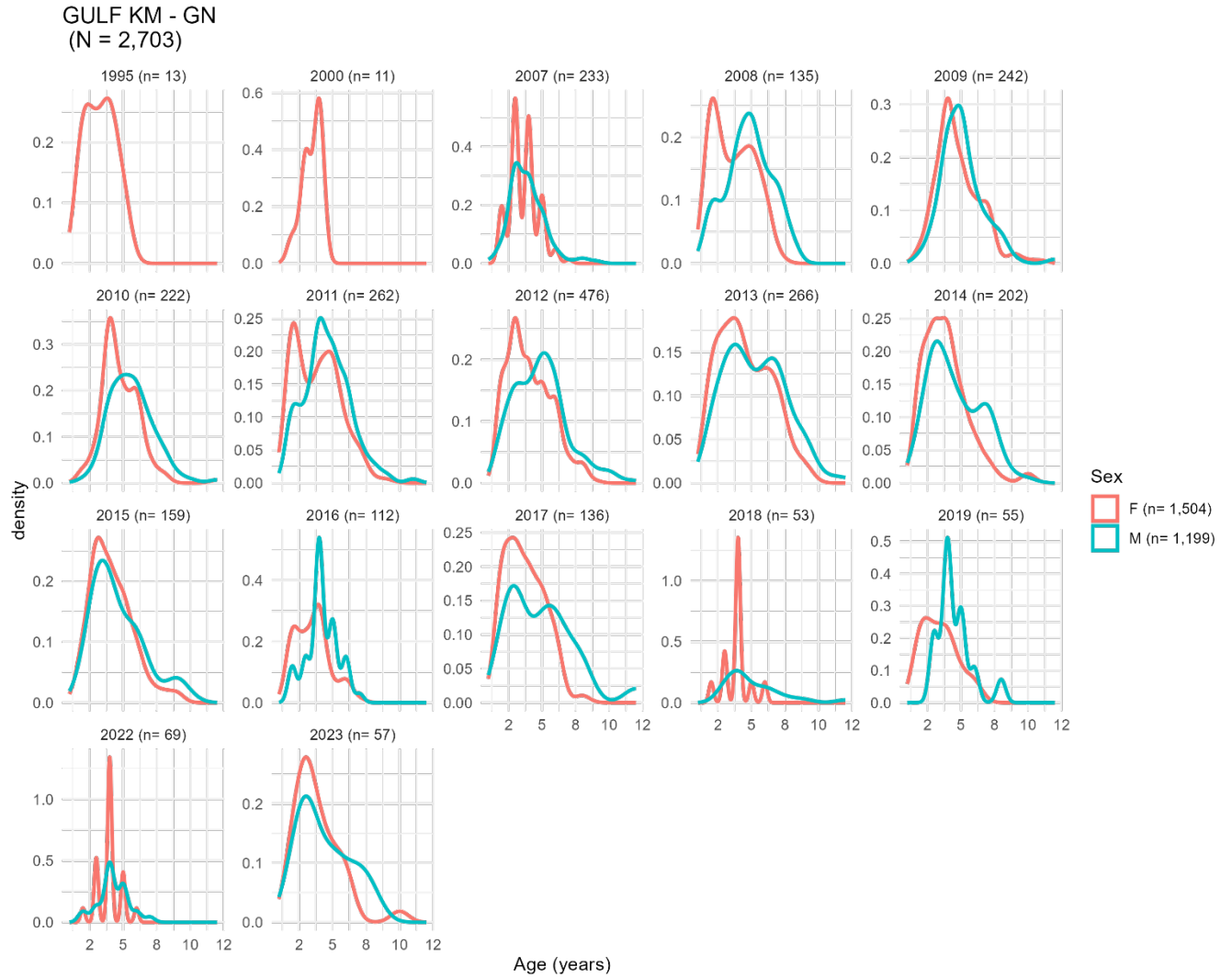


Figure 9. Annual nominal age compositions by sex for the Gulf King Mackerel commercial handline fishery for the sex-specific model.



*Figure 10. Annual nominal age compositions by sex for the Gulf King Mackerel commercial gillnet fishery for the sex-specific model.*

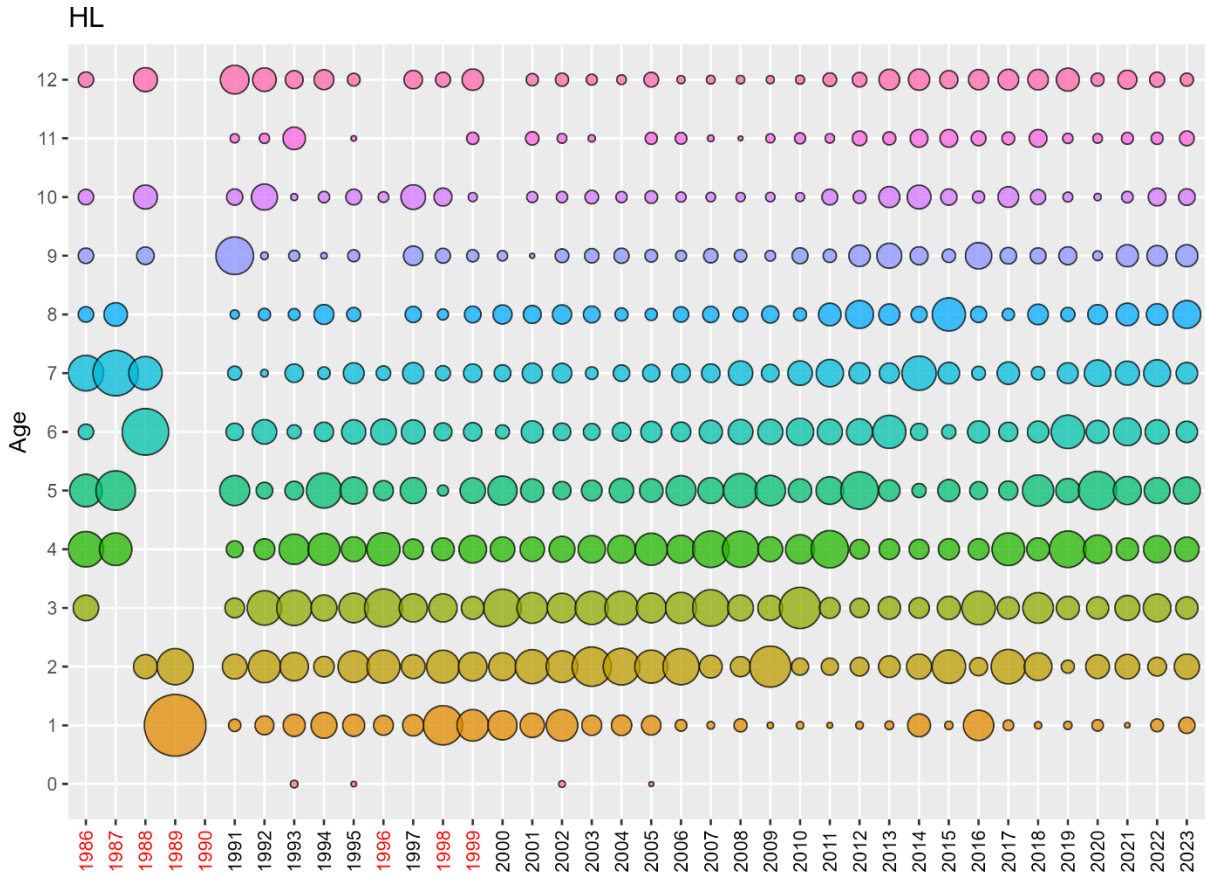


Figure 11. Annual nominal age compositions for the Gulf King Mackerel commercial **handline fishery** for the **sex-aggregated model**. The size of the dots represents the relative proportion at age. Years recommended to be dropped have been highlighted in **red**.

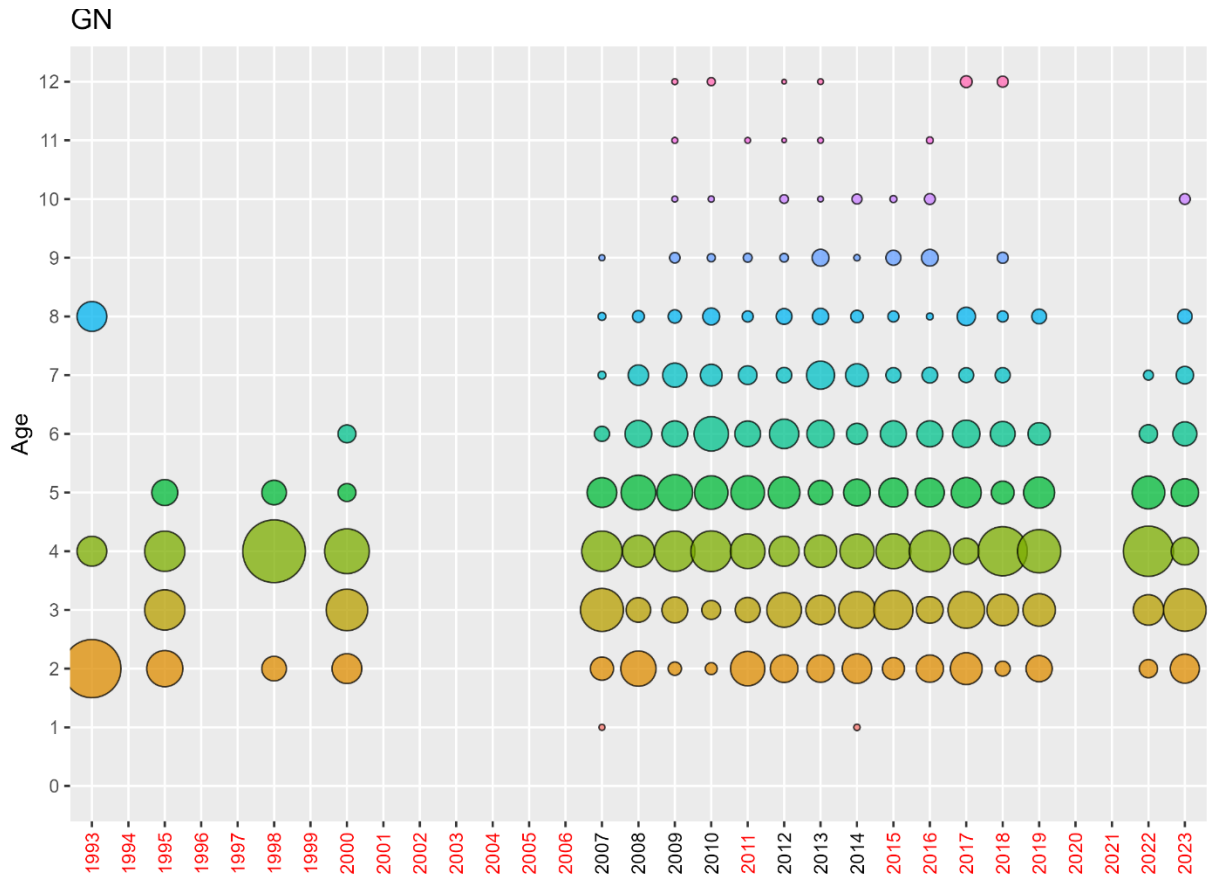


Figure 12. Annual nominal age compositions for the Gulf King Mackerel commercial **gillnet fishery** for the **sex-aggregated model**. The size of the dots represents the relative proportion at age. Years recommended to be dropped have been highlighted in **red**.

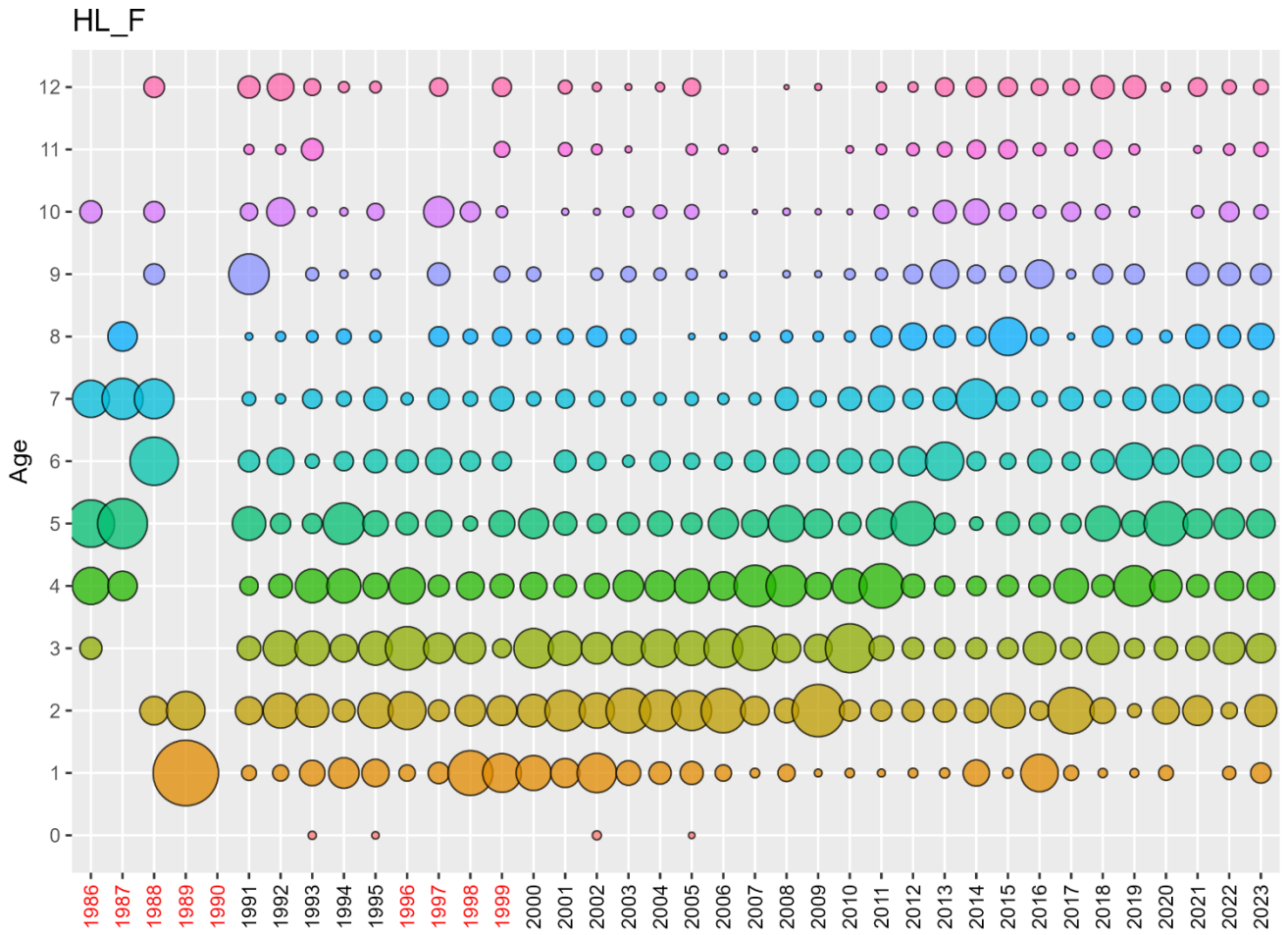


Figure 13. Annual nominal age compositions for the **female** Gulf King Mackerel commercial **handline fishery** for the **sex-specific model**. The size of the dots represents the relative proportion at age. Years recommended to be dropped have been highlighted in **red**.

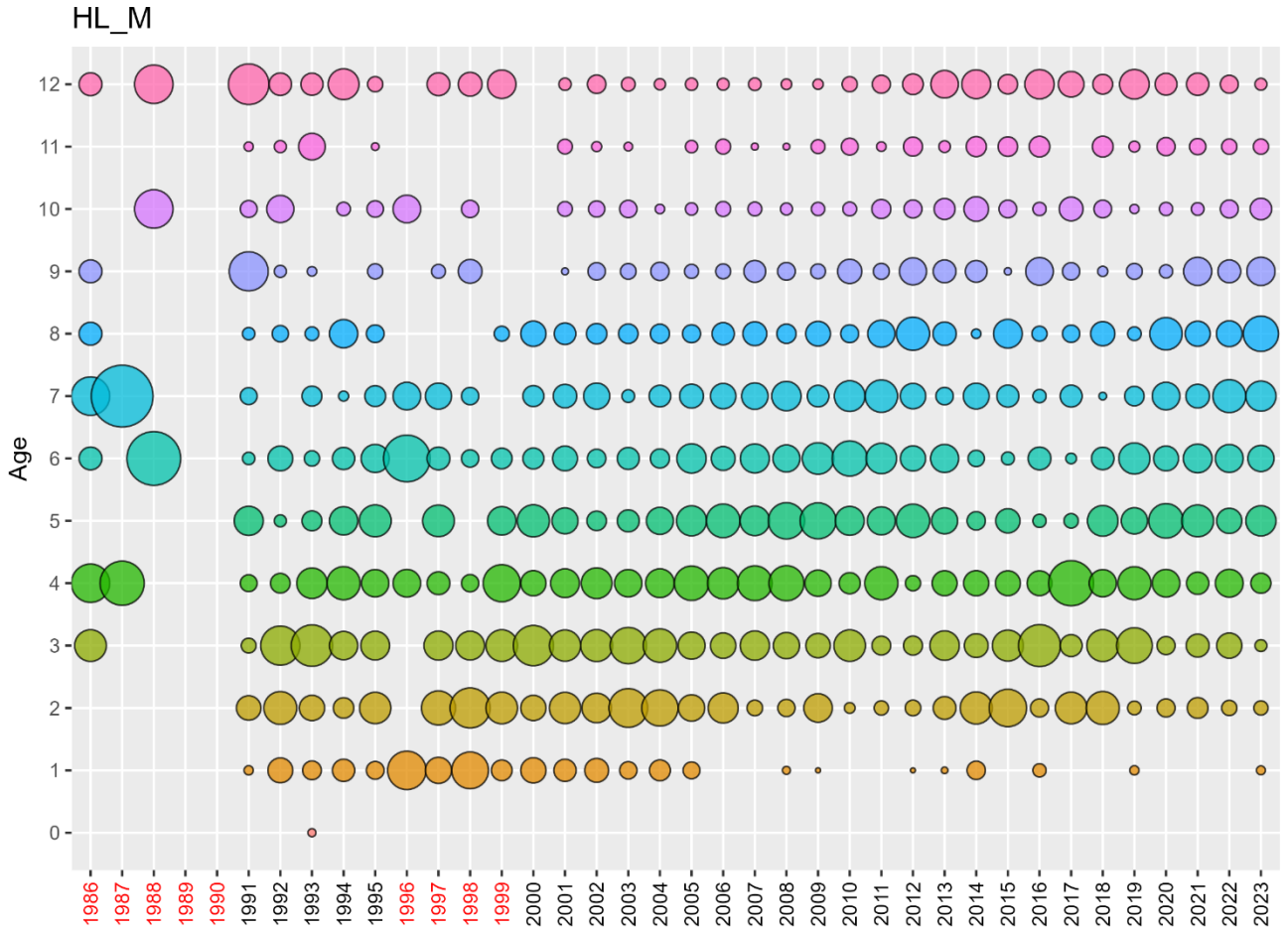


Figure 14. Annual nominal age compositions for the **male** Gulf King Mackerel commercial **handline fishery** for the **sex-specific model**. The size of the dots represents the relative proportion at age. Years recommended to be dropped have been highlighted in **red**.

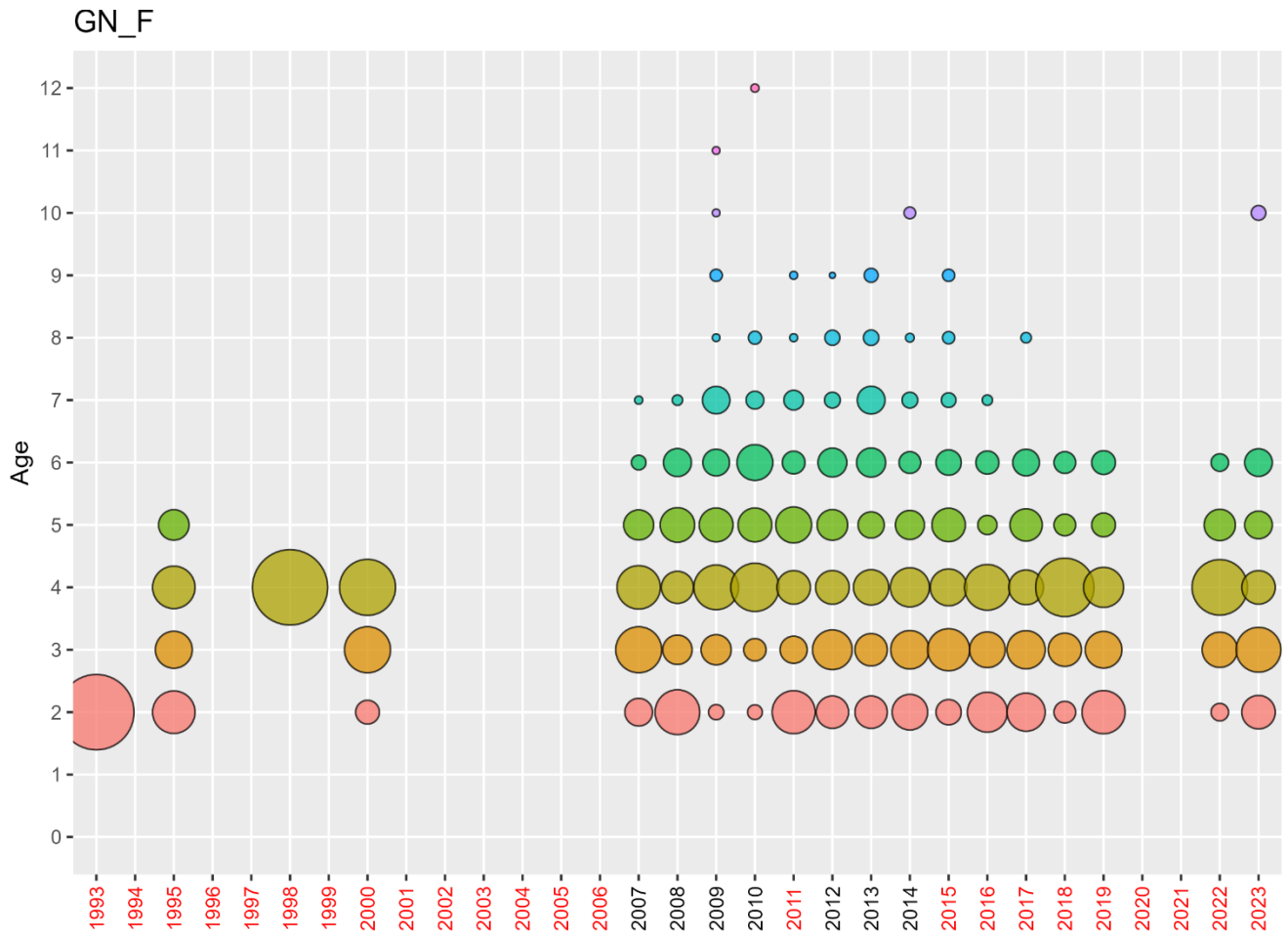


Figure 15. Annual nominal age compositions for the **female** Gulf King Mackerel commercial **gillnet fishery** for the **sex-specific model**. The size of the dots represents the relative proportion at age. Years recommended to be dropped have been highlighted in **red**.

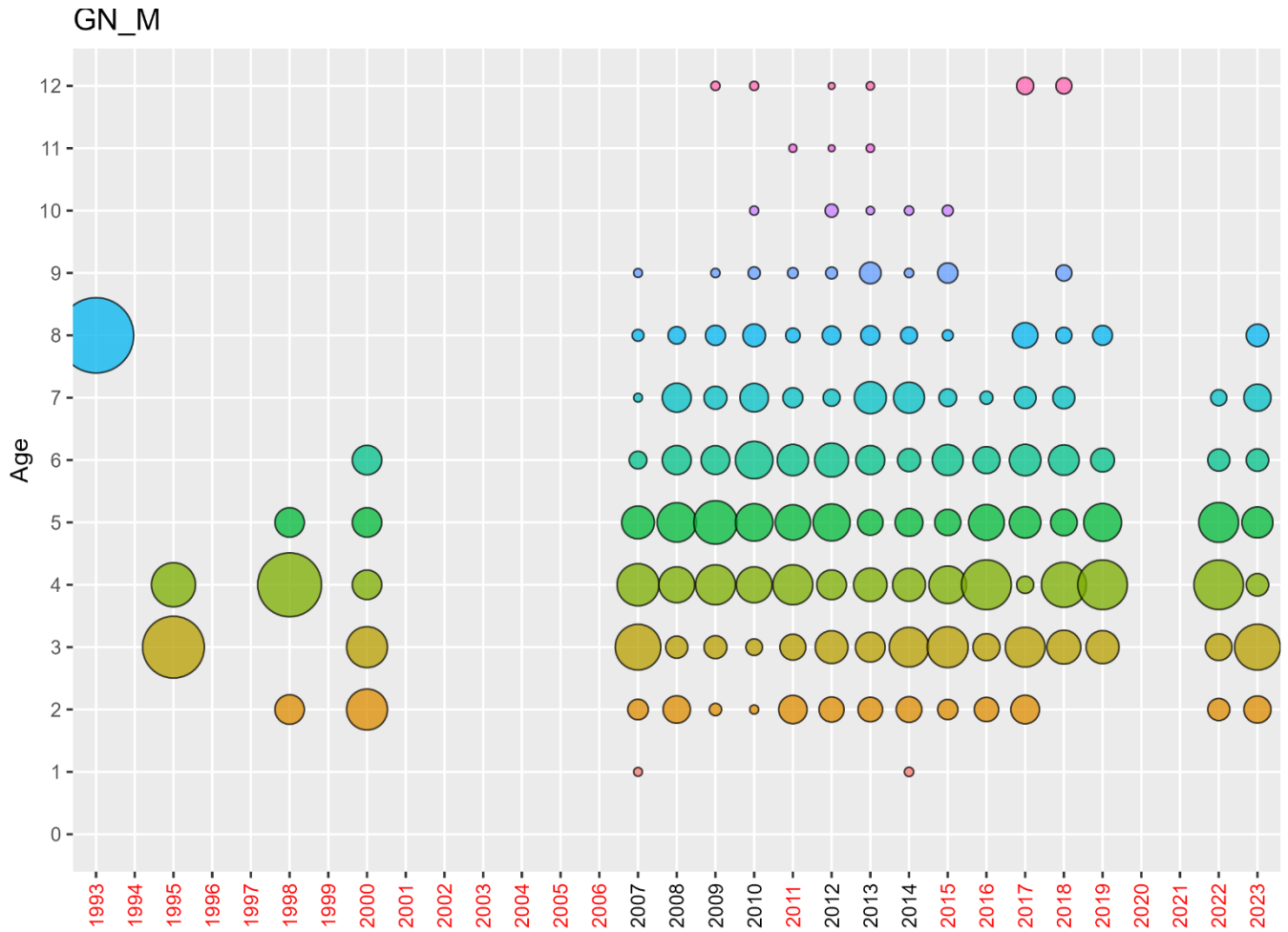


Figure 16. Annual nominal age compositions for the **male** Gulf King Mackerel commercial **gillnet fishery** for the **sex-specific model**. The size of the dots represents the relative proportion at age. Years recommended to be dropped have been highlighted in **red**.

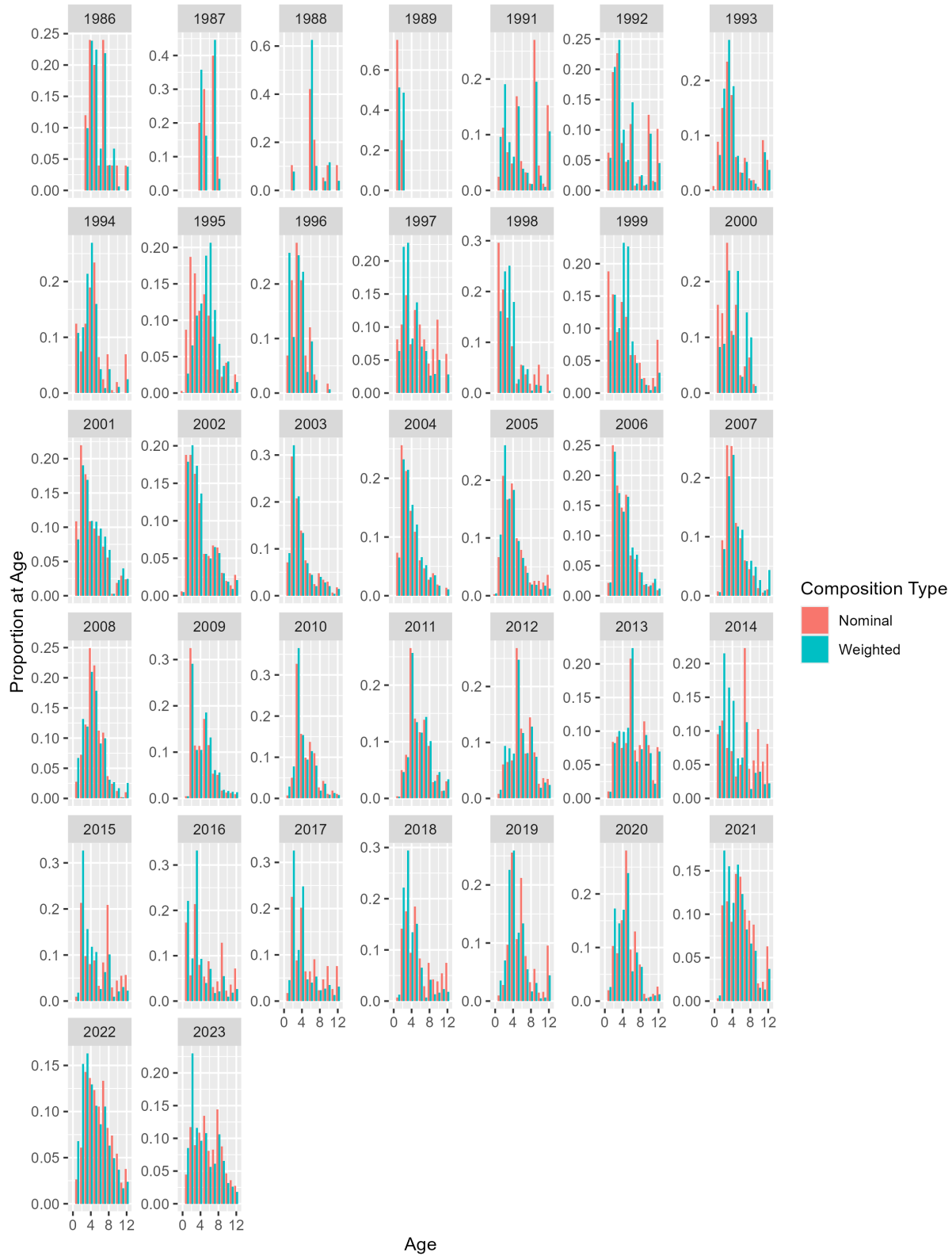


Figure 17. Annual comparison of the nominal and weighted age compositions for the Gulf King Mackerel commercial *handline* fishery for the sex-aggregated model.

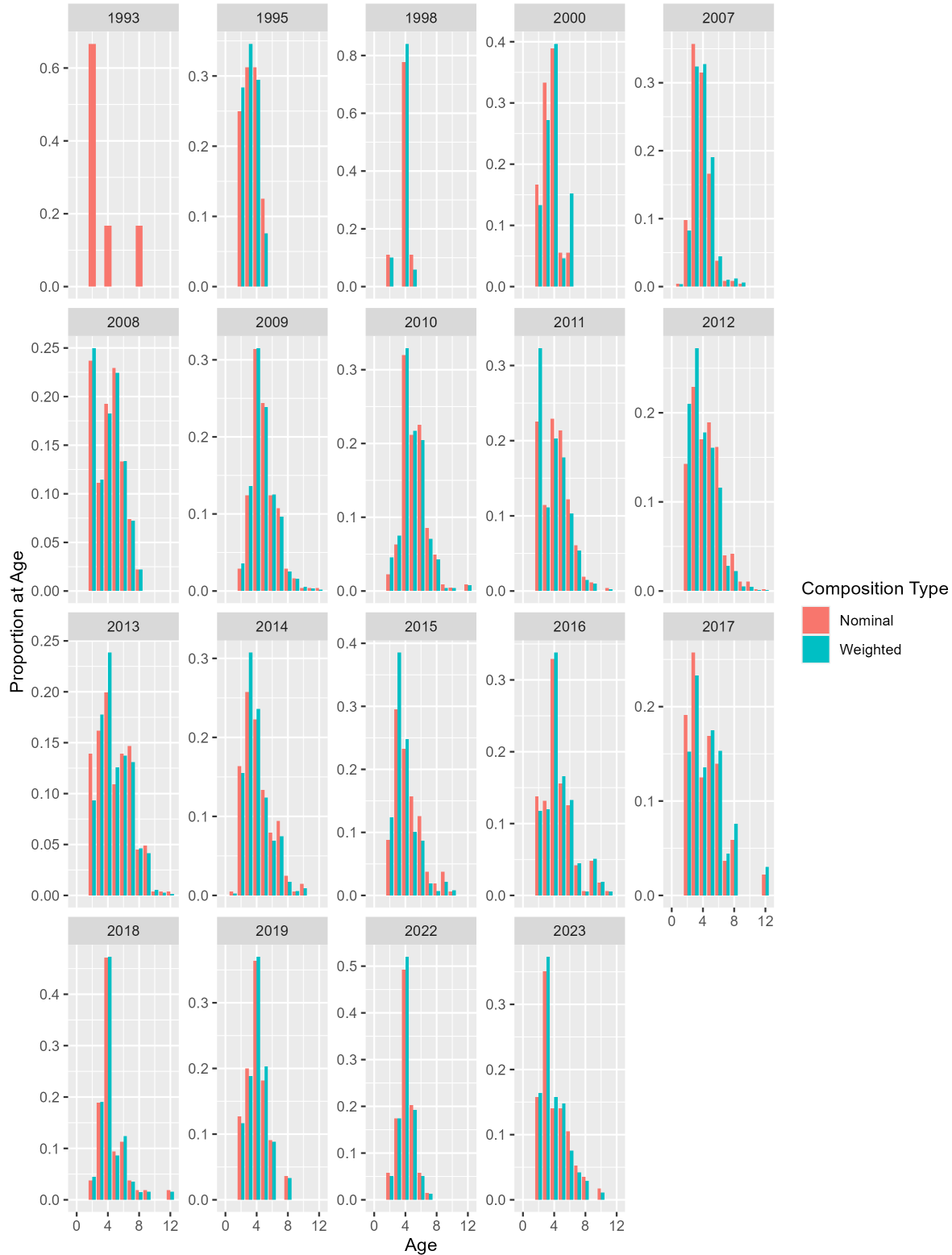


Figure 18. Annual comparison of the nominal and weighted age compositions for the Gulf King Mackerel commercial ***gillnet fishery*** for the ***sex-aggregated model***. Due to a lack of data in the west subregion, no gillnet weighted lengths were available, and therefore ages were re-weighted by nominal lengths.

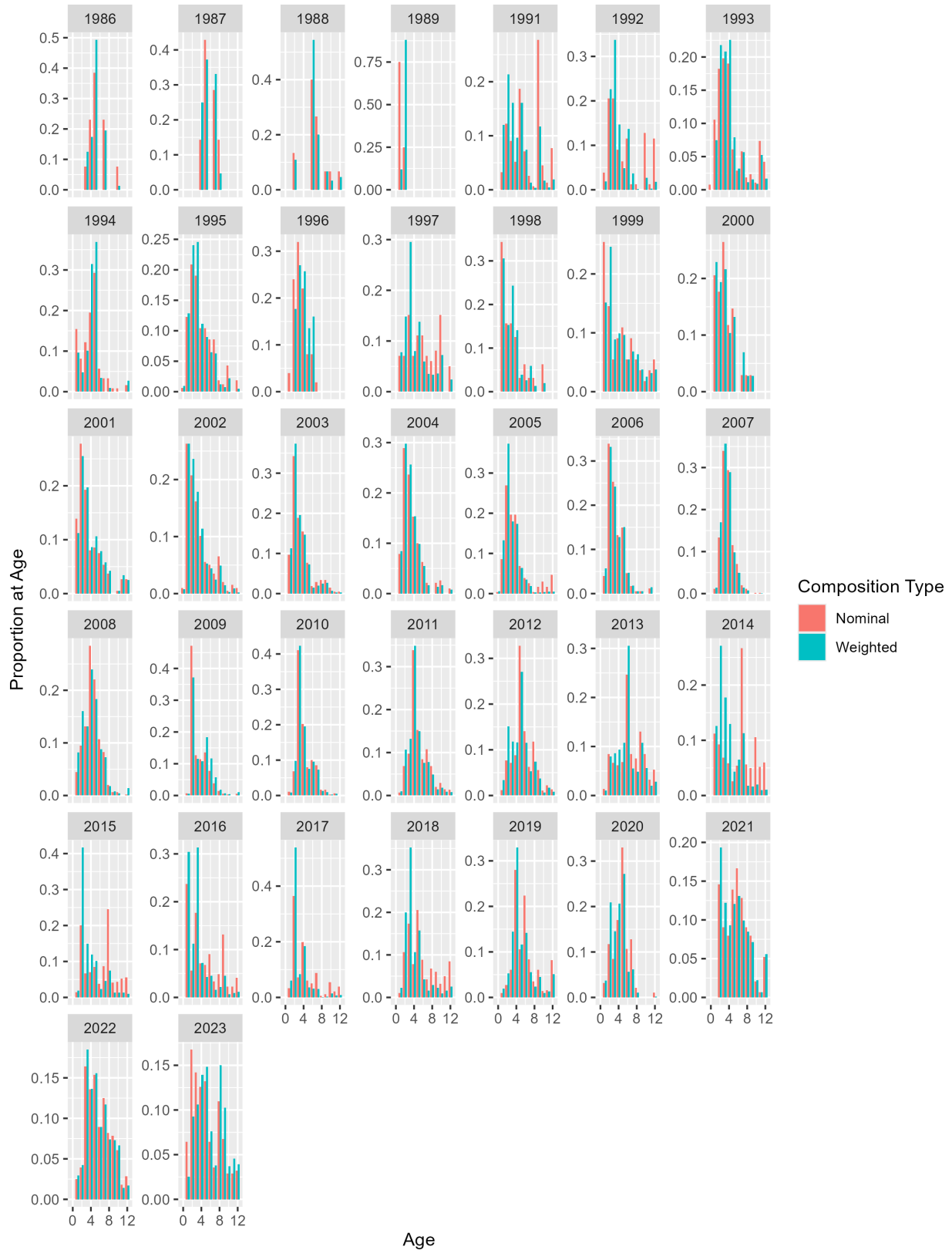


Figure 19. Annual comparison of the nominal and weighted age compositions for the female Gulf King Mackerel commercial **handline** fishery for the **sex-specific** model.

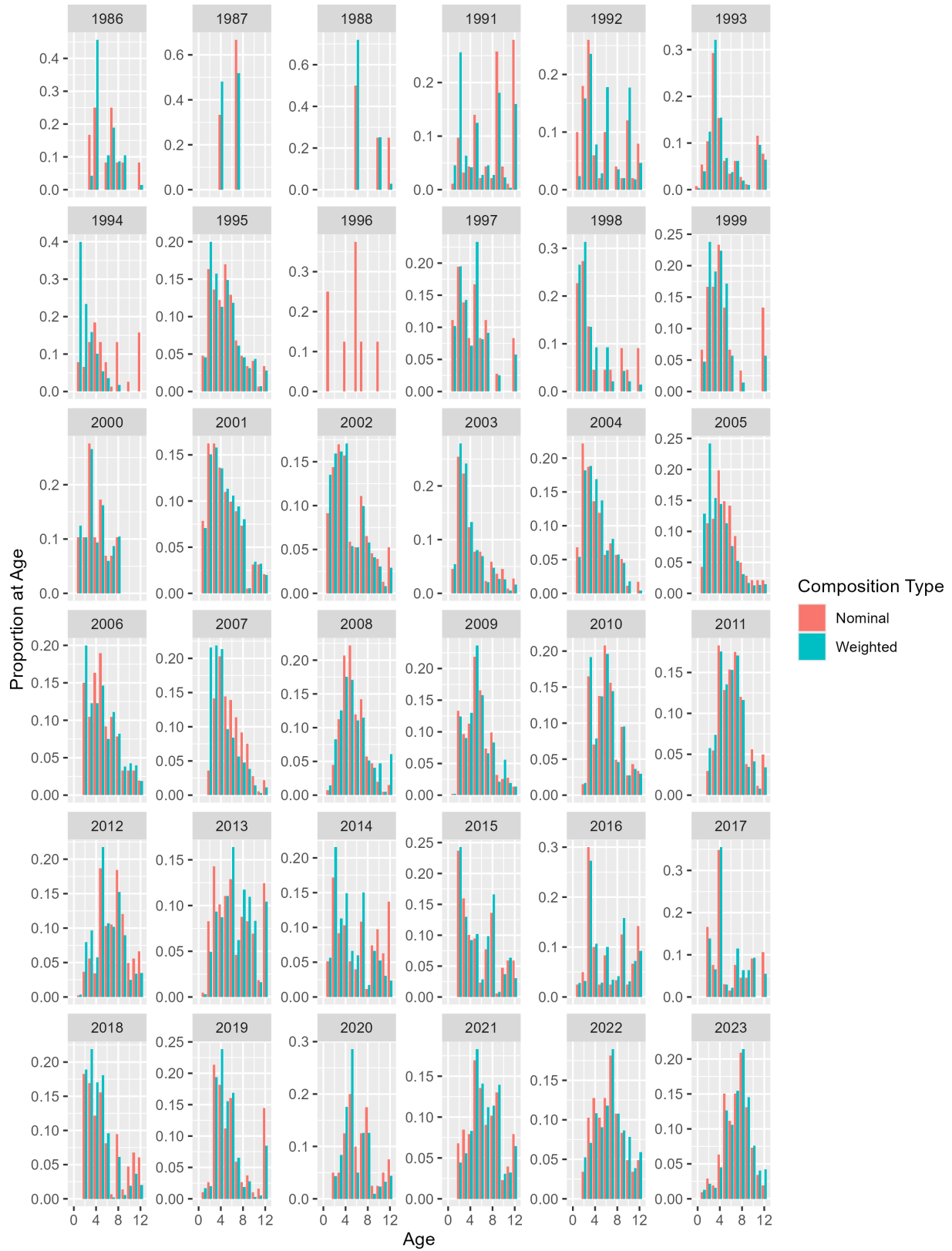


Figure 20. Annual comparison of the nominal and weighted age compositions for the **male Gulf King Mackerel commercial handline fishery for the sex-specific model.**

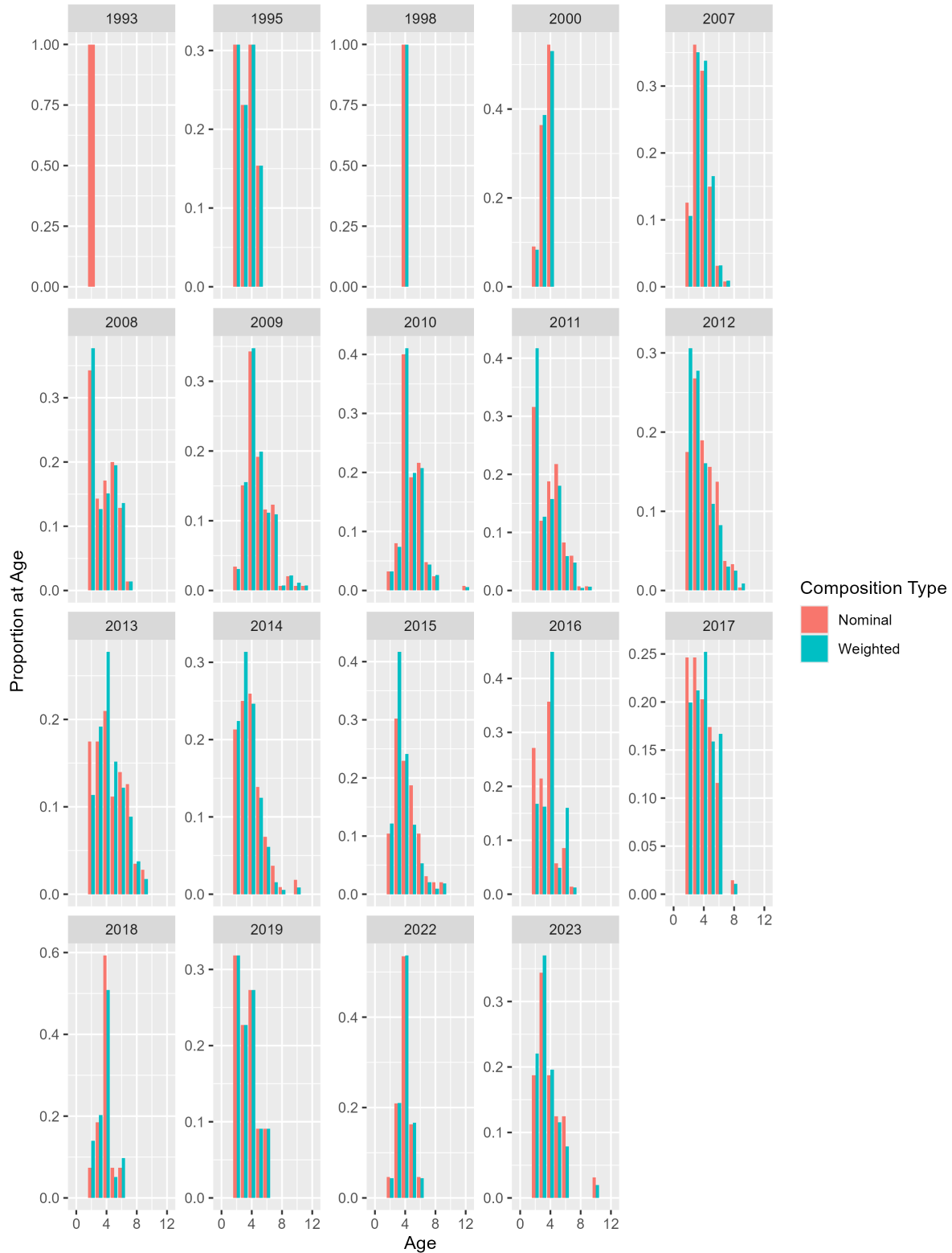


Figure 21. Annual comparison of the nominal and weighted age compositions for the **female Gulf King Mackerel commercial gillnet fishery for the sex-specific model**. Due to a lack of data in the west subregion, no gillnet weighted lengths were available, and therefore ages were re-weighted by nominal lengths.

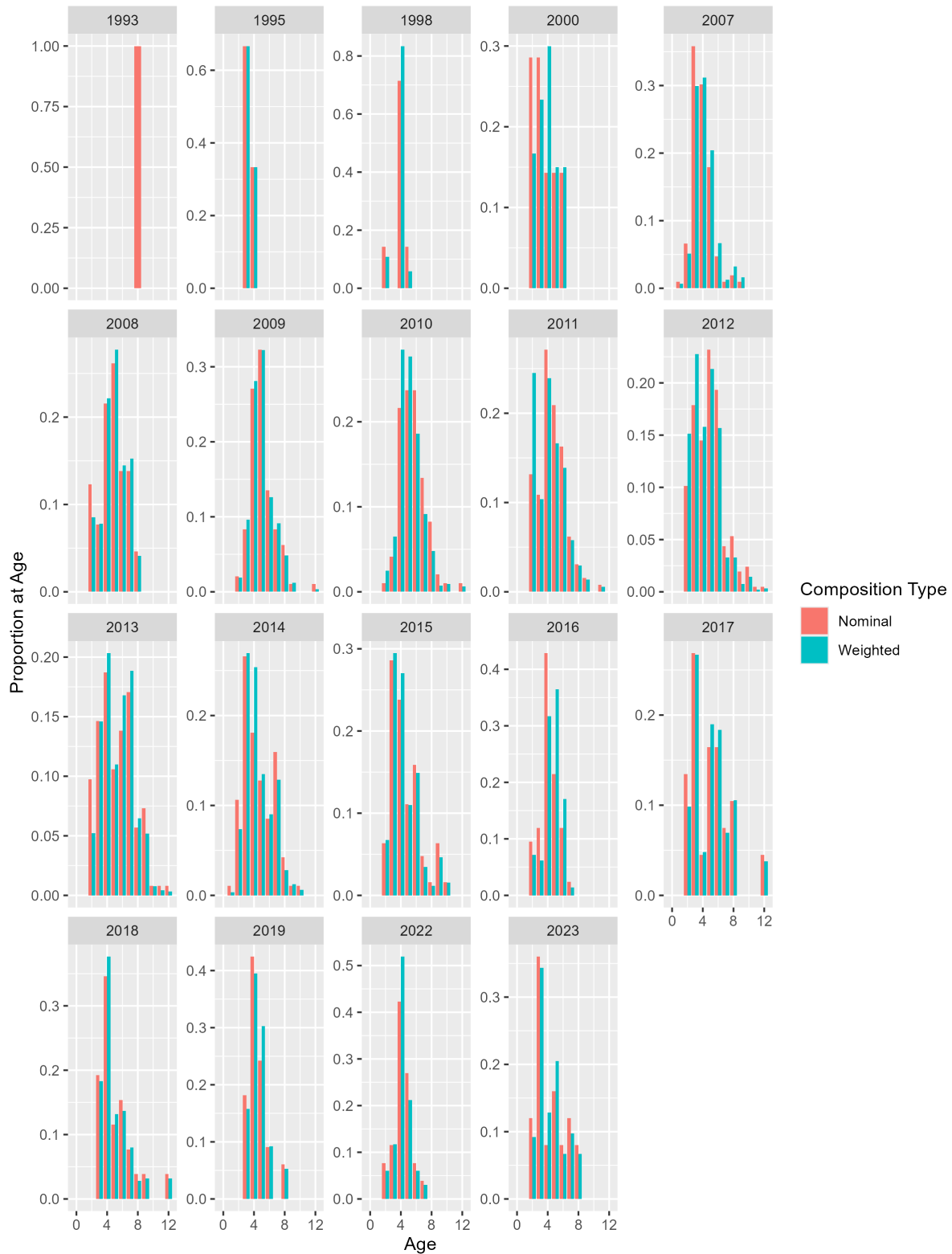


Figure 22. Annual comparison of the nominal and weighted age compositions for the **male** Gulf King Mackerel commercial **gillnet fishery** for the **sex-specific model**. Due to a lack of data in the west subregion, no gillnet weighted lengths were available, and therefore ages were re-weighted by nominal lengths.

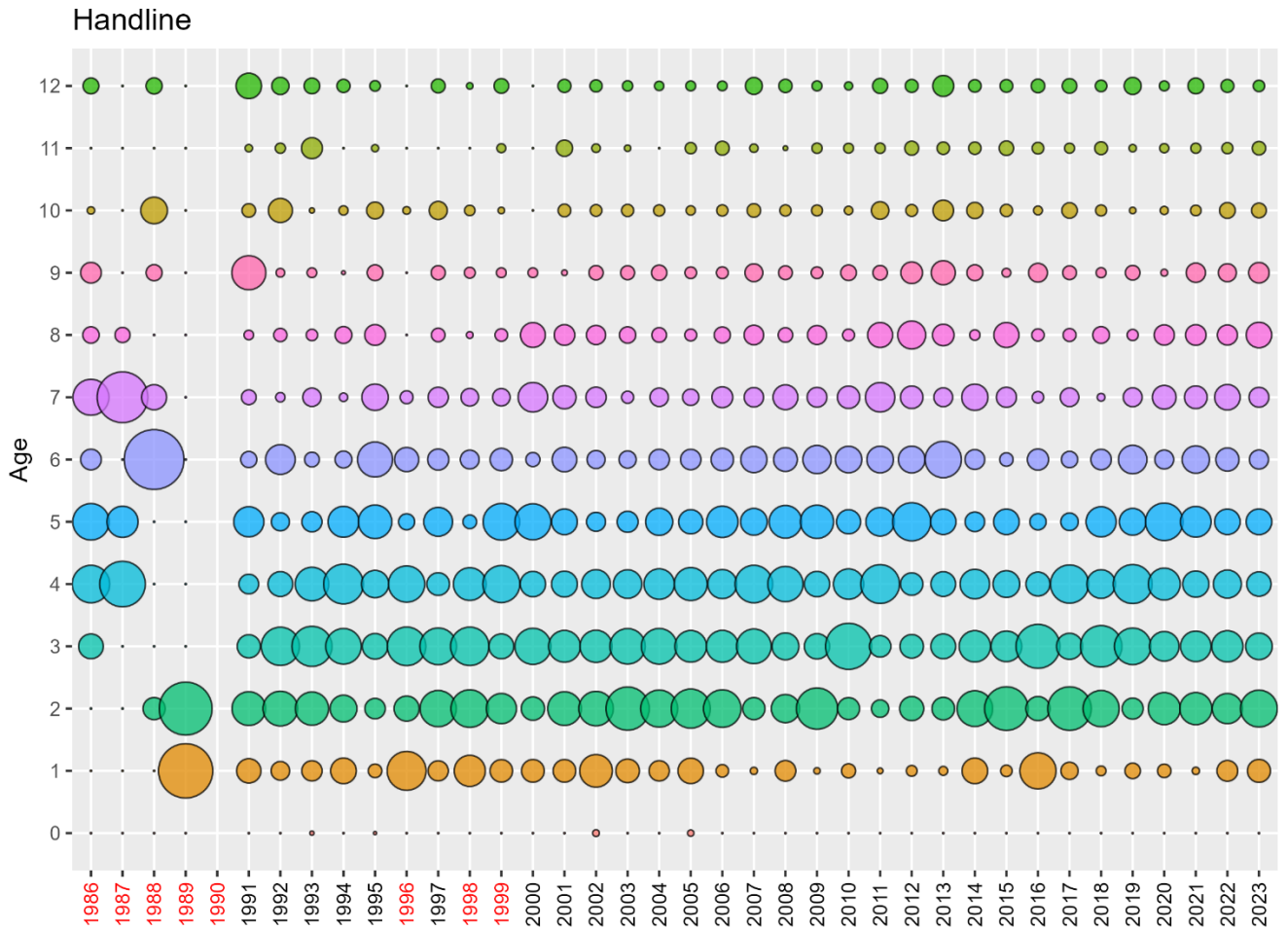


Figure 23. Annual weighted age compositions for the Gulf King Mackerel commercial **handline** fishery for the **sex-aggregated** model. The size of the dots represents the relative proportion at age. Years recommended to be dropped have been highlighted in **red**.

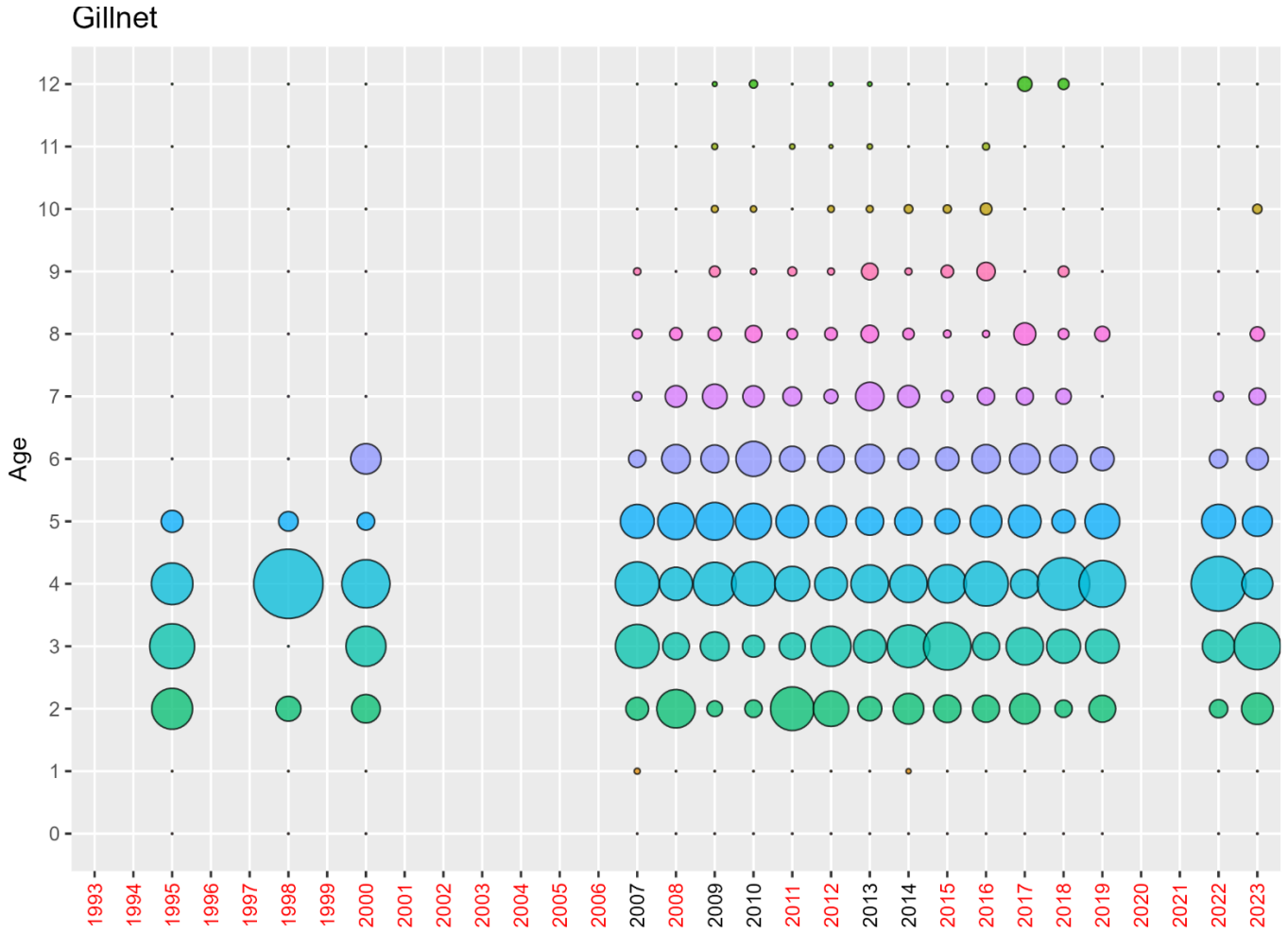


Figure 24. Annual weighted age compositions for the Gulf King Mackerel commercial **gillnet** fishery for the **sex-aggregated** model. The size of the dots represents the relative proportion at age. Due to a lack of data in the west subregion, no gillnet weighted lengths were available, and therefore ages were re-weighted by nominal lengths. Years recommended to be dropped have been highlighted in **red**.

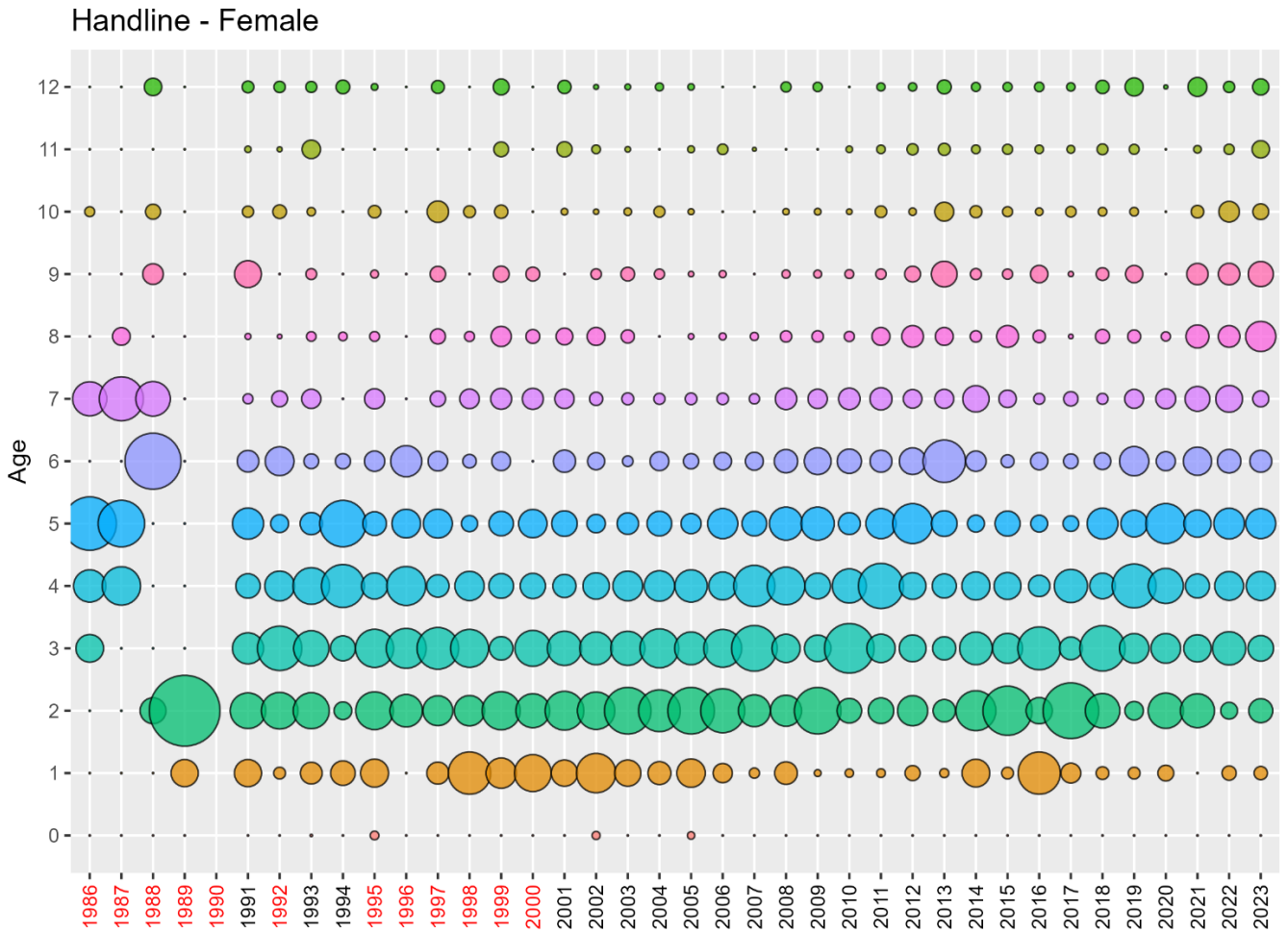


Figure 25. Annual weighted age compositions for the **female** Gulf King Mackerel commercial **handline fishery** for the **sex-specific model**. The size of the dots represents the relative proportion at age. Years recommended to be dropped have been highlighted in **red**.

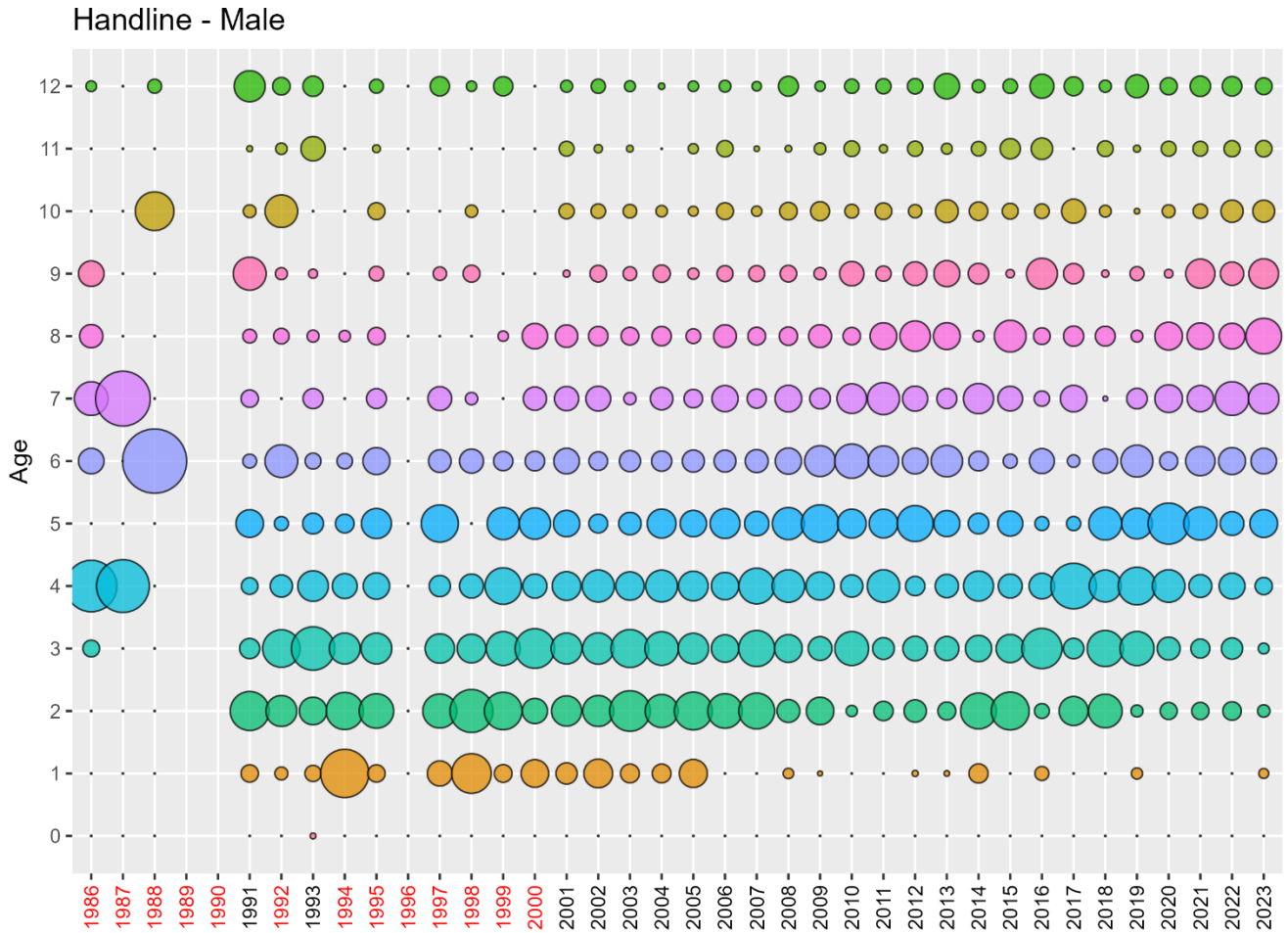


Figure 26. Annual weighted age compositions for the **male** Gulf King Mackerel commercial **handline fishery** for the **sex-specific model**. The size of the dots represents the relative proportion at age. Years recommended to be dropped have been highlighted in **red**.

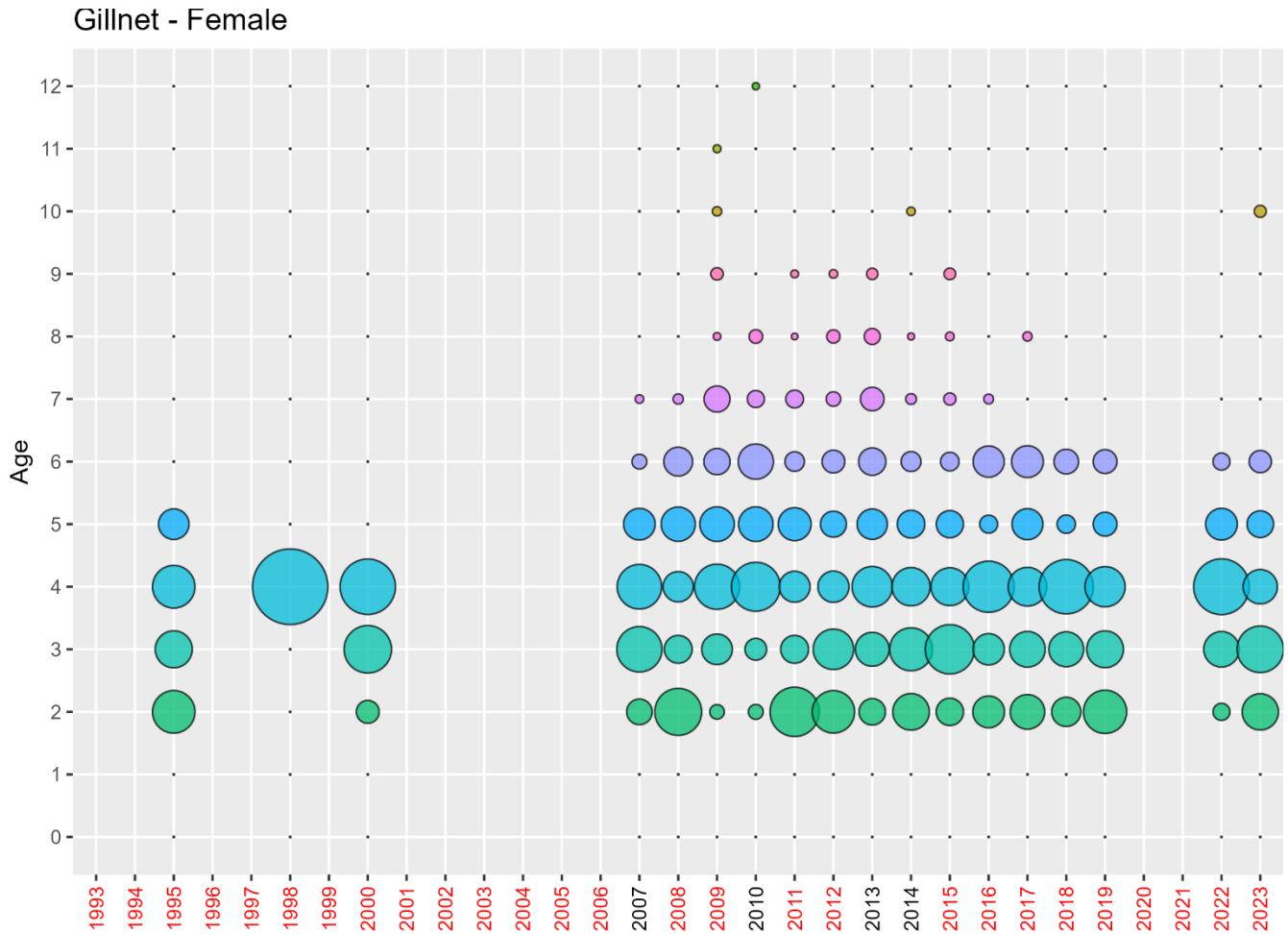


Figure 27. Annual weighted age compositions for the **female** Gulf King Mackerel commercial gillnet fishery for the **sex-specific** model. The size of the dots represents the relative proportion at age. Due to a lack of data in the west subregion, no gillnet weighted lengths were available, and therefore ages were re-weighted by nominal lengths. Years recommended to be dropped have been highlighted in **red**.

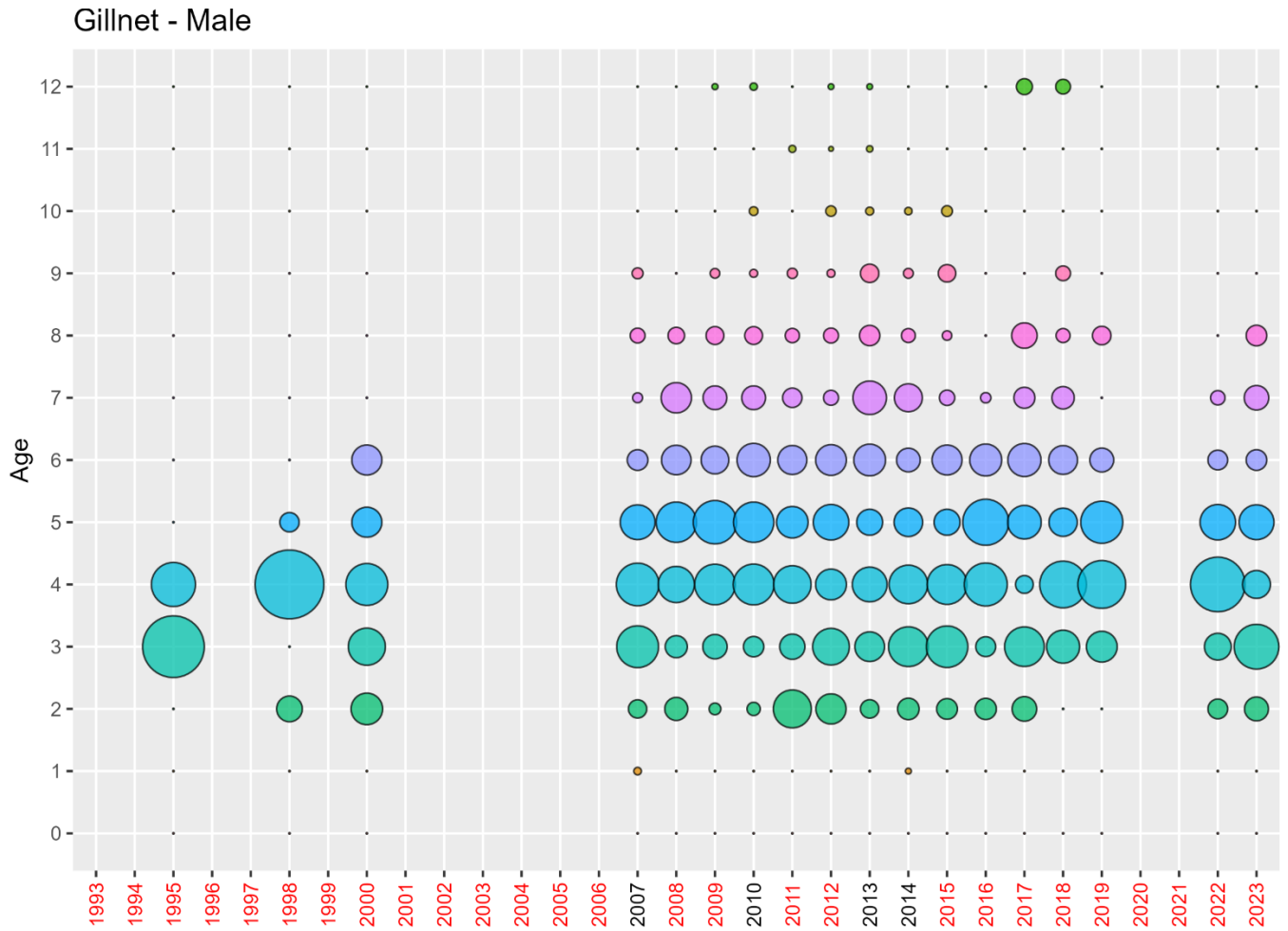


Figure 28. Annual weighted age compositions for the **male** Gulf King Mackerel commercial **gillnet fishery** for the **sex-specific model**. The size of the dots represents the relative proportion at age. Due to a lack of data in the west subregion, no gillnet weighted lengths were available, and therefore ages were re-weighted by nominal lengths. Years recommended to be dropped have been highlighted in **red**.



Figure 29. Conditional Age-at-Length for the Gulf King Mackerel commercial **handline** fishery for the **sex-aggregated** model. The size of the dots represents the relative proportion at age for a given length bin.



Figure 30. Conditional Age-at-Length for the Gulf King Mackerel commercial ***gillnet fishery*** for the ***sex-aggregated model***. The size of the dots represents the relative proportion at age for a given length bin.



Figure 31. Conditional Age-at-Length for the **female** Gulf King Mackerel commercial **handline fishery** for the **sex-specific model**. The size of the dots represents the relative proportion at age for a given length bin.

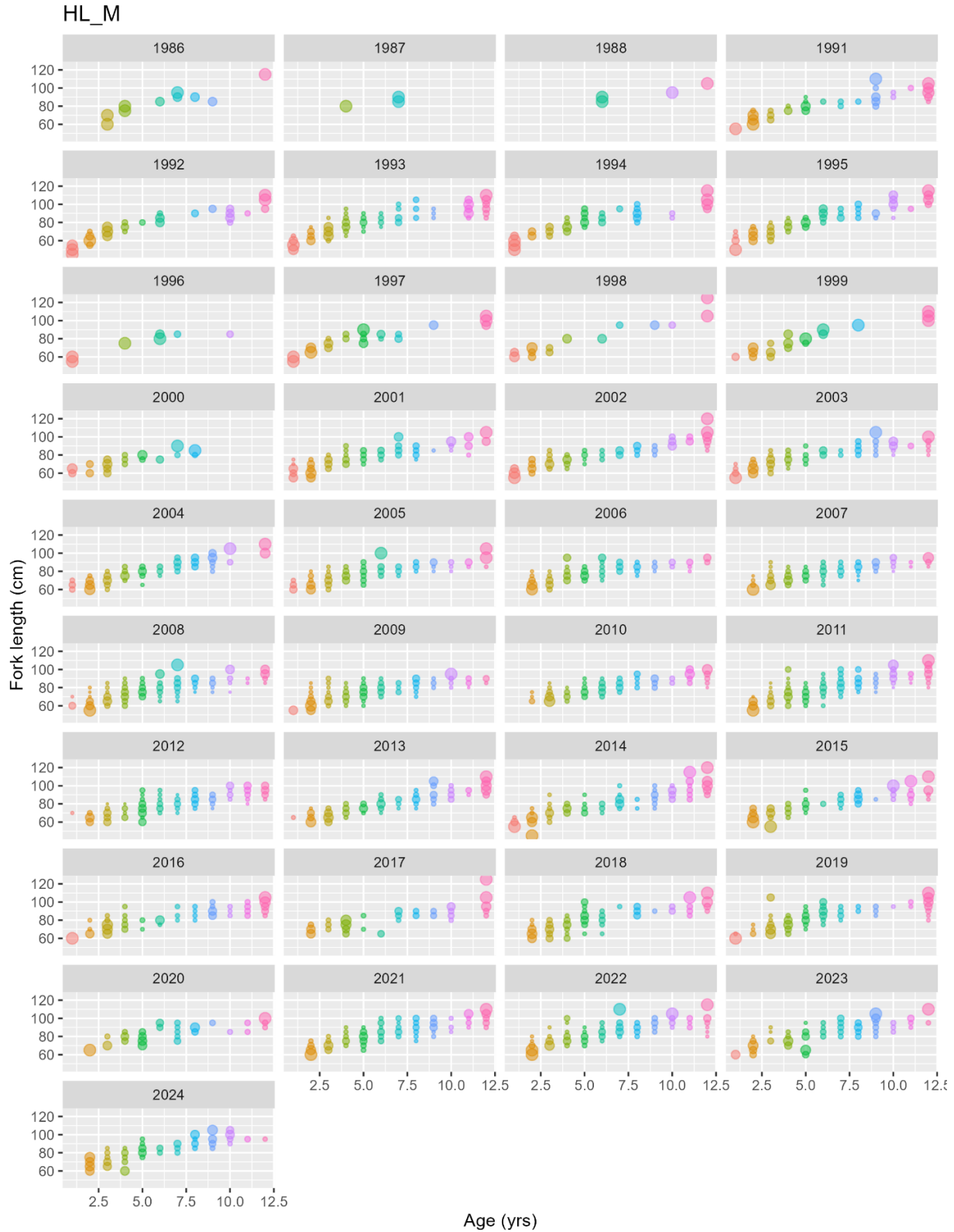


Figure 32. Conditional Age-at-Length for the **male** Gulf King Mackerel commercial **handline fishery** for the **sex-specific model**. The size of the dots represents the relative proportion at age for a given length bin.



Figure 33. Conditional Age-at-Length for the **female** Gulf King Mackerel commercial **gillnet fishery** for the **sex-specific model**. The size of the dots represents the relative proportion at age for a given length bin.

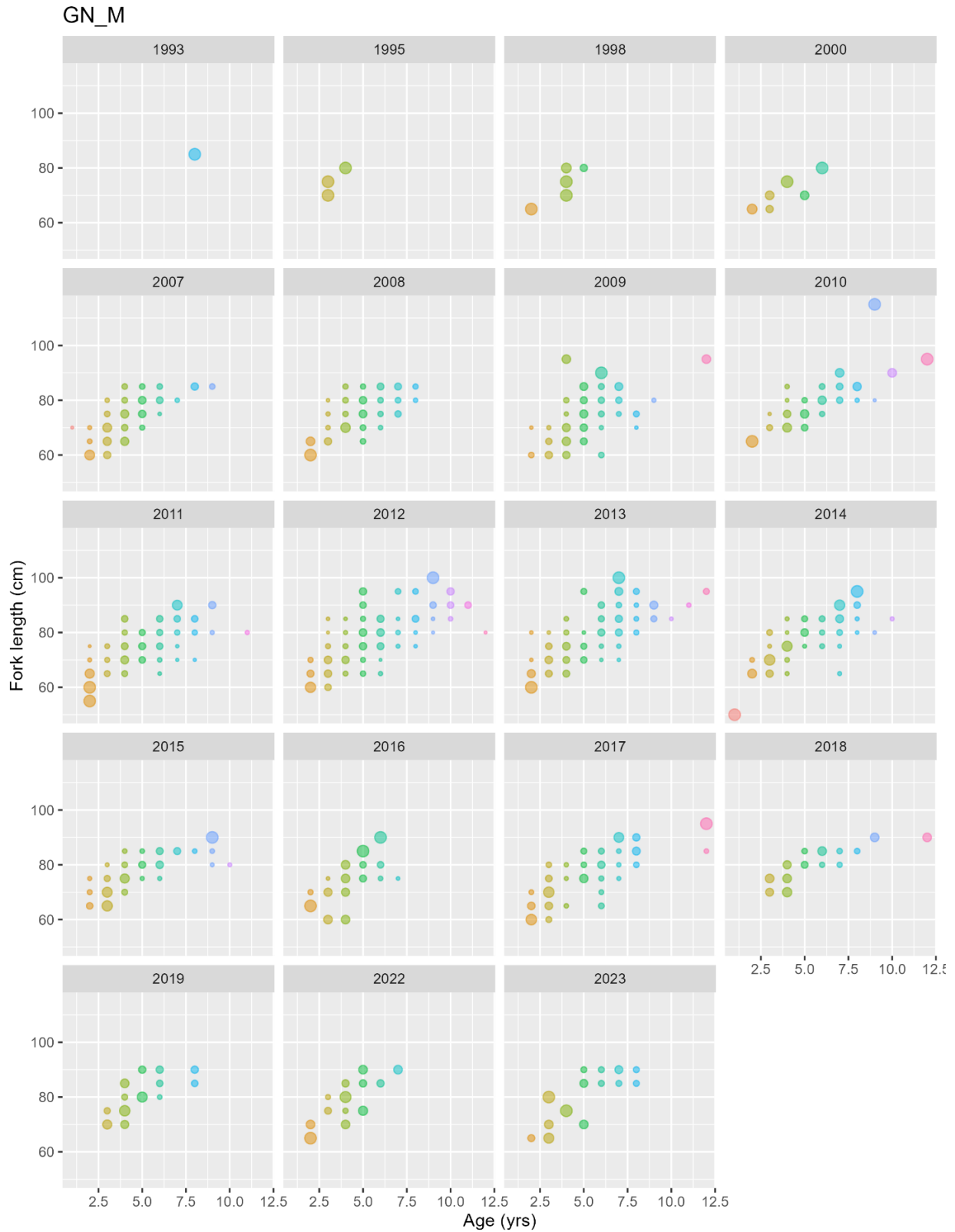


Figure 34. Conditional Age-at-Length for the *male* Gulf King Mackerel commercial *gillnet* fishery for the *sex-specific* model. The size of the dots represents the relative proportion at age for a given length bin.

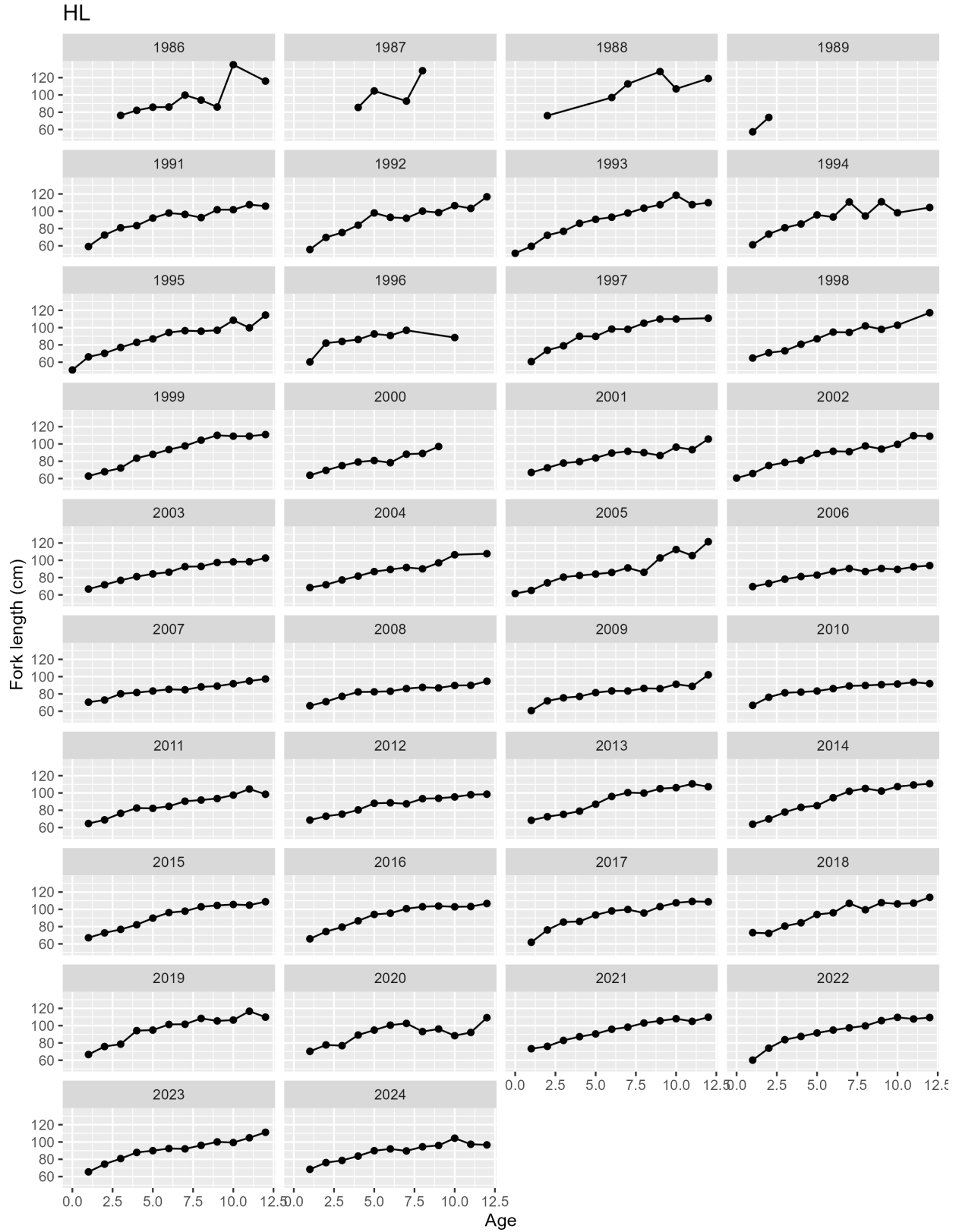


Figure 35. Annual mean fork length at age for the Gulf King Mackerel commercial *handline* fishery for the sex-aggregated model.

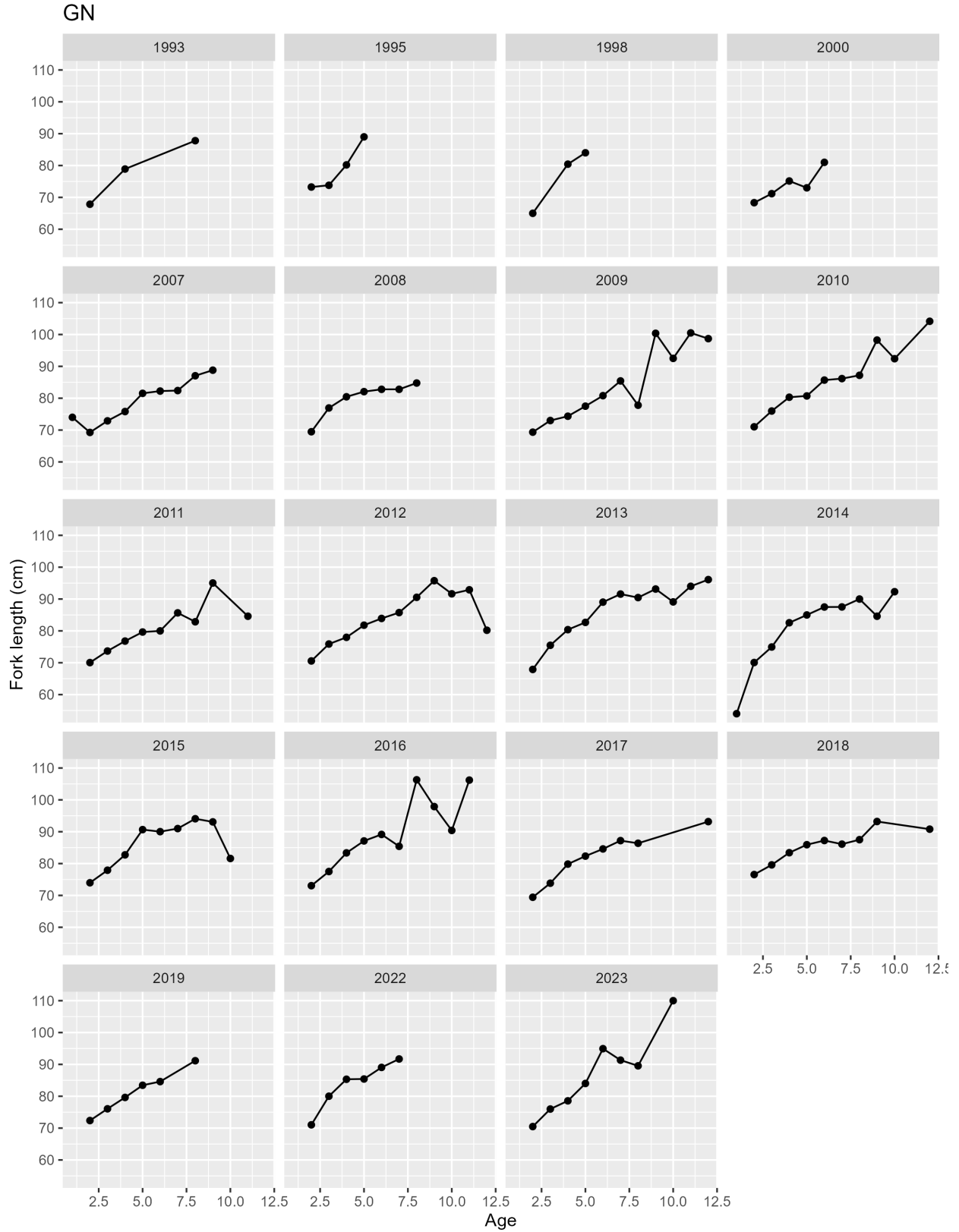


Figure 36. Annual mean fork length at age for the Gulf King Mackerel commercial gillnet fishery for the sex-aggregated model.

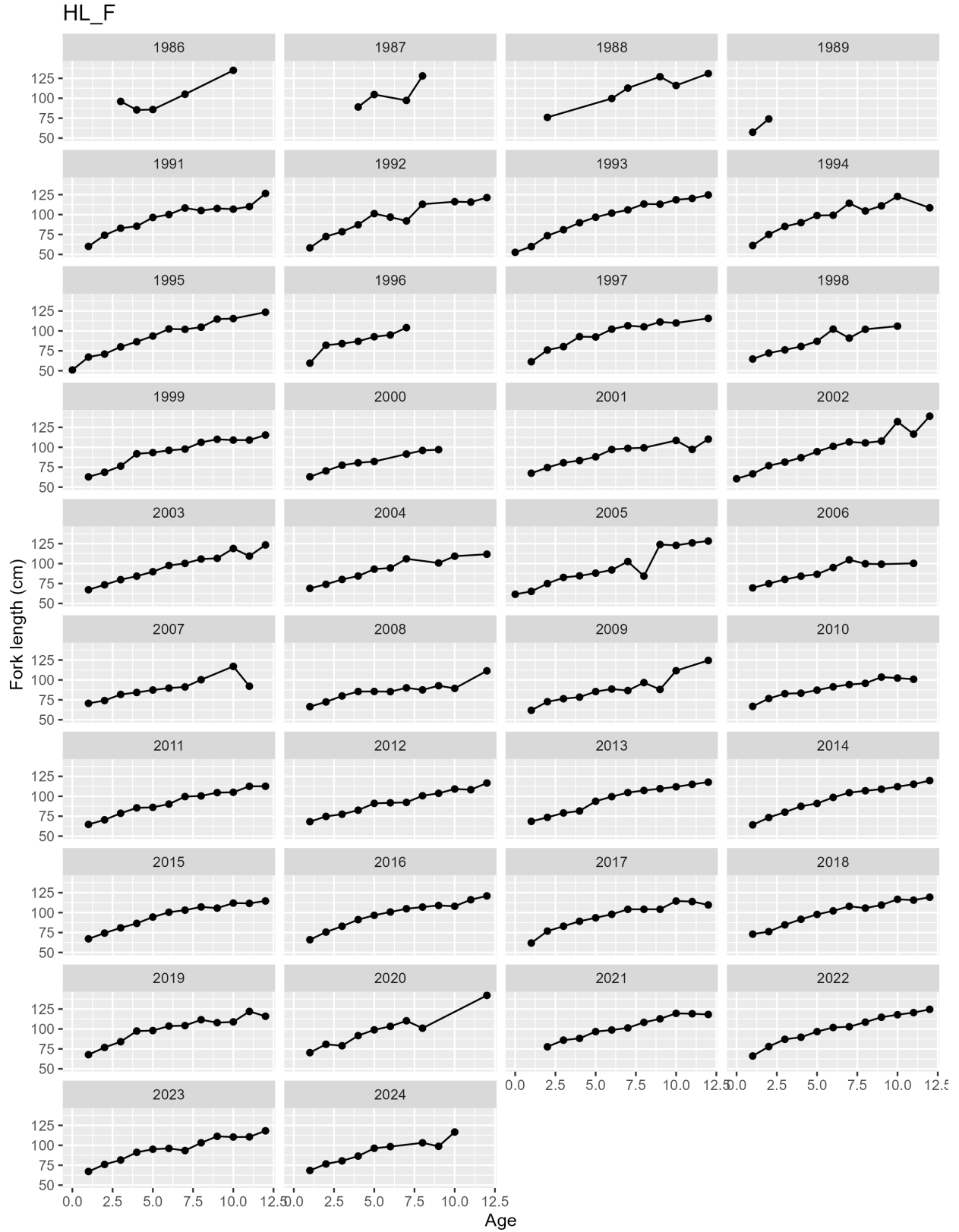


Figure 37. Annual mean fork length at age for the **female** Gulf King Mackerel commercial **handline** fishery for the sex-specific model.

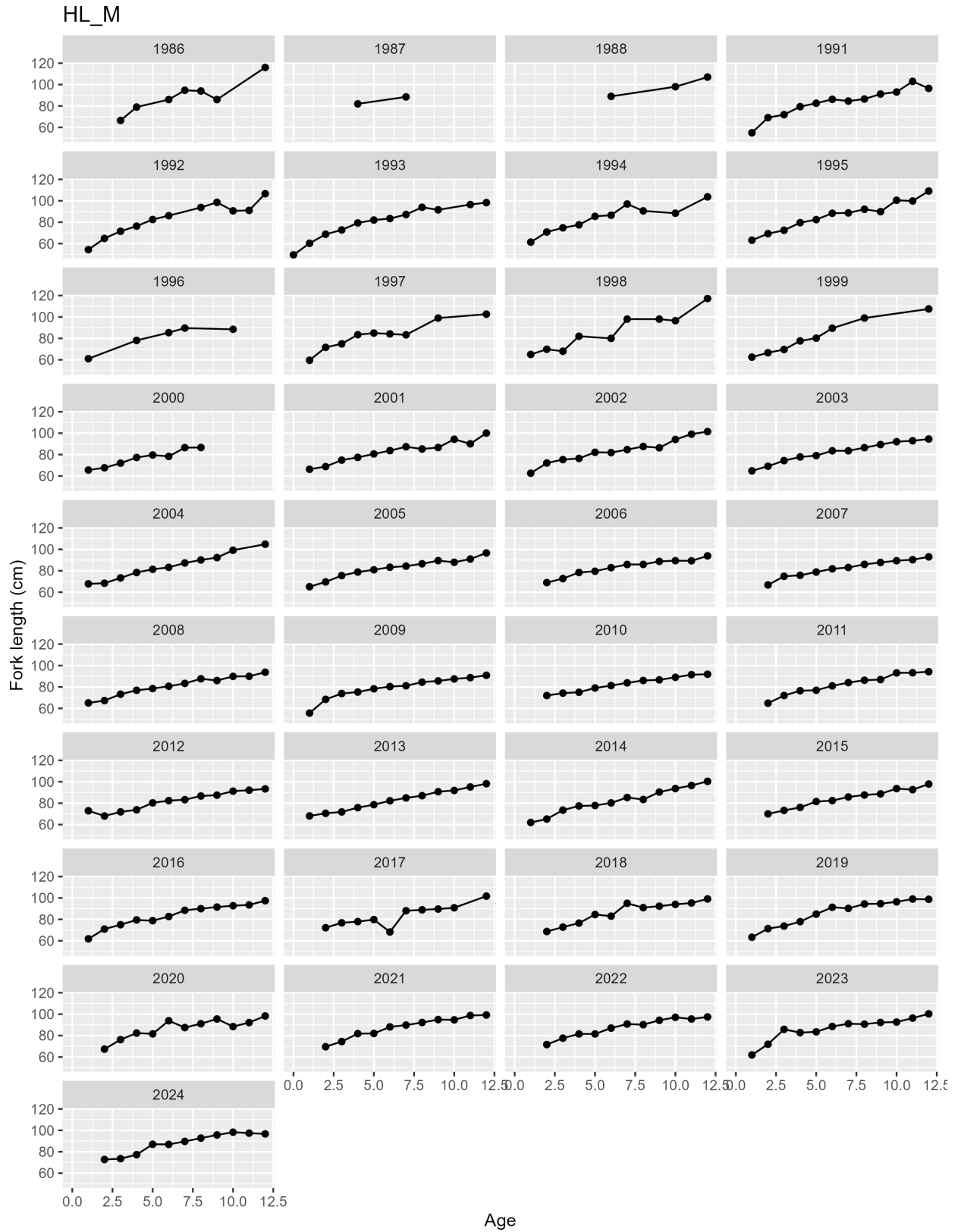


Figure 38. Annual mean fork length at age for the **male** Gulf King Mackerel commercial handline fishery for the sex-specific model.

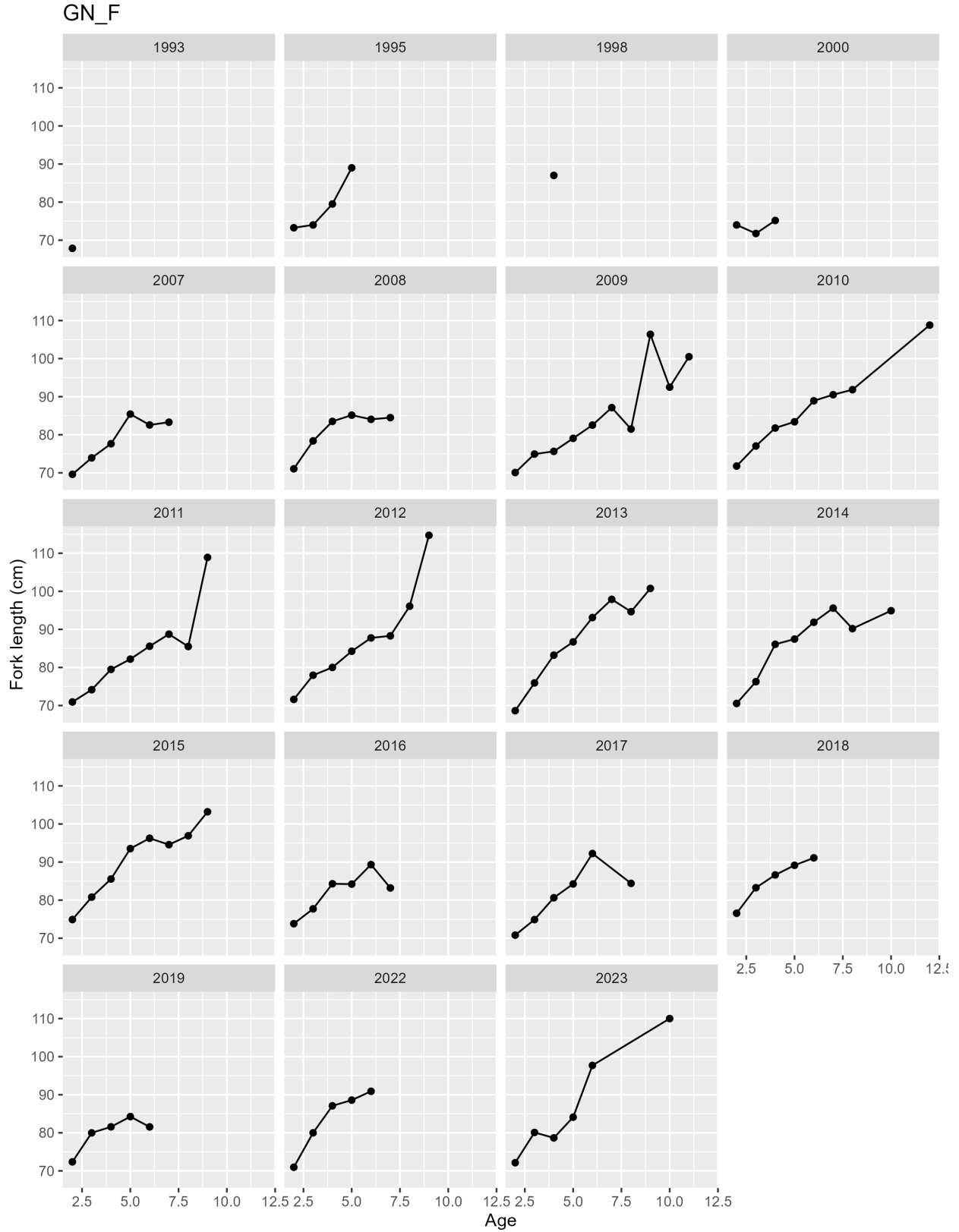


Figure 39. Annual mean fork length at age for the **female** Gulf King Mackerel commercial gillnet fishery for the sex-specific model.

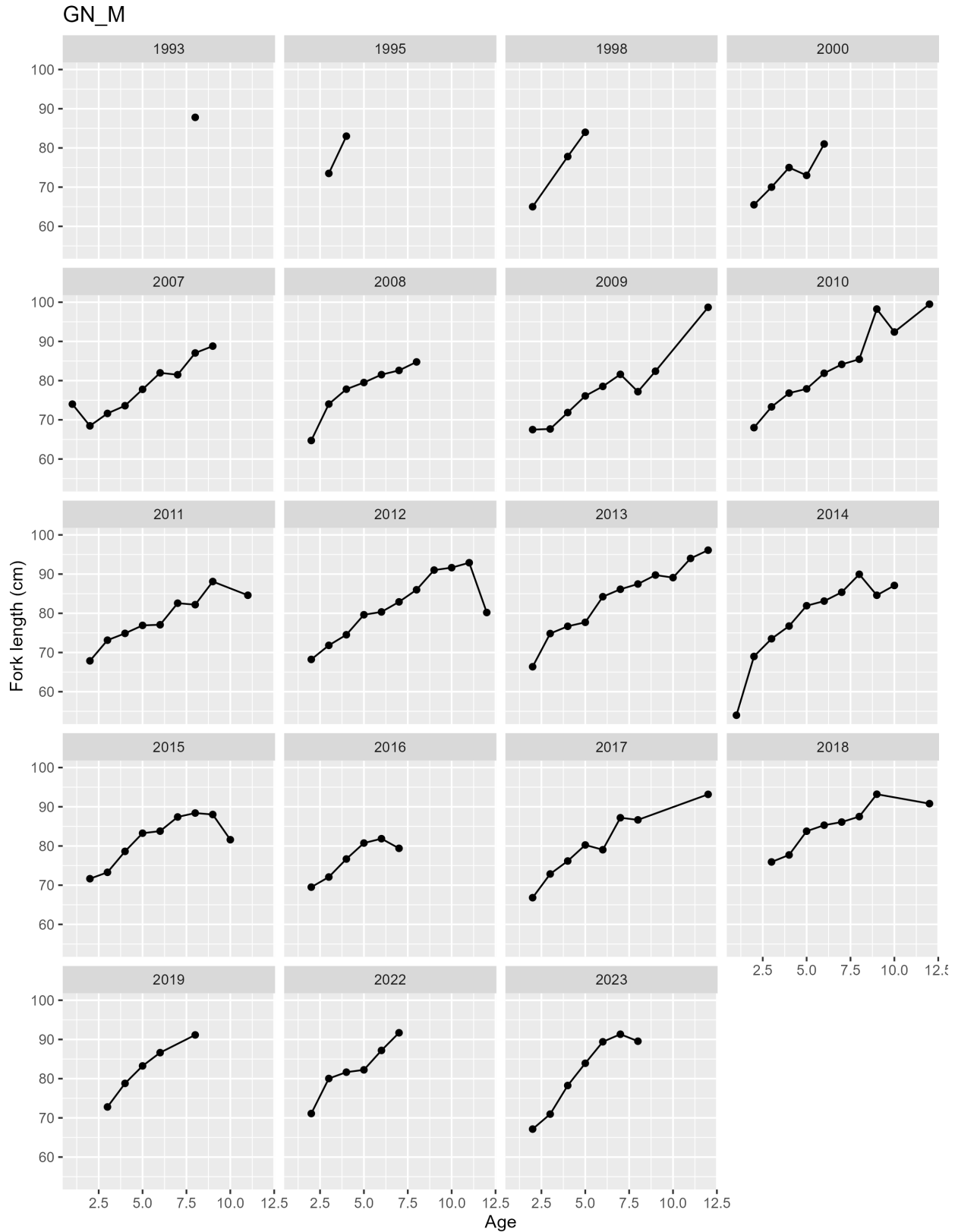


Figure 40. Annual mean fork length at age for the **male** Gulf King Mackerel commercial **gillnet fishery** for the sex-specific model.