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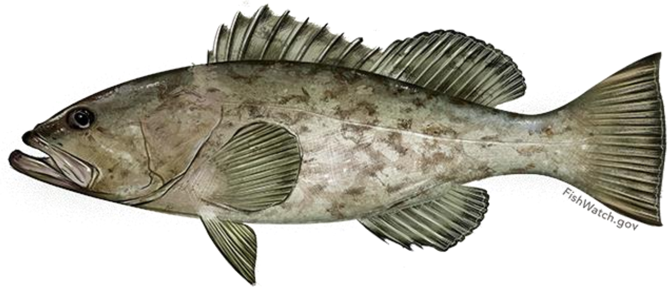

Gulf of Mexico Gag Grouper (*Mycteroperca microlepis*) Commercial and Recreational Length and Age Compositions

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1 Introduction

This document outlines the data and methodologies used to estimate commercial and recreational length and age compositions for the SEDAR 72 Gulf of Mexico Gag Grouper Assessment. These compositions were estimated using the same data sources approved in SEDAR 33 Update and processed using recommended methodologies given data constraints (SEDAR 2015, Thorson et al. 2017, Methot et al. 2020). Because fishery-dependent sampling is typically opportunistic, sampled lengths may not be representative of the true size composition of landings (and, by extension, sampled otoliths may not be representative of the true age composition of the landings). To account for these potential biases, length samples from commercial and recreational fleets were weighted by their respective landings at the finest spatial and temporal scale available without losing data. Commercial age data were considered conditional on the length data, therefore conditional age-at-length (CAAL) and mean length-at-age (MLAA) were estimated because these data contain more detailed information on the relationship between size and age while avoiding double use of fish (Thorson et al. 2017, Methot et al. 2020). Recreational age samples were weighted by their respective fleet's final length composition to remove any potential sampling bias (Chih 2009, SEDAR 2015).

2 Data Description

SEDAR 72 assesses all Gulf of Mexico Gag Grouper in federal waters extending northward from the Texas/Mexico border and eastward to the Florida Keys US1 boundary. Length data from the commercial and recreational fisheries of the Gulf of Mexico are collected by multiple state and federal agencies. Commercial data sources utilized to generate length compositions include the Trip Interview Program (TIP, 1983-2019) and Accumulated Landings Systems (ALS, 1962-2019). Recreational sources utilized were the Marine Recreational Information Program (MRIP, 2008-2019), formerly the Marine Recreational Fisheries Statistics Survey (MRFSS, 1981-2007), Texas Parks and Wildlife Department's Marine Sport-Harvest Monitoring Program (TPWD, 1981-2019), and the Southeast Region Headboat Survey (SRHS, 1986-2019). The Gulf States Marine Fisheries Commission's Fisheries Information Network (GulfFIN) provided both commercial and recreational length and age data from multiple state sources (2001-2019). The majority of the age data were processed by and received from the SEFSC's Panama City Laboratory, where the data were filtered to match the starting year in SEDAR 33 Update (1991-2019). Commercial fleets were defined by vertical line (VL) and longline (LL) gears, and recreational fleets were defined by headboat (HB), charterboat (CB), and private (PR) modes. These data were aggregated using length bins of 2 centimeters (cm).

Natural total length (TL_{nat}), maximum total length (TL_{max}), and standard length (SL) were converted to fork length (FL) using the following conversion equations estimated in the SEDAR 33 Data Workshop:

$$FL = 1.315 + 0.96 * TL_{nat}$$
$$FL = 0.107 + 0.97 * TL_{max}$$
$$FL = 1.953 + 1.12 * SL$$

Fish landings measuring less than 20cm FL ($n = 8$) were deleted as these were assumed to be unit errors (e.g. fish recorded as 20cm were likely 20"). Considering that the current recreational world record from the region is 1.3m TL, fish lengths greater than 1.6m FL ($n = 27$) were also deleted and assumed to be errors.

3 Commercial and Recreational Length Compositions of Landings

3.1 Length Samples

Length samples of commercial landings were obtained from the TIP database maintained by the NMFS Southeast Fisheries Science Center (SEFSC) and were filtered to remove biases that include samples from pooled trips. These were supplemented with commercial lengths submitted by state agencies through GulfFIN. Length samples of recreational landings were obtained through federal and state sampling programs via SEFSC and GulfFIN, respectively. Because this assessment is an Operational, imputed lengths were dropped from the MRIP data to maintain model continuity.

3.2 Length Compositions

Because fishery-dependent sampling is typically opportunistic, sampled lengths may not be representative of the true landings composition. Possible sampling bias in the collection of length samples was removed by weighting the length compositions with the associated landings on the finest spatial and temporal scale available without losing data. Commercial fleets, VL and LL, were aggregated into three major subregions in the Gulf of Mexico based on the NMFS areas fished shown in Figure 1: SouthEastern (SE: areas 1-5), NorthEastern (NE: areas 6-12), and Western (W: areas 13-21). Recreational fleets, CB and PR, were aggregated into three major subregions in the Gulf of Mexico based on county landed defined east to west: SouthEastern (SE: FL Collier-FL Levy), NorthEastern (NE: FL Dixie-MS), and Western (W: LA-TX). These regions approximately match the regions defined in the commercial fleets. HB survey data cannot be split at this boundary and were aggregated into two major subregions in the Gulf of Mexico based on state landed: Eastern (E: FL-MS) and Western (W: LA-TX). Within each fleet, subregional-specific nominal length compositions were estimated using length bins of 2 cm, where for each year i, length bin j, and subregion r

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

$n_{i,j,r}$ is the number of samples in year i, subregion r, and lower inclusive length bin j; $n_{i,r}$ is the number of samples in year i and subregion r; and $LC_{i,j,r}$ is the proportion of the total number of sampled fish in each year i and subregion r within each lower inclusive length bin j. A minimum sample size threshold was applied annually within each strata, $LC_{i,r}$, where these were dropped and excluded from further analyses if $n_{i,r} < 30$. Next, the remaining subregional-specific length compositions were weighted based on the distribution of the landings estimates among subregions.

Number of commercial samples within gear/subregion strata are shown in Table 1, and the proportion of landings within gear/subregion strata are shown in Table 2. These proportions were multiplied by the number of trips in the associated gear/subregion strata, resulting in effective sample size used in the assessment model (Table 3). Sampling appears approximately representative of landings, where the majority of VL length samples and landings occur in the NE, while the majority of LL samples and landings occur in the SE.

Number of recreational samples within mode/subregion strata are shown in Table 4, and the proportion of landings within mode/subregion strata are shown in Table 5. These proportions were multiplied by the number of trips in the associated mode/subregion strata, resulting in effective sample size used in the assessment model (Table 6). Trends in the recreational data are less consistent compared to the commercial fleets, with the majority of landings and samples not always falling in the same subregion. The majority of landings for all recreational fleets occur in the eastern Gulf, but the trends between NE and SE shift through time.

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

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

resulting in the final weighted estimates of landings length compositions, $LC_{i,j}$. This procedure would downweight, 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.

4 Commercial and Recreational Age Compositions of Landings

4.1 Age Samples

Age estimates from sectioned and whole otoliths were compiled by the SEFSC Panama City Laboratory and were filtered to remove duplicated and biased data. Annual sample sizes of fish and trips were provided for each commercial and recreational fleet modeled in the assessment (Table 7). Gag maximum age was estimated to be 33, but a plus group of 20 was used here to overcome gaps at older ages and simplify the modeling process.

4.2 Commercial Conditional Age-at-Length

Commercial age samples were a subset of the length samples. Length distributions of otolith samples were compared to nominal and weighted length compositions for all commercial fleets (Figures 2- 5). Within each commercial fleet (VL, LL) conditional age-at-length was estimated where for each year i, length bin j, and age class k

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

$a_{i,j,k}$ is the number of age samples in year i, lower inclusive length bin j, and age class k; $a_{i,j}$ is the number of age samples in year i and lower inclusive length bin j; and $CAAL_{i,j,k}$ is the proportion of fish samples in year i and length bin j within age class k (Figure 6 and Figure 7).

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

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

4.3 Recreational Age Compositions

Age compositions were estimated for each recreational fleet (CB, PR, HB). The process outlined below was applied to each fleet individually, and any year with less than 10 age samples was dropped. First, nominal age compositions of landings were estimated using the following equation for each year i and age bin k.

$$NAC_{i,k} = \frac{a_{i,k}}{a_i}$$

To account for potential sampling biases in the recreational data, a reweighting factor was estimated within year i and length bin j. The reweighting factor, $RW_{i,j}$, corrects 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 landings,

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

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

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

where all length bins j within an age class k were summed, then rescaled to sum to 1 across each year. The reweighting factor will upweight ages from less represented length bins and will generate a more representative estimate of recreational landings' age compositions. For example, weighting the CB age composition from the years 2013-2014 resulted in a younger age distribution (Figure 8 and Figure 9) because the length composition of the samples with otoliths collected was from a larger size distribution than the representative estimate (Figure 10 and Figure 11). Similarly, the weighting procedure resulted in an older age distribution for the PR mode in 1999 (Figure 12 and Figure 13) because the samples with otoliths taken, PR Otoliths, were from a smaller size distribution than the representative estimate, PR Weighted (Figure 14 and Figure 15). If the length compositions of the length and age data are equal, there will be no effect on the final age compositions (e.g. $RW_{i,j} = 1$). The effects of the weighting procedure for HB fleets (Figure 16 and Figure 17) can also be explained by observing the differences in the years' respective length compositions (Figure 18 and Figure 19).

5 References

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6 Tables

Table 1: Annual number of commercial vertical line (VL) and longline (LL) length samples by subregion. The length compositions resulting from these samples were weighted with landings where there were 30 or more samples in each strata or dropped from further analyses if n<30.

Year	SE_VL	NE_VL	W_VL	SE_LL	NE_LL	W_LL
1984	548	253	20	412	46	0
1985	492	226	78	522	26	7
1986	610	64	77	676	51	0
1987	535	10	14	685	0	0
1988	175	0	0	187	89	0
1989	35	7	0	119	51	0
1990	560	349	50	1,289	373	7
1991	216	503	185	663	216	49
1992	628	384	110	849	75	6
1993	688	1,001	229	650	142	2
1994	1,261	1,494	81	499	282	0
1995	256	2,101	75	462	545	1
1996	602	2,457	43	438	617	2
1997	297	2,952	67	555	666	0
1998	2,223	5,599	169	3,941	1,084	0
1999	2,072	3,596	34	3,980	678	0
2000	901	2,816	39	3,172	1,029	0
2001	742	4,642	15	2,989	1,172	0
2002	1,017	3,066	19	3,071	1,045	8
2003	431	1,737	13	3,012	895	3
2004	164	2,589	25	1,955	521	6
2005	197	1,160	42	1,808	610	2
2006	131	492	19	1,304	440	17
2007	84	265	15	785	195	2
2008	64	882	37	769	511	0
2009	190	655	38	506	174	1
2010	547	449	38	712	244	4
2011	314	1,028	44	276	254	0
2012	351	1,442	114	351	140	7
2013	443	1,723	151	469	263	30

Year	SE_VL	NE_VL	W_VL	SE_LL	NE_LL	W_LL
2014	479	1,117	62	831	185	1
2015	347	725	62	910	144	2
2016	582	1,629	97	1,056	300	1
2017	512	1,220	51	682	264	18
2018	331	1,193	59	477	307	14
2019	195	1,323	79	394	265	10

Table 2: Annual distribution of commercial vertical line (VL) and longline (LL) ALS landings by subregion, where each value is the proportion of landings $p_{i,r}$ from year i and subregion r within fleets. The majority of VL samples were caught in the NE, while the majority of LL samples were caught in the SE. These proportions were used to re-scale length compositions where there were 30 or more samples in each strata.

Year	SE_VL	NE_VL	W_VL	SE_LL	NE_LL	W_LL
1984	0.460	0.434	0.1057	0.695	0.281	0.023824
1985	0.462	0.432	0.1058	0.532	0.411	0.056950
1986	0.323	0.644	0.0334	0.460	0.481	0.058699
1987	0.448	0.485	0.0670	0.538	0.452	0.010240
1988	0.334	0.603	0.0628	0.556	0.429	0.014607
1989	0.260	0.717	0.0230	0.573	0.421	0.006044
1990	0.308	0.669	0.0229	0.460	0.536	0.003225
1991	0.470	0.499	0.0309	0.778	0.195	0.026339
1992	0.561	0.422	0.0170	0.874	0.120	0.006521
1993	0.292	0.692	0.0158	0.741	0.255	0.004859
1994	0.262	0.725	0.0130	0.732	0.265	0.002991
1995	0.216	0.768	0.0164	0.641	0.344	0.014518
1996	0.284	0.696	0.0199	0.712	0.283	0.005214
1997	0.252	0.719	0.0296	0.637	0.359	0.003622
1998	0.239	0.733	0.0283	0.772	0.227	0.001154
1999	0.221	0.739	0.0401	0.776	0.218	0.005546
2000	0.208	0.760	0.0313	0.664	0.329	0.006876
2001	0.242	0.742	0.0162	0.570	0.425	0.005297
2002	0.226	0.754	0.0207	0.619	0.377	0.004249
2003	0.263	0.716	0.0215	0.665	0.326	0.008825

Year	SE_VL	NE_VL	W_VL	SE_LL	NE_LL	W_LL
2004	0.213	0.765	0.0220	0.633	0.365	0.002589
2005	0.226	0.752	0.0215	0.588	0.409	0.002539
2006	0.305	0.672	0.0235	0.645	0.350	0.004813
2007	0.186	0.772	0.0420	0.640	0.352	0.008145
2008	0.130	0.845	0.0248	0.460	0.533	0.006363
2009	0.196	0.762	0.0417	0.594	0.385	0.021498
2010	0.283	0.697	0.0194	0.731	0.240	0.028412
2011	0.282	0.696	0.0224	0.760	0.240	0.000677
2012	0.239	0.744	0.0172	0.758	0.239	0.003262
2013	0.252	0.728	0.0202	0.697	0.291	0.012032
2014	0.300	0.665	0.0349	0.790	0.209	0.000863
2015	0.317	0.656	0.0276	0.745	0.247	0.008206
2016	0.286	0.698	0.0157	0.743	0.253	0.003491
2017	0.313	0.675	0.0128	0.678	0.311	0.010415
2018	0.245	0.736	0.0195	0.562	0.436	0.002492
2019	0.254	0.727	0.0188	0.505	0.490	0.004557

Table 3: Number of trips for VL and LL fleets. Land_rep is the percentage of landings that are represented in the length compositions for each fleet (<1 where one or more strata were dropped due to low sample sizes in the associated subregion for that year). Trips_rep (trips x land_rep) is the effective sample size for each fleet and year represented in the length compositions.

Year	VL trips	VL land_rep	VL trips_rep	LL trips	LL land_rep	LL trips_rep
1984	27	0.89	24.15	22	0.98	21
1985	65	1.00	65.00	23	0.53	12
1986	46	1.00	46.00	49	0.94	46
1987	24	0.45	10.76	23	0.54	12
1988	9	0.33	3.01	16	0.99	16
1989	1	0.26	0.26	7	0.99	7
1990	71	1.00	71.00	69	1.00	69
1991	141	1.00	141.00	74	1.00	74
1992	131	1.00	131.00	77	0.99	76
1993	216	1.00	216.00	100	1.00	100

Year	VL trips	VL land_rep	VL trips_rep	LL trips	LL land_rep	LL trips_rep
1994	193	1.00	193.00	96	1.00	96
1995	239	1.00	239.00	102	0.99	101
1996	240	1.00	240.00	99	0.99	98
1997	230	1.00	230.00	132	1.00	132
1998	294	1.00	294.00	273	1.00	273
1999	264	1.00	264.00	310	0.99	308
2000	228	1.00	228.00	244	0.99	242
2001	220	0.98	216.43	230	0.99	229
2002	229	0.98	224.25	257	1.00	256
2003	178	0.98	174.18	316	0.99	313
2004	143	0.98	139.85	260	1.00	259
2005	140	1.00	140.00	270	1.00	269
2006	82	0.98	80.07	243	1.00	242
2007	56	0.96	53.65	187	0.99	185
2008	109	1.00	109.00	198	0.99	197
2009	175	1.00	175.00	115	0.98	113
2010	188	1.00	188.00	114	0.97	111
2011	239	1.00	239.00	98	1.00	98
2012	384	1.00	384.00	110	1.00	110
2013	460	1.00	460.00	154	1.00	154
2014	367	1.00	367.00	138	1.00	138
2015	270	1.00	270.00	124	0.99	123
2016	366	1.00	366.00	144	1.00	143
2017	288	1.00	288.00	145	0.99	143
2018	310	1.00	310.00	113	1.00	113
2019	376	1.00	376.00	92	1.00	92

Table 4: Annual number of Gag Grouper recreational charterboat (CB), private (PR), and headboat (HB) length samples within defined subregions in the Gulf. The length compositions resulting from these samples were weighted with landings where there were 30 or more samples in each strata or dropped from further analyses if n<30.

Year	SE_CB	NE_CB	W_CB	SE_PR	NE_PR	W_PR	E_HB	W_HB
1981	10	12	0	27	41	0	32	0
1982	6	2	0	79	37	3	28	0
1983	2	2	3	57	25	0	82	0
1984	19	0	1	46	0	2	58	1
1985	0	20	0	36	8	8	119	0
1986	158	69	24	25	32	2	625	44
1987	66	130	5	81	66	1	602	50
1988	43	71	0	98	64	3	336	46
1989	54	34	1	30	5	4	426	27
1990	59	9	0	18	17	5	329	32
1991	7	11	10	76	5	4	144	12
1992	123	34	6	125	12	3	126	17
1993	82	30	5	110	51	1	82	48
1994	69	6	2	96	47	5	183	36
1995	88	18	3	124	12	0	151	40
1996	5	96	6	67	59	8	234	35
1997	207	193	1	175	20	0	283	29
1998	354	666	5	269	43	11	354	166
1999	514	1,211	6	404	120	14	355	135
2000	434	1,101	9	238	171	13	283	56
2001	258	720	1	216	81	19	234	29
2002	425	652	7	179	127	9	283	17
2003	386	936	10	197	94	7	369	15
2004	503	1,616	4	169	83	8	228	5
2005	226	1,297	19	139	84	5	204	17
2006	86	561	16	52	75	11	150	20
2007	104	251	8	68	81	7	160	1
2008	238	256	4	131	111	5	210	3
2009	240	94	7	110	41	10	243	2
2010	453	149	3	123	26	4	345	2

Year	SE_CB	NE_CB	W_CB	SE_PR	NE_PR	W_PR	E_HB	W_HB
2011	38	84	1	48	19	2	78	1
2012	253	301	1	45	19	4	117	6
2013	94	33	0	147	15	1	127	6
2014	213	15	0	148	17	2	272	6
2015	99	17	2	110	19	1	87	4
2016	89	30	1	82	16	2	39	2
2017	68	13	0	85	25	3	69	2
2018	59	21	0	51	34	4	95	2
2019	78	47	0	88	69	2	103	4

Table 5: Annual distribution of recreational charterboat (CB), private (PR), and headboat (HB) landings by subregion, where each value is the proportion of landings in numbers $p_{i,r}$ from year i and subregion r within fleets. The majority of landings across all fleets were in the eastern Gulf. These proportions were used to re-scale length compositions where there were 30 or more samples in each strata.

Year	SE_CB	NE_CB	W_CB	SE_PR	NE_PR	W_PR	E_HB	W_HB
1981	0.825	0.1754	0.000000	0.628	0.3725	0.00e+00	0.994	0.00586
1982	0.942	0.0584	0.000000	0.775	0.2172	7.71e-03	0.993	0.00653
1983	0.925	0.0544	0.021014	0.935	0.0653	1.51e-05	0.990	0.00997
1984	0.968	0.0214	0.010773	0.999	0.0000	5.77e-04	0.989	0.01137
1985	0.904	0.0958	0.000000	0.361	0.6191	2.02e-02	0.996	0.00419
1986	0.486	0.5096	0.004452	0.258	0.7406	1.81e-03	0.970	0.03025
1987	0.249	0.7493	0.001447	0.478	0.5122	9.43e-03	0.969	0.03136
1988	0.174	0.8257	0.000000	0.514	0.4638	2.24e-02	0.977	0.02342
1989	0.420	0.5765	0.003775	0.362	0.6201	1.82e-02	0.993	0.00709
1990	0.753	0.2474	0.000000	0.525	0.4741	4.34e-04	0.990	0.00957
1991	0.346	0.5775	0.076832	0.910	0.0892	4.04e-04	0.985	0.01503
1992	0.754	0.2443	0.001213	0.814	0.1770	8.59e-03	0.987	0.01296
1993	0.663	0.3274	0.009856	0.755	0.2436	1.88e-03	0.966	0.03419
1994	0.624	0.3747	0.001707	0.738	0.2508	1.14e-02	0.985	0.01460
1995	0.779	0.2163	0.004413	0.758	0.2422	0.00e+00	0.977	0.02257
1996	0.124	0.8750	0.001024	0.485	0.4816	3.34e-02	0.967	0.03274
1997	0.470	0.5279	0.001687	0.636	0.3623	1.22e-03	0.979	0.02125

Year	SE_CB	NE_CB	W_CB	SE_PR	NE_PR	W_PR	E_HB	W_HB
1998	0.300	0.6914	0.008996	0.789	0.2055	5.27e-03	0.945	0.05479
1999	0.337	0.6511	0.011956	0.753	0.2185	2.85e-02	0.974	0.02582
2000	0.625	0.3691	0.005631	0.633	0.3631	3.57e-03	0.991	0.00872
2001	0.531	0.4672	0.001369	0.614	0.3763	1.01e-02	0.983	0.01659
2002	0.675	0.3197	0.005468	0.479	0.5172	3.72e-03	0.968	0.03226
2003	0.358	0.6271	0.014580	0.655	0.3423	2.34e-03	0.964	0.03643
2004	0.375	0.6225	0.002422	0.517	0.4708	1.17e-02	0.993	0.00698
2005	0.285	0.6891	0.025526	0.419	0.5787	2.44e-03	0.983	0.01748
2006	0.281	0.6907	0.028006	0.188	0.8008	1.12e-02	0.964	0.03596
2007	0.317	0.6651	0.018154	0.367	0.6165	1.61e-02	0.982	0.01805
2008	0.668	0.3293	0.002638	0.450	0.5445	5.06e-03	0.977	0.02316
2009	0.677	0.2677	0.055324	0.590	0.4075	2.58e-03	0.980	0.02035
2010	0.873	0.1216	0.005316	0.743	0.2564	2.36e-04	0.988	0.01180
2011	0.692	0.3049	0.003386	0.554	0.4285	1.79e-02	0.993	0.00691
2012	0.551	0.4465	0.002617	0.444	0.5549	7.02e-04	0.985	0.01467
2013	0.797	0.2034	0.000000	0.741	0.2582	8.01e-04	0.994	0.00634
2014	0.686	0.2967	0.017545	0.800	0.2002	2.17e-04	0.998	0.00218
2015	0.624	0.3682	0.007706	0.811	0.1889	7.96e-05	0.995	0.00468
2016	0.522	0.4722	0.005674	0.840	0.1590	1.00e-03	0.982	0.01802
2017	0.866	0.1322	0.001613	0.523	0.4768	2.87e-04	0.994	0.00639
2018	0.551	0.4479	0.000858	0.568	0.4317	2.32e-04	0.989	0.01054
2019	0.500	0.4924	0.007534	0.495	0.5050	1.26e-04	0.985	0.01479

Table 6: Number of trips for CB, PR, and HB fleets. Land_rep is the percentage of landings that are represented in the length compositions for each fleet (<1 where one or more strata were dropped due to low sample sizes in the associated subregion for that year). Trips_rep (trips x land_rep) is the effective sample size for each fleet and year represented in the length compositions.

Year	CB trips	CB land_rep	CB trips_rep	PR trips	PR land_rep	PR trips_rep	HB trips	HB land_rep	HB trips_rep
1981	0	0.00	0.0	13	0.37	4.8	23	0.99	23
1982	0	0.00	0.0	48	0.99	47.6	0	0.00	0
1983	0	0.00	0.0	18	0.93	16.8	58	0.99	57
1984	0	0.00	0.0	17	1.00	17.0	38	0.99	38

Year	CB trips	CB land_rep	CB trips_rep	PR trips	PR land_rep	PR trips_rep	HB trips	HB land_rep	HB trips_rep
1985	0	0.00	0.0	15	0.36	5.4	66	1.00	66
1986	59	1.00	58.7	15	0.74	11.1	263	1.00	263
1987	64	1.00	63.9	70	0.99	69.3	301	1.00	301
1988	42	1.00	42.0	58	0.98	56.7	203	1.00	203
1989	31	1.00	30.9	15	0.36	5.4	171	0.99	170
1990	11	0.75	8.3	0	0.00	0.0	134	1.00	134
1991	0	0.00	0.0	36	0.91	32.8	67	0.98	66
1992	35	1.00	35.0	77	0.81	62.7	66	0.99	65
1993	30	0.99	29.7	73	1.00	72.9	85	1.00	85
1994	9	0.62	5.6	73	0.99	72.2	86	1.00	86
1995	25	0.78	19.5	59	0.76	44.7	95	1.00	95
1996	33	0.88	28.9	74	0.97	71.5	121	1.00	121
1997	152	1.00	151.7	83	0.64	52.8	109	0.98	107
1998	324	0.99	321.1	152	0.99	151.2	234	1.00	234
1999	503	0.99	497.0	236	0.97	229.3	196	1.00	196
2000	486	0.99	483.3	171	1.00	170.4	133	1.00	133
2001	318	1.00	317.6	158	0.99	156.4	77	0.98	76
2002	331	0.99	329.2	158	1.00	157.4	83	0.97	80
2003	359	0.99	353.8	156	1.00	155.6	124	0.96	119
2004	484	1.00	482.8	122	0.99	120.6	85	0.99	84
2005	449	0.97	437.5	123	1.00	122.7	86	0.98	84
2006	217	0.97	210.9	68	0.99	67.2	58	0.96	56
2007	156	0.98	153.2	89	0.98	87.6	63	0.98	62
2008	164	1.00	163.6	117	0.99	116.4	78	0.98	76
2009	139	0.94	131.3	94	1.00	93.8	172	0.98	168
2010	278	0.99	276.5	74	0.74	55.0	264	0.99	261
2011	59	1.00	58.8	27	0.55	14.9	51	0.99	51
2012	214	1.00	213.4	19	0.44	8.4	63	0.99	62
2013	64	1.00	64.0	71	0.74	52.6	64	0.99	64
2014	63	0.69	43.2	67	0.80	53.6	133	1.00	133
2015	34	0.62	21.2	59	0.81	47.9	38	1.00	38
2016	71	0.99	70.6	42	0.84	35.3	30	0.98	29

Year	CB trips	CB land_rep	CB trips_rep	PR trips	PR land_rep	PR trips_rep	HB trips	HB land_rep	HB trips_rep
2017	35	0.87	30.3	55	0.52	28.8	36	0.99	36
2018	26	0.55	14.3	60	1.00	60.0	45	0.99	45
2019	61	0.99	60.5	94	1.00	94.0	71	0.99	70

Table 7: Annual number of age samples for commercial vertical line (VL) and longline (LL) fleets, and recreational charterboat (CB), private (PR), and headboat (HB) fleets used to estimate final age compositions (a_i<10 fish were excluded). Data are shown as number of fish (number of trips).

Year	VL	LL	CB	PR	HB
1991	210 (27)	7 (1)	77 (25)	5 (2)	38 (25)
1992	66 (17)	22 (12)	230 (73)	13 (8)	130 (80)
1993	417 (85)	12 (7)	281 (49)	11 (4)	89 (62)
1994	435 (44)	3 (2)	182 (45)	8 (5)	104 (66)
1995	284 (46)	31 (7)	199 (35)	2 (2)	101 (66)
1996	197 (21)	57 (14)	438 (60)	1 (1)	141 (82)
1997	34 (9)	6 (5)	155 (27)	2 (2)	70 (50)
1998	106 (13)	101 (21)	51 (11)	2 (2)	66 (35)
1999	145 (21)	243 (49)	84 (14)	15 (6)	11 (10)
2000	387 (57)	177 (28)	36 (13)	-- (--)	23 (16)
2001	745 (91)	867 (138)	127 (44)	5 (1)	31 (17)
2002	809 (105)	1085 (155)	312 (50)	31 (13)	17 (7)
2003	520 (104)	1117 (220)	180 (41)	79 (30)	76 (21)
2004	894 (114)	1484 (220)	75 (30)	25 (10)	39 (17)
2005	740 (101)	857 (93)	119 (21)	3 (3)	127 (47)
2006	641 (94)	534 (181)	26 (12)	17 (9)	57 (26)
2007	408 (80)	936 (195)	36 (12)	20 (8)	25 (14)
2008	680 (64)	506 (94)	160 (27)	79 (15)	27 (15)
2009	1027 (192)	812 (137)	149 (31)	81 (7)	147 (23)
2010	799 (151)	1091 (147)	399 (47)	174 (41)	219 (40)
2011	1429 (260)	521 (100)	243 (30)	72 (29)	24 (9)
2012	1615 (361)	459 (101)	254 (22)	1 (1)	16 (8)
2013	2222 (465)	815 (211)	155 (24)	34 (9)	45 (21)

Year	VL	LL	CB	PR	HB
2014	1515 (355)	1011 (163)	91 (17)	20 (11)	346 (20)
2015	973 (258)	959 (123)	20 (16)	43 (29)	88 (41)
2016	1790 (315)	1240 (152)	70 (37)	57 (39)	34 (27)
2017	1562 (254)	903 (146)	89 (39)	105 (71)	42 (24)
2018	1422 (276)	700 (118)	174 (78)	83 (46)	121 (65)
2019	1278 (322)	582 (85)	280 (129)	105 (56)	107 (58)

7 Figures

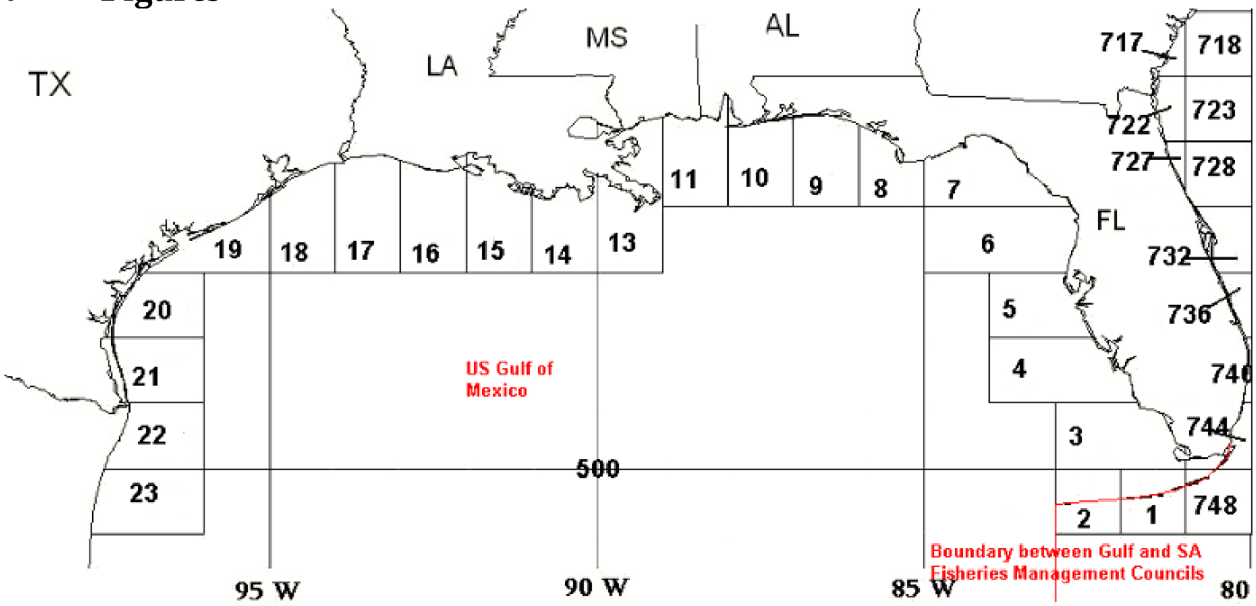

Figure 1: NMFS commercial fishing areas in the Gulf of Mexico used to define spatial strata in the weighting procedure.

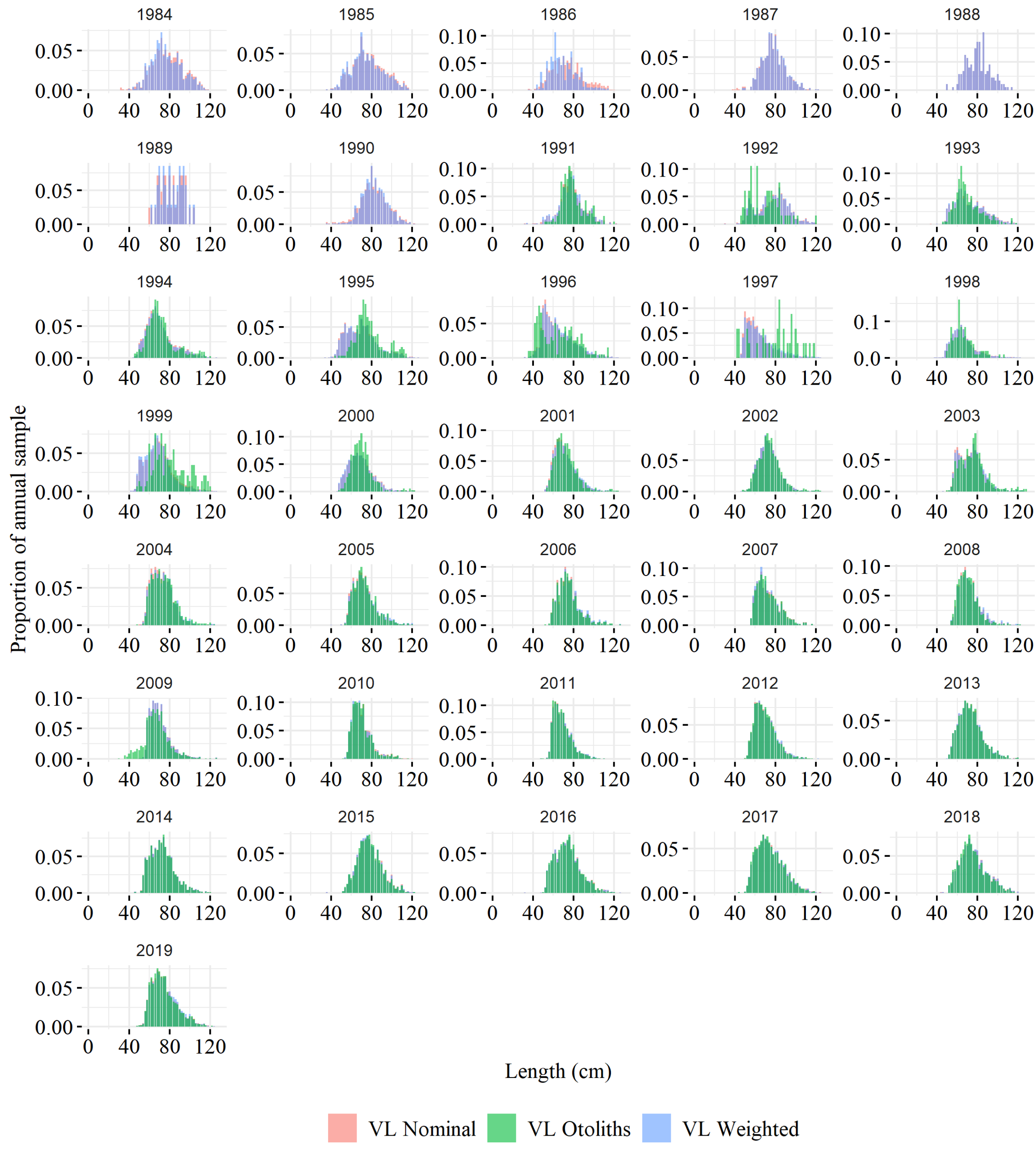

Figure 2: Annual Gag Grouper commercial VL length frequency distributions: unweighted (nominal), weighted with the final landings, and age data (otoliths).

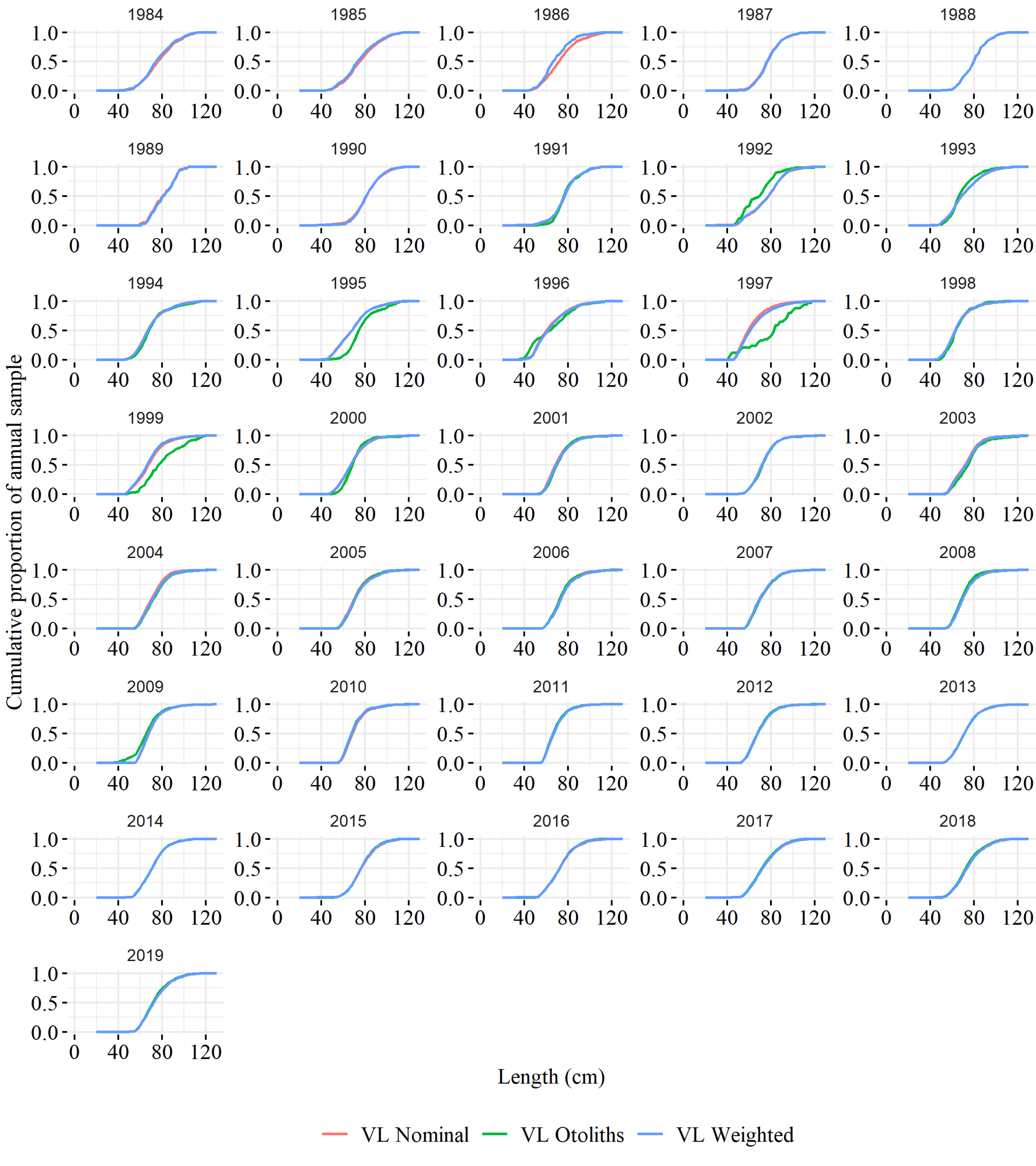

Figure 3: Annual Gag Grouper commercial VL cumulative length distributions: unweighted (nominal), weighted with the final landings, and age data (otoliths).

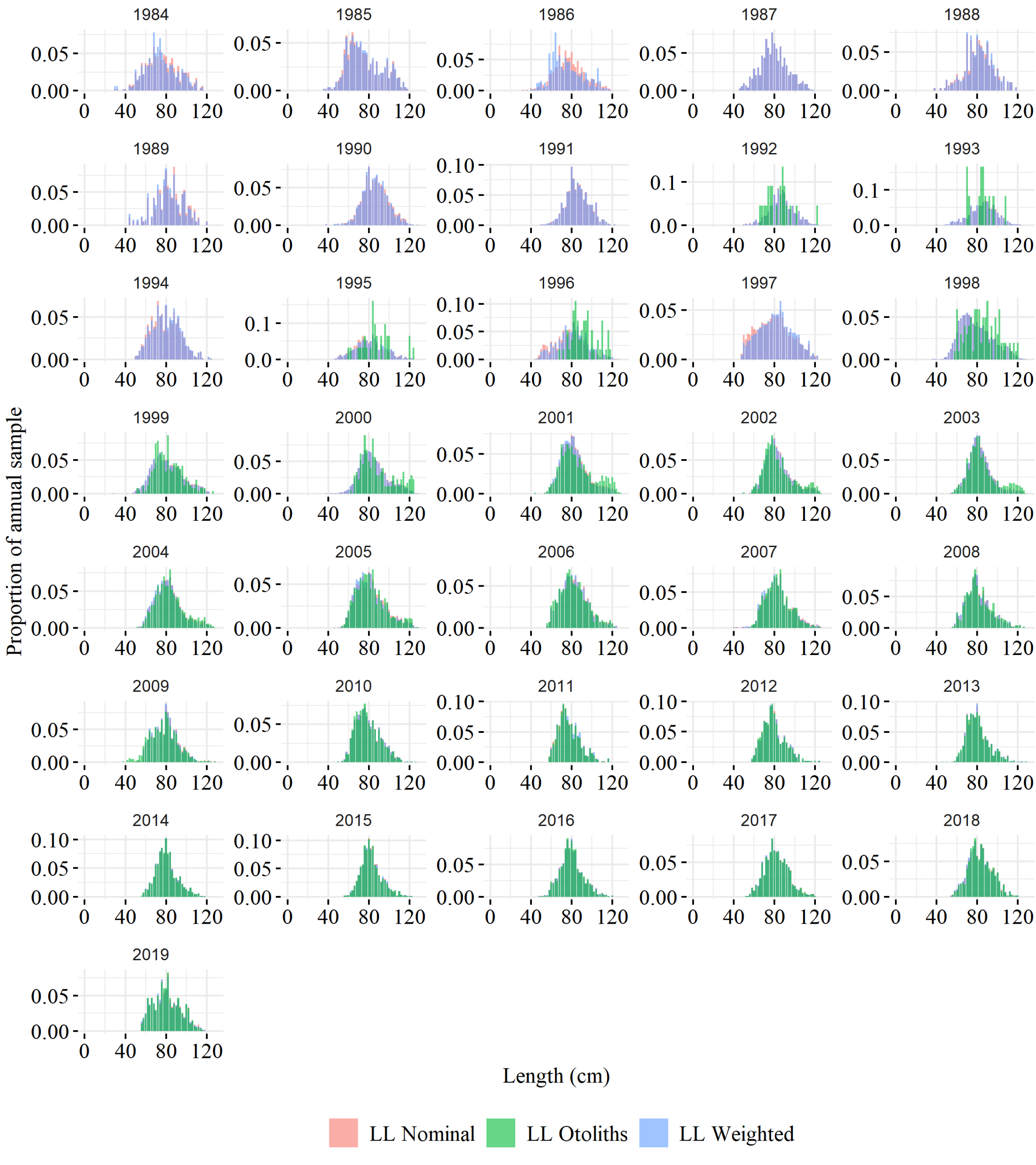

Figure 4: Annual Gag Grouper commercial LL length frequency distributions: unweighted (nominal), weighted with the final landings, and age data (otoliths).

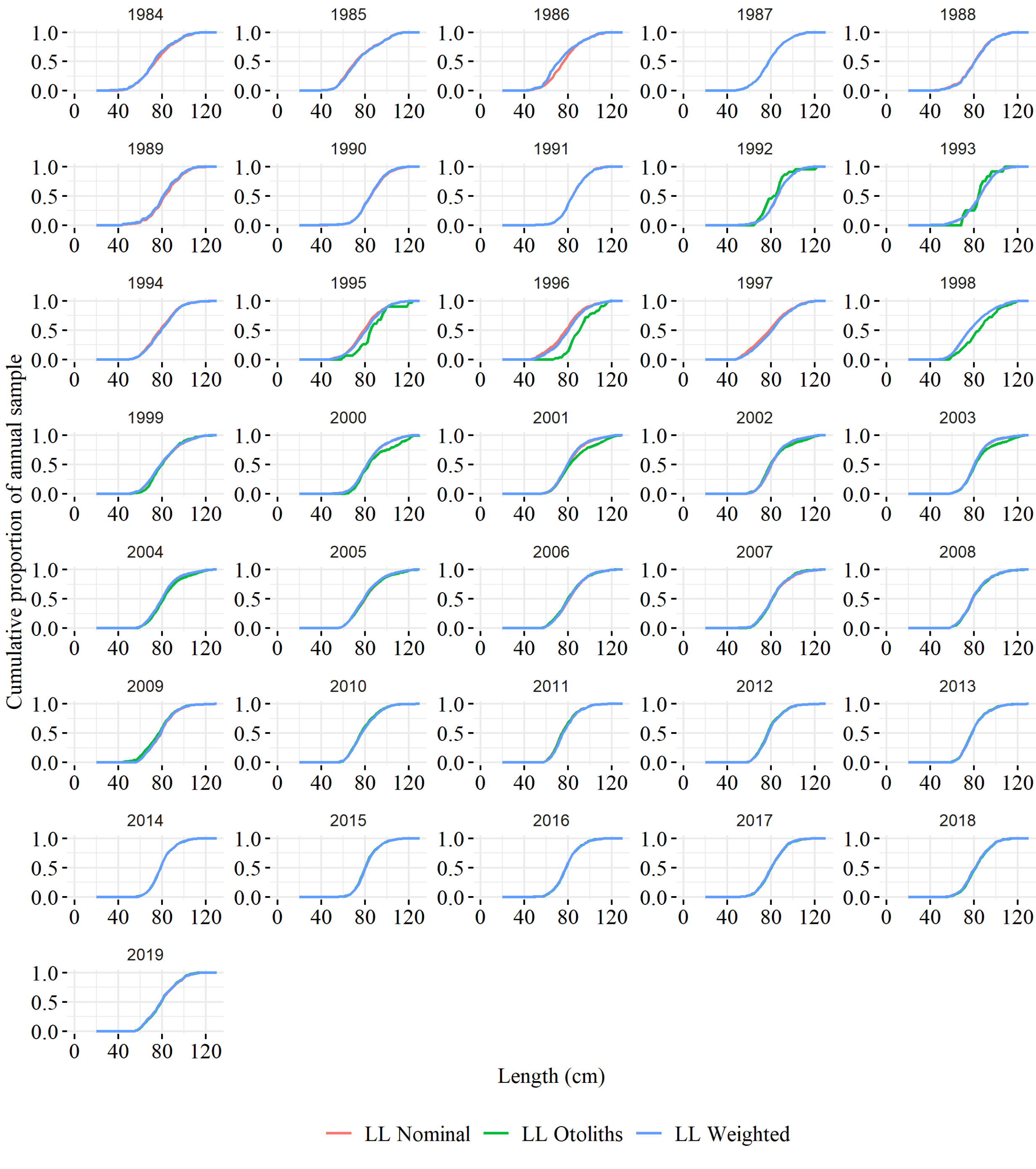

Figure 5: Annual Gag Grouper commercial LL cumulative length distributions: unweighted (nominal), weighted with the final landings, and age data (otoliths).

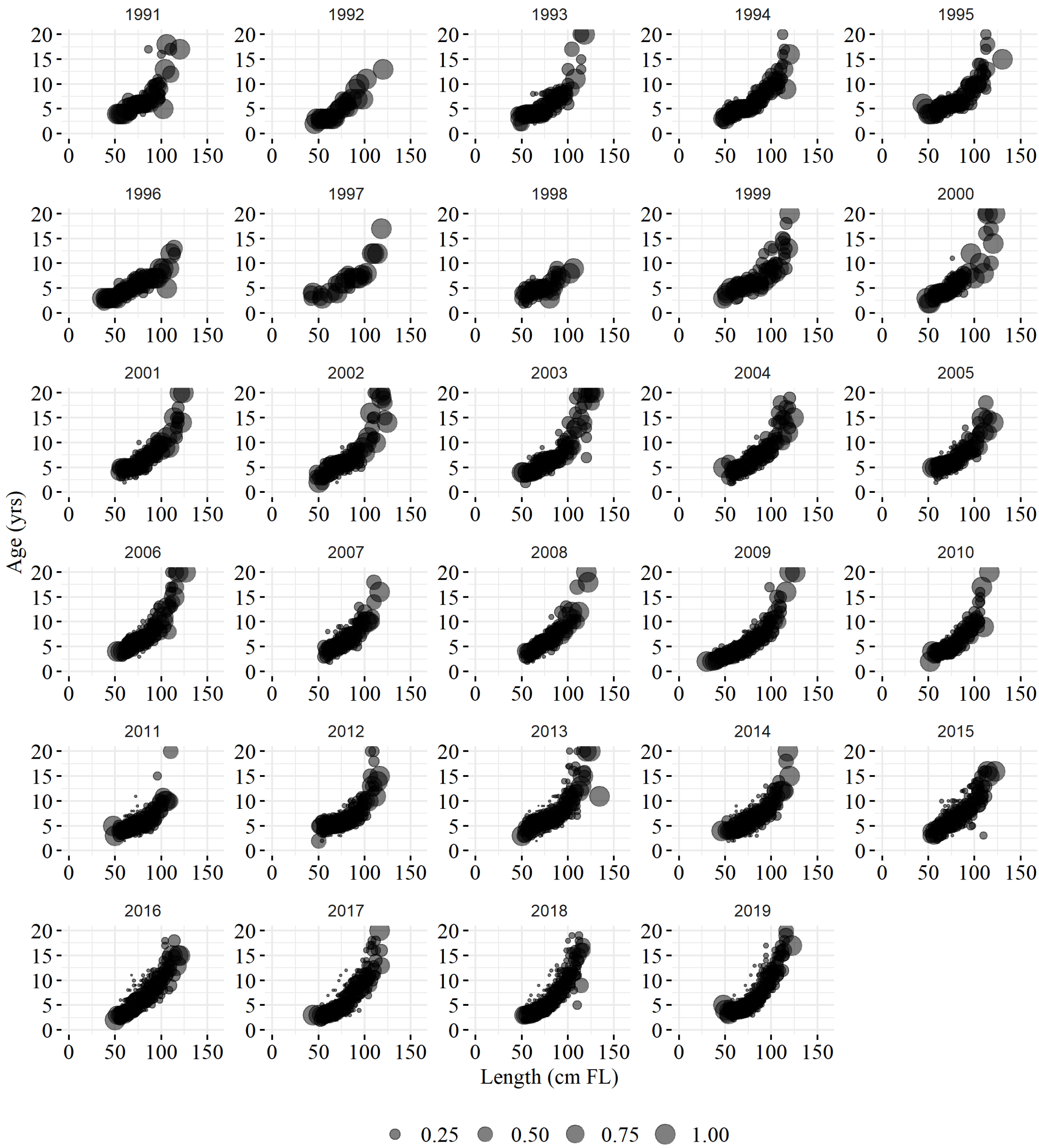

Figure 6: Annual Gag Grouper commercial VL conditional age-at-length estimates.

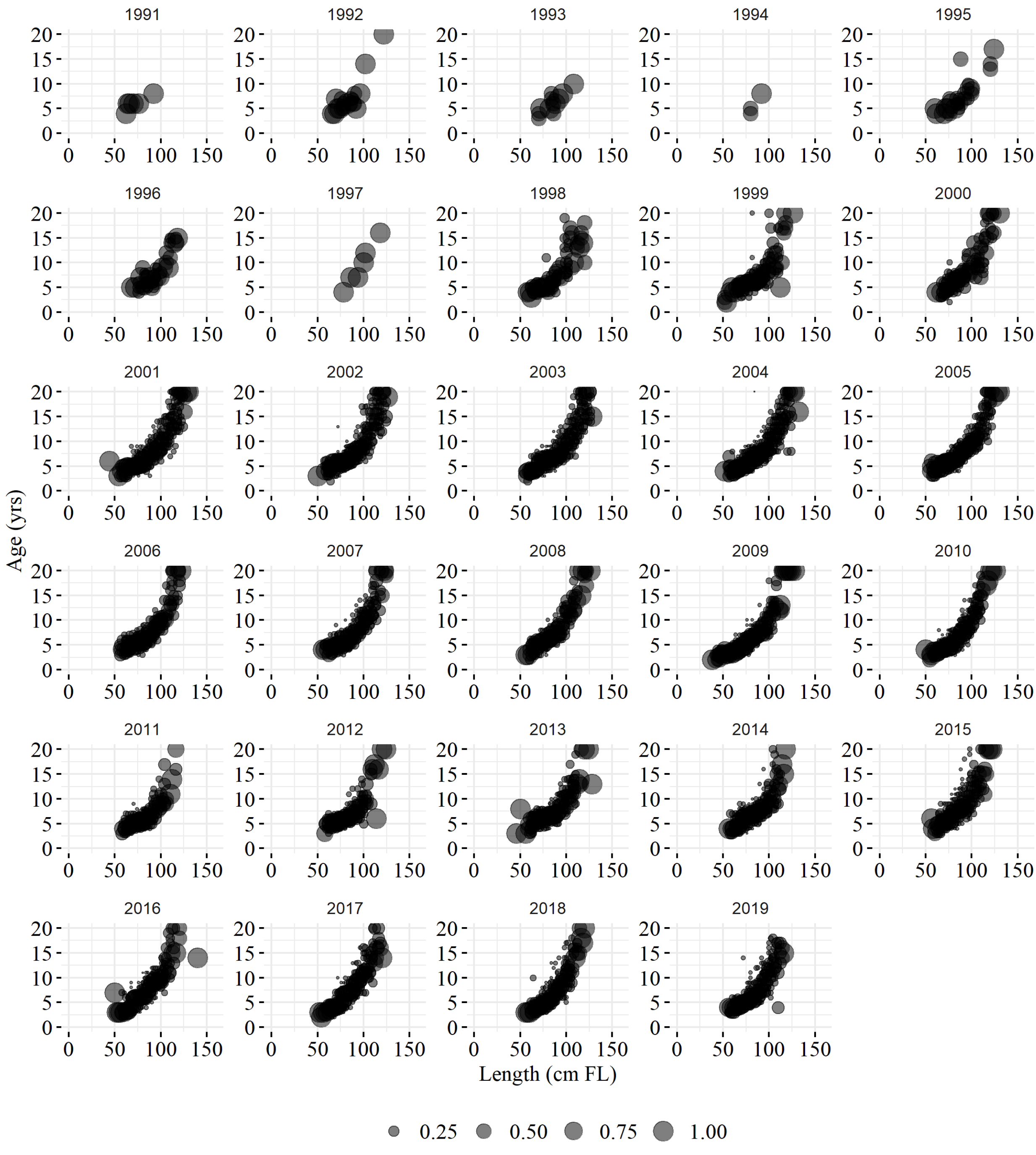

Figure 7: Annual Gag Grouper commercial LL conditional age-at-length estimates.

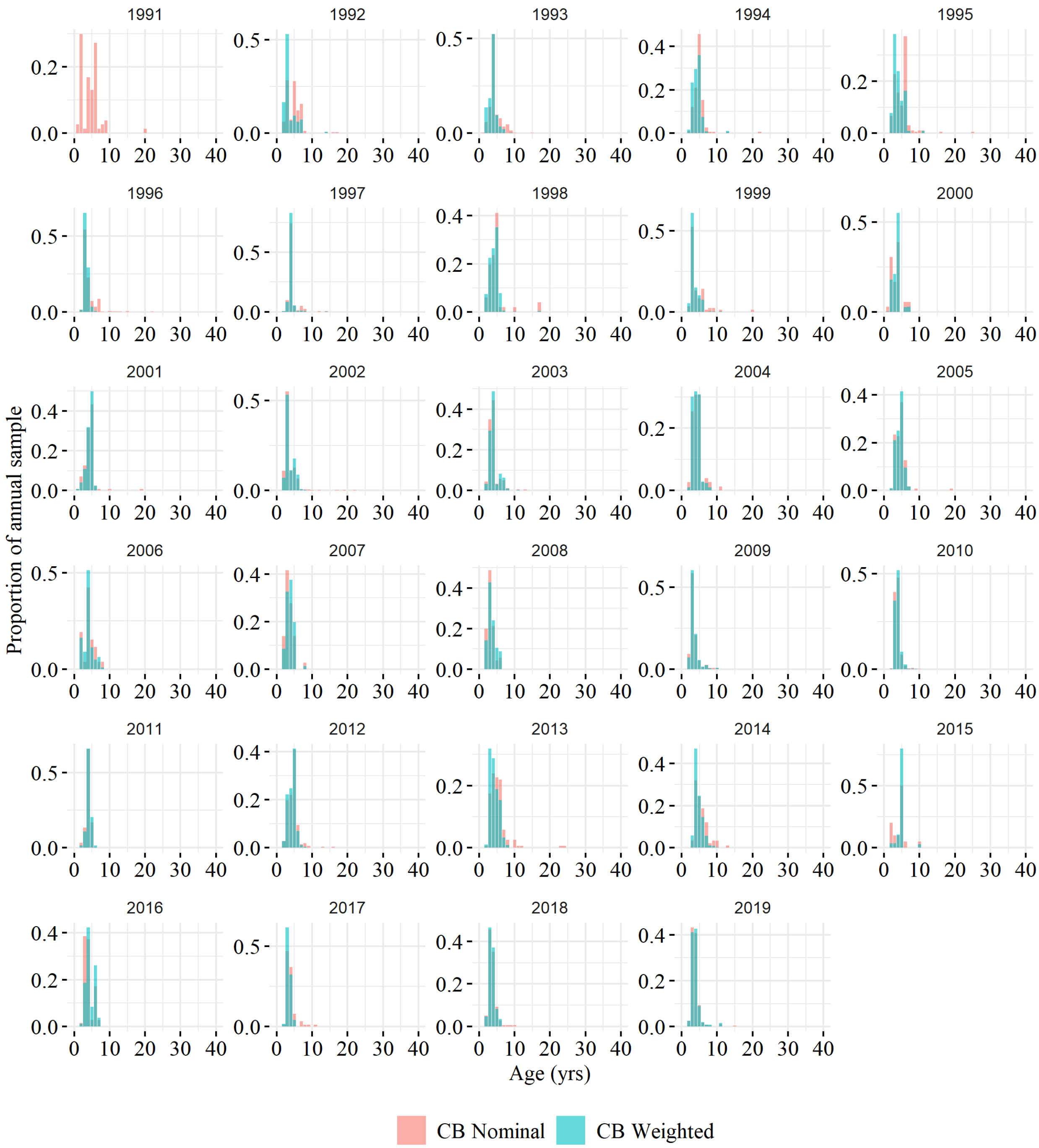

Figure 8: Annual Gag Grouper recreational charterboat age frequency distributions, both unweighted (nominal) and weighted with the final length compositions..

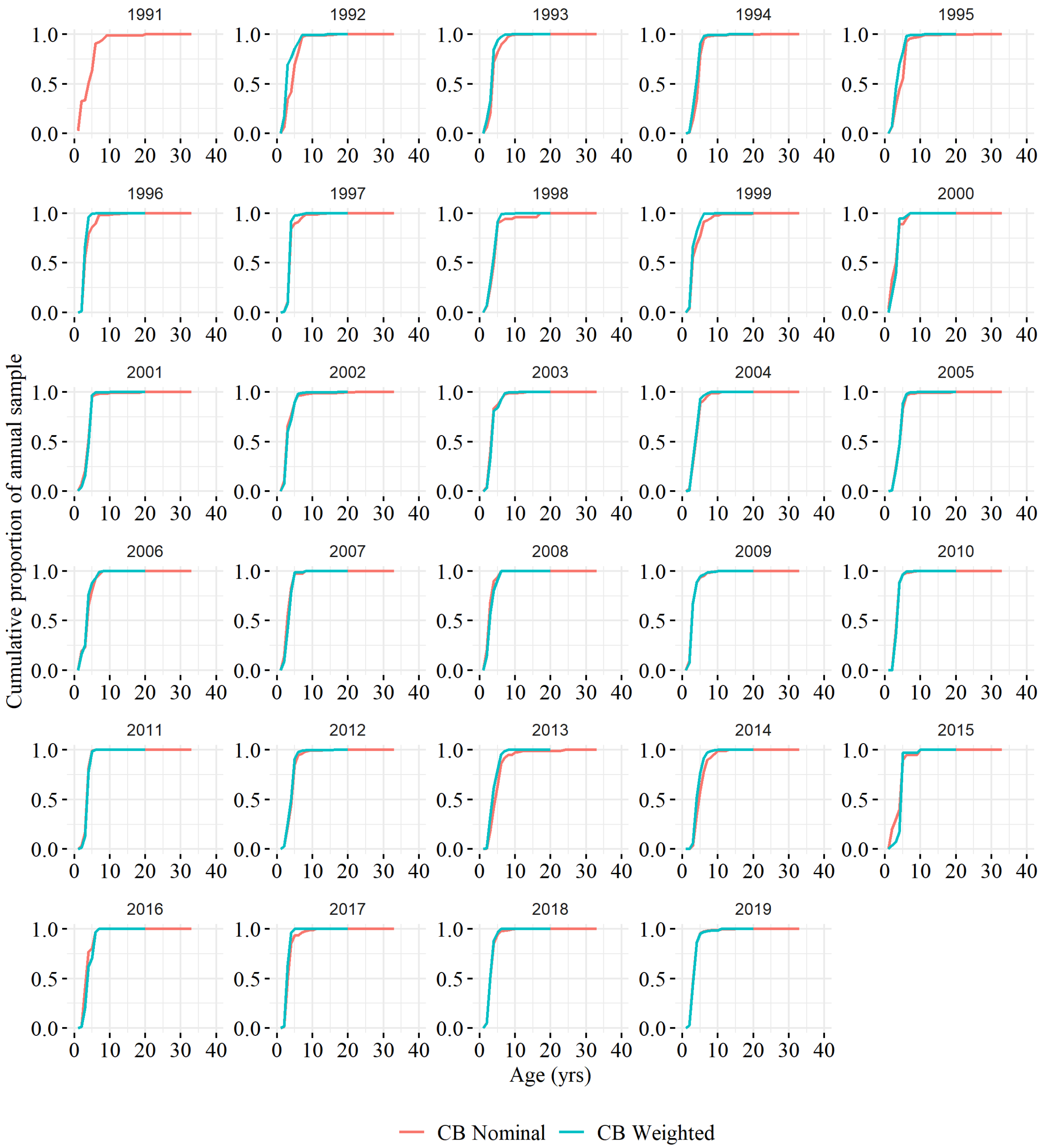

Figure 9: Annual Gag Grouper recreational charterboat cumulative age distributions, both unweighted (nominal) and weighted with the final length compositions..

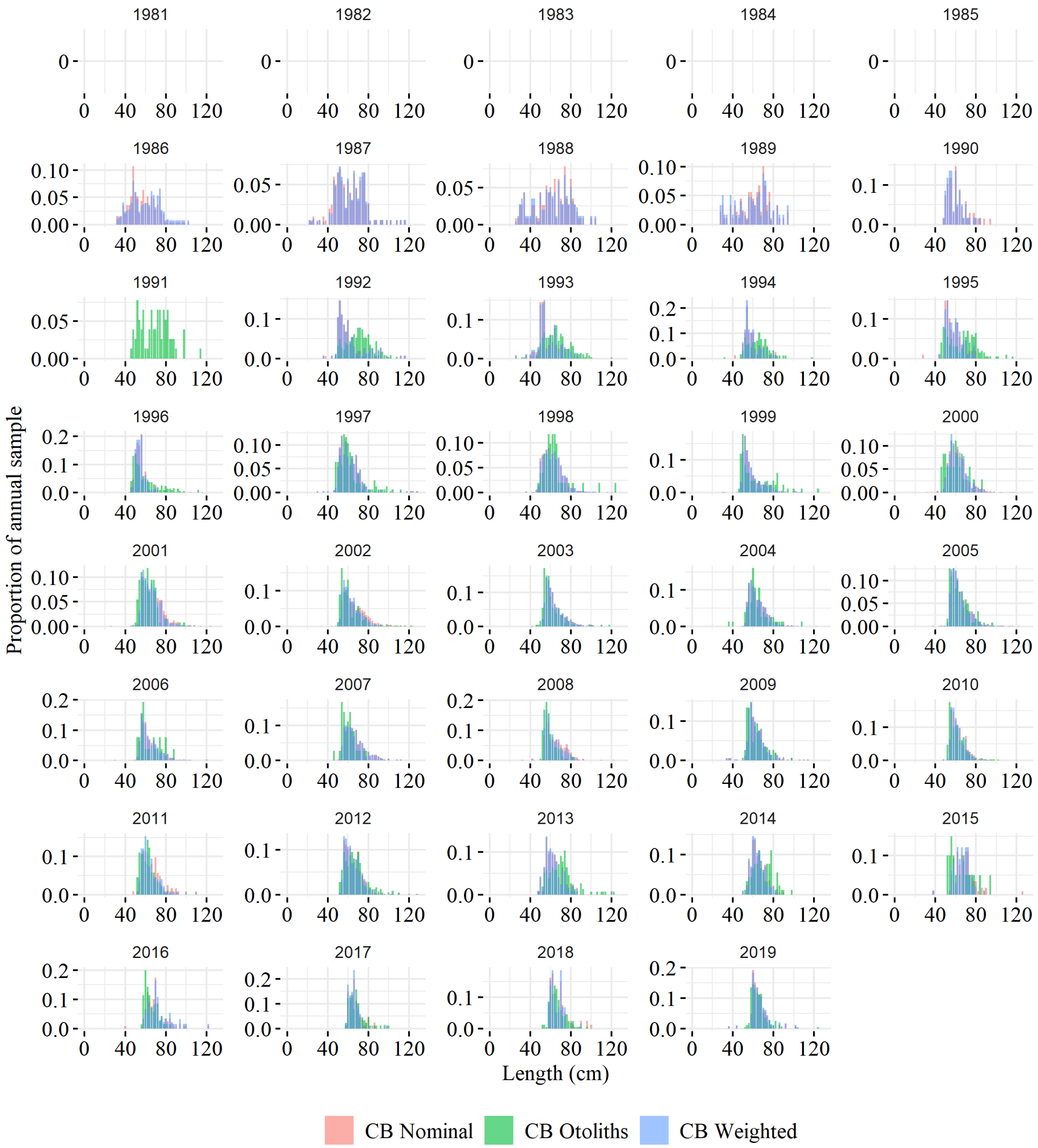

Figure 10: Annual Gag Grouper recreational charterboat length frequency distributions: unweighted (nominal), weighted with the final landings, and age data (otoliths).

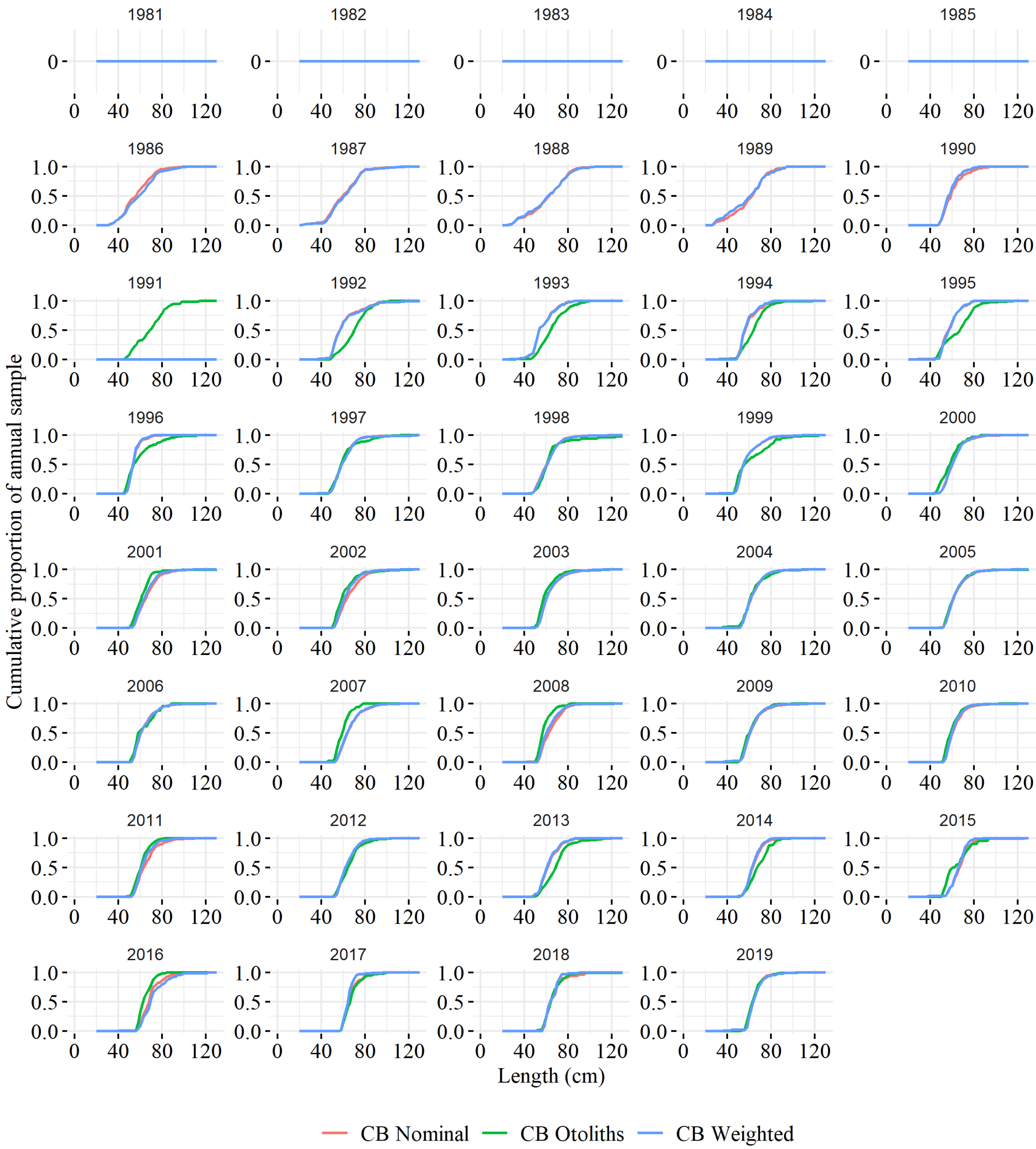

Figure 11: Annual Gag Grouper recreational charterboat cumulative length distributions: unweighted (nominal), weighted with the final landings, and age data (otoliths).

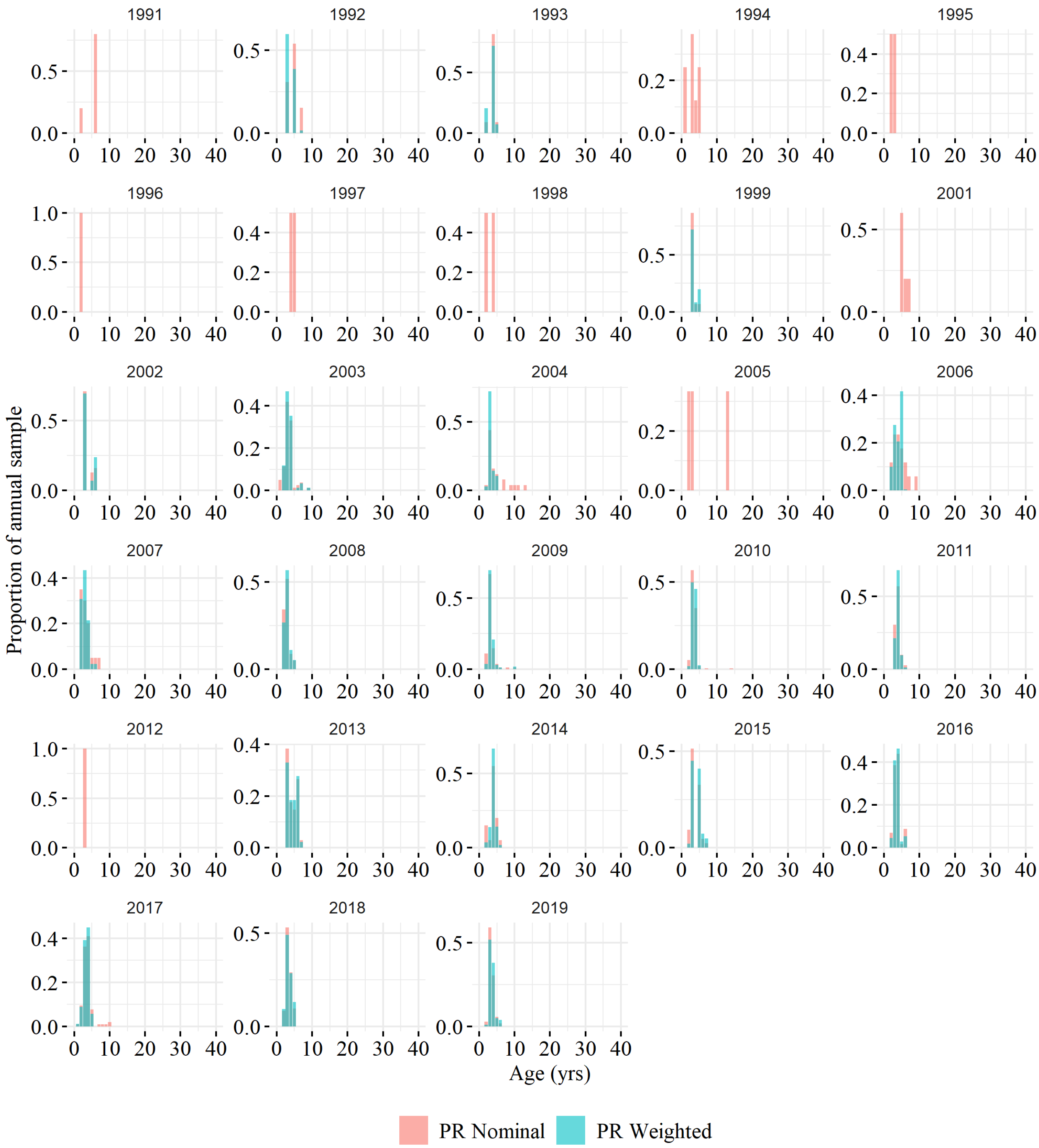

Figure 12: Annual Gag Grouper recreational private age frequency distributions, both unweighted (nominal) and weighted with the final length compositions..

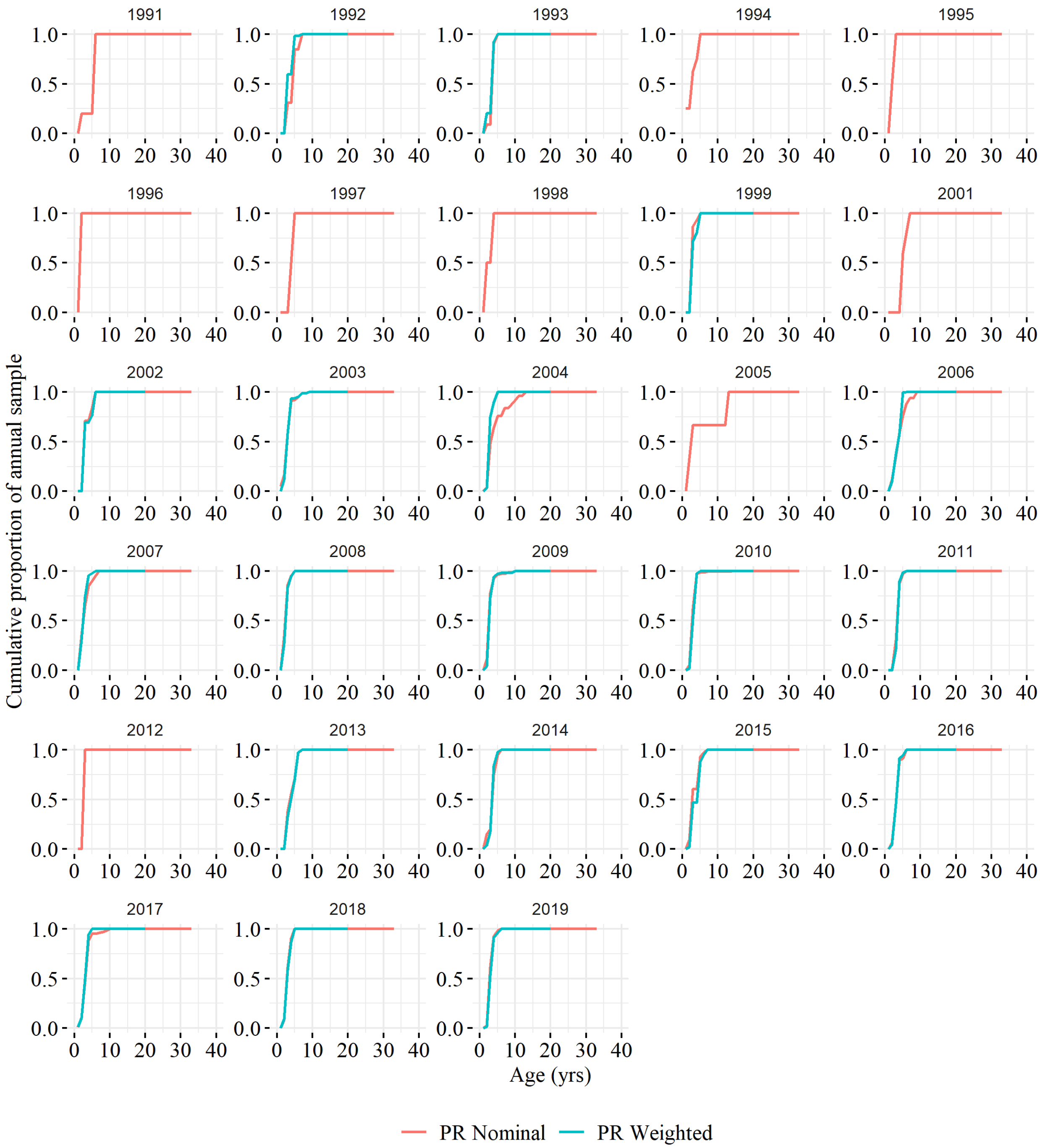

Figure 13: Annual Gag Grouper recreational private cumulative age distributions, both unweighted (nominal) and weighted with the final length compositions..

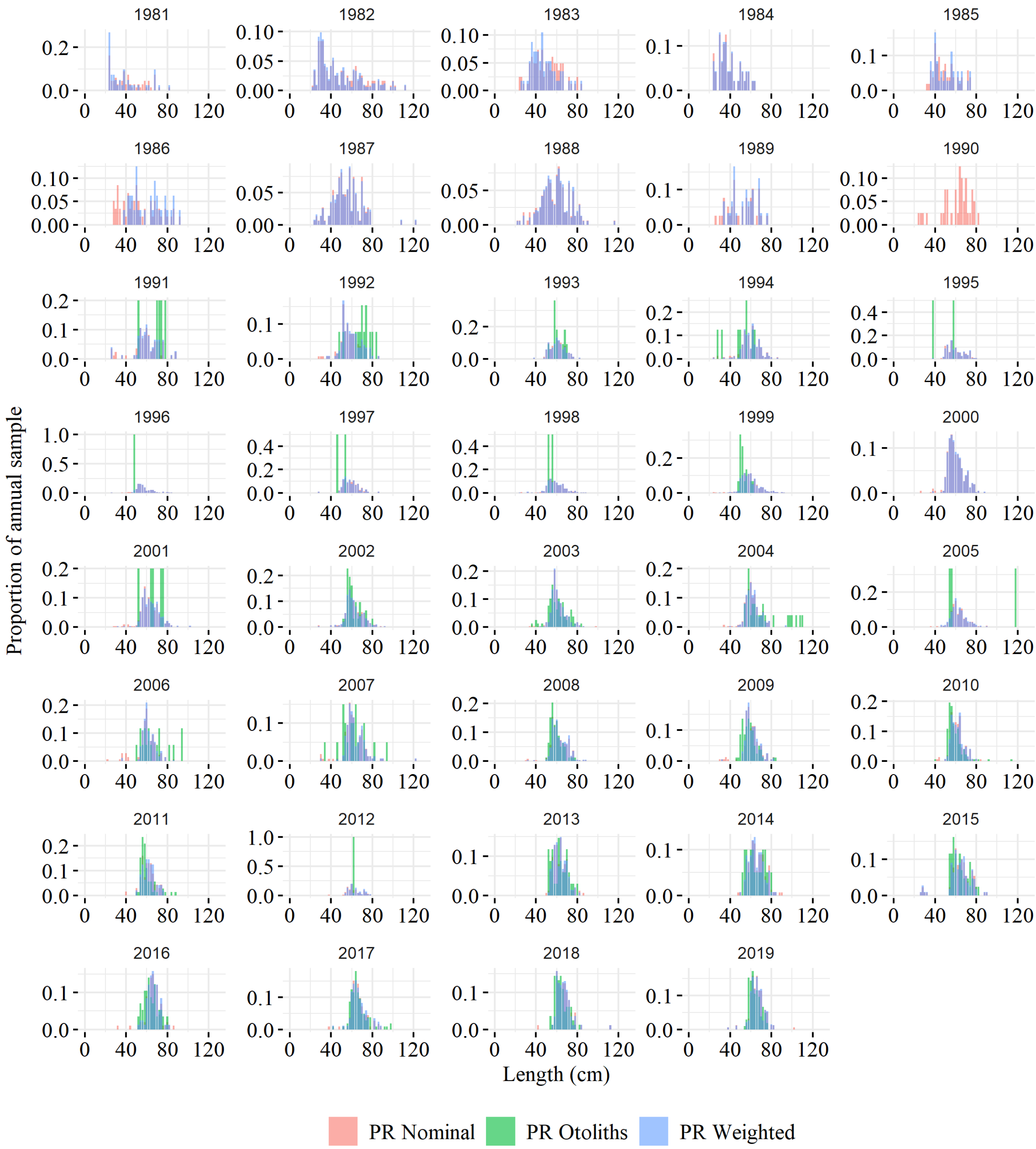

Figure 14: Annual Gag Grouper recreational private length frequency distributions: unweighted (nominal), weighted with the final landings, and age data (otoliths).

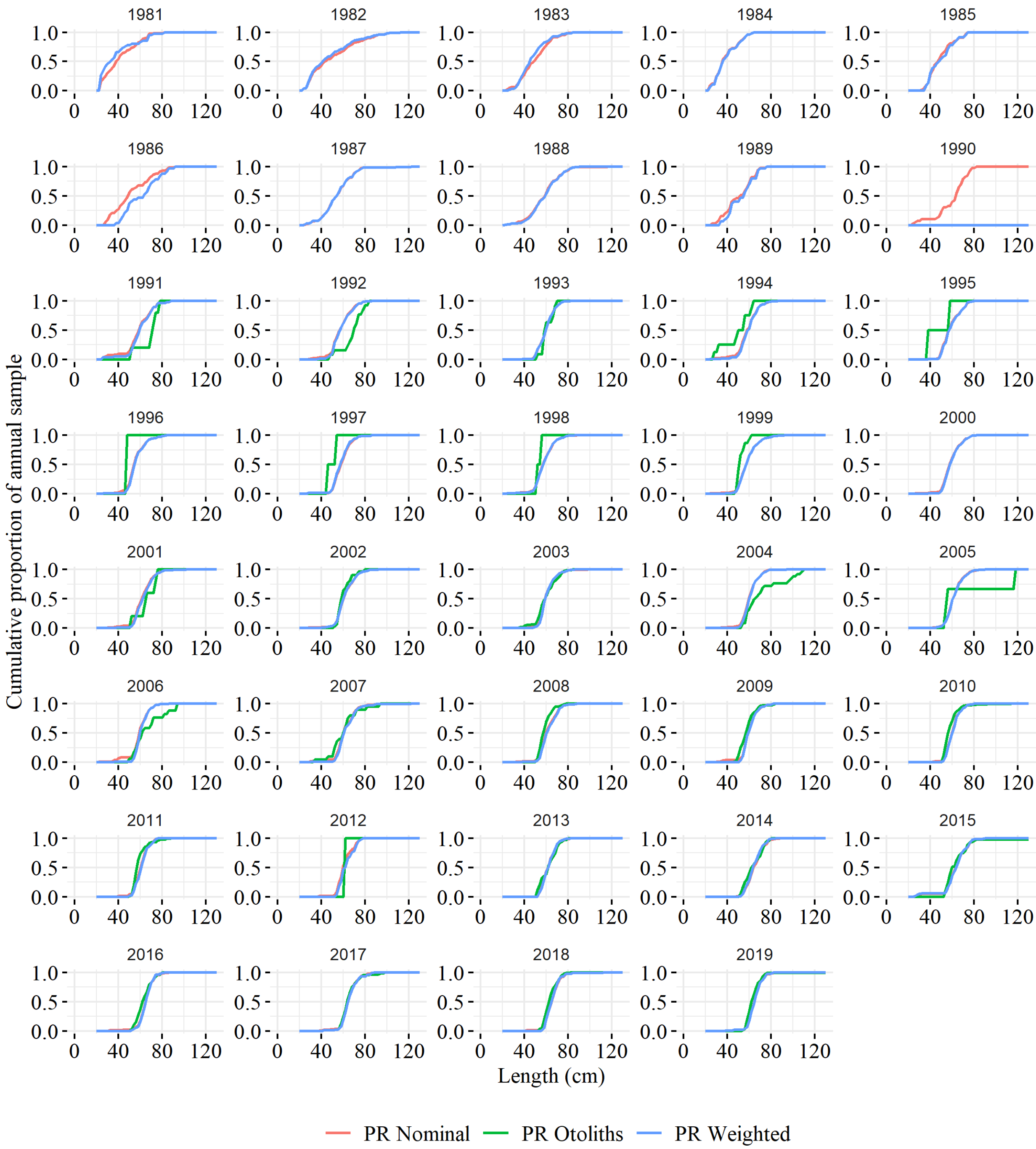

Figure 15: Annual Gag Grouper recreational private cumulative length distributions: unweighted (nominal), weighted with the final landings, and age data (otoliths).

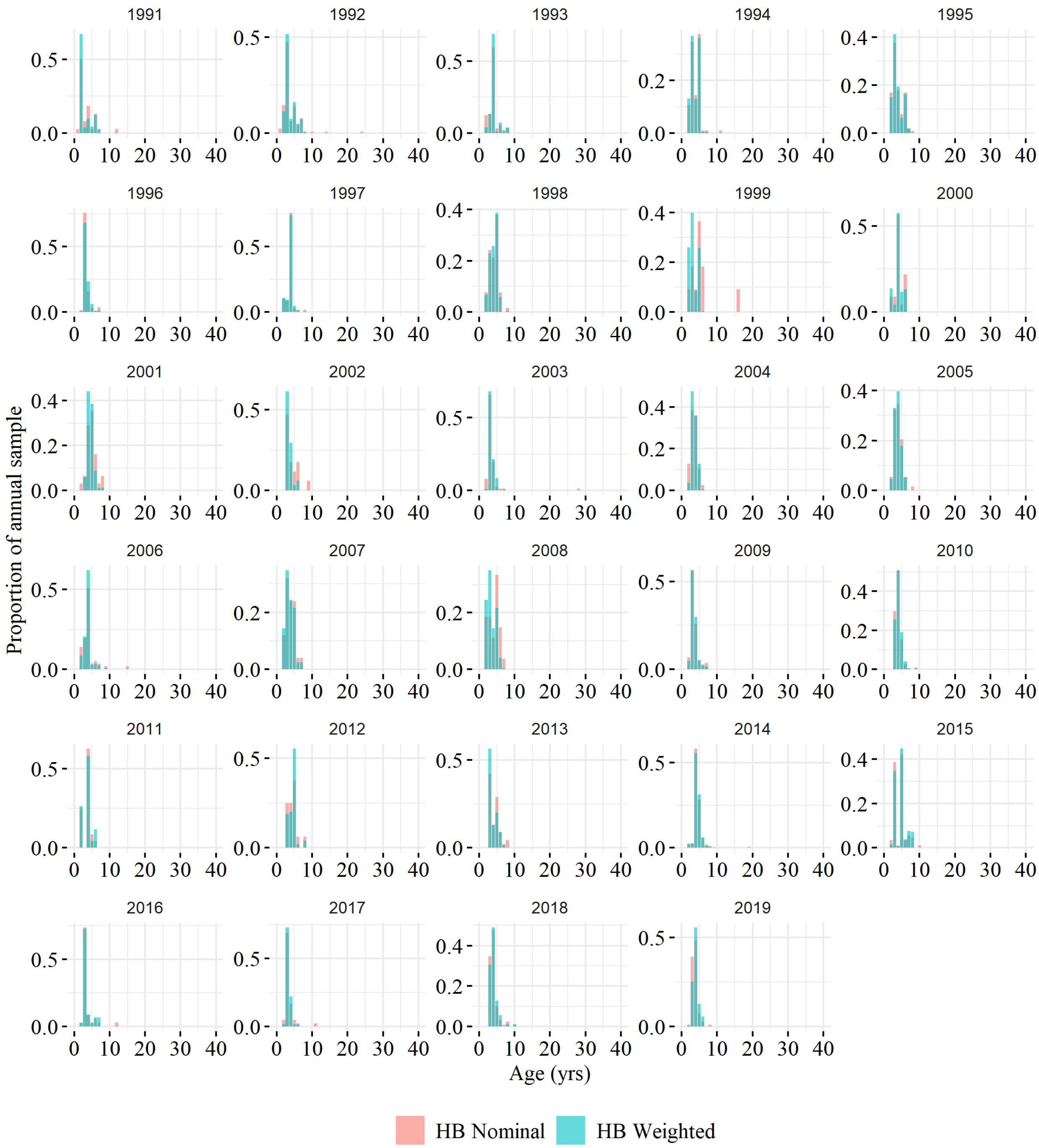

Figure 16: Annual Gag Grouper recreational headboat age frequency distributions, both unweighted (nominal) and weighted with the final length compositions..

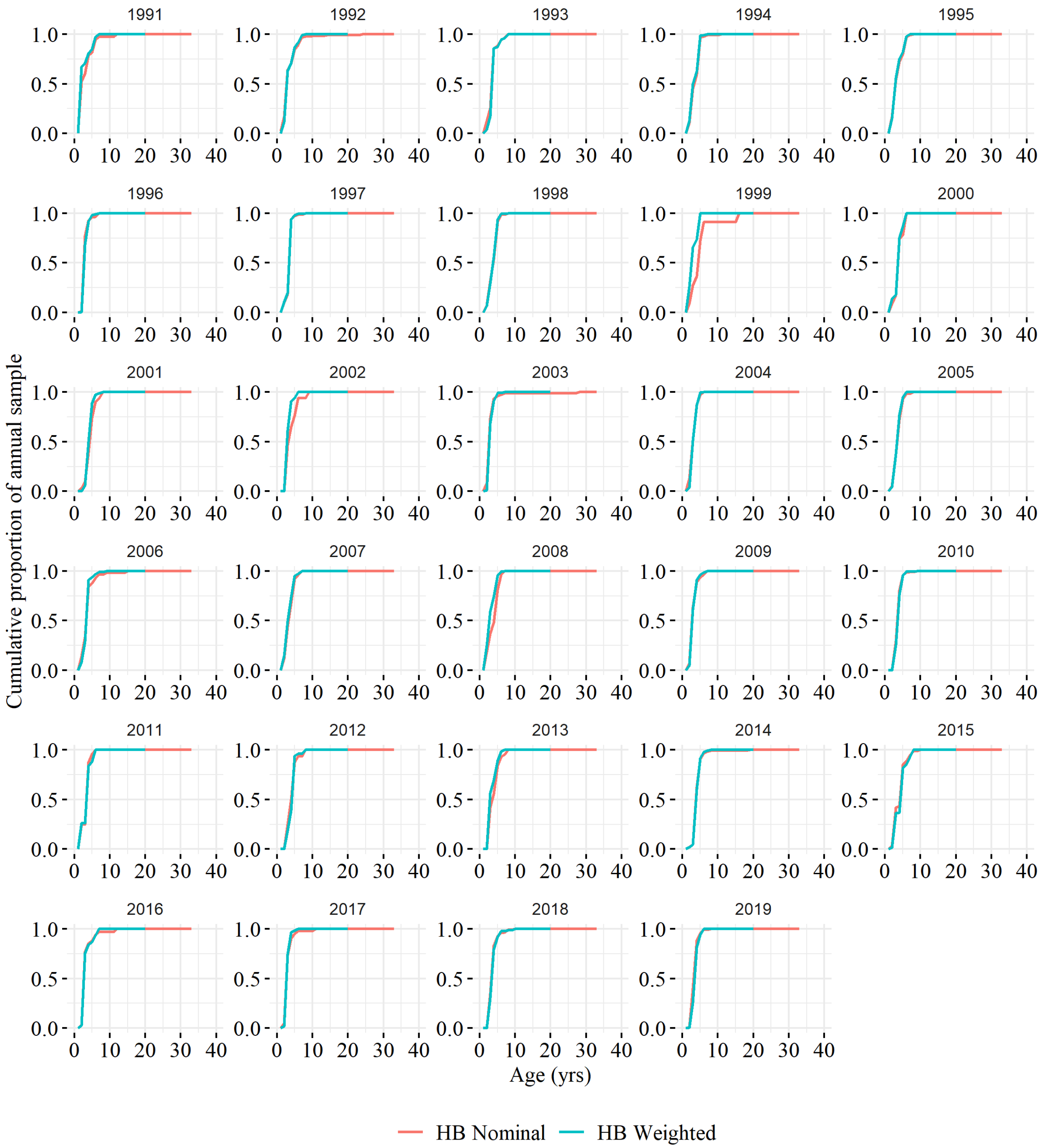

Figure 17: Annual Gag Grouper recreational headboat cumulative age distributions, both unweighted (nominal) and weighted with the final length compositions..

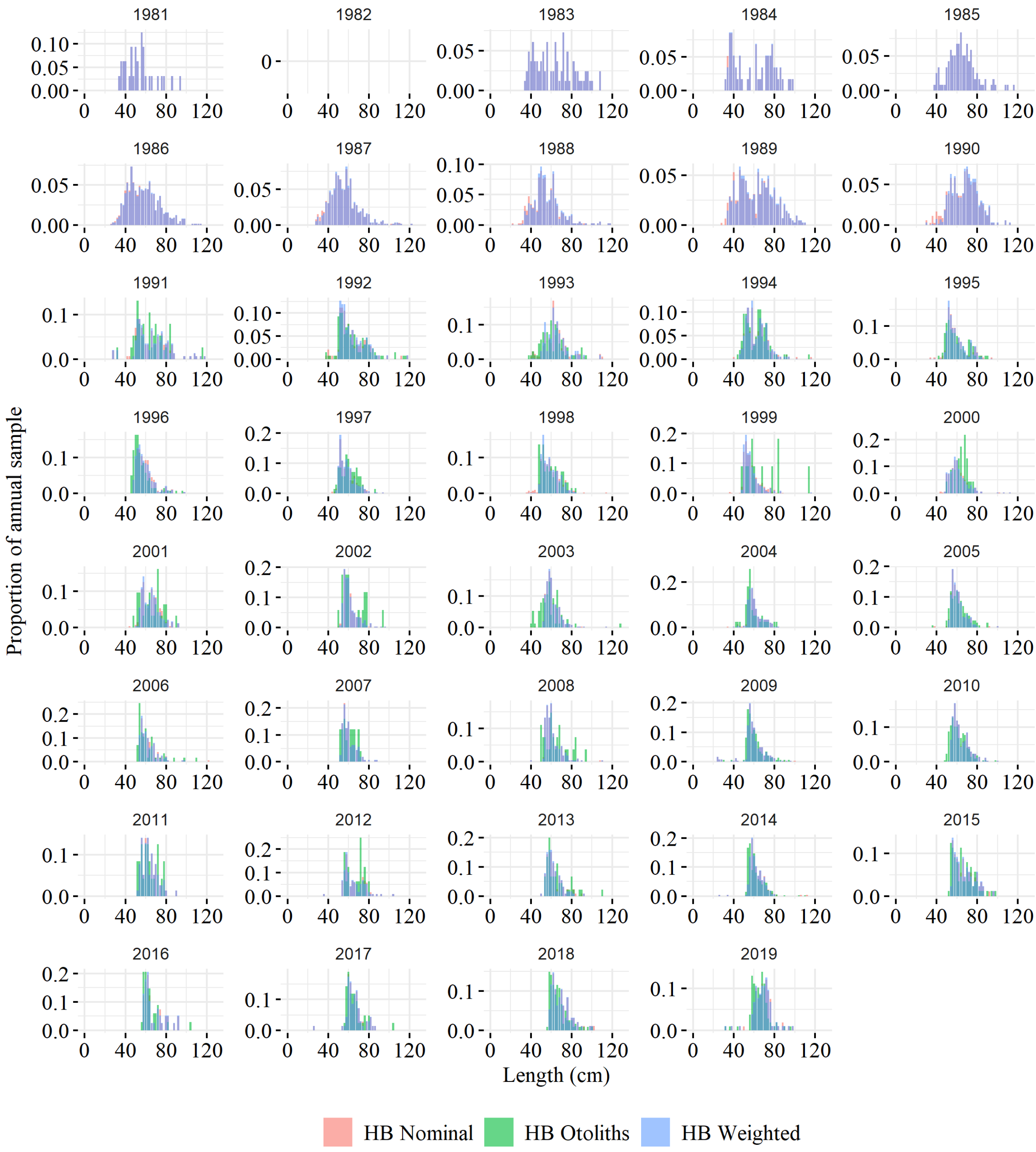

Figure 18: Annual Gag Grouper recreational headboat length frequency distributions: unweighted (nominal), weighted with the final landings, and age data (otoliths).

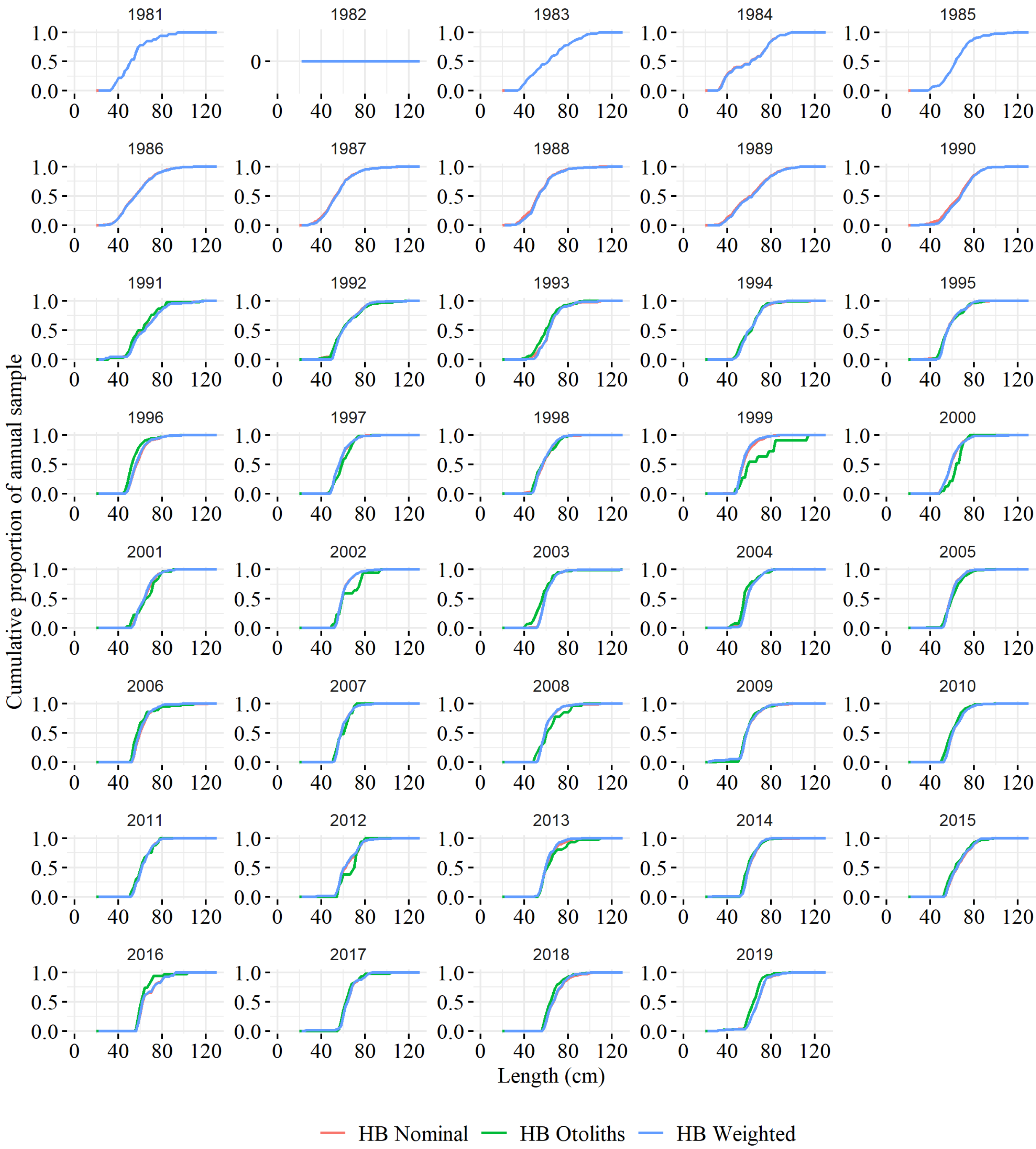

Figure 19: Annual Gag Grouper recreational headboat cumulative length distributions: unweighted (nominal), weighted with the final landings, and age data (otoliths).