South Atlantic Golden Tilefish (*Lopholatilus chamaeleonticeps*) Commercial Landings Length and Age Compositions

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South Atlantic Golden Tilefish (*Lopholatilus chamaeleonticeps*) Commercial Landings Length and Age Compositions

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Introduction

This document outlines the data and methodologies used to estimate length and age compositions of commercial landings for the SEDAR 89 South Atlantic Golden Tilefish Assessment. These compositions were estimated using data sources approved in SEDAR 66. Nominal length compositions were weighted by landings, and nominal age compositions were weighted by the weighted length compositions. The resultant weighted length compositions were then used to weight the age compositions as lengths are more heavily sampled and provide a clearer picture of the size distribution. Additionally, mean length-at-age (MLAA) was 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). Resulting analyses are documented below.

Data Description

SEDAR 89 assesses all South Atlantic Golden Tilefish in federal waters along the east coast of Florida from the Florida Keys US1 boundary northward to the North Carolina/Virginia border. Commercial data sources utilized to generate length compositions include length samples from the Trip Interview Program (Beggerly *et al.* 2022) and landings data from the Accumulated Landings Systems from 1984 until state trip ticket programs came into effect. Age estimates from South Carolina Department of Natural Resources (SCDNR) were compiled by the SEFSC Beaufort Laboratory alongside their data.

Commercial fleets were defined by handline (HL) and longline (LL) gears. These data were compiled using length bins of 30 millimeters (mm) with the midpoint of the bin being labeled to match SEDAR 66. Fork length (FL) and standard length (SL) were converted to maximum total length ($MaxTL$) using the following conversion equations:

$$MaxTL = -13.059 + 1.080 * FL$$

$$MaxTL = 2.428 + 1.213 * SL$$

When neither (FL) or (SL) were available, and maximum total length was not recorded, natural total length was used.

Following SEDAR 66, a minimum length bin of 340 mm was used, and a maximum length bin of 1000 mm was used, with fish falling outside of this range being pooled in the smallest or largest bin. Fish lengths greater than 1500 mm TL were deleted and assumed to be errors.

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 were filtered to remove biases that include samples from pooled trips.

Length Compositions

Due to the opportunistic nature of fishery-dependent sampling, lengths may not be representative of the true landings composition throughout the entire South Atlantic. Possible sampling bias in

the collection of length samples is typically removed by weighting the length compositions with the associated landings on the finest spatial and temporal scale available without losing data.

Each commercial fleet (HL, LL) was modeled for the entire South Atlantic region, with weighting done using the landings proportions by state. These gears were sufficiently distinct to remain separate fleets (Figure 1) and gear-specific annual compositions are shown in Figure 2. Length distributions are also shown by state landed aggregated across all years for HL (Figure 3), and LL (Figure 4). Sample sizes of commercial lengths (Table 1) and trips (Table 2) were provided for each stratum (year, gear, and state) for each fleet. Strata with fewer than 30 length samples were dropped from further analyses.

Within each fleet, strata-specific nominal length compositions were estimated using length bins of 30 cm, where for each year i, length bin j, and state s

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

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

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

$$LC_{i,j} = \sum_{s} \left(LC_{i,j,s} * p_{i,s}\right)$$

resulting in the final weighted estimates of landings length compositions, $LC_{i,j}$. In order to maintain confidentiality of the landings, the proportions of landings by year and state, $p_{i,s}$, were averaged over two time blocks (1984 - 2002; 2003 - 2022) and are shown in Table 3. This procedure would down-weight, for example, any instances where 60% of the length samples come from a state that only accounts for 20% of the landings for that fleet. The effects of this weighting procedure are shown for handline in Figure 5, and longline in Figure 6.

Commercial Age Compositions of Landings

Age Samples

Commercial age samples were a subset of the length samples. Age data compiled by the SEFSC Beaufort Laboratory were filtered to remove duplicated and biased data. Sample sizes of commercial ages (Table 4) and commercial trips sampled for age (Table 5) were provided. Golden Tilefish maximum age was estimated to be 40 years, with a plus group for age 20 plus used in modeling.

Age Compositions

Nominal age compositions were estimated for each commercial gear (HL, LL) in each year. The process outlined below was applied to each fleet individually, and any strata with fewer than 10

age samples were recommended to be dropped. Nominal age compositions of landings were estimated for each gear using the following equation within each year i, and age bin k.

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

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

To account for potential sampling biases in the data, a re-weighting factor was estimated within year i and length bin j. The re-weighting 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 weighted length composition in year i and length bin j, $a_{i,j}$ 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 down-weighted to zero and effectively dropped from further analysis. The final commercial weighted age compositions were estimated as

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

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 are shown for handline (Figure 7), and longline (Figure 8). Additionally, bubble plots showing the final weighted age distribution are shown for handline (Figure 9) and longline (Figure 10).

Commercial Mean Length-at-Age

Fleet-specific mean length-at-age and associated sample sizes were also provided to the lead analyst 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.

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

While mean-length-at-age was provided to the lead analyst, the results of this analysis are not provided in this document.

Changes from SEDAR 66

Several updates to the available age data led to age sample size discrepancies compared to SEDAR 66. Firstly, the South Carolina Department of Natural Resources (SCDNR) implemented updates to 531 samples across a range of years (1995, 2003, 2005, 2006, 2008, 2012, 2013, 2014) that resulted in changes to whether or not the samples were classified as biased or non-random. Since biased and/or non-random samples are filtered out for this analysis, this resulted in changes to the available age sample sizes. Additional sample size discrepancies stem from updates to the Trip Interview Program (TIP) database. For example, samples with an "unassigned" gear type in several years were updated with gear information, leading to additional samples not previously included in SEDAR 66.

References

Beggerly, S., M. Stevens, H. Baertlein. 2022. Trip Interview Program Metadata. SEDAR74-DW14. 12pp.

Methot, R.D., C.R. Wetzel, I.G. Taylor, K. Doering. 2020. Stock Synthesis User Manual Version 3.30.16. NOAA Fisheries, Seattle WA. 220 pp.

Thorson, J.T., K.F. Johnson, R.D. Methot, I.G. Taylor. 2017. Model-based estimates of effective sample size in stock assessment models using the Dirichlet-multinomial distribution. Fisheries Research 192: 84–93.

Tables

Table 1. *Annual number of Golden Tilefish commercial handline (HL) and longline (LL) length samples by state. The length compositions resulting from these samples were recommended to be dropped from further analyses if n<30.*

Year	HL_NC	HL_SC	HL_GA	HL_FL	LL_NC	LL_SC	LL_GA	LL_FL
1984	3	0	0	0	288	1,259	806	0
1985	11	0	3	0	98	0	62	4,820
1986	1	0	0	0	172	0	0	1,737
1987	0	0	0	0	172	0	58	0
1988	0	0	0	3	591	0	0	253
1989	68	0	0	0	766	0	0	0
1990	11	0	0	0	360	0	0	23
1991	1	0	12	14	1,471	267	584	3,640
1992	0	22	0	27	1,287	282	192	11,246
1993	52	0	0	13	541	0	58	27,623
1994	0	0	0	99	351	159	41	10,722
1995	0	0	0	166	145	0	33	10,152
1996	0	0	0	13	21	994	0	1,894
1997	0	0	0	160	79	1,242	0	1,311
1998	0	0	0	92	0	591	0	1,122
1999	0	3	0	116	0	951	0	2,771
2000	2	0	0	834	303	1,202	0	3,549
2001	0	0	0	306	307	581	0	1,307
2002	0	0	0	618	0	928	0	1,009
2003	0	1	0	76	0	410	0	256
2004	0	0	0	271	198	439	0	148
2005	0	0	0	300	0	117	0	331
2006	0	52	0	204	0	317	0	574
2007	0	0	0	249	0	49	0	999
2008	0	1	0	16	0	23	0	634
2009	0	0	0	7	0	198	0	706
2010	0	13	0	46	0	175	0	829
2011	0	0	0	65	0	0	0	579
2012	0	45	0	324	0	114	0	1,201
2013	3	36	0	216	0	66	0	608
2014	21	53	0	543	0	87	0	721
2015	33	55	0	103	0	37	0	927
2016	99	47	0	125	0	157	0	1,326
2017	43	46	0	66	0	115	0	1,084
2018	6	11	0	0	44	144	0	731
2019	10	20	0	11	0	134	0	334
2020	19	15	0	121	21	14	0	660
2021	1	111	0	135	0	54	0	678
2022	49	44	0	107	0	0	0	863

Table 2. *Annual number of Golden Tilefish commercial handline (HL) and longline (LL) trips sampled for length by state.*

Year	HL_NC	HL_SC	HL_GA	HL_FL	LL_NC	LL_SC	LL_GA	LL_FL
1984	1	0	0	0	5	16	4	0
1985	4	0	1	0	2	0	2	31
1986	1	0	0	0	2	0	0	7
1987	0	0	0	0	5	0	2	0
1988	0	0	0	1	5	0	0	1
1989	2	0	0	0	6	0	0	0
1990	3	0	0	0	4	0	0	1
1991	1	0	3	3	11	6	18	13
1992	0	3	0	7	15	10	8	85
1993	1	0	0	3	12	0	2	147
1994	0	0	0	5	8	2	4	55
1995	0	0	0	2	3	0	1	76
1996	0	0	0	2	2	11	0	29
1997	0	0	0	9	1	19	0	19
1998	0	0	0	7	0	9	0	17
1999	0	1	0	9	0	11	0	25
2000	1	0	0	28	2	13	0	31
2001	0	0	0	29	3	7	0	21
2002	0	0	0	41	0	11	0	21
2003	0	1	0	5	0	13	0	10
2004	0	0	0	11	5	10	0	7
2005	0	0	0	11	0	6	0	12
2006	0	1	0	8	0	11	0	27
2007	0	0	0	12	0	1	0	37
2008	0	1	0	1	0	2	0	23
2009	0	0	0	1	0	4	0	22
2010	0	2	0	2	0	6	0	28
2011	0	0	0	4	0	0	0	23
2012	0	6	0	13	0	4	0	45
2013	1	7	0	11	0	4	0	24
2014	3	14	0	19	0	3	0	23
2015	7	10	0	8	0	3	0	26
2016	22	11	0	5	0	12	0	34
2017	11	16	0	4	0	14	0	32
2018	4	4	0	0	6	13	0	25
2019	6	7	0	3	0	6	0	13
2020	4	5	0	7	1	1	0	25
2021	1	19	0	6	0	6	0	24
2022	5	10	0	6	0	0	0	23

Table 3. *Distribution of commercial handline (HL) and longline (LL) landings by state and time interval, where these were estimated as averages of landings proportions in numbers* $p_{i,s}$ *from year i and state s within fleets.*

Time Block	HL_NC	HL_SC	HL_GA	HL_FL	LL_NC	LL_SC	LL_GA	LL_FL
1984 - 2002	0.26	0.12	0.02	0.61	0.06	0.22	0.02	0.70
2003 - 2022	0.16	0.15	0.00	0.68	0.01	0.16	<0.01	0.83

Table 4. *Annual number of commercial handline (HL) and longline (LL) age samples by state.*

Year	HL_NC	HL_SC	HL_FL	LL_NC	LL_SC	LL_FL
1992	0	0	5	0	25	99
1993	0	0	11	0	0	203
1994	0	0	28	0	0	8
1995	0	0	0	0	0	351
1996	0	0	0	0	0	216
1997	0	0	103	0	0	195
1998	0	0	39	0	0	165
1999	0	0	36	0	0	197
2000	0	0	241	0	0	302
2001	0	0	46	0	0	236
2002	0	0	199	0	0	25
2003	0	0	61	0	0	160
2004	0	0	255	119	0	146
2005	0	0	255	0	43	325
2006	0	0	196	0	227	566
2007	0	0	272	0	26	1,089
2008	0	0	17	0	17	624
2009	0	0	37	0	67	682
2010	0	37	30	0	145	709
2011	0	0	71	0	0	528
2012	0	41	413	0	108	1,139
2013	3	33	227	0	64	461
2014	0	51	411	12	85	302
2015	29	43	105	0	36	410
2016	71	43	83	0	148	514
2017	17	42	56	16	88	508
2018	2	11	0	43	131	520
2019	10	39	11	6	102	330
2020	2	14	143	21	11	572
2021	1	99	147	0	34	600
2022	29	41	84	0	34	589

Table 5. *Annual number of commercial handline (HL) and longline (LL) trips sampled for ages by state.*

Year	HL_NC	HL_SC	HL_FL	LL_NC	LL_SC	LL_FL
1992	0	0	2	0	3	7
1993	0	0	2	0	0	16
1994	0	0	3	0	0	1
1995	0	0	0	0	0	24
1996	0	0	0	0	0	11
1997	0	0	5	0	0	8
1998	0	0	5	0	0	10
1999	0	0	5	0	0	16
2000	0	0	11	0	0	17
2001	0	0	5	0	0	11
2002	0	0	21	0	0	3
2003	0	0	4	0	0	9
2004	0	0	10	5	0	7
2005	0	0	10	0	5	12
2006	0	0	6	0	12	27
2007	0	0	12	0	1	45
2008	0	0	2	0	2	23
2009	0	0	2	0	4	22
2010	0	3	1	0	5	25
2011	0	0	3	0	0	22
2012	0	6	15	0	4	43
2013	1	6	11	0	4	22
2014	0	14	21	1	3	13
2015	6	10	9	0	3	18
2016	23	11	5	0	12	21
2017	3	14	4	5	13	25
2018	2	4	0	6	13	22
2019	6	3	3	1	5	13
2020	1	5	8	2	1	23
2021	1	19	7	0	4	22
2022	4	10	5	0	6	27

Figures

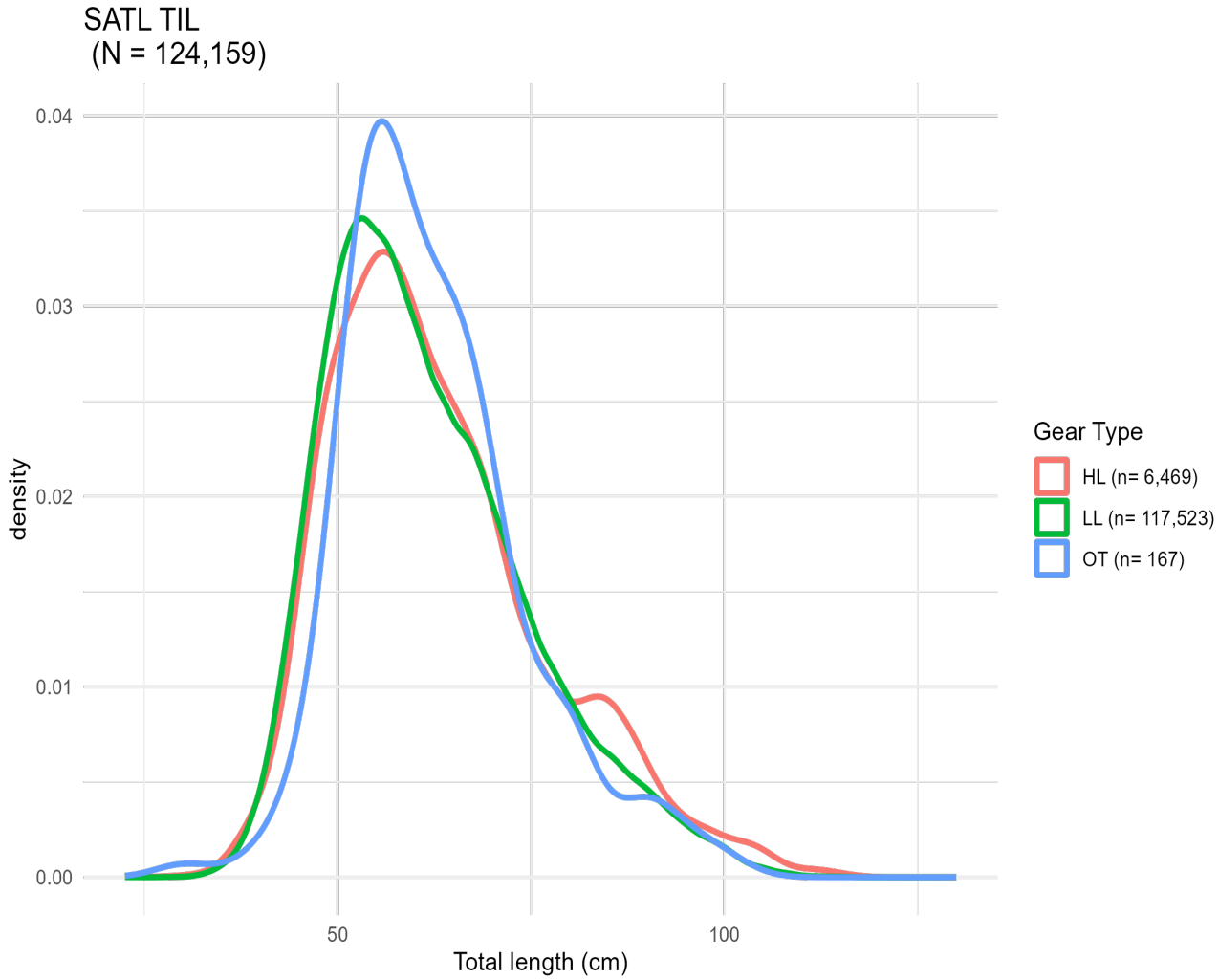

Figure 1. *Annually and spatially aggregated commercial gear length distributions: Handline (HL), longline (LL), and other (OT) gears.*

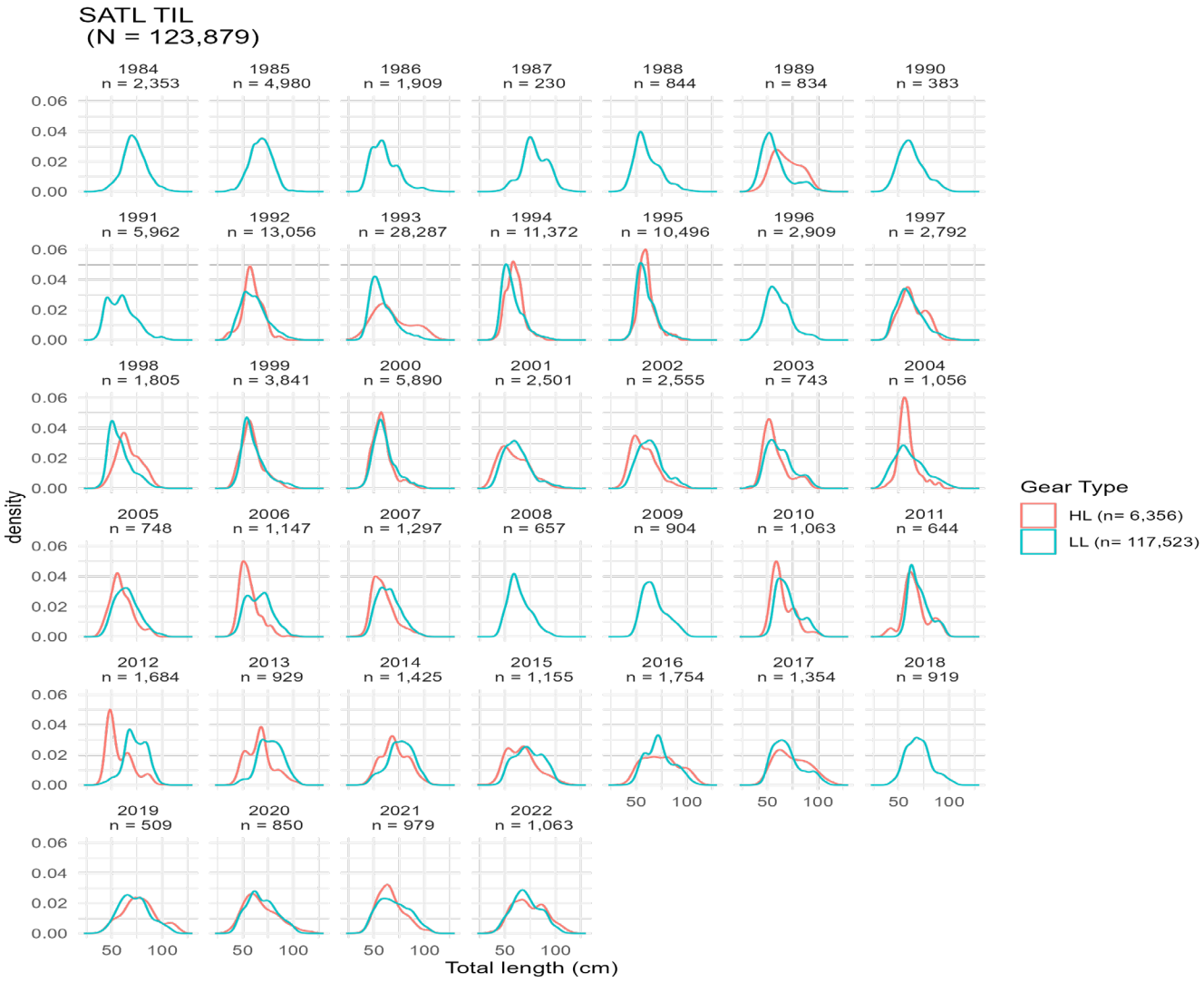

Figure 2. *Spatially aggregated Golden Tilefish commercial gear cumulative length distributions: handline (HL) and longline (LL) gears. Strata with less than 30 samples were dropped.*

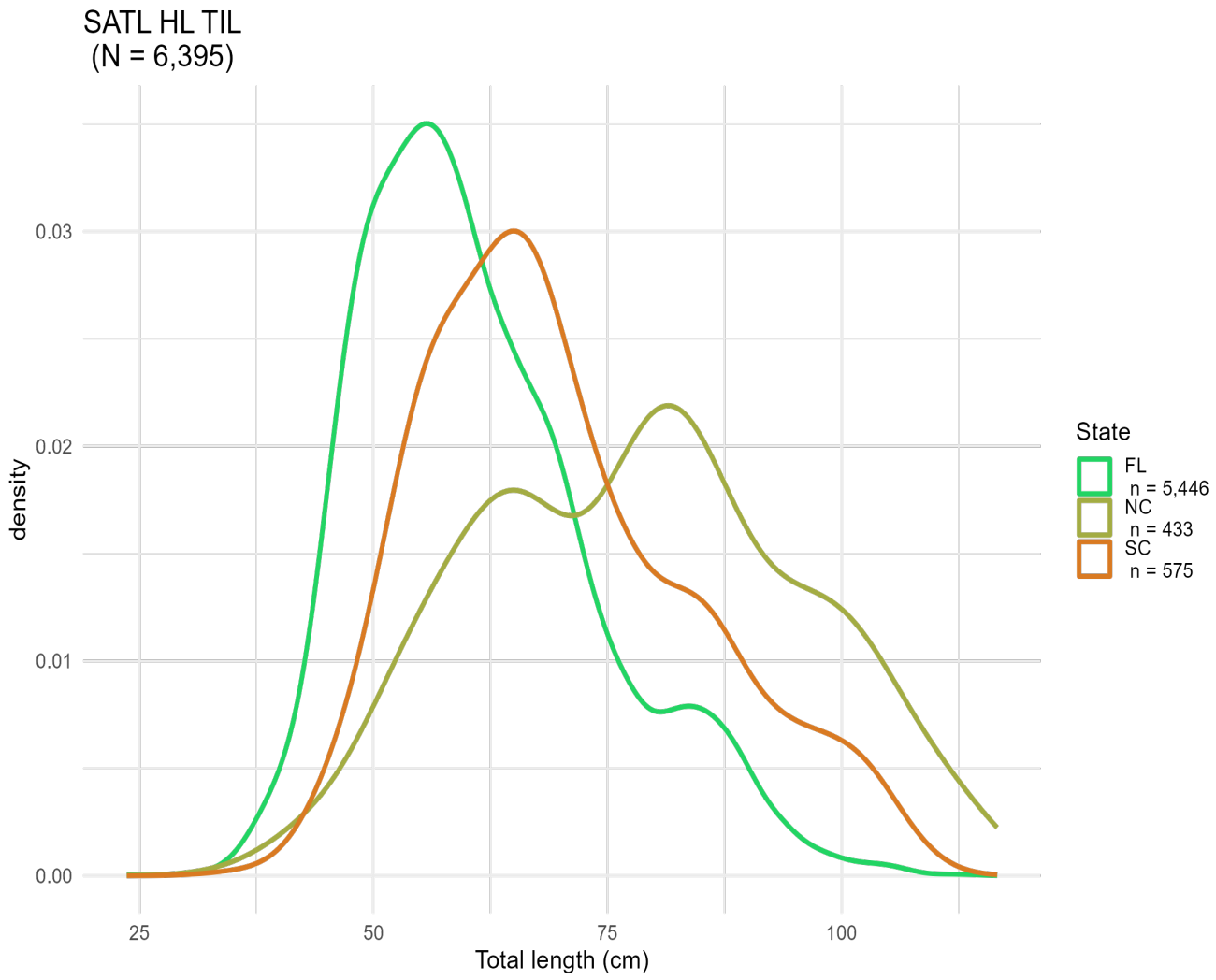

Figure 3. *Annually aggregated Golden Tilefish commercial HL length distributions by state landed.*

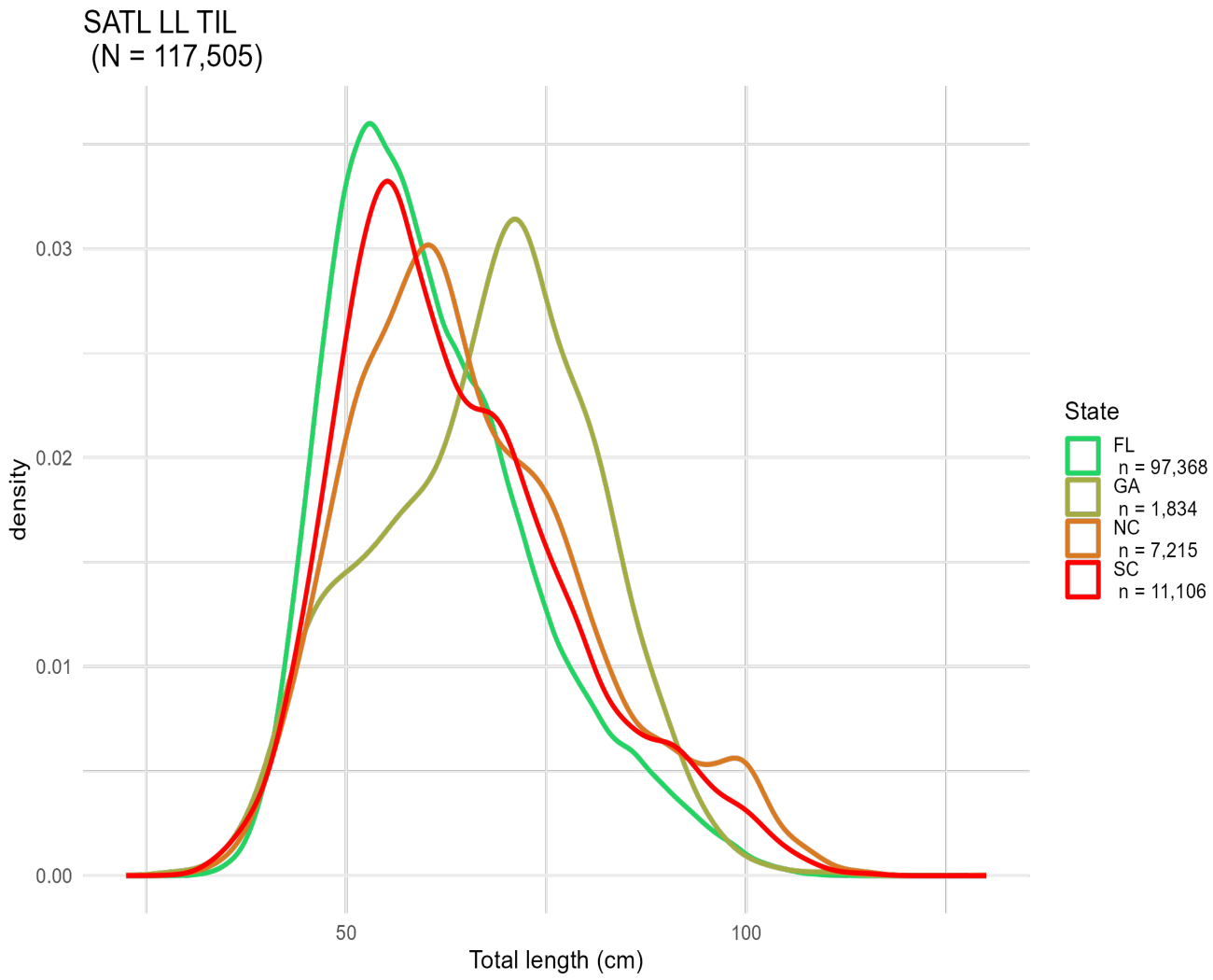

Figure 4. *Annually aggregated Golden Tilefish commercial LL length distributions by state landed.*

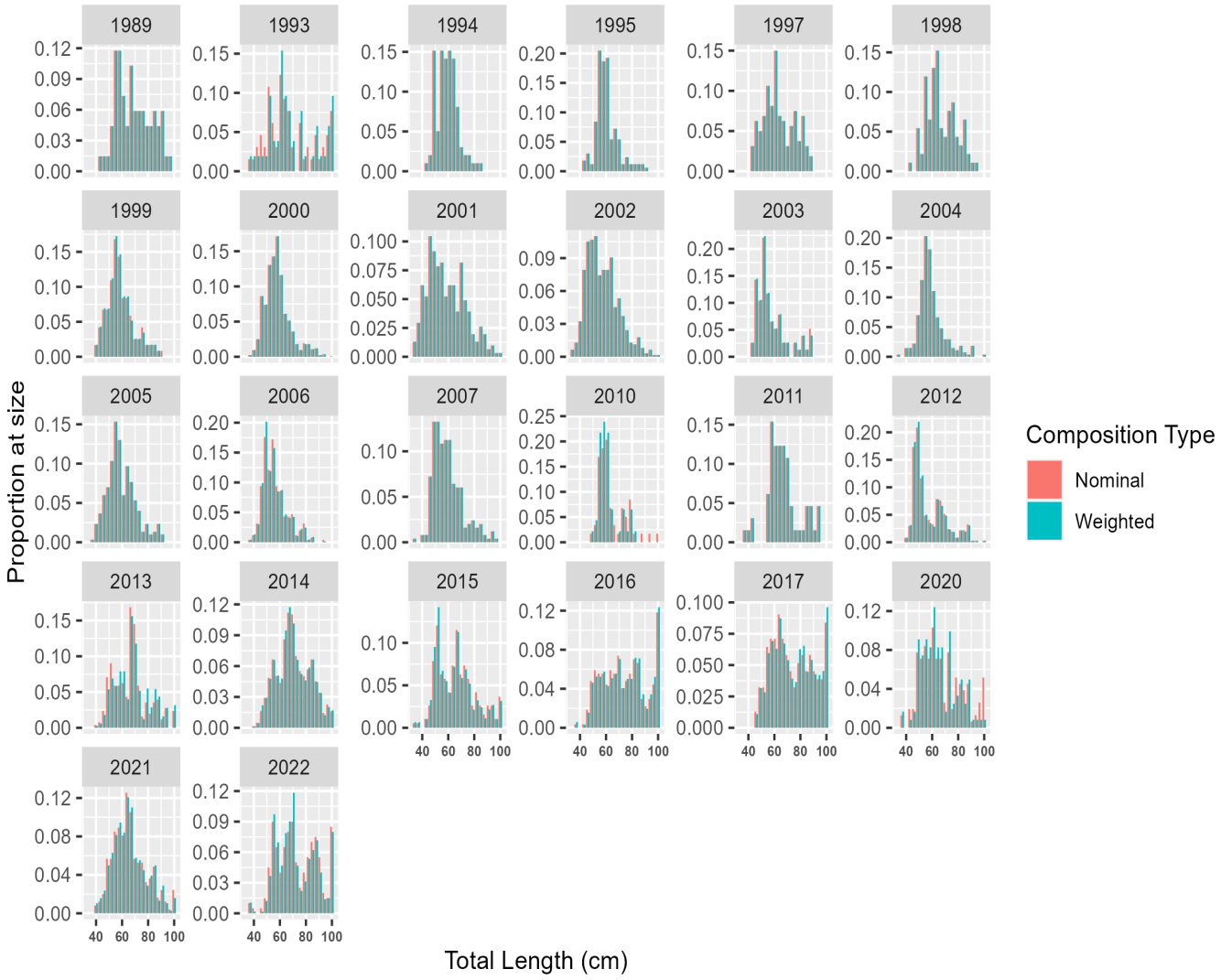

Figure 5. *Nominal and weighted Golden Tilefish length compositions from the commercial handline fleet.*

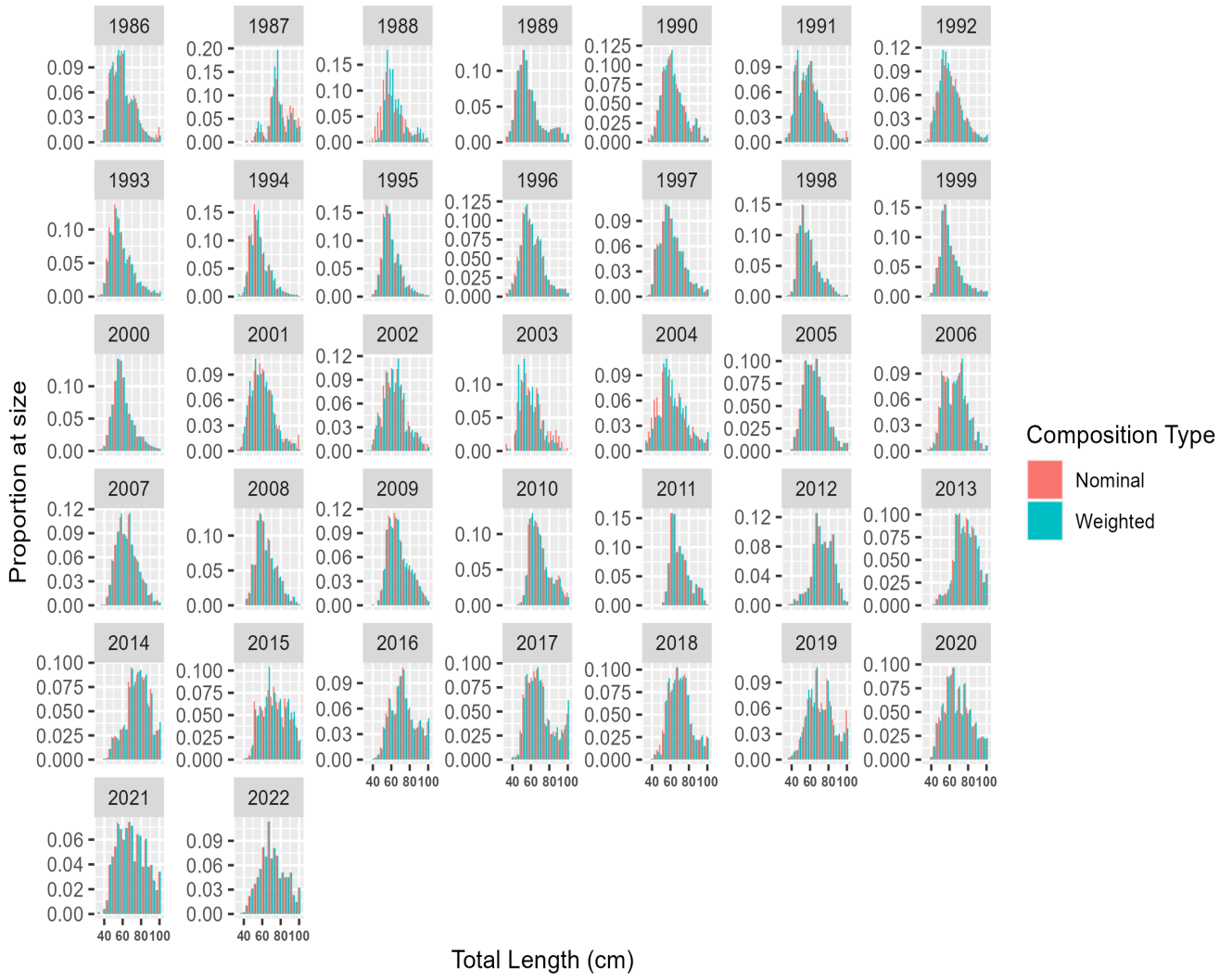

Figure 6. *Nominal and weighted Golden Tilefish length compositions from the commercial longline fleet.*

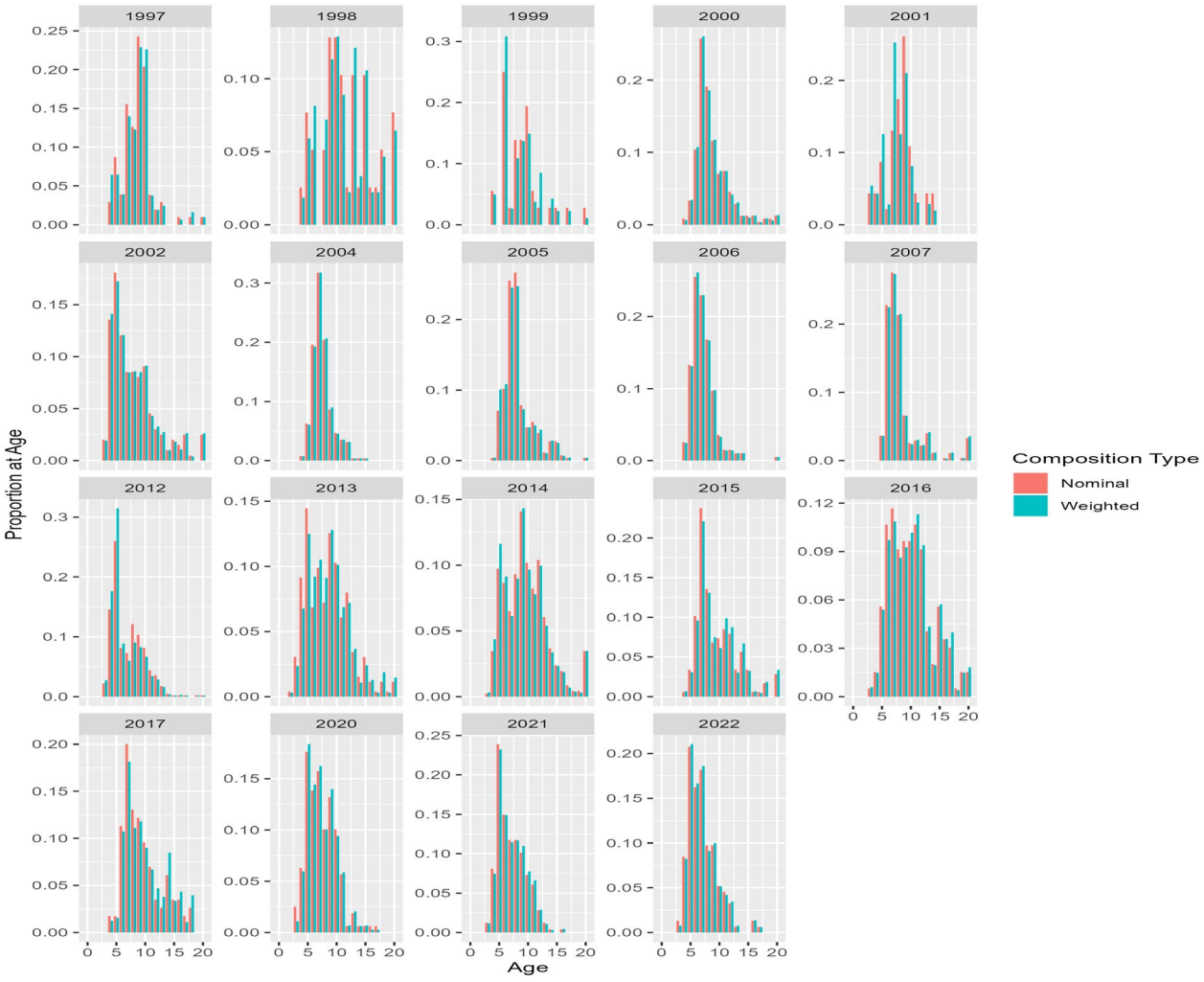

Figure 7. *Nominal and weighted Golden Tilefish age compositions from the commercial handline fleet.*

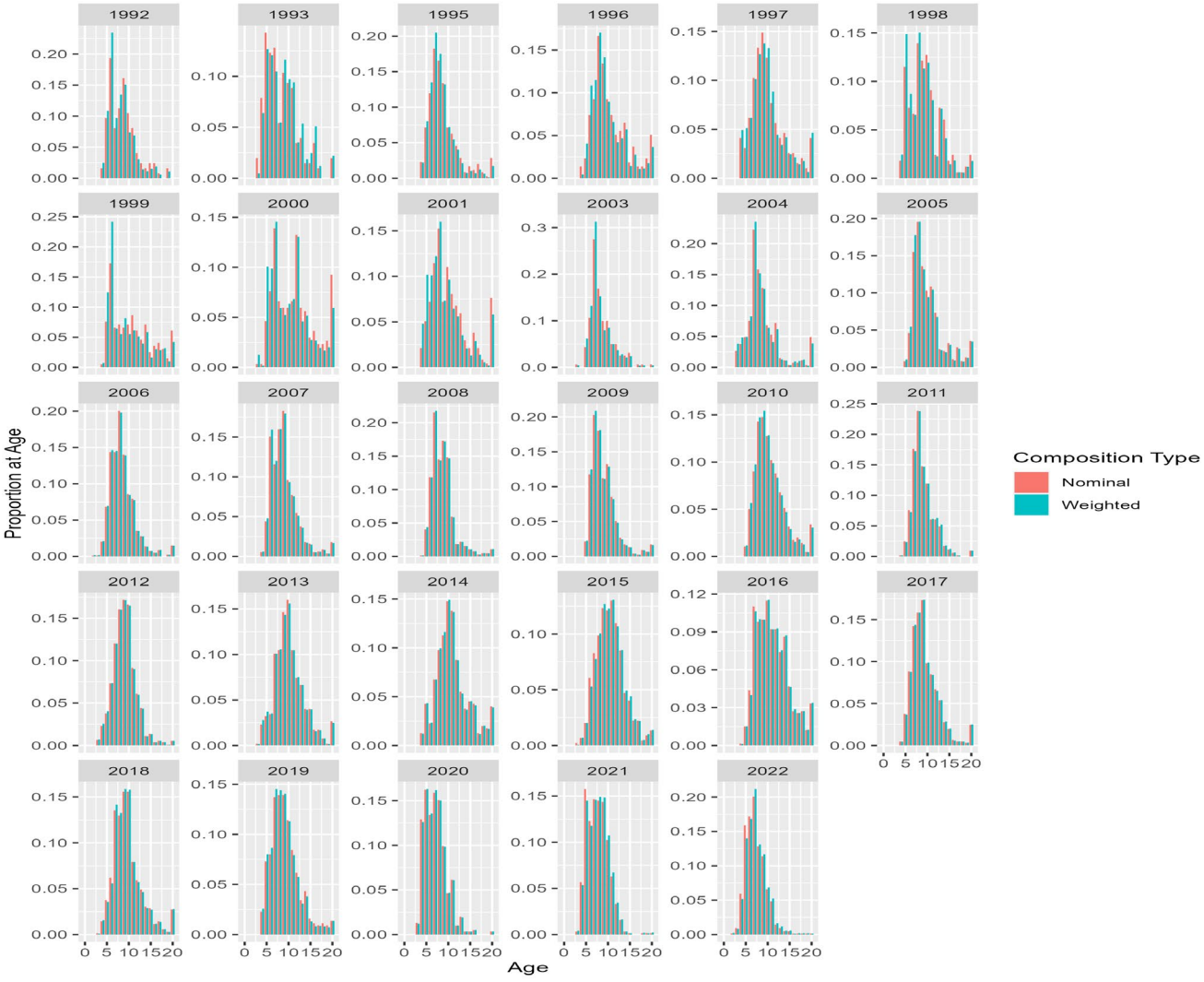

Figure 8. *Nominal and weighted Golden Tilefish age compositions from the commercial longline fleet.*

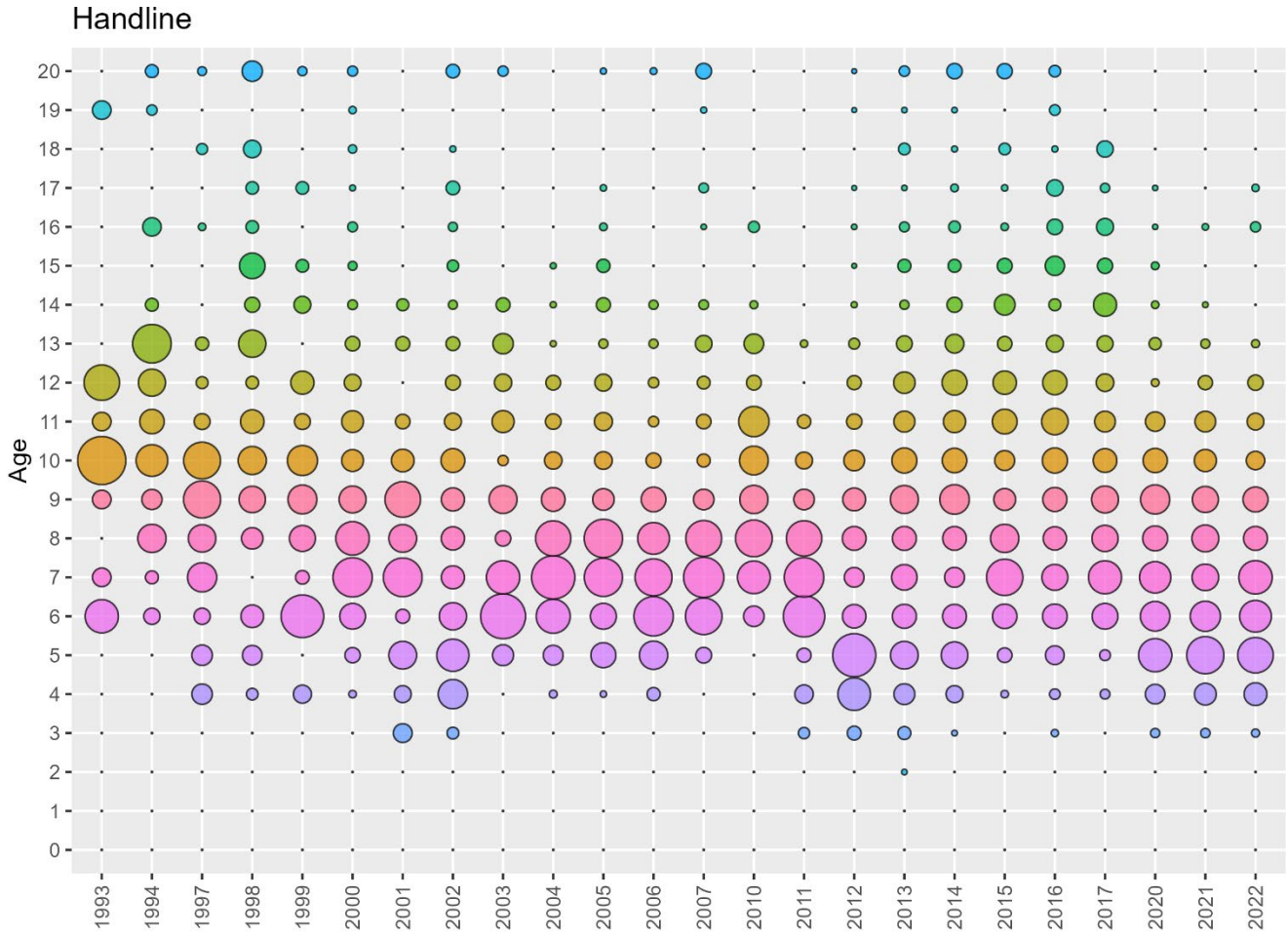

Figure 9. *Final annual weighted age compositions for the Golden Tilefish commercial handline fishery. The size of the dots represents the relative proportion at age.*

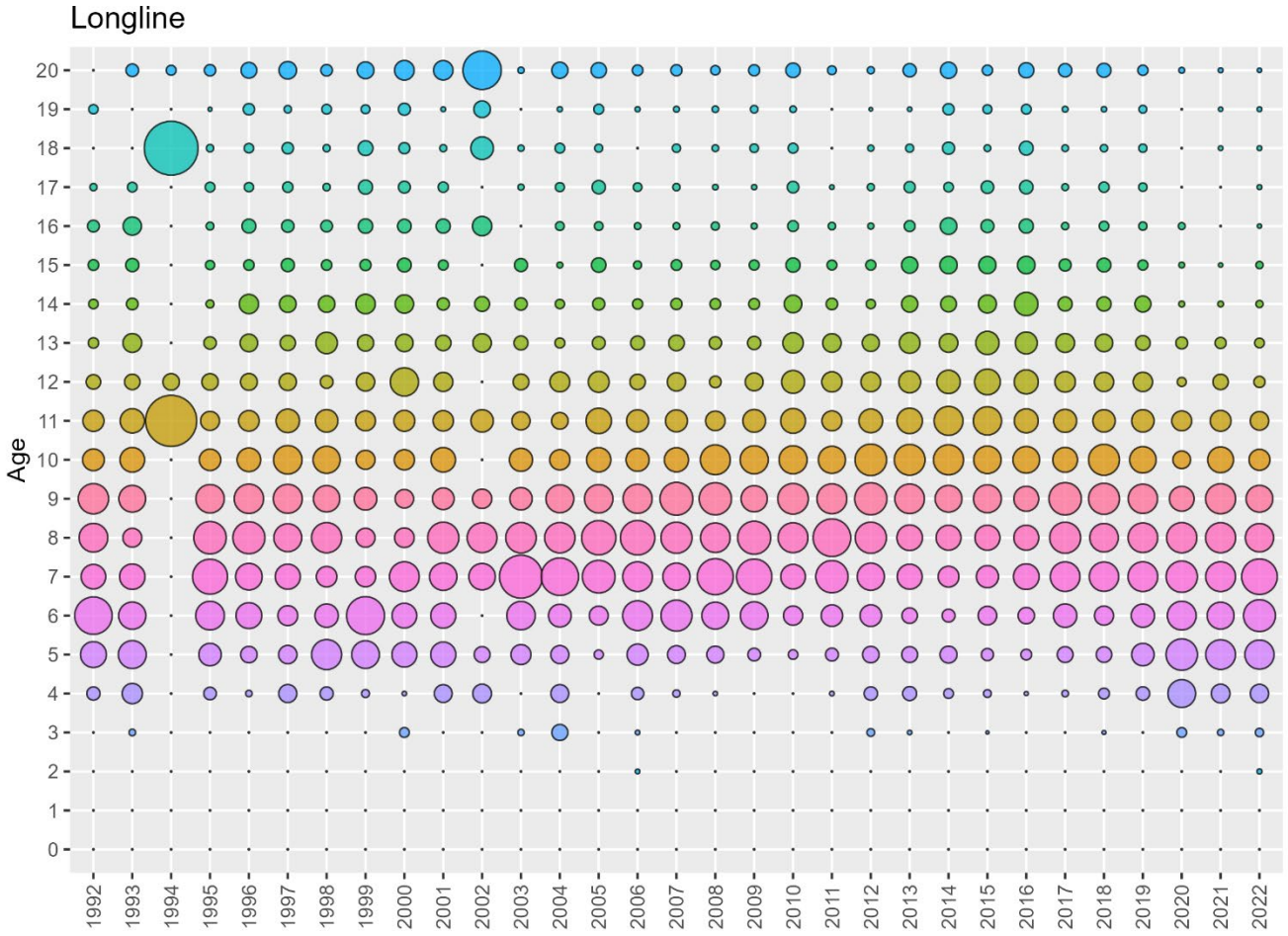

Figure 10. *Final annual weighted age compositions for the Golden Tilefish commercial longline fishery. The size of the dots represents the relative proportion at age.*