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1 Introduction

The SEDAR 82 data workshop developed raw length and age compositions for each of the recreational fisheries where sufficient data were available. The fishery-dependent data collection for lengths and ages may be biased due to sampling protocols, state-specific sampling effort, or other non-random methods. The selection of fish from which to collect ageing structures may be biased, typically towards larger fish, because the selection process is rarely formally randomized. One technique to overcome bias in the length sampling is to weight (i.e. assign weights to) samples by the associated landings at a spatial and temporal scale at which the bias is expected. Usually this is unknown and samples are weighted at the finest scale available without losing data (e.g. length samples with no associated landings). This document describes how the length data were weighted and how these weightings are extended to the age data. Similar methods have been used in previous SEDAR assessments and completed between the data and assessment workshops.

2 Data Description

2.1 Lengths

Headboat Survey Biological Sampling
Lengths were collected from 1972 to 2021 by headboat dockside samplers (Table 1). From 1972 to 1975, only North Carolina and South Carolina were sampled whereas Georgia and northeast Florida were sampled beginning in 1976. The Southeast Region Headboat Survey conducted dockside sampling for the entire range of Atlantic waters along the southeast portion of the US from the NC-VA border through the Florida Keys beginning in 1978.

MRIP Biological Sampling
The MRIP angler intercept survey includes the sampling of fish lengths from the harvested (landed, whole condition) catch (Table 1). The survey covers the charter boat, shore, and private modes (general recreational modes) from East Florida to Maine and the headboat mode from Virginia to Maine. Up to 15 of each species landed per angler interviewed are measured to the nearest millimeter (mm) along a center line (defined as tip of snout to center of tail along a straight line, not curved over body). Weights are typically collected for the same fish measured. When time is constrained a weight may be collected without a length measurement.

SCDNR Biological Sampling

Gray Triggerfish lengths are available from SCDNR's State Finfish Survey (SFS) and supplement MRIP's lengths from this state from 1988 to 2012, primarily from the private mode. SC charterboat lengths were included with the MRIP fleet.

The sample sizes in Table 1 represent the data prior to applied a minimum sample size criterion for inclusion.

2.2 Ages

Aging structures and other biological samples are not collected during MRIP assignments because of concerns over the introduction of bias to survey data collection. Biological samples (scales, otoliths, spines, stomachs and gonads) are collected by the SRHS and processed for aging, diet studies, and maturity studies from the headboat mode. Aging structures provided from the charter boat and private boat modes were collected by state agencies, special projects, and sometimes as add-ons to the MRIP survey. ~~SRHS port agents~~. There were no age structures collected for Gray Triggerfish from the shore mode.

Annual numbers of gray triggerfish sampled for age and the number of annual trips that were sampled from the recreational fishery are reported in Table 2. The sample sizes in Table 2 represent the data prior to applied a minimum sample size criterion for inclusion.

3 Weighting methods

3.1 Lengths

A minimum of 30 fish per region was established to calculate a weighted length composition. The recreational landings estimates for SEDAR 82 were developed at the year and region (2 regions for SRHS and 3 regions for MRIP, NC/SC, GA/FL and VANorth (MRIP only)) level in order to consolidate the MRIP and SRHS landings estimates. (NC/SC=Carolinas, GA/FL= Georgia and Florida, VANorth (all samples north of Virginia). Also, SRHS only samples from FL to NC and MRIP samples from Virginia north include the headboat mode sampled by MRIP Therefore, the finest scale to weight the length data was by year and region for each of the fleet groupings (SRHS and MRIP). For each year, the region-specific length composition was multiplied by the proportion of landings from that region. The weighted region-specific length compositions were then combined and scaled to sum to one.

3.1.1. Summary of length data treatment

- State/spatial strata cutoff: include region of 30 or more fish sampled
- Region assigned (SRHS: NC/SC and GA/FL, MRIP: NC/SC, GA/FL, and VANorth)
- Fleet assigned: 1. Headboat (SRHS) and 2. General recreational- CH/SH/PR (MRIP, SCDNR)
- Range of lengths: 15 to 69 cm (3 cm bins)

3.2 Ages

A minimum of 10 fish per region was established to calculate a weighted age composition. The fishery-dependent age composition estimates were weighted to correct biases in age composition due to non-representative sampling. This weighting method was adapted from a technique to reduce bias associated with non-representative age sampling to produce unbiased growth curves (Chih, 2009) and has been previously used in SEDAR assessments. Lengths are recorded for each fish sampled for age. A reweighting value (RW) associated with the length interval (i) and year (j) of the age sample was assigned to each age sample by fishery as in the formula:

$$RW_{ij} = \frac{LC_{ij}}{OL_{ij}/TO_j}$$

where LC_{ij} is the weighted length composition value associated with the year j and length interval i for each aged fish, OL_{ij} is the number of aged samples in length interval i and year j , and $TO_j$is the total number of aged samples in year j. This weighting corrects for a potential sampling bias of age samples relative to length samples (Chih, 2009). The numerator in this method differs slightly from the method used by Chih (2009) in that the length composition is weighted by the landings.

3.2.1. Summary of age data treatment

- State/spatial strata cutoff: include region of 10 or more fish sampled
- Region assigned (NC/SC and GA/FL)
- Fleet assigned: 1. Headboat (SRHS) and 2. General recreational- CH/PR
- Range of ages: 1 to 11 (1 increment bins)

4 Results

4.1 Lengths

It is important to note that weighting had limited influence on the length compositions (Figure 1), in years that met the 30 fish minimum.

4.2 Ages

Due to limited spatial and temporal sampling of ages from the general recreational (CH/PR) fleet, only nominal age compositions were provided. The weighted age compositions are very similar to the nominal age compositions for the headboat fleet . The majority of fish encountered in both fleets were under 7 year (Figures 1 – 4).

5 Discussion

There is minimal influence when weighting the recreational length or age compositions for gray triggerfish in the SRHS. However, the weighted compositions are recommended for use as a matter of protocol and to remove whatever minimal bias may be present.

Literature Cited

Chih, Ching-Ping. 2009. Evaluation of the sampling efficiency of three otolith sampling methods for commercial king mackerel fisheries. Transactions of the American Fisheries Society. 138:990-999.

Table 1. Annual number of fish measured and annual number of trips containing measured gray triggerfish in the recreational fishery (SRHS, MRIP, SCDNR).

	Recreational							
	Headboat		Private		Charterboat		Shore Mode	
Year	n.fish	n.trips	n.fish	n.trips	n.fish	n.trips	n.fish	n.trips
1981			16	8			1	1
1982			21	10			3	3
1983	975	417	17	7	1	1	2	2
1984	853	419	19	9	3	3	6	3
1985	963	430	22	13	1	1	1	1
1986	719	336	34	25	5	3	5	3
1987	552	286	42	21	17	7	0	0
1988	431	228	38	26	24	12	4	4
1989	708	256	129	52	36	14	5	4
1990	793	251	127	52	37	19	6	4
1991	678	224	127	58	52	26	13	7
1992	738	241	128	70	198	75	21	13
1993	807	265	148	57	104	32	51	9
1994	1029	240	107	48	320	60	19	12
1995	868	247	58	35	159	48	15	9
1996	1047	199	145	51	282	52	14	10
1997	1554	301	108	43	219	54	8	6
1998	954	348	64	31	131	50	10	4
1999	707	261	108	55	179	53	1	1
2000	416	187	73	31	76	33	7	6
2001	489	200	111	54	167	66	3	3
2002	579	225	154	67	284	110	6	4
2003	961	298	118	64	337	126	12	6
2004	1293	339	131	67	513	158	4	3
2005	951	255	127	60	253	101	11	4
2006	760	262	129	72	223	79	2	2
2007	901	269	193	98	365	115	8	7
2008	531	161	193	84	202	69	4	3
2009	680	225	246	117	436	114	24	13
2010	1159	298	214	90	661	131	5	4
2011	979	268	146	62	513	72	2	2
2012	1025	254	160	69	401	104	7	6
2013	660	376	215	117	546	59	19	14
2014	126	356	232	100	552	133	10	8
2015	5	254	118	68	288	93	6	5
2016	6	327	204	89	286	89	12	10
2017	445	221	309	118	416	98	12	9
2018	342	182	234	111	547	120	29	14
2019	365	140	192	87	761	121	9	7
2020	61	25	185	81	1080	179	10	6
2021	2	2	326	126	563	148	5	4

Table 2. Annual numbers of gray triggerfish sampled for age and the number of annual trips containing aged gray triggerfish in the recreational fishery.

	Recreational					
	Headboat		Private		Charterboat	
Year	n.fish	n.trips	n.fish	n.trips	n.fish	n.trips
1990	18	10				
1991	42	24				
1992	1	2				
1994	1	1				
1997	2	2				
2001			4	1		
2002					5	4
2003	35	18	1	1	5	3
2004	9	4	4	2	48	18
2005	68	19			91	35
2006	129	30			29	9
2007	97	51			30	2
2008	21	13			3	2
2009	31	30			1	1
2010	100	56			1	1
2011	68	38			3	2
2012	137	46	2	1		
2013	508	135			7	6
2014	557	171			29	11
2015	286	133	2	2		
2016	594	238				
2017	404	180	8	6	47	23
2018	291	146	31	16	44	13
2019	92	56	17	17	53	23
2020			15	4	13	4

Figure 1: Nominal and weighted length composition of gray triggerfish measured in the headboat fishery.

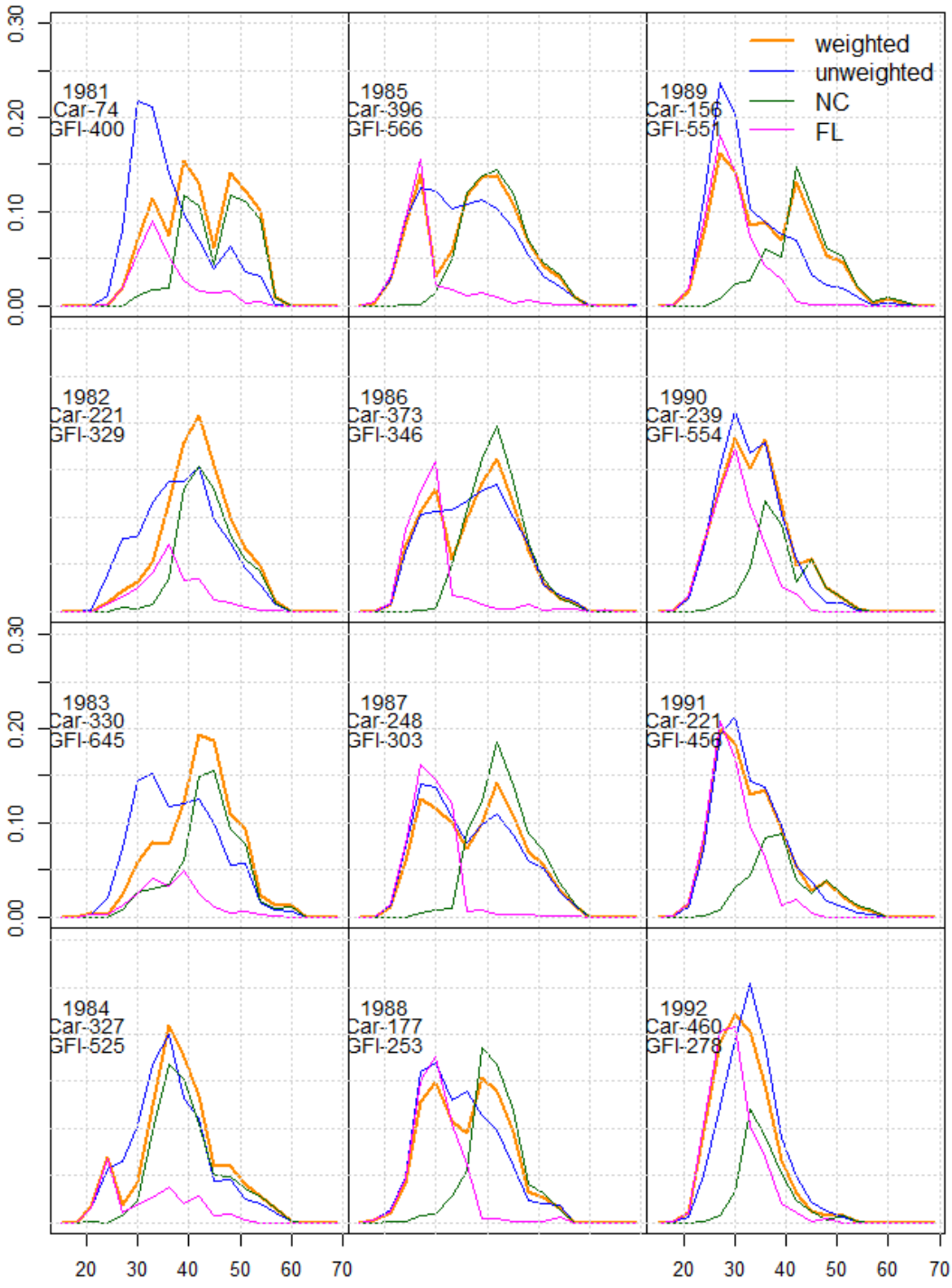

Figure 1: Continued.

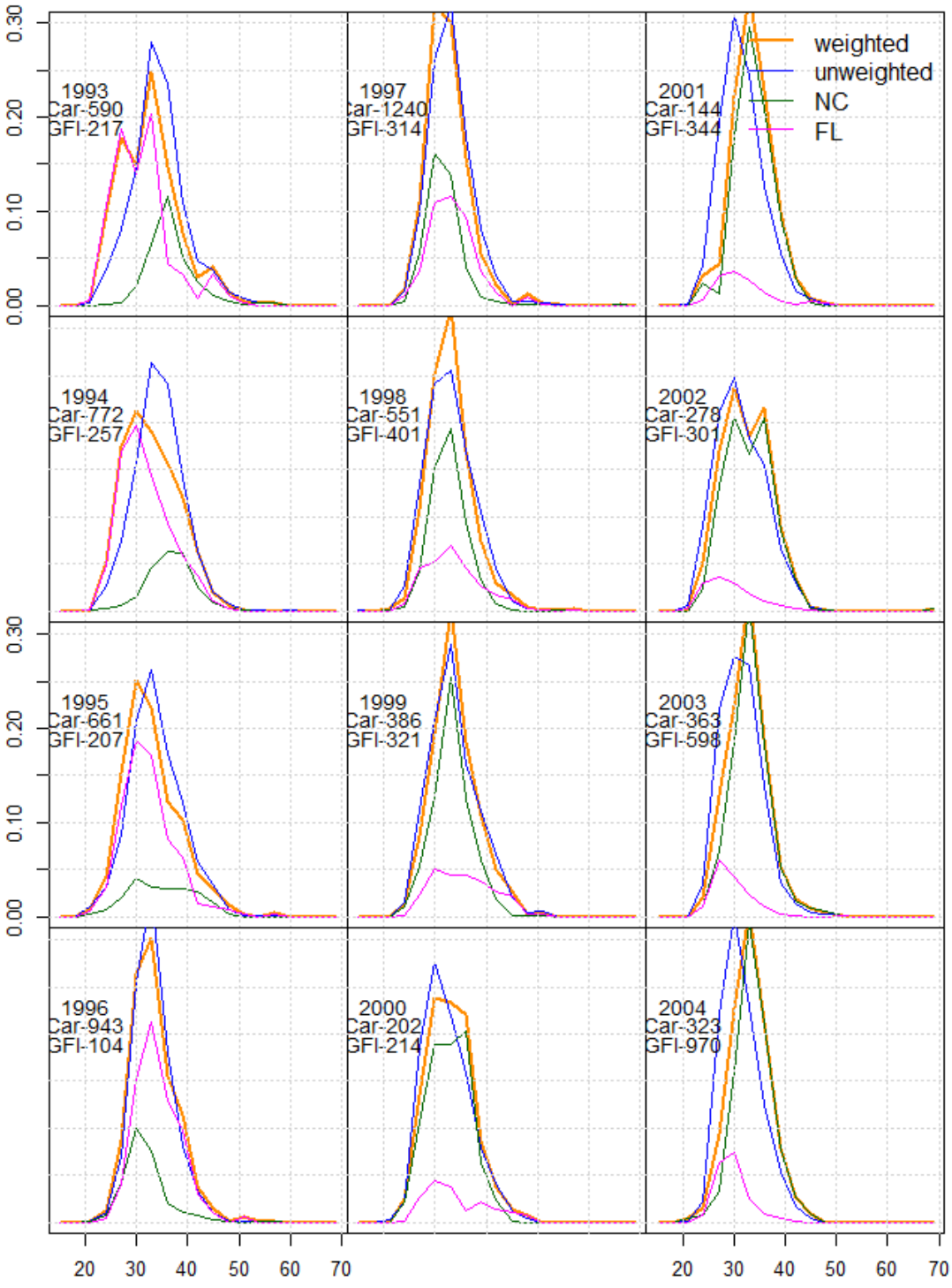

Figure 1: Continued.

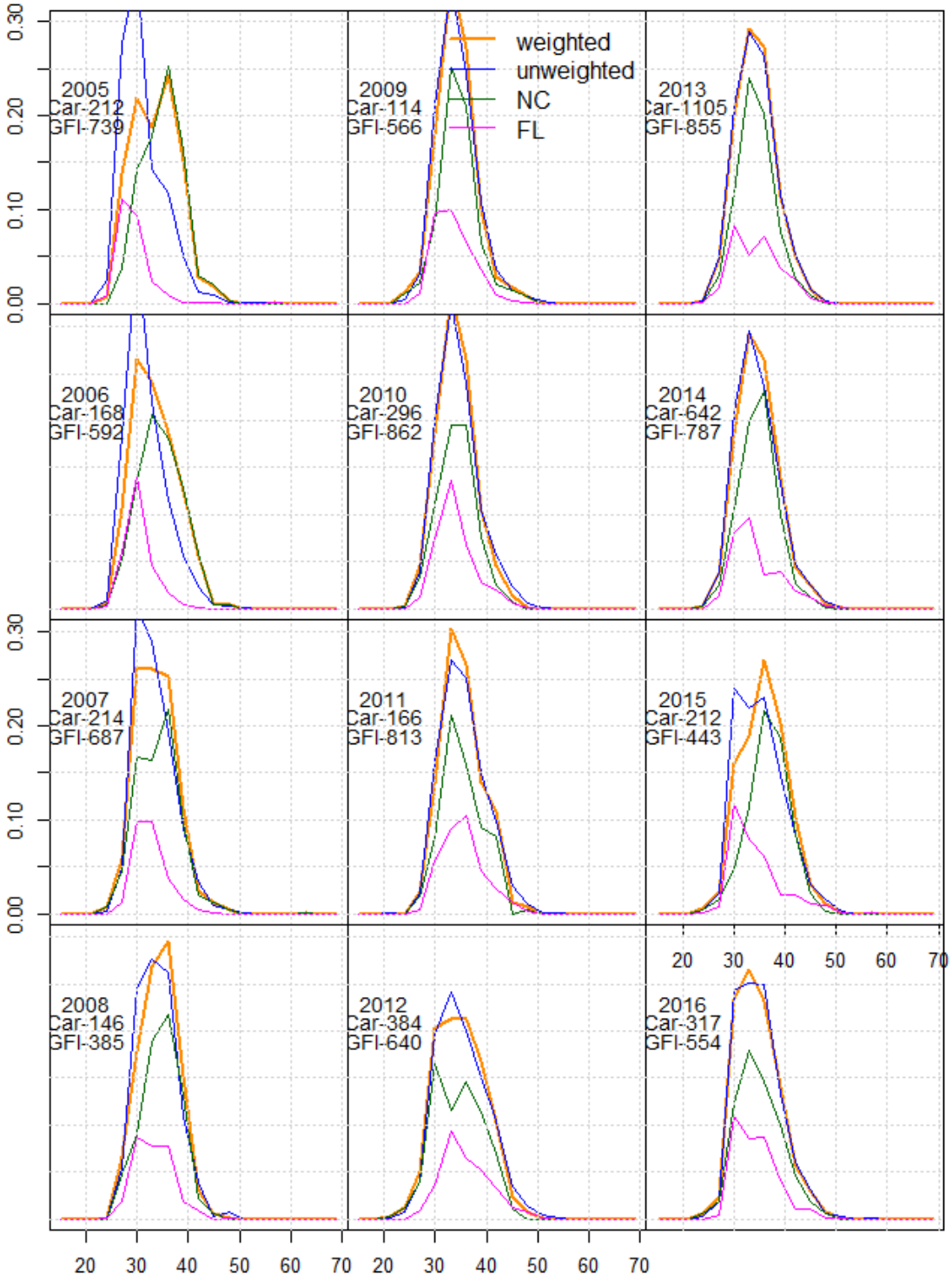

Figure 1: Continued.

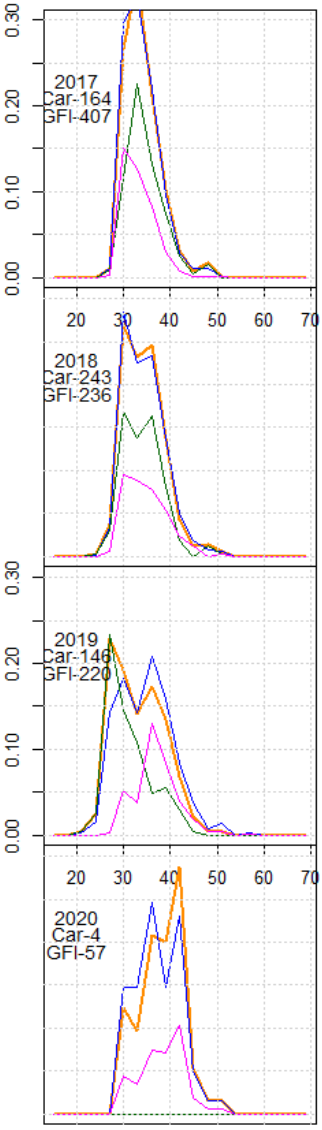

Figure 2: Gray triggerfish nominal and weighted length composition from the charter and private boat modes.

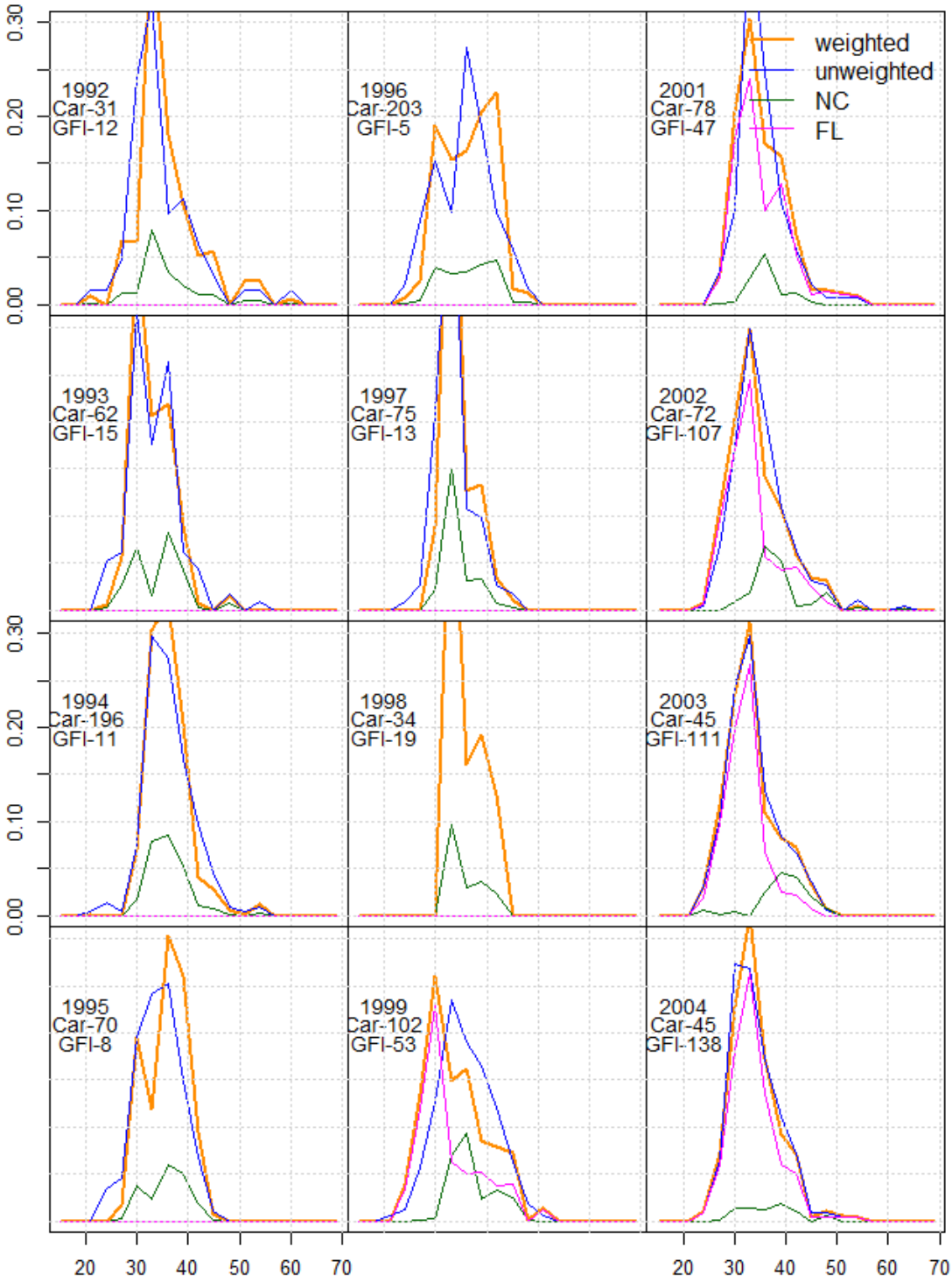

Figure 2: Continued.

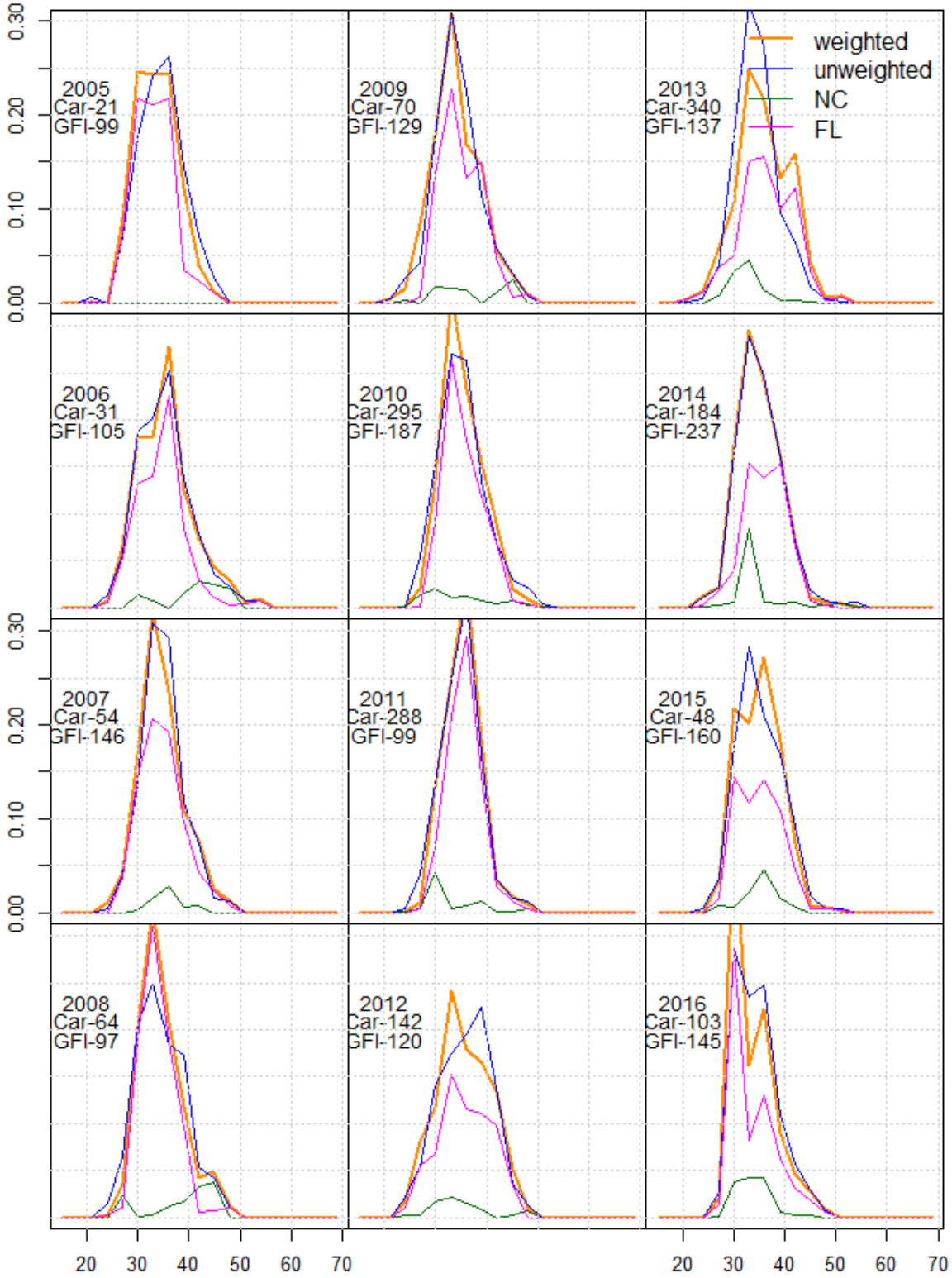

Figure 2: Continued.

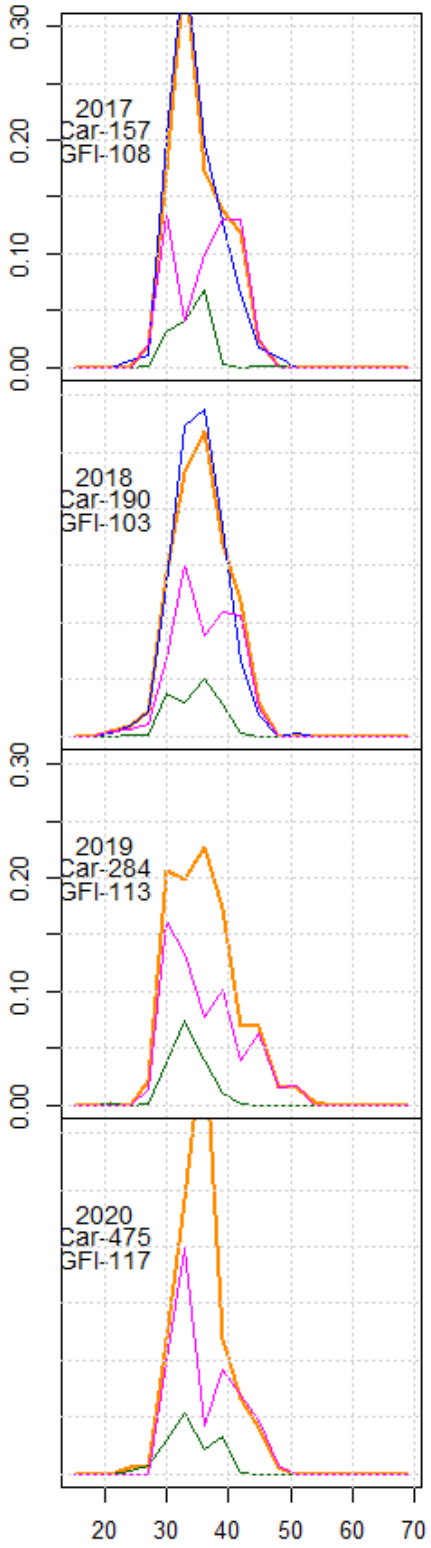

Figure 3: Gray triggerfish nominal and weighted age composition from the headboat fishery.

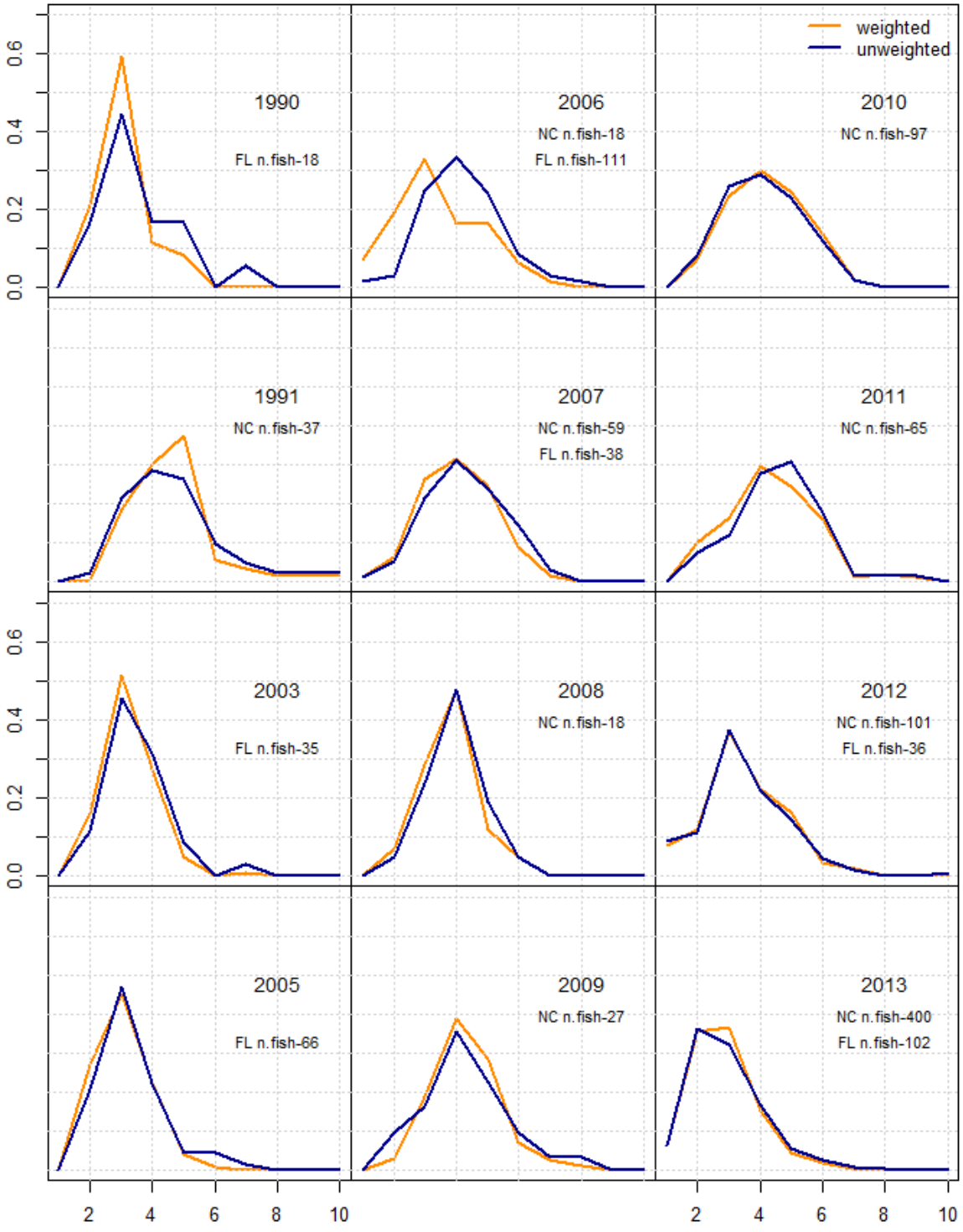

Figure 3: Continued.

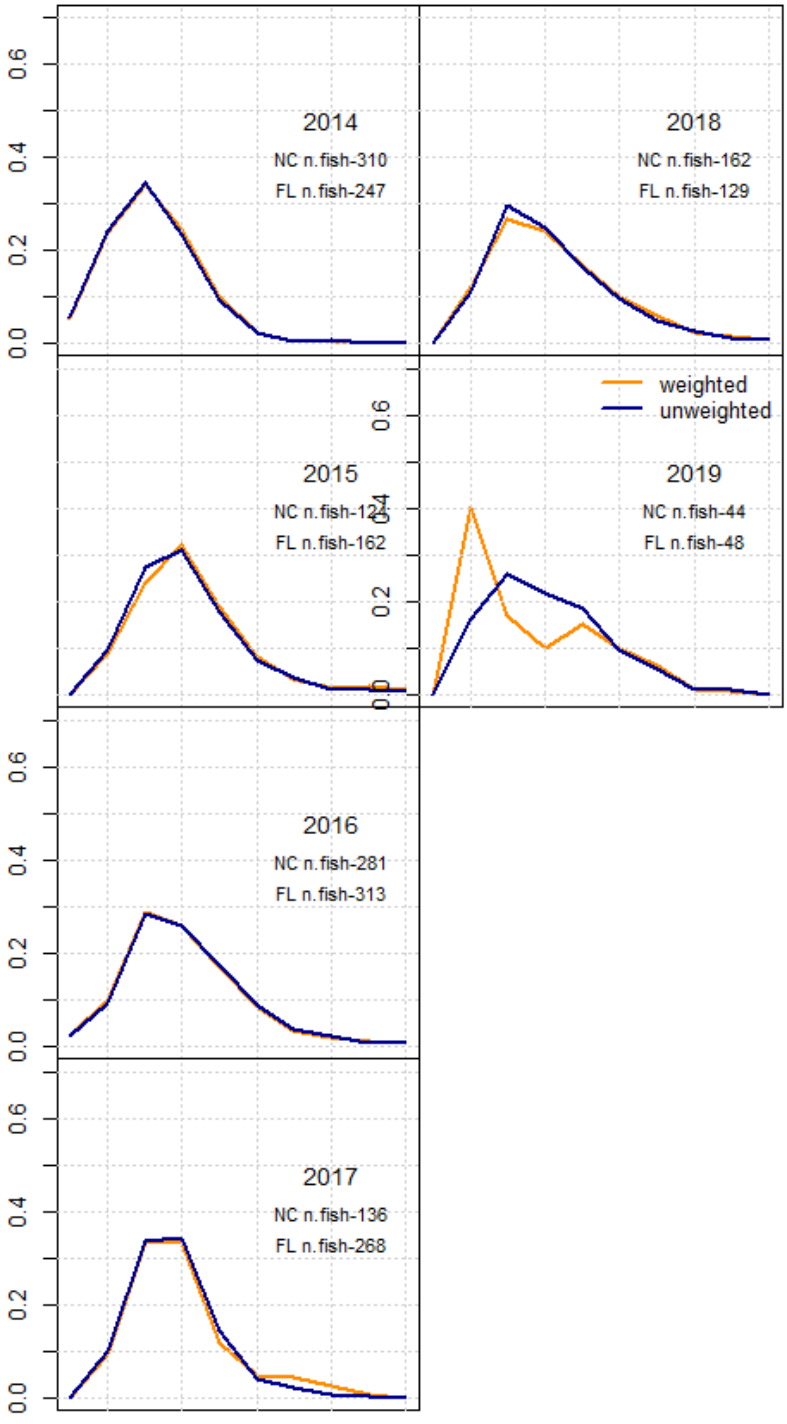

Figure 4: Gray triggerfish nominal age compositions from the charter and private boat modes.