Commercial age and length composition weighting for U.S. greater amberjack (*Seriola dumerili*)

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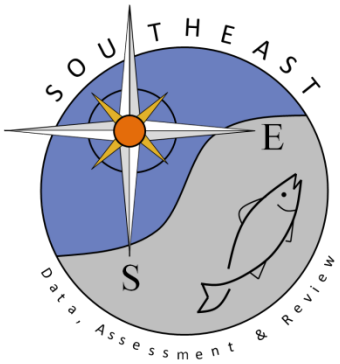

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December 2018

Introduction

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 because the selection process is rarely randomized. One technique to overcome bias in the length sampling is to weight 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). In this document we describe how the length data were weighted and how these weightings are extended to the age data. These methods have been used in previous SEDAR assessments and completed between the data and assessment workshops.

Data Description

Commercial – general

Biological sample data were obtained from the NMFS/SEFSC Trip Interview Program (TIP). Data were filtered to eliminate those records: 1) that included a size or effort bias, 2) where lengths were collected using a non-random method, 3) were not from commercial trips, 4) were selected by quota sampling, or 5) the data was not collected shore-side. These data were further limited to those that could be assigned a year, gear, and state. Length samples were assigned a state based on landing location or sample location if there was no landing location assigned.

Commercial-Lengths

The number of fish sampled had a high of 1238 for handline gear in 2001 (Table 1).

All greater amberjack lengths were converted to FL in mm using the formula provided by the SEDAR 15 Life History Group and binned into five centimeter intervals. The length data and landings data were initially grouped into two categories; 1) handlines and 2) diving and spear (diving and spear were subsequently dropped due to low sample size and changes to the fleet structure of the model).

Commercial Ages

Very few age samples were collected from diving and spear gear. Age samples of greater amberjack from handline occurred between 1998 and 2017. The lowest numbers of trips sampled was in 1999. The highest number of trips sampled was in 2002. The number of commercial trips sampled for greater amberjack ages can be found by year, gear, and state can be found in Table 2.

Weighting methods

The finest scale to weight the SEFSC-TIP length data was by year and state for each of the gear groupings (handline). For each year, the state-specific length composition was multiplied by the proportion of landings from that state. The weighted state-specific length compositions were then combined and scaled to sum to one.

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 year (j) and length interval (i) 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 of 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 in that the length composition is weighted by the landings. The minimum sample size cutoff for length compositions was 30 fish per area and the minimum sample size cutoff for age compositions was 10 fish per area.

Results

Commercial Lengths

The commercial handline length compositions were similar in size spatially for most years (Figure 1). The weighting of the length composition for the handline fishery had almost no

influence. The commercial "other" lengths were excluded as data input in since the lengths were similar to handline while the sample sizes were much lower (Figure 1a).

The commercial longline length compositions were very similar when compared across regions (Figure 1).

Ages

Commercial

Possible sampling bias related to the collection of age samples was examined by comparing the length composition of the aged fish to the original TIP length composition (Figure 2). The weighted age compositions are very similar to the nominal age compositions (Figure 3).

Discussion

There is minimal influence when weighting the commercial length or age composition for greater amberjack. However, the weighted compositions are recommended for use as a matter of protocol and to remove whatever minimal bias may be present.

The commercial weighted length composition for input into the model is given in Table 3.

Several factors where considered in determining the maximum age for the model including the growth, maturity, and fecundity. Based on these analyses a plus group is recommended at 10 years of age.

Tables

Table 1. Number of fish sampled for lengths for greater amberjack by year and gear for the commercial handline gears and other gears (diving/spear).

	Handline				Diving/Spear			
	N.trips		N.fish		N.trips		N.fish	
Year	Car	GFL	Car	GFL	Car	GFL	Car	GFL
1984	1	0	1	0				
1985	6	1	23	1				
1986	3	4	7	15				
1987	11	6	23	16				
1988	13	1	54	5				
1989	10	4	14	9				
1990	13	8	45	53				
1991	19	18	65	360				
1992	9	33	41	338	0	1	0	9
1993	9	87	23	705	0	5	0	60
1994	21	45	64	286	0	3	0	14
1995	24	41	54	231	0	5	0	39
1996	17	35	27	254				
1997	10	60	24	546	0	2	0	4
1998	12	53	30	454	0	1	0	1
1999	70	50	202	374	0	9	0	145
2000	125	80	436	717	0	10	0	217
2001	115	70	450	788	0	7	0	38
2002	78	58	386	693	0	5	0	12
2003	90	52	408	412	0	9	0	96
2004	84	35	275	579				
2005	64	14	270	58				
2006	55	23	183	88	1	2	1	4
2007	64	30	184	47	0	1	0	2
2008	87	17	327	81				
2009	79	12	208	122	2	0	6	0
2010	56	7	261	41	1	0	2	0
2011	58	18	229	115	3	0	19	0
2012	83	23	284	365	0	1	0	1
2013	43	14	97	101				
2014	59	34	181	432	5	1	8	2
2015	46	17	116	96	1	0	1	0
2016	49	8	118	67	2	0	2	0
2017	4	27	10	226				

Table 2. Number of trips sampled and number of fish sampled for age and for greater amberjack by year and gear by state for the commercial gears.

	Trips						Fish					
	Diving	Handline				n.trips	Diving	Handline				n.fish
	FL	FL	GA	NC	SC		FL	FL	GA	NC	SC	
1998		7				7		35				35
1999	5	2				7	48	15				63
2000	2	7	2		6	17	21	25	10		33	89
2001		8	3		15	26		27	25		93	145
2002		17	6		13	36		202	81		99	382
2003		22	5		3	30		281	51		12	344
2004		9		6		15		34		15		49
2005		2		2		4		4		3		7
2007		9				9		12				12
2008		7				7		31				31
2009		7			16	23		23			25	48
2010		9			13	22		38			24	62
2011		6		5	7	18		36		6	10	52
2012		3		13	8	24		6		17	17	40
2013		13		4	6	23		42		12	7	61
2014		29		4	6	39		166		4	7	177
2015		18			3	21		55			4	59
2016		8			2	10		36			3	39
2017		12		2	1	15		29		2	3	34
Grand Total	7	195	16	36	99	353	69	1097	167	59	337	1729

Table 3. Weighted age composition for commercial handline greater amberjack with ages.

	n.fish	n.trips	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1998	35	7	0	0	0.0416577	0.1777931	0.3982364	0.1478265	0.0736658	0.071425	0.0159506	0	0	0.073445	0	0	0
1999	15	2	0	0	0.0951891	0.1538486	0.4920689	0.2099486	0	0	0.0247717	0.0241732	0	0	0	0	0
2000	68	15	0	0.1871884	0.426518	0.1419379	0.101421	0.1208389	0	0.0162348	0	0	0.005861	0	0	0	0
2001	145	26	0.000869	0.0887535	0.2817007	0.406259	0.1173041	0.051662	0.0328677	0.0138134	0.0034895	0	0.0032811	0	0	0	0
2002	382	36	0.0096367	0.1124971	0.19356	0.4015863	0.1626019	0.0253852	0.047183	0.0331557	0.0111463	0.0007047	0	0	0	0	0.002543
2003	344	30	0.00867	0.0580375	0.4979559	0.2070276	0.1265438	0.0668298	0.0117318	0.0107794	0.0041265	0.005522	0	0.002776	0	0	0
2004	49	15	0	0.0711941	0.165854	0.554867	0.0601345	0.1050267	0.0429237	0	0	0	0	0	0	0	0
2007	12	9	0	0	0	0	0.2547304	0.6239299	0.038909	0	0.0824307	0	0	0	0	0	0
2008	31	7	0	0.0306442	0.1802284	0.32086	0.1795873	0.1729589	0.0444005	0.0159817	0.055339	0	0	0	0	0	0
2009	48	23	0	0.0085698	0.109928	0.6873984	0.0392288	0.1405766	0.0040797	0.0034914	0	0	0	0	0.006727	0	0
2010	62	22	0.0043784	0	0.374931	0.4603889	0.1317319	0.0185644	0.0041845	0	0.0014579	0	0	0	0.004363	0	0
2011	52	18	0	0.036291	0.1578044	0.3044405	0.2201922	0.1364055	0.1236784	0.021188	0	0	0	0	0	0	0
2012	34	21	0	0.1083388	0.3996881	0.203084	0.1194088	0.1049897	0.0644906	0	0	0	0	0	0	0	0
2013	61	23	0.0194289	0.048187	0.4059651	0.4181903	0.0546914	0.0242381	0.0292992	0	0	0	0	0	0	0	0
2014	177	39	0	0.0061982	0.3726894	0.1975089	0.2114701	0.1331319	0.047141	0.0236865	0	0.0081739	0	0	0	0	0
2015	55	18	0	0	0.0956836	0.5434424	0.1110916	0.1686601	0.0308969	0.027038	0.0231874	0	0	0	0	0	0
2016	36	8	0	0.014205	0.1849636	0.4604213	0.2212203	0.0923241	0	0.0268657	0	0	0	0	0	0	0
2017	29	12	0	0	0.1092096	0.2575093	0.5228968	0.0789199	0.0314645	0	0	0	0	0	0	0	0

Figures

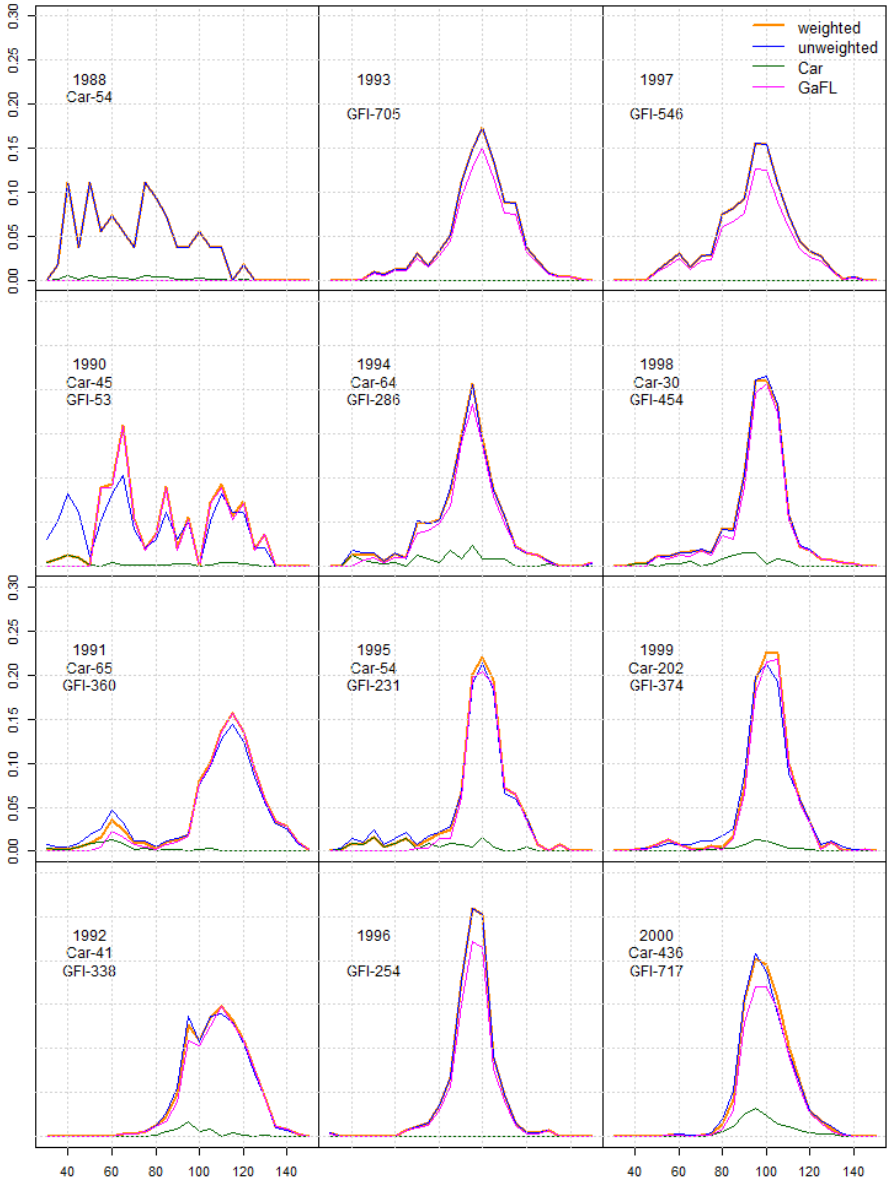

Figure 1. Weighted and un-weighted greater amberjack length composition for handline gear by region by year.

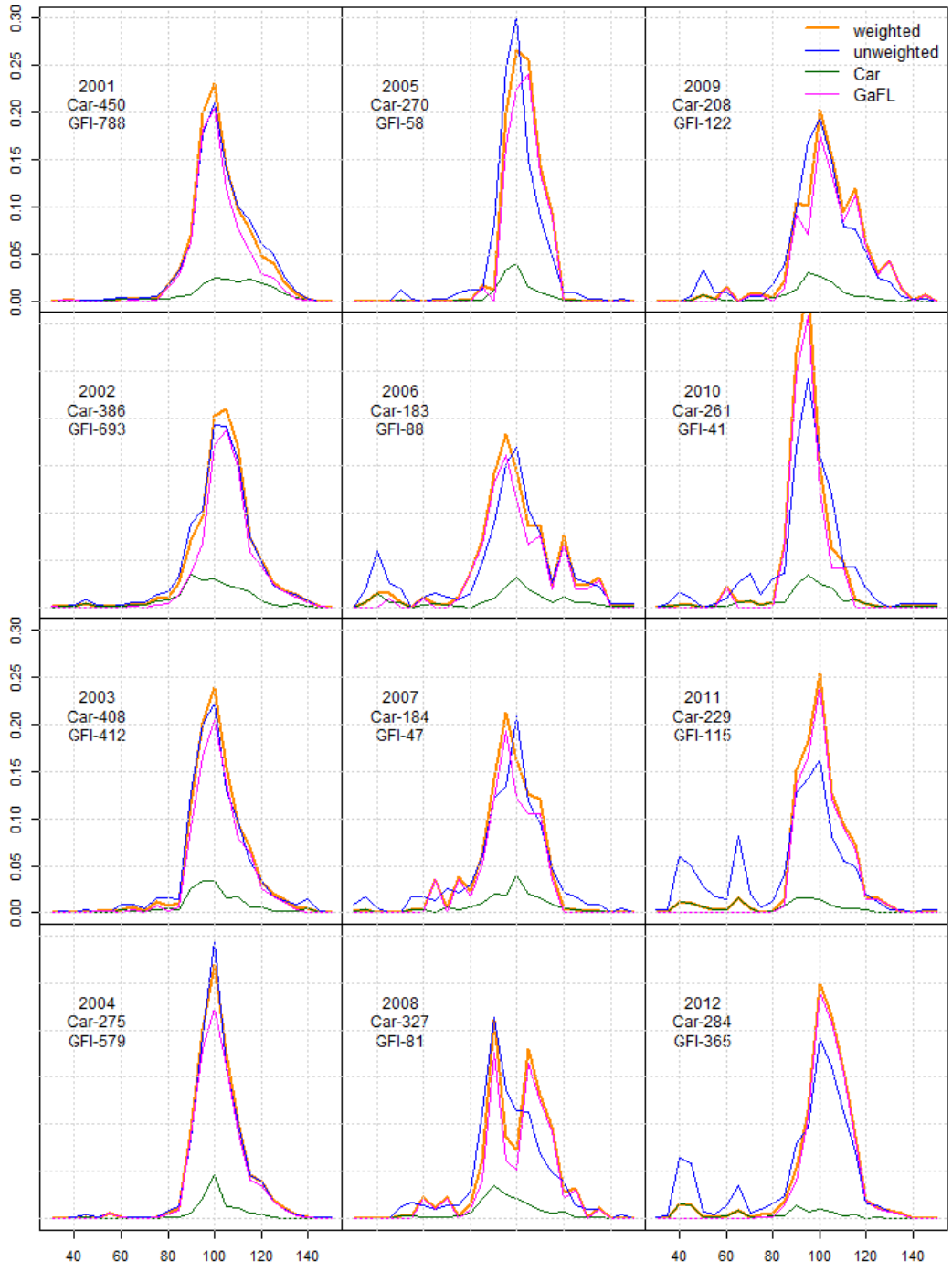

Figure 1 (continued).

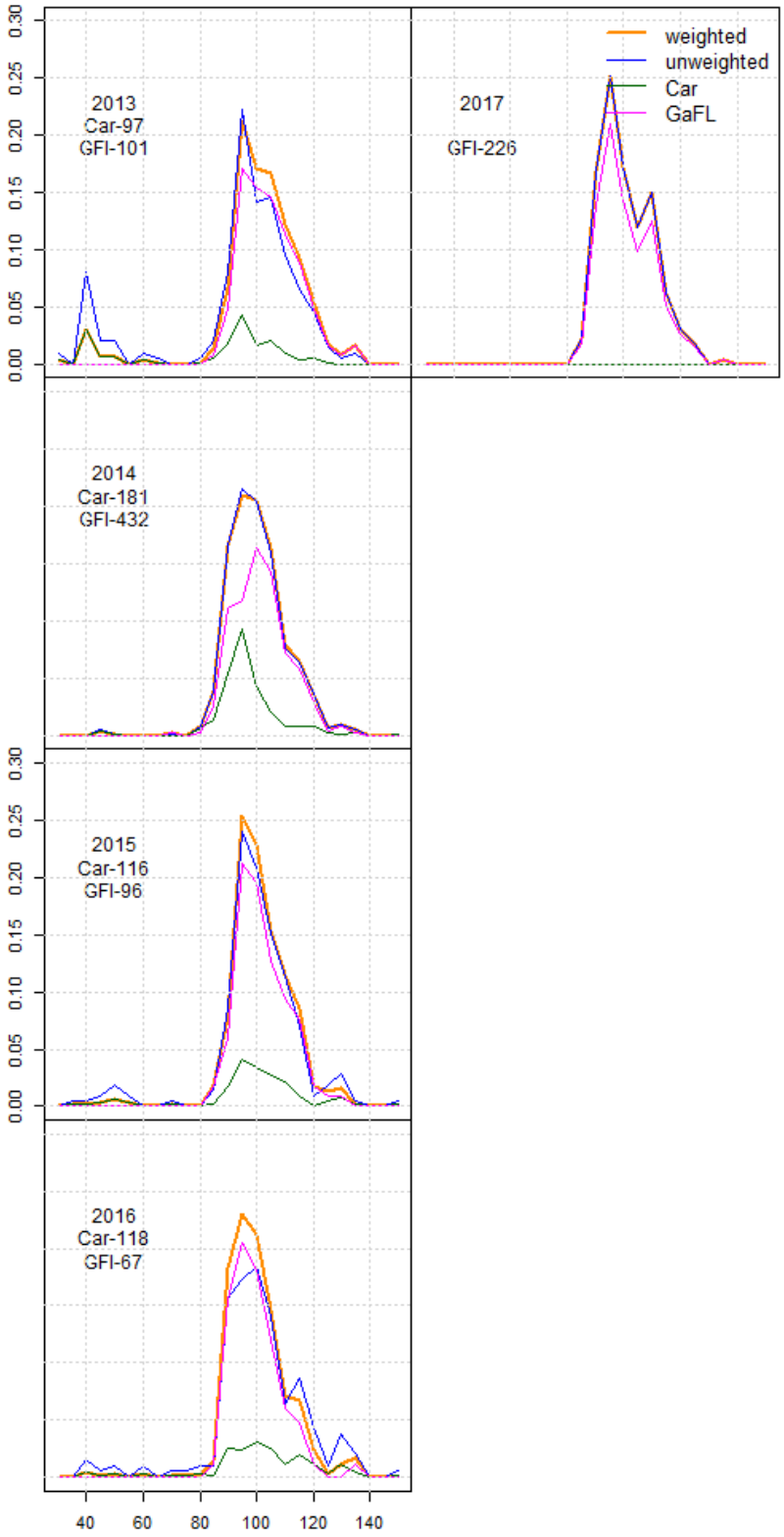

Figure 1 (continued).

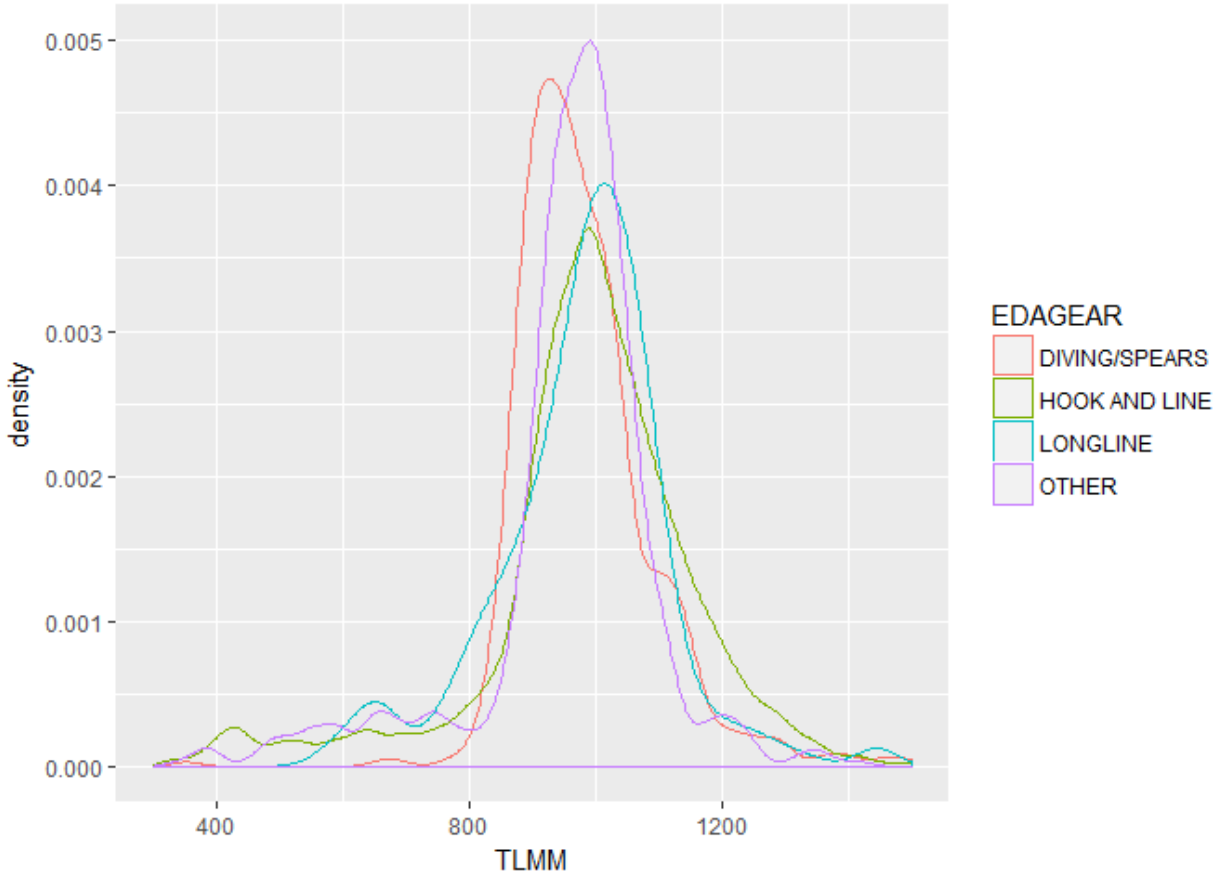

Figure 1a. Greater amberjack length composition for various gears combined across years.

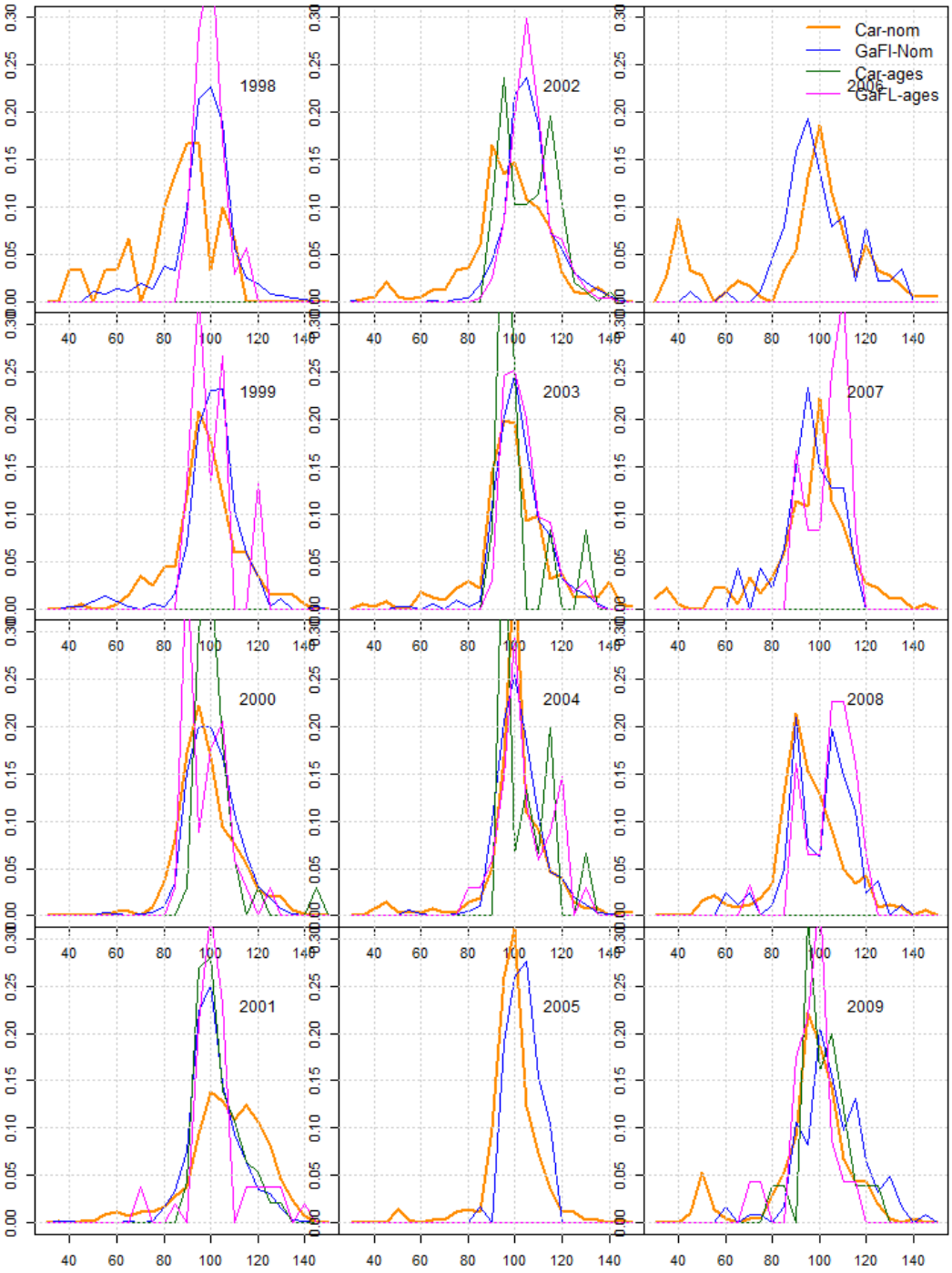

Figure 2. Weighted and un-weighted greater amberjack age composition for handline and longline gear by region by year.

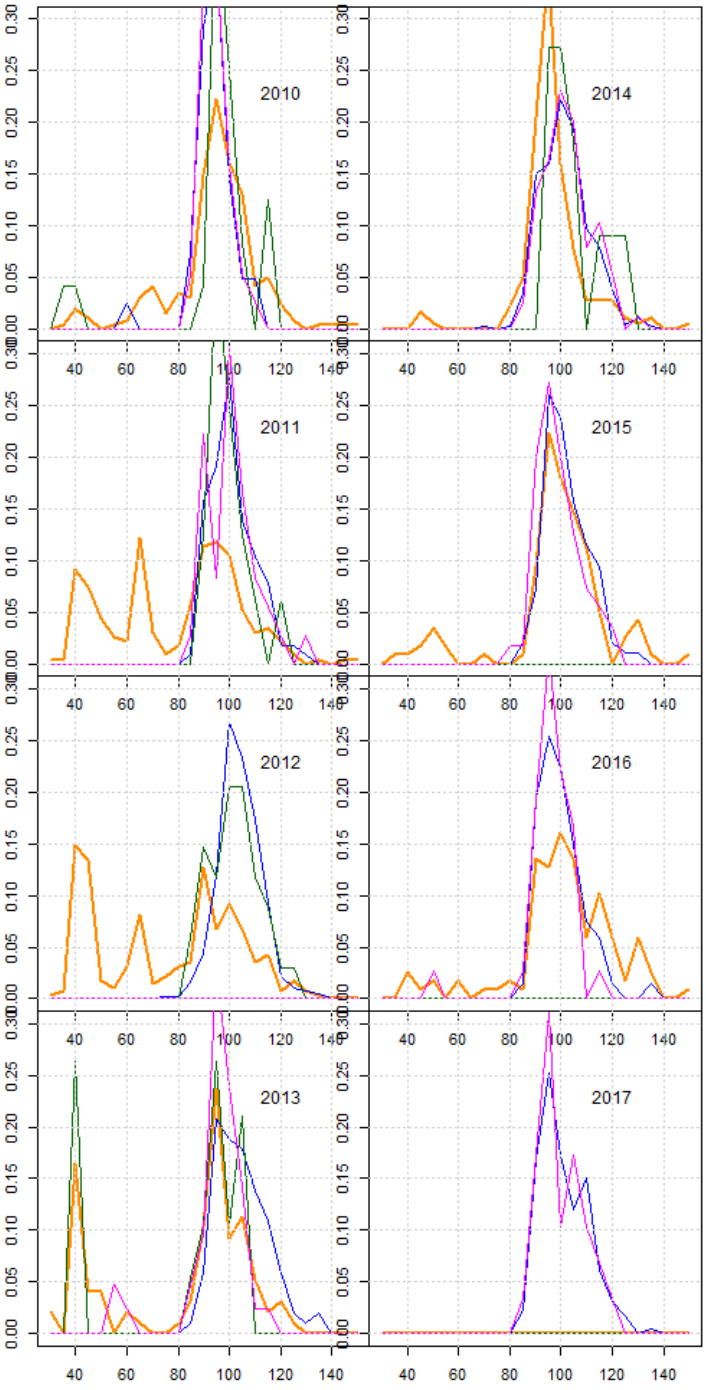

Figure 2. (continued).

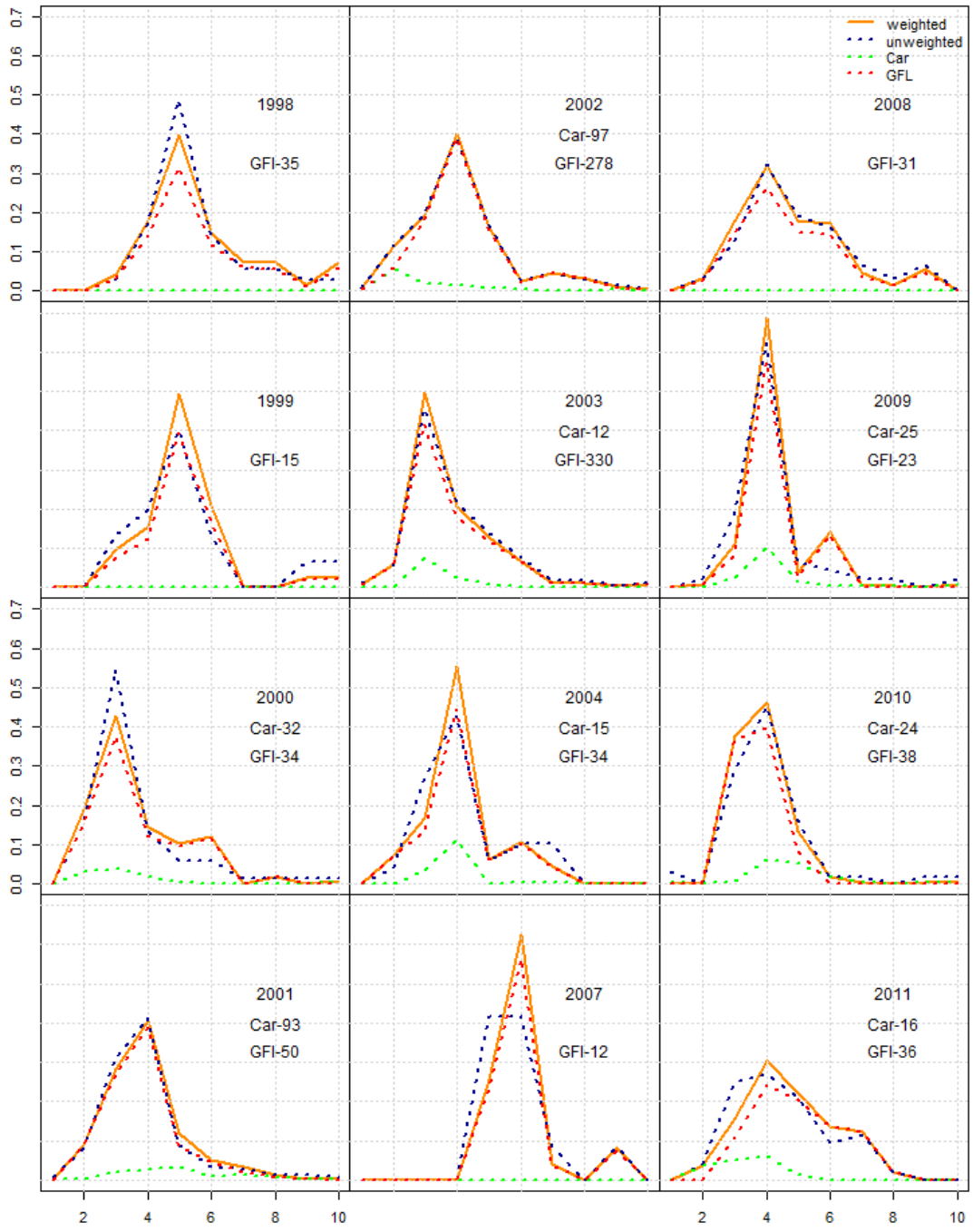

Figure 3. Weighted and un-weighted greater amberjack age composition for handline and longline gear by region by year.

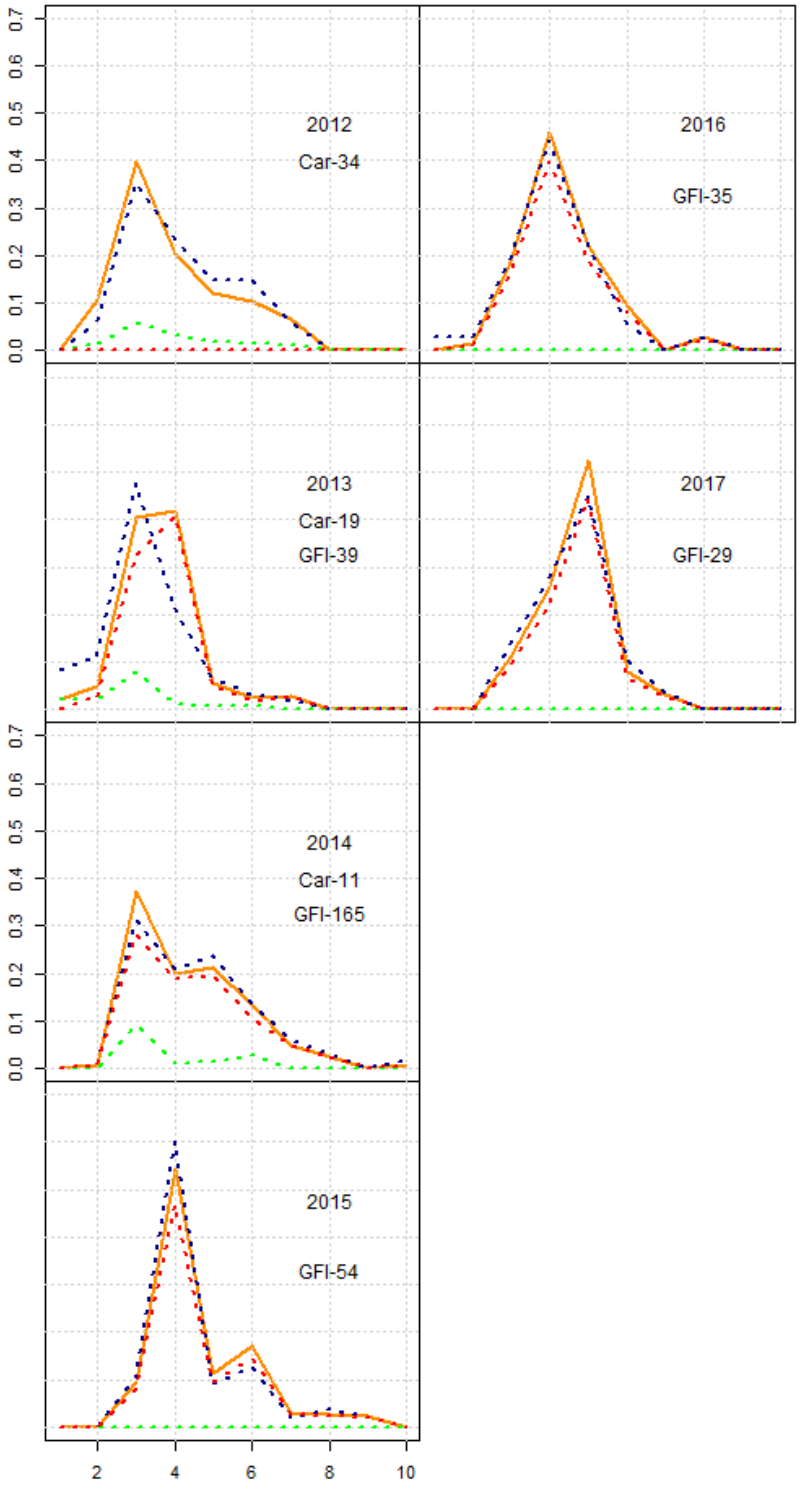

Figure 3. (continued).