Commercial age and length composition weightings for Atlantic gray triggerfish (*Balistes capriscus*)
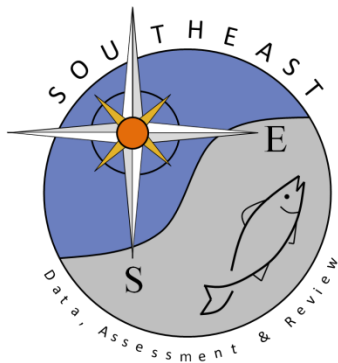
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SEDAR41-AW06

Submitted: 30 November 2015

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Commercial age and length composition weightings for Atlantic gray triggerfish (Balistes Capriscus)

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Introduction

The SEDAR 41 data workshop developed raw length and age compositions for each of the 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 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. Similar methods have been used in previous SEDAR assessments and completed between the data and assessment workshops.

Summary of DW decisions (see SEDAR41-DW report)
- Develop length and age compositions for handline gear only
- Weight length compositions by regional landings (Carolinas and Georgia-Florida)
- Weight age compositions by length compositions
- Exclude years with very limited spatial coverage or small sample size

Weighted Length Composition (Figure 1)
Summary of decisions and methods
- Year and region-specific cutoff of 30 fish
- Develop weighted composition in 1cm bins with no pooling
- Multiply each regions annual composition by its annual proportion of commercial handline landings
- Combine regional compositions and renormalize so that each year sums to 1

- Pool lower (15cm) and upper (69cm) and convert to 3cm bins

Weighted Age Composition (Figure 1)

Summary of decisions and methods

- Year and region-specific cutoff of 10 fish
- Weight by region-specific length composition to account for non-random sampling of fish for age structures

    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:

    $$RW_{ij} = \frac{NL_{ij}/TN_j}{OL_{ij}/TO_j}$$

    where NL_{ij} is the number of observations associated with the year *j* and length interval *i* from the length samples, TN_j is the total number length observations in year j, 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). This reweighting factor is assigned to each age observation and then summed across year and age to give a weighted age composition for each region.

- Multiply each regions annual age composition by its annual proportion of commercial handline landings
- Combine regional age compositions and renormalize so that each year sums to 1
- Pool ages over 8 years with age-8 fish

Results

Sample sizes changed slightly from the nominal compositions due to cutoffs and are given Table 1 for length compositions and Table 2 for age compositions. Commercial handline length compositions are fairly consistent over time and across regions (Table 3 and Figure 2). Commercial handline age compositions are almost entirely from the Carolinas. For those years with only one region it is clear the reweighting to remove bias in age sampling had very little influence on the final age composition (Table 4 and Figure 3).

References

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. Sample size of weighted length compositions with number of fish sampled (n.fish) and number of trips sampled (n.trips).

Year	n.fish	n.trips
1984	282	42
1985	650	61
1986	201	33
1987	409	46
1988	212	32
1989	339	38
1990	650	38
1991	572	36
1992	487	34
1993	1107	77
1994	1480	66
1995	3131	136
1996	1789	78
1997	906	51
1998	1338	65
1999	1822	95
2000	2565	154
2001	2020	137
2002	1429	93
2003	2230	78
2004	3478	148
2005	2678	136
2006	2706	220
2007	2130	285
2008	1583	269
2009	1831	242
2010	2447	269
2011	3162	297
2012	1992	202
2013	1594	148
2014	406	51

Table 2. Sample size of weighted age compositions with number of fish sampled (n.fish) and number of trips sampled (n.trips).

Year	n.fish	n.trips
2004	188	25
2005	386	47
2006	463	86
2007	681	196
2008	736	205
2009	686	180
2010	965	215
2011	1237	211
2012	756	110
2013	563	97
2014	431	69

Table 3. Weighted coastwide length composition for commercial handline gray triggerfish in 3cm bins pooled at 15 and 69 cm.

Year	15	18	21	24	27	30	33	36	39
1984	0.0000	0.0000	0.0000	0.0000	0.0042	0.0247	0.0244	0.0755	0.1665
1985	0.0000	0.0000	0.0000	0.0035	0.0022	0.0116	0.0326	0.0800	0.1301
1986	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0159	0.0510	0.1342
1987	0.0000	0.0000	0.0000	0.0000	0.0107	0.0056	0.0165	0.0381	0.1163
1988	0.0000	0.0000	0.0042	0.0043	0.0151	0.0255	0.0453	0.1109	0.1669
1989	0.0000	0.0000	0.0000	0.0000	0.0028	0.0222	0.0660	0.1158	0.1914
1990	0.0000	0.0000	0.0000	0.0013	0.0029	0.0143	0.0533	0.1900	0.2526
1991	0.0000	0.0000	0.0000	0.0028	0.0059	0.0440	0.1098	0.1923	0.2077
1992	0.0015	0.0000	0.0000	0.0000	0.0073	0.0589	0.1742	0.1994	0.2192
1993	0.0000	0.0000	0.0000	0.0000	0.0039	0.0347	0.1368	0.2349	0.2201
1994	0.0000	0.0000	0.0000	0.0000	0.0030	0.0357	0.1617	0.2455	0.2162
1995	0.0000	0.0000	0.0000	0.0032	0.0298	0.0859	0.1463	0.2183	0.2236
1996	0.0000	0.0000	0.0000	0.0052	0.0223	0.1047	0.2287	0.2656	0.1779
1997	0.0000	0.0000	0.0000	0.0129	0.0271	0.1190	0.2036	0.2795	0.1696
1998	0.0000	0.0000	0.0023	0.0098	0.0401	0.0984	0.2200	0.2502	0.2109
1999	0.0000	0.0000	0.0000	0.0006	0.0182	0.0589	0.1632	0.2416	0.1965
2000	0.0000	0.0000	0.0021	0.0077	0.0340	0.0939	0.1537	0.2175	0.2116
2001	0.0000	0.0000	0.0006	0.0036	0.0281	0.0895	0.2017	0.2345	0.2091
2002	0.0000	0.0000	0.0000	0.0042	0.0409	0.0954	0.1910	0.2186	0.2130
2003	0.0000	0.0000	0.0015	0.0007	0.0144	0.0829	0.2051	0.2549	0.2311
2004	0.0000	0.0000	0.0003	0.0020	0.0140	0.0828	0.2025	0.3032	0.2256
2005	0.0000	0.0000	0.0000	0.0015	0.0101	0.0670	0.1638	0.2604	0.2663
2006	0.0000	0.0000	0.0003	0.0036	0.0142	0.0673	0.1511	0.2167	0.2294
2007	0.0000	0.0000	0.0000	0.0009	0.0126	0.0491	0.1130	0.2032	0.2386
2008	0.0000	0.0000	0.0000	0.0006	0.0063	0.0261	0.1163	0.1756	0.2823
2009	0.0000	0.0000	0.0005	0.0023	0.0219	0.0647	0.1785	0.2082	0.2264
2010	0.0000	0.0000	0.0000	0.0000	0.0094	0.0511	0.1289	0.1983	0.2329
2011	0.0000	0.0000	0.0002	0.0007	0.0080	0.0370	0.1331	0.2117	0.2198
2012	0.0000	0.0000	0.0000	0.0017	0.0097	0.0412	0.1037	0.1854	0.1993
2013	0.0000	0.0000	0.0000	0.0010	0.0099	0.0612	0.1361	0.2022	0.1701
2014	0.0000	0.0000	0.0000	0.0042	0.0064	0.0415	0.0891	0.1756	0.1857

Table 3 continued.

Year	42	45	48	51	54	57	60	63	66	69
1984	0.1828	0.1563	0.0987	0.0955	0.1037	0.0367	0.0154	0.0040	0.0042	0.0073
1985	0.1931	0.2301	0.1677	0.0747	0.0422	0.0196	0.0094	0.0032	0.0000	0.0000
1986	0.1718	0.2372	0.1827	0.1066	0.0578	0.0313	0.0059	0.0056	0.0000	0.0000
1987	0.2601	0.1641	0.1608	0.1313	0.0703	0.0263	0.0000	0.0000	0.0000	0.0000
1988	0.2117	0.1699	0.0846	0.0748	0.0605	0.0212	0.0050	0.0000	0.0000	0.0000
1989	0.2159	0.1962	0.1114	0.0344	0.0357	0.0054	0.0028	0.0000	0.0000	0.0000
1990	0.2122	0.1599	0.0589	0.0299	0.0155	0.0092	0.0000	0.0000	0.0000	0.0000
1991	0.2235	0.1354	0.0615	0.0142	0.0000	0.0028	0.0000	0.0000	0.0000	0.0000
1992	0.1523	0.0990	0.0624	0.0183	0.0042	0.0014	0.0018	0.0000	0.0000	0.0000
1993	0.1628	0.1039	0.0573	0.0297	0.0115	0.0008	0.0009	0.0008	0.0000	0.0018
1994	0.1725	0.0832	0.0512	0.0200	0.0088	0.0022	0.0000	0.0000	0.0000	0.0000
1995	0.1517	0.0859	0.0324	0.0132	0.0073	0.0019	0.0000	0.0000	0.0003	0.0000
1996	0.1022	0.0558	0.0249	0.0061	0.0033	0.0021	0.0008	0.0004	0.0000	0.0000
1997	0.0929	0.0498	0.0292	0.0109	0.0055	0.0000	0.0000	0.0000	0.0000	0.0000
1998	0.1092	0.0415	0.0106	0.0049	0.0013	0.0007	0.0000	0.0000	0.0000	0.0000
1999	0.1683	0.0960	0.0318	0.0091	0.0047	0.0074	0.0029	0.0008	0.0000	0.0000
2000	0.1391	0.0902	0.0356	0.0111	0.0033	0.0002	0.0000	0.0000	0.0000	0.0000
2001	0.1219	0.0709	0.0258	0.0092	0.0031	0.0004	0.0000	0.0000	0.0000	0.0014
2002	0.1370	0.0620	0.0292	0.0061	0.0016	0.0000	0.0004	0.0000	0.0000	0.0005
2003	0.1136	0.0590	0.0275	0.0077	0.0007	0.0005	0.0000	0.0000	0.0000	0.0004
2004	0.1010	0.0470	0.0134	0.0062	0.0017	0.0000	0.0002	0.0000	0.0000	0.0000
2005	0.1363	0.0645	0.0188	0.0096	0.0010	0.0007	0.0000	0.0000	0.0000	0.0000
2006	0.1759	0.0908	0.0352	0.0132	0.0015	0.0000	0.0003	0.0000	0.0000	0.0003
2007	0.1811	0.1207	0.0605	0.0136	0.0048	0.0005	0.0008	0.0006	0.0000	0.0000
2008	0.1878	0.1041	0.0756	0.0226	0.0027	0.0000	0.0000	0.0000	0.0000	0.0000
2009	0.1403	0.0867	0.0363	0.0249	0.0072	0.0014	0.0000	0.0009	0.0000	0.0000
2010	0.1737	0.1112	0.0654	0.0235	0.0048	0.0005	0.0002	0.0000	0.0000	0.0000
2011	0.1838	0.1113	0.0601	0.0299	0.0045	0.0001	0.0000	0.0000	0.0000	0.0000
2012	0.1833	0.1476	0.0779	0.0437	0.0036	0.0016	0.0005	0.0000	0.0000	0.0008
2013	0.1692	0.1262	0.0832	0.0273	0.0131	0.0002	0.0002	0.0000	0.0000	0.0000
2014	0.2207	0.1260	0.1072	0.0396	0.0019	0.0022	0.0000	0.0000	0.0000	0.0000

Table 4. Coastwide weighted age composition for commercial handline gray triggerfish pooled at age 8.

Year	1	2	3	4	5	6	7	8
2004	0.0000	0.0056	0.1796	0.3708	0.2900	0.1258	0.0209	0.0000
2005	0.0046	0.0567	0.1875	0.3090	0.2506	0.1210	0.0477	0.0228
2006	0.0025	0.0447	0.1799	0.2604	0.2589	0.1565	0.0723	0.0248
2007	0.0172	0.0629	0.1826	0.2660	0.2227	0.1382	0.0707	0.0397
2008	0.0014	0.0244	0.1320	0.2679	0.2319	0.1547	0.1079	0.0798
2009	0.0000	0.0219	0.1844	0.2542	0.2498	0.1537	0.0744	0.0616
2010	0.0020	0.0371	0.1362	0.2474	0.2240	0.1644	0.1047	0.0844
2011	0.0000	0.0358	0.1631	0.2924	0.2570	0.1438	0.0551	0.0528
2012	0.0028	0.0404	0.1453	0.2646	0.2360	0.1821	0.0760	0.0527
2013	0.0207	0.2280	0.2081	0.2036	0.1808	0.0999	0.0407	0.0182
2014	0.0018	0.0658	0.2556	0.3207	0.1785	0.1091	0.0372	0.0312

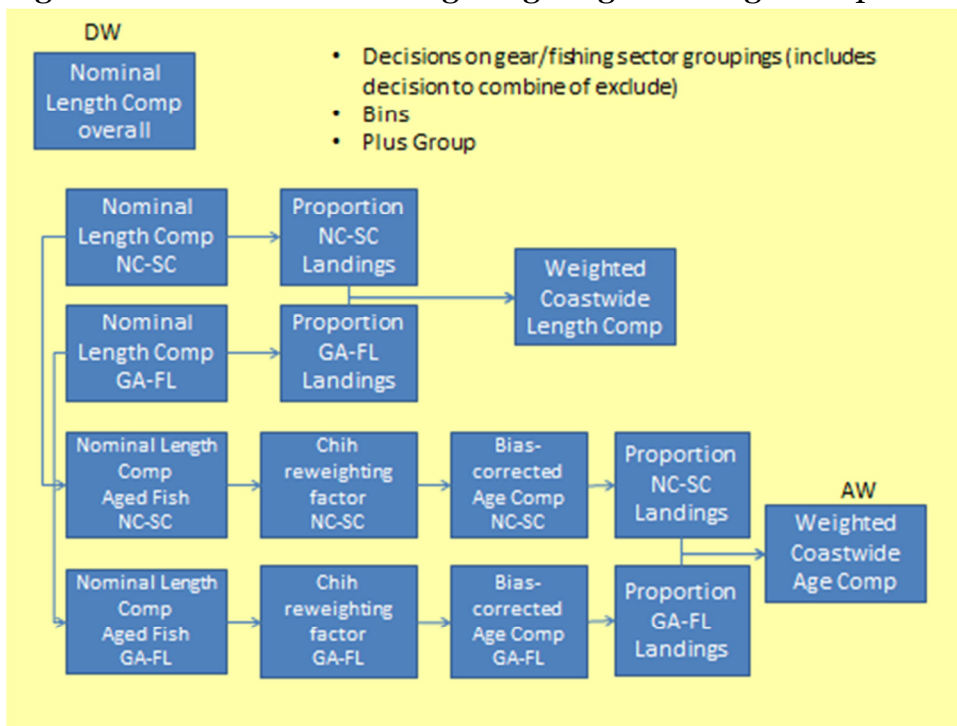Figure 1. Flow chart for weighting length and age compositions.

Figure 2. Nominal and weighted coastwide length compositions of gray triggerfish in 1cm bins unpooled. Sample sizes and region-specific compositions are shown for comparison.
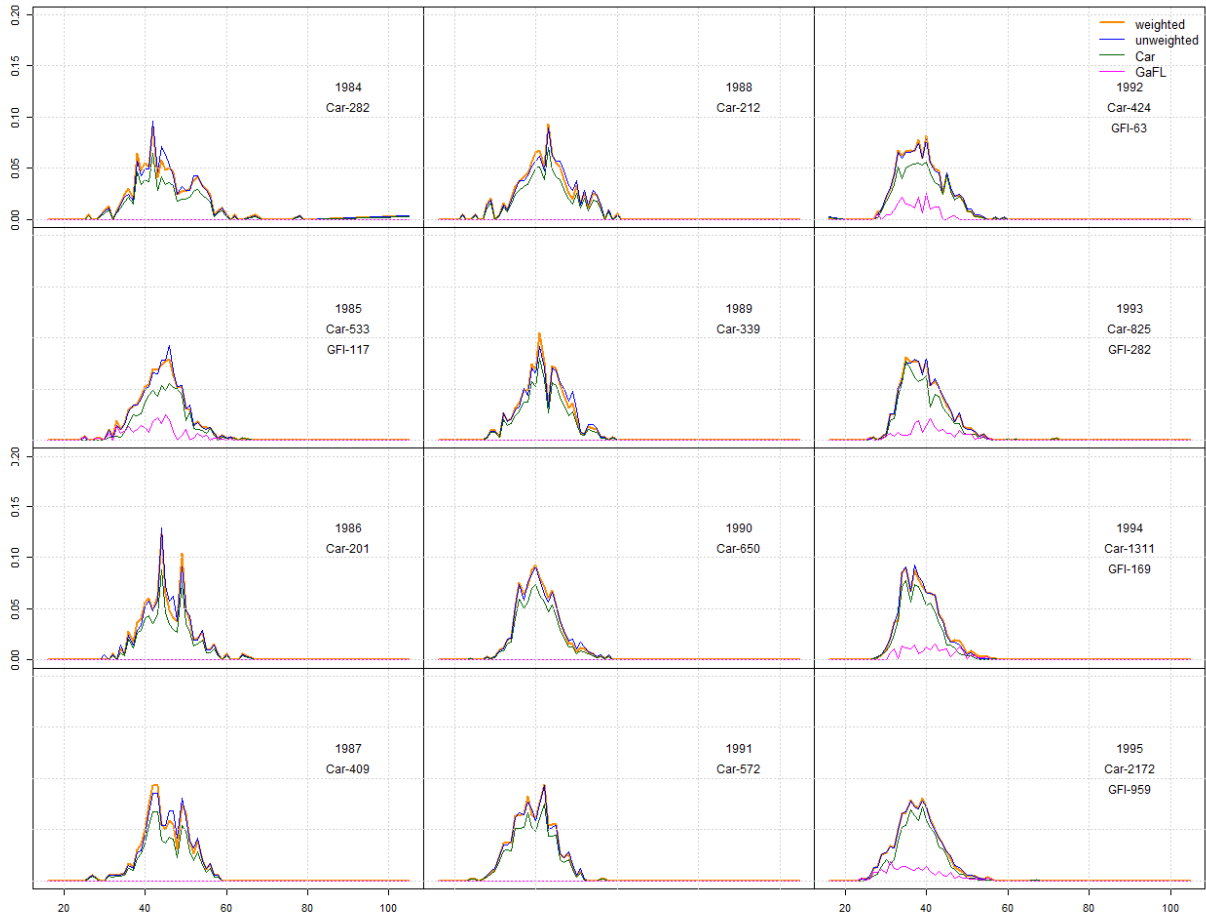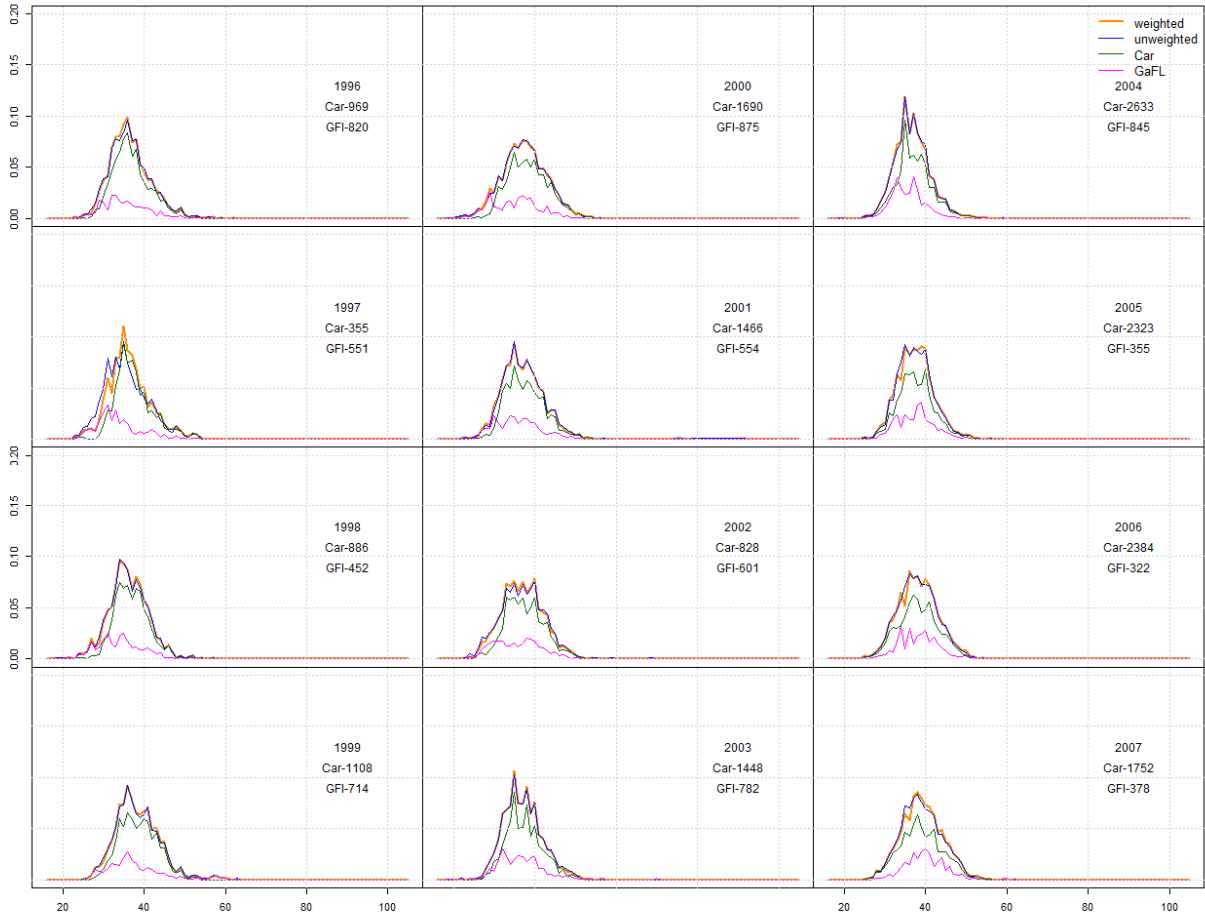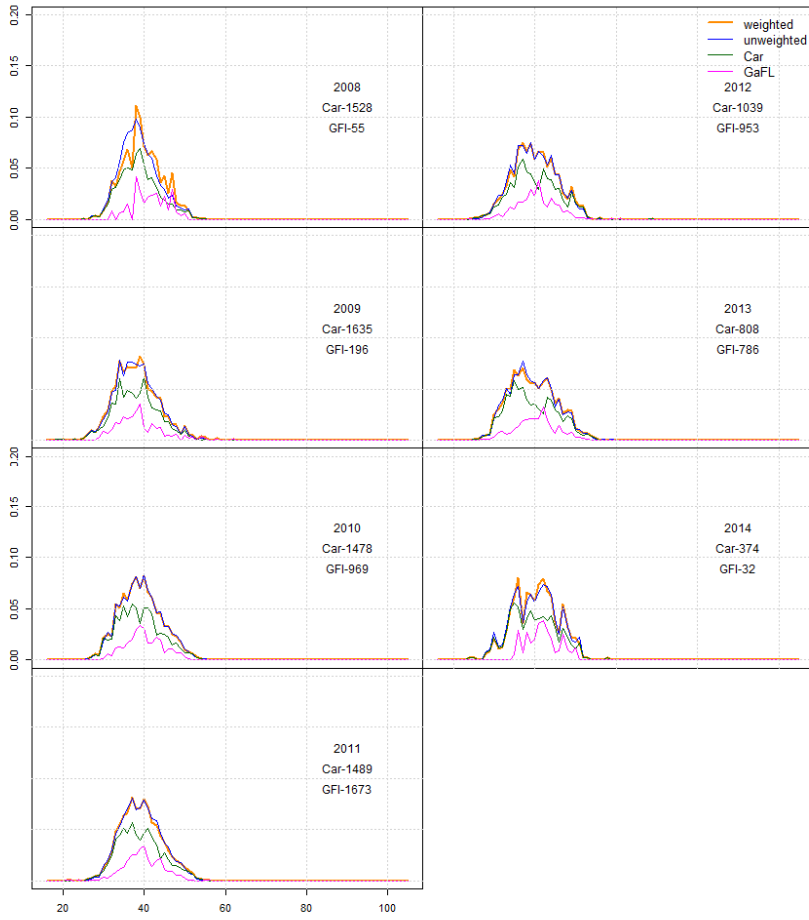
Figure 2 Continued.

Figure 2 Continued.

Figure 3. Unpooled nominal and weighted coastwide age compositions of gray triggerfish. Region-specific sample sizes are provided for each year.