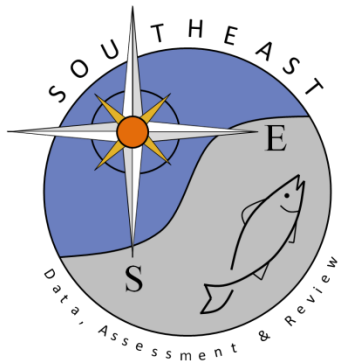General recreational and commercial age and length composition weighting for Southeast U.S. Spanish mackerel (Scomberomorus maculatus)

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General recreational and commercial age and length composition weighting for Southeast U.S. Spanish mackerel (*Scomberomorus maculatus*)

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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.

Lengths

Commercial

The number of commercial length samples by gear are in Table 1.

All Spanish mackerel lengths were converted to FL in mm using the formula provided by the SEDAR 28 Life History Group and binned into one-centimeter intervals. The length data and landings data were initially grouped into five categories; 1) handlines, 2) cast nets, 3) gillnets, 4) pound nets, and other (defined as longline, sink net, seine net, trammel net and trawl net).

Due to limited spatial samples for the age compositions the gillnet gear was the only fleet that had sufficient samples to develop weighted compositions.

Recreational

Headboat Survey Biological Sampling
Lengths were collected from 1972 to 2020 by headboat dockside samplers. 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. 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.

Lengths were excluded in the SEDAR 28 assessment and due to limited spatial sampling for the age samples, the recreational lengths were not needed to weight the age compositions.

Ages

Commercial

The number of commercial Spanish mackerel otoliths sampled by gear and region are in Table 2.

Due to age limited spatial samples for the age compositions the gillnet gear was the only fleet that had sufficient samples to weight the length compositions. All other fleets (including the general recreational fleet) were provided as a nominal composition.

Recreational

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. Aging structures provided from the charter boat and private boat modes were collected ad hoc by MRIP state subcontractors and SRHS port agents.

The number of recreational Spanish mackerel otoliths sampled by region are in Table 3.

Weighting methods

The finest scale to weight the SEFSC-TIP length data was by year and state for each of the gear groupings (gillnet). 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 and age compositions was 30 fish per area and 10 trips per area.

Results

Lengths
The weighted length composition for the gillnet fishery was very similar to the nominal composition for most years (Figure 1).

Ages

Commercial
The weighted age compositions are very similar to the nominal age compositions for the gillnet fishery (Figure 2). The nominal age compositions for the remaining fleets are in Figures 3-5.

General Recreational

Due to limited spatial samples the nominal age composition for the recreational fleet are in Figure 6.

Discussion

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

Tables

Table 1. Number of fish sampled for lengths of Spanish mackerel by year and gear for the commercial fleets (gillnet, handline, etc.).

Sum of QUANTITY Row Lab	CAST NET	GILL NET	HAND LINE	OTHER	POUND NET	Grand Total
1980				2	9	11
1982		15		7	259	281
1983				4	42	46
1984		68	11	336	56	471
1985		1266	7	736	296	2305
1986		1083	20	74	181	1358
1987		1747	49	46	557	2399
1988		2553		285	666	3504
1989		1171	2	249	2347	3769
1990		4396	33	915	2807	8151
1991		7058	57	633	4553	12301
1992		7506	104	650	4564	12824
1993		10972	194	615	1619	13400
1994	2	5977	243	197	2782	9201
1995		4587	156	87	2726	7556
1996	3	3942	238	268	2404	6855
1997	50	1987	162	767	2081	5047
1998	4	6487	690	154	1472	8807
1999	1	5877	3075	334	1494	10781
2000	2141	5798	2192	356	874	11361
2001	3297	1577	2139	340	1057	8410
2002	2897	1134	5440	204	2293	11968
2003	2660	1206	937	68	994	5865
2004	2344	1695	666	31	739	5475
2005	2641	2588	667	107	1467	7470
2006	3031	3210	1247	208	1268	8964
2007	5337	3868	3831	839	882	14757
2008	1191	3691	2246	862	860	8850
2009	446	4540	4085	404	2073	11548
2010	2291	6311	1628	251	1352	11833
2011	1252	6270	1609	730	2343	12204
2012	1189	7011	2925	72	1279	12476
2013	799	5144	3760	272	548	10523
2014	942	6669	2681	7	700	10999
2015	438	8188	1435	95	738	10894
2016	672	10074	3627	4	614	14991
2017	1150	7141	2067	8	797	11163
2018	1611	6459	2550	254	1081	11955
2019	660	6029	1322	95	3222	11328
2020	548	4911	1893	53	1272	8677
2021		12	7	42	174	235
Grand Total	**37597**	**170218**	**53995**	**11661**	**57542**	**331013**

Table 2. Number of fish sampled for ages of Spanish mackerel by year, region and gear for the commercial fleets (gillnets, handline, etc.).

Count of CALENDAR_A Row Labels	CN	CN Total	GN				GN Total	HL						HL Total	PN		PN Total	Grand Total
	EF		EF	NC	SF	VA		EF	NC	SC	SEF	SF	VA		NC	VA		
1990				80			80	41						41	6		6	127
1991			49	126			175											175
1992			51	139			190	34	16	31				81	28		28	299
1993			106	44			150											150
1994				10			10	6						6				16
1995			138	29			167	25						25	20		20	212
1996			414	3			417	35						35				452
1997	34	34	212	34			246	34						34	4		4	318
1998			300	63			363	31						31	50		50	444
1999			339	108			447	120						120	23		23	590
2000	3	3	318	270			588	147						147				738
2001	110	110	149	166			315	55	187					242	60		60	727
2002			281	55		29	365	61						61		773	773	1199
2003			311	2		52	365									329	329	694
2004			502	22		27	551	1				1		2	2	398	400	953
2005	147	147	249	1		6	256	5	8					13		341	341	757
2006	211	211	280		75	3	358									286	286	855
2007	50	50	145	68		21	234	173			4			177		226	226	687
2008	265	265	221			67	288	185					2	187		110	110	850
2009	331	331	301			47	348	100	4				1	105		98	98	882
2010	139	139	203	66		18	287									187	187	613
2011	95	95	332	44		13	389	94						94		210	210	788
2012	309	309	152	56			208	54	4					58		166	166	741
2013	1	1	118	29		54	201	202	2		26	1		231		42	42	475
2014	30	30	117	33		53	203	180			34			214		172	172	619
2015	59	59	147	50		8	205	2	1					3		186	186	453
2016	29	29	209			19	228	86	3		1			90		175	175	522
2017	36	36	88	32		16	136	82					2	84		193	193	449
2018	230	230				31	31	317	4				3	324		111	111	696
2019	123	123				30	30	330	5	10				345		134	134	632
2020	58	58	20			48	68	239				5		244		78	78	448
Grand Total	2260	2260	5752	1530	75	542	7899	2639	234	31	76	1	13	2994	193	4215	4408	17561

Table 3. Number of fish sampled for ages of Spanish mackerel by year, region and gear for the general recreational fleet.

Year	Carolinas	Georgia/Florida
1990	262	0
1991	121	221
1992	204	36
1993	113	0
1994	171	0
1995	68	2
1996	77	1
1997	316	0
1998	222	0
1999	101	0
2000	130	0
2001	49	0
2002	162	43
2003	304	17
2004	231	10
2005	195	13
2006	228	4
2007	176	1
2008	203	1
2009	41	2
2010	294	1
2011	347	1
2012	483	6
2013	320	8
2014	464	30
2015	344	14
2016	520	5
2017	315	16
2018	366	26
2019	365	36
2020	240	10

Figures
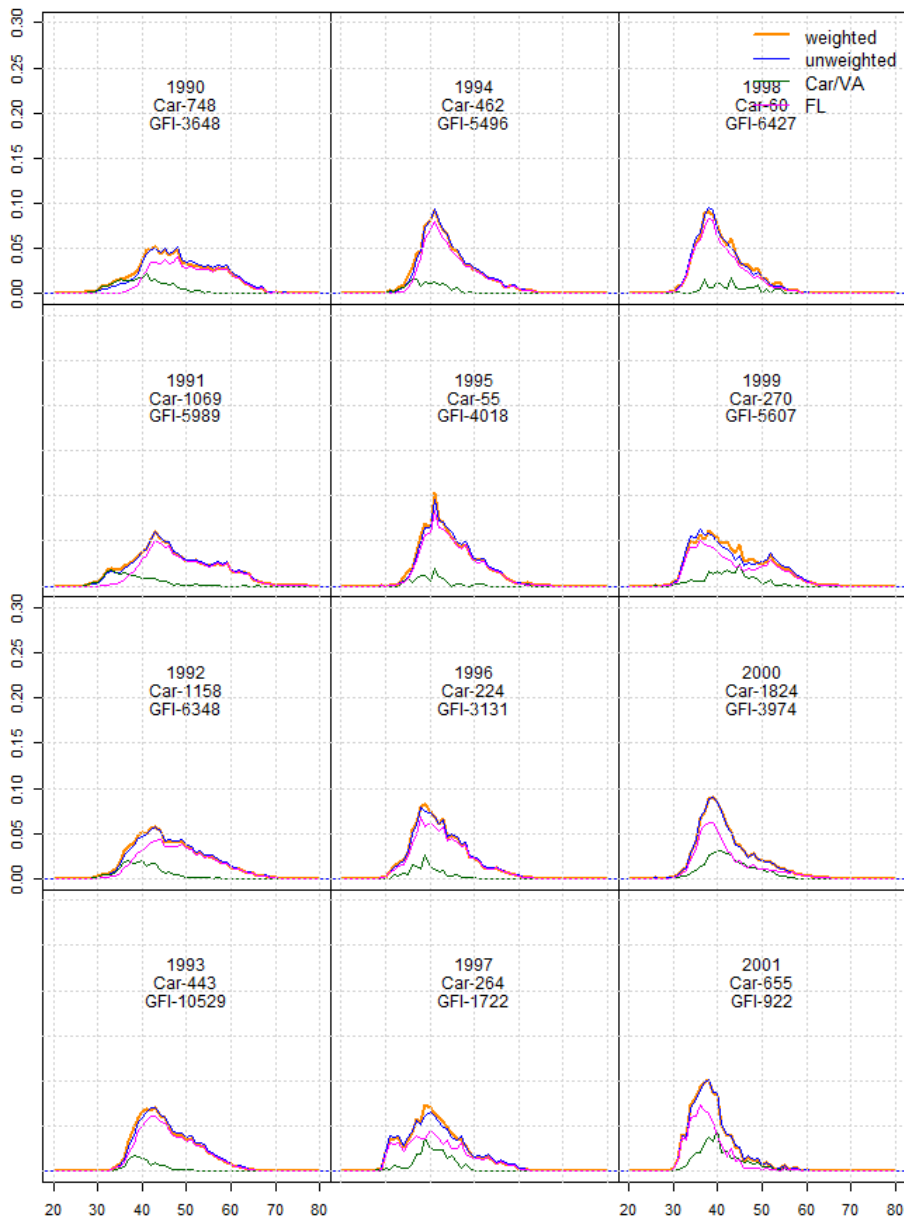
Figure 1. Weighted and un-weighted Spanish mackerel length composition for gillnet fleet by region and by year.
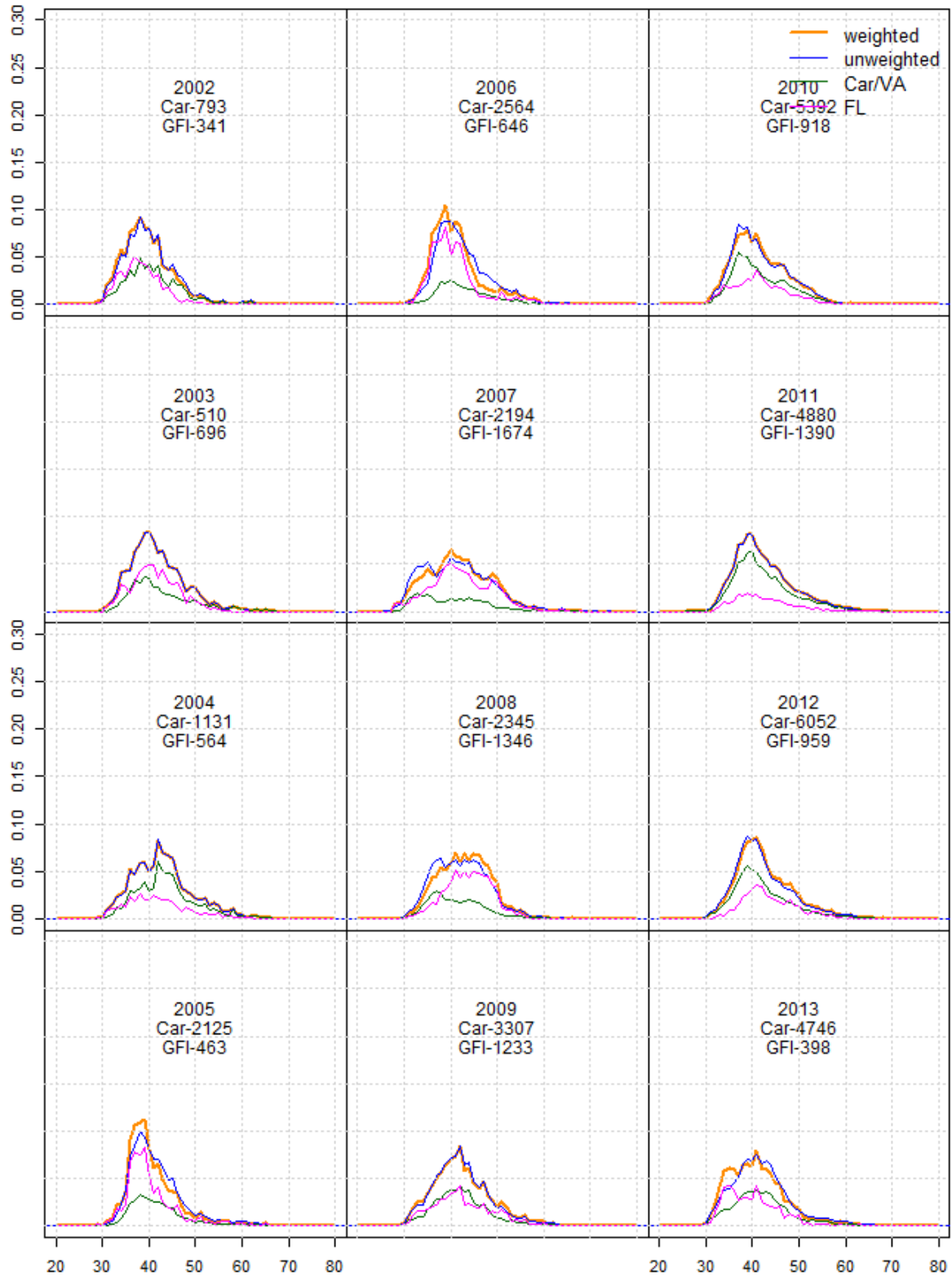
Figure 1 (continued).
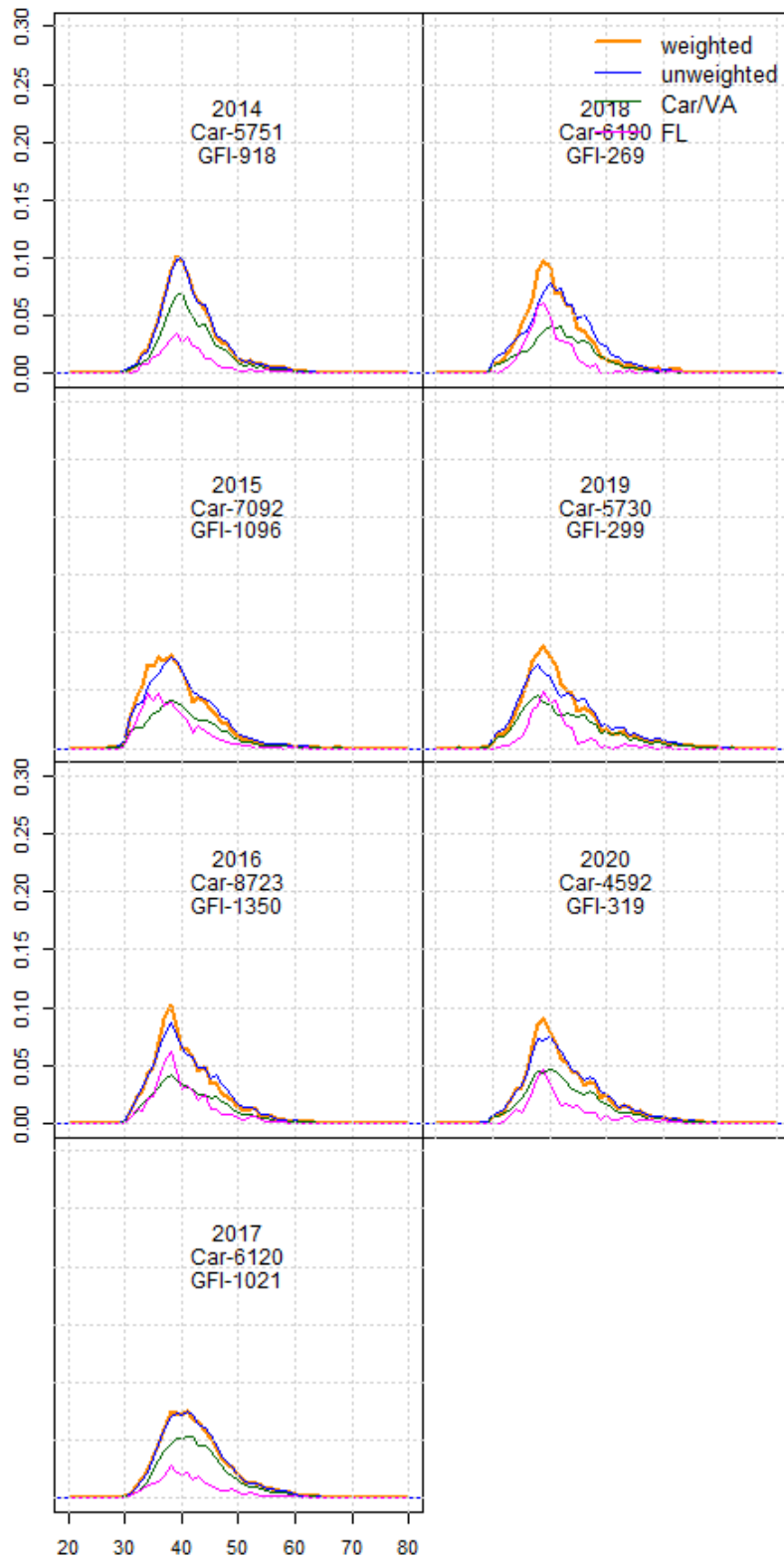
Figure 1 (continued).
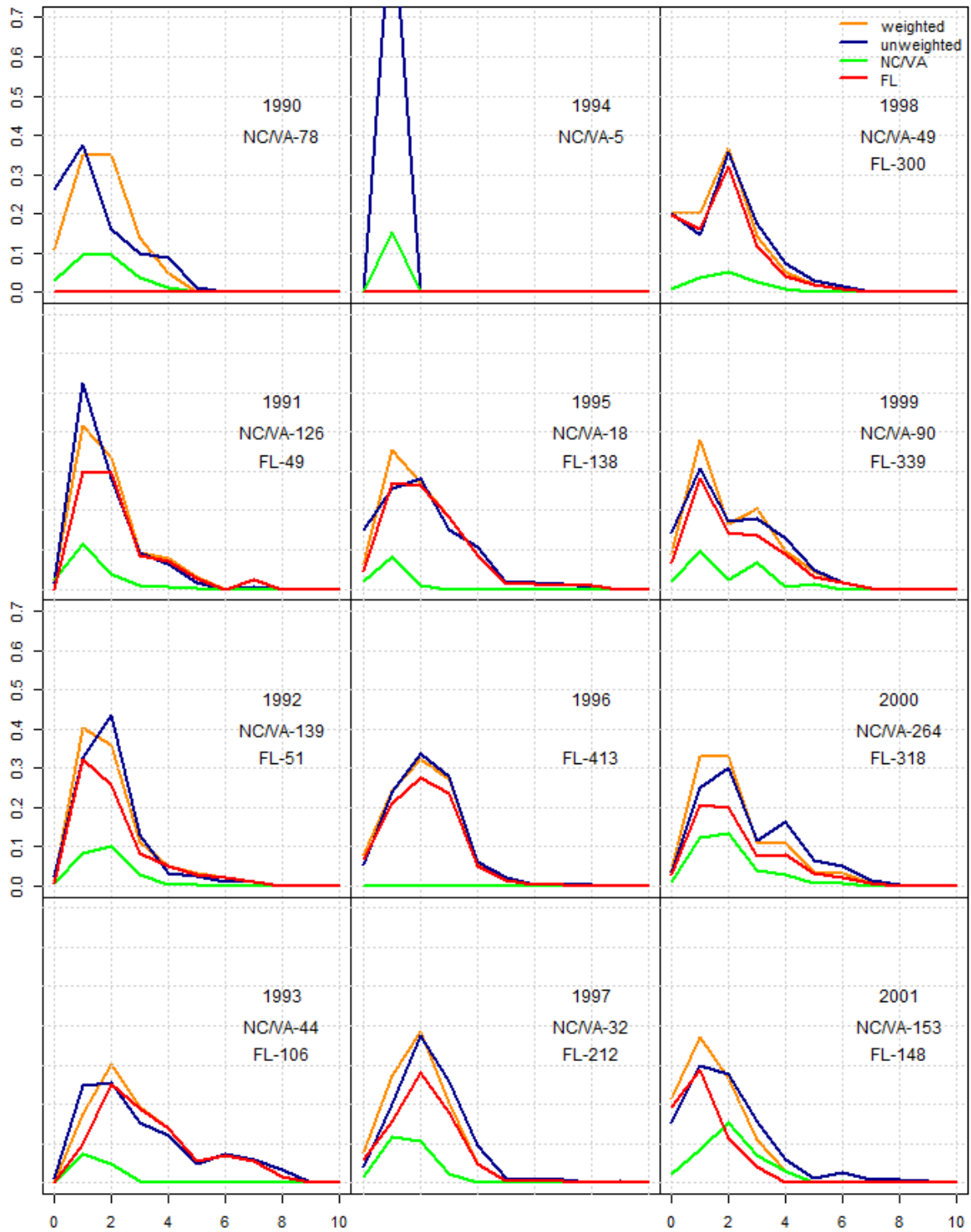
Figure 2. Weighted and un-weighted Spanish mackerel age composition for gillnet feet by region and by year.
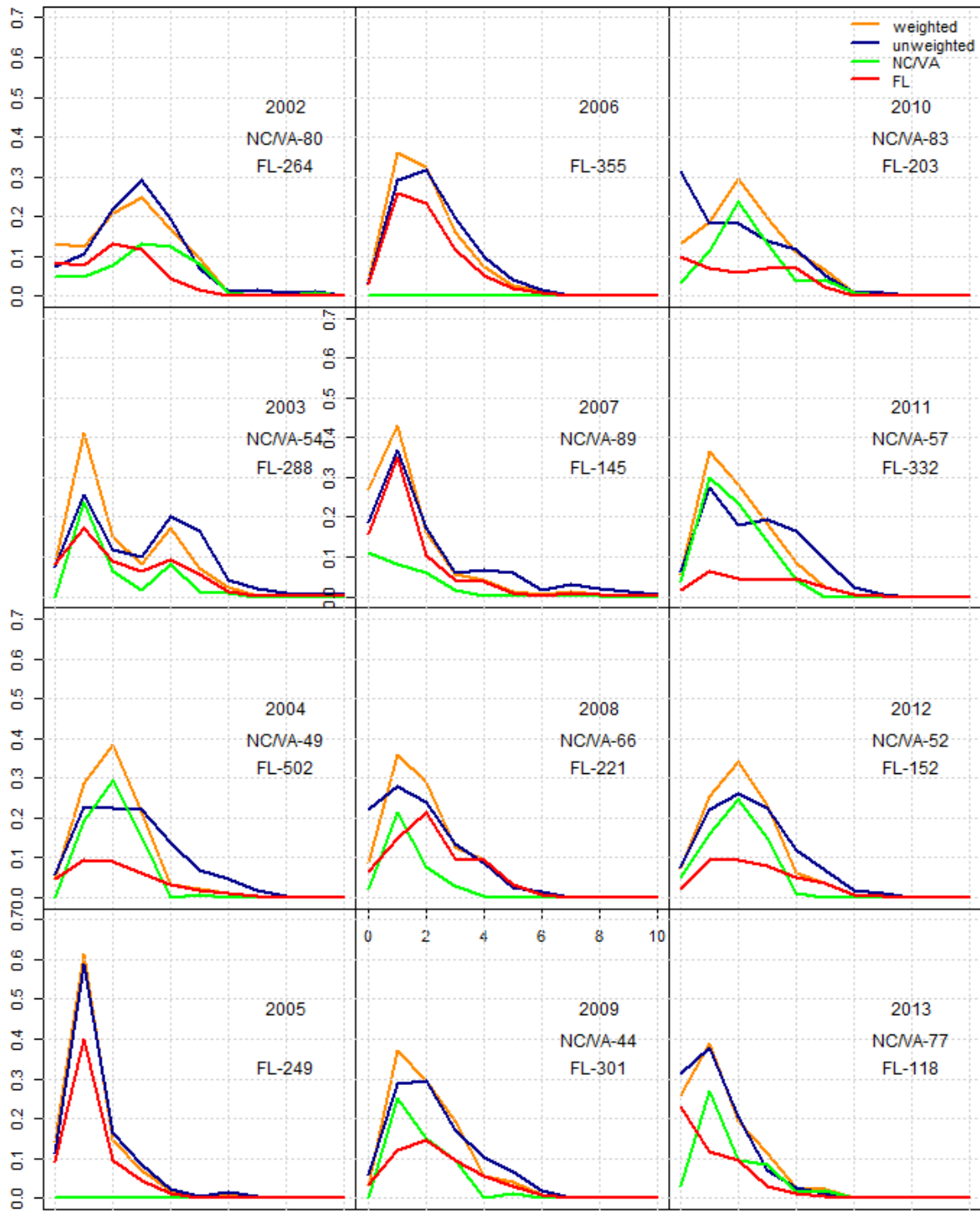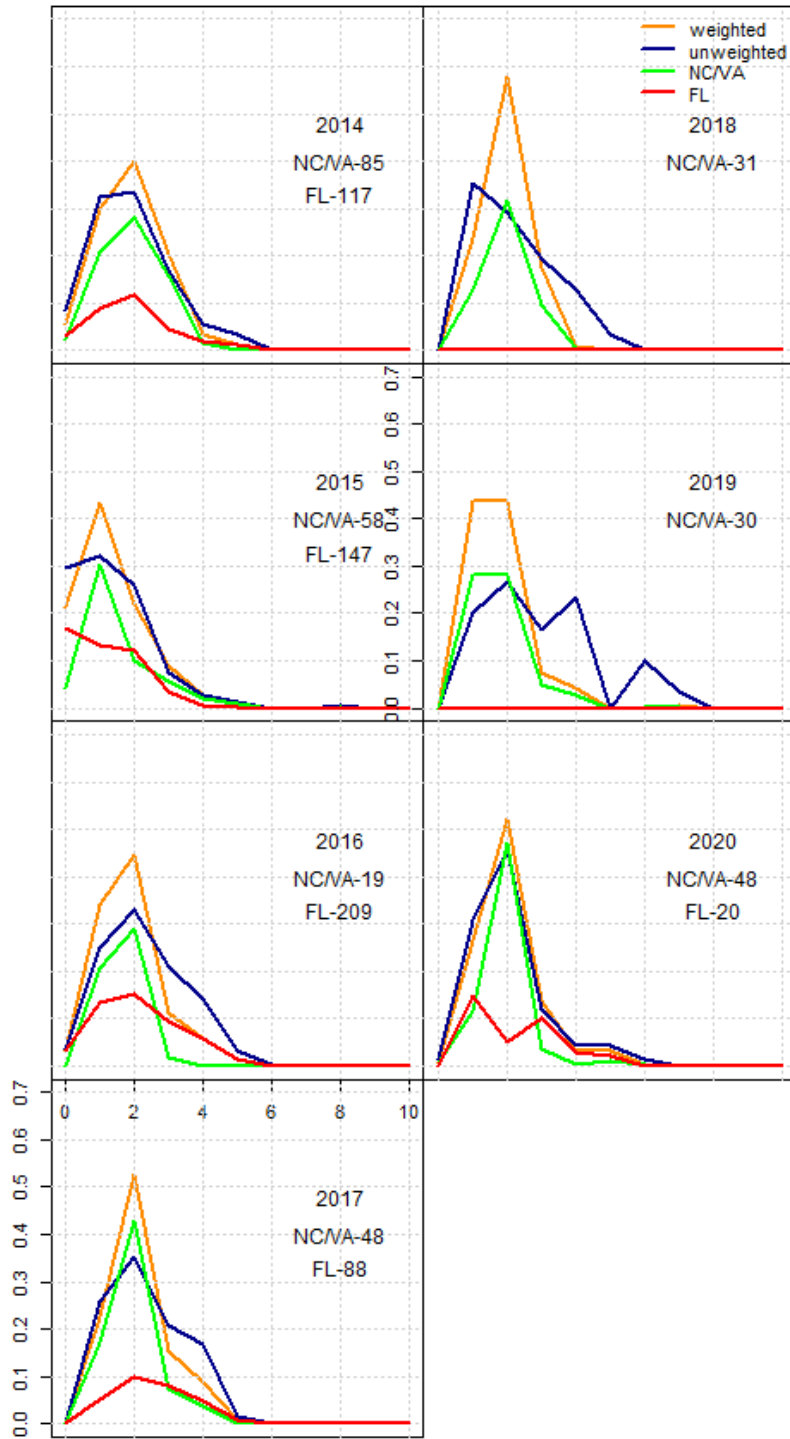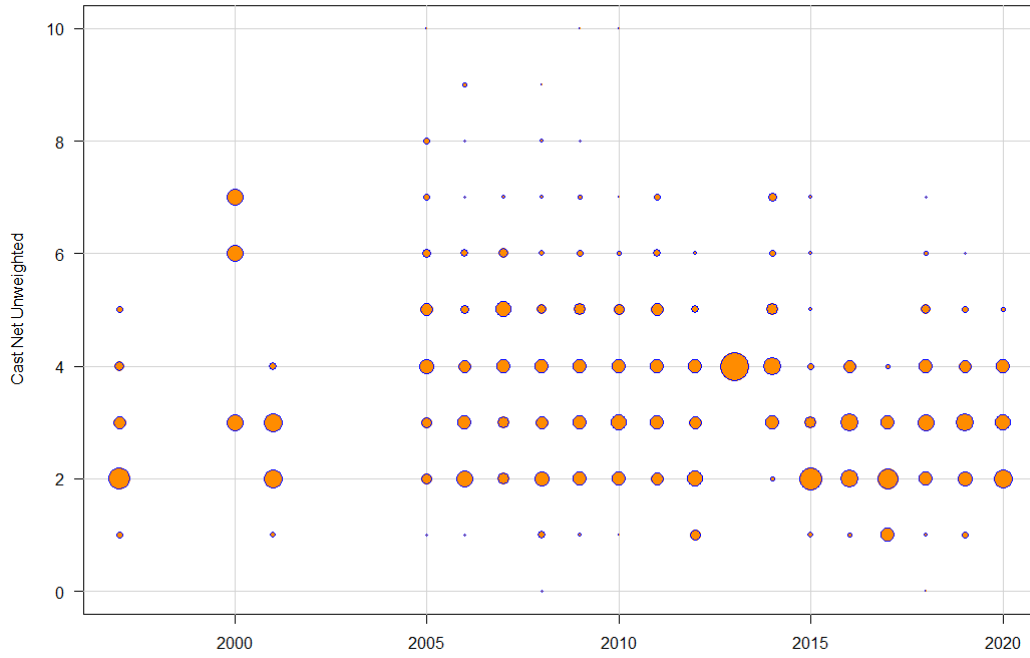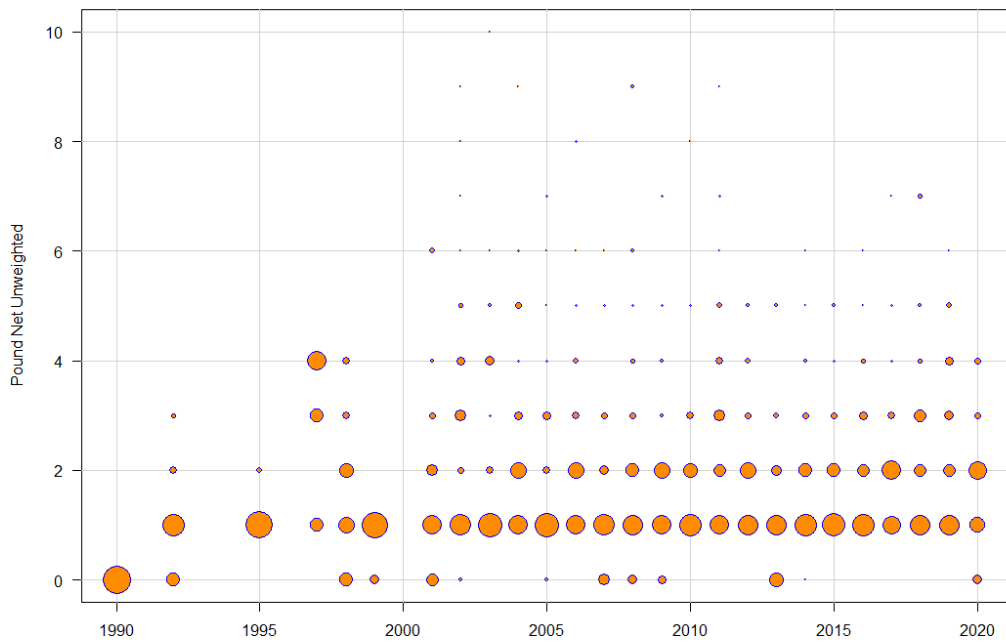
Figure 2 (continued).

Figure 2 (continued).

Figure 3. Nominal Spanish mackerel age composition for cast net fleet.

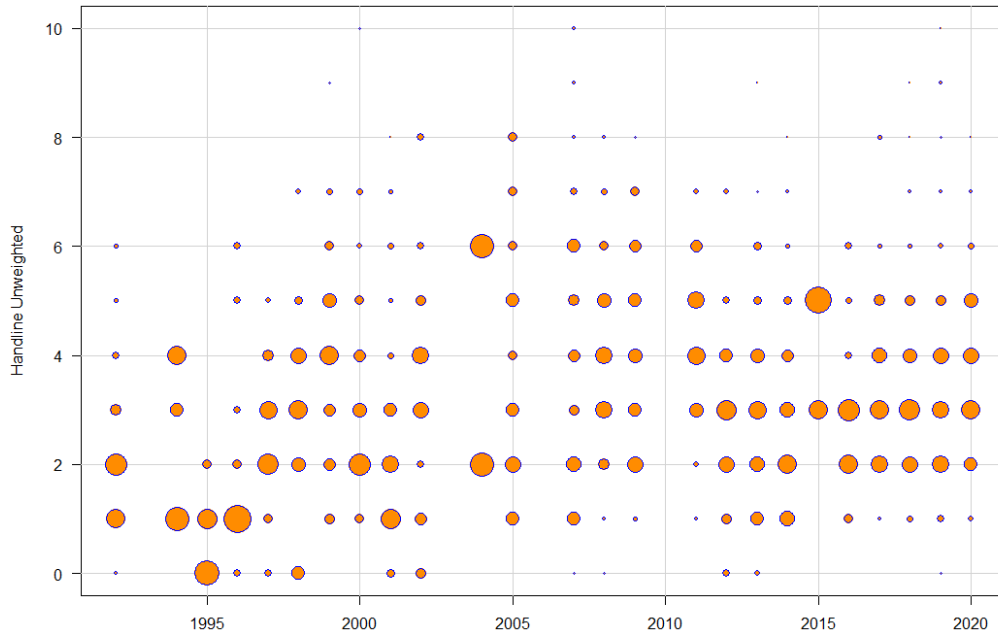Figure 4. Nominal Spanish mackerel age composition for pound net fleet.

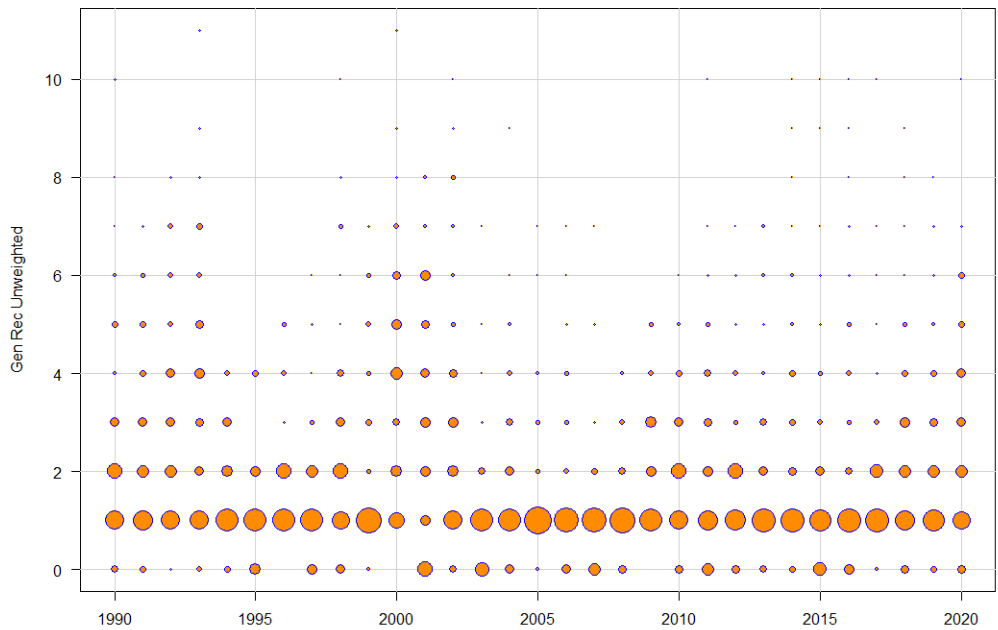Figure 5. Nominal Spanish mackerel age composition for handline fleet.

Figure 6. Nominal Spanish mackerel age composition for general recreational fleet.