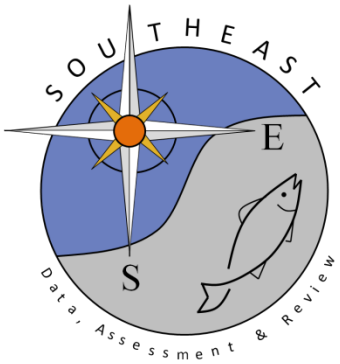
Commercial age and length compositions for U.S. vermilion snapper, *Rhomboplites aurorubens*

Sustainable Fisheries Branch – NMFS (contact: Eric Fitzpatrick)

SEDAR55-WP06

Submitted: 13 November 2017
Addendum added: 19 January 2018

****ADDENDUM ADDED TO REFLECT CHANGES MADE DURING THE ASSESSMENT PROCESS. THE FINAL COMMERCIAL LENGTH AND AGE COMPOSITIONS ARE FOUND IN THE ADDENDUM (PDF PAGE 18).****



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Commercial age and length compositions for U.S. vermilion snapper (*Rhomboplites aurorubens*)

Sustainable Fisheries Branch, National Marine Fisheries Service, Southeast Fisheries Science Center, 101 Pivers Island Rd., Beaufort, NC 28516

13-November-2017

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 4,930 for handline gear in 2007 and 445 for miscellaneous gear (traps, spears, trolling lines and trawls) in 2014 (Table 1). The number of fish sampled by state relative to estimated landings was less than 1% in most years and states.

All vermilion snapper lengths were converted to FL in mm using the formula provided by the SEDAR 17 Life History Group and binned into one centimeter intervals (e.g. 25cm interval = 24.5cm to 25.4cm). The length data and landings data were grouped into two categories; 1) handlines and 2) other Miscellaneous or ‘other’.

Commercial Ages

Very few age samples were collected from 'other' gear between 1997 and 2016. Age samples of vermilion snapper from handline occurred between 1992 and 2016. The number of commercial trips sampled for vermilion snapper 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 and other). 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.

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 unweighted length compositions for the 'other' fisheries are in Figure 2.

Ages

Commercial

The weighted age compositions are very similar to the nominal age compositions for handline age compositions (Figure 3).

Discussion

There is minimal influence when weighting the commercial length or age composition for vermilion snapper. 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 age 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 12 years of age.

Tables

Table 1. Number of fish sampled for lengths for vermilion snapper by year and gear for the commercial handline and other gears.

	Other				Handline			
Year	FL	GA	NC	SC	FL	GA	NC	SC
1983							391	
1984			35	200		1242	4762	1933
1985	11	23	36		625	1399	5229	2477
1986			4	653	43	1281	4950	1607
1987		366	168	284		741	4435	1936
1988			17	695	175	795	3206	1381
1989			5		19	362	3841	1398
1990	2		7	158	190		4341	1309
1991	61		208	872	317	905	6128	2034
1992	112		72	46	1304	819	2787	1021
1993	109		19	169	1367	716	4898	1007
1994	25		6	33	432	767	5367	857
1995	54	33	52	24	2294	4167	5531	942
1996				9	775	1402	2519	2012
1997	178				1162	866	1559	3092
1998	14				1799	233	1557	3072
1999	126		5	32	3201	1125	4008	3842
2000	312		1	3	4447	2115	7791	4560
2001	60				1965	4554	6969	4516
2002	389		22		859	3377	4538	3378
2003	272		25		891	3606	4126	3169
2004	32			3	49	5837	5334	2190
2005	15		11		210	1242	5250	1973
2006	23		6	41	1022	1524	7424	1005
2007	176		9	4	1034	85	4613	1309
2008	140		38	6	290		3228	2192
2009	240		2	30	99		2208	2505
2010	1804		10	9	164		1963	1956
2011	2527			42	71		2890	1806
2012	2134				59		2108	2006
2013	2394		1	11	182	90	1416	1495
2014	2766		23		909		1662	758
2015	1937		18	36	560		1922	830
2016	1827		34	41	402		1094	926

Table 2. Number of trips sampled and number of fish sampled (number of fish in parentheses) for age and for vermilion snapper by year and gear by state for the commercial gears.

	Hook and Line			Horizontal Longline	Spear		Trap			Trolling Lines	Trawl	Unknown	Vertical Longline
Year	FL	NC	SC	FL	NC	SC	FL	NC	SC	NC	FL	FL	SC
1992	8 (2)											1 (1)	
1993	52 (3)	68 (6)										21 (2)	
1994	92 (8)	20 (5)	23 (5)									26 (2)	
1995	263 (18)	50 (4)											
1996													
1997	43 (11)												
1998	100 (15)												
1999	122 (14)												
2000	179 (16)												
2001	222 (11)												
2002	116 (9)												
2003	99 (10)	34 (4)											
2004	17 (2)	296 (51)		1 (1)									
2005	63 (6)	492 (52)	209 (29)										
2006	9 (2)	1940 (140)	825 (126)			3 (2)			4 (2)				
2007	40 (7)	3838 (275)	1052 (163)			10 (1)		5 (3)	5 (2)				
2008	40 (2)	3067 (264)	542 (116)			4 (1)		30 (8)	6 (2)				
2009	120 (10)	1962 (196)	233 (83)			14 (3)		2 (1)	()	6 (1)			
2010	285 (12)	1867 (136)	1617 (103)		9 (1)	3 (2)			6 (2)	6 (1)			
2011	152 (9)	2812 (192)	1775 (89)						1 (1)				
2012	172 (9)	2044 (137)	1769 (120)				9 (1)						
2013	424 (19)	1321 (93)	1414 (111)			3 (1)		1 (1)					
2014	625 (25)	1596 (101)	708 (71)			11 (1)		1 (1)					
2015	572 (27)	1548 (117)	787 (69)		5 (1)				7 (1)		18 (1)		
2016	415 (21)	1824 (113)	844 (77)			16 (2)							12 (1)

Table 3. Weighted age composition for commercial handline vermilion snapper with older ages pooled to the 12-plus bin.

year	n.fish	n.trips	1	2	3	4	5	6	7	8	9	10	11	12
1993	120	9	0.000	0.024	0.251	0.261	0.132	0.113	0.148	0.058	0.010	0.000	0.001	0.000
1994	135	18	0.000	0.000	0.036	0.174	0.141	0.164	0.216	0.177	0.085	0.006	0.000	0.001
1995	313	22	0.000	0.005	0.154	0.254	0.346	0.112	0.063	0.047	0.013	0.002	0.001	0.002
1997	43	11	0.000	0.000	0.000	0.101	0.234	0.399	0.176	0.039	0.000	0.000	0.052	0.000
1998	100	15	0.000	0.086	0.149	0.276	0.149	0.159	0.145	0.018	0.000	0.000	0.017	0.000
1999	122	14	0.000	0.081	0.636	0.248	0.032	0.000	0.003	0.000	0.000	0.000	0.000	0.000
2000	179	16	0.000	0.043	0.256	0.349	0.157	0.110	0.030	0.013	0.043	0.000	0.000	0.000
2001	222	11	0.000	0.015	0.340	0.399	0.208	0.003	0.006	0.016	0.008	0.004	0.000	0.000
2002	116	9	0.000	0.017	0.174	0.586	0.143	0.024	0.026	0.018	0.012	0.000	0.000	0.000
2003	133	14	0.000	0.007	0.295	0.274	0.134	0.162	0.103	0.017	0.003	0.000	0.005	0.000
2004	313	53	0.000	0.028	0.462	0.319	0.062	0.052	0.046	0.023	0.006	0.003	0.000	0.000
2005	764	87	0.000	0.009	0.157	0.312	0.243	0.112	0.064	0.061	0.034	0.001	0.007	0.000
2006	2765	265	0.000	0.042	0.088	0.212	0.261	0.176	0.093	0.051	0.049	0.019	0.008	0.000
2007	4930	445	0.000	0.038	0.175	0.169	0.206	0.212	0.113	0.042	0.015	0.017	0.009	0.005
2008	3649	382	0.002	0.057	0.332	0.173	0.118	0.186	0.071	0.031	0.016	0.006	0.004	0.003
2009	2315	289	0.000	0.063	0.235	0.366	0.100	0.055	0.086	0.062	0.016	0.013	0.002	0.002
2010	3769	251	0.000	0.008	0.231	0.239	0.291	0.074	0.050	0.042	0.029	0.025	0.007	0.005
2011	4739	290	0.001	0.023	0.242	0.395	0.173	0.095	0.030	0.016	0.016	0.004	0.002	0.004
2012	3985	266	0.000	0.004	0.056	0.130	0.303	0.225	0.134	0.057	0.031	0.050	0.004	0.007
2013	3159	223	0.000	0.019	0.145	0.193	0.200	0.204	0.115	0.066	0.026	0.017	0.005	0.010
2014	2929	197	0.000	0.022	0.096	0.223	0.237	0.203	0.136	0.045	0.024	0.006	0.004	0.004
2015	2907	213	0.000	0.012	0.063	0.120	0.196	0.206	0.161	0.100	0.078	0.034	0.023	0.006
2016	3083	211	0.000	0.000	0.013	0.111	0.154	0.151	0.190	0.145	0.104	0.067	0.038	0.026

Figures

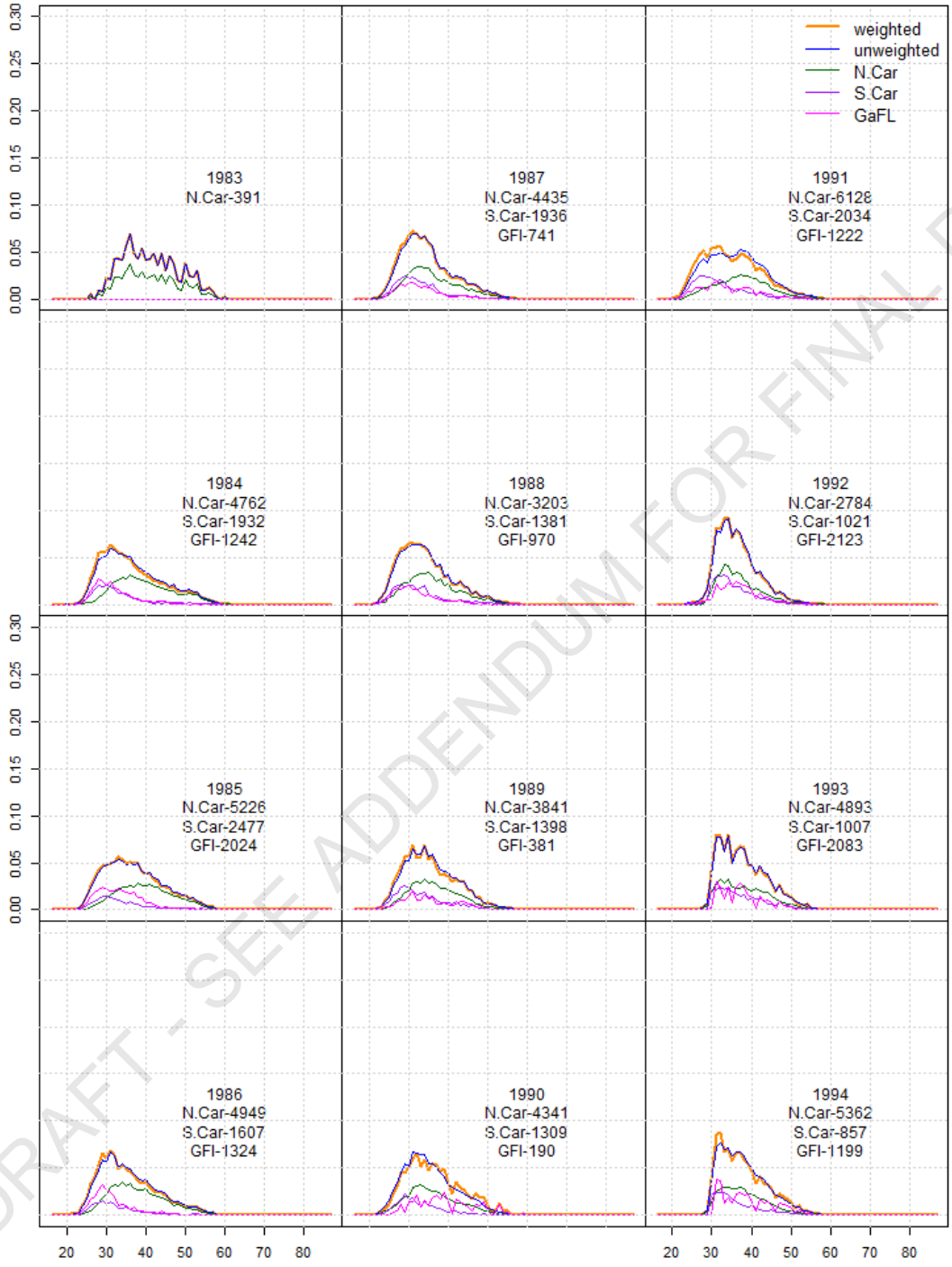


Figure 1. Weighted and un-weighted vermilion snapper length composition for handline gear by region by year.

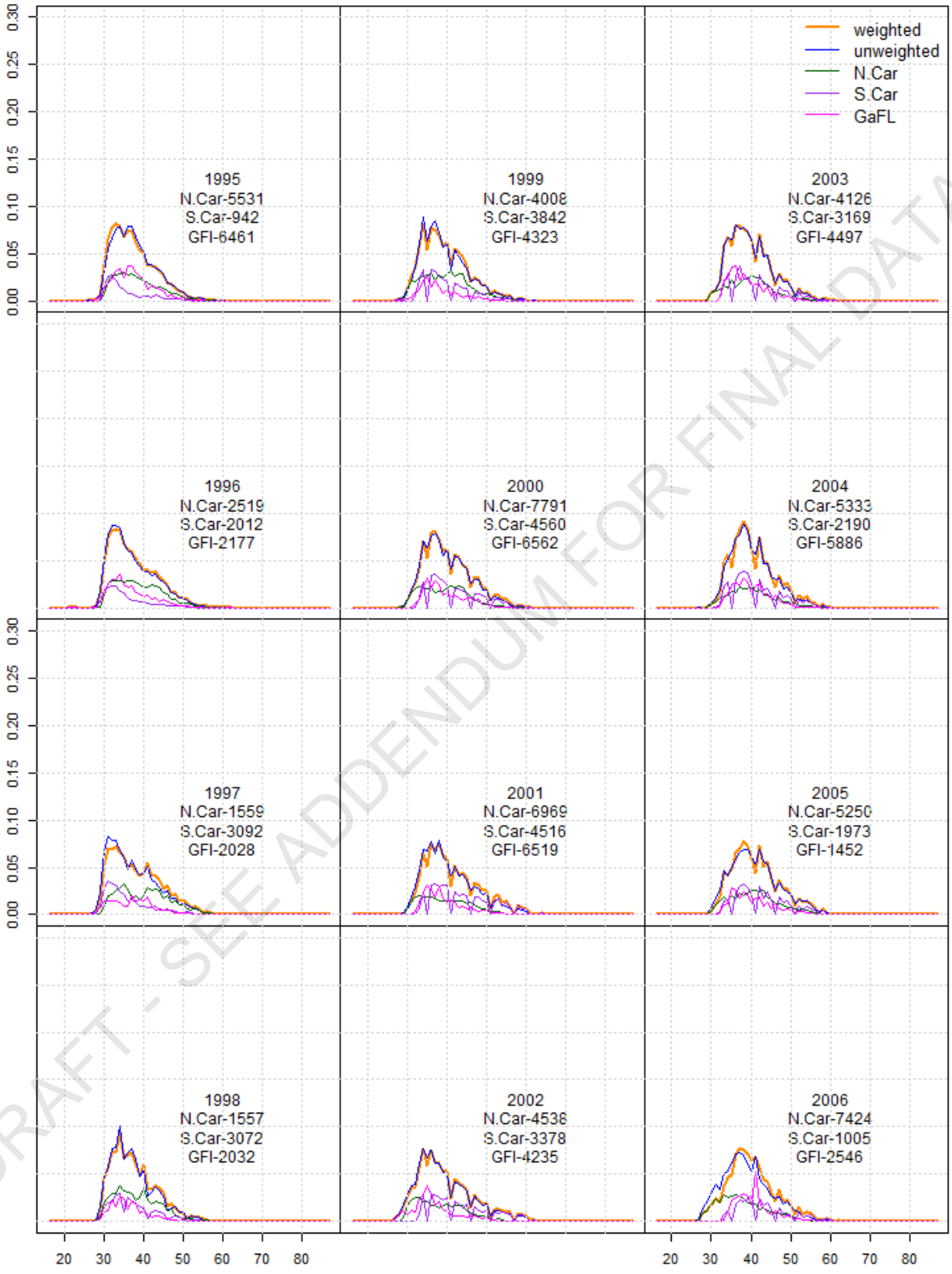


Figure 1 (continued).

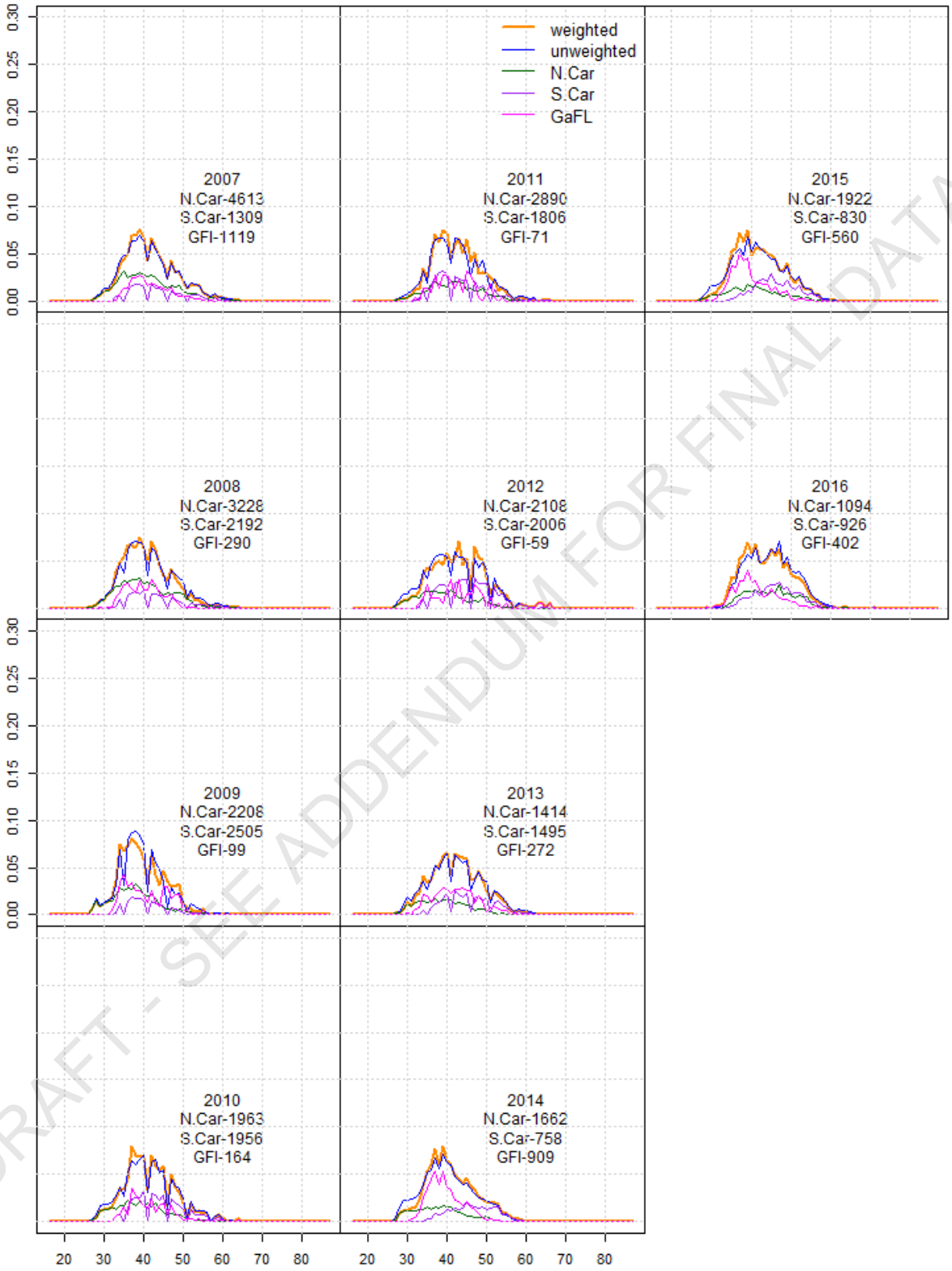


Figure 1 (continued).

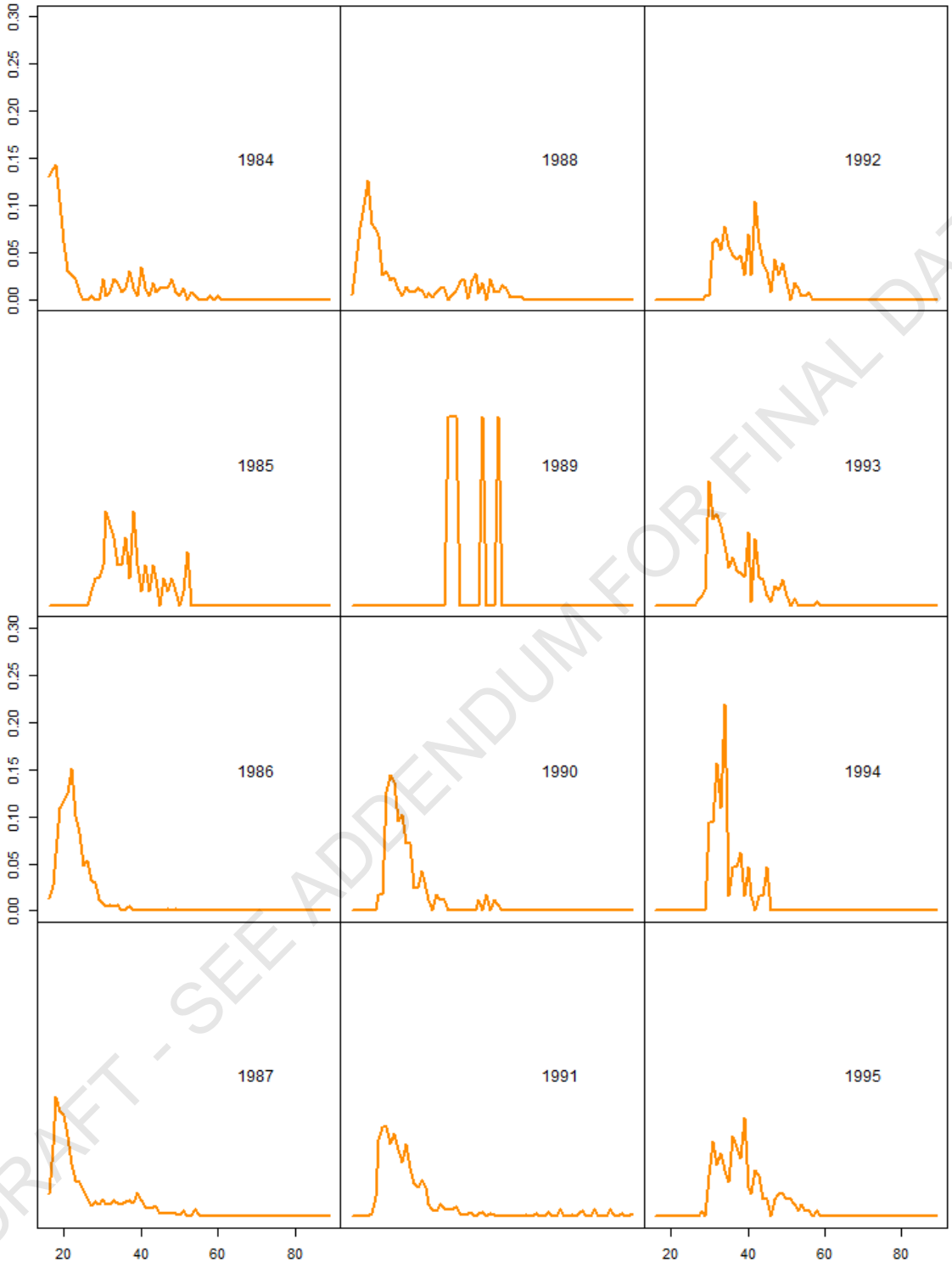
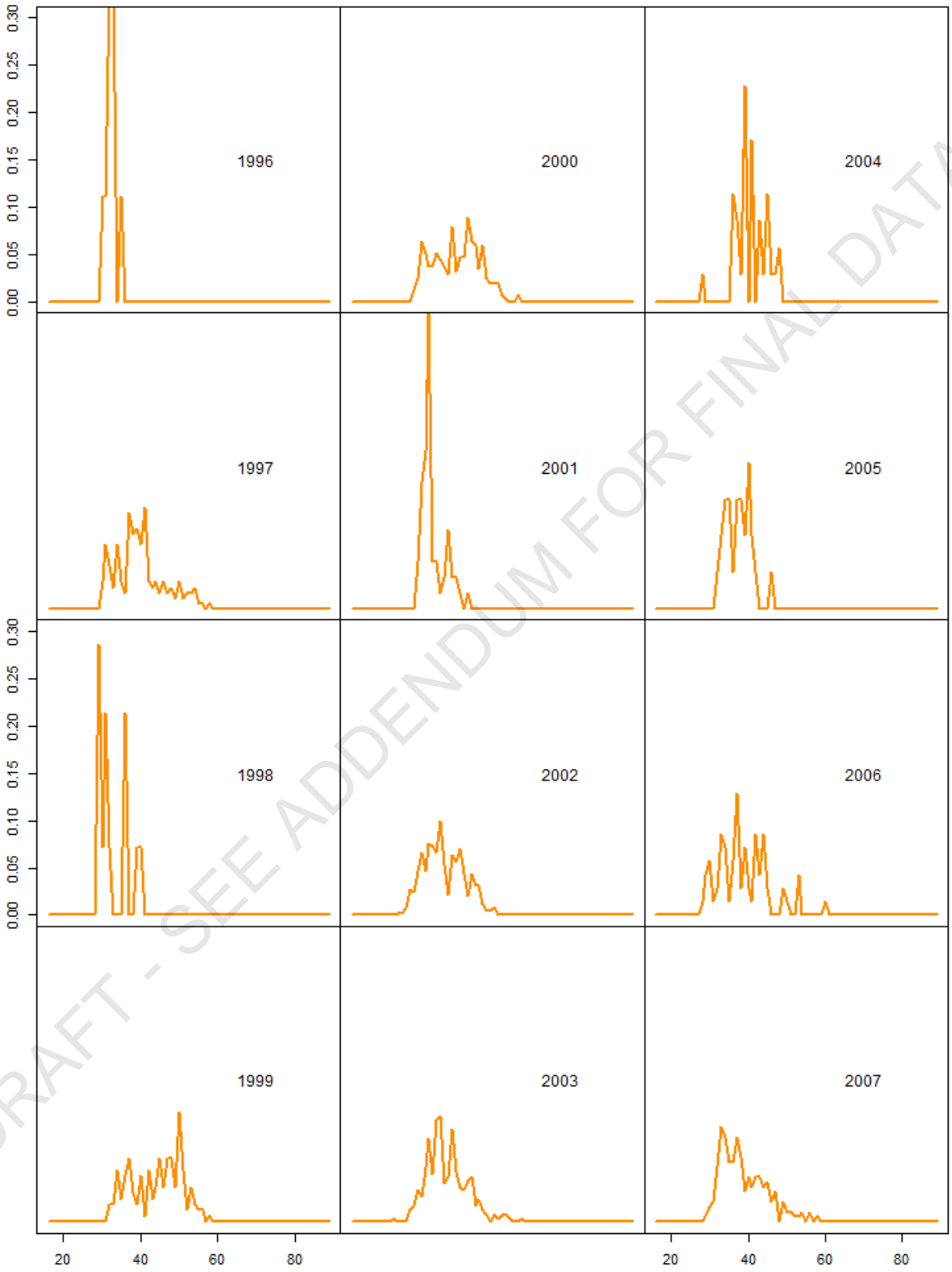


Figure 2. Un-weighted vermilion snapper length composition for 'other' gear by year.



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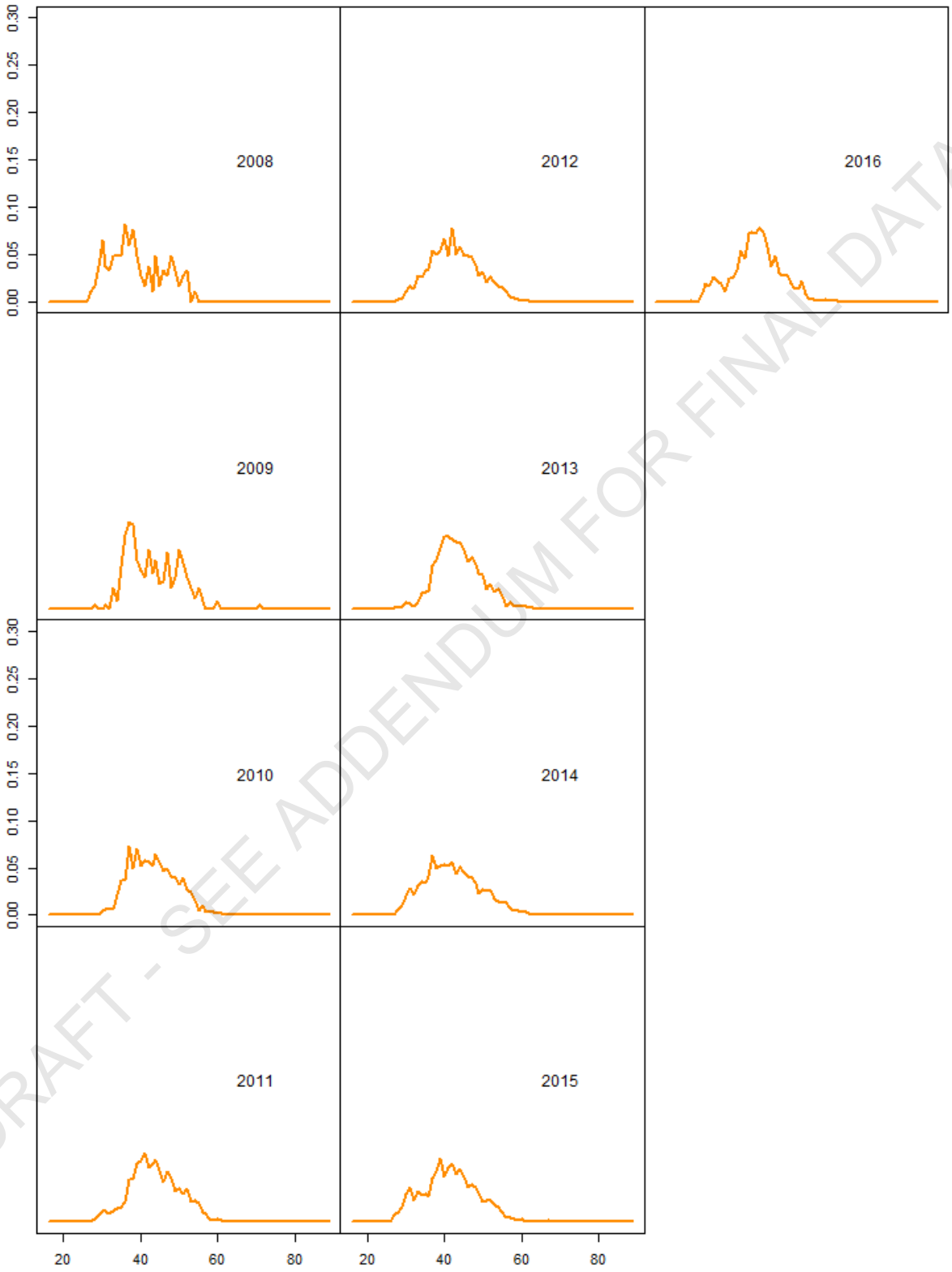

Figure 2 (continued).

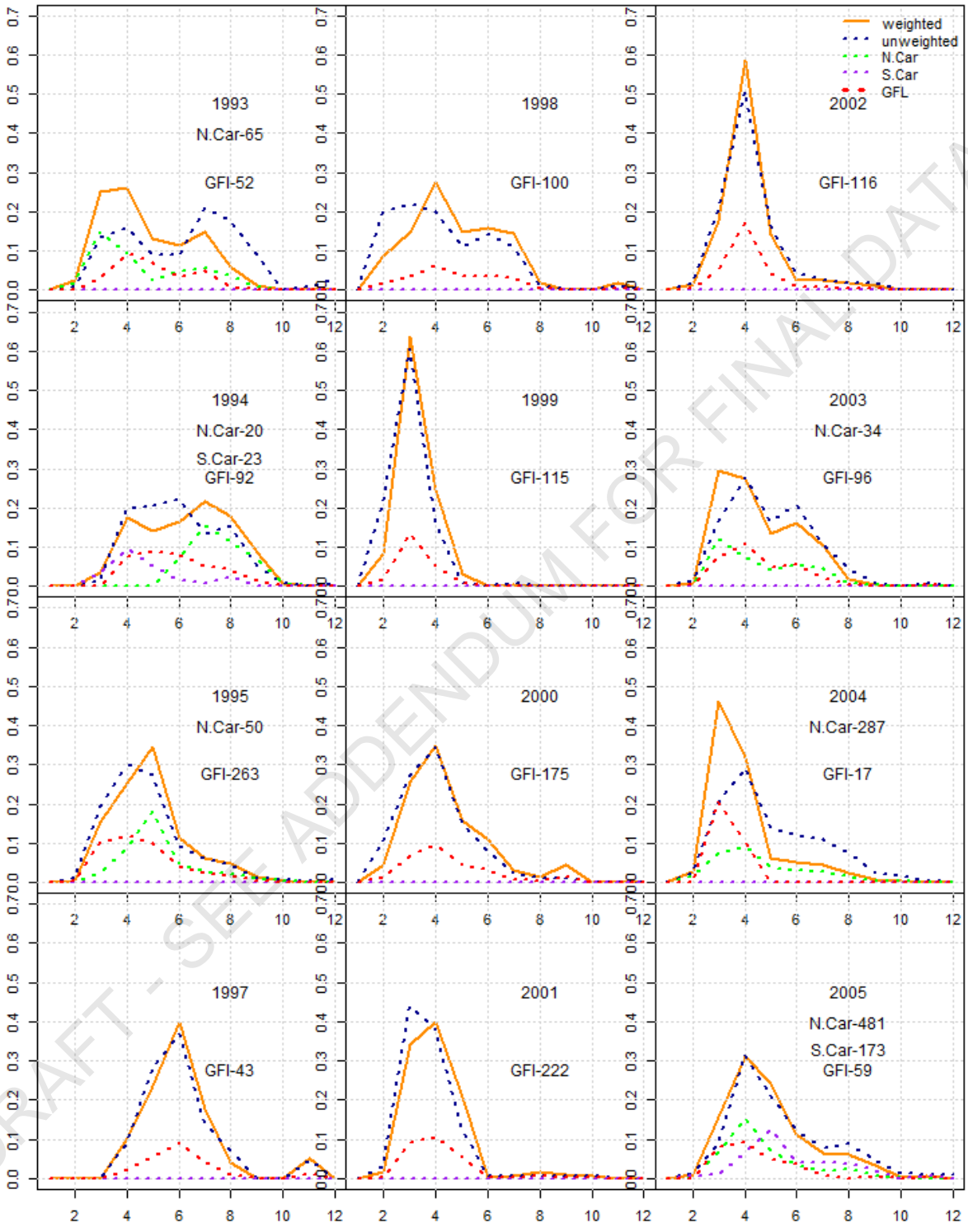

Figure 3. Weighted and un-weighted vermilion snapper age composition for handline gear by region by year.

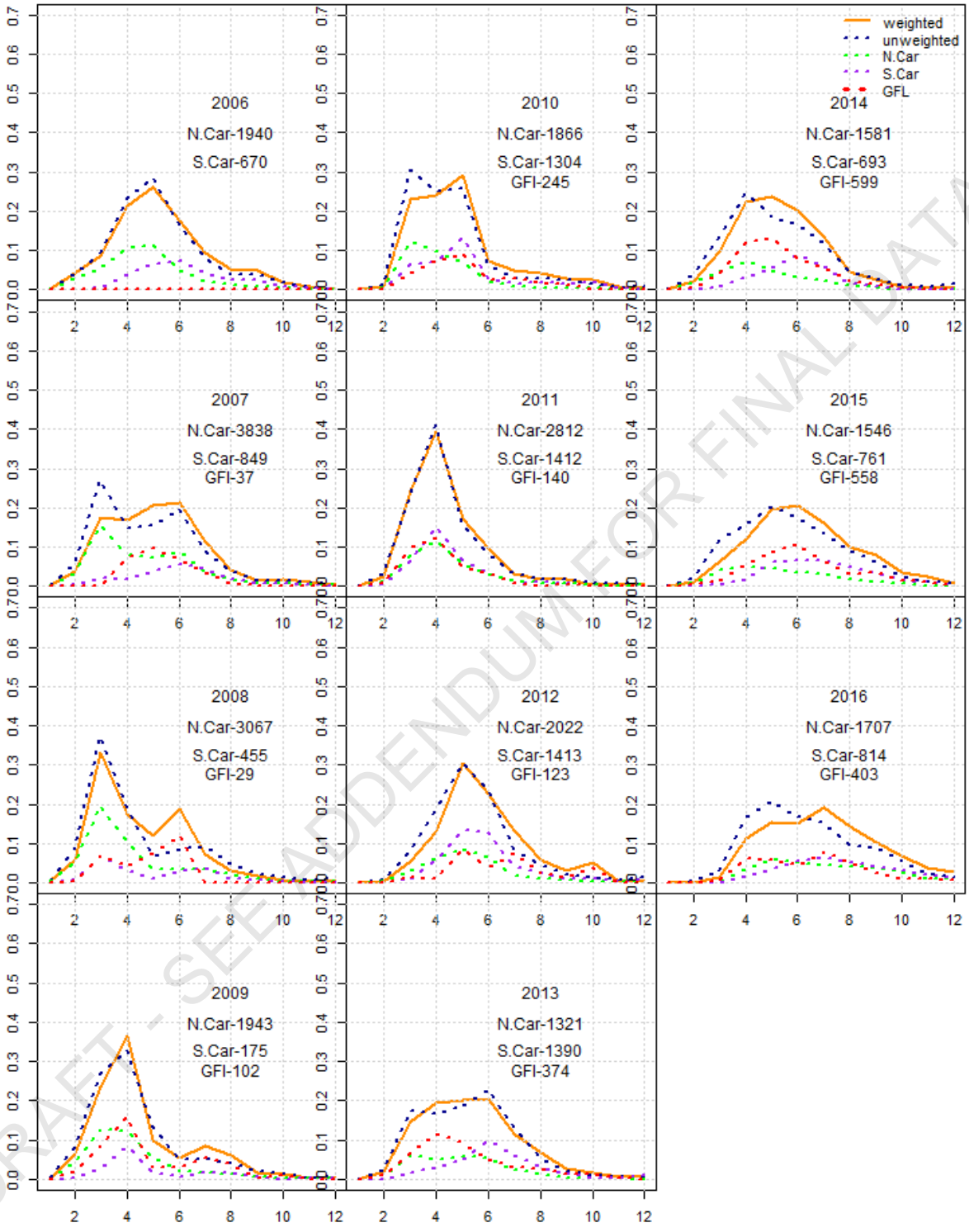

Figure 3. (continued).

ADDENDUM

Addendum added January 18, 2018 to reflect changes made during the assessment process. The final length and age compositions are found in the addendum.

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15-January-2018

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Very few age samples were collected from ‘other’ gear between 1997 and 2016. Age samples of vermilion snapper from handline occurred between 1992 and 2016. The number of commercial trips sampled for vermilion snapper ages can be found by year, gear, and state can be found in Table 2.

Weighting methods

Order of operations for weighting length and age compositions

- 2 files provided from TIP (lengths where trip catch is recorded, lengths removed for various reasons)
- Subset removed trips to just records that were removed because trip catch is not recorded
- Concatenate length record files (with and without trip-level catch)
- Convert to length unit
    - Total length and fork length are the same for BSB, 1 record had a max. total length and was dropped, there were no standard lengths
- Create 1cm bins
- Calculate mean weight from length data by year, gear, and region using length-weight conversion provided.
- Calculate average trip-level landings by year, gear, and region and convert to numbers
- Convert landings in pounds to landings in number for trip-level catch for each record
- Merge trip level landings in number
    - Actual when available, average by year, gear, and region when not available
- For each trip - multiply quantity in length bin * trip-level landings
- Pivot year*weight and then renormalize by region
- Multiply each regions annual landings fraction in number by the regional comps
- Sum across regions for final length comp
- Ages – use Chih method: proportion at length (measured fish)/ weight ages using proportion at length (aged fish)

Results

Commercial Lengths

The commercial handline length compositions were similar in size spatially for most years (Figure 1). The commercial other length compositions are in Figure 2.

Ages

Commercial

The weighted age compositions are very similar to the nominal age compositions for handline age compositions (Figure 3).

Discussion

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

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 12 years of age.

Tables

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	Other				Handline			
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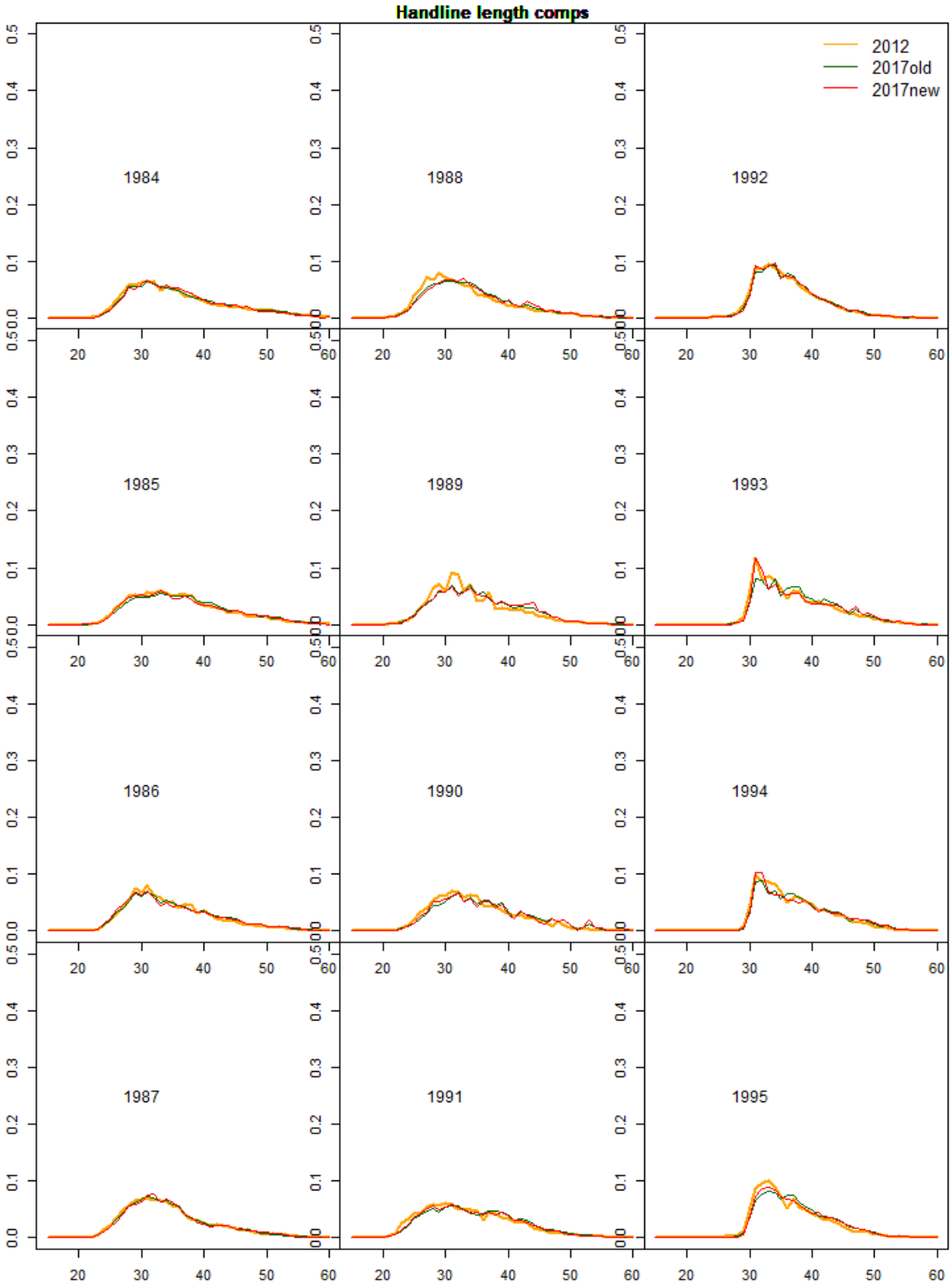
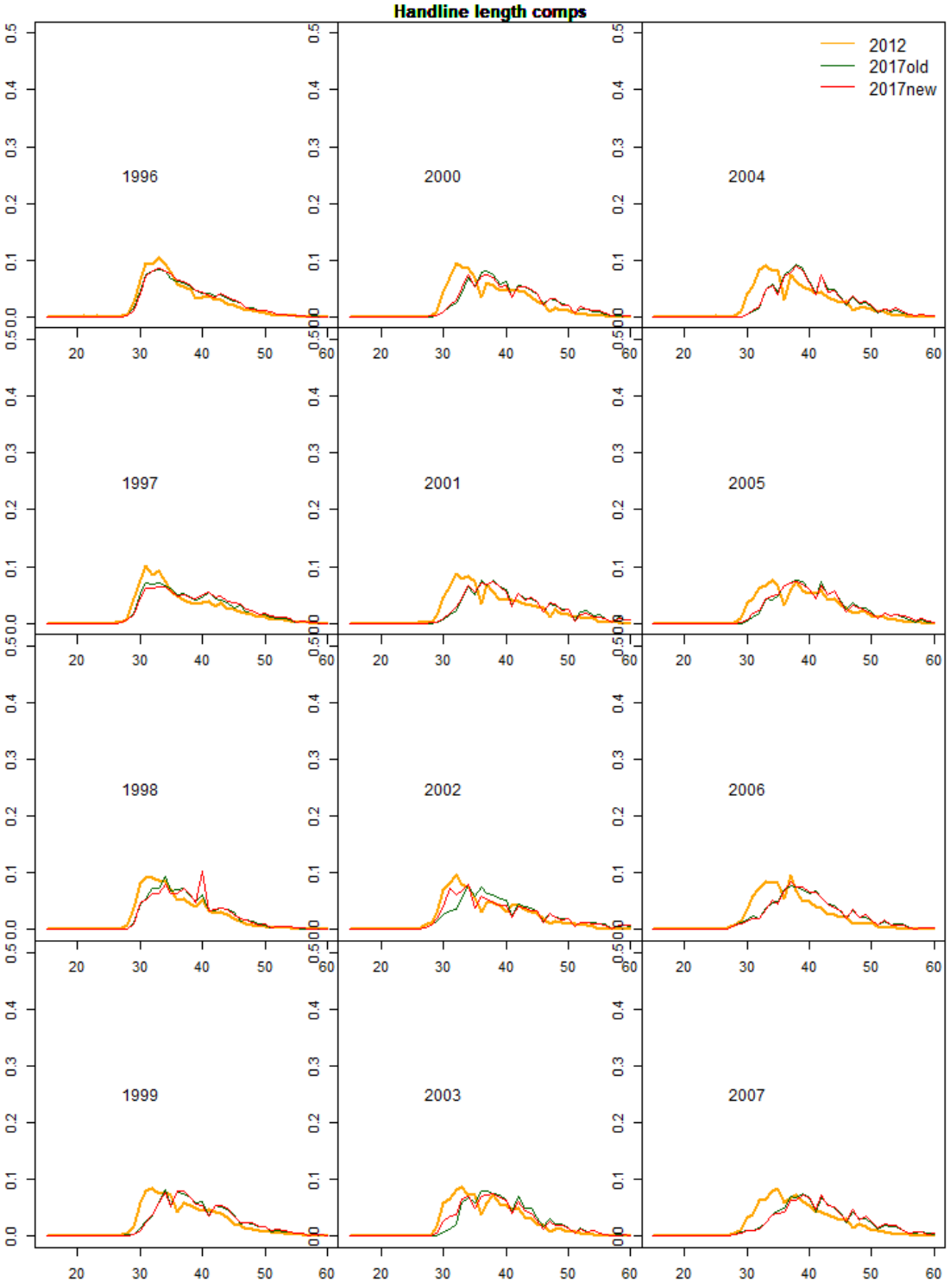
Table 2. Number of trips sampled and number of fish sampled (number of fish in parentheses) for age and for vermilion snapper by year and gear by state for the commercial gears.

	Hook and Line			Horizontal Longline	Spear		Trap			Trolling Lines	Trawl	Unknown	Vertical Longline
Year	FL	NC	SC	FL	NC	SC	FL	NC	SC	NC	FL	FL	SC
1992	8 (2)											1 (1)	
1993	52 (3)	68 (6)										21 (2)	
1994	92 (8)	20 (5)	23 (5)									26 (2)	
1995	263 (18)	50 (4)											
1996													
1997	43 (11)												
1998	100 (15)												
1999	122 (14)												
2000	179 (16)												
2001	222 (11)												
2002	116 (9)												
2003	99 (10)	34 (4)											
2004	17 (2)	296 (51)		1 (1)									
2005	63 (6)	492 (52)	209 (29)										
2006	9 (2)	1940 (140)	825 (126)			3 (2)			4 (2)				
2007	40 (7)	3838 (275)	1052 (163)			10 (1)		5 (3)	5 (2)				
2008	40 (2)	3067 (264)	542 (116)			4 (1)		30 (8)	6 (2)				
2009	120 (10)	1962 (196)	233 (83)			14 (3)		2 (1)	()	6 (1)			
2010	285 (12)	1867 (136)	1617 (103)		9 (1)	3 (2)			6 (2)	6 (1)			
2011	152 (9)	2812 (192)	1775 (89)						1 (1)				
2012	172 (9)	2044 (137)	1769 (120)				9 (1)						
2013	424 (19)	1321 (93)	1414 (111)			3 (1)		1 (1)					
2014	625 (25)	1596 (101)	708 (71)			11 (1)		1 (1)					
2015	572 (27)	1548 (117)	787 (69)		5 (1)				7 (1)		18 (1)		
2016	415 (21)	1824 (113)	844 (77)			16 (2)							12 (1)

Figures

Figure 1. Weighted commercial handline length compositions.




Handline length comps
2012
2017old
2017new
1996
2000
2004
1997
2001
2005
1998
2002
2006
1999
2003
2007

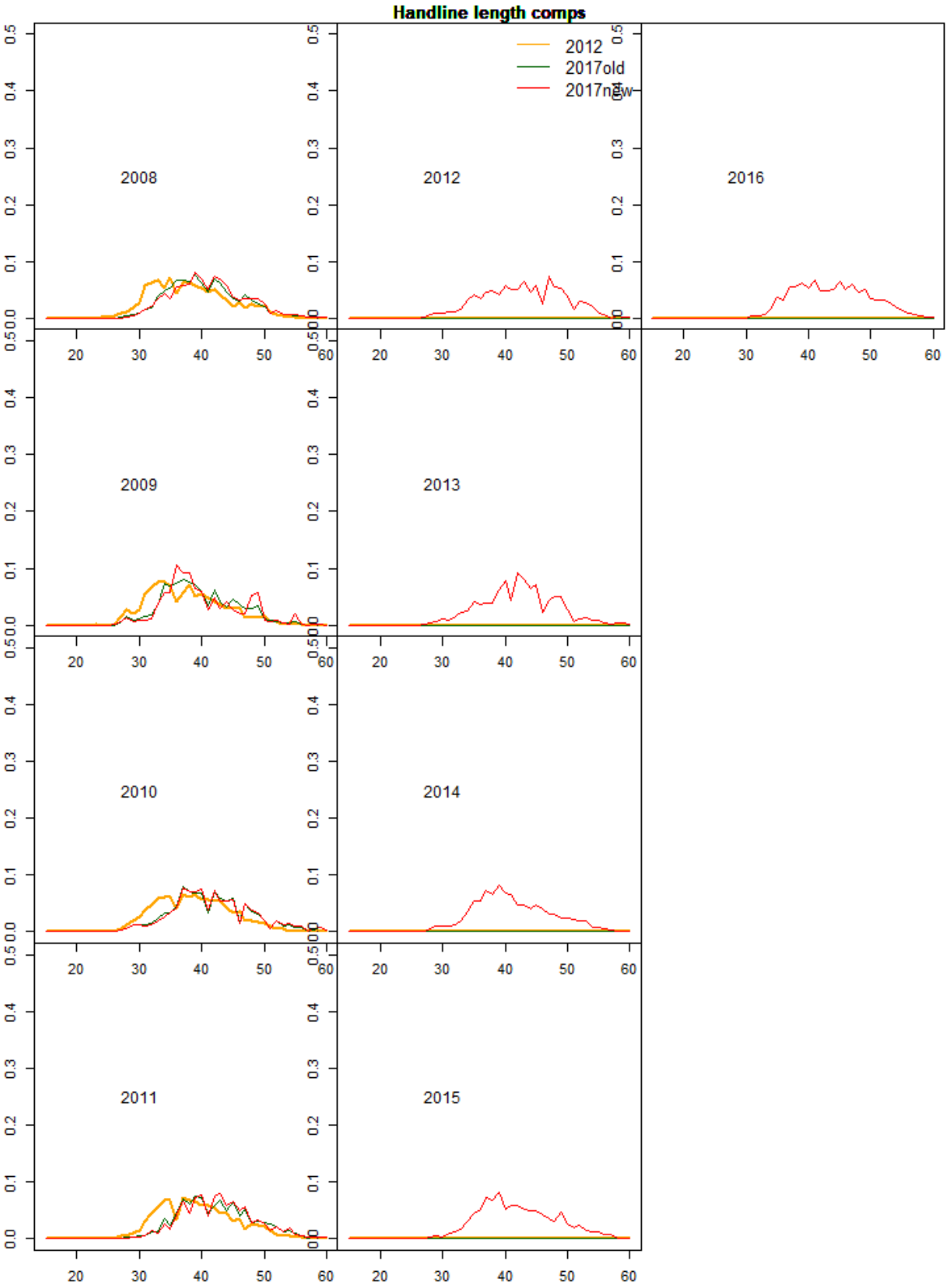
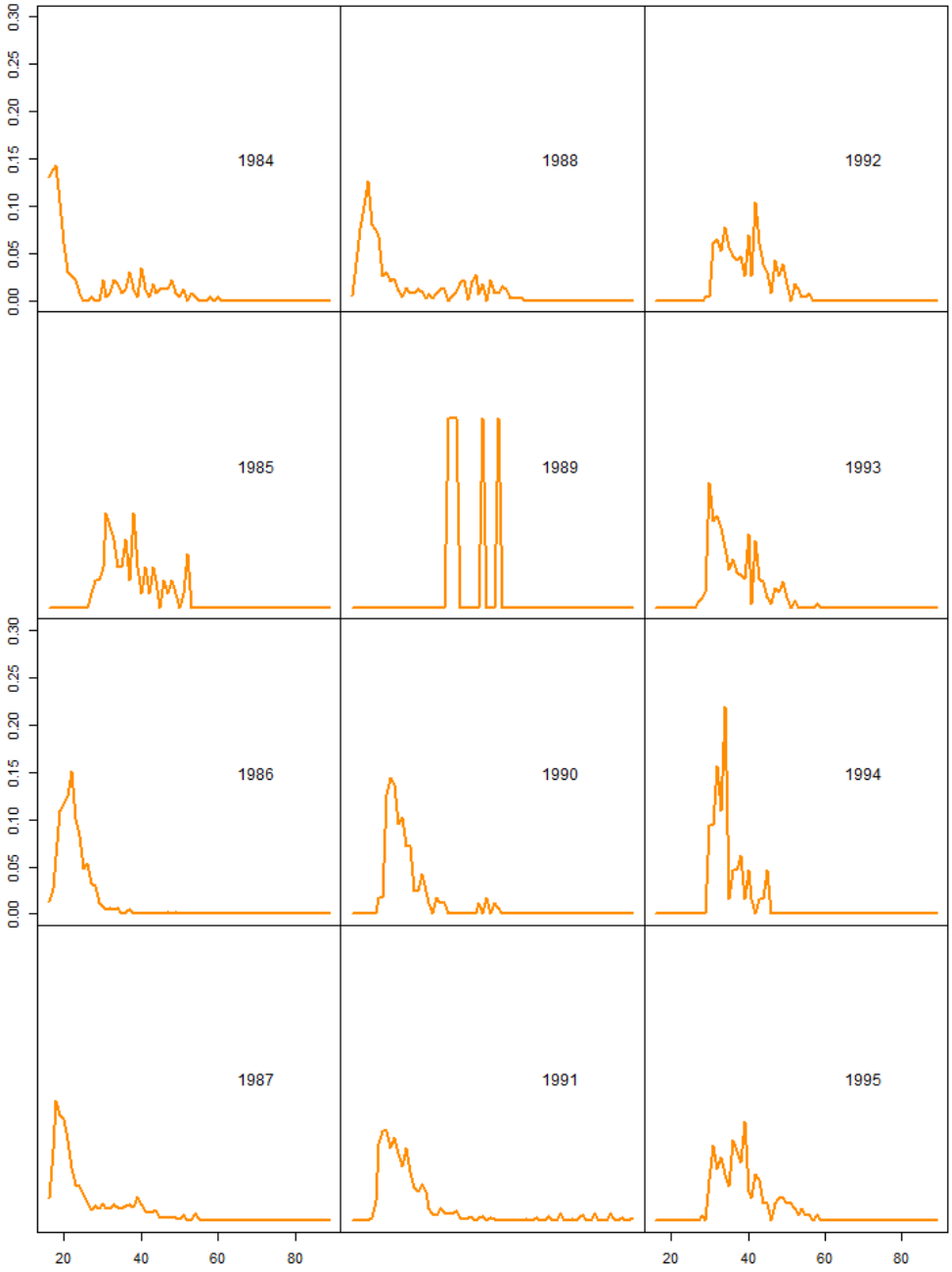
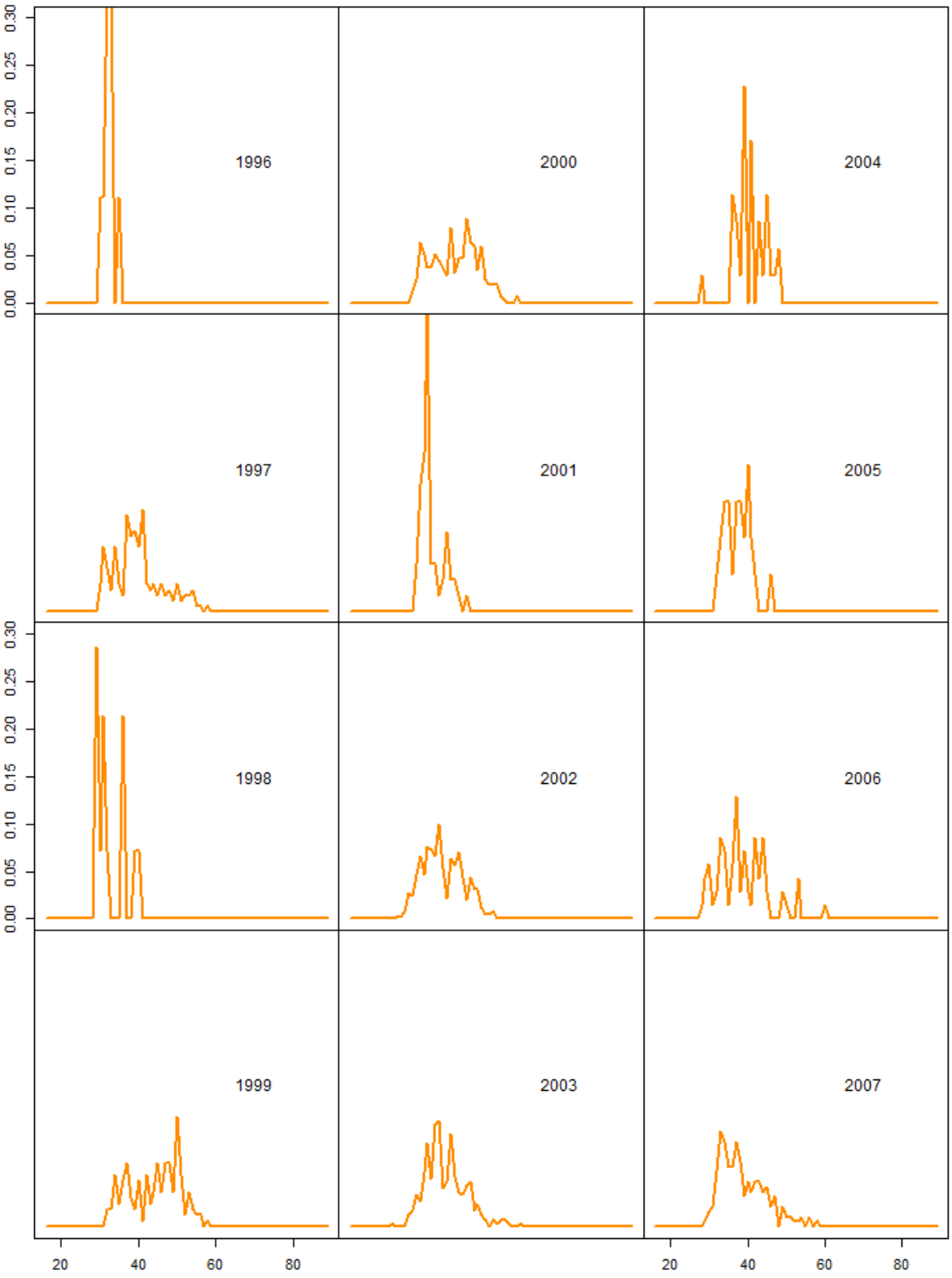

Handline length comps
2012
2017old
2017new
2008
2012
2016
2009
2013
2010
2014
2011
2015

Figure 2. Unweighted commercial 'other' length compositions.




1996
2000
2004
1997
2001
2005
1998
2002
2006
1999
2003
2007
0.00
0.05
0.10
0.15
0.20
0.25
0.30
20
40
60
80

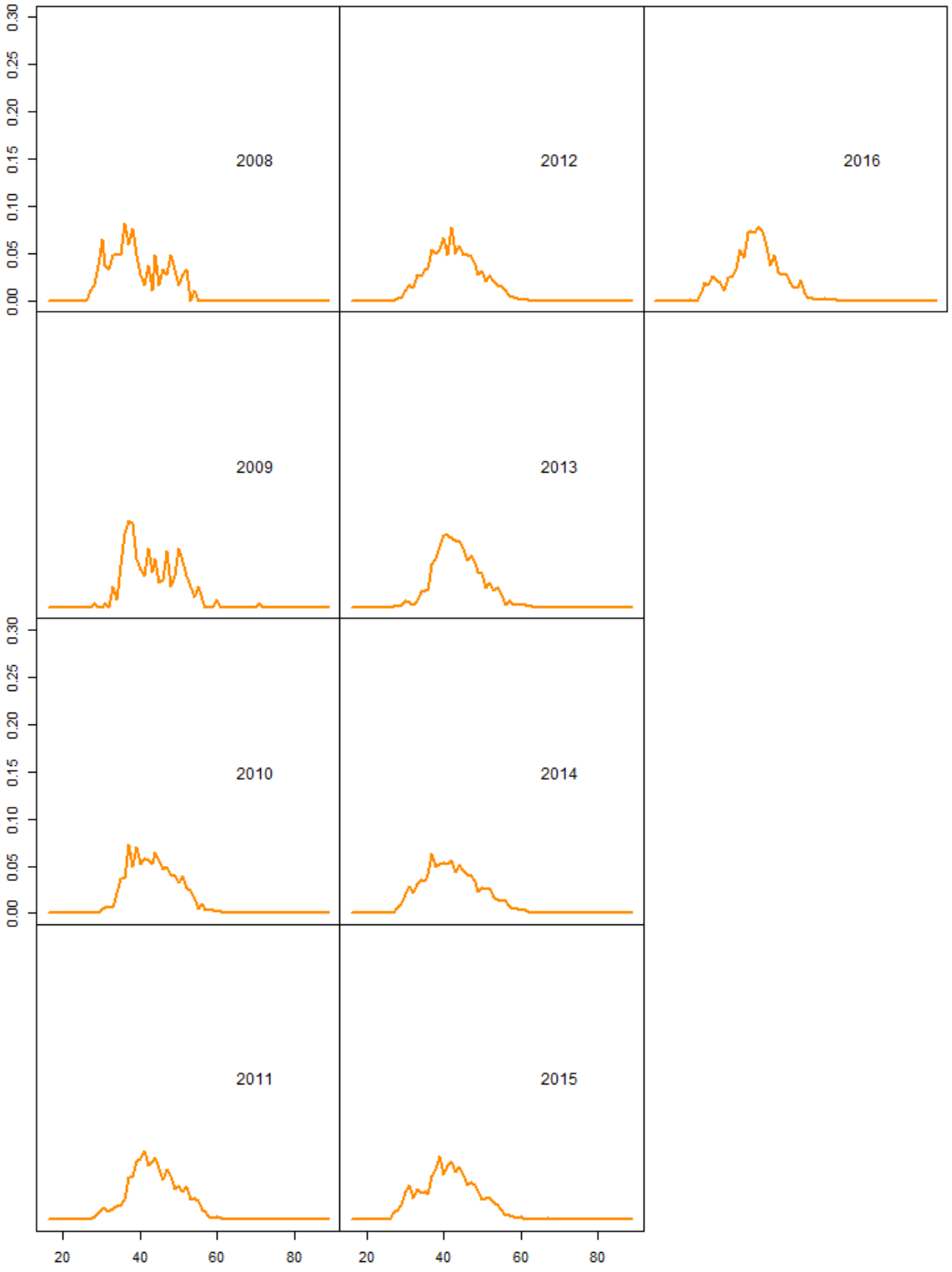
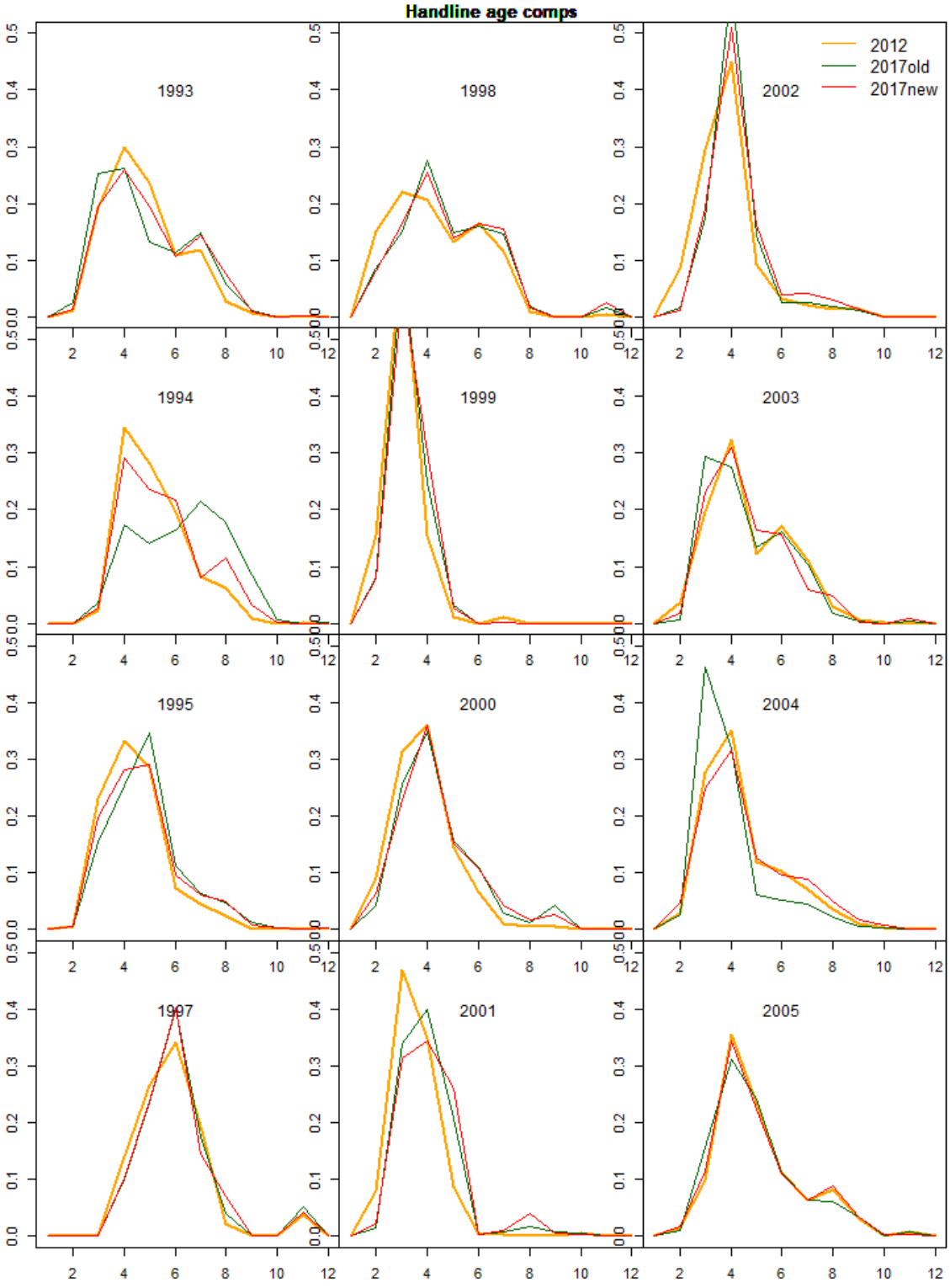
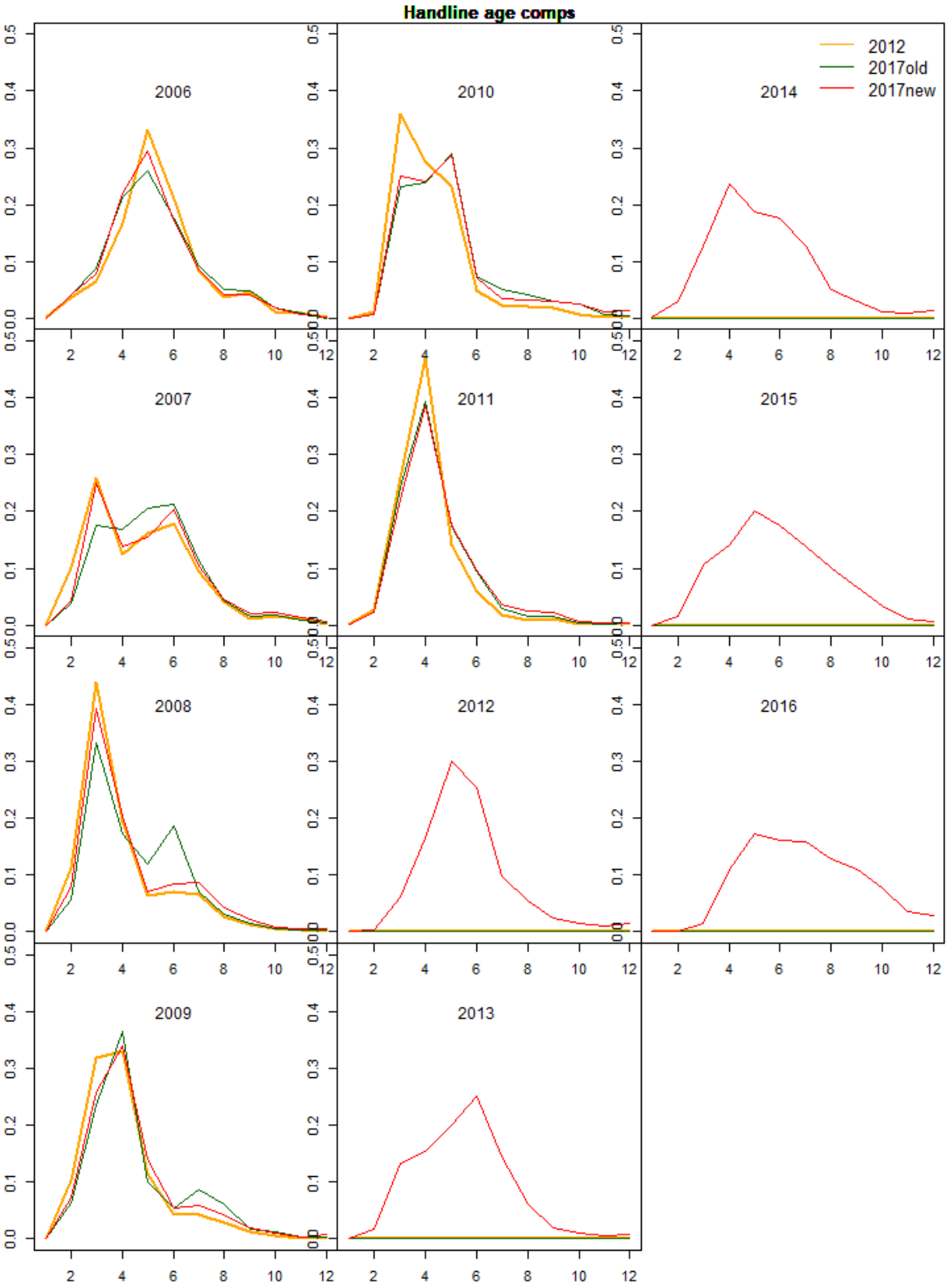

2008
2012
2016
2009
2013
2010
2014
2011
2015
0.00
0.05
0.10
0.15
0.20
0.25
0.30
20
40
60
80

Figure 3. Weighted commercial handline age compositions.




Handline age comps
2012
2017old
2017new
2006
2010
2014
2007
2011
2015
2008
2012
2016
2009
2013