South Atlantic U.S. greater amberjack (*Seriola dummerili*) age and length composition from the recreational fisheries

Fisheries Ecosystems Branch, National Marine Fisheries Service,

Southeast Fisheries Science Center, Beaufort, NC (contact: Kelly Fitzpatrick)

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South Atlantic U.S. greater amberjack (*Seriola dummerili*) age and length composition from the recreational fisheries

Fisheries Ecosystems Branch, National Marine Fisheries Service,
Southeast Fisheries Science Center,
101 Pivers Island Rd, Beaufort, NC 28516
October 8, 2019

1 Introduction

The SEDAR 59 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 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 2016 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.

MRFSS/MRIP Biological Sampling
The MRFSS/MRIP angler intercept survey includes the sampling of fish lengths from the harvested (landed, whole condition) catch (Table 1). 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.

2.2 Ages

Aging structures and other biological samples are not collected during MRFSS/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 MRFSS/MRIP state subcontractors and SRHS port agents.

Annual numbers of greater amberjack sampled for age and the number of annual trips that were sampled from the recreational fishery are reported in Table 2.

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 59 were developed at the year and region (2 regions, NC/SC and GA/FL) level in order to consolidate the MRFSS/MRIP and SRHS landings estimates. Therefore, the finest scale to weight the length data was year and region 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 (NC/SC and GA/FL)
- Fleet assigned: 1. Headboat (SRHS) and 2. CH/PR (MRIP)
- Range of lengths: 9 to 198 cm (5 cm bins)

3.2 Ages

A minimum of 10 fish per region was established to calculate a weighted age composition. For greater amberjack age could not be determined, therefore the increment count was used and will hereafter be referred to as age. 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* 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. CH/PR (MRIP)
- Range of ages: 0 to 11 (1 increment bins)
- Range of lengths: 28 to 159 cm (5 cm bins)

4 Results

4.1 Lengths

The SRHS length compositions (Figure 1) showed a wide range of fish (9 to 192 cm FL). Prior to the early 1980s fish sampled in the headboat fishery generally ranged from 30 cm to 150 cm FL, with a small number of samples outside of that range. The maximum length captured decreased to approximately 100 cm FL to 125 cm FL in the early 1980s. Throughout the 1980s to early 1990s the distribution included greater numbers of smaller fish (30 cm FL to 60 cm FL). In the mid-1990s to early 2000s the maximum length captured remained closer to 100 cm FL, before shifting toward 125 cm FL in the late 2000s and 2010s.

It's important to note that weighting had limited influence on the length composition (Figure 1), of the SRHS, in years that met the 30 fish minimum.

The MRIP CH/PR mode length compositions showed a similar range of fish (8 to 198 cm FL). In the early 1980s to early 1990s fish sampled in the charter/private boat fishery (Figure 2) generally ranged from 45 cm to 150 cm FL, with a small number of samples outside of that range. Beginning in the mid-1990s the maximum length captured decreased to approximately 125 cm FL. The maximum length captured shifted closer to 100 cm FL to 125 cm FL in the early 2000s.

It's important to note that weighting had limited influence on the length composition (Figure 2), of the CH/PR mode, in years that met the 30 fish minimum.

4.2 Ages

The weighted age compositions are very similar to the nominal age compositions, with similar ages encountered in both the SRHS and MRIP CH/PR fisheries (0-11 years, Figure 4). In the SRHS most fish sampled were under 4 years. Slightly older fish were encountered in the MRIP

CH/PR mode with the majority of fish under 5 years. However, in the SRHS no fish were sampled that were 9 or 10 years.

5 Discussion

There is minimal influence when weighting the recreational length or age compositions for greater amberjack 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.

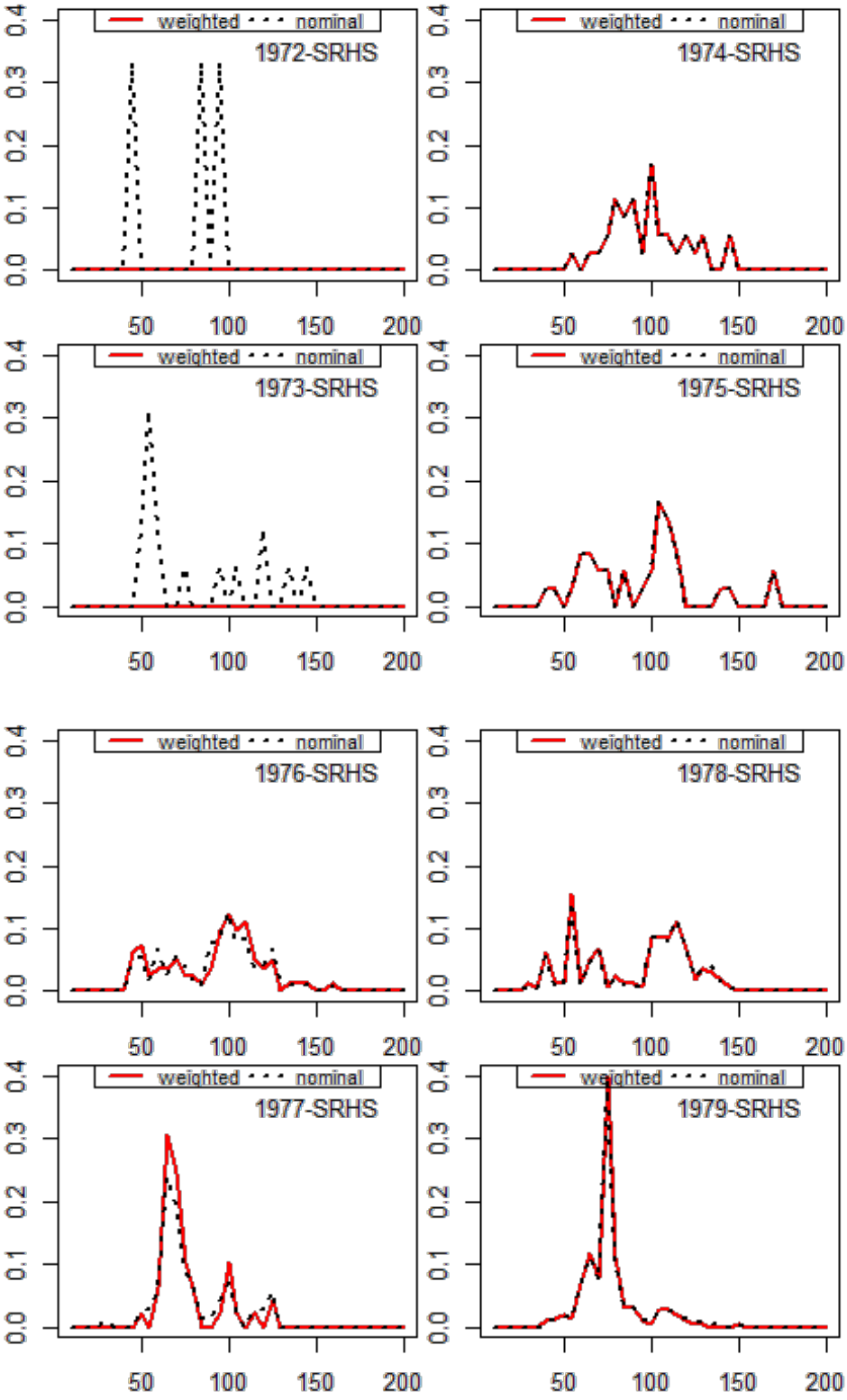
Table 1. Annual number of fish measured and annual number of trips containing measured greater amberjack in the recreational fishery. A minimum of 30 length measurements was required.

Year	SRHS		MRIP	
	Fish (n)	Trips (n)	Fish (n)	Trips (n)
1972	3	3		
1973	16	11		
1974	35	19		
1975	36	29		
1976	104	58		
1977	71	33		
1978	174	86		
1979	231	57		
1980	112	64		
1981	218	59	29	13
1982	98	44	32	19
1983	282	126	29	21
1984	231	130	75	53
1985	238	118	64	28
1986	248	137	110	75
1987	268	138	177	89
1988	144	99	123	78
1989	186	95	164	108
1990	113	65	166	89
1991	74	50	148	90
1992	129	68	226	158
1993	121	76	149	80
1994	117	56	224	111
1995	112	67	101	58
1996	80	46	172	86
1997	67	43	114	57
1998	98	57	156	77
1999	131	60	451	170
2000	88	49	288	136
2001	39	27	387	172
2002	148	71	418	196
2003	156	65	496	199
2004	69	42	300	147
2005	38	32	217	102
2006	84	57	159	86
2007	91	50	193	91
2008	79	44	352	164
2009	112	61	360	141
2010	82	45	516	207
2011	54	35	254	110
2012	129	62	312	147
2013	194	92	190	81
2014	138	77	381	156
2015	215	94	420	176
2016	276	124	402	183
2017	126	68	198	102

Table 2. Annual numbers of greater amberjack sampled for age and the number of annual trips containing aged greater amberjack in the recreational fishery. A minimum of 10 aged fish was required.

Year	SRHS		MRIP	
	Fish (n)	Trips (n)	Fish (n)	Trips (n)
1994	6	5	0	0
1995	1	1	0	0
1996	2	2	0	0
1997	0	0	0	0
1998	0	0	2	1
1999	0	0	0	0
2000	8	7	1	1
2001	0	0	18	8
2002	5	1	216	73
2003	47	4	540	113
2004	3	3	377	108
2005	4	4	358	87
2006	11	10	178	32
2007	9	5	20	8
2008	11	9	6	4
2009	21	14	7	7
2010	13	13	0	0
2011	12	11	0	0
2012	24	14	5	4
2013	9	6	24	15
2014	11	7	14	7
2015	13	12	32	12
2016	10	7	0	0
2017	9	7	73	20

Figure 1: Greater amberjack nominal and weighted length composition from the headboat fishery.



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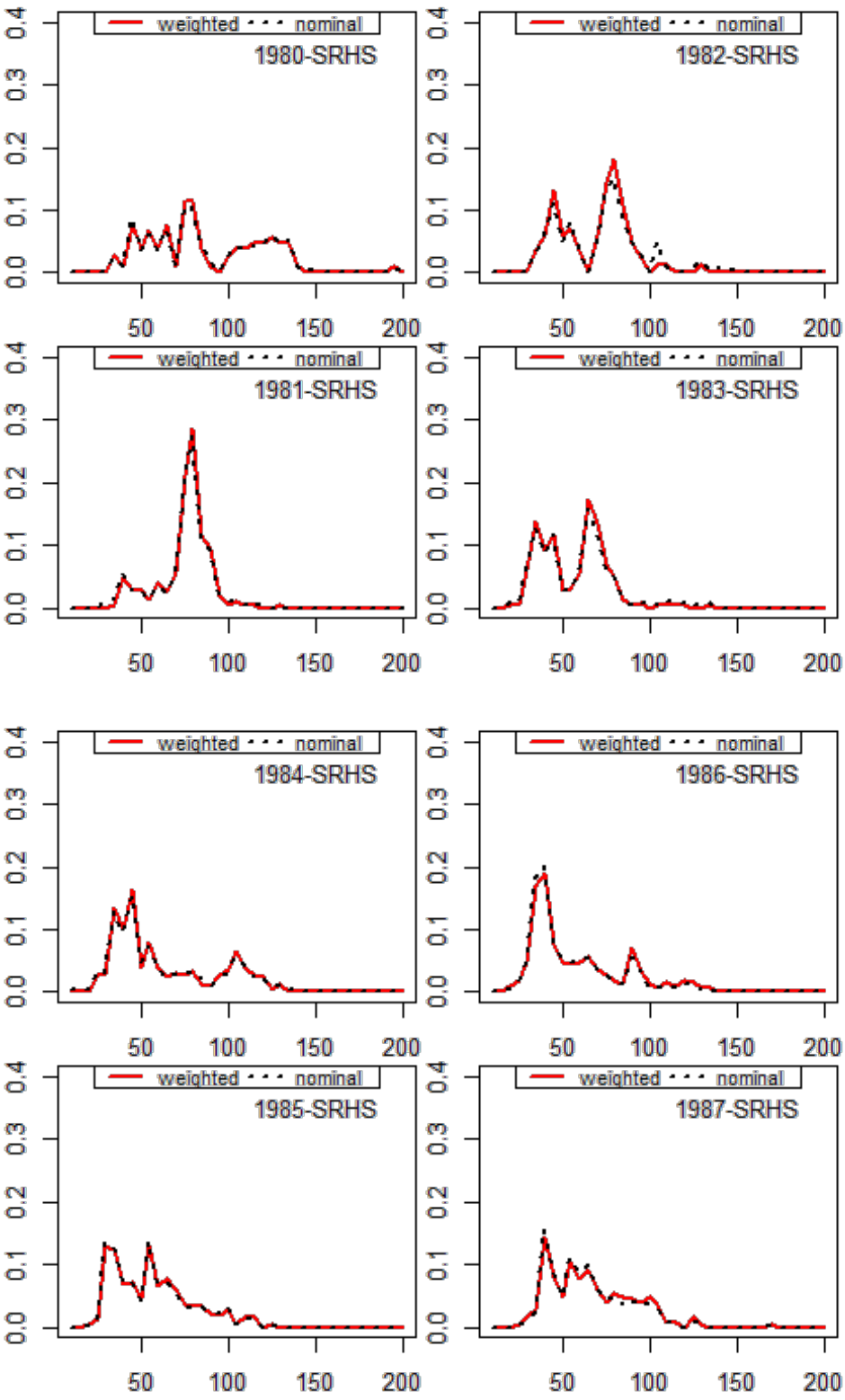

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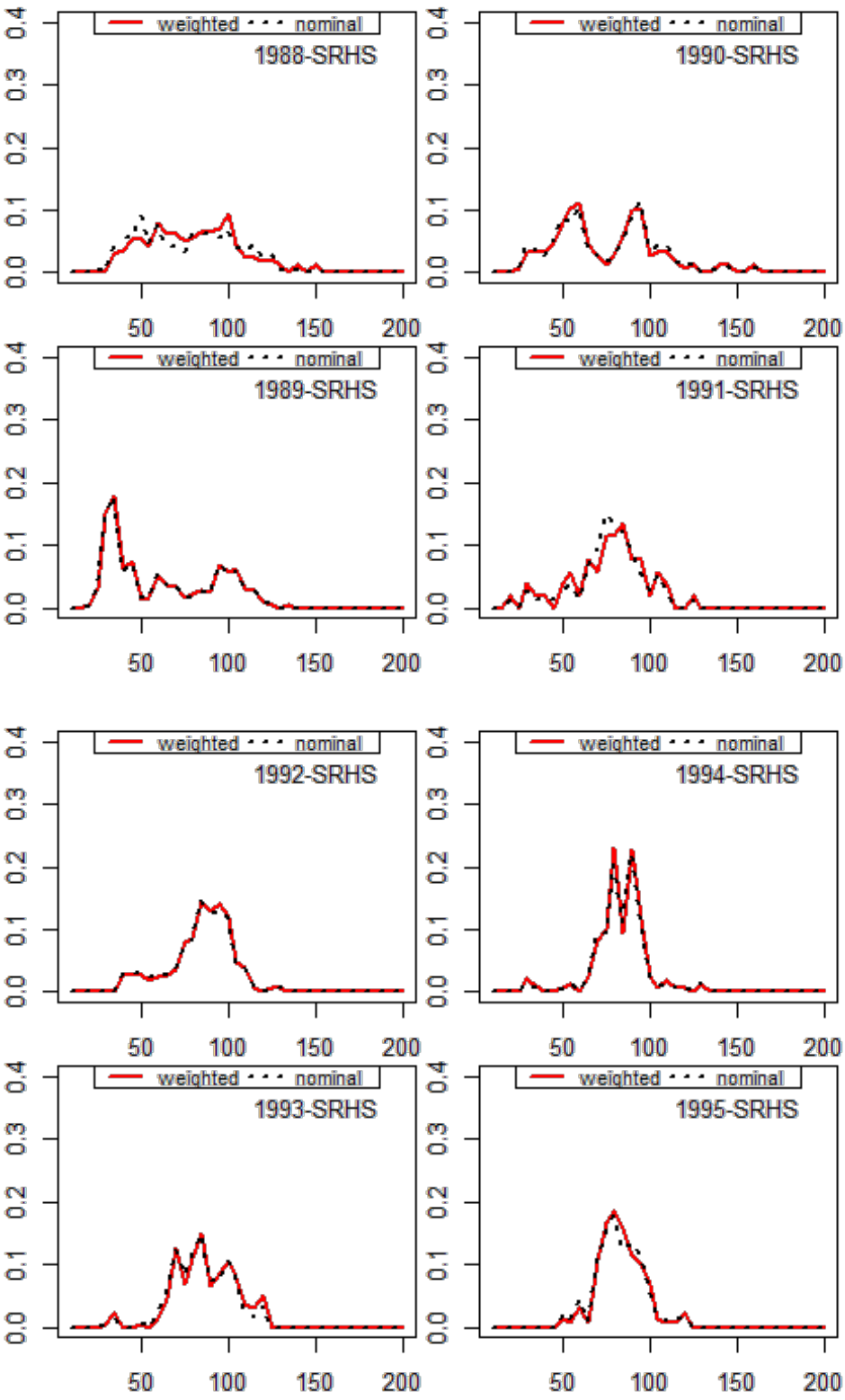

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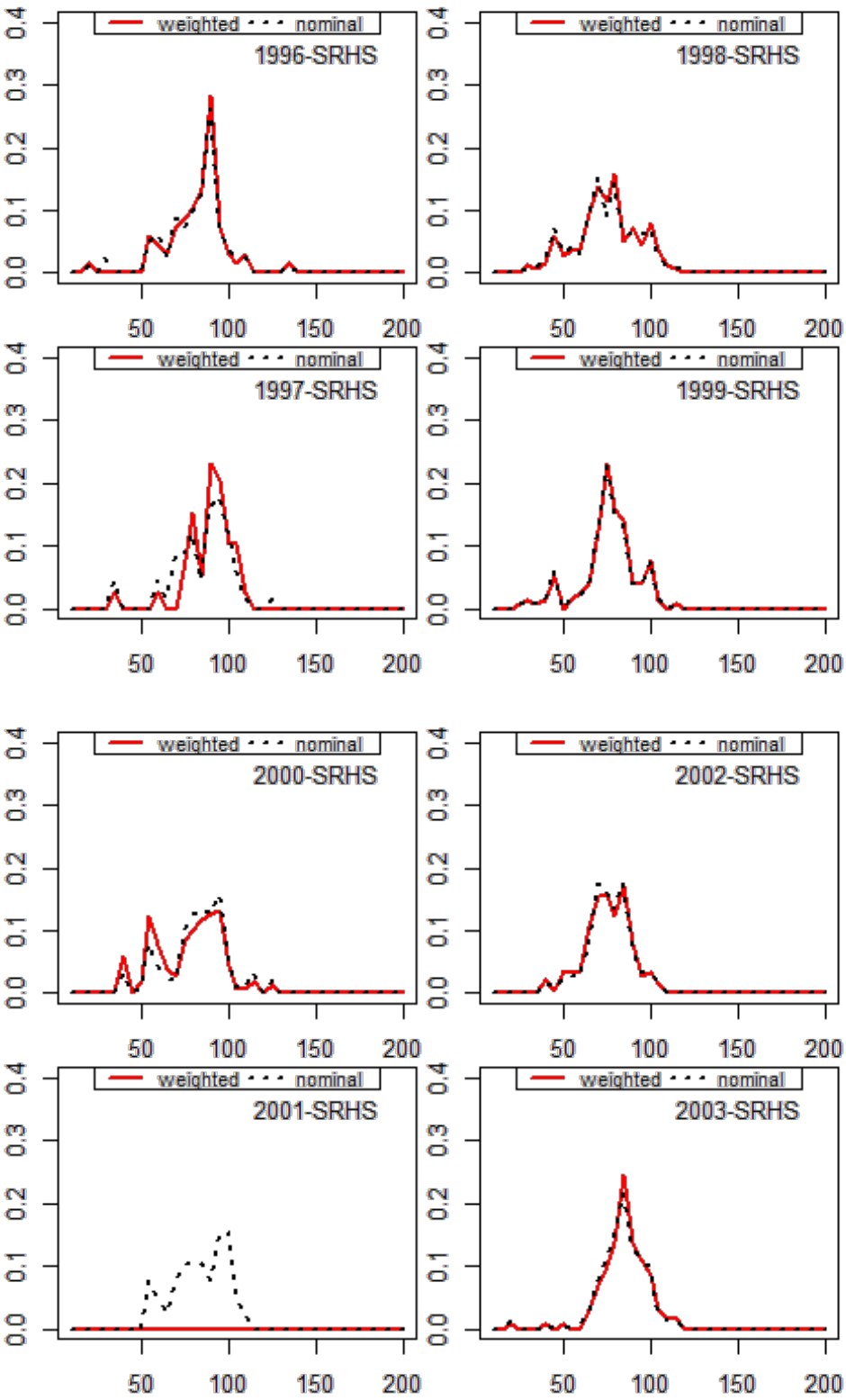

Figure 1: Continued.

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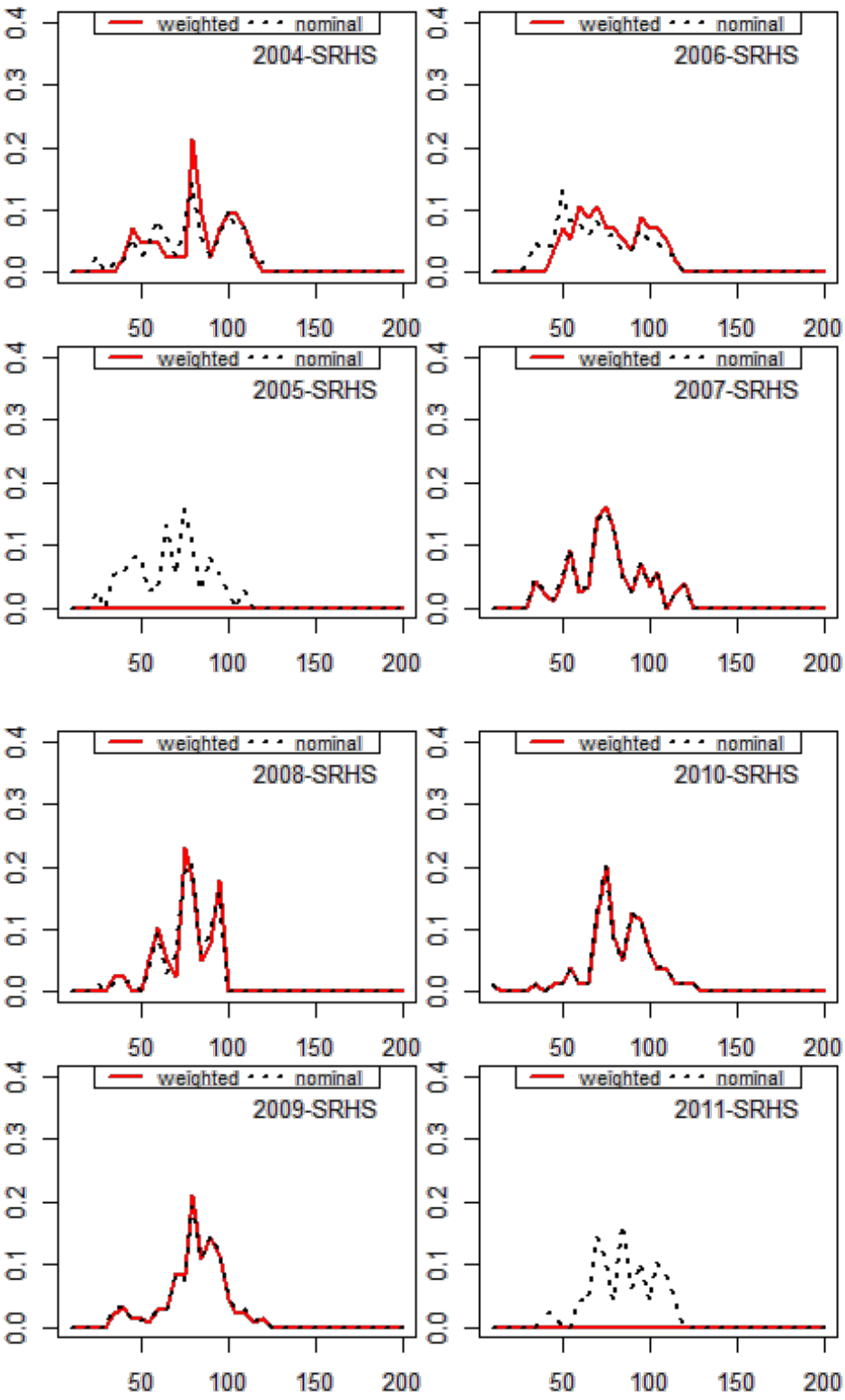

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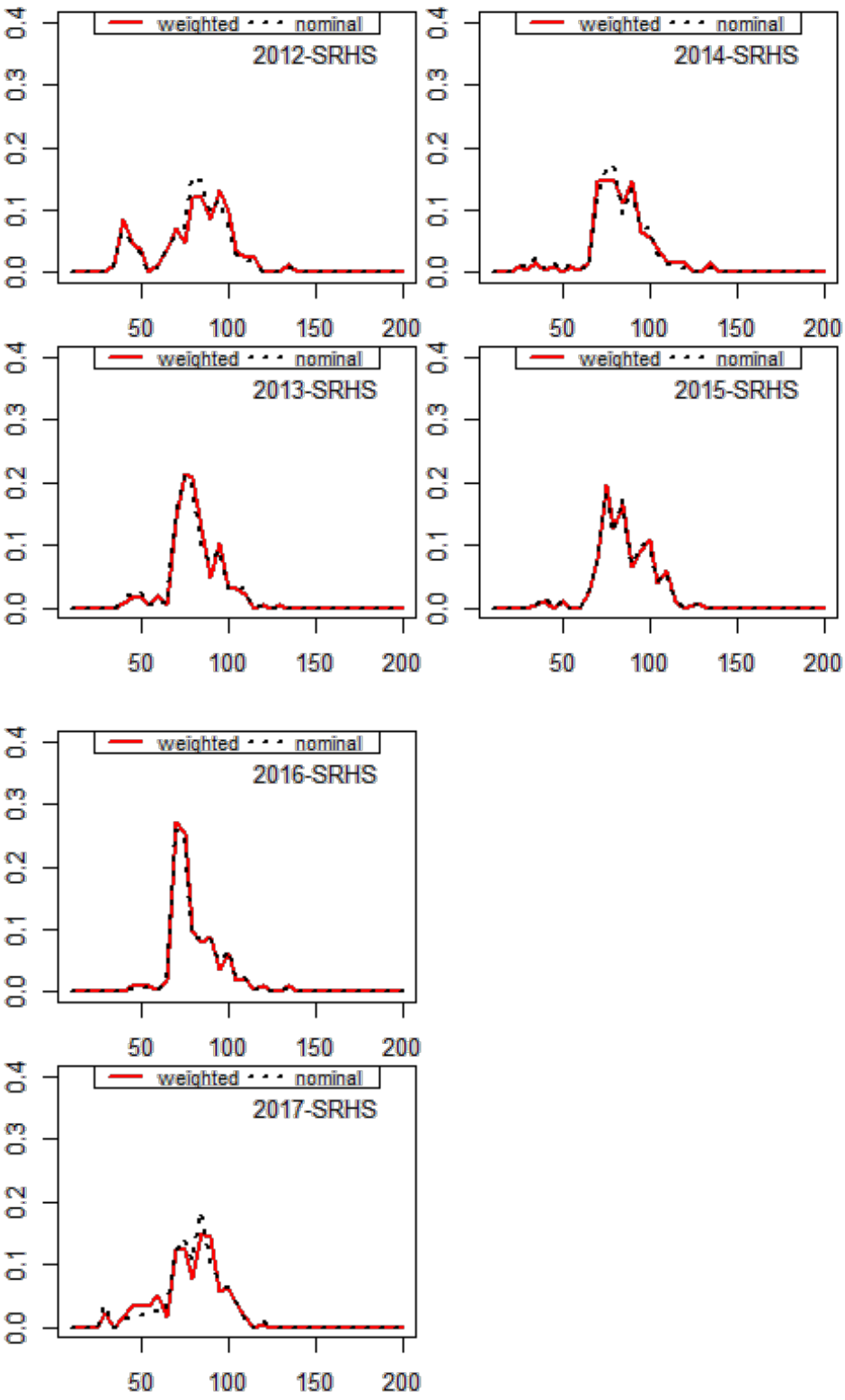
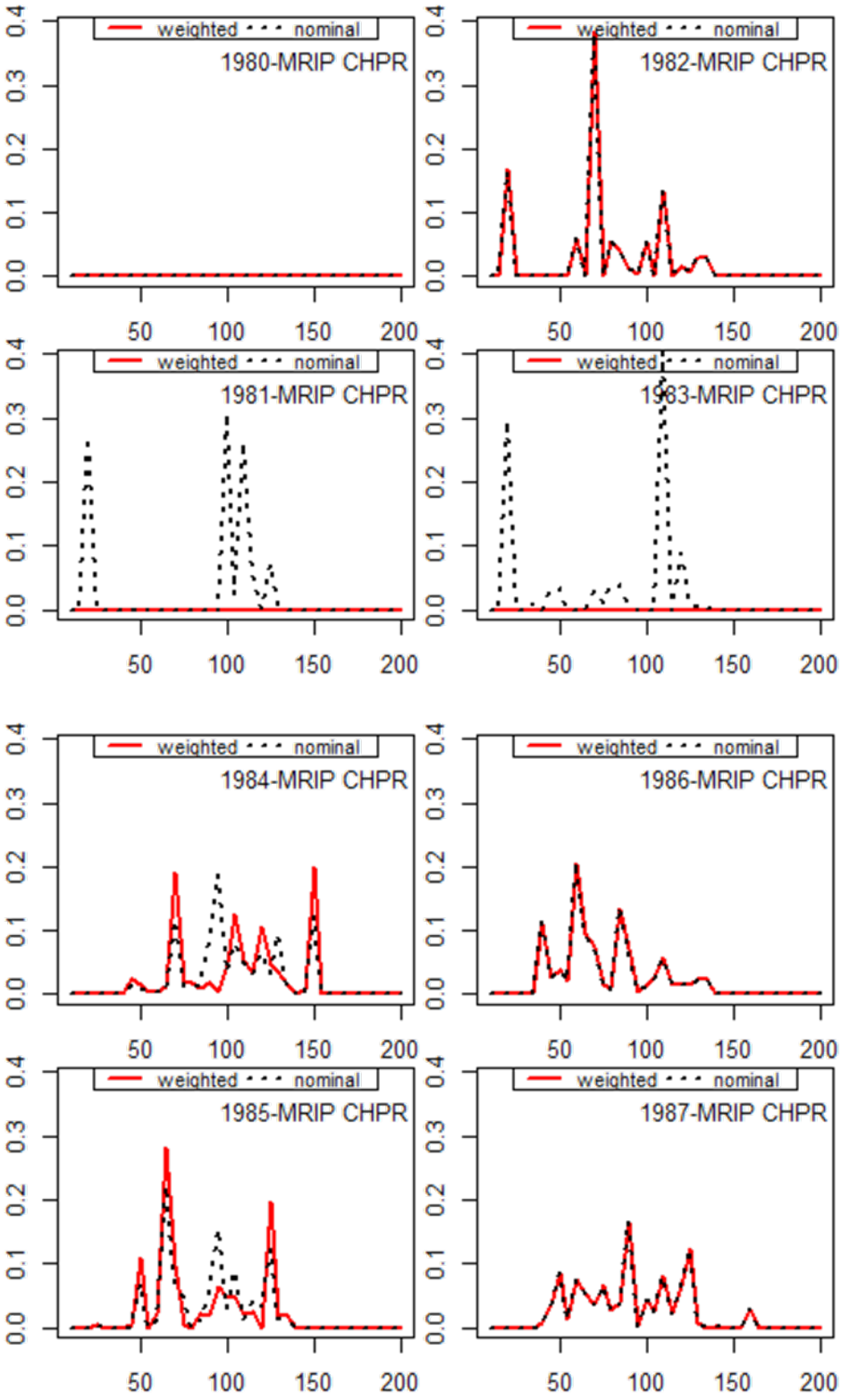


Figure 2: Greater amberjack nominal length composition of fish measured and of fish aged from the charter and private boat modes.



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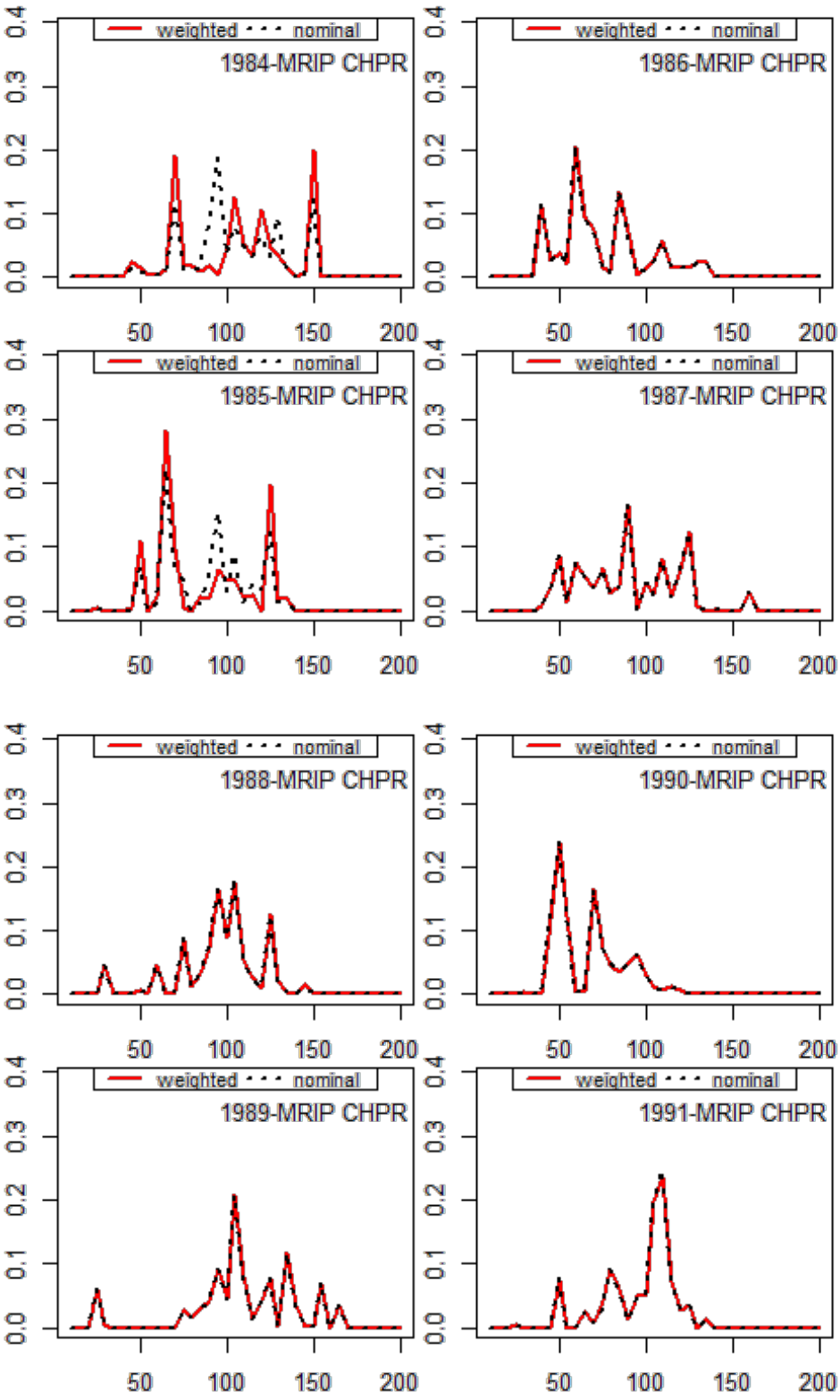

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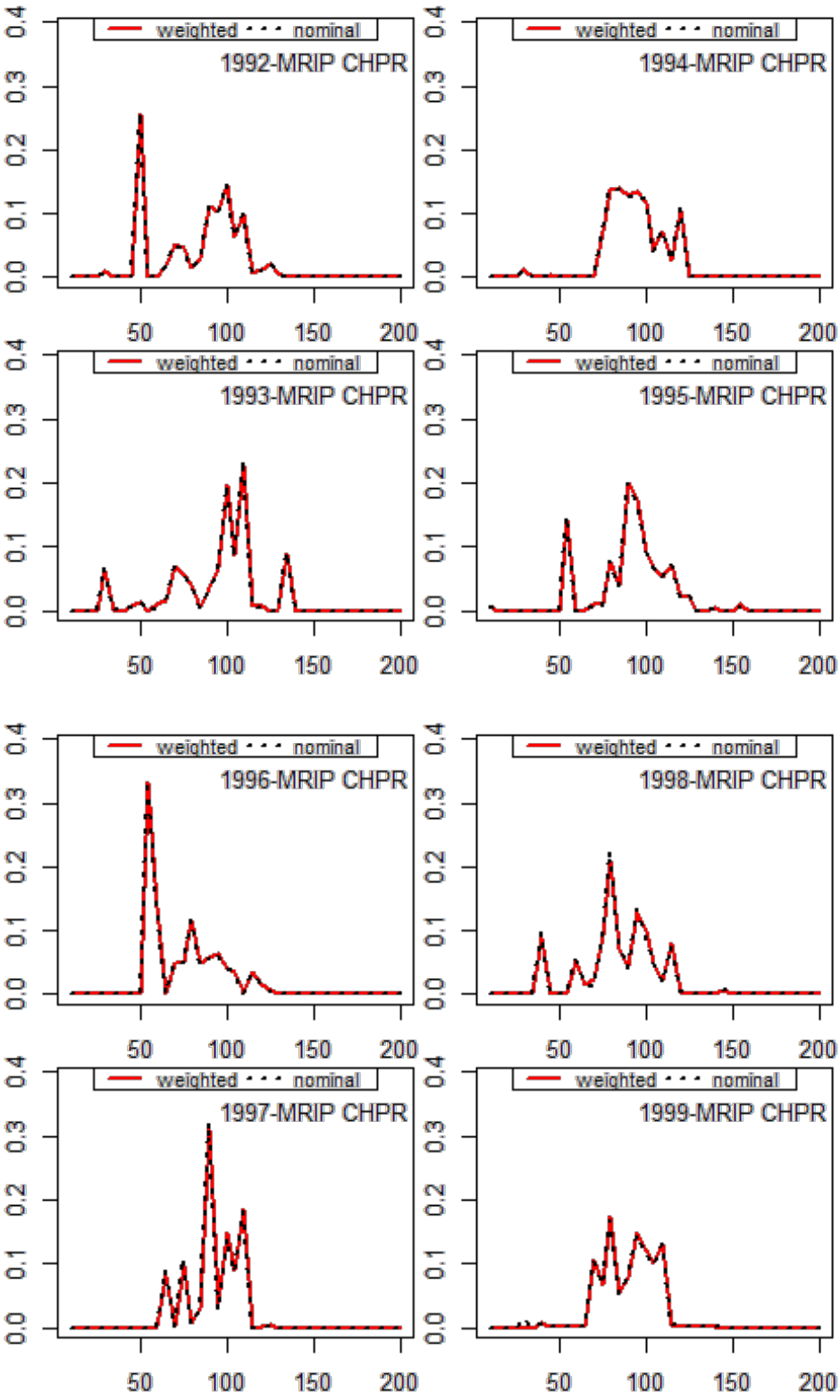

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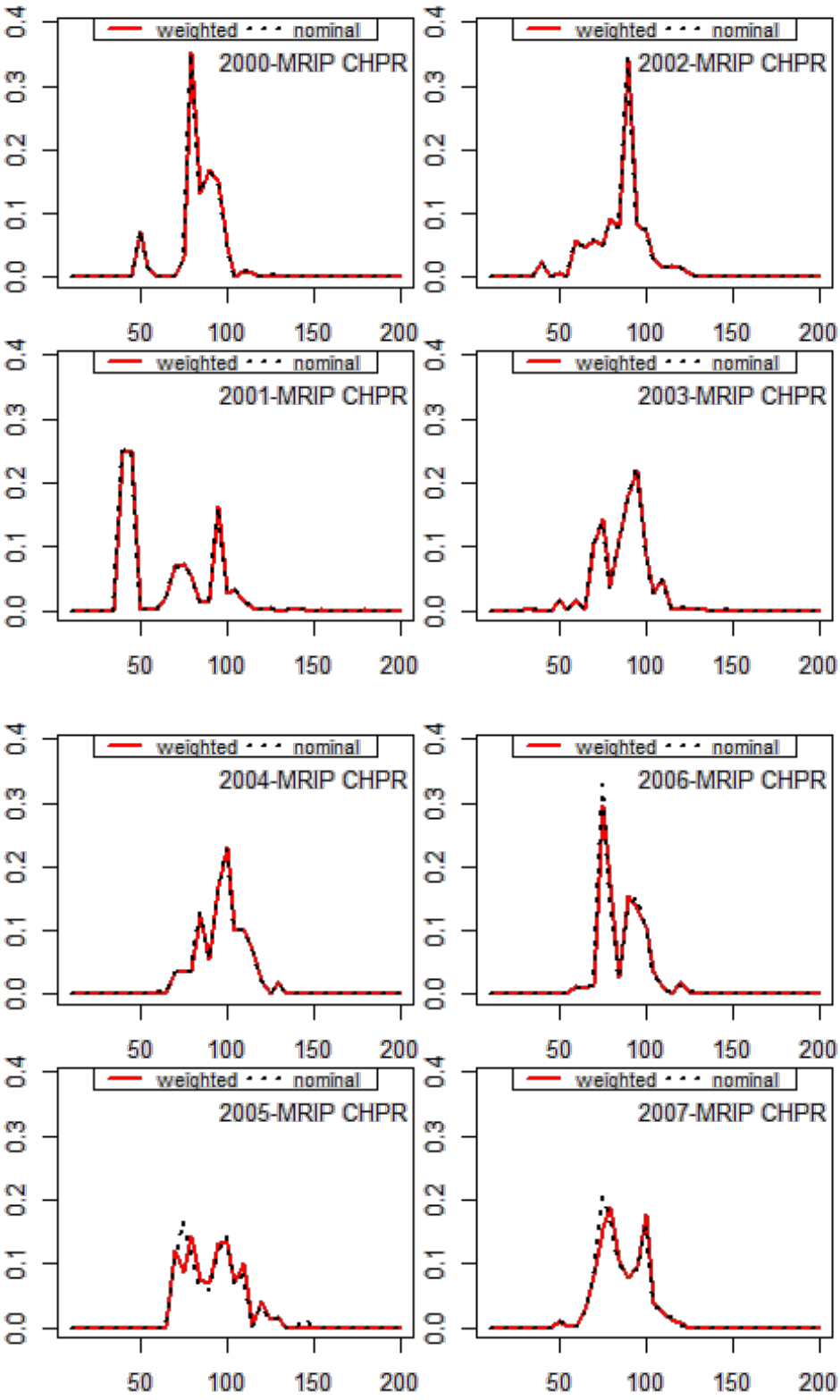

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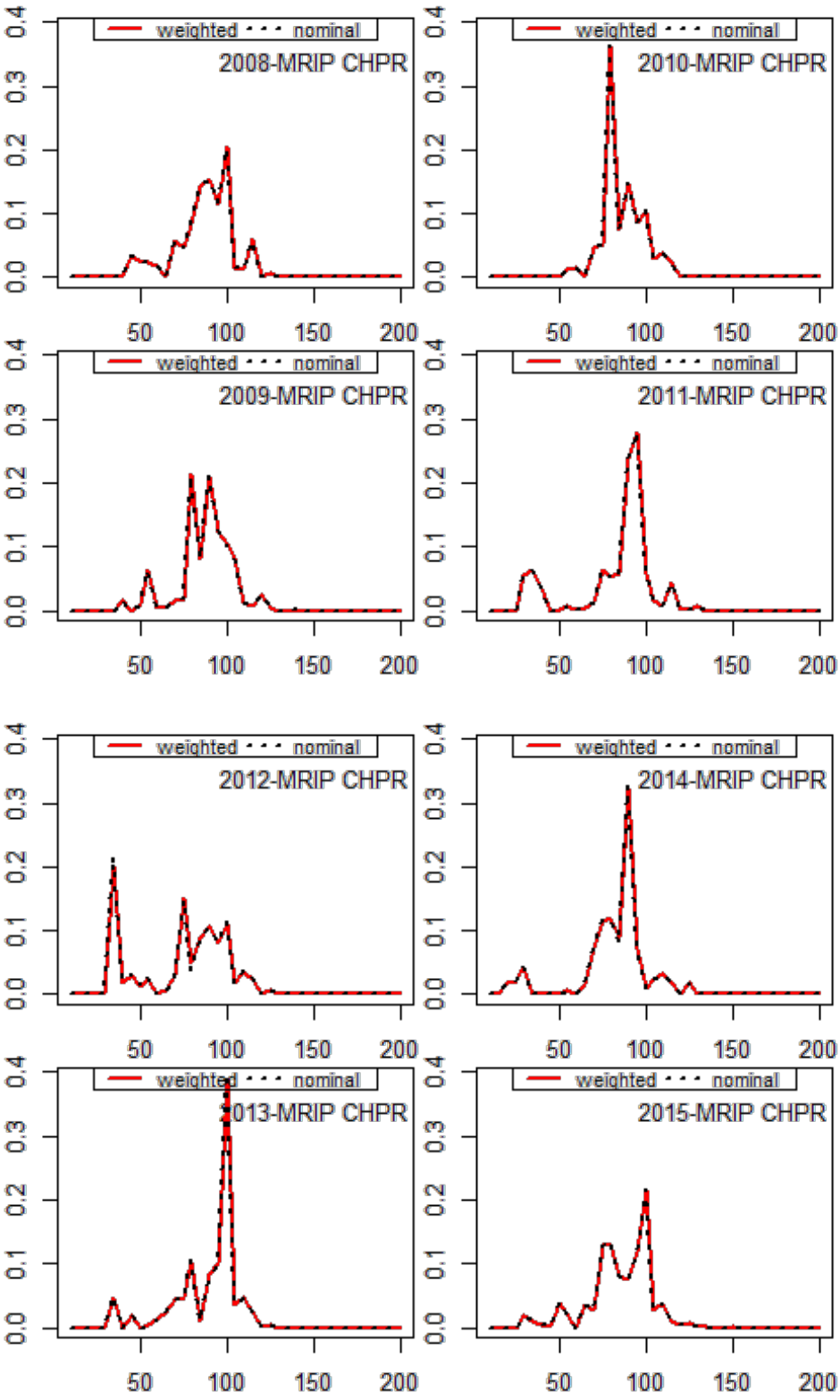

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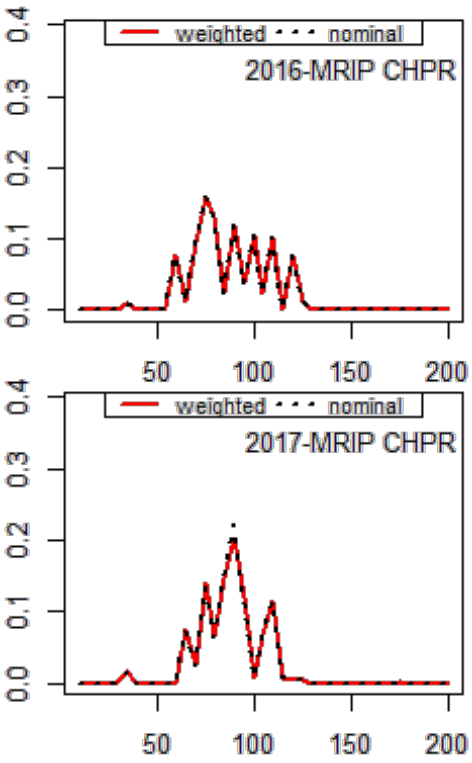
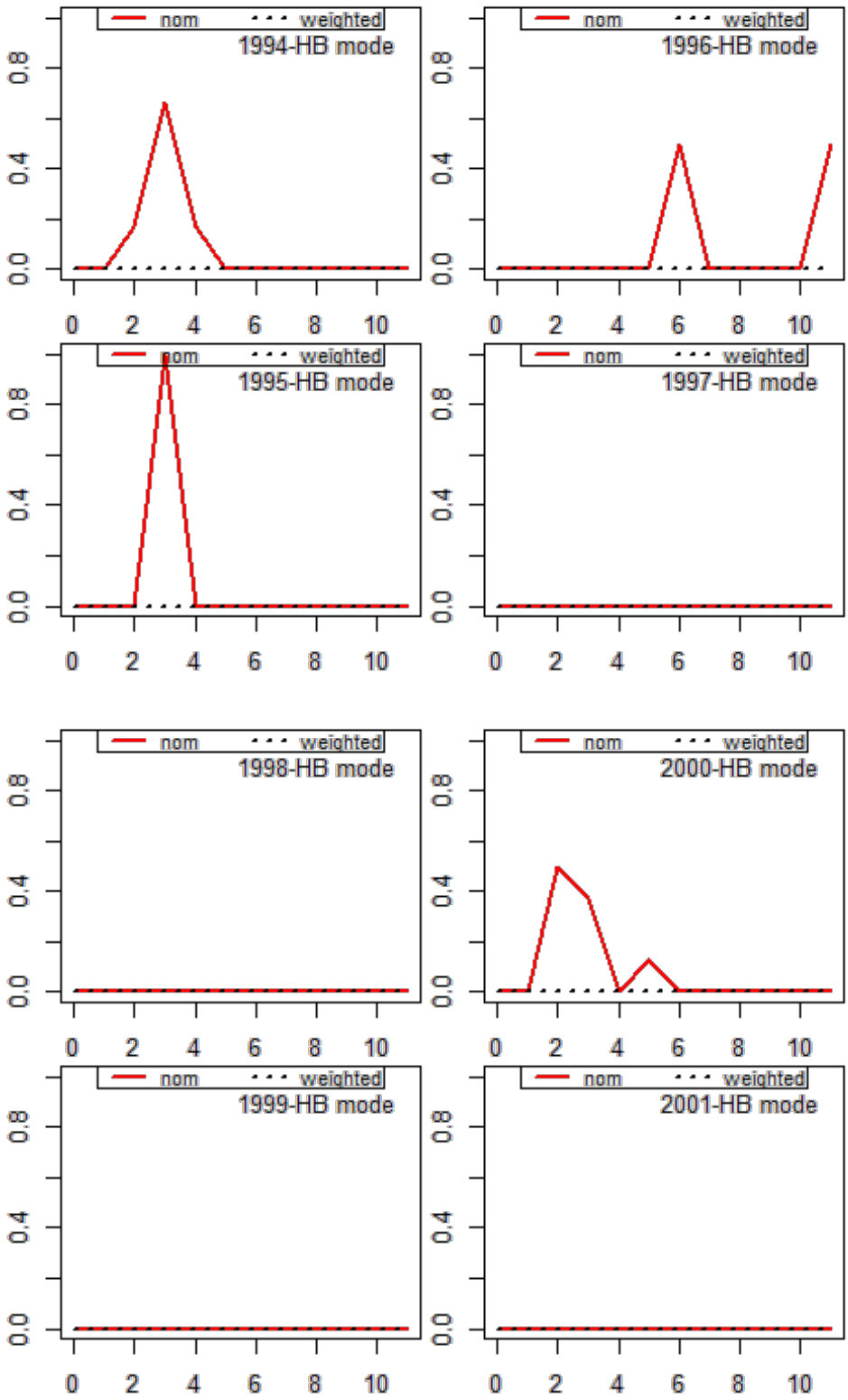


Figure 3: Greater amberjack nominal and weighted age composition from the headboat fishery.



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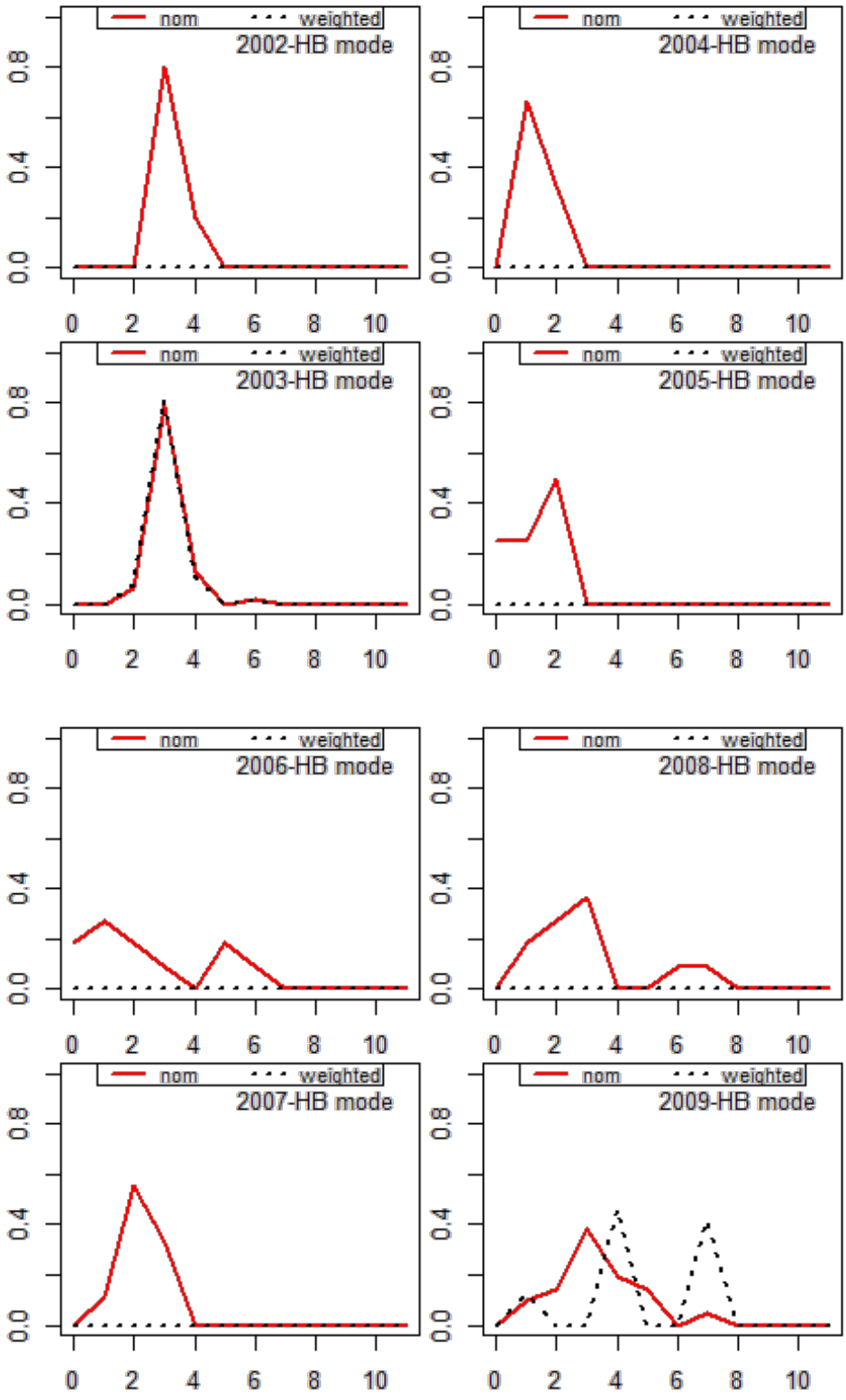

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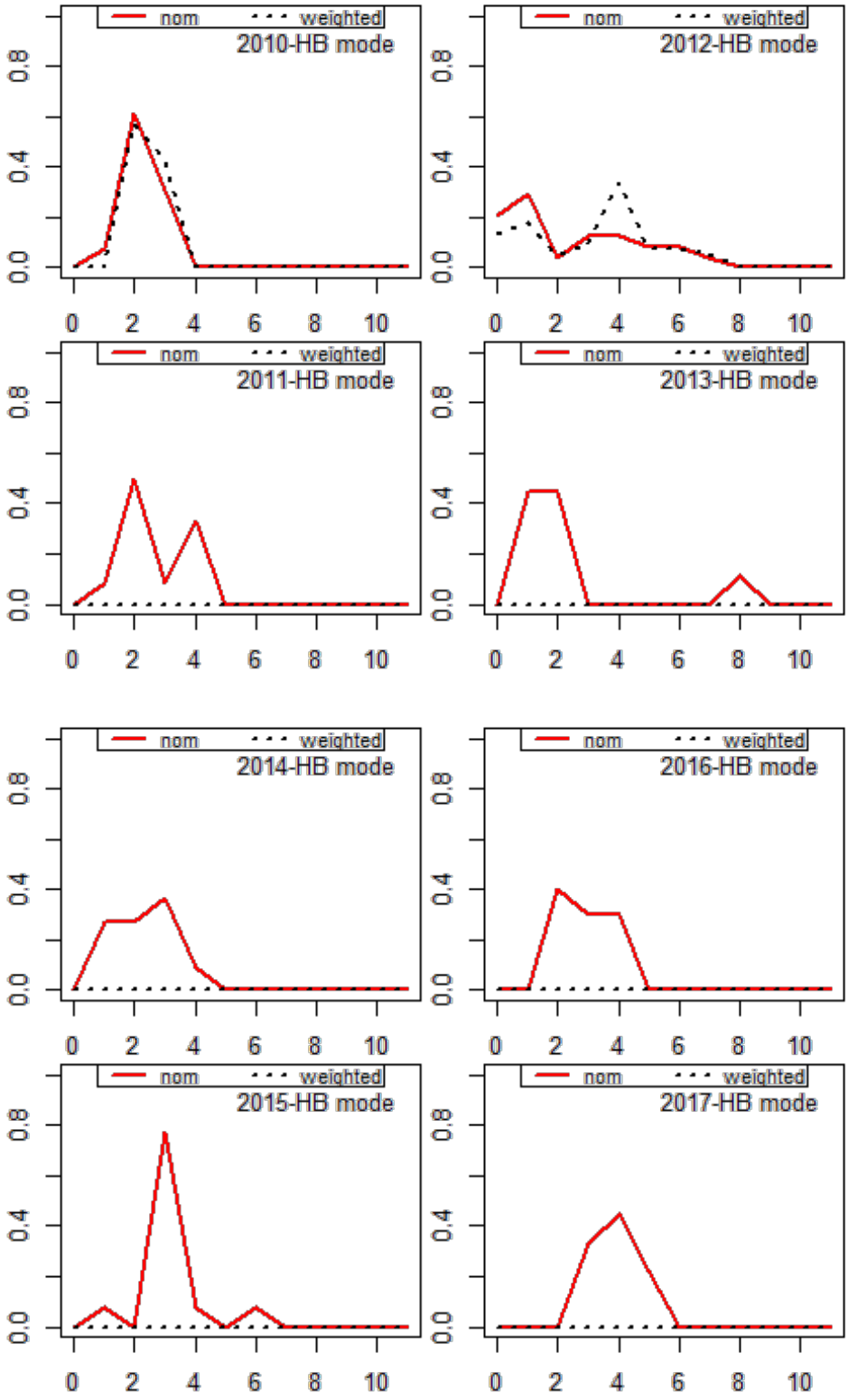
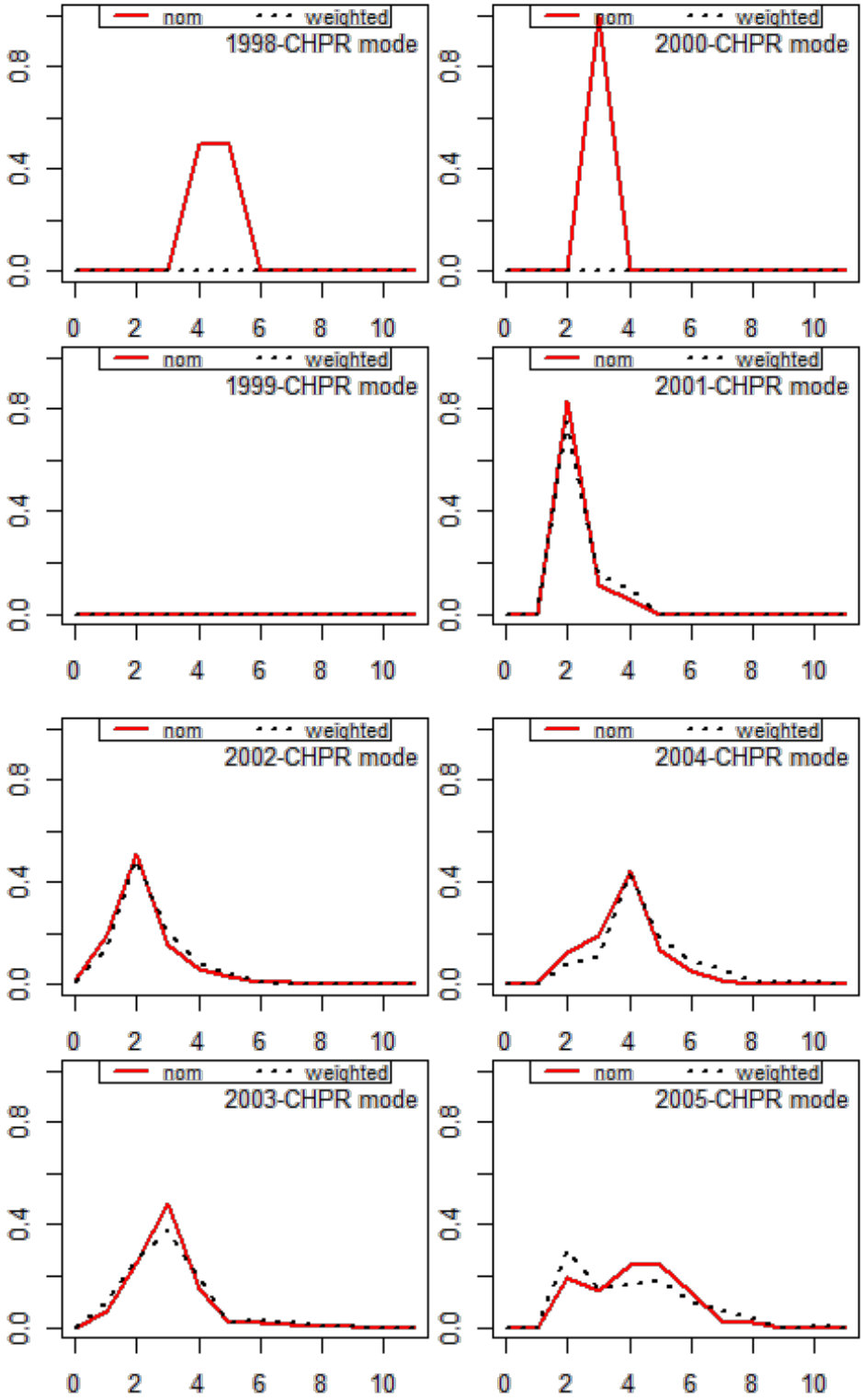


Figure 4: Greater amberjack nominal and weighted age compositions from the charter and private boat modes. The weighted age composition is weighted by the nominal length composition.



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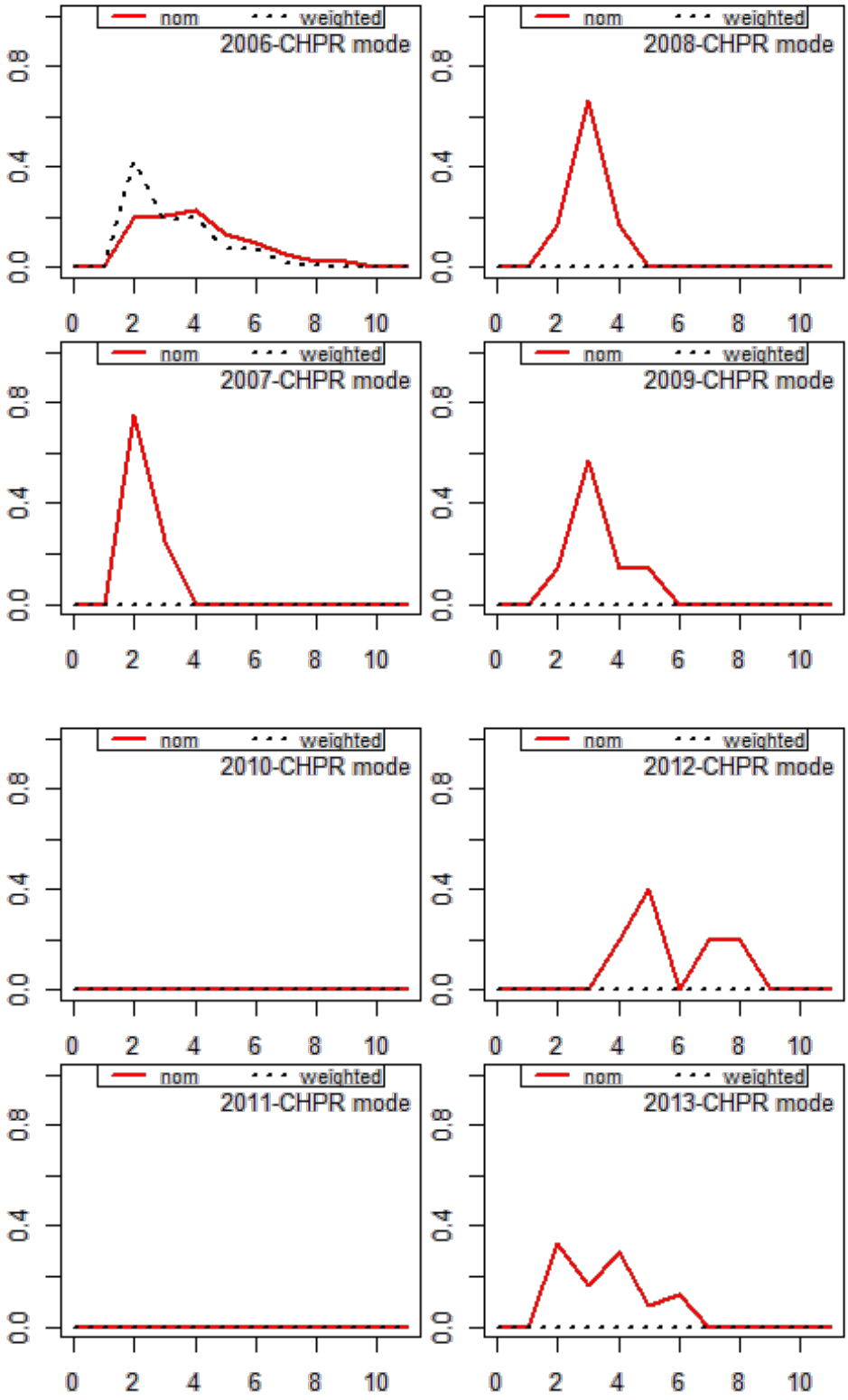

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