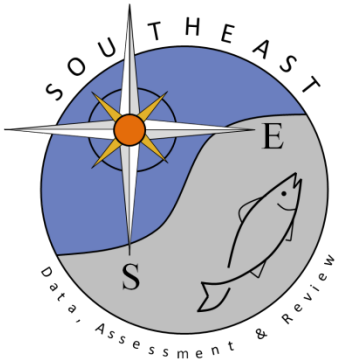
Length and age frequency distributions for red groupers collected in the Gulf of Mexico from 1984 to 2013

Ching-Ping Chih

SEDAR 42-DW-18

10 December 2014



Please cite this document as:

Chih, Ching-Ping. 2014. Length and age frequency distributions for red groupers collected in the Gulf ofMexico from 1984 to 2013. SEDAR42-DW-18. SEDAR, North Charleston, SC. 42 pp.

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Introduction

This report documents changes in the length frequency distributions (LFDs) and age frequency distributions (AFDs) of red groupers collected from the Gulf of Mexico from 1981 to 2013. The methods for estimating LFDs and AFDs for red groupers differ from those used in SEDAR 12 in several ways: (1) LFDs for hand line and long line strata were stratified into north and south regions due to apparent differences in LFDs between the two regions (Chih, 2014), (2) AFDs were reweighted by LFDs due to non-random sampling of some otolith samples, and (3) AFDs for handline and longline strata were also stratified into north and south regions due to apparent differences in ALKs between the two regions (Chih, 2014).

Materials and Methods

Length samples from commercial fisheries were obtained from the TIP database housed at the Southeast Fisheries Science Center (SEFSC). Commercial samples were grouped into three strata: handline, longline and trap (Table 1). Length samples for recreational fisheries (Table 2) were obtained from the Marine Recreational Fisheries Statistics Survey (i.e., the Marine Recreational Information Program, MRIP), the Head Boat Survey, the Gulf FIN database, and the TIP database. All recreational samples were combined into one stratum. Otolith samples were subsamples of length samples. Age samples were processed and read by the Panama City Laboratory, SEFSC. All lengths are fork lengths in centimeters. Conversion equations for different length types were from Lombardi-Carson (2014).

For the estimation of LFDs for longline and handline fisheries, samples were grouped into northern and southern Gulf regions that were separated at 28^{o} N latitude (Chih, 2014). The selection of 28° N latitude was based on the changes in LFDs/ALKs observed in different grids. For the estimation of LFDs for longline and handline samples collected before 2000, and for samples collected from trap and recreational fisheries, no stratification was done in order to match the stratification for age samples (see below).

For the estimation of AFDs, age samples were reweighted by length samples because some age samples were non-randomly selected. The reweighting method was published previously (Chih, 2009). The length interval used for reweighting procedure was 2 cm. For longline and handline samples collected during and after 2000, samples were grouped into northern and southern Gulf regions that were separated at 28^{o} N latitude. For each stratum, age samples from each region were first reweighted by the LFDs for that region. The resulting AFDs for the north and south regions were then combined and weighted by the landings of the two regions. For longline and handline samples collected before 2000, and for trap samples and recreational samples, AFDs were reweighted by the corresponding LFDs without stratification into north and south regions because of the small sizes of age samples (Table 3 & 4).

Results and Discussion

Small red groupers (fork length < 48 cm) were present in much greater proportions in all strata before the implementation of the 20 inch total length size limit in 1990 (Fig 1-4 (a)). Apparent increases in smaller fish were also observed for LFDs estimated from longline and handline samples collected after 2009, when size limits for commercial landings were reduced from 20 inches to 18 inches in total length (Fig 1-2 (e)). Overall, there was a greater proportion of larger fish in longline samples than in handline and trap samples. However, this may be due to a higher proportion of longline landings in the south Gulf region, where older and larger red groupers tend to aggregate (Chih, 2014).

Since red grouper ALKs in the south are different from those in the north, reweighted AFDs for each stratum can also be influenced by the proportion of landings in different regions. Overall, there was a greater proportion of older fish in longline samples compared to handline and trap samples, which could be due to a higher proportion of longline landings in the south Gulf region. Because of the small age sample sizes in some years/strata, the estimated AFDs from these strata need to be interpreted with caution. For example, age sample sizes for trap fisheries were small for all years except 2006 (Table 3). Such small age sample sizes may not fully represent age-length relationships for all age/length categories.

References

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Chih, C-P. 2014. Variations in length frequency distributions and age length keys for red groupers collected in the Gulf of Mexico SEDAR42-DW-12. SEDAR, North Charleston, SC. 26pp.

Lombardi-Carlson, L. 2014. An age and growth description of Red Grouper (*Epinephelus morio*) from the northeastern Gulf of Mexico: 1978-2013 for SEDAR42 SEDAR42-DW-10. SEDAR,North Charleston, SC. 37 pp.

Table 1. Sample sizes for length samples collected between 1984 and 2013 from commercial fisheries in the Gulf of Mexico.

Year	Handline	Longline	Trap	Total
1984	1383	1121	18	2522
1985	2051	1715	900	4666
1986	520	5761	1244	7525
1987	1106	2558	766	4430
1988	1137	1375		2512
1989	607	1793	341	2741
1990	945	10888	359	12192
1991	1850	12293	410	14553
1992	2445	8398	843	11686
1993	2516	9685	457	12658
1994	3235	8217	207	11659
1995	3298	11097	342	14737
1996	3094	9756	702	13552
1997	2417	13668	1522	17607
1998	3479	28933	1060	33472
1999	6752	44233	1883	52868
2000	7753	30163	2702	40618
2001	6958	20007	3962	30927
2002	5464	18120	2178	25762
2003	2977	13663	1342	17982
2004	2852	10973	384	14209
2005	1888	7668	584	10140
2006	873	4487	989	6349
2007	1434	2890		4324
2008	1483	4653		6136
2009	4032	1966		5998
2010	3324	2400		5724
2011	6134	4670		10804
2012	10728	7140		17868
2013	9922	7206		17128

Table 2. Sample sizes for length samples collected between 1984 and 2013 from recreational fisheries in the Gulf of Mexico.

Year	Charter boat	Private boat	Head boat	Total
1981	12	10	20	42
1982	1	74	5	80
1983	10	50	35	95
1984	65	22	47	134
1985		11	31	42
1986	39	21	367	427
1987	26	93	546	665
1988	49	182	353	584
1989	48	150	699	897
1990	13	43	240	296
1991	53	91	109	253
1992	142	217	56	415
1993	78	120	36	234
1994	135	103	56	294
1995	73	100	57	230
1996	123	34	79	236
1997	109	32	69	210
1998	189	83	49	321
1999	261	136	112	509
2000	373	143	69	585
2001	369	121	55	545
2002	535	130	144	809
2003	668	102	219	989
2004	1418	279	175	1872
2005	1178	108	77	1363
2006	447	48	87	582
2007	289	90	136	515
2008	280	89	124	493
2009	222	79	145	446
2010	421	135	120	676
2011	631	84	168	883
2012	721	166	157	1044
2013	831	244	183	1258

Table 3. Sample sizes for age samples collected between 1984 and 2013 from commercial fisheries in the Gulf of Mexico.

Year	Handline	Longline	Trap	Total
1991	43	37	2	82
1992	42	143	14	199
1993	93	200	84	377
1994	239	88	29	356
1995	180	140	39	359
1996	141	96	8	245
1997	35	7	17	59
1998	39	122	33	194
1999	77	643	31	751
2000	206	405	38	649
2001	575	1210	39	1824
2002	573	1067	89	1729
2003	561	1080	65	1706
2004	1062	1153	38	2253
2005	626	1455		2081
2006	629	538	173	1340
2007	497	599		1096
2008	503	509		1012
2009	895	994		1889
2010	1030	650		1680
2011	629	499		1128
2012	1019	861		1880
2013	558	1130		1688

Table 4. Sample sizes for age samples collected between 1991 and 2013 from recreational fisheries in the Gulf of Mexico.

Year	Charter boat	Private boat	Head boat	Total
1991	1		36	37
1992	24	1	33	58
1993	61	1	21	83
1994	72		29	101
1995	91		53	144
1996	134		41	175
1997	61	9	28	98
1998	72	4	21	97
1999	104	2	8	114
2000	59		12	71
2001	45	2	1	48
2002	292	7	50	349
2003	101	68	30	199
2004	144	41	43	228
2005	64	1	52	117
2006	38	6	33	77
2007	52	10	28	90
2008	73	32	44	149
2009	90	27	102	219
2010	263	47	85	395
2011	391	13	114	518
2012	223	14	39	276
2013	216	25	45	286

Fig 1 (a) Length frequency distributions (LFDs) for red grouper length samples collected between 1984 and 1989 from handline fisheries in the Gulf of Mexico.

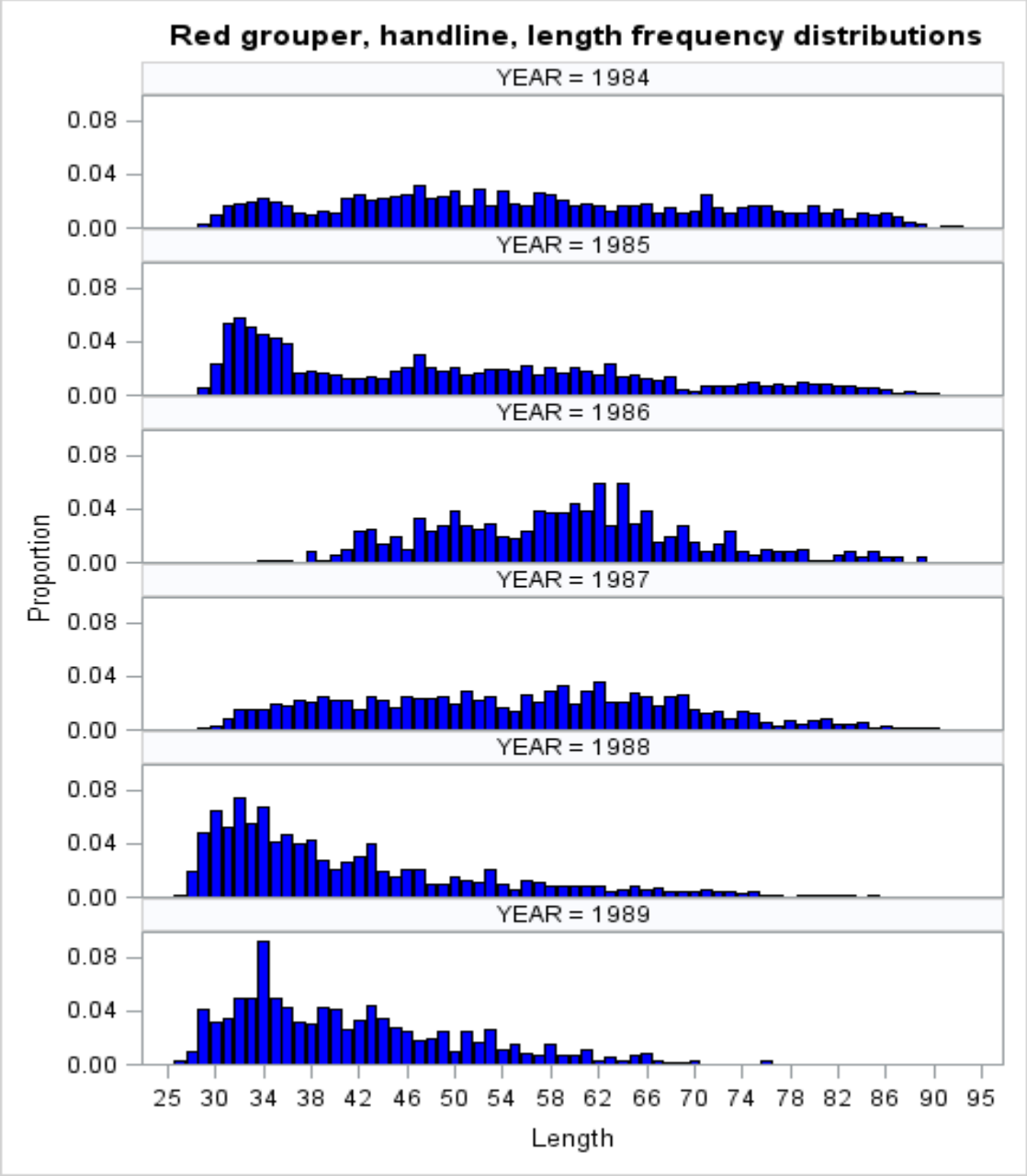

Fig 1 (b) Length frequency distributions (LFDs) for red grouper length samples collected between 1990 and 1995 from handline fisheries in the Gulf of Mexico.

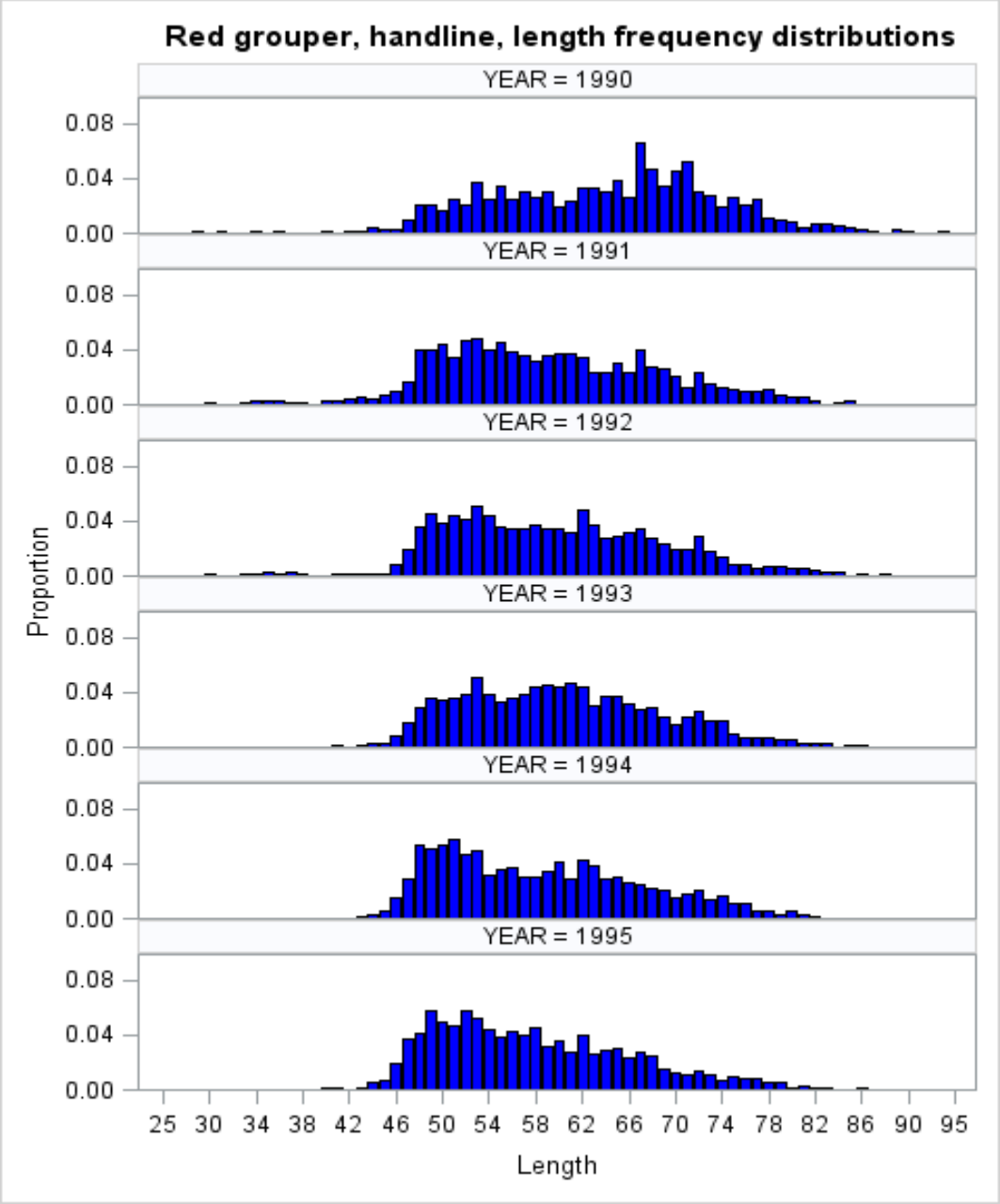

Fig 1 (c) Length frequency distributions (LFDs) for red grouper length samples collected between 1996 and 2001 from handline fisheries in the Gulf of Mexico.

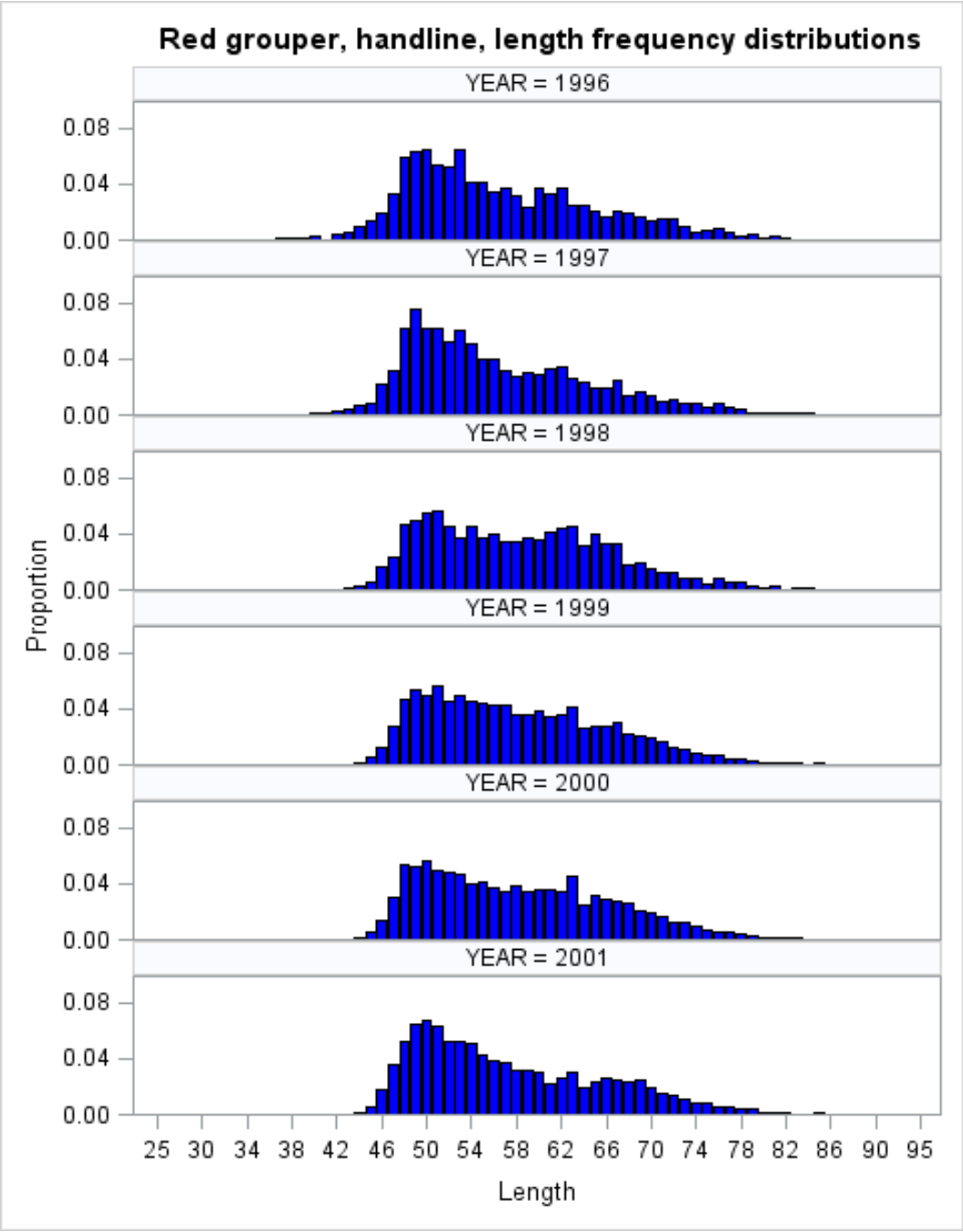

Fig 1 (d) Length frequency distributions (LFDs) for red grouper length samples collected between 2002 and 2007 from handline fisheries in the Gulf of Mexico.

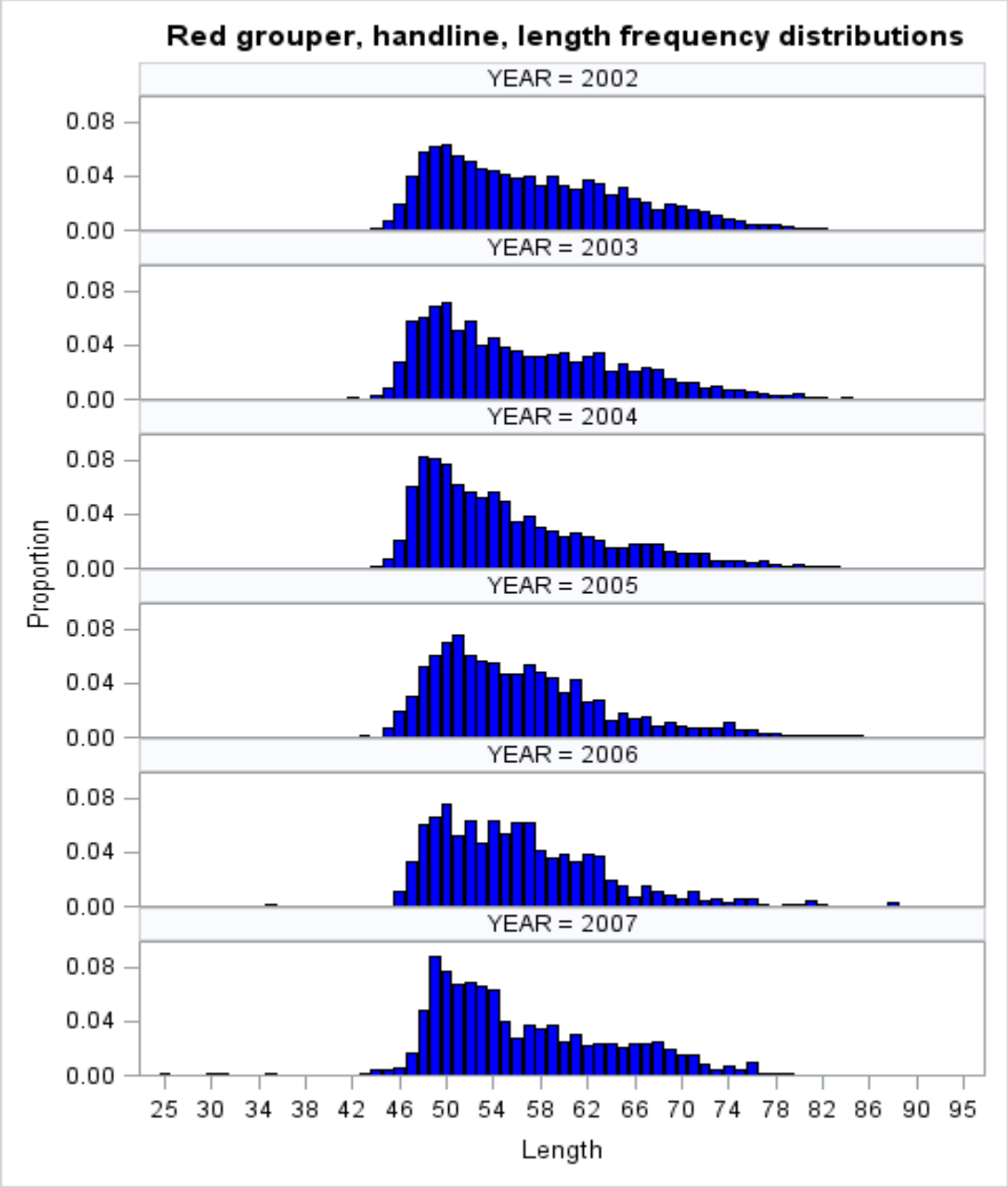

Fig 1 (e) Length frequency distributions (LFDs) for red grouper length samples collected between 2008 and 2013 from handline fisheries in the Gulf of Mexico.

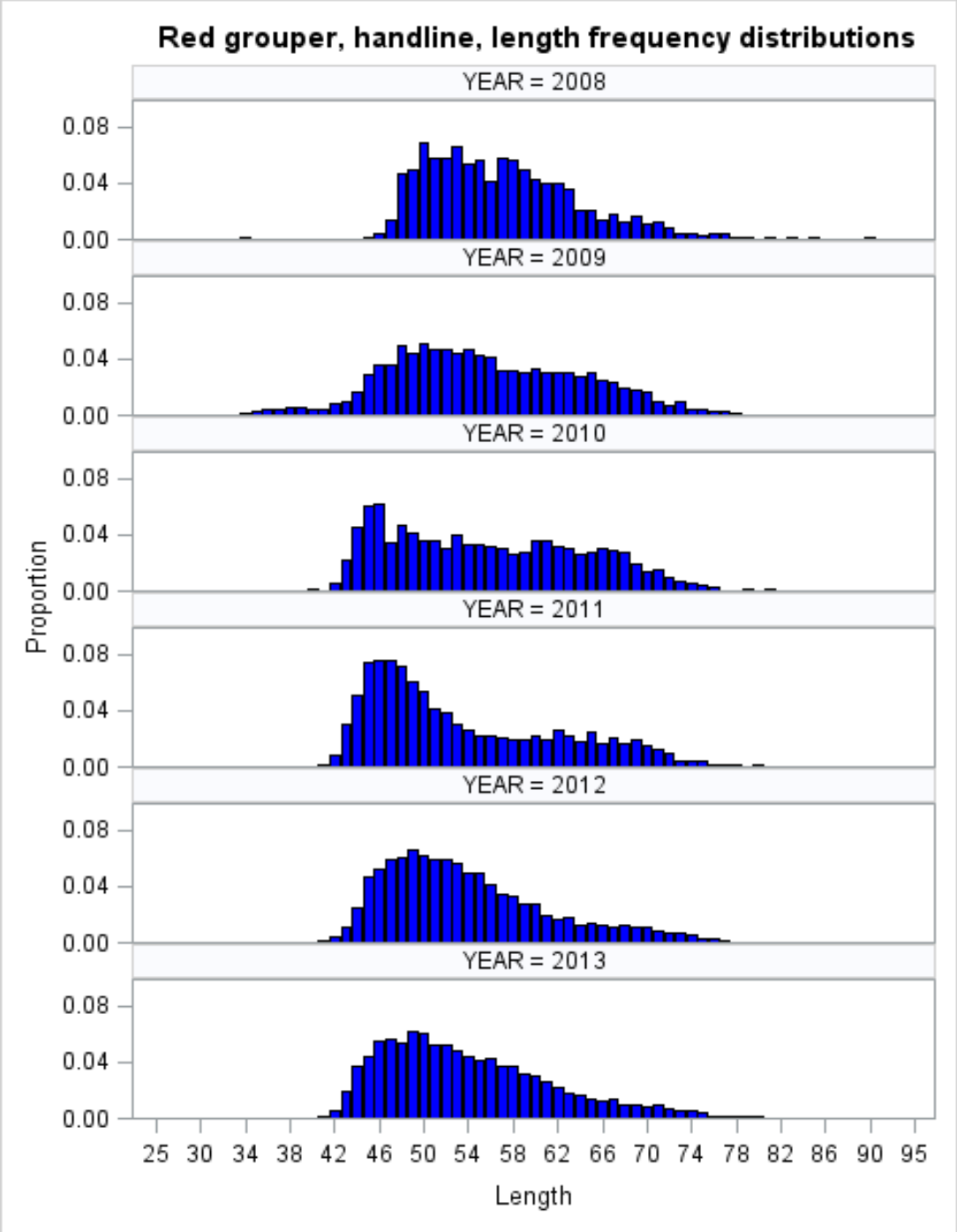

Fig 2 (a) Length frequency distributions (LFDs) for red grouper length samples collected between 1984 and 1989 from longline fisheries in the Gulf of Mexico.

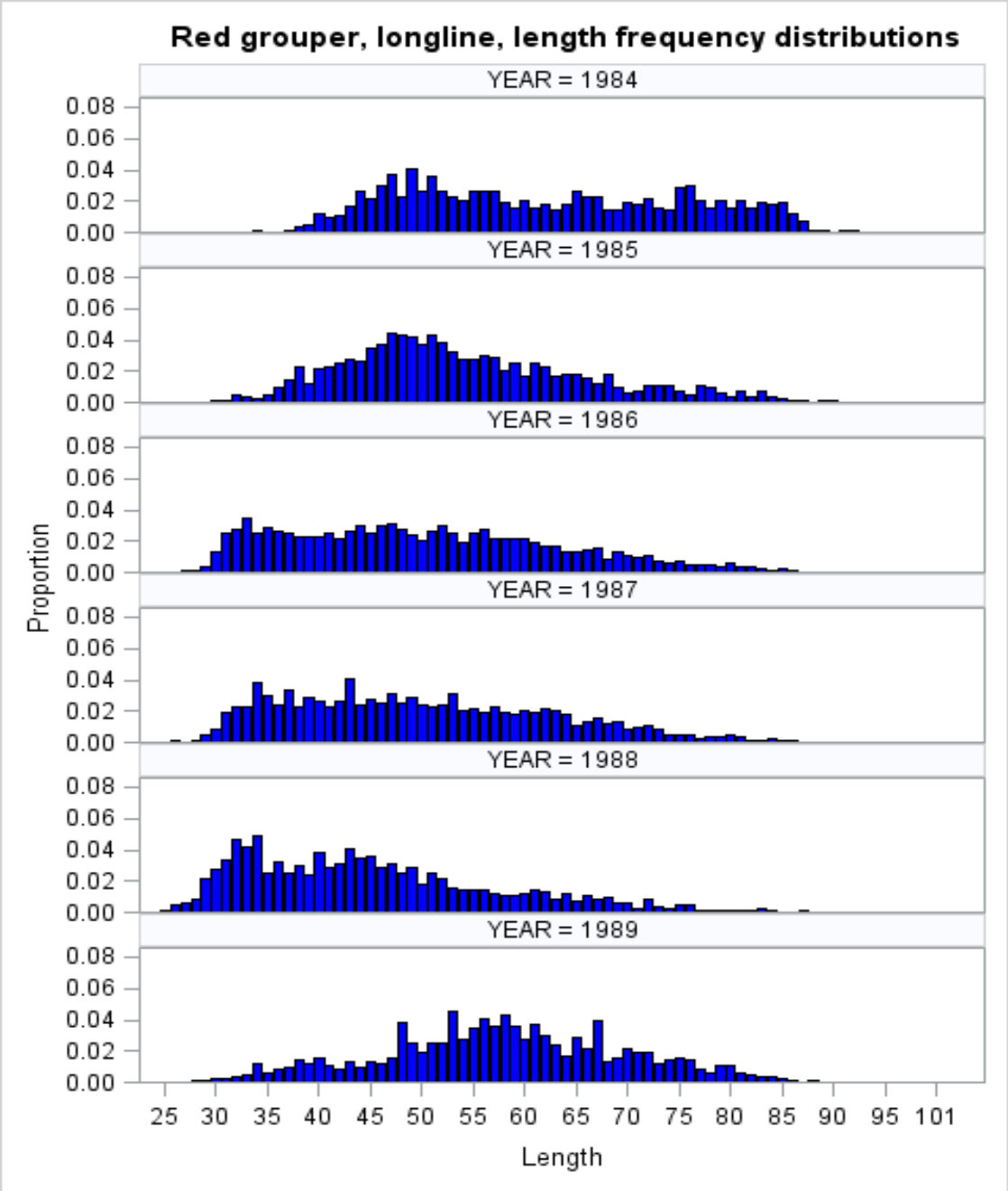

Fig 2 (b) Length frequency distributions (LFDs) for red grouper length samples collected between 1990 and 1995 from longline fisheries in the Gulf of Mexico.

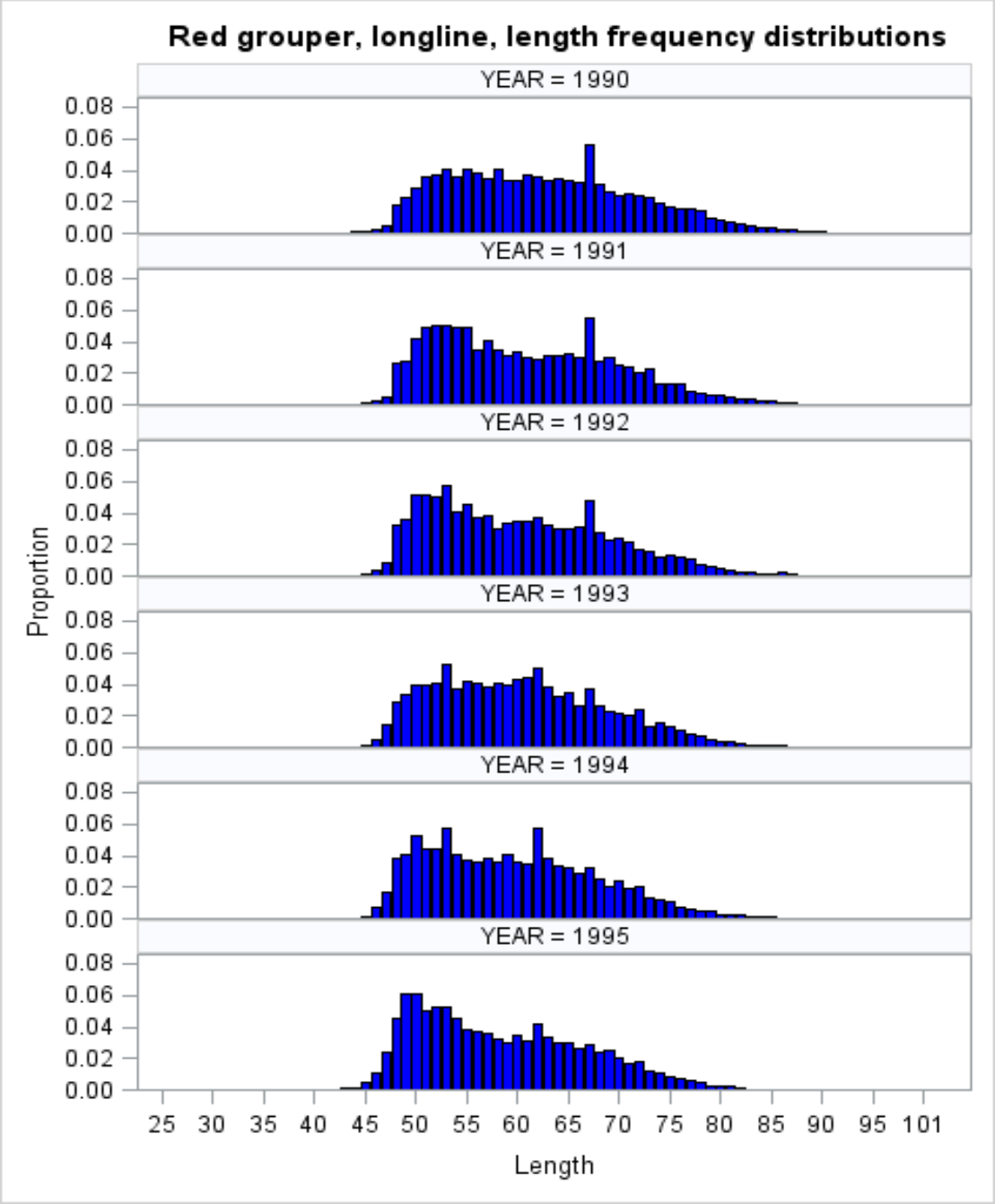

Fig 2 (c) Length frequency distributions (LFDs) for red grouper length samples collected between 1996 and 2001 from longline fisheries in the Gulf of Mexico.

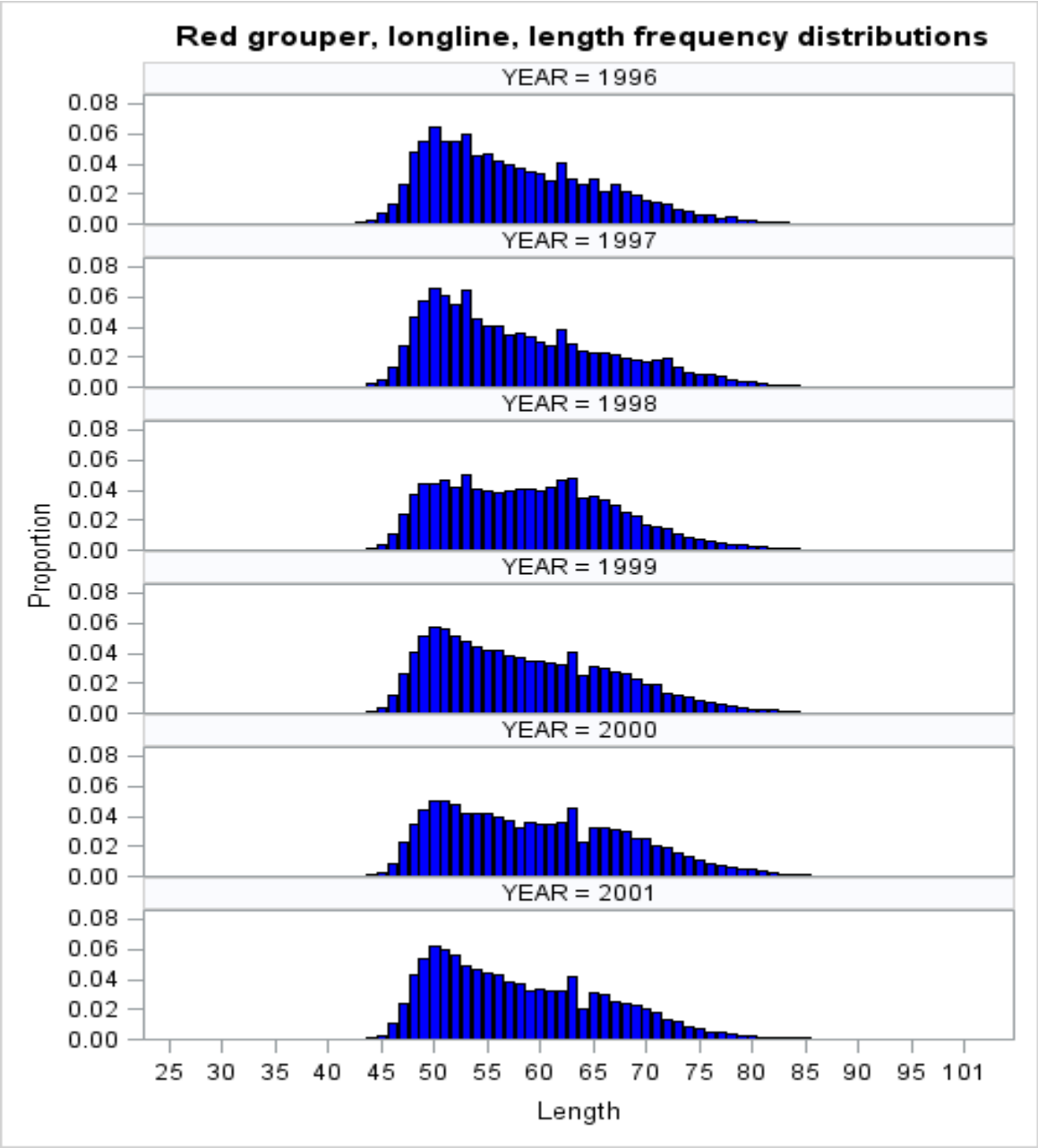

Fig 2 (d) Length frequency distributions (LFDs) for red grouper length samples collected between 2002 and 2007 from longline fisheries in the Gulf of Mexico.

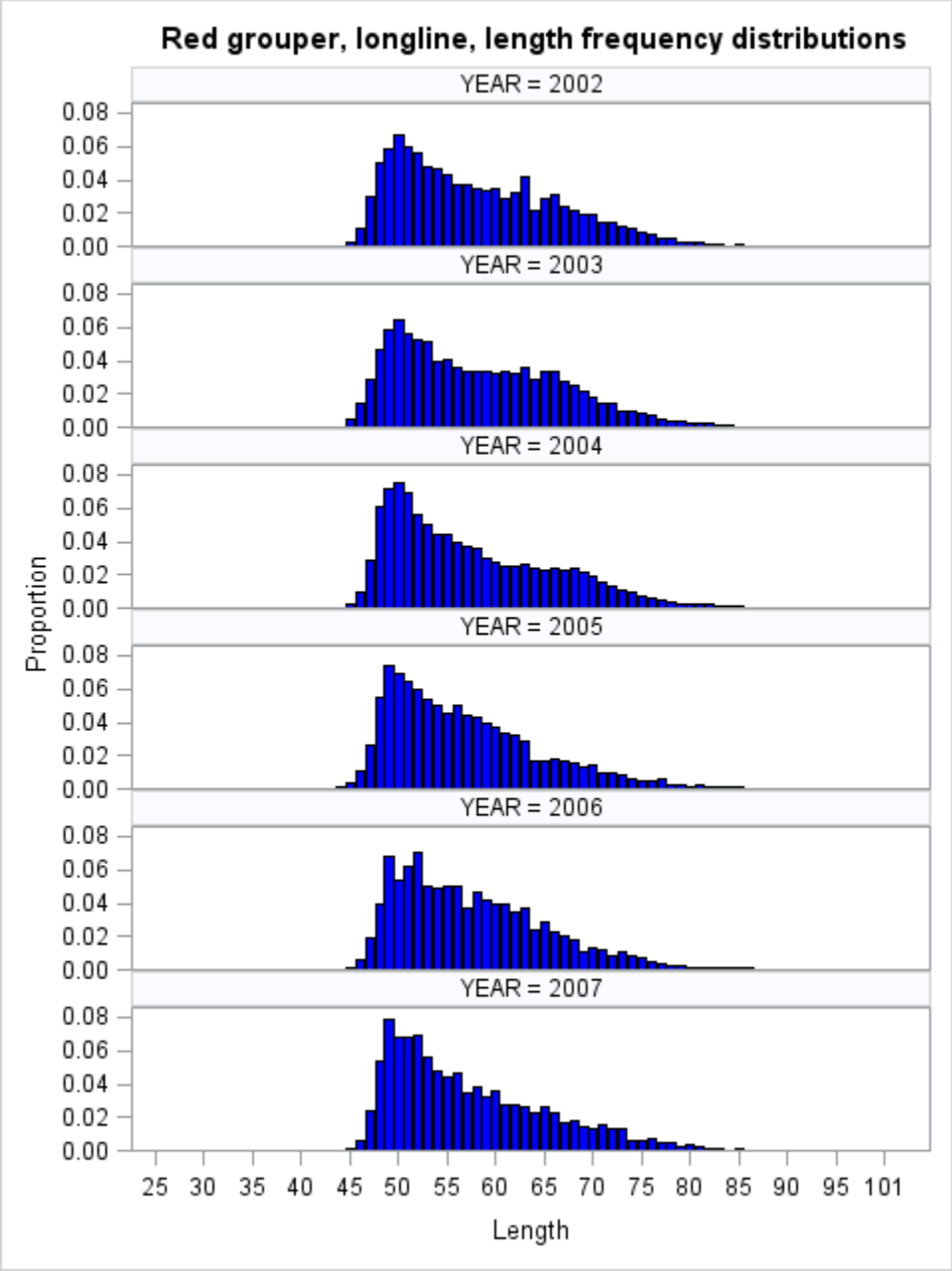

Fig 2 (e) Length frequency distributions (LFDs) for red grouper length samples collected between 2008 and 2013 from longline fisheries in the Gulf of Mexico.

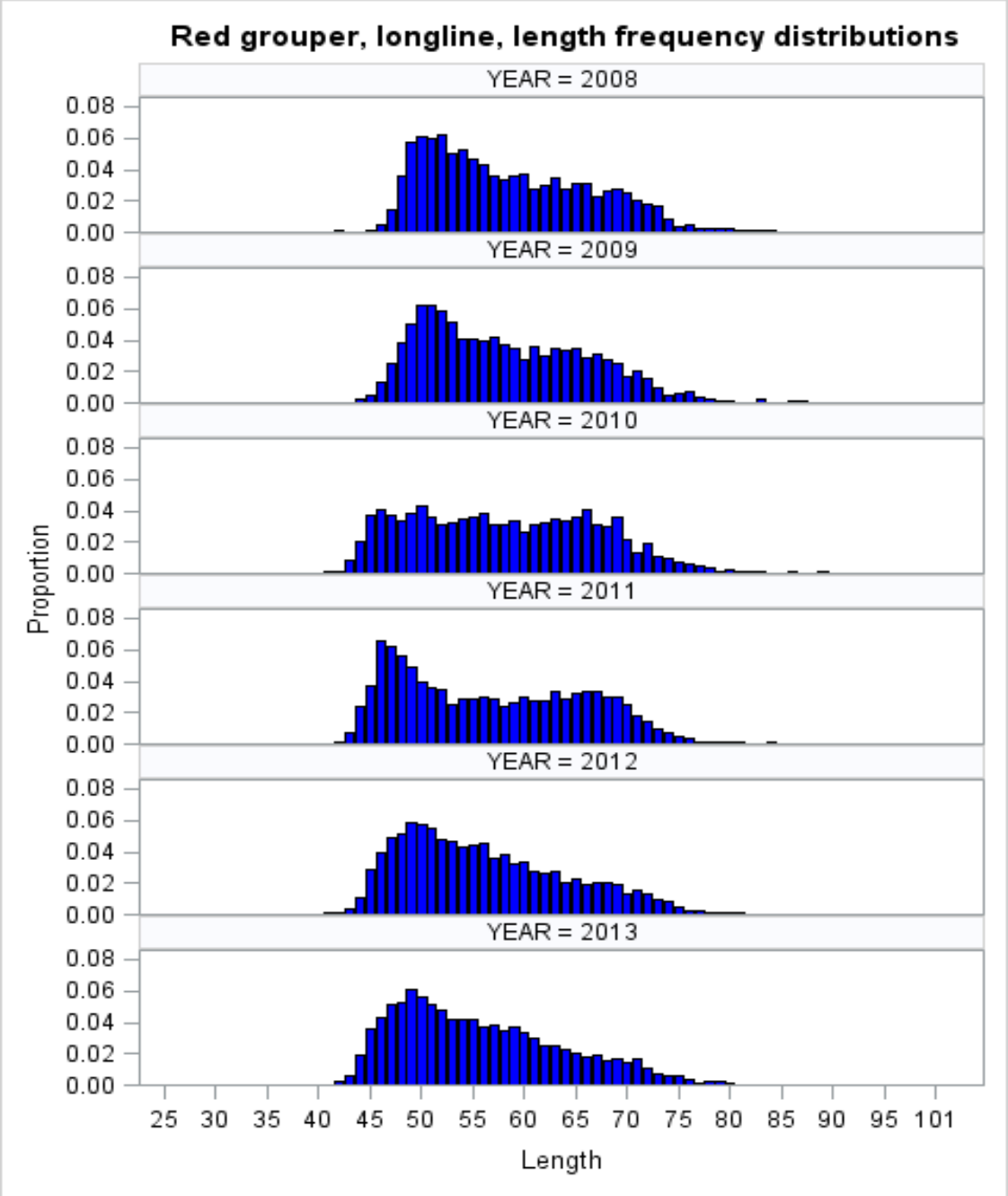

Fig 3 (a) Length frequency distributions (LFDs) for red grouper length samples collected between 1984 and 1990 from trap fisheries in the Gulf of Mexico.

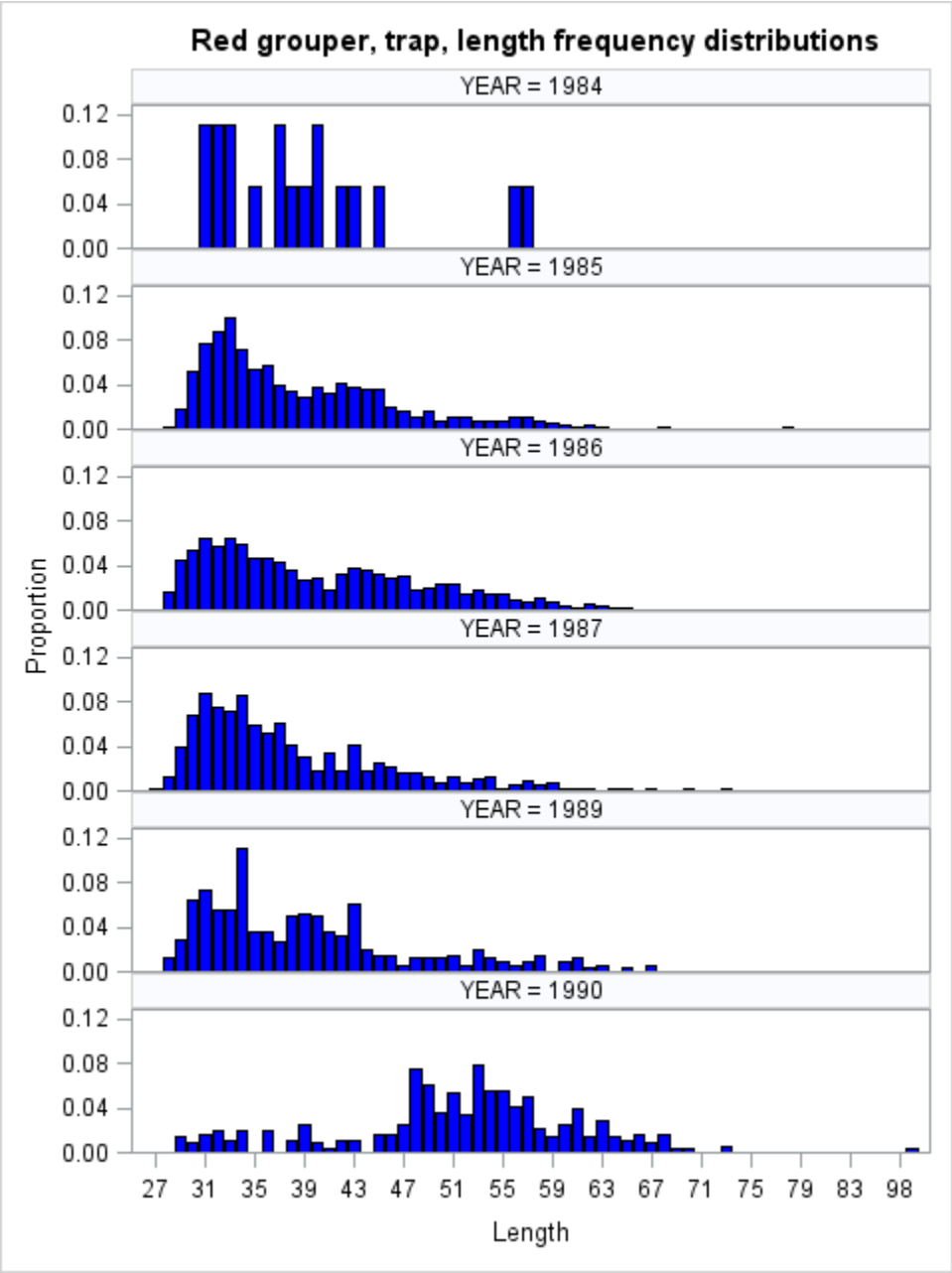

Fig 3 (b) Length frequency distributions (LFDs) for red grouper length samples collected between 1991 and 1996 from trap fisheries in the Gulf of Mexico.

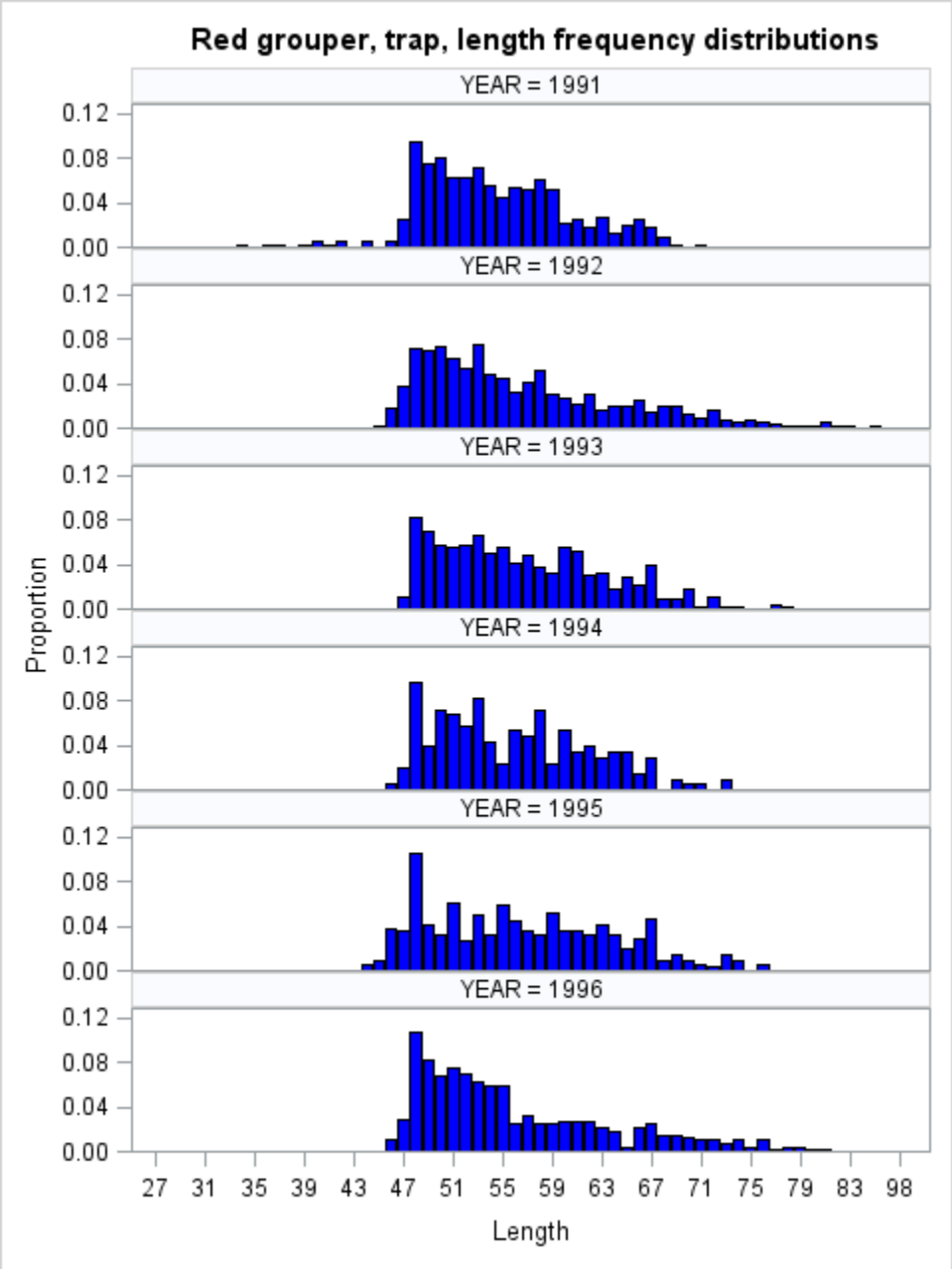

Fig 3 (c) Length frequency distributions (LFDs) for red grouper length samples collected between 1997 and 2002 from trap fisheries in the Gulf of Mexico.

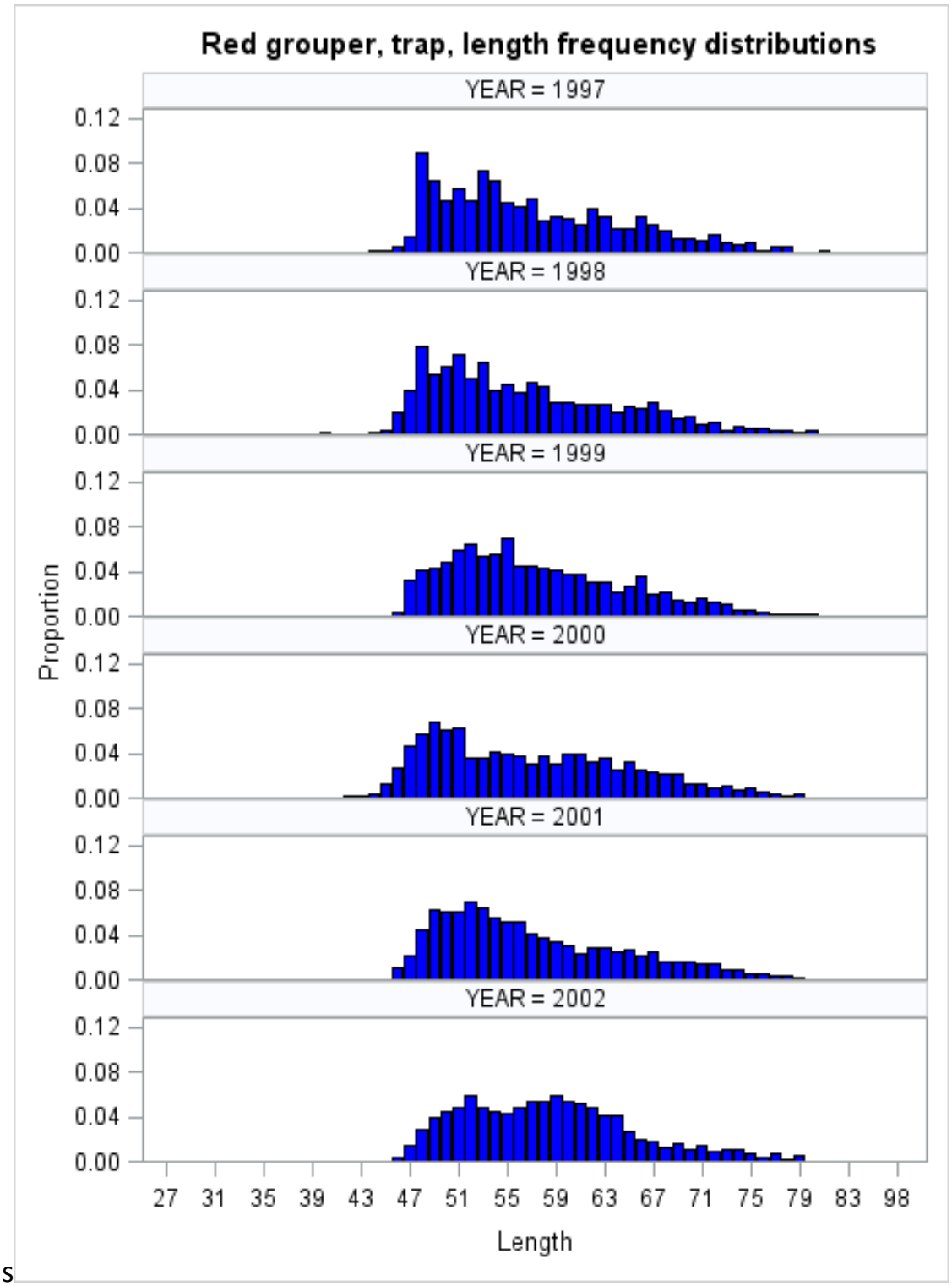

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Fig 3 (d) Length frequency distributions (LFDs) for red grouper length samples collected between 2003 and 2006 from trap fisheries in the Gulf of Mexico.

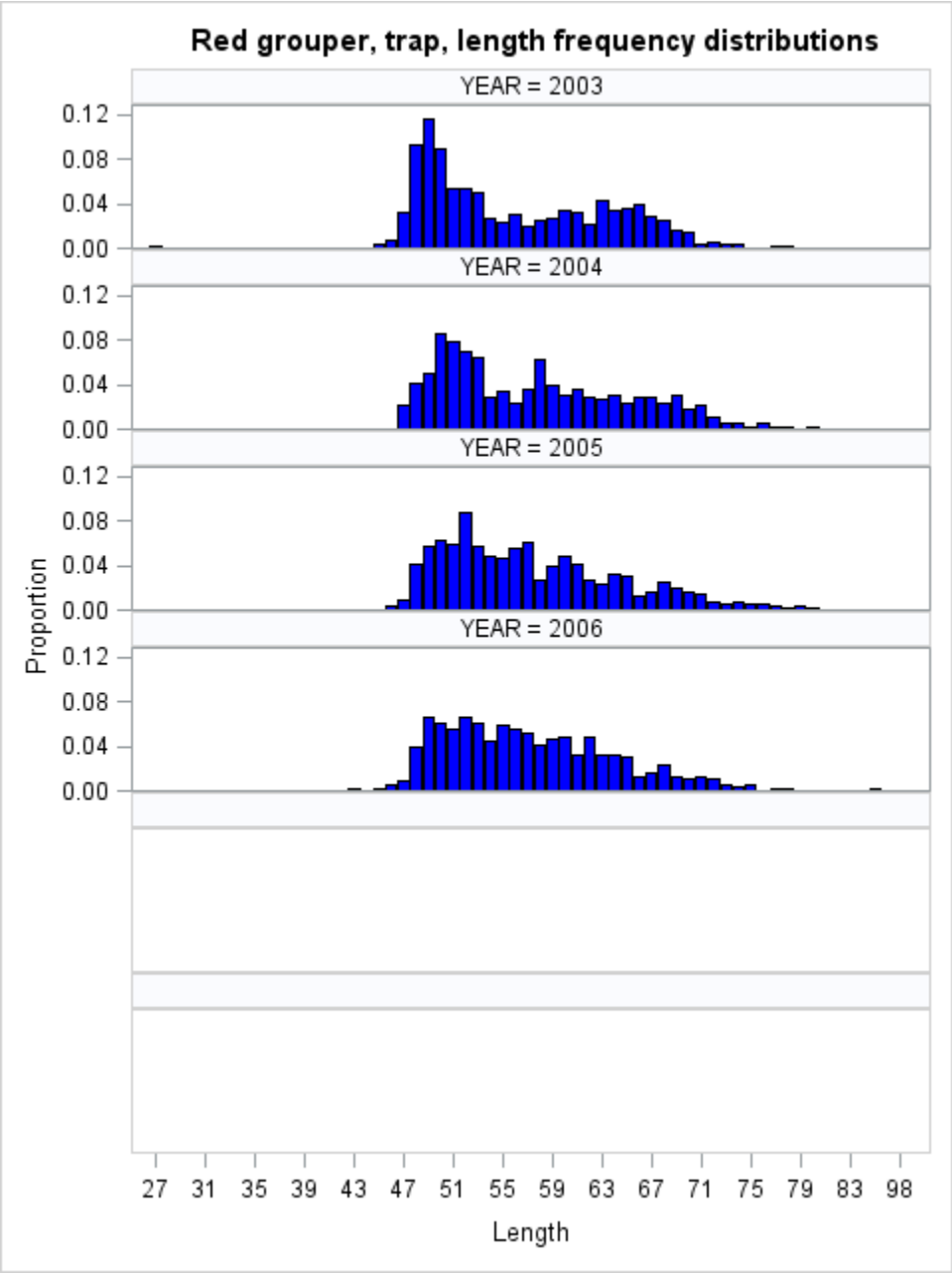

Fig 4 (a) Length frequency distributions (LFDs) for red grouper length samples collected between 1981 and 1986 from recreational fisheries in the Gulf of Mexico.

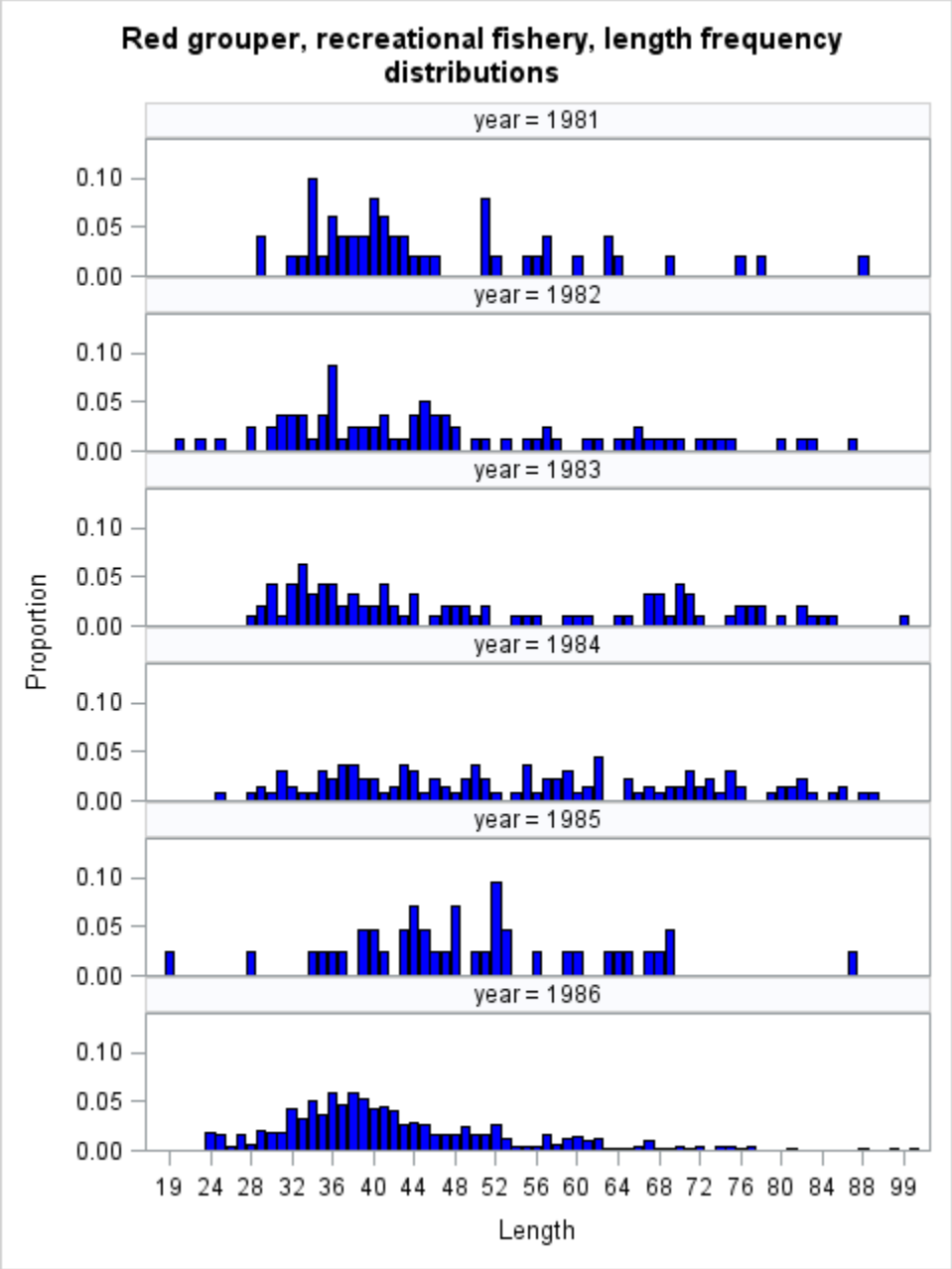

Fig 4 (b) Length frequency distributions (LFDs) for red grouper length samples collected between 1987 and 1992 from recreational fisheries in the Gulf of Mexico.

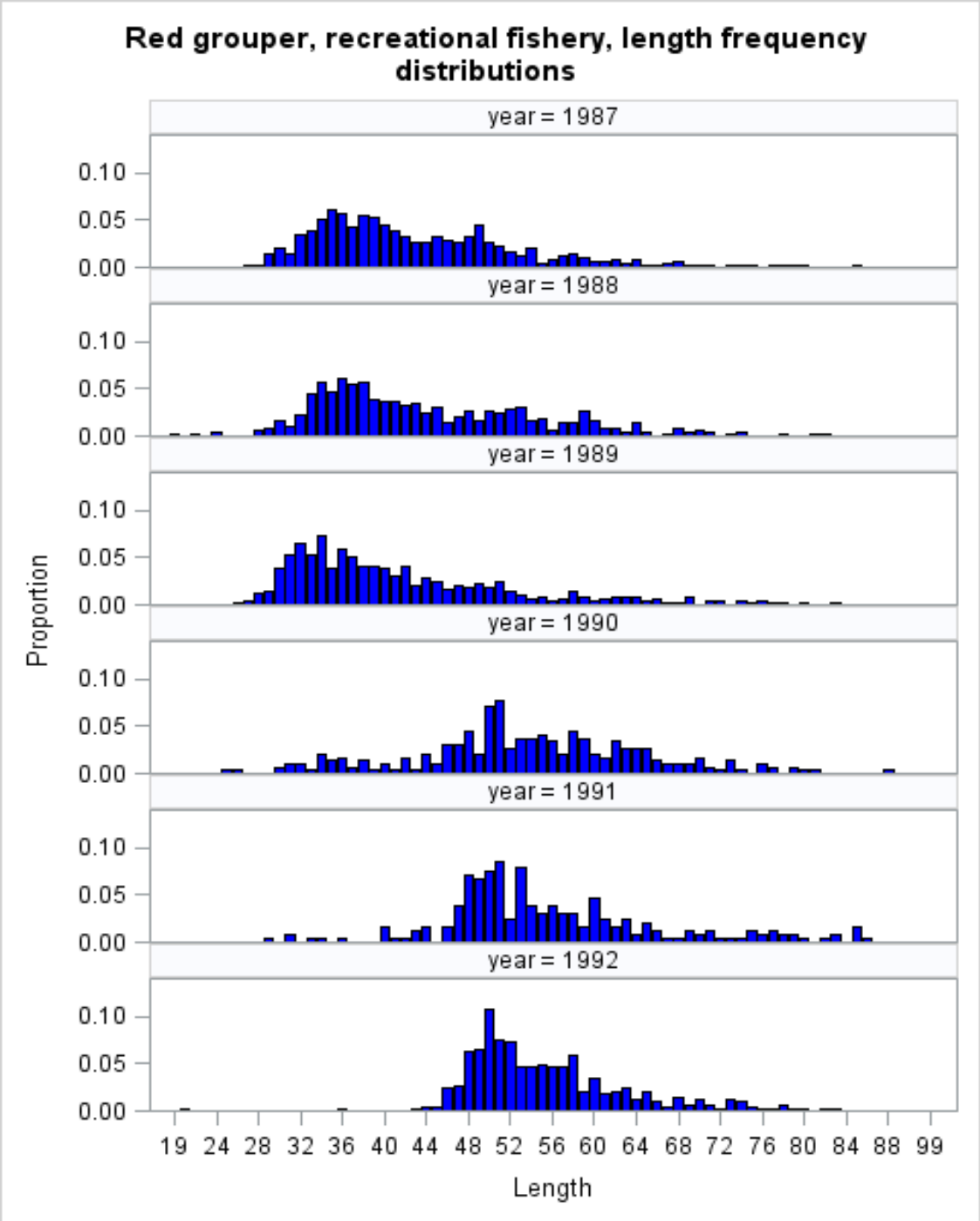

Fig 4 (c) Length frequency distributions (LFDs) for red grouper length samples collected between 1993 and 1998 from recreational fisheries in the Gulf of Mexico.

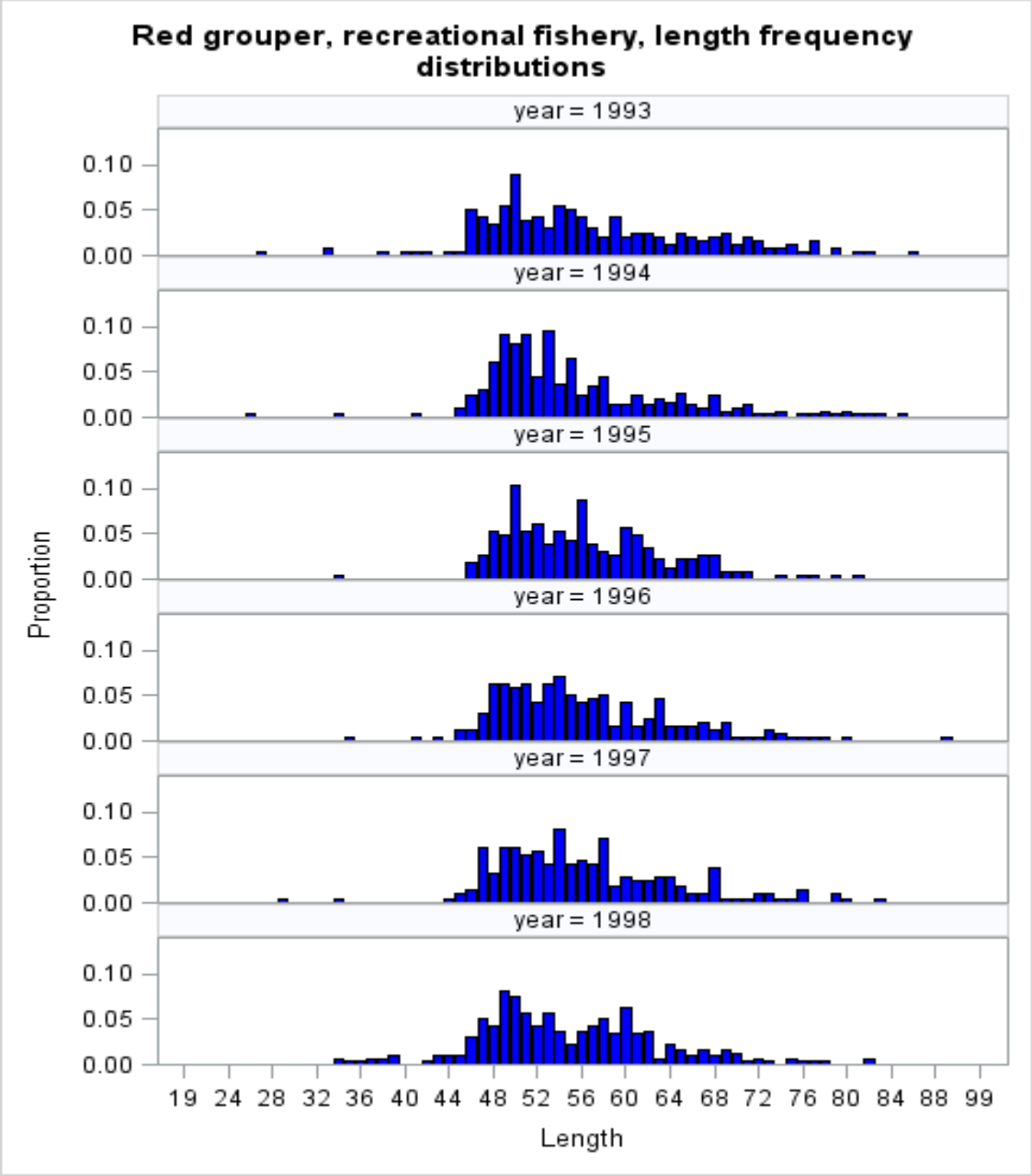

Fig 4 (d) Length frequency distributions (LFDs) for red grouper length samples collected between 1999 and 2004 from recreational fisheries in the Gulf of Mexico.

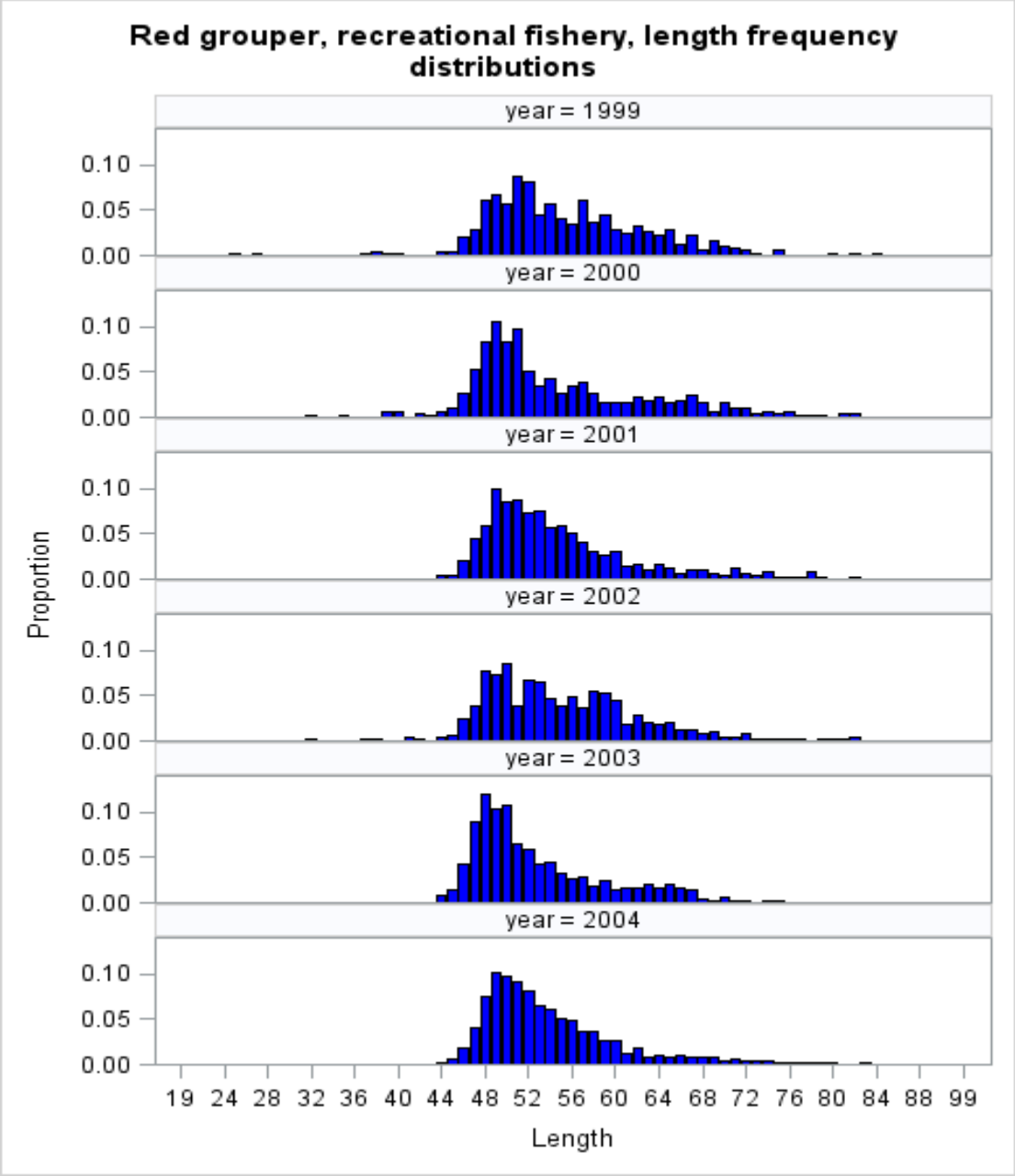

Fig 4 (e) Length frequency distributions (LFDs) for red grouper length samples collected between 2005 and 2010 from recreational fisheries in the Gulf of Mexico.

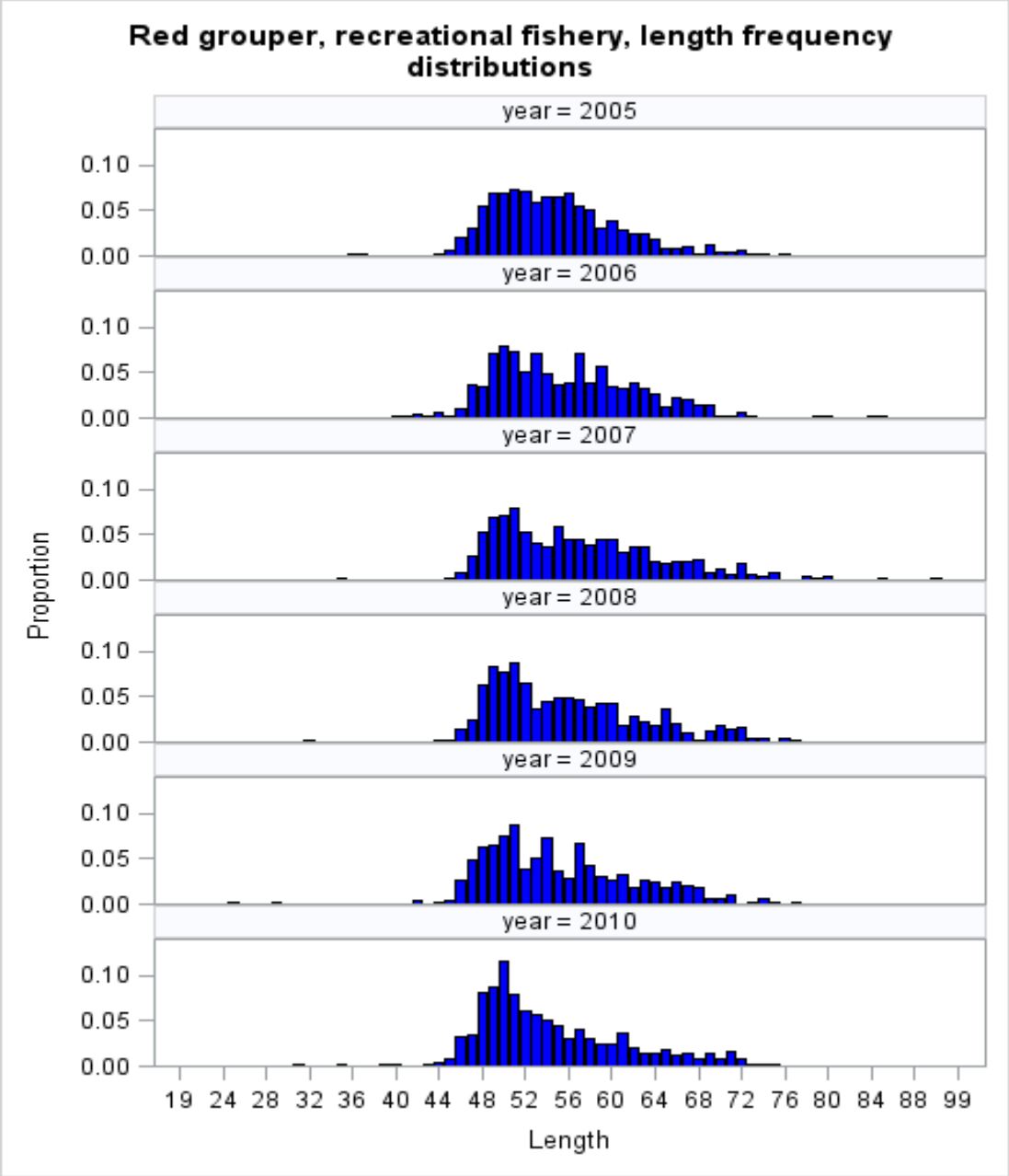

Fig 4 (f) Length frequency distributions (LFDs) for red grouper length samples collected between 2011 and 2013 from recreational fisheries in the Gulf of Mexico.

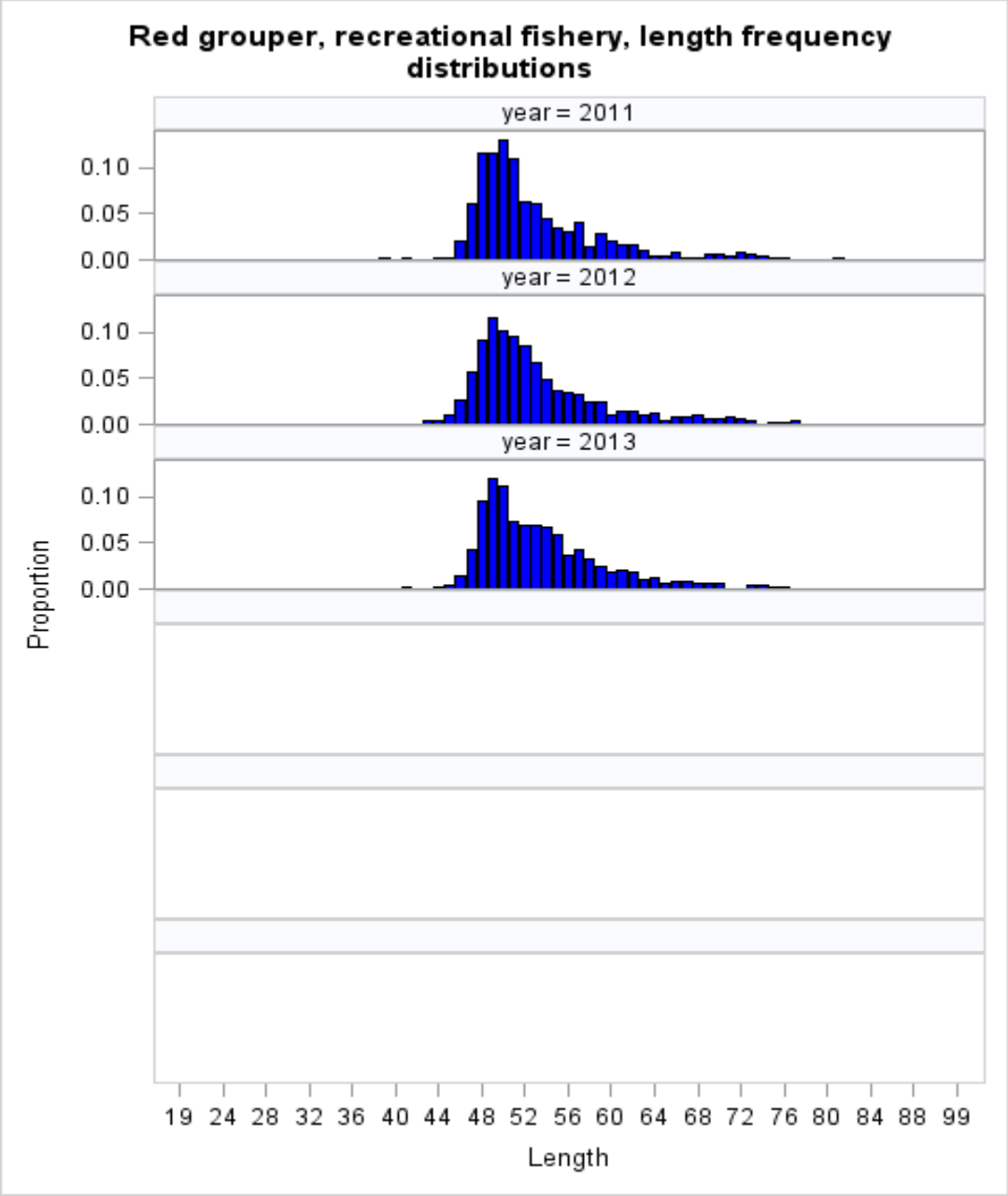

Fig 5 (a) Reweighted age frequency distributions (AFDs) for red grouper age samples between 1991 and 1996 collected from handline fisheries in the Gulf of Mexico.

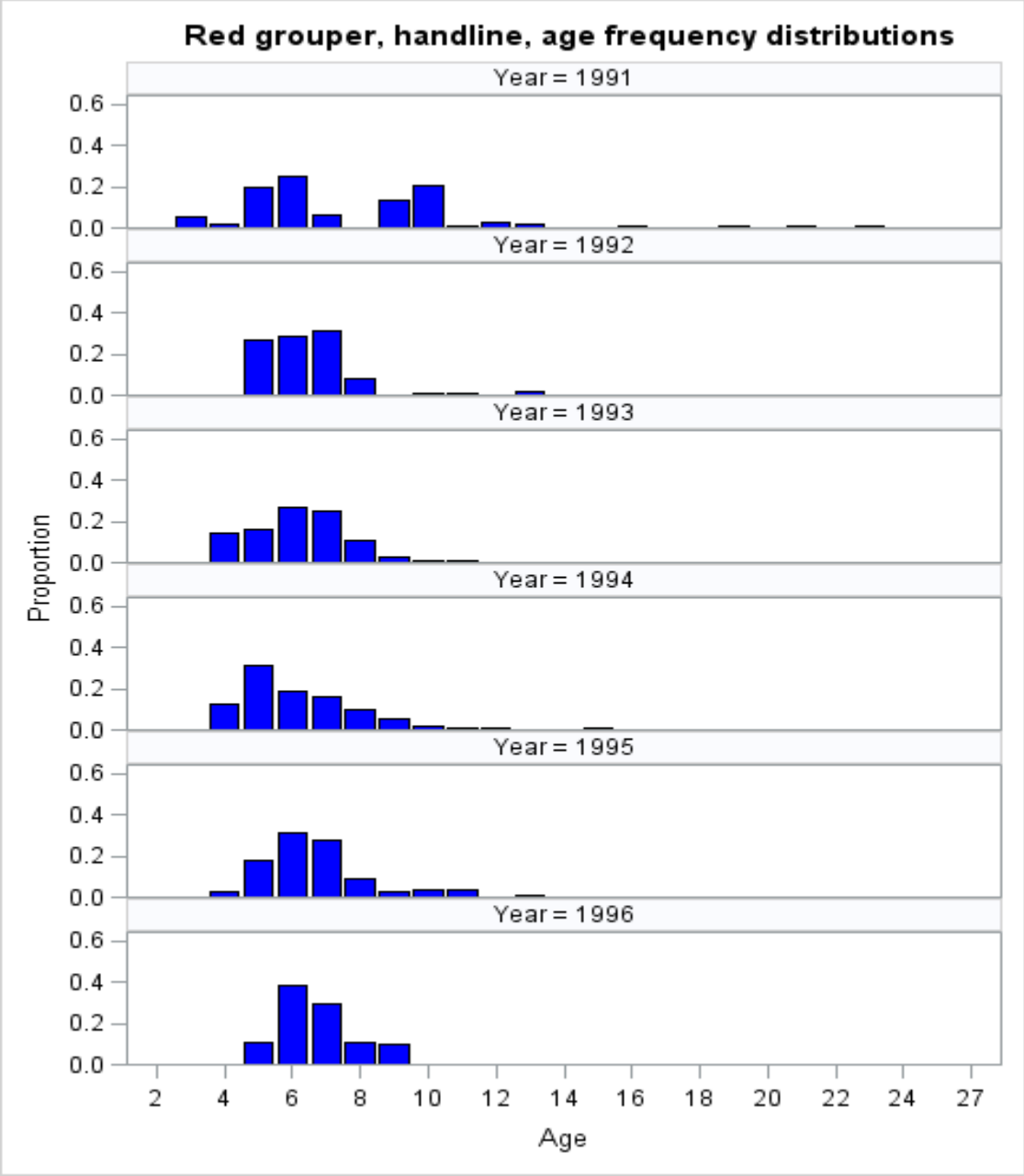

Fig 5 (b)Reweighted age frequency distributions (AFDs) for red grouper age samples collected between 1997 and 2002 from handline fisheries in the Gulf of Mexico.

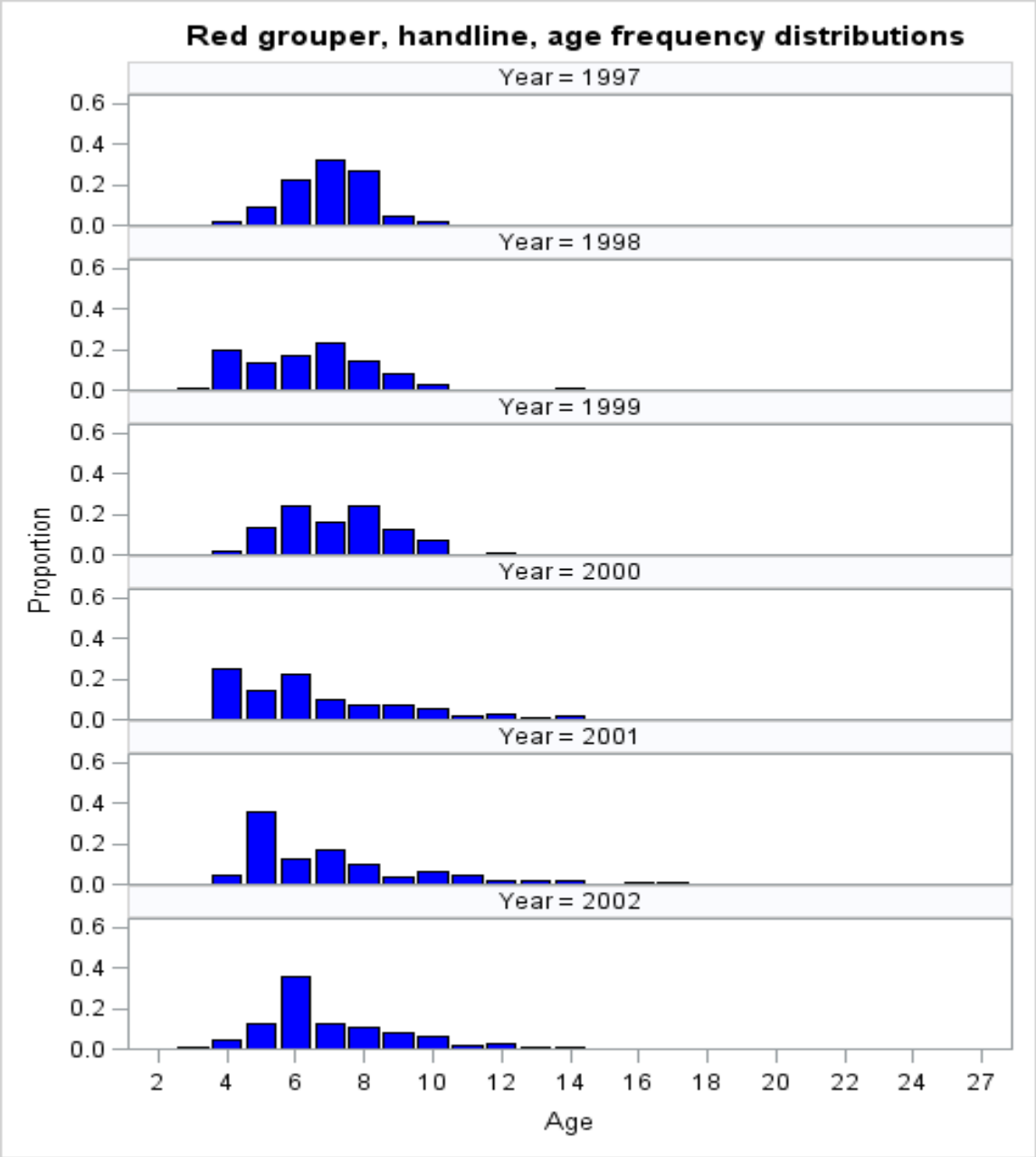

Fig 5 (c) Reweighted age frequency distributions (AFDs) for red grouper age samples collected between 2003 and 2008 from handline fisheries in the Gulf of Mexico.

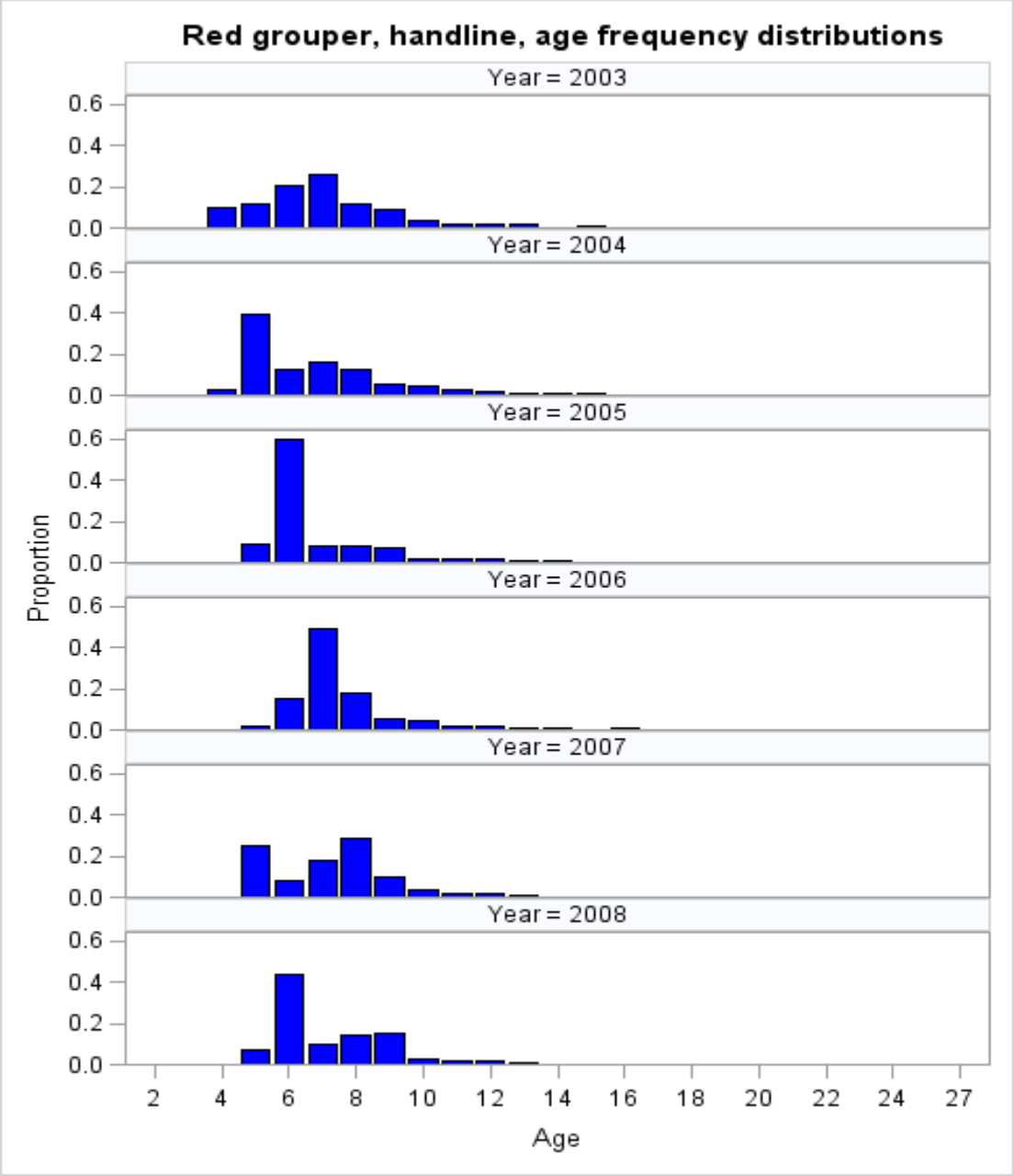

Fig 5 (d) Reweighted age frequency distributions (AFDs) for red grouper age samples collected between 2009 and 2013 from handline fisheries in the Gulf of Mexico.

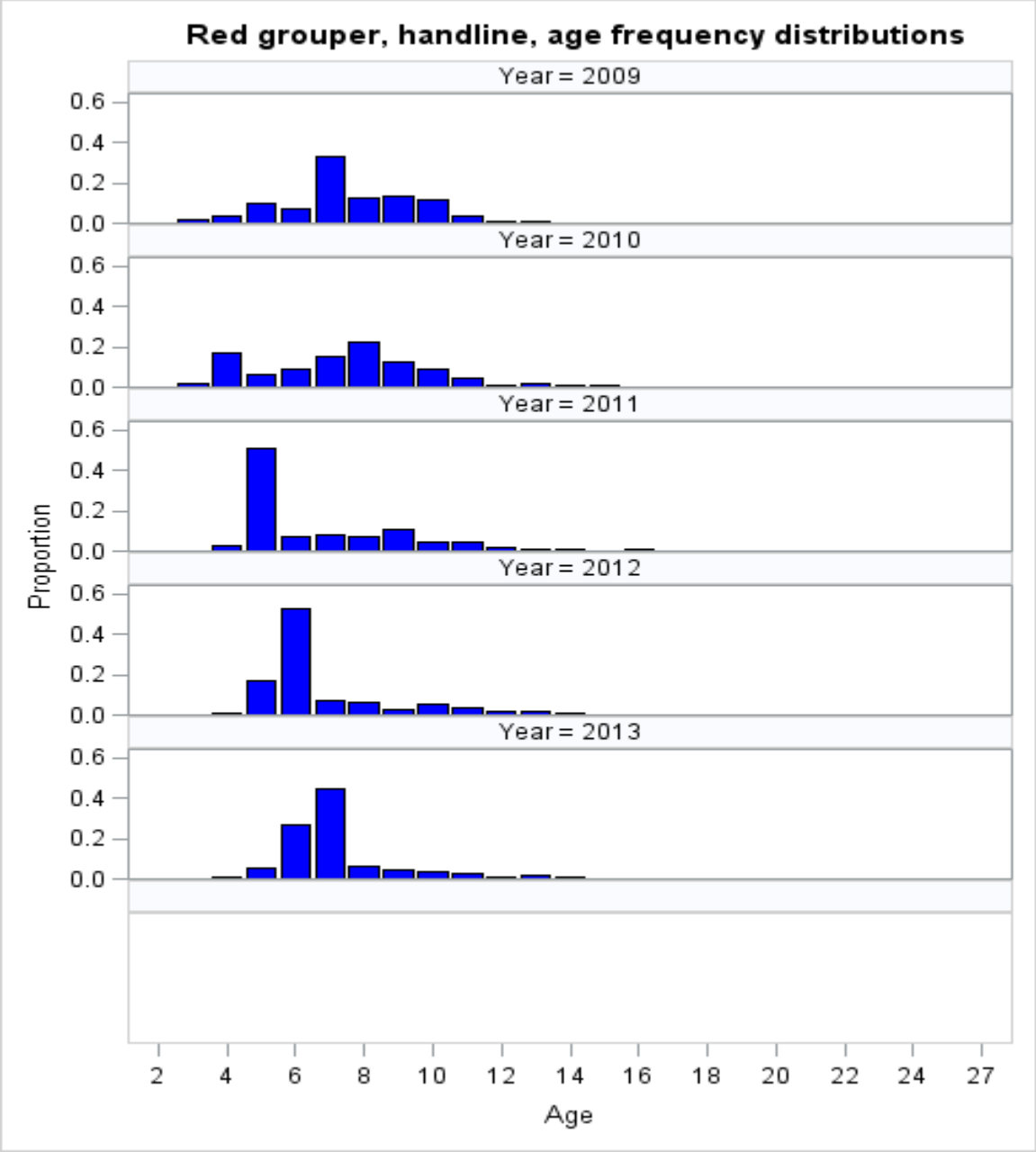

Fig 6 (a) Reweighted age frequency distributions (AFDs) for red grouper age samples collected between 1991-1996 and 2013 from longline fisheries in the Gulf of Mexico.

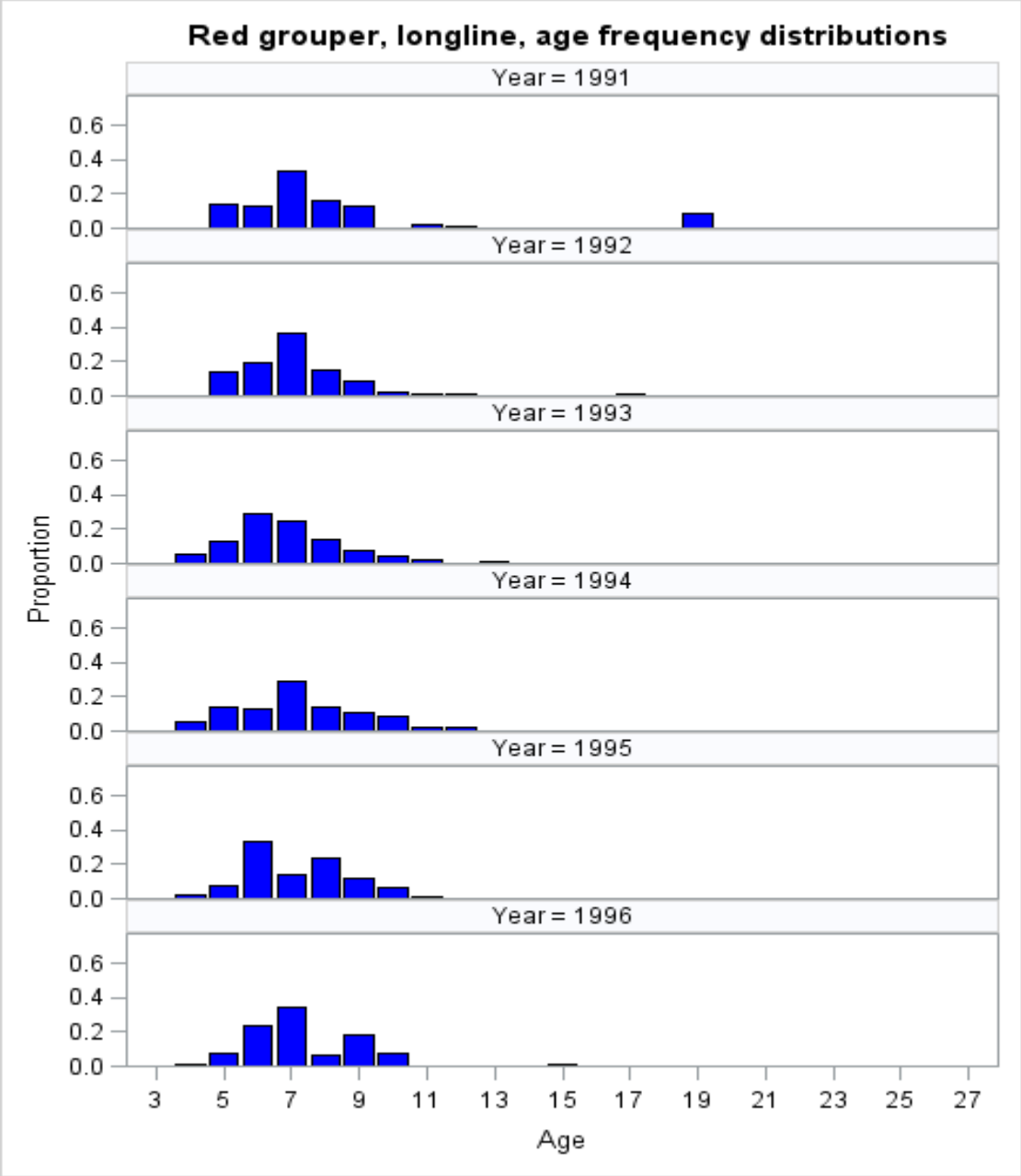

Fig 6(b) Reweighted age frequency distributions (AFDs) for red grouper age samples collected between 1997 and 2002 from longline fisheries in the Gulf of Mexico.

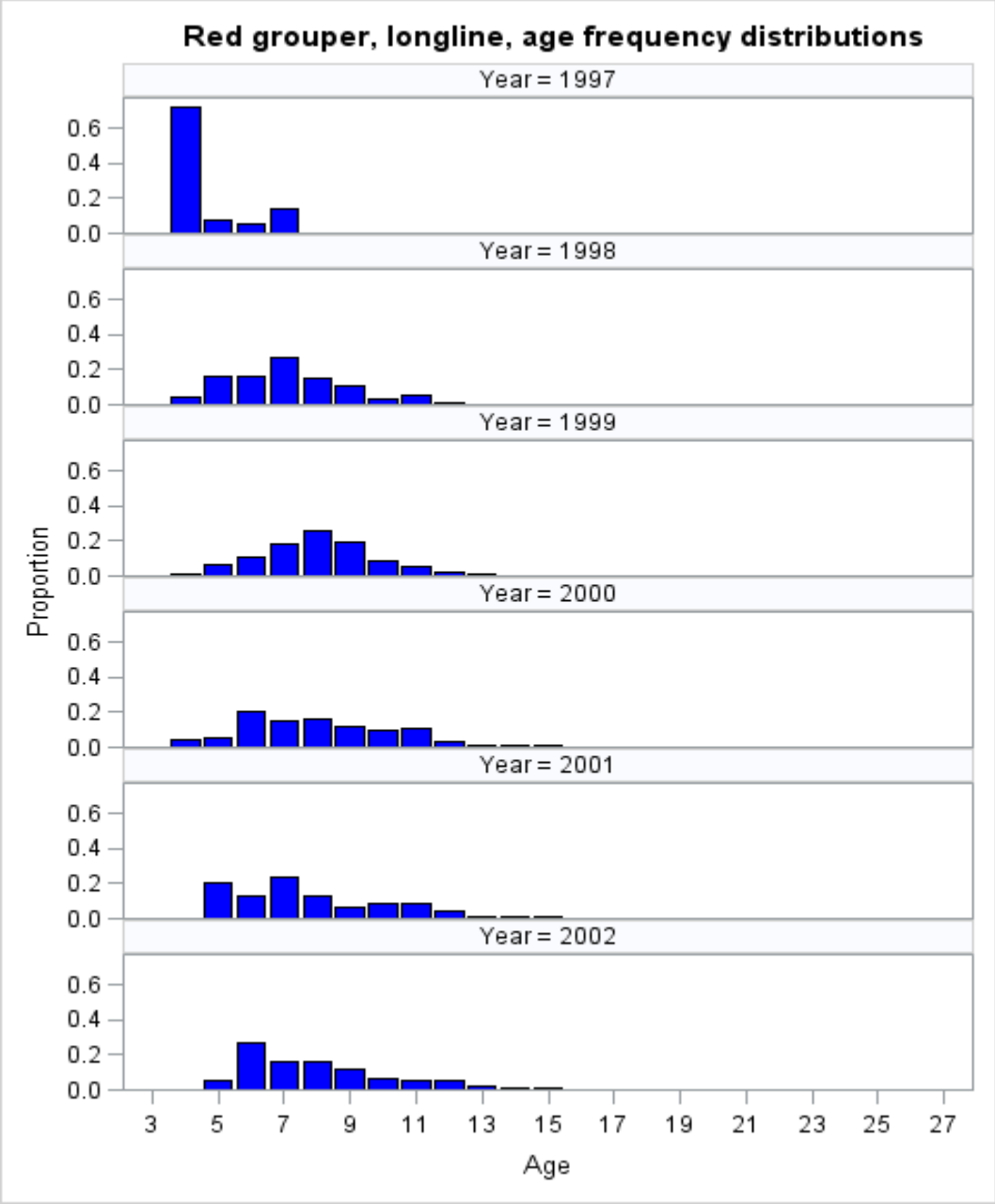

Fig 6 (c) Reweighted age frequency distributions (AFDs) for red grouper age samples collected between 2003 and 2008 from longline fisheries in the Gulf of Mexico.

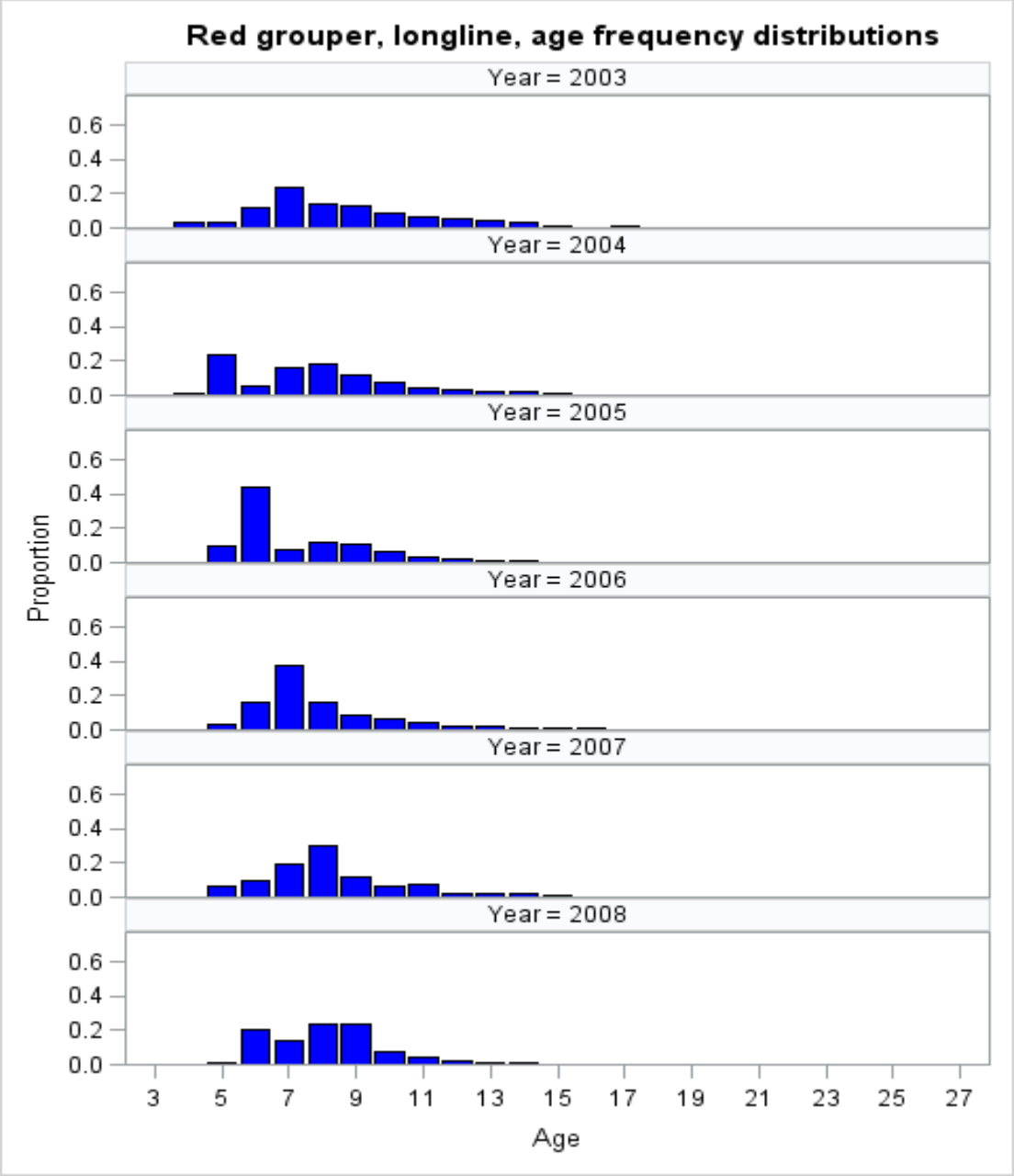

Fig 6(d) Reweighted age frequency distributions (AFDs) for red grouper age samples collected between 2009 and 2013 from longline fisheries in the Gulf of Mexico.

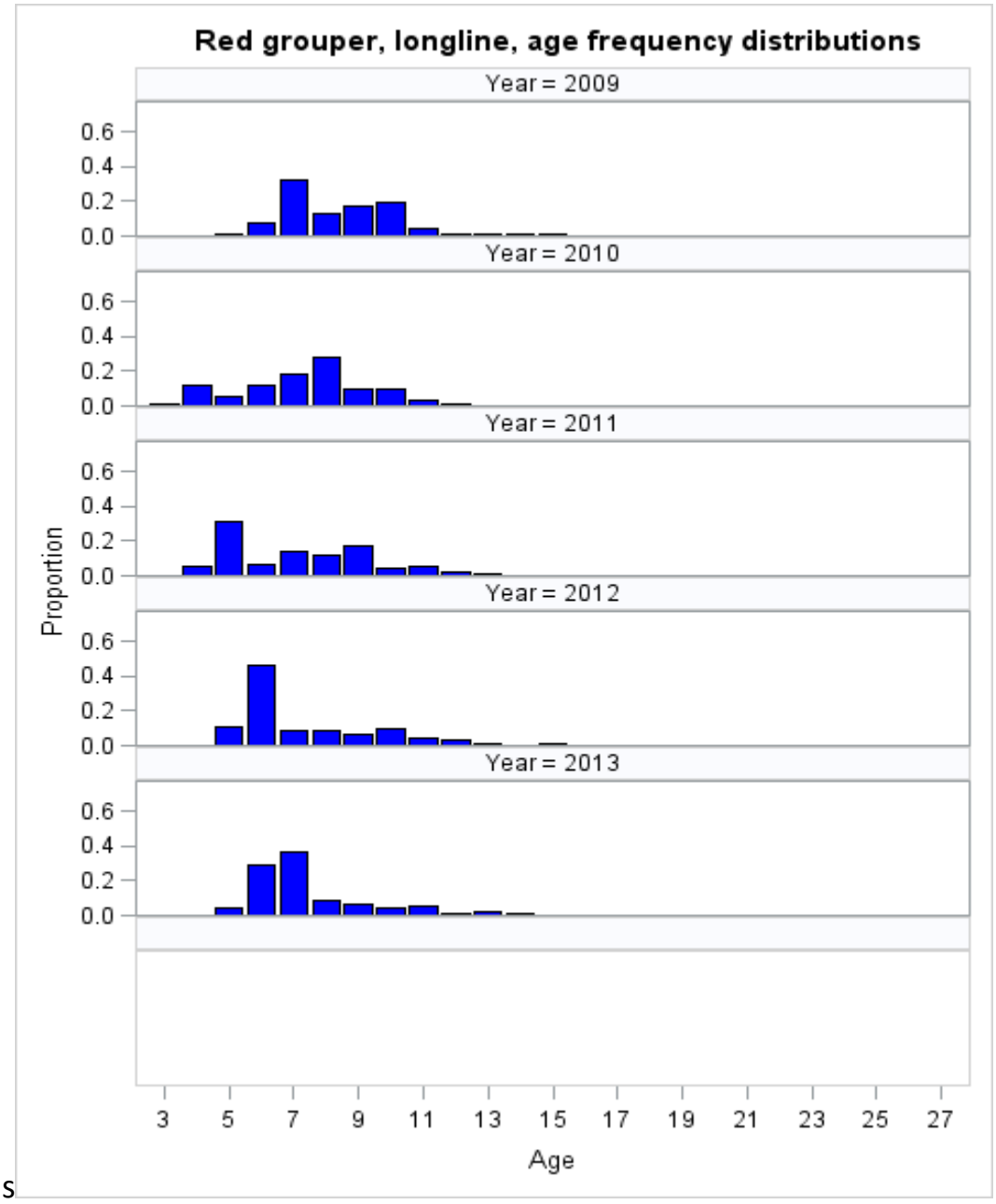

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Fig 7(a) Reweighted age frequency distributions (AFDs) for red grouper age samples collected between 1991 and 1996 from trap fisheries in the Gulf of Mexico.

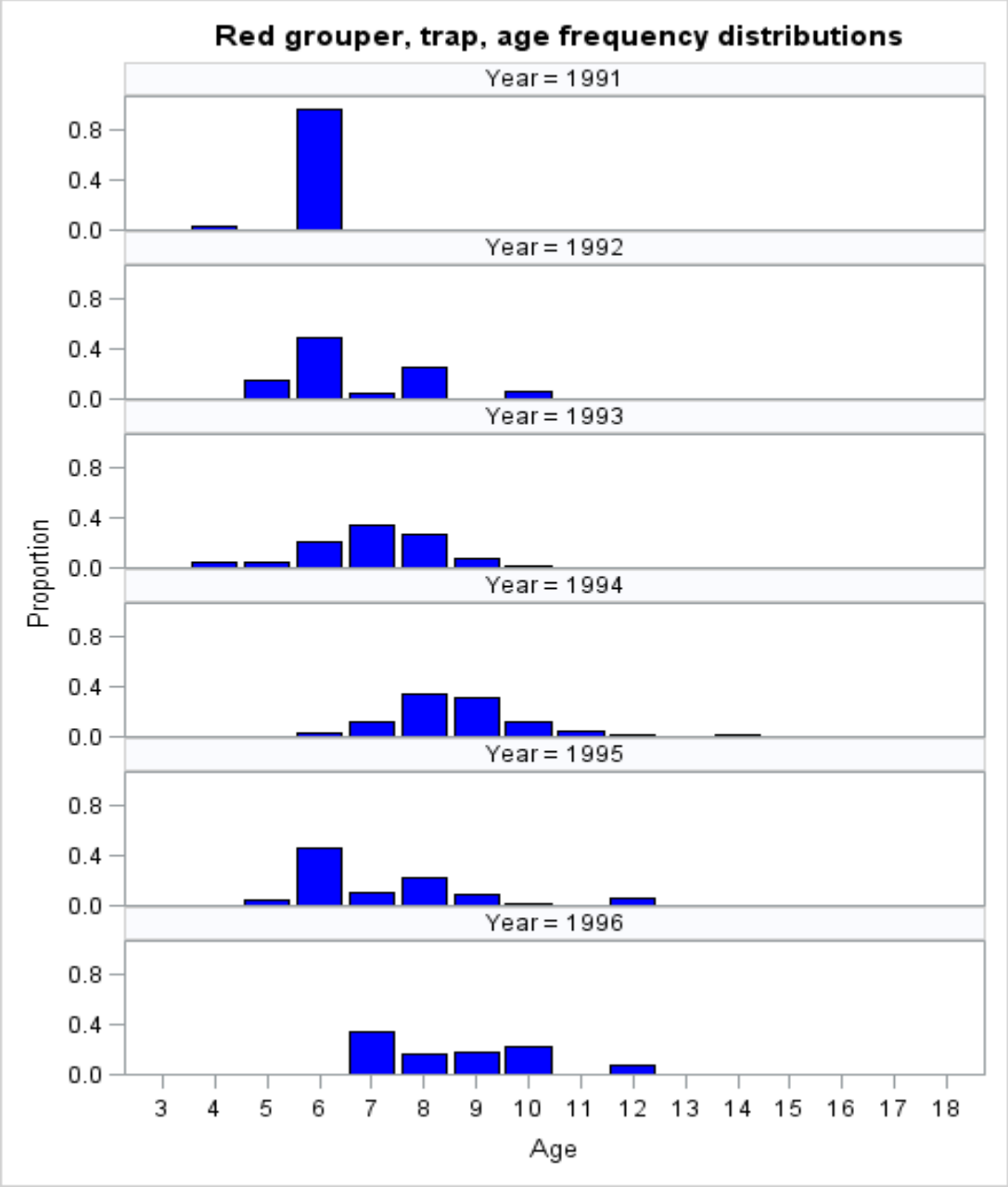

Fig 7 (b) Reweighted age frequency distributions (AFDs) for red grouper age samples collected between 1997 and 2002 from trap fisheries in the Gulf of Mexico.

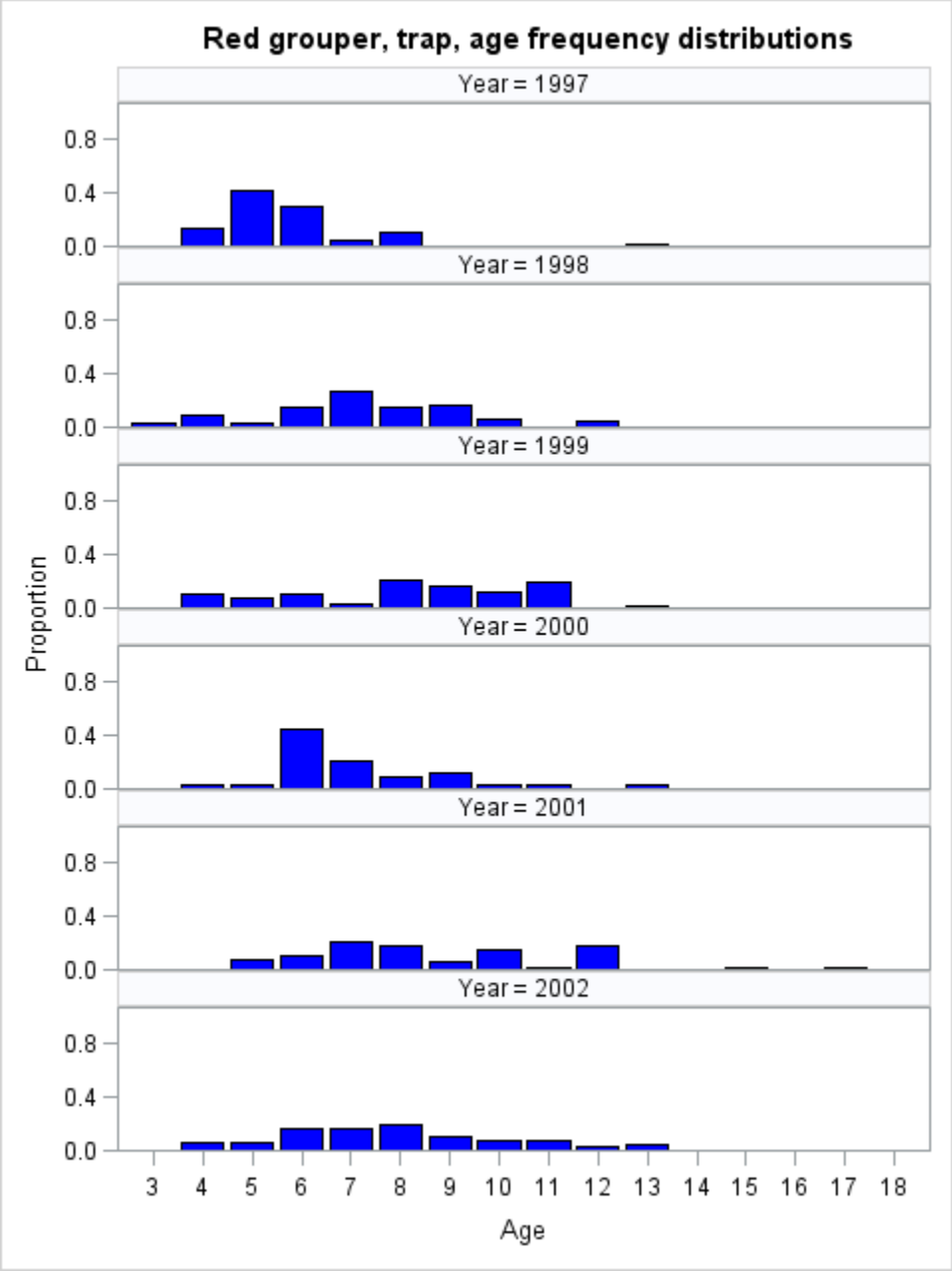

Fig 7 (c) Reweighted age frequency distributions (AFDs) for red grouper age samples collected between 2003 and 2006 from trap fisheries in the Gulf of Mexico.

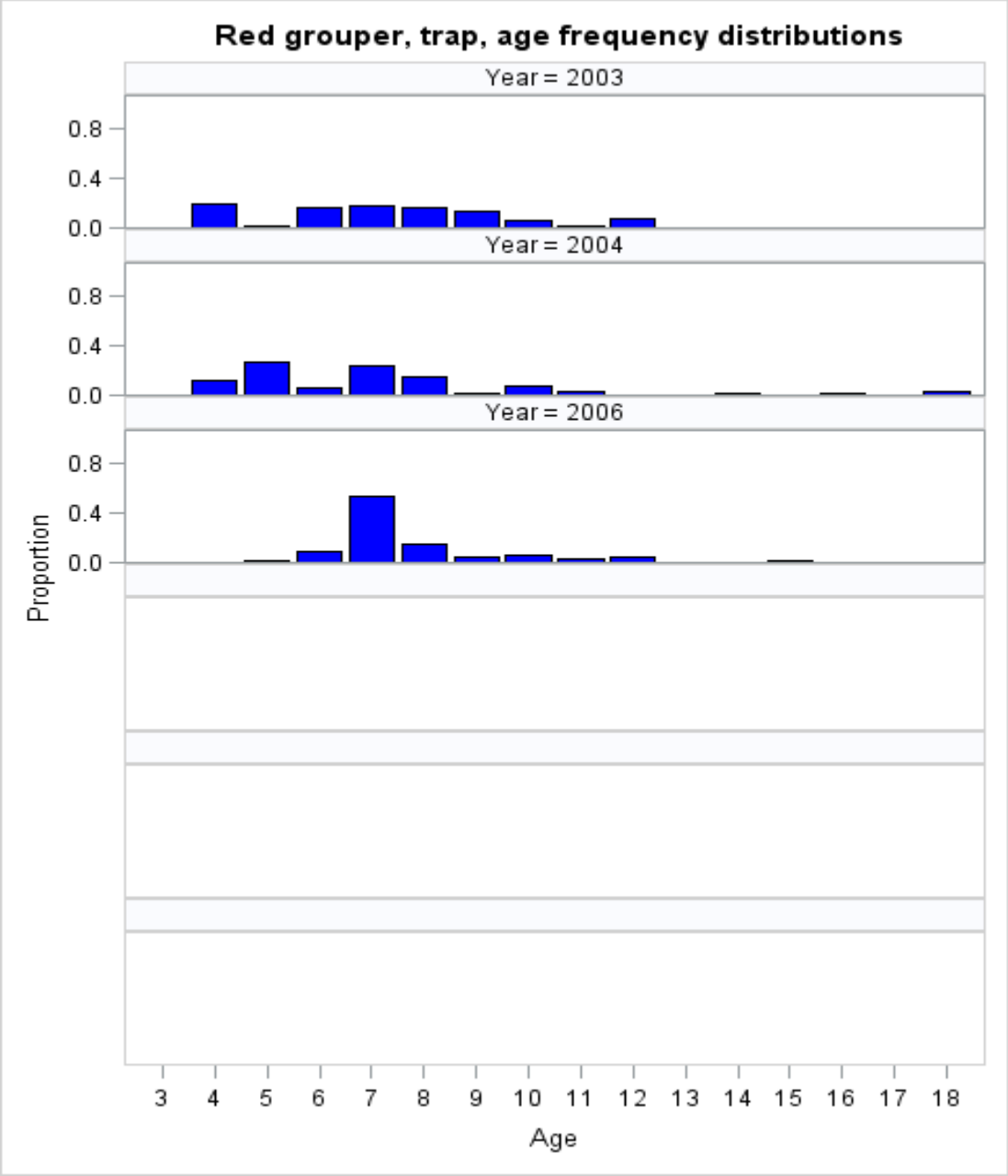

Fig 8 (a) Reweighted age frequency distributions (AFDs) for red grouper age samples collected between 1991 and 1996 from recreational fisheries in the Gulf of Mexico.

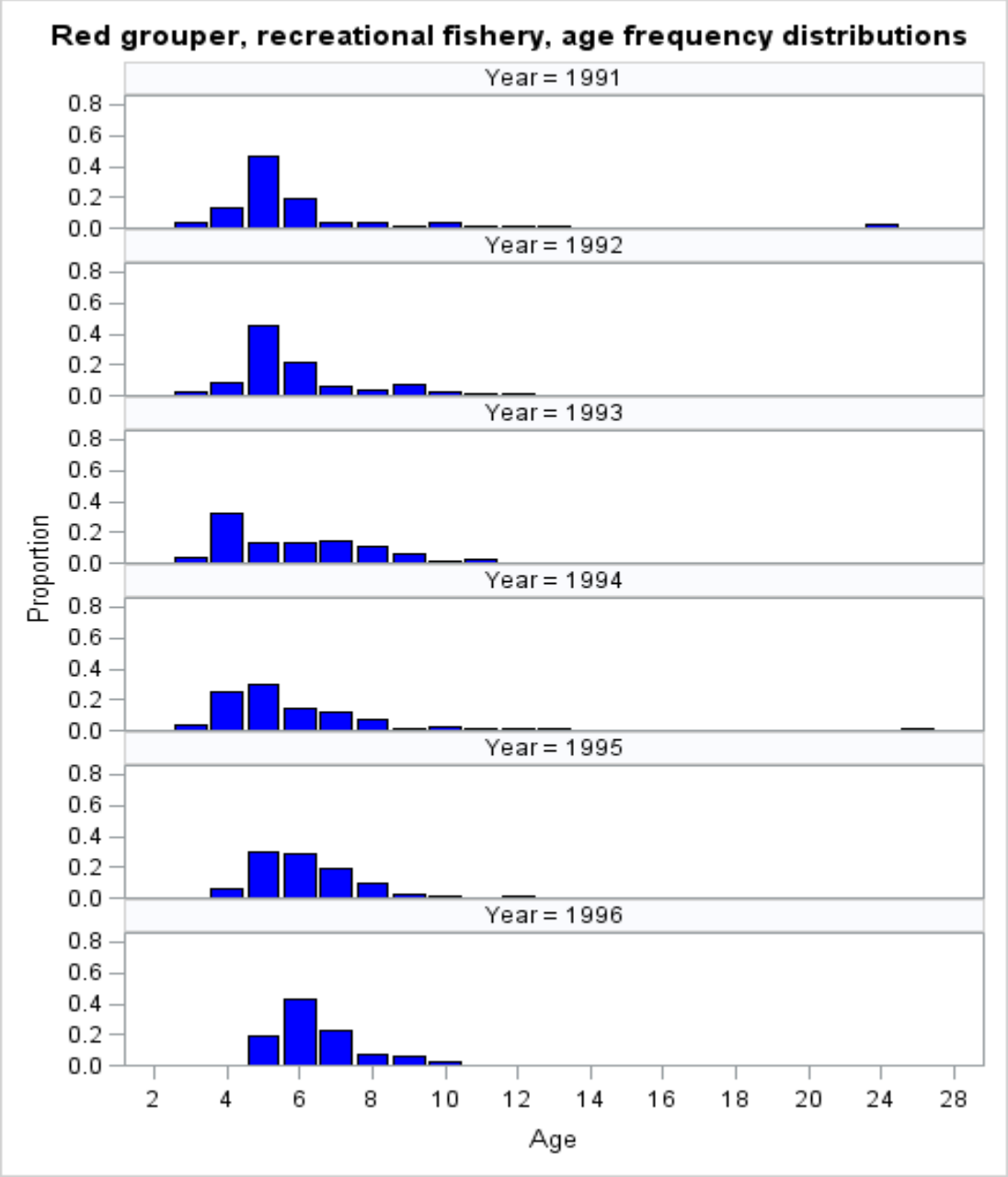

Fig 8 (b) Reweighted age frequency distributions (AFDs) for red grouper age samples collected between 1997 and 2002 from recreational fisheries in the Gulf of Mexico.

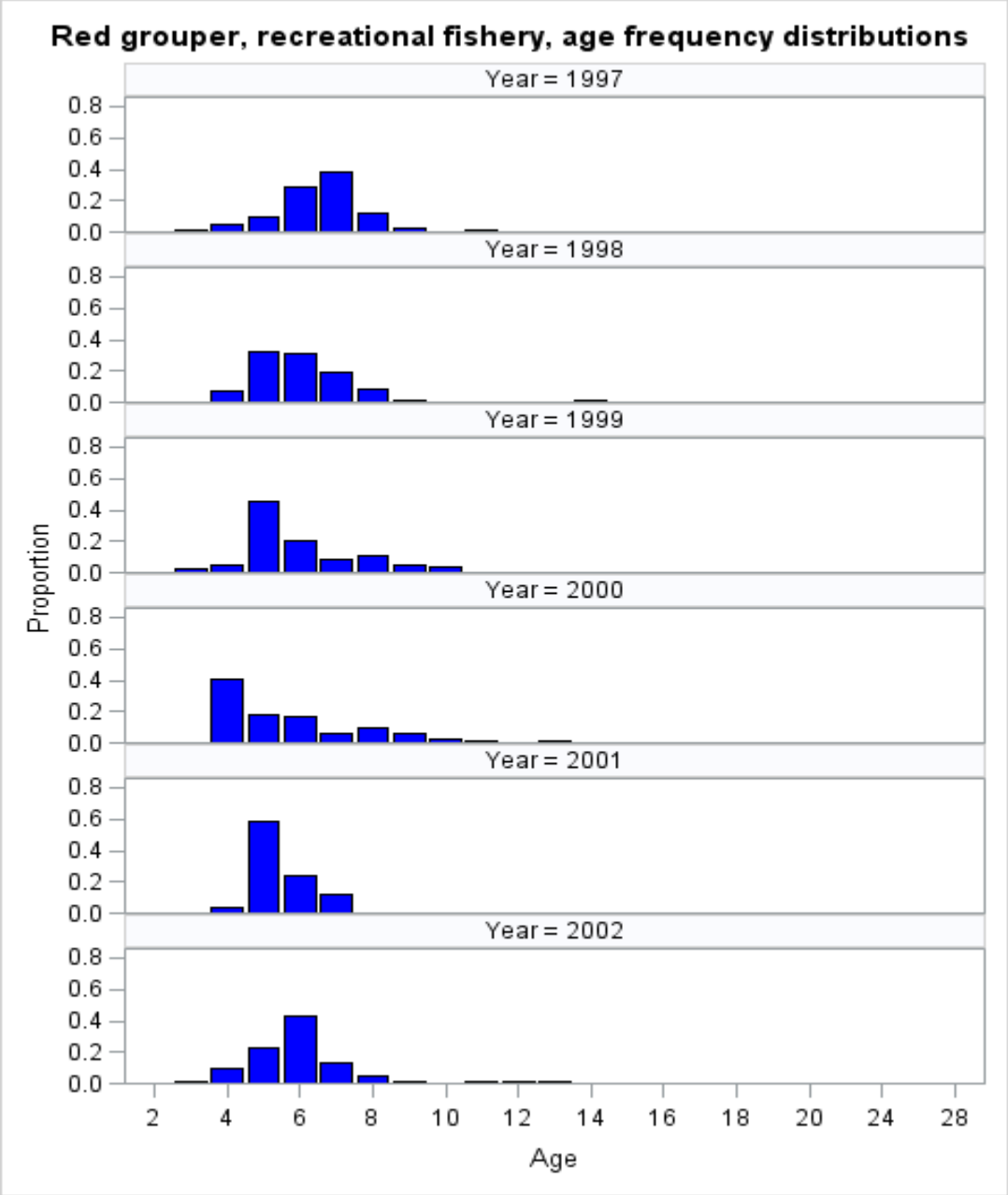

Fig 8 (c) Reweighted age frequency distributions (AFDs) for red grouper age samples collected between 2003 and 2008 from recreational fisheries in the Gulf of Mexico.

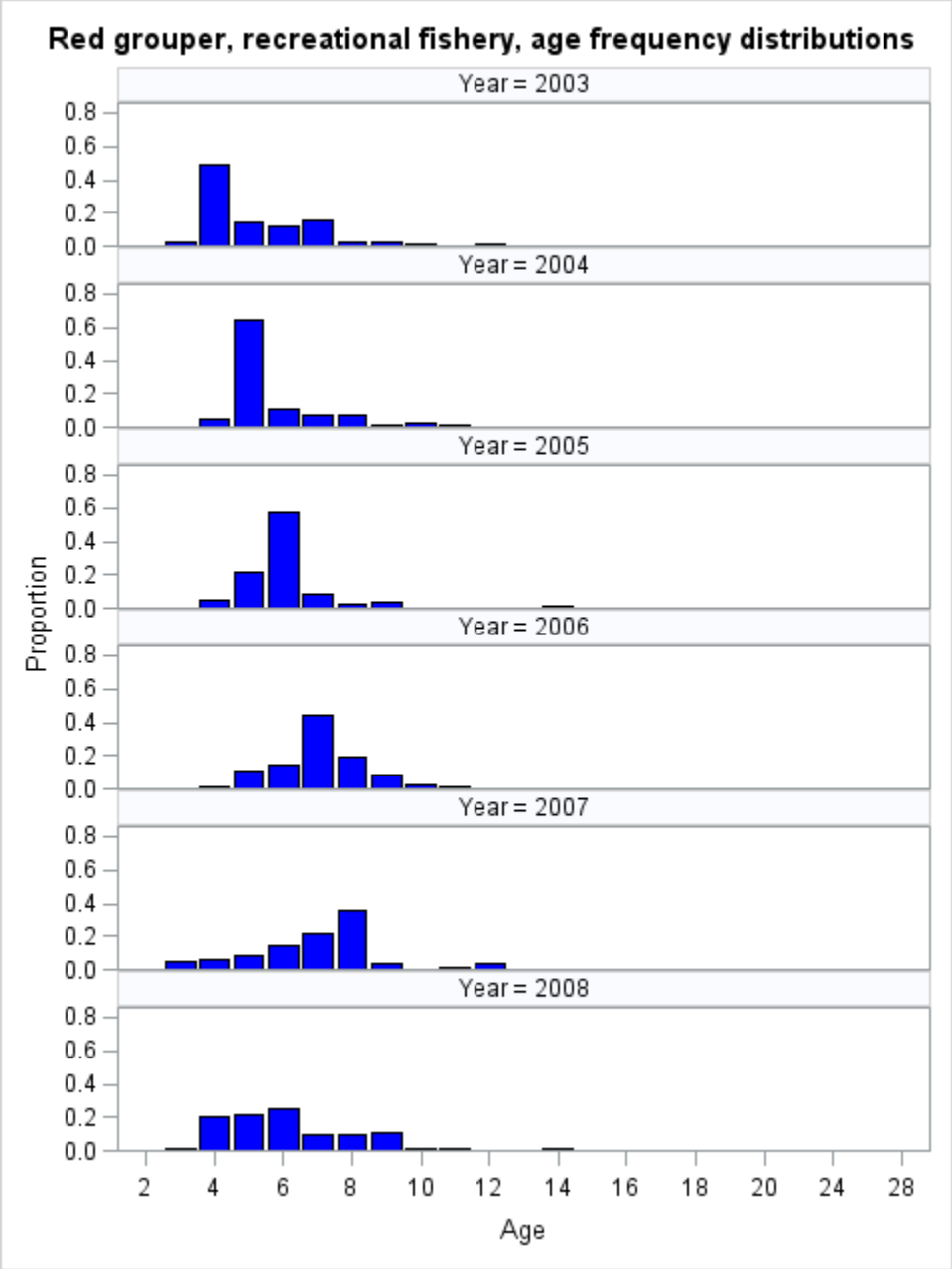

Fig 8 (d) Reweighted age frequency distributions (AFDs) for red grouper age samples collected between 2009 and 2013 from recreational fisheries in the Gulf of Mexico.