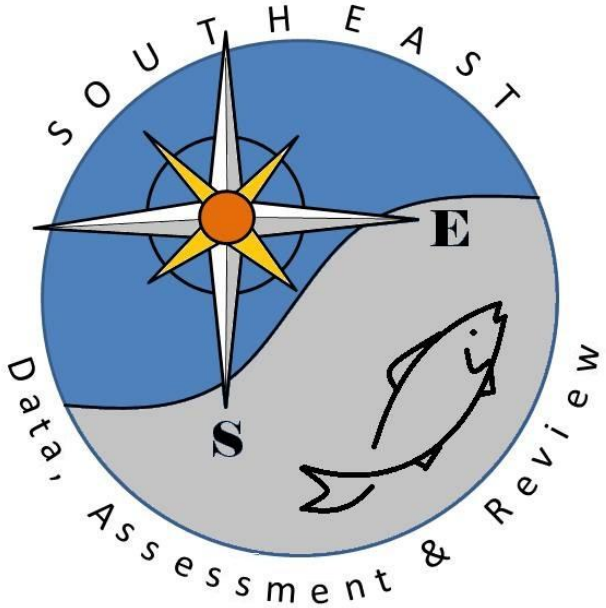
Age frequency distributions estimated with reweighting methods for gag groupers in the Gulf of Mexico from 1991 to 2012

Ching-Ping Chih

SEDAR33-AW03

10 June 2013



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Introduction

A reweighting method was used to estimate the age frequency distributions of gag groupers samples collected from the Gulf of Mexico from 1991 to 2012. A reweighting method was used because gag groupers otolith samples may not have been representative of actual gag grouper landings (Chih, 2013). Briefly, otolith samples from commercial handline, longline, recreational head boat, charter boat and private boat fisheries, including non-random samples, were combined to provide an age-length-relationship (ALR) for a given year. The ALR was then reweighted with the length frequency distribution to obtain the reweighted age frequency distribution (Chih, 2009). The ALR is similar to the age-length-key (ALK) except that the sampling methods were different and that no actual age length key was built. Because gag grouper otoliths were collected with random otolith sampling (ROS) methods, the numbers of samples were not evenly distributed among the different length categories (i.e., there were many more samples for younger fish than for older fish). As a result, the use of the estimated ALR may not yield as good an estimate of an age frequency distribution as might have been obtained had the ALK sampling method been used. However, using a reweighting method is a reasonable alternative for estimating age distributions when otolith samples are non-representative.

Methods

Age frequency distributions for four strata (commercial handline, long line, recreational head boat, and charter-private boat) were estimated with otolith samples processed by the Panama City Laboratory, NMFS. Details for estimating length frequency distributions for the four strata have been reported elsewhere (Chih, 2013).

For the reweighting methods, otolith samples from the four strata were pooled together to provide an age-length relationship (ALR). Reweighted age frequency distributions for each stratum/year were then estimated by reweighting the ALR with the length frequency distribution (Chih, 2009) for each stratum/year. All lengths were fork length in inches.

Results & Discussion

The pooling of all age samples to build age-length relationships was necessary because of the small sample sizes for age samples before 2000 and the small sample sizes in head boat fisheries (Table 1,2). Also, a comparison of age frequency distributions at the 29 inch length showed few consistent differences in ALKs between samples collected from handline and longline fisheries (Fig 10 a,b).

The reweighted age frequency distributions are quite different from the age frequency distributions estimated directly with the ROS method, particularly for samples collected before 2000 (Fig 5-8). Some significant differences in age frequency distributions estimated with these two methods were also observed in recreational fisheries in more recent years. The results show that it may be more appropriate to use reweighted age frequency distributions instead of the original age frequency distribution for gag grouper stock assessments.

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.

Chih, Ching-Ping 2013, Length frequency distributions for gag groupers in the Gulf of Mexico from 1984 to 2012. SEDAR33-DW.

Table 1. Sample sizes for gag grouper length and age samples collected from commercial fisheries in the Gulf of Mexico from 1984 to 2012.

Year	Age samples handline	Length samples handline	Age samples longline	Length samples longline	Age samples other gears	Length samples other gears
1984	0	820	0	475	0	4
1985	0	787	0	565	0	78
1986	0	356	0	1133	0	41
1987	0	559	0	685	0	0
1988	0	175	0	276	0	0
1989	0	42	0	129	0	21
1990	0	984	0	1665	0	1
1991	210	770	7	943	0	38
1992	66	1149	22	933	0	73
1993	417	1871	12	791	1	41
1994	439	2858	3	777	2	43
1995	284	2453	31	1001	0	6
1996	197	3140	57	1055	3	39
1997	34	3398	6	1221	2	392
1998	106	8072	101	5063	3	149
1999	145	5926	243	4659	2	306
2000	387	4018	177	4201	6	206
2001	745	5514	867	4159	0	287
2002	809	4114	1085	4149	15	323
2003	520	2213	1117	3908	3	110
2004	894	2826	1480	2672	0	18
2005	740	1844	857	2401	9	113
2006	641	813	527	1761	1	42
2007	408	388	936	1040	2	26
2008	680	1069	506	1315	0	50
2009	1027	894	772	741	0	3
2010	798	1108	883	949	27	21
2011	1436	1486	518	530	11	24
2012	1616	1945	457	500	34	38

Table 2. Sample sizes for gag grouper length and age samples collected from recreational fisheries in the Gulf of Mexico from 1981 to 2012.

Year	Age samples headboat	Length samples headboat	Age samples charter boat & private boat	Length samples charter boat & private boat
1981	0	18	0	27
1982	0	19	0	69
1983	0	78	0	42
1984	0	34	0	284
1985	0	116	0	21
1986	0	663	0	171
1987	0	651	0	203
1988	0	381	0	138
1989	0	450	0	92
1990	0	367	0	105
1991	38	165	79	152
1992	131	160	234	551
1993	89	149	281	556
1994	104	239	187	404
1995	101	191	201	244
1996	141	277	448	469
1997	70	320	164	766
1998	66	527	53	1355
1999	11	493	99	2267
2000	23	339	36	1982
2001	31	263	132	1300
2002	17	301	345	1450
2003	74	384	257	1662
2004	39	234	100	2641
2005	127	238	122	1974
2006	57	170	40	856
2007	25	174	53	588
2008	27	223	235	1030
2009	198	307	206	700
2010	219	340	521	1204
2011	24	51	377	562
2012	16	107	256	757

Table 3. Age length key for samples with length at 29 inches. Age samples were collected from handline, longline, headboat and charter-private boat fisheries from 1991-2012.

Year	n	age3	age4	age5	age6	age7	age8	age9	age10
1991	31	.	0.032	0.258	0.710	.	.	.	.
1992	37	.	0.081	0.730	0.135	0.027	0.027	.	.
1993	40	0.050	0.375	0.175	0.300	0.025	0.075	.	.
1994	50	.	0.060	0.780	0.140	0.020	.	.	.
1995	51	.	0.059	0.196	0.627	0.118	.	.	.
1996	14	.	.	0.500	0.357	0.143	.	.	.
1997	4	.	0.250	0.250	0.500	.	.	.	.
1998	14	.	0.143	0.643	0.214	.	.	.	.
1999	24	.	0.167	0.375	0.375	0.083	.	.	.
2000	68	.	0.338	0.221	0.324	0.059	0.044	.	0.015
2001	141	0.007	0.064	0.652	0.163	0.078	0.028	0.007	.
2002	197	0.005	0.071	0.294	0.599	0.020	0.005	0.005	.
2003	131	0.015	0.076	0.176	0.473	0.237	0.008	0.015	.
2004	164	0.012	0.116	0.543	0.146	0.128	0.049	0.006	.
2005	133	.	0.068	0.173	0.639	0.105	0.008	0.008	.
2006	111	.	0.054	0.288	0.477	0.162	0.018	.	.
2007	101	0.010	0.139	0.495	0.168	0.178	.	0.010	.
2008	113	0.018	0.044	0.221	0.673	0.009	0.035	.	.
2009	123	0.016	0.301	0.374	0.252	0.041	0.016	.	.
2010	150	0.033	0.440	0.420	0.087	0.013	0.007	.	.
2011	169	.	0.071	0.621	0.237	0.053	0.012	0.006	.
2012	177	0.006	0.045	0.435	0.395	0.102	0.017	.	.

Table 4. Age length key for samples with length at 29 inches. Age samples were collected from handline fisheries from 1991-2012.

Year	n	age3	age4	age5	age6	age7	age8	age9
1991	23	.	.	0.217	0.783	.	.	.
1992	5	.	.	1.000	.	.	.	.
1993	26	0.077	0.385	0.115	0.346	.	0.077	.
1994	34	.	0.059	0.824	0.118	.	.	.
1995	31	.	0.032	0.194	0.613	0.161	.	.
1996	8	.	.	0.250	0.500	0.250	.	.
1997	1	.	.	.	1.000	.	.	.
1998	5	.	.	0.800	0.200	.	.	.
1999	5	.	.	0.600	0.200	0.200	.	.
2000	47	.	0.362	0.234	0.319	0.064	0.021	.
2001	73	0.014	0.027	0.671	0.164	0.096	0.027	.
2002	84	.	0.071	0.262	0.631	0.024	.	0.012
2003	37	.	0.027	0.135	0.541	0.297	.	.
2004	67	0.015	0.030	0.657	0.045	0.179	0.075	.
2005	69	.	0.043	0.145	0.696	0.101	.	0.014
2006	70	.	0.014	0.229	0.557	0.186	0.014	.
2007	29	.	0.103	0.345	0.276	0.241	.	0.034
2008	67	0.015	0.045	0.194	0.716	0.015	0.015	.
2009	66	0.015	0.227	0.424	0.273	0.030	0.030	.
2010	45	0.067	0.422	0.378	0.133	.	.	.
2011	104	.	0.058	0.596	0.250	0.077	0.010	0.010
2012	120	0.008	0.042	0.350	0.450	0.133	0.017	.

Table 5. Age length key for samples with length at 29 inches. Age samples were collected from longline fisheries from 1991-2012.

Year	n	age3	age4	age5	age6	age7	age8	age9	age10
1992	2	.	.	1.000	.	.	.	.	.
1995	1	.	.	1.000	.	.	.	.	.
1998	5	.	0.200	0.800	.	.	.	.	.
1999	16	.	0.188	0.313	0.438	0.063	.	.	.
2000	17	.	0.294	0.235	0.235	0.059	0.118	.	0.059
2001	64	.	0.109	0.625	0.172	0.047	0.031	0.016	.
2002	104	0.010	0.077	0.279	0.606	0.019	0.010	.	.
2003	86	0.012	0.058	0.198	0.488	0.209	0.012	0.023	.
2004	92	.	0.174	0.467	0.217	0.098	0.033	0.011	.
2005	58	.	0.103	0.190	0.569	0.121	0.017	.	.
2006	37	.	0.108	0.378	0.351	0.135	0.027	.	.
2007	72	0.014	0.153	0.556	0.125	0.153	.	.	.
2008	43	.	0.047	0.279	0.605	.	0.070	.	.
2009	49	.	0.367	0.306	0.265	0.061	.	.	.
2010	91	0.022	0.440	0.451	0.055	0.022	0.011	.	.
2011	55	.	0.073	0.636	0.255	0.018	0.018	.	.
2012	41	.	0.049	0.561	0.341	0.049	.	.	.

Fig 1a. Age frequency distributions for gag grouper age samples collected from commercial handline fisheries located in the Gulf of Mexico from 1991 to 1997.

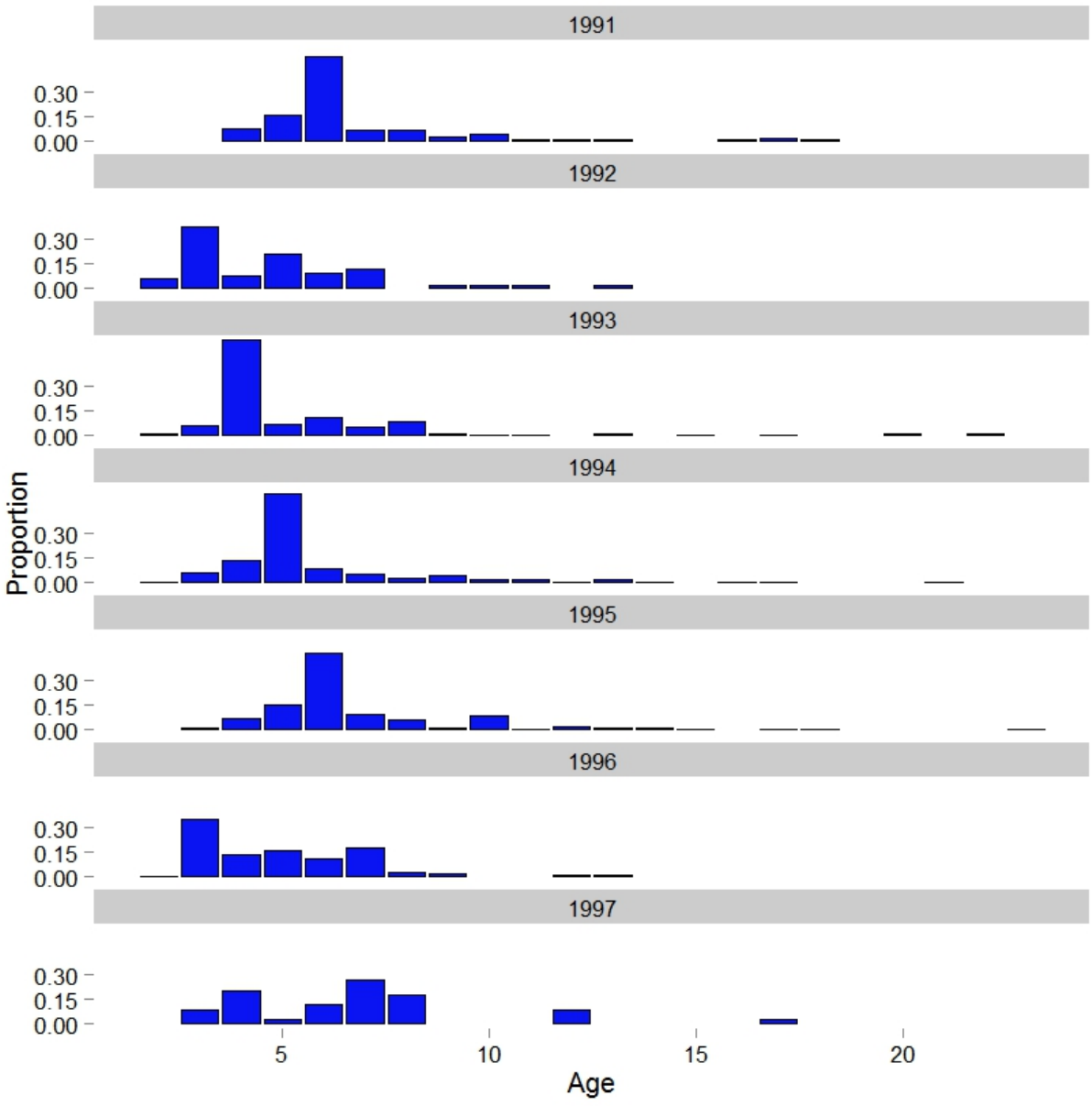


Fig 1b. Age frequency distributions for gag grouper age samples collected from commercial handline fisheries located in the Gulf of Mexico from 1998 to 2004.

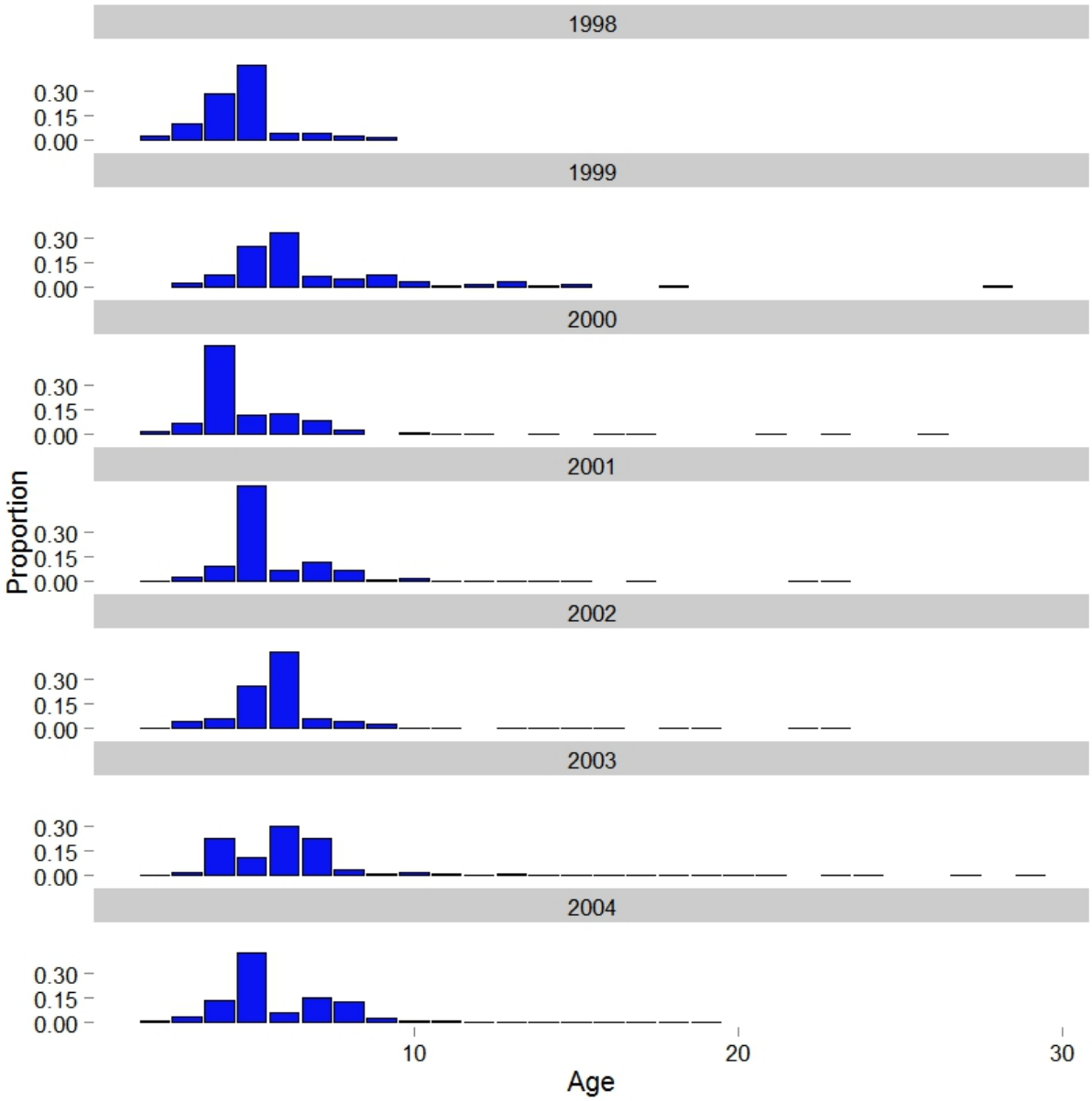


Fig 1c. Age frequency distributions for gag grouper age samples collected from commercial handline fisheries located in the Gulf of Mexico from 2005 to 2012.

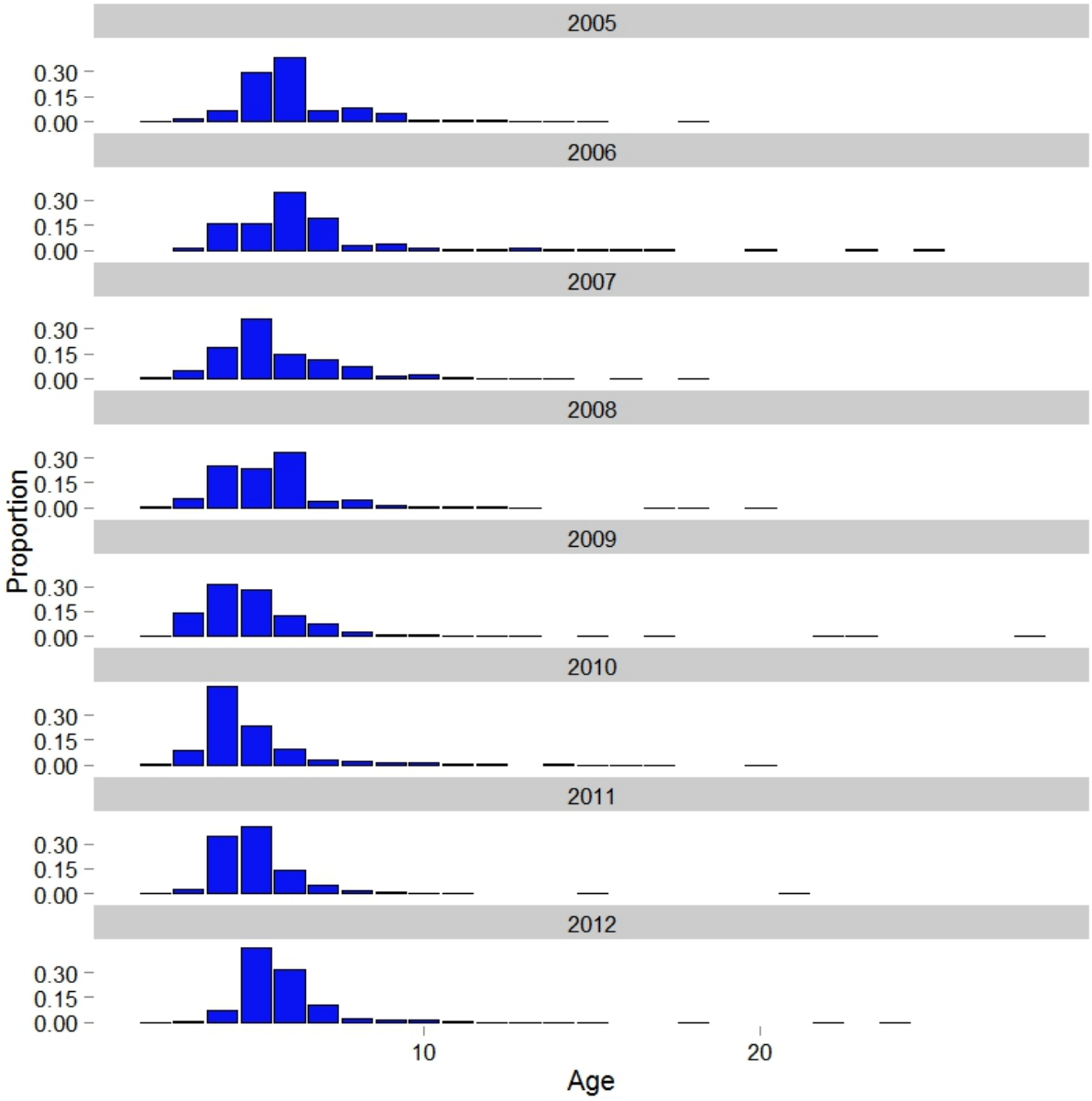


Fig 2a. Age frequency distributions for gag grouper age samples collected from commercial longline fisheries located in the Gulf of Mexico from 1991 to 1997.

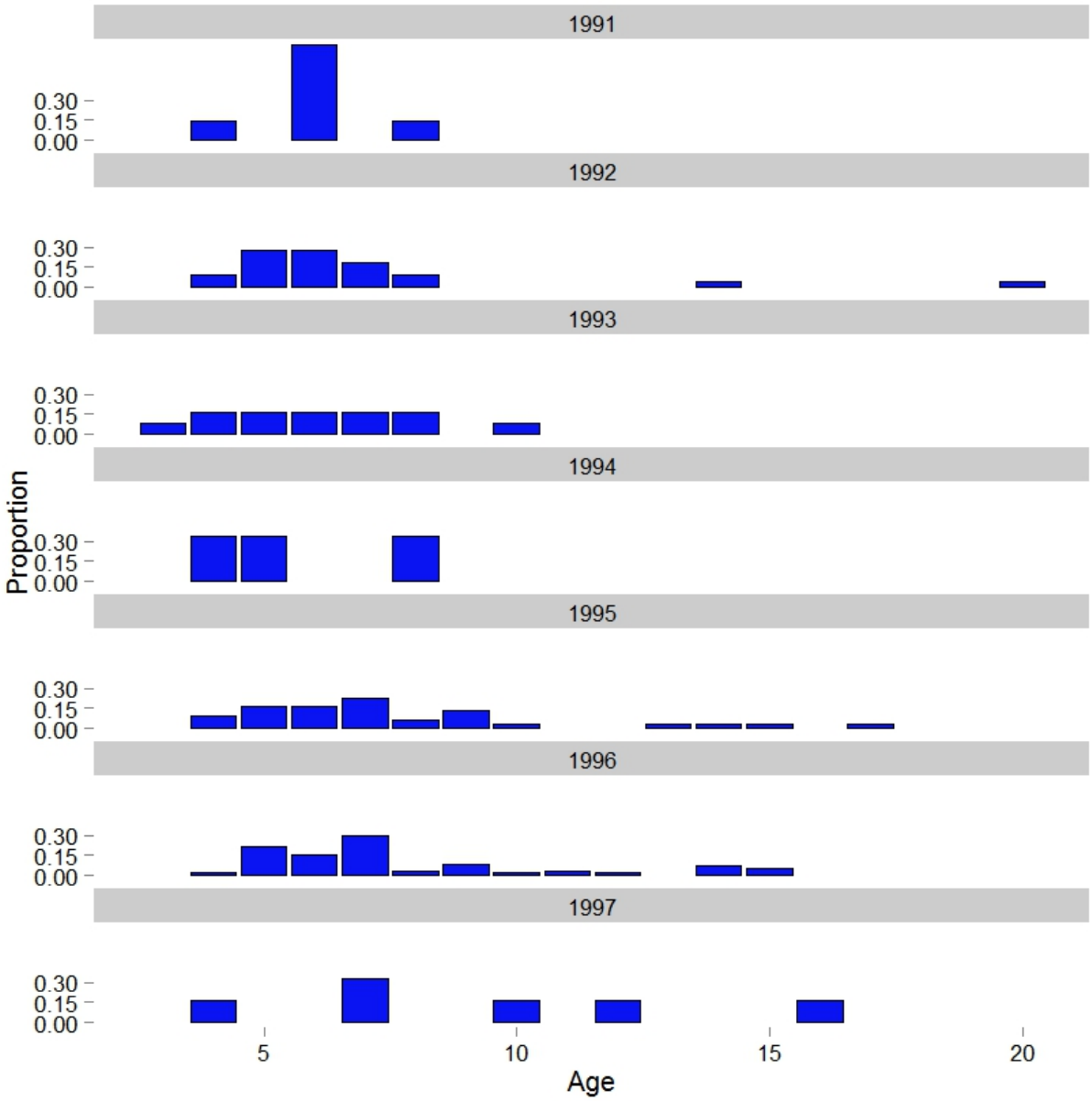
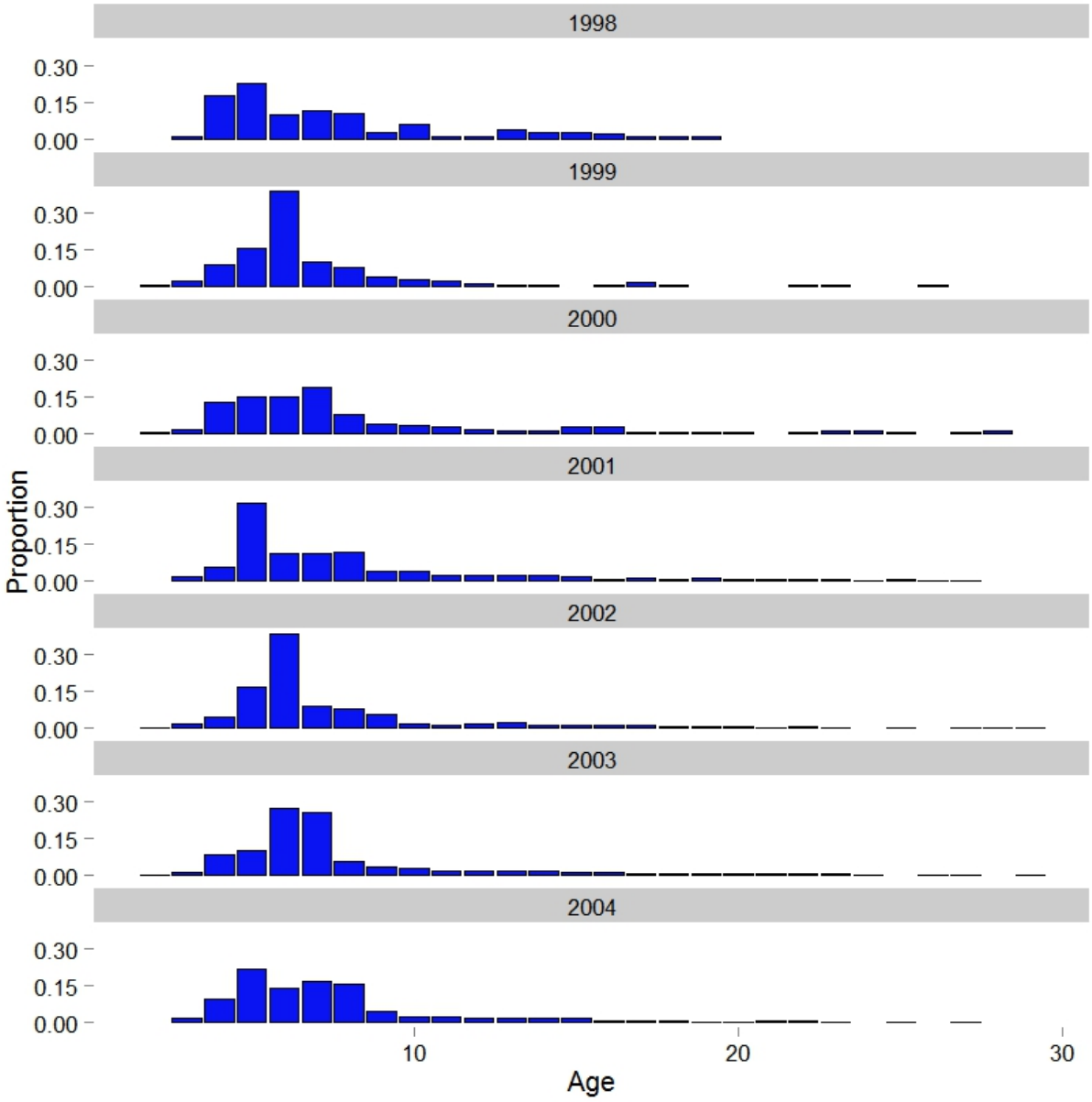


Fig 2b. Age frequency distributions for gag grouper age samples collected from commercial longline fisheries located in the Gulf of Mexico from 1998 to 2004.



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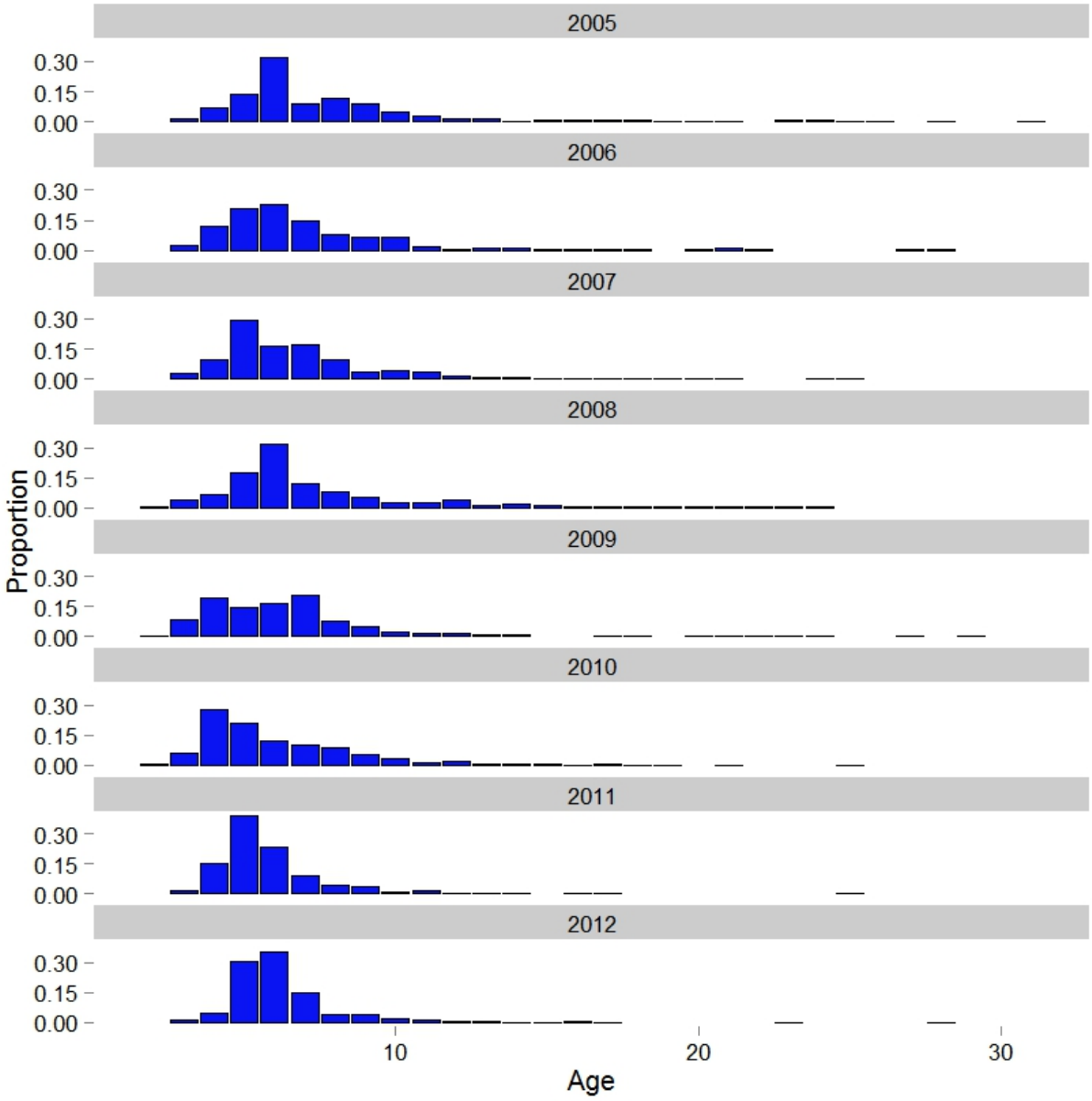


Fig 3a. Age frequency distributions for gag grouper age samples collected from recreational head boat fisheries located in the Gulf of Mexico from 1991 to 1997.

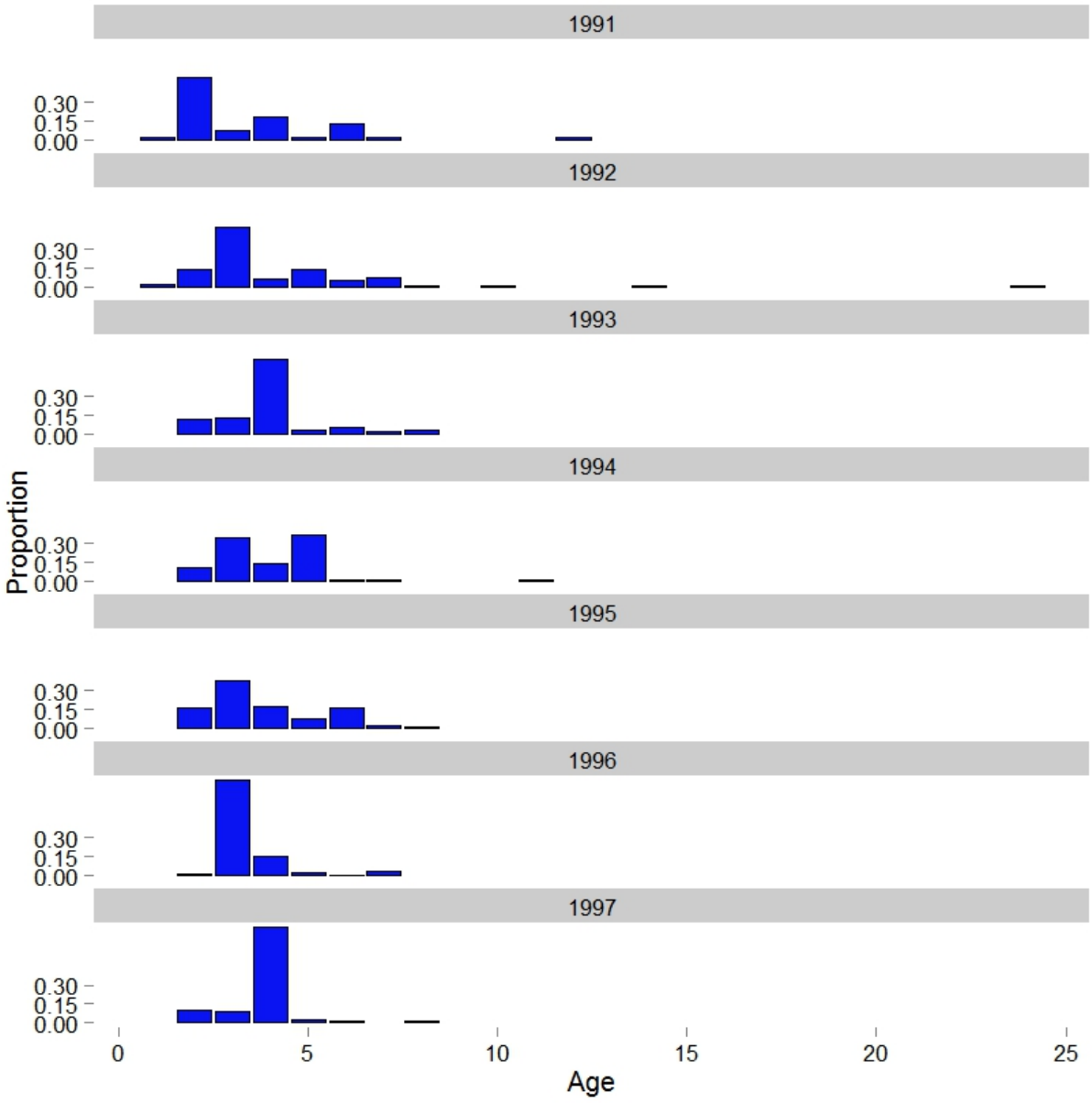
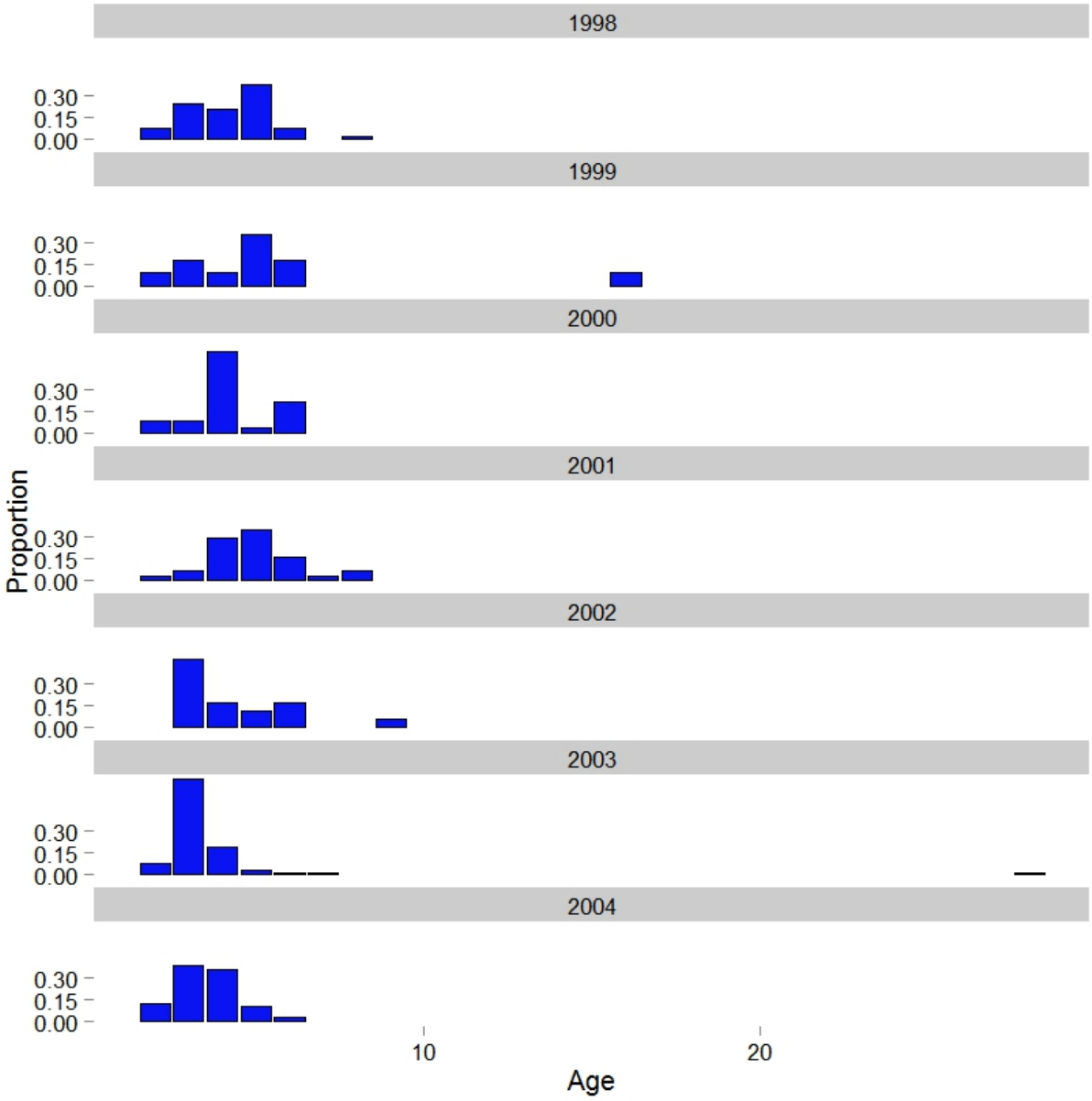


Fig 3b. Age frequency distributions for gag grouper age samples collected from recreational head boat fisheries located in the Gulf of Mexico from 1998 to 2004.



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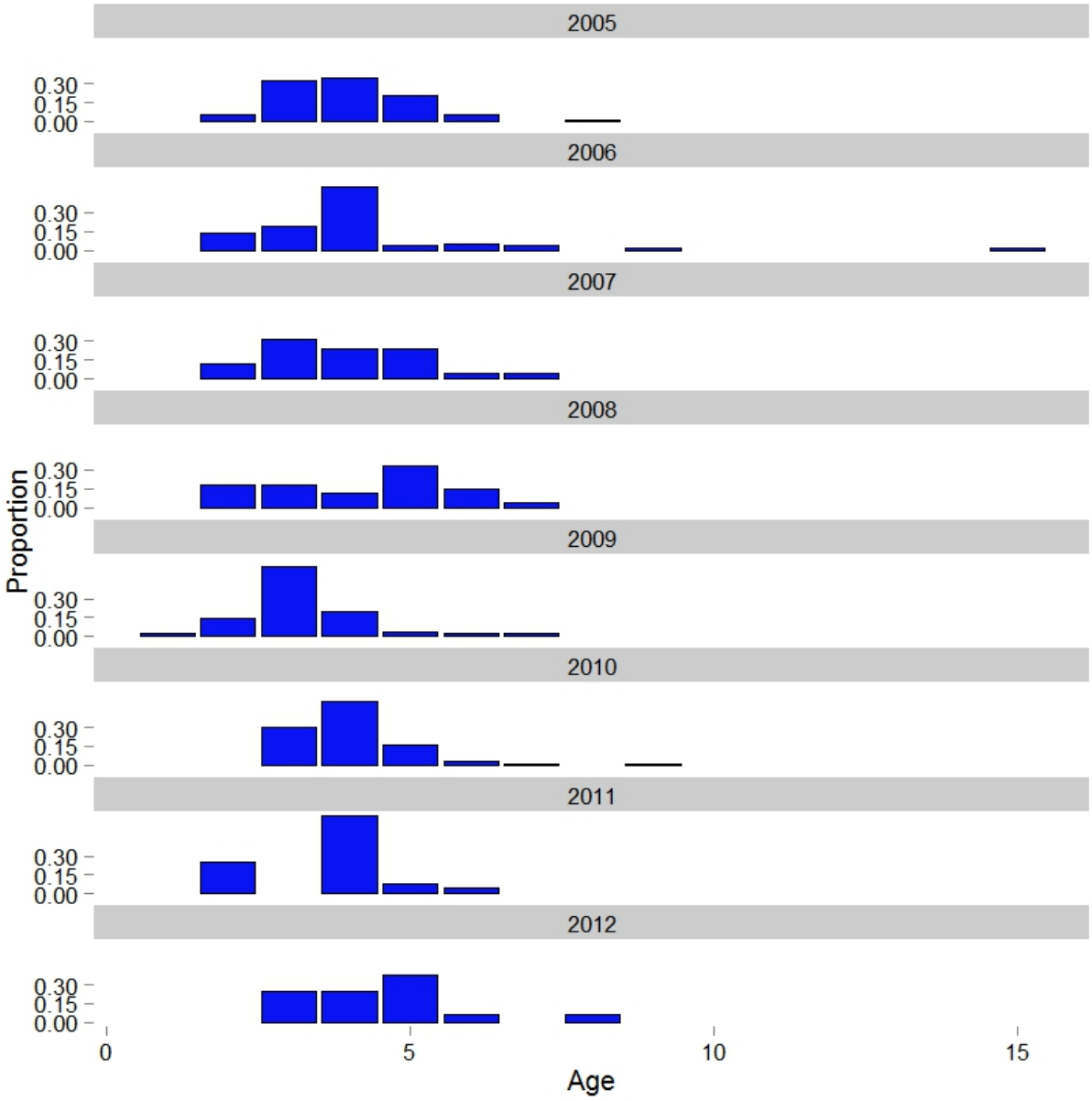


Fig 4a. Age frequency distributions for gag grouper age samples collected from recreational charter boat and private boat fisheries located in the Gulf of Mexico from 1991 to 1997.

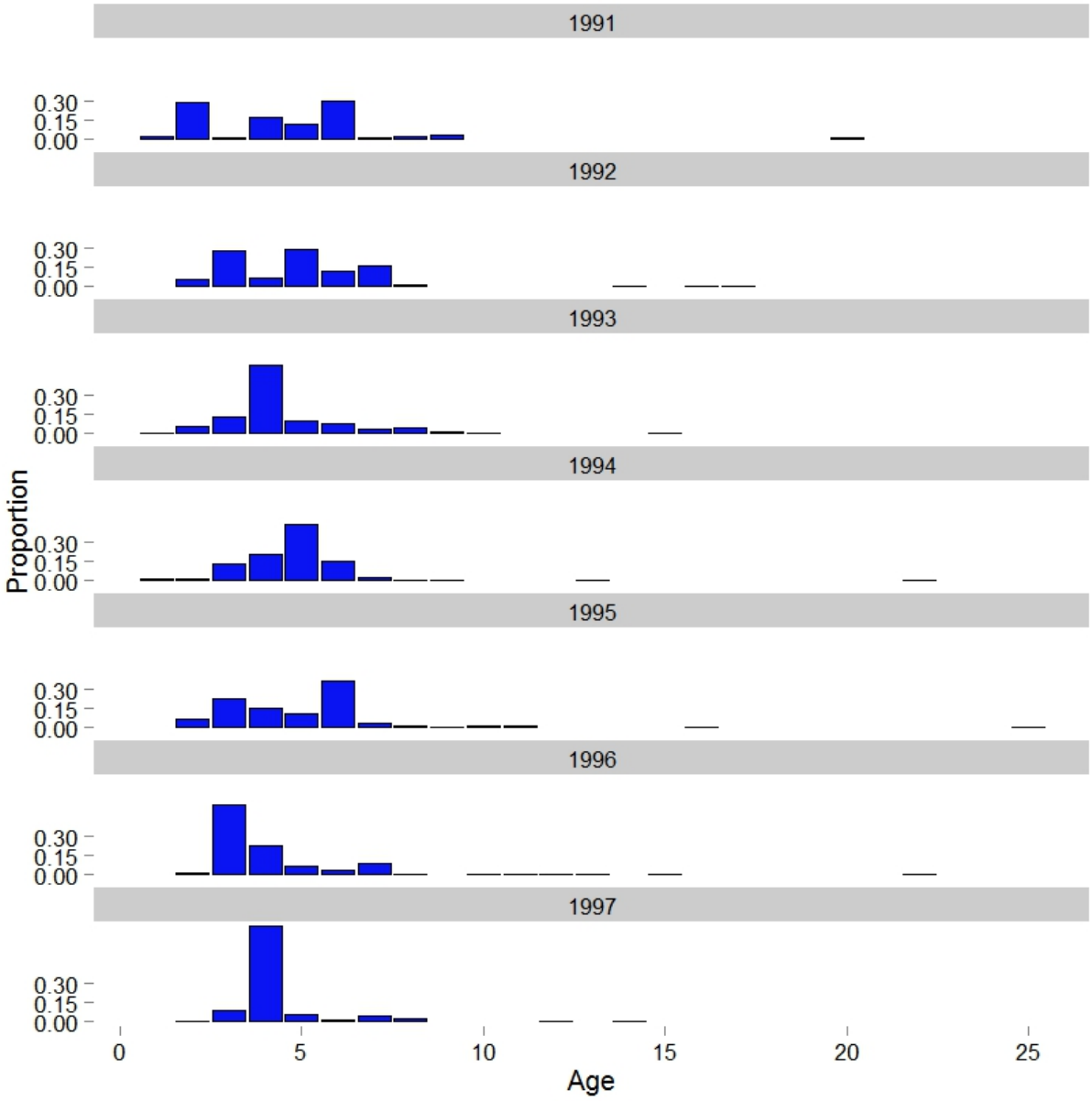
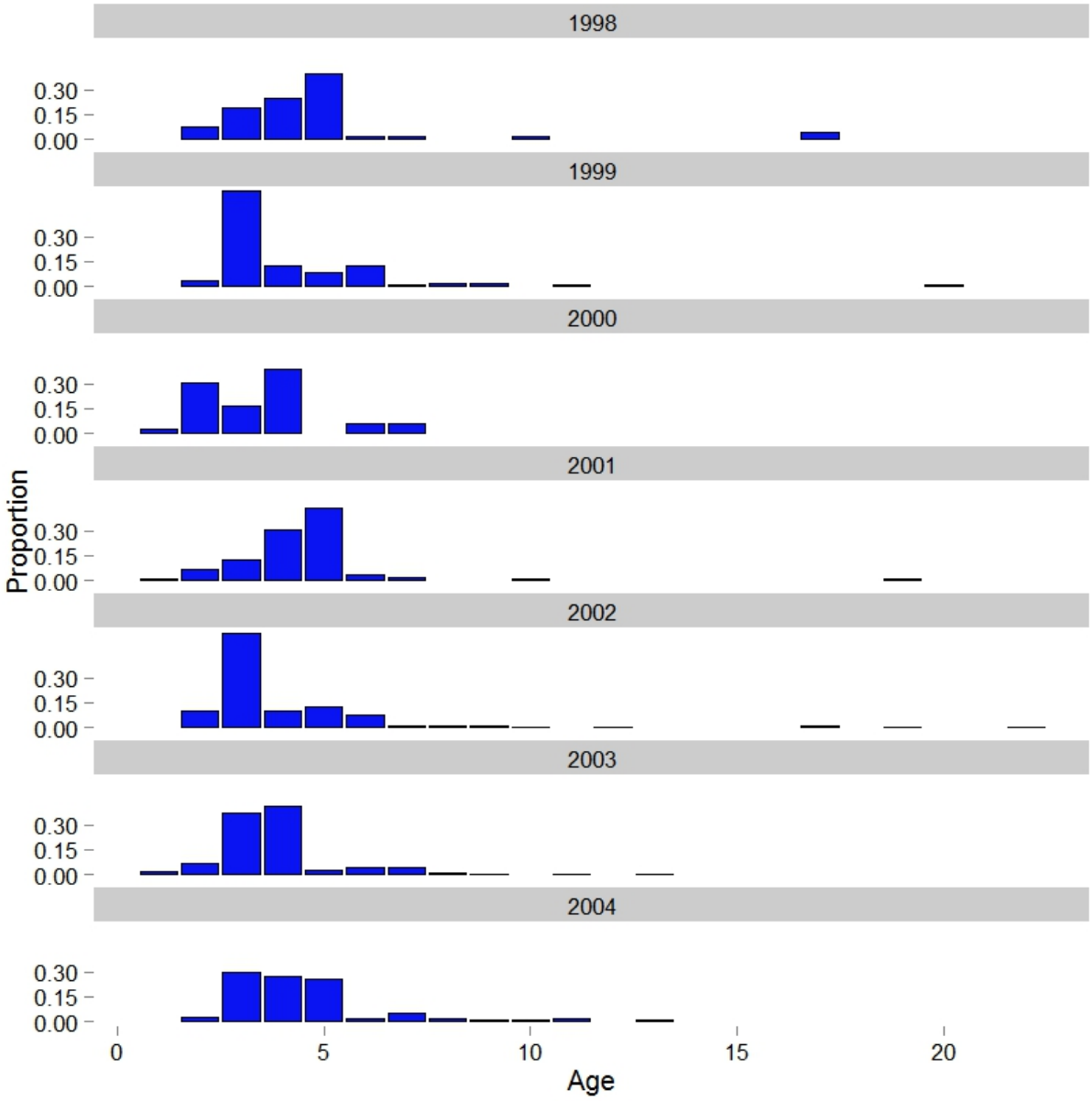


Fig 4b. Age frequency distributions for gag grouper age samples collected from recreational charter boat and private boat fisheries located in the Gulf of Mexico from 1998 to 2004.



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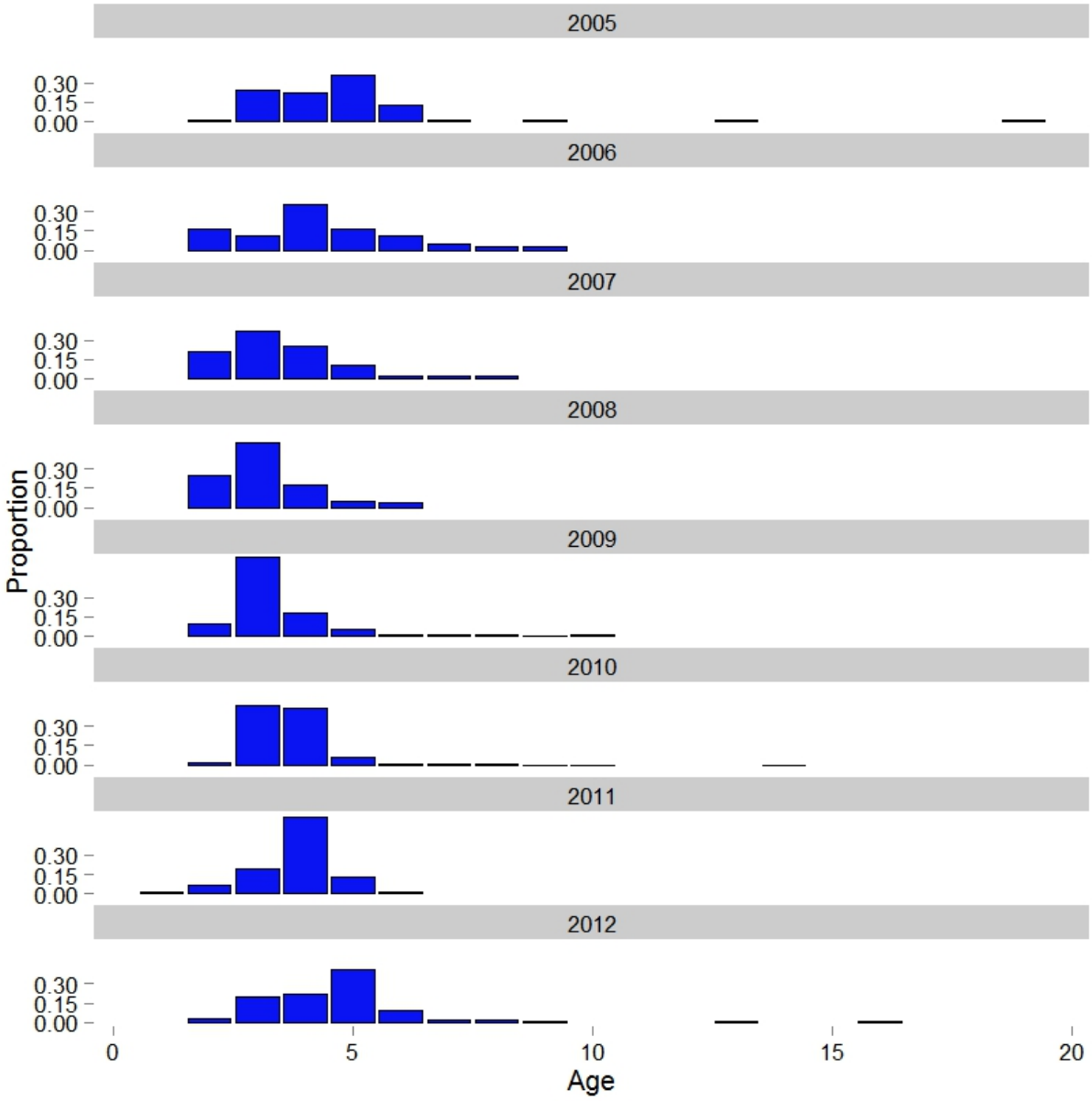
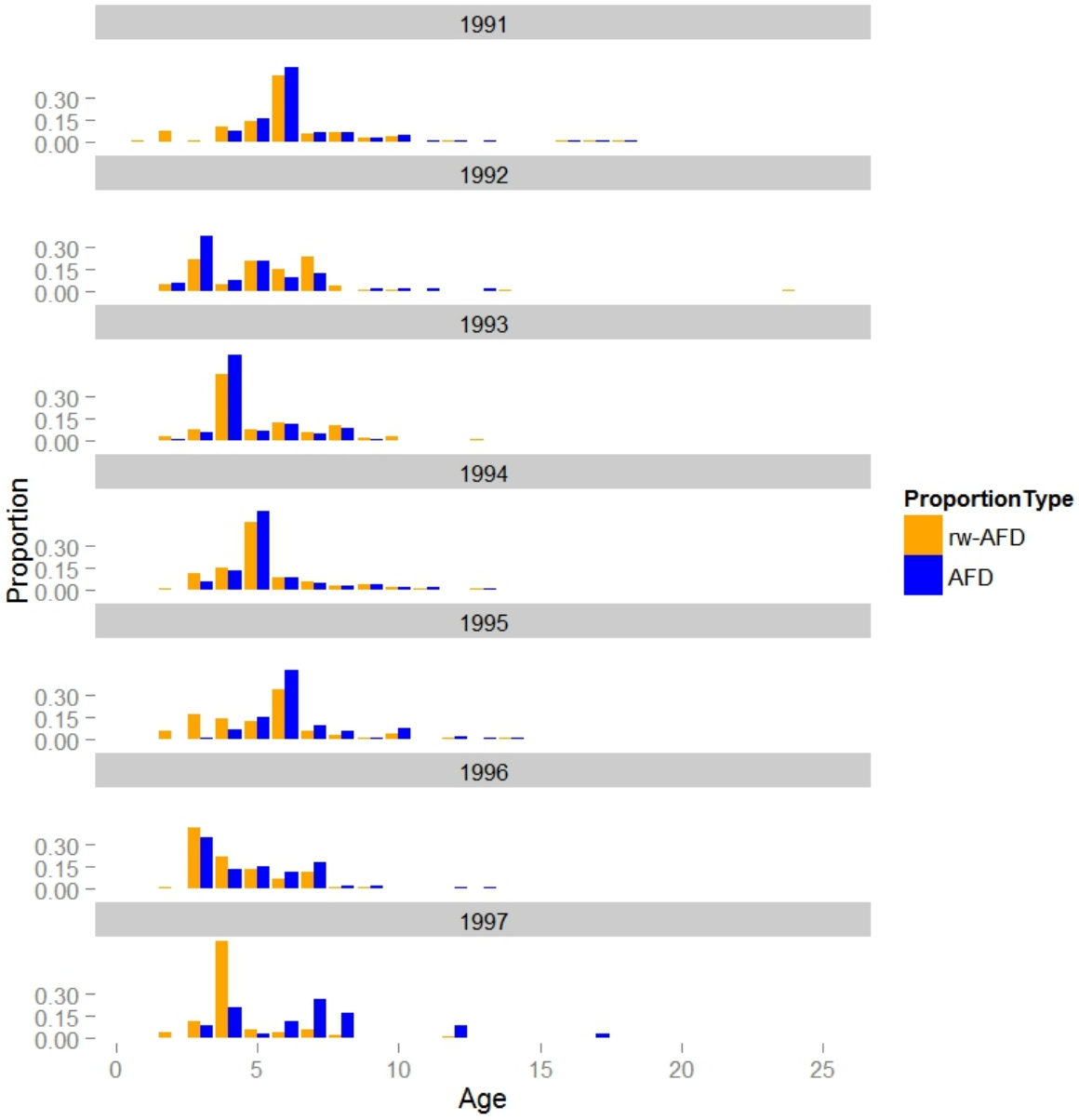


Fig 5a. Comparison for gag grouper age frequency distributions (AFD) with reweighted age frequency distributions (rw-AFD) estimated from samples collected from commercial handline fisheries from 1991 to1997.



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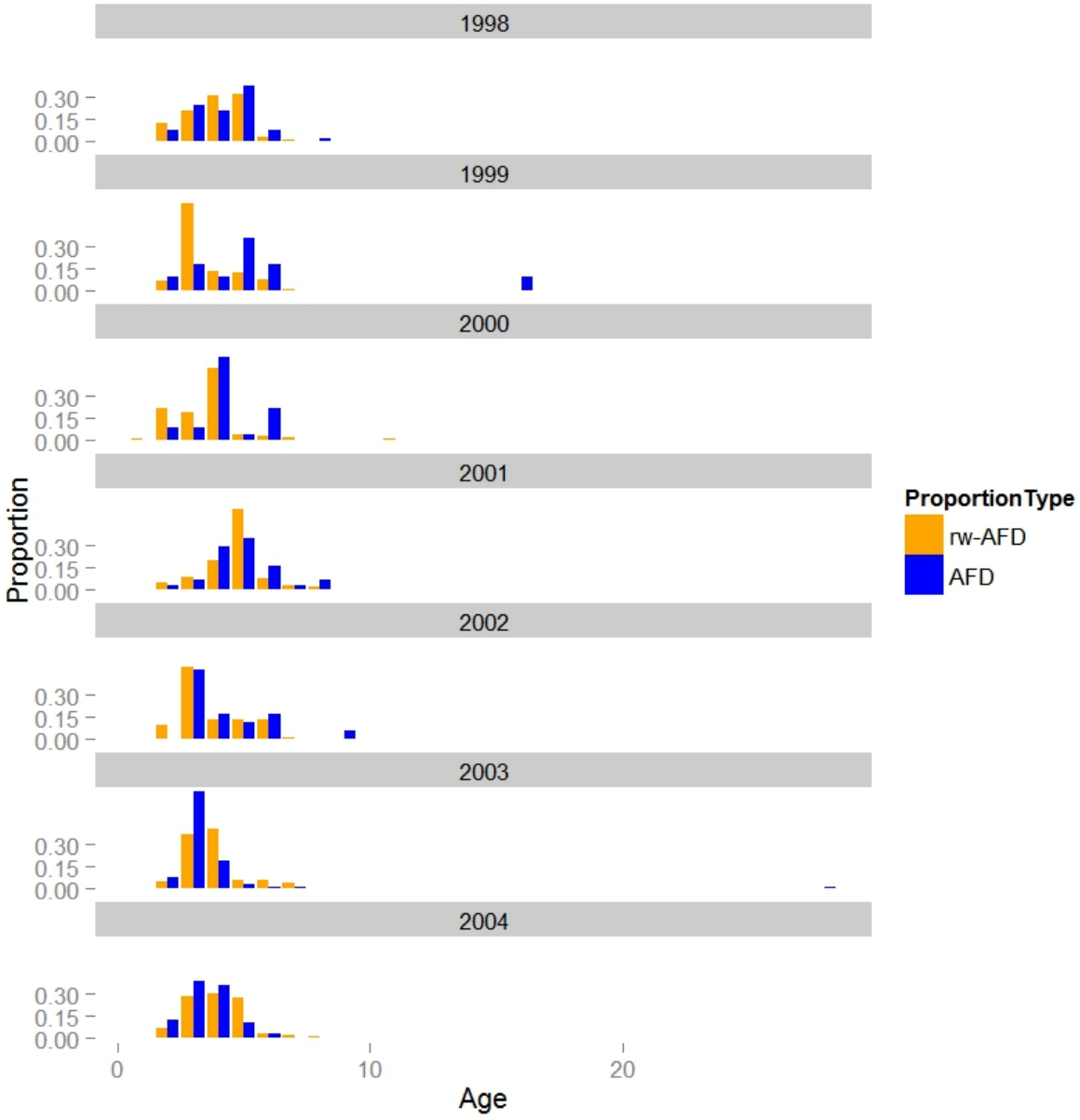

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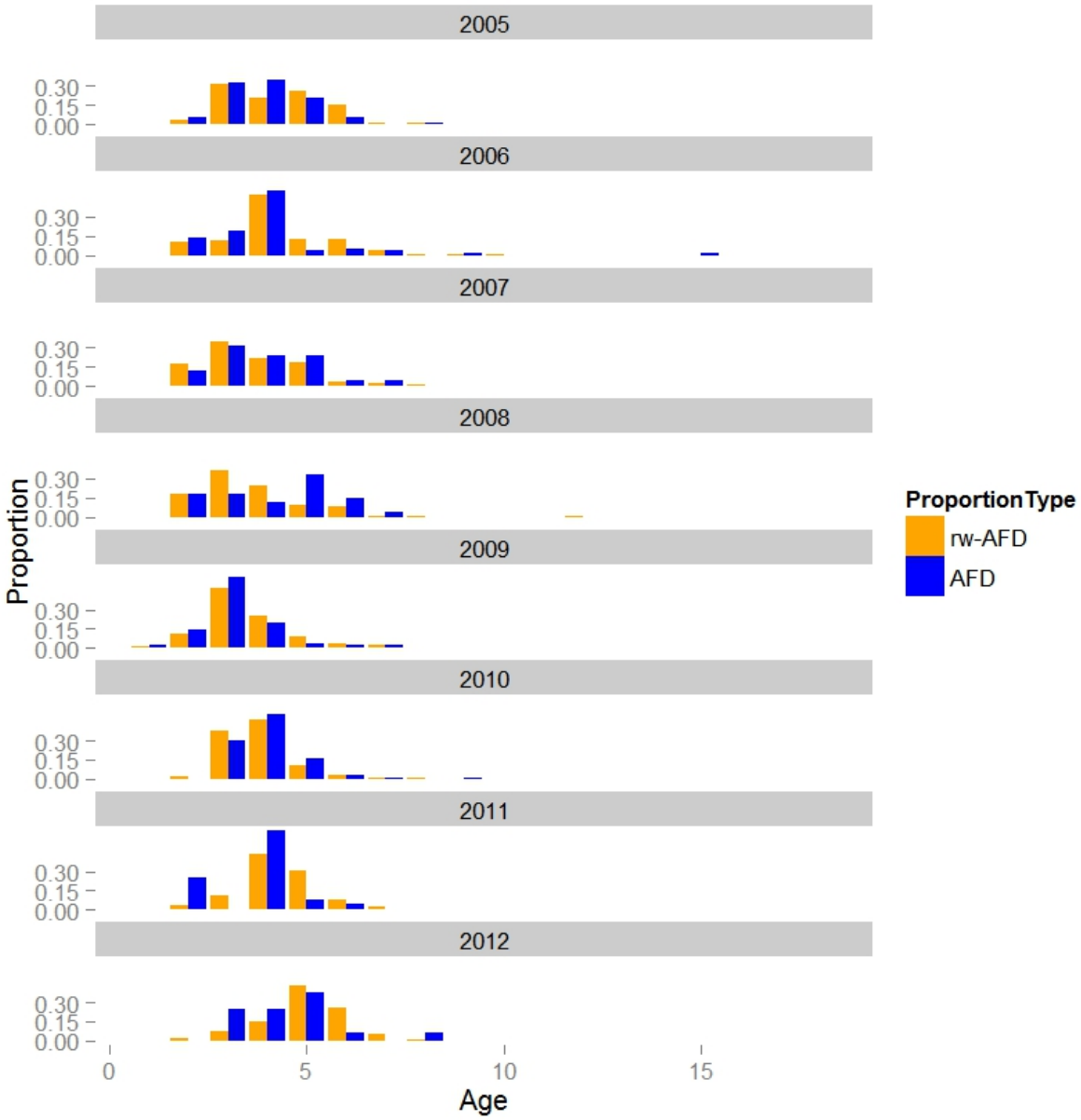


Fig 6a. Comparison for gag grouper age frequency distributions (AFD) with reweighted age frequency distributions (rw-AFD) estimated from samples collected from commercial longline fisheries from 1991 to1997.

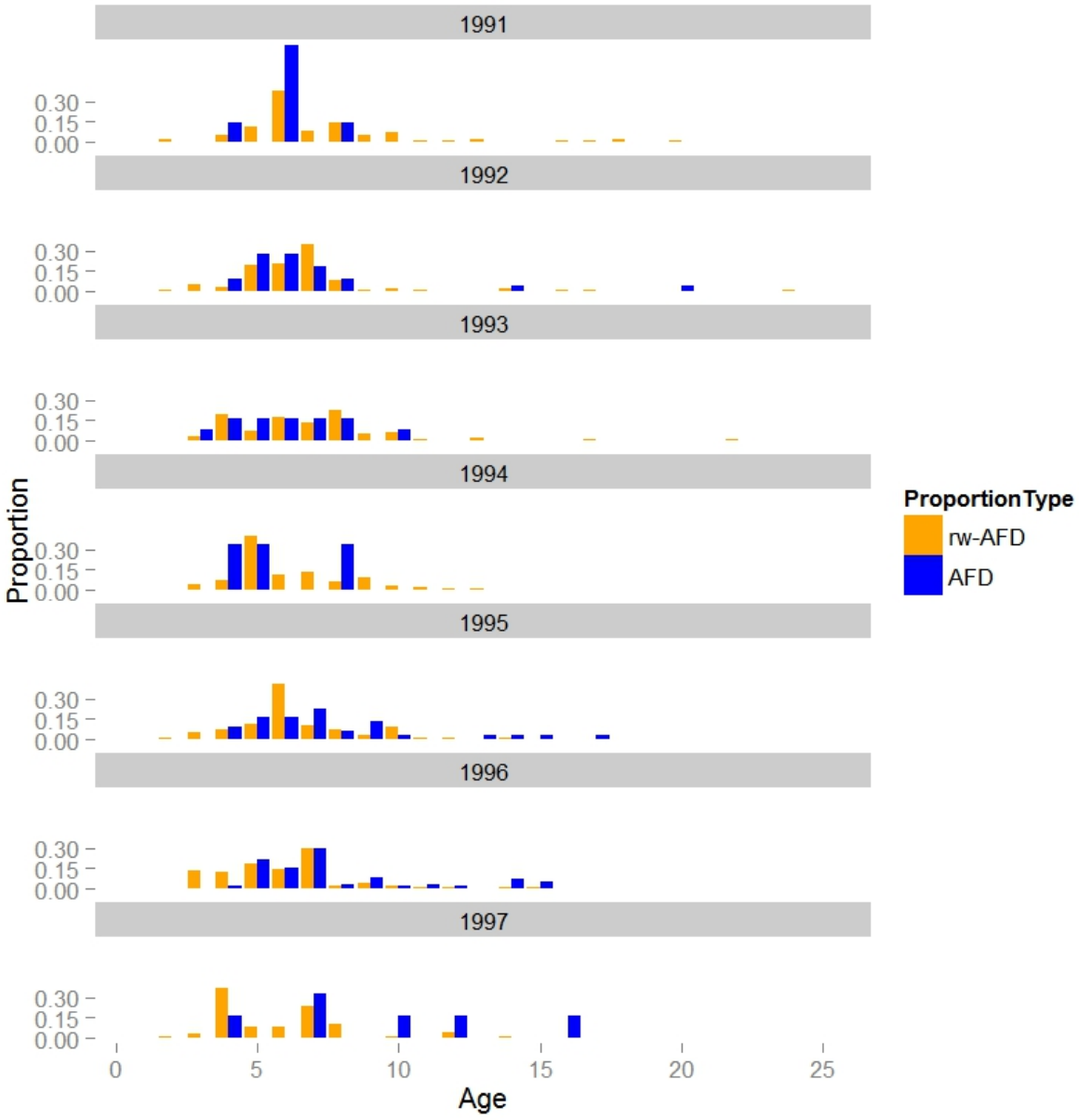


Fig 6b. Comparison for gag grouper age frequency distributions (AFD) with reweighted age frequency distributions (rw-AFD) estimated from samples collected from commercial longline fisheries from 1998 to 2004.

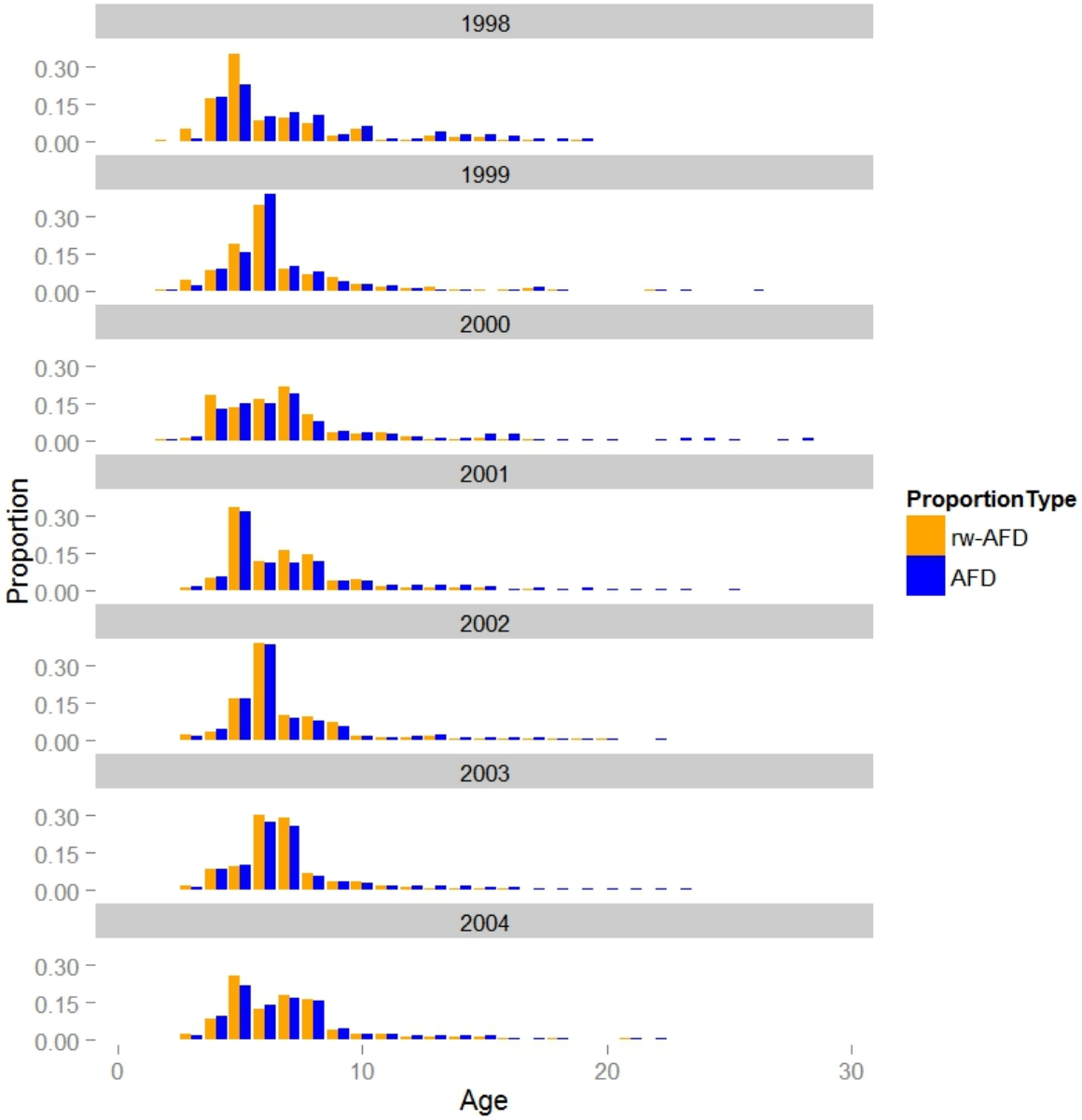


Fig 6c. Comparison for gag grouper age frequency distributions (AFD) with reweighted age frequency distributions (rw-AFD) estimated from samples collected from commercial longline fisheries from 2005 to 2011.

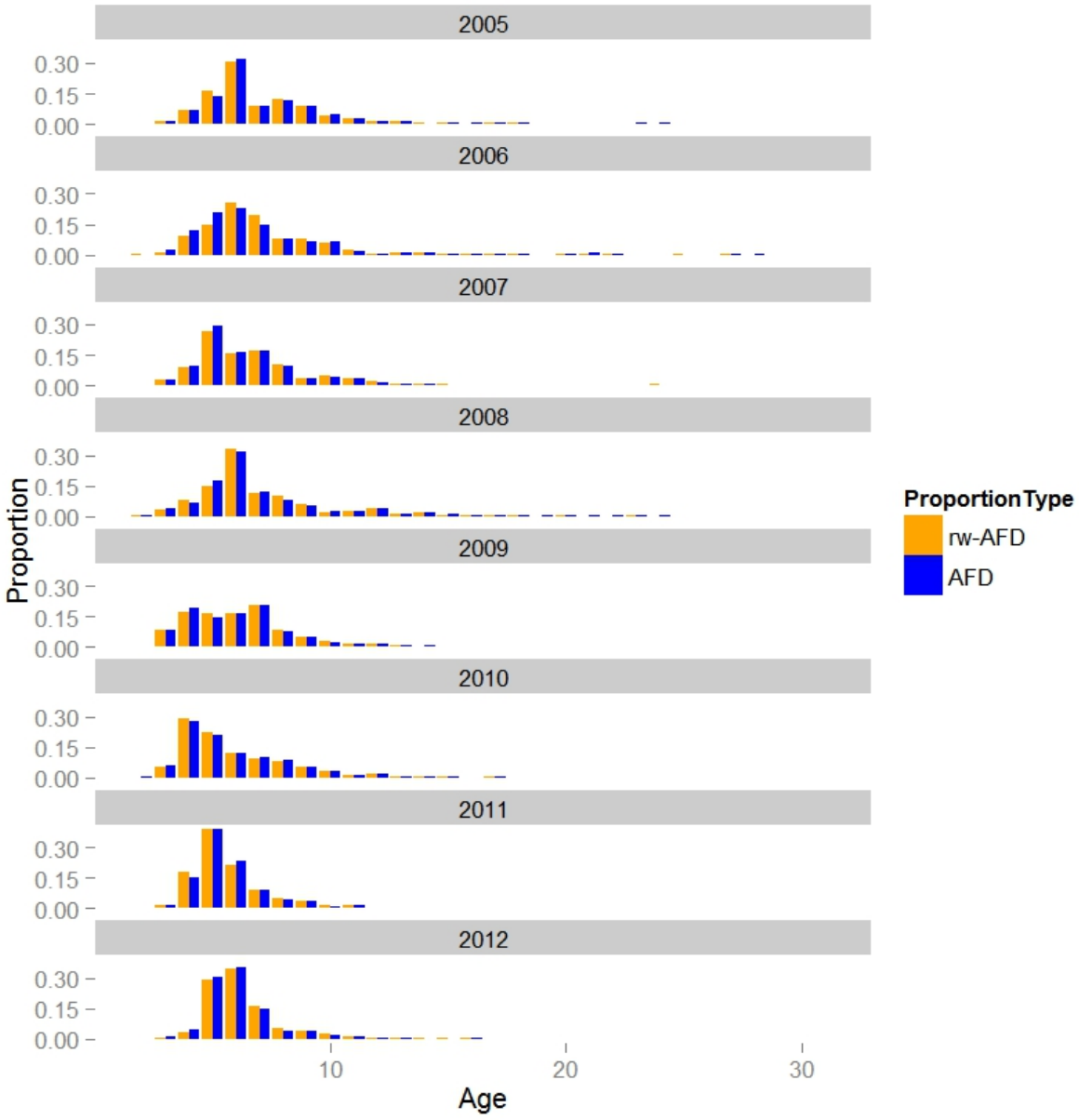


Fig 7a. Comparison for gag grouper age frequency distributions (AFD) with reweighted age frequency distributions (rw-AFD) estimated from samples collected from recreational head boat fisheries from 1991 to 1997.

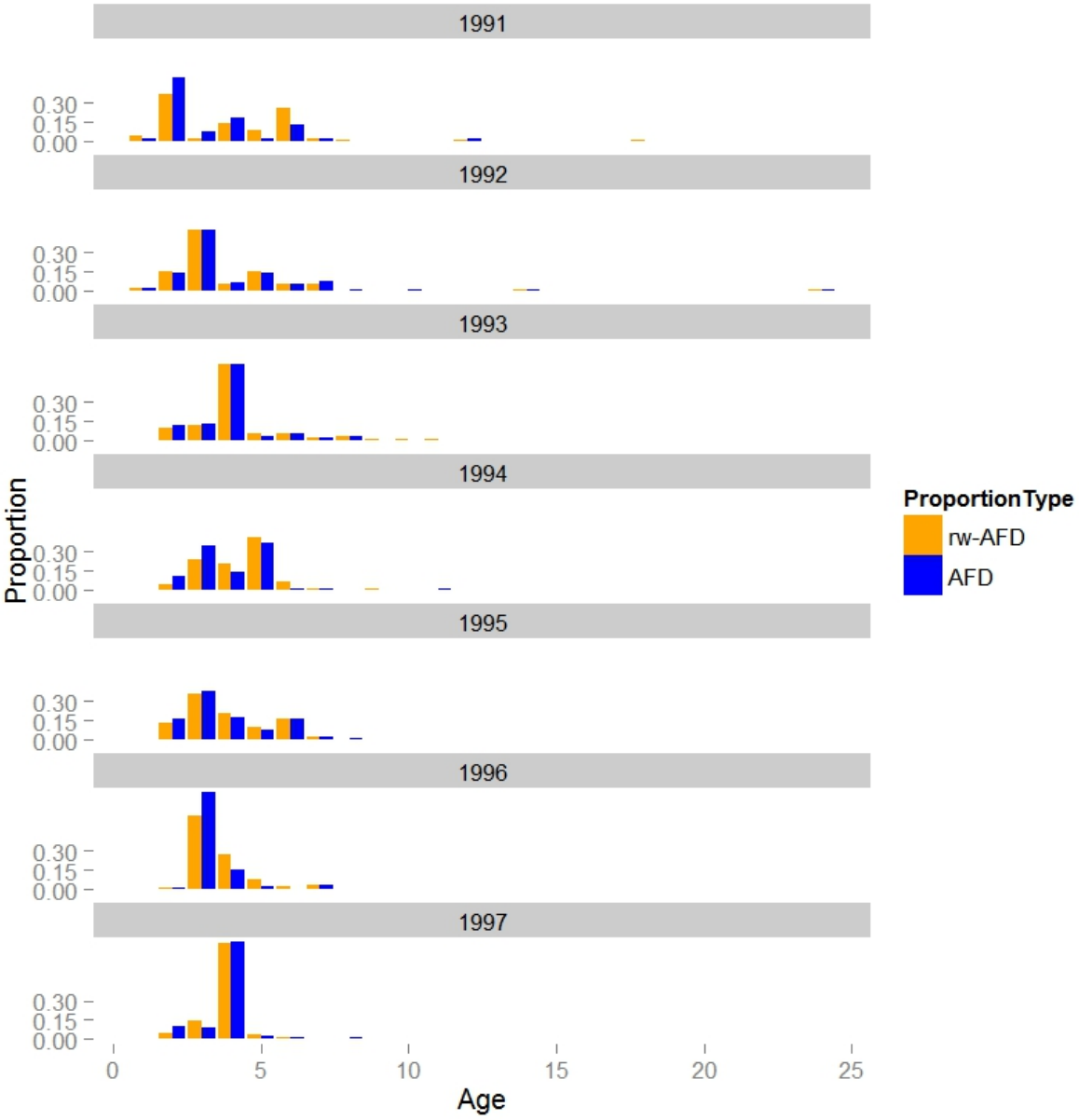


Fig 7b. Comparison for gag grouper age frequency distributions (AFD) with reweighted age frequency distributions (rw-AFD) estimated from samples collected from recreational head boat fisheries from 1998 to 2004.

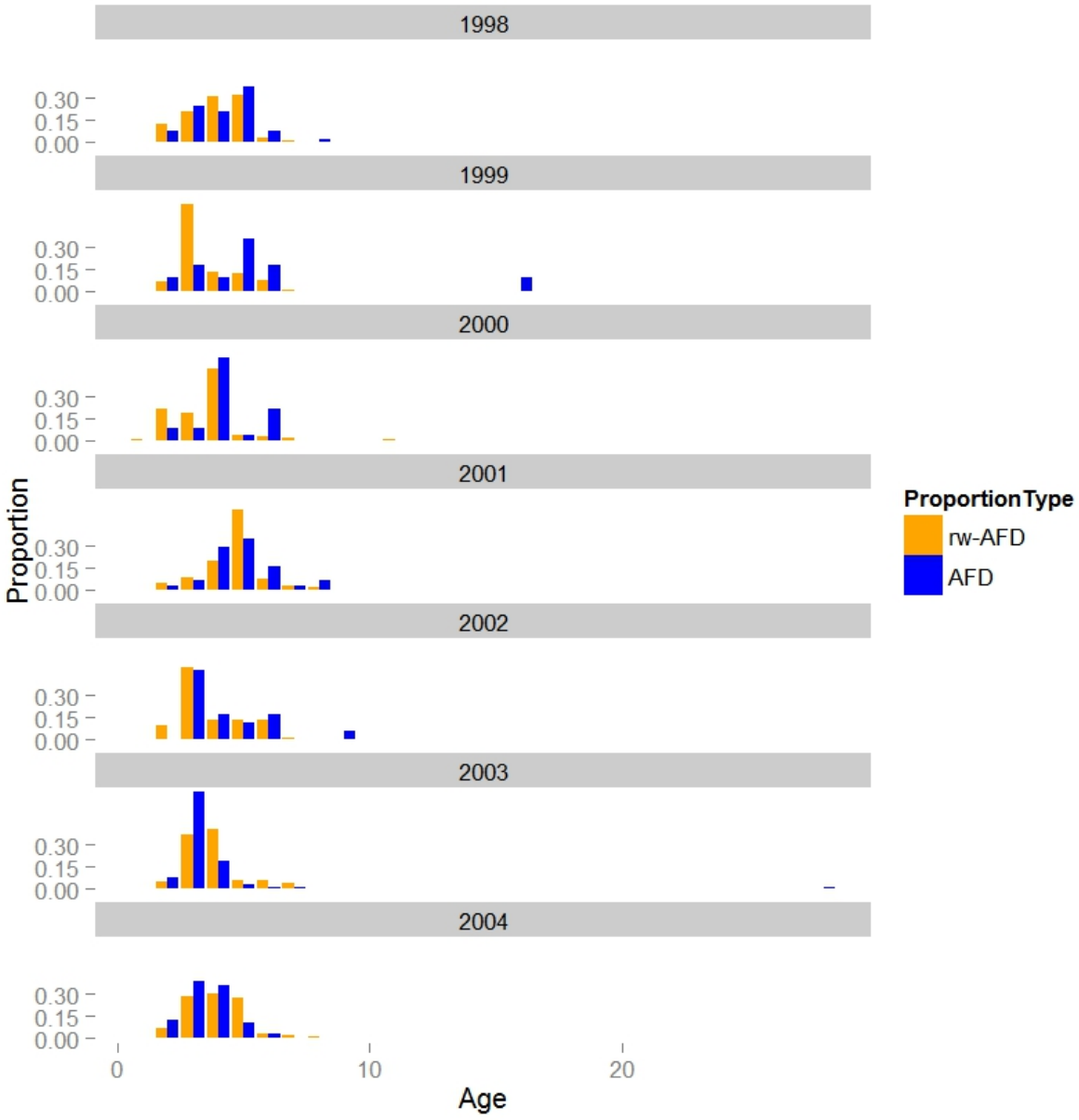


Fig 7c. Comparison for gag grouper age frequency distributions (AFD) with reweighted age frequency distributions (rw-AFD) estimated from samples collected from recreational head boat fisheries from 2005 to 2012.

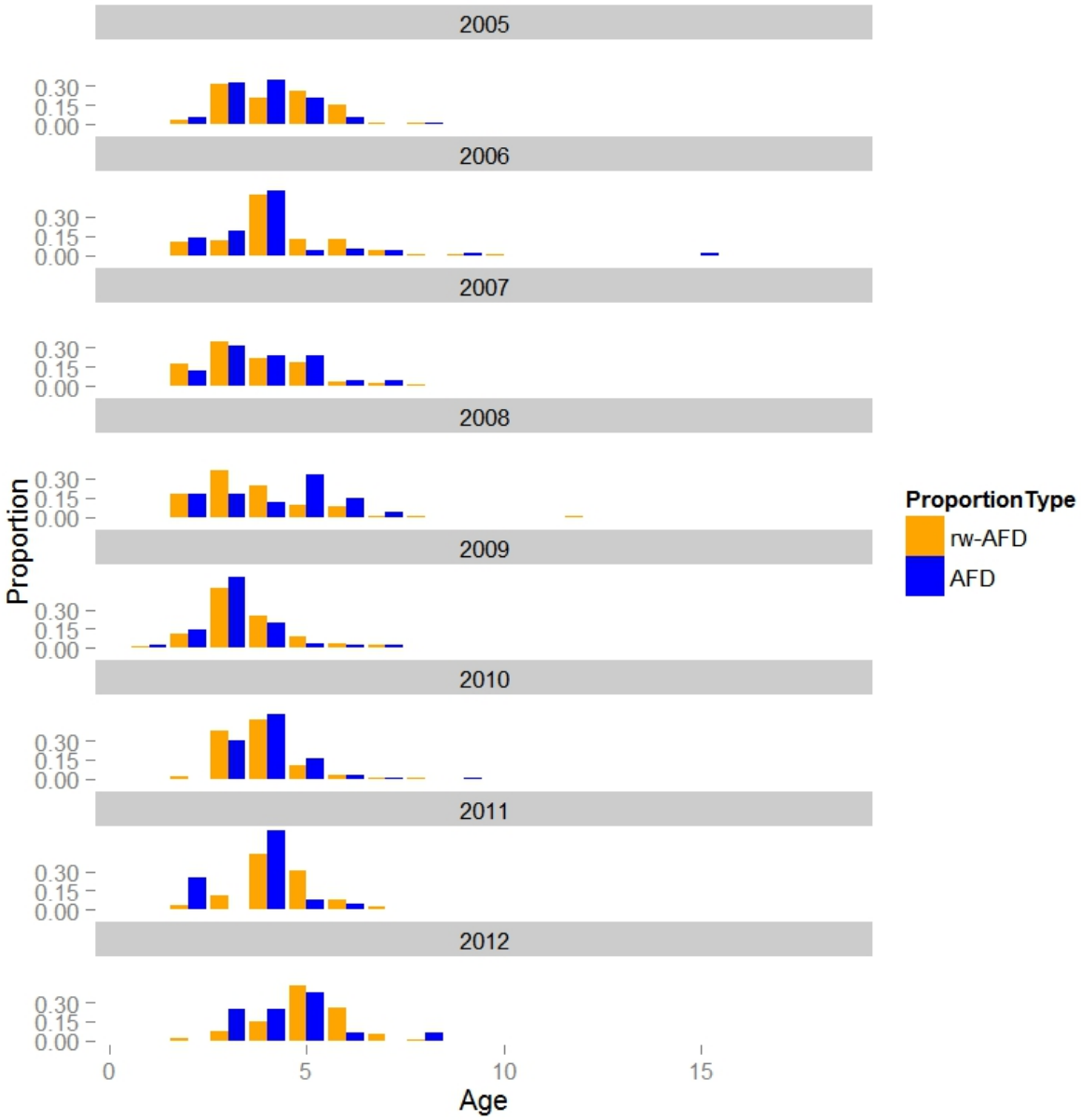


Fig 8a. Comparison for gag grouper age frequency distributions (AFD) with reweighted age frequency distributions (rw-AFD) estimated from samples collected from recreational charter boat and private boat fisheries from 1991 to 1997.

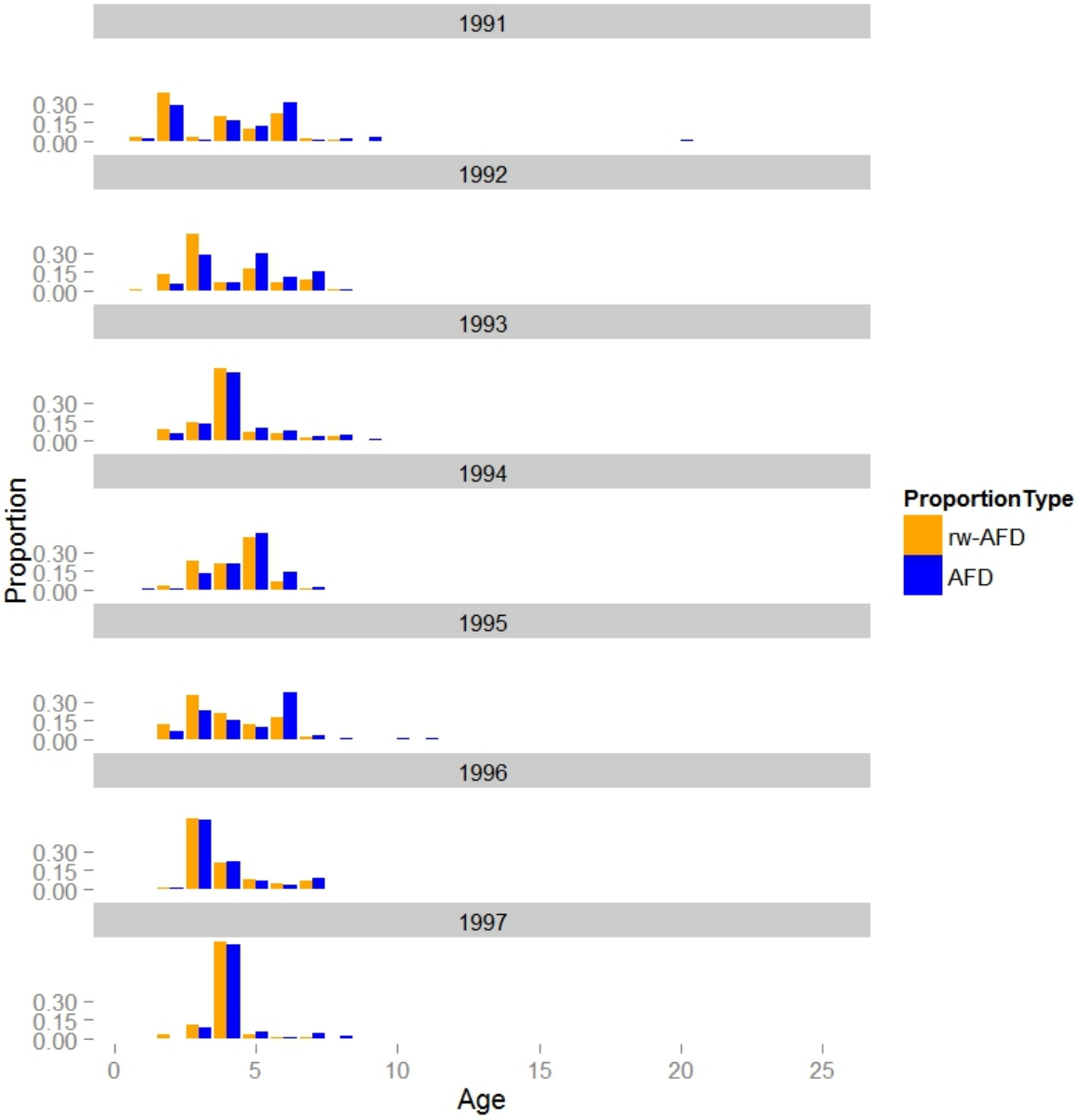


Fig 8b. Comparison for gag grouper age frequency distributions (AFD) with reweighted age frequency distributions (rw-AFD) estimated from samples collected from recreational charter boat and private boat fisheries from 1998 to 2004.

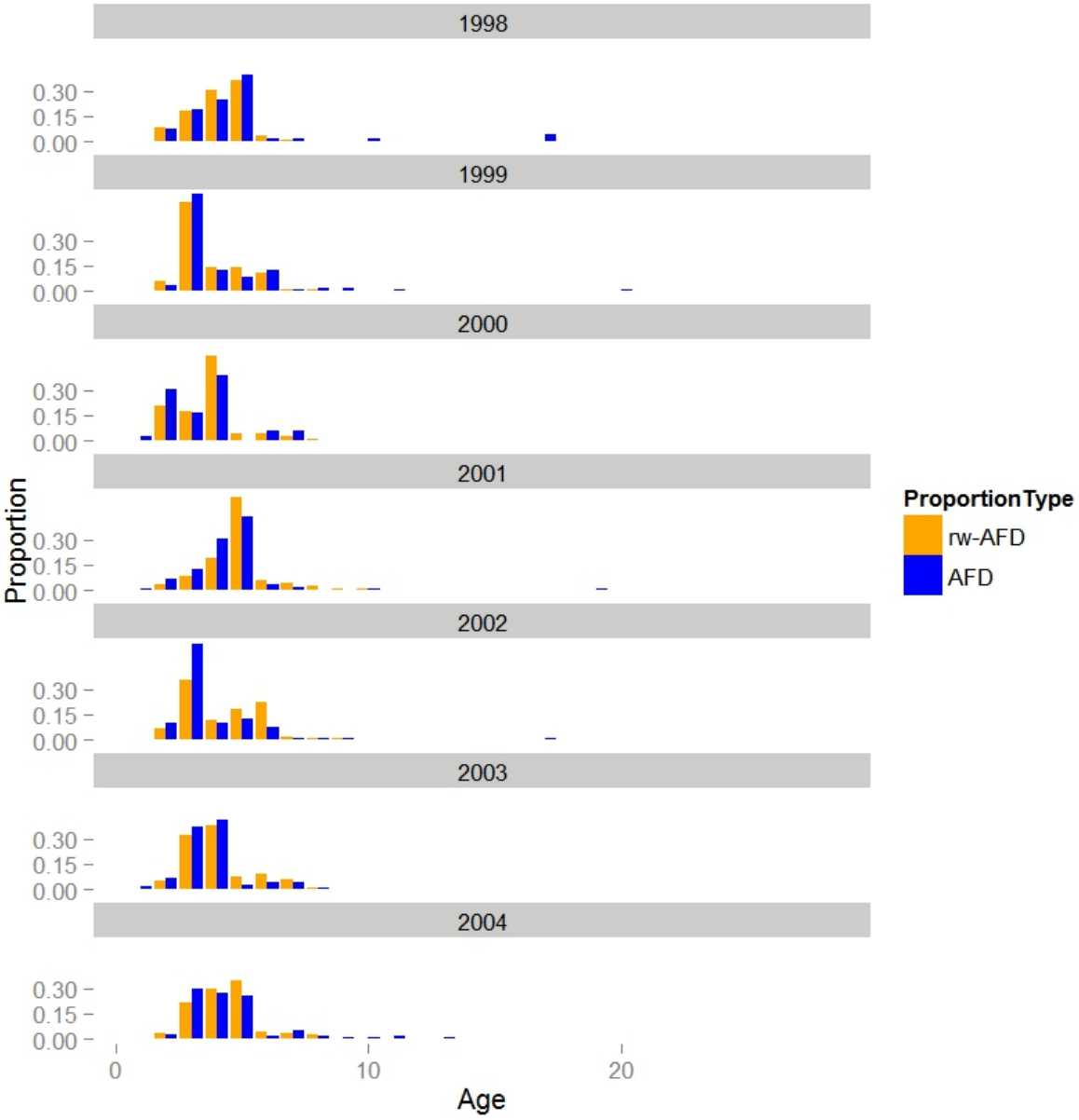


Fig 8c. Comparison for gag grouper age frequency distributions (AFD) with reweighted age frequency distributions (rw-AFD) estimated from samples collected from recreational charter boat and private boat fisheries from 2005 to 2011.

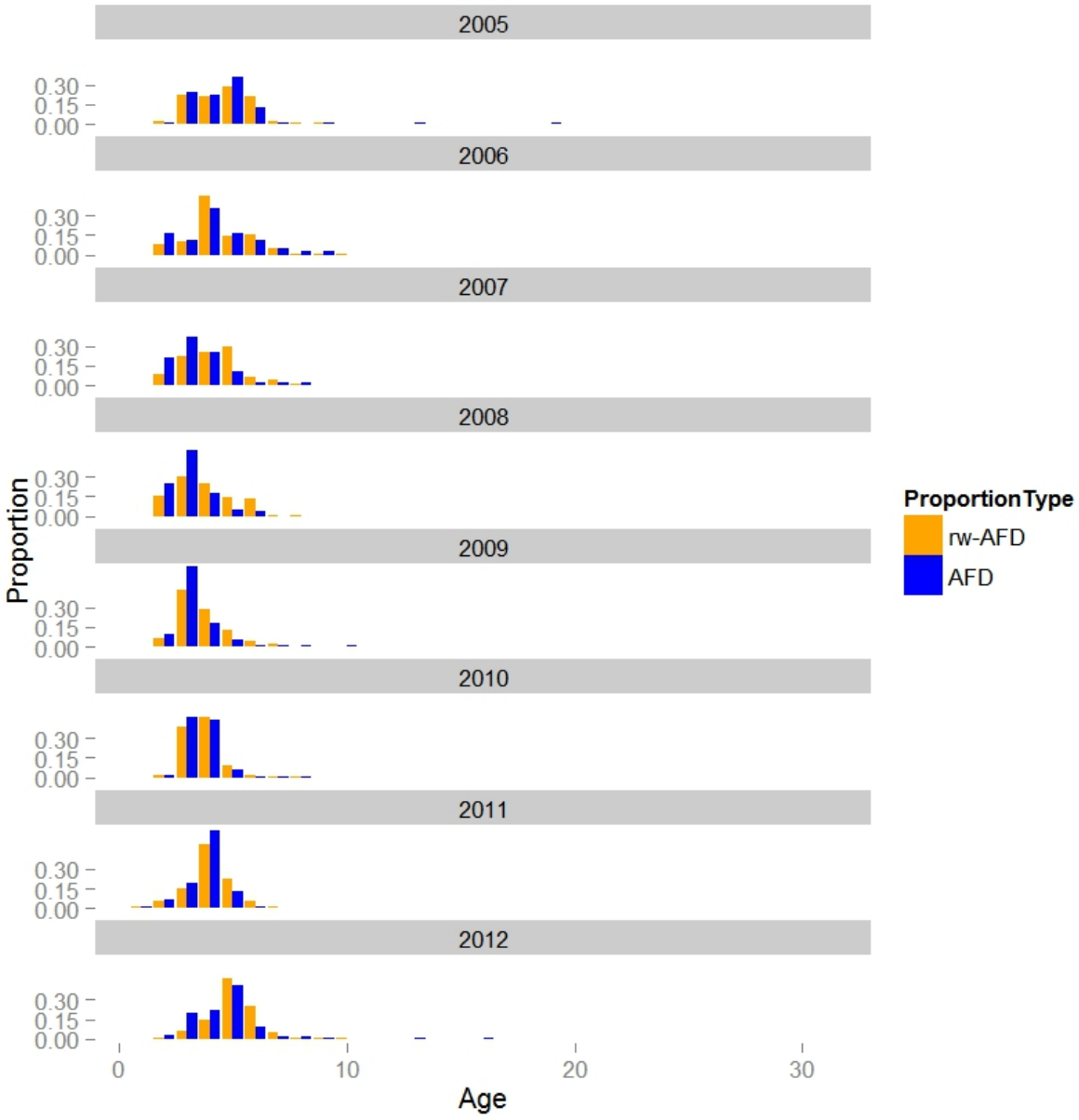


Fig 9. Age frequency distributions for age samples with fork length of 29 inches collected from handline, longline, head boat and charter-private boat fisheries from 1984-2012. For sample sizes, see Table 3.

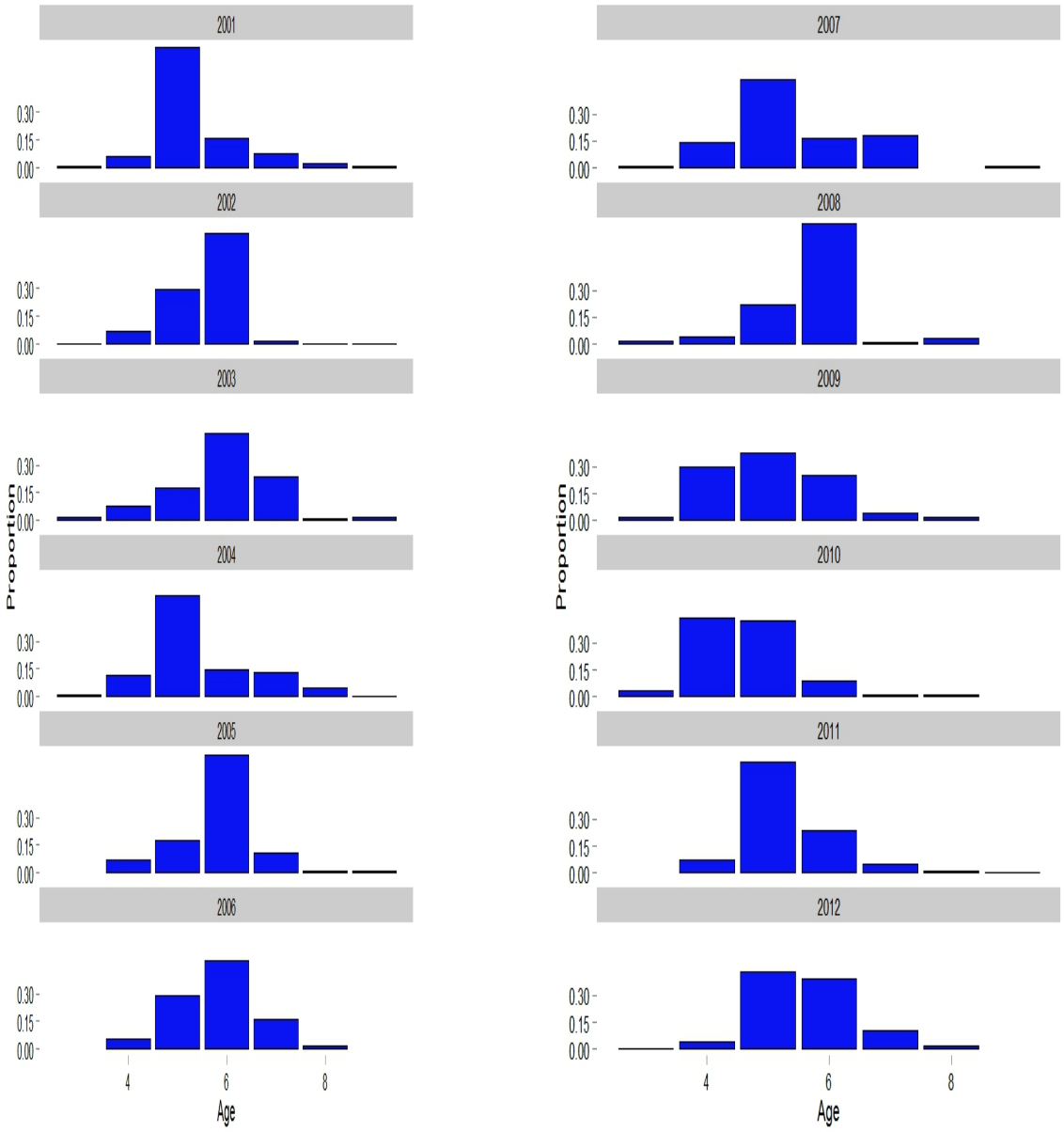
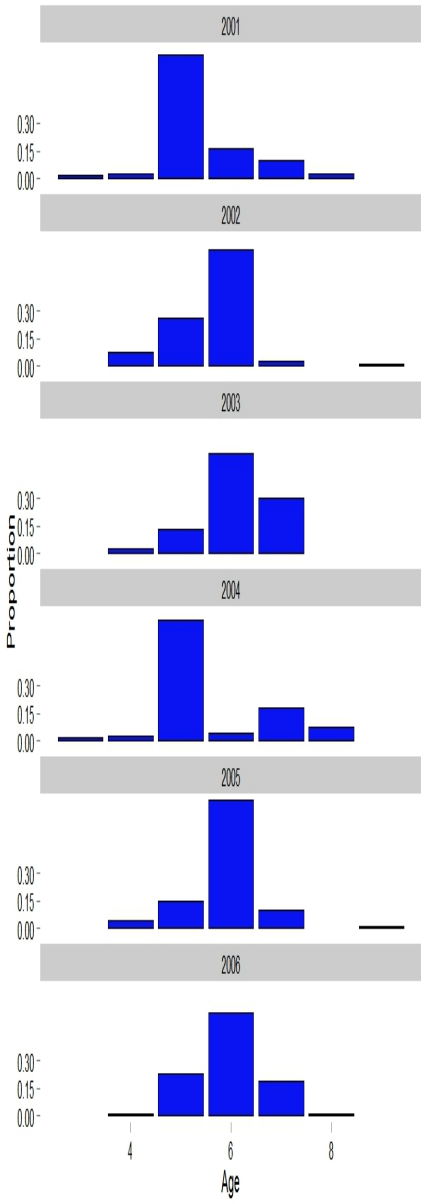


Fig 10a. Age frequency distributions for age samples with fork length of 29 inches collected from handline and longline fisheries from 2001-2006. For sample sizes, see Table 4-5.

(1). HL



(2). LL

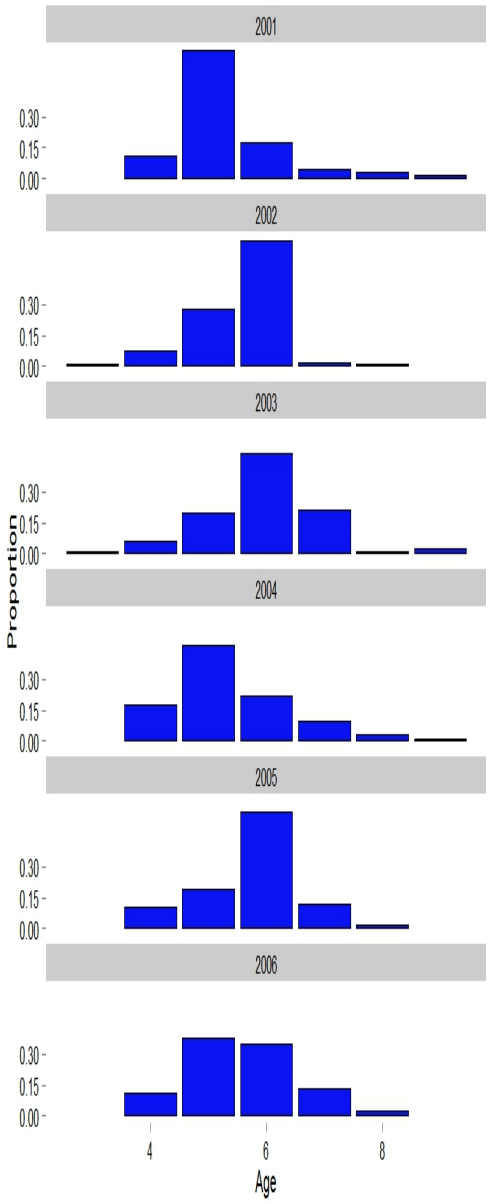
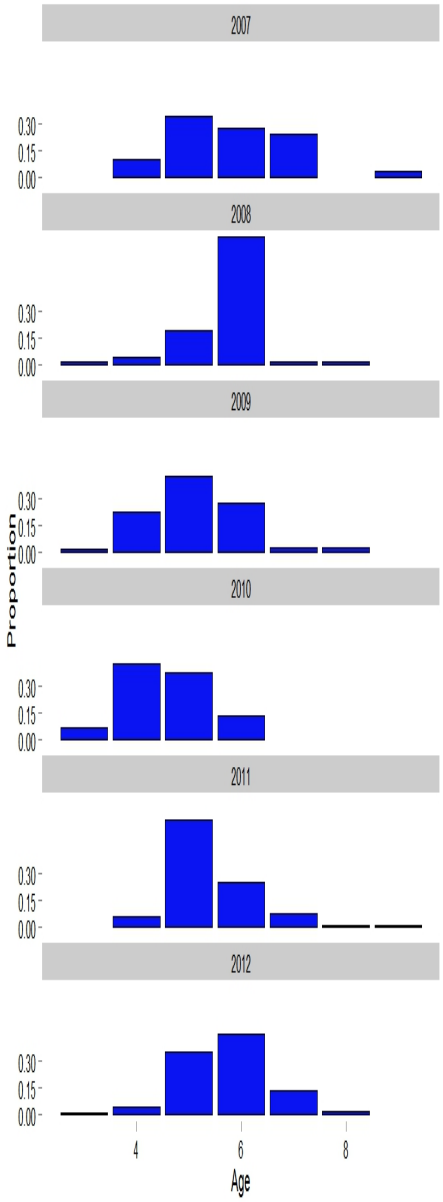


Fig 10b, Age frequency distributions for age samples with fork length of 29 inches collected from handline and longline fisheries from 2007-2012. For sample sizes, see Table 4-5.

(1) HL



(2). LL