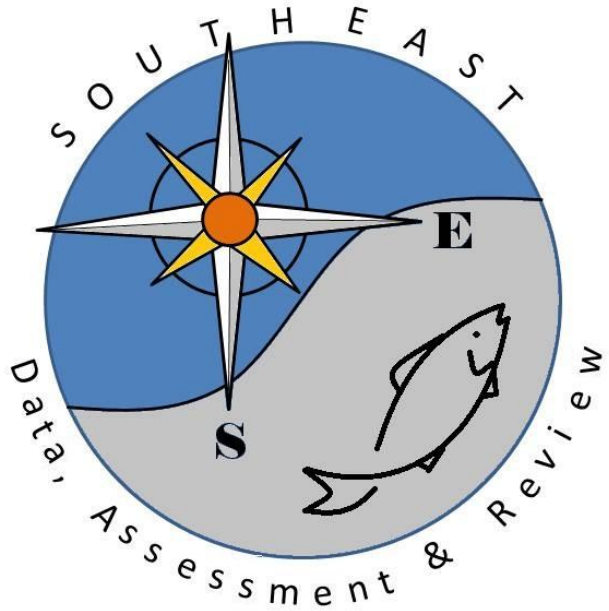
Age frequency distributions estimated with reweighting methods for red snappers in the Gulf of Mexico from 1991 to 2011

Ching-Ping Chih

SEDAR31-AW15

29 January 2013



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Introduction

A reweighting method was used to estimate the age frequency distribution of red snappers samples collected from the Gulf of Mexico from 1991 to 2011. The analysis reported here was in response to discussions at the SEDAR 31 workshop that red snapper otolith samples collected from earlier years (mostly before 2000) and from some strata may not have been representative of the actual red snapper landings (SEDAR 31 DW final reports). A reweighting method was first used by the Beauford Laboratory of the SEFSC to correct the representativeness of age frequency distributions. In this report, a modified reweighting method was used. Briefly, otolith samples from six strata, including non-random samples, were combined to provide an age-length-relationship (ALR) for a given year. The ALR was then reweighted (Chih, 2009) with the length frequency distribution to obtain the reweighted age frequency distribution. 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. The age definition from the CATCHEM model was used so that the results of the current analysis could be compared with the observed age frequency distribution estimated in a previous SEDAR update (Cass-Calay, 2009).

Methods

Red snapper length samples from commercial fisheries were obtained from the (1) Trip Interview Program (TIP) database, (2) the Gulf Fisheries Information Network (FIN) database and (3) the Panama City Laboratory age data base. Otolith samples from commercial fisheries were obtained from (1) the Panama City Laboratory age data base and (2) the Gulf Fisheries Information Network (FIN) database. All commercial data were grouped into four strata (handline east (HE), handline west (HW), longline east (LE), and longline west (LW)). The eastern Gulf and western Gulf were defined based on Gulf shrimp grids (grids 1 to 12 for the eastern Gulf and 13 to 21 for the western Gulf). The details for estimating length frequency distributions for each stratum have been reported elsewhere (Chih, 2012).

Length and otolith samples for recreational fisheries were obtained from (1) the Marine Recreational Fisheries Statistics Survey, (2) the Headboat survey, (3) the Texas Parks and Wildlife Department database, (4) the Gulf FIN database, (5) the Florida Fish and Wildlife Research Institute, and (6) the TIP database. All recreational length data were grouped into two strata (recreational east (RE) and recreational west (RW)). The eastern Gulf included Florida, Alabama and Mississippi, while the western Gulf included Louisiana and Texas. The details for estimation of Length frequency distributions for each stratum have been reported elsewhere (Chih, 2012).

Otolith samples from commercial handline and longline fisheries and from recreational fisheries (private boat, charter boat and head boat) were pooled together to provide an age-length relationship (ALR). Age frequency distributions for each stratum/year were then estimated by reweighting the ALR with the length frequency distribution for each stratum/year (see Chih, 2009 for the re-weighting method). The age definition used was that of the CATCHEM model (integer (biological age)) (Cass-Calay, 2009). All lengths were total length in inches.

Results & Discussion

The reweighting method used in this report is essentially the same as the age-length-key method except that no actual age-length-key was built. Because red snapper 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 estimated ALR may not be as precise as it would have been if the ALK sampling method had been used. However, the reweighting method is a reasonable alternative for estimating age distributions when the otolith samples are determined to be non-representative. The reweighting method differs from the reweighting method used previously by the Beaufort Laboratory in that otoliths from all strata, including non-random samples, were combined to estimate the age-length relationship. The pooling from all strata was necessary particularly for early years (mostly before 2000) where otolith sample sizes were small.

The reweighted age frequency distributions are quite different from the age frequency distributions estimated directly with the ROS method (Cass-Calay, 2009), particularly before 2002. Some significant differences in age frequency distributions estimated with these two methods were also observed in more recent years. Some of these differences may have resulted from (a) non-random sampling of otolith samples in certain years/strata, (b) variations in age due to the use of CATCHEM age (i.e.,integer

(biological age)), and (c) loss of precision when the ALR was used to convert length to age.

References

Cass-Calay, 2009, Direct Observations of Catch-at-age. SEDAR 2009 Red snapper update report.

Ching-Ping Chih, 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, C.P. 2012, Length frequency distribution for red snappers in the Gulf of Mexico from 1984-2011. SEDAR31-DW10.

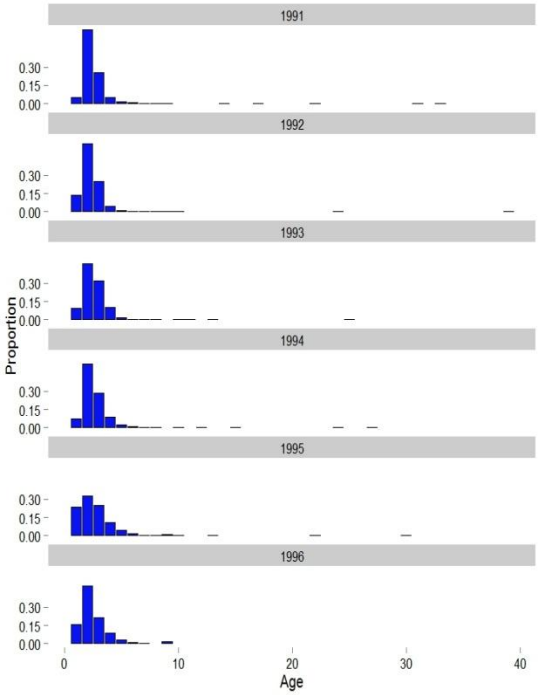
SEDAR 31, Gulf of Mexico red snapper data workshop final report, December,2012.

Table 1. Sample sizes for red snapper length and otolith samples collected from the Gulf of Mexico from 1991 to 2011 (HE-commercial handline East, HW-commercial handline west, LE-commercial longline east, LW- commercial longline west, RE-recreational handline east, RW-recreational handline west) .

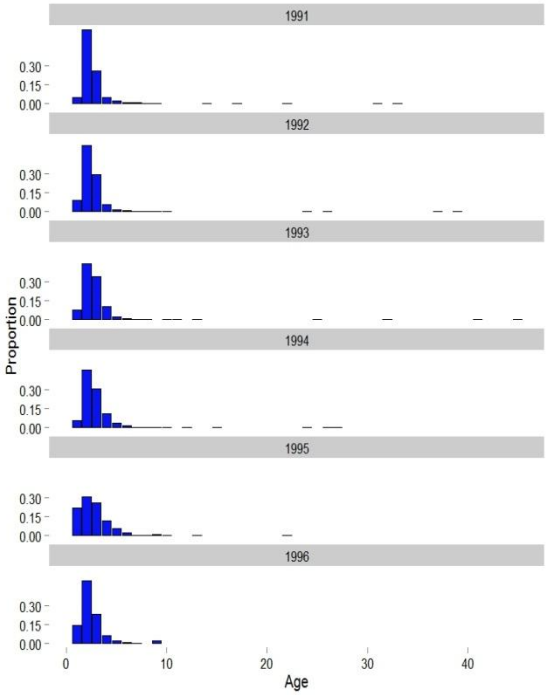
Year	Combined otolith Sample size	HE Length Sample size	HW Length Sample size	RE Length Sample size	RW Length Sample size	LE Length Sample size	LW Length Sample size
1991	1102	3014	7303	2232	5643	136	272
1992	1309	1249	10135	3407	10078	161	111
1993	2374	2422	8576	1797	9324	153	51
1994	1750	4088	6145	2744	8663	102	4
1995	592	2572	6116	1047	10576	199	7
1996	233	2837	7998	918	7052	79	11
1997	195	2444	10324	2571	5610	68	63
1998	4950	4629	10019	5435	8075	219	358
1999	4994	5787	5465	9589	4234	290	218
2000	3440	5342	3610	9324	4406	283	540
2001	3292	5116	4442	7830	3531	231	192
2002	7362	5570	6395	12622	4500	282	705
2003	10622	5963	5355	15723	4499	312	259
2004	9003	5305	4099	10975	3447	423	699
2005	11078	5031	5051	11232	4082	574	356
2006	10353	4771	5552	8459	4536	240	502
2007	5225	5866	2137	6586	3615	218	363
2008	4268	5335	3621	3868	2118	518	382
2009	7112	5454	4365	2330	2831	80	287
2010	7567	5229	5316	2075	2023	658	85
2011	6585	7731	4528	2697	2545	573	14

Fig 1. Age frequency distributions of red snapper samples collected from the Gulf of Mexico from 1991 to 1996 (HE-commercial handline East, HW-commercial handline west, RE-recreational handline east, RW-recreational handline west).

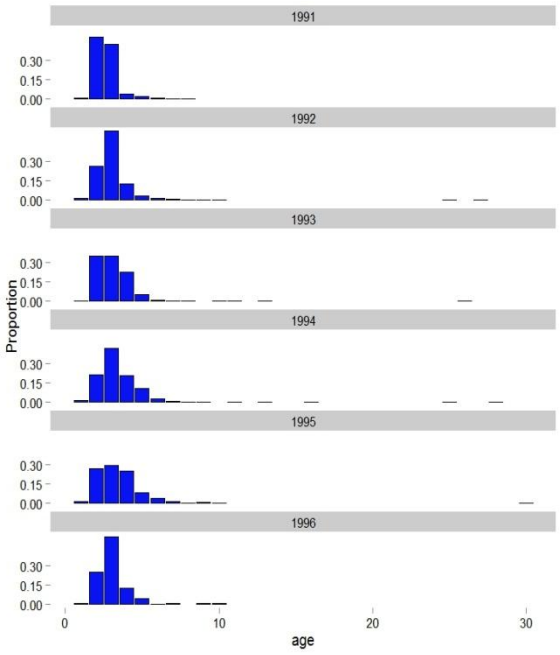
(a) HE



(b) HW



(c) RE



(d) RW

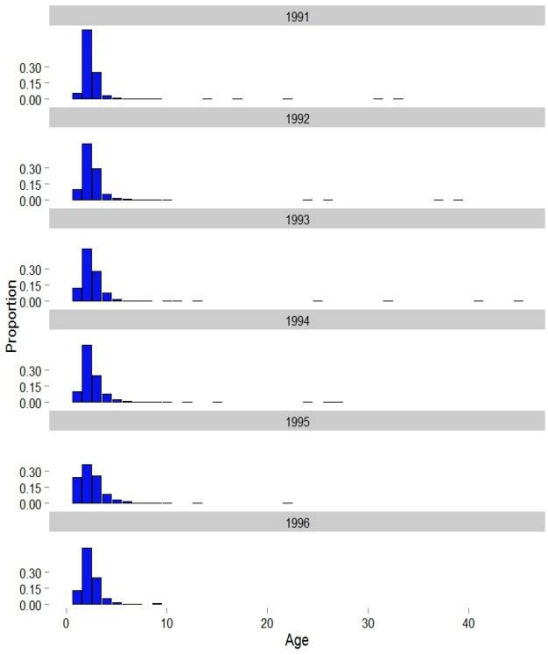
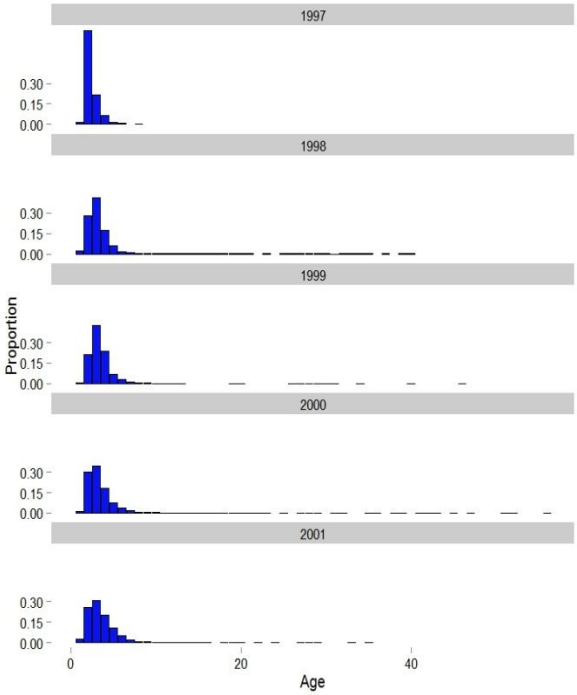
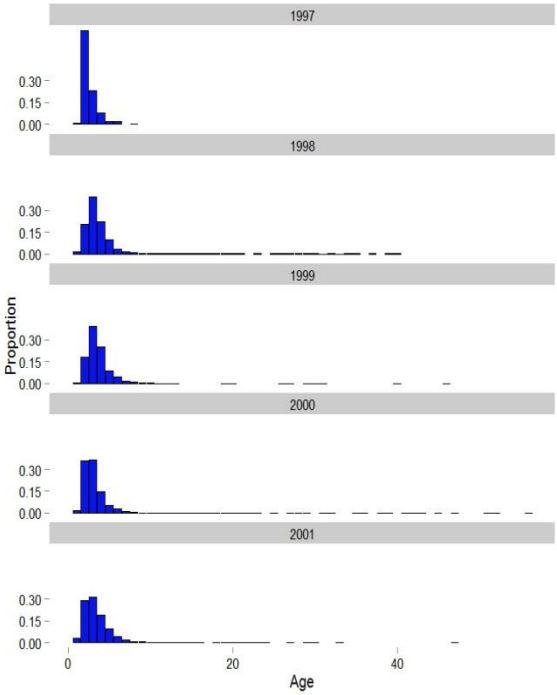


Fig 2. Age frequency distributions for red snapper samples collected from the Gulf of Mexico from 1997 to 2001 (HE-commercial handline East, HW-commercial handline west, RE-recreational handline east, RW-recreational handline west).

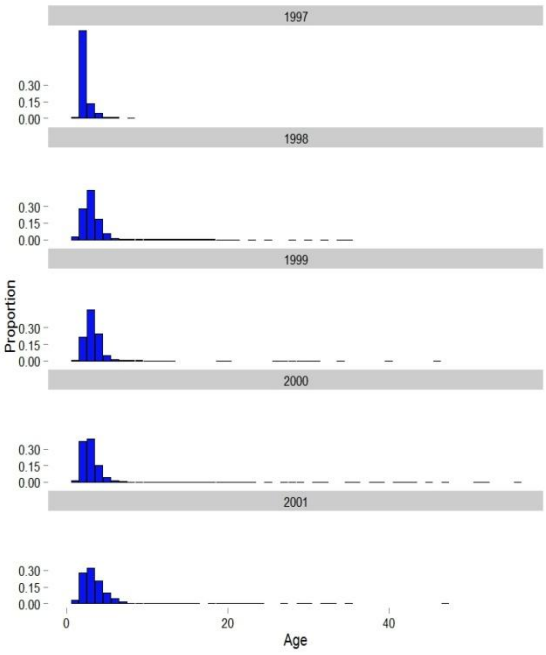
(a) HE



(b) HW



(c) RE



(d) RW

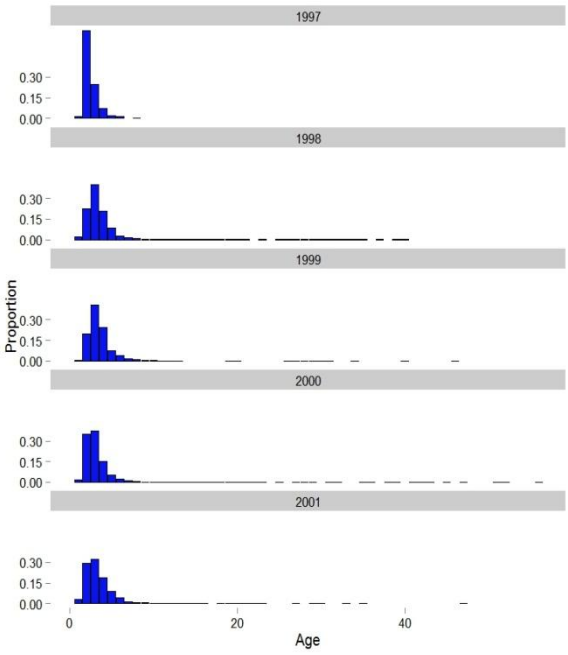
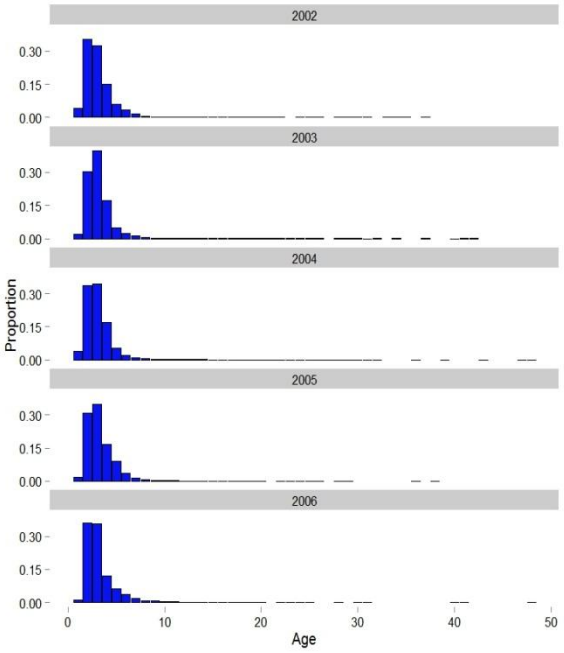
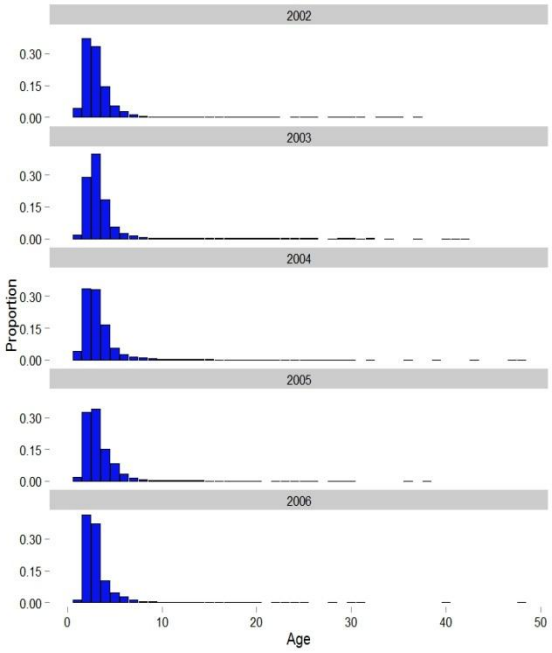


Fig 3. Age frequency distributions for red snapper samples collected from the Gulf of Mexico from 2002 to 2006 (HE-commercial handline East, HW-commercial handline west, RE-recreational handline east, RW-recreational handline west).

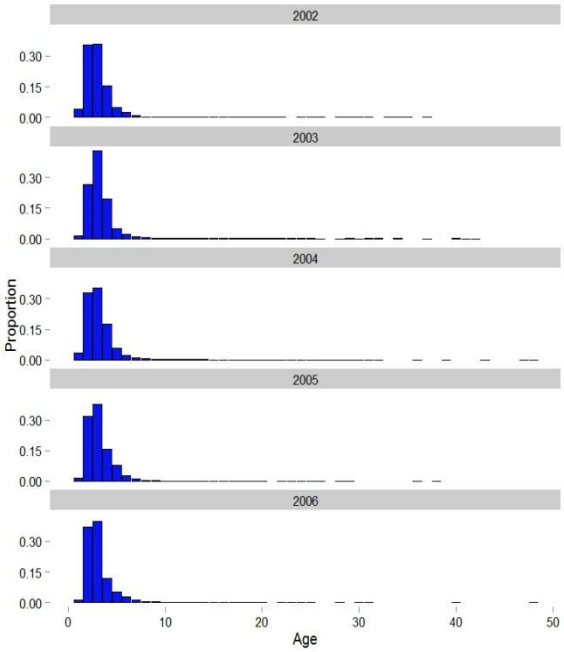
(a) HE



(b) HW



(c) RE



(d) RW

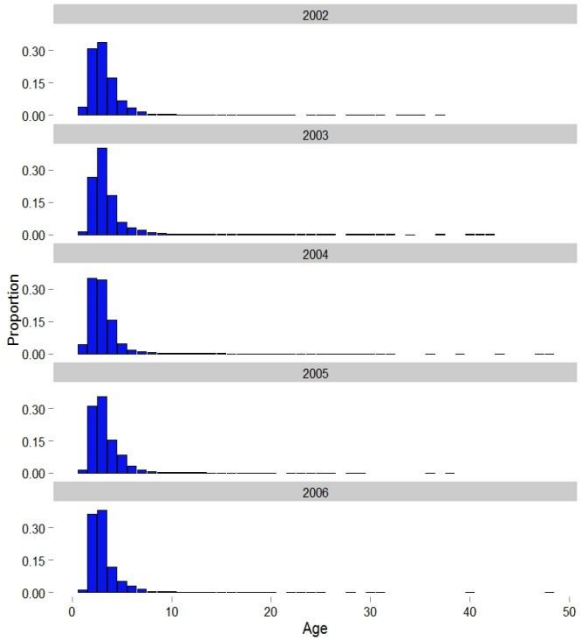
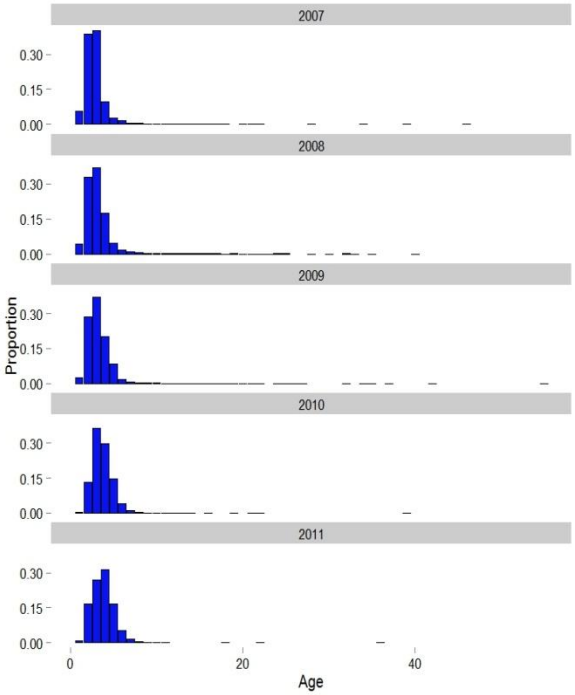
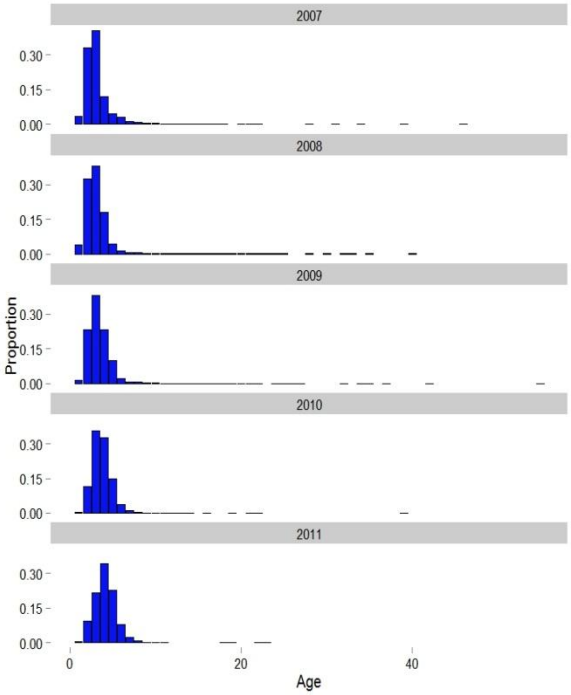


Fig 4. Age frequency distributions for red snapper samples collected from the Gulf of Mexico from 2007 to 2011 (HE-commercial handline East, HW-commercial handline west, RE-recreational handline east, RW-recreational handline west).

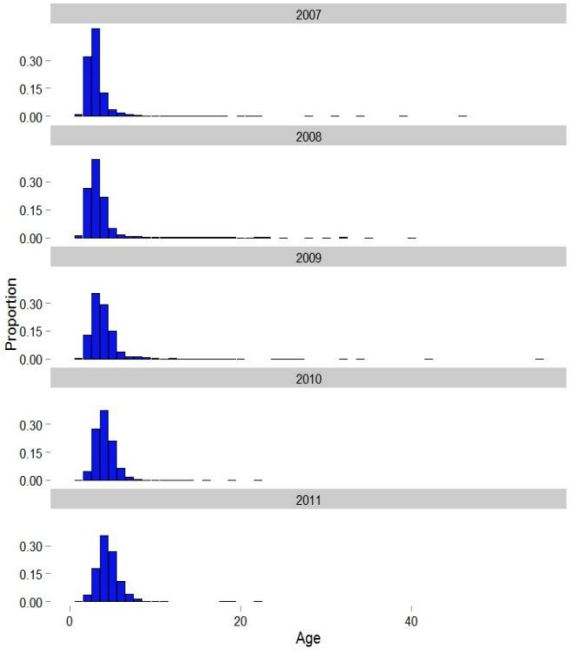
(a) HE



(b) HW



(c) RE



(d) RW

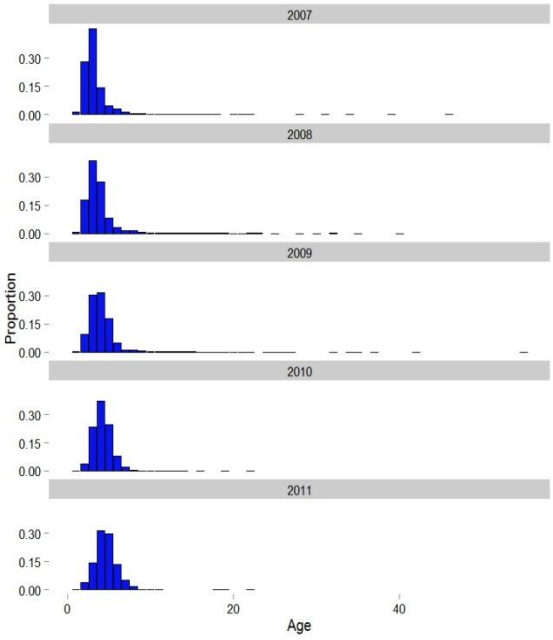
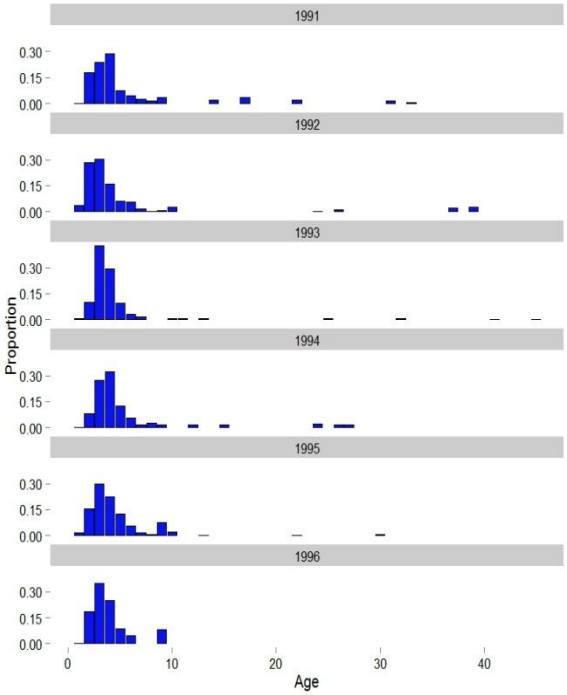
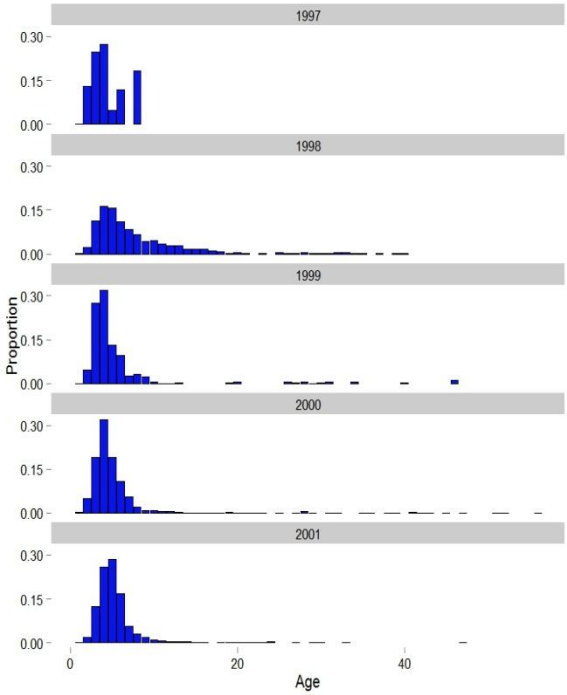


Fig 5. Age frequency distributions for red snapper samples collected from commercial longline fisheries in the East Gulf of Mexico (LE) from 1991 to 2011.

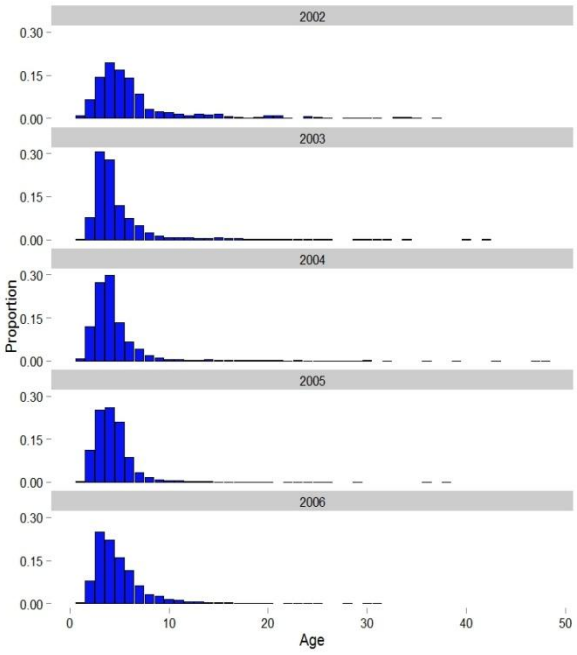
(a) 1991-1996



(b) 1997-2001



(c) 2002-2006



(d) 2007-2011

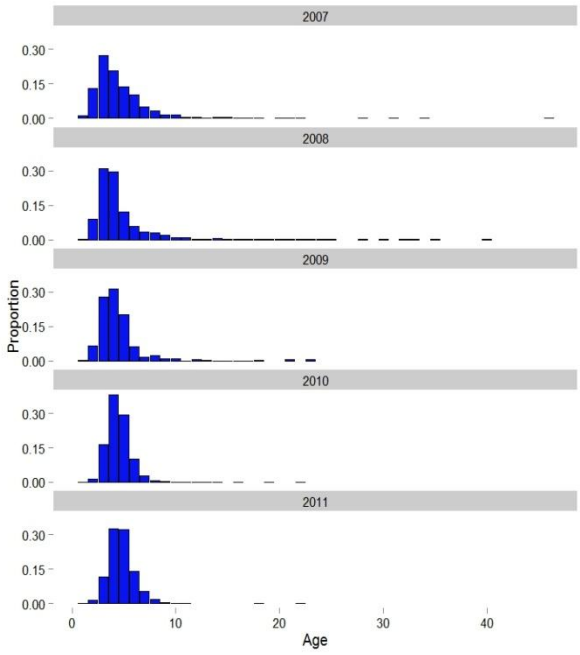
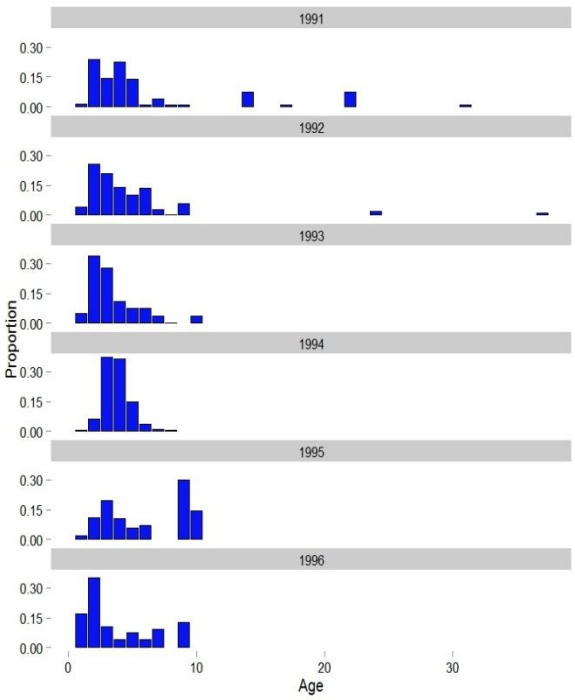
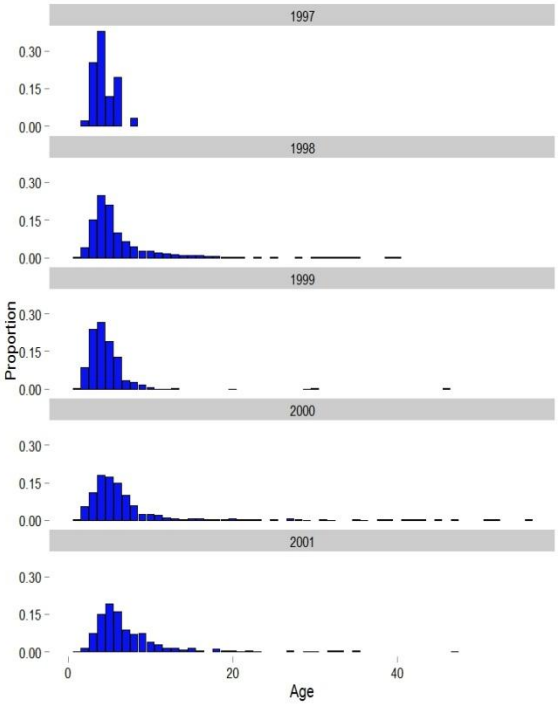


Fig 6. Age frequency distributions for red snapper samples collected from commercial longline fisheries in the West Gulf of Mexico (LW) from 1991 to 2011.

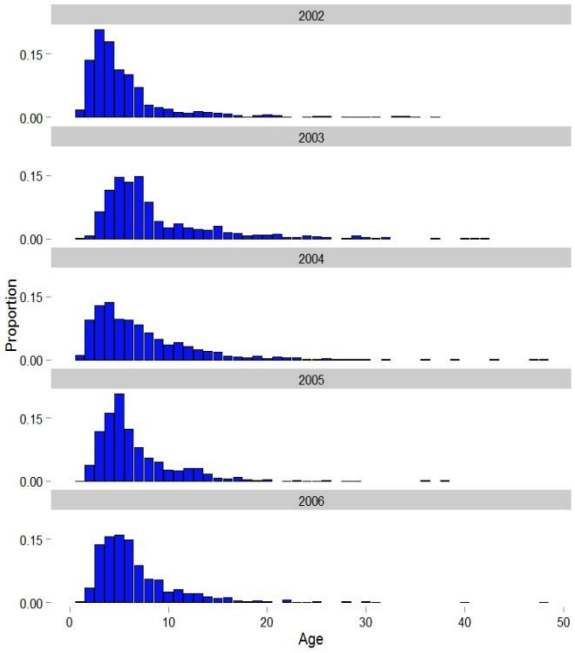
(a) 1991-1996



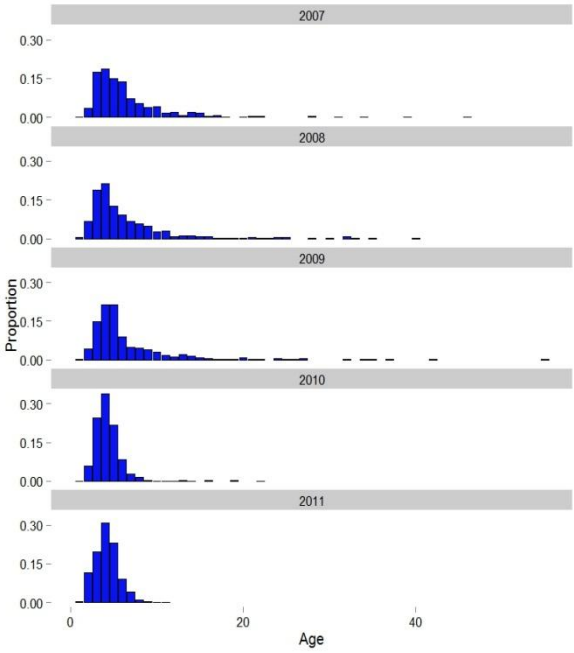
(b) 1997-2001



(c) 2002-2006



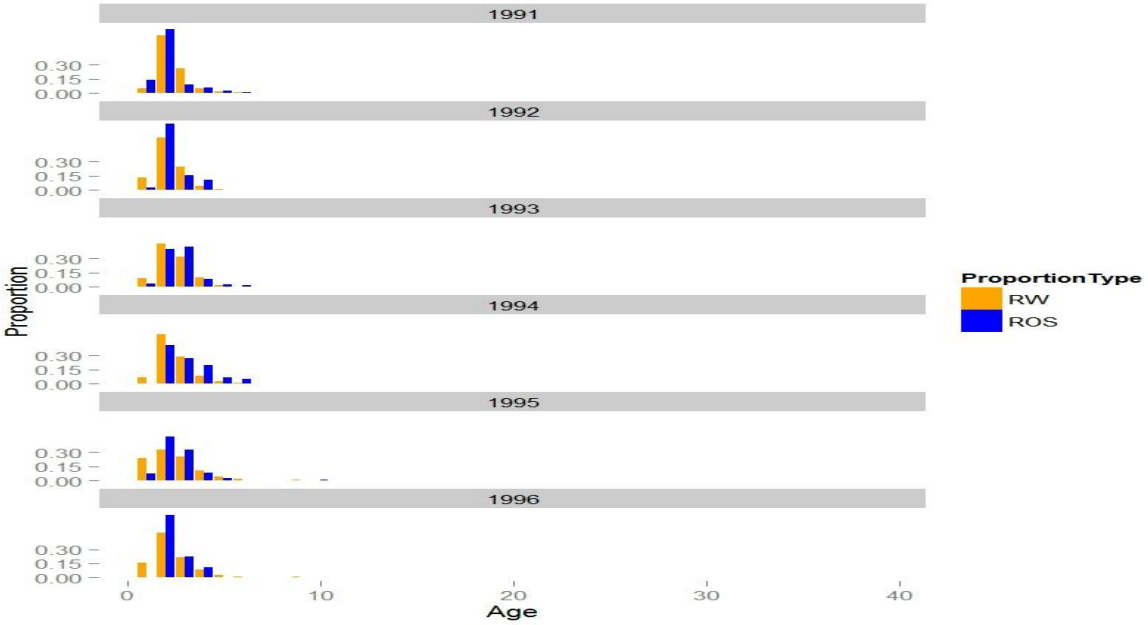
(d) 2007-2011



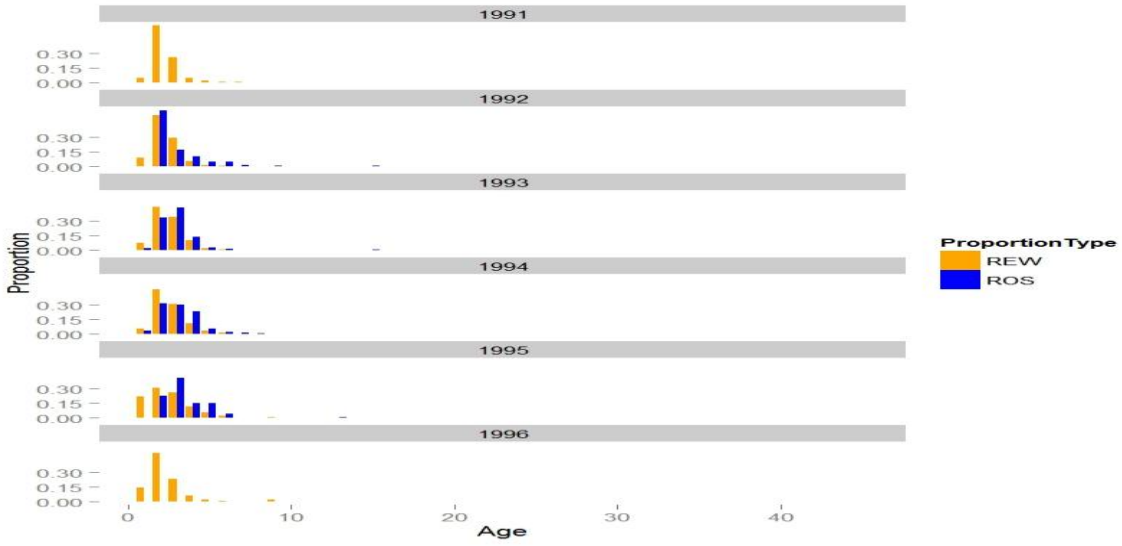
Appendix: Comparisons of red snapper age frequency distributions estimated directly from otolith samples (ROS) with those estimated with reweighting methods (REW).

Fig A-1 Comparison of red snapper age frequency distributions estimated with ROS and REW methods for the years 1991-1996. (HE-commercial handline East, HW-commercial handline west, RE-recreational handline east, RW-recreational handline west)

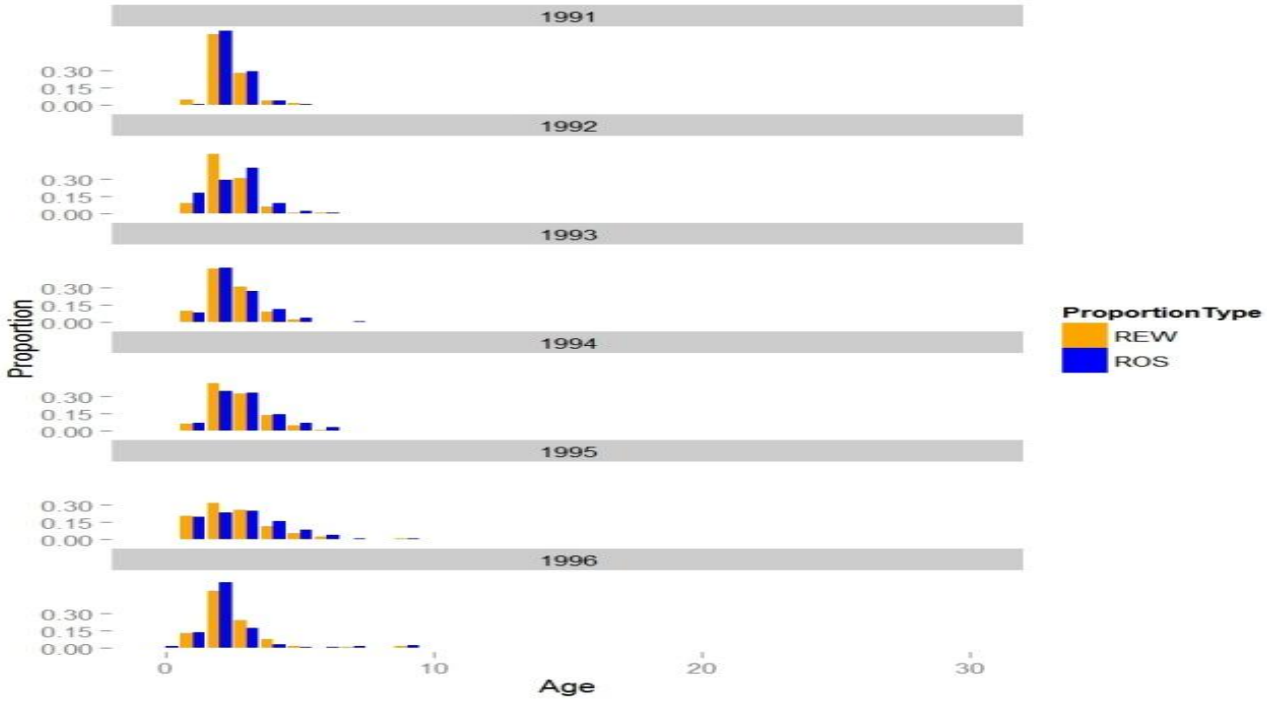
(a) HE



(b) HW



(c) RE


1991
1992
1993
1994
1995
1996
0.30
0.15
0.00
Proportion
0
10
20
30
Age
ProportionType
REW
ROS

(d) RW

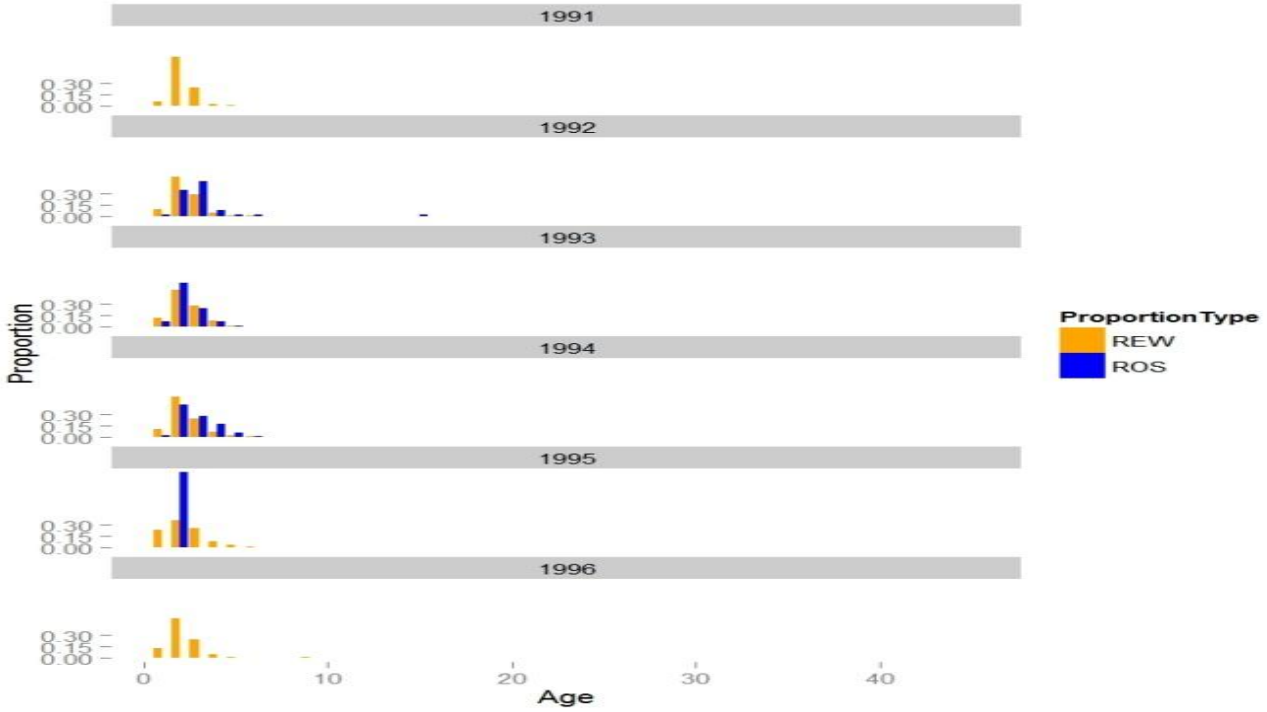
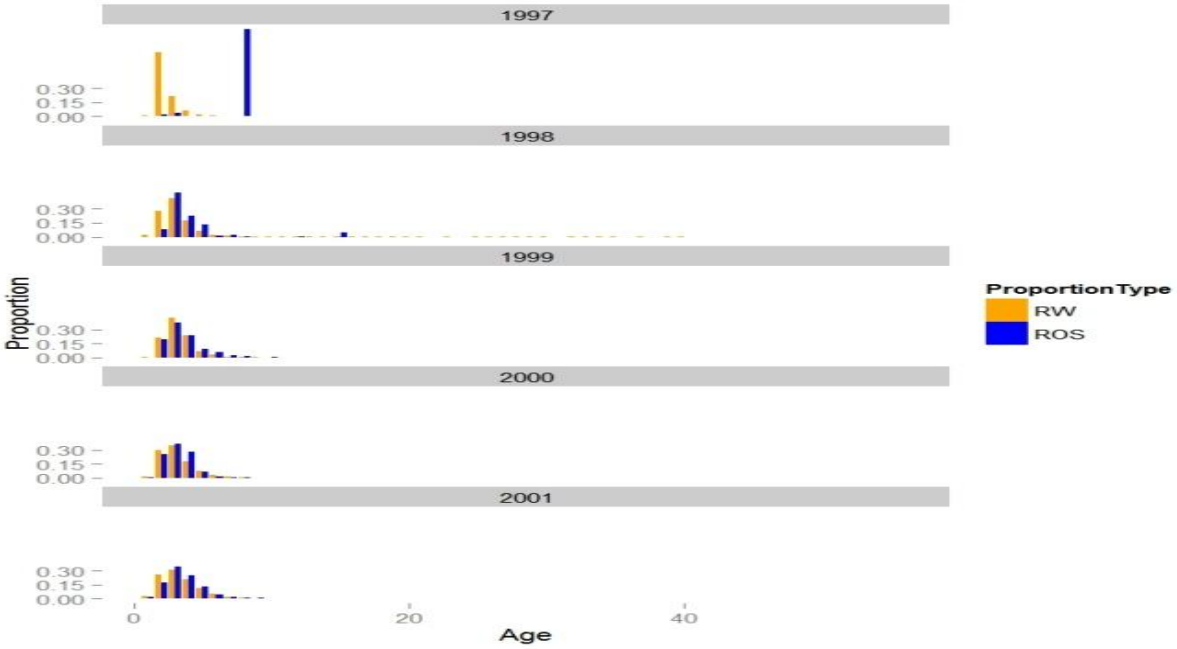
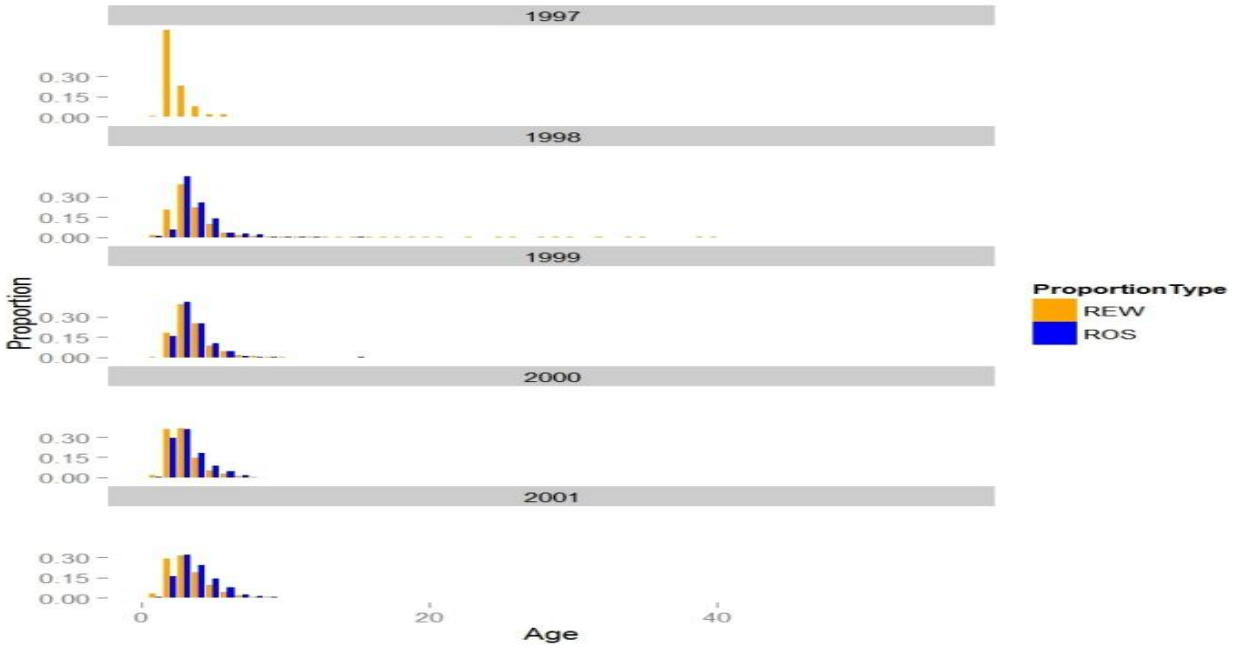

1991
1992
1993
1994
1995
1996
0.30
0.15
0.00
Proportion
0
10
20
30
40
Age
ProportionType
REW
ROS

Fig A-2. Comparison of red snapper age frequency distributions estimated with ROS and REW methods for the years 1997-2001. (HE-commercial handline East, HW-commercial handline west, RE-recreational handline east, RW-recreational handline west)

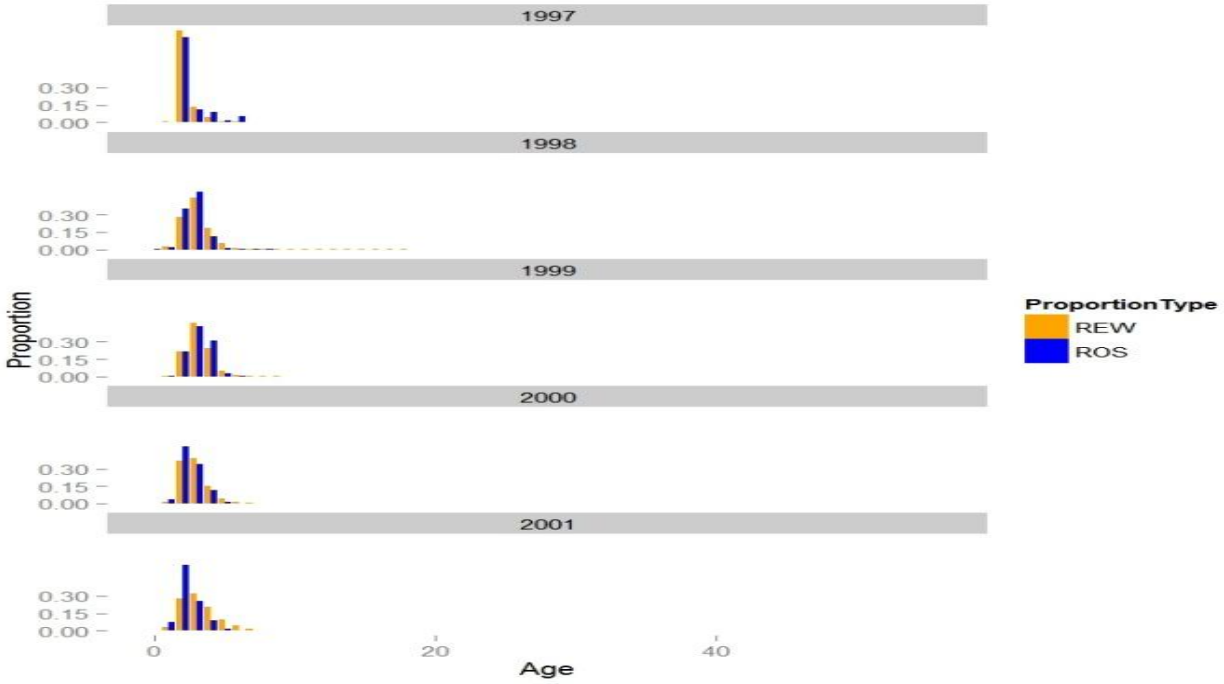
(a) HE



(b) HW



(c) RE


1997
1998
1999
2000
2001
0.30
0.15
0.00
Proportion
0
20
40
Age
ProportionType
REW
ROS

(d) RW

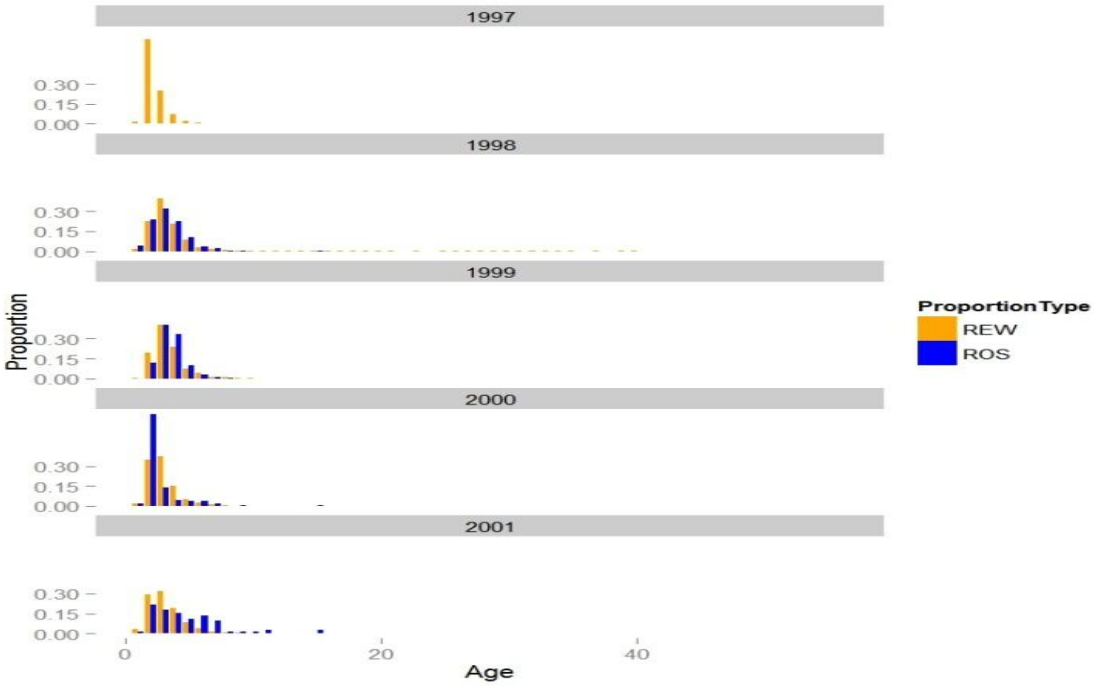
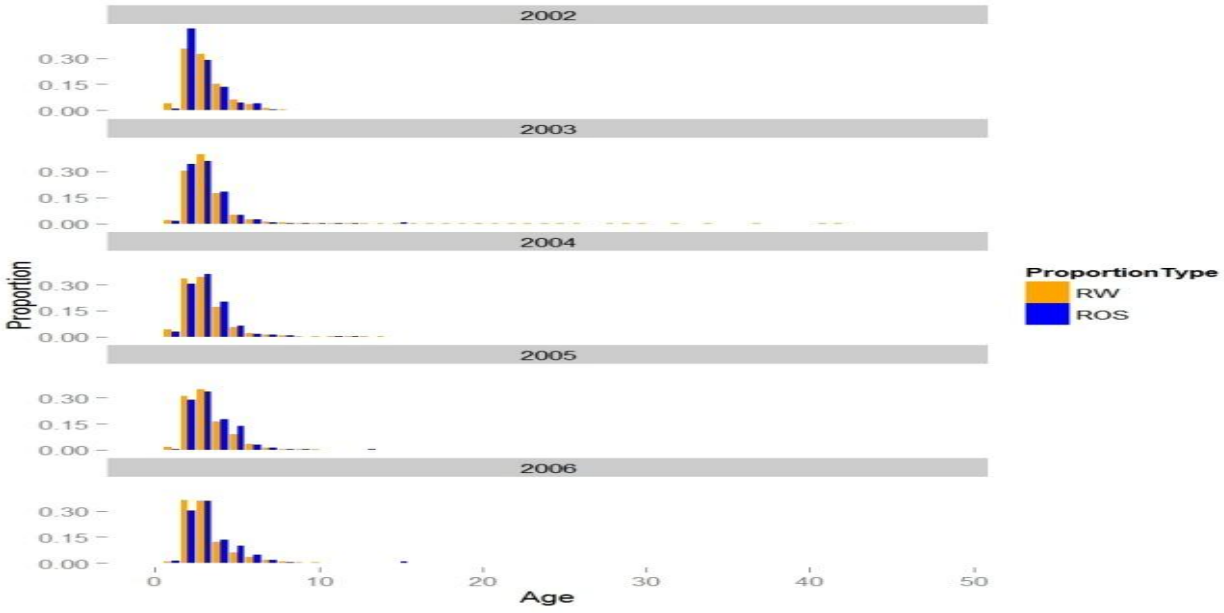
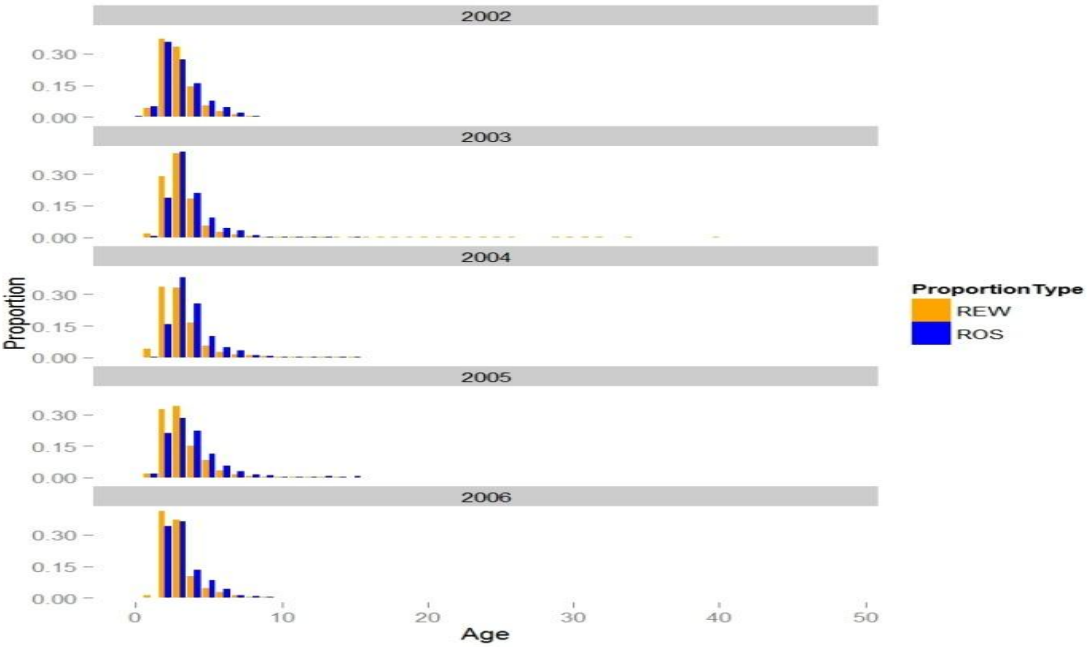

1997
1998
1999
2000
2001
0.30
0.15
0.00
Proportion
0
20
40
Age
ProportionType
REW
ROS

Fig A-3. Comparison of red snapper age frequency distributions estimated with ROS and REW methods for the years 2002-2006. (HE-commercial handline East, HW-commercial handline west, RE-recreational handline east, RW-recreational handline west)

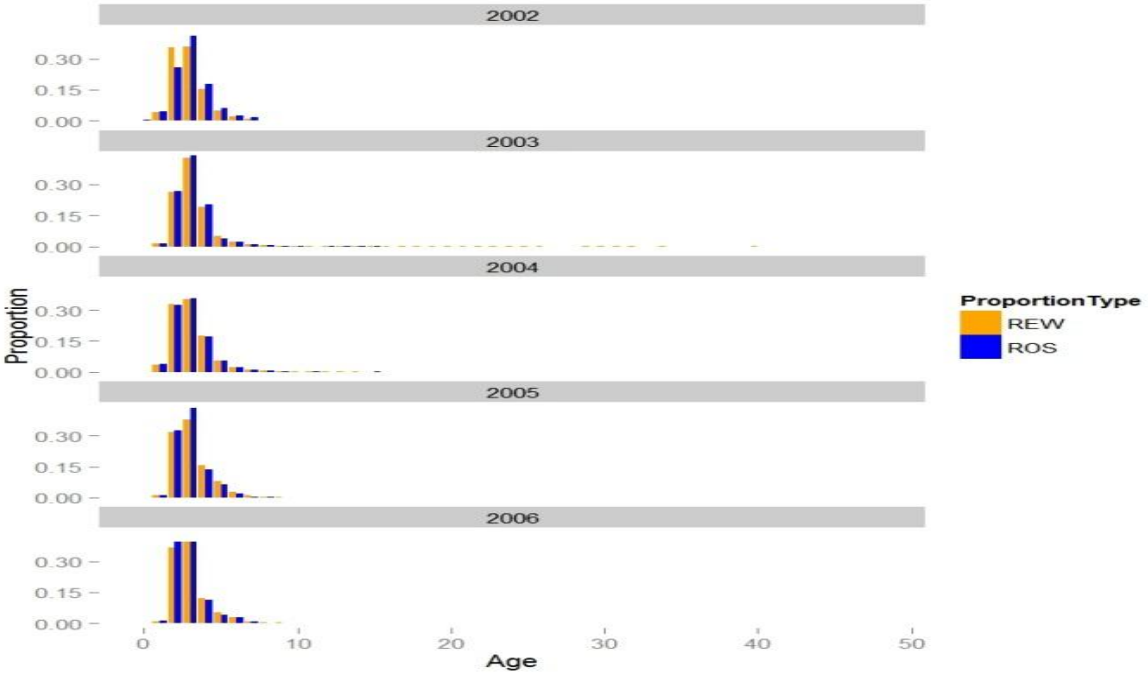
(a) HE



(b) HW



(b) RE


2002
2003
2004
2005
2006
0.30
0.15
0.00
Proportion
0
10
20
30
40
50
Age
ProportionType
REW
ROS

(c) RW

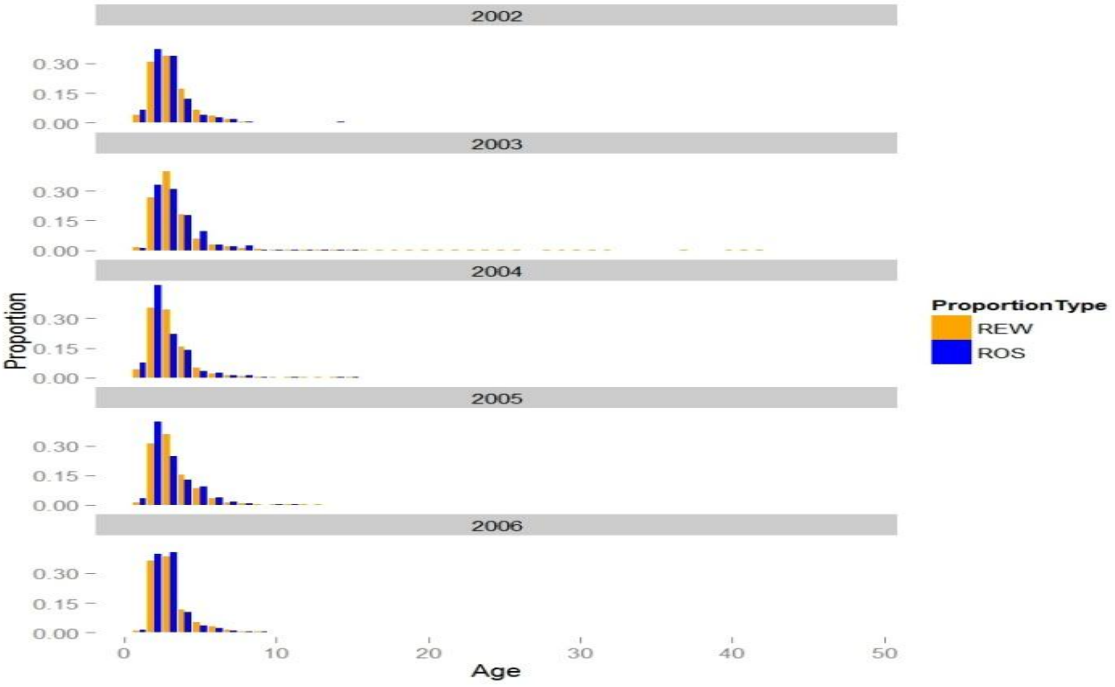
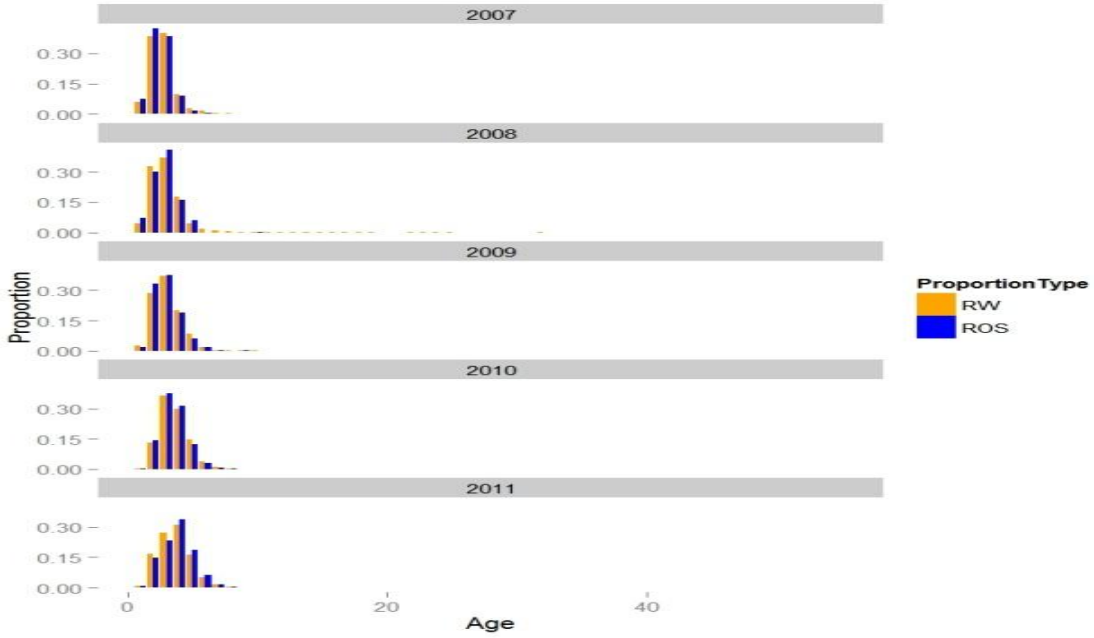
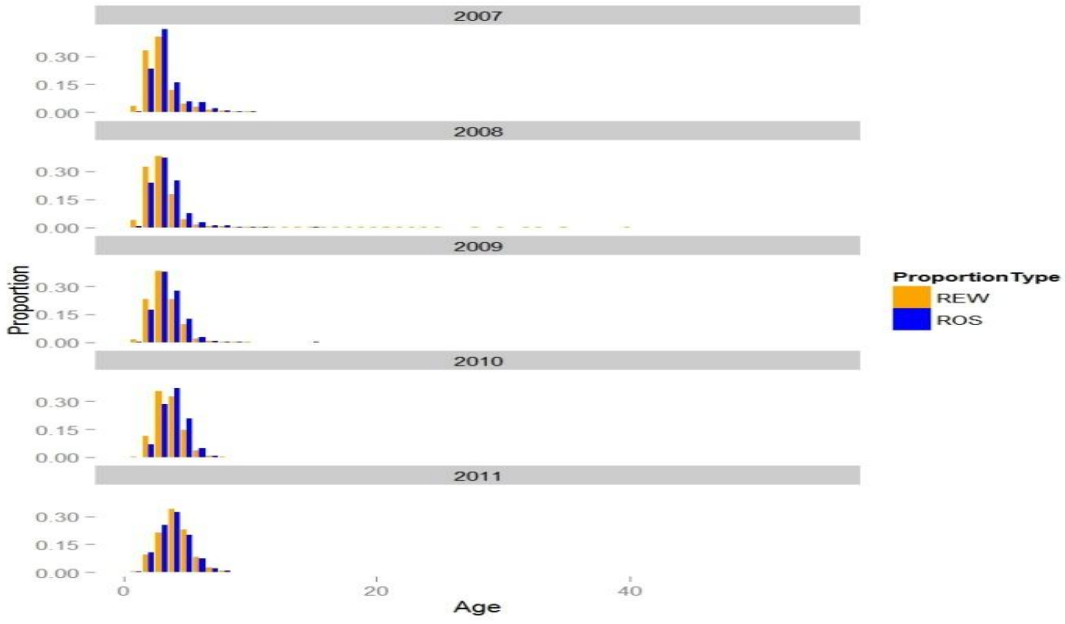

2002
2003
2004
2005
2006
0.30
0.15
0.00
Proportion
0
10
20
30
40
50
Age
ProportionType
REW
ROS

Fig A-4. Comparison of red snapper age frequency distributions estimated with ROS and REW methods for the years 2007-2011. (HE-commercial handline East, HW-commercial handline west, RE-recreational handline east, RW-recreational handline west)

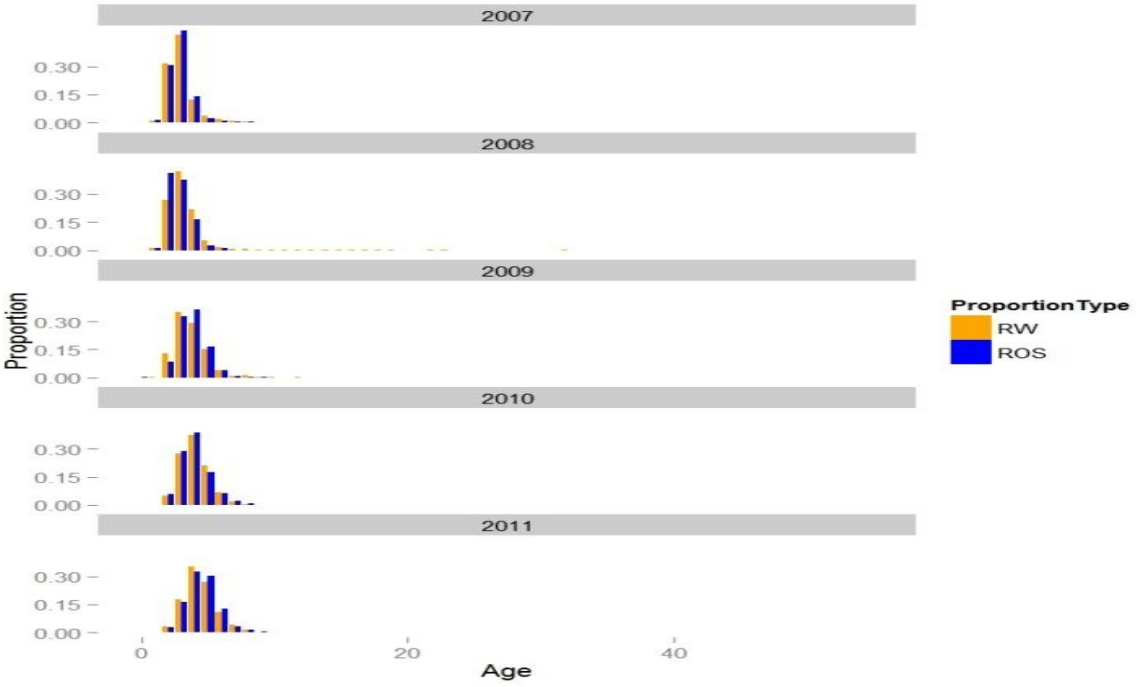
(a) HE



(b) HW



(c) RE


2007
2008
2009
2010
2011
0.30
0.15
0.00
Proportion
0
20
40
Age
ProportionType
RW
ROS

(d) RW

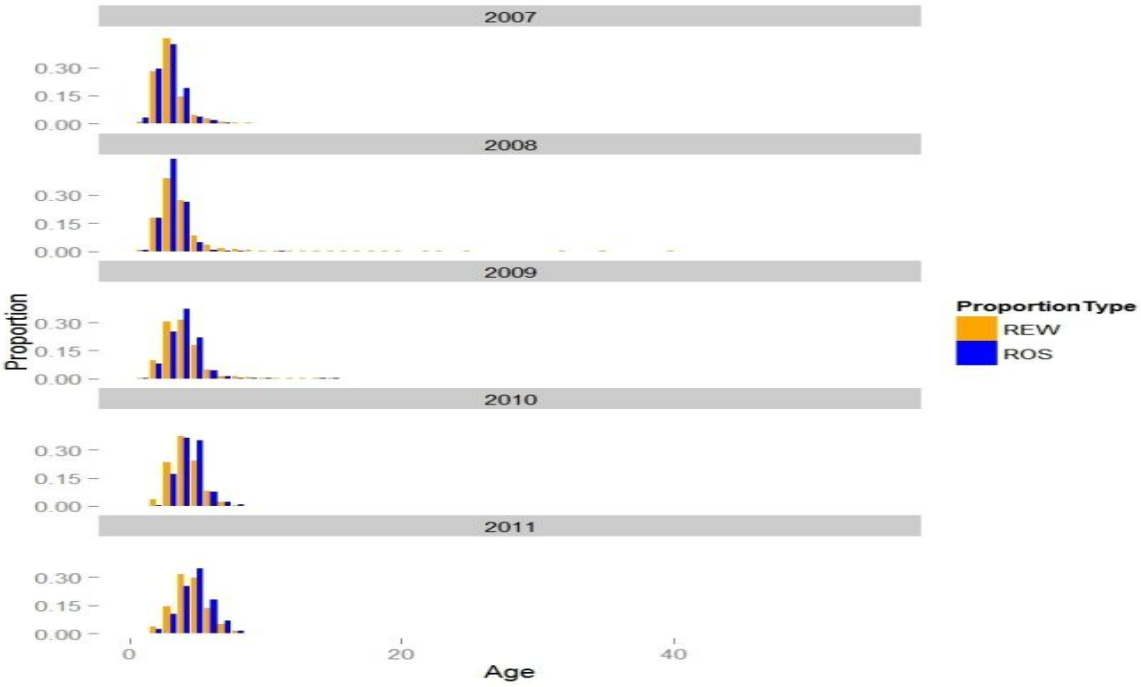
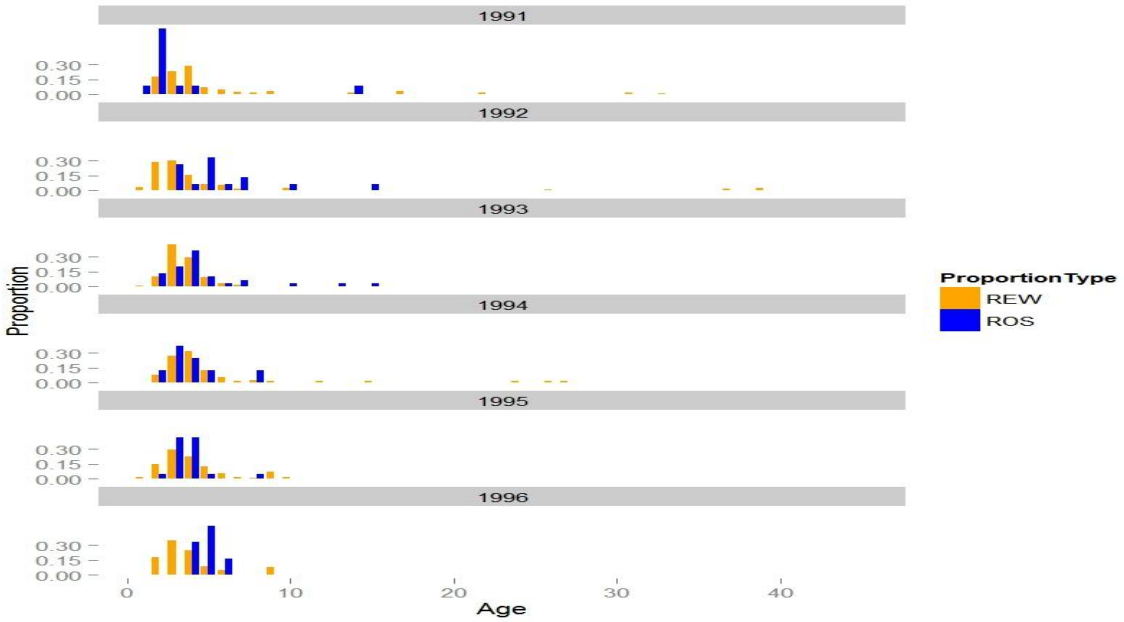
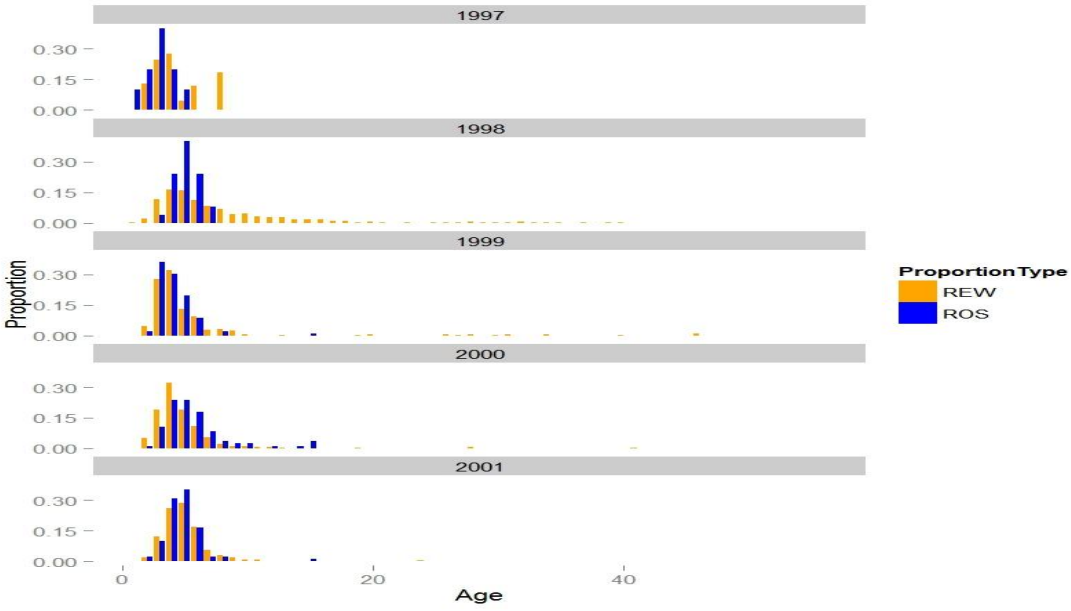

2007
2008
2009
2010
2011
0.30
0.15
0.00
Proportion
0
20
40
Age
ProportionType
REW
ROS

Fig A-5. Comparison of red snapper age frequency distributions estimated with ROS and REW methods for longline fisheries located in the eastern Gulf of Mexico (LE)

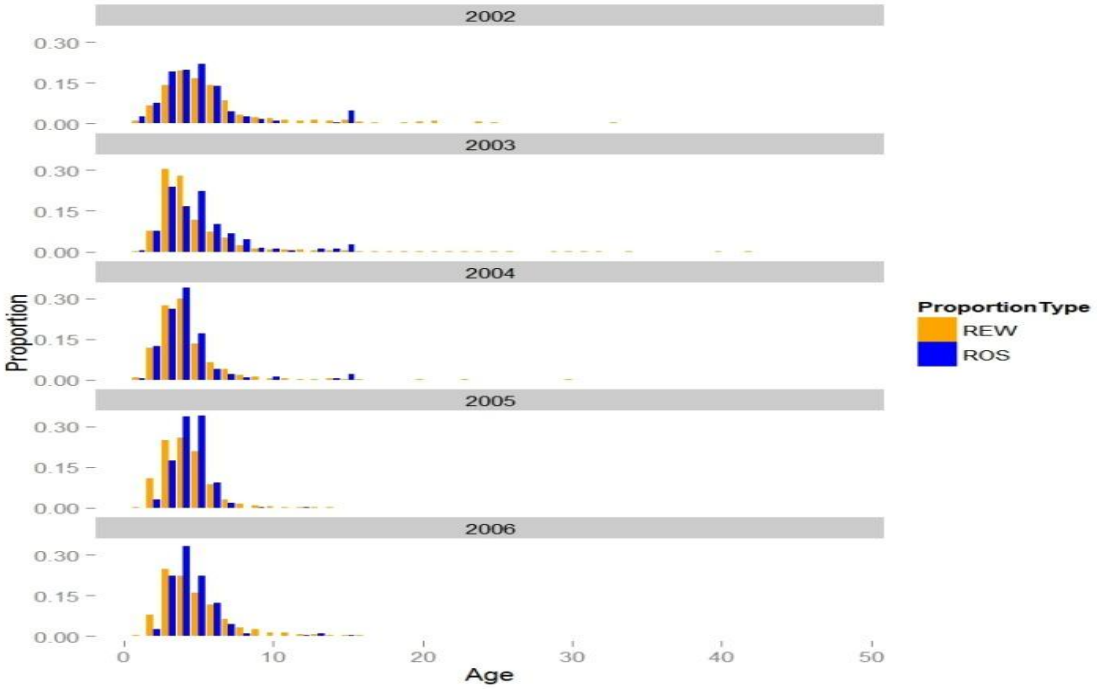
(a)1991-1996



(b) 1997-2001



(c) 2002-2006



(d) 2007-2011

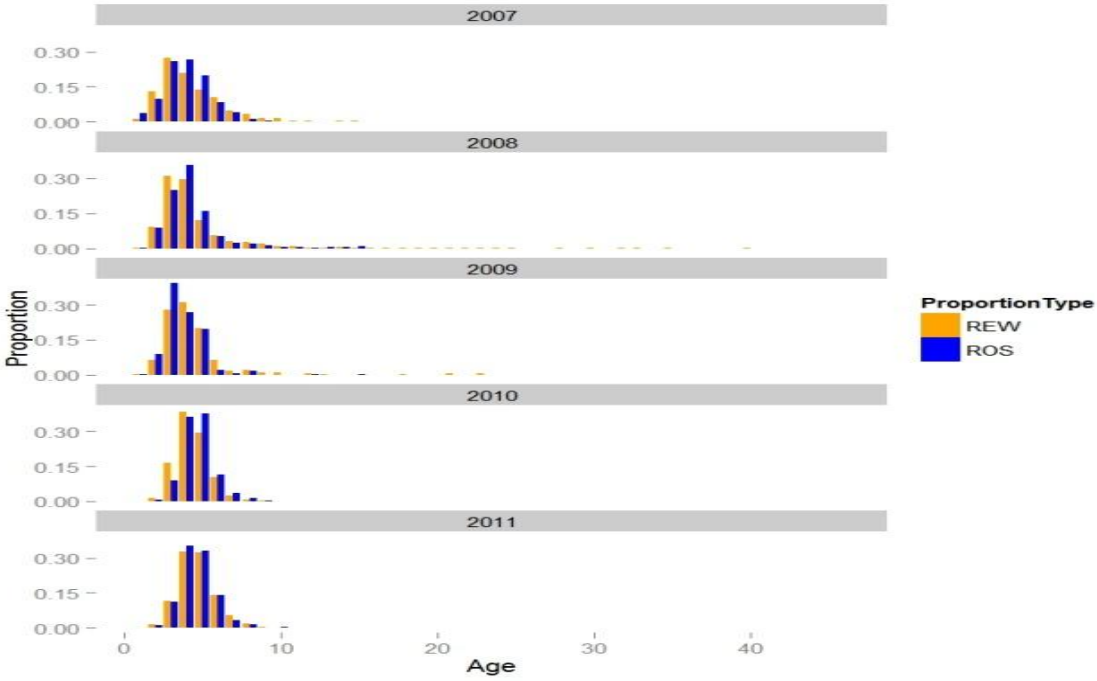
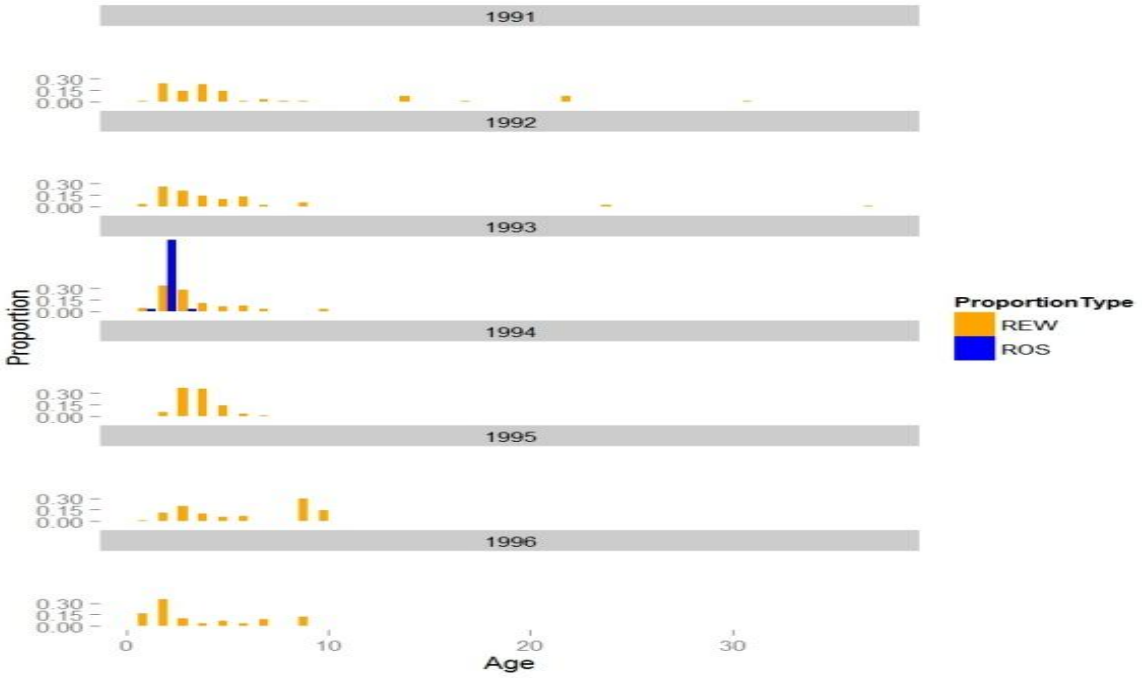
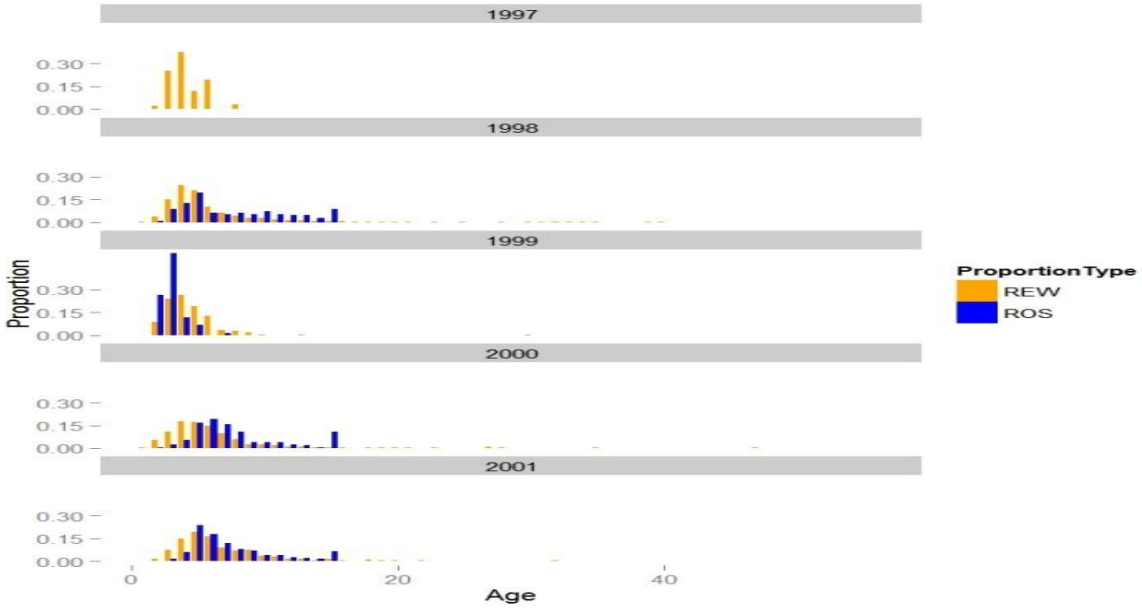


Fig A-6. Comparison of red snapper age frequency distributions estimated with ROS and REW methods for longline fisheries located in the western Gulf of Mexico (LW)

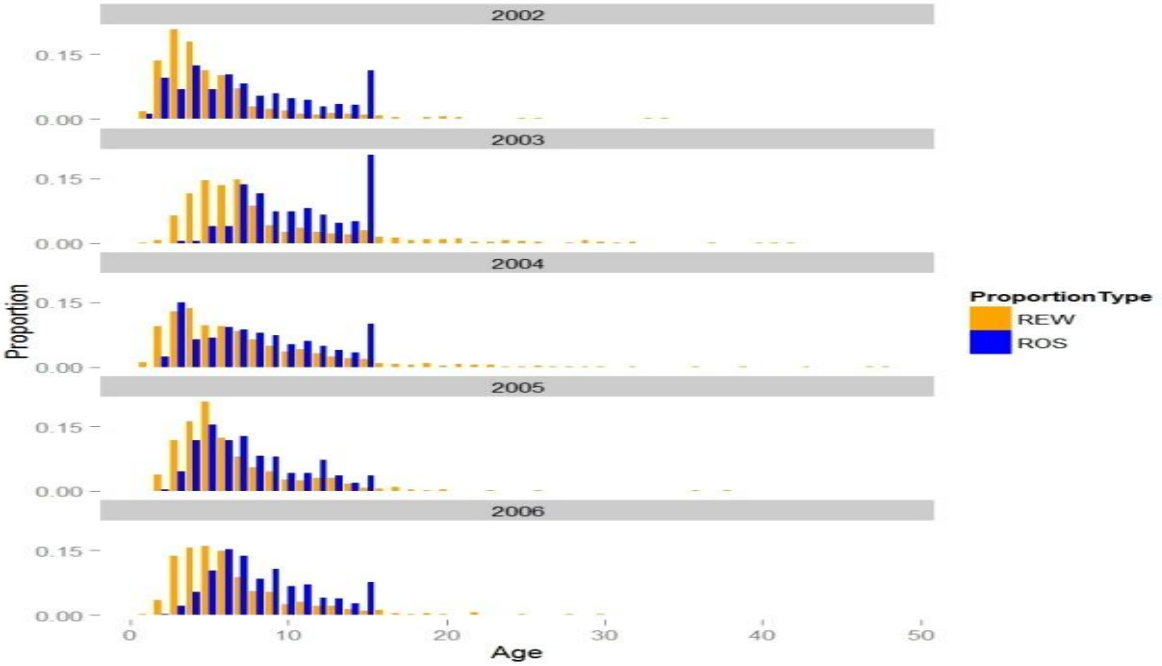
(a) 1991-1996



(b) 1997-2001



(c)2002-2006



(c) 2007-2011