A review of Gulf of Mexico and Atlantic king mackerel *(Scomberomorus cavalla)* age data, 1986 – 2013, from the Panama City Laboratory, Southeast Fisheries Science Center, NOAA Fisheries Service

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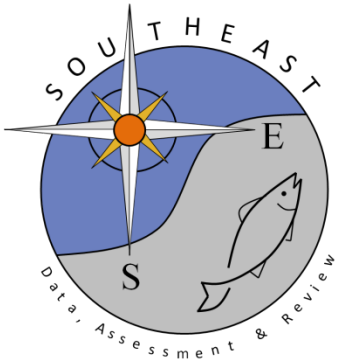
**ADDENDUM ADDED TO REFLECT CHANGES REQUESTED DURING THE DATA WORKSHOP. PLEASE SEE ADDENDUM FOR FINAL DETAILS. (PDF PAGE 32)*



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A review of Gulf of Mexico and Atlantic king mackerel *(Scomberomorus cavalla)* age data, 1986 – 2013, from the Panama City Laboratory, Southeast Fisheries Science Center, NOAA Fisheries Service

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Introduction

King mackerel, *Scomberomorus cavalla*, are highly sought after and economically valuable to both U. S. recreational and commercial fishermen from Texas to North Carolina (Manooch, 1979). The fishery is managed under the Coastal Migratory Pelagic Resources Fishery Management Plan which outlines two different stocks or migratory groups for management purposes: the Gulf of Mexico stock, extending from the Florida west coast to the Texas border with Mexico, and the Atlantic stock, ranging from the New England area to the Florida southeast coast. Tag return data collected during 1975 – 1978 showed considerable seasonal movement between the Atlantic Ocean and the Gulf of Mexico (Sutter et al., 1991). The boundary between the Gulf of Mexico and Atlantic stocks is defined as the Volusia – Flagler County line (northeast Florida) during November – March and the Monroe – Collier County line (southwest Florida) during April – October.

This is the third SEDAR (Southeast Data, Assessment and Review) for king mackerel following SEDAR 5 in 2003 and SEDAR 16 in 2008. The primary objective of this report is to give an overview of the temporal and spatial distributions, as well as distributions by fishery and gear, of king mackerel age samples from the years 1986 through 2013 aged by the Panama City Laboratory of the Southeast Fisheries Science Center, NOAA Fisheries Service. Information on quality control and sub-sampling procedures is also provided.

Methods

Otolith collection and data proofing

Otoliths were collected 1986 – 2013 by federal and state agencies and academic institutions from both commercial (CM) and recreational (REC) fisheries. Fishery dependent samples were obtained from several NMFS programs, including the Trip Interview Program (TIP), Panama City Lab (PCLAB), North Carolina Division of Marine Fisheries (NCDMF), Beaufort Lab Headboat Survey (HB), Recreational Fisheries Information Network (RECFIN), Marine Fisheries Recreational Statistical Survey (MRFSS), The University of South Alabama (USAL), South Carolina Department of Natural Resources (SCDNR), Cooperative Research (CO-OP), Florida Fish and Wildlife Research Institute (FWRI), Florida Department of

Environmental Protection (FLDEP), Virginia Department of Marine Resources (VADMR), and The Louisiana Department of Wildlife and Fisheries (LADWF). Fishery independent samples were obtained from NMFS Pascagoula (MSLAB) and the Expanded Stock Assessment Survey (EASA).

Each of the data collection sources had separate but similar sampling procedures, data protocols, and reporting methods. Data quality control guidelines as described by the Panama City Lab's Procedure Manual for Age, Growth, and Reproduction (AGR) (NMFS, 2008) were used to interpret source-specific data sheets. First, beginning in 2000, each species specific collection was assigned an annual collection (or tracking) number and all collection-specific data (i.e. source, source number, state, sector, and gear) were entered in Microsoft® Access database. Validation rules for data entry and user-specific security for data accessibility guidelines were followed to enhance data quality control. The source (or interview) number is a source-specific number that permits cross-referencing of data between the original and the Panama City AGR databases. Next, all individual fish data were proofed against the original data sheets. Corrections were made to the Annual AGR Database as needed and any specific data issues were resolved by personal contact with port agents or samplers.

To insure uniform standards of quality control, all 1986 – 1997 data, collected prior to the establishment of written data quality guidelines in 1988, were proofed against original data sheets (archived at the Panama City Lab). TIP specific data were proofed using original TIP data sheets or by accessing online TIP files.

Sampling trends

Annual numbers of otolith samples received and aged at the Panama City lab during 1986 through April 2013 were summarized by sector (commercial – CM, recreational REC, scientific survey – SS, and tournament – TRN) and by commercial gear type (hand-line – HL, longline – LL, and gillnet – GN). Hand-lines included rod and reel gear or methods such as bandit rigs, trolling, sight casting, etc. Gill nets were broadly defined as any type of entangling net, including cast nets. The recreational sector included samples from charter boats (CP), head boats (HB), and private vessels (PR), but excluded tournament samples. Data that could not be defined or reconciled was classified as unknown (Unknown).

Sample numbers were also summarized by region (Gulf and Atlantic) where the fish were caught (not necessarily where they were landed nor their stock or migratory group as currently defined in the FMP). In addition, data were summarized by sub-region within those regions (Figure 1). Gulf sub-regions included Mexico, the states of Texas, Louisiana, Mississippi, and Alabama, and four areas on the west coast of Florida. The Florida sub-regions included northwest Florida (NWF) (all coastal counties north of Levy County to the Florida-Alabama state border), west Florida (WF) (Citrus County south to Sarasota County), southwest Florida (SWF) (Charlotte County south to Collier County), and south Florida (SF) Monroe County only). Atlantic sub-regions included southeast Florida (SEF) (Dade through Broward County), east Florida (EF) (Palm Beach through Volusia County), and northeast Florida (NEF) (Flagler County to the Florida-Georgia border), the states of Georgia, South Carolina, North Carolina, and all remaining coastal states north of North Carolina.

Sub-sampling

Samples collected from TIP for the year 2012 (n = 4,207) from the state of Louisiana (n = 2,743) made up just over 65% of all samples collected for that year. All of these samples were collected during July and August from commercial (CM) hand-line (HL) sources. Of the 2012 Louisiana TIP samples, 1,000 were randomly sub-sampled for ageing (Figure 2), and 66 of those were unreadable or were unusable due to otolith storage issues. The remaining 934 samples consisted of 547 (59%) females and 387 (41%) males - similar to the ratio of 57% females and 43% males observed in the total sample.

Age determination and estimates of precision

All ages were derived from sagittal otoliths (Beaumariage, 1973; GSMFC, 2009) by at least two readers. Otoliths from males < 800 mm and from females < 900 mm were read whole while larger king mackerel from both sexes were sectioned (DeVries and Grimes, 1997). Annuli of whole otoliths were identified as stated by Johnson et al. (1983) and annuli in sections as described by Waltz (1986). All king mackerel collected prior to the 2001-02 fishing year were aged by Reader 2. Thereafter, Reader 1 became the primary ager. Reader 3 aged all sectioned samples from calendar years 2006-11 and Reader 4 aged 871 (61%) sectioned samples from 2012. The primary ager, Reader 1, aged the remaining samples from 2012 and all 2013 samples.

One hundred whole otoliths from 2012 were read by both Readers 1 and 2, and three indices of precision were calculated from those data to check for consistency and drifts in precision between readers. The indices were average percent error (APE), coefficient of variation (CV), and precision (D). The goal was to achieve an APE of less than 5.0%. See Palmer et al. 2007 for further discussion on ageing precision. Reader 3 became the primary reader for all sectioned samples beginning with the 2006 collections. One hundred sectioned samples from 2007 were read by both Readers 1 and 3, and those data were analyzed to assure acceptable levels of precision. In addition, 100 sectioned samples from 2012 were read by both Readers 1 and 4 and those data were analyzed as well. To check for drift in otolith interpretation over time between Readers 1 and 2, 100 whole otoliths from 2012 were aged by both readers.

Annual ages, based on calendar year, were calculated using the annulus count, edge-type, and capture date. Annulus formation typically occurs in the spring (Beaumariage, 1973; Johnson et al., 1983), and advancement of ages is often necessary for fish captured that time of year in order to assign fish to the correct cohort (DeVries and Grimes, 1997). The protocol for advancing ages was: 1) fish sampled January – May with a marginal increment estimated to be > 35% of the previous increment were advanced one year; and 2) fish sampled June – July 15th with > 2 annuli and a marginal increment > 35% of the previous increment were advanced one year, while those with 2 or fewer annuli were advanced one year only if the marginal increment was > 70% of the previous one. The distinction was made because younger fish grow more and faster than older fish, and it is not uncommon for them to already have relatively large marginal increments as early as June. Ages were not advanced for fish sampled July 16th – December (DeVries and Grimes, 1997).

Results and Discussion

Sampling trends

A total of 60,672 king mackerel collected from fishing year (FY) 1985-1986 through early in FY 2013-2014 (25,390 from the Gulf of Mexico, 22,300 from the Atlantic, and 12,982 from the winter mixing zone) have been aged by the Panama City Laboratory and made available for SEDAR 38 (Table 1). Of all the aged samples, 46% were from the commercial sector, 24% from the recreational sector (CP, HB, and PR combined), and 24% from tournaments (Table 2). In addition, 1% of the fish aged were from scientific surveys, and 4% were from unknown

sectors. North Carolina (52%) and east Florida (30%) were the main sources of aged samples from the Atlantic region (Table 3). From the Gulf of Mexico, northwest Florida (34%) accounted for the majority of samples, with another 32% coming from Louisiana, west Florida (12%), and Texas (10%) (Table 4).

Of the Atlantic commercial samples, the majority (67%) came from east Florida (Table 5), while in the Gulf the vast majority came from Louisiana (70%) (Table 6). East Florida was the main contributor (74%) of commercial samples from the winter mixing zone (Table 7). Approximately half of the recreational, non-tournament samples from the Atlantic (Table 8) were from east Florida (50%). Recreational samples came predominantly from northwest Florida (68%) in the Gulf (Table 9) and from east Florida (47%) and south Florida (45%) in the winter mixing zone (Table 10). Tournament sampled fish were excluded from the recreational catches from both the Gulf and winter mixing zone. North Carolina was the largest source of tournament samples, (n = 8,591); 58% of all and 83% of Atlantic, samples came from that state (Table 11). Most Gulf tournament samples were collected in west Florida (37%), northwest Florida (25%), and Louisiana (17%) (Table 12). The winter mixing zone contributed a minimal number of all tournament samples (n= 255).

Of all commercial king mackerel age samples (both stocks plus the mixing zone), 89% were collected from hand-line fisheries (Table 13). Within regions, 97% of Atlantic commercial samples were from hand-line fisheries, compared to 91% from the Gulf and 84% from the winter mixing zone (Tables, 14, 15, and 16).

Age determination and estimates of precision

Reader comparison results (Table 17) showed high precision between all readers. Whole otolith age comparisons between Readers 1 and 2 for the 2012 samples yielded an APE of 5.07%, CV of 7.16%, and D of 3.58%. Precision levels were also high between Readers 1 and 3 for sectioned otolith age comparisons for the 2007 samples, with an APE of 2.34%, CV of 3.31%, and D of 1.66%. Age comparisons for the 2012 sectioned samples between Readers 1 and 4 produced an APE of 2.84%, CV of 4.02%, and D of 2.01%.

Age and length composition

King mackerel collected during the 1985-1986 (incomplete) through 2013-2014 (incomplete) fishing seasons and aged by the NMFS Panama City Lab ranged in age from 0 to 26 yr, with 70% Gulf, 59% Atlantic, and 88% winter mixing zone fish between the ages of 1 and 5 yr (Figure 3). Females ranged from ages 0 to 26 and males from 0 to 24 yr. Females ranged from ages 0 to 24 (74% ages 1 – 5) in the Gulf, ages 0 to 26 (58% ages 1 – 5) in the Atlantic, and ages 0 – 17 (87% ages 1 – 5) in the winter mixing zone (Figure 4). Males ranged from ages 0 to 23 yr (62% ages from 1 – 5) in the Gulf, ages 0 – 24 (61% ages from 1 – 5) in the Atlantic, and in the winter mixing zone ages 0 – 16 (89% ages from 1 -5) (Figure 5).

The size distributions of the commercial age samples from the winter mixing, Gulf, and Atlantic stocks were similar, although the mode for the winter mixing zone was smaller (740 - 760mm) than the Gulf (~840mm) and Atlantic (~780mm) modes (Figure 6a). Recreational size distributions differed but not in the same pattern as commercial samples (Figure 6b). The Atlantic stock had the largest mode (~820mm) with the Gulf ~100mm smaller (720mm), and the winter mixing samples ~180mm smaller (640mm). The Gulf tournament size distribution was much more uniform than that from the Atlantic, which had an obvious mode around 880 – 940mm) (Figure 6c). Winter mixing zone tournament samples had a considerably larger mode (1240 – 1280mm) but a drastically smaller sample size.

The ranges in length at age for almost all ages for females were similar for both stocks and the mixing zone (Figure 7). Gulf males ages 5 – 9 had a wider range in length at age than the Atlantic stock and the mixing zone fish (Figure 8). Conversely, Atlantic males age 14 and older had wider ranges in size at age than the Gulf or mixing zone fish, but this can be likely attributed to their smaller samples sizes.

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Table 1. Annual numbers of king mackerel, fishing years 1985-1986 (incomplete) through 2013-2014 (incomplete), by stock aged by NMFS Panama City.

Fishing Year	Gulf	Atlantic	Winter Mix	Total
1985-1986	15	6		21
1986-1987	612	515	48	1,175
1987-1988	842	502	31	1,375
1988-1989	877	467	52	1,396
1989-1990	1,109	853	88	2,050
1990-1991	888	987	97	1,972
1991-1992	1,521	779	322	2,622
1992-1993	1,123	1,380	118	2,621
1993-1994	1,438	867	50	2,355
1994-1995	949	820	60	1,829
1995-1996	949	650	464	2,063
1996-1997	871	897	1,074	2,842
1997-1998	492	589	317	1,398
1998-1999	311	711	284	1,306
1999-2000	306	883	578	1,767
2000-2001	217	635	1,202	2,054
2001-2002	607	907	1,089	2,603
2002-2003	968	863	1,288	3,119
2003-2004	883	1,720	823	3,426
2004-2005	568	1,687	587	2,842
2005-2006	635	350	270	1,255
2006-2007	556	617	310	1,483
2007-2008	1,200	423	359	1,982
2008-2009	1,248	1,035	623	2,906
2009-2010	1,625	843	895	3,363
2010-2011	1,563	891	622	3,076
2011-2012	1,618	776	765	3,159
2012-2013	1,395	557	566	2,518
2013-2014		90		90
Unknown	4			4
Total	25,390	22,300	12,982	60,672

Table 2. Annual numbers of king mackerel, fishing years 1985-1986 (incomplete) through 2013-2014 (incomplete), aged by NMFS Panama City. CM = commercial, REC = recreational, TRN = tournament, Unknown = no data, SS = scientific survey.

Fishing Year	CM	REC	TRN	Unknown	SS	Total
1985-1986		1		20		21
1986-1987	27	386	160	602		1,175
1987-1988	10	223	341	781	20	1,375
1988-1989	20	323	476	573	4	1,396
1989-1990	144	867	849	161	29	2,050
1990-1991	201	795	922	52	2	1,972
1991-1992	732	1,004	882		4	2,622
1992-1993	572	660	1,369	15	5	2,621
1993-1994	1,127	458	746		24	2,355
1994-1995	684	383	744	18		1,829
1995-1996	1,111	383	504	65		2,063
1996-1997	1,536	533	707	66		2,842
1997-1998	593	205	518	81	1	1,398
1998-1999	498	174	587	47		1,306
1999-2000	1,034	261	472			1,767
2000-2001	1,354	174	518		8	2,054
2001-2002	1,537	517	546		3	2,603
2002-2003	1,364	1,055	529		171	3,119
2003-2004	1,029	1,149	1,247		1	3,426
2004-2005	769	1,562	505		6	2,842
2005-2006	447	554	248		6	1,255
2006-2007	537	700	208		38	1,483
2007-2008	1,538	209	235			1,982
2008-2009	2,262	386	256		2	2,906
2009-2010	2,498	638	210		17	3,363
2010-2011	2,129	563	327		57	3,076
2011-2012	2,319	484	351		5	3,159
2012-2013	1,945	196	362		15	2,518
2013-2014	90					90
Unknown				4		4
Total	28,107	14,843	14,819	2,485	418	60,672
% of Total	46.3%	24.5%	24.4%	4.1%	0.7%	100.0%

Table 3. Annual numbers of king mackerel from the Atlantic, fishing years 1985-1986 (incomplete) through 2013-2014 (incomplete), by sub-region, aged by NMFS Panama City. EF = east Florida, NEF = northeast Florida, SEF = southeast Florida.

Fishing Year	NC	EF	NEF	SC	GA	SEF	SF	VA	MA	Total
1985-1986		5	1							6
1986-1987	155	96	25	94	107	21	17			515
1987-1988	236	94	32	124	14		2			502
1988-1989	104	96		167	60	35	5			467
1989-1990	586			108	139		3	17		853
1990-1991	785	4		93	98		5		2	987
1991-1992	628	1		109	15		26			779
1992-1993	924	226		140	81		4		5	1,380
1993-1994	565	216		80			6			867
1994-1995	468	337					15			820
1995-1996	299	351								650
1996-1997	357	333	121	29	49		8			897
1997-1998	404	139	22		24					589
1998-1999	441	225	42				3			711
1999-2000	485	387				11				883
2000-2001	500	64	63	7			1			635
2001-2002	536	189	73	76		27	6			907
2002-2003	434	319	72	29		7	2			863
2003-2004	430	852	419			3	16			1,720
2004-2005	377	570	703			37				1,687
2005-2006	89	140	97			17	7			350
2006-2007	146	358	88			25				617
2007-2008	289	126				8				423
2008-2009	526	440	28			17	24			1,035
2009-2010	511	302				3	27			843
2010-2011	356	412	51			48	24			891
2011-2012	475	227	55			5	14			776
2012-2013	449	107					1			557
2013-2014		42					48			90
Total	11,555	6,658	1,892	1,056	587	264	264	17	7	22,300
% of Total	51.8%	29.9%	8.5%	4.7%	2.6%	1.2%	1.2%	0.1%	0.0%	100.0%

Table 4. Annual numbers of king mackerel from the Gulf, fishing years 1985-1986 (incomplete) through 2013-2014 (incomplete), by sub-region, aged by NMFS Panama City. NWF = northwest Florida, WF = west Florida, SWF = southwest Florida.

Fishing Year	NWF	LA	WF	TX	MEX	SWF	AL	MS	Total
1985-1986				15					15
1986-1987	192	50	2	167			132	69	612
1987-1988	50	75		382	102		172	61	842
1988-1989	133	68		336	177		83	80	877
1989-1990	438	58		345	244		7	17	1,109
1990-1991	448	41		181	103		18	97	888
1991-1992	411	305	123	443	177		4	58	1,521
1992-1993	346	292	215	214			9	47	1,123
1993-1994	244	567	244	147	199	29	8		1,438
1994-1995	301	348	196	56		48			949
1995-1996	565	158	150			76			949
1996-1997	768		103						871
1997-1998	410		82						492
1998-1999	158		74			58	1	20	311
1999-2000	148		41			47	4	66	306
2000-2001	128		5			66		18	217
2001-2002	321	216	14			24	22	10	607
2002-2003	504	41	206	15		78	124		968
2003-2004	568	32	282			1			883
2004-2005	224	44	235	34		23	8		568
2005-2006	295	197	110	4			29		635
2006-2007	226	206	70	2			52		556
2007-2008	118	891	49	1		141			1,200
2008-2009	290	847	37	4		52	18		1,248
2009-2010	437	923	208	27		30			1,625
2010-2011	277	927	284	62		13			1,563
2011-2012	352	979	224	3		60			1,618
2012-2013	143	938	146	75		89		4	1,395
Unknown			4						4
Total	8,495	8,203	3,104	2,513	1,002	835	691	547	25,390
% of Total	33.5%	32.3%	12.2%	9.9%	3.9%	3.3%	2.7%	2.2%	100.0%

Table 5. Annual numbers of king mackerel from Atlantic commercial samples, fishing years 1985-1986 (incomplete) through 2013-2014 (incomplete), by sub-region, aged by NMFS Panama City. EF = east Florida, NEF = northeast Florida, SEF = southeast Florida.

Fishing Year	EF	NC	SF	SC	NEF	SEF	GA	Total
1989-1990		18						18
1990-1991		68						68
1991-1992		51	12	1				64
1992-1993	176	159						335
1993-1994	202	147	1	1				351
1994-1995	315	107	10					432
1995-1996	309	45						354
1996-1997	325	19	6	29	24			403
1997-1998	139				22		24	185
1998-1999	214		2					216
1999-2000	387	9				11		407
2000-2001	64			7	27			98
2001-2002	160	29	4	39		14		246
2002-2003	150			29		5		184
2003-2004	106		5			2		113
2004-2005	75	4				11		90
2005-2006	40		4			6		50
2006-2007	102					3		105
2007-2008	106	45						151
2008-2009	423	276	11		28	17		755
2009-2010	281	311	19					611
2010-2011	384	139	12					535
2011-2012	214	211	12					437
2012-2013	107	87	1					195
2013-2014	42		48					90
Total	4,321	1,725	147	106	101	69	24	6,493
% of Total	66.5%	26.6%	2.3%	1.6%	1.6%	1.1%	0.4%	100.0%

Table 6. Annual numbers of king mackerel from Gulf commercial samples, fishing years 1985-1986 (incomplete) through 2013-2014 (incomplete), by sub-region, aged by NMFS Panama City. NWF = northwest Florida, SWF = southwest Florida, WF = west Florida.

Fishing Year	LA	NWF	SWF	WF	MEX	AL	TX	MS	Total
1986-1987							25	2	27
1987-1988	10								10
1988-1989	19								19
1989-1990		8			83			4	95
1990-1991					103			4	107
1991-1992	247	1			177				425
1992-1993	128								128
1993-1994	430	184	29	2	110	8			763
1994-1995	186		16						202
1995-1996	106	159	76						341
1996-1997		59							59
1997-1998		56		81					137
1998-1999			58	11					69
1999-2000			47	40					87
2000-2001		22	66						88
2001-2002	163	171	24	1		22			381
2002-2003	40	45	78	40					203
2003-2004	32	207		4					243
2004-2005	39	155	23	6		8			231
2005-2006	197	21		1					219
2006-2007	206	7							213
2007-2008	891	6	141	2					1,040
2008-2009	847		52	1		18	3		921
2009-2010	920		30	115			10		1,075
2010-2011	921	5	13	117					1,056
2011-2012	967	1	59	99					1,126
2012-2013	934	12	89	144			1	4	1,184
Total	7,283	1,119	801	664	473	56	39	14	10,449
% of Total	69.7%	10.7%	7.7%	6.4%	4.5%	0.5%	0.4%	0.1%	100.0%

Table 7. Annual numbers of king mackerel from the winter mixing zone commercial samples, fishing years 1988-1989 through 2012-2013, by sub-region, aged by NMFS Panama City. EF = east Florida, SF = south Florida, SEF = southeast Florida.

Fishing Year	EF	SF	SEF	Total
1988-1989		1		1
1989-1990	31			31
1990-1991		26		26
1991-1992	178	65		243
1992-1993	76	33		109
1993-1994		13		13
1994-1995	36	14		50
1995-1996	385	31		416
1996-1997	1,052	13	9	1,074
1997-1998	216	55		271
1998-1999	184	29		213
1999-2000	530	10		540
2000-2001	1,084	84		1,168
2001-2002	513	382	15	910
2002-2003	658	319		977
2003-2004	571	98	4	673
2004-2005	318	126	4	448
2005-2006	97	79	2	178
2006-2007	158	57	4	219
2007-2008	172	175		347
2008-2009	458	128		586
2009-2010	637	175		812
2010-2011	266	272		538
2011-2012	423	333		756
2012-2013	185	381		566
Total	8,228	2,899	38	11,165
% of Total	73.7%	26.0%	0.3%	100.0%

Table 8. Annual numbers of king mackerel from Atlantic recreational samples (excluding tournaments), fishing years 1985-1986 (incomplete) through 2011-2012, by sub-region, aged by NMFS Panama City. EF = east Florida, NEF = northeast Florida, SEF = southeast Florida.

Fishing Year	EF	NEF	NC	SC	SEF	SF	GA	VA	Total
1985-1986		1							1
1986-1987	28	22	41	5	7	3			106
1987-1988	94	32		10		2			138
1988-1989	66			14	11				91
1989-1990			126	29		3	69	17	244
1990-1991			49	33		5			87
1991-1992			32	62		14			108
1992-1993	50		57	81		4			192
1993-1994	10			79		5			94
1994-1995	21		26			5			52
1995-1996	42		15						57
1996-1997	2					2			4
1997-1998			6						6
1998-1999			2						2
1999-2000			38						38
2000-2001		36				1			37
2001-2002	29	16	62	2	13	2			124
2002-2003	169				2	2			173
2003-2004	676	6			1	11			694
2004-2005	495	703	9		26				1,233
2005-2006	100	1			11	3			115
2006-2007	223	88	24		22				357
2007-2008	20		9		8				37
2008-2009	17		2			13			32
2009-2010	21				3	8			32
2010-2011	28	2	7		48	12			97
2011-2012	13	55			5	2			75
Total	2,104	962	505	315	157	97	69	17	4,226
% of Total	49.8%	22.8%	11.9%	7.5%	3.7%	2.3%	1.6%	0.4%	100.0%

Table 9. Annual numbers of king mackerel from the Gulf recreational samples (excluding tournaments), fishing years 1986-1987 (incomplete) through 2012-2013 (incomplete), by sub-region, aged by NMFS Panama City. NWF = northwest Florida, WF = west Florida, SWF = southwest Florida.

Fishing Year	NWF	TX	WF	MS	LA	MEX	AL	SWF	Total
1986-1987	168	41		22	1				232
1987-1988	10	44							54
1988-1989	39	176							215
1989-1990	308	245		13					566
1990-1991	408	163		66					637
1991-1992	347	435	1	37	1				821
1992-1993	254	205							459
1993-1994	44	147	2		72	89			354
1994-1995	265	56							321
1995-1996	278								278
1996-1997	529								529
1997-1998	155		1						156
1998-1999	149		2				1		152
1999-2000	148		1	55			4		208
2000-2001	98		5						103
2001-2002	147		13	1	53				214
2002-2003	400	15	166						581
2003-2004	317		10					1	328
2004-2005	68	34	105		4				211
2005-2006	250	4	78				26		358
2006-2007	219	2	70				18		309
2007-2008	112	1	47						160
2008-2009	290	1	36						327
2009-2010	435	5	93						533
2010-2011	271	12	115						398
2011-2012	351		38		11				400
2012-2013	129	65	2						196
Total	6,189	1,651	785	194	142	89	49	1	9,100
% of Total	68.0%	18.1%	8.6%	2.1%	1.6%	1.0%	0.5%	0.0%	100.0%

Table 10. Annual numbers of king mackerel from the winter mixing zone recreational samples (excluding tournaments), fishing years 1986-1987 (incomplete) through 2012-2013 (incomplete), by sub-region, aged by NMFS Panama City. EF = east Florida, SF = south Florida, SEF = southeast Florida.

Fishing Year	EF	SF	SEF	Total
1986-1987	48			48
1987-1988	16	1	14	31
1988-1989	11		6	17
1989-1990		57		57
1990-1991		71		71
1991-1992	28	47		75
1992-1993		9		9
1993-1994	3	7		10
1994-1995		10		10
1995-1996		48		48
1997-1998		43		43
1998-1999		20		20
1999-2000		15		15
2000-2001		34		34
2001-2002	75	104		179
2002-2003	188	112	1	301
2003-2004	115	12		127
2004-2005	67	15	36	118
2005-2006	53	7	21	81
2006-2007	21	7	6	34
2007-2008	2	7	3	12
2008-2009	12	11	4	27
2009-2010	42	18	13	73
2010-2011	32	24	12	68
2011-2012	2	6	1	9
Total	715	685	117	1,517
% of Total	47.1%	45.2%	7.7%	100.0%

Table 11. Annual numbers of king mackerel from Atlantic tournament samples, fishing years 1985-1986 (incomplete) through 2012-2013(incomplete), by sub-region, aged by NMFS Panama City. NEF = northeast Florida, EF = east Florida.

Fishing Year	NC	NEF	SC	GA	EF	Total
1986-1987	23		23	9		55
1987-1988	43		106	4		153
1988-1989	38		86	60		184
1989-1990	442		79	70		591
1990-1991	634		60	98	4	796
1991-1992	545		46	15	1	607
1992-1993	696		59	81		836
1993-1994	394				4	398
1994-1995	317				1	318
1995-1996	239					239
1996-1997	338	97		33	6	474
1997-1998	319					319
1998-1999	393	42			11	446
1999-2000	438					438
2000-2001	500					500
2001-2002	445	57	35			537
2002-2003	265	72				337
2003-2004	430	413			70	913
2004-2005	364					364
2005-2006	89	96				185
2006-2007	122					122
2007-2008	235					235
2008-2009	246					246
2009-2010	200					200
2010-2011	210	49				259
2011-2012	264					264
2012-2013	362					362
Total	8,591	826	494	370	97	10,378
% of Total	82.8%	8.0%	4.8%	3.6%	0.9%	100.0%

Table 12. Annual numbers of king mackerel from the Gulf tournament samples, fishing years 1986-1987 (incomplete) through 2011-2012, by sub-region, aged by NMFS Panama City. WF = west Florida, NWF = northwest Florida, SWF = southwest Florida.

Fishing Year	WF	NWF	LA	TX	AL	MS	SWF	Total
1986-1987		24		28	42	11		105
1987-1988		11	65	112				188
1988-1989		60	42	131	59			292
1989-1990		93	58	100	7			258
1990-1991		32	33	17	18	26		126
1991-1992	122	63	57	8	4	21		275
1992-1993	215	90	164	8	9	47		533
1993-1994	240	16	65					321
1994-1995	196	36	162				32	426
1995-1996	85	128	52					265
1996-1997	53	180						233
1997-1998		199						199
1998-1999	61	9				20		90
1999-2000						11		11
2000-2001						18		18
2001-2002						9		9
2002-2003		58			124			182
2003-2004	268	43						311
2004-2005	124							124
2005-2006	31	21						52
2006-2007					29			29
2010-2011	52							52
2011-2012	87							87
Total	1,534	1,063	698	404	292	163	32	4,186
% of Total	36.6%	25.4%	16.7%	9.7%	7.0%	3.9%	0.8%	100.0%

Table 13. Annual numbers of king mackerel samples (Gulf, Atlantic, and winter mixing zone combined) from commercial samples by gear, fishing years 1986-1987 (incomplete) through 2013-2014 (incomplete), aged by NMFS Panama City.

Fishing Year	HL	GN	Unknown	TRW	LL	Misc.	Total
1986-1987	25					2	27
1987-1988	10						10
1988-1989	19	1					20
1989-1990	4		140				144
1990-1991	157	8	36				201
1991-1992	649	83					732
1992-1993	571	1					572
1993-1994	1,018	109					1,127
1994-1995	671	11				2	684
1995-1996	1,077	16	10			8	1,111
1996-1997	1,477	59					1,536
1997-1998	584	9					593
1998-1999	468	30					498
1999-2000	1,025	9					1,034
2000-2001	1,334	20					1,354
2001-2002	1,199	338					1,537
2002-2003	1,084	280					1,364
2003-2004	967	62					1,029
2004-2005	724	45					769
2005-2006	423	24					447
2006-2007	495	42					537
2007-2008	1,274	264					1,538
2008-2009	2,044	155		60	3		2,262
2009-2010	2,252	246					2,498
2010-2011	1,857	272					2,129
2011-2012	2,020	267			32		2,319
2012-2013	1,426	511				8	1,945
2013-2014	90						90
Total	24,944	2,862	186	60	35	20	28,107
% or Total	88.7%	10.2%	0.7%	0.2%	0.1%	0.1%	100.0%

Table 14. Annual numbers of Atlantic commercial king mackerel samples, fishing years 1990-1991 through 2013-2014 (incomplete), from gill nets (GN) and hand-lines (HL) aged by NMFS Panama City. NEF = northeast Florida, EF = east Florida, SF = south Florida, SEF = southeast Florida.

	GN					HL								
Fishing Year	NC	SC	NEF	EF	Total	EF	NC	SF	SC	SEF	NEF	GA	Total	Grand Total
1990-1991							36						36	36
1991-1992							51	12	1				64	64
1992-1993						176	159						335	335
1993-1994						202	147	1	1				351	351
1994-1995						313	107	10					430	430
1995-1996						299	45						344	344
1996-1997		29	24	6	59	319	19	6					344	403
1997-1998						139					22	24	185	185
1998-1999						214		2					216	216
1999-2000	9				9	387				11			398	407
2000-2001						64			7		27		98	98
2001-2002	29				29	160		4	39	14			217	246
2002-2003						150			29	5			184	184
2003-2004						106		5		2			113	113
2004-2005						75	4			11			90	90
2005-2006						40		4		6			50	50
2006-2007						102				3			105	105
2007-2008	8				8	106	37						143	151
2008-2009	20				20	391	256	11		17			675	695
2009-2010	3				3	281	308	19					608	611
2010-2011	26				26	384	113	12					509	535
2011-2012	2				2	182	209	12					403	405
2012-2013	29				29	107	58	1					166	195
2013-2014						42		48					90	90
Total	126	29	24	6	185	4,239	1,549	147	77	69	49	24	6,154	6,339
% of Grand Total	2.0%	0.5%	0.4%	0.1%	2.9%	66.9%	24.4%	2.3%	1.2%	1.1%	0.8%	0.4%	97.1%	100.0%

Table 15. Annual numbers of Gulf commercial king mackerel samples, fishing years 1986-1987 (incomplete) through 2013-2014 (incomplete), from gill nets (GN) and hand-lines (HL) aged by NMFS Panama City. WF = west Florida, SWF = southwest Florida, NWF = northwest Florida.

	GN					HL									
Fishing Year	WF	SWF	MEX	NWF	Total	LA	NWF	SWF	WF	MEX	AL	TX	MS	Total	Grand Total
1986-1987												25		25	25
1987-1988						10								10	10
1988-1989						19								19	19
1989-1990							4							4	4
1990-1991			8		8					95				95	103
1991-1992			83		83	247	1			94				342	425
1992-1993						128								128	128
1993-1994			104	5	109	430	179	29	2	6	8			654	763
1994-1995						186		16						202	202
1995-1996		16			16	106	159	60						325	341
1996-1997							59							59	59
1997-1998							56		81					137	137
1998-1999		12			12			46	11					57	69
1999-2000								47	40					87	87
2000-2001		20			20		22	46						68	88
2001-2002						163	171	24	1		22			381	381
2002-2003						40	45	78	40					203	203
2003-2004						32	207		4					243	243
2004-2005						39	155	23	6		8			231	231
2005-2006						197	21		1					219	219
2006-2007						206	7							213	213
2007-2008		141			141	891	6		2					899	1,040
2008-2009		52			52	847			1		18			866	918
2009-2010	110				110	920		30	5			10		965	1,075
2010-2011	114				114	921	5	13	3					942	1,056
2011-2012	98				98	967	1	59	1					1,028	1,126
2012-2013	144	28			172	934	12	61				1	4	1,012	1,184
Total	466	269	195	5	935	7,283	1,110	532	198	195	56	36	4	9,414	10,349
% of Grand Total	4.5%	2.6%	1.9%	0.0%	9.0%	70.4%	10.7%	5.1%	1.9%	1.9%	0.5%	0.3%	0.0%	91.0%	100.0%

Table 16. Annual numbers of winter mixing zone commercial king mackerel samples, fishing years 1988 - 1989 (incomplete) through 2012 - 2013, from gill nets (GN) and hand-lines (HL) aged by NMFS Panama City. SF = south Florida, EF = east Florida, SEF = southeast Florida.

	GN			HL				
Fishing Year	SF	EF	Total	EF	SF	SEF	Total	Grand Total
1988-1989	1		1					1
1990-1991					26		26	26
1991-1992				178	65		243	243
1992-1993		1	1	75	33		108	109
1993-1994					13		13	13
1994-1995	11		11	36	3		39	50
1995-1996				377	31		408	408
1996-1997				1,052	13	9	1,074	1,074
1997-1998	9		9	216	46		262	271
1998-1999	18		18	184	11		195	213
1999-2000				530	10		540	540
2000-2001				1,084	84		1,168	1,168
2001-2002	265	44	309	469	117	15	601	910
2002-2003	280		280	658	39		697	977
2003-2004	62		62	571	36	4	611	673
2004-2005	45		45	318	81	4	403	448
2005-2006	24		24	97	55	2	154	178
2006-2007	42		42	158	15	4	177	219
2007-2008	112	3	115	169	63		232	347
2008-2009	83		83	458	45		503	586
2009-2010	133		133	637	42		679	812
2010-2011	132		132	266	140		406	538
2011-2012	167		167	423	166		589	756
2012-2013	310		310	185	63		248	558
Total	1,694	48	1,742	8,141	1,197	38	9,376	11,118
% of Grand Total	15.2%	0.4%	15.7%	73.2%	10.8%	0.3%	84.3%	100.0%

Table 17. Indices of precision from reader comparisons. APE = average percent error, CV = coefficient of variation, and D = index of precision.

Reader pair	Data years	Ageing method	APE	CV	D
1 and 2	2012	Whole	5.07%	7.16%	3.58%
1 and 3	2007	Sectioned	2.34%	3.31%	1.66%
1 and 4	2012	Sectioned	2.84%	4.02%	2.01%

Figure 1. Mackerel sampling sub-regions (states and sub-areas of Florida): NWF = northwest Florida, WF = west Florida, SWF = southwest Florida, SF + south Florida, SEF = southeast Florida, EF = east Florida, NEF = northeast Florida.

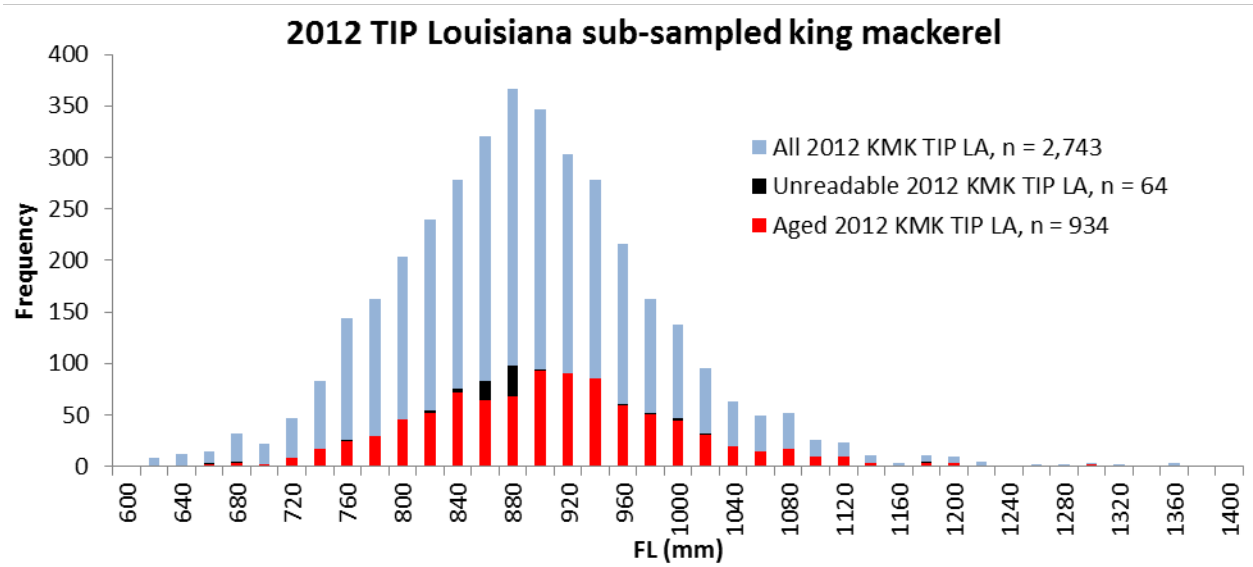

Figure 2. Size distributions of total available (blue), sub-sampled (red), and unreadable (black) 2012 TIP Louisiana king mackerel aged by NMFS Panama City.

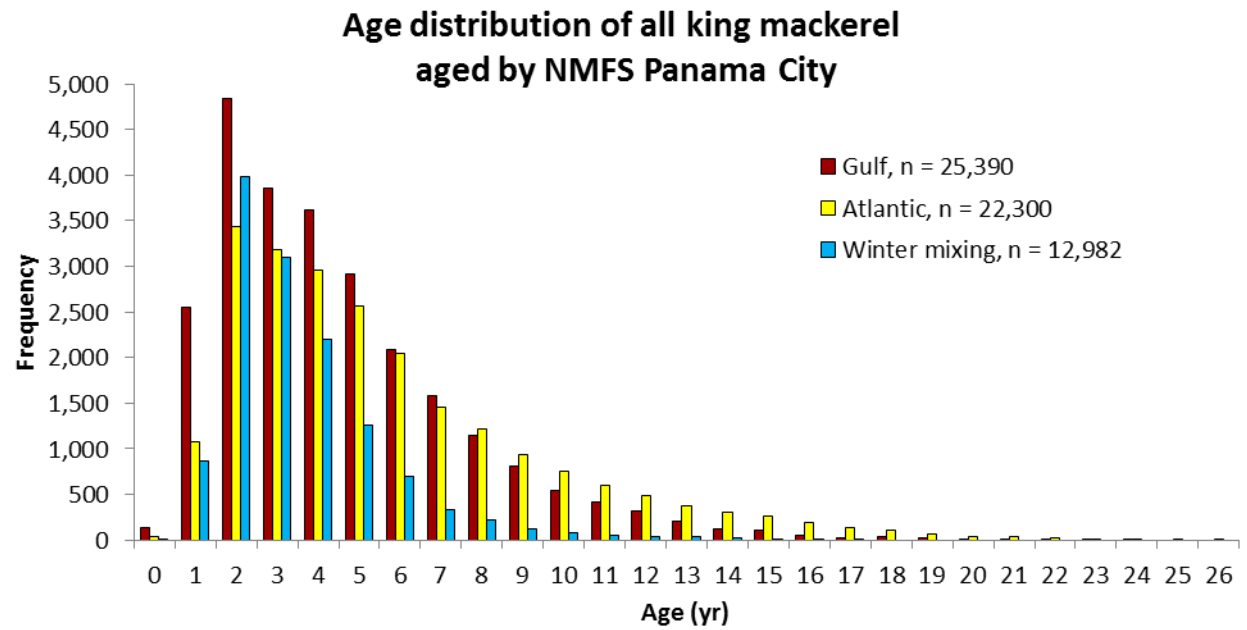

Figure 3. Age frequency distribution of all king mackerel, sexes combined, aged by NMFS Panama City, 1986-2013.

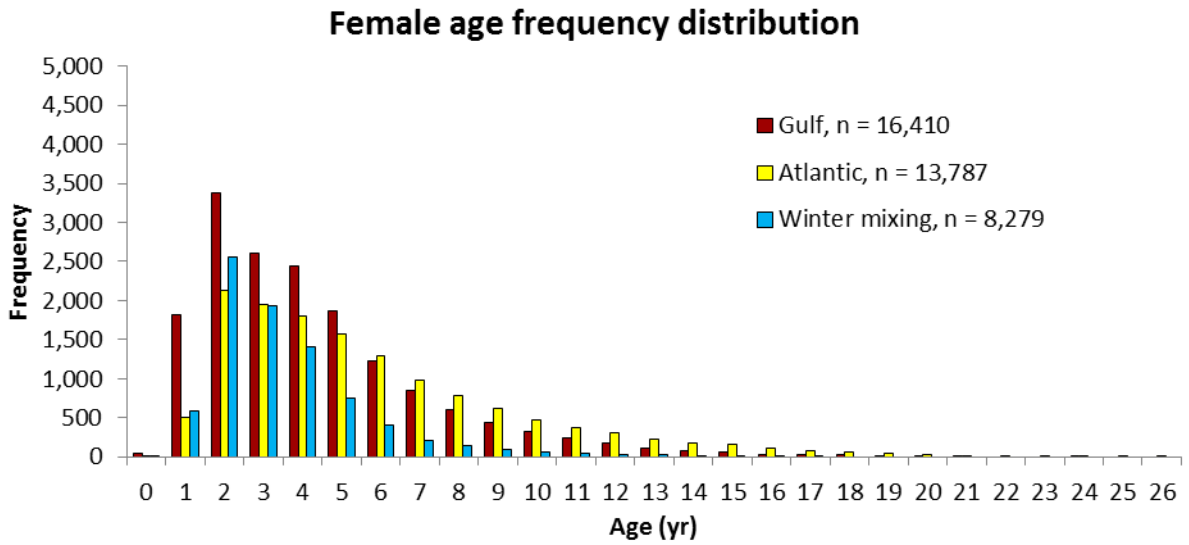

Figure 4. Age frequency distribution of all female king mackerel from the three stocks, aged by NMFS Panama City, fishing years 1985-1986 (incomplete) through 2013-2014 (incomplete).

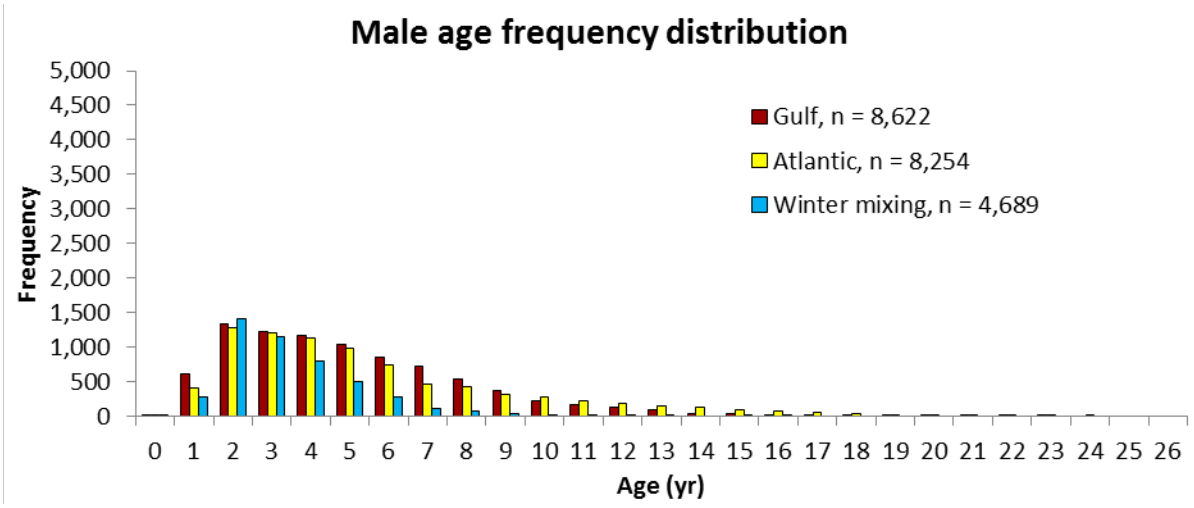

Figure 5. Age frequency distribution of all male king mackerel from the three stocks, aged by NMFS Panama City, fishing years 1985-1986 (incomplete) through 2013-2014 (incomplete).

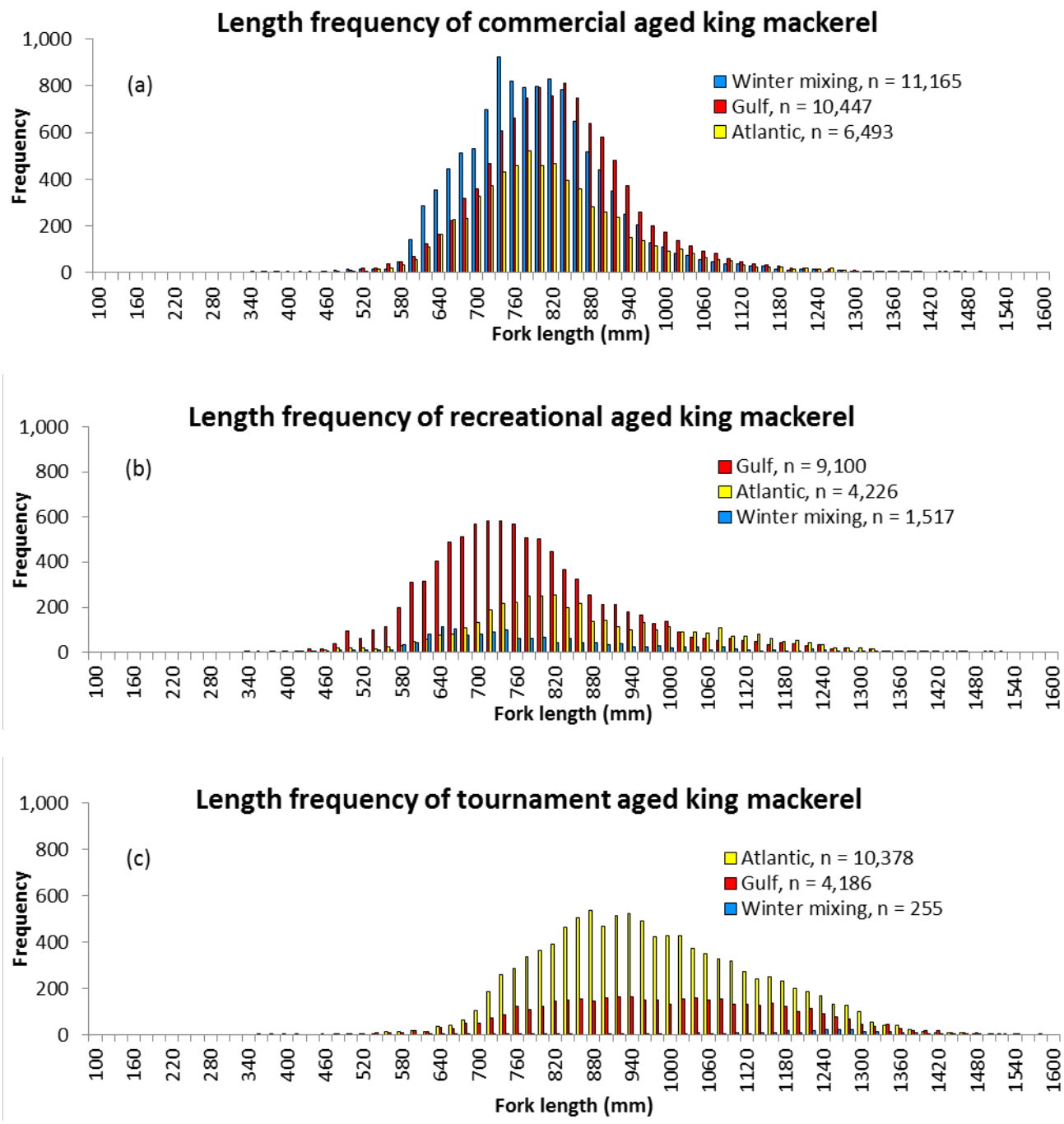

Figure 6. Length frequency distributions of king mackerel commercial (a) 1986-1986 (incomplete) through 2013-2014 (incomplete), (b) recreational 1985-1986 (incomplete) through 2012-2013 (incomplete), and (c) tournament 1986-1987 (incomplete) through 2012-2013 (incomplete), sexes combined, from the three stocks aged by the NMFS PC Lab.

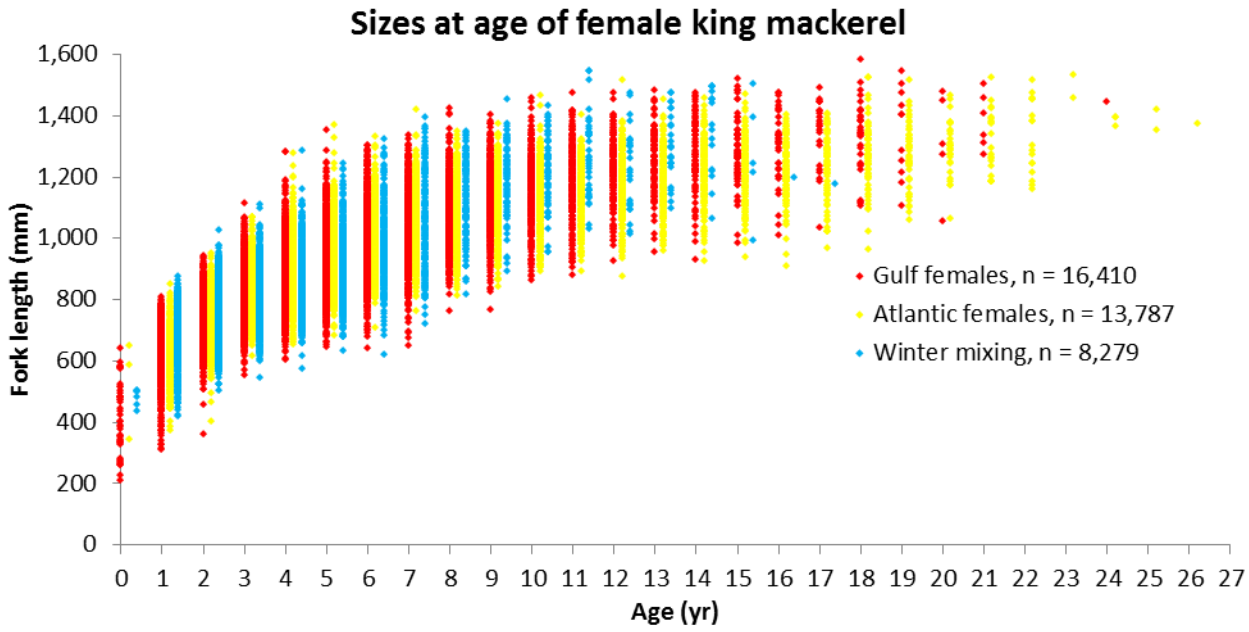

Figure 7. Sizes at age of female king mackerel, 1986 – 2013, from all three stocks, aged by NMFS Panama City.

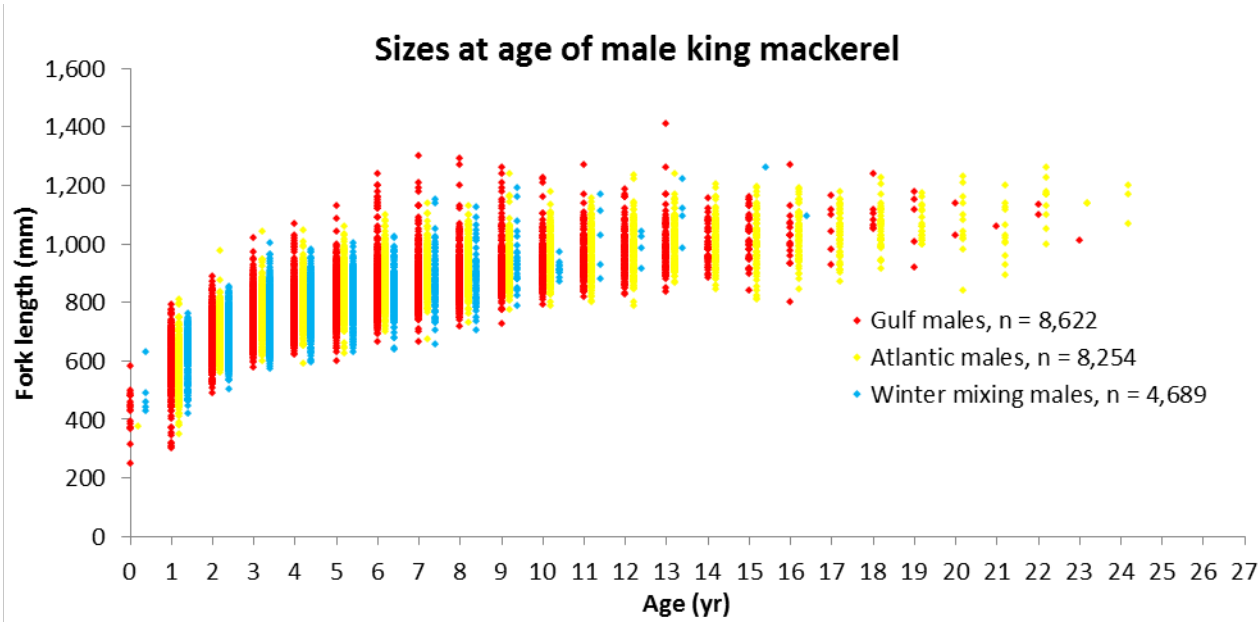

Figure 8. Sizes at age of male king mackerel, 1986 – 2013, from all three stocks, aged by NMFS Panama City.

Addendum to

SEDAR38-DW-15

A review of Gulf of Mexico and Atlantic king mackerel *(Scomberomorus cavalla)* age data, 1986 – 2013, from the Panama City Laboratory, Southeast Fisheries Science Center, NOAA Fisheries Service

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Contribution 13-09

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Post SEDAR38DW update:

During SEDAR38 it was decided that the previous winter mixing zone boundaries would be reduced to include only Monroe County (south Florida). These changes to the winter mixing zone were the following:

- All grid 2 fish are Gulf stock

- All grid 3 fish are Gulf stock

- All samples north of US1 for grid 1 are Gulf stock

- All samples south of US1 for grid 1 are either winter mixing zone or Atlantic

For those fish in Monroe County, FL with no grid information:

- All gill net fish are Gulf stock (assumed to be fished north of US1)

- All commercial or recreation hook-and-line fish are winter mixing zone or Atlantic stock (assumed to be fishing deeper water south of US1)

-All unknown modes fishing with hook-and-line gear are winter mixing zone or Atlantic stock (assumed to be fishing deeper water south of US1)

-All unknown mode and unknown gear are mixing zone or Atlantic

Updated stock numbers and percentages within this addendum to SEDAR38-DW-15 are noted in **bold** text. Any new changes to tables or figures will be noted as **UPDATE** within the legend. Tables or figures that remain the same will be noted as NO CHANGE within the legend. Please refer to the original SEDAR38-DW-15 document for the original tables and figures as needed.

Introduction

King mackerel, *Scomberomorus cavalla*, are highly sought after and economically valuable to both U. S. recreational and commercial fishermen from Texas to North Carolina (Manooch, 1979). The fishery is managed under the Coastal Migratory Pelagic Resources Fishery Management Plan which outlines two different stocks or migratory groups for management purposes: the Gulf of Mexico stock, extending from the Florida west coast to the Texas border with Mexico, and the Atlantic stock, ranging from the New England area to the Florida southeast coast. Tag return data collected during 1975 – 1978 showed considerable seasonal movement between the Atlantic Ocean and the Gulf of Mexico (Sutter et al., 1991). The boundary between the Gulf of Mexico and Atlantic stocks is defined as the Volusia – Flagler County line (northeast Florida) during November – March and the Monroe – Collier County line (southwest Florida) during April – October.

This is the third SEDAR (Southeast Data, Assessment and Review) for king mackerel following SEDAR 5 in 2003 and SEDAR 16 in 2008. The primary objective of this report is to give an overview of the temporal and spatial distributions, as well as distributions by fishery and gear, of king mackerel age samples from the years 1986 through 2013 aged by the Panama City Laboratory of the Southeast Fisheries Science Center, NOAA Fisheries Service. Information on quality control and sub-sampling procedures is also provided.

Methods

Otolith collection and data proofing

Otoliths were collected 1986 – 2013 by federal and state agencies and academic institutions from both commercial (CM) and recreational (REC) fisheries. Fishery dependent samples were obtained from several NMFS programs, including the Trip Interview Program (TIP), Panama City Lab (PCLAB), North Carolina Division of Marine Fisheries (NCDMF), Beaufort Lab Headboat Survey (HB), Recreational Fisheries Information Network (RECFIN),

Marine Fisheries Recreational Statistical Survey (MRFSS), The University of South Alabama (USAL), South Carolina Department of Natural Resources (SCDNR), Cooperative Research (CO-OP), Florida Fish and Wildlife Research Institute (FWRI), Florida Department of Environmental Protection (FLDEP), Virginia Department of Marine Resources (VADMR), and The Louisiana Department of Wildlife and Fisheries (LADWF). Fishery independent samples were obtained from NMFS Pascagoula (MSLAB) and the Expanded Stock Assessment Survey (EASA).

Each of the data collection sources had separate but similar sampling procedures, data protocols, and reporting methods. Data quality control guidelines as described by the Panama City Lab's Procedure Manual for Age, Growth, and Reproduction (AGR) (NMFS, 2008) were used to interpret source-specific data sheets. First, beginning in 2000, each species specific collection was assigned an annual collection (or tracking) number and all collection-specific data (i.e. source, source number, state, sector, and gear) were entered in Microsoft® Access database. Validation rules for data entry and user-specific security for data accessibility guidelines were followed to enhance data quality control. The source (or interview) number is a source-specific number that permits cross-referencing of data between the original and the Panama City AGR databases. Next, all individual fish data were proofed against the original data sheets. Corrections were made to the Annual AGR Database as needed and any specific data issues were resolved by personal contact with port agents or samplers.

To insure uniform standards of quality control, all 1986 – 1997 data, collected prior to the establishment of written data quality guidelines in 1988, were proofed against original data sheets (archived at the Panama City Lab). TIP specific data were proofed using original TIP data sheets or by accessing online TIP files.

Sampling trends

Annual numbers of otolith samples received and aged at the Panama City lab during 1986 through April 2013 were summarized by sector (commercial – CM, recreational REC, scientific survey – SS, and tournament – TRN) and by commercial gear type (hand-line – HL, longline – LL, and gillnet – GN). Hand-lines included rod and reel gear or methods such as bandit rigs, trolling, sight casting, etc. Gill nets were broadly defined as any type of entangling net,

including cast nets. The recreational sector included samples from charter boats (CP), head boats (HB), and private vessels (PR), but excluded tournament samples. Data that could not be defined or reconciled was classified as unknown (Unknown).

Sample numbers were also summarized by region (Gulf and Atlantic) where the fish were caught (not necessarily where they were landed nor their stock or migratory group as currently defined in the FMP). In addition, data were summarized by sub-region within those regions (Figure 1). Gulf sub-regions included Mexico, the states of Texas, Louisiana, Mississippi, and Alabama, and four areas on the west coast of Florida. The Florida sub-regions included northwest Florida (NWF) (all coastal counties north of Levy County to the Florida-Alabama state border), west Florida (WF) (Citrus County south to Sarasota County), southwest Florida (SWF) (Charlotte County south to Collier County), and south Florida (SF) Monroe County only). Atlantic sub-regions included southeast Florida (SEF) (Dade through Broward County), east Florida (EF) (Palm Beach through Volusia County), and northeast Florida (NEF) (Flagler County to the Florida-Georgia border), the states of Georgia, South Carolina, North Carolina, and all remaining coastal states north of North Carolina.

Sub-sampling

Samples collected from TIP for the year 2012 (n = 4,207) from the state of Louisiana (n = 2,743) made up just over 65% of all samples collected for that year. All of these samples were collected during July and August from commercial (CM) hand-line (HL) sources. Of the 2012 Louisiana TIP samples, 1,000 were randomly sub-sampled for ageing (Figure 2), and 66 of those were unreadable or were unusable due to otolith storage issues. The remaining 934 samples consisted of 547 (59%) females and 387 (41%) males - similar to the ratio of 57% females and 43% males observed in the total sample.

Age determination and estimates of precision

All ages were derived from sagittal otoliths (Beaumariage, 1973; GSMFC, 2009) by at least two readers. Otoliths from males < 800 mm and from females < 900 mm were read whole while larger king mackerel from both sexes were sectioned (DeVries and Grimes, 1997). Annuli

of whole otoliths were identified as stated by Johnson et al. (1983) and annuli in sections as described by Waltz (1986). All king mackerel collected prior to the 2001-02 fishing year were aged by Reader 2. Thereafter, Reader 1 became the primary ager. Reader 3 aged all sectioned samples from calendar years 2006-11 and Reader 4 aged 871 (61%) sectioned samples from 2012. The primary ager, Reader 1, aged the remaining samples from 2012 and all 2013 samples. One hundred whole otoliths from 2012 were read by both Readers 1 and 2, and three indices of precision were calculated from those data to check for consistency and drifts in precision between readers. The indices were average percent error (APE), coefficient of variation (CV), and precision (D). The goal was to achieve an APE of less than 5.0%. See Palmer et al. 2007 for further discussion on ageing precision. Reader 3 became the primary reader for all sectioned samples beginning with the 2006 collections. One hundred sectioned samples from 2007 were read by both Readers 1 and 3, and those data were analyzed to assure acceptable levels of precision. In addition, 100 sectioned samples from 2012 were read by both Readers 1 and 4 and those data were analyzed as well. To check for drift in otolith interpretation over time between Readers 1 and 2, 100 whole otoliths from 2012 were aged by both readers.

Annual ages, based on calendar year, were calculated using the annulus count, edge-type, and capture date. Annulus formation typically occurs in the spring (Beaumariage, 1973; Johnson et al., 1983), and advancement of ages is often necessary for fish captured that time of year in order to assign fish to the correct cohort (DeVries and Grimes, 1997). The protocol for advancing ages was: 1) fish sampled January – May with a marginal increment estimated to be > 35% of the previous increment were advanced one year; and 2) fish sampled June – July 15th with > 2 annuli and a marginal increment > 35% of the previous increment were advanced one year, while those with 2 or fewer annuli were advanced one year only if the marginal increment was > 70% of the previous one. The distinction was made because younger fish grow more and faster than older fish, and it is not uncommon for them to already have relatively large marginal increments as early as June. Ages were not advanced for fish sampled July 16th – December (DeVries and Grimes, 1997).

Results and Discussion

Sampling trends

A total of 60,672 king mackerel collected from fishing year (FY) 1985-1986 through early in FY 2013-2014 (**27,597** from the Gulf of Mexico, **31,380** from the Atlantic, and **1,695** from the winter mixing zone) have been aged by the Panama City Laboratory and made available for SEDAR 38 (Table 1). Of all the aged samples, 46% were from the commercial sector, 24% from the recreational sector (CP, HB, and PR combined), and 24% from tournaments (Table 2). In addition, 1% of the fish aged were from scientific surveys, and 4% were from unknown sectors. East Florida (**50%**) and North Carolina (**37%**) were the main sources of aged samples from the Atlantic region (Table 3). From the Gulf of Mexico, northwest Florida (**31%**) accounted for the majority of samples, with another **30%** coming from Louisiana, west Florida (**11%**), and Texas (**9%**) (Table 4).

Of the Atlantic commercial samples, the majority (**85%**) came from east Florida (Table 5), while in the Gulf the vast majority came from Louisiana (**58%**) (Table 6). The winter mixing zone contributed **813** commercial samples (Table 7). A little over half of the recreational, non-tournament samples from the Atlantic (Table 8) were from east Florida (**56%**). Recreational samples came predominantly from northwest Florida (68%) in the Gulf (Table 9). The winter mixing zone added **663** recreational samples (Table 10). Tournament sampled fish were excluded from the recreational catches from both the Gulf and winter mixing zone. North Carolina was the largest source of tournament samples, (n = 8,591); **83%** of Atlantic samples came from that state (Table 11). Most Gulf tournament samples were collected in west Florida (**36%**), northwest Florida (25%), and Louisiana (17%) (Table 12). The winter mixing zone contributed a minimal number of all tournament samples (n= **192**).

Of all commercial king mackerel age samples (both stocks plus the mixing zone), 89% were collected from hand-line fisheries (Table 13). Within regions, 97% of Atlantic commercial samples were from hand-line fisheries, compared to 91% from the Gulf and 84% from the winter mixing zone (Tables, 14, 15, and 16).

Age determination and estimates of precision

Reader comparison results (Table 17) showed high precision between all readers. Whole otolith age comparisons between Readers 1 and 2 for the 2012 samples yielded an APE of 5.07%, CV of 7.16%, and D of 3.58%. Precision levels were also high between Readers 1 and 3 for sectioned otolith age comparisons for the 2007 samples, with an APE of 2.34%, CV of 3.31%, and D of 1.66%. Age comparisons for the 2012 sectioned samples between Readers 1 and 4 produced an APE of 2.84%, CV of 4.02%, and D of 2.01%.

Age and length composition

King mackerel collected during the 1985-1986 (incomplete) through 2013-2014 (incomplete) fishing seasons and aged by the NMFS Panama City Lab ranged in age from 0 to 26 yr, with **71%** Gulf, **69%** Atlantic, and **73%** winter mixing zone fish between the ages of 1 and 5 yr (Figure 3). Females ranged from ages 0 to 26 and males from 0 to 24 yr. Females ranged from ages 0 to 24 (74% ages 1 – 5) in the Gulf, ages 0 to 26 (**68%** ages 1 – 5) in the Atlantic, and ages 0 – **15** (**69%** ages 1 – 5) in the winter mixing zone (Figure 4). Males ranged from ages 0 to 23 yr (**64%** ages from 1 – 5) in the Gulf, ages 0 – 24 (**70%** ages from 1 – 5) in the Atlantic, and in the winter mixing zone ages 0 – **15** (**84%** ages from 1 -5) (Figure 5).

The size distributions of the commercial age samples from the winter mixing, Gulf, and Atlantic stocks were similar, although the mode for the winter mixing zone was smaller (740 - 760mm) than the Gulf (**~800mm**), and Atlantic (**740 - 820mm**) modes (Figure 6a). Recreational size distributions differed but not in the same pattern as commercial samples (Figure 6b). The Atlantic stock was similar to the commercial mode stock (**740 - 820mm**) followed by the Gulf (720mm). The winter mixing samples had a mode of **~860mm**. The Gulf tournament size distribution was much more uniform than that from the Atlantic, which had an obvious mode around 880 – 940mm (Figure 6c). Winter mixing zone tournament samples had a considerably larger mode (1240 – 1280mm) but a drastically smaller sample size.

The ranges in length at age for almost all ages for females were similar for both stocks and the mixing zone (Figure 7). Gulf males ages 5 – 9 had a wider range in length at age than the Atlantic stock and the mixing zone fish (Figure 8). Conversely, Atlantic males age 14 and

older had wider ranges in size at age than the Gulf or mixing zone fish, but this can be likely attributed to their smaller samples sizes.

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Table 1. **(UPDATE)** Annual numbers of king mackerel, fishing years 1985-1986 (incomplete) through 2013-2014 (incomplete), by stock aged by NMFS Panama City.

Fishing Year	Atlantic	Gulf	Winter Mix	Total
1985-1986	6	15		21
1986-1987	563	612		1,175
1987-1988	532	842	1	1,375
1988-1989	498	878	20	1,396
1989-1990	884	1,109	57	2,050
1990-1991	987	888	97	1,972
1991-1992	989	1,521	112	2,622
1992-1993	1,456	1,123	42	2,621
1993-1994	897	1,438	20	2,355
1994-1995	856	960	13	1,829
1995-1996	1,035	949	79	2,063
1996-1997	1,958	871	13	2,842
1997-1998	805	501	92	1,398
1998-1999	895	329	82	1,306
1999-2000	1,413	306	48	1,767
2000-2001	1,719	217	118	2,054
2001-2002	1,510	872	221	2,603
2002-2003	1,710	1,248	161	3,119
2003-2004	2,410	945	71	3,426
2004-2005	2,112	613	117	2,842
2005-2006	523	659	73	1,255
2006-2007	806	598	79	1,483
2007-2008	600	1,351	31	1,982
2008-2009	1,509	1,373	24	2,906
2009-2010	1,532	1,785	46	3,363
2010-2011	1,188	1,841	47	3,076
2011-2012	1,200	1,931	28	3,159
2012-2013	741	1,774	3	2,518
2013-2014	46	44		90
Unknown		4		4
Total	31,380	27,597	1,695	60,672

Table 2. (NO CHANGE) Annual numbers of king mackerel, fishing years 1985-1986 (incomplete) through 2013-2014 (incomplete), aged by NMFS Panama City. CM = commercial, REC = recreational, TRN = tournament, Unknown = no data, SS = scientific survey.

Fishing Year	CM	REC	TRN	Unknown	SS	Total
1985-1986		1		20		21
1986-1987	27	386	160	602		1,175
1987-1988	10	223	341	781	20	1,375
1988-1989	20	323	476	573	4	1,396
1989-1990	144	867	849	161	29	2,050
1990-1991	201	795	922	52	2	1,972
1991-1992	732	1,004	882		4	2,622
1992-1993	572	660	1,369	15	5	2,621
1993-1994	1,127	458	746		24	2,355
1994-1995	684	383	744	18		1,829
1995-1996	1,111	383	504	65		2,063
1996-1997	1,536	533	707	66		2,842
1997-1998	593	205	518	81	1	1,398
1998-1999	498	174	587	47		1,306
1999-2000	1,034	261	472			1,767
2000-2001	1,354	174	518		8	2,054
2001-2002	1,537	517	546		3	2,603
2002-2003	1,364	1,055	529		171	3,119
2003-2004	1,029	1,149	1,247		1	3,426
2004-2005	769	1,562	505		6	2,842
2005-2006	447	554	248		6	1,255
2006-2007	537	700	208		38	1,483
2007-2008	1,538	209	235			1,982
2008-2009	2,262	386	256		2	2,906
2009-2010	2,498	638	210		17	3,363
2010-2011	2,129	563	327		57	3,076
2011-2012	2,319	484	351		5	3,159
2012-2013	1,945	196	362		15	2,518
2013-2014	90					90
Unknown				4		4
Total	28,107	14,843	14,819	2,485	418	60,672
% of Total	46.3%	24.5%	24.4%	4.1%	0.7%	100.0%

Table 3. **(UPDATE)** Annual numbers of king mackerel from the Atlantic (non winter mixing zone), fishing years 1985-1986 (incomplete) through 2013-2014 (incomplete), by sub-region, aged by NMFS Panama City. EF = east Florida, NEF = northeast Florida, SEF = southeast Florida.

Fishing Year	EF	NC	NEF	SC	GA	SEF	SF	VA	MA	Total
1985-1986	5		1							6
1986-1987	144	155	25	94	107	21	17			563
1987-1988	110	236	32	124	14	14	2			532
1988-1989	120	104		167	60	42	5			498
1989-1990	31	586		108	139		3	17		884
1990-1991	4	785		93	98		5		2	987
1991-1992	211	628		109	15		26			989
1992-1993	302	924		140	81		4		5	1,456
1993-1994	246	565		80			6			897
1994-1995	373	468					15			856
1995-1996	736	299								1,035
1996-1997	1,385	357	121	29	49	9	8			1,958
1997-1998	355	404	22		24					805
1998-1999	409	441	42				3			895
1999-2000	917	485				11				1,413
2000-2001	1,148	500	63	7			1			1,719
2001-2002	777	536	73	76		42	6			1,510
2002-2003	1,165	434	72	29		8	2			1,710
2003-2004	1,538	430	419			7	16			2,410
2004-2005	955	377	703			77				2,112
2005-2006	290	89	97			40	7			523
2006-2007	537	146	88			35				806
2007-2008	300	289				11				600
2008-2009	910	526	28			21	24			1,509
2009-2010	981	511				16	24			1,532
2010-2011	710	356	51			60	11			1,188
2011-2012	652	475	55			6	12			1,200
2012-2013	292	449								741
2013-2014	42						4			46
Total	15,645	11,555	1,892	1,056	587	420	201	17	7	31,380
% of total	49.9%	36.8%	6.0%	3.4%	1.9%	1.3%	0.6%	0.1%	0.0%	100.0%

Table 4. **(UPDATE)** Annual numbers of king mackerel from the Gulf (non winter mixing zone), fishing years 1985-1986 (incomplete) through 2013-2014 (incomplete), by sub-region, aged by NMFS Panama City. NWF = northwest Florida, WF = west Florida, SWF = southwest Florida.

Fishing Year	NWF	LA	WF	TX	SF	MEX	SWF	AL	MS	Total
1985-1986				15						15
1986-1987	192	50	2	167				132	69	612
1987-1988	50	75		382		102		172	61	842
1988-1989	133	68		336	1	177		83	80	878
1989-1990	438	58		345		244		7	17	1,109
1990-1991	448	41		181		103		18	97	888
1991-1992	411	305	123	443		177		4	58	1,521
1992-1993	346	292	215	214				9	47	1,123
1993-1994	244	567	244	147		199	29	8		1,438
1994-1995	301	348	196	56	11		48			960
1995-1996	565	158	150				76			949
1996-1997	768		103							871
1997-1998	410		82		9					501
1998-1999	158		74		18		58	1	20	329
1999-2000	148		41				47	4	66	306
2000-2001	128		5				66		18	217
2001-2002	321	216	14		265		24	22	10	872
2002-2003	504	41	206	15	280		78	124		1,248
2003-2004	568	32	282		62		1			945
2004-2005	224	44	235	34	45		23	8		613
2005-2006	295	197	110	4	24			29		659
2006-2007	226	206	70	2	42			52		598
2007-2008	118	891	49	1	151		141			1,351
2008-2009	290	847	37	4	125		52	18		1,373
2009-2010	437	923	208	27	160		30			1,785
2010-2011	277	927	284	62	278		13			1,841
2011-2012	352	979	224	3	313		60			1,931
2012-2013	143	938	146	75	379		89		4	1,774
2013-2014					44					44
Unknown			4							4
Total	8,495	8,203	3,104	2,513	2,207	1,002	835	691	547	27,597
% of total	30.8%	29.7%	11.2%	9.1%	8.0%	3.6%	3.0%	2.5%	2.0%	100.0%

Table 5. **(UPDATE)** Annual numbers of king mackerel from Atlantic (non winter mixing zone) commercial samples, fishing years 1985-1986 (incomplete) through 2013-2014 (incomplete), by sub-region, aged by NMFS Panama City. EF = east Florida, NEF = northeast Florida, SEF = southeast Florida.

Fishing Year	EF	NC	SEF	SC	NEF	SF	GA	Total
1989-1990	31	18						49
1990-1991		68						68
1991-1992	178	51		1		12		242
1992-1993	252	159						411
1993-1994	202	147		1		1		351
1994-1995	351	107				10		468
1995-1996	694	45						739
1996-1997	1,377	19	9	29	24	6		1,464
1997-1998	355				22		24	401
1998-1999	398					2		400
1999-2000	917	9	11					937
2000-2001	1,148			7	27			1,182
2001-2002	673	29	29	39		4		774
2002-2003	808		5	29				842
2003-2004	677		6			5		688
2004-2005	393	4	15					412
2005-2006	137		8			4		149
2006-2007	260		7					267
2007-2008	278	45						323
2008-2009	881	276	17		28	11		1,213
2009-2010	918	311				19		1,248
2010-2011	650	139				1		790
2011-2012	637	211				12		860
2012-2013	292	87						379
2013-2014	42					4		46
Total	12,549	1,725	107	106	101	91	24	14,703
% of total	85.3%	11.7%	0.7%	0.7%	0.7%	0.6%	0.2%	100.0%

Table 6. **(UPDATE)** Annual numbers of king mackerel from Gulf (non winter mixing zone) commercial samples, fishing years 1985-1986 (incomplete) through 2013-2014 (incomplete), by sub-region, aged by NMFS Panama City. NWF = northwest Florida, SWF = southwest Florida, WF = west Florida.

Fishing Year	LA	SF	NWF	SWF	WF	MEX	TX	AL	MS	Total
1986-1987							25		2	27
1987-1988	10									10
1988-1989	19	1								20
1989-1990			8			83			4	95
1990-1991						103			4	107
1991-1992	247		1			177				425
1992-1993	128									128
1993-1994	430		184	29	2	110		8		763
1994-1995	186	11		16						213
1995-1996	106		159	76						341
1996-1997			59							59
1997-1998		9	56		81					146
1998-1999		18		58	11					87
1999-2000				47	40					87
2000-2001			22	66						88
2001-2002	163	265	171	24	1			22		646
2002-2003	40	280	45	78	40					483
2003-2004	32	62	207		4					305
2004-2005	39	45	155	23	6			8		276
2005-2006	197	24	21		1					243
2006-2007	206	42	7							255
2007-2008	891	151	6	141	2					1,191
2008-2009	847	110		52	1		3	18		1,031
2009-2010	920	144		30	115		10			1,219
2010-2011	921	246	5	13	117					1,302
2011-2012	967	311	1	59	99					1,437
2012-2013	934	379	12	89	144		1		4	1,563
2013-2014		44								44
Total	7,283	2,142	1,119	801	664	473	39	56	14	12,591
% of total	57.8%	17.0%	8.9%	6.4%	5.3%	3.8%	0.3%	0.4%	0.1%	100.0%

Table 7. **(UPDATE)** Annual numbers of king mackerel from the winter mixing zone commercial samples, fishing years 1990-1991 through 2012-2013, aged by NMFS Panama City.

Fishing Year	SF
1990-1991	26
1991-1992	65
1992-1993	33
1993-1994	13
1994-1995	3
1995-1996	31
1996-1997	13
1997-1998	46
1998-1999	11
1999-2000	10
2000-2001	84
2001-2002	117
2002-2003	39
2003-2004	36
2004-2005	81
2005-2006	55
2006-2007	15
2007-2008	24
2008-2009	18
2009-2010	31
2010-2011	37
2011-2012	22
2012-2013	3
Total	813

Table 8. **(UPDATE)** Annual numbers of king mackerel from Atlantic (non winter mixing zone) recreational samples (excluding tournaments), fishing years 1985-1986 (incomplete) through 2011-2012, by sub-region, aged by NMFS Panama City. EF = east Florida, NEF = northeast Florida, SEF = southeast Florida.

Fishing Year	EF	NC	SEF	SC	NEF	SF	GA	VA	Total
1985-1986					1				1
1986-1987	76	41	7	5	22	3			154
1987-1988	110		14	10	32	2			168
1988-1989	77		17	14					108
1989-1990		126		29		3	69	17	244
1990-1991		49		33		5			87
1991-1992	28	32		62		14			136
1992-1993	50	57		81		4			192
1993-1994	13			79		5			97
1994-1995	21	26				5			52
1995-1996	42	15							57
1996-1997	2					2			4
1997-1998		6							6
1998-1999		2							2
1999-2000		38							38
2000-2001					36	1			37
2001-2002	104	62	13	2	16	2			199
2002-2003	357		3			2			362
2003-2004	791		1		6	11			809
2004-2005	562	9	62		703				1,336
2005-2006	153		32		1	3			189
2006-2007	244	24	28		88				384
2007-2008	22	9	11						42
2008-2009	29	2	4			13			48
2009-2010	63		16			5			84
2010-2011	60	7	60		2	10			139
2011-2012	15		6		55				76
Total	2,819	505	274	315	962	90	69	17	5,051
% of total	55.8%	10.0%	5.4%	6.2%	19.0%	1.8%	1.4%	0.3%	100.0%

Table 9. **(UPDATE)** Annual numbers of king mackerel from the Gulf (non winter mixing zone) recreational samples (excluding tournaments), fishing years 1986-1987 (incomplete) through 2012-2013 (incomplete), by sub-region, aged by NMFS Panama City. NWF = northwest Florida, WF = west Florida, SWF = southwest Florida.

Fishing Year	NWF	TX	WF	MS	LA	MEX	AL	SF	SWF	Total
1986-1987	168	41		22	1					232
1987-1988	10	44								54
1988-1989	39	176								215
1989-1990	308	245		13						566
1990-1991	408	163		66						637
1991-1992	347	435	1	37	1					821
1992-1993	254	205								459
1993-1994	44	147	2		72	89				354
1994-1995	265	56								321
1995-1996	278									278
1996-1997	529									529
1997-1998	155		1							156
1998-1999	149		2				1			152
1999-2000	148		1	55			4			208
2000-2001	98		5							103
2001-2002	147		13	1	53					214
2002-2003	400	15	166							581
2003-2004	317		10						1	328
2004-2005	68	34	105		4					211
2005-2006	250	4	78				26			358
2006-2007	219	2	70				18			309
2007-2008	112	1	47							160
2008-2009	290	1	36					5		332
2009-2010	435	5	93					6		539
2010-2011	271	12	115					16		414
2011-2012	351		38		11			2		402
2012-2013	129	65	2							196
Total	6,189	1,651	785	194	142	89	49	29	1	9,129
% of total	67.8%	18.1%	8.6%	2.1%	1.6%	1.0%	0.5%	0.3%	0.0%	100.0%

Table 10. **(UPDATE)** Annual numbers of king mackerel from the winter mixing zone recreational samples (excluding tournaments), fishing years 1987-1988 (incomplete) through 2012-2013 (incomplete), aged by NMFS Panama City.

Fishing Year	SF
1987-1988	1
1989-1990	57
1990-1991	71
1991-1992	47
1992-1993	9
1993-1994	7
1994-1995	10
1995-1996	48
1997-1998	43
1998-1999	20
1999-2000	15
2000-2001	34
2001-2002	104
2002-2003	112
2003-2004	12
2004-2005	15
2005-2006	7
2006-2007	7
2007-2008	7
2008-2009	6
2009-2010	15
2010-2011	10
2011-2012	6
Total	663

Table 11. **(UPDATE)** Annual numbers of king mackerel from Atlantic (non winter mixing zone) tournament samples, fishing years 1985-1986 (incomplete) through 2012-2013(incomplete), by sub-region, aged by NMFS Panama City. NEF = northeast Florida, EF = east Florida.

Fishing Year	EF	NC	SC	NEF	GA	Total
1986-1987		23	23		9	55
1987-1988		43	106		4	153
1988-1989		38	86		60	184
1989-1990		442	79		70	591
1990-1991	4	634	60		98	796
1991-1992	1	545	46		15	607
1992-1993		696	59		81	836
1993-1994	31	394				425
1994-1995	1	317				318
1995-1996		239				239
1996-1997	6	338		97	33	474
1997-1998		319				319
1998-1999	11	393		42		446
1999-2000		438				438
2000-2001		500				500
2001-2002		445	35	57		537
2002-2003		265		72		337
2003-2004	70	430		413		913
2004-2005		364				364
2005-2006		89		96		185
2006-2007		122				122
2007-2008		235				235
2008-2009		246				246
2009-2010		200				200
2010-2011		210		49		259
2011-2012		264				264
2012-2013		362				362
Total	124	8,591	494	826	370	10,405
% of total	1.2%	82.6%	4.7%	7.9%	3.6%	100.0%

Table 12. **(UPDATE)** Annual numbers of king mackerel from the Gulf (non winter mixing zone) tournament samples, fishing years 1986-1987 (incomplete) through 2011-2012, by sub-region, aged by NMFS Panama City. WF = west Florida, NWF = northwest Florida, SWF = southwest Florida.

Fishing Year	NWF	WF	LA	TX	AL	MS	SF	SWF	Total
1986-1987	24			28	42	11			105
1987-1988	11		65	112					188
1988-1989	60		42	131	59				292
1989-1990	93		58	100	7				258
1990-1991	32		33	17	18	26			126
1991-1992	63	122	57	8	4	21			275
1992-1993	90	215	164	8	9	47			533
1993-1994	16	240	65						321
1994-1995	36	196	162					32	426
1995-1996	128	85	52						265
1996-1997	180	53							233
1997-1998	199								199
1998-1999	9	61				20			90
1999-2000						11			11
2000-2001						18			18
2001-2002						9			9
2002-2003	58				124				182
2003-2004	43	268							311
2004-2005		124							124
2005-2006	21	31							52
2006-2007					29				29
2008-2009							10		10
2009-2010							10		10
2010-2011		52					16		68
2011-2012		87							87
Total	1,063	1,534	698	404	292	163	36	32	4,222
% of total	25.2%	36.3%	16.5%	9.6%	6.9%	3.9%	0.9%	0.8%	100.0%

Table 13. (NO CHANGE) Annual numbers of king mackerel samples (Gulf, Atlantic, and winter mixing zone combined) from commercial samples by gear, fishing years 1986-1987 (incomplete) through 2013-2014 (incomplete), aged by NMFS Panama City.

Fishing Year	HL	GN	Unknown	TRW	LL	Misc.	Total
1986-1987	25					2	27
1987-1988	10						10
1988-1989	19	1					20
1989-1990	4		140				144
1990-1991	157	8	36				201
1991-1992	649	83					732
1992-1993	571	1					572
1993-1994	1,018	109					1,127
1994-1995	671	11				2	684
1995-1996	1,077	16	10			8	1,111
1996-1997	1,477	59					1,536
1997-1998	584	9					593
1998-1999	468	30					498
1999-2000	1,025	9					1,034
2000-2001	1,334	20					1,354
2001-2002	1,199	338					1,537
2002-2003	1,084	280					1,364
2003-2004	967	62					1,029
2004-2005	724	45					769
2005-2006	423	24					447
2006-2007	495	42					537
2007-2008	1,274	264					1,538
2008-2009	2,044	155		60	3		2,262
2009-2010	2,252	246					2,498
2010-2011	1,857	272					2,129
2011-2012	2,020	267			32		2,319
2012-2013	1,426	511				8	1,945
2013-2014	90						90
Total	24,944	2,862	186	60	35	20	28,107
% of Total	88.7%	10.2%	0.7%	0.2%	0.1%	0.1%	100.0%

Table 14. **(UPDATE)** Annual numbers of Atlantic commercial king mackerel samples, fishing years 1990-1991 through 2013-2014 (incomplete), from gill nets (GN) and hand-lines (HL) aged by NMFS Panama City. NEF = northeast Florida, EF = east Florida, SF = south Florida, SEF = southeast Florida.

	GN					HL								Grand
Fishing Year	NC	EF	SC	NEF	Total	NC	EF	SEF	SF	SC	NEF	GA	Total	Total
1990-1991						36							36	36
1991-1992						51	178		12	1			242	242
1992-1993		1			1	159	251						410	411
1993-1994						147	202		1	1			351	351
1994-1995						107	349		10				466	466
1995-1996						45	676						721	721
1996-1997		6	29	24	59	19	1,371	9	6				1,405	1,464
1997-1998							355				22	24	401	401
1998-1999							398		2				400	400
1999-2000	9				9		917	11					928	937
2000-2001							1,148			7	27		1,182	1,182
2001-2002	29	44			73		629	29	4	39			701	774
2002-2003							808	5		29			842	842
2003-2004							677	6	5				688	688
2004-2005						4	393	15					412	412
2005-2006							137	8	4				149	149
2006-2007							260	7					267	267
2007-2008	8	3			11	37	275						312	323
2008-2009	20				20	256	849	17	11				1,133	1,153
2009-2010	3				3	308	918		19				1,245	1,248
2010-2011	26				26	113	650		1				764	790
2011-2012	2				2	209	605		12				826	828
2012-2013	29				29	58	292						350	379
2013-2014							42		4				46	46
Total	126	54	29	24	233	1,549	12,380	107	91	77	49	24	14,277	14,510
% of Grand Total	0.9%	0.4%	0.2%	0.2%	1.6%	10.7%	85.3%	0.7%	0.6%	0.5%	0.3%	0.2%	98.4%	100.0%

Table 15. **(UPDATE)** Annual numbers of Gulf commercial king mackerel samples, fishing years 1986-1987 (incomplete) through 2013-2014 (incomplete), from gill nets (GN) and hand-lines (HL) aged by NMFS Panama City. WF = west Florida, SWF = southwest Florida, NWF = northwest Florida.

	GN						HL										Grand
Fishing Year	SF	WF	SWF	MEX	NWF	Total	LA	NWF	SWF	SF	WF	MEX	AL	TX	MS	Total	Total
1986-1987														25		25	25
1987-1988							10									10	10
1988-1989	1					1	19									19	20
1989-1990								4								4	4
1990-1991				8		8						95				95	103
1991-1992				83		83	247	1				94				342	425
1992-1993							128									128	128
1993-1994				104	5	109	430	179	29		2	6	8			654	763
1994-1995	11					11	186		16							202	213
1995-1996			16			16	106	159	60							325	341
1996-1997								59								59	59
1997-1998	9					9		56			81					137	146
1998-1999	18		12			30			46		11					57	87
1999-2000									47		40					87	87
2000-2001			20			20		22	46							68	88
2001-2002	265					265	163	171	24		1		22			381	646
2002-2003	280					280	40	45	78		40					203	483
2003-2004	62					62	32	207			4					243	305
2004-2005	45					45	39	155	23		6		8			231	276
2005-2006	24					24	197	21			1					219	243
2006-2007	42					42	206	7								213	255
2007-2008	112		141			253	891	6		39	2					938	1,191
2008-2009	83		52			135	847			27	1		18			893	1,028
2009-2010	133	110				243	920		30	11	5			10		976	1,219
2010-2011	132	114				246	921	5	13	114	3					1,056	1,302
2011-2012	167	98				265	967	1	59	144	1					1,172	1,437
2012-2013	310	144	28			482	934	12	61	61				1	4	1,073	1,555
2013-2014										44						44	44
Total	1,694	466	269	195	5	2,629	7,283	1,110	532	440	198	195	56	36	4	9,854	12,483
% of Grand Total	13.6%	3.7%	2.2%	1.6%	0.0%	21.1%	58.3%	8.9%	4.3%	3.5%	1.6%	1.6%	0.4%	0.3%	0.0%	78.9%	100.0%

Table 16. **(UPDATE)** Annual numbers of winter mixing zone commercial king mackerel samples, fishing years 1990 - 1991 (incomplete) through 2012 - 2013, from hand-lines (HL) aged by NMFS Panama City. SF = south Florida.

	HL
Fishing Year	Total
1990-1991	26
1991-1992	65
1992-1993	33
1993-1994	13
1994-1995	3
1995-1996	31
1996-1997	13
1997-1998	46
1998-1999	11
1999-2000	10
2000-2001	84
2001-2002	117
2002-2003	39
2003-2004	36
2004-2005	81
2005-2006	55
2006-2007	15
2007-2008	24
2008-2009	18
2009-2010	31
2010-2011	37
2011-2012	22
2012-2013	3
Total	813

Table 17. Indices of precision from reader comparisons. APE = average percent error, CV = coefficient of variation, and D = index of precision.

Reader pair	Data years	Ageing method	APE	CV	D
1 and 2	2012	Whole	5.07%	7.16%	3.58%
1 and 3	2007	Sectioned	2.34%	3.31%	1.66%
1 and 4	2012	Sectioned	2.84%	4.02%	2.01%

Figure 1. Mackerel sampling sub-regions (states and sub-areas of Florida): NWF = northwest Florida, WF = west Florida, SWF = southwest Florida, SF = south Florida, SEF = southeast Florida, EF = east Florida, NEF = northeast Florida.

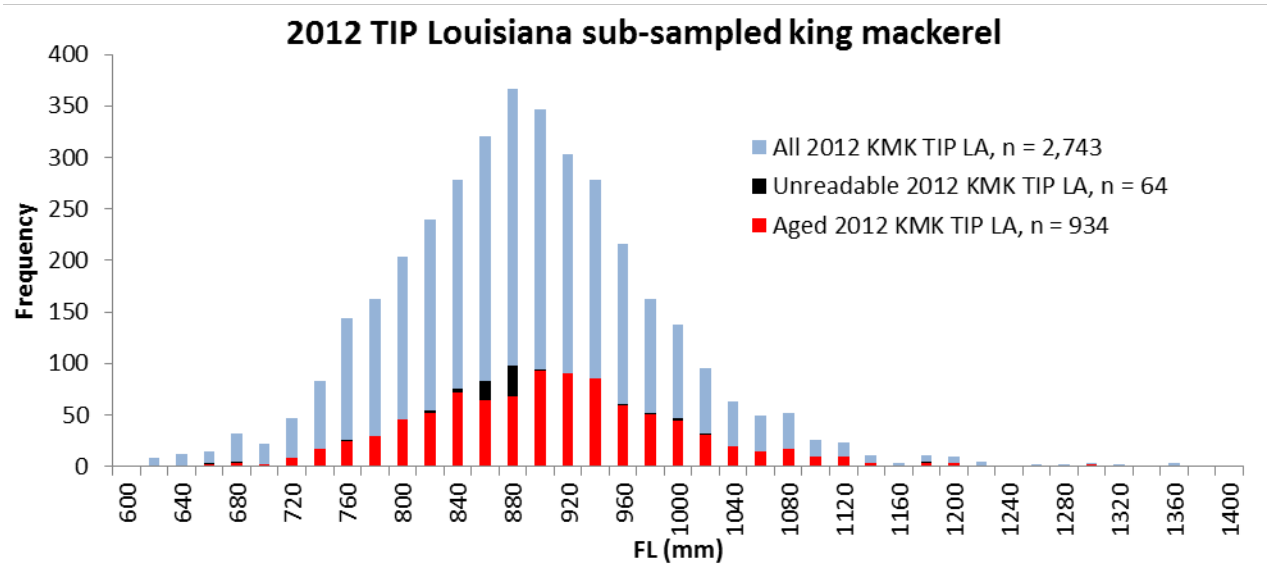


Figure 2. Size distributions of total available (blue), sub-sampled (red), and unreadable (black) 2012 TIP Louisiana king mackerel aged by NMFS Panama City.

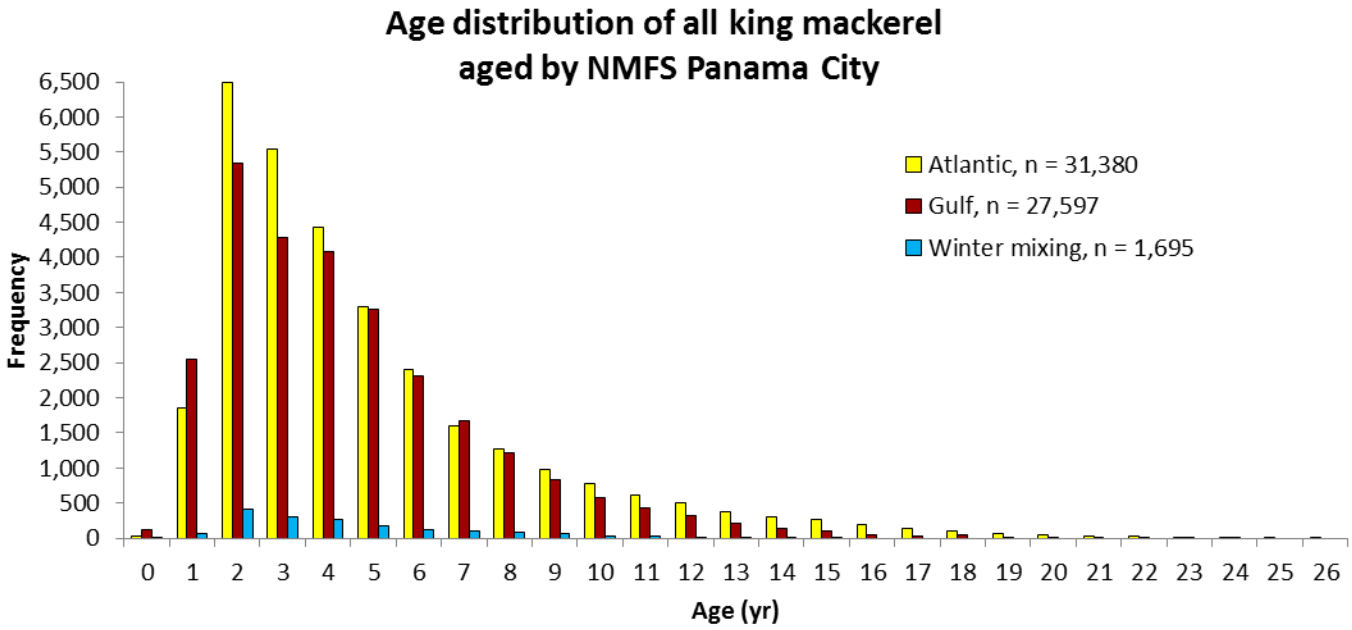


Figure 3. **(UPDATE)** Age frequency distribution of all king mackerel, sexes combined, aged by NMFS Panama City, 1986-2013.

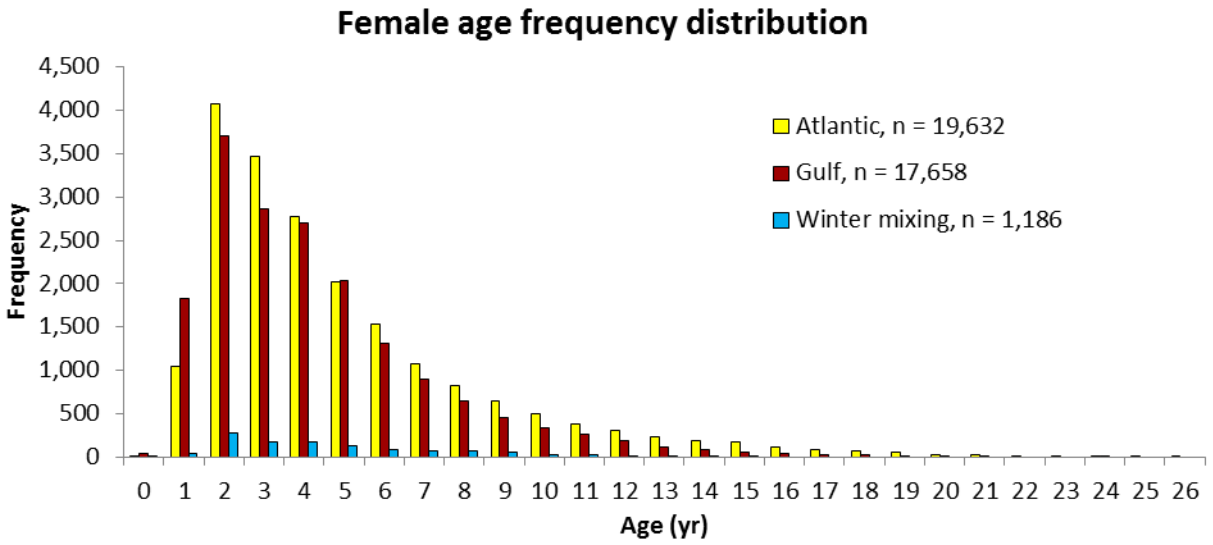


Figure 4. **(UPDATE)** Age frequency distribution of all female king mackerel from the three stocks, aged by NMFS Panama City, fishing years 1985-1986 (incomplete) through 2013-2014 (incomplete).

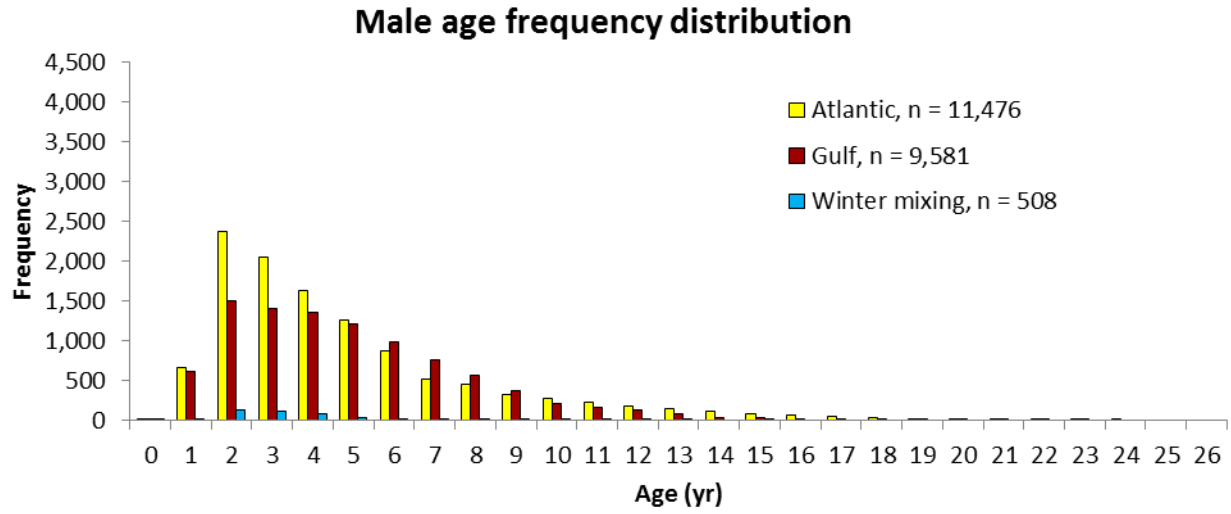
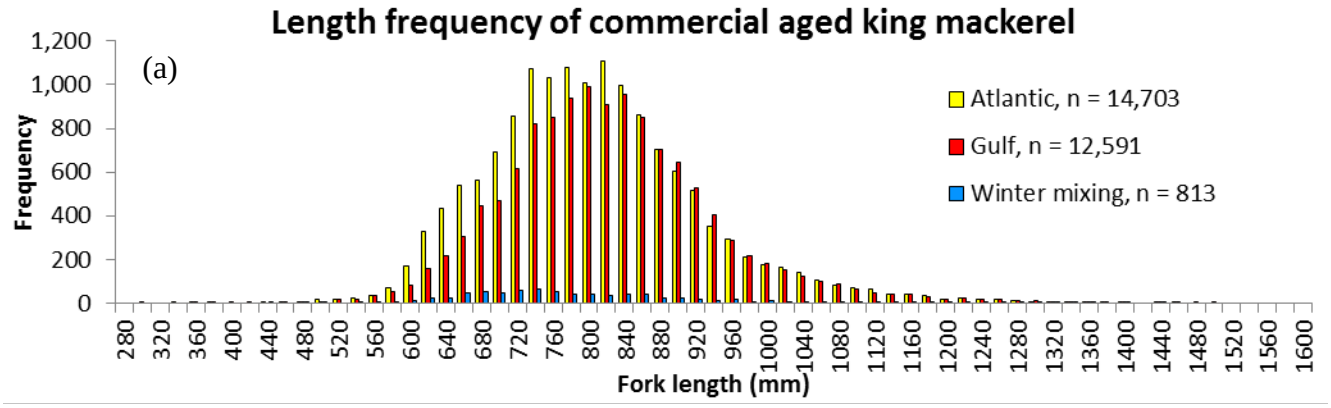
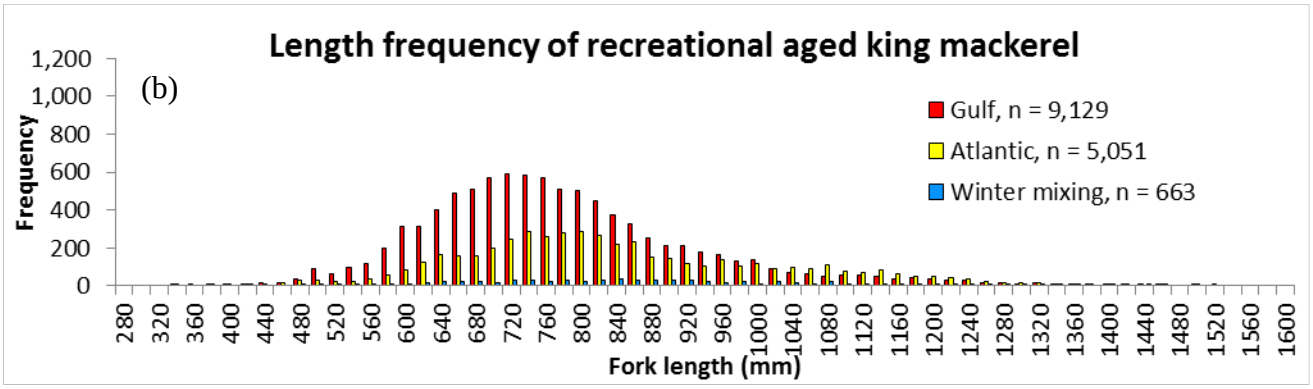


Figure 5. **(UPDATE)** Age frequency distribution of all male king mackerel from the three stocks, aged by NMFS Panama City, fishing years 1985-1986 (incomplete) through 2013-2014 (incomplete).





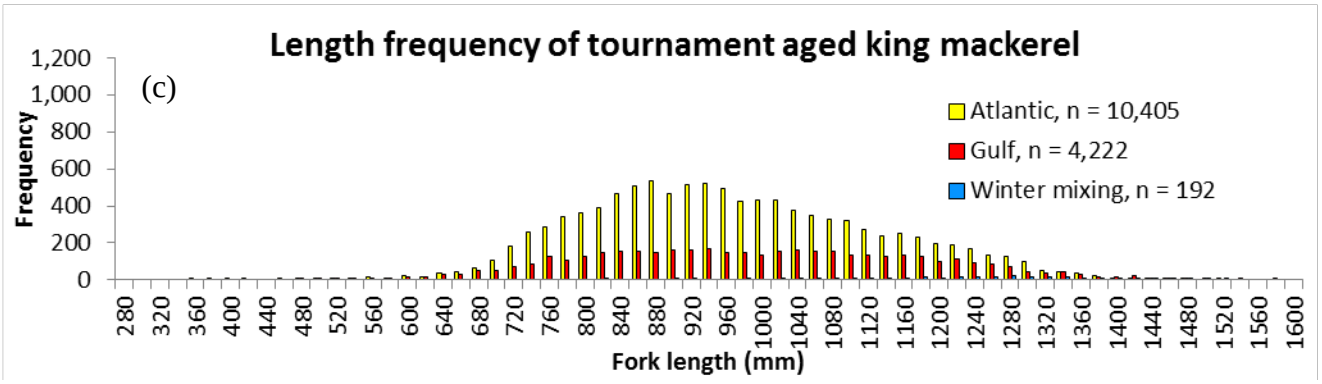


Figure 6. **(UPDATE)** Length frequency distributions of king mackerel commercial (a) 1986-1986 (incomplete) through 2013-2014 (incomplete), (b) recreational 1985-1986 (incomplete) through 2012-2013 (incomplete), and (c) tournament 1986-1987 (incomplete) through 2012-2013 (incomplete), sexes combined, from the three stocks aged by the NMFS PC Lab.

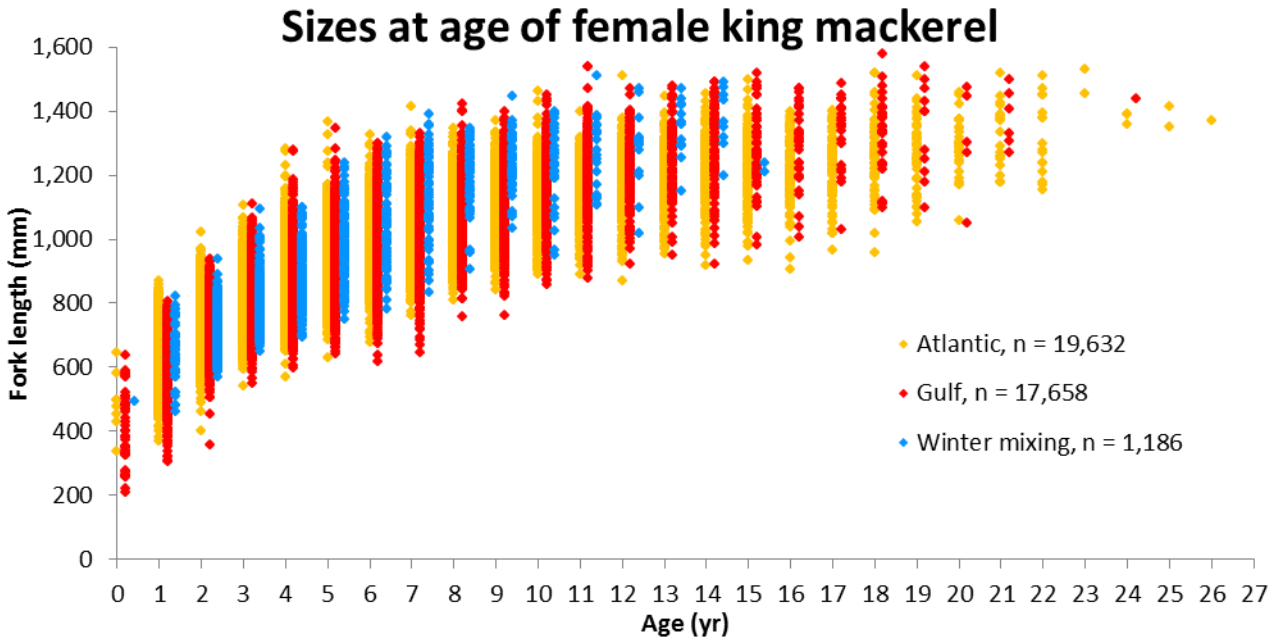


Figure 7. **(UPDATE)** Sizes at age of female king mackerel, 1986 – 2013, from all three stocks, aged by NMFS Panama City.

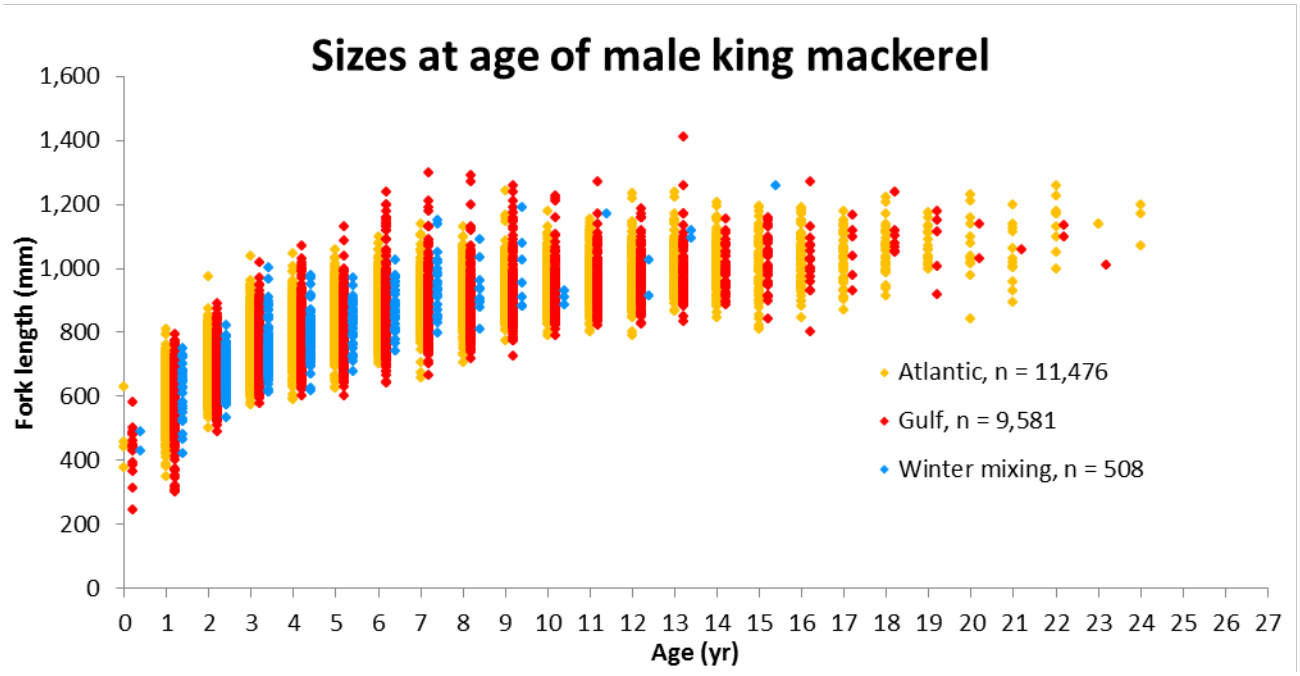


Figure 8. **(UPDATE)** Sizes at age of male king mackerel, 1986 – 2013, from all three stocks, aged by NMFS Panama City.