A review of Gulf of Mexico and Atlantic Spanish mackerel (*Scomberomorus maculatus*) age data, 1987-2011, from the Panama City Laboratory, Southeast Fisheries Science Center, NOAA Fisheries Service

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Introduction

Spanish mackerel, *Scomberomorus maculatus*, range from the western Atlantic Ocean from the Gulf of Maine to the Yucatan Peninsula (Collete et al. 1978). Florida waters embody the majority of the population which is targeted by both the commercial and recreational fishing sectors throughout their range (Trent and Anthony 1978). The Spanish mackerel fishery is managed under the Coastal Migratory Pelagic Resources Fishery Management Plan which includes both the Gulf of Mexico and Atlantic stocks. The principal objective of this report is to give a summary of the age samples of Spanish mackerel along with temporal, spatial, fishery, and gear distributions collected in Atlantic (Massachusetts through Dade County, Florida and south of Highway 1 in Monroe County, FL) and Gulf of Mexico (north of Highway 1 in Monroe County, FL through Mexico) waters from the years 1987 – 2011 (to date) aged by the Panama City Laboratory of the Southeast Fisheries Science Center, NOAA Fisheries Service. Information on quality control procedures is also provided.

Methods

Otolith collection and data proofing

Otoliths were collected 1987 – 2011 by federal and state agencies and academic institutions from both commercial (CM) and recreational (REC) fisheries. Fishery dependent samples were collected from several NMFS programs, including the Trip Interview Program (TIP), Panama City Lab (PCLAB), Beaufort Lab Head Boat Survey (HB), Marine Fisheries Recreational Statistical Survey (MRFSS), Gulf States Marine Fisheries Commission's Recreational Fisheries Independent Network (RECFIN), North Carolina Division of Marine Fisheries (NCDMF), and the Virginia Institute of Marine Science (VIMS). Fishery independent samples were received from NMFS Pascagoula (MSLAB), Mote Marine Laboratory (MML), and the Texas Parks and Wildlife Department (TPWD), and were collected by the NMFS Panama City Lab (PCLAB).

Each of the data collection sources had separate but uniform sampling methods, protocols, and reporting methods. Data quality control guidelines as illustrated by the Panama City Lab's Procedure Manual for Age, Growth, and Reproduction (AGR) (NMFS, 2008) were used to interpret source-specific data sheets. Initially, beginning in 2000, each species specific collection was given an annual collection (or tracking) number and all collection-specific data (i.e. source, source number, state, sector, and gear) were entered in a Microsoft® Access database. Validation rules for data entry and user-specific security for data access guidelines were observed to enhance data quality control. The source (or interview) number is a source-specific number that allows for cross-referencing of data between the original and the Panama City Annual 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 anomalies were resolved by personal contact with samplers or port agents.

To insure uniform rules of quality control, all 1987 – 1997 data, collected prior to the incorporation of written data quality guidelines in 1998, 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 TIP files online.

Sampling trends

Annual numbers of Spanish mackerel otolith samples received and aged at the Panama City lab, 1987 through 2011 (as of the date of this report), were summarized by sector (commercial – CM, and recreational – REC) and, for commercial samples, by gear type (hand-line – HL, and gillnet – GN). Hand-lines included rod and reel gear and trolling methods. Gill nets were characterized 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 did not include tournament (TRN) samples. Tournament samples were most likely by-catch from king mackerel tournaments or other targeted species events.

Sample numbers were also summarized by region (Gulf of Mexico – GOM and Atlantic - ATL) where the fish were caught (not necessarily where they were landed nor

their stock), as well as by sub-region within those regions (Figure 1). Gulf of Mexico sub-regions included Mexico, Texas (some samples before 1993 were classified as North Texas – NTX and South Texas – STX), Louisiana, Mississippi, Alabama, and four areas of the west coast of Florida. 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 north of Highway 1 only). Atlantic sub-regions included south Florida (SF) (Monroe County south of Highway 1 only), southeast Florida (SEF) (Dade through Broward County), east Florida (EF) (Palm Beach through Volusia County), northeast Florida (NEF) (Flagler County to the Florida – Georgia border), and the coastal states of Georgia north to Virginia, and Massachusetts.

Age determination and estimates of precision

All ages were derived from sagittal otoliths. Otoliths from males < 45 cm FL and females < 55 cm FL were read whole; larger fish were aged using sections. Annuli of whole and sectioned otoliths were identified using the methods of Fable et al. (1987) and those used for king mackerel (DeVries and Grimes 1997). All Spanish mackerel collected prior to the 2001-02 fishing season were aged by Reader 1 (D. DeVries). Reader 2 (C. Palmer) became the primary ager of all samples thereafter and Reader 3 (C. Fioramonti) became the primary ager of sectioned otoliths in 2008. Three indices of precision – average percent error (APE), coefficient of variation (CV), and precision (D) – were calculated from whole otolith ages of 100 fish from 2010 aged by both Readers 1 and 2 and from sectioned otolith ages of 100 fish from 2008 read by both Reader 2 and Reader 3 to check for consistency and precision between readers. The goal was to achieve an APE of < 5.0%. See Palmer et al. (2007) for further discussion on ageing precision.

Annual ages, based on calendar year, were calculated using the annulus count, edge-type, and capture date. Typically annuli are deposited in the spring (Fable et al. 1987), and advancing ages is often necessary for fish captured that time of year to

designate fish into the correct cohort (DeVries and Grimes 1997). Protocols for advancing ages were the same as that used for the closely related king mackerel: 1) fish sampled January – May with marginal increments estimated to be > 35% of the previous increment were advance one year; and 2) otoliths sampled June – July 15th with > 2 annuli and a marginal increment > 35% of the previous increment were advanced one year. Otoliths with 2 or fewer annuli sampled during the same were advanced one year only if the marginal increment was > 70% of the previous one. This different standard for younger fish was necessary because their overall annual growth is much greater and their growth rate is faster than in older fish, and it is common for them to already have relatively large marginal increments as early as June. Ages were not advanced for fish sampled July 16th through the end of the calendar year (DeVries and Grimes 1997).

Results and Discussion

Sampling trends

A total of 29,168 (n = 16,667 ATL, n = 12,501 GOM) Spanish mackerel collected during 1987 - 2011 have been aged by the Panama City Laboratory. Of those aged, 49% were from the commercial sector, 33% from the recreational sector (CP, HB, and PR combined), 10% from scientific surveys, 4% from tournaments, and 4% from unknown sectors (Table 1). The Trip Interview Program was the largest source of samples (45%), followed by the North Carolina Division of Marine Fisheries (23%), and the Panama City Lab (13%) (Table 2). Atlantic samples came primarily from east Florida (46%) and North Carolina (42%) (Table 3). The majority of Gulf samples were from northwest Florida (45%) and south Florida (16%) (Table 4).

Of the Atlantic commercial samples, the bulk (69%) came from east Florida, followed by North Carolina (22%) (Table 5). South Florida (46%), Louisiana (18%), and Mexico (15%) were the main sources of commercial samples in the Gulf (Table 6). North Carolina (92%) provided an overwhelming proportion of Atlantic recreational samples, excluding tournament fish, followed by South Carolina (4%) and east Florida (3%) (Table 7). Most Gulf recreational samples came from northwest Florida (62%),

west Florida (17%), and Mississippi (12%) (Table 8). Of all tournament fish samples (Atlantic and Gulf combined), 41% came from Georgia, 26% from Louisiana, and 15% from North Carolina (Table 9).

Commercial Spanish mackerel age samples (Atlantic and Gulf combined) came primarily from gill-net (59%) and hand-line (17%) fisheries (Table 10). Within regions, 59% of Atlantic commercial samples were from gill-net fisheries, 13% from hand-line, and 12% from cast-net (Table 11); in the Gulf they were mainly from gill-net (61%) and hand-line (31%) fisheries (Table 12).

Age determination and estimates of precision

The reader comparison between Readers 1 and 2 for the whole otoliths aged from 2010 yielded an APE of 7.94%, CV of 11.24%, and a resulting index of precision (D) of 5.61%, reflecting low reader error. Analysis of the sectioned otoliths comparison between Readers 2 and 3 from data year 2008 yielded an APE of 0.72%, CV of 1.02%, and a corresponding D of 0.51%, indicating low reader error / high precision.

Age and length composition

Spanish mackerel collected during 1987 – 2011 and aged by the NMFS Panama City Lab ranged in age from 0 to 11 yr, with the majority (Atlantic 90%, Gulf 89%) between 0 and 4 yr (Figure 2). Females from the Atlantic and Gulf ranged in age from 0 to 11 yr. Atlantic males ranged from 0 to 11 yr and Gulf males from 0 to 10 yr. Ninety percent of both Atlantic females and males and 89% of both Gulf females and males were ages 0 to 4 yr (Figures 3 and 4).

The size ranges of Atlantic and Gulf commercial age samples were similar, although the mode of the Gulf samples was ~100 mm larger than that for the Atlantic (500-550 vs 400-450 mm FL) (Figure 5). Recreational (charter boat - CP, head boat - HB, and private-PR combined) size distributions from the two regions showed similar modes around 400 mm, but the proportion of fish >400 mm was much higher in the Gulf (Figure 6). The size distributions of tournament fish differed considerably between the

Gulf and Atlantic. Modal size of Gulf fish was 550-600 mm FL compared to 400 mm for Atlantic fish (Figure 7).

The size ranges of Atlantic commercial (N = 10,699) and recreational (N = 3,972) Spanish mackerel age samples were similar (~250 – 700 mm / 9.8 – 27.6 in), and modal sizes were only slightly different (CM: 350-400 mm vs REC: 400-450 mm) (Figure 8a). However, the proportion of larger fish (>400 mm FL) was much higher (62 vs 28%) in the commercial samples. The size ranges of Gulf commercial (N = 3,548) and recreational (N = 5,733) Spanish mackerel age samples were similar (~300 – 650 mm / 011.8 – 25.6 in), but modal sizes of recreational samples were ~100 mm smaller than that of commercial samples (400 vs 500-550 mm) (Figure 8b).

Size ranges at age, and more importantly, mean observed lengths at age, were very similar for both Atlantic and Gulf regions for both sexes, suggesting very similar growth rates (Figures 9-12). Low sample sizes for females > 7 yr and males >8 yr made interpretation of growth patterns of these older fish problematic (Figures 11 and 12). Female sizes at age averaged about 50-75 mm larger than males from ages 2-8 in both the Gulf and Atlantic (Figures 13 and 14).

Recreationally-caught females from the Atlantic, ages 4 -10, averaged 53 mm larger at age than those from commercial catches, probably reflecting differences in selectivity and/or spatial distribution of the samples (Table 13, Figures 15a). Atlantic males showed the opposite pattern, with observed mean size at age consistently smaller (mean difference = 22 mm) in recreational than commercial samples for ages 1 – 5 (Table 13, Figure 15b). It's not clear why the patterns would be opposite between sexes, but it may be related to the smaller maximum sizes of males in combination with gear selectivity. Above age 5 small sample sizes made comparisons questionable at best. In Gulf samples both sexes showed the same pattern observed in Atlantic males, i.e., recreationally-caught fish consistently averaged smaller than commercial for females ages 2-8 (mean diff =17 mm) and males ages 2-6 (mean diff = 26 mm) (Table 13, Figures 15c,d).

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Table 1. Annual numbers of Spanish mackerel, 1987 – 2011, by sector, aged by NMFS Panama City. CM – commercial, REC – recreational (charter boat, head boat, and private combined), SS- scientific survey, TRN – tournament, Unk – incomplete data.

Year	CM	REC	SS	TRN	Unk	Total
1987		326	59	26	226	637
1988	35	251	75	82	42	485
1989	117	252	27	181	227	804
1990	646	713	24	191	147	1,721
1991	579	387	322	271	4	1,563
1992	1,165	439	57	90	74	1,825
1993	492	183	144	96		915
1994	507	272	26	58	1	864
1995	464	178	62	69		773
1996	737	326	15	20		1,098
1997	346	426	4	2	26	804
1998	537	348	6	9	3	903
1999	630	578	58	19	12	1,297
2000	817	283	8	1	104	1,213
2001	796	154	44	14		1,008
2002	1,310	633	162	4	1	2,110
2003	349	821	86	91		1,347
2004	561	580	143	2	2	1,288
2005	554	262	177		77	1,070
2006	580	388	156			1,124
2007	459	390	206	1		1,056
2008	692	581	417	25		1,715
2009	771	149	365	5		1,290
2010	445	506	103	19	5	1,078
2011	658	279	39			976
Unknown					204	204
Total	14,247	9,705	2,785	1,276	1,155	29,168
% of Total	48.84%	33.27%	9.55%	4.37%	3.96%	100.00%

Table 2. Annual numbers of Spanish mackerel, 1987 – 2011, by source, aged by NMFS Panama City. TIP - Trip Interview Program, NCDMF - North Carolina Division of Marine Fisheries, PCLAB - NMFS Panama City Lab, Unk - incomplete data sheet, VIMS - Virginia Institute of Marine Science, MRFSS - Marine Fisheries Recreational Statistical Survey, RECFIN - Gulf States Marine Fisheries Commission's Statistical Survey, MML - Mote Marine Laboratory, HB - Beaufort Head Boat Survey, TPWD - Texas Parks and Wildlife Department, MSLAB - NMFS Pascagoula.

Year	TIP	NCDMF	PCLAB	MRFSS	VIMS	RECFIN	MML	HB	TPWD	MSLAB	Unk	Total
1987			83								554	637
1988	32		80				24		8		341	485
1989			95								709	804
1990	54	379	252								1,036	1,721
1991	1,236	306	1								20	1,563
1992	1,298	453									74	1,825
1993	647	268										915
1994	682	182										864
1995	602	171										773
1996	984	114										1,098
1997	401	403										804
1998	485	418										903
1999	665	273		359								1,297
2000	528	458	123		104							1,213
2001	364	485	127	32								1,008
2002	372	333	295	132	853	125						2,110
2003	325	318	526	178								1,347
2004	527	280	228	82		168		3				1,288
2005	542	285	204	5		34						1,070
2006	578	277	254			11		4				1,124
2007	377	294	352	12		21						1,056
2008	692	322	523	81		97						1,715
2009	767	299	193	11		11		2		7		1,290
2010	381	394	133	42		128						1,078
2011	658		279	35		4						976
Unknown											204	204
Total	13,197	6,712	3,748	969	957	599	24	9	8	7	2,938	29,168
% of Total	45.24%	23.01%	12.85%	3.32%	3.28%	2.05%	0.08%	0.03%	0.03%	0.02%	10.07%	100.00%

Table 3. Annual numbers of Spanish mackerel from the Atlantic, 1987 – 2011, by sub-region, aged by NMFS Panama City. NEF - northeast Florida, EF - east Florida, SEF - southeast Florida, SF - south Florida; south of US Highway 1.

	Atlantic Mackerel States									
Year	MA	VA	NC	SC	GA	NEF	EF	SEF	SF	Total
1987			67	28	59		104			258
1988			91	62	25		6			184
1989			7	30	171					208
1990	21		412	28	72		42			575
1991	40		328	11	210		60			649
1992	37		553	93	36		85			804
1993			268	31			164			463
1994			182				22			204
1995			171				165			336
1996			114				450			564
1997			403				280			683
1998			418				331			749
1999			273				459			732
2000		104	458				468			1,030
2001			485				315			800
2002		853	333			2	395			1,583
2003			318				328			646
2004			280				512	2		794
2005			285				413			698
2006			277				492	4	75	848
2007			294				368	4	1	667
2008			322				671			993
2009			299				732	1		1,032
2010			394				341		1	736
2011							431			431
Total	98	957	7,032	283	573	2	7,634	11	77	16,667
% of Total	0.59%	5.74%	42.19%	1.70%	3.44%	0.01%	45.80%	0.07%	0.46%	100.00%

Table 4. Annual numbers of Spanish mackerel from the Gulf, 1987 – 2011, by sub-region, aged by NMFS Panama City. NTX - north Texas, SF - south Florida; north of US Highway 1, STX - south Texas, SWF – southwest Florida.

	Gulf Mackerel States											
Year	SF	SWF	WF	NWF	AL	MS	LA	NTX	TX	STX	MEX	Total
1987				83	102	71	53	42		28		379
1988	32			80	17	110	21		17		24	301
1989	68			93		181	8			129	117	596
1990	252			224		391	95	3	1	52	128	1,146
1991	43		94	370			207	5	72	23	100	914
1992	445			221	14		124	1	33		183	1,021
1993	11	72	4	116	1		145		4		99	452
1994	405		19	125			62				49	660
1995	199	1	11	163			63					437
1996	251		15	268								534
1997	2		1	118								121
1998		6		142		6						154
1999	4		18	191	9	343						565
2000	13			162	8							183
2001	24	23	26	119		14	2					208
2002	3	12	213	299								527
2003	9	12	146	534								701
2004	20	7	221	246								494
2005	37	47	35	225			28					372
2006			3	262			11					276
2007			33	352			4					389
2008			143	569			10					722
2009	1		18	197		2	37		3			258
2010	1		103	201			37					342
2011	3		75	279			188					545
Unknown	204											204
Total	2,027	180	1,178	5,639	151	1,118	1,095	51	130	232	700	12,501
% of Total	16.21%	1.44%	9.42%	45.11%	1.21%	8.94%	8.76%	0.41%	1.04%	1.86%	5.60%	100.00%

Table 5. Annual numbers of Spanish mackerel from Atlantic commercial samples, 1990 – 2011, by sub-region, aged by NMFS Panama City. EF - east Florida, SEF - southeast Florida, SF - south Florida; south of US Highway 1.

	Atlantic Mackerel States						
Year	VA	NC	SC	EF	SEF	SF	Total
1990		111		41			152
1991		154		49			203
1992		375	53	85			513
1993		71		164			235
1994		10		22			32
1995		56		163			219
1996		37		449			486
1997		76		265			341
1998		196		331			527
1999		169		459			628
2000		328		468			796
2001		433		314			747
2002	853	90		354			1,297
2003		2		311			313
2004		40		503	1		544
2005		13		400			413
2006		2		492		75	569
2007		68		368	4		440
2008				670			670
2009		4		732			736
2010		66		341			407
2011				431			431
Total	853	2,301	53	7,412	5	75	10,699
% of Total	7.97%	21.51%	0.50%	69.28%	0.05%	0.70%	100.00%

Table 6. Annual numbers of Spanish mackerel from Gulf commercial samples, 1988 – 2011, by sub-region, aged by NMFS Panama City. SF - south Florida; north of US Highway 1, SWF - southwest Florida, WF - west Florida, NWF - northwest Florida.

	Gulf Mackerel States									
Year	SF	SWF	WF	NWF	AL	MS	LA	STX	MEX	Total
1988	32					3				35
1989				4		113				117
1990	222			11		148			113	494
1991	35		94				146	1	100	376
1992	385						84		183	652
1993	11	72					75		99	257
1994	403		11				12		49	475
1995	199			40			6			245
1996	251									251
1997	2			3						5
1998		6		4						10
1999	2									2
2000	13				8					21
2001	24	23					2			49
2002	1	12								13
2003	7			29						36
2004	17									17
2005	37	47	29				28			141
2006							11			11
2007				15			4			19
2008			12				10			22
2009							35			35
2010			1				37			38
2011			39				188			227
Total	1,641	160	186	106	8	264	638	1	544	3,548
% of Total	46.25%	4.51%	5.24%	2.99%	0.23%	7.44%	17.98%	0.03%	15.33%	100.00%

Table 7. Annual numbers of Spanish mackerel from Atlantic recreational samples, 1987 – 2010, by sub-region, aged by NMFS Panama City. NEF - northeast Florida, EF - east Florida, SEF - southeast Florida, SF - south Florida ; south of US Highway 1.

	Atlantic Mackerel States							
Year	NC	SC	GA	NEF	EF	SEF	SF	Total
1987	57	20	29		18			124
1988	90	19			6			115
1989	4	30						34
1990	253	18						271
1991	173	8			11			192
1992	162	36						198
1993	75	29						104
1994	171							171
1995	68				2			70
1996	77				1			78
1997	316							316
1998	219							219
1999	89							89
2000	130							130
2001	49							49
2002	162			2	40			204
2003	218				17			235
2004	229				9	1		239
2005	191				13			204
2006	251					4		255
2007	182						1	183
2008	178				1			179
2009	36					1		37
2010	275						1	276
Total	3,655	160	29	2	118	6	2	3,972
% of Total	92.02%	4.03%	0.73%	0.05%	2.97%	0.15%	0.05%	100.00%

Table 8. Annual numbers of Spanish mackerel from Gulf recreational samples, 1987 – 2011, by sub-region, aged by NMFS Panama City. SF - south Florida ; north of US Highway 1, SWF - southwest Florida, WF - west Florida, NWF - northwest Florida.

	Gulf Mackerel States										
Year	SF	SWF	WF	NWF	AL	MS	LA	NTX	TX	STX	Total
1987				24	76	65		16		21	202
1988				1		107	21		7		136
1989				59		47	2			110	218
1990	29			189		126	44	3	1	50	442
1991	8			88			2	4	71	22	195
1992	1			199			7	1	33		241
1993				75					4		79
1994	2			99							101
1995				108							108
1996				248							248
1997				110							110
1998				129							129
1999	2		18	135	9	325					489
2000				153							153
2001			26	79							105
2002	2		213	214							429
2003	2	12	143	429							586
2004	3	7	219	112							341
2005			6	52							58
2006			3	130							133
2007			33	174							207
2008			131	271							402
2009	1		18	93							112
2010	1		102	127							230
2011	3		36	240							279
Total	54	19	948	3,538	85	670	76	24	116	203	5,733
% of Total	0.94%	0.33%	16.54%	61.71%	1.48%	11.69%	1.33%	0.42%	2.02%	3.54%	100.00%

Table 9. Annual numbers of Spanish mackerel from Atlantic and Gulf tournament samples, 1987 – 2010, by sub-region, aged by NMFS Panama City. SWF - southwest Florida, WF - west Florida, NWF - northwest Florida.

Year	NC	SC	GA	SWF	WF	NWF	AL	MS	LA	TX	STX	Total
1987	1	6	19									26
1988	1	43	18			1	17			2		82
1989			171						6		4	181
1990	28	10	72					28	51		2	191
1991		1	210						59	1		271
1992	2	4	36			1	14		33			90
1993	21				4		1		70			96
1994					8				50			58
1995				1	11				57			69
1996					15	5						20
1997					1	1						2
1998						3		6				9
1999	5							14				19
2000						1						1
2001								14				14
2002						4						4
2003	86				3	2						91
2004	2											2
2007	1											1
2008	25											25
2009	5											5
2010	19											19
Total	196	64	526	1	42	18	32	62	326	3	6	1,276
% of Total	15.36%	5.02%	41.22%	0.08%	3.29%	1.41%	2.51%	4.86%	25.55%	0.24%	0.47%	100.00%

Table 10. Annual numbers of commercial Spanish mackerel (Atlantic and Gulf combined) samples, 1988 – 2011, by gear type aged by NMFS Panama City. GN - gill net, HL - hand-lines, CN - cast net, Unk - incomplete data sheet, TRW - trawl, LH - long haul, PN - pound net, SN - seine net, Other - sink net and trammel net combined.

Year	GN	HL	CN	TRW	LH	PN	SN	Other	Unk	Total
1988	32	3								35
1989		117								117
1990	325	201		113		6	1			646
1991	373	177		1			27		1	579
1992	698	198		145	36	28			60	1,165
1993	328	63		16	27				58	492
1994	462	29							16	507
1995	380	43		14	7	20				464
1996	660	43			34					737
1997	246	24	34	20	18	4				346
1998	363	41		2	81	50				537
1999	447	122				23	4	34		630
2000	609	147	3	4	54					817
2001	352	254	110		20	60				796
2002	336	74		12			35		853	1,310
2003	313	36								349
2004	536	7		16		2				561
2005	249	33	260		12					554
2006	356	11	211		2					580
2007	213	196	50							459
2008	286	207	199							692
2009	301	139	331							771
2010	269	38	138							445
2011	305	259	94							658
Total	8,439	2,462	1,430	343	291	193	67	34	988	14,247
% of Total	59.23%	17.28%	10.04%	2.41%	2.04%	1.35%	0.47%	0.24%	6.93%	100.00%

Table 11. Annual numbers of Spanish mackerel from Atlantic commercial samples, 1990 – 2011, by gear type, aged by NMFS Panama City. GN - gill net, HL - hand-lines, CN - cast net, Unk - incomplete data sheet, LH - long haul, TRW - trawl, PN - pound net, SN - seine net, Other - sink net, trammel net, and spear combined.

	Atlantic Commercial Gear Types									
Year	GN	HL	CN	TRW	LH	PN	SN	Other	Unk	Total
1990	80	41		24		6	1			152
1991	175						27		1	203
1992	190	81		118	36	28			60	513
1993	150				27				58	235
1994	10	6							16	32
1995	167	25			7	20				219
1996	417	35			34					486
1997	246	19	34	20	18	4				341
1998	363	31		2	81	50				527
1999	447	120				23	4	34		628
2000	588	147	3	4	54					796
2001	315	242	110		20	60				747
2002	336	61		12			35		853	1,297
2003	313									313
2004	524	2		16		2				544
2005	249	5	147		12					413
2006	356		211		2					569
2007	213	177	50							440
2008	286	185	199							670
2009	301	104	331							736
2010	269		138							407
2011	268	69	94							431
Total	6,263	1,350	1,317	196	291	193	67	34	988	10,699
% of Total	58.54%	12.62%	12.31%	1.83%	2.72%	1.80%	0.63%	0.32%	9.23%	100.00%

Table 12. annual numbers of Spanish mackerel from Gulf commercial samples, 1988 – 2010, by gear type, aged by NMFS Panama City. GN - gill net, HL - hand lines, TRW - trawl net.

	Gulf Commercial Gear Types				
Year	GN	HL	TRW	CN	Total
1988	32	3			35
1989		117			117
1990	245	160	89		494
1991	198	177	1		376
1992	508	117	27		652
1993	178	63	16		257
1994	452	23			475
1995	213	18	14		245
1996	243	8			251
1997		5			5
1998		10			10
1999		2			2
2000	21				21
2001	37	12			49
2002		13			13
2003		36			36
2004	12	5			17
2005		28		113	141
2006		11			11
2007		19			19
2008		22			22
2009		35			35
2010		38			38
2011	37	190			227
Total	2,176	1,112	147	113	3,548
% of Total	61.33%	31.34%	4.14%	3.18%	100.00%

Table 13. Mean observed fork length (FL) at age in mm and standard error for commercially- and recreationally- caught female and male Spanish mackerel (1987-2011) aged by NMFS Panama City.

Commercial

	Females						Males					
	Atlantic			Gulf			Atlantic			Gulf		
Age	N	Mean	Std. Err.	N	Mean	Std. Err.	N	Mean	Std. Err.	N	Mean	Std. Err.
0	425	341.0	1.76	41	305.0	4.67	352	332.2	1.64	24	310.3	6.72
1	1,701	386.1	1.22	278	365.9	2.92	1,016	359.2	1.27	212	338.2	2.16
2	1,502	444.1	1.38	450	455.4	2.75	928	412.9	1.56	300	409.7	2.98
3	1,108	475.0	1.81	670	507.2	2.28	760	444.9	2.09	304	454.0	3.19
4	799	516.6	2.22	485	539.6	2.47	582	471.8	2.64	193	487.0	3.87
5	413	534.9	3.16	226	558.3	3.82	328	491.7	3.83	123	513.3	4.09
6	189	559.6	5.12	78	578.2	5.77	146	510.4	5.73	53	529.6	5.96
7	87	573.4	6.84	48	582.0	7.85	63	532.4	7.28	23	522.5	8.45
8	29	590.2	10.37	7	566.3	18.04	30	541.9	8.90	12	547.9	17.58
9	9	625.8	12.86	2	614.5	20.50	14	532.2	12.07	6	570.3	10.34
10	5	595.6	16.00				5	543.9	23.50			
11				1	592.0	0.00						

Recreational

	Females						Males					
	Atlantic			Gulf			Atlantic			Gulf		
Age	N	Mean	Std. Err.	N	Mean	Std. Err.	N	Mean	Std. Err.	N	Mean	Std. Err.
0	148	328.1	2.92	215	329.9	2.27	116	313.6	3.50	98	315.8	5.86
1	1,165	362.6	1.14	1,204	375.1	1.34	1,089	341.3	0.90	721	346.4	2.16
2	319	430.6	3.09	854	438.9	1.88	295	391.8	2.31	594	383.6	2.38
3	159	475.9	5.35	666	477.4	2.50	124	414.0	4.19	348	417.3	3.11
4	136	550.0	6.21	381	524.0	3.32	56	452.1	8.47	196	465.2	4.14
5	72	603.5	7.82	168	541.6	5.48	24	473.8	10.94	115	481.0	5.41
6	38	602.8	10.38	68	563.5	8.00	18	508.7	16.14	46	517.0	8.55
7	25	644.0	17.25	17	571.6	13.24	15	540.0	18.23	11	530.8	17.49
8	16	648.5	25.46	6	549.8	31.78	4	568.3	38.79	6	525.5	23.68
9	3	666.7	31.93	1	690.0	0.00	1	475.0	0.00			
10	2	677.5	42.50							2	550.0	41.01
11	2	742.0	18.00				1	555.0	0.00			

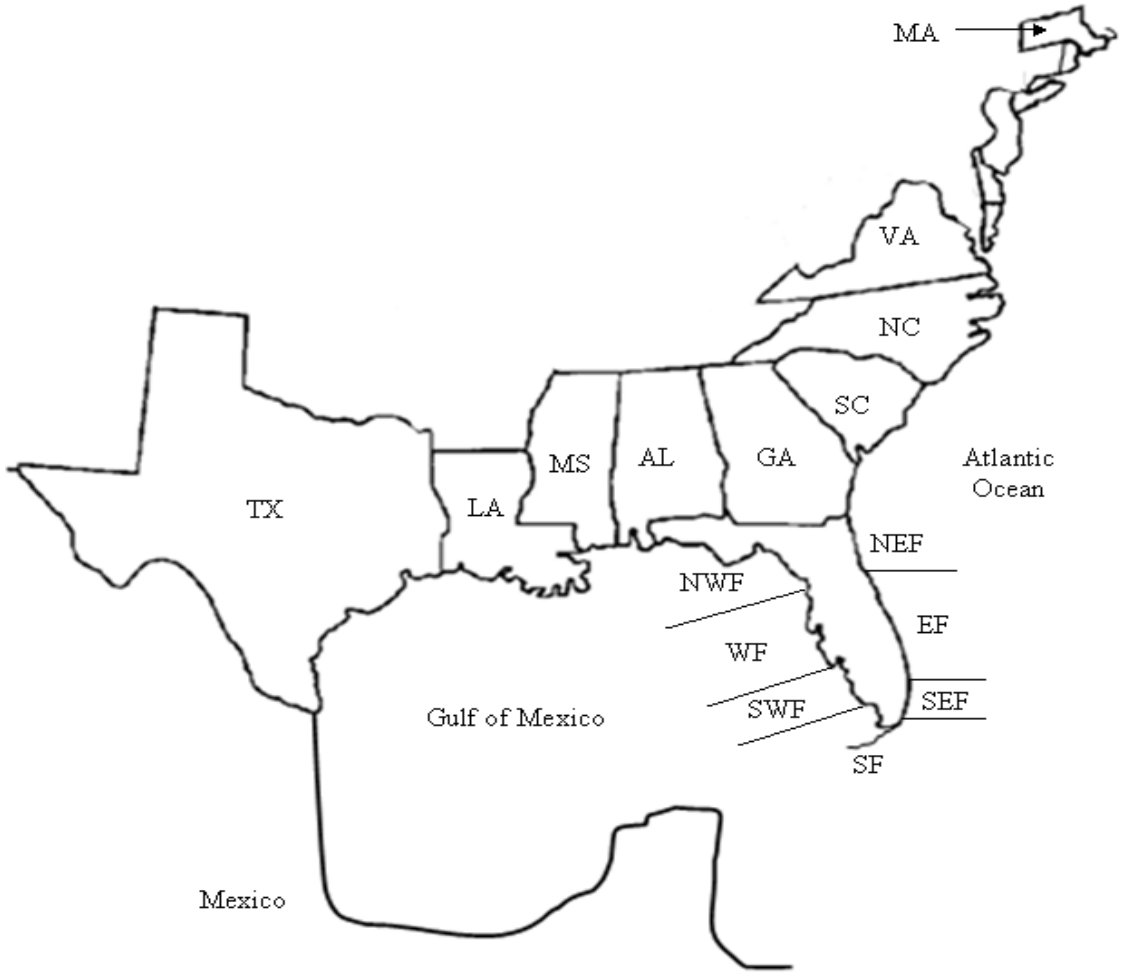

Figure 1. Mackerel sampling sub-regions (states and sub-area of Florida): NWF – northwest Florida, WF – west Florida, SWF – southwest Florida, SF – south Florida, SEF – southeast Florida, EF - east Florida, NEF – northeast Florida.

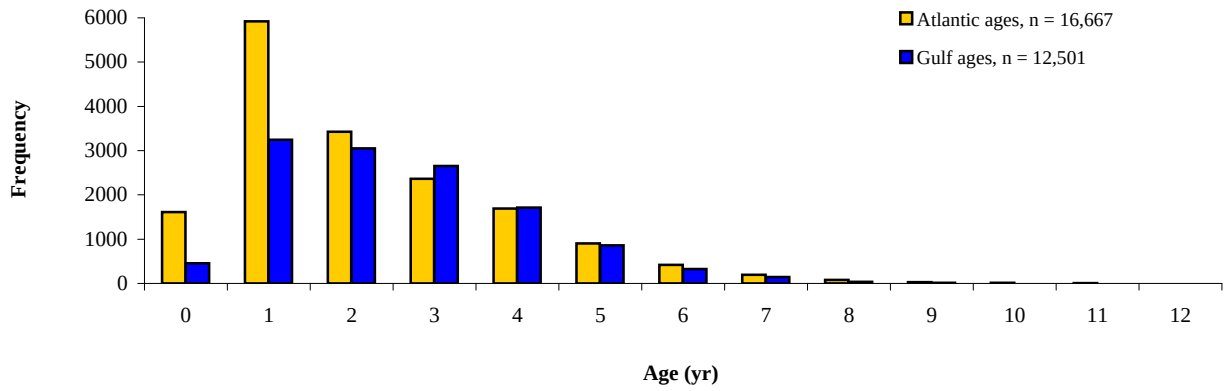

Figure 2. Age disttribution of Spanish mackerel from the Atlantic and Gulf (1987 - 2011) aged by NMFS Panama City.

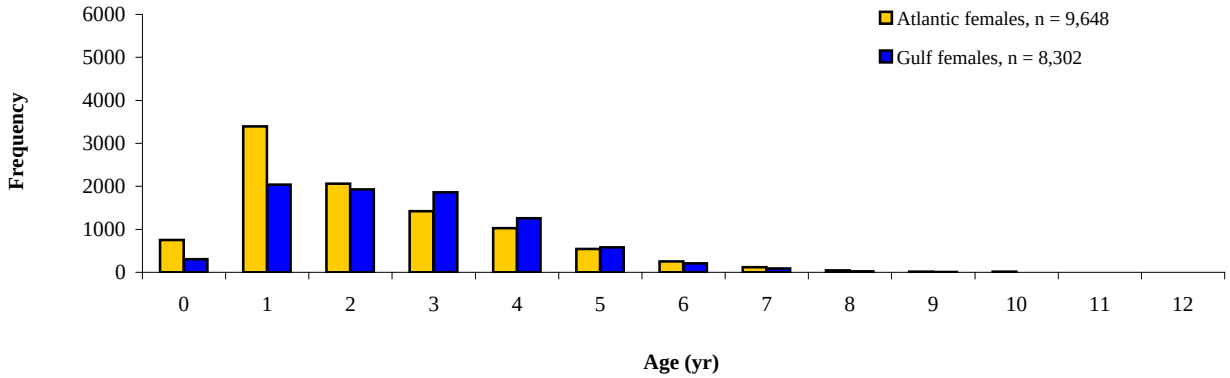

Figure 3. Age distribution of female Spanish mackerel from the Atlantic and Gulf (1987 - 2011) aged by NMFS Panama City.

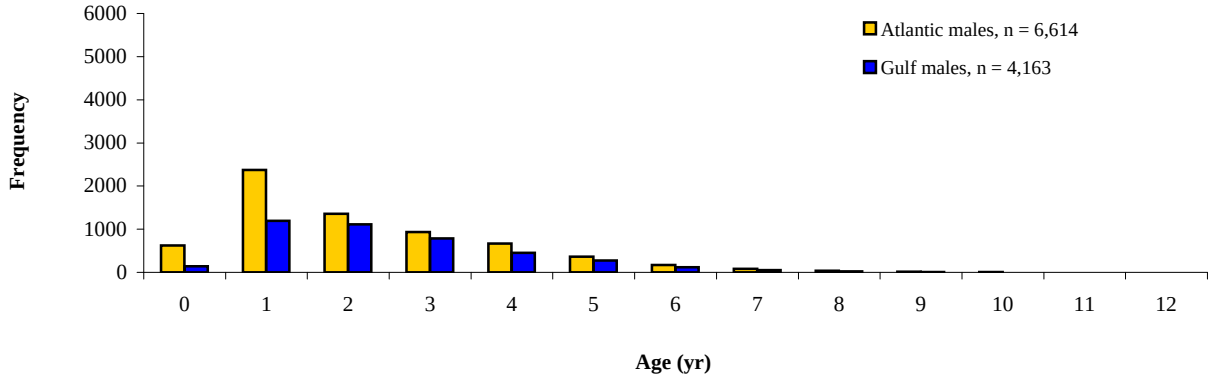

Figure 4. Age distribution of male Spanish mackerel from the Atlantic and Gulf (1987 - 2011) aged by NMFS Panama City.

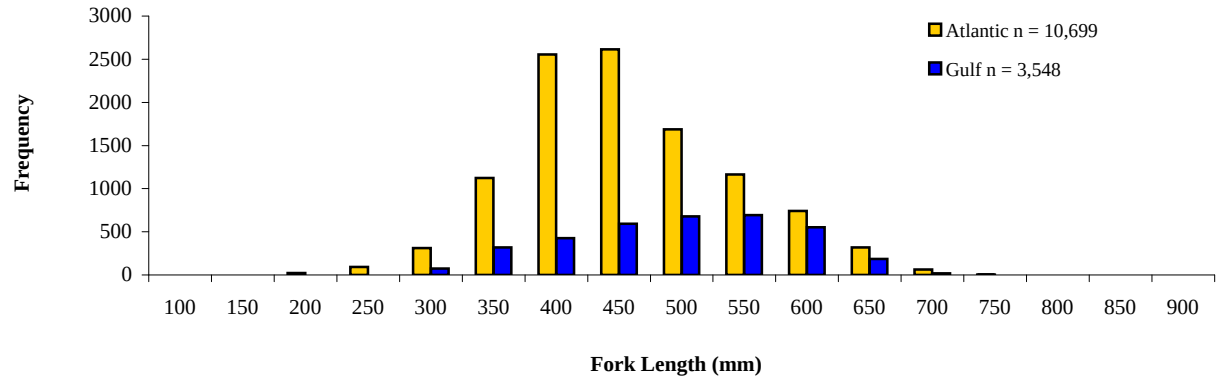

Figure 5. Size distributions of Spanish mackerel from the Atlantic and Gulf commercial sectors, (1988 - 2011), aged by NMFS Panama City.

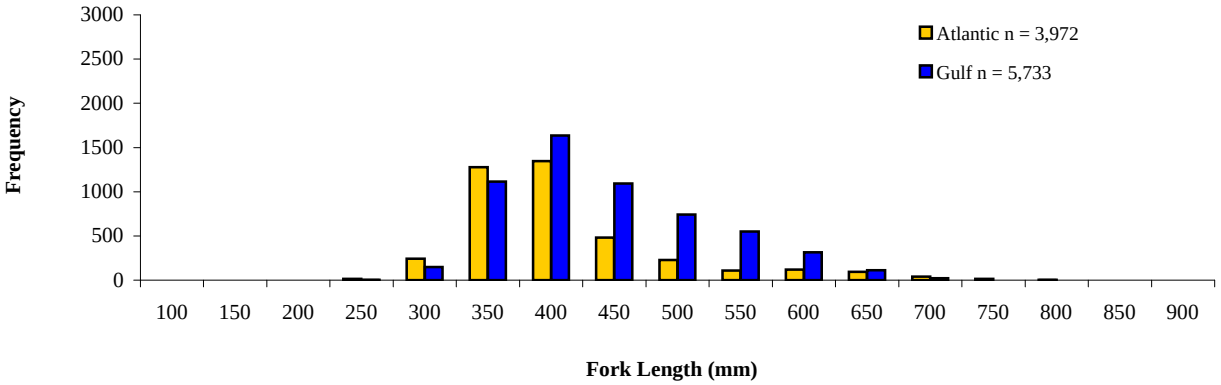

Figure 6. Size distributions of Spanish mackerel from the Atlantic and Gulf recreational sectors, (1987 - 2011), aged by NMFS Panama City.

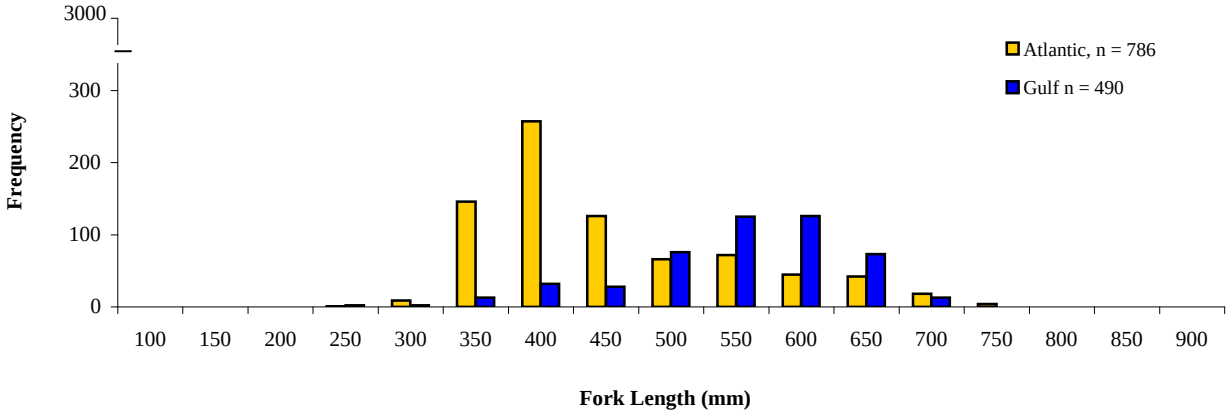

Figure 7. Size distributions of Spanish mackerel from the Atlantic and Gulf tournament sectors, (1987 - 2010), aged by NMFS Panama City.

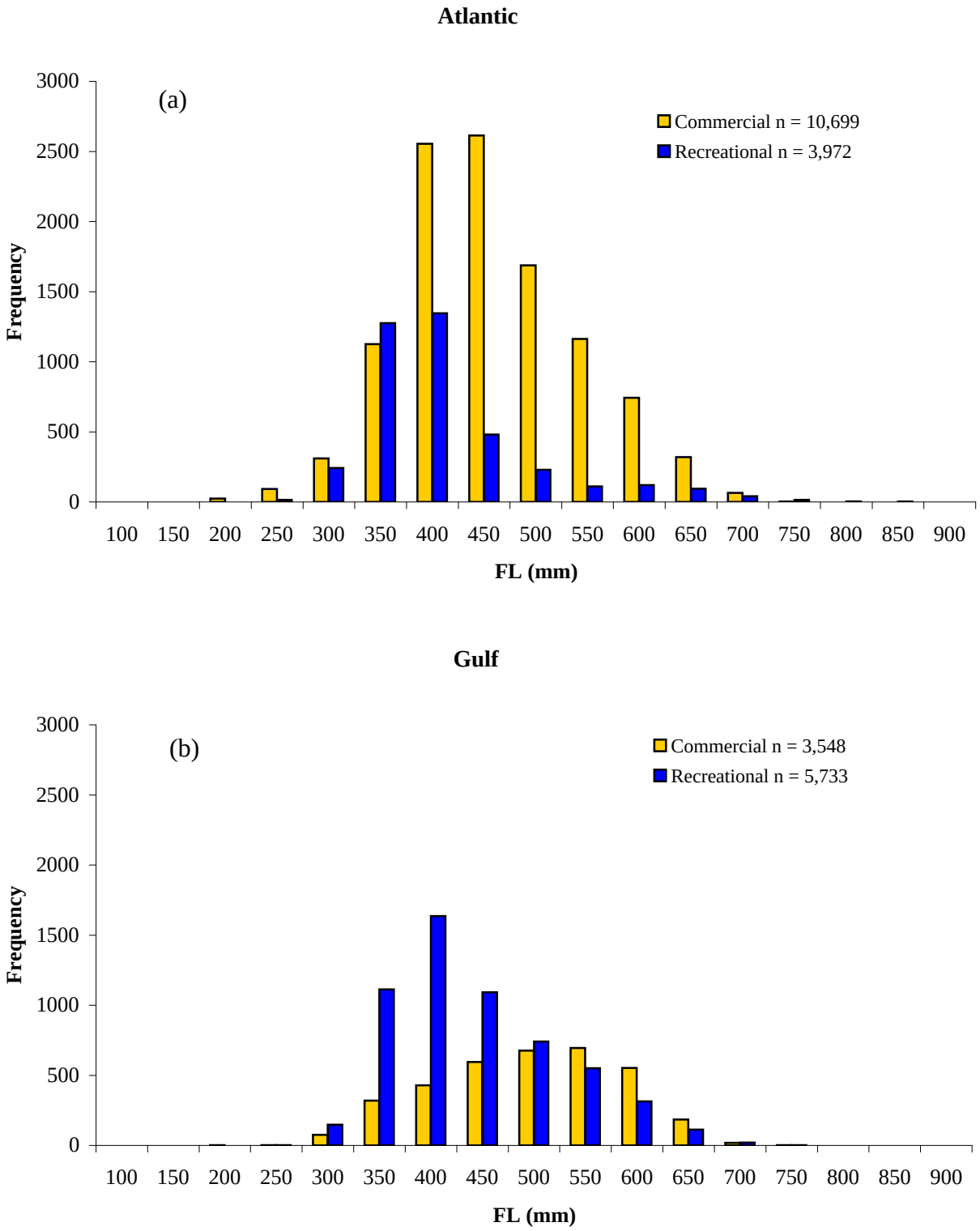

Figure 8. Size distributions of Spanish mackerel from commercial and recreational sectors (1987 (1987 - 2011) aged by NMFS Panama City. Panel (a) Atlantic samples, (b) Gulf of Mexico samples.

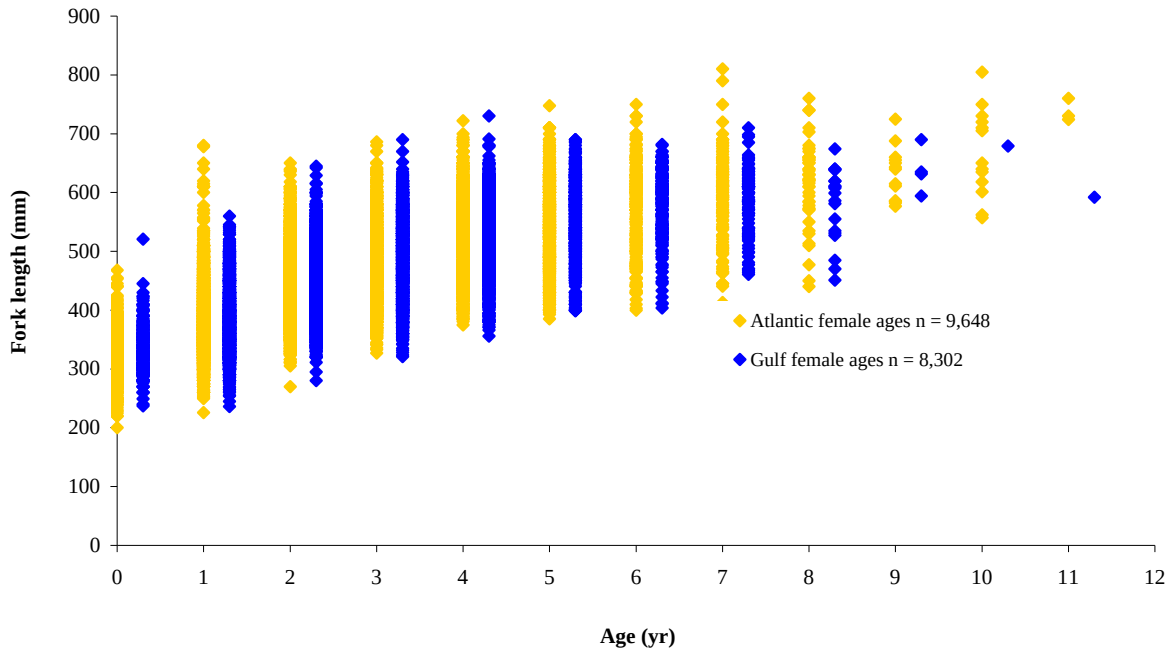

Figure 9. Sizes at age of female Spanish mackerel from the Atlantic and Gulf (1987 - 2011) aged by NMFS Panama City.

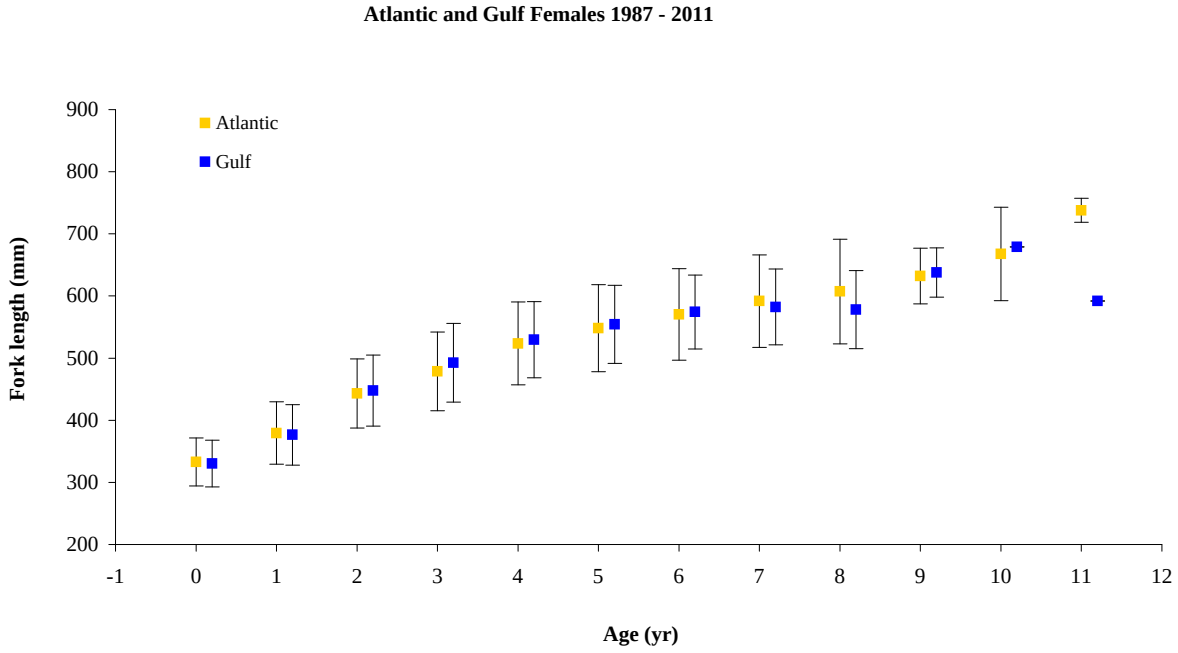

Figure 10. Mean size at age of female Spanish mackerel from the Atlantic and Gulf (1987 - 2011) aged by NMFS Panama City. Error bars are +/- 1 standard deviation.

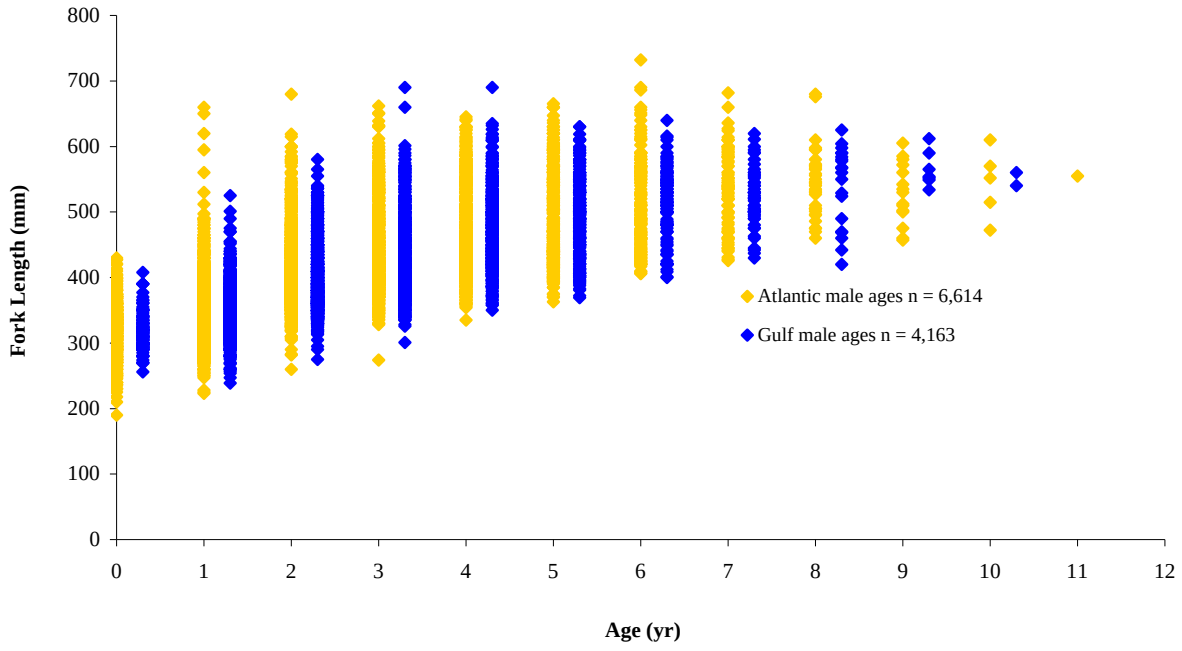

Figure 11. Sizes at age of male Spanish mackerel from the Atlantic and Gulf (1987 - 2011) aged by NMFS Panama City.

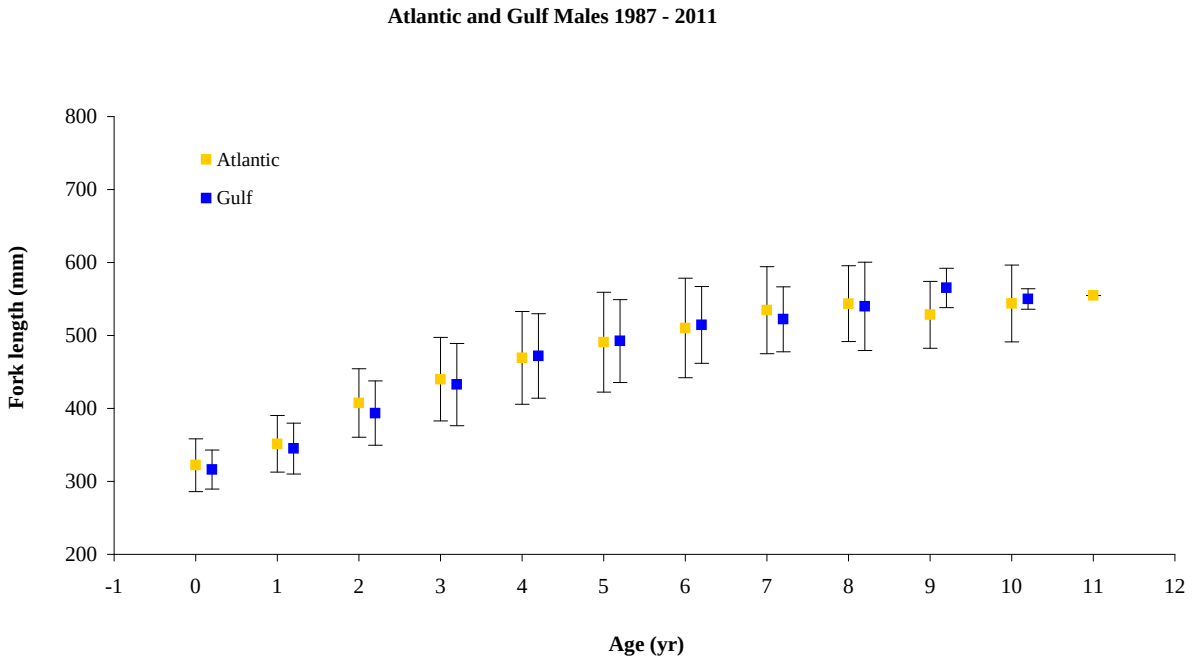

Figure 12. Mean sizes at age of male Spanish mackerel from the Atlantic and Gulf (1987 - 2011) aged by NMFS Panama City. Error bars are +/- 1 standard deviation.

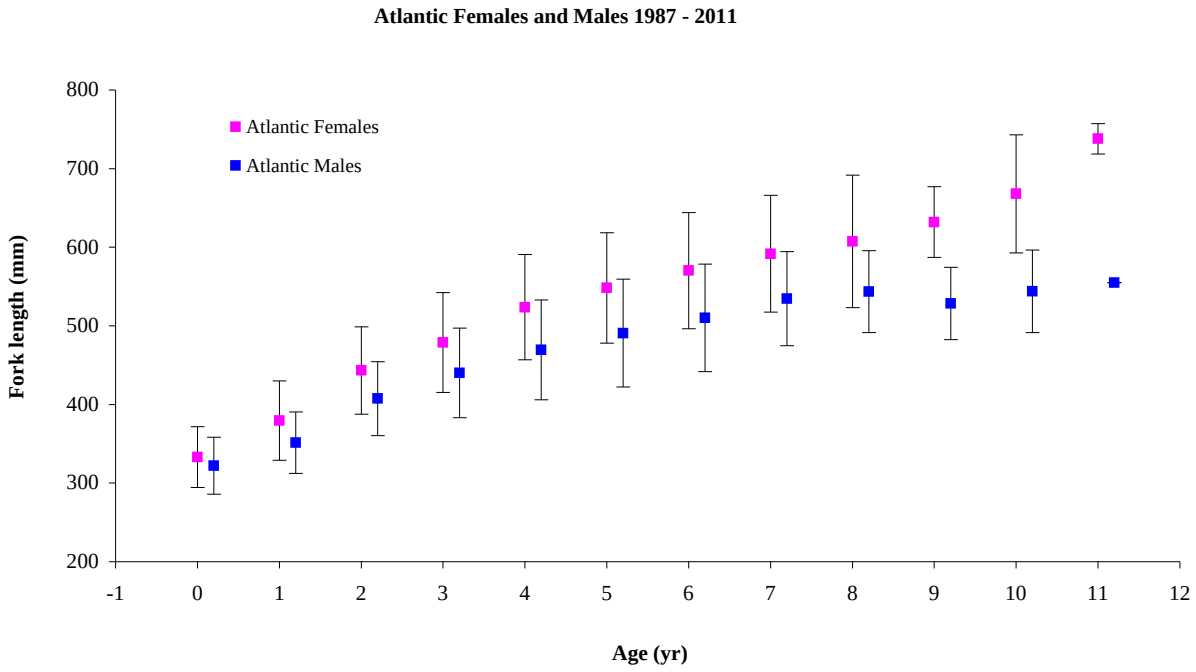

Figure 13. Mean sizes at age of female and male Spanish mackerel from the Atlantic (1987 - 2011) aged by NMFS Panama City. Error bars are +/- 1 standard deviation.

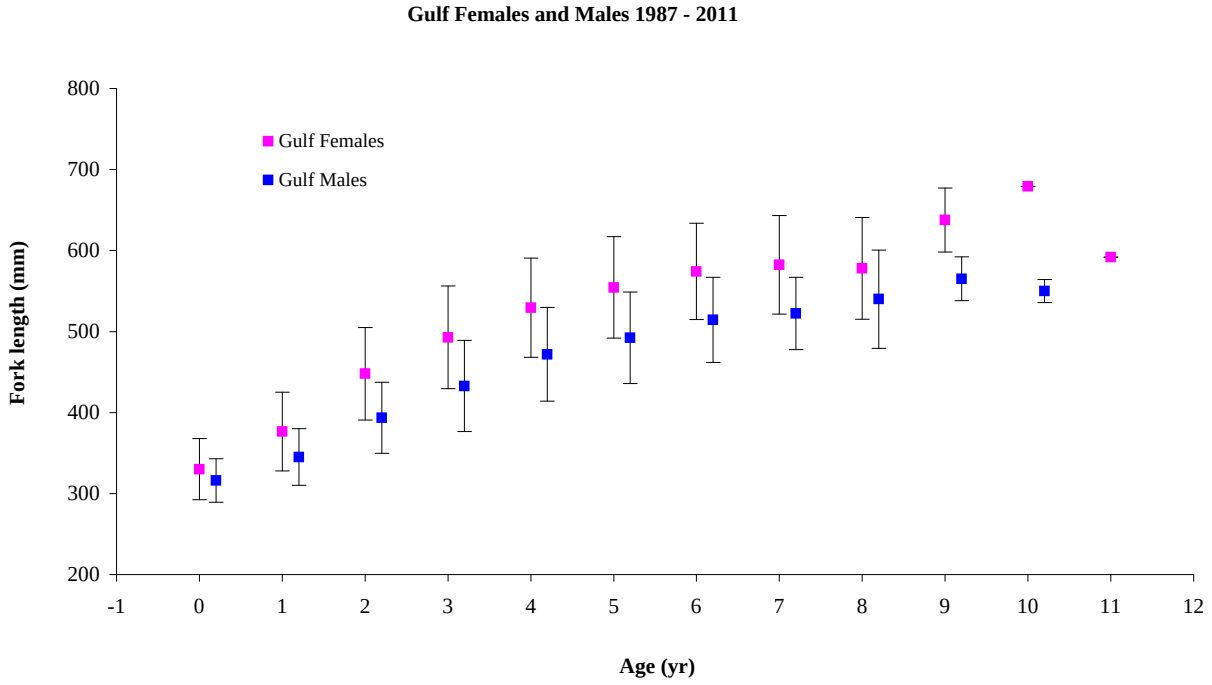

Figure 14. Mean sizes at age of female and male Spanish mackerel from the Gulf (1987 - 2011) aged by NMFS Panama City. Error bars are +/- 1 standard deviation.

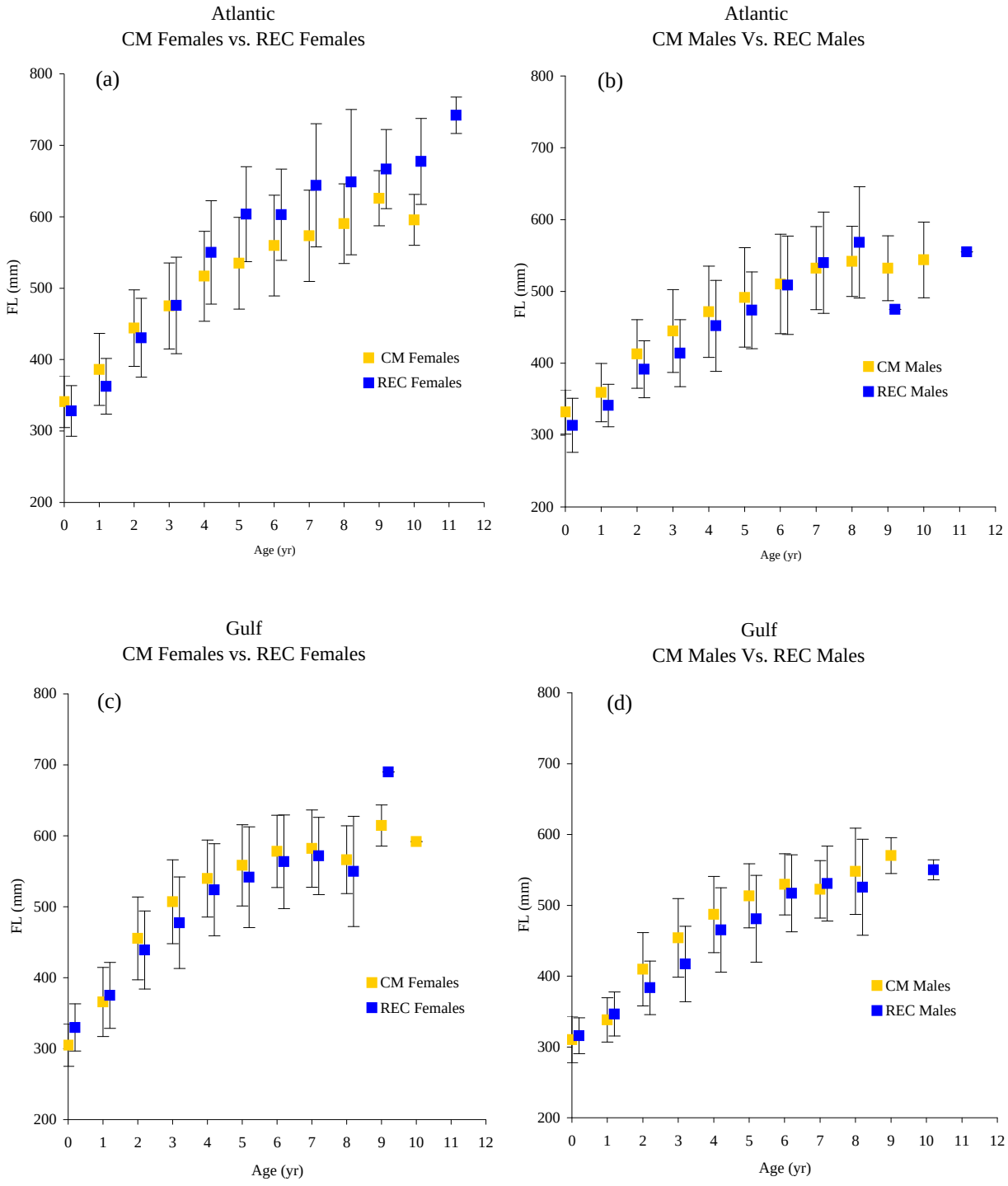

Figure 15. Mean sizes at age of Spanish mackerel (1987 - 2011) aged by NMFS Panama City. (a) Atlantic commercial females versus recreational females, (b) Atlantic commercial males versus recreational males, (c) Gulf commercial females versus recreational females, (d) Gulf commercial males versus recreational males. Error bars are +/- 1 standard deviation.