Further Notes on the Otolith Samples Available for Ageing Gulf King Mackerel in the 2000 and 2002 Stock Assessments

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Introduction

Annual stock assessments of mackerels in the southeastern United States have been conducted since 1985 using age-based assessment methodology (see Nichols 1985). These annual assessments have utilized extensive collections of otolith samples collected by the National Marine Fisheries Service (NMFS), Southeast Fisheries Science Center(SFSC), Panama City Laboratory since 1986 in addition to information on growth from the published literature. This report 1)provides additional information regarding the ageing of Gulf of Mexico king mackerel catches for the 2002 Mackerel assessment and 2)summarizes the current ageing data available and revisions through 2003 for Atlantic and Gulf of Mexico king mackerel stocks.

Background

Cummings and Devries (2002) provided a comprehensive summary of all the available otolith ageing data through fishing year 2000. Tables of the numbers of observations by calendar year (and fishing-year) and month were provided for each migratory group and catch sampling fractions provided. Cummings and Devries (2002) also summarized the analytical procedures used to estimate the historical age composition of US king mackerel catches since the 1989 annual stock assessment. The current protocol for converting mackerel catches at length to catches at age was adopted by the Mackerel Stock Assessment Panel (MSAP) in 1989, at the Mackerel Stock Assessment Data Review Workshop convened January 1989 at the NMFS, Panama City Laboratory in Panama City Florida (Anon. 1989). This ageing protocol has been used consistently since 1989 for converting densities of catch at length to catch at age.

In their report, Cummings and Devries (2002) also summarized for the record, the procedures used by earlier researchers to estimate mackerel age composition in stock assessments prior to the 1989 and noted the differences between procedures. The earliest age based stock assessment made use of a) deterministic growth equations to convert length to age (see Nichols 1985, 1986 and b) others later smoothed age-length keys (see Scott and Burn 1987,1988). As described in the Cummings and Devries (2002) report, since 1986 extensive collections of king mackerel otoliths have been ongoing throughout the South Atlantic and Gulf of Mexico resulting from sampling of the directed commercial and recreational mackerel fisheries by NMFS field agents as well as through intense collaborative work by various state or academic groups (e.g., Virginia Division of Marine Resources, North Carolina Dept. of Environmental Protection, Florida Fish and Wildlife Commission, or through federally funded contract research efforts (e.g., Savannah (Georgia) State University; NOAA, NMFS, MARFIN Initiative). These collections make up some 31,460 observations of king mackerel ageing observations from 1986 through 2002 spanning Virginia through Texas, with a few observations from Mexico being collected in years before 1995. Logistical procedures used to assign annual age readings have remained constant over the time period of otolith collections and were described by Devries et al.(1988).

The current ageing protocol for estimating age composition of king mackerel as adopted by the MSAP Panel in 1989 and repeated here from the report of Cummings and Devries (2002) is as follows. The application of annual sex-specific age length keys (ALK's) for each migratory group, calendar year, and quarter period where sufficient age samples were available was the preferred method. However, in some instances there were not sufficient age samples to (1) develop an annual ALK (this was especially a problem in the years before 1986) or (2)to consider that the observed catches were sufficiently represented in the age samples. There had to be approximately 500 individual age sample observations across all size intervals (generally 15-20 intervals of 5 cm width) for a sex to develop an annual ALK. Additionally if a relatively large catch were substantially under-represented in the ageing samples then the ALK was not considered sufficient. Where ALK samples are not sufficient (e.g., complete in time or spatial coverage or complete over the catch length distribution) or were completely absent for a catch stratum (i.e., a migratory group, calendar years, sex, quarter period) the stochastic length deconvolution method of Shepherd (1985), which applies a stochastic growth equation, was used to transform densities of catch at size to catch at age. The idea was originally proposed by Bartoo and Parker (1983) and an analysis of the estimator performance given recently in Parrack and Cummings (2003). The stochastic growth equation method was preferred to a simple deterministic growth equation or from a visual length separation procedure. The stochastic ageing procedure minimizes bias in age composition resulting from visually sorting out modes (cohorts) in length frequency distributions. Secondly, the procedure minimizes sensitivity in estimates associated with use of a particular growth model and/or various subjective assumptions integral to the particular model to separate modes. Thirdly, the stochastic transformation procedure eliminates the necessity that the deterministic age is the only age that exists. Fourth, the stochastic procedure eliminates bias in estimates introduced from changes in year class size (recruitment variability) not accounted for by the deterministic growth model. Also, the use of a deterministic growth model often yields unreasonably old ages as sizes approach the asymptotic size. Finally, in cases where multiple age length keys have been used as a single key, the stochastic method minimizes the possibility of introducing biases in age composition from smoothing effects. Thus, in each annual mackerel stock assessment since 1989 the Shepherd deconvolution procedure has been used to transform length to age.

Additional information on the MSAP 2002 Gulf King Mackerel Ageing Observations

In their report Cummings and Devries (2002) summarized the ageing data available the 2002 stock assessment (Tables 1 and 2 of Cummings and Devries 2002). Prior to MSAP 2002 assessment the last year of a complete (full) assessment for the Gulf king mackerel migratory group was in calendar year 2000 (MSAP 2000). The otolith ageing database of MSAP 2000 contained otolith observations through fishing year 1998/1999. As in previous mackerel stock assessment evaluations the procedure for updating the ageing database was followed. The procedure followed was 1) any new ageing data obtained or made available since the last complete stock assessment (MSAP 2000) were incorporated into the revised or updated database for MSAP 2002 (i.e., fishing years 1999/2000 and 2000/2001) and 2) usually the data from one or two prior years could possibly be replaced (e.g., 1997/1998, 1998/1999) due to possible

additions or corrections to the raw data. In the MSAP 2002 mackerel assessment not only was data from the otolith database revised and new data incorporated but also revisions of the basic commercial landings, recreational catch (estimates) and revised estimates of catch at size were generated for fishing years 1998 and 1999 and (Phares unpublished 2002) by NMFS, SEFSC, Sustainable Fisheries Division staff. These revisions of earlier years' catch and ageing data and additions of new data are routine and the normal part of each full stock assessment for any stock under examination. Such revisions and additions result in changes to the assessment database(s). The revisions are necessary and critical to developing updated datasets and in insuring that the fishery catch and biostatistical data used in stock evaluations represent the most accurate and updated information. Not incorporating all known revisions that may include either updated data, new data or corrections to the data, could produce biases of unknown levels and direction in evaluations from such datasets.

For the 2002 MSAP stock assessment it was determined that a more historical review of the complete raw ageing database was justified since all of the basic data had not been reviewed in its entirety since the comprehensive review of 1997 (see MSAP 1997). In their report, Cummings and Devries (2002) noted revisions (see page 5) were necessary to three earlier calendar years of ageing data: 1995, 1996, and 1997. These revisions or edits were deemed necessary because of identifying multiple area codes being used for the same region throughout the file by them collecting group, the NMFS, Panama City Laboratory. As a result a number of observations had been excluded from the final file of observations available for producing an ALK used in MSAP 2000. As summarized by Cummings and Devries (2002), the confounding of area coding resulted in an addition of 108 fish in 1995, 144 fish in 1996 and 37 additional fish in1997. Cummings and Devries (2002) pointed out that the additional otolith observations in these three years (1995, 1996, and 1997) were from four main areas (southeast Florida, South Florida, west Florida, and northwest Florida (Table 1). Shown here in Table 2 is the number of otolith observations available for the Gulf migratory group by calendar year and quarter of the year for the two most recent complete assessments (MSAP 2000, MSAP 2002). This table also identifies for the two most recent assessments the years where data were complete through.

In terms of altering ageing procedures used between assessment years, in no case, in either 1995 or 1996 did the updating of the ALK's result in a switch from one ageing method to another (i.e. from a stochastic to an ALK method) (Table 3). Thus, the updating of the 1995 or 1996 calendar year ALK's did not produce a change in ageing methods between the prior MSAP 2000 and 2002 assessments. The main effect was mainly to add fish at the tails of the length distributions (i.e., at the smaller and/or larger sizes of fishes). The specific results from addition of the extra ageing observations can be best seen by contrasting each individual calendar year ALK's from the prior assessment, MSAP 1998 or 2000 depending on which year the ALK was first derived for, with those of MSAP 2002 (Tables 4-9). The adding of extra fish at the distribution ends can be seen in these tables. In addition, the interval width was reduced in a few cases after the ALK's were updated whereas in the original age length key length intervals were somewhat broader in some cases, and sometimes broader than the requested field sampling length interval for king mackerel of 5 cm fork length specified by the MSAP in 1989. For

catches in 1997 after updating the 1997 ageing data observations to account for the confounding in area coding and reviewing the distribution of samples across month (and quarter), the updated ALK resulted in applying an ALK to all four quarters catch data whereas in the prior complete assessment (MSAP 2000), only quarters 1-3 (January-August) were considered sufficient in terms of age data sample size (Table 3). The decision was made to extend the ALK's to the 4th quarter also. A detailed summary of the numbers of ageing observations available by migratory group, calendar year (and fishing year), geographical area of sampling, and month of year is available upon request from the author for calendar years 1986 through 2001 as updated through MSAP 2003.

Estimates of the total catch at age for Gulf king mackerel are shown here in for the most recent two complete stock assessments, MSAP 2000 and MSAP 2002 (Tables 10 and 11). The data for MSAP 2002 reflect the revisions made to age length keys for 1995,1996, and 1997 in addition to revisions in total catch landed and at size for 1998 and 1999, plus new catch data for 2000 and 2001. The effect on resulting estimates of catch at age from updating the otolith ageing database for 1994, 1995, 1996, and 1997 is also shown here graphically (Figures 1-5) and also in Table 12. The percentage differences in catch at age estimates between the two assessment years, 2000 and 2002, are shown separately for each year in Figure 6. This presentation also shows the difference in absolute catch at age between for the two assessments, 2002 and 2000. The figures include difference estimates, either in percent catch at age or absolute catch numbers, for each separate age, 0 to age 19. The 1994 panel in Figure 6 shows that updating the ALK data for 1994, 1995 calendar year did not result in a significant change to the catch at age estimates for FY 1994. For the remaining three fishing years, 1995-1997, Figure 1-6 indicates that updating the ALK's mainly effected the younger ages, mostly ages six and younger, in terms of the difference in estimated absolute catch, as shown by the dotted line marked 'Catch 02-00' for each age. Percent difference in catch at age estimates, on the order of 20-50% are apparent for a number of the older ages (12+) in the 1995, 1996, and 1997 fishing years however, these differences did not translate into significant differences in the numbers of absolute catch at age for these ages. It should be pointed out that the king mackerel stock assessment evaluates catch at age history using a summed group for ages 11+ as input into the virtual population analysis. Figure 7 provides a further detailed breakdown of the estimated catch at age for each of the two assessments, 2000 and 2002. These figures show that in most of the quarters in the four years where the ALK data were updated that the differences between assessments (2002 vs 2000) are small. Differences are apparent in quarter 4 of 1995, 1996 and 1997 for ages 5 and younger. As noted earlier and as shown in Table 2, the updating of the ALK data resulted in addition of fish to certain quarters. The addition of 108 fish to the 1995 ALK was in quarter 4 (see Table 2) as was the addition of 123 fish to quarter 4 of the 1997 ALK providing one source of the resulting change in age distributions between years. Updating of the 1996 ALK data was from the addition of 143 fish to quarter one and one fish to quarter 3 however this addition would also have affected any catches aged in quarter 4 as an annual key is applied to each separate migratory sex catch.

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Table 1a. Summary of the number of additional Gulf of Mexico King mackerel ageing observations available for the MSAP 2002 stock assessment as reviewed again in the April 2003 for the MSAP 2003 stock assessment.

Sex	**1995**	**1996**	**1997**
Males	+15	+42	+65
Females	+93	+102	+95
Total # Additional	**+108**	**+144**	**+130**

Table 1b. Identification of geographical areas in the king mackerel ageing samples with multiple area code identified in the MSAP 2002 mackerel stock assessment.

Geographical Collection Area
Pinellas Cnty
Pasco Cnty
Monroe Cnty
Key West
Monroe Cnty
Palm Beach Cnty
St. Lucie Cnty

Table 2. Number of available otolith observations for Gulf king mackerel by calendar year and quarter of the year for MSAP 2000 and MSAP 2002

Migratory Group	Calendar Year	Jan-March	April-June	July-Sept.	Oct-Dec	Total	MSAP 2000 - MSAP 2000	Assessment	Year	Notes1
EG	1986	0	0	228	6	234	0	MSAP	2000	
EG	1986	0	0	228	6	234		MSAP	2002	
EG	1987	47	198	317	36	598	0	MSAP	2000	
EG	1987	47	198	317	36	598		MSAP	2002	
EG	1988	0	39	302	26	367	0	MSAP	2000	
EG	1988	0	39	302	26	367		MSAP	2002	
EG	1989	39	49	397	36	521	0	MSAP	2000	
EG	1989	39	49	397	36	521		MSAP	2002	
EG	1990	51	116	239	55	461	0	MSAP	2000	
EG	1990	51	116	239	55	461		MSAP	2002	
EG	1991	55	353	561	262	1231	0	MSAP	2000	
EG	1991	55	353	561	262	1231		MSAP	2002	
EG	1992	119	240	579	120	1058	0	MSAP	2000	
EG	1992	119	240	579	120	1058		MSAP	2002	
EG	1993	70	243	668	181	1162	0	MSAP	2000	
EG	1993	70	243	668	181	1162		MSAP	2002	
EG	1994	30	263	428	205	926	0	MSAP	2000	
EG	1994	30	263	428	205	926		MSAP	2002	
EG	1995	41	246	307	**324**	918	**108**	MSAP	2000	**Revisions made to Area coding**
EG	1995	41	246	307	**432**	1026		MSAP	2002	

EG	1996	**157**	321	**473**	664	1615	**144**	MSAP	2000	**Revisions made to Area coding**
EG	1996	**300**	321	**474**	664	1759		MSAP	2002	
EG	1997	641	166	243	123	1173	**37**	MSAP	2000	**Revisions made to Area coding**
EG	1997	641	166	280	123	1210		MSAP	2002	
EG	1998	293	42	83	228	646	**0**	MSAP	2000	
EG	1998	293	42	83	228	646		MSAP	2002	
EG	1999	144	60	0	0	204	384	MSAP	2000	**CY 1999 Data updated in MSAP 2000**
EG	1999	196	94	146	152	588		MSAP	2002	
EG	2000	0	0	0	0	0	891	MSAP	2000	**No Data available for CY 2000 in MSAP 2000**
EG	2000	530	56	107	198	891		MSAP	2002	
EG	2001	0	0	0	0	0	1114	MSAP	2000	**No Data Available for CY 2001 in MSAP 2000**
EG	2001	1105	9	0	0	1114		MSAP	2002	

[1] MSAP FY97/98, 98/99 complete 2000

[1] MSAP FY99/00, 00/01complete 2002

Table 3. Identification of Ageing Procedure used to age the Calendar Year 1995,1996, and 1997 Gulf king mackerel catches for the 2000 and 2002 MSAP assessments

Mig Group	Cal Year	Assessment Year	Ageing Method Jan-March	April-June	July-Sept.	Oct-Dec	NOTES
EG	1995	MSAP 2000	STOCHASTIC	ALK	ALK	ALK	CY95 CATCHES FIRST AGED IN MSAP1996, UPDATED IN MSAP 1998, 2000, 2002
		MSAP 2002	STOCHASTIC	ALK	ALK	ALK	
EG	1996	MSAP 2000	ALK	ALK	ALK	ALK	CY96 CATCHES FIRST AGED IN MSAP 1998, UPDATED IN MSAP 2000,2002
		MSAP 2002	ALK	ALK	ALK	ALK	
EG	1997	MSAP 2000	ALK	ALK	ALK	**STOCHASTIC**	CY97 CATCHES FIRST AGED IN MSAP 1998, UPDATED IN MSAP 2000, 2002
		MSAP 2002	ALK	ALK	ALK	**ALK**	

CY =
Calendar
Year
MSAP= Mackerel
Stock Assessment
Panel
EG= Eastern Gulf of Mexico migratory
group of Gulf of Mexico king mackerel

Table 4. Annual Age length Key for Gulf king mackerel males and females for calendar year 1995 as originally derived for the MSAP 1998 assessment.

[Format is as follows:
Record 1: Header record for each ALK: species, calendar year and migratory group, sex stratum, number of total fish in the key, number of fork length (cm)intervals, followed by the upper bound (cm) of each length interval). Records 2+ Each header record followed by 1 to # n density records giving the probablity of age from age 0 to age 19 for each length interval. Male Code = M, Female Code = F, Species KM = King Mackerel, Migratory Group EG = Eastern Gulf].

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KM 95 EG  M 259 11   35  60  65  70  75  80  85  90  95 100 200
 35  0 19  0 1.000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000
 60  0 19 11  .000 .727 .273 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000
 65  0 19 17  .059 .235 .647 .059 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000
 70  0 19 20  .000 .200 .600 .200 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000
 75  0 19 20  .000 .000 .450 .400 .150 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000
 80  0 19 41  .000 .000 .146 .220 .390 .195 .049 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000
 85  0 19 49  .000 .000 .020 .102 .265 .388 .122 .082 .020 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000
 90  0 19 51  .000 .000 .000 .000 .137 .157 .314 .176 .078 .118 .020 .000 .000 .000 .000 .000 .000 .000 .000 .000
 95  0 19 18  .000 .000 .000 .000 .167 .000 .333 .000 .111 .222 .056 .056 .000 .000 .056 .000 .000 .000 .000 .000
100  0 19 14  .000 .000 .000 .000 .000 .071 .214 .143 .071 .000 .286 .071 .000 .143 .000 .000 .000 .000 .000 .000
200  0 19 18  .000 .000 .000 .000 .000 .000 .000 .000 .056 .056 .333 .000 .000 .333 .056 .000 .056 .056 .000 .056

KM 95 EG  F 618 19   35  55  60  65  70  75  80  85  90  95 100 105 110 115 120 125 130 135 200
 35  0 19  0 1.000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000
 55  0 19 10  .100 .900 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000
 60  0 19 10  .000 .600 .400 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000
 65  0 19 32  .000 .563 .438 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000
 70  0 19 48  .000 .208 .729 .063 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000
 75  0 19 41  .000 .293 .561 .122 .024 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000
 80  0 19 38  .000 .079 .368 .447 .105 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000
 85  0 19 36  .000 .000 .361 .278 .278 .056 .028 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000
 90  0 19 75  .000 .000 .080 .400 .267 .213 .027 .013 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000
 95  0 19 60  .000 .000 .000 .083 .333 .250 .250 .050 .017 .000 .000 .000 .000 .000 .017 .000 .000 .000 .000 .000
100  0 19 71  .000 .000 .028 .014 .169 .268 .268 .155 .028 .042 .014 .000 .000 .000 .000 .014 .000 .000 .000 .000
105  0 19 39  .000 .000 .000 .026 .231 .256 .333 .128 .000 .000 .026 .000 .000 .000 .000 .000 .000 .000 .000 .000
110  0 19 40  .000 .000 .000 .000 .075 .125 .325 .225 .050 .100 .100 .000 .000 .000 .000 .000 .000 .000 .000 .000
115  0 19 35  .000 .000 .000 .029 .029 .086 .114 .400 .057 .086 .114 .029 .000 .057 .000 .000 .000 .000 .000 .000
120  0 19 29  .000 .000 .000 .000 .000 .069 .069 .069 .103 .172 .345 .034 .034 .103 .000 .000 .000 .000 .000 .000
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Table 4. Continued (CY 1995 ALK, Derived 1998 MSAP)

125	0	19	20	.000	.000	.000	.000	.000	.000	.050	.050	.150	.050	.550	.050	.050	.000	.050	.000	.000	.000	.000	.000
130	0	19	11	.000	.000	.000	.000	.000	.000	.182	.000	.000	.000	.364	.091	.091	.091	.091	.000	.000	.000	.000	.091
135	0	19	12	.000	.000	.000	.000	.000	.000	.000	.000	.000	.083	.167	.000	.083	.500	.083	.083	.000	.000	.000	.000
200	0	19	11	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.182	.000	.182	.273	.091	.091	.091	.091	.000	.000

Table 5. Annual Age length Key for Gulf king mackerel males and females for calendar year 1995 as updated for the MSAP 2002 assessment and reviewed again in MSAP 2003.

[Format is as follows:
Record 1: Header record for each ALK: species, calendar year and migratory group, sex stratum, number of total fish in the key, number of fork length (cm)intervals, followed by the upper bound (cm) of each length interval). Records 2+ Each header record followed by 1 to # n density records giving the probablity of age from age 0 to age 19 for each length interval. Male Code = M, Female Code = F, Species KM = King Mackerel, Migratory Group EG = Eastern Gulf].].

KM 1995 EG M 274 12 35 60 65 70 75 80 85 90 95 100 105 200

35	0	19	0	1.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
60	0	19	12	.083	.667	.250	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
65	0	19	18	.056	.278	.611	.056	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
70	0	19	23	.000	.261	.522	.217	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
75	0	19	20	.000	.000	.450	.400	.150	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
80	0	19	42	.000	.000	.143	.238	.381	.190	.048	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
85	0	19	54	.000	.000	.037	.111	.278	.370	.111	.074	.019	.000	.000	.000	.000	.000	.000	.000	.000	.000
90	0	19	51	.000	.000	.000	.000	.137	.157	.314	.176	.078	.118	.020	.000	.000	.000	.000	.000	.000	.000
95	0	19	21	.000	.000	.000	.000	.190	.000	.333	.048	.095	.190	.048	.048	.000	.000	.048	.000	.000	.000
100	0	19	14	.000	.000	.000	.000	.000	.071	.214	.143	.071	.000	.286	.071	.000	.143	.000	.000	.000	.000
105	0	19	9	.000	.000	.000	.000	.000	.000	.000	.000	.111	.000	.333	.000	.000	.333	.111	.000	.111	.000
200	0	19	10	.000	.000	.000	.000	.000	.000	.000	.000	.000	.200	.300	.000	.000	.300	.000	.000	.000	.100

KM 1995 EG F 711 19 35 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 200

35	0	19	0	1.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
55	0	19	11	.182	.818	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
60	0	19	12	.000	.667	.333	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
65	0	19	32	.000	.563	.438	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
70	0	19	52	.000	.269	.673	.058	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
75	0	19	44	.000	.273	.591	.114	.023	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
80	0	19	40	.000	.075	.375	.450	.100	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
85	0	19	40	.000	.000	.400	.250	.275	.050	.025	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
90	0	19	83	.000	.000	.120	.373	.277	.193	.024	.012	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
95	0	19	66	.000	.000	.000	.136	.318	.242	.227	.045	.015	.000	.000	.000	.000	.000	.015	.000	.000	.000
100	0	19	78	.000	.000	.026	.013	.205	.269	.256	.141	.026	.038	.013	.000	.000	.000	.000	.013	.000	.000
105	0	19	50	.000	.000	.000	.040	.300	.240	.300	.100	.000	.000	.020	.000	.000	.000	.000	.000	.000	.000
110	0	19	53	.000	.000	.000	.019	.132	.189	.264	.208	.038	.075	.075	.000	.000	.000	.000	.000	.000	.000

Table 5. Continued (CY 1995, Updated MSAP 2002, Reviewed MSAP 2003)

115	0	19	42	.000	.000	.000	.024	.024	.119	.095	.405	.048	.071	.143	.024	.000	.048	.000	.000	.000	.000	.000	.000
120	0	19	39	.000	.000	.000	.000	.000	.128	.103	.103	.103	.128	.308	.026	.026	.077	.000	.000	.000	.000	.000	.000
125	0	19	26	.000	.000	.000	.000	.000	.000	.115	.077	.154	.038	.500	.038	.038	.000	.038	.000	.000	.000	.000	.000
130	0	19	19	.000	.000	.000	.000	.053	.000	.158	.053	.000	.000	.421	.105	.053	.053	.053	.000	.000	.000	.000	.053
135	0	19	13	.000	.000	.000	.000	.000	.000	.000	.000	.000	.077	.231	.000	.077	.462	.077	.077	.000	.000	.000	.000
200	0	19	11	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.182	.000	.182	.273	.091	.091	.091	.091	.000	.000

Table 6. Annual Age length Key for Gulf king mackerel males and females for calendar year 1996 as derived for the MSAP 1998 assessment.

[Format is as follows:
Record 1: Header record for each ALK: species, calendar year and migratory group, sex stratum, number of total fish in the key, number of fork length (cm)intervals, followed by the upper bound (cm) of each length interval). Records 2+ Each header record followed by 1 to # n density records giving the probablity of age from age 0 to age 19 for each length interval. Male Code = M, Female Code = F, Species KM = King Mackerel, Migratory Group EG = Eastern Gulf].

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KM 96 EG  M 338 10   35  55  60  65  70  75  80  85  90 200
 35  0 19  0 1.000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 55  0 19 10  .000 1.000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 60  0 19 21  .000  .905  .095  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 65  0 19 51  .000  .314  .510  .176  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 70  0 19 56  .000  .089  .607  .286  .018  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 75  0 19 57  .000  .000  .333  .614  .053  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 80  0 19 37  .000  .000  .216  .459  .189  .054  .081  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 85  0 19 46  .000  .000  .043  .087  .130  .239  .413  .065  .022  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 90  0 19 30  .000  .000  .000  .067  .067  .033  .500  .200  .067  .033  .033  .000  .000  .000  .000  .000  .000  .000  .000  .000
200  0 19 30  .000  .000  .000  .000  .033  .233  .033  .367  .033  .000  .100  .133  .033  .000  .000  .000  .033  .000  .000  .000

KM 96 EG  F 1269 17   35  55  60  65  70  75  80  85  90  95 100 105 110 115 120 125 200
 35  0 19  1  .000 1.000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 55  0 19  9  .000 1.000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 60  0 19 43  .000  .907  .093  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 65  0 19 87  .000  .701  .287  .011  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 70  0 19105  .000  .400  .486  .086  .029  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 75  0 19 99  .000  .091  .576  .253  .081  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 80  0 19143  .000  .084  .455  .364  .098  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 85  0 19283  .000  .085  .590  .230  .074  .014  .007  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 90  0 19183  .000  .000  .481  .284  .148  .049  .033  .005  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 95  0 19124  .000  .000  .177  .234  .202  .185  .129  .048  .016  .000  .000  .008  .000  .000  .000  .000  .000  .000  .000  .000
100  0 19 42  .000  .000  .000  .048  .214  .476  .167  .024  .071  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
105  0 19 43  .000  .000  .000  .000  .116  .186  .302  .279  .116  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
110  0 19 25  .000  .000  .000  .000  .040  .120  .400  .240  .080  .000  .000  .120  .000  .000  .000  .000  .000  .000  .000  .000
115  0 19 27  .000  .000  .000  .000  .000  .037  .259  .185  .444  .000  .000  .074  .000  .000  .000  .000  .000  .000  .000  .000
120  0 19 23  .000  .000  .000  .000  .000  .000  .043  .261  .217  .087  .087  .217  .043  .000  .043  .000  .000  .000  .000  .000
125  0 19 21  .000  .000  .000  .000  .000  .000  .048  .143  .095  .095  .048  .429  .048  .000  .095  .000  .000  .000  .000  .000
200  0 19 11  .000  .000  .000  .000  .000  .000  .000  .091  .091  .000  .000  .455  .091  .000  .273  .000  .000  .000  .000  .000
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Table 7. Table 2. Annual Age length Key for Gulf king mackerel males and females for calendar year 1996 as updated for the MSAP 2002 assessment and reviewed again in MSAP 2003.

[Format is as follows:
Record 1: Header record for each ALK: species, calendar year and migratory group, sex stratum, number of total fish in the key, number of fork length (cm)intervals, followed by the upper bound (cm) of each length interval). Records 2+ Each header record followed by 1 to # n density records giving the probablity of age from age 0 to age 19 for each length interval. Male Code = M, Female Code = F, Species KM = King Mackerel, Migratory Group EG = Eastern Gulf].

KM 1996 EG M 380 11 35 55 60 65 70 75 80 85 90 95 200

35	0	19	0	1.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
55	0	19	11	.000	1.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
60	0	19	21	.000	.905	.095	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
65	0	19	60	.000	.267	.583	.150	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
70	0	19	62	.000	.081	.613	.274	.032	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
75	0	19	59	.000	.000	.356	.593	.051	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
80	0	19	40	.000	.000	.225	.475	.175	.050	.075	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
85	0	19	56	.000	.000	.036	.143	.161	.214	.375	.054	.018	.000	.000	.000	.000	.000	.000	.000	.000	.000
90	0	19	36	.000	.000	.000	.083	.083	.111	.417	.167	.056	.028	.056	.000	.000	.000	.000	.000	.000	.000
95	0	19	22	.000	.000	.000	.000	.000	.318	.091	.455	.000	.000	.091	.045	.000	.000	.000	.000	.000	.000
200	0	19	13	.000	.000	.000	.000	.077	.077	.154	.077	.077	.077	.077	.231	.077	.000	.000	.000	.077	.000	.000	.000

KM 1996 EG F 1371 17 35 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 200

35	0	19	1	.000	1.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
55	0	19	9	.000	1.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
60	0	19	43	.000	.907	.093	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
65	0	19	93	.000	.656	.333	.011	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
70	0	19	115	.000	.374	.496	.104	.026	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
75	0	19	113	.000	.080	.602	.239	.080	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
80	0	19	159	.000	.075	.472	.346	.107	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
85	0	19	298	.000	.081	.570	.228	.087	.023	.010	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
90	0	19	200	.000	.000	.440	.280	.170	.065	.040	.005	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
95	0	19	134	.000	.000	.164	.231	.239	.172	.119	.052	.015	.000	.000	.007	.000	.000	.000	.000	.000	.000
100	0	19	47	.000	.000	.000	.043	.191	.447	.170	.064	.064	.000	.021	.000	.000	.000	.000	.000	.000	.000
105	0	19	47	.000	.000	.000	.021	.106	.191	.277	.298	.106	.000	.000	.000	.000	.000	.000	.000	.000	.000
110	0	19	28	.000	.000	.000	.000	.107	.107	.357	.250	.071	.000	.000	.107	.000	.000	.000	.000	.000	.000
115	0	19	28	.000	.000	.000	.000	.000	.036	.286	.179	.429	.000	.000	.071	.000	.000	.000	.000	.000	.000

Table 7. (Continued). (CY 1996, Updated MSAP 2002, Reviewed MSAP 2003)

120	0	19	23	.000	.000	.000	.000	.000	.000	.043	.261	.217	.087	.087	.217	.043	.000	.043	.000	.000	.000	.000	.000
125	0	19	21	.000	.000	.000	.000	.000	.000	.048	.143	.095	.095	.048	.429	.048	.000	.095	.000	.000	.000	.000	.000
200	0	19	12	.000	.000	.000	.000	.000	.000	.000	.083	.083	.000	.000	.500	.083	.000	.250	.000	.000	.000	.000	.000

Table 8. Annual Age length Key for Gulf king mackerel males and females for calendar year 1997 as originally derived for the MSAP 2000 assessment.

[Format is as follows:
Record 1: Header record for each ALK: species, calendar year and migratory group, sex stratum, number of total fish in the key, number of fork length (cm)intervals, followed by the upper bound (cm) of each length interval). Records 2+ Each header record followed by 1 to # n density records giving the probablity of age from age 0 to age 19 for each length interval. Male Code = M, Female Code = F, Species KM = King Mackerel, Migratory Group EG = Eastern Gulf].

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KM 97 EG  M 289 9   35  60  65  70  75  80  85  90 200
 35  0 19  0 1.000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 60  0 19 29  .000  .207  .793  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 65  0 19 34  .000  .029  .941  .029  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 70  0 19 45  .000  .000  .889  .111  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 75  0 19 44  .000  .023  .523  .318  .136  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 80  0 19 28  .000  .000  .250  .536  .179  .036  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 85  0 19 35  .000  .000  .000  .171  .600  .114  .057  .057  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 90  0 19 41  .000  .000  .000  .024  .268  .220  .098  .293  .073  .024  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
200  0 19 33  .000  .000  .000  .000  .000  .242  .061  .152  .242  .030  .000  .121  .121  .000  .000  .000  .000  .000  .030  .000

KM 97 EG  F 761 13    35  60  65  70  75  80  85  90  95 100 105 110 200
 35  0 19  0 1.000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 60  0 19 43  .000  .349  .651  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 65  0 19 35  .000  .229  .771  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 70  0 19 74  .000  .108  .878  .014  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 75  0 19 93  .000  .054  .828  .086  .032  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 80  0 19 86  .000  .000  .442  .430  .116  .012  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 85  0 19166  .000  .000  .187  .620  .163  .024  .006  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 90  0 19 98  .000  .000  .041  .582  .296  .051  .020  .000  .010  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
 95  0 19 62  .000  .000  .000  .194  .371  .226  .129  .048  .016  .016  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
100  0 19 26  .000  .000  .000  .038  .500  .154  .154  .115  .038  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000
105  0 19 37  .000  .000  .000  .027  .162  .189  .108  .216  .189  .081  .000  .000  .027  .000  .000  .000  .000  .000  .000  .000  .000
110  0 19 19  .000  .000  .000  .000  .000  .263  .105  .158  .158  .263  .000  .000  .053  .000  .000  .000  .000  .000  .000  .000  .000
200  0 19 22  .000  .000  .000  .000  .091  .000  .000  .045  .318  .182  .000  .000  .318  .000  .000  .045  .000  .000  .000  .000  .000
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Table 9. Annual Age length Key for Gulf king mackerel males and females for calendar year 1997 as updated for the MSAP 2002 assessment and reviewed again in MSAP 2003.

[Format is as follows:
Record 1: Header record for each ALK: species, calendar year and migratory group, sex stratum, number of total fish in the key, number of fork length (cm)intervals, followed by the upper bound (cm) of each length interval). Records 2+ Each header record followed by 1 to # n density records giving the probablity of age from age 0 to age 19 for each length interval. Male Code = M, Female Code = F, Species KM = King Mackerel, Migratory Group EG = Eastern Gulf].

KM 1997 EG M 354 11 35 55 60 65 70 75 80 85 90 95 200

35	0	19	0	1.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
55	0	19	9	.000	.778	.222	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
60	0	19	28	.000	.214	.786	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
65	0	19	40	.000	.125	.850	.025	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
70	0	19	59	.000	.000	.864	.136	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
75	0	19	59	.000	.017	.542	.305	.119	.017	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
80	0	19	34	.000	.000	.235	.500	.206	.029	.029	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
85	0	19	42	.000	.000	.000	.167	.524	.143	.048	.119	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
90	0	19	45	.000	.000	.000	.022	.267	.200	.111	.289	.089	.022	.000	.000	.000	.000	.000	.000	.000	.000	.000
95	0	19	18	.000	.000	.000	.000	.000	.389	.056	.278	.111	.000	.000	.111	.056	.000	.000	.000	.000	.000	.000
200	0	19	20	.000	.000	.000	.000	.000	.100	.050	.000	.300	.100	.000	.100	.300	.000	.000	.000	.000	.050	.000

KM 1997 EG F 856 15 35 55 60 65 70 75 80 85 90 95 100 105 110 115 200

35	0	19	0	1.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
55	0	19	13	.000	.846	.154	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
60	0	19	38	.000	.289	.711	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
65	0	19	41	.000	.341	.659	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
70	0	19	82	.000	.159	.829	.012	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
75	0	19	113	.000	.053	.814	.097	.035	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
80	0	19	104	.000	.000	.442	.442	.106	.010	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
85	0	19	178	.000	.000	.208	.607	.152	.028	.006	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
90	0	19	110	.000	.000	.064	.582	.282	.045	.018	.000	.009	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
95	0	19	65	.000	.000	.000	.200	.369	.231	.123	.046	.015	.015	.000	.000	.000	.000	.000	.000	.000	.000	.000
100	0	19	29	.000	.000	.000	.069	.448	.138	.172	.103	.069	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
105	0	19	40	.000	.000	.000	.025	.150	.225	.125	.200	.175	.075	.000	.000	.025	.000	.000	.000	.000	.000	.000
110	0	19	20	.000	.000	.000	.000	.050	.250	.100	.150	.150	.250	.000	.000	.050	.000	.000	.000	.000	.000	.000
115	0	19	10	.000	.000	.000	.000	.200	.000	.000	.100	.200	.300	.000	.000	.200	.000	.000	.000	.000	.000	.000
200	0	19	13	.000	.000	.000	.000	.000	.000	.000	.000	.385	.154	.000	.000	.385	.000	.000	.077	.000	.000	.000	.000

Table 10. Estimated Catch at age (number of fish) for Gulf of Mexico king mackerel as estimated in MSAP 2000.

	Fishing Year																		
AGE	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	65.	9441.	82.	38.	497.	3577.	1367.	771.	2292.	7005.	2218.	2239.	5768.	2758.	1415.	667.	332.	454.	2.
1	1446.	22522.	368.	6669.	10645.	77665.	64736.	39373.	220559.	78530.	215542.	89107.	168104.	169836.	109111.	72942.	49126.	19970.	206.
2	7242.	183273.	129346.	10386.	41627.	178847.	167700.	123181.	191102.	199413.	307759.	247546.	212503.	139821.	271146.	378967.	267197.	69091.	913.
3	65376.	135946.	258564.	183855.	39065.	100524.	78833.	81653.	97434.	223494.	188532.	316783.	190773.	148294.	199388.	232187.	337058.	207833.	1004.
4	572111.	324974.	166109.	286885.	190830.	132548.	43595.	190716.	72016.	78530.	124847.	123335.	162643.	201243.	73641.	116400.	240916.	296274.	7074.
5	187534.	287056.	49403.	127509.	150344.	38378.	26985.	67345.	37602.	39696.	33281.	91130.	78023.	228489.	104574.	80744.	79383.	253610.	12122.
6	48128.	91735.	69101.	53807.	80569.	33590.	15806.	61996.	15230.	34648.	34331.	46570.	30426.	97443.	66303.	37074.	42585.	77463.	468.
7	32219.	64634.	28827.	35385.	17960.	20219.	10627.	29372.	21013.	14600.	13481.	28818.	28361.	15063.	53358.	39267.	29972.	26489.	624.
8	15491.	38302.	15842.	11628.	8789.	10150.	3828.	12207.	12830.	12055.	5645.	32853.	25445.	47852.	14236.	31378.	27489.	23820.	113.
9	7458.	73266.	5819.	1915.	6325.	6203.	1844.	9957.	6204.	14711.	13850.	15529.	15776.	34897.	8707.	14149.	20251.	10489.	877.
10	4108.	19877.	2097.	1946.	4700.	1307.	1680.	7529.	6826.	2929.	5807.	11488.	4481.	12373.	7482.	2101.	6687.	8767.	84.
11	2110.	13434.	1235.	1142.	3292.	4880.	636.	5879.	6325.	2408.	2060.	13266.	11506.	4245.	8422.	5577.	2804.	4970.	0.
12	2020.	1473.	1241.	369.	909.	1909.	785.	2559.	2867.	3559.	3680.	5994.	7846.	7678.	1984.	17702.	6183.	529.	1.
13	613.	234.	423.	892.	770.	861.	605.	2278.	974.	2301.	4238.	4015.	2722.	4023.	1726.	16.	2774.	2521.	1.
14	2087.	280.	274.	443.	558.	1349.	742.	1604.	455.	598.	1145.	5651.	3585.	1848.	1706.	189.	661.	617.	22.
15	1144.	609.	151.	100.	492.	606.	336.	2263.	892.	585.	844.	2329.	1982.	1912.	240.	1826.	376.	87.	18.
16	462.	176.	307.	77.	396.	420.	284.	2210.	892.	1345.	212.	941.	452.	640.	627.	343.	781.	633.	8.
17	388.	131.	182.	56.	303.	228.	197.	1453.	1046.	238.	282.	641.	1185.	686.	288.	5.	8.	41.	4.
18	248.	195.	168.	90.	405.	403.	292.	1674.	766.	377.	600.	660.	126.	358.	106.	571.	352.	73.	14.
19	2551.	3807.	1253.	857.	2564.	911.	660.	3309.	431.	1727.	2641.	3323.	386.	2736.	309.	52.	129.	684.	281.
total	952799.	1271355.	730788.	724045.	561041.	614573.	421539.	647326.	697756.	718748.	960989.	1042215.	952091.	1122193.	924768.	1032153.	1115061.	1004411.	23836.

Table 11. Estimated Catch at age (number of fish) for Gulf of Mexico king mackerel as estimated in MSAP 2002.

AGE	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
0	65.	9441.	82.	38.	497.	3577.	1367.	771.	2292.	7005.	2218.	2239.	5768.	3389.	3722.	649.	161.	36.	163.	994.
1	1446.	22522.	368.	6669.	10645.	77665.	64736.	39373.	220559.	78530.	215542.	89107.	168104.	170473.	126449.	139544.	78033.	19973.	173947.	75407.
2	7242.	183273.	129346.	10386.	41627.	178847.	167700.	123181.	191102.	199413.	307759.	247546.	212503.	139494.	298995.	396921.	363508.	70997.	178738.	232711.
3	65376.	135946.	258564.	183855.	39065.	100524.	78833.	81653.	97434.	223494.	188532.	316783.	190773.	148795.	177464.	187029.	318288.	206344.	130183.	242627.
4	572111.	324974.	166109.	286885.	190830.	132548.	43595.	190716.	72016.	78530.	124847.	123335.	162643.	202540.	99129.	99113.	145077.	296774.	128359.	149029.
5	187534.	287056.	49403.	127509.	150344.	38378.	26985.	67345.	37602.	39696.	33281.	91130.	78023.	228710.	66396.	53908.	78987.	255143.	81238.	80121.
6	48128.	91735.	69101.	53807.	80569.	33590.	15806.	61996.	15230.	34648.	34331.	46570.	30426.	96235.	69827.	44443.	29871.	75853.	30997.	37341.
7	32219.	64634.	28827.	35385.	17960.	20219.	10627.	29372.	21013.	14600.	13481.	28818.	28361.	14868.	35673.	34766.	26286.	24594.	21337.	31078.
8	15491.	38302.	15842.	11628.	8789.	10150.	3828.	12207.	12830.	12055.	5645.	32853.	25445.	47590.	14235.	31014.	28730.	22513.	14190.	10420.
9	7458.	73266.	5819.	1915.	6325.	6203.	1844.	9957.	6204.	14711.	13850.	15529.	15776.	34305.	7660.	16136.	22974.	10982.	15394.	15367.
10	4108.	19877.	2097.	1946.	4700.	1307.	1680.	7529.	6826.	2929.	5807.	11488.	4481.	12395.	10313.	2421.	6725.	8798.	4893.	6378.
11	2110.	13434.	1235.	1142.	3292.	4880.	636.	5879.	6325.	2408.	2060.	13266.	11506.	3469.	7554.	6672.	2831.	4826.	4124.	5261.
12	2020.	1473.	1241.	369.	909.	1909.	785.	2559.	2867.	3559.	3680.	5994.	7846.	8049.	1125.	16460.	7051.	520.	3526.	4758.
13	613.	234.	423.	892.	770.	861.	605.	2278.	974.	2301.	4238.	4015.	2722.	3848.	2756.	0.	2121.	2498.	3209.	854.
14	2087.	280.	274.	443.	558.	1349.	742.	1604.	455.	598.	1145.	5651.	3585.	1838.	2159.	406.	325.	642.	3483.	532.
15	1144.	609.	151.	100.	492.	606.	336.	2263.	892.	585.	844.	2329.	1982.	1899.	294.	1579.	475.	93.	659.	594.
16	462.	176.	307.	77.	396.	420.	284.	2210.	892.	1345.	212.	941.	452.	711.	681.	650.	660.	634.	0.	6.
17	388.	131.	182.	56.	303.	228.	197.	1453.	1046.	238.	282.	641.	1185.	598.	154.	0.	0.	45.	0.	3.
18	248.	195.	168.	90.	405.	403.	292.	1674.	766.	377.	600.	660.	126.	356.	0.	443.	379.	74.	0.	3.
19	2551.	3807.	1253.	857.	2564.	911.	660.	3309.	431.	1727.	2641.	3323.	386.	2631.	184.	0.	0.	646.	1581.	336.
total	952799.	1271355.	730788.	724045.	561041.	614573.	421539.	647326.	697756.	718748.	960989.	1042215.	952091.	1122192.	924768.	1032154.	1112481.	1001979.	796022.	893818.

Table 12. Difference (percent) in estimated catch at age between the MSAP 2000 and MSAP 2002 assessments for four fishing years where the age length keys were updated (percentage computed as: (SAP 2002 estimate at age-MSAP 2000 estimate at age)/MSAP 2002 estimate*100.

AGE	1994	1995	1996	1997	1998
0	18.62	61.98	-2.77	-106.21	-1161.11
1	0.37	13.71	47.73	37.04	0.02
2	-0.23	9.31	4.52	26.49	2.68
3	0.34	-12.35	-24.14	-5.90	-0.72
4	0.64	25.71	-17.44	-66.06	0.17
5	0.10	-57.50	-49.78	-0.50	0.60
6	-1.26	5.05	16.58	-42.56	-2.12
7	-1.31	-49.58	-12.95	-14.02	-7.71
8	-0.55	-0.01	-1.17	4.32	-5.81
9	-1.73	-13.67	12.31	11.85	4.49
10	0.18	27.45	13.22	0.57	0.35
11	-22.37	-11.49	16.41	0.95	-2.98
12	4.61	-76.36	-7.55	12.31	-1.73
13	-4.55	37.37	NE	-30.79	-0.92
14	-0.54	20.98	53.45	-103.38	3.89
15	-0.68	18.37	-15.64	20.84	6.45
16	9.99	7.93	47.23	-18.33	0.16
17	-14.72	-87.01	NE	NE	8.89
18	-0.56	NE	-28.89	7.12	1.35
19	-3.99	-67.93	NE	NE	-5.88

NE= not estimable

Figure 1. Estimation of Gulf king mackerel catch at age for fishing year 1994 for the 2000 and 2002 annual stock assessments.

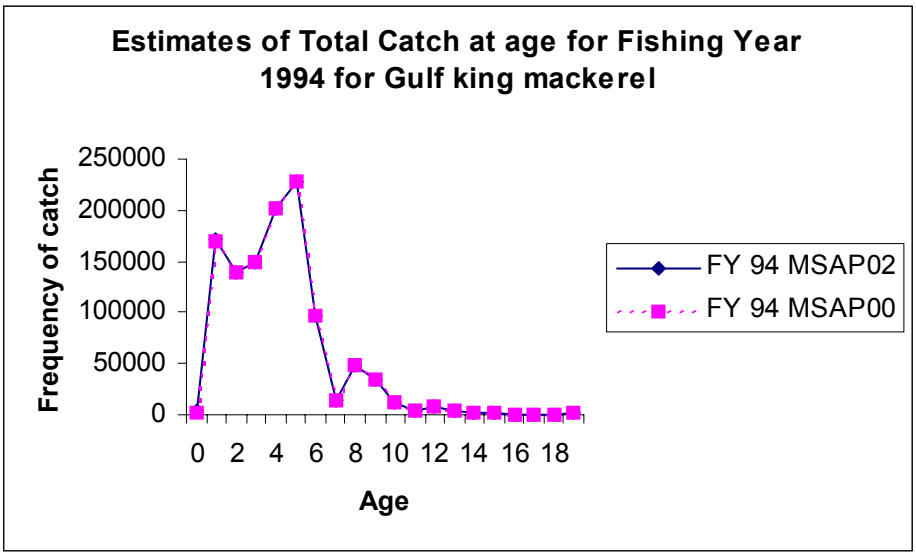


Figure 2. Estimation of Gulf king mackerel catch at age for fishing year 1995 for the 2000 and 2002 annual stock assessments.

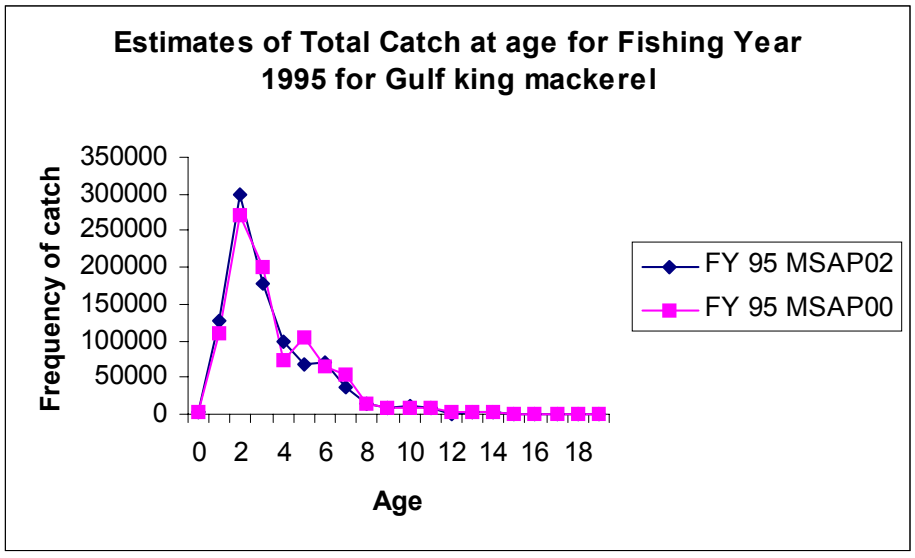


Figure 3. Estimation of Gulf king mackerel catch at age for fishing year 1996 for the 2000 and the 2002 annual stock assessments.

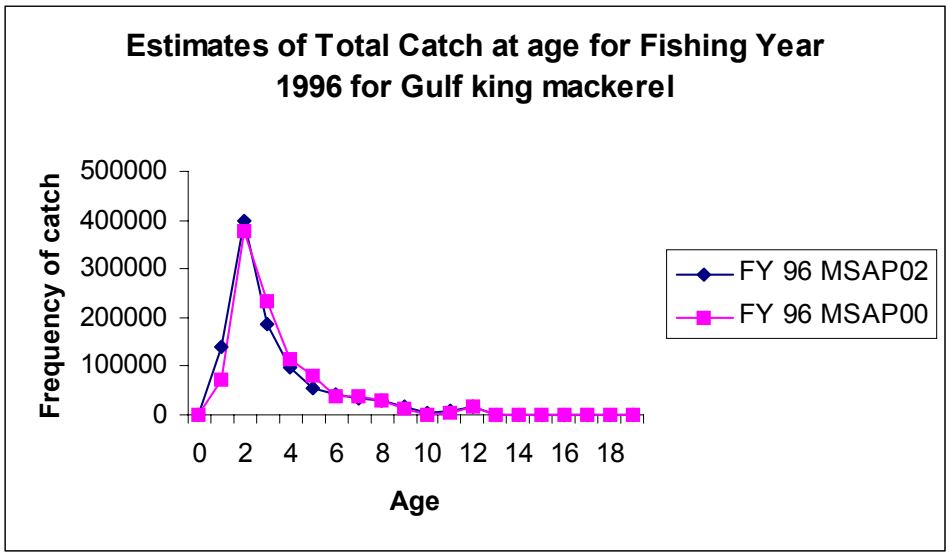


Figure 4. Estimation of Gulf king mackerel catch at age for fishing year 1997 for the 2000 and the 2002 annual stock assessments.

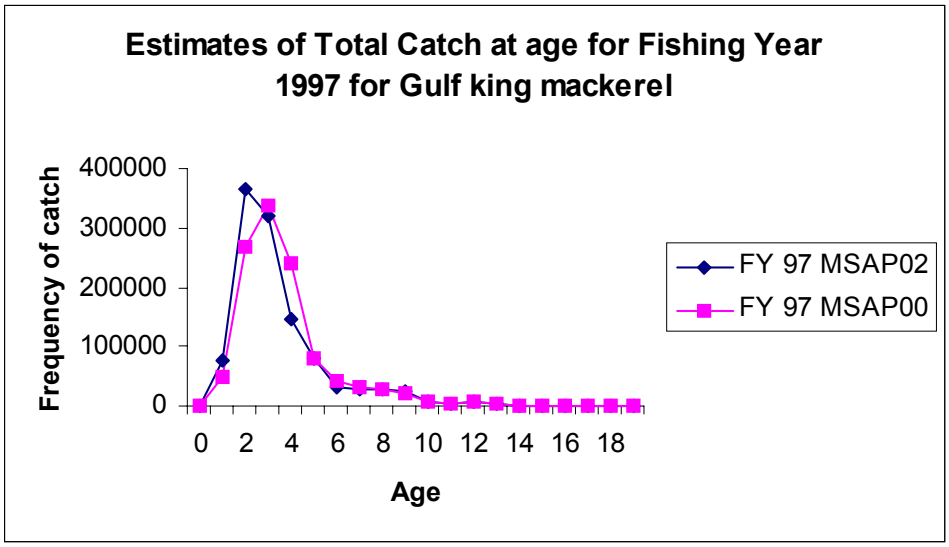


Figure 5. Calculated difference (Percent) in estimate of Catch at age for fishing years 1994-1997 for two assessment years (Difference = ((MSAP 2002 estimate at age - MSAP 2000 estimate at age) / MSAP 2002 estimate at age)*100).

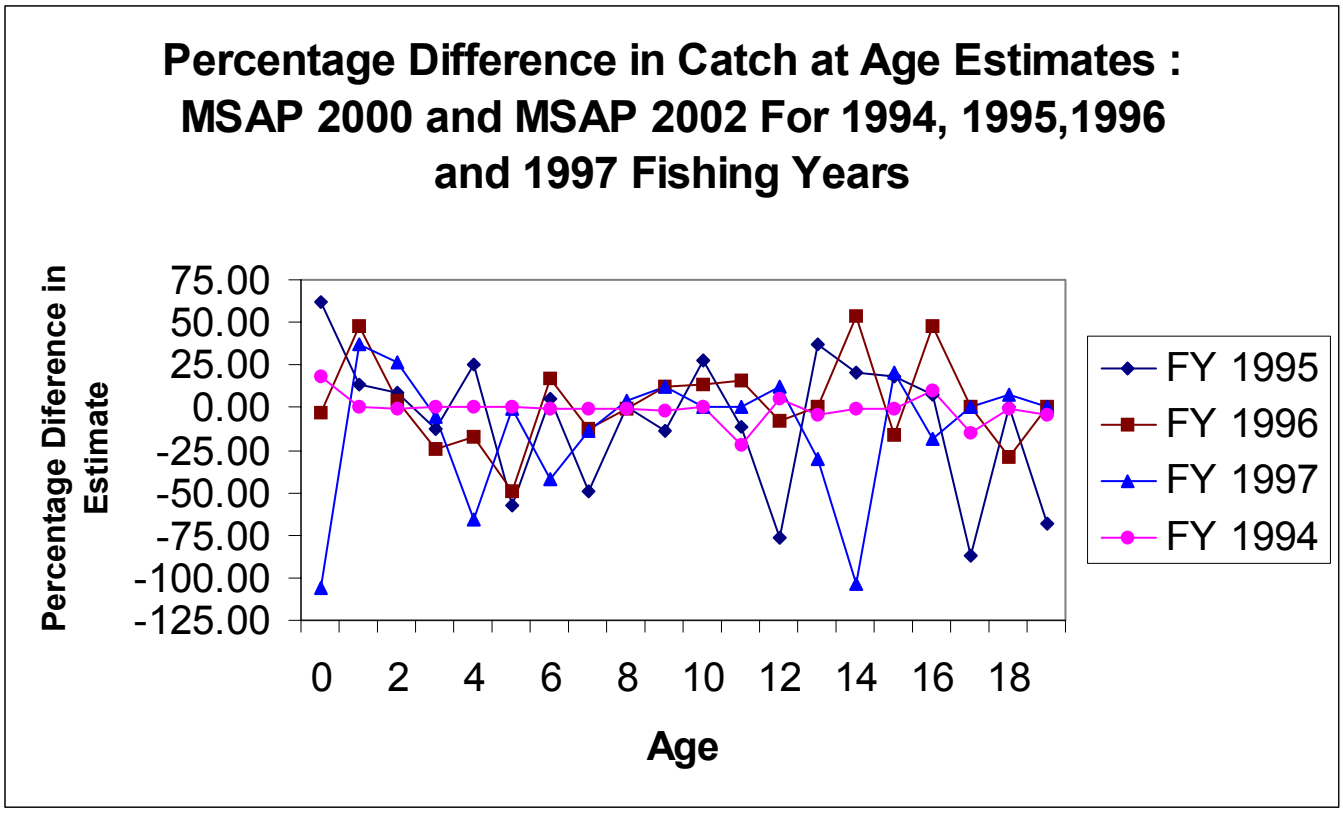
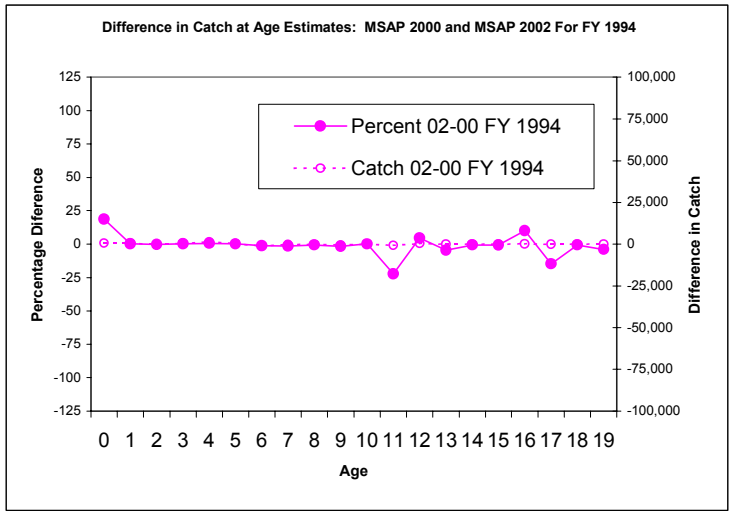
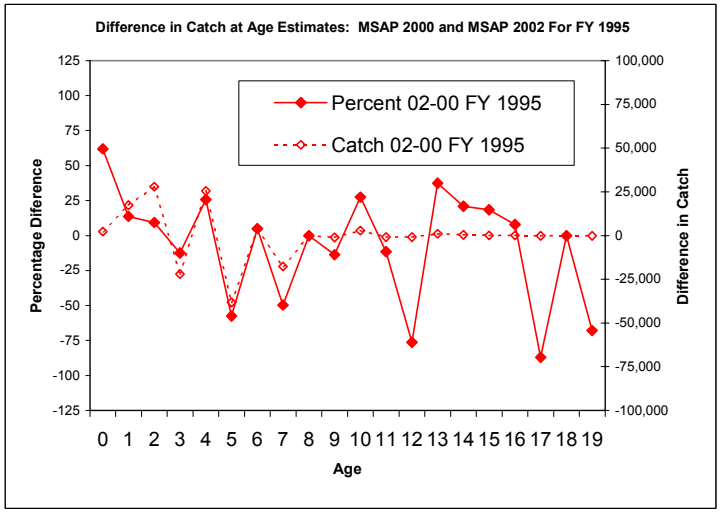
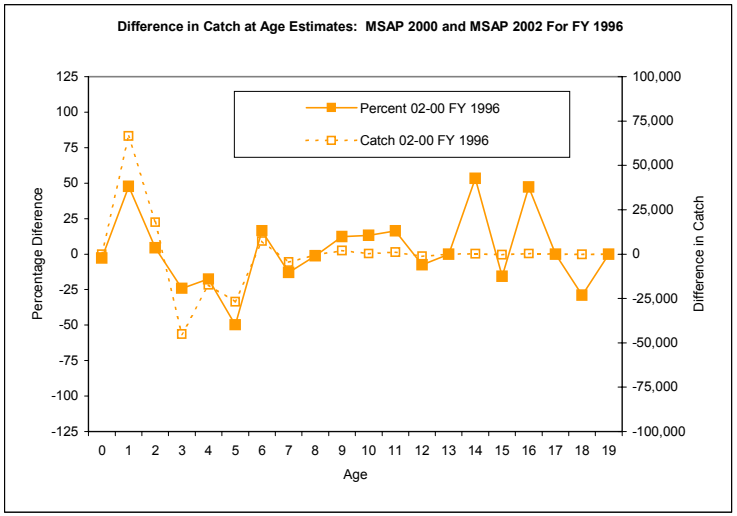


Figure 6. Difference in catch at age estimates for the 2000 and 2002 MSAP's for fishing years 1994-1997 (solid lines indicate Percent difference at age, dotted lines indicate absolute difference in catch at age).







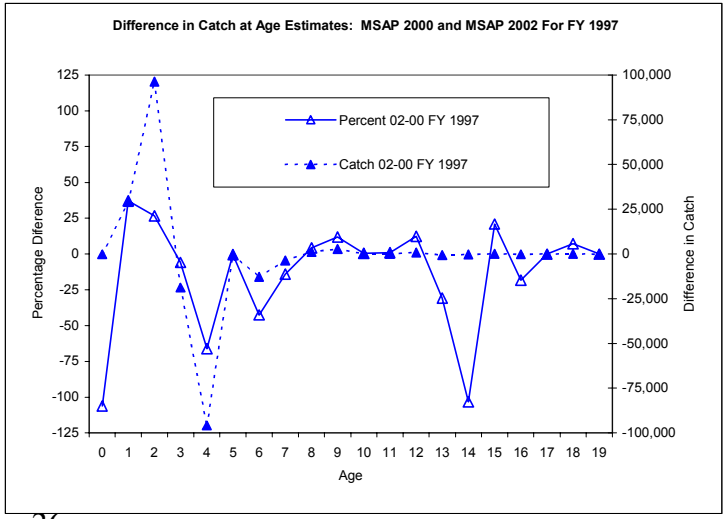


Figure 7. Estimated Catch at age by quarter and calendar year for the 2000 and 2002 Gulf king mackerel stock assessments (quarter 1=January-March, 2=April-June, 3=July-September, 4=October-December for the years where the age length key data were updated.