

Cobia (*Rachycentron canadum*) stock assessment study in the Gulf of Mexico and in the South Atlantic

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# **COBIA (*Rachycentron canadum*) STOCK ASSESSMENT STUDY IN THE GULF OF MEXICO AND IN THE SOUTH ATLANTIC**

***Award No. NA57FF0294 (MARFIN)***

## **Final Report**

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## I. PREFACE

The following information constitutes the Final Report (August 1, 1995 - December 31, 1997) by Mote Marine Laboratory (MML), on the Cobia Stock Assessment Study in the Gulf of Mexico and South Atlantic. This project was conducted by Mote Marine Laboratory and Gulf Coast Research Laboratory under the MARFIN Program.

## II. INTRODUCTION

This study was undertaken as part of an attempt to understand the stock identity of the cobia, *Rachycentron canadum*, in the Gulf of Mexico and South Atlantic. Mote Marine Laboratory (MML) and Gulf Coast Research Laboratory (GCRL) personnel worked together to provide age and growth information, develop an age/length key and obtain data on reproduction of cobia captured off the southeast coast of the United States from North Carolina to the Florida Keys and in the Gulf of Mexico from the Florida Gulf Coast to the coast of Texas. This report outlines our success in achieving the above-mentioned goals.

## III. SPECIMEN AND DATA COLLECTION

During this two-year project, a grand total of 703 (480 females and 223 males) cobia specimens were obtained. Of these fish, 329 were tournament fish (239 females, 90 males). Anglers responded favorably by donating cobia carcasses, even though there were major difficulties in obtaining specimens during Quarters I, II and III due to prolonged, **severe** weather conditions. The numerous hurricanes during August - November, 1995, stirred up so many nutrients in the warm Gulf waters that conditions were favorable for red tide blooms, resulting in massive fish kills along the southwest coast of Florida during 1995; however, 20 females and 10 males were collected during the first two quarters. One tournament was scheduled during Quarter III, but was cancelled and rescheduled because of bad weather. Cold weather (the coldest winter since 1989) and high winds prevailed during much of January, February and March, 1996, so that few specimens could be obtained during that time. Few boats fished the tournament because of the cold weather and high winds, even though 198 boats were registered. In spite of the weather, 25 fish (15 females and 10 males) were caught. In addition to the tournament fish, 37 additional fish were collected from fishers from Sunshine Key and Port Canaveral. These included 21 females and 16 males.

Quarter IV brought better weather and more productive fishing. A total of 191 cobia specimens (131 females, 60 males) were logged in during quarter IV, having been collected from fishers, charter boats and 13 fishing tournaments from which 101 specimens were collected (81 females, 20 males). A total of 136 specimens (95 females and 41 males) were logged in during Quarter V. Of these, 40 were tournament fish (28 females, 12 males), and 96 (67 females, 29 males) were non tournament fish. Of the non-tournament fish, eight undersized cobia were obtained from GCRL; 3 from Texas (1 female, 2 males), 4 from Alabama (3 females, 1 male), and 1 male from the Florida panhandle.

During the fall quarter (Quarter VI), 30 (19 females, 11 males) cobia specimens were logged in, including 5 undersized cobia (2 females, 3 males), caught by MML personnel. Quarter VII brought in 46 more specimens (33 females, 13 males), of which 16 (13 females, 3 males) were tournament fish collected from the Florida east coast. The tournament had been cancelled twice and rescheduled because of bad weather and high winds. During the tournament, a tornado was sighted near the docks where the tournament was held. Two more undersized cobia (both females) were caught by MML personnel.

Quarter VIII yielded 88 cobia (68 females, 20 males). Seventy-four of these were tournament fish (59 females, 15 males), and 6 were undersized fish captured by MML and GCRL personnel. Quarter IX yielded 73 (42 females, 31 males), of which 45 (22 females, 23 males) were tournament fish. Two other tournaments held this quarter, one on the east coast of Florida and one on the west coast, were attended by MML personnel, but no cobia were caught.

The final quarter, Quarter X, yielded 47 cobia specimens (36 females, 11 males). Eighteen of these fish were from tournaments (13 females, 5 males). This brings the grand total for the entire project to 703 cobia (480 females, 223 males) (**Figure 1**). **Table 1** shows tournament fish broken down by area, sex and size range. **Figure 2** shows the size of tournament cobia vs. non-tournament cobia from all areas sampled.

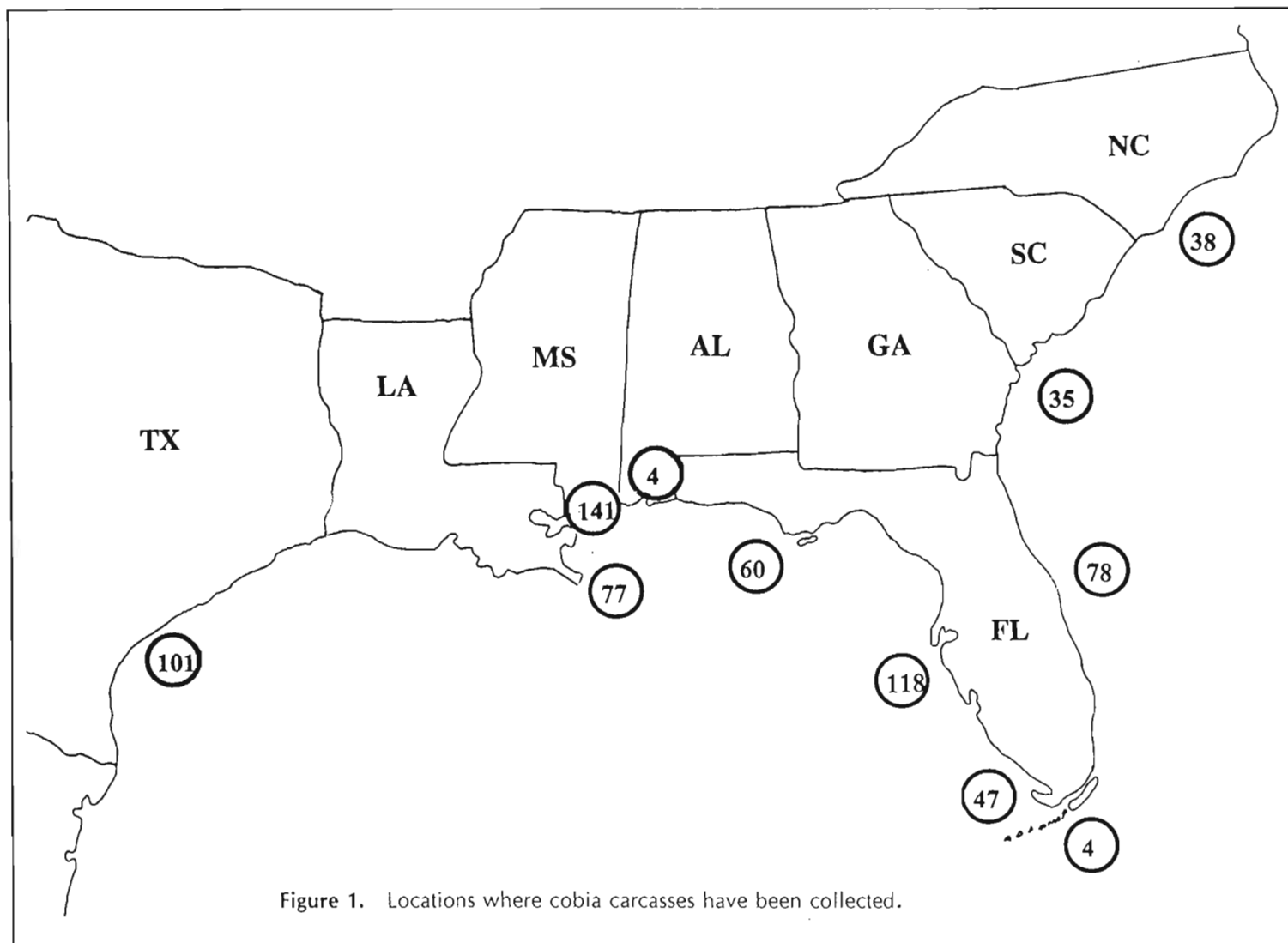
At the beginning of the project, six freezers were purchased and placed at various locations for the collection of cobia carcasses from anglers. These locations were: Harkers Island, NC, Hilton Head, SC, Big Pine Key, FL, Ocean Springs, MI (GCRL), and 2 at Port Aransas, TX. Additional freezer space was secured in 20 walk-in freezers at various fish houses and marina bait shops from Manteo, NC, to Tampa, FL.

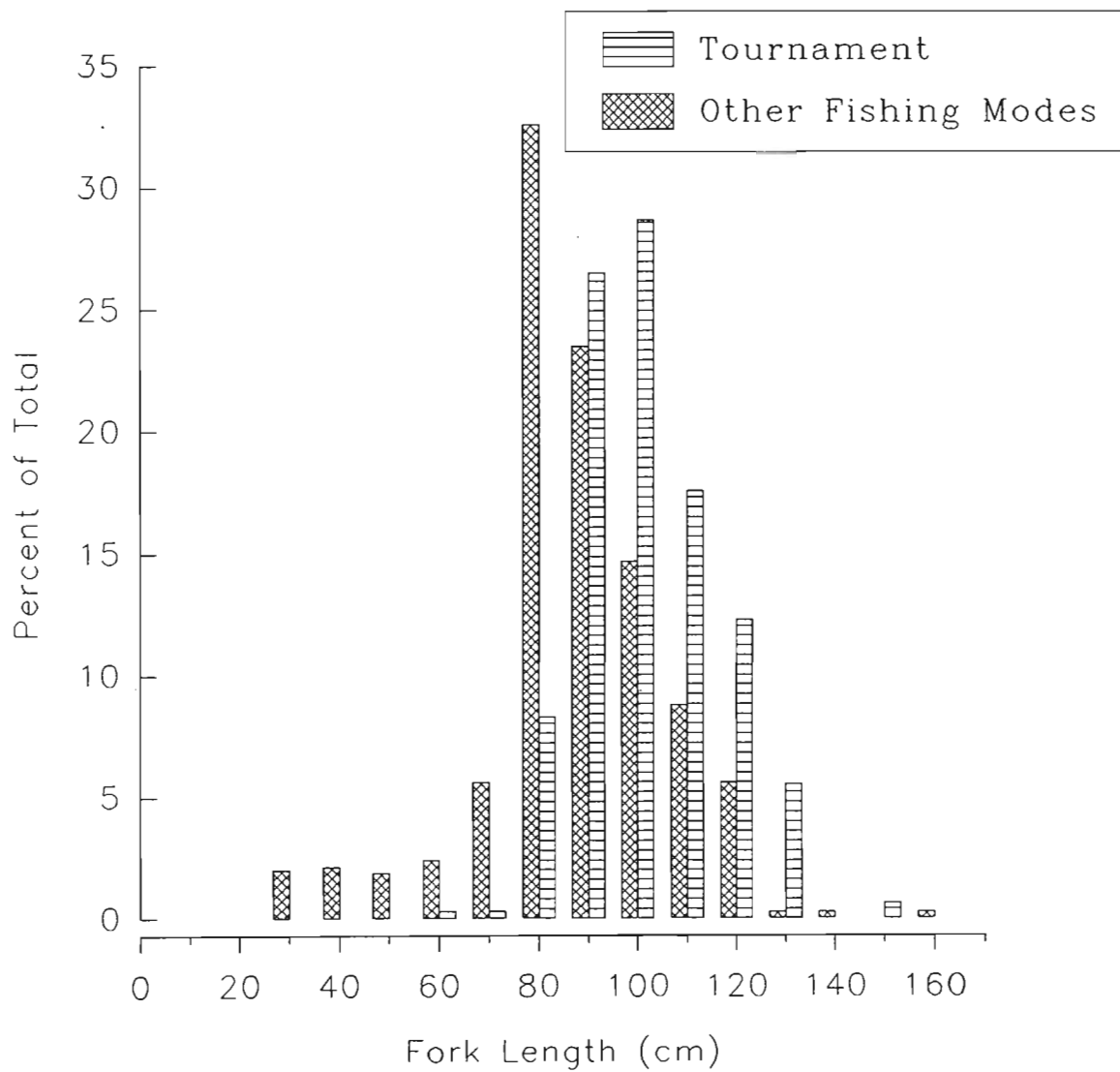
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**Table 1.** Tournament fish, broken down by area, sex and size range:

<u>Area</u>	<u>F</u>	<u>Size Range(cm)</u>	<u>M</u>	<u>Size Range(cm)</u>
Northern Gulf	173	79.4-158.5	51	82.5-139.0
Florida Gulf	5	37.0-101.0	0	N/A
Florida Atlantic	30	86.0-123.0	19	83.0-110.0
North and South Carolina	<u>31</u>	94.5-138.5	<u>20</u>	80.5-110.0
<b>TOTAL</b>	<b>239</b>		<b>90</b>	

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**Figure 2.** Size of cobia collected over the sampling area from tournaments vs. those from anglers.

**Table 2** shows the areas where cobia were caught and the number of females and males collected. In all cases, more females were available than males. Female cobia grow larger than male cobia. Since larger fish are targeted during tournaments, more females would be expected in the samples. Although the samples may be biased toward females in locations where most of the specimens were collected during tournaments, all fish from Texas and the Florida Keys were non-tournament fish, and still exhibited a greater percentage of females.

**Table 2.** Female to male ratio of cobia collected through the sampling area.

<u>Area</u>	<u>Females</u>	<u>Males</u>
Texas	61 (60%)	40 (40%)
Northern Gulf (MS,LA,AL,FL/Pan)	216 (77%)	66 (23%)
Florida Gulf	75 (65%)	41 (35%)
Florida Keys	28 (58%)	20 (42%)
Florida Atlantic	55 (66%)	28 (34%)
North and South Carolina	<u>45 (62%)</u>	<u>28 (38%)</u>
<b>TOTAL</b>	<b>480 (68%)</b>	<b>223 (32%)</b>

Data for the specimens collected during Quarters I-X, are presented as **Table 3**. Length/frequency data are included as **Figures 3 thru 7**. **Figures 3, 4** show the sizes of the female vs. male fish in the study. A breakdown of fish size by sex, month and location appears as **Figures 5 and 6**. **Figure 7** shows the length frequency of female and male cobia by total weight and fork length. Cobia distribution appears to be temperature dependent. Almost all cobia (both female and male) were captured from waters ranging from 20.0 - 30.0°C. **Figure 8** shows water temperature where female and male cobia were caught. Data for fish included in the reproductive portion of this study are included as **Table 4**. **Tables 5, 6 & 7** show the summary statistics by length, total weight and gonad weight for female and male cobia, including both total cobia and tournament cobia. Totals of cobia caught include tournament fish.

Seasonal variations in gonad weight as a percent of total weight for both female and male cobia is illustrated in **Figure 9**. **Figures 10 - 13** show the same data broken down by month, size and area. **Figure 14** shows gonad weight as percent of total weight for female and male cobia by area. All gonad samples were sent to and processed by GCRL. Results of the analyses are presented in the reproduction section of this report.

**Table 3.** Data from cobia from which biological samples were collected during (8/1/95 - 12/31/97 listed by state - (RR = rod & reel, GN = gill net, TRL = trawl, SP = spear).

Fish	State	Capture Date	Capture Area	Water Depth (ft)	Water Temp. (C)	Gear Type	Fork Length (cm)	Sex
117	FL/ATL	21-Apr-95	PALM BEACH	-	-	RR	110.0	F
18	NC	11-Jun-95	HARKERS ISLAND	-	-	RR	108.0	F
19	NC	11-Jun-95	HARKERS ISLAND	-	-	RR	119.0	F
20	NC	11-Jun-95	HARKERS ISLAND	-	-	RR	116.0	F
21	NC	11-Jun-95	HARKERS ISLAND	-	-	RR	133.0	F
22	NC	11-Jun-95	HARKERS ISLAND	-	-	RR	122.0	F
23	NC	11-Jun-95	HARKERS ISLAND	-	-	RR	107.0	F
24	NC	11-Jun-95	HARKERS ISLAND	-	-	RR	130.0	F
25	NC	11-Jun-95	HARKERS ISLAND	-	-	RR	130.0	F
26	NC	11-Jun-95	HARKERS ISLAND	-	-	RR	127.0	F
27	NC	11-Jun-95	HARKERS ISLAND	-	-	RR	130.0	F
118	FL/PAN	13-Aug-95	PANAMA CITY	-	-	RR	100.0	F
119	FL/PAN	13-Aug-95	PANAMA CITY	-	-	RR	106.0	F
1	FL/GULF	06-Sep-95	SANIBEL ISLAND	8.0	29.0	GN	57.2	F
2	FL/GULF	21-Sep-95	WACCASASSA BAY	7.0	28.0	GN	58.0	M
316	TX	11-Oct-95	CORPUS CHRISTI	14.7	27.5	TRL	40.0	M
314	TX	17-Oct-95	GALVESTON	14.0	-	TRL	31.0	M
313	TX	17-Oct-95	GALVESTON	14.7	-	TRL	31.5	F
3	FL/GULF	24-Oct-95	LONG BOAT KEY	15.0	25.0	RR	87.0	M
4	FL/GULF	24-Oct-95	LONG BOAT KEY	15.0	25.0	RR	89.0	F
5	FL/KEYS/GULF	26-Oct-95	BIG PINE KEY	52.0	29.0	RR	85.0	M
6	FL/KEYS/GULF	26-Oct-95	BIG PINE KEY	52.0	29.0	RR	84.5	M
7	FL/KEYS/GULF	26-Oct-95	BIG PINE KEY	52.0	29.0	RR	89.5	M
8	FL/GULF	27-Oct-95	WACCASASSA BAY	7.0	22.0	GN	57.0	F
317	AL	06-Nov-95	MOBILE	16.0	-	TRL	37.0	F
318	AL	06-Nov-95	MOBILE	16.0	-	TRL	41.5	F
319	AL	06-Nov-95	MOBILE	16.0	-	TRL	38.5	M
320	AL	06-Nov-95	MOBILE	16.0	-	TRL	43.0	F
315	FL/PAN	15-Nov-95	APALACHICOLA	16.2	-	TRL	38.0	M
9	FL/GULF	26-Nov-95	BUNCHE BEACH	5.0	20.5	RR	82.0	F
16	FL/GULF	28-Nov-95	FT. MYERS BEACH	5.0	20.5	RR	91.5	M
17	FL/GULF	28-Nov-95	FT. MYERS BEACH	5.0	20.5	RR	86.5	F
15	FL/GULF	04-Dec-95	BUNCHE BEACH	5.0	20.5	RR	86.5	F
12	FL/GULF	04-Dec-95	BUNCHE BEACH	6.0	20.5	RR	102.0	F
11	FL/GULF	05-Dec-95	BUNCHE BEACH	3.0	20.5	RR	122.0	F
13	FL/GULF	05-Dec-95	BUNCHE BEACH	6.0	20.5	RR	94.0	F
14	FL/GULF	05-Dec-95	BUNCHE BEACH	7.0	20.5	RR	89.0	M
10	FL/GULF	06-Dec-95	LONGBOAT KEY	17.0	17.0	RR	82.0	M
28	FL/GULF	15-Dec-95	SARASOTA	4.0	13.3	RR	84.0	M

**Table 3 (continued).** Data from cobia from which biological samples were collected during (8/1/95 - 12/31/97) listed by state - (RR = rod & reel, GN = gill net, TRL = trawl, SP = spear).

Fish	State	Capture Date	Capture Area	Water Depth (ft)	Water Temp. (C)	Gear Type	Fork Length (cm)	Sex
30	FL/GULF	16-Dec-95	FT. MYERS BEACH	5.0	13.3	RR	87.6	F
29	FL/GULF	18-Dec-95	FT. MYERS BEACH	5.0	13.3	RR	84.0	M
31	FL/ATL	16-Jan-96	PORT CANAVERAL	-	-	RR	88.0	M
32	FL/ATL	16-Jan-96	PORT CANAVERAL	-	-	RR	104.0	F
59	FL/KEYS/GULF	20-Jan-96	KEY WEST	12.0	22.5	RR	82.0	F
52	FL/KEYS/GULF	02-Feb-96	SUNSHINE KEY	10.0	22.5	RR	73.0	M
48	FL/KEYS/ATL	10-Feb-96	SUNSHINE KEY	40.0	22.5	RR	73.0	F
49	FL/KEYS/ATL	10-Feb-96	SUNSHINE KEY	40.0	22.5	RR	84.0	M
50	FL/KEYS/ATL	10-Feb-96	SUNSHINE KEY	40.0	22.5	RR	90.5	M
36	FL/KEYS/GULF	21-Feb-96	SUNSHINE KEY	10.0	22.5	RR	71.0	F
56	FL/KEYS/GULF	22-Feb-96	SUNSHINE KEY	9.0	22.5	RR	87.5	M
55	FL/KEYS/GULF	22-Feb-96	SUNSHINE KEY	10.0	22.5	RR	86.0	M
60	FL/KEYS/GULF	23-Feb-96	SUNSHINE KEY	10.0	22.5	RR	84.5	M
61	FL/KEYS/GULF	23-Feb-96	SUNSHINE KEY	10.0	22.5	RR	90.0	M
37	FL/KEYS/GULF	24-Feb-96	SUNSHINE KEY	10.0	22.5	RR	88.0	F
38	FL/KEYS/GULF	24-Feb-96	SUNSHINE KEY	10.0	22.5	RR	100.5	M
39	FL/KEYS/GULF	24-Feb-96	SUNSHINE KEY	10.0	22.5	RR	86.5	M
40	FL/KEYS/GULF	24-Feb-96	SUNSHINE KEY	10.0	22.5	RR	81.0	F
41	FL/KEYS/GULF	24-Feb-96	SUNSHINE KEY	10.0	22.5	RR	83.0	F
42	FL/KEYS/GULF	24-Feb-96	SUNSHINE KEY	10.0	22.5	RR	91.5	M
43	FL/KEYS/GULF	24-Feb-96	SUNSHINE KEY	10.0	22.5	RR	82.5	F
44	FL/KEYS/GULF	24-Feb-96	SUNSHINE KEY	10.0	22.5	RR	99.0	F
45	FL/KEYS/GULF	25-Feb-96	SUNSHINE KEY	10.0	22.5	RR	82.5	F
46	FL/KEYS/GULF	25-Feb-96	SUNSHINE KEY	10.0	22.5	RR	93.0	F
47	FL/KEYS/GULF	25-Feb-96	SUNSHINE KEY	10.0	22.5	RR	92.5	F
51	FL/KEYS/GULF	25-Feb-96	SUNSHINE KEY	10.0	22.5	RR	91.0	F
53	FL/KEYS/GULF	25-Feb-96	SUNSHINE KEY	10.0	22.5	RR	96.5	F
62	FL/ATL	25-Feb-96	PORT CANAVERAL	70.0	-	RR	112.0	F
63	FL/ATL	25-Feb-96	PORT CANAVERAL	70.0	-	RR	93.5	F
64	FL/ATL	25-Feb-96	PORT CANAVERAL	70.0	-	RR	91.5	F
65	FL/ATL	25-Feb-96	PORT CANAVERAL	70.0	-	RR	93.0	M
66	FL/ATL	25-Feb-96	PORT CANAVERAL	70.0	-	RR	87.0	M
67	FL/ATL	25-Feb-96	PORT CANAVERAL	70.0	-	RR	98.5	F
57	FL/KEYS/GULF	26-Feb-96	SUNSHINE KEY	10.0	22.5	RR	71.5	F
58	FL/KEYS/GULF	26-Feb-96	SUNSHINE KEY	10.0	22.5	RR	80.0	M
54	FL/KEYS/GULF	27-Feb-96	SUNSHINE KEY	10.0	22.5	RR	70.0	F
33	FL/KEYS/GULF	27-Feb-96	SUNSHINE KEY	72.0	22.5	RR	70.5	M

**Table 3 (continued).** Data from cobia from which biological samples were collected during (8/1/95 - 12/31/97) listed by state - (RR = rod & reel, GN = gill net, TRL = trawl, SP = spear).

Fish	State	Capture Date	Capture Area	Water Depth (ft)	Water Temp. (C)	Gear Type	Fork Length (cm)	Sex
34	FL/KEYS/GULF	27-Feb-96	SUNSHINE KEY	72.0	22.5	RR	87.0	M
35	FL/KEYS/GULF	27-Feb-96	SUNSHINE KEY	72.0	22.5	RR	91.0	F
115	FL/KEYS/GULF	28-Feb-96	SUNSHINE KEY	9.0	-	RR	86.5	F
114	FL/KEYS/GULF	28-Feb-96	SUNSHINE KEY	-	-	RR	105.0	F
112	FL/KEYS/GULF	15-Mar-96	SUNSHINE KEY	10.0	-	RR	77.0	F
94	FL/ATL	16-Mar-96	PORT CANAVERAL	118.0	20.0	RR	96.5	F
95	FL/ATL	16-Mar-96	PORT CANAVERAL	118.0	20.0	RR	107.0	F
98	FL/ATL	16-Mar-96	PORT CANAVERAL	118.0	20.0	RR	98.5	F
96	FL/ATL	17-Mar-96	PORT CANAVERAL	70.0	20.0	RR	113.0	M
97	FL/ATL	17-Mar-96	PORT CANAVERAL	-	20.0	RR	96.5	M
435	FL/GULF	20-Mar-96	PALM HARBOR	6.0	-	RR	79.0	F
93	FL/ATL	29-Mar-96	PORT CANAVERAL	50.0	20.0	RR	94.0	F
74	FL/ATL	30-Mar-96	PORT CANAVERAL	25.0	20.0	RR	118.0	F
80	FL/ATL	30-Mar-96	PORT CANAVERAL	35.0	20.0	RR	87.0	F
75	FL/ATL	30-Mar-96	PORT CANAVERAL	40.0	20.0	RR	101.0	F
69	FL/ATL	30-Mar-96	PORT CANAVERAL	43.0	20.0	RR	94.0	F
70	FL/ATL	30-Mar-96	PORT CANAVERAL	45.0	20.0	RR	94.5	M
77	FL/ATL	30-Mar-96	PORT CANAVERAL	50.0	20.0	RR	100.0	M
78	FL/ATL	30-Mar-96	PORT CANAVERAL	50.0	20.0	RR	93.0	M
83	FL/ATL	30-Mar-96	PORT CANAVERAL	50.0	20.0	RR	107.5	M
73	FL/ATL	30-Mar-96	PORT CANAVERAL	52.0	20.0	RR	92.0	F
81	FL/ATL	30-Mar-96	PORT CANAVERAL	52.0	20.0	RR	94.5	M
72	FL/ATL	30-Mar-96	PORT CANAVERAL	55.0	20.0	RR	105.5	F
71	FL/ATL	30-Mar-96	PORT CANAVERAL	56.0	20.0	RR	90.5	F
68	FL/ATL	30-Mar-96	PORT CANAVERAL	58.0	20.0	RR	110.0	M
76	FL/ATL	30-Mar-96	PORT CANAVERAL	58.0	20.0	RR	109.5	M
89	FL/ATL	30-Mar-96	PORT CANAVERAL	59.0	20.0	RR	93.0	F
91	FL/ATL	30-Mar-96	PORT CANAVERAL	75.0	20.0	RR	96.0	M
90	FL/ATL	30-Mar-96	PORT CANAVERAL	80.0	20.0	RR	92.0	F
88	FL/ATL	30-Mar-96	PORT CANAVERAL	98.0	20.0	RR	123.0	F
92	FL/ATL	30-Mar-96	PORT CANAVERAL	118.0	20.0	RR	86.0	F
79	FL/ATL	30-Mar-96	PORT CANAVERAL	-	20.0	RR	84.0	M
82	FL/ATL	30-Mar-96	PORT CANAVERAL	-	20.0	RR	98.0	F
84	FL/ATL	30-Mar-96	PORT CANAVERAL	-	20.0	RR	86.5	F
85	FL/ATL	30-Mar-96	PORT CANAVERAL	-	20.0	RR	104.5	F
86	FL/ATL	30-Mar-96	PORT CANAVERAL	-	20.0	RR	103.0	M
87	FL/ATL	30-Mar-96	PORT CANAVERAL	-	20.0	RR	96.0	F

**Table 3 (continued).** Data from cobia from which biological samples were collected during (8/1/95 - 12/31/97) listed by state - (RR = rod & reel, GN = gill net, TRL = trawl, SP = spear).

Fish	State	Capture Date	Capture Area	Water Depth (ft)	Water Temp. (C)	Gear Type	Fork Length (cm)	Sex
113	FL/KEYS/GULF	30-Mar-96	SUNSHINE KEY	50.0	-	RR	80.5	F
116	FL/KEYS/GULF	30-Mar-96	SUNSHINE KEY	-	-	RR	72.0	F
100	FL/GULF	04-Apr-96	TARPON SPRINGS	5.0	20.8	GN	88.0	M
99	FL/GULF	05-Apr-96	TARPON SPRINGS	5.0	21.0	GN	67.0	M
110	FL/ATL	06-Apr-96	PORT CANAVERAL	-	-	RR	107.0	F
111	FL/ATL	06-Apr-96	PORT CANAVERAL	-	-	RR	129.0	F
106	FL/ATL	07-Apr-96	PORT CANAVERAL	-	-	RR	90.0	F
107	FL/ATL	07-Apr-96	PORT CANAVERAL	-	-	RR	110.0	F
101	FL/GULF	11-Apr-96	SARASOTA	9.0	19.1	GN	72.5	M
102	FL/GULF	11-Apr-96	SARASOTA	9.0	20.0	GN	81.5	M
103	FL/GULF	12-Apr-96	SARASOTA	9.0	19.8	GN	70.0	F
104	FL/ATL	12-Apr-96	PORT CANAVERAL	21.0	-	RR	95.0	F
109	FL/ATL	12-Apr-96	PORT CANAVERAL	21.0	-	RR	112.0	F
461	FL/PAN	13-Apr-96	PANAMA CITY	140.0	-	RR	91.8	F
105	FL/ATL	13-Apr-96	PORT CANAVERAL	-	-	RR	83.0	M
108	FL/ATL	13-Apr-96	PORT CANAVERAL	-	-	RR	109.0	F
458	FL/PAN	19-Apr-96	PANAMA CITY	-	-	RR	89.6	M
459	FL/PAN	19-Apr-96	PANAMA CITY	-	-	RR	90.7	F
227	FL/ATL	20-Apr-96	PORT CANAVERAL	35.0	-	RR	94.0	M
212	FL/ATL	21-Apr-96	PORT CANAVERAL	30.0	-	RR	85.0	F
219	FL/ATL	21-Apr-96	PORT CANAVERAL	30.0	-	RR	83.0	F
220	FL/ATL	21-Apr-96	PORT CANAVERAL	30.0	-	RR	89.0	M
474	FL/PAN	21-Apr-96	PANAMA CITY	140.0	-	RR	107.8	F
218	FL/ATL	21-Apr-96	PORT CANAVERAL	-	-	RR	92.0	F
120	FL/GULF	25-Apr-96	SARASOTA	17.0	21.0	RR	116.0	F
121	FL/GULF	25-Apr-96	SARASOTA	25.0	21.0	RR	109.0	F
122	FL/GULF	25-Apr-96	SARASOTA	25.0	21.0	RR	85.5	F
123	FL/GULF	25-Apr-96	TAMPA BAY	7.0	24.1	GN	69.5	M
124	FL/GULF	26-Apr-96	SARASOTA	17.0	21.0	GN	101.5	F
125	FL/GULF	26-Apr-96	SARASOTA	17.0	21.0	GN	82.0	F
154	MS	27-Apr-96	HORN ISLAND	5.0	-	RR	97.3	F
148	LA	27-Apr-96	CHANDELEUR ISLAND	8.0	-	RR	109.6	F
149	LA	27-Apr-96	CHANDELEUR ISLAND	8.0	-	RR	97.1	F
150	LA	27-Apr-96	CHANDELEUR ISLAND	8.0	-	RR	90.0	M
152	LA	27-Apr-96	CHANDELEUR ISLAND	8.0	-	RR	99.0	F
153	LA	27-Apr-96	CHANDELEUR ISLAND	8.0	-	RR	107.5	F
156	LA	27-Apr-96	CHANDELEUR ISLAND	10.0	-	RR	115.2	F

**Table 3 (continued).** Data from cobia from which biological samples were collected during (8/1/95 - 12/31/97) listed by state - (RR = rod & reel, GN = gill net, TRL = trawl, SP = spear).

Fish	State	Capture Date	Capture Area	Water Depth (ft)	Water Temp. (C)	Gear Type	Fork Length (cm)	Sex
157	LA	27-Apr-96	CHANDELEUR ISLAND	10.0	-	RR	111.1	F
158	MS	27-Apr-96	PETIT BOIS ISLAND	10.0	-	RR	128.1	F
159	LA	27-Apr-96	CHANDELEUR ISLAND	11.0	-	RR	138.5	F
155	MS	27-Apr-96	HORN ISLAND	12.0	-	RR	122.6	F
160	LA	27-Apr-96	CHANDELEUR ISLAND	12.0	-	RR	133.0	F
161	LA	27-Apr-96	CHANDELEUR ISLAND	12.0	-	RR	128.6	F
453	FL/PAN	27-Apr-96	PANAMA CITY	140.0	-	RR	121.0	F
454	FL/PAN	27-Apr-96	PANAMA CITY	140.0	-	RR	109.0	F
455	FL/PAN	27-Apr-96	PANAMA CITY	140.0	-	RR	121.0	F
456	FL/PAN	27-Apr-96	PANAMA CITY	140.0	-	RR	86.0	M
457	FL/PAN	27-Apr-96	PANAMA CITY	140.0	-	RR	119.0	F
147	LA	27-Apr-96	CHANDELEUR ISLAND	-	-	RR	125.4	F
476	FL/PAN	28-Apr-96	PANAMA CITY	140.0	-	RR	111.7	F
126	FL/GULF	01-May-96	ANCLOTE KEY	4.0	22.5	GN	36.5	M
127	FL/GULF	01-May-96	ANCLOTE KEY	4.0	22.5	GN	72.0	F
128	FL/GULF	01-May-96	ANCLOTE KEY	6.0	22.8	GN	74.0	F
228	FL/KEYS/GULF	02-May-96	SUNSHINE KEY	72.0	-	RR	99.0	F
229	FL/KEYS/GULF	02-May-96	SUNSHINE KEY	72.0	-	RR	88.0	M
230	FL/KEYS/GULF	02-May-96	SUNSHINE KEY	72.0	-	RR	93.0	M
259	MS	03-May-96	BILOXI	8.0	-	RR	158.5	F
170	LA	03-May-96	CHANDELEUR ISLAND	10.0	-	RR	106.5	F
171	LA	03-May-96	CHANDELEUR ISLAND	10.0	-	RR	115.0	F
172	LA	03-May-96	CHANDELEUR ISLAND	10.0	-	RR	115.0	F
174	MS	03-May-96	HORN ISLAND	10.0	-	RR	96.5	F
175	MS	03-May-96	HORN ISLAND	10.0	-	RR	92.5	F
168	MS	03-May-96	HORN ISLAND	11.0	-	RR	103.0	F
169	MS	03-May-96	HORN ISLAND	11.0	-	RR	105.0	F
181	MS	03-May-96	HORN ISLAND	11.0	-	RR	98.3	M
173	LA	03-May-96	CHANDELEUR ISLAND	12.0	-	RR	116.5	F
231	FL/KEYS/GULF	03-May-96	SUNSHINE KEY	86.0	-	RR	106.0	F
162	MS	03-May-96	BILOXI	-	-	RR	93.0	M
163	MS	03-May-96	BILOXI	-	-	RR	95.5	F
164	MS	03-May-96	BILOXI	-	-	RR	104.5	F
165	MS	03-May-96	BILOXI	-	-	RR	103.5	F
166	MS	03-May-96	BILOXI	-	-	RR	101.5	F
167	MS	03-May-96	BILOXI	-	-	RR	104.5	F
176	MS	03-May-96	BILOXI	-	-	RR	102.0	F

**Table 3 (continued).** Data from cobia from which biological samples were collected during (8/1/95 - 12/31/97) listed by state - (RR = rod & reel, GN = gill net, TRL = trawl, SP = spear).

Fish	State	Capture Date	Capture Area	Water Depth (ft)	Water Temp. (C)	Gear Type	Fork Length (cm)	Sex
177	MS	03-May-96	BILOXI	-	-	RR	98.5	F
178	MS	03-May-96	BILOXI	-	-	RR	98.8	F
179	MS	03-May-96	BILOXI	-	-	RR	85.0	F
180	LA	03-May-96	CHANDELEUR ISLAND	-	-	RR	135.0	F
260	MS	03-May-96	BILOXI	-	-	RR	155.5	F
190	LA	04-May-96	CHANDELEUR ISLAND	7.0	-	RR	105.0	M
192	LA	04-May-96	CHANDELEUR ISLAND	7.0	-	RR	99.2	F
193	LA	04-May-96	CHANDELEUR ISLAND	7.0	-	RR	107.8	F
194	LA	04-May-96	CHANDELEUR ISLAND	9.0	-	RR	93.5	F
195	LA	04-May-96	CHANDELEUR ISLAND	9.0	-	RR	98.7	F
187	LA	04-May-96	CHANDELEUR ISLAND	10.0	-	RR	123.0	F
188	LA	04-May-96	CHANDELEUR ISLAND	10.0	-	RR	104.0	F
189	LA	04-May-96	CHANDELEUR ISLAND	10.0	-	RR	126.0	F
199	LA	04-May-96	CHANDELEUR ISLAND	10.0	-	RR	100.0	F
200	LA	04-May-96	CHANDELEUR ISLAND	10.0	-	RR	95.5	F
201	LA	04-May-96	CHANDELEUR ISLAND	10.0	-	RR	131.0	F
183	LA	04-May-96	CHANDELEUR ISLAND	11.0	-	RR	106.5	F
184	LA	04-May-96	CHANDELEUR ISLAND	11.0	-	RR	109.6	F
185	LA	04-May-96	CHANDELEUR ISLAND	11.0	-	RR	114.6	F
196	LA	04-May-96	CHANDELEUR ISLAND	12.0	-	RR	119.5	F
197	LA	04-May-96	CHANDELEUR ISLAND	12.0	-	RR	120.8	F
198	LA	04-May-96	CHANDELEUR ISLAND	12.0	-	RR	118.4	F
191	MS	04-May-96	HORN ISLAND	13.0	-	RR	102.6	F
186	LA	04-May-96	CURLEW RIGS, LA	27.0	-	RR	106.0	F
182	MS	04-May-96	BILOXI	-	-	RR	87.0	M
203	LA	05-May-96	CHANDELEUR ISLAND	10.0	-	RR	123.0	F
204	LA	05-May-96	CHANDELEUR ISLAND	10.0	-	RR	114.0	F
205	LA	05-May-96	CHANDELEUR ISLAND	10.0	-	RR	134.5	F
206	LA	05-May-96	CHANDELEUR ISLAND	10.0	-	RR	131.2	F
151	LA	05-May-96	CHANDELEUR ISLAND	12.0	-	RR	108.5	F
202	LA	05-May-96	CHANDELEUR ISLAND	12.0	-	RR	90.0	F
207	MS	05-May-96	CHANDELEUR ISLAND	12.0	-	RR	98.5	F
208	LA	05-May-96	CHANDELEUR ISLAND	12.0	-	RR	128.0	F
209	LA	05-May-96	CHANDELEUR ISLAND	12.0	-	RR	129.5	F
210	LA	05-May-96	CHANDELEUR ISLAND	12.0	-	RR	110.0	F
211	LA	05-May-96	CHANDELEUR ISLAND	12.0	-	RR	117.5	F
146	SC	08-May-96	HH SOUTH BEACH	10.0	22.0	RR	96.5	M

**Table 3 (continued).** Data from cobia from which biological samples were collected during (8/1/95 - 12/31/97) listed by state - (RR = rod & reel, GN = gill net, TRL = trawl, SP = spear).

Fish	State	Capture Date	Capture Area	Water Depth (ft)	Water Temp. (C)	Gear Type	Fork Length (cm)	Sex
216	FL/GULF	08-May-96	YANKEE TOWN	7.0	26.8	GN	69.0	M
217	FL/GULF	08-May-96	YANKEE TOWN	7.0	26.8	GN	74.0	M
145	SC	10-May-96	HH TIRE REEF	50.0	22.0	RR	91.0	M
221	SC	10-May-96	HH TIRE REEF	50.0	22.0	RR	117.0	F
463	FL/PAN	12-May-96	PANAMA CITY	140.0	-	RR	121.0	F
300	TX	14-May-96	PORT ARANSAS	325.0	25.7	RR	89.5	M
297	TX	15-May-96	PORT ARANSAS	325.0	25.7	RR	104.8	M
298	TX	15-May-96	PORT ARANSAS	325.0	25.7	RR	83.8	M
144	SC	16-May-96	HH TIRE REEF	60.0	22.0	RR	117.0	F
222	SC	16-May-96	HH TIRE REEF	60.0	22.0	RR	116.0	F
129	FL/GULF	19-May-96	BRADENTON	5.0	-	RR	93.0	F
223	SC	21-May-96	HH TIRE REEF	35.0	22.0	RR	118.0	F
308	TX	21-May-96	PORT ARANSAS	325.0	25.7	RR	99.4	M
296	TX	21-May-96	PORT ARANSAS	325.0	25.8	RR	91.4	M
301	TX	21-May-96	PORT ARANSAS	325.0	25.8	RR	86.4	M
302	TX	21-May-96	PORT ARANSAS	325.0	25.8	RR	95.6	M
304	TX	21-May-96	PORT ARANSAS	325.0	25.8	RR	85.1	M
305	TX	21-May-96	PORT ARANSAS	325.0	25.8	RR	94.0	M
306	TX	21-May-96	PORT ARANSAS	325.0	25.8	RR	85.4	M
307	TX	21-May-96	PORT ARANSAS	325.0	25.8	RR	88.3	M
130	SC	22-May-96	BROAD RIVER	20.0	22.0	RR	101.0	M
131	SC	22-May-96	EAGLE'S NEST REEF	65.0	22.0	RR	113.0	F
132	SC	22-May-96	BETSY ROSS REEF	-	22.0	RR	102.0	F
133	SC	22-May-96	EAGLE'S NEST REEF	-	22.0	RR	110.0	M
134	SC	22-May-96	HH TIRE REEF	-	22.0	RR	107.0	M
135	SC	22-May-96	EAGLE'S NEST REEF	-	22.0	RR	99.0	M
136	SC	22-May-96	L BUOY	-	22.0	RR	98.5	M
137	SC	22-May-96	HH TIRE REEF	-	22.0	RR	104.0	M
138	SC	22-May-96	HH TIRE REEF	-	22.0	RR	97.0	M
139	SC	22-May-96	SAVANNA TOWER	-	22.0	RR	102.0	M
140	SC	22-May-96	HILTON HEAD	-	22.0	RR	95.5	M
278	TX	22-May-96	PORT ARANSAS	325.0	25.8	RR	121.9	F
299	TX	22-May-96	PORT ARANSAS	325.0	25.8	RR	87.0	M
392	TX	22-May-96	PORT ARANSAS	-	25.8	RR	88.3	M
142	SC	24-May-96	BROAD RIVER	25.0	22.0	RR	80.5	M
261	MS	24-May-96	BILOXI	-	-	RR	125.1	F
262	MS	24-May-96	BILOXI	-	-	RR	90.2	F

**Table 3 (continued).** Data from cobia from which biological samples were collected during (8/1/95 - 12/31/97) listed by state - (RR = rod & reel, GN = gill net, TRL = trawl, SP = spear).

Fish	State	Capture Date	Capture Area	Water Depth (ft)	Water Temp. (C)	Gear Type	Fork Length (cm)	Sex
263	MS	24-May-96	BILOXI	-	-	RR	123.1	F
141	SC	25-May-96	BROAD RIVER	12.0	22.0	RR	104.0	M
143	SC	25-May-96	BROAD RIVER	40.0	22.0	RR	84.5	M
215	FL/ATL	25-May-96	PORT CANAVERAL	20.5	-	RR	94.0	M
214	FL/ATL	25-May-96	PORT CANAVERAL	120.0	-	RR	99.0	M
213	FL/ATL	25-May-96	PORT CANAVERAL	130.0	-	RR	94.5	M
237	NC	26-May-96	HARKERS ISLAND	20.0	-	RR	101.0	M
255	SC	26-May-96	HILTON HEAD	30.0	-	RR	117.5	F
238	NC	26-May-96	SHACKLEFORD ISLAND	-	-	RR	127.0	F
239	NC	26-May-96	HARKERS ISLAND	-	-	RR	132.0	F
240	NC	26-May-96	HARKERS ISLAND	-	-	RR	106.0	F
241	NC	26-May-96	HARKERS ISLAND	-	-	RR	100.0	M
460	FL/PAN	30-May-96	PANAMA CITY	140.0	-	RR	98.8	F
282	TX	01-Jun-96	PORT ARANSAS	325.0	27.3	RR	85.4	M
283	TX	02-Jun-96	PORT ARANSAS	325.0	27.3	RR	83.8	F
284	TX	02-Jun-96	PORT ARANSAS	325.0	27.3	RR	93.4	F
285	TX	02-Jun-96	PORT ARANSAS	325.0	27.3	RR	102.2	F
286	TX	02-Jun-96	PORT ARANSAS	325.0	27.3	RR	118.8	F
224	FL/GULF	05-Jun-96	TARPON SPRINGS	-	-	GN	57.0	M
225	FL/ATL	08-Jun-96	PORT CANAVERAL	55.0	-	RR	104.5	F
226	FL/ATL	08-Jun-96	PORT CANAVERAL	90.0	-	RR	109.0	F
242	NC	08-Jun-96	HARKERS ISLAND	-	-	RR	120.0	F
243	NC	08-Jun-96	HARKERS ISLAND	-	-	RR	101.0	F
244	NC	08-Jun-96	HARKERS ISLAND	-	-	RR	127.0	F
245	NC	08-Jun-96	HARKERS ISLAND	-	-	RR	107.0	F
246	NC	08-Jun-96	HARKERS ISLAND	-	-	RR	99.0	F
247	NC	08-Jun-96	HARKERS ISLAND	-	-	RR	121.0	F
248	NC	08-Jun-96	HARKERS ISLAND	-	-	RR	114.0	F
249	NC	08-Jun-96	HARKERS ISLAND	-	-	RR	114.0	F
250	NC	08-Jun-96	HARKERS ISLAND	-	-	RR	120.0	F
251	NC	08-Jun-96	HARKERS ISLAND	-	-	RR	118.0	F
252	NC	08-Jun-96	HARKERS ISLAND	-	-	RR	134.0	F
236	NC	09-Jun-96	NEWPORT BEACH	-	-	RR	85.0	M
235	NC	10-Jun-96	NEWPORT BEACH	20.0	-	RR	85.0	M
477	FL/PAN	15-Jun-96	PANAMA CITY	140.0	-	RR	144.7	F
234	FL/GULF	17-Jun-96	SARASOTA	3.0	30.4	GN	80.0	F
232	FL/GULF	17-Jun-96	TAMPA	35.0	-	RR	84.0	M

**Table 3 (continued).** Data from cobia from which biological samples were collected during (8/1/95 - 12/31/97) listed by state - (RR = rod & reel, GN = gill net, TRL = trawl, SP = spear).

Fish	State	Capture Date	Capture Area	Water Depth (ft)	Water Temp. (C)	Gear Type	Fork Length (cm)	Sex
233	FL/GULF	17-Jun-96	TAMPA	35.0	-	RR	111.0	F
462	FL/PAN	22-Jun-96	PANAMA CITY	-	-	RR	90.5	M
464	FL/PAN	23-Jun-96	PANAMA CITY	-	-	RR	88.7	M
465	FL/PAN	23-Jun-96	PANAMA CITY	-	-	RR	98.0	F
466	FL/PAN	23-Jun-96	PANAMA CITY	-	-	RR	118.4	M
303	TX	27-Jun-96	PORT ARANSAS	325.0	28.5	RR	90.8	M
288	TX	28-Jun-96	PORT ARANSAS	325.0	28.5	RR	91.4	M
253	FL/GULF	28-Jun-96	CRYSTAL RIVER	8.0	31.0	GN	56.0	F
280	TX	29-Jun-96	PORT ARANSAS	325.0	28.5	RR	117.5	F
281	TX	29-Jun-96	PORT ARANSAS	325.0	28.5	RR	84.5	F
287	TX	29-Jun-96	PORT ARANSAS	325.0	28.5	RR	83.2	M
264	MS	02-Jul-96	GULFPORT	-	-	RR	92.0	F
265	MS	02-Jul-96	GULFPORT	-	-	RR	89.8	F
267	MS	03-Jul-96	GULFPORT	-	-	RR	105.5	F
268	MS	03-Jul-96	GULFPORT	-	-	RR	92.2	F
269	MS	03-Jul-96	GULFPORT	-	-	RR	88.8	F
270	MS	05-Jul-96	GULFPORT	-	-	RR	101.3	M
271	MS	05-Jul-96	GULFPORT	-	-	RR	100.0	F
272	MS	05-Jul-96	GULFPORT	-	-	RR	97.0	M
273	MS	05-Jul-96	GULFPORT	-	-	RR	100.0	F
274	MS	05-Jul-96	GULFPORT	-	-	RR	120.1	F
275	MS	06-Jul-96	GULFPORT	-	-	RR	122.2	F
276	MS	06-Jul-96	GULFPORT	-	-	RR	123.0	M
277	MS	06-Jul-96	GULFPORT	-	-	RR	102.1	F
289	TX	07-Jul-96	PORT ARANSAS	325.0	29.0	RR	118.8	F
290	TX	07-Jul-96	PORT ARANSAS	325.0	29.0	RR	92.7	M
291	TX	07-Jul-96	PORT ARANSAS	325.0	29.0	RR	91.4	M
292	TX	07-Jul-96	PORT ARANSAS	325.0	29.0	RR	87.6	M
293	TX	07-Jul-96	PORT ARANSAS	325.0	29.0	RR	92.1	M
294	TX	07-Jul-96	PORT ARANSAS	325.0	29.0	RR	102.9	M
295	TX	07-Jul-96	PORT ARANSAS	325.0	29.0	RR	115.6	F
257	FL/GULF	08-Jul-96	HILLSBOROUGH BAY	4.0	-	RR	90.0	F
258	FL/GULF	08-Jul-96	HILLSBOROUGH BAY	50.0	-	RR	84.5	M
256	FL/GULF	08-Jul-96	SARASOTA	-	-	RR	88.0	F
325	TX	11-Jul-96	PORT ARANSAS	-	29.0	RR	95.3	M
327	TX	16-Jul-96	PORT ARANSAS	55.0	29.0	RR	104.1	F
328	TX	16-Jul-96	PORT ARANSAS	55.0	29.0	RR	116.2	F

**Table 3 (continued).**

Data from cobia from which biological samples were collected during (8/1/95 - 12/31/97) listed by state - (RR = rod & reel, GN = gill net, TRL = trawl, SP = spear).

Fish	State	Capture Date	Capture Area	Water Depth (ft)	Water Temp. (C)	Gear Type	Fork Length (cm)	Sex
329	TX	16-Jul-96	PORT ARANSAS	55.0	29.0	RR	90.5	F
330	TX	16-Jul-96	PORT ARANSAS	55.0	29.0	RR	100.3	F
332	TX	16-Jul-96	PORT ARANSAS	55.0	29.0	RR	109.9	F
333	TX	16-Jul-96	PORT ARANSAS	55.0	29.0	RR	99.1	F
335	TX	16-Jul-96	PORT ARANSAS	55.0	29.0	RR	83.2	M
390	TX	16-Jul-96	PORT ARANSAS	55.0	29.0	RR	111.8	F
389	TX	16-Jul-96	PORT ARANSAS	325.0	29.0	RR	83.2	F
391	TX	16-Jul-96	PORT ARANSAS	325.0	29.0	RR	106.0	F
254	FL/GULF	16-Jul-96	HILLSBOROUGH BAY	50.0	-	RR	93.0	F
266	FL/GULF	16-Jul-96	HILLSBOROUGH BAY	50.0	-	RR	87.0	M
334	TX	17-Jul-96	PORT ARANSAS	55.0	29.0	RR	81.9	F
331	TX	17-Jul-96	PORT ARANSAS	120.0	29.0	RR	79.4	F
336	TX	17-Jul-96	PORT ARANSAS	120.0	29.0	RR	118.4	F
338	TX	17-Jul-96	PORT ARANSAS	120.0	29.0	RR	124.5	F
339	TX	17-Jul-96	PORT ARANSAS	120.0	29.0	RR	88.3	F
309	FL/GULF	17-Jul-96	HILLSBOROUGH BAY	50.0	-	RR	86.0	F
310	FL/GULF	17-Jul-96	HILLSBOROUGH BAY	50.0	-	RR	91.0	M
321	MS	18-Jul-96	OCEAN SPRINGS	-	-	RR	76.0	M
322	MS	19-Jul-96	BILOXI	-	-	RR	123.0	F
323	MS	19-Jul-96	BILOXI	-	-	RR	125.0	F
324	MS	22-Jul-96	OCEAN SPRINGS	3.0	-	RR	96.5	F
326	TX	24-Jul-96	PORT ARANSAS	325.0	29.0	RR	101.0	F
341	TX	24-Jul-96	PORT ARANSAS	325.0	29.0	RR	121.9	F
342	TX	24-Jul-96	PORT ARANSAS	325.0	29.0	RR	95.6	F
343	TX	24-Jul-96	PORT ARANSAS	325.0	29.0	RR	86.0	M
344	TX	24-Jul-96	PORT ARANSAS	325.0	29.0	RR	101.3	F
279	TX	25-Jul-96	PORT ARANSAS	-	25.8	RR	105.4	M
345	TX	25-Jul-96	PORT ARANSAS	325.0	29.0	RR	121.9	F
346	TX	25-Jul-96	PORT ARANSAS	325.0	29.0	RR	94.0	M
347	TX	25-Jul-96	PORT ARANSAS	325.0	29.0	RR	97.8	F
348	TX	25-Jul-96	PORT ARANSAS	325.0	29.0	RR	85.1	F
349	TX	25-Jul-96	PORT ARANSAS	325.0	29.0	RR	94.0	M
350	TX	25-Jul-96	PORT ARANSAS	325.0	29.0	RR	120.7	F
351	TX	25-Jul-96	PORT ARANSAS	325.0	29.0	RR	100.3	F
352	TX	25-Jul-96	PORT ARANSAS	325.0	29.0	RR	89.2	F
353	TX	25-Jul-96	PORT ARANSAS	325.0	29.0	RR	106.0	F
354	TX	25-Jul-96	PORT ARANSAS	325.0	29.0	RR	87.9	F

**Table 3 (continued).** Data from cobia from which biological samples were collected during (8/1/95 - 12/31/97) listed by state - (RR = rod & reel, GN = gill net, TRL = trawl, SP = spear).

Fish	State	Capture Date	Capture Area	Water Depth (ft)	Water Temp. (C)	Gear Type	Fork Length (cm)	Sex
355	TX	25-Jul-96	PORT ARANSAS	325.0	29.0	RR	108.9	F
356	TX	25-Jul-96	PORT ARANSAS	325.0	29.0	RR	90.2	F
357	TX	26-Jul-96	PORT ARANSAS	325.0	29.0	RR	100.0	F
358	TX	26-Jul-96	PORT ARANSAS	325.0	29.0	RR	109.9	F
359	TX	26-Jul-96	PORT ARANSAS	325.0	29.0	RR	104.8	F
360	TX	26-Jul-96	PORT ARANSAS	325.0	29.0	RR	89.5	F
361	TX	26-Jul-96	PORT ARANSAS	325.0	29.0	RR	102.2	F
362	TX	26-Jul-96	PORT ARANSAS	325.0	29.0	RR	97.8	F
363	TX	26-Jul-96	PORT ARANSAS	325.0	29.0	RR	108.6	F
364	TX	26-Jul-96	PORT ARANSAS	325.0	29.0	RR	87.9	F
365	TX	26-Jul-96	PORT ARANSAS	325.0	29.0	RR	107.6	F
366	TX	26-Jul-96	PORT ARANSAS	325.0	29.0	RR	99.1	F
367	TX	26-Jul-96	PORT ARANSAS	325.0	29.0	RR	93.3	M
368	TX	26-Jul-96	PORT ARANSAS	325.0	29.0	RR	87.9	F
369	TX	26-Jul-96	PORT ARANSAS	325.0	29.0	RR	89.9	M
370	TX	26-Jul-96	PORT ARANSAS	325.0	29.0	RR	86.4	F
371	TX	26-Jul-96	PORT ARANSAS	325.0	29.0	RR	101.3	F
372	TX	26-Jul-96	PORT ARANSAS	325.0	29.0	RR	91.8	M
373	TX	26-Jul-96	PORT ARANSAS	325.0	29.0	RR	95.6	F
374	TX	26-Jul-96	PORT ARANSAS	325.0	29.0	RR	128.3	F
375	TX	26-Jul-96	PORT ARANSAS	325.0	29.0	RR	117.5	F
376	TX	26-Jul-96	PORT ARANSAS	325.0	29.0	RR	99.4	F
377	TX	28-Jul-96	PORT ARANSAS	80.0	29.0	RR	105.7	F
378	TX	28-Jul-96	PORT ARANSAS	80.0	29.0	RR	101.3	M
379	TX	28-Jul-96	PORT ARANSAS	80.0	29.0	RR	94.6	M
380	TX	28-Jul-96	PORT ARANSAS	80.0	29.0	RR	90.8	F
381	TX	28-Jul-96	PORT ARANSAS	80.0	29.0	RR	104.5	F
382	TX	28-Jul-96	PORT ARANSAS	80.0	29.0	RR	87.9	M
383	TX	30-Jul-96	PORT ARANSAS	325.0	29.0	RR	97.2	M
384	TX	30-Jul-96	PORT ARANSAS	325.0	29.0	RR	88.6	M
385	TX	30-Jul-96	PORT ARANSAS	325.0	29.0	RR	115.6	F
311	FL/GULF	30-Jul-96	HILLSBOROUGH BAY	41.0	-	RR	89.0	F
312	FL/GULF	30-Jul-96	HILLSBOROUGH BAY	41.0	-	RR	86.0	F
469	FL/PAN	03-Aug-96	PANAMA CITY	140.0	-	RR	104.0	F
386	TX	07-Aug-96	PORT ARANSAS	325.0	29.0	RR	84.5	F
387	TX	07-Aug-96	PORT ARANSAS	325.0	29.0	RR	83.8	M
388	TX	07-Aug-96	PORT ARANSAS	325.0	29.0	RR	86.0	F

**Table 3 (continued).** Data from cobia from which biological samples were collected during (8/1/95 - 12/31/97) listed by state - (RR = rod & reel, GN = gill net, TRL = trawl, SP = spear).

Fish	State	Capture Date	Capture Area	Water Depth (ft)	Water Temp. (C)	Gear Type	Fork Length (cm)	Sex
337	TX	07-Aug-96	PORT ARANSAS	325.0	-	RR	81.6	M
398	MS	08-Aug-96	OCEAN SPRINGS	30.0	-	RR	102.0	F
399	MS	08-Aug-96	OCEAN SPRINGS	30.0	-	RR	103.0	F
400	MS	08-Aug-96	OCEAN SPRINGS	30.0	-	RR	95.0	F
401	MS	08-Aug-96	OCEAN SPRINGS	35.0	-	RR	65.5	F
402	MS	08-Aug-96	SHIP ISLAND	35.0	-	RR	89.3	M
470	FL/PAN	11-Aug-96	PANAMA CITY	140.0	-	RR	91.5	F
471	FL/PAN	11-Aug-96	PANAMA CITY	140.0	-	RR	92.4	M
472	FL/PAN	11-Aug-96	PANAMA CITY	140.0	-	RR	89.5	M
393	FL/GULF	14-Aug-96	SARASOTA BAY	-	31.0	RR	78.0	F
467	FL/PAN	17-Aug-96	PANAMA CITY	140.0	-	RR	95.2	M
475	FL/PAN	24-Aug-96	PANAMA CITY	140.0	-	RR	88.2	F
468	FL/PAN	01-Sep-96	PANAMA CITY	140.0	-	RR	103.0	F
394	FL/GULF	05-Sep-96	CHARLOTTE HARBOR	6.0	30.1	GN	67.0	F
473	FL/PAN	14-Sep-96	PANAMA CITY	140.0	-	RR	82.0	M
403	MS	14-Sep-96	OFF COASTAL MS	-	-	RR	82.5	M
404	MS	14-Sep-96	OFF COASTAL MS	-	-	RR	92.5	F
405	MS	15-Sep-96	OFF COASTAL MS	-	-	RR	99.0	M
406	MS	15-Sep-96	OFF COASTAL MS	-	-	RR	102.0	F
407	MS	15-Sep-96	OFF COASTAL MS	-	-	RR	84.2	M
408	MS	15-Sep-96	OFF COASTAL MS	-	-	RR	93.0	F
409	MS	15-Sep-96	OFF COASTAL MS	-	-	RR	97.6	F
410	MS	15-Sep-96	OFF COASTAL MS	-	-	RR	95.6	F
411	MS	15-Sep-96	OFF COASTAL MS	-	-	RR	113.0	F
412	MS	15-Sep-96	OFF COASTAL MS	-	-	RR	96.5	F
413	MS	15-Sep-96	OFF COASTAL MS	-	-	RR	108.5	F
414	MS	15-Sep-96	OFF COASTAL MS	-	-	RR	95.3	F
415	LA	15-Sep-96	WEST OF MS RIVER	-	-	RR	87.5	F
416	LA	15-Sep-96	WEST OF MS RIVER	-	-	RR	89.0	M
340	MS	19-Sep-96	OCEAN SPRINGS	18.0	-	RR	96.0	F
395	FL/ATL	21-Sep-96	PORT CANAVERAL	120.0	-	RR	91.0	M
396	FL/ATL	21-Sep-96	PORT CANAVERAL	120.0	-	RR	102.0	M
397	FL/ATL	21-Sep-96	PORT CANAVERAL	120.0	-	RR	83.0	M
652	MS	24-Sep-96	SHIP ISLAND	35.0	-	RR	83.5	M
417	FL/GULF	27-Sep-96	LONGBOAT KEY	18.0	28.0	RR	92.0	F
418	FL/GULF	27-Sep-96	LONGBOAT KEY	18.0	28.0	RR	81.5	M
419	FL/GULF	30-Sep-96	LONGBOAT KEY	18.0	29.0	RR	89.0	F

Table 3 (continued).

Data from cobia from which biological samples were collected during (8/1/95 - 12/31/97) listed by state - (RR = rod & reel, GN = gill net, TRL = trawl, SP = spear).

Fish	State	Capture Date	Capture Area	Water Depth (ft)	Water Temp. (C)	Gear Type	Fork Length (cm)	Sex
420	FL/GULF	01-Oct-96	LONGBOAT KEY	17.0	29.0	RR	94.0	F
421	FL/GULF	01-Oct-96	LONGBOAT KEY	17.0	29.0	RR	80.5	F
422	FL/GULF	01-Oct-96	LONGBOAT KEY	17.0	29.0	RR	85.0	F
423	FL/GULF	01-Oct-96	LIDO KEY	17.0	29.0	RR	82.0	M
424	FL/GULF	02-Oct-96	LONGBOAT KEY	18.0	29.0	RR	94.0	F
425	FL/GULF	02-Oct-96	LONGBOAT KEY	18.0	29.0	RR	89.5	F
426	FL/GULF	04-Oct-96	SARASOTA	18.0	28.0	RR	89.0	M
427	FL/GULF	04-Oct-96	SARASOTA	18.0	28.0	RR	97.0	F
428	FL/GULF	06-Oct-96	SARASOTA	18.0	27.0	RR	83.0	M
429	FL/GULF	06-Oct-96	SARASOTA	18.0	27.0	RR	102.0	F
430	FL/GULF	06-Oct-96	SARASOTA	18.0	27.0	RR	85.0	F
431	FL/GULF	06-Oct-96	SARASOTA	18.0	27.0	RR	87.5	F
432	FL/GULF	22-Oct-96	LONGBOAT KEY	6.0	23.3	GN	44.0	F
433	FL/GULF	27-Oct-96	SARASOTA	-	26.0	RR	86.0	F
434	FL/GULF	27-Oct-96	SARASOTA	-	26.0	RR	89.0	F
436	FL/GULF	31-Oct-96	SARASOTA	30.0	26.0	RR	99.5	F
448	FL/GULF	01-Nov-96	PALMETTO	45.0	-	SP	86.0	M
437	FL/GULF	02-Nov-96	ALAN FISHER REEF	31.0	27.0	RR	100.5	F
439	FL/GULF	05-Nov-96	LONGBOAT KEY	18.0	24.0	RR	82.0	F
440	FL/GULF	05-Nov-96	LONGBOAT KEY	18.0	24.0	RR	92.0	F
438	FL/GULF	05-Nov-96	ALAN FISHER REEF	31.0	24.0	RR	89.0	M
442	FL/GULF	06-Nov-96	LONGBOAT KEY	18.0	25.0	RR	86.0	M
441	FL/GULF	08-Nov-96	DONALD ROEHR REEF	21.0	25.0	RR	82.0	M
443	FL/GULF	19-Nov-96	LONGBOAT KEY	8.0	19.9	GN	61.0	F
444	FL/GULF	19-Nov-96	LONGBOAT KEY	8.0	19.9	GN	62.0	M
445	FL/GULF	19-Nov-96	LONGBOAT KEY	8.0	20.0	GN	39.5	M
446	FL/GULF	19-Nov-96	LONGBOAT KEY	8.0	20.0	GN	41.5	M
447	FL/GULF	21-Nov-96	SARASOTA	70.0	22.0	RR	101.0	F
451	FL/KEYS/GULF	25-Nov-96	N.OF CONTENT KEY	16.0	-	RR	89.5	F
452	FL/KEYS/GULF	25-Nov-96	N.OF CONTENT KEY	16.0	-	RR	86.5	F
449	FL/GULF	03-Dec-96	SARASOTA D6	104.0	20.0	RR	127.0	M
450	FL/KEYS/GULF	02-Feb-97	UPPER HARBOR KEY	8.0	-	RR	79.5	M
478	FL/GULF	06-Mar-97	LONGBOAT KEY	5.0	25.1	GN	35.5	F
498	FL/GULF	06-Mar-97	BIG PINE KEY	50.0	-	RR	100.0	F
499	FL/GULF	06-Mar-97	BIG PINE KEY	50.0	-	RR	86.0	M
479	FL/GULF	25-Mar-97	LONGBOAT KEY	7.0	24.0	GN	47.0	F
488	FL/ATL	29-Mar-97	COCOA BEACH	30.0	22.0	RR	86.0	M

**Table 3 (continued).**

Data from cobia from which biological samples were collected during (8/1/95 - 12/31/97) listed by state - (RR = rod & reel, GN = gill net, TRL = trawl, SP = spear).

Fish	State	Capture Date	Capture Area	Water Depth (ft)	Water Temp. (C)	Gear Type	Fork Length (cm)	Sex
482	FL/ATL	29-Mar-97	COCOA BEACH	40.0	22.0	RR	89.0	F
489	FL/ATL	29-Mar-97	COCOA BEACH	40.0	22.0	RR	117.0	F
485	FL/ATL	29-Mar-97	COCOA BEACH	50.0	22.0	RR	107.0	F
486	FL/ATL	29-Mar-97	COCOA BEACH	50.0	22.0	RR	106.0	F
487	FL/ATL	29-Mar-97	COCOA BEACH	50.0	22.0	RR	96.0	F
480	FL/ATL	29-Mar-97	COCOA BEACH	52.0	22.0	RR	98.0	F
481	FL/ATL	29-Mar-97	COCOA BEACH	52.0	22.0	RR	94.0	F
490	FL/ATL	29-Mar-97	COCOA BEACH	55.0	22.0	RR	90.5	F
484	FL/ATL	29-Mar-97	COCOA BEACH	75.0	22.0	RR	96.0	F
483	FL/ATL	29-Mar-97	COCOA BEACH	80.0	22.0	RR	89.0	M
493	FL/ATL	29-Mar-97	COCOA BEACH	80.0	22.0	RR	107.0	M
494	FL/ATL	29-Mar-97	COCOA BEACH	80.0	22.0	RR	116.0	F
495	FL/ATL	29-Mar-97	COCOA BEACH	80.0	22.0	RR	98.5	F
492	FL/ATL	29-Mar-97	COCOA BEACH	85.0	22.0	RR	102.0	F
491	FL/ATL	29-Mar-97	COCOA BEACH	-	22.0	RR	100.0	F
496	FL/GULF	03-Apr-97	HUDSON CHANNEL	9.0	20.4	GN	70.4	F
497	FL/ATL	10-Apr-97	ISLAMORADA	-	-	RR	114.3	F
599	FL/PAN	19-Apr-97	NW FLORIDA	-	-	RR	98.0	F
600	FL/PAN	19-Apr-97	NW FLORIDA	-	-	RR	100.0	M
601	FL/PAN	19-Apr-97	NW FLORIDA	-	-	RR	109.6	F
602	FL/PAN	19-Apr-97	NW FLORIDA	-	-	RR	98.0	F
603	FL/PAN	19-Apr-97	NW FLORIDA	-	-	RR	112.0	F
604	FL/PAN	19-Apr-97	NW FLORIDA	-	-	RR	124.6	F
605	FL/PAN	19-Apr-97	NW FLORIDA	-	-	RR	110.2	F
606	FL/PAN	19-Apr-97	NW FLORIDA	-	-	RR	113.0	F
607	FL/PAN	19-Apr-97	NW FLORIDA	-	-	RR	118.1	F
608	FL/PAN	19-Apr-97	NW FLORIDA	-	-	RR	118.0	F
609	FL/PAN	19-Apr-97	NW FLORIDA	-	-	RR	91.9	M
610	FL/PAN	19-Apr-97	NW FLORIDA	-	-	RR	108.7	F
611	FL/PAN	19-Apr-97	NW FLORIDA	-	-	RR	109.9	F
612	FL/PAN	19-Apr-97	NW FLORIDA	-	-	RR	112.2	F
613	FL/PAN	19-Apr-97	NW FLORIDA	-	-	RR	96.0	M
614	FL/PAN	19-Apr-97	NW FLORIDA	-	-	RR	102.3	M
615	FL/PAN	19-Apr-97	NW FLORIDA	-	-	RR	104.0	M
616	FL/PAN	19-Apr-97	NW FLORIDA	-	-	RR	112.4	F
617	FL/PAN	19-Apr-97	NW FLORIDA	-	-	RR	99.0	M
526	AL	02-May-97	SAND ISLAND	6.0	-	RR	125.0	F

**Table 3 (continued).** Data from cobia from which biological samples were collected during (8/1/95 - 12/31/97) listed by state - (RR = rod & reel, GN = gill net, TRL = trawl, SP = spear).

Fish	State	Capture Date	Capture Area	Water Depth (ft)	Water Temp. (C)	Gear Type	Fork Length (cm)	Sex
518	LA	02-May-97	CHANDELEUR ISLAND	8.0	-	RR	101.0	F
529	MS	02-May-97	ISLE OF CAPRICE BAR	8.0	-	RR	120.4	F
527	MS	02-May-97	ISLE OF CAPRICE BAR	10.0	-	RR	120.5	F
528	MS	02-May-97	ISLE OF CAPRICE BAR	10.0	-	RR	120.6	F
511	LA	02-May-97	CHANDELEUR ISLAND	12.0	-	RR	133.2	F
525	LA	02-May-97	CHANDELEUR ISLAND	12.0	-	RR	112.0	F
512	FL/PAN	02-May-97	DESTIN	30.0	-	RR	101.0	M
513	FL/PAN	02-May-97	DESTIN	30.0	-	RR	103.4	M
502	MS	02-May-97	OFF MS	35.0	-	RR	100.3	F
515	LA	02-May-97	CHANDELEUR ISLAND	35.0	-	RR	130.0	F
516	LA	02-May-97	CHANDELEUR ISLAND	35.0	-	RR	121.0	F
517	LA	02-May-97	CHANDELEUR ISLAND	35.0	-	RR	111.0	F
503	LA	02-May-97	CHANDELEUR ISLAND	-	-	RR	122.5	F
504	MS	02-May-97	OFF MS	-	-	RR	109.0	F
505	MS	02-May-97	OFF MS	-	-	RR	108.0	F
506	MS	02-May-97	OFF MS	-	-	RR	110.0	F
507	MS	02-May-97	OFF MS	-	-	RR	124.0	F
508	MS	02-May-97	HORN ISLAND	-	-	RR	102.0	F
509	MS	02-May-97	OFF MS	-	-	RR	104.0	M
510	MS	02-May-97	OFF MS	-	-	RR	121.5	F
514	FL/PAN	02-May-97	DESTIN	-	-	RR	102.5	F
519	MS	02-May-97	PETIT BOIS ISLAND	-	-	RR	106.5	M
520	MS	02-May-97	PETIT BOIS ISLAND	-	-	RR	108.0	M
521	MS	02-May-97	PETIT BOIS ISLAND	-	-	RR	105.0	M
522	MS	02-May-97	OFF MS	-	-	RR	111.0	M
523	MS	02-May-97	OFF MS	-	-	RR	118.5	F
524	MS	02-May-97	OFF MS	-	-	RR	117.5	F
530	MS	02-May-97	PETIT BOIS ISLAND	-	-	RR	102.0	M
531	FL/PAN	02-May-97	DESTIN	-	-	RR	102.5	F
544	MS	03-May-97	ISLE OF CAPRICE BAR	8.0	-	RR	121.8	F
545	MS	03-May-97	ISLE OF CAPRICE BAR	8.0	-	RR	115.5	F
559	MS	03-May-97	ISLE OF CAPRICE BAR	8.0	-	RR	128.6	F
534	MS	03-May-97	ISLE OF CAPRICE BAR	9.0	-	RR	119.3	F
548	MS	03-May-97	HORN ISLAND	12.0	-	RR	112.0	F
549	MS	03-May-97	HORN ISLAND	12.0	-	RR	121.5	F
556	LA	03-May-97	CHANDELEUR ISLAND	12.0	-	RR	120.0	F
566	MS	03-May-97	PETIT BOIS RIGS	32.0	-	RR	110.2	F

**Table 3 (continued).** Data from cobia from which biological samples were collected during (8/1/95 - 12/31/97) listed by state - (RR = rod & reel, GN = gill net, TRL = trawl, SP = spear).

Fish	State	Capture Date	Capture Area	Water Depth (ft)	Water Temp. (C)	Gear Type	Fork Length (cm)	Sex
539	LA	03-May-97	CHANDELEUR ISLAND	62.0	-	RR	115.5	F
550	MS	03-May-97	OFF MS	180.0	-	RR	121.7	F
551	MS	03-May-97	OFF MS	180.0	-	RR	106.5	F
552	MS	03-May-97	OFF MS	180.0	-	RR	103.4	M
532	MS	03-May-97	HORN ISLAND	-	-	RR	110.5	F
533	MS	03-May-97	ISLE OF CAPRICE BAR	-	-	RR	116.0	F
535	MS	03-May-97	PETIT BOIS ISLAND	-	-	RR	110.0	M
536	MS	03-May-97	PETIT BOIS ISLAND	-	-	RR	107.0	M
537	MS	03-May-97	PETIT BOIS ISLAND	-	-	RR	109.0	F
538	LA	03-May-97	CHANDELEUR ISLAND	-	-	RR	105.5	F
540	LA	03-May-97	CHANDELEUR ISLAND	-	-	RR	120.5	F
541	LA	03-May-97	CHANDELEUR ISLAND	-	-	RR	105.0	F
542	LA	03-May-97	CHANDELEUR ISLAND	-	-	RR	107.0	F
546	MS	03-May-97	HORN ISLAND	-	-	RR	115.0	F
553	MS	03-May-97	HORN ISLAND	-	-	RR	117.0	F
554	MS	03-May-97	HORN ISLAND	-	-	RR	110.0	F
555	MS	03-May-97	OFF MS	-	-	RR	132.0	M
557	LA	03-May-97	CHANDELEUR ISLAND	-	-	RR	94.6	M
558	MS	03-May-97	HORN ISLAND	-	-	RR	94.5	F
560	MS	03-May-97	HORN ISLAND	-	-	RR	101.5	F
564	LA	04-May-97	CHANDELEUR ISLAND	8.0	-	RR	127.0	F
562	MS	04-May-97	HORN ISLAND	12.0	-	RR	123.1	F
543	MS	04-May-97	HORN ISLAND	-	-	RR	111.5	F
547	MS	04-May-97	HORN ISLAND	-	-	RR	123.5	F
561	MS	04-May-97	HORN ISLAND	-	-	RR	109.8	F
563	MS	04-May-97	HORN ISLAND	-	-	RR	105.0	F
501	FL/GULF	06-May-97	HUDSON CHANNEL	9.0	23.9	GN	47.0	M
500	FL/GULF	06-May-97	ARIPEKA CHANNEL	9.0	24.1	GN	67.0	F
565	MS	07-May-97	HORN ISLAND	6.0	-	RR	114.4	F
567	MS	07-May-97	HORN ISLAND	6.0	-	RR	87.7	F
574	SC	08-May-97	HILTON HEAD	-	-	RR	115.5	F
575	SC	08-May-97	HILTON HEAD	-	-	RR	105.5	M
576	SC	08-May-97	HILTON HEAD	-	-	RR	110.0	F
647	FL/PAN	10-May-97	NW FLORIDA	-	-	RR	92.6	M
577	FL/GULF	14-May-97	SANIBEL ISLAND	8.0	27.9	GN	52.5	M
618	MS	14-May-97	HORN ISLAND BAR	4.0	-	RR	94.3	F
619	MS	14-May-97	HORN ISLAND BAR	4.0	-	RR	79.4	F

**Table 3 (continued).**

Data from cobia from which biological samples were collected during (8/1/95 - 12/31/97) listed by state - (RR = rod & reel, GN = gill net, TRL = trawl, SP = spear).

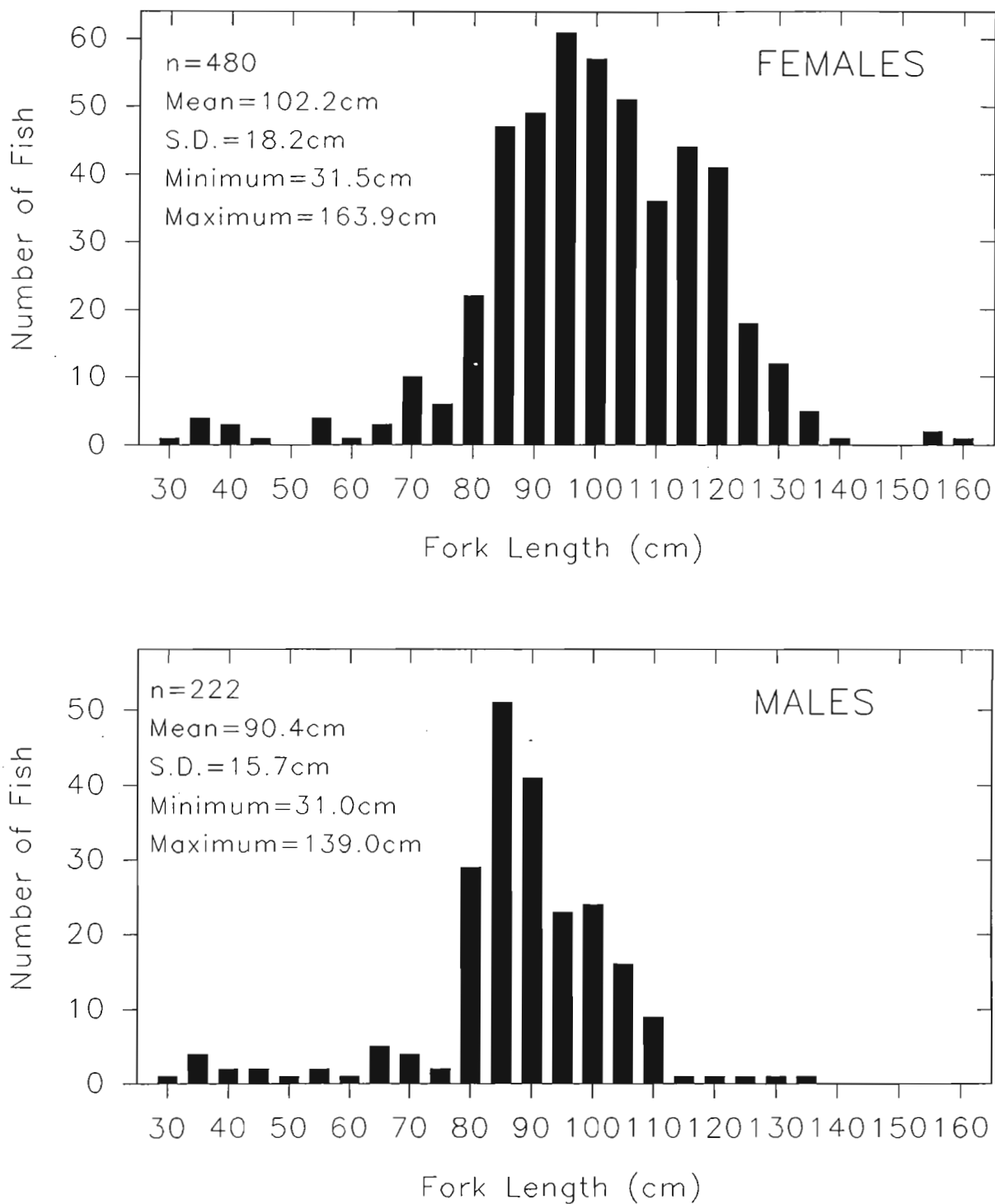
Fish	State	Capture Date	Capture Area	Water Depth (ft)	Water Temp. (C)	Gear Type	Fork Length (cm)	Sex
569	SC	21-May-97	HILTON HEAD	-	-	RR	117.0	F
570	SC	21-May-97	HILTON HEAD	-	-	RR	113.5	F
571	SC	21-May-97	HILTON HEAD	-	-	RR	88.5	M
572	SC	21-May-97	HILTON HEAD	-	-	RR	90.0	M
573	SC	21-May-97	HILTON HEAD	-	-	RR	94.5	F
568	FL/GULF	27-May-97	SARASOTA BAY	6.0	-	RR	87.0	M
579	NC	31-May-97	SHACKLEFORD BANKS	22.0	-	RR	95.0	F
578	NC	31-May-97	CAPE LOOKOUT	37.0	-	RR	138.5	F
582	NC	01-Jun-97	CAPE LOOKOUT	23.0	-	RR	105.5	F
581	NC	01-Jun-97	CAPE LOOKOUT	35.0	-	RR	138.5	F
580	NC	01-Jun-97	CAPE LOOKOUT	-	-	RR	103.0	F
587	SC	14-Jun-97	BROAD RIVER	30.0	-	RR	86.0	M
588	SC	14-Jun-97	BROAD RIVER	30.0	-	RR	91.0	M
592	SC	14-Jun-97	BROAD RIVER	30.0	-	RR	85.5	M
589	SC	16-Jun-97	BROAD RIVER	30.0	-	RR	90.0	M
591	SC	20-Jun-97	BROAD RIVER	25.0	-	RR	81.0	M
590	SC	21-Jun-97	BROAD RIVER	25.0	-	RR	87.0	M
620	FL/PAN	21-Jun-97	OFF PENSACOLA	300.0	-	RR	93.7	M
621	FL/PAN	21-Jun-97	OFF PENSACOLA	300.0	-	RR	107.8	M
623	FL/PAN	21-Jun-97	OFF PENSACOLA	1200.0	-	RR	97.6	F
622	FL/PAN	21-Jun-97	OFF PENSACOLA	1800.0	-	RR	98.3	M
624	FL/PAN	21-Jun-97	OFF PENSACOLA	-	-	RR	-	M
625	FL/PAN	21-Jun-97	OFF PENSACOLA	-	-	RR	139.0	M
626	FL/PAN	21-Jun-97	OFF PENSACOLA	-	-	RR	108.6	M
583	FL/GULF	23-Jun-97	SARASOTA	45.0	-	RR	108.0	F
627	MS	27-Jun-97	SHIP ISLAND	30.0	-	RR	83.2	F
628	MS	27-Jun-97	SHIP ISLAND	30.0	-	RR	96.5	F
594	NC	29-Jun-97	MANTEO	-	-	RR	123.0	F
584	FL/GULF	30-Jun-97	TAMPA BAY	-	-	RR	98.0	F
595	NC	30-Jun-97	MANTEO	-	-	RR	102.0	F
593	NC	01-Jul-97	MANTEO	-	-	RR	125.0	F
585	FL/GULF	02-Jul-97	ANCLOTE KEY	10.0	30.1	GN	65.0	M
629	MS	03-Jul-97	GULFPORT SHIP CHANL	20.0	-	RR	85.5	F
632	MS	03-Jul-97	OFF MS	65.0	-	RR	101.4	M
633	MS	03-Jul-97	OFF MS	65.0	-	RR	123.5	F
631	MS	03-Jul-97	OFF MS	80.0	-	RR	97.5	F
596	NC	03-Jul-97	MANTEO	-	-	RR	127.0	F

**Table 3 (continued).** Data from cobia from which biological samples were collected during (8/1/95 - 12/31/97) listed by state - (RR = rod & reel, GN = gill net, TRL = trawl, SP = spear).

Fish	State	Capture Date	Capture Area	Water Depth (ft)	Water Temp. (C)	Gear Type	Fork Length (cm)	Sex
630	MS	03-Jul-97	OFF MS	-	-	RR	103.6	M
586	FL/GULF	04-Jul-97	SOUTH SKYWAY	8.0	-	RR	114.3	M
634	MS	05-Jul-97	S. OF SHIP ISLAND	25.0	-	RR	135.0	F
635	LA	05-Jul-97	OFF LA	200.0	-	RR	92.9	M
597	NC	05-Jul-97	MANTEO	-	-	RR	113.0	M
639	MS	06-Jul-97	OFF MS	62.0	-	RR	114.1	M
637	LA	06-Jul-97	WEST OF MS RIVER	150.0	-	RR	90.0	M
638	LA	06-Jul-97	WEST OF MS RIVER	150.0	-	RR	106.5	M
636	MS	06-Jul-97	OFF MS	-	-	RR	87.5	F
640	MS	09-Jul-97	GULFPORT SHIP CHANL	20.0	-	RR	91.4	F
641	MS	15-Jul-97	GULFPORT SHIP CHANL	30.0	-	RR	93.0	F
642	MS	15-Jul-97	GULFPORT SHIP CHANL	30.0	-	RR	87.8	F
598	FL/GULF	17-Jul-97	HUDSON	5.5	31.3	GN	48.0	M
643	MS	24-Jul-97	GULFPORT SHIP CHANL	30.0	-	RR	98.0	F
644	MS	24-Jul-97	GULFPORT SHIP CHANL	30.0	-	RR	99.0	F
645	MS	24-Jul-97	GULFPORT SHIP CHANL	30.0	-	RR	96.5	F
646	FL/PAN	26-Jul-97	S. OF PENSACOLA	-	-	RR	163.9	F
648	FL/GULF	17-Aug-97	MANATEE RIVER, MOUTH	5.0	-	RR	101.0	F
649	FL/GULF	17-Aug-97	TAMPA BAY	40.0	-	RR	39.7	F
650	FL/GULF	17-Aug-97	TAMPA BAY	40.0	-	RR	95.0	F
651	FL/GULF	17-Aug-97	TAMPA BAY	40.0	-	RR	37.0	F
654	FL/GULF	21-Aug-97	ANCLOTE	6.0	31.0	GN	56.7	F
655	FL/GULF	22-Aug-97	SKYWAY SOUTH	12.0	-	RR	86.0	M
653	FL/ATL	30-Aug-97	PORT CANAVERAL	75.0	-	RR	93.0	F
656	FL/GULF	10-Sep-97	APOLLO BEACH	42.0	-	RR	121.0	F
657	MS	31-Jul-97	GULFPORT SHIP CHANNE	10.0	-	RR	104.8	F
658	MS	31-Jul-97	GULFPORT SHIP CHANNE	10.0	-	RR	90.8	F
659	MS	05-Aug-97	SHIP ISLAND/MS	30.0	-	RR	88.9	F
660	MS	05-Aug-97	SHIP ISLAND/MS	30.0	-	RR	98.4	M
661	MS	05-Aug-97	SHIP ISLAND/MS	30.0	-	RR	88.9	M
662	MS	05-Aug-97	SHIP ISLAND/MS	30.0	-	RR	92.7	F
663	MS	07-Aug-97	PASCAGOULA SHIP CHAN	20.0	-	RR	114.3	M
664	MS	14-Aug-97	SHIP ISLAND/MS	30.0	-	RR	106.7	F
665	MS	14-Aug-97	SHIP ISLAND/MS	30.0	-	RR	95.9	F
666	LA	13-Sep-97	SW CHANDELEUR ISLAND	30.0	-	RR	104.0	F
667	LA	13-Sep-97	SW CHANDELEUR ISLAND	30.0	-	RR	97.0	F
668	LA	13-Sep-97	MAIN PASS,MS RIVER	60.0	-	RR	96.5	F

**Table 3 (continued).** Data from cobia from which biological samples were collected during (8/1/95 - 12/31/97) listed by state - (RR = rod & reel, GN = gill net, TRL = trawl, SP = spear).

Fish	State	Capture Date	Capture Area	Water Depth (ft)	Water Temp. (C)	Gear Type	Fork Length (cm)	Sex
669	LA	13-Sep-97	MAIN PASS,MS RIVER	40.0	-	RR	96.0	F
670	LA	13-Sep-97	CURLEW RIGS	45.0	-	RR	89.0	M
671	LA	13-Sep-97	E.MONKEY BAYOU/LA	35.0	-	RR	115.0	F
672	MS	13-Sep-97	MR.GUS RIGS, MS	12.0	-	RR	108.0	M
673	MS	13-Sep-97	MR.GUS RIGS, MS	120.0	-	RR	97.0	M
674	LA	13-Sep-97	BLOCK 107, LA	62.0	-	RR	114.0	F
675	LA	14-Sep-97	MAIN PASS RIGS,MS RI	60.0	-	RR	104.0	F
676	LA	14-Sep-97	MAIN PASS RIGS,MS RI	60.0	-	RR	96.0	F
677	LA	14-Sep-97	BLOCK 103 CHAND.ISL	60.0	-	RR	102.5	F
678	LA	14-Sep-97	BLOCK 103 CHAND.ISL	60.0	-	RR	95.0	M
679	MS	14-Sep-97	OFF SHORE, MS	60.0	-	RR	115.5	F
680	MS	14-Sep-97	OFF SHORE, MS	60.0	-	RR	114.0	F
681	LA	14-Sep-97	E.MONKEY BAYOU/LA	35.0	-	RR	118.0	F
682	MS	14-Sep-97	PASCAGOULA SHIP CH	30.0	-	RR	97.0	M
683	MS	14-Sep-97	PASCAGOULA SHIP CH	30.0	-	RR	94.0	F
684	FL/GULF	09-Oct-97	SARASOTA	25.0	27.8	RR	101.0	F
685	FL/GULF	09-Oct-97	SARASOTA	18.0	27.8	RR	87.0	F
686	FL/GULF	10-Nov-97	SARASOTA	47.0	21.3	RR	114.0	F
687	FL/GULF	18-Nov-97	SARASOTA	7.0	0.9	RR	76.5	F
688	FL/GULF	25-Nov-97	LONGBOAT KEY	18.0	20.4	RR	87.0	F
689	FL/KEYS/GULF	17-Oct-97	BIG PINE KEY	50.0	-	RR	84.5	F
690	FL/KEYS/GULF	17-Oct-97	BIG PINE KEY	50.0	-	RR	84.5	F
691	FL/KEYS/GULF	17-Oct-97	BIG PINE KEY	50.0	-	RR	90.5	F
692	FL/KEYS/GULF	17-Oct-97	BIG PINE KEY	50.0	-	RR	93.3	M
693	FL/GULF	26-Nov-97	LONGBOAT KEY	17.0	20.7	RR	86.0	F
694	FL/GULF	26-Nov-97	LONGBOAT KEY	17.0	-	RR	83.5	F
695	FL/GULF	26-Nov-97	LONGBOAT KEY	17.0	-	RR	83.0	F
696	FL/GULF	03-Dec-97	LONGBOAT KEY	4.5	19.6	GN	71.0	F
697	FL/GULF	03-Dec-97	LONGBOAT KEY	5.5	19.8	GN	69.5	M
698	FL/ATL	04-Dec-97	PONCE INLET	72.5	-	RR	96.0	F
699	FL/ATL	04-Dec-97	PONCE INLET	72.5	-	RR	114.0	F
700	FL/ATL	04-Dec-97	PONCE INLET	72.5	-	RR	120.5	F
701	FL/ATL	04-Dec-97	PONCE INLET	72.5	-	RR	108.0	M
702	FL/GULF	05-Dec-97	LONGBOAT KEY	17.0	20.5	RR	99.0	F
703	FL/GULF	16-Dec-97	NEW PASS	-	17.5	RR	117.0	F



**Figure 3.** Length/frequency histograms of female and male cobia samples from all locations.  
 (Length of one male unavailable)

# COBIA DATA SHEET

SEDAR28-RD28

AREA: S. Atlantic & Gulf of Mexico

SUB AREA: Gulf States & SE States

PERIOD: 8/1/95-12/31/97: Quarters I-X

GEAR TYPE: Rod & Reel, Gill Net, Trawl & Spear

SAMPLER: MML, GCRL & U of TX

MEASUREMENT: FL

CM	MALE	FEM	CM	MALE	FEM	CM	MALE	FEM	CM	MALE	FEM
			39	2		79		3	119		3
0			40	1	1	80	2	2	120		9
				1			2	2			11
2			42		1	82	7	5	122		9
					1		7	8		1	10
4			44		1	84	8	4	124		1
							11	7			7
6			46			86	10	7	126		1
				1	1		9	10		1	5
8			48	1		88	11	12	128		2
							9	8			3
10			50			90	10	9	130		5
							9	9			2
12			52	1		92	6	10	132	1	1
							9	12			3
14			54			94	6	12	134		1
							8	5			3
16			56		1	96	4	17	136		
				1	3		6	10			
18			58	1		98	3	11	138	1	2
							6	19			1
20			60			100	3	11	140		
					1		7	10			
22			62	1		102	5	17	142		
							4	5			
24			64			104	5	7	144		
				1			5	13			1
26			66		1	106	2	11	146		
				1	2		3	9			
28		1	68			108	5	7	148		
				2			1	11			
30			70	1	3	110	5	16	150		
	1			1	2		1	4			
32		1	72		3	112		9	152		
				2	1		2	4			
34			74	1	1	114	3	9	154		
								10			
36		2	76	1	1	116		9	156		1
	1	1			1			7			
38	1		78		1	118	1	15	158		
									159		1
									164		1

	MALE	FEM	ALL
TOTAL	222	480	702

CM = CENTIMETER MIDPOINT: IE 30CM=296-305MM, LENGTHS: FL=FORK, TL=TOTAL

Figure 4. Cobia Data Sheet (8/1/95 - 12/31/97). (Length of one male unavailable)

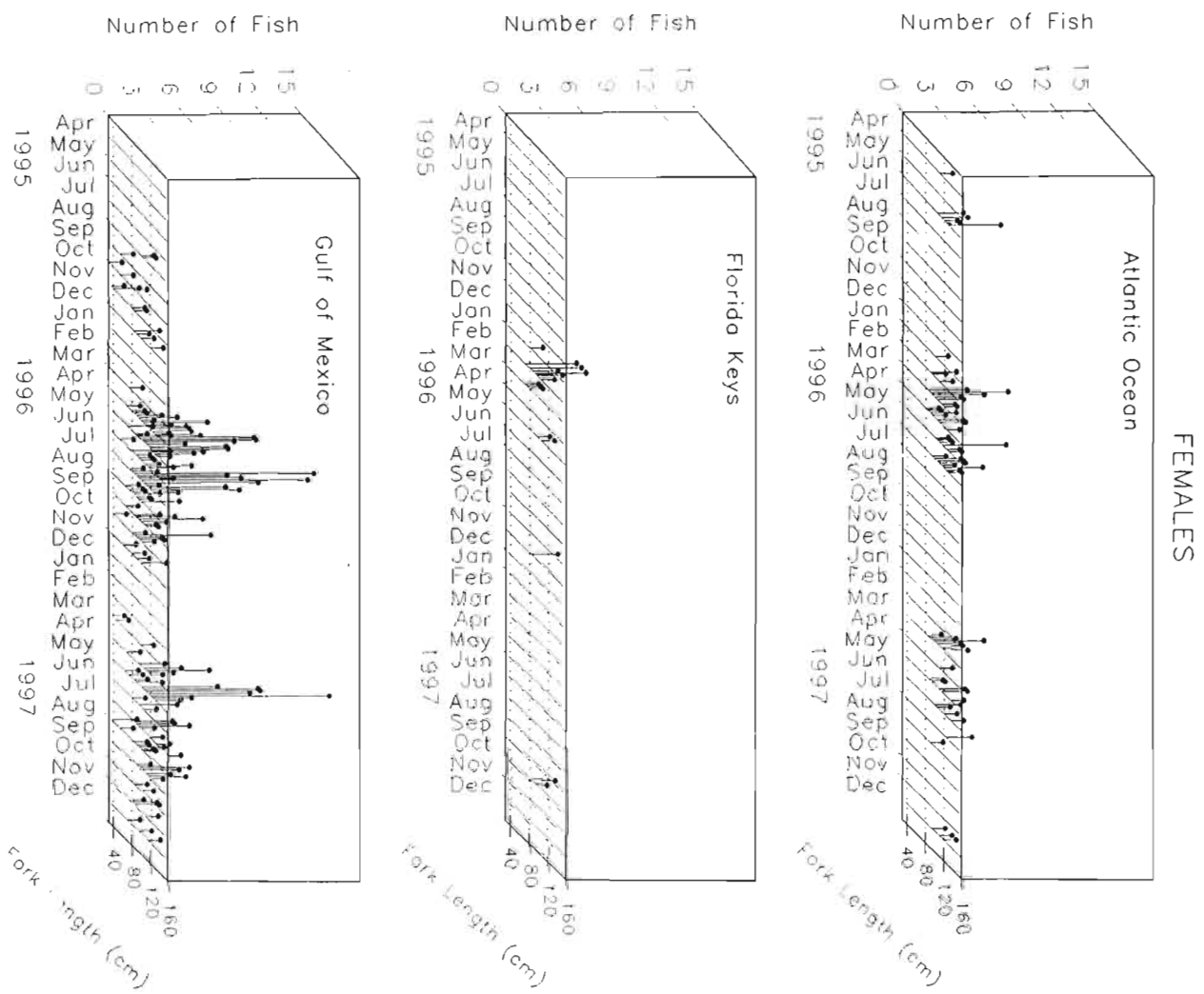
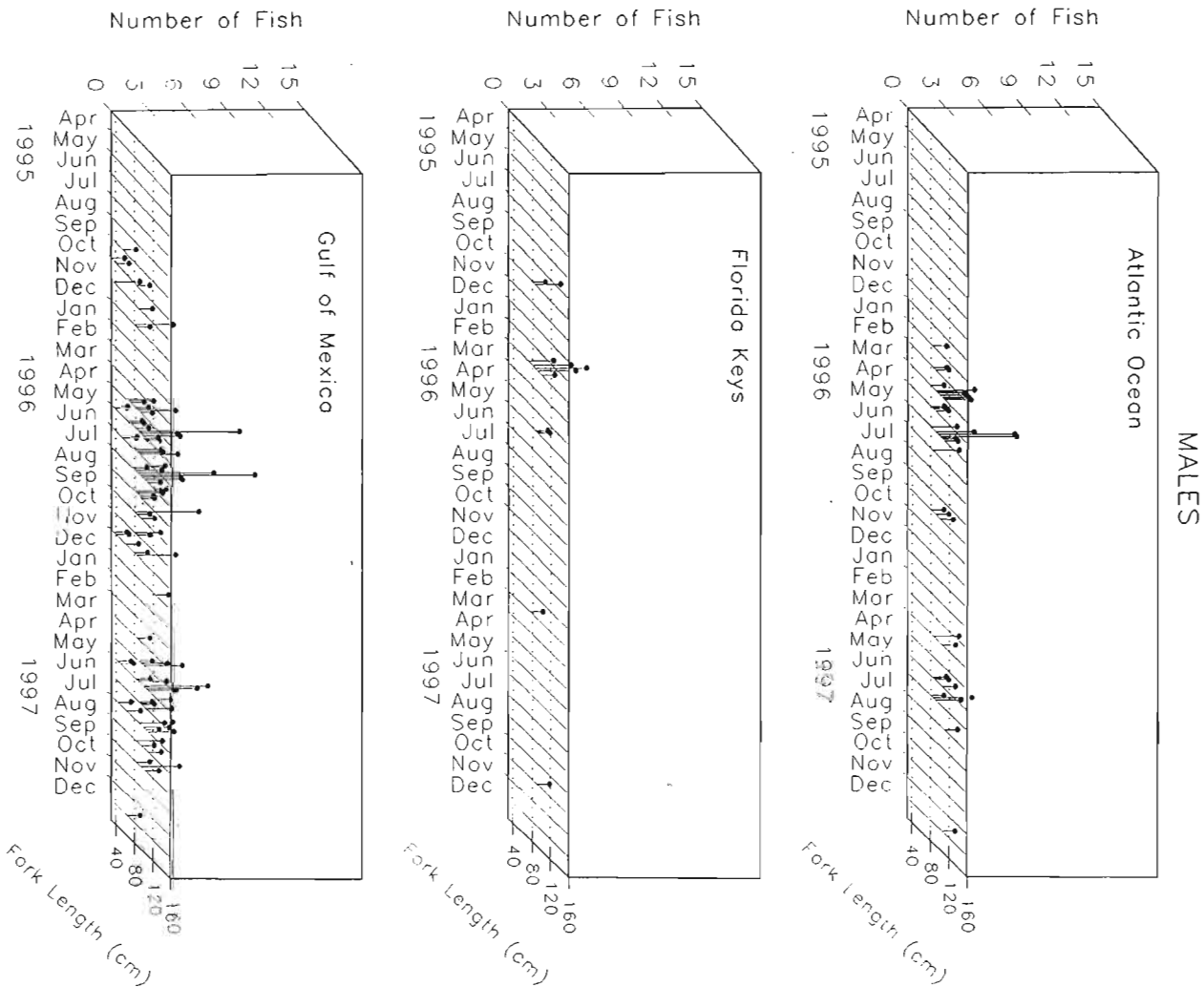
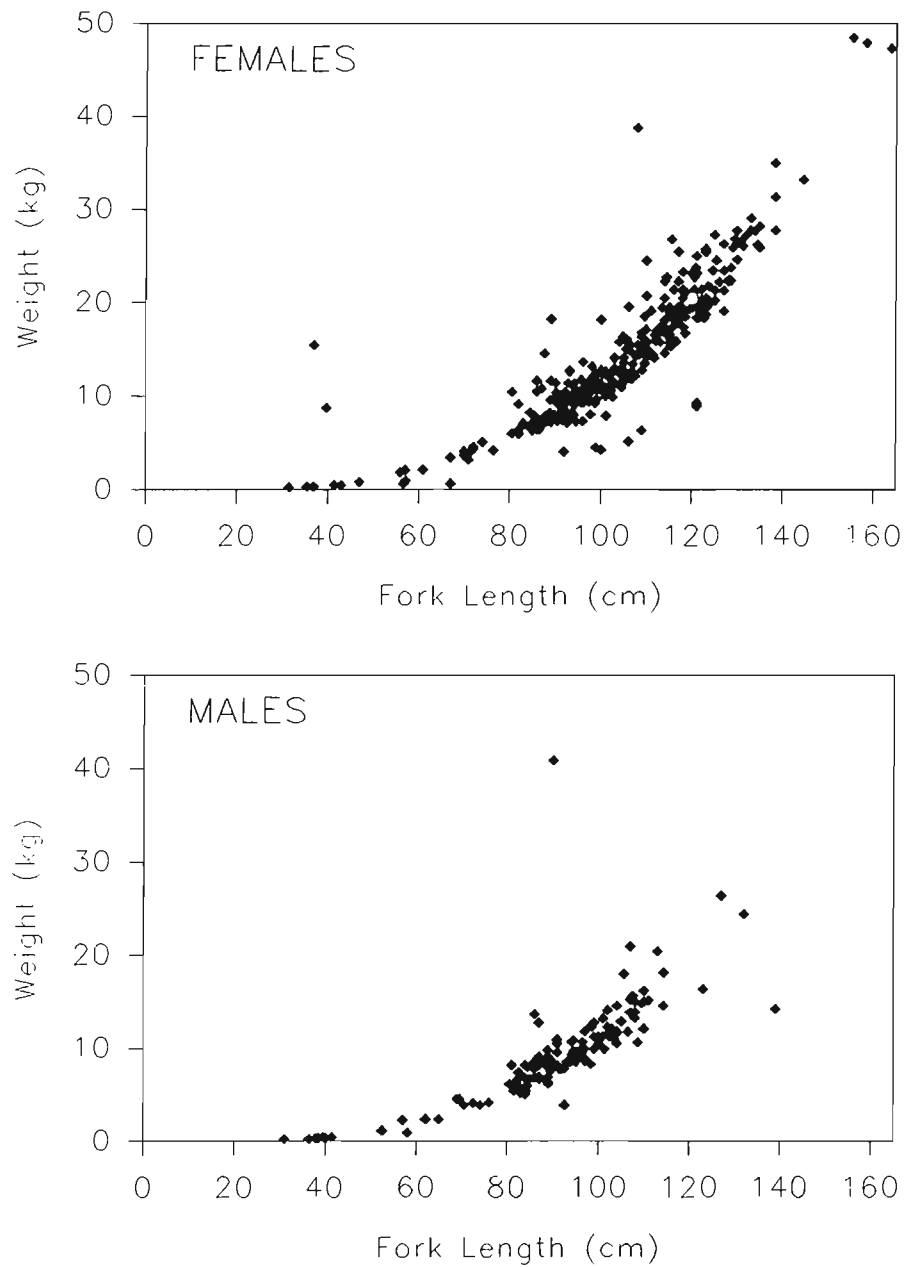


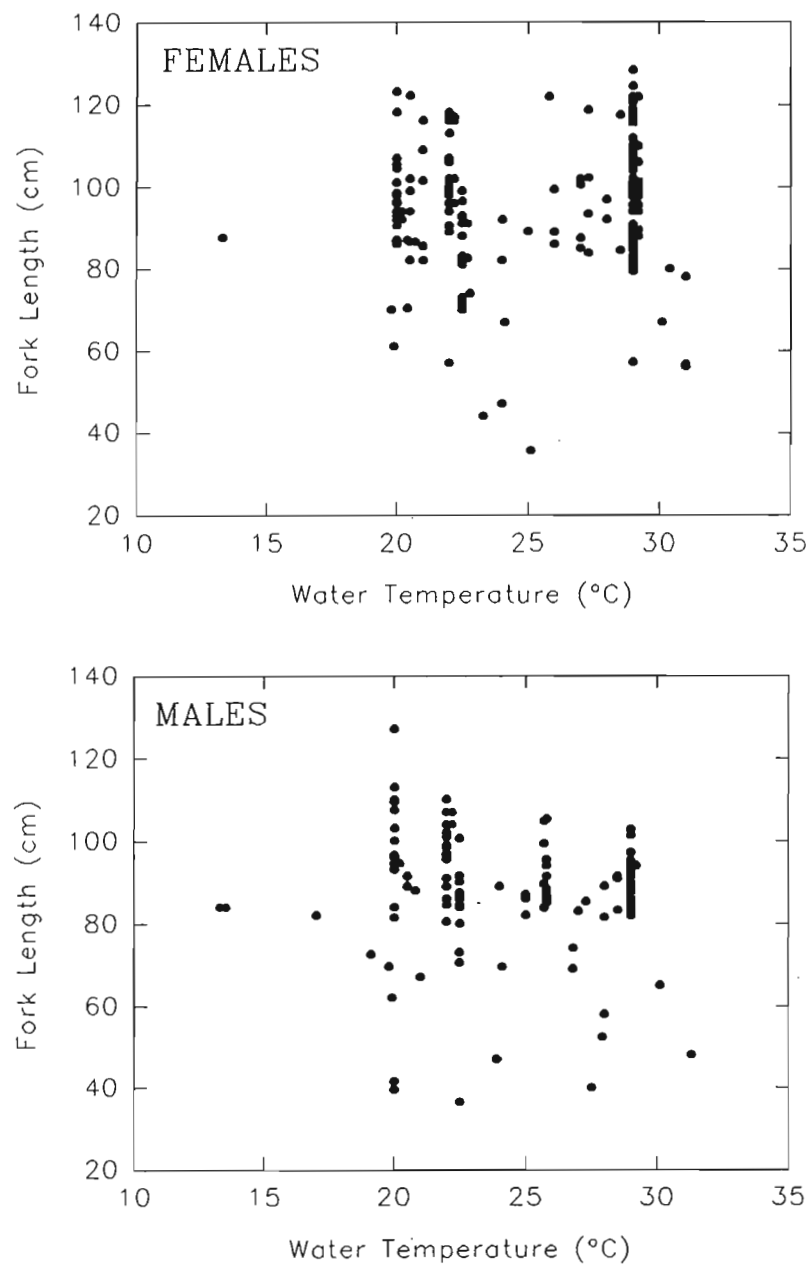
Figure 5. Length/frequency of female cobia by month and location.



**Figure 6.** Length/frequency of male cobia by month and location.



**Figure 7.** Length/frequency of female and male cobia by total weight and fork length.



**Figure 8.** Water temperatures (°C) where female and male cobia were captured.

**Table 4.** Data for cobia specimens used in reproduction section of study  
(F = females, M = males).

State/Coast	Capture Date	Fork Length (cm)	Fish Weight (lbs)	Fish Weight (kgs)	Gonad Weight (g)	Sex
FL/GULF	06-Sep-95	57.2	2.10	.95	12.14	F
FL/GULF	21-Sep-95	58.0	2.00	.91	5.00	M
FL/GULF	24-Oct-95	87.0	14.70	6.67	36.20	M
FL/GULF	24-Oct-95	89.0	16.50	7.48	27.86	F
FL/KEYS/GULF	26-Oct-95	84.5	14.50	6.58	9.55	M
FL/KEYS/GULF	26-Oct-95	85.0	14.75	6.69	12.81	M
FL/KEYS/GULF	26-Oct-95	89.5	17.75	8.05	77.79	M
FL/GULF	27-Oct-95	57.0	4.60	2.09	13.20	F
FL/GULF	26-Nov-95	82.0	13.00	5.90	33.70	F
FL/GULF	28-Nov-95	86.5	14.50	6.58	63.70	F
FL/GULF	28-Nov-95	91.5	17.00	7.71	25.04	M
FL/GULF	04-Dec-95	86.5	14.00	6.35	54.06	F
FL/GULF	04-Dec-95	102.0	24.00	10.89	98.77	F
FL/GULF	05-Dec-95	89.0	19.50	8.85	19.15	M
FL/GULF	05-Dec-95	94.0	25.00	11.34	92.00	F
FL/GULF	05-Dec-95	122.0	47.00	21.32	221.43	F
FL/GULF	06-Dec-95	82.0	13.12	5.95	18.49	M
FL/GULF	15-Dec-95	84.0	18.00	8.16	10.66	M
FL/GULF	16-Dec-95	87.6	17.00	7.71	65.40	F
FL/GULF	18-Dec-95	84.0	15.00	6.80	13.44	M
FL/KEYS/GULF	20-Jan-96	82.0	20.00	9.07	54.70	F
FL/KEYS/GULF	02-Feb-96	73.0	-	-	3.60	M
FL/KEYS/ATL	10-Feb-96	90.5	-	-	13.50	M
FL/KEYS/ATL	10-Feb-96	84.0	-	-	14.40	M
FL/KEYS/ATL	10-Feb-96	73.0	-	-	29.00	F
FL/KEYS/GULF	21-Feb-96	71.0	7.00	3.18	28.80	F
FL/KEYS/GULF	22-Feb-96	86.0	-	-	19.60	M
FL/KEYS/GULF	22-Feb-96	87.5	-	-	50.30	M
FL/KEYS/GULF	23-Feb-96	90.0	-	-	45.80	M
FL/KEYS/GULF	23-Feb-96	84.5	-	-	53.50	M
FL/KEYS/GULF	24-Feb-96	86.5	-	-	28.90	M
FL/KEYS/GULF	24-Feb-96	91.5	-	-	35.90	M
FL/KEYS/GULF	24-Feb-96	83.0	-	-	41.00	F
FL/KEYS/GULF	24-Feb-96	82.5	-	-	54.70	F
FL/KEYS/GULF	24-Feb-96	81.0	-	-	62.40	F
FL/KEYS/GULF	24-Feb-96	100.5	-	-	64.40	M
FL/KEYS/GULF	24-Feb-96	88.0	-	-	74.60	F
FL/KEYS/GULF	24-Feb-96	99.0	-	-	105.80	F
FL/ATL	25-Feb-96	87.0	-	-	21.20	M

**Table 4 (continued).** Data for cobia specimens used in reproduction section of study (F = females, M = males).

State/Coast	Capture Date	Fork Length (cm)	Fish Weight (lbs)	Fish Weight (kgs)	Gonad Weight (g)	Sex
FL/KEYS/GULF	25-Feb-96	96.5	-	-	27.90	F
FL/ATL	25-Feb-96	93.0	-	-	29.90	M
FL/KEYS/GULF	25-Feb-96	82.5	-	-	42.50	F
FL/KEYS/GULF	25-Feb-96	91.0	-	-	77.60	F
FL/KEYS/GULF	25-Feb-96	92.5	-	-	97.50	F
FL/KEYS/GULF	25-Feb-96	93.0	-	-	98.30	F
FL/ATL	25-Feb-96	112.0	-	-	158.80	F
FL/ATL	25-Feb-96	91.5	16.50	7.48	74.60	F
FL/ATL	25-Feb-96	93.5	18.00	8.16	92.20	F
FL/KEYS/GULF	26-Feb-96	80.0	-	-	10.50	M
FL/KEYS/GULF	26-Feb-96	71.5	9.00	4.08	31.40	F
FL/KEYS/GULF	27-Feb-96	70.5	8.50	3.86	5.40	M
FL/KEYS/GULF	27-Feb-96	70.0	9.00	4.08	30.50	F
FL/KEYS/GULF	27-Feb-96	87.0	18.00	8.16	21.40	M
FL/KEYS/GULF	27-Feb-96	91.0	20.00	9.07	93.60	F
FL/KEYS/GULF	28-Feb-96	86.5	-	-	89.30	F
FL/KEYS/GULF	28-Feb-96	105.0	-	-	131.40	F
FL/KEYS/GULF	15-Mar-96	77.0	-	-	25.40	F
FL/ATL	16-Mar-96	98.5	-	-	129.50	F
FL/ATL	16-Mar-96	107.0	-	-	174.70	F
FL/ATL	17-Mar-96	113.0	45.00	20.41	211.00	M
FL/ATL	29-Mar-96	94.0	20.00	9.07	99.40	F
FL/KEYS/GULF	30-Mar-96	72.0	9.50	4.31	27.10	F
FL/ATL	30-Mar-96	84.0	12.80	5.81	25.20	M
FL/ATL	30-Mar-96	86.0	15.00	6.80	84.00	F
FL/ATL	30-Mar-96	86.5	15.60	7.08	67.90	F
FL/ATL	30-Mar-96	90.5	16.00	7.26	86.40	F
FL/ATL	30-Mar-96	92.0	18.60	8.44	127.40	F
FL/ATL	30-Mar-96	93.0	18.80	8.53	27.60	M
FL/ATL	30-Mar-96	96.0	20.40	9.25	45.00	M
FL/ATL	30-Mar-96	94.0	21.00	9.53	103.00	F
FL/ATL	30-Mar-96	94.5	21.40	9.71	49.20	M
FL/ATL	30-Mar-96	93.0	21.60	9.80	112.00	F
FL/ATL	30-Mar-96	96.0	22.40	10.16	158.60	F
FL/ATL	30-Mar-96	100.0	23.00	10.43	58.90	M
FL/KEYS/GULF	30-Mar-96	80.5	23.00	10.43	131.00	F
FL/ATL	30-Mar-96	92.0	23.00	10.43	156.70	F
FL/ATL	30-Mar-96	98.0	23.20	10.52	131.70	F
FL/ATL	30-Mar-96	87.0	23.70	10.75	206.00	F

**Table 4 (continued).** Data for cobia specimens used in reproduction section of study (F = females, M = males).

State/Coast	Capture Date	Fork Length (cm)	Fish Weight (lbs)	Fish Weight (kgs)	Gonad Weight (g)	Sex
FL/ATL	30-Mar-96	94.5	23.80	10.80	111.10	M
FL/ATL	30-Mar-96	103.0	26.60	12.07	127.40	M
FL/ATL	30-Mar-96	101.0	27.80	12.61	121.50	F
FL/ATL	30-Mar-96	104.5	28.60	12.97	175.40	F
FL/ATL	30-Mar-96	109.5	32.60	14.79	96.60	M
FL/ATL	30-Mar-96	107.5	34.40	15.60	131.80	M
FL/ATL	30-Mar-96	105.5	35.40	16.06	175.30	F
FL/ATL	30-Mar-96	110.0	35.60	16.15	127.20	M
FL/ATL	30-Mar-96	123.0	41.20	18.69	232.00	F
FL/ATL	30-Mar-96	118.0	51.20	23.22	275.00	F
FL/GULF	04-Apr-96	88.0	-	-	37.40	M
FL/GULF	05-Apr-96	67.0	-	-	5.10	M
FL/ATL	06-Apr-96	107.0	-	-	228.00	F
FL/ATL	06-Apr-96	129.0	57.00	25.85	159.00	F
FL/ATL	07-Apr-96	90.0	-	-	131.00	F
FL/ATL	07-Apr-96	110.0	-	-	327.00	F
FL/GULF	11-Apr-96	72.5	9.00	4.08	29.20	M
FL/GULF	11-Apr-96	81.5	13.00	5.90	23.80	M
FL/GULF	12-Apr-96	70.0	8.00	3.63	27.40	F
FL/ATL	12-Apr-96	95.0	22.00	9.98	110.50	F
FL/ATL	12-Apr-96	112.0	35.00	15.88	212.00	F
FL/ATL	13-Apr-96	83.0	-	-	7.50	M
FL/ATL	13-Apr-96	109.0	-	-	261.00	F
FL/ATL	20-Apr-96	94.0	23.50	10.66	75.60	M
FL/ATL	21-Apr-96	85.0	-	-	61.20	F
FL/ATL	21-Apr-96	83.0	-	-	86.90	F
FL/ATL	21-Apr-96	92.0	-	-	114.80	F
FL/ATL	21-Apr-96	89.0	-	-	115.20	M
FL/GULF	25-Apr-96	69.5	10.00	4.54	33.40	M
FL/GULF	25-Apr-96	85.5	17.00	7.71	214.00	F
FL/GULF	25-Apr-96	109.0	37.00	16.78	61.20	F
FL/GULF	25-Apr-96	116.0	47.00	21.32	395.00	F
FL/GULF	26-Apr-96	82.0	-	-	78.80	F
FL/GULF	26-Apr-96	101.5	-	-	558.00	F
LA	27-Apr-96	111.1	-	-	618.10	F
LA	27-Apr-96	90.0	17.80	8.07	103.50	M
MS	27-Apr-96	97.3	20.50	9.30	229.80	F
LA	27-Apr-96	99.0	21.20	9.62	419.60	F
LA	27-Apr-96	97.1	21.40	9.71	202.10	F

**Table 4 (continued).** Data for cobia specimens used in reproduction section of study (F = females, M = males).

State/Coast	Capture Date	Fork Length (cm)	Fish Weight (lbs)	Fish Weight (kgs)	Gonad Weight (g)	Sex
LA	27-Apr-96	107.5	26.70	12.11	232.50	F
LA	27-Apr-96	115.2	33.70	15.29	224.70	F
MS	27-Apr-96	122.6	40.30	18.28	553.60	F
LA	27-Apr-96	109.6	40.70	18.46	698.60	F
MS	27-Apr-96	128.1	49.50	22.45	530.90	F
LA	27-Apr-96	125.4	54.00	24.49	737.50	F
LA	27-Apr-96	133.0	61.10	27.71	847.70	F
LA	27-Apr-96	138.5	61.10	27.71	1037.10	F
FL/GULF	01-May-96	36.5	.50	.23	.50	M
FL/GULF	01-May-96	72.0	10.00	4.54	40.70	F
FL/GULF	01-May-96	74.0	11.00	4.99	46.70	F
FL/KEYS/GULF	02-May-96	88.0	-	-	52.60	M
FL/KEYS/GULF	02-May-96	93.0	-	-	116.40	M
FL/KEYS/GULF	02-May-96	99.0	-	-	126.20	F
MS	03-May-96	98.8	-	-	63.80	F
MS	03-May-96	85.0	-	-	182.00	F
MS	03-May-96	104.5	-	-	275.50	F
MS	03-May-96	101.5	-	-	276.90	F
MS	03-May-96	95.5	-	-	287.60	F
MS	03-May-96	102.0	-	-	335.70	F
MS	03-May-96	98.5	-	-	400.50	F
MS	03-May-96	103.5	-	-	411.60	F
MS	03-May-96	92.5	15.60	7.08	101.50	F
MS	03-May-96	104.5	24.00	10.89	662.00	F
MS	03-May-96	96.5	25.00	11.34	385.10	F
LA	03-May-96	106.5	25.90	11.75	653.20	F
MS	03-May-96	103.0	30.90	14.02	478.10	F
MS	03-May-96	105.0	31.00	14.06	517.50	F
LA	03-May-96	116.5	34.90	15.83	656.50	F
LA	03-May-96	115.0	36.50	16.56	831.80	F
LA	03-May-96	115.0	41.60	18.87	479.00	F
FL/KEYS/GULF	03-May-96	106.0	43.00	19.50	240.70	F
LA	03-May-96	135.0	62.00	28.12	1544.60	F
LA	04-May-96	95.5	20.40	9.25	660.80	F
LA	04-May-96	93.5	22.10	10.02	538.30	F
LA	04-May-96	99.2	23.40	10.61	234.80	F
MS	04-May-96	102.6	25.20	11.43	259.90	F
LA	04-May-96	106.5	26.30	11.93	472.10	F
LA	04-May-96	98.7	27.30	12.38	773.70	F

**Table 4 (continued).** Data for cobia specimens used in reproduction section of study (F = females, M = males).

State/Coast	Capture Date	Fork Length (cm)	Fish Weight (lbs)	Fish Weight (kgs)	Gonad Weight (g)	Sex
LA	04-May-96	100.0	28.10	12.75	761.00	F
LA	04-May-96	109.6	29.60	13.43	697.20	F
LA	04-May-96	107.8	31.40	14.24	923.00	F
LA	04-May-96	106.0	34.60	15.69	714.40	F
LA	04-May-96	104.0	34.70	15.74	665.60	F
LA	04-May-96	114.6	36.20	16.42	607.00	F
LA	04-May-96	118.4	36.80	16.69	684.30	F
LA	04-May-96	119.5	45.80	20.77	1509.60	F
LA	04-May-96	126.0	48.90	22.18	1280.90	F
LA	04-May-96	120.8	52.30	23.72	1151.50	F
LA	04-May-96	123.0	56.70	25.72	631.60	F
LA	04-May-96	131.0	58.80	26.67	1509.70	F
MS	05-May-96	98.5	20.20	9.16	355.30	F
LA	05-May-96	90.0	20.80	9.43	619.70	F
LA	05-May-96	108.5	31.80	14.42	857.40	F
LA	05-May-96	114.0	38.10	17.28	980.80	F
LA	05-May-96	117.5	41.00	18.60	809.90	F
LA	05-May-96	123.0	43.90	19.91	802.80	F
LA	05-May-96	128.0	49.00	22.23	831.00	F
LA	05-May-96	110.0	53.90	24.45	494.00	F
LA	05-May-96	131.2	57.40	26.04	937.40	F
LA	05-May-96	134.5	57.70	26.17	1241.60	F
LA	05-May-96	129.5	59.10	26.81	847.80	F
FL/GULF	08-May-96	74.0	8.50	3.86	28.20	M
FL/GULF	08-May-96	69.0	10.00	4.54	94.70	M
SC	08-May-96	96.5	23.50	10.66	129.00	M
SC	10-May-96	91.0	23.00	10.43	251.00	M
SC	10-May-96	117.0	43.00	19.50	356.00	F
SC	16-May-96	117.0	40.00	18.14	314.00	F
SC	16-May-96	116.0	40.00	18.14	595.00	F
FL/GULF	19-May-96	93.0	27.70	12.56	487.00	F
TX	22-May-96	88.3	-	-	153.49	M
SC	22-May-96	95.5	-	-	410.00	M
SC	22-May-96	102.0	-	-	734.00	F
TX	22-May-96	121.9	-	-	1373.70	F
SC	22-May-96	97.0	26.00	11.79	678.00	M
SC	22-May-96	98.5	27.00	12.25	427.00	M
SC	22-May-96	99.0	28.00	12.70	735.00	M
SC	22-May-96	101.0	29.00	13.15	736.00	M

**Table 4 (continued).** Data for cobia specimens used in reproduction section of study (F = females, M = males).

State/Coast	Capture Date	Fork Length (cm)	Fish Weight (lbs)	Fish Weight (kgs)	Gonad Weight (g)	Sex
SC	22-May-96	102.0	31.00	14.06	677.00	M
SC	22-May-96	104.0	32.00	14.51	545.00	M
SC	22-May-96	110.0	33.00	14.97	410.00	M
SC	22-May-96	107.0	33.50	15.20	676.00	M
SC	22-May-96	113.0	37.00	16.78	1307.00	F
SC	24-May-96	80.5	13.50	6.12	149.00	M
SC	25-May-96	84.5	13.00	5.90	328.00	M
FL/ATL	25-May-96	94.0	20.50	9.30	393.90	M
SC	25-May-96	104.0	26.00	11.79	630.00	M
FL/GULF	05-Jun-96	57.0	5.00	2.27	18.50	M
FL/ATL	08-Jun-96	104.5	28.60	12.97	621.00	F
FL/ATL	08-Jun-96	109.0	33.00	14.97	596.00	F
FL/GULF	17-Jun-96	80.0	-	-	290.00	F
FL/GULF	28-Jun-96	56.0	4.05	1.84	10.42	F
TX	07-Jul-96	91.4	-	-	93.78	M
TX	07-Jul-96	92.7	-	-	157.27	M
TX	07-Jul-96	92.1	-	-	169.98	M
TX	07-Jul-96	102.9	-	-	238.50	M
FL/GULF	08-Jul-96	88.0	16.50	7.48	66.60	F
FL/GULF	08-Jul-96	84.5	17.50	7.94	242.00	M
FL/GULF	08-Jul-96	90.0	25.00	11.34	360.00	F
TX	11-Jul-96	95.3	-	-	209.93	M
TX	16-Jul-96	83.2	-	-	113.67	M
TX	16-Jul-96	104.1	-	-	120.10	F
TX	16-Jul-96	83.2	-	-	137.64	F
TX	16-Jul-96	111.8	-	-	412.53	F
TX	16-Jul-96	116.2	-	-	461.22	F
TX	16-Jul-96	90.5	-	-	533.96	F
FL/GULF	16-Jul-96	87.0	28.00	12.70	313.00	M
FL/GULF	16-Jul-96	93.0	28.00	12.70	626.00	F
FL/GULF	17-Jul-96	86.0	23.00	10.43	487.00	F
FL/GULF	17-Jul-96	91.0	24.00	10.89	232.00	M
MS	19-Jul-96	125.0	44.50	20.18	408.20	F
MS	19-Jul-96	123.0	56.00	25.40	897.40	F
TX	24-Jul-96	86.0	-	-	78.13	M
TX	24-Jul-96	95.6	-	-	383.93	F
TX	24-Jul-96	101.3	-	-	393.67	F
TX	24-Jul-96	101.0	-	-	473.99	F
TX	24-Jul-96	121.9	-	-	895.59	F

**Table 4 (continued).** Data for cobia specimens used in reproduction section of study (F = females, M = males).

State/Coast	Capture Date	Fork Length (cm)	Fish Weight (lbs)	Fish Weight (kgs)	Gonad Weight (g)	Sex
TX	25-Jul-96	89.2	-	-	60.37	F
TX	25-Jul-96	87.9	-	-	68.16	F
TX	25-Jul-96	97.8	-	-	87.04	F
TX	25-Jul-96	94.0	-	-	150.91	M
TX	25-Jul-96	105.4	-	-	153.49	M
TX	25-Jul-96	94.0	-	-	154.40	M
TX	25-Jul-96	85.1	-	-	205.29	F
TX	25-Jul-96	100.3	-	-	390.10	F
TX	25-Jul-96	108.9	-	-	439.69	F
TX	25-Jul-96	106.0	-	-	565.22	F
TX	25-Jul-96	121.9	-	-	643.07	F
TX	25-Jul-96	120.7	-	-	674.06	F
TX	26-Jul-96	102.2	-	-	96.64	F
TX	26-Jul-96	97.8	-	-	139.16	F
TX	26-Jul-96	89.9	-	-	143.78	M
TX	26-Jul-96	108.6	-	-	151.07	F
TX	26-Jul-96	93.3	-	-	154.44	M
TX	26-Jul-96	91.8	-	-	157.74	M
TX	26-Jul-96	89.5	-	-	162.60	F
TX	26-Jul-96	109.9	-	-	247.81	F
TX	26-Jul-96	100.0	-	-	318.36	F
TX	26-Jul-96	117.5	-	-	370.09	F
TX	26-Jul-96	128.3	-	-	372.77	F
TX	26-Jul-96	87.9	-	-	429.14	F
TX	26-Jul-96	107.6	-	-	484.44	F
TX	26-Jul-96	99.4	-	-	523.56	F
TX	26-Jul-96	104.8	-	-	565.02	F
TX	26-Jul-96	99.1	-	-	707.58	F
TX	28-Jul-96	87.9	-	-	179.46	M
TX	28-Jul-96	90.8	-	-	224.78	F
TX	28-Jul-96	94.6	-	-	265.51	M
TX	28-Jul-96	101.3	-	-	279.44	M
TX	28-Jul-96	105.7	-	-	421.83	F
TX	28-Jul-96	104.5	-	-	567.91	F
TX	30-Jul-96	97.2	-	-	109.90	M
TX	30-Jul-96	115.6	-	-	690.35	F
FL/GULF	30-Jul-96	89.0	25.50	11.57	207.00	F
FL/GULF	30-Jul-96	86.0	25.50	11.57	547.00	F
TX	07-Aug-96	84.5	-	-	107.53	F

**Table 4 (continued).** Data for cobia specimens used in reproduction section of study (F = females, M = males).

State/Coast	Capture Date	Fork Length (cm)	Fish Weight (lbs)	Fish Weight (kgs)	Gonad Weight (g)	Sex
TX	07-Aug-96	83.8	-	-	172.23	M
FL/ATL	21-Sep-96	83.0	16.00	7.26	44.80	M
FL/ATL	21-Sep-96	91.0	18.00	8.16	55.70	M
FL/ATL	21-Sep-96	102.0	27.00	12.25	146.70	M
MS	24-Sep-96	83.5	-	-	18.10	M
FL/GULF	27-Sep-96	81.5	11.90	5.40	44.40	M
FL/GULF	27-Sep-96	92.0	18.30	8.30	69.10	F
FL/GULF	30-Sep-96	89.0	15.70	7.12	57.20	F
FL/GULF	01-Oct-96	80.5	13.10	5.94	41.60	F
FL/GULF	01-Oct-96	82.0	13.30	6.03	21.50	M
FL/GULF	01-Oct-96	85.0	15.60	7.08	53.20	F
FL/GULF	01-Oct-96	94.0	19.70	8.94	61.70	F
FL/GULF	02-Oct-96	89.5	17.00	7.71	71.10	F
FL/GULF	02-Oct-96	94.0	22.60	10.25	195.70	F
FL/GULF	04-Oct-96	89.0	15.20	6.89	36.40	M
FL/GULF	04-Oct-96	97.0	22.60	10.25	78.30	F
FL/GULF	22-Oct-96	44.0	-	-	2.70	F
FL/GULF	31-Oct-96	99.5	26.25	11.91	80.80	F
FL/GULF	05-Nov-96	82.0	14.10	6.40	35.00	F
FL/GULF	05-Nov-96	89.0	19.34	8.77	110.40	M
FL/GULF	05-Nov-96	92.0	22.10	10.02	77.40	F
FL/GULF	06-Nov-96	86.0	17.00	7.71	26.40	M
FL/GULF	08-Nov-96	82.0	14.30	6.49	19.80	M
FL/GULF	19-Nov-96	39.5	.94	.43	.00	M
FL/GULF	19-Nov-96	41.5	.94	.43	.00	M
FL/GULF	19-Nov-96	61.0	4.69	2.13	11.90	F
FL/GULF	19-Nov-96	62.0	5.19	2.35	.70	M
FL/GULF	21-Nov-96	101.0	17.19	7.80	85.50	F
FL/GULF	03-Dec-96	127.0	58.00	26.31	120.00	M
FL/GULF	06-Mar-97	35.5	.69	.31	2.60	F
FL/GULF	25-Mar-97	47.0	1.80	.82	4.50	F
FL/ATL	29-Mar-97	100.0	-	-	184.00	F
FL/ATL	29-Mar-97	86.0	18.50	8.39	53.00	M
FL/ATL	29-Mar-97	89.0	20.00	9.07	47.00	M
FL/ATL	29-Mar-97	96.0	22.00	9.98	92.00	F
FL/ATL	29-Mar-97	90.5	22.00	9.98	123.00	F
FL/ATL	29-Mar-97	94.0	24.00	10.89	85.00	F
FL/ATL	29-Mar-97	96.0	24.00	10.89	125.00	F
FL/ATL	29-Mar-97	98.5	25.00	11.34	223.00	F

**Table 4 (continued).** Data for cobia specimens used in reproduction section of study (F = females, M = males).

State/Coast	Capture Date	Fork Length (cm)	Fish Weight (lbs)	Fish Weight (kgs)	Gonad Weight (g)	Sex
FL/ATL	29-Mar-97	102.0	27.00	12.25	152.00	F
FL/ATL	29-Mar-97	98.0	29.00	13.15	193.00	F
FL/ATL	29-Mar-97	107.0	32.00	14.51	264.00	F
FL/ATL	29-Mar-97	106.0	33.50	15.20	194.00	F
FL/ATL	29-Mar-97	116.0	35.00	15.88	333.00	F
FL/ATL	29-Mar-97	89.0	40.00	18.14	56.00	F
FL/ATL	29-Mar-97	107.0	46.00	20.87	130.00	M
FL/ATL	29-Mar-97	117.0	49.00	22.23	1044.00	F
FL/GULF	06-May-97	47.0	-	-	4.40	M
FL/GULF	06-May-97	67.0	1.41	.64	20.00	F
SC	21-May-97	88.5	18.00	8.16	252.00	M
SC	21-May-97	94.5	23.00	10.43	1012.00	F
SC	21-May-97	117.0	42.50	19.28	1072.00	F
SC	21-May-97	113.5	42.75	19.39	1662.00	F
SC	21-May-97	90.0	90.00	40.82	310.00	M
FL/GULF	27-May-97	87.0	20.00	9.07	213.30	M
NC	31-May-97	95.0	22.00	9.98	245.00	F
NC	31-May-97	138.5	77.00	34.93	954.00	F
NC	01-Jun-97	103.0	31.00	14.06	673.00	F
NC	01-Jun-97	105.5	33.00	14.97	1581.00	F
NC	01-Jun-97	138.5	69.00	31.30	1209.00	F
FL/GULF	23-Jun-97	108.0	32.00	14.51	566.00	F
MS	27-Jun-97	96.5	-	-	32.60	F
MS	27-Jun-97	83.2	-	-	48.10	F
FL/GULF	02-Jul-97	65.0	5.10	2.31	55.20	M
MS	15-Jul-97	87.8	17.30	7.85	60.60	F
MS	15-Jul-97	93.0	21.50	9.75	316.60	F
MS	24-Jul-97	96.5	21.00	9.53	105.10	F
MS	24-Jul-97	99.0	24.00	10.89	74.30	F
MS	24-Jul-97	98.0	24.50	11.11	468.40	F
FL/GULF	17-Aug-97	39.7	19.10	8.66	476.00	F
FL/GULF	17-Aug-97	95.0	21.30	9.66	403.00	F
FL/GULF	17-Aug-97	101.0	27.00	12.25	266.00	F
FL/GULF	17-Aug-97	37.0	34.00	15.42	147.00	F
FL/GULF	21-Aug-97	56.7	1.40	.64	9.70	F
FL/ATL	30-Aug-97	93.0	20.75	9.41	76.00	F
FL/GULF	10-Sep-97	121.0	55.00	24.95	1130.00	F
MS	31-Jul-97	90.8	17.50	7.94	-	F
MS	31-Jul-97	104.8	36.00	16.33	-	F
MS	05-Aug-97	88.9	21.00	9.53	-	F

**Table 4 (continued).** Data for cobia specimens used in reproduction section of study (F = females, M = males).

State/Coast	Capture Date	Fork Length (cm)	Fish Weight (lbs)	Fish Weight (kgs)	Gonad Weight (g)	Sex
MS	05-Aug-97	88.9	21.50	9.75	-	M
MS	05-Aug-97	92.7	25.00	11.34	-	F
MS	05-Aug-97	98.4	27.50	12.47	-	M
MS	07-Aug-97	114.3	32.00	14.51	212.6	M
MS	14-Aug-97	95.9	16.00	7.26	58.7	F
MS	14-Aug-97	106.7	26.00	11.79	280.2	F
LA	13-Sep-97	89.0	14.00	6.35	-	M
MS	13-Sep-97	97.0	19.60	8.89	-	M
LA	13-Sep-97	96.5	20.70	9.39	-	F
LA	13-Sep-97	96.0	23.10	10.48	-	F
LA	13-Sep-97	104.0	24.30	11.02	-	F
LA	13-Sep-97	97.0	24.90	11.29	-	F
MS	13-Sep-97	108.0	29.10	13.20	-	M
LA	13-Sep-97	114.0	32.20	14.61	-	F
LA	13-Sep-97	115.0	34.60	15.69	-	F
MS	14-Sep-97	94.0	17.40	7.89	-	F
LA	14-Sep-97	95.0	18.80	8.53	-	M
LA	14-Sep-97	96.0	20.30	9.21	-	F
MS	14-Sep-97	97.0	21.80	9.89	-	M
LA	14-Sep-97	102.5	25.60	11.61	-	F
LA	14-Sep-97	104.0	27.20	12.34	-	F
MS	14-Sep-97	115.5	35.40	16.06	-	F
MS	14-Sep-97	114.0	39.70	18.01	-	F
LA	14-Sep-97	118.0	47.10	21.36	-	F
FL/GULF	09-Oct-97	87.0	15.50	7.03	66.9	F
FL/GULF	09-Oct-97	101.0	27.00	12.25	157.9	F
FL/KEYS/	17-Oct-97	84.5	15.00	6.80	-	F
FL/KEYS/	17-Oct-97	84.5	18.00	8.16	-	F
FL/KEYS/	17-Oct-97	90.5	20.00	9.07	-	F
FL/KEYS/	17-Oct-97	93.3	-	-	-	M
FL/GULF	10-Nov-97	114.0	45.00	20.41	152.4	F
FL/GULF	18-Nov-97	76.5	9.13	4.14	25.2	F
FL/GULF	25-Nov-97	87.0	15.00	6.80	59.0	F
FL/GULF	26-Nov-97	86.0	14.00	6.35	53.0	F
FL/GULF	26-Nov-97	83.5	15.00	6.80	49.0	F
FL/GULF	26-Nov-97	83.0	15.50	7.03	62.0	F
FL/GULF	03-Dec-97	71.0	-	-	32.0	F
FL/GULF	03-Dec-97	69.5	-	-	8.0	M
FL/ATL	04-Dec-97	96.0	24.00	10.89	82.0	F
FL/ATL	04-Dec-97	108.0	33.00	14.97	65.0	M
FL/ATL	04-Dec-97	120.5	50.00	22.68	263.0	F
FL/ATL	04-Dec-97	114.0	-	-	190.0	F
FL/GULF	05-Dec-97	99.0	-	-	-	F
FL/GULF	16-Dec-97	117.0	56.00	25.40	-	F

**Table 5.** Summary statistics for fork length (cm) for female & male cobia by sampling area. *(Length of one male unavailable)*

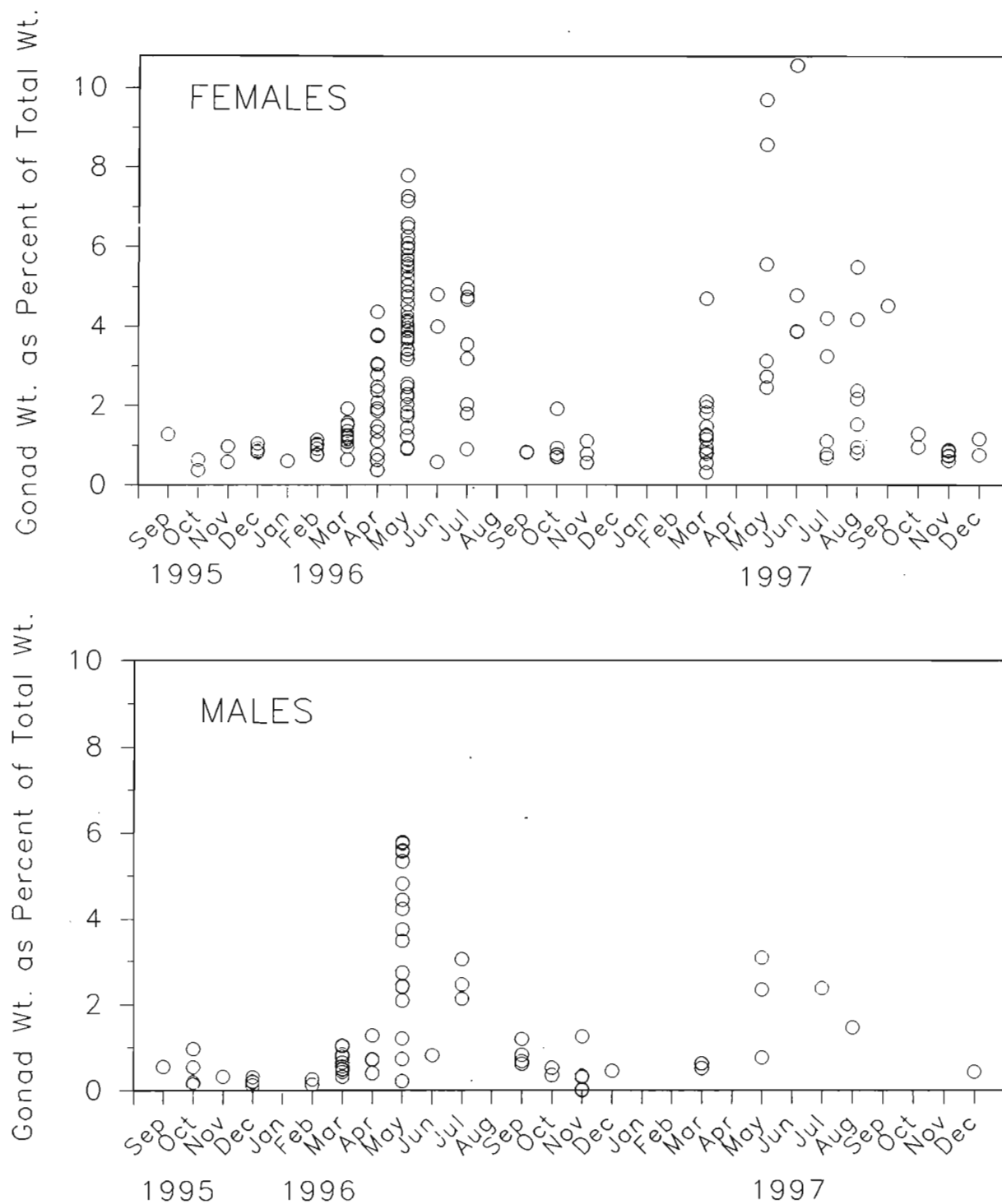
	Fork Length (cm)				
	Total Atlantic	Total FL Keys	Total Gulf	Tournament Atlantic	Tournament Gulf
<b>Females</b>					
n	100	28	352	60	178
Mean	108.2	86.0	101.8	108.7	108.8
S.D.	13.6	9.9	19.0	13.9	15.4
Minimum	83.0	70.0	31.5	86.5	37.0
Maximum	138.5	106.0	163.9	138.5	158.5
<b>Males</b>					
n	56	20	146	39	50
Mean	95.5	86.2	89.0	95.4	100.8
S.D.	8.8	6.9	18.1	8.6	11.4
Minimum	80.5	70.5	31.0	80.5	82.5
Maximum	113.0	100.5	139.0	110.0	139.0

**Table 6.** Summary statistics by weight (lbs) for female & male cobia by sampling area.

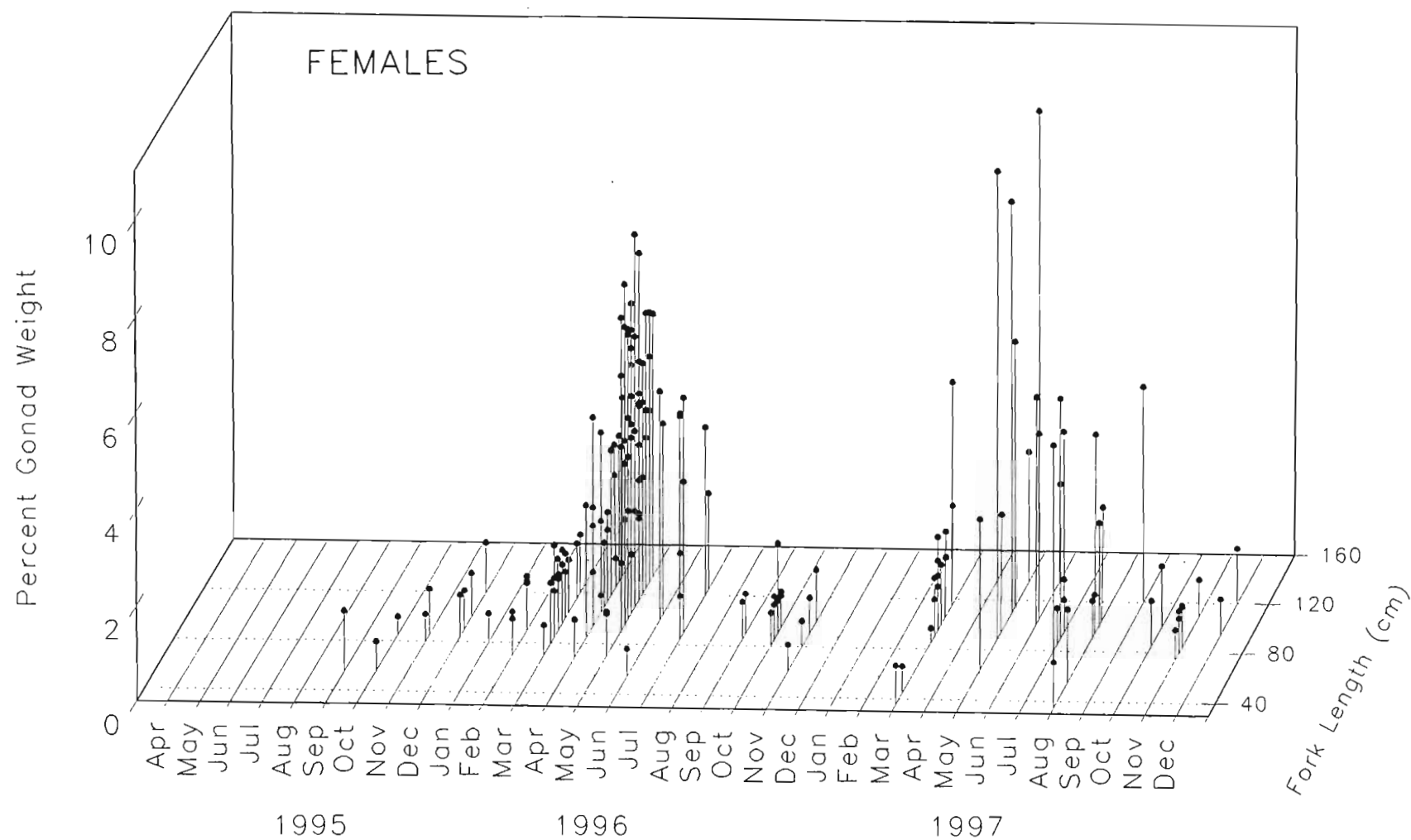
	Weight (lbs)				
	Total Atlantic	Total FL Keys	Total Gulf	Tournament Atlantic	Tournament Gulf
<b>Females</b>					
n	77	11	255	57	161
Mean	37.3	17.6	30.5	37.4	35.6
S.D.	15.6	10.1	16.4	16.0	14.1
Minimum	15.0	7.0	0.5	15.6	15.6
Maximum	85.5	43.0	106.8	85.5	106.8
<b>Males</b>					
n	44	5	87	38	37
Mean	26.3	14.7	18.5	25.6	23.9
S.D.	12.6	3.8	10.7	12.9	7.6
Minimum	12.8	8.5	0.5	12.8	11.8
Maximum	90.0	18.0	58.0	90.0	53.7

**Table 7.** Summary statistics of gonad weight (g) for female & male cobia by area.

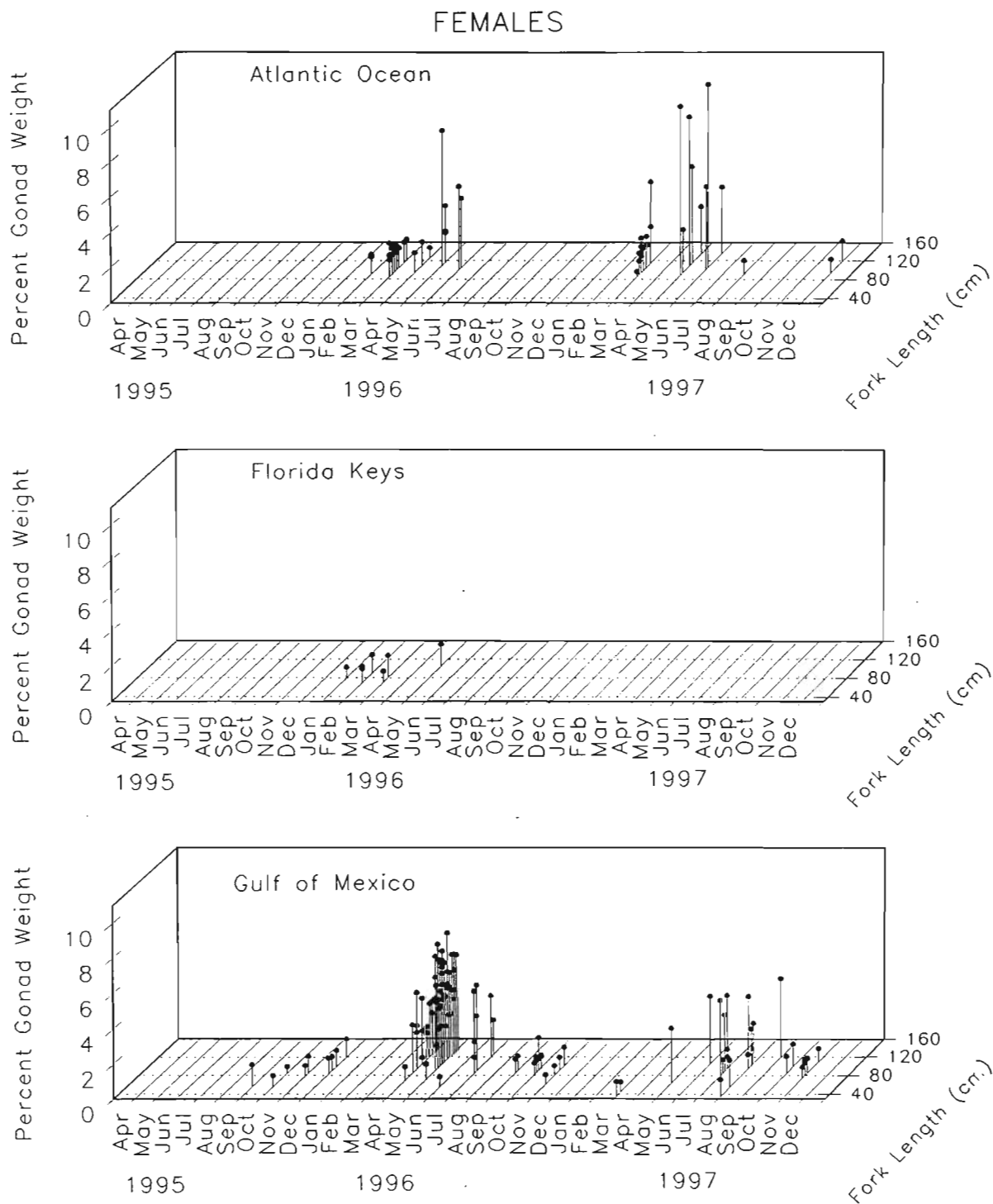
	Gonad Weight (g)				
	Total Atlantic	Total FL Keys	Total Gulf	Tournament Atlantic	Tournament Gulf
<b>Females</b>					
n	63	23	167	39	64
Mean	337.2	74.8	390.2	432.4	617.3
S.D.	384.5	51.0	345.7	455.5	341.7
Minimum	56.0	25.4	2.6	56.0	63.8
Maximum	1,662.0	240.7	1,544.6	1,662.0	1,544.6
<b>Males</b>					
n	40	18	55	31	2
Mean	238.5	35.4	96.7	278.5	60.8
S.D.	233.0	30.0	88.0	247.6	60.4
Minimum	7.5	3.6	0.0	25.2	18.1
Maximum	736.0	116.4	313.0	736.0	103.5



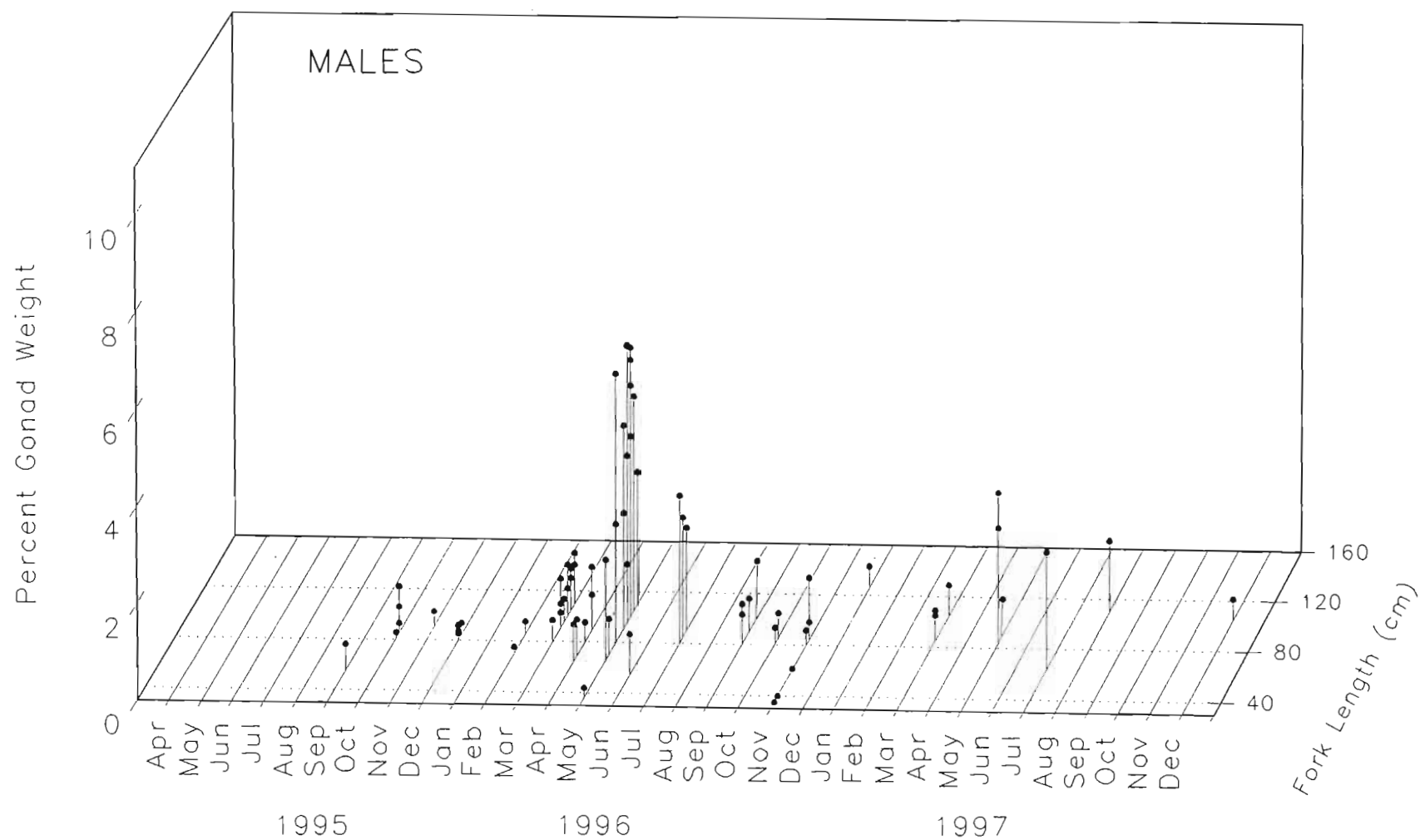
**Figure 9.** Seasonal variations of gonad weight as percent of total weight for female and male cobia.



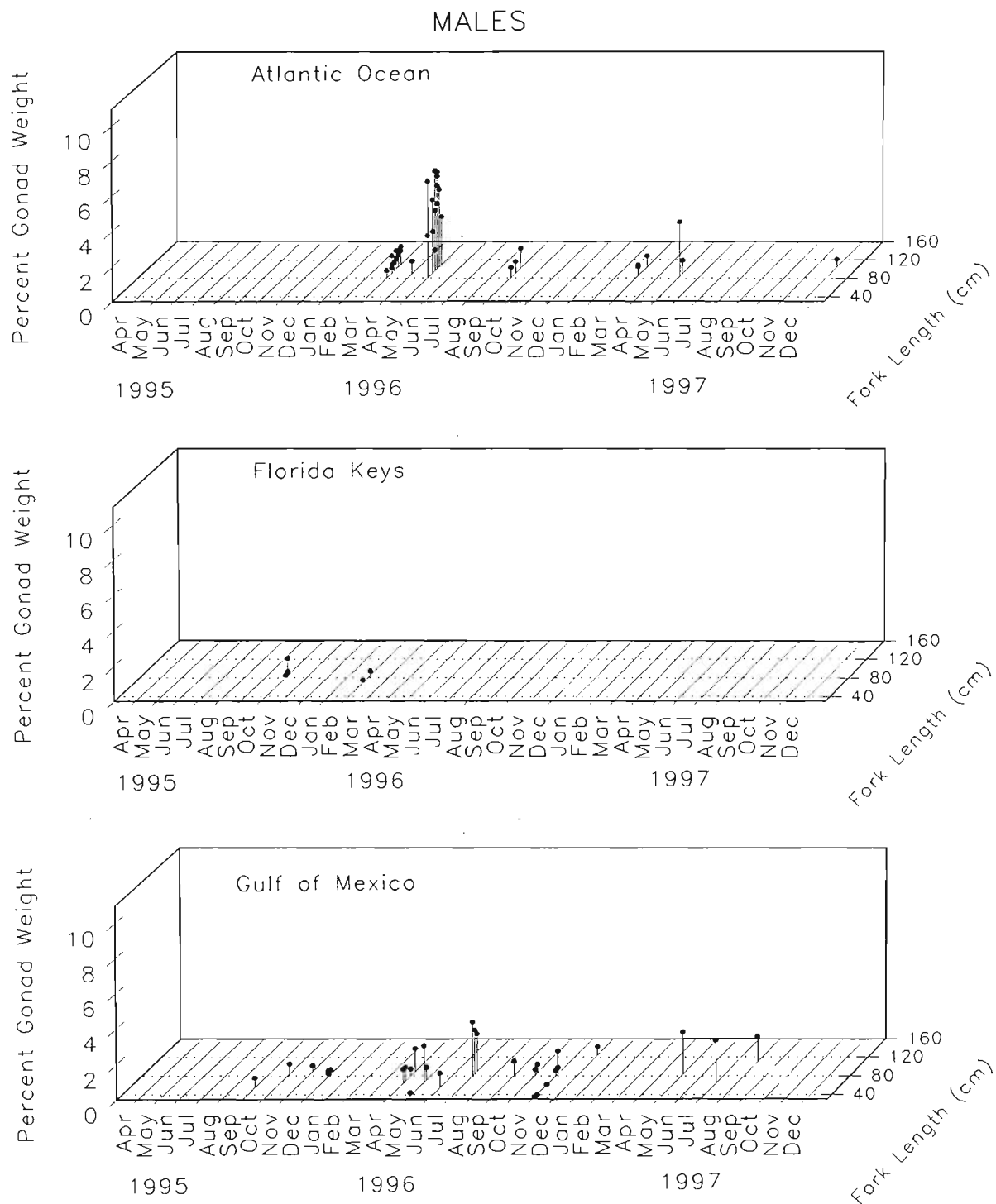
**Figure 10.** Percent gonad weight in relation to total body weight for female cobia by fork length (cm) and month of capture.



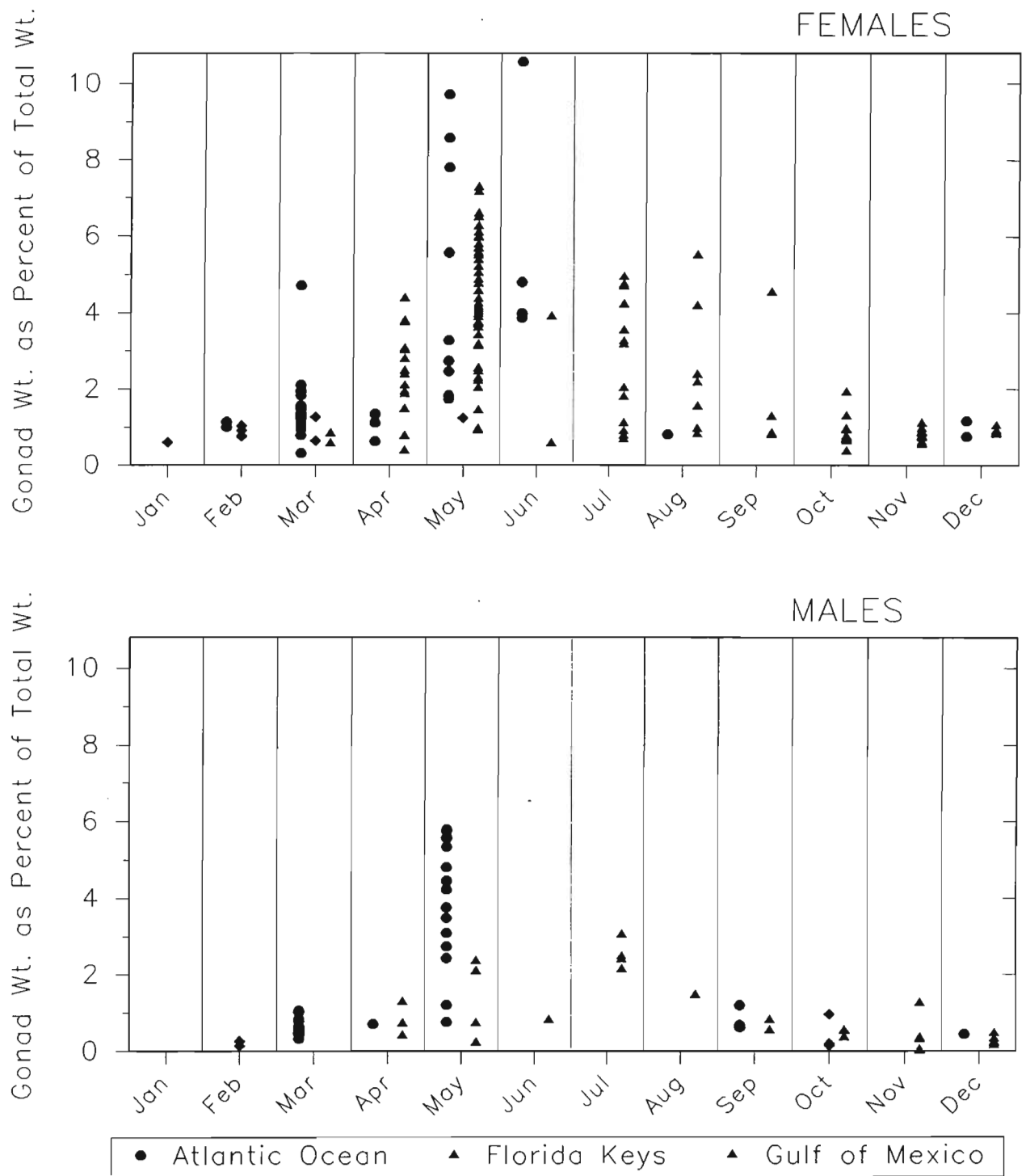
**Figure 11.** Percent gonad weight in relation to total body weight for female cobia by fork length (cm), month of capture and area.



**Figure 12.** Percent gonad weight in relation to total body weight for male cobia by fork length (cm) and month of capture.



**Figure 13.** Percent gonad weight in relation to total body weight for male cobia by fork length (cm), month of capture and area.



**Figure 14.** Gonad weight as percent of total weight for female and male cobia by area.

# Otolith Tally

## COBIA OTOLITH TALLY SHEET

AREA: South Atlantic and Gulf of MexicoPERIOD: 8/1/95-12/31/97 Quarters I-X

SEX AND FORK LENGTH INTERVAL (CM)	ATLANTIC NC SC FL EAST COAST	EAST GULF FL KEYS FL	NORTH GULF AL MISS LA FL PAN	WEST GULF TX	TOTAL	SEX AND FORK LENGTH INTERVAL (CM)	ATLANTIC NC SC FL EAST COAST	EAST GULF FL KEYS FL	NORTH GULF AL MISS LA FL PAN	WEST GULF TX	TOTAL
FEMALE						MALE					
0-20						0-20					
21-30						21-30					
31-40		3	1	1	5	31-40		2	2	2	6
41-50		2	2		4	41-50		3			3
51-60		4			4	51-60		3			3
61-70		6	1		7	61-70		6			6
71-80		13	1	1	15	71-80		6	1		7
81-90	8	38	13	15	74	81-90	19	31	16	18	84
91-100	26	21	53	13	113	91-100	20	7	19	15	61
101-110	24	10	57	16	107	101-110	15	1	20	5	41
111-120	24	4	43	9	80	111-120	2	1	4		7
121-130	13	2	33	6	54	121-130		1	1		2
131-140	5		8		13	131-140			2		2
141-150			1		1	141-150					
151-160			2		2	151-160					
161-170			1		1	161-170					
171-180						171-180					
181-190						181-190					

**Figure 15.** Number of cobia otoliths collected from start through December 31, 1997 and segregated by fish size, sex and geographic location.  
(Length of one male unavailable)

#### IV. PUBLICITY

As part of the publicity campaign to obtain cobia carcasses from fishers in Florida, press releases were periodically sent to local sports writers. Articles appeared in various newspapers throughout the two-year project. Please see **Appendix A** for examples of the publicity campaign and newspaper articles which are listed below.

##### Quarter II

- The Fort Myers News-Press by Byron Stout (November 26, 1995)
- The Pelican Press (Sarasota, Florida) by Bob Ardren (December 7, 1995)
- The Sarasota Herald-Tribune in the "Floridoors" Section (December 10, 1995)
- The Key West Citizen by Kevin Brockway (no example)

##### Quarter III

- Florida Today (Brevard County)
- The Key West Citizen by Sea Grant Marine Extension Agent, Douglas Gregory

##### Quarter IV

- The Tampa Tribune by Bill Sargent
- The Sarasota Herald-Tribune in "On the Gulf Coast" section by Steve Gibson (May 21, 1996)

##### Quarter V

- The Pelican Press (Sarasota, Florida) by Bob Ardren (August 15, 1996)
- The Southwest Florida Fishing News (September, 1996)

##### Quarter VI

- The Pelican Press (Sarasota, Florida) by Bob Ardren - 2 articles (October 10, 1996 and November 7, 1996)
- The Sarasota Herald-Tribune by Steve Gibson (January 1, 1997)

##### Quarter VIII

- The Georgia Times-Union by Joe Jularits (Jacksonville, Florida - May 18, 1997)

##### Quarter IX

- The East Bay Breeze - Tampa Metropolitan Area, Apollo Beach, Florida Edition, "Angler's Almanac" section by Dan Scopes (June 25, 1997)
- The Suncoast News - four editions, by Nick Stubbs
  - Tampa Metro Area Countryside/Dunedin Edition
  - Palm Harbor/Tarpon Springs Edition
  - East Lake/Oldsmar Edition
  - New Port Richey/Port Richey Edition

*(Quarters VII and X did not have any newspaper articles)*

During the month of July, 1996, MML P.I., Karen Burns, gave two interviews on 570 WINS News radio and on the Captain Sergio Fishing show on an affiliate station of 570, briefly describing the project and requesting help from fishers in collecting cobia carcasses from fish caught in Tampa Bay, Florida. The request for help from fishers was also made on the Mel Berman radio fishing show.

In August of 1996, Teresa DeBruler of MML, gave a talk to the Florida Conservation Association of Manatee County (FCA) on the cobia project. In September of 1996, she gave another talk to the Englewood Rotary Club.

## V. AGE AND GROWTH

### Materials and Methods

#### Sampling Protocol:

Cobia otoliths (sagittae) were used to determine age and growth. Seven hundred and three otoliths were collected and analyzed from the Gulf of Mexico and the South Atlantic. Data taken during collection of otoliths included date, sex, size, capture location, gear type and water temperature from cobia captured off North and South Carolina, South Florida, the Florida Keys, the northern Gulf of Mexico and Texas. Water depth was also recorded. Specimens were obtained from fishing tournaments, charter boat captains, recreational and commercial fishers. MML personnel collected samples from the Carolinas, South Florida and the Florida Keys. GCRL personnel obtained samples from the northern Gulf. Texas samples were obtained by a graduate student from the University of Texas from charter boat captains fishing off Port Aransas.

The length-weight relationships for males and females were described using the model:  $\text{weight} = a\text{FL}^b$ , where weight = total body weight and FL = fork length (mm). Analyses of covariance (Ott, 1977) were used to test for differences between regressions.

#### Otolith Processing Protocol:

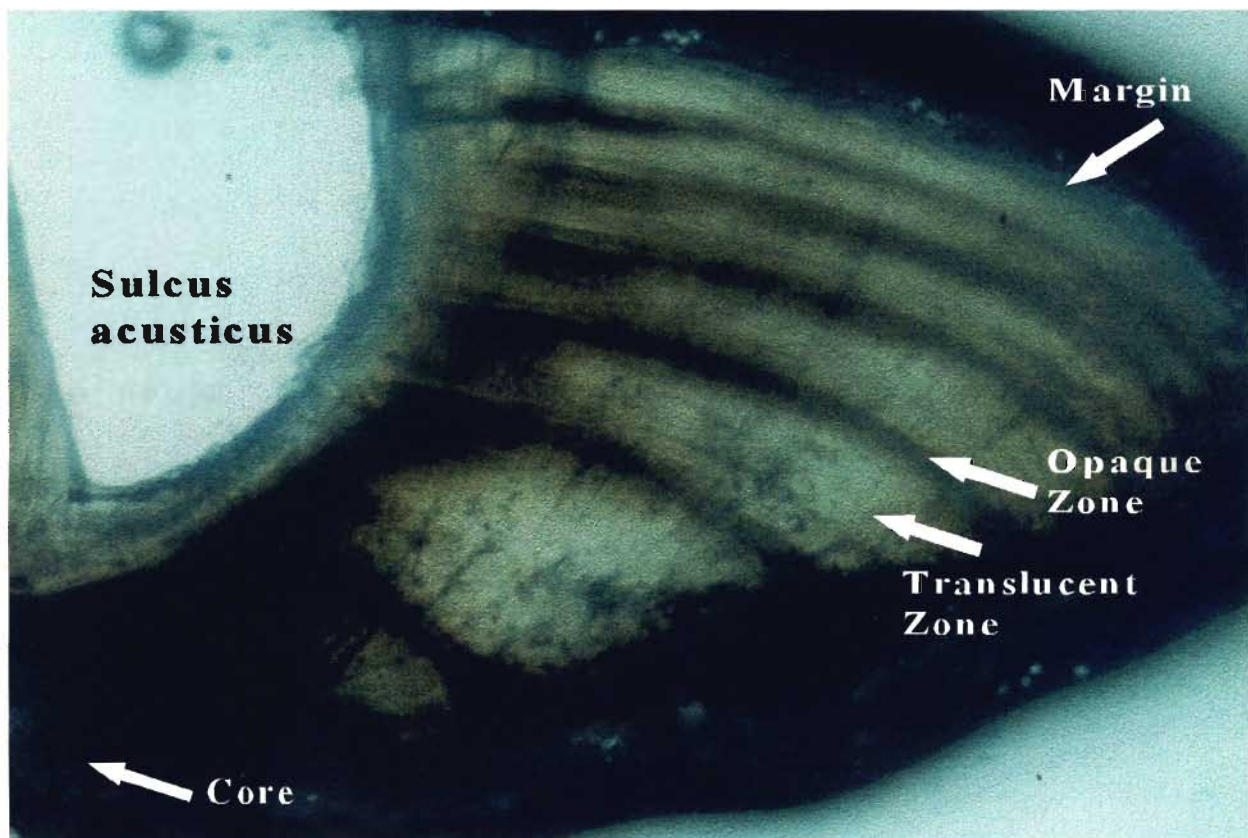
Otoliths (sagittae) were removed by making a cross cut in the cranium with a hack saw. Sagittae were removed from the sacculi, rinsed with water, blotted, air dried and stored in labelled glass vials until processed. The left sagitta was used for age determination except when broken, lost, damaged during processing, or unreadable; in these instances, the right sagitta was substituted. When the left sagitta was processed, the right was archived. During year one, otoliths were embedded in Crystal Bond 509.

In year two, otoliths were embedded in plastic molds filled with Araldite CY 8702 epoxy encapsulating resin plus a hardener. This second year procedure was preferred because it reduced otolith damage during cutting. The resin was not as brittle as the Crystal Bond and provided better protection for the otolith.

Otoliths were cut using a Buehler Isomet low-speed saw with a diamond blade. Otoliths were sectioned (0.5 - 0.7 mm) transversely through the core. Sections were mounted on glass slides using Flo-Texx Mounting Medium, and allowed to dry for 12 hours. Finished slides were viewed using a stereo dissection microscope with transmitted light at 30/40X magnification.

Age was estimated by counting opaque zones in sections as annuli, counting from the core to the outer edge (margin). Franks and McBee (1991) verified that opaque zones delineated annuli. The appearance of the margin was recorded as either opaque or translucent (Wilson *et al.*, 1987). In an effort to deter any bias during examination, sections were read without reference to sample source, sex, fish size, or date of catch. All sections were independently read once by two readers, followed by a joint reading in an effort to resolve any differences between counts. Disagreement in counts usually involved the presence or absence of an annulus on the otolith margin. After all the otoliths were read, those with different counts were re-examined. In most cases an agreement was reached and an age was assigned to the fish. In those cases where disagreements could not be reconciled, the otoliths were discarded and not included in the analysis.

Figure 16 of the ventral lobe a thin sectioned cobia sagittal otolith, shows the sulcus, core, opaque zone and translucent zone.



## Results

### Age/Length:

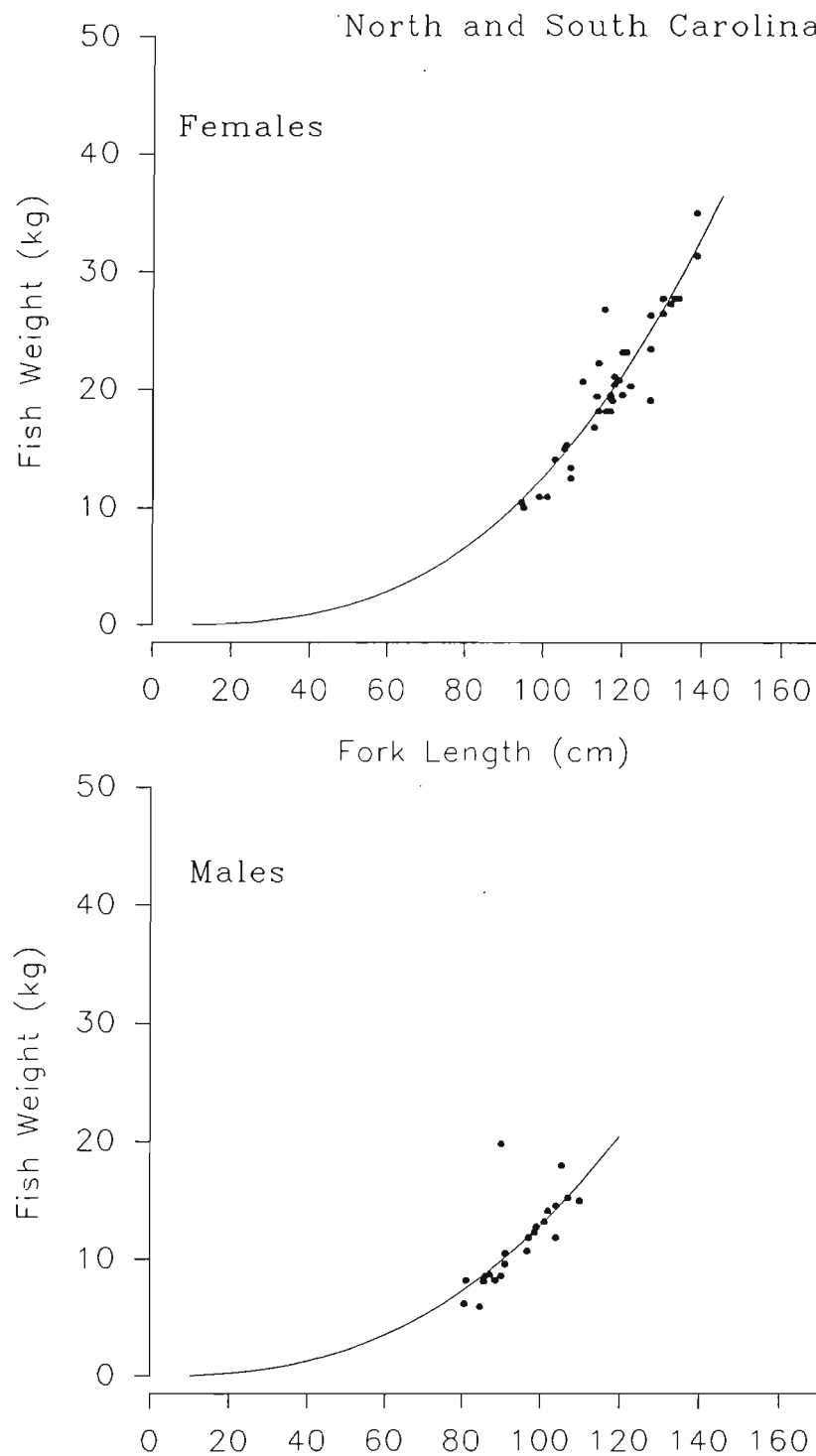
A total of 703 cobia, (480 females and 223 males) from North Carolina to Texas were sampled. Fish were grouped by geographic region, the Carolinas, Florida Atlantic coast, Florida Gulf coast, northern Gulf and Texas coast. Female cobia (n=45) collected off the Carolinas ranged in size from 940.5 - 1380.5 mm FL, mean=1155.7 mm, and weighed 48.40 - 188.10 kg, mean=98.70 kg. Male cobia (n=28 mm) from the same locations ranged 800.50 -1130.0 mm FL, mean=950.70 mm, and weighed 28.60-198.0 kg, mean=59.95 kg. A total of 83 cobia, (55 females and 28 males) were sampled from the Florida Atlantic coast. Females ranged from 830.0-1290.0 mm FL, mean=1000.83 mm, and weighed 33-125.40 kg, mean=62.04 kg. Males ranged from 830.0-1130.0 mm FL, mean=960.0 mm, and weighed 28.16-101.20 kg, mean=55.9 kg. Cobia captured off the Florida Gulf coast ranged from 350.0-1270.0 mm FL, mean=820.26 mm. Females (n=75), measured 350.5-1220.0 mm FL, mean=850.35 mm while males (n=41) measured 360.5-1270.0 mm, mean=760.6 mm. Females weighed 1.518-123.20 kg, mean=44.88 kg, while males weighed 1.1-127.60 kg, mean=40.41 kg. Northern Gulf females (n=216) ranged 370-1630.9 mm FL, mean=1050.40 mm, and weighed 1.65-234.96 kg, mean=69.43 kg. Male cobia (n=66) from this region, ranged in length from 380-1390 mm FL, mean=970.30 mm, and weighed from 1.65-118.14 kg, mean=48.38 kg. Cobia (61 females and 40 males) collected off Texas, ranged 310.0-1280.3 mm FL, mean=950.80 mm. Females ranged from 310.50-1280.30 mm FL, mean=950.80 mm, while males varied 310.0-1050.40 mm, mean=950.80 mm. Weights were not available for most of the Texas fish.

Length/frequency distributions for females and males were markedly different, with females larger than males at all locations (**See Figures 3-7**). Female cobia were significantly larger than male cobia (Mann-Whitney U test).

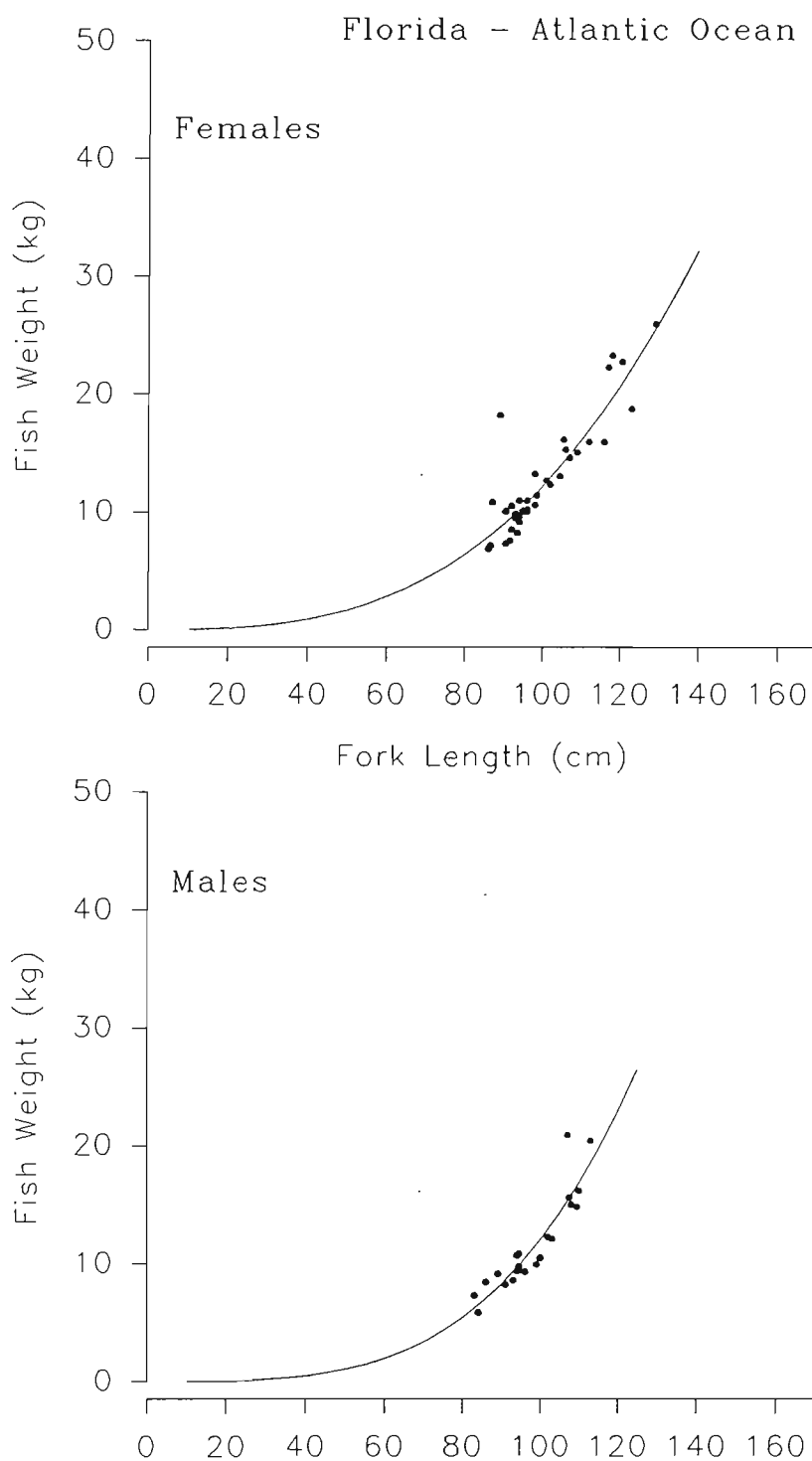
More female (n=480) than male (n=223) cobia were collected at all of the sampling stations. Samples from areas where most of the fish were collected from tournaments, might be expected to be biased toward females, which are larger; however, the sex ratio for non-tournament cobia also was not 1:1. The sex ratio at most locations was approximately 2:1 in favor of the females, with the exception of the northern Gulf, where the ratio was 3:1.

For each coast ANOVA's were performed to test for differences in the slopes of length/weight (log transformed) regression lines between the sexes. The slopes were not statistically different for any of the coasts. (The p-values of the slopes were: 0.6252-Carolinas; 0.2655-Florida Atlantic; 0.4130-Florida Gulf; and 0.8847-Northern Gulf.

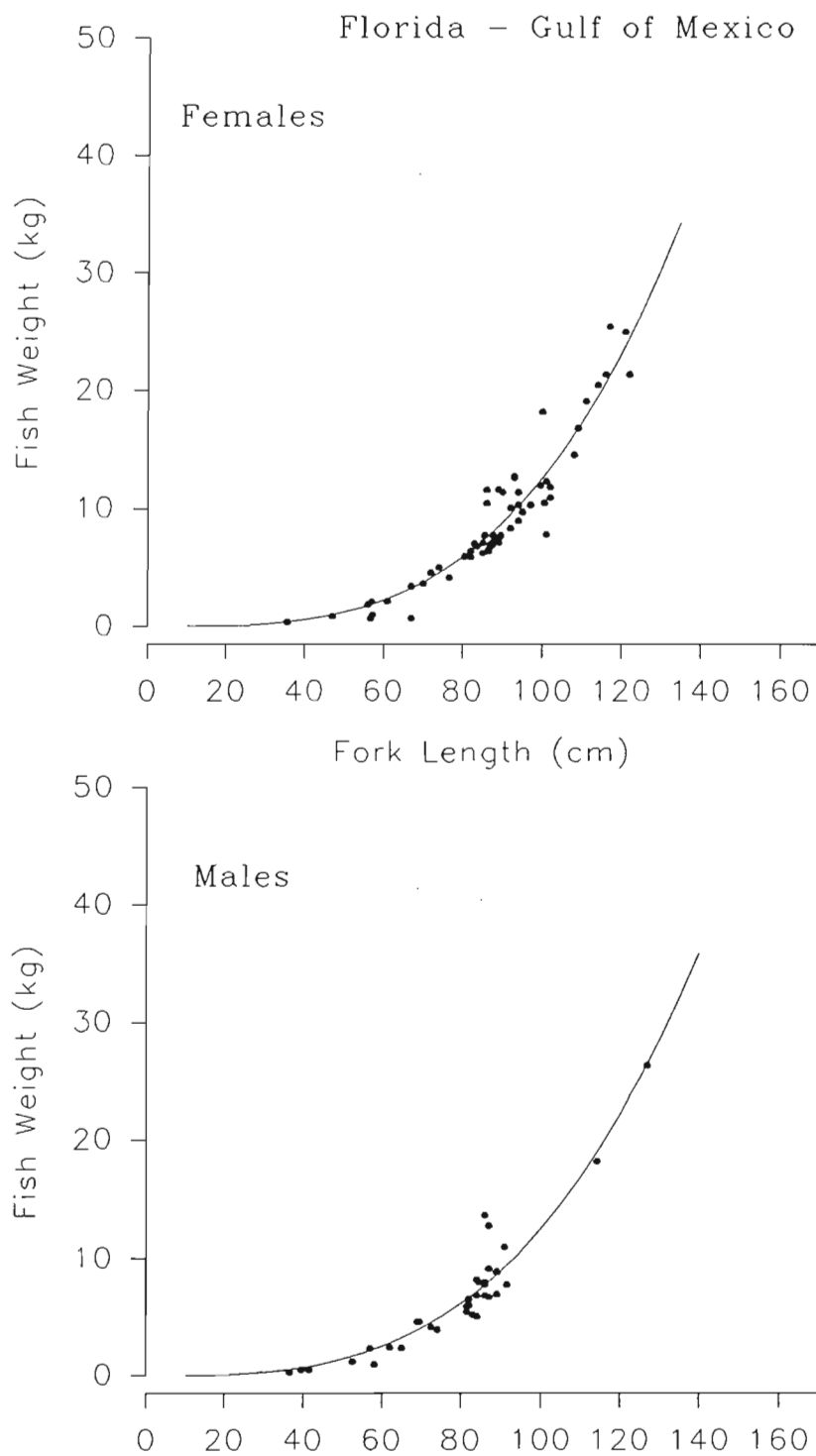
Length-weight regressions were calculated for both male and female cobia by each geographic area, the Carolinas, Florida east coast, Florida west coast and northern Gulf of Mexico. Regressions were calculated using linear regression of log<sub>10</sub>- transformed data. Slopes and elevations of the regressions were compared by analysis of covariance (Snedecor and Cochran, 1967), (**Figures 17-20, Tables 8, 9 and 10**).



**Figure 17.** Weight and Length for cobia captured off North and South Carolina.



**Figure 18.** Weight and Length for cobia captured off the east coast of Florida.



**Figure 19.** Weight and Length for cobia captured off Florida Gulf coast.

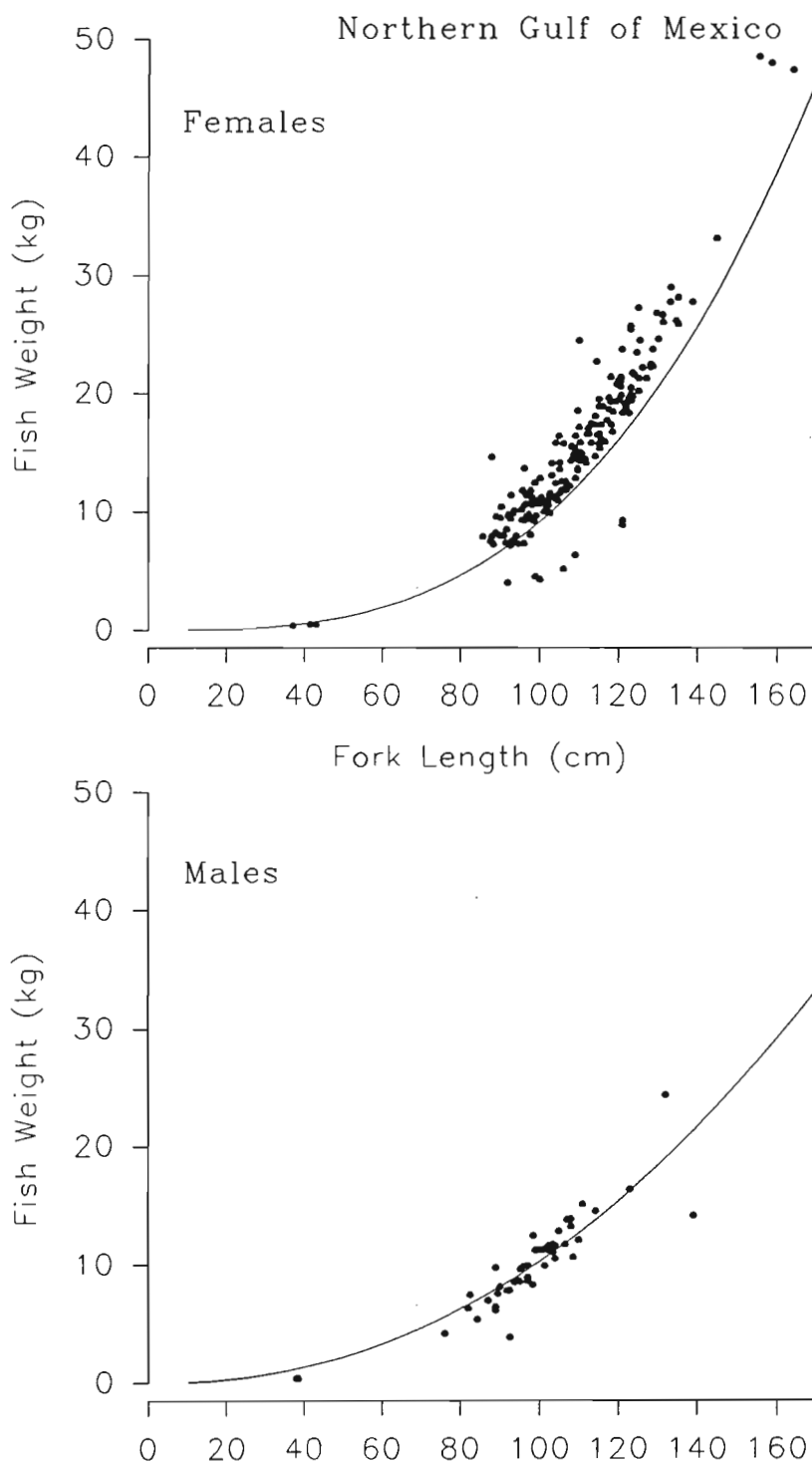


Figure 20. Weight and Length for cobia captured in the Northern Gulf of Mexico.

**Table 8.** Length (mmFL)/Weight (kg) data for female cobia sampled off the southeastern United States used in age/growth determination.

Location	n	Size Range (mmFL)	Mean Size	Weight Range (kg)	Mean Weight
Carolinas	45	940.5-1380.5	1155.7	48.4-188.1	98.7
FL Atlantic	55	830.0-1290.0	1000.8	33.0-125.4	62.0
FL Keys	28	700.0-1060.0	86.0	15.4-94.6	38.6
FL Gulf	75	350.5-1270.0	820.3	1.5-123.2	44.9
N. Gulf	216	370.0-1630.9	1050.4	1.7-235.0	69.4
Texas	61	310.5-1280.3	950.8	N/A	N/A

**Table 9.** Length (mmFL)/Weight (kg) data for male cobia sampled off the southeastern United States used in age/growth determination.

Location	n	Size Range (mmFL)	Mean Size	Weight Range (kg)	Mean Weight
Carolinas	28	800.5-1130.0	950.7	28.6-198.0	59.9
FL Atlantic	28	830.0-1130.0	960.0	28.1-101.2	55.9
FL Keys	20	700.5-1000.5	86.2	18.7-39.6	14.7
FL Gulf	41	360.5-1220.0	760.6	1.1-127.6	40.4
N. Gulf	66	380.0-1390.0	970.3	1.6-118.1	48.3
Texas	20	310.0-1050.4	950.8	1.1-1.6	1.3

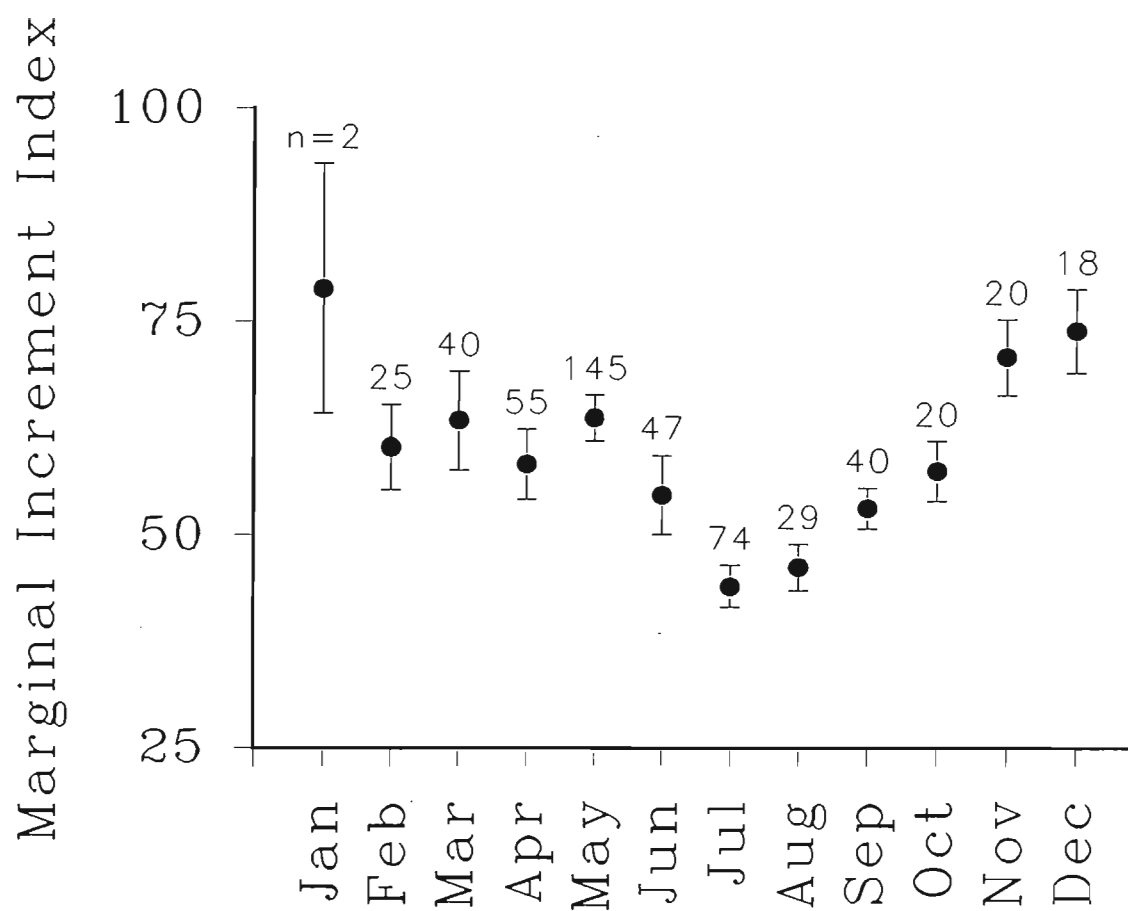
**Table 10.** Power curve relation of length/weight of female and male cobia by location.

<u>Females</u>	<u>a</u>	<u>b</u>	<u>r<sup>2</sup></u>
Carolinas	0.236	2.8633	.858
Florida Atlantic	0.021	2.8909	.793
Florida Gulf	0.00179	3.42034	.900
Northern Gulf	0.00811	3.06541	.884
<u>Males</u>			
Carolinas	0.103	2.548	.513
Florida Atlantic	0.000970	3.545877	.822
Florida Gulf	0.00619	3.15110	.899
Northern Gulf	0.371	2.221	.773

Age/length keys for both female and male cobia were constructed. This was accomplished by combining observed age at length for each sex following Ricker, 1975). Cobia (n = 605, 413 females and 192 males) were aged and divided into 50 mm length intervals. Age distribution, represented as percent, was calculated for each size interval. Results from this study agree with those of both Franks in the northern Gulf, and Smith off the Carolinas. Gulf cobia appear to grow faster than those off the Carolinas; however, fish off the Carolinas appear to live longer than their Gulf counterparts. From these data, it appears that older fish are not abundant in the Gulf of Mexico, and that Gulf fishers are fishing younger fish than their counterparts off the Carolinas. Age/length keys (**Appendix B: Tables 1 through 6**) were constructed by location. Separate keys were made for female and male cobia because female cobia grow larger and faster than their male counterparts.

Marginal Increment Analysis:

Marginal increment analysis was performed for validation of annuli following Crabtree *et al.*, (1996). Each ring represented an annual event with the minimum occurring in July (**Figure 21**). This figure represents all data. Opaque zones were validated as annuli, i.e. plotting monthly percentage frequencies of otoliths with opaque margins (Barger, 1985; Fable *et al.*, 1987; Beckman *et al.*, 1990). Additional analyses were conducted to determine if annulus formation varied by geographic location or if differences exist between age classes. In **Figure 22 and 23**, each individual fish is shown by location and season. Data from the Carolinas and Texas are incomplete because fish were only collected a few months of the year. **Figure 24a and 24b** shows the standard error for the marginal increment index by sampling location and month. Annulus formation was also analyzed by age. Marginal increments of individual cobia by age was plotted in **Figures 25a and 25b**.



**Figure 21.** Marginal increment index for cobia verifying that otolith rings are annuli.

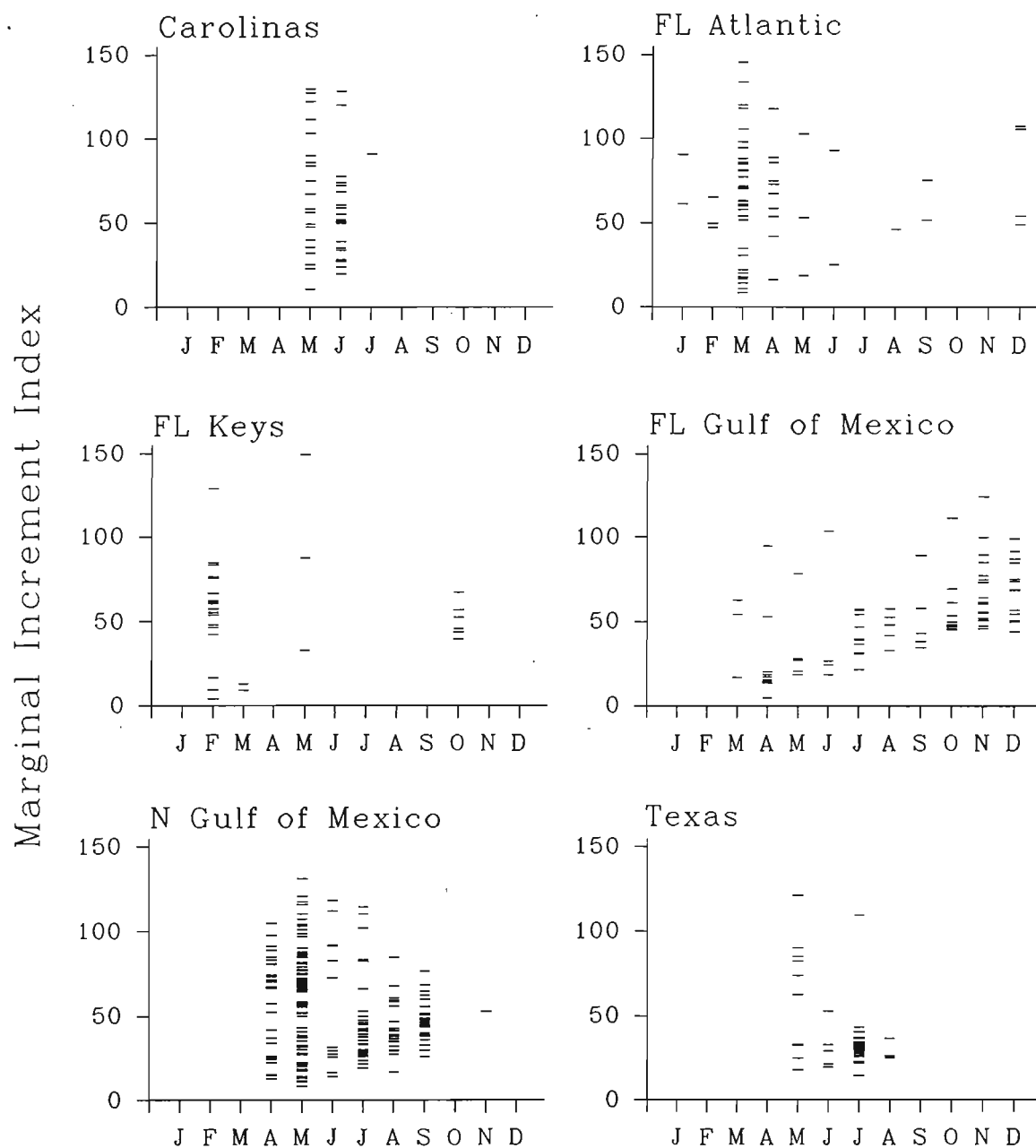
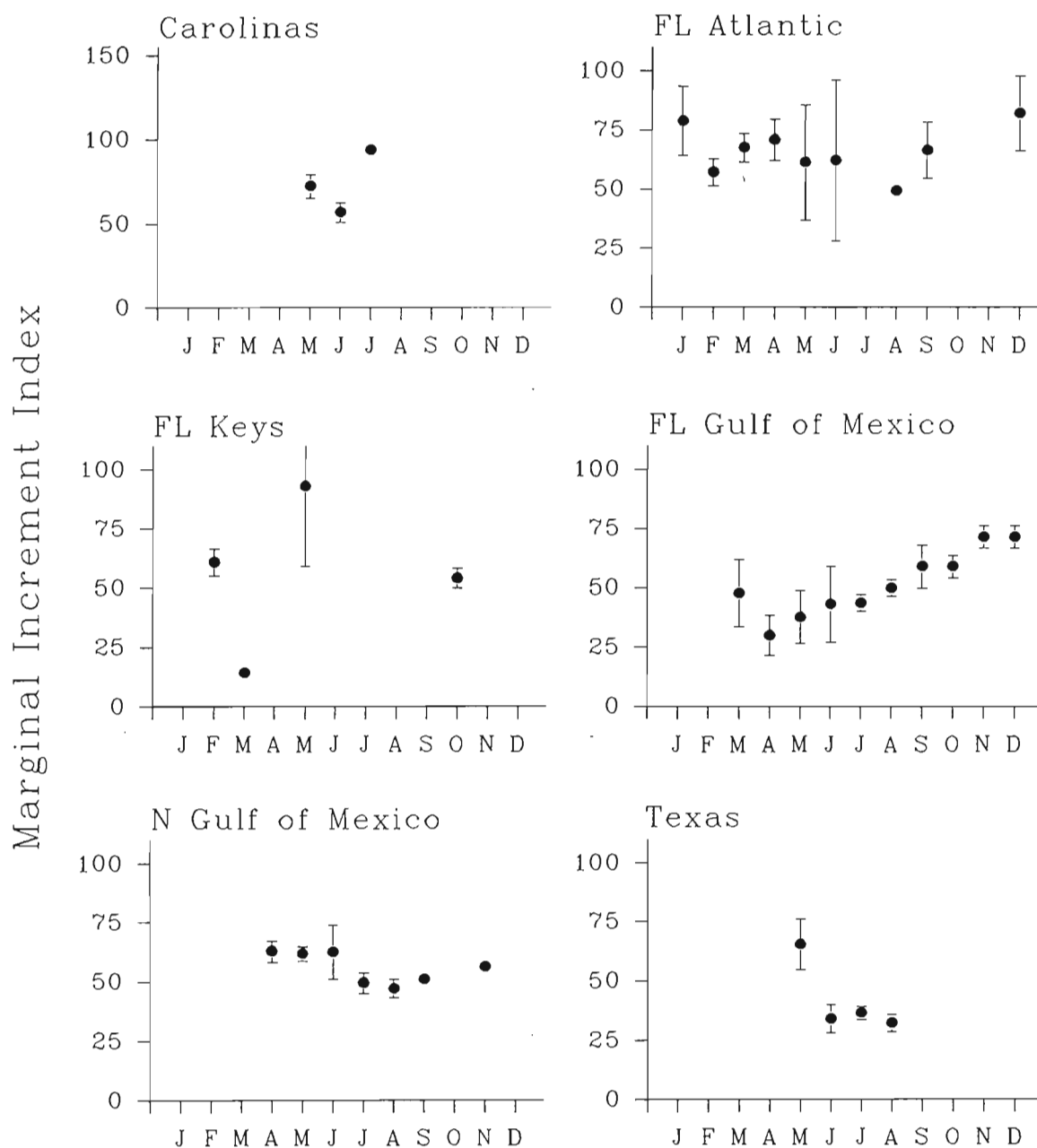
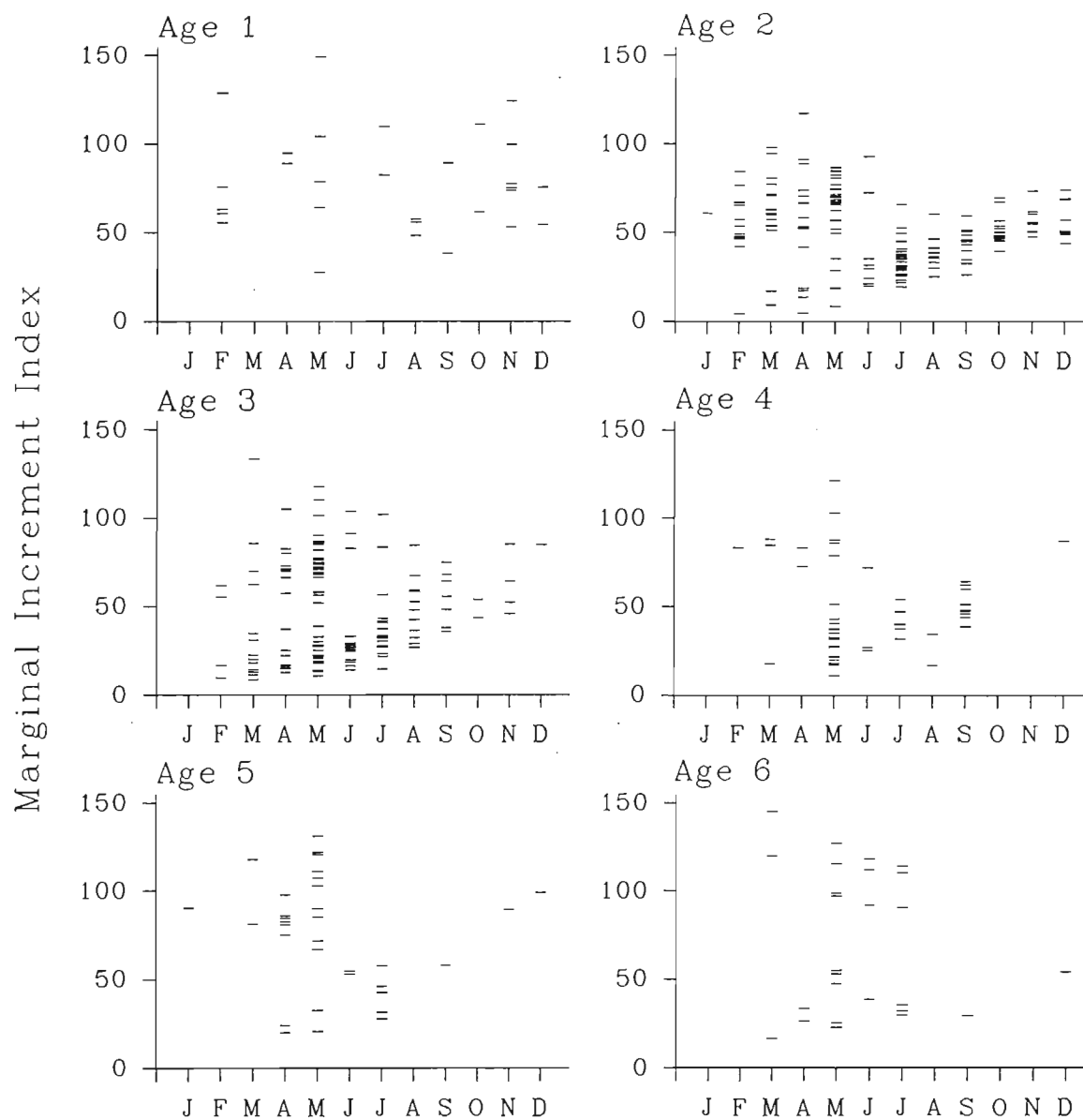


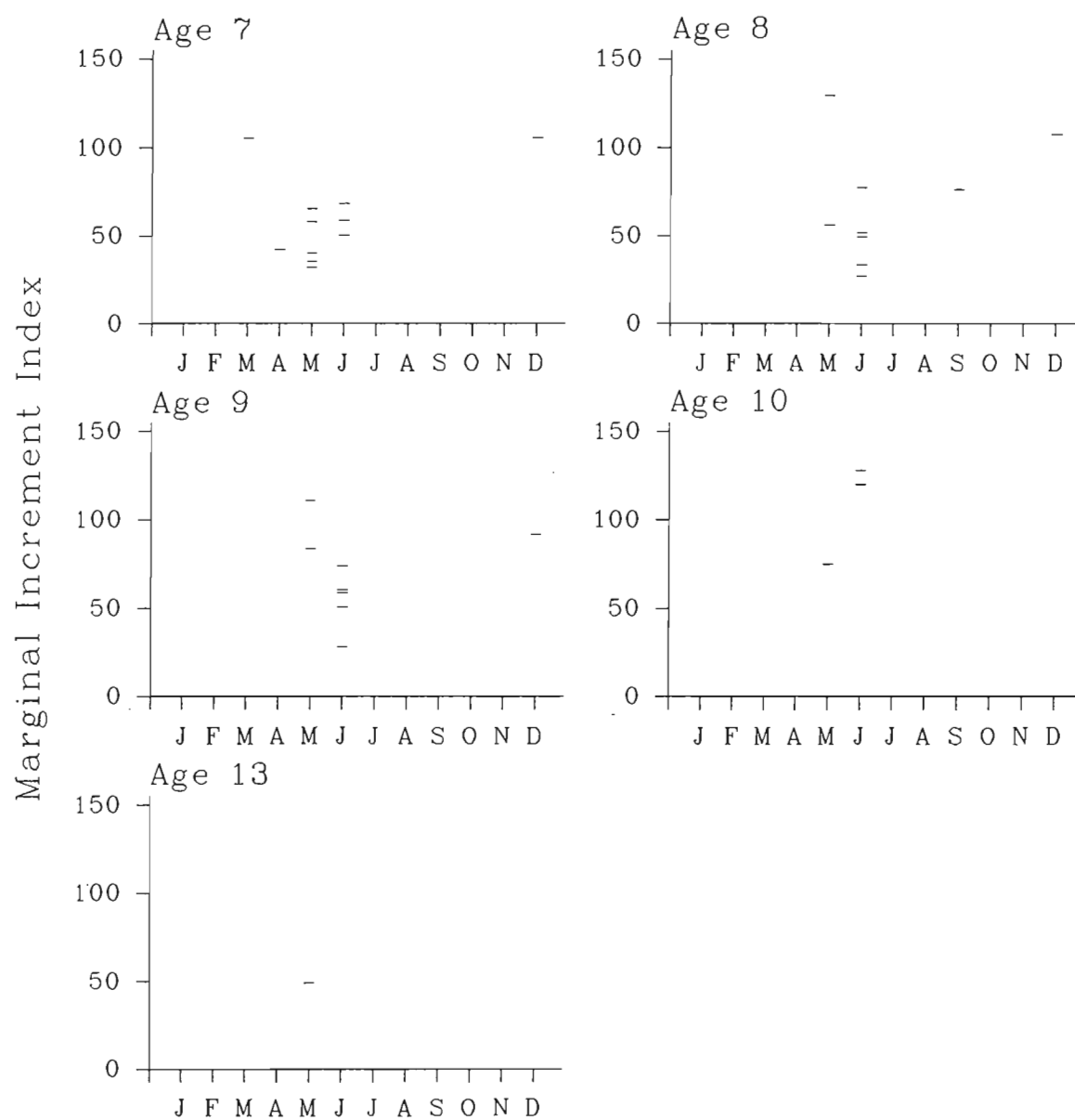
Figure 22. Marginal increment of cobia otoliths by capture location.



**Figure 23.** Marginal increment mean by month for cobia by capture location.



**Figure 24a.** Marginal increment of cobia otoliths by age class.



**Figure 24b.** Marginal increment of cobia otoliths by age class.

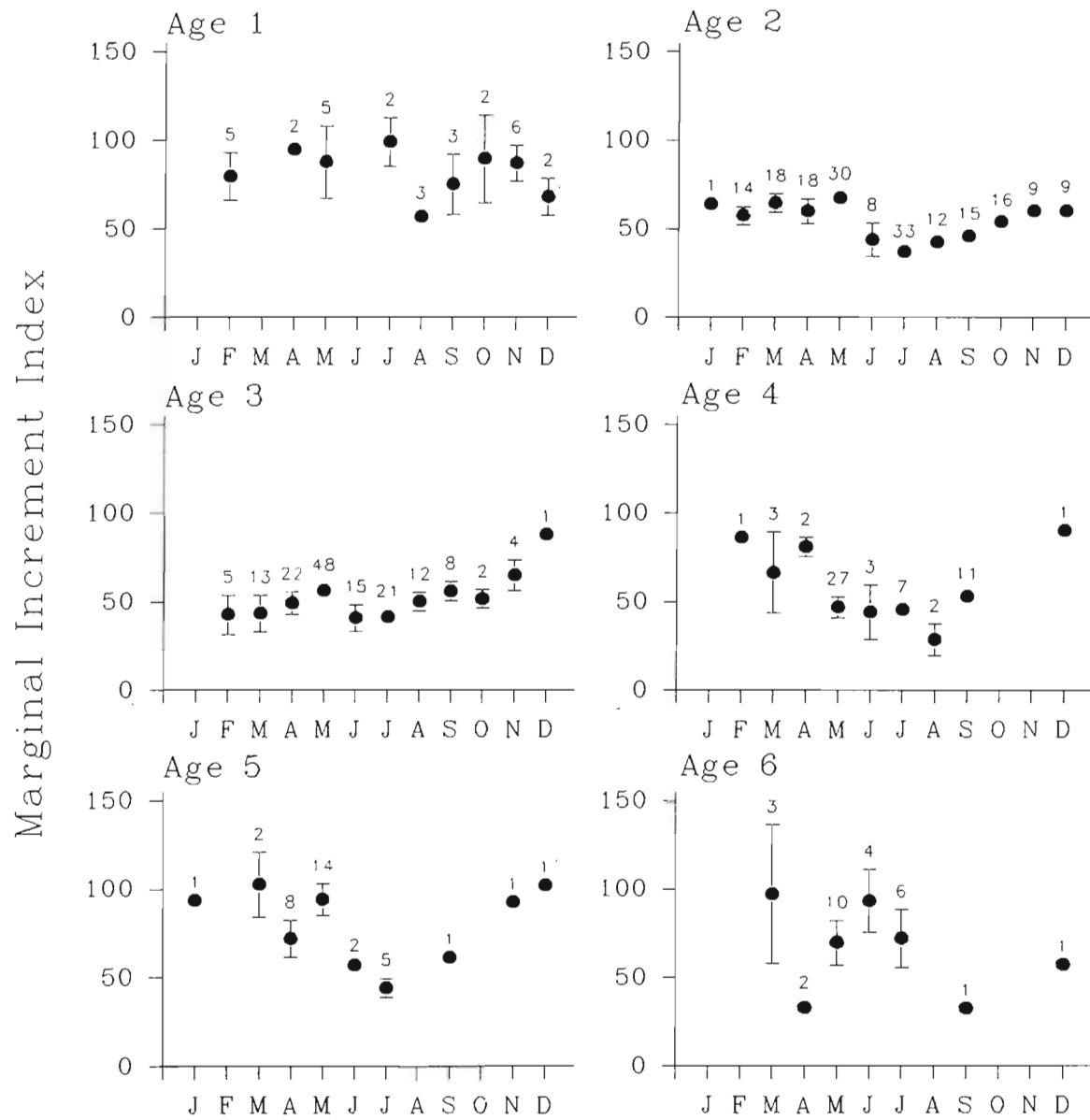
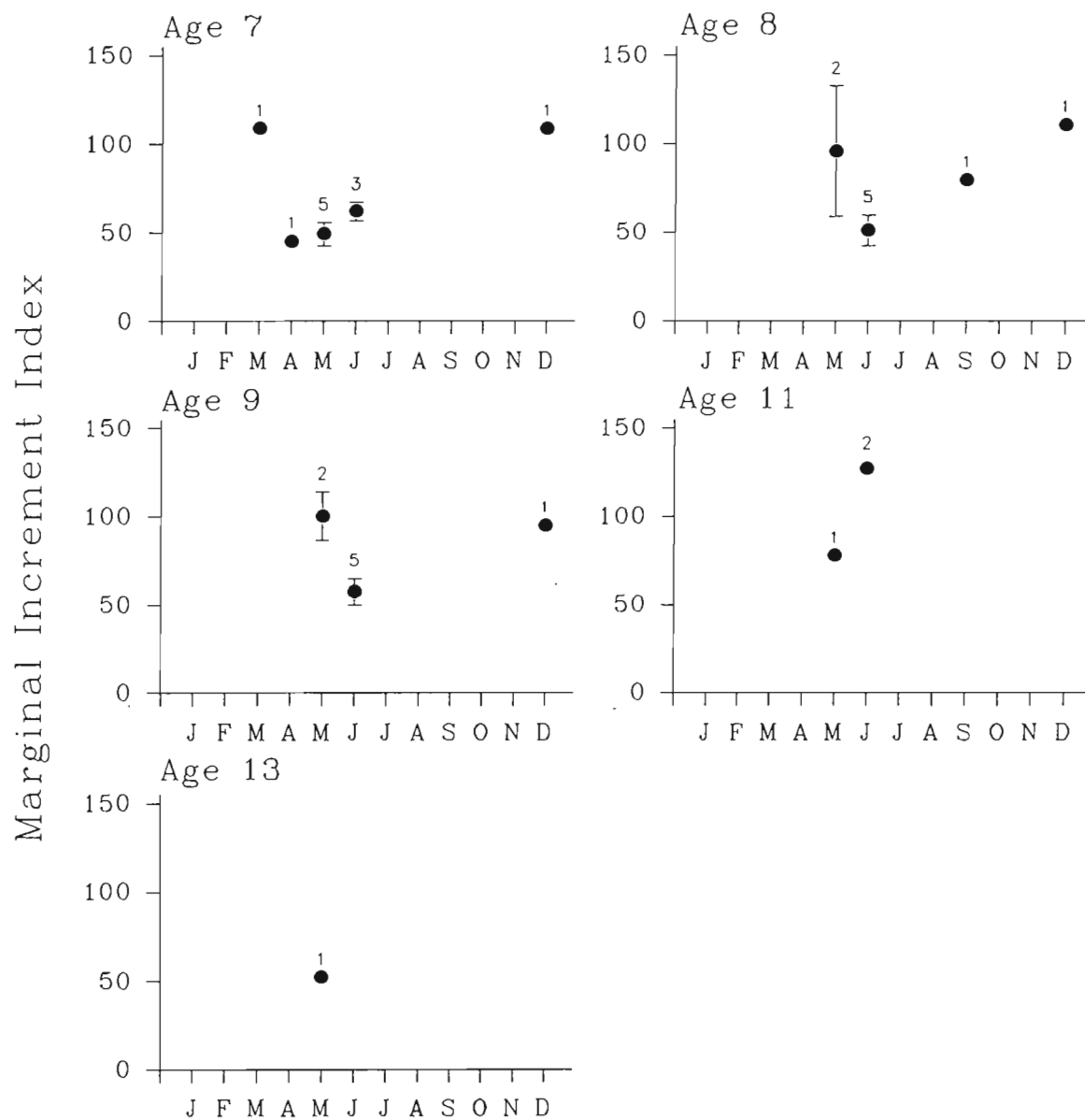


Figure 25a. Marginal increment mean for cobia by age class.



**Figure 25b.** Marginal increment mean for cobia by age class.

**Table 11** shows the parameter estimates for the von Bertalanffy growth model for cobia from each of the sampling locations. **Figures 26 through 31 and Table 12** show the observed and predicted lengths of female and male cobia from all sampling locations. High variation of sizes in the 0-1 year old age groups at some sites was the result of a lack of small fish in the sample.

**Table 11.** Von Bertalanffy parameters for both female and male cobia by location.

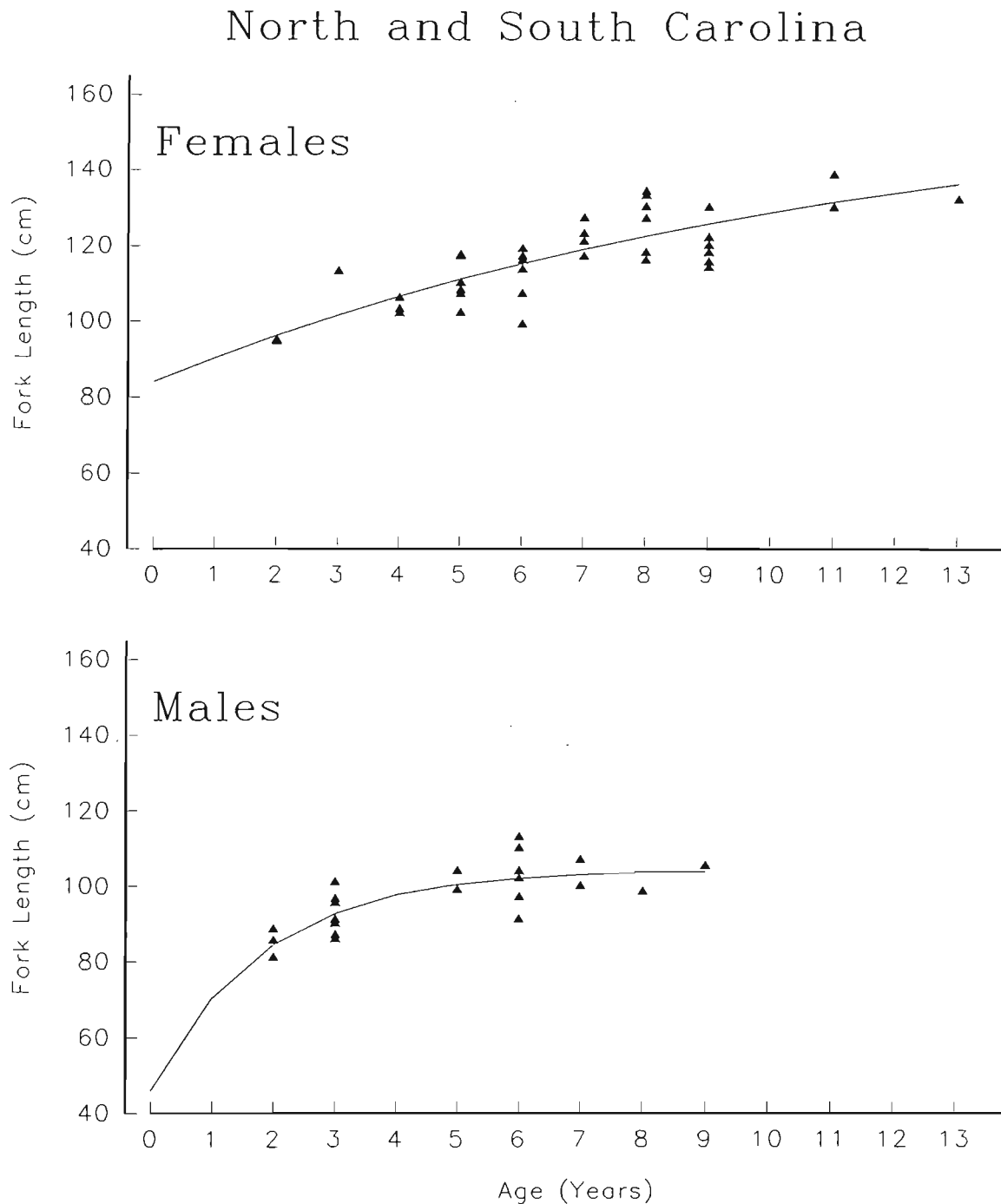
	$n$	$L_{\infty}$	$K$	$t_0$
N. and S. Carolina	39	162.2	.085	-8.596
Florida Atlantic	46	133.3	.182	-4.664
Florida Keys	21	117.7	.230	-3.846
Florida Gulf	72	147.3	.245	-1.551
Northern Gulf	194	130.2	.461	-.968
Texas	41	183.9	.125	-3.621
N. and S. Carolina	22	104.6	.536	-1.085
Florida Atlantic	24	113.8	.195	-5.681
Florida Keys	17	165.1	.075	-7.674
Florida Gulf	37	122.5	.294	-1.347
Northern Gulf	63	113.2	.550	-.759
Texas	29	92.9	1.430	-.395

The distance from the center of the otolith's core to the distal margin (edge) was measured from the core to the leading edge of each opaque zone, including any distance from the last zone to the section's distal margin. The relationship between otolith radius and fork length (FL) was determined and was used to back-calculate length at earlier ages (Ricker, 1975).

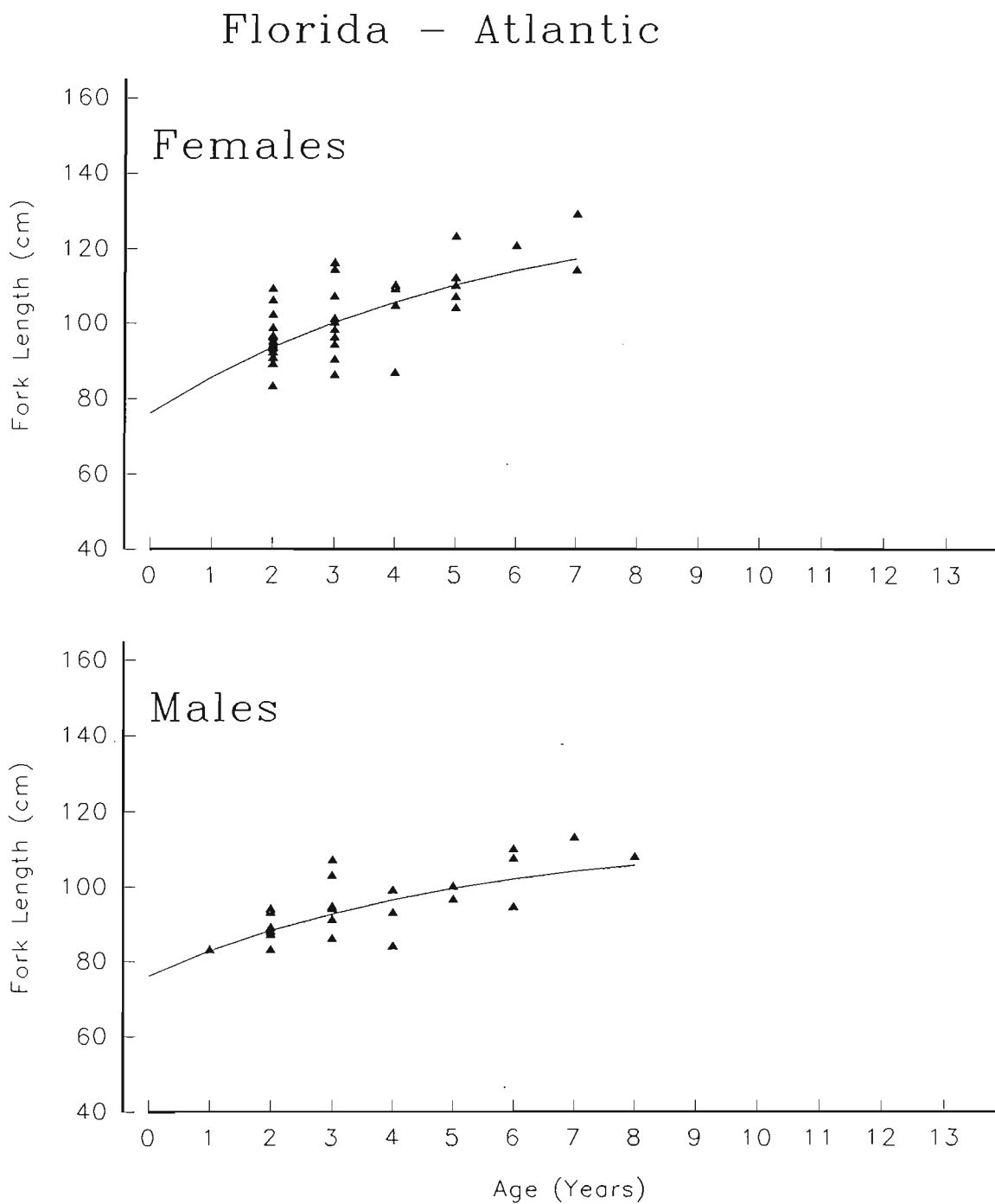
Mean back-calculation (FL) data was used to calculate theoretical growth equations for both sexes. Von Bertalanffy (1938) growth curves were fit by non-linear regression (SAS, 1985) to length-at-age by sex.

All age/length calculations were based on the von Bertalanffy formula:

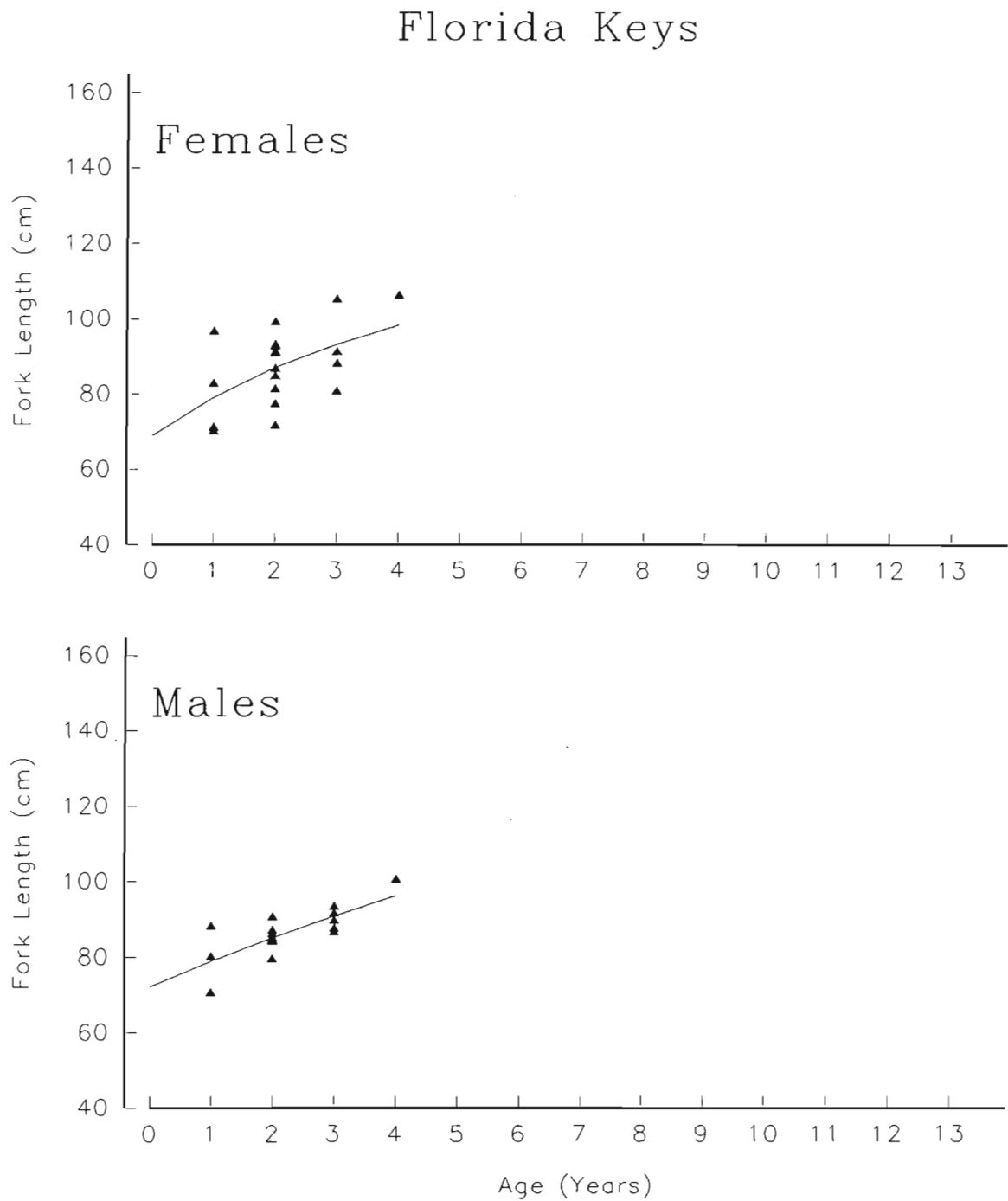
$$\text{von Bertalanffy: } FL_t = L_{\infty} (1 - e^{-K(t-t_0)})$$



**Figure 26.** Observed (symbols) and predicted lengths (cm) and the von Bertalanffy growth model for female and male cobia from North and South Carolina.

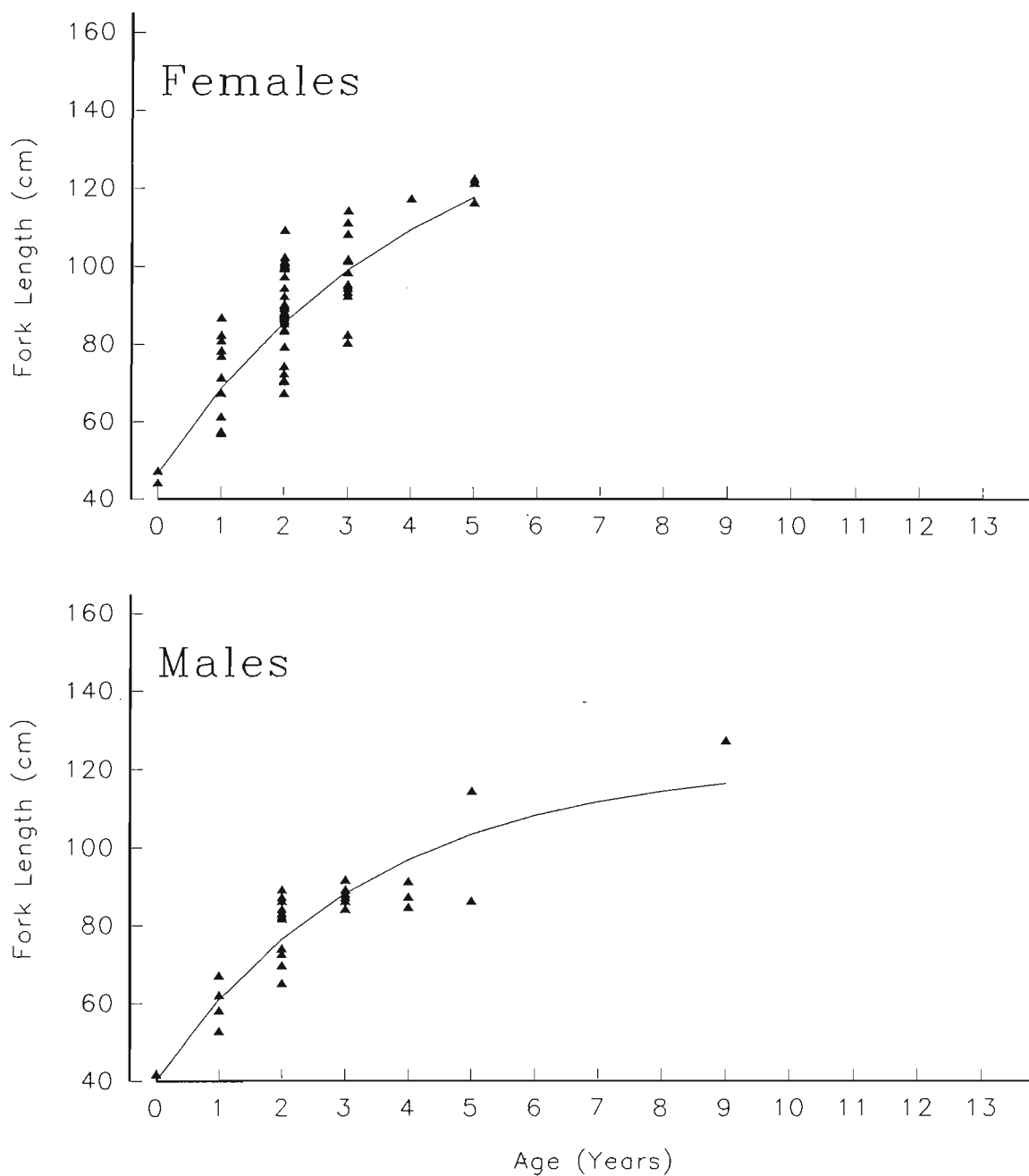


**Figure 27.** Observed (symbols) and predicted lengths (cm) and the von Bertalanffy growth model for female and male cobia from the Florida Atlantic.

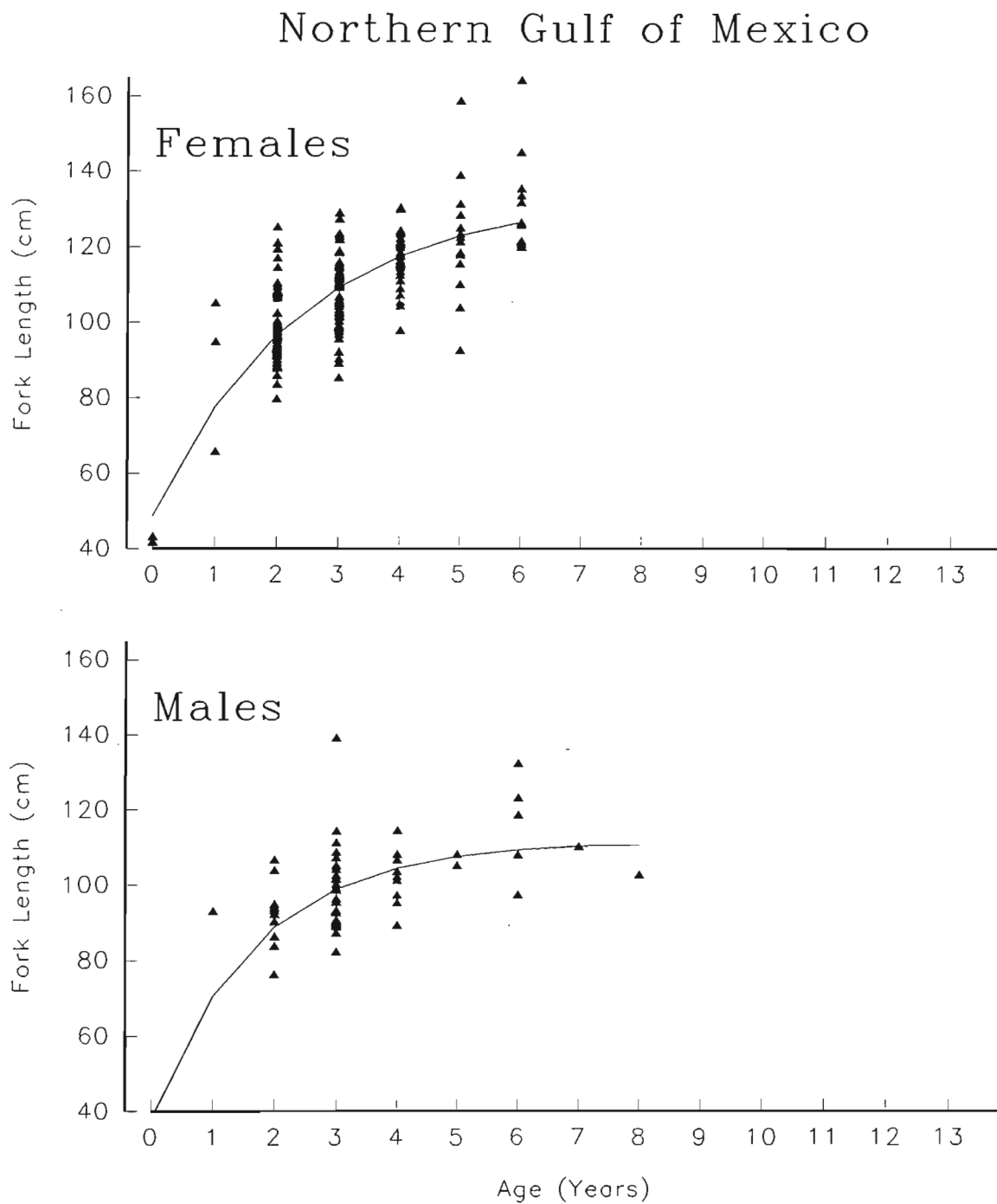


**Figure 28.** Observed (symbols) and predicted lengths (cm) and the von Bertalanffy growth model for female and male cobia from the Florida Keys.

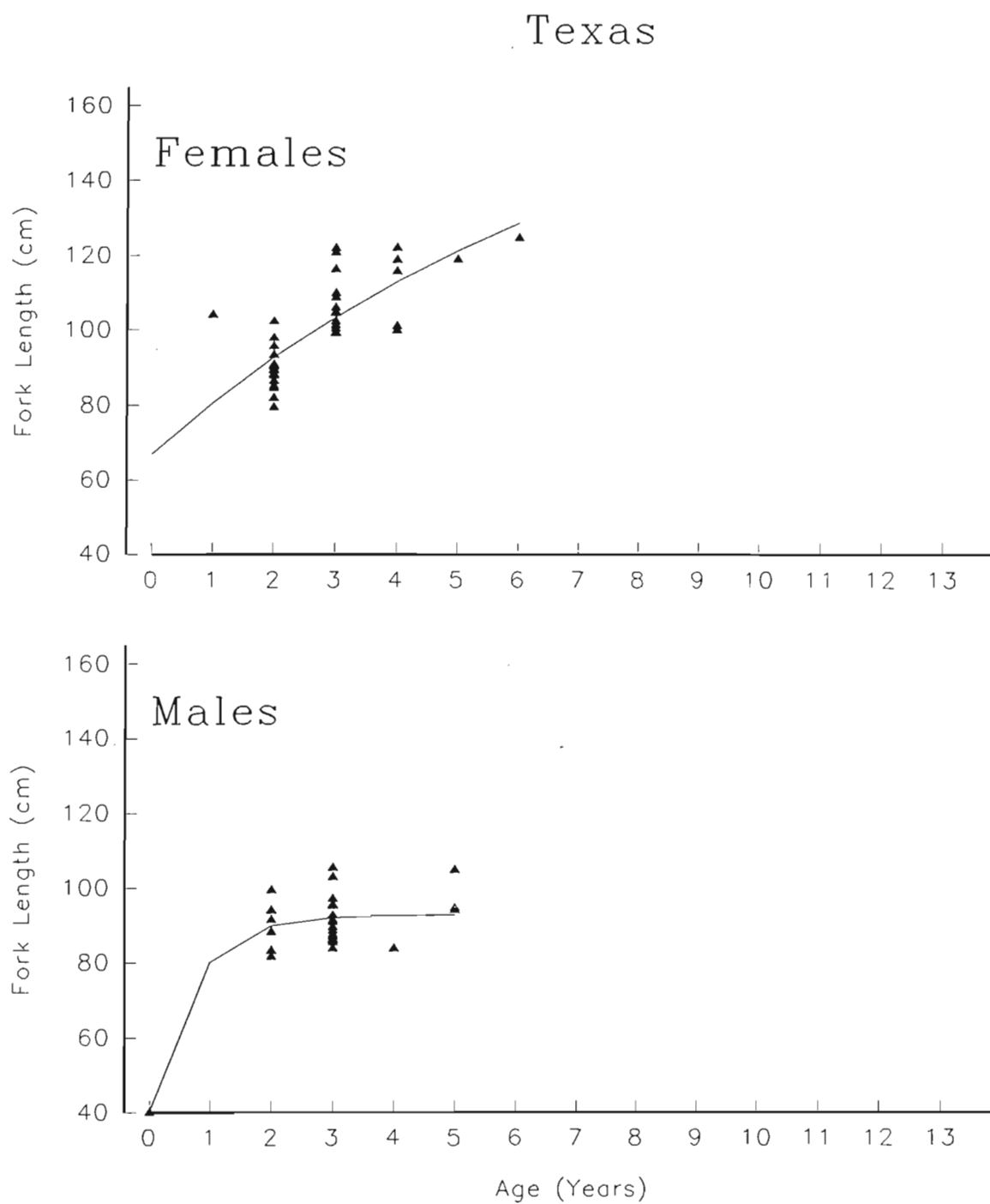
## Florida – Gulf of Mexico



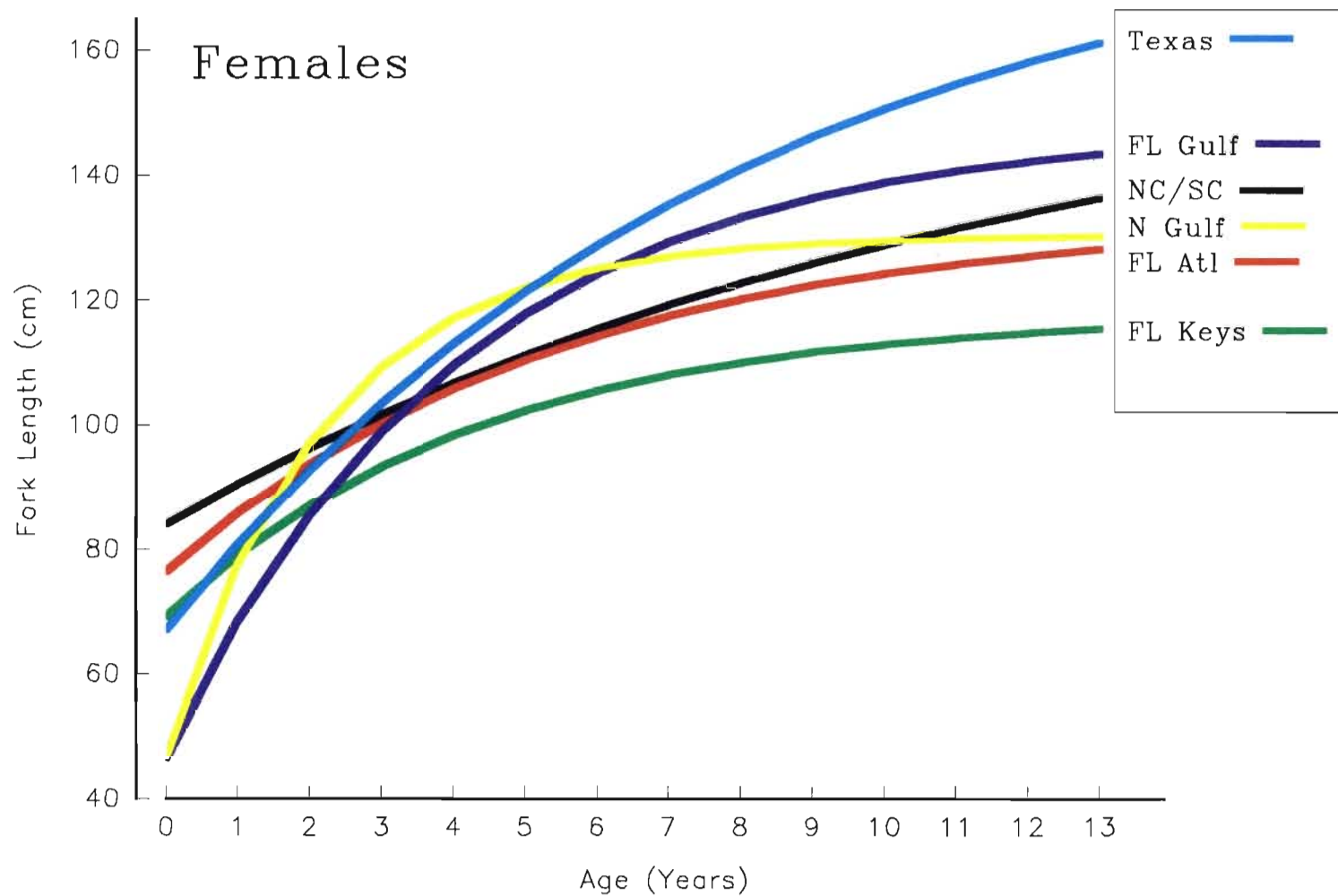
**Figure 29.** Observed (symbols) and predicted lengths (cm) and the von Bertalanffy growth model for female and male cobia from the Florida Gulf of Mexico.



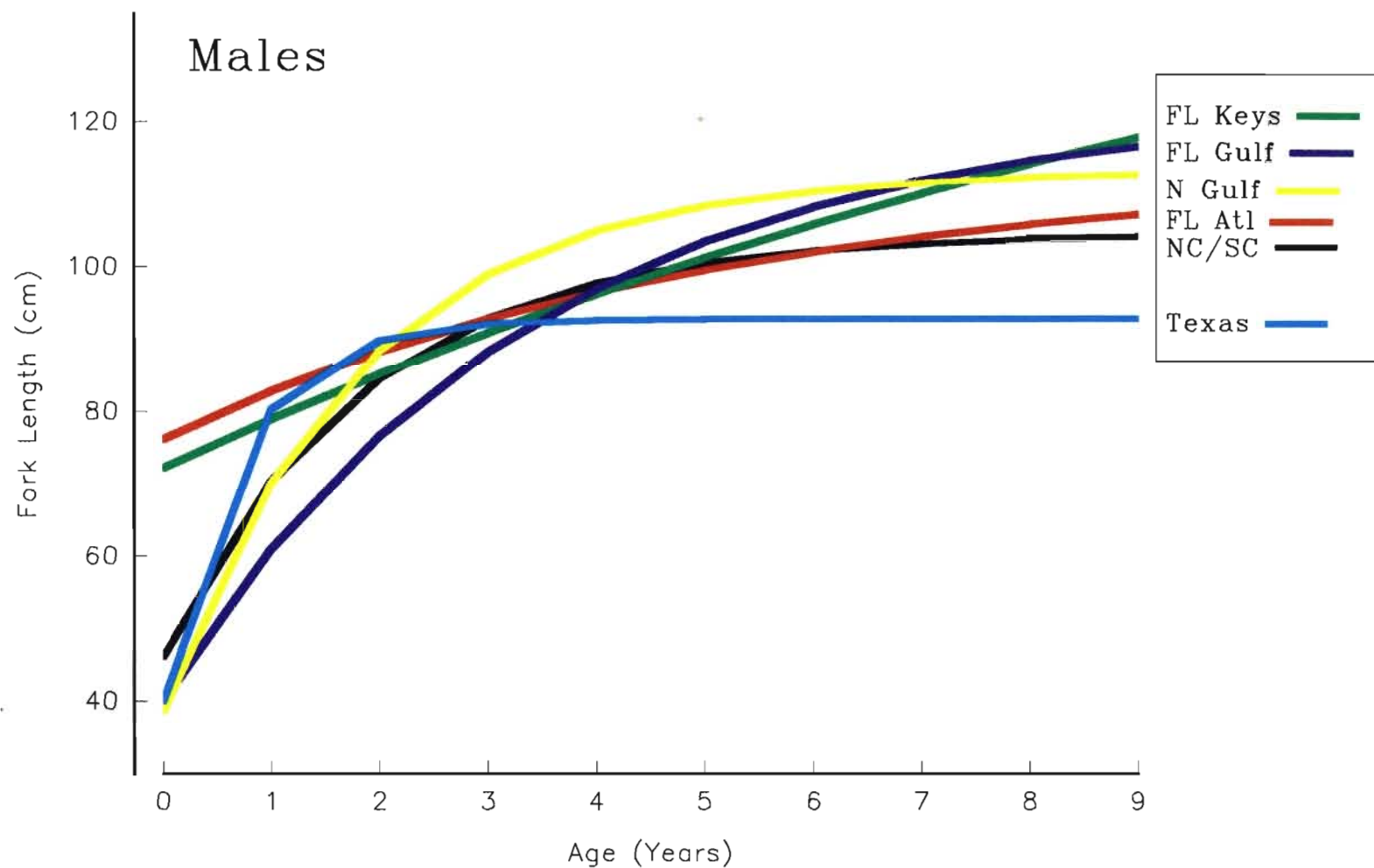
**Figure 30.** Observed (symbols) and predicted lengths (cm) and the von Bertalanffy growth model for female and male cobia from the Northern Gulf of Mexico.



**Figure 31.** Observed (symbols) and predicted lengths (cm) and the von Bertalanffy growth model for female and male cobia from Texas.



**Figure 32.** Predicted length at age for female cobia at all capture locations calculated from the von Bertalanffy growth equation.



**Figure 33.** Predicted length at age for male cobia at all capture locations calculated from the von Bertalanffy growth equation.

**Table 12.** Observed and predicted length at age by location for female and male cobia.

FEMALES													
Age		Carolinas		FL-Atl		FL-Gulf		FL-Keys		N-Gulf		TX	
		Obs	Pred	Obs	Pred	Obs	Pred	Obs	Pred	Obs	Pred	Obs	Pred
0	FL		84.1		76.3	42.2	46.6	69.1	40.5	48.7	66.9		
	n					3				3			
1	FL		90.4		85.8	71.3	68.5	80.0	79.1	88.3	77.7	104.1	80.7
	n					12		4		3		1	
2	FL	94.8	96.3	95.3	93.7	85.3	85.6	87.5	87.0	98.1	96.7	89.2	92.8
	n	2		21		39		12		61		17	
3	FL	113.0	101.6	99.8	100.3	97.4	99.0	91.1	93.3	107.5	109.2	106.9	103.5
	n	1		11		14		4		67		15	
4	FL	103.7	106.6	102.9	105.8	117.0	109.5	106.0	98.3	116.6	117.5	113.2	113.0
	n	3		5		1		1		32		6	
5	FL	110.3	111.1	111.3	110.3	119.7	117.7			122.1	122.9	118.8	121.3
	n	6		6		3				16		1	
6	FL	111.9	115.3	120.5	114.2					131.3	126.4	124.5	128.6
	n	6		1						12		1	
7	FL	123.0	119.1	121.5	117.4								
	n	5		2									
8	FL	126.3	122.6										
	n	6											
9	FL	119.9	125.8										
	n	6											
10	FL		128.8										
	n												
11	FL	135.7	131.5										
	n	3											
12	FL		134.0										
	n												
13	FL	132.0	136.3										
	n	1											

Table 12, Continued

Observed and predicted length at age by location for female and male cobia.

<u>MALES</u>		<u>Carolinas</u>		<u>FL-Atl</u>		<u>FL-Gulf</u>		<u>FL-Keys</u>		<u>N-Gulf</u>		<u>TX</u>	
<u>Age</u>		<u>Obs</u>	<u>Pred</u>	<u>Obs</u>	<u>Pred</u>	<u>Obs</u>	<u>Pred</u>	<u>Obs</u>	<u>Pred</u>	<u>Obs</u>	<u>Pred</u>	<u>Obs</u>	<u>Pred</u>
0	FL		46.1		76.2	40.5	40.0		72.3	38.0	37.6	40.0	40.1
	n					2				1		1	
1	FL		70.4	83.0	82.9	55.2	61.0	79.5	79.0	65.6	70.5		80.3
	n			1		5		3		2			
2	FL	85.0	84.6	89.0	88.4	80.1	76.7	85.1	85.2	91.9	88.8	90.4	89.9
	n	3		6		17		8		10		8	
3	FL	92.4	92.9	95.9	92.9	87.4	88.3	89.7	91.0	98.4	98.9	91.6	92.2
	n	7		6		7		5		31		16	
4	FL		97.7	92.0	96.6	87.5	97.0	100.5	96.3	102.0	104.5	83.8	92.8
	n			3		3		1		10		1	
5	FL	101.5	100.6	98.3	99.6	100.2	103.5			106.5	107.7	97.8	92.9
	n	2		2		2				2		3	
6	FL	102.8	102.2	101.6	102.2		108.3			115.6	109.4		
	n	6		4						5			
7	FL	103.5	103.2	113.0	104.2		111.9			110.0	110.4		
	n	2		1						1			
8	FL	98.5	103.8	108.0	105.9		114.6			102.5	110.9		
	n	1		1						1			
9	FL	105.5	104.1			127.0	116.6						
	n	1				1							

### Age and Growth Discussion

Female and male cobia grow at different rates. The female cobia grow larger and faster than their male counterparts. There were also differences between Gulf cobia and fish off the Carolinas. In this study, the oldest female cobia captured in the Gulf of Mexico was 6+ years old (**Figure 34**), however, older females have been collected in the northern Gulf by Franks of GCRL (personal communication). Out of 600 fish aged by Franks, he collected three 9 year old females, one 10 year old, and one 11 year old.

Things were different off the Carolinas where out of 73 (45 females) cobia collected, 12 (11 off North Carolina, 1 off South Carolina) were older females 9-13+ years old (**Figure 35**). Work conducted by Smith (1995) of NMFS, Beaufort, found female cobia up to 13 years of age.

In the Gulf of Mexico and off the Carolinas, the oldest male cobia collected in this study, were 9 years old. The oldest males collected by Franks in the northern Gulf were also 9 years old (personal communication) Smith (1995), however, collected a few males at 10, 11, 13 and 14 years of age.

Although, some of the Carolina fish caught in this study, were older than those caught in the Gulf, Gulf fish were larger at age. For example, the 6+ Gulf female (**Figure 34**) 131.2 cm FL and weighed 57.4 lbs. While the 13+ Carolina female (**Figure 35**) measured 132 cm FL and weighed 60 lbs.

Results from this study agree with those of both Franks in the northern Gulf, and Smith off the Carolinas. Gulf cobia appear to grow faster than those off the Carolinas; however, fish off the Carolinas appear to live longer than their Gulf counterparts. From these data, it appears that older fish are not abundant in the Gulf of Mexico, and that Gulf fishers are fishing younger fish than their counter parts off the Carolinas.

These results are interesting in light of the fact that tagging studies (Jim Franks, Gulf Coast Research Lab, Don Hammond, South Carolina Fish & Wildlife, personal communication; MML Coastal Pelagic Tagging Program) have shown that there is mixing of cobia from the Gulf of Mexico to and from the South Atlantic and within the Gulf itself. Additional studies to determine the genetic make-up and amount of mixing of cobia in the Gulf and South Atlantic are necessary to resolve these issues for cobia stock assessment.



Figure 34. Otolith from the oldest female cobia (6+ years, 131.2 cm FL, 57.4 lbs.) caught in the Gulf of Mexico, during this study.



Figure 35. Otolith from the oldest female cobia (13+ years, 132 cm FL, 60 lbs.) caught off the Carolinas during this study.

## VI. REPRODUCTIVE BIOLOGY

### Study Area

Cobia were sampled from the southeastern Atlantic Ocean through the northwestern Gulf of Mexico. The sampling sites were divided into five general areas to compare the reproductive biology of cobia throughout the region. These areas were defined as the southeastern Atlantic Ocean (extending down the east coast from Morehead City, North Carolina through Cape Canaveral, Florida), the Florida Keys (Sunshine Key and Big Pine Keys), the northeastern Gulf of Mexico (extending up the west coast of Florida from Ft. Myers to Crystal River), the north central Gulf of Mexico (extending along the Gulf from Destin, Florida, to the Chandelier Islands, Louisiana) and the northwestern Gulf of Mexico (Port Aransas, Texas area).

### Materials and Methods

#### Sampling Protocol:

Cobia were sampled opportunistically from the recreational fishery between December 1995 and December 1997. Sampling teams were present at major cobia fishing tournaments throughout the study area; the majority of the samples taken came from fishing tournaments in the southeastern Atlantic and the north-central Gulf of Mexico. All Texas fish were obtained from a charter boat captain during regular fishing trips. The majority of the cobia sampled from the northeastern Gulf of Mexico and the Florida Keys were captured by non-tournament recreational fishers. Anglers were interviewed to determine the location of capture of each fish. Total length (cm) and total weight (g) were recorded for all cobia sampled. The gonads were excised, weighed to the nearest g and the total volume of water displaced by each gonad was recorded. Sections were removed from the left and right gonads and preserved in 10% neutral buffered formalin for histological inspection. Additionally, a portion of the ovary was removed, weighed and preserved in Gilson's fixative for fecundity analysis.

#### Histological Protocol:

Tissues were placed into individually labeled cassettes and rinsed with running tap water overnight prior to dehydration and embedding in paraffin following standard histological techniques. The paraffin blocks were sectioned at 4  $\mu$ m using a rotary microtome. Duplicate slides were prepared for each tissue, resulting in a total of four slides for each cobia specimen (two from the left gonad and two from the right gonad). The slides were stained using Gills I hematoxylin and eosin phloxine (Polyscientific Corporation) following standard histological procedures.

Three separate views of one slide from each side of the gonad of each fish were analyzed to determine maturity stages. Ovarian maturity stages were based on those previously described by Lotz et al. (1996) for cobia. The entire ovarian section was examined for the presence of post ovulatory follicles (POF) and oocytes undergoing final oocyte maturation (FOM). POF stages were classified following Hunter et al. (1986) and FOM stages were classified following Brown-Peterson et al. (1988).

Following inspection of the entire ovarian section, three areas were haphazardly selected from each slide for quantification of oocytes. Oocytes in all stages of development (including atretic oocytes) and POF's were counted at 100x and the percentage of each oocyte stage in the field of view was estimated. Oocyte atresia stages were classified following Hunter and Macewicz (1985a).

The entire testicular section of each cobia was examined to determine the maturity classification for male fish. Three haphazardly selected portions of each section were examined at 100x and 400x to classify all stages of spermatogenesis present. Maturity stages were defined as maturing (all stages of spermatogenesis present, little to no spermatozoa in the lumen of the lobule), mature (all stages of spermatogenesis present, lobules partially full of spermatozoa, no spermatozoa in the sperm duct), ripe (various stages of spermatogenesis present, lobules full or partially full of spermatozoa, spermatozoa evident in the sperm duct) and spent (early spermatogenesis [primary and secondary spermatogonia only], residual spermatozoa in the lobules, no spermatozoa in the sperm duct). Ripe fish were further subdivided into three categories; (1) spermatogenic cysts occurring throughout the testis, (2) spermatogenic cysts occurring only in the peripheral portions of the testis and (3) no spermatogenic cysts in the testis.

#### Oocyte Counts and Gonad Development:

Estimates of batch spawn size were made from oocyte counts of formalin-fixed and Gilson's fixed ovaries. One piece of each ovary (approximately 5g) was removed from each female, weighed to the nearest 0.1g, and placed into separate jars of Gilson's fluid. After 3-4 months the ovarian tissue had been broken down freeing most of the oocytes. Similar sized pieces were fixed in 10% formalin. Oocytes from formalin fixed samples were freed by teasing them away from the ovarian tissue by hand.

Subsequently oocytes were treated the same. All of the oocytes from a sample were then placed in a known volume of water and the number of oocytes greater than 500 $\mu$ m in the sample was estimated by counts in known volumetric subsamples.

Females were classified into one of four groups based on the size of oocytes in their ovaries. Group 1 ovaries contained no oocytes greater than 400 $\mu$ m in diameter, group 2 ovaries had some eggs greater than 400  $\mu$ m but none were less than 700 $\mu$ m, group 3 ovaries contained oocytes some of which were greater than 700  $\mu$ m but none were greater than 900  $\mu$ m, and group 4 ovaries contained some oocytes that were greater than 900 $\mu$ m in diameter.

Gonosomatic indices (GSI) were determined for both females and males as the total gonad weight to the total somatic weight (Total fish weight minus gonad weight).

## Results

### Spawning Season:

A total of 164 male cobia and 393 female cobia throughout the region were assessed histologically during the course of this study. **Table 13** shows the number of individuals examined from each area as well as the range of months during which fish were sampled. Most samples were obtained during the reproductive season.

GSI's were calculated for 237 females and 88 males. The seasonal changes in GSI are shown in **Figures 36 and 37**. No differences were noted in GSI seasonality among sites for either males or females. No fish weights were available for cobia collected from the NW Gulf, however, the mean oocyte size groups for the five locations show little evidence for seasonal differences in spawning activity by this measure (**Figure 38**). GSI data combined across locations suggest that peak spawning of cobia occurs during May, June and July (**Figure 39**).

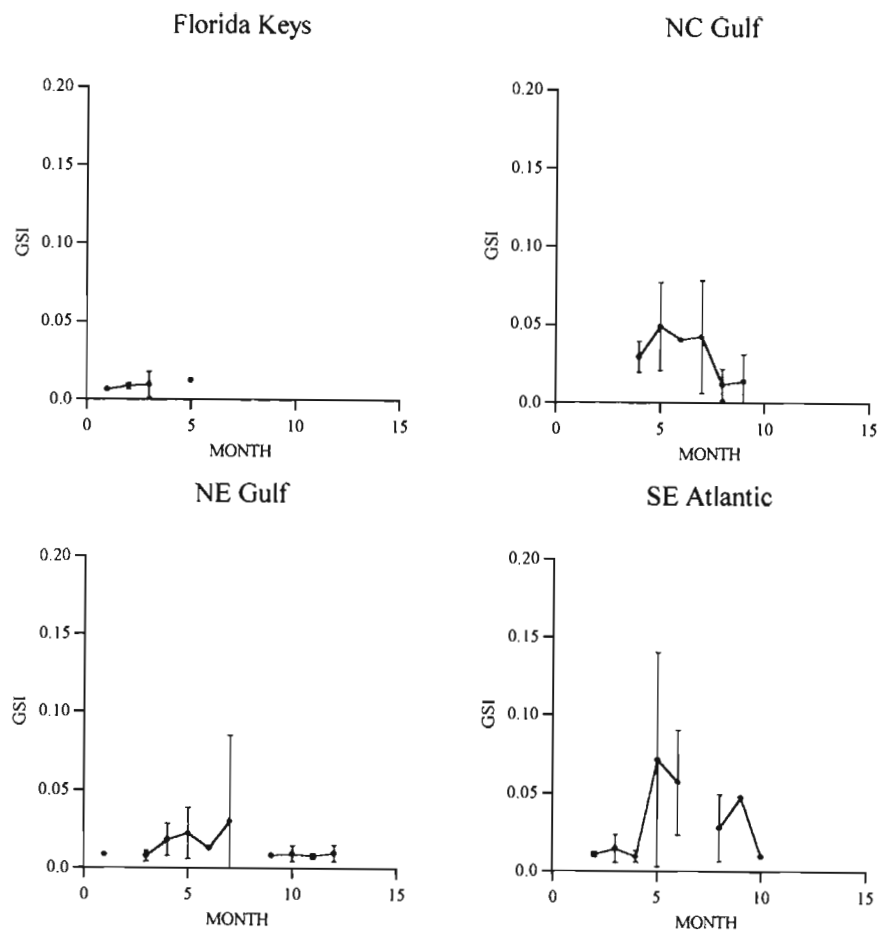
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**Table 13.** Numbers of cobia examined histologically from each sampling area.

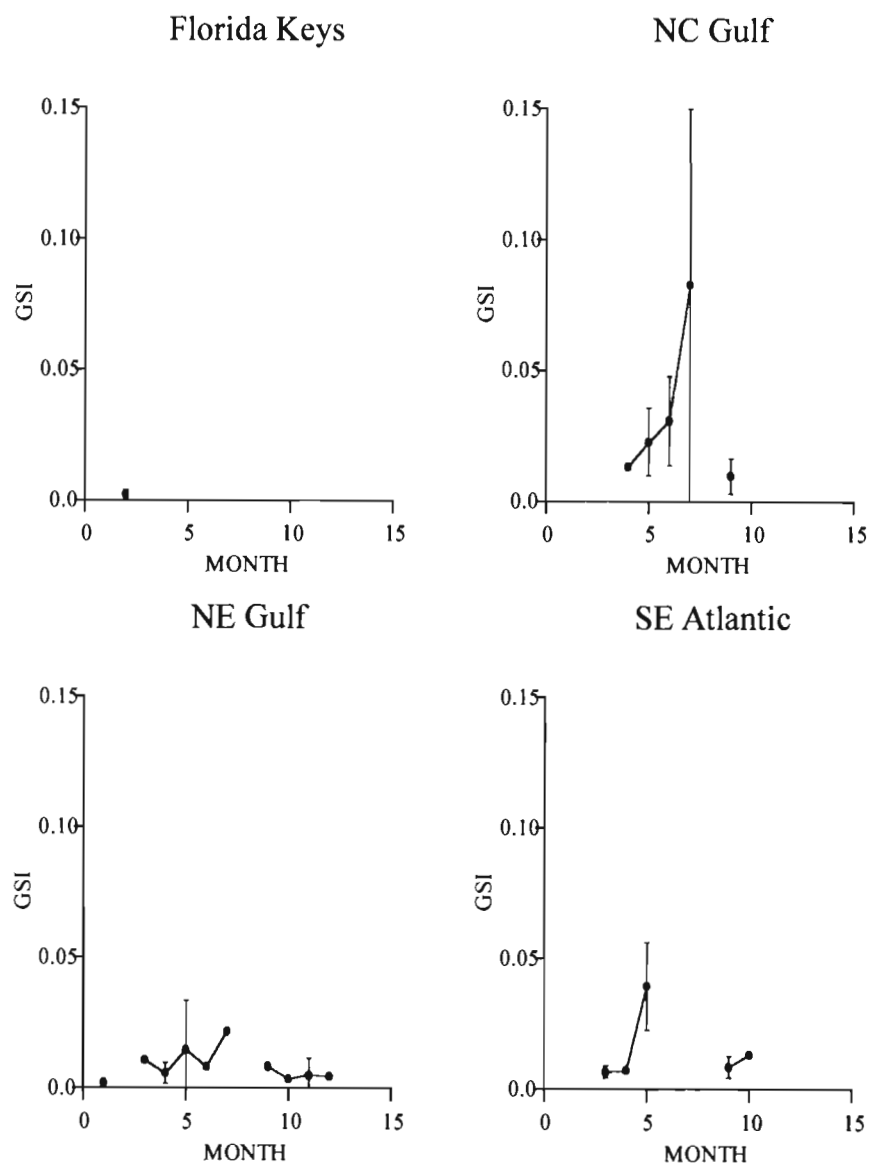
Area	N Males	Months Captured	N Females	Months Captured
North-central Gulf of Mexico	48	April-October	188	April-September
Northeastern Gulf of Mexico	43	February-December	60	March-December
Florida Keys	17	Feb., May, Dec.	24	February-June, December
Southeastern Atlantic Ocean	33	February-May	62	February-June, December
Northwestern Gulf of Mexico	23	May-August	59	May-August
TOTALS	164		393	

---

Monthly male maturity stages for all areas are shown in **Tables 14-18**. **Figure 40** illustrates the three ripe categories for male cobia. Although all the fish in **Figure 40** are ripe, **Figure 40c** (no spermatogenic activity) represents a more advanced stage of testicular maturity than **Figure 40a** (spermatogenic activity throughout the testis).

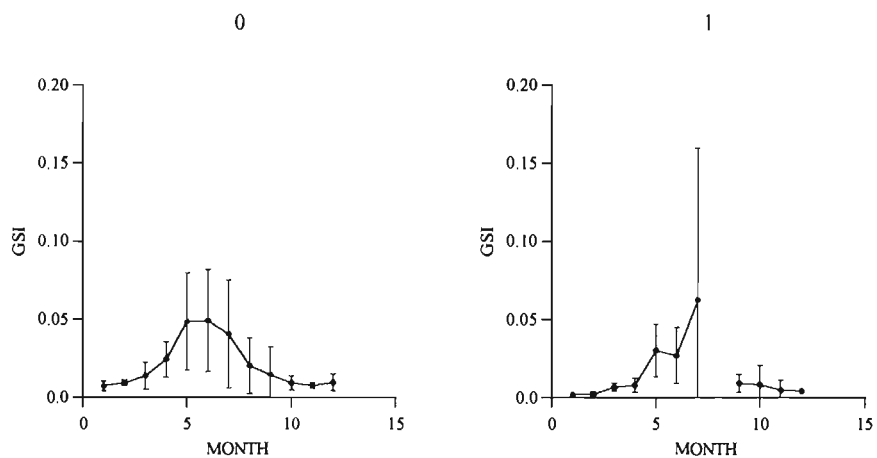
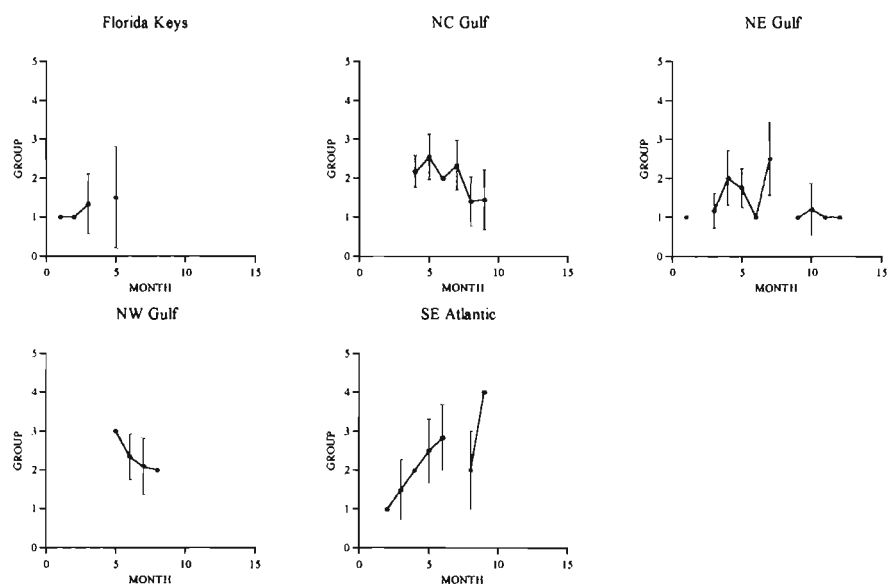


**Figure 36.** Seasonal gonosomatic index for female cobia by locality. Except for the Florida Keys where no females were examined during the primary cobia spawning season, there appear to be no differences in GSI seasonality among the locations. Points represent means and error bars are 95% confidence intervals.



**Figure 37.** Seasonal gonosomatic index for male cobia by locality. There appear to be no differences in GSI seasonality among the locations. Points represent means and error bars are 95% confidence intervals.

**Figure 38.** Mean largest oocyte group by season. There is little evidence of differences in seasonality among the locations. The points are the error bars represent 95% confidence intervals.



**Figure 39.** Seasonal gonosomatic index for female (0) and male (1) cobia. Peak GSI's occur in May, June and July for both sexes.

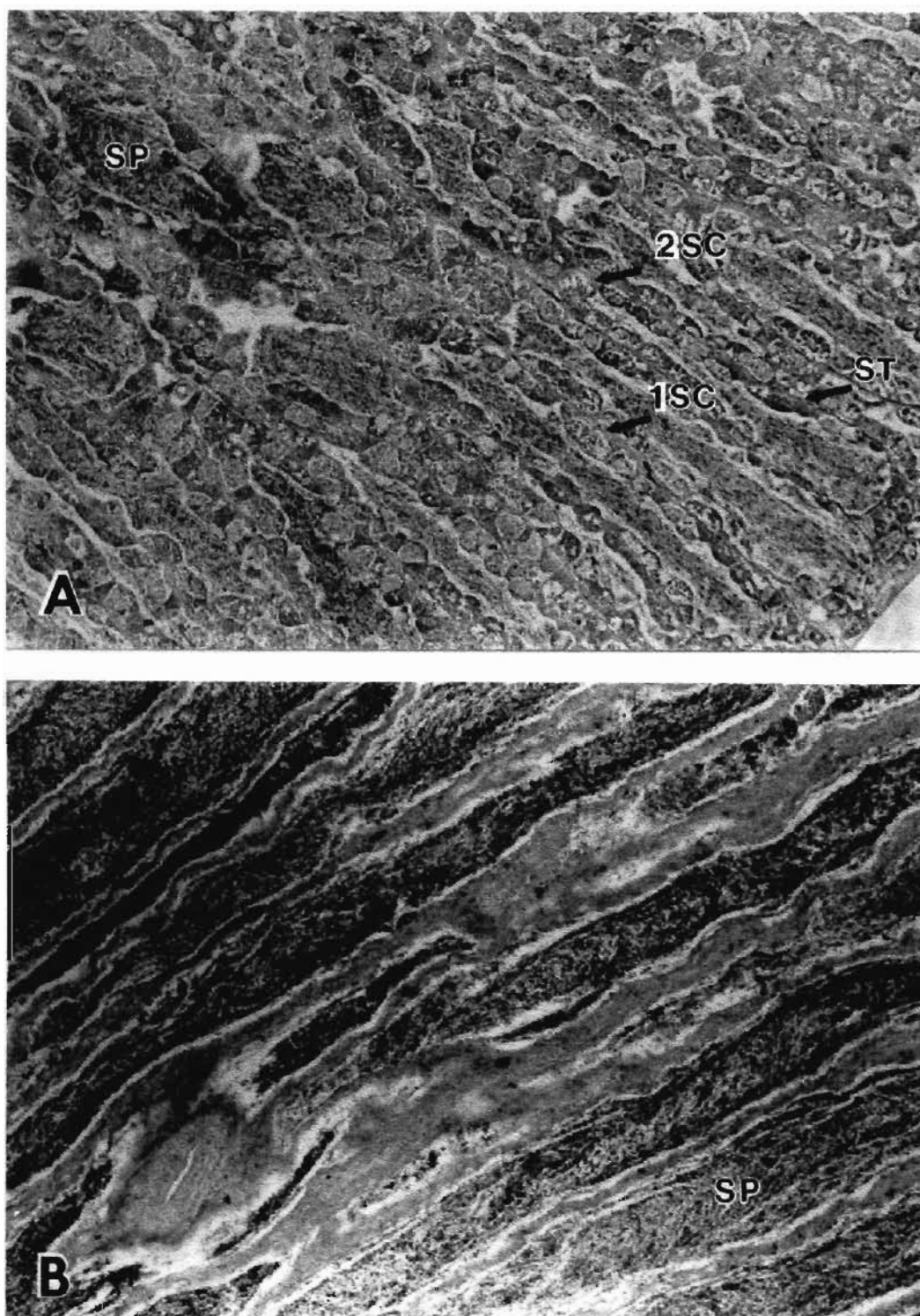


Figure 40. Histological sections of cobia testis in the ripe maturity stage. A. Spermatogenic activity throughout the testis. 53X magnification. B. No spermatogenic activity. 82.5X magnification. Key: SP, spermatozoa; ST, spermatids; 2SC, secondary spermatocytes; 1SC, primary spermatocytes.

An intermediate stage of ripeness, with spermatogenic activity in the periphery of the testis only, was also commonly observed. All male cobia examined from the north-central Gulf of Mexico (**Table 14**), the southeastern Atlantic Ocean (**Table 17**), and the northwestern Gulf of Mexico (**Table 18**) were ripe. As the reproductive season progressed in the north-central Gulf of Mexico, ripe males advanced from active spermatogenesis throughout the testis in April and May (**Figure 40a**) to no evidence of spermatogenic activity at the end of the season in September and October (**Figure 40c**; **Table 14**). Although data are more limited, a similar pattern was seen in cobia from the northwestern Gulf of Mexico (**Table 18**). Cobia were captured from the southeastern Atlantic Ocean during the beginning of the spawning season only, and thus spermatogenic activity was found in all testis examined from that area (**Table 17**). It is interesting to note that cobia captured from the southeastern Atlantic Ocean were in a more advanced stage of testicular maturity during February and March than during April and May. Male fish were captured from the northeastern Gulf of Mexico during all months except January and August, and most fish were ripe from February through December (**Table 15**). Male cobia in the regressed and early developing maturity stages were not found, suggesting male cobia have an extended reproductive season and the testis are rarely in a resting stage. Spent fish were found in November and December only, although a portion of the cobia collected during those months were ripe. The limited sample of male cobia obtained from the Florida Keys (**Table 16**) show a similar extended reproductive season, with the majority of fish captured in February and October classified as ripe. However, samples from the Florida Keys had the highest percentage of maturing and mature males of any other area in this study.

**Table 14.** Percentage of cobia in each testicular maturity stage for the north-central Gulf of Mexico (Destin, FL, to Chandelier Islands, LA). Date from 1996-1997 combined. Spermatogenic activity refers to the presence of spermatogonia, spermatocytes, and spermatids.

Month	N	Ripe; Spermatogenic Activity Throughout	Ripe; Spermatogenic Activity in Periphery	Ripe; No Spermatogenic Activity
April	1	100	0	0
May	17	88	12	0
June	7	43	57	0
July	8	25	50	25
August	1	0	100	0
September	13	0	0	100
October	1	0	0	100

**Table 15.** Percentage of cobia in each testicular maturity stage for the northeastern Gulf of Mexico (Crystal River to Ft. Meyers, FL). Data from 1995-1997 combined. Spermatogenic activity refers to the presence of spermatogonia, spermatocytes, and spermatids.

Month	N	Maturing	Mature	Ripe; Spermatogenic Activity Throughout	Ripe; Spermatogenic Activity in Periphery	Ripe; No Spermatogenic Activity	Spent
February	2	0	0	50	50	0	0
March	1	0	0	100	0	0	0
April	5	20	20	60	0	0	0
May	5	0	0	60	20	20	0
June	1	0	0	0	100	0	0
July	5	0	0	60	40	0	0
August	0	0	0	0	0	0	0
September	5	0	0	0	40	60	0
October	3	0	0	0	0	100	0
November	8	0	0	0	12.5	25	62.5
December	8	0	0	0	12.5	37.5	50

**Table 16.** Percentage of cobia in each testicular maturity stage for the Florida Keys (Sunshine and Big Pine keys). Data from 1996-1997 combined. Spermatogenic activity refers to the presence of spermatogonia, spermatocytes, and spermatids.

Month	N	Maturing	Mature	Ripe; Spermatogenic Activity Throughout	Ripe; Spermatogenic Activity in Periphery	Ripe; No Spermatogenic Activity	Spent
February	13	23	24	7	31	7	7
May	1	0	0	0	0	100	0
October	3	0	0	0	33.3	33.3	33.3

**Table 17.** Percentage of cobia in testicular maturity stages from the southeastern Atlantic Ocean (Morehead City, NC, to Cape Canaveral, FL). Data from 1996-1997 combined. Spermatogenic activity refers to the presence of spermatogonia, spermatocytes, and spermatids.

Month	N	Ripe; Spermatogenic Activity Throughout	Ripe; Spermatogenic Activity in Periphery	Ripe; No Spermatogenic Activity
February	2	50	50	0
March	11	82	12	0
April	3	100	0	0
May	17	100	0	0

**Table 18.** Percentage of cobia in each testicular maturity stage for the northwestern Gulf of Mexico (Port Aransas, TX) in 1996. Spermatogenic activity refers to the presence of spermatogonia, spermatocytes, and spermatids.

Month	N	Ripe; Spermatogenic Activity Throughout	Ripe; Spermatogenic Activity in Periphery	Ripe; No Spermatogenic Activity
May	1	100	0	0
June	1	100	0	0
July	19	42	37	21
August	2	50	0	50

The reproductive season of female cobia is shorter than that seen for the males. **Tables 19-23** show the monthly ovarian maturity stages for all areas. The majority of the females were in the late developing stage by April in the north-central Gulf of Mexico (**Table 19**), the northeastern Gulf of Mexico (**Table 20**) and the southeastern Atlantic Ocean (**Table 22**). Limited data from the northwestern Gulf of Mexico (**Table 23**) and the Florida Keys (**Table 21**) do not allow an accurate analysis of the reproductive season from those areas. Ovarian recrudescence began as early as February in both the Florida Keys and the southeastern Atlantic Ocean and females in the late developing stage were apparent in both areas by March. Spent females were first observed in July along the entire Gulf of Mexico (**Tables 19, 20 and 23**), although some females remained in the late developing stage through September.

Females in the regressed stage were found as early as July along the Gulf of Mexico, suggesting a portion of female cobia only spawn during the beginning of the reproductive season (April through June) or some individuals have a short resting period between two major spawning periods, while others remain in spawning condition throughout the entire season.

**Table 19.** Percentage of cobia in each ovarian maturity stage for north-central Gulf of Mexico (Destin, FL, to Chandelier Islands, LA). Data from 1989, 1990, 1996, and 1997 combined. Percentage atresia calculated per development stage for ovaries with alpha- or beta-stage atresia only.

Stage	April	May	June	July	August	September
<b>N</b>	20	112	1	25	8	22
<b>Early Dev.</b> % atresia	0 --	4.5 20	0 --	0 --	0 --	0 --
<b>Mid Dev.</b> % atresia	10 100	7 62	0 --	4 0	0 --	0 --
<b>Late Dev.</b> % atresia	90 44	88.5 38	100 0	64 31	37.5 33	18 25
<b>Spent</b> % atresia	0 --	0 --	0 --	28 86	50 100	23 80
<b>Regressed</b> % atresia	0 --	0 --	0 --	4 0	12.5 0	59 100

**Table 20.** Percentage of cobia in each ovarian maturity stage for the northeastern Gulf of Mexico (Crystal River to Ft. Meyers, FL). Data from 1995 - 1997 combined. Percentage atresia calculated per development stage for ovaries with alpha- or beta-stage atresia only.

Stage	March	April	May	June	July	August	September	October	November	December
N	2	7	3	2	6	6	3	11	13	7
Immature	0	0	0	50	0	0	0	0	0	0
Early Dev. % atresia	0 --	29 50	0 --	0 --	0 --	0 --	0 --	0 --	0 --	0 --
Mid Dev. % atresia	0 --	14 0	66 50	0 --	0 --	0 --	0 --	0 --	0 --	0 --
Late Dev. % atresia	0 --	57 50	33 0	50 0	83 0	67 50	33 0	0 --	0 --	0 --
Spent % atresia	0 --	0 --	0 --	0 --	17 100	0 --	0 --	18 100	8 100	14 100
Regressed % atresia	100 0	0 --	0 --	0 --	0 --	33 50	66 100	82 67	92 42	86 83

**Table 21.** Percentage of cobia in each ovarian maturity stage for the Florida Keys (Sunshine and Big Pine keys). Data from 1995 - 1997 combined. Percentage atresia calculated per development stage for ovaries with alpha- or beta-stage atresia only.

Stage	January	February	March	April	May
<b>N</b>	1	17	3	0	3
<b>Early Dev.</b>	0	64.7	66	0	33
% atresia	--	91	50	--	100
<b>Mid Dev.</b>	0	5.9	0	0	0
% atresia	--	100	--	--	--
<b>Late Dev.</b>	0	0	34	0	67
% atresia	--	--	100	--	100
<b>Spent</b>	0	0	0	0	0
% atresia	--	--	--	--	--
<b>Regressed</b>	100	29.4	0	0	0
% atresia	100	20	--	--	--

**Table 22.** Percentage of cobia in each ovarian maturity stage for the southeastern Atlantic Ocean (Morehead City, NC, to Cape Canaveral, FL). Data from 1996 - 1997 combined. Percentage atresia calculated per development stage for ovaries with alpha- or beta-stage atresia only.

Stage	February	March	April	May	June	December
<b>N</b>	3	31	10	10	6	2
<b>Early Dev.</b>	66	41.9	20	0	0	0
% atresia	100	92	0	0	--	--
<b>Mid Dev.</b>	34	16	10	0	0	0
% atresia	100	80	100	--	--	--
<b>Late Dev.</b>	0	41.9	70	100	100	0
% atresia	--	85	66	60	0	--
<b>Spent</b>	0	0	0	0	0	0
% atresia	--	--	--	--	--	--
<b>Regressed</b>	0	3.2	0	0	0	100
% atresia	--	0	--	--	--	50

**Table 23.** Percentage of cobia in each ovarian maturity stage for the northwestern Gulf of Mexico (Port Aransas, TX) in 1996. Percentage atresia calculated per development stage for ovaries with alpha- or beta-stage atresia only.

Stage	May	June	July	August
N	1	8	48	2
Mid Dev. % atresia	0 --	0 --	4 50	50 0
Late Dev. % atresia	100 0	100 0	73 5.7	50 0
Spent % atresia	0 --	0 --	21 100	0 --
Regressed % atresia	0 --	0 --	2 100	0 --

Atresia:

Cobia ovarian tissue showed all stages of atresia throughout the reproductive season. Alpha and beta-stage atresia of yolked oocytes (**Figure 41a**) were most abundant in spent fish but were also found in females in the mid-developing and late developing ovarian stages. Atresia of hydrated oocytes (**Figure 41b**) was only found in ovaries in the late developing and spent stages. Atresia of non-yolked oocytes was more difficult to recognize but was a common occurrence in early developing ovaries (**Tables 21 and 22**). The later stages of atresia (gamma and delta; **Figure 41c**) were found in ovaries in all maturity stages from early developing through regressed.

The spawning success of a fish can be determined, in part, by analysis of atretic oocytes. A low percentage of atresia is common throughout the reproductive season, representing oocytes that did not fully mature. However, a high percentage of late developing females captured from the southeastern Atlantic Ocean in March, April and May exhibited alpha or beta-stage atresia (**Table 22**). This high percentage of atresia suggests many oocytes did not reach final maturation, indicative of reduced spawning success. The relatively low percentage of females with atretic oocytes along the Gulf of Mexico (**Tables 19, 20 and 23**) suggests high spawning success throughout the spawning season in the Gulf of Mexico.

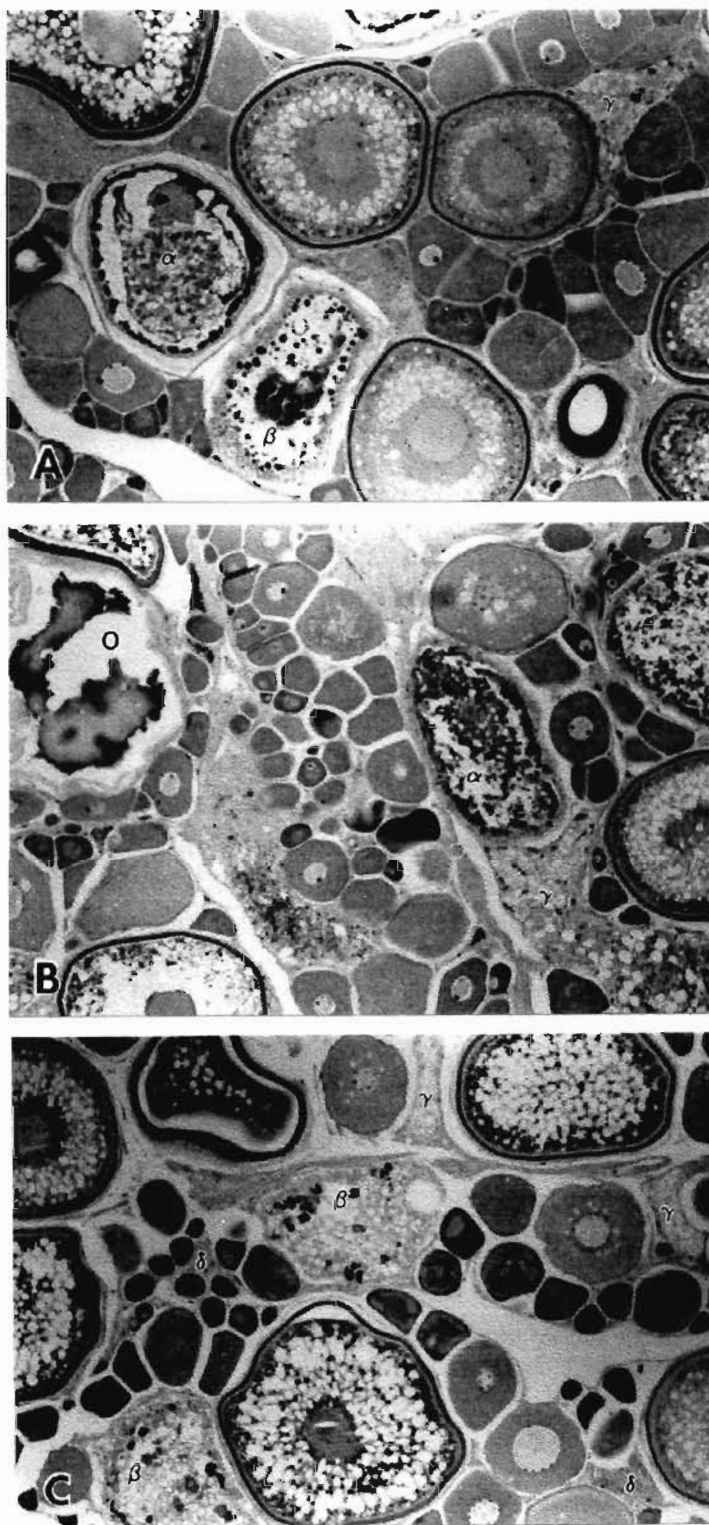


Figure 41. Stages of atresia in cobia ovaries. A. Alpha ( $\alpha$ ), beta ( $\beta$ ), and gamma ( $\gamma$ ) stage atresia in a late developing/spent stage ovary. 100x magnification. B. Alpha-stage atresia of a hydrated oocyte (O). 100X magnification. C. Beta ( $\beta$ ), gamma ( $\gamma$ ) and delta ( $\delta$ ) stages of atresia in a spent ovary. 100X magnification.

#### Final Oocyte Maturation:

Female cobia were found to be undergoing final oocyte maturation (FOM) in all areas sampled with the exception of the Florida Keys. Cobia in early stages of FOM showed the beginning of lipid coalescence (**Figure 42a**). More advanced stages of FOM were identified by complete lipid coalescence and migration of the nucleus to the periphery of the oocyte (**Figure 42b**). The final stages of FOM, the breakdown of the nuclear membrane and yolk coalescence, followed by hydration, were not observed in any sample. Final oocyte maturation appeared to be a relatively synchronous process; most oocytes undergoing FOM within an ovary were in the same FOM stage (**Figure 42c**). The percentage of fully mature oocytes undergoing FOM varied from 5% to 84% of the oocytes within a 100x field of view. Females from the northeastern Gulf of Mexico had the highest mean percentage of mature oocytes undergoing FOM (49%), followed by the north-central Gulf of Mexico (19%), the southeastern Atlantic Ocean (16%) and the northwestern Gulf of Mexico (15%). The mean percentage of females in the late developing ovarian stage undergoing FOM ranged from a high of 59% (n=16) in the northeastern Gulf of Mexico to a low of 11% (n=37) in the northwestern Gulf of Mexico; an average of 19% of the females from the north-central Gulf of Mexico (n=141) and the southeastern Atlantic Ocean (n=36) were undergoing FOM.

#### Spawning Frequency:

Postovulatory follicles (POF) were found in cobia ovaries from all areas sampled throughout the reproductive season (**Table 24**). However, POF were never abundant in any ovary examined; the greatest density of POF recorded was two POF per 100x field of view. The least commonly observed POF stage was 0-12 hours (**Figure 43a**), occurring in only 16% of all ovaries containing POF. Early-stage POF's were only found in female cobia from the southeastern Atlantic Ocean and the northeastern and north-central Gulf of Mexico. The most commonly observed POF stage was 24 hours (**Figure 43b**), occurring in 51% of all ovaries containing POF. Twenty-four-hour POF's were found in cobia from all areas and were most common in fish from the northeastern and north-central Gulf of Mexico. The 48-hour POF stage (**Figure 43c**) was often difficult to distinguish from gamma and delta-stage atresia, occurred in 33% of all ovaries containing POF and was most commonly found in fish from the northwestern Gulf of Mexico.

#### Batch Spawn Size:

We were unable to collect female cobia that had ovaries containing hydrated eggs so the estimate of spawn size was estimated from the frequency distribution of oocyte diameters in ovaries showing FOMs histologically. Those animals are within 21-24h of spawning. The mode of the largest batch of oocytes in such ovaries was between 700 and 800 $\mu$ m. The frequency of diameters diminished on either side of the mode providing a symmetrical frequency histogram of oocytes between 500 and 1000 $\mu$ m (**Figure 44**). We therefore estimated batch spawn size as the number of oocytes greater than 500 $\mu$ m in ovaries containing oocytes in the final stages maturation.

Initially we compared the spawn size estimates for samples from six females that were fixed in Gilson's to samples from the same fish fixed in formalin. The mean spawn size estimates for six fish was 1,332,080 (SEM=287,273) for formalin fixed samples and 1,704,280 (SEM=576,874). A paired t-test detected no significant differences (t=0.8297,

5df,  $P=0.4445$ ) in estimated spawn size. In addition there was no indication that one method consistently under estimated relative to the other. The 95% confidence limits for the difference between Gilson's and formalin estimates of the same fish was from 780,900 to 1,525,000 with three differences being positive and three negative. We subsequently chose to use formalin fixed samples for all spawn size estimates.

Nineteen female cobia that had been found to have oocytes in the final stages of maturation. The estimates from each fish are given in **Figure 45**. The estimates range from less than 1,000,000 to over 4,000,000. The mean estimates for each fish range from 654,217 to 3,820,616 and the mean of the mean for the 19 cobia was 1,944,811 (SEM=208,118) with a 95% confidence interval from 1,507,570 to 2,382,053.

**Table 24.** Percentages of postovulatory follicle (POF) stages in cobia with ovaries in the late developing stage.

Area	Number with POF	POF Stage		
		0-12 hour	24 hour	48 hour
Southeastern Atlantic Ocean	13	23	38	38
Florida Keys	1	0	100	0
Northeastern Gulf of Mexico	6	33	67	0
North-central Gulf of Mexico	47	17	55	28
Northwestern Gulf of Mexico	13	0	38	62
Total Region	80	16	51	33

Two methods were used to estimate the spawning frequency of cobia; the percentage of late developing ovaries containing 0- to 24-hour POF and the percentage of late developing ovaries with oocytes undergoing FOM. Both these methods assume that spawning either has taken place within 24 hours (POF) or will take place within 24 hours (FOM). **Tables 25-27** show estimated monthly spawning frequencies for cobia from all areas except the Florida Keys, and the northeastern Gulf of Mexico, which had insufficient data for this analysis. The spawning frequency of cobia from the north-central Gulf of Mexico (**Table 25**) and the southeastern Atlantic Ocean (**Table 26**) were similar for both the POF and FOM method, averaging one spawn every 3.9 to 5.1 days.

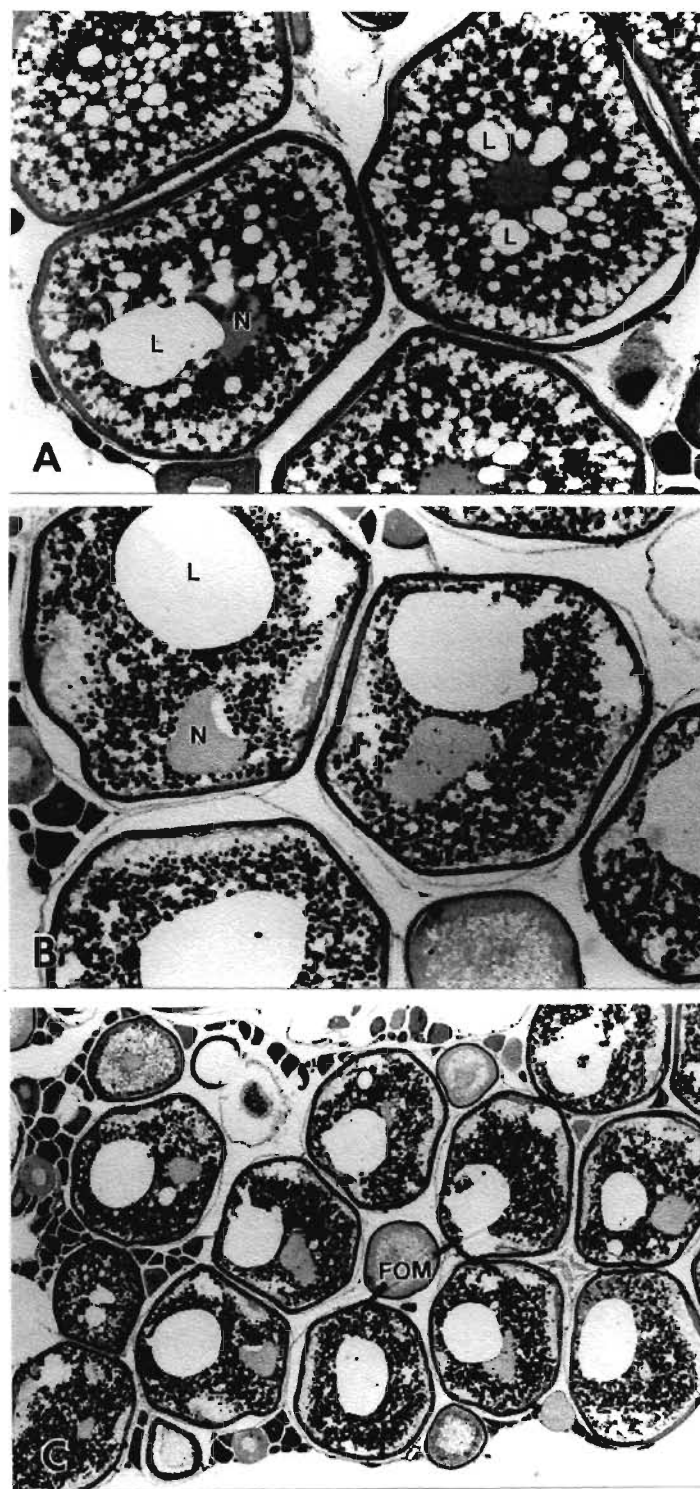


Figure 42. Final oocyte maturation (FOM) in late developing cobia ovaries. A. Early stage of FOM showing initial lipid coalescence (L). 100X magnification. B. More advanced stage of FOM. Lipids have coalesced to form a single large droplet (L) and the nucleus (N) is beginning to migrate to the periphery of the oocyte. 100X magnification. C. Synchrony of FOM. 39X magnification.

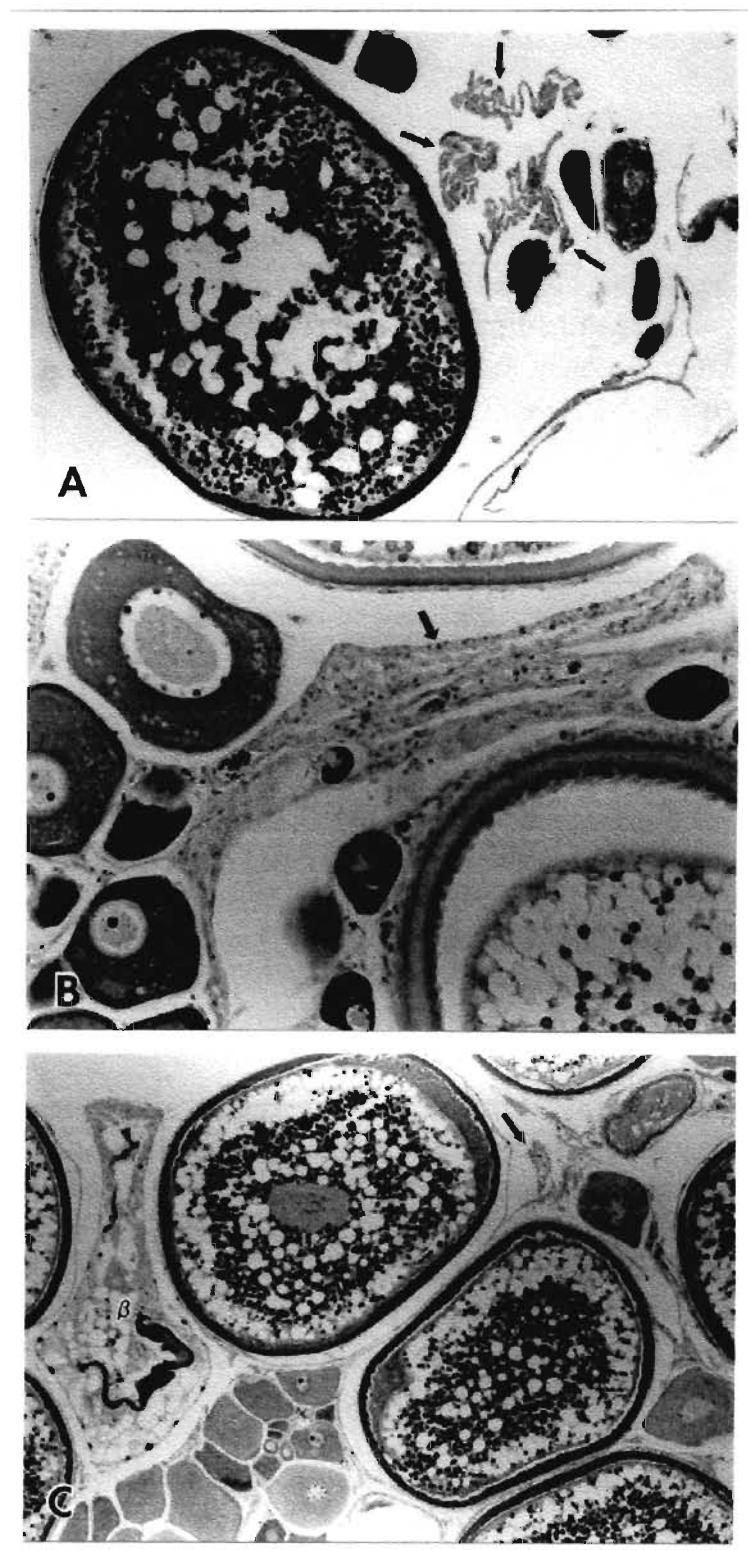
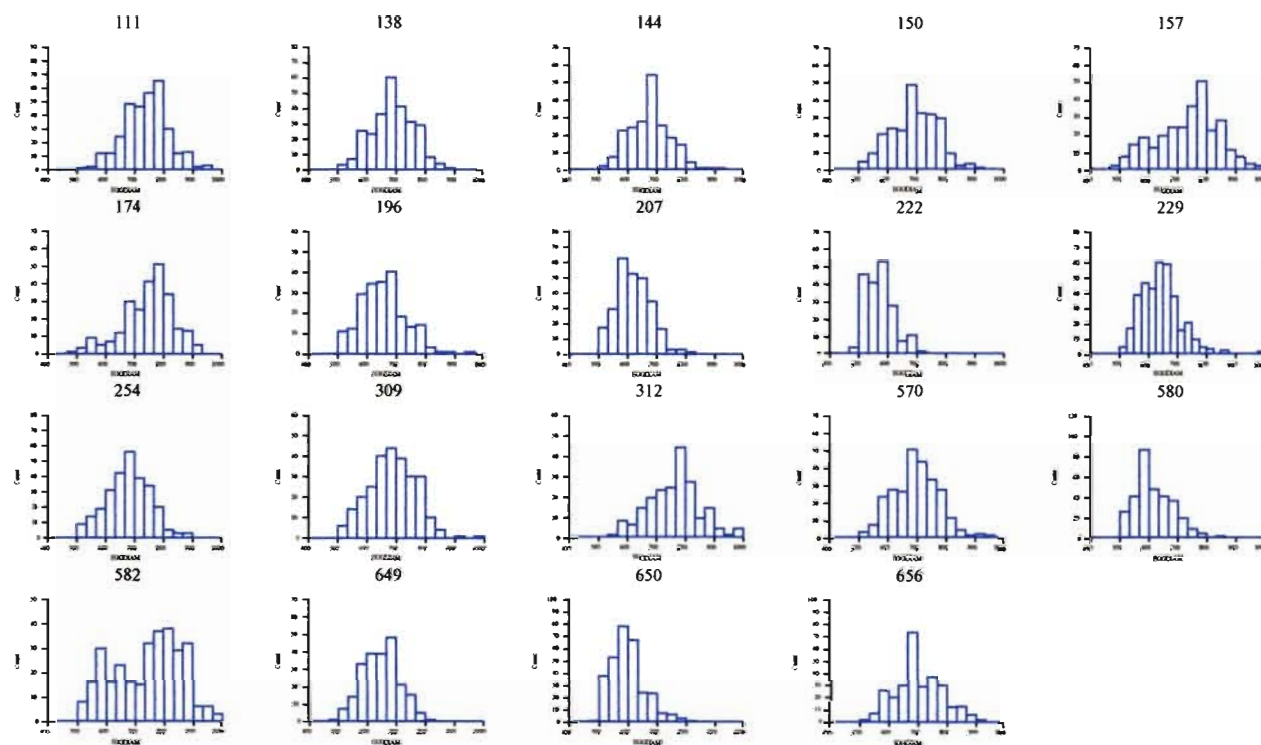
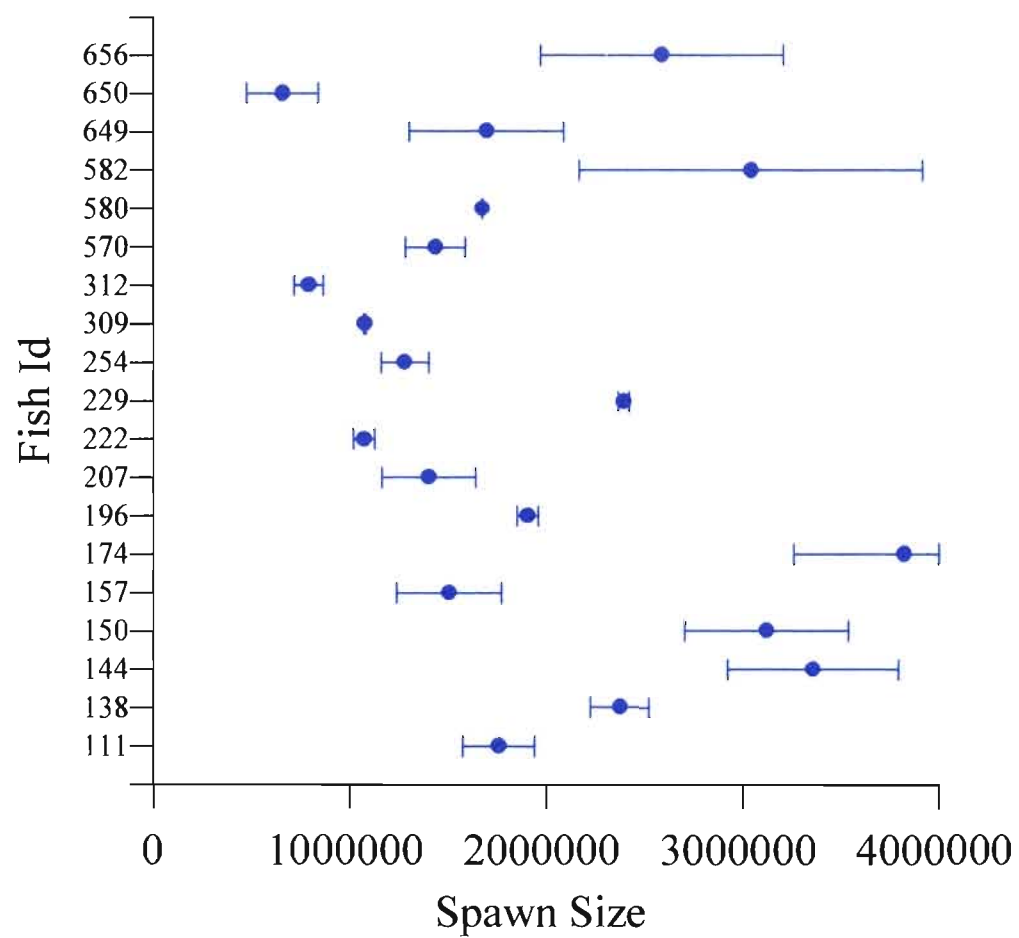


Figure 43. Postovulatory follicles (POF) in late developing cobia ovaries. A. 0- to 12-hour POF (arrows). 125X magnification. B. 24-hour POF (arrow). 324X magnification. C. 48-hour POF (arrow) with early-stage beta atresia apparent ( $\beta$ ). 100X magnification.



**Figure 44.** Oocyte diameter histograms for 19 fish with ovaries that contained FOM.



**Figure 45.** Spawn size estimations for 19 cobia whose ovaries contain FOM's.

Monthly spawning frequency estimates were relatively consistent for both the FOM and POF method in the north-central Gulf of Mexico (**Table 25**), although frequency estimates obtained from monthly samples sizes less than five may not be accurate. In contrast, there was greater variation in monthly spawning frequency estimates for cobia from the southeastern Atlantic Ocean (**Table 26**). However, if frequency estimates from March are eliminated (a reasonable assumption since less than half the fish examined during March were in the late developing stage, suggesting the spawning season was just starting), average spawning frequency for April through June increases to every 4.0 days for the POF method and every 4.3 days for the FOM method. In contrast, spawning frequency is much lower for cobia in the northwestern Gulf of Mexico (**Table 27**), averaging once every 12.5 days for the POF method and once every 9.0 days for the FOM method. These estimates are based on fish captured in July only; if fish from June were included, frequency estimates would decrease to 25 days for POF and 18 days for FOM.

**Table 25.** Spawning frequency estimates for cobia in the late development ovarian maturity stage from the north-central Gulf of Mexico (Destin, FL, to Chandelier Islands, LA). Data from 1996 and 1997 combined. Postovulatory follicles (POF) represent a combination of 12 and 24 hour POF. FOM-final oocyte maturation.

Month	N	% POF	Spawning Frequency using POF	% FOM	Spawning Frequency using FOM
April	18	28	3.6 days	17	5.9 days
May	99	24	4.2 days	17	5.9 days
June	1	100	1 day	0	---
July	16	25	4.0 days	44	2.3 days
August	3	33	3 days	0	--
September	4	0	--	17	5.9
<b>Mean Spawning Frequency</b>	141	22	4.5 days	19	5.3 days

**Table 26.** Spawning frequency estimates for cobia in the late development ovarian maturity stage from the southeastern Atlantic Ocean (Morehead City, NC, to Cape Canaveral, FL). Data from 1996 and 1997 combined. Postovulatory follicles (POF) represent a combination of 12- and 24-hour POF. FOM-final oocyte maturation.

Month	N	% POF	Spawning Frequency from POF	% FOM	Spawning Frequency from FOM
March	13	7.6	13.5 days	7.6	13.5 days
April	7	42.8	2.3 days	0	---
May	10	30.0	3.0 days	20	5.0 days
June	6	0	--	50	2.0 days
Average Spawning Frequency	36	20.0	5.0 days	19.4	5.1 days

**Table 27.** Spawning frequency estimates for cobia in the late development ovarian maturity stage from the northwestern Gulf of Mexico (Port Aransas, TX) in 1996. Post ovulatory follicles (POF) represent a combination of 12- and 24-hour POF. FOM-final oocyte maturation.

Month	N	% POF	Spawning Frequency from POF	% FOM	Spawning Frequency from FOM
June	6	0	—	0	—
July	37	8	12.5 days	11	9 days
August	2	50	2 days	0	—
Average Spawning Frequency*	37	8	12.5 days	11	9 days

\* July only

## Discussion

This study suggests that the timing and duration of the cobia reproductive season along the southeastern Atlantic Ocean and the northern Gulf of Mexico are similar to previous reports of cobia reproduction in the region (Richards 1976; Thompson *et al.* 1992; Beisiot *et al.* 1994; Lotz *et al.* 1996) and that there are no major differences in the reproductive season among the areas studied. Cobia have been reported to migrate to the Florida Keys during the winter (Lotz *et al.* 1996), and there has been some speculation regarding spawning of an overwintering stock of cobia in the Florida Keys. However, the limited data collected from the Florida Keys in this study suggests spawning does not occur during the winter, since females in the late developing ovarian stage were not found until March and 47% of the males captured in February in the Florida Keys did not yet have ripe testis. Additional samples from the Keys are necessary to thoroughly understand the reproductive dynamics of cobia from that area.

Male cobia appear to be capable of spawning for ten months of the year, whereas the female spawning season appears to be confined to a six-month period from April through September. The longer duration of the male reproductive season is not uncommon in marine, subtropical, multiple-spawning species (Brown-Peterson *et al.* 1988; Cuellar *et al.* 1996). Energetic investment in spermatogenesis is less than that for oocyte development and maturation, which may contribute to the ability of male fish to be reproductively ready longer than females. Dividing ripe males into three stages based on spermatogenic activity shows that although males remain ripe through late fall, most spermatogenic activity ceases by late summer, similar to the maturity pattern seen in female cobia.

While the female reproductive season appears to extend for six months, there is a significant number of female fish that were spent by July throughout the northern Gulf of Mexico. Lotz *et al.* (1996) found similar results in cobia from the same area, suggesting this is not an unusual occurrence. The reason that a portion of the female cobia appear to end their reproductive season in July while other females continue spawning through September is unclear, but suggests there may be two distinct groups of cobia in the northern Gulf of Mexico. Alternatively, younger, smaller females may cease spawning sooner than older females; a future investigation of otolith morphology genetics and age & growth patterns of northern Gulf cobia might reveal the presence of distinct groups.

This study presents the first detailed look at atresia, final oocyte maturation (FOM), and postovulatory follicles (POF) in cobia. Although atresia in cobia ovaries has been previously illustrated (Lotz *et al.* 1996), the various stages of atresia were not defined for cobia. Hunter and Macewicz (1985a) found that rates of atresia in northern anchovy (*Engraulis mordax*) could be useful in classifying the spawning condition of multiple spawning species. Cobia in the late developing maturity stage were never found with > 50% of the yolked oocytes undergoing alpha or beta stage atresia (Hunter and Macewicz's (1985a) atresia state 2), although this was a common occurrence in spent fish in July, August, and September. Many cobia along the southeastern Atlantic Ocean during the early portion of the spawning season had alpha or beta stage atresia (**Table 22**). The low levels of atresia within each fish did not appear to reduce spawning

frequency (**Table 26**), although it may have influenced batch fecundity, as suggested by Hunter and Macewicz (1985a). In general, the high percentages of atresia observed in northern anchovy (Hunter and Macewicz 1985a) were uncommon in cobia except at the very end of the reproductive season when spawning had ceased.

Final oocyte maturation appears to be a synchronous process in individual cobia. However, the percentage of yolked oocytes undergoing final oocyte maturation was quite variable, suggesting cobia batch fecundities may also be very variable. Although the amount of time necessary between initiation of FOM and hydration and spawning in cobia is currently unknown, FOM generally occurs within 24 hours of spawning and can begin as little as 12 hours prior to spawning in sciaenid fishes (Brown-Peterson *et al.* 1988). The time of day that cobia spawn is unclear. Ditty and Shaw (1992) suggested cobia spawn during the day, based on examination of wild-caught larval cobia. Cobia induced to spawn at the Gulf Coast Research Laboratory spawned during the early morning prior to dawn (J.S. Franks and J.M. Lotz, personal communication). However, the timing of hormone-initiated spawning may not reflect natural spawning in the wild. Nevertheless, these data suggest that FOM may require 18-24 hours in cobia, since fish undergoing the early stages of FOM were captured during the daytime. Further information on the timing and duration of final oocyte maturation could resolve the temporal question of when cobia spawn.

There has never been an estimate of spawning frequency for cobia. Although the percentage of fish captured containing 24-hour or younger POF has been shown to be an effective method of determining spawning frequency in multiple spawning fish (Hunter and Macewicz 1985b; Hunter *et al.* 1992), we have shown that the percentage of fish undergoing FOM can also be used to estimate spawning frequency of cobia. Spawning frequency estimates using both the POF and FOM methods were similar for cobia from the southeastern Atlantic Ocean and the north-central Gulf of Mexico (**Tables 25 and 26**), and averaged once every four days. This is similar to the once every three-day spawning frequency reported for bigeye scad (*Selar crumenophthalmus*; Clarke and Privitera 1995), a subtropical carangid species, somewhat related to cobia. A spawning frequency of once every four days seems a reasonable estimate for cobia, and is supported by the fact that fish undergoing FOM were never found with POF of any age in the ovaries, suggesting a minimum of a three-day interval between spawning events. There appears to be a major difference in spawning frequency between cobia from the northwestern Gulf of Mexico and those captured in more eastern locations. Spawning occurs much less frequently in the northwestern Gulf of Mexico (once every nine to 12.5 days) than in locations further east. Additionally, the agreement between spawning frequency estimates using POF and FOM is not as close as for areas further east. However, these data are based on fish captured during July only; perhaps additional samples from other months would show spawning frequencies more similar to those estimated for cobia from the north-central Gulf of Mexico and the southeastern Atlantic Ocean. An additional explanation could be that cobia utilize the northwestern Gulf of Mexico primarily as a feeding ground and make extensive (1-2 day) migrations to the spawning grounds.

The location of spawning of cobia is still unclear. Joseph *et al.*, (1964) and Richards (1967) indicated that spawning occurs in nearshore waters, in the lower Chesapeake Bay and in inshore waters of the Atlantic Ocean. Burns collected cobia eggs and larvae (described in Ditty and Shaw 1992) inshore in Crystal Bay, Florida and has been told by numerous fishers that they have witnessed small groups of cobia spawning in Tampa Bay, Florida. There have been suggestions that cobia along the southeastern Atlantic Ocean spawn offshore (Hassler and Rainville 1975; Shaffer and Nakamura 1989). These speculations are supported by the histological data from this study. The lack of fish with oocytes in the final stages of FOM or hydrated oocytes suggests that the cobia collected for this study did not spawning in the nearshore areas where our samples were taken. Additionally, the relatively low percentage of ovaries containing POF's less than 12-hours-old indicates fish collected in this study did not spawn in the nearshore areas, but may have returned from offshore spawning grounds within 24 hours of spawning. Perhaps the reasons for this disparity of identification of spawning grounds is due to the fact that cobia may spawn both inshore and offshore.

Assuming females spawn 1,000,000 - 2,000,000 eggs every 2-6 days during the 91 days of May, June, and July, total fecundity may range from 15,000,000 - 90,000,000 eggs during that period. These estimates for total fecundity are similar to estimates obtained by Lotz *et al.* 1995 for batch spawn size. Lotz *et al.* 1995 did not observe fish with oocytes larger than 700 $\mu$ m and did not prescreen animals for presence of ovaries in final stages of oocyte maturation. It is likely that their estimates are of total fecundity rather than batch spawn size.

## VII. RECOMMENDATIONS FOR FUTURE RESEARCH

Recommendations for needed research on cobia from the Gulf of Mexico and the South Atlantic:

- Further investigate the reproductive biology of Florida Keys cobia to determine spawning season duration and spawning frequency.
- Collect additional cobia samples off Texas to resolve the difference in spawning frequency between Texas cobia and cobia from the northern and eastern Gulf and the South Atlantic.
- Procure additional fish from the north central Gulf to fill in the gaps in collections in order to better estimate spawning frequency.
- Conduct a population genetics study to determine whether cobia from the northwestern gulf are a different population with differing reproductive patterns, than cobia from more eastern locations within the Gulf of Mexico.
- Collect additional fish from the later part of the spawning season from the South Atlantic for comparison with northern Gulf and Texas fish.

- Obtain gonad and otolith samples from the Chesapeake Bay for stock identification, since cobia migrate into the Bay ready to spawn. Compare these data with growth rates and spawning frequencies of fish from the South Atlantic and Gulf of Mexico fish.
- Obtain much needed samples from cobia which overwintering in deep waters (150-300+ feet) of the northern Gulf of Mexico and off the Carolinas.
- Collect additional samples from southeastern Atlantic Ocean during the latter part of the reproductive season (June - September) to confirm the duration of the season and verify spawning frequency estimates.
- Collect additional samples from the northeastern Gulf of Mexico to determine spawning frequencies and to ascertain if spawning frequencies from the northeastern Gulf are similar to those of the north central Gulf of Mexico and the southeastern Atlantic Ocean.
- Determine the reproductive status of cobia overwintering in the north central Gulf of Mexico and the Florida Keys, as well as cobia that are resident in the Keys during the summer.
- Collect smaller (immature) males to determine age/length of males at first maturity.
- Conduct an analysis of trade-off among egg production, yield-per-recruit and size regulations to determine which size regulations are optimal in order to protect the spawning biomass.
- Develop a reliable index of recruitment.
- Spawn cobia in captivity to obtain sequential ovarian samples before and after spawning to document the timing of final oocyte maturation as well as the appearance of 12 and 24 hour post ovulatory follicles (POF).

## VIII. LITERATURE CITED

- Barger, L.E. 1985. Age and growth of Atlantic croakers in the northern Gulf of Mexico, based on sections. *Trans. Amer. Fish. Soc.* 114: 847-850.
- Beckman, W.D., A.L. Stanley, J.H. Render and C.A. Wilson. 1990. Age and growth of black drum in Louisiana waters of the Gulf of Mexico. *Trans. Amer. Fish. Soc.* 119: 537-544
- Beisiot, P.M, R.E. Caylor and J.S. Franks. 1994. Biochemical and histological changes during ovarian development of cobia, *Rachycentron canadum*, from the northern Gulf of Mexico. *Fish. Bull.* 92: 686-696.
- Brown-Peterson, N., P. Thomas and C.R. Arnold. 1988. Reproductive biology of the spotted seatrout, *Cynoscion nebulosus*, in south Texas. *Fish. Bull.* 86: 373-388.
- Clarke, T.A. and L.A. Privitera. 1995. Reproductive biology of two Hawaiian pelagic carangid fishes, the bigeye scad, *Selar crumenophthalmus*, and the round scad, *Decapturus macarellus*. *Bull. Mar. Sci.* 56: 33-47.
- Crabtree, R.E., C.W. Harnden, D. Snodgrass and C. Stevens. 1996. Age, growth, and mortality of bonefish, *Albula vulpes*, from the waters of the Florida Keys. *Fish Bull.* 94: 442-451.
- Crabtree, R.E., E.C. Cyr and J.M. Dean. 1995. Age and growth of tarpon, *Megalops atlanticus*, from South Florida waters. *Fish. Bull.* 93:619-628.
- Cuellar, N., G.R. Sedberry and D.W. Wyanski. 1996. Reproductive seasonality, maturation, fecundity, and spawning frequency of the vermillion snapper, *Rhomboplites aurorubens*, off the southeastern United States. *Fish. Bull.* 94: 635-653.
- Ditty, J.G. and R.F. Shaw. 1992. Larval development, distribution and ecology of cobia, *Rachycentron canadum*. *Copeia* 1971: 65-71.
- Fable, W.A., Jr., A.G. Johnson and L.E. Barger. 1987. Age and growth of Spanish mackerel, *Scomberomorus maculatus*, from Florida and the Gulf of Mexico. *Fish. Bull.* 85(4): 777-783.
- Franks, J.S. and J.T. McBee. 1991. Age and growth in cobia. In: Franks, J.S., T.D. McIlwain, D.M. Overstreet, J.T. McBee, J.M. Lotz, and G. Meyer, Investigations of the cobia (*Rachycentron canadum*) in Mississippi waters and adjacent Gulf waters. Gulf Coast Res. Lab., Ocean Springs, MS 39566-7000. Final Rep. to Miss. Dept. Wildl., Fish & Parks/Bur. Mar. res. and U.S. Fish Wildl. Serv., Atlanta, GA 30303, Project No. F-91, pp. 2-1 to 2-42.
- Hassler, W.W. and R.P. Rainville. 1975. Techniques for hatching and rearing cobia, *Rachycentron canadum*, through larval and juvenile stages. Publication UNC-SG-75-30, University of North Carolina Sea Grant College Program, Raleigh, NC, 26 p.

- Hunter, J.R. and B.J. Macewicz. 1985a. Rates of atresia in the ovary of captive and wild northern anchovy, *Engraulis mordax*. *Fish. Bull.* 83: 119-136.
- Hunter, J.R. and B.J. Macewicz. 1985b. Measurement of spawning frequency in multiple spawning fishes. pp. 79-94 In: Lasker, R.L. (ed.), An egg production method for estimating spawning biomass of pelagic fish: Application to the northern anchovy, *Engraulis mordax*. NOAA Technical Report NMFS 36.
- Hunter, J.R., B.J. Macewicz and H.R. Sibert. 1986. The spawning frequency of skipjack tuna, *Katsuwonus pelamis*, from the south Pacific. *Fish. Bull.* 84: 895-903.
- Hunter, J.R., B.J. Macewicz, N.C. Lo and C.A. Kimbrell. 1992. Fecundity, spawning and maturity of female Dover sole, *Microstomus pacificus*, with an evaluation of assumptions and precision. *Fish. Bull.* 490: 101-128.
- Joseph, E.B., J.J. Norcross and W.H. Massmann. 1964. Spawning of Cobia, *Rachycentron canadum* in the Chesapeake Bay area, with observations on juvenile specimens. *Chesapeake Sci.* 5(1-2): 67-71.
- Lotz, J.M., R.M. Overstreet and J.S. Franks. 1996. Gonadal maturation in the cobia, *Rachycentron canadum*, from the north central Gulf of Mexico. *Gulf Research Reports* 9: 147-159.
- Potts, J.C. and C. Manooch, III. 1996. Age and growth of red hind and rock hind collected from North Carolina through the Dry Tortugas, Florida. *Bull. Mar. Sci.* 56(3): 784-794.
- Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. *Fish. Res. Board. Can. Bull.* 191, 322 pp.
- Richards, C.E. 1967. Age, growth and fecundity of the cobia, *Rachycentron canadum*, from the Chesapeake Bay and adjacent Mid-Atlantic waters. *Trans. Amer. Fish. Soc.* 96: 343-350.
- Statistical Analysis System (SAS). 1985. SAS user's guide: statistics, version 5 edition. SAS Institute, Cary, North Carolina.
- Shaffer, R.V. and E. L. Nakamura. 1989. Synopsis of biological data on the cobia, *Rachycentron canadum*, (Pisces: Rachycentridae). NOAA Technical Report, NMFS 82 (FAO Fisheries Symposium 153), 21 p.
- Smith, J.W. 1995. Life History of cobia, *Rachycentron canadum* (Osteichthyes: Rachycentridae) in North Carolina waters. *Brimleyana* 23: 1-23.
- Thompson, B.A., C.A. Wilson, J.H. Render, M. Beasley and C. Cauthron. 1992. Age, growth, and reproductive biology of greater amberjack and cobia from Louisiana waters. Final Report, MARFIN Cooperative Agreement NA90AA-H-MF722 to NMFS (NOAA). Coastal Fisheries Institute, LSU Center for Coastal, Energy, and Environmental Resources, Baton Rouge, LA, 77 p.

- Von Bertalanffy, L. 1938. A quantitative theory of organic growth (inquiries on growth laws. 11) *Hum. Biol.* 19(2): 181-213.
- Wilson, C.A. and eight other co-authors. 1987. Glossary. pp. 527-530. In: R.C. Summerfelt and G.E. Hall, editors. Age and growth of fish. Iowa State University Press, Ames.

## APPENDICES

Not included

## **Appendix A**

Examples of Publicity Campaign

## **Appendix B**

### Age/Length Keys

Tables 1-6

[illegible]

[illegible]

**Appendix Table 5(a).** Age length key, fork length (cm) composition in percent, of cobia females from the northern Gulf of Mexico, by age group.

Length (cm)	0	1	2	3	4	5	6	7	8	9	10	11	12	13
<b>N Gulf Females</b>														
35	100.0													
40	100.0													
45														
50														
55														
60														
65		100.0												
70														
75			100.0											
80			100.0											
85			80.0	20.0										
90		6.7	73.3	13.3		6.7								
95			73.3	23.3	3.3									
100		4.2	12.5	75.0	4.2	4.2								
105			37.5	45.8	12.5	4.2								
110			9.1	63.6	27.3									
115			10.5	26.3	42.1	15.8	5.3							
120			3.8	23.1	42.3	19.2	11.5							
125			12.5	25.0	12.5	25.0	25.0							
130					25.0	25.0	50.0							
135						33.3	66.7							
140							100.0							
145														
150														
155						100.0								
160							100.0							

[illegible]

**Appendix Table 6(a).** Age length key, fork length (cm) composition in percent, of cobia females from Texas, by age group.

[illegible]

[illegible]

[illegible]



[illegible]

[illegible]

[illegible]

