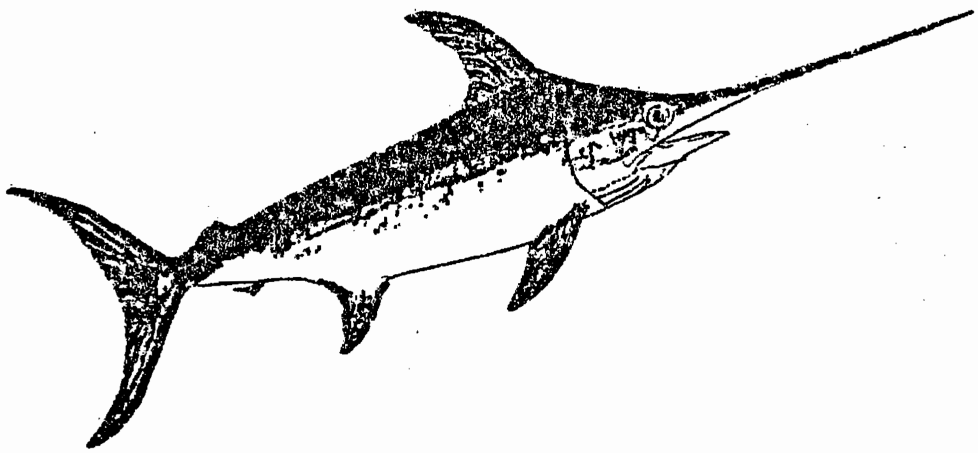
SOURCE DOCUMENT
FOR THE
SWORDFISH
FISHERY MANAGEMENT PLAN

FEBRUARY 1985



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NEW ENGLAND FISHERY MANAGEMENT COUNCIL

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SOURCE DOCUMENT
FOR THE
SWORDFISH FISHERY MANAGEMENT PLAN

PART I: ADDENDUM TO THE SOURCE DOCUMENT
(FEBRUARY 1985)

PART II: SOURCE DOCUMENT
(MAY 1982)

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Financial assistance for producing this source document was provided by grant funds from the National Marine Fisheries Service, National Oceanic and Atmospheric Administration, under Public Law 94-265, the Magnuson Fishery Conservation and Management Act.

ACKNOWLEDGEMENTS

The original swordfish source document (May 1982) has been updated and expanded. The addendum to the source document was prepared principally by John Hoey. The present source document was prepared by the South Atlantic Fishery Management Council staff:

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Thanks are due to the following National Marine Fisheries Service personnel for their continued assistance and time in providing swordfish monthly landings data: Ernie Snell, Ken Harris, Bill Kelly, Ronnie Schultz, Orvill Alan, Ormon Farley, and Joan Palmer. Thanks are also due Gregory Peacock, Fisheries Operations Branch, Canadian Department of Fisheries and Oceans, Halifax, Nova Scotia for providing Canadian data.

Very special thanks are due to the fishermen and processors who have helped us extensively during the preparation of this document. The data contained in the document represent an example of the way in which managers and individuals in the fishery can cooperate to the mutual benefit of all concerned. We have made every attempt to be responsive to the many suggestions received during the numerous public hearings. Special thanks are due to the following individuals:

Melvin Siegel, Mar Quest Corporation
Roy Merritt, Merritt Seafood, Inc.
Becky Phillips, Merritt Seafood, Inc.
Michael W. Montella, Triple M Seafood
Arthur Dorsay, Beach Shrimp Packers
Captain Marty R. Bartlett, Penobscot Gulf Co.
Steve Lowe, Charlie's Seafood
Mr. & Mrs. Phil Ruhle, F/V Audrey Lynn
James C. Vogel, J.J.V., Inc.
Curt Blinsinger
Mr. & Mrs. Charles Johnson, F/V Powhatan
Ted Malley

Without the data supplied by these individuals we would still be using recorded catch by month and would not have as detailed an understanding of the swordfish fishery as we now have.

PART I

ADDENDUM TO THE SOURCE DOCUMENT FOR THE SWORDFISH FISHERY MANAGEMENT PLAN

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8.1 Description of Stocks

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8.1.2.1 Reproduction

Wilson and Dean (1983) report that males become reproductively active between year 2 (LJFL*=114 cm, dressed weight=12.7 kg; 28 lb) and year 3 (LJFL=126 cm, dressed weight=17 kg; 37.5 lb) with all observed males greater than 3 years old reported as mature. Females become reproductively active between years 4 (LJFL=135 cm, dressed weight=21 kg; 46 lb) and 5 (LJFL=151 cm, dressed weight=28.8 kg; 63.4 lb). These estimates indicate that both males and females reach reproductive maturity at smaller sizes than reported by Berkeley and Houde (1981).

In the South Carolina sample (catches from Jacksonville, FL to Cape Lookout, NC; Wilson and Dean, 1983) all mature fish showed evidence of recent sexual activity or were ripe. Of 109 swordfish captured north of Cape Hatteras (47 males:62 females) none were ripe or showed evidence of sexual activity (C. Stillwell, NMFS, Narragansett, RI; pers. comm.). Beckett (1974) also reports that the vast majority of gonads from fish captured north of Cape Hatteras (35° N Latitude) have been in an inactive or recovery stage. He reports that ripening ovaries have been rarely reported, numbering only 1 or 2 per year.

Wilson and Dean (1983) estimated fecundity for several females with values ranging from 1×10^6 to 2.6×10^7 eggs ready for release. The highest egg estimate was 29×10^6 eggs from a 272 kg (600 lb) female (round weight). Wilson (U.S.C. Baruch Institute, Columbia, SC; pers. comm.) considers females to be continuous pulse spawners with spawning activity occurring primarily during March and April but possibly as late as October. This extended spawning season agrees with Grall et al.'s (1983) observation that swordfish larvae were present in all months.

8.1.2.2 Age and Growth

Wilson and Dean (1983) examined swordfish otoliths to disclose age-associated features. They observed daily growth increments and determined the ages of 210 swordfish. Daily growth increments formed areas characterized as "rapid-growth zones" and "slow-growth zones." These zones were differentiated as translucent or opaque with transmitted light and the number

*LJFL = lower jaw to fork length.

of opaque zones were assumed to correspond to age assuming annual formation of opaque zones during December-February which agrees with annulus formation in spines of swordfish (Berkeley and Houde, 1983) and in sailfish (Jolley, 1977). Age estimates ranged from 5 days to 21 years. The smallest individuals examined and the number of daily increments are as follows:

LJFL (cm)	LJFL (in)	Number of Increments (days)
0.82	0.32	5
2.00	0.79	11
25.50	10.04	53

Estimated growth rates of larval fish indicated very rapid growth rates throughout the first six months (2-6 mm/day; 0.08-0.24 in/day). The following whole weight values are compared with the number of daily increments observed:

Whole Weight (kg)	Whole Weight (lb)	Number of Increments (days)
4.5	10	185
6.4	14	170
7.3	16	180
8.2	18	210

Swordfish less than 9.1 kg (20 lb) round weight (6.8 kg dressed weight; 15 lb) are approximately 6 or 7 months old.

Wilson and Dean (1983) compared their age estimates (based on otoliths) to age estimates from anal spines from the same fish (Berkeley's method). They found no significant differences in the counts (age estimates) for fish less than 6 years old. Age estimates based on spines from older fish, however, gave statistically lower estimates than those based on otoliths. Beyond year class 3, mean lengths at age based on otoliths were less than those based on spines. Wilson, Dean, and Berkeley (pers. comm.) agree that Berkeley's methodology may underestimate age in older fish (age 8) because increasing calcification near the focus obscures inner annulae. Wilson and Dean's (1983) age estimates ranged from 1 to 14 years for males and 2 to 21 years for females. Eighty-five percent of fish beyond 11 years were female, suggesting as Berkeley and Houde (1981) did, that females live longer. A major difference between this more recent study and those conducted by Berkeley and Houde (1980, 1981) was that Wilson and Dean found no significant difference between the growth rates of males and females. They believe that males are subject to differential mortality and die at an earlier age than females. It is important to note, however, that males enter the reproductive stage of their lives at a smaller size and younger age than females. Results from Wilson and Dean's study are compared to Berkeley and Houde's results in Table 1. In comparing these results, Wilson and Dean (1983) suggest that the most important points to consider are that swordfish grow old and that "whether a 200 cm (78.7 in) fish was 8 or 10 years old was not as important as knowing that a 200 cm fish was of middle age which, based on existing data, had been potentially reproductively active for 4 to 6 years."

Based on 1983 weight frequency data from South Carolina (S.C. Wildlife and Marine Resources), 54 percent of the commercial harvest consists of swordfish less than or equal to 18.1 kg (40 lb) dressed weight. In the area north of 35° N, based on a sample of 10,232 carcass weights, 23 percent are less than or equal to 18.1 kg (40 lb) dressed weight. The comparable value for Florida east coast landings (catches from Florida Keys to Cape Canaveral, Florida) based on 17,481 carcass weights is 33 percent. These proportions consist of pre-reproductive females and males some of which may have been reproductively active for the first time. Two and three year old fish predominate in the commercial harvest.

Wilson and Dean's (U.S.C. Baruch Institute, Columbia, SC; pers. comm.) von Bertalanffy parameters for males and females combined are as follows: L_{oo} = 277 cm (109.1 in), K = 0.13, and t_o = -2.83. Berkeley and Houde's (1981) parameter estimates were L_{oo} = 297 cm (116.9 in), K = 0.1054, and t_o = -2.87. A comparison of the parameter estimates from both studies is presented in Table 2. Although parameter estimates for K and t_o appear similar, the estimates for L_{oo} differ by 20 cm (7.9 in). The estimation of L_{oo} in both studies may be influenced by the size range of sampled swordfish, which may also influence the length-weight regressions. In Figure 1, predicted round weight of swordfish is plotted against lengths from 4 different length-weight regressions. Wilson and Dean's (1983) predicted regression line does not correspond well to the other 3 lines producing lower weights at lengths greater than 150 cm (59.1 in) LJFL. The other 3 lines are more similar despite differences in the areas from which the samples were obtained. Whereas Berkeley and Houde's (1980) sample is based on Florida east coast landings, the NMFS-Narragansett regression (Jack Casey, NMFS,

Table 1. Comparison of age and growth results based on otoliths (Wilson and Dean, 1983) and anal spines (Berkeley and Houde, 1981).

Age & Growth - Males and Females Combined

	Wilson and Dean (1983)			Berkeley & Houde (1981)	Wilson and Dean (1983)	Berkeley and Houde (1981)
Estimated Age	Lower Jaw Fork Length	Estimated Round Weight (lb)	Estimated Dressed Weight (lb)	Estimated Dressed Weight (lb)	Dressed Weight Groups (lb)	Dressed Weight Groups (lb)
1	75	11.1	8.3	18.1	18	18
2	114	37.4	28.0	34.2	19-33	19-34
3	126	50.0	37.5	54.0	34-42	35-53
4	135	61,0	46.0	75.2	43-55	54-75
5	151	84.5	63.4	101.0	56-68	76-101
6	158	96.4	72.3	126.0	69-81	102-126
7	170	119.2	89.4	153.0	82-93	127-153
8	180	140.7	106.0	180.0	99-113	154-180
9	188	159.6	119.7		114-139	
10	207	211.0	158.3		140-168	
11	215	236.0	177.0		169-187	
12	223	262.0	196.5		188-237	
13	251	369.0	277.0		238-300	

Table 2. Comparative YPR parameters from two sources.

	BERKELEY & HOUDE (1980, 1981)			WILSON & DEAN (pers.comm.)		
	male	female	combined*** sexes	male	female	combined**** sexes
L_{oo}	217	340	297	155	291	277
t_o	-2.04	-2.59	-2.87	0.42	-3.20	-2.83
K	0.195	0.095	0.1054	0.66	0.10	0.13
b_o			$2.94X10^{-6}$			$1.83X10^{-5}$
b_1			3.2828			2.901
M	0.27	0.14	0.16			0.185*
L'**			130.0 cm			variable (computer run)
$\bar{L}$**			68.0 kg			variable (computer run)
F	0.17	0.19	0.24			
Z			0.40			

$l_t = L_{oo}\ 1 - e^{-K(t-to)}$

$l_t = 297\ 1 - e^{-.1054(t+2.87)}$

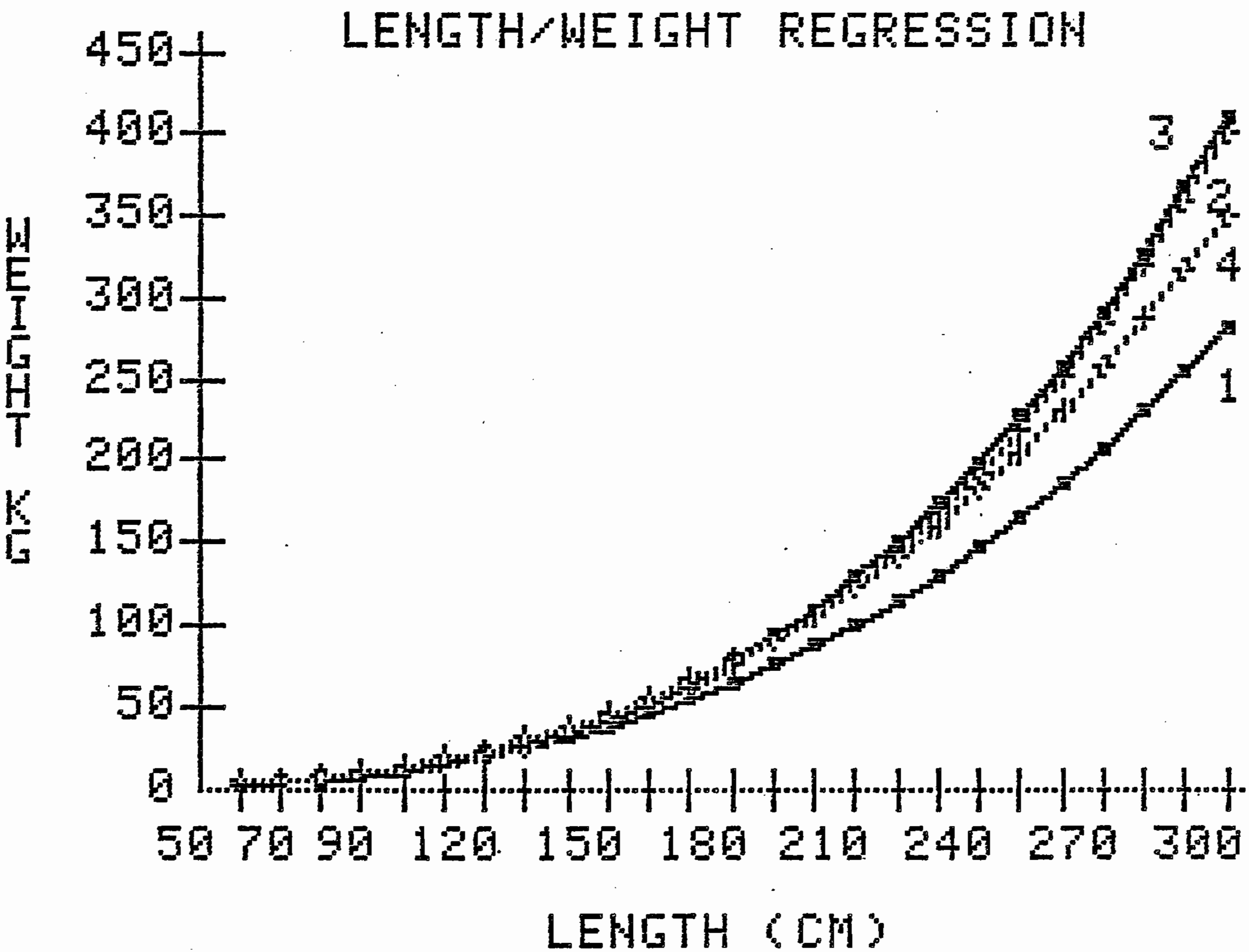
$Wt = .0000026\ l_t^{3.2828}$

*Calculated by John Hoey based on Wilson and Dean's (pers. comm.) K = 0.13 substituted into the equation used by Berkeley and Houde.

**Length and also corresponding weight

***Based on a hypothetical sex ratio of 1:1 at all ages.

****Based on the sex ratio in the sample.



1) WILSON AND DEAN (1983) - S.C.
2) BERKELEY AND HOUDE (1980) - FL.
3) GARCES AND REY (1983) - ICCAT
4) JACK CASEY, NMFS NARR., UNPUBL. DATA

Figure 1. Length-weight regressions for swordfish landed in the western North Atlantic.

Narragansett, RI; unpubl. data) is based on landings north of Cape Hatteras. Both of these western North Atlantic regressions compare favorably with the ICCAT regression from an eastern North Atlantic sample from the Spanish fishery (Garces and Rey, 1983). We believe that Wilson and Dean's (1983) regression (based on a South Carolina sample) predicts lower weights because the sample did not include some of the very large swordfish which are more common in samples from Florida and the area north of Cape Hatteras. This highlights the critical nature of the size ranges represented in the different samples. This is especially important when different L_{oo} values must be evaluated because they are used directly in mortality estimates. Zweifel and Slater (1982) emphasize this consideration and further point out that the von Bertalanffy model produces L_{oo} values which are higher than those produced by the Gompertz (Ricklefs, 1967) growth equation. Utilizing Berkeley and Houde's (1981) data, Zweifel and Slater (1982) state that the female L_{oo} of 339 cm (133.5 in) predicted by the von Bertalanffy model is too large. Based on the Gompertz equation, Zweifel and Slater (1982) derive an L_{oo} of 262.6 cm (103.4 in) for females, which they maintain compares favorably with a length of 236 cm (92.9 in) corresponding to a largest fish weight of 181.4 kg (400 lb). This female L_{oo} (263 cm) is very close to Wilson and Dean's (USC Baruch Institute, Columbia, SC; pers. comm.) L_{oo} (277 cm; 109.1 in) for males and females combined. L_{oo} values for males and females combined are intermediate between L_{oo} values for females only and males only. This would lead us to believe that the Gompertz equation would predict an L_{oo} for males and females combined lower than that predicted by Wilson and Dean (probably less than 240 cm; 94.5 in). We believe that Wilson and Dean's L_{oo} value of 277 cm is low because the South Carolina sample does not adequately reflect the larger fish in the population which are more common along the Florida east coast and in the area north of Cape Hatteras. Zweifel and Slater (1982) raise valid concerns about the different values produced by the Gompertz versus the von Bertalanffy models. We feel however that their Gompertz L_{oo} value (262 cm) is also too low based on reported capture weights of swordfish in the western North Atlantic. By way of explanation, a 262 cm (103.1 in) swordfish would weigh approximately 257 kg (567 lb based on Berkeley and Houde's regression which would yield a dressed carcass weight of 192.8 kg (425 lb). In 1979, 38 out of 7,985 (0.5 percent) swordfish landed along the east coast of Florida, exceeded 181.4 kg (400 lb) dressed weight. In 1980, 77 out of 14,837 (0.5 percent) exceeded 181.4 kg (400 lb) dressed weight. Maximum dressed carcass weights reported in landings data from different areas in the western North Atlantic are listed in Table 3. Therefore fish exceeding the dressed weight corresponding to Zweifel and Slater's (1982) L_{oo} are captured in the fishery. If L_{oo} represents the length that an average swordfish would achieve if it continues to live and grow indefinitely (Ricker, 1975 - p 221 citing Fabens, 1965), maximum sizes recorded in the landings data and published literature should be considered when L_{oo} estimates are evaluated. The maximum dressed carcass weight in S.C. landings (1981 -393.7 kg; 868 lb) is double Zweifel and Slater's (1982) predicted dressed carcass weight corresponding to L_{oo}. The IGFA all tackle record for swordfish is 536 kg (1,182 lb) or approximately 402 kg (886 lb) dressed (Pacific Ocean). Beckett (1974) reports a swordfish landed in Cape Breton, Nova Scotia which weighed 415.0 kg (915 lb) dressed, approximately 550 kg (1,213 lb) round weight. Both of these maximum values are also double the size corresponding to Zweifel and Slater's (1982)L_{oo}.

In subsequent calculations we have chosen an L_{oo} for males and females combined of 297 cm (116.9 in). Rounding this value to 300 cm (118.1 in) would produce round weights of between 350 - 400 kg (771.6 -881.8 lb) (based on the particular length-weight regression used, Berkeley & Houde or NMFS-NARR) which would correspond to dressed weights of between 262.2 and 299.8 kg (578 and 661 lb). We feel that this range is more realistic for L_{oo} based on the rather frequent occurrence of dressed weights exceeding 181.4 kg (400 lb) (Zweifel & Slater's L_{oo}) and maximum sizes which exceed 362.9 kg (800 lb) dressed weight.

8.1.2.3 Mortality

The reliability of mortality estimates derived from any of the available procedures (Beverton & Holt, 1956; Robson and Chapman, 1961; Ssentongo & Larkin, 1973; Pauly, 1980) is critically dependent on the choice of the numerical input values for L_{oo}, $\bar{L}$, L' , and K. As noted in the previous section, there are a number of choices for L_{oo} alone. We believe that L_{oo} = 297 cm (116.9 in) for males and females combined represents a reasonable choice. Of the remaining values ($\bar{L}$, L', and K) the choice of L' is very important because it then establishes the value of $\bar{L}$. Once these values are chosen different values of K can be easily compared. L' represents the length of the smallest fish fully represented in the sample while $\bar{L}$ represents

Table 3. Maximum dressed carcass weights reported in landings data from different areas in the western North Atlantic.

	Canada[1]		Florida East Coast[2]		South Carolina[3]		North of North Carolina[4]	
Year	kg	lb	kg	lb	kg	lb	kg	lb
1959	260.8	575						
1960	215.5	475						
1961	226.8	500						
1962	238.1	525						
1963	294.8	650						
1964	215.5	475						
1965	272.2	600						
1966	351.5	775						
1967	340.2	750						
1978					193.7	427		
1979			238.1	525	196.0	432		
1980			265.4	585	256.3	565	261.3	576
1981					393.7	868		
1982					264.0	582		
1983			297.6	656	272.6	601	240.4	530

1. Beckett and Tibbo (1968)
2. Data volunteered by dealers
3. Data from the Division of Marine Resources, South Carolina Wildlife and Marines Resources Department
4. Data volunteered by dealers and individual vessel operators

the average length of fish caught greater than L'. L' and $\bar{L}$ measurements refer to lower jaw fork length (LJFL) in cm. In practice L' is usually chosen based on the modal size from either length or weight histograms. Berkeley and Houde (1981) specified L' = 130 cm (51.2 in) for males and females combined. This length corresponds to a round weight of approximately 25.6 kg (56.4 lb) or a dressed carcass weight of 19.1 kg (42 lb). We note however that the mode of the 10 lb weight frequencies for Florida east coast landings for 1979 (N = 7,985) and 1980 (N = 14,837) occurs in the 31-40 lb group. Whereas the 31-40 lb group represented the mode in the 1979 South Carolina landings, in 1980 the 41-50 lb group was the mode. In a sample of 15,358 swordfish landed north of 35° N in 1980, the 21-30 lb group represented the mode. We believe that for the years 1979 and 1980 the L' was in all likelihood between 120 cm and 130 cm (47.2-51.2 in) corresponding either to the 31-40 or 41-50 lb dressed weight groups. We note, however, that based on 1983 landings data from South Carolina (N= 12,229) the mode has decreased to the 21-30 lb dressed weight group. That group also represents the mode in a sample of 10,232 swordfish landed north of 35° N in 1983, and in a sample of 17,481 swordfish landed along Florida's east coast in 1983. This implies a decrease in the age liable to capture from 1979-80 to 1983 which may have resulted from increased effort on small fish or a change in gear or fishing strategy which has increased the vulnerability of smaller fish. Based on conversations with commercial fishermen and equipment dealers, the size and type of hooks used has changed from large mustad shark hooks to large (#42 or #40) and then progressively to smaller (#38 or #36) Japanese style hooks. Increased competition and congestion on the longline grounds now forces many operators to fish in less than optimal areas where they report increased catches of the less desirable, smaller fish. This decrease in age liable to capture could also reflect the occurrence of a dominant year class. In either case, if we assume swordfish in the 21-30 lb weight group are fully represented in the sample, L' for 1983 is between 101 cm (39.8 in; dressed weight 20 lb) and 116 cm (45.7 in; dressed weight 30 lb). Caddy (1976) suggested a size at first capture for the longline fishery of 80 cm (31.5 in). In subsequent calculations we have chosen to calculate mortality rates for three different L' values corresponding to 100 cm (39.4 in; dressed weight = 20 lb), 116 cm (45.7 in; dressed weight = 30 lb), and 130 cm (51.2 in; dressed weight = 42 lb). Corresponding $\bar{L}$ will then reflect the average lengths of all fish greater than 20 lb, greater than 30 lb, and greater than 40 lb. Calculations will also use Berkeley and Houde's (1981) K = 0.1054 and Wilson and Dean's (USC Baruch Institute, Columbia, SC; pers. comm.) K = 0.13. Calculations will utilize frequency distributions for 1980 and 1983 from different areas. In all cases L_{∞} = 297 cm (116.9 in). L' values (LJFL-cm) correspond to weight groups for the 21-30, 31-40, and 41-50 lb increments. $\bar{L}$ values are derived by calculating the average weight of all swordfish carcasses greater than 20 lb, greater than 30 lb, and greater than 40 lb. That average weight value is then converted to whole weight (dressed weight X 1.333) and the length corresponding to that weight ($\bar{L}$) is determined from Berkeley and Houde's length-weight regression. Z values derived from calculations based on the different input parameters (L', $\bar{L}$, K) previously described are listed in Table 4.

Berkeley and Houde (1981) estimated natural mortality rates (M) based on Pauly's (1980) relationship between natural mortality, growth parameters and mean environmental temperature. Utilizing a mean environmental temperature of 15°C and K = 0.1054 they estimated M = 0.16 for both sexes combined. We used that same relationship but substituted Wilson and Dean's (pers. comm.) K = 0.13 and a mean environmental temperature of 20 °C (Hoey and Casey, 1983a) to derive estimates of M which ranged between 0.17 and 0.20.

8.1.3 Ecological Relationships

8.1.3.1 Larval Ecology

8.1.3.2 Food-Chain Relationships

Stillwell and Kohler (1983) analyzed stomach contents of 182 swordfish (162 contained food - 89 percent) caught from off Cape Hatteras, North Carolina to the Tail of the Grand Banks of Newfoundland. Cephalopods (squids) were the dominant food item (82 percent by frequency of occurrence) followed by fish (53 percent) consisting primarily of gadids, scombrids, butterfish, bluefish and sand lance. Table 5 (from Stillwell and Kohler, 1983) lists the families and species of prey represented in the stomach samples and it documents the considerable diversity in the swordfish diet which includes near surface, demersal, and mesopelagic species. Cephalopod dominance was not documented in earlier reports from the same general area (Goode, 1883; Rich, 1947; Bigelow and Schroeder, 1953; Tibbo et al., 1961; Scott and Tibbo, 1968; Beckett, 1974). Although these studies represent a mix of qualitative

Table 4. Input parameters (L', $\bar{L}$, L_{∞}, K) and derived mortality rates (Z values*) for 1980 and 1983 samples from the east coast of Florida, South Carolina, and ports located north of 35° N.

REGION	YEAR	NUMBER OF CARCASSES	L_{∞}(cm)	K	L'(cm)	$\bar{L}$(cm)	Z
FLORIDA EAST COAST	1980	14,837	297	.13	100	168	.2466
					116	171	.2978
					130	177	.3319
				.1054	100	168	.2000
					116	171	.2415
					130	177	.2691
	1983	17,737	297	.13	100	166	.2580
					116	172	.2902
					130	177	.3319
				.1054	100	166	.2092
					116	172	.2353
					130	177	.2691
SOUTH CAROLINA	1980	3,598	297	.13	100	156	.3273
					116	158	.4302
					130	165	.4903
				.1054	100	156	.2654
					116	158	.3488
					130	165	.3975
	1983	12,229	297	.13	100	154	.3443
					116	163	.3706
					130	174	.3634
				.1054	100	154	.2791
					116	163	.3005
					130	174	.2946
NORTH OF 35°N	1980	15,358	297	.13	100	165	.2640
					116	169	.3140
					130	173	.3749
				.1054	100	165	.2140
					116	169	.2546
					130	173	.3039
	1983	9,172	297	.13	100	168	.2466
					116	172	.2902
					130	177	.3319
				.1054	100	168	.2000
					116	172	.2353
					130	177	.2691

*The coefficient of mortality, Z, was derived from Beverton and Holt's (1956) formula:

$$Z = \frac{K(L_{\infty} - \bar{L})}{\bar{L} - L'}$$

Table 5. List of prey species or family groups occurring in 182 swordfish stomachs from the western North Atlantic (1975-81) by number, volume, and frequency of occurrence. (Source: Stillwell and Kohler, 1983.)

	Number	% No.	Vol. (ml)	% Vol.	Frequency	% Frequency
Cephalopoda						
Ommastrephidae	626	27.95	24,422	20.70	52	28.57
Illex illecebrosus (short-finned squid)	665	29.69	30,036	25.46	48	26.37
Gonatidae	13	0.58	12	0.01	5	2.75
Octopoteuthidae	19	0.85	301	0.26	4	2.20
Histioteuthidae	3	0.13	7	0.01	3	1.65
Onychoteuthidae	30	1.34	163	0.14	2	1.10
Sepiolidae	9	0.40	2	0.00	2	1.10
Octopoda	3	0.13	2	0.00	2	1.10
Loligo pealei (long-finned squid)	3	0.13	60	0.05	1	0.55
Thysanoteuthidae	4	0.18	1	0.00	1	0.55
Chiroteuthidae	2	0.09	1	0.00	1	0.55
Architeuthidae	1	0.04	1	0.00	1	0.55
Unidentified Cephalopoda	467	20.85	24,423	20.70	56	30.77
Teleosts						
Merluccius bilinearis (silver hake)	72	3.21	11,126	9.43	11	6.04
Scomber scombrus (Atlantic mackerel)	25	1.12	6,385	5.41	9	4.94
Gadidae (codfishes)	16	0.71	3,090	2.62	6	3.30
Pomatomus saltatrix (bluefish)	10	0.45	4,735	4.01	5	2.75
Ammodytes americanus (sand lance)	18	0.80	195	0.16	5	2.75
Peprilus triacanthus (butterfish)	55	2.46	1,800	1.53	3	1.65
Cubiceps athenae (bigeye cigarfish)	6	0.27	750	0.64	3	1.65
Gempylidae (snake mackerels)	10	0.45	234	0.20	3	1.65
Stromateidae (butterfishes)	5	0.22	65	0.06	3	1.65
Myctophidae (lanternfishes)	4	0.18	18	0.02	3	1.65
Alepisauridae (lancetfishes)	2	0.09	615	0.52	2	1.10
Brevoortia tyrannus (Atlantic menhaden)	2	0.09	574	0.49	2	1.10
Paralepis atlantica (duckbill barracudina)	4	0.18	310	0.26	2	1.10
Scopelosauridae	4	0.18	51	0.04	2	1.10
Nemichthys scolopaceus (snipe eel)	4	0.18	20	0.02	2	1.10
Sebastes marinus (redfish)	8	0.36	2,775	2.35	1	0.55
Scorpaenidae (scorpionfishes)	1	0.04	400	0.34	1	0.55
Clupea harangus (Atlantic herring)	1	0.04	200	0.17	1	0.55
Hyperoglyphe perciformis (barrelfish)	1	0.04	95	0.08	1	0.55
Cottidae (sculpins)	1	0.04	15	0.01	1	0.55
Unidentified teleosts	123	5.49	4,914	4.16	41	22.53
Miscellaneous						
Animal remains	2	0.09	190	0.16	2	1.10
Salpidae	4	0.18	1	0.00	1	0.55
Nematoda	17	0.76	1	0.00	1	0.55
Total	2,240		117,990			

and quantitative studies, they generally reported a higher utilization of various fish species. Toll and Hess (1981) report a similar cephalopod dominance in the stomachs of swordfish sampled in the Florida Straits. Stillwell and Kohler (1983) hypothesize that the current dietary importance of cephalopods reflects their steadily increasing abundance (Illex sp. in particular) along the continental margin from Cape Hatteras to the Gulf of Maine. Lange (1982) has documented an increase in estimated biomass of Illex sp. from 1,845 to 68,611 metric tons between 1968 and 1981. Within the teleost category, the silver hake (Merluccius bilinearis) provided the largest single species component. Stillwell and Kohler (1983) report an overall average food volume of 648 milliliters corresponding to approximately 1.1 percent of the average body weight (58 kg; 127.9 lb). Daily ration was estimated to range from 0.585 kg (1.0 percent body weight) to 0.993 kg (1.7 percent body weight) with yearly food consumption ranging from 214 to 363 kg (471.8 -800.3 lb).

Examinations of stomach contents revealed that swordfish engulfed whole food items, as well as slashed and maimed a variety of prey types before ingesting them. Approximately 25-30 percent of the squid with mantle lengths of 7-25 cm (2.8 - 9.8 in) that were found in the stomachs were decapitated or showed slash marks across the mantle. Lancetfish, redfish, and many mesopelagics were either cut in two or had been slashed (Stillwell and Kohler, 1983).

8.1.3.3 Predator-Prey Relationships

Recent studies have increased our understanding of intraspecific and interspecific relationships of swordfish. Intraspecific relationships of swordfish were investigated by Hoey and Casey (1983a) through the analysis of spatial statistics for four size groups of swordfish: very small less than 9 kg (19.8 lb); small 9.1 - 33.6 kg (20.1 - 74.1 lb); medium 34-68 kg (75.0 - 149.9 lb); and large greater than 68 kg (> 149.9 lb). Results document size stratification on the longline grounds with distinct central moments for each size group. Central moments are the average location parameters (latitude and longitude) for the different size groups of swordfish caught in each season. They are calculated by weighting each latitude and longitude by the numbers of swordfish in each group. In all seasons, the central moment of the largest size group occurs further north and east of the central moments of the smaller size groups. These results should not be interpreted as indicating complete size segregation but only a strong tendency within the population for larger fish to predominate in colder water. In terms of fishing practices, these results and additional analyses of swordfish catches correlated with surface water temperature data indicate that fishermen could probably reduce the proportion of small swordfish caught through focusing effort in the coldest water available. The mean weight of 7,181 swordfish caught where surface temperatures were below 20°C was 52 kg (114.6 lb) and only 26.3 percent were less than 34 kg (75.0 lb). The mean weight of 4,784 swordfish caught where surface temperatures were above 20°C was 34 kg and 61 percent were less than 34 kg (Hoey and Casey, 1983a).

In terms of interspecific relations, similarities in temporal and spatial distribution patterns between swordfish and other species susceptible to pelagic longline gear were analyzed by forming recurrent species groups based on abundance correlation values (Hoey, 1983). Swordfish were closely associated with blue and mako sharks in areas north of Cape Hatteras, and with hammerhead and blacktip sharks in the Gulf of Mexico and Atlantic south of Cape Hatteras. Associated species which share similar ecological preferences and distribution patterns, naturally compete for available food resources and may prey upon one another. Competition for food may not be important in a limiting sense because of the dietary diversity and opportunistic feeding habits of these large predators (swordfish, tuna, sharks, billfish). The Swordfish Source Document (SAFMC, 1982) notes that larval and juvenile swordfish are preyed upon by competing species and larger swordfish. Stillwell and Kohler (1983) cite several previous reports on mako shark feeding habits, which document the occurrence of large volumes of swordfish flesh in the stomachs of makos. In their study, two stomachs from the largest makos examined contained swordfish remains. Twenty six kilograms (57.3 lb) of swordfish were found in the stomach of a 158 kg (348.3 lb) mako.

8.1.3.4 Movement Patterns

8.1.3.4.1 Horizontal and Vertical Movements

An analysis of spatial statistics for 4 size groups of swordfish (Hoey and Casey, 1983a), revealed seasonal shifts in the central moments of each group consistent with a dominant north-south component to the annual migrations. Hoey and Casey (1983a) report that New England longline effort concentrates along the edge of the shelf and along frontal zones between water masses. Previous reports document this effort distribution pattern throughout the range of the U.S. swordfish fishery. Assuming that the prevalent effort distribution pattern reflects economic forces which have sought maximization of catch rates, then swordfish are apparently restricted to a rather narrow horizontal zone.

Dr. Frank Carey (Woods Hole Oceanographic Institute) has continued his sonic tracking work with swordfish (Carey and Robison, 1981). Subsequent experiments have shown that vertical movements of swordfish tagged in oceanic waters near the edge of the continental shelf appear to correspond to vertical movements of the deep scattering layer. Vertical movements of swordfish tagged beyond the edge of the shelf appear to be related to light intensity (Casey et al., 1982).

8.1.3.4.2 Migrations

As previously mentioned, analysis of spatial statistics revealed seasonal shifts in the central moments for the different size groups of swordfish which were consistent with a dominant south-north migration (Hoey and Casey, 1983a). The central moments for the largest size group (swordfish greater than 68 kg; 149.9 lb) occurred further north and east of the central moments for the smaller size groups in all seasons. Central moments for all groups are located the furthest south during the winter season and the furthest north during the summer season. This north-south migration would typify a response to seasonal warming of the surface waters. The apparent rate of movement of the central moments ranged between 5.3 and 18.3 km/day (3.3 -11.4 mi/day) with an overall average of 12.6 km/day (7.8 mi/day). The apparent rate of movement can be used as an index of relative speed along the dominant migration axis. It indicates the rate of progression of the population rather than the speed of an individual involved in its normal activity. The calculated values were well within the swimming speed values presented by Carey and Robison (1981).

The preceding should not be interpreted as indicating that the whole population participates in long range migrations. Some elements of the population occur year-round in specific areas. Different age groups in the population may migrate differently as has been noted for tuna (Nakamura, 1969). Large female swordfish participate in a reproductive migration predominantly along a north-south axis either along the Gulf Stream or further offshore, presumably seeking water optimal for larval survival.

Young swordfish are limited in their ability to travel because of their small size, and migrate relatively short distances (again, along a north-south axis) in response to temperature and feeding preferences. Intermediate sized fish (males and females) are capable of longer migrations, motivated primarily by the search for food on either a north-south or inshore-offshore axis. Intermediate sized fish may overwinter in the Gulf Stream or along its northern boundary and move onto the shelf as seasonal warming occurs, agreeing with the idea of hypothetical local "races" or "sub-stocks" as described by Caddy (1976). It may be more appropriate to consider these groups "changing resident populations," thereby avoiding the genetic basis of "races" and "sub-stocks" which cannot be substantiated at this time. The inshore-offshore pattern in response to seasonal warming would account for seasonal changes in availability to the commercial fishery, which concentrates along the edge of the shelf. The preceding is consistent with the generalization that temperature sets limits of total species range, and food supply determines distribution within the range limits (Blackburn, 1969).

8.1.4 Stock Definition

Hoey and Casey (1983a) noted a continuous distribution of swordfish from Cape Hatteras to the Tail of the Grand Banks during the summer. They examined capture locations for over 25,000 swordfish and compared their data to data from the Florida fishery. They maintained that there was no evidence to indicate any stock breaks between the Gulf of Mexico and the entire east coast of the U.S. and Canada. In terms of the Atlantic Ocean, the recent NMFS stock assessment workshop (Powers, 1982) still recognized the three distinct seasonal concentrations (described in the May 1982 Swordfish Source Document) which suggest three populations in the Atlantic Ocean. Clear-cut dividing lines between the seasonal concentrations of swordfish were not apparent. The widespread distribution of swordfish throughout the Atlantic Ocean, and the lack of any clear divisions between the presumed populations, implies the possibility of considerable interchange between these groups. Despite large active fisheries in the western and eastern North Atlantic, there have been no trans-Atlantic tag recaptures for swordfish. There have been a number of trans-Atlantic recaptures reported for blue sharks and two trans-Atlantic blue marlin recaptures have also been documented. This would add credibility to the assumption of a distinct stock of swordfish in the western North Atlantic. The NMFS stock assessment workshop (Powers, 1982) has recommended that various stock structure hypotheses be examined in conjunction with all stock assessment work on swordfish. The similarities between the length-weight regressions from the western and eastern North Atlantic probably reflect similarities in genetically constrained growth patterns. These similarities should not be used at this time to substantiate a single North Atlantic stock.

8.1.5 Abundance, Historical Fluctuations, and Present Condition

The Canadian fishery reopened once the U.S. mercury restrictions were relaxed in 1978. The Canadian fishery operates under both a quota restriction (3,500 tons; 7 million lb) and an effort restriction (only 65 vessels). Based on data provided by F. Gregory Peacock (Fisheries Operations Branch, Canadian Department of Fisheries and Oceans, Halifax, Nova Scotia; pers. comm.) the following estimates can be derived. In 1981, Canadian effort of approximately 1.1 million hooks produced 1.3 million kg (2.9 million lb) of swordfish. In 1982, approximately 2.4 million hooks produced 2.7 million kg (6.0 million lb), while in 1983, 2.4 million hooks produced 2.2 million kg (4.9 million lb) of swordfish. Estimates of the total Canadian harvest for 1981 ranged from 1.3 to 1.8 million kg (2.9-3.9 million lb), for 1982 estimates ranged from 2.1 to 2.8 million kg (4.6-6.2 million lb), and for 1983 the point estimate was 2.2 million kg (4.9 million lb). These estimates were derived from expanding 1981 and 1982 logbook records from landings data from a 15-20 percent sample of the Canadian fleet. The 1983 estimates were based on records from a 25 percent sample. In terms of catch rates, measured as both kg landed per day and kg landed per 100 hooks, values for 1981 were the highest and they progressively declined through 1983. Individual set records from Canadian log books for 1982 and 1983 (June-September) indicate that mean size and mean pounds caught per 100 hooks has also declined. The trans-shipment of Canadian caught swordfish carcasses at sea to U.S. vessels to circumvent FDA mercury restrictions is a continuing problem which would bias some of the Canadian and U.S. data. Because this practice is almost impossible to control, Canadian and U.S. data, especially weight frequency information, should be combined to get a more accurate portrayal of the swordfish fishery north of Cape Hatteras.

Hoey and Casey (1983a) analyzed catch and effort data from 1,588 sets of New England style swordfish gear from 1963 through 1982. Effort exceeded 1.8 million hooks and accounted for the capture of 25,914 swordfish and 61,748 sharks and other teleosts. These data compliment the data on New England longline effort presented in the May 1982 Swordfish Source Document Appendix B (approximately 500 sets). Most of the data were provided by a single captain who operated two different vessels. The authors realized that this limited the generality of conclusions which could be drawn about stock status; however, they felt that the records represented a continuous record of standard effort and could be used to investigate changes in relative abundance in the area exploited by the U.S. swordfish fishery, especially along the edge of the shelf north of Cape Hatteras. The extrapolation of these data to the entire stock must take into account the limited nature of this data set both in terms of area and the fact that these records are from one captain.

A second data set included the fisherman's estimated dressed weights of swordfish caught on each set, classified into 14 weight groups with both sexes combined. Dressed weights were recorded for 14,064 swordfish caught on 659 sets from 1970 through 1982. These data were used to examine size stratification on the longline grounds, regional and seasonal differences in mean size, and changes in mean size over time.

Catch per unit effort (CPUE), the number of fish caught per 100 hooks, was calculated for each individual set. Because of non-normal characteristics of the CPUE values, the individual set values for CPUE were rank-transformed (Conover and Iman, 1981) and nonparametric statistical procedures were used for CPUE comparisons.

Estimates of the total weight landed per set were obtained by multiplying the number of swordfish in each weight group by the central weight value, or class mark, of that group and then summing over all groups. Average weights by set, year and region, etc. were obtained by dividing the total estimated weight caught by the total number of swordfish in all groups. The average weight landed per hundred hooks (CPUE-WT) was calculated by dividing the estimated total weight landed for a set by the total hooks from that set and multiplying by 100. Individual set values for CPUE-WT were averaged to provide $\bar{X}$ CPUE-WT.

The overall distribution of effort (numbers of sets by one degree quadrangles of latitude and longitude) is shown in Figure 2 while Table 6 lists the number of sets and the number of hooks fished along with the number of swordfish caught by region and year. Data are available for 17 years between

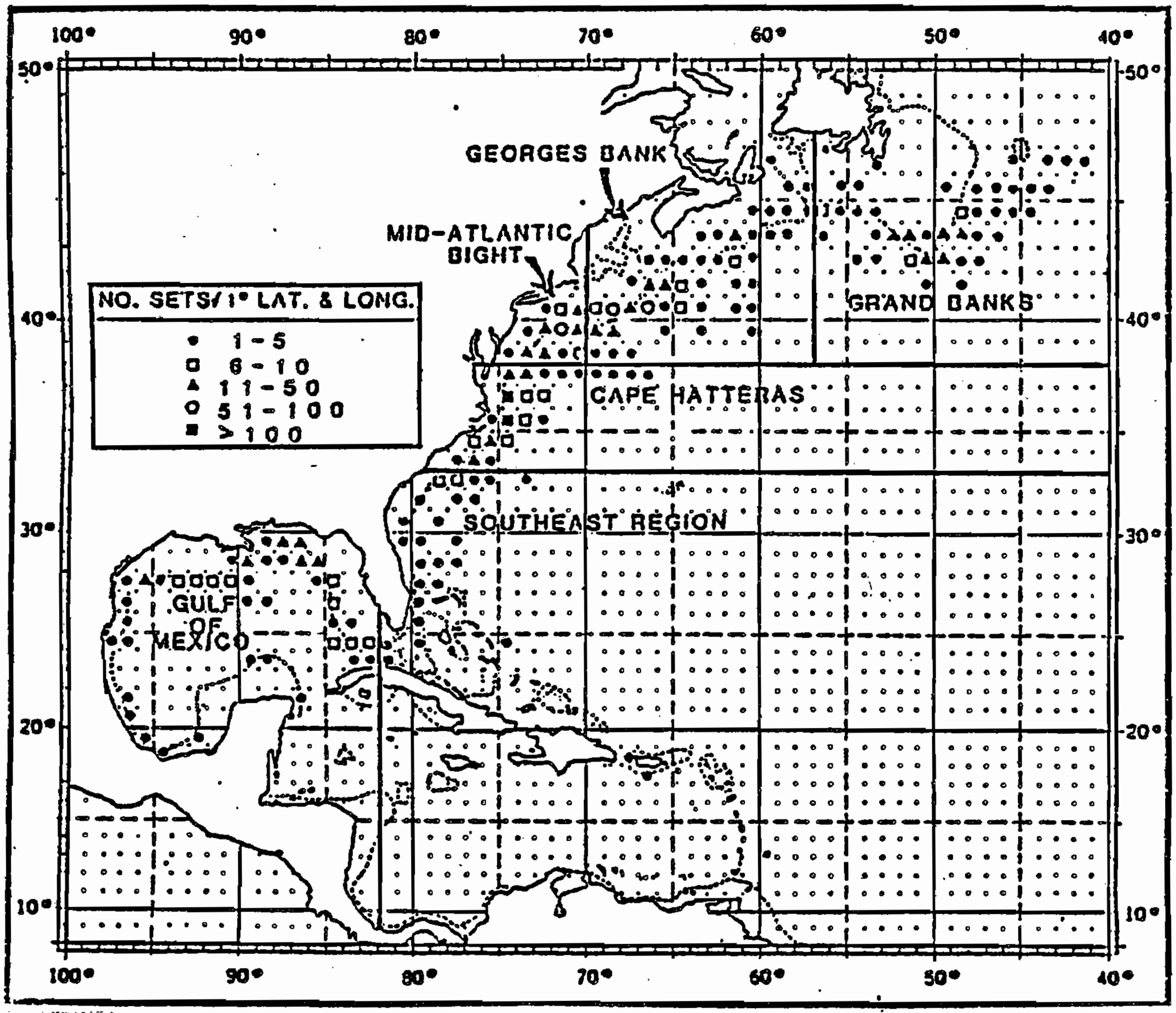


Figure 2. Geographical distribution of swordfish effort for 1,588 sets from 1963 through 1982. Numbers of sets by 1° quadrangles of latitude and longitude (Source: Hoey and Casey, 1983a).

Table 6. Effort totals (sets and hooks) and the number of swordfish caught listed by year and region (Source: Hoey and Casey, 1983a).

Regions	Effort/ Catch	1963	1964	1965	1966	1968	1970	1971	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	Regional Total
		Years																	
Grand Banks	Sets									1	15	7	11	17	31	39	39	38	198
	Hooks									1,680	29,310	10,320	20,390	32,640	55,645	59,591	59,318	48,662	317,556
	Swordfish									15	736	98	277	546	811	917	707	825	4,932
Georges Bank-Scotian Shelf	Sets	5	40	25	27	22	1		27	21	37	43	21	28	16	2	31	26	372
	Hooks	1,860	35,977	26,415	36,869	32,269	850		40,831	36,280	48,905	59,944	31,820	43,940	19,870	2,400	48,877	34,163	501,270
	Swordfish	26	370	305	299	214	0		1,388	1,317	558	763	371	646	151	20	312	231	6,971
Mid-Atlantic	Sets	8	29	20	20	30	21		6	13	9	1	6	24	8	3		7	205
	Hooks	3,060	23,835	19,842	24,357	35,075	27,582		5,347	12,786	5,820	240	3,320	36,225	5,765	720		4,661	208,635
	Swordfish	25	251	124	142	386	557		47	101	34	0	12	612	78	0		29	2,398
Hatteras	Sets	2	43	79	58	15	3		1	14	25	26	22	33	54	25	37	31	468
	Hooks	795	30,025	67,740	61,258	17,943	3,460		1,375	17,410	27,507	24,190	26,880	49,275	49,055	21,514	31,107	34,051	463,585
	Swordfish	10	603	1,044	572	245	53		93	539	232	131	728	1,383	532	154	196	174	6,689
S.E. Region	Sets			2							3	21		1	14	14	11	1	67
	Hooks			800							680	23,660		1,665	13,800	17,834	9,829	1,152	69,420
	Swordfish			5							0	254		50	79	214	71	4	677
Gulf of Mexico	Sets						89	10	6	54	44				23	48	4		278
	Hooks						95,012	11,915	7,019	76,173	32,655				30,714	66,537	3,203		323,228
	Swordfish						1,150	128	62	1,460	215				613	608	11		4,247
Total	Sets	15	112	126	105	67	114	10	40	103	133	98	60	103	146	131	122	103	1,588
	Hooks	5,715	89,837	114,797	122,484	85,287	126,904	11,915	54,572	144,329	144,877	118,354	82,410	163,745	174,849	168,596	152,334	122,689	1,883,694
	Swordfish	61	1,224	1,478	1,013	845	1,760	128	1,590	3,432	1,775	1,246	1,388	3,237	2,264	1,913	1,297	1,263	25,914

1963 and 1982 (no data for 1967 and 1969) with 11 years represented by more than 100 individual sets. Table 7 lists the numbers of swordfish, $\bar{X}$ dressed weights and $\bar{X}$ CPUE-WT by region and season.

The following paragraphs are taken from the results and discussion sections in Hoey and Casey's (1983a) manuscript. While it is recognized that this data set is primarily from one fishermen, this represents very valuable information. The trends indicated and conclusions drawn should not be extrapolated to the entire stock in the western North Atlantic without appropriate qualification with respect to the limited area of coverage and possible biases due to only having the records of primarily one captain. It may however be an accurate indication of the catch rates and average sizes in the area north of Cape Hatteras and the trends may be further substantiated as supporting data become available.

Results

Yearly trends may provide valuable information about the status of a fishery. An analysis of variance on rank transformed CPUE values indicates that effects of year on CPUE are significant. Multiple range tests indicate that mean CPUE ranks for the years 1979 through 1982 are all located in the lower half of the ordered (highest to lowest CPUE rank) 17-year array. Trends within a specific region may reflect relative abundance over a smaller seasonal time period in a reduced area (Figure 3). Regional effort has a high degree of consistency because the records are primarily from a single fishing vessel. When mean yearly CPUE ranks are compared within regions, the results from an ANOVA indicate that effects of year on CPUE are significant for all regions except the Southeast. In the Southeast region, catch rates were available for only 8 years and mean yearly CPUE values were based on small sample sizes (N less than or equal to 3 for 4 years). In the Gulf of Mexico, mean yearly CPUE ranks for 1980 and 1981 are 6th and 7th in the ordered (highest to lowest) 8-year array, significantly lower than values from the 1970s. In the Georges Bank-Scotian Shelf, Mid-Atlantic, and Cape Hatteras region, mean CPUE ranks for the years 1979 through 1982 are all located in the bottom half of each region's array of yearly CPUE ranks. In the Grand Banks regions, yearly CPUE ranks for 1982, 1981 and 1979 were 2nd, 3rd and 4th in the array behind the top value for 1975. These high catch rates explain the increased importance of and reliance on Grand Banks effort as catches have decreased in other areas in recent years.

Table 7. Number of swordfish, average dressed weight (kg), and $\bar{X}$ weight-CPUE (kg/100 hooks) by region and year (Source: Hoey and Casey, 1983a).

Region	Grand Banks Region			Georges Bank-Scotian Shelf Region			Mid-Atlantic Region			Hatteras Region			Southeast Region			Gulf of Mexico			Yearly totals All Regions		
Year	Swordfish N	$\bar{X}$-WT	$\bar{X}$-WT CPUE	Swordfish N	$\bar{X}$-WT	$\bar{X}$-WT CPUE	Swordfish N	$\bar{X}$-WT	$\bar{X}$-WT CPUE	Swordfish N	$\bar{X}$-WT	$\bar{X}$-WT CPUE	Swordfish N	$\bar{X}$-WT	$\bar{X}$-WT CPUE	Swordfish N	$\bar{X}$-WT	$\bar{X}$-WT CPUE	Swordfish N	$\bar{X}$-WT	$\bar{X}$-WT CPUE
1970							371	23.8	36.9	41	23.9	26.7				308	36.0	35.2	720	29.0	35.3
1971																115	30.1	29.2	115	30.0	29.2
1972																					
1973				924	36.4	115.8	42	39.0	40.5										966	36.5	106.0
1974	15	40.9	36.5	1279	45.7	156.2	17	37.9	17.9	484	28.5	88.4							1795	40.9	123.8
1975	721	58.7	144.7	534	54.0	62.0	28	40.1	29.4	207	44.7	38.7				161	31.7	22.5	1651	52.5	65.4
1976				133	54.8	78.3				65	39.9	15.2	212	36.8	37.7				410	43.1	38.1
1977	278	64.1	87.2	320	62.5	69.5	11	55.6	36.4	597	27.2	66.7							1206	45.3	72.2
1978	524	62.3	106.3	385	42.9	56.7	420	32.4	47.1	440	32.7	67.9							1769	43.6	69.5
1979	499	62.0	101.6	12	34.3	28.6				107	44.7	34.0	66	43.2	22.3	556	41.1	75.0	1240	49.8	65.7
1980	897	54.0	79.2	19	40.2	[illegible]				135	31.7	22.7	178	30.5	32.8	537	32.8	28.8	1766	43.4	48.3
1981	682	48.9	53.9	305	46.4	30.4				177	41.1	26.2	56	30.1	29.5	10	21.5	7.5	1230	46.1	37.3
1982	800	44.5	80.2	217	42.8	27.1	26	30.1	28.1	151	55.7	31.3	2	35.4	5.9				1196	45.3	50.4
Regional Totals	4416	54.8	84.6	4128	45.9	68.8	915	29.8	38.8	2404	34.1	39.6	514	34.7	30.9	1687	35.8	36.2			

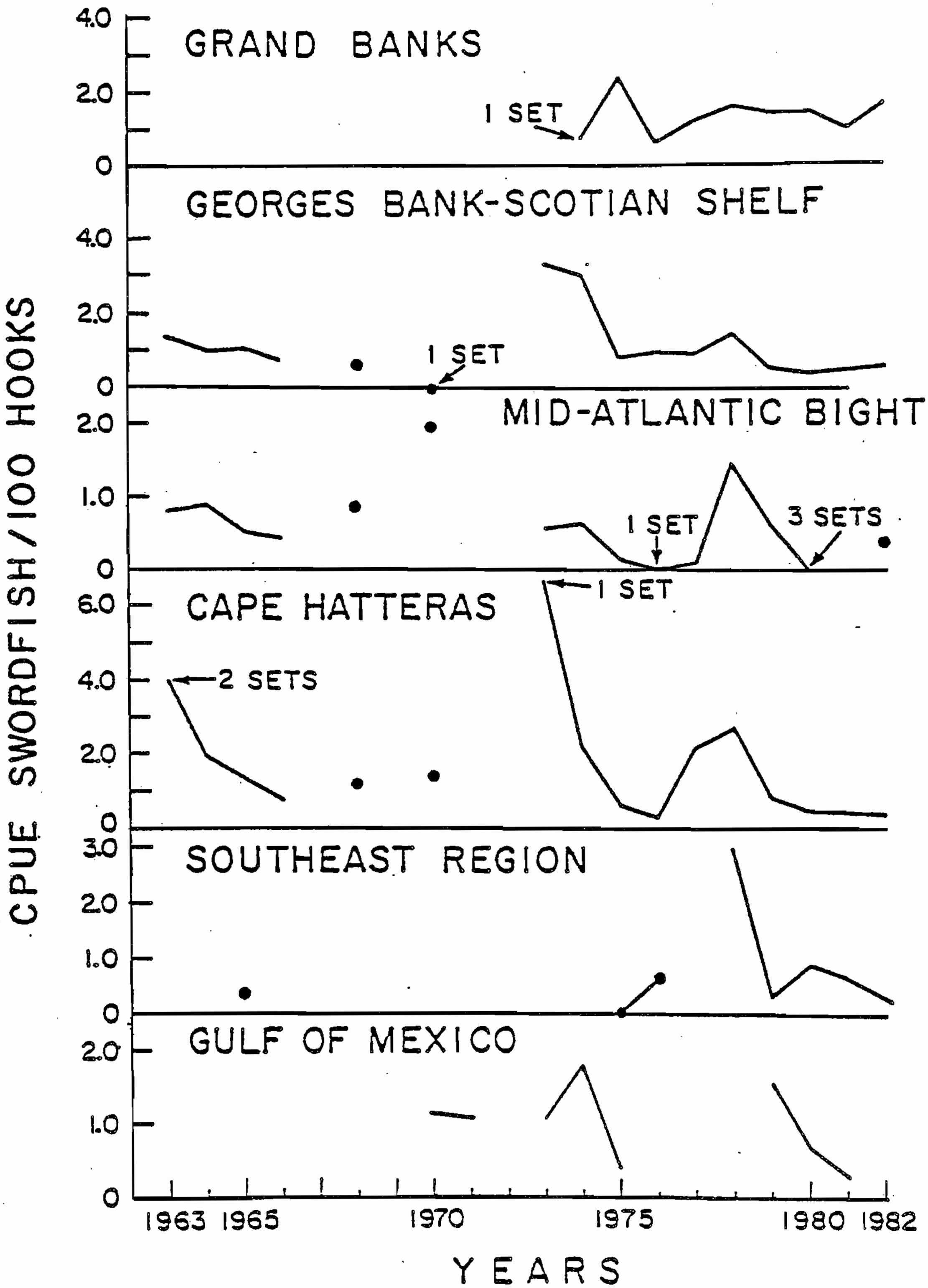


Figure 3. Mean swordfish CPUE plotted by year and region (Source: Hoey and Casey, 1983a).

Yearly differences in regional effort distribution are large, contributing substantially to yearly variability in CPUE and also in $\bar{X}$ CPUE-WT. To reduce the influence of seasonal differences in effort distribution, as was done with CPUE, average weights and $\bar{X}$ CPUE-WT values are listed by year for each region (Table 7). Significant effects of years within regions, on both rank transformed average weights (from individual sets) and rank transformed CPUE-WT values, were identified by analysis of variance and multiple range tests. Yearly effects on average weights were not significant in the Gulf of Mexico and Southeast region. Yearly effects on CPUE-WT were also not significant in the Southeast and Mid-Atlantic regions. These results are undoubtedly influenced by the small number of weight samples available from those regions. Average weights and CPUE-WT values for 1980-1982 are lower than values for the mid-1970s in the Grand Banks and Georges Bank-Scotian Shelf regions. In the Hatteras region, average weights for 1978, 1980, and 1981 are lower than values for 1982 and 1979 which were not different from 1975-1976 values. CPUE-WT values, however, were significantly lower than values for 1974, 1975 and 1978. The average weight and CPUE-WT values for the Mid-Atlantic, Southeast Region, and Gulf of Mexico in recent years also appear lower than values for the mid 1970s, although the samples are much smaller and the yearly values are not consecutive. We interpret these results as indicating both a decline in the number or density of swordfish over time and a decline in the average size caught.

Discussion

Trends in catch rates, both in terms of numbers and weight, provide a preliminary description of the status of the stocks and can aid in monitoring the effect of future fishing effort. It is not our intention to provide surplus production or absolute abundance estimates but only to investigate changes in relative abundance and mean size. Yearly catch rates in terms of numbers and average dressed weights from the Canadian fishery from 1963 through 1969 are provided by Beckett (1971). Caddy (1976) and Hurley and Iles (1980) reviewed Beckett's original data and provided some catch rate and average weight values from 1974, 1975 and 1979. Our catch rate values from 1964, 1965, 1966 and 1968 were recalculated to correspond to Beckett's yearly values (the ratio of averages described by Rothschild and Yong, 1970). The yearly mean values from the two sets of data were highly correlated (r=0.955). Beckett (1971) also presented yearly CPUE values for ten 5 degree quadrangles. Although we did not recalculate our data for these quadrangles, Beckett's CPUE values were generally contained within bounds set by our lower 25th and upper 75th percentiles (14 out of 18 matched pairs). Catch rate values from these two sources for the early years of the fishery (1964-1969), agree remarkably well considering the high degree of variability in CPUE data. This close agreement in catch rates between the Canadian and United States data indicate that both fisheries exploited the same stock of swordfish. Weight data from the Canadian fishery indicate changes in average size prior to 1970. Beckett (1971 - Table 2) reports that mean dressed weight declined from 76 kg (167.6 lb) in 1963 to 45.3 kg (99.9 lb) in 1969. Canadian weight values from 1963 through 1967 exceed all mean weight values in our data from 1970 through 1982. Our peak yearly values during 1975 and 1979 are only slightly greater than Beckett's lowest values in 1968 and 1969. Although our yearly average weight values for 1976 through 1982 appear to fluctuate around 45 kg (99.2 lb) with no distinct trend, the weight values from the Canadian data for the early 1960s (1963-1966) average 67.5 kg (148.8 lb). This reflects a 22 kg (48.5 lb) decrease in average weight from the mid-1960s through the late 1970s. When Canadian weight data presented by 5 degree squares (Beckett, 1971 - Appendix; Hurley and Iles, 1980 -Table 3) are combined, so that it is comparable to our Georges Bank-Scotian Shelf and Grand Banks area, declining average weights are clearly evident. In the Georges Bank-Scotian Shelf region, the Canadian data indicate an average weight decline from 79.2 kg (174.6 lb) in 1963 to 51 kg (112.4 lb) in 1969. Canadian average weights from 1963 through 1966 (average 73.8 kg; 162.7 lb) exceed all our yearly average weights from 1973 through 1982. The Canadian average weight for the Georges Bank-Scotian Shelf area from 1963 through 1969 is approximately 64.5 kg (142.2 lb), compared to our average of 45.8 kg (101.0 lb) from 1973 through 1982. On the Grand Banks, Canadian data indicate a decline in average weight from 94 kg (207.2 lb) in 1963 to a low of approximately 44 kg (97.0 lb) in 1967, which then increased to 59.5 kg (131.2 lb) in 1969. The Canadian average weight for the Grand Banks from 1963 through 1969 is approximately 67.4 kg (148.6 lb) compared to our average of 54.7 kg (120.6 lb) from 1974 through 1982.

Although these trends indicate declining average sizes in small samples from restricted areas in the western North Atlantic swordfish stock, the data are extremely variable and size data appear to have a cyclic quality. The mercury ban in 1970 drastically reduced effort, arrested the development of the swordfish fishery and separated two distinct periods of rapid effort expansion (mid and late 1960s and late 1970s). Caddy (1976) maintains that there was limited evidence of an increase in the catch per unit effort and average weight of swordfish during the years of reduced effort, indicating that the population may have recovered slightly from the initial period of rapid expansion of the fishery. Our data also document an increase in average weights during the mid and late 1970s on Georges Bank and Grand Banks. Those values exceeded average weights from the same areas during the late 1960s (Canadian data) and early 1980s. At the present time, following the recent expansion of the fishery (1977 through 1980), the condition of the swordfish stock in terms of the average sizes and size proportions in the catch may be very similar to the conditions which preceded the mercury ban. The fact that Berkeley and Houde (1980) found no difference between the age structure in 1970 Canadian data and 1979 Florida data may reflect the condition of the swordfish stock after three to four years of intensive fishing effort. The major difference between the late 1960s and the early 1980s, however, is that the total fishing effort appears to be greater with a major part of the increase resulting from expanded effort in the southern areas. Berkeley and Houde (1981) report an 18.5 percent decline in the CPUE (based on numbers caught) from 1979 to 1980. Berkeley and Irby (1982) report a 26 percent decline in the weight caught per hundred hooks. Although Berkeley and Houde (1981) and Berkeley and Irby (1982) maintain that the average size and age structure of the population have remained constant, these declining catch rates are of concern, especially when we consider, as Berkeley and Irby (1982) did, that the effectiveness of the effort also increased between 1979 and 1980. The actual decline in CPUE may therefore have been greater than the decline observed in the data.

Farber and Conser (1983) using Japanese longline catch and effort data as an index of swordfish abundance found no significant change in abundance since 1957 on an Atlantic or North Atlantic-wide basis. They did, however, detect a decline in abundance in the Northwest Atlantic area between 1977 and 1980. These data must be used with caution, though since swordfish are an incidental species in the Japanese longline fishery, and as was noted by Kikawa and Honma (1983), Japan's share of the total Atlantic catch is so small that it is unlikely that longline CPUE data will reflect the general condition of the stocks.

Data from the Canadian, New England and Florida fisheries were compared and appear to reflect effort on the same swordfish stock. Catch rates and average sizes were consistent between fleets, especially when standardized by region and season. Data from each fishery documented declining trends in relative abundance (CPUE) and average size in response to increasing effort. Declining trends in relative abundance have persisted, despite reported increased effectiveness of the gear in the last few years (Berkeley et al., 1981). Furthermore, differences between the distribution of effort in 1969 and 1980, and the resultant increase in the catch of small individuals (less than 4 years old) and large females should be of concern. These changes highlight the need for careful monitoring of the fishery.

8.1.5.6 <u>Abundance and Present Condition</u>

Commercial landings decreased slightly from 8.4 million lb in 1980 to 7.7 million lb in 1981 (Table 8). Recorded landings in 1982 and 1983 were almost the same, 9.0 and 9.3 million lb respectively. The stock assessment in the swordfish FMP presented at public hearings in March 1983 (draft dated February 1983) was based on yield-per-recruit (YPR) analyses done by Berkeley and Houde (1980, 1981). The major limitation of this work for the five Council management plan was that the analyses were based on fish exclusively from the Straits of Florida. There were no data to verify if the size frequency observed by Berkeley and Houde in 1979-80 in Florida was representative of the entire western North Atlantic fishery (five Council areas developing the swordfish plan).

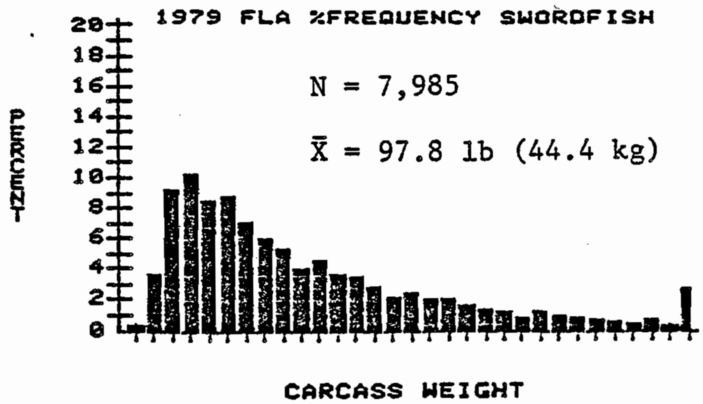
The Source Document (May 1982) also relied heavily on samples obtained from the swordfish fishery off the East Coast of Florida during 1979 (N = 7,985) and 1980 (N = 14,837) (Figure 4). Additional weight frequency data have been made available through contacts with State agencies, swordfish dealers, and commercial fishermen. Unfortunately, there is no way to identify the sexes from the carcasses. These new data have been volunteered to improve the data base on which the plan is founded to insure that the plan is based on data from the entire range of the fishery and not a restricted area (Florida's east coast) over a short time span. In all cases, fishermen and dealers have supplied vessel trip sheets which record individual carcass weights.

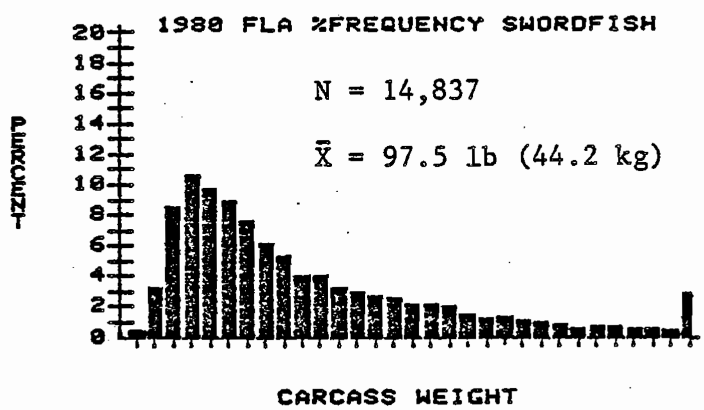
Table 8. Annual domestic swordfish landings.

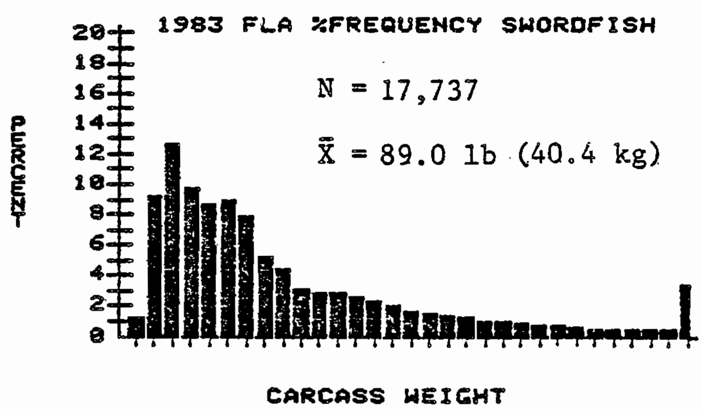
	GMFMC*	SAFMC**	MAFMC	NEFMC+	TOTAL ALL AREAS
	'000 lb	'000 lb	'000 lb	'000 lb	'000 lb
1960	-	-	69	942	1,011
1961	-	-	72	829	901
1962	-	-	67	867	934
1963	-	1	423	2,331	2,755
1964	-	483	1,113	1,456	3,052
1965	-	524	1,391	788	2,703
1966	-	77	425	855	1,357
1967	-	-	404	641	1,045
1968	-	-	216	389	605
1969	2	-	40	336	378
1970	346	-	18	268	632
1971	1	1	4	73	78
1972	-	-	-	541	541
1973	14	-	7	873	894
1974	86	-	76	3,353	3,515
1975	149	-	149	4,294	4,592
1976	391	262	187	3,408	4,248

	TX	FL W.C.	FL E.C.	NC	SC	VA	MD	NY	NJ	RI	MA	ME	TOTAL ALL AREAS
1977	0	2,321	113,000	120,000	0	-	222,278	-	0	81,000	845,000	380,000	1,763,599
1978	0	52,708	536,000	439,306	581,542	-	0	-	511,000	668,000	3,985,000	369,000	7,145,178
1979	60,000	318,000	1,391,000	170,436	822,711	-	72,554	-	271,000	511,000	3,509,000	392,000	7,517,701
1980	965,500	760,475	2,308,042	316,576	845,097	-	488,098	-	101,215	454,000	1,587,000	610,000	8,436,003
1981	435,300	723,204	2,718,871	251,428	688,345	54,819	311,520	126,811	103,082	596,565	1,112,440	567,463	7,689,848
1982	271,500	984,275	2,946,805	146,565	1,158,358	66,570	350,226	350,677	314,419	275,355	1,727,524	439,376	9,031,650
1983	118,400	598,331	2,817,983	163,915	1,181,144	19,214	485,921	402,670	550,350	275,633	2,334,068	316,253	9,263,882

* MS landed 6,000 lb in 1981
** GA landed 2,622 lb in 1978; GA 1982 landings are confidential
+NH landed 96,561 lb in 1981







% Less Than Or Equal To 50 lb	% Greater Than 50 lb
32%	68%
32%	68%
41%	59%

Figure 4. The weight-frequency distribution for 7,985 swordfish landed by longline in Florida in 1979 (mean weight = 97.8 lb, 44.4 kg), 14,837 swordfish landed in 1980 (mean weight = 97.5 lb, 44.2 kg), and 17,737 swordfish landed in 1983 (mean weight = 89.0 lb, 40.4 kg). Weight is shown in 10 lb increments, beginning with the 1-10 lb group and ending with the over 300 lb group. Dressed weight equals whole weight X 0.75 (Source: Berkeley and Houde, 1981)

The Marine Resources Division of the South Carolina Wildlife and Marine Resources Department has collected carcass weights for 40,366 swordfish landed in South Carolina from 1978 through 1983. Yearly weight histograms for these data are displayed in Figure 5.

Carcass weights are also available for 15,358 swordfish landed in ports located north of 35° N in 1980 and an additional 9,172 carcasses landed in 1983 (Figure 6).

More recent data have also become available from landings along the east coast of Florida. As of April 1984, 17,737 carcass weights were available for swordfish landed in 1983 (Figure 4). A small sample from the Gulf of Mexico is also available for 1980 (7,637 carcasses) and for 1983 (1,229 carcasses) (Figure 7).

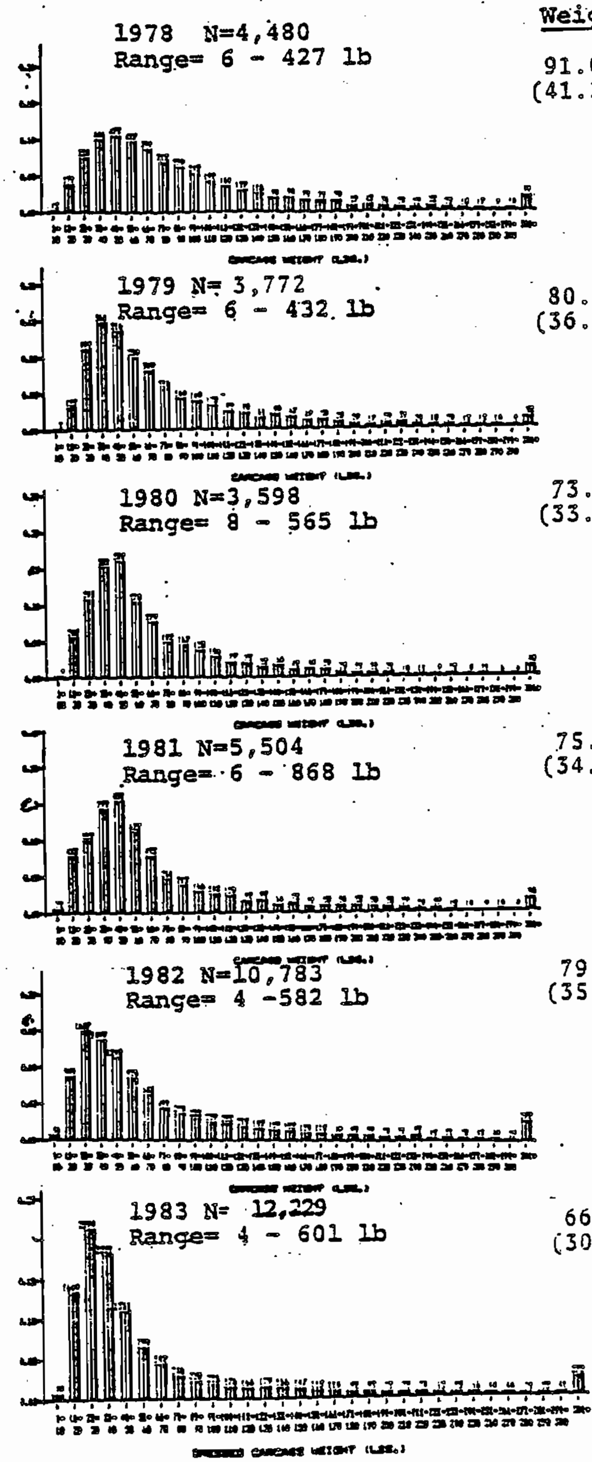
SUMMARY OF AVAILABLE SWORDFISH WEIGHT DATA

numbers of dressed carcass weights

Year	Gulf of Mexico	Fla. East Coast	S.C.[1]	North Carolina and North
1978			4,480	853[2]
1979		7,985[3]	3,772	
1980	7,637[4]	14,837[3]	3,598	15,358[4]
1981		X[5]	5,504	800[2]
1982		X[5]	10,783	1,082[2]
1983	1,229[4]	17,737[4]	12,229	9,172[4]

Annual totals	-	1978	5,333			
	-	1979	11,757	Region totals	Gulf of Mexico	8,866
		1980	41,430		Florida	40,559
	-	1981	6,304		S.C.	40,366
		1982	11,865		N.C. and North	27,265
		1983	40,367			
Grand total	-		117,056			

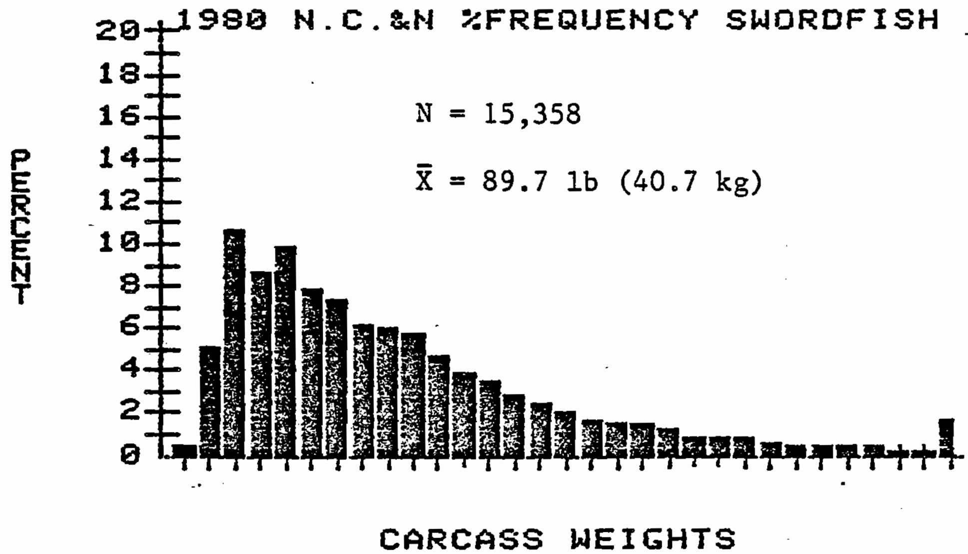
Sources:
1. S.C. Marine Resources Division
2. New England fishermen
3. Berkeley & Houde
4. Dealer
5. Data being prepared by dealers, number of carcasses still unknown



Mean Weight	% Less Than Or Equal To 50 lb	% Greater Than 50 lb
91.0 lb (41.3 kg)	33%	67%
80.7 lb (36.6 kg)	44%	56%
73.4 lb (33.3 kg)	48%	52%
75.0 lb (34.0 kg)	48%	52%
79.0 lb (35.8 kg)	50%	50%
66.1 lb (30.0 kg)	65%	35%

Figure 5. South Carolina's swordfish size distribution 1978-83. Weight is shown in 10 lb increments, beginning with the 1-10 lb group and ending with the group over 300 lb. (Source: S.C. Marine Resources Division, unpubl. data)

% Less Than or Equal To 50 lb	% Greater Than 50 lb
35%	65%
31%	69%



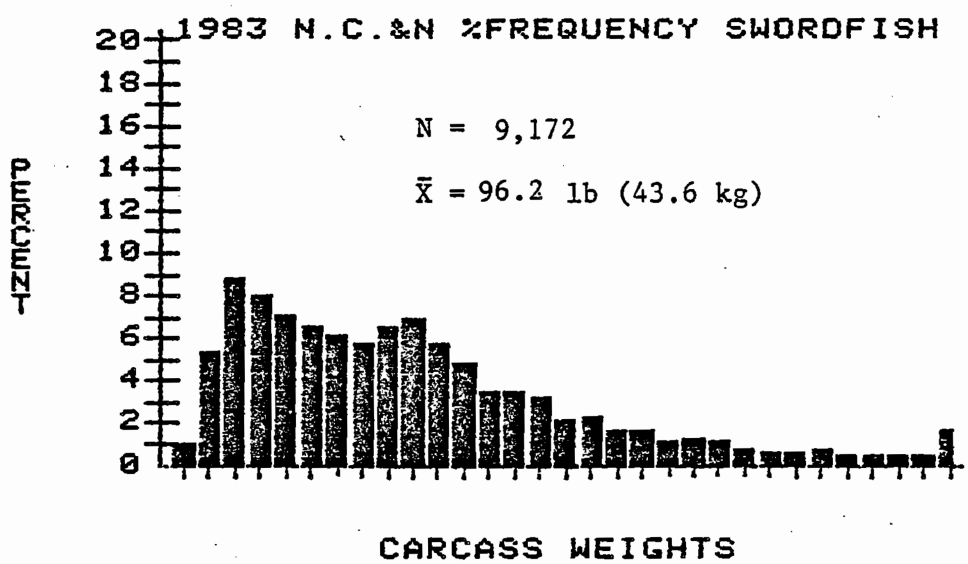
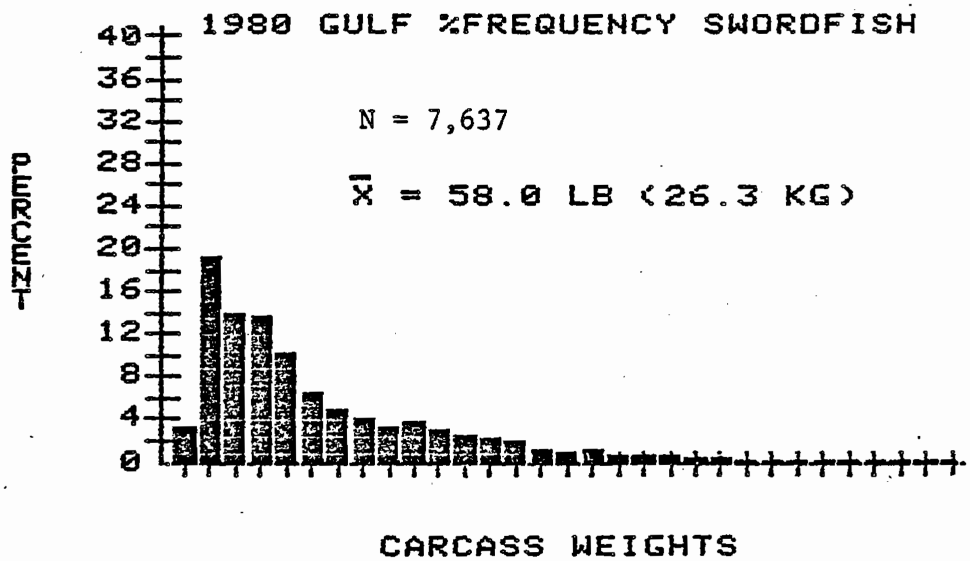
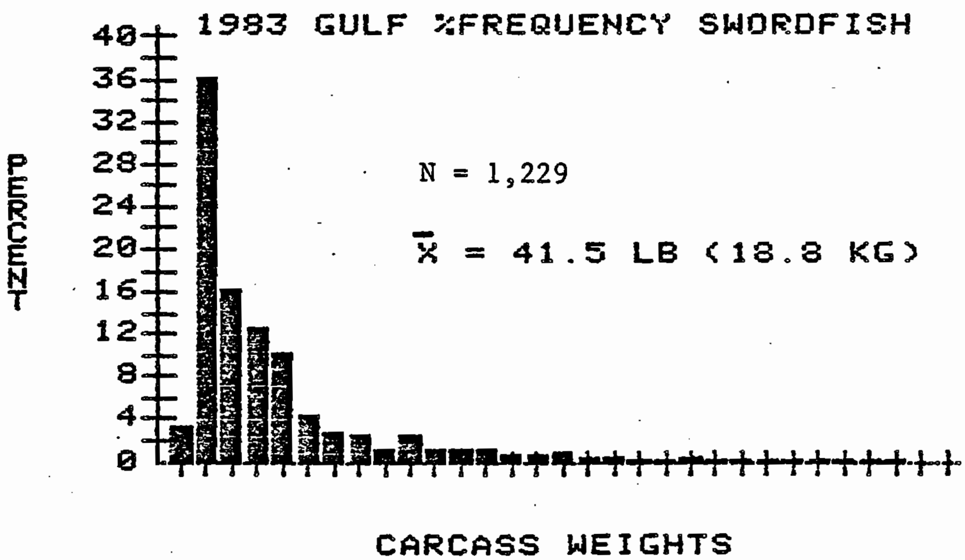


Figure 6. Landings North of 35° N. 1980 sample based on 15,358 swordfish with mean dressed carcass weight of 89.7 lb (40.7 kg). 1983 sample based on 9,172 swordfish with mean dressed carcass weight of 96.2 lb (43.6 kg). Weight is shown in 10 lb increments, beginning with the 1-10 lb group and ending with the group over 300 lb.





	% Less Than or Equal to 50 lb	% Greater Than 50 lb
1980	61%	39%
1983	79%	21%

Figure 7. The weight-frequency distribution for 7,637 swordfish landed by longline in the Gulf of Mexico in 1980 (mean weight = 58.0 lb, 26.3 kg) and 1,229 swordfish landed in 1983 (mean weight = 41.5 lb, 18.8 kg). Weight is shown in 10 lb increments, beginning with the 1-10 lb group and ending with the group over 300 lb.

In terms of the average carcass weights, the following facts are apparent:

1. In the Florida east coast sample, the mean dressed weight was essentially the same in 1979, 97.8 lb (44.4 kg) and 1980, 97.5 lb (44.2 kg) and then declined to 89 lb (40.4 kg) in 1983. The proportion of carcasses weighing 50 lb or less which was constant at 32 percent in 1979 and 1980 has increased to 41 percent in 1983.
2. In the South Carolina data, the mean dressed weight has declined from 91 lb (41.3 kg) in 1978 to 73.4 lb (33.3 kg) in 1980 and then to 66.1 lb (30 kg) in 1983. Concomitant with this decline in average size, the proportion of carcasses 50 lb or less has increased from 33 percent in 1978 to 48 percent in 1980 and then to 65 percent in 1983.
3. In the sample from landings north of 35° N, the mean dressed weight has increased from 89.7 lb (40.7 kg) in 1980 to 96.2 lb (43.6 kg) in 1983. The proportion of carcasses weighing 50 lb or less has decreased from 35 percent in 1980 to 31 percent in 1983.

Approach 1: Cap Fishing Mortality at the Maximum Yield-Per-Recruit for Female Swordfish - No Closure Initially

The swordfish plan initially used the variable season closure to cap fishing mortality at the maximum YPR for females. The variable season closure caps mortality by a method that is equitable to all fishing areas in the management unit. Based on the 1980 YPR analysis, this would have required restricting fishing mortality at approximately what occurred in 1980. Subsequent YPR analyses may have produced new YPR parameters that would have indicated that in 1980 the fishery was not at maximum YPR for females. The variable season closure would have capped effort at whatever was the maximum YPR for females based on the best available YPR analysis at the time.

Initially, no closure was proposed because no estimate of fishing mortality was available other than Berkeley and Houde's (1981) estimate for 1980. The plan described a procedure whereby a working panel would review information on an annual basis and as soon as the most recent YPR analysis indicated the need for a closure to restrict fishing mortality, the

Councils would request the NMFS Southeast Regional Director to implement regulations closing each Council region based on the number of closed days called for by the swordfish calendar. This would have been done by field order.

Prior to the second round of public hearings (March/April, 1984) weight frequency information from South Carolina became available. This allowed us to perform the first YPR analysis as called for in the plan. These calculations are discussed under Approach 2.

Approach 2: Cap Fishing Mortality at the Maximum Yield-Per-Recruit for Female Swordfish - Closure with Plan Implementation Based on South Carolina Data

The South Carolina data (particularly 1980-83; 32,114 fish) show three things. First, the size frequency Berkeley and Houde observed in the Straits of Florida in 1979-80 was also occurring in South Carolina. Second, since 1980 the size frequency of the catch in South Carolina has shifted considerably (average size declined) as shown in Figure 5. Third, since 1979 the age liable to capture has decreased from the 40-50 to 20-30 pound dressed weight class. "Age liable to capture" is the term used on the computer printout of the Beverton and Holt yield-per-recruit analyses (Appendix A). It is equivalent to L' (fork length) in Beverton and Holt terminology (Ricker, 1975). In the case of the South Carolina data (Figure 5), age liable to capture (L') is interpreted to be in the range of the 10 pound (dressed weight) categories that comprise the mode of the frequency*.

1978	L'=	41-50 pounds	(18.6 - 22.7 kg)
1979	L'=	31-40 pounds	(14.1 - 18.1 kg)
1980	L'=	41-50 pounds	(18.6 - 22.7 kg)
1981	L'=	41-50 pounds	(18.6 - 22.7 kg)
1982	L'=	21-30 pounds	(9.5 - 13.6 kg)
1983	L'=	21-30 pounds	(9.5 - 13.6 kg)

The five Council swordfish FMP is built on the premise that there is a group of swordfish that can be managed as a unit and that the status of the stock can be adequately monitored for management purposes by YPR analysis. This is a scientifically established method to calculate relative fishing pressure (instantaneous fishing mortality) from the sizes of fish (size frequency) in the catch.

*Note, all lengths are converted to weights according to the Berkeley and Houde length-weight equation (Table 2).

Total landings (weight) could also be an important indicator of stock condition (especially when used with size frequency data). However, at this time, historical landings are suspect due to likely under-reporting. Also, both Berkeley and Houde YPR parameters and those of Wilson and Dean theoretically indicate that total landings will not significantly change when growth overfishing occurs (Figure 8).

A complicating feature of YPR analysis for swordfish is that males and females have different growth rates (females live longer and grow larger). There is no way for fishermen to target swordfish by sex, consequently the strategy of the plan was to prevent growth overfishing of the most vulnerable sex (sex with the lowest fishing mortality to maximize YPR). This means that if fishing mortality on females does not exceed that which produces maximum YPR for females it will automatically prevent growth overfishing of males.

Since the sexes could not be identified from the carcasses, the only YPR analyses that could be done was for sexes combined. YPR analyses on sexes combined causes two problems. First, the chosen YPR parameters are hybrid values of those that actually occur for males and females. If Wilson and Dean (1983) are correct and there are no real differences in the growth rates of males and females, this may turn out not to be too important. However, the main reason for the onboard technician program in the FMP is to identify sexes and further substantiate the growth rates of males and females.

The second problem with YPR on combined sexes is that the measure of "growth overfishing" which triggers the variable season closure in the FMP is for females, not sexes combined. The result is that the estimate of instantaneous fishing mortality (F) on combined sexes is higher than would occur if it could be done solely on females. At the same time, the estimate of the maximum YPR F for sexes combined is also higher than it would be for females.* These factors work in opposite directions so that it is difficult to say if the estimate of growth overfishing for sexes combined is much lower than would be the estimate solely for females. Berkeley and Houde (1981) estimates indicate that if we would have used this measure of

*This assumes no significant differences in age liable to capture between the sexes.

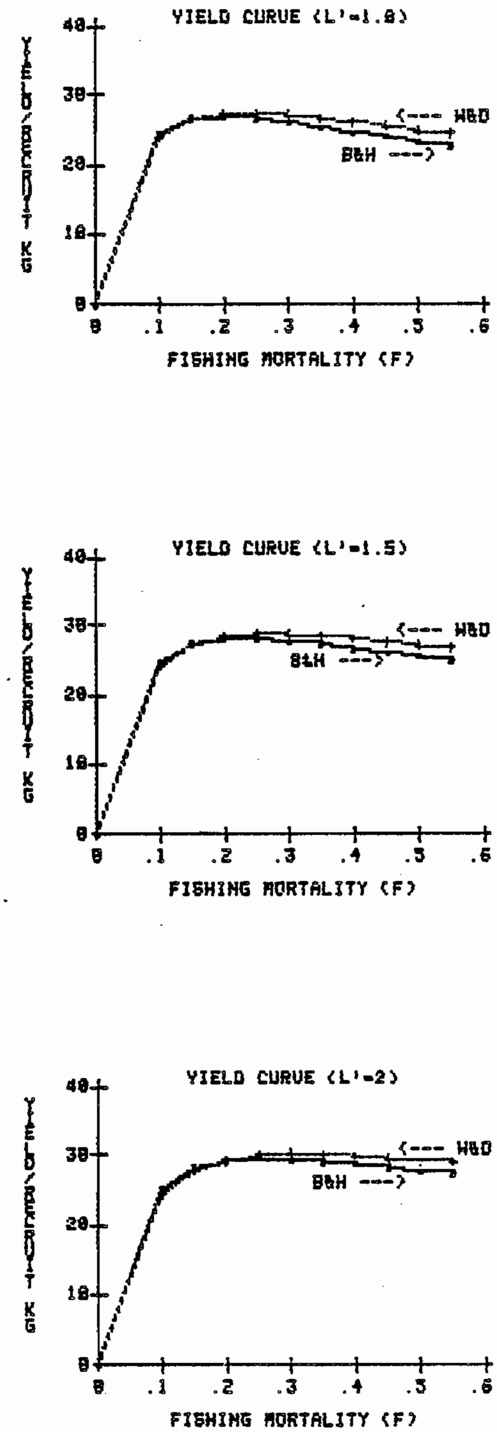


Figure 8. Yield curves for swordfish given different ages first liable to capture (L').

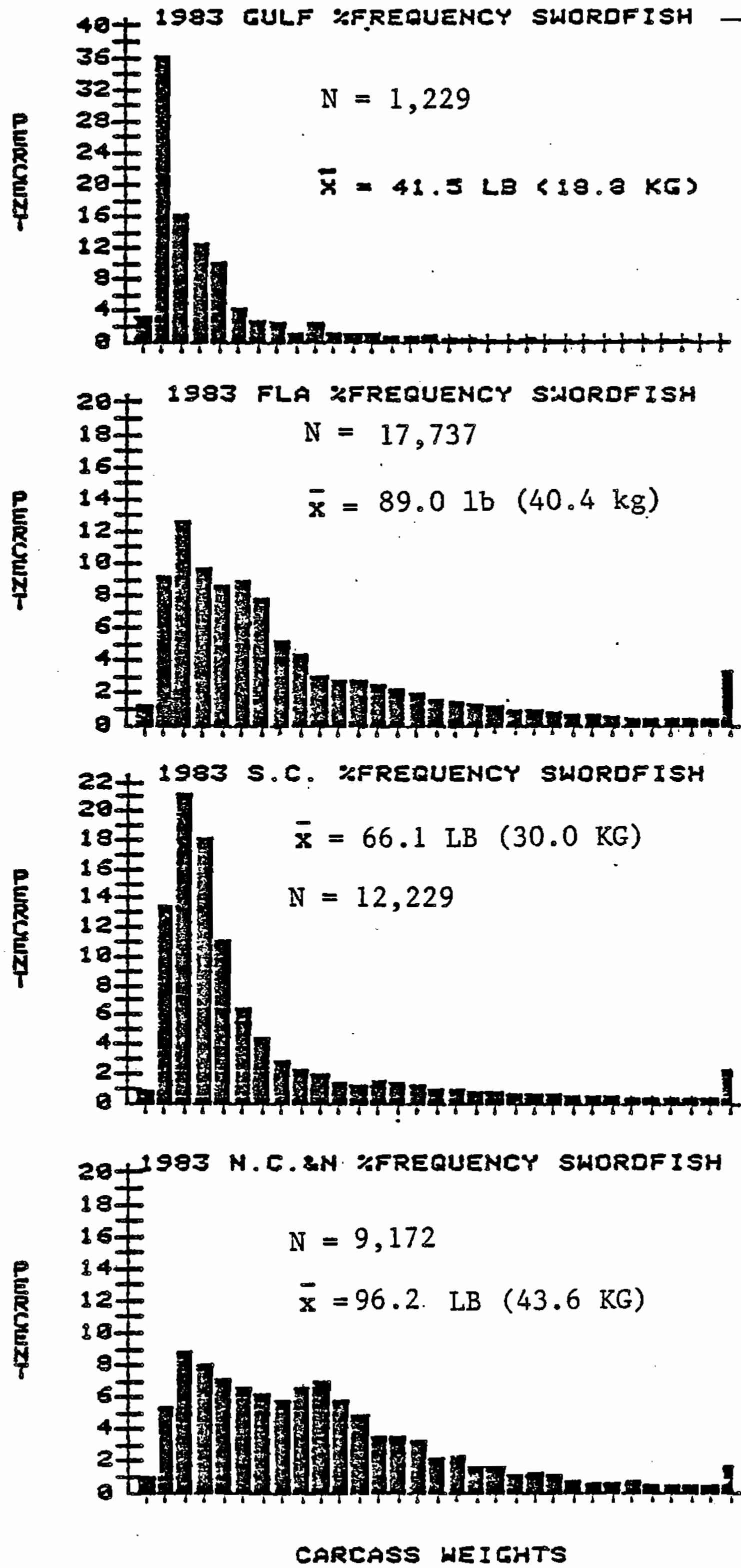
growth overfishing in the FMP with their data (comparing existing F to maximum YPR F) we would have drawn the same conclusions with sexes combined as we would have with females. This may not be the case in 1983 because the decrease in age liable to capture is a strong influence on estimated fishing mortality and it may not be the same for females or males (or sexes combined).

In accordance with the methods outlined in the FMP, YPR analyses were performed on the 1983 data (Figure 9). The results were also compared to the 1979-80 analysis from the Straits of Florida (Berkeley and Houde, 1980, 1981) and the 1980 data (Figure 10). Plots of all areas combined for 1980 and 1983 are shown in Figure 11.

Preliminary results show that fishing pressure (fishing mortality estimated by YPR) in 1983 was approximately 25 percent above that which maximizes YPR at the prevailing age liable to capture (20-30 pound dressed weight) based on data from South Carolina. This preliminary "best estimate" is of course dependent on all the assumptions that are inherent in YPR analysis.

It must be emphasized that these conclusions are tentative pending scientific review and the analysis of the remaining data from other areas. Also, these are simply mechanistic calculations that should be balanced with some judgement and history about the plan. For example, it was not anticipated that age liable to capture (especially in all areas) would substantially decline resulting in 20-30 lb (dressed weight) fish being the biggest size class (by number) in the catch.

An examination of the YPR values (column 3, Appendix A) clearly indicates that controlling fishing pressure (instantaneous fishing mortality, Column 1) has little impact on increasing total landings (YPR, Column 3). At the smaller 1983 age liable to capture (around L' = 118.5 cm, 27.5 pounds dressed weight, age 2.0 on the printout) the only thing that even modestly influences YPR is increasing or decreasing the age liable to capture.



Area	% Less Than Or Equal To 50 lb	% Greater Than 50 lb
Gulf	79%	21%
FLA	41%	59%
S.C.	65%	35%
N.C.&N	31%	69%

Figure 9. Weight-frequency plots for 1983 by area. Weights are shown in 10 lb increments, beginning with the 1-10 lb group and ending with the group over 300 lb.

Area	% Less Than Or Equal To 50 lb	% Greater Than 50 lb
Gulf	61%	39%
FLA	32%	68%
S.C.	48%	52%
N.C.&N	35%	65%

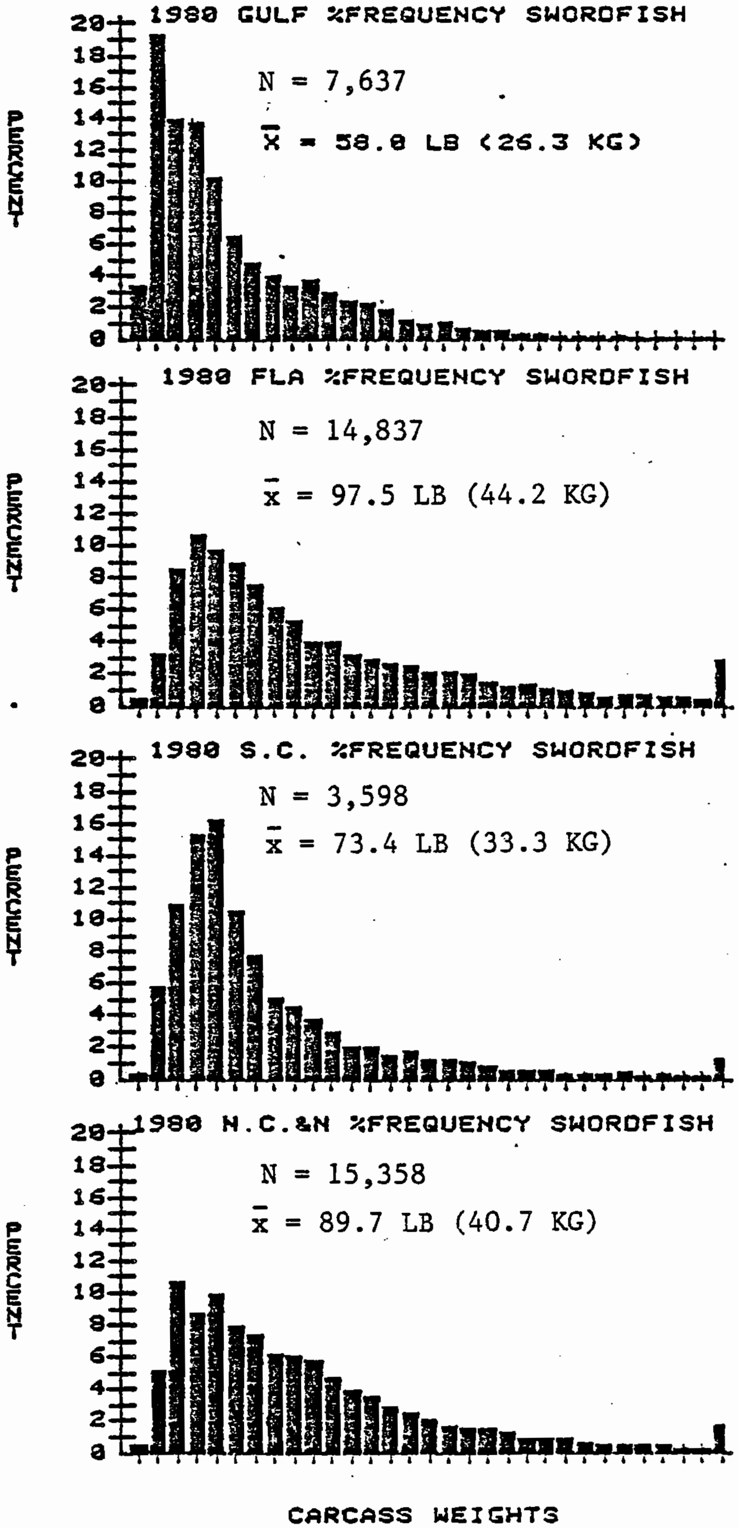
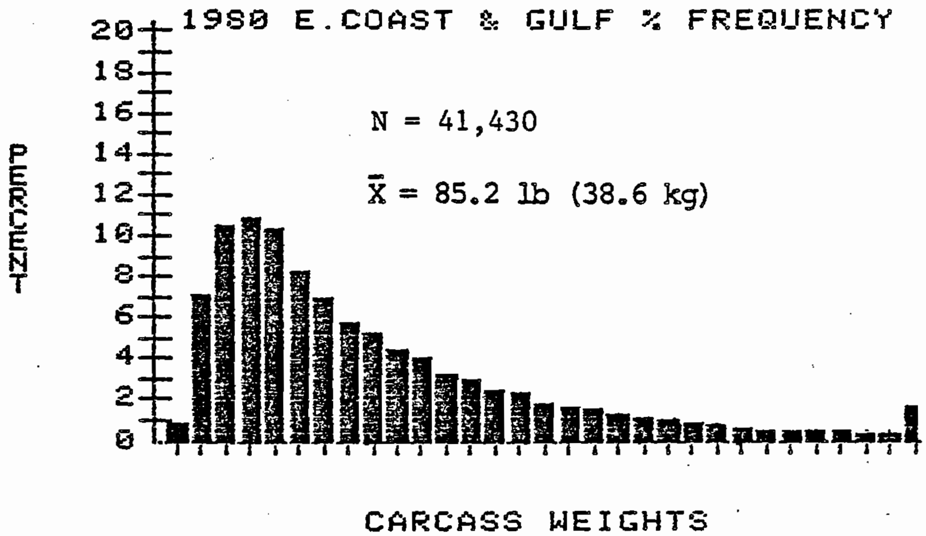


Figure 10. Weight-frequency plots for 1980 by area. Weights are shown in 10 lb increments, beginning with the 1-10 lb group and ending with the group over 300 lb.

% Less Than or Equal to 50 lb.	% Greater Than 50 lb.
44%	56%
54%	46%



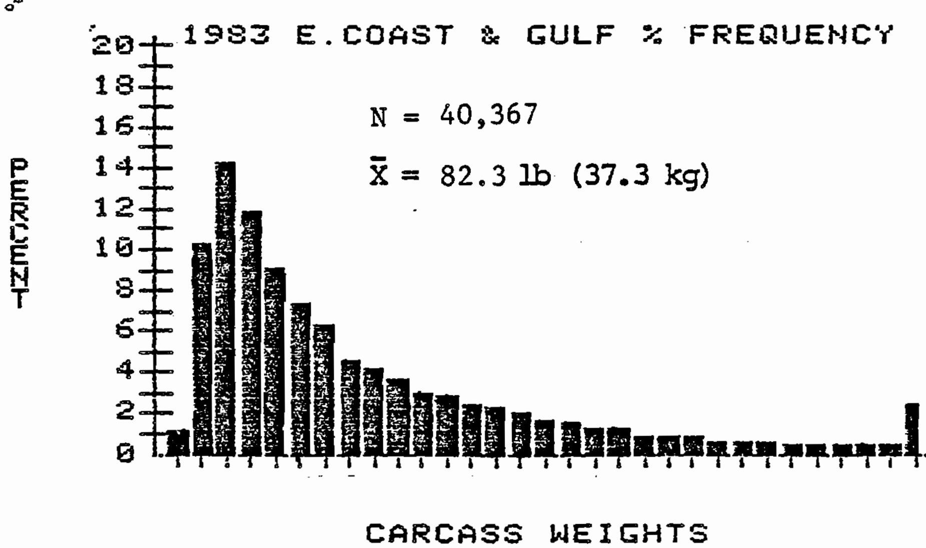


Figure 11. Composite histograms for 1980 and 1983 produced by combining data from the Gulf of Mexico, the east coast of Florida, South Carolina, and north of 35° N. 1980 histogram based on 41,430 swordfish carcasses with a mean dressed weight of 85.2 lb (38.6 kg). 1983 histogram based on 40,367 swordfish carcasses with a mean dressed weight of 82.3 lb (37.3 kg).

However, controlling fishing pressure does have a significant influence on the size of the fish in the catch (average size, Column 6). The economic goal of the plan is to keep the size of fish from substantially declining because larger fish are preferred in the market. The resulting biological advantage is that if growth overfishing is prevented, it is anticipated that there will be little chance of recruitment overfishing. But the printout shows that the maximum YPR for different ages liable to capture produces very different average sizes (and percent surviving to sexual maturity). For example, the average size associated with maximum YPR was 66.62 kg (Column 6) when the age liable to capture was 2.5 in 1979. When the age liable to capture dropped to 2.0 in 1983, the maximum YPR only produced an average size of 61.67 kg. To maintain an average size of 66 kg would require moving below maximum YPR to a fishing mortality of 0.20-0.21. Therefore, 1983 fishing mortality (0.33-0.34) would have to decrease by approximately 40 percent instead of 25 percent to return us to the sizes occurring in 1979. Maintaining preferred sizes of fish, not total pounds landed (which does not change substantially with growth overfishing) is the intent of this plan. Unfortunately, at this stage of growth overfishing, returning to any historical sizes (even 1979) would require percent reductions based on pounds of swordfish in excess of 30 percent.

Figure 12 is a summary of how, conceptually, YPR is done. This discussion refers to new information on each of the components in the table. Also, refer to the computer printouts in Appendix A.

I. Wilson and Dean (U.S.C. Baruch Institute, Columbia, SC; pers. comm.) indicate slightly different growth rates (K) and maximum sizes (L_{oo}) than Berkeley and Houde (1980, 1981) as shown in Table 2. Our analysis is restricted to sexes combined because the sexes are not identified in the weight-frequency data. The computer run uses Berkeley and Houde sexes combined estimates of K = .1054 and L_{oo} = 297 cm.

II. Wilson and Dean did not calculate a new natural mortality (M) value. John Hoey did this based on their K value (0.13) and alternative temperatures to produce an estimate of M = 0.185 from the same equation

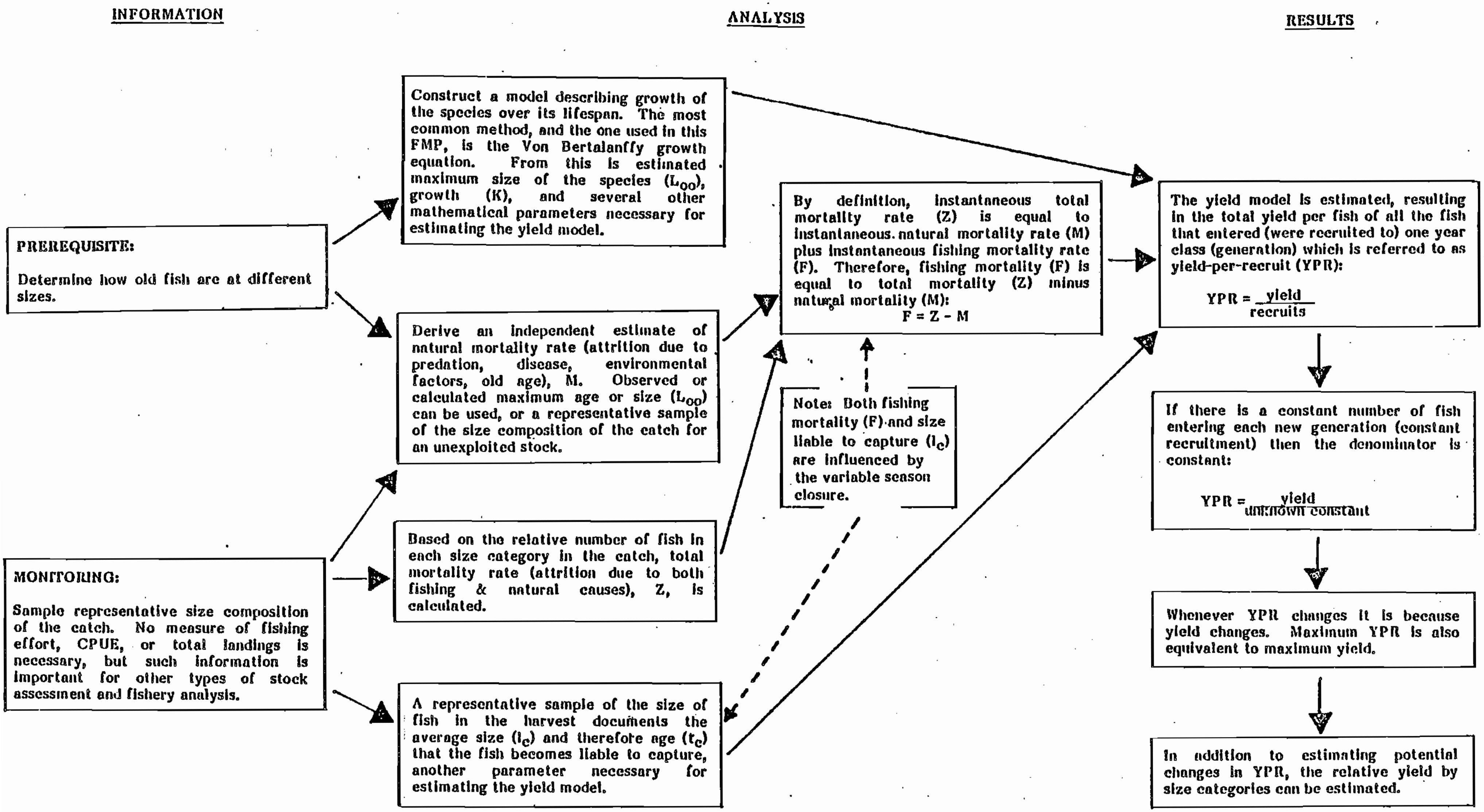


Figure 12. How yield-per-recruit works.

used by Berkeley and Houde. The computer run uses the Berkeley and Houde estimate of M = 0.16. Ultimately sensitivity analysis will be done on all the alternative parameter values.

III. The age (or size) liable to capture (L') is the most problematical parameter. Berkeley and Houde used L'= 130 cm for sexes combined in 1979-80 data. Our best estimate is that in 1983 this is a lower value (around 100-120 cm). This is supported by the mode in the South Carolina size frequency data. It is also indirectly supported by the theoretical calculations from the YPR analysis (discussed next under IV).

IV. Total mortality (Z) was calculated on the S.C. data by the same three methods used by Berkeley and Houde (1981), (Beverton and Holt, 1956; Robson and Chapman, 1961; and Ssentongo and Larkin, 1973). It is not necessary to do this calculation when the computer calculates alternative individual mean weights (column 6) for a range of fishing mortality values (see the attached printout). Fishing mortality can be determined by simply finding the theoretical "instantaneous fishing mortality" (Column 1) that matches (same row) the actually observed (from the catch) "individual mean weight" (column 6) on the computer run for the appropriate "age liable to capture."

Age liable to capture in the computer model is (t) in the von Bertalanffy growth equation for calculating L' (Table 2). Average size (above L') is interpreted in kilos (Column 6) by converting $\bar{L}$ in cm (Beverton and Holt terminology) into weight with the length weight equation (Table 2).

Age liable to capture of 2.5 (L' = 127.7 cm, 35.3 pounds dressed weight) approximately replicates the Berkeley and Houde calculations (done by a different method) on 1979-80 data. They reported L' = 130 cm and $\bar{L}$ = 72.1 kg.*

The $\bar{L}$ (converted to kilos) associated with alternative L' on 1979-80 Florida data (Berkeley and Houde) and with the 1983 South Carolina data

*Their reported value was slightly different, 72.1 kg is our calculation of $\bar{L}$ on their data, given L' = 130 cm. The terminology is somewhat confusing because of the way the computer print-out is interpreted. L' is converted to age and then read as "age liable to capture" on the print-out. L is converted to weight and then read as average weight on the print-out.

are indicated on the computer printout. In order for $\bar{L}$ to decline from what Berkeley and Houde observed in 1979-80 (72.1 kg) to the 1983 observed value in South Carolina (68.0 kg) requires fishing mortality to increase from approximately 0.22-0.23 in 1979 to 0.26 - 0.27 in 1983. This would have been an increase of 13-23 percent. Note however that both the 1979 and 1983 F levels are still below the theoretical maximum YPR level. This is not likely to be the situation because the 1983 length frequency mode is around 100-120 cm which implies that age liable to capture is now smaller than 130 cm.

For comparative purposes, we can find the fishing mortality value (column one) that corresponds with the observed $\bar{L}$ (column six in kilos) for the 1983 South Carolina data given different assumed L'. These rows are indicated on the printout for ages liable to capture of 2.0 (L' = 118.5 cm), 1.5 (L' = 109.0 cm), and 1.0 (L' = 98.6 cm). These fishing mortality rates (column one) are then compared with the mortality rate (column one) that maximizes YPR (column three) for the same age liable to capture.

SUMMARY OF THE PERCENT THAT 1983 FISHING MORTALITY IS OVER MAXIMUM YPR GIVEN DIFFERENT ASSUMED AGES LIABLE TO CAPTURE

L' (cm)	$\bar{L}$ (kg)	F	F_{max}	$(F_{max}-F)/F$
127.7	68.0	.25-.30	.20	-6% (below F_{max})
118.5	55.0	.30-.35	.25	24% (above F_{max})
98.6	45.1	.25-.30	.20	30% (above F_{max})

The percentages in the last column in the foregoing table are the critical information for decision making. We believe that the best estimate of L' is around 118.5 cm. Therefore, the best estimate of the percent reduction that would be applied to the variable season closure would be approximately 25 percent.

Approach 3: Delaying the Harvest of Small Fish - Closure with Plan Implemented Based on Data from the Range of the Fishery

Members of the swordfish industry submitted data under the auspices of a data collection program developed by John Hoey while serving as a visiting scientist with the South Atlantic Council. These data allowed the Councils to expand the data set provided by the State of South Carolina and for the first time examine the size composition of the commercial catch from the New England, Mid-Atlantic, South Atlantic, Florida, and Gulf of Mexico areas. Without the cooperation of these individuals, the swordfish source document and plan would not contain the large amount of original data and detailed technical analyses that they currently contain.

The variable season closure approach was initially based on a monthly landings index calculated using pounds of catch as recorded by the NMFS. The monthly landings index (MLI) represents the percentage of annual landings that occur in a particular month. Public hearing comments suggested that the Councils use the volunteered data based on pounds of swordfish or better yet numbers of swordfish. This was done using both the average (1980-83) and latest (1983) MLI values calculated using NMFS recorded pounds of catch as well as the voluntary data submitted for 1983 (both pounds and numbers). The results (Tables 1-4; Appendix B) illustrate that the MLI values are not greatly influenced by the method of calculation based on: 1) NMFS average 1980-83 or 1983 recorded pounds of catch, 2) 1983 volunteered pounds of catch, or 3) 1983 volunteered numbers of swordfish caught. (Note: Table 14 (Appendix B) contains the MLI values by area by year for 1980-1983 based on NMFS recorded pounds of catch.)

The next step was to use the weight frequency data to look at the importance of small fish to the catch composition. There are currently four market categories present in the swordfish fishery: 1) pups - less than 25 pounds dressed weight, 2) small - 25 to 49 pounds dressed weight, 3) medium - 50 to 99 pounds dressed weight, and 4) large - over 100 pounds dressed weight. A small fish index was calculated from the 1983 volunteered data for fish ≤ 25 lb, ≤ 50 lb and ≤ 70 lb dressed weight (Tables 5-8; Appendix B). The small fish index is calculated by multiplying the monthly landings index based on numbers of swordfish by the percentage of swordfish that are within the particular size category that month. For example if the MLI was 5.00 for the month of January (i.e. 5% of the annual catch occurs in January) and the percentage of swordfish ≤ 50 lb was 20%, then the small fish index (SFI) would be equal to 1.00.

The choice of which size group to use was based on the price for different market categories, the rate of growth from one category to another, and the magnitude of the absolute change in size composition. Using the category of ≤ 25 lb dressed weight would result in large closures because the percent of the catch in this category has changed by a large amount from 1980 to 1983. Currently there is no market category at 70 lb dressed weight and again the magnitude of the closures would be large based on the changes in size composition of this category. The Councils chose the small fish index based on swordfish ≤ 50 lb dressed weight. This corresponds to an existing market category and the magnitude of change for this size grouping was not as great as the others. The changes in size composition from 1980 to 1983 are summarized in Table 9 (Appendix B).

The percentage of swordfish ≤ 50 lb dressed weight by area was used to calculate the numbers of fish in this category (Table 10; Appendix B). This was done by calculating the numbers of swordfish caught in each area (NMFS recorded pounds of catch divided by the average size from the volunteered data) and multiplying by the percent ≤ 50 lb dressed weight. The number of small fish in each area was summed to estimate the total numbers caught. Estimates are that 33,750 swordfish ≤ 50 lb dressed weight were caught in 1980 and that 39,718 were caught in 1983, an increase of about 18 percent.

Time and area closures ("variable season closure") are calculated to reduce the catch of small fish in all areas. The Swordfish Fishery Management Plan goes into more detail about the dates chosen, impacts of the closure, benefits of the closure, etc. The reader is encouraged to review that document for a more complete discussion of the variable season closure.

8.1.6 <u>Probable Future Condition</u>

8.1.7 <u>Interdependence on Other Species</u>

8.1.7.1 <u>Incidental Species</u>

Species composition of the incidental bycatch from 1,588 sets of New England style swordfish effort is shown in Table 9. The incidental bycatch of sharks accounted for the largest single component of the total catch (68.5 percent), more than twice the catch of swordfish (29.6 percent). Tuna accounted for 0.8 percent of the total catch, miscellaneous teleosts (primarily lancetfish) added an additional 0.6 percent and billfish (primarily white marlin) added only 0.5 percent. In comparing the number of billfish caught versus the number of swordfish caught, the data in Table 9 indicate that the billfish bycatch is 1.7 percent of the swordfish catch while it accounts for only half of one percent of the total catch. The value of 1.7 percent agrees well with the data presented in the Swordfish Source Document (May 1982) which predicts 1.5 percent of the swordfish catch.

Table 9. Species and effort totals for swordfish effort 1963-82. Species totals, percentages, and mean CPUE values (mean CPUE calculated by averaging individual sets) listed in descending order of percentage of species composition. (Source: Hoey and Casey, 1983a)

Species	Number	Percent	Mean CPUE
Blue shark	32,467	37.0	1.65
Swordfish	25,914	29.6	1.17
Misc. sharks	14,042	16.0	.80
Hammerhead shark	3,989	4.5	.29
Blacktip shark	3,407	3.9	.18
Mako shark	2,974	3.4	.16
Sandbar shark	1,226	1.4	.08
Dusky shark	1,185	1.4	.06
Tuna	683	.8	.04
Misc. Teleosts	565	.6	.03
Marlin	441	.5	.02
Tiger	313	.4	.02
Thresher	296	.3	.03
Lamnids	133	.2	<.01
Silky	27	<.1	<.01
Effort			
Total Catch	87,662		
Total Hooks	1,883,694		
Total Sets	1,588		
No. Caught/Set[1]	55.2		
No. Hooks/Set[2]	1,186		
Avg. Total CPUE	4.53		

[1]Calculated by dividing total catch by total sets.

[2]Calculated by dividing total hooks by total sets.

To gain a better understanding of the incidental bycatch associated with longline effort directed at swordfish, it is helpful to compare that data to effort targeting tunas and sharks. Species composition and effort data are provided for longline fisheries targetting sharks, swordfish, and tuna in Table 10 (Hoey and Casey, 1983b). Records from over 2,500 sets of gear accounting for 1.9 million hooks and the capture of over 92,000 sharks and teleosts were analyzed. The fishing area included the Gulf of Mexico and the east coast of North America to the Tail of the Grand Banks. Information was also obtained from U.S. observers stationed aboard Japanese vessels fishing within the U.S. Fishery Conservation Zone (FCZ). The observers recorded catches of 143,000 sharks and teleosts on 2,272 sets with total effort exceeding 4.9 million hooks. Data from the inshore (depth less than 100 meters) and offshore shark fisheries were combined to form a single NMFS shark effort category. The relative proportions of the different species caught by each longline fishery are shown in Figure 13 (Casey et al., 1983).

The U.S. swordfish effort and the Japanese tuna effort are established commercial fisheries, whereas the NMFS shark and tuna effort was more exploratory in nature. Directed tuna effort (both NMFS and Japanese) produces a larger proportional catch of teleosts than does effort directed at swordfish and sharks. Tuna fisheries produce higher proportions of billfish (excluding swordfish) and other teleosts, whereas the swordfish fishery produces a higher shark bycatch. These results indicate similarities in activity patterns between swordfish and sharks which are more active at night, and tunas and billfish which are more active during the day. Fishermen exploit these differences by fishing primarily during the nighttime for swordfish and during the daytime for tunas. Fishermen also attempt to fish within the preferred temperature range of their target species by regulating the depth of the line and fishing in different geographic areas. Differences in fishing grounds partially account for differences in the proportions of swordfish caught by the Japanese and NMFS tuna fisheries (3.4 percent vs 12.4 percent, respectively). The NMFS tuna effort occurred primarily north of Cape Hatteras and was directed at bluefin tuna. The Japanese effort was more evenly distributed throughout the Gulf of Mexico and Atlantic FCZ, and was primarily directed at yellowfin, bigeye, and albacore tuna. Relatively large catches of bluefin

Table 10. Species and effort summaries by fishery. (Mean CPUE was calculated by averaging individual sets.) (Source: Hoey and Casey, 1983b.)

Species	Inshore Shark Fishery			Offshore Shark Fishery			Commercial Swordfish Fishery			NMFS Tuna Fishery			Japanese Tuna Fishery		
	Number	Percent	CPUE[1]	Number	Percent	CPUE	Number	Percent	CPUE	Number	Percent	CPUE[2]	Number	Percent	CPUE[3]
Sharks															
Blue shark	2,724	59.0	5.04	4,129	65.2	5.41	25,413	33.8	1.42	1,166	17.9	.83	22,620	15.7	
Hammerhead	75	1.6	.18	336	5.3	.47	3,619	4.8	.31	100	1.7	.08	369	.3	
Blacktip	57	1.2	.35	-	-	-	3,308	4.4	.20	-	-	-	49	<.1	
Mako	93	2.0	.18	362	5.7	.56	2,152	2.9	.13	101	1.6	.08	1,817	1.3	
Sandbar	664	14.4	1.62	68	1.1	.13	1,164	1.5	.08	1	<.1	<.01	71	<.1	
Dusky	179	3.9	.46	91	1.4	.11	1,105	1.6	.07	78	1.2	.07	587	.4	
Tiger	142	3.1	.30	22	.3	.03	297	.4	.02	4	.1	<.01	285	.2	
Thresher	17	.4	.03	77	1.2	.10	216	.3	.02	3	<.1	<.01	919	.6	
Silky	50	1.1	.12	126	2.0	.17	27	<.1	<.01	124	1.9	.08	487	.3	
Lamnids	35	.8	.09	19	.3	.02	110	.1	<.01	31	.5	.02	255	.2	
Misc. sharks	522	11.3	1.41	193	3.0	.25	12,764	17.0	.85	171	2.6	.13	2,787	1.9	
Teleosts															
Swordfish	7	.2	.01	413	6.5	.35	23,354	31.1	1.22	806	12.4	.46	4,934	3.4	
Tuna	8	.2	<.01	298	4.7	.26	627	.8	.04	3,377	51.9	2.33	70,151	48.8	
Billfish	4	<.1	<.01	21	.3	.02	438	.6	.02	78	1.2	.05	4,591	3.2	
Misc. Teleosts	41	.9	.11	177	2.8	.24	518	.7	.03	463	7.1	.34	33,728	23.5	

Effort	Inshore Shark Fishery	Offshore Shark Fishery	Commercial Swordfish Fishery	NMFS Tuna Fishery	Japanese Tuna Fishery
Total Catch	4,618	6,332	75,192	6,511	143,650
Total Hooks	47,356	80,252	1,609,411	144,890	4,975,101
Total Sets	538	309	1,368	331	2,272
No. Caught/Set[4]	8.6	20.5	54.9	19.7	63.2
No. Hooks/Set[5]	88	260	1,176	438	2,190
Avg. Total CPUE	9.91	8.12	4.44	4.48	N/A

[1]Based on 527 sets.

[2]Based on 330 sets.

[3]No CPUE values availab.e

[4]Calculated by dividing total catch by total sets.

[5]Calculated by dividing total hooks by total sets.

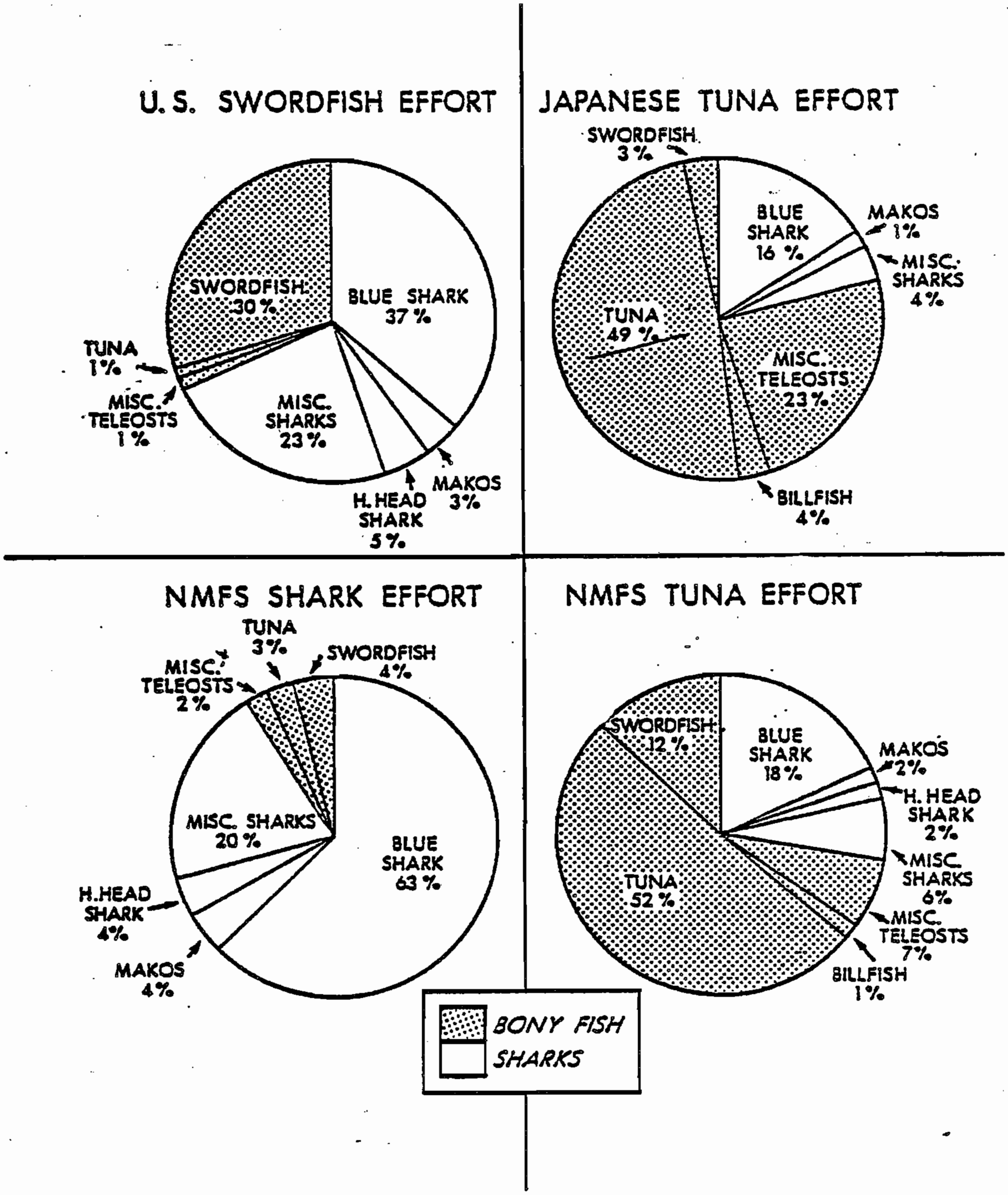


Figure 13. Species composition (%) from longline fisheries in the western North Atlantic. (Source: Casey et al., 1983.)

tuna were often associated with large catches of swordfish in both the NMFS and Japanese data. This relationship reflects greater similarities in temperature preferences, between swordfish and bluefin tuna than between swordfish and the other more tropical tunas. It may also reflect preferences for regions characterized by sharp thermal gradients. With respect to differences in catch during the day and night, the proportion of billfish (marlins) caught by the NMFS tuna effort (primarily daytime effort) was double that produced by the commercial swordfish effort (night), despite greater swordfish effort in southern areas where billfish are more abundant.

Based on the values in Table 10, the NMFS tuna fishery occupies a position midway between the swordfish and Japanese tuna fisheries, in terms of the proportion of swordfish and billfish caught. As previously mentioned, this can be partially attributed to differences in the areas exploited and target species sought. Of greater importance, however, is that night sets were made during some of the NMFS tuna cruises. These sets established the commercial feasibility of longline exploitation of swordfish stocks off the U.S. east coast. The published fishing records from these early Bureau of Commercial Fisheries and NMFS cruises (Wilson and Bartlett, 1967; Casey and Hoenig, 1977 - Appendix 9) did however list time at the start and end of the set. These data allow for a more thorough examination of day versus night sets. In Table 10, 331 sets of NMFS tuna effort produced 3,377 tuna, 78 billfish, and 806 swordfish. Of the 331 sets summarized, 226 sets occurred between 0500 and 1800 hours. Those sets produced 2,964 tuna, 73 billfish, and only 6 swordfish. Sixty eight percent of the sets (all daytime sets) produced 88 percent of the tunas, 94 percent of the billfish and only 0.7 percent of the swordfish. The remaining night sets (105 -32 percent) produced 413 tuna (12 percent), 5 billfish (6 percent) and 800 swordfish (99 percent). These data dramatically substantiate the temporal segregation between tuna and billfish which are more vulnerable to daytime longline effort, and swordfish which are more vulnerable to nighttime effort.

8.1.8 Estimate of MSY

8.1.8.1 Yield-per-Recruit Analysis

8.2 Description of Habitat

8.2.1 Condition of Habitat

Effort distribution data from various areas in the U.S. commercial swordfish fishery (Berkeley and Irby, 1982 - Florida East Coast; Hoey and Casey, 1983a - North of 35° N) indicate a rather narrow concentration of effort along the edge of the shelf and along frontal zones between water masses (Section 8.1.3.4). Assuming that the prevalent effort distribution pattern reflects economic forces which have sought maximization of catch rates, then swordfish are apparently restricted to a rather narrow horizontal zone. In the Swordfish Source Document (May 1982) the importance of the Gulf Stream system is emphasized as the primary hydrographic habitat of the swordfish. The importance of the position of the "North Wall" and the location of meanders and eddies is especially important north of Cape Hatteras. Hoey and Casey (1983a) classified 165 longline sets from 1978-1980 into seven water mass types. All sets were located north of 35° N and west of 55° W, and classification was based on the date and location of the set, surface water temperature and the correlation and plotting of these values on weekly National Earth Satellite Service oceanographic analyses charts (modified by the Atlantic Environmental Group (AEG), Narragansett, Rhode Island). Water mass totals for sets and swordfish along with the mean swordfish CPUE and the CPUE rank were calculated (Table 11). The following is taken directly from the manuscript:

There were 59 autumn sets, 58 summer sets, 32 spring sets and 16 winter sets. An analysis of variance on rank transformed CPUE values indicates that effects of season, water mass, and season-water mass interaction on CPUE are all significant. The multiple range tests indicate that the summer and autumn CPUE ranks do not differ significantly, but they are significantly greater than the winter and spring ranks. With regard to the water mass ranks, the slope, shelf-slope front, ring edge and northwall values do not differ significantly from each other, but are significantly greater than the ring, Gulf Stream, and shelf rank values. Only the highest average rank from the slope and the lowest average rank from the shelf are distinctly different, while there is some overlap between the remaining ranks in the two major groupings. The mean CPUE rank for the slope is clearly the highest value; however the remaining values indicate that frontal zones between water masses are more productive than the water masses themselves. When the water mass ranks are compared within seasons, the results from an

Table 11. Total number of sets and swordfish, and mean swordfish CPUE values and mean CPUE rank, by water mass (Source: Hoey and Casey, 1983a).

Water mass	Sets	Total Swordfish Caught	Mean CPUE	Mean CPUE Rank
Shelf	10	55	.36	42.7
Shelf/slope front	43	975	1.53	88.9
Gulf Stream	13	69	.52	53.3
Northwall of Gulf Stream	26	511	1.35	78.4
Ring	7	72	.91	72.4
Ring edge	44	973	1.35	88.6
Slope	22	657	1.87	105.1
	165	3,312		

ANOVA indicate that the water masses are not significantly different from each other during the spring, summer and winter. Autumn water mass ranks form two groups with the northwall, shelf-slope front, and slope ranks exceeding the ring edge, ring, Gulf Stream and shelf ranks. There is some overlap between these groups with the average rank from the ring edge not significantly different from the average ranks from the shelf-slope front and slope.

The water mass data (Table 11) indicate that swordfish catch rates are significantly greater in the slope water and along frontal zones. Effort in the slope water mass is the most productive. The areal extent of the slope water is seasonally controlled by the extent and offshore boundary of the shelf water. When the shelf-slope front is further offshore, the areal extent of the slope water is reduced, and this may act to further concentrate swordfish, increasing the productivity of effort in that area. Additional data are necessary before this hypothesis can be tested. Effort along frontal zones delineating two water masses however, is generally very productive, indicating that swordfish may concentrate there. Squire (1962), Laurs and Lynn (1977), Sharp (1978), and Roberts (1980) have all documented a similar tendency for tunas to aggregate along frontal zones. These productive areas between water masses may represent the feeding habitat of large oceanic predators. Swordfish are commercially concentrated along frontal zones which can be very effectively exploited by wide-ranging longline vessels. This may partially account for the responsiveness of the swordfish stocks, in terms of changing catch rates and average sizes, to increasing fishing effort.

8.4 Description of Fishery Activity

8.4.1 History of Exploitation

8.4.1.1 Recreational

No new information on the historical recreational fishery is available.

8.4.1.2 Commercial

Hoey and Casey (1983a) provide additional information on the catch rates and average sizes caught from 1963-1982 including additional records from the clandestine fishery in the early 1970's.

8.4.2 Domestic Recreational and Commercial Fishery Activities

8.4.2.1 Participating User Groups

8.4.2.1.1 Recreational

In the Swordfish Source Document (May 1982) the rapid expansion and the decline of the recreational swordfish fishery was described. Poor recreational fishing success in 1979 and subsequent years has caused the cancellation of tournaments and reduced recreational interest in swordfish. Data provided by the Stuart Sailfish Club (Figure 14) confirm decreasing angler interest and also decreasing catches. This trend is also apparent in the South Carolina recreational records (Figure 15) which indicate that 1978 was the banner year for the recreational swordfish fishery. In a survey of New Jersey's offshore recreational canyon fishery which primarily targets tuna, 86 swordfish were reported captured in 1981 and 53 were reported in 1982 (Figley et al., 1983).

8.4.2.1.2 Commercial

Changes have occurred in the characteristics of the commercial effort directed at swordfish in the western North Atlantic. Most Cuban-American type effort (Berkeley et al., 1981) has been replaced by the primarily monofilament gear first popularized by Florida east coast fishermen. This southern style gear has been widely accepted, it has replaced the older New England style gear (Ruhle, 1969), and it now represents the dominant gear type used in the U.S. commercial fishery. Another major change which has occurred since 1980 involves the sizes and numbers of vessels which characterize the highly mobile component of the fleet. In 1979 and 1980, the highly mobile vessels were primarily larger New England boats which fished from the Gulf of Mexico and the Florida Keys (winter months) to the Tail of the Grand Banks (summer-fall). At that time (1979-80), the smaller southern vessels (particularly Florida boats) were not considered to be very mobile. Between 1980 and 1983 many of the smaller vessels, which had primarily operated off the east coast of Florida, expanded their range through the Carolinas and into the Mid-Atlantic area. Currently the smaller vessels operate throughout the entire range of the U.S. fishery from the Straits of Florida to the U.S.-Canadian boundary. Some of these vessels have even made trips to the Tail of the Grand Banks, an area which previously had only been exploited by the largest and most weather safe vessels. In general terms, the number of vessels which would be classified as highly mobile, moving up and down the east coast focusing effort on the most productive areas, has surely increased. The effectiveness of each of these vessels has

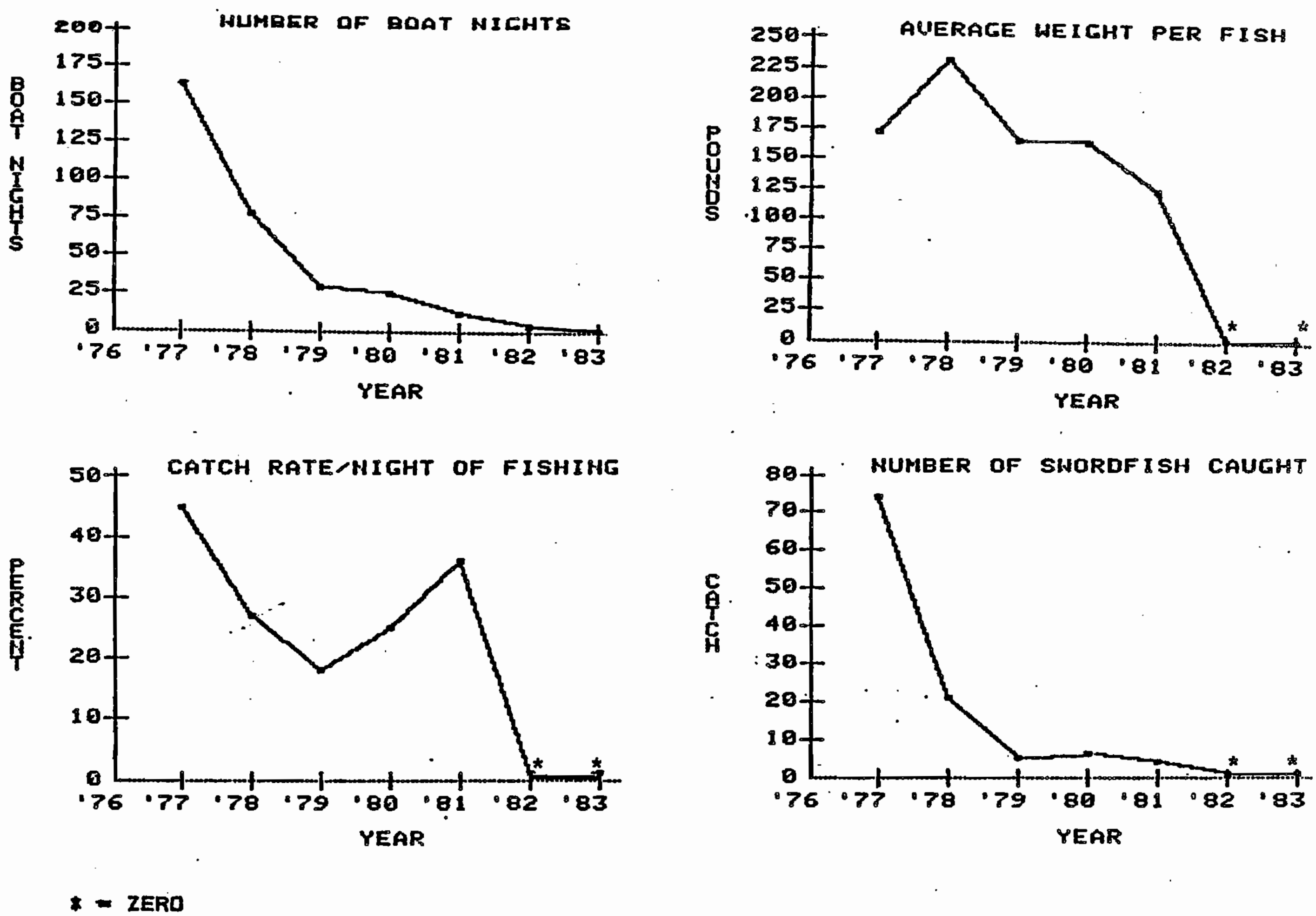


Figure 14. Swordfish statistics from the Stuart Sailfish Club. (Source: Robert Pelosi, Stuart Sailfish Club, Stuart, FL; pers. comm.)

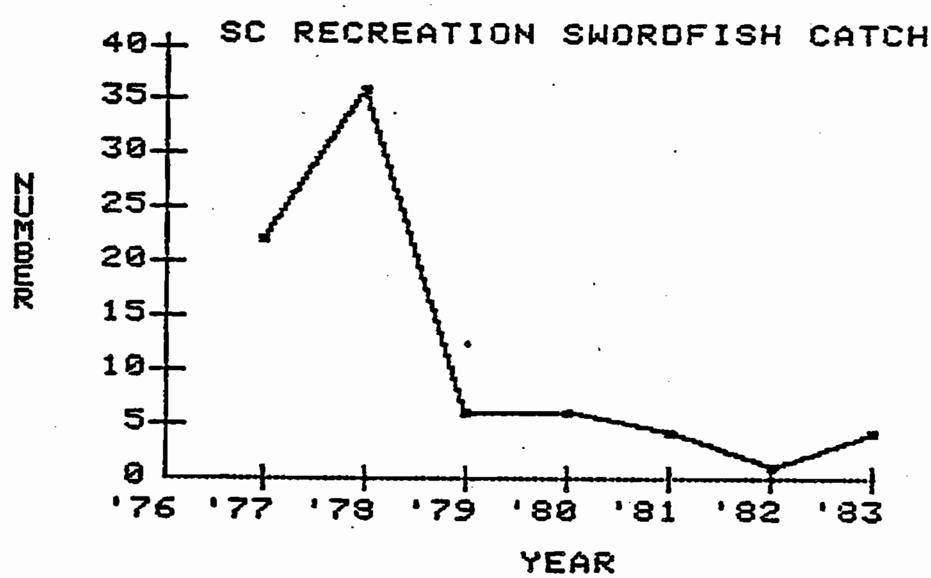


Figure 15. South Carolina recreation swordfish catch (Source: S.C. Wildlife and Marine Resources Department, unpubl. data).

also increased as they have shifted to the more sophisticated monofilament gear. These highly mobile vessels probably account for more landings than would be indicated by their proportional importance in the total fleet. Resident smaller vessels, (fishing year round in their respective areas) were primarily confined to Florida's east coast in 1979-1980. In 1983 resident vessels operated out of Florida, South Carolina, Virginia, Maryland, and New Jersey. Many of these operators are either part-time commercial fishermen, supplementing income from charter boat fishing; or full-time commercial fishermen who fish for snappers, groupers, tilefish, and other species when they are not targeting swordfish or tuna.

Since 1979-80 the number of individuals participating in each of these user groups has probably increased. This has occurred because of the high value of the product and because gear modifications, the use of smaller boats, and diversification into other longline fisheries (tunas or bottom fish) has reduced the initial cost of entering the fishery. Although accurate estimates of the numbers of vessels in each user group category are not currently available, the Management Councils and the National Marine Fisheries Service are planning to remedy this deficiency by the end of 1984 through a data collection plan which has a swordfish fishery survey as one of its components.

8.4.3 Vessels and Fishing Gear

8.4.3.1 Recreational

No new information.

8.4.3.2 Commercial

As mentioned in Section 8.4.2.1.2, the southern style monofilament longline has become widely accepted throughout the U.S. fishery. Currently, fewer hooks are used per set, hook spacing is wider, the total length of the mainline fished per set is longer, and the sophistication of the individual branch lines (gangions) complete with cyalume light sticks is greater than was used during the late 1970's. The use of sea surface temperature analysis charts has also become more widespread (Figure 16). The traditional New England harpoon fishery remains relatively unchanged (Figure 17). Large mesh entanglement nets are used by a small number of vessels primarily in the New England area. Documentation of the effectiveness of the gear is lacking. The Councils and the National Marine Fisheries Service are working towards establishing an observer program for these vessels so that data can

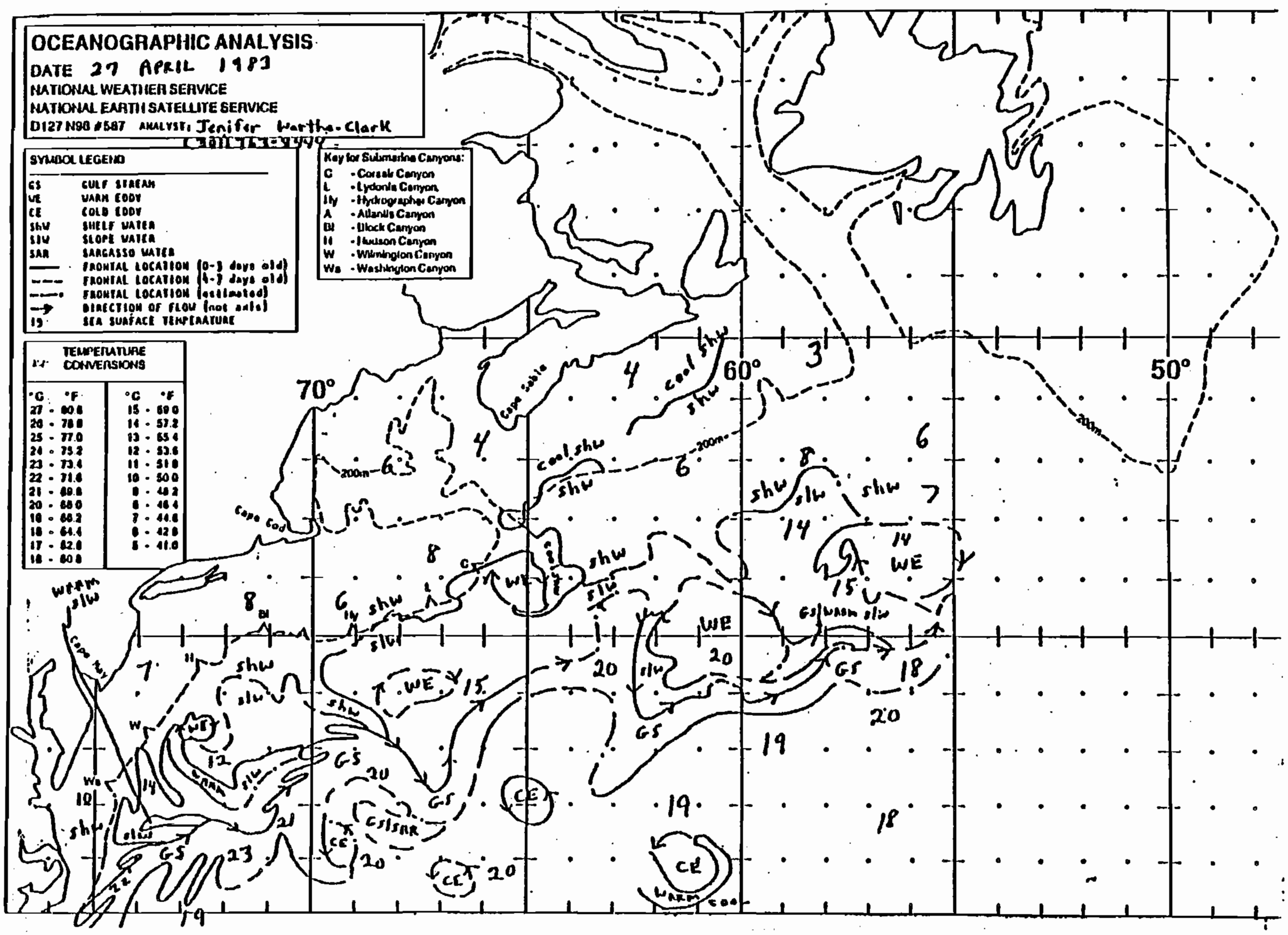


Figure 16. Oceanographic Analysis for 27 April 1983. (Source: Clark et al., 1983.)

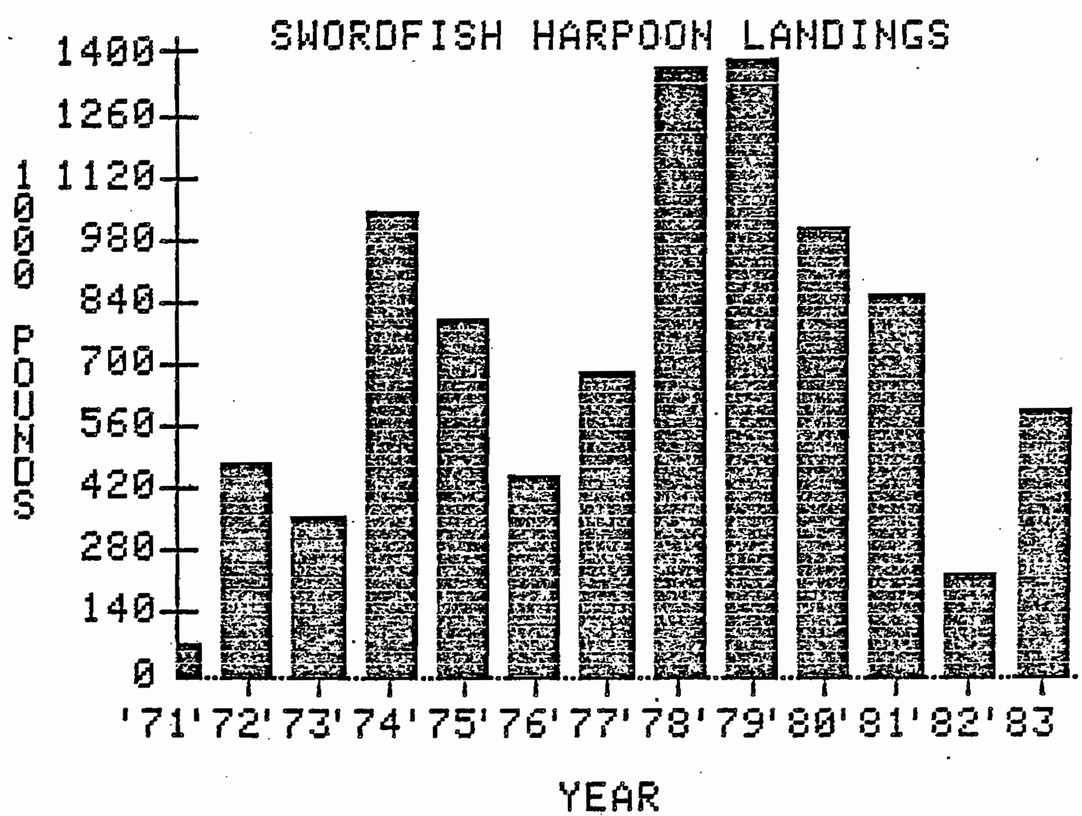


Figure 17. Harpoon landings for the years 1971 through 1983. (Source: 1971-76 Fishery Statistics of the U.S.; 1977-83 NMFS Unpubl. Data)

be collected to help resolve this contentious issue. The recent use of these large mesh entanglement nets by U.S. fishermen started in California. This gear was originally used in a directed fishery for pelagic sharks, primarily the common thresher, Alopias vulpinus, and the bonito shark, Isurus oxyrinchus (Cailliet and Bedford, 1983). Blue sharks, Prionace glauca, are also taken in large numbers; however, marketing problems currently limit their retention for sale. Swordfish were at first a relatively small but desirable bycatch. As fishermen gained experience with the net and expanded their range of operation, the gear became very effective to use during the late summer and early fall to harvest swordfish (Bedford and Hagerman, 1983). In response to the market demand for sharks and swordfish, the number of vessels participating in the fishery increased from 15 in 1976 to about 200 vessels in 1981. Bedford and Hagerman (1983) review the history of California swordfish management, which has been primarily based on social and economic considerations, and they maintain that the limited activities of the commercial swordfish fleet pose no threat to the stability of the swordfish stock. At the present time there are no quotas or limits placed on the harvest of sharks and swordfish by the entanglement nets, although entry into the fishery is limited and there are gear size restrictions and some closed areas (Bedford and Hagerman, 1983). The only other known new development in the swordfish fishery has been the use of a small number (less than 4) of ultra-light airplanes in conjunction with offshore harpooning.

8.4.4 Foreign Fishing Activities

8.4.4.1 Foreign Fishing Within the FCZ

Japanese longliners fish for tunas within the U.S. FCZ, although the number of vessels deployed has been reduced over levels observed in the mid-1970's. Table 12 updates swordfish bycatch values presented in the Swordfish Source Document (May 1982) Tables 8-20 and 8-21. Table 13 documents the swordfish bycatch by area for 1978-1980.

Based on observer records from July 1982 through December 1982, with coverage ranging from a low of 63 percent (December) to 100 percent (August and November), 1,020 swordfish were reportedly captured of which 537 (53 percent) were released alive, 459 (45 percent) were released dead, and 24 (2 percent) were released with status undetermined. During that period, the swordfish bycatch accounted for 77 percent of the total incidental catch of billfish and 5.1 percent of the total catch of tunas.

Table 12. Total incidental swordfish catch (number of fish) extrapolated from observer data and data reported by the Japanese. (Source: NMFS Observer Program Data.)

	ATLANTIC		GULF		TOTAL	
	Japanese data	Observer data	Japanese data	Observer data	Japanese data	Observer data
1978	4,222	5,639	770	987	4,992	6,626
1979	1,347	1,999	2,450	2,426	3,797	4,425
1980	2,843	3,660	2,068	4,415	4,911	8,075
1981	6,314	1,321*	2,148	480*	8,462	1,801*
1982	1,136	1,028*	0	0	1,136	1,028*
1983		249		0		249

*These are preliminary data obtained with less than 100 percent observer coverage. Near 100 percent coverage was accomplished in 1982.

Table 13. Longline incidental swordfish catch (number of fish) by area as reported by the Japanese and extrapolated from Observer data. (Source: NMFS Observer Program Data)

	1978	1979	1980
Japanese Data			
Gulf	770	2,450	2,068
South Atlantic	828	394	558
Mid-Atlantic	3,382	953	2,285
New England	12	-	-
Total	4,992	3,797	4,911
Observer Data			
Gulf	987	2,426	4,415
South Atlantic	1,106	526	524
Mid-Atlantic	4,533	1,473	3,136
New England	-	-	-
Total	6,626	4,425	8,075

With 100 percent coverage in 1983, 249 swordfish were recorded of which 79 (32 percent) were released alive, 169 (68 percent were released dead, and 1 was released with status undetermined. Swordfish account for 67 percent of the total incidental catch of billfish, and 2.1 percent of the total catch of tunas.

A more detailed species account of the catches associated with Japanese longline effort in the U.S. FCZ, based on observer records from 1978-1981, is provided in Table 14. Tunas account for 49 percent of the total catch in all areas combined, followed by miscellaneous teleosts (23 percent), sharks (21 percent), swordfish (3.4 percent), and other billfish (3.2 percent). The swordfish bycatch represents 7 percent of the tuna catch based on the numbers of individuals caught.

The largest proportional catch of tunas (58 percent of the total catch) occurred in the Gulf of Mexico. Effort there also produced the largest percentages of billfish (6.7 percent) and swordfish (7.4 percent). In the Atlantic south of Cape Hatteras, the proportion of tunas (55.6 percent) and billfish (5.9 percent) remained high, but the swordfish bycatch (2.1 percent) was much lower. The reduction in the proportional catch of swordfish from 7.4 percent to 2.1 percent can be partially explained by a change in the relative importance of the different species of tunas caught. Whereas bluefin tuna account for 0.2 and 1.5 percent of the total tuna catch in the Atlantic south of Hatteras and Atlantic north of Hatteras, respectively, in the Gulf of Mexico bluefin account for 37 percent of the total catch of tunas (tuna species composition data not provided in Table 14).

Sharks accounted for 13 and 17 percent of the total catch in the Gulf of Mexico and Atlantic south of Cape Hatteras, respectively. In the Atlantic north of Cape Hatteras, the shark bycatch was the highest (25 percent) while the proportions of tunas (43.5 percent) and billfish (1.2 percent) were lower than values for the more southern areas. The proportions of swordfish landed north of Cape Hatteras, (3.0 percent) exceeded the value in the Atlantic south of Cape Hatteras, but was lower than the corresponding value in the Gulf of Mexico. North of Cape Hatteras, swordfish account for 72 percent of the total billfish catch with white marlin contributing an additional 24 percent. Swordfish account for 6.8 percent of the total catch of tunas north of Cape Hatteras.

Table 14. Summary of U.S. observer records of Japanese longline effort in the U.S. Fishery Conservation Zone 1978-1981. Data provided by the Southeast Fisheries Center of NMFS.

	Gulf of Mexico		Atlantic South of Cape Hatteras		Atlantic North of Cape Hatteras		Total All Areas	
	Number	%	Number	%	Number	%	Number	%
Blue shark	136	.6	3,903	10.9	18,581	21.7	22,620	15.7
Hammerhead	69	.3	208	.6	92	.1	369	.3
Blacktip	25	.1	22	.1	2	<.1	49	<.1
Mako	607	2.7	391	1.1	819	1.0	1,817	1.3
Sandbar	19	.1	48	.1	4	<.1	71	<.1
Dusky	387	1.7	90	.3	110	.1	587	.4
Tiger	92	.4	118	.3	75	.1	285	.2
Thresher	245	1.1	401	1.1	273	.3	919	.6
Silky	453	2.0	29	.1	5	<.1	487	.3
Lamnids	118	.5	37	.1	100	.1	255	.2
Misc. sharks	717	3.2	976	2.7	1,094	1.3	2,787	1.9
Swordfish	1,641	7.4	753	2.1	2,540	3.0	4,934	3.4
Tuna	13,011	58.3	19,960	55.6	37,180	43.5	70,151	48.8
Billfish	1,486	6.7	2,101	5.9	1,004	1.2	4,591	3.2
Misc. Teleost	3,310	14.8	6,839	19.1	23,579	27.6	33,728	23.5
Total Catch	22,316		35,876		85,458		143,650	
Total Hooks	1,596,052		822,140		2,556,989		4,975,181	
Total Sets	768		374		1,130		2,272	

Data on the incidental catch of swordfish in the foreign squid trawl fishery are updated in Table 15. Although the observed bycatch (42,000 lb) is only slightly lower than 1981 and 1982 levels, the extrapolated total bycatch is about half the reported 1982 value. This is most likely due to a reduction in the number of foreign vessels trawling for squid off our coast as joint ventures have increased in importance.

8.4.4.2 Foreign Swordfish Fishing in the North Atlantic

Total reported commercial landings of swordfish from the North Atlantic are listed by country in Table 16. From 1978 to 1982, Spain and the U.S. accounted for between 42 and 71 percent of the total reported landings. Adding Canada and Japan raises the proportion of the total catch accounted for between 69 and 85 percent. These FAO statistics however do not correspond exactly to data presented in other sections of this addendum. U.S. reported commercial landings (Table 8, Section 8.1.5.6) for 1978, 1979, and 1980 exceed values in the FAO statistics by a few hundred thousand pounds. In 1981, the FAO landings for the U.S. are greater than those listed in Table 8; then in 1982, the U.S. catch in Table 8 exceeds that reported in the FAO statistics. The estimated 1981 Canadian harvest was reported to range between 2.9 and 3.9 million pounds (Section 8.1.5), almost triple the FAO reported value. Although these discrepancies need to be addressed, the relative magnitudes of each nation's total landings may be fairly accurate.

8.4.4.3 Foreign Swordfish Fishery in the Western North Atlantic

Total reported commercial landings of swordfish from the western North Atlantic are listed by country and year (1978-1982) in Table 17. The U.S. accounted for between 45 percent (1978) and 75 percent (1981) of the total landings. This percentage decreased slightly to 71 percent in 1982. Combining the U.S. and Canada accounted for between 87 and 89 percent of the total landings between 1978 and 1982 (Table 18). Western North Atlantic landings (FAO areas 21 and 31) accounted for 53 percent of the total reported landings in the North Atlantic (FAO areas 21, 31, 27, and 34) in 1978. This increased to a peak of 73 percent in 1979 and has decreased each year since to 42 percent in 1982.

8.4.5 Conflicts Between Domestic and Foreign Fishing

Recent revisions to the PMP for Atlantic Billfishes and Sharks (June, 1983) present the following material which summarizes reported conflicts:

Table 15. Foreign squid trawls swordfish bycatch. (Source: NMFS Observer Program Data.)

Year	Observed Bycatch (lb)	Extrapolated Total Bycatch (lb)
1980	43,793	144,522
1981	49,152	162,207
1982	47,366	176,298
1983	42,022	85,888

Table 16. Swordfish catches (pounds) from the North Atlantic.* (Source: FAO, Yearbook of Fishery Statistics)

	1978	1979	1980	1981	1982
Canada	6,730,643	6,547,662	4,153,466	1,272,054	2,078,938
Cuba	1,322,760	881,840	1,309,532	824,520	1,512,355
Japan	1,265,440	1,194,894	2,422,855	1,483,696	1,990,754
Korea Republic	2,204,600	961,205	1,463,854	961,206	1,430,786
Morocco	394,623	458,557	299,826	275,575	224,869
Poland	13,228	a	2,205	a	a
Spain	5,222,697	2,202,395	3,919,778	6,375,703	10,809,153
Togo/Ghana	4,160,080	a	242,506	22,046	11,023
USA	7,125,267	7,321,476	8,095,291	8,004,903	8,258,431
USSR	321,871	127,867	308,644	79,366	198,414
Venezuela	101,412	147,708	88,184	55,115	55,115
Portugal	37,478	63,933	33,069	a	a
France	a	a	11,023	8,818	a
Liberia	a	a	11,023	83,775	74,956
Other[b]	705,472	1,234,576	714,290	709,882	652,562
Total	29,605,571	21,142,113	23,075,546	20,156,659	27,297,356

* FAO statistical reporting areas 21, 27, 31 and 34.

a None reported

b FAO estimate

Table 17. Swordfish catches (pounds) from the western North Atlantic.*
(Source: FAO, Yearbook of Fishery Statistics)

	1978	1979	1980	1981	1982
Canada	6,730,643	6,547,662	4,153,466	1,272,054	2,078,938
Cuba	881,840	220,460	471,784	350,531	235,892
Japan	593,037	577,606	815,702	683,426	568,787
Korea Republic	24,251	a	a	a	57,320
Morocco	a	a	a	a	a
Poland	13,228	a	2,205	a	a
Spain	a	a	a	a	4,409[b]
Togo/Ghana	a	a	a	a	a
USA	7,125,267	7,321,476	8,095,291	8,004,903	8,258,431
USSR	a	a	a	a	a
Venezuela	101,412	147,708	88,184	55,115	55,115
Portugal	a	a	a	a	a
France	a	a	a	a	a
Liberia	a	a	a	a	a
Other[b]	352,736	617,288	357,145	354,941	326,281
Totals	15,822,414	15,432,200	13,983,777	10,720,970	11,585,173

* FAO statistical reporting areas 21 and 31
a None reported
b FAO estimate

Table 18. Percent swordfish catch from the western North Atlantic taken by the USA, by Canada, and by both combined. (Source: FAO, Yearbook of Fishery Statistics)

	1978	1979	1980	1981	1982
USA	45	47	58	75	71
Canada	43	42	30	12	18
US and Canada	88	89	88	87	89

A conflict is a direct encounter between the vessels or gear of foreign longliners and the vessels or gear of domestic fishermen that results in: damage or destruction of fishing gear, loss of gear and associated catch through disappearance of the gear or its location buoys, preemption of fishing grounds, removal of catch from the gear, or vessel collision. Such encounters are generally inadvertent (e.g., vessel severing an unseen longline, drifting longline gear entangling longline or lobster trap buoy) but may be hostile because of differing uses of Atlantic billfishes or the fishing grounds in the FCZ as each group pursues its legitimate interests. Also, similar encounters may occur between domestic vessels and gear.

Four sources on gear conflicts were used to document whether or not gear conflicts occurred in which areas. These sources were the U.S. Coast Guard reported conflicts; Gear Compensation Files, National Marine Fisheries Service (NMFS); conflicts involving Japanese longline vessels reported by NMFS observers on Japanese or domestic vessels; and informal reports to NMFS.

There are numerous areas along the Atlantic and Gulf coasts of the United States where U.S. sportfishermen come into direct contact with foreign longliners. Some of these are in the Gulf of Mexico off Port Aransas, Texas, the Mississippi Delta off Louisiana, and the Dry Tortugas, Florida; off Cape Hatteras, North Carolina; and off New Jersey and Maryland. U.S. fishermen have reportedly destroyed longline gear, although there is no record of U.S. sportfishing gear being damaged by foreign fishermen (Charles Fuss, Jr., Southeast Regional Office, NMFS, 1982; pers. comm.). Conflicts between foreign commercial and U.S. sportfishermen reached a peak in the late 1960s and prompted private negotiations between representatives of the Japanese fishing industry and the U.S. sportfishing industry. These negotiations resulted in an informal understanding between the two parties that Japanese vessels would restrict their fishing to areas other than those where U.S. sportfishermen fished for billfishes, and U.S. sportfishing representatives would discourage the destruction of Japanese longline gear. Subsequent negotiations were conducted between the Japanese fishing industry and the U.S. commercial and sportfishing industries.

The U.S. Coast Guard provided information on reported conflicts between Japanese longline vessels (JAPLL) and domestic commercial and recreational fishermen (Table 19). Based on this information, there were 21

Table 19. Gear conflicts involving domestic and Japanese longline fishing vessels as reported by the Coast Guard. (Source: NMFS PMP for Atlantic Billfishes and Sharks, June, 1983.)

DATE		REPORTING VESSEL	LONGLINER VESSEL INVOLVED	LOCATION LATITUDE	LOCATION LONGITUDE	GEAR LOST	$ VALUE	PREVENTED BY CLOSURE YES	PREVENTED BY CLOSURE NO	FIXED GEAR BROADCASTING
1978										
1/	3/1	Phoenix	JAPLL	39° 19'N	72° 20'W	380 pots			X	X
1979										
	1/12	Yankee Clipper	JAPLL	37° 58'N	73° 54'W	—	200		X	X
1980										
2/	9/21	Sophie G	JAPLL	--	--	160 pots	8,000	X		X
	9/21	Sea Fisher I	JAPLL	39° 50'N	71° 31'W	none-entanglement		X		X
1/	10/6	Independence	JAPLL	39° 13'N	72° 05'W	12 nautical miles of longline gear	20,000	X		
1981										
	3/2	Sophie G	JAPLL	39° 30'N	72° 09'W	270 pots	19,310		X	X
	6/19	Audrey Lynn	JAPLL	40° 02'N	68° 44'W	none-entanglement		X		
	7/27	Reliance	JAPLL	40° 20'N	68° 10'W	3 high flyers	250	X		
	8/2	JAPLL	Western Boy	39° 53'N	70° 31'W	vessel collision	43,500	X		
	8/29	JAPLL	Western Boy	39° 52'N	71° 21'W	vessel collision	none	X		
	8/30	JAPLL	American Boy	40° 04'N	68° 48'W	none-entanglement		X		
1/	9/19	Colleen	JAPLL	36° 49'N	74° 38'W	Pots	25,745	X		X
	9/11	Patriot	JAPLL	40° 04'N	70° 14'W	none-entanglement		X		
	9/25	Taurus	JAPLL	39° 52'N	70° 40'W	none-entanglement		X		
	10/8	Colleen	JAPLL	36° 50'N	74° 39'W	none-entanglement		X		
	11/21	Calico Jack	JAPLL	36° 31'N	74° 09'W	none-entanglement		X		
		Venka M	JAPLL	36° 00'N	74° 03'W	5 miles of lost gear		X		
	11/20	Original Jackson	JAPLL	37° 41'N	74° 09'W	3conflicts 75 pots	2,600	X		X
	11/22	Dealer's Choice	JAPLL	37° 43'N	71° 56'W	7.5nm longline gear	9,000	X		
	11/27	JAPLL	Happy Glen	36° 28'N	74° 16'W	none-entanglement		X		
								19	3	7

1/ Included in damage to domestic vessels and fishing gear. Attributed to foreign fishing vessels.
2/ Normal fishing grounds are covered by the closure.

gear conflict incidents involving domestic and JAPLL vessels from March 1978 through May 1982. One conflict occurred in 1978 and in 1979, three occurred in 1980, and 16 occurred in 1981. Because of no JAPLL fishing, none occurred in 1982. Of the 21 conflicts, 18 would be preventable by the proposed Atlantic closures.

The Gear Compensation Files showed that NMFS paid 15 claims between March 1978 and September 1981 for gear damage attributed to foreign vessels (Table 20). Incidents by unknown vessels and identified foreign trawlers were excluded. Of the 15 claims, nine incidents might have been prevented by the proposed closures. Of the remaining incidents, six involved crab or lobster pot fishermen and might have been prevented by the fixed gear broadcast.

Twenty-seven incidents were reported to NMFS or other government officials involving JAPLL and domestic vessels involved in conflicts that might have been prevented by the proposed Atlantic and Dry Tortugas closures (Table 21). NMFS observers on JAPLL and domestic vessels report gear conflicts involving the two groups. Under these circumstances, four conflicts were reported, all of which might have been prevented by the proposed closures.

Since 1977 when the domestic swordfishery expanded, conflicts between Japanese and U.S. longline fishermen have grown rapidly in number and severity. In 1980, bluefin tuna and swordfish were concentrated in a small area northwest of the Dry Tortugas, Florida. U.S. swordfish longliners (at least 17 vessels) and Japanese tuna longliners (at least 18 vessels) attempted to fish in this area. Conflicts and gear loss was experienced by both groups (Table 22). The domestic fishermen lost at least 77 miles of gear valued at $77,000. Some U.S. fishermen were forced to leave the area due to gear losses. Domestic longline fishermen have reported that similar situations occurred along the Atlantic coast in 1980 and 1981 during the summer and fall when the foreign tuna fishery was active. U.S. fishermen using lobster and crab traps along the Atlantic coast also reported gear losses from Japanese longlines in 1980 and 1981. The above incidents were reported at the Gulf of Mexico Fishery Management Council, Swordfish Management Committee, Fact-Finding Meeting, Naples, Florida, June 3, 1980, and South Atlantic Fishery Management Council, Inter-Council Swordfish Fishery Management Plan Meeting, Atlanta, Georgia, December 1-3, 1981. Also,

Table 20. Damage to domestic vessels and fishing gear attributed to foreign vessels as reported by the NMFS gear compensation fund. (Source: NMFS PMP for Atlantic Billfishes and Sharks, June, 1983)

No.	Date of Incident		Vessel	Location	Damage Type	Amount Reimbursed	Prevented by Closure Yes	Prevented by Closure No	Fixed Gear Broadcast
1.	1978	March 1	Phoenix	39°10'N/72°20'W	Lobster pots	$ 15,998.12		X	X
2.	1979	June 10	Saturn	38°10'N/74°10'W	Traps	5,207.44	X		X
3.	1980	March 22	Aladdin	25°13'N/84°15'W	Longline gear/hooks	3,310.40	X		
4.		March 24	Independence	24°50'N/84°21'W	Longline gear/hooks	3,514.63	X		
5.		March 27	Dan's Plan	25°00'N/84°00'W	Longline gear	3,410.69	X		
6.		May 2	Fair Wind	40°45'N/67°22'W	Pots	3,594.14		X	X
7.		June 18	Phoenix	39°10'N/72°30'W	Lobster pots	7,663.81	X		X
8.		June 27	Lady Janet	39°03'N/73°55'W	Lobster pots	3,510.98	X		X
9.		Oct 6	Independence	39°15'N/72°02'W	Longline gear/hooks	5,662.42	X		
10.		Oct 17	Original Jackson	38°26'N/73°45'W	Red crab pots	5,309.96	X		X
11.		Oct 24	Ari D	38°10'N/73°40'W	Longline gear/hooks	4,061.44	X		
12.		Dec 1	Colleen	37°10'N/74°32'W	Lobster pots	587.66		X	X
13.		Dec 4	Fishing Lady	37°32'N/74°11'W	Lobster pots	5,143.62		X	X
14.	1981	Jan 21	Phyllis Ann	39°30'N/72°26'W	Lobster pots	9,309.26		X	X
15.		Sept 16	Phyllis Ann	38°30'N/72°00'W	Lobster pots	11,387.88		X	X
					Total Amount Reimbursed	$ 87,672.45			

15 Claims Actually Paid out	
10 Claims for damage to pots/traps:	$ 67,712.87
5 Claims for damage to longline gears:	19,959.58
Total Amount Reimbursed for damage : Caused by foreign vessels	$ 87,672.45

SOURCE: National Marine Fisheries Service
Gear Compensation files Washington, DC.

Table 21. Japanese/U.S. vessel longline conflicts reported to NMFS. (Source: NMFS PMP for Atlantic Billfishes and Sharks, June, 1983)

A.

Date of Incident	U.S. Vessels' Names	Location 1/	Prevented by Closure Yes	Prevented by Closure No	Type of Incident	Damage	Type of Foreign Vessel	Fixed Gear Broadcast
1980 Aug. 2/	L & N	Hudson Canyon	X		Longline entanglement	Unknown	Japanese longliner	No
Oct. 12 2/	Bobby Gale III, Proud Rebel, Shiloh, Darana R	30°00'N/74°44'W	X		Gear entanglement, preemption of fishing grounds	Longline gear/lost catches	Japanese longliner	No
Oct. 13 2/	Bobby Gale III	35°00'N/74°44'W	X		Gear entanglement, preemption of fishing grounds	12 miles longline gear	Japanese longliner	No
1981 Jan 13 3/	Miss Eunice	Dry Tortugas Area	X		Longline gear cut	Unknown	Japanese longliner	No
Feb. 15 3/	Edith	Dry Tortugas Area	X		Longline gear cut	Unknown	Japanese longliner	No
June-Oct. 2/ (10 incidents)	Vivian III, Frances Anne	Hudson Canyon Veach Canyon	X		Longline entanglement, preemption of fishing grounds	Unknown	Japanese longliner	No
Aug. 11-18 4/	Heather Anne, Donna Marie, Sundance II, Dearest Choice	Hudson Canyon Block Canyon	X		Longline entanglement, preemption of fishing grounds	3 miles line	2-10 Japanese longliners	No
July-Aug. 2/ (4 incidents)	L & N	Hudson Canyon	X		Longline entanglement	Unknown	Japanese longliner	No
Oct. 22 2/	Heather Anne	Carteret Canyon	X		Longline entanglement	Unknown	Japanese longliner	No

1./ Only some reports provided latitude and longitude, others just provided the general areas and depth of water.

2./ As reported to Richard Stone, NMFS, Washington, DC.

3./ As reported to Charles Fuss Law Enforcement Division, NMFS, St. Petersberg, FL

4./ Reported by William H. Feinberg in a memo of 8/20/81 to Theodore Kronmiller, Department Of State, Washington, DC.

B.

Japanese/U.S. Vessels Longline Conflicts Reported by NMFS Observers

Date of Incident	U.S. Vessel Name	Location	Prevented by Closure Yes	Prevented by Closure No	Type of Incident	Damage	Fixed Gear Broadcast
1981 Aug. 29	Unknown/Longline	39°35'N/71°10'W	X		Gear Entanglement	Unknown	No
Aug. 30	Unknown/Longline	40°03'N/68°48'W	X		Gear Entanglement	Unknown	No
Aug. 30	Unknown/Longline	36°27'N/74°22'W	X		Gear Entanglement	Unknown	No
Aug. 31	Unknown/Longline	39°58'N/68°54'W	X		Gear Entanglement	Unknown	No

SOURCE: NMFS-SOUTHEAST REGIONAL OFFICE, LAW ENFORCEMENT FILES, ST. PETERSBURG, FL.

Table 22. Japanese/U.S. vessel longline conflicts reported to the Gulf of Mexico Council. (Source: NMFS PMP for Atlantic Billfishes and Sharks, June 1983.)

DATE 1980	U.S. VESSEL NAME	LOCATION	PREVENTED BY CLOSURE YES	NO	TYPE OF INCIDENT	DAMAGE	FIXED GEAR BROADCAST
Feb 22-25	Sea Hunter	Dry Tortugas Area	X		longline gear entanglement	Unknown	No
"	Big O	"	X		longline gear entanglement	Unknown	No
"	Sea Gull	"	X		longline gear entanglement	Unknown	No
"	Full House	"	X		longline gear entanglement	Unknown	No
"	Martha Ingeham	"	X		longline gear entanglement	Unknown	No
"	Flying Cloud	"	X		longline gear lost	Unknown	No
"	Independent	"	X		longline gear lost	Unknown	No
"	Empress	"	X		longline gear lost	Unknown	No
"	Olympic Champion	"	X		longline gear lost	Unknown	No
"	Tiki 12	"	X		longline gear cut	Unknown	No
"	Tiki 13	"	X		longline gear cut	Unknown	No
"	Benga	"	X		longline gear lost	Unknown	No
Mar 20-24	Flying Cloud	"	X		Near collision	Unknown	No
"	Jesse Bell	"	X		Near collision	Unknown	No

1. These incidents were reported to the Gulf of Mexico Council at the Fact Finding Meeting in Naples, FL, on June 3, 1980.

incidents were reported by U.S. observers on board foreign vessels, by U.S. vessel operators to the NMFS through requests for compensation under the Fishing Vessel and Gear Damage Fund, and by U.S. vessel operators to the U.S. Coast Guard or NMFS. Few incidents can be documented involving damage or entanglement of U.S. recreational fishing gear by foreign longline gear. However, the adverse impact on U.S. recreational fishing results from pre-emption of fishing grounds and lower availability of swordfish and other billfishes.

There are several major factors causing increased conflicts: an increasing U.S. fleet, expansion of the geographical area fished by the U.S. fleet, and changes in Japanese fishing strategy. The number of vessels in the U.S. longline fleet has increased from 115 in 1976 to 411 in 1981. The Japanese appear to have changed their fishing strategy in such a way that catch rates and total catches of marlins decreased, while swordfish catches fluctuated (Table 23). Japanese vessels have been concentrating in areas where swordfish abundance is high, apparently because of high tuna abundance. These areas are highly desirable to U.S. swordfish fishermen.

In addition, Table 24 supplements the information presented in Table 19.

Table 23. Changes in incidental catches of billfishes by Japanese longline vessels (1978-1980) (Source: NMFS PMP for Atlantic Billfishes and Sharks, June, 1983)

Area	Species	U.S. Observer Reported Catches 1978	1980	Annual[1/] Change
Gulf of Mexico	Swordfish	987	3,867	98
	Blue Marlin	346	196	-25
	White Marlin	1,803	936	-28
	Sailfish	326	70	-54
	Spearfish	182	55	-45
	TOTAL	3,644	5,124	
Atlantic	Swordfish	5,639	3,771	-18
	Blue Marlin	851	488	-24
	White Marlin	1,110	1,324	9
	Sailfish	125	333	63
	Spearfish	158	492	76
	TOTAL	7,883	6,408	

1/ Based on the formula $C_T = (1+g)^T C_B$ where:
C_T = catches in 1980
C_B = catches in 1978
T = two years
g = annual percentage change.

solving for g:

$$(1+g)^T = \frac{C_T}{C_B}$$

$$\ln(1+g) = \frac{\ln C_T - \ln C_B}{T}$$

$$g = e^x - 1 \text{ where } x = \frac{\ln C_T - \ln C_B}{T}$$

Table 24. Gear conflicts involving domestic and Japanese longline fishing vessels. (Source: NMFS PMP for Atlantic Billfishes and Shark, June, 1983.)

DATE	REPORTING VESSEL	JAPANESE LONGLINER (JAPLL) AND U. S. VESSELS INVOLVED	LOCATION LATITUDE	LOCATION LONGITUDE	GEAR LOST	PREVENTABLE BY CLOSURE Yes	PREVENTABLE BY CLOSURE No
1982							
July 3	CANCHEN TOO	JAPLL	40°00'N	66°42'W	None, gear entanglement		X
July 13	LINDA MARIE	JAPLL	(4)	(4)	Unknown gear lost	X	
July 18	SEA DOG V	JAPLL	(4)	(4)	Unknown gear lost	X	
August 4	JAPLL	JAPLL, Unknown U.S.Longliner	39°52'N	69°58'W	Gear entanglement, JAPLL lost	X	lt.buoy &4 floats
August 7	JAPLL	JAPLL, Unknown U.S.Longliner	39°53'N	69°43'N	Gear entanglement	X	
August 9	JAPLL	JAPLL, Unknown U.S. Longliner	39°53'N	70°04'W	Gear entanglement	X	
August 10	JAPLL	JAPLL, Unknown U.S. Longliner	39°51'N	69°42'W	Gear entanglement	X	
August 13	JAPLL	JAPLL, Unknown U.S.Trapper	39°22'N	72°05'W	U.S. fixed gear (3) Gear	X	entanglement
August 18	JAPLL	JAPLL, Unknown U.S. Longliner	39°49.9N	71°03.6W	Gear entanglement	X	
August 20	JAPLL	JAPLL, Unknown U.S. Longliner	39°54.N	70°04.N	Gear entanglement	X	
August 24	JAPLL	JAPLL, Unknown U.S. Longliner	39°53.2N	69°37.7W	Gear entanglement	X	
August 26	JAPLL	JAPLL, PROVIDER	39°47.N	71°07.W	Gear entanglement	X	
August 26	JAPLL	JAPLL, Unknown U.S. Longliner	39°48.8N	70°46.8W	Gear entanglement	X	
August 26	LINDA MARIE	JAPLL, Unknown U.S. Longliner	40°46.3N	71°07.6W	LINDA MARIE had line cut in eight places, JAPLL lost flag with radar reflect.	X	
August 28	JAPLL	JAPLL, PROVIDER	39°51.N	71°11.W	Gear entanglement	X	
August 28	JAPLL	JAPLL, WOBBEGONG II	39°50.N	71°00.W	Gear entanglement	X	
August 29	JAPLL	JAPLL, WOBBEGONG II	39°49.N	71°15.W	Gear entanglement, JAPLL lost 20 orange floats, no damage to U.S. Longliner	X	
August 29	JAPLL	JAPLL, WHITE SAIL	39°51.N	70°45.W	Gear entanglement, JAPLL lost 2 floats and 1 radio buoy	X	
August 30	JAPLL	JAPLL, LADY LAURA	39°54.N	70°29.W	Gear entanglement	X	
August 30	JAPLL	JAPLL, WHITE SAIL	39°25.N	70°07.W	JAPLL caught U.S.Longliner gear in prop. gear retied		X
Sept. 1	JAPLL	JAPLL, PENOBSCOT GULF	40°11.9N	68°02.2W	Gear entanglement	X	
Sept. 11	JAPLL	JAPLL, MARION FRANCIS	39°55.3N	70°08.1W	Gear entanglement	X	
Sept. 15	JAPLL	JAPLL, GRACIE II, FRANCIS ANNE	39°53.N	71°15:W	Gear entanglement	X	
Sept. 19	JAPLL	JAPLL, CALICO JACK	39°52.4N	69°53.6W	Gear entanglement	X	
Sept. 19	JAPLL	JAPLL, FRANCIS ANNE	39°52.6N	70°19.9W	Gear entanglement	X	
Sept. 20	JAPLL	JAPLL, GRACIE III	40°03.2N	68°24.4W	Gear entanglement, JAPLL1 lost gear, U.S.Longliner lost unknown amouth of gear,also	X	
						24	2

Source: U. S. Coast Guard, Governor's Island, N. Y.
(1) July 1, 1982 Japanese resumed tuna longline fishing within the FCZ.
On September 24, all of Japanese vessels left FCZ.
(2) Coordinates are located in area that Japanese industry voluntarily agreed would be closed o Japanese longlines from June 1 through August 31
(3) Coordinates were reported to the U. S. Coast Guard when gear was set. The Coast Guard brodcast the location of this gear to all vessels.
(4) Just beyond 1,000 fathom curve - Southeast edge of Georges Bank

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APPENDIX A

SWORDFISH YIELD-PER-RECRUIT ANALYSIS

SOUTHEAST FISHERIES CENTER/BEAUFORT LABORATORY

BEVERTON & HOLT YIELD PER RECRUIT ANALYSIS SWORDFISH

INPUT PARAMETERS

INSTANTANEOUS NATURAL MORTALITY	0.1600000		
INSTANTANEOUS FISHING MORTALITY			
MINIMUM VALUE	0.1500000		
MAXIMUM VALUE	0.4000000	MAXIMUM AGE IN FISHERY	25.0000000
INCREMENTING VALUE	0.0100000		
		THEORETICAL AGE AT LENGTH ZERO	-2.8671999
AGE AT FIRST RECRUITMENT	0.5000000		
		GROWTH RATE	0.1054000
AGE LIABLE TO CAPTURE			
MINIMUM VALUE	1.0000000	MAXIMUM ASYMPTOTIC VALUES	
MAXIMUM VALUE	5.5000000	WEIGHT	385.0000000
INCREMENTING VALUE	0.1000000	LENGTH	297.0000000

INSTANTANEOUS FISHING MORTALITY	YIELD IN NUMBERS PER RECRUIT	YIELD IN WEIGHT PER RECRUIT	ABUNDANCE PER RECRUIT	BIOMASS PER RECRUIT	INDIVIDUAL MEAN WEIGHT	INDIVIDUAL MEAN LENGTH
AGE LIABLE TO CAPTURE (1.0000000)						
0.1500000	0.4464069	26.5949015	2.9760459	177.2993433	59.5754744	149.4746095
0.1600000	0.4613449	26.7697405	2.8834059	167.3108780	58.0254336	148.3126740
0.1700000	0.4753720	26.8881497	2.7963057	158.1655864	56.5623372	147.2014678
0.1800000	0.4885690	26.9592818	2.7142719	149.7737880	55.1800965	146.1380404
0.1900000	0.5010076	26.9908195	2.6368822	142.0569448	53.8730722	145.1196208
0.2000000	0.5127517	26.9892229	2.5637585	134.9461144	52.6360476	144.1436112
0.2100000	0.5238580	26.9599338	2.4945619	128.3806372	51.4642020	143.2075794
0.2200000	0.5343773	26.9075440	2.4289876	122.3070180	50.3530835	142.3092510
0.2300000	0.5443551	26.8359337	2.3667612	116.6779727	49.2985828	141.4465001
0.2400000	0.5538323	26.7483872	2.3076346	111.4516131	48.2969076	140.6173412
0.2500000	0.5628458	26.6476874	2.2513833	106.5907495	47.3445584	139.8199202
0.2600000	0.5714290	26.5361958	2.1978040	102.0622915	46.4383056	139.0525057
0.2700000	0.5796121	26.4159180	2.1467114	97.8367334	45.5751678	138.3134811
0.2800000	0.5874224	26.2885591	2.0979373	93.8877112	44.7523916	137.6013365
0.2900000	0.5948851	26.1555695	2.0513278	90.1916190	43.9674335	136.9146612
0.3000000	0.6020227	26.0181836	2.0067425	86.7272788	43.2179417	136.2521367
0.3100000	0.6088563	25.8774523	1.9640525	83.4756527	42.5017412	135.6125300
0.3200000	0.6154048	25.7342702	1.9231400	80.4195944	41.8168184	134.9946877
0.3300000	0.6216857	25.5893985	1.8838962	77.5436319	41.1613082	134.3975297
0.3400000	0.6277153	25.4434848	1.8462213	74.8337787	40.5334814	133.8200442
0.3500000	0.6335082	25.2970790	1.8100233	72.2773686	39.9317337	133.2612828
0.3600000	0.6390781	25.1506480	1.7752170	69.8629110	39.3545754	132.7203556
0.3700000	0.6444378	25.0045868	1.7417237	67.5799643	38.8006217	132.1964274
0.3800000	0.6495989	24.8592292	1.7094707	65.4190242	38.2685848	131.6887131
0.3900000	0.6545722	24.7148562	1.6783903	63.3714261	37.7572654	131.1964749
0.4000000	0.6593679	24.5717033	1.6484196	61.4292583	37.2655461	130.7190182

AGE LIABLE TO CAPTURE (1.1000000)

0.1500000	0.4393131	26.7906261	2.9287538	178.6041743	60.9829928	151.0189503
0.1600000	0.4540153	26.9814389	2.8375959	168.6339930	59.4284740	149.8696326
0.1700000	0.4678208	27.1152231	2.7518873	159.5013123	57.9606998	148.7704359
0.1800000	0.4808093	27.2011260	2.6711628	151.1173668	56.5736274	147.7184537
0.1900000	0.4930513	27.2468335	2.5950070	143.4043868	55.2616567	146.7109547
0.2000000	0.5046097	27.2588153	2.5230484	136.2940765	54.0196040	145.7453774
0.2100000	0.5155403	27.2425274	2.4549536	129.7263211	52.8426767	144.8193228
0.2200000	0.5258931	27.2025788	2.3904230	123.6480856	51.7264463	143.9305466
0.2300000	0.5357129	27.1428692	2.3291864	118.0124747	50.6668234	143.0769504
0.2400000	0.5450400	27.0667032	2.2709999	112.7779299	49.6600321	142.2565740
0.2500000	0.5539107	26.9768852	2.2156429	107.9075407	48.7025868	141.4675862
0.2600000	0.5623579	26.8757980	2.1629150	103.3684540	47.7912691	140.7082769
0.2700000	0.5704113	26.7654687	2.1126343	99.1313657	46.9231071	139.9770488
0.2800000	0.5780978	26.6476233	2.0646350	95.1700834	46.0953552	139.2724098
0.2900000	0.5854421	26.5237327	2.0187658	91.4611472	45.3054758	138.5929657
0.3000000	0.5924666	26.3950511	1.9748886	87.9835035	44.5511225	137.9374132
0.3100000	0.5991917	26.2626484	1.9328766	84.7182207	43.8301241	137.3045335
0.3200000	0.6056364	26.1274376	1.8926136	81.6482426	43.1404701	136.6931859
0.3300000	0.6118177	25.9901975	1.8539930	78.7581743	42.4802979	136.1023025
0.3400000	0.6177515	25.8515923	1.8169163	76.0340950	41.8478799	135.5308828
0.3500000	0.6234525	25.7121880	1.7812929	73.4633942	41.2416132	134.9779887
0.3600000	0.6289341	25.5724663	1.7470392	71.0346287	40.6600088	134.4427402
0.3700000	0.6342087	25.4328369	1.7140776	68.7373972	40.1016823	133.9243109
0.3800000	0.6392879	25.2936472	1.6823366	66.5622294	39.5653460	133.4219246
0.3900000	0.6441823	25.1551909	1.6517495	64.5004896	39.0498005	132.9348511
0.4000000	0.6489019	25.0177160	1.6222547	62.5442900	38.5539281	132.4624035

AGE LIABLE TO CAPTURE (1.2000000)

0.1500000	0.4323317	26.9798365	2.8822117	179.8655770	62.4054019	152.5470524
0.1600000	0.4468020	27.1864429	2.7925123	169.9152682	60.8467396	151.4102266
0.1700000	0.4603895	27.3354438	2.7081733	160.7967281	59.3746077	150.3229193
0.1800000	0.4731727	27.4359790	2.6287374	152.4221058	57.9830106	149.2822672
0.1900000	0.4852213	27.4957360	2.5537961	144.7144000	56.6663875	148.2855786
0.2000000	0.4965968	27.5211925	2.4829842	137.6059625	55.4195888	147.3303281
0.2100000	0.5073545	27.5178172	2.4159738	131.0372248	54.2378503	146.4141494
0.2200000	0.5175434	27.4902349	2.3524702	124.9556133	53.1167680	145.5348280
0.2300000	0.5272078	27.4423635	2.2922078	119.3146240	52.0522724	144.6902930
0.2400000	0.5363872	27.3775271	2.2349467	114.0730296	51.0406051	143.8786090
0.2500000	0.5451174	27.2985503	2.1804696	109.1942010	50.0782945	143.0979678
0.2600000	0.5534307	27.2078364	2.1285798	104.6455245	49.1621342	142.3466801
0.2700000	0.5613565	27.1074330	2.0790980	100.3978999	48.2891621	141.6231680
0.2800000	0.5689211	26.9990863	2.0318612	96.4253081	47.4566406	140.9259570
0.2900000	0.5761490	26.8842869	1.9867207	92.7044375	46.6620390	140.2536693
0.3000000	0.5830621	26.7643083	1.9435403	89.2143609	45.9030162	139.6050165
0.3100000	0.5896806	26.6402389	1.9021954	85.9362544	45.1774052	138.9787937
0.3200000	0.5960230	26.5130094	1.8625718	82.8531542	44.4831991	138.3738733
0.3300000	0.6021063	26.3834156	1.8245644	79.9497442	43.8185379	137.7891992
0.3400000	0.6079460	26.2521380	1.7880764	77.2121707	43.1816962	137.2237821
0.3500000	0.6135565	26.1197582	1.7530186	74.6278805	42.5710723	136.6766941
0.3600000	0.6189511	25.9867726	1.7193086	72.1854794	41.9851784	136.1470649
0.3700000	0.6241420	25.8536049	1.6868703	69.8746078	41.4226309	135.6340773
0.3800000	0.6291406	25.7206157	1.6556332	67.6858309	40.8821422	135.1369631
0.3900000	0.6339573	25.5881117	1.6255317	65.6105428	40.3625131	134.6550003
0.4000000	0.6386020	25.4563525	1.5965050	63.6408812	39.8626256	134.1875093

AGE LIABLE TO CAPTURE (1.3000000)

0.1500000	0.4254611	27.1624120	2.8364074	181.0827467	63.8422911	154.0590852
0.1600000	0.4397030	27.3846209	2.7481436	171.1538803	62.2798168	152.9346268
0.1700000	0.4530759	27.5486690	2.6651526	162.0509941	60.8036452	151.8590900
0.1800000	0.4656573	27.6636871	2.5869849	153.6871507	59.4078276	150.8296542
0.1900000	0.4775154	27.7373624	2.5132389	145.9861177	58.0868441	149.8436672
0.2000000	0.4887111	27.7761790	2.4435555	138.8808949	56.8355794	148.8986390
0.2100000	0.4992986	27.7856168	2.3776124	132.3124611	55.6492985	147.9922360
0.2200000	0.5093263	27.7703154	2.3151196	126.2287063	54.5236223	147.1222731
0.2300000	0.5188377	27.7342093	2.2558160	120.5835187	53.4545022	146.2867068
0.2400000	0.5278717	27.6806411	2.1994655	115.3360046	52.4381973	145.4836262
0.2500000	0.5364636	27.6124546	2.1458546	110.4498184	51.4712510	144.7112459
0.2600000	0.5446452	27.5320727	2.0947894	105.8925874	50.5504691	143.9678973
0.2700000	0.5524454	27.4415627	2.0460939	101.6354174	49.6728998	143.2520215
0.2800000	0.5598901	27.3426902	1.9996076	97.6524649	48.8358141	142.5621618
0.2900000	0.5670034	27.2369648	1.9551841	93.9205683	48.0366883	141.8969562
0.3000000	0.5738069	27.1256786	1.9126895	90.4189286	47.2731870	141.2551316
0.3100000	0.5803204	27.0099378	1.8720013	87.1288317	46.5431480	140.6354967
0.3200000	0.5865622	26.8906905	1.8330069	84.0334077	45.8445682	140.0369366
0.3300000	0.5925490	26.7687489	1.7956029	81.1174209	45.1755904	139.4584072
0.3400000	0.5982960	26.6448094	1.7596942	78.3670864	44.5344916	138.8989300
0.3500000	0.6038175	26.5194685	1.7251930	75.7699101	43.9196720	138.3575876
0.3600000	0.6091266	26.3932373	1.6920182	73.3145481	43.3296448	137.8335192
0.3700000	0.6142351	26.2665530	1.6600949	70.9906837	42.7630276	137.3259162
0.3800000	0.6191544	26.1397892	1.6293536	68.7889190	42.2185331	136.8340192
0.3900000	0.6238947	26.0132649	1.5997299	66.7006792	41.6949625	136.3571137
0.4000000	0.6284656	25.8872515	1.5711640	64.7181289	41.1911978	135.8945275

AGE LIABLE TO CAPTURE (1.4000000)

0.1500000	0.4186994	27.3382436	2.7913293	182.2549571	65.2932477	155.5552163
0.1600000	0.4327166	27.5758533	2.7044785	172.3490834	63.7272902	154.4430023
0.1700000	0.4458784	27.7547690	2.6228142	163.2633470	62.2473937	153.3791183
0.1800000	0.4582610	27.8841101	2.5458946	154.9117229	60.8476576	152.3607865
0.1900000	0.4699318	27.9715620	2.4733251	147.2187475	59.5226032	151.3853933
0.2000000	0.4809505	28.0236138	2.4047524	140.1180691	58.2671503	150.4504842
0.2100000	0.4913705	28.0457552	2.3398596	133.5512153	57.0765939	149.5537576
0.2200000	0.5012396	28.0426389	2.2783616	127.4665404	55.9465800	148.6930582
0.2300000	0.5106004	28.0182152	2.2200016	121.8183271	54.8730818	147.8663689
0.2400000	0.5194914	27.9758440	2.1645473	116.5660167	53.8523763	147.0718037
0.2500000	0.5279472	27.9183872	2.1117888	111.6735488	52.8810222	146.3075995
0.2600000	0.5359992	27.8482865	2.0615353	107.1087942	51.9558384	145.5721083
0.2700000	0.5436757	27.7676279	2.0136136	102.8430661	51.0738835	144.8637902
0.2800000	0.5510024	27.6781956	1.9678658	98.8506987	50.2324378	144.1812057
0.2900000	0.5580029	27.5815178	1.9241480	95.1086822	49.4289847	143.5230091
0.3000000	0.5646985	27.4789043	1.8823284	91.5963477	48.6611951	142.8879418
0.3100000	0.5711088	27.3714787	1.8422863	88.2950926	47.9269118	142.2748263
0.3200000	0.5772516	27.2602057	1.8039111	85.1881427	47.2241356	141.6825604
0.3300000	0.5831434	27.1459136	1.7671011	82.2603443	46.5510129	141.1101117
0.3400000	0.5887992	27.0293142	1.7317625	79.4979829	45.9058230	140.5565127
0.3500000	0.5942332	26.9110186	1.6978091	76.8886247	45.2869683	140.0208560
0.3600000	0.5994579	26.7915520	1.6651610	74.4209778	44.6929636	139.5022902
0.3700000	0.6044854	26.6713648	1.6337444	72.0847697	44.1224273	139.0000158
0.3800000	0.6093266	26.5508434	1.6034911	69.8706406	43.5740732	138.5132813
0.3900000	0.6139917	26.4303188	1.5743377	67.7700483	43.0467028	138.0413803
0.4000000	0.6184901	26.3100739	1.5462253	65.7751848	42.5391983	137.5836475

AGE LIABLE TO CAPTURE (1.5000000)

0.1500000	0.4120449	27.5072338	2.7469659	183.3815590	66.7578575	157.0356116
0.1600000	0.4258409	27.7600332	2.6615057	173.3002075	65.1887424	155.9355202
0.1700000	0.4387950	27.9536267	2.5811472	164.4330981	63.7054331	154.8831727
0.1800000	0.4509821	28.0971211	2.5054560	156.0951173	62.3020779	153.8758337
0.1900000	0.4624684	28.1981982	2.4340444	148.4115696	60.9732397	152.9109278
0.2000000	0.4733130	28.2633505	2.3665648	141.3167527	59.7138741	151.9860356
0.2100000	0.4835682	28.2980761	2.3027057	134.7527432	58.5193067	151.0988875
0.2200000	0.4932811	28.3070395	2.2421868	128.6683616	57.3852094	150.2473573
0.2300000	0.5024938	28.2942058	2.1847554	123.0182862	56.3075775	149.4294547
0.2400000	0.5112440	28.2629508	2.1301832	117.7622952	55.2827066	148.6433178
0.2500000	0.5195659	28.2161538	2.0782636	112.8646152	54.3071713	147.8872058
0.2600000	0.5274903	28.1562742	2.0288089	108.2933621	53.3778036	147.1594912
0.2700000	0.5350452	28.0854159	1.9816487	104.0200587	52.4916736	146.4586529
0.2800000	0.5422558	28.0053811	1.9366278	100.0192183	51.6460705	145.7832685
0.2900000	0.5491453	27.9177156	1.8936045	96.2679850	50.8384859	145.1320083
0.3000000	0.5557347	27.8237465	1.8524491	92.7458216	50.0665969	144.5036284
0.3100000	0.5620433	27.7246140	1.8130429	89.4342388	49.3282518	143.8969647
0.3200000	0.5680887	27.6212991	1.7752772	86.3165597	48.6214559	143.3109276
0.3300000	0.5738870	27.5146457	1.7390516	83.3777141	47.9443589	142.7444963
0.3400000	0.5794532	27.4053802	1.7042741	80.6040595	47.2952432	142.1967142
0.3500000	0.5848009	27.2941284	1.6708598	77.9832241	46.6725133	141.6666839
0.3600000	0.5899428	27.1814288	1.6387300	75.5039689	46.0746859	141.1535633
0.3700000	0.5948905	27.0677449	1.6078122	73.1560672	45.5003807	140.6565618
0.3800000	0.5996549	26.9534754	1.5780392	70.9301985	44.9483124	140.1749361
0.3900000	0.6042459	26.8389632	1.5493486	68.8178543	44.4172833	139.7079871
0.4000000	0.6086730	26.7245022	1.5216824	66.8112554	43.9061759	139.2550571

AGE LIABLE TO CAPTURE (1.6000000)

0.1500000	0.4054959	27.6692967	2.7033058	184.4619778	68.2357054	158.5004351
0.1600000	0.4190743	27.9370650	2.6192142	174.6066566	66.6637550	157.4123459
0.1700000	0.4318240	28.1451375	2.5401409	165.5596322	65.1773420	156.3714200
0.1800000	0.4438186	28.3026062	2.4656588	157.2367010	63.7706640	155.3749637
0.1900000	0.4551235	28.4171478	2.3953867	149.5639357	62.4383264	154.4204398
0.2000000	0.4657966	28.4952566	2.3289830	142.4762830	61.1753213	153.5054635
0.2100000	0.4758897	28.5424377	2.2661413	135.9163700	59.9770053	152.6277971
0.2200000	0.4854489	28.5633665	2.2065860	129.8334839	58.8390767	151.7853430
0.2300000	0.4945158	28.5620211	2.1500686	124.1827005	57.7575536	150.9761375
0.2400000	0.5031275	28.5417927	2.0963644	118.9241361	56.7287507	150.1983427
0.2500000	0.5113176	28.5055765	2.0452703	114.0223061	55.7492589	149.4502400
0.2600000	0.5191165	28.4558491	1.9966018	109.4455733	54.8159238	148.7302222
0.2700000	0.5265516	28.3947313	1.9501912	105.1656716	53.9258273	148.0367866
0.2800000	0.5336480	28.3240427	1.9058856	101.1572955	53.0762683	147.3685281
0.2900000	0.5404283	28.2453459	1.8635457	97.3977445	52.2647465	146.7241326
0.3000000	0.5469132	28.1599845	1.8230440	93.8666149	51.4889459	146.1023707
0.3100000	0.5531218	28.0691150	1.7842637	90.5455323	50.7467205	145.5020919
0.3200000	0.5590713	27.9737340	1.7470977	87.4179186	50.0360802	144.9222189
0.3300000	0.5647776	27.8747003	1.7114473	84.4687889	49.3551786	144.3617425
0.3400000	0.5702555	27.7727551	1.6772221	81.6845739	48.7023013	143.8197166
0.3500000	0.5755184	27.6685378	1.6443382	79.0529651	48.0758553	143.2952541
0.3600000	0.5805787	27.5626001	1.6127185	76.5627781	47.4743592	142.7875220
0.3700000	0.5854479	27.4554183	1.5822916	74.2038332	46.8964344	142.2957384
0.3800000	0.5901367	27.3474031	1.5529912	71.9668503	46.3407968	141.8191679
0.3900000	0.5946549	27.2389087	1.5247560	69.8433557	45.8062494	141.3571193
0.4000000	0.5990116	27.1302401	1.4975291	67.8256003	45.2916755	140.9089418

AGE LIABLE TO CAPTURE (1.7000000)

0.1500000	0.3990507	27.8243568	2.6603378	185.4957123	69.7263756	159.9498491
0.1600000	0.4124149	28.1068651	2.5775933	175.6679069	68.1519089	158.8736431
0.1700000	0.4249634	28.3292089	2.4997849	166.6424051	66.6626980	157.8440251
0.1800000	0.4367687	28.5004641	2.4264928	158.3359117	65.2529908	156.8583428
0.1900000	0.4478950	28.6283007	2.3573422	150.6752667	63.9174356	155.9140967
0.2000000	0.4583995	28.7192133	2.2919973	143.5960664	62.6510615	155.0089365
0.2100000	0.4683330	28.7787126	2.2301570	137.0414886	61.4492567	154.1406559
0.2200000	0.4777410	28.8114835	2.1715500	130.9612886	60.3077468	153.3071859
0.2300000	0.4866644	28.8215163	2.1159321	125.3109405	59.2225728	152.5065889
0.2400000	0.4951397	28.8122161	2.0630823	120.0509005	58.1900693	151.7370511
0.2500000	0.5032002	28.7864936	2.0128007	115.1459744	57.2068438	150.9968757
0.2600000	0.5108755	28.7468411	1.9649059	110.5647733	56.2697562	150.2844756
0.2700000	0.5181929	28.6953959	1.9192328	106.2792441	55.3759002	149.5983666
0.2800000	0.5251767	28.6339939	1.8756312	102.2642639	54.5225851	148.9371604
0.2900000	0.5318496	28.5642140	1.8339640	98.4972895	53.7073190	148.2995586
0.3000000	0.5382317	28.4874157	1.7941056	94.9580523	52.9277933	147.6843463
0.3100000	0.5443418	28.4047713	1.7559413	91.6282944	52.1818676	147.0903861
0.3200000	0.5501969	28.3172922	1.7193654	88.4915380	51.4675572	146.5166132
0.3300000	0.5558128	28.2258520	1.6842812	85.5328848	50.7830196	145.9620297
0.3400000	0.5612038	28.1312058	1.6505993	82.7388405	50.1265439	145.4257003
0.3500000	0.5663832	28.0340064	1.6182376	80.0971610	49.4965398	144.9067475
0.3600000	0.5713632	27.9348184	1.5871199	77.5967179	48.8915282	144.4043478
0.3700000	0.5761551	27.8341305	1.5571760	75.2273796	48.3101323	143.9177275
0.3800000	0.5807695	27.7323649	1.5283408	72.9799077	47.7510693	143.4461596
0.3900000	0.5852160	27.6298872	1.5005539	70.8458646	47.2131433	142.9889602
0.4000000	0.5895036	27.5270128	1.4737591	68.8175320	46.6952384	142.5454855

AGE LIABLE TO CAPTURE (1.8000000)

0.1500000	0.3927076	27.9723499	2.6180509	186.4823327	71.2294522	161.3840142
0.1600000	0.4058612	28.2693608	2.5366323	176.6835052	69.6527845	160.3195737
0.1700000	0.4182117	28.5057602	2.4600688	167.6809424	68.1610785	159.3011513
0.1800000	0.4298306	28.6906060	2.3879479	159.3922557	66.7486325	158.3261354
0.1900000	0.4407812	28.8315598	2.3199011	151.7450518	65.4101385	157.3920641
0.2000000	0.4511197	28.9351152	2.2555984	144.6755762	64.1406633	156.4966213
0.2100000	0.4608961	29.0067872	2.1947435	138.1275582	62.9356271	155.6376316
0.2200000	0.4701554	29.0512688	2.1370699	132.0512220	61.7907834	154.8130547
0.2300000	0.4789376	29.0725615	2.0823372	126.4024412	60.7021968	154.0209787
0.2400000	0.4872788	29.0740832	2.0303282	121.1420132	59.6662219	153.2596137
0.2500000	0.4952116	29.0587589	1.9808463	116.2350356	58.6794836	152.5272845
0.2600000	0.5027653	29.0290960	1.9337129	111.6503694	57.7388563	151.8224240
0.2700000	0.5099667	28.9872476	1.8887657	107.3601762	56.8414463	151.1435661
0.2800000	0.5168400	28.9350649	1.8458570	103.3395174	55.9845733	150.4893396
0.2900000	0.5234070	28.8741424	1.8048518	99.5660084	55.1657543	149.8584614
0.3000000	0.5296880	28.8058552	1.7656265	96.0195174	54.3826883	149.2497308
0.3100000	0.5357012	28.7313904	1.7280683	92.6819044	53.6332412	148.6620238
0.3200000	0.5414635	28.6517740	1.6920733	89.5367936	52.9154335	148.0942877
0.3300000	0.5469903	28.5678937	1.6575462	86.5693747	52.2274273	147.5455359
0.3400000	0.5522957	28.4805181	1.6243992	83.7662296	51.5675152	147.0148436
0.3500000	0.5573929	28.3903130	1.5925512	81.1151801	50.9341100	146.5013431
0.3600000	0.5622939	28.2978557	1.5619276	78.6051548	50.3257350	146.0042201
0.3700000	0.5670099	28.2036466	1.5324591	76.2260719	49.7410154	145.5227093
0.3800000	0.5715510	28.1081195	1.5040817	73.9687355	49.1786701	145.0560917
0.3900000	0.5759270	28.0116506	1.4767358	71.8247451	48.6375044	144.6036908
0.4000000	0.5801466	27.9145659	1.4503664	69.7864147	48.1164032	144.1648698

AGE LIABLE TO CAPTURE (1.9000000)

0.1500000	0.3864652	28.1132217	2.5764343	187.4214779	72.7445196	162.8030893
0.1600000	0.3994113	28.4244906	2.4963207	177.6530665	71.1659627	161.7502980
0.1700000	0.4115670	28.6747223	2.4209825	168.6748371	69.6720608	160.7429599
0.1800000	0.4230026	28.8729551	2.3500142	160.4053061	68.2571633	159.7785041
0.1900000	0.4337802	29.0268407	2.2830538	152.7728457	66.9160065	158.8545059
0.2000000	0.4439554	29.1428702	2.2197768	145.7143508	65.6436951	157.9686827
0.2100000	0.4535773	29.2265615	2.1598916	139.1741023	64.4356825	157.1188903
0.2200000	0.4626901	29.2826147	2.1031368	133.1027940	63.2877501	156.3031164
0.2300000	0.4713333	29.3150411	2.0492753	127.4567002	62.1959865	155.5194749
0.2400000	0.4795425	29.3272706	1.9980938	122.1969607	61.1567675	154.7661993
0.2500000	0.4873497	29.3222416	1.9493989	117.2889664	60.1667351	154.0416361
0.2600000	0.4947839	29.3024757	1.9030149	112.7018296	59.2227791	153.3442379
0.2700000	0.5018712	29.2701405	1.8587822	108.4079279	58.3220185	152.6725567
0.2800000	0.5086355	29.2271024	1.8165553	104.3825087	57.4617841	152.0252379
0.2900000	0.5150984	29.1749708	1.7762015	100.6033476	56.6396020	151.4010139
0.3000000	0.5212798	29.1151353	1.7375994	97.0504510	55.8531790	150.7986980
0.3100000	0.5271977	29.0487975	1.7006377	93.7057984	55.1003878	150.2171794
0.3200000	0.5328686	28.9769975	1.6652144	90.5531171	54.3792544	149.6554174
0.3300000	0.5383077	28.9006366	1.6312356	87.5776865	53.6879455	149.1124367
0.3400000	0.5435291	28.8204964	1.5986149	84.7661659	53.0247578	148.5873229
0.3500000	0.5485454	28.7372555	1.5672726	82.1064444	52.3881072	148.0792180
0.3600000	0.5533687	28.6515032	1.5371352	79.5875089	51.7765198	147.5873166
0.3700000	0.5580098	28.5637514	1.5081345	77.1993281	51.1886230	147.1108621
0.3800000	0.5624789	28.4744451	1.4802076	74.9327503	50.6231374	146.6491432
0.3900000	0.5667854	28.3839710	1.4532958	72.7794128	50.0788698	146.2014906
0.4000000	0.5709380	28.2926652	1.4273450	70.7316630	49.5547063	145.7672747

AGE LIABLE TO CAPTURE (2.0000000)

0.1500000	0.3803216	28.2469281	2.5354774	188.3128541	74.2711627	164.2072317
0.1600000	0.3930637	28.5722035	2.4566482	178.5762721	72.6910248	163.1659745
0.1700000	0.4050277	28.8360371	2.3825159	169.6237479	71.1952228	162.1696108
0.1800000	0.4162828	29.0474461	2.3126822	161.3747008	69.7781579	161.2156100
0.1900000	0.4268903	29.2140708	2.2467910	153.7582675	68.4346110	160.3015840
0.2000000	0.4369047	29.3423984	2.1845234	146.7119920	67.1597258	159.4252841
0.2100000	0.4463745	29.4379485	2.1255930	140.1807069	65.9489887	158.5845962
0.2200000	0.4553432	29.5054268	2.0697420	134.1155765	64.7982100	157.7775363
0.2300000	0.4638497	29.5488536	2.0167380	128.4732765	63.7035030	157.0022436
0.2400000	0.4719290	29.5716697	1.9663710	123.2152903	62.6612645	156.2569752
0.2500000	0.4796126	29.5768258	1.9184505	118.3073032	61.6681547	155.5400987
0.2600000	0.4869290	29.5668569	1.8728040	113.7186806	60.7210790	154.8500863
0.2700000	0.4939041	29.5439447	1.8292744	109.4220173	59.8171694	154.1855080
0.2800000	0.5005612	29.5099695	1.7877186	105.3927482	58.9537681	153.5450259
0.2900000	0.5069217	29.4665550	1.7480060	101.6088104	58.1284109	152.9273873
0.3000000	0.5130051	29.4151050	1.7100171	98.0503501	57.3388127	152.3314199
0.3100000	0.5188292	29.3568349	1.6736425	94.6994676	56.5828531	151.7560256
0.3200000	0.5244102	29.2927984	1.6387817	91.5399950	55.8585640	151.2001757
0.3300000	0.5297630	29.2239098	1.6053425	88.5573023	55.1641170	150.6629062
0.3400000	0.5349015	29.1509634	1.5732398	85.7381278	54.4978131	150.1433129
0.3500000	0.5398383	29.0746501	1.5423952	83.0704289	53.8580717	149.6405474
0.3600000	0.5445850	28.9955708	1.5127362	80.5432521	53.2434217	149.1538133
0.3700000	0.5491525	28.9142486	1.4841960	78.1466179	52.6524930	148.6823623
0.3800000	0.5535507	28.8311394	1.4567124	75.8714194	52.0840081	148.2254908
0.3900000	0.5577889	28.7466401	1.4302279	73.7093335	51.5367755	147.7825371
0.4000000	0.5618756	28.6610966	1.4046890	71.6527414	51.0096825	147.3528781

AGE LIABLE TO CAPTURE (2.1000000)

0.1500000	0.3742754	28.3734349	2.4951696	189.1562325	75.8089675	165.5965970
0.1600000	0.3868167	28.7124588	2.4176045	179.4528675	74.2275530	164.5667600
0.1700000	0.3985921	28.9896575	2.3446592	170.5273970	72.7301431	163.5812620
0.1800000	0.4096696	29.2140253	2.2759421	162.3001406	71.3111914	162.6376122
0.1900000	0.4201096	29.3931897	2.2111033	154.7009984	69.9655242	161.7334590
0.2000000	0.4299658	29.5336326	2.1498292	147.6681630	68.6883243	160.8665868
0.2100000	0.4392860	29.6408740	2.0918382	141.1470189	67.4751121	160.0349119
0.2200000	0.4481129	29.7196243	2.0368770	135.0892012	66.3217270	159.2364779
0.2300000	0.4564849	29.7739113	1.9847169	129.4517881	65.2243075	158.4694495
0.2400000	0.4644363	29.8071858	1.9351514	124.1966076	64.1792719	157.7321066
0.2500000	0.4719983	29.8224101	1.8879932	119.2896405	63.1832992	157.0228384
0.2600000	0.4791989	29.8221317	1.8430726	114.7005064	62.2333104	156.3401362
0.2700000	0.4860634	29.8085451	1.8002349	110.4020190	61.3264515	155.6825880
0.2800000	0.4926151	29.7835445	1.7593395	106.3698018	60.4600760	155.0488722
0.2900000	0.4988748	29.7487670	1.7202579	102.5819551	59.6317298	154.4377512
0.3000000	0.5048618	29.7056298	1.6828725	99.0187661	58.8391362	153.8480666
0.3100000	0.5105935	29.6553618	1.6470757	95.6624573	58.0801823	153.2787332
0.3200000	0.5160860	29.5990294	1.6127686	92.4969668	57.3529060	152.7287342
0.3300000	0.5213539	29.5375597	1.5798604	89.5077567	56.6554842	152.1971165
0.3400000	0.5264109	29.4717594	1.5482674	86.6816452	55.9862221	151.6829863
0.3500000	0.5312694	29.4023309	1.5179126	84.0066596	55.3435429	151.1855047
0.3600000	0.5359408	29.3298865	1.4887245	81.4719070	54.7259789	150.7038841
0.3700000	0.5404358	29.2549604	1.4606374	79.0674606	54.1321622	150.2373844
0.3800000	0.5447642	29.1780188	1.4335901	76.7842599	53.5608179	149.7853099
0.3900000	0.5489352	29.0994685	1.4075261	74.6140218	53.0107560	149.3470059
0.4000000	0.5529571	29.0196650	1.3823926	72.5491625	52.4808655	148.9218562

AGE LIABLE TO CAPTURE (2.2000000)

0.1500000	0.3683251	28.4927170	2.4555007	189.9514467	77.3575215	166.9713390
0.1600000	0.3806688	28.8452257	2.3791798	180.2826606	75.7751308	165.9528098
0.1700000	0.3922585	29.1355466	2.3074027	171.3855681	74.2764016	164.9780700
0.1800000	0.4031612	29.3726497	2.2397846	163.1813871	72.8558404	164.0446685
0.1900000	0.4134365	29.5641482	2.1759815	155.6007798	71.5083193	163.1502896
0.2000000	0.4231370	29.7165173	2.1156852	148.5825866	70.2290608	162.2927506
0.2100000	0.4323100	29.8352762	2.0586189	142.0727440	69.0136199	161.4699981
0.2200000	0.4409973	29.9251388	2.0045334	136.0233583	67.8578655	160.6801030
0.2300000	0.4492369	29.9901395	1.9532039	130.3919108	66.7579618	159.9212551
0.2400000	0.4570625	30.0337380	1.9044272	125.1405751	65.7103492	159.1917573
0.2500000	0.4645048	30.0589072	1.8580192	120.2356287	64.7117255	158.4900197
0.2600000	0.4715913	30.0682061	1.8138129	115.6469466	63.7590283	157.8145530
0.2700000	0.4783472	30.0638419	1.7716562	111.3475626	62.8494174	157.1639628
0.2800000	0.4847950	30.0477213	1.7314108	107.3132902	61.9802584	156.5369437
0.2900000	0.4909556	30.0214943	1.6929502	103.5223940	61.1491075	155.9322732
0.3000000	0.4968476	29.9865911	1.6561588	99.9553037	60.3536968	155.3488065
0.3100000	0.5024885	29.9442532	1.6209305	96.5943651	59.5919210	154.7854713
0.3200000	0.5078939	29.8955596	1.5871683	93.4236239	58.8618242	154.2412625
0.3300000	0.5130783	29.8414497	1.5547828	90.4286353	58.1615890	153.7152381
0.3400000	0.5180551	29.7827416	1.5236915	87.5962989	57.4895253	153.2065142
0.3500000	0.5228365	29.7201495	1.4938186	84.9147127	56.8440602	152.7142615
0.3600000	0.5274338	29.6542964	1.4650940	82.3730456	56.2237292	152.2377011
0.3700000	0.5318575	29.5857272	1.4374527	79.9614249	55.6271675	151.7761011
0.3800000	0.5361173	29.5149180	1.4108349	77.6708369	55.0531023	151.3287735
0.3900000	0.5402220	29.4422856	1.3851846	75.4930399	54.5003457	150.8950707
0.4000000	0.5441801	29.3681945	1.3604502	73.4204862	53.9677883	150.4743832

AGE LIABLE TO CAPTURE (2.3000000)

0.1500000	0.3624691	28.6047587	2.4164604	190.6983910	78.9164138	168.3316101
0.1600000	0.3746183	28.9704830	2.3413642	181.0655189	77.3333433	167.3242773
0.1700000	0.3860253	29.2736777	2.2707369	172.1981042	75.8335797	166.3601895
0.1800000	0.3967561	29.5232869	2.2042004	164.0182608	74.4116827	165.4369346
0.1900000	0.4068692	29.7269082	2.1414167	156.4574113	73.0625709	164.5522326
0.2000000	0.4164166	29.8910086	2.0820828	149.4550432	71.7815069	163.7039336
0.2100000	0.4254446	30.0211054	2.0259266	142.9576449	70.5640806	162.8900139
0.2200000	0.4339946	30.1219147	1.9727029	136.9177942	69.4061912	162.1085716
0.2300000	0.4421039	30.1974765	1.9221908	131.2933761	68.3040290	161.3578215
0.2400000	0.4498057	30.2512586	1.8741904	126.0469106	67.2540568	160.6360891
0.2500000	0.4571302	30.2862433	1.8285208	121.1449731	66.2529919	159.9418054
0.2600000	0.4641045	30.3050006	1.7850175	116.5576948	65.2977885	159.2735002
0.2700000	0.4707534	30.3097493	1.7435311	112.2583309	64.3856208	158.6297968
0.2800000	0.4770991	30.3024082	1.7039253	108.2228863	63.5138670	158.0094056
0.2900000	0.4831620	30.2846394	1.6660759	104.4297911	62.6800937	157.4111191
0.3000000	0.4889607	30.2578856	1.6298689	100.8596186	61.8820422	156.8338062
0.3100000	0.4945121	30.2234003	1.5952003	97.4948396	61.1176149	156.2764071
0.3200000	0.4998318	30.1822746	1.5619744	94.3196080	60.3848628	155.7379287
0.3300000	0.5049340	30.1354593	1.5301031	91.3195738	59.6819742	155.2174394
0.3400000	0.5098319	30.0837844	1.4995055	88.4817187	59.0072638	154.7140657
0.3500000	0.5145374	30.0279745	1.4701070	85.7942129	58.3591630	154.2269875
0.3600000	0.5190618	29.9686637	1.4418384	83.2462880	57.7362108	153.7554346
0.3700000	0.5234154	29.9064068	1.4146361	80.8281264	57.1370454	153.2986833
0.3800000	0.5276075	29.8416897	1.3884408	78.5307625	56.5603966	152.8560530
0.3900000	0.5316471	29.7749387	1.3631977	76.3459966	56.0050787	152.4269035
0.4000000	0.5355424	29.7065272	1.3388559	74.2663180	55.4699839	152.0106316

AGE LIABLE TO CAPTURE (2.4000000)

0.1500000	0.3567058	28.7095527	2.3780389	191.3970181	80.4852354	169.6775608
0.1600000	0.3686637	29.0882188	2.3041479	181.8013678	78.9017776	168.6813145
0.1700000	0.3798909	29.4040340	2.2346523	172.9649057	77.4012606	167.7277736
0.1800000	0.3904525	29.6659150	2.1691805	164.8106388	75.9782980	166.8145648
0.1900000	0.4004060	29.8814422	2.1074001	157.2707485	74.6278551	165.9394436
0.2000000	0.4098027	30.0570737	2.0490134	150.2853687	73.3452355	165.1002923
0.2100000	0.4186881	30.1983233	1.9937528	143.8015393	72.1260643	164.2951168
0.2200000	0.4271030	30.3099081	1.9413773	137.7723097	70.9662713	163.5220422
0.2300000	0.4350840	30.3958730	1.8916697	132.1559694	69.8620735	162.7793079
0.2400000	0.4426640	30.4596924	1.8444334	126.9153852	68.8099566	162.0652623
0.2500000	0.4498726	30.5043578	1.7994904	122.0174313	67.8066576	161.3783566
0.2600000	0.4567365	30.5324491	1.7566790	117.4324965	66.8491480	160.7171399
0.2700000	0.4632801	30.5461957	1.7158522	113.1340583	65.9346166	160.0802525
0.2800000	0.4695253	30.5475280	1.6768760	109.0983142	65.0604543	159.4664212
0.2900000	0.4754921	30.5381197	1.6396280	105.3038610	64.2242389	158.8744531
0.3000000	0.4811989	30.5194251	1.6039964	101.7314169	63.4237209	158.3032305
0.3100000	0.4866623	30.4927093	1.5698785	98.3635785	62.6568109	157.7517063
0.3200000	0.4918977	30.4590751	1.5371802	95.1846096	61.9215668	157.2188988
0.3300000	0.4969190	30.4194844	1.5058151	92.1802556	61.2161830	156.7038874
0.3400000	0.5017392	30.3747779	1.4757035	89.3375821	60.5389793	156.2058083
0.3500000	0.5063701	30.3256912	1.4467717	86.6448319	59.8883915	155.7238508
0.3600000	0.5108227	30.2728683	1.4189520	84.0913009	59.2629623	155.2572533
0.3700000	0.5151072	30.2168740	1.3921816	81.6672270	58.6613333	154.8053001
0.3800000	0.5192328	30.1582038	1.3664022	79.3636942	58.0822368	154.3673183
0.3900000	0.5232083	30.0972928	1.3415598	77.1725456	57.5244896	153.9426744
0.4000000	0.5270418	30.0345233	1.3176045	75.0863083	56.9869858	153.5307720

AGE LIABLE TO CAPTURE (2.5000000)

0.1500000	0.3510339	28.8071005	2.3402262	192.0473364	82.0635796	171.0093404
0.1600000	0.3628035	29.1984301	2.2675216	182.4901882	80.4800228	170.0240717
0.1700000	0.3738538	29.5266077	2.1991398	173.6859279	78.9790297	169.0809738
0.1800000	0.3842488	29.8005215	2.1347158	165.5584528	77.5552680	168.1777118
0.1900000	0.3940453	30.0277333	2.0739229	158.0407013	76.2037504	167.3120761
0.2000000	0.4032937	30.2146905	2.0164684	151.0734527	74.9198217	166.4819813
0.2100000	0.4120387	30.3669026	1.9620893	144.6042979	73.6991429	165.6854624
0.2200000	0.4203207	30.4890868	1.9105487	138.5867583	72.5376749	164.9206714
0.2300000	0.4281756	30.5852914	1.8616329	132.9795278	71.4316616	164.1858721
0.2400000	0.4356357	30.6589971	1.8151486	127.7458211	70.3776121	163.4794352
0.2500000	0.4427302	30.7132030	1.7709207	122.8528120	69.3722838	162.7998326
0.2600000	0.4494855	30.7504984	1.7287902	118.2711476	68.4126654	162.1456320
0.2700000	0.4559254	30.7731228	1.6886126	113.9745291	67.4959611	161.5154911
0.2800000	0.4620717	30.7830172	1.6502559	109.9393472	66.6195747	160.9081524
0.2900000	0.4679440	30.7818664	1.6135999	106.1443669	65.7810952	160.3224376
0.3000000	0.4735603	30.7711357	1.5785344	102.5704524	64.9782830	159.7572425
0.3100000	0.4789371	30.7521015	1.5449585	99.2003273	64.2090570	159.2115325
0.3200000	0.4840895	30.7258772	1.5127796	96.0183661	63.4714826	158.6843373
0.3300000	0.4890312	30.6934357	1.4819127	93.0104112	62.7637600	158.1747469
0.3400000	0.4937749	30.6556283	1.4522792	90.1636126	62.0842146	157.6819075
0.3500000	0.4983324	30.6132005	1.4238069	87.4662872	61.4312869	157.2050175
0.3600000	0.5027144	30.5668065	1.3964289	84.9077958	60.8035235	156.7433238
0.3700000	0.5069309	30.5170204	1.3700834	82.4784335	60.1995692	156.2961189
0.3800000	0.5109911	30.4643469	1.3447133	80.1693339	59.6181597	155.8627370
0.3900000	0.5149035	30.4092299	1.3202654	77.9723843	59.0581138	155.4425517
0.4000000	0.5186761	30.3520602	1.2966903	75.8801504	58.5183280	155.0349733

AGE LIABLE TO CAPTURE (2.6000000)

0.1500000	0.3454519	28.8974112	2.3030126	192.6494083	83.6510423	172.3270961
0.1600000	0.3570361	29.3011223	2.2314757	183.1320145	82.0676708	171.3526977
0.1700000	0.3679123	29.6414005	2.1641902	174.3611793	80.5664749	170.4199401
0.1800000	0.3781435	29.9271037	2.1007975	166.2616870	79.1421769	169.5265265
0.1900000	0.3877855	30.1657740	2.0409765	158.7672316	77.7898375	168.6702824
0.2000000	0.3968879	30.3638472	1.9844396	151.8192362	76.5048429	167.8491538
0.2100000	0.4054949	30.5268270	1.9309280	145.3658427	75.2828906	167.0612049
0.2200000	0.4136460	30.6594297	1.8802090	139.3610439	74.1199732	166.3046143
0.2300000	0.4213767	30.7657059	1.8320725	133.7639389	73.0123617	165.5776700
0.2400000	0.4287188	30.8491417	1.7863283	128.5380906	71.9565891	164.8787649
0.2500000	0.4357011	30.9127433	1.7428042	123.6509731	70.9494335	164.2063911
0.2600000	0.4423494	30.9591081	1.7013440	119.0734929	69.9879014	163.5591351
0.2700000	0.4486874	30.9904854	1.6618052	114.7795754	69.0692125	162.9356717
0.2800000	0.4547363	31.0088258	1.6240583	110.7458063	68.1907839	162.3347590
0.2900000	0.4605156	31.0158246	1.5879848	106.9511193	67.3502164	161.7552333
0.3000000	0.4660429	31.0129577	1.5534764	103.3765257	66.5452803	161.1960037
0.3100000	0.4713345	31.0015120	1.5204340	100.0048774	65.7739032	160.6560478
0.3200000	0.4764052	30.9826115	1.4887663	96.8206608	65.0341578	160.1344069
0.3300000	0.4812686	30.9572392	1.4583896	93.8098159	64.3242512	159.6301814
0.3400000	0.4859371	30.9262566	1.4292267	90.9595784	63.6425141	159.1425273
0.3500000	0.4904223	30.8904191	1.4012065	88.2583404	62.9873918	158.6706521
0.3600000	0.4947348	30.8503902	1.3742632	85.6955284	62.3574353	158.2138113
0.3700000	0.4988843	30.8067533	1.3483361	83.2614954	61.7512929	157.7713051
0.3800000	0.5028801	30.7600219	1.3233687	80.9474260	61.1677032	157.3424752
0.3900000	0.5067305	30.7106484	1.2993089	78.7452523	60.6054879	156.9267022
0.4000000	0.5104433	30.6590318	1.2761081	76.6475795	60.0635457	156.5234025

AGE LIABLE TO CAPTURE (2.7000000)

0.1500000	0.3399583	28.9805022	2.2663888	193.2033478	85.2472223	173.6309741
0.1600000	0.3513602	29.3963092	2.1960011	183.7269323	83.6643160	172.6673394
0.1700000	0.3620651	29.7484222	2.1297947	174.9907188	82.1631866	171.7448206
0.1800000	0.3721351	30.0456677	2.0674170	166.9203760	80.7386115	170.8611585
0.1900000	0.3816250	30.2955667	2.0085526	159.4503510	79.3856995	170.0142128
0.2000000	0.3905837	30.5045420	1.9529186	152.5227099	78.0998790	169.2019612
0.2100000	0.3990548	30.6780903	1.9002610	146.0861445	76.8768843	168.4224968
0.2200000	0.4070771	30.8209262	1.8503507	140.0951192	75.7127397	167.6740243
0.2300000	0.4146856	30.9371018	1.8029811	134.5091382	74.6037444	166.9548559
0.2400000	0.4219117	31.0301072	1.7579653	129.2921133	73.5464555	166.2634063
0.2500000	0.4287835	31.1029549	1.7151339	124.4118195	72.5376720	165.5981881
0.2600000	0.4353266	31.1582501	1.6743332	119.8394235	71.5744188	164.9578060
0.2700000	0.4415643	31.1982505	1.6354232	115.5490760	70.6539312	164.3409519
0.2800000	0.4475174	31.2249163	1.5982763	111.5175582	69.7736402	163.7463994
0.2900000	0.4532051	31.2399525	1.5627762	107.7239740	68.9311584	163.1729992
0.3000000	0.4586449	31.2448448	1.5288162	104.1494826	68.1242665	162.6196737
0.3100000	0.4638526	31.2408902	1.4962987	100.7770651	67.3509011	162.0854126
0.3200000	0.4688429	31.2292227	1.4651340	97.5913208	66.6091425	161.5692685
0.3300000	0.4736291	31.2108352	1.4352398	94.5782886	65.8972046	161.0703523
0.3400000	0.4782236	31.1865989	1.4065400	91.7252908	65.2134239	160.5878298
0.3500000	0.4826377	31.1572785	1.3789648	89.0207956	64.5562508	160.1209174
0.3600000	0.4868818	31.1235466	1.3524493	86.4542961	63.9242406	159.6688791
0.3700000	0.4909655	31.0859956	1.3269339	84.0162043	63.3160454	159.2310227
0.3800000	0.4948979	31.0451474	1.3023629	81.6977564	62.7304071	158.8066974
0.3900000	0.4986872	31.0014628	1.2786851	79.4909303	62.1661503	158.3952905
0.4000000	0.5023410	30.9553486	1.2558526	77.3883714	61.6221760	157.9962250

AGE LIABLE TO CAPTURE (2.8000000)

0.1500000	0.3345518	29.0563977	2.2303452	193.7093181	86.8517212	174.9211187
0.1600000	0.3457742	29.4840122	2.1610887	184.2750761	85.2695560	173.9681426
0.1700000	0.3563105	29.8476913	2.0959443	175.5746545	83.7687585	173.0557621
0.1800000	0.3662218	30.1562285	2.0345657	167.5346030	82.3441615	172.1817554
0.1900000	0.3755621	30.4171227	1.9766427	160.0901196	80.9909226	171.3440162
0.2000000	0.3843795	30.6367824	1.9218976	153.1839120	79.7045127	170.5405535
0.2100000	0.3927169	30.8206965	1.8700804	146.7652214	78.4807032	169.7694889
0.2200000	0.4006125	30.9735764	1.8209659	140.7889835	77.3155510	169.0290532
0.2300000	0.4081008	31.0994748	1.7743511	135.2151077	76.2053833	168.3175824
0.2400000	0.4152125	31.2018852	1.7300522	130.0078550	75.1467820	167.6335132
0.2500000	0.4219756	31.2838255	1.6879026	125.1353019	74.1365673	166.9753780
0.2600000	0.4284153	31.3479078	1.6477510	120.5688760	73.1717829	166.3417999
0.2700000	0.4345541	31.3963976	1.6094598	116.2829542	72.2496801	165.7314876
0.2800000	0.4404130	31.4312639	1.5729035	112.2545140	71.3677041	165.1432303
0.2900000	0.4460106	31.4542208	1.5379677	108.4628304	70.5234796	164.5758927
0.3000000	0.4513642	31.4667635	1.5045473	104.8892117	69.7147979	164.0284105
0.3100000	0.4564894	31.4701984	1.4725464	101.5167691	68.9396048	163.4997856
0.3200000	0.4614006	31.4656690	1.4418768	98.3302157	68.1959887	162.9890815
0.3300000	0.4661109	31.4541778	1.4124574	95.3156904	67.4821704	162.4954197
0.3400000	0.4706326	31.4366050	1.3842134	92.4606028	66.7964924	162.0179756
0.3500000	0.4749766	31.4137244	1.3570761	89.7534982	66.1374104	161.5559745
0.3600000	0.4791534	31.3862175	1.3309817	87.1839374	65.5034843	161.1086886
0.3700000	0.4831724	31.3546850	1.3058713	84.7423920	64.8933701	160.6754337
0.3800000	0.4870424	31.3196573	1.2816905	82.4201508	64.3058132	160.2555661
0.3900000	0.4907716	31.2816029	1.2583886	80.2092383	63.7396411	159.8484798
0.4000000	0.4943674	31.2409363	1.2359186	78.1023408	63.1937575	159.4536043

AGE LIABLE TO CAPTURE (2.9000000)

0.1500000	0.3292309	29.1251295	2.1948726	194.1675297	88.4641440	176.1976727
0.1600000	0.3402767	29.5642604	2.1267296	184.7766274	86.8829914	175.2552512
0.1700000	0.3506472	29.9392339	2.0626305	176.1131407	85.3827871	174.3529099
0.1800000	0.3604023	30.2588094	2.0022351	168.1044969	83.9584198	173.4884635
0.1900000	0.3695954	30.5304621	1.9452389	160.6866428	82.6050961	172.6598400
0.2000000	0.3782737	30.7605853	1.8913685	153.8029263	81.3183298	171.8650790
0.2100000	0.3864795	30.9546587	1.8403784	147.4031368	80.0939299	171.1023305
0.2200000	0.3942504	31.1173898	1.7920473	141.4426811	78.9279863	170.3698511
0.2300000	0.4016203	31.2528310	1.7461754	135.8818737	77.8168548	169.6660006
0.2400000	0.4086197	31.3644781	1.7025820	130.6853254	76.7571421	168.9892373
0.2500000	0.4152758	31.4553536	1.6611033	125.8214144	75.7456903	168.3381134
0.2600000	0.4216135	31.5280758	1.6215905	121.2618299	74.7795620	167.7112702
0.2700000	0.4276553	31.5849175	1.5839084	116.9811758	73.8560251	167.1074330
0.2800000	0.4334213	31.6278556	1.5479334	112.9566270	72.9725390	166.5254065
0.2900000	0.4389303	31.6586127	1.5135528	109.1676301	72.1267410	165.9640694
0.3000000	0.4441991	31.6786930	1.4806636	105.5956435	71.3164333	165.4223705
0.3100000	0.4492430	31.6894119	1.4491711	102.2239094	70.5395711	164.8993236
0.3200000	0.4540764	31.6919219	1.4189887	99.0372560	69.7942512	164.3940034
0.3300000	0.4587121	31.6872344	1.3900366	96.0219225	69.0787013	163.9055417
0.3400000	0.4631620	31.6762385	1.3622412	93.1654072	68.3912705	163.4331233
0.3500000	0.4674372	31.6597166	1.3355348	90.4563331	67.7304198	162.9759825
0.3600000	0.4715477	31.6383587	1.3098548	87.8843298	67.0947138	162.5333998
0.3700000	0.4755030	31.6127738	1.2851431	85.4399291	66.4828127	162.1046985
0.3800000	0.4793116	31.5834999	1.2613462	83.1144734	65.8934656	161.6892421
0.3900000	0.4829816	31.5510134	1.2384143	80.9000344	65.3255029	161.2864315
0.4000000	0.4865204	31.5157361	1.2163010	78.7893402	64.7778313	160.8957023

AGE LIABLE TO CAPTURE (3.0000000)

0.1500000	0.3239943	29.1867357	2.1599621	194.5782379	90.0840992	177.4607774
0.1600000	0.3348664	29.6370900	2.0929149	185.2318123	88.5042265	176.5288078
0.1700000	0.3450736	30.0230840	2.0298447	176.6063762	87.0048726	175.6364074
0.1800000	0.3546751	30.3534416	1.9704171	168.6302312	85.5809826	174.7814276
0.1900000	0.3637232	30.6356134	1.9143329	161.2400704	84.2278124	173.9618298
0.2000000	0.3722647	30.8759760	1.8613235	154.3798800	82.9409194	173.1756844
0.2100000	0.3803410	31.0799994	1.8111474	147.9999971	81.7161503	172.4211693
0.2200000	0.3879892	31.2523858	1.7635873	142.0562989	80.5496284	171.6965668
0.2300000	0.3952427	31.3971862	1.7184465	136.5095052	79.4377384	171.0002601
0.2400000	0.4021314	31.5178983	1.6755475	131.3245762	78.3771125	170.3307290
0.2500000	0.4086823	31.6175482	1.6347292	126.4701929	77.3646150	169.6865455
0.2600000	0.4149197	31.6987596	1.5958452	121.9183063	76.3973275	169.0663688
0.2700000	0.4208658	31.7638120	1.5587624	117.6437482	75.4725349	168.4689408
0.2800000	0.4265406	31.8146895	1.5233594	113.6238912	74.5877113	167.8930814
0.2900000	0.4319624	31.8531229	1.4895254	109.8383549	73.7405067	167.3376835
0.3000000	0.4371476	31.8806245	1.4571588	106.2687483	72.9287345	166.8017084
0.3100000	0.4421117	31.8985182	1.4261668	102.8984459	72.1503597	166.2841821
0.3200000	0.4468684	31.9079652	1.3964639	99.7123911	71.4034874	165.7841903
0.3300000	0.4514306	31.9099853	1.3679716	96.6969251	70.6863530	165.3008749
0.3400000	0.4558100	31.9054760	1.3406177	93.8396353	69.9973119	164.8334302
0.3500000	0.4600174	31.8952282	1.3143354	91.1292235	69.3348307	164.3810994
0.3600000	0.4640627	31.8799399	1.2890631	88.5553885	68.6974791	163.9431709
0.3700000	0.4679552	31.8602277	1.2647439	86.1087235	68.0839216	163.5189759
0.3800000	0.4717034	31.8366376	1.2413248	83.7806253	67.4929108	163.1078849
0.3900000	0.4753152	31.8096532	1.2187569	81.5632133	66.9232809	162.7093054
0.4000000	0.4787979	31.7797033	1.1969947	79.4492583	66.3739409	162.3226791

AGE LIABLE TO CAPTURE (3.1000000)

0.1500000	0.3188407	29.2412611	2.1256045	194.9417407	91.7111988	178.7105727
0.1600000	0.3295418	29.7025439	2.0596360	185.6408994	90.1328688	177.7889534
0.1700000	0.3395883	30.0992824	1.9975784	177.0546023	88.6346186	176.9063968
0.1800000	0.3490386	30.4401639	1.9391034	169.1120215	87.2114496	176.0607909
0.1900000	0.3579442	30.7326128	1.8839169	161.7505937	85.8586677	175.2501299
0.2000000	0.3663510	30.9829884	1.8317549	154.9149421	84.5718740	174.4725148
0.2100000	0.3742998	31.1967495	1.7823801	148.5559502	83.3469536	173.7261513
0.2200000	0.3818273	31.3785923	1.7355787	142.6299652	82.1800632	173.0093471
0.2300000	0.3889662	31.5325657	1.6911575	137.0981117	81.0676172	172.3205086
0.2400000	0.3957461	31.6621680	1.6489419	131.9256999	80.0062734	171.6581370
0.2500000	0.4021934	31.7704284	1.6087735	127.0817134	78.9929185	171.0208238
0.2600000	0.4083322	31.8599752	1.5705083	122.5383661	78.0246539	170.4072460
0.2700000	0.4141842	31.9330938	1.5340154	118.2707177	77.0987816	169.8161621
0.2800000	0.4197691	31.9917752	1.4991754	114.2563398	76.2127905	169.2464069
0.2900000	0.4251050	32.0377574	1.4658792	110.4750254	75.3643439	168.6968872
0.3000000	0.4302081	32.0725605	1.4340271	106.9085351	74.5512665	168.1665773
0.3100000	0.4350935	32.0975166	1.4035275	103.5403760	73.7715333	167.6545148
0.3200000	0.4397749	32.1137947	1.3742965	100.3556084	73.0232582	167.1597964
0.3300000	0.4442648	32.1224230	1.3462568	97.3406756	72.3046841	166.6815742
0.3400000	0.4485747	32.1243068	1.3193374	94.4832554	71.6141733	166.2190517
0.3500000	0.4527154	32.1202451	1.2934725	91.7721289	70.9501981	165.7714809
0.3600000	0.4566966	32.1109434	1.2686015	89.1970650	70.3113333	165.3381584
0.3700000	0.4605273	32.0970261	1.2446684	86.7487193	69.6962480	164.9184228
0.3800000	0.4642161	32.0790464	1.2216212	84.4185432	69.1036987	164.5116518
0.3900000	0.4677705	32.0574949	1.1994116	82.1987050	68.5325230	164.1172593
0.4000000	0.4711980	32.0328075	1.1779949	80.0820187	67.9816330	163.7346933

AGE LIABLE TO CAPTURE (3.2000000)

0.1500000	0.3137687	29.2887566	2.0917913	195.2583771	93.3450587	179.9471969
0.1600000	0.3243015	29.7606717	2.0268844	186.0041982	91.7685301	179.0358273
0.1700000	0.3341900	30.1678771	1.9658235	177.4581006	90.2716325	178.1630188
0.1800000	0.3434915	30.5190222	1.9082861	169.5501232	88.8494245	177.3266949
0.1900000	0.3522568	30.8215044	1.8539831	162.2184440	87.4972620	176.5248829
0.2000000	0.3605310	31.0816642	1.8026551	155.4083211	86.2107900	175.7557139
0.2100000	0.3683545	31.3049485	1.7540689	149.0711833	84.9859327	175.0174211
0.2200000	0.3757631	31.4960463	1.7080143	143.1638470	83.8188806	174.3083375
0.2300000	0.3827893	31.6590036	1.6643014	137.6478416	82.7060780	173.6268925
0.2400000	0.3894620	31.7973185	1.6227584	132.4888272	81.6442086	172.9716085
0.2500000	0.3958074	31.9140226	1.5832296	127.6560903	80.6301820	172.3410962
0.2600000	0.4018491	32.0117481	1.5455734	123.1221079	79.6611196	171.7340505
0.2700000	0.4076085	32.0927855	1.5096611	118.8621686	78.7343408	171.1492462
0.2800000	0.4131050	32.1591321	1.4753751	114.8540433	77.8473499	170.5855329
0.2900000	0.4183564	32.2125327	1.4426083	111.0776991	76.9978233	170.0418314
0.3000000	0.4233787	32.2545147	1.4112624	107.5150490	76.1835977	169.5171285
0.3100000	0.4281867	32.2864175	1.3812475	104.1497339	75.4026582	169.0104737
0.3200000	0.4327939	32.3094180	1.3524809	100.9669312	74.6531276	168.5209744
0.3300000	0.4372126	32.3245518	1.3248867	97.9531873	73.9332568	168.0477927
0.3400000	0.4414542	32.3327322	1.2983948	95.0962712	73.2414148	167.5901417
0.3500000	0.4455292	32.3347654	1.2729407	92.3850439	72.5760801	167.1472816
0.3600000	0.4494473	32.3313645	1.2484647	89.8093457	71.9358328	166.7185173
0.3700000	0.4532173	32.3231610	1.2249116	87.3598946	71.3193466	166.3031948
0.3800000	0.4568475	32.3107152	1.2022303	85.0281979	70.7253821	165.9006987
0.3900000	0.4603456	32.2945245	1.1803734	82.8064732	70.1527805	165.5104497
0.4000000	0.4637187	32.2750314	1.1592967	80.6875784	69.6004572	165.1319017

AGE LIABLE TO CAPTURE (3.3000000)

0.1500000	0.3087770	29.3292786	2.0585135	195.5285242	94.9852989	181.1707869
0.1600000	0.3191443	29.8115290	1.9946516	186.3220561	93.4108259	180.2695677
0.1700000	0.3288772	30.2289224	1.9345719	177.8171907	91.9155260	179.4064123
0.1800000	0.3380323	30.5900694	1.8779572	169.9448302	90.4945148	178.5792798
0.1900000	0.3466595	30.9023392	1.8245238	162.6438906	89.1431989	177.7862300
0.2000000	0.3548033	31.1720527	1.7740167	155.8602634	87.8572677	177.0254239
0.2100000	0.3625034	31.4046434	1.7262067	149.5459211	86.6326845	176.2951219
0.2200000	0.3697952	31.6047927	1.6808871	143.6581488	85.4656742	175.5936820
0.2300000	0.3767104	31.7765425	1.6378712	138.1588804	84.3527112	174.9195567
0.2400000	0.3832777	31.9233901	1.5969903	133.0141256	83.2905056	174.2712891
0.2500000	0.3895227	32.0483686	1.5580909	128.1934743	82.2759901	173.6475092
0.2600000	0.3954689	32.1541134	1.5210341	123.6696668	81.3063065	173.0469295
0.2700000	0.4011372	32.2429196	1.4856932	119.4182208	80.3787920	172.4683410
0.2800000	0.4065467	32.3167901	1.4519525	115.4171076	79.4909663	171.9106082
0.2900000	0.4117149	32.3774760	1.4197067	111.6464688	78.6405196	171.3726653
0.3000000	0.4166577	32.4265112	1.3888590	108.0883707	77.8253004	170.8535121
0.3100000	0.4213895	32.4652424	1.3593211	104.7265883	77.0433043	170.3522093
0.3200000	0.4259237	32.4948535	1.3310116	101.5464171	76.2926635	169.8678754
0.3300000	0.4302724	32.5163875	1.3038557	98.5345075	75.5716367	169.3996823
0.3400000	0.4344468	32.5307648	1.2777846	95.6787201	74.8786001	168.9468522
0.3500000	0.4384572	32.5387990	1.2527347	92.9679970	74.2120386	168.5086541
0.3600000	0.4423131	32.5412100	1.2286474	90.3922500	73.5705375	168.0844007
0.3700000	0.4460233	32.5386365	1.2054683	87.9422608	72.9527754	167.6734455
0.3800000	0.4495959	32.5316453	1.1831472	85.6095930	72.3575174	167.2751800
0.3900000	0.4530385	32.5207405	1.1616373	83.3865141	71.7836081	166.8890313
0.4000000	0.4563581	32.5063707	1.1408952	81.2659268	71.2299664	166.5144594

AGE LIABLE TO CAPTURE (3.4000000)

0.1500000	0.3038644	29.3628894	2.0257629	195.7525960	96.6315435	182.3814781
0.1600000	0.3140687	29.8551772	1.9629295	186.5948572	95.0593758	181.4903111
0.1700000	0.3236486	30.2824789	1.9038154	178.1322290	93.5659143	180.6367150
0.1800000	0.3326596	30.6533650	1.8481091	170.2964723	92.1463321	179.8186842
0.1900000	0.3411510	30.9751754	1.7955316	163.0272388	90.7960863	179.0343108
0.2000000	0.3491665	31.2542102	1.7458324	156.2710509	89.5109114	178.2817852
0.2100000	0.3567451	31.4958890	1.6987863	149.9804239	88.2868100	177.5593950
0.2200000	0.3639218	31.7048843	1.6541901	144.1131106	87.1200417	176.8655230
0.2300000	0.3707279	31.8852332	1.6118603	138.6314488	86.0071114	176.1986442
0.2400000	0.3771914	32.0404315	1.5716308	133.5017978	84.9447559	175.5573227
0.2500000	0.3833378	32.1735127	1.5333511	128.6940509	83.9299317	174.9402075
0.2600000	0.3891899	32.2871151	1.4968842	124.1812121	82.9598007	174.3460286
0.2700000	0.3947685	32.3835378	1.4621055	119.9390289	82.0317184	173.7735928
0.2800000	0.4000924	32.4647884	1.4289015	115.9456729	81.1432205	173.2217795
0.2900000	0.4051788	32.5326238	1.3971684	112.1814613	80.2920110	172.6895366
0.3000000	0.4100433	32.5885842	1.3668111	108.6286141	79.4759505	172.1758761
0.3100000	0.4147002	32.6340228	1.3377426	105.2710412	78.6930454	171.6798706
0.3200000	0.4191625	32.6701302	1.3098829	102.0941568	77.9414373	171.2006489
0.3300000	0.4234423	32.6979564	1.2831584	99.0847162	77.2193933	170.7373929
0.3400000	0.4275505	32.7184285	1.2575015	96.2306721	76.5252968	170.2893340
0.3500000	0.4314973	32.7323670	1.2328495	93.5210485	75.8576389	169.8557496
0.3600000	0.4352921	32.7404986	1.2091447	90.9458294	75.2150109	169.4359604
0.3700000	0.4389435	32.7434685	1.1863337	88.4958607	74.5960963	169.0293272
0.3800000	0.4424594	32.7418500	1.1643669	86.1627631	73.9996645	168.6352483
0.3900000	0.4458474	32.7361534	1.1431985	83.9388548	73.4245642	168.2531572
0.4000000	0.4491143	32.7268334	1.1227858	81.8170836	72.8697175	167.8825200

AGE LIABLE TO CAPTURE (3.5000000)

0.1500000	0.2990296	29.3896561	1.9935309	195.9310407	98.2834207	183.5794045
0.1600000	0.3090736	29.8916832	1.9317100	186.8230202	96.7138039	182.6981925
0.1700000	0.3185029	30.3286130	1.8735463	178.4036058	95.2224175	181.8540631
0.1800000	0.3273721	30.7089745	1.8187339	170.6054137	93.8044923	181.0450454
0.1900000	0.3357298	31.0400773	1.7669989	163.3688280	92.4555365	180.2692635
0.2000000	0.3436190	31.3282000	1.7180949	156.6409999	91.1713297	179.5249371
0.2100000	0.3510781	31.5787471	1.6718007	150.3749860	89.9479143	178.8103805
0.2200000	0.3581416	31.7963813	1.6279165	144.5290059	88.7815850	178.1240013
0.2300000	0.3648402	31.9851342	1.5862619	139.0658008	87.6688773	177.4642969
0.2400000	0.3712017	32.1484991	1.5466737	133.9520795	86.6065555	176.8298520
0.2500000	0.3772509	32.2895097	1.5090037	129.1580386	85.5915994	176.2193344
0.2600000	0.3830105	32.4108060	1.4731173	124.6569461	84.6211923	175.6314916
0.2700000	0.3885009	32.5146905	1.4388921	120.4247796	83.6927078	175.0651463
0.2800000	0.3937406	32.6031753	1.4062163	116.4399116	82.8036976	174.5191924
0.2900000	0.3987465	32.6780222	1.3749878	112.6828353	81.9518800	173.9925913
0.3000000	0.4035339	32.7407775	1.3451131	109.1359250	81.1351282	173.4843675
0.3100000	0.4081170	32.7928001	1.3165066	105.7832261	80.3514594	172.9936048
0.3200000	0.4125087	32.8352872	1.2890896	102.6102725	79.5990248	172.5194428
0.3300000	0.4167206	32.8692951	1.2627897	99.6039245	78.8761001	172.0610731
0.3400000	0.4207637	32.8957575	1.2375402	96.7522280	78.1810761	171.6177361
0.3500000	0.4246479	32.9155013	1.2132798	94.0442893	77.5124507	171.1887177
0.3600000	0.4283825	32.9292596	1.1899515	91.4701656	76.8688208	170.7733464
0.3700000	0.4319760	32.9376839	1.1675027	89.0207674	76.2488751	170.3709903
0.3800000	0.4354362	32.9413537	1.1458848	86.6877730	75.6513876	169.9810545
0.3900000	0.4387705	32.9407853	1.1250525	84.4635521	75.0752109	169.6029789
0.4000000	0.4419855	32.9364393	1.1049638	82.3410983	74.5192710	169.2362354

AGE LIABLE TO CAPTURE (3.6000000)

0.1500000	0.2942714	29.4096509	1.9618094	196.0643390	99.9405633	184.7646986
0.1600000	0.3041576	29.9211193	1.9009849	187.0069958	98.3737386	183.8933457
0.1700000	0.3134386	30.3673965	1.8437567	178.6317441	96.8846598	183.0585913
0.1800000	0.3221684	30.7569692	1.7898243	170.8720509	95.4686157	182.2584991
0.1900000	0.3303945	31.0971156	1.7389184	163.6690297	94.1211660	181.4912248
0.2000000	0.3381594	31.3940917	1.6907972	156.9704585	92.8381356	180.7550171
0.2100000	0.3455010	31.6532861	1.6452430	150.7299336	91.6156070	180.0482170
0.2200000	0.3524531	31.8793508	1.6020595	144.9061402	90.4499103	179.3692563
0.2300000	0.3590460	32.0763111	1.5610695	139.4622223	89.3376123	178.7166549
0.2400000	0.3653070	32.2476572	1.5221124	134.3652382	88.2755044	178.0890179
0.2500000	0.3712606	32.3964219	1.4850425	129.5856875	87.2605908	177.4850318
0.2600000	0.3769292	32.5252466	1.4497276	125.0971025	86.2900758	176.9034613
0.2700000	0.3823327	32.6364366	1.4160471	120.8756910	85.3613517	176.3431448
0.2800000	0.3874895	32.7320076	1.3838911	116.9000270	84.4719868	175.8029908
0.2900000	0.3924162	32.8137263	1.3531591	113.1507802	83.6197135	175.2819741
0.3000000	0.3971278	32.8831439	1.3237594	109.6104796	82.8024179	174.7791313
0.3100000	0.4016383	32.9416252	1.2956076	106.2633070	82.0181284	174.2935577
0.3200000	0.4059604	32.9903731	1.2686262	103.0949161	81.2650060	173.8244034
0.3300000	0.4101056	33.0304502	1.2427442	100.0922733	80.5413350	173.3708697
0.3400000	0.4140846	33.0627962	1.2178958	97.2435181	79.8455140	172.9322059
0.3500000	0.4179072	33.0882440	1.1940207	94.5378399	79.1760477	172.5077063
0.3600000	0.4215826	33.1075329	1.1710629	91.9653693	78.5315389	172.0967072
0.3700000	0.4251191	33.1213205	1.1489706	89.5170824	77.9106817	171.6985838
0.3800000	0.4285245	33.1301920	1.1276959	87.1847158	77.3122547	171.3127481
0.3900000	0.4318058	33.1346695	1.1071944	84.9606911	76.7351149	170.9386462
0.4000000	0.4349699	33.1352193	1.0874247	82.8380481	76.1781916	170.5757559

AGE LIABLE TO CAPTURE (3.7000000)

0.1500000	0.2895885	29.4229504	1.9305902	196.1530023	101.6026087	185.9374915
0.1600000	0.2993195	29.9435625	1.8707466	187.1472656	100.0388127	185.0759028
0.1700000	0.3084547	30.3989065	1.8144392	178.8170973	98.5522699	184.2504329
0.1800000	0.3170471	30.7974260	1.7613728	171.0968109	97.1383271	183.4591795
0.1900000	0.3251438	31.1463668	1.7112831	163.9282462	95.7925957	182.7003299
0.2000000	0.3327864	31.4519611	1.6639322	157.2598054	94.5109464	181.9721614
0.2100000	0.3400123	31.7195808	1.6191063	151.0456231	93.2895021	181.2730415
0.2200000	0.3468548	31.9538668	1.5766126	145.2448489	92.1246285	180.6014260
0.2300000	0.3533436	32.1588367	1.5362766	139.8210293	91.0129238	179.9558571
0.2400000	0.3595058	32.3379770	1.4979407	134.7415710	89.9512073	179.3349599
0.2500000	0.3653654	32.4943193	1.4614614	129.9772772	88.9365075	178.7374399
0.2600000	0.3709443	32.6305055	1.4267089	125.5019441	87.9660502	178.1620785
0.2700000	0.3762624	32.7488428	1.3935644	121.2920102	87.0372466	177.6077299
0.2800000	0.3813376	32.8513504	1.3619200	117.3262515	86.1476817	177.0733171
0.2900000	0.3861863	32.9397991	1.3316769	113.5855142	85.2951028	176.5578278
0.3000000	0.3908234	33.0157449	1.3027445	110.0524829	84.4774085	176.0603112
0.3100000	0.3952625	33.0805576	1.2750402	106.7114761	83.6926389	175.5798737
0.3200000	0.3995160	33.1354458	1.2484876	103.5482680	82.9389650	175.1156756
0.3300000	0.4035955	33.1814774	1.2230168	100.5499316	82.2146801	174.6669281
0.3400000	0.4075115	33.2195982	1.1985632	97.7047007	81.5181905	174.2328894
0.3500000	0.4112735	33.2506468	1.1750673	95.0018481	80.8480079	173.8128619
0.3600000	0.4148907	33.2753684	1.1524741	92.4315789	80.2027413	173.4061897
0.3700000	0.4183711	33.2944260	1.1307326	89.9849351	79.5810903	173.0122552
0.3800000	0.4217224	33.3084106	1.1097958	87.6537120	78.9818383	172.6304771
0.3900000	0.4249517	33.3178497	1.0896198	85.4303838	78.4038466	172.2603075
0.4000000	0.4280656	33.3232149	1.0701640	83.3080373	77.8460484	171.9012304

AGE LIABLE TO CAPTURE (3.8000000)

0.1500000	0.2849798	29.4296356	1.8998653	196.1975706	103.2691988	187.0979131
0.1600000	0.2945579	29.9590944	1.8409871	187.2443398	101.7086639	186.2459946
0.1700000	0.3035496	30.4232251	1.7855860	178.9601477	100.2248813	185.4297196
0.1800000	0.3120070	30.8304269	1.7333722	171.2801495	98.8132561	184.6472196
0.1900000	0.3199763	31.1879125	1.6840857	164.1469081	97.4694516	183.8967126
0.2000000	0.3274986	31.5018896	1.6374930	157.5094480	96.1893846	183.1765048
0.2100000	0.3346107	31.7777123	1.5933841	151.3224396	94.9692184	182.4849896
0.2200000	0.3413452	32.0200092	1.5515692	145.5454963	93.8053550	181.8206468
0.2300000	0.3477317	32.2327901	1.5118770	140.1425659	92.6944243	181.1820406
0.2400000	0.3537966	32.4195368	1.4741523	135.0814035	91.6332735	180.5678162
0.2500000	0.3595636	32.5832788	1.4382544	130.3331154	90.6189559	179.9766974
0.2600000	0.3650544	32.7266581	1.4040553	125.8717619	89.6487191	179.4074828
0.2700000	0.3702884	32.8519834	1.3714385	121.6740126	88.7199935	178.8590419
0.2800000	0.3752833	32.9612766	1.3402976	117.7188451	87.8303809	178.3303120
0.2900000	0.3800553	33.0563121	1.3105354	113.9872833	86.9776436	177.8202941
0.3000000	0.3846189	33.1386502	1.2820631	110.4621673	86.1596935	177.3280493
0.3100000	0.3889877	33.2096654	1.2547991	107.1279529	85.3745821	176.8526953
0.3200000	0.3931739	33.2705714	1.2286685	103.9705356	84.6204909	176.3934027
0.3300000	0.3971888	33.3224414	1.2036024	100.9770953	83.8957221	175.9493922
0.3400000	0.4010427	33.3662266	1.1795373	98.1359606	83.1986903	175.5199308
0.3500000	0.4047451	33.4027710	1.1564146	95.4364885	82.5279140	175.1043293
0.3600000	0.4083049	33.4328252	1.1341803	92.8689589	81.8820088	174.7019393
0.3700000	0.4117301	33.4570578	1.1127841	90.4244804	81.2596798	174.3121503
0.3800000	0.4150283	33.4760649	1.0921797	88.0949077	80.6597155	173.9343876
0.3900000	0.4182064	33.4903795	1.0723241	85.8727680	80.0809814	173.5681096
0.4000000	0.4212709	33.5004781	1.0531772	83.7511953	79.5224149	173.2128059

AGE LIABLE TO CAPTURE (3.9000000)

0.1500000	0.2804440	29.4297916	1.8696269	196.1986104	104.9399803	188.2460917
0.1600000	0.2898718	29.9678009	1.8116990	187.2987556	103.3829346	187.4037507
0.1700000	0.2987223	30.4404387	1.7571900	179.0614041	101.9021322	186.5965820
0.1800000	0.3070467	30.8560589	1.7058152	171.4225493	100.4930369	185.8227506
0.1900000	0.3148907	31.2218399	1.6573193	164.3254734	99.1513642	185.0805054
0.2000000	0.3222946	31.5439640	1.6114730	157.7198202	97.8730768	184.3681805
0.2100000	0.3292946	31.8277669	1.5680696	151.5607949	96.6543795	183.6841954
0.2200000	0.3359230	32.0778641	1.5269228	145.8084731	95.4917102	183.0270538
0.2300000	0.3422088	32.2982567	1.4878642	140.4272030	94.3817309	182.3953412
0.2400000	0.3481779	32.4924211	1.4507413	135.3850878	93.3213172	181.7877233
0.2500000	0.3538539	32.6633841	1.4154155	130.6535364	92.3075473	181.2029418
0.2600000	0.3592579	32.8137871	1.3817612	126.2068735	91.3376909	180.6398122
0.2700000	0.3644092	32.9459398	1.3496636	122.0219994	90.4091979	180.0972194
0.2800000	0.3693251	33.0618664	1.3190182	118.0780942	89.5196874	179.5741150
0.2900000	0.3740215	33.1633442	1.2897294	114.3563592	88.6669366	179.0695129
0.3000000	0.3785130	33.2519373	1.2617099	110.8397909	87.8488710	178.5824863
0.3100000	0.3828126	33.3290247	1.2348793	107.5129828	87.0635539	178.1121638
0.3200000	0.3869325	33.3958246	1.2091640	104.3619518	86.3091773	177.6577264
0.3300000	0.3908837	33.4534152	1.1844962	101.3739855	85.5840526	177.2184042
0.3400000	0.3946766	33.5027527	1.1608134	98.5375079	84.8866027	176.7934731
0.3500000	0.3983203	33.5446862	1.1380580	95.8419606	84.2153534	176.3822520
0.3600000	0.4018237	33.5799716	1.1161768	93.2776988	83.5689268	175.9840998
0.3700000	0.4051946	33.6092824	1.0951205	90.8358983	82.9460337	175.5984134
0.3800000	0.4084405	33.6332200	1.0748433	88.5084736	82.3454677	175.2246245
0.3900000	0.4115681	33.6523221	1.0553029	86.2880054	81.7660991	174.8621977
0.4000000	0.4145840	33.6670703	1.0364601	84.1676758	81.2068692	174.5106282

AGE LIABLE TO CAPTURE (4.0000000)

0.1500000	0.2759801	29.4235071	1.8398672	196.1567137	106.6146046	189.3821542
0.1600000	0.2852599	29.9697720	1.7828746	187.3110750	105.0612718	188.5492990
0.1700000	0.2939714	30.4506382	1.7292437	179.1214011	103.5836656	187.7511492
0.1800000	0.3021651	30.8744133	1.6786948	171.5245182	102.1773087	186.9859028
0.1900000	0.3098857	31.2482407	1.6309772	164.4644247	100.8379687	186.2518391
0.2000000	0.3171731	31.5782763	1.5858654	157.8913815	99.5616551	185.5473204
0.2100000	0.3240629	31.8698365	1.5431565	151.7611263	98.3446137	184.8707918
0.2200000	0.3305868	32.1275230	1.5026673	146.0341954	97.1833190	184.2207804
0.2300000	0.3367734	32.3553275	1.4642323	140.6753368	96.0744654	183.5958935
0.2400000	0.3426484	32.5567202	1.4277015	135.6530010	95.0149572	182.9948162
0.2500000	0.3482347	32.7347249	1.3929389	130.9388996	94.0018977	182.4163089
0.2600000	0.3535534	32.8919815	1.3598206	126.5076210	93.0325790	181.8592033
0.2700000	0.3586232	33.0308001	1.3282341	122.3362968	92.1044706	181.3223999
0.2800000	0.3634614	33.1532067	1.2980764	118.4043096	91.2152092	180.8048641
0.2900000	0.3680835	33.2609811	1.2692536	114.6930384	90.3625874	180.3056228
0.3000000	0.3725039	33.3556909	1.2416796	111.1856364	89.5445442	179.8237612
0.3100000	0.3767354	33.4387189	1.2152756	107.8668352	88.7591551	179.3584189
0.3200000	0.3807901	33.5112876	1.1899690	104.7227737	88.0046226	178.9087871
0.3300000	0.3846788	33.5744797	1.1656932	101.7408475	87.2792679	178.4741051
0.3400000	0.3884115	33.6292560	1.1423867	98.9095765	86.5815219	178.0536576
0.3500000	0.3919975	33.6764706	1.1199928	96.2184876	85.9099183	177.6467716
0.3600000	0.3954453	33.7168842	1.0984591	93.6580116	85.2630854	177.2528136
0.3700000	0.3987627	33.7511750	1.0777371	91.2193920	84.6397403	176.8711873
0.3800000	0.4019572	33.7799494	1.0577820	88.8946037	84.0386816	176.5013310
0.3900000	0.4050353	33.8037497	1.0385519	86.6762814	83.4587844	176.1427154
0.4000000	0.4080033	33.8230622	1.0200082	84.5576555	82.8989943	175.7948413

AGE LIABLE TO CAPTURE (4.1000000)

0.1500000	0.2715868	29.4108743	1.8105786	196.0724953	108.2927284	190.5062263
0.1600000	0.2807211	29.9651014	1.7545067	187.2818837	106.7433277	189.6827662
0.1700000	0.2892958	30.4539184	1.7017401	179.1406962	105.2691296	188.8935488
0.1800000	0.2973607	30.8855858	1.6520041	171.5865876	103.8657155	188.1368047
0.1900000	0.3049600	31.2672111	1.6050524	164.5642689	102.5289056	187.4108435
0.2000000	0.3121327	31.6049230	1.5606636	158.0246150	101.2547561	186.7140551
0.2100000	0.3189140	31.9040178	1.5186383	151.9238944	100.0395543	186.0449100
0.2200000	0.3253352	32.1690826	1.4787963	146.2231029	98.8798116	185.4019588
0.2300000	0.3314243	32.4040990	1.4409751	140.8873870	97.7722550	184.7838301
0.2400000	0.3372065	32.6125305	1.4050272	135.8855440	96.7138175	184.1892288
0.2500000	0.3427047	32.7973969	1.3708188	131.1895875	95.7016281	183.6169330
0.2600000	0.3479393	32.9613363	1.3382282	126.7743702	94.7330015	183.0657912
0.2700000	0.3529290	33.1066587	1.3071446	122.6172544	93.8054272	182.5347189
0.2800000	0.3576907	33.2353911	1.2774669	118.6978254	92.9165593	182.0226955
0.2900000	0.3622398	33.3493157	1.2491026	114.9976405	92.0642064	181.5287609
0.3000000	0.3665902	33.4500028	1.2219672	111.5000095	91.2463212	181.0520118
0.3100000	0.3707547	33.5388388	1.1959829	108.1898025	90.4609914	180.5915989
0.3200000	0.3747452	33.6170499	1.1710786	105.0532811	89.7064306	180.1467234
0.3300000	0.3785722	33.6857232	1.1471886	102.0779492	88.9809693	179.7166341
0.3400000	0.3822458	33.7458238	1.1242523	99.2524230	88.2830474	179.3006242
0.3500000	0.3857750	33.7982103	1.1022142	96.5663150	87.6112058	178.8980287
0.3600000	0.3891681	33.8436477	1.0810226	94.0101325	86.9640800	178.5082215
0.3700000	0.3924330	33.8828191	1.0606297	91.5751868	86.3403929	178.1306134
0.3800000	0.3955768	33.9163353	1.0409915	89.2535138	85.7389486	177.7646490
0.3900000	0.3986060	33.9447430	1.0220668	87.0378027	85.1586270	177.4098050
0.4000000	0.4015270	33.9685331	1.0038175	84.9213327	84.5983781	177.0655880

AGE LIABLE TO CAPTURE (4.2000000)

0.1500000	0.2672630	29.3919888	1.7817536	195.9465919	109.9740129	191.6184324
0.1600000	0.2762541	29.9538862	1.7265879	187.2117889	108.4287595	190.8042777
0.1700000	0.2846942	30.4503778	1.6746720	179.1198691	106.9581771	190.0239071
0.1800000	0.2926325	30.8896760	1.6257362	171.6093110	105.5579065	189.2755835
0.1900000	0.3001123	31.2788515	1.5795385	164.6255344	104.2238203	188.5576466
0.2000000	0.3071723	31.6240051	1.5358613	158.1200257	102.9520218	187.8685134
0.2100000	0.3138468	31.9304122	1.4945087	152.0495820	101.7388400	187.2066800
0.2200000	0.3201668	32.2026446	1.4553038	146.3756571	100.5808233	186.5707198
0.2300000	0.3261599	32.4446729	1.4180867	141.0637951	99.4747317	185.9592828
0.2400000	0.3318510	32.6599534	1.3827124	136.0831393	98.4175273	185.3710933
0.2500000	0.3372624	32.8515013	1.3490495	131.4060051	97.4063649	184.8049473
0.2600000	0.3424143	33.0219523	1.3169782	127.0075087	96.4385819	184.2597096
0.2700000	0.3473252	33.1736158	1.2863896	122.8652436	95.5116883	183.7343109
0.2800000	0.3520116	33.3085193	1.2571843	118.9589977	94.6233560	183.2277444
0.2900000	0.3564887	33.4284469	1.2292713	115.2705065	93.7714093	182.7390627
0.3000000	0.3607703	33.5349712	1.2025675	111.7832373	92.9538152	182.2673742
0.3100000	0.3648689	33.6294816	1.1769964	108.4821988	92.1686738	181.8118405
0.3200000	0.3687961	33.7132081	1.1524880	105.3537753	91.4142097	181.3716729
0.3300000	0.3725626	33.7872413	1.1289776	102.3855797	90.6887633	180.9461291
0.3400000	0.3761780	33.8525505	1.1064058	99.5663250	89.9907833	180.5345112
0.3500000	0.3796512	33.9099984	1.0847178	96.8857096	89.3188183	180.1361620
0.3600000	0.3829906	33.9603544	1.0638628	94.3343177	88.6715108	179.7504629
0.3700000	0.3862037	34.0043057	1.0437938	91.9035290	88.0475899	179.3768313
0.3800000	0.3892976	34.0424675	1.0244674	89.5854407	87.4458652	179.0147185
0.3900000	0.3922789	34.0753908	1.0058432	87.3727969	86.8652217	178.6636071
0.4000000	0.3951535	34.1035704	0.9878838	85.2589261	86.3046136	178.3230091

AGE LIABLE TO CAPTURE (4.3000000)

0.1500000	0.2630077	29.3669490	1.7533848	195.7796597	111.6581248	192.7188953
0.1600000	0.2718578	29.9362269	1.6991112	187.1014179	110.1172293	191.9139575
0.1700000	0.2801656	30.4401183	1.6480327	179.0595196	108.6504664	191.1423491
0.1800000	0.2879792	30.8867872	1.5998844	171.5932620	107.2535358	190.4023654
0.1900000	0.2953415	31.2832663	1.5544288	164.6487701	105.9223633	189.6923752
0.2000000	0.3022904	31.6356278	1.5114520	158.1781392	104.6530990	189.0108233
0.2100000	0.3088599	31.9491254	1.4707616	152.1386926	103.4421142	188.3562303
0.2200000	0.3150804	32.2283149	1.4321838	146.4923405	102.2859944	187.7271927
0.2300000	0.3209791	32.4771554	1.3955612	141.2050236	101.1815328	187.1223816
0.2400000	0.3265804	32.6990953	1.3607516	136.2462304	100.1257207	186.5405406
0.2500000	0.3319064	32.8971444	1.3276254	131.5885775	99.1157393	185.9804833
0.2600000	0.3369770	33.0739356	1.2960653	127.2074447	98.1489489	185.4410909
0.2700000	0.3418103	33.2317772	1.2659639	123.0806562	97.2228799	184.9213089
0.2800000	0.3464226	33.3726968	1.2372235	119.1882027	96.3352224	184.4201444
0.2900000	0.3508289	33.4984795	1.2097547	115.5119983	95.4838169	183.9366624
0.3000000	0.3550427	33.6107002	1.1834756	112.0356675	94.6666446	183.4699833
0.3100000	0.3590765	33.7107510	1.1583112	108.7443582	93.8818183	183.0192792
0.3200000	0.3629415	33.7998649	1.1341923	105.6245777	93.1275738	182.5837713
0.3300000	0.3666483	33.8791360	1.1110556	102.6640484	92.4022617	182.1627266
0.3400000	0.3702064	33.9495373	1.0888425	99.8515802	91.7043392	181.7554556
0.3500000	0.3736247	34.0119353	1.0674990	97.1769581	91.0323633	181.3613090
0.3600000	0.3769111	34.0671036	1.0469753	94.6308432	90.3849834	180.9796755
0.3700000	0.3800733	34.1157332	1.0272251	92.2046844	89.7609349	180.6099795
0.3800000	0.3831181	34.1584434	1.0082056	89.8906406	89.1590333	180.2516785
0.3900000	0.3860521	34.1957893	0.9898772	87.6815110	88.5781683	179.9042609
0.4000000	0.3888812	34.2282696	0.9722029	85.5706739	88.0172990	179.5672445

AGE LIABLE TO CAPTURE (4.4000000)

0.1500000	0.2588197	29.3358560	1.7254650	195.5723736	113.3447354	193.8077368
0.1600000	0.2675311	29.9122267	1.6720694	186.9514166	111.8084044	193.0119282
0.1700000	0.2757086	30.4232452	1.6218152	178.9602661	110.3456606	192.2489985
0.1800000	0.2833996	30.8770260	1.5744421	171.5390331	108.9522630	191.5172747
0.1900000	0.2906462	31.2805634	1.5297169	164.6345441	107.6241903	190.8151550
0.2000000	0.2974859	31.6399000	1.4874296	158.1995000	106.3576401	190.1411110
0.2100000	0.3039521	31.9602672	1.4473910	152.1917484	105.1490258	189.4936880
0.2200000	0.3100746	32.2462040	1.4094302	146.5736544	103.9949705	188.8715055
0.2300000	0.3158804	32.5016574	1.3733929	141.3115539	102.8923006	188.2732553
0.2400000	0.3213933	32.7300671	1.3391389	136.3752797	101.8380374	187.6977001
0.2500000	0.3266353	32.9344373	1.3065412	131.7377493	100.8293880	187.1436712
0.2600000	0.3316259	33.1173974	1.2754841	127.3746055	99.8637362	186.6100658
0.2700000	0.3363828	33.2812539	1.2458622	123.2639033	98.9386332	186.0958444
0.2800000	0.3409222	33.4280341	1.2175794	119.3858360	98.0517874	185.6000275
0.2900000	0.3452588	33.5595240	1.1905477	115.7224965	97.2010555	185.1216929
0.3000000	0.3494060	33.6773000	1.1646867	112.2576667	96.3844333	184.6599724
0.3100000	0.3533759	33.7827565	1.1399224	108.9766339	95.6000464	184.2140488
0.3200000	0.3571798	33.8771292	1.1161870	105.8660289	94.8461422	183.7831531
0.3300000	0.3608279	33.9615155	1.0934180	102.9136834	94.1210813	183.3665615
0.3400000	0.3643297	34.0368917	1.0715579	100.1085050	93.4233301	182.9635928
0.3500000	0.3676937	34.1041280	1.0505535	97.4403656	92.7514537	182.5736056
0.3600000	0.3709281	34.1640013	1.0303558	94.9000037	92.1041087	182.1959960
0.3700000	0.3740402	34.2172069	1.0109193	92.4789375	91.4800369	181.8301949
0.3800000	0.3770367	34.2643674	0.9922019	90.1693880	90.8780598	181.4756662
0.3900000	0.3799242	34.3060420	0.9741646	87.9642102	90.2970722	181.1319042
0.4000000	0.3827084	34.3427330	0.9567709	85.8568325	89.7360378	180.7984322

AGE LIABLE TO CAPTURE (4.5000000)

0.1500000	0.2546981	29.2988137	1.6979870	195.3254249	115.0335217	194.8850772
0.1600000	0.2632729	29.8819916	1.6454557	186.7624477	113.5019573	194.0983112
0.1700000	0.2713222	30.3998665	1.5960128	178.8227441	112.0434282	193.3439776
0.1800000	0.2788925	30.8605021	1.5494028	171.4472341	110.6537525	192.6204348
0.1900000	0.2860253	31.2708539	1.5053965	164.5834416	109.3289623	191.9261100
0.2000000	0.2927576	31.6369340	1.4637878	158.1846702	108.0653025	191.2595014
0.2100000	0.2991220	31.9639508	1.4243907	152.2092897	106.8592289	190.6191791
0.2200000	0.3051482	32.2564260	1.3870374	146.6201180	105.7074025	190.0037849
0.2300000	0.3108625	32.5182936	1.3515760	141.3838852	104.6066832	189.4120312
0.2400000	0.3162886	32.7529842	1.3178690	136.4707676	103.5541221	188.8426999
0.2500000	0.3214478	32.9634957	1.2857913	131.8539828	102.5469529	188.2946397
0.2600000	0.3263596	33.1524534	1.2552293	127.5094363	101.5825832	187.7667639
0.2700000	0.3310414	33.3221617	1.2260794	123.4154136	100.6585847	187.2580475
0.2800000	0.3355091	33.4746471	1.1982469	119.5523110	99.7726848	186.7675246
0.2900000	0.3397772	33.6116959	1.1716455	115.9023997	98.9227565	186.2942855
0.3000000	0.3438588	33.7348858	1.1461959	112.4496193	98.1068103	185.8374734
0.3100000	0.3477659	33.8456130	1.1218254	109.1793968	97.3229849	185.3962818
0.3200000	0.3515096	33.9451157	1.0984674	106.0784866	96.5695393	184.9699513
0.3300000	0.3550999	34.0344941	1.0760603	103.1348305	95.8448445	184.5577673
0.3400000	0.3585462	34.1147274	1.0545476	100.3374335	95.1473763	184.1590569
0.3500000	0.3618569	34.1866892	1.0338769	97.6762549	94.4757077	183.7731865
0.3600000	0.3650400	34.2511600	1.0140001	95.1421111	93.8285029	183.3995592
0.3700000	0.3681028	34.3088383	0.9948723	92.7265900	93.2045103	183.0376129
0.3800000	0.3710519	34.3603505	0.9764522	90.4219750	92.6025572	182.6868175
0.3900000	0.3738935	34.4062591	0.9587013	88.2211771	92.0215440	182.3466733
0.4000000	0.3766336	34.4470701	0.9415839	86.1176753	91.4604389	182.0167089

AGE LIABLE TO CAPTURE (4.6000000)

0.1500000	0.2506416	29.2559281	1.6709438	195.0395204	116.7241656	195.9510356
0.1600000	0.2590821	29.8456303	1.6192633	186.5351895	115.1975658	195.1732266
0.1700000	0.2670052	30.3700929	1.5706189	178.6476050	113.7434429	194.4274074
0.1800000	0.2744568	30.8373283	1.5247600	171.3184906	112.3576744	193.7119676
0.1900000	0.2814777	31.2542522	1.4814614	164.4960639	111.0363455	193.0253631
0.2000000	0.2881041	31.6268456	1.4405206	158.1342282	109.7757489	192.3661184
0.2100000	0.2943685	31.9602933	1.4017549	152.1918727	108.5723829	191.7328280
0.2200000	0.3002999	32.2590987	1.3649995	146.6322668	107.4229466	191.1241560
0.2300000	0.3059242	32.5271826	1.3301051	141.4225332	106.3243335	190.5388354
0.2400000	0.3112647	32.7679658	1.2969363	136.5331909	105.2736250	189.9756669
0.2500000	0.3163426	32.9844392	1.2653705	131.9377568	104.2680816	189.4335165
0.2600000	0.3211769	33.1792237	1.2352958	127.6123988	103.3051344	188.9113132
0.2700000	0.3257848	33.3546209	1.2066103	123.5356328	102.3823766	188.4080469
0.2800000	0.3301819	33.5126561	1.1792211	119.6880575	101.4975541	187.9227651
0.2900000	0.3343825	33.6551156	1.1530431	116.0521228	100.6485569	187.4545702
0.3000000	0.3383995	33.7835779	1.1279984	112.6119262	99.8334103	187.0026170
0.3100000	0.3422448	33.8994407	1.1040156	109.3530344	99.0502662	186.5661093
0.3200000	0.3459292	34.0039442	1.0810289	106.2623256	98.2973953	186.1442976
0.3300000	0.3494627	34.0981911	1.0589780	103.3278517	97.5731794	185.7364762
0.3400000	0.3528544	34.1831634	1.0378072	100.5387160	96.8761034	185.3419805
0.3500000	0.3561128	34.2597378	1.0174650	97.8849652	96.2047490	184.9601846
0.3600000	0.3592454	34.3286978	0.9979039	95.3574938	95.5577878	184.5904988
0.3700000	0.3622596	34.3907451	0.9790800	92.9479599	94.9339749	184.2323675
0.3800000	0.3651620	34.4465096	0.9609525	90.6487095	94.3321437	183.8852669
0.3900000	0.3679586	34.4965570	0.9434835	88.4527102	93.7512000	183.5487030
0.4000000	0.3706551	34.5413967	0.9266379	86.3534917	93.1901169	183.2222100

AGE LIABLE TO CAPTURE (4.7000000)

0.1500000	0.2466493	29.2073071	1.6443285	194.7153804	118.4163542	197.0057298
0.1600000	0.2549577	29.8032535	1.5934854	186.2703343	116.8949129	196.2367931
0.1700000	0.2627566	30.3340374	1.5456271	178.4355144	115.4453838	195.4994077
0.1800000	0.2700913	30.8076197	1.5005075	171.1534430	114.0637039	194.7919938
0.1900000	0.2770020	31.2308752	1.4579055	164.3730272	112.7460116	194.1130357
0.2000000	0.2835244	31.6097534	1.4176221	158.0487669	111.4886476	193.4610842
0.2100000	0.2896904	31.9494144	1.3794779	152.1400687	110.2881528	192.8347578
0.2200000	0.2955284	32.2543433	1.3433109	146.6106512	109.1412644	192.2327428
0.2300000	0.3010641	32.5284466	1.3089745	141.4280286	108.0449103	191.6537926
0.2400000	0.3063205	32.7751347	1.2763356	136.5630614	106.9962019	191.0967264
0.2500000	0.3113184	32.9973913	1.2452735	131.9895653	105.9924267	190.5604274
0.2600000	0.3160764	33.1978322	1.2156784	127.6839701	105.0310400	190.0438406
0.2700000	0.3206115	33.3787558	1.1874501	123.6250214	104.1096562	189.5459701
0.2800000	0.3249392	33.5421858	1.1604971	119.7935207	103.2260403	189.0658769
0.2900000	0.3290734	33.6899079	1.1347358	116.1720963	102.3780992	188.6026755
0.3000000	0.3330269	33.8235011	1.1100896	112.7450037	101.5638733	188.1555322
0.3100000	0.3368114	33.9443643	1.0864883	109.4979492	100.7815279	187.7236610
0.3200000	0.3404375	34.0537393	1.0638672	106.4179354	100.0293458	187.3063223
0.3300000	0.3439150	34.1527311	1.0421668	103.4931245	99.3057193	186.9028190
0.3400000	0.3472530	34.2423242	1.0213325	100.7127181	98.6091430	186.5124949
0.3500000	0.3504597	34.3233977	1.0013135	98.0668506	97.9382070	186.1347317
0.3600000	0.3535428	34.3967383	0.9820632	95.5464952	97.2915907	185.7689468
0.3700000	0.3565092	34.4630506	0.9635384	93.1433801	96.6680562	185.4145912
0.3800000	0.3593655	34.5229676	0.9456987	90.8499146	96.0664428	185.0711473
0.3900000	0.3621178	34.5770580	0.9285072	88.6591230	95.4856619	184.7381268
0.4000000	0.3647716	34.6258344	0.9119291	86.5645860	94.9246918	184.4150691

AGE LIABLE TO CAPTURE (4.8000000)

0.1500000	0.2427201	29.1530607	1.6181342	194.3537379	120.1097799	198.0492763
0.1600000	0.2508985	29.7549739	1.5681154	185.9685871	118.5936868	197.2891283
0.1700000	0.2585753	30.2918156	1.5210309	178.1871506	117.1489351	196.5600968
0.1800000	0.2657950	30.7714940	1.4766390	170.9527443	115.7715214	195.8606326
0.1900000	0.2725973	31.2008425	1.4347226	164.2149607	114.4576375	195.1892481
0.2000000	0.2790173	31.5857786	1.3950863	157.9288930	113.2036719	194.5445199
0.2100000	0.2850863	31.9314371	1.3575539	152.0544626	112.0062087	193.9250904
0.2200000	0.2908325	32.2422838	1.3219661	146.5558356	110.8620232	193.3296680
0.2300000	0.2962811	32.5222107	1.2881789	141.4009161	109.7680776	192.7570260
0.2400000	0.3014548	32.7746173	1.2560615	136.5609052	108.7215139	192.2060025
0.2500000	0.3063738	33.0024791	1.2254953	132.0099165	107.7196467	191.6754974
0.2600000	0.3110568	33.2084067	1.1963722	127.7246411	106.7599556	191.1644714
0.2700000	0.3155203	33.3946947	1.1685938	123.6840544	105.8400766	190.6719432
0.2800000	0.3197796	33.5633648	1.1420701	119.8691599	104.9577939	190.1969866
0.2900000	0.3238485	33.7162018	1.1167190	116.2627647	104.1110315	189.7387288
0.3000000	0.3277395	33.8547846	1.0924650	112.8492821	103.2978451	189.2963468
0.3100000	0.3314641	33.9805131	1.0692391	109.6145583	102.5164136	188.8690654
0.3200000	0.3350329	34.0946305	1.0469777	106.5457202	101.7650319	188.4561541
0.3300000	0.3384554	34.1982434	1.0256224	103.6310406	101.0421032	188.0569250
0.3400000	0.3417405	34.2923387	1.0051192	100.8598196	100.3461318	187.6707300
0.3500000	0.3448964	34.3777979	0.9854183	98.2222797	99.6757167	187.2969582
0.3600000	0.3479306	34.4554102	0.9664739	95.7094728	99.0295447	186.9350342
0.3700000	0.3508500	34.5258832	0.9482433	93.3131978	98.4063851	186.5844155
0.3800000	0.3536611	34.5898524	0.9306871	91.0259275	97.8050836	186.2445905
0.3900000	0.3563697	34.6478898	0.9137686	88.8407431	97.2245571	185.9150767
0.4000000	0.3589815	34.7005107	0.8974537	86.7512768	96.6637892	185.5954188

AGE LIABLE TO CAPTURE (4.9000000)

0.1500000	0.2388531	29.0933005	1.5923542	193.9553367	121.8041405	199.0817905
0.1600000	0.2469035	29.7009062	1.5431469	185.6306640	120.2935812	198.3303484
0.1700000	0.2544601	30.2435446	1.4968240	177.9032037	118.8537866	197.6095920
0.1800000	0.2615667	30.7290708	1.4531484	170.7170597	117.4808130	196.9180022
0.1900000	0.2682623	31.1642761	1.4119069	164.0225058	116.1709056	196.2541191
0.2000000	0.2745815	31.5550451	1.3729076	157.7752253	114.9205010	195.6165452
0.2100000	0.2805552	31.9064868	1.3359773	151.9356516	113.7262263	195.0039464
0.2200000	0.2862111	32.2230473	1.3009596	146.4683967	112.5848955	194.4150527
0.2300000	0.2915740	32.5086032	1.2677129	141.3417529	111.4935050	193.8486578
0.2400000	0.2966661	32.7665426	1.2361088	136.5272609	110.4492276	193.3036178
0.2500000	0.3015076	32.9998328	1.2060306	131.9993312	109.4494055	192.7788498
0.2600000	0.3061167	33.2110781	1.1773721	127.7349158	108.4915425	192.2733298
0.2700000	0.3105099	33.4025692	1.1500365	123.7132194	107.5732965	191.7860907
0.2800000	0.3147019	33.5763253	1.1239354	119.9154476	106.6924710	191.3162197
0.2900000	0.3187065	33.7341298	1.0989879	116.3245857	105.8470075	190.8628558
0.3000000	0.3225360	33.8775615	1.0751200	112.9252049	105.0349769	190.4251873
0.3100000	0.3262017	34.0080204	1.0522636	109.7032917	104.2545722	190.0024493
0.3200000	0.3297140	34.1267511	1.0303563	106.6460970	103.5041005	189.5939207
0.3300000	0.3330823	34.2348615	1.0093404	103.7420046	102.7819759	189.1989223
0.3400000	0.3363155	34.3333405	0.9891631	100.9804133	102.0867127	188.8168141
0.3500000	0.3394214	34.4230719	0.9697754	98.3516339	101.4169186	188.4469929
0.3600000	0.3424075	34.5048470	0.9511320	95.8467973	100.7712885	188.0888902
0.3700000	0.3452807	34.5793761	0.9331910	93.4577733	100.1485986	187.7419699
0.3800000	0.3480472	34.6472974	0.9159136	91.1770983	99.5477012	187.4057266
0.3900000	0.3507129	34.7091853	0.8992638	88.9979110	98.9675190	187.0796834
0.4000000	0.3532832	34.7655580	0.8832081	86.9138951	98.4070405	186.7633902

AGE LIABLE TO CAPTURE (5.0000000)

0.1500000	0.2350473	29.0281395	1.5669820	193.5209303	123.4991391	200.1033864
0.1600000	0.2429717	29.6411667	1.5185734	185.2572916	121.9942949	199.3605685
0.1700000	0.2504100	30.1893436	1.4730003	177.5843742	120.5596334	198.6480092
0.1800000	0.2574054	30.6804717	1.4300298	170.4470649	119.1912700	197.9642193
0.1900000	0.2639960	31.1212998	1.3894526	163.7963146	117.8855037	197.3077665
0.2000000	0.2702160	31.5176787	1.3510801	157.5883933	116.6388193	196.6772786
0.2100000	0.2760959	31.8746913	1.3147425	151.7842442	115.4478869	196.0714449
0.2200000	0.2816629	32.1967629	1.2802859	146.3489225	114.3095593	195.4890172
0.2300000	0.2869414	32.4877548	1.2475713	141.2511078	113.2208676	194.9288087
0.2400000	0.2919534	32.7510429	1.2164724	136.4626786	112.1790154	194.3896939
0.2500000	0.2967186	32.9895855	1.1868746	131.9583421	111.1813725	193.8706067
0.2600000	0.3012551	33.2059806	1.1586733	127.7153101	110.2254674	193.3705384
0.2700000	0.3055789	33.4025144	1.1317736	123.7130162	109.3089799	192.8885361
0.2800000	0.3097047	33.5812030	1.1060884	119.9328679	108.4297334	192.4237000
0.2900000	0.3136461	33.7438283	1.0815382	116.3580287	107.5856865	191.9751812
0.3000000	0.3174150	33.8919683	1.0580502	112.9732277	106.7749259	191.5421789
0.3100000	0.3210228	34.0270233	1.0355574	109.7645913	105.9956586	191.1239383
0.3200000	0.3244795	34.1502384	1.0139985	106.7194950	105.2462041	190.7197480
0.3300000	0.3277946	34.2627230	0.9933169	103.8264334	104.5249878	190.3289374
0.3400000	0.3309765	34.3654674	0.9734603	101.0749042	103.8305339	189.9508745
0.3500000	0.3340332	34.4593574	0.9543807	98.4553068	103.1614591	189.5849635
0.3600000	0.3369721	34.5451865	0.9360335	95.9588513	102.5164663	189.2306429
0.3700000	0.3397997	34.6236671	0.9183776	93.5774787	101.8943392	188.8873831
0.3800000	0.3425224	34.6954399	0.9013747	91.3037892	101.2939363	188.5546846
0.3900000	0.3451458	34.7610819	0.8849893	89.1309792	100.7141862	188.2320761
0.4000000	0.3476754	34.8211137	0.8691886	87.0527843	100.1540830	187.9191127

AGE LIABLE TO CAPTURE (5.1000000)

0.1500000	0.2313017	28.9576921	1.5420111	193.0512810	125.1944839	201.1141769
0.1600000	0.2391022	29.5758728	1.4943887	184.8492048	123.6955322	200.3799022
0.1700000	0.2464241	30.1293331	1.4495536	177.2313714	122.2661757	199.6754631
0.1800000	0.2533099	30.6258201	1.4072771	170.1434449	120.9025891	198.9993995
0.1900000	0.2597972	31.0720393	1.3673538	163.5370489	119.6011251	198.3503066
0.2000000	0.2659197	31.4738074	1.3295985	157.3690368	118.3583166	197.7268372
0.2100000	0.2717073	31.8361803	1.2938442	151.6008586	117.1708771	197.1277040
0.2200000	0.2771868	32.1635625	1.2599399	146.1980113	116.0356984	196.5516799
0.2300000	0.2823823	32.4597987	1.2277490	141.1295596	114.9498461	195.9975981
0.2400000	0.2873154	32.7282526	1.1971473	136.3677190	113.9105551	195.4643509
0.2500000	0.2920056	32.9718730	1.1680222	131.8874921	112.9152228	194.9508889
0.2600000	0.2964705	33.1932510	1.1402711	127.6663502	111.9614028	194.4562187
0.2700000	0.3007261	33.3946679	1.1138003	123.6839552	111.0467970	193.9794014
0.2800000	0.3047868	33.5781365	1.0885244	119.9219160	110.1692483	193.5195503
0.2900000	0.3086659	33.7454365	1.0643652	116.3635743	109.3267334	193.0758281
0.3000000	0.3123753	33.8981451	1.0412511	112.9938169	108.5173547	192.6474452
0.3100000	0.3159261	34.0376621	1.0191163	109.7989101	107.7393331	192.2336569
0.3200000	0.3193281	34.1652334	0.9979003	106.7663543	106.9910010	191.8337611
0.3300000	0.3225907	34.2819690	0.9775475	103.8847546	106.2707950	191.4470957
0.3400000	0.3257223	34.3888608	0.9580067	101.1437083	105.5772495	191.0730368
0.3500000	0.3287306	34.4867961	0.9392303	98.5337031	104.9089903	190.7109962
0.3600000	0.3316229	34.5765703	0.9211747	96.0460287	104.2647285	190.3604190
0.3700000	0.3344057	34.6588980	0.9037993	93.6726973	103.6432551	190.0207821
0.3800000	0.3370852	34.7344219	0.8870664	91.4063736	103.0434352	189.6915919
0.3900000	0.3396671	34.8037215	0.8709413	89.2403114	102.4642036	189.3723828
0.4000000	0.3421566	34.8673195	0.8553915	87.1682988	101.9045596	189.0627148

AGE LIABLE TO CAPTURE (5.2000000)

0.1500000	0.2276152	28.8820737	1.5174350	192.5471580	126.8898885	202.1142736
0.1600000	0.2352938	29.5051434	1.4705866	184.4071466	125.3970029	201.3884623
0.1700000	0.2425012	30.0636352	1.4264779	176.8449128	123.9731195	200.6920671
0.1800000	0.2492792	30.5652407	1.3848846	169.8068929	122.6144726	200.0236572
0.1900000	0.2556649	31.0166220	1.3456049	163.2453789	121.3174684	199.3818546
0.2000000	0.2616914	31.4235608	1.3084570	157.1178039	120.0786883	198.7653371
0.2100000	0.2673882	31.7910857	1.2732770	151.3861223	118.8948892	198.1728404
0.2200000	0.2727816	32.1235795	1.2399163	146.0162705	117.7630018	197.6031585
0.2300000	0.2778954	32.4248702	1.2082409	140.9776967	116.6801266	197.0551442
0.2400000	0.2827509	32.6983085	1.1781286	136.2429522	115.6435300	196.5277077
0.2500000	0.2873672	32.9468335	1.1494688	131.7873340	114.6506372	196.0198159
0.2600000	0.2917618	33.1730288	1.1221606	127.5885721	113.6990268	195.5304909
0.2700000	0.2959503	33.3791702	1.0961120	123.6265564	112.7864230	195.0588075
0.2800000	0.2999469	33.5672671	1.0712390	119.8830967	111.9106890	194.6038918
0.2900000	0.3037648	33.7390967	1.0474647	116.3417127	111.0698191	194.1649185
0.3000000	0.3074156	33.8962346	1.0247186	112.9874488	110.2619317	193.7411088
0.3100000	0.3109102	34.0400805	1.0029360	109.8067113	109.4852621	193.3317280
0.3200000	0.3142584	34.1718800	0.9820575	106.7871250	108.7381553	192.9360832
0.3300000	0.3174694	34.2927441	0.9620284	103.9174064	108.0190596	192.5535212
0.3400000	0.3205514	34.4036656	0.9427982	101.1872517	107.3265196	192.1834257
0.3500000	0.3235121	34.5055331	0.9243203	98.5872375	106.6591702	191.8252158
0.3600000	0.3263586	34.5991440	0.9065516	96.1087333	106.0157311	191.4783438
0.3700000	0.3290973	34.6852144	0.8894523	93.7438227	105.3950005	191.1422926
0.3800000	0.3317344	34.7643892	0.8729853	91.4852347	104.7958505	190.8165748
0.3900000	0.3342754	34.8372498	0.8571163	89.3262814	104.2172218	190.5007299
0.4000000	0.3367254	34.9043212	0.8418135	87.2608030	103.6581193	190.1943235

AGE LIABLE TO CAPTURE (5.3000000)

0.1500000	0.2239871	28.8014005	1.4932475	192.0093368	128.5850721	203.1037869
0.1600000	0.2315457	29.4290986	1.4471609	183.9318660	127.0984218	202.3863600
0.1700000	0.2386404	29.9923728	1.4037673	176.4257226	125.6801759	201.6979335
0.1800000	0.2453124	30.4988597	1.3628465	169.4381093	124.3266280	201.0371054
0.1900000	0.2515981	30.9551766	1.3242004	162.9219820	123.0342380	200.4025243
0.2000000	0.2575301	31.3670701	1.2876504	156.8353504	121.7996355	199.7928929
0.2100000	0.2631375	31.7395408	1.2530355	151.1406704	120.6196210	199.2069695
0.2200000	0.2684462	32.0769494	1.2202100	145.8043153	119.4911643	198.6435692
0.2300000	0.2734796	32.3831065	1.1890419	140.7961154	118.4114011	198.1015639
0.2400000	0.2782587	32.6613496	1.1594114	136.0889565	117.3776291	197.5798817
0.2500000	0.2828024	32.9146072	1.1312096	131.6584289	116.3873019	197.0775060
0.2600000	0.2871277	33.1454553	1.1043374	127.4825205	115.4380231	196.5934738
0.2700000	0.2912502	33.3561641	1.0787043	123.5413486	114.5275394	196.1268738
0.2800000	0.2951838	33.5487386	1.0542278	119.8169237	113.6537343	195.6768447
0.2900000	0.2989413	33.7249535	1.0308322	116.2929431	112.8146199	195.2425731
0.3000000	0.3025345	33.8863826	1.0084483	112.9546087	112.0083311	194.8232908
0.3100000	0.3059738	34.0344247	0.9870124	109.7884667	111.2331174	194.4182733
0.3200000	0.3092692	34.1703253	0.9664661	106.7822665	110.4873368	194.0268368
0.3300000	0.3124293	34.2951958	0.9467556	103.9248356	109.7694492	193.6483365
0.3400000	0.3154626	34.4100297	0.9278311	101.2059697	109.0780097	193.2821641
0.3500000	0.3183764	34.5157170	0.9096469	98.6163342	108.4116626	192.9277461
0.3600000	0.3211778	34.6130562	0.8921606	96.1473783	107.7691359	192.5845413
0.3700000	0.3238732	34.7027653	0.8753330	93.7912576	107.1492355	192.2520392
0.3800000	0.3264685	34.7854909	0.8591276	91.5407655	106.5508403	191.9297579
0.3900000	0.3289692	34.8618162	0.8435107	89.3892723	105.9728973	191.6172428
0.4000000	0.3313804	34.9322683	0.8284509	87.3306708	105.4144168	191.3140642

AGE LIABLE TO CAPTURE (5.4000000)

0.1500000	0.2204164	28.7157897	1.4694424	191.4385981	130.2797589	204.0828262
0.1600000	0.2278569	29.3478588	1.4241057	183.4241177	128.7995094	203.3737055
0.1700000	0.2348407	29.9156702	1.3814160	175.9745306	127.3870616	202.6931733
0.1800000	0.2414083	30.4268041	1.3411572	169.0378003	126.0387685	202.0398560
0.1900000	0.2475956	30.8878330	1.3031347	162.5675421	124.7511433	201.4124286
0.2000000	0.2534347	31.3044677	1.2671733	156.5223387	123.5208643	200.8096181
0.2100000	0.2589541	31.6816804	1.2331147	150.8651446	122.3447756	200.2302056
0.2200000	0.2641795	32.0238089	1.2008159	145.5627679	121.2198861	199.6730268
0.2300000	0.2691338	32.3346464	1.1701472	140.5854193	120.1433670	199.1369728
0.2400000	0.2738378	32.6175162	1.1409908	135.9063176	119.1125473	198.6209895
0.2500000	0.2783099	32.8753363	1.1132398	131.5013452	118.1249090	198.1240763
0.2600000	0.2825671	33.1106744	1.0867967	127.3487475	117.1780810	197.6452851
0.2700000	0.2866246	33.3257944	1.0615726	123.4288683	116.2698331	197.1837185
0.2800000	0.2904962	33.5226972	1.0374863	119.7239185	115.3980686	196.7385278
0.2900000	0.2941944	33.7031541	1.0144635	116.2177727	114.5608182	196.3089111
0.3000000	0.2977308	33.8687370	0.9924361	112.8957901	113.7562328	195.8941112
0.3100000	0.3011158	34.0208435	0.9713414	109.7446566	112.9825767	195.4934132
0.3200000	0.3043591	34.1607188	0.9511220	106.7522462	112.2382211	195.1061426
0.3300000	0.3074692	34.2894742	0.9317250	103.9074977	111.5216375	194.7316630
0.3400000	0.3104545	34.4081040	0.9131015	101.2003058	110.8313916	194.3693740
0.3500000	0.3133222	34.5174989	0.8952063	98.6214254	110.1661371	194.0187092
0.3600000	0.3160793	34.6184588	0.8779980	96.1623854	109.5246107	193.6791343
0.3700000	0.3187320	34.7117029	0.8614377	93.8154132	108.9056260	193.3501449
0.3800000	0.3212861	34.7978795	0.8454898	91.5733670	108.3080688	193.0312650
0.3900000	0.3237472	34.8775735	0.8301210	89.4296756	107.7308923	192.7220453
0.4000000	0.3261202	34.9513138	0.8153004	87.3782845	107.1731128	192.4220612

APPENDIX B

MONTHLY LANDINGS INDEXES

Table 1. Comparison of monthly landings index (MLI) as calculated by pounds (lb) vs numbers (num) and NMFS vs volunteered data.

NEW ENGLAND AND MID-ATLANTIC AREA

	NMFS		VOLUNTEERED	
	MLI LB		MLI LB	MLI NUM
	1980-83	1983	1983	1983
JANUARY	0.00	0.00	0.00	0.00
FEBRUARY	0.00	0.00	0.00	0.00
MARCH	0.00	0.00	0.00	0.00
APRIL	0.29	0.03	0.38	0.49
MAY	2.05	1.11	2.24	2.35
JUNE	9.93	12.76	9.02	7.64
JULY	19.45	19.18	14.97	11.86
AUGUST	24.15	23.64	23.94	26.47
SEPTEMBER	18.63	18.63	23.53	22.33
OCTOBER	18.09	17.71	15.81	15.93
NOVEMBER	5.78	5.99	8.85	11.57
DECEMBER	1.63	0.92	1.27	1.35

Table 2. Comparison of monthly landings index (MLI) as calculated by pounds (lb) vs numbers (num) and NMFS vs volunteered data.

SOUTH ATLANTIC AREA

	NMFS		VOLUNTEERED	
	MLI LB		MLI LB	MLI NUM
	1980-83	1983	1983	1983
JANUARY	0.04	0.14	0.17	0.25
FEBRUARY	0.34	0.00	0.00	0.00
MARCH	0.38	0.78	0.94	0.61
APRIL	4.27	8.47	6.43	5.97
MAY	11.81	21.56	16.90	17.29
JUNE	11.91	14.55	16.21	13.51
JULY	17.19	8.84	10.02	8.82
AUGUST	19.71	10.88	12.10	13.97
SEPTEMBER	16.10	10.80	11.96	13.80
OCTOBER	12.64	16.95	18.82	19.40
NOVEMBER	5.06	6.72	6.05	5.82
DECEMBER	0.57	0.32	0.39	0.59

Table 3. Comparison of monthly landings index (MLI) as calculated by pounds (lb) vs numbers (num) and NMFS vs volunteered data.

FLORIDA EAST COAST AREA

	NMFS		VOLUNTEERED	
	MLI LB		MLI LB	MLI NUM
	1980-83	1983	1983	1983
JANUARY	4.81	6.57	7.20	8.32
FEBRUARY	4.60	4.65	7.61	7.73
MARCH	7.09	2.52	9.91	9.14
APRIL	13.35 •	20.53	22.70	17.73
MAY	16.61	19.61	19.56	16.48
JUNE	12.84	16.56	12.76	11.98
JULY	11.67	9.17	3.68	4.35
AUGUST	6.40	4.27	2.84	4.36
SEPTEMBER	6.73	3.69	2.91	3.54
OCTOBER	6.07	4.09	3.42	5.34
NOVEMBER	5.26	4.49	4.41	6.41
DECEMBER	4.59	3.86	3.01	4.62

Table 4. Comparison of monthly landings index (MLI) as calculated by pounds (lb) vs numbers (num) and NMFS vs volunteered data.

GULF OF MEXICO AREA

	NMFS		VOLUNTEERED	
	MLI LB		MLI LB	MLI NUM
	1980-83	1983	1983	1983
JANUARY	13.83	23.39	14.49	14.32
FEBRUARY	22.04	29.47	20.97	20.10
MARCH	18.02	17.62	8.73	9.19
APRIL	13.34	8.41	0.00	0.00
MAY	6.34	5.30	0.00	0.00
JUNE	4.16	1.12	0.00	0.00
JULY	3.03	0.46	0.00	0.00
AUGUST	1.69	0.46	0.00	0.00
SEPTEMBER	1.84	0.42	0.00	0.00
OCTOBER	1.86	0.33	0.00	0.00
NOVEMBER	4.46	4.99	5.90	6.10
DECEMBER	9.41	8.05	49.92	50.28

Table 5. Comparison of monthly landings index (MLI) as calculated by pounds (lb) and small fish index* (MLI*MSFI).

NEW ENGLAND & MID-ATLANTIC AREA

	NMFS	1983 VOLUNTEERED DATA SMALL FISH INDEX		
	1980-83 MLI LB	≤ 70 lb MLI*MSFI	≤ 50 lb MLI*MSFI	≤ 25 lb MLI*MSFI
JANUARY	0.00	0.00	0.00	0.00
FEBRUARY	0.00	0.00	0.00	0.00
MARCH	0.00	0.00	0.00	0.00
APRIL	0.29	0.35	0.32	0.03
MAY	2.05	1.22	0.87	0.15
JUNE	9.93	2.68	1.90	0.38
JULY	19.45	3.31	2.09	0.38
AUGUST	24.15	11.96	7.53	1.65
SEPTEMBER	18.63	8.48	5.60	1.86
OCTOBER	18.09	6.68	4.94	2.17
NOVEMBER	5.78	7.87	6.91	3.45
DECEMBER	1.63	0.81	0.70	1.27
TOTAL		43.36	30.86	10.34

*SMALL FISH INDEX = MLI*MSFI = DISTRIBUTION OF SMALL FISH CATCH OVER THE YEAR.

Table 6. Comparison of monthly landings index (MLI) as calculated by pounds (lb) and small fish index* (MLI*MSFI).

SOUTH ATLANTIC AREA

	NMFS	1983 VOLUNTEERED DATA SMALL FISH INDEX		
	1980-83 MLI LB	≤ 70 lb MLI*MSFI	≤ 50 lb MLI*MSFI	≤ 25 lb MLI*MSFI
JANUARY	0.04	0.22	0.17	0.07
FEBRUARY	0.34	0.00	0.00	0.00
MARCH	0.38	0.41	0.33	0.07
APRIL	4.27	4.26	3.49	0.82
MAY	11.81	13.21	11.09	2.56
JUNE	11.91	9.13	7.16	1.51
JULY	17.19	6.07	4.90	1.18
AUGUST	19.71	11.27	9.83	3.43
SEPTEMBER	16.10	11.30	10.04	4.52
OCTOBER	12.64	15.02	13.50	6.82
NOVEMBER	5.06	4.32	3.84	1.44
DECEMBER	0.57	0.50	0.44	0.19
TOTAL		75.71	64.79	22.61

*SMALL FISH INDEX = MLI*MSFI = DISTRIBUTION OF SMALL FISH CATCH OVER THE YEAR.

Table 7. Comparison of monthly landings index (MLI) as calculated by pounds (lb) and small fish index* (MLI*MSFI).

FLORIDA EAST COAST AREA

	NMFS	1983 VOLUNTEERED DATA SMALL FISH INDEX		
	1980-83 MLI LB	≤ 70 lb MLI*MSFI	≤ 50 lb MLI*MSFI	≤ 25 lb MLI*MSFI
JANUARY	4.81	5.56	4.61	1.83
FEBRUARY	4.60	4.52	3.52	1.37
MARCH	7.09	4.78	2.98	0.84
APRIL	13.35	7.63	3.83	0.79
MAY	16.61	7.88	4.11	0.87
JUNE	12.84	6.28	4.09	0.84
JULY	11.67	2.81	2.03	0.59
AUGUST	6.40	3.34	2.87	1.17
SEPTEMBER	6.73	2.28	1.89	0.68
OCTOBER	6.07	4.25	3.76	2.22
NOVEMBER	5.26	4.84	4.22	2.21
DECEMBER	4.59	3.56	3.14	1.62
TOTAL		57.73	41.05	15.03

*SMALL FISH INDEX = MLI*MSFI = DISTRIBUTION OF SMALL FISH CATCH OVER THE YEAR.

Table 8. Comparison of monthly landings index (MLI) as calculated by pounds (lb) and small fish index* (MLI*MSFI).

GULF OF MEXICO AREA

	NMFS	1983 VOLUNTEERED DATA SMALL FISH INDEX		
	1980-83 MLI LB	≤ 70 lb MLI*MSFI	≤ 50 lb MLI*MSFI	≤ 25 lb MLI*MSFI
JANUARY	13.83	12.37	10.66	5.94
FEBRUARY	22.04	16.44	15.46	10.90
MARCH	18.02	7.56	7.32	5.29
APRIL	13.34	0.00	0.00	0.00
MAY	6.34	0.00	0.00	0.00
JUNE	4.16	0.00	0.00	0.00
JULY	3.03	0.00	0.00	0.00
AUGUST	1.69	0.00	0.00	0.00
SEPTEMBER	1.84	0.00	0.00	0.00
OCTOBER	1.86	0.00	0.00	0.00
NOVEMBER	4.46	5.53	5.12	3.50
DECEMBER	9.41	44.02	40.19	20.67
TOTAL		85.92	78.75	46.30

*SMALL FISH INDEX = MLI*MSFI - DISTRIBUTION OF SMALL FISH CATCH OVER THE YEAR.

Table 9. Swordfish catch size composition by area.

	≤ 70 lb		≤ 50 lb		≤ 25 lb	
	1980	1983	1980	1983	1980	1983
NE & MA	49.79	43.36	34.57	30.86	10.44	10.34
SA	66.62	75.71	48.36	64.79	9.98	22.61
FL-EC	48.98	57.73	32.44	41.05	7.84	15.03
GM	72.02	85.92	60.64	78.75	28.41	46.30

Table 10. Percent increase in numbers of small fish.

	1980			1983		
AREA	% ≤ 50 lb	L/$\bar{X}$	N*	% ≤ 50 lb	L/$\bar{X}$	N
NE&MA	34.57	$\frac{2,667,667}{89.7}$	10,281	30.86	$\frac{3,411,018}{96.2}$	10,942
SA	48.36	$\frac{633,823}{73.4}$	4,176	64.79	$\frac{885,858}{66.1}$	8,683
FL-EC	32.44	$\frac{1,731,032}{97.5}$	5,759	41.05	$\frac{2,113,487}{87.7}$	9,893
GM	60.64	$\frac{1,294,481}{58.0}$	13,534	78.75	$\frac{537,548}{41.5}$	10,200
		N =	33,750	N =		39,718

17.68 % INCREASE

FROM 1980 to 1983

*Numbers (N) less than or equal to 50 lb carcass weight = landings (carcass weight+) in pounds divided by the average carcass weight in pounds times the percentage of carcasses equal to or less than 50 lb carcass weight.

+Carcass weight = 0.75 times round weight.

Table 11. Percent reduction using the small fish index.

AREA	% ≤ 50 LB	% INCREASE FROM 1980-1983	% REDUCTION
NE & MA	30.86		5.46
SA	64.79	17.68	11.45
FL-EC	41.05		7.26
GM	78.75		13.92

Table 12. Swordfish calendar based on the small fish index for fish ≤ 50 lb carcass weight.

	NE & MA 1983 VOLUNTEERED NUM ≤ 50 LB		SA 1983 VOLUNTEERED NUM ≤ 50 lb		FL-EC 1983 VOLUNTEERED NUM ≤ 50 lb		GM 1983 VOLUNTEERED NUM ≤ 50 lb	
	5.46%	% DECREASED BASED ON MLI LB	11.45%	% DECREASED BASED ON MLI LB	7.26%	% DECREASED BASED ON MLI LB	13.92%	% DECREASED BASED ON MLI LB
APRIL	123		52	13	56	27	251	
MAY	94		33	13	54	26	221	26
JUNE	67		57	27	73	27	190	19
JULY	45	30	52	31	96	26	160	15
AUGUST	22	17	36	22	82	17	129	12
SEPTEMBER	29	18	33	17	72	15	98	10
OCTOBER	33	18	26	11	56	10	68	8
NOVEMBER	24	5	190*	*	60	10	37	7
DECEMBER	237		171		59	9	11	3

*SA COULD CLOSE 30 DAYS IN NOVEMBER AND 17 DAYS IN OCTOBER TO REDUCE THE PERCENTAGE OF FISH ≤ 50 LB BY 11.45%. THIS WOULD REPRESENT A 12% REDUCTION BASED ON MLI LB.

Table 13. Common starting date of October 15.

AREA	% REDUCTION BASED ON VOLUNTEERED NUMBER ≤ 50 LB	DAYS CLOSED BEGINNING ON OCTOBER 15	% REDUCTION BASED ON NMFS MLI LB
NE & MA	5.46	29	12
SA	11.45	47	12
FL-EC	7.26	57	10
GM	13.92	54	8

Table 14. MONTHLY LANDINGS INDEX VALUES BY AREA AND YEAR.

	GULF OF MEXICO					FLORIDA EAST COAST					SOUTH ATLANTIC					MID-ATLANTIC				
YEAR	1980	1981	1982	1983	AVERAGE	1980	1981	1982	1983	AVERAGE	1980	1981	1982	1983	AVERAGE	1980	1981	1982	1983	AVERAGE
JANUARY	10.27	13.99	7.65	23.39	13.83	4.81	4.71	3.15	6.57	4.81	0.00	0.00	0.00	0.14	0.04	0.00	0.00	0.00	0.00	0.00
FEBRUARY	19.26	24.63	14.79	29.47	22.04	4.47	3.79	5.50	4.65	4.60	0.00	1.36	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00
MARCH	15.83	15.35	23.27	17.62	18.02	7.89	10.06	7.90	2.52	7.09	0.00	0.00	0.73	0.78	0.38	0.00	0.00	0.00	0.00	0.00
APRIL	15.22	14.86	14.88	8.41	13.34	7.15	14.87	10.85	20.53	13.35	0.19	0.23	8.18	8.47	4.27	0.00	0.00	0.69	0.04	0.18
MAY	3.71	9.27	7.07	5.30	6.34	11.71	17.03	18.08	19.61	16.61	5.06	6.48	14.15	21.56	11.81	0.00	0.71	1.38	0.85	0.74
JUNE	2.80	7.60	5.13	1.12	4.16	7.19	11.84	15.76	16.56	12.84	14.26	10.97	7.87	14.55	11.91	2.86	3.60	6.27	6.54	4.82
JULY	2.76	2.65	6.24	0.46	3.03	16.06	9.28	12.17	9.17	11.67	17.22	26.72	15.96	8.84	17.19	30.83	24.77	13.24	18.14	21.75
AUGUST	2.55	0.25	3.50	0.46	1.69	13.21	4.09	4.02	4.27	6.40	25.67	21.98	20.30	10.88	19.71	26.10	14.27	12.63	19.59	18.15
SEPTEMBER	5.01	0.36	1.56	0.42	1.84	12.15	5.38	5.70	3.69	6.73	25.33	18.81	9.45	10.80	16.10	8.79	27.84	21.32	17.97	18.98
OCTOBER	4.72	1.73	0.66	0.33	1.86	7.27	7.51	5.39	4.09	6.07	8.99	11.35	13.25	16.95	12.64	20.35	13.58	26.67	23.11	20.93
NOVEMBER	5.93	2.88	4.03	4.99	4.46	4.70	6.73	5.11	4.49	5.26	3.27	1.37	8.89	6.72	5.06	11.07	15.15	13.88	11.54	12.91
DECEMBER	11.94	6.44	11.21	8.05	9.41	3.40	4.71	6.38	3.86	4.59	0.00	0.74	1.23	0.32	0.57	0.00	0.07	3.93	2.22	1.56

Table 14. (continued)

	NEW ENGLAND					MID-ATLANTIC & NEW ENGLAND					SOUTH ATLANTIC, MID-ATLANTIC & NEW ENGLAND				
YEAR	1980	1981	1982	1983	AVERAGE	1980	1981	1982	1983	AVERAGE	1980	1981	1982	1983	AVERAGE
JANUARY	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.01
FEBRUARY	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.08
MARCH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.18	0.10
APRIL	0.60	0.00	0.00	0.02	0.16	0.49	0.00	0.65	0.03	0.29	0.57	0.06	2.71	2.01	1.34
MAY	0.72	0.71	3.97	1.25	1.66	0.59	3.31	3.19	1.11	2.05	0.89	4.08	6.18	5.91	4.27
JUNE	7.44	3.60	11.76	15.87	9.67	6.60	10.10	10.26	12.76	9.93	7.62	10.31	9.61	13.18	10.18
JULY	16.02	24.77	22.96	19.70	20.86	18.71	23.33	16.59	19.18	19.45	16.38	24.16	16.42	16.75	18.43
AUGUST	25.07	14.27	28.26	25.68	23.32	25.26	25.41	22.28	23.65	24.15	25.12	24.57	21.74	20.65	23.02
SEPTEMBER	24.01	27.84	16.61	18.96	21.86	21.24	18.90	15.75	18.63	18.63	23.75	18.88	14.03	16.79	18.36
OCTOBER	16.58	13.58	13.55	15.02	14.68	17.27	13.56	23.80	17.71	18.09	16.35	13.02	20.91	17.53	16.95
NOVEMBER	4.84	15.15	2.88	3.22	6.52	5.97	5.39	5.75	5.99	5.78	4.91	4.41	6.61	6.16	5.52
DECEMBER	4.72	0.07	0.00	0.28	1.27	3.86	0.01	1.73	0.92	1.63	4.43	0.19	1.59	0.78	1.75

APPENDIX C

SWORDFISH PERMIT INFORMATION

Table 1. Number of swordfish vessels by size by ability to carry an observer. (Source: Councils' Request to the Secretary of Commerce under Section 303(e). Data input and analysis by NMFS SEFC.)

LENGTH	CARRY OBSERVER YES	CARRY OBSERVER NO	NO ANSWER	TOTAL
1-10	0	0	0	0
11-20	0	1	0	1
21-30	8	21	7	36
31-40	14	45	12	71
41-50	25	40	10	75
51-60	24	21	7	52
61-70	22	23	6	51
71-80	13	18	5	36
81-90	12	4	0	16
91-100	2	0	0	2
TOTALS	120	173	47	340

Table 2. Total number of vessels by month, by gear and by area for a yes response to carrying an observer. (Source: Councils' Request to the Secretary of Commerce under Section 303(e). Data input and analysis by NMFS SEFC.)

	LONGLINE	HARPOON	GILLNET	OTHER	COMBINATION
JANUARY					
Gulf of Mexico	44	1	0	0	3
Florida East Coast	28	1	0	0	5
Jacksonville, FL to Cape Hatteras	0	0	0	0	4
Hatteras through New York	3	0	0	0	3
North of New York	1	2	0	0	1
Caribbean	1	0	0	0	1
TOTALS	77	4	0	0	17
FEBRUARY					
Gulf of Mexico	45	1	0	0	3
Florida East Coast	29	1	0	0	4
Jacksonville, FL to Cape Hatteras	0	0	0	0	4
Hatteras through New York	3	0	0	0	3
North of New York	1	2	0	0	1
Caribbean	1	0	0	0	1
TOTALS	79	4	0	0	16
MARCH					
Gulf of Mexico	33	1	0	0	2
Florida East Coast	37	1	0	0	5
Jacksonville, FL to Cape Hatteras	0	1	0	0	4
Hatteras through New York	3	0	0	0	4
North of New York	2	2	0	0	2
Caribbean	1	0	0	0	2
TOTALS	76	5	0	0	19
APRIL					
Gulf of Mexico	13	1	0	0	2
Florida East Coast	41	1	0	0	5
Jacksonville, FL to Cape Hatteras	3	1	0	0	4
Hatteras through New York	4	0	0	0	4
North of New York	4	2	1	0	3
Caribbean	1	0	0	0	2
TOTALS	66	5	1	0	20

Table 2. Continued

	LONGLINE	HARPOON	GILLNET	OTHER	COMBINATION
MAY					
Gulf of Mexico	9	1	0	0	2
Florida East Coast	39	1	0	0	5
Jacksonville, FL to Cape Hatteras	7	1	0	0	4
Hatteras through New York	5	1	0	0	6
North of New York	10	9	1	0	5
Caribbean	1	0	0	0	2
TOTALS	71	13	1	0	24
JUNE					
Gulf of Mexico	1	0	0	0	1
Florida East Coast	33	0	0	0	0
Jacksonville, FL to Cape Hatteras	19	0	1	0	0
Hatteras through New York	20	0	1	0	5
North of New York	15	31	0	0	14
Caribbean	1	0	0	0	0
TOTALS	89	31	2	0	20
JULY					
Gulf of Mexico	1	0	0	0	0
Florida East Coast	30	0	0	0	0
Jacksonville, FL to Cape Hatteras	18	0	1	0	0
Hatteras through New York	20	0	1	0	5
North of New York	20	30	0	0	15
Caribbean	1	0	0	0	0
TOTALS	90	30	2	0	20
AUGUST					
Gulf of Mexico	2	0	0	0	1
Florida East Coast	24	0	0	0	1
Jacksonville, FL to Cape Hatteras	19	0	0	0	1
Hatteras through New York	20	0	1	0	5
North of New York	22	30	0	0	16
Caribbean	1	0	0	0	0
TOTALS	88	30	1	0	24

Table 2. Continued

	LONGLINE	HARPOON	GILLNET	OTHER	COMBINATION
SEPTEMBER					
Gulf of Mexico	4	0	0	0	1
Florida East Coast	24	0	0	0	2
Jacksonville, FL to Cape Hatteras	18	0	0	0	1
Hatteras through New York	25	0	1	0	5
North of New York	19	29	0	0	16
Caribbean	1	0	0	0	1
TOTALS	91	29	1	0	26
OCTOBER					
Gulf of Mexico	8	0	0	0	1
Florida East Coast	27	0	0	0	2
Jacksonville, FL to Cape Hatteras	19	0	0	0	2
Hatteras through New York	25	0	0	0	6
North of New York	14	13	0	0	13
Caribbean	1	0	0	0	1
TOTALS	94	13	0	0	25
NOVEMBER					
Gulf of Mexico	27	0	0	0	1
Florida East Coast	27	1	0	0	2
Jacksonville, FL to Cape Hatteras	7	0	0	0	2
Hatteras through New York	6	0	0	0	6
North of New York	12	5	0	0	10
Caribbean	1	0	0	0	1
TOTALS	80	6	0	0	22
DECEMBER					
Gulf of Mexico	38	0	0	0	1
Florida East Coast	33	1	0	0	3
Jacksonville, FL to Cape Hatteras	1	0	0	0	4
Hatteras through New York	5	0	0	0	5
North of New York	6	3	0	0	4
Caribbean	1	0	0	0	1
TOTALS	84	4	0	0	18

Table 3. Number of swordfish vessel-months* by gear and by area for a yes response to carrying an observer. (Source: Councils' Request to the Secretary of Commerce under Section 303(e). Data input and analysis by NMFS SEFC.)

	LONGLINE	HARPOON	GILLNET	OTHER	COMBINATION
Gulf of Mexico	225	5	0	0	18
Florida East Coast	372	7	0	0	34
Jacksonville, FL to Cape Hatteras	111	3	2	0	30
Hatteras through New York	139	1	4	0	57
North of New York	126	158	2	0	100
Caribbean	12	0	0	0	12
TOTALS	985	174	8	0	251

*This table is a summation of the monthly information shown in Table 2. Vessel-month refers to a vessel fishing in a particular area in a particular month. The numbers shown here in Table 3 are not numbers of vessels; the total number of vessels as of October 29, 1984 was 340.

Table 4. Number of swordfish vessels by month, by gear and by area. (Source: Councils' Request to the Secretary of Commerce under Section 303(e). Data input and analysis by NMFS SEFC.)

	LONGLINE	HARPOON	GILLNET	OTHER	COMBINATION
JANUARY					
Gulf of Mexico	98	2	0	0	4
Florida East Coast	57	3	0	0	6
Jacksonville, FL to Cape Hatteras	2	0	0	0	4
Hatteras through New York	11	1	0	0	5
North of New York	7	4	0	0	1
Caribbean	2	0	0	0	1
TOTALS	177	10	0	0	21
FEBRUARY					
Gulf of Mexico	97	2	0	0	4
Florida East Coast	60	3	0	0	5
Jacksonville, FL to Cape Hatteras	2	0	0	0	4
Hatteras through New York	11	1	0	0	5
North of New York	6	4	0	0	1
Caribbean	1	0	0	0	2
TOTALS	177	10	0	0	21
MARCH					
Gulf of Mexico	66	2	0	0	2
Florida East Coast	81	3	0	0	8
Jacksonville, FL to Cape Hatteras	3	1	0	0	4
Hatteras through New York	14	0	0	0	6
North of New York	6	5	0	1	5
Caribbean	2	0	0	0	2
TOTALS	172	11	0	1	27
APRIL					
Gulf of Mexico	35	2	0	0	2
Florida East Coast	93	3	0	0	7
Jacksonville, FL to Cape Hatteras	8	1	0	0	4
Hatteras through New York	18	1	0	0	6
North of New York	11	6	1	1	5
Caribbean	2	0	0	0	2
TOTALS	167	13	1	1	26

Table 4. Continued

	LONGLINE	HARPOON	GILLNET	OTHER	COMBINATION
MAY					
Gulf of Mexico	24	2	0	0	2
Florida East Coast	87	3	0	1	7
Jacksonville, FL to Cape Hatteras	15	1	0	0	4
Hatteras through New York	20	2	0	0	10
North of New York	18	16	1	1	9
Caribbean	1	0	0	0	2
TOTALS	165	24	1	2	34
JUNE					
Gulf of Mexico	9	1	0	0	2
Florida East Coast	68	2	0	1	4
Jacksonville, FL to Cape Hatteras	28	0	1	0	1
Hatteras through New York	41	5	1	0	12
North of New York	40	79	0	0	34
Caribbean	3	0	0	0	1
TOTALS	189	87	2	1	54
JULY					
Gulf of Mexico	6	1	0	0	0
Florida East Coast	55	1	0	1	1
Jacksonville, FL to Cape Hatteras	29	1	1	0	0
Hatteras through New York	41	5	1	0	10
North of New York	49	88	0	0	38
Caribbean	2	0	0	0	1
TOTALS	182	96	2	1	50
AUGUST					
Gulf of Mexico	7	1	0	0	1
Florida East Coast	48	1	0	1	2
Jacksonville, FL to Cape Hatteras	29	0	0	0	1
Hatteras through New York	45	5	1	0	12
North of New York	53	90	0	0	39
Caribbean	2	0	0	0	1
TOTALS	184	97	1	1	56

Table 4. Continued

	LONGLINE	HARPOON	GILLNET	OTHER	COMBINATION
SEPTEMBER					
Gulf of Mexico	10	2	0	0	1
Florida East Coast	50	1	0	1	3
Jacksonville, FL to Cape Hatteras	27	0	0	0	1
Hatteras through New York	54	5	1	0	11
North of New York	49	84	0	0	39
Caribbean	1	0	0	0	3
TOTALS	191	92	1	1	58
OCTOBER					
Gulf of Mexico	22	1	0	0	2
Florida East Coast	58	1	0	0	3
Jacksonville, FL to Cape Hatteras	29	1	0	0	2
Hatteras through New York	54	1	0	0	11
North of New York	38	26	0	0	27
Caribbean	1	0	0	0	3
TOTALS	202	30	0	0	48
NOVEMBER					
Gulf of Mexico	54	2	0	0	2
Florida East Coast	55	2	0	0	3
Jacksonville, FL to Cape Hatteras	12	0	0	0	2
Hatteras through New York	31	1	0	0	11
North of New York	29	9	0	1	15
Caribbean	3	0	0	0	2
TOTALS	184	14	0	1	35
DECEMBER					
Gulf of Mexico	75	2	0	0	2
Florida East Coast	60	2	0	0	4
Jacksonville, FL to Cape Hatteras	6	0	0	0	4
Hatteras through New York	19	1	0	0	8
North of New York	15	6	0	1	5
Caribbean	3	0	0	0	1
TOTALS	178	11	0	1	24

Table 5. Number of swordfish vessel-months* by gear and by area. (Source: Councils' Request to the Secretary of Commerce under Section 303(e). Data input and analysis by NMFS SEFC.)

	LONGLINE	HARPOON	GILLNET	OTHER	COMBINATION
Gulf of Mexico	503	20	0	0	24
Florida East Coast	772	25	0	5	53
Jacksonville, FL to Cape Hatteras	190	5	2	0	31
Hatteras through New York	359	28	4	0	107
North of New York	321	417	2	5	218
Caribbean	23	0	0	0	21
TOTALS	2,168	495	8	10	454

*This table is a summation of the monthly information shown in Table 4. Vessel-month refers to a vessel fishing in a particular area in a particular month. The numbers shown here in Table 5 are not numbers of vessels; the total number of vessels as of October 29, 1984 was 340.

Table 6. Average trip length in days by month and by area. (Source: Councils' Request to the Secretary of Commerce under Section 303(e). Data input and anlysis by NMFS SEFC.)

	MEAN	STANDARD DEVIATION	NUMBER VESSELS	TOTAL DAYS
JANUARY				
Gulf of Mexico	9.90	5.37	72	713
Florida East Coast	7.13	5.40	52	371
Jacksonville, FL to Cape Hatteras	15.33	8.60	6	92
Hatteras through New York	11.89	7.16	9	107
North of New York	17.00	12.03	3	51
Caribbean	22.00	8.00	2	44
TOTALS	9.57	6.51	144	1,378
FEBRUARY				
Gulf of Mexico	9.73	5.33	73	710
Florida East Coast	7.30	5.33	53	387
Jacksonville, FL to Cape Hatteras	15.33	8.60	6	92
Hatteras through New York	11.89	7.16	9	107
North of New York	17.00	12.03	3	51
Caribbean	22.00	8.00	2	44
TOTALS	9.53	6.43	146	1,391
MARCH				
Gulf of Mexico	10.38	5.47	53	550
Florida East Coast	7.55	5.21	71	536
Jacksonville, FL to Cape Hatteras	13.29	9.41	7	93
Hatteras through New York	11.85	6.25	13	154
North of New York	8.86	10.48	7	62
Caribbean	21.33	5.19	3	64
TOTALS	9.47	6.44	154	1,459
APRIL				
Gulf of Mexico	11.71	6.33	28	328
Florida East Coast	7.68	4.94	82	630
Jacksonville, FL to Cape Hatteras	13.00	8.37	9	117
Hatteras through New York	13.67	11.09	15	205
North of New York	10.25	9.71	12	123
Caribbean	21.33	5.19	3	64
TOTALS	9.85	7.33	149	1,467

Table 6. Continued.

	MEAN	STANDARD DEVIATION	NUMBER VESSELS	TOTAL DAYS
MAY				
Gulf of Mexico	11.44	7.35	18	206
Florida East Coast	7.58	5.01	79	599
Jacksonville, FL to Cape Hatteras	12.47	6.58	19	237
Hatteras through New York	13.74	12.76	19	261
North of New York	9.58	8.04	24	230
Caribbean	25.00	0.00	2	50
TOTALS	9.83	7.78	161	1,583
JUNE				
Gulf of Mexico	7.60	4.84	5	38
Florida East Coast	5.69	2.65	58	330
Jacksonville, FL to Cape Hatteras	8.17	3.75	24	196
Hatteras through New York	8.24	4.17	41	338
North of New York	8.08	7.50	95	768
Caribbean	14.00	0.00	1	14
TOTALS	7.52	5.67	224	1,684
JULY				
Gulf of Mexico	9.25	3.96	4	37
Florida East Coast	5.40	2.55	45	243
Jacksonville, FL to Cape Hatteras	6.62	2.34	26	172
Hatteras through New York	8.44	5.25	39	329
North of New York	8.19	7.58	116	950
Caribbean	14.00	0.00	1	14
TOTALS	7.55	6.10	231	1,745
AUGUST				
Gulf of Mexico	14.50	8.10	6	87
Florida East Coast	5.80	3.93	41	238
Jacksonville, FL to Cape Hatteras	7.26	4.27	27	196
Hatteras through New York	9.18	9.19	45	413
North of New York	8.07	7.71	118	952
Caribbean	14.00	0.00	1	14
TOTALS	7.98	7.36	238	1,900

Table 6. Continued.

	MEAN	STANDARD DEVIATION	NUMBER VESSELS	TOTAL DAYS
SEPTEMBER				
Gulf of Mexico	12.33	7.47	9	111
Florida East Coast	6.70	5.29	44	295
Jacksonville, FL to Cape Hatteras	7.84	5.27	25	196
Hatteras through New York	8.94	10.43	52	465
North of New York	8.03	7.75	108	867
Caribbean	30.00	0.00	2	60
TOTALS	8.31	8.12	240	1,994
OCTOBER				
Gulf of Mexico	13.11	6.81	18	236
Florida East Coast	6.22	4.51	50	311
Jacksonville, FL to Cape Hatteras	8.74	5.45	27	236
Hatteras through New York	9.91	10.92	46	456
North of New York	10.66	8.08	53	565
Caribbean	30.00	0.00	2	60
TOTALS	9.51	8.24	196	1,864
NOVEMBER				
Gulf of Mexico	10.72	5.61	43	461
Florida East Coast	6.10	4.70	48	293
Jacksonville, FL to Cape Hatteras	11.83	6.50	12	142
Hatteras through New York	12.59	13.77	27	340
North of New York	13.43	9.58	28	376
Caribbean	25.00	5.00	2	50
TOTALS	10.39	8.80	160	1,662
DECEMBER				
Gulf of Mexico	10.47	5.41	60	628
Florida East Coast	6.06	4.90	47	285
Jacksonville, FL to Cape Hatteras	14.00	8.60	7	98
Hatteras through New York	10.00	6.90	17	170
North of New York	9.56	10.07	9	86
Caribbean	22.00	8.00	2	44
TOTALS	9.23	6.67	142	1,311

Table 7. Average trip length in days by area - grand totals for 1983. (Source: Councils' Request to the Secretary of Commerce under Section 303(e). Data input and anlysis by NMFS SEFC.)

	MEAN	STANDARD DEVIATION	NUMBER VESSELS	TOTAL DAYS
Gulf of Mexico	10.55	5.84	389	4,105
Florida East Coast	6.74	4.75	670	4,518
Jacksonville, FL to Cape Hatteras	9.57	6.38	195	1,867
Hatteras through New York	10.08	9.52	332	3,345
North of New York	8.82	8.15	576	5,081
Caribbean	22.70	6.82	23	522
TOTALS	8.90	7.25	2,185	19,438

Table 8. Average number of hooks per set times the average trip length in days by month and by area. (Source: Councils' Request to the Secretary of Commerce under Section 303(e). Data input and analysis by NMFS SEFC.)

	MEAN	STANDARD DEVIATION	NUMBER VESSELS	TOTAL DAYS TIMES HOOKS/SET
JANUARY				
Gulf of Mexico	3,900.74	5,298.53	58	226,243
Florida East Coast	2,904.52	5,573.28	42	121,990
Jacksonville, FL to Cape Hatteras	25,000.00	0.00	2	50,000
Hatteras through New York	6,637.14	9,650.00	7	46,460
North of New York	15,125.00	14,875.00	2	30,250
Caribbean	17,800.00	12,200.00	2	35,600
TOTALS	4,518.08	7,228.69	113	510,543
FEBRUARY				
Gulf of Mexico	3,865.83	5,305.44	58	224,218
Florida East Coast	2,994.40	5,657.34	42	125,765
Jacksonville, FL to Cape Hatteras	25,000.00	0.00	2	50,000
Hatteras through New York	6,637.14	9,650.00	7	46,460
North of New York	15,125.00	14,875.00	2	30,250
Caribbean	17,800.00	12,200.00	2	35,600
TOTALS	4,533.57	7,249.84	113	512,293
MARCH				
Gulf of Mexico	4,479.65	5,970.02	43	192,625
Florida East Coast	2,483.79	4,472.94	57	141,576
Jacksonville, FL to Cape Hatteras	25,000.00	0.00	2	50,000
Hatteras through New York	7,153.00	9,075.08	10	71,530
North of New York	16,750.00	11,667.26	3	50,250
Caribbean	18,533.33	9,145.25	3	55,600
TOTALS	4,759.16	7,325.08	118	561,581
APRIL				
Gulf of Mexico	7,140.79	8,097.56	19	135,675
Florida East Coast	2,508.02	4,223.99	65	163,021
Jacksonville, FL to Cape Hatteras	14,150.00	10,868.65	4	56,600
Hatteras through New York	6,590.83	8,494.73	12	79,090
North of New York	11,714.29	10,006.77	7	82,000
Caribbean	18,533.33	9,145.25	3	55,600
TOTALS	5,199.87	6,635.13	110	571,986

Table 8. Continued.

	MEAN	STANDARD DEVIATION	NUMBER VESSELS	TOTAL DAYS TIMES HOOKS/SET
MAY				
Gulf of Mexico	6,111.67	7,799.05	15	91,675
Florida East Coast	2,448.75	4,375.87	59	144,476
Jacksonville, FL to Cape Hatteras	10,780.00	9,475.21	10	107,800
Hatteras through New York	7,299.23	8,282.19	13	94,890
North of New York	9,254.55	8,929.13	11	101,800
Caribbean	25,000.00	0.00	2	50,000
TOTALS	5,369.46	7,685.96	110	590,641
JUNE				
Gulf of Mexico	1,033.67	857.24	3	3,101
Florida East Coast	1,264.31	745.42	49	61,951
Jacksonville, FL to Cape Hatteras	1,822.11	812.21	19	34,620
Hatteras through New York	2,773.08	3,267.97	26	72,100
North of New York	7,909.26	7,559.82	27	213,550
Caribbean	0.00	0.00	0	0
TOTALS	3,107.44	4,665.35	124	385,322
JULY				
Gulf of Mexico	1,550.00	550.00	2	3,100
Florida East Coast	1,146.51	593.45	37	42,421
Jacksonville, FL to Cape Hatteras	1,460.00	528.64	23	33,580
Hatteras through New York	3,210.42	5,673.99	24	77,050
North of New York	7,362.61	8,418.98	38	279,779
Caribbean	0.00	0.00	0	0
TOTALS	3,515.56	5,931.96	124	435,930
AUGUST				
Gulf of Mexico	13,275.00	11,731.45	4	53,100
Florida East Coast	1,871.85	4,131.60	33	61,771
Jacksonville, FL to Cape Hatteras	2,816.52	5,069.56	23	64,780
Hatteras through New York	3,004.69	5,119.02	32	96,150
North of New York	7,059.97	8,256.21	38	268,279
Caribbean	0.00	0.00	0	0
TOTALS	4,185.23	6,817.72	130	544,080

Table 8. Continued.

	MEAN	STANDARD DEVIATION	NUMBER VESSELS	TOTAL DAYS TIMES HOOKS/SET
SEPTEMBER				
Gulf of Mexico	9,933.33	10,728.73	6	59,600
Florida East Coast	2,977.81	6,047.35	36	107,201
Jacksonville, FL to Cape Hatteras	3,615.91	6,775.56	22	79,550
Hatteras through New York	2,772.63	4,841.35	38	105,360
North of New York	7,715.27	8,687.04	33	254,604
Caribbean	30,000.00	0.00	1	30,000
TOTALS	4,678.79	7,561.68	136	636,315
OCTOBER				
Gulf of Mexico	8,679.55	9,041.86	11	95,475
Florida East Coast	2,309.91	5,050.99	43	99,326
Jacksonville, FL to Cape Hatteras	3,861.25	6,510.50	24	92,670
Hatteras through New York	3,292.16	5,463.77	37	121,810
North of New York	8,040.00	8,525.81	25	201,000
Caribbean	30,000.00	0.00	1	30,000
TOTALS	4,541.00	7,225.30	141	640,281
NOVEMBER				
Gulf of Mexico	5,067.42	6,493.91	33	167,225
Florida East Coast	2,309.17	5,171.84	41	94,676
Jacksonville, FL to Cape Hatteras	6,987.00	9,051.54	10	69,870
Hatteras through New York	5,513.00	7,609.90	20	110,260
North of New York	8,351.76	8,341.33	17	141,980
Caribbean	30,000.00	0.00	1	30,000
TOTALS	5,032.88	7,469.20	122	614,011
DECEMBER				
Gulf of Mexico	4,354.59	5,633.04	49	213,375
Florida East Coast	2,323.05	5,377.94	38	88,276
Jacksonville, FL to Cape Hatteras	13,144.00	10,369.94	5	65,720
Hatteras through New York	5,179.17	8,312.68	12	62,150
North of New York	8,427.50	12,522.69	4	33,710
Caribbean	30,000.00	0.00	1	30,000
TOTALS	4,525.06	7,369.76	109	493,231

Table 9. Average number of hooks per set times the average trip length in days by area - grand totals for 1983. (Source: Councils' Request to the Secretary of Commerce under Section 303(e). Data input and anlysis by NMFS SEFC.)

	MEAN	STANDARD DEVIATION	NUMBER VESSELS	TOTAL DAYS TIMES HOOKS/SET
Gulf of Mexico	4,868.48	6,561.38	301	1,465,412
Florida East Coast	2,310.79	4,597.76	542	1,252,450
Jacksonville, FL to Cape Hatteras	5,172.53	8,050.94	146	755,190
Hatteras through New York	4,131.55	6,608.89	238	983,310
North of New York	8,151.94	8,904.34	207	1,687,452
Caribbean	22,025.00	9,726.99	16	352,400
TOTALS	4,480.15	7,076.52	1,450	6,496,214

APPENDIX D

COUNCIL STAFF DRIFT NET OBSERVATIONS

Table 1. Longline (L/L) and drift entanglement net (NET) observations by Bruce Austin (SAFMC Staff) aboard fishing vessel number one (FV#1). Radio reports from FV#2, September 20-26, 1984.

	FISHING VESSEL NUMBER 1		FISHING VESSEL NUMBER 2	
	L/L	NET	L/L	NET
9/20	X		X	
9/21	X		X	
9/22		X		X
9/23	X	X		X
9/24		X		X
9/25	X	X		X

Table 2. Catch composition from longline and net gear sets between September 21 and September 26.

DATE	GEAR	SWORDFISH	BILLFISH	TUNAS	BLUE SHARKS	OTHER SHARKS	RAYS	TURTLES	MAMMALS	OTHER
September 21	L/L	1			12	1	Many	1		
September 22	L/L				35					
	L/L	1	1	4				1		
September 23	NET			16	2	4				
	NET	1		25	8	5				
September 24	NET			7		2				
	NET	2		57	20	20				1 (Sunfish)
	L/L	1			40					
September 25	NET	1		26		8				
	NET	1		9		4				
September 26	NET	2		20	4	5				
	NET	2		20		2				
	L/L	1		3	Many		1			

Table 3. Species composition of catches of tunas and sharks.

Date	Gear	TUNAS			SHARKS			
		Skipjack	Albacore	Yellowfin	Blue	Mako	Hammerhead	Mackerel
September 21	L/L				12	1		
September 22	L/L				35			
	L/L			4				
September 23	NET	10		6	2	3	1	
	NET	12	8	5	8	2	3	
September 24	NET	7				2		
	NET	50		7	20		10	10
	L/L				40			
September 25	NET	20		6		1	7	
	NET			9		1	3	
September 26	NET	12		8	4	3	2	
	NET	7	8	5				2
	L/L			3	Many			