

became available. Controlling fishing on all size females would produce more pounds and bigger fish than controlling fishing on all size males, but controlling fishing on smaller fish of both sexes produces the largest potential increase in landings by weight and larger fish.

9.6 Domestic Annual Harvest (DAH)

From 1980-83 reported domestic landings reached and stabilized at around 9 million pounds. Any significant increase in landings is unlikely and if an increase occurred it would be at the expense of producing more smaller fish. Therefore DAH, measured by weight landed, is approximately 9 million pounds whole weight. DAH is also defined in terms of the number of small fish. In 1983 approximately 39,718 fish under 50 pounds dressed weight were harvested.

9.7 Expected Domestic Annual Processing (DAP)

Swordfish are sold as carcasses, either fresh or frozen. They are dressed at sea by the crew. Landside processing entails only refrigeration and transportation. Therefore, domestic annual processing capacity tracks harvesting capacity.

Domestic harvest currently exceeds the OY level, therefore no surplus is available for joint venture. Consequently, the amount of swordfish available for JVP is zero.

9.8 Total Allowable Level of Foreign Fishing (TALFF)

There is no TALFF. Total allowable level of foreign fishing is OY (33,750 fish under 50 pounds dressed weight) minus the domestic annual harvest (estimated to have been 39,718 fish under 50 pounds dressed weight in 1983). There are likely to be restrictions placed on domestic fishermen (variable season closure) to decrease the domestic annual harvest (measured in terms of number of fish under 50 pounds caught in 1983) to the optimum level (measured as the number of fish under 50 pounds caught in 1980). This precludes the possibility of a TALFF.

10.0 ALTERNATIVE DOMESTIC FISHERY MANAGEMENT MEASURES AND REGULATORY IMPACT REVIEW

Executive Order 12291. "Federal Regulation" established guidelines for promulgating new regulations and reviewing existing regulations. Under these guidelines each agency, to the extent permitted by law, is

expected to comply with the following requirements: (1) administrative decisions shall be based on adequate information concerning the need for and consequences of proposed government action; (2) regulatory action shall not be undertaken unless the potential benefits to society for the regulation outweigh the potential costs to society; (3) regulatory objectives shall be chosen to maximize the net benefits to society; (4) among alternative approaches to any given regulatory objective, the alternative involving the least net cost to society shall be chosen; and (5) agencies shall set priorities regularly with the aim of maximizing the aggregate net benefit to society, taking into account the condition of the particular industries affected by regulations, the condition of the national economy, and other regulatory actions contemplated for the future.

In compliance with Executive Order 12291, the Department of Commerce (DOC) and the National Oceanic and Atmospheric Administration (NOAA) require the preparation of a Regulatory Impact Review (RIR) for all regulatory actions which either implement a new fishery management plan or significantly amend an existing plan, or may be significant in that they affect important DOC/NOAA policy concerns and are the object of public interest.

The RIR is part of the process of developing and reviewing fishery management plans and is prepared by the Regional Fishery Management Councils with the assistance of the National Marine Fisheries Service (NMFS), as necessary. The RIR provides a comprehensive review of the level and incidence of impact associated with the proposed or final regulatory actions. The analysis also provides a review of the problems and policy objectives prompting the regulatory proposals and an evaluation of the major alternatives that could be used to solve problems. The purpose of the analysis is to ensure that the regulatory agency or Council systematically and comprehensively considers all available alternatives so that the public welfare can be enhanced in the most efficient and cost effective way.

The RIR serves as the basis for determining whether the proposed regulations implementing the fishery management plan or amendment are major/non-major under Executive Order 12291, and whether or not the

proposed regulations will have a significant economic impact on a substantial number of small entities under the Regulatory Flexibility Act (P.L. 96-354).

Regulatory Flexibility Act. The purpose of the Regulatory Flexibility Act (RFA) is to relieve small businesses, small organizations, and small governmental entities from burdensome regulations and recordkeeping requirements.

Paperwork Reduction Act. The purpose of the Paperwork Reduction Act (PRA) is to control paperwork requirements imposed on the public by the Federal government. The authority to manage information collection and recordkeeping requirements is vested with the Director of Office of Management and Budget. This authority encompasses establishment of guidelines and policies, approval of information collection requests and reductions of paperwork burdens and duplications.

Small Business Administration. The Small Business Administration (SBA) defines a small business in the commercial fishing activity, classified and found in the Standard Industrial Classification Code, Major Group, Hunting, Fishing and Trapping (SIC 09), as a firm with receipts up to \$2.0 million annually.

SBA defines a small business in the charter boat activity to be in the SIC 7999 code, Amusement and Recreational Services, not elsewhere classified as a firm with receipts up to \$3.5 million per year.

Management measures that apply to domestic fishermen

These are the management measures agreed upon by all five Councils that are the basis of the FMP to regulate domestic swordfishing. They apply to the entire management unit:

- o Management Measure #1: Variable season closure and annual adjustments of the closures (by notice in the Federal Register) to achieve optimum yield
- o Management Measure #2: Procedures for evaluating and restricting specific fishing practices in the future by regulatory amendments
- o Management Measure #3: Statistical reporting and procedures for altering data reporting in the future by regulatory amendments

Procedures for Implementing Changes by Notice Action

Increasing or decreasing the closure based on the annually updated VSC calendar will be accomplished by a rule-related notice. If the closure occurs during the traditional harpoon season (June - October) the notice will also specify the historical catch (cap) that occurred in that time period and advise that the harpoon fishery will be closed when that cap is attained.

The working panel is the formal body through which information is provided to the five committee chairmen. This does not preclude information being provided by the advisory panels, scientific and statistical committees, Council staffs, general public, etc. It merely establishes a procedure whereby the necessary analyses are prepared annually. The previous year's landings and size frequency data are to be provided to the working panel by February 1 of each year. By March 15th of each year the working panel will provide a report to the five committee chairmen. The committee chairmen will then prepare recommendations for Inter-Council and/or Council action. Each Council submits the number of days to be closed in conformance with the updated VSC calendar to the Southeast Regional Director by April 15th. The proposed changes are published as a notice in the Federal Register and the Southeast Regional Director implements closures by May 1st. If the proposed changes are contentious, additional time for public input can be provided.

Procedure for Implementing Changes by Regulatory Amendment

Four categories of actions have been identified to be implemented by regulatory amendment: (1) future modifications of fishing gear included or excluded from the VSC; (2) changes to the computational base of the VSC (e.g. change in definitions of "small fish," change in divisional boundaries for VSC area, and change from small fish index to small female fish index); (3) additional restrictions on fishing practices (e.g. drift entanglement nets, minimum size limits, and spawning closures); and, (4) statistical reporting (e.g. mandatory landings, change in level of onboard technician coverage and alternatives to the onboard technician program). The examples provided do not limit regulatory amendments to only these examples; they are presented to illustrate the kinds of changes possible.

The working panel (and other groups such as advisory panels, scientific and statistical committees, Council staffs, general public, etc.) upon becoming aware of a problem in the fishery covered by one of the identified categories prepares a report which is presented to the five committee chairmen. The report is to include but not be limited to: (1) identification of the problem; (2) how it is covered in one of the identified categories; (3) proposed alternative measures; and, (4) analysis of the impacts of proposed alternatives. The five committee chairmen, advised by the working panel, are responsible for approving (by a vote of 4 of 5) recommendations to be taken to the Inter-Council committee and/or Councils for their consideration. Changes to the plan must be approved by all five Councils. This procedure does not restrict the agenda of any committee or Council meeting discussing swordfish. Working panel recommendations are still only one source of recommended changes.

The Councils review the alternative management regimes and determine which is most appropriate to meet the objectives of the FMP, least burdensome to those concerned, and most likely to correct the problem. A notice of the Councils' proposed recommendation for regulatory action, the analyses, and rationale is made available for public review. The Councils then hold public hearings following which final recommendations and analyses of the impacts are prepared and submitted to the Southeast Regional Director. The Southeast Regional Director, in consultation with the Southeast Regional Attorney, reviews the action to determine that it falls inside the scope and objectives of the FMP. The Southeast Regional Director would advise the NMFS Office of Fisheries Resource Management in Washington of his intent to submit the necessary regulatory changes and analyses for processing through National Marine Fisheries Service, National Oceanic and Atmospheric Administration/Department of Commerce, Office of Management and Budget to the Office of the Federal Register. This procedure will provide the opportunity for public input at several junctures: (1) at each of the Council meetings; (2) at the public hearings; and (3) during the comment period following the date of publication of the regulations.

10.1 Management Measure #1: Variable Season Closure (VSC)

The variable season closure is designed to indirectly regulate the catch of swordfish under 50 pounds dressed weight by closing times and

areas when concentrations of these small fish are caught. Ideally the best method to control the harvest of smaller fish is directly with a minimum size limit that requires small fish to be released. Unfortunately this is not possible at this time. Available information indicates that there are no fishing strategies (e.g. hook size, location) that will selectively avoid small fish. Most swordfish hooked on longlines are landed dead. Time and area closures are presently the only way to delay the harvest of small fish until they are larger when more pounds can be landed at higher value per pound because larger swordfish are preferred in the market. The disadvantage of time and area closures is that they delay the harvest of some large fish as well as small fish. The variable season closure is a method to calculate time and area closures that minimize and equitably distribute the undesirable but necessary delay in the harvest of large fish to achieve the over-riding advantage of delaying the harvest of small fish.

The VSC is an incentive program. The intent is to channel existing commercial fishing experimentation towards finding ways to avoid catching small fish. The calculation of the VSC is designed to automatically reduce closures when fishermen, by whatever means they discover, reduce their catch of small fish.

Fishing gear included and excluded from the VSC. The variable season closures (time and area closures) apply to all fishing methods other than conventional rod and reel and harpoons. There is also a one fish per trip exemption for traditional Caribbean handline fishing. Fish caught by the traditional handline fishery in the Caribbean may be sold.

Recreational rod and reel exemption. Conventional recreational rod and reel are exempt from the VSC because there are many diverse fishermen catching fewer than 500 fish per year. Time and area closures would be difficult and costly to enforce and the exemption of rod and reel will not seriously alter the ability of the variable season closure to achieve optimum yield (control the number of small fish harvested). Rod and reel caught fish cannot be sold during the variable season closure. This no sale provision is to prevent the at-sea transfer of fish from commercial longline vessels to recreational rod and reel boats during the closures.

Harpooning exemption. Harpoon gear is exempt from the closure if the closure occurs during the historical harpoon season which is between June and October. Harpooners are exempt because they only take preferred larger fish and their annual landings have averaged about 800,000 pounds in recent years. Harpoons are only used in the Northeast. Their use is limited by a short summer season in a relatively small geographical area during calm weather where swordfish fin on the surface. While the variable season closure treats all longliners as equally as possible, the closed season could have an unequal effect on harpooners because they are so weather dependent. If a closure occurred during the best summer weather days the closure would be more severe for harpooners than longliners who are less weather dependent.

Harpooners are not allowed to have operable longlines or nets aboard their vessels during the VSC. There is a 125 pound minimum size (dressed weight) for harpooned fish during the VSC. Harpooners seldom take fish smaller than 125 pounds and this size is readily identifiable from the surface. This minimum size is to prevent the at-sea transfer of fish from commercial longline vessels to harpoon vessels.

It is unlikely that the harpoon fishery will expand significantly due to geographical (New England only), seasonal (summertime daylight hours) and weather (calm sea) limitations. Also the recent World Court decision transferring the northeast portion of Georges Bank to Canada, will mean the loss of important harpooning grounds to U.S. fishermen.

Landings indicate that the harpoon fishery has averaged approximately 800,000 lb annually from 1974-1983 (Table 9). This is approximately 9 percent of total landings (all areas) but is approximately 28 percent of New England landings in 1983.

To limit the potential increase in harpoon landings during the VSC when longliners cannot keep swordfish, the harpoon fishery is capped at its historical (1973-83) level. The cap is the average monthly harpoon landings (1973-83) excluding the highest and lowest years (Table 10).

The proposed time and area closures are at times that will not adversely affect harpooning in the immediate future. Closures will be in the fall after the harpoon season is over. However, if in the future, the VSC expands into active harpooning months then the historical monthly

Table 9. Swordfish harpoon landings (in pounds) for the years 1974 through 1983. (Source: Dick Schween, National Marine Fisheries Service, National Statistics Program, Washington, D. C.; Joan Palmer, National Marine Fisheries Service, Northeast Fisheries Center, Woods Hole, MA., personal communication.)

<u>Month</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>
May					394	850				
June	3,243	40,682	23,038	32,269	143,108	136,583	160,623	51,732	2,213	85,268
July	165,012	92,776	141,067	247,966	539,130	549,681	380,833	338,661	73,392	213,437
August	598,676	474,692	238,227	246,853	599,653	406,209	295,392	395,751	155,094	230,797
Sept.	270,805	178,269	46,168	152,555	76,023	263,193	172,932	69,375		50,865
Oct.		19,382		1,781	6,375	28,875				21,250
Nov.	<u>3,463</u>			<u>877</u>						
Total	1,041,199	805,801	448,500	682,301	1,364,683	1,385,391	1,009,800	855,519	230,699	601,617

Table 10. Monthly average harpoon landings (1973-83) in pounds whole weight (excluding highest and lowest years).

	<u>1973-83</u> <u>MONTHLY AVERAGE</u>
June	64,490
July	264,860
August	360,825
September	126,175
October	6,099

averages will be the monthly quotas for the harpoon fishery during the VSC. If the closure extends into only some fraction of a harpoon month, then the harpoon quota will be that fraction of the month's historical landings. If the VSC occurs during harpooning months dealers will be required to make their records available. NMFS port agents will collect these landings data at a frequency sufficient to prevent exceeding the quota. If and when the quota is reached, the fishery will be closed by notice in the Federal Register.

Caribbean handline exemption. The traditional handline fishery for billfish in the Caribbean will be allowed the bycatch of one swordfish per trip during the variable season closure. The bycatch of swordfish by traditional Caribbean handline fisheries is such a rare event that this exemption will not seriously alter the ability of the variable season closure to achieve OY.

Future modification of fishing gear included or excluded from the VSC. Future inclusion or exclusion of any fishing gear from the VSC and other regulations can be addressed by timely regulatory amendments under Management Measure #2.

Fishing restrictions during the closures. The importation of any swordfish taken from the western North Atlantic is prohibited during a closure. During closures only conventional rod and reel and harpoon may be used to target swordfish. The intent is to allow longlining that targets species other than swordfish during the closures. Therefore, during the closures longlining is allowed during daylight hours (0500 - 1800 hours) so that tuna fishing can continue. Currently there are no domestic longliners fishing exclusively for tuna. Therefore, limiting longlining to daytime hours during closures will not place a burden on another existing fishery. Rather it will encourage domestic swordfish fishermen to develop a domestic tuna fishery, reducing (and possibly eliminating) the initial economic burden imposed by a closure. Experimental longline cruises determined that sets made during daylight hours produced only 1 percent of the swordfish while night sets produced 99 percent of the swordfish (Section 8.1.7.1, Source Document). No longlining or netting is allowed at night in a closed area. During the closure, all swordfish caught by other than rod and reel, harpoon, or handline in the Caribbean, must be released.

Possession prohibition during the closures. All swordfish caught at any time from the western North Atlantic and retained for sale must be landed whole (carcass). In a closed area fishing for swordfish by other than exempt gear is prohibited, the possession of swordfish shoreward of the outer boundary of the FCZ is prohibited, and the landing of swordfish is prohibited. Exceptions are fresh carcasses that are taken with exempt gear (rod and reel, Caribbean handline, or harpooned fish 125 pounds dressed weight during closures or swordfish caught outside the management unit (outside the western North Atlantic)). No vessel can possess swordfish with operable longlines or nets aboard the vessel in closed areas.

Data necessary to calculate the VSC calendar. The main data requirements are estimates of the number of small fish caught in each area by month. This information is not presently recorded by existing data collection programs. The best estimates are derived from two independent data sources. First, NMFS landings data (total pounds dressed weight) that are voluntarily reported by fish houses and recorded by month by state. Second, size frequency data by month by location that have been voluntarily provided by fishermen, fish houses and dealers to the Councils. These two data sets were combined to estimate the total number of small fish caught in each month in each area. Small fish were alternatively categorized as under 70 pounds, under 50 pounds, and under 25 pounds dressed weight.

Decision on what constitutes a small fish. The intent of the VSC is to delay the harvest of small fish for two reasons. The first reason is that a delay will produce more total pounds landed. The net gain by weight is the result of the extent to which the growth rate of surviving fish exceeds the loss of some fish through natural mortality. Estimates of yield-per-recruit which calculate these potential gains and losses are complicated because male and female swordfish grow at different rates and have different mortality rates. Accurate estimates of the potential gains from closures (delayed harvest) depends on the relative numbers of males and females in different areas. Because growth estimates by sex are not well established and because sex ratios by area by month are also not precise, gains in weight from a delayed harvest cannot be estimated. However, two general conditions are expected to hold. First, in the pre-adult and adult size

ranges (i.e., after recruitment), natural mortality is expected to be low and relatively constant. Second, swordfish follow a growth pattern in these ranges such that smaller fish grow faster than larger fish. These two characteristics lead to the conclusion that any given time delay in harvest will result in greater net gains (by weight) for smaller fish than larger fish. That is, delaying the harvest of a 25 pound fish for 6 months will result in a greater potential gain than delaying the harvest of a 50 pound fish. This holds for both males and females. Estimates of these gains are probably more precise for smaller fish because there is better agreement in the estimates of age and growth of smaller fish.

The potential increase in weight landed does not pinpoint exactly the size fish that should drive the VSC, only that there is a gain for both sexes of delaying the harvest up to at least 40 pounds for males and 160 pounds for females at reasonable levels of exploitation (F (males) = 0.5; F (females) = 0.26).

The second consideration is the market preference for larger fish. There is a substantial price differential for fish under or over 50-pounds. The greatest dollar gains from a delayed harvest come from allowing fish under 50-pounds (pups) to grow into the next market category. There are also gains from allowing medium fish 50-99 pounds to grow into the most valuable "marker" category (over 100 pounds). Estimates of these values are in Section 10.5.

Therefore, for purposes of this FMP small swordfish are defined as fish under 50 pounds dressed weight. This matches the existing market category of 0-49 pounds in the industry. Values for under 70 pounds and under 25 pounds are presented in Appendix B of the Source Document. In this FMP, the term "small fish" means fish under 50 pounds.

Division of the five Council areas. The division of the Atlantic, Gulf, and Caribbean for the purpose of time and area closures does not follow Council jurisdictional boundaries. The following divisions are based on landings patterns: New England/Mid Atlantic (North of Cape Hatteras), South Atlantic (Cape Hatteras to Georgia/Florida border), Florida East Coast (Georgia/Florida border to Gulf of Mexico), Gulf of Mexico, and the Caribbean (Puerto Rico and U.S. Virgin Islands).

Each of these areas have distinctly different monthly landings patterns by weight (Tables 11-14). These patterns have remained relatively stable from 1980-83 and are expected to remain stable in the near future. They reflect general fishery conditions including relative abundance, weather conditions, and alternative fishing opportunities. In New England and the Mid Atlantic, fishing is most concentrated in the summer. The season starts earlier and runs longer in the South Atlantic. The Florida East Coast has fishing all year. In the Gulf of Mexico, fishing is concentrated in the winter. There is not yet an established fishery in the Caribbean. Some commercial exploratory fishing in 1983-84 produced catches in December through February. Additional fishing is currently taking place; however, until a fishery develops it is assumed that it will be similar to the Florida East Coast.

Annual and monthly patterns of harvesting small fish (Tables 11-14) are unique for each defined area. These patterns, like those of total landings by weight, have been relatively stable from 1980-83 and are expected to remain stable in the near future. They are believed to reflect size composition by area by month. Migratory patterns are not known so they cannot be used to definitively explain seasonal size frequencies in each area at this time.

Future modification of fish size or boundaries. The size fish chosen to drive the VSC, divisional boundaries for VSC areas, seasonal landings by weight, or small fish are all subject to refinement as part of the ongoing data collection and analysis of this plan. If and when these values change with new data the calculation of the VSC calendar will change accordingly. This will not alter the intent of the plan.

Calculation of the small fish index. Total landings and size frequency data sets are used to calculate a small fish index. This is the catch of small fish (under 50 lb dressed weight) taken in each month expressed as a percent of each region's annual catch.

The monthly pattern of the small fish indexes by area (Tables 11-14) is the foundation for the variable season closure management strategy to reduce the catch of small fish. Relatively more small fish are caught in the fall months in all areas (Tables 11-14 and Figure 4).

Table 11. New England and Mid-Atlantic small fish index.

	1980-83 MONTHLY LANDINGS INDEX*	1983 SMALL FISH INDEX		
		<u>POUNDS LANDED CARCASS WEIGHT</u>	<u>PERCENT 50 lb AND UNDER</u>	<u>NUMBER 50 lb AND UNDER</u>
JANUARY	0.00	0	0	0
FEBRUARY	0.00	0	0	0
MARCH	0.00	0	0	0
APRIL	0.29	32,876	0.32	113
MAY	2.05	84,975	0.87	308
JUNE	9.93	457,100	1.90	674
JULY	19.45	630,710	2.09	741
AUGUST	24.15	779,282	7.53	2,670
SEPTEMBER	18.63	613,304	5.60	1,986
OCTOBER	18.09	582,462	4.94	1,752
NOVEMBER	5.78	199,958	6.91	2,450
DECEMBER	1.63	<u>30,351</u>	<u>0.70</u>	<u>248</u>
TOTALS		3,411,018	30.86	10,942

*Monthly landings index = percent of total weight of all landings for the years 1980-83.

Table 12. South Atlantic small fish index.

	1980-83 MONTHLY LANDINGS INDEX*	1983 SMALL FISH INDEX		
		<u>POUNDS LANDED CARCASS WEIGHT</u>	<u>PERCENT 50 lb AND UNDER</u>	<u>NUMBER 50 lb AND UNDER</u>
JANUARY	0.04	1,391	0.17	23
FEBRUARY	0.34	0	0.00	0
MARCH	0.38	7,873	0.33	44
APRIL	4.27	53,540	3.49	468
MAY	11.81	169,156	11.09	1,486
JUNE	11.91	109,359	7.16	959
JULY	17.19	89,212	4.90	657
AUGUST	19.71	108,063	9.33	1,317
SEPTEMBER	16.10	108,282	10.04	1,346
OCTOBER	12.64	170,972	13.50	1,809
NOVEMBER	5.06	64,762	3.84	515
DECEMBER	0.57	<u>3,250</u>	<u>0.44</u>	<u>59</u>
TOTALS		885,858	64.79	8,683

*Monthly landings index = percent of total weight of all landings for the years 1980-83.

Table 13. Florida East Coast small fish index.

	1980-83 MONTHLY LANDINGS INDEX*	1983 SMALL FISH INDEX		
		<u>POUNDS LANDED CARCASS WEIGHT</u>	<u>PERCENT 50 lb AND UNDER</u>	<u>NUMBER 50 lb AND UNDER</u>
JANUARY	4.81	138,895	4.61	1,111
FEBRUARY	4.60	98,196	3.52	848
MARCH	7.09	53,204	2.98	718
APRIL	13.35	433,871	3.83	923
MAY	16.61	414,393	4.11	991
JUNE	12.84	349,909	4.09	986
JULY	11.67	193,868	2.03	489
AUGUST	6.40	90,331	2.87	692
SEPTEMBER	6.73	77,907	1.89	455
OCTOBER	6.07	86,403	3.76	906
NOVEMBER	5.26	94,832	4.22	1,017
DECEMBER	4.59	<u>81,680</u>	<u>3.14</u>	<u>757</u>
TOTALS		2,113,487	41.05	9,893

*Monthly landings index = percent of total weight of all landings for the years 1980-83.

Table 14. Gulf of Mexico small fish index.

	1980-83 MONTHLY LANDINGS INDEX*	1983 SMALL FISH INDEX		
		<u>POUNDS LANDED CARCASS WEIGHT</u>	<u>PERCENT 50 lb AND UNDER</u>	<u>NUMBER 50 lb AND UNDER</u>
JANUARY	13.83	125,732	10.66	1,381
FEBRUARY	22.04	158,413	15.46	2,002
MARCH	18.02	94,694	7.32	948
APRIL	13.34	45,188	0.00	0
MAY	6.34	28,493	0.00	0
JUNE	4.16	6,014	0.00	0
JULY	3.03	2,456	0.00	0
AUGUST	1.69	2,471	0.00	0
SEPTEMBER	1.84	2,233	0.00	0
OCTOBER	1.86	1,760	0.00	0
NOVEMBER	4.46	26,819	5.12	663
DECEMBER	9.41	<u>43,276</u>	<u>40.19</u>	<u>5,206</u>
TOTALS		537,548	78.75	10,200

*Monthly landings index = percent of total weight of all landings for the years 1980-83.

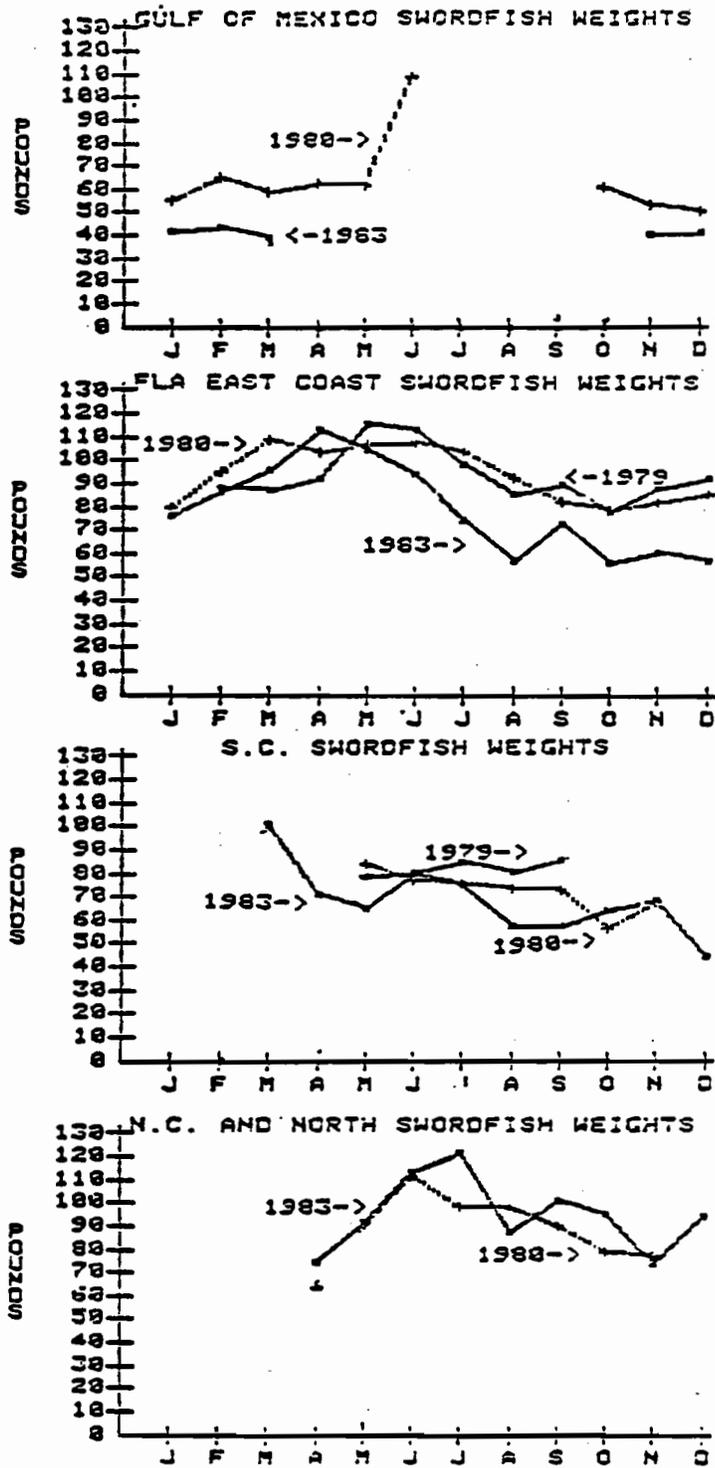


Figure 4. Average size (dressed carcass weight) by month by area.

Calculation of the change in the catch of small fish. Calculation of the annual increase or decrease of small fish by region is simply the small fish index (percent) times a region's annual landings (total number of fish). The change (percent and total number) of small fish by region from 1980 to 1983 is shown in Table 15. In 1980, 43.0 percent of the total catch by number (33,750 of 78,448 fish) were under 50 pounds dressed weight. In 1983, 46.2 percent of the total catch by number (39,718 of 85,912 fish) were under 50 pounds dressed weight. The 17.7 percent increase for all areas combined (33,750 in 1980 to 39,718 in 1983) equates to the target reduction of 15.03 percent in the catch of small fish in all areas combined necessary to achieve optimum yield.

Distribution of the burden to reduce the catch of small fish between regions. The necessary total percent reduction in small fish (15.03%) is achieved by distributing the burden according to the percent of small fish caught in each area (Table 15). The percent decrease in small fish required for all areas (15.03% from 1980-83) is multiplied by the percent of small fish in each area to arrive at the percent reduction that each individual area must achieve. This number multiplied by the total number of fish landed in that region gives the number of fish under 50 pounds that must be reduced. This number can also be derived by multiplying the necessary percent reduction (15.03%) by the number of small fish landed in the region.

Calculation of the VSC calendar. The intent of the plan is to restrain the number of small fish caught. The VSC calendar (Table 16) calculates the number of actual calendar days that must be closed (no swordfishing) in each area to reduce the catch of small fish by the necessary amount. This is predicated on the number of days in the previous year it took to catch the specified number of small fish.

Important economic and social considerations for choosing closure times. The VSC calendar (Table 16) calculates the number of days that must be closed for different starting dates for the closure. Each Council used their VSC calendar to evaluate the advantages and disadvantages of alternative starting dates.

Table 15. Percent reduction in number of small fish required by each area based on the the small fish index.

AREA	1980		1983		% REDUCTION REQUIRED FOR EACH AREA
	% UNDER 50 lb	NO. UNDER 50 lb	% UNDER 50 lb	NO. UNDER 50 lb	
NE & MA	34.57	10,281	30.86	10,942	4.64
SA	48.36	4,176	64.79	8,683	9.74
FL-EC	32.44	5,759	41.05	9,893	6.17
GM	60.64	<u>13,534</u>	78.75	<u>10,200</u>	11.84
ALL AREAS		33,750		39,718	

Table 16. VSC calendar based on the small fish index for fish under 50 lb carcass weight. Number of days that must be closed to fishing in 1985 with alternative starting months for the closure. Any one row must be chosen.

	NE & MA		SA		FL-EC		GM	
	Days closed to achieve required % reduction	Resulting % decrease in landings by weight	Days closed to achieve the % reduction	Resulting % decrease in landings by weight	Days closed to achieve the % reduction	Resulting % decrease in landings by weight	Days closed to achieve the % reduction	Resulting % decrease in landings by weight
APRIL	123	34	52	13	56	27	251	23
MAY	94	35	33	13	54	26	221	26
JUNE	67	37	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	30	171	24	59	9	11	3

*SA could close 30 days in November and 17 days in October to reduce the percentage of fish under 50 lb by 11.45%. This would represent a 12% reduction based on MLI lb. All calculations are based on an earlier 1983 estimated reduction of 5.42 for NE & MA, 11.45 for SA, 7.26 for FL-EC, and 13.92 for GM. Final values for 1985 closures will be recalculated with 1984 data.

Conforming to the swordfish calendar (number of days for a given percent reduction) achieves the primary economic and biological objectives associated with reducing the catch of small fish. Choosing when to close in conformance with the swordfish calendar takes into account all the other relevant social and economic considerations for each region.

The VSC is a mechanism whereby the impacts of closures can be equitably distributed among areas with varying fishing patterns. The flexibility of the VSC allows it to be simple or complicated depending on common or different starting dates. The Councils decided that for simplicity, enforceability, and to discourage the movement of boats from closed to open areas, all area closures would begin on or near the same date. Lengths of the closures (ending dates) vary, based on the swordfish calendar. It was agreed to avoid "no credit" months in regions where the percentage of landings is so low that there is no "credit" for closing the month. These are primarily the winter months (January-March) in the New England, Mid Atlantic and South Atlantic.

Three major factors were considered by each Council in choosing closure times. The first and most important consideration was to minimize the loss (delay) in harvest of all fish (total weight landed) and still achieve the required percent reduction in the catch of small fish. The resulting percent loss (delay) in the harvest of total weight with alternative closures that achieve the necessary reduction in the catch of small fish is shown in Table 16. October or November starting dates for closures result in the smallest losses (5-8%) of total landings in each area (Table 16). Choosing a starting date in April or May would result in larger losses in landings by weight (13-35%).

Fortunately the fall months are when most of the small fish are caught. Therefore, this is the preferred time to close for all areas because this is the time period that minimizes the length of the closures necessary to achieve a given reduction in the catch of small fish. Other months could theoretically be closed (in conformance with the VSC calendar) but an area would have to pay a premium price in terms of longer closures (foregoing more total landings) to achieve the necessary percent reduction in the catch of small fish (Table 16).

The second consideration in choosing closure times was swordfish markets. Closing times with high concentrations of small fish has the advantage of being the same times when value per pound is low because smaller fish are less valuable per pound than larger fish. It would have been preferable from a marketing perspective to stagger the closures such that there was always fresh fish available. However, this produces undesirable fleet migrations and enforcement problems. The best alternative for concurrent (overlapping) closures are the highest production lowest price per pound months which are in the fall because there is an inverse relationship between prices and total production (as well as a positive relationship between price and size). This is also the time that small fish have the lowest market value relative to large fish.

The third consideration in choosing closure times was vessel mobility. The intent of each Council was to minimize, to the extent practical, the movement of boats from closed to open fishing areas. The rationale is that minimum mobility will most evenly distribute the burden of closures throughout the fleet. This objective was achieved by all Councils agreeing on closures that overlap as much as possible. An additional consideration is that northern boats do not move south in the summer (when the northern fishery is best). However, southern boats frequently migrate north in the summer. Closures in the summer would result in longer closures in the south than the north (according to the VSC) which would encourage southern boats to move north. Closures in the fall do not encourage southern boats to move north because of deteriorating offshore weather conditions. In the fall northern boats migrating south move into longer closures in the south than the north such that the migrating vessels do not avoid closures.

An additional advantage of a fall closure is that tuna (yellowfin and bigeye) are apparently most available then. Since daytime tuna longlining will be permitted during closures, swordfish longliners will have an alternative fishery in which they can participate without incurring major gear expenses. This will help minimize the economic burden on domestic longliners while encouraging development of a domestic tuna fishery.

Choice of closure times. The last four months of the year are the best candidates for concurrent (overlapping) closure times because these months: (1) produce the smallest loss (delay) in the harvest of total weight while achieving the necessary reductions in the catch of small fish, (2) are the lowest value per pound season because of small fish and total landings, and (3) will not promote vessel migrations to avoid closures. Based on these considerations, the Councils chose to start all the closures as near November 1 as possible. Whether or not all closures start before, on, or after this date depends on the required lengths of the closures.

The Caribbean Council does not have enough swordfish landings to calculate a VSC calendar. They have adopted the Florida East Coast calendar for two reasons. First, they anticipate similar fishery conditions to those that have developed in Florida. Second, if the Caribbean tracks the Florida closure they will avoid undesirable migrations of Florida boats to the Caribbean during the Florida VSC.

Predicted Closures for 1985. Based on the estimated increase in the catch of small fish from 1980 to 1983, the following periods would be closed in conformance with the VSC calendar in 1985. The length of the 1985 closures will be adjusted to reflect the increase from 1980 to 1984 rather than 1980 to 1983 when the 1984 data are available.

<u>Area</u>	<u>Closed Fishing</u>
North of Cape Hatteras	Nov 7-30
Cape Hatteras to Georgia/Florida Border	Oct 16-Nov 30
Georgia/Florida Border to Gulf of Mexico	Nov 1-Dec 30
Gulf of Mexico	Nov 1-Dec 7
Puerto Rico and U.S. Virgin Islands	Nov 1-Dec 30

Final determination of actual closures for 1985. In accordance with the annual update specified by this plan, the first update will be completed by March 15, 1985 and the results will apply to the 1985 closures. If at that time more or fewer small fish were caught in 1984 than 1983 (compared to 1980) then the 1985 closures will be adjusted accordingly. Should fishing patterns and/or the monthly distribution of small fish significantly change, the closures may need to be adjusted by shifting the dates slightly, either forward or backward consistent with the criteria set forth in the plan.

Annual adjustment of closures by notice action. By April 15 of each year (beginning April 15, 1985) each Council will inform the Regional Director on which end of the closure they want the closure to be expanded or contracted in conformance with the VSC based on the previous year's catch of small fish.

Future closures (after 1985). The VSC is designed to be an incentive program for fishermen to find other ways (new gear or fishing practices) to voluntarily reduce their catch of small fish. At this time there is considerable doubt that any gear or fishing practice can effectively select for larger fish. Fishing location is the most important determinant of the size of fish caught. Vessel congestion at the better fishing locations (where larger fish concentrate) means that at times the only alternative is to fish less desirable locations where there are higher concentrations of smaller fish.

However, the rapid evolution of fishing gear and practices in this fishery suggests that if there is a strong incentive to not catch smaller fish such as avoiding or reducing the lengths of the closures then fishermen will discover how to do it.

Whenever the catch of small fish is reduced relative to the optimum yield target level during the open seasons the VSC will be reduced accordingly. The reopening of closed days will take into consideration documented changes in the catch of small fish. An example would be that the increase in the catch of small fish from 1980 to 1983 calls for closures that reduce the catch of small fish by 15.0 percent. If, after the closure was in effect, there was a 15.0 percent reduction in the catch of small fish during the open season, it would eliminate the closure (if the same 15 percent reduction was expected to occur during the re-opened time period).

The VSC is also designed to automatically adjust for future management measures that aid in reducing the catch of small fish. For example, if a minimum size limit or vessel quotas of small fish were to become workable (small fish could be avoided or released alive), the computational procedures for the VSC automatically would reduce or eliminate closures.

Ideally the catch of small fish ultimately will be controlled by fishermen voluntarily adopting new fishing gear and practices to avoid

closures. At that point the VSC would accomplish the economic and biological goals of the plan simply by providing an incentive to avoid catching small fish to avoid closures.

Regulatory amendment to alter the computation of the variable season closure. Three general principles have guided the development of the variable season closure. First, there are simultaneous biological and economic advantages to maintaining a population structure and resulting harvest of larger fish. More total pounds of fish can be harvested at a higher value per pound. Available yield-per-recruit models indicate that these biological and economic advantages are best achieved by reducing the catch of small fish (increasing the size at which fish are harvested).

Second, encouraging fishing practices that avoid small fish or target larger fish is the best way to achieve these biological and economic advantages. The best way to do this is to set target reductions in the catch of small fish and strongly encourage fishermen to voluntarily explore methods to reduce their catch of small fish. The incentive is to avoid closure. A time and area closure during periods when concentrations of small fish are caught is the best regulatory method available at this time if fishermen do not find methods to reduce their catch of small fish. In the future, a minimum size limit may supplement or substitute for time and area closures to achieve target reductions in the catch of small fish if hooked small fish can be released alive.

Third, the burden of time and area closures should be equitably distributed among all areas.

It is possible that new data on the sizes and sex ratios of fish in each area by month could reveal other computational bases for the VSC that would better serve the primary economic and biological goals of the plan. An example of this might be to base the VSC on the number of fish caught by size and sex rather than just size.

Modifying the computation of the VSC would produce a different VSC calendar for each area, but these closures could still be consistent with the three main principles of the VSC.

The intent is that if data and analysis become available to modify the computation of VSC in a fashion that better achieves the economic and

biological goals of the plan then this could be done by regulatory amendment.

Monitoring and evaluation by a working panel. The variable season closure requires regular scientific attention to arrive at timely annual estimates of the catch of small fish in order to use the VSC calendar to calculate the lengths of the closures for the coming year.

The VSC calendar must also be annually updated to reflect the correct size composition of the catch by area by month during the open season should there be a need to expand the closure times. In addition, there is the need to evaluate alternative computations for the VSC when new stock assessment data and analyses become available. There may also be a need to alter data collection to accommodate new stock assessment requirements or to evaluate specific fishing gear or practices.

The high level of ongoing attention required by this plan is complicated by the fact that it is a five-Council plan requiring the approval of all Councils for any changes. Normal Inter-Council committee meetings for five Councils are very expensive and complicated to arrange. Therefore, the five swordfish committee chairmen will meet as a subgroup to formulate recommendations to be taken to Inter-Council committee or Council meetings. To assist them, a special "working panel" will be created to advise the five committee chairmen.

The working panel will include (1) no more than six scientists with demonstrated knowledge about the stock assessment of swordfish including at least one staff scientist from NMFS, (2) one advisory panel member from each Council, (3) a representative of the Scientific and Statistical Committee from each Council (SSC) and (4) one staff member from each Council. Staff, SSC representatives and advisory panel members will be appointed by their respective Councils. Scientists will be appointed by the Inter-Council swordfish steering committee or by the five committee chairmen. Each Council is not required to make their allotted appointments if they are satisfied with representation appointed by other Councils. By March 15th of each year the working panel will provide a report to the five committee chairmen. The chairmen will then prepare recommendations for Inter-Council committee and/or Council action. The working panel report is to include but not be limited to the following:

1. Update of the VSC calendar.
2. Recommended modifications of the calendar.
3. Biological status of the stock including recommendations for future stock assessment.
4. Economic evaluation of the fishery.
5. Recommended changes in data collection and analysis.

In addition to the annual report, the working panel may, at any time, also consider proposed regulatory amendments to this plan under Management Measures numbers 2 or 3.

The five committee chairmen (Council members) advised by the working panel are responsible for approving (by a vote of 4 of 5) recommendations they want to be taken to the Inter-Council committee and/or Councils for their consideration. All changes in the plan must be approved by all Councils. This will provide an opportunity for public comment. This procedure does not restrict the agenda of any committee or Council meeting discussing swordfish. Working panel recommendations are still only one source of recommended changes.

10.2 Management Measure #2: Procedures for Restricting Fishing Practices by Regulatory Amendment

Gear and fishing practices will be monitored. Vessels employing new methods (or any practice in the process of change or not fully understood) may be required to carry an onboard technician or directly provide information to document their activity. Should any fishing practice result in: (1) an undesirable bycatch level (for example billfish or mammals), (2) conflicts with other gear such as interference or competition for space, (3) changes that would upset the variable season closure, or (4) changes that could complement the variable season closure, such as targeting larger fish, then modification of the regulations may be justified. Such modifications can be accomplished by regulatory amendment.

New types of mandatory reporting may also be necessary to evaluate fishing practices. Reporting requirements (Management Measure #3) may also be altered by regulatory amendment to collect information that would be used to evaluate specified types of fishing practices.

This measure is designed to offer future timely responses to a wide variety of situations that are likely to occur. Some of these circumstances are anticipated, but there is not yet sufficient information to arrive at appropriate measures. The following are examples of possible future restrictions and data collection that could be implemented by regulatory amendment. This management measure is not limited to these examples.

Drift entanglement nets. Three of the five Councils do not believe that currently there is sufficient information to justify restricting drift entanglement nets. However, there is well founded concern that drift entanglement nets may have an undesirable bycatch in many areas. On June 11, 1984 NMFS began an observer program on drift entanglement nets as a result of a five Council request under Section 303(e) of MFCMA. Data collection as specified in this program will continue under the swordfish plan until sufficient data are available to evaluate drift entanglement nets.

Spawning closures. Spawning closures are one means of limiting effort on adult fish. Current information does not clearly identify areas and times of spawning nor does it suggest that inadequate recruitment is currently a problem. However, should this situation change in the future, methods to maintain adequate numbers of adult spawners will be actively considered.

Minimum size limits. A minimum size limit and increasing the size at capture by hook size were considered and rejected because there is not sufficient evidence that released fish would survive or that gear modification or other practices can selectively target larger fish or avoid smaller fish. If evidence supporting these or other strategies becomes available, a minimum size could be an important complement to or substitute for the variable season closure. The lengths of the closures would be automatically adjusted through the computational procedure for the VSC.

10.3 Management Measure #3: Statistical Reporting Requirement

The primary reporting requirement for all areas is a commercial permit with an onboard technician program to collect scientific information on a sample number of commercial vessels (primarily longliners). A permit is required for anyone wishing to retain swordfish for sale. Permits

are available from the Southeast Regional Director and are issued annually. This is in addition to an observer program for drift entanglement nets, sample reporting by recreational fishermen in the Mid-Atlantic, and mandatory commercial landings reporting in the Caribbean.

Onboard technician program. The primary purpose of placing technicians aboard vessels on a sample number of trips is to collect biological data for age and growth analysis and to determine sex ratios by size and area. This information is the basis for predicting gains from delaying the harvest of any size fish.

Hard body parts are needed to age swordfish and thus to determine the age structure of the population. Three age and growth studies have been conducted recently but their results are not in agreement. The accuracy of mortality rate estimates and yield-per-recruit analysis is ultimately dependent upon the age analysis. Estimates of these parameters largely will determine our ability to monitor the status of the stock. This in turn will allow evaluation of the economic and biological benefits of fishing restrictions and modification of the regulations to better accomplish the objectives of the plan.

The best structure for aging is not yet known; therefore, both fin spines and otoliths must be collected. These structures must be removed at sea and keyed to the size and sex of individual swordfish.

Sex ratios are known to differ by area. It appears that growth and mortality rates are different for males and females. Therefore, stock assessment and monitoring must consider the sexes separately. Sex can only be determined internally by examining the gonads before the fish are dressed.

Rationale for using onboard technicians. Collecting hard body parts and ensuring that each sample is properly labeled and keyed to the correct fish is time consuming and requires considerable care. Improperly collected or labeled parts are of no value. Mislabeled material usually cannot be identified as such and analyses based on these data will lead to erroneous conclusions. In addition, it is essential that each fish sampled be sexed and measured.

To maintain a high quality product, swordfish must be dressed and iced immediately after being brought aboard the vessel. Sex must be determined at that time from internal organs that are discarded. Body parts to age fish (e.g., anal fin spines and/or otoliths) must be removed, labeled, and preserved for laboratory examination. Fish must be weighed and measured. Body parts, sex determination, and measurements must match up for each individual carcass that is examined.

In addition to the basic biological data, the technician would collect other critical data on size selectivity of fishing gear or techniques, survival of hooked swordfish, and bycatch data that may alter the plan. These studies are described under research needs (Section 12.3). The onboard technician program also provides the opportunity to determine the accuracy of information voluntarily submitted under the auspices of the swordfish plan.

The Councils recognize that an at-sea technician program will be costly and considered the following alternatives before ultimately concluding that only the at-sea technician program provides the necessary information. If at any time a more cost effective alternative than onboard technicians, that provides the necessary information, becomes available, it will be adopted by regulatory amendment.

Alternatives Considered and Rejected

Interview fishermen with existing port agents. Utilizing existing port agents to interview fishermen would not provide the hard body parts needed for age analysis or allow the determination of the sex composition by area. Fishermen would be put in the position of providing incidental catch and fishing practice information that may ultimately lead to restrictions. This alternative was rejected because it would not provide the necessary information.

Require fishermen to maintain a logbook. A logbook program could provide information on fishing practices and bycatch but with the same potential shortcomings as discussed with the port agent alternative. This would not provide the hard parts or sex composition information. This alternative was rejected because it would not provide the necessary information.

Require that swordfish be landed with head, fins, and ovaries intact. The swordfish industry has developed a high quality, high priced product. To maintain that quality, swordfish must be dressed and iced immediately after being brought aboard the vessel. Requiring that they be landed with the head, fins, and ovaries intact would result in an inferior product that is worth less. The government could offer to pay the difference in price but the industry probably would not be willing to put an inferior product on the market. The government could also purchase the swordfish needed for the sampling program. This would involve 2,442 fish (at a 3 percent sampling level) for a total weight of 200,977 pounds (average weight in all areas for 1983 = 82.3 lb dressed weight). Using the average price of \$3.11 per pound for 1983, this would represent a cost of \$625,038. The price per pound has continued to increase and the cost in 1985 would be higher.

Both alternatives were rejected because neither would provide the necessary information on size selectivity of fishing, survival of hooked swordfish, and bycatch data. Additionally, neither would provide the opportunity to verify the accuracy of the size frequency information being submitted on a voluntary basis. Purchasing the fish outright would be more costly than the onboard technician program.

Require fishermen to collect hard parts and determine sex. When a fish is brought aboard it is dressed and iced immediately to maintain a high quality product. Sex must be determined at that time from internal organs that are discarded. Body parts to age fish must be removed, labeled and preserved. Fish could be measured but not weighed until they are off-loaded at the dock. Body parts, sex determination, and measurements must match up for each individual carcass which means that the fishermen would have to tag each carcass. It is unlikely that fishermen will have sufficient time to properly collect and record this material. It is possible that these tasks could be performed by trained fishermen but it is difficult to train fishermen to sex swordfish without having whole fish to use for demonstration. Such whole fish are not readily available because swordfish are landed dressed. A training program would not be simple, the quality of the data could not be controlled, and it would be expensive. In addition, reliable records of the bycatch and fishing practice information as discussed above would not be available.

This alternative was rejected because it would not provide all the necessary information and it would be a complex and costly program. It was recognized that some fishermen would prefer to see a program of this type in lieu of carrying an onboard technician. However, the Councils concluded that potential inaccuracies and lack of control over data thus collected, combined with the cost and problems associated with a training program, outweighed the benefits of the alternative.

Operation of the Onboard Technician Program

The onboard technician program will operate in the following way. All fishing boats that intend to catch swordfish for sale or by methods other than conventional rod and reel must obtain a permit from the NMFS Southeast Regional Director. The permit application will require fishermen to report when and where they intend to fish in the future or have fished in the past. These declarations will not restrict fishermen in any way. The Regional Director will issue a permit. This permit must be carried aboard the boat. Vessels applying will be the universe from which a statistically valid sample will be drawn. The permit will be valid for the calendar year. All vessels selected to be sampled are required to participate subject to their capability to carry a technician. Actual number of vessels participating and the length and frequency of trips will be critical factors in the selection process. Where possible, the number of vessels will be grouped by region and trips will be selected using a random process. Every effort will be made to insure that a vessel will not be asked to carry a technician for more than one trip during the year. The observer program on drift entanglement nets is discussed elsewhere.

Sampling level and cost of the onboard technician program. Onboard sampling for size, sex and age structure, have the most intensive sampling demands. If observer coverage is adequate to accomplish these objectives it will suffice for the others. Tables 17-19 show the anticipated number of fish in each size class that would be sampled in each area at sampling intensities of 1, 3 and 5 percent (based on 1983 landings). A sampling intensity of 3 percent is adequate for estimating age structure and minimally acceptable for determining sex ratio by size class and area. This level is probably insufficient for accurately estimating total catch or mean CPUE by area and month.

Table 17. Estimated number of fish that will be sampled in each area and dressed weight class at 1 percent level of sampling.

<u>SIZE CLASS</u> (lb)	<u>GULF OF MEXICO</u>	<u>FLORIDA EAST COAST</u>	<u>SOUTH ATLANTIC</u>	<u>MID-ATLANTIC & NEW ENGLAND</u>
1-10	4	3	1	3
11-20	49	23	18	17
21-30	22	31	29	27
31-40	17	25	25	25
41-50	14	21	15	22
51-60	6	20	9	20
61-70	4	18	6	18
71-80	3	12	4	17
81-90	2	10	3	20
91-100	3	8	2	21
101-110	2	7	2	17
111-120	1	7	2	15
121-130	1	7	2	11
131-140	1	6	2	11
141-150	1	5	2	10
151-160	1	4	1	7
161-170	1	4	1	7
171-180	1	4	1	5
181-190	1	3	1	5
191-200	1	2	1	3
200+	2	22	9	26
Totals	135	241	135	303

Table 18. Estimated number of fish that will be sampled in each area and dressed weight class at 3 percent level of sampling.

<u>SIZE CLASS</u> (lb)	<u>GULF OF MEXICO</u>	<u>FLORIDA EAST COAST</u>	<u>SOUTH ATLANTIC</u>	<u>MID-ATLANTIC & NEW ENGLAND</u>
1-10	13	9	3	9
11-20	146	70	55	50
21-30	66	93	86	82
31-40	51	74	74	75
41-50	42	62	45	66
51-60	17	59	26	59
61-70	11	53	18	55
71-80	10	36	11	52
81-90	5	31	9	59
91-100	10	24	7	62
101-110	5	20	6	50
111-120	4	20	5	45
121-130	4	20	6	32
131-140	2	17	6	32
141-150	2	16	5	29
151-160	3	12	4	20
161-170	2	12	4	20
171-180	2	11	3	15
181-190	1	10	3	15
191-200	1	7	2	9
200+	6	67	27	77
Totals	404	723	405	910

Table 19. Estimated number of fish that will be sampled in each area and dressed weight class at 5 percent level of sampling.

<u>SIZE CLASS</u> (lb)	<u>GULF OF MEXICO</u>	<u>FLORIDA EAST COAST</u>	<u>SOUTH ATLANTIC</u>	<u>MID-ATLANTIC & NEW ENGLAND</u>
1-10	22	16	5	15
11-20	243	117	91	83
21-30	111	154	143	137
31-40	85	123	123	124
41-50	69	104	75	109
51-60	29	99	44	99
61-70	19	88	30	91
71-80	17	60	19	86
81-90	8	32	16	99
91-100	16	40	12	103
101-110	8	34	9	83
111-120	7	34	9	74
121-130	7	33	10	53
131-140	4	28	9	53
141-150	4	27	8	49
151-160	5	21	6	33
161-170	3	19	6	33
171-180	3	18	5	24
181-190	1	17	5	24
191-200	1	11	4	15
200+	9	112	45	129
Totals	671	1,207	674	1,516

Data derived from requests for permits to fish indicate the number of vessels by area in each month (Table 20). Average trip lengths were also derived from permit applications. During the active fishing months for each area, we estimate that vessels in the Gulf of Mexico, South Atlantic and the Mid Atlantic north take 1-2 trips per month, each lasting 11 days for the Gulf and 10 days elsewhere. Vessels on the Florida east coast take 2-3 trips per month, each of 7 days duration. The number of trips and days at sea required to obtain a 3 percent sample is given in Table 21. A total of 111 trips lasting 952 days is estimated to be required to obtain the minimal sample of 3 percent. At a cost of \$150 per day at sea the total cost of the onboard technician program will be \$142,800. Sampling at even this relatively low level need not be maintained every year. We anticipate that sufficient data for monitoring and refining the plan can be obtained by sampling at this level every two or three years with greatly reduced onboard sampling during intervening years. Thus the average annual cost of the onboard technician program will be considerably less than the figure given. Sampling intensity and frequency after the first year will be based on results of the initial year's program and modified as necessary by regulatory amendment.

Continuation of mandatory reporting begun under Section 303(e) of MFCMA. On January 31, 1984 the five Councils submitted a two-part request to the Secretary of Commerce to collect data that was necessary to complete this plan. First, a request for information on the number of vessels and their 1983 fishing patterns (time, area, gear) to complete an evaluation of the proposed onboard technician program. The permit and data collection program established by NMFS for all commercial swordfish vessels as a result of this request will be continued by this plan. It will be expanded to include the onboard technician program.

The second request was to place observers on vessels using drift entanglement nets to gather sufficient information to resolve differences of opinion between Councils on what should be done about nets. These nets are not currently used commercially on the east coast outside New England. Attempts to use them elsewhere apparently have not been profitable for swordfishing. They may be effective for the developing tuna

Table 20. Number of swordfish vessels by month, by gear and by area. (Source: Councils' Request to the Secretary of Commerce under Section 303(e) MFCMA. Data input and analysis by NMFS SEFC.)

	<u>LONGLINE</u>	<u>HARPOON</u>	<u>GILLNET</u>	<u>OTHER</u>	<u>COMBINATION</u>
<u>JANUARY</u>					
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	<u>177</u>	<u>10</u>	<u>0</u>	<u>0</u>	<u>21</u>
<u>FEBRUARY</u>					
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	<u>177</u>	<u>10</u>	<u>0</u>	<u>0</u>	<u>21</u>
<u>MARCH</u>					
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	<u>172</u>	<u>11</u>	<u>0</u>	<u>1</u>	<u>27</u>
<u>APRIL</u>					
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	13	1	0	0	6
North of New York	11	6	1	1	5
Caribbean	?	0	0	0	2

Table 20. Continued

	<u>LONGLINE</u>	<u>HARPOON</u>	<u>GILLNET</u>	<u>OTHER</u>	<u>COMBINATION</u>
<u>MAY</u>					
Gulf of Mexico	24	2	0	0	2
Florida East Coast	37	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	<u>165</u>	<u>24</u>	<u>1</u>	<u>2</u>	<u>34</u>
<u>JUNE</u>					
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	<u>189</u>	<u>87</u>	<u>2</u>	<u>1</u>	<u>54</u>
<u>JULY</u>					
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	<u>182</u>	<u>96</u>	<u>2</u>	<u>1</u>	<u>50</u>
<u>AUGUST</u>					
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

Table 20. Continued

	<u>LONGLINE</u>	<u>HARPOON</u>	<u>GILLNET</u>	<u>OTHER</u>	<u>COMBINATION</u>
<u>SEPTEMBER</u>					
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	<u>191</u>	<u>92</u>	<u>1</u>	<u>1</u>	<u>58</u>
<u>OCTOBER</u>					
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	<u>202</u>	<u>30</u>	<u>0</u>	<u>0</u>	<u>48</u>
<u>NOVEMBER</u>					
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	<u>184</u>	<u>14</u>	<u>0</u>	<u>1</u>	<u>35</u>
<u>DECEMBER</u>					
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	<u>178</u>	<u>11</u>	<u>0</u>	<u>1</u>	<u>24</u>

Table 21. Estimated number of vessel trips and days at sea required to obtain a 3 percent sample.

Month	<u>GULF OF MEXICO</u>		<u>FLORIDA EAST COAST</u>		<u>SOUTH ATLANTIC</u>		<u>MID-ATLANTIC & NEW ENGLAND</u>	
	<u>No. Trips</u>	<u>No. Days</u>	<u>No. Trips</u>	<u>No. Days</u>	<u>No. Trips</u>	<u>No. Days</u>	<u>No. Trips</u>	<u>No. Days</u>
JAN	4	44	4	28				
FEB	4	44	5	35				
MAR	3	33	6	42				
APR	2	22	7	49				
MAY	1	11	7	49	1	10	2	20
JUN			5	35	1	10	4	40
JUL			4	28	1	10	4	40
AUG			4	28	1	10	4	40
SEP			4	28	1	10	5	50
OCT			4	28	1	10	4	40
NOV	2	22	4	28	1	10	3	30
DEC	<u>3</u>	<u>33</u>	<u>5</u>	<u>35</u>				
TOTALS	19	209	59	413	7	70	26	260

fishery. If the nets expand to southern waters, observer coverage is particularly important to document fishing practices and bycatch.

It is important for the Councils to establish policy on drift entanglement nets before they become widely used. The nets are expensive and require considerable vessel modification. Fishermen stand to lose a considerable investment if the nets are prohibited after their adoption.

The observer program on vessels with drift entanglement nets did not produce much data in 1984 (since June 11 when the program was implemented). The net season was effectively over by October. Experimental drift entanglement net fishing for swordfish or tuna fishing from a research vessel or contracting with established net fishermen may be the only way in the near future to observe net fishing in all areas of the management unit. A data collection program the same as the one authorized under the request to the Secretary in 1984 will continue under the swordfish plan until there are sufficient data to evaluate drift entanglement nets. This program specifies observer coverage as close to 100 percent as possible.

Landings data from the Caribbean. There are few landings or size frequency data from the Caribbean. In 1984, a commercial fisherman from the U.S. mainland provided some landings data to the Caribbean Council. This fisherman airfreighted his catch from Puerto Rico to Florida. This practice will likely continue with other boats because of the high value U.S. market and established business relationships between boats that will likely do exploratory swordfishing in the Caribbean and their mainland fish houses and dealers.

The established voluntary reporting system has not captured the necessary landings and size frequency data for the Caribbean area necessary to calculate a variable season closure. Therefore, these data for the Caribbean are mandatory. Vessels retaining swordfish for sale that were caught in the Caribbean and landed in Puerto Rico or U.S. Virgin Islands must report their catch by individual carcass weight. This will involve approximately 10 vessels providing copies of their weigh-out sheets which contain individual carcass weights.

Swordfish bycatch in the squid fishery. The existing data collection program that is providing an estimate of the bycatch of swordfish in the

foreign squid trawl fishery should continue even as the fishery changes from foreign to joint-venture and ultimately to a domestic fishery. This information is necessary to evaluate the cap on the rate of bycatch established by this plan.

Recreational rod and reel data from the Mid-Atlantic. The Mid-Atlantic region has a small commercial longline fishery but relatively large landings of rod and reel caught swordfish. The Mid-Atlantic Council desires more information on this fishery. Data will be collected from these recreational fishermen on catch rates, participation rates, and other data to describe the fishery.

Anyone desiring to retain swordfish caught from the Mid-Atlantic region is required to obtain a permit. There will be no additional technician coverage beyond that required in other areas but at least 20 percent of all swordfish fishermen (both commercial and recreational) will be sampled for additional information, by questionnaire.

The 20 percent minimum sampling will require proportionately more longline samples because the overall sampling percentage will be approximately 3 percent. It is not known how many rod and reel fishermen catch swordfish. However, it is known that swordfish are seldom an incidental catch so that only big game fishermen targeting swordfish would probably apply. Only a small number of anglers participate in this offshore night time activity. The best estimate of 1983 rod and reel landings is 92 fish from the Mid-Atlantic offshore canyons.

Harpoon landings. Should the VSC in the New England-Mid-Atlantic area expand backwards from November in the calendar year into the active harpooning months (June-October) then all dealers handling harpoon-caught fish must make their records available on a real-time basis so that the quota can be enforced. NMFS port agents will collect these landings data at a frequency sufficient to prevent exceeding the quota. This is unlikely in the first couple of years of the plan and possibly will never occur.

Future modification of data collection. Data collection can be altered by regulatory amendment. This includes but is not limited to making all landings data mandatory (or making selective sectors, e.g., harpoon landings mandatory) if these data are deemed necessary to manage

the fishery. It would also include modifying or deleting the onboard technician program if a more cost effective alternative becomes available that provides the necessary information. Such modifications would likely result from a recommendation by the working panel should landings data no longer be supplied voluntarily. Scientists have pointed out that the availability of total landings data would allow the use of virtual population analyses (a more powerful model than yield-per-recruit) to determine status of the stock. This has been rejected at this time because of complications with the industry over the mercury issue. If this issue is resolved in the future, resistance to requiring mandatory landings would decrease.

10.4 Management Measures for Domestic Fishing Considered and Rejected

Over the past six years of plan development a number of alternative management measures were considered and rejected. Some of these may be reconsidered in the future when new information is available.

Effort and catch limiting alternatives

Most of the major considerations had to do with limiting fishing effort on the entire stock. These measures included restricting the length of longlines or number of hooks, and establishing vessel quotas, regional quotas, management unit quotas or limited entry. Each of these measures have specific shortcomings. The major shortcoming they all have in common is that such management approaches do not address what has evolved as the major problem in the fishery, the increasing harvest of small fish. Neither the problem nor the proposed solution (variable season closure) became evident until size frequency data on the catch by area by month became available.

Limit the number of hooks or length of longline on a vessel. This approach would not control the catch of small fish. Also it would not control catch or effort unless there were also restrictions on the number of boats and/or closed seasons. It would economically damage larger vessels that are required for the most distant fishing in the FCZ. The measure would not be enforceable because vessels must carry replacement gear.

Individual vessel quota or trip limits. This will not control the catch of small fish. In fact, unless fishermen can effectively select for larger fish (gear or fishing practices) they might catch then later discard dead

small swordfish in order to maximize their catch by value if under a number or poundage quota. Given the different size vessels, distances to the fishing grounds, and required days offshore to be profitable, it is not possible to determine an equitable quota for each vessel. One possible future strategy is a quota of small fish (absolute number or percentage of the catch). This could be equivalent to a tolerance on a minimum size limit.

Regional Quotas. This will control the total catch but will not control the catch of small fish. All five Council regions are presumed to be fishing the same stock. During 1980 and 1983 landings were distributed by Council area in the following way:

REGION	1980		1983	
	Pounds	Percent of Total	Pounds	Percent of Total
New England	2,651,000	31	2,925,954	32
Mid-Atlantic	589,313	7	1,458,155	16
South Atlantic	3,469,715	41	4,163,042	45
Gulf of Mexico	1,725,975	21	716,731	8
Caribbean	*	*	*	*

The expansion of the fishery from 1976 to 1980 was primarily in the South. The Caribbean presently shows no recorded landings but it is anticipated that the area offers swordfishing opportunities.

There is no predetermined distribution (e.g., existing distribution) that is acceptable to all the Councils. Predetermined quotas would unnecessarily restrict the fishery if they are based on recorded landings that have historically underestimated total landings.

Management unit quota. This will not control the catch of small fish. It could increase the harvest of small fish. Closing the entire fishery when a quota for the whole management unit is reached would not equitably distribute the impacts because there are different seasonal fishing patterns throughout the management unit.

Uniform season closure over the entire fishery. Different months of the year have varying importance for each region as indicated by the relative landings and catches of small fish in each month in different areas.

*Landings are confidential.

Fishing conditions result in the summer months being the most important for the Atlantic east coast (Maine through Georgia). The Florida east coast has the most uniformly distributed fishing conditions over the year, while the winter months are the most important for the Gulf of Mexico. The fall months represent the time when the largest number of small fish are caught. The uniform closure of any time period for all areas would not equitably distribute restrictions.

Limited Entry. Restricting the number of boats in the fishery could possibly influence the catch of small fish. At the present time a major determinant of size fish caught is the location fished. Vessel congestion at the better locations (bigger fish) forces some boats to fish in areas with higher concentrations of smaller fish until a "berth" opens up at the better locations. There is no information on how many boats can be accommodated at the "big fish" locations nor are these locations predictable.

Limited entry has many economic and social side effects that the Councils want to avoid. Limited entry may be reconsidered if the chosen alternative does not achieve the goals of the plan. The South Atlantic Council has begun a study to evaluate how limited entry could be applied to the swordfish fishery. The results of this study will be presented to all Councils so that a more thorough evaluation of limited entry can take place.

Direct Control Over the Catch of Small Fish

Once the increasing catch of small fish was identified as the major problem, the primary candidates for corrective action were minimum size limits and/or gear restrictions.

Minimum size limit. The best estimate is that approximately 70 percent of swordfish hooked by longlines are landed dead. It is questionable whether the 30 percent that are alive when landed would survive if released. There are reports that longer gangions or other practices reduce hooking mortality. None of these strategies has been verified.

There are differing opinions about whether a minimum size would make fishermen move away from locations with higher concentrations of small fish. There would no longer be an economic incentive to catch small

fish but if a profit could still be made on just the few large fish in a set, small fish would still be caught and discarded dead.

A minimum size limit requiring the release of small fish could be a valuable management tool to augment or replace the VSC if and when it proves feasible. If a minimum size motivated fishermen not to set where there were mixed sizes, the economic effect of a minimum size could be similar to the variable season closure. The undesirable delay in the harvest of larger fish would have to be weighed against the desirable delay in the harvest of smaller fish.

Set hook size to control size fish caught. There is no apparent relationship between hook size and the size of swordfish caught because all swordfish have big mouths. However, should hook size or other gear specification increase the minimum size at which swordfish are caught it will be considered and could be implemented to complement the variable season closure by Regulatory Amendment (Management Measure #2).

Other Measures

Mandatory reporting of landings. The primary stock assessment method that triggers the variable season closure is an analysis of the size composition of the catch to determine the number of small fish harvested. Landings data would be valuable for developing more sophisticated stock assessment techniques (e.g. virtual population analysis) and for more accurately estimating the total benefits of preventing growth overfishing.

Landings are now voluntarily reported through fish houses. Total landings data would have to be directly collected from fishermen (mandatory reporting) because many swordfish are not handled through established fish houses. This might be done with log books maintained by the known universe of commercial fishermen.

Mandatory landings data are not being required at this time because they are not necessary for the current level of management and there are strong motivations for fishermen to under-report landings to avoid future court battles with the FDA. Since 1971, swordfishermen have had continuing legal battles with the U.S. Food and Drug Administration over the "action level" the FDA has set as the maximum allowable concentration of mercury. From 1971-78 the industry was virtually eliminated or

operated illegally when the action level was set at 0.5 PPM based on five assumptions, one of which was that average seafood consumption was 60 g/day.

In 1978, the FDA action level was raised to 1.0 PPM which allowed the industry to develop. This Federal court decision was based in part on a more sophisticated analysis of the consumption patterns of 25,000 households (the survey is used for many purposes other than swordfish consumption). The consumption patterns in a given period are indirectly tied to total landings (including imports) during the same time period. If accurately documented landings of swordfish are actually larger than reported landings or show discernable upward trends since 1978, it will likely bring the FDA and swordfishermen back into Federal court over the FDA action level.

The collection of mandatory landings data may be required in the future if they are necessary to adequately monitor the fishery. This could be done within the scope of the working panel's ongoing review of statistical reporting and implemented by regulatory amendment.

Administration of the VSC

Once it was decided to use the variable season closure to control the catch of small fish, several important decisions (rejected management measures) had to be made. These include the types of fishing to be included or excluded from the VSC and restrictions during the VSC.

Include rod and reel in the closure. The rationale is that each Council can choose closures according to the variable season closure (conform to the swordfish calendar) that can mitigate the influence on rod and reel swordfishing. Including rod and reel will improve enforcement of the closure. This will improve dockside enforcement.

Including rod and reel fishing in the VSC was rejected because there are many diverse fishermen catching very few fish (less than 500 per year). A rod and reel closure would be both difficult and costly to enforce. This exemption will not seriously alter the ability of the VSC to achieve OY.

Include harpoons in the closure. The rationale is the same presented for including rod and reel. Additional reasons for including harpoons in the closure are that while the harpooners take less than 6 percent of the total

catch, their exclusion would effectively shelter approximately 20 percent of New England's catch from the variable season closure. Enforcement of the closure for longlines would be hampered by allowing an alternative commercial fishing gear to operate during the closure. The enforcement problem was addressed by setting a minimum size of 125 pounds (dressed weight) on harpooned fish during the VSC. This will limit the ability to transfer illegally caught longline fish during the VSC to harpoon boats. Total monthly harpoon catch during the VSC is also restricted to historical (1973-83) levels.

Including harpoons in the VSC was rejected because harpoon gear takes preferred larger fish and their landings have fluctuated about an average of approximately 800,000 pounds in recent years. The primary purpose of the FMP is to prevent the increased catch of smaller fish by longliners which reduces the number of larger fish in the catch that are preferred in the market. If the entire fishery was pursued by only harpooners there would not be a need for domestic regulations.

Prohibit all oceanic longlining during the VSC. During the first rounds of public hearings this was the intent of the plan. A total prohibition on oceanic longlining would idle the approximately 340 vessels for the duration of the VSC. Enforcement would be through prohibiting the possession of oceanic longline gear during the closures. This unnecessarily restricts the development of U.S. tuna longlining. Tuna longlining can be done during the day with a minimal swordfish bycatch (that cannot be retained during the VSC). Extensive public input during the public hearings and from letters received support allowing daytime longlining.

Prohibit possession of swordfish only at-sea during the VSC. This unnecessarily limits enforcement when all areas are not open or closed for the same time periods. The NMFS and Coast Guard have continually recommended that as many regulations as possible be written to facilitate dockside enforcement because funding for at-sea enforcement is extremely limited. This measure could only be enforced at-sea and was rejected.

Prohibit the possession of all swordfish (fresh and frozen) during the VSC. If all frozen inventory had to be sold prior to closures it would

seriously disrupt markets. Requiring all swordfish to be sold prior to a closure would impose extreme hardships on dealers, restaurant owners and the general public. This alternative would prohibit possession of swordfish at all levels in a closed area during a closure. The preferred alternative is a more effective and practical enforcement approach.

10.5 No Action Alternative

The results of no action would be loss of the benefits that would accrue from the proposed actions. These benefits are measured in terms of the relative dollar value of domestic swordfish production that will result from the VSC. The additional potential biological benefits of preventing growth and/or recruitment overfishing cannot be quantified at this time.

There are three scenarios presented that bound the "worst case" (#1) and the "best case" (#3) followed by a detailed discussion of the most likely scenario (#4). All analyses are based on 1983 size-frequency, landings, and market data.

The number of fish and pounds of fish in each category that were harvested in 1983 during the time periods proposed for closures in 1985 are shown in Table 22. The number of fish was calculated by combining two different data bases. The percent of the catch in each category was calculated from 1983 size frequency data volunteered by fishermen/dealers in each area. These percentages were then used to partition the reported 1983 landings (State/NMFS data) from each area into the market categories. Numbers of fish were converted to pounds of fish using the mean weight of the age class that most closely corresponds to the market category.

Case #1 If all fish that were not captured during the closure were never captured (migrated outside the management unit) then the annual loss to the industry would be 540,067 pounds, worth \$1,747,204. This would be the worst possible case. It is highly unlikely.

Table 22. Predicted closures for 1985 based on 1983 size frequency data. The number of fish are the number caught during these time periods in 1983.

Closure Time	Under 50 lb DW		50-100 lb DW		Over 100 lb DW	
	Number	lb	Number	lb	Number	lb
North of Cape Hatteras Nov 6-30	1,967	67,896	557	36,483	787	86,176
South of Cape Hatteras Oct 15-Nov 30	1,500	51,750	308	20,174	397	43,472
Florida East Coast Nov 1-Dec 30	1,807	62,342	424	27,772	424	46,428
Gulf of Mexico Nov 1-Dec 7	1,854	63,963	249	16,310	158	17,301
All Areas	7,129	245,951	1,538	100,739	1,766	193,377
Market Price		\$ 2.63/lb		\$ 3.59/lb		\$ 3.82/lb
Market Value		\$646,851		\$361,653		\$738,700

Case #2 If the incentive to avoid a closure encouraged fishermen to voluntarily discover ways to reduce the catch of fish under 50 pounds by 7,129 fish (the difference between the 1983 and the 1980 levels) and these 7,129 fish moved into the next market category (50-100 pound) before they were caught and there was no natural mortality or opportunity cost during the delay, the annual gain would be 220,999, pounds totaling \$793,385.

Case #3 Carrying the logic of case #2 to the extreme, if the incentive to avoid closures resulted in fishermen discovering ways not to catch any fish under 50 pounds (39,718 in 1983) and all these were captured in the next market size category the annual increase in pounds would be 1,231,258 totalling \$4,420,216.

Case #4. VSC benefits including biological and economic parameters. The best estimate of net gains or losses from closures (or incentives to avoid closures) lies somewhere between these extremes. These estimates must include:

- (1) Natural mortality (reduction in number of fish available)
- (2) Growth rate of surviving fish
- (3) Increase in value/pound when fish move into a more valuable market category
- (4) Opportunity cost of delayed income (measured by present value or internal rate of return)

Each of these cases can be evaluated in terms of assumed lengths of the delay in the harvest of swordfish. Each of these factors is expressed in monthly values. The analysis calculates net gains or losses based on different assumed lengths of delay (months) in the harvest due to closures.

The estimation process is complicated because the length of time (age) a swordfish is in a market category (0-24, 25-49, 50-99, 100+) is not constant. This means that any assumed harvest delay may move only a portion of the number of fish in a category on to the next category. If the delay is long enough, fish could move through more than one market category.

The length of the harvest delay is influenced by but not limited to the length of the closures. The harvest is delayed at least as long as the closure but may be longer depending on the length of time after the closure

it takes to capture the fish. The maximum length of the delay in this analysis is limited to 12 months which is approximately the length of time it takes for the 26-43 pound fish (age 2) to grow to the 44-87 pound range (age 3-4). This is based on Berkeley and Houde growth estimates, dressed weight, sexes combined. It takes approximately 2 years for 44-87 pound fish (age 3-4) to grow to the 88-131 range (age 5-6).

To match market categories with biological growth, it is assumed that the 0-49 market category (primarily 25-49) are age 2 (26-43 pound), that the 50-99 market category are age 3-4 (44-87 pound). The 100+ market category is age 5-6 (88-131 pound). This implies that it takes approximately 1 year for all the fish in the 0-49 market category to grow to the 50-99 category and that it takes approximately 2 years for all the fish in the 50-99 category to grow to the 100+ category.

Another simplifying assumption is that there is an even distribution of the number of fish within each of these categories. If natural mortality (instantaneous rate) is constant then this assumption is violated. That is, within each of the market categories, there are more smaller fish than bigger fish (by number). This violation is not too damaging if the categories are not too long (span 1-2 years).

A further simplifying assumption is that the individual growth rate of fish in any category is constant. This is equivalent to assuming that the von Bertalanffy growth curve over the size range of any market category can be approximated by a straight line.

These assumptions allow a simplified model with the following characteristics.

- (1) All fish in market category I (0-49 pounds) move at a constant monthly rate ($1/12$) over one year into market category II (50-99 pounds).
- (2) All fish in market category II (50-99 pounds) move at a constant monthly rate ($1/24$) over two years into market category III (over 100 pounds).
- (3) The opportunity cost of the delayed harvest is measured in terms of the internal rate of return fishermen receive on their "investment" of a delayed harvest. This is done by calculating the annual internal rate of return (r) that equilibrates the value of any harvest delay with the value without a harvest delay.

Columns 11, 12, and 13 on Table 23 show the total value, incremental increase in that value, and total increase in that value for 1-12 months delay in the harvest of the number of swordfish taken in 1983 during the time period that would be closed in 1985. The incremental increase (column 12) remains large over 12 months and accumulates to a considerable magnitude (column 13). There is no way to predict how long the actual harvest delay will be, but by definition, it will be at least as long as the closure.

The internal rate of return analysis is more revealing. The IRR declines with longer delays. This is because while the incremental increase in value remains large (column 12), that increase can only be achieved with progressively larger investments (foregone catch). For example, a one month delay produces an incremental increase of \$74,791 with an investment of \$1,747,204 (delayed harvest) for one month. If the delay is from 8 to 9 months the incremental gain is \$55,559 but it requires an investment of \$2,278,224 for one month if the choice is to harvest the fish after eight rather than nine months delay.

The conclusion is that the absolute increase in value from the harvest delays depends on the length of the delay (column 13). However, any delay (1-12 months) produces high returns (IRR) on the "investment" of a delayed harvest. Short delays are particularly attractive short term investments (high IRR, column 14).

The VSC as an incentive program. The values on Table 23 are based on any delay in the harvest of small fish being strictly a result of the closures. An important feature of the VSC is the expectation that fishermen will voluntarily discover methods to reduce their catch of small fish to avoid closures. To the extent that this happens it will significantly increase the potential net benefits derived from this plan. Benefits from the delayed harvest of small fish will still occur but without the costs of delaying the harvest of larger fish. If fishermen voluntarily discover ways to catch 7,129 fewer small fish there would be no closure. The net benefits would simply be the gains in pounds and value of delaying the harvest of small fish.

Table 23. Estimated change in the size composition (number of fish and value) with 1 to 12 months delay in the harvest of fish that would have otherwise been caught during the closure.

Harvest delay in Months	2		3		4		5		6		7		8		9		10		11		12		13		14				
	Number*	Market Category I 0-49 lbs DW \$2.63/lb. 39.5 Pounds	Value	Number	Market Category II 50-99 lbs DW \$3.59/lb. 65.5 Pounds	Value	Number	Market Category III 100+ lbs DW \$3.82/lb. 109.5 Pounds	Value	Number	Value	Total Value	Incremental increase in value of delay	Total Increase in Value of delay	IRR of Delay														
0	7,129	285,931	606,851	1,538	100,739	361,653	1,766	193,377	738,700		1,747,204																		
1	6,454	222,676	585,638	2,043	133,785	480,286	1,808	197,924	756,071		1,821,995	74,791	74,791																
2	5,794	199,907	525,754	2,534	165,974	595,848	1,847	202,299	772,781		1,896,383	72,388	72,388																
3	5,149	177,642	467,199	3,012	197,308	708,337	1,886	206,500	788,830		1,964,366	69,983	69,983																
4	4,518	155,883	409,973	3,478	227,787	817,755	1,923	210,528	804,218		2,031,946	67,380	67,380																
5	3,902	134,630	354,076	3,930	237,409	924,100	1,958	214,384	818,945		2,097,121	65,175	65,175																
6	3,301	113,881	299,508	4,369	286,176	1,027,373	1,991	218,066	833,012		2,159,893	62,772	62,772																
7	2,714	93,638	246,268	4,795	314,087	1,127,574	2,024	221,575	846,418		2,220,260	60,367	60,367																
8	2,142	73,900	196,357	5,208	311,143	1,224,703	2,054	224,912	859,164		2,278,224	57,964	57,964																
9	1,585	54,667	143,775	5,608	367,343	1,318,760	2,083	228,075	871,248		2,333,783	55,559	55,559																
10	1,042	35,940	94,521	5,995	372,637	1,409,745	2,110	231,066	882,672		2,386,938	53,155	53,155																
11	514	17,717	46,596	6,369	417,175	1,497,658	2,136	233,883	893,435		2,437,689	50,751	50,751																
12	0	0	0	6,730	440,808	1,582,499	2,160	236,528	903,537		2,486,036	48,347	48,347																

*All estimated numbers are carried to 2 decimal places in the computer program.

Table 23 (Column 2) indicates the rate that small fish grow out of the small fish category with different assumed lengths of delays in the harvest. Table 24 shows the results of these fish moving into the next weight category. The different lengths of delay would not be from closures but rather from fishermen discovering ways to avoid catching small fish to avoid closures. Table 24 (like Table 23) computes incremental gain, total gain, and internal rates of return for delaying the harvest.

Reducing the catch voluntarily to avoid closures is obviously preferable to closures. The absolute gain in pounds and dollars is almost as great with much less cost in terms of larger fish (compare Tables 24 and 23). The internal rate of return exceeds 1.0 from 1 to 12 month delays. In addition, there would be no enforcement costs or market disruption because there would be no closures.

The likely benefits of this plan are probably somewhere between the projections on Tables 23 and 24. Fishermen will undoubtedly find ways to reduce the catch of small fish to avoid closures but it is unlikely (at least in the first year) that they will be able to reduce the small fish catch by 7,129 fish. Therefore, there will be some combination of voluntary reductions and closures (adjusted accordingly).

10.6 Benefit/cost analyses

Potential benefits must be weighed against the likely costs of the proposed management regime. Net benefits are defined as the dollar gains resulting from the delayed harvest. The amount of these gains depends on the lengths of the harvest delay and the extent to which the delay is accomplished by closures (resulting in the delayed harvest of all size fish) or fishermen finding methods to voluntarily reduce the catch of small fish to avoid closures. These two situations are depicted by Tables 23 and 24.

Table 24. Estimated change in the size composition (number of fish and value) with 1 to 12 months voluntary delays in the harvest of fish to avoid closures.

1	2	3	4	5	6	7	8	9	10	11
Harvest delay in Months	Number	Market Category I 0-49 lbs DW \$2.63/lb Pounds 34.5	Value	Number	Market Category II 50-99 lbs DW \$3.59/lb Pounds 63.5	Value	Total Value	Incremental Increase in Value of Delay	Total Increase in Value of Delay	IKR of Delay
0	7,129	245,951	646,851	0	0	0	646,851			
1	6,434	222,676	585,638	587	38,433	137,974	723,612	76,761	76,761	2.82
2	5,794	199,907	525,754	1,199	75,907	272,504	798,258	74,646	151,407	2.48
3	5,149	177,642	467,199	1,716	112,421	403,591	870,790	72,532	223,939	2.28
4	4,518	155,833	409,973	2,259	147,976	531,235	941,208	70,418	294,357	2.08
5	3,902	134,630	354,076	2,787	182,572	655,435	1,009,511	68,303	362,660	1.92
6	3,301	113,881	299,508	3,301	216,209	776,191	1,075,699	66,183	428,808	1.78
7	2,714	93,638	246,268	3,800	248,887	893,504	1,139,772	64,073	492,921	1.64
8	2,142	73,900	194,357	4,284	280,606	1,007,374	1,201,731	61,959	554,880	1.54
9	1,585	54,667	143,775	4,754	311,365	1,117,800	1,261,575	59,844	614,724	1.44
10	1,042	35,940	94,521	5,209	341,165	1,224,782	1,319,303	57,228	672,452	1.36
11	514	17,717	46,596	5,609	370,006	1,328,321	1,374,917	55,614	728,066	1.28
12	0	0	0	6,075	397,888	1,428,417	1,428,417	53,500	781,566	1.71

The primary costs of the FMP are:

Sunk cost:

- | | |
|---------------------------------|------------|
| 1. SAFMC plan development costs | \$ 771,858 |
|---------------------------------|------------|

Annual costs:

- | | |
|--|------------|
| 2. Annual plan administration costs
(\$18,500 annually for age and growth analysis, annual data collection and analysis of size frequency data and working panel meeting, plus \$13,500 every 2 years to prepare hard parts for aging.) | \$ 25,250 |
| 3. Annual data collection and analysis costs at 3 percent sampling every 2 years | \$ 71,450 |
| 4. Annual enforcement costs
(Coast Guard \$76,600)
(NMFS/States \$30,500) | \$ 107,100 |

Annual benefits of the plan range from approximately \$284,742 for a 4 month delay to \$738,832 for a 12 month delay in harvest by the VSC (Table 23). If the capture of fish not caught during a 1-2 month closure is evenly distributed over the remainder of the year, the effective delay in harvest will average approximately 6½ to 7 months. The annual benefit will be approximately \$443,000 to \$473,000. If a delay in the catch of small fish is voluntarily achieved by fishermen to avoid closures, then the annual dollar benefits range from approximately \$294,357 for four months to \$781,566 for 12 month delay in the harvest. The main difference is that the latter has no enforcement costs because there are no closures.

Present Value Benefits

For the purpose of benefit/cost analysis the effective delay in harvest is assumed to be 7 months for the proposed 1-2 month closure. The annual benefit will be approximately \$473,056.

Present value (in dollars) is calculated at a 10 percent discount rate. The present value in dollars depends on the price per pound for the various market categories. The price and size information used to calculate the benefits are from 1983 and underestimate the current price by market category. The entire benefit/cost analysis will be recalculated based on

1984 data prior to a closure taking effect. The present value benefit of the proposed closure discounted over 20 years is \$4,027,392.38.

Present Value Costs

SAFMC cost for plan development was \$771,858. Annual costs after plan implementation are \$203,750. The present value of annual costs over 20 years at a 10 percent discount rate is \$1,734,638.60.

Benefit/Cost Analysis

The benefit/cost ratio is defined as present value benefits divided by present value costs. Adding plan development costs to the present value of annual costs results in a total cost of \$2,506,496.60 and a benefit/cost ratio of 1.61. Comparing only the annual costs and benefits increases the benefit/cost ratio to 2.32.

There are additional benefits from plan implementation that cannot be quantified at this time. The no action alternative would result in the continued increase in the catch of fish under 50 pounds. This is prevented under the FMP which results in additional benefits. Further refinements to the plan resulting from the onboard technician program will lead to increased benefits.

10.7 Special Recommendations to the States

The Councils recommend that the states implement the management measures proposed in this plan within their jurisdiction, where applicable.

10.8 Special Recommendations to Other Countries Harvesting Swordfish from the Management Unit

The Councils recommend that other countries use the procedures in this plan to calculate VSC calendars for their areas and implement time and area closures consistent with the VSC.

10.9 Summary of Regulatory Impacts of Measures

Domestic Measures. The variable season closure (VSC) will restrict the catch of small swordfish (under 50 lb dressed weight) to the 1980 level (33,750 fish). Initial closure dates, based on 1983 data, are as follows: (1) North of Cape Hatteras (Area 1) would be closed November 7-30; (2) Cape Hatteras to Georgia/Florida border (Area 2) would be closed October 16-November 30; (3) Georgia/Florida border to the Gulf of Mexico (Area 3) would be closed November 1-December 30; (4) Gulf of Mexico (Area 4)

would be closed November 1-December 7; and (5) Puerto Rico and the U.S. Virgin Islands (Area 5) would be closed November 1-December 30. Fishermen in each of these areas would be "investing" the fish that would normally be caught during these times with the expectation that they catch these fish in the future when the fish are larger and worth more. Area 1 fishermen are investing 5 percent of their annual landings, Area 2 fishermen 12 percent, Area 3 fishermen 10 percent and Area 4 fishermen 7 percent. A calendar cannot be calculated for Area 5 fishermen but utilizing the Area 3 calendar, they would also be investing 10 percent of their annual landings. Annual benefits of the plan range from approximately \$284,742 for a 4 month delay to \$738,832 for a 12 month delay in harvest. If the capture of fish not caught during a 1-2 month closure is evenly distributed over the remainder of the year, the effective delay in harvest will average approximately 6½ to 7 months. The annual benefit will be approximately \$443,000 to \$473,000.

The Councils recognized that such a closure would be expensive and could idle swordfish vessels resulting in substantial economic losses and disruptions to the market. To mitigate this effect, during the closures longlining is allowed during daylight hours (0500 - 1800 hours) so that tuna fishing can continue; however, the swordfish bycatch must be released. Recreational rod and reel, harpoon gear, and the Caribbean handline fishery are exempt from the VSC. All swordfish caught at any time from the western North Atlantic and retained for sale must be landed whole (carcass). In a closed area fishing for swordfish by other than exempt gear is prohibited, the possession of swordfish shoreward of the outer boundary of the FCZ is prohibited, and the landing of swordfish taken by other than exempt gear is prohibited. The importation of any swordfish taken from the western North Atlantic is prohibited during a closure. No longlining or netting is allowed at night in a closed area. If the closure occurs during the traditional harpoon season (June - October) harpooned fish must be larger than 125 pounds dressed weight and the total catch is limited to the average monthly catch of the past 10 years after discarding the highest and lowest years. These measures serve to minimize the burden on fishermen, processors, and the market during a closure. These measures have also

been developed to provide for effective enforcement of the closure while at the same time minimizing the resulting impact.

Anyone wishing to retain swordfish for sale must have a permit. Technicians will be placed onboard a sample number of commercial vessels and if selected the fisherman must carry a technician. The Councils recognize that this imposes a burden on fishermen and every attempt will be made to select only those vessels that can accommodate a technician. The technician will be placed onboard at no cost to the fishermen and every effort will be made to insure that a vessel will not be asked to carry a technician for more than one trip during the year. A data collection program, the same as the one authorized under the request to the Secretary in 1984 will continue under the swordfish plan until there are sufficient data to evaluate drift entanglement nets. Vessels retaining swordfish for sale that were caught in the Caribbean and landed in Puerto Rico or the U.S. Virgin Islands must report their catch by individual carcass weight. This will involve approximately 10 vessels providing copies of their weigh-out sheets which contain individual carcass weights. The existing data collection program that is providing an estimate of the bycatch of swordfish in the foreign squid trawl fishery should continue even as the fishery changes to joint-venture and ultimately to a domestic fishery. At least 20 percent of permit holders in the Mid-Atlantic area will be sampled for additional information, by questionnaire. Should the VSC in the New England/Mid-Atlantic area expand backwards from November in the calendar year into the active harpooning months (June-October) then all dealers handling harpoon caught fish must make their records available on a real-time basis so that the quota can be enforced.

Foreign measures. All swordfish must be reported and released. No foreign longlines which have an incidental catch of swordfish are allowed in the Atlantic FCZ out to 100 miles north of Cape Lookout to the U.S./Canada boundary from June 1 to November 30. These two measures will not place any additional burden on foreign fishermen. No foreign longlines which have an incidental catch of swordfish are allowed in the Atlantic FCZ out to 100 miles from Key West to Cape Lookout from June 1 to September 30. This would impose an additional closure for foreign

vessels. At the request of the Gulf of Mexico Council, both the general Gulf closure and the Dry Tortugas closure, as provided for in the PMP for Atlantic Billfishes and Sharks, are to be reserved in the final regulations so long as the voluntary agreement with the Japanese industry not to fish the Gulf of Mexico is maintained, and so long as other foreign vessels do not longline, or evidence an intent to longline for tuna or billfish in the Gulf of Mexico FCZ. The foreign longline catch allotment (number of swordfish hooked) is capped at 1½ percent of the previous year's domestic harvest, or 1,136 fish in the Atlantic and Caribbean and 400 fish in the Gulf of Mexico, whichever is the lesser amount. At present fishing levels, this measure will not restrict foreign longlining. The foreign squid trawl bycatch for foreign vessels operating with a GIFA for squid is limited to the 1982 ratio of swordfish to target catch in the foreign squid trawls in the New England and Mid-Atlantic regions. This measure will not restrict current fishing practices because it only caps the rate of bycatch and not the total level. Equivalent restrictions are placed on foreign fishing in the FCZ that are placed on domestic fishing. This includes a reduction in the bycatch allotment by an amount equivalent to total catch reduction experienced by domestic fishermen and any restrictions that apply to domestic fishermen during the VSC such as prohibition of nighttime longlining. Based on 1983 data, the daytime only restriction would reduce the catch of each of the 6 permitted foreign vessels for 24 days.

11.0 ALTERNATIVE FOREIGN FISHING MANAGEMENT MEASURES

11.1 Foreign Fishing Management Measures

There is presently no allowable foreign fishing for swordfish. Foreign fishing measures refer to management measures that address the foreign bycatch of swordfish when targeting species not under MFCMA (tuna) or foreign fishing targeting species pursuant to a Governing International Fisheries Agreement (GIFA).

Already existing measures pertaining to swordfish. The measures for swordfish in the Preliminary Fishery Management Plan for Atlantic Billfish and Sharks are adopted into this fishery management plan (numbers 1-5). Detailed rationale for these measures is contained in the PMP document as amended and in the Swordfish Source Document (Part I, Section 8.4.5).