

## 1.0 INTRODUCTION

This Fishery Management Plan is based on a source document which contains the detailed scientific, technical and other supportive documentation on which the management regime is based. The numbering system in the FMP is the same as the source document for the major headings in Sections 5.0 through 8.0. The source document is available for review at the following locations:

South Atlantic Fishery Management Council  
Southpark Building, Suite 306  
1 Southpark Circle  
Charleston, South Carolina 29407-4699

New England Fishery Management Council  
Suntaug Office Park, 5 Broadway (Route 1)  
Saugus, Massachusetts 01906

Mid-Atlantic Fishery Management Council  
Federal Building, Room 2115  
North and New Streets  
Dover, Delaware 19901

Gulf of Mexico Fishery Management Council  
Lincoln Center, Suite 881  
5401 West Kennedy Boulevard  
Tampa, Florida 33609

Caribbean Fishery Management Council  
Suite 1108, Banco de Ponce Building  
Hato Rey, Puerto Rico 00918

National Marine Fisheries Service  
Southeast Regional Office  
Duval Building  
9450 Koger Boulevard  
St. Petersburg, Florida 33702

National Marine Fisheries Service  
Southeast Fisheries Center  
75 Virginia Beach Drive  
Miami, Florida 33149

National Marine Fisheries Service  
Northeast Regional Office  
14 Elm Street  
Gloucester, Massachusetts 01930

National Marine Fisheries Service  
Northeast Fisheries Center  
Woods Hole, Massachusetts 02543

National Marine Fisheries Service  
Page 2 Building  
3300 Whitehaven St., N.W.  
Washington, D.C. 20235

Definitions of terms used in this document:

**Age At Entry:** Age at which swordfish are first vulnerable to the predominant fishing gear (longlines) which is age two, 26-43 pounds dressed weight. Also referred to as age liable to capture and age of recruitment to the fishery.

**Carcass:** Swordfish after it has been gutted and the head and fins removed.

**Catch per unit of effort (CPUE):** The total number or weight of fish harvested by a defined unit of fishing effort in a given time period.

**Domestic annual harvest (DAH):** The capacity and the extent to which fishing vessels of the U.S. will, on an annual basis, harvest the optimum yield. For swordfish DAH (1983) was approximately 9.3 million pounds.

**Dressed weight (Carcass weight):** Weight of carcass after fish are gutted and head and fins are removed (dressed weight = 0.75 x whole weight).

**Environmental Impact Statement (EIS):** Required by the National Environmental Policy Act of 1969 whenever major Federal actions may significantly affect the quality of the environment, including the human environment. A draft (DEIS) and a final (FEIS) environmental impact statement are prepared.

**Executive Order 12291 (E.O. 12291):** Directs agencies to develop or revise informal rulemaking procedures to ensure that regulations are necessary, appropriate, and cost effective.

**Fishery Conservation Zone (FCZ):** The area in which the U.S. asserts exclusive fishery management authority, established by the Magnuson Fishery Conservation and Management Act of 1976: "The inner boundary of the FCZ is a line coterminous with the seaward boundary of each of the coastal states, and the outer boundary of such zone is a line drawn in such a manner that each point on it is 200 nautical miles from the baseline from which the territorial sea is measured."

**Fishing effort:** The amount of fishing activity measured in this plan primarily by the resulting "fishing mortality" as estimated by yield-per-recruit analyses or other forms of size structure analysis.

**Fishing mortality:** Instantaneous rate of fishing mortality calculated in yield-per-recruit analysis. It is that portion of total mortality attributable to fishing. It is equal to total mortality minus natural mortality. It is the primary measure for stock assessment and important for management considerations in this FMP.

**Food and Drug Administration (FDA):** Federal agency that determines and enforces health standards.

**FDA Action Level:** Maximum allowable mercury concentration in seafood measured in parts per million (ppm) (1971-78=0.5 ppm; 1978-present=1.0 ppm).

**Fishery Management Plan (FMP):** Prepared by a Fishery Management Council to aid in managing a particular fishery, as directed by the MFCMA.

**Growth Overfishing:** The harvesting of a fish stock to the point that the harvest is less than the maximum possible (by weight) with constant recruitment. Growth overfishing can be controlled by limiting fishing mortality on all size fish and/or by increasing age at entry (age liable to capture) to the fishery which reduces fishing mortality on smaller fish. Growth overfishing is defined in this FMP as an existing combination of fishing mortality (fishing effort) and age liable to capture such that an increase in age liable to capture or a decrease in fishing mortality (fishing effort) will significantly increase yield. Growth overfishing is an established scientific definition measured by yield-per-recruit analyses but is not considered to be "overfishing" in the context of National Standard One of MFCMA.

**ICCAT:** International Commission for the Conservation of Atlantic Tunas

**ICES:** International Commission for the Exploration of the Seas

**Incidental Catch:** Catch other than the target species; also called bycatch. Incidental species taken with swordfish longlines include marlin, sailfish, tuna, and sharks. Swordfish is an incidental catch of foreign longline fishing for tuna and foreign squid trawling.

**Internal rate of return (IRR):** The discount rate that produces a present value (PV) of zero for a stream of future values (FV) over a number of years. It is the primary measure in this plan of the economic value of delaying the harvest of smaller fish until they are larger. This delay is treated as an "investment problem." Fishermen "invest" by foregoing the harvest of small fish and receive a return on that investment in the future in terms of larger fish that are more valuable. The internal rate of return calculates the value of that investment.

**JVP:** Joint Venture Processing.

**Magnuson Fishery Conservation and Management Act (16 U.S.C. 1801 et seq.) (MFCMA):** Established the FCZ and eight Regional Fishery Management Councils to prepare, monitor, and revise fishery management plans.

**Maximum sustainable yield (MSY):** The largest quantity (by weight) of fish that can be harvested annually without reducing its long-term production potential.

**Maximum Yield-Per-Recruit (YPR):** Maximum YPR is comparable to maximum yield (MY) for the purposes of management which is comparable to MSY if there is constant recruitment.

**National Marine Fisheries Service (NMFS):** A division of the National Oceanic and Atmospheric Administration, Department of Commerce, responsible for conservation and management of fisheries.

**Natural Mortality:** Instantaneous rate of natural mortality calculated in yield-per-recruit analysis. It is equal to total mortality minus fishing mortality or that portion of total mortality attributable to all causes except fishing.

**Net:** Drift entanglement net.

**Overfishing:** Fishing effort above the level which will produce MSY, resulting in catches less than MSY. See growth overfishing and recruitment overfishing.

**Optimum Yield (OY) (defined by MFCMA):** "The amount of fish (1) which will provide the greatest overall benefit to the Nation with particular reference to food product and recreational opportunity; and (2) which is prescribed as such on the basis of the maximum sustainable yield from such fishery as modified by relevant economic, social, or ecological factors." Optimum yield for swordfish is defined in terms of the harvest that results while not exceeding the catch of a maximum number of small swordfish.

**Preliminary Fishery Management Plan (PMP):** Management plan prepared by the Secretary of Commerce to manage the harvest by foreign fishermen in the FCZ until a FMP has been prepared by a regional Fishery Management Council.

**Recruitment:** Number of fish growing into the smallest harvestable size category each year.

**Recruitment overfishing:** The harvesting of a stock to the point that reproduction by the remaining brood stock is inadequate to produce as many fish as the habitat can support. Recruitment overfishing is an established scientific definition that is not measured by YPR analyses. Recruitment overfishing is considered to be "overfishing" in the context of National Standard One of MFCMA.

**Regional Director (RD):** Southeast Regional Director of the National Marine Fisheries Service.

**Regulatory Impact Review (RIR):** An assessment of the economic impacts of proposed government regulations.

**Secretary:** Secretary of Commerce.

**Section 7 Consultation:** As specified by Section 7 of the Endangered Species Act of 1973, each Federal Agency shall, through consultation with the NMFS and/or the Fish and Wildlife Service, as appropriate, ensure that actions authorized, funded, or carried out by such agency are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of the critical habitat of such species.

**Stock:** A group of fish manageable as a unit. For purposes of this FMP, the swordfish stock is defined as swordfish in the western North Atlantic.

**Total Allowable Level of Foreign Fishing (TALFF):** The portion of the optimum yield on an annual basis which will not be harvested by U.S. vessels. OY minus DAH. For swordfish, the TALFF is zero because the fishery is fully exploited by U.S. fishermen.

**Total mortality:** Instantaneous rate of mortality calculated by yield-per-recruit analysis. It is equal to the sum of natural mortality and fishing mortality. Total mortality represents the total instantaneous mortality from both natural causes and fishing.

**Variable season closure (VSC):** Time and area closures to regulate the harvest of small swordfish. The method of calculating the lengths of closure in each area results in no closures if more preferred methods to regulate the catch of small fish (voluntary actions by fishermen or a minimum size limit) are effective in controlling the catch of small fish.

**Western North Atlantic:** FAO Statistical reporting areas 21 and 31 (Figure 8-12, Source Document, Part II, p. 8-84). This area is bounded on the west by the North, Central and South American land masses and on the east by a line running from the eastern coast of South America at 5°00' N out to 40°00' W, north to 36°00' N, west to 42°00' W, north to 59°00' N, west to 44°00' W and continuing north to Greenland.

**Whole weight (Round weight):** Weight of fish before heading or gutting.

**Yield-per-recruit (YPR):** A theoretical calculation based on known or assumed growth rates, natural and fishing mortality rates that allows an estimate of relative yield from a fishery without knowing landings. It does not permit a calculation of total landings but it is possible to calculate the relative amount of fishing effort and landings compared to maximum yield-per-recruit which is comparable to MSY given constant recruitment. Its primary use in this plan is to calculate the relative increases in yield and revenue from controlling the harvest of small swordfish.

#### A short primer on YPR:

Two major approaches exist for the problem of determining yield from a fishery: (1) surplus production models and (2) yield-per-recruit analysis.

Surplus production models are descriptive. They are based on population growth curves that assume the rate of population growth is related to population size and that catch per unit effort (CPUE) is a valid index of population size. Catch and effort data are used to derive a yield curve from which maximum sustainable yield (MSY) can be calculated.

The major shortcoming of this approach for management is that only one datum point can be generated each year. Approximately 10 years of data are required which can result in a post-mortem of the fishery by the time enough knowledge exists to implement regulations. Even when historical catch records exist, they are often available for only a portion of the range and there are further problems with the accurate estimation of fishing effort.

Yield-per-recruit analysis is based on an analytical rather than a descriptive model. This approach predicts yield according to the growth pattern of individual fish rather than the growth of the entire population. The only prerequisite information is ages of fish at different lengths and natural mortality. Yield is not calculated in terms of total weight per year from the fishery. Instead, an index of yield, rather than an absolute total weight is calculated. This index is called yield-per-recruit.

The advantage of YPR analysis is that it is extremely rapid compared to surplus production modeling and does not require catch-per-unit effort data. It allows a quick assessment of the stock using basic biological information.

All mathematical abstractions designed to simulate natural phenomena are at the mercy of their imperfectly met assumptions, and neither of the two approaches are exempt from this imperfection. YPR analysis is not subject to some of the delays imposed by surplus production models but fulfills the basic management task of monitoring the stock and estimating the relative yield from a fishery with different regulations.

Yield-per-recruit analysis has the advantage of being able to estimate yield by size fish. This is important for swordfish because larger fish not only weigh more in pounds than smaller fish but they are more valuable per pound. There is a well documented market preference for larger swordfish. This means that even if management measures do not significantly increase the yield of the fishery by total weight landed, there can still be substantial economic benefits from the pounds being embodied in larger fish. Yield-per-recruit analysis can measure these benefits because it estimates the catch by size fish.

**INFORMATION**

**ANALYSIS**

**RESULTS**

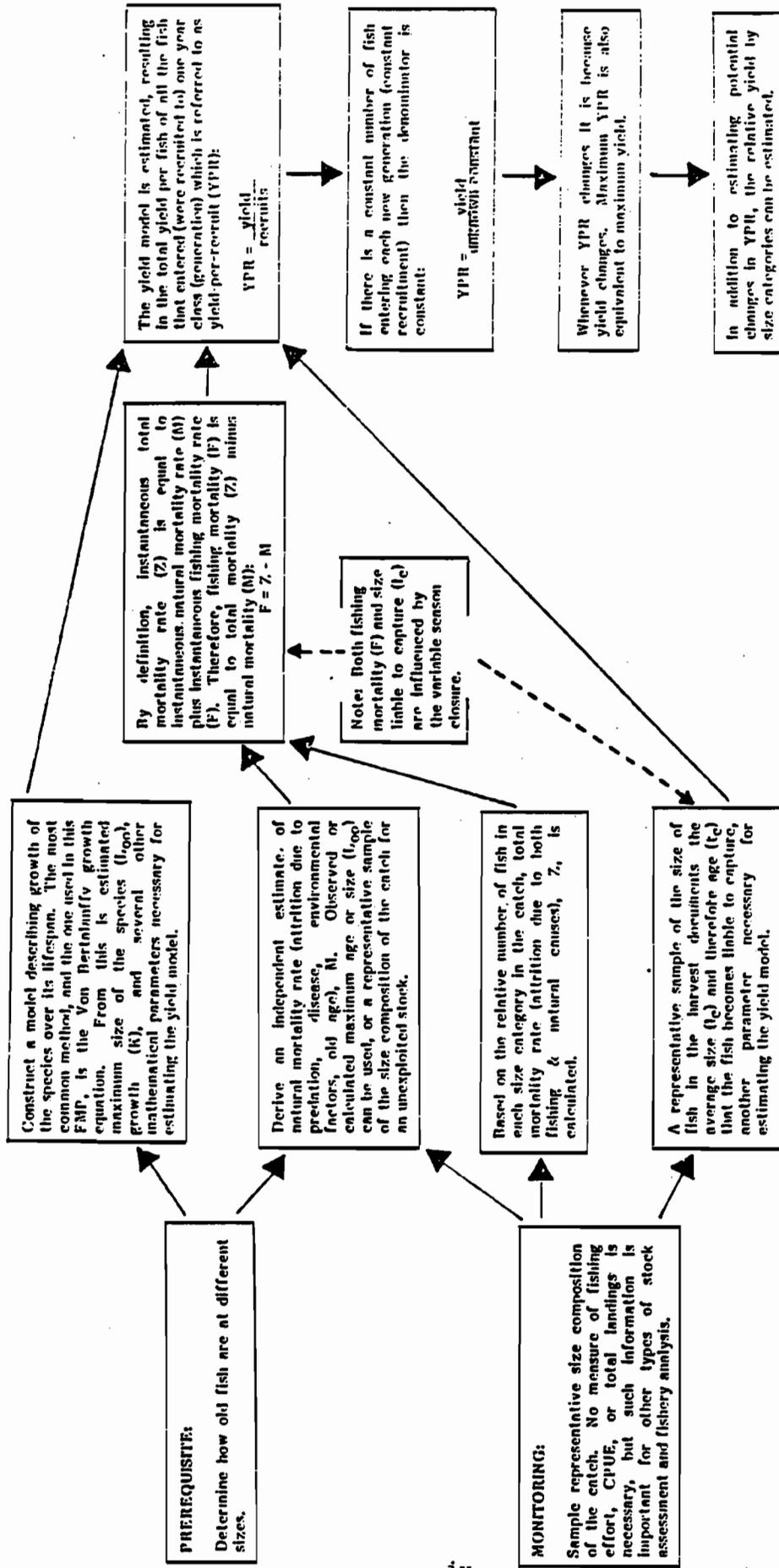


Figure 1. How yield-per-recruit works.