differentiate (clearnose, little, smooth, rosette), as are some of the large-sized species (thorny and winter; barndoor skates can be more easily identified).

The Council clearly recognizes the problems associated with skate species identification. Because species-specific information is critical to the long-term success of this FMP, the Council is working closely with NMFS and the Northeast Fisheries Science Center (NEFSC) to develop a species identification guide for skate vessels and dealers as well as enforcement agents, sea samplers, and port agents. Draft copies of this guide were made available at the skate public hearings for review and comment. Final copies of the guide are expected to be distributed prior to implementation of the Skate FMP.

The reporting requirements proposed in this document include two reporting categories that address some of the potential identification problems: (1) little/winter skate, primarily for use in the bait fishery for the portion of the catch that cannot be separated into either little skate or juvenile winter skate, and (2) unclassifiable skate, for those that vessels and/or dealers cannot identify, even with the assistance of a guide.

State-Waters Skate Activity: The nature and extent of skate fishing activity occurring in state waters is currently unknown. It is believed that the majority of skate activity in state waters is in the bait fishery, through smaller vessels selling their skate catches to local lobster vessels. The Council anticipates working closely with states to coordinate the collection of fishery information for vessels fishing only in state waters. The measures proposed in this FMP that are intended to resolve this issue include the permit and catch reporting systems and the letter of authorization for vessels engaged in the bait-only fishery that are not subject to the wing possession limit.

3.0 SKATE FMP GOALS AND OBJECTIVES

The overall goal of the Skate FMP is:

> Consistent with the requirements of the Magnuson-Stevens Fishery Conservation and Management Act and other applicable laws, to develop a Fishery Management Plan (FMP) to research and manage the Northeast skate complex at long-term sustainable levels.

To achieve this goal, the Council has identified several FMP objectives:

1. Collect information critical for substantially improving knowledge of skate fisheries by species and for monitoring: (a) the status of skate fisheries, resources, and related markets and (b) the effectiveness of skate management approaches.
2. Implement measures to: protect the two currently overfished species of skates (barndoor and thorny) and increase their biomass to target levels, reduce fishing mortality on winter skate, and prevent overfishing of the other species in the Northeast skate complex – this may be accomplished through management measures in other FMPs (groundfish, monkfish, scallops), skate-specific management measures, or a combination of both as necessary.
3. Develop a skate permit system, coordinate data collection with appropriate state agencies for vessels fishing for skates or catching skates as bycatch only in state waters, and work with

the fishing industry to establish a catch reporting system consistent with industry capabilities, including the use of study fleets.

4. Minimize the bycatch and discard mortality rates for skates caught in both directed and non-directed fisheries through the promotion and encouragement of experimentation, conservation engineering, and gear development.
5. Promote and encourage research for critical biological, ecological, and fishery information based on the research needs identified in the Skate SAFE Report and scoping document, including the development and dissemination of a skate species identification guide.
6. Minimize, to the extent possible, the impacts of skate management approaches on fisheries for other species on which New England and Mid-Atlantic fishermen depend (for example, groundfish, monkfish, scallops, and fluke), recognizing the interconnected nature of skate and other fisheries in the Northeast Region.
7. To the extent possible, manage clearnose and rosette skates separately from the other five species in the skate complex, recognizing that these two species are distributed primarily in the Mid-Atlantic and South Atlantic regions.

4.0 PROPOSED ACTION

The following subsections describe the actions proposed in this FMP and the rationale for the Council's choices. Additional information about the Council's choices can be found within the analyses of the proposed action and the discussion of the alternatives that were considered but rejected by the Council during the development of this FMP. Alternatives to the proposed action, including the no action alternative, non-preferred alternatives, and alternatives that the Council considered but rejected, are described in Section 5.0 of this document.

4.1 MANAGEMENT UNIT

For this FMP, the management unit will be the **Northeast Region (Maine–North Carolina)**. The northern and western boundaries of the management unit are the coastline of the continental United States, and the eastern boundary is the Hague Line and the outer edge of the U.S. Exclusive Economic Zone (EEZ). The southern boundary of the management unit is Cape Hatteras, North Carolina (35º 15.3' North Latitude).

Discussion: The Council must specify a management unit for the Skate FMP. The choice of a management unit depends on the FMP's objectives and may be organized around geographic, economic, technical, social, and/or ecological perspectives. The management unit includes the species of concern, the identification of distinct stocks (if any), and the geographic area subject to management.

The species to which this management unit applies are those in the Northeast skate complex:

- Winter Skate (*Leucoraja ocellata*)
- Barndoor Skate (*Dipturis laevis*)
- Thorny Skate (*Amblyraja radiata*)
- Smooth Skate (*Malacoraja senta*)

- Little Skate (*Leucoraja erinacea*)
- Clearnose Skate (*Raja eglanteria*)
- Rosette Skate (*Leucoraja garmani*)

4.2 FISHING YEAR

The skate fishing year will be the same as the multispecies fishing year, currently May 1 – April 30. If the multispecies fishing year changes in the future, the skate fishing year will change automatically to remain consistent with the multispecies fishing year.

Discussion: Establishment of a fishing year for the Skate FMP provides a clear starting date for any new regulations and controls or adjustments to the fishery that may take place on an annual schedule. Currently, the Council is not proposing any measures in this FMP that rely on an annual schedule, but it may do so in the future.

Since the majority of skate fishing occurs under Multispecies DAS, which do rely on an annual schedule, the Council proposes that the skate fishing year be the same as the multispecies fishing year. Currently, the multispecies fishing year begins on May 1. If this date changes in the future (for example, through Amendment 13 to the Northeast Multispecies FMP, which is currently under development), the skate fishing year would change in accordance so that the skate fishing year is always the same as the multispecies fishing year.

4.3 MAXIMUM SUSTAINABLE YIELD (MSY) AND OPTIMUM YIELD (OY)

4.3.1 Introduction

National Standard 1 of the Magnuson-Stevens Act states that:

> (1) Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the *optimum yield* from each fishery for the United States fishing industry.

The Magnuson-Stevens Act requires that the conservation and management measures contained in an FMP achieve optimum yield (OY) from the fishery on a continuing basis. The Act defines OY as follows:

> **Definition of Optimum Yield [16 U.S.C. 1802 § 3]:**
>
> (28) The term "optimum," with respect to the yield from a fishery, means the amount of fish which --
>
> (A) will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems;
>
> (B) is prescribed as such on the basis of the maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factor; and
>
> (C) in the case of an overfished fishery, provides for rebuilding to a level consistent with producing the maximum sustainable yield in such fishery.

The National Standard Guidelines (NSGs) define MSY as "the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions." The NSGs also provide some guidance for cases in which MSY cannot be estimated directly:

> When data are insufficient to estimate MSY directly, Councils should adopt other measures of productive capacity that can serve as reasonable proxies for MSY, *to the extent possible* (emphasis added). Examples include various reference points defined in terms of relative spawning per recruit. For instance, the fishing mortality rate that reduces the long-term average level of spawning per recruit to 30-40 percent of the long-term average that would be expected in the absence of fishing mortality may be a reasonable proxy for the MSY fishing mortality rate. The long-term average stock size obtained by fishing year after year at this rate under average recruitment may be a reasonable proxy for MSY. The natural mortality rate may also be a reasonable proxy for the MSY fishing mortality rate. If a reliable estimate of pristine stock size is available, a stock size approximately 40% of this value may be a reasonable proxy for the MSY stock size, and the product of this stock size and the natural mortality rate may be a reasonable proxy for MSY.

Unfortunately, as discussed in the following subsections, these approaches to developing MSY proxies cannot be utilized for skates at this time because the basic information needed to develop them is not currently available. Fishing mortality rates on these species are unknown, as are absolute stock sizes and pristine stock sizes. F_{MSY} estimates are not available, and the Council's Scientific and Statistical Committee (SSC) concluded that estimates of natural mortality are unreliable at this time as well. Additional discussion is provided below.

4.3.2 MSY

MSY for the individual skate species and/or the complex as a whole cannot be estimated at this time. Estimating MSY for the Northeast skate complex was explored by the SAW 30 Working Group in November 1999 as well as the Skate PDT in developing this FMP. A discussion of the alternatives that were considered to estimate MSY and the conclusions that were drawn is provided below.

Traditional Approaches Used to Estimate MSY

<u>Sequential Population Analysis</u>

The sequential population analysis (SPA) is an age-structured model that uses catch and fishery-independent data broken down by age class to estimate population numbers and fishing mortality. It is also known as virtual population analysis, or VPA. This model cannot be used to derive estimates of MSY for skates at this time because catch data is incomplete and unreliable. In addition, age data and other necessary biological data are lacking.

Biomass Dynamics

Biomass dynamic models use total catch combined with fishery-independent data to estimate fishing mortality and population biomass for a species or species complex. This type of model has been utilized in other skate fisheries that have very good catch data (in aggregate) and moderate catch-per-unit-effort (CPUE) data (see Agnew et al, 2000, for a study of the Falkland Island skate complex). Even with reliable catch data, however, the biomass dynamic model did not perform well in the Agnew et al. study, and several varied estimates of MSY for the skate complex were obtained. The situation with the Northeast skate complex is more difficult because of the lack of catch data. Given the inadequate catch data for both the complex as a whole and the individual species, this model cannot be used to estimate MSY for the species in the Northeast skate complex at this time.

Dynamic Pool Models

The dynamic pool model utilizes linkages between various biological relationships such as yield-per-recruit as well as spawning stock biomass and recruitment. Much of the information required comes from an age-structured assessment (such as SPA). This approach is very data-intensive, and for the same reasons discussed for SPA, dynamic pool models cannot be used to estimate MSY for the species in the Northeast skate complex at this time.

SAW 30 Conclusions

The following Terms of Reference were provided by the SAW Steering Committee for the benchmark assessment of the Northeast skate complex reviewed in the SAW 30 Report in November 1999: (1) Summarize available biological studies (age and growth, maturity, etc.) for the seven species in the skate complex; (2) Update commercial and recreational landings and survey indices through 1998/1999; (3) To the extent practicable, summarize fishery discard rates through the use of sea sampling data or other information sources; (4) Estimate fishing mortality rates, and trends in relative or absolute stock size, and consider appropriate reference points for stock size and fishing mortality rate consistent with the provisions of the Sustainable Fisheries Act (SFA); and (5) Provide an assessment of the status of the species in the complex relative to overfishing criteria, and evaluate the status of the barndoor skate resource relative to listing factors considered in the Endangered Species Act.

The following conclusions were reached at SAW 30 regarding the species in the Northeast skate complex:

- Yield-per-recruit-based reference points for winter skate in the Northeast Region are unreliable due to the use of growth parameters from Canadian waters and the uncertainty of partial recruitment to the commercial fishery.
- Yield-per-recruit-based reference points for little skate in the Northeast Region are unreliable due to the use of outdated growth parameters from the 1970s and the uncertainty of partial recruitment to the commercial fishery.
- For barndoor skate, there are insufficient data on age and growth to determine fishing mortality rates or propose SFA fishing mortality reference points.

- There are insufficient data on age and growth of thorny skate to determine fishing mortality rates or propose SFA fishing mortality reference points.
- There are insufficient data on age and growth of smooth skate to determine fishing mortality rates or propose SFA fishing mortality reference points.
- There are insufficient data on age and growth of clearnose skate to determine fishing mortality rates or propose SFA fishing mortality reference points.
- There are insufficient data on age and growth of rosette skate to determine fishing mortality rates or propose SFA fishing mortality reference points.

The SARC noted that the landings attributable to individual species are very uncertain, since over 99% of the landings records are reported as "unclassified skates." The SARC also discussed species identification problems, which may exist in the survey data, particularly for winter and little skates at sizes less than 35 cm. There was general discussion among SARC members as to whether sustainable yield reference points were appropriate for large sized skates such as winter, thorny and barndoor, since they are generally characterized by relatively slow growth and low intrinsic rates of population increase. It was noted that reference points based on threshold levels or indices of spawning biomass may be more appropriate for these species, since recruitment success is more closely related to standing spawning stock biomass than for most teleost stocks. It was also noted that a major source of fishing mortality is bycatch-related and therefore yield based reference points may not be appropriate. The SARC acknowledged, however, that as SFA reference points can be developed, consideration of maximum sustainable yields should be addressed.

The majority of the SAW 30 Report is included in Volume II of this FMP (2000 Skate SAFE Report) and should be referenced for additional information and discussion regarding this issue. In conclusion, the best available scientific information, as reported by the SARC in the SAW 30 Report, is insufficient to provide a basis for developing estimates of MSY for the species in the Northeast skate complex using traditional approaches.

Other Approaches Considered

MSY Based on Catch History

Restrepo et al. (1998) provide technical guidance on implementing National Standard 1 of the SFA in data-poor situations such as the one that the Council currently faces with skates. Restrepo et al. suggest that if there is no reliable information available to estimate fishing mortality or biomass reference points, it may be reasonable to use the historical average catch as a proxy for MSY, taking care to select a period when there is no evidence that abundance was declining. Unfortunately, as noted in Section 7.3.2, this approach cannot be utilized at this time to develop an MSY proxy for individual skate species or the complex as a whole. The available time series of commercial landings is known to be incomplete and is considered unreliable. Almost all skates that have been reported in the past are reported as "unclassified skates," so no time series of landings for individual species is available. Reporting of "unclassified skates" is incomplete because skates are not currently a federally-managed species (with permit and reporting requirements), and it is likely that some unreported skate fishing activity is occurring in federal waters. Also, the time series of landings does not capture skate activity by state permit holders, which may be a significant component of the bait fishery. This means that the time series of landings of "unclassified skates" probably (and potentially significantly) underestimates total skate landings. The other important unknown is the extent to which these species are caught as bycatch by various gears in various fisheries. Bycatch could be another significant component of the overall yield from these species.

The Northeast skate complex could be characterized as a "reverse data-poor situation" in that the data that are lacking for these species is opposite from the data that are usually lacking for species that are characterized as "data poor." The method for determining MSY in data poor situations described in Restrepo et al. (1998) requires catch or landings with little or no fishery-independent data. In the case of the Northeast skate complex, the fishery-independent data are generally available through a long time series of NEFSC trawl survey data. However, as discussed above, catch information is inadequate and misrepresentative of actual activity in the fishery. Most data-poor fisheries are facing the opposite situation.

Aggregate MSY for the Skate Complex

In the context of an aggregate overfishing definition for the seven skate species, the Skate PDT considered estimating MSY for the skate complex as a whole and concluded that this approach is not appropriate at this time for several reasons:

- The life histories and distributions of the individual species are different, and an aggregate approach would not capture considerations unique to the individual species. Productivity, therefore, is also different for the individual species in the complex.
- An aggregate approach would still need to be based on data and information from the individual species, most of which is not available at this time.
- As previously discussed, the time series of skate landings is considered incomplete and unreliable and therefore does not lend itself well to an estimation of MSY even for the complex in aggregate. For many reasons, the time series of skate landings likely underestimates the true level of historical and recent skate activity.
- The economics are different for different skate species and fisheries (wings vs. bait). The PDT expressed concern that an aggregate approach could produce economically inefficient management measures and/or would not capture the unique economics and other characteristics of the very different skate fisheries.
- Similar to the point above, catchability (vulnerability) of co-occurring species of skates by different kinds of fishing gear will vary. Fishing mortality rates for these species will not be affected equally if effort in a particular fishery is reduced.
- If an aggregate approach were to be based on indicator stocks within the complex, remaining stocks may be over- or under-exploited with respect to their individual MSY levels (which would remain unknown). If the indicator stock(s) is more productive than other species in the complex, some stocks in the complex may not be able to withstand the same level of fishing effort associated with the MSY estimate for the complex.

Estimates of MSY Based on Carrying Capacity

The Skate PDT considered the possibility of estimating MSY for these species based on considerations of carrying capacity (K), derived from the biomass reference points. In general, carrying capacity equates to a biomass that is twice the B_{MSY} level. In theory, since B_{MSY} proxies have been developed for these species, one approach would be to derive MSY estimates from these reference points. Two species, clearnose and rosette skates, are already at levels that are more than twice their B_{MSY} levels, suggesting that these species are above their theoretical carrying capacities.

The general formula for calculating MSY based on carrying capacity is that MSY = (Kr)/4, where r is the species' intrinsic rate of increase. In the case of the species in the Northeast skate complex, estimates of K are available only in survey units (kg/tow) and no estimates of r are available. Therefore, MSY cannot be calculated from K. Even if r could be estimated using some assumptions, converting trawl survey units into absolute biomass units requires knowledge of catchability, which currently remains unknown for the species in the Northeast skate complex. Therefore, this approach cannot be utilized to estimate MSY at this time.

Summary

As previously discussed, reliable estimates of MSY are not available and cannot be derived for the skate species in the Northeast complex at this time. There is no reliable time series of commercial fishery landings or discards for any of the individual species, and the time series for the complex as a whole is considered to be incomplete. In addition, very little reliable and current growth and maturity information is available for any of the species in the complex. Very little information is available on the length composition of the landings and discards. Together, these factors preclude the estimation of MSY from sequential population (e.g., age- or length-based virtual population analysis), biomass dynamics (e.g., surplus production models), or dynamic pool models (e.g., yield-per-recruit analysis). The NSGs state that status determination criteria and reference points must be specified only "to the extent possible." Since it is not possible to estimate a reasonable proxy for MSY at this time, it would be inappropriate to give the impression otherwise.

Nevertheless, it is important to define management strategies that have a high probability of ensuring that fishing mortality rates do not increase to levels that will compromise the long-term rebuilding of these stocks to their biomass targets. Even in this situation of extremely sparse data, it is possible to judge whether current management strategies are sustainable or whether fishing needs to be curtailed to facilitate rebuilding. The Council has specified management measures in this FMP and in other fisheries that enhance the probability of future stock increases with the expectation that progressively more data will become available to continually evaluate management strategies and more reliably estimate SFA reference points over time. A precautionary approach implements conservation measures even in the absence of scientific certainty that fish stocks are being overexploited. The stocks of most concern at this time are barndoor and thorny skates. The following discussion of OY as well as other components of this FMP (Sections 4.4, 4.5, and 4.7) underscore the Council's intent relative to defining appropriate management strategies, rebuilding these stocks, and continuously monitoring and evaluating progress as more and better information becomes available.

The primary objective of this FMP is to collect the information necessary to manage and monitor the skate fisheries and assess the status of the skate resources. As more information becomes available, it may be possible to develop estimates of MSY and other reference points that currently cannot be estimated. The Council intends to update the reference points and status determination criteria in this FMP as necessary data become available. The specification of MSY and OY, therefore, are items that the Council can adjust through a framework adjustment to this FMP (Section 4.8), provided that the specifications do not require management adjustments that are outside of the realm of the framework adjustment process. The Skate PDT will annually review available information and consider developing estimates of MSY when possible (Section 4.7).

4.3.3 OY

4.3.3.1 Overview

Specifications of optimum yield (OY) for these species is hampered by many of the same limitations that preclude reliable specifications of MSY (see above discussion). If quantitative estimates of MSY were available, then they could serve as starting points for estimating OY for each of the species in the skate complex. Similarly, an aggregate estimation of MSY for the complex could lend itself to the development of an aggregate OY estimate for the complex. The NSGs provide for specification of a fishery-wide OY for a mixed-stock fishery, where management measures for separate target harvest levels for individual stocks may be specified, but are not required. For the same reasons discussed relative to MSY, these approaches cannot be adopted to estimate OY at this time. For some species in the skate complex (for example, smooth skate), it is currently unknown whether the species is caught and/or landed in any fisheries. Nevertheless, the Council is again taking a precautionary approach to specifying OY, implementing conservation measures even in the absence of scientific information, and focusing special attention on barndoor and thorny skates, the two overfished species.

In general, optimum yield will equate to the yield of skates that results from effective implementation of the Skate FMP. Consistent with the NSGs and the Magnuson-Stevens Act, the Council intends that OY cannot exceed MSY or the allowable portion of MSY necessary to be consistent with the MSY-based control rule (see Section 4.5.2 for a discussion of control rules). If the Skate FMP is successful in achieving its objective of rebuilding the skate species to their long-term target biomass levels, then the measures in the FMP should provide for extraction of the optimal amount of skates.

The following OY specifications for each species in the Northeast skate complex are based on the management measures that the Council has selected to be included in this FMP. For example, in the cases where possession of a certain species is prohibited, the Council has set OY for the species at zero. Setting OY at zero for some skate species, especially those that are overfished, is consistent with the approach suggested by Restrepo et al. regarding the MSY-based control rule (see Section 4.5.2). Note that setting OY at zero for some species may result in continued difficulty estimating MSY in the future.

Related to OY are the following important considerations:

- The Council is proposing a management regime that it believes includes the most appropriate management measures to protect and rebuild the skate resources, maintain sustainable levels of fishing effort for some skate species, and has the least impact on other fisheries in the Northeast Region.
- Based on available information and the analyses presented in this document, the proposed action provides sufficient protection for the resources to prevent overfishing and rebuild overfished stocks.
- Landings that occur under the measures proposed in this FMP are intended to equate to OY.

The following paragraphs address OY for each skate species individually.

Winter Skate. Winter skate is the primary species harvested for skate wings, and it also represents a small fraction of the bait fishery. Winter skate is not overfished, but it has not yet rebuilt to its long-term biomass target. Measures proposed in this FMP to reduce fishing mortality on winter skates and ensure rebuilding to long-term sustainable levels include possession limits for the wing fishery. In addition, the overlap between skate wing fishing and multispecies fishing suggests that more benefits will be afforded to the winter skate resource as effort is reduced in the multispecies fishery. Moreover, the groundfish closed areas, as they are currently defined, provide a great deal of protection to the winter skate resource.

Because fishery data are lacking, there is currently no time series of catch or landings of winter skate on which to base an absolute specification of OY. OY for winter skate will therefore be defined as the amount of winter skates that are harvested legally under the provisions of this FMP and the yield that results from the management measures in other fisheries to the extent that these measures further impact (and likely reduce) the harvest of winter skates (see Section 4.16). Consistent with the National Standard Guidelines, the Council intends that OY cannot exceed MSY or the allowable portion of MSY necessary to be consistent with the MSY-based control rule. As better fishery information becomes available, this specification may be revised and/or refined.

Little Skate. Little skate is the primary target species for the skate bait fishery and is considered to be "rebuilt" (above its biomass target). There are no measures proposed in this FMP specific to the little skate resource; however, an overfishing definition for little skate is proposed, and permit options, reporting requirements, and other provisions of this FMP apply to the harvest and sale of little skates. These tools provide a framework for collecting better information and implementing management measures specific to little skates in the future if such measures are warranted.

Because fishery data are lacking, there is currently no time series of catch or landings of little skate on which to base an absolute specification of OY. Anecdotal information suggests that the bait fishery is a relatively stable fishery that has occurred regularly for many years, responding to demand for bait primarily from southern New England lobster vessels. Since abundance of the little skate resource has increased considerably over a time period that coincides with the operation of the bait fishery, it can be assumed that the resource is being harvested at a fishing mortality rate that is below F_{MSY}. OY for little skate will therefore be defined as the amount of little skates that are harvested legally for bait under the provisions of this FMP. Consistent with the National Standard Guidelines, the Council intends that OY cannot exceed MSY or the allowable portion of MSY necessary to be consistent with the MSY-based control rule. As better fishery information becomes available, this specification may be revised and/or refined.

Barndoor Skate. Barndoor skate is thought to represent a very small component of the skate wing fishery. Because barndoor skate is in an overfished condition, the Council is proposing action to rebuild the resource to its long-term sustainable level. This FMP proposes to prohibit the possession of barndoor skate on all vessels fishing in federal waters. The interaction of skate fishing and multispecies fishing suggests that even more benefits will be afforded to barndoor skates as effort is further reduced in the multispecies fishery. Moreover, the groundfish closed areas, as they are currently defined, provide a great deal of protection to the barndoor skate resource.

To be as precautionary as possible, the Council is setting OY for barndoor skate at **zero**. As better fishery information becomes available, this specification may be revised and/or refined.

Thorny Skate. Thorny skate is thought to represent a component of the skate wing fishery. Because thorny skate is in an overfished condition, the Council is proposing action to rebuild the resource to its long-term sustainable level. This FMP proposes to prohibit the possession of thorny skate on all vessels fishing in federal waters. The interaction of skate fishing and multispecies fishing suggests that even more benefits will be afforded to thorny skates as effort is further reduced in the multispecies fishery. Moreover, the groundfish closed areas, as they are currently defined, provide a great deal of protection to the thorny skate resource.

To be as precautionary as possible, the Council is setting OY for thorny skate at **zero**. As better fishery information becomes available, this specification may be revised and/or refined.

Smooth Skate. Smooth skate is not overfished, but it has not yet rebuilt to its long-term biomass target. This FMP proposes to prohibit the possession of smooth skate on all vessels fishing in the GOM. Smooth skate is distributed almost exclusively in the GOM, so this prohibition is intended to address the majority of the species' range. The interaction of skate fishing and multispecies fishing suggests that even more benefits will be afforded to smooth skates as effort is further reduced in the multispecies fishery. Moreover, the groundfish closed areas in the GOM, as they are currently defined, provide a great deal of protection to the smooth skate resource.

To be as precautionary as possible, the Council is setting OY for smooth skate at **zero**. Through this FMP, the Council intends to prevent the development and/or expansion of a fishery for this species. As better fishery information becomes available, this specification may be revised and/or refined.

Clearnose Skate. Clearnose skate is considered to be "rebuilt" and is more than two times its target biomass level. There are no measures proposed in this FMP specific to the clearnose skate resource; however, an overfishing definition for clearnose skate is proposed, and permit requirements, reporting requirements, and other provisions of this FMP apply to the harvest and sale of clearnose skates. These tools provide a framework for collecting better information and implementing management measures specific to clearnose skates in the future if such measures are warranted.

Because fishery data are lacking, there is currently no time series of catch or landings of clearnose skate on which to base an absolute specification of OY. Since abundance of the clearnose skate resource has increased considerably over a time period and in an area that coincides with the operation of many fisheries, it can be assumed that the resource is being harvested at a fishing mortality rate that is below F_{MSY}. OY for clearnose skate will therefore be defined as the amount of clearnose skates that are harvested legally under the provisions of this FMP. Consistent with the National Standard Guidelines, the Council intends that OY cannot exceed MSY or the allowable portion of MSY necessary to be consistent with the MSY-based control rule. As better fishery information becomes available, this specification may be revised and/or refined.

Rosette Skate. Rosette skate is considered to be "rebuilt" and is more than two times its target biomass level. There are no measures proposed in this FMP specific to the rosette skate resource; however, an overfishing definition for rosette skate is proposed, and permit requirements, reporting requirements, and other provisions of this FMP apply to the harvest and sale of rosette skates. These tools provide a framework for collecting better information and implementing management measures specific to rosette skates in the future if such measures are warranted.

Because fishery data are lacking, there is currently no time series of catch or landings of rosette skate on which to base an absolute specification of OY. Since abundance of the rosette skate resource has increased considerably over a time period and in an area that coincides with the operation of many fisheries, it can be assumed that the resource is being harvested at a fishing mortality rate that is below F_{MSY}. OY for rosette skate will therefore be defined as the amount of rosette skates that are harvested legally under the provisions of this FMP. Consistent with the National Standard Guidelines, the Council intends that OY cannot exceed MSY or the allowable portion of MSY necessary to be consistent with the MSY-based control rule. As better fishery information becomes available, this specification may be revised and/or refined.

4.3.3.2 Summary of OY Specifications

Table 2 summarizes the proposed OY specifications for the seven species in the skate complex.

Table 2 Proposed OY Specifications

Species	OY Specification	Action	Comments
Winter Skate	Yield from FMP measures and management measures in other fisheries	10,000/20,000-pound possession limit for wing fishery	• Management measures in other fisheries highly likely to further reduce mortality
Little Skate	Status quo catch	Status quo	• Management measures in other fisheries likely to further reduce mortality
Barndoor Skate	0	No possession	• Discard mortality unknown • Management measures in other fisheries highly likely to further reduce mortality
Thorny Skate	0	No possession	• Discard mortality unknown • Management measures in other fisheries highly likely to further reduce mortality
Smooth Skate	0	No possession in GOM	• Prevents development of a fishery for smooth skate • Management measures in other fisheries likely to reduce mortality
Clearnose Skate	Status quo catch	Status quo	
Rosette Skate	Status quo catch	Status quo	

4.4 OVERFISHING DEFINITIONS

4.4.1 Introduction

The Magnuson-Stevens Act includes a requirement that all FMPs "specify objective and measurable criteria for identifying when the fishery to which the plan applies is overfished." NMFS' National Standard Guidelines (NSGs) require the specification of "status determination criteria" (63 FR 24212). These criteria are to be "expressed in a way that enables the Council and Secretary to monitor the stock or stock complex and determine annually whether overfishing is occurring and whether the stock or stock complex is overfished."

The NSGs call for the specification of a maximum fishing mortality rate and a minimum stock size within the overfishing definition. Further, the guidelines state that the minimum stock size threshold should be the larger of ½ the MSY stock size or the minimum stock size at which rebuilding to the MSY level would be expected to occur within 10 years. In the Council's arena, these principles are well known and have been translated into the terms $F_{threshold}$ and $B_{threshold}$ with the minimum stock size level usually set at ½ B_{MSY} (see the Glossary in Section 13.0 of this document for definitions of these terms).

Before presenting the proposed skate overfishing definitions, it is useful to examine the information base available for the skate complex. The NEFSC trawl survey, conducted in the fall (since 1963), the spring (since 1968) and winter (since 1992) currently provides the only region-wide information about skate biomass. These fishery-independent data, collected using standardized bottom trawl gear, may be sufficient in describing biomass trends in the various skate stocks. These data cannot, however, characterize the absolute level of biomass.

Other, more analytical approaches to estimating biomass such as direct estimation via an area-swept calculation, the use of various biomass dynamics models, sequential population estimates and dynamic pool modeling are not possible in this case without the acquisition of additional information (see Section 4.3.2 for more discussion of these analytical approaches).

Among the key components in advancing knowledge of stock levels is fisheries dependent information on catches, effort, and the length and age composition of the catch. Fisheries dependent data on the magnitude of landings, discards by species, and length composition would allow estimation of fishing mortality rates. Unfortunately, these data are currently not available for the Northeast skate complex.

4.4.2 FMP Relationship to National Standard 1

Given the background on overfishing definitions and the limited information available for constructing such definitions for the species in the skate complex, it is useful to examine how the overfishing definitions proposed for skates relate to National Standard 1 and NMFS' National Standard Guidelines (NSGs). According to the NSGs, an overfishing definition must provide, at a minimum, a specification of a maximum fishing mortality threshold (or a reasonable proxy), and specification of a minimum stock size threshold (or a reasonable proxy). It also follows that specification of the biomass threshold stand in some relation to the biomass that produces MSY (B_{MSY}) and that specification of a fishing mortality rate threshold should have some relationship to the fishing mortality rate that produces MSY (F_{MSY}).

In the case of skates, it is not currently possible to formally estimate reference points such as B_{MSY} and F_{MSY}. Instead, the Council has reviewed all available information and taken the following general approach to constructing overfishing definitions that are in compliance with the NS1 Guidelines.

Since there are no direct estimates of biomass available for these species, biomass indices from the Northeast Fisheries Science Center trawl surveys have been used to characterize stock size. More specifically, for each species in the complex, information on the weight of the catch per tow (kg/tow) from the most representative trawl survey series over the longest possible time span was assembled. The data in the selected series were then used to characterize the distribution of biomass over the examined time period. Finally, candidate reference points were selected from the distribution so as to provide proxies for biomass targets that have a high probability of correctly characterizing the stock level that produces MSY. Minimum biomass threshold levels were taken to be half of these values, as referenced in the NS1 Guidelines. Further discussion of this approach and specific recommendations for each skate species are provided below.

Determining the maximum fishing mortality rate threshold for these stocks is quite problematic given the current inability to directly estimate fishery exploitation rates. To address this, the Council considered two different approaches. One approach to determining a maximum fishing mortality threshold in data poor situations is suggested in the NS1 Guidelines – that a Council could adopt the natural mortality rate, M, as a proxy for F_{MSY}, and hence the maximum fishing mortality rate threshold. Alternatively, one could use the biomass levels as indexed by the NEFSC trawl surveys as an indicator of exploitation. More specifically, if the biomass of a species is in decline (for several years or in a moving average sense, see discussion below), one can be certain that current/recent removals are in excess of the stock's ability to maintain its current population size. This situation is in fact, a diagnosis of overexploitation, or in SFA terms, overfishing. Therefore, under this approach, the Council would determine, via examination of biomass levels, that the stock was or had been overexploited and would adopt measures to eliminate such overfishing. This second approach is the basis of the proposed overfishing definitions, which are described below.

4.4.3 Skate Overfishing Definitions

The overfishing definitions for the skate species represent a slightly modified version of the reference points developed at SAW 30. Instead of using the fishing mortality thresholds for winter and little skates from SAW 30 and not specifying thresholds for the other skate species, the proposed overfishing definitions establish fishing mortality thresholds for all seven skate species based on a percentage decline in the NEFSC trawl survey. The thresholds for fishing mortality are based on annual percentage declines of the three-year average of the NEFSC trawl survey (spring or autumn, depending on the species). The percentages are specified for each species individually based on historical variation within the survey. The fishing mortality thresholds also include a precautionary "backstop" that indicates that overfishing is occurring if the trawl survey mean weight per tow declines for three consecutive years. The language for the overfishing definitions is presented below. The reference points are summarized in Table 3.

Winter skate is in an overfished condition when the three-year moving average of the autumn survey mean weight per tow is less than one-half of the 75th percentile of the mean weight per tow observed in the autumn trawl survey from the selected reference time series. Overfishing occurs when the three-year moving average of the autumn survey mean weight per tow declines ***20% or more, or when the autumn survey mean weight per tow declines for three consecutive years****. The reference points and selected time series may be re-specified through a peer-reviewed process and/or as updated stock assessments are completed.*

Little skate is in an overfished condition when the three-year moving average of the spring survey mean weight per tow is less than one-half of the 75th percentile of the mean weight per tow observed in the spring trawl survey from the selected reference time series. Overfishing occurs when the three-year moving average of the spring survey mean weight per tow declines ***20% or more, or when the spring survey mean weight per tow declines for three consecutive years****. The reference points and selected time series may be re-specified through a peer-reviewed process and/or as updated stock assessments are completed.*

Barndoor skate is in an overfished condition when the three-year moving average of the autumn survey mean weight per tow is less than one-half of the mean weight per tow observed in the autumn trawl survey from 1963-1966 (currently 0.81 kg/tow). Overfishing occurs when the three-year moving average of the autumn survey mean weight per tow declines ***30% or more, or when the autumn survey mean weight per tow declines for three consecutive years****. The reference points and selected time series may be re-specified through a peer-reviewed process and/or as updated stock assessments are completed.*

Thorny skate is in an overfished condition when the three-year moving average of the autumn survey mean weight per tow is less than one-half of the 75th percentile of the mean weight per tow observed in the autumn trawl survey from the selected reference time series. Overfishing occurs when the three-year moving average of the autumn survey mean weight per tow declines ***20% or more, or when the autumn survey mean weight per tow declines for three consecutive years****. The reference points and selected time series may be re-specified through a peer-reviewed process and/or as updated stock assessments are completed.*

Smooth skate is in an overfished condition when the three-year moving average of the autumn survey mean weight per tow is less than one-half of the 75th percentile of the mean weight per tow observed in the autumn trawl survey from the selected reference time series. Overfishing occurs when the three-year moving average of the autumn survey mean weight per tow declines ***30% or more, or when the autumn survey mean weight per tow declines for three consecutive years****. The reference points and selected time series may be re-specified through a peer-reviewed process and/or as updated stock assessments are completed.*

Clearnose skate is in an overfished condition when the three-year moving average of the autumn survey mean weight per tow is less than one-half of the 75th percentile of the mean weight per tow observed in the autumn trawl survey from the selected reference time series. Overfishing occurs when the three-year moving average of the autumn survey mean weight per tow declines ***30% or more, or when the autumn survey mean weight per tow declines for three consecutive years****. The reference points and selected time series may be re-specified through a peer-reviewed process and/or as updated stock assessments are completed.*

Rosette skate is in an overfished condition when the three-year moving average of the autumn survey mean weight per tow is less than one-half of the 75th percentile of the mean weight per tow observed in the autumn trawl survey from the selected reference time series. Overfishing occurs when the three-year moving average of the autumn survey mean weight per tow declines ***60% or more, or when the autumn survey mean weight per tow declines for three consecutive years****. The reference points and selected time series may be re-specified through a peer-reviewed process and/or as updated stock assessments are completed.*

Table 3 Proposed Overfishing Definition Reference Points

SKATE SPECIES	TARGET BIOMASS, B_{target} (kg/tow)	THRESHOLD BIOMASS, $B_{threshold}$ (kg/tow)	TARGET FISHING MORTALITY F_{target}	THRESHOLD FISHING MORTALITY $F_{threshold}$
Winter	6.46	3.23	N/S	A decline of **20% or more** in the three-year moving average of the autumn trawl survey, or a decline in the autumn survey mean weight per tow for three consecutive years
Little	6.54	3.27	N/S	A decline of **20% or more** in the three-year moving average of the spring trawl survey, or a decline in the spring survey mean weight per tow for three consecutive years
Barndoor	1.62	0.81	N/S	A decline of **30% or more** in the three-year moving average of the autumn trawl survey, or a decline in the autumn survey mean weight per tow for three consecutive years
Thorny	4.41	2.20	N/S	A decline of **20% or more** in the three-year moving average of the autumn trawl survey, or a decline in the autumn survey mean weight per tow for three consecutive years
Smooth	0.31	0.16	N/S	A decline of **30% or more** in the three-year moving average of the autumn trawl survey, or a decline in the autumn survey mean weight per tow for three consecutive years
Clearnose	0.56	0.28	N/S	A decline of **30% or more** in the three-year moving average of the autumn trawl survey, or a decline in the autumn survey mean weight per tow for three consecutive years
Rosette	0.03	0.01	N/S	A decline of **60% or more** in the three-year moving average of the autumn trawl survey, or a decline in the autumn survey mean weight per tow for three consecutive years

Discussion: These overfishing definitions incorporate the biomass targets and thresholds that were developed at SAW 30. At SAW 30, the panel used a comprehensive approach where, for each species, the longest available survey biomass time series was used to index the recent range of stock biomass. Additionally, there was some discussion as to which survey series (spring or fall) and which strata sets of the survey were most appropriate in characterizing total stock biomass. With the exception of little skate, the SARC recommended that the fall trawl survey be used to index biomass, as that series represents a longer interval for observing the dynamic range of stock size.

With respect to specification of a biomass threshold, the SARC took the general approach of examining the high point of the survey time series. Without fisheries-dependent data, it is not possible to relate biomass to exploitation rates. However, two possible scenarios were examined with respect to historical peak abundance (as reflected in the survey). One possibility is that the maximal value might represent a proxy for the stock's carrying capacity, known as K and numerically equal to twice B_{MSY}. Thus, the biomass target would be ½ this peak value. This follows if one assumes that the stock was not exploited (or very lightly exploited) at the point in time maximal biomass was observed. A second possibility is that the upper value represents some period of stock stability in the face of an approximate match between stock productivity and fishery exploitation. Under that scenario, the upper value could stand as a proxy for the biomass target or B_{MSY} and, therefore, an appropriate $B_{threshold}$ would be ½ that value.

Given this background and a subsequent conversion of this concept to a statistical basis which examines smoothed series and percentiles of distribution of the range of observations, the panel's two choices can be translated into a selection of the 100th percentile or the 50th percentile as a biomass target. Since neither polar set of assumptions was likely to be true, the SARC chose the 75th percentile of the appropriate series as the best approximation of a reasonable biomass target. Thresholds were specified as equal to ½ of that target value.

The following bullets provide additional discussion of the rationale for the biomass reference points for each skate species.

Winter Skate

The selected reference time series currently encompasses the GOM-MA offshore region from 1967-1998. The target biomass reference point for winter skate is the 75th percentile value of the NEFSC autumn biomass index for the GOM-MA offshore region from 1967-1998, and the threshold biomass is one-half of that value.

- This incorporates data from the longest and most geographically comprehensive time series of survey data available for winter skate. The autumn trawl survey dates back to 1963, but the Mid-Atlantic region was not included until 1967. Given the range of this species, it may be inappropriate and inconsistent to include years prior to 1967.
- The autumn survey was selected instead of the spring survey primarily because it is the longer time series. (In this case, it is only longer by one year.) Generally, the trends in the spring and autumn surveys are similar in time and area. In addition, a different net was used in the spring survey from 1973-1981, and there is some uncertainty associated with the conversion factors to adjust for the differences. The autumn survey time series was not affected by the spring survey net modifications.
- The winter survey began in 1992. It was developed primarily to catch flatfish and therefore catches skates. However, it does not cover the same area as the autumn and spring surveys. It does not sample in the Gulf of Maine, and samples on Georges Bank are inconsistent. It may become more useful in the future for comparison purposes as the time series grows.

Little Skate

The selected reference time series currently encompasses the GOM-MA inshore and offshore regions from 1982-1999. The target biomass reference point for little skate is the 75th percentile value of the NEFSC spring biomass index for the GOM-MA offshore region from 1982-1999, and the threshold biomass is one-half of that value.

- This is the only skate species for which spring survey data are used to develop biomass estimates and overfishing definition reference points. Trends in the spring and autumn surveys as well as trends in survey catchability for this species are more variable than they are for other skate species. The spring survey was selected instead of the autumn survey for little skate because the distribution of the fish during the spring survey results in higher catchability and potentially more reliable indices of abundance.
- A spring survey time series throughout the geographic range of little skate exists since 1975, but because of changes in the survey net from 1973-1981 (and uncertainties associated with the catch conversion factors), the proposed time series for the overfishing definition begins in 1982. Using a reference time series from 1975-1999 would result in less certain data from 1975-1981 that would be inconsistent with the data from 1982-1999.
- Similar to winter skate, the catchability of little skate in the winter survey is significantly higher than in the spring and autumn surveys. However, inconsistent area coverage on Georges Bank, the absence of sampling in the Gulf of Maine, and the short time series prevent the winter survey from being used to develop an overfishing definition reference point for little skate at this time. It may become more useful in the future as the time series grows.

Barndoor Skate

The selected reference time series currently encompasses the GOM-SNE offshore region from 1963-1966. The target biomass reference point for barndoor skate is mean value of the NEFSC autumn biomass index for the GOM-SNE offshore region from 1963-1966, and the threshold biomass is one-half of that value.

- 1963-1966 are the years of greatest abundance in the time series (62-120 individuals), with greatly reduced observations thereafter (until more recently). Given the numbers of barndoor skates that were captured from 1963-1966, it is likely that barndoors were more abundant before the contemporary autumn trawl survey began in 1963. Historical survey data (1948-1962) are being analyzed for consideration in the next barndoor skate stock assessment. This historical survey data is in an inconsistent format (within itself and inconsistent with contemporary data) and cannot be developed into a reliable time series without considerable work and a peer-reviewed analysis. Historical surveys were opportunistic; in other words, data were not collected for the purposes of establishing a time series that could characterize trends in abundance for barndoor skate. It is unknown at this time whether survey data from 1948-1963 will provide any information that can be used to develop overfishing definition reference points for barndoor skate.
- Using a longer time series and incorporating all of the near-zero and zero survey observations since 1966 would underestimate the long-term sustainable biomass of

barndoor skates. It is inappropriate to use a time period when the barndoor skate resource was essentially "collapsed" to estimate B_{MSY}. As an example, using 1963-1998 would approximate B_{MSY} at about 0.1 kg/tow. A stock's carrying capacity is generally estimated to be twice the level of B_{MSY} (in this example, carrying capacity would be 0.2 kg/tow). This approach would lead to a conclusion that the barndoor skate resource is currently above carrying capacity, which is scientifically infeasible given the significantly higher survey indices during the mid-1960s (well above 1.5 kg/tow).

- In the future, as the time series grows longer, the winter survey may become more useful as an indicator for barndoor skates than for some other skate species. The catchability of barndoor skates appears to be higher in the winter survey (123 barndoors were caught in the last winter survey). However, there are still problems with its inconsistent sampling on Georges Bank and the absence of sampling in the Gulf of Maine.

Thorny Skate

The selected reference time series currently encompasses the GOM-SNE offshore region from 1963-1998. The target biomass reference point for thorny skate is the 75th percentile value of the NEFSC autumn biomass index for the GOM-SNE offshore region from 1963-1998, and the threshold biomass is one-half of that value.

- This incorporates the longest and most geographically comprehensive time series of survey data for thorny skates. The survey from the Mid-Atlantic region is insignificant due to the distribution of the stock, so the time series dates back further than it would if the Mid-Atlantic component were included (the Mid-Atlantic component was incorporated in 1967). The autumn survey was chosen instead of the spring survey because it is five years longer (1963 versus 1968). In addition, as previously discussed, the spring survey net was modified for several years, and there are uncertainties associated with conversion factors. The autumn survey time series therefore appears to be more robust.
- The winter survey does not adequately sample thorny skates, which are distributed primarily in the Gulf of Maine. The winter survey does not sample the Gulf of Maine.
- The shrimp survey may become a more valuable indicator of thorny skate in the future as the time series grows, but it covers a relatively small area and has been rather variable to date.

Smooth Skate

The selected reference time series currently encompasses the GOM-SNE offshore region from 1963-1998. The target biomass reference point for smooth skate is the 75th percentile value of the NEFSC autumn biomass index for the GOM-SNE offshore region from 1963-1998, and the threshold biomass is one-half of that value.

- This incorporates the longest and most geographically comprehensive time series of survey data for smooth skates. The survey from the Mid-Atlantic region is insignificant due to the distribution of the stock, so the time series dates back further than it would if the Mid-Atlantic component were included (the Mid-Atlantic component was incorporated in 1967). The autumn survey was chosen instead of the spring survey because it is five years longer (1963 versus 1968). In addition, as previously discussed, the spring survey net was modified for several years, and there are uncertainties associated with conversion factors. The autumn survey time series therefore appears to be more robust.

- The winter survey does not adequately sample smooth skates, which are distributed primarily in the Gulf of Maine. The winter survey does not sample the Gulf of Maine.

Clearnose Skate

The selected reference time series currently encompasses the Mid-Atlantic inshore and offshore region from 1975-1998. The target biomass reference point for clearnose skate is the 75th percentile value of the NEFSC autumn biomass index for the Mid-Atlantic inshore and offshore region from 1975-1998, and the threshold biomass is one-half of that value.

- This incorporates the longest and most geographically comprehensive time series of survey data for clearnose skates. This stock is primarily an inshore species, especially in the autumn. Since the Mid-Atlantic inshore autumn survey did not begin until 1975, it would be inappropriate to use a reference time series that includes years prior to 1975.
- The autumn survey was selected instead of the spring survey because a greater portion of the population may be within the survey range (through North Carolina) in the autumn. Clearnose skate are thought to inhabit waters farther south and offshore during the spring.
- The winter survey may become a more useful indicator for clearnose skate as the time series grows.

Rosette Skate

The selected reference time series currently encompasses the Mid-Atlantic offshore region from 1967-1998. The target biomass reference point for rosette skate is the 75th percentile value of the NEFSC autumn biomass index for the Mid-Atlantic offshore region from 1967-1998, and the threshold biomass is one-half of that value.

- This incorporates the longest and most geographically comprehensive time series of survey data for rosette skates, which is distributed primarily in offshore Mid-Atlantic waters. The Mid-Atlantic region of the autumn trawl survey was incorporated in 1967. Since the inshore component of the survey is not necessary to capture the range of this stock, the time series is able to date back further (versus the clearnose time series, which dates back to 1975 when the inshore component of the survey was incorporated).
- The reference points are low because the species is distributed only in the most offshore sample strata. It is likely that rosette skates range farther offshore than the NEFSC survey samples.
- The winter survey may become a more useful indicator for rosette skate as the time series grows.

The proposed skate overfishing definitions incorporate the Council's Scientific and Statistical Committee's recommendation to not use the fishing mortality reference points developed at SAW 30, but it does utilize the SAW 30 biomass reference points (targets and thresholds).

At its September 7, 2001 meeting, the Council's Scientific and Statistical Committee (SSC) reviewed available information about skates and the overfishing definition reference points developed at SAW 30. The SSC concluded that fishing mortality-based reference points currently could not be adequately estimated in a way that can inform management because although it might be possible to calculate F_{MAX}, there is not a reliable time series of fishing mortality estimates to compare with F_{MAX}. The SSC considered but did not recommend that Hoenig-based Fs be used (for winter and little skate) because equilibrium assumptions might not be valid.

As an example of how the approach embedded in these overfishing definitions would be used, consider the current status of barndoor skate. The three-year biomass index for 1999-2001 is 0.375, and the characteristic CV is 30%. Thirty percent of the current index is 0.30*0.375 = 0.113. So, if the 2000-02 three-year average index declines to below 0.375-0.113 = 0.263, then the decline in biomass is assumed to be real, and therefore $F > F_{MSY}$, and overfishing is occurring.

Using this approach means that a decline in survey biomass indicates that fishing mortality is greater than F_{MSY}. In a production model, if biomass declines, then F is assumed to be greater than F_{MSY}. (By definition, if $F<F_{MSY}$, then biomass increases and stabilizes above B_{MSY}; if $F= F_{MSY}$, then biomass stabilizes at B_{MSY}; if $F>F_{MSY}$, then biomass declines and stabilizes below B_{MSY}.) Given the variability inherent in the survey, it is important to be sure that an observed decline is "real" and a reliable indication that $F>F_{MSY}$.

This kind of "control rule" approach is based on the statistical theory of process control, where the primary concern is to keep a process (such as a manufacturing process) at a stable level. In process control, past and current observations of the process are used as aids to infer the current and future behavior of the process. A measure of the "characteristic" variability of the process is determined from the data, and "control limits" established which define the region within which sampling noise is causing the fluctuations in the process. If the state of the process is outside these "control limits," one assumes that the change in the process level is real. The narrower the "control limits," the more power the control rule has to detect a real change in the process level (e.g., Shewhart control charts; Rickmers and Todd, 1967).

For skates, one possibility is to base the required percentage decline in the biomass index (i.e., to define the lower "control limit") on the variation observed in the survey time series used in the biomass reference points. Applying the general theory to skates, the question to address is how much change in the biomass index is necessary for the change to be declared "real." While it is important to not overreact to annual variability in the survey indices, it is also important to not miss a true signal of overfishing.

As a starting point, one may conclude that declines equal to or less than the current index minus one coefficient of variation (CV; standard error/mean, in %) are not "real" declines (i.e., are within the "control limits" and therefore simply reflective of sampling noise in the index). However, if a three-year average biomass index declines by more than one CV (%), one would conclude that the decline in the biomass index is "real," and therefore $F > F_{MSY}$, and overfishing is occurring.

Further, a survey index plus/minus one CV corresponds to about a 67% confidence interval. So, if the current index declines below the last value minus one CV (below the "lower control limit"), one is at least 84% sure (67% + 16.5%) that the current value of the index is below the last index.

The Skate PDT calculated the average annual CVs of the biomass indices included in the biomass reference points as candidates for these "characteristic" CVs for use in defining the lower "control limits." These average annual CVs range from about 60% for rosette skate, to 30% for barndoor, clearnose, and smooth skates, to about 20% for winter, thorny, and little skates (see Table 3).

The Skate PDT considered several approaches for defining the baseline against which fishing mortality would be measured for the purposes of the threshold. These approaches included: comparing the current three-year average to the three-year average when the FMP is implemented (i.e., a fixed baseline); comparing the current three-year average to the most recent three-year average (i.e., a moving baseline); and comparing the current three-year average to a shifting three-year average (i.e., re-fixing the baseline every three years). To test the validity of these approaches, the PDT simulated the performance of them over the historical survey time series. The results of this simulation led the PDT to conclude that the moving baseline is the most appropriate metric. The approach using the moving baseline is embedded in the proposed fishing mortality thresholds.

In addition to the "control rule" approach, these overfishing definitions include a precautionary "backstop" for monitoring fishing mortality until better information becomes available on which to base the reference points. The proposed backstop states that overfishing is assumed to be occurring if the NEFSC survey mean weight per tow (spring or autumn, depending on the species) declines for three consecutive years. This approach may more adequately address the variable nature of the trawl surveys, which are being used to monitor fishing mortality, and may be more useful in capturing slower declines in abundance. For example, if a species' survey index is slowly declining over time, it is possible that the decline will never reach the required decline in the three-year moving average for an "overfishing" determination to be made. However, consecutive declines in the survey index often indicate that fishing mortality is too high and that overfishing may be occurring. This approach acknowledges this possibility and requires that an "overfishing" determination be made if the survey index declines for three consecutive years.

4.5 REBUILDING PROGRAMS FOR OVERFISHED SPECIES

4.5.1 Overview

The proposed rebuilding program described in this section applies to species that are considered to be in an overfished condition upon implementation of the Skate FMP or at any time in the future. A determination of "overfished" is made based on the biomass reference points contained in the overfishing definition (see Section 4.4). A stock is considered to be in an overfished condition if it falls below the biomass threshold component of the overfishing definition. Once the "overfished" determination is made, then the provisions of the rebuilding program apply.

Currently, barndoor and thorny skates are considered to be in an overfished condition (based on the proposed overfishing definitions) and will be subject to a rebuilding program when the Skate FMP is implemented. Consistent with NMFS' NSGs, the rebuilding programs for barndoor and thorny skates will commence as soon as the management measures in the Skate FMP are implemented.

Section 304(e)(4)(A) of the Magnuson-Stevens Act states that:

(4) For a fishery that is overfished, any fishery management plan, amendment, or proposed regulations…shall--

(A) specify a time period for ending overfishing and rebuilding the fishery that shall--

(i) be as short as possible, taking into account the status and biology of any overfished stocks of fish, the needs of fishing communities, recommendations by international organizations in which the United States participates, and the interaction of the overfished stock of fish within the marine ecosystem; and

(ii) not exceed 10 years, except in cases where the biology of the stock of fish, other environmental conditions, or management measures under an international agreement in which the United States participates dictate otherwise;

NMFS' NSGs provide the following guidance relative to specifying a rebuilding program for overfished species (§600.310(e)(4)(ii)(B)):

(1) The lower limit of the specified time period for rebuilding is determined by the status and biology of the stock or stock complex and its interactions with other components of the marine ecosystem, and is defined as the amount of time that would be required for rebuilding if fishing mortality were eliminated entirely.

(2) If the lower limit is less than 10 years, then the specified time period for rebuilding may be adjusted upward to the extent warranted by the needs of fishing communities…, except that no such upward adjustment can result in the specified time period exceeding 10 years,…

(3) If the lower limit is 10 years or greater, then the specified time period for rebuilding may be adjusted upward to the extent warranted by the needs of fishing communities…, except that no such upward adjustment can exceed the rebuilding period calculated in the

absence of fishing mortality, plus one mean generation time or equivalent period based on the species' life-history characteristics.

4.5.2 Rebuilding Programs and "Control Rules"

A control rule describes a variable over which management has some direct control as a function of some other variable(s) related to the status of the stock. It represents a pre-agreed plan for adjusting management measures depending on the condition of the resource. Most times, the control rule is described in terms of a fishing mortality rate as a function of stock size.

The NSGs link biomass and fishing mortality reference points to an "MSY control rule" that specifies how fishing mortality or catches could vary as a function of stock biomass in order to achieve yields close to MSY. The NSGs define an MSY control rule as a harvest strategy which, if implemented, would be expected to result in a long-term average catch approximating MSY. Development of such a control rule for skates is obviously hampered by the inability to estimate MSY for the species in the skate complex or for the complex as a whole. In addition, information does not exist to estimate fishing mortality rates and/or determine the effects of specific management actions on fishing mortality for these species.

Restrepo et. al. (1998) provide guidance on developing MSY control rules in data-poor situations, such as the one with skates. Restrepo et. al. recommend that the default limit control rule be developed by multiplying the average catch from a time period when there is no quantitative or qualitative evidence of declining abundance by a factor depending on a qualitative estimate of relative stock size. Restrepo et. al. recommend the following as a default limit control rule in data-poor situations:

Above B_{MSY}	Target Catch = 1.00*(Recent Catch).
Above biomass threshold but below B_{MSY}	Target Catch = 0.67*(Recent Catch).
Below biomass threshold (i.e., overfished)	Target Catch = 0.33*(Recent Catch).

For reasons discussed in Section 4.3, this approach cannot be adopted as a control rule for the species in the skate complex at this time. The principal problem is that recent and historical catches of the individual species are unknown. It should be noted, however, that for the two overfished species (barndoor and thorny skates), prohibitions on possession are expected to result in target catches as close to zero as possible (assuming that discard mortality is low), which would fall below the Restrepo-proposed control rule limit for overfished species. This applies as well to smooth skate, although it is not considered overfished and subject to a formal rebuilding program.

Restrepo et. al. note that in cases of severe data limitations, qualitative approaches may be necessary for developing default control rules. Such approaches were considered for the skate complex through the development of four options for rebuilding programs for overfished skate species. While the proposed rebuilding program does not fit the standard definition of a control rule, it serves as a proxy for a control rule until better information becomes available on which to base a more quantitative rule. It does fulfill the basic function of a control rule; that is, it establishes specific criteria to determine when additional action is necessary to ensure the continued rebuilding of an overfished species to its long-term target biomass level. While the criteria in the rebuilding program cannot be linked to specific management actions, they relate to the actions that a Council may take through a framework adjustment to this FMP (Section 4.8). Presumably, if management action is triggered as a result of the criteria specified in the rebuilding program, the Council could address the issue expeditiously through a framework adjustment to this FMP. Certainly, as more and better information becomes available, the Skate PDT will develop an appropriate control rule that provides a direct link to specific fishing mortality rates and management measures.

4.5.3 Rebuilding Time Periods

The above guidance provides a mechanism to develop initial estimates of the rebuilding time periods necessary to rebuild the overfished species in the skate complex. The first step in developing an initial estimate is to determine whether it is likely that the overfished skate species (barndoor skate and thorny skate) could be rebuilt within 10 years, even in the complete absence of fishing mortality. If they cannot, the M-S Act maximum rebuilding period is extended to the time necessary to rebuild in the absence of fishing mortality plus one mean generation.

To implement the rebuilding 'philosophy' of the M-S Act and the NSGs, it is necessary to have some means of projecting stock biomass under various fishing mortality scenarios (including a no-fishing scenario). This must be done, as a first step, to determine whether the 10-year horizon trigger is met, and at a more direct level, to determine the particular value of the fishing mortality rate, F, that will result in the attainment of the chosen biomass target over the chosen rebuilding period. Unfortunately, for the reasons identified in the preceding sections of this document, such analytical tools are not available for modeling skate population response to fishing pressure at this time. To comply with the provisions of the M-S Act and the intent of the National Standard 1 Guidelines, an adaptive approach is necessary.

The general conclusion that the Skate PDT and the Council reached is that **rebuilding time periods for the species in the skate complex will be on the order of decades**. The following discussion provides examples of the potential rebuilding time periods for the currently overfished species and provides context for concluding that rebuilding will likely occur on the scale of decades. These examples should be considered only as ballpark estimates of rebuilding time periods and may actually be only *minimum* estimates, as some life history parameters were estimated using very limited data and making many assumptions.

There are several factors that contribute to the likelihood of a species being rebuilt within ten years: (1) whether the species is long-lived or not; (2) the time it takes for individuals of the species to mature; (3) the growth rate of the species; and (4) fecundity, or the number of offspring generated per mature female. Basically, slow-growing, long-lived, late-maturing species with low fecundity are expected to rebuild slower than fast-growing, short-lived, early maturing species with high fecundity.

Most skate species have life history characteristics that suggest they would rebuild much slower than many finfish species. Based on Frisk et al. (2001), certain life history characteristics were estimated for the species of skates in the Northeast skate complex (see Table 4). These include estimates of maximum age of approximately 24 years for barndoor and thorny skates; estimates of age at maturity of approximately 10.6 and 8.4 years for barndoor and thorny skates, respectively; estimates of fecundity of 14.8 and 13.6 for barndoor and thorny skates, respectively; and estimates of potential population increase (in the absence of fishing mortality) of 0.25 and 0.31 for barndoor and thorny skates, respectively. By comparison, haddock are estimated to have an age at maturity of 2.2 years, fecundity of 169,050, and a potential population increase of 5.47. On average for the seven species of skates in the complex, contrasted against seven species of regulated finfish (cod, haddock, pollock, whiting, yellowtail flounder, winter flounder, and monkfish), the finfish mature in only 34% of the time it takes the skates, are more than 38,000 times more fecund than the skates, and have populations that can increase more than 15 times as fast as the skates.

While the above are averages of broad estimates for these species and should not be considered as absolute, they do indicate the scale of the differences between the two groups of species. Thus, in general, skates would be expected to rebuild much slower than the other regulated species contrasted above. Given this conclusion, it seems reasonable to conclude that barndoor and thorny skates, in particular, could not be rebuilt from an overfished state in less than 10 years, even in the complete absence of fishing mortality.

The guidance in the NSGs can be used to develop ballpark estimates of rebuilding time periods that reflect the relatively slow rebuilding expected for skate species. The rebuilding time periods are estimated based on the conclusion that it would take *at least 10 years*, in the absence of fishing mortality, for these species to rebuild, plus the allowable upward adjustment of one mean generation time.

For barndoor and thorny skates, Frisk et al. (2001) can be used to estimate age at maturity as 10.58 years and 8.35 years, respectively. Frisk et al. (2001) also provide generalized estimates based on size classes of elasmobranches that equal approximately 11 years for both barndoor and thorny skates. Based on this information, the age at maturity for barndoor skates likely ranges from 10.6 to 11 years; and the age at maturity for thorny skates likely ranges from 8.4 to 11 years. Applying this range to the minimum 10 years required to rebuild in the absence of fishing mortality, the rebuilding time periods could be estimated as **approximately 21 years for barndoor skates, and approximately 18.4 to 21 years for thorny skates** (see Table 4).

These estimates should be considered as **minimum** estimates of the allowable rebuilding time periods. The NSGs state that when the lower limit is 10 years or greater, the rebuilding time period cannot exceed the "rebuilding period calculated in the absence of fishing mortality, plus one mean generation time." Thus, if the lower limit is 15 years and the mean generation time is 10 years, the maximum rebuilding period would be 25 years. Because the actual lower limit for the skate species cannot be calculated but, in all likelihood, exceeds 10 years, adding one mean generation time to 10 years results in the lower limit of the likely maximum rebuilding time period rather than the actual maximum rebuilding time period.

The utility of this exercise, despite its imprecision and providing only a lower limit, is that it provides an estimate of the scale of the time periods that would be required to rebuild the overfished skate species. Given the requirement of the Magnuson-Stevens Act and the NSGs to "specify a time period for rebuilding," this approach may prove a better solution than failing to provide any estimate at all. As previously noted, the general conclusion is that the scale of the time periods that would be required to rebuild the overfished skate species is on the order of **decades**, as illustrated by the above discussion and the information presented in Table 4.

Table 4 Life History Parameters Used to Estimate Minimum Rebuilding Time Periods for Skates, Including Comparisons with Other Species

Species	L(max)	T(max)-A	T(m)-A	f-A	T(m)-B	f-B	k-B	r'-B	M-B
Barndoor skate (#)	180	~ 24	~ 11	~ 31	10.58	14.82	0.09	0.25	0.03
Thorny skate (*)	116	~ 24	~ 11	~ 31	8.35	13.55	0.16	0.31	0.06
Smooth skate (*)	71	~ 14	~ 5	~ 21	5.87	9.08	0.25	0.38	0.10
Clearnose skate (#)	95	~ 14	~ 5	~ 21	7.34	11.96	0.20	0.34	0.07
Little skate (*)	62	~ 14	~ 5	~ 21	5.18	7.69	0.27	0.39	0.11
Rosette skate (*)	57	~ 14	~ 5	~ 21	4.76	6.85	0.28	0.40	0.11
Winter skate (#)	150	~ 24	~ 11	~ 31	9.65	14.73	0.12	0.28	0.04
Average					7.39	11.24	0.19	0.34	0.07

Comparison Species	T(m)	f	r'
Atlantic cod	2.2	94,000	2.26
Haddock	2.2	169,050	5.47
Whiting	1.7	343,000	7.50
Pollock	2.0	200,000	6.10
Yellowtail flounder	1.8	400,000	7.17
Winter flounder	3.5	500,000	3.75
Monkfish	4.0	1,300,000	3.52
Average	2.5	429,436	5.11

mean comparison species to mean skate species	
r' ratio:	15.24
f ratio:	38,208
T(m) ratio:	0.34

(#) -- max length comes from Bigelow and Schroeder (2002)
(*) -- max length comes from largest specimen observed on NEFSC trawl survey

"-A" = generalized estimate based on size classes of elasmobranchs from Frisk et al. (2001)
"-B" = estimate based on formulas provided in Frisk et al. (2001)

T(max) = maximum age
T(m) = age at maturity
f = fecundity
k = growth rate
r' = potential population increase
M = natural mortality rate

Scientific uncertainty suggests that it is possible that the actual rebuilding of overfished skate species could occur either more quickly or more slowly than the minimum time frames estimated above. The rebuilding time period may not reflect reality if the assumptions of maximum age and age at maturity are estimated incorrectly. For example, if barndoor and thorny skates do not live to be more than twenty years old, rebuilding could occur much quicker than the two decade estimate would suggest. However, if the maximum age is much higher, then rebuilding could take more than three decades.

As more information becomes available after the implementation of this FMP, the Council intends to re-evaluate rebuilding time periods and possibly adjust them before the overfished stocks are rebuilt. For example, in the course of the first ten years of FMP implementation, data should become available that would facilitate calculation of the actual lower limit on the time it would take these species to rebuild in the absence of fishing mortality. At the same time, better information may become available on the age at maturity for these species. In conjunction, these two pieces of information would serve to refine and improve the rebuilding time period estimate.

4.5.4 Ex-Post Approach

Most rebuilding programs specify control rules, and evaluations are made "ex-ante." This means that once a stock is considered to be in an overfished condition, a control rule prescribes specific action (or specific fishing mortality targets) for the upcoming year(s). Without the appropriate fishery information, an ex-ante analysis cannot be completed. As a result, the skate rebuilding program must be based on an ex-post evaluation.

An ex-post rebuilding program provides a framework for annually evaluating progress towards rebuilding and adapting management measures to ensure that goals are met in as short a time frame as possible. An annual comparison of trawl survey moving averages provides a mechanism to monitor changes in stock abundance relative to changes in fishing mortality and, as a proxy, fishing mortality relative to F_{MSY}. This is an adaptive approach in the sense that the performance of rebuilding measures will be evaluated from the previous year, and management actions will be taken in the following year as necessary to ensure that rebuilding goals are met.

The Council recognizes that this is a relatively rudimentary approach, but it is the only approach available at this time. The Council intends to modify the mechanisms for determining the need for rebuilding action at the earliest possible opportunity. Hopefully, as more and better information becomes available from the managed skate fisheries and through the FMP, more robust approaches will emerge.

4.5.5 Dynamic Response Problem

It is important to understand the fundamental problems associated with all of the rebuilding programs considered during the development of this FMP given the paucity of biological information on which they must be based. All of the rebuilding programs considered in this FMP rely on evaluating trends in the NEFSC trawl surveys, as these are the only region-wide time series of species-specific information currently available for the northeast skate complex. Rebuilding evaluations, therefore, will be subject to the variability that occurs naturally within the NEFSC trawl survey and may encounter problems of *dynamic response*.

Because of the variability in the survey, it is possible that ex-post annual evaluations of progress towards rebuilding will result in inconsistent management advice. The survey is already being utilized in this FMP to generate proxies for biomass and fishing mortality reference points as well as to monitor the effectiveness of the FMP's measures to achieve rebuilding. Survey variability is an important consideration for many reasons:

- Survey variability could lead to a determination that management action is required despite progress towards rebuilding. It is possible that survey variability could produce this kind of situation several years in a row, or several times within the same rebuilding time period.
- As a stock rebuilds and grows towards its long-term target biomass level, slowed growth and even small declines in stock size are not uncommon, nor are they absolute signs of high F or declining biomass. In this situation, evaluating progress towards rebuilding based on the

annual three-year survey index may prove problematic, as different determinations may be reached every time the evaluation is conducted.

- B_{MSY} itself is a long-term equilibrium target level. Stock biomass is expected to fluctuate around B_{MSY} as the stock rebuilds and then stabilizes.

Survey biomass estimates are considered most reliable for displaying general trends in biomass. The precision associated with annual point estimates make their use as management triggers inappropriate. For this reason, a three-year moving average is included in the overfishing definitions and rebuilding program to account for inter-annual variation in survey estimates. An annual evaluation of rebuilding progress is proposed for overfished skate species. It should be understood that the three-year moving average may contradict the directionality of the survey index itself for the terminal year or two (see smooth or clearnose skate 1998-2000, winter skate 1975-1976).

The shortcomings of a survey-based approach to both status determinations and rebuilding progress can be addressed to some degree by allowing maximum flexibility for those who are evaluating progress towards rebuilding (presumably the Skate PDT). Flexibility and discretion should be provided under the rebuilding program so that those conducting the evaluation can apply their expertise in making determinations as to whether progress towards rebuilding is really being achieved. Such flexibility will allow the evaluators to consider factors external to the trawl survey, including but not limited to the status of the stock relative to its long-term biomass target, trends in the fishery, and the direct and indirect effects of management measures in other fisheries.

In addition to the no action alternative, four options for rebuilding programs were considered during the development of this FMP, all of which rely on the trawl survey and all of which are subject to the dynamic response problem identified above. A discussion of the non-preferred options is included in Section 5.2 of this document. A retrospective evaluation of the performance of several of the options, including the proposed rebuilding program, is provided in Section 6.1 of this document.

4.5.6 Skate Rebuilding Program

The rebuilding program for overfished skate species requires Council action if the three-year moving average of the appropriate survey mean weight per tow does not increase when compared to the average for the three years previous. The Skate PDT will be charged with annually updating NEFSC trawl survey data and stock status determinations for the seven species in the skate complex. The Skate PDT will report to the Council the difference between the current three-year average and the average from the three years prior, and Council action will be required any time that the current three-year average is not higher than the prior three-year average. The language for the proposed rebuilding program is provided below:

For overfished skate species, the Skate PDT and the Council will monitor the trawl survey index as a proxy for stock biomass. As long as the three-year average of the appropriate weight per tow increases above the average for the previous three years, it is assumed that the stock is rebuilding to target levels. If the three-year average of the appropriate survey mean weight per *tow declines below the average for the previous three years, then the Council would be required to take management action to ensure that stock rebuilding will continue to target levels.*

Discussion: This approach will be applied in the following manner for overfished skate species:

- In 2004, the 2001-2003 fall survey average would be compared to the 1998-2000 average. Council action would be required if the 2001-2003 average is below the 1998-2000 average.
- In 2005, the 2002-2004 fall survey average would be compared to the 1999-2001 average. Council action would be required if the 2002-2004 average is below the 1999-2001 average.
- In 2006, the 2003-2005 fall survey average would be compared to the 2000-2002 average. Council action would be required if the 2003-2005 average is below the 2000-2002 average.

The advantage to this rebuilding program is that it takes a proactive approach by requiring that the survey average must be increasing over time to ensure rebuilding. Nevertheless, it will be important to allow for maximum flexibility and discretion while evaluating progress towards rebuilding.

Additional discussion and a retrospective performance analysis of this rebuilding program are provided in Section 6.1.3 of this document (p. 165).

4.6 ESSENTIAL FISH HABITAT

4.6.1 Background

4.6.1.1 Legal Authority and Mandate

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act, known as the Sustainable Fisheries Act (SFA), expanded the focus of the Magnuson-Stevens Act by emphasizing the importance of habitat protection to healthy fisheries and by strengthening the ability of the National Marine Fisheries Service (NMFS) and the Councils to protect and conserve the habitat of marine, estuarine, and anadromous finfish, mollusks, and crustaceans. This habitat is termed "essential fish habitat" and is broadly defined to include "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."

To improve fish habitat protection, the Magnuson-Stevens Act now requires the Councils, NMFS, and other federal agencies to take specific new actions. The Magnuson-Stevens Act requires the Council, after receiving recommendations from NMFS, to complete the following for all new FMPs or FMP amendments:

EFH Designation Mandate [16 U.S.C. 1853]:

(a) Any fishery management plan which is prepared by any Council . . . shall --

(7) describe and identify essential fish habitat for the fishery based on the guidelines established by the Secretary . . . minimize to the extent practicable adverse effects on such habitat caused by fishing, and identify other actions to encourage the conservation and enhancement of such habitat;