#1

Initial Report
of the
Monkfish Plan Development Team

to the
New England Fishery Management Council's
Scientific and Statistical Committee (SSC)

Biological and Management Reference Point Recommendations

February 27, 2009

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1.0 Background

The following section describes the legal and regulatory authority and requirements for the Council with respect to managing fisheries, with a focus on the requirement to stop or prevent overfishing and to maintain stocks at sustainable levels while achieving optimum yield for the benefit of the nation. This section also includes the reference points and definitions of relevant terms as provided in the Magnuson-Stevens Reauthorization Act (MSRA) and NMFS' National Standard 1 Guidelines (NS1G, 50 CFR 600, published in 74 *Federal Register* 3178, January 16, 2009). The PDT analysis starts on page 8, Section 3.0.

Attached, for your reference, are the Monkfish Assessment Summary for 2007, by the Data Poor Stocks Working Group (DPWG), and articles by Haring and Maguire, and Dr. Anne Richards, et al., that were published in the ICES Journal of Marine Science in 2008. The Haring & Maguire article summarizes the history of the management plan and the science/management interface, and the Richards et al. article covers the population dynamics of monkfish.

1.1 MSRA

1.1.1 SSC responsibilities:

MSRA Sec 302 (g)(1)(b): Each scientific and statistical committee shall provide its Council ongoing scientific advice for fishery management decisions, including recommendations for acceptable biological catch, preventing overfishing, maximum sustainable yield, and achieving rebuilding targets, and reports on stock status and health, bycatch, habitat status, social and economic impacts of management measures, and sustainability of fishing practices.

1.1.2 Limits on Council action:

MSRA Sec 302 (h)(6): (Each Council shall) develop annual catch limits for each of its managed fisheries that may not exceed the fishing level recommendations of its scientific and statistical committee or the peer review process established under subsection (g).

1.1.3 Fishery management plan requirements:

MSRA Sec 303 (a)(15): (Any FMP shall) establish a mechanism for specifying annual catch limits in the plan (including a multiyear plan), implementing regulations, or annual specifications, at a level such that overfishing does not occur in the fishery, including measures to ensure accountability.

1.1.4 Overfishing:

MSRA Sec 3(34): The terms "overfishing" and "overfished" mean a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce the maximum sustainable yield on a continuing basis.

1.1.5 Optimum yield:

MSRA Sec 3(33): 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 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.

MSRA Sec 301(a)(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.

1.2 National Standard 1 Guidelines

The MSRA requires the Secretary of Commerce to establish advisory guidelines (which shall not have the force and effect of law, based on the national standards, to assist in the development of FMPs. On January 16, 2009, NMFS published the Final Rule amending the National Standard 1 (NS1) Guidelines (74 *Federal Register* 3178).

1.2.1 Acronyms:

ABC – Acceptable Biological Catch
ACL - Annual Catch Limit
AM – Accountability Measure
ACT – Annual Catch Target
MFMT – Maximum Fishing Mortality Threshold
MSST – Minimum Stock Size Threshold
MSY – Maximum Sustainable Yield
OFL – Overfishing Limit
OY – Optimum Yield
SDC – Status Determination Criteria

1.2.2 Summary of items to include in FMPs related to NS1

The Councils must evaluate and describe the following items in their FMPs and amend the FMPs, if necessary, to align their management objectives to end or prevent overfishing (references are to paragraphs in 50 CFR 600.310, NS1G):

(1) **MSY** and **SDC** (see paragraphs (e)(1) and (2) of this section).
(2) **OY** at the stock, stock complex, or fishery level and provide the **OY specification analysis** (see paragraph (e)(3) of this section).
(3) **ABC** control rule (see paragraph (f)(4) of this section).
(4) Mechanisms for specifying **ACLs** and possible sector-specific ACLs in relationship to the ABC (see paragraphs (f)(5) and (h) of this section).
(5) **AMs** (see paragraphs (g) and (h)(1) of this section).
(6) Stocks and stock complexes that have statutory exceptions from ACLs…

1.2.3 MSY

MSY is the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological, environmental conditions and fishery technological characteristics (e.g. gear selectivity), and the distribution of catch among fleets. **Fmsy** is the fishing mortality rate that, if applied over the long term would result in MSY. **Bmsy** means the long-term average size of the stock or stock complex that would be achieved by fishing at Fmsy. Because MSY is a long-term average, it need not be estimated annually, but it must be based on the best scientific information available. When data are insufficient to estimate MSY directly, Councils should adopt other measures of reproductive potential that can serve as reasonable proxies for MSY, Fmsy and Bmsy, to the extent possible.

1.2.4 SDC

SDC mean the quantifiable factors, MFMT, OFL, and MSST, or their proxies that are used to determine if overfishing has occurred, or if the stock or stock complex is overfished. "Overfished" relates to biomass, while "overfishing" pertains to a rate or level of removal of fish from a stock. SDC must be expressed in a way that enables the Council to monitor each stock, and determine annually, if possible, whether overfishing is occurring and whether the stock is overfished. In specifying SDC, a Council must provide an analysis of how the SDC were chosen and how they relate to reproductive potential. Each FMP must specify, to the extent possible, objective and measurable SDC.

1.2.4.1 MFMT

MFMT means the level of fishing mortality (F), on an annual basis, above which overfishing is occurring.

1.2.4.2 OFL

OFL means the annual amount of catch that corresponds to the estimate of MFMT applied to a stock's abundance and is expressed in terms of numbers or weight of fish. OFL is an estimate of the catch level above which overfishing is occurring, corresponds to the level that jeopardizes the capacity of a stock to produce MSY on a continuing basis.

1.2.4.3 MSST

MSST means the level of biomass below which the stock is considered to be overfished, and corresponds to the level that jeopardizes the capacity of the stock to produce MSY on a continuing basis.

If the fishing mortality rate exceeds the MFMT, or the catch exceeds the OFL for one year or more, overfishing is occurring, and if the estimated stock size in a given year falls below the MSST, the stock is considered overfished.

1.2.5 OY

OY is a long-term average amount of desired yield from a stock, stock complex or fishery. An FMP must contain conservation and management measures, including ACLs and AMs, to achieve OY on a continuing basis, and provisions for information collection

that are designed to determine the degree to which OY is achieved. Exceeding OY does not necessarily constitute overfishing. However, even if no overfishing resulted from exceeding OY, continual harvest at a level above OY would violate NS1, because OY was not achieved on a continuing basis.

OY cannot exceed MSY in any circumstance, and must take into account the need to prevent overfishing and rebuild overfished stocks. If the estimates of MFMT and current biomass are known with a high level of certainty and management controls can accurately limit catch, then OY could be set very close to MSY, assuming no other reductions are necessary for social, economic or ecological factors. The amount of fish that constitutes OY should be expressed in terms of numbers or weight of fish, and may be either a range or single value. All catch, including that resulting from bycatch, scientific research and all fishing activities, must be counted against OY. There should be a mechanism in the FMP for periodic assessment of the OY specification, so that it is responsive to changing circumstances in the fishery.

1.2.6 ABC, ACL and ACTs

ABC is a level of a stock's annual catch that accounts for scientific uncertainty in the estimate of OFL and any other scientific uncertainty. ABC should be expressed in terms of catch, but may be expressed in terms of landings as long as estimates of bycatch and any other fishing mortality not accounted for in the landings are incorporated into the determination of ABC. ABC may equal, but may not exceed OFL.

The ABC control rule means a specified approach to setting the ABC. Control rules are policies for setting limit or target fishing levels, and are established by fishery managers in consultation with fisheries scientists, particularly the SSC. The determination of ABC should be based, when possible, on a probability of 50 percent or less that a catch equal to ABC would result in overfishing. The ABC control rule must articulate how ABC will be set compared to the OFL based on the scientific knowledge about the stock, the scientific uncertainty in the estimate of OFL, and any other scientific uncertainty. An SSC may recommend an ABC that differs from the result of the ABC control rule calculation, based on factors such as data uncertainty, recruitment variability, declining trends in population variables, and other factors, but must explain why.

ACL may equal but cannot exceed the ABC, and may be set annually or on a multiyear basis. ACL is the level of annual catch of a stock that serves as the basis for invoking AMs. ACL may be subdivided into sector ACLs, which may be necessary if the management measures for different sectors differ in the degree of management uncertainty so that appropriate AMs can be developed for each sector. In this usage, "sector" means a distinct user group to which separate management strategies and separate catch quotas apply, such as the commercial sector, recreational sector, or various user groups within a fishery.

ACT is an amount of catch of a stock that is the management target of the fishery, and accounts for management uncertainty in controlling catch at or below the ACL. The ACT control rule means a specified approach to setting the ACT for a stock such that the risk

of exceeding the ACL due to management uncertainty is at an acceptably low level, and should articulate how management uncertainty is accounted for in setting ACT. Two sources of management uncertainty that should be accounted for are: uncertainty in the ability of managers to constrain catch so the ACL is not exceeded; and, uncertainty in quantifying the true catch amounts (i.e., estimation errors).

1.2.7 AMs

AMs are management controls to prevent ACLs, including sector ACLs, from being exceeded, and to correct or mitigate overages of the ACL, if they occur. NMFS identifies two categories of AMs, in-season AMS and AMs for when the ACL is exceeded. [**Note:** for purposes of the Monkfish FMP, the Plan Development Team refers to these, in the discussion below, as **"proactive" and "reactive" AMs**].

1.2.7.1 In-season AMs

Whenever possible, FMPs should include in-season monitoring and management measures to prevent catch from exceeding ACLs. In-season AMs could include, but are not limited to: ACT; closure of a fishery; closure of specific areas; changes in gear; changes in trip size or bag limits; reductions in effort; or other appropriate management controls. FMPs should contain in-season closure authority, giving NMFS the ability to close fisheries if it determines, based on data that it deems sufficiently reliable, that an ACL has been exceeded or is projected to be reached, and that closure of the fishery is necessary to prevent overfishing.

1.2.7.2 AMs for when the ACL is exceeded

On an annual basis, the Council must determine as soon as possible after the fishing year if an ACL was exceeded. If an ACL was exceeded, AMs must be triggered and implemented as soon as possible to correct the operational issue that caused the overage, as well as any biological consequences to the stock resulting from the overage when it is known. These AMs could include, among other things, modifications of in-season AMs or overage adjustments. If catch exceeds the ACL for a given stock more than once in the last four years, the system of ACLs and AMs should be re-evaluated, and modified if necessary to improve its performance and effectiveness.

2.0 Monkfish Stock Status

Monkfish were most recently assessed within the Data Poor Stocks Working Group (DPWG) in 2007, with the terminal year of the assessment being 2006. The DPWG Report is attached and the findings are summarized in Table 1. The DPWG concluded that both northern and southern management components are not overfished and overfishing is not occurring. The Report also stressed that these conclusions be considered in the context of the high degree of uncertainty due to, among other things, input data quality, assumptions (such as natural mortality rates), the newness of the assessment model, and the lack of complete understanding about basic biological parameters, such as growth and reproduction rates. These sources of scientific uncertainty are also enumerated in greater detail under the discussion of ABC, below.

3.0 Plan Development Team (PDT) Analysis and Recommendations

Since the terminal year of the last stock assessment is 2006, and since another assessment is tentatively scheduled for mid-2010, around the time that the Council will be submitting Amendment 5, the PDT developed the following reference point recommendations and alternatives as a set of formulas. The PDT calculated the corresponding reference point values using the last assessment output, with a recommendation that the amendment include a provision that NMFS will recalculate the values and adopt them without requiring the Council to take additional regulatory action. The formulas correspond to the reference point control rules required in the NS1 Guidelines.

3.1 MSY

The DPWG did not calculate estimates of F_{msy}, but retained the existing MFMT of $F_{threshold}=F_{max}$, and re-estimated the associated values. $F_{threshold}$ is the proxy value for F_{msy}.

The DPWG developed new biomass reference points based on output from the SCALE model, which assumed natural mortality, M=0.3. The new B_{target} is the average of total biomass during 1980 – 2006 estimated from the SCALE model. The PDT recommends that this be the proxy for B_{msy}.

Based on the use of the proxy reference points:

$$\mathbf{MSY=F_{threshold} \times B_{target}}$$

The PDT notes that catch may fluctuate above and below MSY depending on the current biomass relative to the biomass target. Based on the 2007 DPWG assessment, the values for MSY are **21,397** mt and **35,239** for northern and southern components, respectively (Table 2).

3.2 OFL

In the NS1G, the response to comment 27, the text of the rule states "The annual OFL varies above and below the MSY level depending on fluctuations in stock size." Earlier in the response, there is a discussion of the relationship between the OFL and the MFMT: "The OFL for a year is calculated from the MFMT and the best estimate of biomass for a stock in that year, and thus is simply the MFMT converted into an amount of fish. The OFL is an annual level of catch that corresponds directly to the MFMT . . ." Since the MFMT is an F rate ($F_{threshold}$) that provides a yield equal to MSY when biomass is exactly equal to B_{msy}, the expected catch when biomass is less than B_{msy} would be less than MSY, and higher than MSY when biomass is above B_{msy}. The OFL is simply the result of this calculation:

$$\mathbf{OFL = F_{threshold} \times B_{current}}$$

Based on the 2007 DPWG assessment which concluded that 2006 biomass was above B_{target} for both stock components, the values for OFL are **27,546** mt and **38,979** mt for northern and southern components, respectively (Table 3).

3.3 ABC

The guidelines define ABC as the level of catch that accounts for scientific uncertainty in the estimate of OFL, and any other scientific uncertainty. The PDT recommends that, in the case of monkfish, the ABC should always (at least for the foreseeable future) be set below OFL due to the extent and magnitude of scientific uncertainty in the assessment. PDT members expressed concern about the calculation of OFL when the estimate of current biomass is highly uncertain. Further, the terminal year of the last assessment was 2006 (would be three years old by 2010), and the assessment methodology did not produce projections that could provide a basis for updating the current biomass estimate.

The PDT enumerated the sources of scientific uncertainty (Table 4), but did not assign a specific value to them, nor did it recommend a specific percentage reduction from OFL for setting ABC. The PDT suggests that the process of determining the reduction will involve qualitative assessment and estimation, and seeks the guidance of the SSC on that estimation.
At the maximum, the ABC could be capped at the MSY level, even if the most recent estimate of current biomass was above Bmsy, and the catch associated with the OFL was above MSY.

ABC<OFL, not to exceed MSY

However, the magnitude of uncertainty in the assessment (Table 4) suggests that ABCs should be set very conservatively for both management areas.

3.4 ACLs

The guidelines define ACLs as the level of annual catch that serves as the basis for invoking AMs. An ACL cannot exceed the OFL, and it may be set annually or on a multi-year basis. The PDT recommends that ACLs be set equal to ABC, as there is no technical basis for setting it below ABC. Scientific uncertainty is accounted for in setting ABC, and management uncertainty is taken into account in the setting of catch targets to prevent exceeding the ACL, i.e., AMs.

ACL=ABC

3.5 AMs

As noted above, the PDT identified two types of AMs, which it has termed "proactive" and "reactive", corresponding roughly to the division in the NS1G for in-season AMs to prevent an ACL from being exceeded, and AMs that apply when the Council determines that ACL has been exceeded. Both approaches should be used. A reactive AM would be a management measure that would be triggered if and when catch approached or exceeded the ACL, such as a closure of fisheries contributing to monkfish mortality, or a reduction in future catch targets. As discussed below, a reactive AM in concept could be either in-season or apply in a subsequent year. A proactive AM would be an ACT that is set sufficiently below the ACL such that the measures that are based on the ACT prevent the ACL from being exceeded, in consideration of all sources of management uncertainty.

AMs take into account management uncertainty. A proactive AM, as described below, would set catch targets based on the expectation that, in spite of uncertainty in the effectiveness of management measures, those measures would ensure that the ACL is not exceeded. A reactive AM would be invoked in the case where assumptions about the effectiveness of management measures are shown to be invalid, and the catches approach or exceed the ACL.

In general, sources of management uncertainty include the potential for violation of the assumptions in the analytical model used to set management measures, such as days-at-sea (DAS) and trip limits under the current system, or the models used to apportion individual transferable quotas (ITQ) and/or sector catch shares, should the Council adopt one of those systems. Another general source of management uncertainty stems from the inability to predict the effect of changes to management measures in other fisheries that have an incidental catch of monkfish. A list of specific sources of management uncertainty is provided in Table 5.

The list in Table 5 is a compilation of factors identified by the PDT based on its past experience with the DAS/trip limits management system. While many of these would carry over to other management approaches, such as ITQs or sectors, some of them would no longer be relevant, such as those uncertainties stemming from the DAS usage patterns. Conversely, new management systems could inherently bring with them a different set of management uncertainties which would need to be identified and evaluated in the development of the new management program and the AM-setting process.

3.5.1 Proactive AMs

A proactive AM would be an ACT which would be the basis for setting management measures (DAS/trip limits, sector contribution, ITQ), after accounting for incidental catch in non-directed fisheries, and includes discards in all fisheries. Under the current management program, it would be used to calculate trip limits and DAS, as is currently done.

Depending on how well monkfish discards in all fisheries are monitored, the ACT itself could be the basis for management measures, or another value could be established based on target total allowable landings (TTAL) that would be calculated by subtracting estimated or projected discards from the ACT, perhaps, incorporating some measure of expected discard mortality. Under sector management or ITQs, if the Council ultimately adopts one of those approaches, the ACT would be the basis of individual sector contributions or allocations, since those programs would likely incorporate comprehensive catch monitoring, including discards.

The guidelines specifically allow for, but do not require using ACTs as an AM. The PDT identified two alternative methods for setting the ACT: reducing the ACL by some amount to account for management uncertainty, termed the "top-down" method; and, adjusting the current TAC in consideration of its relationship to the ACL, and the known

sources of management uncertainty, and applying a precautionary approach, referred to as the "bottom-up" method.

Under the first method, the ACT would be determined by reducing the ACL by some amount determined by the evaluation and quantification of the management uncertainty, a so-called "top down approach". For example, if the ACL were 10,000 mt, and the sources of management uncertainty were calculated to have a precision of only 75%, then the ACT would be set at 7,500 mt. The difficulty in this approach will be to place a numerical value of the different sources of management uncertainty.

The second, "bottom up" approach would offer a way to avoid having to quantify management uncertainty. Under the bottom-up approach, the calculation of ACT would start with the current TAL levels, add in the estimated or observed discards and evaluate the relationship between the ACL and that value. If the stock status is such that an increase over the current TAL is warranted (i.e., biomass above the target and fishing mortality rates below the threshold), a reasonable or precautionary percentage increase could be adopted that would still provide a buffer against the likelihood of reaching the ACL. This would still require a subjective decision on the appropriate level of precaution to be applied in raising, or lowering the ACT from current levels, but it would allow for incremental increases in catch over time while evaluating the impact of those increases on stock status.

One basis for setting the ACT under this method could be found in the approach used in Framework 2 to the Monkfish FMP. The provision is no longer part of the regulations, since the Framework 2 TAC-setting method was replaced with Framework 4, but, in Framework 2, the Council, on the recommendation of both the Monkfish Committee and Industry Advisory Panel, adopted a provision that said, "if the stock is above B_{target} (stock is rebuilt) and current F cannot be determined, the TAC will be set at not more than 20% above previous year's landings." Even though there is now an estimate of F, it is a relatively uncertain estimate. Secondly, to account for management uncertainty, the increase in TAC (or, in this case, the ACT) could be applied based on the previous year's TAC (ACT) rather than the previous year's landings. (Of note here is the fact that under the Framework 2 TAC-setting method, the previous year's landings were incorporated into the formula, regardless of whether the TAC was exceeded or not.)

Unfortunately, the sources of management uncertainty are varied, difficult to identify, and are not quantifiable (Table 5). This situation presents particular difficulty for the top-down approach to setting ACT. Some PDT members suggested using the past history of observed catch compared to the annual TACs, such as an average of the TAC overage/underage over the past several years, as a way to provide some objective quantification of the uncertainty (see Table 6). Others observed that the relationship between the TAC and the landings could be the result of numerous factors, not necessarily management uncertainty, such as better or worse recruitment than anticipated in any given year.

In some cases, however, the TAC overage could be attributed to a management measure, such as inappropriately large numbers of carryover DAS, or fishing on trips less than 3 hours (avoiding the 15 hour rule), which have since been corrected and are no longer a factor. Furthermore, since the method for calculating the TAC has been modified at least twice, and the management program itself (in terms of the application of DAS, trip limits and changes to other management measures) several times during the last decade under the FMP, there is not a consistent time series on which to evaluate management uncertainty as an average of landings/TAC. Such considerations raises questions about the validity of using past performance to characterize, or place a numerical value on future management uncertainty in calculating the ACT.

In summary, the ACT alternatives are:

> **Method 1** - "top down" – Reduce value of ACL by some amount to account for management uncertainty. If possible, quantitative measures of uncertainty should be used, otherwise, a subjective, precautionary amount would be applied to ensure ACL is not reached.
>
> **Method 2** - "bottom up" – Use current TTALs, add in estimates of discards, and, if stock is rebuilt and overfishing is not occurring, apply an incremental increase based on a subjective, precautionary approach.

In developing the ACT concept, some PDT members suggested that there also be some reactive measures if catches exceed the ACT, in addition to those that would apply if catch exceeded the ACL. Other members commented that adjustments could be made to the management measures, or the ACT could be modified without adjustment to the management measures as part of the multi-year specifications process, but that there is no requirement for automatic restrictions for exceeding the ACT, as long as the ACL is not reached. The latter approach would allow for a detailed examination of the data, an analysis of the causes of the ACT overage, and implementation of appropriate responses through the regulatory process. Such causes could be attributable to management measures within the plan or in other FMPs (if incidental catch is different than what was expected), or to improved bycatch estimates, or could be biological (if recruitment to the fishery were different than what was anticipated and catch rates go up or down). Under this approach, having the ACT as a proactive AM provides an opportunity to set multi-year specifications without creating the threat of a reactive AM in any given year.

Furthermore, an issue with the automatic approach is the lag time in availability of information on catches (especially discards) across the spectrum of fisheries that interact with the monkfish resource. The same obstacles would exist regardless of the management system in place (DAS, sectors or trip limits). There was no agreement on this matter, although the PDT may revisit it as the process evolves, and after the SSC has an opportunity to review the conceptual framework of the different approaches.

3.5.2 Reactive AMs

Reactive AMs could include both in-season and post-season actions that would be taken to mitigate or prevent an overage of the ACL, should one occur or be likely to occur. Reactive AMs could include closure to all, or specific sources of monkfish fishing mortality, reductions in ACT (if used) or ACLs in a subsequent year or season, or other specified consequences. The PDT did not recommend any specific reactive AMs, and is seeking input from the Monkfish Committee and Industry Advisory Panel. If the ACT is set appropriately below the ACL, either in a precautionary approach or by adequately accounting for all sources of management uncertainty, then the risk that the reactive AMs would be invoked would be minimized.

4.0 Tables

	North	South	Comment
$F_{threshold}$ (MFMT)	0.31	0.40	F_{MSY} proxy based on F_{max}
$F_{current}$ (2006)	0.09	0.12	Not updated for 2007, 2008
B_{target}	92,200 mt	122,500 mt	B_{MSY} proxy
$B_{current}$ (2006)	118,700 mt	135,500 mt	Not updated for 2007, 2008
$B_{threshold}$ (MSST)	65,200 mt	96,400 mt	

Table 1 Monkfish reference points and status (2006) based on DPWG 2007 assessment

	F threshold	M	B target (mt)	MSY = F/Z*(1-e^{-Z})*B	Discard ratio	Discards (mt)
North	0.31	0.30	92,200	**21,397**	0.07	1,498
South	0.40	0.30	122,500	**35,239**	0.22	7,753

Table 2 Calculation of MSY based on 2007 DPWG Report, assumes mean weights are the same in the catch and stock biomass. Discard ratio is average of 2004-2006 d/(k+d) from 2007 DPWG report.

	F threshold	M	B current (mt, 2006)	OFL = F/Z*(1-e^{-Z})*B	Discard ratio	Discards (mt)
North	0.31	0.30	118,700	**27,546**	0.07	1,928
South	0.40	0.30	135,500	**38,979**	0.22	8,575

Table 3 Calculation of OFL based on 2007 DPWG Report, assumes mean weights are the same in the catch and stock biomass. Discard ratio is average of 2004-2006 d/(k+d) from 2007 DPWG report.

		Source of Uncertainty
Fishery Data	**Landings**	under-reported before ~1980
		poorly characterized (length, age) before 1993
		Market Category change over time
		Foreign Landings (?)
	Discards	unknown prior to 1989
		discard mortality rate unknown, variable by circumstances
	Observer/Port Sampling	tail lengths being expanded to whole lengths, conversion factor based on old data. Maine currently conducting an ACCSP conversion factor pilot study for Monkfish landed in ME, NH & MA
		Seasonality in port sampling
Biological Parameters	**Growth**	observed linear growth suggests problems with ageing method or severely truncated age structure; form of growth model uncertain
	Longevity	not known, likely greater than observed maximum age due to truncation of size structure before ageing began
	Natural mortality	used M=0.3 in 2007 assessment based on observed longevity, M=0.2 used previously
		rates of cannibalism not well known, but evidence suggests is higher in larger monkfish (e.g. > 70 cm)
Model	**SCALE**	new (relatively untested) model
		results sensitive to assumption of M
		projection module not yet developed
Survey Data	**Survey Index**	Change in survey platform, conversion coefficients expected to be problematic
		low numbers of monkfish caught in the Albatross IV survey results in uncertainty in annual estimates of abundance based on the survey.
Other		Lag time before updated assessment results available

Table 4 Sources of monkfish scientific uncertainty

		Source of Uncertainty
Permits	**Limited Access**	# active vs. total permits changes annually
		# participating as Cat. F (Offshore fishery) varies annually
	Open access (incidental catch)	# active incidental catch permits changes annually
DAS/trip limits	**DAS usage rate**	# DAS used vs. total allocated to active vessels changes annually
		carryover DAS
	DAS usage pattern	# landings per partial DAS
		steaming time inside VMS demarcation line (compared to pre-VMS call-in system)
	Catch rates	Variable # and amount of landings below trip limit
		Variable # and amount of catch above trip limit (bycatch)
		Catch below minimum fish size varies depending on recruitment and fishing effort patterns
Incidental Catch Fisheries	**Participants**	Type of Fishery (gear, location, etc.), governing regulations changes over time
		# LA vessels catching of monkfish while not on a DAS (under incidental limit)
	Catch rates	catch above incidental limit (bycatch)
		Catch below minimum fish size
Management Areas	**Participation**	vessels fishing in different areas varies annually
Gear	**Gillnets**	# nets used above minimum mesh size
Enforcement		Unknown extent of illegal behavior
Other FMPs/Protected Species Regs.		Regulations in other FMPs and to address protected species may change unpredictably, with consequences for directed and incidental monkfish effort and catch

Table 5 Sources of monkfish management uncertainty

	Landings (mt)			TAC (mt)			Percentage			Overage/Underage of TAC		
	NFMA	SFMA	Coast-wide	NFMA	SFMA	Coast-wide	NFMA	SFMA	Coast-wide	NFMA	SFMA	Coast-wide
1999	9,720	14,311	24,031	5,673	6,024	11,697	171%	238%	205%	4,047	8,287	12,334
2000	11,859	7,960	19,819	5,673	6,024	11,697	209%	132%	169%	6,186	1,936	8,122
2001	14,853	11,069	25,922	5,673	6,024	11,697	262%	184%	222%	9,180	5,045	14,225
2002	14,491	7,478	21,969	11,674	7,921	19,595	124%	94%	112%	2,817	-443	2,374
2003	14,155	12,198	26,353	17,708	10,211	27,919	80%	119%	94%	-3,553	1,987	-1,566
2004	11,750	6,193	17,944	16,968	6,772	23,740	69%	91%	76%	-5,218	-579	-5,796
2005	9,533	9,656	19,189	13,160	9,673	22,833	72%	100%	84%	-3,627	-17	-3,644
2006	6,677	5,909	12,586	7,737	3,667	11,404	86%	161%	110%	-1,060	2,242	1,182
2007	5,050	7,180	12,230	5,000	5,100	10,100	101%	141%	121%	50	2,080	2,130
2002-2007	61,656	48,614	110,271	72,247	43,344	115,591	85%	112%	95%	-10,590	5,270	-5,321
1999-2007	98,089	81,955	180,043	89,266	61,417	150,683	110%	133%	119%	8,822	20,538	29,360

2002-2007 Summary Stats

	Percentage			Overage/Underage of TAC		
	NFMA	SFMA	Coast-wide	NFMA	SFMA	Coast-wide
Mean	89%	118%	100%	-1,765	878	-887
Median	83%	110%	102%	-2,306	985	-192
Std Deviation	21%	28%	18%	2,945	1,357	3,352
Count	6	6	6	6	6	6
95% CI	17%	23%	14%	2,357	1,086	2,682

Table 6 Monkfish landings and percentage of TAC by area and fishing year. Source: NMFS Northeast Regional Office Preliminary Fisheries Statistics Reports.

5.0 References

1. Haring, P., and Maguire, J.J., 2008. The monkfish fishery and its management in the northeastern USA. In: ICES Journal of Marine Science. 65: 1370-1379.
2. Northeast Data Poor Stocks Working Group. 2007. Monkfish Assessment Summary for 2007. Northeast Fisheries Science Center Reference Document 07-13.
3. Richards, R.A., Nitschke, P. C., and Sosebee, K. A.. 2008. Population biology of monkfish *Lophius Americanus*. In: ICES Journal of Marine Science. 65: 1291 - 1305.