



New England Fishery Management Council

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**MEMORANDUM**

**DATE:** August 4, 2010  
**TO:** Scientific and Statistical Committee (SSC)  
**FROM:** Phil Haring, Monkfish PDT  
**SUBJECT:** PDT Calculation of OFL, Updated calculation of ABC, Sources of uncertainty

The Monkfish Plan Development Team (PDT) has updated the calculation of the Overfishing Limit (OFL), and Acceptable Biological Catch (ABC) using data and models that have been reviewed by the June 2010 stock assessment panel, SARC 50. The PDT also describes and characterizes the sources of uncertainty in these estimates based on the SARC 50 report.

OFL

The OFL is the annual amount of catch that corresponds to the estimate of fishing mortality threshold applied to the current estimate of biomass, and is expressed in the formula:

$$\mathbf{F_{threshold} \times B_{current}},$$

where  $B_{current}$  is the estimate of exploitable biomass.

When catch is above the OFL, overfishing is occurring. If current biomass is above the long-term  $B_{msy}$  target, or its proxy, then the catch can exceed maximum sustainable yield (MSY). In the case of monkfish, both stock components are above  $B_{target}$ , based on both the current definition and the definition recommended by SARC 50 but not yet adopted into the FMP.

SARC 50 updated the biomass estimates and provided data for a recalculation of the OFL. The revised OFL value for the Northern Management Area (NMA) is 14,084 mt, based on 2009 exploitable biomass of 46,150 mt, and  $F_{threshold}$  of  $F=0.43$ . The revised OFL value for the Southern Management Area (SMA) is 35,036 mt, based on 2009 exploitable biomass of 108,740 mt and  $F_{threshold}$  of  $F=0.46$ .

ABC

In 2009, the SSC recommended an interim ABC control rule which the Council adopted into the recently submitted Amendment 5 to the Monkfish FMP, as follows:

*An interim Acceptable Biological Catch should be derived as the product of the average exploitation rate during the recent period of stable or increasing trend in*

***biomass for each management unit and the most recent estimate of exploitable biomass.***

From the previous assessment (Data Poor Stocks Working Group, 2007), the estimates of 2006 exploitable biomass, and what was used in the development of Amendment 5, were 97,940 mt in the north and 98,250 mt in the south. At the time, the periods 1999-2006 and 2000-2006 were the most recent periods of stable or increasing biomass for the NMA and SMA, respectively. The average exploitation rates during those periods were 0.18 in the NMA and 0.14 in the SMA. Therefore, according to the interim ABC specification method recommended by the SSC in March 2009 (above), the ABCs for 2011-2013 fishing years were 17,485 mt in northern management area and 13,326 mt in southern management area. These are the values that were incorporated into Amendment 5.

SARC 50 updated the biomass estimates and provided data for a recalculation of the ABC using the interim control rule. Based on these results, the period of stable or increasing biomass for each area changed to 2006-2009 (NMA) and 2002-2009 (SMA), and the average exploitation rates during those periods were, 0.16 and 0.11 (NMA and SMA, respectively). These inputs resulted in a recalculation of ABC under the interim control rule. The new ABC values are 7,592 mt (NMA) and 12,316 mt (SMA). The original calculations based on DPWG (2007) are shown in Table 1 and the updated calculations based on SARC 50 results are in Table 2.

Paradoxically, under the interim ABC control rule, the lower the exploitation rate during the “period of stable or increasing biomass”, the lower the ABC will be, while a higher the exploitation rate during that period will produce a higher ABC, in effect “penalizing” the fishery for lower exploitation or “rewarding” it for higher exploitation rates, provided the biomass is stable or increasing. This situation suggests that a revision to the interim rule is warranted.

Based on DPSWG (2007) assessment

	F threshold	M	exploitable B 2006	B target (exploitable)*	$U = F/Z*(1-e^{-Z})$	MSY proxy = $F/Z*(1-e^{-Z})*B$	OFL	Fabc**	Uabc	ABC	ABC/OFL	% reduction in OFL
North	0.31	0.30	97,940	73,484	0.2321	17,053	22,729	0.23	0.18	17,485	0.77	23.1
South	0.40	0.30	98,250	88,598	0.2877	25,487	28,263	0.17	0.14	13,326	0.47	52.8

\* calculated as average of exploitable biomass (1980-2006) from SCALE using selectivity curve for 2004-2006 for entire time series  
B target was defined by DPWG as average of total biomass (1980-2006)

\*\*Fabc=F during recent increases in biomass

North: 1998-2006=0.23

South: 2000-2006=0.17

**Table 1 PDT calculation of OFL and ABC based on 2007 DPWG assessment, and incorporated into Amendment 5**

Based on SAW 50 (2010) assessment AGEPRO longterm projected catch from Btarget at Fmax

	F threshold	M	$U = F/Z*(1-e^{-Z})$	B target <sup>1</sup>	B threshold	exploitable B 2009	MSY proxy <sup>2</sup>	OFL <sup>3</sup>	Fabc <sup>4</sup>	Uabc	ABC	ABC/OFL	% reduction in OFL
North	0.43	0.30	0.3052	52,930	26,465	46,150	10,745	14,084	0.21	0.16	7,592	0.54	46.1
South	0.46	0.30	0.3222	74,490	37,245	108,740	15,279	35,036	0.14	0.11	12,316	0.35	64.8

<sup>1</sup> total biomass, SAW 50 estimate from longterm projected biomass at Fmsy proxy (=Fmax)

<sup>2</sup> catch produced from Fmax at Btarget, SAW 50

<sup>3</sup> Fmax \* B current (exploitable biomass)

<sup>4</sup>Fabc=F during recent increases in biomass North: 2006-2009 South: 2002-2009

**Table 2 PDT calculation of OFL and ABC based on SARC 50 (2010), using the interim ABC control rule adopted into Amendment 5.**

Since ABC is defined as the level of catch that accounts for scientific uncertainty in the estimate of OFL, and any other scientific uncertainty, the PDT has compiled a list of the sources of uncertainty based on the SARC 50 report.

### Uncertainty in OFL

Assessment uncertainties for monkfish are significant and difficult to quantify because they stem largely from unknowns in fundamental data inputs for the SCALE assessment model. Uncertainty estimates output from the SCALE model are trivial in light of the input uncertainties and downplay the true level of uncertainty in the assessment (and thus the OFL).

Fundamental input uncertainties include estimated growth rates, which appear to be linear with age, rather than slowing and reaching an asymptote as would be expected. Questions have been raised concerning the aging method, which has not been validated. A tagging study currently in progress is expected to help test the aging method. Until the aging method is validated, however, it is imperative that any analyses which incorporate a growth model (e.g. SCALE and yield-per-recruit, both of which play into the OFL) be viewed with caution. Related biological parameters that are poorly understood yet critical for assessment are longevity and natural mortality (M). M was assumed = 0.2 in earlier assessments, but was set to M=0.3 in recent assessments to reflect the apparently differing longevity of males (age 7-9) and females (at least age 12, but probably longer). The estimates of longevity, of course, would be affected by bias in the ageing method.

Other important input uncertainties for the SCALE model include the history of landings and discards. Landings data prior to 1980 were deemed too poorly known for inclusion in the model, so the time period before exploitation began to increase steadily is excluded from the frame of reference. Even for the time period included in the model, landings data are probably significantly under-reported at least until the mid-1990s. Discard estimates are not available on a yearly basis until the mid-1990s, and not at all before 1989.

In addition to the input uncertainties, the population models for both areas exhibit retrospective patterns in the output. These are strongest for 2002-2006 terminal years, weaker for the 2007-2008 terminal years, and stronger in general for the northern area. No corrections for retrospective patterns were made to the population estimates because the retrospective pattern shifted over time, making it unclear what correction might be appropriate. The projections are based on output from the SCALE model, and thus are subject to the same uncertainties described above for the SCALE model.

The bottom line from this discussion is that the monkfish assessment has a number of serious sources of uncertainty, and though the SCALE model represents a step forward as it integrates data from many sources, the results should be used very conservatively in developing overfishing limits. One approach to addressing this uncertainty is to use historical landings coupled with survey index trends as a reality check on the estimate of ABC.

## Projections

SARC 50 performed a number of projection runs using SCALE model results and AGEPRO to evaluate stock trends during 2011-2016. Of note is the SARC 50 comment that “uncertainty in the current state for the northern management area makes it difficult to predict stock dynamics in that area.” Projections were done using  $F_{\text{threshold}}$  and proposed Annual Catch Targets (ACTs) from Amendment 5, as well as ABCs based on the values calculated for Amendment 5 (interim control rule and DPWG biomass estimates from 2007), Table 3 (NMA) and Table 5 (SMA).

In addition, at the Council’s request, the PDT ran two projections to compare an alternative ACT (13,988 mt) option for the NMA with the proposed ACT (10,750 mt). These runs (Table 4) show the probabilities that total biomass will be below  $B_{\text{threshold}}$ , as calculated in 2007 (Bloss 2007) and updated with data through 2009 (Bloss 2009). The PDT did not run these projections against the  $B_{\text{threshold}}$  recommended by SARC 50, because it ran the projections prior to the release of the final assessment report. These projections also show the probability that  $F$  will exceed the updated  $F_{\text{threshold}}$  ( $F_{\text{max}}$ ).

## Northern Management Area Projection Table

Annual P relative to BRP                      Catch and Biomass in Metric tons

**Basis for Projection = Proposed ACT**

Year	F	Total Catch	Total Biomass	P < 0.5*Bmax	P > Fmax
2010	0.10	4,447	74,102	0%	0%
2011	0.22	10,750	81,907	0%	0%
2012	0.22	10,750	81,204	0%	0%
2013	0.22	10,750	80,225	0%	0%
2014	0.23	10,750	78,944	0%	0%
2015	0.24	10,750	77,548	0%	0%
2016	0.24	10,750	76,383	0%	0%

**Basis for Projection = Proposed ABC**

Year	F	Total Catch	Total Biomass	P < 0.5*Bmax	P > Fmax
2010	0.10	4,447	74,102	0%	0%
2011	0.38	17,485	81,907	0%	4%
2012	0.44	17,485	73,769	0%	52%
2013	0.54	17,485	64,796	0%	94%
2014	0.71	17,485	55,815	0%	99%
2015	1.01	17,485	46,871	0%	100%
2016	1.69	17,485	37,631	12%	100%

**Basis for Projection = Fthreshold**

n/a = not applicable

Year	F	Total Catch	Total Biomass	P < 0.5*Bmax	P > Fmax
2010	0.10	4,447	74,102	0%	0%
2011	0.43	19,557	81,907	0%	n/a
2012	0.43	16,553	70,831	0%	n/a
2013	0.43	14,120	62,846	0%	n/a
2014	0.43	12,402	57,627	0%	n/a
2015	0.43	11,384	54,619	0%	n/a
2016	0.43	10,883	53,298	0%	n/a

**Table 3 SARC 50 projections of NMA under Amendment 5 proposed ACT and interim ABC catch, and under Fmax**

<b>ACT Option 2</b>						
<b>Year</b>	<b>F</b>	<b>Total Catch</b>	<b>Total Biomass</b>	<b>P &lt; Bloss2006</b>	<b>P &lt; Bloss2009</b>	<b>P &gt; Fmax</b>
2010	0.10	4,447	74,102	5%	0%	0%
2011	0.22	10,750	81,907	0%	0%	0%
2012	0.22	10,750	81,204	1%	0%	0%
2013	0.22	10,750	80,225	2%	0%	0%
2014	0.23	10,750	78,944	4%	0%	0%
2015	0.24	10,750	77,548	8%	0%	0%
2016	0.24	10,750	76,383	14%	0%	0%
<b>ACT Option 3</b>						
<b>Year</b>	<b>F</b>	<b>Total Catch</b>	<b>Total Biomass</b>	<b>P &lt; Bloss2006</b>	<b>P &lt; Bloss2009</b>	<b>P &gt; Fmax</b>
2010	0.10	4,447	74,102	5%	0%	0%
2011	0.29	13,988	81,907	0%	0%	0%
2012	0.31	13,988	77,383	3%	0%	0%
2013	0.35	13,988	72,578	15%	0%	6%
2014	0.39	13,988	67,610	39%	0%	26%
2015	0.44	13,988	62,744	60%	1%	54%
2016	0.51	13,988	58,098	73%	5%	71%

**Table 4. Projections of the impact of NMA ACT Option 2 (10,750 mt) and Option 3 (13,988 mt) on F and Total Biomass. Also shown are probabilities that total biomass will be below Bthreshold, as calculated in 2007 (Data Poor Working Group) and updated with data through 2009, and the probability that F will exceed Fthreshold (Fmax).**

**Southern Management Area Projection Table**

**Annual P relative to BRP Catch and Biomass in Metric tons**

**Basis for Projection = Proposed ACT**

<b>Year</b>	<b>F</b>	<b>Total Catch</b>	<b>Total Biomass</b>	<b>P &lt; 0.5*Bmax</b>	<b>P &gt; Fmax</b>
2010	0.07	6,235	131,344	0%	0%
2011	0.13	11,469	132,243	0%	0%
2012	0.14	11,469	126,295	0%	0%
2013	0.15	11,469	121,055	0%	0%
2014	0.16	11,469	116,674	0%	0%
2015	0.17	11,469	113,979	0%	0%
2016	0.17	11,469	113,777	0%	0%

**Basis for Projection = Proposed ABC**

<b>Year</b>	<b>F</b>	<b>Total Catch</b>	<b>Total Biomass</b>	<b>P &lt; 0.5*Bmax</b>	<b>P &gt; Fmax</b>
2010	0.07	6,235	131,344	0%	0%
2011	0.15	13,326	132,243	0%	0%
2012	0.16	13,326	124,255	0%	0%
2013	0.18	13,326	114,149	0%	0%
2014	0.20	13,326	111,160	0%	0%
2015	0.22	13,326	107,047	0%	0%
2016	0.23	13,326	105,443	0%	0%

**Basis for Projection = Fthreshold**

**n/a = not applicable**

<b>Year</b>	<b>F</b>	<b>Total Catch</b>	<b>Total Biomass</b>	<b>P &lt; 0.5*Bmax</b>	<b>P &gt; Fmax</b>
2010	0.07	6,235	131,344	0%	0%
2011	0.46	36,245	132,243	0%	n/a
2012	0.46	25,171	99,182	0%	n/a
2013	0.46	18,484	80,735	0%	n/a
2014	0.46	15,033	72,167	0%	n/a
2015	0.46	13,857	69,597	0%	n/a
2016	0.46	13,878	69,949	0%	n/a

**Table 5 SARC 50 projections of SMA under Amendment 5 proposed ACT and interim ABC catch, and under Fmax**