C. GULF OF MAINE (GOM) WINTER FLOUNDER ASSESSMENT SUMMARY FOR 2011

State of Stock:
The assessment of GOM winter flounder stock is based on an empirical swept-area model utilizing data from the 2010 NEFSC fall survey, the MADMF fall survey, and the Maine-New Hampshire fall inshore survey. Using a survey trawl efficiency value of 0.6 the estimated stock biomass in 2010 of fish greater than 30 cm was 6,341 mt (80% CI 4,230 - 8,800 mt). The overfished status remains unknown because a biomass reference point or proxy could not be determined and an analytical assessment model was not accepted.

In 2010 overfishing was not occurring for the stock (Figure C1). A proxy BRP value of the overfishing threshold was derived from a length-based yield per recruit analysis that assumes all fish above 30 cm are fully recruited to the fishery and that natural mortality is 0.3. Using $F_{40\%}$ (0.31) as a proxy for F_{MSY}, the corresponding threshold exploitation rate is 0.23. The overfishing status is based on the ratio of 2010 catch (195 mt) to survey based swept area estimate of biomass for winter flounder exceeding 30 cm in length (6,341 mt). Exploitation rate in 2010 was estimated at 0.03 (80% CI 0.02 - 0.05), which is less than the threshold exploitation rate (0.23). The conclusion that overfishing was not occurring in 2010 is robust to the range of uncertainty in the biomass estimate (Figures C7 and C8).

The biomass estimate for 2010 is 16% lower than that for 2009 using the same survey methods but this difference is not statistically significant (Figures C3 and C5).

The most recent biological reference points for this stock were F_{MSY}=0.43 and B_{MSY}=4,100 mt; these estimates came from the assessment at SARC 36 in 2003. It is not appropriate to compare the 2010 exploitation rate and stock size estimates to those earlier BRP values which should no longer be used.

Projections: Projections were not possible.

Catch: Commercial landings were near 1,000 mt from 1964 to the mid 1970s. Thereafter commercial landings increased to a peaked of 2,793 mt in 1982, and then steadily declined to 350 metric tons (mt) in 1999 (Figure C2). Landings have been near 650 mt from 2000 to 2004 and about 300 mt from 2005 to 2009. Landings have declined to a record low of 140 mt in 2010. Recreational landings reached a peak in 1981 with 2,554 mt but declined substantially thereafter. Recreational landings have generally been less than 100 mt since 1994, with exception of 2008 where the landings were estimated at 103 mt. A discard mortality of 15% was assumed for recreational discards. Discards were estimated for the large mesh trawl (1982-2010), gillnet (1986-2010), and northern shrimp fishery (1982-2010). A discard mortality of 50% was assumed for commercial fishery. In general the total discards are a small percentage (time series average 11%) of the total catch (Figure C2). There has been a substantial decline in the total catch compared to the early 1980s (recent catch is roughly 5% of the 1980s catch).

Catch Table (weights in 000s mt,): GOM Winter Flounder

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Max[1]	Min[1]	Mean[1]
Commercial landings	0.7	0.7	0.8	0.6	0.3	0.2	0.3	0.3	0.3	0.1	2.8	0.1	0.9
Commercial discards	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.4	<0.1	0.1
Recreational landings	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	<0.1	3.0	<0.1	0.5
Recreational discards	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Catch used in assessment	0.8	0.7	0.8	0.7	0.4	0.2	0.3	0.4	0.4	0.2	6.2	0.2	1.3

1: Over the period 1982-2010

Stock Distribution and Identification: Winter flounder (*Pseudopleuronectes americanus*) is a demersal flatfish species commonly found in North Atlantic estuaries and on the continental shelf. The species is distributed between the Gulf of St. Lawrence, Canada and North Carolina, U.S., although it is not abundant south of Delaware Bay. Gulf of Maine winter flounder undergo annual migrations from estuaries and near shore areas, where spawning occurs in the late winter and early spring, to offshore shelf areas of less than 60 fathoms (110 meters). The current Gulf of Maine stock extends from the coastal shelf east of Provincetown, MA northward to the Bay of Fundy, including NEFSC statistical areas 511-515.

Data and Assessment: GOM winter flounder models developed in ADAPT VPA, SCALE, and ASAP (NFT 2011) were too unreliable for stock status determination. The population models have difficulty with the conflicting data trends within the assessment, specifically the large decrease in the catch over the time series with very little change in the indices or age structure in both the catch and surveys. A new value for natural mortality has been adopted, changing from M = 0.20 to M = 0.30 which was used in the estimation of the $F_{40\%}$ reference point. A combined survey 30+ cm biomass area swept estimate using the NEFSC, MADMF and the Maine-New Hampshire surveys was used to estimate biomass. The fall surveys were selected over the spring surveys because some portion of the stock is located within estuaries, which are not surveyed during the spring.

Uncertainty in the individual estimates of survey abundance and swept area trawl footprints were characterized empirically and used to construct an overall estimate of uncertainty in the aggregate biomass estimate. The efficiency value of 0.6 was supported by comparison of VPA estimates of efficiency for the Georges Bank winter flounder while making the assumption that the same fraction of each stock is available to the respective surveys. The NEFSC fall survey (expressed in Albatross equivalents) had an efficiency estimate of 0.3. Calibration experiments between the FSV Bigelow and the R/V Albatross revealed a biomass conversion coefficient of ~2. Thus an efficiency estimate for the Bigelow survey estimate in 2010 of 0.6 was supported. An analysis of catch rates in overlapping areas by the NEFSC and MADMF surveys demonstrated similar catchabilities for winter flounder by the two surveys. Sensitivity analyses were conducted with efficiencies of 0.8 and 1.0. The sampling distributions of biomass and fishing mortality are approximated by integrating over the factors which constitute the primary sources of uncertainty. These factors include the sampling variability in the NEFSC, MADMF and the Maine-New Hampshire spring and fall bottom surveys for 2009 and 2010. The second major source of variability for the survey estimates is the variation in the size of the area swept by an average tow.

Biological Reference Points (BRP): Biological reference points for stock biomass are unknown.

A proxy value of the overfishing threshold was derived for the 2011 assessment from a length-based yield per recruit (NFT 2011) analysis that assumes all fish above 30 cm are fully recruited to the fishery and that natural mortality is 0.3 (Figure C4). Von Bertalanffy parameters were estimated from the spring and fall NEFSC survey age data (n = 2,035) from 2006 to 2010. Maturity at length information is estimated from the spring MDMF survey (L_{50}=29cm). The reference points were converted to exploitation rates to be consistent with the swept area biomass approach. Using $F_{40\%}$ (0.31) as a proxy for F_{MSY}, the corresponding threshold exploitation rate is 0.23. This serves as a proxy for the overfishing threshold (Figure C1). Current practice is to set catch advice based on 75% F_{MSY}. 75% of the estimated $F_{40\%}$ exploitation rate is 0.17. The previous estimates of F_{MSY} (from SARC 36 in 2003) used an M of 0.2 and observed average weights at age.

MSY could not be estimated.

Fishing Mortality: Exploitation rate in 2010 was estimated at 0.03 (80% CI 0.02 - 0.05) using the 2010 ratio of catch (195 mt) to the 30+ area swept biomass (6,341 mt; 80% CI 4,230 - 8,800 mt) from the fall surveys (Figure C6). An assumed efficiency of 60% was used to construct this estimate from the NEFSC fall survey, the MADMF fall survey, and the Maine-New Hampshire fall inshore survey.

Recruitment: Recruitment is unknown.

Spawning Stock Biomass: Spawning stock biomass is unknown.

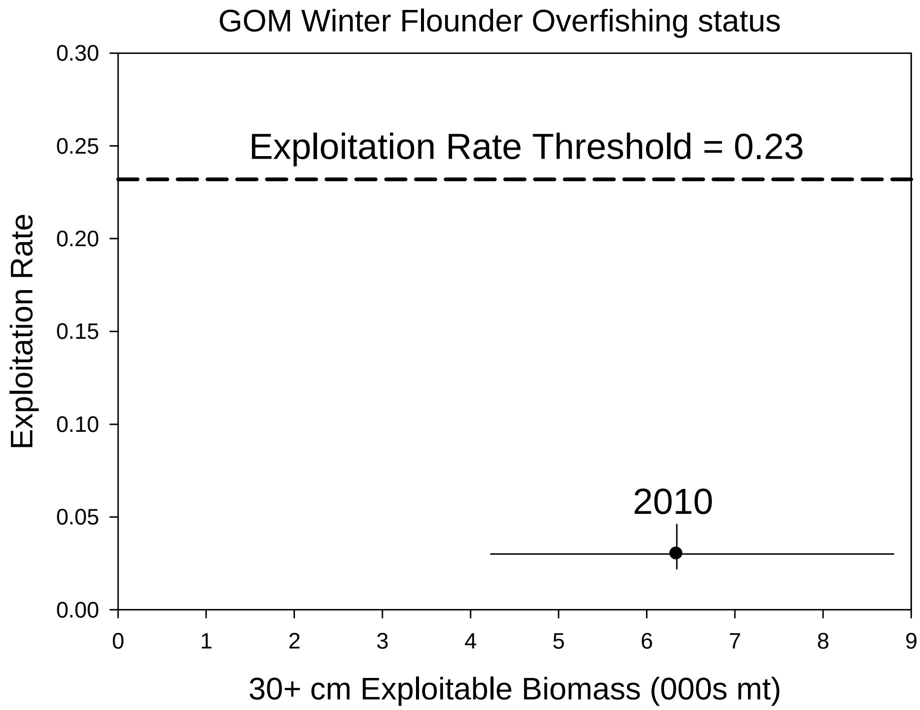
Special Comments: There is considerable uncertainty with the GOM winter flounder assessment. There was a major effort to develop an ASAP assessment model for GOM winter flounder; however, no version of the model was satisfactory. The attempted analytical models had difficulty estimating population scale due to the conflicting data trends within the assessment, specifically the large decrease in the catch over the time series with very little change in the indices or age structure in both the catch and surveys. The scaling of the population estimates was sensitive to the weighting imposed on the catch at age compositions. The ASAP model did allow errors in the fit to the catch at age and improved fit to the survey indices without the split in survey catchability (See GARM III). However this resulted in a lack of fit to the plus group in the catch at age composition. The stock assessment report will summarize the ASAP model application, but its results are not used for the determination of stock status.

An analytic assessment was not accepted in GARM III (NEFSC 2008) resulting in the status of the stock being unknown in 2008.

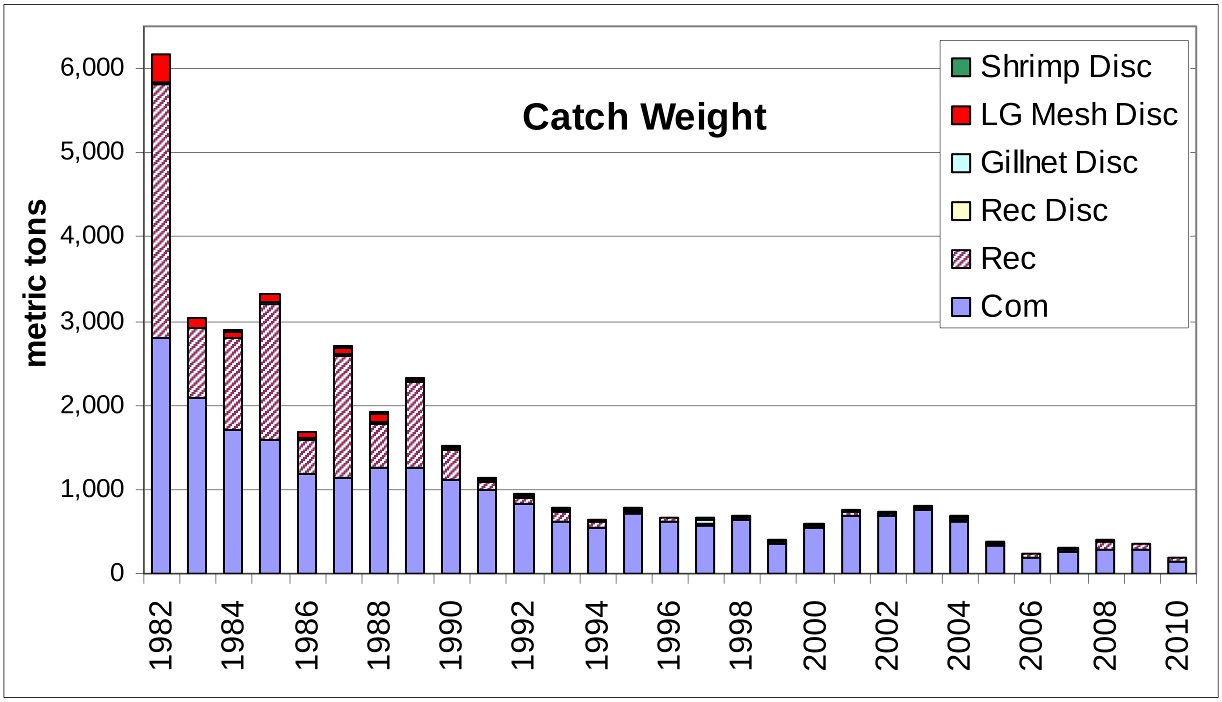
References:

NEFSC. 2008. Assessment of 19 Northeast groundfish stocks through 2007. Report of the 3rd Groundfish Assessment Review Meeting (GARM III), Northeast Fisheries Science Center, Woods Hole, Massachusetts. Aug. 4-8, 2008. NEFSC Ref Doc. 08-15. 884 p.

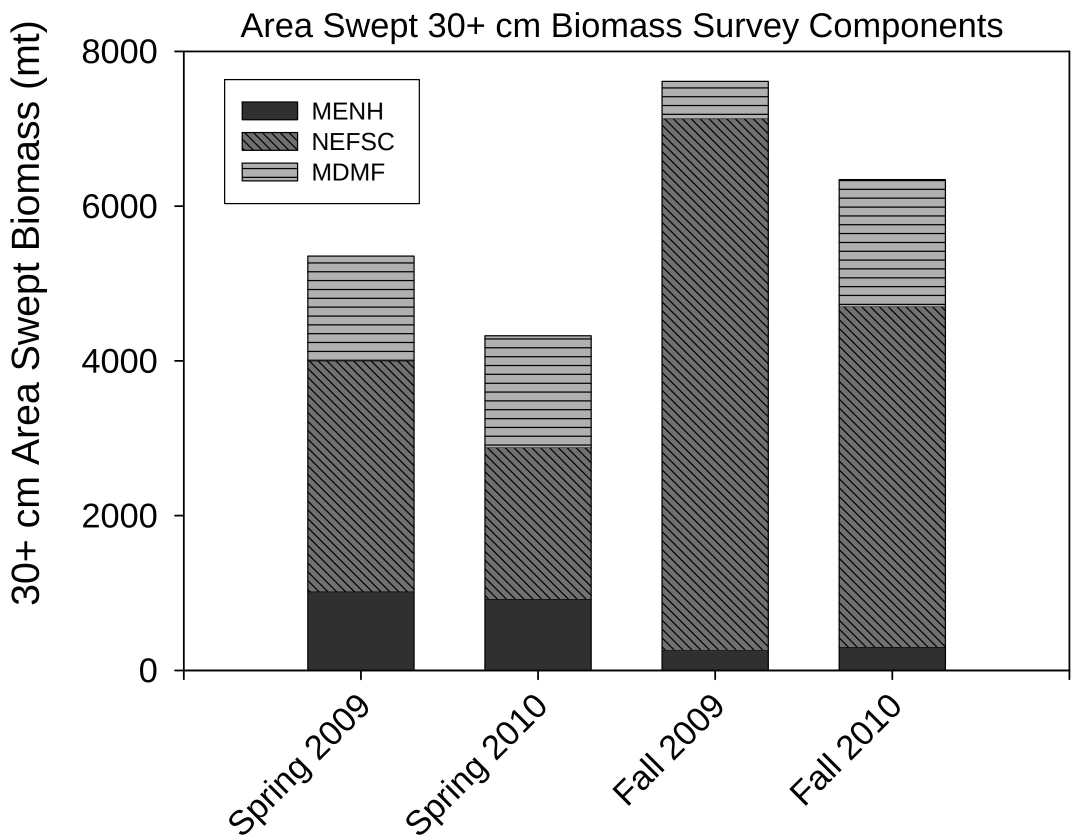
NOAA Fisheries Toolbox (NFT) 2011. [Internet address: http://nft.nefsc.noaa.gov/].



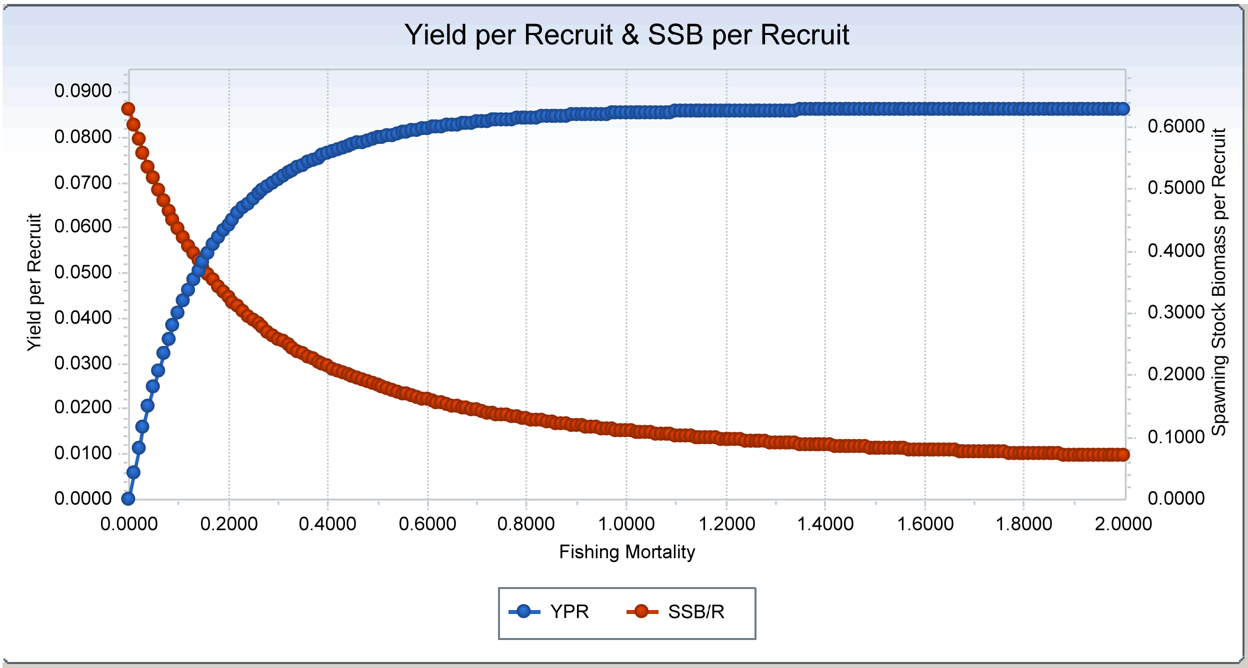
C1. Stock status for GOM winter flounder in 2010 with respect to a proxy for F_{MSY}. 80% confidence intervals are shown for biomass and exploitation rate. $F_{40\%} = 0.31$, which corresponds to an exploitation rate of 0.23.



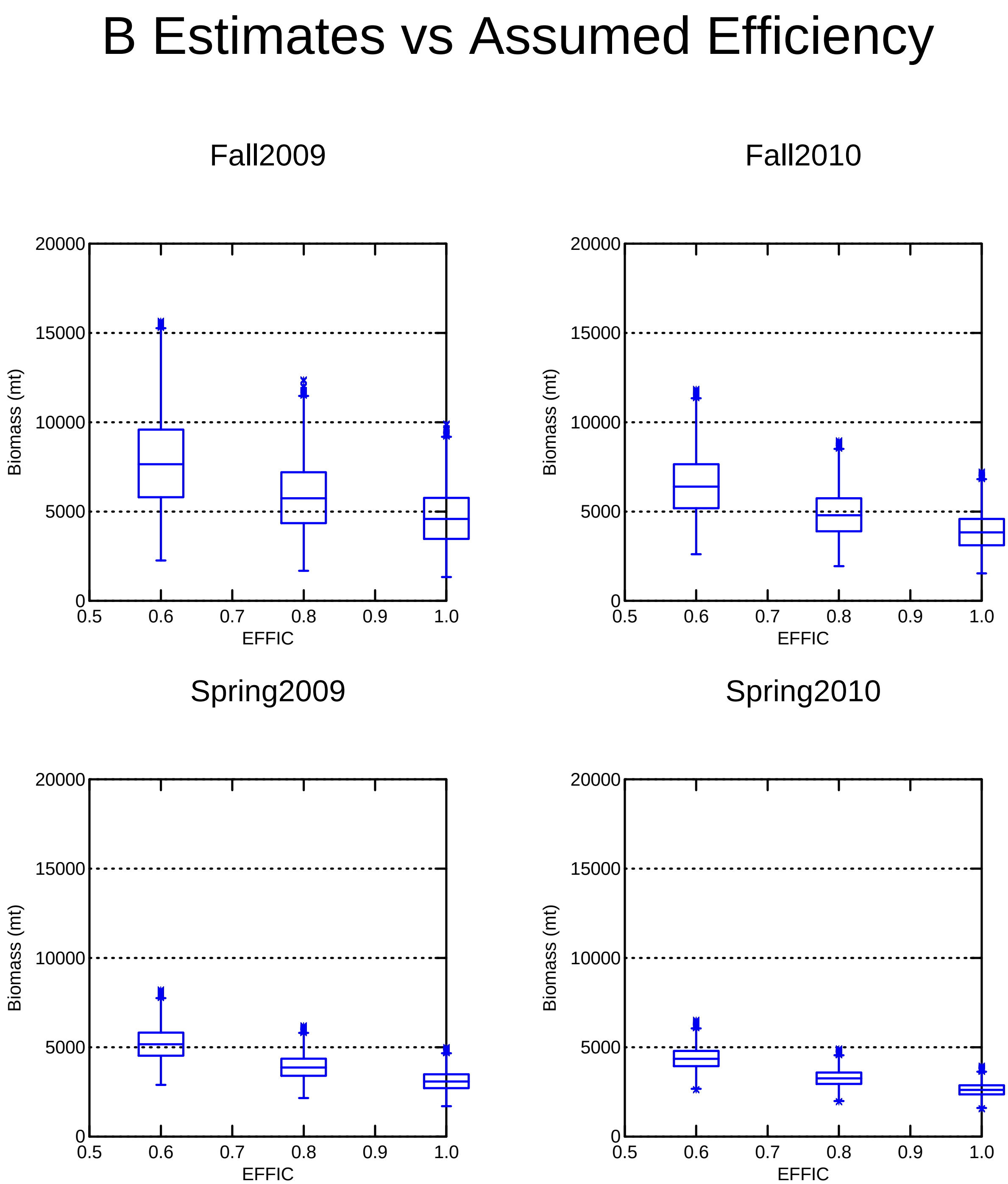
C2. GOM winter flounder composition of the catch by weight in metric tons from 1982 to 2010.



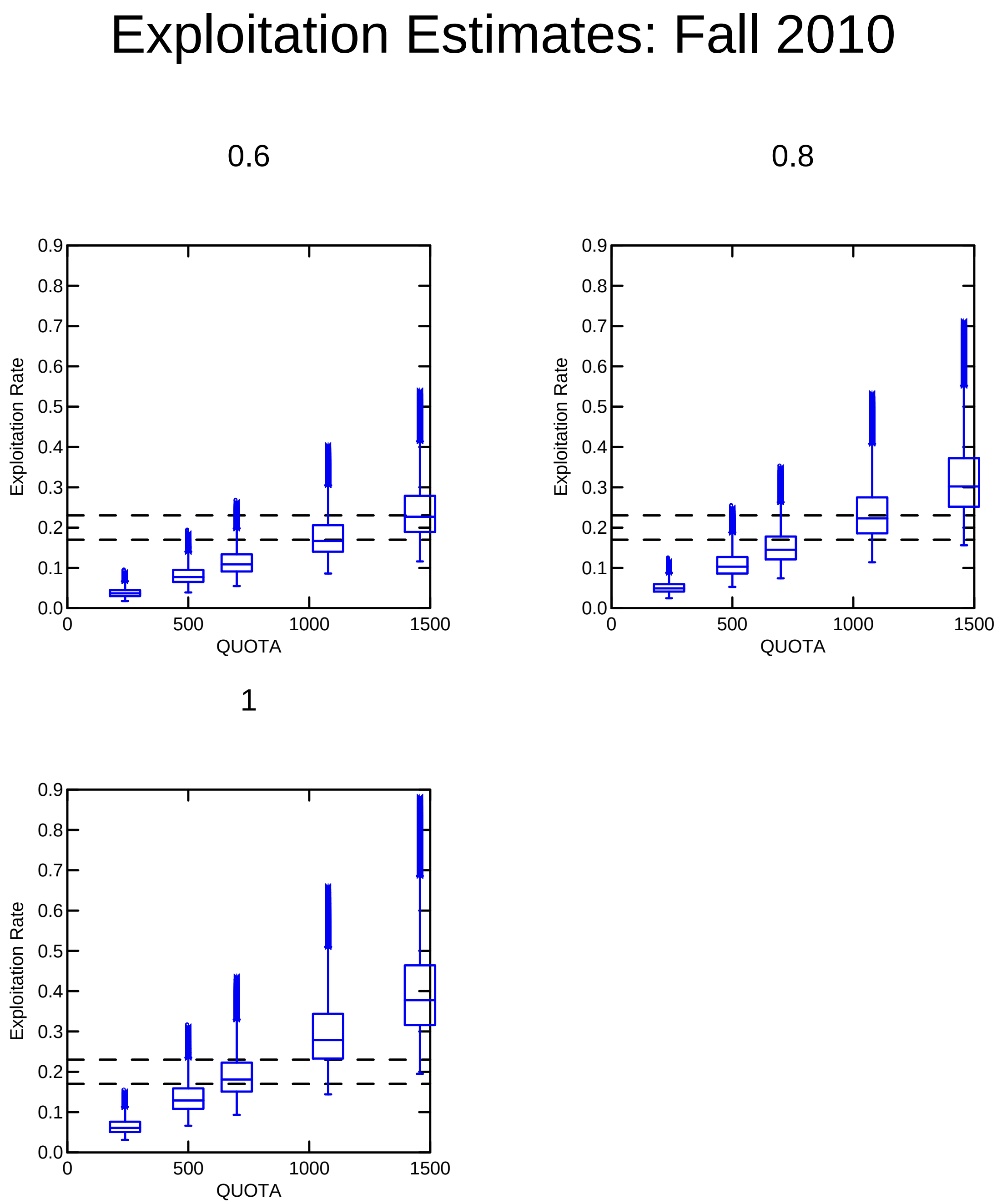
C3. 30+ cm area swept biomass estimates for the spring and fall surveys from 2009 to 2010 assuming efficiency is 0.6. The NEFSC survey used a TOGA tow criteria of 132x.



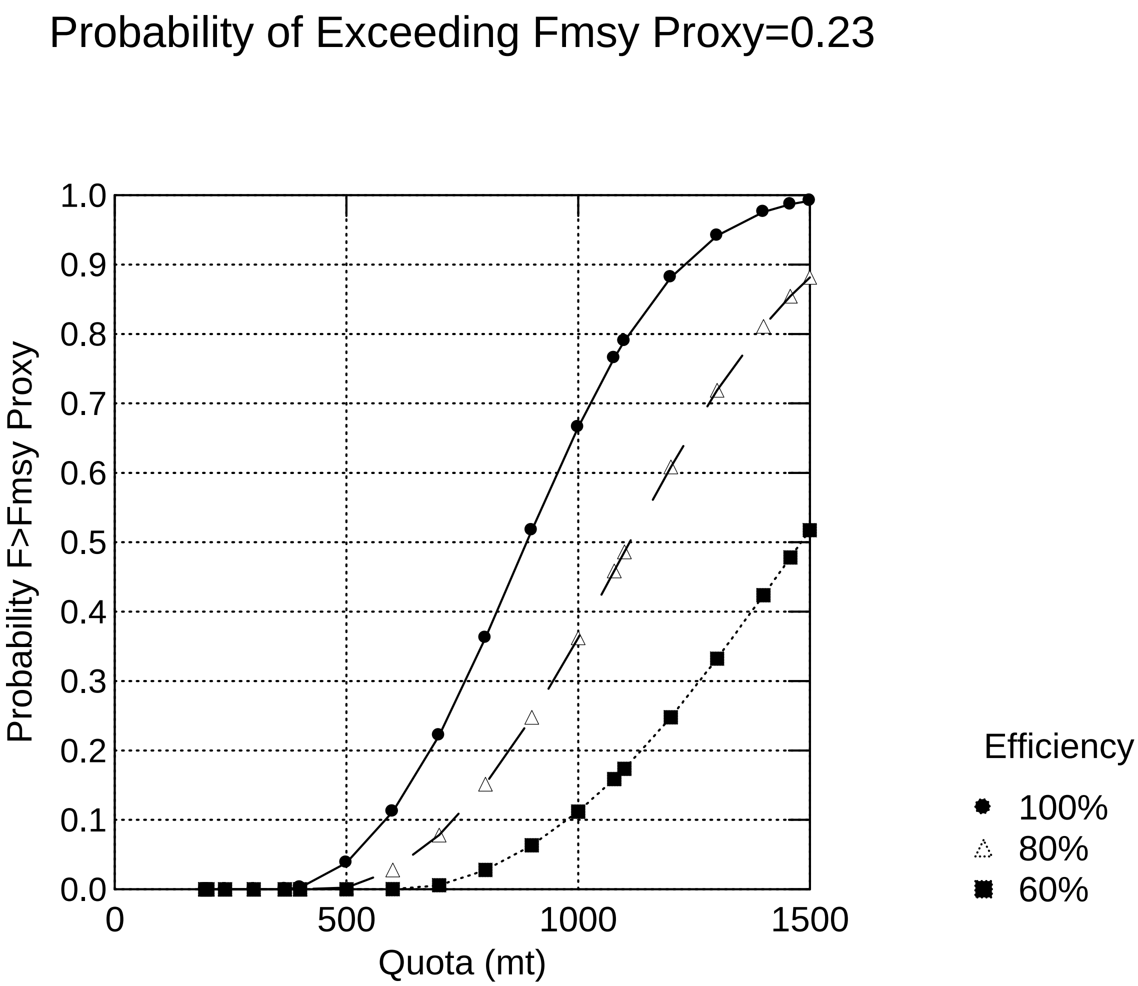
C4. Length-based yield per recruit analysis using von Bertalanffy parameters estimated from the spring and fall 2006-2010 NEFSC surveys, maturity at length from the MDMF survey and assuming a natural mortality of 0.3. $F_{40\%}$ was estimated at 0.31. The SSB/R line (red) decreases as F increases.



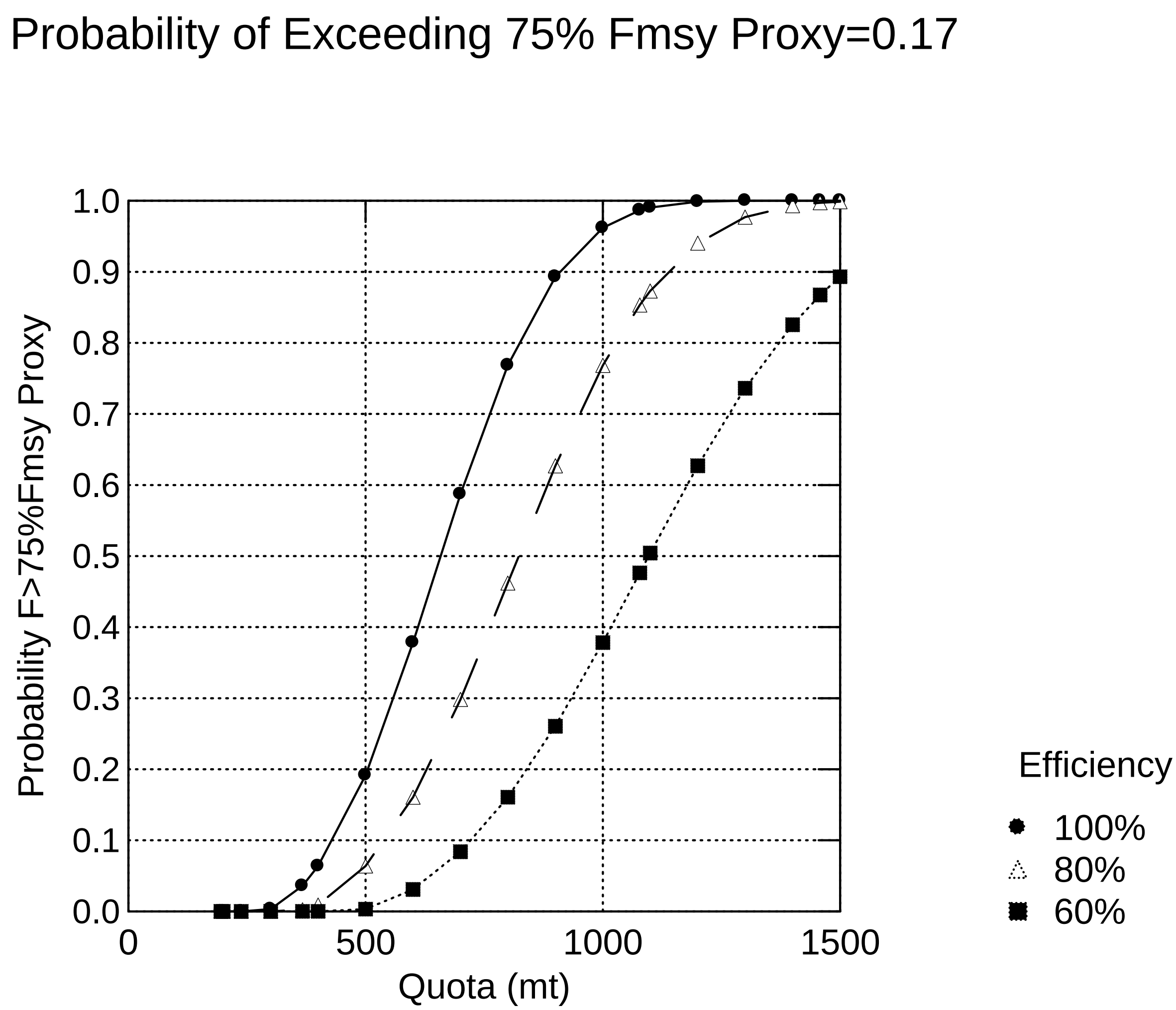
C5. Sensitivity of swept area 30+ cm biomass estimates for Gulf of Maine winter flounder for varying seasons and years under three alternative assumed values of trawl efficiency for all three surveys**.**



C6. Estimated exploitation rates for Gulf of Maine winter flounder for Fall 2010 based on three assumed gear efficiencies (0.6, 0.8, and 1.0) and 5 levels of catch (the 2010 catch of 195 mt, an assumed quota of 500 mt, assumed quota of 700 mt, 75% OFL of 1,078 mt and the OFL of 1,458 mt based on $F_{40\%}$). Dashed lines represent length-based exploitation rate estimates of $F_{40\%}$ (0.23) and 75% of $F_{40\%}$ (0.17). SSB per recruit is derived using GOM winter flounder growth and maturation relationships and an assumed knife edge selection curve at 30 cm.



C7. Estimated probability of exceeding F_{MSY} proxy ($F_{40\%}$), expressed as an exploitation rate of 0.23, and assuming efficiencies of 60%, 80% and 100% based of the fall 2010 survey across a range of quotas.



C8. Estimated probability of exceeding 75% of F_{MSY} proxy ($F_{40\%}$), expressed as an exploitation rate of 0.17, and assuming efficiencies of 60%, 80% and 100% based of the fall 2010 survey across a range of quotas.