draft working paper for peer review only

Cape Cod-Gulf of Maine Yellowtail flounder

2015 Assessment Update Report

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Science Center
Woods Hole, Massachusetts

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State of Stock: Based on this updated assessment, Cape Cod-Gulf of Maine Yellowtail flounder (*Limanda ferruginea*) stock is overfished and overfishing is occurring (Figures 1-2). Spawning stock biomass (SSB) in 2014 was estimated to be 1,695 (mt) which is 32% of the biomass target for an overfished stock (SSB_{MSY} *proxy* = 5,259; Figure 1). The 2014 fishing mortality (average for ages 4-5) was estimated to be 0.35 which is 125% of the overfishing threshold proxy (F_{MSY} *proxy* = 0.28; Figure 2).

Table 1: Catch and model results for Cape Cod-Gulf of Maine Yellowtail flounder. All weights are in (mt) recruitment is in (000s) and F_{Full} is the average fishing mortality on fully selected ages (ages 4 and 5). Model results are from the current updated VPA assessment.

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
					Data					
Commercial discards	282	85	141	156	175	87	74	146	86	54
Commercial landings	715	534	492	543	464	546	684	946	590	421
Total Catch for Assessment	997	620	633	699	639	633	758	1,092	676	475
					Model Results					
Spawning Stock Biomass	687	668	789	944	1,120	1,474	1,659	1,285	1,179	1,695
F_{Full}	1.68	1.48	1.06	1.16	0.75	0.49	0.65	0.98	0.82	0.35
Recruits $age1$	2,927	3,593	3,458	3,816	4,151	3,542	3,332	4,666	8,013	10,268

Table 2: Comparison of reference points estimated in an earlier assessment and from the current assessment update. An $F_{40\%}$ proxy was used for the overfishing threshold and was based on long-term stochastic projections. The medians and 90% probability intervals are reported for MSY and SSBMSY. The median recruits is descriptive and does not reflect the RMSY proxy.

	2012	Current
F_{MSY} *proxy*	0.26	0.28
SSB_{MSY} (mt)	7,080	5,259 (3,950 - 7,412)
MSY (mt)	1,720	1,285 (968 - 1,806)
Median recruits (age 1) (000s)	7,279	6,562
Overfishing	Yes	Yes
Overfished	Yes	Yes

Projections: Short term projections of biomass were derived by sampling from a cumulative distribution function of recruitment estimates from ADAPT VPA. Recruitment estimates were hindcasted based on a simple linear regression between the NEFSC Fall survey abundance at age 1 and the VPA estimate at age 1. The most recent two years (2013 and 2014) were not included in the series of values due to high uncertainty in these estimates. This resulted in a total of 36

recruitment values: 8 from the hindcast predictions (years 1977-1984) and 28 from the VPA (years 1985-2012). The annual fishery selectivity, maturity ogive, and mean weights at age used in projection are the most recent 5 year averages; retrospective adjustments were applied in the projections.

Table 3: Short term projections of total fishery catch and spawning stock biomass for Cape Cod-Gulf of Maine Yellowtail flounder based on a harvest scenario of fishing at F_{MSY} *proxy* between 2017 and 2018. Catch in 2015 was assumed to be 376 (mt).

Year	Catch (mt)	SSB (mt)	F_{Full}
2015	376	1,762 (1,364 - 2,300)	0.276
2016	555 (426 - 750)	2,429 (1,846 - 3,341)	0.279
2017	680 (542 - 892)	2,847 (2,313 - 3,656)	0.279
2018	814 (645 - 1,075)	3,518 (2,706 - 4,832)	0.279

Special Comments:

- What are the most important sources of uncertainty in this stock assessment? Explain, and describe qualitatively how they affect the assessment results (such as estimates of biomass, F, recruitment, and population projections).

  The largest source of uncertainty is the source of the retrospective pattern.This pattern has persisted for a number of years causing SSB estimates to decrease and F estimates to increaseas more years of data are added.

- Does this assessment model have a retrospective pattern? If so, is the pattern strong, moderate, or mild?

  The model has a major retrospective pattern (Mohns rho SSB=0.977, F=-0.445). When applied to the terminal year point estimates ofSSB and F, the rho adjusted values are 2014 SSB rho adjusted=857 mt (49% decrease from the unadjusted SSB) andF rho adjusted= 0.64 (80% increase from the unadjusted F).

- Based on this stock assessment, are population projections well determined or uncertain?

  Population projections for Cape Cod-Gulf of Maine Yellowtail flounder, are uncertain with projected biomass from the last assessmentabove the confidence bounds of the biomass estimated in the current assessment.

- Describe any changes that were made to the current stock assessment, beyond incorporating additional years of data and the affect these changes had on the assessment and stock status.

  No changes, other than the incorporation of new data were made to the Cape Cod-Gulf of Maine Yellowtail flounder assessment for this update. However, commercial discards were increased over the last ten years due to an adjustment in NEFSC discard estimation methodology, but was inconsequential to the assessment results.

- If the stock status has changed a lot since the previous assessment, explain why this occurred.

  The stock status has not changed since the previous assessment.

- Indicate what data or studies are currently lacking and which would be needed most to improve this stock assessment in the future.

  Extensive studies have examined the causes of the retrospective patterns with no definitive conclusions other than a change in modeldoes not resolve the issue.

- Are there other important issues?

  No.

References:

Legault, C, L. Alade, S.Cadrin, J. King, and S. Sherman. 2008. In. Northeast Fisheries Science Center. 2008. Assessment of 19 Northeast Groundfish Stocks through 2007: Report of the 3^{rd} Groundfish Assessment Review Meeting (GARM III), Northeast Fisheries Science Center, Woods Hole, Massachusetts, August 4-8, 2008. US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 08-15; 884 p + xvii. http://www.nefsc.noaa.gov/publications/crd/crd0815/

Legault, C, L. Alade, S.Emery, J. King, and S. Sherman. 2012. In. Northeast Fisheries Science Center. 2012. Assessment or Data Updates of 13 Northeast Groundfish Stocks through 2010. US Dept Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 12-06.; 789 p. http://nefsc.noaa.gov/publications/crd/crd1206/

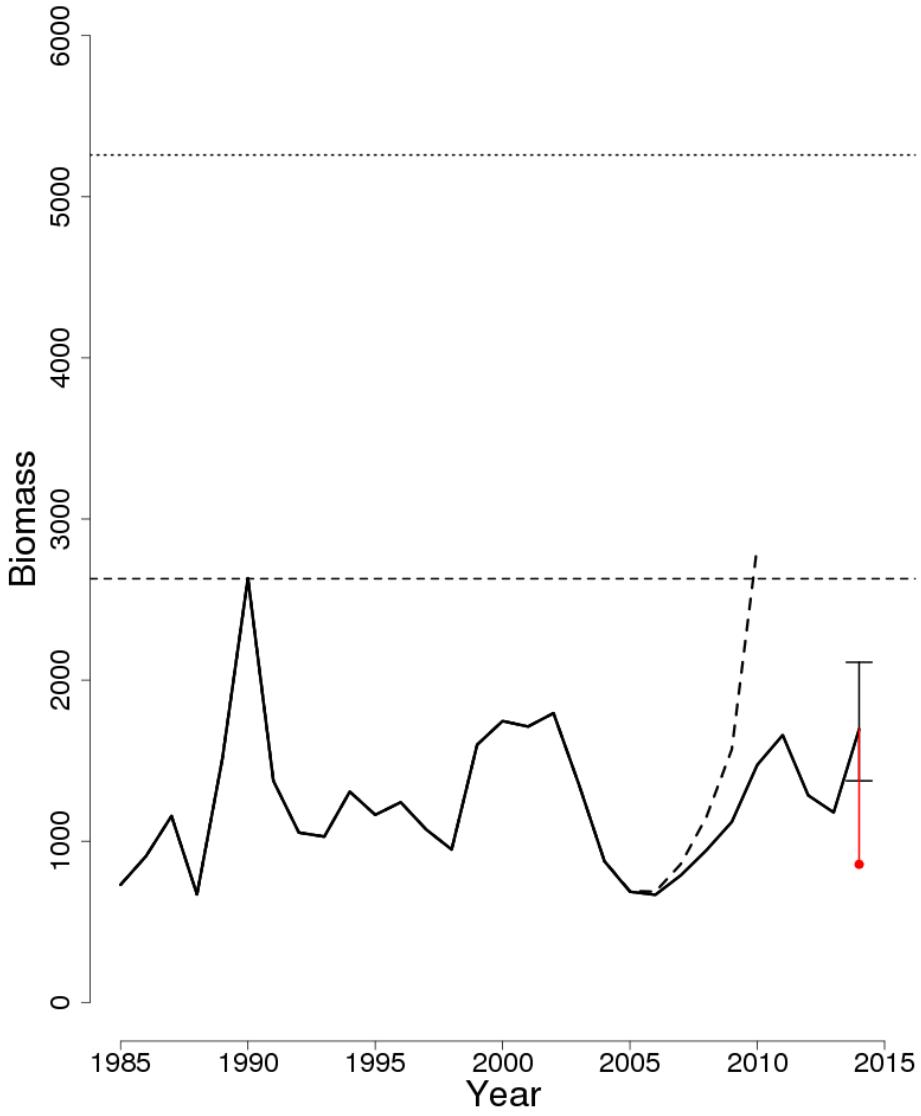

Figure 1: Trends in spawning stock biomass of Cape Cod-Gulf of Maine Yellowtail flounder between 1985 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{Threshold}$ ($\frac{1}{2}$ SSB_{MSY} *proxy*; horizontal dashed line) as well as SSB_{Target} (SSB_{MSY} *proxy*; horizontal dotted line) based on the 2015 assessment. Biomass was adjusted for a retrospective pattern and the adjustment is shown in red. The 90% bootstrap probability intervals are shown.

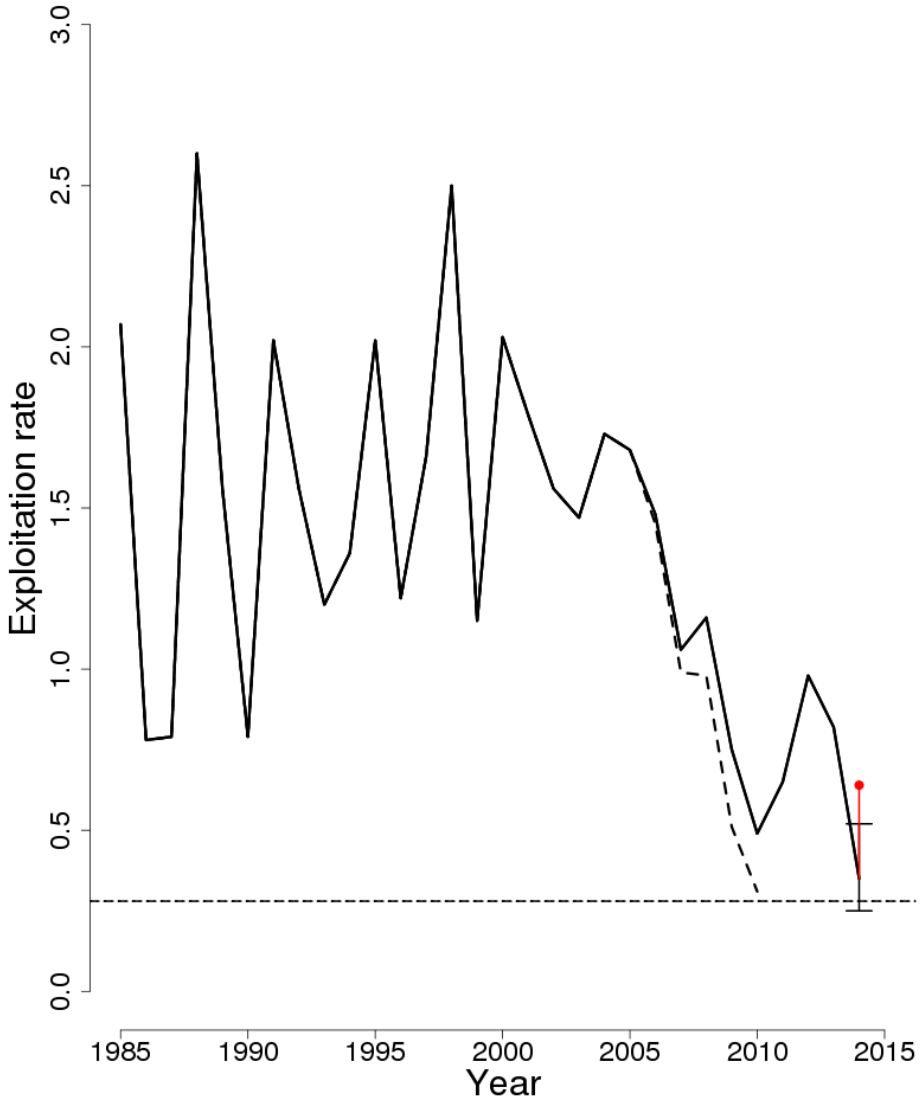

Figure 2: Trends in the fully selected fishing mortality (F_{Full}) of Cape Cod-Gulf of Maine Yellowtail flounder between 1985 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ (F_{MSY} *proxy*=0.28; horizontal dashed line). F_{Full} was adjusted for a retrospective pattern and the adjustment is shown in red based on the 2015 assessment. The 90% bootstrap probability intervals are shown.

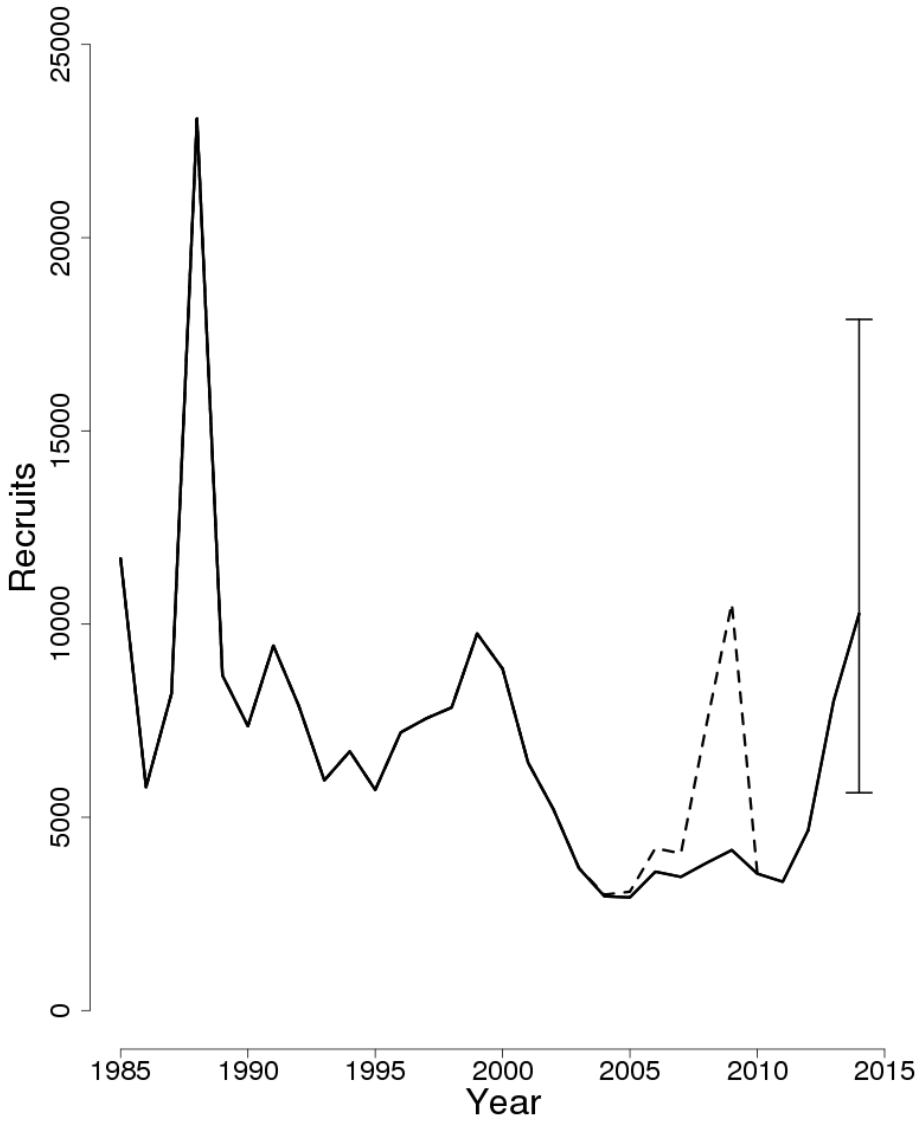

Figure 3: Trends in Recruits (age 1) (000s) of Cape Cod-Gulf of Maine Yellowtail flounder between 1985 and 2014 from the current (solid line) and previous (dashed line) assessment. The 90% bootstrap probability intervals are shown.

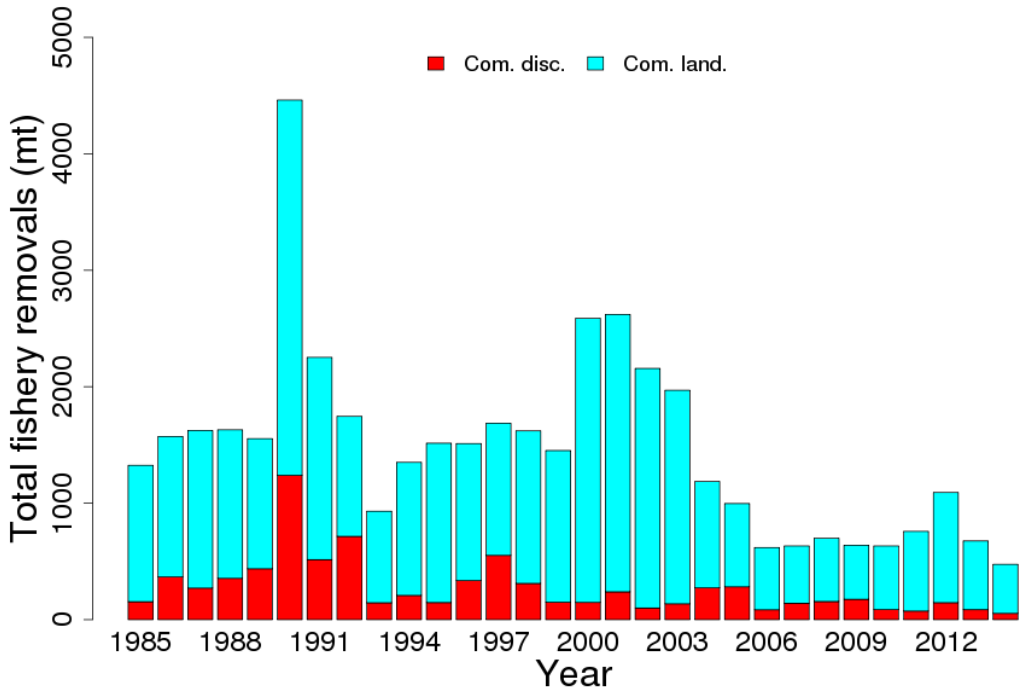

Figure 4: Total catch of Cape Cod-Gulf of Maine Yellowtail flounder between 1985 and 2014 by disposition (landings and discards).

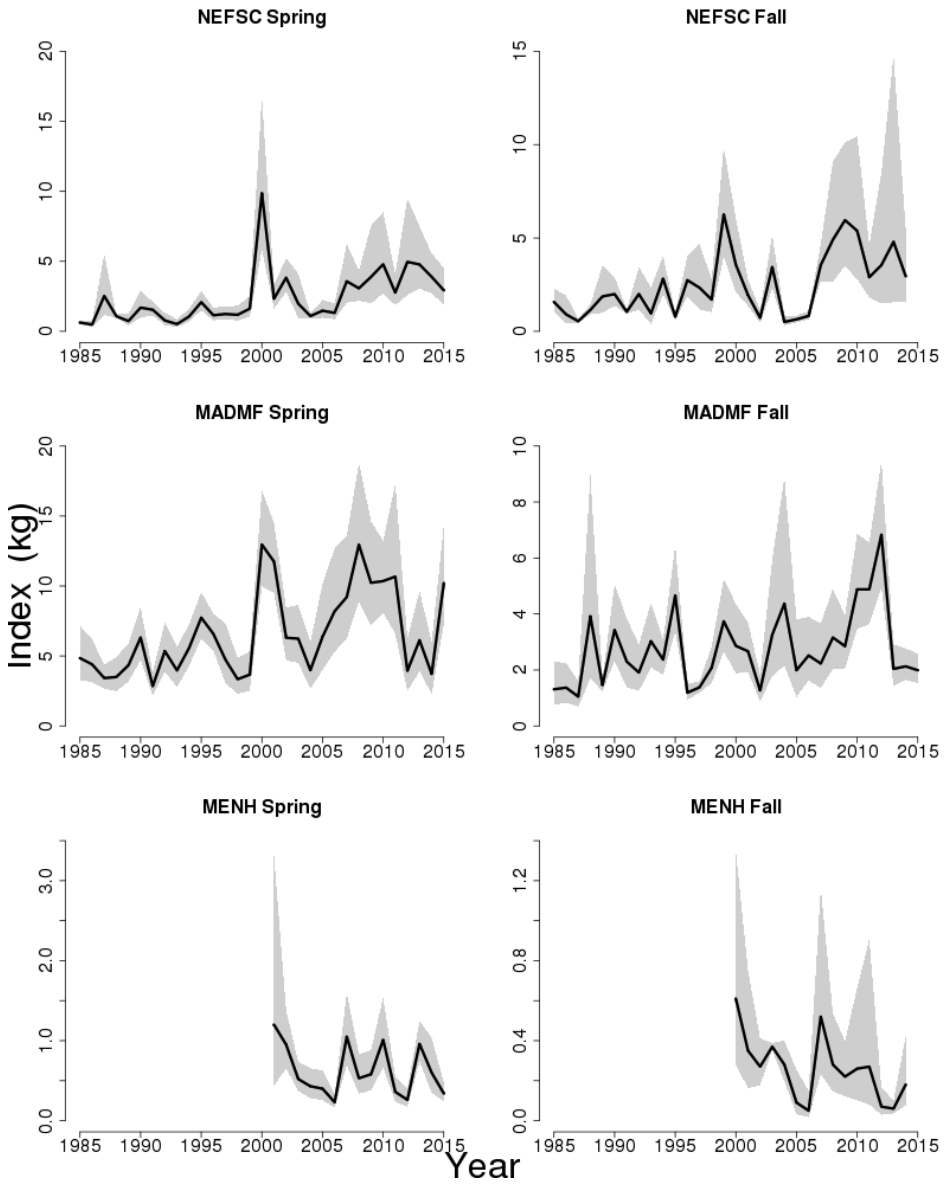

Figure 5: Indices of biomass for the Cape Cod-Gulf of Maine Yellowtail flounder between 1985 and 2015 for the Northeast Fisheries Science Center (NEFSC) spring and fall bottom trawl surveys, Massachusetts Department of Marine Fisheries (MADMF) inshore state spring and fall bottom trawl surveys,and the Maine New Hampshire inshore state spring and fall state surveys The 90% bootstrap probability intervals are shown.