7 Southern New England-Mid Atlantic yellowtail flounder

Larry Alade

This assessment of the Southern New England-Mid Atlantic yellowtail flounder (Limanda ferruginea) stock is an operational assessment update of the existing 2012 benchmark assessment (NEFSC 2012). Based on the last operational assessment (Alade 2015), the stock was overfished and overfishing was occurring. This assessment updates commercial fishery catch data, research survey indices of abundance, weights at age and the analytical ASAP assessment model and reference points through 2016. Additionally, stock projections have been updated through 2020. This report reflects decisions made during the Peer review meeting on September 12, 2017.

State of Stock: Based on this updated assessment, Southern New England-Mid Atlantic yellowtail flounder (*Limanda ferruginea*) stock is overfished and overfishing is occurring (Figures 34-35). Retrospective adjustments were made to the model results. Spawning stock biomass (SSB) in 2016 was estimated to be 152 (mt) which is 8% of the biomass target (SSB_{MSY} *proxy* = 1,860; Figure 34). The 2016 fully selected fishing mortality was estimated to be 1.09 which is 320% of the overfishing threshold proxy (F_{MSY} *proxy* = 0.341; Figure 35).

Table 23: Catch and model results for Southern New England-Mid Atlantic yellowtail flounder. All weights are in (mt) recruitment is in (000s) and F_{Full} is the average fishing mortality on ages (ages 4 and 5). Model results are from the current updated ASAP assessment. Note: Terminal year estimates of SSB and F reflect the unadjusted values for retrospective error.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Data										
Commercial discards	296	391	268	177	145	221	185	109	53	26
Commercial landings	205	192	185	113	243	342	461	516	284	126
Total Catch for Assessment	502	583	453	291	388	563	646	625	337	152
Model Results										
Spawning Stock Biomass	1,433	1,533	1,480	1,614	1,712	1,671	1,437	942	541	300
F_{Full}	0.58	0.51	0.38	0.24	0.32	0.53	0.7	0.84	0.77	0.58
Recruitment (age 1)	2,592	3,981	3,550	3,279	6,502	1,665	1,384	521	326	902

Table 24: 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.

	2015	2017
F_{MSY} *proxy*	0.349	0.341
SSB_{MSY} (mt)	1,959	1,860 (1,149 - 2,725)
MSY (mt)	541	511 (319 - 742)
Median recruitment (age 1) (000s)	7,634	7,242
Overfishing	Yes	Yes
Overfished	Yes	Yes

Projections: Short term projections of biomass were derived by sampling from an empirical cumulative distribution function of 26 recruitment estimates from the ASAP model results. Following the previous and accepted benchmark formulation, recruitment was based on recent estimates of recruitments from the model time series (i.e. corresponding to year classes 1990 through 2015) to reflect the low recent pattern of recruitment in the stock. 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 25: Short term projections of total fishery catch and spawning stock biomass for Southern New England-Mid Atlantic yellowtail flounder based on a harvest scenario of fishing at F_{MSY} *proxy* between 2019 and 2020. Catch in 2017 was assumed to be 90 (mt).

Year	Catch (mt)	SSB (mt)	F_{Full}
2017	90	187 (127 - 272)	0.541

Year	Catch (mt)	SSB (mt)	F_{Full}
2018	45 (28 - 69)	151 (93 - 235)	0.341
2019	81 (44 - 145)	406 (179 - 819)	0.341
2020	186 (84 - 356)	912 (381 - 1,737)	0.341

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).

  Recruitment remains a major source of uncertainty in this assessment. The choice of recruitment assumption (i.e. historical recruitment values or contemporary recruitment values) will influence stock status determination and short-term forecast of the stock. Although, contemporary recruitment is likely to reflect curent conditions for the stock, the underlying mechanism for the recent low recruitment is not clearly understood. Another source of uncertainty is the retrospective pattern that has persisted since the last operational *assessment. It should be noted that this operational assessment resulted in a reduction of retrospective bias(22% for F and 42% for SSB) due to the revision of the 2009-2014 NEFSC survey indices.*

- Does this assessment model have a retrospective pattern? If so, is the pattern minor, or major? (A major retrospective pattern occurs when the adjusted SSB or F_{Full} lies outside of the approximate joint confidence region for SSB and F_{Full}; see Table 8).

  The 7-year Mohn's ρ, relative to SSB, was 1.06 in the 2015 assessment and was 0.98 in 2016. The 7-year Mohn's ρ, relative to F, was -0.53 in the 2015 assessment and was -0.47 in 2016. There was a major retrospective pattern for this assessment because the ρ adjusted estimates of 2016 SSB (SSB_ρ=152) and 2016 F (F_ρ=1.09) were outside the approximate 90% confidence region around SSB (217 - 459) and F (0.362 - 0.843).

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

  Following the panel's recommendation from the 2015 operational assessment to use the Rho unadjusted projections as an upper bound for estimating OFL, the performance of the population projections for Southern New England-Mid Atlantic yellowtail flounder cannot be determined due to different approaches used in the projections for this assessment and the previous operational assessment. Projections in this assessment were Rho adjusted to account for a major retrospective pattern, and therefore is not comparable to the panel's recommendation from 2015 operational assessment.

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

  In addition to data updates through 2016, this assessment revises the NEFSC fall and spring survey data for years 2009-2014 to be consistent with the NEFSC level of acceptable survey tow criteria. The revision to the NEFSC survey indices resulted in a slight upward scaling of estimated spawning stock biomass and a downward scaling of fishing mortality estimates for the recent years in the model (2008-2014). Further, sensitivity analyses were conducted to relax the input variance in the catch data time series as a scalar from a CV = 0.1 to CV = 0.2 to better account for the level of uncertainty in the catch data. Input effective sample sizes for both the catch and survey indices were also modified (See Supplemental information in the data Portal) in attempt to improve the quality of the model fit to the observed data. Overall, the changes in the sensitivity assessment model resulted in an improved model diagnostic (i.e. reduced retrospective bias but minimal difference in model parameter precision estimates). The sensitivity analyses were brought forward to the peer review panel for consideration, but due to the minimal influence of the sensitivity analyses on the assessment results and stock status determination, the panel agreed to accept the base model without changes as basis for catch advice. It was recognized that the range of changes made in the sensitivity model were outside of the scope of permissible changes in an operational assessment framework. However, the panel recommended that future work on the sensitivity analyses (i.e. determinnng the appropriate model weighting) should be pursued as an avenue to potentially improve model disgnostics.

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

  Stock status for Southern New England-Mid Atlantic yellowtail flounder remains *unchanged since the last 2015 operational assessment as overfished and overfishing occuring. Recruitment of young fish continues to be low, resulting in declining trends in the SSB.*

- Provide qualitative statements describing the condition of the stock that relate to stock status.

  Fishing mortality has been declining in recent years but still above the fishing reference point. Recent below average recruitment has resulted in declining Spawning Stock Biomass(SSB) with 2016 SSB lowest in the time series. Spawning Stock Biomass is projected to decrease in the short term, even at current level of catches (Note: 2016 catches was estimated to be second lowest in the time series).

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

  Recruitment of Southern New England-Mid Atlantic yellowtail flounder continues to be weak. Should this pattern of poor recruitment continue into the future, the ability of the stock to recover could be compromised. Therefore, future studies should build on current knowledge to further investigate some of the underlying ecological mechanisms of poor recruitment in the stock as it may relate to the physical environment. Recent studies on evaluating environmental effects on Southern New England yellowtail stock productivity suggest that oceanographic features, such as the cold pool and Gulf Stream are likely important predictors of recruitment (Miller et al.2016, Xu et al. 2017), however the mechanisms driving these predictions are not well known. Other areas of future work should continue to address the retrospective bias, including further work on the sensitivity analyses (i.e. determination of appropriate input data weighting by evaluating the CV and effective sample sizes in the model).

- Are there other important issues?

  None.

7.1 Reviewer Comments: Southern New England-Mid Atlantic yellowtail flounder

Assessment Recommendation:

The panel concluded that the operational assessment with adjustments for retrospective bias was acceptable as a scientific basis for management advice. The panel received an initial presentation for this stock exploring sensitivity to data-weighting in the model. However, the panel felt that these changes exceeded what was stated as permissible in this operational assessment cycle. Further, the results of the two methods were nearly identical; thus, the panel recommends the original base model be used for management advice.

Alternative Assessment Approach:

Not applicable

Status Recommendation:

Based on this operational assessment, the panel agrees with the conclusion that the Southern New England-Mid Atlantic yellowtail flounder stock is overfished and overfishing is occurring. Recent below average recruitment has resulted in declining spawning stock biomass. Spawning stock biomass is projected to decrease in the short term, even at current level of catches (2016 catch was estimated to be the second lowest in the time series). Recruitment of Southern New England-Mid Atlantic yellowtail flounder continues to be weak and if this pattern of poor recruitment continues into the future, the ability of the stock to recover could be compromised.

Key Sources of Uncertainty:

Underlying mechanisms for the recent low recruitment is not clearly understood. Another source of uncertainty is the retrospective pattern that has persisted since the last operational assessment. Catchability is a source of uncertainty. Catchability estimates derived from the cooperative research study are substantially different from those estimated in this assessment.

Research Needs:

The panel recommends future studies that build on current knowledge to further investigate some of the underlying ecological mechanisms of poor recruitment in the stock as it may relate to the physical environment. Recent studies that evaluated environmental effects on Southern New England yellowtail productivity suggest that oceanographic features, such as the cold pool and Gulf Stream are likely important predictors of recruitment. Future work should continue to address the retrospective bias, including the proposed changes to the catch CV and effective sample sizes that were provided in the initial assessment presentation, among other factors. Finally, the panel recommends further research and consideration of survey catchability estimates.

References:

Alade, L, C. Legault, S. Cadrin. 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. CRD08-15

Richardson, D, J. Hare, W. Overholtz, D. Johnson. 2009. Development of long-term larval indices for Atlantic herring (*Clupea harengus*) on the northeast US continental shelf. ICES Journal of Marine Science, Volume 67, Issue 4, 1 May 2010, Pages 617627.

Northeast Fisheries Science Center. 2012. 54^{th} Northeast Regional Stock Assessment Workshop (54^{th} SAW) Assessment Report. US Dept Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 12-18.; 600 p. CRD12-18

Alade, L. 2015. In Northeast Fisheries Science Center. 2015. Operational Assessment of 20 Northeast Groundfish Stocks, Updated Through 2014. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 15-24; 251 p.

Miller, T.J., J. Hare, L. Alade. 2016. A State-Space approach to Incorporating Environmental Effects on Recruitment in Age-Structured Assessment Model with an Application to Southern New England Yellowtail Flounder. Canadian Journal of Fisheries and Aquatic Sciences. Vol. 73(8): pp1261-1270

Xu, H., T.J. Miller, S. Hameed, L.A. Alade, J. Nye. (2017). Evaluating the Utility of the Gulf Stream Index for Predicting Recruitment of Southern New England- Mid Atlantic yellowtail flounder. Fisheries Oceanography. DOI: 10.1111/fog.12236

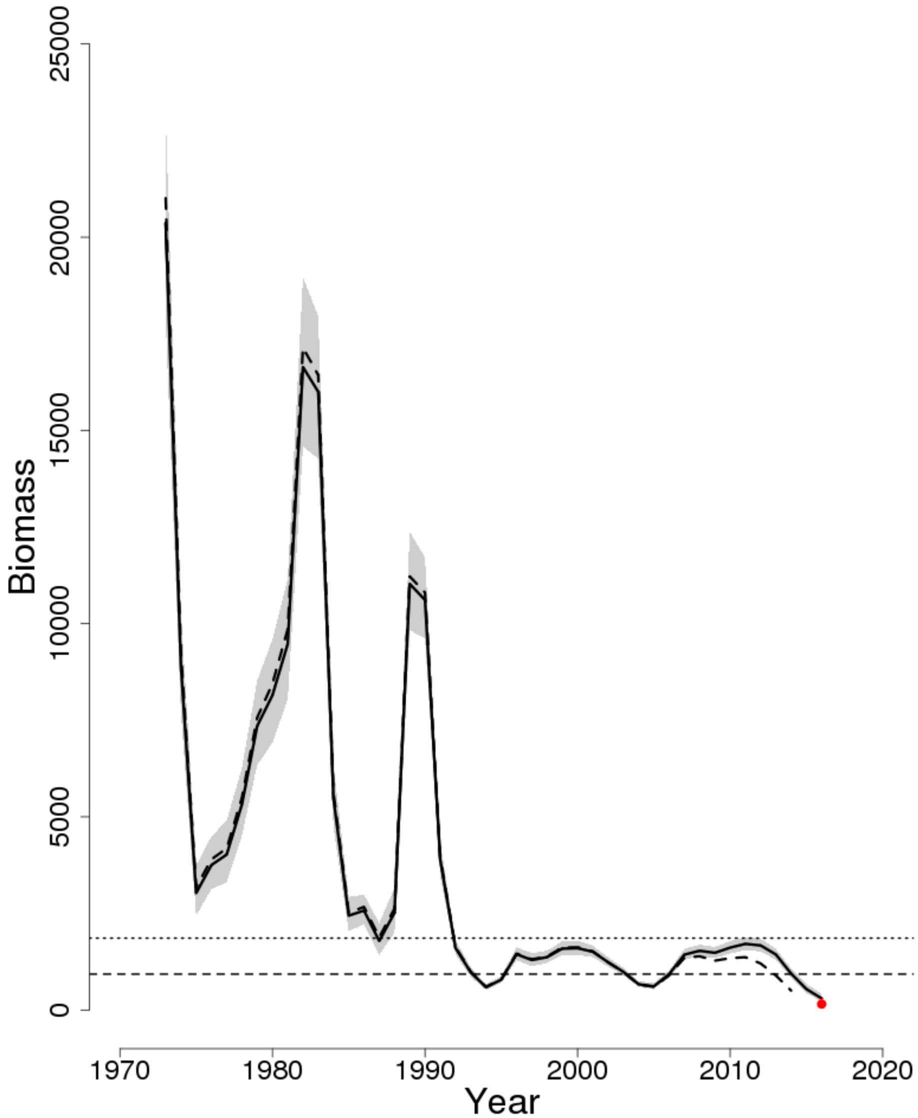

Figure 34: Trends in spawning stock biomass of Southern New England-Mid Atlantic yellowtail flounder between 1973 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{Threshold}$ ($\frac{1}{2}$ SSB_{MSY} *proxy*; horizontal dashed line) as well as SSB_{Target} (SSB_{MSY} *proxy*; horizontal dotted line) based on the 2017 assessment. Biomass was adjusted for a retrospective pattern and the adjustment is shown in red. The approximate 90% lognormal confidence intervals are shown.

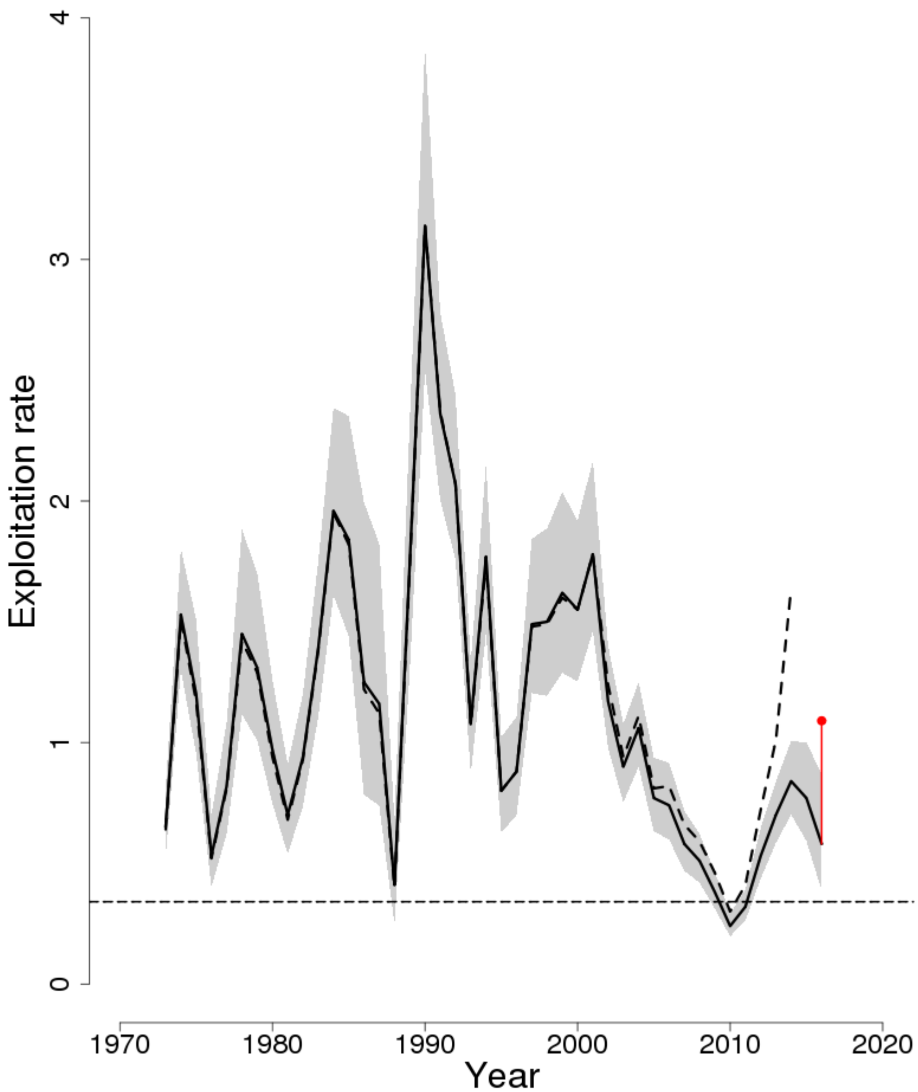

Figure 35: Trends in the fully selected fishing mortality (F_{Full}) of Southern New England-Mid Atlantic yellowtail flounder between 1973 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ (F_{MSY} *proxy*=0.341; horizontal dashed line). F_{Full} was adjusted for a retrospective pattern and the adjustment is shown in red based on the 2017 assessment. The approximate 90% lognormal confidence intervals are shown.

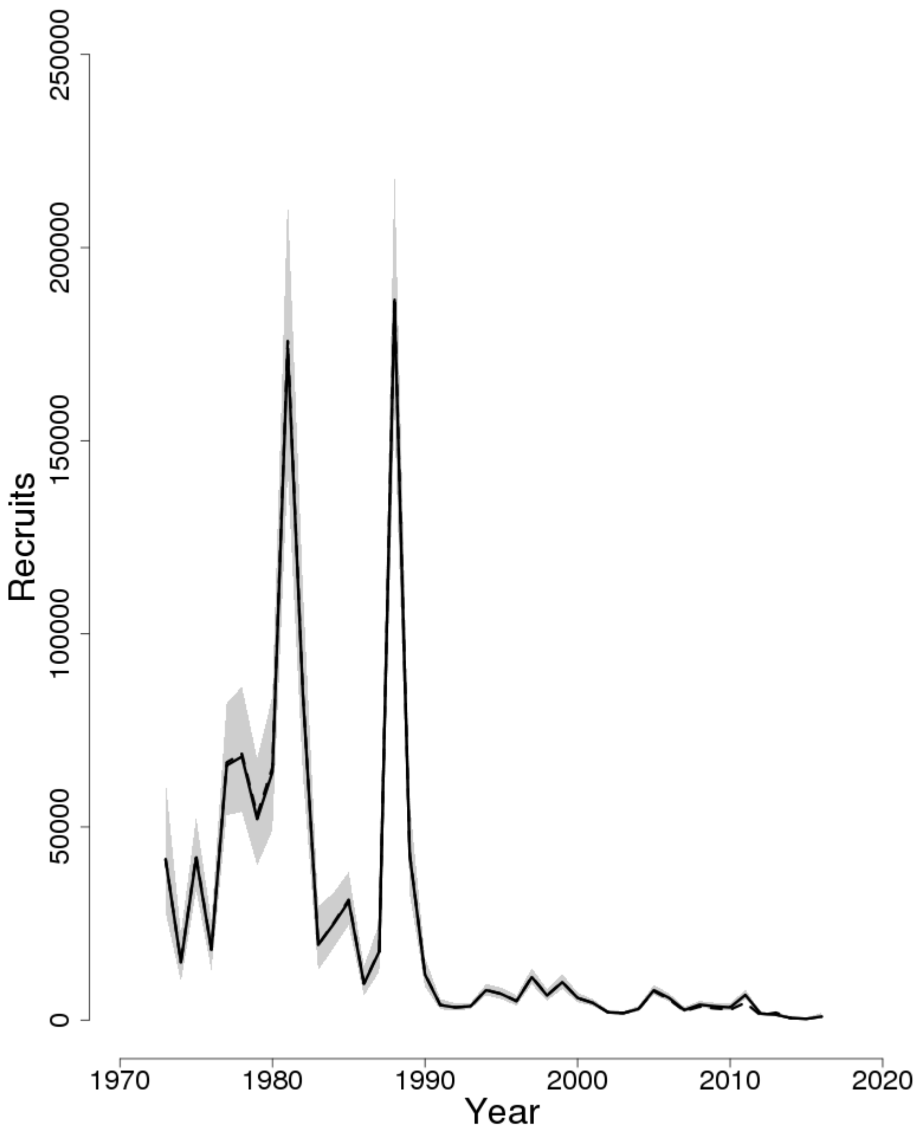

Figure 36: Trends in Recruitment (age 1) (000s) of Southern New England-Mid Atlantic yellowtail flounder between 1973 and 2016 from the current (solid line) and previous (dashed line) assessment. The approximate 90% lognormal confidence intervals are shown.

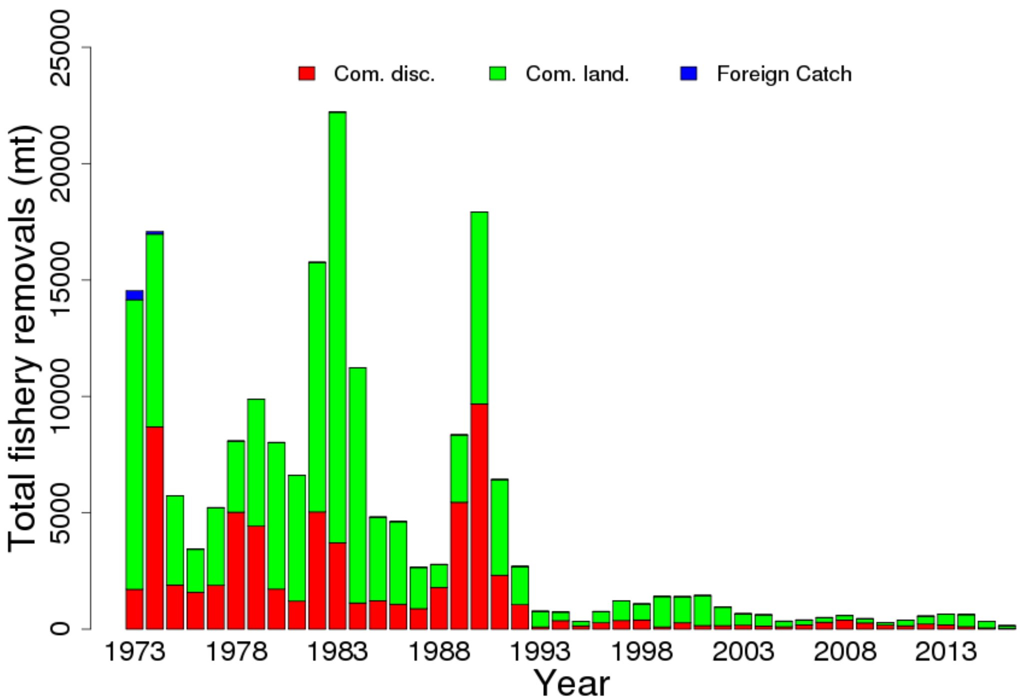

Figure 37: Total catch of Southern New England-Mid Atlantic yellowtail flounder between 1973 and 2016 by fleet (US domestic and foreign catch) and disposition (landings and discards).

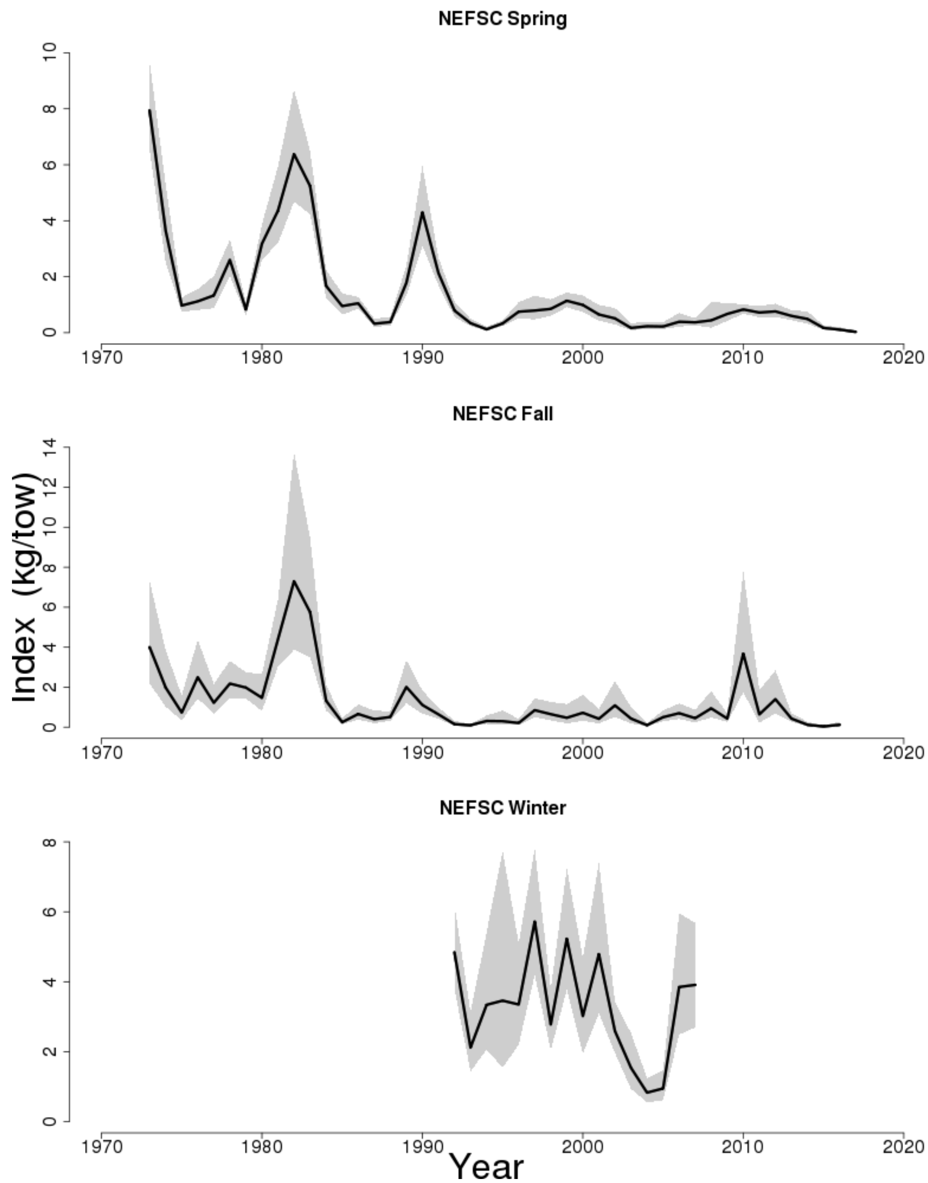

Figure 38: Indices of biomass for the Southern New England-Mid Atlantic yellowtail flounder between 1973 and 2017 for the Northeast Fisheries Science Center (NEFSC) spring, fall and winter bottom trawl surveys. The approximate 90% lognormal confidence intervals are shown. Note: Larval index based on Richardson et al (2009) was also used in this assessment and is available in the supplemental documentation.

8 Georges Bank Winter Flounder

Lisa Hendrickson

This assessment of the Georges Bank Winter Flounder (Pseudopleuronectes americanus) stock is an operational update of the existing 2015 operational VPA assessment which included data for 1982-2014 (NEFSC 2015). Based on the previous assessment the stock was overfished and overfishing was ocurring. This assessment updates commercial fishery catch data, research survey biomass indices, and the analytical VPA assessment model and reference points through 2016. Additionally, stock projections have been updated through 2020.

State of Stock: Based on this updated assessment, the Georges Bank Winter Flounder (*Pseudopleuronectes americanus*) stock is not overfished and overfishing is not occurring (Figures 39-40). Retrospective adjustments were made to the model results. Spawning stock biomass (SSB) in 2016 was estimated to be 3,946 (mt) which is 52% of the biomass target for an overfished stock (SSB_{MSY} = 7,600 with a threshold of 50% of SSBMSY; Figure 39). The 2016 fully selected fishing mortality (F) was estimated to be 0.117 which is 22% of the overfishing threshold (F_{MSY} = 0.522; Figure 40). However, the 2016 point estimate of SSB and F, when adjusted for retrospective error (54% for SSB and -31% for F), is outside the 90% confidence interval of the unadjusted 2016 point estimate. Therefore, the 2016 F and SSB values used in the stock status determination were the retrospective-adjusted values of 0.117 and 3,946 mt, respectively.

Table 26: Catch input data and VPA model results for Georges Bank Winter Flounder. All weights are in (mt), recruitment is in (000s) and F_{Full} is the fishing mortality on fully selected ages (ages 4-6). Catch and model results are only for the most recent years (2007-2016) of the current updated VPA assessment.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Data										
US landings	795	947	1,658	1,252	1,801	1,911	1,675	1,114	866	462
CA landings	12	20	12	45	52	83	12	12	13	4
US discards	188	143	91	138	129	113	47	46	20	6
CA scall dr discards	45	68	250	113	88	79	29	44	42	21
Catch for Assessment	1,040	1,178	2,011	1,548	2,070	2,185	1,763	1,216	941	493
Model Results										
Spawning Stock Biomass	4,411	4,061	4,448	5,291	5,691	5,625	5,281	5,800	7,116	6,083
F_{Full}	0.3	0.364	0.441	0.318	0.457	0.424	0.398	0.28	0.122	0.081
Recruits (age 1)	9,677	13,702	13,318	6,795	7,258	5,346	5,668	3,391	800	2,556

Table 27: Comparison of reference points estimated in the 2015 assessment and the current assessment update and stock status during 2014 and 2016, respectively. An estimate of F_{MSY} was used for the overfishing threshold and was based on long-term stochastic projections.

	2015	2017
F_{MSY}	0.536	0.522
SSB_{MSY} (mt)	6,700	7,600 (4,170 - 14,690)
MSY (mt)	2,840	3,500 (1,940 - 6,720)
Median recruits (age 1) (000s)	9,880	9,677
Overfishing	Yes	No
Overfished	Yes	No

Projections: Short-term projections of biomass were derived by sampling from a cumulative distribution function of recruitment estimates (1982-2015 YC) from the final run of the ADAPT VPA model. The annual fishery selectivity, maturity ogive (a 3-year moving window), and mean weights-at-age used in the projection are the most recent five-year averages (2012-2016). An SSB retrospective adjustment factor of 0.649 was applied in the projections.

Table 28: Short-term projections of catch (mt) and spawning stock biomass (mt) for Georges Bank Winter Flounder based on a harvest scenario of fishing at F_{MSY} between 2018 and 2020. Catch in 2017 was assumed to be 574 (mt)

Year	Catch (mt)	SSB (mt)	F_{Full}
2017	574	3,026 (2,307 - 3,875)	0.158

Year	Catch (mt)	SSB (mt)	F_{Full}
2018	1,083	2,380 (1,780 - 3,091)	0.522
2019	1,095	2,313 (1,707 - 3,571)	0.522
2020	1,600	3,454 (1,916 - 7,841)	0.522

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 estimate of natural mortality, which is based on longevity (max. age = 20). Natural mortality is not well studied in Georges Bank Winter Flounder and is assumed constant over time. Natural mortality affects the scale of the biomass and fishing mortality estimates. Other sources of uncertainty include the underestimation of catches. Discards from the Canadian bottom trawl fleet were not provided by the CA DFO and the precision of the Canadian scallop dredge discard estimates, with only 1-2 trips per month, are uncertain. The lack of age data for the Canadian spring survey catches requires the use of the US spring survey A/L keys despite selectivity differences. In addition, there are no length or age composition data for the Canadian landings or discards of GB winter flounder.

- Does this assessment model have a retrospective pattern? If so, is the pattern minor, or major? (A major retrospective pattern occurs when the adjusted SSB or F_{Full} lies outside of the 90% confidence intervals for SSB and F_{Full}; see Table 8).

  The 7-year Mohn's ρ, relative to SSB, was 0.830 in the 2015 assessment and was 0.540 in 2016. The 7-year Mohn's ρ, relative to F, was -0.513 in the 2015 assessment and was -0.308 in 2016. There was a major retrospective pattern for this assessment because the ρ adjusted estimates of 2016 SSB (SSB_ρ=3,946) and 2016 F (F_ρ=0.117) were outside the 90% confidence limits for SSB (4,898 - 7,812) and F (0.064 - 0.106). A retrospective adjustment was made for both the determination of stock status and for projections of catch in 2018. The retrospective adjustment changed the 2016 SSB from 6,083 to 3,946 and the 2016 F_{Full} from 0.081 to 0.117.

- Based on this stock assessment, are population projections well determined or uncertain? If this stock is in a rebuilding plan, how do the projections compare to the rebuilding schedule?

  Population projections for Georges Bank Winter Flounder were reasonably well determined and projected biomass from the last assessment was within the confidence bounds of the biomass estimated in the current assessment. This stock was required to be rebuilt by 2017.

- 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.

  The only change made to the Georges Bank Winter Flounder assessment, other than the incorporation of additional data for 2015 and 2016 and updating the most recent five-year averages for fishery selectivity-, proportion mature-, stock weights-, catch weights-, and spawning stock weights-at-age, were the Canadian scallop dredge discard estimates for 2004-2014. The Canadian scallop dredge discards were re-esitmated by the CA DFO staff to reflect the discard estimation method they use for the TRAC stock assessments (Sameoto et al. 2013). This change resulted in discard estimates that differed from those included in the most recent GB winter flounder assessment by -8% to 14%. In addition, the updated 2004 CA scallop drdege discard estimate now includes all months of the year; representing an increase of 85%.

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

  The stock status of Georges Bank Winter Flounder has changed from overfished and overfishing is occurring to not overfished and overfishing is not occurring.This change was attributable to a rapid decline in F, from near 75% of FMSY (= 0.392) in 2013 to 0.081 in 2016, and a gradual increase in SSB from near the SSBMSY threshold (= 3,800 mt) in 2008 to slightly below SSBMSY (= 7,600 mt) in 2015 (7,116 mt). However, SSB then declined to 6,083 mt in 2016. In addition, the Mohn's rho values used to adjust the 2016 F and SSB values were 60% and 65% lower, respectively, than the values from the previous assessment.

- Provide qualitative statements describing the condition of the stock that relate to stock status.

  Fishing mortality declined rapidly between 2013 and 2016 and is at the lowest level of the time series. Following a decline in the catch mean weights-at-age for the older fish (ages 4-7+), during 2007-2014, mean weights for these ages increased during 2015-2016. The mean length and weight of fish caught in the NEFSC fall and spring bottom trawl surveys *has been increasing since 2008 and 2009, respectively. Spawning stock biomass estimates increased during 2008-2015 with a slight decrease in 2016. However, recruitment declined after 2008 and reached a time series low in 2015. Although recruitment increased during 2016-2017, it remained below average and the 2017 estimate is uncertain because it is based solely on the geometric mean of recruitment during 2009-2015.*

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

  The Georges Bank Winter Flounder assessment could be improved with discard estimates from the Canadian bottom trawl fleet and age data from the Canadian spring bottom trawl surveys.

- Are there other important issues?

  None.

8.1 Reviewer Comments: Georges Bank Winter Flounder

Assessment Recommendation:

The panel concluded that the operational assessment with adjustments for retrospective bias was acceptable as a scientific basis for management advice, including the decision to use updated Canadian scallop dredge discard estimates for 2004-2014.

Alternative Assessment Approach:

Not applicable

Status Recommendation:

Based on this operational assessment, the panel supports the conclusion that the Georges Bank winter flounder stock is not overfished and overfishing is not occurring. This conclusion results in a change from the 2015 operational assessment, indicating that the stock was overfished and that overfishing was occurring. The deadline for rebuilding this stock is 2017. As of 2016 the stock remains well below target biomass. Fishing mortality declined rapidly between 2013 and 2016 and is at the lowest level of the time series. Following a decline in the catch mean weights-at-age for the older fish (ages 4-7+), during 2007-2014, mean weights for these ages increased during 2015-2016. The mean length and weight of fish caught in the National Marine Fisheries Service (NMFS) fall and spring bottom trawl surveys has been increasing since 2008 and 2009, respectively. Spawning stock biomass estimates increased during 2008-2015 but declined slightly in 2016. However, recruitment declined after 2008 and reached a time series low in 2015.

Key Sources of Uncertainty:

The largest source of uncertainty is the retrospective bias and the estimate of natural mortality, which is based on longevity (max. age = 20). Other sources of uncertainty include the underestimation of catches. Discards from the Canadian bottom trawl fleet were not provided by the Canadian Department of Fisheries and Oceans (DFO) and the precision of the Canadian scallop dredge discard estimates, with only 1-2 trips per month, are uncertain. The lack of age data for the Canadian spring survey catches requires the use of the US spring survey age-length keys despite selectivity differences. In addition, there are no length or age composition data for the Canadian landings or discards of Georges Bank winter flounder.

Research Needs:

The panel recommends that future work be conducted to consider discard estimates from the Canadian bottom trawl fleet and age data from the Canadian spring bottom trawl surveys. Also, the assessment may be improved by converting from a Virtual Population Analysis (VPA) to a statistical catch-at-age model.

References:

Sameoto, J., B. Hubley, L. Van Eeckhaute and A. Reeves. 2013. A Review of the standardization of effort for the calculation of discards of Atlantic cod, haddock and yellowtail flounder from the 2005 to 2011 Canadian scallop fishery on Georges Bank. Transboundary Resources Assessment Committee (TRAC) Reference Document 2013/04, 22 pp.

Northeast Fisheries Science Center. 2015. Operational assessment of 20 Northeast groundfish stocks, updated through 2014. U.S. Dept. Commer., Northeast Fish. Sci. Cent. Ref. Doc. 15-24; 251 p.

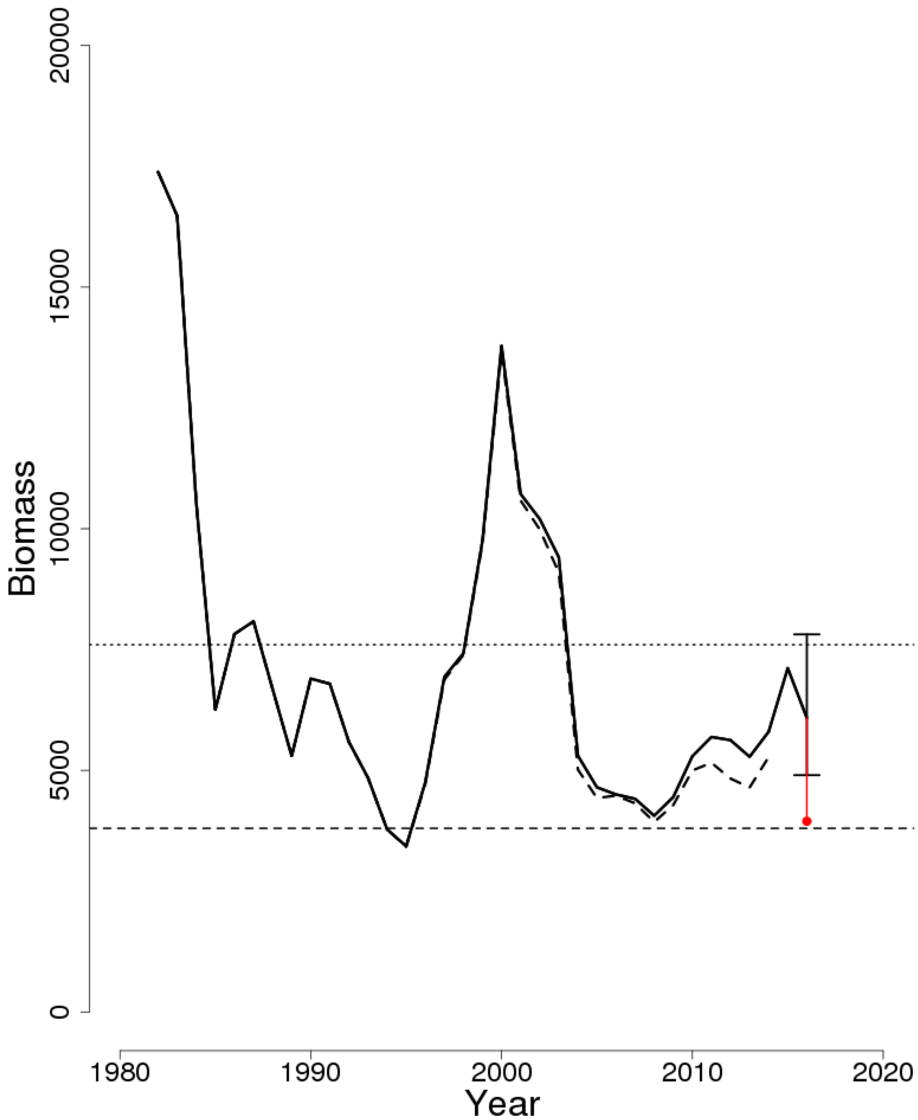

Figure 39: Trends in spawning stock biomass (mt) of Georges Bank Winter Flounder between 1982 and 2016 from the current (solid line) and previous (dashed line) assessments and the corresponding $SSB_{Threshold}$ ($\frac{1}{2}$ SSB_{MSY}; horizontal dashed line) as well as SSB_{Target} (SSB_{MSY}; horizontal dotted line) based on the 2017 assessment. Biomass was adjusted for a retrospective pattern and the adjustment is shown in red. The 90% normal confidence interval is shown for 2016.

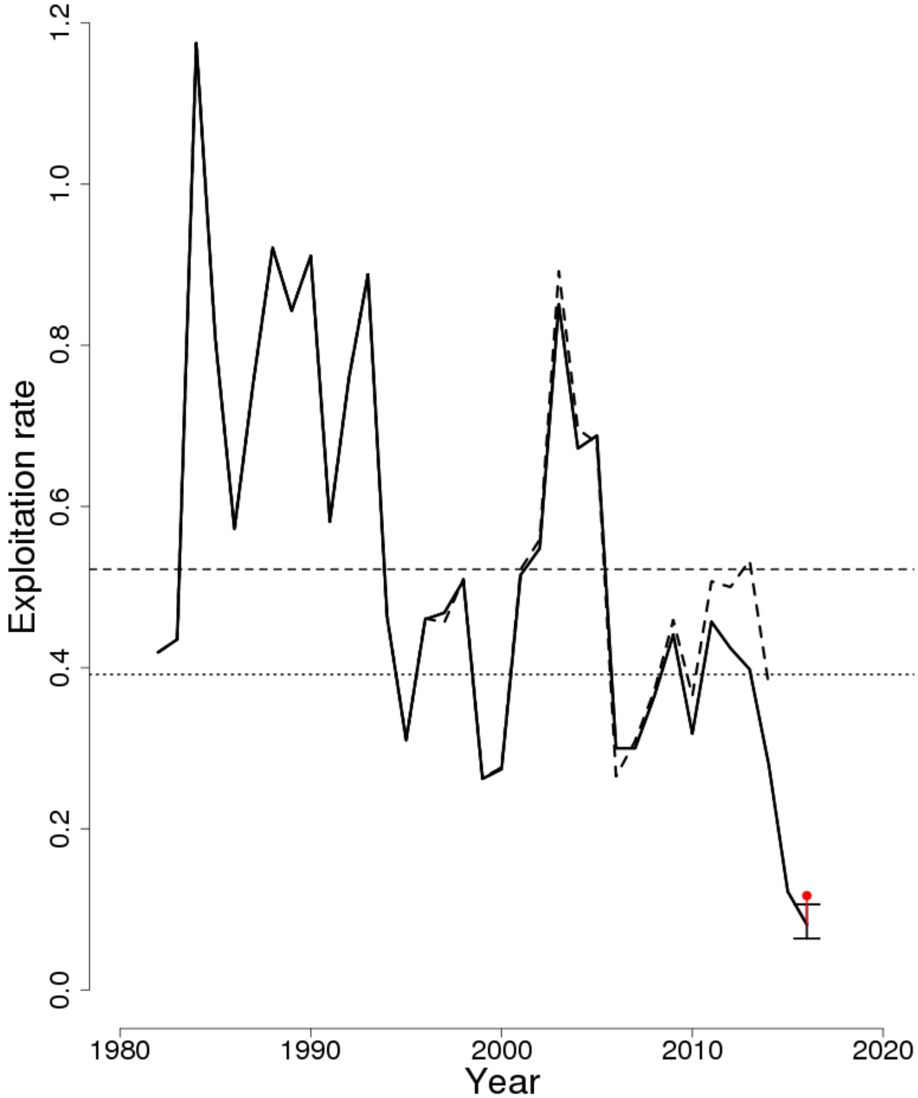

Figure 40: Trends in fully selected fishing mortality (F_{Full}) of Georges Bank Winter Flounder between 1982 and 2016 from the current (solid line) and previous (dashed line) assessments and the corresponding $F_{Threshold}$ (F_{MSY}=0.522; horizontal dashed line) as well as (F_{Target}= 75% of FMSY; horizontal dotted line). F_{Full} was adjusted for a retrospective pattern and the adjustment is shown in red. The 90% normal confidence interval is shown for 2016.

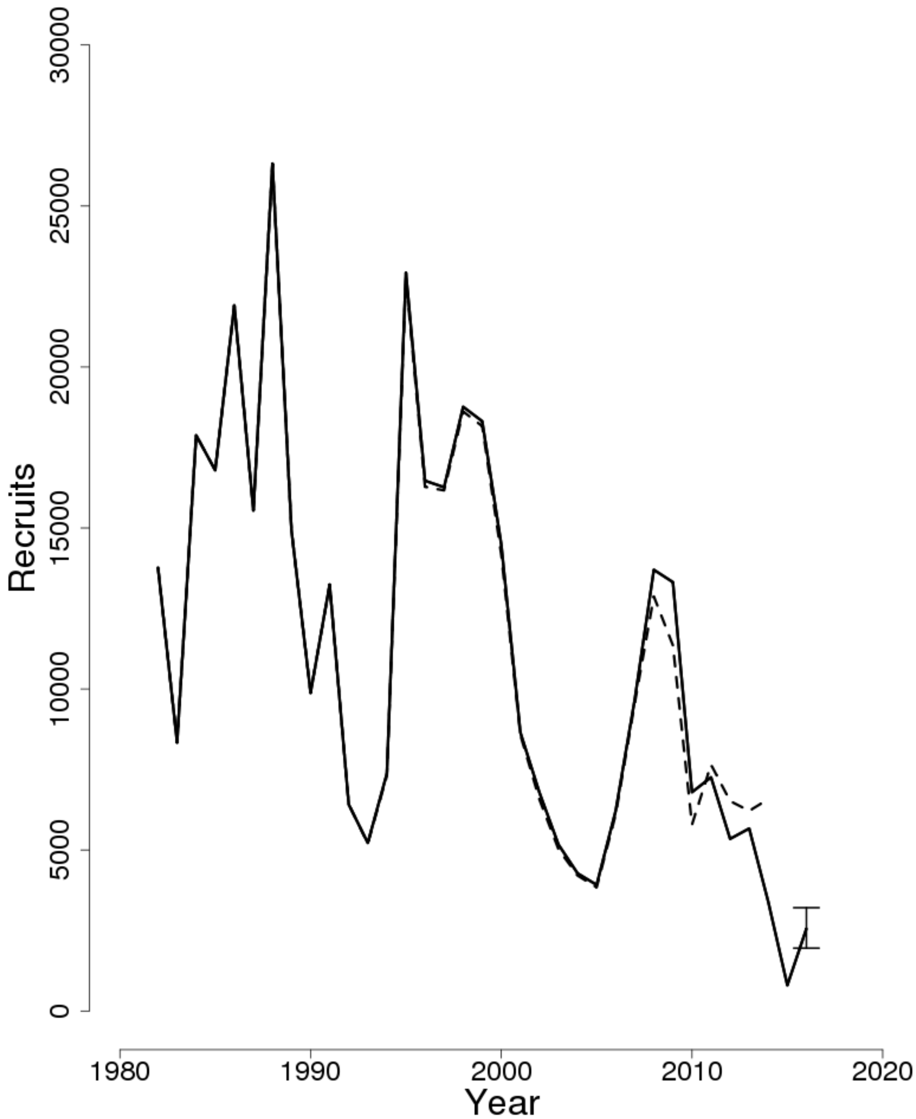

Figure 41: Trends in Recruits (age 1) (000s) of Georges Bank Winter Flounder between 1982 and 2016 from the current (solid line) and previous (dashed line) assessments. The 90% normal confidence interval is shown for 2016.

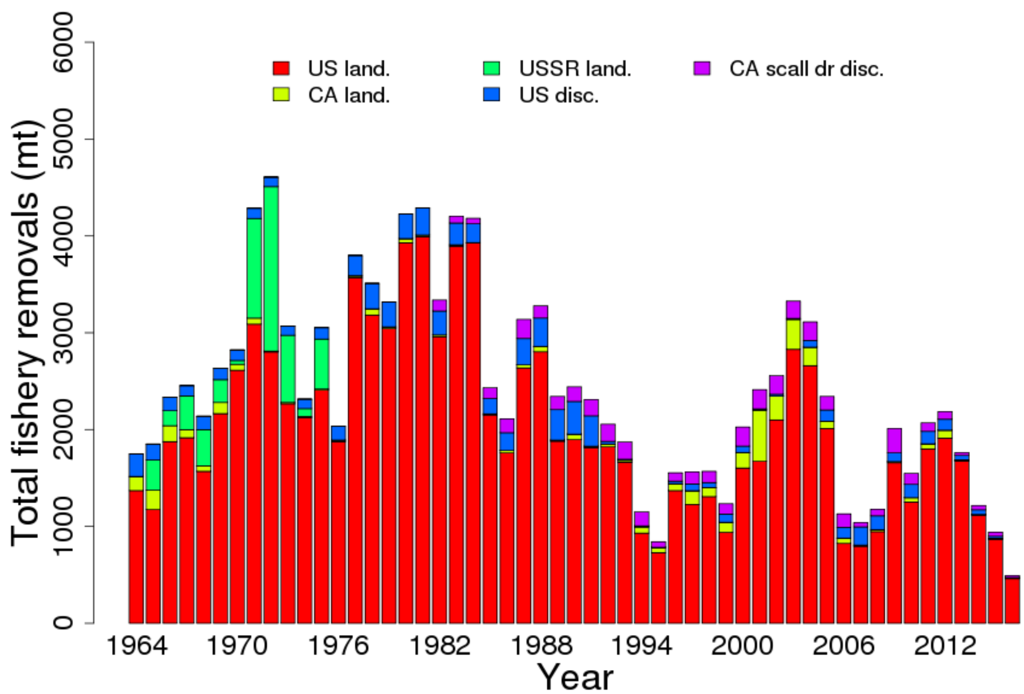

Figure 42: Total catches (mt) of Georges Bank Winter Flounder between 1982 and 2017 by country and disposition (landings and discards).

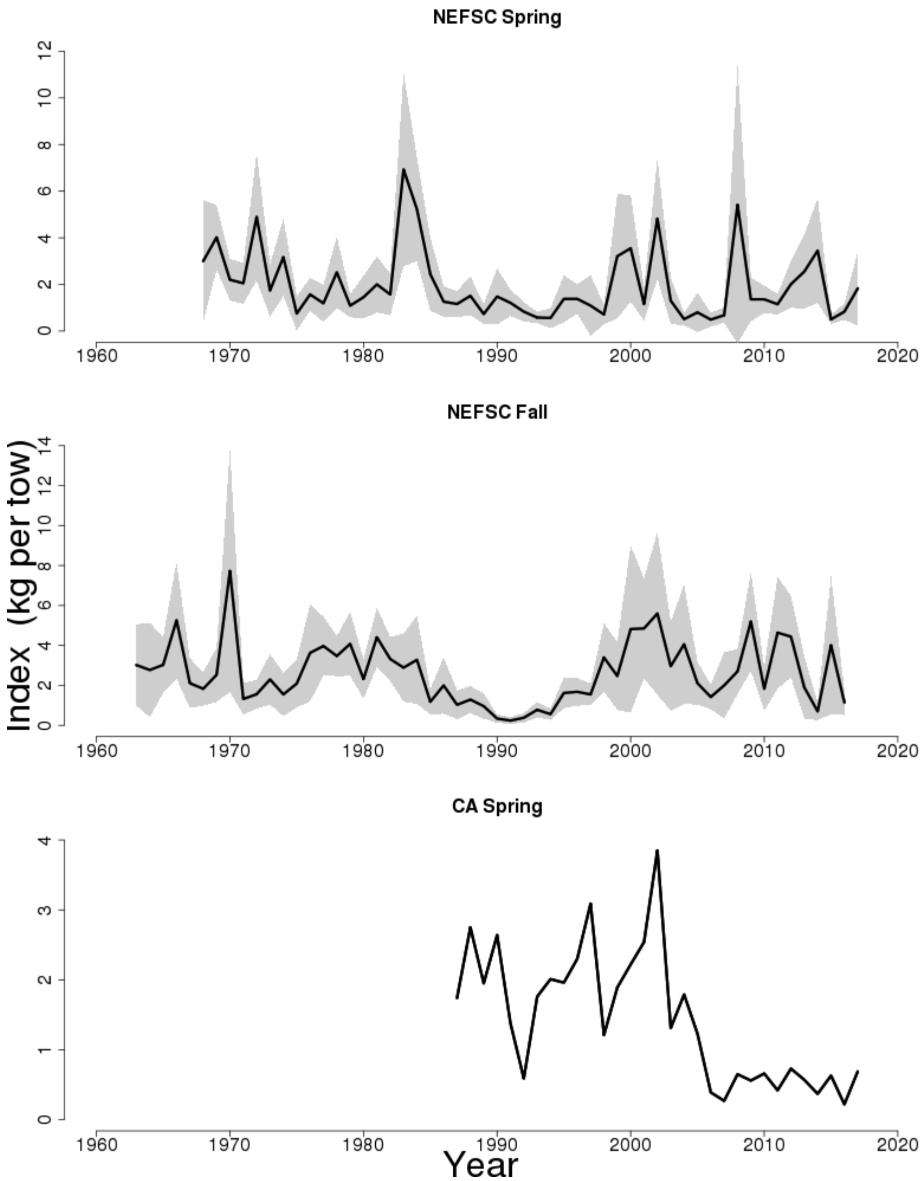

Figure 43: Indices of biomass for the Georges Bank Winter Flounder for the Northeast Fisheries Science Center (NEFSC) spring (1968-2017) and fall (1963-2016) bottom trawl surveys and the Canadian DFO spring survey (1987-2017). The 90% normal confidence interval is shown.

11 Witch flounder

Susan Wigley

This assessment of the witch flounder (Glyptocephalus cynoglossus) stock is an operational assessment of the existing 2016 benchmark assessment (NEFSC 2017). Based on the 2016 assessment the stock status was overfished and overfishing unknown, and stock condition was poor. This assessment updates commercial fishery catch data through 2016 (Table 35, Figure 56), and updates research survey biomass indices and the empirical approach assessment through 2016 (Figure 57). No stock projections can be computed using the empirical approach.

State of Stock: Based on this updated assessment, witch flounder (*Glyptocephalus cynoglossus*) recommended stock status is overfished and overfishing is unknown due to a lack of biological reference points associated with the empirical approach; stock condition remains poor. Retrospective adjustments were not made to the model results. The exploitable biomass in 2016 (defined as the arithmetic average of the 2016 NEFSC spring and 2015 NEFSC fall surveys population biomass estimates and converted to exploitable biomass using 0.9 based on examination of survey and fishery selectivity patterns) was estimated to be 14,563 (mt) (Figure 54). The 2016 exploitation rate (2016 catch divided by 2016 exploitable biomass) was estimated to be 0.035 (Figure 55).

Table 35: Catch and model results table for witch flounder. All weights are in (mt). The exploitable biomass in year y is the arithmetic average of the year y NEFSC spring and year y-1 NEFSC fall surveys then converted to exploitable biomass using 0.9. The exploitation rate is the year y catch divided by the year y exploitable biomass. Model results are from the current updated empirical approach assessment.

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Data											
Commercial Landings	1,863	1,076	1,009	954	759	870	1,038	686	570	492	397
Commercial Discards	211	135	127	203	153	201	230	124	106	93	115
Catch for Assessment	2,075	1,210	1,136	1,158	912	1,071	1,268	810	675	585	512
Model Results											
Exploitable Biomass	18,082	16,728	31,661	18,756	16,380	14,834	16,817	10,617	13,486	15,862	14,563
Exploitation Rate	0.115	0.072	0.036	0.062	0.056	0.072	0.075	0.076	0.05	0.037	0.035

Table 36: Comparison of reference points estimated in an earlier assessment and from the current assessment update.

	2016	2017
F_{MSY} *proxy*	NA	NA
SSB_{MSY} (mt)	NA	NA
MSY (mt)	NA	NA
Overfishing	Unknown	Unknown
Overfished	Yes	Yes

Projections: Short term projections cannot be computed using the empirical approach. The estimated 2017 exploitable biomass is 19,202 mt. Using the January 2017 NEFMC PDT/SSC approach for catch advice, application of the mean exploitation rate of 6.0% (based on nine years, 2007-2015) to the 3 year (2015- 2017) moving average of exploitable biomass (16,543 mt) results in an estimated catch for 2018 of 993 mt.

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).
  Uncertainty in the catch has increased due to recent reports/allegations of catch misreporting currently under litigation.

- Does this assessment model have a retrospective pattern? If so, is the pattern minor, or major? (A major retrospective pattern occurs when the adjusted SSB or F_{Full} lies outside of the approximate joint confidence region for SSB and F_{Full}; see Table 8).
  The model used to estimate status of this stock does not allow estimation of a retrospective pattern.

- Based on this stock assessment, are population projections well determined or uncertain? If this stock is in a rebuilding plan, how do the projections compare to the rebuilding schedule?
  Population projections for witch flounder are not computed. Catch advice is derived from applying a mean exploitation rate of 0.060 (based on nine years, 2007-2015) to the 3 year average (2015-2017) of the exploitable biomass.

- Describe any changes that were made to the current stock assessment, beyond incorporating additional years of data and the effect these changes had on the assessment and stock status.
  Recent landings and discards were updated and the time series of survey indices was updated; however, this has no impact on the stock status.

- If the stock status has changed a lot since the previous assessment, explain why this occurred.
  No change in stock status has occurred for witch flounder since the previous assessment. Biological references points remain unknown.

- Provide qualitative statements describing the condition of the stock that relate to stock status.
  The witch flounder stock condition remains poor. Fishery landings and survey catch by age indicate truncation of age structure and a reduction in the number of older fish in the population. NEFSC relative indices of abundance and biomass remain below their time series average.

- Indicate what data or studies are currently lacking and which would be needed most to improve this stock assessment in the future.
  The witch flounder assessment could be improved with accurate catch statistics. Additional research recommendations are given in NEFSC 2017.

- Are there other important issues?

  Minimum estimates of scientific research removals of witch flounder ranged between 0.1 and 15.9 mt, with an average of 1 mt between 1963 and 2016. The NEFSC bottom trawl surveys, Massachusetts Division of Marine Fisheries inshore surveys, Atlantic States Marine Fisheries Commission summer shrimp surveys, and various Cooperative Research surveys (e.g., such as Industry-based surveys for cod and for yellowtail flounder) and gear studies have contributed to scientific research removals. The August 2016 Gear Efficiency Study removed 14.0 mt of witch flounder.

11.1 Reviewer Comments: Witch flounder

Assessment Recommendation:

The panel concluded that the operational assessment with the August 2016 cooperative research catchability estimates was acceptable as a scientific basis for management advice. At the previous 2016 benchmark assessment, where the analytical model was rejected, an empirical approach was adopted as a basis for management advice. The panel affirmed the approach to developing a catch recommendation as described in the assessment report was adequate.

Alternative Assessment Approach:

Not applicable

Status Recommendation:

Based on this operational assessment, the panel supports the conclusion that the witch flounder stock status remains overfished with overfishing unknown due to a lack of biological reference points associated with the empirical approach. The witch flounder stock condition remains poor. Fishery landings and survey catch by age indicate truncation of age structure and a reduction in the number of older fish in the population. Catch is at a time-series low and relative indices of abundance and biomass from the National Marine Fisheries Service survey remain below their time series average.

Key Sources of Uncertainty:

Uncertainty in the catch has increased due to recent reports/allegations of catch misreporting currently under litigation, which creates additional uncertainty surrounding the exploitation rate estimate. Additional uncertainties with the empirical approach applied to witch flounder include the survey indices, catchability estimates, catch efficiency, and the consequent swept-area-biomass expansion methods.

Research Needs:

The witch flounder assessment could be improved with research into the veracity of catch statistics. Additional research recommendations were provided in the recent benchmark stock assessment report and these should be addressed in an attempt to return to an analytical model. Work was conducted by the Plan Development Team, following the 2016 benchmark assessment on the relationships between the survey indices, catchability estimates, and resulting swept-area-biomass estimates. Further work exploring the validity of the swept-area-biomass estimates, catch efficiency, and the approach to developing catch advice is warranted.

References:

Northeast Fisheries Science Center. 2017. 62^{nd} Northeast Regional Stock Assessment Workshop Assessment Report, Northeast Fisheries Science Center, Woods Hole, Massachusetts, January 2017. US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 17-03; 822 p. CRD17-03

Northeast Fisheries Science Center. 2015. Operational Assessment of 20 Northeast Groundfish Stocks, Updated through 2014. US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 15-24; 251 p. CRD15-24

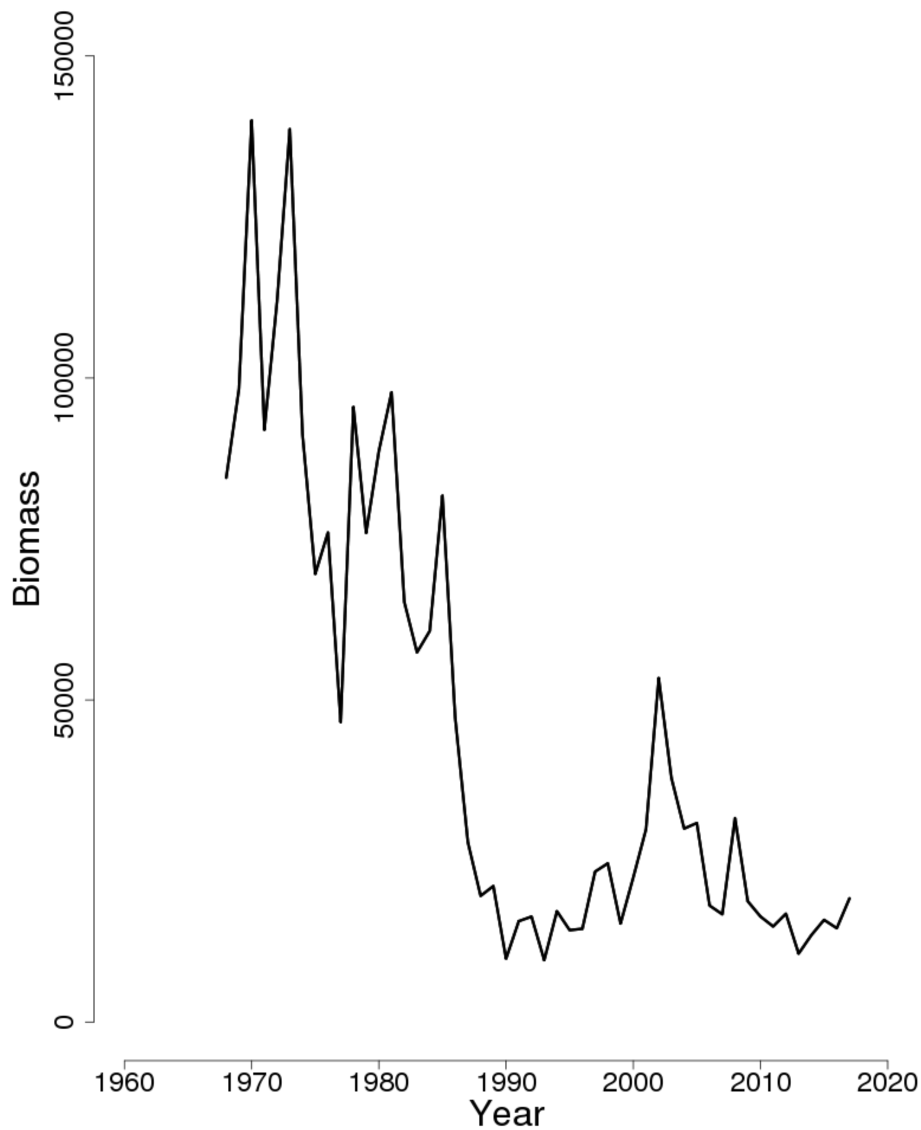

Figure 54: Trends in exploitable biomass (mt) of witch flounder between 1968 and 2017 from the current assessment.

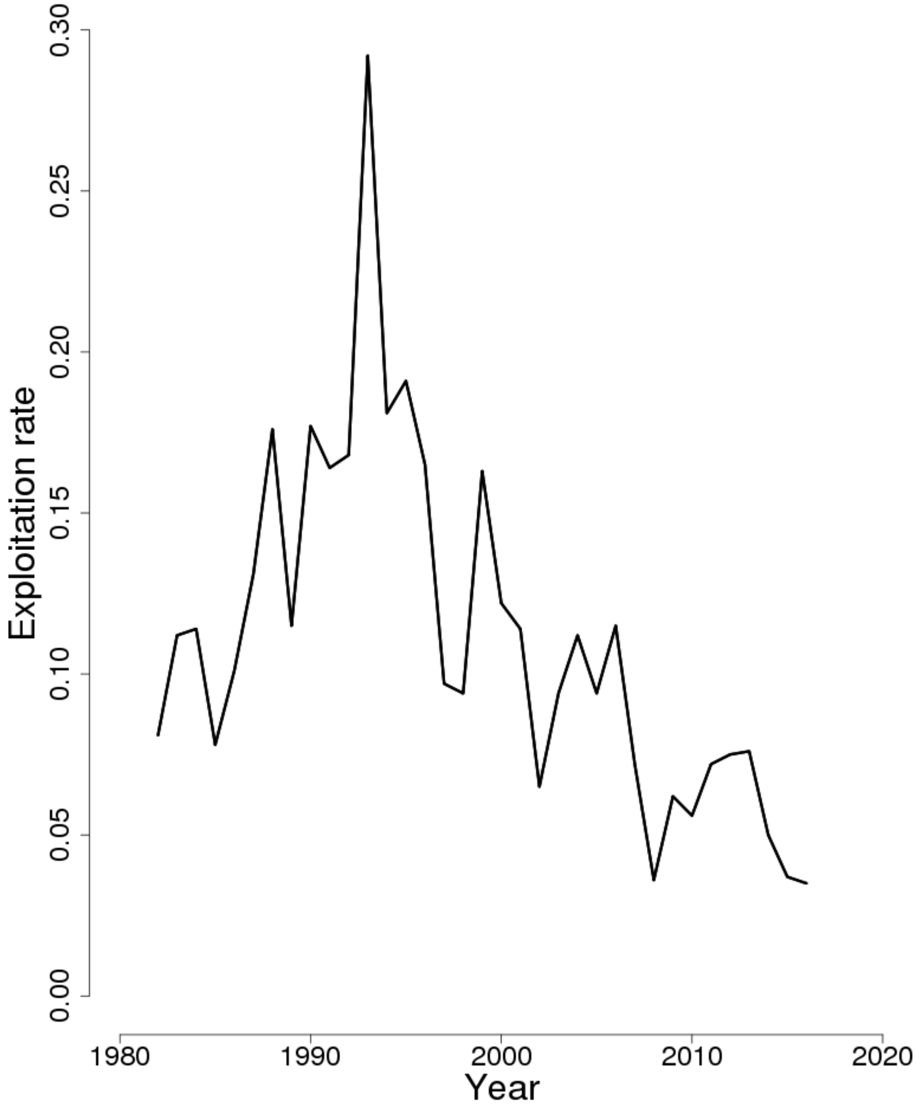

Figure 55: Trends in the exploitation rate (catch/ exploitable biomass) of witch flounder between 1982 and 2016 from the current assessment.

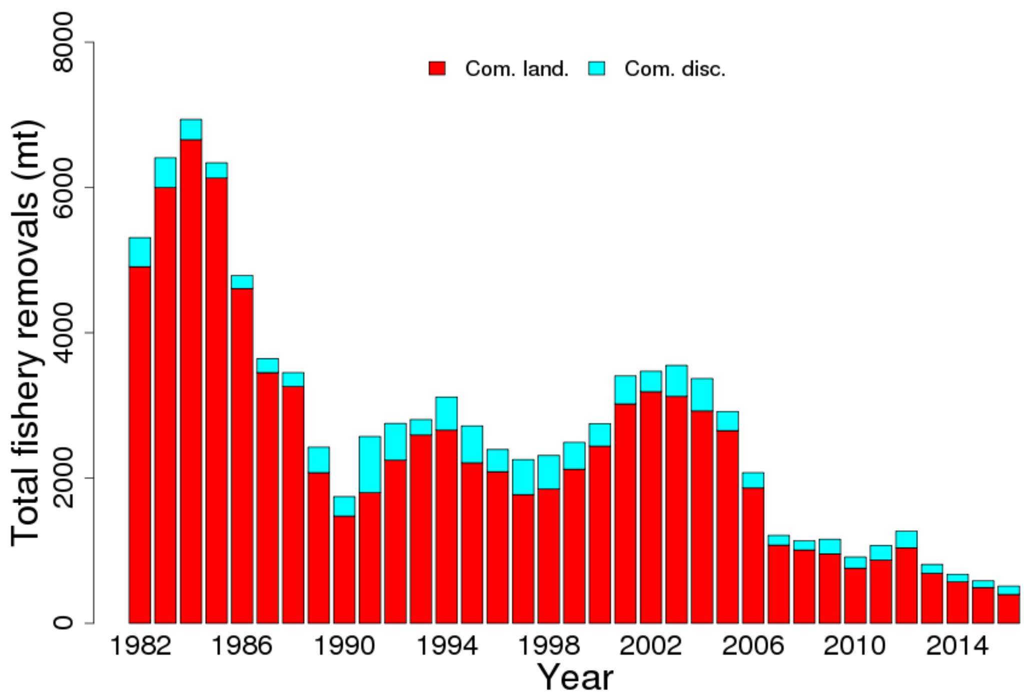

Figure 56: Total catch of witch flounder between 1982 and 2016 by fleet (commercial) and disposition (landings or discards).

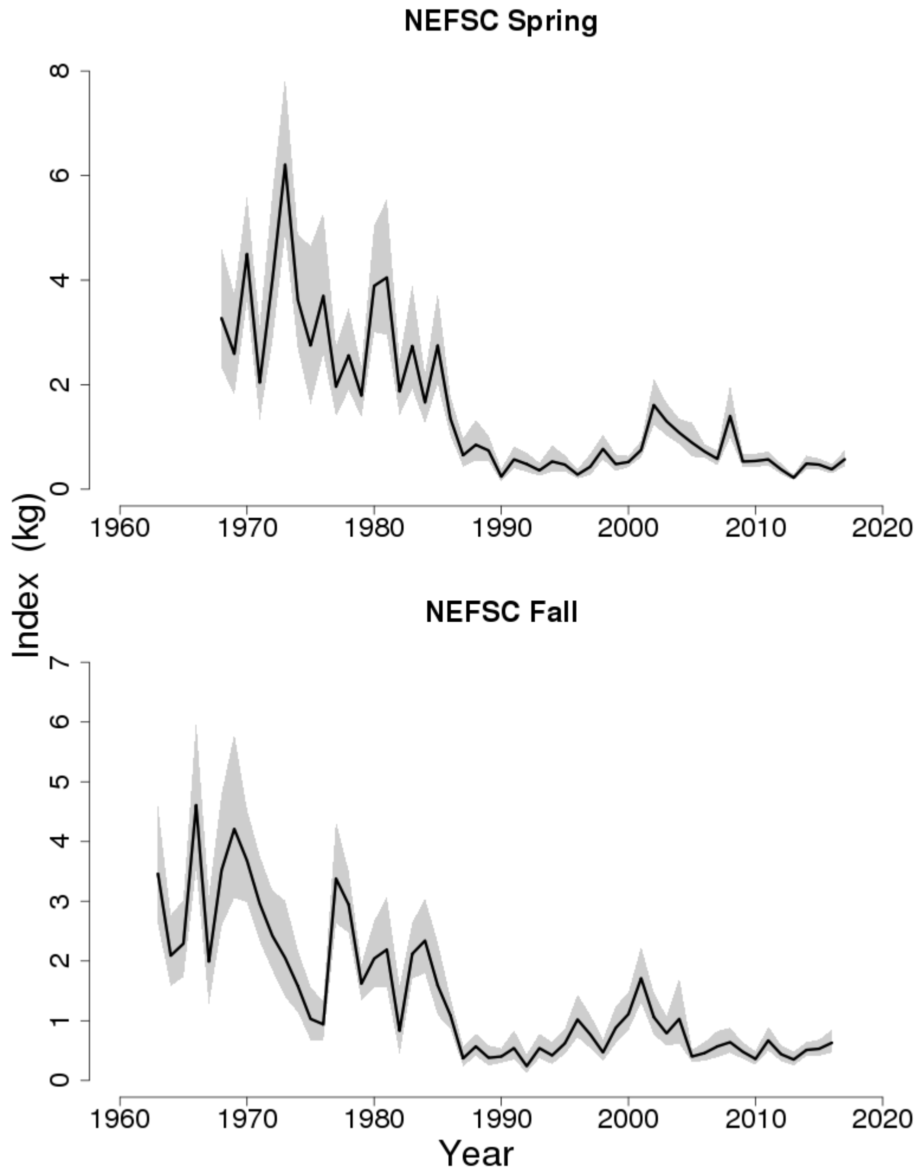

Figure 57: Indices of biomass for the witch flounder between 1963 (Fall) and 2017 (Spring) for the Northeast Fisheries Science Center (NEFSC) spring and fall bottom trawl surveys. The approximate 90% lognormal confidence intervals are shown.

16 Gulf of Maine - Georges Bank windowpane flounder

Toni Chute

This assessment of the Gulf of Maine - Georges Bank windowpane flounder (Scophthalmus aquosus) stock is an operational update of the 2015 assessment which was based on survey and fishery data through 2014 (NEFSC 2015). Based on the 2015 assessment the stock was overfished, but overfishing was not ocurring. This assessment updates commercial fishery catch data, survey biomass indices, AIM model results, and reference points through 2016.

State of Stock: Based on this updated assessment, the Gulf of Maine - Georges Bank windowpane flounder (*Scophthalmus aquosus*) stock is overfished but overfishing is not occurring (Figures 78-79). Retrospective adjustments were not made to the model results. The mean NEFSC fall bottom trawl survey index from years 2014, 2015 and 2016 (a 3-year moving average is used as a biomass index) was 0.359 kg/tow which is lower than the $B_{Threshold}$ of 1.030 kg/tow. The 2016 relative fishing mortality was estimated to be 0.222 kt per kg/tow which is lower than the F_{MSY} *proxy* of 0.340 kt per kg/tow.

Table 48: Catch and model results table for Gulf of Maine - Georges Bank windowpane flounder. All landings and discard weights are rounded to the nearest metric ton. Biomass index is in units of kg/tow, and relative F is in units of kt per kg/tow (catch in kt per kg/tow of the survey index).

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Data										
Commercial discards	974	329	412	235	180	198	355	215	187	85
Commercial landings	117	46	28	0	0	1	0	0	0	0
Total catch	1,091	376	440	236	180	199	355	215	188	85
Model Results										
Biomass index	0.524	0.448	0.442	0.467	0.433	0.343	0.518	0.535	0.536	0.36
Relative F	2.079	0.849	0.996	0.514	0.416	0.584	0.676	0.393	0.354	0.222

Table 49: Reference points estimated in the 2015 assessment and in the current assessment update. F_{MSY} *proxy* is in units of kt per kg/tow.

	2015	2017
F_{MSY} *proxy*	0.450	0.340 (0.009 - 0.659)
B_{MSY} *proxy* (kg/tow)	1.554	2.060
MSY proxy (mt)	700	700
Overfishing	No	No
Overfished	Yes	Yes

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).

  Even though estimated catch has decreased in recent years, the survey index has not shown any resulting increase despite evidence of regular recruitment from survey length frequencies. Since there has been a 'no possession' rule in place since 2010, almost 100% of catch has consisted of estimated discards. These estimates have a higher CV than those for the southern stock but are still fairly low at a mean of 0.124 since 2010 so it is unlikely discards are being poorly estimated. Removals by Canadian fisheries occur from the northern stock area and are not used as a catch component in the model. Using them, especially if they have changed over time, might improve the model fit, which is not as good as the southern stock.

- Does this assessment model have a retrospective pattern? If so, is the pattern minor, or major? (A major retrospective pattern occurs when the adjusted SSB or F_{Full} lies outside of the approximate joint confidence region for SSB and F_{Full}).

  The AIM (An Index Model) model used to estimate status of this stock does not allow estimation of a retrospective pattern.

- Based on this stock assessment, are population projections well determined or uncertain? If this stock is in a rebuilding plan, how do the projections compare to the rebuilding schedule?

  The GARM benchmark indicated that projections should not be made based on discards, so no projections are run for windowpane flounder. Northern windowpane flounder was supposed to be rebuilt by 2017, however the 2008 GARM report states 'Given that current catch is mostly incidental and also given the high uncertainty of index based assessments, it was concluded that it was not appropriate to calculate F rebuild for this stock'.

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

  No changes were made to the Gulf of Maine - Georges Bank windowpane flounder assessment for this update other than the incorporation of 2015 and 2016 NEFSC fall bottom trawl survey data and 2015 and 2016 U.S. commercial landings and discard data.

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

  The stock status of Gulf of Maine - Georges Bank windowpane flounder has not changed since the previous assessment. In 2015, the F status changed from overfishing to no overfishing.

- Provide qualitative statements describing the condition of the stock that relate to stock status.

  Since the year 2000, Gulf of Maine - Georges Bank windowpane flounder has shown decreasing survey indices despite reductions in catch and relative F levels, and the model output replacement ratio for 2016 was only 0.68. The stock was declared overfished in 2007 (the final year of data for GARM 2008) and was scheduled to be rebuilt by 2017, but the stock still remains below the biomass threshold. According to 21.6, windowpane flounder has low *overall climate vulnerability and both males and females are currently showing high condition indices. There are also new recruits regularly present in the fall bottom trawl survey catches.*

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

  While the Gulf of Maine - Georges Bank windowpane flounder AIM model fit is reasonable (the relationship between ln(relative F) and ln(replacement ratio), a measure of the relationship between catch and survey index values, has a p-value of 0.11) there may be catches (such as from the Canadian groundfishery on Georges Bank), discards, or incidental mortality unaccounted for in the model. The fit might be improved in the future by estimating additional sources of mortality or removal from the population that may be increasing over recent years. There may also be value in looking carefully at the windowpane stock definitions to see if there might be reason to change them. For the last several years the NEFSC has been collecting otoliths from northern windowpane during the fall survey and we now have several year's worth of ages, enough to explore an age-based model such as ASAP which could provide insight into the population dynamics of northern windowpane.

- Are there other important issues?

  None.

16.1 Reviewer Comments: Gulf of Maine - Georges Bank windowpane flounder

Assessment Recommendation:

The panel concluded that the operational assessment was acceptable as a scientific basis for management advice.

Alternative Assessment Approach:

Not applicable

Status Recommendation:

Based on this updated assessment, the panel agrees with the conclusion that the Gulf of Maine-Georges Bank windowpane flounder stock is overfished but overfishing is not occurring. Since the year 2000, Gulf of Maine-Georges Bank windowpane flounder has shown decreasing survey indices despite reductions in catch and relative F levels. The stock was declared overfished in 2007 (the final year of data for Groundfish Assessment Review Meeting 2008) and was scheduled to be rebuilt by 2017, but the stock still remains below the biomass threshold. Windowpane flounder has low overall climate vulnerability, the larval index has been stable over many years, and both males and females are currently showing high condition indices. There are also new recruits regularly present in the fall bottom trawl survey catches.

Key Sources of Uncertainty:

Even though estimated catch has decreased in recent years, the survey index has not shown any resulting increase despite evidence of regular recruitment from survey length frequencies. There are uncertainties around discard estimates. Removals by Canadian fisheries occur from the Gulf of Maine-Georges Bank stock area and are not used as a catch component in the model. The model fit is notably poor and is worse than in the 2015 operational assessment.

Research Needs:

The panel recommends research focused on estimating additional sources of mortality or removal from the population that may be increasing over recent years. There may also be value in looking carefully at the windowpane stock definitions to see if there might be reason to change them. For the last several years the National Marine Fisheries Service has been collecting otoliths from Gulf of Maine-Georges Bank windowpane during the fall survey and now has several years' worth of ages, enough to explore a statistical catch-at-age model, which could provide insight into the population dynamics of Gulf of Maine-Georges Bank windowpane.

References:

Most recent assessment update:
Northeast Fisheries Science Center. 2015. Operational Assessment of 20 Northeast Groundfish Stocks, updated through 2014. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 15-24; 251 p. Available online at http://nefsc.noaa.gov/publications/crd/crd1524

Most recent benchmark assessment:
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.

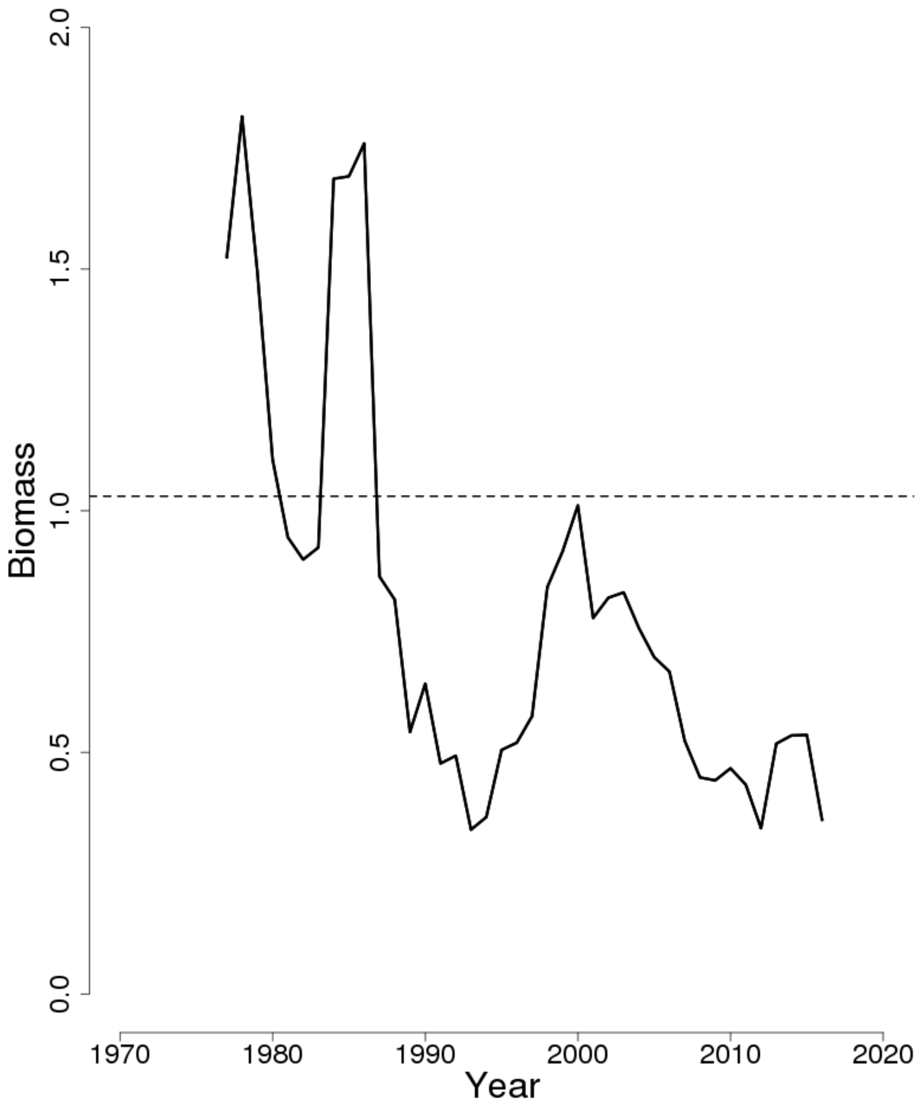

Figure 78: Trends in the biomass index (a 3-year moving average of the NEFSC fall bottom trawl survey index) of Gulf of Maine - Georges Bank windowpane flounder between 1975 and 2016 from the current assessment, and the corresponding $B_{Threshold} = \frac{1}{2}\ B_{MSY}$ *proxy* $= 1.030$ kg/tow (horizontal dashed line).

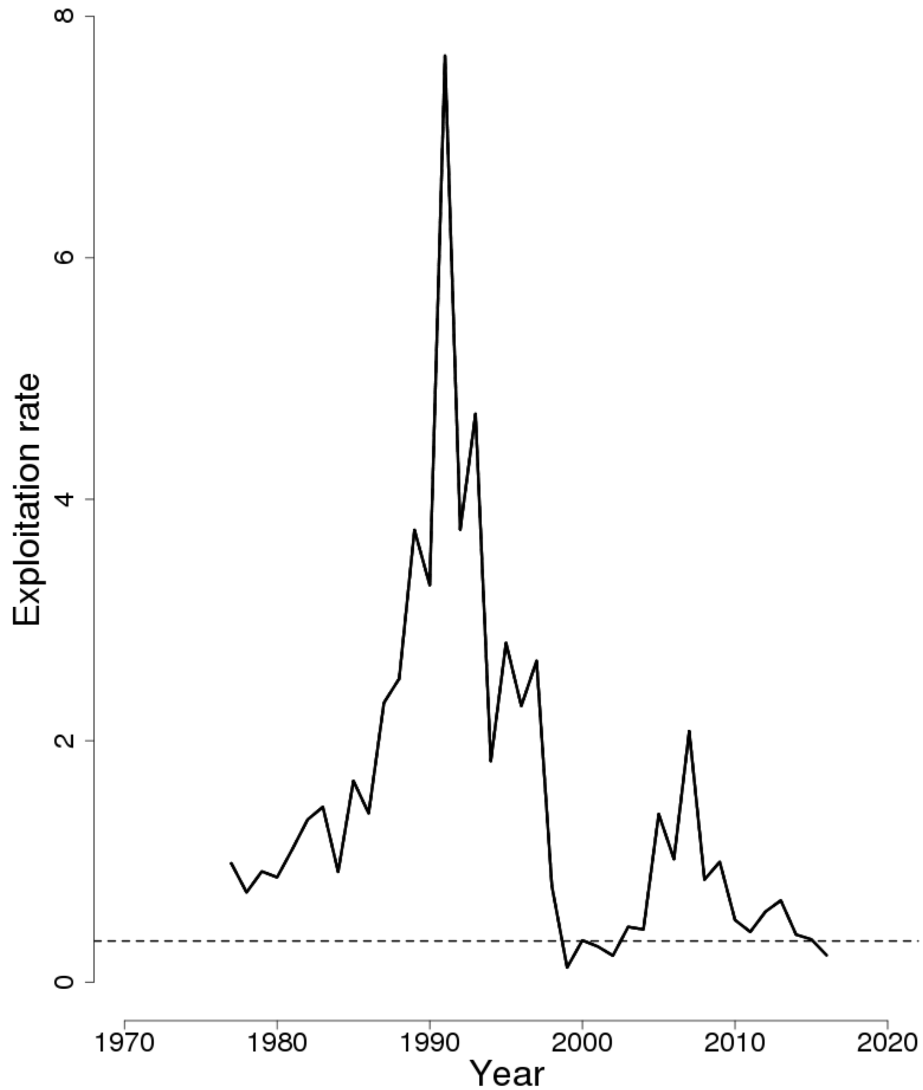

Figure 79: Trends in estimated relative fishing mortality of Gulf of Maine - Georges Bank windowpane flounder between 1975 and 2016 from the current assessment, and the corresponding F_{MSY} *proxy* = 0.34 (horizontal dashed line).

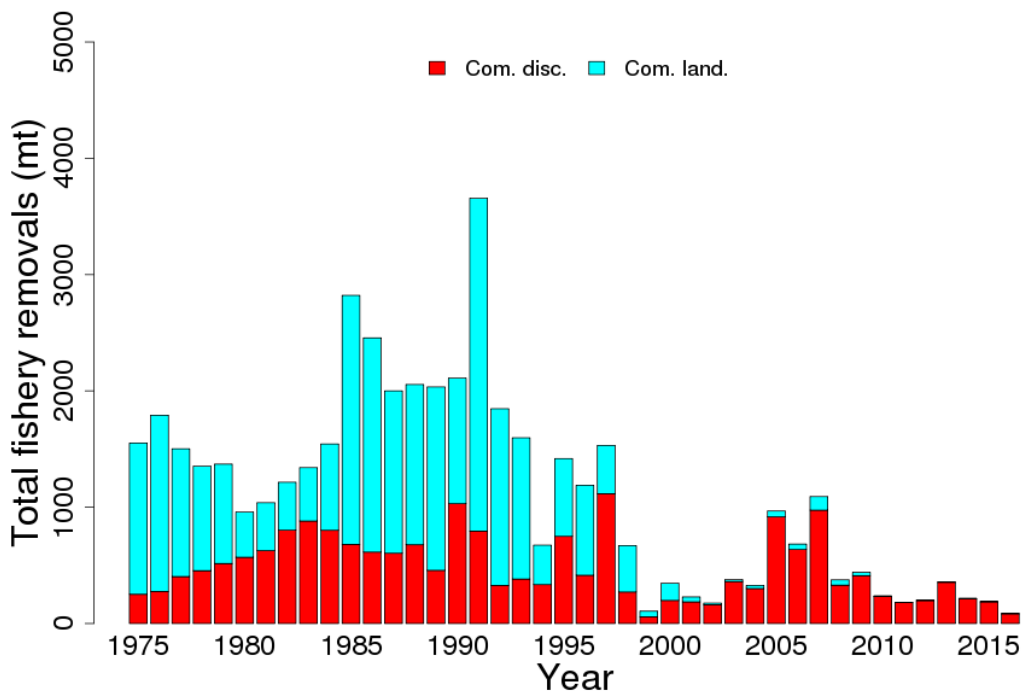

Figure 80: Total catch of Gulf of Maine - Georges Bank windowpane flounder between 1975 and 2016 by disposition (landings and discards).

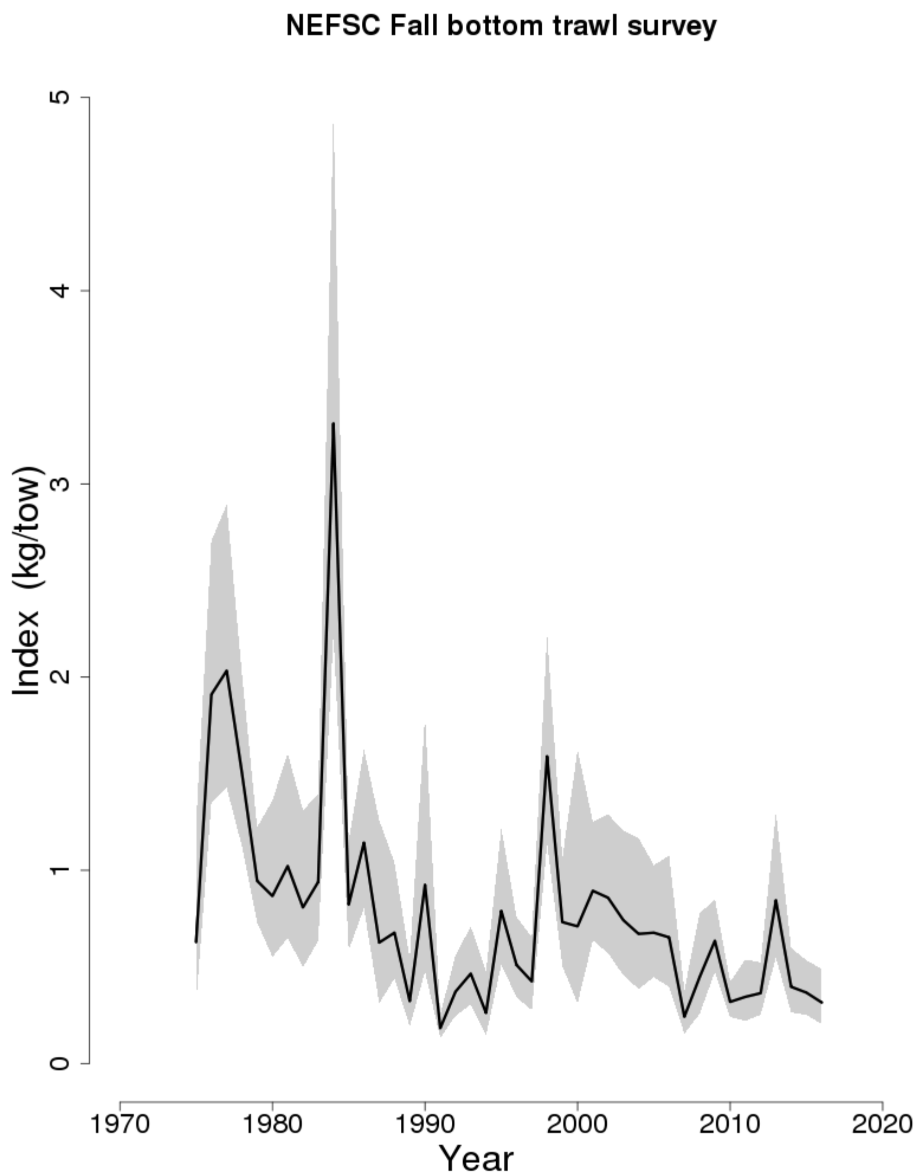

Figure 81: NEFSC fall bottom trawl survey indices in kg/tow for Gulf of Maine - Georges Bank windowpane flounder between 1975 and 2016. The approximate 90% lognormal confidence intervals are shown.

18 Ocean pout

Susan Wigley

This assessment of the ocean pout (Zoarces americanus) stock is an operational assessment of the 2015 operational assessment (NEFSC 2015). Based on the 2015 assessment, the stock was overfished but overfishing was not occurring. This assessment updates commercial fishery catch data, research survey indices and the exploitation ratios through 2016. There are no stock projections.

State of Stock: Based on the current assessment, the ocean pout (*Zoarces americanus*) stock is overfished and overfishing is not occurring (Figures 86-87). Retrospective adjustments were not made to the model results. Biomass proxy (B) in 2016 was estimated to be 0.223 (kg/tow) which is 5% of the biomass target (B_{MSY} *proxy* = 4.94; Figure 86). The 2016 fully selected fishing mortality was estimated to be 0.221 which is 29% of the overfishing threshold proxy (F_{MSY} *proxy* = 0.76; Figure 87).

Table 52: Catch and model results table for ocean pout. Catch weights are in (mt), survey biomass is in (kg/tow), and the relative exploitation ratio is the total catch / NEFSC 3 year average spring biomass index. Model results are from the current updated index assessment. Note: A 2014 landings database correction was made.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Data										
US Commercial discards	164	118	165	125	76	94	68	74	63	49
US Commercial landings	4	7	3	0	0	0	0	0	0	0
Other landings	0	0	0	0	0	0	0	0	0	0
Catch for Assessment	167	126	168	126	77	90	68	74	63	49
Model Results										
NEFSC 3 yr average Spring Survey	0.475	0.513	0.479	0.44	0.343	0.298	0.357	0.29	0.317	0.223
Relative Exploitation Ratio	0.352	0.245	0.35	0.286	0.224	0.302	0.191	0.256	0.197	0.221

Table 53: Comparison of reference points estimated in an earlier assessment and from the current updated assessment. For ocean pout, median NEFSC 3 year average Spring survey biomass and median exploitation ratio during 1977-1985 are used as B_{MSY} and F_{MSY} proxies, respectively.

	2015	2017
F_{MSY} *proxy*	0.76	0.76
B_{MSY} *proxy* (kg/tow)	4.94	4.94
MSY (mt)	3,754	3,754
Overfishing	No	No
Overfished	Yes	Yes

Projections: The index-based assessment approach does not support catch projections; catch advice for ocean pout has been based on the target exploitation rate and the most recent centered 3-year average biomass index from the NEFSC spring survey.

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).
  An important source of uncertainty is the stock has not responded to low catch as expected.

- Does this assessment model have a retrospective pattern? If so, is the pattern minor or major? (A major retrospective pattern occurs when the adjusted SSB or F_{Full} lies outside of the approximate joint confidence region for SSB and F_{Full}; see Table 8).
  The model used to estimate status of this stock does not allow estimation of a retrospective pattern.

- Based on this stock assessment, are population projections well determined or uncertain? If this stock is in a rebuilding plan, how do the projections compare to the rebuilding schedule?
  N/A

- Describe any changes that were made to the current stock assessment, beyond incorporating additional years of data and the effect these changes had in the assessment and stock status.
  A database correction was made to the 2014 ocean pout landings. This change had a negligible effect on the assessment. Recreational landings were updated and were found to be negligible (time series average of recreational landings to total catch was less than 1%) and therefore not included in this assessment.

- If the stock status has changed a lot since the previous assessment, explain why this occurred.
  Ocean pout stock status has not changed since the previous assessment.

- Provide qualitative statements describing the condition of the stock that relate to stock status.
  Discards comprise most of the catch since the no possession regulation was implemented in May 2010. The NEFSC survey indices remain at near-record low levels; there are few large fish in the population. The ocean pout stock remains in poor condition.

- Indicate what data or studies are currently lacking and which would be needed most to improve this stock assessment in the future.
  The ocean pout assessment could be improved with studies that explore why this stock is not rebuilding as expected.

- Are there other important comments?
  Biological reference points are based on catch; the estimated discards used in the catch are based on a mix of direct (1989 onward) and indirect (1988 and back) methods. The catch

used to determine MSY is based on indirect methods. Minimum estimates of scientific research removals of ocean pout ranged between 0.2 and 24.9 mt, with an average of 3 mt between 1963 and 2016. The NEFSC bottom trawl surveys, Massachusetts Division of Marine Fisheries inshore surveys, Atlantic States Marine Fisheries Commission summer shrimp surveys, and various Cooperative Research surveys (e.g., such as Industry-based surveys for cod and for yellowtail flounder) and gear studies have contributed to scientific research removals.

18.1 Reviewer Comments: Ocean pout

Assessment Recommendation:

The panel concluded that the operational assessment was acceptable as a scientific basis for management advice.

Alternative Assessment Approach:

Not applicable

Status Recommendation:

Based on the operational assessment, the panel agrees with the conclusion that the ocean pout stock is overfished and overfishing is not occurring. Discards comprise most of the catch since the no possession regulation was implemented in May 2010. The National Marine Fisheries Service survey indices remain at near-record low levels, and there are few large fish in the population. The ocean pout stock remains in poor condition.

Key Sources of Uncertainty:

An important source of uncertainty is that the stock size has not increased as a result of catch reductions. The majority of catch is comprised of discards, which are estimated using both direct and indirect methods. There are questions over whether the current perspective of the stock is due to environmental drivers influencing stock abundance.

Research Needs:

The ocean pout assessment could be improved with studies that explore why this stock is not rebuilding, in particular an exploration of whether fishing mortality, biological dynamics, or environmental drivers may be causing this issue.

References:

Northeast Fisheries Science Center. 2015. Operational Assessment of 20 Northeast Groundfish Stocks,Updated Through 2014. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 15-24; 251 p. CRD15-24

Northeast Fisheries Science Center. 2012. Assessment or Data Updates of 13 Northeast Groundfish Stocks through 2010. US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 12-06; 789 p. CRD12-06

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. CRD08-15

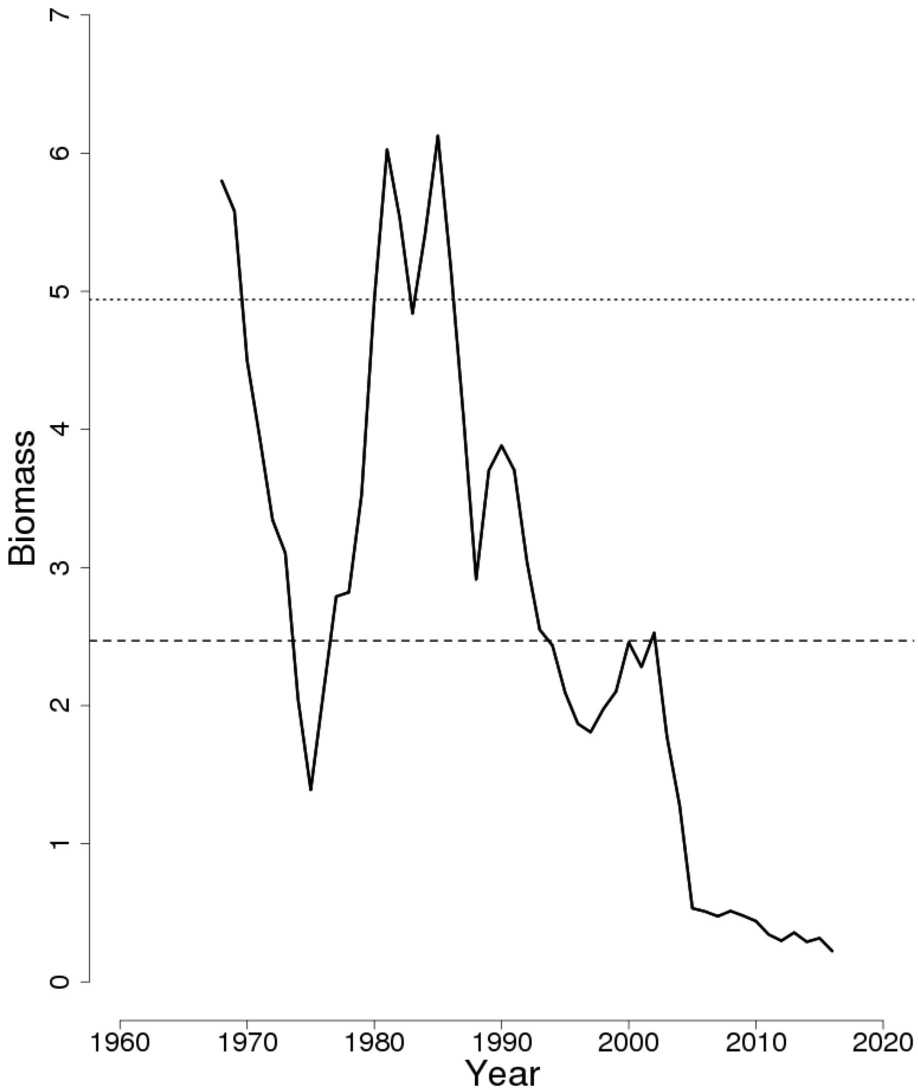

Figure 86: Trends in biomass (kg/tow) of ocean pout between 1968 and 2016 from the current (solid line) and previous (dashed line) assessment, and the corresponding $B_{Threshold}$ ($\frac{1}{2}$ B_{MSY} *proxy*; horizontal dashed line) as well as B_{Target} (B_{MSY} *proxy*; horizontal dotted line) based on the current assessment.

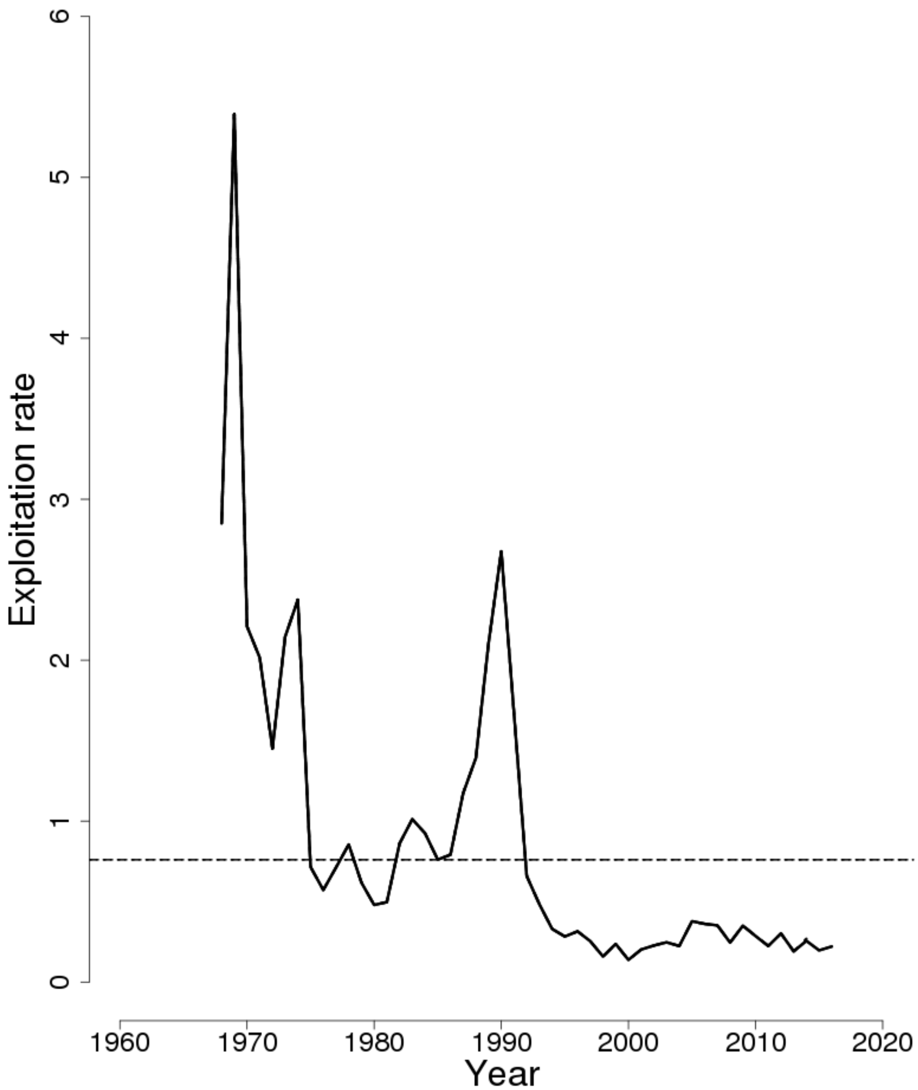

Figure 87: Trends in the exploitation rate of ocean pout between 1968 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ (F_{MSY} *proxy*=0.76; horizontal dashed line) based on the current assessment.

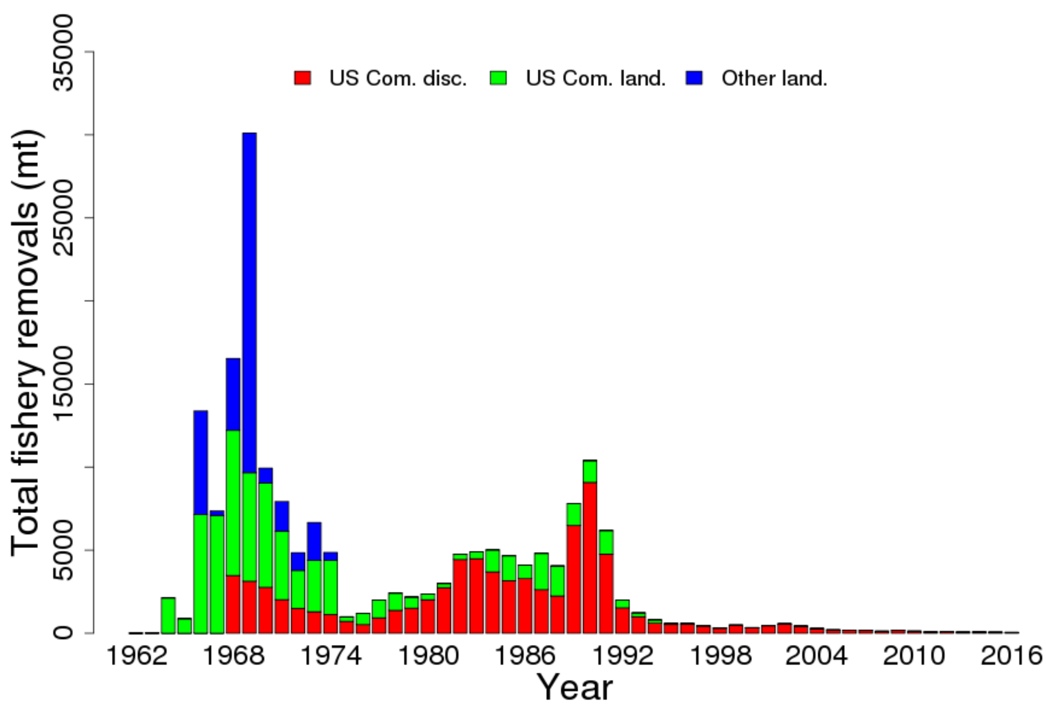

Figure 88: Total catch of ocean pout between 1968 and 2016 by fleet (US and Other) and disposition (landings and discards).

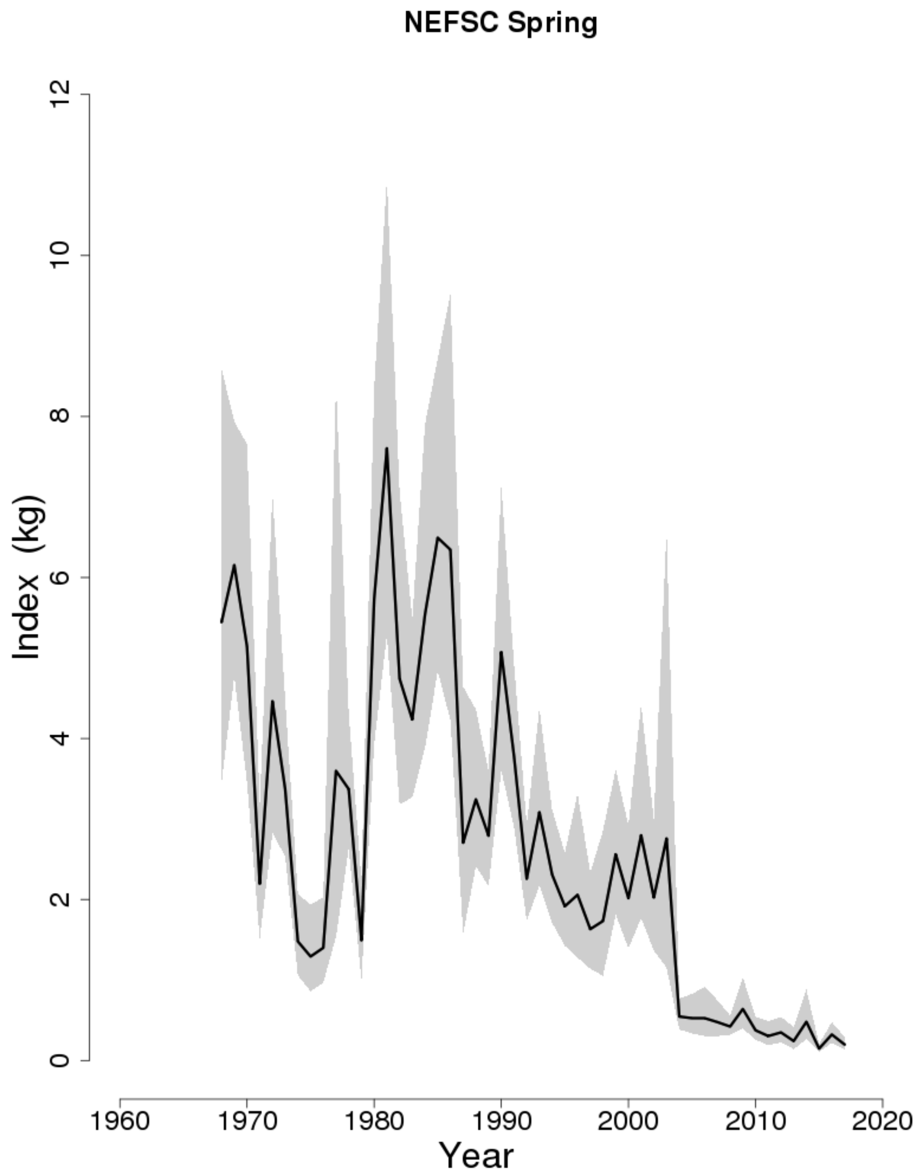

Figure 89: Indices of biomass (kg/tow) for ocean pout between 1968 and 2017 for the Northeast Fisheries Science Center (NEFSC) spring survey. The approximate 90% lognormal confidence intervals are shown.