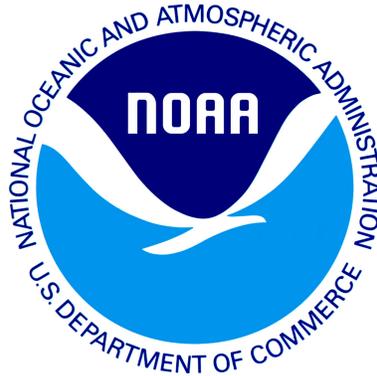


draft working paper for peer review only



Acadian redfish

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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This assessment of the Acadian redfish (*Sebastes fasciatus*) stock is an update of the existing 2012 operational assessment (NEFSC 2012). This assessment updates commercial fishery catch data, research survey indices of abundance, the ASAP analytical model, and biological reference points through 2014. Additionally, stock projections have been updated through 2018. The most recent benchmark assessment of the Acadian redfish stock was in 2008 as part of the 3rd Groundfish Assessment Review Meeting (GARM III; NEFSC 2008), which includes a full description of the model formulations.

State of Stock: Based on this updated assessment, the Acadian redfish (*Sebastes fasciatus*) stock is not overfished and overfishing is not occurring (Figures 1-2). Spawning stock biomass (SSB) in 2014 was estimated to be 414,544 (mt) which is 147% of the biomass target (SSB_{MSY} proxy of SSB at $F_{50\%} = 281,112$; Figure 1). The 2014 fully selected fishing mortality (F) was estimated to be 0.012 which is 32% of the overfishing threshold (F_{MSY} proxy of $F_{50\%} = 0.038$; Figure 2).

Table 1: Catch and status table for Acadian redfish. All weights are in (mt), and F_{Full} is the fishing mortality on fully selected ages. Model results are from the current updated ASAP assessment.

	2007	2008	2009	2010	2011	2012	2013	2014
	<i>Data</i>							
Commercial landings	787	1,193	1,461	1,646	2,011	3,844	3,550	4,573
Commercial discards	373	180	206	206	212	302	424	513
Catch for Assessment	1,160	1,373	1,667	1,852	2,223	4,146	3,974	5,086
	<i>Model Results</i>							
Spawning Stock Biomass	205,903	228,151	252,149	278,878	309,190	342,567	377,993	414,544
F_{Full}	0.006	0.006	0.007	0.007	0.008	0.012	0.011	0.012
Recruits age1	177,255	274,310	142,068	46,308	63,366	72,633	126,756	108,697

Table 2: Comparison of biological reference points for Acadian redfish estimated in the 2012 assessment and from the current assessment update. An F_{MSY} proxy of $F_{50\%}$ was used for the overfishing threshold, and was based on long-term stochastic projections. Recruits represent the median of the predicted recruits. Intervals shown are 5th and 95th percentiles.

	2012	Current
F_{MSY} proxy	0.038	0.038
SSB_{MSY} (mt)	238,000	281,112 (201,740 - 376,533)
MSY (mt)	8,891	10,466 (7,458 - 14,081)
Median recruits (age 1) (000s)	48,177	47,006
<i>Overfishing</i>	No	No
<i>Overfished</i>	No	No

Projections: Short term projections of median total fishery yield and spawning stock biomass

for Acadian redfish were conducted based on a harvest scenario of fishing at the F_{MSY} proxy between 2016 and 2018. Catch in 2015 has been estimated at 5,204 (mt). Recruitments were sampled from a cumulative distribution function derived from ASAP estimated age 1 recruitment between 1969 and 2014. The annual fishery selectivity, maturity ogive, and mean weights at age used in projections are the same as those used in the assessment model. Retrospective adjusted SSB (330004 (mt)) and fully selected F (0.015) in 2014 fell outside the 90% confidence intervals of the unadjusted 2014 values (365,952 to 463,136 (mt) and 0.011 to 0.014, respectively). Therefore, retrospective adjustments were applied in the projections.

Table 3: Short term projections of median total fishery yield and spawning stock biomass for Acadian redfish based on a harvest scenario of fishing at an F_{MSY} proxy of $F_{50\%}$ between 2016 and 2018. Catch in 2015 has been estimated at 5,204 (mt). F_{Full} is the fully selected F.

Year	Catch (mt)	SSB (mt)	F_{Full}
2015	5,204	343,190	0.015
2016	13,723	367,307	0.038
2017	14,541	382,319	0.038
2018	15,007	393,124	0.038

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 in the Acadian redfish assessment is the lack of age data, particularly from the commercial fishery. Age measurements from landings halted after 1985, due to relatively low landings. Current landings have increased to levels seen in the mid-1980s. If landings continue to increase, then age data from the fishery will become increasingly important. Dimorphic growth is another source of uncertainty in this assessment, with females growing faster than males. The use of female weights at age in the stock projections may lead to overestimation of stock productivity, as well as having an unknown effect on biological reference points.

- Does this assessment model have a retrospective pattern? If so, is the pattern minor, or major?

This assessment has a major retrospective pattern in SSB and F. Retrospective adjusted SSB (Mohn's rho = 0.256) and fully selected F (Mohn's rho = -0.190) in 2014 fell outside the 90% confidence intervals of the unadjusted 2014 values.

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

Population projections for Acadian redfish appear to be reasonably well determined.

- 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.

Only one major change was made to the Acadian redfish assessment as part of this

update. Likelihood constants were excluded from likelihood calculations to avoid potential bias caused by one of the recruitment likelihood constants, which is the sum of the log-scale predicted recruitments, and therefore not a constant. Inclusion of this likelihood constant allows the assessment model to minimize the negative log likelihood by estimating lower recruitments. Exclusion of the likelihood constants led to slightly higher estimates of SSB in recent years.

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

There has been no change in the stock status of Acadian redfish 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.

The Acadian redfish assessment could be improved by 1) including additional age data, particularly from the commercial fishery, and 2) investigating the sensitivity of biological reference points and stock projections to the weights at age.

- Are there other important issues?

Northeast Fisheries Science Center (NEFSC) fall bottom trawl index values for 2013 and 2014 are lower than in previous years (Figure 5), but the current assessment model continues to predict an increase in SSB for the last two years (Figure 1). If future index values remain low (i.e., if the index is responding to a change in abundance, rather than interannual variability), then the predicted trend in SSB may change abruptly in a future assessment.

References:

Northeast Fisheries Science Center. 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, August 4-8, 2008. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 08-15; 884 p + xvii. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at <http://www.nefsc.noaa.gov/nefsc/publications/>

Northeast Fisheries Science Center. 2012. Assessment or Data Updates of 13 Northeast Groundfish Stocks through 2010. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 12-06; 789 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at <http://www.nefsc.noaa.gov/nefsc/publications/>

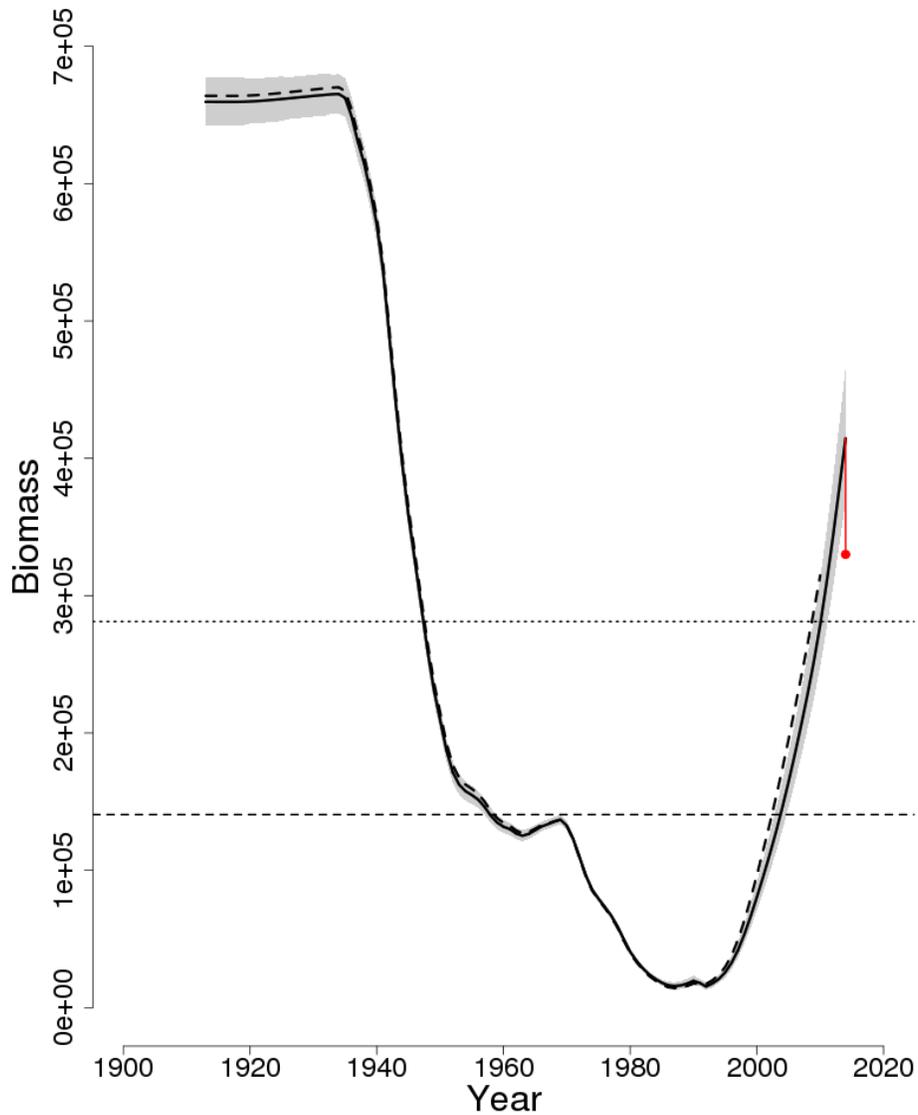


Figure 1: Trends in spawning stock biomass of Acadian redfish between 1913 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{Threshold}$ ($0.5 * SSB_{MSY}$ proxy; horizontal dashed line) as well as SSB_{Target} (SSB_{MSY} proxy; horizontal dotted line) based on the 2015 assessment. Biomass was adjusted for a retrospective pattern and the adjustment is shown in red. The approximate 90% lognormal confidence intervals are shown.

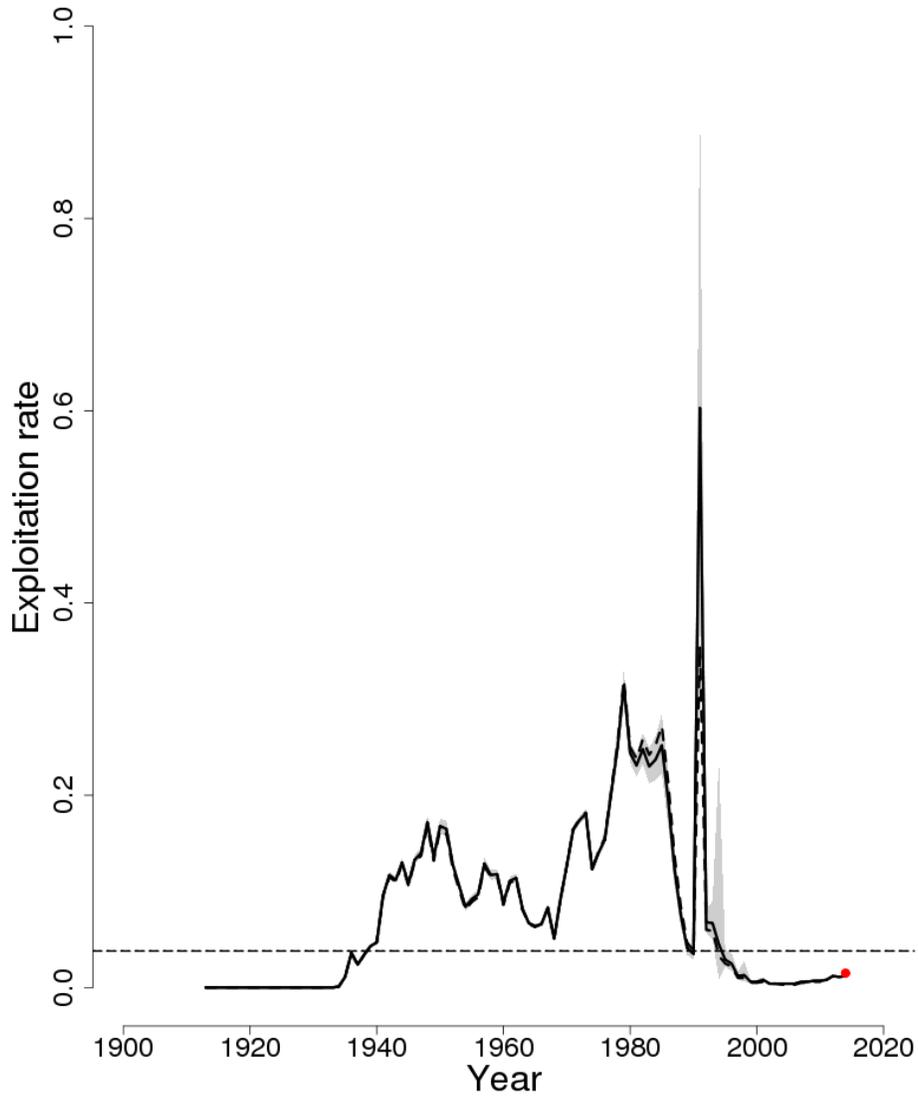


Figure 2: Trends in the fully selected fishing mortality (F_{Full}) of Acadian redfish between 1913 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ (F_{MSY} proxy=0.038; horizontal dashed line) based on the 2015 assessment. F_{Full} was adjusted for a retrospective pattern and the adjustment is shown in red. The approximate 90% lognormal confidence intervals are shown.

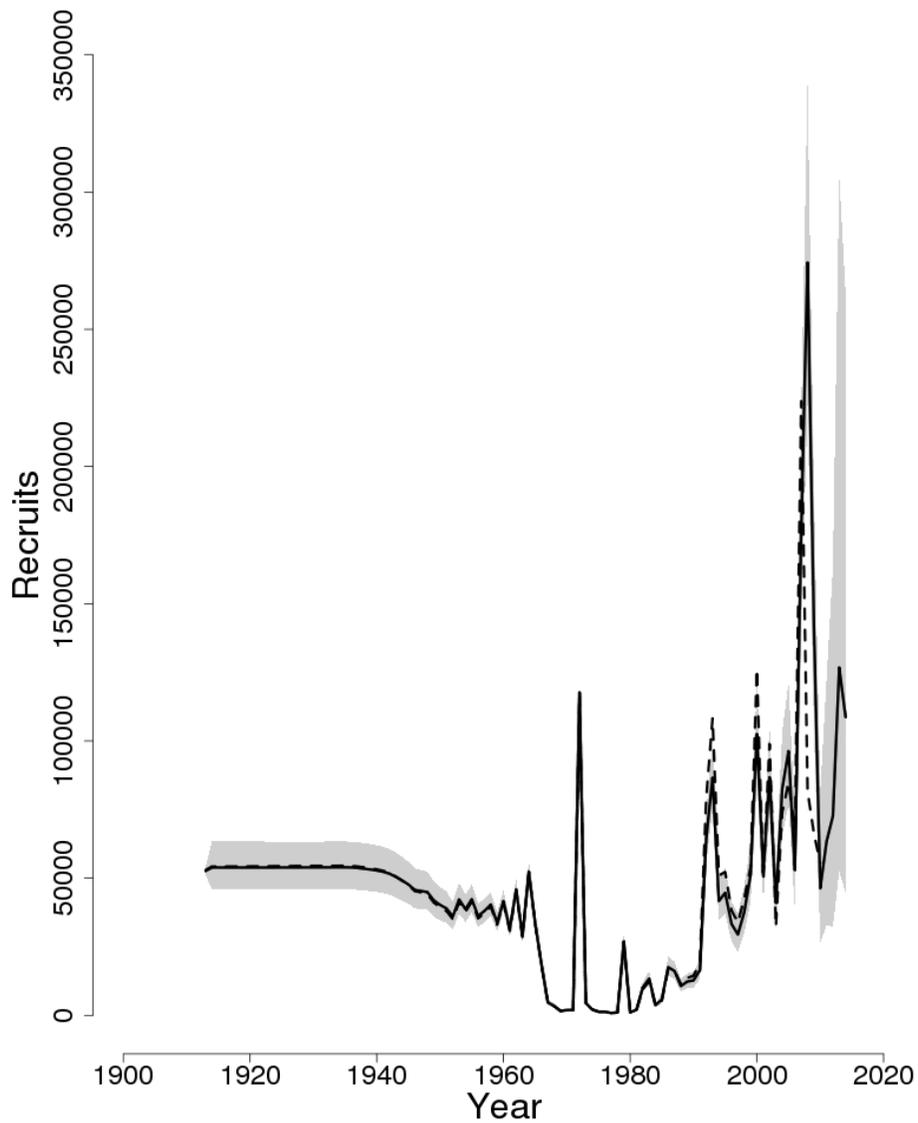


Figure 3: Trends in Recruits (age 1) (000s) of Acadian redfish between 1913 and 2014 from the current (solid line) and previous (dashed line) assessment. The approximate 90% lognormal confidence intervals are shown.

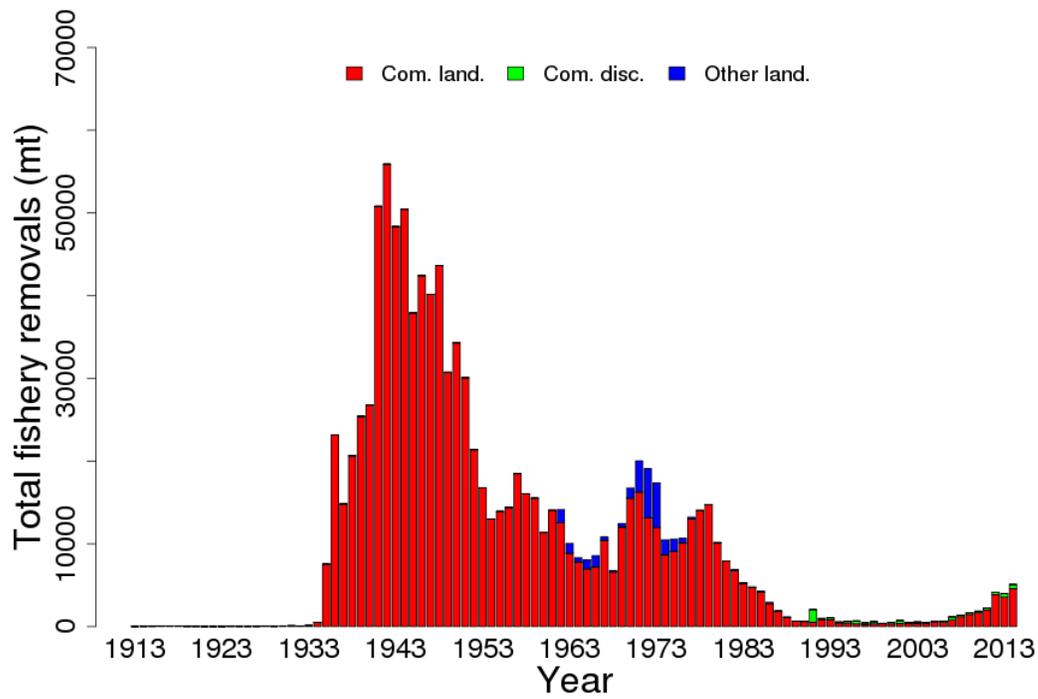


Figure 4: Total catch of Acadian redfish between 1913 and 2014 by fleet (commercial and other) and disposition (landings and discards).

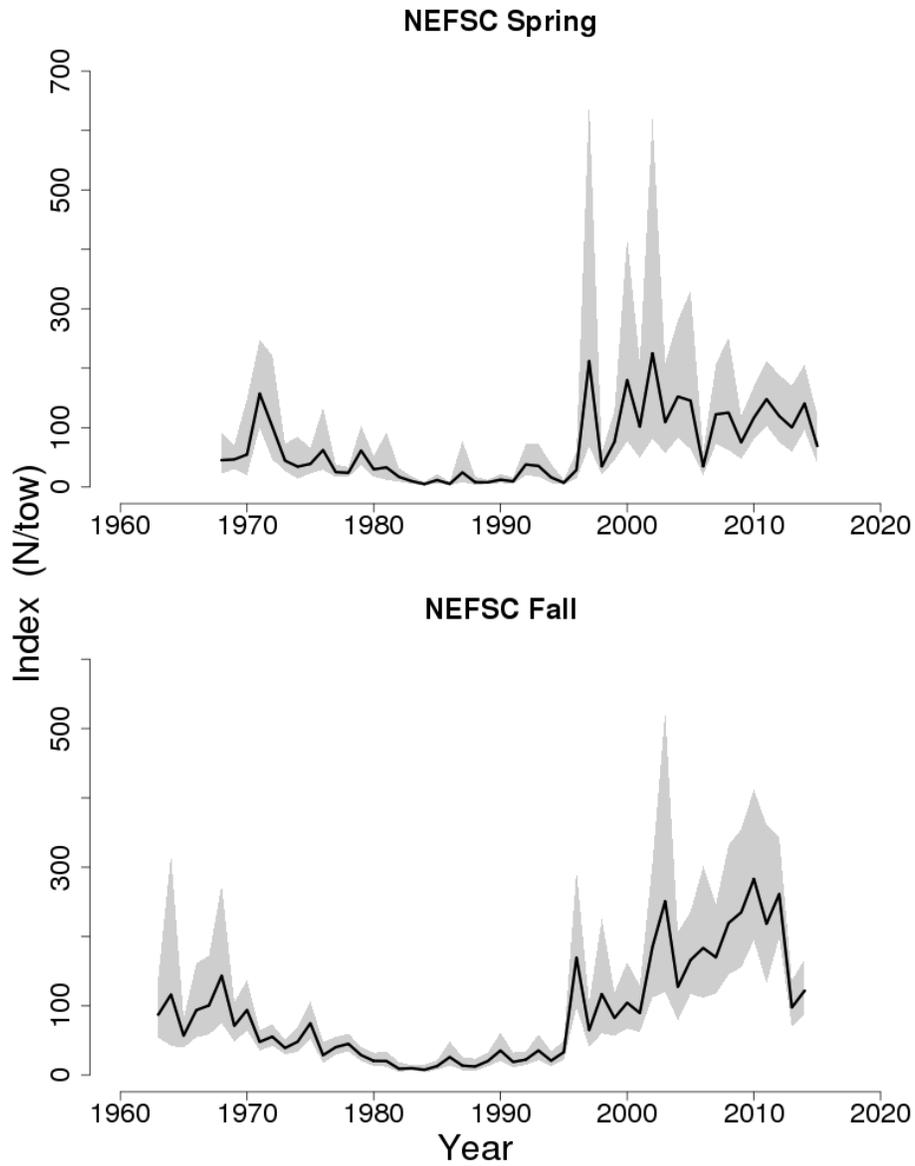


Figure 5: Indices of abundance for Acadian redfish between 1963 and 2015 for the Northeast Fisheries Science Center (NEFSC) spring and fall bottom trawl surveys. The approximate 90% lognormal confidence intervals are shown.