

12 Acadian redfish

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*This assessment of the Acadian redfish (*Sebastes fasciatus*) stock is an operational assessment 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 61-62). Retrospective adjustments were made to the model results. Retrospective adjusted spawning stock biomass (SSB) in 2014 was estimated to be 330,004 (mt) which is 117% of the biomass target (SSB_{MSY} proxy of SSB at $F_{50\%} = 281,112$; Figure 61). The retrospective adjusted 2014 fully selected fishing mortality (F) was estimated to be 0.015 which is 39% of the overfishing threshold (F_{MSY} proxy of $F_{50\%} = 0.038$; Figure 62).

Table 39: Catch and status table for Acadian redfish. All weights are in (mt), and F_{Full} is the fishing mortality on fully selected ages. Unadjusted SSB and F estimates are reported. 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 <i>age</i> 1	177,255	274,310	142,068	46,308	63,366	72,633	126,756	108,697

Table 40: 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 from 1969 to the final assessment year. Intervals shown are 5th and 95th percentiles.

	2012	Current
F_{MSY} proxy	0.038	0.038
SSB_{MSY} (mt)	238,480	281,112 (201,740 - 376,533)
MSY (mt)	8,891	10,466 (7,458 - 14,081)
Median recruits (age 1) (000s)	22,477	31,391
<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, natural mortality, maturity ogive, and mean weights used in projections are the same as those used in the assessment model. Retrospective adjusted SSB and fully selected F in 2014 fell outside the 90% confidence intervals of the unadjusted 2014 values. Therefore, retrospective adjustments were applied in the projections.

Table 41: Retrospective adjusted 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 were not collected 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? (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 0.036 in the 2012 assessment and was 0.256 in 2014. The 7-year Mohn's ρ , relative to F , was -0.035 in the 2012 assessment and was -0.190 in 2014. There was a major retrospective pattern for this assessment because the ρ adjusted estimates of 2014 SSB ($SSB_{\rho}=330,004$) and 2014 F ($F_{\rho}=0.015$) were outside the approximate 90% confidence region around SSB (368,906 - 465,828) and F (0.011 - 0.014). A retrospective adjustment was made for both the determination of stock status and for projections of catch in 2016. The retrospective adjustment changed the 2014 SSB from 414,544 to 330,004 and the 2014 F_{Full} from 0.012 to 0.015.

- 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 effect 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 mean 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 65), but the current assessment model continues to predict an increase in SSB for the last two years (Figure 61). 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. Such an abrupt change may lead to an increase in the retrospective pattern.

12.1 Reviewer Comments: Acadian redfish

Recommendation: The Panel concluded that the updated stock assessment with retrospective adjustment was acceptable as a scientific basis for management advice and agreed with the status determination that the stock is not overfished and overfishing is not occurring. The Panel accepted the current projections as the basis for the 2016-2018 overfishing limits. All data updates and the model change (removal of likelihood constants) were accepted by the Panel.

Alternative Assessment Approach: Not applicable

Sources of Uncertainty: Major sources of uncertainty are the retrospective pattern, lack of age samples from the commercial fishery, historical discard estimates and model inconsistencies. The current assessment model underestimates fishing mortality and overestimates spawning stock biomass, and compared to the 2012 assessment, the magnitude of the retrospective pattern has increased slightly. The current retrospective pattern is similar in magnitude to the retrospective pattern from the GARM III benchmark assessment. No age measurements from the commercial fishery have been made since 1985. There is dimorphic growth of sexes and the current use of female weights-at-age in the stock projections may lead to overestimation of stock productivity and have unknown effects on the biological reference points. The relatively high uncertainty in the 1991 discard estimate ($CV = 76\%$) led to an overestimation of total removals and a spike in predicted F in that year. The shift in peak recruitment from 2006 in the last assessment to 2007 in the current assessment, and lack of fit to the fall survey values in 2013-2014 suggests potential model/data inconsistencies.

Research Needs: For the next benchmark assessment, the Panel recommended that processing of historical samples and age sampling of the current commercial fishery should occur since the landings of redfish are increasing, and age data will better inform the model. In addition, they suggested work should focus on ageing samples from select years (since the ASAP does not require ages for every year) or targeting years where there are problems. Since redfish are long-lived, errors in ageing should be investigated and quantified.

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. [CRD08-15](#)

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. [CRD12-06](#)

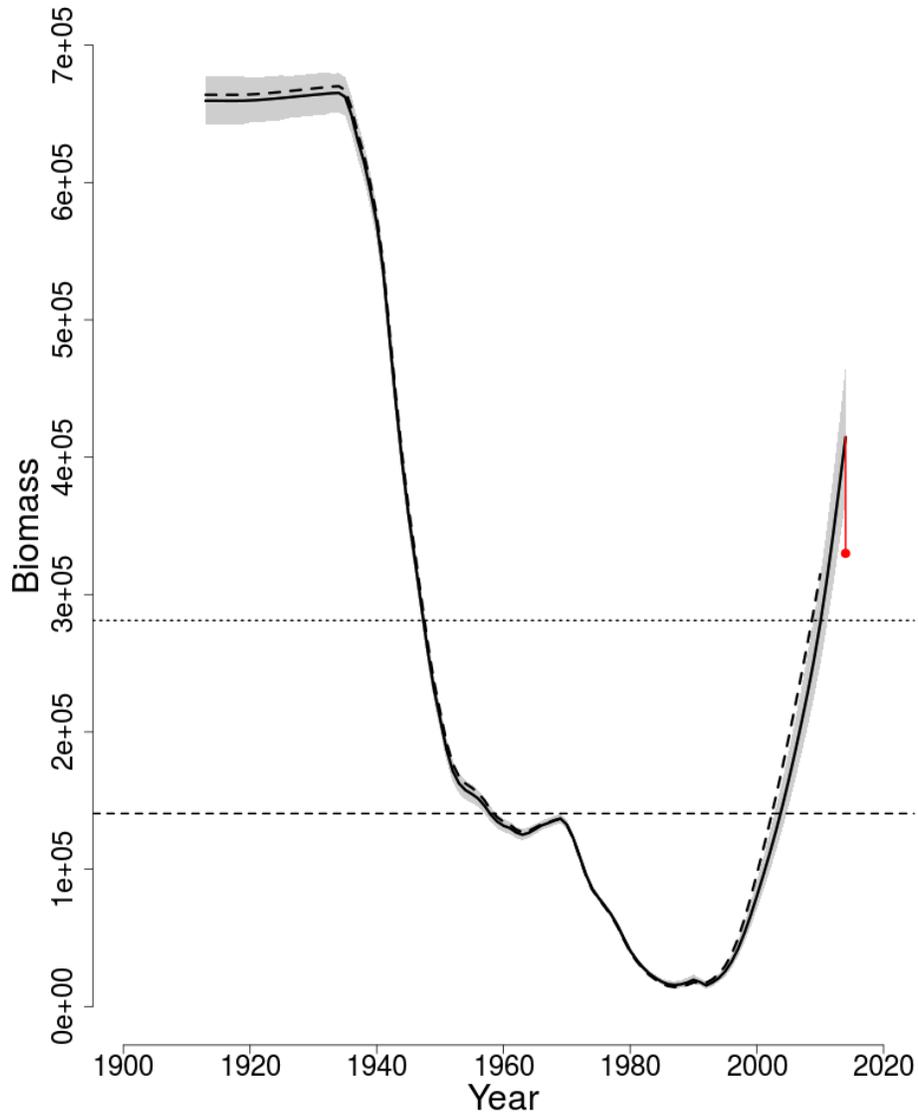


Figure 61: Trends in spawning stock biomass of Acadian redfish between 1913 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{Threshold}$ ($0.5 * SSB_{MSY proxy}$; horizontal dashed line) as well as SSB_{Target} ($SSB_{MSY proxy}$; horizontal dotted 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.

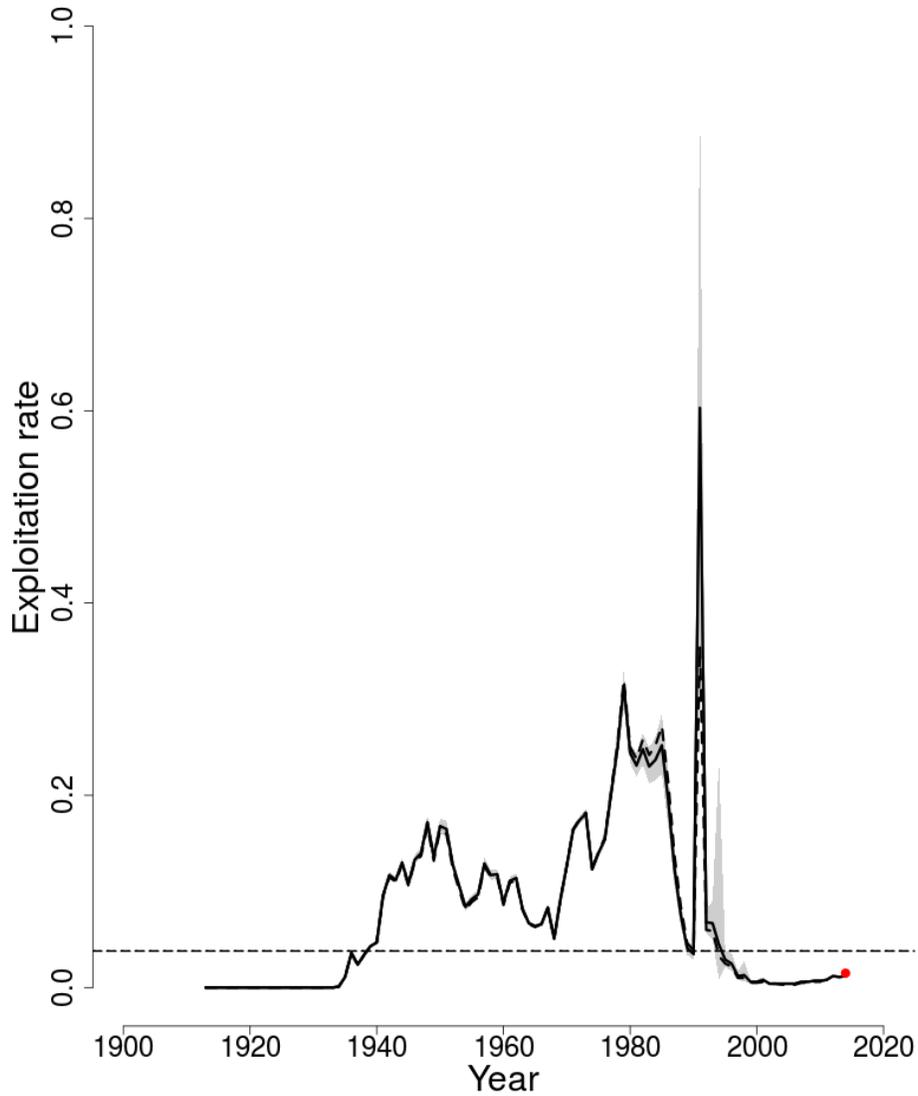


Figure 62: Trends in the fully selected fishing mortality (F_{Full}) of Acadian redfish between 1913 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ (F_{MSY} proxy=0.038; horizontal dashed line) based on the 2015 assessment. F_{Full} was adjusted for a retrospective pattern and the adjustment is shown in red. The approximate 90% lognormal confidence intervals are shown.

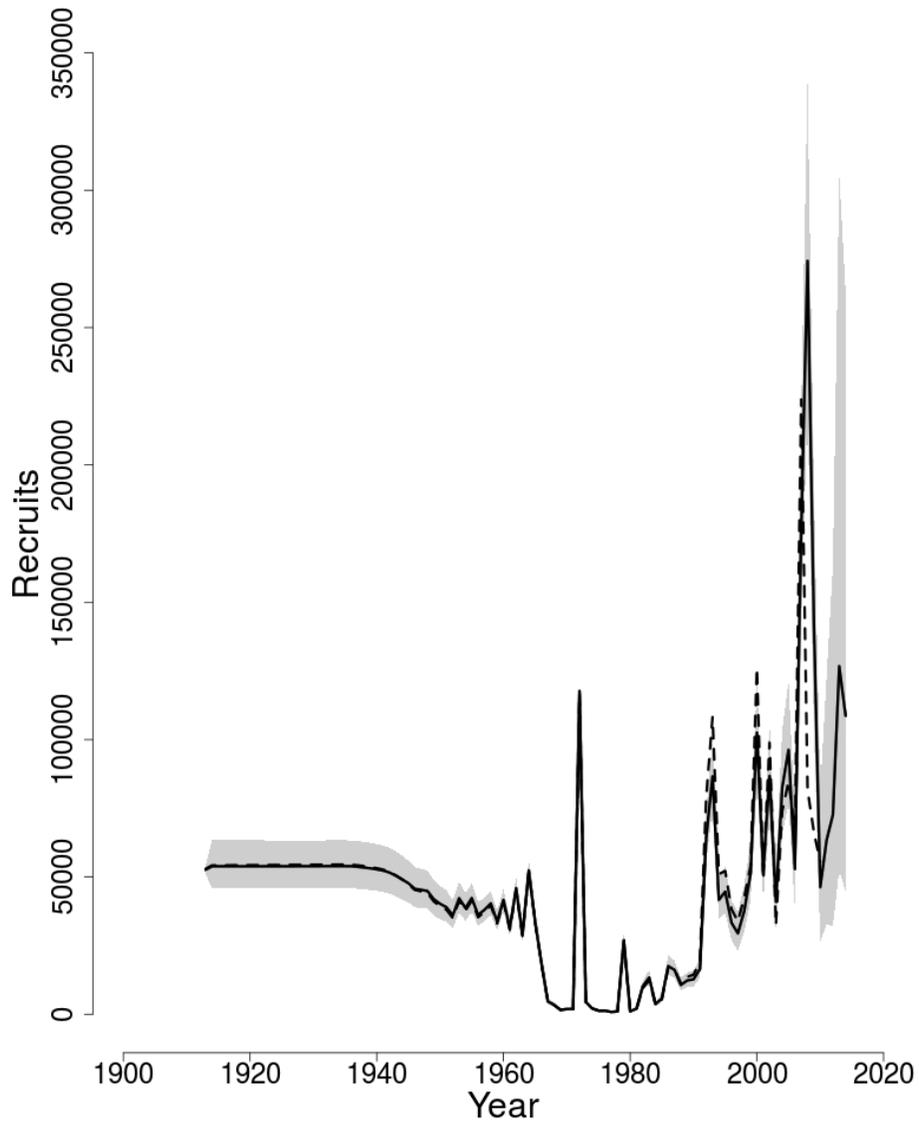


Figure 63: Trends in Recruits (age 1) (000s) of Acadian redfish between 1913 and 2014 from the current (solid line) and previous (dashed line) assessment. The approximate 90% lognormal confidence intervals are shown.

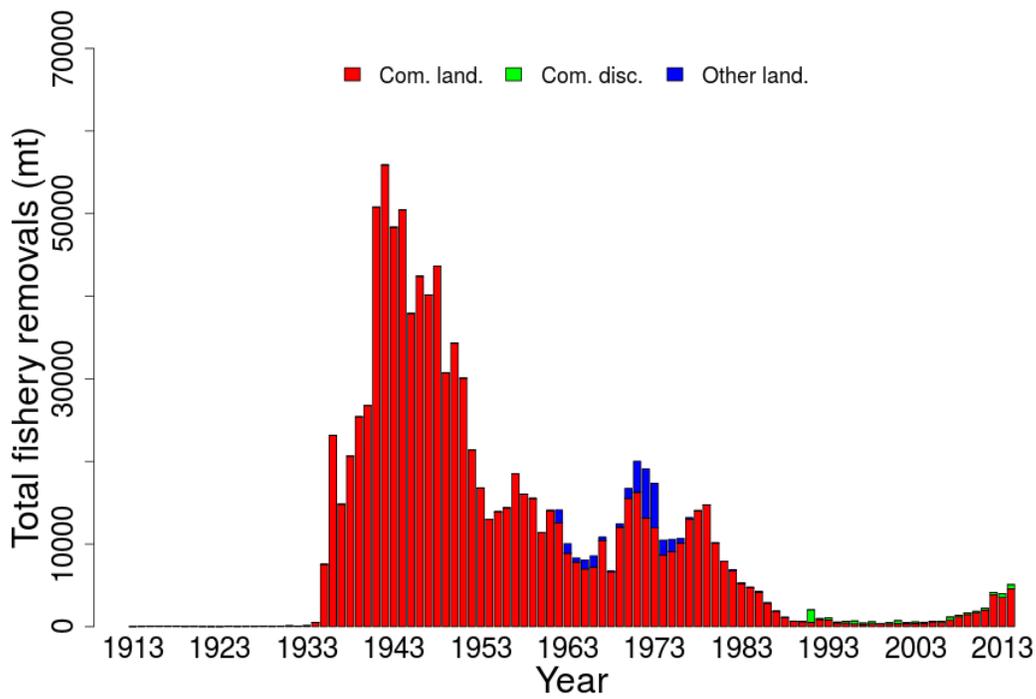


Figure 64: Total catch of Acadian redfish between 1913 and 2014 by fleet (commercial and other) and disposition (landings and discards).

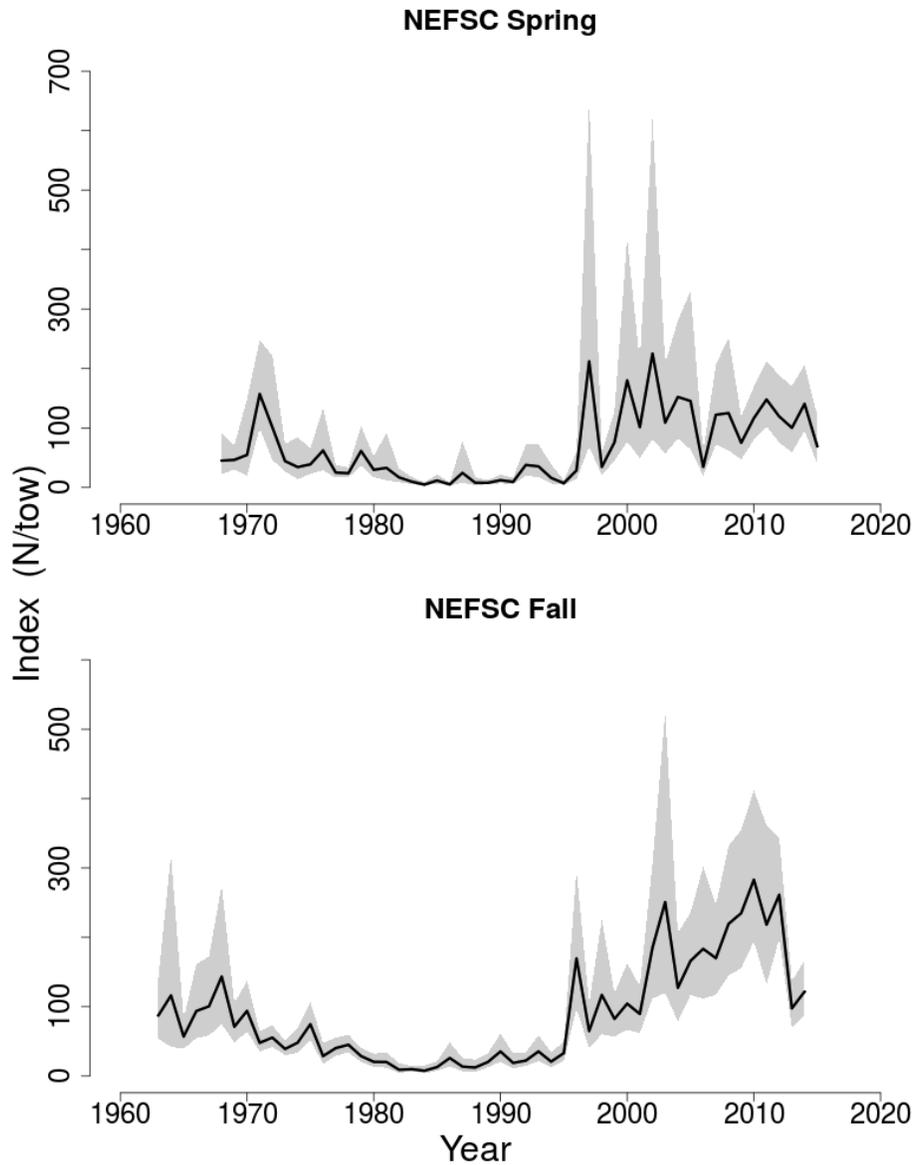


Figure 65: Indices of abundance for Acadian redfish from the Northeast Fisheries Science Center (NEFSC) spring (1963 to 2015) and fall (1963 to 2014) bottom trawl surveys. The approximate 90% lognormal confidence intervals are shown.