15 Atlantic wolffish

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This assessment of the Atlantic wolffish (Anarhichas lupus) stock is an operational assessment of the existing 2015 operational assessment (NEFSC 2015). Based on the previous assessment the stock was overfished, but overfishing was not occurring. This assessment updates commercial fishery catch data, research survey indices of abundance, and the analytical assessment models and reference points through 2016.

State of Stock: Based on this updated assessment, the Atlantic wolffish (*Anarhichas lupus*) stock is overfished and overfishing is not occurring (Figures 73-74). Retrospective adjustments were not made to the model results. Spawning stock biomass (SSB) in 2016 was estimated to be 652 (mt) which is 40% of the biomass target (SSB_{MSY} *proxy* = 1,612; Figure 73). The 2016 fully selected fishing mortality was estimated to be 0.002 which is 1% of the overfishing threshold proxy (F_{MSY} *proxy* = 0.222; Figure 74).

Table 46: Catch and status table for Atlantic wolffish. All weights are in (mt) recruitment is in (mt) and F_{Full} is the fully selected fishing mortality. Model results are from the current updated SCALE assessment.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
					Data					
Commercial landings	63	49	33	3	0	0	0	0	0	0
Commercial discards	0	0	0	1	3	2	2	1	1	1
Recreational landings	12	14	7	1	2	0	0	0	0	0
Catch for Assessment	75	64	40	5	5	2	2	1	1	1
					Model Results					
Spawning Stock Biomass	368	335	296	303	353	410	477	537	593	652
F_{Full}	0.421	0.512	0.284	0.024	0.019	0.009	0.005	0.003	0.003	0.002
Recruits (age 1)	87	67	64	80	86	127	288	289	289	289

Table 47: Comparison of reference points from the previous assessment and the current assessment update. An $F_{40\%}$ proxy was used for the overfishing threshold and was based on yield per recruit calculations within the SCALE model.

	2015	2017
F_{MSY} *proxy*	0.243	0.222
SSB_{MSY} (mt)	1,663	1,612
MSY (mt)	244	232
Median recruits (age 1) (mt)	252	235
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).

  The primary sources of uncertainty are the use of the ocean pout calibration coefficient (Atlantic wolffish coefficients are unknown), and the change to a no possession limit in May 2010. The ocean pout calibration coefficient (4.575) is one of the largest for any species (Miller et al. 2010), and results in lower biomass estimates. The change to a no possession limit places greater importance on discard mortality. Additionally, it is unclear whether the lack of a recruitment index since 2004 is due to an actual decrease in recruitment, or a change in catchability resulting from the increase in liner mesh size associated with the switch to the Bigelow. Other sources of uncertainty were identified in previous Atlantic wolffish assessments (NDPSWG 2009, NEFSC 2012): the surveys may have reached the limit of wolffish detectability due to the decline in abundance; and the lack of commercial length information results in model estimation difficulties for fishery selectivity.

- 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).

  This assessment has retrospective patterns with Mohn's rho = 0.47 for SSB and -0.21 for F. Confidence intervals are not available because MCMC is not fully developed for the SCALE model. Thus, retrospective adjustments were not done for this assessment.

- 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 Atlantic wolffish were not done. Due to the uncertainties in the assessment, the Northeast Data Poor Stocks Working Group (NDPSWG 2009) concluded that stock projections would be unreliable and should not be conducted. This stock was not in a rebuilding plan.

- 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.

  There were no changes since the previous assessment.

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

  Stock status has not changed since the previous assessment.

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

  Catch has been limited almost exclusively to discards since the implementation of the no possession rule in May 2010. No age 1 recruits have been caught in the NEFSC spring survey since 2004. Both NEFSC adult indices (spring and fall) declined in 2016. In contrast, the spring MADMF adult index has increased over the past two years.

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

The Atlantic wolffish maturity study in the Gulf of Maine has been expanded through funding by a Saltonstall-Kennedy grant. Sampling in summer 2017 should provide sufficient histological data to allow for the development of a definitive maturity ogive that can be used in the next assessment.

Other research needs were identified by the Peer Review Panel in the previous assessment (NEFSC 2015): potential use of a likelihood profile to apply the criterion for a retrospective adjustment; further studies on growth parameters; a tagging study to provide information on stock structure and movement; and a study of post-capture nest site fidelity.

- Are there other important issues?

  Recruitment at the end of the time series increases toward the initial recruitment estimate (Table 1; Figure 3) because there is no information in the model to inform these estimates. There is no indication in the data that recruitment has increased recently.

  Approximate 90% lognormal confidence intervals are not shown in Figures 1-3 because MCMC is not fully developed for the SCALE model.

  An 8% discard mortality rate was adopted by the Peer Review Panel in the previous assessment (NEFSC 2015). This results in very low removals under the no possession rule. Future model updates should see a population response from these low removals. However, if no change is observed in the data inputs (e.g. increased survey indices) then the diagnostics may worsen.

15.1 Reviewer Comments: Atlantic wolffish

Assessment Recommendation:

The panel concluded that the operational assessment with no adjustment for retrospective bias was acceptable as a scientific basis for management advice.

Alternative Assessment Approach:

Not applicable

Status Recommendation:

Based on this operational assessment, the panel agrees with the conclusion that the Atlantic wolffish stock is overfished and overfishing is not occurring. Catch has been limited almost exclusively to discards since the implementation of the no possession rule in May 2010. No age-1 recruits have been caught in the National Marine Fisheries Service spring survey since 2004. Both adult survey indices (spring and fall) declined in 2016. In contrast, the Massachusetts Division of Marine Fisheries spring survey began catching wolffish again after 2014.

Key Sources of Uncertainty:

The primary sources of uncertainty are the use of the ocean pout calibration coefficient (Atlantic wolffish coefficients are unknown), and effects due to the change to a no possession limit in May 2010, which causes discards to represent the only source of fishing mortality. The ocean pout calibration coefficient is one of the largest for any species, and results in lower biomass estimates. Additionally, a possible contributor to the apparent lack of a recruitment since 2004 may be due to a change in catchability resulting from the increase in liner mesh size associated with the switch to the new survey net, which occurred in 2009. The surveys may have reached the limit of wolffish detectability due to the decline in abundance; and the lack of commercial length information results in model estimation difficulties for fishery selectivity. Other sources of uncertainty were identified in previous Atlantic wolffish assessments.

Research Needs:

An Atlantic wolffish maturity study in the Gulf of Maine has been expanded through funding by a Saltonstall-Kennedy grant. Sampling in summer 2017 should provide sufficient histological data to allow for the development of a definitive maturity ogive that can be used in the next assessment. Other research needs were identified by the peer review panel in the previous assessment, such as the potential use of a likelihood profile to apply the criterion for a retrospective adjustment, further studies on growth parameters, a tagging study to provide information on stock structure and movement, and a study of post-capture nest site fidelity.

References:

Miller TJ, Das C, Politis PJ, Miller AS, Lucey SM, Legault CM, Brown RW, Rago PJ. 2010. Estimation of Albatross IV to Henry B. Bigelow calibration factors. US Dep Commer, Northeast Fish Sci Cent Ref Doc. 10-05; 233 p. CRD10-05

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

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

Northeast Data Poor Stocks Working Group (NDPSWG). 2009. The Northeast Data Poor Stocks Working Group Report, December 8-12, 2008 Meeting. Part A. Skate species complex, deep sea red crab, Atlantic wolffish, scup, and black sea bass. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 09-02; 496 p. CRD09-02

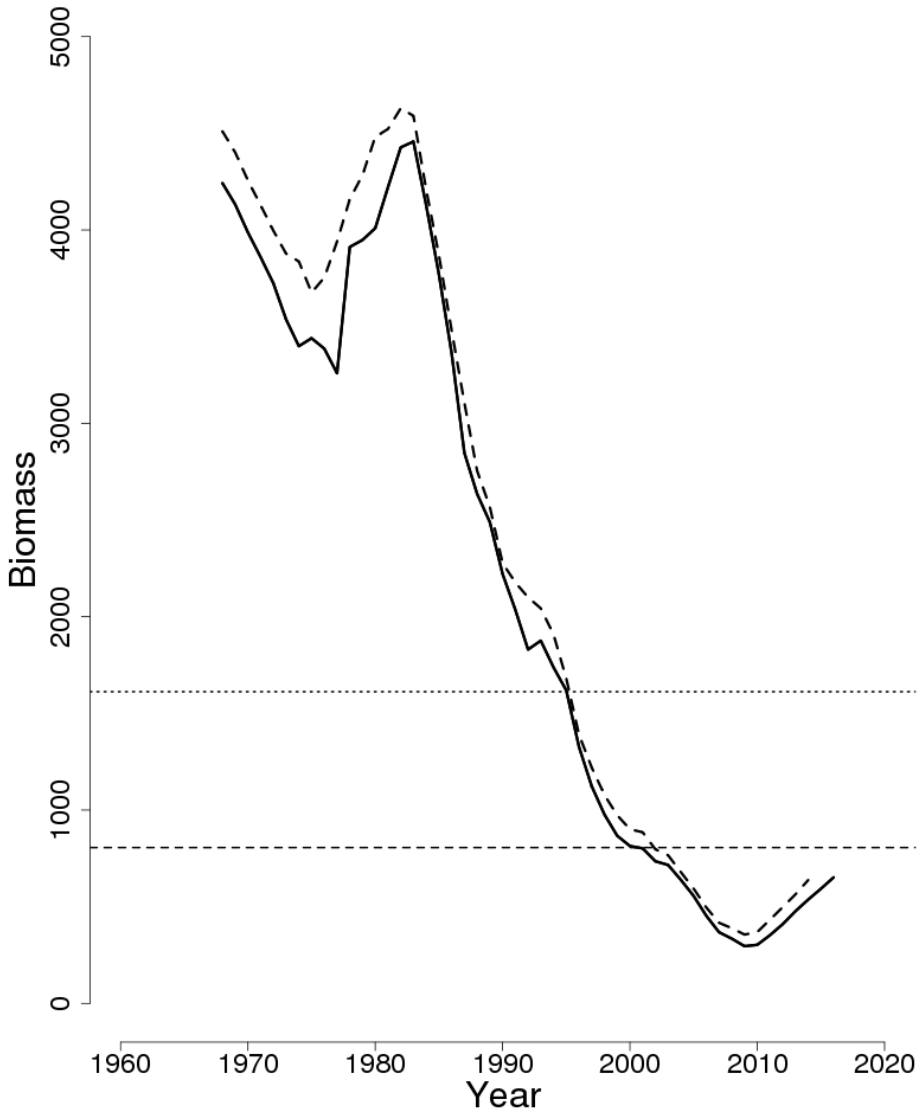

Figure 73: Trends in spawning stock biomass of Atlantic wolffish between 1968 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{Threshold}$ ($\frac{1}{2}$ SSB_{MSY} *proxy*; horizontal dashed line) as well as SSB_{Target} (SSB_{MSY} *proxy*; horizontal dotted line) based on the current assessment.

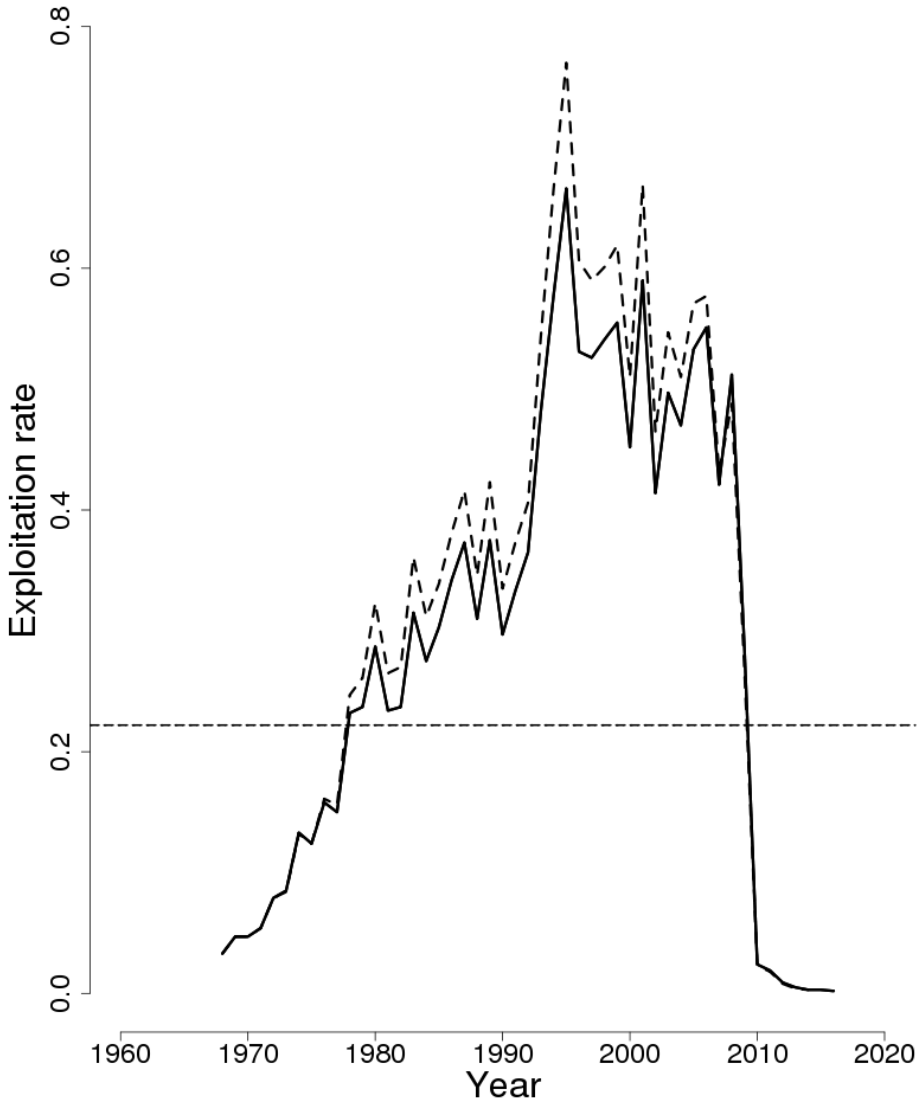

Figure 74: Trends in the fully selected fishing mortality (F_{Full}) of Atlantic wolffish between 1968 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ (F_{MSY} *proxy*=0.222; horizontal dashed line).

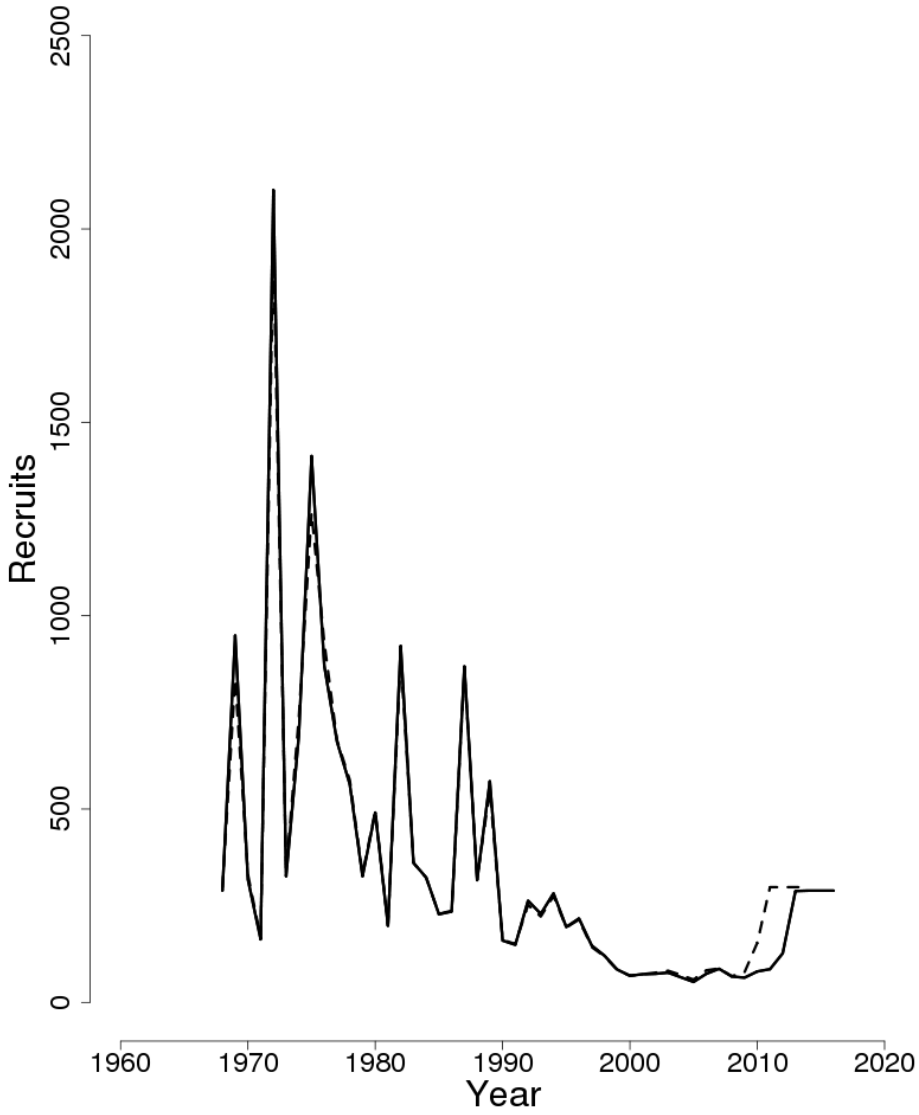

Figure 75: Trends in age 1 recruits of Atlantic wolffish between 1968 and 2016 from the current (solid line) and previous (dashed line) assessment.

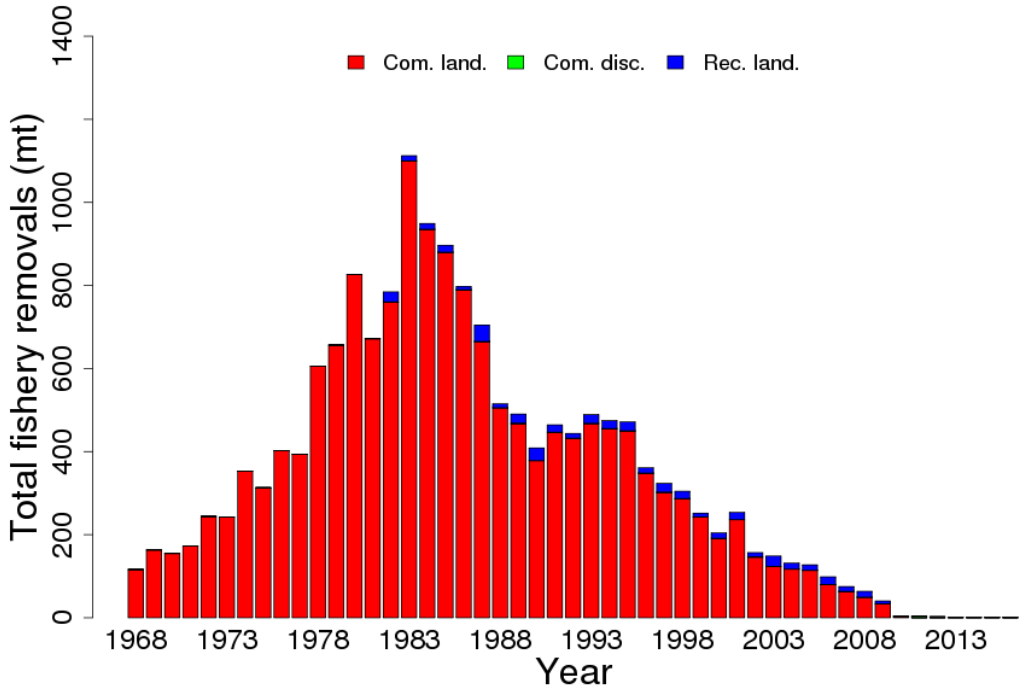

Figure 76: Total catch of Atlantic wolffish between 1968 and 2016 by fleet (commercial and recreational) and disposition (landings and discards). Note that a no possession limit was put in place in May 2010.

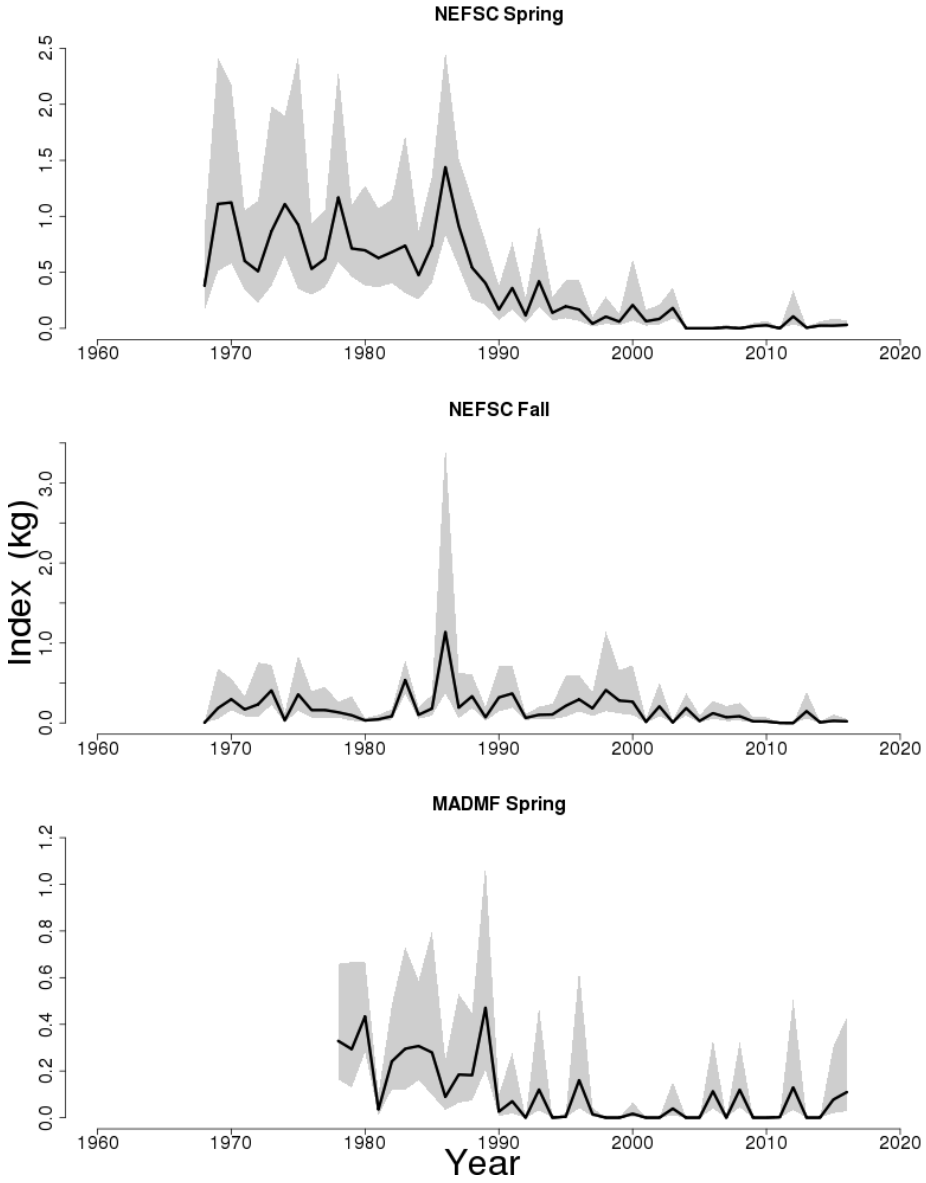

Figure 77: Indices of biomass for the Atlantic wolffish between 1968 and 2016 for the Northeast Fisheries Science Center (NEFSC) spring and fall bottom trawl surveys, and the Massachusetts Division of Marine Fisheries (MADMF) spring bottom trawl survey. The approximate 90% lognormal confidence intervals are shown. NEFSC indices for 2009-2015 are calibrated using the ocean pout coefficient from Miller et al. (2010).