draft working paper for peer review only

Ocean quahog

2020 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 ocean quahog (Arctica islandica) stock is a management track assessment of the existing 2017 benchmark Stock Synthesis (SS) assessment (NEFSC 2017). Based on the previous assessment the stock was not overfished, and overfishing was not occurring. This assessment updates commercial fishery catch data, and commercial length composition data, as well as the analytical SS assessment model and reference points through 2019. No new survey data have been collected since the last assessment. Stock projections have been updated through 2026

State of Stock: Based on this updated assessment the, ocean quahog (*Arctica islandica*) stock is not overfished and overfishing is not occurring (Figures 1-2). Retrospective adjustments were not made to the model results. Spawning stock biomass (SSB) in 2019 was estimated to be 3,651 ('000 mt) which is 172.8% of the biomass target (SSB_{MSY} *proxy* = 2,113; Figure 1). The 2019 fully selected fishing mortality was estimated to be 0.005 which is 25.5% of the overfishing threshold proxy (F_{MSY} *proxy* = 0.019; Figure 2).

Table 1: Catch and status table for ocean quahog. All data weights are in (mt) model results are ratios relative to reference points. Model results are from the current SS assessment.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
					Data					
Landings South	16,257	14,332	15,757	14,555	13,817	13,629	13,689	13,406	14,328	10,928
Landings North	13	0	106	166	681	81	276	980	258	232
Discards South	5	7	104	5	2	1,682	566	623	795	0
Discards North	0	0	1	0	0	10	11	46	14	0
Catch for Assessment	16,275	14,339	15,968	14,726	14,500	15,402	14,542	15,055	15,396	11,160
					Model Results					
Spawning Stock Biomass	2.02	2.04	2.06	2.07	2.09	2.11	2.12	2.14	2.15	2.16
F_{Full}	0.406	0.354	0.391	0.356	0.347	0.363	0.34	0.35	0.354	0.255
Recruits (age 3)	0.995	0.997	0.997	0.997	0.997	0.998	0.998	0.998	0.998	0.998

Table 2: Comparison of reference points estimated in an earlier assessment and from the current assessment update. An F_{MSY} proxy was used for the overfishing threshold and was based on a simulation study and scaled to the current assessment.

	2017	2020
F_{MSY} *proxy*	0.019	0.019 (0.011 - 0.032)
SSB_{MSY} ('000 mt)	2,014	2,113 (1,754 - 2,473)
MSY ('000 mt)	73	77
Overfishing	No	No
Overfished	No	No

Projections: Short term projections of biomass were derived by assumming average recruitment in each forecast year. Growth, fishery selectivity, and maturity ogive, were constant over time for

each area and used in projection. Three projection scenarios were developed for use in management: status quo, which sets annual catch in each forecast year equal to the average catch over the last five years in each area; quota in which the current quota is caught each year and the proportions taken from each area are equal to the average proportions removed from each area over the last five years, and finally, OFL in which the catch is equal to the OFL applied to the terminal biomass in each area. These projections are available in the document entitled 'OceanQuahogUpdateMT2020...pdf' and found on the SASINF

Table 3: Short term projections of total fishery catch and spawning stock biomass for ocean quahog based on a harvest scenario of fishing at F_{MSY} *proxy* between 2020 and 2026.

Year	Catch (mt)	SSB ('000 mt)	F_{Full}
2020	44893	3694	1.02

Year	Catch (mt)	SSB ('000 mt)	F_{Full}
2021	44961	3686	1.02
2022	45001	3675	1.02
2023	45012	3664	1.02
2024	44994	3650	1.02
2025	44948	3636	1.02
2026	44875	3620	1.02

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).

  Scale has been uncertain in all previous ocean quahog assessments. Scale uncertainty is driven by the the fact that the stock is lightly fished. Survey indices generally do not respond to contrast in fishing intensity and the model has difficulty deciding on scale once there are enough animals to make fishing an unimportant driver of total mortality. Additionally, the NEFSC clam survey did not survey the northern area very well in the early part of the time series. Evidence for this includes relatively low precision and improbably large changes in abundance for a very long lived species that was not being fished at the time. Recent changes to the NEFSC clam survey have improved performance of the survey and the assessment for Atlantic surfclam. Scale is expected to be better defined in future assessments once new ocean quahog survey data are collected.

  Estimates of recruitment remain uncertain as the survey gear does not select well for younger animals. Uncertainty in recruitment is relatively unimportant in this stock due to their longevity and low fishing mortality.

- 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}).

  No retrospective adjustment of spawning stock biomass or fishing mortality in 2019 was

required. The 7-year Mohn's ρ, relative to SSB, was 0.008 in 2019. The 7-year Mohn's ρ, relative to F, was -0.038 in 2019.

- 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 ocean quahog, are 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 not in a rebuilding plan.

- 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 ocean quahog assessment for this update beyond updating to the latest version of Stock Sythesis. No new survey data was available, but the NEFSC clam survey was re-stratified see the section 'Build a Bridge' in 'OceanQuahogUpdateMT2020...pdf' found on the SASINF.

- If the stock status has changed a lot since the previous assessment, explain why this occurred.
  Stock status did not change. Without any new survey data since the last assessment, there was very little change of any kind.

- Provide qualitative statements describing the condition of the stock that relate to stock status.
  The assessment shows that the ocean quahog stock remains lightly fished and at relatively high abundance. Empirical estimates of abundance and exploitation rate support assessment results - see the section entitled 'Plan B assessment' in 'OceanQuahogUpdateMT2020...pdf' found on the SASINF.

- Indicate what data or studies are currently lacking and which would be needed most to improve this stock assessment in the future.
  There is little age data for ocean quahog available due to the high cost of aging. Therefore growth changes over time are relatively poorly known. Additional work on age and growth would be useful.

- Are there other important issues?
  No.

References:

Northeast Fisheries Science Center. 2017. In: 63^{rd} Northeast Regional Stock Assessment Workshop (63^{rd} SAW) Assessment Summary Report. US Dept
Commer, Northeast Fish Sci Cent Ref Doc. 17-10; 409 p. http://www.nefsc.noaa.gov/publications/

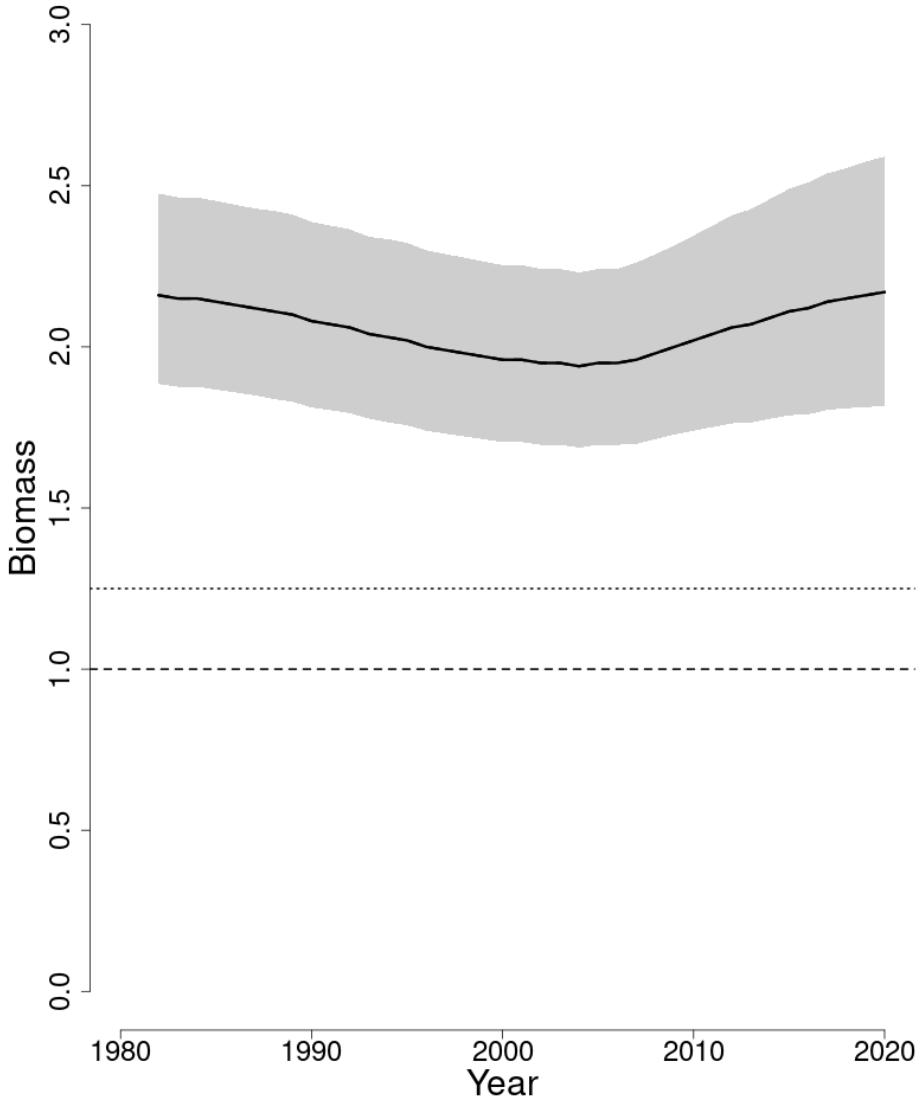

Figure 1: Trends in spawning stock biomass of ocean quahog between 1982 and 2020 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{Threshold}$ ($\frac{1}{2}$ SSB_{MSY} *proxy*; horizontal dashed line) as well as SSB_{Target} (SSB_{MSY} *proxy*; horizontal dotted line) based on the 2020 assessment. Units of SSB are the ratio of annual biomass to the biomass threshold ($\frac{SSB}{SSB_{Threshold}}$). The approximate 90% lognormal confidence intervals are shown.

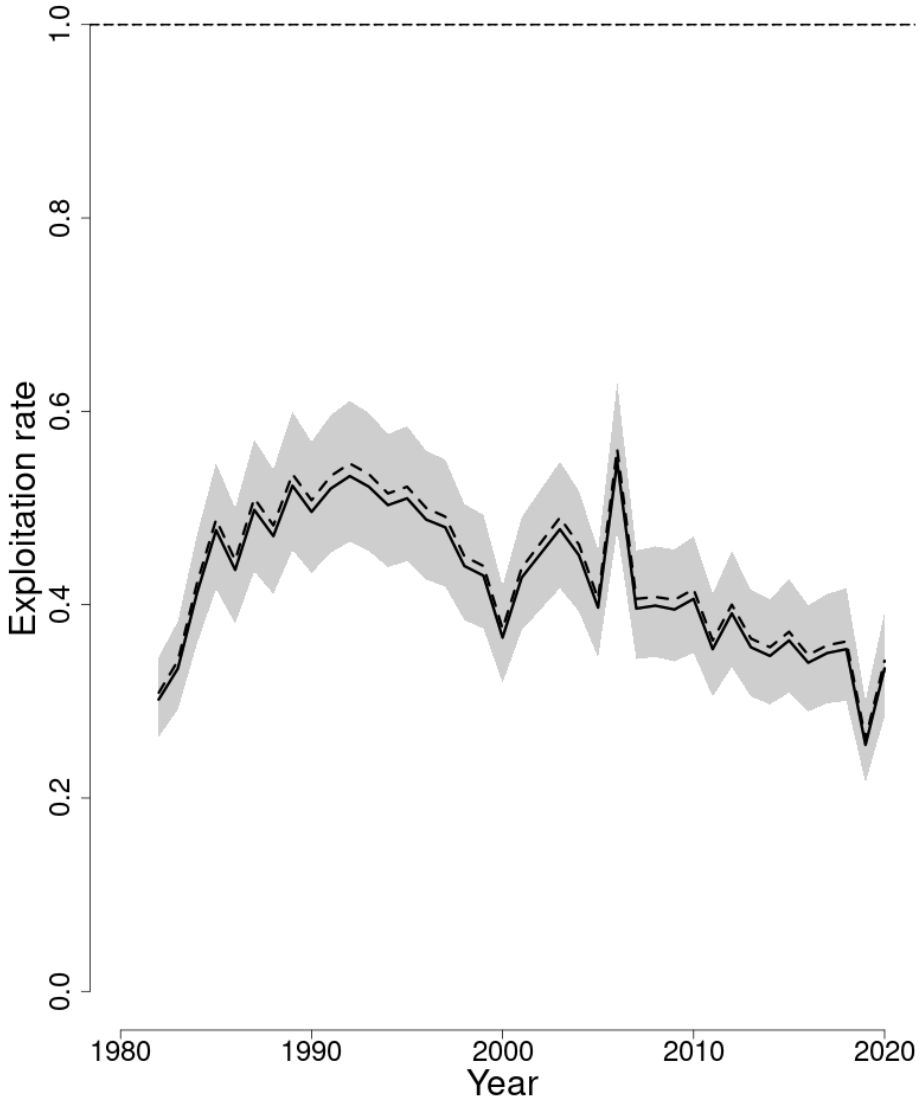

Figure 2: Trends in the fully selected fishing mortality (F_{Full}) of ocean quahog between 1982 and 2020 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ (F_{MSY} *proxy*=0.019; horizontal dashed line), based on the 2020 assessment. Units of fishing mortality are the ratio of annual F to the F threshold ($\frac{F}{F_{Threshold}}$). The approximate 90% lognormal confidence intervals are shown.

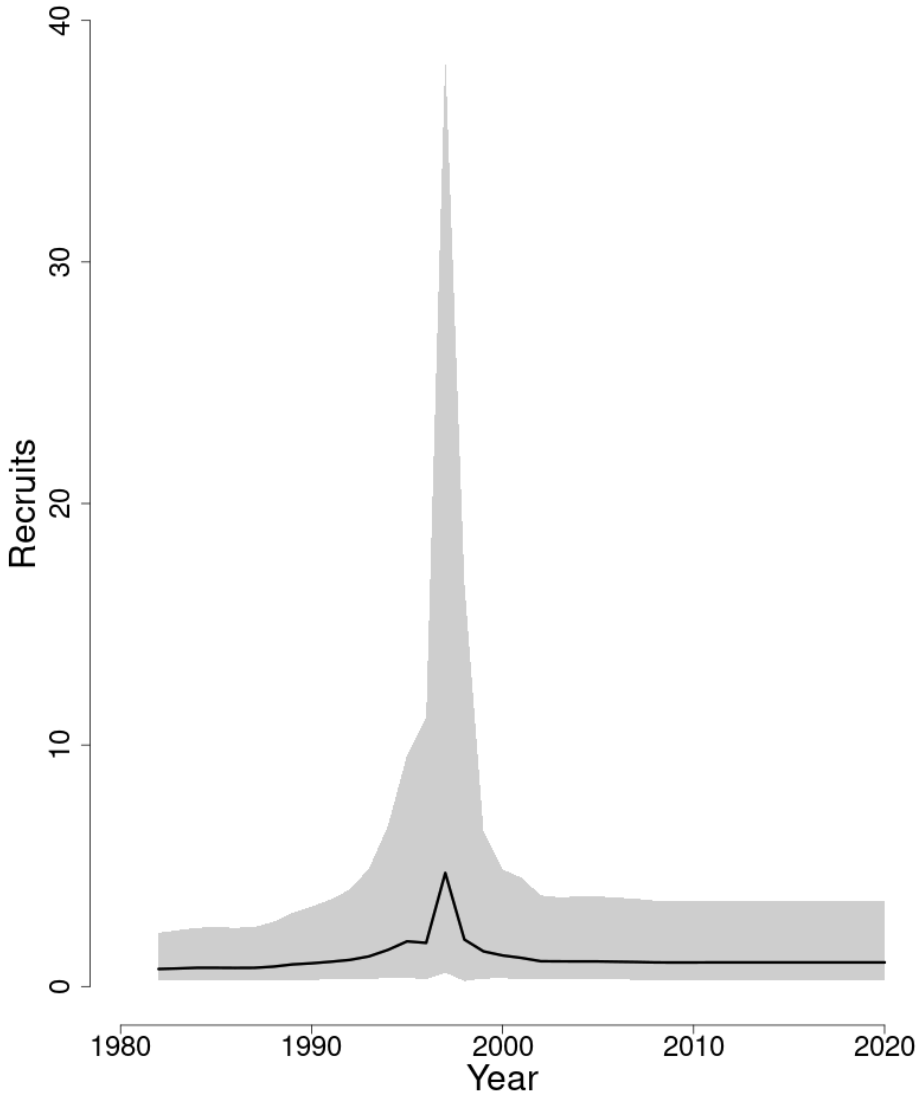

Figure 3: Trends in Recruits (age 3) of ocean quahog between 1982 and 2020 from the current (solid line) and previous (dashed line) assessment. Units of recruitment are the ratio of annual R to the unfished R ($\frac{R}{R_0}$). The approximate 90% lognormal confidence intervals are shown.

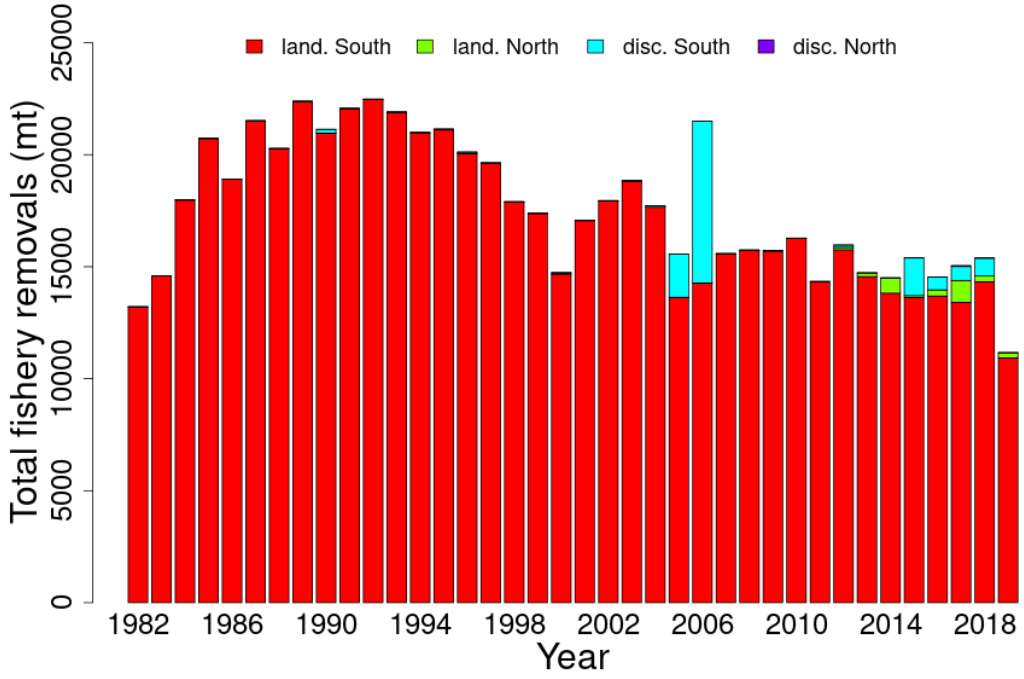

Figure 4: Total catch of ocean quahog between 1982 and 2020 by fleet and disposition (landings and discards).

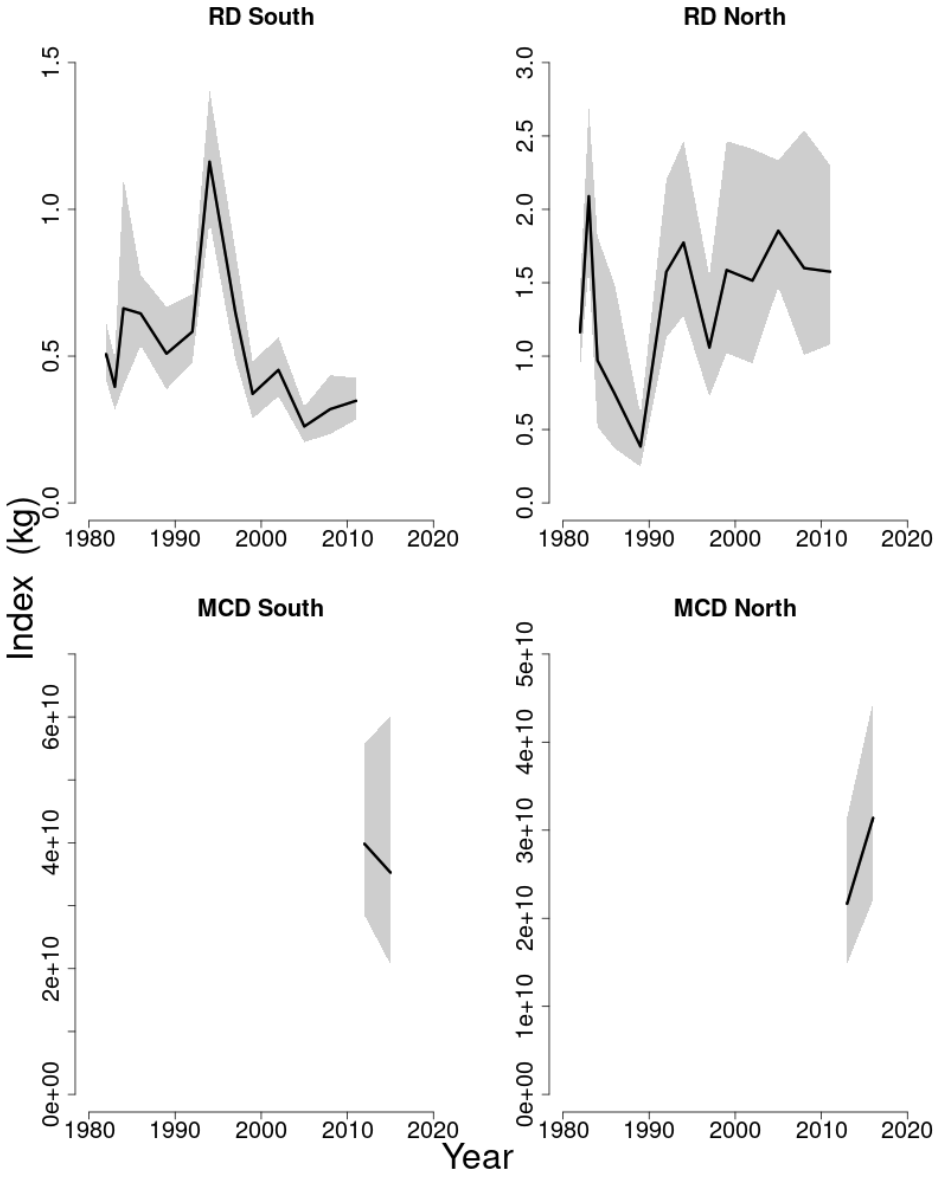

Figure 5: Indices of biomass for the ocean quahog between 1982 and 2016 for the Northeast Fisheries Science Center (NEFSC) clam surveys in the north and south. The RD survey units are weight per tow (kg) and the MCD survey units are swept area numbers (n). The approximate 90% lognormal confidence intervals are shown.