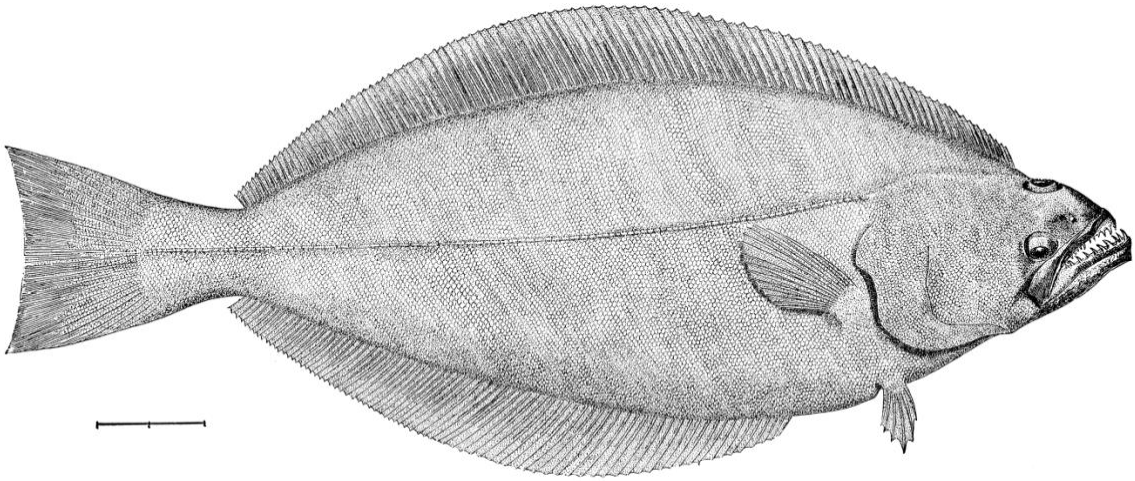
5. Assessment of the Greenland turbot stock in the Bering Sea and Aleutian Islands



THE GREENLAND TURBOT.

Meaghan D. Bryan., Steven J. Barbeaux, James Ianelli, Dan Nichol and Jerry Hoff
Alaska Fisheries Science Center
November, 2019

Executive Summary

Bering Sea and Aleutian Islands (BSAI) Greenland turbot is assessed biennially according to the stock assessment prioritization schedule. During odd years, an executive summary is presented with recommendations of harvest levels for the next two years for this species. Information regarding the 2018 stock assessment model and results is available online (Bryan et. al, 2018; https://www.fisheries.noaa.gov/resource/data/2018-assessment-greenland-turbot-bering-sea-and-aleutian-islands). A full stock assessment document with updated assessment and projection model results will be presented in November, 2020.

A statistical catch-at-age model configured in Stock Synthesis 3 (Methot and Wetzel, 2013) is used as the primary assessment tool for BSAI Greenland turbot, which qualifies as a Tier 3 stock. The assessment model is not run during an off-cycle year, but the projection model is updated with new catch information. This incorporates the most current catch information without re-estimating model parameters and biological reference points.

Summary of changes in the assessment inputs

Changes in the input data: Changes were not made to the assessment model inputs since this was an off-cycle year. New data added to the projection model included a final 2018 catch estimate from the NMFS Alaska Regional Office Catch Accounting System and a preliminary catch estimate for 2019. The 2018 catch input was reduced to 1,835 t from 3,758 t. The 2019 catch input, 3,579 t, was calculated as the product of the 2019 total allowable catch (TAC, 5,294 t) and the average proportion of the TAC caught between 2014 and 2018 (67.6%). This follows the procedure used in previous assessments.

Changes in the assessment methodology: Changes were not made to the assessment model.

Summary of results

The recommended maximum ABC for 2020 from the updated projection model is 9,625 t. This is similar to the 2019 ABC (<1% difference) and 8% higher than the 2020 ABC projected from last year's assessment. The corresponding reference values for BSAI Greenland turbot are summarized in the table below. Overfishing is not occurring, the stock is not overfished, and it is not approaching an overfished condition. Status is determined by comparing from the most recent complete year (2018) of official catch to the OFL and comparing the projected spawning biomass relative to $B_{35\%}$. The official Greenland turbot, total catch for 2018 (1,835 t) is less than the 2018 OFL (13,148 t) indicating overfishing is not occurring. Spawning biomass is projected to be above $B_{35\%}$ for 2019-2021; hence, the stock is not overfished and it is not approaching an overfished condition.

	As estimated or *specified last* year for:		As estimated or *recommended this* year* for:	
Quantity	2019	2020	2020	2021
M (natural mortality rate)	0.112	0.112	0.112	0.112
Tier	3a	3a	3a	3a
Projected total (age 1+)	105,930	98,876	106,101	98,532
Female spawning biomass	54,244	52,743	57,094	53,617
Projected				
$B_{100\%}$	90,534	90,534	90,534	90,534
$B_{40\%}$	36,213	36,213	36,213	36,213
$B_{35\%}$	31,687	31,687	31,687	31,687
F_{OFL}	0.21	0.21	0.21	0.21
$maxF_{ABC}$	0.18	0.18	0.18	0.18
F_{ABC}	0.18	0.18	0.18	0.18
OFL (t)	11,362	10,476	11,319	10,006
maxABC (t)	9,658	8,908	9,625	8,510
ABC (t)	9,658	8,908	9,625	8,510
	As determined *last* year for:		As determined *this* year for:	
Status	2017	2018	2018	2019
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

*Projections are based on the final catch of 1,835 t in 2018 and estimated catch of 3,579 t in 2019.

Region specific ABCs are specified for this species. Apportionment is derived from the biomass estimates from the eastern Bering Sea slope bottom trawl survey and the Aleutian Islands bottom trawl survey. More specifically, biomass estimates from the last four years of overlap were used and the apportionment is as follows: 87.3% for the eastern Bering Sea and 12.7% for the Aleutian Islands. The slope survey has not been conducted since 2016; hence, this ratio has remained unchanged since. The region specific ABCs are in the following table:

Region	2020 ABC (t)	2021 ABC (t)
BSAI	9,625	8,510
Bering Sea	8,403	7,429
Aleutian Islands	1,222	1,080

The catch-biomass ratio has ranged from 0.24 and 0.01 between 1962 and 1992, which corresponds to a period of relatively high catch (Table 5.1 and Figure 5.1). The average ratio during this time was 0.08. The catch-biomass ratio ranged from 0.03 and 0.07 (average = 0.043) between 1993 and 2012, and ~ 0.02 after 2012 (Table 5.1 and Figure 5.1).

The EBS shelf trawl survey and the Auke Bay Laboratory's longline survey were conducted in 2019. The 2019 biomass estimate, 16,053 t, from the EBS trawl survey continued to decline (Figure 5.2a). This represents a 12% decline from the 2018 biomass estimate, 18,017 t. The numbers of Greenland turbot from the ABL longline survey also continued to decline (Figure 5.2b). Numbers declined from 20,524 in 2018 to 14,332 in 2019. This represents a 30% decrease. The Northern Bering Sea trawl survey was also conducted in 2019 and encountered Greenland turbot. The biomass estimates are summarized in Table 5. 2.

Responses to SSC and Plan Team comments on assessments in general

The SSC requests that all authors fill out the risk table in 2019… (SSC December 2018)

…risk tables only need to be produced for groundfish assessments that are in 'full' year in the cycle. (SSC, June 2019)

The SSC recommends the authors complete the risk table and note important concerns or issues associated with completing the table. (SSC, October 2019)

As this is an 'off' year for this assessment we do not provide a risk table and will follow guidance from the PT and SSC as to what to include in the next full assessment.

Responses to SSC and Plan Team comments specific to this assessment

The SSC agrees that the inclusion of an environmental effect on recruitment is promising and warrants further examination, but without a better understanding of the underlying mechanisms it is premature to include this environmental relationship in the assessment. This is especially true because the effect is largely based on the observation of single period of recent strong recruitments (2007-2009) that coincided with a period of cold years (2007-2013).

This will be addressed in the 2020 assessment.

The SSC agrees with PT and author recommendations regarding further improvements to the model. Specifically, we encourage the author to investigate (1) the use of selectivity blocks if an appropriate rationale can be developed for these time blocks, (2) spatial distribution and migration to better understand changes in the proportion of the stock extending into Russian waters, and (3) approaches to incorporating Russian catches into the assessment.

This will be looked into for the 2020 assessment.

References

Bryan, M.D., S.J. Barbeaux, J. Ianelli, D. Nichol, and J. Hoff. 2018. Assessment of the Greenland turbot (Reinhardtius hippoglossoides) in the Bering Sea and Aleutian Islands. In Stock assessment and fishery evaluation document for groundfish resources in the Bering Sea/Aleutian Islands region as projected for 2019. Section 5. North Pacific Fishery Management Council, Anchorage, AK.

Methot, R. D. and C.R. Wetzel. 2013 Stock synthesis: a biological and statistical framework for fish stock assessment and fishery management. Fisheries Research. 142:86-99.

Tables

Table 5.1. Catch in tons, total biomass in tons, and the corresponding catch-biomass ratio using the model estimated biomass. Catch was obtained from the NMFS AKRO Catch Accounting System. Total biomass is from the 2018 assessment model (1960-2018) and the projection model for 2019.

Year	Catch (t)	Total Biomass (t)	Catch/biomass
1960	27,632	234,112	0.12
1961	43,011	214,989	0.2
1962	43,670	179,104	0.24
1963	23,679	143,355	0.17
1964	25,675	134,829	0.19
1965	7,535	141,922	0.05
1966	9,829	199,033	0.05
1967	18,197	290,695	0.06
1968	26,584	398,641	0.07
1969	27,193	504,587	0.05
1970	19,976	601,823	0.03
1971	42,214	690,426	0.06
1972	77,384	735,424	0.11
1973	63,946	720,159	0.09
1974	78,442	697,130	0.11
1975	67,789	643,631	0.11
1976	62,590	593,073	0.11
1977	30,161	548,852	0.05
1978	42,189	546,301	0.08
1979	41,409	539,868	0.08
1980	52,552	538,157	0.1
1981	57,321	522,807	0.11
1982	52,122	495,039	0.11
1983	47,558	462,520	0.1
1984	23,120	424,885	0.05
1985	14,731	404,683	0.04
1986	9,864	387,422	0.03
1987	9,585	371,177	0.03
1988	7,108	352,624	0.02
1989	8,822	334,902	0.03
1990	12,696	313,813	0.04
1991	7,863	287,964	0.03
1992	3,752	268,139	0.01
1993	8,470	253,572	0.03
1994	10,272	234,223	0.04
1995	8,194	212,424	0.04
1996	6,556	193,287	0.03
1997	7,200	176,407	0.04
1998	8,757	159,417	0.05
1999	5,853	141,516	0.04
2000	6,974	127,299	0.05
2001	5,312	112,819	0.05
2002	3,636	101,258	0.04
2003	3,111	93,004	0.03

Table 5.1. Continued.

Year	Catch (t)	Total Biomass (t)	Catch/biomass
2004	2,259	86,688	0.03
2005	2,608	82,241	0.03
2006	1,989	77,875	0.03
2007	2,004	74,360	0.03
2008	2,911	70,995	0.04
2009	4,515	67,514	0.07
2010	4,123	64,684	0.06
2011	3,668	65,839	0.06
2012	4,716	70,832	0.07
2013	1,742	76,786	0.02
2014	1,656	86,267	0.02
2015	2,204	95,068	0.02
2016	2,272	101,777	0.02
2017	2,834	106,426	0.03
2018	1,835	108,433	0.02
2019	3,759	105,930	0.04

Table 5. 2. Northern Bering Sea biomass estimates and 95% confidence interval (lower and upper), the number of hauls with positive catch rates (N_{pos}), and the total number of hauls (N_{total}) from the NBS trawl survey.

Year	Biomass	Lower	Upper	N_{pos}	N_{total}
2010	123.78	26.87	220.69	18	141
2017	58.46	0	148.28	3	143
2019	423.58	60.45	786.71	6	144

Figures

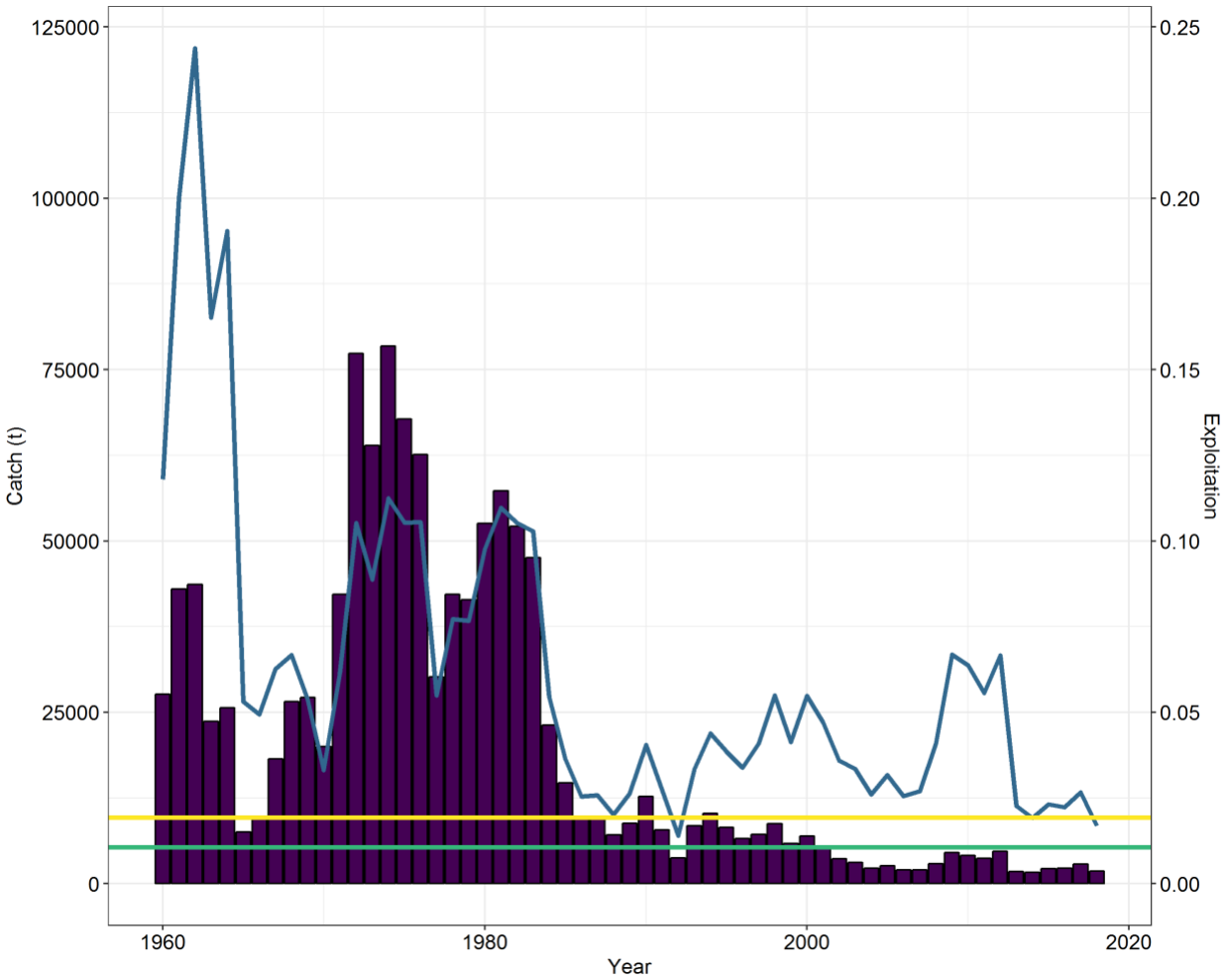


Figure 5.1. Time series of catch in tons (purple bars) and exploitation rate (catch : total biomass, blue line) and the specified 2019 ABC (yellow line) and TAC (green line).

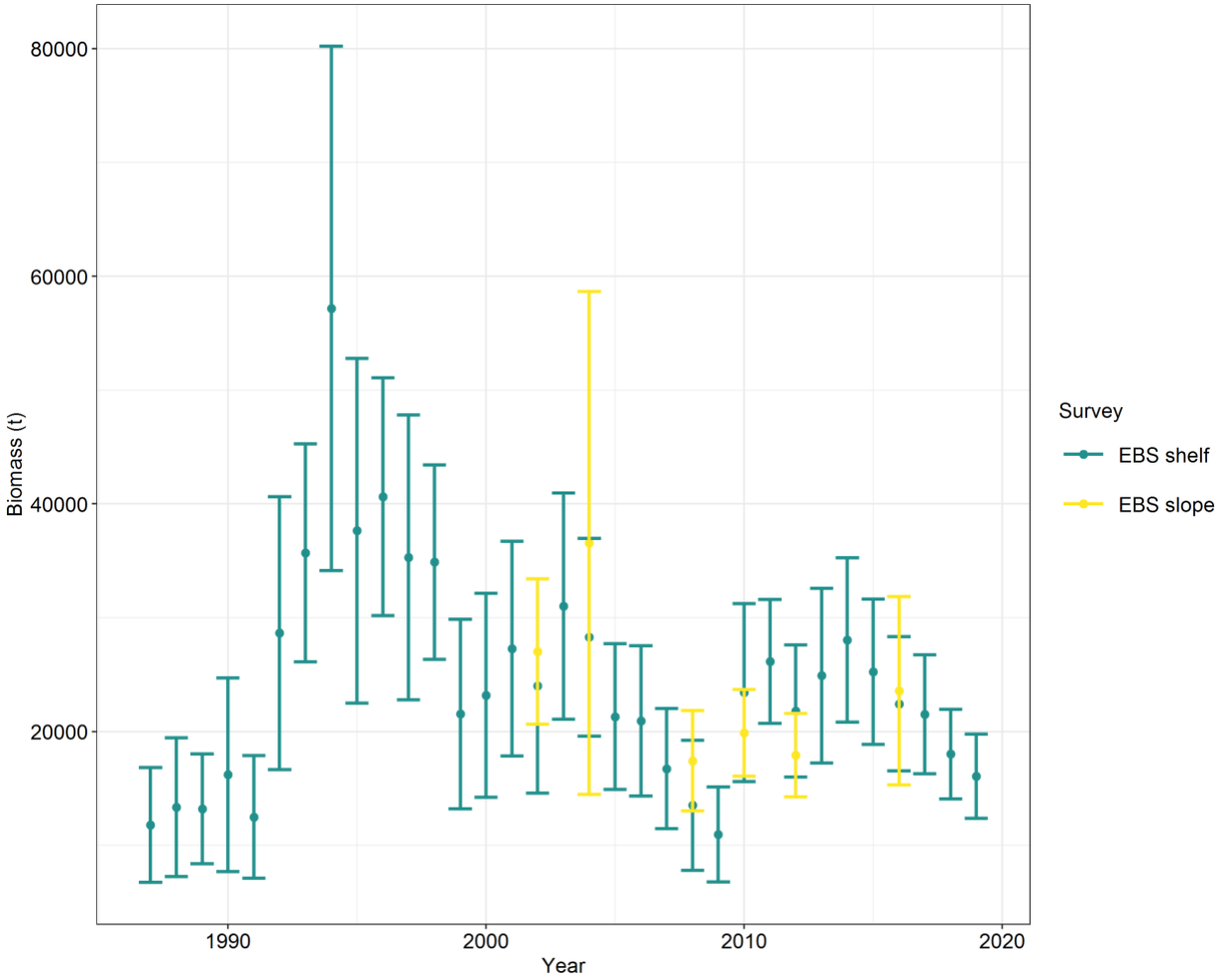


Figure 5.2. Biomass estimates from the Eastern Bering Sea shelf and slope bottom trawl surveys.

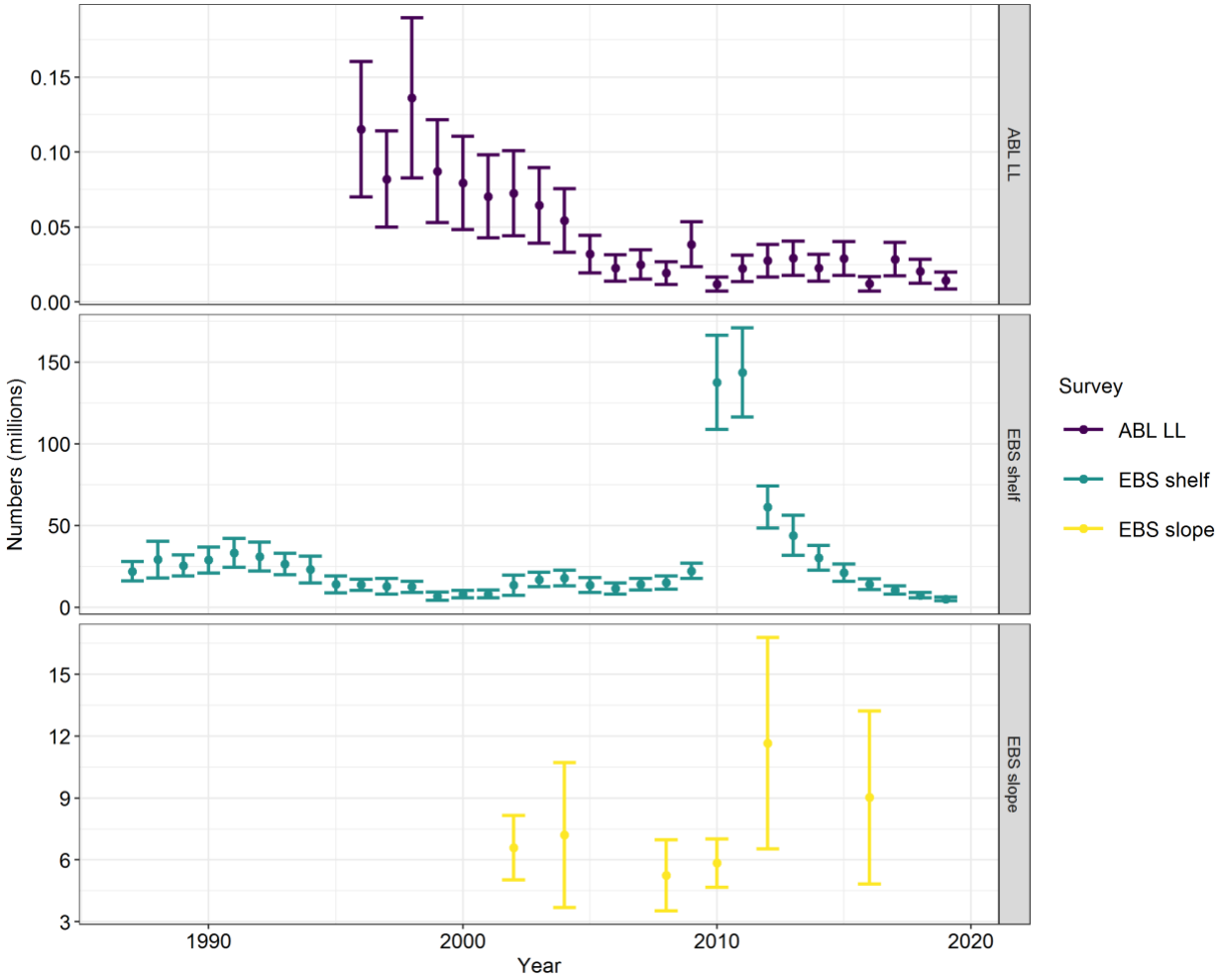


Figure 5.3. BSAI population numbers from the Eastern Bering Sea shelf and slope bottom trawl surveys and the ABL longline survey. Note the differences in the y-axis scale.