19. Assessment of the sculpin stock complex in the Bering Sea and Aleutian Islands

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Executive Summary

The Bering Sea and Aleutian Island (BSAI) sculpin complex is managed in Tier 5. The last full BSAI sculpin assessment was performed in 2016. The 2016 full assessment can be found at http://www.afsc.noaa.gov/REFM/stocks/assessments.htm. This document consists of an executive summary.

Summary of Changes in Assessment Inputs

Summary of Changes in the Input Data

1) The 2017 Bering Sea shelf survey estimates of sculpin biomass were used in this assessment.
2) Complete catch is presented for 2016, as well as partial catch for 2017 (through October 26, 2017).

Changes in the assessment methodology:
There were no changes in the assessment methodology.

Summary of Results

The estimated ABC and OFL values for 2018 and 2019 in this update are slightly lower than the values for 2017 and 2018 produced in the 2016 assessment because the biomass estimate of sculpins in the Bering Sea shelf were lower than the 2016 estimate (164,449 t vs. 180,729 t). The other two surveys (Aleutian Islands and Bering Sea slope) that provide data for this assessment have not changed. OFL and ABC declined slightly from the 2018 estimated presented in the 2016 stock assessment, and the F_{OFL} changed slightly because the proportion of the six most common species shifted slightly since the 2016 assessment. Stock size, harvest, and fishing rate reference values are shown in the following table:

Quantity	As estimated or *specified last* year for: 2017	2018	As estimated or *recommended this* year for: 2018	2019
M (natural mortality rate)*	0.283	0.283	0.282	0.282
Tier	5	5	5	5
Biomass (t)	199,937	199,937	188,656	188,656
F_{OFL}	0.283	0.283	0.282	0.282
$maxF_{ABC}$	0.212	0.212	0.212	0.212
F_{ABC}	0.212	0.212	0.212	0.212
OFL (t)	56,582	56,582	53,201	53,201
maxABC (t)	42,387	42,387	39,995	39,995
ABC (t)	42,387	42,387	39,995	39,995
Status	As determined *last* year for: 2015	2016	As determined *this* year for: 2016	2017
Overfishing	No	n/a	No	n/a

** The sculpin complex mortality rate is a biomass-weighted average of the instantaneous natural mortality rates for the six most abundant sculpins in the BSAI: bigmouth (Hemitripterus bolini), great (Myoxocephalus polyacanthocephalus), plain (Myoxocephalus jaok), threaded (Gymnocanthus pistilliger), warty (Myoxocephalus verrucosus/scorpius), and yellow Irish lord (Hemilepidotus jordani). The complex mortality rate may change as new survey data become available. See "results" section for more detail.*

Area apportionment

GOA sculpins are managed with a single total allowable catch (TAC) for the entire Gulf of Alaska region; there is no area apportionment.

Summary

Results of the annual Bering Sea shelf survey are shown in Table 19.1 for the sculpin species found on the BSAI shelf: bigmouth, great, plain, warty, and yellow Irish lord. There was no Bering Sea slope or Aleutian Islands survey in 2017, and 2016 survey biomass estimates can be found in the 2016 BSAI Sculpin assessment. Biomass estimates were fairly stable for those species with the exception of plain sculpin which declined from 53,570 t in 2016 to 33,962 t in 2017. The 5-year average (2012-2016) for plain sculpin was 56,951 t so the 2017 estimate appears to be a decline (Figure 19.1). Catch and retention for BSAI sculpin has been updated for 2017 and is shown in Table 19.2. Catches appear stable, with 4,967 t in 2015, 4,892 t in 2016, and 4,698 t in 2017 (through October 26, 2017). Retention has been less than 2% since 2015 and was 1.16% in 2017 through October 26, 2017. The catch to biomass ratios are presented in Table 19.3 and indicate the catch to biomass ratio has been stable and remains so in 2016 and 2017 with catch to biomass at 2% in those years. There was no sculpin assessment prior to 2006 and all three regions of the BSAI were sampled in 2004, 2010, 2012, and 2016. Therefore, the time series of estimated sculpin biomass in the BSAI begins in 2004. The 2017 estimate of sculpin biomass is based on the new EBS shelf survey but used 2016 estimates from the EBS slope and AI surveys, because there was no AI or EBS slope survey in 2017. Reference points OFL, ABC, TAC, and catch are presented in Table 19.4 for the years 2011-2017. Random effect model estimates for the 6 most common sculpin species and other sculpins are shown in Table 19.5.

Table 19.1. Eastern Bering Sea (EBS) shelf sculpin complex biomass estimates (t) and coefficients of variation (CV) for the five most abundant BSAI shelf sculpin species, from EBS shelf surveys 1982-2017. YIL = yellow Irish lord. Asterisks represent cases in which sculpin were not identified to species.

	YIL		**bigmouth**		**great**		**plain**		**warty**	
	biomass	CV	biomass	CV	biomass	CV	biomass	CV	biomass	CV
1982	52,700	0.33	22,841	0.22	6,026	0.29	58,297	0.19	*	
1983	46,475	0.40	19,945	0.21	37,989	0.27	86,344	0.16	2,008	0.63
1984	31,569	0.32	27,644	0.21	19,204	0.33	57,482	0.12	54,900	0.33
1985	13,116	0.24	14,219	0.22	30,234	0.19	37,122	0.10	1,985	0.78
1986	25,810	0.31	11,234	0.23	56,836	0.11	48,549	0.09	293	0.50
1987	41,574	0.48	22,996	0.18	50,845	0.13	55,852	0.11	3,938	0.24
1988	24,867	0.33	22,038	0.25	47,806	0.13	53,772	0.13	3,794	0.32
1989	22,047	0.39	16,636	0.22	37,244	0.16	57,857	0.15	*	
1990	10,212	0.18	16,123	0.24	37,573	0.26	36,991	0.26	*	
1991	10,258	0.17	20,483	0.23	67,848	0.23	113,180	0.08	3,306	0.45
1992	17,091	0.20	18,300	0.21	95,097	0.15	74,712	0.13	*	
1993	22,031	0.46	19,630	0.18	67,549	0.12	87,653	0.13	49	1.00
1994	17,911	0.28	28,426	0.22	99,271	0.10	44,319	0.15	*	
1995	19,112	0.28	29,492	0.18	88,622	0.18	67,240	0.13	*	
1996	14,573	0.19	31,250	0.22	90,999	0.13	54,096	0.10	*	
1997	23,727	0.28	29,722	0.17	85,371	0.24	73,287	0.08	3,915	0.48
1998	13,913	0.31	36,276	0.24	65,840	0.22	57,306	0.09	8,968	0.33
1999	13,229	0.20	24,681	0.18	50,039	0.14	47,324	0.12	11,090	0.19
2000	11,249	0.22	26,200	0.19	62,963	0.40	43,618	0.08	11,744	0.18
2001	9,121	0.35	25,760	0.16	41,071	0.28	48,449	0.10	15,726	0.15
2002	9,415	0.35	32,180	0.34	65,888	0.19	52,525	0.17	9,630	0.20
2003	14,205	0.25	29,161	0.14	67,357	0.19	80,187	0.09	7,098	0.17
2004	33,637	0.33	34,409	0.14	61,176	0.11	69,363	0.10	10,212	0.18
2005	27,444	0.26	31,289	0.13	60,100	0.09	76,426	0.10	25,500	0.51
2006	31,720	0.44	30,118	0.13	57,804	0.10	66,851	0.10	16,136	0.25
2007	23,765	0.34	27,859	0.18	66,000	0.11	77,922	0.11	13,370	0.27
2008	32,389	0.35	30,846	0.14	70,223	0.13	56,914	0.15	11,392	0.27
2009	23,056	0.43	20,196	0.16	44,901	0.12	47,322	0.09	7,952	0.26
2010	21,518	0.45	32,477	0.13	49,665	0.14	55,132	0.12	6,991	0.27
2011	20,212	0.59	31,643	0.11	54,177	0.17	59,306	0.09	6,472	0.27
2012	22,154	0.54	24,080	0.14	40,733	0.14	53,271	0.12	6,477	0.24
2013	7,990	0.42	27,005	0.12	32,185	0.16	47,273	0.15	4,040	0.18
2014	9,218	0.69	23,576	0.13	44,222	0.16	69,999	0.09	7,136	0.21
2015	28,835	0.48	29,542	0.13	36,000	0.12	60,641	0.30	10,436	0.26
2016	30,743	0.29	37,766	0.11	53,282	0.12	53,570	0.21	16,052	0.35
2017	32,351	0.28	39,438	0.11	50,668	0.09	33,962	0.12	11,305	0.28

Table 19.2. Total catch in metric tons (t) of sculpin complex retained and discarded, 1999-2017. Source: NMFS AKRO BLEND/Catch Accounting System, *complete as of October 26, 2017.

Year	EBS sculpin catch	AI sculpin catch	BSAI sculpin catch	% of sculpins retained
1999	315	90	405	44.87%
2000	276	77	353	17.38%
2001	203	9	212	34.34%
2002	2,715	75	2,790	3.73%
2003	5,152	669	5,821	5.33%
2004	5,087	955	6,042	1.42%
2005	4,958	685	5,643	1.97%
2006	4,820	909	5,729	2.91%
2007	6,677	996	7,673	5.52%
2008	6,497	892	7,389	6.22%
2009	5,779	1,284	7,063	9.03%
2010	4,127	1,307	5,434	4.45%
2011	4,874	503	5,377	5.42%
2012	4,991	807	5,798	4.73%
2013	5,234	624	5,858	2.67%
2014	4,495	384	4,879	2.46%
2015	4,062	905	4,967	1.94%
2016	4,381	511	4,892	1.82%
2017*	3,869	829	4,698	1.16%

Table 19.3. Random effect model estimates of biomass for all sculpin species combined, catch, and a catch/biomass ratio, 2004-2017. Catch in 2017 was estimated through October 26, 2017.

Year	Biomass (t)	Catch (t)	Catch/biomass ratio
2004	221,282	6,042	0.03
2005	228,775	5,643	0.02
2006	227,798	5,729	0.03
2007	236,181	7,673	0.03
2008	223,315	7,389	0.03
2009	200,400	7,063	0.04
2010	202,174	5,434	0.03
2011	199,348	5,377	0.03
2012	183,942	5,798	0.03
2013	171,523	5,858	0.03
2014	189,359	4,879	0.03
2015	186,386	4,967	0.03
2016	199,937	4,892	0.02
2017	188,656	4,698	0.02

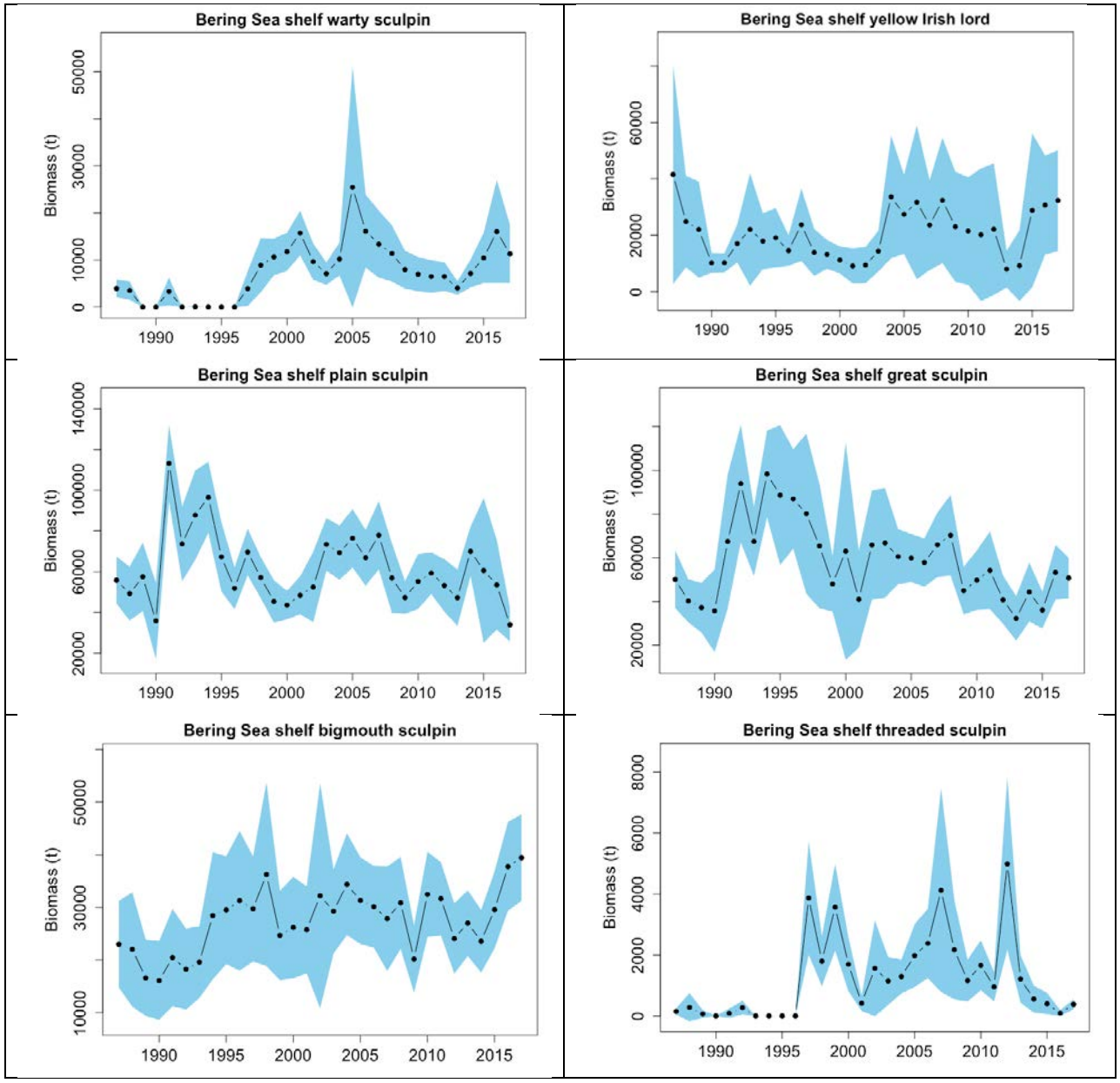
Table 19.4. Total allowable catch (TAC), acceptable biological catch (ABC), and catch of the BSAI sculpin complex 2011 to 2017. Source: NMFS AKRO Blend/Catch Accounting System, Alaska Regional Office Harvest Specification Tables. *Current as of October 26, 2017.

Year	OFL (t)	ABC (t)	TAC (t)	Catch (t)
2011	58,300	43,700	5,200	5,377
2012	58,300	43,700	5,200	5,798
2013	56,400	42,300	5,600	5,857
2014	56,400	42,300	5,600	4,878
2015	52,365	39,725	4,700	4,967
2016	52,365	39,725	4,500	4,892
2017	56,582	42,387	4,500	4,698*

Table 19.5. Random effect estimates for Bering Sea shelf sculpin species bigmouth, great, plain, warty, yellow Irish lord, threaded, and other (t), 1987-2017.

Year	Bigmouth	Great	Plain	Warty	YIL	Threaded	Other
1987	21,042	46,813	55,139	3,789	25,634	157	19,707
1988	20,600	42,504	52,491	3,450	21,847	178	36,556
1989	19,995	42,334	57,727	3,090	17,126	125	43,767
1990	19,990	48,591	63,974	2,768	11,924	139	61,352
1991	20,609	62,431	101,100	2,479	11,640	155	47,511
1992	21,265	77,245	81,752	1,783	15,433	274	33,710
1993	22,526	75,383	87,048	1,283	17,172	454	26,421
1994	24,713	90,118	90,672	1,786	17,493	753	22,632
1995	26,472	87,090	69,122	2,487	17,450	1,249	12,746
1996	27,593	83,047	56,502	3,463	16,047	2,071	5,445
1997	28,156	74,198	66,177	4,823	17,715	3,433	8,204
1998	28,314	63,864	56,775	7,733	14,926	2,001	5,503
1999	27,541	54,321	47,300	10,281	13,258	3,253	7,010
2000	27,560	55,148	44,664	11,863	11,822	1,620	7,715
2001	27,894	54,736	48,917	14,342	11,340	569	6,407
2002	28,903	60,115	55,930	9,990	12,395	1,146	6,646
2003	29,718	61,989	70,324	7,892	15,952	1,177	4,560
2004	30,748	60,668	70,266	10,382	22,907	1,327	4,680
2005	30,470	59,872	74,320	14,749	25,570	1,941	7,613
2006	29,847	59,315	68,998	15,080	26,544	2,410	8,245
2007	29,117	63,149	72,374	13,098	25,728	3,286	6,389
2008	28,707	61,775	58,447	10,926	26,260	2,138	5,757
2009	27,547	50,211	49,544	8,374	23,713	1,306	6,521
2010	29,071	49,348	54,510	7,187	21,654	1,567	7,369
2011	29,066	48,092	57,938	6,531	19,818	1,149	7,429
2012	27,564	41,938	54,207	6,042	18,059	3,567	5,480
2013	27,584	38,052	53,250	4,705	15,580	1,284	3,785
2014	27,937	40,860	65,647	7,017	17,852	607	4,317
2015	30,699	40,284	57,256	9,910	22,930	378	5,432
2016	34,375	48,747	48,539	12,541	27,349	189	4,576
2017	36,366	50,172	37,340	11,724	29,597	367	3,883

Figure 19.1. EBS shelf survey biomass estimates for the six most abundant sculpin species, warty, plain, great, bigmouth, threaded, and yellow Irish lord, from annual EBS shelf bottom trawl surveys, 1982-2017. Shaded portion represents 95% confidence intervals for survey estimates of biomass.



The following table shows how the BSAI sculpin complex *M* was calculated. The relative proportion of the 6 most common species out of the total, 177,601 t for each species was multiplied by the estimate of *M* for each species and summed for the estimate of *M* for the complex.

2017-2018 sculpin complex *M* harvest specification							
	2017 random effects model estimate for EBS shelf and 2016 values for the AI and EBS slope						
species	EBS shelf	EBS slope	AI	**BSAI**	Relative proportion	*M*	weighted contribution to mort. est.
bigmouth	36,366	1,889	476	34,367	0.182	0.21	0.038
great	50,172	0	990	49,319	0.261	0.28	0.073
YIL	29,597	75	8,605	34,378	0.182	0.17	0.031
plain	37,340	0	0	57,753	0.306	0.40	0.122
threaded	367	0	0	148	0.001	0.45	0.000
warty	11,724	0	0	12,066	0.064	0.26	0.017
other	3,883	3,206	3,966	11,905		-	
total	169,449	5,170	14,037	**188,656**		Complex *M*: 0.282	
			Total (6 most common species only):	**177,601**			

The 2018 ABC is 39,995 t, based on an F_{ABC} of 0.212 and a total biomass estimate of 188,656 t. The 2018 OFL is 53,201 t, based on F_{OFL} of 0.282.

weighted-average mortality rate	0.282
BSAI sculpin complex biomass estimate (t)	188,656
F_{OFL}	0.282
max F_{ABC}	0.212
rec. F_{ABC}	0.212
OFL (t)	53,201
max. ABC (t)	39,995
rec. ABC (t)	39,995