

Ecosystem Report of the Sculpin Stock Complex in the Gulf of Alaska, Eastern Bering Sea, and Aleutian Islands

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Executive Summary

Sculpins are managed as non-target species in the BSAI and GOA, and are taken only as bycatch during directed fishing for other species. In 2020, a final rule was issued which reclassified sculpins as Ecosystem Component category, non-target species in the Bering Sea/Aleutian Islands (BSAI) (Amendment 121) and Gulf of Alaska (Amendment 110) Groundfish Fishery Management Plans ([85 FR 06310](#), March 23, 2020 for the proposed rule, and [85 FR 41427](#), July 10, 2020 for the final rule). Prior to this rule the sculpin complexes were not in the FMPs (i.e. “nonspecified”). Under this rule, sculpins are not allowed to be targeted, and there is a Maximum Retainable Allowance (MRA) of 20% in the BSAI and GOA (Federal Register, Proposed Rules, Vol. 79, No. 93). This rule applies to all vessels processing groundfish harvested in the BSAI or GOA (50 CFR 679) and it prohibits directed fishing.

Stock assessments are not required for Ecosystem Component species. There are no ABC or OFL catch limits adopted in the annual groundfish harvest specifications. This Ecosystem Report for the combined BSAI and GOA is presented for tracking trends in abundance and catch. For the first year of this Ecosystem Component sculpin report, unofficial OFL and ABC values based on the former Tier 5 assessment methods, are provided for comparison as an appendix (Appendix 1). Because overfishing is not defined for an Ecosystem Component, these values are not used for management or for determining if overfishing is occurring.

Through the stock assessment prioritization process, the sculpin report is now on a 4-year cycle. Prior to the shift of sculpins to the Ecosystem Component category, the last full GOA SAFE assessment was completed in 2015, and a partial assessment in 2019. The last full BSAI SAFE assessment was presented in 2016 and a partial assessment in 2019.

New data in this report include: 1) updated catch data through October 16, 2023; 2) survey biomass estimates from the 2022 Aleutian Islands survey, the 2020-2023 Eastern Bering Sea surveys, the 2021 and 2023 Gulf of Alaska surveys and 3) updated GOA and BSAI trawl survey biomass time series estimates through 2023 using a random effects multivariate assessment (REMA) model (Appendix 1).

Introduction

Sculpins are a group of benthic-dwelling predatory teleost fishes that include 48 species in waters off the coast of Alaska (Families Cottidae, Hemitripterae, Psychrolutidae, and Rhamphocottidae). A total of forty-six species of sculpins have been listed as occurring in the GOA, and 39 of these have been identified on NMFS GOA research surveys. Forty-seven species of sculpins have been identified in the Bering Sea Aleutian Islands (BSAI) region. These

species have previously been managed as a complex, and the complex natural mortality (M) estimate was based on the biomass of the six most abundant sculpins in the BSAI and the four most common species in the GOA surveys since 1984. In the GOA these species are: bigmouth (*Hemitripterus bolini*), great (*Myoxocephalus polyacanthocephalus*), and plain (*Myoxocephalus jaok*) sculpins, and yellow Irish lord (*Hemilepidotus jordani*). In the BSAI, the six most abundant sculpins in the BSAI: bigmouth (*Hemitripterus bolini*), great (*Myoxocephalus polyacanthocephalus*), plain (*Myoxocephalus jaok*), threaded (*Gymnocanthus pistilliger*), warty (*Myoxocephalus verrucosus*), and yellow Irish lord (*Hemilepidotus jordani*).

Sculpins belong to the superfamily Cottoidea in the order Scorpaeniformes. They are relatively small, benthic-dwelling teleost fish with modified pectoral fins that allow them to grip the substrate, and they lack swim bladders. Most, if not all sculpins, lay adhesive eggs in nests, and many exhibit parental care for eggs (Eschmeyer et al, 1983). Markevich (2000) observed the sea raven, *Hemitripterus villosus*, releasing eggs into crevices of boulders and stones in shallow waters in Peter the Great Bay, Sea of Japan. This type of reproductive strategy may make sculpin populations more sensitive to changes in benthic habitats than other groundfish species such as pollock, which are broadcast spawners with pelagic eggs. In the western Pacific, great sculpins *Myoxocephalus polyacanthocephalus* are reported to have relatively late ages at maturity (5-8 years, Tokranov, 1985) despite being relatively short-lived. Great sculpin length and age at 50% maturity was estimated at 57.2 cm and 6.9 years from data collected in 2006 and 2007 along the eastern Bering Sea shelf (TenBrink and Aydin, 2009). The maximum age for great sculpin from this study was 17 years. Fecundity for the great sculpin off East Kamchatka waters ranged from 48,000 to 415,000 eggs (Tokranov, 1985). In contrast, preliminary information on reproduction for bigmouth sculpin (*Hemitripterus bolini*) in the GOA showed fecundity averaged 2,283 eggs per female (Morgan Busby, AFSC, personal comm.). The diversity of sculpin species in the GOA and BSAI suggests that each sculpin population might respond differently to environmental changes (whether natural or fishing induced). Within each sculpin species, observed spatial differences in fecundity, egg size, and other life history characteristics suggest local population structure (Tokranov, 1985). Information such as depth range, distribution, and maximum length has been collected for several years for many species during research surveys. There is no specific age-and-growth or maturity data for most sculpins.

Biomass calculations for the Gulf of Alaska and Bering Sea and Aleutian Islands sculpin complexes are based on the most common large sculpin species in those regions. These species are from the genera *Myoxocephalus*, *Hemitripterus*, and *Hemilepidotus*, and have been identified to the species level by observers from the North Pacific Groundfish Observer Program since 2008.

Data

Fishery

There are no directed fisheries for sculpin species in the BSAI or GOA at this time. Total catch (retained and discarded) has ranged from 2% to 6% of the total estimated biomass. There is no market for sculpins, and there has not been recent interest in marketing sculpin in any product form. Based on data from the NMFS Alaska Regional Office (AKRO) the main gear type catching sculpins is the non-pelagic trawl, and the main fisheries that catch sculpins are flatfish, Pacific cod, and IFQ halibut. Catch and retention data for sculpin is provided in Table 1 for the Bering Sea and Aleutian Islands, and Gulf of Alaska.

Survey

Aggregate sculpin biomass estimates are derived from the GOA and BSAI bottom trawl surveys that have been conducted since 1982 in the EBS, since 1984 in the GOA and since 1980 in the Aleutian Islands. Survey estimates for the six most abundant sculpin species and “other” sculpin are provided in Table 3 for the eastern Bering Sea, Table 4 for the Aleutian Islands, and Table 5 for the Gulf of Alaska. Random effects biomass estimates (Sullivan et al. 2022) are provided for comparison in Appendix 1. Biomass trends based on the survey time series are provided in Figure 1 for the eastern Bering Sea, Figure 2 for the Aleutian Islands, and Figure 3 for the Gulf of Alaska). Research catch of sculpin are provided in Appendix 2, Table 1.

Ecosystem Considerations

A determination of ecosystem considerations for sculpins in Alaska is hampered by lack of biological and habitat information for these species and by limited knowledge in general on the diverse environments they inhabit. However, declining trends are apparent in several species. These declines are most apparent in common species in the Aleutian Islands with the exception of the yellow Irish Lord (Figure 2), and in the total sculpin biomass in the eastern Bering Sea (Figure 1).

Literature cited

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Tables

Table 1. Total catch in metric tons (t) of sculpin complex retained and discarded, for the eastern Bering Sea and Aleutian Islands, 1999-2023. Percent retained refers to the entire BSAI. Source: NMFS AKRO BLEND/Catch Accounting System, *complete as of October 16, 2023.

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	4,419	887	5,306	1.21%
2018	4,323	711	5,034	1.89%
2019	4,810	794	5,604	0.89%
2020	4,363	818	5,181	1.24%
2021	4,878	750	5,628	0.71%
2022	4,984	849	5,833	3.99%
2023*	3,297	490	3,787	4.49%

*Current as of October 16, 2023.

Table 2. GOA total sculpin complex catch, retention rate, total Other Species catch (sculpin, sharks, skates, octopus and squid), and sculpin percentage of Other Species catch, 1997-2023. *Source: Other species total catch: AKRO Catch Accounting System, retention rate: estimated from fishery observer data obtained from the AFSC Fishery Monitoring and Analysis program, Sculpin complex total catch Source: NMFS AKRO BLEND/Catch Accounting System, through October 16, 2023.*

Year	Sculpin complex total catch	Retention rate	Other species total catch	Percent of Other Species catch
1997	898		4,823	19%
1998	526		7,422	7%
1999	544		3,788	14%
2000	940		5,455	17%
2001	587		3,383	17%
2002	919		8,162	11%
2003	629	7%	6,266	10%
2004 ⁺	701	9%	1,705	41%
2005	626	16%	2,513	25%
2006	583	16%	3,881	15%
2007	960	19%	3,035	32%
2008	1,925	14%	2,967	65%
2009	1,374	18%	3,188	43%
2010	911	12%	1,866	49%
2011	763	10%	1,678	45%
2012	795	13%		
2013	1,966	1%		
2014	1,187	3%		
2015	1,016	1%		
2016	1,330	3%		
2017	1,379	1%		
2018	635	2%		
2019	643	2%		
2020	575	1%		
2021	859	1%		
2022	753	0%		
2023	389	1%		

+ Beginning in 2004, skates were removed from Other Species complex. Sculpin were split out from the Other Species complex in 2011.

Table 2. Survey biomass estimates (t) of bigmouth, great, plain, warty, threaded, yellow Irish lord (YIL), and other sculpins from the eastern Bering Sea survey, 1982 – 2023.

Year	Bigmouth	Great	Plain	Warty	Threaded	YIL	Other	Total
1982	21,808	5,809	56,401	0	3,429	50,682	56,167	194,296
1983	18,611	36,373	81,224	1,884	389	43,652	62,721	244,855
1984	25,695	17,945	54,084	51,151	217	29,626	52,003	230,721
1985	14,162	30,220	37,373	265	5	13,139	61,537	156,702
1986	10,474	53,096	45,671	275	119	24,217	164,633	298,485
1987	22,918	48,439	56,177	3,924	150	41,738	13,678	187,025
1988	21,869	40,251	49,459	3,482	291	24,957	56,428	196,737
1989	16,457	36,209	57,883	0	72	22,128	29,076	161,824
1990	16,014	34,064	36,136	0	0	10,234	44,955	141,402
1991	20,402	65,039	113,943	3,306	93	10,281	54,992	268,056
1992	18,200	91,263	74,140	0	282	17,156	22,998	224,039
1993	19,633	64,104	88,264	50	0	22,175	17,758	211,984
1994	28,296	93,900	97,116	0	0	17,976	20,907	258,194
1995	29,404	87,437	67,659	0	0	19,191	12,505	216,196
1996	31,221	84,941	52,220	0	0	14,571	2,604	185,558
1997	29,538	78,429	70,204	3,906	3,905	23,837	6,439	216,258
1998	36,256	62,918	57,535	8,770	1,820	13,974	4,223	185,495
1999	24,599	43,593	45,753	10,538	3,609	13,274	5,553	146,919
2000	26,148	60,982	43,975	11,728	1,714	11,290	6,028	161,864
2001	25,683	39,874	48,837	15,016	428	9,153	4,827	143,817
2002	31,904	64,879	52,918	9,514	1,577	9,420	5,167	175,377
2003	29,205	63,824	74,042	7,004	1,165	14,443	3,645	193,329
2004	34,367	58,051	69,881	10,054	1,309	33,778	3,035	210,475
2005	31,256	56,361	76,937	25,141	1,997	27,484	7,288	226,464
2006	30,073	54,606	67,215	16,063	2,409	31,860	6,956	209,184
2007	27,736	63,371	78,487	13,333	4,169	23,740	5,451	216,286
2008	30,778	67,905	57,014	11,323	2,196	32,563	4,681	206,461
2009	20,027	43,327	47,682	7,932	1,173	23,187	5,787	149,115
2010	32,219	48,890	55,648	6,929	1,680	21,636	6,487	173,489
2011	31,074	52,230	59,733	6,450	971	20,341	7,514	178,313
2012	23,998	39,311	53,605	6,459	5,043	22,296	4,982	155,695
2013	26,132	30,679	47,685	4,044	1,230	8,033	3,113	120,915
2014	23,295	43,259	70,500	7,144	565	9,258	3,840	157,862
2015	27,911	34,517	60,815	10,352	407	29,032	5,538	168,571
2016	36,880	49,851	53,691	15,964	91	30,915	3,608	191,000
2017	38,127	47,296	34,172	11,257	393	32,538	3,420	167,203
2018	37,861	49,450	37,502	7,800	96	31,807	1,871	166,388
2019	34,322	84,086	50,585	8,580	191	41,781	1,878	221,423
2021	25,212	45,593	37,180	2,128	678	18,355	3,160	132,307
2022	18,546	62,922	39,123	560	430	25,819	1,982	149,382
2023	22,364	39,459	26,678	546	599	21,028	2,881	113,555

Table 4. Survey biomass estimates (t) of bigmouth, great, plain, warty, threaded, yellow Irish lord (YIL), and other sculpins from the Aleutian Islands survey, 1980 – 2022.

Year	Bigmouth	Great	Plain	Warty	Threaded	YIL	Other	Total
1980	1429.6	8749	0	2462	0	0	3263.9	15904.5
1983	8169.9	11967	0	5047.5	0	0	4760.6	29945
1986	2549.8	6300.7	0	9876.3	317.9	11.4	13983.5	33039.6
1991	993.5	4117.2	0	3813	2.6	0	7534.4	16460.7
1994	1830.1	2328.7	0	7227.2	11.8	0	5828.7	17226.5
1997	1617	2137.5	0	4668.1	0	8.1	5281	13711.7
2000	1005.3	1167.7	0	6710.6	0	0	4078.9	12962.5
2002	1191.2	1560.2	32.1	4307.6	0	0	7195.8	14286.9
2004	789.5	1518.6	0	8357	0	0	8428.3	19093.4
2006	1649.2	2141.4	0	10797.2	0	0	6290.9	20878.7
2010	791.3	1071	0	15416.1	0	4.2	7541.3	24823.9
2012	338.8	1929.8	0	14165.8	0	0	5871.1	22305.5
2014	708.7	805	0	13916	0	0.5	4517	19947.2
2016	450.5	1266.6	0.8	10097.1	0	0	4000	15815
2018	132.9	1211.1	10.5	12372.1	0	0.4	2867.4	16594.4
2022	255.2	944.4	0	14048.6	0	0.4	2775.2	18023.8

Table 5. Survey biomass estimates (t) of bigmouth, great, plain, warty, threaded, yellow Irish lord (YIL), and other sculpins from the Gulf of Alaska survey, 1984 – 2023

Year	Bigmouth	Great	Plain	YIL	Other	Total
1984	15,871	8,833	0	14,439	5,087	44,229
1987	10,196	6,007	403	13,592	1,581	31,779
1990	8,600	3,815	433	11,701	2,205	26,755
1993	5,612	5,846	461	11,661	1,784	25,363
1996	4,246	7,326	1,015	17,804	1,276	31,667
1999	3,983	3,913	1,692	20,255	989	30,832
2001	3,471	3,540	932	20,945	1,640	30,528
2003	5,767	6,037	1,220	12,064	1,381	26,468
2005	5,543	6,542	3,913	15,943	1,864	33,804
2007	3,128	7,970	4,548	15,508	1,565	32,719
2009	3,154	8,215	2,562	25,219	1,447	40,597
2011	3,591	8,384	3,160	15,771	794	31,700
2013	3,947	6,282	3,036	19,841	866	33,972
2015	4,783	9,128	508	29,532	1,227	45,177
2017	4,430	5,877	1,844	17,333	768	30,252
2019	5,559	5,643	1,658	14,964	2,054	29,879
2021	3,210	5,113	2,752	12,242	827	24,145
2023	2,857	3,828	2,375	14,264	569	23,893

Figures

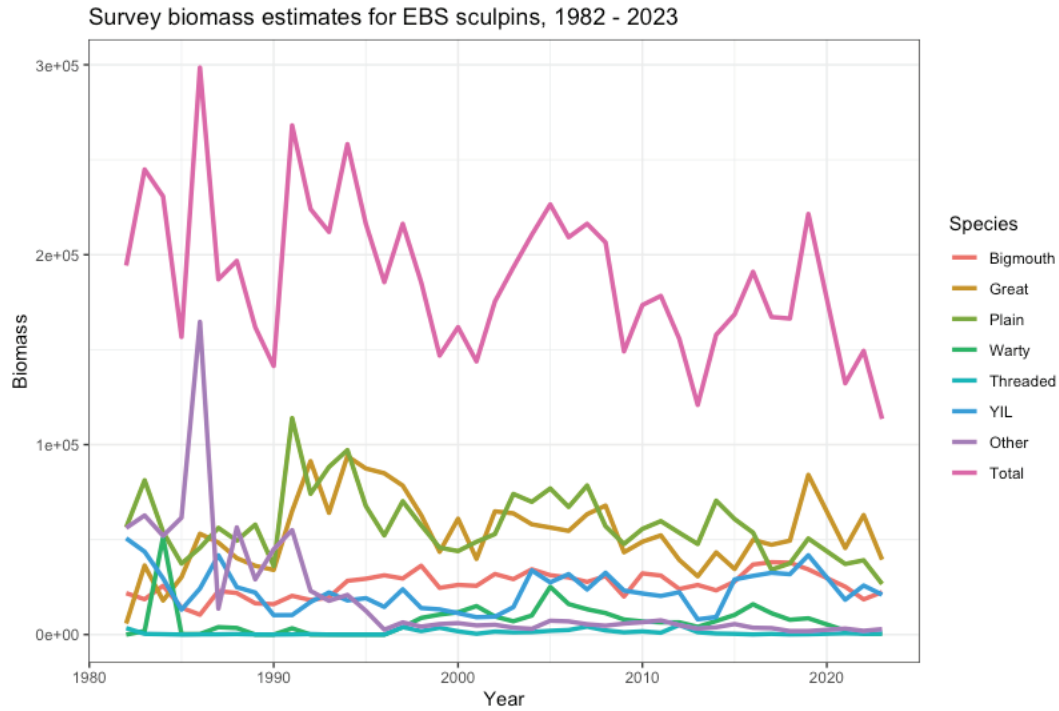


Figure 1. Survey biomass estimates (t) for the most abundant sculpin species in the eastern Bering Sea, 1982 – 2023.

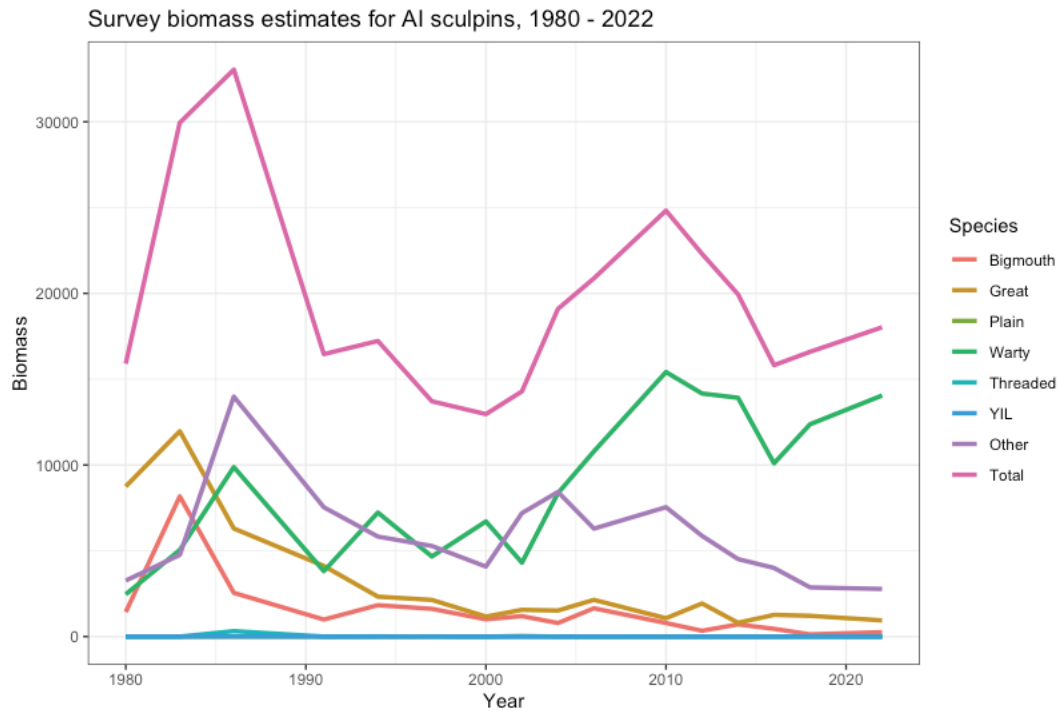


Figure 2. Survey biomass estimates (t) for the most abundant sculpin species in the Aleutian Islands, 1980 – 2022.

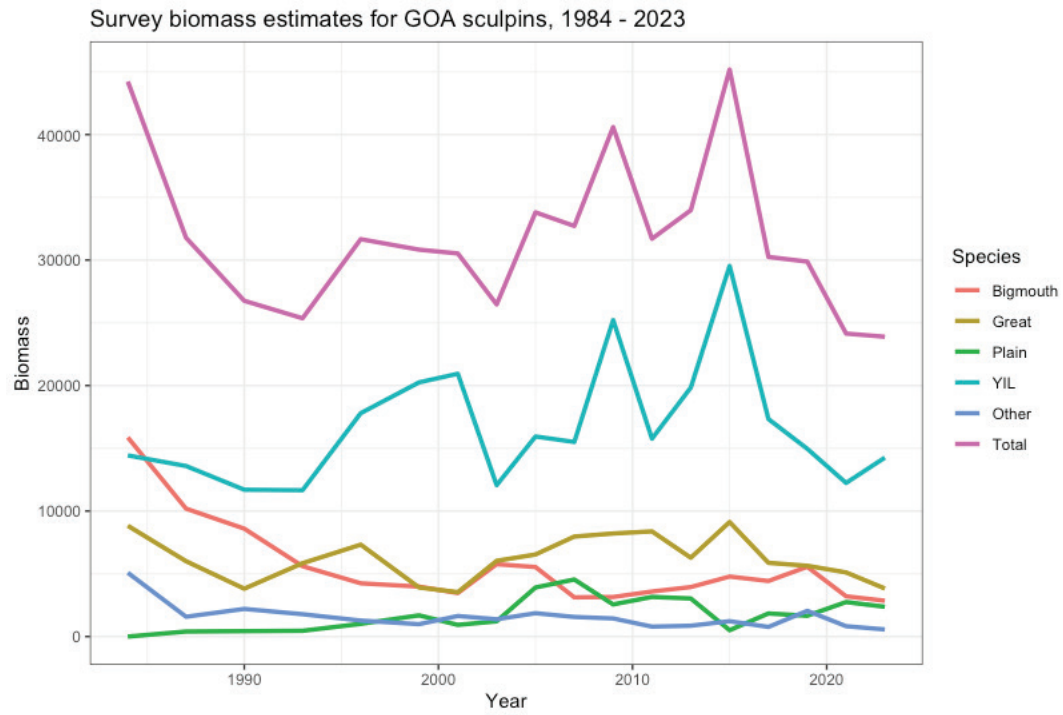


Figure 3. Survey biomass estimates (t) for the most abundant sculpin species in the Gulf of Alaska, 1984 – 2023.

Appendix 1. This appendix provides unofficial reference points for the sculpin complexes and describes the methodology used.

Summary of Results

Updated unofficial calculations of maximum allowable ABC for 2024 is 29,417 t in the BSAI and 3,968 mt in the GOA. Compared to the last full assessments completed in 2016 (BSAI) and 2015 (GOA), this is a 42% decrease in the BSAI and a 24% decrease in the GOA. The corresponding reference values for the sculpin complex are summarized in the following tables, with the updated unofficial **ABC and OFL values in bold**. Overfishing is not occurring in either the BSAI or GOA. Catches are not approaching unofficial OFLs. The estimated OFLs and ABCs in the tables presented below are much larger than the mean catches for the sculpin complexes and also much larger than the catch in any single year (Table 1). Detailed REMA biomass estimates (Sullivan et al. 2022) are provided in Tables A1, A2, and A3.

Gulf of Alaska Sculpin Complex

Quantity	As estimated or specified in the <i>last</i> SAFE ¹ for:		As estimated or recommended <i>this</i> year for:	
	2023	2024	2024	2025
<i>M</i> (natural mortality)	0.21	0.21	0.21	0.21
Specified/recommended Tier	5	5	5	5
Biomass (mt)	33,010	33,010	25,192	25,192
<i>F</i> _{OFL} (F=M)	0.21	0.21	0.21	0.21
<i>maxF</i> _{ABC} (maximum allowable = 0.75 <i>x</i> <i>F</i> _{OFL})	0.1575	0.1575	0.1575	0.1575
<i>F</i> _{ABC}	0.1575	0.1575	0.1575	0.1575
OFL (t)	6,932	6,932	5,290	5,290
maxABC (t)	5,199	5,199	3,968	3,968
ABC (t)	5,199	5,199	3,968	3,968
Status	As determined in the <i>last</i> SAFE for:		As determined <i>this</i> year for:	
	2021	2022	2022	2023
Overfishing	No	n/a	No	n/a

¹The last full assessment was in the 2015 SAFE..

The sculpin complex is an Ecosystem Component and, therefore, ABCs or OFLs are not used for catch specification.

Bering Sea and Aleutian Islands Sculpin Complex

Quantity	As estimated or specified in the <i>last</i> SAFE ¹ for:		As estimated or recommended <i>this</i> year for:	
	2023	2024	2024	2025
M (natural mortality)	0.282	0.282	0.282	0.282
Specified/recommended Tier	5	5	5	5
Biomass (t)	240,487	240,487	139,087	139,087
F_{OFL} (F=M)	0.282	0.282	0.282	0.282
$maxF_{ABC}$ (maximum allowable = $0.75x F_{OFL}$)	0.2115	0.2115	0.2115	0.2115
F_{ABC}	0.2115	0.2115	0.2115	0.2115
OFL (mt)	67,817	67,817	39,223	39,223
maxABC (mt)	50,863	50,863	29,417	29,417
ABC (mt)	50,863	50,863	29,417	29,417
Status	As determined in the <i>last</i> SAFE for:		As determined <i>this</i> year for:	
	2021	2022	2022	2023
Overfishing	No	n/a	No	n/a

¹The last full assessment was in the 2016 SAFE.

The sculpin stock complex is an Ecosystem Component and, therefore, ABCs or OFLs are not used for catch specification.

Tier 5 computations for sculpin OFL and ABC (t) are summarized by region (AI = Aleutian Islands, EBS = Eastern Bering Sea, GOA = Gulf of Alaska) for 2023:

BSAI and GOA Sculpin

Area	Biomass	Natural	OFL	ABC		
		mortality M	definition	OFL	definition	ABC
EBS	121,407	0.282	biomass x M	34,237	OFL x 0.75	25,678
AI	17,680	0.282	biomass x M	4,986	OFL x 0.75	3,940
BSAI total	139,087			39,223		29,417*
GOA	25,192	0.21	biomass x M	5,290	OFL x 0.75	3,968
Grand total	164,279			44,513		33,385

The sculpin stock complex is an Ecosystem Component therefore, ABCs or OFLs are not used for catch specifications.

*Depending on order of operations, rounding error can result in 29,418 or 29,417. For the ABC we combined the EBS+AI estimates first and only rounded once, resulting in 29,417.

Methodology

Biomass estimates were performed using the REMA method (<https://afsc-assessments.github.io/rema/>) (Sullivan et al. 2022). Biomass was calculated separately for the three large marine ecosystems: the Aleutian Islands, eastern Bering Sea, and the Gulf of Alaska. Within each large marine ecosystem, the most prominent species were enumerated separately, and the remaining species were combined into an “other” sculpin category. In the AI and EBS, REMA estimates were performed for the 6 most common sculpins: bigmouth sculpin

(*Hemitripteris bolini*), great sculpin (*Myoxocephalus polyacanthocephalus*), plain sculpin (*Myoxocephalus jaok*), threaded sculpin (*Gymnocanthus pistilliger*), warty sculpin (*Myoxocephalus verrucosus/scorpius*), and yellow Irish lord (*Hemilepidotus jordani*). There were 4 sculpin species considered the most abundant in the Gulf of Alaska. These were the yellow Irish lord (*Hemilepidotus jordani*), bigmouth sculpin (*Hemitripteris bolini*), great sculpin (*Myoxocephalus polyacanthocephalus*), plain sculpin (*Myoxocephalus jaok*), and yellow Irish lord (*Hemilepidotus jordani*). Data that was input into the REMA model were annual survey biomass estimates (by species), and estimates of the uncertainty (coefficient of variance). Therefore, estimates of six species + “other” sculpins were performed for the Aleutian Islands and eastern Bering Sea, and four species + “other” sculpins. These estimates were combined in each region to estimate annual sculpin biomass. The Bering Sea and Aleutian Islands estimates were further combined for a BSAI biomass estimate.

Table A1.1. Biomass estimates (t) for sculpin in the eastern Bering Sea using REMA. Biomass estimates for the six most abundant sculpin species are listed (YIL= yellow Irish lord), as well as “other” species of sculpin and the total estimate.

Year	Bigmouth	Great	Plain	Warty	Threaded	YIL	other	TOTAL
1982	19,917	12,842	60,970	3,959	1,891	39,160	62,312	201,051
1983	19,495	21,045	66,270	3,959	433	33,788	62,599	207,588
1984	19,311	24,325	53,260	28,634	200	26,475	61,386	213,591
1985	17,715	32,317	41,079	1,261	48	19,439	60,610	172,468
1986	17,281	47,515	46,049	538	109	21,964	50,574	184,031
1987	18,825	46,640	53,628	3,521	147	23,426	34,541	180,727
1988	18,983	41,167	52,329	3,462	181	20,921	32,905	169,947
1989	18,578	39,262	57,972	3,168	117	16,800	30,602	166,499
1990	18,768	44,559	64,418	2,898	130	11,962	29,076	171,812
1991	19,682	61,016	101,785	2,652	145	11,716	27,164	224,159
1992	20,454	78,557	82,271	730	273	15,429	22,839	220,555
1993	21,985	70,547	87,551	201	457	17,141	19,194	217,076
1994	24,772	88,874	91,209	422	763	17,494	16,156	239,691
1995	26,900	86,480	69,552	887	1,274	17,456	13,114	215,663
1996	28,148	82,710	56,912	1,863	2,129	16,091	10,654	198,507
1997	28,618	73,247	66,675	3,914	3,555	17,662	9,316	202,987
1998	28,695	60,695	57,208	8,307	1,982	14,970	8,187	180,043
1999	27,339	48,450	47,659	10,494	3,353	13,318	7,615	158,229
2000	27,237	51,027	45,025	11,767	1,647	11,913	7,112	155,729
2001	27,548	50,602	49,308	14,769	544	11,476	6,809	161,057
2002	28,822	59,164	56,364	9,569	1,198	12,542	6,546	174,204
2003	29,787	60,732	70,874	7,139	1,189	16,050	6,364	192,136
2004	31,190	58,217	70,788	10,159	1,334	22,801	6,228	200,716
2005	30,720	56,531	74,814	20,274	1,964	25,479	6,161	215,943
2006	29,884	55,826	69,401	16,103	2,437	26,487	6,080	206,217
2007	28,934	61,731	72,820	13,345	3,455	25,771	5,984	212,040
2008	28,486	61,756	58,696	11,200	2,171	26,264	5,904	194,478
2009	26,727	47,251	49,907	8,028	1,288	23,808	5,842	162,851
2010	28,961	48,279	54,930	6,962	1,596	21,793	5,789	168,309
2011	28,851	47,698	58,352	6,473	1,123	19,998	5,727	168,222
2012	26,684	39,979	54,582	6,319	3,843	18,285	5,357	155,048
2013	26,447	35,034	53,683	4,171	1,291	15,911	5,015	141,552
2014	26,500	39,709	66,118	7,097	602	18,167	4,828	163,021
2015	29,342	37,443	57,670	10,342	375	23,134	4,661	162,967
2016	33,774	46,887	48,981	14,842	171	27,505	4,450	176,609
2017	35,716	47,908	37,958	11,206	352	29,866	4,258	167,263
2018	35,165	52,521	39,267	7,962	133	30,203	4,090	169,341
2019	32,300	66,288	48,063	8,197	202	29,342	3,959	188,350
2020	28,446	56,798	43,230	4,063	348	25,576	3,866	162,326
2021	25,051	48,667	38,882	2,013	600	22,294	3,775	141,283
2022	21,936	49,206	36,819	708	459	23,096	3,698	135,921
2023	22,083	42,276	29,848	559	569	22,427	3,645	121,407

Table A1.2. Biomass estimates (t) for sculpin in the Aleutian Islands using REMA. Biomass estimates for the six most abundant sculpin species are listed (YIL= yellow Irish lord), “other” species of sculpin, and the total estimate.

Year	Bigmouth	Great	Plain	Warty	Threaded	YIL	other	TOTAL
1980	2,423	8,686	28	294	10	2,959	3,620	18,019
1981	2,957	8,612	28	294	10	3,437	3,896	19,234
1982	3,609	8,539	28	294	10	3,991	4,194	20,665
1983	4,404	8,466	28	294	10	4,636	4,515	22,353
1984	3,684	7,649	28	294	10	5,176	4,765	21,605
1985	3,081	6,910	28	294	10	5,779	5,029	21,131
1986	2,577	6,242	28	294	10	6,452	5,307	20,911
1987	2,189	5,624	28	122	10	5,915	5,100	18,988
1988	1,859	5,066	28	51	9	5,423	4,901	17,338
1989	1,578	4,564	28	21	9	4,972	4,709	15,883
1990	1,340	4,112	28	9	9	4,559	4,525	14,582
1991	1,138	3,704	28	4	9	4,179	4,348	13,411
1992	1,260	3,217	28	5	8	4,590	4,639	13,748
1993	1,395	2,795	28	7	8	5,041	4,949	14,223
1994	1,545	2,427	28	11	8	5,536	5,279	14,834
1995	1,531	2,274	28	11	8	5,471	5,228	14,551
1996	1,518	2,131	28	11	7	5,406	5,178	14,280
1997	1,505	1,996	28	11	7	5,343	5,128	14,018
1998	1,367	1,812	28	11	7	5,599	4,991	13,815
1999	1,241	1,645	28	11	6	5,868	4,858	13,657
2000	1,127	1,494	28	11	6	6,150	4,728	13,543
2001	1,121	1,529	28	11	5	5,549	5,563	13,805
2002	1,114	1,564	28	11	5	5,006	6,546	14,275
2003	1,032	1,602	23	11	4	6,271	6,934	15,878
2004	957	1,641	19	11	4	7,856	7,344	17,831
2005	1,081	1,734	15	11	4	9,013	6,909	18,766
2006	1,221	1,832	12	11	3	10,341	6,500	19,919
2007	1,068	1,689	10	11	3	11,074	6,572	20,426
2008	934	1,557	8	11	3	11,860	6,645	21,017
2009	817	1,435	6	11	3	12,702	6,718	21,693
2010	715	1,323	5	11	2	13,603	6,793	22,453
2011	592	1,332	4	11	2	13,743	6,205	21,889
2012	490	1,342	3	11	1	13,885	5,668	21,400
2013	516	1,221	3	11	1	13,586	5,065	20,402
2014	544	1,111	2	11	1	13,293	4,526	19,488
2015	474	1,135	2	11	1	12,035	4,168	17,825
2016	413	1,160	1	11	1	10,895	3,838	16,319
2017	342	1,150	3	11	1	11,522	3,470	16,499
2018	282	1,141	7	11	1	12,185	3,138	16,764
2019	278	1,113	7	11	1	12,507	3,060	16,976
2020	274	1,087	7	11	1	12,837	2,984	17,199
2021	269	1,061	7	11	0	13,176	2,911	17,434
2022	265	1,035	7	11	0	13,523	2,838	17,680
2023	265	1,035	7	11	0	13,523	2,838	17,680

Table A1.3. Biomass estimates (t) for sculpin in the Gulf of Alaska using REMA. Biomass estimates for the four most abundant sculpin species are listed (YIL= yellow Irish lord), “other” species of sculpin, and the total estimate.

Year	Bigmouth	Great	Plain	YIL	Other	TOTAL
1984	15,040	7,482	436	14,163	4,237	41,358
1985	13,280	7,106	436	14,082	3,235	38,138
1986	11,725	6,749	436	14,001	2,470	35,380
1987	10,353	6,409	436	13,920	1,886	33,003
1988	9,512	6,193	448	13,877	1,946	31,976
1989	8,740	5,984	460	13,834	2,009	31,027
1990	8,031	5,781	473	13,791	2,073	30,149
1991	7,193	5,771	500	13,888	1,962	29,314
1992	6,443	5,760	528	13,986	1,858	28,575
1993	5,772	5,750	557	14,084	1,759	27,921
1994	5,342	5,719	657	14,562	1,599	27,880
1995	4,944	5,689	776	15,055	1,454	27,919
1996	4,576	5,659	916	15,566	1,323	28,040
1997	4,435	5,393	1,018	16,021	1,252	28,119
1998	4,299	5,140	1,131	16,488	1,185	28,243
1999	4,166	4,899	1,257	16,970	1,122	28,413
2000	4,172	4,963	1,227	16,646	1,281	28,290
2001	4,179	5,028	1,198	16,329	1,463	28,197
2002	4,554	5,427	1,349	15,857	1,440	28,628
2003	4,963	5,857	1,519	15,399	1,418	29,156
2004	4,881	6,193	2,091	15,753	1,587	30,505
2005	4,800	6,549	2,879	16,115	1,775	32,117
2006	4,237	6,926	3,070	16,546	1,667	32,446
2007	3,740	7,325	3,273	16,989	1,566	32,894
2008	3,604	7,523	2,994	17,863	1,479	33,462
2009	3,473	7,725	2,738	18,782	1,397	34,115
2010	3,569	7,732	2,711	18,403	1,111	33,527
2011	3,668	7,739	2,685	18,031	884	33,008
2012	3,833	7,475	2,299	18,363	893	32,863
2013	4,004	7,220	1,968	18,702	903	32,797
2014	4,221	7,366	1,391	18,776	1,025	32,779
2015	4,450	7,514	983	18,851	1,164	32,962
2016	4,447	6,975	1,217	17,986	1,004	31,629
2017	4,445	6,475	1,506	17,160	866	30,452
2018	4,455	6,118	1,621	16,336	1,151	29,680
2019	4,464	5,781	1,745	15,551	1,530	29,071
2020	4,048	5,482	1,938	14,954	1,138	27,561
2021	3,671	5,199	2,153	14,380	847	26,250
2022	3,461	4,944	2,218	14,361	713	25,697
2023	3,264	4,701	2,285	14,342	600	25,192

Appendix 2.

Table A2.1.—Research catches (kg) of sculpin compiled by NMFS Alaska Region: Sourced by the AKR.V_NONCOMMERCIAL_FISHERY_CATCH table.

Year	ADFG	IPHC	NMFS	Total
1988	0	0	145	145
1989	0	0	82	82
1990	0	0	53	53
1991	0	0	102	102
1992	0	0	45	45
1993	0	0	23	23
1994	0	0	33	33
1995	0	0	43	43
1996	0	0	1,186	1,186
1997	0	0	43	43
1998	693	0	716	1,409
1999	1,029	0	50	1,079
2000	1,410	0	662	2,072
2001	1,014	0	42	1,056
2002	1,674	0	618	2,292
2003	1,710	0	43	1,753
2004	2,058	0	1,041	3,099
2005	2,388	0	55	2,443
2006	1,258	0	983	2,241
2007	1,869	0	101	1,970
2008	1,071	0	906	1,977
2009	1,350	0	220	1,570
2010	406	8,174	19,001	27,581
2011	1,441	6,547	18,803	26,791
2012	1,391	4,367	13,341	19,099
2013	2,268	7,809	6,550	16,627
2014	171	9,550	10,394	20,115
2015	175	9,482	9,563	19,220
2016	630	5,319	12,985	18,934
2017	3,638	6,958	12,937	23,533
2018	1,963	7,570	12,448	21,981
2019	730	13,078	12,268	26,076
2020	315	2,340	2,052	4,707
2021	265	8,263	7,474	16,002