18. Assessment of the skate stock complex in the Bering Sea and Aleutian Islands

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Executive Summary

The Bering Sea and Aleutian Islands (BSAI) skate complex is managed in aggregate, with a single set of harvest specifications applied to the entire complex. However to generate the harvest recommendations the stock is divided into two units. Alaska skate (*Bathyraja parmifera*), the most abundant skate species in the BSAI, is in Tier 3 so harvest recommendations are made using the results of an age structured model. The remaining species ("other skates") are managed under Tier 5 due to a lack of data. The Tier 3 and Tier 5 recommendations are combined to generate recommendations for the complex as a whole.

Alaska skate is found mainly on the eastern Bering Sea (EBS) shelf, while "other" skates occur mainly on the EBS slope and in the AI. Because the EBS slope and AI trawl surveys are biennial, full information regarding the BSAI skate complex is available only every other year. As a result, full assessments for the BSAI skate complex are only conducted in years when all three BSAI surveys occur. In "off" (odd) years, an executive summary is prepared that incorporates updated catch information, results from the EBS shelf survey (conducted annually), and updated harvest recommendations from a new run of the Alaska skate projection model.

Summary of Changes in Assessment Inputs

1) Biomass estimates for Alaska skate and "other" skates are included from the 2015 EBS shelf bottom trawl survey, and an updated random-effects model was run for the EBS shelf survey.
2) Catch data are updated through October 18, 2015.
3) For Alaska skates, an updated run of the Alaska projection model was performed. Due to the timing of the assessment, full catch data for 2015 were not available. For the projection model, the complete 2015 catch was estimated based on additional catch that occurred after October 18 in the preceding 5 years.

Summary of results

1) Biomass estimates from the EBS shelf survey increased substantially from 2014 for Alaska skate and the "other skates" group (Tables 1 & 2). Although the estimates have fluctuated on an annual basis, they have maintained a level of approximately 400,000 t since 1990.
2) The 2015 catch appears it will be slightly less than in previous years (Tables 3 & 4), and retention remains fairly consistent at ~30% (Table 5).
3) The 2015 EBS shelf survey biomass estimate for "other" skates (Table 6) increased relative to 2014. The corresponding RE model biomass estimate also increased relative to 2014 (Table 6 & Figure 1), so harvest recommendations increased for "other" skates and the skate complex as a whole.
4) The increase discussed in (3) was slightly offset by a small decrease in the harvest recommendations produced by the Alaska skate projection model.

Alaska skate harvest recommendations

Quantity	As estimated or *specified last* year for: 2015	2016	As estimated or *recommended this* year for: 2016	2017
M (natural mortality rate)	*0.13*	*0.13*	**0.13**	0.13
Tier	*3a*	*3a*	**3a**	3a
Projected total (age 0+) biomass (t)	*528,391*	*498,957*	**527,932**	498,546
Female spawning biomass (t)				
Projected	*115,490*	*112,195*	**115,378**	112,087
$B_{100\%}$	*186,923*	*186,923*	**186,923**	186,923
$B_{40\%}$	*74,769*	*74,769*	**74,769**	74,769
$B_{35\%}$	*65,423*	*65,423*	**65,423**	65,423
F_{OFL}	*0.090*	*0.090*	**0.090**	0.090
$maxF_{ABC}$	*0.077*	*0.077*	**0.077**	0.077
F_{ABC}	*0.077*	*0.077*	**0.077**	0.077
OFL (t)	*39,883*	*37,343*	**39,847**	37,306
maxABC (t)	*34,389*	*32,199*	**34,358**	32,167
ABC (t)	*34,389*	*32,199*	**34,358**	32,167
Status	As determined *last* year for: 2013	2014	As determined *this* year for: 2014	2015
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

other skate harvest recommendations

Quantity	As estimated or *specified last* year for: 2015	2016	As estimated or *recommended this* year for: 2016	2017
M (natural mortality rate)	*0.1*	*0.1*	**0.1**	0.1
Tier	*5*	*5*	**5**	5
Biomass (t)	*96,923*	*96,923*	**103,682**	
F_{OFL}	*0.1*	*0.1*	**0.1**	0.1
$maxF_{ABC}$	*0.075*	*0.075*	**0.075**	0.075
F_{ABC}	*0.075*	*0.075*	**0.075**	0.075
OFL (t)	*9,692*	*9,692*	**10,368**	10,368
maxABC (t)	*7,269*	*7,269*	**7,776**	7,776
ABC (t)	*7,269*	*7,269*	**7,776**	7,776
Status	As determined *last* year for: 2013	2014	As determined *this* year for: 2014	2015
Overfishing	No	n/a	No	n/a

aggregate harvest recommendations for the BSAI complex

Quantity	As estimated or *specified last* year for: 2015	2016	As estimated or *recommended this* year for: 2016	2017
OFL (t)	*49,575*	*47,035*	**50,215**	47,674
ABC (t)	*41,658*	*39,468*	**42,134**	39,943

Responses to SSC and Plan Team Comments on Assessments in General

There were no relevant general comments for the skate complex SAFE, except for the continuing recommendation from both the Plan Team and SSC that the random-effects model be used for Tier 5 species. This recommendation was adopted last year for BSAI skates and will continue to be used in all future assessments.

Responses to SSC and Plan Team Comments Specific to this Assessment

From the November 2014 BSAI Plan Team minutes:
"For Alaska skates, the Team concurred with the author and recommended Model 2. However, concern about the change in estimated spawning biomass between the two assessments led the Team to recommend rolling over the lower 2014 ABC for 2015 and 2016. The Team also recommends, for September 2015, an evaluation of the optimum starting year, age composition data, and recruitment variability. Recruitment variability may help explain the change in the estimates of spawning biomass. The Team reminds the author to include a retrospective analysis and harvest scenarios next year."

Response: Because this is an off-year assessment, no additional work on the Alaska skate model was performed for 2015. The 2016 SAFE will address all of the recommendations from the BSAI Plan Team.

From the December 2014 SSC minutes:
"Acceptance of Model 2 is contingent upon having accurate historical catches between 1950 and 1977. It is unclear if the author addressed a primary concern of the SSC regarding the evaluation of historical catch data in regard to the assumptions on the proportion of gear-specific effort and species compositions. Further evaluation of selectivity as a function of age and/or length is also warranted."

Response: Because this is an off-year assessment, no additional work on the Alaska skate model was performed for 2015. The 2016 SAFE will address all of the recommendations from the SSC.

Tables

Table 1. Total skate biomass (t) with coefficient of variation (CV) from bottom trawl surveys of the Eastern Bering Sea (EBS) shelf, EBS slope, and Aleutian Islands (AI), 1982-2015.

year	EBS shelf		EBS slope		AI	
	biomass	CV	biomass	CV	biomass	CV
1982	175,647	0.09	2,723	0.10		
1983	171,720	0.08			9,750	0.12
1984	198,893	0.08				
1985	187,503	0.13	3,329	0.10		
1986	267,356	0.14			15,515	0.19
1987	356,530	0.09				
1988	369,934	0.12	3,271	0.21		
1989	418,424	0.08				
1990	483,735	0.11				
1991	453,788	0.08	4,031	0.25	15,013	0.17
1992	399,625	0.09				
1993	389,285	0.07				
1994	404,888	0.08			25,051	0.10
1995	361,694	0.08				
1996	422,747	0.06				
1997	418,782	0.06			29,021	0.14
1998	369,576	0.05				
1999	339,135	0.17				
2000	336,654	0.06			29,129	0.09
2001	431,944	0.06				
2002	382,652	0.06	69,275	0.50	34,471	0.11
2003	404,761	0.05				
2004	439,462	0.05	33,156	0.08	53,242	0.16
2005	507,765	0.05				
2006	456,252	0.05			53,922	0.12
2007	496,279	0.07				
2008	380,917	0.05	37,548	0.08		
2009	370,395	0.06				
2010	385,088	0.06	35,177	0.12	51,988	0.11
2011	428,111	0.05				
2012	386,545	0.06	60,730	0.10	35,454	0.12
2013	413,776	0.06				
2014	428,845	0.05			42,983	0.12
2015	487,488	0.05				

Table 2. Survey biomass estimates (t) and coefficient of variation (CV) for Alaska skate, other skates, and total skates by area and year, 1999-2015. EBS = eastern Bering Sea; AI = Aleutian Islands.

		Alaska		other skates		all skates	
		biomass	CV	biomass	CV	biomass	CV
EBS slope	2002	35,932	0.95	33,344	0.14	69,275	0.50
	2004	4,248	0.33	28,909	0.08	33,156	0.08
	2008	4,516	0.32	33,033	0.08	37,548	0.08
	2010	1,296	0.32	33,882	0.12	35,177	0.12
	2012	19,829	0.27	40,901	0.08	60,730	0.10
AI	2000	9,578	0.15	19,551	0.12	29,129	0.09
	2002	10,739	0.20	23,732	0.13	34,471	0.11
	2004	12,923	0.22	40,319	0.21	53,242	0.16
	2006	13,279	0.19	40,643	0.14	53,922	0.12
	2010	3,681	0.20	48,307	0.12	51,988	0.11
	2012	1,503	0.31	33,951	0.12	35,454	0.12
	2014	3,515	0.40	39,468	0.12	42,983	0.12
EBS shelf	1999	323,240	0.17	15,896	0.43	339,135	0.17
	2000	311,977	0.06	24,677	0.21	336,654	0.06
	2001	414,539	0.06	17,405	0.15	431,944	0.06
	2002	364,004	0.07	18,647	0.14	382,652	0.06
	2003	372,379	0.05	32,381	0.25	404,761	0.05
	2004	424,808	0.05	14,655	0.13	439,462	0.05
	2005	487,046	0.05	20,719	0.25	507,765	0.05
	2006	437,737	0.05	18,515	0.15	456,252	0.05
	2007	479,043	0.07	17,236	0.22	496,279	0.07
	2008	361,300	0.06	19,617	0.22	380,917	0.05
	2009	350,233	0.06	20,162	0.17	370,395	0.06
	2010	366,186	0.06	18,902	0.16	385,088	0.06
	2011	410,340	0.05	17,771	0.24	428,111	0.05
	2012	369,881	0.06	16,664	0.15	386,545	0.06
	2013	386,816	0.06	26,961	0.23	413,776	0.06
	2014	404,380	0.05	24,465	0.18	428,845	0.05
	2015	448,224	0.06	39,264	0.23	487,488	0.05

Table 3. Estimated catch (t) of all skate species combined by target fishery, 2003-2015. Source: AKRO CAS YFS = yellowfin sole, FHS = flathead sole, ATF = arrowtooth flounder.

	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	***2015****
Pacific cod	14,950	18,369	19,456	15,115	13,463	14,311	12,698	11,431	16,698	18,487	20,498	21,896	*19,456*
pollock	471	841	732	1,308	1,287	2,758	3,856	1,881	2,353	2,018	1,757	815	*824*
YFS	1,524	594	943	1,133	1,409	1,303	1,784	1,912	2,107	2,232	2,683	1,970	*796*
Atka	91	143	140	141	153	179	185	246	269	510	345	490	*457*
IFQ halibut	265	282	130	84	20	1,370	0	25	10	48	339	844	*370*
rock sole	530	500	422	930	996	555	964	1,204	709	634	526	689	*284*
Gr. turbot	221	136	168	121	176	69	209	369	382	357	51	43	*210*
rockfish	73	23	29	37	72	63	91	53	103	97	232	163	*151*
FHS	625	1,192	839	852	768	663	360	304	112	76	206	272	*101*
ATF	103	64	135	282	81	297	191	184	116	207	183	160	*98*
Kamchtaka	0	0	0	0	0	0	0	0	92	101	49	57	*68*
sablefish	57	12	26	123	62	41	131	116	138	46	114	92	*17*
AK plaice	0	0	0	1	2	2	1	5	38	9	45	0	*12*
other flatfish	26	78	42	7	64	2	14	4	3	3	0	0	*6*
total	**19,154**	**22,329**	**23,084**	**20,250**	**18,623**	**21,677**	**20,596**	**17,737**	**23,154**	**24,824**	**27,030**	**27,511**	***22,864***

*2015 data incomplete; retrieved October 18, 2015.

Table 4. Estimated catch (t) of all skate species combined by reporting area, 2003-2015. Source: AKRO CAS.

		2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	***2015****
EBS	**509**	1,972	2,189	3,271	3,537	3,584	4,040	5,009	2,791	6,090	6,148	8,259	3,798	*1,833*
	512	25	205	15	0	0	28	16	13	7	161	50	21	*64*
	513	2,722	2,747	3,902	2,607	2,321	2,048	2,503	1,885	3,086	1,811	3,416	4,533	*4,428*
	514	275	67	196	221	445	83	134	78	150	1,588	235	934	*1,147*
	516	130	408	239	253	398	488	575	664	243	777	968	399	*175*
	517	2,893	3,020	3,772	2,459	2,175	2,467	3,200	2,809	2,619	3,294	4,724	4,206	*3,402*
	518	25	6	16	11	5	459	57	51	28	20	54	98	*83*
	519	184	140	104	69	109	240	56	80	103	122	64	145	*61*
	521	8,979	10,369	8,513	8,383	7,120	7,755	6,181	6,603	8,669	8,024	7,172	10,814	*8,891*
	523	304	324	243	282	333	242	264	395	268	1,066	868	657	*294*
	524	990	1,970	2,116	1,462	1,122	2,426	1,396	1,014	1,159	730	162	720	*1,291*
	530	0	0	0	0	0	0	1	0	0	0	0	0	*0*
AI	**541**	302	466	488	563	340	492	452	474	501	776	612	950	*744*
	542	234	280	125	337	400	566	335	453	185	272	360	184	*242*
	543	118	139	83	67	271	343	419	427	45	35	86	51	*208*
EBS total		18,500	21,445	22,388	19,283	17,612	20,276	19,390	16,383	22,422	23,740	25,972	26,326	*21,670*
AI total		655	885	696	966	1,011	1,401	1,206	1,354	732	1,083	1,058	1,185	*1,194*
BSAI total		19,154	22,329	23,084	20,250	18,623	21,677	20,596	17,737	23,154	24,824	27,030	27,511	*22,864*

*2015 data are incomplete; retrieved October 18, 2015.

Table 5. Retention rates of skates in federal groundfish fisheries in the BSAI, 2011-2015. Data source: AKRO CAS. .

year	percent retained
2011	24%
2012	29%
2013	29%
2014	30%
*2015**	*28%*

*2015 are incomplete; retrieved October 30, 2015.

Table 6. Biomass estimates from the EBS shelf trawl survey and predictions from a random-effects model based on those estimates for other skates, 1999-2015

	survey		**RE model**	
	estimate (t)	**CV**	**estimate (t)**	**CV**
1999	15,896	0.41	19,454	0.15
2000	24,677	0.21	19,683	0.12
2001	17,405	0.15	18,954	0.09
2002	18,647	0.14	18,936	0.09
2003	32,381	0.24	19,056	0.10
2004	14,655	0.12	17,581	0.10
2005	20,719	0.25	18,161	0.09
2006	18,515	0.15	18,378	0.09
2007	17,236	0.21	18,539	0.10
2008	19,617	0.22	18,993	0.10
2009	20,162	0.17	19,328	0.09
2010	18,902	0.16	19,390	0.09
2011	17,771	0.24	19,636	0.11
2012	16,664	0.15	20,214	0.10
2013	26,961	0.23	22,574	0.11
2014	24,465	0.18	24,400	0.13
2015	39,264	0.22	26,354	0.20

Figures

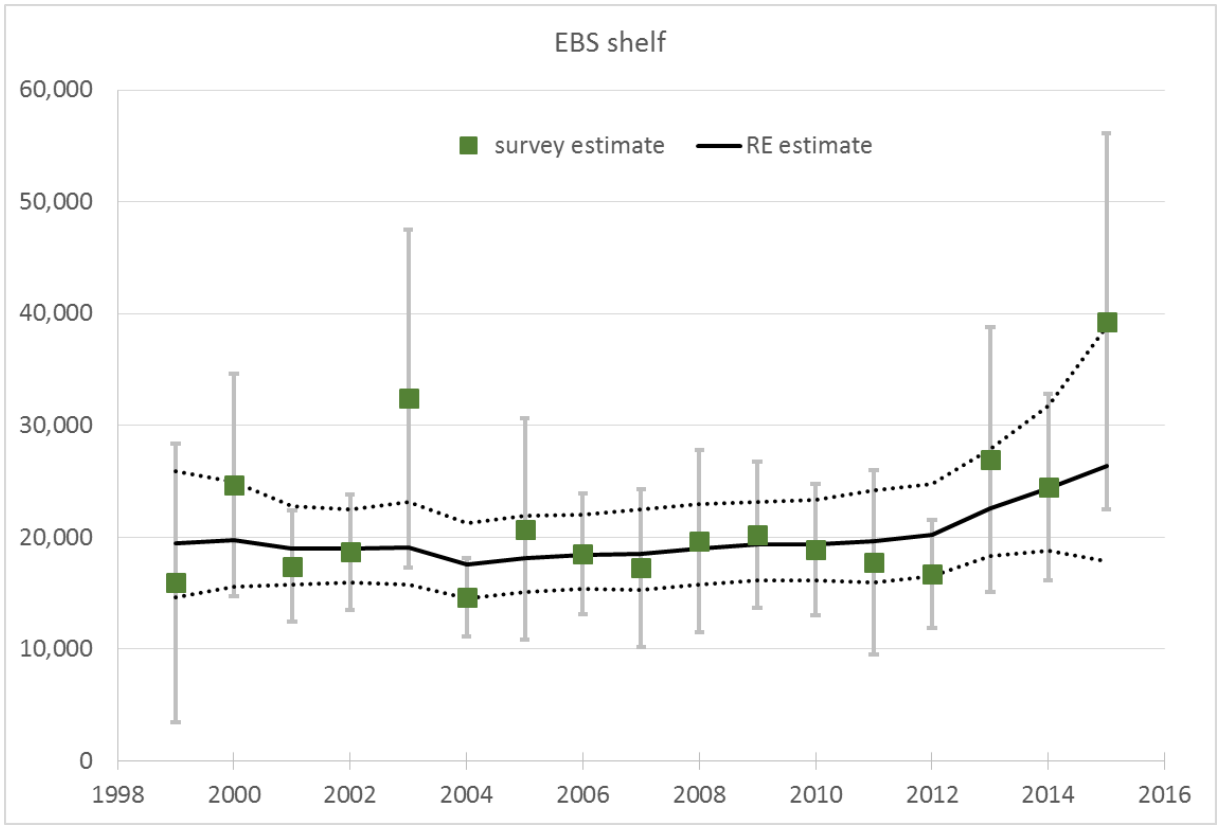

Figure 1. Biomass estimates from the EBS shelf trawl survey (green squares) and predictions from a random-effects model based on those estimates (black line) for other skates, 1999-2015. 95% confidence intervals are indicated by grey error bars and dotted black lines for the survey and model estimates, respectively.

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