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

Olav A. Ormseth
Alaska Fishery Science Center
October 30, 2017

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. Harvest recommendations for Alaska skate *Bathyraja parmifera*, the most abundant skate species in the BSAI, are made using the results of an age structured model and Tier 3. 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.

Beginning in 2017, groundfish stocks managed by the North Pacific Fishery Management Council are on a new assessment cycle. As was previously the case, full assessments for the BSAI skate complex will be performed in even years when full survey data are available. In off years, the previous update format has been expanded to include more complete data regarding catch and biomass.

Summary of Changes in Assessment Inputs

Changes in the input data:

1) Catch data have been updated through October 31, 2017. The 2015 and 2016 catch data used in the projection model have been updated, and an estimate of 2017 catch was created for use in the projection model.
2) Survey biomass estimates from the 2017 eastern Bering Sea shelf bottom trawl survey have been included.

Changes in assessment methodology:

1) There were no changes to the assessment methodology. The projection model for harvest recommendations was re-run with updated catch data.

Summary of results

1) The survey biomass estimate for the aggregate skate complex on the EBS shelf increased relative to 2016 (610,666 t vs. 587,741 t: Figure 3).
2) The estimated EBS shelf biomass for Alaska skate (the most abundant species on the shelf) decreased slightly from 2016 (Table 1 and Figure 3).
3) The estimated EBS shelf biomass for the Other Skate assemblage (all skates except for Alaska skate) increased relative to 2016 (Table 1 and Figure 2). This was due to increase in the estimated biomass of Aleutian, Bering, and big skates (Table 1 and Figure 3).
4) The harvest recommendations for 2018 have changed slightly from last year's assessment, and recommendations for 2019 are included.

Alaska skate harvest recommendations

	As estimated or *specified last* year for:		As estimated or *recommended this* year for:	
Quantity	2017	2018	2018*	2019*
M (natural mortality rate)	*0.13*	*0.13*	**0.13**	0.13
Tier	*3a*	*3a*	**3a**	3a
Projected total (age 0+) biomass (t)	506,921	487,035	**478,306**	452,245
Female spawning biomass (t)				
Projected	*110,180*	*110,159*	**107,136**	103,953
$B_{100\%}$	*180,556*	*180,556*	**180,556**	180,556
$B_{40\%}$	*72,222*	*72,222*	**72,222**	72,222
$B_{35\%}$	*63,195*	*63,195*	**63,195**	63,195
F_{OFL}	*0.092*	*0.092*	**0.092**	0.092
$maxF_{ABC}$	*0.079*	*0.079*	**0.079**	0.079
F_{ABC}	*0.079*	*0.079*	**0.079**	0.079
OFL (t)	*39,162*	*37,365*	**36,655**	34,189
maxABC (t)	*33,731*	*32,183*	**31,572**	29,447
ABC (t)	*33,731*	*32,183*	**31,572**	29,447
	As determined *last* year for:		As determined *this* year for:	
Status	2015	2016	2016	2017
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

** The catch data used in the projection model that produces these recommendations are presented in Table 1. The full 2017 catch was estimated by multiplying the partial 2017 catch by a correction factor based on the additional catch that occurred after October in the 5 previous years.*

other skate harvest recommendations				
	As estimated or *specified last* year for:		As estimated or *recommended this* year for:	
Quantity	2017	2018	2018	2019
M (natural mortality rate)	*0.1*	*0.1*	**0.1**	0.1
Tier	*5*	*5*	**5**	5
Biomass (t)	*100,130*	*100,130*	**100,130**	100,130
F_{OFL}	*0.10*	*0.10*	**0.10**	0.10
$maxF_{ABC}$	*0.075*	*0.075*	**0.075**	0.075
F_{ABC}	*0.075*	*0.075*	**0.075**	0.075
OFL (t)	*10,013*	*10,013*	**10,013**	10,013
maxABC (t)	*7,510*	*7,510*	**7,510**	7,510
ABC (t)	*7,510*	*7,510*	**7,510**	7,510
	As determined *last* year for:		As determined *this* year for:	
Status	2015	2016	2016	2017
Overfishing	No	n/a	No	n/a

aggregate harvest recommendations for the BSAI skate complex				
	As estimated or *specified last* year for:		As estimated or *recommended this* year for:	
Quantity	2017	2018	2018	2019
OFL (t)	*49,063*	*46,583*	**46,668**	44,202
maxABC (t)	*41,144*	*39,008*	**39,082**	36,957
ABC (t)	*41,144*	*39,008*	**39,082**	36,957

SSC and Plan Team Comments on Assessments in General

There were no relevant general comments.

SSC and Plan Team Comments Specific to this Assessment

These comments will be addressed in the next full assessment, scheduled for 2018.

From the November 2016 Plan Team minutes:

1) Investigate appropriate Bmsy proxies for skates and relate the values to current harvest recommendations, for example, most elasmobranchs have Bmsy >= B50%, less productive species have been documented to have Bmsy=B79%. The BSAI skate species are likely between these two extremes.
2) Examine the utility of including IPHC and AFSC longline survey indices in both Model 14.2 and the random effects model for the Tier 5 species.
3) Expand on appendix 2 of the SAFE document by reconciling more explicitly the differences between the results of the 2013 and 2014 assessments with respect to the substantial decreases in FOFL and 2015 spawning biomass and the substantial increase in 2015 OFL.

From the December 2016 SSC minutes:
In addition to supporting the Plan Team's recommendations, the SSC has the following recommendations:

- Re-evaluate the use of trawl survey data to apportion longline. The assessment uses trawl survey species composition to apportion Alaska skate from other skates caught in the longline fishery. Trawl species composition from a survey maybe quite different from species composition in the longline fishery. Speciation in the observer data has improved since the Ormseth and Matta (2007) paper referenced in the assessment. The author should compare the observer data from the longline fishery to the trawl survey catch to evaluate this assumption.
- The assessment should incorporate relevant information pertaining to the relationship between water temperature and recruitment. Development time for some skate species is influenced by water temperature (i.e., warmer water results in shorter development periods). This may functionally affect recruitment trends and variability.
- The stock structure section for Alaska skates has conflicting and inaccurate information regarding national standard guidelines. This section needs to be updated.

Tables

Table 1. Estimated catch of skates (t) in the Bering Sea and Aleutian Islands management area. "Official estimate" refers to the catch estimates as of October 31, 2017 maintained by the NMFS Alaska Regional Office in the Catch Accounting System. "Author's estimate" refers to catch estimates for Alaska skates and the Other Skates group calculated by the author, based on survey species composition data and data from fishery observers.

	official estimate	author's estimate	
Year	**total BSAI skate catch**	**Alaska skate catch**	**Other Skates catch**
1992	16,962	15,299	1,663
1993	12,226	11,027	1,199
1994	14,223	12,829	1,394
1995	14,892	13,432	1,460
1996	12,643	11,403	1,240
1997	17,747	15,991	1,756
1998	19,318	17,278	2,040
1999	14,080	12,606	1,474
2000	18,877	16,417	2,460
2001	20,570	17,535	3,035
2002	21,279	19,514	1,765
2003	21,144	19,273	1,871
2004	22,329	20,199	2,130
2005	23,084	21,066	2,018
2006	20,250	18,254	1,996
2007	18,623	16,707	1,916
2008	21,677	19,299	2,378
2009	20,596	18,419	2,177
2010	17,702	15,635	2,067
2011	23,148	21,113	2,036
2012	24,824	22,444	2,380
2013	27,021	24,512	2,509
2014	27,450	24,868	2,582
2015	28,117	25,406	2,712
2016	29,682	26,888	2,794
2017*	*27,263*	*24,697*	*2,566*

* 2017 catch data are incomplete; data retrieved on October 31, 2017.

Table 2. Biomass estimates from the NMFS eastern Bering Sea (EBS) shelf bottom trawl survey for the major skate species found on the shelf (no survey was conducted for the EBS slope or Aleutian Islands during 2017). CV = coefficient of variation.

	big		**Bering**		**Aleutian**		**Alaska**	
	biomass	**CV**	**biomass**	**CV**	**biomass**	**CV**	**biomass**	**CV**
1999	6,492	1.00	9,404	0.20	0	-	323,240	0.05
2000	5,155	0.83	16,842	0.16	2,232	0.54	311,977	0.17
2001	1,811	0.78	14,263	0.14	1,232	0.61	414,539	0.06
2002	1,489	0.59	12,746	0.16	2,893	0.47	364,004	0.06
2003	0	-	13,602	0.12	18,253	0.43	372,379	0.07
2004	951	0.71	11,209	0.12	2,494	0.41	424,808	0.05
2005	2,307	0.71	8,774	0.17	8,223	0.56	487,046	0.05
2006	1,036	0.68	11,674	0.13	5,568	0.41	437,737	0.05
2007	1,804	0.76	9,480	0.14	2,718	0.43	479,043	0.05
2008	2,870	0.63	9,943	0.16	6,278	0.57	361,300	0.07
2009	4,500	0.50	13,274	0.18	2,171	0.49	350,233	0.06
2010	3,445	0.66	11,992	0.14	3,332	0.35	366,186	0.06
2011	5,263	0.72	9,795	0.17	2,525	0.54	410,340	0.06
2012	1,161	0.70	10,190	0.16	4,565	0.37	369,881	0.05
2013	3,379	1.00	12,099	0.28	11,483	0.35	386,816	0.06
2014	3,596	0.60	12,570	0.15	8,149	0.41	404,380	0.06
2015	15,438	0.49	12,210	0.13	11,084	0.40	448,224	0.05
2016	10,668	0.54	10,981	0.12	14,449	0.27	550,892	0.06
2017	13,716	0.41	15,249	0.17	36,900	0.56	544,657	0.04

Figures

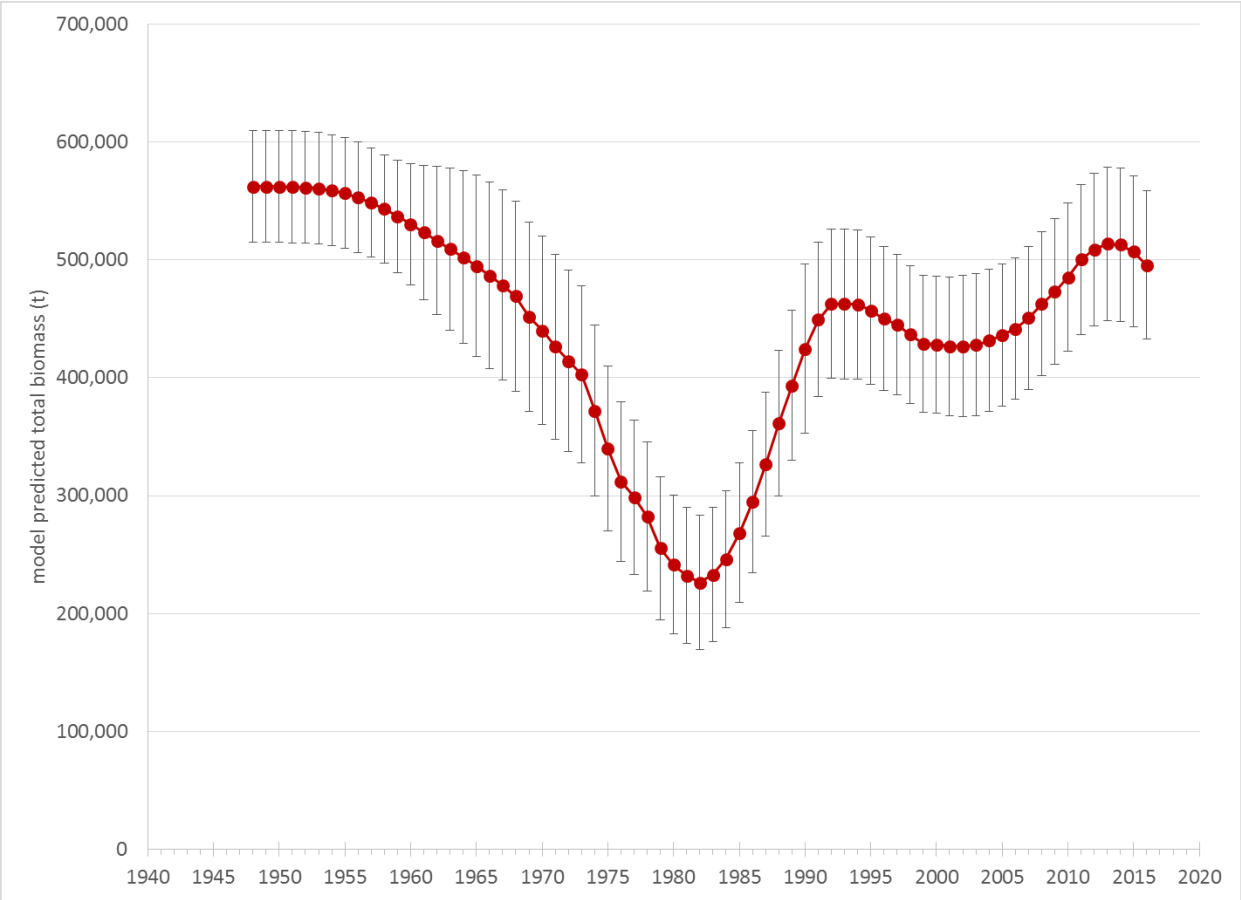

Figure 1. Model estimates of total Alaska skate biomass. Error bars indicate 95% confidence interval. Results are from an age-structured model described in the 2016 Bering Sea and Aleutian Islands stock assessment (https://www.afsc.noaa.gov/REFM/Docs/2016/BSAIskate.pdf).

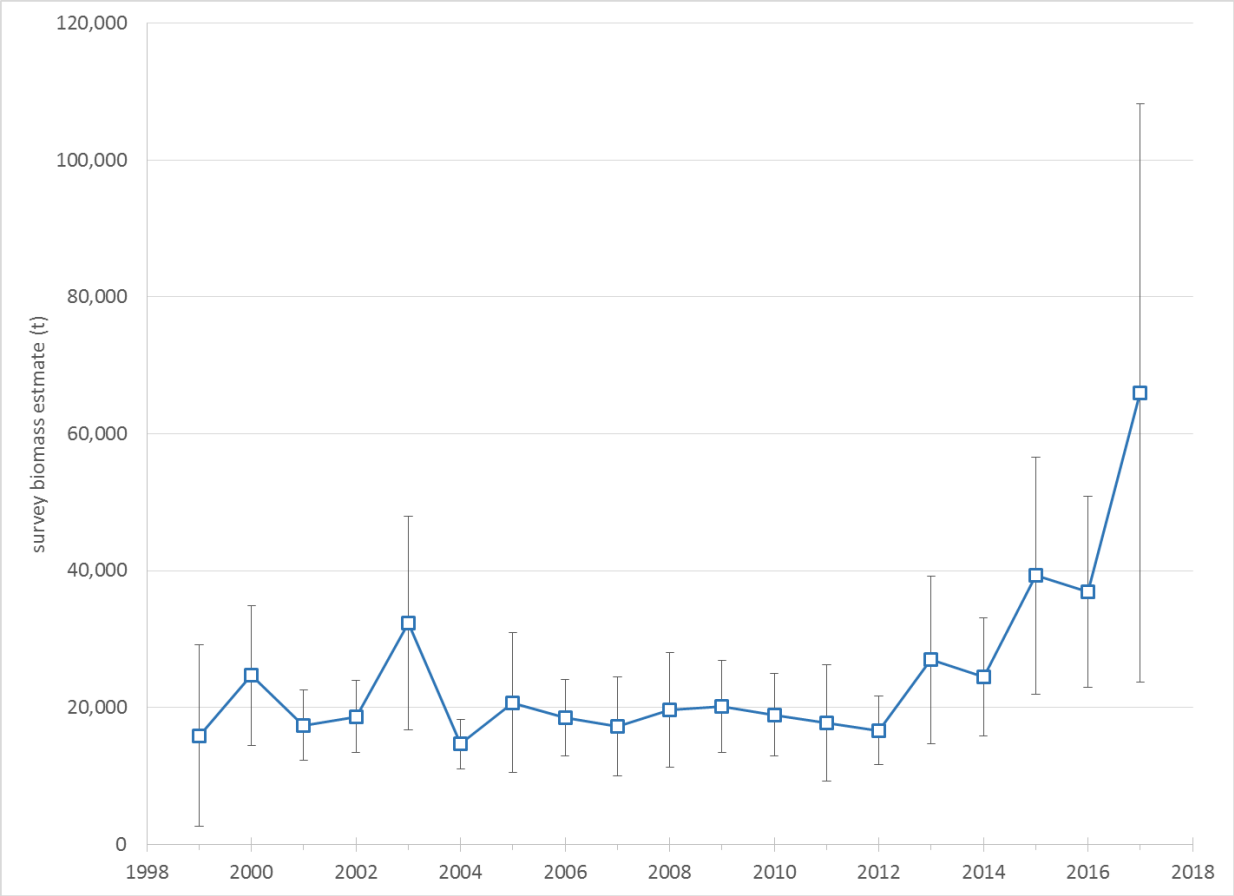

Figure 2. Biomass estimates of Other Skates (i.e. all skate species except Alaska skate) from the NMFS eastern Bering Sea (EBS) shelf trawl survey. Error bars indicate 95% confidence interval. The other relevant surveys for skates (Aleutian Islands and EBS slope bottom trawl surveys) are conducted in even years, so no new data are available.

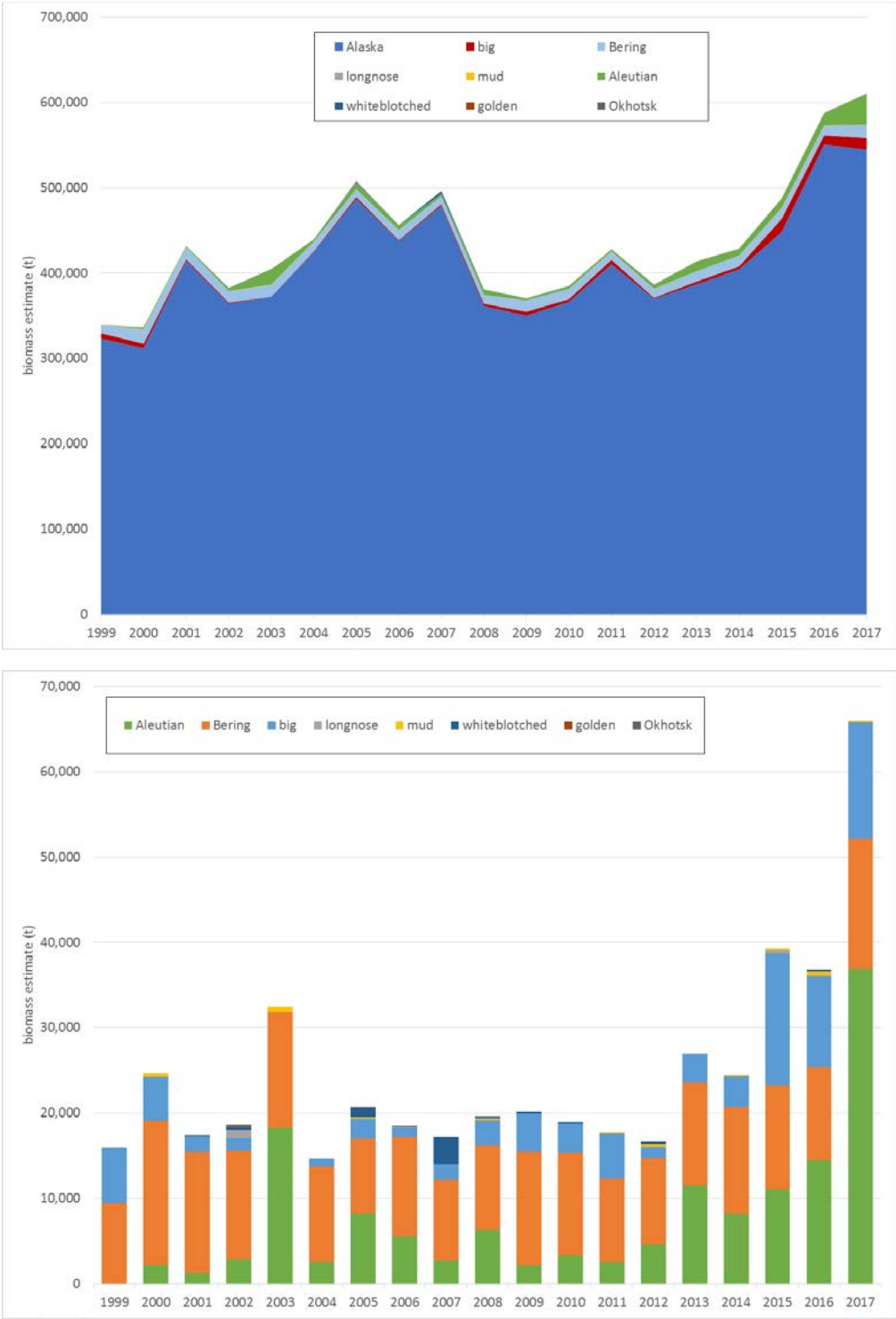

Figure 3. Species composition of survey biomass estimates for skates on the eastern Bering Sea shelf (EBS) by year from 1999-2017. Total biomass (t) is displayed for the assemblage either with (top) or without (bottom) Alaska skate, which is the dominant species. Data are from the NMFS EBS shelf bottom trawl survey.

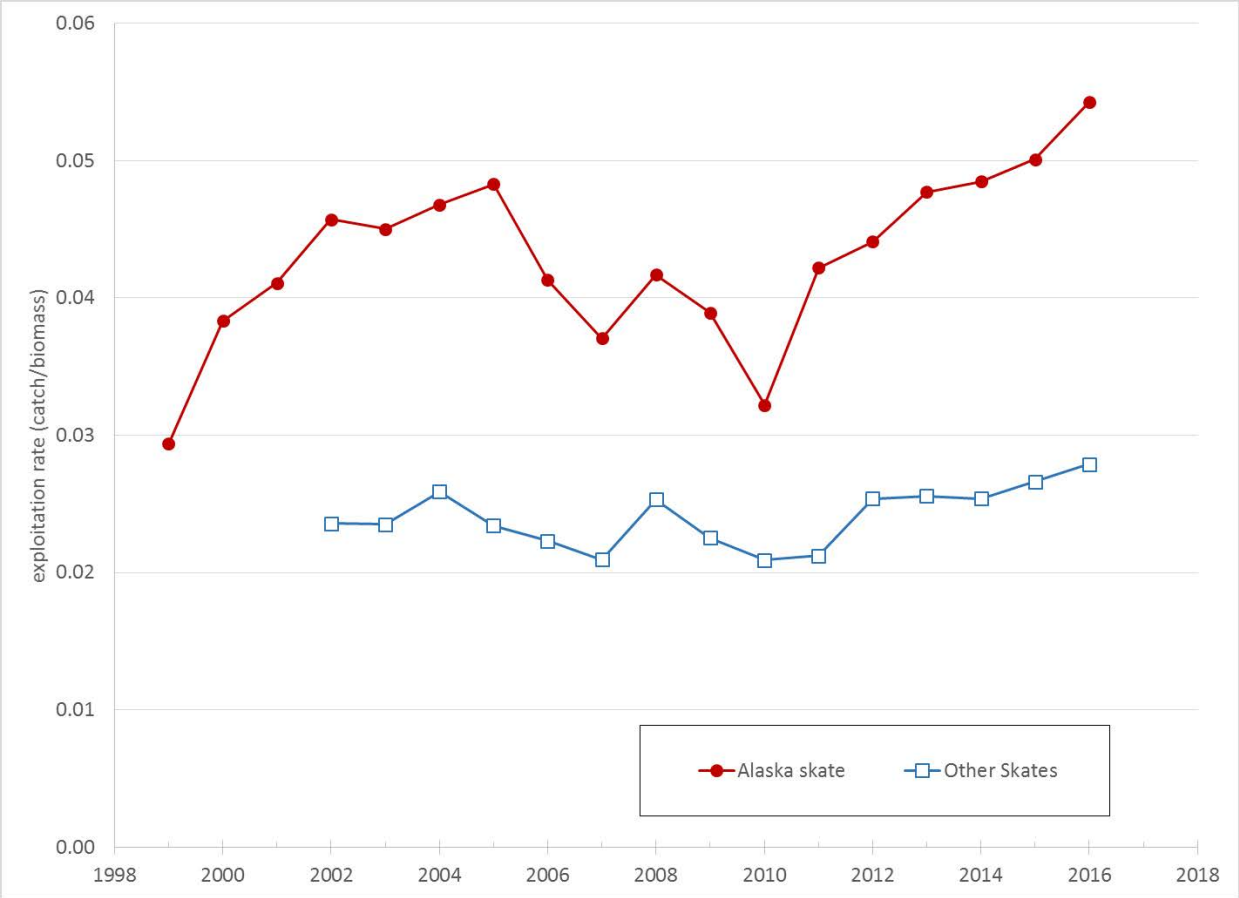

Figure 4. Exploitation rate (total catch/total biomass) for skates in the Bering Sea and Aleutian Islands regions (BSAI) from 1999-2017. For both groups, catch data are the author's estimate described in Table 1. For Alaska skate, biomass is the model-predicted total biomass described in Figure 1. For Other Skates, biomass is a combination of three separate random-effects models for each of the three BSAI surveys (eastern Bering Sea (EBS) shelf, EBS slope, and AI). A full description of the random-effects model can be found in the 2016 Bering Sea and Aleutian Islands stock assessment (https://www.afsc.noaa.gov/REFM/Docs/2016/BSAIskate.pdf).