

SUPPORTING INFORMATION

LESSONS FROM SEABIRD CONSERVATION IN ALASKA LONGLINE FISHERIES

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Table S1. Definitions of model variables.

Variables	Definition	Levels
Era	Time period pre- and post-streamer line adoption	Pre-adoption – 1993-2001 Post-adoption – 2002-2015
Year	Calendar year	continuous integer
Season	Defined by target fishery	Sablefish: Mar-Jun, Jul-Nov Pacific cod: Jan-Jun, Jul-Dec
Area	Large management area specific to target fishery	Sablefish: BSAI – Bering Sea (BS)/Aleutian Islands (AI) W – GOA – western Gulf of Alaska C – GOA – central GOA E – GOA – eastern GOA Pacific Cod: BS, AI, GOA
Processing Type	Vessel processing type	CP – catcher-processing vessel CV – catcher-only vessel
Time-Of-Day	Time-of-day defined by civil twilight	Day Night
Total Hooks	Total hooks deployed in a set	continuous integer
Target Fish CPUE	Kg of target fish/1,000 hooks	continuous integer
Depth	Bottom depth	continuous integer

Table S2. Variables tested in zero-inflated negative binomial models by target species and seabird groupings for the entire data series (1993 to 2015) and after the adoption of streamer lines (2002 to 2015) by Alaska longline fleets.

Era	1993-2015			2002-2015		
	Sablefish		Pacific cod	Sablefish		Pacific cod
Seabird Grouping	Albatross	Non-Albatross	Non-Albatross	Albatross	Non-Albatross	Non-Albatross
Era	X	X	X			
Year				X	X	X
Season	X	X	X	X	X	X
Time-of-Day				X	X	X
Area	X	X	X	X	X	X
Processing Type				X	X	
Total Hooks				X	X	X
Target Fish CPUE				X	X	X
Depth				X	X	X

Table S3. Final and competing zero-inflated negative binomial models (count | binomial) with associated Δ AICs relative to final model by target species–seabird grouping for the full 1993 – 2015 time series.

Model	Δ AIC
Albatross (Sablefish target)	
~ Era + Area+ Season + Area:Season + Era:Area Era + Area + Season + Area:Season	0.0
~ Era + Area+ Season + Area:Season + Era:Area Era + Area + Season +Area:Season + Season:Era	-0.4
~ Era + Area+ Season + Area:Season + Era:Area + Season:Era Era + Area + Season +Area:Season	-2.0
~ Era + Area+ Season + Area:Season + Era:Area Era + Area + Season +Area:Season + Era:Area	10.2
~ Era + Area+ Season Era + Area + Season	89.4
Null model (~1 1)	344.2
Non-Albatross (Sablefish target)	
~ Era + Area + Era:Area Era + Area + Season	0.0
~ Era + Area + Season Era + Area + Season	3.2
~ Area Era + Area + Season	8.9
Null model (~1 1)	248.7
Non-Albatross (Pacific cod target)	
~ Era + Season + Era:Season Era	0.0
~ Era + Season Era	22.0
~ Era + Season + Area 1	178.5
Null model (~1 1)	4,623.3

See Table S1 for variable definitions

Table S4. Final and competing zero-inflated negative binomial models (count | binomial) with associated Δ AICs relative to final model by target species and seabird grouping in the post-streamer line adoption era (2002-2015).

Model	Δ AIC
Albatross (Sablefish target)	
~ Year + Season + Area Season + TOD + Area	0.0
~ Year + Season + Area Year + Season + TOD + Area	0.2
~ Year + Season + TOD + Area Season + TOD + Area	0.3
~ Year + Season + Area + Area:Season Season + TOD + Area	-1.1
~ Year + Season + Area + Year:Area Season + TOD + Area	3.0
~ Year + Season + Area Season + Area	62.9
~ Year + Season Season	128.4
~ Year 1	135.3
Null model (~ 1 1)	148.1
Non-Albatross (Sablefish target)	
~ Year + Area + Depth + Total Hooks +SableCPUE + Area:Total Hooks Year + Season + Area + Area:Season	0.0
~ Year + Area + Depth + Total Hooks +SableCPUE + Area:Total Hooks Year + Season + Area	2.0
~ Year + Area + Depth + Total Hooks +SableCPUE + Area:Total Hooks + Year:Area Year + Season + Area + Area:Season	3.7
~ Year + Area + Depth + Total Hooks +SableCPUE Year + Season + Area + Area:Season	9.7
~ Year + Area + Depth + Total Hooks + SableCPUE Year + Season + Area	12.4
~ Year + Area Year + Season + Area	32.4
~ Year + Area Year + Area	59.5
~ Year Year	112.1
Null model (~1 1)	136.5
Non-Albatross (Pacific cod target)	
~ Year + Season + TOD + Area + Depth + Area:Year + Season:Area Year + TOD + Area + Depth + Area:Year	0.0
~ Year + Season + TOD + Area + Depth + Area:Year + Season:Area Year + TOD + Area + Depth	18.6
~ Year + Season + TOD + Area + Depth Year + TOD + Area + Depth	128.9
~ Year + TOD + Area + Depth Year + TOD + Area + Depth	594.2
~ Year + TOD + Area Year + TOD + Area	667.1
~ Year + Area Year + Area	877.2
~ Year Year	973.6
Null model (~1 1)	1209.6

See Table S1 for variable definitions

Table S5. Estimated annual total bycatch of albatrosses, nonalbatrosses and total birds and fishing effort (1000 hooks) pre and post adoption of streamer lines in Alaska longline fisheries from Fitzgerald et al. (2008) and Eich et al. (2016).

Year	Pre Streamer Line Adoption				Post Streamer Line Adoption			
	Albatross	Non-Albatross	Total	Effort (1000)	Albatross	Non-Albatross	Total	Effort (1000)*
1993	1,147	8,024	9,171	179,046.2				
1994	608	10,756	11,364	185,473.0				
1995	1,253	19,766	21,019	185,935.5				
1996	1,141	9,113	10,254	177,134.0				
1997	548	21,071	21,619	218,699.0				
1998	2,018	24,252	26,270	206,568.0				
1999	963	12,302	13,265	191,013.9				
2000	738	18,355	19,093	228,842.1				
2001	590	9,964	10,554	262,315.5				
2002					90	4,019	4,109	255,011.7
2003					359	5,342	5,701	331,721.1
2004					158	4,821	4,979	326,087.5
2005					126	6,244	6,370	320,874.4
2006					191	4,340	4,530	265,431.6
2007					235	8,097	8,332	
2008					529	6,001	6,530	
2009					197	9,944	10,141	
2010					308	3,799	4,107	
2011					442	8,904	9,346	
2012					222	4,618	4,840	
2013					673	3,767	4,439	
2014					439	1,650	2,090	
2015					594	4,698	5,292	
Mean	1,001	14,845	15,845	203,892	326	5,446	5,772	299,825
SE	155	2,008	2,075	9,445	49	598	591	16,342
Minimum	548	8,024	9,171	177,134	90	1,650	2,090	255,012
Maximum	2,018	24,252	26,270	262,316	673	9,944	10,141	331,721

* Effort data unavailable after 2006

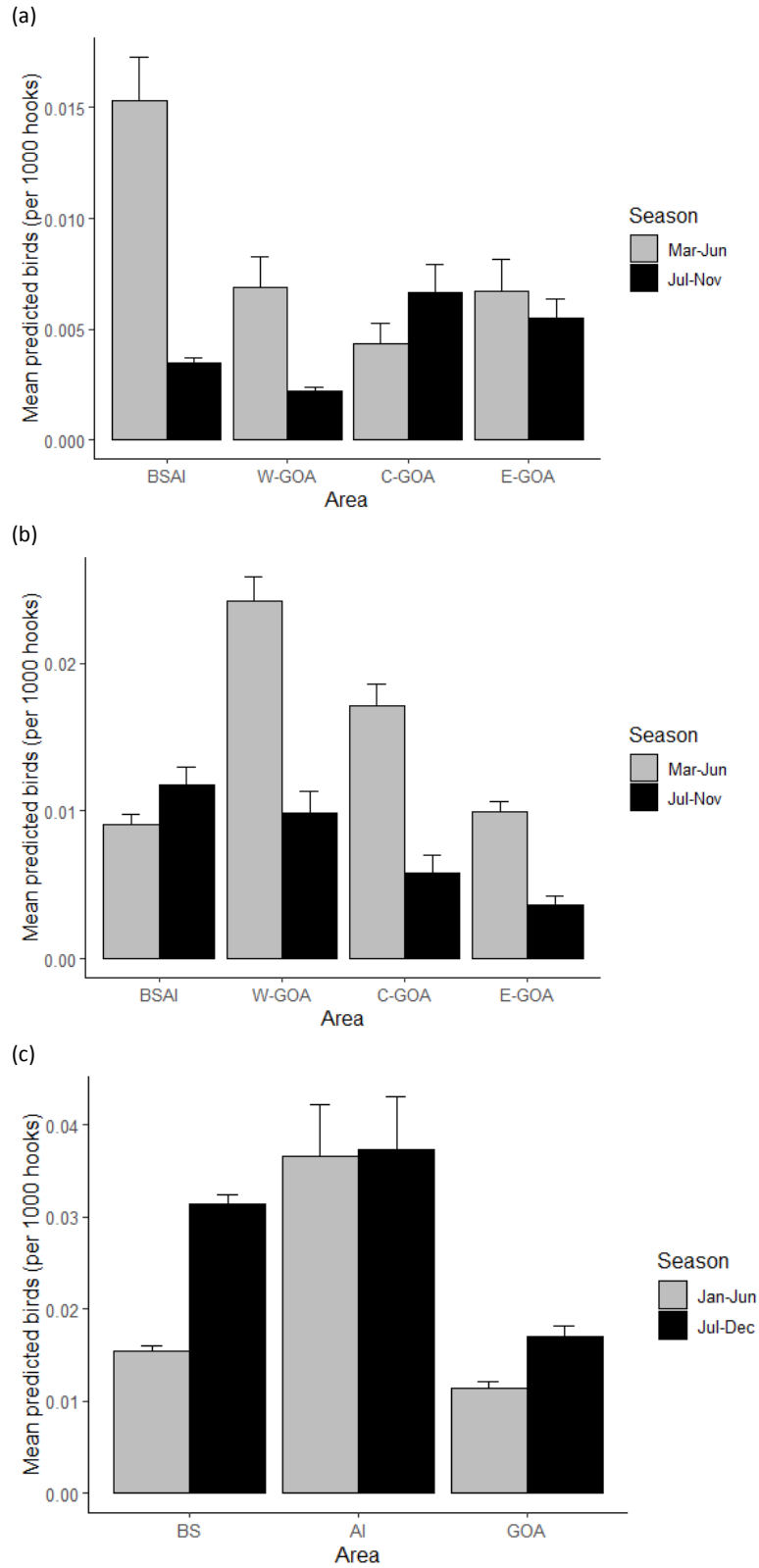


Figure S1. Mean predicted bycatch rates (birds/1,000 hooks) by major fisheries management area and season for albatrosses in the sablefish fishery (a), and nonalbatross species in the sablefish (b) and Pacific cod (c) fisheries in the post streamer line adoption era (2002 to 2015).