

Report to the North Pacific Fishery Management Council
on the 2015
Bering Sea Pollock Intercooperative Salmon Avoidance
Agreement

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This report is to the North Pacific Fishery Management Council and covers the Bering Sea and Aleutian Islands Management Area (BSAI) Pollock Intercoop Salmon Avoidance Agreement (“ICA”). During the course of the B season fishery, the pollock Intercoop closed 62 areas to fishing based on high bycatch rates of chum salmon experienced by vessels working in the area. Maps of the closures are shown in Figure 1.

Under the terms of the ICA, applicants are to submit to the Council a report analyzing:

1. Estimated number of salmon avoided as demonstrated by the movement of fishing effort away from salmon hot-spots.
2. A compliance/enforcement report that will include the results of an external audit designed to evaluate the accuracy of the approach used by Sea State to monitor compliance with the agreement, and a report on the effectiveness of enforcement measures stipulated under the ICA in cases of non-compliance. Examination of a randomly selected subset of vessel/days representing 10% of the catch during each season will be used as the basis of the audit.

Number of non-Chinook salmon taken during the fishery (Table 1):

For the sake of comparison we have included catch and bycatch amounts running back to 1993. These data are compiled from plant landing information for catcher vessels delivering to shoreside processors, and observer data for mothership catcher vessels and catcher-processors. The “other salmon” category includes all non-chinook salmon.

Observer data for both offshore and shoreside deliveries show only very small numbers of salmon other than chum in this category (for example, 152 unidentified, 31 pinks, and 5 silvers for the 2006B season EFP).

Table 1. Catch and bycatch of pollock and “other” salmon in the directed pollock fishery B season, 1993 – 2015.

Year	B season pollock*	B season other salmon bycatch
1993	740,569	242,473
1994	718,582	89,117
1995	647,865	17,625
1996	633,639	77,028
1997	546,988	64,504
1998	539,432	60,040
1999	511,211	44,261
2000	631,755	57,228
2001	813,022	50,948
2002	866,034	83,033
2003	876,784	170,688
2004	858,799	427,234
2005	878,618	637,957
2006	874,435	276,779
2007	775,261	82,641
2008	572,384	14,453
2009	469,128	38,040
2010	471,983	13,585
2011	681,480	191,517
2012	705,716	22,149
2013	738,693	124,661
2014	745,808	217,572
2015	772,975	231,960

* For the years 1993-1999, total groundfish from P and B targets, available on files from NMFS site (below), were used instead of pollock.

Estimates of salmon bycatch for 1993-1999 are for all P and B trawl target fisheries, including CDQ, and are available on the NOAA Fisheries, AK Region web site. (<http://www.fakr.noaa.gov/sustainablefisheries/catchstats.htm>)

Evaluation of salmon savings.

The evaluation of the number of salmon saved by the IC program is based on tracking vessels that fished in a closed area before it closed, and then comparing their subsequent bycatch to see if it was lower than expected if the area had not closed. Put more simply, we perform a before-and-after comparison of the bycatch observed and expected from the vessels that triggered the closure. The procedure is as follows:

1. Extract all observer data for haul locations falling inside a closure area, for a 5 day period preceding the closure. For shoreside catcher vessels, aggregate the hauls that have the same “start fishing date” so that hauls with the same bycatch rate are not artificially repeated. As an example, if 2 hauls from the same catcher vessel trip show up in the closed area, they will have the same bycatch rate because observers pro-rate bycatch evenly across all hauls. Consider them a single observation with a value equal to the sum of the two hauls’ pollock and salmon.
2. Consider all of independent offshore sector (C/P and mothership) hauls, and combined “trip-level” hauls to be estimates of the bycatch ratio $R_i = \sum y_i / \sum x_i$, where y are counts of chinook or chum salmon, and x is the pollock catch from individual hauls (offshore sector) or grouped, same-trip hauls (shoreside), and i indicates a separate closure.
3. Extract the same haul or “grouped” haul information, for the same vessels, for the duration of the closure (either 3 or 4 days). Their associated bycatch is available from either observer or plant delivery information. Compute their expected bycatch had they been able to stay and fish inside the now-closed area, by summing the pollock catch of all vessels in this category, and multiplying this summed pollock catch by the matching bycatch ratio, R_i above.
4. Compute the standard error of this estimated Y (overall salmon bycatch if vessels had stayed in the area and fished with bycatch rate R) treating R as a ratio estimator (Snedecor and Cochran, Statistical Methods, 8th Edition, p 452).

Avoidance results from the 2015 Intercoop Agreement
Locations of the 2015 closures are shown in Figure 1.

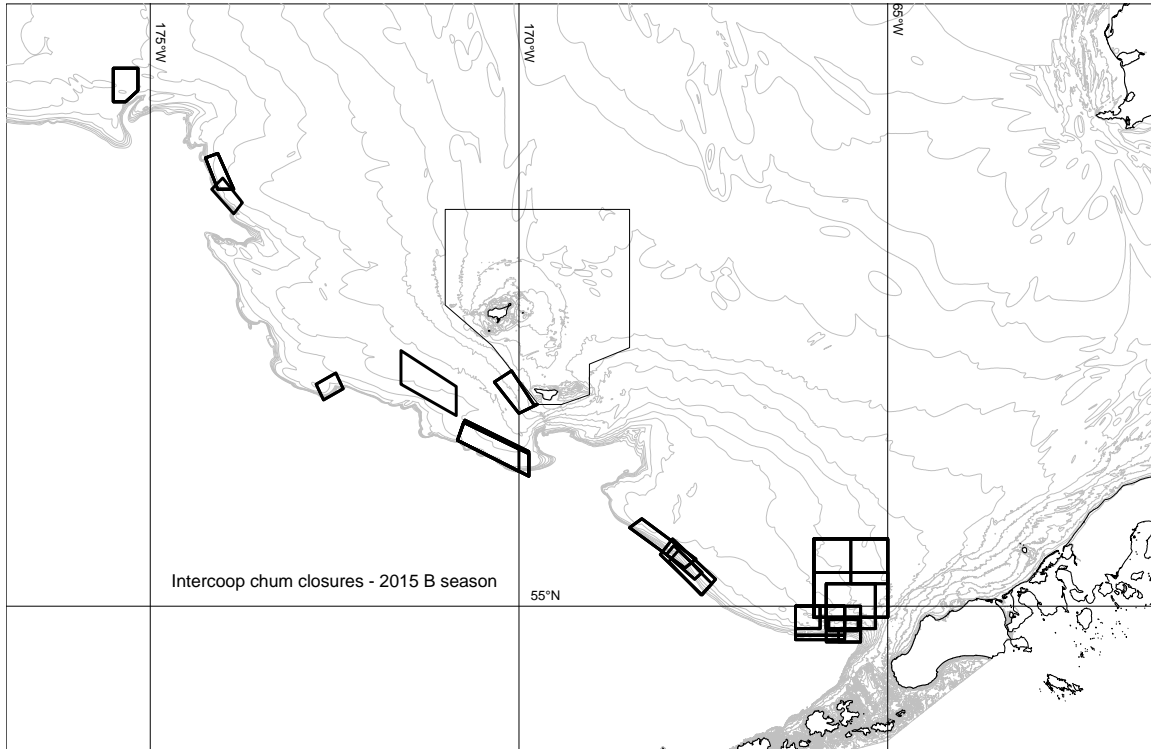


Figure 1. 2015 IC chum closures

Table 2 summarizes the results for both chum and chinook savings resulting from these closures (Appendix Tables A1 and A2 show the underlying data, by closure, with associated standard errors). A total of 47,818 mt of pollock was associated with boats that fished inside areas before they were closed. These same vessels caught 60,536 mt of pollock in the closure interval following the associated closure date. An estimated 18,774 fewer chum were taken outside the closures than would have been expected if the same amount of pollock had been taken inside the closures, based on the comparison of rates inside and outside closure areas. Chinook reduction was negative (that is, the closures are estimated to have increased chinook bycatch): 534 were taken outside the chum closures versus an estimated 459 that would have been caught at within-closure rates, or an increase of 75 chinook. These bycatch differences represent a 27% decrease in expected chum bycatch (for boats that fished in closures, for the 3 or 4 day period after the closure), and a 16% increase in expected chinook bycatch, for vessels that actually fished in the closures during the 5 day period preceding each closure.

Table 2. Chum salmon closure effectiveness for the 2015 B season. 47,818 mt of pollock were taken in closure areas prior to closure, and 60,536 mt were taken by the same vessels after closures.

Closure statistic	Bycatch species	
	Chum	Chinook
Actual bycatch (outside, after closures)	50,493	534
Expected bycatch (at pre-closure rate)	69,267	459
Savings	18,774	-75
% reduction	27%	-16%

A comparison with results from chum closures from previous years is shown in Table 3. The “After-closure pollock” column shows the total tonnage of pollock harvested after closures by vessels that fished inside closures during the closure duration (3 or 4 days, depending on the day of closure). This amount of pollock can be viewed as having been moved from inside the closure area to outside due to the closures. The 2015 amount (60,536 mt) is higher than average (average = 48,706 from 2006 - 2015). The chum savings percentage, for vessels that fished in closures prior to the closures, was only 27%, the lowest on record. We feel that the poor performance of the chum program this year was primarily due to the simultaneous closure of adjacent fishing grounds to avoid squid and herring bycatch. However, the reductions estimated by the methods outlined are likely to be very conservative, as they do not account for any change in behavior of vessels that did not fish in closures in the 5 day period preceding the closure announcement. Chum-related closures continued through October 2, and all pollock fishing effort was concluded by October 15th. These later closures may have had the unintended effect of moving vessels into areas with high chinook bycatch, although the estimated increase of 75 chinook taken as bycatch is not large.

Table 3. Comparison of the effects of chum closures across years.

Year	After-closure pollock	% of harvest affected	Chinook savings	Chinook % reduction	Chum savings	% reduction	Actual chum catch	Percentage reduction
2006	23,049	3%	-97	-21%	65,299	64%	276,779	19%
2007	107,646	14%	2007	56%	75,970	82%	82,641	48%
2008	3,448	1%	53	82%	768	73%	14,453	5%
2009	5,701	1%	52	50%	6,270	76%	38,040	14%
2010	12,537	3%	61	85%	1,808	84%	13,585	12%
2011	146,846	22%	73	7%	79,657	63%	191,517	29%
2012	12,246	2%	48	11%	3,530	50%	22,149	14%
2013	49,818	7%	1051	74%	34,231	65%	124,661	22%
2014	65,232	9%	9	13%	57,938	58%	217,572	21%
2015	60,536	8%	-75	-16%	18,774	27%	231,960	7%
Totals					344,245		1,213,357	22%

Compliance/ Enforcement

No violations were referred to coops for enforcement actions. An audit of Sea State compliance monitoring has again been awarded to ABR Inc of Fairbanks, Alaska. ABR reviewed 10% of the coop fishing records and associated VMS information. The report for this audit states that:

“ABR agreed with the determinations of Sea State for the 10% sample that we examined, and we found no closure zone violations. Of points examined, our determination agreed with Sea State for all 8,843 locations in our subsample.”

Comparison of the 2015 chum ICA program with previous years.

Comparison of the chum bycatch program with actions of the chum bycatch program from previous years is best confined to 2011 onward, since at that point Amendment 91 mandated a census count of chum salmon. Also, from that point onward all vessels were required by their chinook IPAs to stay under chinook caps, and those caps may have influenced behavior towards chums.

Figure 2a-d shows that in 2015, salmon closures were concentrated along the outer shelf and especially along the edge of the horseshoe. The outer shelf pattern was similar to 2014, but in 2014 there was some effort to the north along the 50 fm line. In 2015 there was considerably greater effort in deep water near Unimak Pass. The fleet operating in this area was ultimately moved into shallower waters by squid and herring bycatch. Squid bycatch especially became constraining as the Intercoop was forced to institute the voluntary closure of a region devised in concert with NMFS to prevent reaching the OFL on squid in previous years.

Figure 3 shows a strong decrease in squid landings in response to high squid bycatch. Prior to the closure date on 7/23/15 the fleet began seeking new grounds with lower squid bycatch to avoid hitting the squid OFL. Chum bycatch began increasing dramatically a

week later. With no ability to test fish inside the squid box, we have no way of knowing whether or not chum bycatch increased in the deep water in that area. However, repeated attempts to adjust the lower bounds of chum closures to allow pollock fishing in the strip just north of the squid box revealed lower bycatch rates there than further north, suggesting that fishing in the squid closure would have been clean. Also, fleet experience with chum salmon bycatch has been that deeper waters are generally free of chums (unlike chinook), and that depths from 60 - 100 fm show much higher chum bycatch rates. Figure 4 illustrates the spatial constraints on the fleet that resulted from the squid closure and multiple chum closures.

Pollock harvest in the waters of Bering Canyon (the horseshoe) early on enabled the pollock fleet to leave the grounds by mid-September, which is certainly the goal since at this point chinook generally start to build on the grounds.

Appendix 2 shows the number of times vessels were placed on the weekly dirty 20 lists and for context shows the number of weeks they were in the B season fishery.

Appendix 3 shows spatial intensity of pollock catch and bycatch from 2014 - 2015 B seasons.

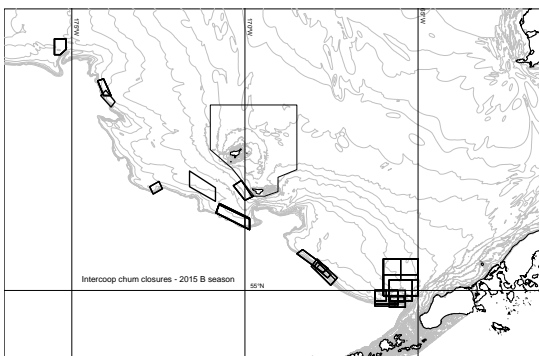


Figure 2a. 2015 Chum closures areas (62 closures),

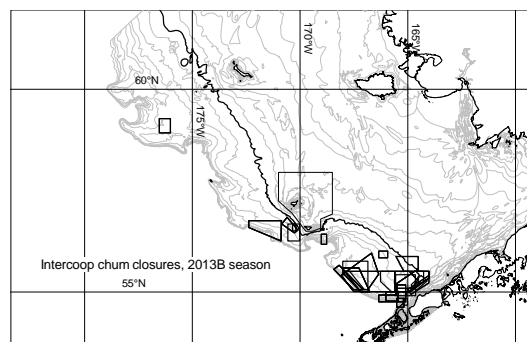
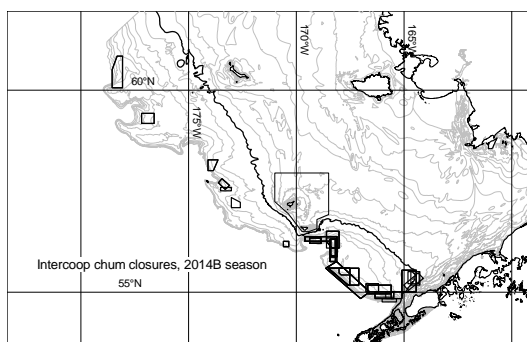


Figure 2b. 2014 Chum closures areas (63 closures), 55-fm contour in bold, 217,572 chums taken

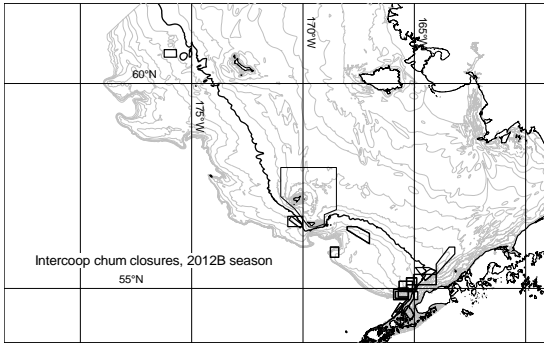


Figure 2c. 2013 Chum closures areas (52 closures), 55-fm contour in bold, 124,661 chums taken

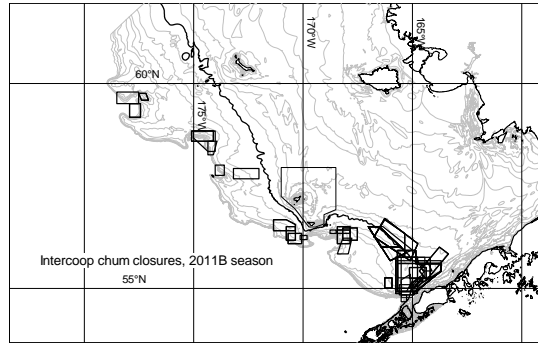


Figure 2d. 2012 Chum closures areas (32 closures), 55-fm contour in bold, 22,149 chums taken

Figure 2e. 2011 Chum closures areas (70 closures), 55-fm contour in bold, 191,517 chums taken

Figure 4. Pollock catch by day of season, 2011 - 2015

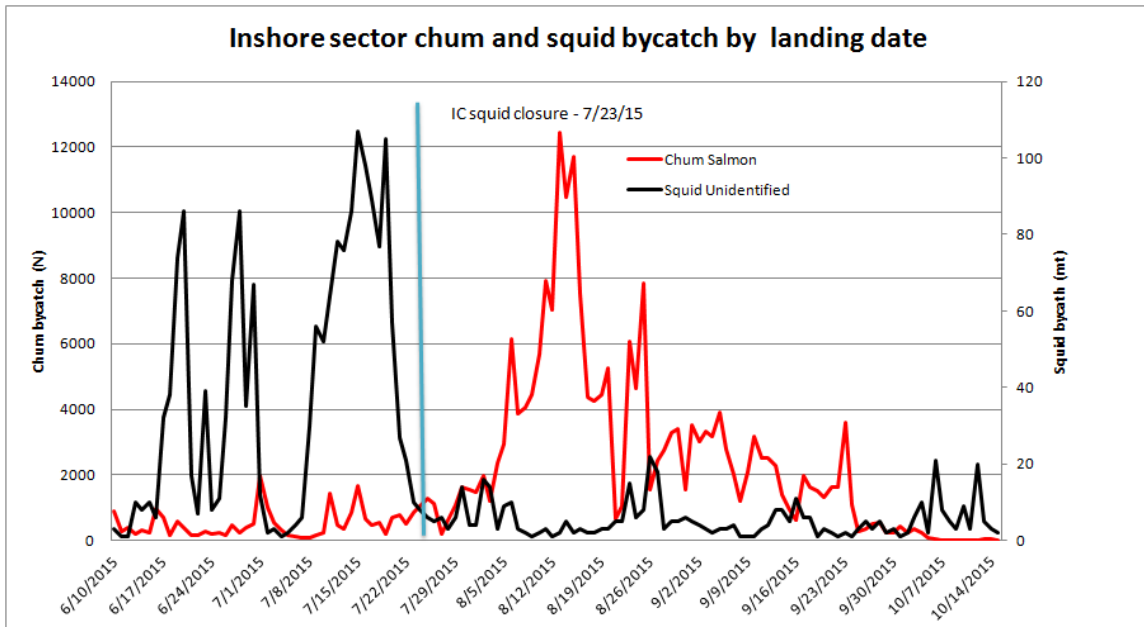


Figure 3. Chum and squid bycatch by landing date.

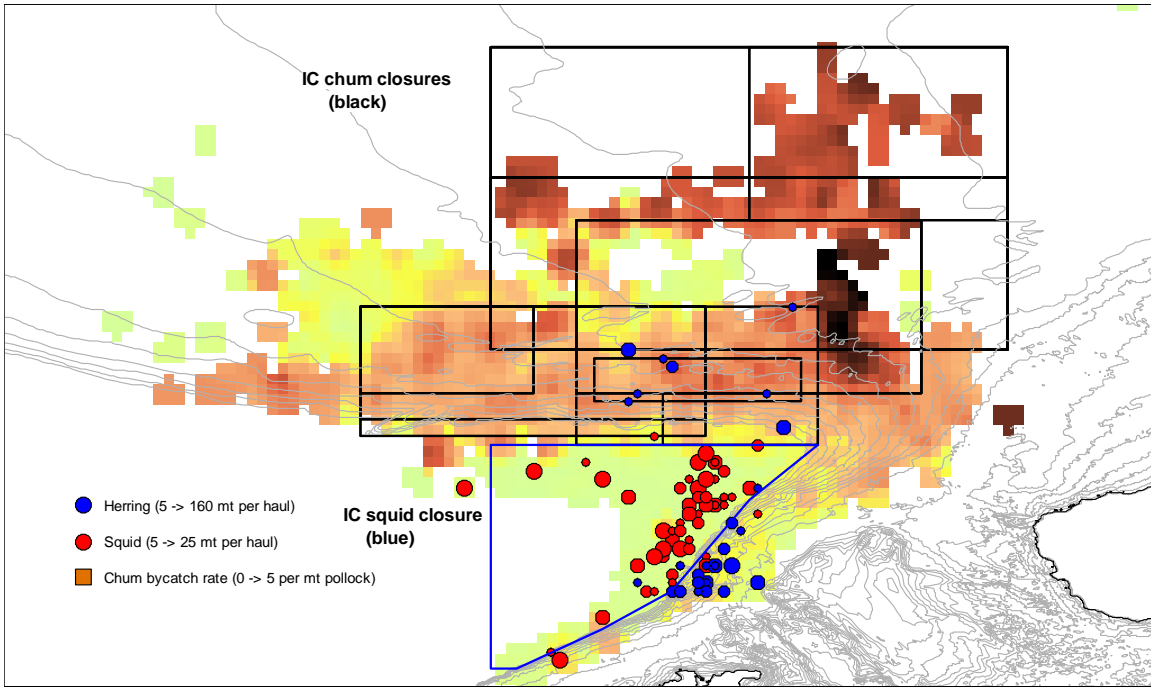


Figure 4. Chum, squid and herring bycatch in relation to the IC squid closure and herring bycatch, B season, 2015

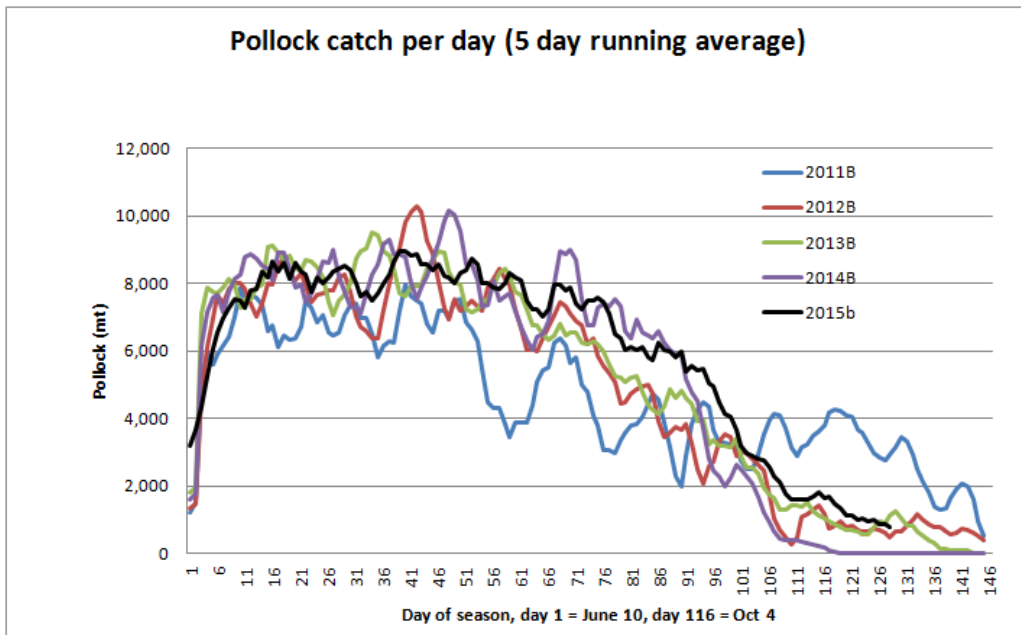


Figure 5. Pollock harvest by day, 2011 - 2015B seasons

Appendix 1. Before-and-after closure fishing comparisons, by closure.

Table A1. Chum savings by closure

Date	Pollock catch (mt) in closures, prior to closure	Chum rate in closure (N/mt)	Chum rate after closure	Displaced pollock (mt)	Actual chum bycatch (N)	Est chum bycatch at closure rate	Chum reduction (estimate - actual)	N Before hauls (N in closure)	N After hauls	Std err
07/03/15	2,802	0.34	0.02	3,779	70	1,279	1,209	32	52	1,056
07/07/15	327	0.09	0.04	340	13	29	16	4	5	26
07/14/15	1,098	0.86	0.47	2,435	1152	2,092	940	10	28	1,369
07/17/15	54	0.44	0.03	161	5	71	66	1	3	
07/21/15	425	0.65	0.06	1,435	80	926	846	5	15	144
07/24/15	1,272	0.30	0.34	4,630	1574	1,405	-169	10	39	361
07/28/15	3,132	0.56	0.09	6,626	599	3,715	3,116	27	61	542
08/07/15	1,010	1.35	1.85	2,766	5123	3,742	-1,381	8	20	563
08/07/15	1,429	0.60	0.16	7,150	1118	4,297	3,179	17	90	1,425
08/11/15	8,634	2.01	3.39	5,503	18677	11,046	-7,631	86	49	1,924
08/11/15	3,729	2.13	0.99	4,670	4617	9,952	5,335	41	58	2,081
08/14/15	707	1.13	0.65	1,660	1074	1,880	806	8	14	832
08/14/15	714	3.20	1.72	1,111	1916	3,557	1,641	7	15	948
08/18/15	1,467	1.27	1.21	1,304	1583	1,650	67	9	11	858
08/18/15	283	3.69	0.02	99	2	363	361	3	1	
08/25/15	1,378	1.53	1.41	2,181	3076	3,341	265	13	19	629
08/25/15	3,983	2.38	1.77	1,506	2671	3,587	916	26	11	1,097
08/28/15	1,191	2.84	0.07	1,048	70	2,977	2,907	11	16	2,451
09/01/15	2,640	1.52	0.80	3,039	2434	4,622	2,188	20	23	1,040
09/04/15	233	0.59	0.64	913	587	540	-47	1	5	
09/04/15	6,091	1.38	0.48	4,490	2133	6,208	4,075	49	44	2,688
09/04/15	91	0.05	0.51	476	244	26	-218	1	6	
09/15/15	194	0.36	0.30	940	286	340	54	3	10	34
09/22/15	3,039	0.66	0.82	1,463	1194	968	-226	33	16	252
09/25/15	1,654	1.08	0.47	347	163	374	211	21	6	92
09/29/15	95	0.43	0.17	192	32	83	51	1	2	
10/02/15	145	0.72	0.00	273	0	196	196	1	4	
Totals	47,818			60,536	50493	69,267	18,774	448	623	

Table A2. Chinook savings by closure

Date	Pollock catch (mt) in closures, prior to closure	Chinook rate in closure (N/mt)	Chinook rate after closure	Displaced pollock (mt)	Actual chinook bycatch (N)	Est chinook bycatch at closure rate	Chinook reduction (estimate - actual)	N Before hauls (N in closure)	N After hauls	Std Err
07/03/15	2,802	0.04	0.00	3,779	18	151	133	32	52	66
07/07/15	327	0.02	0.00	340	1	5	4	4	5	3
07/14/15	1,098	0.00	0.00	2,435	7	9	2	10	28	6
07/17/15	54	0.00	0.00	161	0	0	0	1	3	
07/21/15	425	0.01	0.00	1,435	1	17	16	5	15	6
07/24/15	1,272	0.00	0.01	4,630	29	4	-25	10	39	4
07/28/15	3,132	0.00	0.01	6,626	34	28	-6	27	61	10
08/07/15	1,010	0.00	0.01	2,766	14	14	0	8	20	9
08/07/15	1,429	0.01	0.01	7,150	102	65	-37	17	90	29
08/11/15	8,634	0.01	0.01	5,503	29	28	-1	86	49	11
08/11/15	3,729	0.01	0.01	4,670	44	58	14	41	58	16
08/14/15	707	0.00	0.01	1,660	10	5	-5	8	14	5
08/14/15	714	0.01	0.00	1,111	5	12	7	7	15	4
08/18/15	1,467	0.00	0.01	1,304	14	2	-12	9	11	3
08/18/15	283	0.01	0.00	99	0	1	1	3	1	
08/25/15	1,378	0.00	0.00	2,181	9	2	-7	13	19	3
08/25/15	3,983	0.00	0.00	1,506	7	2	-5	26	11	4
08/28/15	1,191	0.01	0.02	1,048	18	14	-4	11	16	7
09/01/15	2,640	0.00	0.01	3,039	27	3	-24	20	23	4
09/04/15	233	0.00	0.02	913	22	4	-18	1	5	
09/04/15	6,091	0.00	0.02	4,490	82	9	-73	49	44	10
09/04/15	91	0.00	0.01	476	6	0	-6	1	6	
09/15/15	194	0.01	0.00	940	0	5	5	3	10	3
09/22/15	3,039	0.01	0.02	1,463	24	9	-15	33	16	2
09/25/15	1,654	0.01	0.07	347	26	3	-23	21	6	1
09/29/15	95	0.00	0.01	192	1	0	-1	1	2	
10/02/15	145	0.04	0.01	273	4	11	7	1	4	
Totals	47,818			60,536	534	459	-75	448	623	

Appendix 2: Dirty 20 list appearances

Number of times each vessel was on a 2015 chum weekly dirty 20 list. (M) after vessel name indicates vessel was fishing in the mothership coop. Dual-qualified CVs may appear twice if they fished shoreside and delivered to a mothership.

Vessel	N times on Dirty 20 list	N weeks fishing	Vessel	N times on Dirty 20 list	N weeks fishing	Vessel	N times on Dirty 20 list	N weeks fishing
ALASKA OCEAN	1	13	EXCALIBUR II	2	11	OCEANIC	0	9
ALASKA ROSE	0	11	FIERCE ALLEGIANCE	5	9	PACIFIC CHALLENGER	0	2
ALDEBARAN	3	18	GLADIATOR	0	7	PACIFIC CHALLENGER	4	11
ALEUTIAN CHALLENGER	1	8	GOLD RUSH	2	10	PACIFIC EXPLORER	3	17
ALSEA	6	10	GOLDEN DAWN	4	16	PACIFIC FURY	2	14
ALYESKA	0	1	GOLDEN PISCES	0	12	PACIFIC GLACIER	2	16
AMERICAN BEAUTY	1	4	GREAT PACIFIC	0	12	PACIFIC PRINCE	1	15
AMERICAN BEAUTY	3	7	GUN MAR	6	14	PACIFIC VIKING	7	13
AMERICAN DYNASTY	0	14	HALF MOON BAY	4	5	PEGGY JO	3	8
AMERICAN EAGLE	1	12	HICKORY WIND	3	10	PERSEVERANCE	0	7
AMERICAN TRIUMPH	1	12	ISLAND ENTERPRISE	4	11	POSEIDON	2	13
ANITA J	6	12	KODIAK ENTERPRISE	4	12	PROGRESS	4	12
ARCTIC EXPLORER	3	14	LESLIE LEE	0	13	ROYAL AMERICAN	1	14
ARCTIC FJORD	2	16	MAJESTY	5	14	ROYAL ATLANTIC	4	14
ARCTIC RAM	0	9	MARCY J	2	6	SEA WOLF	1	12
ARCTIC STORM	1	11	MARGARET LYN	1	3	SEADAWN	6	18
ARCTURUS	4	16	MARGARET LYN	1	8	SEATTLE ENTERPRISE	6	16
ARGOSY	6	11	MARK I	1	5	SOVEREIGNTY	2	14
AURIGA	4	13	MARK I	1	7	STAR FISH	8	14
AURORA	3	14	MISTY DAWN	2	15	STARBOUND	2	12
BERING DEFENDER	5	12	MORNING STAR	1	13	STARLITE	6	13
BERING ROSE	4	12	NORDIC FURY	0	2	STARWARD	7	13
BRISTOL EXPLORER	3	20	NORDIC FURY	5	10	STORM PETREL	2	12
CAITLIN ANN	3	14	NORDIC STAR	3	13	TRAVELER	1	4
CAPE KIWANDA	1	6	NORTHERN EAGLE	0	12	TRAVELER	1	7
CHELSEA K	5	13	NORTHERN HAWK	0	11	VANGUARD	1	3
COLLIER BROTHERS	0	2	NORTHERN JAEGER	3	14	VANGUARD	4	6
COLUMBIA	5	11	NORTHERN PATRIOT	2	17	VESTERAALEN	1	8
COMMODORE	2	14	NORTHWEST EXPLORER	0	3	VIKING	5	14
DEFENDER	5	13	OCEAN EXPLORER	7	13	VIKING EXPLORER	0	14
DESTINATION	1	11	OCEAN HOPE 3	0	10	WALTER N	1	7
DOMINATOR	4	12	OCEAN LEADER	3	5	WESTERN DAWN	2	7
ELIZABETH F	2	6	OCEAN ROVER	0	14	WESTERN DAWN	1	8
						WESTWARD I	1	15

Appendix 3. Pollock harvest and chum bycatch by .1 deg intervals in the BSAI, 2014 - 2015 B seasons

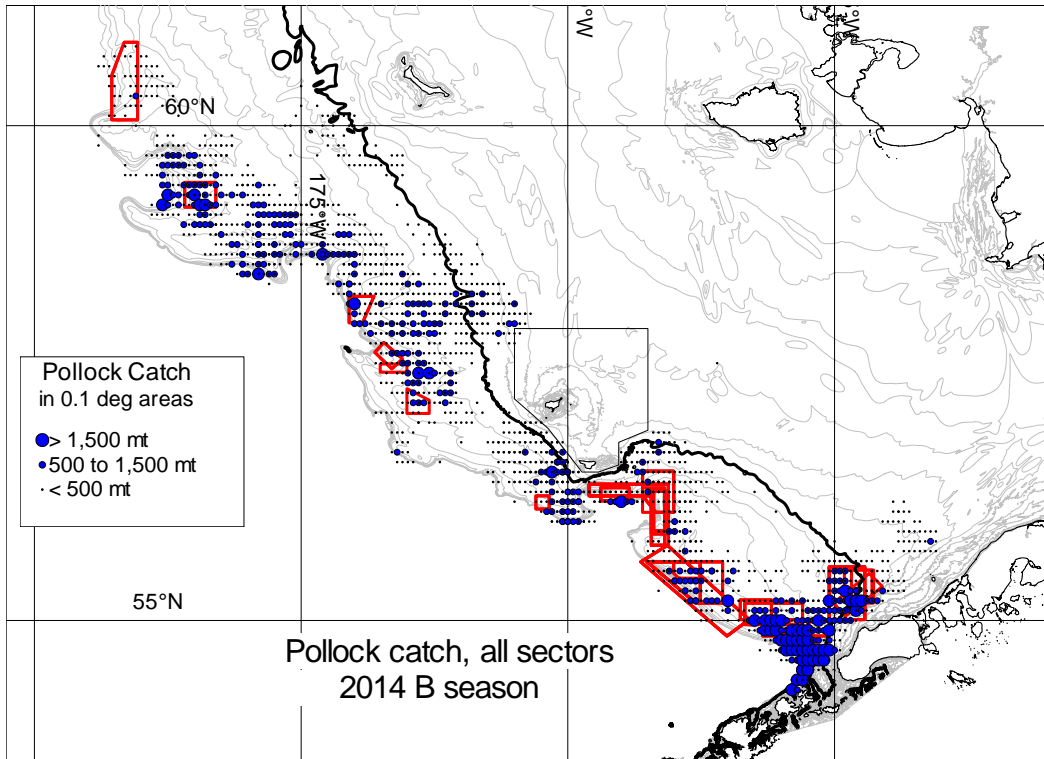


Figure A3-1a. Pollock catch for 2014 summed at .1 deg resolution

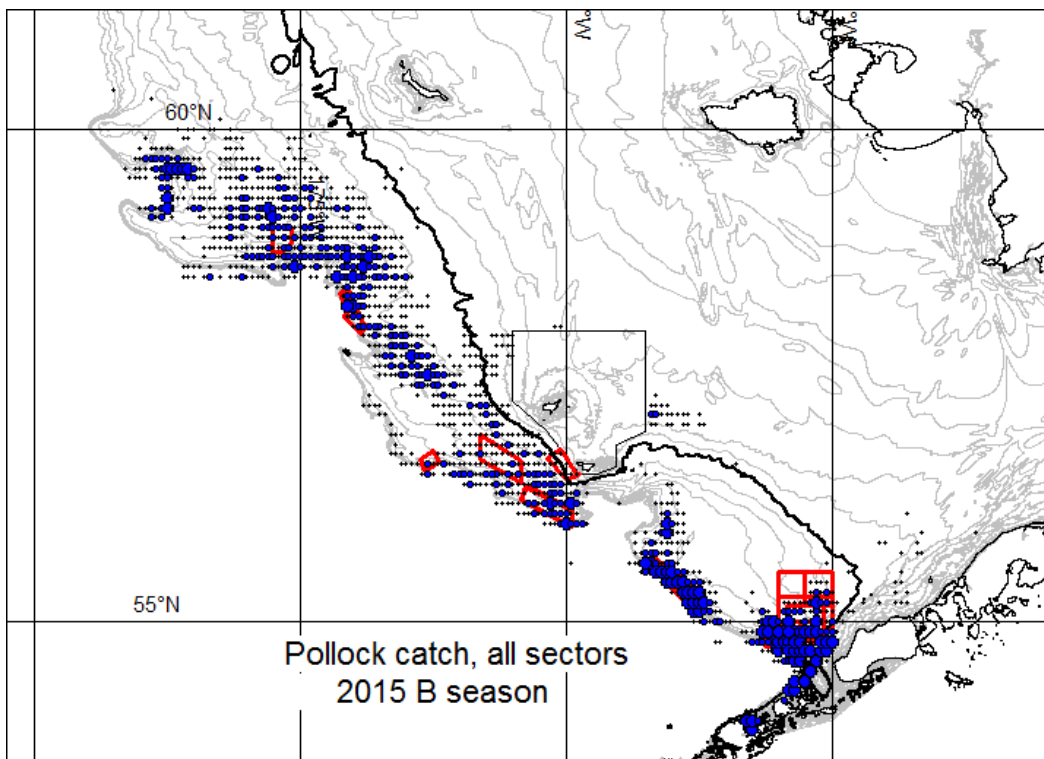


Figure A3-1b. Pollock catch for 2015 summed at .1 deg resolution

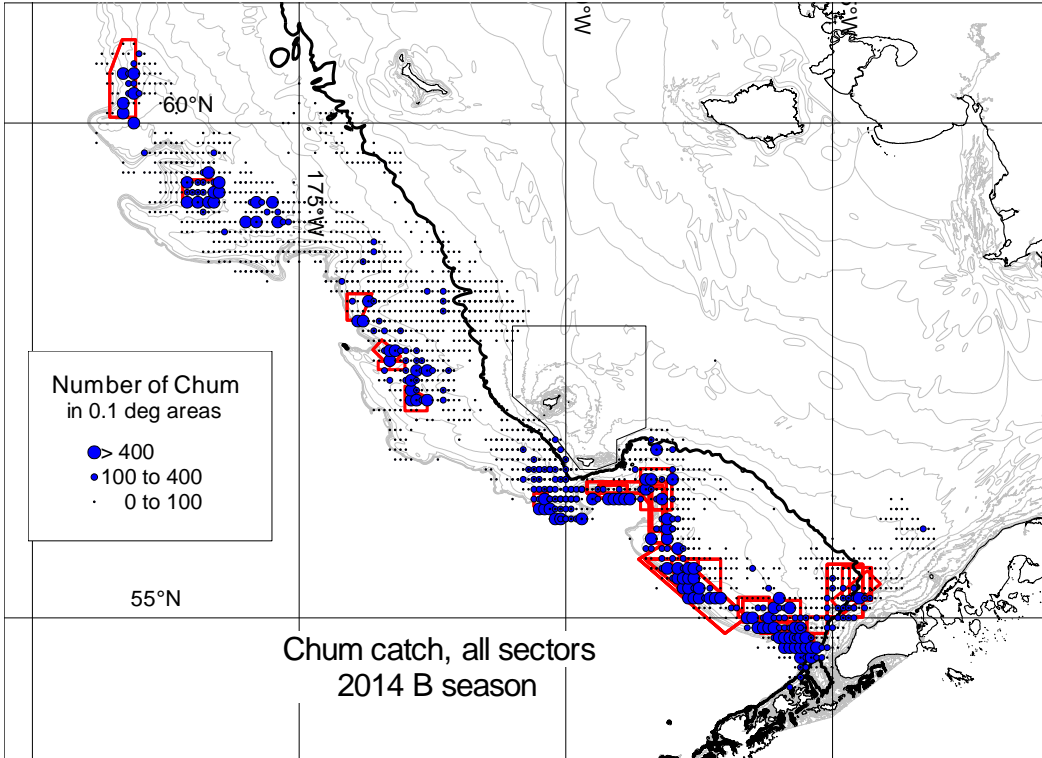


Figure A3-2a. Chum catch for 2014 summed at .1 deg resolution

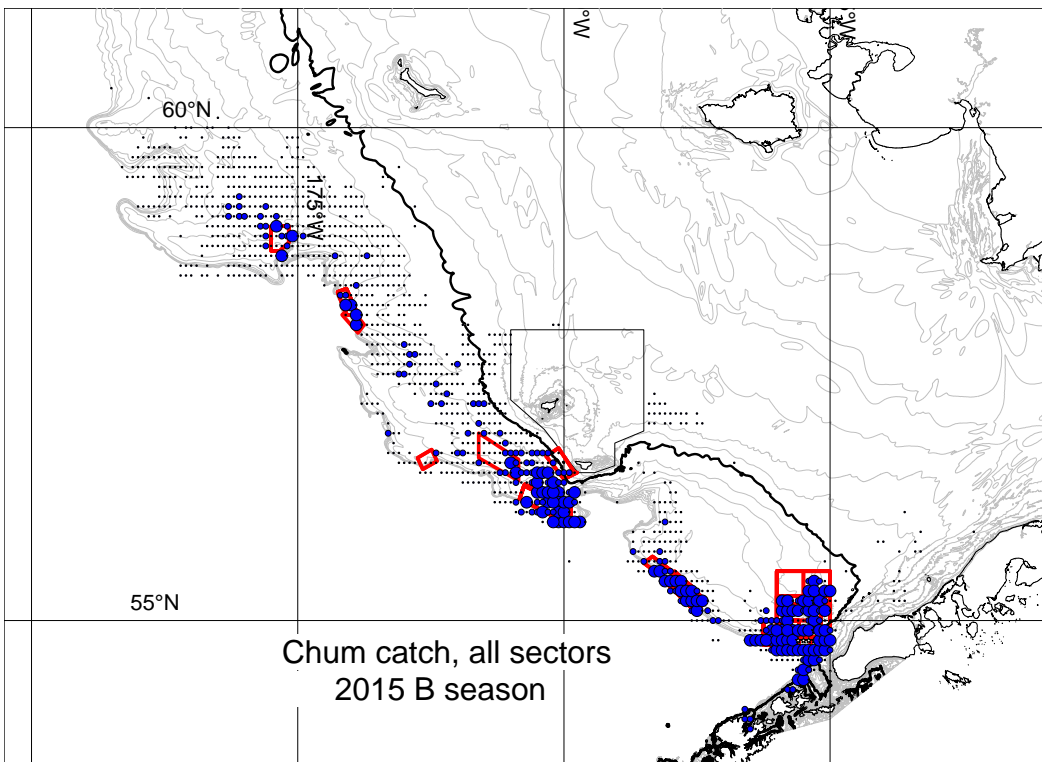


Figure A3-2b. Chum catch for 2015 summed at .1 deg resolution